1791-00013

WESTERN PACIFIC ELECTRIC INC.

Operation & Maintenance Manual

Electrical Equipment

Spring Creek Well #7

Washoe County, Nevada

2395 Tampa St. Suite C Reno, NV 89512, Ph 775-324-2700 Fax 775-324-2560 NV License #55427 CA License # 825620
License Limit $2,000,000.00

EMERSON
Process Management

Emerson Process Management
Electrical Reliability Services, Inc.
1808 Tribute Road, Suite E
Sacramento, CA 95815
USA

T (916) 920 5014
F (916) 920 9020
www.ers.assetweb.com

Ground Resistance Test Report

At

Spring Creek Well #7
Washoe Co. NV.

For

Western Pacific Electric, Inc.
2395 Tampa St. Ste C
Reno, NV 89512

Attn: Mr. Ky Karlson
Order No: KY KARLSON/SPRING CREEK

Reference No. 3004938

Submitted By: Dennis Harris
Field Engineer

Table of Contents

1 PURPOSE

The purpose of ground resistance test is to determine the effectiveness of individual grounding electrodes, grounding electrode systems, ground grids and connections which are used with electrical systems to protect personnel and equipment. The National Electrical Code Section 250-84 requires a single electrode "which does not have a Resistance to ground of 25 ohms or less shall be augmented by one Additional electrode of any of the types specified in Sections 250-81 and 250-83"

2 SUMMARY

2.1 This project was initiated by Mr. Ky Karlson with Western Pacific Electric Inc. All testing was performed by Dennis Harris and Keith Parks on April 20, 2006.

3 EQUIPMENT TESTED AND INSPECTED

3.1 One ufer 3 point fall of potential.

4 PROCEDURES

4.1 Grounding Systems

4.1.1 Electrical Test

1. Performed "fall of potential" method test on the main grounding electrode per IEEE Standard No. 81. If suitable locations for test rods were not available, a low resistance dead earth or reference ground was utilized.

5 Results

5.1 The three-point fall of potential ground resistance was found to be acceptable.

EMERSON
Process Management

GROUND RESISTANCE TEST REPORT

CLIENT:			JOB NUMBER:
Western Pacific Electric			3004938
LOCATION:			**DATE:**
Spring Creek Well #7			4/20/2006
SWITCHGEAR DESIGNATION:	**ENGINEER:**	**ASSET NO.:**	**CALIBRATION DATE:**
Main Switchboard	K.Parks	E72-01128	11/3/2005

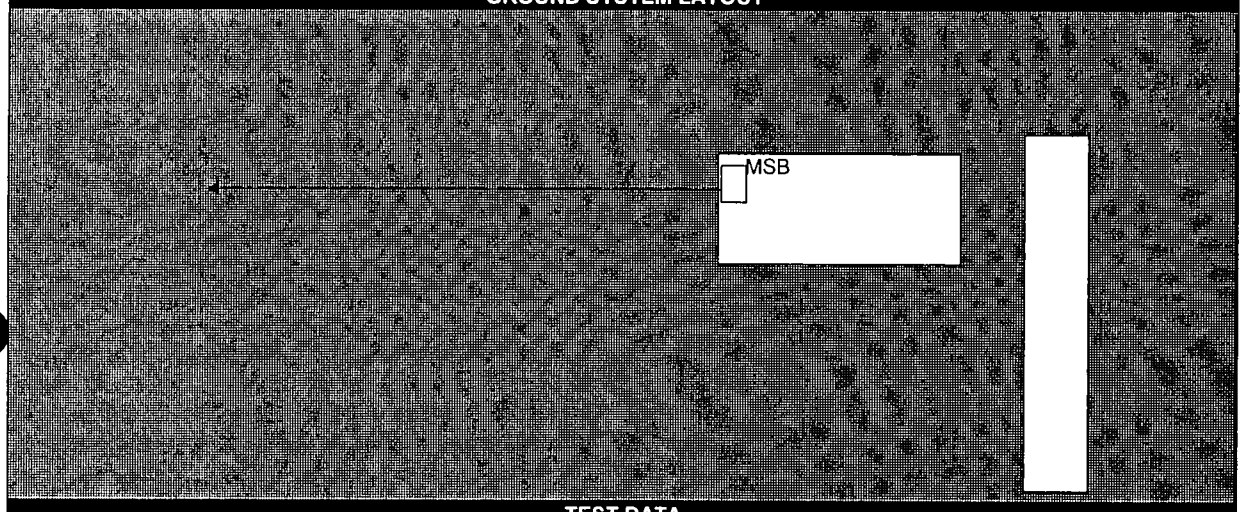
TEST CONDITIONS

- ☑ RAIN FALL WITHIN LAST 24 HOURS
- ☐ RAIN FALL WITHIN LAST WEEK
- ☐ RAIN FALL WITHIN LAST 48 HOURS
- ☐ NO PREVIOUS APPRECIABLE RAIN FALL

TEST EQUIPMENT DATA

MFGR:	MODEL:	SERIAL NO.:
Biddle	DET 2/2	5M633900

GROUND SYSTEM LAYOUT



TEST DATA

LAYOUT NO.	GRD. ROD DESIGNATION	SIZE	DEPTH	TEST METHOD				MEASURED RESISTANCE
				DIRECT		F. O. P.		
				REFERENCE	LEAD RESIST.	C2 DIST. (FT)	P2 DIST. (FT)	
1	Main Switchboard					170'	160'	0.89
2	Main Switchboard					170'	150'	0.214
3	Main Switchboard					170'	140'	0.128
4	Main Switchboard					170'	130'	0.136
5	Main Switchboard					170'	120'	0.084
6								
7								
8								
9								
10								

NOTES

*DIRECT INDICATES TWO TERMINAL METHOD, F. O. P. INDICATES THREE TERMINAL "FALL OF POTENTIAL" METHOD

SIEMENS

Transmittal Letter

O and M Manuals

Date: 6/6/06

Project: SPRING CREEK WELL 7

Attention: Deb Davis

Copies Enclosed: 1

Enclosed please find the above quantity of the sections listed below and materials for Operation & Maintenai manuals on the above referenced project.

SPEC. SECTION	MATERIAL COVERED
	General Electrical
	Switchboard
	Transformers
	Circuit Breakers

Thank you for using Siemens.
The attached documentation constitutes the "Operations & Maintenance" information applicable to your project. You may have already received some of this information in the form of User's Manuals or Operating Instructions shipped with the equipment itself. This format serves to bring all this documentation together into one place for ease of access and safe keeping.

It is possible you may need further information not contained herein. Siemens is pleased to direct you to the wealth of additional information located on our website - http://www.sea.siemens.com. Please feel free to browse this site at your leisure. Should you require further documentation or information, please also feel free to contact any of the contacts listed in the "Your Siemens Contacts" also contained herein.

Sincerely,

Eric Dulce

SO Number: 9566312
PO Number: 836007185P
Quote Number: 5472-2819J-10
MFR #: 59270

SIEMENS

O & M Manuals SECTION COVER SHEET

JOB

SPRING CREEK WELL 7

SECTION: **General Electrical**

CONTENTS:

Total Pages this Section: **4**

O & M Manuals

ENGINEER: N/A

CONTRACTOR: N/A

DISTRIBUTOR: REXEL PACIFIC

DATE: 6/6/06

SO Number: 9566312
PO Number: 836007185P

Quotation Number: 5472-2819J-10
MFR #: 59270

SIEMENS

To: REXEL PACIFIC
1060 ICEHOUSE AVENUE
SPARKS, NV 89431

BILL OF MATERIAL

Attention:

Project Name: Spring Creek Well 7
Quote Name: Spring Creek Well 7
Quote Number: 5472-2819J-10
Bid Date: 9/20/2005

Siemens Energy & Automation, Inc. (Company) agrees to sell to Purchaser and Purchaser agrees to purchase from the Company the goods described below. Written quotations are valid for 30 days from its date unless otherwise stated in the quotation. All quotations are subject to change by Company at any time upon written notice to Purchaser.

Item	Qty	Description
A.	1	**T-LA -- Transformer** Sentron Power Center: 1 Phase, 15 KVA, 480V Primary, 120/240V Secondary, 1LPC015
B.	1	**MSB -- Switchboard SWBD SB3 FCS2 CB** SB3/FCS2 Front Connected, BOTTOM RIGHT, SUSE, 3p/4w, 480/277V, Tapered Al Bus, 800A, AL, 42K AIC, Brac 65K AIC, NEMA1 Enc. 1 - Auxiliary Section Bussed 800A 1 - Utility - SIERRA PACIFIC POWER COMPANY - Hot, 13 Jaw 1 - 800 / 3 HMX Main Breaker 1 - Shunt Trip Wired to Term Block w/ control voltage 120VAC supplied by Siemens 1 - Key Interlock 1 - 800 / 3 HMX Branch Breaker 1 - (3) 1/0-500 kcmil Cu/Al 1 - Key Interlock 1 - 40 / 2 HED4 Branch Breaker 1 - #10-#1/0 AWG Cu/Al 1 - 15 / 3 HED4 Branch Breaker 1 - #12-#10 AWG Al 1 - 20 / 3 HED4 Branch Breaker 1 - #12-#10 AWG Al 1 - 30 / 3 HED4 Branch Breaker 1 - #10-#1/0 AWG Cu/Al 4 - 100 / 3 HED4 Branch Breaker Space 1 - 800 / 3 HMX Branch Breaker 1 - (3) 1/0-500 kcmil Cu/Al 12 - 500 Kcmil AL/CU Mechanical Lugs 1 - TPS Unit # TPSE5160X 1 - Siemens Digital Meter 9200DG - 1ZZA 1 - Current Transformer - 800 1 - Meter w/ integrated display 1 - Enhancement Package: #2 - Advanced Metering 1 - 100-240VAC/110-300VDC 1 - 50 - 347V L-N 1 - Communication: STD - RS485 Modbus/ION 2 - 100% Neutral Bus

SIEMENS

C.	**7**	**Q120 -- Standard Product** BREAKER 20A 1P 120V 10K QP
D.	**2**	**Q115 -- Standard Product** BREAKER 15A 1P 120V 10K QP
E.	**1**	**Q130 -- Standard Product** BREAKER 30A 1P 120V 10K QP
F.	**1**	**Q230 -- Standard Product** BREAKER 30A 2P 120/240V 10K QP

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(b) Buyer's exclusive remedy for a nonconformity in any item of the goods shall be the repair or the replacement (at Seller's option) of the item and any affected part of the goods. Seller's obligation to repair or replace shall be in effect for a period of one (1) year from initial operation of the goods but not more than eighteen (18) months from Seller's shipment of the goods, provided Buyer has sent written notice within that period of time to Seller that the goods do not conform to the above warranty. Repaired and replacement parts shall be warranted for the remainder of the original period of notification set forth above, but in no event less than 12 months from repair or replacement. At its expense, Buyer shall remove and ship to Seller any such nonconforming items and shall reinstall the repaired or replaced parts. Buyer shall grant Seller access to the goods at all reasonable times in order for Seller to determine any nonconformity in the goods. Seller shall have the right of disposal of items replaced by it. If Seller is unable or unwilling to repair or replace, or if repair or replacement does not remedy the nonconformity, Seller and Buyer shall negotiate an equitable adjustment in the contract price, which may include a full refund of the contract price for the nonconforming goods.

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(d) Buyer and successors of Buyer are limited to the remedies specified in this article and shall have no others for a nonconformity in the goods. Buyer agrees that these remedies provide Buyer and its successors with a minimum adequate remedy and are their exclusive remedies, whether Buyer's or its successors' remedies are based on contract, warranty, tort (including negligence), strict liability, indemnity, or any other legal theory, and whether arising out of warranties, representations, instructions, installations, or non-conformities from any cause.

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If you cannot find the information you require, please see the "Your Siemens Contacts" sheet for further help.

Equipment / Topic	Siemens Web Link
ACCESS/Power Monitoring	http://www.sea.siemens.com/power/product/pdprodacc.html
Busway	http://www.sea.siemens.com/power/product/pdprodbus.html
Circuit Breakers	http://www.sea.siemens.com/power/product/pdprodcb.html
Critical Power	http://www.sea.siemens.com/power/product/pdcriticalpower.html
Lighting Control	http://www.sea.siemens.com/power/product/pdprodlc.html
Low Voltage Switchgear	http://www.sea.siemens.com/power/product/pdlvs.html
Medium Voltage Switchgear	http://www.siemenstd.com/switchgear/00_switchghome.html
Motor Control Centers	http://www.sea.siemens.com/power/product/pdtiastar_index.html
Panelboards	http://www.sea.siemens.com/power/product/pdprodpb.html
Switchboards	http://www.sea.siemens.com/power/product/pdprodsb.html
Switches	http://www.sea.siemens.com/power/product/pdprodswi.html
Surge Protection	http://www.sea.siemens.com/power/product/pdprodsp.html
Transformers	http://www.sea.siemens.com/power/product/pdprodtrn.html

We're Siemens. We can do that.™

*Portable Document Format by Adobe

SIEMENS

O & M Manuals SECTION COVER SHEET

JOB

SPRING CREEK WELL 7

SECTION: **Switchboard**

CONTENTS:

Total Pages this Section: **103**

O & M Manuals

ENGINEER: N/A

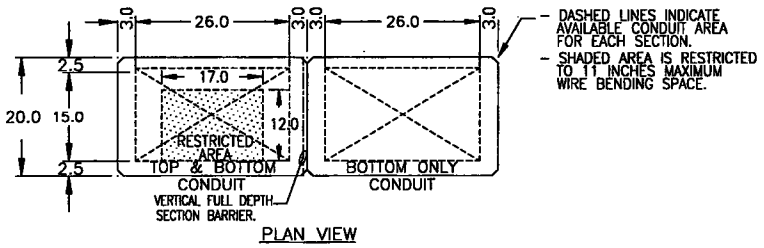
CONTRACTOR: N/A

DISTRIBUTOR: REXEL PACIFIC

DATE: 6/6/06

SO Number: 9566312
PO Number: 836007185P

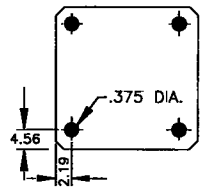
Quotation Number: 5472-2819J-10
MFR #: 59270



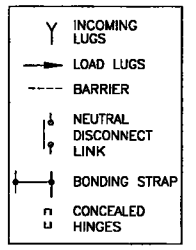
PLAN VIEW

NAMEPLATE SCHEDULE "A"	
NO	ENGRAVING
N1	SWITCHBOARD MSB

2.5" x 5.0" ENGRAVED NAMEPLATE
BLACK W/WHITE CORE



TYPICAL BOLTDOWN HOLE PROVISION FOR CUBICLE BOTTOM EACH SECTION.



LEGEND

NOTES

CONSTRUCTION-SWITCHBOARD IS BUILT AND LABELED PER UL 891 IN EFFECT STANDARD AT TIME OF MANUFACTURE

INCOMING SERVICE -AMPERES: 800
VOLTS: 480Y/277V
SYSTEM: 3 PHASE, 4 WIRE

INTERRUPTING RATING-THE SHORT CIRCUIT INTERRUPTING CAPABILITY IS 42000 RMS SYMMETRICAL AMPERES AT 480 VOLTS BASED ON THE LOWEST SHORT CIRCUIT CURRENT RATING OF THE INDIVIDUAL OR SERIES RATED COMBINATION DEVICE INSTALLED AT TIME OF MANUFACTURE. THE BUSSING STRUCTURE IS CONSTRUCTED TO WITHSTAND FAULTS OF 65000 RMS SYMMETRICAL AMPERES.

ENCLOSURE -ENCLOSURE IS TYPE NEMA 1 FOR INDOOR APPLICATION. CUBICLE FRAMES AND COVERS ARE CONSTRUCTED FROM CODE GAUGE STEEL.

EXTERIOR FINISH -ASA 61 GREY PAINT

TERMINATIONS-FRONT ACCESS REQUIRED

BUS BARS -ALUMINUM SIZED ON BASIS OF 65 DEG. C MAX. TEMP. RISE.

1) 800A 'SIERRA PACIFIC POWER' CT COMPARTMENT WITH PROVISIONS ONLY FOR UTILITY CT'S.

2) CAPTIVE SEALING SCREWS WITH WINGNUTS ARE REQUIRED ON FRONT COVERS WHERE SHOWN. ALSO REQUIRED ON TOP, SIDE, AND REAR COVERS OF SECTION 2.

INTERRUPTING CAPACITY RATING - SYMMETRICAL AMPS

BREAKER	120V	240V	480V	600V	LUG#
HED4 15-25A	-	100K	42K	-	SA1E025
HED4 30-100A	-	100K	42K	-	LN1E100
HMX_B 600-800A	-	100K	65K	50K	TA3MG500

ABBREVIATIONS

'SUSE' INDICATES THAT THE MARKED SECTION IS SUITABLE ONLY FOR USE AS SERVICE EQUIPMENT AND IS SO IDENTIFIED.

'UL' INDICATES THAT THE MARKED SECTION COMPLIES WITH ALL APPLICABLE UNDERWRITERS LABORATORIES STANDARDS AND IS IDENTIFIED WITH A UL LABEL.

'K' INDICATES A KEY INTERLOCK SYSTEM.

'LO' INDICATES KEY INTERLOCKS ARE LOCKED OPEN WITH THE KEY REMOVED.

'ST' INDICATES A SHUNT TRIP EQUIPPED DEVICE - 120VAC CONTROL POWER BY SIEMENS.

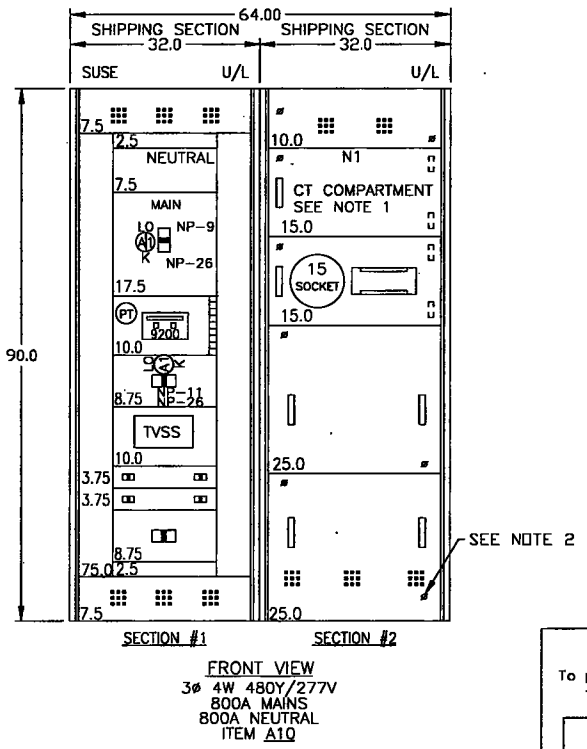
'UNIT SPACE' INDICATES UNOCCUPIED AREA INTENDED FOR FUTURE USE.

'9200' INDICATES SIEMENS MULTI-FUNCTIONAL DIGITAL METER

'CT' INDICATES CURRENT TRANSFORMER

'POT PT' INDICATES POTENTIAL POINT

'TVSS' INDICATES TPSE5160X TRANSIENT VOLTAGE SURGE SUPPRESSOR TO BE MOUNTED IN A HINGED COMPARTMENT



FRONT VIEW
3Ø 4W 480Y/277V
800A MAINS
800A NEUTRAL
ITEM A10

MOLDED CASE BREAKERS
NUMBER & SIZE LUG PER LEG

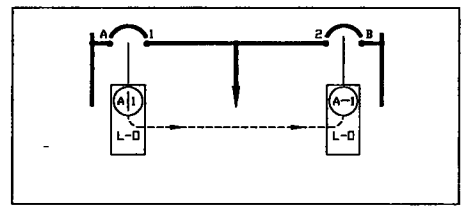
FRAME TYPE	AMPS	CONNECTORS
BL, BLH, HBL, BQD	15-20	1-#14-#8 AWG (CU) 1-#12-#8 AWG (AL)
	25-50	1-#8-#6 AWG CU 1-#8-#4 AWG AL
	55-70	1-#8-#4 AWG (CU) 1-#8-#2 AWG (AL)
	80-100	1-#4-#1/0 AWG (CU) 1-#2-#1/0 AWG (AL)
	110-125	1-#2-#1/0 AWG (CU) 1-#1/0-#2/0 AWG (AL)
QJ2, QJH2, QJ2H	60-225	1-#6 AWG-300 MCM (CU) 1-#4 AWG-300 MCM (AL)
ED2, ED4, ED6, ETI, ED6, HED4, HED6, CED6	15-20	1-#14-#10 AWG (CU) 1-#12-#10 AWG (AL)
	25	1-#10 AWG (CU OR AL)
	30-100	1-#10-#1/0 (CU OR AL)
	110-125	1-#3/0-3 (CU) 1-#2/0-1 (AL)
FXD6, FD6, SFD6 HFD6, SHFD6, CFD6, SCFD6	70-250	1-#6 AWG-350 MCM (CU) 1-#4 AWG-350 MCM (AL)
JXD2, JXD6, JD6, SJD6, HJD2, SHJD6, CJD6, SCJD6	200-400	(1-2)-#3/0-500 MCM (CU) (1-2)-1-#4/0-500 MCM (AL)
LXD6, LD6, SLD6, HLD6 SHLD6, CLD6, SCLD6	250-600	(1-2)-1-#3/0-500 MCM (CU) (1-2)-#4/0-500 MCM (AL)
LMD6, LMXD6, HLMD6, HLMXD6 MD6, MXD6, SMD6, HMD6, SHMD6, CMD6, SCMD6	400-600	2-#1 AWG-500 MCM (CU OR AL)
	700-800	3-#1/0-500 MCM (CU OR AL)
ND6, SND6, HND6 SHND6, CND6, SCND6	800-1200	4-250-500 MCM (CU OR AL)

AMPACITY RATING

		SUPPLY	SECTION
SECTION #1	MAINS	800	800
	NEUTRAL	800	800
SECTION #2	MAINS	800	-
	NEUTRAL	800	-

Interlock Scheme

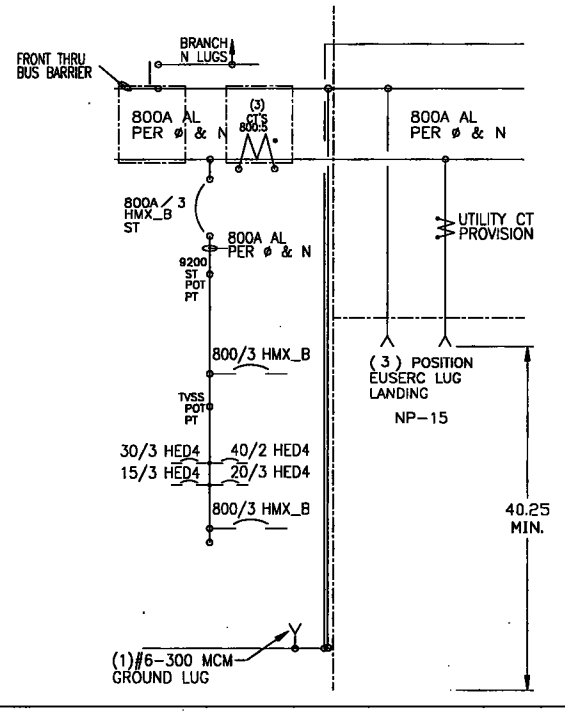
To prevent paralleling of lines A and B.
-Single load, fed from either source.



Key A1 held in Main 1 interlock.

1) Open Main 1.
2) Turn key A1 in L-O interlock on Main 1 to lock open. Key A1 is now free.
3) Insert key A1 in L-O interlock on Main 2 and turn to unlock. Key A1 is now held.
4) Close Main 2.

Reverse sequence to restore service through Main 1.



UTILITY CO. : SPP	
DESCRIPTION	PG No
CT COMPARTMENT	320
UGPS	345
LINE TERMINATION	347
METER PLATES	332
HIGH REAR ENTRY	--
SMM METERING	--

REFERENCE & WIRING DIAGRAM(S)

SECTIONS	DRAWING NUMBER	DESCRIPTION
1	8S-9800-10	MCCB ST
1	8S-9616-10	9200 METER
1	8S-9104-01	TVSS

NO.	REVISIONS	BY & DATE	CHD.	APP.

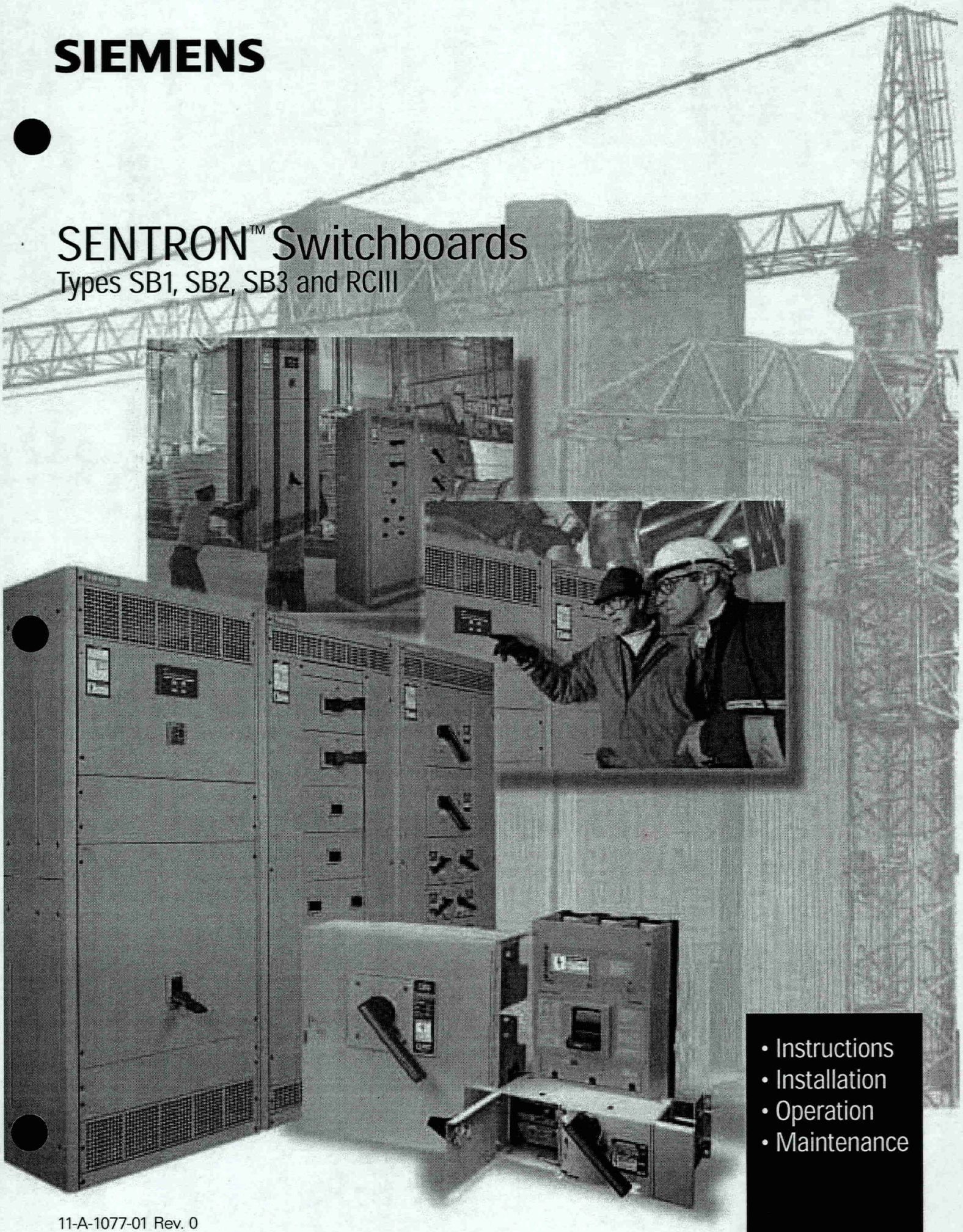
JOB: SPRING CREEK WELL 7
FERNLEY, NV 89408
P.O.: 836007185P
CUST.: REXEL PACIFIC
TIE:
S.O.: 17-59270-A10
BY: JAW
DATE: 02-06-2006
ENG. LOC.: 7170
TITLE: SB3 REV.A SWITCHBOARD MSB
APP.:
MFG. LOC.: 7170
DWG. NO.: 17-6C-59270-A10-A
REV.: 0
APP.:
DWG. FILE: 7170
SHEET 1 OF 1

Siemens Energy & Automation, Inc.
Atlanta, Georgia

SIEMENS

SENTRON™ Switchboards

Types SB1, SB2, SB3 and RCIII



- Instructions
- Installation
- Operation
- Maintenance

11-A-1077-01 Rev. 0

Contents

Introduction

SECTION 1.0 - INTRODUCTION
The purpose of this manual is to assist the user in developing safe and efficient procedures for the installation, maintenance and use of the equipment. For additional information, refer to NEMA Standards Publication PB2.1 "General Instructions for Proper Handling, Installation, Operation, and Maintenance of Deadfront Distribution Switchboards rated 600 volts or less." Contact the nearest Siemens representative if any additional information is required.

Siemens warrants that on the date of shipment all goods manufactured by Siemens are free of non-conformities in workmanship and materials. If within one year from date of initial operation, but not more than eighteen months from date of shipment by company, of any item of the goods, purchaser discovers that such item was not as warranted above, and promptly notifies company in writing thereof, company shall remedy such defect by, at company's option, adjustment, repair or replacement of the item and any affected part of the goods. Refer to "Standard Terms and Conditions of Sale" for complete warranty terms.

1.1 Qualified Person
For the purpose of this manual a Qualified Person is one who is familiar with the installation, construction or operation of the equipment and the hazards involved. In addition, this person has the following qualifications:

1.1.1. Training and authorization to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

1.1.2. Training in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses, face shields, flash clothing, etc., in accordance with established safety procedures.

1.1.3. Training in rendering first aid.

1.1.4. Knowledgeable of NEC requirements and other applicable codes, laws and standards

1.2 Signal Words
The signal words "Danger," "Warning" and "Caution" used in this manual indicate the degree of hazard that may be encountered by the user. These words are defined as:

1.2.1. Danger - Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

1.2.2. Warning - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

1.2.3. Caution - Indicates a potentially hazardous situation which, if not avoided may result in minor or moderate injury.

1.3 Dangerous Procedures
In addition to other procedures described in this manual as dangerous, user personnel must adhere to the following warnings:

1.3.1. Danger! High Voltage. Qualified personnel only. Lock off all power to this equipment before working inside. Always work on de-energized equipment. Always de-energize equipment before performing any tests, maintenance or repair.

1.3.2. Warning! Always perform maintenance on the interrupting device after the closing mechanism(s) are discharged.

1.3.3. Caution! Always let an interlock device or safety mechanism perform its function without forcing or defeating the device.

1.3.4. Caution! Hydrocarbon spray propellants and hydrocarbon compounds will cause degradation of certain plastics. Contact your local Siemens representative before using these products to clean or lubricate components during installation or maintenance.

1.4 Field Service
Siemens can provide Field Service Representatives to provide technical guidance and advisory assistance for the installation, overhaul, repair and maintenance of Siemens equipment, processes and systems. Contact regional service centers, sales offices or the factory for details. For emergency service, call 1-800-241-4453.

1.5 General Description
Siemens switchboards are designed and manufactured to perform efficiently under normal operating conditions. The instructions included in this manual are provided to aid in obtaining long and economical service from your switchboards. For proper operation and maintenance, this information should be distributed to the owner's operators and engineers.

These instructions cover the standard construction details of Siemens' switchboards including auxiliary equipment and necessary accessories. Any special equipment furnished in accordance with purchase order requirements are covered by supplementary instruction books.

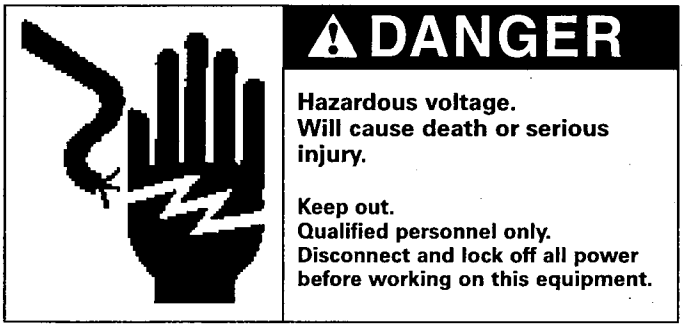
The switchboards described in this manual are the deadfront type as defined in NFPA70 (NEC), UL891 and NEMA PB2. All parts, conductors, and insulation materials are designed and constructed to suit the voltage class of the equipment and are enclosed within grounded metal enclosures.

The equipment furnished has been designed to operate in a system having the circuit capacity specified by the purchaser. If, for any reason, the equipment is later used in a different system, or if the short-circuit capacity of the system is increased, the momentary rating of the switchboards, the interrupting capacity of the protective devices and the bus capacity must be checked. Should the service be changed, the equipment must be checked to assure that the short circuit capacity, amperage and voltage class of the equipment meets or exceeds the requirement of the new system.

Safety Precautions and Switchboard Preparation

Switchboards are free-standing units rated 6000 amperes or less at 600 volts AC or less. A typical switchboard will contain the service entrance section with main devices and distribution sections with branch devices. The sections contain disconnect devices, protective devices, auxiliary equipment, and any current transformers for metering, control, or ground fault protection. Devices are applied in a broad range of sizes and mounting arrangements. Outdoor switchboards consist of indoor equipment enclosed in a weatherproof housing and a door over the inner front panels.

SECTION 2.0 - SAFETY PRECAUTIONS



2.1. Only qualified persons familiar with the construction and operation of switchboards should perform work described in this set of instructions. Such work should be performed only after reading this complete set of instructions.

2.2. Follow safety related work practices, as described in NFPA 70E, part II, at all times.

2.3. Hazardous voltages in electrical equipment can cause severe personal injury or death. Energizing a switchboard for the first time after initial installation or maintenance is potentially dangerous.

2.4. Some types of electrical equipment will cause harmonics in the electrical system which may result in overheating. Consider this condition when determining switchboard loading, as possible de-rating of equipment may be necessary.

SECTION 3.0 - SWITCHBOARD PREPARATION

3.1 Receiving

Prior to shipment, each switchboard is inspected to ensure structural and electrical construction is in compliance with applicable specifications, codes, and standards. Depending on the size and number of sections, the switchboard is divided into shipping sections of one or more vertical sections and placed onto wooden skids. Each shipping section is packaged, securely blocked and braced for shipment. Whatever method of shipment, every precaution is taken to minimize the possibility of damage and to ensure its safe arrival. Relatively delicate instruments or devices may be included and the assembly must be handled carefully when unloading.

When the equipment arrives at the destination, the packing list or marking tag(s) should be checked against the equipment actually received to make sure the shipment is correct and complete. Claims for shortages or incorrect material must be made in writing within 30 days after receipt of the shipment and failure to give such a notice constitutes unqualified acceptance and a waiver of all such claims.

On shipments with more than one shipping group, marking tags are attached to each crate or package for identification. In lieu of the marking tags, the rating label on each section contains the section marking. Refer to the general arrangement drawing for the location of each unit within the group lineup.

3.2 Inspection

Inspect the equipment as soon as possible after receiving for any damage that may have occurred in transit. Carefully remove packing to inspect for any possible damage. Retain the packing material for equipment storage or return shipment if necessary. The switchboard should remain in an upright position and secured to the shipping skid to prevent distortion of the bottom frame when moving or handling.

3.3 Shipping Damage Claims

All claims for lost or damaged goods in transit are to be handled by purchaser directly with the carrier. Notification to carrier within the 15 day limit on concealed damage is essential if loss resulting from unsettled claims is to be eliminated or minimized.

3.3.1. When shipment arrives, note whether equipment is properly protected from the elements. Note trailer number on which the equipment arrived. Note blocking of equipment. During unloading make sure count agrees with delivery receipt.

3.3.2. Make immediate inspection upon arrival for visible damage. This should be done prior to unloading when possible. When total inspection cannot be made on vehicles prior to unloading, close inspection during unloading must be maintained and visible damage noted. Take pictures if possible.

3.3.3. Any visible damage must be noted on the delivery receipt and acknowledged with the driver's signature. The damage should be detailed as much as possible. It is essential that a notation "Possible internal damage, subject to inspection" be included on delivery receipt.

3.3.4. If driver will not sign the delivery receipt with damage noted, the shipment should not be signed for by the consignee or his agent.

3.3.5. Notify the Siemens Sales Office immediately of any damage.

3.3.6. Arrange for a carrier inspection of damage immediately. **IMPORTANT**: Do not remove equipment from the place

it was set when unloading. Be sure this location is properly protected to ensure further damage will not occur. Equipment must be inspected by carrier prior to handling after receipt. This eliminates loss due to claims by carrier that equipment was damaged or fur ther damaged on site after unloading.

3.3.7. Be sure equipment is properly protected from any further damage by covering it properly after unloading. Equipment should be stored in a clean dry place having a uniform temperature to prevent condensation and protected from further damage.

3.3.8. If practical, make further inspection for possible concealed damage while carrier inspector is on site. If inspection for concealed damage is not practical at the time the carrier is present, it must be done within 15 days of receipt of equipment. If concealed damage is found, the carrier must again be notified and inspection made prior to making any corrective action to repair. Also notify Siemens Sales Office immediately.

3.3.9. Obtain the original of the carrier inspection report and forward it along with a copy of the noted delivery receipt to the Siemens Sales Office. Approval must be obtained by Siemens from the carrier before any repair work can be performed. Before approval can be obtained, the documents requested must be in Siemens' hands. The carrier inspection report and/or driver's signature on the delivery receipt does not constitute approval to repair.

3.4 Handling
Each switchboard shipping section has provisions for attaching lifting equipment. The lift points are designed for use with a crane of adequate height and capacity. To estimate the maximum required crane capacity, multiply the number of sections to be lifted by 2,000 pounds.

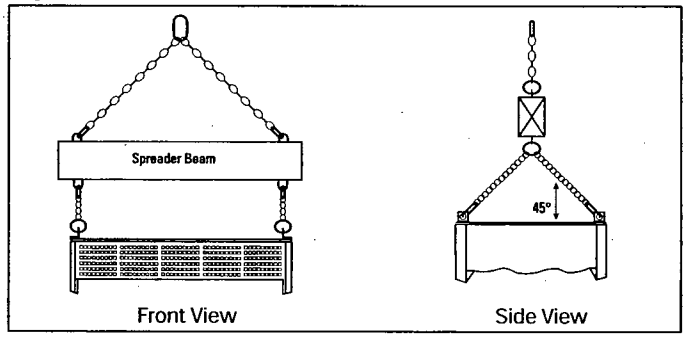
NOTE: 2,000 LBS IS AN AVERAGE WEIGHT. SOME SECTIONS MAY HAVE A WEIGHT OF GREATER THAN 2,000 LBS. PLEASE CALL THE SIEMENS SALES OFFICE TO VERIFY SECTION WEIGHTS.

Switchboard sections may be moved by crane with lift cables attached to the lifting bars on the top of the switchboard. If crane facilities are unavailable, or if tight spaces prevent use of a crane, rollers under the skids may be used.

Recommended lifting is by means of four cables connected to an overhead crane or by fork lift.

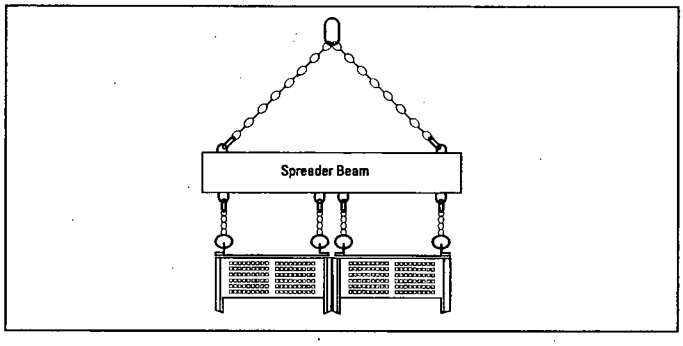
3.4.1 Lifting By Means Of An Overhead Crane
Single Section Lifting – The cables are connected to the lifting brackets, mounted at the top front and top rear mounting locations (See Fig. #1A). A crane with sufficient height should be used so the load angle (from horizontal) on the lifting cables will be a minimum of 45 degrees, when viewed from side of section. The lifting cables must have spreaders from side to side to prevent twisting the lifting brackets.

Figure 1A



3.4.2 Multi-Section Lifting — The method of lifting a multi-section unit is similar to lifting single section. The cables need to be connected to all lifting brackets. The lifting cables must have correct spreader from side to side (See Fig #1B). A crane with sufficient height and lift is required.

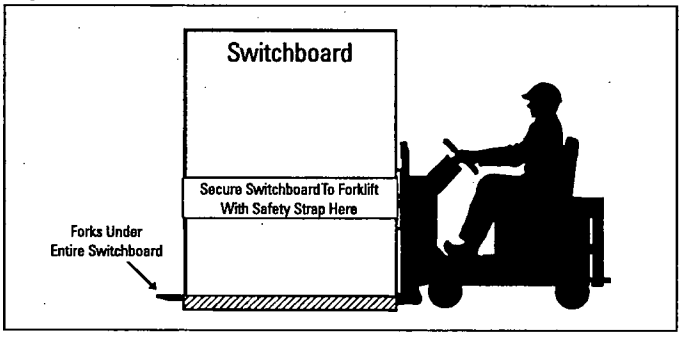
Figure 1B



3.4.3 Lifting By Means Of A Forklift
Forklift trucks should be used with care as improper lift points could cause damage to equipment. Balance the load carefully and use safety straps when handling with a forklift. Jacks may be used to lift switchboard sections which are properly supported by sturdy timbers. To prevent distortion of the enclosures, rollers and cribbing of equal height must be used in sufficient number to evenly distribute the load.

Figure 2 shows a method of using a forklift on an indoor switchboard.

Figure 2



For alternate handling means, please refer to the NEMA Standards Publication PB 2.1.

Installation

3.5. Storage
3.5.1 Indoor Switchboards
When switchboard is not to be installed immediately, it should be unpacked, inspected and stored in a clean dry location having adequate air circulation and uniform temperature to prevent condensation. If switchboard is to be stored for any length of time prior to installation, restore the packing for protection. If the packing material is removed, cover the switchboard to protect from dust, debris, and moisture.

Indoor switchboards are neither weatherproof nor drip-proof. Therefore, it should be stored indoors. If it is to be kept either outdoors or in a humid, unheated area, provide an adequate covering to protect against weather and dirt, and place a heat source of approximately 250 watts output within each vertical section to prevent condensation. Space heaters are not standard equipment on indoor switchboards. Remove any loose packaging or flammable materials inside the switchboard before energizing the heat source. Lubricate any moving parts such as hinges, shutters, etc., if storage is for an extensive period of time.

3.5.2 Storage – Outdoor Switchboards
It is important that outdoor switchboards are stored exactly as described for indoor switchboards. When it is necessary to store outdoor switchboards in an area exposed to the weather or under humid conditions, they should be kept clean and dry as described above. Energize the self-contained space heaters (if provided) and make certain that louvers and vents are uncovered to allow air to circulate and cover shipping splits to protect from the elements. Refer to wiring diagram drawing for space heater circuit connections. Lubricate hinges, shutters, and other moving parts.

SECTION 4.0 - INSTALLATION

The proper switchboard installation method depends on whether the units are shipped as one complete group (maximum of 84.0") or in two or more shipping sections.The general arrangement drawing supplied by the factory will indicate the shipping groups and their respective location within the lineup. Units must be assembled in accordance with the general arrangement drawing.

4.1. Location
Find the designated area on the building floor plan where the switchboard will be installed. If this area is not specified, the location chosen for installation should provide working clearances complying with article 110-26 of the National Electrical Code (NEC). Front accessible switchboards require that field connections including mains, branches, ground bus, and neutral bus are accessible and maintainable from the front. Equipment drawings identify switchboards that require rear access.

4.2. Foundation Requirements
Extreme care should be taken in layout of foundation or floor. Refer to general arrangement drawing for exact location of anchor bolts, area for conduits, other limitations, and instructions. Foundations must be sufficiently strong to support the weight of the equipment. Conduit couplings should be stubbed flush with or below the finished floor level. (Refer to NEC 384-10.) After the equipment has been lowered to the foundation and set in place, conduit extension sleeves may be screwed into couplings.

Floors and sills must have a smooth level surface and be in the same plane. The surface of the foundation must not protrude above the grouted sills or bed plates at any point. Grouted sills or bed plates must be set true and level and be in an aligned position in the same plane to each other over the entire length.

Outdoor equipment is usually installed on a concrete pad with a level and smooth surface. Outdoor equipment which has been assembled on formed base plates must be supported at each section. Adjacent units at each shipping split must be supported on a single support, and this must be taken into consideration when the foundation is designed and constructed.

4.3. Positioning of Sections
Positioning and connection of the switchboard sections at the installation site is done in the following manner.

4.3.1. Space to the front and rear should be sufficient for opening of doors, insertion and withdrawal of removable breakers, inspection, and maintenance. Service entrance equipment should be located as close as possible to the incoming service of the building.

4.3.2. Clean the mounting surface to remove all dirt and debris. Start with the left end shipping group and continue in sequence. Maneuver the section into the desired position using procedures described under "Handling." Use care in locating sections over conduit areas and beware of any conduits which stub-up above floor level as these may block sliding the section in either direction.

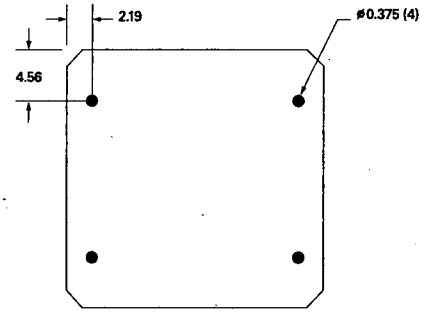
4.3.3. Prepare for the connections across shipping splits before the equipment is moved into final position. Bus supports and bus joints should be removed using side, rear and front access options as required. Note the mounting position and orientation and save hardware for use in reinstallation.

4.3.4. Remove the shipping skid and stand the section in an upright position. Remove all packing material and the bottom floor plate if one is installed in the section. To protect the bottom channel, any sliding force must be carefully applied across the bottom 4 inches (100mm) of the side to fully distribute the sliding force.

4.3.5. All shipping sections must be leveled and aligned to each other in order to maintain proper alignment of the horizontal main through bus and splice bus connections. Bolt all section frames together and connect all through bus and ground bus at shipping breaks using the splice plate bus and hardware supplied. Tighten bolted connections in accordance with torque specifications indicated on the instruction label supplied.

4.4. Anchoring, Leveling and Assembly
Indoor switchboard shipping groups are held in alignment by bolts holding the vertical sections to each other. The entire shipping group is to be anchored and leveled as a single element without loosening any hardware until entire shipping group is leveled and anchored. Supporting surfaces for the switchboard at each anchoring bolt location must be level and in the same plane. There must not be any projection above this plane within the area covered by the switchboard cubicles.

Figure 3



Typical bolt-down hole provisions for cubical bottom, each section.

If the floor or ground sill channels do not meet this requirement, it may be necessary to shim in the following manner. All anchor bolt locations in each cubicle must freely rest in firm contact with the mounting support surfaces. There must not be any projection or obstruction in other areas which may distort the cubicle. Do not force cubicle in firm contact by drawing down anchoring bolts as such drastic means will distort cubicles. Add 4" (100mm) square shims adjacent to anchor bolts until firm contact is achieved. Check each anchor bolt location (See Figure 3 and 4).

4.4.1. If side mounted lifting bars are supplied on shipping sections, it is necessary to remove the lifting bars. If top mounted lifting brackets are supplied on shipping sections, removal is optional.

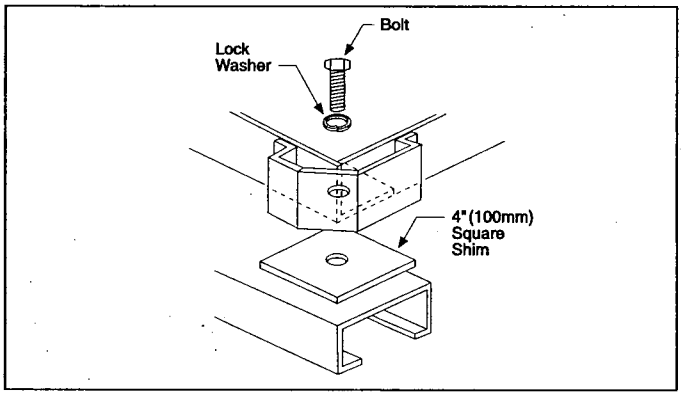
4.4.2. Tighten anchor bolts or weld to sills.

4.4.3. If line-up consists of multiple groups, move the next group into position, with the rear of units in line and tight against the adjacent group. Do not bolt groups together at this time. Check that the cubicles are in firm contact with the foundation at each corner and anchor point and that bolt holes are in alignment. Add square shims as necessary. Tighten the anchor bolts. Now bolt groups together as described in "Joining Shipping Sections."

4.4.4. Repeat Step 3 above until all shipping groups have been installed securely and in the correct order per the front elevation drawing supplied from the factory.

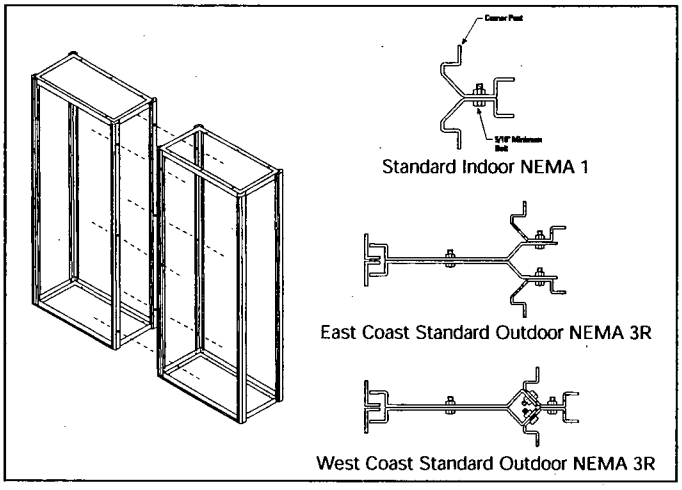
Note: For seismic installation, refer to installation instructions furnished with the equipment.

Figure 4



4.5. Joining Shipping Sections
The front panels and, if possible, the back plates should be removed so that adjacent shipping section frames can be bolted firmly together. Place 5/16-16 x 1.00 inch steel bolts through the holes in each front and rear corner post as shown in Figure 5. Torque the bolts to 12 ft lbs.

Figure 5



4.6. Electrical Connections
Electrical connections within switchboards are made using either bus bar or cable. Bus bar is furnished for connections between the main bus, circuit breakers fusible devices and pads for cable terminations.

Switchboards are designed to fully comply with standard electrical clearances. However, since cable and bus connections are being made in the field, care must be taken to ensure that all minimum clearances are maintained for electrical connections.

Installation

Between live parts of opposite polarity	0-125V	126-250V	251-600V
Through Air	1/2"	3/4"	1"
Over Surface	3/4"	1 1/4"	2"

Between live parts and grounded metal	0-125V	126-250V	251-600V
Through Air	1/2"	1/2"	1"
Over Surface	1/2"	1/2"	1"

4.7. Through Bus Splice Connections
When a switchboard group is split for shipping purposes, the cross bus and ground bus connections must be made when installing the equipment. To make these bolted connections, refer to Figures 6 through 12 and these instructions:

4.7.1. Access to the main bus from the cable termination area is achieved by removing the main bus compartment barrier which separates the main bus from the cable area. For some arrangements, it may be necessary to remove items between the main bus barriers and the rear of the unit in order to gain full access. After completion of the bus assembly and installation, these items should be reassembled in reverse sequence.

4.7.2. All surfaces must be free of dust, dirt or other foreign material. Do not use any abrasive cleaner on plated contact surfaces. Cleaning is normally not necessary and should not be done unless parts are badly tarnished. If cleaning is necessary, use a mild cleaner and thoroughly remove all residue. Keep cleaning agent off insulation.

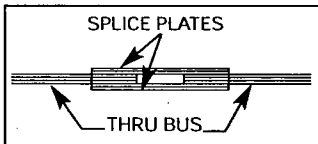
4.7.3. Before assembling any bus bar joint, check that the bar is inserted through bus supports (when required). Observe the relationship of the bus bar and maintain this relationship when connecting bus bars. Spacers may be required in some bus joint connections.

4.7.4. Assemble all joints with the parts dry. Do not use grease or "no-oxide" product.

4.7.5. Use the hardware provided with the Splice Plate Kit. Using smaller or different grade hardware may result in over-heating of the connection.

4.7.6. Single Bolt Connections: Insert the bolt through the hole on the tie plate and the through bus. Next, place the large diameter Belleville washer on the 1/2-13 bolt. Hand tighten the nut and then torque to 50 lbs. Duplicate for each set.

4.7.7. Four Bolt Connections: Position the (4) 3/8-16 carriage bolts in the slotted holes in the splice plate and the through bus. Hand tighten the 3/8-16 belleville washer nut and then torque to 20 ft lbs. Duplicate for each set.



HARDWARE	GRADE	MAX. TORQUE
3/8-16	5	20 FT/LBS
1/2-13	5	50 FT/LBS

WHEN MORE THAN ONE SPLICE PLATE IS PROVIDED PER PHASE INSTALL ON EACH SIDE OF THE THRU BUS.

11-A-1021-01 REV. 2

Figure 6 (Typical Bolt Alignment for Tie Plates)

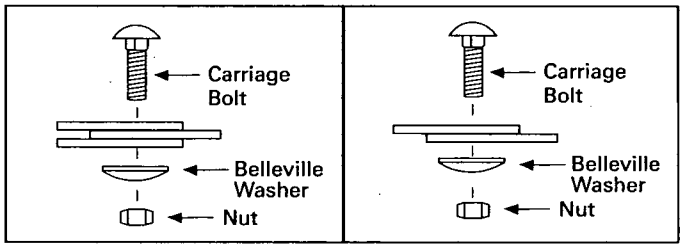


Figure 7 (Splice Plate – Single Hole)

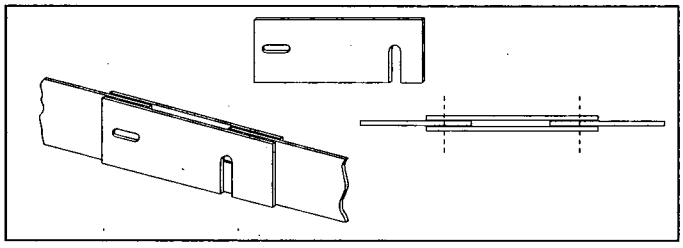


Figure 8 (Straight Tie Plate – Single Hole)

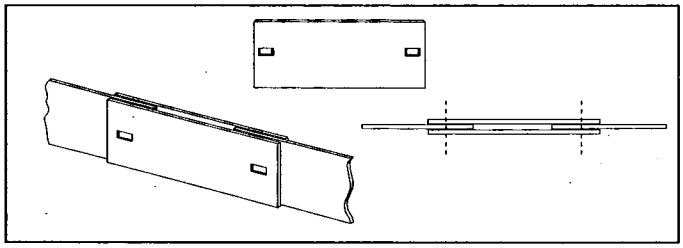


Figure 9 (Angle Tie Plate – Single Hole)

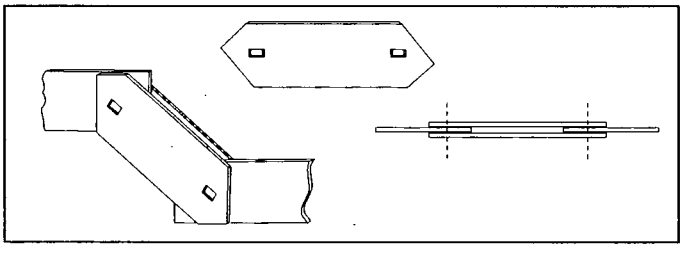


Figure 10 (Straight Tie Plate - Four Hole to Single Hole)

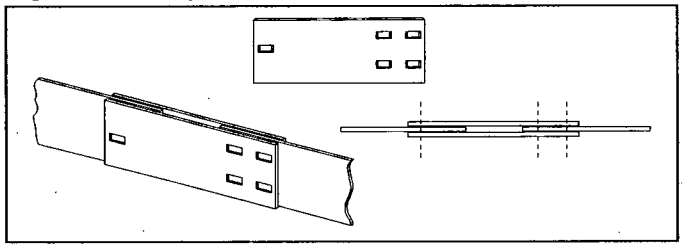


Figure 11 (Offset Tie Plate – Four Hole to Single Hole)

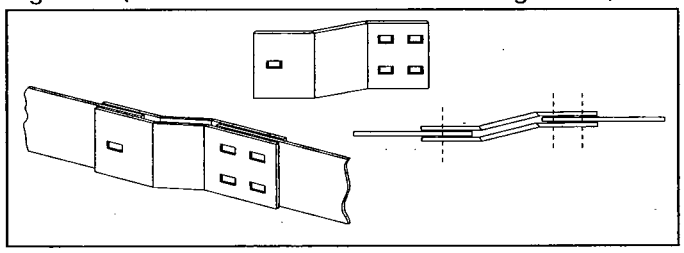
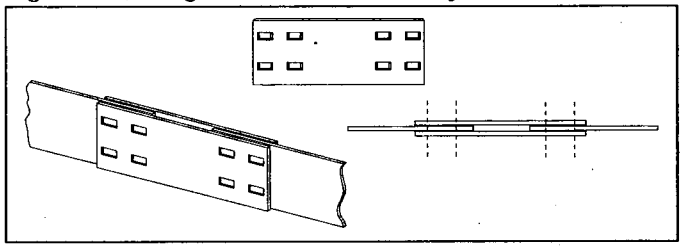


Figure 12 (Straight Tie Plate - RCIII Only)

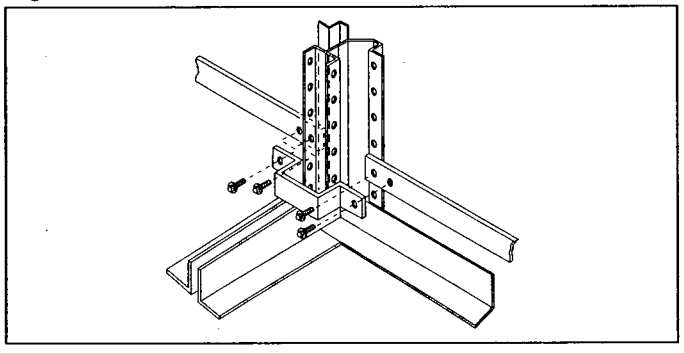


4.8 Ground Bus Splice Connections

Remove ground bus splice plate and rotate the bar into place. Align and secure the ground bus splice connection between shipping sections. Refer to Figure 12 for connection. Torque connections to 6 ft lbs.

NOTE: Proper installation is essential for safe and proper operation of ground fault protection system (when provided).

Figure 12



4.9 Grounding and Bonding

For grounded systems used as service equipment or as a main switchboard on a separately derived system, follow the steps below:

4.9.1. Run a ground electrode conductor from the grounding electrode at the installation site to the ground lug located on the switchboard ground bus. Select the proper material and size the grounding conductor to comply with sections 250-62 and 250-66 of the National Electric Code (NEC). Install the grounding electrode conductor as specified in section 250-64(b) of the National Electric Code (NEC). No ground conductor allowed on load side of neutral disconnect link or ground fault sensor.

4.9.2. The main bonding jumper between the neutral bus and the ground bus will be installed at the factory. Ensure that the bonding jumper is in place and properly labeled.

4.9.3 It is important that none of the grounding conductors are connected to load side of any neutral; neutral disconnecting link or any sensor used for ground fault protection.

4.9.4. When the system is a dual fed (double ended) and has ground fault protection, refer to switchboard front elevation drawing for proper grounding and handling.

4.9.5. For ungrounded systems used as service equipment, or as main switchboard on a separately derived system, follow the steps below:

4.9.5.1. Run a grounding electrode as described in part 4.9.1. above.

4.9.5.2. If the system is grounded at any point ahead of the switchboard, the grounded conductor must be run from that point and connected to the ground bus as described in paragraph 250-24(b) of the National Electric Code (NEC).

4.9.6. For a switchboard not used as service equipment or as a main switchboard on a separately derived system:

4.9.6.1. Use equipment grounding conductors sized according to paragraph 250-66 and Table 250-122 of the National Electric Code to ground the switchboard frame and ground bus to the service ground.

4.10 Busway Connection

Refer to the SENTRON™ Busway Storage, Installation and Maintenance Instructions Piece No. 31-9918-01 supplied with the Busway for installation of the busway runs.

4.11 Switchboard Busway Flange Connection
In most cases, the Sentron Busway standard stubs are shipped to the job site already factory connected to the switchboard. In applications where the flange stub is not installed from the factory, refer to the following instructions below:

4.11.1. From inside the switchboards, remove the ⅜" bolts that fasten the switchboard bus to the busway flanges.

4.11.2. Remove the screws from the switchboard that are around the opening busway cutout.

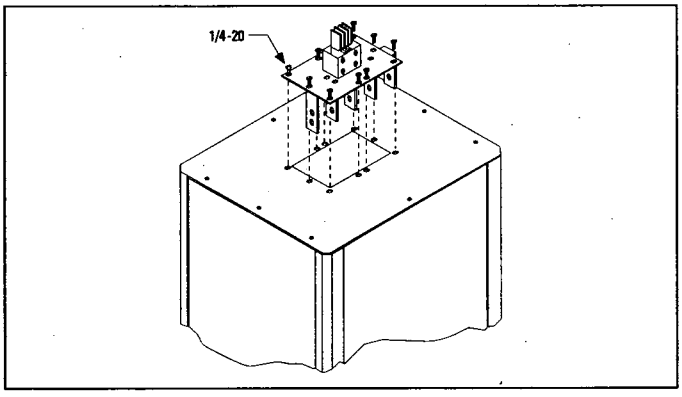
4.11.3. Insert the busway flange end into the switchboard bus connectors in the switchboard and align the holes. **NOTE:** Top plate is not designed to support weight of busway. Busway must be supported by other means.

4.11.4. Insert the ⅜" bolts at bus joint and torque to 20 ft lbs. Tighten bus joint connections, all phases, neutral and ground bars.

4.11.5. Insert the screws that attached the busway flange to the switchboard top plate or outer cover.

4.11.6. Verify busway flange phasing with switchboard phasing (i.e., ABCN, front to rear).

Figure 13



4.12 Conduit Area
All conduits and stubs must be located to avoid cable interference with structural members and live bus. Deep switchboard frames will need to have side-to-side frame support removed. Install conduit properly, with appropriate hubs or sleeves and ring connectors to protect cables and prevent water from entering and accumulating in the switchboard. Bond all metallic conduit and stubs to the switchboard with substantial electrical connections. Before pulling cable, verify that their size, temperature rating, and conductor insulation comply with the switchboard markings. (Ref NEC 110-14(C).

NOTES: 1) If bottom plates are furnished, holes for any conduit entering the bottom of the switchboard must be made by the customer. After making the holes, re-install the bottom plate. 2) Top plate is not designed to support weight for conduit. Conduit must be supported by other means.

4.13 Cable Pulling
Siemens switchboards are constructed according to NEMA specifications standards for cable arrangements. It is important that all cables enter the switchboard in the conduit area shown on the front elevation drawing and per the instructions shown below:

4.13.1. Use only cable sizes suitable for a proper fit with the corresponding lugs.

4.13.2. Pull the proper number of line side and load side cables as per the load served.

4.13.3. Position the cables inside the switchboard so that they are not subject to physical damage.

4.13.4. Maintain the maximum possible bending radii and proper clearance to bus bars and grounded parts. If any cables are lying or bearing on structural members, support them to relieve this condition or place suitable protective material at the bearing point to protect the cable insulation.

4.13.5. Where cables enter or leave the switchboard, or pass through any metal which has magnetic properties, be certain to run all phase conductors, including the neutral, through the same opening.

4.14 Cable Termination

4.14.1. Strip a length of insulation from the end of the cable sufficient to fit into the full length of the lug barrel, being careful not to nick or ring the strands. Use a proper insulation stripping tool.

4.14.2. Thoroughly clean aluminum cable contact surfaces with a wire brush.

4.14.3. Apply an acceptable joint compound to the bare aluminum.

4.14.4. If compression type lugs are furnished on any switch or circuit breaker, or as the main incoming power lugs, unbolt and remove them. Insert the cable into the lug barrel and, using the crimping tool, make the specified number of crimps. Wipe excess sealant from the connector and insulation. With the cables connected, remount the lugs onto the bus bars, switches, or circuit breakers. Torque the bolts per the chart on page 16.

4.14.5. Set screw type lugs may be furnished as main incoming lugs and are standard on all devices supplied by Siemens. Torque values for these lugs are marked on these units. Torque values for other switchboard lugs are marked on the switchboard.

4.15 Cable Lashing Requirements
For conductor lashing instructions on switchboards marked **65kA, 100kA** or **200kA** short circuit current ratings, refer to the following instructions:

4.15.1. Switchboards with a single fusible main switch rated 4000A or less do not require lashing.

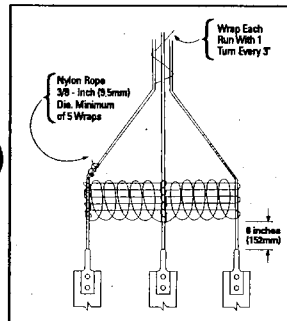
4.15.2. Switchboards with a single main molded case circuit breaker rated 4000A or less do not require lashing. When using insulated case SB Circuit Breaker, lashing is required.

4.15.3. Switchboards with a single main fused circuit breaker rated 4000A and less do not require lashing.

4.15.4. Switchboards of single section construction with fusible disconnects, circuit breakers, or fusible circuit breakers do not require lashing.

For switchboard sections requiring lashing, refer to the instructions below:

65kA



Lashing Instructions to 65,000A Maximum

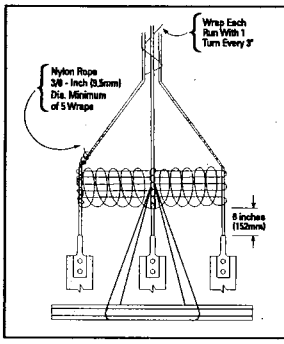
To comply with UL short circuit withstand ratings the adjacent Ø & N connections shall be lashed per the instructions provided below.

Wrap line cables together with nominal 3/8" nylon rope or rope having a minimum tensile strength of 2000 pounds. From switchboard entrance to the point that the cables lace together, wrap each run of cable with 1 turn every 3 inches. Where cables lace into terminals, support must be added to the cables per the diagram. This should be installed 6" from the terminals and every 12" beyond that point.

Crimp Connectors - Refer to instructions on connector for proper crimping tool and quantity of crimps required. The lashing shall be as described above.

11-1000-01 REV. 7

100kA



Lashing Instructions to 100,000A Maximum

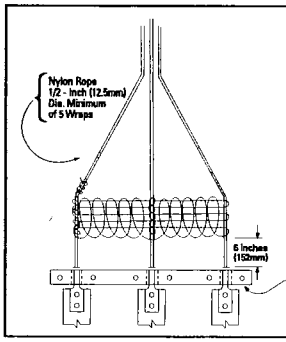
To comply with UL short circuit withstand ratings the adjacent Ø & N connections shall be lashed per the instructions provided below.

Wrap line cables together with nominal 3/8" nylon rope or rope having a minimum tensile strength of 2000 pounds. From switchboard entrance to the point that the cables lace together, wrap each run of cable with 1 turn every 3 inches. Where cables lace into terminals, support must be added to the cables per the diagram. This should be installed 6" from the terminals and every 9" beyond that point.

Crimp Connectors - Refer to instructions on connector for proper crimping tool and quantity of crimps required. The lashing shall be as described above.

11-1001-01 REV. 6

200kA



Lashing Instructions to 200,000A Maximum

To comply with UL short circuit withstand ratings the adjacent Ø & N connections shall be lashed per the instructions provided below.

Crimp Connectors - Refer to instructions on connector for proper crimping tool and quantity of crimps required. Wrap line cables together with nominal 1/2" nylon rope or rope having a minimum tensile strength of 3000 pounds. Where cables lace into line terminals support must be added to cable per the diagram provided. This should be installed every 6" from line terminals and every 6" above that point.

Note: Cable support must be re-installed over lug barrels after cable termination.

11-1006-01 REV. 3

4.16 Control Wiring

Control wiring is carefully installed and checked at the factory. Inter-group wiring at shipping splits can be readily connected by referring to wire markings. These wires are of sufficient length to be routed to their termination point after cubicles are bolted together. Terminals for these leads are furnished by others to suit the available crimping tools. When required, terminal block hardware is furnished with the switchboard. All wiring diagrams needed for installation are furnished in advance.

Wires can be easily traced on a wiring diagram furnished for the switchboard. Each device is illustrated and each terminal on each device is identified. The wire list adjacent to each device on the diagram indicates the device and terminal number to which each wire is connected at the next connection point.

All control wiring installed by the factory is neatly bundled and secured to the cubicle side plate or wiring pan. Make all field connections in a similar manner. Check that all parts and components clear any additional wiring installed. All field wiring is to be routed behind the cable retainer which is removable for installation purposes. Use plastic or nylon ties to secure all field installed wire to the cubicle structure.

4.17 Ground Fault Protection System

THIS CIRCUIT PROTECTED BY GROUND FAULT PROTECTION

11-1004-01 Rev. 3

NEC Section 230-95 requires ground fault protection on all service disconnects rated 1000 amperes and larger in switchboards when fed by a solidly grounded wye system of more than 150 volts to ground. When provided, all ground fault protection equipment for the switchboard is tested before shipment from the factory. The ground fault protection system, when provided, must be tested when first installed in accordance with NEC Section 230-95 paragraph C. Ground fault protection also required per NEC Section 215-10 and 240-13.

Figure 14

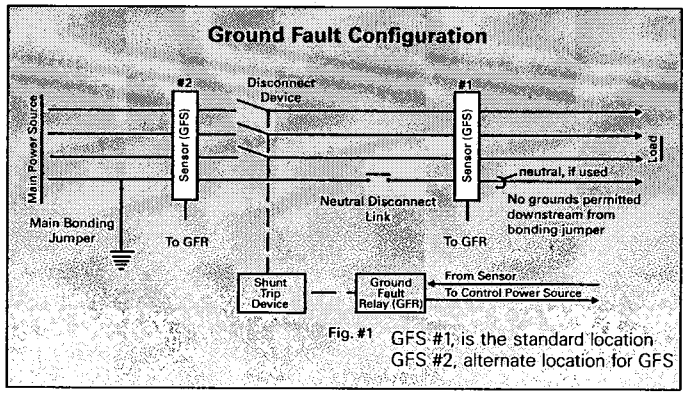


Fig. #1 GFS #1, is the standard location
GFS #2, alternate location for GFS

WARNING: The following should be performed only by qualified personnel as defined in NEC Article 100. The ground fault sensor (GFS), ground fault relay (GFR), must be installed as in **Figure 14. NOTE:** Test Report and Test Record forms found on Page 18 and 19 of this manual can be used to record ground fault field testing.

4.17.1 External Ground Fault

4.17.1.1. Disconnect Main Power Source.

4.17.1.2. Remove the neutral disconnect link. Make sure the neutral is grounded only by the main bonding jumper, which must be on the line side of the sensor.

4.17.1.3. Close all branch devices.

4.17.1.4. Using a "megger" type meter, measure the resistance of the load phase and neutral to ground. This is to ensure that no ground connections exist in the system. Resistance readings of one (1) Megohm or greater are preferred.

4.17.1.5. Re-install the neutral disconnect link.

4.17.1.6. Open all devices.

4.17.1.7. Connect the main power source.

To test the entire system including the disconnect device.

- Check for control power (LED should be illuminated).
- Press the "push to test" switch on the relay.
- The trip indicator should go to the "trip" position and the disconnect device will open.
- Release the "push to test" switch on the relay.
- Reset the relay, and the disconnect device. System is now back to normal.

To test the ground fault relay and sensor only (the sensor will trip the relay in this test).

- Check for control power, "LED" should be illuminated.
- Press and hold the "shunt trip bypass" switch on the relay.
- Press the "push to test" switch. The ground fault relay will trip.
- Reset the relay, then release the "shunt trip bypass" switch. System is now back to normal.

4.17.2 Internal Ground Fault

The procedures below are for SJD6, SHJD6, SCJD6, SLD6, SHLD6, SCLD6, SMD6, SHMD6, SCMD6, SND6, SHND6, SCND6, SPD6, SHPD6, SCPD6, SBA, SBS and SBH Breakers.

4.17.2.0 General

The Siemens Type SB circuit breaker may be equipped with integral ground fault protection. These devices are identified by a "G" in the trip unit catalog number and the presence of the ground fault adjustments. The National Electrical Code® requires that these devices be performance tested when first installed (230-95 (c). These instructions are intended to guide the installer in meeting this requirement.

General Instructions

4.17.2.1. The interconnected system shall be evaluated when initially installed by qualified personnel. It is also suggested this be done periodically thereafter.

4.17.2.2. The proper location of the sensors around the bus of the circuit to be protected shall be determined. This can be done visually, with knowledge of which bus is involved.

4.17.2.3. The grounding points of the system shall be verified to determine that ground paths do not exist that would bypass the sensors.

4.17.2.4. The polarity of the sensor connections must agree with the installation instructions to avoid improper operation.

4.17.2.5. A simulated test is to be done using a low voltage, high current source. This test is not intended to verify the calibration of the ground fault protection but to verify it is properly functioning.

4.17.2.6. The results of this testing should be recorded on the form provided at the end of this document or on other appropriate forms and should be available to the inspection authority.

4.17.2.7. These breakers may be set for different modes of operation. Residual or Ground Return, as described in the instructions supplied with the circuit breaker. For further information on applications, refer to the NEMA standards publication No. PB 2.2 Application Guide for Ground Fault Protective Devices for Equipment.

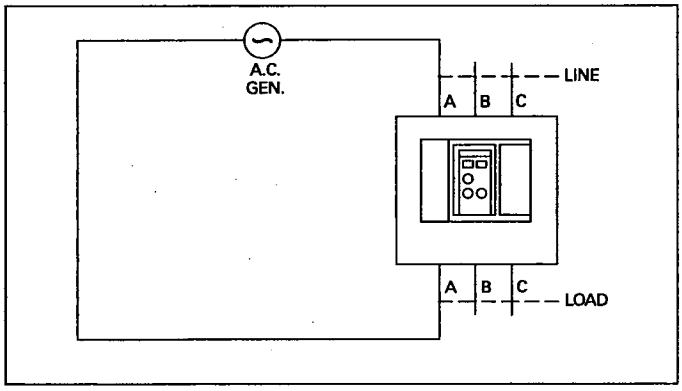
4.17.3 Operation Test
Switch Setting - Residual
Outgoing Circuit Method

4.17.3.1 3 Phase/ 3 Wire

Using **Figure 15,** individually test breaker poles A, B and C for proper Ground Fault operation.

Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply a test current equal to 125 percent of the ground fault pickup setting to one pole of the circuit breaker. The circuit breaker must trip.

Figure 15



Warning: NEVER pass test current through an unterminated Neutral Sensor. Permanent sensor damage may occur if operated in this manner.

4.17.3.2 3 Phase/4 Wire
Using Figure 16, individually test breaker poles A, B and C in conjunction with the proper Neutral Sensor for proper Ground Fault operation.

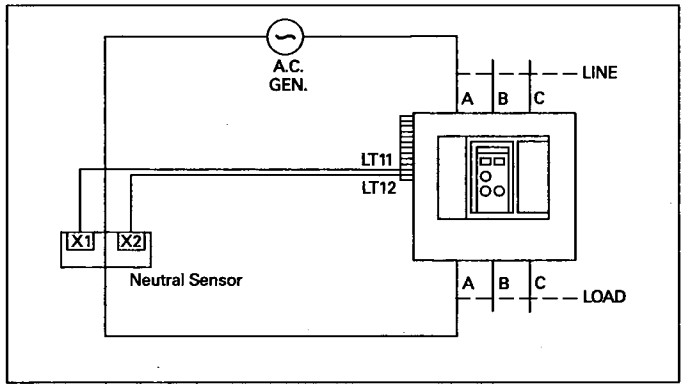
Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply 125 percent of the ground fault setting to one pole of the circuit breaker. The circuit breaker must not trip. Reduce the test current to zero.

Using a suitable means, short the X1/wire and X2/wire connections together on the Neutral Sensor. Re-apply the 125 percent test current to the breaker pole under test. The breaker must trip. Reduce the test current to ZERO and remove the shorting means from the Neutral Sensor.

4.17.4 GF Switch Setting - Ground Return Ground Return Method

4.17.4.1 3 Phase/3 Wire or 3 Phase/4 Wire
Each of the circuit breaker's front panel controls should be set to the highest setting. Using a low-voltage current source, apply a current equal to 125 percent of the ground fault pickup setting per Figure 16. The circuit breaker must trip.

Figure 16



Complete Test Record and keep for future reference and customer record.

GROUND FAULT TEST RECORD	
Date Tested	Circuit Breaker No.
Tested By	
Results	

GROUND FAULT TEST RECORD	
Date Tested	Circuit Breaker No.
Tested By	
Results	

Pre-Energizing, Inspection and Testing

SECTION 5.0 - PRE-ENERGIZING, INSPECTION AND TESTING

Before the equipment is energized, it must be thoroughly inspected and tested. Correct any deviations and re-inspect equipment before energizing.

5.1 Inspection
Check the following points:

5.1.1. Visually inspect switchboard for any damage that may have affected bus bar supports, device mountings or reduced electrical clearances within the switchboard (minimum clearance values are listed on Page 7).

5.1.2. Electrical disconnecting contacts, machine parts, shutter, etc., checked for lubrication and operation.

5.1.3. Blocking, supports and other temporary ties removed from breakers, instruments, relays, etc.

5.1.4. Check torque of all bus bar connections, including factory and field installed connections. (Torque values are listed on Page 16.)

5.1.5. Proper fuses correctly installed.

5.1.6. Manually operate all devices (circuit breakers, switches, etc.) Check for alignment and proper operation.

5.1.7. Operate all electrically operated devices (circuit breakers, switches, meters, relays, etc.). An auxiliary power source may be required.

5.1.8. Temporary wiring jumpers (used on the secondaries of current transformers tied to external devices, as shown on wiring diagrams) removed.

5.1.9. Check current transformer shorting terminal block screw position.

5.1.10. All protective devices and relays are shipped from the factory with all adjustable settings configured at the lowest possible values. Adjustments based on required system coordination study must be done by the end user. Siemens Technical Services can be contracted to perform the system coordination study and system commissioning.

5.1.11. Make sure ground connections properly made.

5.1.12. Make sure incoming primary and secondary connections properly made and checked for shorts or undesired grounds.

5.1.13. Make sure all equipment which has been removed during assembly has been replaced.

5.1.14. Confirm that interlocks performing properly.

5.1.15. Disconnect devices checked per instruction books.

5.1.16. Make sure any filters in vent areas are clean and free of foreign material.

5.1.17. Inspect and remove any tools or objects left inside the equipment.

5.1.18. Make sure all covers are installed. Close doors and ensure that all conductors are not pinched or nicked.

5.2 Testing

5.2.1. A megger test can be made to ensure that all connections made in the field are properly insulated. Test from phase to phase, phase to ground, phase to neutral, and neutral to ground. Resistance readings of 1 Megohm or greater are preferred. If low readings are observed and an investigation for possible corrections does not correct test readings, then contact your Siemens Sales Office for assistance.

5.2.2. A dielectric test should be made on the circuit for one minute at twice the voltage plus 1,000 volts corresponding to the rated volt of the equipment. (Voltage transformers, control power transformers, surge arresters, and surge capacitors must be disconnected during this test.)

NOTE: The dieletric test voltage is given as a reference only for those using dielectric tests to verify the integrity of connected cable installations without disconnecting the cables from the switchboard. It represents values believed to be appropriate and approximately equivalent to the corresponding power frequency withstand test values specified for each voltage rating of switchboard. When performing dielectric tests, the voltage should be raised to the test value in discrete steps and held for a period of one minute.

In accordance with ANSI C37.20.02 Clause 5.5, Field Dielectric Tests are also recommended when new units are added to an existing installation, or after major field modifications. The equipment should be put in good condition prior to the field test. It is not expected that equipment shall be subjected to these tests after it has been stored for long periods of time or has accumulated a large amount of dust, moisture, or other contaminants without being first restored to good condition.

Energizing and Operation, Switchboard Loading and Maintenance

SECTION 6.0 - ENERGIZING AND OPERATION

WARNING. HAZARDOUS VOLTAGES IN ELECTRICAL EQUIPMENT CAN CAUSE SEVERE PERSONAL INJURY OR DEATH. ENERGIZING A SWITCHBOARD FOR THE FIRST TIME AFTER INITIAL INSTALLATION OR MAINTENANCE IS POTENTIALLY DANGEROUS.

6.1 Placing Equipment Into Service

To place equipment in service, qualified personnel should be supervising placing equipment into service. Proceed as follows:

6.1.1. Check all interrupting devices. Set all devices to open position. Check and open all control circuits.

6.1.2. Energize primary incoming power source to equipment. **Note:** The primary incoming power source should not exceed the normal rating of equipment.

6.1.3. Close control circuit to check all instruments, relays, meters, etc., during this time. **Note:** There should be no load on switchboard when it is energized.

6.1.4. Close main device then feeder devices then branch devices to source load. As the smallest branch load is added, observe instruments. Allow several minutes before connecting additional load.

6.1.5. Gradually connect more loads to equipment. Observe instruments and allow several minutes before adding additional load. Follow this procedure until the full load is connected.

6.1.6. After all mains and branch devices have been closed, down stream loads such as lighting load, contactors, heaters, and motors may be turned on.

6.1.7. Check primary and secondary circuits for overheating. Also check all instruments during the first week of operation.

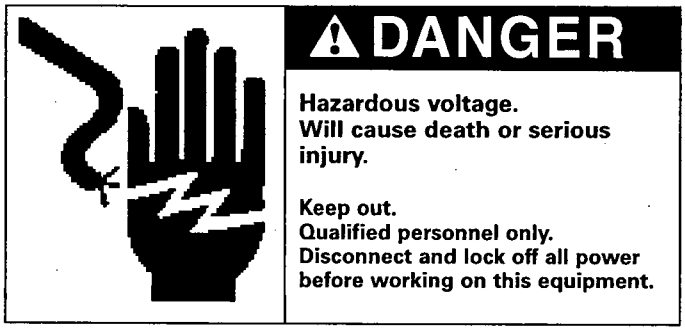
SECTION 7.0 - SWITCHBOARD LOADING

7.0.1. Main Lug Switchboards (without main).
The total continuous load current through the supply bus should not exceed the current rating of the switchboard.

7.0.2. Single Main Switchboards
The total continuous load current on main device should not exceed 80 percent of main device unless rated for 100 percent of its ampere rating. The same will apply to each main of a multi-main switchboard. Feeders and branch circuits follow same 80 percent rule for load applied to feeder and branch circuit.

7.0.3. Some types of electrical equipment will cause harmonics in electrical systems. This may result in overheating. When determining loading of switchboard, this condition should be considered. Possible de-rating of equipment may be necessary.

SECTION 8.0 - MAINTENANCE



8.1 Inspection and Maintenance Intervals

Periodic inspections and maintenance are essential to obtain safe and reliable operation. When equipment is operated under "Usual Service Conditions," maintenance and lubrication is recommended at least annually. Generally, "usual service conditions" are defined as an environment in which the equipment is not exposed to excessive dust, acid fumes, damaging chemicals, salt air, rapid or frequent changes in temperature, vibration, high humidity, and extremes of temperature. Where equipment is exposed to these conditions, more frequent maintenance is recommended.

For the safety of maintenance personnel, as well as others who might be exposed to hazards associated with maintenance activities, the safety related work practices of NFPA 70E, parts II and III and other recognized safety practices such as those contained in the National Electric Code and OSHA should always be followed when working on electrical equipment. Maintenance personnel should be trained in the safety practices, procedures and requirements that pertain to their respective job assignments. This manual should be reviewed and retained in a location readily accessible for reference during maintenance of this equipment.

The user must establish a periodic maintenance program to ensure trouble-free and safe operation. The frequency of inspection, periodic cleaning and preventative maintenance schedule will depend upon the operating conditions. NFPA Publication 70B, "Electrical Equipment Maintenance" may be used as a guide to establish such a program.

A preventative maintenance program is not intended to cover reconditioning or major repair, but should be designed to reveal, if possible, the need for such actions in time to prevent malfunctions during operation.

Switchboard assemblies are enclosed on all sides and top with sheet metal. Access into the enclosure is provided by doors or removable covers. Although the bus and connections are a coordinated insulation system; insulation plus air or creep distance equals a given insulation level.

8.2 Recommended Maintenance

Periodic maintenance includes cleaning, lubrication and the exercising of component parts. The interval between maintenance checks can vary depending on the amount of usage and environmental conditions of each installation.

Maintenance and Adverse Conditions

The maximum recommended inspection interval should not exceed one year and should include all the tests shown in the section below, "Maintenance Tasks."

Always inspect the switchboard after a fault (see section on "Adverse Conditions"). Instruction manuals for the various disconnecting and overcurrent devices mounted in the switchboard are indicated in the "Supplemental Instruction Manuals" section and are available through your local Siemens sales office.

A permanent record of all maintenance work should be kept. The record should include a list of periodic checks and tests made, the date they were made, the condition of the equipment, and any repairs or adjustments that were performed.

8.3 Maintenance Tasks

8.3.1. **Before any maintenance work is performed, make certain that the equipment is completely de-energized, tested, grounded, tagged or properly identified and released for work in an authorized manner.**

8.3.2. Before starting work on the equipment, the following should be completed on any equipment that will affect the area of the work:

A. Disable remote control and automatic transfer schemes.

B. De-energize all direct and back feed power and control sources, test and ground

C. Disconnect all voltage and control power transformers.

D. Open all disconnects.

8.3.3. Include the following items in your procedure:

A. Check general condition of switchboard installation.

B. Inspect interior for accumulation of dust, dirt or any foreign matter. Vacuum the interior to remove any dirt or dust deposits. Do not use an air hose as pressurized air may blow dust into critical electrical contact areas.

C. Check the interior carefully for moisture, condensation buildup, or signs of any previous wetness. Inspect all conduit entrances and cracks and seal off any leaks to eliminate moisture. Clean air filters by washing in a mild household detergent.

D. Examine indicating lamps and replace as required.

E. Check terminal blocks contacts for loose connections.

F. Check instrument and control switches and inspect their contacts.

G. Check for proper condition of instrument transformers. Replace burned out fuses, if any. Check primary and secondary connections.

H. Remove dust from all de-energized insulators.

I. Inspect bus bars and connections for proper condition.If bus bars are overheating, check for poor or loose connections or for overload.

J. Examine fuse clip contact pressure and contact means. If signs of over-heating or looseness, contact sales for replacement.

K. Look for and replace deteriorated insulated material where sealing compound has melted.

L. Examine all safety interlocks to insure they are functional and in proper working order.

M. Carefully inspect all devices for any worn, cracked, or missing parts. Manually open and close devices several times to insure they are in proper working order. Perform maintenance of interrupting devices as out lined in the device instruction manual. Do not open sealed breaker or trip unit as calibration may be disturbed. Return to factory for any replacement. For reference, see NEMA AB4-2000.

N. Check space heaters and thermostat (if equipped) for proper operation.

O. Maintain other auxiliary equipment per their respective instruction book requirements.

P. Lubricate mechanisms, contacts, and other moving components. Do not lubricate parts of molded case circuit breakers.

Q. Inspect painted surfaces and touch up as needed.

R. Check for signs of rodent or insect nesting inside the switchboard.

S. Replace, reassemble, re-insulate, return all items to proper operating conditions and remove grounds prior to energization.

T. Ensure satisfactory operation of relays and instruments as per instruction books furnished separately. Do not leave device covers off longer than necessary. When a cover has been broken, cover the device temporarily and replace broken glass as soon as possible.

U. Test ground fault protection system (if furnished).

V. Conduct an electrical insulation resistance test to ensure that the switchboard is free of short circuit and ground.

8.4 Cleaning Insulation

Most of the plastics and synthetics used in insulation systems are attacked by solvents containing aromatics or halogenated hydrocarbons which may cause crazing and deformation of the material reducing the dielectric strength. ISOPROPYL ALCOHOL IS THE ONLY RECOMMENDED SOLVENT CLEANER.

9.2 Short Circuits
Overcurrent protective devices will normally prevent electrical damage except at the actual point where the short circuit or fault condition occurred. However, the high mechanical stress developed by short circuit currents may cause damage to conductors, insulation, or other equipment installed within the switchboard. After any fault, a thorough inspection of the entire system must be made to ensure there is no damage to conductors, insulation or equipment (Refer to inspection and maintenance procedures.)

In addition, overcurrent protective device(s) which performed the short-circuit interruption must be inspected for possible arcing damage to contacts, arc chutes, and/or insulation. Do not open any sealed devices or breaker trip units. Equipment should be hi-pot tested prior to being placed back in service.

If device is damaged, replacement of that device is required.

9.3 Arcing Damage
During a fault, some organic insulation materials carbonize when subjected to the intense heat of an electrical arc, and lose their insulation qualities. Any carbon deposits or tracking must be completely removed with a dry, lint-free cloth, or the material must be replaced before re-energization.

9.4 Water Damage
Completely de-energize the switchboard if there is any sign of moisture or water damage. If damage is believed to be extensive, or if the equipment has been subjected to moisture for extended periods, contact your local Siemens sales representative. Additional information is also available from NEMA publication, "Guidelines for Handling Water Damaged Electrical Equipment."

9.5 Corrosive Atmospheres
Switchboards are designed to give optimum performance when installed in normal indoor or outdoor locations. Where corrosive atmospheres are encountered, special precautions must be taken to minimize their effect. Exposed metallic surfaces, non-insulated bus bars, disconnect switches, primary and secondary disconnecting contact, wire ends, instrument terminals, etc. must all be protected. At each maintenance inspection, all of the old grease should be wiped off of the contacts and new lubricant applied to all sliding surfaces.

Apply the material in a layer .03-.06" thick. Use only Siemens Electrical Contact Lubricant, Part No. 15-171-370-002, available in 8 oz. tubes. Other exposed components can be protected with a coat of glyptol or other corrosion-resistant coating. When old grease becomes dirty, wipe the part clean and apply new grease immediately.

SECTION 10.0 - INFORMATIONAL CHARTS

10.1 Torque Values

NOTE

THIS EQUIPMENT HAS BEEN TESTED AND INSPECTED BEFORE SHIPMENT. SHIPPING CONDITIONS MAY HAVE LOOSENED SOME CONNECTIONS. BEFORE ENERGIZING, IT IS RECOMMENDED THAT THE TIGHTNESS OF ALL CONNECTIONS BE CHECKED.

BELLEVILLE WASHER NUTS				THREAD FORMING SCREWS					
Bolt Size	Torque		Screw Size	Torque in lbs-in.					
	Lbs.-in.	Lbs.-ft.		0.125 Thick		0.187 Thick		0.25 Thick	
				AL	CU	AL	CU	AL	CU
1/4-20	72	6							
5/16-18	144	12	8-32	20	25	30	35	30	35
3/8-16	240	20	10-24	20	25	30	50	30	50
1/2-13	600	50	1/4-20	30	50	30	72	50	72

BREAKER CONNECTING MACHINE SCREW	
Screws	Torque in inch lbs
#10	20
1/4"	72

BRANCH LOAD CONDUCTORS-PANEL MOUNTED DEVICES

This switchboard designed for installation of conductors per NEC 373-6. Refer to branch circuit devices for cable size and torque.

EXCEPTIONS FOR 38" WIDE ENCLOSURES

(1) 400 ampere twin mounted JD6, JXD6, JXD2, HJD6, SJD6, CJD6, SHJD6 and SCJD6 type are limited to a maximum of (1) 500 MCM OR (2) 250 MCM CU-AL per pole.

As a minimum, wire bending space as required (NEC Tables 373(a) and 373(b) for this product is based on wire or cable sizes per table 310-16 of the NEC. Circuits 110 amps and less are sized from the 60° C aluminum column. Above 110 amps circuits are sized from the 75° C aluminum column. 400 amp circuits are based on (2) 250 or (1) 500 kcmil cables per phase. 600 amp circuits and greater are sized based on multiple 500 kcmil cables per phase.

FIELD WIRED CONNECTORS - TIGHTENING TORQUE

Torque all wire connectors, where not marked on the device or component, to the values indicated in the table below:

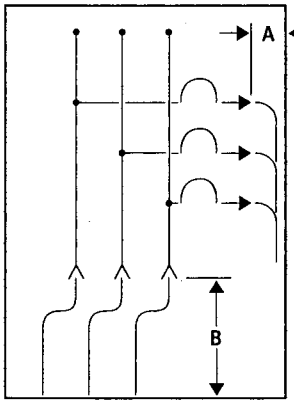
Hex Socket Set Screw		Slotted Head Screws		
Socket Size (Across Flats)	Torque Lbs.-in.	AWG Wire Size	Torque Lbs.-in.	
			Small Hole #6 - Max.	Large Hole 1/0 Max.
7/32"	150			
1/4"	200	#14-10	20	35
5/16"	275	#8	25	40
3/8"	375	#6	35	45
1/2"	500	#4	—	45
9/16"	600	#3-1/0	—	50

CONNECTORS USED TO TERMINATE FIELD MADE CONNECTIONS ARE SUITABLE FOR USE WITH CU OR AL 60 DEG C OR 75 DEG C RATED CONDUCTORS. UNLESS NOTED OTHERWISE ON THE DEVICES.
CAUTION: IF A PANELBOARD IS INSTALLED IN THE SWBD AND MORE THAN 10% OF THE BREAKER POLES OR FUSIBLE UNITS ARE SUPPLYING LIGHTING AND/OR APPLIANCE CIRCUITS THEN THIS UNIT IS NOT TO EXCEED 42 CIRCUITS (NEC ARTICLE 384.14, 384.15) ALSO, IF THIS UNIT IS USED AS SERVICE EQUIPMENT, IT IS LIMITED TO SIZE DISCONNECTS (NEC ARTICLE 230.71).
BOLTED PRESSURE EXCEPTION: WHEN CABLES ARE MOUNTED DIRECTLY TO BOLTED PRESSURE SWITCH TERMINALS, REFER TO CABLE SELECTION INSTRUCTIONS ON SWITCH.

Informational Charts

10.2 Wire Bending Requirements

Wire Bending NEC 373-6



WIRES	A	B
#1/0	3-1/2"	5-1/2"
1-300	5"	10"(3)
1-500	6"	14"(3)
1-750	8"	17"(3)
2-300	8"	10"(2)
2-500	8"	14"(3)
2-750	12"	19"(3)
3-400	10"	14"(3)
3-500	10"	15"(3)
3-750	14"	22"(3)
4-500	12"	16"(3)
4-750	16"	24"(3)
5-500	14"	16"(3)
5-750	18"	24"(3)

Wire Bending space at terminals shall be measured in a straight line from the end of the lug or wire connector (in the direction that the wire leaves the terminal) to the wall, barrier, or obstruction.

For removable (compression type) and lay-in-wire terminals intended for only one wire, bending space shall be permitted to be reduced by the number of inches shown in parenthesis.

10.3 Strap Kits

10.3.1 Connecting Strap Kits - Circuit Breaker

For use with Series 6 Circuit Breaker, SB1, SB2 and SB3 Switchboards — includes copper straps, cover plates and necessary hardware for switchboards. For replacement strap kits for RCIII switchboards, contact your local sales office.

Breaker Type	Strap Kit Catalog Number	Height (inches)	Mounting
ED2, ED4, ED6, HED4, HED6	6E62	3.75	D
CED6	6CLE2	3.75	D
QJ2, QJH2, QH2-H	6QJ2	5	D
FXD6, FD6, HFD6	6F62	5	D
CFD6	6CLF1	5	S
JXD2, JXD6, JD6, HJD6 Single Branch	6JJ61	8.75	S
JXD2, JXD6, JD6, HJD6 Double Branch	6JJ62	8.75	D
CJD6	6CLJ1	8.75	S
SJL, SJD6, SHD6	6SJL1	8.75	S
SCJD6	6SCJ1	8.75	S
LXD6, LD6, HLD6	6LL61	8.75	S
CLD6	6CLL1	8.75	S
SLL, SLD6, SHLD6	6SLL1	8.75	S
SCLD6	6SCL1	8.75	S
LMD6, HLMD6	SLM1D	8.75	S
MD6, HMD6, CMD6	SMND	10	S
SMD6, SHMD6, SCMD6	SSMND	10	S
ND6, HND6, CND6	SMND	10	S
SND6, SHND6, SCND6	SSMND	10	S

Note: D = Denotes double branch or twin mounting
S = Denotes single mount

10.3.2 Filler Plates

For use with Series 6 Circuit Breaker Panelboards, SB1, SB2, and SB3 Switchboards.

Breaker Frame	Filler Plate Catalog Number
BQ, BQH, HBQ, E2, E4, E6, HE4, HE6, E2-A, E-4A, E6-A, HE4-A OR HE6-A AND ED2, ED4, ED6, HED4, HED6	QF3

Note: When a front filler plate is not completely filled with breakers, the openings in the unused space must be closed with 1-pole filler plates from table.

10.3.3 Connecting Strap Kits Vacu-Break and HCP

For use with SB1, SB2 and SB3 Switchboards. Includes copper straps and necessary hardware for switchboards.

Ampere Rating	Unit Height (inches)	Catalog Number
30-30	5, 7½	VB657
30-60	5, 7½	
60-60	5, 7½	
60-100	7½	
100-100	7½	
100	7½	
200	7½, 10	VB671
200-200	10	VB610
400-600	15	VB6150
800-1200 (HCP)	16½	F6162D

10.3.4 Blank Plates — Circuit Breaker and Vacu-Break

For use with Series 6, SB1, SB2 and SB3 Switchboards

Height (inches)	Catalog Number Series 6
1¼	6FPB01
2½	6FPB02
3¾	6FPB03
5	6FPB05
10	6FPB10

10.4 Ground Fault Test Record - External

PERFORMANCE TEST REPORT
GROUND FAULT PROTECTION

Job: _____

Location: _____ Date of Test: _____

Circuit: _____

Switchboard: _____ Single/Double End _____

Disconnect Device: _____

GF Protective Device: _____

GF Sensor: _____

Test Equipment: (Describe on back or attach a page.)
Test Setup and Method: (Describe on back or attach a page.)

A. INSPECTION
☐ 1. Wiring and conductors
☐ 2. Connections and wire clamping
☐ 3. Bonding, splice bussing and grounding
☐ 4. Sensor mounting and wiring
☐ 5. Control circuit overcurrent protection
☐ 6. Other: _____

B. INSULATION RESISTANCE
☐ 1. Neutral-to-ground
☐ 2. Neutral-to-enclosure
☐ 3. Enclosure and grd. bus-to-ground
☐ 4. Grounded service conductor-to-ground
☐ 5. Other: _____

C. OPERATION TEST
1. GF protective device setting: _____A, _____sec. Time Curve: _____
2. Control Power _____
3. Test Current: (a) _____A, x _____ turns = _____AT
or (b) Test set signal _____
or (c) Primary Current _____A
☐ 4. Trip operation
☐ 5. Time Delay: one second or less
☐ 6. Test button, lamp, indicator operation
7. Other: _____

D. LABEL AFFIXED ☐

E. EQUIPMENT RESTORED TO OPERATIONAL CONDITION
☐ GFP settings (as left) _____

Tested by: _____

(1) This test record to be retained by those in charge of the building electrical installation.
(2) Make the report available to the authority having jurisdiction.

Dwg. No. 15-7732 Rev. 1

Informational Charts

10.5 Ground Fault Test Record - Internal
NEC Section 230-95 requires ground fault protection on all service disconnects rated 1000 amperes and larger in 600 volt class switchboards when fed by a solidly grounded Wye system of more than 150 volts to ground. Ground fault protection is required on 480 and 600 volt, 3-phase 3-wire, (i.e., no neutral bus), when the serving transformer is Wye connected.

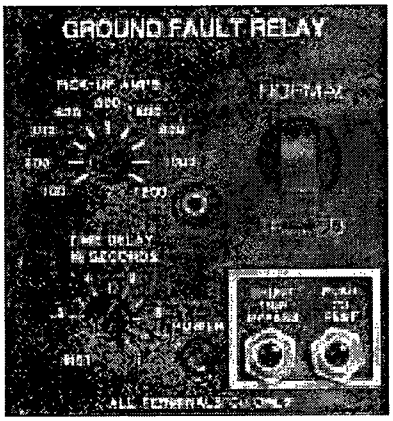
There is an exception to this rule: Ground fault protection is not required on fire pumps or continuous industrial loads where a non-orderly shutdown would cause a hazard.

Health care facilities, such as hospitals require additional levels of ground fault protection. These requirements are described in NEC article 517.

Sections 215-10 and 240-13 of the NEC require ground fault protection on all 1000 ampere and larger devices, breakers, and switches, applied in a system as described above, unless there is ground fault protection upstream.

Many utilities use a grounded Wye secondary transformer and bring a connection from the grounded midpoint to the service section ground bar. When this is the case, ground fault protection is required.

For a 1000 ampere or larger 480 volt, 3-phase 3-wire service section, an inquiry should be made to determine if the utility is using a 3-wire delta secondary transformer. Should this be the case, no ground fault protection is required.



Ground Fault Relay

Ground Fault Testing

WARNING: The following should be performed only by qualified personnel as defined in N.E.C. Article 100. The ground fault sensor (GFS), ground fault relay (GFR), must be installed as in Fig. 1.

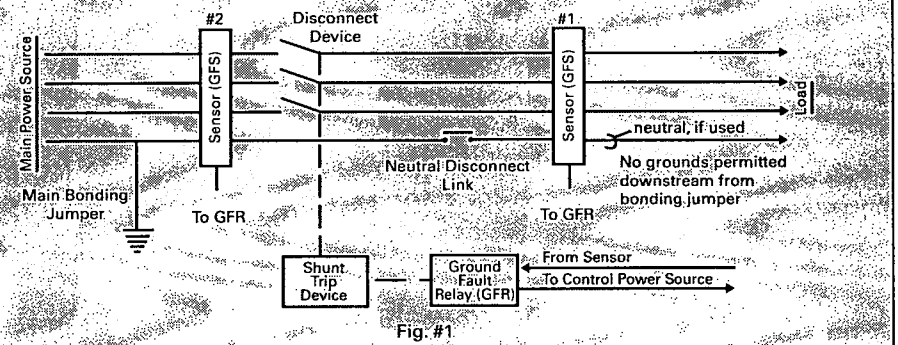


Fig. #1

GFS #1, is the standard location
GFS #2, alternate location for GFS

1. Disconnect Main Power Source.
2. Remove the neutral disconnect link. Make sure the neutral is grounded only by the main bonding jumper, which must be on the line side of the sensor.
3. Close all branch devices.
4. Using a "megger" type meter, measure the resistance of the load phase and neutral to ground. This is to ensure that no ground connections exist in the system. Resistance readings of (1) Megohm or greater are preferred.
5. Re-install the neutral disconnect link.
6. Open all branch devices.
7. Connect the main power source.
8. To Test The Entire System.
   a. Check for control power. (LED should be illuminated).
   b. Press the "push to test" switch on the relay.
   c. The trip indicator should go to the "tripped" position and the disconnect device should operate.
   d. Release the "push to test" switch and return the trip indicator to the "reset" position.
   e. Reset or "close" the disconnect device for normal operation of the switchboard.
9. This test meets the requirements of the National Electrical Code Section 230-95 (C).

Test Record

Date	By	Amp Setting	Time Setting	Notes

SECTION 11.0 - SERVICE BULLETINS

REFERENCE INFORMATION
NFPA70 (NEC)
NEMA PB2
UL891
NEMA PB2.1

Siemens Energy & Automation, Inc.
3333 Old Milton Parkway
Alpharetta, GA 30005

1-800-964-4114
seainfo@sea.siemens.com

www.siemens.com/power

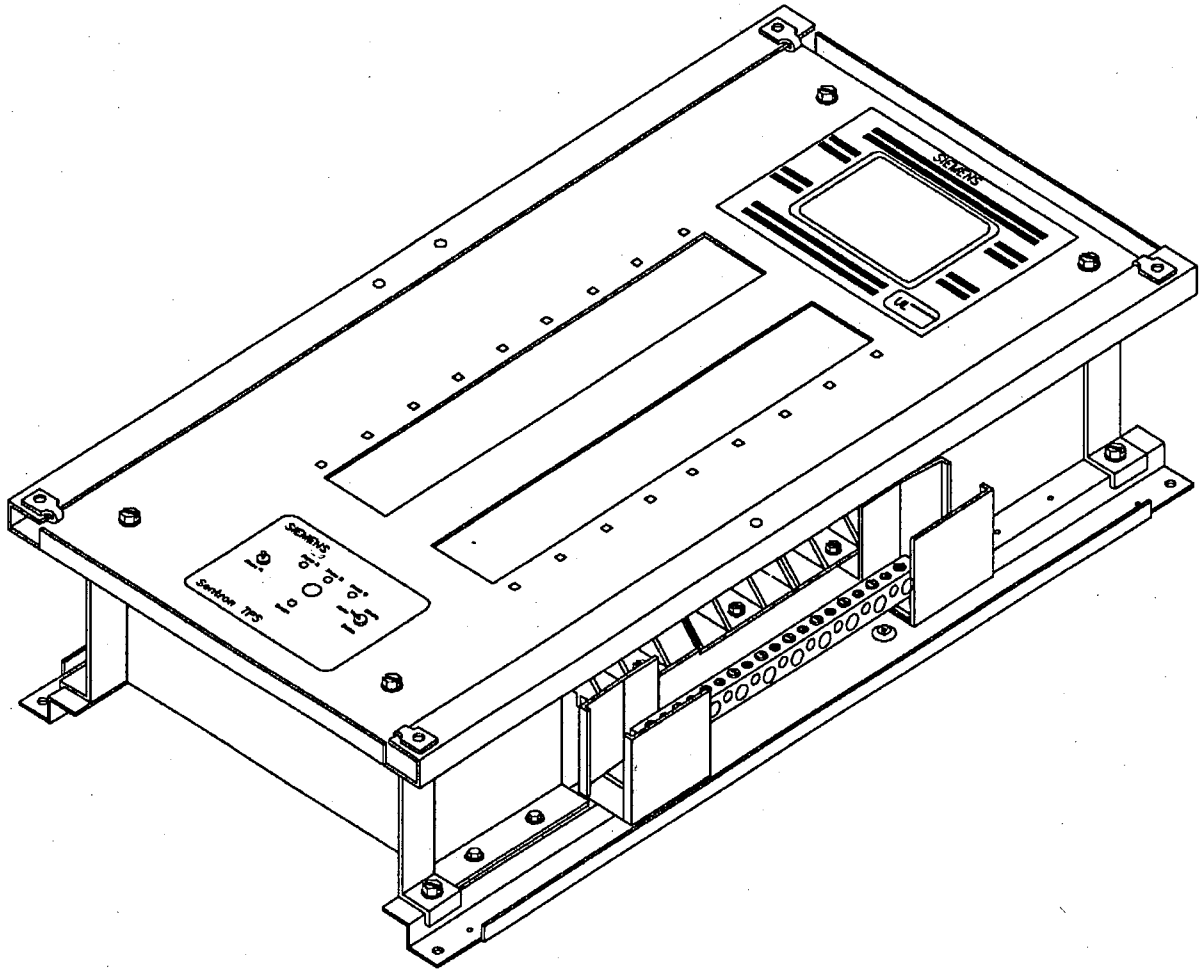
Order # SWIM-00100-1100 0102 B&A

S

Sentron™ TPS (Transient Protection System)

Sentron™ TPS

Installation, Operation & Maintenance Manual



12-A-1013-01, Rev. 6

THIS EQUIPMENT CONTAINS HAZARDOUS VOLTAGES. DEATH, SERIOUS INJURY, OR PROPERTY DAMAGE CAN RESULT IF SAFETY INSTRUCTIONS ARE NOT FOLLOWED. ONLY QUALIFIED PERSONNEL SHOULD WORK ON OR AROUND THIS EQUIPMENT AFTER BECOMING THOROUGHLY FAMILIAR WITH ALL WARNINGS, SAFETY NOTICES, AND MAINTENANCE PROCEDURES CONTAINED HEREIN. THE SUCCESSFUL AND SAFE OPERATION OF THIS EQUIPMENT IS DEPENDENT UPON PROPER HANDLING, INSTALLATION, OPERATION AND MAINTENANCE.

QUALIFIED PERSON

FOR THE PURPOSES OF THIS MANUAL AND PRODUCT LABELS, A **QUALIFIED PERSON** IS ONE WHO IS FAMILIAR WITH THE INSTALLATION, CONSTRUCTION AND OPERATION OF THIS EQUIPMENT, AND THE HAZARDS INVOLVED. IN ADDITION, HE OR SHE HAS THE FOLLOWING QUALIFICATIONS:

(a) Is trained and authorized to energize, de-energize, clear, ground and tag circuits and equipment in accordance with established safety practices.

(b) Is trained in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc. in accordance with established safety practices.

(c) Is trained in rendering first aid.

DANGER

FOR THE PURPOSES OF THIS MANUAL AND PRODUCT LABELS, **DANGER** INDICATES AN IMMINENTLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

CAUTION

FOR THE PURPOSES OF THIS MANUAL AND PRODUCT LABELS, **CAUTION** INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, MAY RESULT IN MINOR OR MODERATE INJURY.

THESE INSTRUCTIONS DO NOT PURPORT TO COVER ALL DETAILS OR VARIATIONS IN EQUIPMENT, NOR TO PROVIDE FOR EVERY POSSIBLE CONTINGENCY TO BE MET IN CONNECTION WITH INSTALLATION, OPERATION OR MAINTENANCE. SHOULD FURTHER INFORMATION BE DESIRED OR SHOULD PARTICULAR PROBLEMS ARISE WHICH ARE NOT COVERED SUFFICIENTLY FOR THE PURCHASER'S PURPOSES, THE MATTER SHOULD BE REFERRED TO THE LOCAL SIEMENS SALES OFFICE. THE CONTENTS OF THIS INSTRUCTION MANUAL SHALL NOT BECOME PART OF OR MODIFY ANY PRIOR OR EXISTING AGREEMENT, COMMENT OR RELATIONSHIP. THE SALES CONTRACT CONTAINS THE ENTIRE OBLIGATION OF SIEMENS. THE WARRANTY CONTAINED IN THE CONTRACT BETWEEN THE PARTIES IS THE SOLE WARRANTY OF SIEMENS ANY STATEMENTS CONTINUED HEREIN DO NOT CREATE NEW WARRANTIES OR MODIFY THE EXISTING WARRANTY.

Table of Contents

The Siemens Sentron TPS Surge Protective Device

The Siemens Sentron TPS surge protective module is a high quality, high energy surge system that has been designed to protect sensitive equipment from damaging transient voltage surges. Proper installation is imperative to maximize the surge suppressor effectiveness and performance. The installer should follow the steps outlined in this manual to ensure a proper installation.

This entire installation, operation, and maintenance manual should be read prior to beginning the installation. These instructions do not replace the national or local electric codes. Check all applicable electrical codes to verify compliance. Installation of the Siemens Sentron TPS surge suppressor should only be installed by qualified personnel.

Unpacking and Preliminary Inspection

Unpacking and Preliminary Inspection

- Inspect the entire shipping container for damage or signs of mishandling before unpacking the unit.
- Remove the packing material and further inspect the unit for any obvious shipping damages.
- If any damage was found and is a result of shipping or handling, immediately file a claim with the shipping company and forward a copy to your local Siemens sales office.

Storage

The unit should be stored in a clean, dry environment. Storage temperature is -55 C (-67 F) to +85 C (+185 F). Avoid exposing the unit to areas of high condensation. All of the packaging materials should be left intact until the unit is ready for installation. If the unit has been stored for an extended period of time, it may be necessary to clean the unit and make a complete inspection of the unit prior to installing and placing into service.

Location Considerations

Environment

The unit is designed to operate inside the equipment in room ambient temperature range of: -40 C(-40 F) to +55 C (+131 F) with relative humidity of 0%-90% (non-condensing).

The standard LTPS unit is in a NEMA 1 industrial use enclosure which is dust-tight and should not be installed in areas with flammable materials, corrosive vapors or explosive atmospheres.

Audible Noise

The unit background is negligible which permits the unit to be installed within the equipment in almost any room.

Equipment Performance

For optimum transient surge protection, staged surge suppression should be implemented at the service entrance and all other electrical connections to the building (telephone, CATV, etc.), also at recognized surge generating loads (arc welding rigs, large motors, switched capacitors, etc.) as well as sensitive electronic loads (computer equipment, facsimile machines, copy machines, solid state motor drives, variable frequency drives etc.). For interconnected electronic loads (via data cabling), surge protective devices should also be utilized to protect the devices on either end of the interconnecting data cables.

Installation

Voltage Rating

Prior to installing the Sentron TPS, verify that the unit has the correct voltage rating for the equipment installed by checking the nameplates of both the equipment and TPS module. The service type should match the intended power source. See Tables for voltage applications.

*Optional Features:
(Add Option Letter as a Suffix)
X = Surge Counter
R = Remote Monitor

Table 1: S1/S2

PRODUCT SELECTION	VOLTAGE	CATALOGUE NUMBER		
		120kA	160kA	240kA
S1/S2, 125-250A *OPTIONAL FEATURES: X, R	120/240, 1PH	TPSA1120	TPSA1160	TPSA1240
	208/120, 3PH Y	TPSC1120	TPSC1160	TPSC240
	480/277, 3PH Y	TPSE1120	TPSE1160	TPSE240

Table 2: S1/S2/SE

PRODUCT SELECTION	VOLTAGE	CATALOGUE NUMBER	
		160kA	240kA
S1/S2, 400-800A and SE 100-800A *OPTIONAL FEATURES: X, R	120/240, 1PH	TPSA2160	TPSA2240
	240/120, 3PH D	TPSB2160	TPSB2240
	208/120, 3PH Y	TPSC2160	TPSC2240
	240, 3PH D	TPSD2160	TPSD2240
	480/277, 3PH Y	TPSE2160	TPSE2240
	480, 3PH D	TPSF2160	TPSE2240
	600, 3PH D	TPSG2160	TPSG2240
	380/220, 3PH Y	TPSK2160	TPSK2240
	600/347, 3PH Y	TPSL2160	TPSL2240

Table 3: S4/S5/F1/F2/SB3 DIST.

PRODUCT SELECTION	VOLTAGE	CATALOGUE NUMBER	
		160kA	240kA
S4/S5, F1/F2 and SB3 DIST. *OPTIONAL FEATURES: X, R	120/240, 1PH	TPSA5160	TPSA5240
	240/120, 3PH D	TPSB5160	TPSB5240
	208/120, 3PH Y	TPSC5160	TPSC5240
	240, 3PH D	TPSD5160	TPSD5240
	480/277, 3PH Y	TPSE5160	TPSE5240
	480, 3PH D	TPSF5160	TPSE5240
	600, 3PH D	TPSG5160	TPSG5240
	380/220, 3PH Y	TPSK5160	TPSK5240
	600/347, 3PH Y	TPSL5160	TPSL5240

Table 4: SB3/RCIII SERVICE

PRODUCT SELECTION	VOLTAGE	CATALOGUE NUMBER		
		240kA	320kA	400kA
SB3/RCIII SERVICE *OPTIONAL FEATURES: X, R	120/240, 1PH	TPSA6240	TPSA6320	TPSA6400
	240/120, 3PH D	TPSB6240	TPSB6320	TPSB6400
	208/120, 3PH Y	TPSC6240	TPSC6320	TPSC6400
	240, 3PH D	TPSD6240	TPSD6320	TPSD6400
	480/277, 3PH Y	TPSE6240	TPSE6320	TPSE6400
	480, 3PH D	TPSF6240	TPSE6320	TPSF6400
	600, 3PH D	TPSG6240	TPSG6320	TPSG6400
	380/220, 3PH Y	TPSK6240	TPSK6320	TPSK6400
	600/347, 3PH Y	TPSL6240	TPSL6320	TPSL6400

Table 5: TYPE R LV SWITCHGEAR

PRODUCT SELECTION	VOLTAGE	CATALOGUE NUMBER		
		240kA	320kA	400kA
TYPE R LV SWITCHGEAR *OPTIONAL FEATURES: X, R	208/120, 3PH Y	TPSC8240	TPSC8320	TPSC8400
	240, 3PH D	TPSD8240	TPSD8320	TPSD8400
	480/277, 3PH Y	TPSE8240	TPSE8320	TPSE8400
	480, 3PH D	TPSF8240	TPSE8320	TPSF8400
	600, 3PH D	TPSG8240	TPSG8320	TPSG8400
	380/220, 3PH Y	TPSK8240	TPSK8320	TPSK8400
	600/347, 3PH Y	TPSL8240	TPSL8320	TPSL8400

Installation (Cont.)

Overcurrent Protection

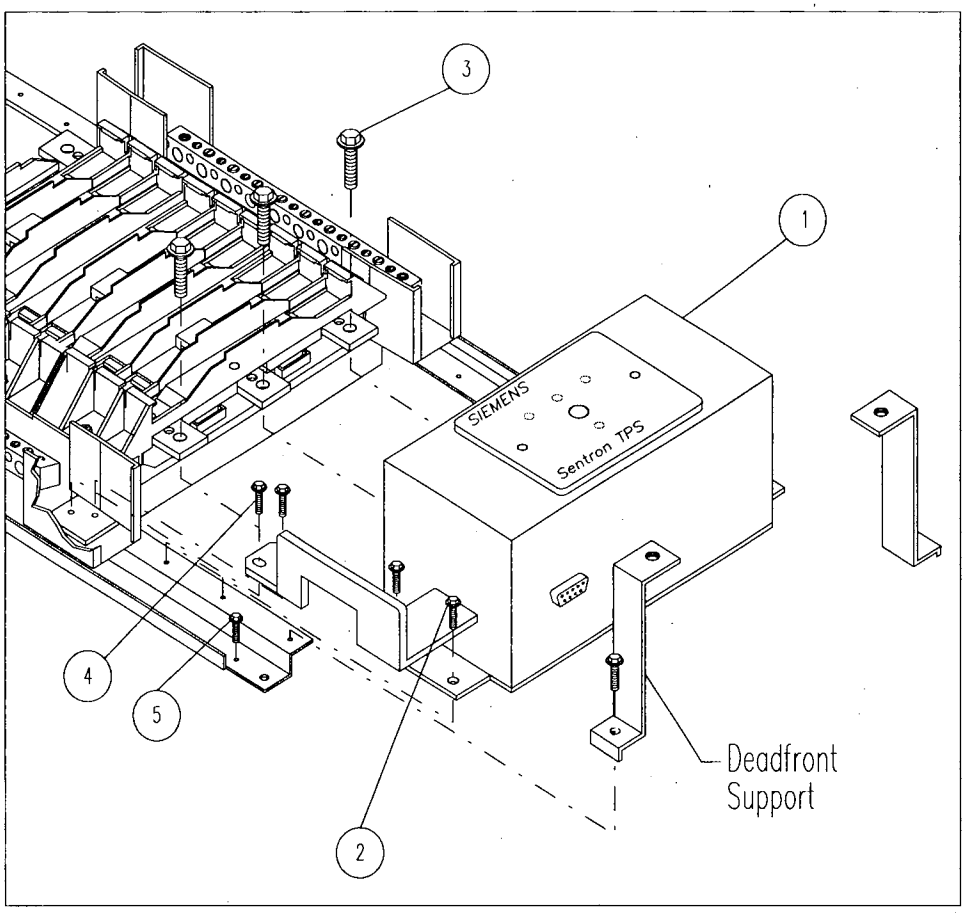
The Sentron TPS unit draws very little current under normal operation and will only conduct current for a very brief duration upon encountering a transient surge. The TPS unit contains UL approved internal fusing to protect against failure of the device. The fuses on the TPS module are not serviceable.

System Grounding

Proper operation of any grounding surge suppression system or device depends on a proper grounding system. Incorrect grounding practices can reduce the effectiveness or interfere with the TPS systems operation and performance, as well as endanger personnel and equipment. For best performance, use a single point ground system where the service entrance grounding electrode system is connected and bonded to all other available electrodes, building steel, metal water pipes, driven rods, etc. For sensitive computer systems, it is recommended that the grounding impedance be 25 ohms or less.

Installation (Cont.)

FIGURE 1: S1/S2 125–250A



Item	Description	Qty.
1	Sentron TPS Unit **(See Page 4, Table 1)**	1
2	#10–32 x 1/4 Slotted Hex Thread Forming Screw	4
3	1/4–20 Hex Head SEMS Assembly	3
4	#10–24 Slotted Hex Thread Forming Screw	2
5	#10–32 x 5/8 Slotted Hex Thread Forming Screw	4

Installation (Cont.)

The following instructions are for the installation of Siemens Sentron TPS SPD module in Siemens Type S1 and S2 lighting panelboard. All hardware is supplied for complete installation of the TPS module. See page 4, Table 1, for Catalogue numbers.

⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
Keep Out.
Qualified personnel only.
Disconnect and lock off all power before working on this equipment.

⚠ CAUTION

CONDUCTING DIELECTRIC AND/OR HI-POTENTIAL TESTING WILL CAUSE INTERNAL DAMAGE TO TPS UNIT.

Do not perform dielectric or high potential tests with the TPS unit installed.

For Installation in Panelboard - Figure 1

Determine the mounting location of the TPS in the panel board. If it is to be mounted in the top, refer to the included **Internal Connections** section before proceeding with installation.

1. Lock off all power supplying this equipment before working on it.
2. Remove the trim and dead front.
3. Remove the (2) deadfront supports.
4. Position the TPS unit on the panel base rail so that the TPS neutral connector is in front of the panel neutral and the and the phase tabs are behind the interior bus. Slide the unit toward the interior until the four mounting holes line holes line up with the four holes in the base rail.

Note: If a neutral lug is mounted in the position where the TPS neutral connection is made, it must be moved to one of the three remaining neutral lug positions prior to TPS installation.

5. Attach the unit (item 1) to the base rail using (4) of the #10-32 slotted hex washer head thread forming screws (item 2) provided as shown in figure 1.
6. Fasten unit to the main bus using the 1/4-20 hex head (with captive washer) assembly machine screws (item 3) provided. Do not tighten at this time.
7. Fasten TPS neutral to panel neutral using (2) #10-24 slotted hex washer head thread forming screws (item 4).
8. If the (4) interior leveling screws are not already installed (4) additional screws (item 5) are provided for installation to ensure proper ground path for TPS module.
9. Torque all connections to the values as specified on the installation and maintenance instruction label affixed to the rear of the dead front.
10. Replace deadfront supports by installing screws, finger tight. Then tighten with tool.
11. Replace trim.

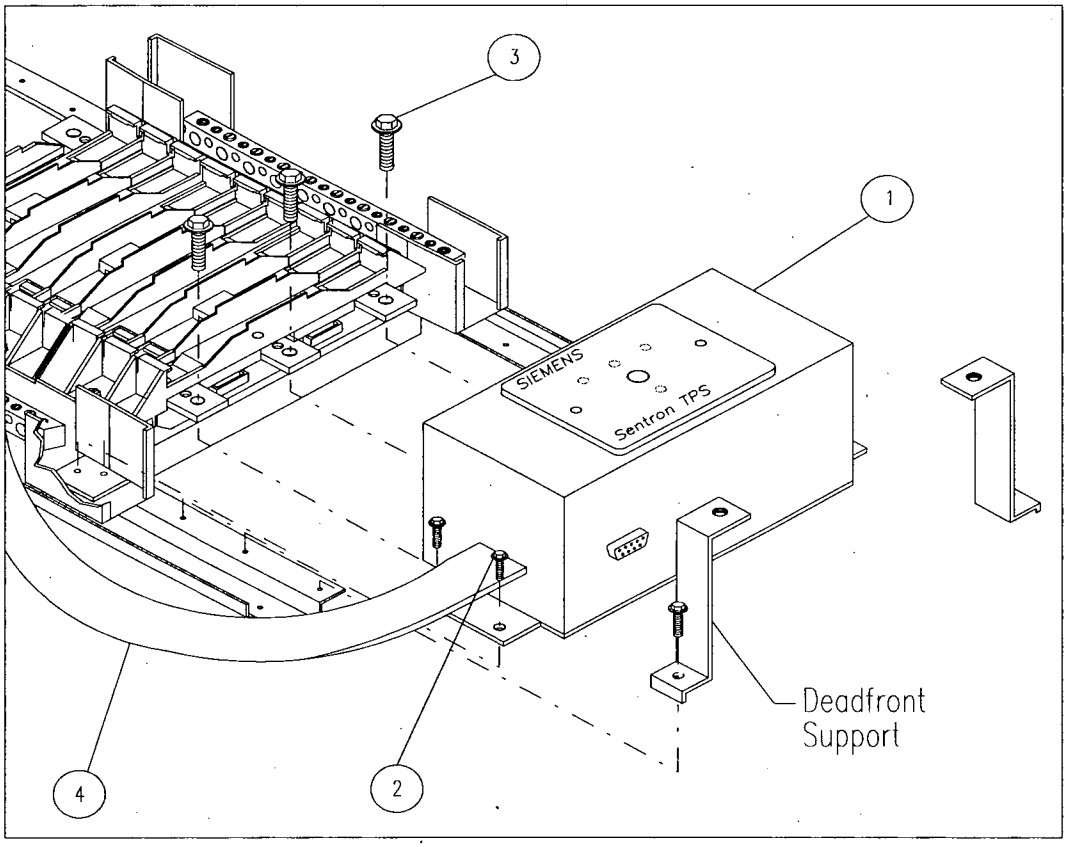
Internal Connections

NOTE: If the TPS module is to be mounted in the top of the panelboard or relocated after installation, internal connections must be changed to ensure proper diagnostic board indication. These modifications should be made prior to installation. If the TPS module is field installed in the bottom, or if it is mounted in a factory assembled panelboard, the internal connections have already been made and the following steps are not necessary.

1. Remove the (4) face plate screws on the TPS module.
2. Remove the face plate and identify the leads labeled "A" and "C", noting where each is connected to the circuit board. Remove these leads from the circuit board and the face plate 180 degrees clockwise. Reattach the leads to the jacks, switching their connection locations (reverse the original wiring).
3. Replace face plate and (4) screws.

Installation (Cont.)

FIGURE 2: S1/S2 125-250A **(240kA Version)**



Item	Description	Qty.
1	Sentron TPS Unit **(See Page 4 , Table 1)**	1
2	#10–32 x 1/4 Slotted Hex Thread Forming Screw	4
3	1/4–20 Hex Head SEMS Assembly	3
4	TPS Neutral Connection Point	–

Installation (Cont.)

The following instructions are for the installation of Siemens Sentron **TPS1240kA** SPD module in Siemens Type S1 and S2 lighting panelboard. All hardware is supplied for complete installation of the TPS module. See page 4, Table 1, for Catalogue numbers.

⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
Keep Out.
Qualified personnel only.
Disconnect and lock off all power before working on this equipment.

⚠ CAUTION

CONDUCTING DIELECTRIC AND/OR HI-POTENTIAL TESTING WILL CAUSE INTERNAL DAMAGE TO TPS UNIT.

Do not perform dielectric or high potential tests with the TPS unit installed.

For Installation in Panelboard - Figure 2

Determine the mounting location of the TPS in the panel board. If it is to be mounted in the top, refer to the included **Internal Connections** section before proceeding with installation.

1. Lock off all power supplying this equipment before working on it.
2. Remove the trim and dead front.
3. Remove the (2) deadfront supports.
4. Position the TPS unit on the panel base rail so that the TPS neutral connector is in front of the panel neutral and the and the phase tabs are behind the interior bus. Slide the unit toward the interior until the four mounting holes line holes line up with the four holes in the base rail.
5. Attach the unit (item 1) to the base rail using (4) of the #10-32 slotted hex washer head thread forming screws (item 2) provided as shown in figure 1.
6. Fasten unit to the main bus using the 1/4-20 hex head (with captive washer) assembly machine screws (item 3) provided. Do not tighten at this time.
7. Fasten TPS neutral to panel neutral at the neutral connection point (item 4).
8. Torque all connections to the values as specified on the installation and maintenance instruction label affixed to the rear of the dead front.
9. Replace deadfront supports by installing screws, finger tight. Then tighten with tool.
10. Replace trim.

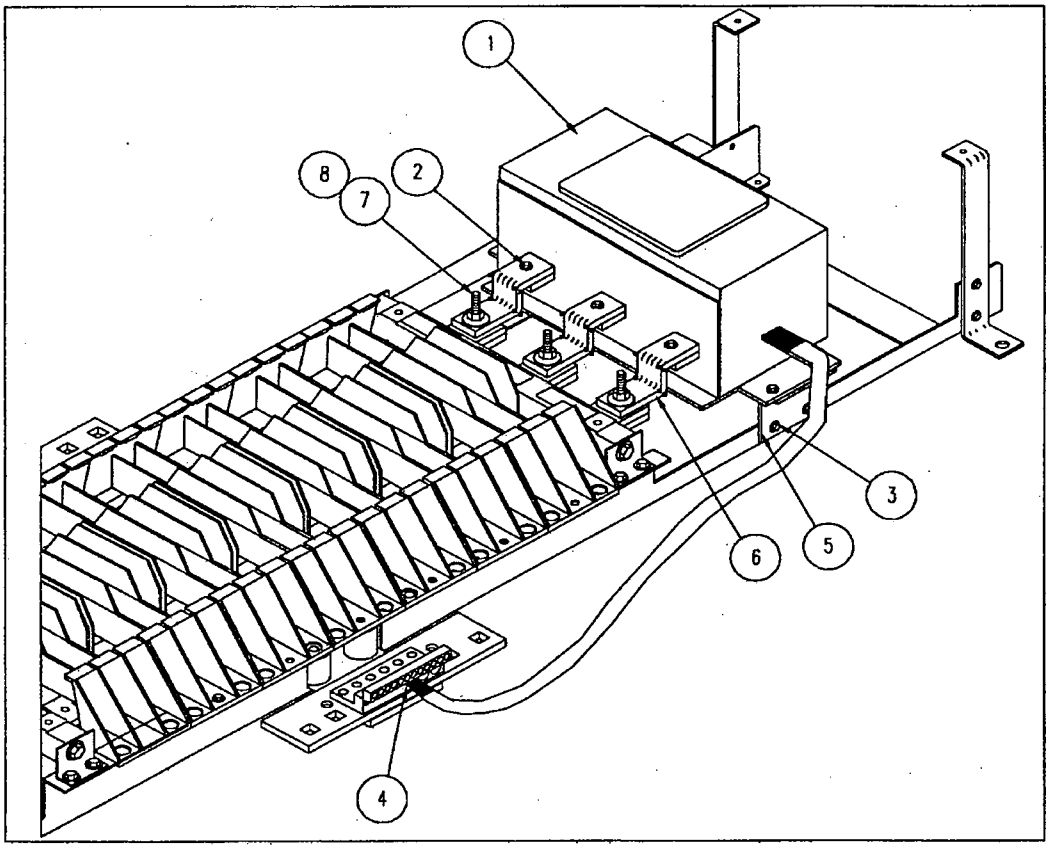
Internal Connections

NOTE: If the TPS module is to be mounted in the top of the panelboard or relocated after installation, internal connections must be changed to ensure proper diagnostic board indication. These modifications should be made prior to installation. If the TPS module is field installed in the bottom, or if it is mounted in a factory assembled panelboard, the internal connections have already been made and the following steps are not necessary.

1. Remove the (4) face plate screws on the TPS module.
2. Remove the face plate and identify the leads labeled "A" and "C", noting where each is connected to the circuit board. Remove these leads from the circuit board and the face plate 180 degrees clockwise. Reattach the leads to the jacks, switching their connection locations (reverse the original wiring).
3. Replace face plate and (4) screws.

Installation (Cont.)

FIGURE 3: ENHANCED S1/S2/SE



Item	Description	Qty.
1	Sentron TPS-2 Unit **(See Page 4, Table 2)**	1
2	1/4-20 Hex Head SEMS Assembly	3
3	10-24 Head Thread Forming Screw	6
4	TPS Neutral Connection Point	–
5	TPS Mounting Bracket	1
6	Phase Connectors.	3
7	1/4" Carriage Bolt	3
8	1/4"Belleville Washer Nut	3

Installation (Cont.)

The following instructions are for the installation of Siemens Sentron TPS SPD module in Siemens S1/S2/ SE lighting panelboard. All hardware is supplied for complete installation of the TPS module.

⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
Keep Out.
Qualified personnel only.
Disconnect and lock off all power before working on this equipment.

⚠ CAUTION

CONDUCTING DIELECTRIC AND/OR HI-POTENTIAL TESTING WILL CAUSE INTERNAL DAMAGE TO TPS UNIT.

Do not perform dielectric or high potential tests with the TPS unit installed.

For Installation in Panelboard - Figure 3

Determine the mounting location of the TPS in the panelboard. If it is to be mounted in the top, refer to the included **Internal Connections** section before proceeding with installation.

1. Lock off all power supplying this equipment before working on it.
2. Remove the trim and dead front.
3. Install the mounting bracket (Item 5) to the base rail as shown in fig. 2 using (2) of the #10 thread forming screws (item 3).
4. Position the TPS unit on the panel base rail so that the phase tabs are on top of the interior bus and the four mounting holes line up with the two holes in the base rail and the two holes in the mounting bracket.
5. Attach the unit (item 1) to the base rail using (4) of the #10 slotted hex washer head thread forming screws (item 3) provided as shown in figure 2.
6. Fasten unit to the main bus using the phase connectors (item 6). The connectors will be attached to the unit with (3) 1/4" hex head SEMS assemblies (item 2) provided. Then they will be connected to the interior with (3) 1/4" carriage bolts and (3) belleville washer nuts (items 7 & 8). Do not tighten at this time.
7. Fasten TPS neutral to panel neutral at the neutral connection point (item 4).
8. Torque all connections to the values as specified on the installation the installation and maintenance instruction label affixed to the rear of the dead front.
9. Replace deadfront and trim.

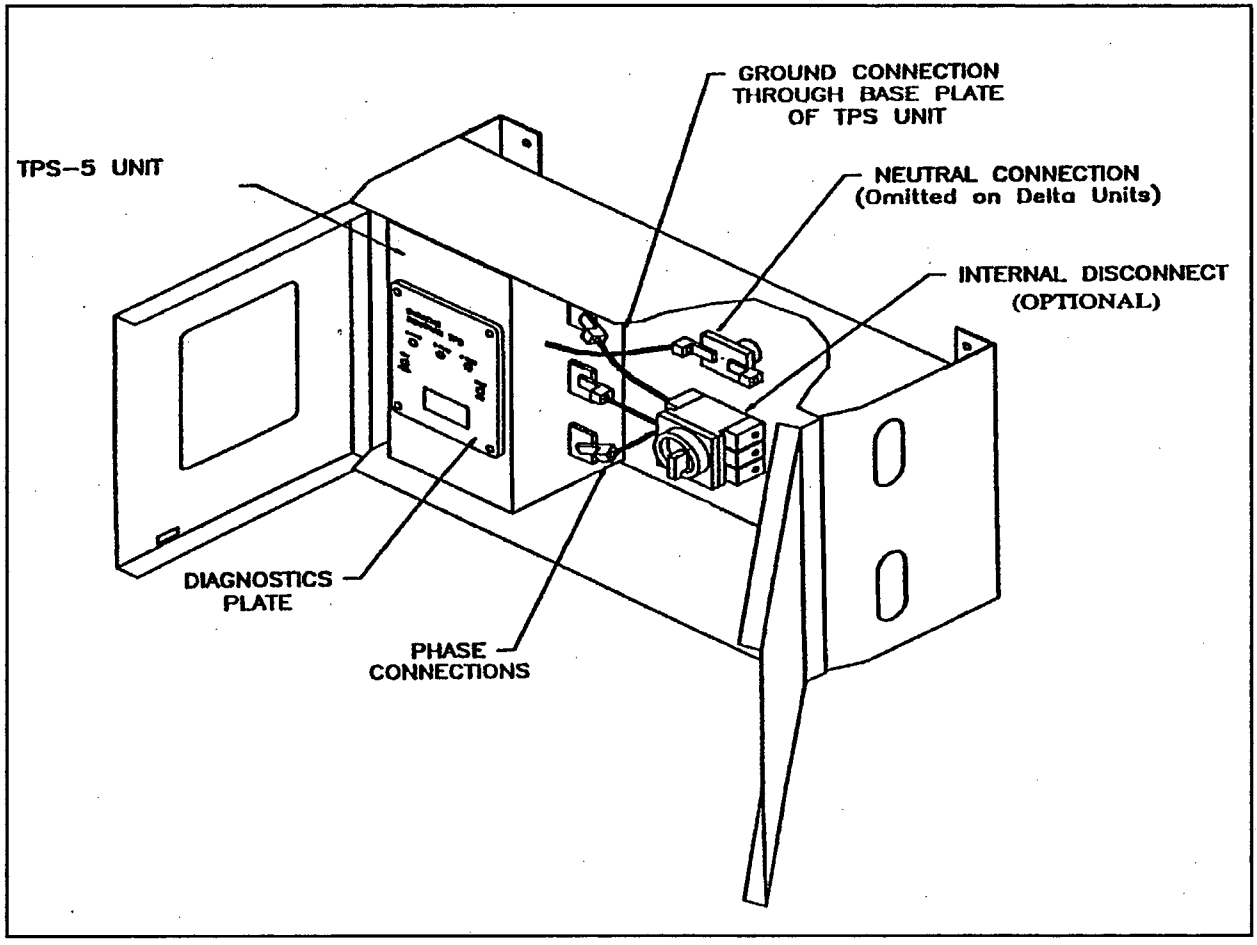
Internal Connections

NOTE: If the TPS module is to be mounted in the top of the panelboard or relocated after installation, internal connections must be changed to ensure proper diagnostic board indication. These modifications should be made prior to installation. If the TPS module is field installed in the bottom, or if it is mounted in a factory assembled panelboard, the internal connections have already been made and the following steps are not necessary.

1. Remove the (4) face plate screws on the TPS module.
2. Remove the face plate and identify the leads labeled "A" and "C", noting where each is connected to the circuit board. Remove these leads from the circuit board and rotate the face plate 180 degrees clockwise. Reattach the leads leads to the jacks, switching their connection locations (reverse the original wiring).
3. Replace face plate and (4) screws.

Installation (Cont.)

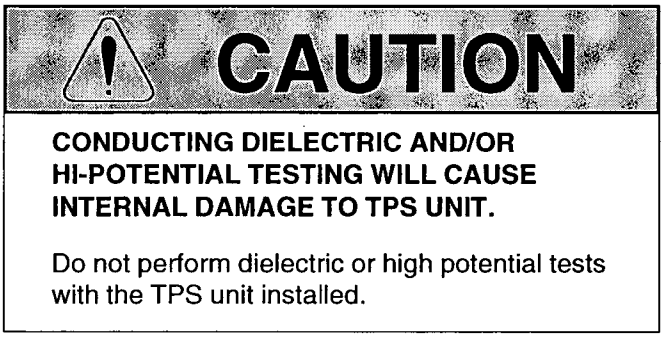
FIGURE 4: S4/S5/F1/F2/SB3 DISTRIBUITON



NOTE: TPS-5 UNIT MAY BE REPLACED IF SUPPLIED WITH AN INTERNAL DISCONNECT. SEE REPLACEMENT INSTRUCTIONS.

Installation (Cont.)

The following instructions are for the replacement of Siemens Sentron TPS SPD module in Siemens TPS-5 unit.



Replacment of the SPD Module in a TPS-5 Unit Figure 4

1. Lock off all power supplying this equipment before working on it.
2. Open unit door.
3. Turn the internal disconnect to the off position.
4. Remove the neutral lug wire from the neutral lug.
5. Remove the phase lug wires from the TPS-5 unit.
6. Remove the TPS-5 unit and discard properly.
7. Replace unit with the new TPS-5 unit.
8. Attach the phase lug wires to the correct phase on the TPS-5 unit.
9. Attach the neutral wire back to the neutral connection lug.
10. Torque all connections to the values as specified on the installation and maintenance instruction label affixed to the rear of the dead front.
11. Turn the internal disconnect back to the on position.
12. Close unit doors before reenergizing.

Installation (Cont.)

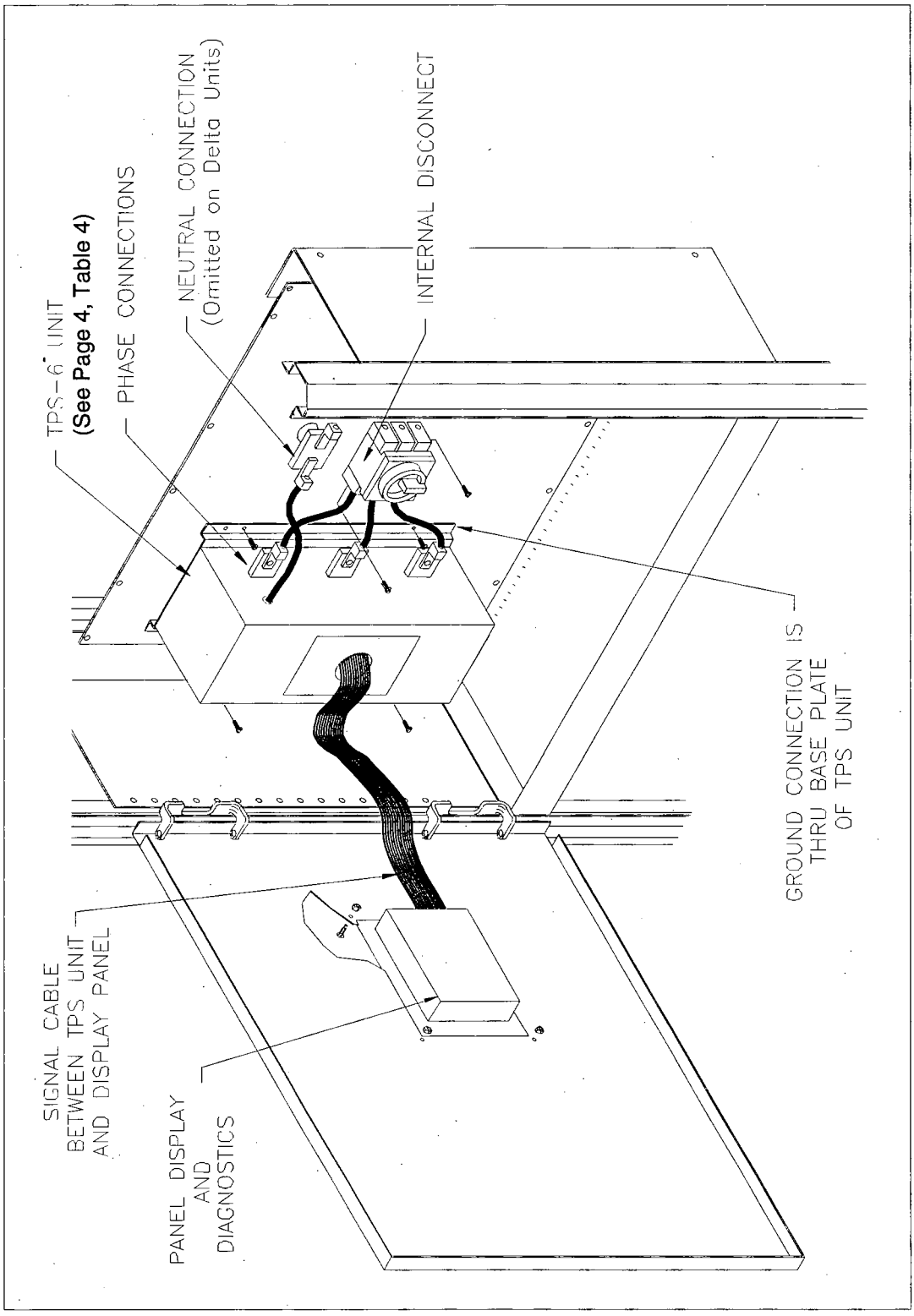
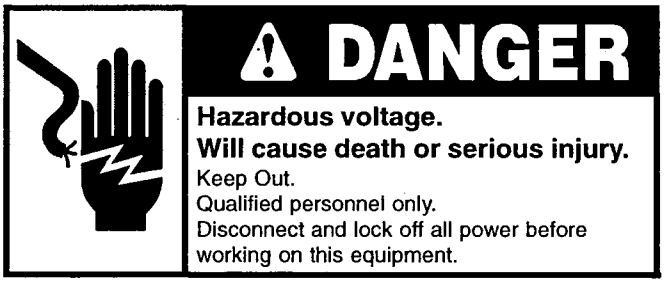


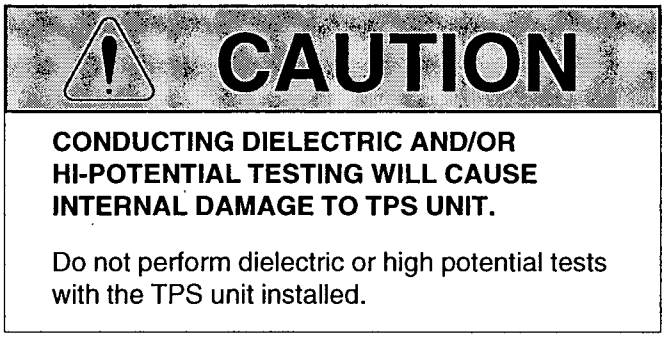
FIGURE 5: SB3/RCIII

NOTE: TPS-6 UNIT MAY BE REPLACED IF SUPPLIED WITH AN INTERNAL DISCONNECT. SEE REPLACEMENT INSTRUCTIONS.

Installation (Cont.)

The following instructions are for the replacement of Siemens Sentron TPS SPD module in Siemens TPS-6 unit.





Replacment of the SPD Module in a TPS-6 Unit Figure 5

1. Lock off all power supplying this equipment before working on it.
2. Open unit door.
3. Turn the internal disconnect to the off position.
4. Remove the neutral lug wire from the neutral lug.
5. Remove the phase wires from the TPS-6 unit lugs.
6. Remove the TPS-6 unit with the panel and diagnostics displays and discard properly.
7. Replace units with the new TPS-6 units.
8. Attach the phase lug wires to the correct phase on the TPS-6 unit.
9. Attach the neutral wire back to the neutral connection lug.
10. Torque all connections to the values as specified on the installation and maintenance instruction label affixed to the rear of the dead front.
11. Turn the internal disconnect back to the on position.
12. Close unit doors before reenergizing.

Operation

Operation instructions for TPS units installed in:

- S1/S2 (Figure 1, pg.6)
- S1/S2/SE (Figure 2, pg.8)
- S4/S5/F1/F2/SB3 Dist. (Figure 3, pg.10)
- SB3/RCIII Service (Figure 4, pg.12)

TPS surge protective devices do not require operator intervention after installation. They contain a diagnostic circuit which monitors the suppressor's status continuously and automatically. All phase indicators and controls are located on the display panel of the unit. Display panels are formatted either for horizontal or for vertical mounting orientation as required for each application.

TPS Control and Diagnostic Display Panel

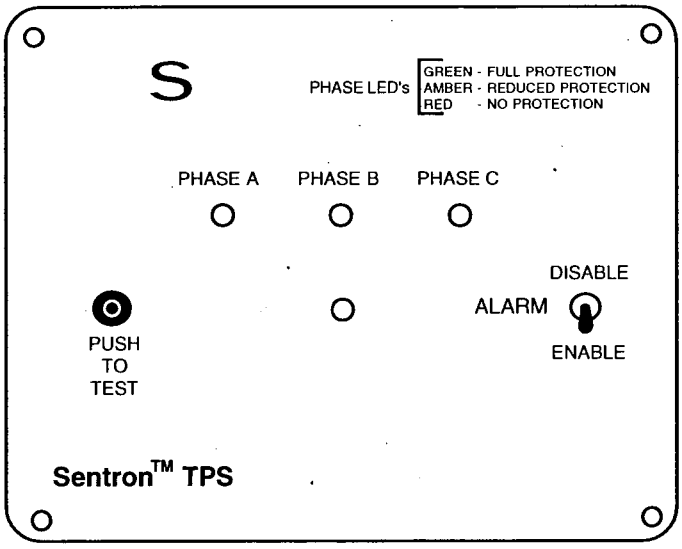


Figure 5, Basic Display - Horizontal

The TPS unit is equipped with a **status indicating LED** for each module on the panel. Each phase LED is capable of displaying any one of three separate colors; green for normal operation, amber for reduced protection, and red for a fault condition. When all LED's are green, the suppressor is on-line and functioning properly. If a fault condition occurs, the built-in diagnostics panel **audible alarm** will sound and the LED representing the affected phase will change to amber or red, indicating that the unit is in need of service. The audible alarm can be silenced by toggling the "ALARM" switch to the "DISABLE" position. The red (or amber) phase LED will continue to be illuminated even though the audible alarm has been silenced, until such time that the fault condition has been cleared. The audible alarm can be tested by depressing the "PUSH TO TEST" button when the alarm switch is in the "ENABLE" position. If a fault alarm does occur, see Corrective Maintenance (Testing and Repair) for further information.

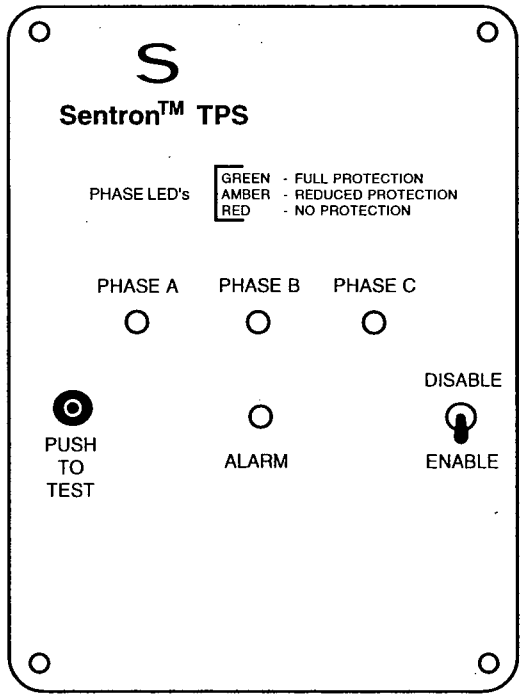


Figure 6, Basic Display - Vertical

TPS Control and Diagnostic Display Panel with Surge Counter Option

The TPS unit is equipped with a **status indicating LED** for each module on the panel. Each phase LED is capable of displaying any one of three separate colors; green for normal operation, amber for reduced protection, and red for a fault condition. When all LED's are green, the suppressor is on-line and functioning properly. If a fault condition occurs, the built-in diagnostics panel **audible alarm** will sound and the LED representing the affected phase will change to amber or red, indicating that the unit is in need of service. The audible alarm can be silenced by toggling the "ALARM" switch to the "DISABLE" position. The red (or amber) phase LED will continue to be illuminated even though the audible alarm has been silenced, until such time that the fault condition has been cleared. The audible alarm can be tested by toggling the "ALARM" switch to the "ENABLE" position.

Operation (Cont.)

The surge counter option provides a means to display the total number of transient voltage surge events since the counter was last reset. The counter is powered by a long life lithium battery located within the counter. This will provide power to retain memory in the event of a power loss to the TPS unit. The "COUNTER" switch is provided on the face of the display that, when toggled, will reset the counter to zero and test the circuitry for proper operation. If a fault alarm does occur, see Corrective Maintenance (Testing and Repair) for further information.

Figure 7, Surge Counter Display - Horizontal

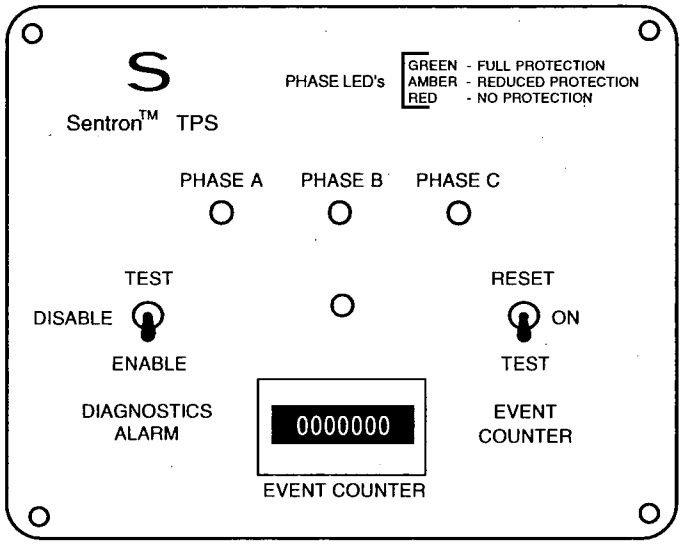
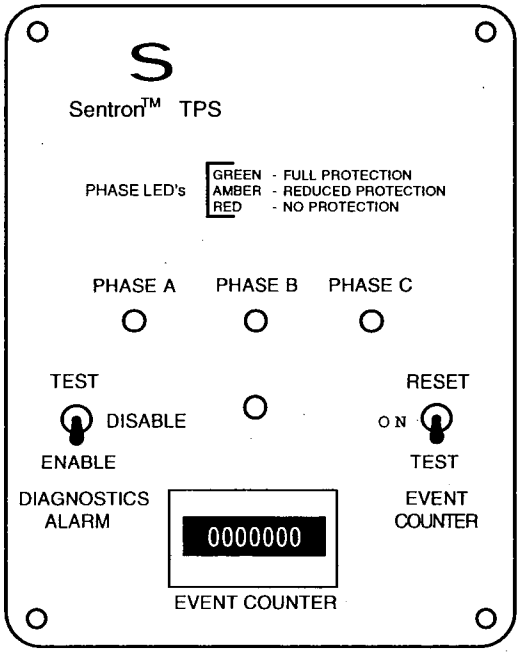


Figure 8, Surge Counter Display - Vertical



Additional Features and Options (Avilable on all TPS models)

Dry Contacts Feature

All TPS units are equipped with dry contacts. This feature provides normally open (N.O.) and (N.C.) circuits, which can be used for remote indication of a failed suppression module on any phase. The dry contact DB-9 connector is located at the user access location. This connector is designed for low voltage or control signals only. Maximum voltage should not exceed 24 volts and maximum current should not exceed 1 amperes. These contacts may be used to provide a signal to an emergency management system or computer interface board. The relay contact pin arrangement is outlined in the table below.

Table 6 - DB-9 Pin Configuration

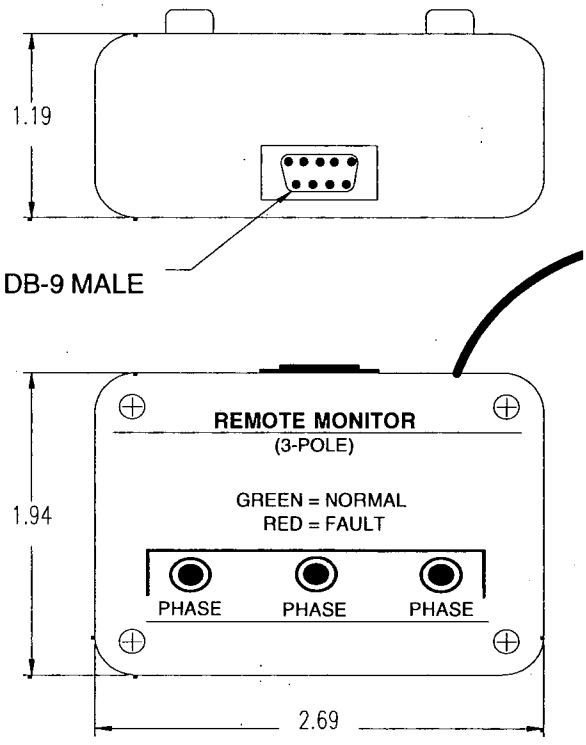
PIN	Contact Type	Phase
1	Normally Closed	A
2	Common	A
3	Normally Open	A
4	Normally Closed	B
5	Common	B
6	Normally Open	B
7	Normally Closed	C
8	Common	C
9	Normally Open	C

Operation (Cont.)

Remote Monitor Option

A remote monitor is available to display TPS status up to 1000 feet away from the unit. The remote monitor requires an external 9VDC power source, and is provided with the necessary 120VAC-to-9VDC adapter (with a six foot DC power cord). The monitor has up to three dual color (red/green) LED's, one for each monitored phase, and a built-in audible alarm. Normal status is indicated by all phase LED's glowing green, and an unsounded alarm. If loss of surge protection occurs on any phase, the alarm will sound and the affected phase LED will glow red. If an alarm occurs, the unit can be silenced (disabled) by upplugging the external power source. Following replacement of the affected TPS unit, the remote monitor will resume normal operation when external power is restored. Connections between the remote monitor and the TPS are made by DB-9 connectors (provided) and 22-26 gauge, 3, 6 or 9 conductor cable (not provided).

Figure 9, Remote Monitor (Model RM-3P Shown)



Maintenance

⚠ DANGER

Hazardous voltage.
Will cause death or serious injury.
Keep Out.
Qualified personnel only.
Disconnect and lock off all power before working on this equipment.

⚠ CAUTION

CONDUCTING DIELECTRIC AND/OR HI-POTENTIAL TESTING WILL CAUSE INTERNAL DAMAGE TO TPS UNIT.

Do not perform dielectric or high potential tests with the TPS unit installed.

Preventive Maintenance (Inspection & Testing)

Inspection of the TPS unit should be performed periodically, to maintain reliable system performance and continued transient voltage surge protection. The large variations in operating conditions encountered by units in the field make it difficult to set a fixed maintenance interval, but inspections utilizing the built-in diagnostics should be performed on at least a weekly or monthly basis.

Corrective Maintenance (Repair)

The Siemens Sentron TPS unit is designed for years of reliable, trouble-free operation. Unfortunately, in an extreme case, you may experience an alarm condition. In this event, no attempt should be made to repair the TPS itself. There are no serviceable parts within the unit. Any unit that requires service should be removed from the panelboard, and replaced by a new unit of the same model.

S

Sentron™ TPS (Transient Protection System)

For further TPS unit information contact
Siemens Technical Support at
1-888-333-3545
Please have the relavent model and serial
numbers ready for reference.

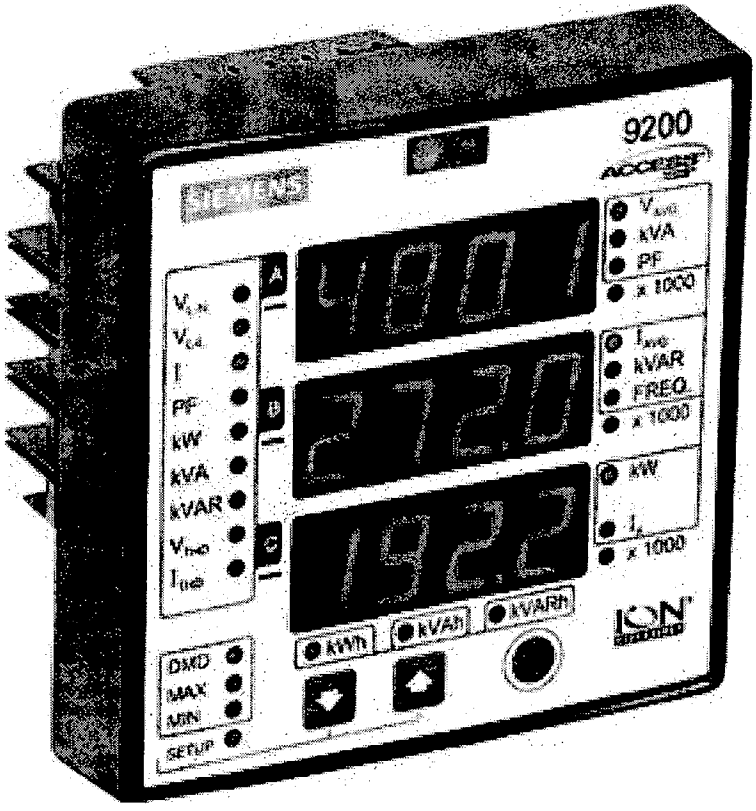
Installation,
Operation &
Maintenance Manual

12-A-1013-01, Rev. 6, 8/00-dw

SIEMENS

9200 Power Meter

Installation & Basic Setup Instructions



⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Can cause death, serious injury or property damage.

See safety instruction contained herein. Restrict use to qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions that can cause death, serious injury or property damage.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSONNEL

For the purposes of this manual and product labels, "qualified personnel" is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, s/he has the following qualifications:

(a) **is trained and authorized** to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective gear equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety procedures

(c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local the sales office.

THE CONTENTS OF THIS INSTRUCTION MANUAL SHALL NOT BECOME PART OF OR MODIFY ANY PRIOR OR EXISTING AGREEMENT, COMMITMENT OR RELATIONSHIP. THE SALES CONTRACT CONTAINS ALL OBLIGATIONS OF SIEMENS ENERGY & AUTOMATION, INC. THE WARRANTY CONTAINED IN THE CONTRACT BETWEEN THE PARTIES IS THE SOLE WARRANTY OF SIEMENS ENERGY & AUTOMATION, INC.

Installation Considerations

Installation and maintenance of the 9200 meter should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current devices. Every effort has been made to ensure the installation instructions presented in this document are clear and easy to understand; however, if you are not sure how to perform any of the instructions provided, DO NOT CONTINUE THE INSTALLATION. The 9200 meter must be installed in accordance with all Local and National Electrical Codes.

WARNING: Failure to observe the following information may result in severe injury or death.

- During normal operation of this device, hazardous voltages are present on the terminal strips of the device and throughout the connected potential transformer (PT), current transformer (CT), control power and external I/O circuits. PT and CT secondary circuits are capable of generating lethal voltages and currents with their primary circuit energized. Follow standard safety precautions while performing any installation or service work (i.e. removing PT fuses, shorting CT secondaries, etc).
- The terminal strips on the meter base should not be user-accessible after installation.
- Do not use digital output devices for primary protection functions. These include applications where the device performs energy limiting functions or provides protection of people from injury. If failure of the device can cause injury or death, or cause sufficient energy to be released that a fire is likely, do not use the 9200 meter. The 9200 meter can be used for secondary protection functions.
- Do not HIPOT/Dielectric test the digital inputs/outputs, or communications terminals. Refer to the label on the device for the maximum voltage level the device can withstand.
- Terminal strip torque:

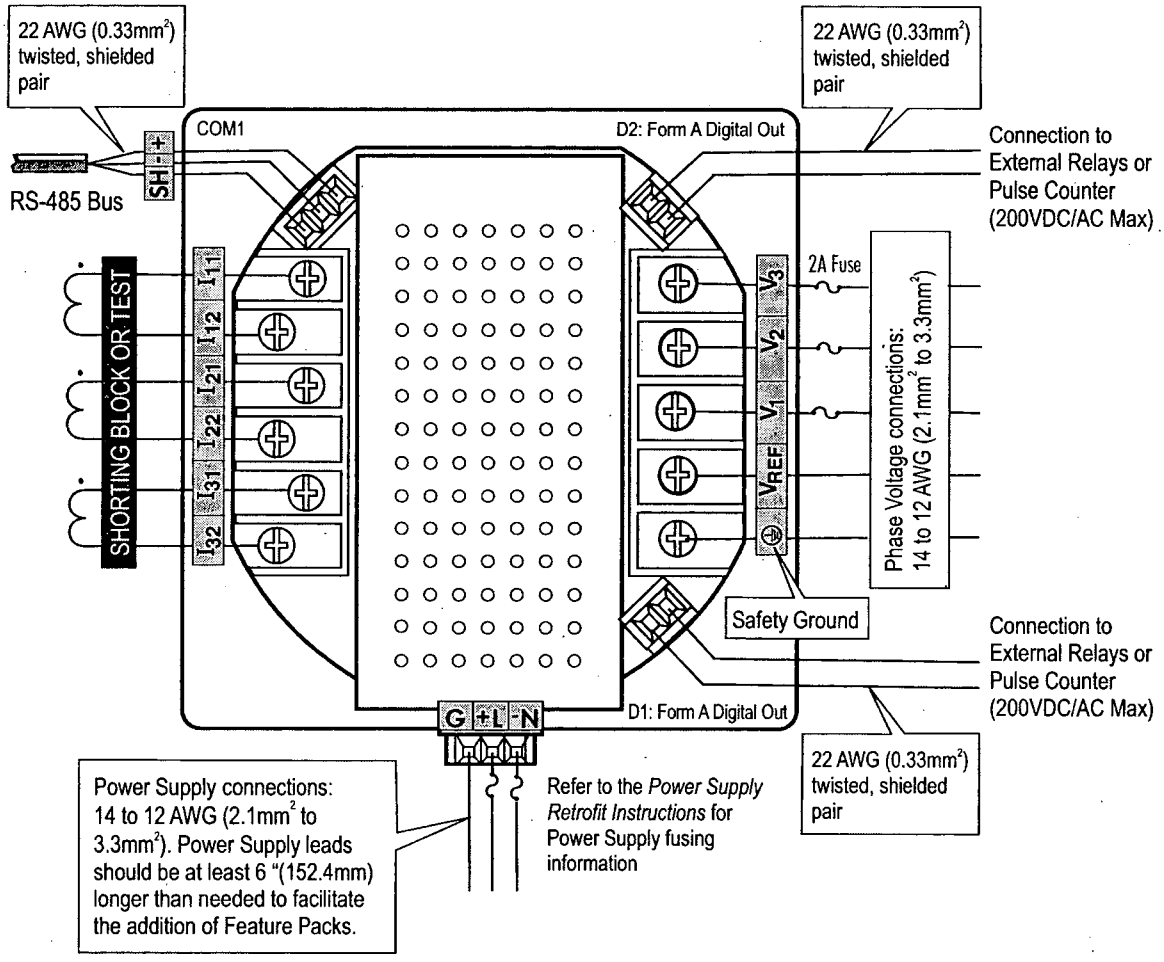
  Current, voltage, and safety ground terminals: 1.35Nm or 1.0 ft • Lbf torque (max). Digital inputs/outputs, communications, and power supply: 0.90Nm or 0.7 ft • Lbf torque (max).

CAUTION: Failure to observe the following may result in permanent damage to the device.

- The 9200 meter offers a range of hardware options that affect input ratings. Applying current levels incompatible with the current inputs will permanently damage the 9200 meter. This document provides detailed installation instructions applicable to each hardware option.
- The 9200 meter safety ground must be properly connected to the switchgear earth ground for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.
- When the integrated display unit or the RMD unit is mounted flush to a panel with the supplied gasket, then the front side meets NEMA type 4, 4x and 5 (according to NEMA standards 1-10-1979 and 5-25-1988) and meets IP 543.

Table of Contents

Installation Overview



1. Insert the Options Card in the slot at the back of the meter (refer to the diagram "Plug-in Modules" on page 8, and the *9200 Options Card Retrofit Instructions*).

2. Mount the meter.

   Integrated model:

   - Cut a hole in the mounting surface to DIN 96 or ANSI 4" specifications (refer to "Mounting the Integrated Model" on page 10).
   - Install the meter in the hole (refer to "Mounting the Integrated Model" on page 10).

   TRAN model:

   - Mount the meter flush against a flat surface with screws, or snap into a standard DIN rail (refer to "Mounting the TRAN Model" on page 11).

3. Mount the Remote Modular Display (RMD) against a flat surface with the supplied screws, if your meter ordering option includes an RMD (refer to the *9200 RMD Retrofit Instructions).*
4. Attach the Feature Pack™ to the meter, if your meter ordering option includes a Feature Pack (refer to the *9200 Feature Pack Retrofit Instructions*).
5. Attach the power supply to the meter, or attach it to the Feature Pack installed in the previous step (refer to "Plugging in the Power Supply" in the *9200 Power Supply Retrofit Instructions*).
6. Connect the RMD to the TRAN meter, if your meter ordering option includes a TRAN meter and an RMD (refer to the *9200 RMD Retrofit Instructions).*
7. Wire the ⏚ (safety ground) terminal to earth ground (refer to "Connecting the Base Unit Safety Ground" on page 14).
8. Wire the power supply (refer to "Connecting the Power Supply" on page 14, or the *9200 Power Supply Retrofit Instructions* for more details). Do not power up the power supply until the rest of the meter wiring is complete.
9. Wire the voltage and current inputs (refer to "Connecting the Phase Voltage Inputs" on page 15, and "Connecting the Phase Current Inputs" on page 16).
10. Wire the digital outputs, if your meter ordering option includes digital outputs (refer to "Digital Outputs Connection" on page 21).
11. Wire the communications, if your meter ordering option includes communications (refer to "RS-485 Communications Connections" on page 22).
12. Close the PT fuses (or direct voltage input fuses), and open the CT shorting blocks.
13. Apply power to the meter.
14. Configure the meter (refer to "Basic Setup" on page 23).
15. Verify the meter operation (refer to "Verifying Meter Operation" on page 40).

Introduction

The 9200 meter is small, simple to install, and can be easily upgraded in the field. It provides revenue accurate measurements, has a large bright display, and is versatile.

The meter's modular design allows you to "plug in" components to expand your metering capabilities as your power system requires. Plug in an enhanced Options Card for a broader range of power measurements, or plug in a Feature Pack for extended capabilities.

Integrated and TRAN Models

The 9200 meter is available as an Integrated (display) or TRAN (transducer) model. The Integrated model has a large, bright front panel display. The TRAN model has no display; it can be connected to a Remote Modular Display unit (RMD) to provide a display identical to that on the Integrated model. Installation for the Integrated and TRAN models is covered in this guide. Refer to the *9200 RMD Retrofit Instructions* regarding the RMD.

NOTE: In the 9200 meter documentation, the term "basic meter" refers to the Integrated or TRAN models with an Options Card that provides standard measurements (voltage and current), and without a Feature Pack.

Options Card

The basic meter has an Options Card that enables standard measurements: voltage and current. You can also order an Options Card that enables extended capabilities: two digital pulse outputs, and additional measurements (Enhanced Measurement Packages 1 and 2). Refer to the Options Card features tables on page 53 and page 54, or the *9200 Options Card Retrofit Instructions.*

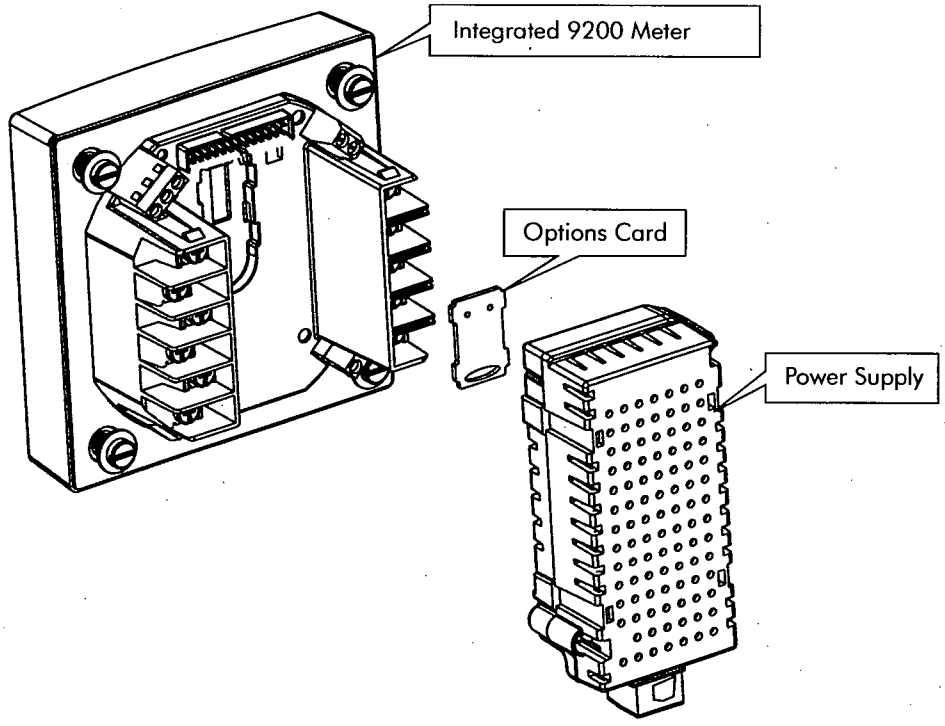
Future Feature Packs

Feature Packs[1] provide advanced capabilities for the meter including digital and analog I/O, communications protocols, and power quality measurements. Refer to the *9200 Feature Packs Retrofit Instructions.*

Power Supply

The power supply is also a plug-in component that is easy to install. Refer to the *9200 Power Supply Retrofit Instructions.*

Plug-in Modules



[1] Feature Packs are in development and will be available in the future. In the diagram above, Feature Packs are not shown. The Feature Pack(s) will install between the meter and the power supply.

Location & Mounting

Mount the meter in a dry location free from dirt and corrosive vapors. Once installed, no cleaning of the device is necessary.

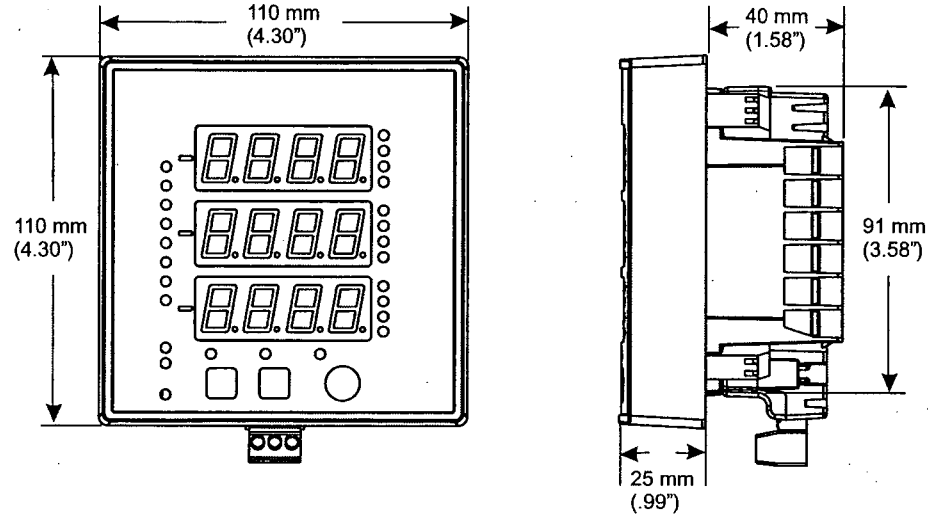
Environmental Specifications

Refer to the Environmental specifications on page 43.

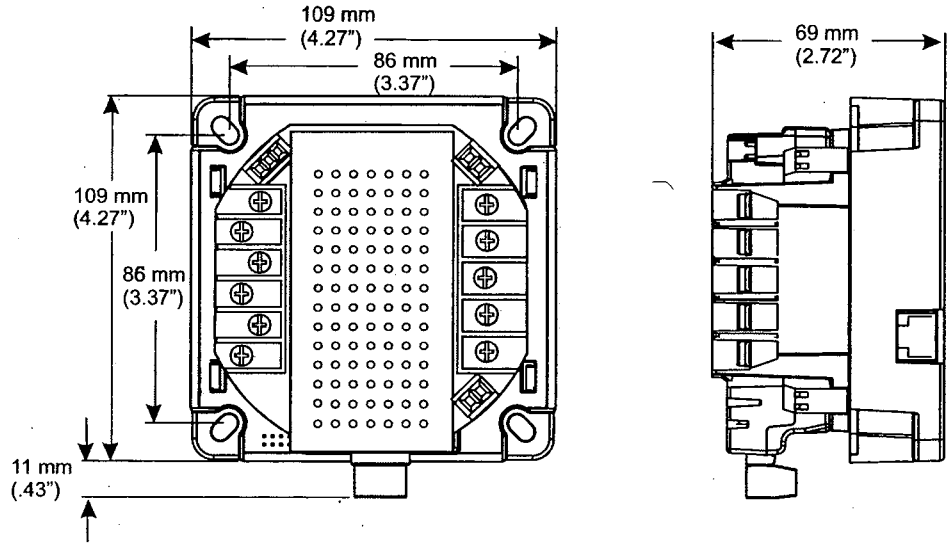
Unit Dimensions

The meter and meter options dimensions are shown below.

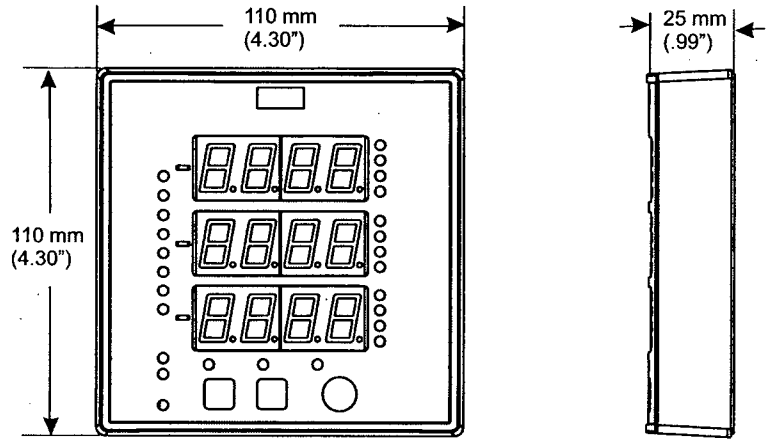
Integrated Model Dimensions



TRAN Model Dimensions



RMD Dimensions



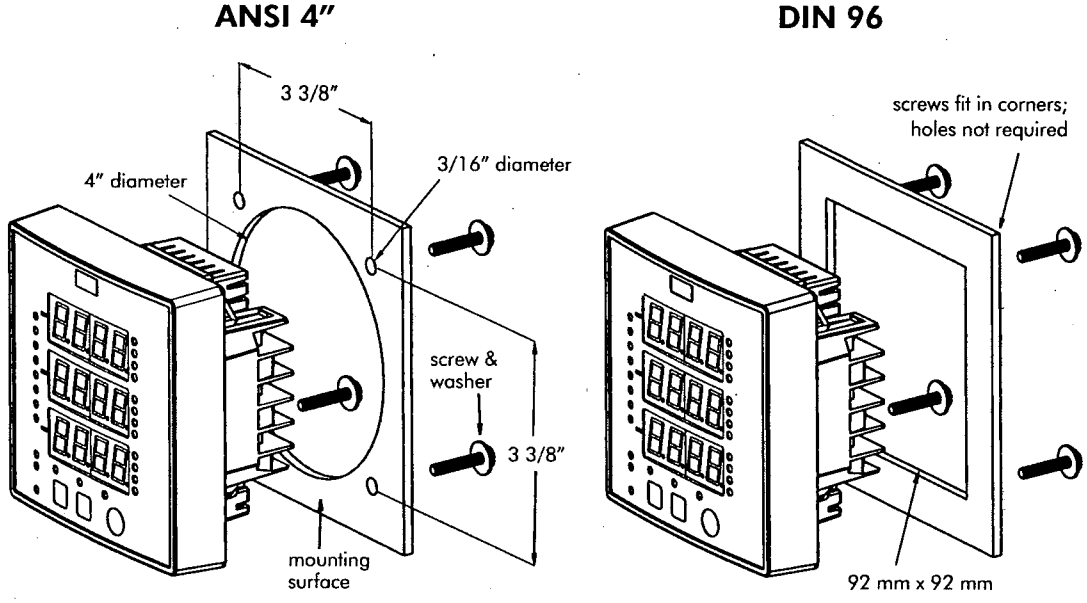
Mounting the Meter

The basic meter (with an integrated display) fits in a DIN standard 92 X 92 mm (3.6" X 3.6") panel cutout, as well as a standard ANSI 4" panel cutout (commonly referred to as a 4 1/2" Switchboard cutout). Standard panel punches are available for retrofit applications.

> **CAUTION**: Include a switch or circuit breaker in each installation, in close proximity to the unit and within easy reach to the operator. Mark this switch (or circuit breaker) as the disconnecting device for the unit.

Mounting the Integrated Model

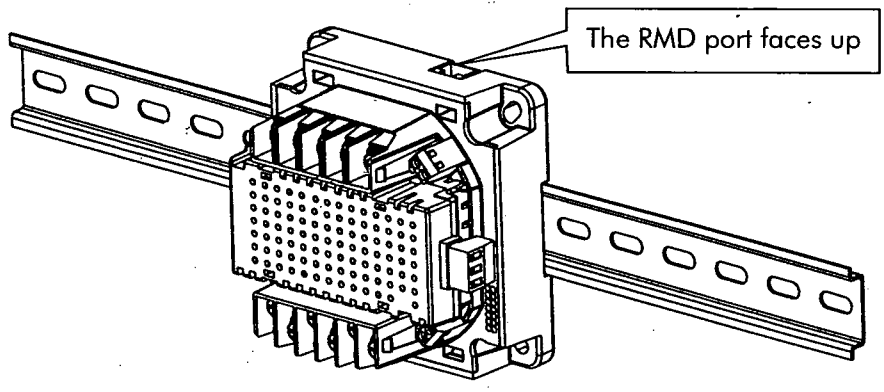
1. Fit the meter into the cutout.
2. Slip the washers on the screws and insert each screw in the corresponding drilled hole on the mounting surface (no drilled holes required in a DIN 96 cutout).
3. Place each screw in its corresponding metal insert located on one of the back corners of the meter.
4. With a #2 Phillips screwdriver, tighten the screws to 1.35Nm or 1 ft • Lbf (maximum).



Mounting the TRAN Model

The TRAN meter is the basic meter with no display. The TRAN can be mounted flush against any flat surface in any orientation with four #8 or #10 size screws (1.35Nm or 1 ft • Lbf maximum). The meter casing provides four slots (in the ANSI 4" bolt pattern) on its mounting flanges for this purpose. The TRAN is typically mounted inside the switchgear cabinet.

The TRAN can be easily snapped in place on a standard DIN rail, European Standard EN50022:1977. The recommended orientation is with the RMD port upwards, as shown in the diagram below. In this orientation, the sliding snap feature has the most strength.



Mounting the RMD

The Remote Modular Display (RMD) is supplied separately as an addition to an existing TRAN meter. The RMD can be mounted in either a standard DIN or ANSI cutout (refer to the diagram in "Mounting the Integrated Model"). With only 5 small holes, the RMD can also be mounted on a flat panel. See the *9200 RMD Retrofit Instructions*.

Field Wiring Connections

DANGER: Be familiar with the warnings presented at the beginning of this document before proceeding with the installation of the meter.

Field Service Considerations

If the meter requires servicing or field upgrading, you may need to disconnect and remove the meter from its mounting. The initial installation should be done in a way that makes this as convenient as possible:

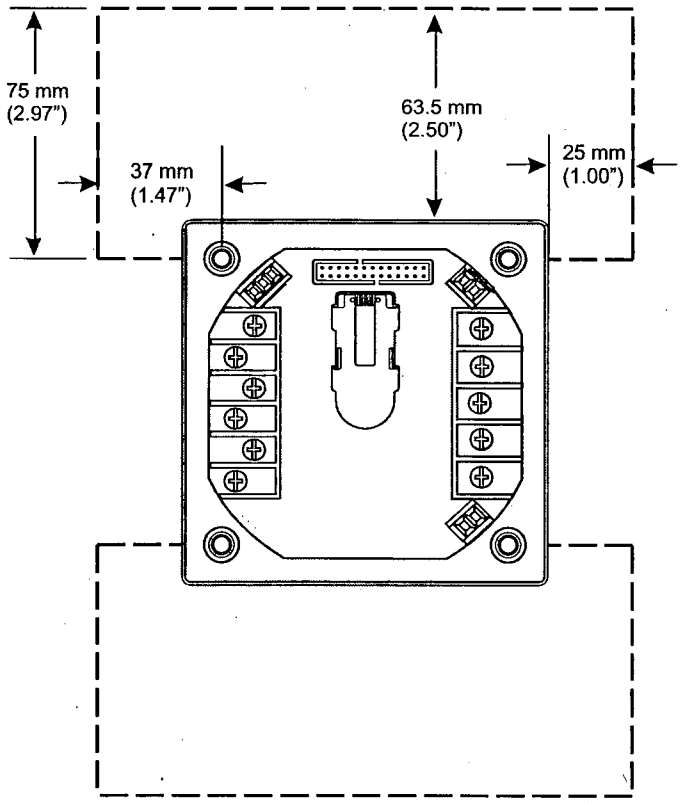
- All phase voltage sense leads should be protected by breakers or fuses at their source so the meter can be safely disconnected.
- A CT shorting block should be provided so that the meter current inputs can be safely disconnected without open circuiting the CTs. The shorting block should be wired so that protective relaying is not affected.
- All wiring should be routed to allow easy removal of the connections to the meter terminal strips and the meter itself.

Feature Pack Requirements*

Feature Packs install between the basic meter and the power supply, and may protrude beyond the meter top and bottom (refer to the following diagram). Note that the power supply rotates 180 degrees. As a result, these requirements should be considered:

- Power supply leads should be at least 152.4 mm (6") longer than needed to facilitate the addition of Feature Packs.
- A minimum of 63.5 mm (2.5") above and below the meter should be left free from cables, wiring, and other devices.
- With a Feature Pack installed, the meter has a maximum depth of 63.5 mm (2.5") behind the panel.

Feature Pack Space Allowances



* This is subject to change without notice.

Terminal Strips

All connections to the meter are made to terminal strips at the back of the unit. The terminal strips for phase voltage and current are barrier-type, for which ring or spade terminals, or bare wire, may be used.

The terminal strips for the digital outputs, the communications port, and the supply power inputs are all captured-wire type; they accept stripped wire ends.

Terminal Strip Covers

Terminal strip covers are provided for the voltage and current terminal strips. These covers easily snap on and off of the meter with a flathead screwdriver.

Connecting the Base Unit Safety Ground

The ⏚ terminal of the meter provides the safety ground connection. This terminal must be connected to earth ground. A good, low impedance safety ground connection is essential for the meter surge and transient protection circuitry to function effectively. It should be made to the switchgear earth ground using a dedicated 14 AWG (2.1 mm^2) or larger wire to a point where there will be no voltage error due to distribution voltage drops.

The power supply G (ground) terminal should be connected to the same point as the meter ⏚ terminal.

Do not rely on metal door hinges as a ground path. Ensure that the ⏚ terminal is tightened securely to the ground wire.

> ⚠ **CAUTION**: Failure to properly connect the meter safety ground will void the warranty.

Connecting the Power Supply

> **NOTE**: Disconnect the power source before removing the power supply.

The meter requires a constant power supply to maintain monitoring, analysis, control, and communications operations. Powering the meter from the voltage source it is monitoring is not suitable for applications where these operations must be maintained in the event of a power outage.

If an AC power supply is being used, connect the line supply wire to the L+ terminal and the neutral supply wire to the N- terminal. If a DC power supply is being used, connect the positive supply wire to the L+ terminal and the negative supply wire to the N- terminal.

Power Supply Specifications

Refer to the Power Supply specifications on page 44, or the *9200 Power Supply Retrofit Instructions*.

Protective Fuses

The meter power supply may need to be externally fused. Refer to the *9200 Power Supply Retrofit Instructions.*

Connecting the Remote Modular Display

The RMD connects to the TRAN meter with a 26 gauge 6 conductor RJ11-type cable. The cable connects between the RJ11 socket on the backside of the RMD, and the RJ11 socket on the side of the TRAN. Refer to the *9200 RMD Retrofit Instructions* for more information.

> ⚠ **CAUTION**: Only use the supplied cable to connect the RMD.

Connecting the Phase Voltage Inputs

Phasing and polarity of the AC voltage inputs and their relationship is critical to the correct operation of the meter. All phase voltage sense leads should be protected by breakers or fuses at their source.

Voltage Input Specifications

Refer to the Voltage Input specifications on page 43.

> ⚠ **CAUTION**: Ensure that the voltage level between V_{REF} and each phase input (V1, V2 or V3) does not exceed 400 volts.

Connection

PTs are required for all systems with voltage levels greater than those indicated in the Voltage Input specifications.

Using Potential Transformers

Use PTs that are compliant with the electrical safety code in your region. It is recommended that PTs comply with the requirements in IEC 61010-1, Pollution Degree 2, Overvoltage Category III.

> ⚠ **CAUTION**: In cases where PTs are required, the secondaries should be fused.

V1 Input Connection

The meter uses the V1 input as the reference for frequency for all power and energy related measurements. For any system configuration, the V1 input must be connected to ensure accurate readings and correct operation of the meter. If the voltage on V1 falls below 50 V, the meter's accuracy could be affected.

Voltage Reference (Vref) Input Connection

The meter voltage reference terminal, Vref, serves as the zero voltage reference for voltage readings. A good, low impedance Vref connection is essential for accurate measurements. It should be made using a dedicated 14 to 12 AWG wire (2.1 to 3.3 mm^2) to a point where there will be no voltage error due to distribution voltage drops.

Connecting the Phase Current Inputs

14 to 12 AWG wire (2.1 to 3.3 mm^2) is recommended for all current connections. Use CTs that are compliant with the electrical safety code in your region. It is recommended that CTs comply with the requirements in IEC 61010-1, Pollution Degree 2, Overvoltage Category III.

Current Input Specifications

For Current Input specifications, refer to page 43.

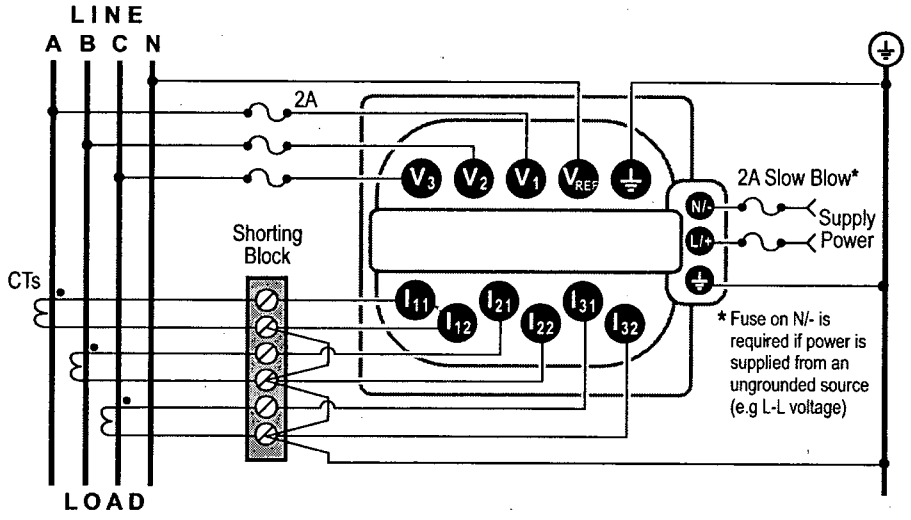
Using Current Transformers

The CT primary rating is normally selected to be equal to the current rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity, you can improve accuracy and resolution by selecting a lower rated CT. In this case, the CT size should be the maximum expected peak current, rounded up to the nearest standard CT size.

The CT secondary should have a burden capacity greater than 3 VA. The length of the CT cabling should be minimized, because long cabling contributes to the burden on the CT secondary. Also, the CT burden rating must exceed the combined burden of the meter plus cabling plus any other connected devices (burden is the amount of load being fed by the CT, measured in Volt-Amps).

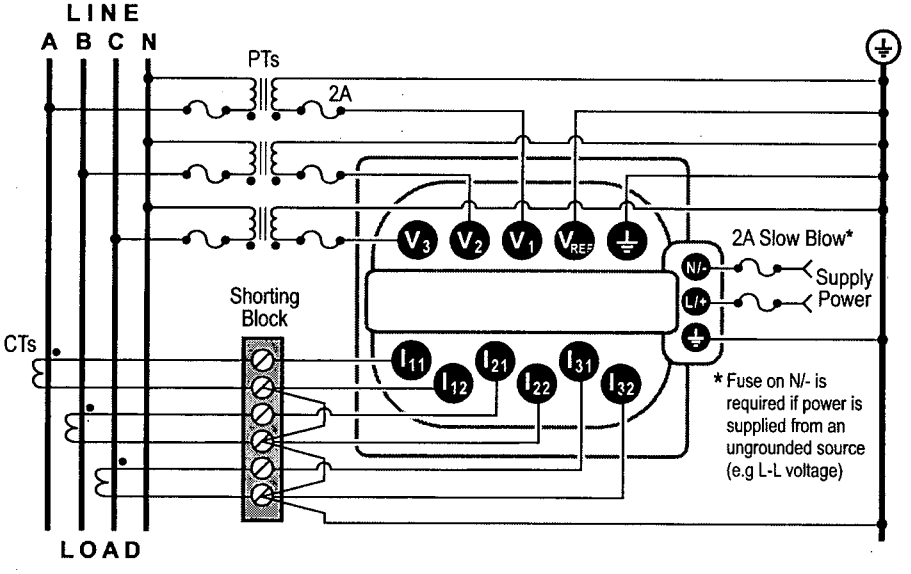
4-Wire Wye, 3-Element Direct Connection

NOTE: The meter senses the line-to-neutral voltage and current for each phase, creating an equivalent 3 element metering configuration. Volts Mode should be set to 4W-Wye.



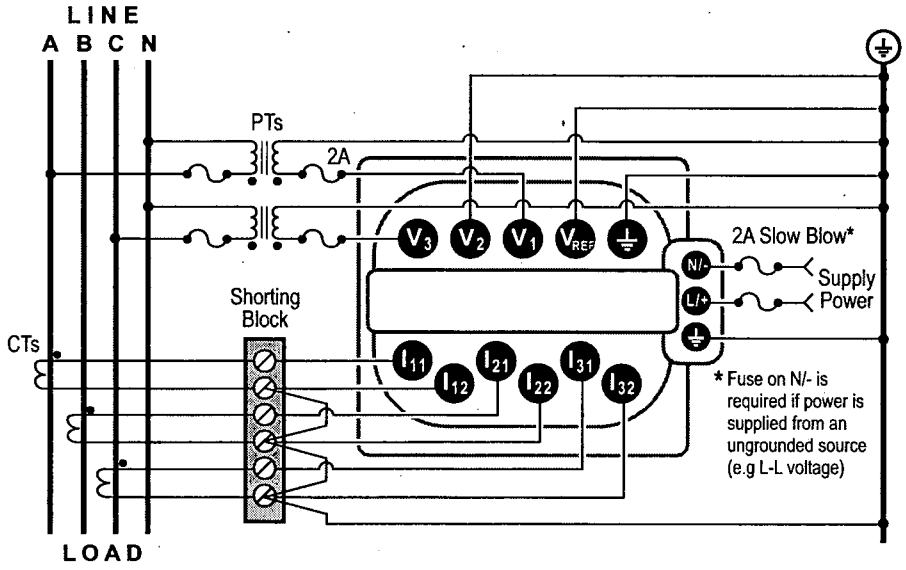
4-Wire Wye, 3-Element, 3 PT, 3 CT

NOTE: Both the PT primary and secondary must be wired in a Wye (star) configuration. Wiring must be exactly as shown for correct operation. Volts Mode should be set to 4W-Wye.



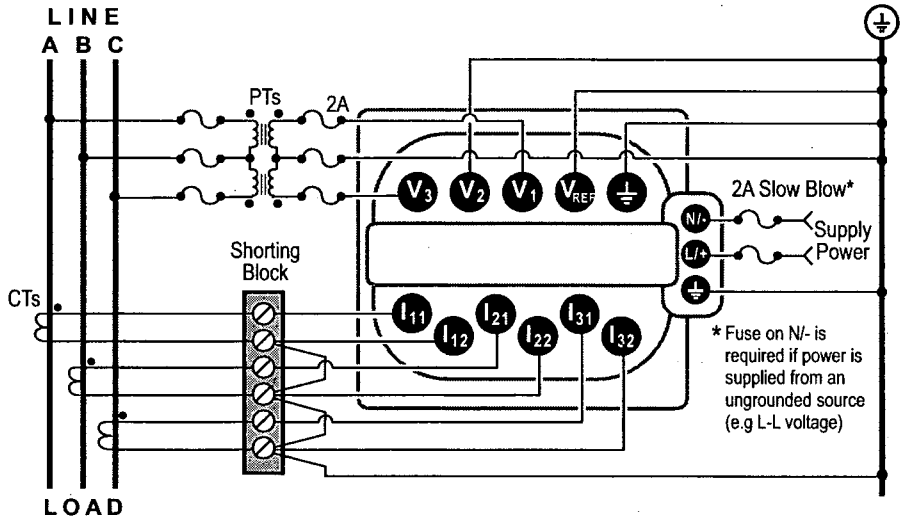
4-Wire Wye, 2½-Element, 2 PT, 3 CT

NOTE: Phase B voltages are derived from the phase A and C voltages. If the voltages are unbalanced, power readings may not meet accuracy specifications. Volts Mode should be set to 3W-Wye.



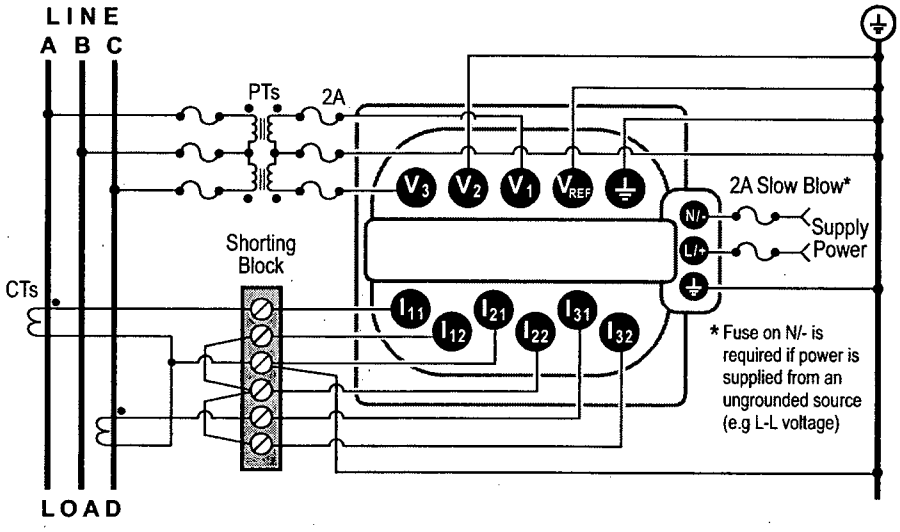
3-Wire Delta, 2½-Element, 2 PT, 3 CT

NOTE: PTs are required for ungrounded 3-wire systems above 690 Volts line-to-line. In this configuration, the meter senses the line-to-line voltages between each of the phases. Volts Mode should be set to Delta.



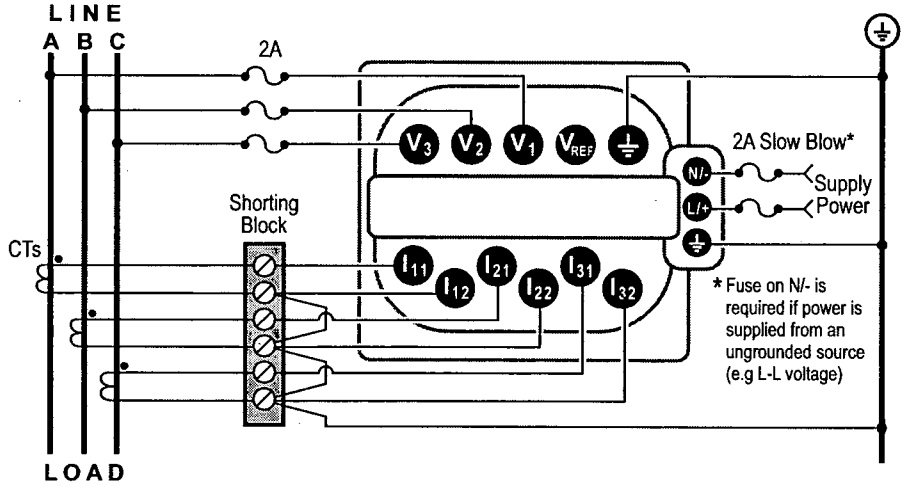
3-Wire Delta, 2-Element, 2 PT, 2 CT

NOTE: The meter requires PTs for ungrounded 3-wire systems above 690 Volts line-to-line. Volts Mode should be set to Delta.



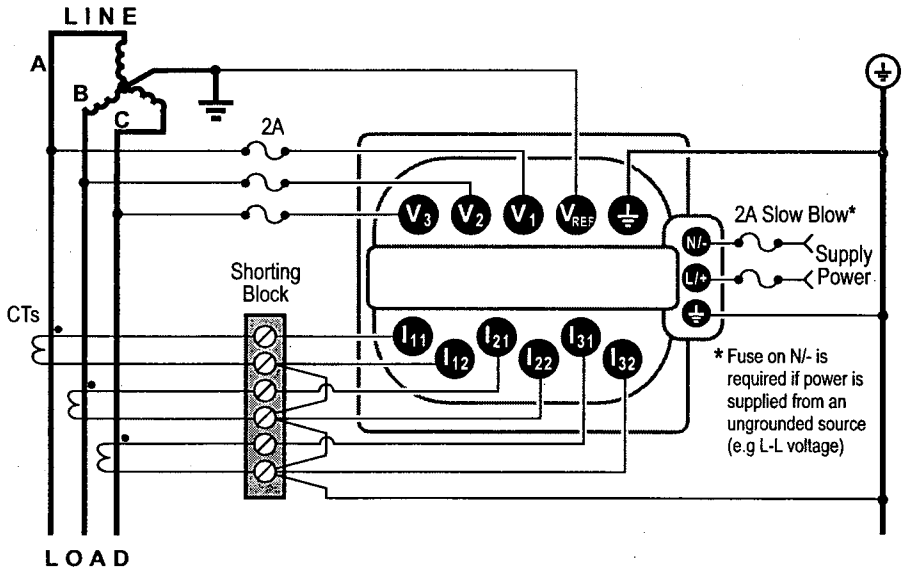
3 Wire Delta Direct Connection

NOTE: Direct Delta connections (with no PTs) are supported for power systems up to 690 Volts line-to-line. Volts Mode must be set to Direct Delta. Vref is not connected.



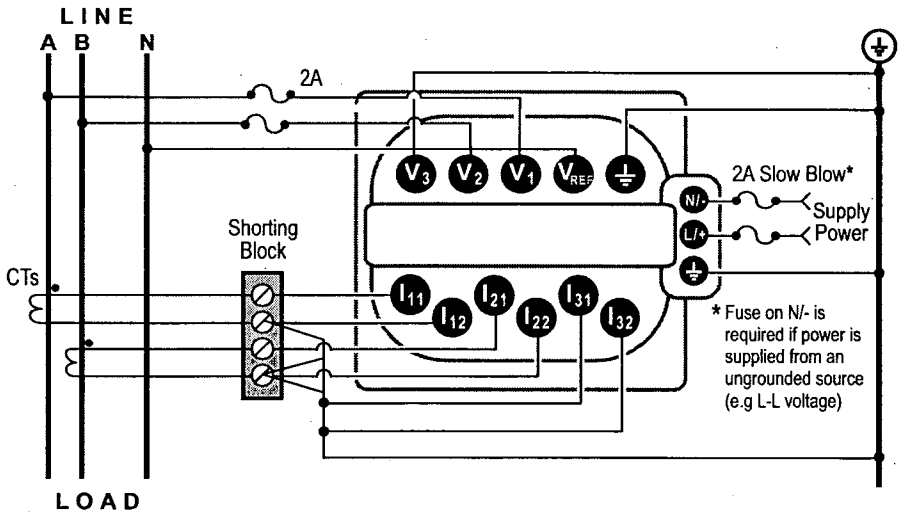
3-Wire Grounded Wye, 3-Element Direct

NOTE: The configuration requires that the transformer secondary star-point is grounded. The phase-to-ground voltages must be within the meter's range. Volts Mode should be set to 4W-Wye.



Single Phase Connection Diagram

NOTE: Connect the two voltage phases (180° apart) to the V1 and V2 inputs, and the CT outputs to the I1 and I2 input pairs. Unused meter inputs are grounded. Volts Mode should be set to Single.



Digital Outputs Connection

Digital outputs can be enabled on the meter with the appropriate Options Card. Refer to "Options Card Combinations" on page 53.

The meter provides two Form A digital relays for energy pulsing applications (kWh, kVARh, and kVAh). By default, port 1 is set to pulse kWh, and port 2 is set to pulse kVARh. The energy pulsing setup can be changed from the front panel, or with software.

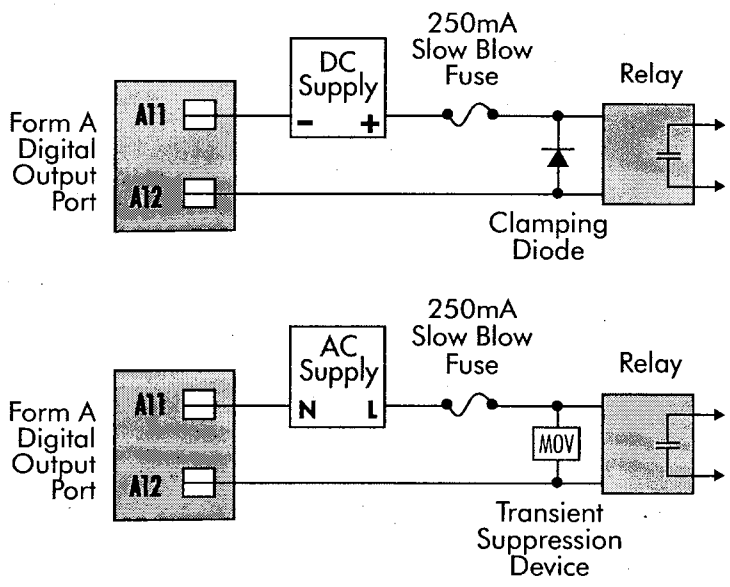
Digital Output Specifications

For Digital Output specifications, refer to page 44.

Form A Digital Output Connection

24 to 16 AWG wire (0.08 mm^2 to 1.3 mm^2) is recommended for both connections. Connections to the terminal strip are shown in the diagram below.

Typical Form A Digital Output Connections



Select an MOV or clamping diode that ensures that the output terminals do not receive a voltage greater than 350 V peak during switching.

Infrared (IR) Pulsing

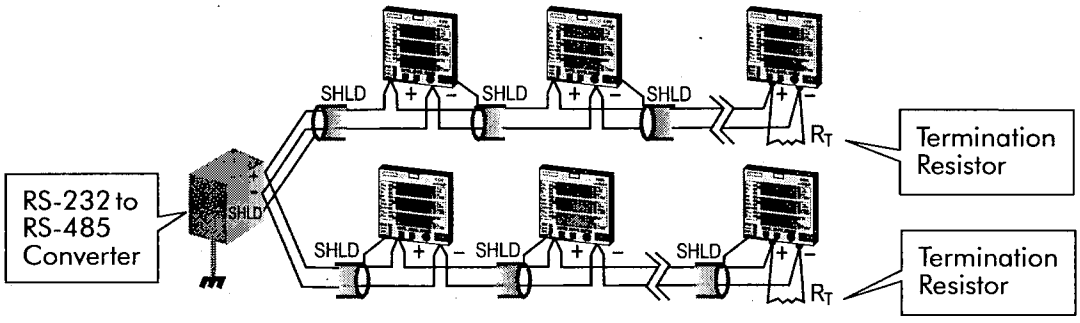
The LED near the top of the meter front panel can be configured to provide energy pulsing (kWh, kVARh, or kVAh).

RS-485 Communications Connections

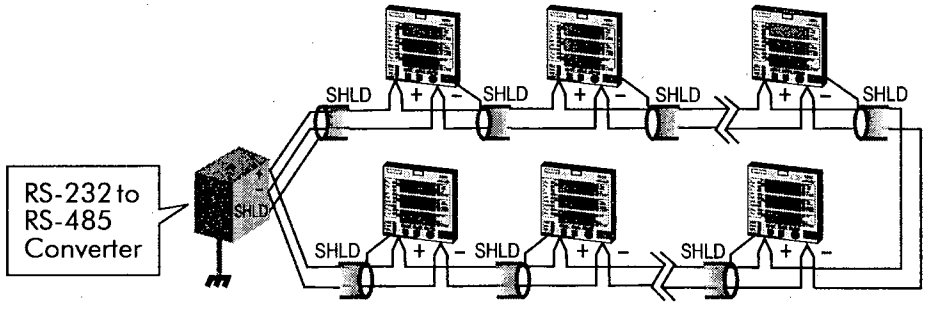
RS-485 communications is standard on the 9200 meter .

RS-485 connections are made via the captured-wire connectors on the meter. Up to 32 devices can be connected on a single RS-485 bus. Use good quality shielded twisted pair RS485 cable, AWG 22 (0.33 mm^2) or larger. The overall length of the RS-485 cable connecting all devices cannot exceed 1219 m (4000 ft). The lengths of all (+ and –) cable segments must be counted including those that connect devices to terminal blocks.

Straight Line Topology



Loop Topology



General Bus Wiring Considerations

Devices connected on the bus, including the meter, converter(s), and other instrumentation can be wired as a straight line or as a loop:

- The shield of each segment of the RS-485 cable must be connected to ground at *one end only.*
- Isolate cables as much as possible from sources of electrical noise.

- Install a ¼ Watt termination resistor (RT) between the (+) and (-) terminals of the device at each end point of a straight-line bus. The resistor should match the nominal impedance of the RS-485 cable (typically 120 ohms – consult the manufacturer's documentation).

> ⚠ **CAUTION**: Do not connect ground to the shield at both ends of a segment. Doing so allows ground loop currents to flow in the shield, passing noise into the communications cable.

RS-485 Connection Methods to Avoid

Any device connection that causes a branch in the main RS-485 bus should be avoided. This includes *star* and *tee* (T) methods. These wiring methods cause signal reflections that may cause interference. **At any connection point on the RS-485 bus, no more than two cables should be connected.** This includes connection points on instruments, converters, and terminal strips.

Dual Purpose RXD/TXD Indicator

Beside the RS-485 connector ⊕ terminal, there is a dual purpose RXD/TXD indicator that flashes red when the meter is transmitting, and green when the meter is receiving data.

Protocol Documents

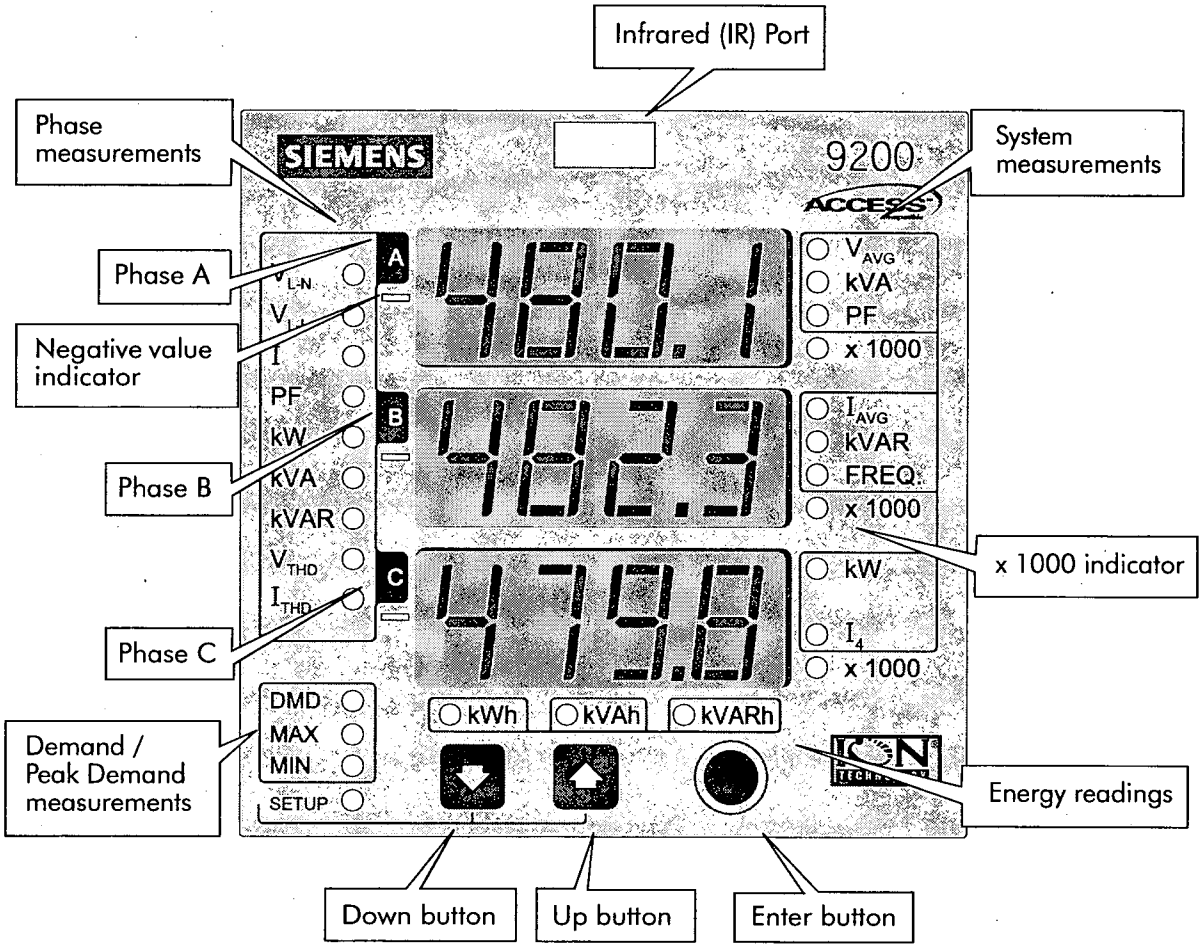
Refer to the *9200/Modbus Register Map* documents for meter protocol implementation details.

Basic Setup

If your meter requires settings other than the factory default settings to communicate with your power monitoring network, then you must set up the meter with the front panel or software. Basic setup determines how the meter interprets the power system it is connected to, as well as how the meter communicates with connected networks or workstations.

For parameter configuration through the front panel, the meter must be in Configuration mode. Refer to "Configuration Mode" on page 31. For meter setting defaults and values refer to "Meter Settings" on page 55.

Front Panel Navigation



With the meter front panel, you can view parameter values; configure parameters; perform demand resets; perform LED checks; and view meter information. Each of these functions can be accomplished by pressing the Up, Down, and Enter buttons on the front panel. These button actions achieve different results according to the mode that the meter is in:

- **Display mode** (default): view parameter measurements
- **Reset mode**: reset demand measurements
- **Configuration Select/Edit modes**: configure a parameter
- **Information mode**: verify that the front panel display LEDs operate, and view meter information, e.g, meter options, firmware version etc.

This section describes front panel navigation within each mode.

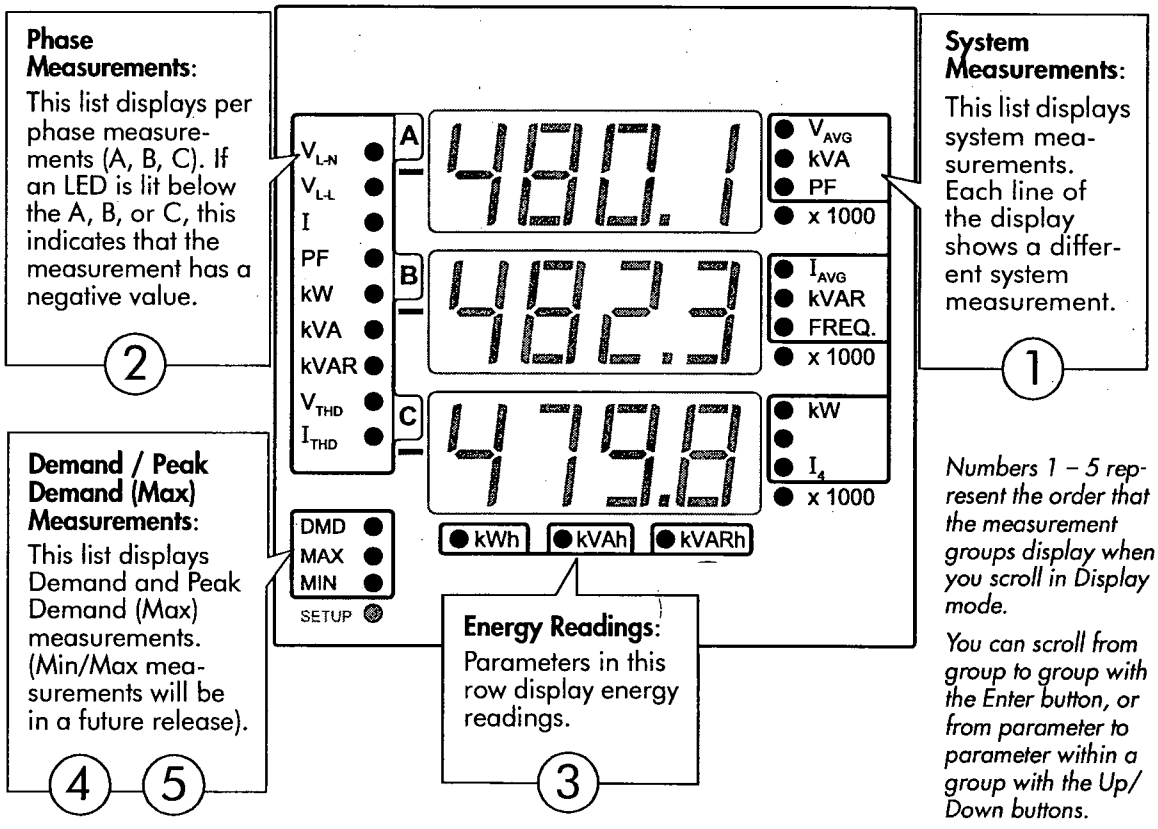
Front Panel Button Functions

UP/DOWN Buttons

ENTER Button

For each mode, a table is included that shows how the buttons function. Three periods following a button (. . .) represent that the pressed button or button combination is held down for 2 seconds.

Display Mode



In Display mode, you can view values from these measurement groups: System (total), Per Phase, Energy, Demand, and Peak Demand. (This assumes that you have ordered Enhanced Measurement Packages 1 and 2. Refer to the "Standard Measurements and Enhanced Packages 1 & 2" on page 54, or the *9200 Options Card Retrofit Instructions* for information regarding Options Cards).

Display Mode Parameter Measurements

The following table lists the parameters in each measurement group:

Measurement Group	Parameters Measured
System (Total)	V_{AVG}, I_{AVG}, kW, kVA, kVAR, PF, Frequency, I4
Phase A, B, and C	V_{LN}, V_{LL}, I, PF, kW, kVA, kVAR, V_{THD}, I_{THD}
Energy	kWh, kVAh, kVARh
Demand*	kVA, kVAR, kW, I_{AVG}
Peak Demand (Max)*	kVA, kVAR, kW, I_{AVG}
Min/Max	Min/Max measurements will be provided in a future release

* Displays system (total) values.

x 1000 Indicator

When the "x 1000" LED is lit, multiply the displayed value by 1000 for the actual value.

Button Functions in Display Mode

The following table shows how the front panel buttons function in Display mode:

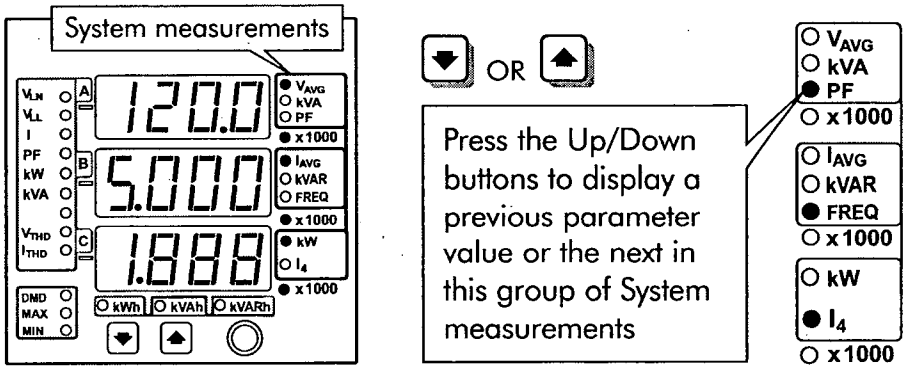
Mode	Button	Function
Display Mode Display mode is the meter default.		View the previous parameter value.
		View the next parameter value.
		Move from one measurement group to the next measurement group.

Viewing Parameter Measurements

The meter defaults to Display mode, and to the System measurements within this mode.

The following illustrates how to view measurements in Display mode.

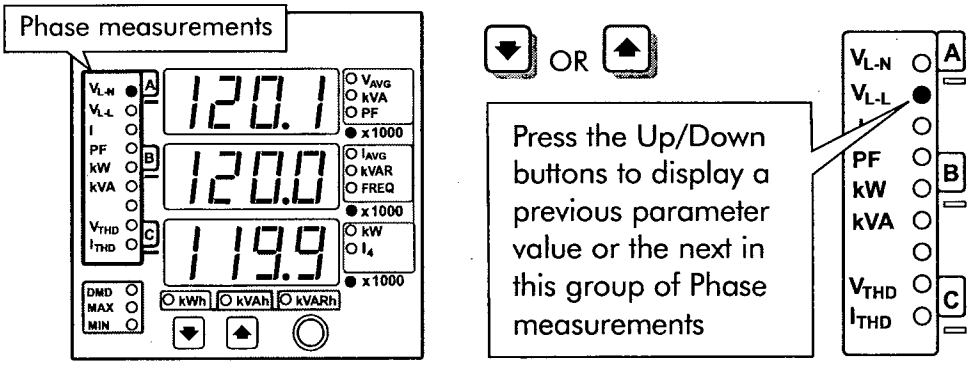
1. System Measurements



Each line of the display shows a System measurement. In the example above, line 1 = System Average Voltage (V_{AVG}) with an actual value* of 120,000; line 2 = System Average Line Current (I_{AVG}) with an actual value of 5,000; line 3 = System Total Active Power (kW) with an actual value of 1,888. (*Actual value = displayed x 1000.)

Press the Enter button to display **Phase** measurements.

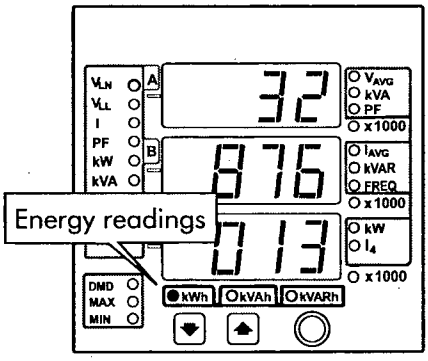
2. Phase Measurements

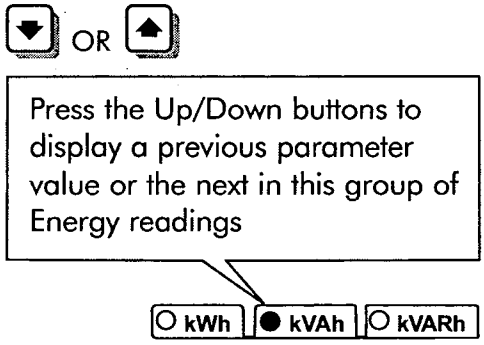


Each line of the display shows a Phase measurement. The example above shows V_{L-N}: Phase A, Phase B, and Phase C on lines 1, 2, and 3 respectively. If the bar-shaped LED below the A, B, or C is lit, then the phase value is negative.

Press the Enter button to display **Energy** readings.

3. Energy Readings

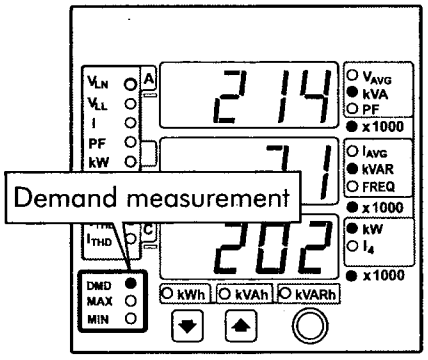


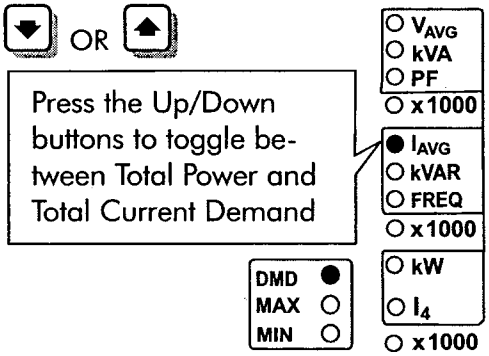


An Energy reading wraps around the three lines of the front panel display. A maximum of three digits appear on each line. The most significant digit is in the left hand corner of the first display line, and the least significant digit is in the bottom right hand corner of the third display line. In the example above, the display shows 32,876,013 kWh.

Press the Enter button to display **Demand** measurements.

4. Demand Measurements

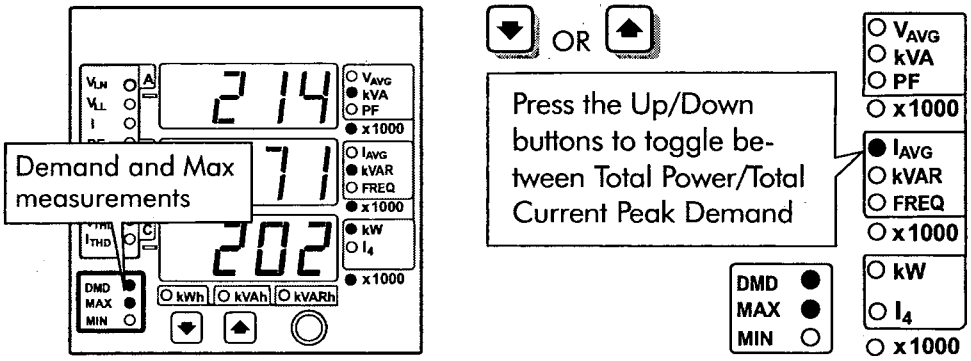




Demand measurements include Total Power Demand and Total Current Demand. The example above shows Total Power Demand for: Apparent Power (kVA); Reactive Power (kVAR) and Real Power (kW).

Press the Enter button to display **Peak Demand** measurements.

5. Peak Demand Measurements



Peak (Max) Demand measurements include Total Power Peak Demand, and Total Current Peak Demand. The example above shows Total Power Peak Demand for: Apparent Power (kVA); Reactive Power (kVAR) and Real Power (kW).

Press the Enter button to return to **System** measurements.

Reset Mode

Enter Reset mode from Display mode (default) by pressing the Enter button and holding for 2 seconds. In Reset mode, you can perform a Current (Peak) Demand reset, or a Power (Peak) Demand reset, or both at the same time.

Screen	String
Current Peak Demand Reset	Curr
Power Peak Demand Reset	PUJr
All	ALL

NOTE: You can perform an Energy Demand reset with software (e.g. WinPM5.0 SP5).

Button Functions in Reset Mode

The following table shows how the front panel buttons function in Reset mode:

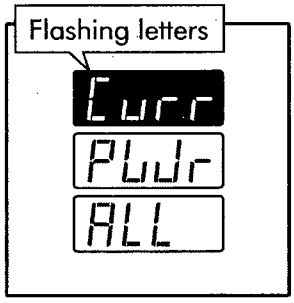
Mode	Button	Function
Reset Mode  ENTER Reset mode by pressing the Enter button and holding for 2 seconds. EXIT Reset mode with the same button sequence.		View the previous reset parameter.
		View the next reset parameter.
		Program the selected (flashing) parameter reset to the meter.

Performing a Demand Reset

The following illustrates how to reset the Current and Power Demand measurements (reset "All").

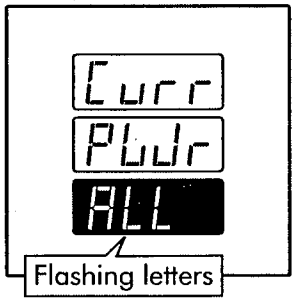
NOTE: If there is no key action or input for 60 seconds during a demand reset, then the meter defaults to Display mode.

1.



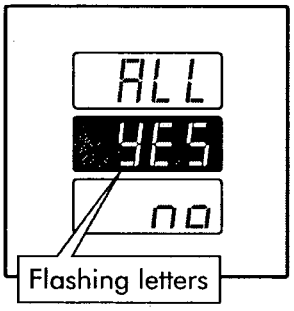
Enter Reset mode:
Press the Enter button and hold for 2 seconds to enter Reset mode from Display mode. The Reset screen appears with the top line letters flashing.

2.



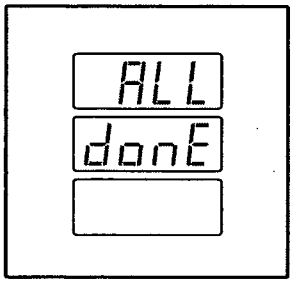
Scroll down to the ALL selection:
Use the Down button to scroll to the third line. The "All" selection flashes.

3.



Initiate the reset:
Press the Enter button to reset All (Current and Power Peak Demand measurements). A confirmation screen with a flashing "Yes" appears.

4.



Confirm the reset:
Press the Enter button to program the reset to the meter. The word "Done" appears on the second line; the third line is blank. After 1 second, the meter defaults to Display mode.

Configuration Mode

> **NOTE:** To learn about the parameters that can be configured, refer to "Meter Settings" on page 55.

Configuration mode is entered when the Up and Down buttons are pressed together and held for 2 seconds. Within Configuration mode, first use the buttons to **locate** the parameter to be edited (Configuration Select mode), then use the buttons to **edit** the displayed parameter (Configuration Edit mode).

Configuration Select mode: locate a displayed parameter that requires editing by pressing the Up or Down button.

Configuration Edit mode: edit a displayed parameter by pressing the Enter button. The parameter digit, value, or decimal point flashes (the meter automatically determines which option to flash for editing, depending on the parameter). With the Up or Down button, you can increase/decrease the digit value, move the decimal point, or select a value from a pre-programmed list. After editing, press the Enter button to set the value.

Refer to following tables to learn how the front panel buttons function in Configuration mode.

Button Functions in Configuration Select Mode

Mode	Button	Function
Configuration Select Mode  ENTER Configuration Select mode by pressing the Up and Down buttons at the same time and holding for 2 seconds. EXIT Configuration Select mode with the same button sequence.		Move to the previous parameter configuration screen.
		Move to the next parameter configuration screen.
		Enter Configuration Edit mode so you can configure the displayed parameter value.

Button Functions in Configuration Edit Mode

Mode	Button	Function
Configuration Edit Mode  ENTER Configuration Edit mode from Configuration Select mode by pressing the Enter button. EXIT Configuration Edit mode by pressing the Up and Down buttons at the same time and holding for 2 seconds. 		**Flashing Digit**: Increase the number. **Flashing Value**: View the previous list value. **Flashing Decimal Point**: Move the decimal point to the right.
		**Flashing Digit**: Decrease the number. **Flashing Value**: Display the next list value. **Flashing Decimal Point**: Move the decimal point to the left.
	 Press and hold for 2 seconds	**Flashing Digit**: Set the new digit value; the digit on the right flashes for editing. **Flashing Decimal Point**: Set the new decimal point location; the digit on the right flashes for editing.
	 Press and hold for 2 seconds	**Flashing Digit**: Set the new digit value; the digit on the left flashes for editing. **Flashing Decimal Point**: Set the new decimal point location; digit on the left flashes for editing.
		Program the edited parameter to the meter; the meter automatically returns to Configuration Select mode.

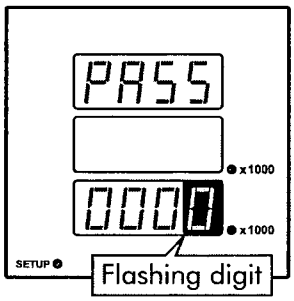
Password Security

A front panel password is required for the first parameter that you configure during an editing session. Once you have entered a valid password, you can configure multiple parameters. The default password is zero.

Example: Entering a Password

In the example below, assume that we are starting an editing session, we are attempting to configure PT1, and that we have been presented with the Password screen. In this example, our password is number 61.

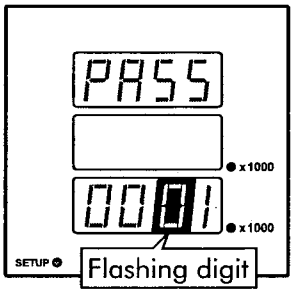
1.



(Press once)

Increment the digit by 1:
Press the Up button once to change the last digit from a zero to a one.

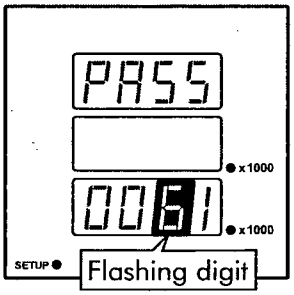
2.



...

Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

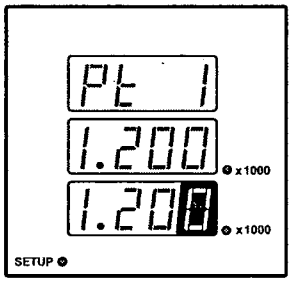
3.



(Press six times)

Increment the digit by 6:
Press the Up button six times to change the digit from a zero to a six.

4.



Send the password to the meter:
Press the Enter button. The password is accepted, and you are returned to the parameter you are configuring (in this example, Pt1).

NOTE: If you enter an incorrect password and send it to the meter, the meter returns to Configuration Select mode, NOT Configuration Edit mode. As a result, you will need to re-select the parameter for editing and re-enter the password.

Example: Configuring PT1 (PT Primary)

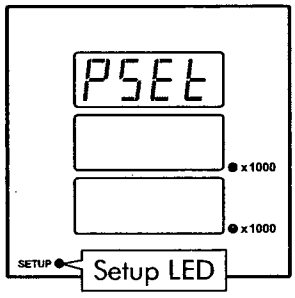
NOTE: If there is no key action or input for 60 seconds, then the meter defaults to Display mode.

In the example below, we will change the value of PT1 from 1,200 to 12,620. The meter displays four digits maximum, so these actual values display as 1.200 and 12.62 with the "x 1000" LED lit on the front panel.

First, we will select the parameter (PT1) to edit. Then, we will confirm the default password, change digit values, and re-locate the decimal point. Finally, we will program the new PT1 value to the meter.

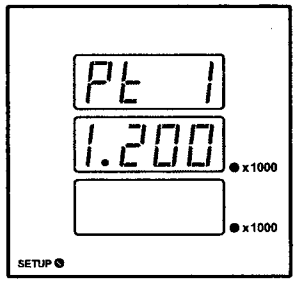
NOTE: You are required to enter a password at the beginning of an editing session. If your password is different from the default "0" you may want to refer to the previous section "Password Security."

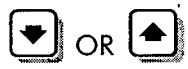
1.



Enter Configuration Select mode:
Press the Up and Down buttons together and hold for 2 seconds to enter Configuration Select mode from Display mode. The Setup LED remains lit in this mode.

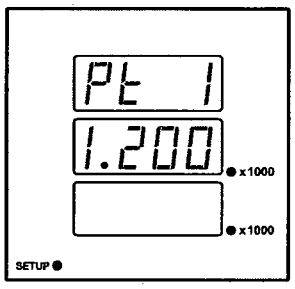
2.





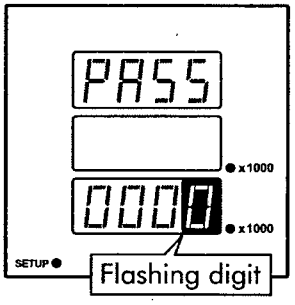
Locate the parameter:
Scroll through the parameter configuration screens with the Up or Down buttons until you locate the parameter you wish to edit (e.g. Pt1).

3.



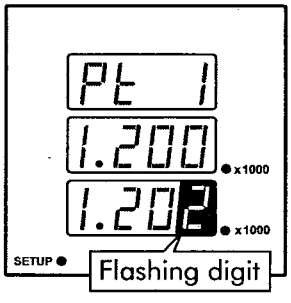
Initiate the edit (Configuration Edit mode):
Press the Enter button to edit the displayed parameter (Pt1). If this is the first edit of a configuration session, the Password screen appears; otherwise proceed to step 5.

4.



Confirm the password
Press the Enter button to send the default password (0) to the meter (or enter and send your facility password). The Pt1 screen appears with the last digit flashing.

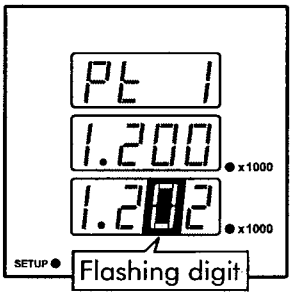
5.



(Press twice)

Increment the digit by 2:
Press the Up button twice to change the last digit from a zero to a two.

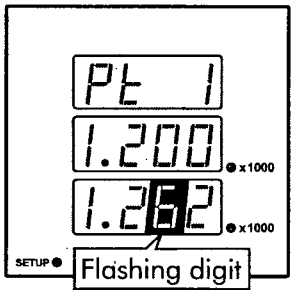
6.



...

Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

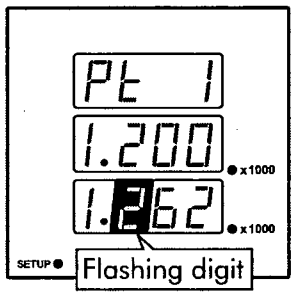
7.



(Press six times)

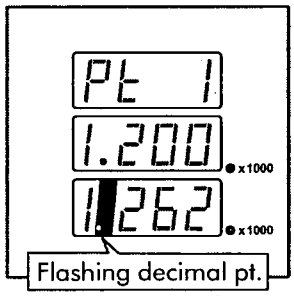
Increment the digit by 6:
Press the Up button six times to change the flashing digit from a zero to a six.

8.



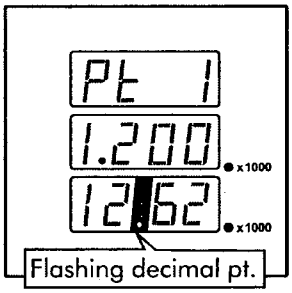
Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

9.



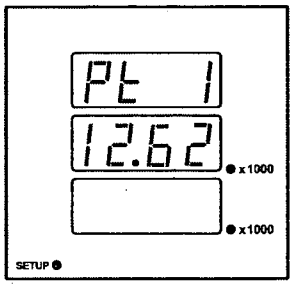
Move to the decimal point:
Press the Down button and hold for 2 seconds. The decimal point flashes for editing.

10.



Re-locate the decimal point:
Press the Up button to move the decimal point to the right. (The Down button moves it to the left).

11.



Program the Pt1 value to the meter:
Press the Enter button. The new Pt1 value displays on the second line; the third line is blank. This indicates that the new Pt1 value is programmed to the meter.

NOTE: If you attempt to configure a parameter with a number that is out of its range, the meter will not accept that number.

Meter Settings

To learn about configurable meter settings, value ranges, and defaults, refer to "Meter Settings" on page 55.

Information Mode

Enter Information mode from Display mode (default) by pressing the Enter, the Up, and the Down buttons together and holding for 2 seconds. In this mode, you can verify that the front panel LEDs operate, and view meter information e.g. firmware version etc.

Verifying that the LEDs and Display Function

When you enter Information mode, every LED on the front panel lights, and each line of the display flashes with four number eights and four decimal points per line. This lasts 3 seconds, and indicates that the front panel LEDs and display are operating.

Information Mode Screens

The following table lists the four Information mode screens:

Screen	String
Manufacturer ID Number	No string; area is used for the meter manufacturer/serial number.
Firmware Version	FWVr
Original Equipment Manufacturer (OEM)	OEM1
Meter Options (e.g. enhanced measurements, digital outputs, communications)	OPt

Button Functions in Information Mode

The following table shows how the front panel buttons function in Information mode:

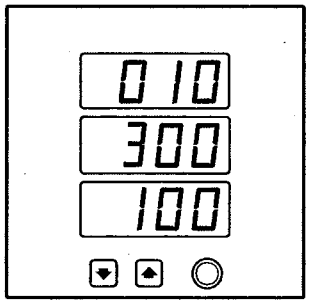
Mode	Button	Function
Information Mode  ENTER Information mode by pressing the Enter, Up and Down buttons together and holding for 2 seconds. EXIT Information mode with the same button sequence.		Move to the previous Information mode screen.
		Move to the next Information mode screen.

Viewing Meter Information

After the LED and display operation verification is completed, the meter automatically displays the first of four screens that provide meter information. Press the Up or Down buttons to scroll through these screens.

NOTE: You have 60 seconds to move from one Information screen to another. After 60 seconds, the front panel defaults to Display mode.

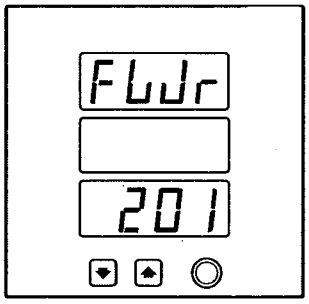
1. Manufacturer ID



This screen displays the Manufacturer ID (serial) number.

Press the Down button to display meter firmware version or the Up button to display the previous screen.

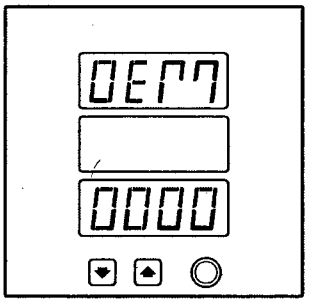
2. Firmware Version



This screen displays the meter firmware version.

Press the Down button to display the OEM identifier, or the Up button to display the previous screen.

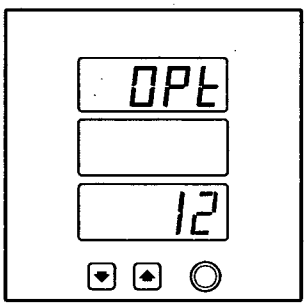
3. OEM



This screen displays the Original Equipment Manufacturer (OEM) identifier.

Press the Down button to display the Options Code or the Up button to display the previous screen.

4. Options Code



This screen displays the Options Card options code.

Press the Down button to display the Manufacturer ID or the Up button to display the previous screen.

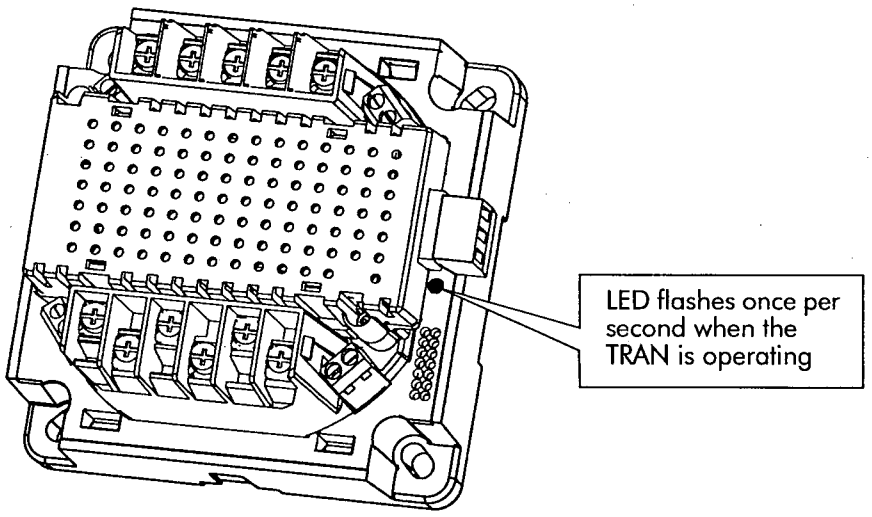
OR

Refer to the table "Options Card Combinations" on page 53 to learn about options codes, and how they relate to product codes.

Verifying Meter Operation

To verify the Integrated model operation, ensure that the meter is receiving power, and that the display shows meaningful values.

To verify the TRAN model operation, ensure that the meter is receiving power, and that the LED located below the 3-position power supply connector flashes once per second. Refer to the diagram below.



Appendix A: Specifications

The following specifications are subject to change without notice.

Standards Compliance

UL	Certified to UL 3111 Certified to CAN/USA C22.2 No. 1010-1
International	IEC 61010-1
	Measuring inputs comply with Installation Category III
	Power supply inputs comply with Installation Category II
	Device operable under Pollution Degree II
Surge Withstand	All inputs pass ANSI/IEEE C37.90-1989 surge withstand and fast transient tests
FCC	Part 15 of FCC Rules for a Class A Digital Device
CE	Marked

Category	**Standards Compliance**
Safety/ Construction	IEC1010-1 (EN61010-1): Safety requirements for electrical equipment for measurement, control and laboratory use
	CAN-CSA C22.2 No 1010-1: Canadian Standards. Listed by Underwriters Laboratories (UL).
	UL 3111-1: Measuring, Testing and Signal Generation Equipment. Listed by Underwriters Laboratories (UL).
IEC Compliance	IEC 60687-1992 0.5S* * Only the Accuracy Measurement Specifications comply with this rating
Enclosure Mounting	Integrated model: DIN (92 mm x 92 mm cutout) ANSI 4" cutout
	TRAN model: Flush mounted (has four slots in an ANSI 4" bolt pattern) DIN rail, European Standard EN50022:1977

Category	Standards Compliance
Electromagnetic Immunity	IEEE C.37-90.1-1989: IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI)
	IEC1000-4-2 (EN61000-4-2/IEC801-2): Electrostatic Discharge (B)
	IEC1000-4-3 (EN61000-4-3/IEC801-3): Radiated EM Field Immunitiy (A)
	IEC1000-4-4 (EN61000-4-4/IEC801-4): Electric Fast Transient (B)
	IEC1000-4-5 (EN61000-4-5/IEC801-5): Surge Immunity (B)
	IEC1000-4-6 (EN61000-4-6/IEC801-6): Conducted Immunity
	IEC1000-3-2 (EN61000-3-2): Limits for harmonic currents emissions (equipment input current < 16 amps per phase)
	IEC1000-3-3 (EN61000-3-3): Limitation of voltage fluctuations and flicker in low voltage supply systems for equipment with rated current < 16 amps
	IEC 61000-6-2: Electromagnetic Compatibility, Immunity for industrial environments
Electromagnetic Emission	FCC Part 15 Subpart B, Class A: Class A Digital Device, Radiated Emissions. Certified by Acme Testing Inc.
	EN55011 (CISPR 11): Radiated/Conducted Emissions (Group 1, Class A)
	EN50081-2: Electromagnetic Compatibility, emissions

c UL us

Certified to UL 3111
and CAN/CSA C22.2
No.1010-1

CE

Quality Assurance

ISO 9002-1994
Registration Cert# 002188

ISO 9000 ISO 9002 certified by QMI

Environmental

Temperature

Base Unit:	Operation: -20° C to 70° C ambient air (no ice formation) Storage: -40° C to +85° C

Humidity

Base Unit and Display Unit:	5% to 95% non-condensing

IP, NEMA Rating

When the integrated display unit or the RMD unit is mounted flush to a panel with the supplied gasket, then the front side meets **NEMA type 4, 4x and 5** (according to NEMA standards 1-10-1979 and 5-25-1988) and meets **IP 543.**

Meter Enclosure

Impact resistant, high strength polycarbonate HBS blend plastic

Input Ratings

Voltage Inputs

Inputs:	V1, V2, V3, Vref
Rated Input:	60 – 400 LN (103.5 – 690 LL) VAC RMS (three phase) 60 – 400 LN VAC (single phase) Installation category III (Distribution). Pollution degree 2.
Overload:	1500 VAC RMS continuous
Dielectric Withstand:	> 3250 VAC RMS, 60 Hz for 1 minute
Impedance:	2 Mohm/phase

Current Inputs

Inputs:	I1, I2, I3
Rated Inputs:	5 A RMS (+ 20% maximum, 300 Vrms to ground) Installation category III (Distribution). Pollution degree 2.
Overload:	120 A RMS for 1 second, non-recurring
Dielectric Withstand:	3000 V RMS, for 1 minute
Starting Current:	0.005 A RMS
Burden:	0.05 VA (typical) @ 5 A RMS

Power Supply

Standard AC/DC Power Supply

Rated Inputs:	AC: 100 – 240 VAC (± 10%), 50 – 60 Hz DC: 110 – 300 VDC (± 10%) Installation category II (Local). Pollution degree 2.
Dielectric Withstand:	2000 VAC RMS, 60 Hz for 1 minute
Burden:	30 VA typical, 50 VA maximum, 15 W maximum

Low Voltage DC Power Supply Option

Rated Inputs:	20 – 60 VDC (± 10%)
Burden:	6 W typical, 12 W maximum

I/O Specifications

Digital Outputs

2 optically isolated digital outputs for KY pulsing
Maximum forward current: 100 mA
Maximum voltage: 200 VAC/DC

RS-485 Input

Input is optically isolated

Measurement Specifications

Parameter	Accuracy ±(%rdg)*	Range
Voltage (L-N)	0.3%	0 to $1x10^6$ V
Voltage (L-L)	0.5%	0 to $1x10^6$ V
Voltage (L-L Delta)	0.8%	0 to $1x10^6$ V
Frequency	0.1%	47 – 63 Hz
Current (I1, I2, I3)	0.3%	0 to $1x10^6$ A
Current (I4 Derivation)	0.6%	0 to $1x10^6$ A
kW, kVAR, kVA	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
kWh, kVARh, kVAh	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
kW, kVA demands	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
Power Factor @ Utility PF	1.0%	-0.01 to –100 and .0001 to 0.01
THD	1.0%	0.1 to 100

* Measurement specifications at 50Hz or 60Hz and 25°C (77°F)
** Complies with the accuracy requirements of IEC 687 class 0.5

Appendix B: Communications

This section describes the Modbus communications protocol employed by a 9200 meter in a Modbus network. It is assumed that the user is familiar with serial communications in general, and the Modbus protocol. Refer to the document *9200 Modbus Protocol* for more information.

Modbus Address Table

In the following Modbus map, many numeric measurements are scaled. Scaling is either fixed or programmable.

For an example of fixed scaling, suppose that the frequency register 40115 contains the value 5987. Since this register is scaled by "x100" the actual measured value is 59.87 Hz.

For an example of programmable scaling, suppose the "Vln a" register 40100 contains the value 4801. Note that the factory default scaling factor is "x10" so the resulting measured value is 480.1 V. If the programmable voltage scale (PVS) is reprogrammed to 0.1, then the resulting measured value is 48,010 V. The meter supports programmable scaling for voltage (PVS), current (PCS), neutral current (PnS), and power (PPS).

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40001	manufacturer's ID	UINT32	x1		See note 1.
40003	firmware revision	UINT16	x1		
40004	oem ID	UINT16	x1		See note 2.
40005	meter options	UINT32	x1		See note 3.
40007	# meter power ups	UINT16	x1		
40008	# peak demand resets	UINT16	x1		
40009	meter on-time	UINT32	x1		See note 4.
40011	# flash erase cycles	UINT32	x1		
40013	device type	UINT16	x1		See note 5.
40014	Reserved	UINT16			
	Reserved				
40100	Vln a	UINT16	PVS	x10	See note 6.
40101	Vln b	UINT16	PVS	x10	
40102	Vln c	UINT16	PVS	x10	
40103	Vln avg	UINT16	PVS	x10	
40104	Vll ab	UINT16	PVS	x10	
40105	Vll bc	UINT16	PVS	x10	
40106	Vll ca	UINT16	PVS	x10	
40107	Vll avg	UINT16	PVS	x10	
40108	I a	UINT16	PCS	x10	See note 7.
40109	I b	UINT16	PCS	x10	
40110	I c	UINT16	PCS	x10	
40111	I avg	UINT16	PCS	x10	
40112	I demand	UINT16	PCS	x10	
40113	I peak demand	UINT16	PCS	x10	
40114	I4	UINT16	PnS	x10	See note 8.
40115	Frequency	INT16	x100		
40116	PF sign total	INT16	x100		
40117	PF sign a	INT16	x100		
40118	PF sign b	INT16	x100		
40119	PF sign c	INT16	x100		
40120	kW total	INT16	PPS	x1	See note 9.
40121	kVAR total	INT16	PPS	x1	
40122	kVA total	INT16	PPS	x1	
40123	kW a	INT16	PPS	x1	
40124	kW b	INT16	PPS	x1	

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40125	kW c	INT16	PPS	x1	
40126	kVAR a	INT16	PPS	x1	
40127	kVAR b	INT16	PPS	x1	
40128	kVAR c	INT16	PPS	x1	
40129	kVA a	INT16	PPS	x1	
40130	kVA b	INT16	PPS	x1	
40131	kVA c	INT16	PPS	x1	
40132	kW demand	INT16	PPS	x1	
40133	kW peak demand	INT16	PPS	x1	
40134	kVAR demand	INT16	PPS	x1	
40135	kVA demand	INT16	PPS	x1	
40136	kVAR peak demand	INT16	PPS	x1	
40137	kVA peak demand	INT16	PPS	x1	
40138	kWh del	UINT32	x1		
40140	kWh rec	UINT32	x1		
40142	kVARh del	UINT32	x1		
40144	kVARh rec	UINT32	x1		
40146	kVAh del+rec	UINT32	x1		
40148	V1 THD	UINT16	x10		
40149	V2 THD	UINT16	x10		
40150	V3 THD	UINT16	x10		
40151	I1 THD	UINT16	x10		
40152	I2 THD	UINT16	x10		
40153	I3 THD	UINT16	x10		
40154	I a demand	UINT16	PCS	x10	
40155	I b demand	UINT16	PCS	x10	
40156	I c demand	UINT16	PCS	x10	
40157	I a peak demand	UINT16	PCS	x10	
40158	I b peak demand	UINT16	PCS	x10	
40159	I c peak demand	UINT16	PCS	x10	
40160	kWh a del	UINT32	x1		
40162	kWh b del	UINT32	x1		
40164	kWh c del	UINT32	x1		
40166	kWh a rec	UINT32	x1		
40168	kWh b rec	UINT32	x1		
40170	kWh c rec	UINT32	x1		
	Reserved				

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40500	Expansion, SnapOn 1, 25 regs	UINT16	x1		
40700	Expansion, SnapOn 2, 25 regs	UINT16	x1		

Read-Write Configuration Map

Modbus Addr	Meter Configuration	Format	Scale	Default	Description
44000	Configuration via display password	UINT16	x1	0	0 – 9999
44001	Volts Mode	Enumerated (See "Enumerated Setup" on page 52)		5 = Delta direct	0 = 4W (4-Wire WYE) 1 = dELt (Delta) 2 = 2W (Single Phase) 3 = dEM (Demonstration) 4 = 3W (3-Wire WYE) 5 = dELd (Delta direct)
44002	PT Primary	UINT16	x1	480	1 – 65535
44003	PT Secondary	UINT16	x1	480	
44004	CT Primary	UINT16	x1	400	
44005	CT Secondary	UINT16	x1	5	
44006	V1 Polarity	Enumerated (See "Enumerated Setup" on page 52)		0 = Normal	0 = nor (Normal) 1 = inv (Inverted)
44007	V2 Polarity				
44008	V3 Polarity				
44009	I1 Polarity				
44010	I2 Polarity				
44011	I3 Polarity				
44012	Programmable Voltage Scale (PVS)	Enumerated (See "Enumerated Setup" on page 52)		4 = 10	0 = 0.001 1 = 0.01 2 = 0.1 3 = 1 4 = 10 5 = 100 6 = 1000
44013	Programmable Current Scale (PIS)				
44014	Programmable Neutral Current Scale (PnS)				
44015	Programmable Power Scale (PPS)			1 = 0.01	
44016	Demand Sub Interval	UINT16	x1	15	1 – 60 minutes
44017	Demand #Sub Intervals	UINT16	x1	1	1 – 5

Modbus Addr	Meter Configuration	Format	Scale	Default	Description
44018	Kt, Digital Output #1	UINT16	x10	1.0	0.1 - 999.9
44019	Kt, Digital Output #2	UINT16	x10		
44020	Kt, Irda	UINT16	x10		
44021	Output Mode, Digital Output #1	Enumerated (See "Enumerated Setup" on page 52)		0 = kWh	0 = kWh 1 = kVAh 2 = kVARh 3 = Ext1 4 = Ext2 See note 10.
44022	Output Mode, Digital Output #2			2 = kVARh	
44023	Output Mode, Irda			3 = Ext1	
44024	Baud Rate	Enumerated (See "Enumerated Setup" on page 52)		3 = 9600bps	0 = 1200bps 1 = 2400bps 2 = 4800bps 3 = 9600bps 4 = 19200bps
44025	Protocol	Enumerated (See "Enumerated Setup" on page 52)		1 = MODBUS	0 = PML 1 = MODBUS See note 11.
44026	Unit ID	UINT16	x1	100 plus the last 2 digits of the Man. ID #	1 – 247
44027	RTS Delay	UINT16	x1	20	0 – 1000 milliseconds See note 12.
44028	Display Scroll Time	UINT16	x1	0	0 – 30 seconds See note 13.
44029	Display Refresh Period	UINT16	x1	2	1 – 6 seconds See note 14.

Read-Write Control Map

Modbus Addr[15]	Meter Control	Format	Scale	Description
42001	Energy Reset	UINT16	x1	Reset kWh, kVAh, and kVARh to 0.
42002	Peak Power Demand Reset	UINT16	x1	Reset kW, kVA, and kVAR peak demand to 0.
42003	Peak Current Demand Reset	UINT16	x1	Reset I peak demand.
42004	Digital Output #1	UINT16	x1	Refer to "Digital Output Control" on page 52.
42005	Digital Output #2	UINT16	x1	

Notes

1. Manufacturer's identification is the serial number of the meter. It has the format of the YYMM##### where YY and MM represent the manufacture date.
2. Identifies the Original Equipment Manufacturer (OEM).
3. Options codes that identify meter options. See "Options Card Combinations" on page 53.
4. Number of seconds that the meter has been powered up.
5. Device identification.
6. PVS = Programmable Voltage Scale.
7. PCS = Programmable Current Scale.
8. PnS = Programmable Neutral Current Scale.
9. PPS = Programmable Power Scale.
10. Digital output modes are: kW pulsing, kVAR pulsing, kVA pulsing, and manual control.
11. The RTS Delay parameter defines the delay between the 9200 becoming ready to transmit data on the serial port, and the 9200 transmitting the data.
12. Number of seconds that a display is shown before scrolling to the next, 0 = no scrolling (disabled).
13. Number of seconds that a measurement value is held on the display before being refreshed; limited to 1-6 seconds.
14. To use the Read-Write Control Map, it is recommended that your meter has firmware version 202 or later. For detailed information, contact Technical Services.

Modbus Data Formats

The 9200 meter supports Modbus Holding registers (address range 4xxxx). There are three types of parameters:

- Metered Parameters
- External Control/Reset Parameters
- Setup Parameters
  - Enumerated Setup Parameters
  - Numeric Bounded Parameters

Metered Parameters

All the values measured by the meter are available through the Modbus protocol. Most of these parameters have fixed scaling. However, the scaling of voltage, current and power values is configurable via a numeric setup register.

There are three blocks. Factory registers such as serial number, firmware revision, etc. are located between addresses 40001 and 40099. Measured quantities such as voltage, current, power and energy are located between addresses 40100 and 40499. The register addresses for the first Feature Pack start at 40500; the register addresses for the second Feature Pack start at 40600. Consult the Feature Pack documentation for the contents of these registers.

The meter supports 4 data formats:

- Unsigned 16-bit Integer Format
- Signed 16-bit Integer Format
- Unsigned 32-bit Integer Format
- Signed 32-bit Integer Format

16-bit Integer Format

Unsigned and Signed 16-bit Integer Formats are the simplest formats. If the format is unsigned the value range for the output registers is 0 to 65535. If the format is signed, the value range is -32767 to +32767 (two's-complement).

32-bit Integer Format

To accommodate values that can reach beyond the 16-bit limitation, the 9200 provides 32-bit integer format. In Signed and Unsigned 32-bit Integer Formats, the 32-bit value is split into two consecutive 16-bit registers. The first register is the low-order word and the second register is the high-order word.

To interpret the value, take the second register (high-order word) and multiply by 65536. Then add the first register (low-order word). The formula is:

value = (second register x 65536) + first register

In Unsigned 32-bit Integer Format, both the high-order and low-order registers are unsigned 16-bit integers.

Example

Value 12345678 is passed in *unsigned* 32-bit integer format:

12345678 = 00BC614E Hex
First Register = 614E Hex (unsigned) = 24910
Second Register = 00BC Hex (unsigned) = 188
value = (188 x 65536) + 24910 = 12345678

In Signed 32-bit Integer Format, the high-order register is a signed 16-bit number, but the low-order register is unsigned.

Example

Value -12345678 is passed in *signed* 32-bit integer format:

-12345678 = FF439EB2 Hex
First Register = 9EB2 Hex (unsigned) = 40626
Second Register = FF43 Hex (signed) = -189
value = (-189 x 65536) + 40626 = -12345678

Control Parameters

There are two types of control parameters in the meter which can be accessed via Modbus: Digital Output Control and Accumulation Reset registers. This section describes how the parameters appear to the Modbus protocol.

Digital Output Control

Registers 42004 and 42005 are available to remotely control the meter's digital outputs. A non-zero value written to these registers places the corresponding digital output in an asserted state. Conversely, a logic zero written to one of these registers de-asserts the output. To use the Read-Write Control Map, it is recommended that your 9200 meter has firmware version 202 or later.

Reset Accumulation

Registers 42001 to 42003 are available to remotely reset energy accumulation and maximum demand values. Writing any value to one of these registers causes the corresponding parameter to reset. If read, these registers will return an error.

Setup Parameters

Meters can be configured remotely via Modbus communications. Registers 4400 to 44029 offer enumerated or numeric parameters.

Enumerated Setup

Enumerated registers are used where a list of options are available. For example, the Volts Mode register has five options: 4W-WYE, DELTA, SINGLE, DEMO, 3W-WYE and DELTA DIRECT. These options are represented by a numeric relationship; for example, the following relationship is defined for the Volts Mode register:

0 = 4W-WYE
1 = DELTA
2 = SINGLE
3 = DEMO
4 = 3W-WYE
5= DELTA DIRECT

Numeric Setup

The numeric setup parameters include: PT/CT ratios, demand intervals, digital output pulse values, unit ID, password, and RTS delay.

All 9200 numeric parameters are represented in Unsigned 16-bit Integer Format. See the register map for details. Note that all parameters have bounds. For example, unit IDs must be in the range 1 to 247; any attempt to write a value outside this range will fail.

Exception Responses

If a Modbus master device sends an invalid command to a meter or attempts to read an invalid holding register, an exception response is generated. The exception response follows the standard packet format. The high order bit of the function code in an exception response is set to 1. The data field of an exception response contains the exception error code. Refer to the table below.

Code	Name	Meaning
01	Illegal Function	An invalid command is contained in the function field of the request packet. The meter only supports Modbus functions 3 and 16.
02	Illegal Address	The address referenced in the data field is an invalid address for the specified function. This could also indicate that the registers requested are not within the valid register range of the meter.
03	Illegal Value	The value referenced in the data field is not allowed for the referenced register on the meter.

Appendix C: Configuration Reference Tables

Options Card Combinations

This table describes Options Card feature sets, and the information on the Options Code screen. Refer to "Viewing Meter Information" on page 39.

Options Code	Part # Suffix	Description
7	A0AN	Standard Measurements, RS-485
8	A0AP	Enhanced Package #1, RS-485
9	A0AR	Enhanced Package #2, RS-485
10	A0BN	Standard Measurements, two pulse outputs, RS-485
11	A0BP	Enhanced Package #1, two pulse outputs, RS-485
12	A0BR	Enhanced Package #2, two pulse outputs, RS-485

Standard Measurements and Enhanced Packages 1 & 2

Stnd	EP1	EP2	Parameter	Displays	Pulses	Comms
●	●	●	Volts L-N Per Phase	●		●
●	●	●	Volts L-L Per Phase	●		●
●	●	●	Volts L-N Avg	●		●
●	●	●	Volts L-L Avg	●		●
●	●	●	Amps Per Phase	●		●
●	●	●	Amps Avg	●		●
	●	●	Power Peak Demand (W)	●		●
	●	●	Energy Del. (Imp.) (Wh)	●	●	●
	●	●	Energy Rec. (Exp.) (Wh)			●
		●	Energy Del. Per Phase (Imp.) (Wh)			●
		●	Energy Rec. Per Phase (Exp.) (Wh)			●
	●	●	Power Total (W)	●		●
	●	●	Frequency	●		●
	●	●	Power Factor Total	●		●
	●	●	Amps Avg. Demand	●		●
	●	●	Amps Demand Per Phase			●
	●	●	Amps Avg. Peak Demand	●		●
	●	●	Amps Peak Demand Per Phase			●
	●	●	Amps Neutral (I4)	●		●
		●	Power Factor Per Phase	●		●
		●	Power Per Phase (W)	●		●
		●	Reactive Energy Del. (Imp.) (VARh)	●	●	●
		●	Reactive Energy Rec. (Exp.) (VARh)			●
		●	Apparent Energy (VAh)	●	●	●
		●	Reactive Power Total (VAR)	●		●
		●	Apparent Power Total (VA)	●		●
		●	Reactive Power Per Phase (VAR)	●		●
		●	Apparent Power Per Phase (VA)	●		●
		●	Power Demand (W)	●		●
		●	Reactive Power Demand (VAR)	●		●
		●	Apparent Power Demand (VA)	●		●
		●	Reactive Power Peak Demand (VAR)	●		●
		●	Apparent Power Peak Demand (VA)	●		●
		●	THD Voltage Per Phase	●		●
		●	THD Current Per Phase	●		●

Meter Settings

These settings can be configured with the meter front panel or software.

	String	Description	Range (Values)	Default
MODE	tYPE	Volts Mode	4W (4-Wire WYE) dELt (Delta) 2W (Single Phase) dEM (Demonstration) 3W (3-Wire WYE) dELd (Delta direct)	Delta direct
PTs	Pt 1	PT1 (Primary)	1 to (65.53 x 1000 LED)	480
	Pt2	PT2 (Secondary)	1 to (65.53 x 1000 LED)	480
CTs	Ct 1	CT1 (Primary)	1 to (65.53 x 1000 LED)	400
	Ct2	CT2 (Secondary)	1 to (65.53 x 1000 LED)	5
POLARITY	UPL 1	V1 Polarity (Phase 1 voltage polarity)	nor(Normal); inv(Inverted)	Normal
	UPL2	V2 Polarity (Phase 2 voltage polarity)	nor (Normal); inv (Inverted)	Normal
	UPL3	V3 Polarity (Phase 3 voltage polarity)	nor (Normal); inv (Inverted)	Normal
	CPL 1	I1 Polarity (Phase 1 current polarity)	nor (Normal); inv (Inverted)	Normal
	CPL2	I2 Polarity (Phase 2 current polarity)	nor (Normal; inv (Inverted)	Normal
	CPL3	I3 Polarity (Phase 3 current polarity)	nor (Normal); inv (Inverted)	Normal
DEMAND	dPr	Demand Sub Interval	1 – 60 min	15
	ndPr	Number of Demand Periods	1 – 5	1
COMMUNICATIONS	Prot	Protocol	PML†; Mod (Modbus RTU)	Modbus
	bAud	Baud Rate	1200, 2400, 4800, 9600, 19200	9600
	un id	Unit ID	1 – 247	100 plus the last 2 digits of the Manu-facturer ID #
	rtS	RTS Delay	0 – 1000 milliseconds	20

	String	Description	Range (Values)	Default
MODBUS SCALING	PUS	Voltage Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
	PCS	Current Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
	PPS	Power Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	1
	PnS	Neutral Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
DIGITAL OUTPUTS	out 1	Output Mode Digital #1	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	Wh
	tc 1	Time Constant 1 (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
	out2	Output Mode Digital #2	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	VARh
	tc2	Time Constant 2 (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
	otIr	Output Mode, Irda	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	Ext 1
	tcIr	Time Constant Irda (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
DISPLAY	dScr	Display Scroll Time	0 – 30 seconds (0 = disable)	0
	dUPd	Display Refresh Period	1 – 6 seconds	2
SECURITY	PSEt	Password	0 – 9999	0

Notes

Programmable Meter Language (PML) Protocol

† ION compatible protocol for use with an WinPM.Net system and other ACCESS meters.

Digital Outputs

* The units displayed on the front panel are Wh, VAh, and VARh with the "x 1000" LED lit. These indicate kWh, kVAh, and kVARh respectively.

** In Ext 1 or Ext 2 mode, the digital pulse outputs are reserved for Feature Packs.

†† Time Constant, sometimes called kT, is the number of units (kWh, kVAh, kVARh) per output transition. The digital output uses KY pulsing. This means that the relay changes from open to closed or from closed to open whenever kT units have been measured (20 transitions/second maximum).

Siemens Energy & Automation, Inc.
Power Management Technologies
3333 Old Milton Parkway
Alpharetta, GA 30005

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O & M Manuals SECTION COVER SHEET

JOB

SPRING CREEK WELL 7

SECTION: **Transformers**

CONTENTS:

Total Pages this Section: 3

O & M Manuals

ENGINEER: N/A

CONTRACTOR: N/A

DISTRIBUTOR: REXEL PACIFIC

DATE: 6/6/06

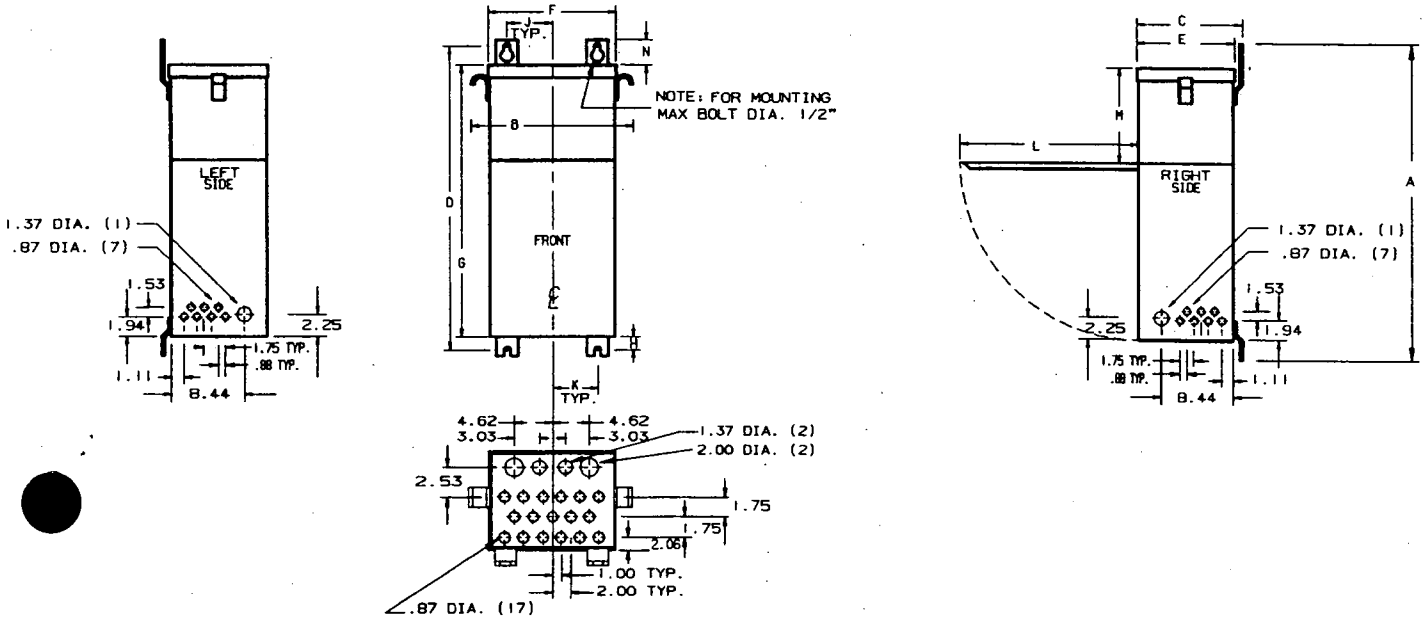
SO Number: 9566312
PO Number: 836007185P

Quotation Number: 5472-2819J-10
MFR #: 59270

SIEMENS

Sentron™ Power Center

Single Phase 15 KVA



DIMENSIONS IN INCHES														
KVA	A MAX	B MAX	C MAX	D	E	F	G	H	J	K	L MIN	M	N	WT.
15	34.38	17.13	12.38	32.88	10.68	14.18	30.06	1.50	4.00	4.00	15.75	13.69	2.63	240

KVA	QUANTITY	CATALOG NUMBER	VOLTAGE		QUANTITY	TAPS
			PRIMARY	SECONDARY		
15	1	1LPC015	480	120/240	2-5%	FCBN

DRAWINGS

( ) APPROVAL

(X) RECORD

( ) OTHER

JOB	SPRING CREEK WELL 7		
P.O.	836007185P	REXEL PACIFIC	
TIE	T-LA	ENG. LOC.	TITLE DRY TYPE GENERAL PURPOSE TRANSFORMER SINGLE PHASE, 15 KVA.
S.O.		MFG. LOC.	DWG NO.
SIEMENS ENERGY & AUTOMATION, INC. ALPHARETTA, GEORGIA 30202		DWG. FILE	A-4-701862

INSTALLATION, OPERATION AND MAINTENANCE OF GENERAL PURPOSE DRY TYPE TRANSFORMERS

600 VOLTS AND BELOW

1. GENERAL

The installation, operation and maintenance of dry type transformers should be performed by an electrician or other qualified personnel who are familiar with national and local electrical codes and with the potential shock hazards associated with electrical equipment.

These instructions cover two types of enclosure construction: ventilated and encapsulated.

A) Ventilated units are NEMA type 2 enclosures suitable for indoor use. They are UL-3R listed and CSA certified for outdoor use with the addition of an optional weather shield kit. The proper weather shield part number is listed on the nameplate.

B) Encapsulated units are NEMA 3R enclosures suitable for either indoor use in harsh environments or for outdoor use.

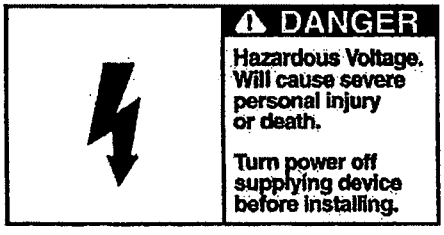
This transformer is ready for installation and operation. It must be installed per the National Electrical Code® and local code requirements. It is recommended that these instructions be read carefully prior to installation and kept for future reference.

2. INSPECTION AND HANDLING

The transformer should be inspected carefully upon receipt to check for any visible or concealed damage that may have occurred during shipment. If damage is found, a claim should be filed immediately with the carrier.

Single and three phase transformers, in smaller KVA sizes, are provided with lifting ears. Larger KVA sizes are palletized and can be lifted with appropriately sized fork lifts or hoisted by the lifting lug bolts provided on the core frame after removal of the top cover. Incorrect handling can bend the enclosure or cause other damage or result in personal injury.

3. INSTALLATION



WARNING: There is a potential danger of electrical shock when working on electrical equipment! Make sure power is off before installation. Replace all covers before energizing transformer.

A) Ventilated Dry Type Transformers

Ventilated units can be installed indoors or outdoors. Outdoor installation requires the addition of a weather shield to be UL-3R listed. For outdoor installation, check electrical codes for the proper protection of transformer against adverse weather conditions.

Ventilated units should be installed in an upright position on walls (optional wall mounting brackets are available for certain KVA sizes), beams, platforms, floors or other structures capable of supporting their weight.

The ambient air should be dry and free from dust, dirt, corrosive fumes, heat or other adverse conditions. The unit should be installed a minimum of 6" from the wall or other obstructions that might prevent proper air flow through the vents.

Ventilated transformers are designed for operation in an average ambient temperature of 30 degrees C (86° F) and a maximum of 40 degrees C (104° F) not to be exceeded.

Larger KVA sizes contain "shipping bolts" to prevent damage during shipping. These should be removed just prior to installation of the unit.

B) Encapsulated Dry Type Transformers

Encapsulated units can be installed indoors or outdoors. When installed outdoors, these units should be installed with the wiring compartment down to prevent the entrance of moisture. Some encapsulated units have a top entry wiring compartment and can be installed vertically (wiring compartment up).

For indoor floor mounting of an encapsulated unit that has a bottom entry wiring compartment, the unit can be installed horizontally (on its back side) for ease of making wire connections.

4. ELECTRICAL CONNECTIONS

WARNING: Danger of electrical shock! Do not remove parts or make connections while the transformer is energized.

Refer to the transformer nameplate label or enclosed wiring diagram for primary and secondary voltage combinations, frequency and number of phases. Tap connections and voltage combinations are also listed on the diagram or nameplate.

CAUTION: Do not make connections other than those shown. The transformer must be as large (KVA) as the load it must operate. Never exceed the nameplate rating as this could result in overheating, reduced life expectancy, or in worst cases, fire.

Proper assembly of the connector (lug) to the transformer terminal is extremely important. Make certain that the connector is sized for the cable and is of the correct type to match cable and terminal metals. Always follow recommendations of the connector (lug) manufacturer. Space and insulate connectors per the NEC®.

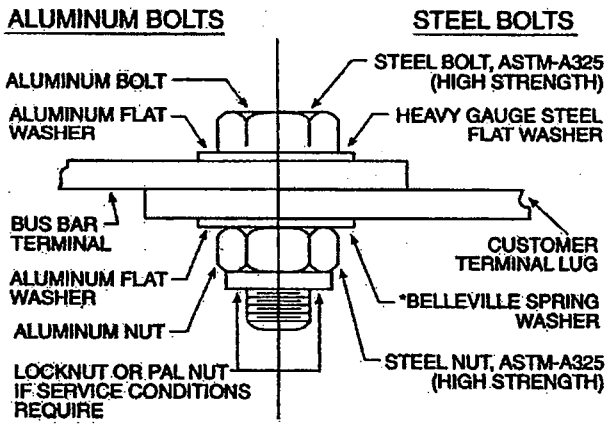
INSTRUCTIONS FOR ALUMINUM BUS BAR CONNECTIONS

NOTE: Single phase 37.5 thru 100 KVA and three phase 27 thru 225 KVA transformers have copper bus terminals. The following steps should be followed when making connections to transformers with ALUMINUM BUS BAR TERMINALS.

1) Remove oxide form joint area of transformer bus terminal. This may be done with a wire brush or emery cloth. Other tools may be used but care should be taken to avoid scratching or gouging terminal.

2) Coat terminal area with joint compound, following manufacturer's instructions.

3) Make connections using one of the bolting methods shown.



CAUTION: Care should be taken to avoid shearing aluminum bolts. Follow manufacturer's maximum torque rating.

* Place cup in washer toward bus bar. Draw washer to flat position for proper torque.

5. GROUNDING

All dry type transformers have a ground stud in the enclosure. The transformer enclosure should be solidly grounded to protect personnel. The customer supplied grounding conductor should have a current-carrying capacity to meet NEC® requirements.

6. MAINTENANCE

Non-ventilated encapsulated styles only require periodic wiping of dust and dirt from the outside of the case under normal conditions and environments. Adverse conditions may require more frequent inspections.

Ventilated units should be inspected within one to three months after initial installation. Air ducts should be kept clear at all times. Vacuum cleaners or low pressure compressed dry air can be used to remove dirt or dust. A regular inspection schedule for cleaning and maintenance will help ensure added safety and longer transformer life.

If a dry type transformer accidentally gets wet, it must be cleaned and thoroughly dried before energizing. Otherwise, complete failure could result!

CAUTION: Never perform internal maintenance while the unit is energized!

7. STORAGE

Both ventilated and encapsulated transformers should be stored in a clean, dry area. Care should be taken to prevent moisture or condensation from entering the transformer, and vent openings should be covered on ventilated units. If stored outside, the transformer must be covered and protected from water, dust and other airborne contaminants.

8. LIMITED PRODUCT WARRANTY

All dry type transformers are warranted against defects in materials and workmanship. This is a limited product warranty and certain conditions apply. Please contact the manufacturer for further information on warranty claims.

NOTICE: These instructions are general in nature and may not cover all variations in transformer design or conditions of installation, operation and maintenance in enough detail to meet customer needs. Additional instructions may be included with this transformer. If you need further information or should a problem arise, please contact the manufacturer.

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O & M Manuals SECTION COVER SHEET

JOB

SPRING CREEK WELL 7

SECTION: **Circuit Breakers**

CONTENTS:

Description	Pgs.
QP Frame Breaker Cutsheets	2

Total Pages this Section: **2**

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ENGINEER: N/A

CONTRACTOR: N/A

DISTRIBUTOR: REXEL PACIFIC

DATE: 6/6/06

SO Number: 9566312
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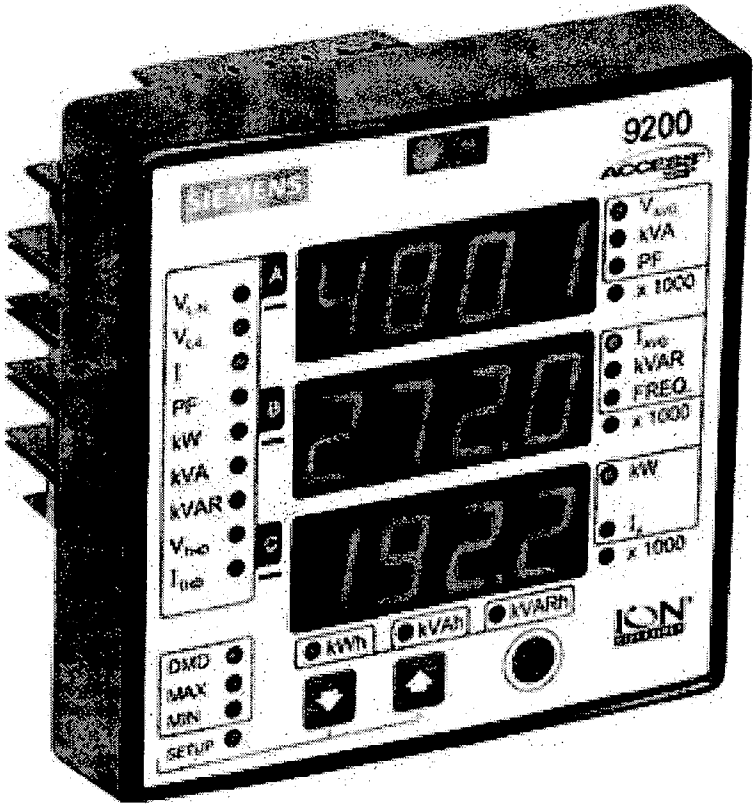
MFR #: 59270

SIEMENS

9200 Power Meter

Installation & Basic Setup Instructions



⚠ DANGER

Electrical equipment contains hazardous voltages and high speed moving parts.

Can cause death, serious injury or property damage.

See safety instruction contained herein. Restrict use to qualified personnel.

The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions that can cause death, serious injury or property damage.

IMPORTANT

The information contained herein is general in nature and not intended for specific application purposes. It does not relieve the user of responsibility to use sound practices in application, installation, operation, and maintenance of the equipment purchased. Siemens reserves the right to make changes at any time without notice or obligations. Should a conflict arise between the general information contained in this publication and the contents of drawings or supplementary material or both, the latter shall take precedence.

QUALIFIED PERSONNEL

For the purposes of this manual and product labels, "qualified personnel" is one who is familiar with the installation, construction, or operation of the equipment and the hazards involved. In addition, s/he has the following qualifications:

(a) **is trained and authorized** to energize, de-energize, clear, ground, and tag circuits and equipment in accordance with established safety practices.

(b) **is trained** in the proper care and use of protective gear equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc., in accordance with established safety procedures

(c) **is trained** in rendering first aid.

SUMMARY

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation, or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the local the sales office.

THE CONTENTS OF THIS INSTRUCTION MANUAL SHALL NOT BECOME PART OF OR MODIFY ANY PRIOR OR EXISTING AGREEMENT, COMMITMENT OR RELATIONSHIP. THE SALES CONTRACT CONTAINS ALL OBLIGATIONS OF SIEMENS ENERGY & AUTOMATION, INC. THE WARRANTY CONTAINED IN THE CONTRACT BETWEEN THE PARTIES IS THE SOLE WARRANTY OF SIEMENS ENERGY & AUTOMATION, INC.

Installation Considerations

Installation and maintenance of the 9200 meter should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current devices. Every effort has been made to ensure the installation instructions presented in this document are clear and easy to understand; however, if you are not sure how to perform any of the instructions provided, DO NOT CONTINUE THE INSTALLATION. The 9200 meter must be installed in accordance with all Local and National Electrical Codes.

WARNING: Failure to observe the following information may result in severe injury or death.

- During normal operation of this device, hazardous voltages are present on the terminal strips of the device and throughout the connected potential transformer (PT), current transformer (CT), control power and external I/O circuits. PT and CT secondary circuits are capable of generating lethal voltages and currents with their primary circuit energized. Follow standard safety precautions while performing any installation or service work (i.e. removing PT fuses, shorting CT secondaries, etc).
- The terminal strips on the meter base should not be user-accessible after installation.
- Do not use digital output devices for primary protection functions. These include applications where the device performs energy limiting functions or provides protection of people from injury. If failure of the device can cause injury or death, or cause sufficient energy to be released that a fire is likely, do not use the 9200 meter. The 9200 meter can be used for secondary protection functions.
- Do not HIPOT/Dielectric test the digital inputs/outputs, or communications terminals. Refer to the label on the device for the maximum voltage level the device can withstand.
- Terminal strip torque:

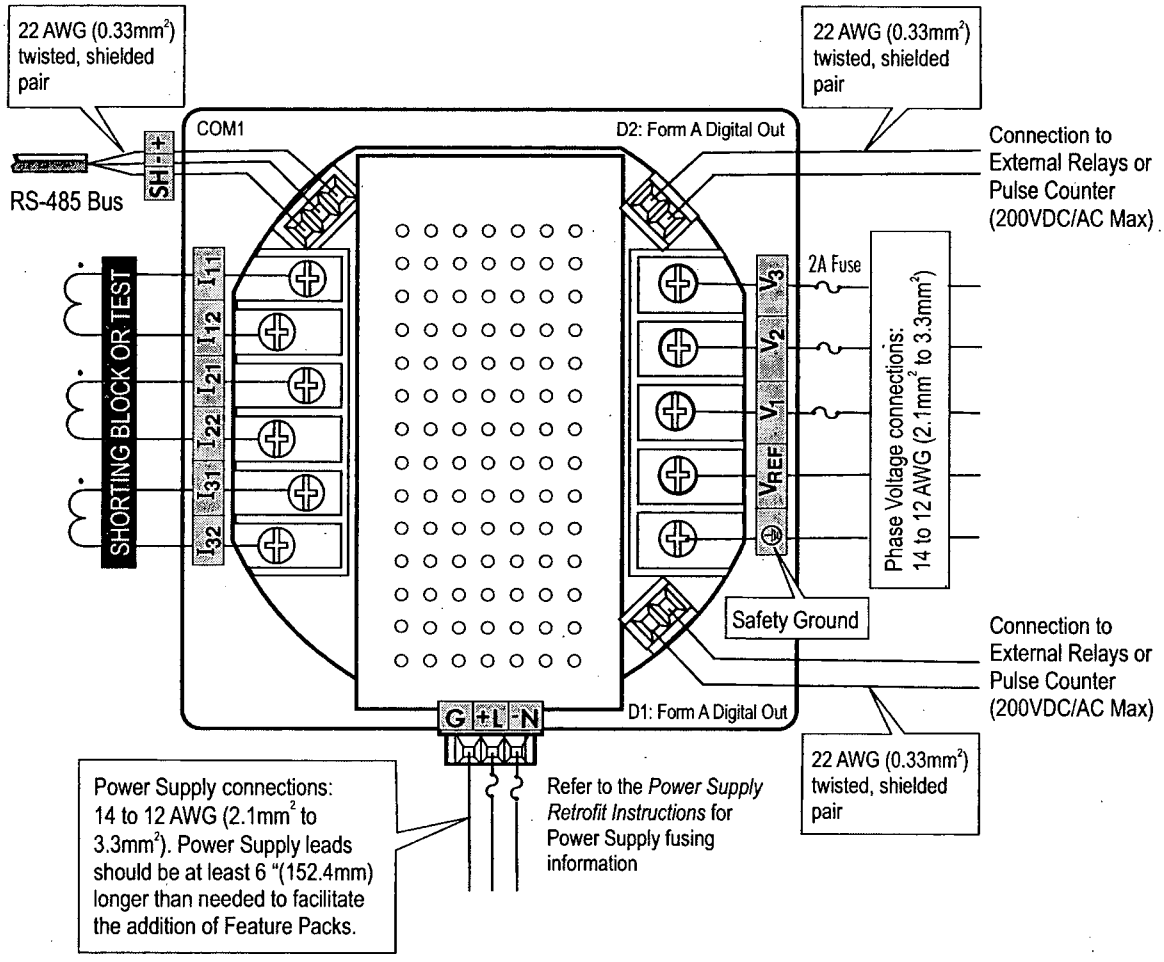
  Current, voltage, and safety ground terminals: 1.35Nm or 1.0 ft • Lbf torque (max). Digital inputs/outputs, communications, and power supply: 0.90Nm or 0.7 ft • Lbf torque (max).

CAUTION: Failure to observe the following may result in permanent damage to the device.

- The 9200 meter offers a range of hardware options that affect input ratings. Applying current levels incompatible with the current inputs will permanently damage the 9200 meter. This document provides detailed installation instructions applicable to each hardware option.
- The 9200 meter safety ground must be properly connected to the switchgear earth ground for the noise and surge protection circuitry to function correctly. Failure to do so will void the warranty.
- When the integrated display unit or the RMD unit is mounted flush to a panel with the supplied gasket, then the front side meets NEMA type 4, 4x and 5 (according to NEMA standards 1-10-1979 and 5-25-1988) and meets IP 543.

Table of Contents

Installation Overview



1. Insert the Options Card in the slot at the back of the meter (refer to the diagram "Plug-in Modules" on page 8, and the *9200 Options Card Retrofit Instructions*).

2. Mount the meter.

   Integrated model:

   - Cut a hole in the mounting surface to DIN 96 or ANSI 4" specifications (refer to "Mounting the Integrated Model" on page 10).
   - Install the meter in the hole (refer to "Mounting the Integrated Model" on page 10).

   TRAN model:

   - Mount the meter flush against a flat surface with screws, or snap into a standard DIN rail (refer to "Mounting the TRAN Model" on page 11).

3. Mount the Remote Modular Display (RMD) against a flat surface with the supplied screws, if your meter ordering option includes an RMD (refer to the *9200 RMD Retrofit Instructions).*
4. Attach the Feature Pack™ to the meter, if your meter ordering option includes a Feature Pack (refer to the *9200 Feature Pack Retrofit Instructions*).
5. Attach the power supply to the meter, or attach it to the Feature Pack installed in the previous step (refer to "Plugging in the Power Supply" in the *9200 Power Supply Retrofit Instructions*).
6. Connect the RMD to the TRAN meter, if your meter ordering option includes a TRAN meter and an RMD (refer to the *9200 RMD Retrofit Instructions).*
7. Wire the ⏚ (safety ground) terminal to earth ground (refer to "Connecting the Base Unit Safety Ground" on page 14).
8. Wire the power supply (refer to "Connecting the Power Supply" on page 14, or the *9200 Power Supply Retrofit Instructions* for more details). Do not power up the power supply until the rest of the meter wiring is complete.
9. Wire the voltage and current inputs (refer to "Connecting the Phase Voltage Inputs" on page 15, and "Connecting the Phase Current Inputs" on page 16).
10. Wire the digital outputs, if your meter ordering option includes digital outputs (refer to "Digital Outputs Connection" on page 21).
11. Wire the communications, if your meter ordering option includes communications (refer to "RS-485 Communications Connections" on page 22).
12. Close the PT fuses (or direct voltage input fuses), and open the CT shorting blocks.
13. Apply power to the meter.
14. Configure the meter (refer to "Basic Setup" on page 23).
15. Verify the meter operation (refer to "Verifying Meter Operation" on page 40).

Introduction

The 9200 meter is small, simple to install, and can be easily upgraded in the field. It provides revenue accurate measurements, has a large bright display, and is versatile.

The meter's modular design allows you to "plug in" components to expand your metering capabilities as your power system requires. Plug in an enhanced Options Card for a broader range of power measurements, or plug in a Feature Pack for extended capabilities.

Integrated and TRAN Models

The 9200 meter is available as an Integrated (display) or TRAN (transducer) model. The Integrated model has a large, bright front panel display. The TRAN model has no display; it can be connected to a Remote Modular Display unit (RMD) to provide a display identical to that on the Integrated model. Installation for the Integrated and TRAN models is covered in this guide. Refer to the *9200 RMD Retrofit Instructions* regarding the RMD.

NOTE: In the 9200 meter documentation, the term "basic meter" refers to the Integrated or TRAN models with an Options Card that provides standard measurements (voltage and current), and without a Feature Pack.

Options Card

The basic meter has an Options Card that enables standard measurements: voltage and current. You can also order an Options Card that enables extended capabilities: two digital pulse outputs, and additional measurements (Enhanced Measurement Packages 1 and 2). Refer to the Options Card features tables on page 53 and page 54, or the *9200 Options Card Retrofit Instructions.*

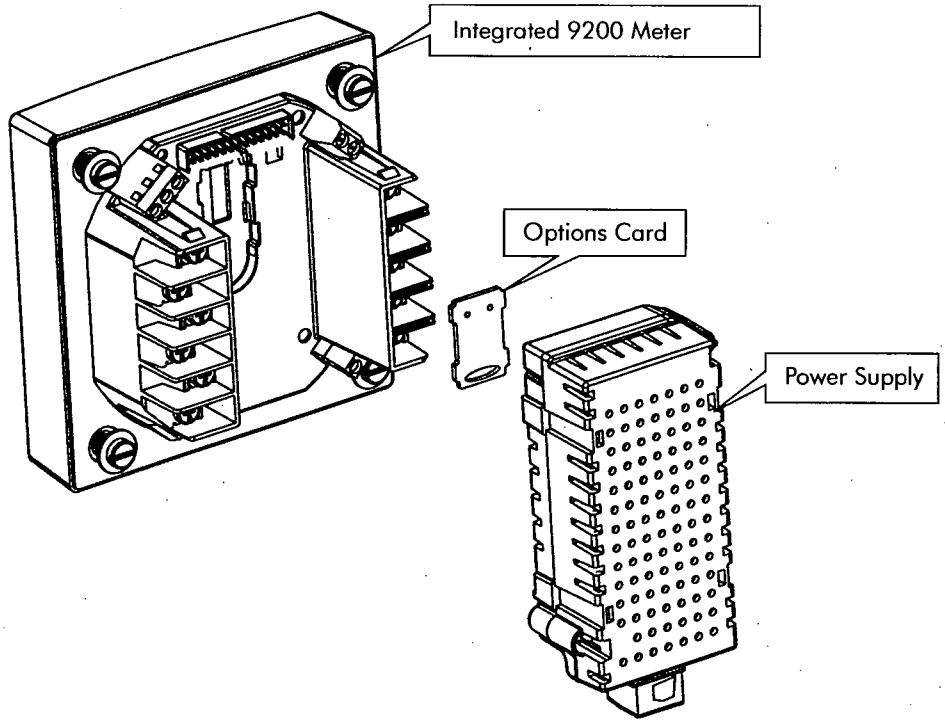
Future Feature Packs

Feature Packs[1] provide advanced capabilities for the meter including digital and analog I/O, communications protocols, and power quality measurements. Refer to the *9200 Feature Packs Retrofit Instructions.*

Power Supply

The power supply is also a plug-in component that is easy to install. Refer to the *9200 Power Supply Retrofit Instructions.*

Plug-in Modules



[1] Feature Packs are in development and will be available in the future. In the diagram above, Feature Packs are not shown. The Feature Pack(s) will install between the meter and the power supply.

Location & Mounting

Mount the meter in a dry location free from dirt and corrosive vapors. Once installed, no cleaning of the device is necessary.

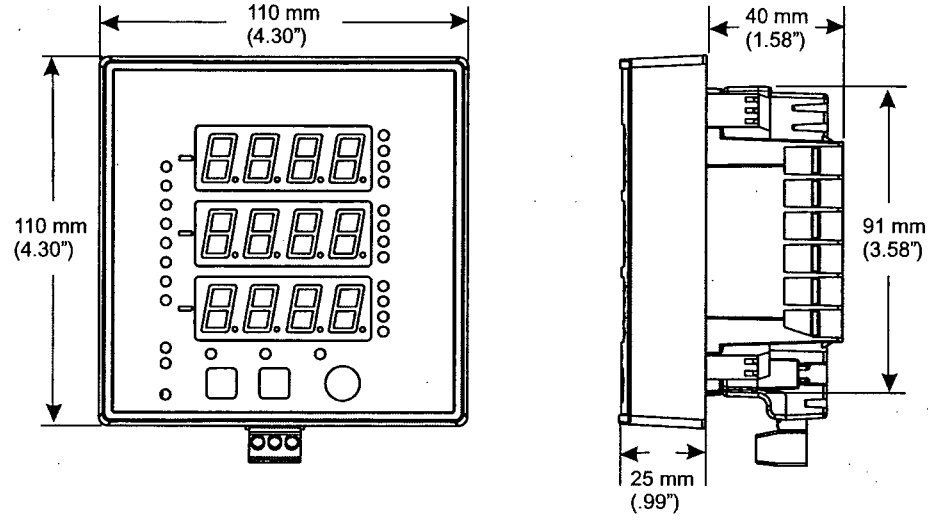
Environmental Specifications

Refer to the Environmental specifications on page 43.

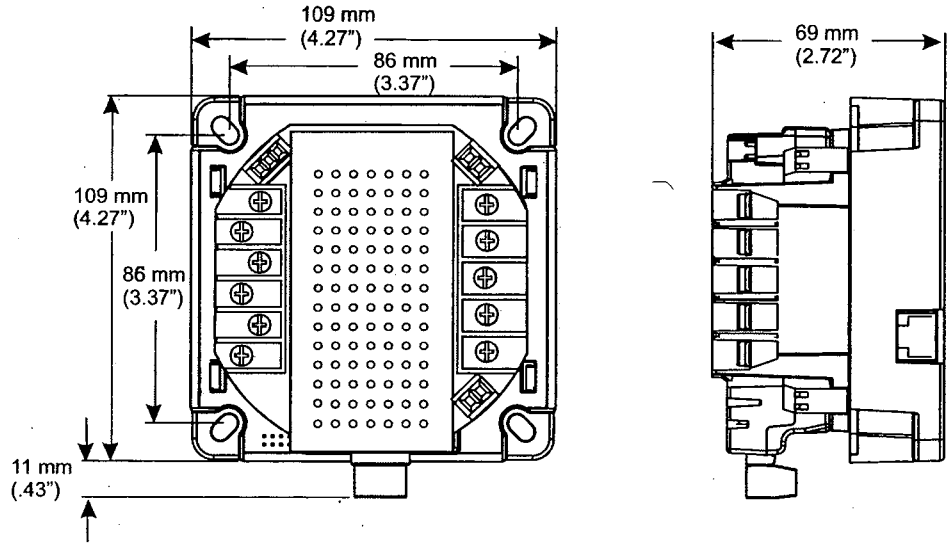
Unit Dimensions

The meter and meter options dimensions are shown below.

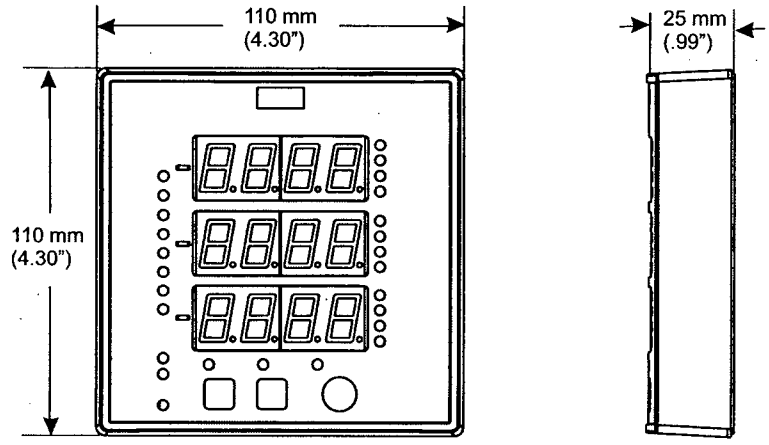
Integrated Model Dimensions



TRAN Model Dimensions



RMD Dimensions



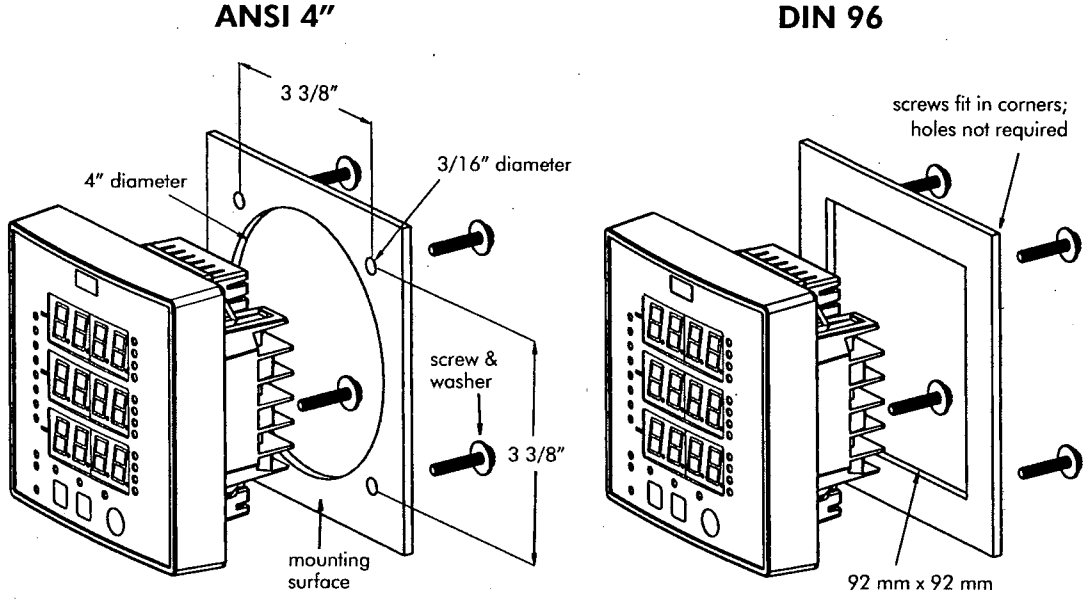
Mounting the Meter

The basic meter (with an integrated display) fits in a DIN standard 92 X 92 mm (3.6" X 3.6") panel cutout, as well as a standard ANSI 4" panel cutout (commonly referred to as a 4 1/2" Switchboard cutout). Standard panel punches are available for retrofit applications.

> **CAUTION**: Include a switch or circuit breaker in each installation, in close proximity to the unit and within easy reach to the operator. Mark this switch (or circuit breaker) as the disconnecting device for the unit.

Mounting the Integrated Model

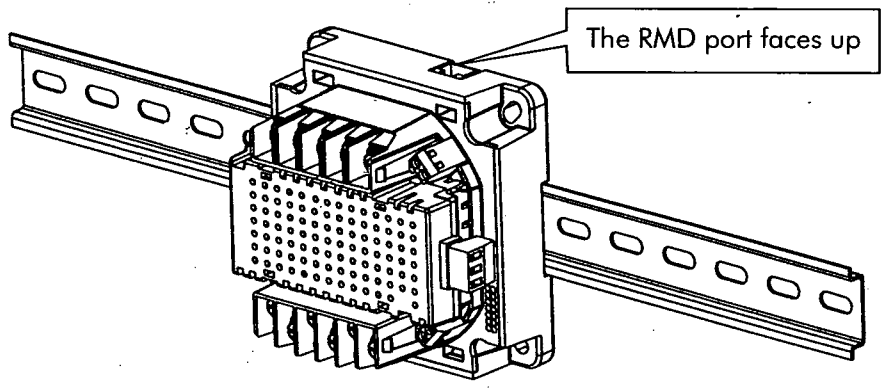
1. Fit the meter into the cutout.
2. Slip the washers on the screws and insert each screw in the corresponding drilled hole on the mounting surface (no drilled holes required in a DIN 96 cutout).
3. Place each screw in its corresponding metal insert located on one of the back corners of the meter.
4. With a #2 Phillips screwdriver, tighten the screws to 1.35Nm or 1 ft • Lbf (maximum).



Mounting the TRAN Model

The TRAN meter is the basic meter with no display. The TRAN can be mounted flush against any flat surface in any orientation with four #8 or #10 size screws (1.35Nm or 1 ft • Lbf maximum). The meter casing provides four slots (in the ANSI 4" bolt pattern) on its mounting flanges for this purpose. The TRAN is typically mounted inside the switchgear cabinet.

The TRAN can be easily snapped in place on a standard DIN rail, European Standard EN50022:1977. The recommended orientation is with the RMD port upwards, as shown in the diagram below. In this orientation, the sliding snap feature has the most strength.



Mounting the RMD

The Remote Modular Display (RMD) is supplied separately as an addition to an existing TRAN meter. The RMD can be mounted in either a standard DIN or ANSI cutout (refer to the diagram in "Mounting the Integrated Model"). With only 5 small holes, the RMD can also be mounted on a flat panel. See the *9200 RMD Retrofit Instructions*.

Field Wiring Connections

DANGER: Be familiar with the warnings presented at the beginning of this document before proceeding with the installation of the meter.

Field Service Considerations

If the meter requires servicing or field upgrading, you may need to disconnect and remove the meter from its mounting. The initial installation should be done in a way that makes this as convenient as possible:

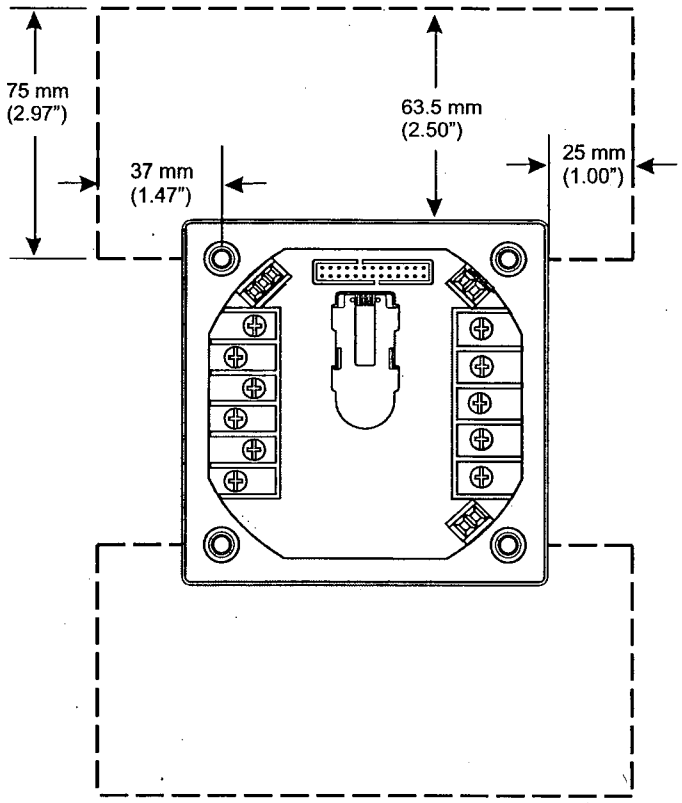
- All phase voltage sense leads should be protected by breakers or fuses at their source so the meter can be safely disconnected.
- A CT shorting block should be provided so that the meter current inputs can be safely disconnected without open circuiting the CTs. The shorting block should be wired so that protective relaying is not affected.
- All wiring should be routed to allow easy removal of the connections to the meter terminal strips and the meter itself.

Feature Pack Requirements*

Feature Packs install between the basic meter and the power supply, and may protrude beyond the meter top and bottom (refer to the following diagram). Note that the power supply rotates 180 degrees. As a result, these requirements should be considered:

- Power supply leads should be at least 152.4 mm (6") longer than needed to facilitate the addition of Feature Packs.
- A minimum of 63.5 mm (2.5") above and below the meter should be left free from cables, wiring, and other devices.
- With a Feature Pack installed, the meter has a maximum depth of 63.5 mm (2.5") behind the panel.

Feature Pack Space Allowances



* This is subject to change without notice.

Terminal Strips

All connections to the meter are made to terminal strips at the back of the unit. The terminal strips for phase voltage and current are barrier-type, for which ring or spade terminals, or bare wire, may be used.

The terminal strips for the digital outputs, the communications port, and the supply power inputs are all captured-wire type; they accept stripped wire ends.

Terminal Strip Covers

Terminal strip covers are provided for the voltage and current terminal strips. These covers easily snap on and off of the meter with a flathead screwdriver.

Connecting the Base Unit Safety Ground

The ⏚ terminal of the meter provides the safety ground connection. This terminal must be connected to earth ground. A good, low impedance safety ground connection is essential for the meter surge and transient protection circuitry to function effectively. It should be made to the switchgear earth ground using a dedicated 14 AWG (2.1 mm^2) or larger wire to a point where there will be no voltage error due to distribution voltage drops.

The power supply G (ground) terminal should be connected to the same point as the meter ⏚ terminal.

Do not rely on metal door hinges as a ground path. Ensure that the ⏚ terminal is tightened securely to the ground wire.

> ⚠ **CAUTION**: Failure to properly connect the meter safety ground will void the warranty.

Connecting the Power Supply

> **NOTE**: Disconnect the power source before removing the power supply.

The meter requires a constant power supply to maintain monitoring, analysis, control, and communications operations. Powering the meter from the voltage source it is monitoring is not suitable for applications where these operations must be maintained in the event of a power outage.

If an AC power supply is being used, connect the line supply wire to the L+ terminal and the neutral supply wire to the N- terminal. If a DC power supply is being used, connect the positive supply wire to the L+ terminal and the negative supply wire to the N- terminal.

Power Supply Specifications

Refer to the Power Supply specifications on page 44, or the *9200 Power Supply Retrofit Instructions*.

Protective Fuses

The meter power supply may need to be externally fused. Refer to the *9200 Power Supply Retrofit Instructions.*

Connecting the Remote Modular Display

The RMD connects to the TRAN meter with a 26 gauge 6 conductor RJ11-type cable. The cable connects between the RJ11 socket on the backside of the RMD, and the RJ11 socket on the side of the TRAN. Refer to the *9200 RMD Retrofit Instructions* for more information.

> ⚠ **CAUTION**: Only use the supplied cable to connect the RMD.

Connecting the Phase Voltage Inputs

Phasing and polarity of the AC voltage inputs and their relationship is critical to the correct operation of the meter. All phase voltage sense leads should be protected by breakers or fuses at their source.

Voltage Input Specifications

Refer to the Voltage Input specifications on page 43.

> ⚠ **CAUTION**: Ensure that the voltage level between V_{REF} and each phase input (V1, V2 or V3) does not exceed 400 volts.

Connection

PTs are required for all systems with voltage levels greater than those indicated in the Voltage Input specifications.

Using Potential Transformers

Use PTs that are compliant with the electrical safety code in your region. It is recommended that PTs comply with the requirements in IEC 61010-1, Pollution Degree 2, Overvoltage Category III.

> ⚠ **CAUTION**: In cases where PTs are required, the secondaries should be fused.

V1 Input Connection

The meter uses the V1 input as the reference for frequency for all power and energy related measurements. For any system configuration, the V1 input must be connected to ensure accurate readings and correct operation of the meter. If the voltage on V1 falls below 50 V, the meter's accuracy could be affected.

Voltage Reference (Vref) Input Connection

The meter voltage reference terminal, Vref, serves as the zero voltage reference for voltage readings. A good, low impedance Vref connection is essential for accurate measurements. It should be made using a dedicated 14 to 12 AWG wire (2.1 to 3.3 mm^2) to a point where there will be no voltage error due to distribution voltage drops.

Connecting the Phase Current Inputs

14 to 12 AWG wire (2.1 to 3.3 mm^2) is recommended for all current connections. Use CTs that are compliant with the electrical safety code in your region. It is recommended that CTs comply with the requirements in IEC 61010-1, Pollution Degree 2, Overvoltage Category III.

Current Input Specifications

For Current Input specifications, refer to page 43.

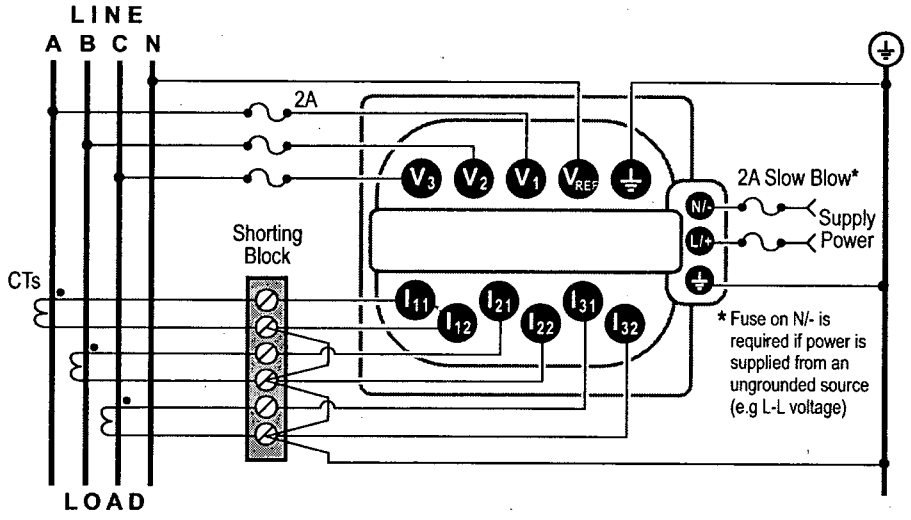
Using Current Transformers

The CT primary rating is normally selected to be equal to the current rating of the power feed protection device. However, if the peak anticipated load is much less than the rated system capacity, you can improve accuracy and resolution by selecting a lower rated CT. In this case, the CT size should be the maximum expected peak current, rounded up to the nearest standard CT size.

The CT secondary should have a burden capacity greater than 3 VA. The length of the CT cabling should be minimized, because long cabling contributes to the burden on the CT secondary. Also, the CT burden rating must exceed the combined burden of the meter plus cabling plus any other connected devices (burden is the amount of load being fed by the CT, measured in Volt-Amps).

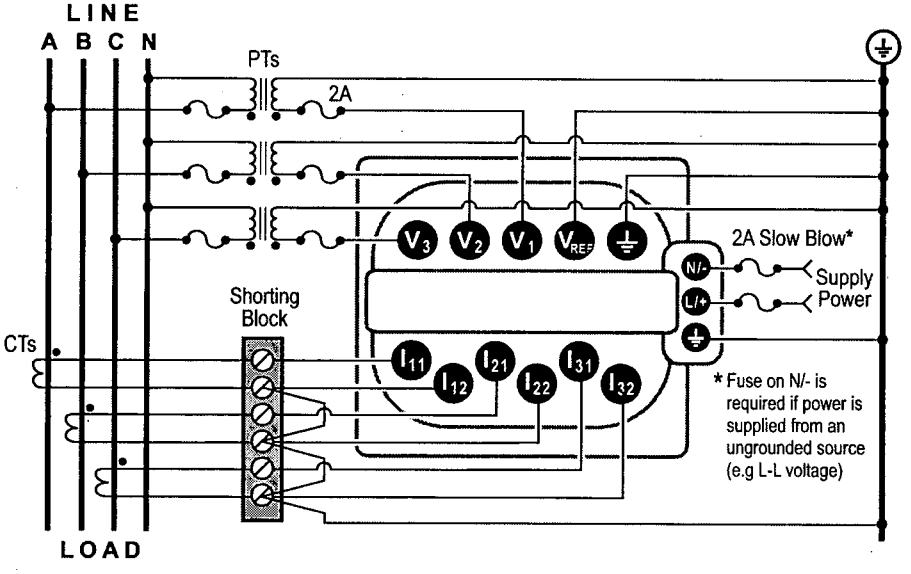
4-Wire Wye, 3-Element Direct Connection

NOTE: The meter senses the line-to-neutral voltage and current for each phase, creating an equivalent 3 element metering configuration. Volts Mode should be set to 4W-Wye.



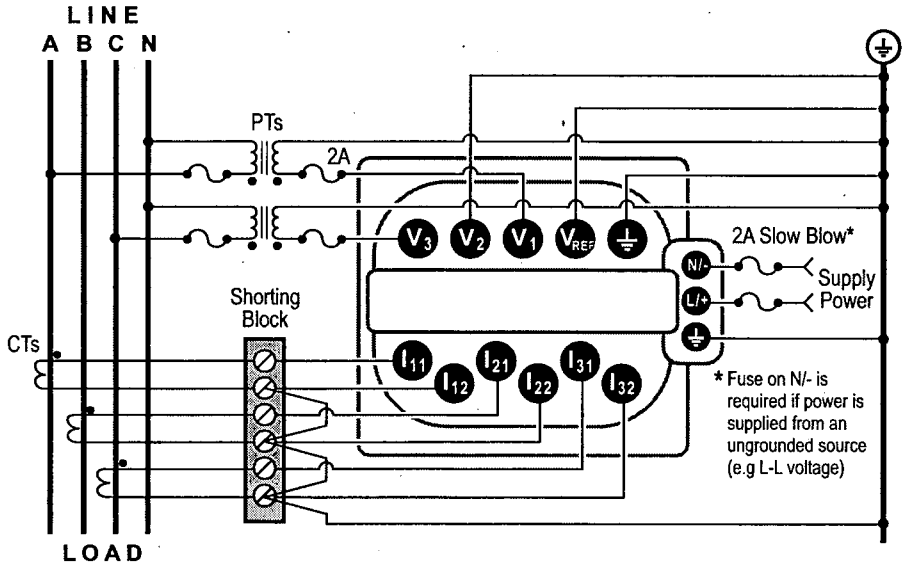
4-Wire Wye, 3-Element, 3 PT, 3 CT

NOTE: Both the PT primary and secondary must be wired in a Wye (star) configuration. Wiring must be exactly as shown for correct operation. Volts Mode should be set to 4W-Wye.



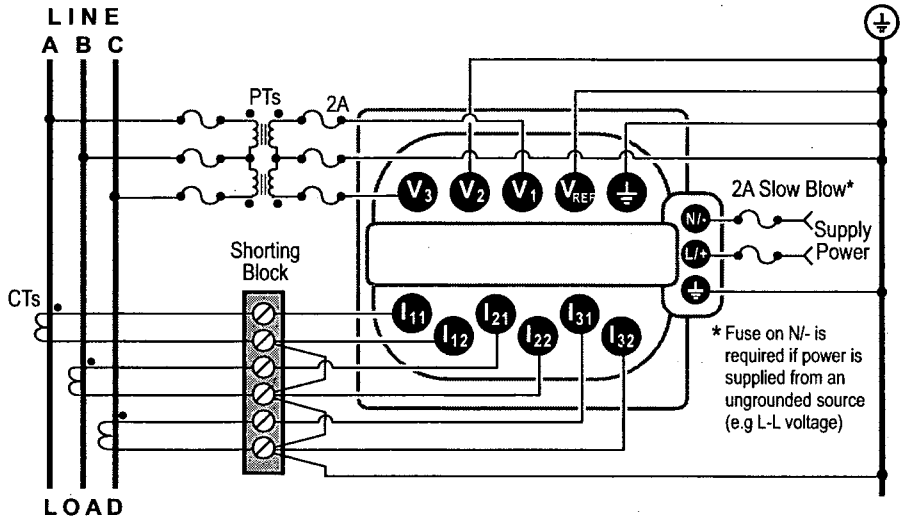
4-Wire Wye, 2½-Element, 2 PT, 3 CT

NOTE: Phase B voltages are derived from the phase A and C voltages. If the voltages are unbalanced, power readings may not meet accuracy specifications. Volts Mode should be set to 3W-Wye.



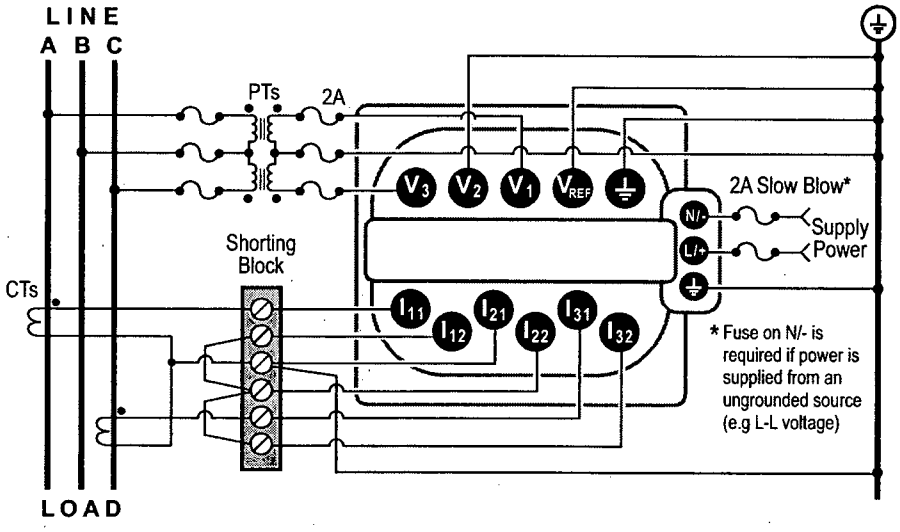
3-Wire Delta, 2½-Element, 2 PT, 3 CT

NOTE: PTs are required for ungrounded 3-wire systems above 690 Volts line-to-line. In this configuration, the meter senses the line-to-line voltages between each of the phases. Volts Mode should be set to Delta.



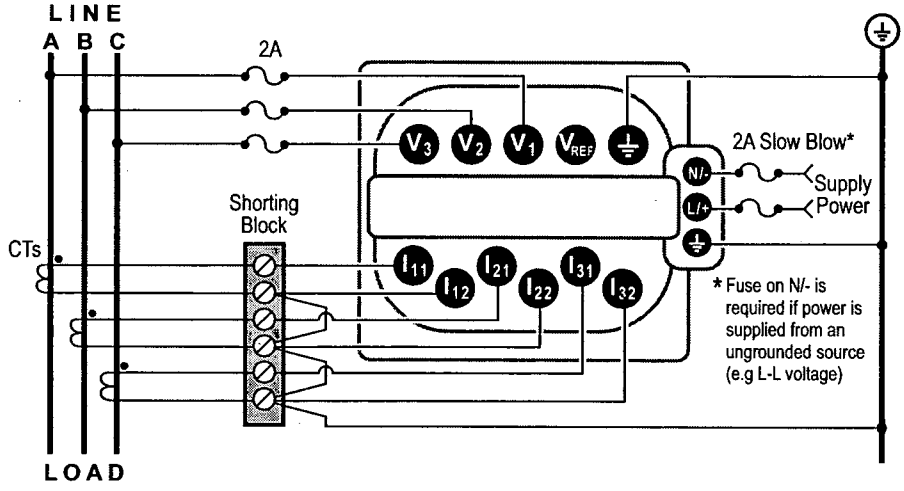
3-Wire Delta, 2-Element, 2 PT, 2 CT

NOTE: The meter requires PTs for ungrounded 3-wire systems above 690 Volts line-to-line. Volts Mode should be set to Delta.



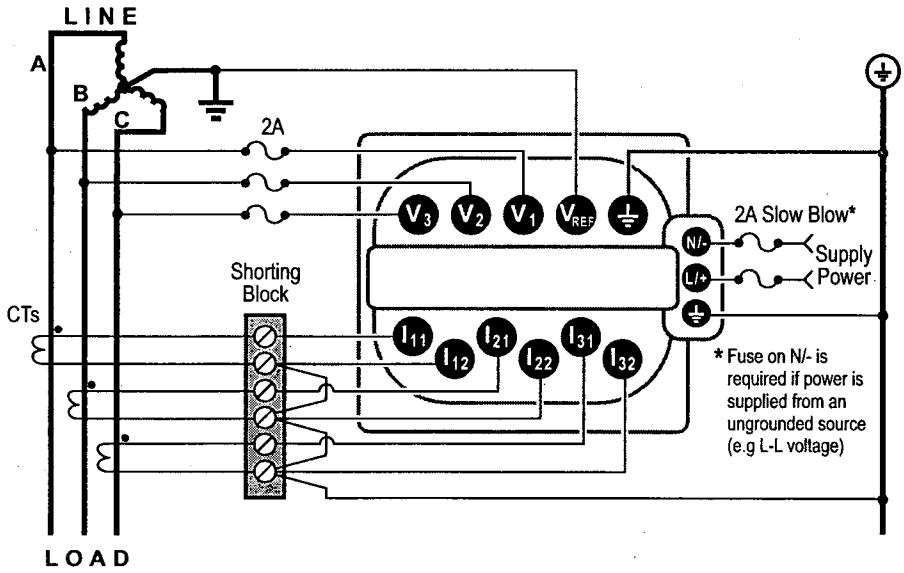
3 Wire Delta Direct Connection

NOTE: Direct Delta connections (with no PTs) are supported for power systems up to 690 Volts line-to-line. Volts Mode must be set to Direct Delta. Vref is not connected.



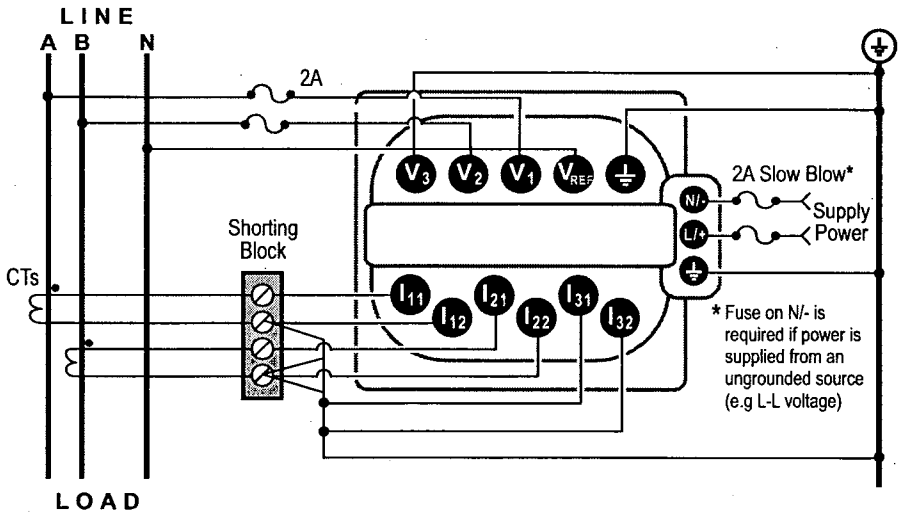
3-Wire Grounded Wye, 3-Element Direct

NOTE: The configuration requires that the transformer secondary star-point is grounded. The phase-to-ground voltages must be within the meter's range. Volts Mode should be set to 4W-Wye.



Single Phase Connection Diagram

NOTE: Connect the two voltage phases (180° apart) to the V1 and V2 inputs, and the CT outputs to the I1 and I2 input pairs. Unused meter inputs are grounded. Volts Mode should be set to Single.



Digital Outputs Connection

Digital outputs can be enabled on the meter with the appropriate Options Card. Refer to "Options Card Combinations" on page 53.

The meter provides two Form A digital relays for energy pulsing applications (kWh, kVARh, and kVAh). By default, port 1 is set to pulse kWh, and port 2 is set to pulse kVARh. The energy pulsing setup can be changed from the front panel, or with software.

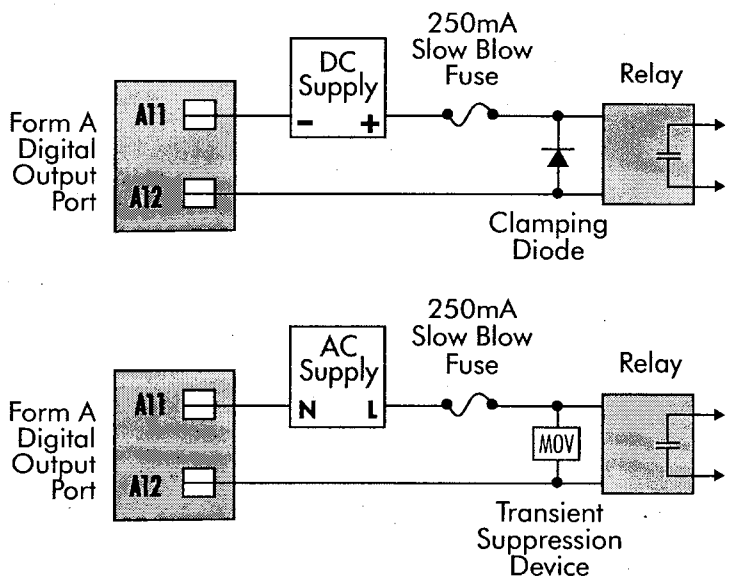
Digital Output Specifications

For Digital Output specifications, refer to page 44.

Form A Digital Output Connection

24 to 16 AWG wire (0.08 mm^2 to 1.3 mm^2) is recommended for both connections. Connections to the terminal strip are shown in the diagram below.

Typical Form A Digital Output Connections



Select an MOV or clamping diode that ensures that the output terminals do not receive a voltage greater than 350 V peak during switching.

Infrared (IR) Pulsing

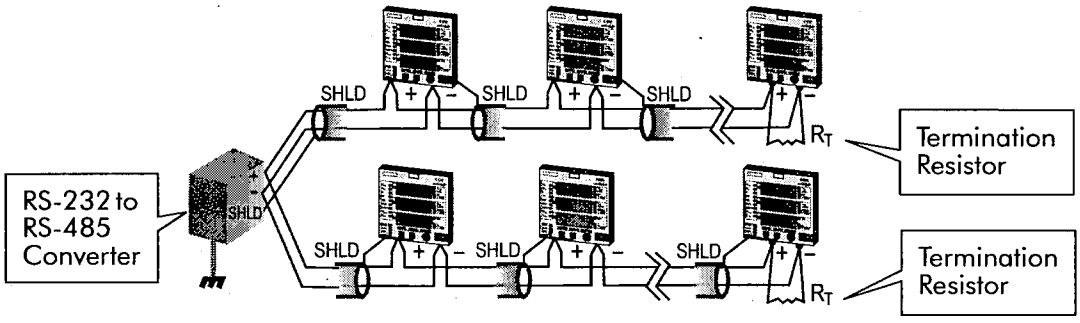
The LED near the top of the meter front panel can be configured to provide energy pulsing (kWh, kVARh, or kVAh).

RS-485 Communications Connections

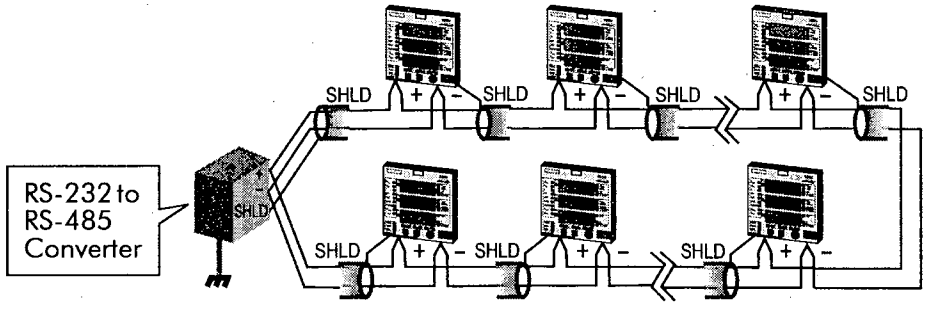
RS-485 communications is standard on the 9200 meter .

RS-485 connections are made via the captured-wire connectors on the meter. Up to 32 devices can be connected on a single RS-485 bus. Use good quality shielded twisted pair RS485 cable, AWG 22 (0.33 mm^2) or larger. The overall length of the RS-485 cable connecting all devices cannot exceed 1219 m (4000 ft). The lengths of all (+ and –) cable segments must be counted including those that connect devices to terminal blocks.

Straight Line Topology



Loop Topology



General Bus Wiring Considerations

Devices connected on the bus, including the meter, converter(s), and other instrumentation can be wired as a straight line or as a loop:

- The shield of each segment of the RS-485 cable must be connected to ground at *one end only.*
- Isolate cables as much as possible from sources of electrical noise.

- Install a ¼ Watt termination resistor (RT) between the (+) and (-) terminals of the device at each end point of a straight-line bus. The resistor should match the nominal impedance of the RS-485 cable (typically 120 ohms – consult the manufacturer's documentation).

> ⚠ **CAUTION**: Do not connect ground to the shield at both ends of a segment. Doing so allows ground loop currents to flow in the shield, passing noise into the communications cable.

RS-485 Connection Methods to Avoid

Any device connection that causes a branch in the main RS-485 bus should be avoided. This includes *star* and *tee* (T) methods. These wiring methods cause signal reflections that may cause interference. **At any connection point on the RS-485 bus, no more than two cables should be connected.** This includes connection points on instruments, converters, and terminal strips.

Dual Purpose RXD/TXD Indicator

Beside the RS-485 connector ⊕ terminal, there is a dual purpose RXD/TXD indicator that flashes red when the meter is transmitting, and green when the meter is receiving data.

Protocol Documents

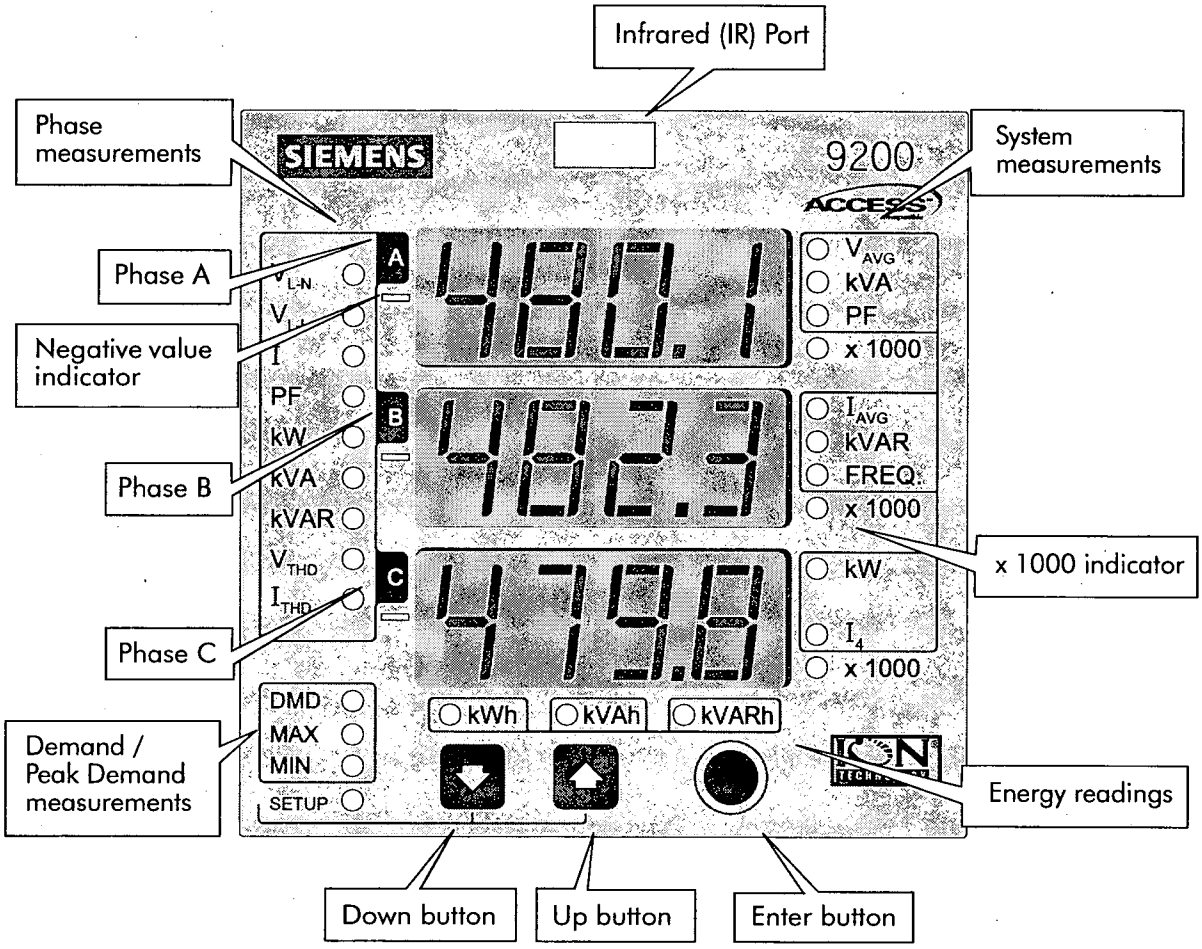
Refer to the *9200/Modbus Register Map* documents for meter protocol implementation details.

Basic Setup

If your meter requires settings other than the factory default settings to communicate with your power monitoring network, then you must set up the meter with the front panel or software. Basic setup determines how the meter interprets the power system it is connected to, as well as how the meter communicates with connected networks or workstations.

For parameter configuration through the front panel, the meter must be in Configuration mode. Refer to "Configuration Mode" on page 31. For meter setting defaults and values refer to "Meter Settings" on page 55.

Front Panel Navigation



With the meter front panel, you can view parameter values; configure parameters; perform demand resets; perform LED checks; and view meter information. Each of these functions can be accomplished by pressing the Up, Down, and Enter buttons on the front panel. These button actions achieve different results according to the mode that the meter is in:

- **Display mode** (default): view parameter measurements
- **Reset mode**: reset demand measurements
- **Configuration Select/Edit modes**: configure a parameter
- **Information mode**: verify that the front panel display LEDs operate, and view meter information, e.g, meter options, firmware version etc.

This section describes front panel navigation within each mode.

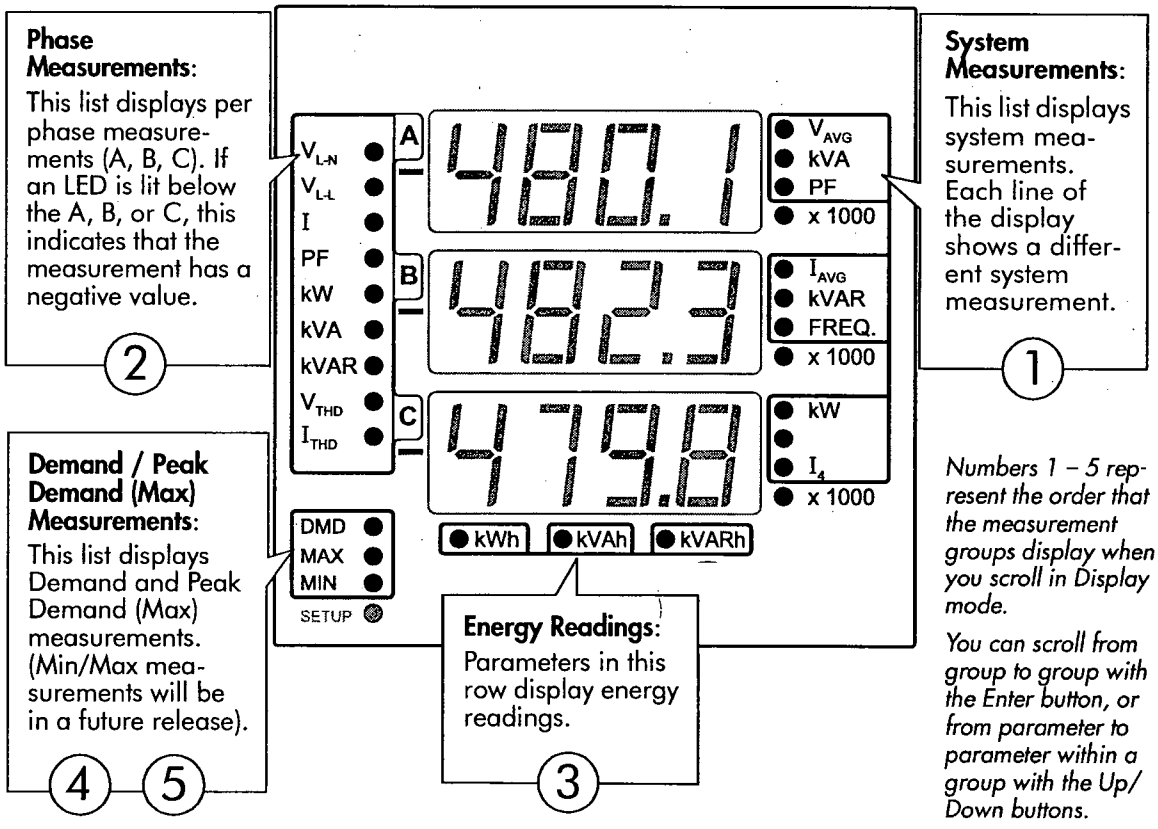
Front Panel Button Functions

UP/DOWN Buttons

ENTER Button

For each mode, a table is included that shows how the buttons function. Three periods following a button (. . .) represent that the pressed button or button combination is held down for 2 seconds.

Display Mode



In Display mode, you can view values from these measurement groups: System (total), Per Phase, Energy, Demand, and Peak Demand. (This assumes that you have ordered Enhanced Measurement Packages 1 and 2. Refer to the "Standard Measurements and Enhanced Packages 1 & 2" on page 54, or the *9200 Options Card Retrofit Instructions* for information regarding Options Cards).

Display Mode Parameter Measurements

The following table lists the parameters in each measurement group:

Measurement Group	Parameters Measured
System (Total)	V_{AVG}, I_{AVG}, kW, kVA, kVAR, PF, Frequency, I4
Phase A, B, and C	V_{LN}, V_{LL}, I, PF, kW, kVA, kVAR, V_{THD}, I_{THD}
Energy	kWh, kVAh, kVARh
Demand*	kVA, kVAR, kW, I_{AVG}
Peak Demand (Max)*	kVA, kVAR, kW, I_{AVG}
Min/Max	Min/Max measurements will be provided in a future release

* Displays system (total) values.

x 1000 Indicator

When the "x 1000" LED is lit, multiply the displayed value by 1000 for the actual value.

Button Functions in Display Mode

The following table shows how the front panel buttons function in Display mode:

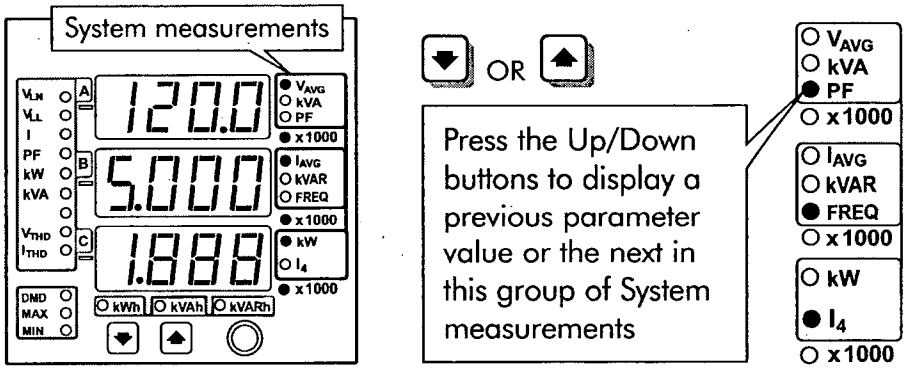
Mode	Button	Function
Display Mode Display mode is the meter default.		View the previous parameter value.
		View the next parameter value.
		Move from one measurement group to the next measurement group.

Viewing Parameter Measurements

The meter defaults to Display mode, and to the System measurements within this mode.

The following illustrates how to view measurements in Display mode.

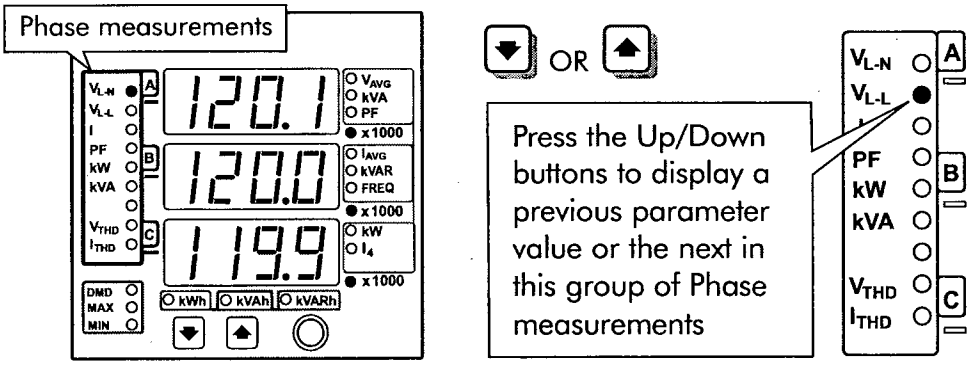
1. System Measurements



Each line of the display shows a System measurement. In the example above, line 1 = System Average Voltage (V_{AVG}) with an actual value* of 120,000; line 2 = System Average Line Current (I_{AVG}) with an actual value of 5,000; line 3 = System Total Active Power (kW) with an actual value of 1,888. (*Actual value = displayed x 1000.)

Press the Enter button to display **Phase** measurements.

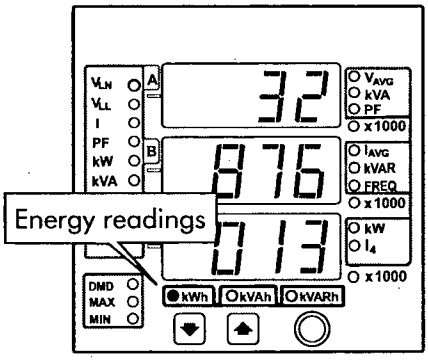
2. Phase Measurements

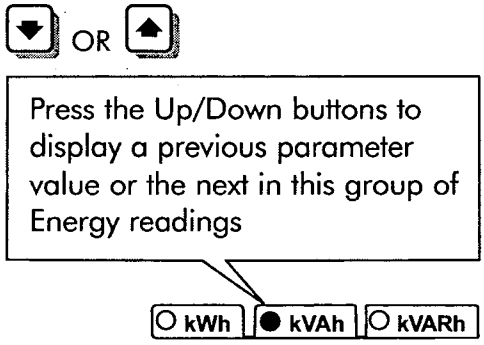


Each line of the display shows a Phase measurement. The example above shows V_{L-N}: Phase A, Phase B, and Phase C on lines 1, 2, and 3 respectively. If the bar-shaped LED below the A, B, or C is lit, then the phase value is negative.

Press the Enter button to display **Energy** readings.

3. Energy Readings

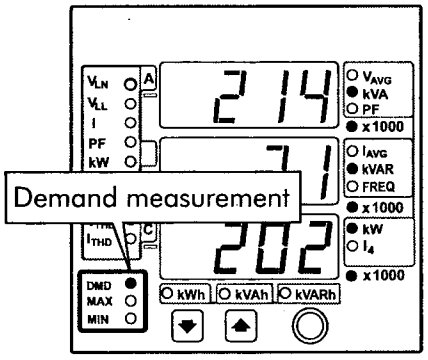


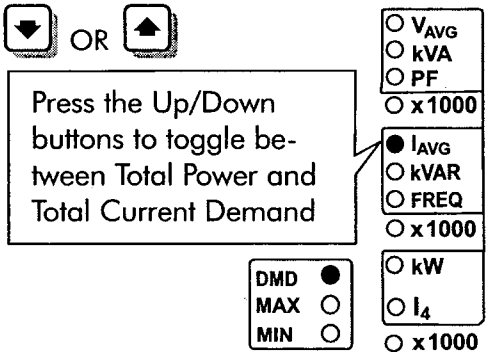


An Energy reading wraps around the three lines of the front panel display. A maximum of three digits appear on each line. The most significant digit is in the left hand corner of the first display line, and the least significant digit is in the bottom right hand corner of the third display line. In the example above, the display shows 32,876,013 kWh.

Press the Enter button to display **Demand** measurements.

4. Demand Measurements

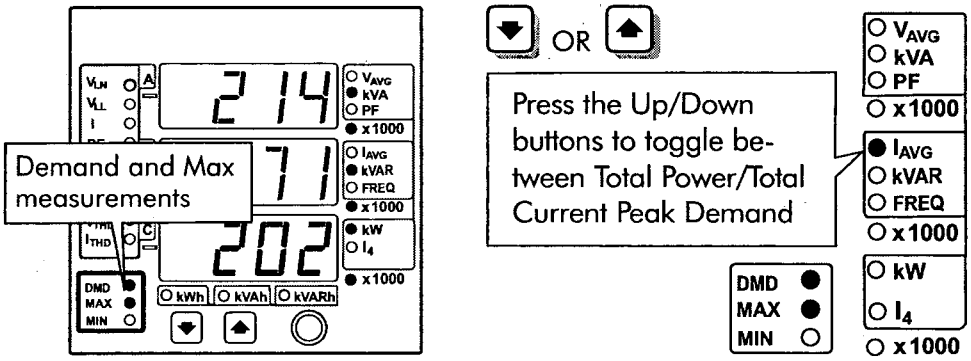




Demand measurements include Total Power Demand and Total Current Demand. The example above shows Total Power Demand for: Apparent Power (kVA); Reactive Power (kVAR) and Real Power (kW).

Press the Enter button to display **Peak Demand** measurements.

5. Peak Demand Measurements



Peak (Max) Demand measurements include Total Power Peak Demand, and Total Current Peak Demand. The example above shows Total Power Peak Demand for: Apparent Power (kVA); Reactive Power (kVAR) and Real Power (kW).

Press the Enter button to return to **System** measurements.

Reset Mode

Enter Reset mode from Display mode (default) by pressing the Enter button and holding for 2 seconds. In Reset mode, you can perform a Current (Peak) Demand reset, or a Power (Peak) Demand reset, or both at the same time.

Screen	String
Current Peak Demand Reset	Curr
Power Peak Demand Reset	PUJr
All	ALL

NOTE: You can perform an Energy Demand reset with software (e.g. WinPM5.0 SP5).

Button Functions in Reset Mode

The following table shows how the front panel buttons function in Reset mode:

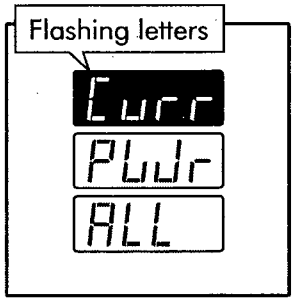
Mode	Button	Function
Reset Mode  ENTER Reset mode by pressing the Enter button and holding for 2 seconds. EXIT Reset mode with the same button sequence.		View the previous reset parameter.
		View the next reset parameter.
		Program the selected (flashing) parameter reset to the meter.

Performing a Demand Reset

The following illustrates how to reset the Current and Power Demand measurements (reset "All").

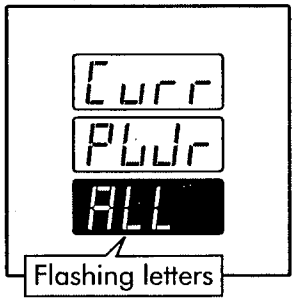
NOTE: If there is no key action or input for 60 seconds during a demand reset, then the meter defaults to Display mode.

1.



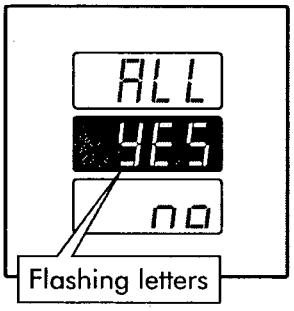
Enter Reset mode:
Press the Enter button and hold for 2 seconds to enter Reset mode from Display mode. The Reset screen appears with the top line letters flashing.

2.



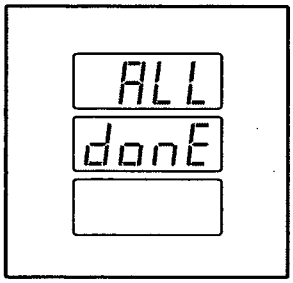
Scroll down to the ALL selection:
Use the Down button to scroll to the third line. The "All" selection flashes.

3.



Initiate the reset:
Press the Enter button to reset All (Current and Power Peak Demand measurements). A confirmation screen with a flashing "Yes" appears.

4.



Confirm the reset:
Press the Enter button to program the reset to the meter. The word "Done" appears on the second line; the third line is blank. After 1 second, the meter defaults to Display mode.

Configuration Mode

> **NOTE:** To learn about the parameters that can be configured, refer to "Meter Settings" on page 55.

Configuration mode is entered when the Up and Down buttons are pressed together and held for 2 seconds. Within Configuration mode, first use the buttons to **locate** the parameter to be edited (Configuration Select mode), then use the buttons to **edit** the displayed parameter (Configuration Edit mode).

Configuration Select mode: locate a displayed parameter that requires editing by pressing the Up or Down button.

Configuration Edit mode: edit a displayed parameter by pressing the Enter button. The parameter digit, value, or decimal point flashes (the meter automatically determines which option to flash for editing, depending on the parameter). With the Up or Down button, you can increase/decrease the digit value, move the decimal point, or select a value from a pre-programmed list. After editing, press the Enter button to set the value.

Refer to following tables to learn how the front panel buttons function in Configuration mode.

Button Functions in Configuration Select Mode

Mode	Button	Function
Configuration Select Mode  ENTER Configuration Select mode by pressing the Up and Down buttons at the same time and holding for 2 seconds. EXIT Configuration Select mode with the same button sequence.		Move to the previous parameter configuration screen.
		Move to the next parameter configuration screen.
		Enter Configuration Edit mode so you can configure the displayed parameter value.

Button Functions in Configuration Edit Mode

Mode	Button	Function
Configuration Edit Mode  ENTER Configuration Edit mode from Configuration Select mode by pressing the Enter button. EXIT Configuration Edit mode by pressing the Up and Down buttons at the same time and holding for 2 seconds. 		**Flashing Digit**: Increase the number. **Flashing Value**: View the previous list value. **Flashing Decimal Point**: Move the decimal point to the right.
		**Flashing Digit**: Decrease the number. **Flashing Value**: Display the next list value. **Flashing Decimal Point**: Move the decimal point to the left.
	 Press and hold for 2 seconds	**Flashing Digit**: Set the new digit value; the digit on the right flashes for editing. **Flashing Decimal Point**: Set the new decimal point location; the digit on the right flashes for editing.
	 Press and hold for 2 seconds	**Flashing Digit**: Set the new digit value; the digit on the left flashes for editing. **Flashing Decimal Point**: Set the new decimal point location; digit on the left flashes for editing.
		Program the edited parameter to the meter; the meter automatically returns to Configuration Select mode.

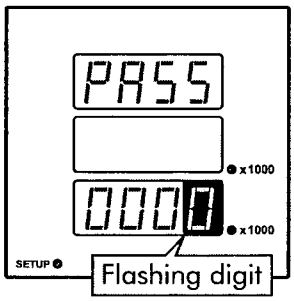
Password Security

A front panel password is required for the first parameter that you configure during an editing session. Once you have entered a valid password, you can configure multiple parameters. The default password is zero.

Example: Entering a Password

In the example below, assume that we are starting an editing session, we are attempting to configure PT1, and that we have been presented with the Password screen. In this example, our password is number 61.

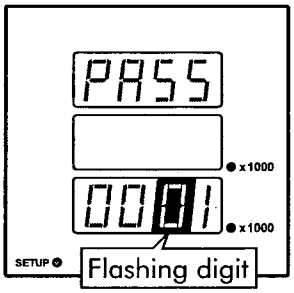
1.



(Press once)

Increment the digit by 1:
Press the Up button once to change the last digit from a zero to a one.

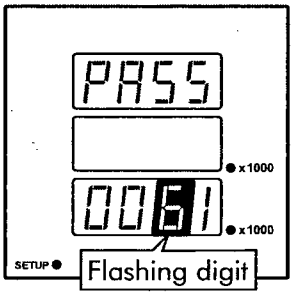
2.



...

Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

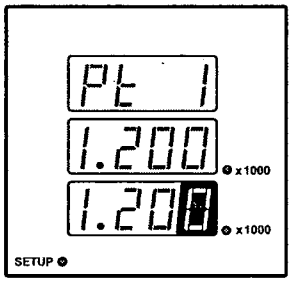
3.



(Press six times)

Increment the digit by 6:
Press the Up button six times to change the digit from a zero to a six.

4.



Send the password to the meter:
Press the Enter button. The password is accepted, and you are returned to the parameter you are configuring (in this example, Pt1).

NOTE: If you enter an incorrect password and send it to the meter, the meter returns to Configuration Select mode, NOT Configuration Edit mode. As a result, you will need to re-select the parameter for editing and re-enter the password.

Example: Configuring PT1 (PT Primary)

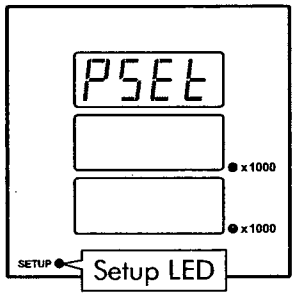
NOTE: If there is no key action or input for 60 seconds, then the meter defaults to Display mode.

In the example below, we will change the value of PT1 from 1,200 to 12,620. The meter displays four digits maximum, so these actual values display as 1.200 and 12.62 with the "x 1000" LED lit on the front panel.

First, we will select the parameter (PT1) to edit. Then, we will confirm the default password, change digit values, and re-locate the decimal point. Finally, we will program the new PT1 value to the meter.

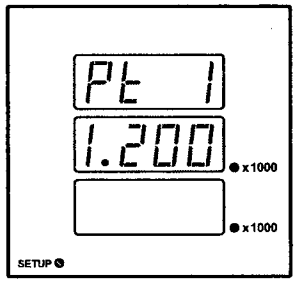
NOTE: You are required to enter a password at the beginning of an editing session. If your password is different from the default "0" you may want to refer to the previous section "Password Security."

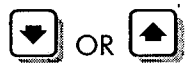
1.



Enter Configuration Select mode:
Press the Up and Down buttons together and hold for 2 seconds to enter Configuration Select mode from Display mode. The Setup LED remains lit in this mode.

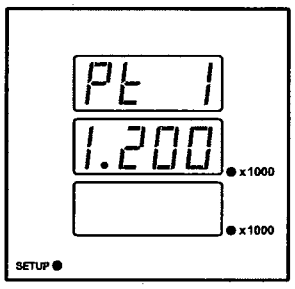
2.





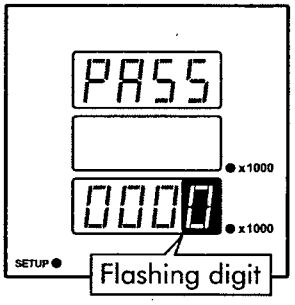
Locate the parameter:
Scroll through the parameter configuration screens with the Up or Down buttons until you locate the parameter you wish to edit (e.g. Pt1).

3.



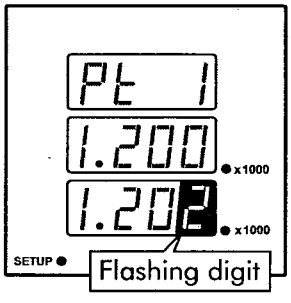
Initiate the edit (Configuration Edit mode):
Press the Enter button to edit the displayed parameter (Pt1). If this is the first edit of a configuration session, the Password screen appears; otherwise proceed to step 5.

4.



Confirm the password
Press the Enter button to send the default password (0) to the meter (or enter and send your facility password). The Pt1 screen appears with the last digit flashing.

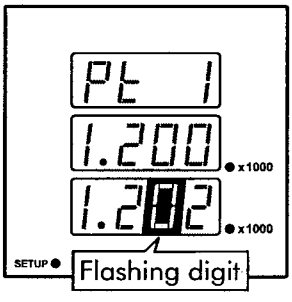
5.



(Press twice)

Increment the digit by 2:
Press the Up button twice to change the last digit from a zero to a two.

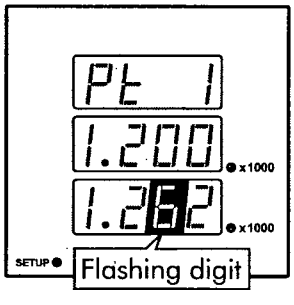
6.



...

Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

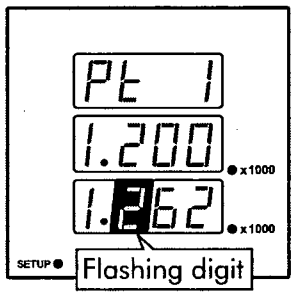
7.



(Press six times)

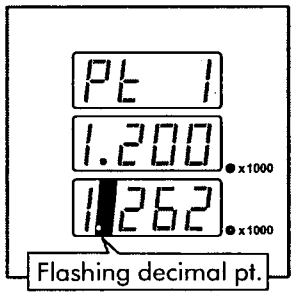
Increment the digit by 6:
Press the Up button six times to change the flashing digit from a zero to a six.

8.



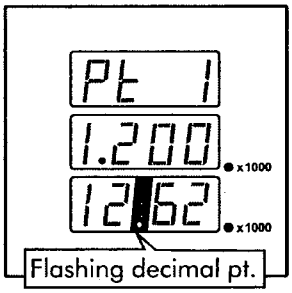
Move to the next digit:
Press the Down button and hold for 2 seconds. The digit on the left flashes for editing.

9.



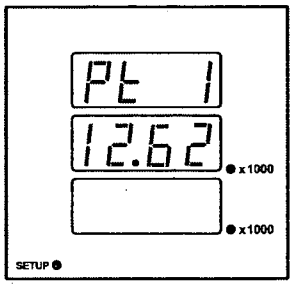
Move to the decimal point:
Press the Down button and hold for 2 seconds. The decimal point flashes for editing.

10.



Re-locate the decimal point:
Press the Up button to move the decimal point to the right. (The Down button moves it to the left).

11.



Program the Pt1 value to the meter:
Press the Enter button. The new Pt1 value displays on the second line; the third line is blank. This indicates that the new Pt1 value is programmed to the meter.

NOTE: If you attempt to configure a parameter with a number that is out of its range, the meter will not accept that number.

Meter Settings

To learn about configurable meter settings, value ranges, and defaults, refer to "Meter Settings" on page 55.

Information Mode

Enter Information mode from Display mode (default) by pressing the Enter, the Up, and the Down buttons together and holding for 2 seconds. In this mode, you can verify that the front panel LEDs operate, and view meter information e.g. firmware version etc.

Verifying that the LEDs and Display Function

When you enter Information mode, every LED on the front panel lights, and each line of the display flashes with four number eights and four decimal points per line. This lasts 3 seconds, and indicates that the front panel LEDs and display are operating.

Information Mode Screens

The following table lists the four Information mode screens:

Screen	String
Manufacturer ID Number	No string; area is used for the meter manufacturer/serial number.
Firmware Version	FWVr
Original Equipment Manufacturer (OEM)	OEM1
Meter Options (e.g. enhanced measurements, digital outputs, communications)	OPt

Button Functions in Information Mode

The following table shows how the front panel buttons function in Information mode:

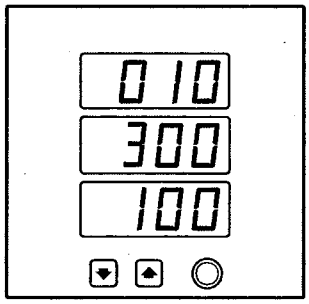
Mode	Button	Function
Information Mode  ENTER Information mode by pressing the Enter, Up and Down buttons together and holding for 2 seconds. EXIT Information mode with the same button sequence.		Move to the previous Information mode screen.
		Move to the next Information mode screen.

Viewing Meter Information

After the LED and display operation verification is completed, the meter automatically displays the first of four screens that provide meter information. Press the Up or Down buttons to scroll through these screens.

NOTE: You have 60 seconds to move from one Information screen to another. After 60 seconds, the front panel defaults to Display mode.

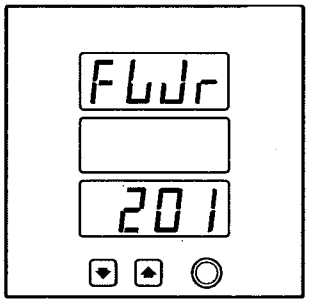
1. Manufacturer ID



This screen displays the Manufacturer ID (serial) number.

Press the Down button to display meter firmware version or the Up button to display the previous screen.

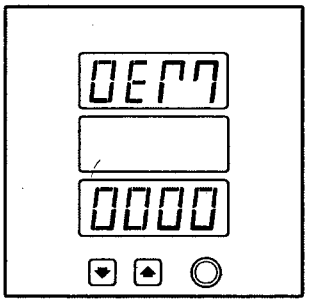
2. Firmware Version



This screen displays the meter firmware version.

Press the Down button to display the OEM identifier, or the Up button to display the previous screen.

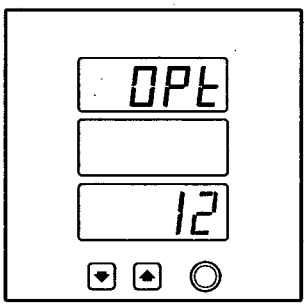
3. OEM



This screen displays the Original Equipment Manufacturer (OEM) identifier.

Press the Down button to display the Options Code or the Up button to display the previous screen.

4. Options Code



This screen displays the Options Card options code.

Press the Down button to display the Manufacturer ID or the Up button to display the previous screen.

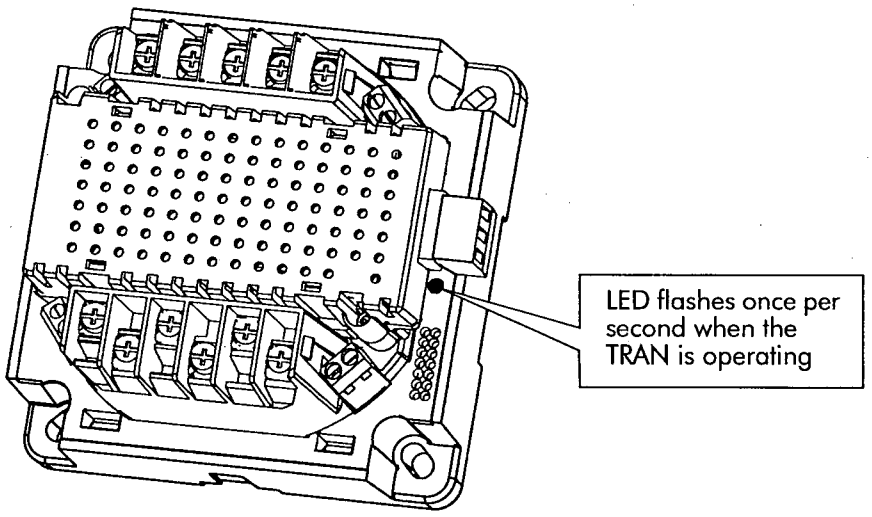
OR

Refer to the table "Options Card Combinations" on page 53 to learn about options codes, and how they relate to product codes.

Verifying Meter Operation

To verify the Integrated model operation, ensure that the meter is receiving power, and that the display shows meaningful values.

To verify the TRAN model operation, ensure that the meter is receiving power, and that the LED located below the 3-position power supply connector flashes once per second. Refer to the diagram below.



Appendix A: Specifications

The following specifications are subject to change without notice.

Standards Compliance

UL	Certified to UL 3111 Certified to CAN/USA C22.2 No. 1010-1
International	IEC 61010-1
	Measuring inputs comply with Installation Category III
	Power supply inputs comply with Installation Category II
	Device operable under Pollution Degree II
Surge Withstand	All inputs pass ANSI/IEEE C37.90-1989 surge withstand and fast transient tests
FCC	Part 15 of FCC Rules for a Class A Digital Device
CE	Marked

Category	**Standards Compliance**
Safety/ Construction	IEC1010-1 (EN61010-1): Safety requirements for electrical equipment for measurement, control and laboratory use
	CAN-CSA C22.2 No 1010-1: Canadian Standards. Listed by Underwriters Laboratories (UL).
	UL 3111-1: Measuring, Testing and Signal Generation Equipment. Listed by Underwriters Laboratories (UL).
IEC Compliance	IEC 60687-1992 0.5S* * Only the Accuracy Measurement Specifications comply with this rating
Enclosure Mounting	Integrated model: DIN (92 mm x 92 mm cutout) ANSI 4" cutout
	TRAN model: Flush mounted (has four slots in an ANSI 4" bolt pattern) DIN rail, European Standard EN50022:1977

Category	Standards Compliance
Electromagnetic Immunity	IEEE C.37-90.1-1989: IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI)
	IEC1000-4-2 (EN61000-4-2/IEC801-2): Electrostatic Discharge (B)
	IEC1000-4-3 (EN61000-4-3/IEC801-3): Radiated EM Field Immunitiy (A)
	IEC1000-4-4 (EN61000-4-4/IEC801-4): Electric Fast Transient (B)
	IEC1000-4-5 (EN61000-4-5/IEC801-5): Surge Immunity (B)
	IEC1000-4-6 (EN61000-4-6/IEC801-6): Conducted Immunity
	IEC1000-3-2 (EN61000-3-2): Limits for harmonic currents emissions (equipment input current < 16 amps per phase)
	IEC1000-3-3 (EN61000-3-3): Limitation of voltage fluctuations and flicker in low voltage supply systems for equipment with rated current < 16 amps
	IEC 61000-6-2: Electromagnetic Compatibility, Immunity for industrial environments
Electromagnetic Emission	FCC Part 15 Subpart B, Class A: Class A Digital Device, Radiated Emissions. Certified by Acme Testing Inc.
	EN55011 (CISPR 11): Radiated/Conducted Emissions (Group 1, Class A)
	EN50081-2: Electromagnetic Compatibility, emissions

c UL us

Certified to UL 3111
and CAN/CSA C22.2
No.1010-1

CE

Quality Assurance

ISO 9002-1994
Registration Cert# 002188

ISO 9000 ISO 9002 certified by QMI

Environmental

Temperature

Base Unit:	Operation: -20° C to 70° C ambient air (no ice formation) Storage: -40° C to +85° C

Humidity

Base Unit and Display Unit:	5% to 95% non-condensing

IP, NEMA Rating

When the integrated display unit or the RMD unit is mounted flush to a panel with the supplied gasket, then the front side meets **NEMA type 4, 4x and 5** (according to NEMA standards 1-10-1979 and 5-25-1988) and meets **IP 543.**

Meter Enclosure

Impact resistant, high strength polycarbonate HBS blend plastic

Input Ratings

Voltage Inputs

Inputs:	V1, V2, V3, Vref
Rated Input:	60 – 400 LN (103.5 – 690 LL) VAC RMS (three phase) 60 – 400 LN VAC (single phase) Installation category III (Distribution). Pollution degree 2.
Overload:	1500 VAC RMS continuous
Dielectric Withstand:	> 3250 VAC RMS, 60 Hz for 1 minute
Impedance:	2 Mohm/phase

Current Inputs

Inputs:	I1, I2, I3
Rated Inputs:	5 A RMS (+ 20% maximum, 300 Vrms to ground) Installation category III (Distribution). Pollution degree 2.
Overload:	120 A RMS for 1 second, non-recurring
Dielectric Withstand:	3000 V RMS, for 1 minute
Starting Current:	0.005 A RMS
Burden:	0.05 VA (typical) @ 5 A RMS

Power Supply

Standard AC/DC Power Supply

Rated Inputs:	AC: 100 – 240 VAC (± 10%), 50 – 60 Hz DC: 110 – 300 VDC (± 10%) Installation category II (Local). Pollution degree 2.
Dielectric Withstand:	2000 VAC RMS, 60 Hz for 1 minute
Burden:	30 VA typical, 50 VA maximum, 15 W maximum

Low Voltage DC Power Supply Option

Rated Inputs:	20 – 60 VDC (± 10%)
Burden:	6 W typical, 12 W maximum

I/O Specifications

Digital Outputs

2 optically isolated digital outputs for KY pulsing
Maximum forward current: 100 mA
Maximum voltage: 200 VAC/DC

RS-485 Input

Input is optically isolated

Measurement Specifications

Parameter	Accuracy ±(%rdg)*	Range
Voltage (L-N)	0.3%	0 to $1x10^6$ V
Voltage (L-L)	0.5%	0 to $1x10^6$ V
Voltage (L-L Delta)	0.8%	0 to $1x10^6$ V
Frequency	0.1%	47 – 63 Hz
Current (I1, I2, I3)	0.3%	0 to $1x10^6$ A
Current (I4 Derivation)	0.6%	0 to $1x10^6$ A
kW, kVAR, kVA	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
kWh, kVARh, kVAh	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
kW, kVA demands	IEC 687 Class 0.5**	0 to $\pm 3.3x10^7$
Power Factor @ Utility PF	1.0%	-0.01 to –100 and .0001 to 0.01
THD	1.0%	0.1 to 100

* Measurement specifications at 50Hz or 60Hz and 25°C (77°F)
** Complies with the accuracy requirements of IEC 687 class 0.5

Appendix B: Communications

This section describes the Modbus communications protocol employed by a 9200 meter in a Modbus network. It is assumed that the user is familiar with serial communications in general, and the Modbus protocol. Refer to the document *9200 Modbus Protocol* for more information.

Modbus Address Table

In the following Modbus map, many numeric measurements are scaled. Scaling is either fixed or programmable.

For an example of fixed scaling, suppose that the frequency register 40115 contains the value 5987. Since this register is scaled by "x100" the actual measured value is 59.87 Hz.

For an example of programmable scaling, suppose the "Vln a" register 40100 contains the value 4801. Note that the factory default scaling factor is "x10" so the resulting measured value is 480.1 V. If the programmable voltage scale (PVS) is reprogrammed to 0.1, then the resulting measured value is 48,010 V. The meter supports programmable scaling for voltage (PVS), current (PCS), neutral current (PnS), and power (PPS).

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40001	manufacturer's ID	UINT32	x1		See note 1.
40003	firmware revision	UINT16	x1		
40004	oem ID	UINT16	x1		See note 2.
40005	meter options	UINT32	x1		See note 3.
40007	# meter power ups	UINT16	x1		
40008	# peak demand resets	UINT16	x1		
40009	meter on-time	UINT32	x1		See note 4.
40011	# flash erase cycles	UINT32	x1		
40013	device type	UINT16	x1		See note 5.
40014	Reserved	UINT16			
	Reserved				
40100	Vln a	UINT16	PVS	x10	See note 6.
40101	Vln b	UINT16	PVS	x10	
40102	Vln c	UINT16	PVS	x10	
40103	Vln avg	UINT16	PVS	x10	
40104	Vll ab	UINT16	PVS	x10	
40105	Vll bc	UINT16	PVS	x10	
40106	Vll ca	UINT16	PVS	x10	
40107	Vll avg	UINT16	PVS	x10	
40108	I a	UINT16	PCS	x10	See note 7.
40109	I b	UINT16	PCS	x10	
40110	I c	UINT16	PCS	x10	
40111	I avg	UINT16	PCS	x10	
40112	I demand	UINT16	PCS	x10	
40113	I peak demand	UINT16	PCS	x10	
40114	I4	UINT16	PnS	x10	See note 8.
40115	Frequency	INT16	x100		
40116	PF sign total	INT16	x100		
40117	PF sign a	INT16	x100		
40118	PF sign b	INT16	x100		
40119	PF sign c	INT16	x100		
40120	kW total	INT16	PPS	x1	See note 9.
40121	kVAR total	INT16	PPS	x1	
40122	kVA total	INT16	PPS	x1	
40123	kW a	INT16	PPS	x1	
40124	kW b	INT16	PPS	x1	

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40125	kW c	INT16	PPS	x1	
40126	kVAR a	INT16	PPS	x1	
40127	kVAR b	INT16	PPS	x1	
40128	kVAR c	INT16	PPS	x1	
40129	kVA a	INT16	PPS	x1	
40130	kVA b	INT16	PPS	x1	
40131	kVA c	INT16	PPS	x1	
40132	kW demand	INT16	PPS	x1	
40133	kW peak demand	INT16	PPS	x1	
40134	kVAR demand	INT16	PPS	x1	
40135	kVA demand	INT16	PPS	x1	
40136	kVAR peak demand	INT16	PPS	x1	
40137	kVA peak demand	INT16	PPS	x1	
40138	kWh del	UINT32	x1		
40140	kWh rec	UINT32	x1		
40142	kVARh del	UINT32	x1		
40144	kVARh rec	UINT32	x1		
40146	kVAh del+rec	UINT32	x1		
40148	V1 THD	UINT16	x10		
40149	V2 THD	UINT16	x10		
40150	V3 THD	UINT16	x10		
40151	I1 THD	UINT16	x10		
40152	I2 THD	UINT16	x10		
40153	I3 THD	UINT16	x10		
40154	I a demand	UINT16	PCS	x10	
40155	I b demand	UINT16	PCS	x10	
40156	I c demand	UINT16	PCS	x10	
40157	I a peak demand	UINT16	PCS	x10	
40158	I b peak demand	UINT16	PCS	x10	
40159	I c peak demand	UINT16	PCS	x10	
40160	kWh a del	UINT32	x1		
40162	kWh b del	UINT32	x1		
40164	kWh c del	UINT32	x1		
40166	kWh a rec	UINT32	x1		
40168	kWh b rec	UINT32	x1		
40170	kWh c rec	UINT32	x1		
	Reserved				

Modbus Addr	Meter Measurement	Format	Scale	Default Scale	Description
40500	Expansion, SnapOn 1, 25 regs	UINT16	x1		
40700	Expansion, SnapOn 2, 25 regs	UINT16	x1		

Read-Write Configuration Map

Modbus Addr	Meter Configuration	Format	Scale	Default	Description
44000	Configuration via display password	UINT16	x1	0	0 – 9999
44001	Volts Mode	Enumerated (See "Enumerated Setup" on page 52)		5 = Delta direct	0 = 4W (4-Wire WYE) 1 = dELt (Delta) 2 = 2W (Single Phase) 3 = dEM (Demonstration) 4 = 3W (3-Wire WYE) 5 = dELd (Delta direct)
44002	PT Primary	UINT16	x1	480	1 – 65535
44003	PT Secondary	UINT16	x1	480	
44004	CT Primary	UINT16	x1	400	
44005	CT Secondary	UINT16	x1	5	
44006	V1 Polarity	Enumerated (See "Enumerated Setup" on page 52)		0 = Normal	0 = nor (Normal) 1 = inv (Inverted)
44007	V2 Polarity				
44008	V3 Polarity				
44009	I1 Polarity				
44010	I2 Polarity				
44011	I3 Polarity				
44012	Programmable Voltage Scale (PVS)	Enumerated (See "Enumerated Setup" on page 52)		4 = 10	0 = 0.001 1 = 0.01 2 = 0.1 3 = 1 4 = 10 5 = 100 6 = 1000
44013	Programmable Current Scale (PIS)				
44014	Programmable Neutral Current Scale (PnS)				
44015	Programmable Power Scale (PPS)			1 = 0.01	
44016	Demand Sub Interval	UINT16	x1	15	1 – 60 minutes
44017	Demand #Sub Intervals	UINT16	x1	1	1 – 5

Modbus Addr	Meter Configuration	Format	Scale	Default	Description
44018	Kt, Digital Output #1	UINT16	x10	1.0	0.1 - 999.9
44019	Kt, Digital Output #2	UINT16	x10		
44020	Kt, Irda	UINT16	x10		
44021	Output Mode, Digital Output #1	Enumerated (See "Enumerated Setup" on page 52)		0 = kWh	0 = kWh 1 = kVAh 2 = kVARh 3 = Ext1 4 = Ext2 See note 10.
44022	Output Mode, Digital Output #2			2 = kVARh	
44023	Output Mode, Irda			3 = Ext1	
44024	Baud Rate	Enumerated (See "Enumerated Setup" on page 52)		3 = 9600bps	0 = 1200bps 1 = 2400bps 2 = 4800bps 3 = 9600bps 4 = 19200bps
44025	Protocol	Enumerated (See "Enumerated Setup" on page 52)		1 = MODBUS	0 = PML 1 = MODBUS See note 11.
44026	Unit ID	UINT16	x1	100 plus the last 2 digits of the Man. ID #	1 – 247
44027	RTS Delay	UINT16	x1	20	0 – 1000 milliseconds See note 12.
44028	Display Scroll Time	UINT16	x1	0	0 – 30 seconds See note 13.
44029	Display Refresh Period	UINT16	x1	2	1 – 6 seconds See note 14.

Read-Write Control Map

Modbus Addr[15]	Meter Control	Format	Scale	Description
42001	Energy Reset	UINT16	x1	Reset kWh, kVAh, and kVARh to 0.
42002	Peak Power Demand Reset	UINT16	x1	Reset kW, kVA, and kVAR peak demand to 0.
42003	Peak Current Demand Reset	UINT16	x1	Reset I peak demand.
42004	Digital Output #1	UINT16	x1	Refer to "Digital Output Control" on page 52.
42005	Digital Output #2	UINT16	x1	

Notes

1. Manufacturer's identification is the serial number of the meter. It has the format of the YYMM##### where YY and MM represent the manufacture date.
2. Identifies the Original Equipment Manufacturer (OEM).
3. Options codes that identify meter options. See "Options Card Combinations" on page 53.
4. Number of seconds that the meter has been powered up.
5. Device identification.
6. PVS = Programmable Voltage Scale.
7. PCS = Programmable Current Scale.
8. PnS = Programmable Neutral Current Scale.
9. PPS = Programmable Power Scale.
10. Digital output modes are: kW pulsing, kVAR pulsing, kVA pulsing, and manual control.
11. The RTS Delay parameter defines the delay between the 9200 becoming ready to transmit data on the serial port, and the 9200 transmitting the data.
12. Number of seconds that a display is shown before scrolling to the next, 0 = no scrolling (disabled).
13. Number of seconds that a measurement value is held on the display before being refreshed; limited to 1-6 seconds.
14. To use the Read-Write Control Map, it is recommended that your meter has firmware version 202 or later. For detailed information, contact Technical Services.

Modbus Data Formats

The 9200 meter supports Modbus Holding registers (address range 4xxxx). There are three types of parameters:

- Metered Parameters
- External Control/Reset Parameters
- Setup Parameters
  - Enumerated Setup Parameters
  - Numeric Bounded Parameters

Metered Parameters

All the values measured by the meter are available through the Modbus protocol. Most of these parameters have fixed scaling. However, the scaling of voltage, current and power values is configurable via a numeric setup register.

There are three blocks. Factory registers such as serial number, firmware revision, etc. are located between addresses 40001 and 40099. Measured quantities such as voltage, current, power and energy are located between addresses 40100 and 40499. The register addresses for the first Feature Pack start at 40500; the register addresses for the second Feature Pack start at 40600. Consult the Feature Pack documentation for the contents of these registers.

The meter supports 4 data formats:

- Unsigned 16-bit Integer Format
- Signed 16-bit Integer Format
- Unsigned 32-bit Integer Format
- Signed 32-bit Integer Format

16-bit Integer Format

Unsigned and Signed 16-bit Integer Formats are the simplest formats. If the format is unsigned the value range for the output registers is 0 to 65535. If the format is signed, the value range is -32767 to +32767 (two's-complement).

32-bit Integer Format

To accommodate values that can reach beyond the 16-bit limitation, the 9200 provides 32-bit integer format. In Signed and Unsigned 32-bit Integer Formats, the 32-bit value is split into two consecutive 16-bit registers. The first register is the low-order word and the second register is the high-order word.

To interpret the value, take the second register (high-order word) and multiply by 65536. Then add the first register (low-order word). The formula is:

value = (second register x 65536) + first register

In Unsigned 32-bit Integer Format, both the high-order and low-order registers are unsigned 16-bit integers.

Example

Value 12345678 is passed in *unsigned* 32-bit integer format:

12345678 = 00BC614E Hex
First Register = 614E Hex (unsigned) = 24910
Second Register = 00BC Hex (unsigned) = 188
value = (188 x 65536) + 24910 = 12345678

In Signed 32-bit Integer Format, the high-order register is a signed 16-bit number, but the low-order register is unsigned.

Example

Value -12345678 is passed in *signed* 32-bit integer format:

-12345678 = FF439EB2 Hex
First Register = 9EB2 Hex (unsigned) = 40626
Second Register = FF43 Hex (signed) = -189
value = (-189 x 65536) + 40626 = -12345678

Control Parameters

There are two types of control parameters in the meter which can be accessed via Modbus: Digital Output Control and Accumulation Reset registers. This section describes how the parameters appear to the Modbus protocol.

Digital Output Control

Registers 42004 and 42005 are available to remotely control the meter's digital outputs. A non-zero value written to these registers places the corresponding digital output in an asserted state. Conversely, a logic zero written to one of these registers de-asserts the output. To use the Read-Write Control Map, it is recommended that your 9200 meter has firmware version 202 or later.

Reset Accumulation

Registers 42001 to 42003 are available to remotely reset energy accumulation and maximum demand values. Writing any value to one of these registers causes the corresponding parameter to reset. If read, these registers will return an error.

Setup Parameters

Meters can be configured remotely via Modbus communications. Registers 4400 to 44029 offer enumerated or numeric parameters.

Enumerated Setup

Enumerated registers are used where a list of options are available. For example, the Volts Mode register has five options: 4W-WYE, DELTA, SINGLE, DEMO, 3W-WYE and DELTA DIRECT. These options are represented by a numeric relationship; for example, the following relationship is defined for the Volts Mode register:

0 = 4W-WYE
1 = DELTA
2 = SINGLE
3 = DEMO
4 = 3W-WYE
5= DELTA DIRECT

Numeric Setup

The numeric setup parameters include: PT/CT ratios, demand intervals, digital output pulse values, unit ID, password, and RTS delay.

All 9200 numeric parameters are represented in Unsigned 16-bit Integer Format. See the register map for details. Note that all parameters have bounds. For example, unit IDs must be in the range 1 to 247; any attempt to write a value outside this range will fail.

Exception Responses

If a Modbus master device sends an invalid command to a meter or attempts to read an invalid holding register, an exception response is generated. The exception response follows the standard packet format. The high order bit of the function code in an exception response is set to 1. The data field of an exception response contains the exception error code. Refer to the table below.

Code	Name	Meaning
01	Illegal Function	An invalid command is contained in the function field of the request packet. The meter only supports Modbus functions 3 and 16.
02	Illegal Address	The address referenced in the data field is an invalid address for the specified function. This could also indicate that the registers requested are not within the valid register range of the meter.
03	Illegal Value	The value referenced in the data field is not allowed for the referenced register on the meter.

Appendix C: Configuration Reference Tables

Options Card Combinations

This table describes Options Card feature sets, and the information on the Options Code screen. Refer to "Viewing Meter Information" on page 39.

Options Code	Part # Suffix	Description
7	A0AN	Standard Measurements, RS-485
8	A0AP	Enhanced Package #1, RS-485
9	A0AR	Enhanced Package #2, RS-485
10	A0BN	Standard Measurements, two pulse outputs, RS-485
11	A0BP	Enhanced Package #1, two pulse outputs, RS-485
12	A0BR	Enhanced Package #2, two pulse outputs, RS-485

Standard Measurements and Enhanced Packages 1 & 2

Stnd	EP1	EP2	Parameter	Displays	Pulses	Comms
●	●	●	Volts L-N Per Phase	●		●
●	●	●	Volts L-L Per Phase	●		●
●	●	●	Volts L-N Avg	●		●
●	●	●	Volts L-L Avg	●		●
●	●	●	Amps Per Phase	●		●
●	●	●	Amps Avg	●		●
	●	●	Power Peak Demand (W)	●		●
	●	●	Energy Del. (Imp.) (Wh)	●	●	●
	●	●	Energy Rec. (Exp.) (Wh)			●
		●	Energy Del. Per Phase (Imp.) (Wh)			●
		●	Energy Rec. Per Phase (Exp.) (Wh)			●
	●	●	Power Total (W)	●		●
	●	●	Frequency	●		●
	●	●	Power Factor Total	●		●
	●	●	Amps Avg. Demand	●		●
	●	●	Amps Demand Per Phase			●
	●	●	Amps Avg. Peak Demand	●		●
	●	●	Amps Peak Demand Per Phase			●
	●	●	Amps Neutral (I4)	●		●
		●	Power Factor Per Phase	●		●
		●	Power Per Phase (W)	●		●
		●	Reactive Energy Del. (Imp.) (VARh)	●	●	●
		●	Reactive Energy Rec. (Exp.) (VARh)			●
		●	Apparent Energy (VAh)	●	●	●
		●	Reactive Power Total (VAR)	●		●
		●	Apparent Power Total (VA)	●		●
		●	Reactive Power Per Phase (VAR)	●		●
		●	Apparent Power Per Phase (VA)	●		●
		●	Power Demand (W)	●		●
		●	Reactive Power Demand (VAR)	●		●
		●	Apparent Power Demand (VA)	●		●
		●	Reactive Power Peak Demand (VAR)	●		●
		●	Apparent Power Peak Demand (VA)	●		●
		●	THD Voltage Per Phase	●		●
		●	THD Current Per Phase	●		●

Meter Settings

These settings can be configured with the meter front panel or software.

	String	Description	Range (Values)	Default
MODE	tYPE	Volts Mode	4W (4-Wire WYE) dELt (Delta) 2W (Single Phase) dEM (Demonstration) 3W (3-Wire WYE) dELd (Delta direct)	Delta direct
PTs	Pt 1	PT1 (Primary)	1 to (65.53 x 1000 LED)	480
	Pt2	PT2 (Secondary)	1 to (65.53 x 1000 LED)	480
CTs	Ct 1	CT1 (Primary)	1 to (65.53 x 1000 LED)	400
	Ct2	CT2 (Secondary)	1 to (65.53 x 1000 LED)	5
POLARITY	UPL 1	V1 Polarity (Phase 1 voltage polarity)	nor(Normal); inv(Inverted)	Normal
	UPL2	V2 Polarity (Phase 2 voltage polarity)	nor (Normal); inv (Inverted)	Normal
	UPL3	V3 Polarity (Phase 3 voltage polarity)	nor (Normal); inv (Inverted)	Normal
	CPL 1	I1 Polarity (Phase 1 current polarity)	nor (Normal); inv (Inverted)	Normal
	CPL2	I2 Polarity (Phase 2 current polarity)	nor (Normal; inv (Inverted)	Normal
	CPL3	I3 Polarity (Phase 3 current polarity)	nor (Normal); inv (Inverted)	Normal
DEMAND	dPr	Demand Sub Interval	1 – 60 min	15
	ndPr	Number of Demand Periods	1 – 5	1
COMMUNICATIONS	Prot	Protocol	PML†; Mod (Modbus RTU)	Modbus
	bAud	Baud Rate	1200, 2400, 4800, 9600, 19200	9600
	un id	Unit ID	1 – 247	100 plus the last 2 digits of the Manu-facturer ID #
	rtS	RTS Delay	0 – 1000 milliseconds	20

	String	Description	Range (Values)	Default
MODBUS SCALING	PUS	Voltage Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
	PCS	Current Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
	PPS	Power Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	1
	PnS	Neutral Scale	0.001, 0.01, 0.1, 1, 10, 100, 1000	10
DIGITAL OUTPUTS	out 1	Output Mode Digital #1	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	Wh
	tc 1	Time Constant 1 (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
	out2	Output Mode Digital #2	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	VARh
	tc2	Time Constant 2 (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
	otIr	Output Mode, Irda	*Wh, VAh, VARh See notes below. **Ext 1, Ext 2	Ext 1
	tcIr	Time Constant Irda (kT)††	0.1 – 999.9 (only 1 digit after the decimal pt. permitted)	1.0
DISPLAY	dScr	Display Scroll Time	0 – 30 seconds (0 = disable)	0
	dUPd	Display Refresh Period	1 – 6 seconds	2
SECURITY	PSEt	Password	0 – 9999	0

Notes

Programmable Meter Language (PML) Protocol

† ION compatible protocol for use with an WinPM.Net system and other ACCESS meters.

Digital Outputs

* The units displayed on the front panel are Wh, VAh, and VARh with the "x 1000" LED lit. These indicate kWh, kVAh, and kVARh respectively.

** In Ext 1 or Ext 2 mode, the digital pulse outputs are reserved for Feature Packs.

†† Time Constant, sometimes called kT, is the number of units (kWh, kVAh, kVARh) per output transition. The digital output uses KY pulsing. This means that the relay changes from open to closed or from closed to open whenever kT units have been measured (20 transitions/second maximum).

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SPRING CREEK WELL 7

SECTION: **Transformers**

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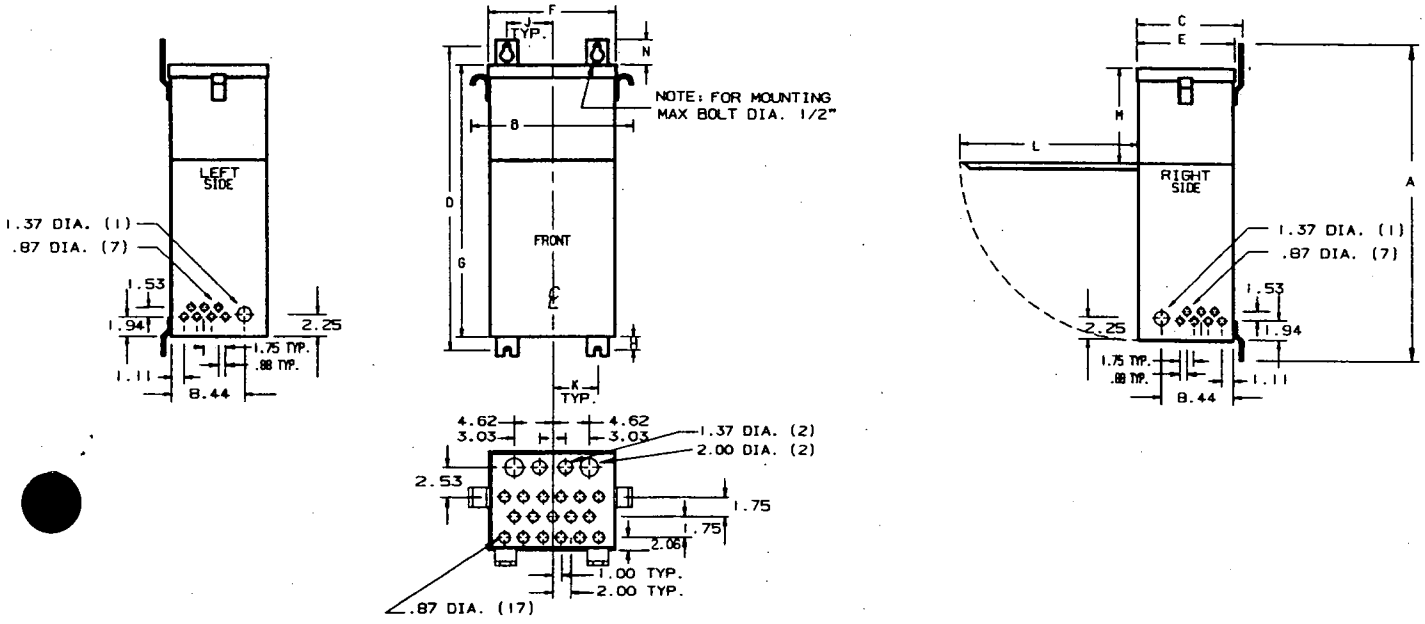


DIMENSIONS IN INCHES														
KVA	A MAX	B MAX	C MAX	D	E	F	G	H	J	K	L MIN	M	N	WT.
15	34.38	17.13	12.38	32.88	10.68	14.18	30.06	1.50	4.00	4.00	15.75	13.69	2.63	240

KVA	QUANTITY	CATALOG NUMBER	VOLTAGE		QUANTITY	TAPS
			PRIMARY	SECONDARY		
15	1	1LPC015	480	120/240	2-5%	FCBN

DRAWINGS

( ) APPROVAL

(X) RECORD

( ) OTHER

JOB	SPRING CREEK WELL 7		
P.O.	836007185P	REXEL PACIFIC	
TIE	T-LA	ENG. LOC.	TITLE DRY TYPE GENERAL PURPOSE TRANSFORMER SINGLE PHASE, 15 KVA.
S.O.		MFG. LOC.	DWG NO.
SIEMENS ENERGY & AUTOMATION, INC. ALPHARETTA, GEORGIA 30202		DWG. FILE	A-4-701862

INSTALLATION, OPERATION AND MAINTENANCE OF GENERAL PURPOSE DRY TYPE TRANSFORMERS

600 VOLTS AND BELOW

1. GENERAL

The installation, operation and maintenance of dry type transformers should be performed by an electrician or other qualified personnel who are familiar with national and local electrical codes and with the potential shock hazards associated with electrical equipment.

These instructions cover two types of enclosure construction: ventilated and encapsulated.

A) Ventilated units are NEMA type 2 enclosures suitable for indoor use. They are UL-3R listed and CSA certified for outdoor use with the addition of an optional weather shield kit. The proper weather shield part number is listed on the nameplate.

B) Encapsulated units are NEMA 3R enclosures suitable for either indoor use in harsh environments or for outdoor use.

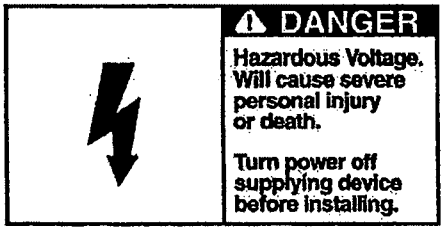
This transformer is ready for installation and operation. It must be installed per the National Electrical Code® and local code requirements. It is recommended that these instructions be read carefully prior to installation and kept for future reference.

2. INSPECTION AND HANDLING

The transformer should be inspected carefully upon receipt to check for any visible or concealed damage that may have occurred during shipment. If damage is found, a claim should be filed immediately with the carrier.

Single and three phase transformers, in smaller KVA sizes, are provided with lifting ears. Larger KVA sizes are palletized and can be lifted with appropriately sized fork lifts or hoisted by the lifting lug bolts provided on the core frame after removal of the top cover. Incorrect handling can bend the enclosure or cause other damage or result in personal injury.

3. INSTALLATION



WARNING: There is a potential danger of electrical shock when working on electrical equipment! Make sure power is off before installation. Replace all covers before energizing transformer.

A) Ventilated Dry Type Transformers

Ventilated units can be installed indoors or outdoors. Outdoor installation requires the addition of a weather shield to be UL-3R listed. For outdoor installation, check electrical codes for the proper protection of transformer against adverse weather conditions.

Ventilated units should be installed in an upright position on walls (optional wall mounting brackets are available for certain KVA sizes), beams, platforms, floors or other structures capable of supporting their weight.

The ambient air should be dry and free from dust, dirt, corrosive fumes, heat or other adverse conditions. The unit should be installed a minimum of 6" from the wall or other obstructions that might prevent proper air flow through the vents.

Ventilated transformers are designed for operation in an average ambient temperature of 30 degrees C (86° F) and a maximum of 40 degrees C (104° F) not to be exceeded.

Larger KVA sizes contain "shipping bolts" to prevent damage during shipping. These should be removed just prior to installation of the unit.

B) Encapsulated Dry Type Transformers

Encapsulated units can be installed indoors or outdoors. When installed outdoors, these units should be installed with the wiring compartment down to prevent the entrance of moisture. Some encapsulated units have a top entry wiring compartment and can be installed vertically (wiring compartment up).

For indoor floor mounting of an encapsulated unit that has a bottom entry wiring compartment, the unit can be installed horizontally (on its back side) for ease of making wire connections.

4. ELECTRICAL CONNECTIONS

WARNING: Danger of electrical shock! Do not remove parts or make connections while the transformer is energized.

Refer to the transformer nameplate label or enclosed wiring diagram for primary and secondary voltage combinations, frequency and number of phases. Tap connections and voltage combinations are also listed on the diagram or nameplate.

CAUTION: Do not make connections other than those shown. The transformer must be as large (KVA) as the load it must operate. Never exceed the nameplate rating as this could result in overheating, reduced life expectancy, or in worst cases, fire.

Proper assembly of the connector (lug) to the transformer terminal is extremely important. Make certain that the connector is sized for the cable and is of the correct type to match cable and terminal metals. Always follow recommendations of the connector (lug) manufacturer. Space and insulate connectors per the NEC®.

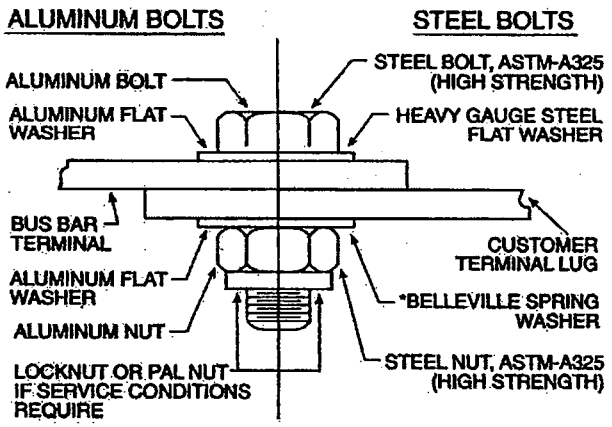
INSTRUCTIONS FOR ALUMINUM BUS BAR CONNECTIONS

NOTE: Single phase 37.5 thru 100 KVA and three phase 27 thru 225 KVA transformers have copper bus terminals. The following steps should be followed when making connections to transformers with ALUMINUM BUS BAR TERMINALS.

1) Remove oxide form joint area of transformer bus terminal. This may be done with a wire brush or emery cloth. Other tools may be used but care should be taken to avoid scratching or gouging terminal.

2) Coat terminal area with joint compound, following manufacturer's instructions.

3) Make connections using one of the bolting methods shown.



CAUTION: Care should be taken to avoid shearing aluminum bolts. Follow manufacturer's maximum torque rating.

* Place cup in washer toward bus bar. Draw washer to flat position for proper torque.

5. GROUNDING

All dry type transformers have a ground stud in the enclosure. The transformer enclosure should be solidly grounded to protect personnel. The customer supplied grounding conductor should have a current-carrying capacity to meet NEC® requirements.

6. MAINTENANCE

Non-ventilated encapsulated styles only require periodic wiping of dust and dirt from the outside of the case under normal conditions and environments. Adverse conditions may require more frequent inspections.

Ventilated units should be inspected within one to three months after initial installation. Air ducts should be kept clear at all times. Vacuum cleaners or low pressure compressed dry air can be used to remove dirt or dust. A regular inspection schedule for cleaning and maintenance will help ensure added safety and longer transformer life.

If a dry type transformer accidentally gets wet, it must be cleaned and thoroughly dried before energizing. Otherwise, complete failure could result!

CAUTION: Never perform internal maintenance while the unit is energized!

7. STORAGE

Both ventilated and encapsulated transformers should be stored in a clean, dry area. Care should be taken to prevent moisture or condensation from entering the transformer, and vent openings should be covered on ventilated units. If stored outside, the transformer must be covered and protected from water, dust and other airborne contaminants.

8. LIMITED PRODUCT WARRANTY

All dry type transformers are warranted against defects in materials and workmanship. This is a limited product warranty and certain conditions apply. Please contact the manufacturer for further information on warranty claims.

NOTICE: These instructions are general in nature and may not cover all variations in transformer design or conditions of installation, operation and maintenance in enough detail to meet customer needs. Additional instructions may be included with this transformer. If you need further information or should a problem arise, please contact the manufacturer.

SIEMENS

O & M Manuals SECTION COVER SHEET

JOB

SPRING CREEK WELL 7

SECTION: **Circuit Breakers**

CONTENTS:

Description	Pgs.
QP Frame Breaker Cutsheets	2

Total Pages this Section: **2**

O & M Manuals

ENGINEER: N/A

CONTRACTOR: N/A

DISTRIBUTOR: REXEL PACIFIC

DATE: 6/6/06

SO Number: 9566312
PO Number: 836007185P

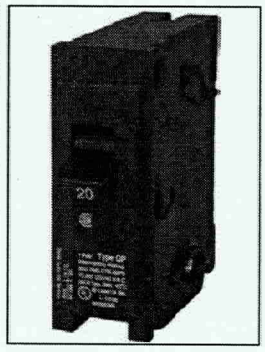
Quotation Number: 5472-2819J-10
MFR #: 59270

Circuit Breakers

Type QP with INSTA-WIRE

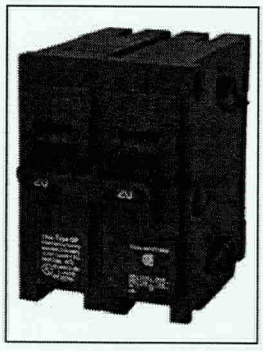
1-Pole Plug-In (120V AC)①

Continuous Current Rating @ 40° C	Type QP 10,000A IR		Type QPH 22,000A IR		Type HQP 65,000A IR	
	Catalog Number	List Price $	Catalog Number	List Price $	Catalog Number	List Price $
15	Q115②	24.50	Q115H②	48.00	Q115HH■②	89.00
20	Q120②	24.50	Q120H②	48.00	Q120HH■②	89.00
25	Q125	24.50	Q125H■	48.00	Q125HH■	89.00
30	Q130	24.50	Q130H	53.00	Q130HH■	103.00
35	Q135■	24.50	Q135H■	53.00	Q135HH■	103.00
40	Q140	24.50	Q140H	53.00	Q140HH■	103.00
45	Q145■	24.50	Q145H■	53.00	Q145HH■	103.00
50	Q150	24.50	Q150H	53.00	Q150HH■	103.00
60	Q160	24.50	Q160H■	53.00	Q160HH■	103.00
70	Q170	51.00	Q170H■	69.00	Q170HH■	129.00



2-Pole Plug-In (Common-Trip 120/240V AC)①

15	Q215	53.00	Q215H	108.00	Q215HH	226.00
20	Q220	53.00	Q220H	108.00	Q220HH	226.00
25	Q225	53.00	Q225H■	108.00	Q225HH■	226.00
30	Q230	53.00	Q230H	108.00	Q230HH	226.00
35	Q235	53.00	Q235H■	108.00	Q235HH■	241.00
40	Q240	53.00	Q240H	108.00	Q240HH■	241.00
45	Q245	53.00	Q245H■	108.00	Q245HH■	241.00
50	Q250	53.00	Q250H	108.00	Q250HH	241.00
60	Q260	53.00	Q260H	108.00	Q260HH	241.00
70	Q270	109.00	Q270H	173.00	Q270HH	402.00
80	Q280	157.00	Q280H■	243.00	—	—
90	Q290	157.00	Q290H	243.00	Q290HH■	497.00
100	Q2100	157.00	Q2100H	243.00	Q2100HH	497.00
110	Q2110	324.00	Q2110H	829.00	Q2110HH■	1645.00
125	Q2125	324.00	Q2125H	829.00	Q2125HH	1645.00

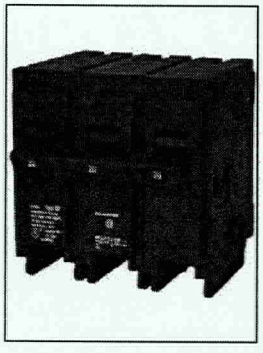


2-Pole Plug-In (Common-Trip 240V AC)①③

15	Q215R	157.00	—	—	—	—
20	Q220R	157.00	—	—	—	—
30	Q230R	157.00	—	—	—	—
40	Q240R	157.00	—	—	—	—
50	Q250R	157.00	—	—	—	—
60	Q260R	157.00	—	—	—	—
70	Q270R	173.00	—	—	—	—
100	Q2100R■	234.00	—	—	—	—

3-Pole Plug-In (Common-Trip 240V AC)①

15	Q315	189.00	Q315H	290.00	Q315HH■	381.00
20	Q320	189.00	Q320H	290.00	Q320HH	381.00
25	Q325	189.00	Q325H■	279.00	—	
30	Q330	189.00	Q330H	290.00	Q330HH	381.00
35	Q335	189.00	—	—	—	
40	Q340	189.00	Q340H	290.00	Q340HH	444.00
45	Q345	189.00	—	—	—	
50	Q350	189.00	Q350H	290.00	Q350HH	444.00
60	Q360	189.00	Q360H	290.00	Q360HH	444.00
70	Q370	238.00	Q370H	355.00	Q370HH■	477.00
80	Q380	285.00	Q380H	394.00	Q380HH■	534.00
90	Q390	285.00	Q390H	394.00	Q390HH■	534.00
100	Q3100	285.00	Q3100H	394.00	Q3100HH	534.00



QP / QPH / HQP Internal Accessories

Control Voltage AC	Catalog Number	Field/Factory Installed	List Price $
120V Shunt Trip	add suffix ...00S01■	Factory	134.00 (adder)
24V Shunt Trip	add suffix ...00S07■	Factory	134.00 (adder)
Auxiliary Switch	add suffix ...01■	Factory	74.00 (adder)
1-Pole Padlocking Device	ECPLD1	Field	7.40
2-Pole Padlocking Device	ECPLD2	Field	7.50
Handle Block	ECHBD1	Field	6.70

Shipping Weights

Number of Poles	Number Per Carton	Shipping Weight (lbs.)
QP, QPH, HQP		
1	12	4
2	6	4
3	4	4

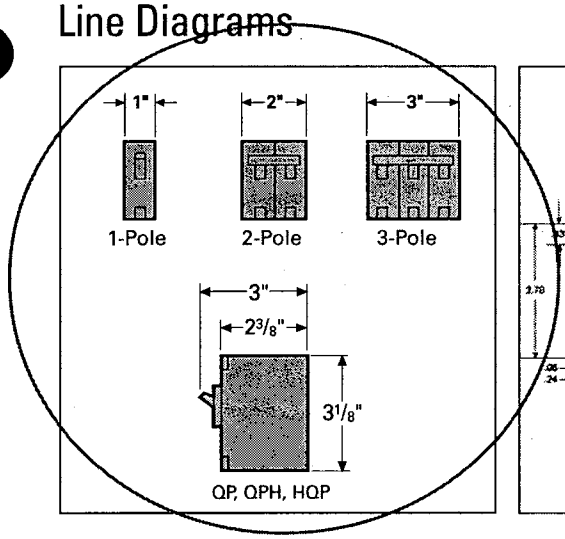
■ Built to order. Allow 2-3 weeks for delivery

①HACR rated.

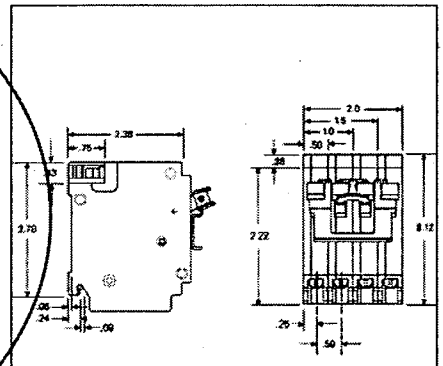
②UL Listed for frequent switching applications (SWD). 120V AC Fluorescent Lighting.

③UL Listed for use on 3 phase grounded "B" systems — 10,000 for this application.

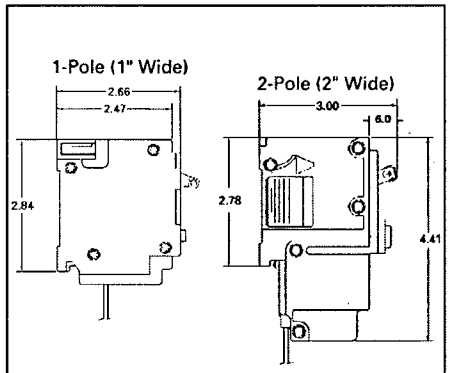
Line Diagrams



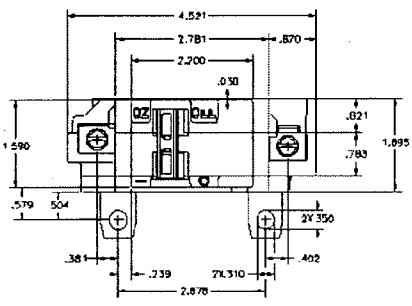
QP, QPH, HQP



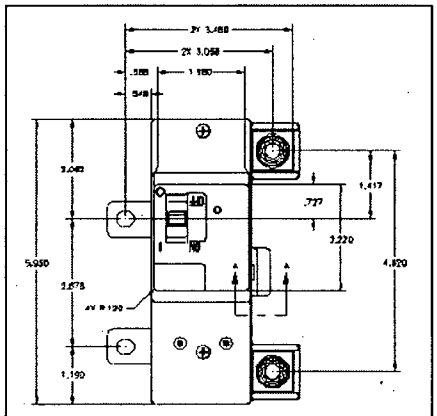
Type QT



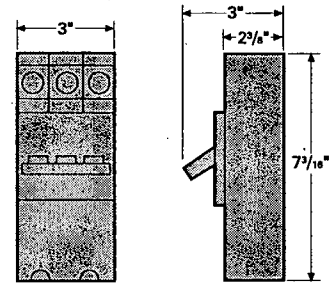
Type QPF, QPHF, QE, QAF, QAFH



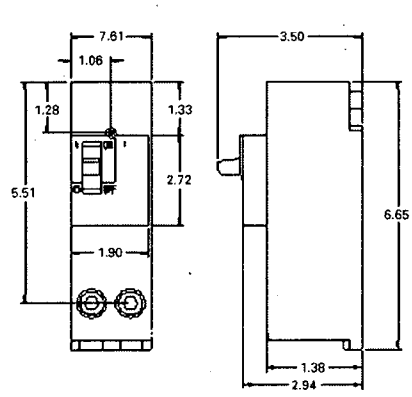
Type EQ8681, EQ8682



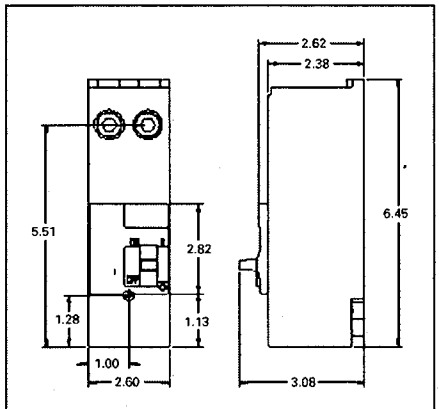
Type EQ8693, EQ8695, EQ8696



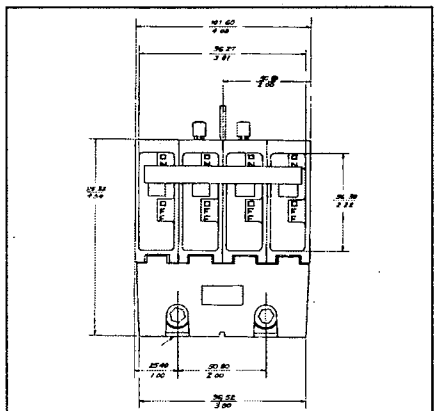
Type QPJ



Type QN, QNH, HQN



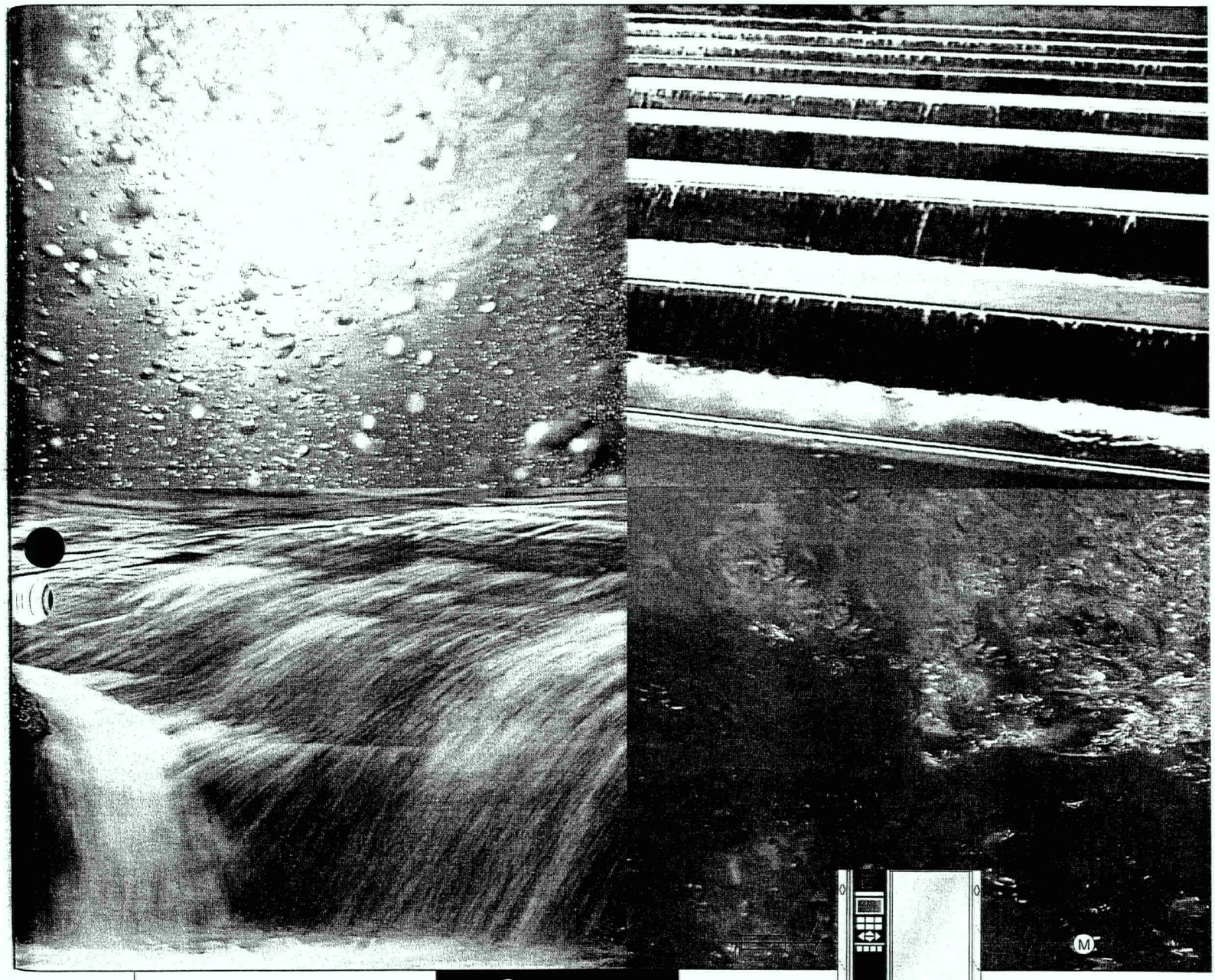
Type QNR, QNRH, HQNR



Type QPP, QPPH, HQPP, HQPPH

①All standard circuit breakers are calibrated to 40°C maximum ambient application.

Danfoss



engineering reference

Water & Wastewater

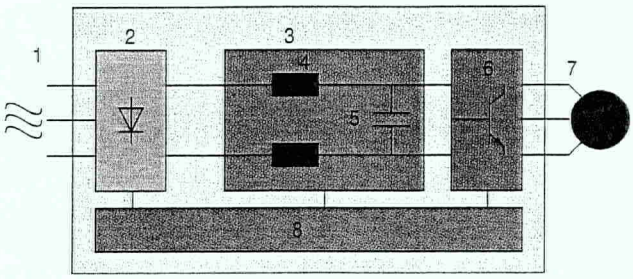
www.us.water.danfoss.com

General Control Principles – All Drives

General Control Principles: What is an AFD?

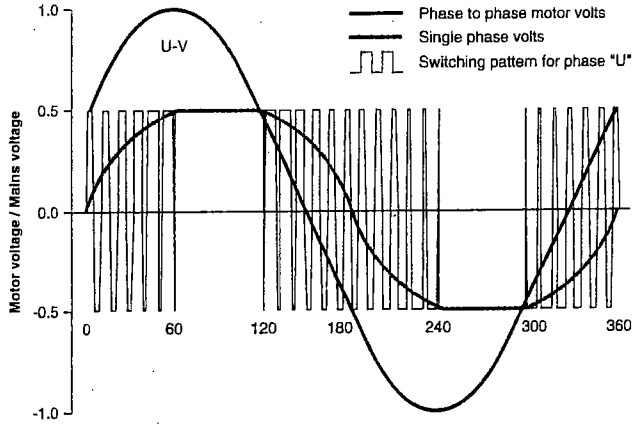
Danfoss VLT Series AFDs (Adjustable Frequency Drives) rectify AC voltage from the AC line into DC voltage. This DC voltage is converted into an AC current with a variable amplitude and frequency.

As a result, the motor is supplied with variable voltage and frequency, which enables infinitely variable speed regulation of three-phase, standard AC motors.



1. **AC line voltage**
   1Ø, 220-240 VAC, 50/60 Hz
   3Ø, 200-240 VAC, 50/60 Hz
   3Ø, 380-480 VAC, 50/60 Hz
2. **Rectifier**
   A rectifier converts the AC voltage from the supply mains to a pulsating DC voltage. There are two basic types of rectifiers: the controlled and the uncontrolled rectifiers.
3. **Intermediate circuit**
   DC voltage = $\sqrt{2}$ x AC line voltage [V]. The intermediate circuit stabilizes the pulsating DC voltage and sends this on to the inverter.
4. **Intermediate circuit coils**
   Smooths the intermediate circuit current and limits the load on AC line and components (AC line transformer, wires, fuses and contactors).
5. **Intermediate circuit capacitors**
   Smooths the intermediate circuit voltage.
6. **Inverter**
   The inverter converts DC voltage into variable AC voltage with a variable frequency.
7. **Motor voltage**
   Variable AC voltage, 0-100% of AC line supply voltage.
   Variable frequency: 0-120 Hz
8. **Control card**
   The electronics of the control circuit can transmit signals to the rectifier, the intermediate circuit and the inverter. The control circuit transmits a signal to the semiconductors of the inverter to switch on or off.

VVC Control Principle for the VLT 2800 Series



The Danfoss VLT 2800 controls both the amplitude and the frequency of the output voltage.

The control circuit uses a mathematical model which calculates two different factors:

- The optimum switching times for the semiconductors of the inverter
- The optimum motor magnetization at varying load

The principle for the switching times works as follows:

- The numerically largest phase is for a 1/6 sine period held fixed on the positive or negative potential.
- The two other phases are varied so that the resulting output voltage is entirely sinusoidal and of the correct amplitude.

Full rated motor voltage is ensured. It is not necessary to overmodulate to utilize the third harmonic. The motor current is entirely sinusoidal and the motor performance is the same as AC line operation.

AMT (Automatic Motor Tuning) for the VLT 2800

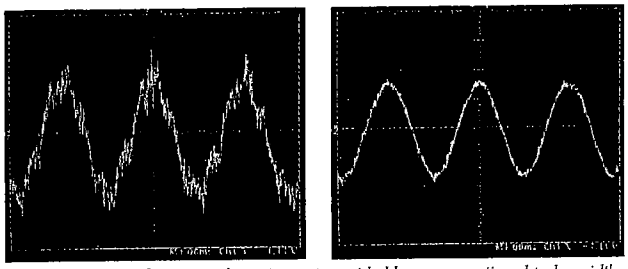
VVC uses AMT (Auto Motor Tuning) to measure static values of stator resistance and inductance. This data is provided to the modes model which serves to calculate no load values for the load compensator and the voltage vector generator.

The optimum motor magnetization is achieved because the VVC models the motor constants R_1 and X_1 and adapts them to the different motor sizes. The AFD calculates the optimum output voltage on the basis of these data. As the unit measures the load current continuously, it can change the output voltage according to the load.

VVC^{PLUS} Control Principle for the VLT 8000 AQUA and VLT 5000 Series

VLT 8000 AQUA Series features an inverter control system called VVC^{PLUS}, which is a further development of the VVC (Voltage Vector Control) from the Danfoss VLT Series 2800.

Danfoss Voltage Vector Control technology uses exclusive digital techniques and a 32-bit microprocessor to generate motor currents that are virtually identical to a pure sine wave. Compared to conventional Pulse Width Modulation, the motor current provided by Danfoss VVC^{PLUS} is clearly more accurate.



Oscilloscope trace of a motor phase current provided by a conventional pulse width modulation system with harmonic elimination (left); a Danfoss VVC^{PLUS} system (right).

Deviation from the ideal sinusoidal wave shape means that the current to the motor contains harmonics of the fundamental frequency, resulting in added heat and reduced performance.

VVC^{PLUS} controls an induction motor by energizing it with a variable frequency and a voltage that matches it. If the motor load is changed, the magnetization of the motor changes too, and so does its speed. Consequently, the motor current is measured continuously and the actual voltage requirement and slip of the motor are calculated from a motor model. Motor frequency and voltage are adjusted to insure that the motor operating point remains optimal under varying conditions.

The development of the VVC^{PLUS} principle is the result of a wish to maintain robust, sensorless regulation that is tolerant to different motor characteristics without motor derating.

The current measurement and the motor model have been improved. The current is split into magnetizing and torque-generating parts and provides a more accurate estimation of the actual motor loads.

Compared with a standard voltage/frequency control, VVC^{PLUS} offers improved dynamics and stability, both when the speed reference and the load torque are changed. In addition, we have implemented a fully digitalized protection concept, which insures reliable operation, even under the worst possible operating conditions. The VLT 8000 AQUA and VLT 5000 Series also offer full protection against faulty coupling, short-circuiting, ground fault and overload.

Danfoss drives with the VVC^{PLUS} control system tolerate shock loads throughout their speed range and react swiftly to changes in reference.

The VLT 8000 AQUA and VLT 5000 Series of Danfoss AFDs control the amplitude and frequency of the output voltage as well as the angle of the voltage vector. Although similar to VVC, this enhanced control principle called VVC^{PLUS} provides these additional advantages:

- Better dynamic response at low speeds (0-10 Hz)
- More torque producing current
- 1:100 speed control range, open loop
- Speed accuracy: ±0.5% of rated speed, open loop
- Open loop torque control
- Active resonance damping
- Maintains operation at the current limit
- AMA

The VVC^{PLUS} control principle utilizes a vector modulation principle for constant, voltage-sourced PWM drives. This principle applies an improved motor model that uses measured values of both the active and reactive current to control the angle of the voltage vector. The result is improved dynamic performance over standard PWM Volts/Hertz drives, especially in the 0-10 Hz speed range.

The VVC^{PLUS} control principle is illustrated in the equivalent circuit diagrams below (Figure A and B).

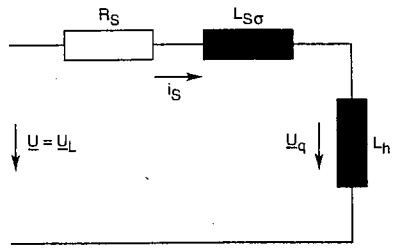


Figure A. Equivalent circuit diagram of a three-phase AC motor with no load

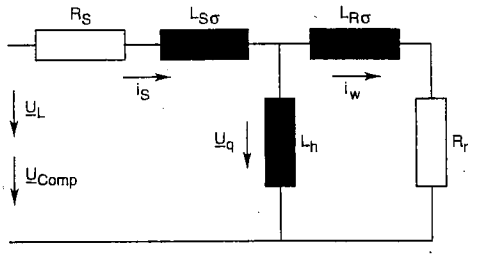


Figure B. Equivalent circuit diagram for loaded three phase AC motors

where

R_S = stator resistance,

R_r = rotor resistance,

i_S = motor magnetization current,

i_W = active (rotor) current

L_{Ss} = stator leakage inductance,

L_{Rs} = rotor leakage inductance,

L_h = main inductance,

L_S $(=L_{Ss} + L_h)$ = stator inductance and

w_s $(=2\pi f_s)$ = angular speed of the rotating field in the air gap

The no-load voltage ($\underline{U}_L$) is determined by using the motor nameplate rated voltage, current, frequency and rpm. When the motor is not loaded, there is no current flowing in the rotor ($i_w = 0$), so the no-load voltage can be expressed as:

$$\underline{U} = \underline{U}_L = (R_S + jw_sL_S) \times i_s$$

When a load is applied to the motor, the active current (i_W) flows in the rotor. Because of the nature of VVC^{PLUS}, an additional voltage ($\underline{U}_{Comp}$) boost is given to the motor:

where $\underline{U}_{Comp}$ = load-dependent voltage compensation

AMA (Automatic Motor Adaptation) for VLT 8000 AQUA and VLT 5000

AMA Measures main motor parameters at motor standstill to:

- Optimize motor performance
- Improve start capabilities
- Compensate for motor cable variances

The AMA (Automatic Motor Adaptation) function automatically optimizes operation between the drive and the motor by reading and checking the values without spinning the motor, so there's no wasted time disconnecting the motor from the load.

Automatic Motor Adaptation is a test algorithm that measures the electrical motor parameters at motor standstill. This means that AMA itself does not supply any torque.

AMA is useful during system start-up when the user wants to optimize the VLT 8000 AQUA or VLT 5000 to the motor applied. It is possible to choose whether a complete Automatic Motor Adaptation is to be carried out, or whether reduced Automatic Motor Adaptation is needed. It is only necessary to carry out the reduced test if a LC-filter has been placed between the VLT 8000 AQUA or VLT 5000 and the motor.

VVC^{PLUS} uses AMA to measure static values of stator resistance and inductance. This data is provided to the motor model, which serves to calculate no-load values for the load compensator and the voltage vector generator. The voltage vector generator calculates the no-load voltage vector ($\underline{U}_L$) and the angle of the voltage vector based on the stator frequency, no-load current, stator resistance and inductance. At this point, a resulting voltage vector amplitude is determined by adding the no load voltage vector amplitude, the start voltage, and load compensation voltage. The availability of the no-load angle component and current vector aids the drive in producing a current vector that corresponds to the actual load. Without the no-load values, current is wasted in over-magnetizing the motor instead of being allocated to produce torque.

The resolution (or accuracy) of the output frequency from the drive is determined by the resolution of the theta components (Ø) and the stator frequency. These values are represented in 32 bit resolution. Based on the calculated actual currents and the values of the voltage vector, the load compensator estimates the air gap torque and calculates how much extra voltage ($\underline{U}_{Comp}$) is required to maintain the magnetic

Operating Conditions – All Drives

Handling AC Line Fluctuations

Every manufacturing facility experiences fluctuations in the AC line. With a Danfoss drive, these fluctuations do not pose any hazard to the drive and will not cause speed or torque variations in the application. Danfoss drives compensate for AC line fluctuations so that the motor shaft's actual torque is constant.

To protect itself from AC line fluctuations, a monitor of the AC line phases interrupts the drive if there is a loss of phase or if there is a significant difference between phases.

Transient Voltage Spikes

Most industrial AC lines are disturbed by line transients which can be short overvoltages of up to 1000 VAC. They arise when high loads are cut in and out elsewhere on the AC line. A lightning strike directly to the supply wire is another common cause of transient high voltage. The transient may damage installations at distances up to four miles from where the lightning strikes. Short circuits in the supply lines can also cause transients. High currents due to short circuits can result in very high voltage in the surrounding cables because of inductive coupling. VLT Series drives are built to a stringent German specification for surge suppression (VDE 160). Fast acting MOVs, Zener diodes and oversized DC link filter provide protection against high potential spikes. The VLT Series drives can withstand a spike of 2.3 times the rated voltage for 1.3 msec.

Power Factor

VLT Series drives hold near unity power factor at all loads and speeds, and eliminate the need for power factor correction, resulting in both financial and space savings.

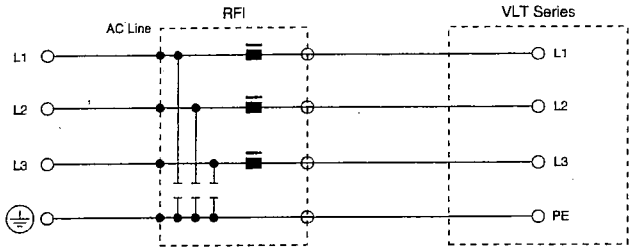
The power factor is the relation between I_1 and I_{RMS}. The power factor indicates the extent to which the drive imposes a load on the AC line supply.

The lower the power factor, the higher the I_{RMS} for the same kW performance.

In addition, a high power factor indicates that the different harmonic currents are low.

$$I_{RMS} = \sqrt{I_1^2 + I_5^2 + I_7^2 + \ldots + I_n^2}$$

RFI



The switching of an adjustable frequency drive's power components causes voltage and current deviations in the voltage and current of the AC line. These deviations contain elements of high frequencies that may disturb equipment sharing the power line and may radiate to nearby equipment which can be affected. High frequencies in the 150 kHz to 30 MHz range are identified as RFI (Radio Frequency Interference).
If filtration is necessary, RFI filters prevent interference currents from transmitting back onto the AC power lines.

Danfoss RFI Filters are comprised of appropriately sized inductor and capacitor banks placed on the AC line input to the VLT.

Building Load (In-Rush)

Using a VLT Series drive eliminates a power in-rush at start-up. The current starts from zero and rises as the load accelerates with no danger of exceeding full load current.

This has two major benefits. The first is that it doesn't matter when the units are switched on, as maximum demand will not be exceeded. The second is that as the current is properly controlled, the installation doesn't require a sequenced start. This removes the need for additional capital equipment.

Minimizing Harmonic Distortion

Danfoss harmonic currents are lower than other drive designs, and therefore, provide the lowest voltage distortion and offer less chance of disturbing other equipment.

The built-in DC link filters in the VLT drives reduces the harmonic distortion currents that it injects back into the AC line. A properly sized inductor, such as that in our VLT drives can reduce line harmonic currents to 40% or less of the fundamental current without the use of AC line inductors and their resultant line voltage reduction.

The added heat generated by harmonic currents requires larger conductors and transformers for the same amount of delivered energy, therefore, increasing the cost of the installation. Other sources of harmonic current distortion include fluorescent lights, computers, UPS systems, copiers, printers, induction heaters, and battery chargers. Many of these nonlinear loads are not only the source of harmonic distortion, but are also adversely affected by harmonic distortion as well.

An adjustable frequency drive causes a non-sinusoidal current on the AC line, which increases the input current I_{RMS}. A non-sinusoidal current can be transformed by means of a Fourier analysis and split up into sine wave currents with different frequencies, i.e. different harmonic currents I_N with 60 Hz as the basic frequency:

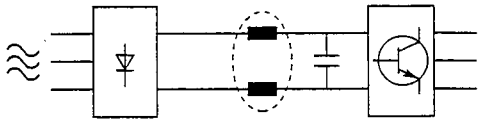
Harmonic currents (Hz)	I_1	I_5	I_7
	60	300	420

The harmonics do not affect the power consumption directly, but increase the heat losses in the installation (transformer, cables). Consequently, in plants with a rather high percentage of rectifier load, it is important to maintain harmonic currents at a low level to avoid overload of the transformer and high temperature in the cables.

Some of the harmonic currents might disturb communication equipment connected to the same transformer or cause resonance in connection with power-factor correction devices.

Harmonic currents compared to the RMS input current:

	Input current
I_{RMS}	1.0
I_1	0.9
I_5	0.4
I_7	0.2
I_{11-49}	< 0.1



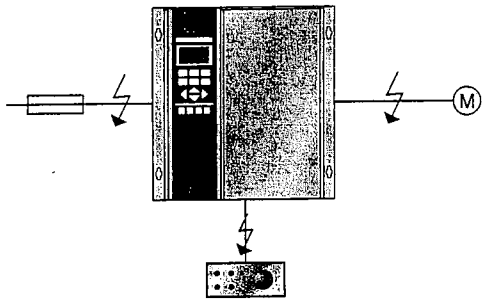
The voltage distortion on the line supply depends on the size of the harmonic currents multiplied by the line impedance for the frequency in question. The total voltage distortion THD is calculated on the basis of the individual voltage harmonics using the following formula:

$$THD\% = \sqrt{U^{25} + U^2_7 + \ldots U^2_N} \quad (U_N\% \text{ of } U)$$

No Motor Derating

VLT drives are optimized for constant or variable torque operation so that motors do not need to be derated. When the RMS current from the drives is taken, the motor sees a near perfect sine wave and full AC line voltage. This waveform helps to overcome torque pulsation, cogging or ripple problems, and delivers smooth running at low speeds.

The rated output currents of Danfoss VLT drives correspond to typical rated motor current values in standard 4-pole asynchronous motors. So, if you know the motor power, you simply select the corresponding VLT model.



Where there is risk of short circuits

Multiple Motors – Parallel Connection of Motors

The VLT Series is able to control several motors connected in parallel. If the motors are to have different rpm values, the motors must have different rated base speed values. Motor rpm is changed simultaneously, which means that the ratio between the rated rpm values is maintained across the range.

The total current consumed by all of the motors may not exceed the maximum output current of the drive.

The individual motors can be switched and reversed an unlimited amount on the output of the VLT without tripping or damaging the drive.

If the total staring current of the motors is higher than the maximum output current of the drive, the output frequency falls. The output current of the drive can exceed the rated current of the individual motor, making it necessary to protect each motor as if it were connected to the AC line.

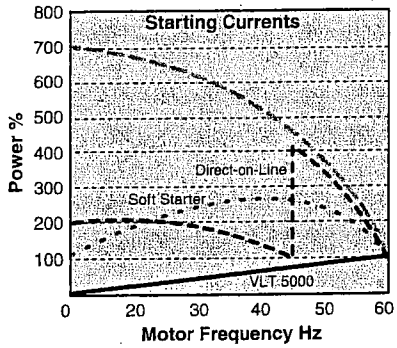
If the motor sizes deviate very much, problems may arise during starting and low speed operation. This is due to the fact that small motors have a relatively large ohmic resistor in the stator, therefore, they demand more compensation-voltage during starting and low speeds.

Often, it will be possible to increase the start voltage and find an acceptable start condition for all the motors. If this is not possible, it may be necessary to replace the small motor with a larger one. This does not necessarily demand a bigger VLT, as the mechanical power output of the motor is unchanged.

In systems with motors connected in parallel, the ETR (electronic thermal relay) of the drive; cannot be used as motor protection for the individual motor. Consequently, additional motor protection is required, such as thermistors in each motor (or individual thermal relays).

Also, the individual motor cable for each motor must be summed and is not to exceed the total motor cable length permitted.

Motor-Generated Overvoltage



The voltage in the intermediate circuit is increased when the motor acts as a generator. This occurs in two cases:

- The load overspeeds the motor
- During deceleration "ramp-down", if the moment of inertia is high, the load is low and the ramp-down time is too short for the energy to be dissipated internally in the VLT, the motor, and the installation.

The unit attempts to correct the ramp if possible. If not, the inverter turns off to protect the transistors and the intermediate circuit capacitors when a predetermined voltage level is reached.

Short Circuit and Ground Faults

Short circuits and ground faults may occur on the supply side, on the motor side or in the control leads.

Any short-circuits or ground faults on the supply side will cause the prefuses in the installation to fail. The VLT will seldom cause short-circuits and it will not be damaged because of faults on the supply side.

As a rule motor faults arise because of missing insulation that causes short-circuits between two phases or between phase and ground. VLT Series drives are protected against short circuits by means of current measurement in each of the three motor phases. A short circuit between two output phases will cause an overcurrent in the inverter which will turn off each IGBT individually when the short circuit current exceeds the permitted value.

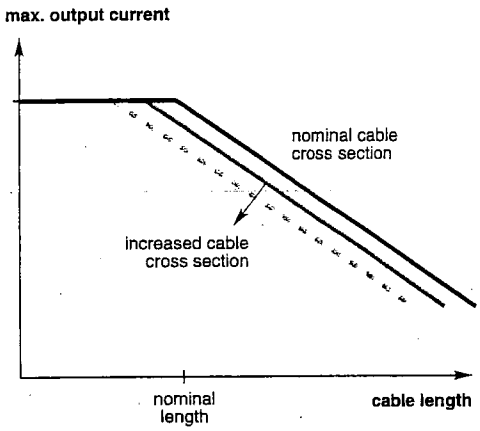
Grounding can also cause the VLT to trip out. The internal voltage supply is therefore protected by a fuse. The drive turns off within 100 ms in case of a ground fault on a motor phase, depending on impedance and motor frequency.

Long Motor Cables

If the length or the gauge of the motor cables exceeds the maximum values, the maximum allowable continuous output decreases.

The longer the cable length or the larger the gauge, the lower the capacitive reactance. High capacitive reactance will increase the losses in the cable. The resulting output current must be reduced by about 5% for each step the wire gauge increases (see figure below). The current is reduced linearly, when the cable length exceeds the maximum for which the drive has been designed.

The typical mode of operation for the drive causes short voltage rise times in the motor cable. This may damage the insulation of the motor windings. The problem intensifies as the switching frequency of the inverter increases.



The maximum output current of the drive depends on the length and gauge of the motor cable. All VLT 2800 units allow for a maximum 250 ft. of motor cable and 1,000 ft. with the optional LC module. VLT 8000 AQUA and VLT 5000 units offer 1,000 feet as standard.

dV/dt Voltage Rise Time and Peak Voltage on the Motor

Voltage rise time is the amount of time for a voltage pulse at the motor to go from 10% to 90% of the DC bus voltage. The rise time is determined by:

- Switching speed of the inverter's power components
- Motor leads (type, size, length and shielding)
- Inductors or filters wired between the drive and motor

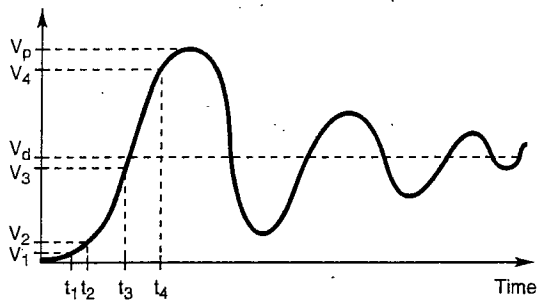
Peak voltage is the maximum voltage that will be applied to the motor windings. Self-inductance of the motor's stator windings causes an instantaneous voltage overshoot when an electrical pulse is applied to the motor. The voltage level at this instantaneous overshoot is the peak voltage. The peak voltage is determined by:

- Rise time of the pulse
- DC bus voltage

Motor insulation is stressed by both excessively short rise time and high peak voltages. Motors without phase coil insulation are especially susceptible to damage. If motors without phase coil insulation must be used, or if lead lengths are long, an output inductor or LC filter should be added to the drive.

Operating Conditions – All Drives

Voltage Rise Time vs Motor Voltage



V_p = Peak Voltage
V_d = Steady State Voltage (DC Bus Voltage Level)
V_1 = 10% of Steady State Voltage
t_1 = Time of V_1
V_2 = 10% of Peak Voltage
t_2 = Time of V_2
V_3 = 90% of Steady State Voltage
t_3 = Time of V_3
V_4 = 90% of Peak Voltage
t_4 = Time of V_4

	IEC 34-17	NEMA MG 1 Part 31
Peak Voltage	V_p	V_p
Rate of Rise	$\frac{V_4 - V_2}{t_4 - t_2}$	$\frac{V_3 - V_1}{t_3 - t_1}$
Rise Time	$t_1 - t_2$	$t_3 - t_4$

The charts below shows typical values for voltage rise time (dV/dt) and peak voltage (V_{PEAK}) measured on the terminals of the motor between two phases at different cable lengths. With the patented Danfoss "soft turn on", the IGBT transistors produce one of the lowest dV/dt in the industry.

VLT 2800 Series

Motor Lead

Length	Input Voltage	Rise Time	Peak Voltage*
50 ft	380 VAC	0.2 µsec	940 V
50 ft	460 VAC	0.2 µsec	1170 V
140 ft	380 VAC	0.3 µsec	980 V
140 ft	460 VAC	0.3 µsec	1230 V

** 380-480 VAC class is worst case scenario for Peak Voltage; 200-240 VAC units operate with lower Peak Voltage.*

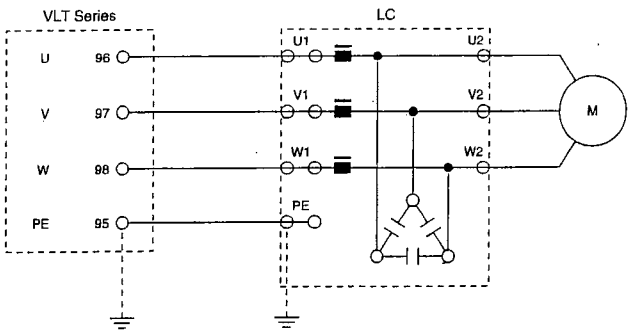
VLT 8000 AQUA and VLT 5000 Series

Motor Lead

Length	Input Voltage	Rise Time	Peak Voltage*
1-10 HP			
160 ft	460 VAC	0.4 µsec	950 V
500 ft	460 VAC	1.3 µsec	1300 V
160 ft	380 VAC	0.3 µsec	850 V
500 ft	380 VAC	1.2 µsec	1000 V
115 ft	600 VAC	0.36 µsec	1360 V
15-75 HP			
160 ft	380 VAC	0.1 µsec	900 V
500 ft	380 VAC	0.2 µsec	1000 V
115 ft	600 VAC	0.38 µsec	1430 V
100-300 HP			
45 ft	460 VAC	0.78 µsec	815 V
65 ft	460 VAC	0.84 µsec	915 V
45 ft	600 VAC	0.80 µsec	1122 V
350-600 HP			
65 ft	460 VAC	1.2 µsec	760 V

** 380-480 VAC class is worst case scenario for Peak Voltage; 200-240 VAC units operate with lower Peak Voltage.*

LC Filter Modules



When the speed of a motor is controlled by a drive, resonance noise from the motor will occur occasionally. This is due to the construction of the motor and the noise occurs whenever one of the IGBTs of the drive is activated. The frequency of the resonance will correspond to the switching frequency.

The filter reduces the voltage rise time dV/dt, the peak voltage V_{PEAK} and the ripple current to the motor. So the current and the voltage are near sinusoidal. That reduces the acoustic motor noise to a minimum.

Because of the ripple current in the coils, there will be some noise from the coils. However, if the filter is built into a cabinet or similar, the coil noise will be no problem.

For VLT Series drives, Danfoss offers an LC filter which dampens the acoustic motor noise.

Galvanic Isolation (PELV)

All analog and digital inputs and outputs and the RS 485 serial communication port are *galvanically isolated from the supply voltage*. Because these points do not share a common, the drive can eliminate ground loop problems.

In the VLT Series, all control terminals as well as terminals 1-5 (AUX relays) are supplied by or connected to circuits that comply with PELV (high impedance) requirements in relation to the AC line potential.

PELV offers protection by way of extra low voltage. Protection against electric shock is considered to be ensured when the electrical supply is of the PELV type and the installation is made as described in local/national regulations on PELV supplies.

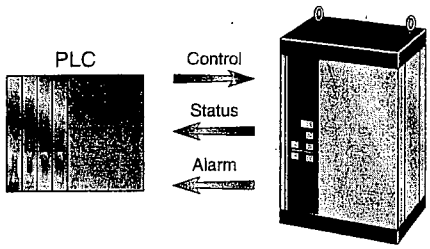
In VLT units, all control terminals as well as terminals 1-3 (AUX relay) are supplied from or in connection with extra low voltage (PELV).

Galvanic (ensured) isolation is obtained by fulfilling requirements concerning higher isolation and by providing the relevant creepage/ clearance distances. These requirements are described in the EN 50178 standard.

The components that make up the electrical isolation, as described. below, also comply with the requirements concerning higher isolation and the relevant test as described in EN 50178. The galvanic isolation can be shown in three locations (see drawing below), namely:

1. Power supply (SMPS) including signal isolation of V_{DC} indicating the intermediate current voltage.
2. Gate drive that runs the IGBTs (trigger transformers/opto-couplers).
3. Current transducers (Hall effect current transducers).

RS-485 Control Inputs/Outputs



Three signal types between PLC and VLT 8000 AQUA, VLT 2800 or VLT 5000.

All Danfoss VLT drives incorporate a standard RS-485 interface allowing up to 31 units to be controlled over a single twisted pair cable. The controlling PC, or PLC, or EMS could be up to three-quarters of a mile away, without using repeaters. The units transmit data in turns over the common wire connection (the bus).

In the communication between PLC and the VLT drive there are three types of signals:

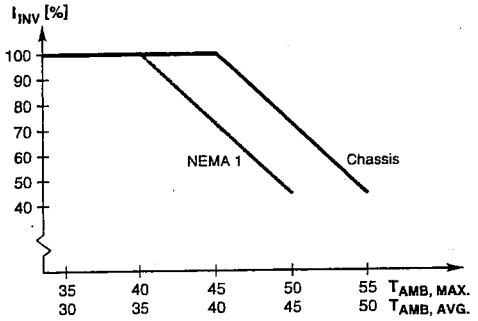
- Control signals (speed change, start/stop, reversing)
- Status signals (motor current, motor frequency, frequency reached)
- Alarm signals (motor stopped, overtemperature)

Derating Conditions – All Drives

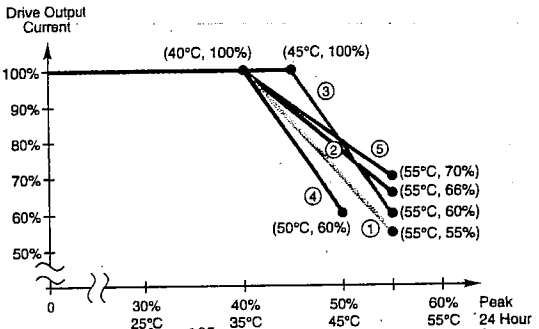
Derating for Ambient Temperature

The ambient temperature ($T_{AMB.\ MAX}$) is the maximum temperature allowed. The average ($T_{AMB.\ AVG}$) measured over 24 hours must be at least 5°C lower. If the VLT unit is operated at temperatures above 45°C, a derating of the continuous output current is necessary.

VLT 2800



VLT 8000 AQUA and VLT 5000



Curve 1: $y = -3x + 105$
Curve 2: $y = -2.3x + 192$
Curve 3: $y = -4x + 280$
Curve 4: $y = -4x + 260$
Curve 5: $y = -2x + 180$
(x = peak temp in °C; y = output current in %)

VLT 8000 and VLT 5000 Derating for Temperature

HP Range	AC Line Voltage	Enclosure	Derate/°C	Curve
1-4 HP	208 VAC	NEMA 1	4%	3
1-4 HP	208 VAC	NEMA 12	4%	4
5-30 HP	208 VAC	All	2.3%	2
40-60 HP	208 VAC	All	3%	1
1-10 HP	460/600 VAC	NEMA 1	4%	3
1-10 HP	460/600 VAC	NEMA 12	4%	4
15-75 HP	460/600 VAC	All	2.3	2
100-300 HP	460/600 VAC	All	3%	1
350-600 HP	460 VAC	All	2%	5

Derating for High Switching Frequency

A higher switching frequency leads to higher losses in the electronics of the VLT drive units.

VLT 8000 AQUA

A higher switching frequency leads to higher losses in the electronics of the VLT 8000 AQUA.

The drive has a pulse pattern in which it is possible to set the switching frequency from 3.0-10.0/14.0 kHz.

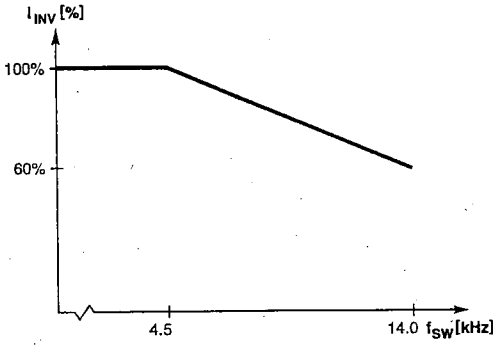
The drive will automatically derate the rated output current $I_{VLT.N}$ when the switching frequency exceeds 4.5 kHz.

In both cases, the reduction is carried out linearly, down to 60% of $I_{VLT.N}$.

The table below gives the minimum, maximum and factory set switching frequencies for VLT 4000 VT drives.

Switching Frequency (kHz)	Min	Max	Factory Setting
200-240 VAC			
VLT 8006-8032	3.0	14.0	4.5
VLT 8042-8062	3.0	4.5	4.5
380-460 VAC			
VLT 8006-8011	3.0	10.0	4.5
VLT 8016-8072	3.0	14.0	4.5
VLT 8100-8300	3.0	4.5	4.5

VLT 2800



The VLT 2800 can be programmed to automatically derate the output current for switching frequencies above 4.5 kHz. At this point, the output current reduces linearly down to 60% of the drive's rated output current to ensure consistent operation.

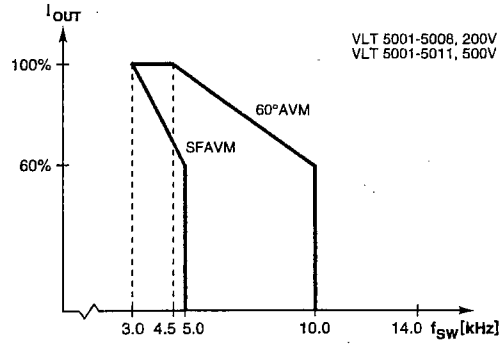
Derating for High Switching Frequency (continued)

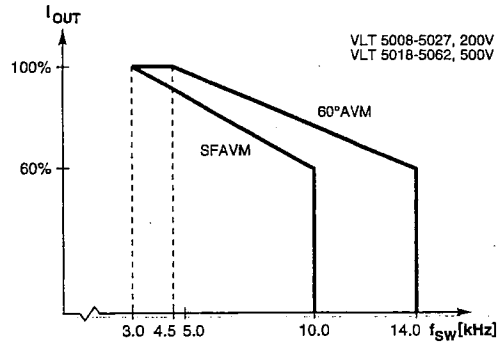
VLT 5000

SFAVM control technique serves to optimize the stator flux by regulating the stator voltage as well as reducing torque ripple. Torque ripple is the result of a deviation between the stator flux vector amplitude and the flux angle. The greater the deviation between the stator flux vector amplitude and the flux angle, the more the effect on the rotating field in the air gap, and the greater the resulting torque ripple. Since the amount of torque ripple is dependent upon the drive's switching sequence, SFAVM calculates the optimum switching sequence based on the desired trajectory of the motor's stator flux.

For the VLT 5000, if SFAVM has been selected in parameter 446, the VLT unit will automatically derate the rated output current $I_{VLT,N}$ when the switching frequency exceeds 3.0 kHz.

If 60° AVM is selected, the drive will automatically derate when the switching frequency exceeds 4.5 kHz. In both cases, the reduction is carried out linearly, down to 60% of $I_{VLT,N}$. The table gives the min., max. and factory-set switching frequencies for the VLT 5000 units. The switching pattern can be changed in parameter 446 and the switching frequency in parameter 411.





	SFAVM		60 ° AVM		
Min.	Max.	Fab.	Min.	Max.	Fab.
200-240 VAC					
VLT 5001-5006	3.0	5.0	3.0	3.0	10.0	4.5
VLT 5008-5027	3.0	10.0	3.0	3.0	14.0	4.5
VLT 5032-5052	3.0	4.5	3.0	3.0	4.5	4.5
380-500 VAC						
VLT 5001-5011	3.0	5.0	3.0	3.0	10.0	4.5
VLT 5016-5052	3.0	10.0	3.0	3.0	14.0	4.5
VLT 5060-5500	3.0	4.5	3.0	3.0	4.5	4.5

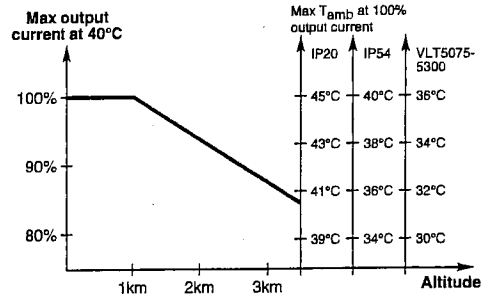
Derating Conditions – All Drives

Derating for Pressure (Altitude)

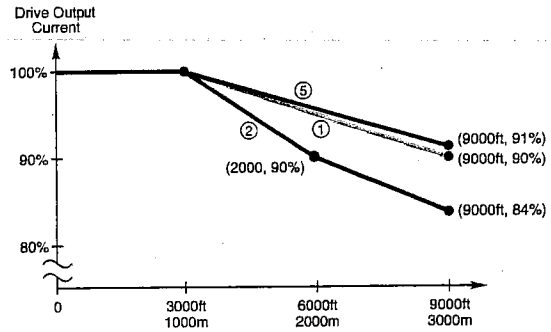
Below 3,300 feet altitude no derating is necessary. Above 3,300 feet the ambient temperature (T_{AMB}) or maximum output current ($I_{VLT,MAX}$) must be derated in accordance with the diagram below.

1. Derating of output current versus altitude at T_{AMB} = max. 45°C
2. Derating of max. T_{AMB} versus altitude at 100% output current

VLT 2800



VLT 8000 AQUA and VLT 5000



Curve 1: $y = 0.005x + 105$
Curve 2: $y = 0.01x + 110$ *(up to 6,600 feet);* $y = 0.006x / 102$ *(above 6,600 feet)*
Curve 5: $y = 0.0045x + 104.5$

VLT 8000 and VLT 5000 Derating for Pressure

HP Range	AC Line Voltage	Derate	Temperature	Curve
1-30 HP	208 VAC	10%	–	2
40-60 HP	208 VAC	5%	4°C	1
1-75 HP	460/600 VAC	10%	–	2
100-300 HP	460/600 VAC	5%	4°C	1
350-600 HP	460 VAC	4.5%	3.5°C	5

Vibration and Shock

The VLT 4000 VT is tested according to a procedure based on the following standards:

- IEC 68-2-6; Vibration (sinusoidal) - 1970
- IEC 68-2-34; Random vibration broad-band – general requirements
- IEC 68-2-35; Random vibration broad-band – high reproducibility
- IEC 68-2-36; Random vibration broad-band – medium reproducibility

VLT 4000 VT drives comply with requirements that correspond to conditions when the unit is mounted on the walls and floors of production premises, as well as in panels bolted to walls or floors.

Air Humidity

All VLT Series drives have been designed to meet the IEC 68-2-3 standard, EN 50178 pkt. 9.4.2.2/DIN 40040, class E, at 40°C. This standard requires a humidity of ≤95%, non-condensing.

Derating for Low Speed Operation

When a motor is connected to a drive, it is important to check whether the cooling of the motor is adequate.

At low rpm values, the motor fan is not able to supply the required volume of air for cooling. This problem occurs when the load torque is constant (e.g. a conveyor belt) across the speed range. The reduced ventilation available determines the amount of the torque that can be permitted under a continuous load. If the motor is to run continuously at an rpm value lower than half the rated value, the motor must be supplied with additional air for cooling.

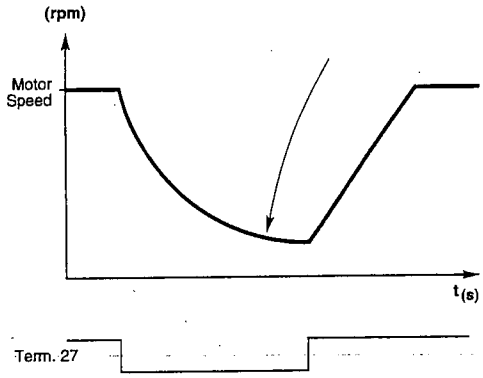
However, instead of extra cooling, the load level of the motor can be reduced. This is done by oversizing the motor. Since the design of the drive sets limits as to the size of the motor that can be connected to it, check with Danfoss application experts before derating.

Flying Starts

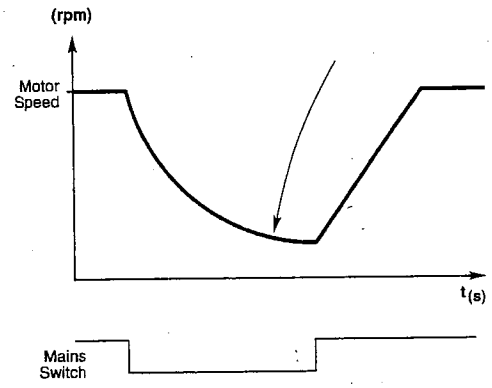
This function makes it possible to "catch" a motor that is spinning freely and for the VLT to take control of the motor speed. This function can be enabled or disabled via parameter 445.

If flying start has been selected, there will be four situations in which the function is activated:

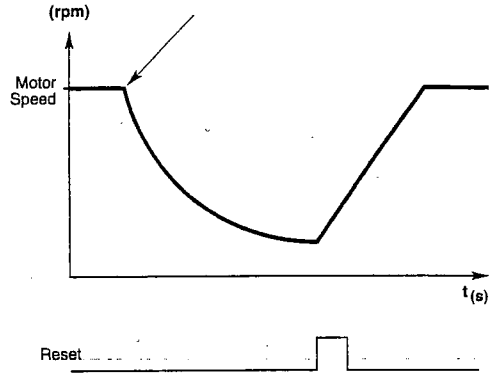
1. Flying start is activated after a coasting stop has been given (via terminal 27).



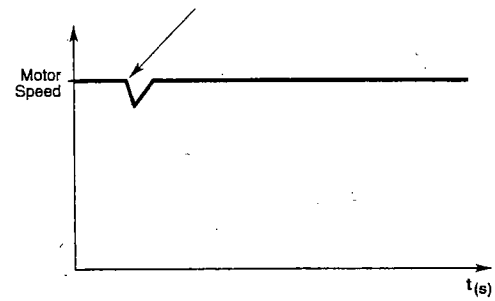
2. Flying start is activated after power-up.



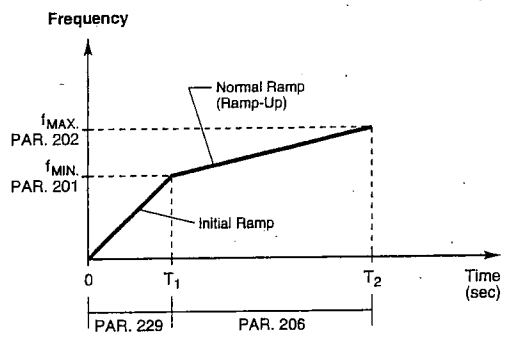
3. Flying start is activated if the VLT is in a trip state and a reset signal has been given.



4. Flying start is activated if the VLT momentarily releases the motor (because of a fault state and the fault disappears before a trip), the VLT will catch the motor and go back to the reference.

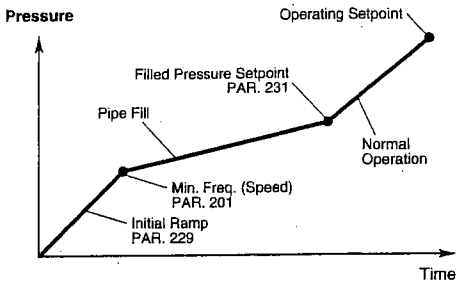


Dual Ramp Mode



Submersible pumps and other equipment often have a requirement to not operate below a minimum speed any longer than necessary to avoid damage and excessive wear. The initial ramp is used to quickly accelerate the motor/equipment to a minimum speed at which point the normal ramp up rate is activated.

Empty Pipe Fill Mode



The VLT 8000 AQUA provides a unique empty pipe fill mode function whereby the drive will operate the pump at an accelerated speed for a preset time, then automatically revert to a second acceleration rate. The function is typically used for dry start-ups to quickly fill a plumbing system without causing a "water hammer" effect that often occurs under such conditions. Both acceleration rates and times are fully programmable to suit any application.

The VLT 8000 AQUA operating in closed loop uses an adjustable fill rate, a "filled pressure" setpoint, an operating pressure setpoint, and a pressure feedback.

Fill Mode is available when:

- The VLT 8000 AQUA is in Closed Loop mode (Parameter 100).
- Fill Rate parameter 230 is not 0.
- Parameter 420 is set to Normal.

After a start command, Fill Mode operation begins when the drive reaches Minimum Frequency (set in parameter 201).

The "filled pressure" setpoint (parameter 231) is actually a setpoint limit. When minimum speed is reached, the pressure feedback is looked at, and the drive begins to ramp to the "filled" pressure setpoint at the rate established by the Fill Rate (parameter 230).

The Fill Rate is dimensioned in units/seconds (selected in parameter 415).

Special Features – VLT® 8000 AQUA

Dual Control PID

The integral PID regulator in VLT 8000 AQUA units is optimized for use in water applications. This means that a number of specialized functions are available in a the VLT 8000 AQUA, such as inverse regulation, anti windup and a low pass noise filter. With the VLT 8000 AQUA, there is no need for extra modules to be installed. In addition, the VLT 8000 AQUA is capable of recognizing two feedback signals.

For optimum process control, the VLT 8000 AQUA has the capability to perform these functions to enhance the existing PID regulation.

Inverse Regulation

In a normal regulation, the motor speed increases when the reference/setpoint is higher than the feedback signal. For inverse regulation, the speed is reduced when the feedback signal is lower than the reference/setpoint.

Anti Windup

This function ensures that when either a frequency limit, current limit or voltage limit is reached, the integrator will be initialized for a frequency that corresponds to the present output frequency. This avoids integration on a deviation between the reference/setpoint and the actual state of the process.

Start-up Conditions

In some applications, optimum setting of the process regulator will require more time for the process state to be reached. In such applications it might be advantageous for the VLT 8000 AQUA to bring the motor to a fixed output frequency before the PID regulator is activated.

Differentiator Gain Limit

If there are very quick changes in the input signal, the deviation between reference/setpoint and the actual process state will quickly change. In this case, one of the differentiators may become too dominant (it reacts to the deviation between the reference/setpoint and the actual process state). The quicker the changes, the more prominent the resulting differentiator frequency contributions. This function limits the differentiator frequency contribution to allow the setting of reasonable differentiation times for slow and rapid changes.

Lowpass Filter

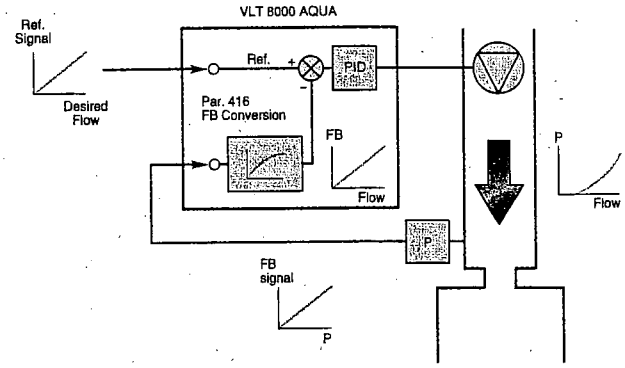
The lowpass filter can dampen ripple currents/voltages on the feedback signal. Setting a suitable lowpass filter time constant limits the frequency of the ripples occurring on the feedback signal.
For example, if the lowpass filter has been set to 0.1s, the limit frequency will be 10 RAD/sec., corresponding to $(10/2 \times \pi) = 1.6$ Hz. This means that all currents/voltages that vary by more than 1.6 oscillations per second will be removed by the filter.

In other words, regulation will only be carried out on a feedback signal that varies by a frequency of less than 1.6 Hz.

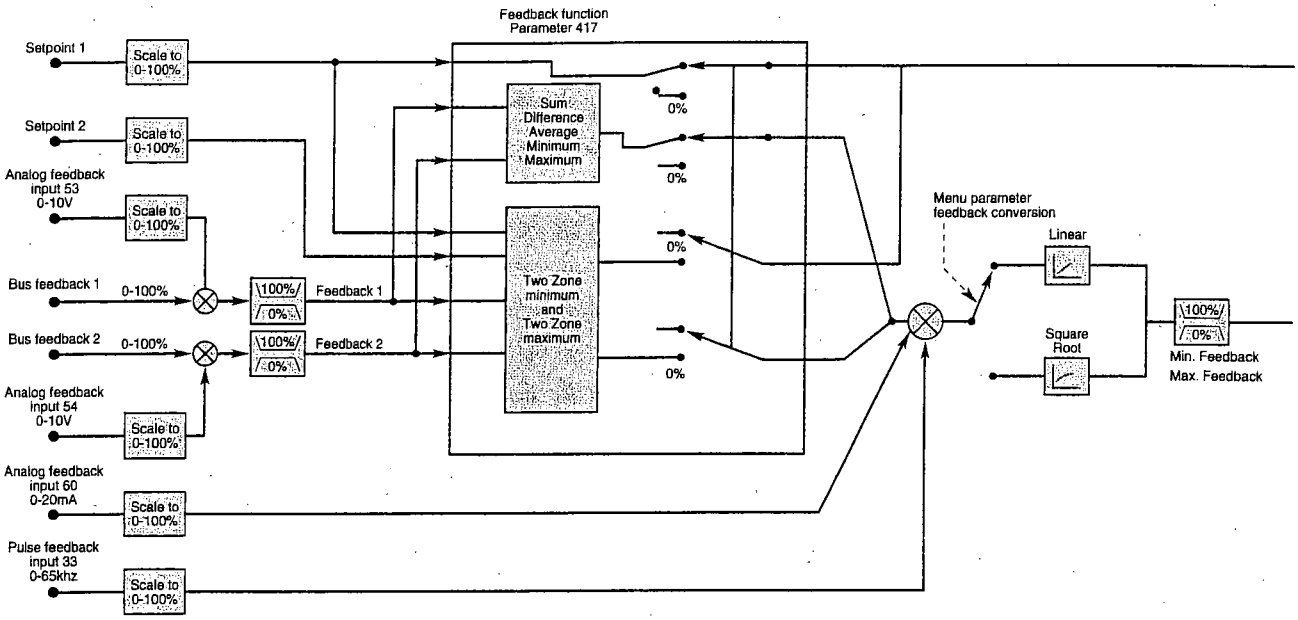
Feedback Conversion

Often times flow regulation will require a feedback based on pressure. flow = constant x $\sqrt{}$ pressure

This function converts a feedback signal to a squared feedback value, making it possible to set the reference to be in a linear relationship with the flow required.



Feedback Handling



The block diagram above shows how different parameters affect the feedback handling. Optional feedback signals are: voltage, current, pulse and bus feedback signals.

The parameters for feedback handling are active both in closed and open loop modes. In open loop, the present pressure can be displayed by connecting a pressure transmitter to a feedback input. All feedback types can easily be monitored by setting the LCP to show the desired process parameter.

In a closed loop, there are three possibilities of using the integral PID regulator and setpoint/feedback handling:

1 Setpoint and 1 Feedback

1 Setpoint and 2 Feedbacks

2 Setpoints and 2 Feedbacks

1 Setpoint and 1 Feedback

If only 1 setpoint and 1 feedback signal are used, the value of Setpoint 1 will be added to the remote reference. The sum of the remote reference and Setpoint 1 becomes the resulting reference, which will then be compared with the feedback signal.

1 Setpoint and 2 Feedbacks

Just like in the above situation, the remote reference is added to Setpoint 1. Depending on the feedback function selected in parameter 417 feedback function, a calculation will be made of the feedback signal with which the sum of the references and the setpoint is to be compared. A description of the individual feedback functions is given in parameter 417 Feedback function.

2 Setpoints and 2 Feedbacks

Used in 2-zone regulation, feedback function calculates the setpoint to be added to the remote reference.

AEO (Automatic Energy Optimizer)

- Minimizes energy consumption
- Maximizes motor efficiency by controlling the motor magnetization current
- Reduces motor noise
- Simplifies commissioning
- Improved load shock handling
- Improved handling of fast reference changes

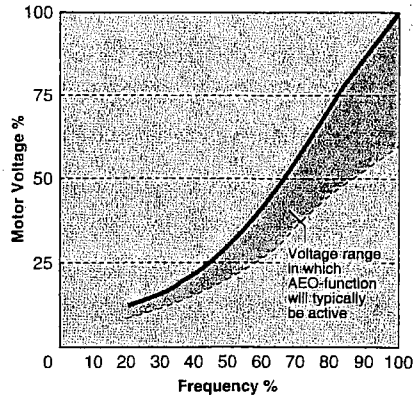
The VLT 8000 AQUA uses a unique control scheme, called AEO (Automatic Energy Optimization), to ensure that the relationship between voltage and frequency is always optimum for the motor's load. By doing this, an additional 5% energy savings can be realized in a typical pumping application.

In order to automatically provide the correct voltage at any operating frequency and load, the drive must continuously monitor the motor's status and respond to any changes. The VLT 8000 AQUA's unique VVC^{PLUS} control algorithm is central to this. Current is monitored on all three motor phases so that both the real and the reactive components of motor current are known at all times. In addition, the Automatic Motor Adaptation (AMA) function, which accurately determines critical motor parameters, allows the drive to interpret the current readings to determine the amount of magnetizing current required by the load.

The result is that the drive automatically maintains peak motor efficiency under all conditions. During acceleration, the output voltages will tend to be high since additional torque is needed to overcome the inertia of the load. After the motor reaches the desired speed, the VLT 8000 AQUA automatically detects the stead-state load level and reduces the output voltage to maximize motor efficiency. If the load changes, as could occur if a valve in a pumping system suddenly opens, the drive detects the load change and immediately increases the output voltage to maintain control of the motor.

The figure above shows the range of the voltages over which AEO functions. As the graph shows, AEO allows the drive to reduce the motor's voltage in order to save energy.

Automatic energy optimization's major benefit is for variable torque loads. As the motor's speed is decreased, the load on the motor drops dramatically. If a constant V/f ratio is supplied to the motor, its efficiency will suffer. Knowing how much the motor voltage can be



AEO allows the VLT 8000 AQUA to control voltage over a wide range in order to match the drive's output with the load's requirements.

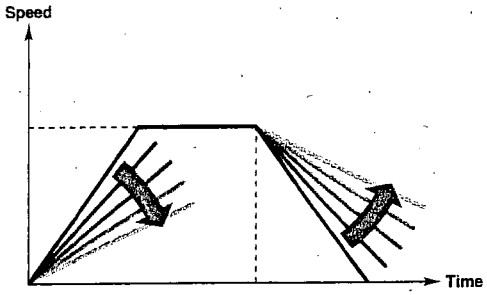
reduced before motor performance begins to suffer is difficult to determine manually. AEO handles this decision automatically and continuously. If the load profile changes, AEO responds to the change and adjusts the voltage supplied to the motor.

Even if there were no change in speed, AEO can still produce energy savings. In order to provide a safety margin, most motors for pumping systems are larger than needed to drive the load. As a result, even under full speed, full flow conditions, the motor is operating at less than full load. Without the voltage reduction that AEO provides, the motor would be operating at less than peak efficiency. With the VLT 8000 AQUA it is common to notice an output voltage from the drive which is less than the motor's nameplate rating, even when the drive is producing full frequency. Rather than being an indication that something is wrong, this shows that AEO is compensating for a motor that is oversized for the application.

Even variable speed, constant pressure applications benefit from AEO. One example of such an application is a pump system for water filtration. Here, the purpose of the drive is to maintain a constant flow, even as the filter becomes dirty. As the filter becomes loaded, the drive automatically increases the speed and the load on the motor increases. AEO ensures that sufficient torque is always available on the motor's shaft, while maintaining high motor efficiency.

Although maximizing the motor's efficiency is the goal of AEO, it also provides side benefits. By reducing heat generation in the motor, it reduces thermal stresses, extending motor life. Reduced current flows also reduce energy losses in the drive and all other components supplying current to the motor. In addition, reducing motor current to the lowest level possible minimizes audible noise generation in the motor.

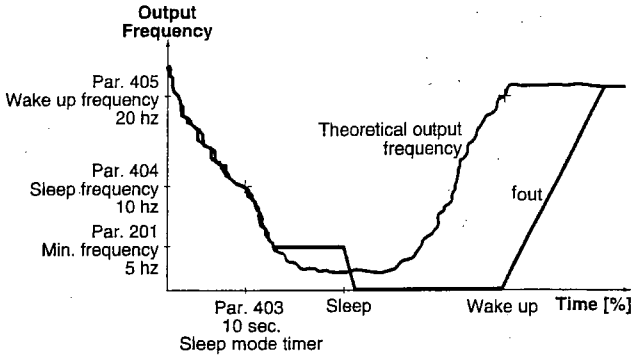
Autoramping



- Simplifies start-up
- Automatically extends the acceleration time to prevent tripping on overcurrent
- Automatically extends the deceleration time to prevent tripping on overvoltage

The Autoramping function prevents the drive from tripping when the acceleration or deceleration ramp time values are inadequate. If the ramp up time is too fast, it maximizes the acceleration rate without exceeding the drives current limit by extending the acceleration time. For instance, a decelerating motor will often send energy back to the drive, causing an overvoltage condition in the DC bus. Under these circumstances, autoramping will extend the ramp down time to keep the drive from tripping.

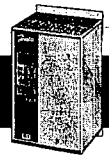
Sleep Mode



By automatically stopping the drive when the motor is running at low speeds, the sleep mode reduces wear on equipment and saves energy. The sleep mode will also start the VLT 8000 AQUA when the system demand rises.

The sleep mode timer determines how long the output frequency can be lower than the set *Sleep frequency*. When the timer runs out, the VLT 8000 AQUA will ramp down the motor to stop. If the output frequency rises above the *Sleep frequency*, the timer is reset. While the VLT 8000 AQUA has stopped the motor in sleep mode, a theoretical output frequency is calculated on the basis of the reference signal. When the theoretical output frequency rises above the *Wake up frequency*, the VLT 8000 AQUA will restart the motor and the output frequency will ramp up to the reference.

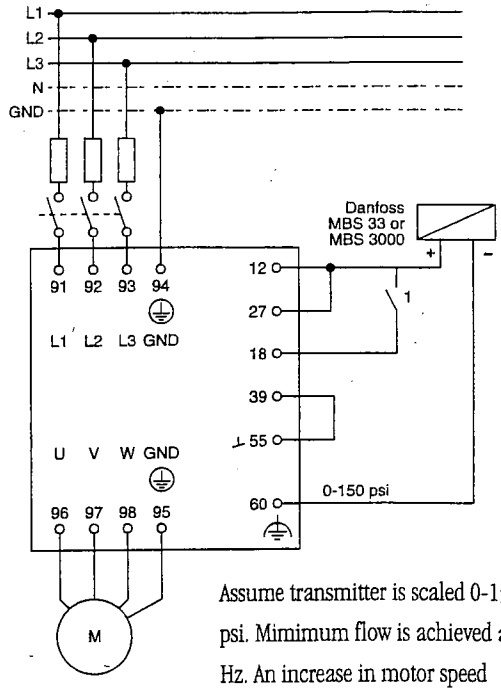
The VLT 8000 AQUA also incorporates a boost setpoint to avoid frequent starts and stops. The boost setpoint extends the time before the VLT 8000 AQUA stops the motor.



Example of Constant Pressure Regulation in Water Supply System

The demand for water from waterworks varies considerably during the course of a 24-hour period. During the night, practically no water is used, while in the morning and evening, the consumption is high. In order to maintain a suitable pressure in the water supply lines in relation to the current demand, the water supply pumps are equipped with speed control. The use of drives enables the energy consumed by the pumps to be kept at a minimum, while optimizing the water supply to consumers.

A VLT 8000 AQUA with its integral PID controller ensures simple and quick installation. For example, a NEMA 12 (IP54) unit can be mounted close to the pump on the wall and the existing line cables can be used as line supply to the drive. A pressure transmitter (i.e. Danfoss MBS 33 or MBS 3000) can be fitted a few feet from the joint outlet point from the waterworks to obtain closed loop regulation. Danfoss MBS 33 and MBS 3000 are two-wire transmitters (4-20 mA) that can be powered directly from the VLT 8000 AQUA. The required setpoint (i.e. 75 psi) can be set locally in parameter 418 Setpoint 1.



Assume transmitter is scaled 0-150 psi. Mimimum flow is achieved at 30 Hz. An increase in motor speed increases the pressure.

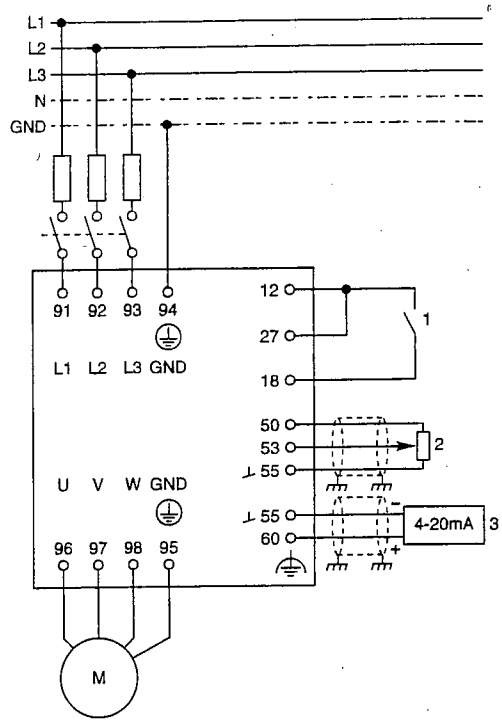
Set the following parameters:

Function	Parameter	Setting	Data Value
Configuration	100	Closed loop	[1]
Minimal output frequency	201	30 Hz	
Maximum output frequency	202	50 or 60 Hz	
Minimum reference	204	0 psi	
Maximum reference	205	150 psi	
Terminal 18 digital inputs	302	Start	[1]
Terminal 60, analog input current	314	Feedback signal	[2]
Terminal 60, min. scale	315	4 mA	
Terminal 60, max. scale	316	20 mA	
Sleep mode timer	403	10 sec.	
Sleep frequency	404	15 Hz	
Wake-up frequency	405	20 Hz	
Boost setpoint	406	125%	
Minimum feedback	413	0 psi	
Maximum feedback	414	150 psi	
Process units	415	psi	[36]
Setpoint 1	418	75 psi	
PID control action	420	Normal	
PID proportional gain	423	0.3*	
PID integral time	424	30 sec.*	

* The PID tuning paraemters depend on the actual system dynamics.

Example of PID for Dissolved Oxygen Control

The following is an example of a process regulator used in aeration. In an aeration system, the dissolved oxygen is to be scalable from 0-10 ppm with a speed pot of 0-10V, the PLC or controller, or directly from the VLT 8000 AQUA keypad. The setpoint DO level must be kept constant, thus requiring the use of the integrated process regulator. When the DO is the aeration basin increases, the blower speed is decreased to reduce air flow. When DO drops, the speed is increased. The transmitter used is an OXY 4100 with a working range of 4-20 mA proportional to the DO level.

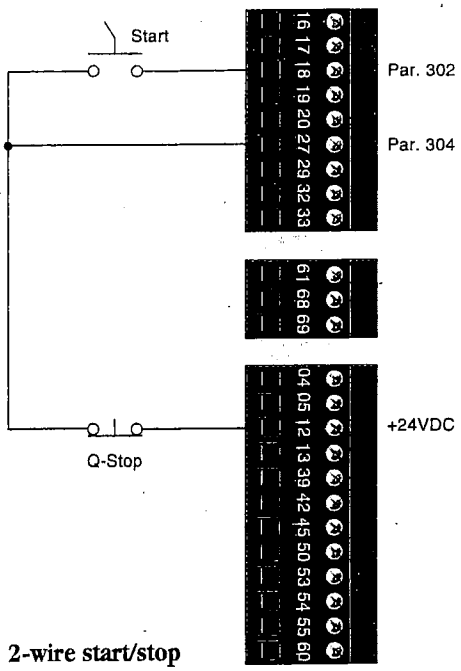


1 = Start/Stop
2 = Setpoint signal from PLC, controller or keypad
3 = Danfoss EVITA® OXY 4100 input 4-20 mA

The following must be programmed in the order shown:

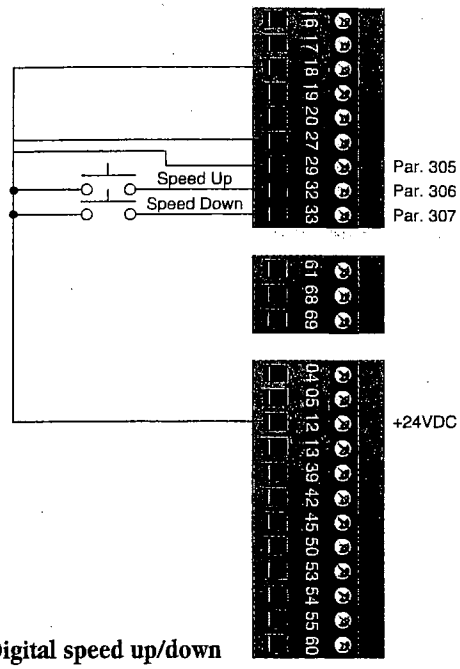
Function	Parameter	Setting	Data Value
Activation of process regulator	100	Process, closed loop mode	[3]
Feedback signal	314	Feedback signal	[2]
Terminal 60, min. scale	315	4 mA	
Terminal 60, max. scale	316	20 mA (factory setting)	
Minimum feedback	414	0	
Maximum feedback	415	10	
Process units	416	ppm	[10]
Reference	308	Reference (factory setting)	[1]
Terminal 53, min. scale	309	0 Volt (factory setting)	
Terminal 53, max. scale	310	10 Volt (factory setting)	
Minimum reference	204	0	
Maximum reference	205	6	
PID control action	420	Normal	
Min. frequency	201	30	
Max. frequency	202	60	
Proportional gain	440	423	
Integration time	441	424	

Connection Examples



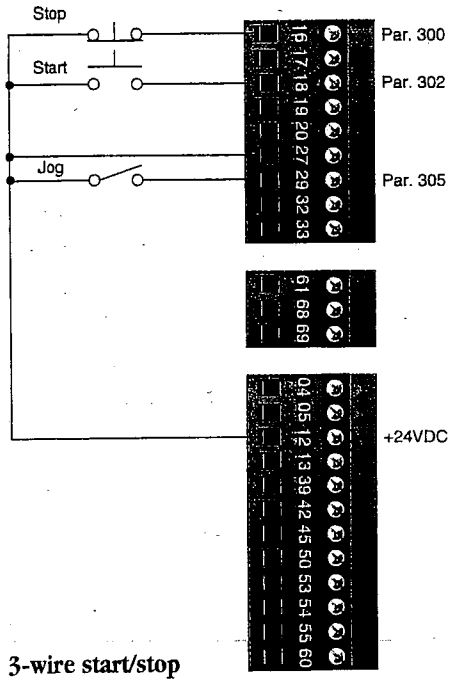
2-wire start/stop

Start/stop using terminal 18
Par. 302 Start [1]
Quick stop using terminal 27
Par. 304 Coasting stop inverse [0]



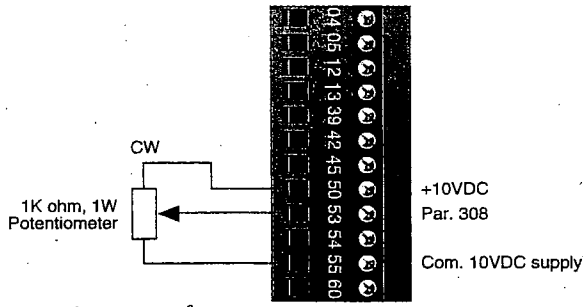
Digital speed up/down

Speed up and down using terminals 32 and 33
Par. 305 Freeze reference [2]
Par. 306 Speed up [7]
Par. 307 Speed down [7]



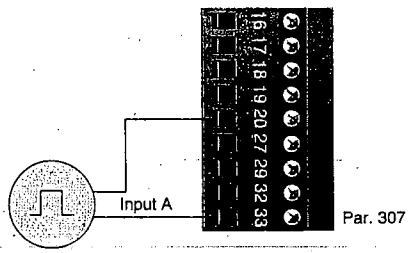
3-wire start/stop

Stop inverted by means of terminal 16
Par. 300 = Stop inverted [2]
Pulse start using terminal 18
Par. 302 = Latched start [2]
Jog by means of terminal 29
Par. 305 = Jog [12]



Potentiometer reference

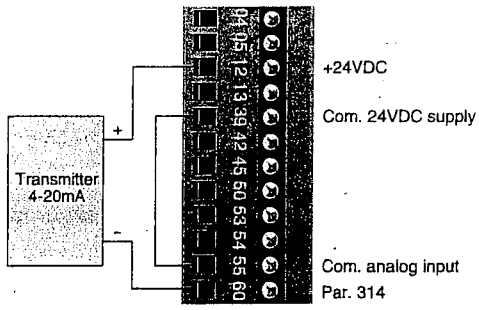
Par. 308 Reference [1]
Par. 309 Terminals 53, min. scaling
Par. 310 Terminals 53, max. scaling



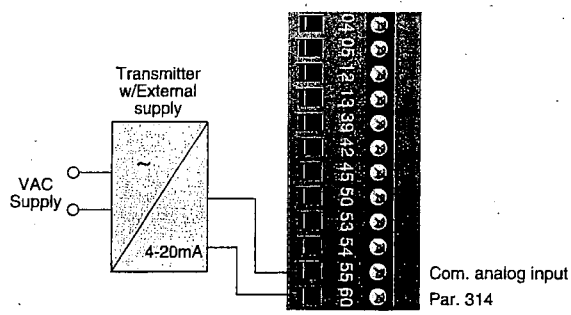
Pulse feedback

Par. 307 Pulse feedback [11]

Connection Examples

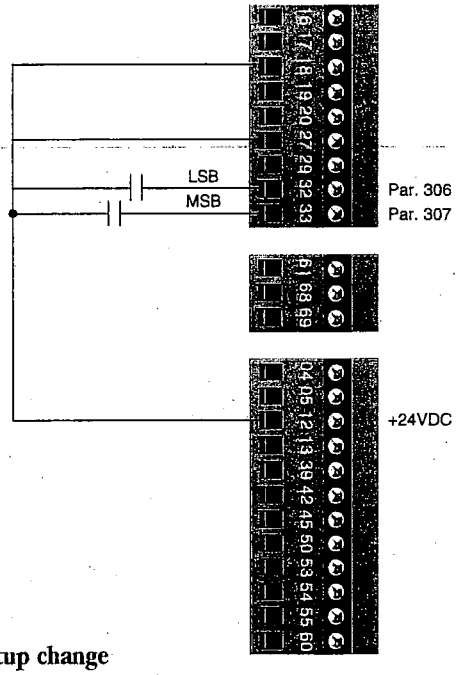


Two-wire transmitter



Transmitter connection

Par. 314 Reference [1]
Par. 315 Terminal 60, min. scaling
Par. 316 Terminal 60, max. scaling

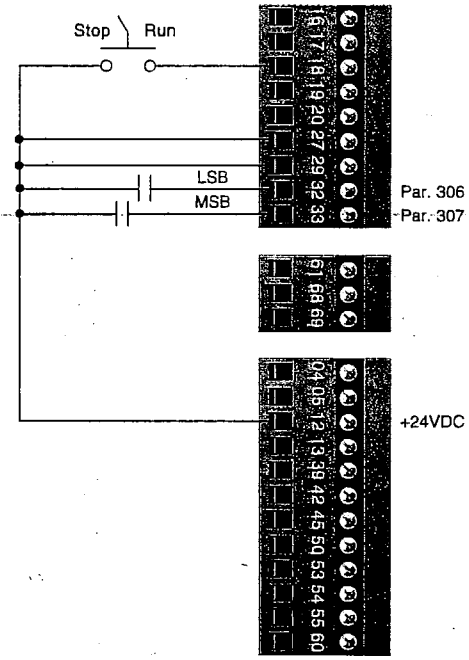


Setup change

Selection of setup using terminals 32 and 33.
Par. 306 Selection of setup, LSB [4]
Par. 307 Selection of setup, MSB [4]
Par. 002 Multi-setup [5]

Speed	Input 33	Input 32
1	0	0
2	0	X
3	X	0
4	X	X

0 = Open X = Closed



Four preset speed references

Par. 305 Preset reference on [6]
Par. 211 Speed #1
Par. 212 Speed #2
Par. 213 Speed #3
Par. 214 Speed #4
Par. 302 Start [1]
Par. 306 Preset Reference LSB [6]
Par. 307 Preset Reference MSB [6]

Speed	Input 33	Input 32
1	0	0
2	0	X
3	X	0
4	X	X

0 = Open X = Closed
Par. 302 Start [1]
Par. 304 Coast Inverse [0]

LITHONIA LIGHTING®

Catalog Number	
TDMS232120GEB	
Notes	Type A

FEATURES & SPECIFICATIONS

INTENDED USE

Intended for low to medium mounting heights in dusty or dirty environments. Aluminum body (AL) option provides corrosion protection against moisture or humidity. Impact resistant lenses and tamper resistant latches available options. Ideal for canopies, dock areas, refrigerated areas, food processing and other non-hazardous environments.

ATTRIBUTES

For unit or row installations, covered ceiling surface or suspended (damp only) mounting

CONSTRUCTION

Welded steel or aluminum housing is fully gasketed and post-painted for corrosion resistance. Captive, corrosion resistant pivot latches secure the diffuser, six on 4' units and ten on 8' units. Cast zinc wet location fittings standard on DMSW for ½" rigid conduit entry.

FINISH

Painted parts pretreated with a five-stage iron-phosphate process to ensure superior paint adhesion and corrosion resistance, then fiished with a high-gloss, baked white enamel.

ELECTRICAL SYSTEM

Thermally protected, resetting, Class P, HPF, non-PCB, UL listed, CSA certified ballast is standard. Sound rating depends on lamp/ballast combination. AWM, TFN or THHN wire used throughout, rated for required temperatures.

LISTING

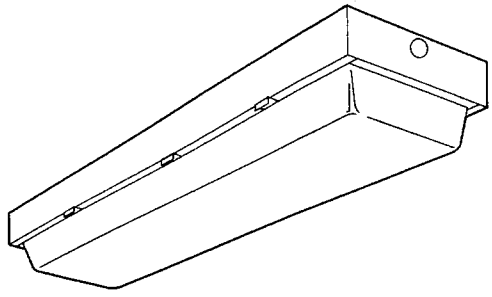
UL listed (standard). CSA certified or NOM Certified (see Options). UL listed and labeled for wet locations in covered ceiling applications. Tested in compliance with the International organization for Standardization (ISO) Worldwide Contamination Classification.

WARRANTY

Guaranteed for one year against mechanical defects in manufacture.

Enclosed and Gasketed Industrial

DMS



RAPID START
4' length
1, 2 or 3 lamps

Specifications

Length: 51 (1295)
Width: 8-5/8 (219)
Depth: 5-5/8 (143)

All dimensions are inches (millimeters).
Specifications subject to change without notice.

ORDERING INFORMATION

Example: **DMSW 2 40 120 ES GLR**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number.

TDMS	2	32		120	GEB
Series	**Lamps**	**Lamp Type**	**Diffuser**	**Voltage**	**Options**
DMS Damp location **DMSW** Wet location For tandem double-length unit, add prefix T. Example: **TDMS**	**1, 2, 3**[1]	**32** 32W T8 (48") **40** 40W T12 (48")	(blank) Deep acrylic **AR** Deep high-impact acrylic **DP** Deep acrylic[2] **ARDP** Deep high-impact acrylic[2]	**120** **277** **347** Others available	**Shipped installed in fixture** **ES** Energy-saving ballast (296 only) **CW** Cold-weather ballast, 0°F starting **GEB** Electronic ballast, ≤20% THD **GEB10IS** Electronic ballast(s) ≤10% THD, Instant start[3] **GEB10RS** Electronic ballasts, <10% THD, rapid start[4] **EL** Emergency battery pack (nominal 300 lumens). See Life Safety Section[5] **GLR** Internal fast-blow fusing **GMF** Internal slow-blow fusing **RIF1** Radio interference filter (one per fixture) **TP** Tamper-resistant latches **AL** Aluminum body **WLF** Wet location fittings (1 pair, installed in fixture top) **SW** Palletized and stretch-wrapped **CSA** CSA Certified **NOM** NOM Certified

NOTES:
1. 32W T8 lamps only.
2. Deep lens is standard on 8' fixtures.
3. Available only with 32 and 40 lamp types.
4. EL option only available on DMS fixture.
5. Hanging devices suitable for damp locations only.

Accessories[5]

Order as separate catalog numbers.

- **SQ** Swivel-stem hanger (specify length in 2" incrments). Hanging devices suitable for damp locations only.
- **1B** Ceiling spacer (adjusts from 1-1/2" to 2-1/2" from ceiling).
- **BCD** Bracket for HC mounting. Two per package.
- **HC36** Chain hangers (1 pair, 36" long)(Requires BCD).
- **WLF** Wet location fittings (1 pair, not installed).
- **U4220** Hex-base driver bit, Torx TX20, for tamper-resistant screws with center pin.

MOUNTING DATA

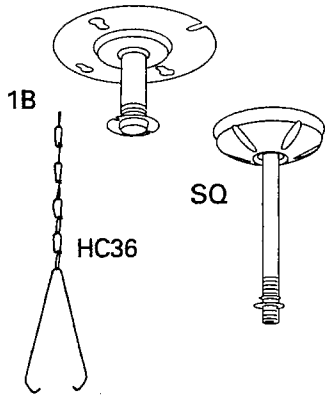
For unit or row installation, suspended mounting.

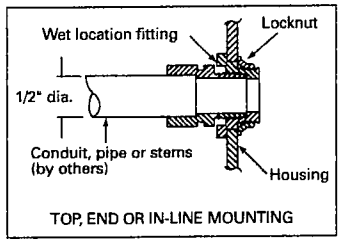
Unit installation — Minimum of two hangers required. Recommend 1/2" nipple with union (by others) for DMSW.

Row installation — One hanger per channel plus one per row required. Recommended 1/2" nipple with union (by others) for DMSW.

DMSW — Includes gasketed wet location fittings on ends for power feeding/mounting. Fitting is threaded for 1/2" rigid conduit. No KOs or mounting holes provided. Drill mounting holes and attach to surface using fasteners and sealing washers (by others) appropriate to ceiling material

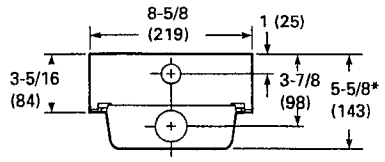
See ACCESSORIES below for hanging devices.

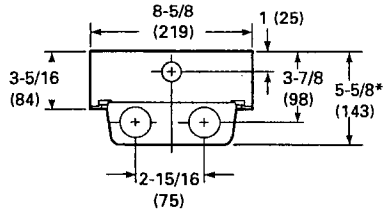


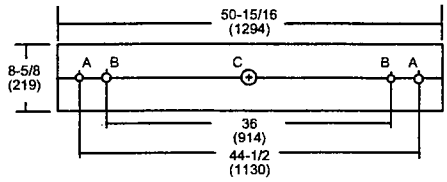


DIMENSIONS

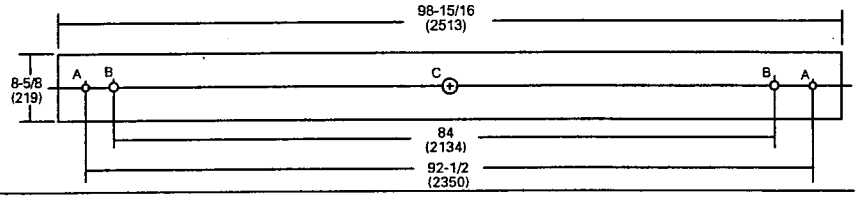
Inches (millimeters). Subject to change without notice.







A = 11/16(17)Dia.K.O.
B = 7/8(22)Dia.K.O.
C = 2(51)Dia K.O.



PHOTOMETRICS

Calculated using the zonal cavity method in accordance with IESNA LM41 procedures. Floor reflectances are 20%. Lamp configurations shown are typical. Full photometric data on these and other configurations available upon request.

DMS 1 40
Report: **L4492.IES**
LUMENS PER LAMP:**3150**
Luminaire Efficiency: 79.6%

Coefficients of Utilization

	pf	20%								
	pc	80%			50%			30%		
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR	0	94	94	94	86	86	86	81	81	81
	1	83	78	73	71	68	65	67	64	62
	2	74	66	60	60	55	51	57	53	49
	3	67	57	50	52	47	42	49	44	40
	4	61	50	42	46	40	35	44	38	34
	5	56	44	37	41	35	30	39	33	29
	6	51	40	32	37	30	26	35	29	25
	7	47	36	28	33	27	22	32	26	22
	8	44	33	25	30	24	20	29	23	19
	9	41	30	23	28	22	18	27	21	17
	10	38	27	21	26	20	16	25	19	16

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	472	15.0	18.8
0° - 40°	802	25.5	32.0
0° - 60°	1546	49.1	61.6
0° - 90°	2350	74.6	93.7
90° - 180°	159	5.0	6.3
0° - 180°	2509	79.6	100.0

DMS 2 32
Report: **L5816**
LUMENS PER LAMP:**2900**
Luminaire Efficiency: 79.2%

Coefficients of Utilization

	pf	20%								
	pc	80%			50%			30%		
	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR	0	93	93	93	85	85	85	81	81	81
	1	83	78	74	72	69	66	68	65	63
	2	75	67	61	62	57	53	58	54	51
	3	68	59	51	54	48	43	51	46	42
	4	62	51	44	47	41	37	45	40	35
	5	57	46	38	42	36	31	40	35	30
	6	52	41	33	38	32	27	36	31	26
	7	48	37	30	34	28	24	33	27	23
	8	45	34	27	31	25	21	30	25	21
	9	42	31	24	29	23	19	28	22	19
	10	39	28	22	27	21	17	25	20	17

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	951	16.4	20.7
0° - 40°	1607	27.7	35.0
0° - 60°	3005	51.8	65.4
0° - 90°	4311	74.3	93.8
90° - 180°	286	4.9	6.2
0° - 180°	4596	79.2	100.0

LITHONIA LIGHTING®
An AcuityBrands Company

Lithonia Lighting
Acuity Lighting Group, Inc.
Fluorescent
One Lithonia Way, Conyers, GA 30012
Phone: 800-858-7763, Fax: 770-929-8789
In Canada: 160 avenue Labrosse, Pointe-Claire, P.Q., H9R 1A1
www.lithonia.com

LITHONIA LIGHTING®

Catalog Number	
	TWA42TRT120PE
Notes	Type B

FEATURES & SPECIFICATIONS

INTENDED USE

For entrances, stairwells, corridors and other pedestrian areas.

CONSTRUCTION

Rear housing is rugged, corrosion-resistant, die-cast aluminum. Corrosion-resistant external hardware includes slotted hex-head and tamper-proof fasteners.

FINISH

Dark bronze (DDB) corrosion resistant polyester powder.

OPTICAL SYSTEM

Front housing and refractor are one-piece, injection molded, UV-stabilized polycarbonate. High-performance optical system consists of specular anodized segmented reflector and computer-designed prism pattern. Standard finish on opaque portion of front cover and back housing is dark bronze polyester enamel. Refractor is sealed with a one-piece high-temperature silicone gasket to inhibit the entrance of outside contaminants.

ELECTRICAL SYSTEM

Multi-volt (120-277) High power factor, solid state, electronic ballast is standard. (Requires 4-pin lamp.) UL listed. Electrical components are heat-sinked to the cast aluminum housing, promoting maximum heat dissipation. Optional multi-volt electronic ballast capable of operating on any line voltage from 120V to 277V.

Four-pin (TRT), positive thermoplastic socket.

Four-pin fluorescent lamp included with fixture.

INSTALLATION

Top 1/2" threaded wiring access. Back wiring access through cast opening. Feed-thru wiring can be achieved by using a condulet tee. Mount on any flat vertical surface.

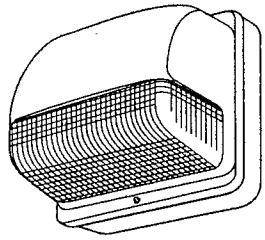
LISTING

UL listed suitable for wet locations. IP65 listed (International Protection). Listed and labeled to comply with Canadian and Mexican Standards (see Options).

Wall-Paks

TWA

TRI-TUBE FLUORESCENT
32TRT
42TRT



Height: 10" (25.4cm)
Width: 11-1/2" (29.2cm)
Depth: 8-15/16" (22.7cm)
Weight: 10 lbs. (4.53kg)

ORDERING INFORMATION

Example: **TWA 32TRT 120 LPI**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog numbers (shipped separately).

TWA	42TRT	120	PE
Series	Wattage /lamp	Voltage	Options
TWA	32TRT 42TRT	120 277 MVOLT[1]	

Shipped installed in fixture

- **SF** Single fuse (120)[2]
- **CR** Enhanced corrosion-resistance
- **CRT** Non-stickProtective coating[3]
- **PE** Photocell[2]
- **L/LP** Less lamp
- **LPI** Lamp included as standard
- **CSA** Listed and labeled to comply with Canadian Standards
- **NOM** Listed and labeled to comply with Mexican Standards (Consult factory)
- **GMF** Internal slow-blow fusing[2]

Architectural Colors (optional)

- **DNA** Natural aluminum
- **DBL** Black
- **DMB** Medium bronze
- **DWH** White
- **DSS** Sandstone

Accessories

Order as separate catalog number

- **RK1 PEB1** Photocell kit (120V only)
- **RK1 PEB1 CSA** Photocell kit (120V only)
- **RK1 PEB2** Photocell kit (277V)
- **TWAWG** Wireguard

NOTES:
1. Standard multi-volt electronic ballast capable of operating on any line voltage from 120V to 277V.
2. Not available with MVOLT.
3. Black finish on housing only.

LITHONIA LIGHTING®

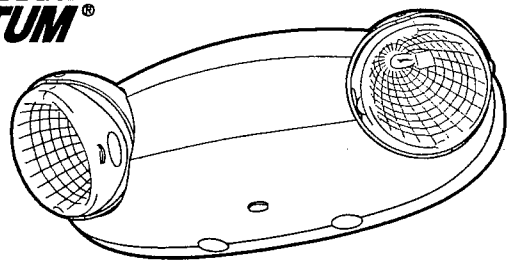
Catalog Number	
ELM2	
Notes	Type
	E

Thermoplastic Emergency Light

ELM2

Lead-Calcium Battery

QUANTUM®



FEATURES

INTENDED USE

Provides a minimum of 90 minutes of illumination for the rated wattage upon loss of AC power. Ideal for applications requiring attractive unit equipment with quick installation.

CONSTRUCTION

White, compact, low-profile contemporary design with UV-stabilized thermoplastic housing that is impact and scratch-resistant.

Two 5.4W wedge-based krypton lamps offer 32 percent more light output than standard incandescent lamps.

Patented MR24, multi-faceted reflector significantly improves photometric performance – 60 to 100 percent more light delivered to path of egress. **US Patent No. D484,272**

Dual-voltage input capability (120/277V). Edge connectors on printed circuit board ensure long-term durability.

Low-profile, integrated test switch/pilot light. Easily visible bright red status indicator.

Unique track-and-swivel arrangement permits full range of direction of lamp head adjustment. Universal J-box mounting pattern. Tool-less access for maintenance. Flexible conduit entry provision on top of the unit. **U.S. Patent No. D473,672**

BATTERY

Sealed, maintenance-free lead-calcium battery provides 12W rated capacity. Automatic 48-hour recharge after a 90-minute discharge.

Low-voltage disconnect prevents excessively deep discharge that can permanently damage the battery.

Single-circuit battery connection. Galvanized battery retaining clip.

ELECTRONICS

Current-limiting charger maximizes battery life and minimizes energy consumption. Provides low operating costs.

Short-circuit protection — current-limiting charger circuitry protects printed circuit board from shorts.

Thermal protection senses circuitry temperature and adjusts charge current to prevent overheating and charger failure.

Thermal compensation adjusts charger output to provide optimum charge voltage relative to ambient temperature.

Regulated charge voltage maintains constant-charge voltage over a wide range of line voltages. Prevents over/undercharging that shortens battery life and reduces capacity.

Filtered charger input minimizes charge voltage ripple and extends battery life.

AC/LVD reset allows battery connection before AC power is applied and prevents battery damage from deep discharge.

Brownout protection is automatically switched to emergency mode when supply voltage drops below 80 percent of nominal.

DIAGNOSTICS (SD option)

Single multi-chromatic LED indicator to display two-state charging, test activation and three-state diagnostic status.

Test switch provides manual activation of 30- second diagnostic testing for on-demand visual inspection.

Self-diagnostic testing for five minutes every 30 days and 30 minutes every six months.

Diagnostic evaluation of lamp, AC to DC transfer, charging and battery condition.

Brownout protection is a standard feature of self-diagnostics.

Continuously monitors AC functionality.

Automatic test is easily postponed for eight hours by activating manual test switch.

LISTING

UL Listed and NOM Certified (standard). Meets UL 924, NFPA 101, NFPA 70-NEC and OSHA illumination standards. Meets Mexican standards.

WARRANTY

Three-year total customer satisfaction warranty. For details, see the Product Selection Guide.

ORDERING INFORMATION

Example: **ELM2 DL**

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number.

ELM2

Family	Input Voltage	Options
ELM2	(blank) 120/277V	**B** Black housing[1]
		DL Damp location listed (10°C to 40°C)[1]
		SD Self-diagnostics

Accessories

Order as separate item.

ELA VS Thermoplastic vandal shield

ELA WGST Wireguard

Note:
1 Black unit not available with damp location option.

ELM2 Thermoplastic Emergency Light, Quantum

SPECIFICATIONS

ELECTRICAL

Primary Circuit

Type	Volts	AC Input Amps	Watts	Output Volts	Watts Output 1-1/2hrs.	2hrs.
ELM2	120	.11	1.2	6	12	9
	277	.12	1.5			

* Half-hour and one-hour run time not applicable for U.S. product.

BATTERY

Sealed Lead-Calcium

Voltage	Shelf life[1]	Expected life[1]	Maintenance	Optimum temperature[2]
6	6 mos.	5-8 yrs.	none[3]	60-90°F (16-32°C)

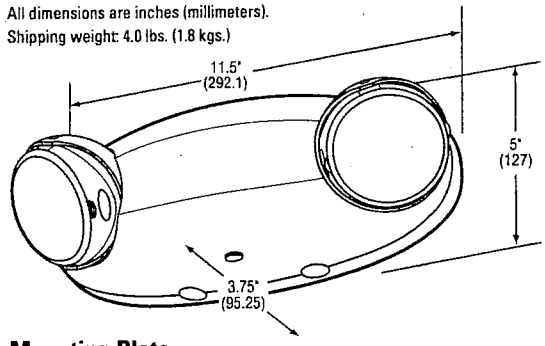
1 At 77°F (25°C).

2 Optimum ambient temperature range where unit will provide capacity for 30 to 90 minutes. Higher and lower temperatures affect life and capacity. Consult factory for detailed information.

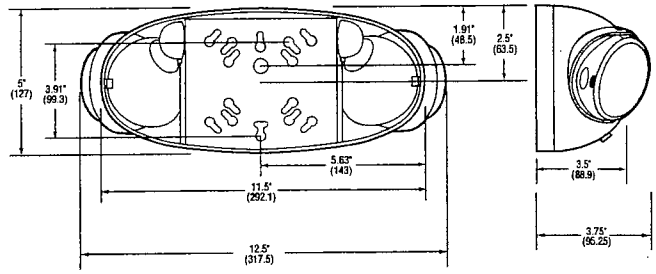
3 Periodic system status test recommended.

MOUNTING

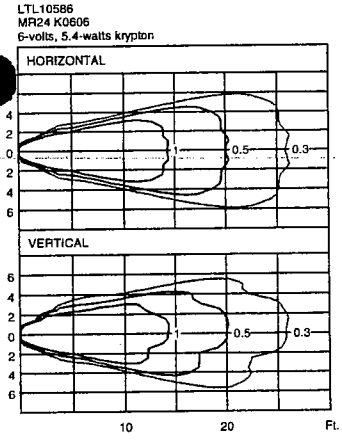
All dimensions are inches (millimeters).
Shipping weight: 4.0 lbs. (1.8 kgs.)



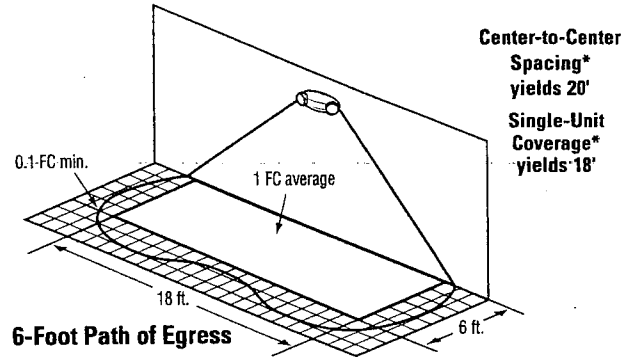
Mounting Plate



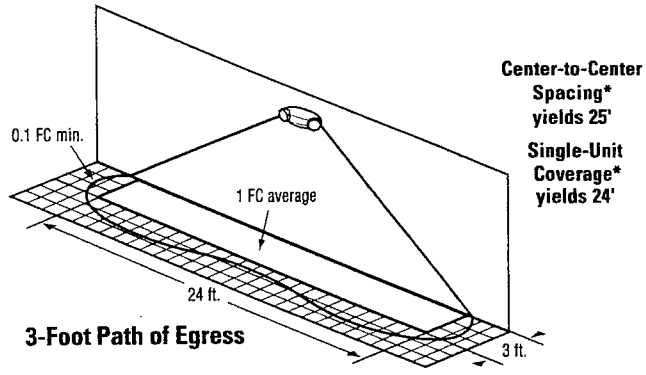
LAMP PHOTOMETRICS



FIXTURE PERFORMANCE



6-Foot Path of Egress



3-Foot Path of Egress

SPACING/COVERAGE GUIDE

MR24 K0606 Lamp	Path of Egress	
	3'-wide	6'-wide
Center-to-Center Spacing	25'	20'
Single-Unit Coverage	24'	18'

* Meets Life Safety Code standard minimum illuminance of 0.1 FC and average illuminance of 1.0 FC. Assumes open space with no obstructions, mounting height: 7.5', ceiling height: 9', and reflectances: 80/50/20. Analysis based on independently tested photometrics.

LITHONIA LIGHTING®
An AcuityBrands Company

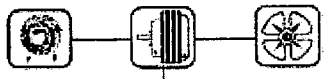
Lithonia Lighting
Acuity Lighting Group, Inc.
Emergency Lighting Systems
One Lithonia Way, Decatur, GA 30035
Phone: 800-334-8694
In Canada: 160 avenue Labrosse, Point-Claire, P.Q. H9R 1A1
www.lithonia.com

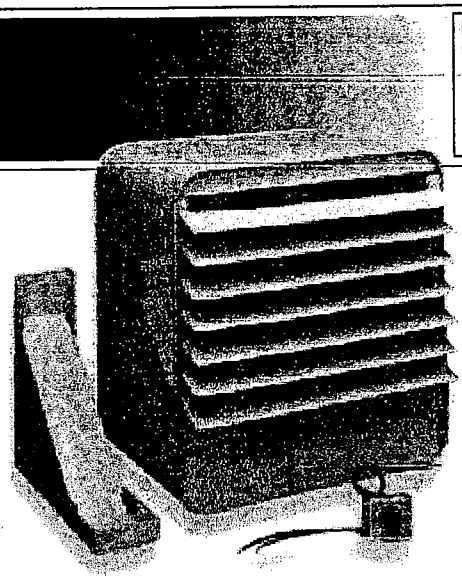
UNIT HEATER

K
SER

LARGE AREA - 2000 WATTS TO 66,000 WATTS

CEILINGS UNDER 12 FT



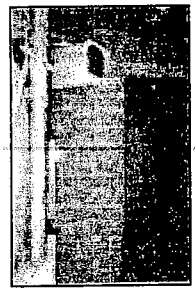


FEATURES:

- Spiral Steel Fin Element
- Cast Iron Motor
- Aluminum Fan Blade
- Heavy Gauge Steel Enclosure
- Adjustable Discharge Louvers
- Totally Enclosed Motor
- Control Options
- Auto-Reset Thermal Cutout
- Optional 1-Pole or 2-Pole Thermostat
- Tested Under UL1278
- Optional Summer Fan Switch
- Optional 3-Position Switch (Heat-Off-Fan)
- Optional Two Stage Thermostat
- Optional Pilot Light (Power On Indication)
- Optional Door Interlocking Disconnect
- Optional Wall Mounted Thermostat
- Available in Stainless Steel Refer to Index.

Convenient, small and powerful are great words that describe our unit heaters which have been standard equipment in most high rise buildings, garages, water treatment and fire room vaults to prevent freezing. High mass steel elements and high CFM keeps outlet temperatures low for long life. For KB's under 5KW, use the KBP Series for higher outlet temperatures.

Other applications are residential garages and warehouse heating. Long life comes standard with the highest quality comp custom designed for use in Series Unit Heater.



Freeze/Moisture Protect in a Generator Vault

ENGINEERING SPECIFICATIONS:

Contractor shall supply and install KB Series unit heaters manufactured by King Electrical Mfg. Company. Heaters shall be of the wattage and voltage as indicated on the plans.

Construction: All exterior and interior metal enclosure parts are made from 20GA electro galvanized steel with a rust inhibiting baked enamel finish. Smooth rounded corners and protective edge trim give an attractive modern appearance.

Adjustable Outlet Louver: Louvers direct air up or down as needed for the heating application.

Rear Intake Screen: Heavy gauge steel screen protects against foreign objects making accidental contact with the rotating fan blade.

Spiral Fin Elements: The metal sheath element is brazed with spiral fins and then molded into a coil configuration. This combination produces the best heat transfer while eliminating the potential for hot spots by positioning the element in the maximum airflow stream.

Totally Enclosed Fan Motor: Permanently lubricated cast iron with 20 cc of oil. Epoxy coated motor with enclosed rotor resists moisture and corrosion for long lasting trouble free operation.

Aluminum Fan Blade: Axial flow type fan mounted directly to motor shaft for maximum efficiency.

Auto-Reset Thermal Cutout: Power is disconnected from the ment if an over heated condition occurs. The fan continues to to dissipate excess heat from the element. The element is energized automatically when the normal operating tempe ture returns.

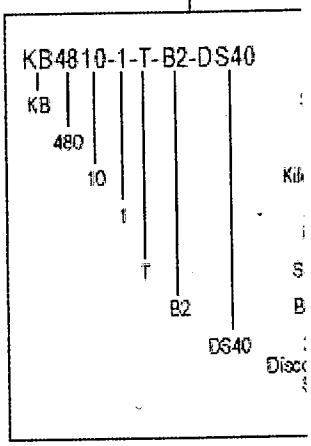
Internal Controls: Magnetic contactors are standard on all 4 heaters, all 208V-1Ø, 240V-1Ø, 277V-1Ø heaters above 6-K and all 3Ø heaters. The control voltage is equal to the line v age (208, 240 or 277) except for 480V models where a tra former is provided for 24V Control. Internal circuit fusing is p vided when the heater ampacity exceeds 48 amps to comply v NEC standards. A fan delay is provided standard on models 1 KW and above to dissipate residual heat from the heating ments.

Easy Installation: A quick access panel located on the botton the heater allows for quick wiring and easy maintanece for the of the heater.

Factory Installed Options:

Power Contactor: Standard on heaters above 5KW and on all 3-Phase models, optional on 2 to 6KW 1-Phase heaters.
24 Volt Control: Standard on 480V heaters, optional on all other heaters.
120 Volt Control: Control components will be modified to accept 120V control. (Not Standard)
Mounting: Choose universal or low profile ceiling bracket made from heavy gauge steel.
Rough Service: 5-Lugs are provided to securely mount heater in heavy industrial applications or marine vessels were vibration and movement are a concern. Includes 5-Hole Bracket.

MODEL CODE:

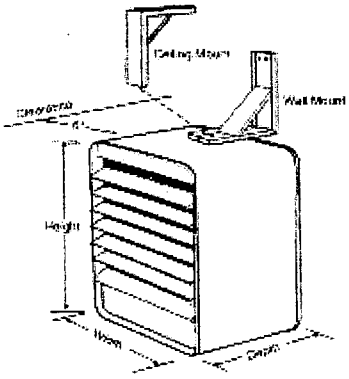


Other Control Options:

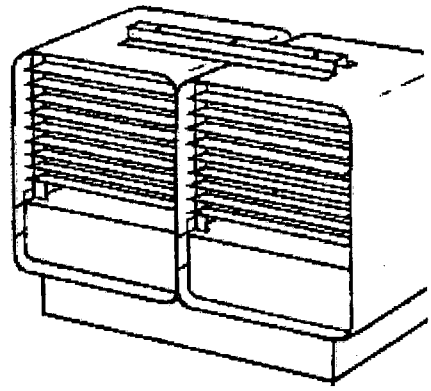
- 1-Pole or 2-Pole Thermostat Temperature Indicated Label with 44° Energy Code Setting
- Summer Fan Switch
- 3-Position Switch (Heat-Off-Fan)
- Pilot Light (Power On Indicating)
- Door Interlocking Disconnect
- Wall Mounted Thermostat Line or Low Voltage

QUICK SELECTION CHART:

KILOWATTS	PHASE	208V MODEL	208V UPC #093319 PART NO.	240V MODEL	240V UPC #093319 PART NO.	277V MODEL	277V UPC #093319 PART NO.	480V MODEL	480V UPC #093319 PART NO.	WEIGHT (lbs.)
3	1	KB2003-1	15003	KB2403-1	15006	KB2703-1	15202	KB4803-1	15009	25
	3	KB2003-3MP	15231	KB2403-3MP	15072			KB4803-3MP	15102	40
4	1	KB2004-1	15012	KB2404-1	15010	KB2704-1	15204	KB4804-1	15015	25
5		KB2005-1	15224	KB2405-1	15018	KB2705-1	15206	KB4805-1	15021	
	3	KB2005-3MP	15228	KB2405-3MP	15075			KB4805-3MP	15105	40
6	1			KB2406-1	15024	KB2706-1	15208	KB4806-1	15027	25
	3			KB2406-3MP	15078			KB4806-3MP	15108	40
7.5	1	KB2007-1	15029	KB2407-1	15030	KB2707-1	15209	KB4807-1	15033	32
	3	KB2007-3MP	15233	KB2407-3MP	15079			KB4807-3MP	15109	40
9	1					KB2709-1	15212			
	3			KB2409-3MP	15081			KB4809-3MP	15111	40
10	1	KB2010-1	15226	KB2410-1	15042	KB2710-1	15214	KB4810-1	15045	32
	3	KB2010-3MP	15230	KB2410-3MP	15082			KB4810-3MP	15113	40
12.5	1	KB2012-1	15227	KB2412-1	15054	KB2712-1	15216	KB4812-1	15057	32
	3	KB2012-3	15235	KB2412-3	15087			KB4812-3MP	15117	40
15	1	KB2015-1	15229	KB2415-1	15064	KB2715-1	15221	KB4815-1	15065	32
	3	KB2015-3	15232	KB2415-3	15090			KB4815-3MP	15120	40
18				KB2418-3	15093			KB4818-3MP	15123	40
20		KB2020-3	15237	KB2420-3	15094			KB4820-3MP	15122	48
25		KB2025-3	15239	KB2425-3	15100			KB4825-3	15130	
30		KB2030-3	15223	KB2430-3	15101			KB4830-3	15162	49
33				KB2433-3	15138			KB4833-3	15165	
40		KB2040-3	15225	KB2440-3	15103			KB4840-3	15169	100
50		KB2050-3	15241	KB2450-3	15148			KB4850-3	15175	
60		KB2060-3	15243	KB2460-3	15153			KB4860-3	15180	110



HEATER SIZE	DIMENSIONS		
	HEIGHT	DEPTH	WIDTH
A	16.5"	11"	15"
B	16.5"	18"	15"
C	18.5"	11"	15"
D	18.5"	18"	15"
E	20.5"	18"	15"
F	18.5"	18"	30"
G	20.5"	18"	30"



SINGLE PHASE TECHNICAL DATA

380V 3Ø Heaters are available in most KW ratings.

CATALOG NO.	UPC VENDOR #093319	KW	BTUH (000)	SINGLE PHASE	VOLTS	AMPS	**T-STAT CONTROL VOLTAGE	MOTOR HP	CFM	TEMP RISE	AIR THROW	MAX MTG HT.	*SIZE	WT (LBS.)
KB2003-1	15005	3	10.2	1	208	14.4	208	3 Watt	300	35°	14ft	8ft	A	25
KB2403-1	15006				240/208	12.5/10.8	240							25
KB2703-1	15202				277	10.8	277							25
KB4803-1	15009				480	6.2	24							28
KB2004-1	15012	4	13.5	1	208	19.2	208	9 Watt	400	38°	15ft	8ft	A	25
KB2404-1	15010				240/208	16.6/14.4	240							25
KB2704-1	15204				277	14.4	277							25
KB4804-1	15015				480	8.3	24							28
KB2005-1	15224	5	17.0	1	208	24.0	208	9 Watt	400	40°	16ft	8ft	A	25
KB2405-1	15018				240/208	20.8/18	240							25
KB2705-1	15206				277	18.1	277							25
KB4805-1	15021				480	10.4	24							28
KB2406-1	15024	6	20.5	1	240/208	25/21.6	240	9 Watt	400	45°	16ft	8ft	A	25
KB2706-1	15208				277	21.6	277							25
KB4806-1	15027				480	12.5	24							28
KB2007-1	15029	7.5	25.6	1	208	36.1	208	16 Watt	600	40°	20ft	9ft	C	29
KB2407-1	15030				240/208	31.2/27	240							29
KB2707-1	15209				277	27.0	277							29
KB4807-1	15033				480	15.6	24							32
KB2010-1	15226	10	34.1	1	208	48.1	208	25 Watt	725	44°	24ft	10ft	B	32
KB2410-1	15042				240/208	41.6/36.1	240							32
KB2710-1	15214				277	36.1	277							32
KB4810-1	15045				480	20.8	24							35
KB2012-1	15227	12.5	42.7	1	208	60.1	208	35 Watt	825	48°	30ft	11ft	B	32
KB2412-1	15054				240/208	52/45.1	240							32
KB2712-1	15216				277	45.1	277							32
KB4812-1	15057				480	26.0	24							35
KB2015-1	15229	15	51.2	1	208	72.1	208	35 Watt	925	51°	33ft	12ft	B	37
KB2415-1	15064				240/208	62.5/54.1	240							37
KB2715-1	15221				277	54.2	277							37
KB4815-1	15065				480	31.3	24							40

*Refer to DIMENSIONS Chart

Heater will draw 13% less amps 25% less wattage.

**Over 6KW Line Voltage Control is operating the Contactor Coil only and will draw under 1 AMP.

Note: Consult factory for special wattages and/or voltages.

Rated KW load tolerance of plus 5% minus 10%.

3-PHASE TECHNICAL DATA CHART:

380V 3Ø Heaters are available in most KW ratings.

CATALOG NO.	UPC VENDOR #093319	KW	BTUH (000)	PHASE	VOLTS	AMPS 1-PH	AMPS 3-PH	**T-STAT CONTROL VOLTAGE	MOTOR HP	CFM	TEMP RISE	AIR THROW	MAX MTG HT.	*SIZE	WT (LBS.)
KB2003-3MP	15231	3	11.0	1-3	208	14.4	8.3	208	3 Watt	300	35°	14ft	8ft	B	32
KB2403-3MP	15072				240/208	12.5/10.8	7.2/6.2	240							32
KB4803-3MP	15102				480	6.2	3.6	24							35
KB2005-3MP	15228	5	17.1	1-3	208	24.0	13.9	208	9 Watt	400	40°	16ft	8ft	B	32
KB2405-3MP	15075				240/208	20.8/18	12/10.4	240							32
KB4805-3MP	15105				480	10.4	6.0	24							35
KB2007-3MP	15233	7.5	25.6	1-3	208	36.1	20.8	208	16 Watt	600	40°	20ft	9ft	B	42
KB2407-3MP	15079				240/208	31.2/27	18/15.6	240							42
KB4807-3MP	15109				480	15.6	9.0	24							45
KB2009-3MP	15135	9	30.7	1-3	208	43.2	24.9	208	25 Watt	725	42°	24ft	9ft	B	42
KB2409-3MP	15081				240/208	37.5/32.5	21.6/18.7	240							42
KB4809-3MP	15111				480	18.7	10.8	24							45
KB2010-3	15230	10	34.1	1-3	208		27.7	208	25 Watt	725	44°	24ft	10ft	B	42
KB2410-3MP	15082				240/208	41.6/36.1	24/20.8	240							42
KB4810-3MP	15113				480	20.8	12.0	24							45
KB2012-3	15235	12.5	42.7	1-3	208		34.6	208	35 Watt	825	48°	30ft	11ft	B	42
KB2412-3	15087				240/208		30/26	240							42
KB4812-3MP	15117				480	26.0	15.0	24							45
KB2015-3	15232	15	51.2	1-3	208		41.6	208	35 Watt	925	51°	33ft	12ft	B	46
KB2415-3	15090				240/208		36/31.2	240							46
KB4815-3MP	15120				480	31.2	18.0	24							49
KB2418-3	15093	18	61.4	1-3	240/208		43.3/37.5	240	35 Watt	925	55°	33ft	12ft	B	46
KB4818-3MP	15123				480	37.5	21.6	24							49
KB2020-3	15237	20	68.3	3	208		55.5	208	50 Watt	1100	57°	37ft	13ft	D	46
KB2420-3	15094			3	240/208		48.1/41.6	240							46
KB4820-3MP	15122			1-3	480	41.6	24.0	24							49
KB2025-3	15239	25	85.3	3	208		69.4	208	1/4hp	1350	58°	41ft	14ft	E	48
KB2425-3	15100				240/208		60.1/52.1	240	50 Watt					D	48
KB4825-3	15130				480		30.1	24							51
KB2030-3	15223	30	102.4	3	208		83.3	208	1/4hp	1800	53°	48ft	15ft	E	49
KB2430-3	15101				240/208		72.1/62.5	240							49
KB4830-3	15162				480		36.1	24							52
KB2433-3	15138	33	113	3	240/208		79.3/68.8	240	1/4hp	1800	53°	48ft	15ft	E	49
KB4833-3	15165				480		39.7	24							52
KB2040-3	15225	40	136.5	3	208		111.0	208	(2) 50 Watt	2200	57°	53ft	15ft	F	100
KB2440-3	15103				240/208		96.2/83.3	240							100
KB4840-3	15169				480		48.1	24							110
KB2050-3	15241	50	170.6	3	208		138.8	208	(2) 50 Watt	2400	65°	58ft	15ft	F	103
KB2450-3	15148				240/208		120.2/104.2	240							103
KB4850-3	15175				480		60.1	24							113
KB2460-3	15153	60	204.8	3	240/208		144.3/125	240	(2) 1/4hp	2700	70°	65ft	18ft	G	105
KB4860-3	15180				480		72.2	24							115
KB2466-3	15156	66	225	3	240/208		158.7/137.6	240	(2) 1/4hp	2700	70°	65ft	18ft	G	105
KB4866-3	15183				480		79.5	24							115

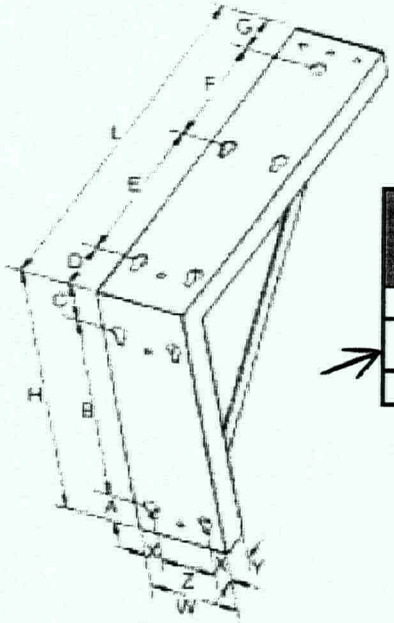
*Refer to DIMENSIONS Chart

Heater will draw 13% less amps 25% less wattage.

**Over 6KW Line Voltage Control is operating the Contactor Coil only, and will draw under 1 AMP.

Note: Consult factory for special wattages and/or voltages.

Rated KW load tolerance of plus 5% minus 10%.



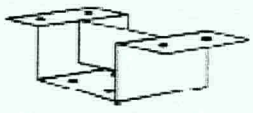
BRACKET NO.	HEATER KW SIZE USED WITH	BRACKET DIMENSIONS											
		L	W	H	A	B	C	D	E	F	G	X	Y
KBB-1	3 to 7.5KW 1-Ph	12-½"	3"	10"	1-¼"	7-¼"	1-½"	1-¾"	5-½"	4"	1-¼"	½"	1"
KBB-2	10 to 15KW 1-Ph, & 3 to 30KW 3-Ph	17"	3"	10"	1-¼"	7-¼"	1-½"	2"	8-½"	6-¼"	1-¼"	½"	1"
KBB-3	40 to 60KW 3-Ph	19"	6"	12"	¾"	9-¼"	2"	18"			1"	¾"	2"

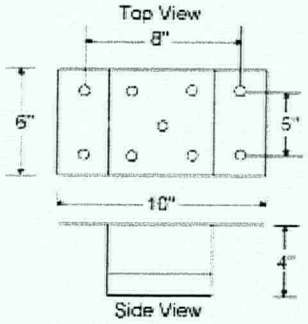
KBB-1 & KBB-2 - Unit heat brackets can be used for mounting on ceiling or wall. 3/8" threaded hole on top of unit heater can also be used with threaded rod to drop the unit closer to floor.

KBT - Capillary bulb style thermostat senses intake air for accurate temperature control Label is calibrated from 40° to 75°F with a 44°F setting for unoccupied space as some energy codes require.

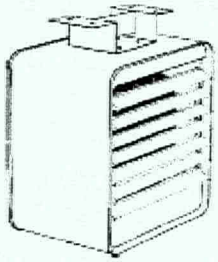
Disconnects can be specified in 30, 40, 80 or 100 amp ratings with door interlock and padlock provision. Standard non-fused interlocking disconnect.

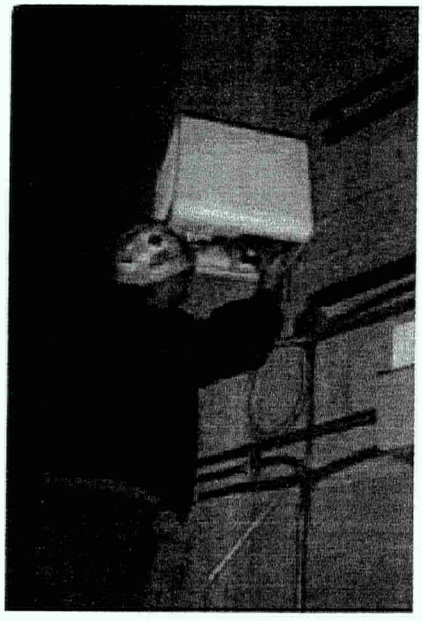
Rough Service/Low Profile - KBB-4 Mounting Bracket



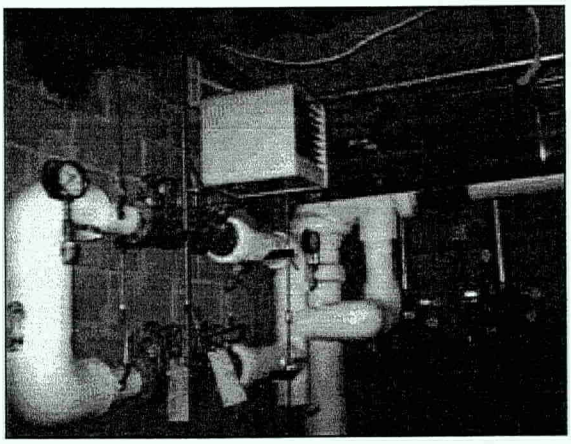


This bracket is manufactured in a Low Profile design with 5 mounting holes. When using this bracket for Low Ceiling Profile installation, use the center hole only. When ***rough service support*** is necessary, order the Option -5MT (when ordering unit heater). The heater will have four mounting holes fabricated into the top. Attach bracket using the four outside mounting holes to provide a rigid mount. This is ideal for use on Ships, Containers or any application that will cause the heater to experience vibration.





A unit heater being installed in a Chicago high rise room for humidity and freeze protection.



Water pumping and a water treatment room, protected from freezing and humidity with King KB Unit Heater.

FIELD MOUNT ACCESSORIES:

MODEL	DESCRIPTION	UPC #093319 PART NO.
KBB-1	Universal Wall/Ceiling Small Mounting Bracket for heaters with Size A & C	15192
KBB-2	Universal Wall/Ceiling Large Mounting Bracket for heaters with Size B,D & E	15195
KBB-3	Universal Wall/Ceiling Double Mounting Bracket for heaters with Size F & G	15350
KBB-4	Rough Service or Low Profile Mounting Bracket for any heater. (2 Ea. req. for Size F & G)	15351
KBT	Capillary Bulb Style Stat Kit (SPST). 25 AMP	15189
KBT-2	Capillary Bulb Style Stat Kit (DPST). 25 AMP	18209

FACTORY INSTALLED OPTIONS:

ADD SUFFIX:	DESCRIPTION
-T	1-Pole Unit Mounted Thermostat. Temperature range 40°F to 100°F
-T2	2-Pole Unit Mounted Thermostat. Temperature range 40°F to 100°F 6KW and Higher
-B1	Mounting Bracket KBB-1 included with heater size A & C
-B2	Mounting Bracket KBB-2 included with heater size B, D, & E
-B3	Mounting Bracket KBB-3 included with heater size F & G
-SF	Summer Fan Switch
-SFR	Control Relay and 24V Transformer for Remote Summer Fan Operation
-3PS	3-Position Switch (Heat/Fan/Off)
-PL	Pilot Light (Power On Indication)
-CX	Power Contactor for 3KW through 5KW, 1-Phase Models (Line Voltage Coil)
-CT24	Adds Transformer and Converts 208, 240 & 277 Volts to 24V Control Circuit. (Add Power Contactor (-CX) for 3KW through 5KW, 1-Phase Models)
-CT120	Same as CT24 except 120V Control Components. (Add Power Contactor (-CX) for 3KW through 5KW, 1-Phase Models)
-DS30	30 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-DS40	40 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-DS80	80 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-DS100	100 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-5MT	5 Mounting Weld Nuts are provided on heater for rough service use. Includes KBB-4 5-hole bracket.
-5MT2	Rough Service Mounting Holes (4 Each) fabricated into the top of each heater to accept KBB-4 Mounting Brackets (2 each KBB-4 included)

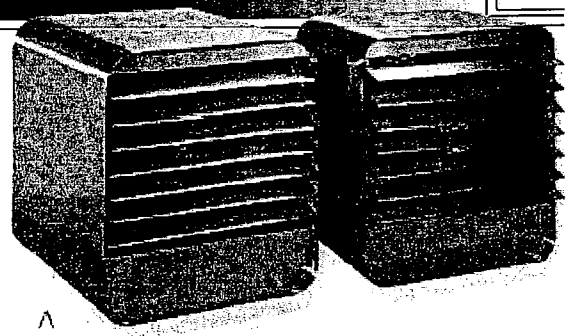
STAINLESS STEEL

KI
SER

3000 WATTS TO 20,000 WATTS

CEILINGS UNDER 12 FT

SS



Shown with 5 Hole Mount

FEATURES:

- 16 GA. Stainless Steel
- Spiral Steel Fin Element
- Cast Iron Motor
- Aluminum Fan Blade
- Adjustable Discharge Louvers
- Monel Element
- Totally Enclosed Motor
- Nema 4 Enclosure
- Control Options
- Auto-Reset Thermal Cutout
- Optional Heavy Gauge Case
- Optional Stainless Steel Bird Screen
- Optional 3-Position Switch (Heat-Off-Fan)
- Optional Two Stage Thermostat
- Optional Pilot Light (Power On Indication)
- Optional Door Interlocking Disconnect

KBS unit heaters are constructed for specialty heating and freeze protection in areas requiring periodic washing or hose-down cleaning of equipment due to dirty, dusty and corrosive environments. The heater is constructed from 16 GA. type 304 stainless steel throughout and Monel #400 elements making it extremely corrosion resistant. The Nema 4 wiring compartment is sealed and gasketed making it water tight. All the optional control comp are UL listed for use in N enclosures. This heate tended for the following a tions:

- Waste Water Treatment
- Car and Truck Washes
- Cement Plants, Steel Mi and other Heavy Industr
- Canneries and Dairy Fa
- Ship and Marine Docks
- Fish Processors
- Load Bank for Generato

ENGINEERING SPECIFICATIONS:

Contractor shall supply and install, KBS-Series stainless steel heaters, manufactured by King Electrical Mfg. Company. Heaters shall be of the wattage and voltage as indicated on the plans.

Stainless Steel Construction: All exterior and interior metal enclosure parts are made from 16 GA. type 304 stainless steel. All fasteners and hardware are stainless steel.

Adjustable Outlet Louver: Stainless steel louvers direct air up or down as needed for the heating application.

Rear Intake Screen: Heavy gauge stainless steel screen protects against foreign objects making accidental contact with the rotating fan blade.

Nema 4 Enclosure: Every electrical component in the wiring compartment is sealed with a polyurethane adhesive. The bottom access panel is sealed with a ¼" Poron high density polyurethane gasket. This provides excellent protection against corrosion, windblown dust, dirt, and rain, splashing water and hose-directed water. All optional control accessories are nema 4X rated.

Monel Spiral Fin Elements: The metal sheath element is brazed with spiral fins and then molded into a coil configuration. This combination produces the best heat transfer while eliminating the potential for hot spots by positioning the element in the maximum airflow stream. Monel alloy #400 composed of 66.5% and 31.5% Cu increases element life in extremely corrosive e ronments such as Waste Water Treatment Plants.

Totally Enclosed Fan Motor: Permanently lubricated cast iron oxy coated motor with enclosed rotor resists moisture and co sion for long lasting trouble free operation.

Aluminum Fan Blade: Axial flow type mounted directly to motor shaft for maximum efficiency.

Auto-Reset Thermal Cutout: Power is disconnected from heater if an over heated condition occurs. The heater is reer gized automatically when the normal operating temperature turns.

Controls: Magnetic contactors are standard on all 480V heat all 208V-1Ø, 240V-1Ø, 277V-1Ø heaters 6 KW and above, all 3Ø heaters. The control voltage is equal to the line volt (208, 240 or 277) except for 480V models where a transforme provided for 24V Control. Subcircuit fusing is provided when hea ampacity exceeds 48 amps to comply with NEC standards. fan delay is provided standard on models 12.5-KW and abov dissipate residual heat from the heating elements.

Optional Coated Fan Blade: Extra corrosion protection.

Factory Installed Options

Heavy Gauge Case: 16 GA. stainless steel can be provided for extra enclosure strength in severe duty applications.
Stainless Steel Bird Screen: Applied to discharge outlet for additional protection from foreign objects.
Fan Delay: (when not standard)
Power Contactor: (when not standard)
24 Volt Control: (when not standard)
120 Volt Control: Control components modified to accept 120V control.
Mounting: Choose universal or low profile ceiling bracket made from Stainless Steel.
Rough Service: 5 weld nuts are provided to securely mount heater in heavy industrial applications or marine vessels were vibration and movement is a concern.

MODEL CODE:

KBS4810-1 or 3 or 3MP-T-B2-DS40

- KBS
- 480
- 10
- 1
- 3
- 3MP
- T
- B2
- DS40
- Ki
- 1
- 3
- Disc

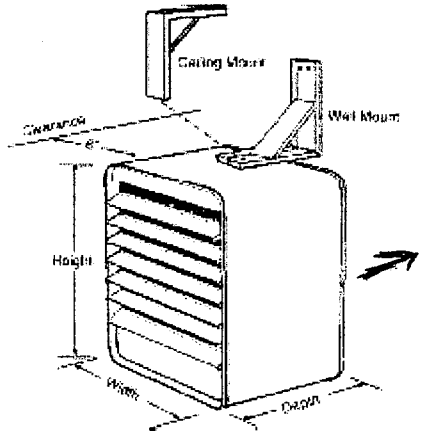
Nema 4 Control Options:

- SPST or DPDT Thermostat
- Two Stage Thermostat
- Summer Fan Switch
- 3-Position Switch (Heat-Off-Fan)
- Pilot Light (power on indicating)
- Door Interlocking Disconnect

QUICK SELECTION CHART:

KILO-WATTS	PHASE	208V MODEL	208V UPC #093319 PART NO.	208V WEIGHT (lbs.)	240V MODEL	240V UPC #093319 PART NO.	240V WEIGHT (lbs.)	277V MODEL	277V UPC #093319 PART NO.	277V WEIGHT (lbs.)	480V MODEL	480V UPC #093319 PART NO.	480V WEI (lb
3	1	KBS2003-1	19700	25	KBS2403-1	19713	25	KBS2703-1	19706	25	KBS4803-1	19709	2
	3	KBS2003-3MP	19703	25	KBS2403-3MP	19714	25				KBS4803-3MP	19710	2
5	1	KBS2005-1	19712	25	KBS2405-1	19715	25	KBS2705-1	19718	25	KBS4805-1	19721	2
	3	KBS2005-3MP	19748	32	KBS2405-3MP	19751	32				KBS4805-3MP	19754	3
7.5	1	KBS2007-1	19724	29	KBS2407-1	19727	29	KBS2707-1	19730	29	KBS4807-1	19733	3
	3	KBS2007-3MP	19757	42	KBS2407-3MP	19760	42				KBS4807-3MP	19763	4
10	1	KBS2010-1	19736	32	KBS2410-1	19739	32	KBS2710-1	19742	32	KBS4810-1	19745	3
	3	KBS2010-3MP	19766	42	KBS2410-3MP	19769	42				KBS4810-3MP	19772	4
12.5		KBS2012-3MP	19775	42	KBS2412-3MP	19778	42				KBS4812-3MP	19781	4
15		KBS2015-3MP	19784	46	KBS2415-3MP	19787	46				KBS4815-3MP	19790	4
20		KBS2020-3	19793	46	KBS2420-3	19796	46				KBS4820-3MP	19799	4

HEATER SIZE	DIMENSIONS HEIGHT	DEPTH	WIDTH
A	16.5"	11"	15"
B	16.5"	18"	15"
C	18.5"	11"	15"
D	18.5"	18"	15"
E	20.5"	18"	15"



ACCESSORIES:

MODEL	DESCRIPTION	UPC #093319 PART NO.
KBB-1-SS	Mounting Bracket - Small	15254
KBB-2-SS	Mounting Bracket - Large	15256
KBB-4-SS	Mounting Bracket - Low Profile 5 Hole	15257
TF115	SP Wall Mount Stat Nema 4X	19150

TECHNICAL DATA CHART:

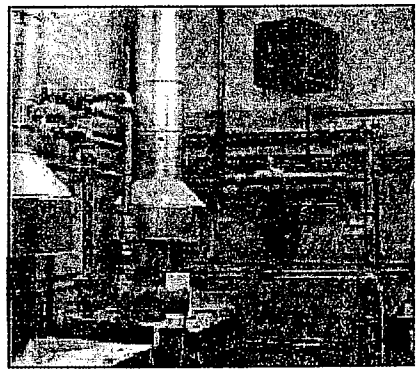
380V 3Ø Heaters are available in most KW ratings.

CATALOG NO.	KW	BTUH (000)	Ø	VOLTS	AMPS 1-PH	AMPS 3-PH	CONTROL VOLTAGE	MOTOR H.P.	CFM	TEMP RISE	AIR THROW	*SIZE	W.T. (LBS.)
KBS2003-1 KBS2403-1 KBS2703-1 KBS4803-1	3	11	1	208 240/208 277 480	14.4 12.5/10.8 10.8 6.2		208 240 277 24	3 Watt	300	35°	14ft	A	25 25 25 28
KBS2005-1 KBS2405-1 KBS2705-1 KBS4805-1	5	17.1	1	208 240/208 277 480	24.0 20.8/18 18.1 10.4		208 240 277 24	9 Watt	400	40°	16ft	A	25 25 25 28
KBS2007-1 KBS2407-1 KBS2707-1 KBS4807-1	7.5	25.6	1	208 240/208 277 480	36.1 31.2/27 27.0 15.6		208 240 277 24	16 Watt	600	40°	20ft	B A	29 29 29 32
KBS2010-1 KBS2410-1 KBS2710-1 KBS4810-1	10	34.1	1	208 240/208 277 480	48.1 41.6/36.1 36.1 20.8		208 240 277 24	25 Watt	725	44°	24ft	B	32 32 32 35
KBS2005-3MP KBS2405-3MP KBS4805-3MP	5	17.1	1-3	208 240/208 480	24.0 20.8/18 10.4	13.9 12/10.4 6.0	208 240 24	9 Watt	400	40°	16ft	B	32 32 35
KBS2007-3MP KBS2407-3MP KBS4807-3MP	7.5	25.6	1-3	208 240/208 480	36.1 31.2/27 15.6	20.8 18/15.6 9.0	208 240 24	16 Watt	600	40°	20ft	B	42 42 45
KBS2010-3 KBS2410-3MP KBS4810-3MP	10	34.1	1-3	208 240/208 480	41.6/36.1 20.8	27.8 24/20.8 12.0	208 240 24	25 Watt	725	44°	24ft	B	42 42 45
KBS2012-3 KBS2412-3 KBS4812-3MP	12.5	42.7	1-3	208 240/208 480	26.0	34.6 30/26 15.0	208 240 24	35 Watt	825	48°	30ft	B	42 42 45
KBS2015-3 KBS2415-3 KBS4815-3MP	15	51.2	1-3	208 240/208 480	31.2	41.6 36/31.2 18.0	208 240 24	35 Watt	925	51°	33ft	B	46 46 49
KBS2420-3 KBS4820-3MP	20	68.3	3	240/208 480	41.6	48.1/41.6 24.1	240 24	50 Watt	1100	57°	37ft	B	46 49

*Refer to DIMENSIONS on previous page.
Heater will draw 13% amps 25% less watta
Note: Consult factory f special wattages and/ voltages.
Rated KW load toleran plus 5% minus 10%.

OPTIONS:

ADD SUFFIX:	DESCRIPTION:
-T	1-Pole Unit Mounted Thermostat
-B1	Adds Bracket to Box - For Heater W/ KBB-1-SS
-B2	Adds Bracket to Box - For Heater W/ KBB-2-SS
-SF	Summer Fan Switch - For Fan Only Operation
-SFR	Control Relay and 24V Transformer for Remote Summer Fan Operation
-3PS	3-Position Switch (Heat/Fan/Off)
-PL	Pilot Light (Power On Indication)
-CX	Power Contactor for KB2 through KB5, 1-Phase Models (Line Voltage Coil)
-CT24	Converts 208, 240 & 277 Volts to 24V Control. (Add Power Contactor for KB2 through KB5, 1-Phase Models)
-CT120	120V Control Circuit Components. (Add Power Contactor for KB2 through KB5, 1-Phase Models)
-DS40	40 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-DS60	60 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-DS80	80 AMP, 3-Pole Disconnect Switch with Door Interlock and Padlock Provision.
-5MT	For Five Hole Mounting for Rough Service



Corrosion resistance for high moisture or chemical treatment areas.

Disconnects can be specified in 40, 60 or 80 amp ratings with door interlock and padlock provision.