

T646 MicroRTU

The Telemetric T646 MicroRTU is a multi-channel I/O device suitable for general-purpose usage in a wide variety of applications. It is designed for indoor or outdoor environments, and operates from AC or DC power. The device's internal cellular modem module provides two-way communications through the fully automated Telemetric operations center to the www.telemetric.net web site or, optionally, directly to a utility's secure SCADA system.

The standard operating program of the device monitors the digital inputs and reports any momentary or continuing changes. Analog inputs are also constantly monitored and compared to preset limits. In addition, a variety of status reports can be time scheduled in advance or requested at any time. The device's control outputs can be used to directly control AC or DC powered devices.

Operation is very simple:

1. Connect a Telemetric device to equipment that is to be monitored or controlled and turn the device on. The device will automatically establish two-way communications over the public cellular network to the Telemetric Network Operations Center (NOC) and the www.telemetric.net web site.
2. Log onto your private page on the web site to:
 - View the status of your equipment – switch open or closed, AC voltage present or not, and any other input states.
 - Initiate a change – turn on a pump, close a switch, open the gate, etc.
 - Configure selected events to trigger a control action or an immediate user notification by pager or e-mail.

As an option to using the www.telemetric.net web site, utilities can monitor and control their devices directly through their current SCADA system using a secure DNP TCP/IP interface.

Configuration

Model #	Digital Inputs	Analog Inputs	Digital Outputs
T646	6	4	6
T600	6	0	0
T422	4	2	2

A variety of other subsets of the T646 are available.

Feature Summary

- Low cost to buy and to operate
- Multi-purpose Remote Terminal Unit (RTU)
- Two-way operation
- Communicates anywhere in the North American cellular coverage area using Aeris MicroBurst technology and the public cellular system
- AC Line Voltage Monitor reports under and over voltage conditions as well as momentary and continuing power outages
- Six opto-isolated digital inputs and four analog inputs provide status monitoring, and six digital outputs are available for controlling equipment
- Optional DNP interface to SCADA system

How it Works

When a Telemetric device makes a call from anywhere in North America, it is recognized locally as a roaming cell phone. As a part of the standard roaming protocol, the local cellular network automatically passes the device's identification numbers and data to the central cellular hub. The Telemetric device passes its data packet in a normally non-utilized data field. This technique

allows the transmission of an identification number and the time and date, plus customer specific data, all at a very low cost. At the fully automated Telemetric Network Operations Center (NOC), the data is validated and processed for distribution to the end user. In addition, control and configuration information can be sent from the Telemetric data center to the field device.

The Intelligent Web Server records and displays all incoming status messages and, depending on the customer's instructions, will:

- Notify a designated person of the reported event,
- Send pre-determined control commands back to the field device, and/or
- Pass the data to the customer's designated e-mail or IP address

When a device receives a command to turn a device on or off, it will do so, and will then provide an acknowledgement to the operations center.

The T646 has the ability to send over 25 different status reports. These are sent when an event occurs, such as an input change, analog input or line voltage out-of-limits, or upon a power outage. Each different event will initiate a report that is designed to provide complete information about that event. Over 20 of the reports can be requested from the web site at any time, or can be scheduled to occur automatically at a specific time and frequency.

Hardware Specifications

Digital Inputs

The MicroRTU T646 has six digital inputs. Each input can be used to monitor and report the open or closed status of a dry contact or open collector equivalent. Momentary, continuing, and multiple input changes will be reported.

The six inputs are individually monitored. When any input change is detected, a pre-programmed delay timer (1 to 240 seconds) will be started.

When all active input timers have expired, the T646 will report the status of each input including the number of state changes that occurred, as well as the final state (open / closed). The factory default delay time is 5 seconds.

- 2 terminal points per input are provided for the dry contact inputs. These are optically isolated to 4000 VDC and are designed for dry contacts or equivalent only. Loop voltage is 12 VDC
- 2 additional terminal points for inputs 5 and 6 are provided for direct monitoring of 120 VAC. These terminals detect the presence or absence of AC voltage (labeled "AC" on the board). These inputs are also optically isolated to 4000 VDC. This feature is only available for inputs 5 and 6, but can be ordered as a custom feature for the other inputs.
- The factory default configuration for digital inputs is for all input changes to be reported.
- Multiple input changes, such as from a recloser operation, will be detected, counted, and reported after the programmable delay.

Digital Inputs as Timer /Counters

All six inputs can be programmatically defined as either five-digit counters or as combination timer/counters. An application example for the timer/counter feature is monitoring both the number of times a pump turns on per day and the total amount of time that it's running.

Analog Inputs

The T646 has four twelve-bit analog inputs that can be used to monitor a variety of sensors. Inputs are jumper selectable as

- 0 to 5 VDC (Default)
- 1-10 VDC (Analog 1 only)
- 0-1 mA DC
- 4-20 mA DC
- 0 to 10 VAC, true RMS

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- A fifth analog input is configured as a battery monitor to check battery voltage during any AC power outage.
 - A sixth analog input is dedicated to 120 VAC line voltage measurements.
 - A single +12V, 100mA terminal point provides voltage to power active sensors (this is not available on models using 12 VDC input power).

Telemetric's products are compatible with standard sensors from numerous manufacturers for monitoring:

- Voltage
- Current
- Temperature
- Humidity
- Flow
- Level
- pH, CO2, and others

Digital Outputs

The T646 features six digital outputs for remote control of equipment. The outputs are industry standard, safety agency approved, mechanical relays. Relays one and two are rated for 30 Amps of continuous current at up to 240V. The other four are rated for 8 Amps of continuous current at up to 240V .

Important Note for Outputs 1 and 2: If the Amp draw from the load on the output will be equal to or less than 12 Amps, the load can be connected to the green terminal block. If the load will be greater than 12 Amps, the load must be connected to the spade connectors in the black relay behind the terminal block.

Contact closure times can be programmed to switch AC or DC control voltages for a specific amount of time or continuously (see the Programmable Configurations section).

Local Manual Control for Maintenance

For test and maintenance, remote control of the outputs can be locally disabled. An on-board toggle switch and DIP switches provide local control of all six outputs.

A time delayed local control option for Outputs 1 and 2 allows field personnel to manually initiate a control action and then move a distance from the equipment before the output change is made. The control action (open or close) can be initiated with the on-board DIP switch or through the local computer interface. In either case, the controller provides the programmable delay time for both the open and close operations. The timers can be set from 0 to 240 seconds.

All local and remote control actions for Outputs 1 and 2 are also limited by a programmable delay time between open and close operations.

Two-Way Communications

Two-way communications allow all remote control commands to be positively acknowledged with a report that includes the status of the affected inputs and outputs. This provides a valuable verification of all switching operations. After any remote control action is activated, the user has the ability to compare the reported inputs to the expected states or conditions, thus ensuring maximum compliance with all remote commands.

Remote control functionality can reduce the need for locally controlled switching with control decisions based upon centralized monitoring and control algorithms.

Web based controls are secured by a multi-level password system with advanced passwords required to send control commands or remotely reconfigure devices.

On-board RS-232 Serial Port

The serial port can be connected directly to a laptop, or desktop computer to facilitate system configuration, testing, radio configuration, and installation. The port can optionally provide

communication with an intelligent monitored device.

Local User Interface

A configuration program is included with the device at no extra cost. This program is designed to run on a Windows-based computer. Connecting a computer to the device's RS-232 port and starting the program initiates local communication with the T646.

The configuration program allows the user to carry out the following tasks: Display Operating Status, View (existing) Programmable Parameters, Download (new) Parameters, Display all Inputs, Control Outputs, and Update Voltage Calibration.

Programmable Operating Parameters

Local Programming of Operating Parameters

A variety of programmable set points are available to configure the operation of the product. These set points are saved into permanent (EEPROM) memory through the use of the configuration program.

The default values for the following parameters are programmed into the device at the factory. These values can be changed in the factory by special order or changed by the user during the local programming process.

Digital Inputs

In the default-operating mode, if any digital input changes, and the change lasts longer than 0.2 seconds, it will be reported. When an input change is detected, a pre-programmed delay timer (1 to 240 seconds) will be started. This parameter specifies the amount of time that the T646 will delay before reporting the event. When all active input delay timers have expired, the T646 will report the status of each input including the number of state changes that occurred as well as the final state (open / closed).

Delay Time Range: 1 to 240 seconds

Factory default delay time: 5 seconds

In addition to the normal "alarm mode", each input can be individually configured as either a counter or a timer/counter. Both the counter and timer report as a 5-digit value. The maximum counter speed is 20 Hz. The timer function reports the number of minutes that the contact is closed.

Digital Outputs

Each of the six outputs can be remotely controlled as:

- Permanent – where the requested on/off state remains fixed until the next change command, or
- Temporary – where the requested state remains fixed for a specified amount of time, then changes to the opposite state. An example application is: Turn a load on for 8 hours and then turn it off. This can be accomplished with one "Temporary" command.

The duration of the temporary change can be programmed to last anywhere from 1 minute to 240 hours, 59 minutes and 59 seconds.

Hours: 0-240
Minutes: 0-59
Seconds: 0-59

Default: 10 seconds

Example Applications:

- In the temporary mode, a 30 second output "pulse" can be used to close a motor driven switch. A four-hour Temporary ON signal may enable a voltage reduction process during late night hours.
- A command can also be sent to turn a device on temporarily for 1 hour when the device is already on. This has the effect of turning the device OFF in one hour.

Local Control Delay Time

For local personnel safety, the controller provides a programmable delay time for manual open and close operations.

Delay time range: 0-240 seconds

Factory default: 0 seconds

Between-Controls Delay Time

For safe operation, the controller provides a minimum delay time between all open and close operations on Outputs 1 and 2. This delay is used for both local and remote control operations.

Delay time range: Disabled or 1-10 minutes

Factory default: Disabled

Command Acknowledgements

After receiving and implementing an output change command, the T646 will delay for a specified amount of time, then report the status of the affected inputs and outputs. This delay can be used to retrieve the status of the controlled equipment or environment after the output change has had time to take effect.

The ACK delay can range from 3 seconds to 240 minutes and 59 seconds. Default is 20 seconds.

Time Scheduled Reports

Up to four standard reports can be time scheduled with the call frequency set anywhere from once every hour to once every 240 hours (10 days). Note that when this option is enabled, reports will begin one hour after the device is powered on. To begin calls at a specific time, leave this setting disabled and initiate the time scheduled reports from the web site at a specific time. Daily status or heartbeat calls should be scheduled in the off-peak hours (10pm to 3am).

Range: 1 hour to 240 hours

Selected report: 1-99

Default: Disabled

Daily Call Limits

To limit the number of calls that might result from over-active input conditions, the number of event-based calls per day can be limited. Time scheduled calls, user requested status calls and command acknowledgements will continue to be placed even after this limit has been reached. The call limit should be selected so that the TOTAL number of calls is limited to no more than 20 calls per day and no more than 400 calls per month.

The daily limit can be set from 1 to 20. The factory default setting is 12.

Analog Input Monitor / Reporting

Measured analog values are reported as a number ranging from 0 - 4095. This value is converted to more meaningful units at the web server (degrees F, flow rate, etc.).

A report is initiated when the measured value crosses one of three predefined set points and the change lasts longer than the trigger time. The call reports the present reading as well as the minimum and maximum values measured since the last report.

Set points are independently programmable for each of the four analog inputs. Individual sensor characteristics should be used to determine the desired set points. The trigger time can be set in 1-second increments between 0 (no delay) and 240 minutes, 59 seconds. The three set points can be set anywhere from 0 to 4095. Setting any of these values to 0 will disable that set point. The factory default settings are 0 (disabled) for all three set points and 10 seconds for the trigger time.

Set Point 1 (Hi): 0-4095, default = 0 (disabled)

Set Point 2 (Mid): 0-4095, default = 0 (disabled)

Set Point 3 (Low): 0-4095, default = 0 (disabled)

Trigger Time: 0-240 minutes, 0-59 seconds,

Default = 0 minutes, 10 sec

Power Outage Reporting

Outage calls report the number of state changes (OFF-ON-OFF =3) and the final state (ON or OFF) at the time of the call. If the power is ON at the time of the call, the report will also include the highest and lowest measured voltage reading. If the power is OFF at the time of the call, the report will include the highest measured voltage reading and a battery voltage indicator. The outage call will be triggered by any power outage that lasts longer than a specified period of time.

The range of trigger times is 0.1 second to 240.9 seconds. Default = 0.1 second.

Under / Over Voltage Reporting

A report is initiated when the AC voltage decreases below a preset level or increases above a preset level for more than N seconds. This call reports the present voltage, plus the minimum and maximum voltage measured since the last report.

The Under Voltage set-point can be set anywhere between 100 and 119 Volts and the Over Voltage set-point can be set anywhere between 121 and 135 Volts. Either or both settings can also be disabled. The factory default settings are 110 and 128 VAC for 5 seconds.

Cellular Channel Selection

If Cellular Auto Select is enabled, the device will automatically communicate with the web server to determine whether it should communicate on the A or the B cellular channel. If there are multiple MicroBurst carriers in the area, and there is a preference for one of them, it is possible to locally specify the preferred channel.

Cellular Channel: A, B or Auto Select
Default: Auto Select

Extended Battery Option

The default operation is to turn the battery off one minute after reporting an AC power outage. To maintain continued operation during a power outage, enable the Extended Battery Option.

Enable or Disable, Default: Disabled

Controls and Display

Several basic functions can be initiated from nine on-board switches without the use of a computer. The first switch is a mechanical toggle switch and the rest are DIP style slide switches.

Toggle Switch

Enable / disable all remote control functions

DIP Switches

- 1 Enable/ disable local control
- 2-7 Set control outputs # 1-6 to on or off
- 8 Radio On/Off - in Radio Off mode, no calls are made to the NOC.

When there is a change in the switch position of the toggle switch or switches 1 – 7, this is immediately reported to the Telemetric NOC.

Pushbutton Switch

The Test button is just above the RSSI LEDs. Press for less than 2 seconds to test the cellular Receive Signal Strength (RSSI) or for more than two seconds to initiate a registration call.

Three LED indicators display the following information:

- 1. Green AC Power present (top of board)
- 2. Green Transmit Success / Misc. indications
- 3. Red Transmit Fault / Misc. indications

Operating Power & Backup Battery

The standard T646 is designed to operate from either 120 VAC, 12 VDC, 24 VDC or 31-144 VDC models are also available. (Any external 12 VDC power supply must be capable of providing up to 2.5 Amps for 3 seconds during the radio transmission.)

An optional 4.5 Amp Hour sealed rechargeable battery (5 year expected lifetime) and an on-board battery charger is included. It is required if, and only if, the device will be used to report power outages. All other functions, including under and over voltage conditions and power restorations will be reported without a battery.

A battery voltage indicator is reported with every power outage report. This value can be used to detect a weak battery.

Intelligent Web Server and SCADA Xchange – An Overview

Note: This subject is described in detail in a separate document.

All monitoring, control, and remote configuration functions can be performed at the www.telemetric.net web site. No software purchases are required. All reported data is saved in a Microsoft SQL Server database, and can be viewed at any time from any web connected PC.

To view stored data, the user logs on to a private secure page on the www.telemetric.net web page. By entering a confidential user name and password, the user can access data from their devices. Descriptive information and utility specific identification data can be entered and stored for each device.

The Current Status display for each device includes the date and time of the latest report and the last reported status or value of:

- Digital inputs
- Analog inputs
- Line voltage
- Highest voltage reported since previous call
- Lowest voltage reported since previous call

In addition to viewing the last reported and historical data, the user can request a new report from an individual device or from an entire group

of devices at any time. A group report allows the user to request the present status of any selected group of devices.

Three password levels control access to data, control functions, and remote configuration functions.

- View data only
- View data and request reports from devices
- View data, initiate control actions, and remotely configure the device

All collected data can be exported to a Microsoft Excel spreadsheet where a variety of reports can be created by sorting, listing, and graphing the data. For example, the user could display all line voltage readings, power outages, or analog readings for a specific device or group of devices. A graph of the present, highest, and lowest line voltage as reported each day provides a useful tool for monitoring power quality.

A “missing device” report can identify any devices that have not called in within a specified period of time.

An optional interface to DNP based SCADA systems, called Telemetric SCADA Xchange, allows the data to be passed directly to the utility without the use of the web site.

SCADA-Xchange translates data from the Telemetric field devices into DNP3 responses, and then returns the data to the utility’s SCADA system over a secure TCP/IP connection. When a change is detected, the event is reported like any other alarm on SCADA

Basic Specifications

Cellular Radio Operating Specifications

The CMM8700 cellular modem module has the following specifications:

- 0.6, 1.2, and 3 Watt transmit power at 824-849 MHz.
- Receive frequency: 869-894 MHz
- Compatible with the AMPS analog cellular system

Antenna

The included antenna is a “rubber duck” style, ½ wave, 2.5dB antenna. An external SMA connector provides the connection to this antenna or to a remote antenna if desired. Larger (50-ohm cellular frequency) antennas including Yagi or higher gain omni-directional models can be used to improve performance in fringe areas.

CPU / Memory

The CPU is a Microchip PIC product. Non-volatile (EEPROM) memory is used to store configuration and operational data.

Environmental Specifications

The recommended operating temperature range is -40 to +70 degrees C.

The maximum operating temperature range

The recommended relative humidity range is 5 - 95% non-condensing.

Electrical Specifications

Operating Voltage Range: 100 -135 VAC, 60 Hz.

Surge Withstand: ANSI C62.41-1987
ANSI C37.90.1

Electrostatic Discharge Test: IEC 801-2, 15 KV
ANSI C37.90

Power Consumption: less than 100 Watts

FCC Part 15: Compliant

Output Relays: Number: 6

Maximum continuous load: 4 - 120 VAC, 8 Amps
2 - 120 VAC, 30 Amps

Contact Closure Period: 1 second to 240
seconds momentary
or continuous

Standard Battery: 12 VDC, 4.5 AH
Sealed lead-Acid,
Rechargeable

On-board battery charger: 13.8VDC float,
current limited
to 700mA

On-board fuse: 120 VAC, 1 Amp

Mechanical Specification

The standard enclosure is a steel box offering the following features:

- NEMA 4 rating
- Integrated mounting flanges
- Provision for a utility seal and padlock
- Gray steel construction
- Four conduit compatible cable entry holes on the box bottom
- Dimensions: 10.5” x 8.5” x 4.5”
- Weight: 17 lbs

Options include: a non-metallic enclosure and a four-jaw socket mount base.