TWACS® BY DCSI

UNIVERSAL METERING TRANSPONDER FOR kV2c METER USER GUIDE

Y10577-TUM REV C

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1

INTRODUCTION

This chapter contains general information about this manual, important safety warnings to observe when using this product, contact information to receive support, and an overview of the TWACS system.

Safety Warnings and Symbols

DANGER

Electrical equipment contains hazardous voltages. May cause death, serious personal injury or equipment damage.

Always de-energize and ground the equipment before maintenance. Maintenance should be performed only by qualified personnel. The use of unauthorized parts in the repair of the equipment or tampering by unqualified personnel will result in dangerous conditions which will cause severe personal injury or equipment damage. Follow all safety instructions contained herein.

IMPORTANT

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

QUALIFIED PERSON

For the purpose of this manual a qualified person is one who is familiar with the installation, configuration, or operation of the equipment and the hazards involved. In addition, the person has the following qualifications and **is trained**:

a) **and authorized** to de-energize, clear, ground, and tag circuits and equipment in accordance with established safety procedures.
b) in the proper care and use of protective equipment such as rubber gloves, hard hat, safety glasses or face shields, flash clothing, etc. in accordance with established safety practices.
c) in rendering first aid.

The following symbols are used in this manual.

Symbols and Warnings	
	WARNING: Indicate a risk of injury, possible death, and equipment damage.
	WARNING: Indicates a risk of electric shock, causing possible injury, death, and equipment damage.

Support

The TWACS Portal (https://portal.twacs.com/) provides a wide range of information that can serve as a starting point when you have a question. The Portal contains information such as:

- User Guides
- Service Advisories
- Training Registration
- Certified Partner Information
- Current News
- FAQs
- Customer Discussion Threads
- Upcoming Events
- User Group Conference Information
- *The Power Line* Newsletter

If, at any time, you would like to speak with a DCSI representative about any product or service or if you do not have a username and password to access the Portal, please contact DCSI Customer Care:

Email: care@twacs.com

Phone: 1-800-892-9008

Address: Distribution Control Systems, Inc.
945 Hornet Drive
Hazelwood, MO 63042
USA

Product Returns

IMPORTANT Before returning product to DCSI, make sure you have identified the root cause of the problem. As needed, perform troubleshooting requesting Technical Support through DCSI Customer Care when additional assistance is required. It is critical to identify the root problem to avoid shipping hardware for repairs when the problem lies elsewhere.

To return DCSI products for repair, complete the Service & Repair RMA Request through the TWACS Portal (https://portal.twacs.com), providing as much detail about the problem as possible. If you have any questions regarding your return, please contact rma@twacs.com or call 1-800-892-9008 and choose the Service and Repair option.

Related Documentation

The following publications are referenced in this manual. The documents listed below plus the latest version of all other DCSI technical publications are available through the TWACS Portal (https://portal.twacs.com/).

Meter Shop Test System Help

Provides all the necessary details required for testing TWACS-enabled devices with the Meter Shop Test Tool software. Access the Help through the Meter Shop Test Tool software interface. The Help is not available through the TWACS Portal.

Meter Shop Test System Set-Up Guide (Y10030TM)

Provides information that enables you to test TWACS-enabled devices for TWACS signaling response, read select transponder registers, zero select transponder registers, and perform various other transponder functions.

Portable RCE Test Unit Technical Manual (Y103127-3TM)

Ships with the Portable RCE Test Unit. Includes detailed product specifications and operating instructions.

TNS End User Guide (Y10285TM)

Serves as a companion manual to the TNS Operational Process Guide. While the TNS Operational Process Guide provides high-level process and procedure recommendations for obtaining optimum results from your TWACS system, the TNS End User Guide provides the detailed procedures, and form field and application definitions, that enable you to perform the functions found in the process manual.

TNS Operational Process Guide (Y10352TM)

Presents high-level procedures and processes for operating your TWACS system, through the TNS interface. These processes and procedures span a number of application sets, and are organized around functions such as reading meters, substation setup, and operating TNS.

Transponder Type and Model Matrix (Y10598-TEB)

Provides a listing of transponders, transponder types, and applicable meter models.

TWACS® Network Gateway Operational Process Guide (Y10433-TUM-NGT)

Includes procedures and processes for operating your TWACS system through the TWACS® NG interface. The information spans a number of application sets, and are organized around functions such as reading meters, substation setup, and operating TWACS NG.

TWACS® NG System Help

Built into the TWACS® NG interface, topic and index-searchable online system help is available. Access the Help through the software interface. The Help is not available through the TWACS Portal.

TWACS® - ORION® for UMT Products User Guide (Y20100-TUM)

Provides a brief overview of the TWACS-ORION system, explains how the TWACS-ORION system interfaces with the TWACS system, and describes the functions of the EMTR-3, HHTR-3, and ORION transmitter.

UMT-C-KV Field Installation Instructions (Y73111-3)

Presents field installation diagrams for all meter forms supported by the transponder.

Let Us Know How We're Doing

In an ongoing effort to produce effective documentation, the Technical Publications department at DCSI welcomes any feedback you can offer regarding this manual.

Please relay feedback, including suggestions for improvement or to alert us to corrections, by sending an email to **techpubs@twacs.com** or calling Customer Care at 1-800-892-9008.

TWACS System Overview

The TWACS system is a fixed network, utility communication system. Running at a centralized location, the TWACS operating software communicates with end points, such as meters, by way of existing power lines. The TWACS system allows full two-way access to and from the consumer's meter, providing communication and control features for the Utility.

The TWACS system consists of three levels of components (see *Figure 1.1*):

- Master Station (MS)

  The Master Station TWACS operating software, either TWACS Net Server (TNS) or TWACS® Network Gateway (TWACS NG), is the chief component of the entire Two-Way Automatic Communication System (TWACS). The Master Station software manages all collected metering and interval data as well as the connection between the utility and the consumer's premises. TNS is DCSI's standard solution while TWACS NG is available for very large deployments requiring a high volume of readings for time-of-use or critical peak pricing programs.

  The primary functions of TNS and TWACS NG are:

  - Managing the TWACS system communication network.
  - Supporting applications such as metering, troubleshooting, outage detection, and load control.
  - Collecting remote meter data for the database server, which forwards the data to a third-party utility software application.

  TNS and TWACS NG are part of the corporate enterprise network. The system is based on the Oracle® database, which is an open system, meaning it can interact and inter-operate with other applications on local and remote systems, on a variety of hardware platforms, and in a number of software environments. The system provides the user interfaces for configuring the necessary parameters to retrieve and send data.

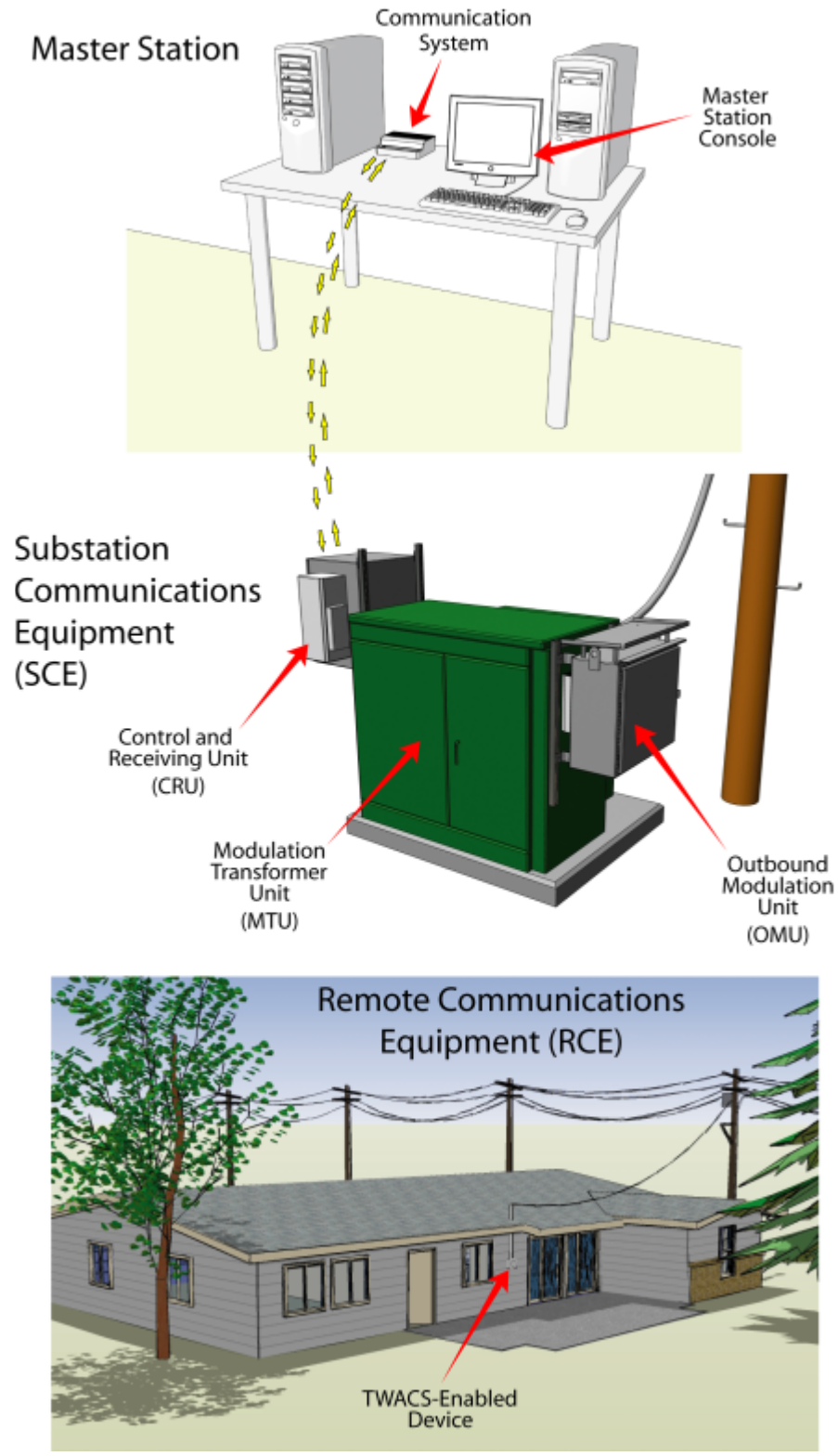
- Substation Communications Equipment (SCE)

- Remote Communications Equipment (RCE)

  This is the level at which the meter transponder resides within the electric meter.

As shown in *Figure 1.1*, outbound messages originate in the Master Station and pass through the substation to the transponder (RCE). Inbound meter data is sent from the transponder to the SCE, where it is decoded and then sent to the Master Station for analysis or bill file creation.

Figure 1.1 TWACS system



CHAPTER

2

FUNCTIONAL DESCRIPTION

This chapter provides an overview of the TWACS® system, explains how the Universal Metering Transponder for the GE kV2c meter (UMT-C-KV MP) interfaces with the TWACS system, and describes the functions of the transponder. This user guide provides feature and functionality information for Firmware version 2.00. Enhancements since version 1.20 include, but are not limited to:

- Addition of EMTR-3-KV interface (multiport)
- New module type number - 101

The kV2c meter may hereafter be referred to as kV2c, kV2c meter, or meter. UMT, UMT-C-KV, transponder, and module refer to the DCSI UMT-C-KV MP.

Time Synchronization

The Master Station is synchronized to an official US reference atomic time clock. The Master Station sets the time in each of the SCEs, and the SCE broadcasts the time to all the RCEs. TWACS communication introduces a fixed time difference (offset) between the Master Station clock and the RCE master clock.

In addition, a free running Real-Time-Clock (RTC) is provided in the UMT-C-KV as an alternate time base for maintaining the time when the RCE experiences a power down or an interruption. The RTC maintains the RCE time (during an outage) for a period of no less than 24 hours. This RTC is a Secondary Time Base for the RCE and is accurate to within 17.5 seconds per day. The RCE uses the RTC time for time-stamping an event when the power is restored. It also maintains all timing functions until the RCE is again in time sync with the SCE transmitted time sync signal. Each time the RCE hears the time sync broadcast, it compares its master clock time with the SCE time. If the offset between SCE time and the master clock time does not exceed the threshold limits (± 15 seconds), they are considered to be operating in synchronization.

The UMT-C-KV internal Serial Date and Serial Time registers are volatile and are initialized at power-up. The UMT-C-KV updates its Serial Date & Time registers when it receives the Set RCE Date/Time command. The Set RCE Date/Time command, normally sent every fifteen minutes from the CCE to the SCE, synchronizes the SCE clock to the CCE clock. To update serial date and time, the SCE sends the Set Date/Time command automatically to the UMT-C-KV.

Certain UMT-C-KV functions are not performed if the Serial Time is invalid. TWACS uses Serial Time Units (STU) as measures of time. Each STU equals 2.5 seconds, with midnight equal to zero.

Daylight Saving Time

The UMT-C-KV does not support the bi-annual Daylight Saving Time (DST) change as a scheduled routine. However, when the Master Station transmits a time sync command after the DST change has occurred, the RCE recognizes an offset exceeding the threshold limits (offset of one hour ± 15 seconds versus the 15 second threshold). The RCE master clock time is updated automatically. Whenever the RCE master clock time is corrected to implement daylight saving time, one hour of data is lost on the 23 and 25 hour days, and the corresponding hour bins are marked as invalid.

Instructions for updating your TNS system for the Daylight Saving time adjustment are in the *TNS Operational Process Guide*.

Universal Metering Transponder (UMT-C-KV)

The Universal Metering Transponder (UMT-C-KV) is a remote power-line communication transponder contained within and interfaced to a kV2c meter. The UMT-C-KV integrates a single or polyphase meter with TWACS. The UMT-C-KV can be integrated with kV2c meters of various forms and classes. See *Table 2.8* on page 30.

AC power enters the kV2c meter from the Utility supply. The UMT-C-KV receives operating DC power from the kV2c meter and communicates with the meter through a multiconductor ribbon cable. Communication between the UMT-C-KV and the utility company is provided by TWACS across the Utility power lines.

Figure 2.1 UMT-C-KV module assembly

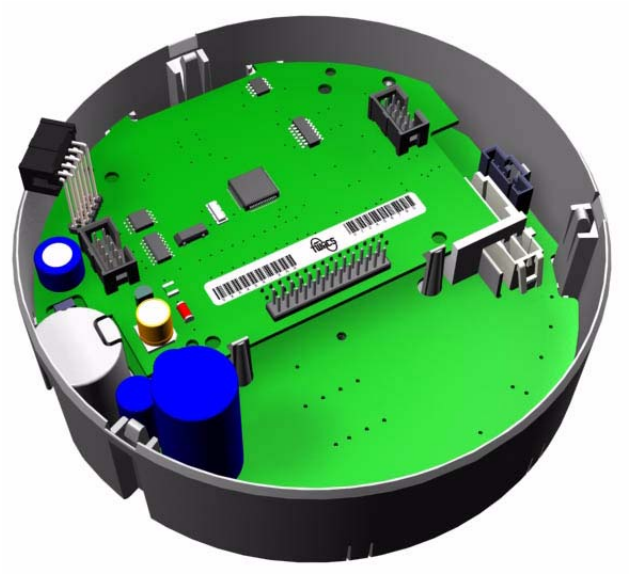


Figure 2.2 View of UMT-C-KV module integrated within the kV2c meter

Functional Description of the UMT-C-KV

The UMT-C-KV acts as an interface between the kV2c meter and TWACS powerline communication technology. It facilitates communication of kV2c meter quantities over the utility company distribution power lines. The diagram in *Figure 2.3, "Block diagram of the UMT-C-KV 2.0"*, illustrates the functionality of the UMT-C-KV. *Table 2.1* explains the block diagram components.

Figure 2.3 Block diagram of the UMT-C-KV 2.0

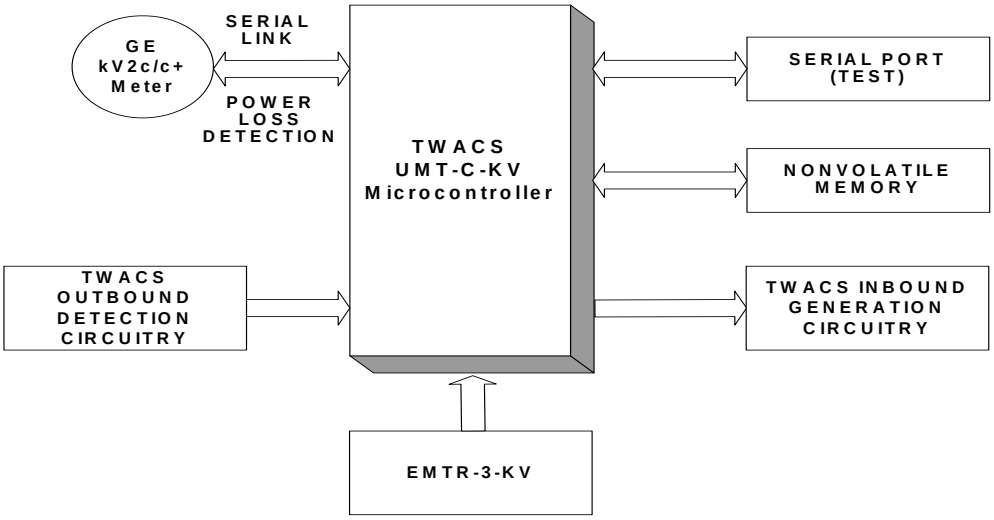


Table 2.1 Explanations for block diagram components

Component	Definition
TWACS UMT-C-KV microprocessor	Processes all inputs and generates and controls transmission of outputs
Power loss detection	UMT-C-KV response facilitates orderly shutdown and saving of important data when AC power is not adequate for operation
kV2c Meter	Provides metering data to the UMT-C-KV via serial communications
TWACS outbound detection circuitry	Monitors the AC power for TWACS outbound signal
Serial port - test	Used to perform initial programming
Non-volatile memory	Preserves register data during power outages
TWACS inbound generation circuitry	Generates TWACS inbound messages at the UMT-C-KV, which are transmitted to the SCE
EMTR-3-KV	Electric Meter Transceiver-3. Serves as the gateway to the TWACS network for the remote RF water, gas, or propane meters.

The kV2c meter is plugged into an American National Standards Institute (ANSI) industry standard meter socket. All UMT-C-KV models can perform five minute reads of voltage values. A choice between 60-, 30-, 15-, 10-, or 5-minute interval electric metering is available. 32 registers from the kV2c meter can be mapped to the transponder. Six of these data values are pre-defined in the transponder.

Primary Functions

The UMT-C-KV has two primary functions:

- Communication - receive TWACS outbound commands and generate TWACS inbound responses.
- Data retrieval - from customer-selected kV2c meter registers configured at meter/transponder integration.

Each of these functions is described in the following sections and is graphically represented in *Figure 2.3*.

Communication

The UMT-C-KV communication process is described in the following sections.

Meter Interface

The UMT-C-KV performs the interface function of connecting a kV2c electric meter to TWACS. It interfaces with the meter's communication port and to the power line using TWACS communication technology.

The UMT-C-KV uses TWACS technology to communicate from the meter, to the SCE, to the utility company over the power distribution lines. The outbound/inbound synchronization techniques allow detection of one outbound command at a time. When a command is detected, the UMT-C-KV either completes two-way command processing and transmits the inbound response before outbound detection resumes, or, the UMT-C-KV completes one-way command processing before outbound detection resumes.

Serial Number Address

The serial number address is the unique, fixed address present in every UMT-C-KV. It is assigned at the factory and can be written using the Serial Communication Port. It is used to address one UMT-C-KV at a time. This address must be used during the initialization of the UMT-C-KV to assign at least the first two-way address. Subsequently, the serial number address is optionally used for communication to a single UMT-C-KV. The serial number address is also used when testing the module with RCE test equipment.

Two-Way Address

Up to eight (8) two-way addresses are assigned to the UMT-C-KV in order for the TWACS operating software and the module to communicate with each other.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

Two-way addresses are comprised of three fields:

- Function - operational application, e.g. outage detection. Valid range 1-63.
- Group - quantity of RCEs addressed by group. Valid range 1-262,143.
- Unit - further subdivision of Group field and specific to channeling scheme. Valid range 1-255.

Certain restrictions are placed on the assignment of multiple addresses. Specifically, no more than one two-way address slot in an individual UMT-C-KV can contain the same function and group fields.

A two-way address is written to a specific address slot using a ‘Write RCE Registers’, ‘Bulk Assign Two-way Addresses’, or ‘Initialize RCE’ command. In order to assign a new two-way address, the contents of the address slot are simply overwritten. A two-way address is de-assigned by writing the slot to zero.

TWACS-10 and TWACS-20 Communication Protocols

TWACS-10 and TWACS-20 communication protocols establish the method and form that can be used to address Remote Communications Equipment. TWACS-10 and TWACS-20 capable RCEs can be addressed using TWACS-10 modes. However, TWACS-10-only capable RCEs can not be addressed using TWACS-20 protocol modes . TWACS-10 and TWACS-20 addressing protocols are supported by the UMT-C-KV.

Following assignment of a two-way address to the UMT-C-KV, subsequent commands may utilize the following TWACS-10 or TWACS-20 address modes:

TWACS-10 Addressing Modes

- Serial Number (Mode 1), addressing a single module, with or without a response
- Two-way unit (Mode 2), addressing a single module, with or without a response
- Two-way group (Mode 3), addressing a group of up to 256 modules, with or without a response
- One-way functional (Mode 4), addressing an unlimited number of modules, with no response

TWACS-20 Addressing Modes

Includes all of the TWACS-10 Addressing Modes, plus the following:

- Serial Number Set (Mode 7.7), addressing ad-hoc sets with or without response, concurrent feeders
- Function/Group/Unit Set, (Mode 7.8)addressing sets of up to 64 non sequential units with or without response, concurrent feeders
- Function/Group Set (Mode 7.9), addressing up to 8 groups of 256 units each, with or without response, concurrent feeders

Two-way addresses are not associated with any particular function or port. The three addressing modes supported by the two-way address can be used to perform any function in the UMT-C-KV when the appropriate command parameters are used.

The table below summarizes addresses and addressing modes supported by the UMT-C-KV.

Table 2.2 Addresses and address modes

Addresses Available	
Serial Number	Supported
Two-Way Assignable	Supported (8 slots)
One-Way Assignable	Not Applicable
Addressing Range	
Serial Number	1 to 4,294,967,295
Two-Way Assignable	
Function	0 to 63
Group	0 to 262,143
Unit Number	0 to 255
TWACS-10 Addressing Modes	
Serial Number (Mode 1)	One-Way & Two-Way
Two-way by Unit (Mode 2)	One-Way & Two-Way
Two-way by Group (Mode 3)	One-Way & Two-Way
One-way Functional (Mode 4)	One-Way only
TWACS-20 Addressing Modes	
Serial Number Set (Mode 7.7)	One-Way & Two-Way
Function/Group/Unit Set (Mode 7.8)	One-Way & Two-Way
Function/Group Set (Mode 7.9)	One-Way & Two-Way

The table below summarizes TWACS system communication features supported by the UMT-C-KV.

Table 2.3 Supported TWACS system communication features

Response Modes - TWACS-10	
Standard Inbound	Header, Data (3 to 13 bytes)
Error Correction	Header, Data, Hamming (4 to 14 bytes)
Fast Poll	Fixed Header Only (1 byte with all indicator bits: Alarm, Diagnostics, Tamper, and Outage, fixed at 1)
Link-Level Acknowledge	Header (3 bytes)
No Response	No Inbound Response (0 bytes)
Response Modes - TWACS-20	
Standard (Mode 0)	Header, Data (3 to 7 bytes)
Standard (Mode 1)	Header, Data (4 to 14 bytes)
Standard (Mode 2)	Header, Data (5 to 14 bytes)
Link-Level (Mode 4)	Header (3 bytes)
Fast Poll (Mode 6)	Fixed Header (1 byte)
No Response (Mode 7)	No Inbound Response (0 bytes)
Standard (Mode 8)	Header, Data (3 to 7 bytes)
Standard (Mode 9)	Header, Data (4 to 14 bytes)
Standard (Mode 10)	Header, Data (5 to 14 bytes)
Inbound Signaling	
Channels	6 channels
Channel Sets	Channel sets 0-5 for SCE and channel set 6 for RCE test equipment
Time Slots	256 time slots
Message Capacity	14 bytes
Burst Capacity	22 bytes
Maximum Outbound Message Length	31 bytes 62 bytes in TWACS-20 extended length mode

Serial Communications Using the Manufacturer's Serial Port

Communications between the UMT-C-KV Serial Port and the meter Test/Programming Connector requires the use of Identification and Security packets. In this mode of operation the transponder recognizes that its serial ports are sharing the same serial communication line and will not transmit from both of its serial ports at the same time.

Meter Optical Port Support

NOTE All serial port opcodes defined for the UMT-C-KV are accessible through the meter optical port.

Communications between the meter optical port and the UMT-C-KV Test/Programming Serial Port begins with the transponder receiving a specified hexadecimal Identification Packet (IP) from the meter optical port - EE 80 20 00 00 01 20 20 75. After receiving the IP from the meter optical port the UMT-C-KV transmits an acknowledgement back to the meter optical port, verifies the password, sends an acknowledgement to the meter, and asserts its Modem Busy line. The transmission of the Identification Packet and Security Packet conforms to the ANSI C12.18 communication protocol. After password acknowledgement, all communication between the meter optical port and the transponder uses the Gateway Serial Protocol, GATEWAY-SPEC, in ASCII at 9600 baud. Communication between the meter optical port and the transponder continues to follow the gateway protocol until 1.0 +/- 0.01 seconds have passed since the last communication. After this period has passed, the Modem Busy line is de-asserted.

Password Access

A default password is supplied to the customer for optical port access to the transponder. The transponder contains a “Bad Password Counter”. After counting 4 incorrect passwords, the transponder locks out Serial Communication between the meter optical port and the transponder Test/Programming Serial Port for 15 minutes. At the same time, the transponder sets bit 0 of register #36,”Indicators Tamper”. Bit 0 of register #36 remains set until cleared by TNS. The “Bad Password Counter” is cleared if no incorrect password has been received by the transponder within the last 15 minutes.

Data Retrieval

The UMT-C-KV reads a subset of 32 registers as selected by the utility company. All selected data are read at power-up and every five minutes thereafter if a valid RCE Time Synchronization command was received. See *Time Synchronization* on page 9.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

Consumption Metering (Wh)

The UMT-C-KV provides remote access to the energy measurement registers of the kV2c meter. The UMT-C-KV retrieves appropriate values from the meter’s internal ANSI Standard tables. The UMT-C-KV retrieves data from only “programmed” kV2c registers. When requested, the UMT-C-KV can supply data from the latest read.

Time-of-Use (TOU)

The kV2c meter can perform time-of-use metering when required and programmed accordingly. The time-of-use schedule is loaded into the meter during meter/RCE integration. This schedule determines the times that the different TOU rates are in effect.

The UMT-C-KV supports the kV2c meter TOU functionality. The UMT-C-KV transponder can be programmed to retrieve TOU data when its registers are appropriately mapped.

Billing Data

The kV2c transponder can retrieve active, reactive, and apparent power from a correspondingly programmed kV2c meter. The UMT-C-KV can be programmed at Integration to retrieve any of these values from a kV2c meter. *Table 2.4* lists the approved quantities that the kV2c meter is capable of measuring.

Table 2.4 Metered quantities

Metered Quantity
Delivered Energy (Wh)
Received Energy (Wh)
Net Energy (Wh)
Secure (Sum) Energy (Wh)
Delivered Reactive Energy (VARh)
Received Reactive Energy (VARh)
Delivered Apparent Energy (VAh)
Received Apparent Energy (VAh)
Delivered Q Energy (Qh)
Received Q Energy (Qh)

Loss of Power Handling

The UMT-C-KV transponder is powered by DC voltage from the meter power supply. It does not have its own “on-board” power supply. The UMT-C-KV recovers from any and all voltage interruptions and low voltage events upon restoration of normal power.

Data is stored in non-volatile memory in the UMT-C-KV and is not lost during brief power interruptions. The UMT-C-KV marks 5-minute bins that were marked as invalid. The Power Down Count register increments for each power event.

AC Input Voltage Tolerance Characteristics

Unregulated AC power for the UMT-C-KV is supplied from the kV2c meter and has a dependent voltage tolerance curve (CBEMA).

Outage Duration Monitoring

For this user guide, an outage is defined as a loss of supply voltage sufficient to cause the UMT-C-KV to power down. Outage duration is the interval between power-down and power-up of the UMT-C-KV. The transponder maintains counts of the number of outages in the Power Down Count register, ID 40.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

There may be power interruptions too short for the UMT-C-KV transponder to see it as an interruption. In this case the interruption is not considered an outage by the UMT-C-KV.

The types of interruptions, per IEEE 1366, are divided into two categories:

- Momentary Interruptions - interruptions of less than five minutes.
- Sustained Interruptions - interruptions not classified as Momentary Interruptions. (A utility can select any duration ranging from a minimum one minute up to a maximum eight minutes in 2.5 second increments. However, if modified, the interruption definition is no longer consistent with IEEE Std. 1366.)

The default Sustained Interruption value is 5 minutes.

The UMT-C-KV captures power interruption data as follows:

- Time stamp and duration of the 12 most recent interruptions.
- Sustained interruption duration data.
- Momentary interruption counter.
- Momentary interruption event counter.

The UMT-C-KV stores the daily interruption data for the last 35 days, but it will not necessarily preserve the time stamp information for all the interruptions. An example of the 35 Day Daily Interruption Summary Data (35D DISD) table is shown in *Table 2.5*. The table represents the daily interruption summary data for the last 35 days and has been designed to maintain the interruption data in a format that supports the calculation of reliability indices such as those described in the IEEE-Std. 1366. Refer to *Power Reliability Indices* for additional information.

Table 2.5 Example 35D DSID table

Date	Total Sustained Interruption Duration for the day[1]	Total Sustained Interruptions during the day	Total Momentary Interruptions during the day	Total Momentary Interruption Events during the day	Data Overflow Alarms
16 Bits	20 Bits	5 Bits	7 Bits	6 Bits	2 Bits

1. 20 Bits with 2.5 sec. resolution corresponds to 30.34 days (728 hours) duration.

It is recommended that TWACS retrieves the daily interruption summary data at least every two weeks.

The transponder will supply the following data as requested by the Master Station:

- A power-down count in a cumulative format.
- A summary of interruptions for the latest 12 time stamped interruptions.
- The time stamped data for any given incident on any given day from the latest 12 time stamped interruption data. The data is read directly from the 35D DSID table.
- A report describing the summary of power-down incidents for a range of dates from the data collected for the past 35 days. The summary for the range of dates includes the summed duration of the sustained interruption, the total number of sustained interruptions, the total number of momentary interruptions, and the total number of momentary interruption events. The date range is limited to a maximum of fifteen days.
- The 35D DISD data pattern for a given date range. The date range is limited to fifteen days.
- A report describing the summary of power-down incidents for any given day from the data collected for the past 35 days. The summary will include the summed duration of the sustained interruption, the number of sustained interruptions, the number of momentary interruptions, and the number of momentary interruption events for the given day. The data is read directly from the DISD table.

The UMT-C-KV offers limited polyphase detection. See *Loss of Power Handling*.

Power Down

The UMT-C-KV maintains a count (in the Power Down Count register) of the number of times it experiences a power-down condition. A date-and-time stamp of power-down, along with the duration for the most recent interruption, is recorded. The register relates only to phase interruptions that affect meter power. A phase loss translates to a loss of power to the meter and transponder.

Power Reliability Indices

The UMT-C-KV registers capture interruption data in the listed categories that can be used to calculate distribution reliability indices as specified in *IEEE Std.1366, 2003 Edition, IEEE Guide for Electric Power Distribution Reliability Indices* - a standard for power reliability within distribution systems, substations, circuits, and defined regions.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

The UMT-C-KV captures power interruption data as follows:

- Time stamped sustained interruption data.
- Time stamped momentary interruption data.
- Time stamped momentary interruption event data.
- Momentary interruption data.
- Sustained Interruption data.

Additional Utility-specific data may be required to properly calculate the associated Distribution Reliability Indices.

IEEE Standard.1366 defined Distribution Reliability Indices are:

- System Average Interruption Frequency Index (SAIFI)
- System Average Interruption Duration Index (SAIDI)
- Customer Average Interruption Duration Index (CAIDI)
- Customer Average Interruption Frequency Index (CAIFI)
- Customer Total Average Interruption Duration Index (CTAIDI)
- Average Service Availability Index (ASAI)
- Average system interruption duration index (ASIDI)
- Average system interruption frequency index (ASIFI)
- Customers Experiencing Multiple Interruptions ($CEMI_n$)
- Momentary Average Interruption Frequency Index (MAIFI)
- Momentary Average Interruption Event Frequency Index ($MAIFI_E$)
- Customers Experiencing Multiple Sustained Interruptions and Momentary Interruption Events ($CEMSMI_n$)

Energy and Demand Measurement

The UMT-C-KV can read the appropriate mapped registers of the kV2c meter on a scheduled basis and then store those readings in registers in its own memory.

Table 2.6 Meter Map and Meter Data Registers

Register Name	Reg ID Dec	Reg Length/# Bytes	Access	Default Value	Units	Status
Meter Map Register #1-kWh	290.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #2-Unassigned	291.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #3-Forward	292.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #4-Reverse	293.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #5-Voltage A	294.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #6-Voltage B	295.2	4	RW	AMI	Tbl/Off	E
Meter Map Register #7-Voltage C	296.2	4	RW	AMI	Tbl/Off	E
Meter Map Registers #8-#16 - Unassigned	297.2-305.2	4	RW	AMI	Tbl/Off	E
Meter Map Registers #17-#32 - Unassigned	1800.0-1815.0	4	RW	AMI	Tbl/Off	N
Meter Data Register #1-kWh	306.0	8	RV	0	AMI	E
Meter Data Register #2-Unassigned	307.0	8	RV	0	AMI	E
Meter Data Register #3-Forward	308.0	8	RV	0	AMI	E
Meter Data Register #4-Reverse	309.0	8	RV	0	AMI	E
Meter Data Register #5-Voltage A	310.0	8	RV	0	AMI	E
Meter Data Register #6-Voltage B	311.0	8	RV	0	AMI	E
Meter Data Register #7-Voltage C	312.0	8	RV	0	AMI	E
Meter Data Registers #8-#16 - Unassigned	313.0-321.0	8	RV	0	AMI	E
Meter Data Registers #17-#32 - Unassigned	1816.1-1831.1	8	RV	0	AMI	N

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

Total Consumption Present

The UMT-C-KV provides Total Consumption data by reading the applicable registers from the kV2c meter. These registers must be mapped by Meter Map Register 1, 3, and 4.

Meter Constants

The UMT-C-KV can store and communicate required meter values when those values are programmed in the meter and are mapped to a register in the UMT-C-KV. Values may include, but are not limited to: VT ratio, CT ratio, meter constant/Kh value, number of dials, meter type, etc.

This allows the TWACS Master Station to automatically capture this information for billing without additional manual data entry.

For example, in the kV2c meter, the Total Consumption in numeric kWH values is captured in the appropriate metering register and then retrieved by the appropriately mapped transponder registers and relayed to the Master Station per scheduled or on demand requests.

Demand Measurement

The UMT-C-KV is configured to perform Demand Metering by reading demand-related values from the kV2c meter's ANSI Standard Table 23 and 63. The UMT-C-KV can retrieve these values from the appropriately mapped meter registers. These locations can be mapped to any available Meter Map Register, except for Meter Map Register 1, and 3 through 7.

Demand Reset

The Demand Reset command instructs the UMT-C-KV to execute a Demand Reset. This operation updates Meter Data registers, but only if the 255-minute RCE Demand Lockout Time is expired. The lockout period is based on the Time/Date Stamp of the last Demand Reset.

When a Demand Reset command is issued, the RCE checks for the presence of a lockout condition and if none exists:

- Updates the Meter Data Registers
- Sends the meter a Demand Reset command
- Shifts the newly populated Meter Data Registers to the Historical Data Billing Shift registers
- The actual date and time of this shift is captured in Actual Shift/Reset Timestamp register #335

The 255-minute RCE Demand Lockout Time prevents an unwanted demand reset when the UMT-C-KV receives a Demand Reset retry. The timer is nonvolatile and evaluates the 255-minute lockout at power-up. If a RCE Demand Lockout is in effect, a demand reset will not occur. If a shorter lockout time is selected for the RCE, the 255-minute lockout time supersedes the shorter value.

NOTE The Demand Reset and shift must occur simultaneously, and a Demand Reset can't occur until 255 minutes after the Time/Date Stamp stored for the last Demand Reset. Therefore it is possible that a shift may be delayed by the 255-minute RCE Demand Lockout.

Since the demand measurement may correspond to the utility's billing system, the Demand Reset command ensures the integrity of the customer's bill.

Billing Cycle Read with Demand Reset

When there is a valid date in the Billing Cycle Date register #334, the same procedure as described in the Demand Reset paragraph automatically executes on the prescribed date and at the time specified in the Meter Daily Shift Time register #332.

Interval Data

Interval data is described as the consumption values recorded over one or more successive time intervals. The UMT-C-KV collects interval data from only the Meter Data Registers.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

The UMT-C-KV supports 4 channels of interval data collection. Each channel can store 7 days of storage per channel at the fastest sampling rate, or 35 days of 5-minute data for a single channel, whichever is greater. The default setting is 1 active channel with a 60-minute sample rate.

The UMT-C-KV can report hourly interval consumption data by collecting the data from the kV2c meter and transmitting it over the TWACS channel. Hourly retrieval (60-minute) is the default read frequency, but the UMT-C-KV can supply data in 5-, 10-, 15-, and 30-minute intervals as well. Refer to the following table for storage days based on sample rate and number of active channels.

Table 2.7 Sample data storage days

Number of Active Channels	Sample Rate				
	5 Minutes	10 Minutes	15 Minutes	30 Minutes	60 Minutes
1	35	70	105	210	420
2	17.5	35	52.5	105	210
3	11.67	23.33	35	70	140
4	8.75	17.5	26.25	52.5	105

NOTE The data is expressed as the difference between data values at successive points in time. The interval used for interval data reporting (e.g. 60 min.) may be different than the interval used for demand capture (e.g. 15 min.).

Additional Features

The following sections describe additional features of the UMT-C-KV transponder.

Configuration Monitoring

The UMT-C-KV monitors the Host Meter Configuration register in the kV2c meter. This register contains the programming information for the meter and is updated whenever the meter is reprogrammed. The UMT-C-KV reads and stores this configuration data in registers within its own memory. When the UMT-C-KV configuration registers are read, the transponder reads the Host Meter Configuration register and compares the data values. If the values differ, the transponder sets a flag in the Alarm Indicators register and stores the new value in its configuration data registers.

NOTE Some features and capabilities of the transponder may not be supported, or may be only partially supported by some versions of master station software.

Installation With Instrument Transformers

In some applications, the meter may be connected using step-down current transformers (CT) and/or voltage transformers (VT). In all such cases, the metered consumption represents energy consumption as seen on the secondary side of the transformer.

Tamper Detection

Detection of meter removal from the socket is implemented via the availability of power-down counts in the transponder. Refer to *Power Down* for additional information. Both Forward energy and Reverse energy are referenced through dedicated Meter Map Registers.

The Master Station may choose to mask one or more bits using the Tamper Indicators Mask Register. This will suppress further tamper indications for the masked bits until the flag is cleared. The Tamper Indicators Mask Register is configured at the time of integration.

Reverse Rotation

The transponder monitors for reverse energy flow and sets an error/alarm flag in the Tamper Indicators register if this condition is detected. Reverse rotation must be greater than or equal to 255 meter units of Reverse energy before this alarm flag is set.

No Consumption

When no consumption is detected for 24 hours, the “No Consumption in 24 Hours” flag in the Tamper Indicators Register is set.

Voltage Agility

The UMT-C-KV utilizes a range of voltages that enables the transponder to automatically use the voltage available to the commercial meter. The UMT-C-KV supports TWACS communication at any voltage (within the range of 120VAC-480VAC) that the meter form supports.

Voltage Monitoring

The UMT-C-KV obtains 3 phase voltage data every 5 minutes from the kV2c meter.

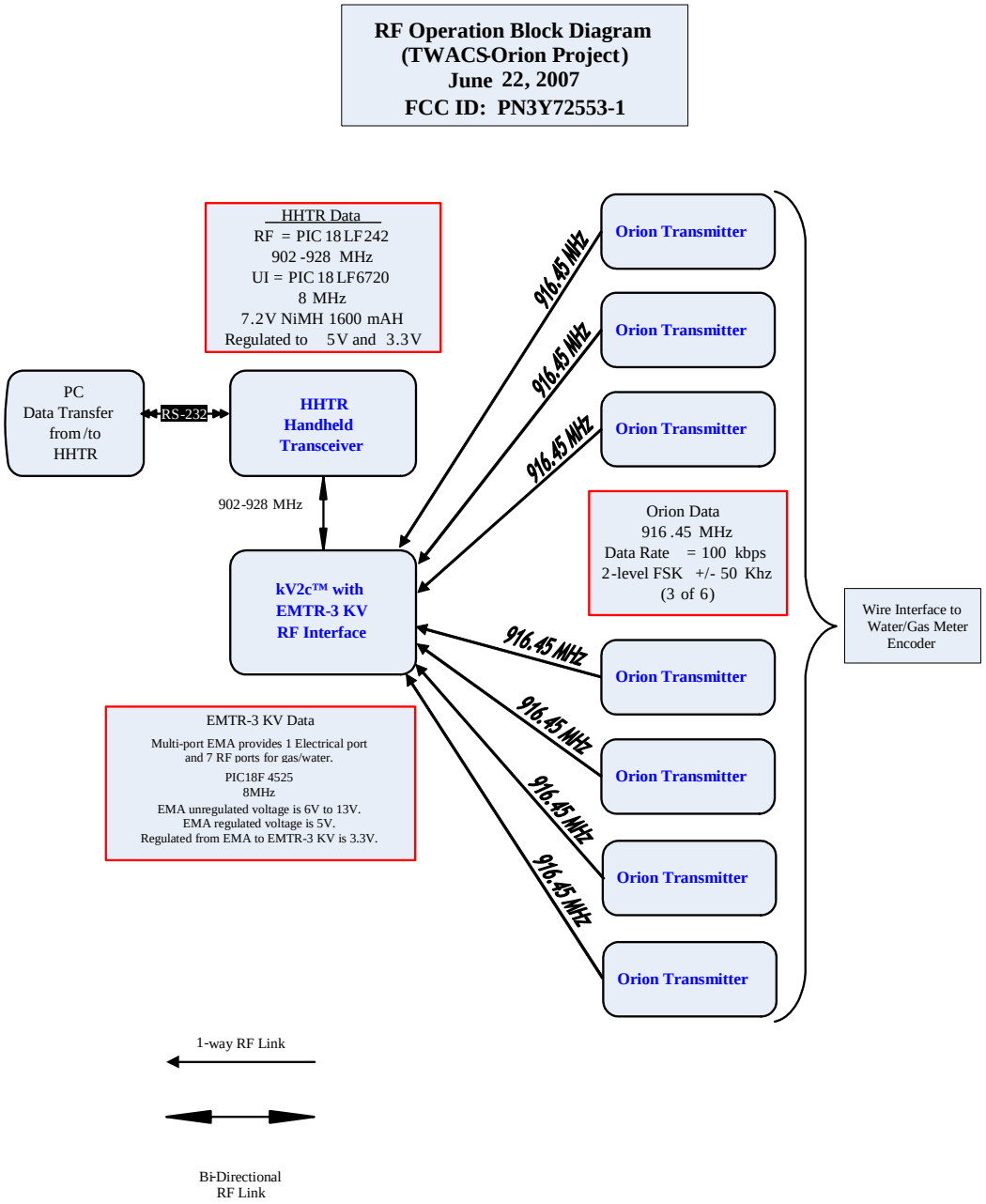
When the CCE detects a voltage anomaly it can read and obtain “full meter accuracy” (by reading all the mapped register values) from the meter via the UMT-C-KV. These values are obtained using the Meter Map Registers and reading the pre-defined Meter Data Registers.

EMTR-3-KV Interface (Multiport Capability)

The UMT-C-KV connects to an integrated RF transceiver called the Electric Meter Transceiver Model 3, referred to as the EMTR-3-KV. The EMTR-3-KV receives power from the UMT-C-KV and has its own microcontroller, RF circuitry, and antenna. The EMTR-3-KV receives and stores RF transmissions containing consumption/status information from Intelligent End Devices (IEDs) such as water, gas, or propane meters.

The following block diagram summarizes the interfaces and communications between the system components.

Figure 2.4 RF operation block diagram



The EMTR-3 KV transmits and receives internally stored data using 79 channels spaced equally across the 902 MHz - 928 MHz band. Channel 1 is at 902.628 MHz, and Channel 79 is at 927.789 MHz. The EMTR-3 KV is primarily a receiver, but transmits 5-second replies to the Hand Held Transceiver (HHTR) installation tool during initial installation of the meter. The EMTR-3 KV operates under Paragraph 15.249 of FCC Regulations and employs frequency shift keying (FSK) to convey data. No subcarriers are used.

The interface between the EMTR-3-KV and the UMT-C-KV is an Inter-Integrated Circuit (I^2C) physical layer over which the Common Data Layer communications format operates. The UMT-C-KV performs the gateway function of connecting the EMTR-3-KV to the TWACS network. TWACS is able to read and write registers as well as execute Opcodes on the EMTR-3-KV using gateway functionality. The UMT-C-KV maintains a status indication of the EMTR-3-KV interface as well as a summary of EMTR-3-KV reported failures. The EMTR-3-KV is optional and may not be present on all UMT-C-KV units.

REGULATORY DATA

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 limits are designed to provide reasonable protection against harmful interference in a residential installation. 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: reorient or relocate the receiving antenna, increase the separation between the equipment and receiver, connect the equipment into an output on a circuit different from that to which the receiver is connected, consult the dealer or an experienced radio/TV technician for help.

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.

Changes not expressly approved by Distribution Control Systems, Inc. could void the user's authority to operate the equipment.

On-Request Reads

UMT-C-KV registers can be read directly using this command. Individual or groups of meters may be read using the TWACS two-way addressing features. See *Two-Way Address*.

Temperature Monitoring

As an additional safety feature, a solid state temperature sensor within the UMT-C-KV module measures the internal temperature of the transponder PCB. If, at any given time, the PCB temperature measured by the thermal sensor is greater than the value stored in the “Temperature Threshold” register, the module will not fire, even if the thermal limits controlled by the module firmware have not been reached.

If any of the thermal limits are reached, (even if the measured temperature indicates that the transponder's internal temperature is lower than the temperature threshold) the transponder will not fire.

Two registers store transponder temperature data in degrees Celsius:

- Temperature Threshold register #736
- Internal Temperature register #735

The accuracy of the thermal sensor is within 6 °C in the range from - 40 °C to + 125 °C. The resolution of the “Internal Temperature” register is within 1 °C in the range - 40 to + 125 °C. The Internal Temperature register is updated at power-up and every 30 seconds thereafter.

When the thermal limit of the transponder is disabled through hardware, the temperature sensing limits are bypassed and over-temperature safeguards will not cause the transponder to cease Inbound transmissions.

Historical Data

All quantities captured by the meter data registers (at the time specified by the Meter Data Daily Shift Time - Register #332) are stored for up to 7 days. Historical Data also includes a copy of all the Meter Data Registers when the Billing Shift occurs.

480 Volt Applications

As is widely recognized within the industry, whenever dealing with 480 volt applications, there are some inherent challenges and risks associated with such high voltages.

WARNING: The modes of failure in such applications may naturally be more aggressive than in lower voltage applications. This is an issue with the industry’s use of 480 volt applications and is by no means limited to GE meters.

Calibration Testing

All models support calibration testing of the integral watt-hour meter using standard meter test equipment. When calibrating an kV2c meter, the optical port is used to output pulses to the test equipment. The UMT-C-KV transponder uses a serial link to the optical port for communication with the meter. The transponder communication must be suspended during meter calibration. This can be done by sending a time sync command containing a Date 0 Time 0x8700. This indicates an invalid time and the transponder will not attempt to communicate.

NOTE If a power down occurs during calibration and the real-time clock has a valid time, the invalid time sync would need to be sent again.

Options

If a kV2c meter supports KYZ/Form A functionality, the operations of the UMT-C-KV module shall not, in any way, adversely affect the performance of the KYZ/Form A inputs or outputs.

TWACS Installation

This section provides an overview of the integration and installation process and procedures for verifying that the meter is properly reading and communicating with the network.

Type and Model Numbers

A complete listing of all DCSI Remote Communications Equipment and the applicable meters can be found on the TWACS portal in the *Transponder Type and Model Matrix*. If you do not have access to the portal, contact Customer Care at Care@twacs.com for assistance.

The following table provides module type, model number, class, voltage, service, and Energy per Count for each form that is usable with the transponder and meter.

Table 2.8 Model number, class, meter form, voltage, service type, and energy

Type 101					
Model Number	**Class**	**Form**	**Voltage**	**Service**	**Energy Per Count**
1	200	1S	120V-480V Autorange	2-Wire Single Phase Self-Contained	0.0025
2	200	2S	120V-480V Autorange	3-Wire Single Phase Self-Contained	0.0025
3	320	2S	120V-480V Autorange	2-Wire Single Phase Self-Contained	0.00375
4	20	3S	120V-480V Autorange	2-Wire Single Phase Current Transformer Rated	0.0025
5	20	4S	120V-480V Autorange	3-Wire Single Phase Current Transformer Rated	0.00025
6	20	45S	120V-480V Autorange	3-Wire Polyphase Current Transformer Rated	0.00025
7	20	36S	120V-480V Autorange	4-Wire Polyphase Current Transformer Rated	0.00025

Type 101					
Model Number	**Class**	**Form**	**Voltage**	**Service**	**Energy Per Count**
8	20	8S/9S	120V-480V Autorange	4-Wire Polyphase Current Transformer Rated	0.00025
9	200	12S	120V-480V Autorange	3-Wire Polyphase Self-Contained	0.0025
10	320	12S	120V-480V Autorange	3-Wire Polyphase Self-Contained	0.00375
11	200	15S/16S	120V-480V Autorange	4-Wire Polyphase Self-Contained	0.0025
12	320	15S/16S	120V-480V Autorange	4-Wire Polyphase Self-Contained	0.00375
13	20	3S	120V	2-Wire Single Phase Voltage Transformer-Rated	0.00025
14	20	4S	120V	3-Wire Single Phase Voltage Transformer-Rated	0.00025
15	20	45S	120V	3-Wire Polyphase Voltage Transformer-Rated	0.00025
16	20	36S	120V	4-Wire Polyphase Voltage Transformer-Rated	0.00025
17	20	8S/9S	120V	4-Wire Polyphase Voltage Transformer-Rated	0.00025

Voltage Transformer (VT) Connected Meter/Transponder

TWACS-enabled kV2c meters that are configured for Voltage Transformer (VT) connected installations must be treated differently than kV2c meters designed for direct line voltage applications.

VT-type kV2c meter/transponder hardware combinations are not compatible with any other kV2c meter/transponder combinations and are, consequently, not interchangeable. kV2c VT-type meter/transponder combinations are designed to operate exclusively on either the primary or the secondary winding side of voltage transformers with nominal secondary voltage of 120V ± 15%.

CAUTION Installation of the VT version of a TWACS-enabled kV2c meter on direct line connected locations without Voltage Transformers could lead to destructive failure of the device during TWACS communication.

All VT connected meter/transponder combinations are configured at the time of integration with the necessary parameters for proper TWACS communication.

NOTE Installed meters, or meters in the meter shop, can not be retrofitted for VT applications. New VT meters only must be installed for VT applications.

Verification of Equipment

Avoid damaging the equipment by verifying that the meter, defined by the nameplate, is compatible with the field socket wiring. Refer to the supported field installation wiring diagrams in the *UMT-C-KV Field Installation Instructions* located on the TWACS portal.

Verify that the meter nameplate has the correct form number, class number, and voltage. Refer to *Figure 2.5* for approximate location of this information on the meter label.

Figure 2.5 Meter nameplate

NOTE Refer to *Table 2.8* for information on the form, class, voltage, and Kh.

Installation Procedure

Refer to the appropriate manufacturer meter installation documentation and your company procedures for the proper safe installation of electric utility meters. For specific installation instructions, refer to the *UMT-C-KV Field Installation Instructions* located on the TWACS portal.

WARNING: When the meter is firmly seated in the base socket, the conductors in the meter socket are energized.

To complete the installation process, the meter must be searched into the TWACS operating software. The following steps provide a general overview of this process. More detailed information is available in the *TNS End User Guide* and the *TWACS Network Gateway Operational Process Guide*.

1. Obtain, from the installer, the following information for the installed meter. There are seven pieces of information that identify the location and communication path and address information of the meter:
   - TWACS Serial number (required)
   - Substation (required)
   - Bus identification
   - Feeder identification
   - Phase
   - Phasor (TNG)
   - Transponder Type: 101
2. Enter the necessary information into TWACS operating software by following the directions in the subsection *Searching Meters into TNS*, in the *Searching Meters* chapter of the *TNS Operational Process Guid*e.
3. The software will start the search process.

   Once in the database, the meter is ready for AMR or On-Request reads.

Registers

The Altimus Command Parameters window shows all registers that *can be* read for the type of meter selected and the registers that *will be* read for the rate class (selected registers, customer class, meter model) and billing type selected (BILLING or DSHTBILL).

Set up the Altimus Command Parameters table by following the instructions in the *TNS System Administration* chapter of the *TNS End User Guide*.

Thermal Limit

The transponder generates a significant amount of heat when replying to a command; the longer the command, the greater the amount of heat. Each transponder type has a message length limit, defined in the transponder specification and in the Product table. In the Altimus Command Configuration window, you can see how TNS will break up the reply into segments to avoid exceeding the thermal limit of the transponder.

See the *TNS System Administration* chapter of the *TNS End User Guide*.

Changing the Sequence Delay

Normally it is not necessary to change the sequence delay. In the event that it is necessary to change the sequence delay for one or more rate classes (because of insufficient time between read commands to permit adequate transponder cooling), the Altimus Command Configuration window is used.

Change the rate class sequence delay by following the instructions in the *TNS System Administration* chapter of the *TNS End User Guide*.

See *Meter Shop Test System* on page 39 for more information on testing tools

CHAPTER

3

TROUBLESHOOTING

The purpose of this chapter is to provide DCSI customers with procedures that will assist in determining if a failed meter issue can be resolved in TNS or if a field visit is required. It is useful for installers and meter shop personnel.

A failed meter or a meter with an invalid response can be the result of several factors including process, software, or hardware. The following sections provide steps for, first, trying to identify the problem in TNS (Complete the steps in *Performing Remote Analysis (TNS)*), and then conducting a field visit if necessary. If a field visit is required, proceed to *Field Troubleshooting* on page 38. Follow the instructions in *Meter Shop Test System* on page 39 if the TNS analysis and field visit steps do not correct the problem.

Use a three-phase approach to troubleshoot the UMT-C-KV.

1. Remote Analysis
2. Field Troubleshooting
3. Meter Shop Test System

For information on loss of power, refer to *Loss of Power Handling* on page 18.

The UMT-C-KV may spontaneously draw a current surge if TWACS inbound communication takes place during the test. This may affect the test equipment or results. This can only occur when the SCE sends an outbound command requesting a response from the UMT-C-KV.

Performing Remote Analysis (TNS)

Complete the following steps to determine if a field visit is required for an unresponsive meter. You can end the procedure at any step and correct the problem when a cause of failure is determined.

1. Check the AMRCOMMFAIL table for TWACS serial numbers that have excessive AMR Communication Failure counts. This enables you to identify meters that are consistently failing AMR.

   If the meter fail count in the AMRCOMMFAIL table is equal to or greater than the MaxFailCnt in the TNSDEFAULTS table, the Quality Code (QC) will be set to RO (Retry Override). When the quality code is RO, the meter unit map will have changed in the AMRCMDLST2WAY table. The meter will be attempted the first time, but will not be issued subsequent retries and must be read manually.

2. Determine if any error messages have occurred during AMR by checking the SCE Notification log for any associated hardware issues for the meters that are not communicating.

NOTE The Notification log contains important information about the status of equipment and is automatically updated by TNS and the SCE. For detailed information about the Notification log and error messages, see the *Notification Log* section of the *SCE Logs* chapter in the *TNS Operational Process Guide* and the *Notification Log* section in the *SCE Maintenance* chapter of the *TNS End User Guide*.

3. Check for TNS errors that may have occurred because of commands time-out, or any software related issues in TNS that may have prevented AMR commands processing.

   For more information on time-out issues, see the *Encode Command Parameters* section in *the TNS System Maintenance* chapter of the *TNS End User Guide*.

4. Perform an On-Request AMR command to determine if the unit communicates. (This command communicates to the unit by serial number to eliminate a two-way addressing issue.)

   For more information about On-Request meter reads, refer to the appropriate sections in the *TNS End User Guide* and the *TNS Operational Process Guide*.

   A site visit is not required, and you may stop this procedure if the meter communicates. If the meter communicates, check two-way addressing. (For more information on two-way addressing, see the *Function-Group Addressing* chapter of the *TNS Operational Process Guide* and the *Two-Way Addressing* section in the *TNS Generic Applications* chapter of the *TNS End User Guide.*)

5. Check for other TWACS meters that are reading on the same distribution transformer, or a nearby meter to narrow the communication problem area.

6. Check the Customer Information System for a disconnected status that may not have updated in the TNS database. If the meter was disconnected, no action in TNS is required, but you may want to change the cycle number.

   The TNS Operator must have some process for dealing with a meter that no longer provides a read. The TNS Operator might consider setting up a special cycle (e.g. cycle 99) for disconnects and continue reading the meters. Having the disconnected meters in a special cycle allows the TNS Operator to isolate meters to scan for usage. If a Customer Service Representative re-activates the service and the notification fails to reach the TNS Operator, or if a customer tampers with the meter and reconnects the service, the TNS Operator can quickly identify a successful read in a group of meters where reads should normally fail. Using this configuration, the TNS Operator can quickly investigate the reason for the successful read of a supposedly disconnected meter.

7. Check for switching events which may have occurred in the system that possibly changed the communication path of the meter. (A communication path may have changed due to a physical move or a temporary switch to a different substation, phase, or other path component.) If the communication path has changed, you can use *Pathmaps* to update the TNS database.

   For more information on communication paths, see the *Adding Meters Interactively* section in the *Searching Meters* chapter of the *TNS Operational Process Guide*. For more information on *Pathmaps*, see the *Alternate Pathmaps Search* chapter in the *TNS End User Guide* and the *Building and Searching Alternate Paths* chapter in the *TNS Operational Process Guide*.

8. Check the Alternate Substation tables for up-to-date information on Alternate Substations that can feed the primary sub.

   For more information on Alternate Substation tables, see the *Adding Alternate Substation Information* section in the *SCE Maintenance* chapter of the *TNS End User Guide*. Also see the *Alternate Substation Mapping* and *Creating and Using Alternate Path Tables* sections in the *Building and Searching Alternate Paths chapter* of the *TNS Operational Process Guide*.

Performing Remote Analysis (TWACS NG)

Complete the following steps to determine if a field visit is required for an unresponsive meter. You can end the procedure at any step and correct the problem when a cause of failure is determined.

1. If communication fails to the transponder, check the path and search state of the transponder. You may do this by going to ***System Monitoring > Edit Path > Search States***.

2. Type in the serial number of the transponder, and click **Lookup**.

   If the transponder is currently in the New, Lost or Tentative path state, the the TWACS NG will need to search the transponder. The TWACS NG Operator will need to be sure that it is in a search state of Ready. The search batch job should automatically pick up the transponder for search when the next job runs.

3. If the transponder is in a Good/Done state, the TWACS NG Operator may issue a ping to the transponder. You may do this by going to ***System Monitoring > Test Transponder*** screen.

4. Type in the serial number or Meter/End Device ID, and click **Ping**.

   If the ping is successful, communication to the transponder is successful and has been verified. If the transponder is still not functioning as expected, a field visit will most likely be necessary.

5. The TWACS NG Operator may also want to check the notifications to verify if any have been received for the transponder in question. For more information regarding notifications, refer to the *Notifications* section of the *TWACS® Network Gateway Operational Process Guide*.

6. If the previous steps determine that the meter has “Failed”, see on page 40 to return the meter.

NOTE For additional information regarding remote troubleshooting, contact DCSI Customer Care (email care@twacs.com or call 1-800-892-9008) to speak with a Technical Support Engineer.

Field Troubleshooting

The most likely field troubleshooting scenario is a failure to display. If the Communication icon ((•)) is not displaying, ensure that the TWACS-enabled kV2c meter is receiving the appropriate power according to its specific form and voltage (refer to *Table 2.8* on page 30). You may use a Portable RCE Test Unit (PRTU) and the *PRTU Technical Manual* for further testing or return the meter to the Meter Shop for further diagnostics.

WARNING: Wear all safety equipment according to your utility rules before opening the meter base: hard hats, safety face shield, fire retardant clothing, high voltage rated gloves, safety rated shoes.

WARNING: Any work on or near energized meters, meter sockets, or other metering equipment can present a danger of electrical shock. Such shock could cause serious injury or death.

Complete the following steps if you determine a field visit is necessary. You can end the procedure at any step and correct the problem when a cause of failure is determined.

1. Once on site, verify the correct TWACS serial number is installed at the site.
2. Determine if the meter is operational by performing a voltage check, verifying the meter is the correct form and class for the application, and making sure the service transformer is at least a 3 KVA transformer or greater.
3. Determine if the meter is disconnected at the service transformer or booted on the line side of the meter base.
4. Remove the meter and check for loose connections in the meter base or any other type of defect that may prevent the meter from communicating through TWACS power line communication.

5. Replace the meter and verify that the Communication icon ((•)) appears on the meter display. This icon should display approximately 5-8 seconds after power up. The icon also displays briefly each minute thereafter, if a valid time sync has been received.
6. Use the Portable RCE Test Unit (PRTU) to confirm that the TWACS module is communicating.

NOTE If a PRTU is not available, communication with the meter can be verified using TNS.

7. Instruct the TNS Operator to search the unit into the TNS database while a technician is on site.
8. If the meter does not communicate, or if a power up indicator is not validated, replace the meter and repeat steps 6 and 7.
9. If the previous steps determine that the meter has "Failed", complete the on page 40 to return the meter.

IMPORTANT Contact DCSI Customer Care (email care@twacs.com or call 1-800-892-9008) and arrange to speak with a Technical support Engineer if a new meter does not successfully communicate from the same site.

Meter Shop Test System

Use the Meter Shop Test System to test TWACS signaling, read select transponder registers, zero select transponder registers, and perform various other transponder functions on a TWACS-enabled kV2c meter. For complete details on the Meter Shop Test System, see the Meter Shop Test System Help (accessed by clicking the **Help** button on the Meter Shop Test Tool main menu) or contact your Program Manager or DCSI Customer Care at care@twacs.com or 1-800-892-9008.

Because of the various test equipment available for use with DCSI products and the configuration requirements/options, the *Meter Shop Test System Set-Up Guide*, will guide you through initial equipment selection and setup for meter/module testing.

This UMT-C-KV user guide contains all the module-specific information necessary to test the UMT-C-KV installed in the kV2c meter. UMT-C-KV module, TWACS serial number, and meter-specific information is available on the meter label. Refer to *Figure 2.5* on page 32. Additional information, such as module Type and Model, can be found in *Table 2.8* on page 30 of this user guide.

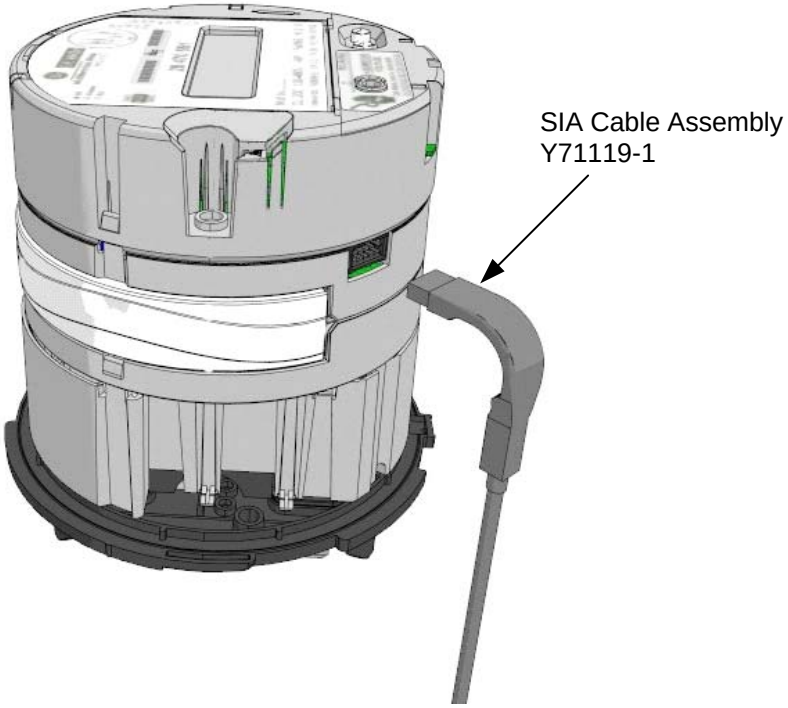
If you are unable to resolve a problem with the UMT-C-KV, return the meter to your integrator or DCSI. See *Product Returns* on page 3.

NOTE To use the Meter Shop Test System optical port communication option with a TWACS-enabled kV2c meter, you must have an Optical Port Cable Assembly (see *Figure 3.1*).

Figure 3.1 Optical port connection for kV2c meter

NOTE To use the Meter Shop Test System serial communication option with a TWACS-enabled kV2c meter, you must have the correct SIA Cable Assembly (see *Figure 3.2*).

Figure 3.2 SIA cable assembly for kV2c meter



CHAPTER

4

SPECIFICATIONS

This chapter contains electrical, environmental, and physical specifications for the UMT-C-KV transponder.

Electrical Specifications

Table 4.1 Electrical ratings

Parameter	Rating
Line voltage	120-480 VAC +/- 15%
Line frequency	60 Hz +/- 3.0 Hz
Quiescent power	1.35 Watts not including TWACS or RF activity
Maximum input surge	25 amps RMS
Internal fusing	Yes on AC connection for TWACS
Grounding	None
Electronics connection	DC energy is provided by the kV2c Meter
Electronics isolation	Electronics are not required to be electrically isolated from the power line.

Compliance Specifications

NOTE ANSI C12.1-2001 is the referring standard for tests listed in tables 3.2, 3.3, and 3.4.

Table 4.2 Compliance specifications

Test Title	Applicable Specification
EMI/RFI Emission conducted/radiated	ANSI C12.1-2001 Test No. 27- “Radio Frequency Conducted and Radiated Emissions” per CFR 47 Part 15, Class A and B. (See also ANSI C63.4)
EMI/RFI Susceptibility	ANSI C12.1-2001 Test No. 26- “Effect of Radio Frequency Interference” Canada: LMB-EG-07 & PS-E-09-E
AC line surge	ANSI C12.1-2001/IEEE C62.41-1991 Test No. 17- “Effect of High Voltage Line Surges” Canada: 61000-4-4:2004
Electrical fast transient	ANSI C12.1-2001 Test No. 25- “Electrical Fast Transient/Burst” (Testing at 100 KHz is required) IEC 61000-4-4: 2004

Table 4.2 Compliance specifications

Test Title	Applicable Specification
Surge withstand capability FT and OSC	ANSI/IEEE C.37.90.1 - 2002
High voltage isolation on meter chassis	ANSI C12.1-2001 Test No. 15- “Insulation”. Canada: LMB-EG-07 & PS-E-09-E
Voltage interruption test	ANSI C12.1-2001 Test No. 16- “Voltage Interruption”.
Electrostatic Discharge	ANSI C12.1-2001 Test No. 28 “Effect of electrostatic discharge (ESD)”.
Variation of Voltage	ANSI C12.1-2001 Test No. 5 & 5a “Effect of variation of voltage on the metering device”.
Variation of Frequency	ANSI C12.1-2001 Test No. 6 “Effect of variation of frequency”.
Dielectric Voltage	ANSI C12.1 Test for: Withstand, Abnormal Voltage Operation, and Faults.
Circuit spacing	Circuit spacing complies with sound engineering principles for 480-volt class equipment.
ITIC (CBEMA)	IEC 61000-4-11.
Effect of Variation of Voltage	Test No. 5 & 5a, performed at 80% to 115% of rated voltage, with 5% or smaller steps.
Effect of Variation of Frequency	Test No. 6.
Effect of External Magnetic Field	Test No. 18.
Occupied Bandwidth	200 kHz.
RF Output Power	0 dBm or less. The EMTR-3 KV meets FCC section 15.249 for field strength of emissions.
Carrier Frequency Stability	Carrier frequency is crystal controlled. Accuracy is +/- 50 ppm, or about +/- 46 kHz.

Environmental Specifications

Table 4.3 Environmental specifications

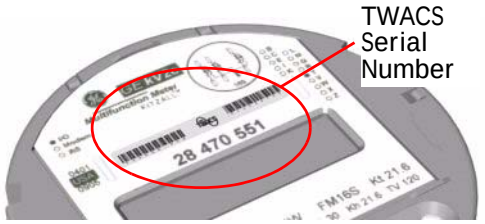
Thermal	
Effect of operating temperature	Per ANSI C12.1-2001 Test No. 30
Humidity	
Effect of relative humidity, both operational and storage	Per ANSI C12.1-2001 Test No. 31

Physical Specifications

Table 4.4 Physical specifications

Parameter	Specification
Size, weight, form factor	
Integrated dimensions	6.94 in. dia. x 8.2 in. lng. - Refer to General Electric specifications for kV2c meter
Integrated weight	kV2c meter w/ plastic cover 2 lbs. Integrated kV2c w/plastic cover 3.5 lbs.
Meter forms	See *Table 2.8, "Model number, class, meter form, voltage, service type, and energy"*.
Installation instructions	Installation instructions can be downloaded from the DCSI Web portal (https://portal.twacs.com).
Meter socket	ANSI C12.7-1987
Compliance Testing Specifications	
Mechanical tests	Per relevant sections of ANSI C12.1 - 2001 described below:
• Mechanical Shock	• Test #32, per IEC 60068 part 2-27
• Mechanical Vibration	• Test #34, per IEC 60068 part 2-6
• Transportation Drop Test	• Test #33, per ISTA Test Procedure 1A
• Transportation Vibration	• Test #35, per ISTA Test Procedure 1A
Labeling Requirements, Faceplate and Serial Number	
All models	
Labeling per ANSI C12.10-1987 and/or customer specifications for: • TWACS logo • Model number • Model number barcode • TWACS serial number • TWACS serial number barcode The TWACS Serial Number is embedded in the utility's meter number. It must be a distinguishable field of the meter number, or may be duplicated elsewhere on the faceplate. The serialized electronics and faceplate must be kept together.	

Table 4.4 Physical specifications

Parameter	Specification
	
Physical Tamper Protection	
Meter seal	Supported

Additional Regulatory Data

The following is a tabulation of regulatory data found elsewhere in this manual and is required by the regulatory agencies of some countries.

Parameter	Specification
Disclaimer noting that operation of the device is subject to conditions and that the device may not cause harmful interference and device must accept any interference received.	Regulatory Data note on page 28.
Principles of device operation	All of Chapter 2.
Block diagram	Page 27.
Operating frequency	902-928 MHz, page 27, paragraph 1.
Channeling	Page 27, paragraph 1.
Mode of transmission	Page 27, paragraph 1.
Internal/External data source	Page 27, paragraph 1.
Type(s) of modulation	Frequency Shift Keying, page 27, paragraph 1.
Is a subcarrier used to modulate carrier?	No. Page 27, paragraph 1.
Type of information transmitted	Digital data, page 27, paragraph 1.
Occupied bandwidth	200 kHz, page 42, third-to-last item in table.
RF output power	FCC 15.249 compliant, page 42, second-to-last item in table.
Carrier frequency stability	+/- 50 ppm or +/- 46 kHz, page 42, last item in table.

Acronyms

AC	Alternating Current
ADLC	Asynchronous Data Link Communication
AMR	Automatic Meter Reading
ANSI	American National Standards Institution
ASCII	American National Standard Code for Information Exchange
CIS	Customer Information System
DC	Direct Current
DCSI	Distribution Control Systems, Inc.
IEEE	Institute of Electrical and Electronics Engineers
kWh	Kilowatt Hours
LCD	Liquid Crystal Display
MC	Master Controller
MS	Master Station
MSTT	Meter Shop Test Tool
NS	Register Not Supported
PRTU	Portable RCE Test Unit
RCE	Remote Communications Equipment
RMA	Return Material Notice
RTC	Real Time Clock
SCE	Substation Communications Equipment
TCT	Test Communication Tool
TNS	TWACS Net Server
TWACS	Two-Way Automatic Communication System
TWACS® NG	TWACS® Network Gateway
UMT	Universal Metering Transponder

Glossary

address

An assigned unique, fixed number to a memory location in order to retrieve or store data.

Automatic Meter Reading (AMR)

Electronic accumulation and transport of meter data. The process of reading a meter from a remote location at scheduled times or on demand.

bins

A register to store the read data.

bus

An electrical common connection through which power is distributed.

bus identification

Identifies the substation bus to which DCSI equipment is connected.

Central Control Equipment (CCE)

The top level of the TWACS hierarchy, also referred to as the master station. The CCE typically resides at the utility home office, providing system control and data storage for TWACS.

Customer Information System (CIS)

A computer database that utilities use to keep track of their customer information (name, address, phone, meter serial number). Often includes bill printing functionality.

energized meter

A meter that is electrically charged

feeder identification

Identifies which feeders are connected to which bus(es).

hourly interval

A statistical count of hourly usage.

integration

The installation of the transponder into the meter.

Master Controller (MC) or Master Station (MS)

The equipment at the utility's home office that provides system control, data storage, and user interface functions for the system.

Meter Shop Test Tool (MSTT)

A software product developed by DCSI that performs troubleshooting and testing of meters.

non-volatile data

Data that is preserved even when the electrical power is off.

phase

The current supply conductors, other than the neutral conductor of a polyphase circuit, that usually carry the designation phase A, phase B, or phase C.

Portable RCE Test Unit (PRTU)

Portable unit for testing a TWACS-enabled device at a customer site. The PRTU, used in conjunction with a laptop running Meter Shop Test Tool software, generates and decodes TWACS signals for communication with a TWACS-enabled device.

pulse accumulation

A device that accepts and stores pulses

registers

Devices, such as transponders, located at a consumer's premises that collect and transmit register data through TWACS.

Remote Communications Equipment (RCE)

The base of the TWACS hierarchy. RCEs consist of the DCSI family of transponder products. RCEs are located at customer sites and interface TWACS communication with various end devices such as meters, water heaters, and air conditioning units to enable automatic meter reading (AMR), load management, or other functions.

rollover

An event, when the meter reading changes from its maximum value to zero.

Substation Communications Equipment (SCE)

The middle tier of the TWACS hierarchy, consisting of all TWACS substation equipment (CRU, OMU, IPU, and MTU). The SCE transmits and receives data between the Master Station and RCE.

synchronization

A means of ensuring that both transmitting and receiving units are operating together.

tampering

To alter improperly

Total Consumption (TC)

The total electrical usage (in kWh) for the specified type of meter read.

transponders

Two-way field devices that can receive and send messages to and from the substation.

TWACS Next Generation (TNG) or TWACS Net Server (TNS)

Chief component of the entire Two-Way Automatic Communication System. Manages all collected metering and interval data as well as the connection between the utility and the consumer's premises.

Two-Way Automatic Communication System (TWACS)

A patented technology that allows the utility to send and retrieve information to and from meters and other devices using the utility's power lines as a communication network.

Universal Metering Transponder (UMT)

An electronic assembly integrated into an electric meter to add TWACS communications capability to the meter.

volatile data

Data that is lost when the electrical power is off.

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