



Knowledge to Shape Your Future

CENTRON® Meter
Technical Reference Guide
Effective Date: October 2006

Putting knowledge to work.

Proprietary Rights Notice

This manual contains the trade secrets and confidential information of Itron, Inc., which are not to be divulged to third parties and may not be reproduced or transmitted in whole or part, in any form or by any means, electronic or mechanical for any purpose, without the express written permission of Itron, Inc. All rights to designs or inventions disclosed herein, including the right to manufacture, are reserved to Itron, Inc.

The information contained in this document is subject to change without notice. Itron, Inc. reserves the right to change the product specifications at any time without incurring any obligations.

Trademarks Used in This Manual

CENTRON and PC-PRO+ are registered trademarks of Itron, Inc.

Windows is a trademark of Microsoft Corporation.

Cellnet is a registered trademark of Cellnet Technologies, Inc.

CENTRON® Meter Technical Reference Guide

100299GM-02

Itron, Inc.
Corporate Headquarters
2111 North Molter Road
Liberty Lake WA, 99019
U.S.A.
Tel: (866) 374-8766
Fax: (509) 891-3355

www.itron.com

Itron, Inc.
Oconee Electricity Metering
313-B North Highway 11
West Union, SC 29696
U.S.A.
Tel: (864) 638-8300
Fax: (864) 638-4950

Copyright© 2004-2006
Itron, Inc.
All rights reserved.

Compliance With FCC Regulations

FCC Part 15, Class B

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These rules are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential/commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help. This device complies with Part 15 of the FCC rules.

THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES. OPERATION IS SUBJECT TO THE FOLLOWING TWO CONDITIONS: (1) THIS DEVICE MAY NOT CAUSE HARMFUL INTERFERENCE, AND (2) THIS DEVICE MUST ACCEPT ANY INTERFERENCE RECEIVED, INCLUDING INTERFERENCE THAT MAY CAUSE UNDESIRE OPERATION.

FCC Part 15, Subpart C

When equipped with a radio transmitter option, this equipment has been tested and found to comply with the limits for an intentional radiator, pursuant to Part 15, Subpart C of the FCC Rules. This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with the instructions, it may cause interference to radio communications.

The limits are designed to provide reasonable protection against such interference in a residential situation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, the user is encouraged to try to correct the interference by one of more of the following measures:

- Reorient or relocate the receiving antenna of the affected radio or television.
- Increase the separation between the equipment and the affected receiver.
- Connect the equipment and the affected receiver to power outlets on separate circuits.
- Consult the dealer or an experienced radio/TV technician for help.

Changes or modifications not expressly approved by Itron, Inc. could void the user's authority to operate the equipment.

RF Exposure Information

This equipment complies with the FCC RF radiation requirements for uncontrolled environments. To maintain compliance with these requirements, the antenna and any radiating elements should be installed to ensure that a minimum separation distance of 20 cm is maintained from the general population.

Canadian Interference Causing Equipment Regulations

This Class B digital apparatus meets all requirements of the Canadian Interference Causing Equipment Regulations. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Cet appareillage numérique de la classe B répond à toutes les exigences de l'interférence Canadienne causant des règlements d'équipement. L'opération est sujette aux deux conditions suivantes: (1) ce dispositif peut ne pas causer l'interférence nocive, et (2) ce dispositif doit accepter n'importe quelle interférence reçue, y compris l'interférence qui peut causer l'opération peu désirée.

Factory Repair of Meters

Itron recommends that all repairs be performed at the factory. Certain repairs may be performed by the user; however, unauthorized repairs will void any existing warranty. All surface mounted parts must be replaced by the factory.

Repair of Meters Under Warranty

If the meter is under warranty, then Itron, Inc. will repair the meter at no charge if the meter has failed due to components or workmanship. A return authorization number must be obtained before the equipment can be sent back to the factory. Contact your Itron Sales Representative for assistance.

Repair of Meters Not Under Warranty

The same procedure as above applies. Itron will charge for the necessary repairs based on the failure.

Service Return Address

Itron, Inc.
Customer Repair Department
313 North Highway 11 Dock C
West Union, SC 29696
U.S.A.

Recycling Information

The product you have purchased contains a battery (or batteries), circuit boards, and switches. The batteries are recyclable. At the end of the meter's useful life, under various state and local laws, it may be illegal to dispose of certain components into the municipal waste system. Check with your local solid waste officials for details about recycling options or proper disposal.

Although polycarbonate is not a commonly recycled plastic, the recycling number for the polycarbonate inner cover, outer cover, and base is seven (7).

Table of Contents

Proprietary Rights Notice	ii
Trademarks Used in This Manual	ii
Compliance With FCC Regulations.....	iii
FCC Part 15, Class B.....	iii
FCC Part 15, Subpart C.....	iii
RF Exposure Information.....	iii
Canadian Interference Causing Equipment Regulations.....	iv
Factory Repair of Meters.....	iv
Repair of Meters Under Warranty.....	iv
Repair of Meters Not Under Warranty	iv
Service Return Address.....	iv
Recycling Information.....	iv

General Information1

About This Manual	1
General Description.....	2
Physical Description	3
Meter Base.....	3
Personality Modules.....	4
Product Availability	5
Battery.....	5
Covers.....	6
Display Functions	6
Specifications	6
Electrical.....	6
Operating Environment.....	6
Characteristic Data	7
Burden Data	7
Technical Data	8
Dimensions	8
C1SD/C1ST/C1SL Dimensions	9
Shipping Weights	9

Installation.....11

Inspection	11
Battery.....	11
Storage	11
Unpacking.....	12
Selecting a Site	12
Installing the Meter into Service	12
Programming the C12.19 C1SD,T, L Meter	13
Retrofitting with Personality Modules.....	13

Operation: Base Metrology.....17

CENTRON 1S, 2S CL200, and 3S.....	17
CENTRON 2S CL320, 4S, 12/25S.....	19

Operation: C1S Version	21
Physical Description (Personality Modules)	22
Registers	22
Kilowatt Hours	22
Resetting Values (ZRO-C2A)	23
LCD Display Function.....	24
Non-Detented Register.....	25
Detented Register	25
Net Register.....	25
Segment Check.....	26
Factory Programming Options	26
Display Timing	26
Digits and Multipliers.....	26
 Operation: C1SR Version.....	 27
Standard Consumption Message (SCM)	28
Interval Data Message (IDM)	28
Physical Description (C1SR).....	28
C1SR Display	29
C1SR Electronic Detent	30
Net Metering.....	30
Resetting Values (C1SR)	31
Transmission	31
FCC Regulations.....	31
Testing the RF Message	31
Tamper Detection.....	32
Testing the C1SR Tamper Counter	32
SCM Testing	32
Retrofitting the C1SR Personality Module.....	33
 Operation: C1SC Version.....	 35
Physical Description	36
Transmission Scheme.....	36
FCC Regulations	37
Display Functions	37
Resetting Values	38
Programming the C1SC/CN1SC.....	38
 Operation: C12.19 C1SD, C1ST, and C1SL Versions.....	 41
Features	42
Type Codes	42
Controls and Indicators	43
Modes of Operations	44
Normal Mode	44
Alternate Mode.....	44
Test Mode	45
Test Mode Timeout.....	45
Test Mode Lockout	45
Displays.....	45

Optical Port.....	47
Programmable Functions	47
Energy Data Display Items	47
Demand Data Display Items	47
Informational Data Display Items.....	47
Demand Registers	49
Demand Calculations.....	49
Demand	49
Block Interval Demand Calculation.....	50
Rolling/Sliding Demand Interval Calculation.....	50
Thermal Emulation.....	50
Cumulative Demand Values	51
Continuous Cumulative Demand Values.....	51
Present Demand.....	51
Previous Demand.....	51
Projected Demand.....	52
Peak Demand (Maximum Demand)	52
Coincident Demand	52
Multiple Peaks	52
Demand Reset.....	52
Cold Load Pickup.....	53
TOU/Load Profile Meters	53
Self Reading and SnapShot Registers	53
Time-of-Use	54
TOU Schedules	54
Calendar Schedule	55
Registers.....	56
TOU Operation	56
Load Profile Specifications.....	57
Capacity.....	57
Bit Resolution.....	57
Interval Lengths	58
Power Outage.....	58
Channel Configurations.....	58
Data Storage.....	59
Recording Duration.....	60
Optional Features	60
Event Log.....	60
Security Codes	61
Firmware Upgrades	62
Power Procedures	62
Applying Power.....	62
Power Down Procedures.....	62
Battery Life (Load Profile & TOU).....	63
Three Button Reset.....	63
RF Options.....	64
Testing, Troubleshooting, and Maintenance.....	67
Testing Support Features.....	68
Infrared Test LED.....	68
Pulse Detector	68
Annunciators	69
Wathour Annunciators	69
TOU Rate Annunciators.....	70

Test Mode Annunciator.....	70
Testing with the Infrared Test LED	70
Testing Using the Disk Emulation Annunciator	71
Recommended Energy Testing Procedures	71
AEP Test Codes	71
Field Testing.....	71
Required Hardware.....	72
Test Method Using a Snap Switch Assembly	72
Troubleshooting.....	72
Fatal Errors	72
Error Codes (C1SR)	72
Error Codes (C12.19 C1SD/T/L)	72
Non-Fatal Errors	74
Inspecting and Troubleshooting—General.....	76
Blank Display	76
Time and Date Wrong (TOU Version)	76
No Accumulation of kWh or kW	76
Software Cannot Communicate with Module.....	77
Reed Switch Does Not Activate the Alternate Mode	77
Reset Mechanism Does Not Initiate Demand Reset	78
Demand Reset Cannot Be Initiated Through PC or Handheld.....	78
Test Mode Switch Does Not Place Meter in Test Mode	78
Inspecting and Troubleshooting—C1S LCD and C1SR	78
Blank Display	78
Specifications and Drawings.....	79
Specifications	79
Drawings.....	79
Glossary of Terms	83
Index	87

Table of Figures

Figure 1: CENTRON Personality Modules.....	3
Figure 2: CENTRON 120 Volt Metrology	4
Figure 3: CENTRON 240 Volt Metrology	4
Figure 4: CENTRON 20 Amp Metrology.....	4
Figure 5: CENTRON Personality Module Assembly	5
Figure 6: Dimensions	8
Figure 7: C12.19 C1SD/T/L C1SR2/R3 Dimensions	9
Figure 8: Removing the Board-to-Board Connector	14
Figure 9: New Module Snap-in.....	15
Figure 10: Circuit Board Notches	15
Figure 11: Board-to-Board Connector, Bottom	16
Figure 12: Board-to-Board Connector, Top	16
Figure 13: Power Measurement Principle in 2S Meter	18
Figure 14: Simplified CENTRON Architecture	18
Figure 15: Hall Cells and ADCs	20
Figure 16: C1S LCD Personality Module	21
Figure 17: Mounted C12.19 D/T/L Register	22
Figure 18: ZRO-C2A Resetter Connected to the CENTRON	23
Figure 19: Reverse Side of ZRO-C2A Resetter.....	24
Figure 20: LCD.....	24
Figure 21: Non-Detented Register	25
Figure 22: Delivered kWh with Detent Enabled	25
Figure 23: Net kWh	25
Figure 24: Segment Check	26
Figure 25: CENTRON C1SR Meter	27
Figure 26: C1SR LCD	29
Figure 27: C1SR FCC Label Location.....	34
Figure 28: CENTRON C1SC.....	35
Figure 29: Cellnet Telemetry.....	37
Figure 30: C1SC LCD	38
Figure 31: C1SC/CN1SC Programming Port Location	39
Figure 32: CENTRON C1SL Meter	41
Figure 33: Controls and Indicators	43
Figure 34: Test LED Location	68
Figure 35: Pulse Detector	69
Figure 36: TOU Rate Annunciator.....	70
Figure 37: Form 1S Wiring Diagram	79
Figure 38: Form 2S Wiring Diagram	80
Figure 39: Form 3S 120V Wiring Diagram.....	80
Figure 40: Form 3S 240V Wiring Diagram.....	81
Figure 41: Form 4S Wiring Diagram	81
Figure 42: Form 12S Wiring Diagram	82
Figure 43: Form 25S Wiring Diagram	82

Notes:

General Information

In This Chapter

About This Manual	1
General Description	2
Physical Description	3
Product Availability	5
Display Functions	6
Specifications.....	6

This technical reference guide explains the installation, operation, and maintenance of the Itron CENTRON® meter family. Itron urges you to read the entire manual before attempting installation, testing, operation, or maintenance of a meter. To operate the Itron PC-PRO+® Advanced Programming Software, refer to the online user manuals that are installed with the PC-PRO+ Advanced software.



The online software manuals are in Adobe® Portable Document Format (PDF) and are accessible from the Windows Start menu. The Adobe Reader is required to view and print these manuals. The Adobe Reader can be downloaded freely from <http://www.adobe.com>.

About This Manual

This manual contains the following information as listed in the chapter descriptions below:

Chapter Title	Description
General Information	Provides a general description, operation, physical and functional descriptions, and complete CENTRON meter specifications.
Installation	Gives instructions for the proper handling and installation.
Operation: Base	Describes the measurement technique used for the base on the CENTRON meter.
Operation: C1S	Provides a physical description and operational characteristics of the C1S watt-hour (kWh) only meter.
Operation: C1SR	Provides a physical description and the operational characteristics of the C1SR R300 900 MHz radio frequency personality module.
Operation: C1SC	Provides a physical description and the operational characteristics of the C1SC Cellnet personality module.

Chapter Title	Description
Operation: C12.19 C1SD, C1ST, C1SL	Provides detailed information and theoretical operation for Demand (C1SD), Time-of-Use (C1ST), and Load Profile (C1SL) versions. Gives step-by-step procedures for accessing the three operational modes and associated displays.
Testing, Troubleshooting, and Maintenance	Provides an explanation of the testing, troubleshooting, and maintenance of the CENTRON meter.
Specification Numbers and Drawings	Provides a reference to meter part numbers and shows meter form drawings.

General Description

The CENTRON meter is a solid-state, singlephase and network meter used for measuring electrical energy consumption. The CENTRON incorporates a two-piece design combining a base metrology with a variety of personality modules that snap on the standard meter base. Utilizing the Hall Effect technology for accurate power measurement, the metrology portion of the meter contains all measurement circuitry and calibration information, while the personality modules contain the register functionality and communication mediums.

Each version of the meter is distinguished by the various personality modules that mount to the standard meter metrology base. The personality modules available include the following versions:

- Energy only—C1S (LCD)
- Demand—C1SD
- Time-of-Use (TOU) with Demand—C1ST
- Load Profile with TOU and Demand—C1SL
- Energy only with radio frequency AMR—C1SR
- Cellnet Fixed Network—C1SC
- Energy plus demand with radio frequency AMR - C1SDR2/R3



Figure 1: CENTRON Personality Modules

Physical Description

The CENTRON meter features a common meter base to which various personality modules are attached. The covers come in configurations of polycarbonate and glass.

Meter Base

The CENTRON meter base contains all of the measurement circuitry and calibration information on the metrology board.

The meter base assembly includes two current conductors, a flux-directing core, a Hall Effect device, the metrology circuit board, and the ultrasonically welded module support. The base also contains a metal oxide varistor (MOV), which is used to protect the meter from line surges.

Meter bases are built specific to the metering form and are available in Form 1S, 2S CL200, 2S CL320, 3S 120V, 3S 240V, 4S, and 12/25S configurations. Examples are shown below.

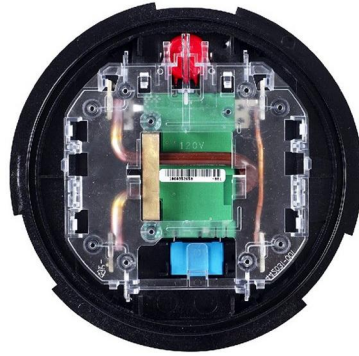


Figure 2: CENTRON 120 Volt Metrology

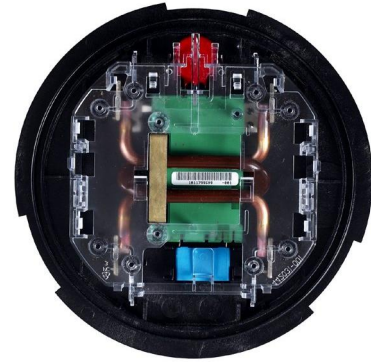


Figure 3: CENTRON 240 Volt Metrology



Figure 4: CENTRON 20 Amp Metrology

Personality Modules

All of the personality modules in the CENTRON meter family snap into the module holder located on the standard meter base as shown below. From the base metrology, the energy data is transmitted to the personality modules, which contain the meter display, communication mediums, and register functionality.



Personality Modules are voltage specific and should be ordered based on the meter's metrology.

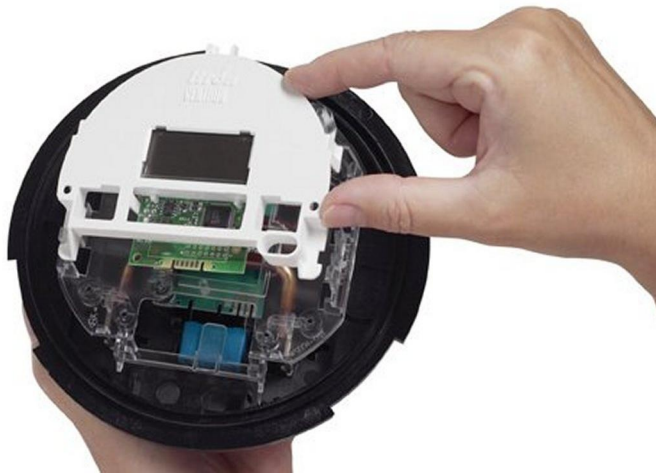


Figure 5: CENTRON Personality Module Assembly

Product Availability

The current offerings for the CENTRON are:

Metrology	Class 100, 120V, Form 1S	Class 20, 240V, Form 4S
	Class 200, 240V, Form 2S	Class 200, 120V, Form 12S
	Class 320, 240V, Form 2S	Class 200, 120V, Form 25S
	Class 20, 120V, Form 3S	
	Class 20, 240V, Form 3S	
Personality Modules	C1S—LCD (5x1 or 4x10)	C1SD—Demand
	C1SR—R300C (Radio Frequency)	C1ST—Time-of-Use (TOU)
	C1SC—Cellnet Data System	C1SL—Load Profile
		C1S_R2/R3—R300CD/CD3 <i>where _ = D, T, or L</i>

Battery

The CENTRON C1SD+Clock, C1ST, and C1SL modules contain a battery that powers the clock circuit during a power outage. The battery is permanently soldered to the module and is expected to last the life of the module.

Refer to Operation: C12.19 C1SD, C1ST, and C1SL Versions (see "Operation: C12.19 C1SD, C1ST, and C1SL Versions" on page 41) for detailed battery information.

Covers

The outer cover configurations available for CENTRON meter family are described below.

Meter Versions	Cover Options	
	Polycarbonate	Glass
C1S, C1SR, C1SC	Standard	Optional
C12.19 C1SD, C1ST, C1SL	Including Demand Reset + Optical Tower	Not Available

Display Functions

The C1S and C1SR modules can display kWh readings in either a 4x1, 4x10, or 5x1 configuration.

The C12.19 C1SD, C1ST, and C1SL modules can display a maximum of 80 display items for the Normal, Alternate, and Test modes.

Specifications

The following sections describe the CENTRON meter specifications.

Electrical

Voltage Rating	120V, 240V
Operating Voltage	± 20% (60 Hz); ± 10% (50 Hz)
Frequency	60 Hz, 50 Hz
Operating Range	± 3 Hz
Battery Voltage	3.6 V nominal (C1SD + Clock, C1ST, C1SL only)
Operating Range	3.4 - 3.8 V
Carryover	10-12 year cumulative and 15 year shelf life

Operating Environment

Temperature	-40°C to +85°C
Humidity	0% to 95% non-condensing
Accuracy	± 0.5% @ unity power factor ± 0.5% @ 50% power factor
Transient/Surge Suppression	ANSI C62.45 - 1992 IEC 61000-4-4

Characteristic Data

Starting Watts

2S CL200	5W
1S, 2S CL320, 12S, 25S	10W
3S CL20	1.2W
4S CL20	2.4W

Temperature Rise

Meets ANSI C12.1 Section 4.7.2.9

Burden Data

Metrology	Voltage	Watt Loss	VA
1S	120	0.45	3.7
2S Class 200	240	0.45	7.2
2S Class 320	240	0.65	10.2
3S	240	0.65	10.2
4S	240	0.65	10.2
12S/25S	120	0.65	5.4

240V Register	LCD	R300	R300 HP	Cellnet	C12.19 D/T/L	R300CD/CD3
Watt Loss	0.01	0.45	1.35	0.90	1.67	1.67
VA	—	7.16	7.29	14.76	21.76	21.57

120V Register	LCD	R300	R300 HP	Cellnet	C12.19 D/T/L	R300CD/CD3
Watt Loss	0.01	0.28	0.65	0.90	1.76	1.80
VA	—	2.40	5.50	11.10	11.87	11.98

To get the watt loss or VA of the overall product, add the metrology watt loss to the register watt loss and option board watt loss.

$$VA(\text{Meter}) = VA(\text{Metrology}) + VA(\text{Register})$$

$$\text{Watt Loss}(\text{Meter}) = \text{Watt Loss}(\text{Metrology}) + \text{Watt Loss}(\text{Register})$$

Technical Data

Meets applicable standards:

- ANSI C12.1 - 2001 (American National Standard for Electric Meters - Code for Electricity Metering)
- ANSI C12.18 - 1996 (American National Standard - Protocol Specification for ANSI Type 2 Optical Port)
- ANSI C12.19 - 1997 (American National Standard - Utility Industry End Device Data Tables)
- ANSI C12.20 - 2002 (American National Standard for Electricity Meters - 0.2 and 0.5 Accuracy Classes)
- ANSI/IEEE C62.45 - 1992 (Guide to Surge Testing in Low-Voltage AC Power Circuits)
- IEC 61000-4-2
- IEC 61000-4-4

Dimensions

The following dimensional measurements are shown in inches and (centimeters).

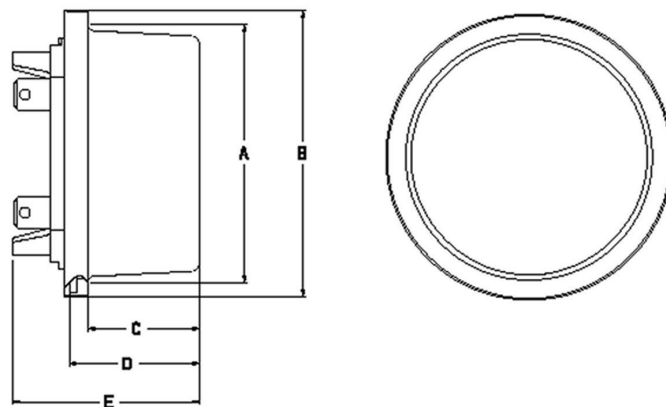


Figure 6: Dimensions

Polycarbonate				
A	B	C	D	E
6.29 (16.00)	6.95 (17.70)	2.70 (6.90)	3.16 (8.00)	4.53 (11.50)

Glass				
A	B	C	D	E
6.42 (16.30)	6.95 (17.70)	3.17 (8.10)	3.64 (9.20)	5.01 (12.70)

C1SD/C1ST/C1SL Dimensions

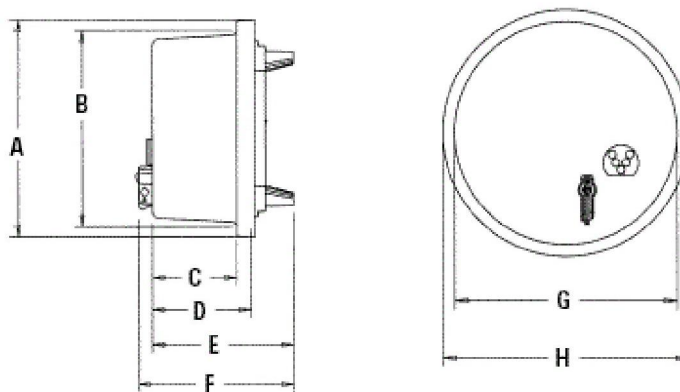


Figure 7: C12.19 C1SD/T/L C1SR2/R3 Dimensions

The following dimensional measurements are shown in inches and (centimeters).

Polycarbonate							
A	B	C	D	E	F	G	H
6.95 (17.70)	6.29 (16.00)	2.70 (6.90)	3.16 (8.00)	4.53 (11.50)	4.98 (12.70)	6.29 (16.00)	6.95 (17.70)

Shipping Weights

The following weight measurements are shown in pounds and (kilograms).

	Polycarbonate	Glass
Meter	1.38 (0.62)	2.75 (1.25)
4 Meters and Carton	8.90 (4.04)	13.96 (6.35)
96 Meter Pallets	214 (97.30)	335 (152.30)

Notes:

Installation

In This Chapter

Inspection	11
Storage	11
Unpacking.....	12
Selecting a Site	12
Installing the Meter into Service.....	12
Programming the C12.19 C1SD,T, L Meter.....	13
Retrofitting with Personality Modules.....	13

This chapter provides information about installing the CENTRON meter.

Inspection

Perform the following inspections when you receive the meter:

- Inspect for obvious damage to the cover, base, and meter assembly.
- Compare the meter and register nameplates to the record card and invoice. Verify the type, class, voltage, form number, and other pertinent data.
- Save the original packing materials.

Battery

The CENTRON C12.19 C1SD + Clock, C1ST and C1SL (timekeeping) modules contain a battery that powers the clock circuit during a power outage. The battery is permanently soldered to the module and is expected to last the life of the module.



The product you have purchased contains a recyclable lithium battery, circuit boards, and switches. At the end of its useful life, under various state and local laws, it may be illegal to dispose of this battery into the municipal waste stream. Check with your local area solid waste officials for details about recycling options or proper disposal.

Storage

Store the meter in a clean, dry (Relative Humidity < 50%) environment between -40° C to +85° C (-40° F to +185° F). Avoid prolonged storage (more than one year) at temperatures above +70° C(+158° F). Store the meter in the original packing material. The lithium battery has a shelf life of approximately 15 years.

Unpacking

As with all precision electronic instruments, the meter should be handled with care in an outdoor environment. Follow these precautions when handling the meter:

- Avoid damaging the meter base, cover, reset mechanism (if supplied), and optical connector (if supplied).
- When handling personality modules, grip the circuit board by its edges. Do not touch the liquid crystal display.

Selecting a Site

The meter is designed and manufactured to be installed in an outdoor environment, at operating temperature ranges between -40°C and $+85^{\circ}\text{C}$ (-40°F to $+185^{\circ}\text{F}$). Operation in moderate temperatures increases reliability and product life.

When using a Demand, TOU, or Load Profile meter where the line frequency is not stable, Iron recommends using either the C1ST or C1SL meter version with Crystal Time synchronization if a clock is needed (TOU or Load Profile).

Installing the Meter into Service

Install the meter base using standard meter installation practices.

The current and potential terminals extend as blades, or bayonets, from the back of the meter. The meter is plugged into the socket so that the bayonets engage the main socket jaws that connect to the service lines. Clamping pressure on the bayonets is provided by the heavy spring pressure of the socket jaws. In some heavy-duty sockets, jaw clamping pressure is provided by a handle or wrench.

On meters equipped with LCD displays, verify register operations by observing the display:

- LCD displays the correct number of digits (4 or 5).
- If the test mode annunciator is flashing, depress the Test mode button to return the meter to the Normal mode (C1S D/T/L only).
- If the register only displays a segment test (all items shown) and flashes "**CNTRON**", "**nordiSP**", or "**3BReset**", then the register is not programmed.
- Verify that no errors are displayed.

The practice of knowingly installing Form 12S/25S meters into metering sockets with either missing or disconnected fifth terminal jaws in the meter socket is NOT recommended for CENTRON Form 12S/25S meters.

The following guidance should be followed when using the Form 12S/25S CENTRON meter:



- This version of the meter should not be used in a non-Form 12S or 25S metering service.
- The meter's 5th terminal should be properly installed on the meter in a location defined in the CENTRON Technical Reference Guide.
- The fifth terminal jaw in the meter socket should be properly connected to the service neutral and installed in the correct location.
- The metering service should match the class, form and voltage rating on the meter's nameplate.

Failure to follow these recommendations will result in damage to the CENTRON Form 12S/25S meter and void all product warranties.

Programming the C12.19 C1SD,T, L Meter

The personality module should be powered prior to programming. The module can be programmed using the optical connector. The communications rates through the optical tower are 9600 baud to 28,800 baud. Refer to PC-PRO+ Advanced documentation for detailed programming information.

Retrofitting with Personality Modules

CENTRON meters can be upgraded to increase functionality by changing the Personality Modules.



Do not power ON the meter without the inner cover in place. Power the meter OFF before removing the inner cover. Personality modules are sensitive to ESD damage. Take appropriate grounding measures before retrofitting!

To change or add a Personality Module:

- 1 Remove power from the meter.
- 2 Remove the outer (polycarbonate or glass) cover.
- 3 Remove plastic inner cover by holding the meter with both hands and applying equal pressure on either side of the three and nine-o'clock positions. The inner cover is held in place by four plastic tabs on the meter base.
- 4 Remove the black board-to-board connector (① in the figure below) between the circuit board and the metrology board by pulling it by its middle while moving it side-to-side. To maintain the integrity of the connector, only remove it when you are upgrading the meter.

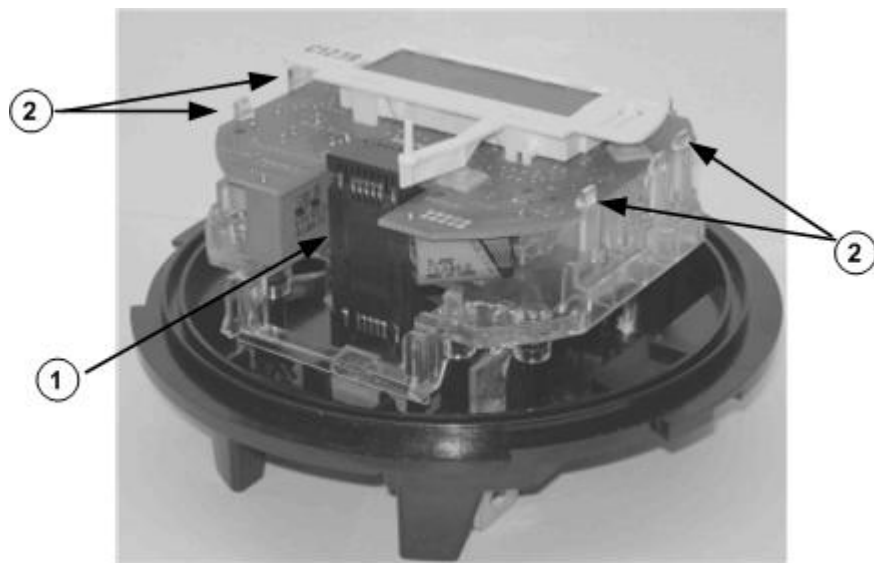


Figure 8: Removing the Board-to-Board Connector

- 5 Remove the register module, one side at a time, by pulling gently outward on the meter frame snaps (② in the figure above) while lifting the module up.
- 6 Snap the new module into the meter frame by aligning the notches at bottom of the circuit board with the lower two snaps.



The module must be aligned properly in the snaps to avoid damaging the connector or circuit board.

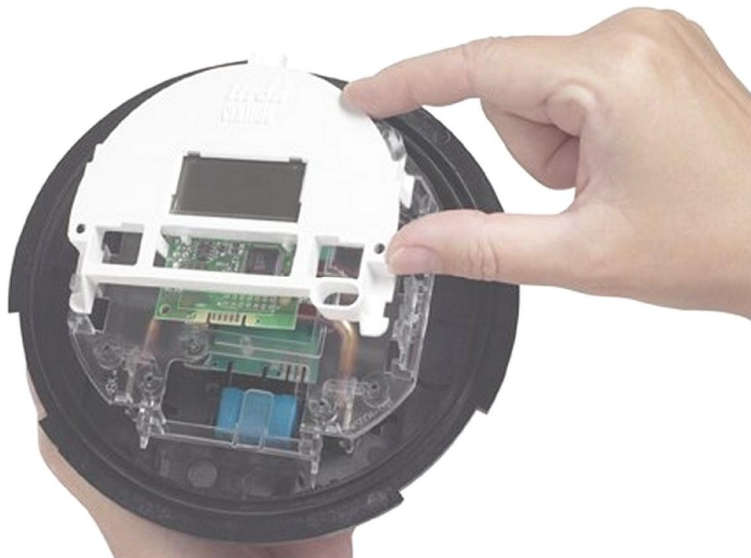


Figure 9: New Module Snap-in

- 7 Replace the board-to-board connector by aligning the top of the connector with the notches in the circuit board and pressing gently at the bottom of connector to mate the connector to metrology board. Then, gently press the top of the connector to mate it to the register module. The connector is seated correctly when you hear it snap into place.

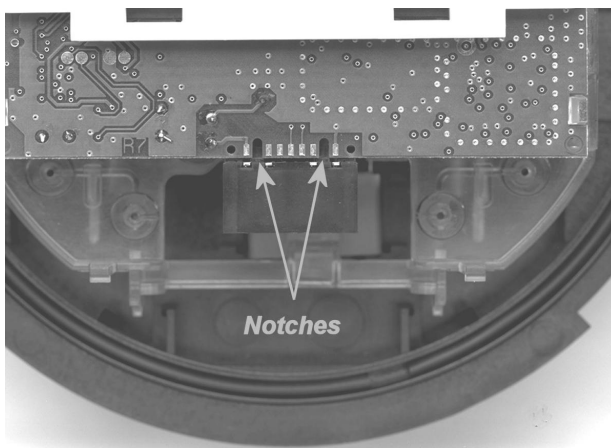


Figure 10: Circuit Board Notches



Be sure to use the meter base for leverage instead of the LCD holder. Pressure on the LCD holder may damage the personality module.

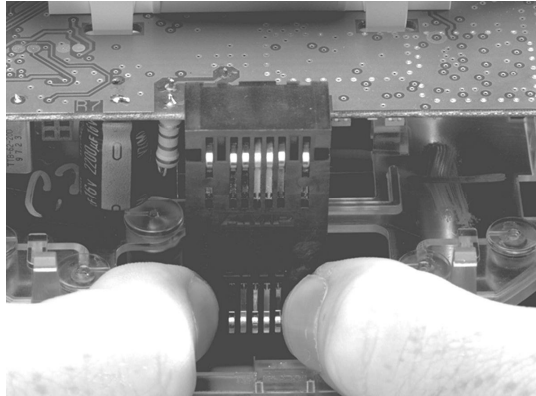


Figure 11: Board-to-Board Connector, Bottom

- 8** Ensure the board-to-board connector is fully seated by pressing firmly in on the middle of the connector.

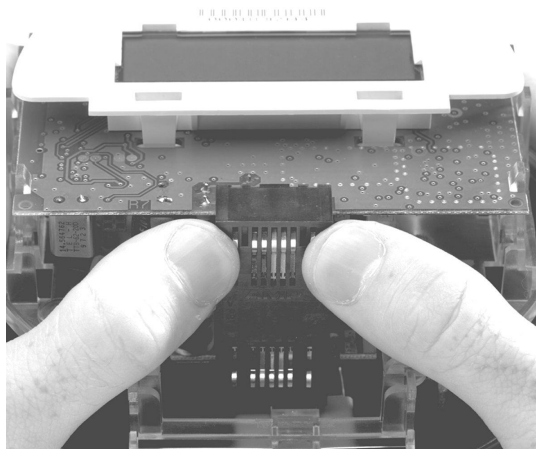


Figure 12: Board-to-Board Connector, Top

- 9** Carefully replace the inner protective cover. Engage the top snaps first, taking care to place the slot at the top of the cover over the IR light pipe. Failure to do so could break the light pipe. Ensure that all four meter base tabs are engaged with the slots at the top and bottom of the inner cover.
- 10** Place the cover over the meter base until the flange on the cover is flush with the flange on the meter base.
- 11** Turn the cover clockwise until the locking tabs are fully engaged with the meter base.
- 12** If the cover has a Demand Reset or an Optical Connector, be sure these are properly aligned with their corresponding accessory on the register faceplate. If not aligned correctly, the Demand Reset or Optical Connector will not function properly. If the Demand Reset plunger is not in the retracted position before turning the outer cover, the mechanism may be damaged.

Operation: Base Metrology

In This Chapter

CENTRON 1S, 2S CL200, and 3S.....	17
CENTRON 2S CL320, 4S, 12/25S.....	19

CENTRON 1S, 2S CL200, and 3S

The CENTRON meter is a solid-state meter which uses the inherent multiplication properties of the Hall Effect to measure power. The Hall Effect principle relies on a physical property: a conductor which carries a current in a magnetic field generates a voltage difference across the conductor proportional to the product of the current and the magnetic field.

The voltage V_{out} created at the output of the Hall device:

$$V_{out} = K i_b \times B$$

Where

i_b is the biasing current (derived from the line voltage)

B is the magnetic field density (derived from the line current)

K is the Hall coefficient (analogous to a gain factor in any meter)

K could be viewed as the Hall sensor intrinsic gain and is maximized by the appropriate choice of semiconductor materials that have been uniquely optimized by Itron for the CENTRON meter.

For the metering application, the biasing current i_b applied to the sensor is generated from the line voltage (V) using a resistor (R).

$$i_b = V/R$$

The magnetic field (B) is generated by the line currents ($I = I_1 + I_2$) that flow through two conductors looped around the core.

$$B = C \times I = C \times (I_1 + I_2)$$

Where

C is a constant that is dependent upon the geometric and magnetic properties of the coil

This field is focused to flow through the Magnetic Core's air gap where the Hall sensor is precisely positioned. The voltage, V_{out} , which is formed on the Hall Effect device is proportional to the input watts (see the Power Measurement Principle figure below).

The output voltage of the Hall Effect device is then:

$$V_{hall} = V_{out} = GIV = GPower$$

G is the combined gain factor of the entire system (Voltage to biasing current, line Current to flux density, Hall sensor).

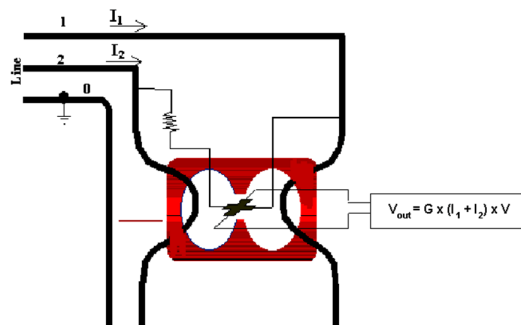


Figure 13: Power Measurement Principle in 2S Meter

From the power information available at the output voltage of the sensor, the meter architecture is simplified over previous designs as the multiplication has already taken place (see the Simplified CENTRON Architecture figure below).

The Hall sensor output voltage is amplified by a differential amplifier in order to bring the signal within the nominal level of the analog to digital converter (ADC). The output of the ADC is integrated over time to get the energy information and generates a pulse stream that is accumulated into a counter. When the accumulated pulses reach a threshold set by meter calibration, a Wh pulse is emitted and the meter LED is flashed. The counter threshold is programmed at the factory and serves as the permanent gain calibration for the life of the product. The calibration is a digital feature and has no variation or adjustment. All the processing steps described above are integrated into an Application Specific Integrated Circuit (ASIC) to improve reliability and reduce cost.

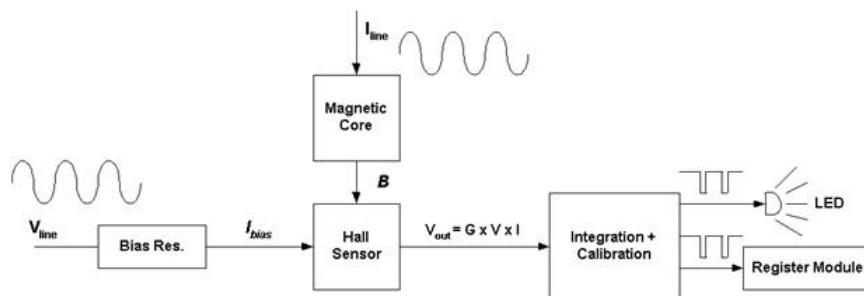


Figure 14: Simplified CENTRON Architecture

The custom ASIC cancels all the offset generated by the meter and removes the need for a light load adjustment of the metrology. This allows the meter to have excellent accuracy over a very large dynamic range, especially at the low current levels. For this reason, no offset adjustment is needed or provided for the CENTRON meter.

There is a slight phase shift in the current to flux density conversion due to eddy currents in the magnetic core material. This shift causes a small power factor error that is uniform across the dynamic range (load curve) of the meter. Itron compensates for this shift in the CENTRON by the use of a capacitor in the biasing current circuit. This correction is permanent.

The custom ASIC provides:

- Wh pulses to drive the Test LED
The same signal is also provided to the electronic register attachments.
- energy direction (sign)
- 60Hz clock signal synchronized with the line voltage (for time keeping)
- pulse that drives the stepper motor for the mechanical register attachment (1 pulse every 10 watthours)

The metrology board, which houses the measurement components described above, passes the Wh pulse, energy direction, and 60Hz clock signals to the personality module attached to the meter base. The two line voltages (one is referred to as meter ground), and power supply references are also supplied for reference purposes.



An inherent feature built into the design of each CENTRON ensures that the calibration of the product is not affected by any electronic board (existing or planned) added to the meter. This is achieved by a distributed power supply and documented design requirements in the CENTRON developer's kit.

CENTRON 2S CL320, 4S, 12/25S

The advanced metering forms of the CENTRON (2S CL320, 4S, and 12/25S) meter use the same Hall Effect measurement principle that is used in the form 1S, 2S, and 3S metering forms described earlier.

The major difference with these metering forms is the presence of two Hall cells, magnetic cores, and ADCs (see the Hall Cells and ADCs figure below).

For these metering applications, the biasing current I_{bias} (I_{bias1} and I_{bias2}) applied to each sensor is generated from the line voltage (V_{line1} and V_{line2}) using a resistor. The magnetic field is generated by the line current (I_{line1} and I_{line2}) that flows through the conductor looped around each core. The voltage (V_{out1} and V_{out2}) that is formed on each Hall Effect device is proportional to the watts produced by each phase.

Each Hall sensor output voltage is amplified by a differential amplifier in order to bring the signal within the nominal level of the ADC. ADC 1 sums the signal from ADC 1 and ADC 2. The output of ADC 1 is integrated over time to get the energy information. Each time the integrated signal exceeds a predetermined amount of energy, a pulse is generated. The pulse stream is accumulated into a counter. When the accumulated pulses reach a threshold, a Wh pulse is emitted and the meter LED is flashed. The counter threshold is programmed at the factory and serves as the permanent gain calibration for the life of the product. The calibration is a digital feature and has no variation or adjustment. ADCs 1 and 2 are calibrated independently, which means that each phase is calibrated independently.

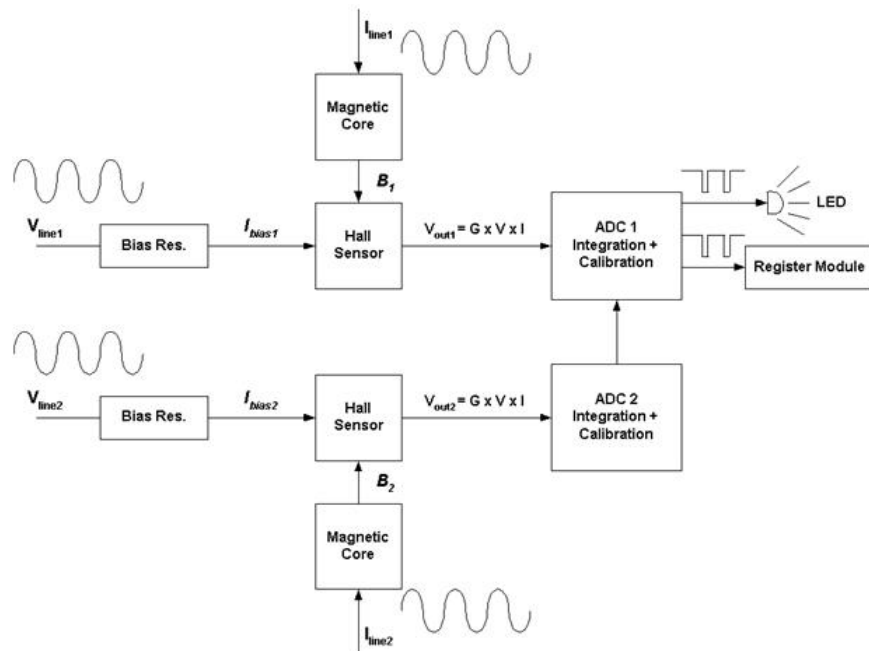


Figure 15: Hall Cells and ADCs

Operation: C1S Version

In This Chapter

Physical Description (Personality Modules).....	22
Registers	22
LCD Display Function.....	24
Non-Detented Register	25
Detented Register	25
Net Register	25
Segment Check.....	26
Factory Programming Options.....	26

The kWh only version of the CENTRON meter is available with an LCD personality module to register energy accumulation.



Figure 16: C1S LCD Personality Module

The LCD module may be ordered with a 5x1 or 4x10 register for self-contained meters, and a 5xTR or 4xTR register for transformer-rated meters.

The kWh only version of the CENTRON not only provides very accurate measurement for energy accumulation for today's needs, but also provides a platform for easy upgrade to higher functionality in the future.

Physical Description (Personality Modules)

The CENTRON Personality Modules snap into the meter register mounting brackets to ease installation of the board.

The LCD module is connected to the metrology board using the board-to-board connector. The following information is sent to the LCD module from the metrology board:

- Line voltage
- Reference voltage
- Energy flow direction
- Energy pulse data
- Line frequency

A connector is located at the 12 o'clock position behind the LCD for resetting the energy register. This is done using the ZRO-C2A Resetter.

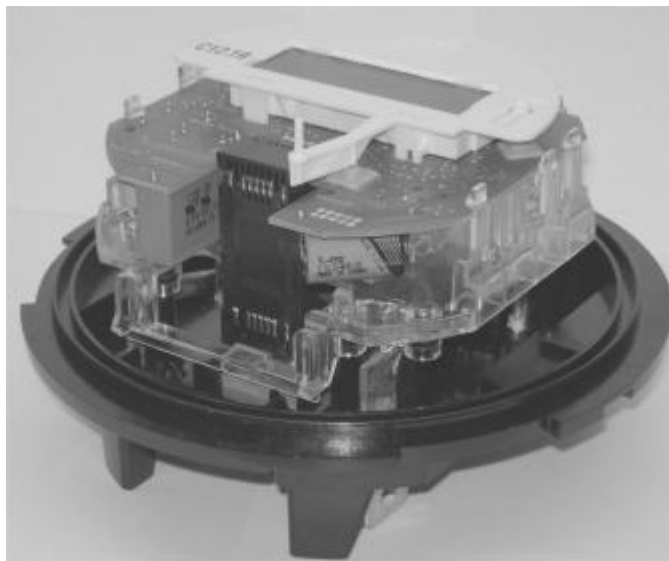


Figure 17: Mounted C12.19 D/T/L Register

Registers

Kilowatt Hours

The modules display energy in increments of whole values of kWh. Standard operation for all modules is to add forward and reverse energy flow, thus providing uni-directional operation. This feature is factory programmable and will only measure delivered energy. At the time of order, the energy-only module can be selected to have a detent register. Programmed at the factory, this feature will cease registration while the meter is inverted, or power flow is otherwise reversed. The module can also be selected to have a net register. This feature is factory programmable and will measure delivered minus received energy.

Resetting Values (ZRO-C2A)

The ZRO-C2A resets the energy register through a direct connection to the connector at the 12 o'clock position on the LCD and R300 modules.



Figure 18: ZRO-C2A Resetter Connected to the CENTRON

The ZRO-C2A is a pocket-sized handheld device for resetting the electronic meter readings in the CENTRON LCD kWh meter (C1S) and the R300 meter (C1SR). The ZRO-C2A also resets the tamper indicators in the C1SR.

The ZRO-C2A requires that the meter **Not Be Powered**. Wait three (3) seconds after power removal to install the probe to ensure the meter has had sufficient time to power down. The device connects to the CENTRON meter through a hole in the plastic inner cover located at the 12 o'clock position on the meter. Extending from the ZRO-C2A is a cable terminating in a connector which mates to the programming connector of the CENTRON.

Beginning February 20, 2002, the C1SR module for the CENTRON meter uses a new EEPROM component. This new EEPROM operates at a different voltage level requiring revision to the CENTRON resetter.



Use of a ZRO-C or ZRO-C2 resetter without the C2A upgrade WILL CAUSE DAMAGE to the personality modules on both the C1S LCD and C1SR meters produced after the new EEPROM implementation date; damaged modules will show "Error" on the display.

All current production resetters and resetters produced after June of 2001 were built with the C2A upgrade and are labeled accordingly as shown below. Although personality modules with the new EEPROM are only compatible with the C2A version of the CENTRON resetter (ZRO-C2A), the older revisions of the personality modules are also compatible with the ZRO-C2A.

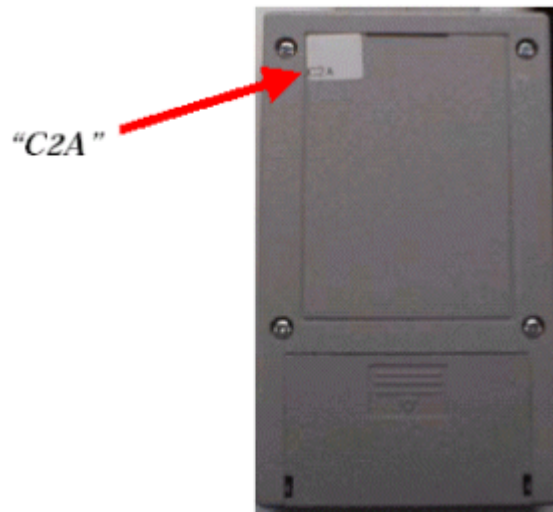


Figure 19: Reverse Side of ZRO-C2A Resetter

LCD Display Function

This display uses five 7-segment digits, four icons to indicate the type of displayed data, and three icons to represent a watt disk emulator. The display may be configured for either four or five digits and will roll over at 100,000 kWh.

This module is compatible with the ZRO-C2A Resetter.

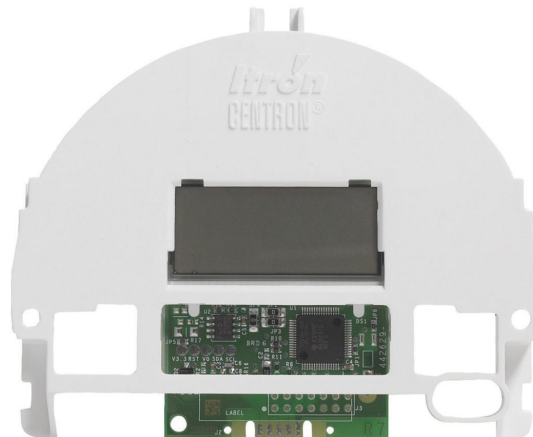


Figure 20: LCD

Non-Detented Register

The Non-Detented Register displays the delivered energy plus received energy.



Figure 21: Non-Detented Register

Detented Register

The Detented Register addresses applications requiring the reading of delivered kWh only. Received energy is discarded.



Figure 22: Delivered kWh with Detent Enabled

Net Register

The Net (kWh) Register addresses applications requiring residential net metering points. Net kWh is the delivered kWh to the customer minus any received kWh from the customer. Net metering emulates a non-detented J5 meter.



Figure 23: Net kWh

Segment Check

The Segment Check Register addresses applications requiring display scrolling between kWh and a full segment check. See Display Timing for factory programming options.



Figure 24: Segment Check



Although the DEL and REC indicators are ON during segment check, they are not currently used.

Factory Programming Options

Display Timing

The display will scroll between the billing register and the segment check mode based on the factory programming option.

Option	Description
1	7 second billing register display, 1 second blank, 7 second segment check display (7/7)
2	7 second billing register display, 1 second blank, 1 second segment check display (7/1)
3	Only the billing register is displayed (7/0)

Digits and Multipliers

The following digit and multiplier settings are available for factory programming:

- 4 digits x 1 kWh
- 4 digits x 10 kWh
- 5 digits x 1 kWh

Factory programmable multipliers are available for CL20 (x20, x40, and x80) applications. This allows the meter to display and transmit via RF primary readings. Meters are labeled accordingly when factory programmed.

Standard Consumption Message (SCM)

Utilizing the 96-bit Itron® Standard Consumption Message protocol (SCM), the C1SR provides the energy (kWh) consumption, module ID number, tamper indications, meter type, and error checking information in each radio frequency transmission. Within the 96-bit SCM, 26 bits are allocated to the module ID number for meter identification (also referred to as ERT ID number). As of October 15, 1999, all CENTRON C1SR meters utilize 26-bit identification numbers.

The C1SR uses frequency hopping and transmits within the unlicensed 910 to 920 MHz band on an average of once per second. In order to avoid interference from other devices, the transmission frequencies and time interval between transmission cycles are completely random in nature.

The C1SR is factory programmed with tuning information, module ID, tamper indicators (ITPR and RTPR), meter type, energy consumption, and scaling factor. The program and all register information are stored in non-volatile memory in the event of a power outage. Upon power restoration, all of the information in the non-volatile memory is restored to the appropriate registers.

The ERT type 4 message indicates that the device is sending this message supports transmitting a single SCM in the XXXXX format.

Interval Data Message (IDM)

The ERT type 7 message transmits one SCM and one IDM type 23 message. The type 23 ERT indicates the transmission of a single IDM message in the XXXXX.XX format.

The RF Personality Module allows meter data to be collected automatically, helping to save time, improve reliability, increase accuracy, and ensure data security. Kilowatt-hours and tamper data are reported through RF transmissions. The R300 IDM module provides both baseline and advanced data collection functionality, including interval data recording and enhanced tamper reporting capability. The R300 IDM delivers the Standard Consumption Message to any of Itron's radio-based data collection technologies, including handheld computers, a vehicle-based Mobile AMR unit such as the Mobile Collector, or a network data collection solution such as the Itron Fixed Network or MicroNetwork. In addition, the R300 IDM is also capable of delivering the Interval Data Message to the Itron Fixed Network AMR system to calculate ANSI standard demand, time-of-use, and load profiling information.

Physical Description (C1SR)

The C1SR personality module is constructed of a flame retardant printed circuit board material which supports the discrete, surface-mounted, and integrated circuit components. A microstrip etched on the circuit board serves as the RF antenna. The C1SR personality module easily snaps into the meter module mounting bracket. This module is then electronically attached to the metrology board via a board to board connector.

The following information is sent to the personality module from the base metrology board:

- Line voltage
- Reference voltage
- Energy flow direction
- Energy pulse data
- Line frequency

The C1SR contains contacts on the module board, located at the 12 o'clock position behind the LCD, for resetting the energy register and tamper counters. This can be accomplished with the ZRO-C2A Resetter.

The C1SR uses a unique module identification number (ERT ID), provided by Itron. This ID number is contained in each message transmission and is used by the handheld and billing system to determine meter identity and location. The ERT ID number, which is contained on a bar-coded label, is placed on the LCD housing directly above the LCD display.

C1SR Display

The C1SR personality module is only available with a liquid crystal display, LCD. The LCD is automatically adjusted for contrast over the operating temperature range.



Figure 26: C1SR LCD

This module can be configured to display either four or five digits of energy consumption and will rollover at 100,000 kWh for both self-contained (Form 1S, 2S, 12S, 25S) and transformer rated meters (3S, 4S). The self-contained meters can be programmed to display normal kWh consumption (5X1 register configuration) or tens of kWh consumption (4X10 register configuration). If the C1SR is programmed for a 4x10 display, a "Mult by 10" label is placed on the module to the left of the LCD display. Thus, the actual energy consumption is obtained by multiplying the value on LCD display by 10.

The transformer rated meters can be programmed to display either a 5xTR or 4xTR. In order to determine the actual energy consumption, the display reading needs to be multiplied by the transformer ratio (TR). If the transformer ratio is 1, then the reading on the display is the actual energy consumption.

The LCD display contains an electronic load indicator (or watt disk emulator). The disk emulator is three square segments in the lower right-hand corner of the display, which scroll in the direction of energy flow.

Icons are illuminated on the display when the meter is programmed with a non-standard algorithm. The LCD will display DET for detented energy. Icons for delivered (DEL) and received (REC) are not used. There is no additional indicator for the standard undetented configuration (i.e., where reverse energy is accumulated in the forward register).

Factory programmable multipliers are available for CL20 (x20, x40, and x80) applications. This allows the meter to display and transmit via RF primary readings. Meters are labeled accordingly when factory programmed.

The display will scroll between the billing register and the segment check mode based on the factory programming option.

Option	Description
1	7 second billing register display, 1 second blank, 7 second segment check display (7/7)
2	7 second billing register display, 1 second blank, 1 second segment check display (7/1)
3	Only the billing register is displayed (7/0)

C1SR Electronic Detent

The C1SR module displays energy in increments of whole values of kWh. Standard operation for this module is to accumulate both forward and reverse energy flow in the positive direction. However, the C1SR personality module is available with an electronic detent that will cause the meter to ignore reverse energy flow. Therefore, if the meter is inverted, the registers will accumulate in the forward direction only, thus providing uni-directional operation. At the time of order, the C1SR module can be selected to have a detent register.

When the meter is undetented, both forward and reverse energy will be accumulated. Therefore, the electronic load indicator will flash at a rate equal to the energy consumption, regardless of the direction of the energy flow.

When the electronic detent is enabled, only forward energy flow will be accumulated.

Net Metering

The C1SR module is available with the option of net metering capability. When the net option is enabled, received energy is subtracted from delivered energy. The net energy value is then displayed on the register.



Net metering is not available with the IDM option.

Resetting Values (C1SR)

The ZRO-C2A Resetter zeros both the energy registers and tamper counters by direct connection to the C1SR module. For more information, see the *ZRO-C2A Handheld Meter Resetter for the CENTRON CIS and C1SR Operating Instructions*.

Transmission

The C1SR R300 communicates within the unlicensed 910-920 MHz frequency band. The transmission frequencies, the frequency hopping pattern, and the time interval between transmission cycles are random in nature; thus providing a method for avoiding interference with transmission from other devices.

FCC Regulations

The C1SR communicates in the unlicensed, 910-920 MHz band governed by the US Code of Federal Regulations (CFR) Title 47, Part 15 Radio Frequency Devices, Sub Part C Paragraph 247 Intentional Radiator.



Changes or modifications not expressly approved by Itron could void the users authority to operate the equipment.

Testing the RF Message

In order to confirm the CENTRON meter is transmitting SCM messages, the meter is capable of a "factory test mode." If the meter has less than 50 Watt-Hours of accumulated energy it will enter "factory test mode." The meter will transmit multiple SCM messages in this mode. This mode is also useful during meter commissioning to verify that the meter is transmitting when first installed.

- 1 Place the meter in a socket.
- 2 Ensure that the meter has less than 50 watt-hours of accumulated energy.



If the meter has more than 50 watt-hours of accumulated energy, you may use the ZRO-C2A resetter to reset the energy consumption to 0.

- 3 Apply power to the meter.
- 4 Read the meter using a hand-held device or other RF capable reading device. The meter will continue to transmit multiple RF messages while under the 50 watt-hour threshold.

Tamper Detection

The CENTRON C1SR features the Itron patented method of tamper detection that senses both meter removal and meter inversion. The removal tamper (RTPR) increments a counter each time the meter is abruptly removed from a live meter socket. The tamper counter utilizes a tilt switch to detect when the meter is removed from a meter socket.

The inversion tamper (ITPR) increments a separate counter each time the meter senses reverse power flow caused by meter inversion. The metrology board senses reverse power flow and sends this status to the C1SR module. Although the C1SR increments an inversion counter when reverse power flow is detected, the meter, when undetented, will still accumulate the energy consumption in the positive direction. Each of these tamper indications, along with the kWh consumption, is then transmitted through the radio frequency transmission.

Testing the C1SR Tamper Counter

SCM Testing

In order to test the power removal counter, the meter must sense a shaken condition associated with a power outage.

- 1 Place the meter in a socket.
- 2 Apply power to the meter.
- 3 Remove the meter from the live socket.
- 4 Replace the meter in the socket.

The meter has incremented the removal tamper counter.

The C1SR uses the power outage (the meter being removed from a live socket) in conjunction with the meter being shaken simultaneously to increment the power removal counter.

In order to test the inversion counter, the meter must sense reverse current flow.

- 1 Place the meter in the meter socket inverted (test LED pointing down).
- 2 Apply a load to the meter in the forward direction.

The meter has incremented the inversion counter due to reverse energy flow through the meter.

The inversion counter increments when the meter senses reverse current flow. The metrology board senses reverse power flow and sends this status to the C1SR personality module. The C1SR then increments the counter and transmits the count.

As part of the 96-bit Standard Consumption Message, 4 bits are allocated for tamper indications, which include the power removal and meter inversion counters. The table below shows the removal and inversion information based on the reported tamper count.

RF Tamper Count:

Binary	Tamper Count	Inversion	Removal
0000	0	0	0
0001	1	1	0
0010	2	2	0
0011	3	3	0
0100	4	0	1
0101	5	1	1
0110	6	2	1
0111	7	3	1
1000	8	0	2
1001	9	1	2
1010	10	2	2
1011	11	3	2
1100	12	0	3
1101	13	1	3
1110	14	2	3
1111	15	3	3

Retrofitting the C1SR Personality Module

The CENTRON R300 is a one-way radio frequency personality module that transmits within the unlicensed 910-920 MHz frequency band governed by the US Code of Federal Regulations (CFR) Title 47, Part 15 Radio Frequency Devices, Sub Part C Paragraph 247 Intentional Radiator. Any device operating within this unlicensed frequency band must contain an FCC Identification number. Therefore, the FCC ID Label included in the Retrofit Kits must be placed on the meter as shown below. The retrofit kits for upgrading a meter to RF capability are only available for energy-only meters.

Recent revisions to the C1SR module include placing the FCC ID on the module itself as shown in the figure below.



Figure 27: C1SR FCC Label Location



Changes or modifications not expressly approved by Itron could void the user's authority to operate the equipment.

To retrofit an existing meter with a R300 module, see [Retrofitting with Personality Modules](#) (on page 13).

Operation: C1SC Version

In This Chapter

Physical Description	36
Transmission Scheme	36
FCC Regulations.....	37
Display Functions.....	37
Resetting Values	38
Programming the C1SC/CN1SC	38

The Itron C1SC is a one-way transmitter used for the Cellnet fixed network technology. The personality module transmits a formatted data packet consisting of the preamble, the utility billing ID, kWh information, and Cyclic Redundancy Checks (CRC) to ensure message integrity. The module also features built in power outage notification, reverse power flow detection, power restoration notification, and redundant transmissions. The C1SC uses spread spectrum to broadcast its message in the 902 to 928 MHz frequency range once every five minutes.



Figure 28: CENTRON C1SC

The C1SC is factory programmed to include the utility billing ID, LAN Address ID, and Register configuration. The utility billing ID is a value decided upon by the utility and Cellnet. The LAN address is a value that is assigned by Itron and programmed into every meter within the network. LAN addresses and utility billing IDs are unique to each meter. Itron activates the LAN ID upon receipt of the meter association file.

After programming, the module is tested to verify the operating system parameters and FCC compliance. A final test is performed via RF to verify a correct LAN address meter ID number of digits and RF signal.

Physical Description

The C1SC is constructed of a flame retardant, glass-filled printed circuit board material which supports the discrete, surface-mounted, and integrated circuitry components. A slot antenna etched on the circuit board serves as the RF antenna. The C1SC board snaps into the meter register mounting brackets to ease in the installation of the board. The LAN address barcode and interpretation is placed on the LCD housing for meter identification.

The C1SC personality module is attached to the metrology board using a board to board connector. The following information is passed from the metrology board to the C1SC:

- Line Voltage
- Reference Voltage
- Energy Flow direction
- Energy pulse data
- Line frequency

The C1SC has two additional labels called the meter change-out labels that are affixed to the bottom of the meter. The change out labels are identical and contain the AEP barcode information and a utility descriptor.

Transmission Scheme

The RF transmission is spread spectrum using Binary Phase Shift Keyed (BPSK) modulation. A chipping signal is used to spread the carrier and actual data is on-off-keyed (OOK). The modulator output drives the amplifier chain that provides a signal of approximately 100mW. The antenna is tuned for maximum efficiency at the carrier frequency.

The figure below shows how messages are typically transmitted. In the example, an interval packet made up of 18 intervals is transmitted every five minutes. Each interval contains a pulse count equivalent to the energy consumption for a 2.5 minute interval. The interval packet transmission represents a sliding 45 minute window of data.

Also shown in figure below, Interval packet 0 shows that the 2.5 minute interval is transmitted in one of the 18 packets of 2.5 minute information. Interval packet 1 is transmitted 5 minutes later and the selected 2.5 minute interval of data is now transmitted as the 16th packet (numbered 15). The following packet slides the information by two 2.5 minute intervals and continues for a total of nine transmissions. The information is then no longer in the sliding 45 minute window.

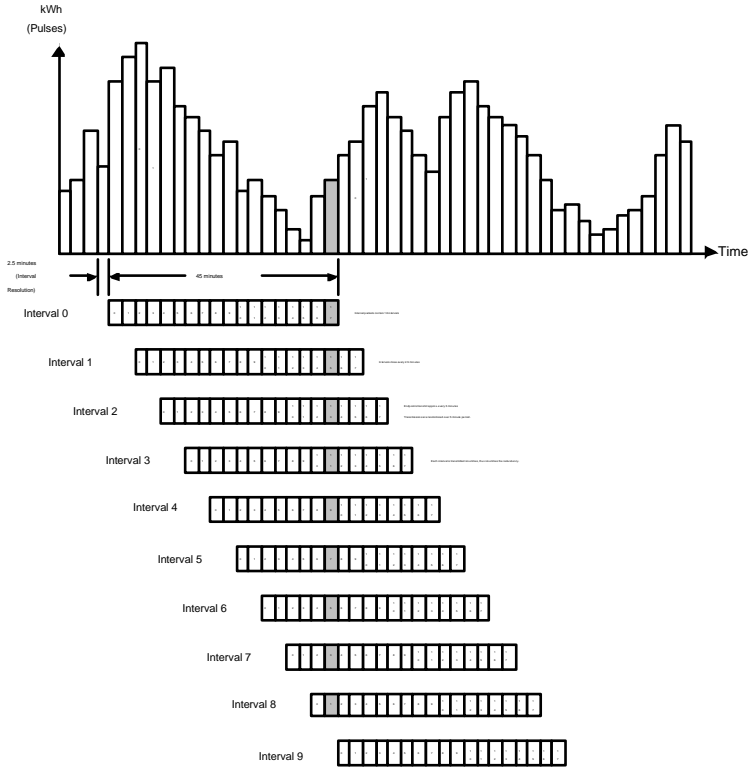


Figure 29: Cellnet Telemetry

FCC Regulations

The C1SC communicates in the unlicensed 902-928 MHz band governed by the US Code of Federal Regulations (CFR) Title 47, Part 15, Subpart C, Paragraph 247. This device complies with Title 47, Part 15, Subpart C, Paragraph 247 of the FCC rules.

Display Functions

The LCD is configured for five digits of energy consumption and will rollover at 100,000 kWh. The LCD is automatically adjusted for contrast over the operating temperature range.

A watt disk emulator is located on the lower right hand corner of the display. The indicator consists of three square segments in the lower right-hand corner of the display, which scroll in the direction of energy flow. The figure below illustrates this revision.



Figure 30: C1SC LCD

The display will scroll between the billing register and the segment check mode based on the factory programming option.

Option	Description
1	7 second billing register display, 1 second blank, 7 second segment check display (7/7)
2	7 second billing register display, 1 second blank, 1 second segment check display (7/1)
3	Only the billing register is displayed (7/0)

Resetting Values

The C1SC can be reset using the Cellnet Shooter device in conjunction with a computer.

Programming the C1SC/CN1SC

The CENTRON C1SC/CN1SC Cellnet personality module programming port is located such that the CENTRON inner cover does not have to be removed when programming or testing the Cellnet module.

In order to communicate with the CENTRON Cellnet module, insert the programming slide into the hole in the inner cover of the CENTRON meter that is located at the 12 o'clock position as shown in the figure below.



Figure 31: C1SC/CNISC Programming Port Location

Notes:

Operation: C12.19 C1SD, C1ST, and C1SL Versions

In This Chapter

Features.....	42
Type Codes.....	42
Controls and Indicators.....	43
Modes of Operations.....	44
Displays.....	45
Optical Port.....	47
Programmable Functions.....	47

The CENTRON meter is available with interchangeable personality modules that snap-into the standard CENTRON metrology base. The three multifunction modules available include the following versions:

- C1SD—a Demand module
- C1ST—a Time-of-Use (TOU) module with Demand
- C1SL—a Load Profile module with TOU and Demand



Figure 32: CENTRON C1SL Meter

These personality modules utilize the ANSI C12.19 and PSEM protocols.

Features

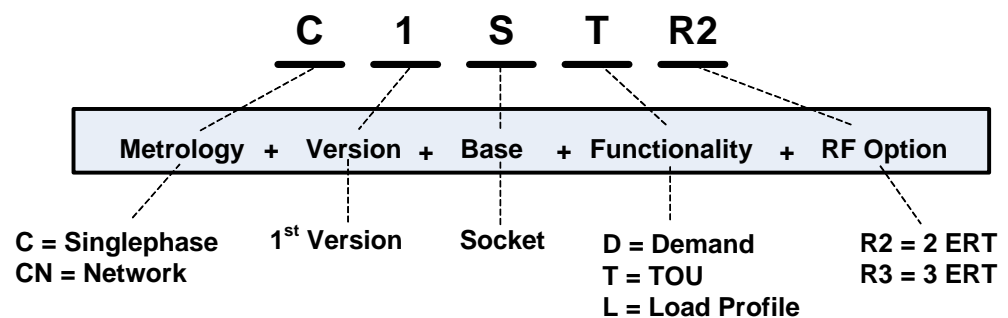
Features of these multifunction modules include:

- **Non-Volatile Memory**—Programming, register, and load profile data are stored in the EEPROM during a power outage. Meters with timekeeping functionality contain a battery, soldered to the circuit board, which maintains the clock circuitry during a power outage.
- **Optical Port Communication**—The optical port is a communication interface from the meter to a PC. Communication through the optical port may be from 9600 (default) to 28,800 baud.
- **Self-Read Capability**—Billing data can be stored automatically at programmable times to be read later. All meters are equipped with two self read (snapshot) registers; however, meters with timekeeping functionality are allotted up to twelve self read registers.
- **Load Profile**—The C1SL module provides 144K RAM for up to eight channels of load profile interval data.
- **Expansion Capability**—An expansion port is available for future functionality (except non-RF versions).
- **Bidirectional Metering**—All three multifunction versions are capable of measuring and displaying forward and reverse energy only (kWh). These modules have four registers. The modules are capable of measuring four types of energy: delivered, received, net, and uni-directional.

The C12.19 C1SD/T/L modules are available with an LCD display and a polycarbonate cover. The cover contains the optical port adapter and demand reset button.

Type Codes

The type code indicates the metrology, version, base, functionality, and RF options in the meter. The type code is found on the nameplate of the meter. The following is a depiction of how type codes are displayed for the C12.19 D/T/L meter:



The example above is a type code for a C12.19 TOU meter with RF capability transmitting 2 ERTs.

Controls and Indicators

All controls and indicators are shown below. For detailed instructions about a feature or control, refer to the appropriate subsection.

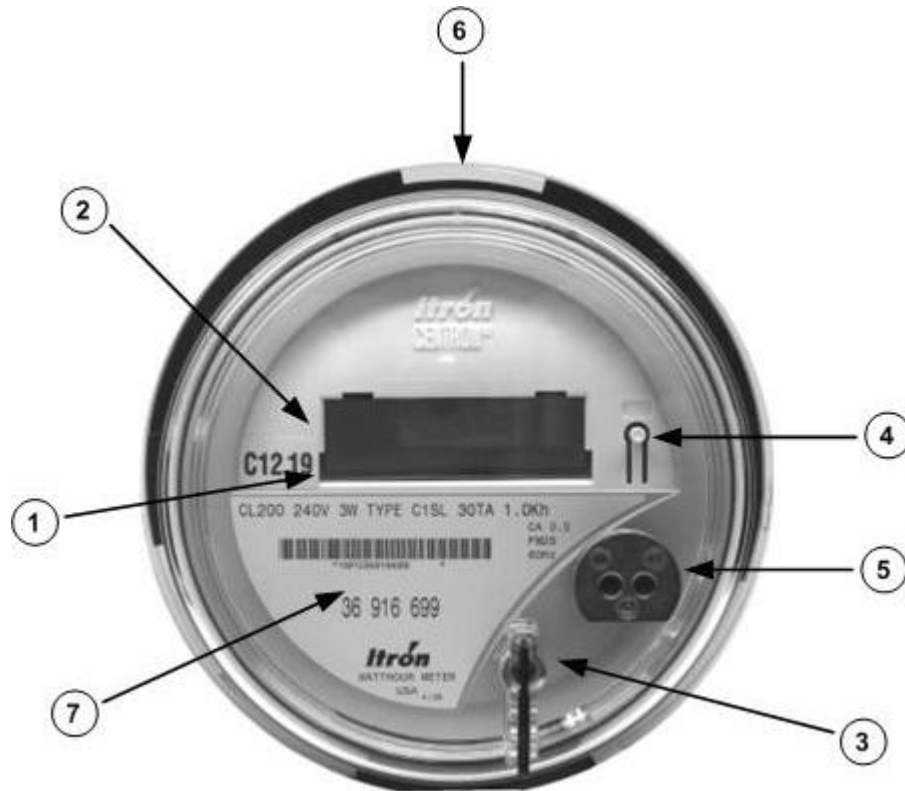


Figure 33: Controls and Indicators

- ① Liquid Crystal Display (LCD)
- ② Magnetic Switch
- ③ Demand Reset Button
- ④ Test Mode Button
- ⑤ Optical Port
- ⑥ Infrared Test LED
- ⑦ Nameplate

Modes of Operations

When the C12.19 C1SD/T/L modules are powered, they automatically enter the normal display mode, perform self-diagnostics, and display any appropriate error codes. If no error codes are detected, an *unprogrammed* module will flash "**nordiSP**" followed by **Segment Test**. A *programmed* module will scroll through the Normal display sequence, displaying each selected quantity, annunciator, and code number for the programmed duration.

The C12.19 C1SD/T/L modules each have three modes of operation:

- Normal
- Alternate
- Test

Each display mode has a separate list of items (quantities) in which it can display. The modules can display a maximum of 80 items total for the three modes of operation. The displayable quantities are configured through PC-PRO+ Advanced.

Normal Mode

In Normal mode, the module display automatically sequences through the programmed display items in the programmed sequence. Each item is displayed for the program-specified period (from 1 to 15 seconds), followed by a brief pause. Annunciators are available for selected quantities. Only the annunciator appropriate to the selected item can appear while its data is displayed. Each display can have a maximum of 3 alphanumeric characters for identification. Valid entries are A-Z, a-z, and 0 through 9.

The meter will continue to operate in Normal mode until power is disconnected, the Alternate display sequence is initiated, Test mode is selected, or a fatal error condition occurs.

Alternate Mode

The Alternate mode provides an additional set of customizable display items that are not typically used for billing applications. The Alternate mode is accessible only from the Normal mode when activated using either the magnetic switch or a meter programming device. Use a magnet to activate the Alternate mode. Place a magnet near the switch located at the 9 o'clock position on the side of the module. The magnetic switch can be accessed with the meter cover in place. To activate the Alternate mode with a programming device, refer to the PC-PRO+ Advanced documentation. Immediately upon activation, Alternate mode is indicated by a flashing *ALT* annunciator. The *ALT* annunciator will not appear unless an Alternate mode display has been programmed.

Once the Alternate mode has been selected, the display will sequence through the program items until the programmed mode timeout expires. The quantities displayed are selected during programming and have the same display timing as in Normal mode. Like the displays in Normal mode, each display in Alternate mode can have maximum of 3 alphanumeric characters to identify each item. Valid entries are A-Z, a-z and 0 through 9.

The operations performed in Normal mode are identical to those in Alternate mode.

Test Mode

The meter can be placed into Test Mode either by pressing the TEST button or through software communications. Manual use of the TEST button can be disabled via PC-PRO+ Advanced software.



If the TEST button is disabled through programming, the meter will not enter Test Mode when the button is pressed.

While in Test Mode, the TEST annunciator is displayed on the LCD. When the Test Mode is activated, all billing registers and certain non-billing registers are preserved in non-volatile memory and are restored when Test Mode is exited.

To exit Test Mode, press the TEST button. The LCD will display "nordiSP" (normal display) signifying the exit of Test Mode and entry into Normal Mode operation.

Test Mode Timeout

If left in Test Mode, the meter will automatically exit after a user-configurable Mode Timeout. A programmable timeout length from 1 to 255 minutes is available. See the PC-PRO+ Advanced online help for more information on configuring the Mode Timeout. This action prevents someone from accidentally leaving a meter in Test Mode and losing billing data.


Test Mode Lockout

Activating Test Mode Lockout via the programming software will prevent entry into Test Mode via manual Test Mode Switch activation.

Displays

The CENTRON meter features a versatile ANSI C12.10 compliant, 104 segment liquid crystal display (LCD). A nine-digit LCD, with a variety of annunciators, is provided on these multifunction personality modules.

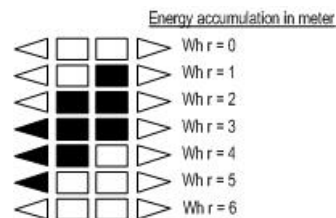
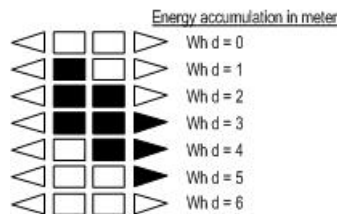


Static Indicators	
Indicator	Description
888 888888	Nine digits (7 segments each) for display of alphanumeric information
EOI	End of Interval—(Registers - Dmd)
VA, VB, VC	Indicators for phase voltage (not applicable in CENTRON C12.19 meters) are present during segment check
	Watt Disk Emulator - scrolls right for positive; scrolls left for negative
120 240 277 480	Nominal Voltage Indicator (not applicable in CENTRON C12.19 meters) are present during segment check
Scr Loc	Scroll Lock (indicates temporary scroll lock of a display item)
SEL nor, SEL Alt	Selection of Normal or Alternate sequence
nor diSP	Entry into Normal Mode.
TEST	Entry into Test Mode.



The indicators shown in the table above actually display in a digital readout font; some characters may display as upper case. The Watt Disk Emulator does not appear for segment check.

The watt disk emulator can represent the delivered or received power as follows:



Optical Port

The optical port is mounted on the meter cover. The optical port is a communication interface from the meter to a PC. Interface to a PC is accomplished through a communication cable which attaches to the optical port on one end and a PC serial port on the other end. This interface cable can be powered by a DC TAP, an AC Adaptor, or the PC's COM Port. Communication through the optical port may be at 9600, 14400, 19200, or 28800 bps.

Programmable Functions

The CENTRON personality module can be programmed using the PC-PRO+ Advanced software. The table below depicts each display item available for each display mode. The display items and sequence of their display, along with any desired annunciators or Identification (ID) code numbers, are selected during the programming process. Detailed information on these display items can be found in the PC-PRO+ Advanced documentation.

Energy Data Display Items

Energy Data Display Item	Display Mode		
	Normal	Alternate	Test
Wh Delivered (d)	X	X	X
Wh Received (r)	X	X	X
Wh Net (d - r)	X	X	X
Wh Uni-Directional (d + r)	X	X	X

Demand Data Display Items

Demand Data Display Item	Display Mode		
	Normal	Alternate	Test
W Delivered (Max, Present, Previous, Projected, Cumulative, Continuous Cumulative)	X	X	X
W Received (Max, Present, Previous, Projected, Cumulative, Continuous Cumulative)	X	X	X
W Net (Max, Present, Previous, Projected, Cumulative, Continuous Cumulative)	X	X	X
W Uni-directional (Max, Present, Previous, Projected, Cumulative, Continuous Cumulative)	X	X	X

Informational Data Display Items

Informational Data Display Item	Display Mode		
	Normal	Alternate	Test
Calibration Date & Calibration Time	X	X	
Cold Load Pickup Outage Time	X	X	

Informational Data Display Item	Display Mode		
	Normal	Alternate	Test
Current Date, Day, & Current Time	X	X	
Days Since Demand Reset	X	X	
Demand Reset Count	X	X	
Display On Time	X	X	
Firmware Revision	X	X	
Last Outage Date & Last Outage Time	X	X	
Last Program Date & Last Program Time	X	X	
Last Reset Date & Last Reset Time	X	X	
Last Test Date & Last Test Time	X	X	
Load Profile Pulse Weight 1-8	X	X	
Load Research ID	X	X	
Last Season Self Read Registers	X	X	
Meter ID & Meter ID 2	X	X	
Minutes on Battery	X	X	
Number of Subintervals	X	X	
Number of Test Subintervals			X
Last Interrogation Date & Time	X	X	
Outage Count	X	X	
Program Count	X	X	
Program ID	X	X	
Register Fullscale	X	X	
Register Multiplier	X	X	
RF ID 1-3	X	X	
Segment Test	X	X	
SnapShot 1-2	X	X	
Self Read 1-4	X	X	
Software Revision Number	X	X	
Test Subinterval Length			X
Time Remaining in Demand Subinterval	X	X	X
Time Remaining in Test Mode			X
TOU Expiration Date	X	X	
User Data 1-3	X	X	X

Demand Registers

Demands can be calculated from any of the four selected energy quantities. The user can configure up to ten demand registers.

Demand Calculations

To calculate demand, the selected quantities are accumulated over a programmable time period (1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, or 60 minutes) depending on the programmed demand interval length. At the end of the interval, the accumulated values are stored in separate demand storage registers and the accumulating registers are cleared. Incremental values for the next demand interval are then accumulated.

The maximum demand in a billing period is determined by comparing the demand values for the most recently completed interval to the respective readings presently stored in the peak demand registers. If the previous demand is greater than the value in the corresponding peak demand register, the lower value (the maximum demand recorded so far) is replaced. If the previous demand is less than the value in the corresponding peak demand register, the maximum demand value remains unchanged. This update process is carried out when a demand interval is completed, when a power outage occurs, when Test Mode is initiated, or when a Real Time Rate change occurs.

The CENTRON meter demand calculations are performed using one of three possible methods: block, rolling, or thermal emulation. The demand method is selected when the register is programmed.

Demand

Calculation of demand is always based on rolling or block intervals. Demand calculations use three constants; the watt-hour constant (Kh), the demand interval length, and the register multiplier.

The weight of an incoming pulse is determined according to the following formula:

$$\text{kW Pulse Weight} \left(\frac{\text{kW}}{\text{Pulse}} \right) = \text{Kh} / 1000 \times \text{Register Multiplier} \times 60 / \text{Demand Interval Length}$$

The demand in a given interval is the product of the number of pulses received during that interval times the pulse weight:

$$\text{Demand (kW)} = \text{Number of Pulses} \times \text{kW Pulse Weight}$$

The Demand value is continuously compared against the stored maximum value. If a demand value is greater than the corresponding maximum demand, it is saved as the new maximum demand. If the demand value is less than the corresponding maximum demand, it is discarded. At the beginning of an interval, the current interval demand is reset to zero and new demand values begin accumulating.

Block Interval Demand Calculation

Block Demand calculations are based on user-defined interval lengths. The demand is the total energy accumulated during the interval divided by the length of the interval. At each end of interval (EOI), demand calculations are made and EOI can be displayed on the LCD.

For block interval, demand calculations are made at the end of each completed demand interval. This method is similar to the way mechanical demand meters operate. As load is applied to the demand register, an indicating pointer and maximum demand indicator are driven upscale. At the end of each interval, the indicating demand pointer is returned to the zero position, and the maximum demand pointer retains its highest or maximum position.

Rolling/Sliding Demand Interval Calculation

A selected number of subintervals make up the demand interval. At the end of each subinterval, new demand calculations occur based on the last full demand interval and EOI can be displayed on the LCD.

The following quantities can be selected for rolling demand: W_d , W_r , W_{net} , and W_{uni} .

Block interval demand calculation is subject to peak splitting, whereby it is possible for an electricity consumer to manipulate the load for limited periods within the demand interval. The registered demand reading will be less than the actual maximum demand of the load.

To counter this situation, the concept of rolling demand was introduced. Rolling demand is calculated as follows:

- 1** For illustration purposes, assume a 15 minute billing demand interval with three five-minute subintervals has been selected. Then, at any given moment, the meter has three complete sets of five-minute information available for demand calculations.
- 2** At the end of the present five-minute subinterval, the information on the oldest five-minute subinterval is discarded, and demand calculations are performed on the three newest sets of subintervals.
- 3** If the billing demand interval is 30 minutes with five-minute subintervals, then six sets of five-minute information or updates will be used for calculating previous demand.

Thermal Emulation

The CENTRON meter will emulate the response of a thermal demand meter. This type of demand calculation is approximated exponentially. The meter will record 90% of a change in load in 15 minutes, 99% in 30 minutes, and 99.9% in 45 minutes. The four characteristics of a thermal demand meter that the CENTRON meter will emulate are:

- Arithmetic phase summation
- Continuous rolling average demand
- Response calibrated to RMS values
- No End-of-Interval (EOI)

The following quantities can be selected for thermal demand: W_d , W_r , W_{net} , and W_{uni} . The thermal demand option has only one demand interval available. This interval length (response time) is 15 minutes. When you enter into Test Mode, this interval length is fixed at one minute.



Thermal demand is not available if TOU is enabled.

Cumulative Demand Values

Cumulative Demand is the summation of previous maximum demands after each demand reset. When a demand reset occurs, the maximum demand values are added to the existing corresponding cumulative demand values, and the sums are saved as the new cumulative demands. These values will not increase until the next demand reset. This feature not only protects the user from false or erroneous readings, but also provides the customer with extra security against tampering. Cumulative demand may be used for block, rolling, and thermal demand types.

Continuous Cumulative Demand Values

Continuous Cumulative Demand is the sum of the maximum demand and the cumulative demand at any point in time. At the end of each demand interval, if a new maximum demand is reached, continuous cumulative demand will also be adjusted to reflect this new maximum demand value. A demand reset will clear the maximum demand value, but will not affect the continuous cumulative demand. Continuous cumulative demand may be used for block, rolling, and thermal demand types.

Present Demand

Present Demand is the value that would be used if an EOI were to occur when the data is being viewed. It is calculated by dividing the accumulated energy in the current interval by the time of a full interval. For block demands, present demand starts at zero for each interval and ramps up to the demand value at the EOI. For rolling demands, the energy from the oldest subinterval is discarded and the present demand is calculated using the energy in the remaining subintervals and the energy in the current subinterval. At the beginning of a new subinterval, it drops by the demand of the oldest subinterval and ramps up to the demand value at the next EOI.

Present demand is not affected by a demand reset.

Previous Demand

Previous Demand is the demand from the most recently completed demand interval. When a demand interval ends, the present demand is transferred to the previous demand. When using rolling demand, this quantity is updated after each subinterval. For thermal demand types, the previous demand value is equal to the present demand.

Projected Demand

Projected Demand is an estimate of the demand the meter will have accumulated by the end of the current interval. This value is calculated by dividing the accumulated energy by the amount of time accumulated in the interval. Projected demand is calculated upon request. Projected demand is available for block and rolling demand only.

Peak Demand (Maximum Demand)

Peak Demand is the largest demand value that has occurred during any demand interval since the last demand reset. At the end of a demand interval, the present demand is compared with the current maximum demand register. If the present demand is greater, it is transferred to the maximum demand. The maximum demand is reset to zero on a demand reset. The date and time of the maximum demand are also recorded. Maximum demand is used for block, rolling, and thermal demand types.

Coincident Demand

Coincident Demand is the energy demand required by a given customer or class of customers during a particular time period. Coincident peak demand is the energy demand by that group during periods of peak system demand. A customer's coincident peak demand is usually calculated from meter readings taken at the time when the customer's demand is likely to be highest. An energy provider may be more concerned with demand at a given time when total customer demand is highest than they are with the peak demand of a given customer during other times.

Multiple Peaks

The CENTRON meter can measure the top five maximum demands for the quantities selected. The possible quantities include W d, W r, W net, and W uni.

Demand Reset

A demand reset can occur in both Normal and Alternate modes. A demand reset can occur in four ways:

- 1** Through the optical port using a compatible programming device.
- 2** With the standard push-button demand reset switch located on the face of the meter (Controls and Indicators (on page 43)).
- 3** Through the use of TOU scheduling for specific reset dates and times.
- 4** Through the use of programmable Billing Schedules and Self Reads.

When a demand reset is initiated, the following events occur:

- As an indication of a demand reset, the display flashes all eights for six seconds.
- The current maximum demand values are added to the corresponding Cumulative Demand values
- A snapshot is performed.

- All Maximum Demand values are reset to zero. All corresponding times and dates of maximum demands are cleared (meters with timekeeping functionality only).
- The number of demand resets is increased by one.
- The number of in-service days since the last reset is set to zero.
- The time and date of the last reset is updated (meters with timekeeping functionality only).
- The normal mode display resumes. Exception is when in Test Mode, the display resumes with next item in display list.

As a security feature, a demand reset lockout time can be programmed to prevent additional demand resets until the programmed time expires.

Cold Load Pickup

Normally, when power is restored to the meter after an outage, a new demand interval is started and demand calculations begin immediately. The meter can be configured to recognize a demand delay or cold load pickup (CLPU) time. If a CLPU is configured in the meter, the meter will delay demand calculations for the configured amount of time (0 to 255 minutes in one-minute increments). For example, if a CLPU time of five minutes is programmed into the meter, a power outage will cause the meter to wait five minutes after power restoration before resuming demand calculations.

TOU/Load Profile Meters

All meters with timekeeping functionality have a battery installed. The battery allows the TOU and Load Profile data, in RAM, to be maintained during a power outage. The battery also allows the timekeeping circuitry in the meter to maintain the meter's clock during an outage.

Upon the return of AC power, the register undergoes a procedure similar to the initial power-up. The meter performs self-diagnostic checks, data is retrieved from non-volatile memory, and normal operation is resumed. The amount of time, in minutes, the meter was sustained by the battery during a power outage is added to the Time on Battery register. Since the demand interval is synchronized to the top of the hour, the first demand interval after a power outage may be shorter than the programmed interval value.

Self Reading and SnapShot Registers

All CENTRON C12.19 D/T/L meters are equipped with two snapshot registers. The snapshot registers store self read data that was triggered by a demand reset. Snapshot 1 contains the most recent demand reset data. Snapshot 2 is the next most recent set of self read data at demand reset. Meters with timekeeping functionality can store up to twelve self reads when a self-read is performed. The first four self read registers are displayable in the Normal and Alternate mode. The remaining 8 self read registers are viewable in the PC-PRO+ Advanced software.

A self-read is programmed to initiate when any of the following occur:

- Before each self read is taken.
- Before each scheduled demand reset.
- Each manual reset using the Demand Reset button on the meter.

A Self-Read Register is programmed to initiate in one of three ways:

- Read on manual or electronic demand reset. When a demand reset is initiated, all energy and maximum demand quantities are immediately transferred to non-volatile memory.
- Read on a programmed day of the month (meters with timekeeping functionality only). A specified date (1st - 28th) can be programmed into the meter to indicate the exact day that a self-read is to be performed. On this date register readings are transferred to nonvolatile memory.

If desired, an automatic demand reset can be performed after this self-read.

- Read on a programmable number of days since the last manual or automatic demand reset (meters with timekeeping functionality only). If the selected number of days (1 to 255) passes without a demand reset, a self-read is initiated.

If desired, an automatic demand reset can be performed after this self-read.

A Self Reading Schedule can be set to occur in the following ways:

- Read daily
- Read n days after a demand reset
- Read on the n th day of the month
- Read n days before the end of the month
- Read on custom schedule

Time-of-Use

The Time-of-Use (TOU) functionality is designed for use in billing applications where multiple rates (bins) are required for energy and demand.

TOU Schedules

Schedule information is programmed on a PC using the PC-PRO+ Advanced software packages.

When using TOU functions on a meter, energy and demand registration are segregated into time blocks during the day. Each time block can be one of four rate periods. In addition to these four rate periods, a total rate is also available.

Calendar Schedule

The calendar schedule contains all daily and yearly information needed for the meter to measure and register data in real time. The TOU calendar is programmable for up to 25 years and accommodates leap year, daylight savings time, and recurring holidays. The schedule contains daily patterns, seasons, and holidays with programmable day types, rates and outputs. For information concerning the entry of these parameters into the PC-PRO+ Advanced software package, consult the *PC-PRO+ Advanced System Manual*. This manual is installed with the PC-PRO+ Advanced software and is accessible through the Windows Start menu.

Rate Schedules

Four independent rates are available for TOU registration. These are designated A, B, C, and D. Only one of these rates can be active at a time. The Total register, designated Rate t, is always active, regardless of the active rate period.

The CENTRON meter TOU rates are applied to all energy and demand registers that have been selected for measurement. Therefore, all energy and demand registers are segmented as per the TOU schedule and available in each rate period, in addition to the Total rate.

Daily Patterns

Each pattern defines the times during the day that rate period A, B, C, or D begins and ends. Up to 24 rate period changes (also called switchpoints) may be specified for each daily pattern.

Day Types

There are four day types: Weekday, Saturday, Sunday, and Holiday. Each day of the week is assigned to one of the four day types. Each day type is assigned one of the four daily patterns when each season is defined. Any of the daily patterns can be used in any combination with the day types. The CENTRON meter TOU implementation supports up to 44 holidays per year; it also supports leap years.

Seasonal Schedules

A season is a period of weeks during the year when a particular rate structure is in effect. The year can be divided into a maximum of eight seasons. The day types with associated daily patterns can be defined differently for each season. Up to eight season change dates are specified for each year in the calendar schedule. If multiple seasons are not used, the TOU schedule contains one year-round season.

Season changes occur at midnight of the season change date (where midnight corresponds to 00:00 hours) or can be designated through programming to occur at the first demand reset following the season change date.

Registers

The CENTRON meter can measure up to four energies and ten demands. When the meter is configured for a TOU calendar, all energies and demands that are selected for measurement also have the configured TOU rates applied to them, with the exception of previous, projected, and instantaneous registers. The TOU energy and demand registers are available for display as well.

Current Season Register

All energy and demand registers selected for the active season are considered current season registers. If a single rate schedule is applicable year-round, then only current season registers are used.

Last Season Registers

Last season registers are available when two or more seasons are used during the year. For every current season register (with the exception of Cumulative and Continuous Cumulative registers), there is a last season register for the same quantity. Last season registers are designated **LS** in the programming software. Last season registers can be selected for display in Normal and Alternate Display Lists.

TOU Operation

This section describes TOU operation specific to the meter display. Several TOU indicators are available on the liquid crystal display (LCD).

Rate Annunciators and Active Rate Indicators

Rate annunciators are available with each demand and energy register. An A, B, C, or D will be displayed on the far right side of the LCD to indicate the rate period for each quantity being displayed. The rate annunciator that may be displayed for the Total Rate is **t**.

If the rate annunciator is flashing while a demand or energy value is displayed, the annunciator indicates that it is the current rate in effect. This gives a quick indication that the register is programmed with the correct TOU schedule and that it is currently set to the correct time.

Season Change

At the end of a specified season, all last season registers are updated with current season register data. The meter can be programmed to either delay the season change until a demand reset occurs, to activate an automatic demand reset at season change, or to change the season without performing a demand reset. A season change occurs at midnight at the end of the programmed season change date, or at the first demand reset following the season change date, depending on how the meter has been programmed. Some utilities program the season change to occur at the first demand reset following the season change date to make season changes concurrent with the meter reading cycles.

The following events take place when an automatic demand reset occurs at a season change:

- 1 The current season energy registers are copied directly to the last season energy registers.
- 2 The current season maximum demand registers are copied directly to the last season maximum demand registers, and t rate is added to the cumulative demand register.
- 3 After the demand reset, the maximum demand registers are reset to zero, and the t rate cumulative demand register is copied to the last season cumulative demand register.

If there is no demand reset at season change, all current season registers are directly copied to last season registers at season change, but no current season registers are zeroed.

Load Profile Specifications

Capacity

The C1SL module provides 144 Kbytes of EEPROM for up to eight channels of interval load profile data. The amount of installed EEPROM actually used for load profile recording is programmable from 1 to 144 Kbytes in one Kbyte increments.

Bit Resolution

The mass memory is configured for 16 bit data resolution. Equivalent pulse count resolution per interval is as follows:

Bits	Pulse Counts
16	65,535
15 ¹	32,767

¹ When a Net quantity (i.e., Net Wh) is chosen as a load profile channel, all load profile channels have 15-bit resolution.

There is a difference between MV-90 and the D/T/L Register concerning load profile data. The D/T/L Register can accommodate a maximum of 65,535 pulses (16 bit) per interval. (A maximum of 32,767 pulses per interval is allowed when using bidirectional quantities because the 16th bit is used for "+" or "-"). MV-90 is a 16 bit system, however the 16th bit is always used for "+" or "-". Since the 16th bit is always signed, the maximum allowed pulses per interval is always 32,767. If MV-90 receives a number of pulses per interval larger than 32,767, MV-90 will record a negative number (received value) for that interval.



Itron recommends programming any D/T/L Register with load profile that is interrogated by MV-90 or any system that exports load profile information to MV-90 to use 15 bit resolution or 32,767 pulses per interval.

Interval Lengths

The load profile records data on a block interval basis. The interval length is programmable: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, or 60 minutes. The default is 15 minutes. This interval length is independent of the interval length chosen for displayed demand quantities.

Power Outage

The C12.19 C1SL module can flag an interval when a power outage exceeds a specified number of seconds. The power outage duration is programmable from 0 to 255 seconds. The default is 60 seconds.

Channel Configurations

The Load Profile register has up to eight channels of load profile interval data. The pulse constant is programmable from 0.01 to 1000.00 watthours per pulse in 0.01 increments. This pulse constant applies to secondary readings only. For example, a watthour pulse constant of 1.8 corresponds to 1.8 watthours per pulse.

Some example pulse weight calculations:

Example 1: Calculation of Pulse Weight

If the customer pulls a 240V, CL200, singlephase, Form 2S electromechanical meter from service, with the following:

Meter Kh = 7.2 watthours/disk revolution

Pulse Initiator = 4 pulses/disk, revolution

then this electromechanical meter has the following pulse weight (PW):

$$\text{PW} = \text{Kh}/\text{PDR} = (7.2 \text{ watt hours per disk revolution}) / (4 \text{ pulses per disk revolution})$$
$$\text{PW} = 1.8 \text{ watt hours per pulse}$$

If this meter is replaced by a Load Profile register of the same form number, voltage and current ratings, and if the utility wants the register to operate the same way, the pulse weight would be entered in the customer files as 1.8 watthours per pulse.

Example 2: Calculation of Pulse Weight

A Load Profile register on a singlephase, 240V, CL200, meter is programmed so that kWh is recorded into mass memory. The maximum 16-bit data resolution is desired for 15 minute intervals.

First, calculate the maximum watthour accumulation during 15 minutes intervals:

$$\text{Wh, Max} = 240 \text{ V} \times 200 \text{ A} \times \text{Iphase} \times 0.25$$
$$\text{Wh, Max} = 12,000 \text{ watt hours}$$

The maximum number of pulses is 65,535; therefore, the smallest pulse weight (PW) that can be used is:

$$PW, \text{ Min} = 12,000 \text{ Wh} / 65,535 = 0.18 \text{ Wh/Pulse}$$

Data Storage

The C12.19 D/T/L Register uses non-volatile flash memory to record load profile data. Data is stored in load profile memory at the end of each interval. Each channel has 16 bits written to load profile memory. For example, consider 8 channels of load profile. At the end of an interval, a 16-bit number is written into load profile memory for channel 1; a 16-bit number for channel 2 follows immediately; and so on, up to the last 16-bit number for channel 8, which follows immediately.

The process continues for each interval until 128 intervals (one block or record) have been recorded. In addition to the profile data, each interval contains eight types of status bits written into each data interval.

- 1 **Partial Interval**-The status bit is set for a partial interval due to a time adjust, power outage, or beginning interval.
- 2 **Long Interval**-The status bit is set for a long interval due to a time adjust backwards.
- 3 **Skipped Interval**-The status bit is set for a skipped interval due to a power outage, Test Mode, or time adjusted forward during the interval.
- 4 **Test Mode**-The status bit is set for Test Mode due to the meter being in test mode during the interval.
- 5 **DST**-The status bit is set for Daylight Savings Time (DST) due to DST being in effect during the interval.
- 6 **Power Outage**-The status bit is set for each interval during which a power outage occurs (greater than the minimum time programmed in software).
- 7 **Time Adjust Forward**-The status bit is set for time adjust during the time interval.
- 8 **Time Adjust Backward**-The status bit is set for time adjust backward during the interval.



[Refer to PC-PRO+ Advanced online help for a list of Load Profile Status Codes.](#)

In addition to the interval profile data and the interval status data, each block contains a time tag specifying the month, day, hour, and second of the end of the data block.

Recording Duration

Use the following equation to determine the recording duration for the load profile register:

$$Duration (days) = (M * I * 1024) / (1440 * ((2 * C + 2) + ((6 * C + 4) / 128)))$$

M= Memory size in kilobytes

C = Number of channels

I = Interval Length in minutes

Recording Duration (in days) for 144 Kbyte load profile memory size:

Number of Channels	Interval Length (Minutes)											
	1	2	3	4	5	6	10	12	15	20	30	60
1	25	50	75	100	125	150	251	301	376	502	753	1506
2	16	33	50	66	83	100	167	200	250	334	501	1003
3	12	25	37	50	62	75	125	150	187	250	375	751
4	10	20	30	40	50	60	100	120	150	200	300	601
5	8	16	25	33	41	50	83	100	125	166	250	500
6	7	14	21	28	35	42	71	85	107	143	214	429
7	6	12	18	25	31	37	62	75	93	125	187	375
8	5	11	16	22	27	33	55	66	83	111	166	333

Optional Features

Event Log

The C12.19 C1SD/T/L register has an Event Log that records historical events that have taken place in the meter. The events to be logged must be configured via the PC-PRO+ Advanced programming software. To aid in troubleshooting, Itron recommends enabling all events to be logged.



In order to have date and time associated with an event, Time-of-Use or Load Profile is required. A Demand-only register allows for event log recording; however, in the event of a power outage, the date and time will not be reliable.

The C12.19 C1SD/T/L register Event Log is circular in nature, allowing for the capture of the most recent events in the meter at all times. The register is capable of retaining 420 events prior to wrapping.

Each event log record includes an event description, a time and date stamp, and additional information on certain events.

For meters with batteries, all logged events are retained through a power outage. For meters without batteries, the Event Log is periodically written to non-volatile memory. Events that occur just prior to a power outage may be lost depending on whether they were backed-up or not.

The contents of the event log can be viewed using the meter programming software.

The following events may be configured for recording in the C12.19 C1SD/T/L register Event Log:

- **Billing Schedule Expired**—billing schedule has expired and needs to be updated in PC-PRO+ Advanced
- **Clear Billing Data**—billing data has been cleared upon initialization of the meter, or as a secondary activity by authorized personnel
- **Configuration Error**—meter configuration was not successful
- **Demand Reset**—a demand reset occurred
- **DST Time Change**—DST adjustment forward or backward has occurred
- **Event Log Cleared**—Event Log was cleared by programming software
- **Full Scale Overflow**—Non-Fatal Error Codes for description
- **Load Profile Error**—Non-Fatal Error Codes for description
- **Logon Successful**—a user or option board logged on successfully to the meter
- **Low Battery**—Non-Fatal Error Codes for description
- **Meter Reprogrammed**—meter was initialized or reconfigured
- **Power Outage**—power was lost
- **Power Restored**—power was restored
- **Rate Change**—TOU rate change occurred
- **Register Self Read**—self read occurred
- **Reverse Power Flow**—Non-Fatal Error Codes for description
- **Reverse Power Flow Restored**—delivered power flow resumed after reverse flow exceeded a configured threshold
- **Season Change**—TOU season change occurred
- **Security Fail**—logon with security code failed
- **Security Pass**—logon with security code succeeded
- **Test Mode Entered**—Test Mode or Alternate Test Mode was entered
- **Test Mode Exited**—Test Mode or Alternate Test Mode was exited
- **Time Changed**—a time adjustment forward or backward occurred
- **TOU Schedule Error**—Non-Fatal Error Codes for description

Security Codes

Register security can be provided with primary, secondary, and tertiary security codes that prevent unauthorized communication with CENTRON products. A Primary security code allows complete access to the meter. A Secondary security code allows full read access with limited write access to perform an automatic demand reset and to access the Alternate and Test modes. A tertiary security code allows read-only access. For more information about security codes, refer to the PC-PRO+ documentation.

Firmware Upgrades

PC-PRO+ Advanced 7.2 and higher supports upgrading firmware for CENTRON meters. When the firmware is upgraded, all billing data in the meter is erased. After a meter's firmware is upgraded, you must re-initialize the meter.

You can determine which version of CENTRON meter firmware is installed on your PC by looking at Add/Remove Programs in the Control Panel (Start | Settings | Control Panel) and reading the Support Information for the CENTRON meter firmware. The firmware version is also displayed each time you begin a firmware upgrade while logged on to a CENTRON meter.



This feature is not available for meters that have been initialized (sealed) for Canadian installations. If a Canadian meter has not been sealed, the firmware can be upgraded.

Installing CENTRON Meter Firmware on the PC

You must install the CENTRON meter firmware on your computer to make it available to PC-PRO+ Advanced . You can obtain firmware upgrades through your Itron, Inc. Sales Representative. You can install only one version of CENTRON meter firmware on a computer.

For more information, refer to your PC-PRO+ Advanced online help files and the PC-PRO+ Advanced CENTRON Device User's Manual.

Power Procedures

Applying Power

Personality Modules are powered directly from line voltage via the board-to-board connector. These modules are energized when AC power is present. During power outages, the permanently installed lithium battery runs the clock circuit on C1ST and C1SL versions. The battery normally lasts for the life of the meter. However, in the unlikely event of a low battery notification, the battery or Register Module may need to be replaced.

Power Down Procedures

To de-energize all electronics, remove power from the meter.

A power outage is recognized any time the line voltage drops 20 percent below the lowest nominal point of the voltage range. When a power outage is recognized, the D/T/L Register saves all billing values to non-volatile Flash memory.

Battery Life (Load Profile & TOU)

The CENTRON meters with timekeeping functionality have a soldered battery present on their circuit boards. This battery powers the clock when AC power is interrupted to the meter. Upon restoration of AC power, all self-diagnostics are completed, and data is retrieved from non-volatile memory. The real time is retrieved from the real time clock. The elapsed time of the outage is also added to the stored value for the time spent on battery.

A very small amount of current is required to keep the real time clock running when the meter is not powered from the AC line. The clock is running from battery power (when not powered from the AC line) when the meter is programmed with the utility that requires clock or calendar functionality.



During programming, as an option using PC-PRO+ Advanced, the user can choose to enable/disable the clock. Disabling the clock will prevent battery carryover, however, all programming parameters will be set. Prior to meter installation, the clock must be set to activate time keeping functionality and features.

When the meter is powered from the beginning of life, the available battery capacity is 15 years of service life, with a carryover capacity of 10-12 years.

Low Battery Error

The firmware for each module monitors the voltage of the battery. Once the voltage of the battery drops below 3.6 V, an error message will be displayed. Alternatively, the Low Battery Error can be set to be ignored via programming software.

Three Button Reset

To return the meter to its original factory setting you must perform a three button reset.



*All programming of the meter will be lost when a factory reset is performed.
All security codes are also cleared.*

To perform a three button reset, follow these steps:

- 1 Activate the magnetic switch using a magnet position at the 9 o'clock point on the meter
- 2 Press and hold the Demand Reset button
- 3 Press and hold the Test Mode button
- 4 While continuing to hold all buttons, cycle the power on. You do not need to hold the buttons while turning the meter OFF, only while turning it ON.
- 5 Once complete, the meter may display "**3BReset**" or "**nordiSP**" and all segments will blink.

The original factory settings of the meter are restored.

RF Options

As an option the C12.19 D/T/L register can be ordered with R300CD/CD3 functionality. The R300CD/CD3 continuously transmits Standard Consumption Messages (SCM) and Interval Data Messaging (IDM) using radio frequency in the unlicensed frequency band which can be read by handheld, drive-by, or fixed network systems.

The table below describes the various versions of the RF option:

Option	SCM ERT Type	IDM ERT Type	Description
R300CD	04	N/A	Two ERT register without IDM
R300CD3	08	24	Three ERT register with IDM

The transmission frequencies, the frequency hopping pattern, and the time interval between transmission cycles are random in nature; thus providing a method for avoiding interference with transmission from other devices.

Each SCM message contains tamper information. Below is a chart that indicates the tamper information available in each SCM:

SCM #	Indicator #	Group
1	1	Meter Inversion
1	2	Meter Removal
2	1	Demand Reset (Push Button)
2	2	Low Battery or End of Billing Schedule (1 year from end of warning)
3	1	Billing Events
3	2	Non-Billing Warnings

- Tamper, Event, and Alarms Indicator Behavior: Two bits are used to log the above alarm, event, and tamper occurrence Groups.
- All Indicators are "Non-Latching", meaning the R300CD/CD3 board continues to increment for each and every alarm, event, or tamper occurrence each time they happen.

Event, Alarm, and Tamper Assignments for the CENTRON R300CD/CD3:

- For all Fatal Errors, the R300CD/CD3 module stops transmitting.
- For Non-Fatal Errors, transmission can be controlled via PC-PRO+ Advanced software.

Tamper/Event/Alarm	1 SCM	2 SCMs	3 SCMs
Meter Inversion (Tamper Circuitry)	SCM 1 - Indicator 1	SCM 1 - Indicator 1	SCM 1 - Indicator 1
Meter Removal (Tamper Circuitry)	SCM 1 - Indicator 2	SCM 1 - Indicator 2	SCM 1 - Indicator 2
Demand Reset (Push Button)	N/A	SCM 2 - Indicator 1	SCM 2 - Indicator 1
Low Battery	N/A	SCM 2 - Indicator 2	SCM 2 - Indicator 2
End of Billing Schedule (1 year from end)	N/A	SCM 2 - Indicator 2	SCM 2 - Indicator 2
Clear Billing Data	N/A	N/A	SCM 3 - Indicator 1
Energy Register Edit	N/A	N/A	SCM 3 - Indicator 1
Test Mode Entered	N/A	N/A	SCM 3 - Indicator 1
TOU Schedule	N/A	N/A	SCM 3 - Indicator 1
Mass Memory Error	N/A	N/A	SCM 3 - Indicator 1
Self Read Cleared	N/A	N/A	SCM 3 - Indicator 1
Meter Reconfigured	N/A	N/A	SCM 3 - Indicator 1
Energy Reconfigured	N/A	N/A	SCM 3 - Indicator 1
ANSI Security Fail	N/A	N/A	SCM 3 - Indicator 2
Reverse Power Flow	N/A	N/A	SCM 3 - Indicator 2
Loss of Phase	N/A	N/A	SCM 3 - Indicator 2

Using The PC-PRO+ Advanced programming software, a user can:

- Configure the quantity(s) to be transmitted.
- Select the type of registers to be transmitted.
- Select the number of digits for the data to be transmitted, as well as the number of decimal place digits for the data.
- Select the one of three date formats to be transmitted as ERT information.
- Enable TOU and select the TOU rate to be transmitted



When using Type 8 ERTs, the format for the KWh value should be 7.2 (XXXXXX.XX) and the format for the demand value should be 7.4 (XXX.XXXX).

Testing, Troubleshooting, and Maintenance

In This Chapter

Testing Support Features	68
Recommended Energy Testing Procedures	71
Field Testing	71
Troubleshooting	72
Inspecting and Troubleshooting—General	76
Inspecting and Troubleshooting—C1S LCD and C1SR.....	78

This section provides information and instructions to help you test and maintain the CENTRON meter. Topics covered include:

- Testing support features
- Energy testing
- Recommended testing procedures
- TOU schedule testing
- Field testing
- Troubleshooting (Fatal and Non-fatal errors)
- Maintenance

Testing Support Features

Infrared Test LED

The CENTRON meter is equipped with an Infrared Test Light Emitting Diode (LED) (① in the figure below) where each pulse represents a fixed value of watthour measurement. The LED is located on the top of the meter as the meter is viewed from a typical installation. The pulse weight represented by the LED pulses is 1.0 watthour per pulse (Kh=1.0).



Figure 34: Test LED Location

Pulse Detector

An optional pulse detector is available for the CENTRON meter. The pulse detector has an infrared pickup with two visible LEDs. When positioned over the CENTRON light pipe as shown in the figure below, it will produce a visible flash when an infrared pulse is received from the metrology. The right LED will flash once for each infrared Wh pulse while the left LED will flash once for every 10Wh infrared pulses received. The left LED on the pulse detector is helpful when heavier loads are present on the system being examined. This can be used to verify that the metrology is measuring energy when installed and to conduct timing tests to determine the amount of load on meter.



Figure 35: Pulse Detector

Annunciators

Watt hour Annunciators

The CENTRON meters equipped with LCDs, the watt disk emulator shows the direction of energy flow. The emulator will scroll left to right for positive (line to load) energy flow, and right to left for negative energy flow.

The C1S and C1SR are equipped with LCD displays that utilize a three square segment annunciator to show the direction of energy flow. The annunciator represents 1.0 watt hour each time it turns on and 1.0 watt hour each time it turns off. Once all three segments have turned on/off, the watt disk emulator produces a Kh of 6.0.

The C12.19 C1SD/T/L meters utilize a watt disk annunciator in which the Kh value of the single segments of the watt disk emulator is equivalent to the value of the Kh of the LED. As a result, a full revolution of the watt disk emulator produces a Kh of 6.0.

TOU Rate Annunciators

The CENTRON meter is equipped with five Time-of-Use annunciators on the LCD. Located on the right side of the display, the annunciator A, B, C, D, or t flashes when the applicable rate is active and is enabled to display their respective values. (Available on the C1ST and C1SL.)

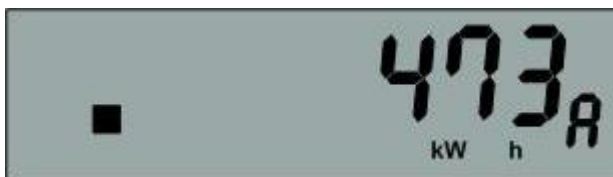


Figure 36: TOU Rate Annunciator

Test Mode Annunciator

The CENTRON meter is equipped with a Test Mode LCD annunciator located in the right portion of the display. This annunciator is enabled when Test Mode is activated. The word TEST appears on the display and flashes at a steady rate when test mode is activated. (Available on the C12.19 C1SD, C1ST, and C1SL.)

Testing with the Infrared Test LED

The CENTRON meter is equipped with an Infrared Test LED (Light Emitting Diode) which is located on the top of the meter at the 12 o'clock position.

The pulse weight represented by the LED pulses is always 1.0 watt-hour per pulse. Since the Kh value for the meter is 1.0, make sure the test board is programmed to accept this Kh value.

# OF PULSES REQUIRED ON TEST BOARDS			
	1S & 2S CL200	120V 3S, 240V 3S, 240V 4S	12S & 25S, 2S CL 320
Full Load	10	7	15
Light Load	10	6	7
Power Factor	10	7	12

1 pulse = 1 Watt-hour as compared to 1 pulse = 7.2 Watt-hours in Electromechanical meters.

To obtain test uncertainties of 0.01% (plus the uncertainties of the test equipment), use a minimum of 30 pulses. With a constant load applied (real or phantom), the LED pulses are compared to the output of a high accuracy watt-hour standard. This is accomplished using a compatible optical pickup and a comparator.

Follow these steps to test the Wh LED:

- 1 Apply a constant delivered watts load (Wapp) to the meter.
- 2 Verify that the LED pulses properly either by counting the pulses or using a comparator to compare the pulses from the meter under test to the standard.

To determine the number of pulses per second, use the following equation:

$$\text{Number of Pulses per sec} = \text{Wapp} \times \frac{1\text{hr}}{3600} \times 1\text{Kh}$$

Testing Using the Disk Emulation Annunciator

The CENTRON meter is capable of visually being tested by using the Watt Disk Emulation Annunciator.

Recommended Energy Testing Procedures

Testing solid-state meters on test boards that were designed primarily for electromechanical meters may give unexpected results. Erroneous readings have been known to occur on “light load” tests when the test sequence calls for said light load test to follow immediately after the full load test. The problem is caused by improper “jogging” and can be avoided by sequencing the test in order of applied power such that the lowest power is tested first. This problem does not exist on modern test boards with the latest test software.

AEP Test Codes

The table below shows the AEP Test Codes.

Meter Specification	Code
CL100 120V 2W 1 Phase Type C1S 15TA 1.0Kh FM1S 60Hz	2B
CL200 240V 3W 1 Phase Type C1S 30TA 1.0Kh FM2S 60Hz	1N
CL320 240V 3W 1 Phase Type C1S 50TA 1.0Kh FM2S 60Hz	2J
CL20 240V 2W 1 Phase Type C1S 2.5TA 1.0Kh FM3S 60Hz	2F
CL20 120V 2W 1 Phase Type C1S 2.5TA 1.0Kh FM3S 60Hz	2E
CL20 240V 3W 1 Phase Type C1S 2.5TA 1.0Kh FM4S 60Hz	2G
CL200 120V 3W 2 Phase Type CN1S 30TA 1.0Kh FM12S 60Hz	2H
CL200 120V 3W 2 Phase Type CN1S 30TA 1.0Kh FM25S 60Hz	2I

Field Testing

Field testing of the CENTRON meter may be accomplished with conventional methods using either the infrared test pulses or the load emulation annunciator.

Required Hardware

The typical field test setup consists of a phantom load, portable standard, and an infrared test pulse adapter with a counter or snap switch assembly. CENTRON meters purchased without a test link will require a more sophisticated loading circuit.

Test Method Using a Snap Switch Assembly

To conduct the test, the technician observes the position of the load emulation annunciator and simultaneously starts the standard through the snap switch. After observing a predetermined number of emulated disk rotations, the technician stops the standard with the snap switch. A comparison is then made between the predetermined number of emulated disk rotations and equivalent disk rotations indicated on the watt-hour standard.

Troubleshooting

Fatal Errors

The CENTRON meter will check for fatal errors:

- when a meter reconfigure is performed.
- when power is initially energized and upon future power restoration.
- while performing key operations.

Error Codes (C1SR)

Cause	Effect	Indication
Unsuccessful writing to or reading from EEPROM memory.	All metering and RF functions are halted. Return the module to the factory for repair.	The LCD will display the word Error in the area normally used for energy accumulation.
Metrology error.	All metering and RF functions are halted. Return the meter and module to the factory for repair.	The LCD will display the word Error in the area normally used for energy accumulation.

Error Codes (C12.19 C1SD/T/L)

Fatal errors cause the display to lock on the error code because of the possibility that billing data may have been corrupted or that the meter may not be operating correctly. If multiple fatal errors occur, the one with the lowest number will be the error code that locks on the display.

The different fatal errors should be handled as described in the table below. Fatal errors can only be cleared by performing a Factory Reset on the meter. A Factory Reset will wipe out all information in the meter, so be sure to try to retrieve any meaningful data from the meter prior to performing the Factory Reset. The meter must be reprogrammed after a Factory Reset has been performed.

Fatal Errors			
Error Code	Error	Possible Cause	Error Description
^{FAt} Error1	MCU FLASH Error	The meter has detected a problem with the program memory.	If this error occurs, Factory Reset the meter, reprogram the meter and check for proper operation. If the error continues to exist, return the meter for repair.
^{FAt} Error2	RAM Error	The meter has detected a problem with the RAM.	If the meter detects this problem, return the meter for repair.
^{FAt} Error3	DATA FLASH Error	The meter has detected a problem with the data flash (non-volatile memory).	If this error occurs, Factory Reset the meter, reprogram the meter and check for proper operation. If the error continues to exist, return the meter for repair.
^{FAt} Error4	Front End Processor Error	A problem has occurred with the metrology portion of the meter.	If the meter detects this problem, return the meter for repair.
^{FAt} Error5	Power Down Error	A problem has occurred while saving billing data at time of a power outage.	The billing data has been corrupted. Factory Reset the meter, reprogram the meter and check for proper operation, including several power cycles. If the error continues to exist, return the meter for repair.
^{FAt} Error6	File System Error	The meter has detected a problem with the file system.	If the meter detects this problem, return the meter for repair.
^{FAt} Error7	Operating System Error	The meter has detected a problem with the operating system.	If the meter detects this problem, return the meter for repair.

Non-Fatal Errors

Non-fatal errors can be programmed to scroll during the one second display off-time or lock on the meter display. If multiple non-fatal errors occur, the meter will display a combined error message. For example, if a Low Battery error and a Time of Use error exist, the error display will read Err 1-3---. In this case, if one of the errors had been programmed to lock, and the other error had been programmed to scroll, the display will lock on the combined error message.

Selecting a display mode by holding the magnet near the cover’s magnet icon at the nine o’clock position allows that display mode sequence to scroll one time during a locked non-fatal error. At the end of the display sequence, the error message locks onto the display again.



For non-fatal errors, transmission can be controlled via PC-PRO+ Advanced software.

Non-Fatal Errors			
Error Code	Error	Possible Cause(s)	Error Description
Err 1-----	Low Battery Error	Battery Voltage Low. Battery Not Connected Properly.	A low battery check is performed once a day and upon a set clock procedure. A low battery continues to function; however, its reliability decreases over time. As long as the meter is not powered down with a dead or missing battery, the meter will continue to function as normal. If the meter is powered down with a dead or missing battery, then, when power is restored, the meter's clock will be off by the duration of the outage, and Load Profile and TOU will be halted.
Err --3---	Time-of-Use (TOU) Error	<ul style="list-style-type: none"> • Current Season is not programmed. • Current Year is not programmed. • TOU halted due to power down with dead or missing battery. 	This is tested at power-up, at midnight crossings, at season changes, upon reconfigures and upon set clocks. Depending on the cause of the error, it can be cleared with a corrective reconfigure or with a set clock with a good battery present.

Non-Fatal Errors			
Error Code	Error	Possible Cause(s)	Error Description
Err ---4--	Reverse Power Flow Error	The configured reverse power threshold has been reached.	Reverse power is tested every second and an accumulator for it is maintained. If power is delivered during the second, then the accumulator is cleared. If power is received during the second, then the accumulator is incremented. If the accumulator reaches the configured reverse power threshold, then the error is triggered. A Demand Reset will clear this error.
Err ----5-	Clock/Load Profile Error	Load Profile halted due to power down with dead or missing battery.	This is tested upon power-up. A set clock with a good battery present will clear this error. Be sure to read the Load Profile data prior to setting the clock to clear the error. The dead battery will cause some invalid intervals at the end of the data. When the error is cleared, Load Profile will be restarted from the beginning to purge the bad data.
Err ----6	Full Scale Overflow Error	The calculated W delivered demand at an EOI exceeded the configured full scale value.	This is tested at a demand EOI. The maximum demand register continues to accumulate and W delivered is still correctly displayed. When a demand reset is performed, the correct maximum W delivered will be added to the cumulative register. A Demand Reset will clear this error. If a full scale overflow occurs, check the installation to ensure that the current capacity of the meter has not been exceeded. A full scale overflow error in no way affects the existing billing data.

Inspecting and Troubleshooting—General

Due to the modular architecture of the CENTRON meter, modules of similar voltage (120V or 240V) may be interchanged. Therefore, the personality module of the CENTRON you are troubleshooting can be placed on a known working base to verify proper operation of the personality module. Likewise, a known working personality module may be placed on the base of a meter to verify proper operation of the meter.

This section provides a list of the most likely problems that you may encounter, along with possible causes and solutions.

Blank Display

Cause	Solution
Power not applied to the meter	Apply power.
Loose power supply connection	Remove and re-seat board to board connector.
LCD/LCD Driver failure	Replace Register circuit board. Note: Energy reading and tamper flags may be uploaded with the ZRO-C2A.

Time and Date Wrong (TOU Version)

- *Time/Date Wrong in PC or Handheld Device*—Verify and update time/date in programming device and download new time and date to meter. Refer to the appropriate software manual for more detailed directions.
- *Wrong Line Frequency*—Verify proper line frequency is selected in setup routine in programming software. Select proper frequency and reconfigure meter.
- *Battery Failure During Power Outage*—Verify battery voltage. Replace module.
- *Daylight Savings Time Not Programmed Correctly*—Verify DST is selected in program. Reconfigure meter with correct program.
- *Component Failure*—Return meter for repair.

No Accumulation of kWh or kW

Cause	Solution
Demand Delay Selected	kW will not immediately accumulate after a power outage if CLPU (Demand Delay) has been selected. Accumulation will begin immediately after Demand Delay has expired. Verify register program and reconfigure meter.
Module was left in Test mode	Accumulation of kW or kWh will not take place while register is in Test mode. Exit Test mode and verify proper accumulation begins.
Module Not Receiving Pulses	Verify that meter is accumulating energy by testing infrared test LED.

Cause	Solution
Time-of-Use Schedule programmed incorrectly	Verify TOU schedule contains continuous 24-hour periods for all weekdays, weekends, or holidays. All 24-hour periods throughout every year must be accounted for within the TOU schedule.
Component Failure	Replace module.

Software Cannot Communicate with Module

Cause	Solution
Optical Probe Cable Assembly Failure	Check cable with known register that communicates. Check cable against known cable that is functioning. Also check batteries in cable assembly.
COM Port in PC is Set Wrong	Verify proper COM Port number has been selected in the programming software. If the wrong COM Port is selected, communications will not occur.
Security code in Module	If security codes have been downloaded to the register, the programming device must have the proper code to make connection to the module. Verify security codes in the programming software.
Probe Not Connected Properly	Verify Optical Probe lines up properly over the optical connector. Re-install cover for proper alignment. Verify PC or handheld and cable are securely connected and attached to the correct Com Port.
Optical Connector Failure	Replace cover assembly.
Electronics Failure	Replace module.
Incorrect Baud Rate	Optical port can be programmed to operate at 4800 or 9600 baud. Factory default baud rate is 4800. For C12.19 D/T/L, the optical port operates at 9600, 14400, 19200, or 28800 baud. The factory default is 9600 baud.

Reed Switch Does Not Activate the Alternate Mode

Cause	Solution
Magnetic Field is too Weak	Place magnet closer to switch or use stronger magnet.
Reed Switch Failure	Replace module.
Alternate Mode Items Not Selected	Re-program meter with items to be displayed in Alternate mode.

Reset Mechanism Does Not Initiate Demand Reset

- *Reset Has Occurred Within Last Programmable Time Period*—Manual demand reset cannot occur within 60 seconds of the previous demand reset. Wait 60 seconds before trying again.
- *Reset Switch Disabled*—Reset switch may be disabled through software.
- *Register Board not Properly Installed in Upper Housing*—Verify that the Register board is fully engaged with the upper inner cover.

Demand Reset Cannot Be Initiated Through PC or Handheld

- Insufficient security.
- Communication cannot be established. See Programmer Cannot Communicate with Meter.

Test Mode Switch Does Not Place Meter in Test Mode

- *No display items in Test Mode Display List.*
- *Switch deactivated by software*—Activate switch in software and reprogram meter.
- *Register Board not Properly Installed in Upper Housing*—Verify that the Register board is fully engaged with the inner cover.
- *Switch or Electronic Failure*—Return meter for repair.

Inspecting and Troubleshooting—C1S LCD and C1SR

Blank Display

- *Power Not Applied to Meter*—Apply voltage to the meter.
- *Voltage Too Low for Meter Startup*—the CENTRON meter requires at least 20% of nominal voltage to start up.
- *Component Failure*—Return the meter for repair.
- *Board-to-Board Connector Not Seated*—Verify proper connection of board-to-board connector.

CHAPTER 9

Specifications and Drawings

In This Chapter

Specifications.....	79
Drawings.....	79

Specifications

For a complete list of the latest CENTRON meter specification numbers, refer to the *CENTRON Meter Specification Numbers Bulletin*, Part Number 428601-220.

Drawings

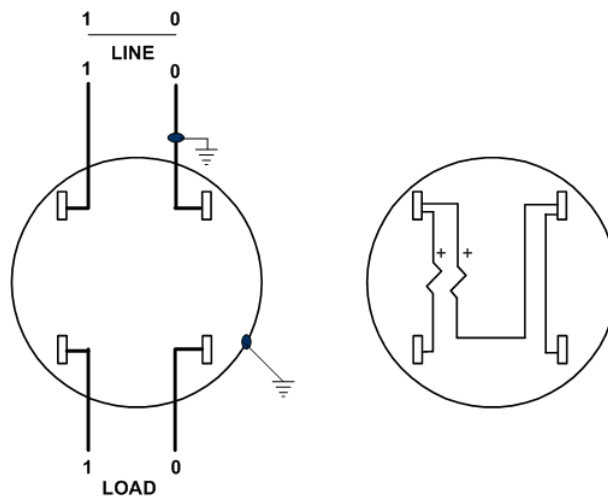


Figure 37: Form 1S Wiring Diagram

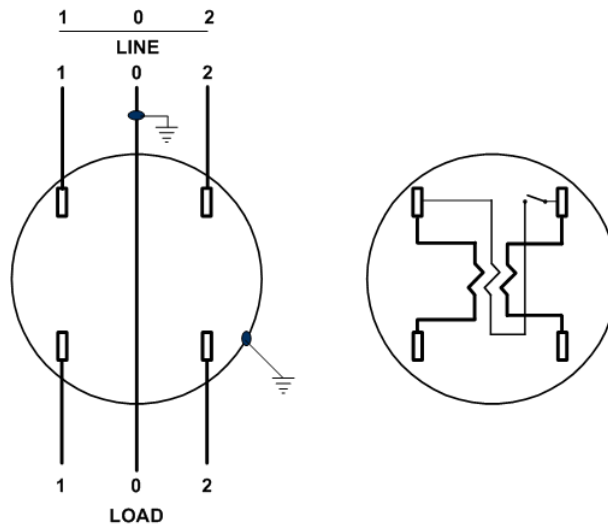


Figure 38: Form 2S Wiring Diagram

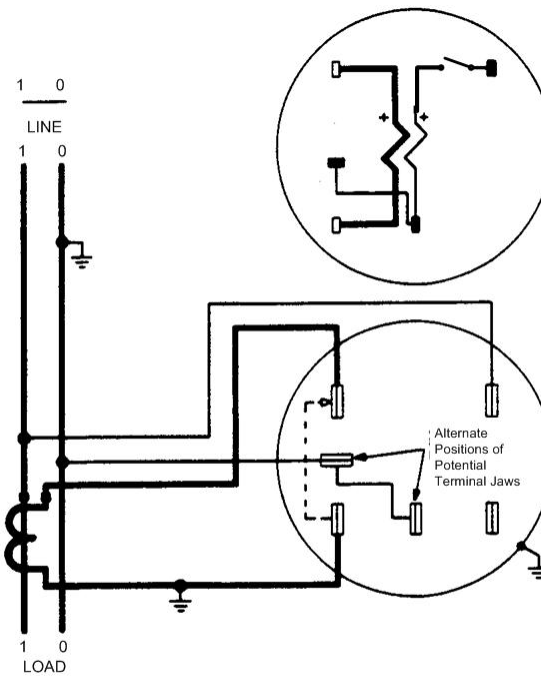


Figure 39: Form 3S 120V Wiring Diagram

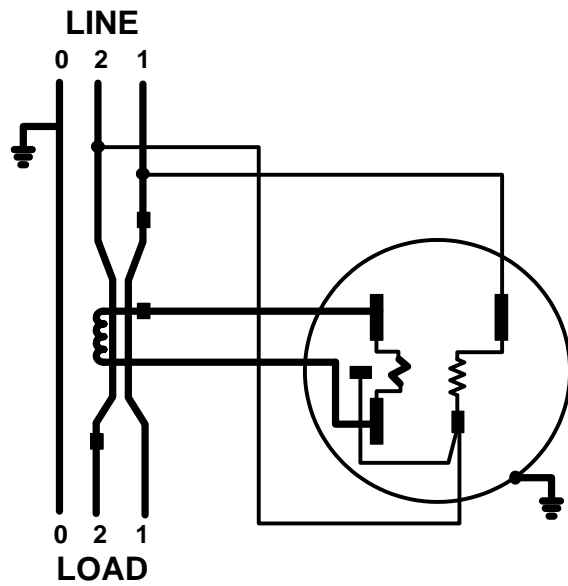


Figure 40: Form 3S 240V Wiring Diagram

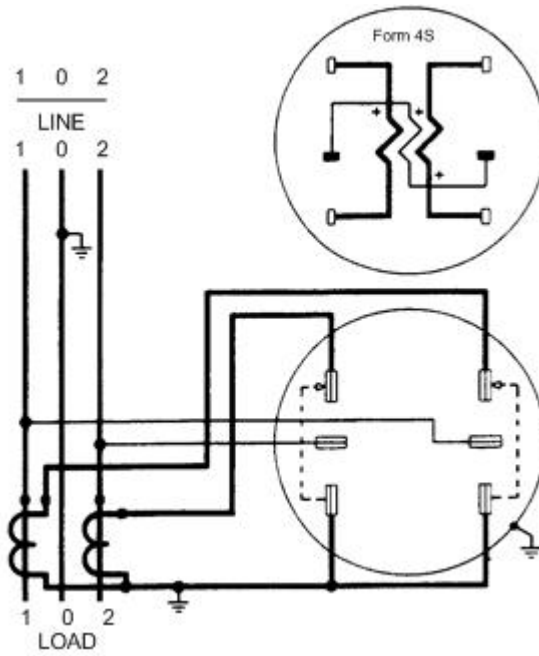


Figure 41: Form 4S Wiring Diagram

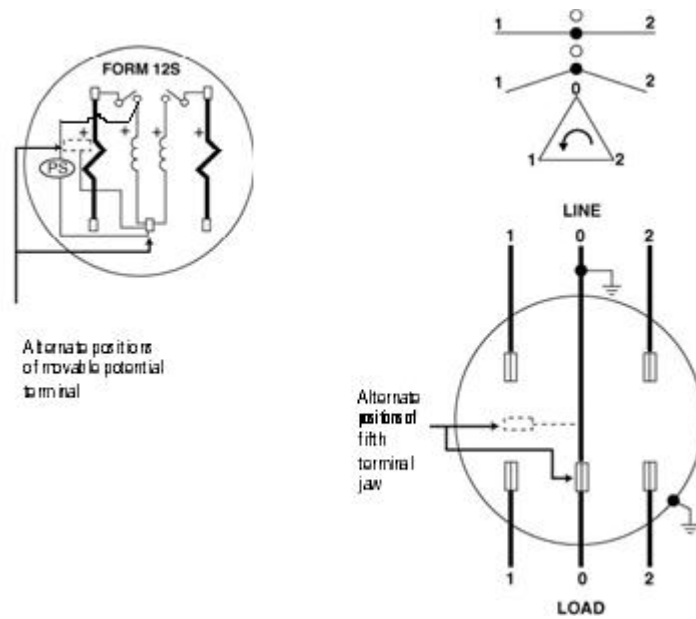


Figure 42: Form 12S Wiring Diagram

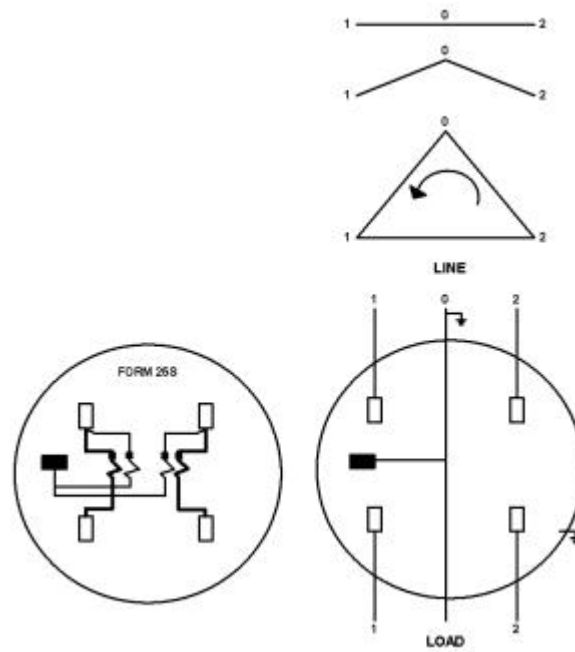


Figure 43: Form 25S Wiring Diagram

Glossary of Terms

Alternate Mode

One of the four modes of register operation used to display quantities that are not needed on a regular basis, for example Kh.

Annunciator

A Liquid Crystal Display (LCD) label that is displayed to identify a particular quantity being displayed.

EEPROM

Electrically Erasable Programmable Read Only Memory (EEPROM) is a memory chip that can only be erased by an electrical signal (retains data during a power outage).

Battery Carryover

The amount of time that the register is energized by the battery to maintain the accuracy of the clock within the microprocessor. All program and billing data are transferred to non-volatile memory when battery carryover operation is activated.

Baud

Unit of data transmission signalling speed, roughly analogous to bits per second (bps).

Block Interval Demand

Demand based on intervals from 1 to 60 minutes in length.

Calendar Schedule

Schedule that determines seasonal changes, Daylight Saving Time (DST) changes, holidays, daily switch points, etc.

Coincident Demand

The energy accumulated in an interval where a second trigger energy attained a peak. For example, Var demand when Watt demand attained a peak.

Cold Load Pickup (CLPU)

See Demand Delay.

Continuous Cumulative Demand

The sum of the previous billing period maximum demands and the present period maximum demand.

CT Ratio

The current transformer ratio to use for viewing current (amperage) quantities for this service point.

Cumulative Demand

The sum of the maximum demand values at each demand reset since the cumulative register was cleared. It is updated at each demand reset by adding the maximum demand register to the cumulative register.

Current Season

The season that defines the present rate schedule.

Daylight Saving Time (DST)

Daylight Saving Time (DST) begins for most of the United States at 2:00 a.m. on the first Sunday of April. Time reverts to standard time at 2:00 a.m. on the last Sunday of October. In the U.S., each time zone switches at a different time.

Beginning in 2007, DST will begin on the second Sunday of March and end the first Sunday of November. The Secretary of Energy will report the impact of this change to Congress. Congress retains the right to revert the Daylight Saving Time back to the 2005 time schedule once the Department of Energy study is complete.

Demand

The average value of power over a specified interval of time. Demand is expressed in kilowatts, kilovoltamperes, kilovars, or other suitable units. An interval may be 1, 5, 10, 15, 30, or 60 minutes.

Demand Delay

Cold Load Pickup (CLPU). The programmable amount of time required before demand calculations are restarted after a power outage.

Demand Interval

The specified time over which demand is calculated.

Demand Reset

When all the current maximum demands are set to zero.

Demand Subinterval

The smaller blocks of time that are used in rolling demand calculations.

Demand Threshold

A programmed value that, when exceeded by calculated demand, initiates a contact closure, a write to a log, or a phone home event.

Display (LCD)

Provides a visual indication of the data accumulated by the register.

Electronic Detent

Programming electronic detent prevents received energy from accumulating in the delivered energy register. When detent is enabled, the received energy is accumulated in a separate register.

Error Codes

Monitor operation of the meter. Error codes are available for display in Normal, Alternate, and Test display modes.

Event Log

Log used to record historical events that occur in the meter. The events that can be logged must be configured via the PC-PRO+ Advanced programming software.

Firmware

The computer program stored in a read-only memory (ROM) or an erasable programmable read-only memory (EPROM) integrated circuit.

Flash Memory

A type of EEPROM chip used for easy and fast information storage. It is a solid-state storing device.

IDM

The Interval Data Message (IDM) contains consumption data for timed intervals that can be used for calculation of demand and time-of-use billing.

Last Season

The season immediately preceding the current season.

LCD

A solid-state Liquid Crystal Display (LCD) is used to show power consumed as well as other metering information.

LED

A Light-Emitting Diode (LED) is used to signal the occurrence of an event or the presence of a pulse.

Load Profile

The functionality of a meter to accumulate pulses in proportion to accumulated energy in programmed intervals. Often referred to as Mass Memory.

Magnetic Switch

A solid-state or mechanical switch which is closed by an external magnetic field.

Maximum Demand

The largest demand calculated during any interval over a billing period. The Maximum Demand quantity displayed in Test Mode is that value calculated over the test interval only (this can differ from the Normal Mode demand interval).

Mode Timeout

The amount of time the meter will remain in Scroll Lock, Alternate Mode, Test Mode, Test Alternate Mode, or Toolbox Mode before automatically returning to Normal Mode. This time is programmable.

Non-volatile Memory

See Flash Memory.

Normal Mode

One of the four operating modes of the meter. It includes all routine meter operations.

Optical port

Optical interface located on the face of the meter. The meter can be programmed and communicated with through the optical port.

Register Multiplier

A programmable value which is used in calculations of displayed energy and demand readings. This can be used by setting the register multiplier equal to the CT ratio times the PT ratio of the installation.

Rolling Interval Demand

A calculation of maximum demand derived from the moving average of the smaller consecutive subintervals.

RS-232/RS-485

Accepted industry standards for serial communications connections. This Recommended Standard (RS) defines the specific lines and signal characteristics used by serial communications controllers to standardize the transmission of serial data between devices.

SCM

The 96-bit Itron® Standard Consumption Message protocol (SCM) provides the energy (kWh) consumption, module ID number, tamper indications, meter type, and error checking information in each radio frequency transmission. Within the 96-bit SCM, 26 bits are allocated to the module ID number for meter identification (also referred to as ERT ID number).

Season

A programmable amount of time that a rate schedule is in effect. Season start dates are programmed in the format MM/DD (Month/Day).

Self-reading Registers

Register data that is captured in the meter at a programmed interval of time and is stored in non-volatile memory.

Sliding Window Demand

See Rolling Interval Demand

Test Mode

One of the four modes of register operation. It allows testing of the register without altering billing data.

Time-of-Use (TOU)

A metering method which records demand during selected periods of time so consumption during different time periods can be billed at different rates.

VT Ratio

The voltage transformer ratio to use for viewing voltage quantities for a service point.

Electronic Detent

Programming electronic detent prevents received energy from accumulating in the delivered energy register. When detent is enabled, the received energy is accumulated in a separate register.

Notes:

Index

A

ADC • 17, 19
AEP barcode • 36
AEP test codes • 71
alternate display mode • 44
Alternate mode annunciator • 45
analog to digital converter (ADC) • 17
annunciator
 Alternate mode • 45
 disk emulator • 71
 EOI • 45
 kWh • 45
 Test • 45
 test mode • 45
antenna
 RF • 36
Application Specific Integrated Circuit (ASIC) • 17
ASIC • 17
automatic demand reset • 53
automatic meter reading (AMR) • 28

B

barcode
 AEP • 36
 LAN address • 36
base metrology • 17
battery • 62, 83
 life • 63
baud • 47
Binary Phase Shift Keyed (BPSK) modulation • 36
blank display • 76
block demand • 52
block interval • 49
BPSK • 36
button
 test mode • 45

C

calendar schedule • 55
calibration • 17
Cellnet RF technology
 C1SC • 35
Cellnet Shooter • 38
CENTRON developer's kit • 17
communication
 optical port • 42
communication problem • 77
comparator • 70

controls and indicators • 43
cover • 63
CRC • 35
current interval demand • 45
current season register • 56
Cyclic Redundancy Checks (CRC) • 35

D

daily schedule • 55
demand calculation • 49
demand reset • 52
 automatic • 53
demand reset button • 42, 63
demand reset switch • 52
detent register • 22
disk emulation annunciator • 71
display modes • 44

E

electronic load indicator • 45
energy testing • 67
EOI annunciator • 45
ERT Type 7 message • 28

F

factory programming • 22
fatal errors • 67
FCC Compliance • iii
field testing • 67
forward energy flow • 22, 42
forward kWh • 42

G

general meter troubleshooting • 76

H

Hall Effect
 principle • 17

I

IDM Type 24 message • 28
Interval Data Message (IDM) • 28

K

kWh annunciator • 45

L

LAN address barcode • 36
LAN Address ID • 35
last season register • 56
LCD
 CISC • 37
LCD display • 42
LCD module • 22
LED • 84
LED pulses • 70
liquid crystal display
 See also LCD • 45
load profile • 28, 63
load profile data • 57
load profile module • 41
Load Profile register • 58

M

magnetic switch • 45, 63, 77
mass memory • 57, 59
maximum demand • 45
meter architecture • 17
meter cover • 63
metrology base • 41
module
 LCD • 22
 load profile • 41
 register • 62

N

net register • 22
non-fatal errors • 67
non-volatile memory • 42, 45, 53
normal display mode • 44

O

operating environment • 6
operating temperature range
 CISC • 37
optical pickup • 70
optical port • 42, 47, 52
optical port adapter • 42

P

personality module • 45, 76
 CISD • 41
 CISL • 41, 54, 57
 CIST • 41, 54
 load profile • 63
 power • 62
 TOU • 63
power outage • 54
primary security code • 61
protocol

SCS • 41
pulse weight • 58
pulse weight calculation • 58

R

rate • 55
rate schedule • 55
recycling • iv
register
 current season • 56
 Load Profile • 58
register module • 62
repair • iv
reverse energy flow • 22, 42
reverse kWh • 42
RF antenna • 36
rolling demand • 52
rolling interval • 49

S

schedule
 calendar • 55
 daily • 55
 rate • 55
 seasonal • 55
SCM message • 31
SCS protocol • 41
Season Change date • 55
seasonal schedule • 55
secondary security code • 61
security code
 primary • 61
 secondary • 61
 tertiary • 61
self-read • 42, 52, 53
Shooter device • 38
specifications
 operating environment • 6
Standard Consumption Message (SCM) • 28
support features • 67
switch
 demand reset • 52
 test mode • 45

T

tertiary security code • 61
Test annunciator • 45
test codes
 AEP • 71
test display mode • 45
Test LED • 17
Test Mode • 70
test mode annunciator • 45, 70
test mode button • 45, 63
test mode switch • 45

testing

- energy • 67
- field • 67
- support features • 67
- TOU schedule • 67

three button reset • 63

time blocks • 54

Time-of-Use (TOU)

- See also TOU • 41

TOU • 54, 63, 70

TOU annunciator • 70

TOU rate indicators • 45

TOU schedule testing • 67

troubleshooting

- blank display • 76
- communication problem • 77
- general meter • 76
- magnetic switch • 77
- no accumulation • 76

U

utility billing ID • 35

W

watt disk emulator • 37, 45

Notes: