TERIDIAN SEMICONDUCTOR CORP.

A Maxim Integrated Products Brand

USER GUIDE

6618_PDU_S8_URT_V1_00
Firmware Description Document

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1 Introduction

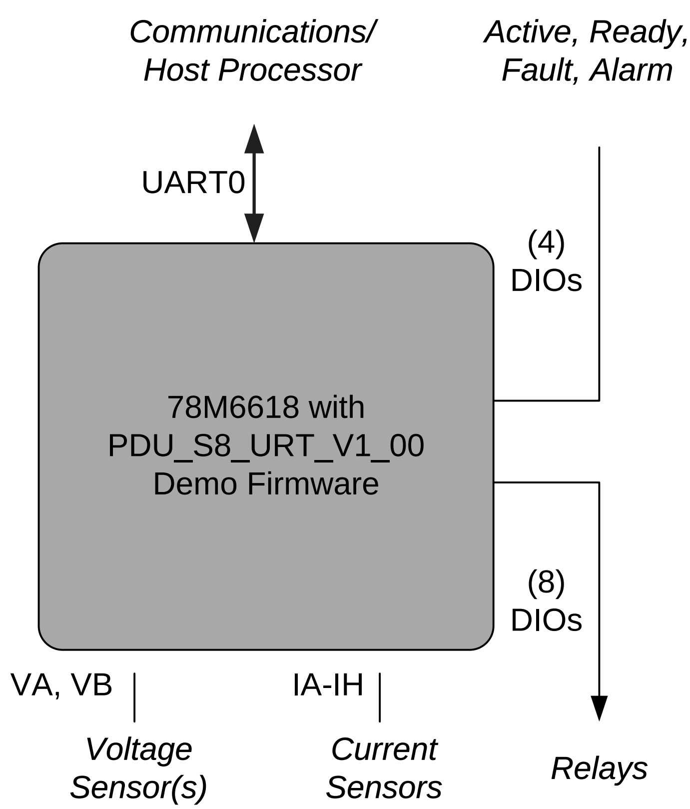
This document describes the 6618_PDU_S8_URT_V1_00 demo firmware and its use with the Teridian 78M6618 power and energy measurement IC. This firmware provides simple methods for calibration, relay control, and access to precision measurement data such as Watts, Voltage, Current, accumulated Energy and line frequency. It is optimized for measurement and control of eight single phase AC loads using current shunts as the current sensors, but Current Transformer (CT) sensors may also be used if desired.

All measurement calculations are computed by the 78M6618 and communicated to the host processor over a serial interface (UART0) on the TX and RX pins of the 78M6618 device at 38.400 bps baud, 8N1, Xon/Xoff.

RTC (real time clock), LCD Driver, and Battery Modes are not supported by this firmware.

DIO pins utilized by this firmware include:

- DIO7, 8, 9, 10, 11, 13, 14, and 15 for relay control of Outlets 8:1 respectively.
- DIO6 for Line/Neutral Reversal FAULT (default) or Watt Pulse output.
- DIO17 and DIO18 for Ready and Active status indicators.
- DIO4 for configurable alarm/interrupt pin.



The following sections detail the commands to be sent by the host to configure the 78M6618 and for accessing measurement information.

2 Description of Basic Measurement Equations

The Teridian 78M6618 with demo firmware 6618_PDU_S8_URT_V1_00 provides the user with two types of continuously updating measurement data (on 1 second increments by default). One is defined as "Narrowband" (NB) and the other is defined as "Wideband" (WB).

> Narrowband measurements are typically used by utilities where the measured waveforms are assumed to be sinusoidal.
>
> Wideband measurements are generally of interest when measuring nonlinear systems such as switched mode power supplies that tend to have non-sinusoidal waveforms.

Table 1 lists the basic measurement equations for the Narrowband and the Wideband methods.

Table 1: Measurement Equations Definitions

Symbol	Parameter	Narrowband Equation	Wideband Equation
V	RMS Voltage	$V = \sqrt{\sum v(t)^2}$	$V = \sqrt{\sum v(t)^2}$
I	RMS Current	I = S/V	$I = \sqrt{\sum i(t)^2}$
P	Active Power	$P = \sum (i(t) * v(t))$	$P = \sum (i(t) * v(t))$
Q	Reactive Power	$Q = \sum (i(t) * v(t)\text{shift } 90^o)$	$Q = \sqrt{(S^2 - P^2)}$
S	Apparent Power	$S = \sqrt{(P^2 + Q^2)}$	S = V * I
PF	Power Factor	P/S	P/S
PA	Phase Angle	ACOS (P/S)	ACOS (P/S)

Both types of measurement outputs are continuously available to the user. To obtain measurement outputs, the serial UART interface between the 78M6618 and the host processor must be set up. This is described in the next section.

3 Serial Communication

The serial communication with the 78M6618 takes place over a UART (UART0) interface. The default settings for the UART of the 78M6618, as implemented in this firmware, are given below:

Baud Rate:	38400bps
Data Bits:	8
Parity:	None
Stop Bits:	1
Flow Control:	Xon/Xoff

The host's serial interface port is required to implement these settings on its UART. To verify communication between the host and the 78M6618, the host must send a <CR> (carriage return) to the 78M6618. Communication is verified when the 78M6618 returns a > (greater than sign) known as the command prompt. An example is given below:

The host sends the following to the 78M6618:

<CR>

The 78M6618 sends the following back to the host:

\>

Commands the host may send to the 78M6618 in order for the host to configure the 78M6618 or to receive the measurement data are given in the next section.

4 Command Line Interface

Firmware 6618_PDU_S8_URT_V1_00 implements an instruction set called the Command Line Interface (CLI), which facilitates simple communication via UART between the 78M6618 and the host processor. The CLI provides a set of commands which are used by the host to configure and to obtain information from the 78M6618.

4.1 Identification and Information Commands

The I command is used to identify the revisions of the 6618_PDU_S8_URT_V1_00 firmware code and the embedded CE code. The host sends the I command to the 78M6618 as follows:

>I<CR>

The 78M6618 will send back to the host the following:

TSC 78M6618 PDU S8 URT v1.00 APRIL 16 2010(c)2009 Teridian Semiconductor Corp.
All Rights Reserved
CE6618_PDU_S8_A01_V0_2

>

4.2 Reset Commands

A soft reset of the 78M6618 can be performed by using the Z command. The soft reset restarts code execution at addr 0000 but does not alter flash contents. To issue a soft reset to the 78M6618, the host sends the following:

>Z<CR>

The W command acts like a hardware reset. The energy accumulators in XRAM will retain their values.

Z	**Reset**	
Description:	Allows the user to cause soft resets.	
Usage:	Z	Soft reset.
	W	Simulates watchdog reset.

4.3 MPU Data Access Command

The most pertinent is the MPU data access command. All the measurement calculations are stored in the MPU data addresses of the 78M6618. The host requests measurement information using the MPU data access command which is a right parenthesis

)

To request information, the host sends the MPU data access command, the address (in hex) which is requested, the format in which the data is desired (Hex or Decimal) and a carriage return. The MPU data contents of the addresses that are available to the host are contained in Section 5.

4.3.1 Individual Address Read

The host can request the information in hex or decimal format. $ requests information in hex, and ? requests information in decimal.

> When requesting information in decimal, the data is preceded by a + or a -. The exception is)20F? which returns a string (see the 20F description in Section 6.1).
>
> When requesting information in hex, 32-bit data (eight hex characters) are returned in 2's compliment data format.

An example of a command requesting the measured power in Watts from Outlet 1 (located at address 0x08) in decimal is as follows:

>)08?<CR>

An example of a command requesting the measured power in Watts from Outlet 1 (located at address 0x08) in hex is as follows:

>)08$<CR>

4.3.2 Consecutive Read

The host can request information from consecutive addresses by adding additional ? for decimal or additional $ for hex.

An example of requests for the contents in decimal of five consecutive addresses starting with 0x10 is:

>)10?????<CR>

An example of requests for the contents in hex of five consecutive addresses starting with 0x10 would be:

>)10$$$$$<CR>

Note: The number of characters per line (CLI command string from host) is limited to no more than 60.

4.3.3 Block Reads

The block read command can also be used to read consecutive registers:)saddr:eaddr? For decimal format or)saddr:eaddr$ for hex format where saddr is the start address and eaddr is the final address.

The following block read command requests the Outlet 1 wideband information contained in Table 2 in decimal format:

>)08:0F?<CR>

4.3.4 Concatenated Reads

Multiple commands can also be added on a single line. Requesting information in decimal from two locations and the block command from above are given below:

>)01?)07?)0B:0F?<CR>

Note: The number of characters per line (CLI command string from host) is limited to no more than 60.

4.3.5 MPU Data Write

Where applicable, the MPU data access command can be used to write values to configurable inputs. An example where the minimum temperature threshold is to be changed to 10°C is set as follows:

>)240=+10.0

4.3.6 MPU Data Access Commands

)	**MPU Data Access**	
Description:	Allows user to read from and write to MPU data space.	
Usage:	) {Starting MPU Data Address} {option}…{option}<CR>	
Command Combinations:	)saddr? <CR>	Read the register in decimal.
	)saddr?? <CR>	Read two consecutive registers in decimal.
	)saddr???<CR>	Read three consecutive registers in decimal.
	)saddr:eaddr?	Block read command in decimal format. Read consecutive registers starting with starting address saddr and ending with address eaddr. Results given in decimal.
	)saddr$<CR>	Read the register word in hex.
	)saddr$$ <CR>	Read two consecutive register words in hex.
	)saddr$$$<CR>	Read three consecutive register words in hex.
	)saddr:eaddr$	Block read command in hex format. Read consecutive registers starting with starting address saddr and ending with address eaddr. Results given in hex.
	)saddr=n<CR>	Write the value n to address saddr in hex format.
	)saddr=n=m<CR>	Write the values n and m to two consecutive addresses starting at saddr in hex format.
	)saddr=+n<CR>	Write the value n to address saddr in decimal format.
	)saddr=+n=+m<CR>	Write the values n and m to two consecutive addresses starting at saddr in decimal format.
Examples:	)08$<CR>	Reads data word 0x08 in hex format.
	)08$$<CR>	Reads data words 0x08, 0x09 in hex format.
	)08$$$<CR>	Reads data words 0x08, 0x09, 0x0A in hex format.
	)108:10F$	Read Outlet 1 narrowband data words in hex.
	)08?<CR>	Reads data word 0x08 in decimal format.
	)08??<CR>	Reads data words 0x08, 0x09 in decimal format.
	)08???<CR>	Reads data words 0x08, 0x09, 0x0A in decimal format.
	)108:10F?	Read Outlet 1 narrowband data words in decimal.
	)04=12345678<CR>	Writes word @ 0x04 in hex format.
	)04=12345678=9876ABCD<CR>	Writes two words starting @ 0x04 in hex format.
	)04=+123<CR>	Writes word @ 0x04 in decimal format.
	)04=+123=+334<CR>	Writes two words starting @ 0x04 in decimal format.

4.4 Auxiliary Commands

4.4.1 Repeat Command

The repeat command is useful for repetitive monitoring measurements and reducing the requesting command to a single character.

If the host requests line frequency, alarm status, overcurrent event count, Vrms SAG event count, Vrms overvoltage event count, and voltage for the PDU with the following command string:

>)01???????<CR>

If the host then desires this same request without issuing another command, the repeat command can be used:

>, (no carriage return needed for the repeat command)

The host only needs to send one character rather than an entire string.

	Auxiliary	
Description:	Various	
Commands:	,	Typing a comma (“,”) repeats the command issued from the previous command line. This is very helpful when examining the value at a certain address over time, such as the CE DRAM address for the temperature.
	/	The slash (“/”) is useful to separate comments from commands when sending macro text files via the serial interface. All characters in a line after the slash are ignored.

4.5 Calibration Commands

Using the precision source method, the user provides a precision voltage and precision current load to the device for calibration. The 6618_PDU_S8_URT_V1_00 firmware provides commands to calibrate the measurement units.

There are two types of calibration commands:

- The first type provides complete calibration.
- The second group, called atomic calibration commands, provides calibration for individual elements in the measurement equations.

Additionally, a “target calibration value” and a “target calibration tolerance” are provided to optimize the single point calibration results with regards to the system requirements.

4.5.1 Complete Calibration Command (“Single Command Calibration”)

There are two calibration commands in this first group: CAL and CALW. **Only one of these commands is needed to calibrate each outlet.**

To use these commands, a precision voltage source and a precision current source are required.

4.5.1.1 CAL Command

To use the CAL command, enter the following for outlet 1:

>CAL1<CR>

The response is:

TCal OK
VCal OK:
ICal 1 OK:
>

The device calibrates the temperature (turns temperature compensation on), then calibrates the voltage (adjusts CAL VA and CAL VB registers and saves them to flash), and finally calibrates the current for Outlet 1 (adjusts CAL IA register and saves all the values to flash).

4.5.1.2 CALW Command

To use the CALW command for outlet 1, enter the following:

>CALW1<CR>

The response is:

TCal OK
VCal OK:
WCal 1 OK:
>
The device will calibrate the temperature, calibrate the voltage, and finally calibrate the power and save all values to flash.

The commands are summarized in the table below:

CALx	**Complete Calibration Commands**	
Description:	Allows the user to Calibrate the IC.	
Usage:	CAL1 CAL2 CAL4 CAL8 CAL10 CAL20 CAL40 CAL80 CALFF	Calibrates temperature, then voltage, and finally current (sequentially for any combination of outlets). Examples: CAL1 for Outlet 1 CAL2 for Outlet 2 CAL4 for Outlet 3 CAL8 for Outlet 4 CAL10 for Outlet 5 CAL20 for Outlet 6 CAL40 for Outlet 7 CAL 80 for Outlet 8 CALFF for Outlets 1 through 8
	CALW1 CALW2 CALW4 CALW8 CALW10 CALW20 CALW40 CALW80 CALWFF	Calibrates temperature, then voltage, and finally power (sequentially for any combination of outlets). Examples: CALW1 for Outlet 1 CALW2 for Outlet 2 CALW4 for Outlet 3 CALW8 for Outlet 4 CALW10 for Outlet 5 CALW20 for Outlet 6 CALW40 for Outlet 7 CALW80 for Outlet 8 CALWFF for Outlets 1 through 8

4.5.2 Setting Target and Tolerance Parameters

Calibration of the 78M6613 board requires two external precision reference sources: a voltage source and a current source. The current source could be replaced with a precision load resistor. The 78M6613 calibration procedure performs a single point calibration for each of the following: ambient temperature, load voltage and load current. The 78M6613 calibrates against the following default conditions:

Target Calibration Temperature: +22.0° C

Target Calibration Voltage: 120.000 VAC

Target Calibration Current: +1.000 Arms

Target Calibration Phase Angle: +0°

Target Calibration Watts: +120.000

Additionally, each of the above target parameters has a respective calibration tolerance. The calibration tolerance sets the threshold at which the calibration procedure closes-in on and then stops. The calibration procedure stops when the measured results fall within: Target Calibration ± Target Tolerance.

Target Temperature Tolerance: +22.0° C

Target Voltage Tolerance: 0.010 mVAC

Target Current Tolerance: 0.010 Arms

Target Phase Angle Tolerance: +0°

Target Watts Tolerance: +120.000

The target calibration and target tolerance parameters can be changed. The target tolerance must be much larger than the reference source noise. Otherwise, the reference source noise will cause the calibration process to take longer or fail to calibrate.

See Table 4 for the address locations of the various target and tolerance registers.

Refer to the *78M661x Calibration Procedure Application Note* for additional calibration procedure information.

4.5.3 Atomic Calibration Commands

The atomic calibration commands provide individual calibration of voltage, current, temperature, and watts. A complete sequence of these atomic commands is equivalent to full calibration for the unit.

4.5.3.1 CLV Command

An example of an atomic calibration command would be to calibrate voltage with the CLV command. The CLV command calibrates voltage to the target value and tolerance and saves the coefficients to flash. The CLV command example is given below:

>CLV<CR>

The response is:

VCal OK:
>

4.5.3.2 CLI Command

The user can then calibrate the current on Outlet 1 using the CLI1 command. The CLI1 command calibrates the current on Outlet 1 to the target value and tolerance and saves the coefficients to flash. The CLI1 command example is given below:

>CLI1<CR>

The response is:

ICal 1 OK:
>

4.5.3.3 CLP Command

The user can calibrate for phase added by a current transformer by using the CLP command. The CLP command calibrates the phase on the selected outlet to the target value and tolerance and saves the coefficient to flash. An example of the procedure for Outlet 1 is given below.

Apply a controlled precision voltage and current signal at a set phase angle.

1. Enter target phase angle at)223.
2. Enter phase tolerance at)21F
3. Enter phase calibration command.

   >CLP1<CR>

   The response is

   >PCal 1 OK:

4.5.3.4 CLT Command

The CLT command is used for the temperature calibration. With this command, temperature compensation is turned on. The target temperature is 22°C. If the ambient temperature is something other than 22°C , then the ambient temperature target at)22E should be set to the ambient temperature prior to issuing the CLT command. The CLT command example is given below:

>CLT<CR>

The response is:

TCal OK
>

A summary of the atomic calibration commands are given in the table below:

CLxx	**Atomic Calibration Commands**	
Description:	Allows the user to Calibrate individual sections of the IC.	
Usage:	CLV	Calibrates voltage only.
	CLI1 CLI2 CLI4 CLI8 CLI10 CLI20 CLI40 CLI80 CLIFF	Calibrate current only for select outlets. Examples: CLI1 for Outlet 1 CLI2 for Outlet 2 CLI4 for Outlet 3 CLI8 for Outlet 4 CLI10 for Outlet 5 CLI20 for Outlet 6 CLI40 for Outlet 7 CLI80 for Outlet 8 CLIFF for all outlets (in sequence)
	CLW1 CLW2 CLW4 CLW8 CLW10 CLW20 CLW40 CLW80 CLWFF	Calibrate power only for select outlets. Examples: CLW1 for Outlet 1 CLW2 for Outlet 2 CLW4 for Outlet 3 CLW8 for Outlet 4 CLW10 for Outlet 5 CLW20 for Outlet 6 CLW40 for Outlet 7 CLW80 for Outlet 8 CLWFF for all outlets (in sequence)
	CLP1 CLP2 CLP4 CLP8 CLP10 CLP20 CLP40 CLP80 CLPFF	Calibrate phase only for select outlets. Examples: CLP1 for Outlet 1 CLP1 for Outlet 2 CLP1 for Outlet 3 CLP1 for Outlet 4 CLP1 for Outlet 5 CLP1 for Outlet 6 CLP1 for Outlet 7 CLP1 for Outlet 8 CLPFF for all outlets (in sequence)
	CLT	Calibrate temperature only.

4.6 Relay Control Command

Relay control is implemented in the sample CLI application using the TC command. See Section 1, Introduction, for relay assignments to the DIOs for each specific channel. The TC command can be used to open (0) or close (1) circuit of all 8 channels. All necessary Sequence (time between each channel), Energized (for closing circuit), and De-Energized (for opening circuit) delay times are set up and used by the library using the following default values:

Energized delay time = 0ms
De-Energized delay time = 0ms
Sequence delay time = 100ms

4.6.1 TC Command

The format of the TC command is as follows (where it is not a case sensitive):

>tc is the same as >TC or >Tc or >tC.

>TCxx where xx is a hex value with each bit represents the setting of each channel. The value of each bit is determined as 1 = closing and 0 = opening 0. All 8 channels will be processed sequentially starting from the highest channel number first with a sequence delay time in between. It is important to note that if the polarity for each Channel is inverted, bit 1 of the Relay Config register (0x0210) will be set accordingly in order for the Relay Control to work properly.

The TC commands are summarized in the following table:

TCx	**Relay Control Commands**	
Description	Allows the user to control the relay of all 8 channels in one command.	
Usage	 TC1 or TC01 TC2 or TC02 TC4 or TC04 TC8 or TC08 TC10 TC20 TC40 TC80 TCFF TC0 or TC00	The CT command can be used to turn on/off relay of all 8 channels. Each bit represents the control (1=on, 0=off) for each channel where the LSB represents the lowest channel number. Examples: Relay ON for Outlet 1, OFF all others. Relay ON for Outlet 2, OFF all others. Relay ON for Outlet 3, OFF all others. Relay ON for Outlet 4, OFF all others. Relay ON for Outlet 5, OFF all others. Relay ON for Outlet 6, OFF all others. Relay ON for Outlet 7, OFF all others. Relay ON for Outlet 8, OFF all others. Relay ON for all channels. Relay OFF for all channels.

4.7 CE Data Access Commands

The commands that follow are included for reference only.

The CE is the main signal processing unit in the 78M6618. User writes to the CE data space are mainly for calibration purposes. For the advanced user, details of CE data access commands are described. The commands are similar to the MPU data access commands except that a] is used for the CE data access command.

The host requests access to information from the CE data space using the CE data access command which is a right square bracket:

]

To request information, the host sends the CE data access command, the address (in hex) which is requested, the format in which the data is desired (hex or decimal) and a carriage return. The contents of the addresses that are available to the host are contained in Section 6.2.

The host can request the information in hex or decimal format. $ requests information in hex and ? requests information in decimal.

4.7.1 Single Register CE Access

An example of a command requesting the calibration constant for current on Outlet 1 (located at address 0x10) in decimal is as follows:

>]10?<CR>

An example of a command requesting the calibration constant for current on Outlet 1 (located at address 0x10) in hex is as follows:

>]10$<CR>

4.7.2 Consecutive CE Reads

The host can request information from consecutive addresses by adding additional ? for decimal or additional $ for hex.

An example of requests for the contents in decimal of ten consecutive addresses starting with 0x10 would be:

>]10??????????<CR>

An example of requests for the contents in hex of ten consecutive addresses starting with 0x10 would be:

>]10$$$$$$$$$$<CR>

Note: The number of characters per line (CLI command string from host) is limited to 60.

4.7.3 CE Data Write

If the cal coefficient for the IA current input is changed:

>]10=FFFFC9B0<CR>

4.7.4 CE Data Access Command Summary

CE Data Access examples are provided in the table that follows:

]	**CE Data Access**	
Description:	Allows user to read from and write to CE data space.	
Usage:	] {Starting CE Data Address}{option}…{option}<CR>	
Command Combinations:	]saddr?<CR>	Read 32-bit word in decimal.
	]saddr??<CR>	Read two consecutive 32-bit words in decimal.
	]saddr???<CR>	Read three consecutive 32-bit words in decimal.
	]saddr$<CR>	Read 32-bit words in hex.
	]saddr$$<CR>	Read two consecutive 32-bit words in hex.
	]saddr$$$<CR>	Read three consecutive 32-bit words in hex.
Examples:	]40$<CR>	Reads CE data word 0x40 in hex.
	]40$$<CR>	Reads CE data words 0x40 and 0x41 in hex.
	]40$$$<CR>	Reads CE data words 0x40, 0x41 and 0x42 in hex.
	]40?<CR>	Reads CE data words 0x40 in decimal.
	]40??<CR>	Reads CE data words 0x40 and 0x41 in decimal.
	]40???<CR>	Reads CE data words 0x40, 0x41 and 0x42 in decimal.
	]7E=12345678<CR>	Writes word at 0x7E (hex format).
	]7E=12345678=9876ABCD<CR>	Writes two words starting at 0x7E (hex format).
	]7E=+2255<CR>	Write the value 2255 in decimal to location 0x7E.
	]7E=+2255=+456<CR>	Write the value 2255 in decimal to location 0x7E and the value 456 in decimal to location 0x7F.

4.8 CE Control and Update Commands

The most pertinent CE control command is the enable command, CEn. It is mainly used to turn the CE on or off. The CE is normally enabled but in order to update any data entry to flash, the CE must first be turned off using the CE0 command.

4.8.1 Turn Off CE Command

For this value to be the default value, the U command is used. The CE must first be turned off by:

>CE0<CR>

4.8.2 Update Command

The U command is now issued to save modified follows:

For saving CE input parameters:

>]U<CR>

For saving MPU input parameters:

>)U<CR>

Important: The CE must be stopped (CE0) before issuing a U command! Also, remember to restart by executing the CE1 command prior to attempting measurements.

4.8.3 Turn On CE Command

The CE must then be turned on by:

>CE1<CR>

The CE Control and Update Commands are highlighted in the table below:

C	**Compute Engine Control**	
Description:	Allows the user to enable and configure the compute engine.	
Usage:	C {option} {argument}<CR>	
Command Combinations:	CEn<CR>	Compute Engine Enable (1 → Enable, 0 → Disable)
	CTn<CR>	Select input n for TMUX output pin. Enter n in hex notation.
	CREn<CR>	RTM output control (1 → Enable, 0 → Disable)
	CRSa.b.c.d<CR>	Selects CE addresses for RTM output. (maximum of four).
	]U<CR>	Update defaults of CE Input Data in FLASH.
	)U<CR>	Update defaults of MPU Input Data in FLASH.
Examples:	CE0<CR>	Disables the CE.
	]U<CR>	Updates CE parameters in Flash
	CE1<CR>	Enables the CE.

4.9 I/O RAM (Configuration) Commands

The RI command is used for altering the I/O RAM contents. This is usually not necessary as the FW defaults these settings appropriately.

R	I/O RAM Control	
Description:	Allows the user to read from and write to I/O RAM.	
Usage:	RI {option} {register} … {option} <CR>	
Command Combinations:	RIx…<CR>	Select I/O RAM location x (0x2000 offset is automatically added).
Example:	RI60$$$$<CR>	Read all four RTM probe registers.

Configuration RAM space is in the address range from 0x2000 to 0x20FF. This RAM contains registers used for configuring basic hardware and functional properties of the 78M6618 and is organized in bytes (8 bits). The 0x2000 offset is automatically added when the command RI is invoked.

4.9.1 Energy Accumulation Interval

The RI command is needed when the change of accumulation interval for energy measurements is desired. The default accumulation interval is 1 second (999.75 ms). The accumulation interval is set by the following:

> 0.01666 * *SUM_CYCLES[5:0]* (in seconds) where *SUM_CYCLE[5:0]* are register bits in the I/O RAM that can be between 15d and 63d (default is 60d). *SUM_CYCLES* must never be set below 15 (0.250 seconds).

To reduce the accumulation interval to 0.5 seconds, enter the following via the UART:

```
>RI1=+30<CR>
```

Entering an update command will preserve the new accumulation value permanently in flash.

```
>CE0<CR>
>
>)U<CR>
>
>CE0<CR>
```

5 MPU Measurement Outputs

This section describes the measurement outputs that can be obtained in Manual CLI Mode. Energy outputs are accumulated numbers. If the host accesses the measurement information from the 78M6613 more frequently than the accumulation interval, results of the same value will be read back until the next accumulation interval.

Table 2 lists Wideband AC Measurement Outputs; Table 3 lists the equivalent Narrowband Outputs

Table 2: MPU Outputs for Wideband Calculations

Output	Location (hex)	LSB	Comment	Example
Delta Temperature	00	0.1 °C	Temperature difference from 22 °C.	If external temperature is 32 °C)00?<CR> Returns: +10.0
Line Frequency	01	0.01 Hz	Line Frequency.	If the line frequency is 60 Hz:)01?<CR> Returns: +60.00
Alarm Status (Common)	02		**Definition for Status Register** Bit 0 – Minimum Temperature Alarm. Bit 1 – Maximum Temperature Alarm. Bit 2 – Minimum Frequency Alarm. Bit 3 – Maximum Frequency Alarm. Bit 4 – SAG(A) Voltage Alarm for VA. Bit 5 – MINVA – under minimum voltage on VA input. Bit 6 – MAXVA – over maximum voltage on VA input. Bit 7 –SAG(B) Voltage Alarm for VB. Bit 8 – MINVB – under minimum voltage on VB input. Bit 9 – MAXVB – over maximum voltage on VB input. Bit 10 – Line/Neutral Reversal Bits 11:15 – Unused. Bit 16 – Creep Alert for Outlet 1 (IA). Bit 17 – Creep Alert for Outlet 2 (IB). Bit 18 – Creep Alert for Outlet 3 (IC). Bit 19 – Creep Alert for Outlet 4 (ID). Bit 20 – Creep Alert for Outlet 5 (IE). Bit 21 – Creep Alert for Outlet 6 (IF). Bit 22 – Creep Alert for Outlet 7 (IG). Bit 23 – Creep Alert for Outlet 8 (IH). Bits 24:31 – Unused.	Alarms become “1” when thresholds exceeded. Note: When AC voltage input is less than or equal to 10 V_{RMS}, • Only MINVA alarm is active. • All measurements are forced to 0 except power factor, which is forced to 1. Note: The frequency measurement is forced to 0 as long as the SAG voltage alarm is active.

Output	Location (hex)	LSB	Comment	Example
Alarm Status (Outlet Specific)	03		**Definition for Status Register** Bit 0 – Maximum Outlet 1 Current Bit 1 – MIN Outlet 1 Power Factor Bit 2 – MAX Outlet 1 Power Factor Bit 3 – Maximum Outlet 2 Current Bit 4 – MIN Outlet 2 Power Factor Bit 5 – MAX Outlet 2 Power Factor Bit 6 – Maximum Outlet 3 Current Bit 7 – MIN Outlet 3 Power Factor Bit 8 – MAX Outlet 3 Power Factor Bit 9 – Maximum Outlet 4 Current Bit 10 – MIN Outlet 4 Power Factor Bit 11 – MAX Outlet 4 Power Factor Bit 12 – Maximum Outlet 5 Current Bit 13 – MIN Outlet 5 Power Factor Bit 14 – MAX Outlet 5 Power Factor Bit 15 – Maximum Outlet 6 Current Bit 16 – MIN Outlet 6 Power Factor Bit 17 – MAX Outlet 6 Power Factor Bit 18 – Maximum Outlet 7 Current Bit 19 – MIN Outlet 7 Power Factor Bit 20 – MAX Outlet 7 Power Factor Bit 21 – Maximum Outlet 8 Current Bit 22 – MIN Outlet 8 Power Factor Bit 23 – MAX Outlet 8 Power Factor Bit 24 – Maximum Total Current Bits 25:31 – Unused.	Alarms become “1” when thresholds exceeded. Note: When AC current input is less than or equal to Creep threshold, respective measurements are forced to 0 except power factor, which is forced to 1.
Irms Over Current Event Count	04	1	Counter increments on each edge event.	If four over current events have occurred:)04?<CR> Returns: +4
Vrms Under Voltage Event Count	05	1	Counter increments on each edge event.	If four under voltage events have occurred:)05?<CR> Returns: +4
Vrms Over Voltage Event Count	06	1	Counter increments on each edge event.	If four over voltage events have occurred:)06?<CR> Returns: +4
Vrms	07	mVrms	Vrms voltage.	If the line voltage is 120 V)07?<CR> Returns: +120.000

OUTLET 1 (IA)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts A	08	mW	Outlet 1 active power measurement (per second).	If 120 Watts are measured on Outlet 1)08?<CR> Returns: +120.000
Wh A	09	mWh	Outlet 1 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 1)09?<CR> Returns: +120.000
Total Cost A	0A	mUnits	Outlet 1 cost of Wh A.	If the cost is 102.536 units on Outlet 1)0A?<CR> +102.536
Irms_wb A	0B	mArms	Outlet 1 wideband rms current measurement.	If wideband current measured on Outlet 1 is 12 Amps)0B?<CR> Returns: +12.000
VARs_wb A	0C	mW	Outlet 1 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 1)0C?<CR> Returns: +120.000
VAs_wb A	0D	mW	Outlet 1 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 1)0D?<CR> Returns: +120.000
Power Factor_wb A	0E	–	Outlet 1 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 1 is 0.95)0E?<CR> Returns: +0.950
Phase Angle_wb A	0F	–	Outlet 1 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 1 is 60 degrees)0F?<CR> Returns: +60.000

OUTLET 2 (IB)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts B	10	mW	Outlet 2 active power measurement (per second).	If 120 Watts are measured on Outlet 2)10?<CR> Returns: +120.000
Wh B	11	mWh	Outlet 2 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 1)11?<CR> Returns: +120.000
Total Cost B	12	mUnits	Outlet 2 cost of Wh B.	If the cost is 102.536 units on Outlet 2)12?<CR> +102.536
Irms_wb B	13	mArms	Outlet 2 wideband rms current measurement.	If wideband current measured on Outlet 2 is 12 Amps)13?<CR> Returns: +12.000
VARs_wb B	14	mW	Outlet 2 wideband reactive power measurement (per second).	If widewband 120 VARs are measured on Outlet 2)14?<CR> Returns: +120.000
VAs_wb B	15	mW	Outlet 2 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 2)15?<CR> Returns: +120.000
Power Factor_wb B	16	–	Outlet 2 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 2 is 0.95)16?<CR> Returns: +0.950
Phase Angle_wb B	17	–	Outlet 2 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 2 is 60 degrees)17?<CR> Returns: +60.000

OUTLET 3 (IC)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts C	18	mW	Outlet 3 active power measurement (per second).	If 120 Watts are measured on Outlet 3)18?<CR> Returns: +120.000
Wh C	19	mWh	Outlet 3 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 3)19?<CR> Returns: +120.000
Total Cost C	1A	mUnits	Outlet 3 cost of Wh C.	If the cost is 102.536 units on Outlet 3)1A?<CR> +102.536
Irms_wb C	1B	mArms	Outlet 3 wideband rms current measurement.	If wideband current measured on Outlet 3 is 12 Amps)1B?<CR> Returns: +12.000
VARs_wb C	1C	mW	Outlet 3 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 3)1C?<CR> Returns: +120.000
VAs_wb C	1D	mW	Outlet 3 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 3)1D?<CR> Returns: +120.000
Power Factor_wb C	1E	–	Outlet 3 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 3 is 0.95)1E?<CR> Returns: +0.950
Phase Angle_wb C	1F	–	Outlet 3 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 3 is 60 degrees)1F?<CR> Returns: +60.000

OUTLET 4 (ID)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts D	20	mW	Outlet 4 active power measurement (per second).	If 120 Watts are measured on Outlet 4)20?<CR> Returns: +120.000
Wh D	21	mWh	Outlet 4 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 4)21?<CR> Returns: +120.000
Total Cost D	22	mUnits	Outlet 4 cost of Wh D.	If the cost is 102.536 units on Outlet 4)22?<CR> +102.536
Irms_wb D	23	mArms	Outlet 4 wideband rms current measurement.	If wideband current measured on Outlet 4 is 12 Amps)23?<CR> Returns: +12.000
VARs_wb D	24	mW	Outlet 4 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 4)24?<CR> Returns: +120.000
VAs_wb D	25	mW	Outlet 4 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 4)25?<CR> Returns: +120.000
Power Factor_wb D	26	–	Outlet 4 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 4 is 0.95)26?<CR> Returns: +0.950
Phase Angle_wb D	27	–	Outlet 4 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 4 is 60 degrees)27?<CR> Returns: +60.000

OUTLET 5 (IE)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts E	28	mW	Outlet 5 active power measurement (per second).	If 120 Watts are measured on Outlet 5)28?<CR> Returns: +120.000
Wh E	29	mWh	Outlet 5 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 5)29?<CR> Returns: +120.000
Total Cost E	2A	mUnits	Outlet 5 cost of Wh E.	If the cost is 102.536 units on Outlet 5)2A?<CR> +102.536
Irms_wb E	2B	mArms	Outlet 5 wideband rms current measurement.	If wideband current measured on Outlet 5 is 12 Amps)2B?<CR> Returns: +12.000
VARs_wb E	2C	mW	Outlet 5 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 5)2C?<CR> Returns: +120.000
VAs_wb E	2D	mW	Outlet 5 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 5)2D?<CR> Returns: +120.000
Power Factor_wb E	2E	–	Outlet 5 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 5 is 0.95)2E?<CR> Returns: +0.950
Phase Angle_wb E	2F	–	Outlet 5 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 5 is 60 degrees)2F?<CR> Returns: +60.000

OUTLET 6 (IF)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts F	30	mW	Outlet 6 active power measurement (per second).	If 120 Watts are measured on Outlet 6)30?<CR> Returns: +120.000
Wh F	31	mWh	Outlet 6 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 6)31?<CR> Returns: +120.000
Total Cost F	32	mUnits	Outlet 6 cost of Wh F.	If the cost is 102.536 units on Outlet 6)32?<CR> +102.536
Irms_wb F	33	mArms	Outlet 6 wideband rms current measurement.	If wideband current measured on Outlet 6 is 12 Amps)33?<CR> Returns: +12.000
VARs_wb F	34	mW	Outlet 6 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 6)34?<CR> Returns: +120.000
VAs_wb F	35	mW	Outlet 6 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 6)35?<CR> Returns: +120.000
Power Factor_wb F	36	–	Outlet 6 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 6 is 0.95)36?<CR> Returns: +0.950
Phase Angle_wb F	37	–	Outlet 6 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 6 is 60 degrees)37?<CR> Returns: +60.000

OUTLET 7 (IG)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts G	38	mW	Outlet 7 active power measurement (per second).	If 120 Watts are measured on Outlet 7)38?<CR> Returns: +120.000
Wh G	39	mWh	Outlet 7 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 7)39?<CR> Returns: +120.000
Total Cost G	3A	mUnits	Outlet 7 cost of Wh G.	If the cost is 102.536 units on Outlet 7)3A?<CR> +102.536
Irms_wb G	3B	mArms	Outlet 7 wideband rms current measurement.	If wideband current measured on Outlet 7 is 12 Amps)3B?<CR> Returns: +12.000
VARs_wb G	3C	mW	Outlet 7 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 7)3C?<CR> Returns: +120.000
VAs_wb G	3D	mW	Outlet 7 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 7)3D?<CR> Returns: +120.000
Power Factor_wb G	3E	–	Outlet 7 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 7 is 0.95)3E?<CR> Returns: +0.950
Phase Angle_wb G	3F	–	Outlet 7 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 7 is 60 degrees)3F?<CR> Returns: +60.000

OUTLET 8 (IH)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts H	40	mW	Outlet 8 active power measurement (per second).	If 120 Watts are measured on Outlet 8)40?<CR> Returns: +120.000
Wh H	41	mWh	Outlet 8 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 8)41?<CR> Returns: +120.000
Total Cost H	42	mUnits	Outlet 8 cost of Wh H.	If the cost is 102.536 units on Outlet 8)42?<CR> +102.536
Irms_wb H	43	mArms	Outlet 8 wideband rms current measurement.	If wideband current measured on Outlet 8 is 12 Amps)43?<CR> Returns: +12.000
VARs_wb H	44	mW	Outlet 8 wideband reactive power measurement (per second).	If wideband 120 VARs are measured on Outlet 8)44?<CR> Returns: +120.000
VAs_wb H	45	mW	Outlet 8 wideband apparent power measurement (per second).	If wideband 120 VAs are measured on Outlet 8)45?<CR> Returns: +120.000
Power Factor_wb H	46	–	Outlet 8 wideband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the wideband power factor on Outlet 8 is 0.95)46?<CR> Returns: +0.950
Phase Angle_wb H	47	–	Outlet 8 wideband phase angle. The output will be between 180.000 and -180.000.	If the wideband phase angle measured on Outlet 8 is 60 degrees)47?<CR> Returns: +60.000

TOTAL OUTLETS				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts T	48	mW	Active power measurement (per second) on all outlets.	If 120 Watts are measured on all outlets)48?<CR> Returns: +120.000
Wh T	49	mWh	Active accumulated energy measurement (per hour) on all outlets.	If 120 Wh are measured on all outlets)49?<CR> Returns: +120.000
Total Cost T	4A	mUnits	Total Cost of Wh for all outlets.	If the total cost is 102.536 units on all outlets)50?<CR> +102.536
Irms_wb T	4B	mArms	Combined outlet wideband rms current measurement.	If wideband current measured on all outlets is 12 Amps)51?<CR> Returns: +12.000
VARs_wb T	4C	mW	Combined outlet wideband reactive power measurement (per second).	If wideband 120 VARs are measured on all outlets)52?<CR> Returns: +120.000
VAs_wb T	4D	mW	Combined outlet wideband apparent power measurement (per second).	If wideband 120 VAs are measured on all outlets)53?<CR> Returns: +120.000

MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Vrms Min	50	mV	Minimum Vrms measured.	If the minimum line voltage measured was 105 V)50<CR> Returns: +15.000
Vrms Max	51	mV	Maximum Vrms measured.	If the maximum line voltage measured was 130 V)51<CR> Returns: +130.000

OUTLET 1 (IA) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts A Min	52	mW	Minimum Outlet 1 active power measured (per second).	If the minimum power measured on Outlet 1 is 80 Watts)52?<CR> Returns: +80.000
Watts A Max	53	mW	Maximum Outlet 1 active power measured (per second).	If the maximum power measured on Outlet 1 is 200 Watts)53?<CR> Returns: +200.000
Irms_wb A Min	54	mArms	Outlet 1 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 1 is 1 Amp)54?<CR> Returns: +1.000
Irms_wb A Max	55	mArms	Outlet 1 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 1 is 30 Amps)55?<CR> Returns: +30.000
VARs_wb A Min	56	mW	Outlet 1 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 1 is 80 VARs)56?<CR> Returns: +80.000
VARs_wb A Max	57	mWs	Outlet 1 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 1 is 300VARs)57?<CR> Returns: +300.000
VAs_wb A Min	58	mW	Outlet 1 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 1 is 80 VARs)58?<CR> Returns: +80.000
VAs_wb A Max	59	mWs	Outlet 1 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 1 is 300VARs)59?<CR> Returns: +300.000
Power Factor_wb A Min	5A	–	Outlet 1 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 1 is -0.6)5A?<CR> Returns: -0.600
Power Factor_wb A Max	5B	–	Outlet 1 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 1 is 0.9)5B?<CR> Returns: +0.900
Phase Angle_wb A Min	5C	–	Outlet 1 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 1 is 10 degrees)5C?<CR> Returns: +10.000
Phase Angle_wb A Max	5D	–	Outlet 1 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 1 is 70 degrees)5D?<CR> Returns: +70.000

OUTLET 2 (IB) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts B Min	5E	mW	Minimum Outlet 2 active power measured (per second).	If the minimum power measured on Outlet 2 is 80 Watts)5E?<CR> Returns: +80.000
Watts B Max	5F	mW	Maximum Outlet 2 active power measured (per second).	If the maximum power measured on Outlet 2 is 200 Watts)5F?<CR> Returns: +200.000
Irms_wb B Min	60	mArms	Outlet 2 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 2 is 1 Amp)60?<CR> Returns: +1.000
Irms_wb B Max	61	mArms	Outlet 2 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 2 is 30 Amps)61?<CR> Returns: +30.000
VARs_wb B Min	62	mW	Outlet 2 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 2 is 80 VARs)62?<CR> Returns: +80.000
VARs_wb B Max	63	mWs	Outlet 2 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 2 is 300VARs)63?<CR> Returns: +300.000
VAs_wb B Min	64	mW	Outlet 2 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 2 is 80 VARs)64?<CR> Returns: +80.000
VAs_wb B Max	65	mWs	Outlet 2 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 2 is 300VARs)65?<CR> Returns: +300.000
Power Factor_wb B Min	66	–	Outlet 2 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 2 is -0.6)66?<CR> Returns: -0.600
Power Factor_wb B Max	67	–	Outlet 2 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 1 is 0.9)67?<CR> Returns: +0.900
Phase Angle_wb B Min	68	–	Outlet 2 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 2 is 10 degrees)68?<CR> Returns: +10.000
Phase Angle_wb B Max	69	–	Outlet 2 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 2 is 70 degrees)69?<CR> Returns: +70.000

OUTLET 3 (IC) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts C Min	6A	mW	Minimum Outlet 3 active power measured (per second).	If the minimum power measured on Outlet 3 is 80 Watts)6A?<CR> Returns: +80.000
Watts C Max	6B	mW	Maximum Outlet 3 active power measured (per second).	If the maximum power measured on Outlet 3 is 200 Watts)6B?<CR> Returns: +200.000
Irms_wb C Min	6C	mArms	Outlet 3 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 3 is 1 Amp)6C?<CR> Returns: +1.000
Irms_wb C Max	6D	mArms	Outlet 3 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 3 is 30 Amps)6D?<CR> Returns: +30.000
VARs_wb C Min	6E	mW	Outlet 3 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 3 is 80 VARs)6E?<CR> Returns: +80.000
VARs_wb C Max	6F	mWs	Outlet 3 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 3 is 300VARs)6F?<CR> Returns: +300.000
VAs_wb C Min	70	mW	Outlet 3 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 3 is 80 VARs)70?<CR> Returns: +80.000
VAs_wb C Max	71	mWs	Outlet 3 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 3 is 300VARs)71?<CR> Returns: +300.000
Power Factor_wb C Min	72	–	Outlet 3 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 3 is -0.6)72?<CR> Returns: -0.600
Power Factor_wb C Max	73	–	Outlet 3 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 3 is 0.9)73?<CR> Returns: +0.900
Phase Angle_wb C Min	74	–	Outlet 3 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 3 is 10 degrees)74?<CR> Returns: +10.000
Phase Angle_wb C Max	75	–	Outlet 3 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 3 is 70 degrees)75?<CR> Returns: +70.000

OUTLET 4 (ID) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts D Min	76	mW	Minimum Outlet 4 active power measured (per second).	If the minimum power measured on Outlet 4 is 80 Watts)76?<CR> Returns: +80.000
Watts D Max	77	mW	Maximum Outlet 4 active power measured (per second).	If the maximum power measured on Outlet 4 is 200 Watts)77?<CR> Returns: +200.000
Irms_wb D Min	78	mArms	Outlet 4 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 4 is 1 Amp)78?<CR> Returns: +1.000
Irms_wb D Max	79	mArms	Outlet 4 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 4 is 30 Amps)79?<CR> Returns: +30.000
VARs_wb D Min	7A	mW	Outlet 4 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 4 is 80 VARs)7A?<CR> Returns: +80.000
VARs_wb D Max	7B	mWs	Outlet 4 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 4 is 300VARs)7B?<CR> Returns: +300.000
VAs_wb D Min	7C	mW	Outlet 4 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 4 is 80 VARs)7C?<CR> Returns: +80.000
VAs_wb F Max	7D	mWs	Outlet 4 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 4 is 300VARs)7D?<CR> Returns: +300.000
Power Factor_wb D Min	7E	–	Outlet 4 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 4 is -0.6)7E?<CR> Returns: -0.600
Power Factor_wb D Max	7F	–	Outlet 4 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 4 is 0.9)7F?<CR> Returns: +0.900
Phase Angle_wb D Min	80	–	Outlet 4 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 4 is 10 degrees)80?<CR> Returns: +10.000
Phase Angle_wb D Max	81	–	Outlet 4 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 4 is 70 degrees)81?<CR> Returns: +70.000

OUTLET 5 (IE) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts E Min	82	mW	Minimum Outlet 5 active power measured (per second).	If the minimum power measured on Outlet 5 is 80 Watts)82?<CR> Returns: +80.000
Watts E Max	83	mW	Maximum Outlet 5 active power measured (per second).	If the maximum power measured on Outlet 5 is 200 Watts)83?<CR> Returns: +200.000
Irms_wb E Min	84	mArms	Outlet 5 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 5 is 1 Amp)84?<CR> Returns: +1.000
Irms_wb E Max	85	mArms	Outlet 5 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 5 is 30 Amps)85?<CR> Returns: +30.000
VARs_wb E Min	86	mW	Outlet 5 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 5 is 80 VARs)86?<CR> Returns: +80.000
VARs_wb E Max	87	mWs	Outlet 5 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 5 is 300VARs)87?<CR> Returns: +300.000
VAs_wb E Min	88	mW	Outlet 5 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 5 is 80 VARs)88?<CR> Returns: +80.000
VAs_wb E Max	89	mWs	Outlet 5 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 5 is 300VARs)89?<CR> Returns: +300.000
Power Factor_wb E Min	8A	–	Outlet 5 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 5 is -0.6)8A?<CR> Returns: -0.600
Power Factor_wb E Max	8B	–	Outlet 5 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 5 is 0.9)8B?<CR> Returns: +0.900
Phase Angle_wb E Min	8C	–	Outlet 5 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 5 is 10 degrees)8C?<CR> Returns: +10.000
Phase Angle_wb E Max	8D	–	Outlet 5 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 5 is 70 degrees)8D?<CR> Returns: +70.000

OUTLET 6 (IF) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts F Min	8E	mW	Minimum Outlet 6 active power measured (per second).	If the minimum power measured on Outlet 6 is 80 Watts)8E?<CR> Returns: +80.000
Watts F Max	8F	mW	Maximum Outlet 6 active power measured (per second).	If the maximum power measured on Outlet 6 is 200 Watts)8F?<CR> Returns: +200.000
Irms_wb F Min	90	mArms	Outlet 6 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 6 is 1 Amp)90?<CR> Returns: +1.000
Irms_wb F Max	91	mArms	Outlet 6 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 6 is 30 Amps)91?<CR> Returns: +30.000
VARs_wb F Min	92	mW	Outlet 6 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 6 is 80 VARs)92?<CR> Returns: +80.000
VARs_wb F Max	93	mWs	Outlet 6 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 1 is 300VARs)93?<CR> Returns: +300.000
VAs_wb F Min	94	mW	Outlet 6 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 1 is 80 VARs)94?<CR> Returns: +80.000
VAs_wb F Max	95	mWs	Outlet 6 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 6 is 300VARs)95?<CR> Returns: +300.000
Power Factor_wb F Min	96	–	Outlet 6 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 6 is -0.6)5A?<CR> Returns: -0.600
Power Factor_wb F Max	97	–	Outlet 6 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 6 is 0.9)5B?<CR> Returns: +0.900
Phase Angle_wb F Min	98	–	Outlet 6 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 6 is 10 degrees)5C?<CR> Returns: +10.000
Phase Angle_wb F Max	99	–	Outlet 6 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 6 is 70 degrees)5D?<CR> Returns: +70.000

OUTLET 7 (IG) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts G Min	9A	mW	Minimum Outlet 7 active power measured (per second).	If the minimum power measured on Outlet 7 is 80 Watts)9A?<CR> Returns: +80.000
Watts G Max	9B	mW	Maximum Outlet 7 active power measured (per second).	If the maximum power measured on Outlet 7 is 200 Watts)9B?<CR> Returns: +200.000
Irms_wb G Min	9C	mArms	Outlet 7 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 7 is 1 Amp)9C?<CR> Returns: +1.000
Irms_wb G Max	9D	mArms	Outlet 7 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 7 is 30 Amps)9D?<CR> Returns: +30.000
VARs_wb G Min	9E	mW	Outlet 7 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 7 is 80 VARs)9E?<CR> Returns: +80.000
VARs_wb G Max	9F	mWs	Outlet 7 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 7 is 300VARs)9F?<CR> Returns: +300.000
VAs_wb G Min	A0	mW	Outlet 7 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 7 is 80 VARs)A0?<CR> Returns: +80.000
VAs_wb G Max	A1	mWs	Outlet 7 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 7 is 300VARs)A1?<CR> Returns: +300.000
Power Factor_wb G Min	A2	–	Outlet 7 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 7 is -0.6)A2?<CR> Returns: -0.600
Power Factor_wb G Max	A3	–	Outlet 7 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 7 is 0.9)A3?<CR> Returns: +0.900
Phase Angle_wb G Min	A4	–	Outlet 7 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 7 is 10 degrees)A4?<CR> Returns: +10.000
Phase Angle_wb G Max	A5	–	Outlet 7 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 7 is 70 degrees)A5?<CR> Returns: +70.000

OUTLET 8 (IH) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts H Min	A6	mW	Minimum Outlet 8 active power measured (per second).	If the minimum power measured on Outlet 8 is 80 Watts)A6?<CR> Returns: +80.000
Watts H Max	A7	mW	Maximum Outlet 8 active power measured (per second).	If the maximum power measured on Outlet 8 is 200 Watts)A7?<CR> Returns: +200.000
Irms_wb H Min	A8	mArms	Outlet 8 minimum wideband rms current measured.	If the smallest wideband current measured on Outlet 8 is 1 Amp)A8?<CR> Returns: +1.000
Irms_wb H Max	A9	mArms	Outlet 8 maximum wideband rms current measured.	If the largest wideband current measured on Outlet 8 is 30 Amps)A9?<CR> Returns: +30.000
VARs_wb H Min	AA	mW	Outlet 8 minimum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 8 is 80 VARs)AA?<CR> Returns: +80.000
VARs_wb H Max	AB	mWs	Outlet 8 maximum wideband reactive power measured (per second).	If the largest wideband VARs measured on Outlet 8 is 300VARs)AB?<CR> Returns: +300.000
VAs_wb H Min	AC	mW	Outlet 8 minimum wideband apparent power measured (per second).	If the smallest wideband VAs measured on Outlet 8 is 80 VARs)AC?<CR> Returns: +80.000
VAs_wb H Max	AD	mWs	Outlet 8 maximum wideband apparent power measured (per second).	If the largest wideband VAs measured on Outlet 8 is 300VARs)AD?<CR> Returns: +300.000
Power Factor_wb H Min	AE	–	Outlet 8 minimum wideband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum wideband power factor measured on Outlet 8 is -0.6)AE?<CR> Returns: -0.600
Power Factor_wb H Max	AF	–	Outlet 8 maximum wideband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum wideband power factor measured on Outlet 8 is 0.9)AF?<CR> Returns: +0.900
Phase Angle_wb H Min	B0	–	Outlet 8 minimum wideband phase angle measured.	If the minimum wideband phase angle measured on Outlet 8 is 10 degrees)B0?<CR> Returns: +10.000
Phase Angle_wb H Max	B1	–	Outlet 8 maximum wideband phase angle measured.	If the maximum wideband phase angle measured on Outlet 8 is 70 degrees)B1?<CR> Returns: +70.000

TOTAL MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts T Min	B2	mW	Minimum active power measured on all outlets (per second).	If the minimum power measured on all outlets is 80 Watts)B2?<CR> Returns: +80.000
Watts T Max	B3	mW	Maximum active power measured on all outlets (per second).	If the maximum power measured on all outlets is 200 Watts)B3?<CR> Returns: +200.000
Irms_wb T Min	B4	mArms	Minimum wideband rms current measured on all outlets.	If the smallest wideband current measured on all outlets is 1 Amp)B4?<CR> Returns: +1.000
Irms_wb T Max	B5	mArms	Maximum wideband rms current measured on all outlets.	If the largest wideband current measured on all outlets is 30 Amps)B5?<CR> Returns: +30.000
VARs_wb T Min	B6	mW	Minimum wideband reactive power measured (per second) on all outlets.	If the largest wideband VARs measured on all outlets is 80 VARs)B6?<CR> Returns: +80.000
VARs_wb T Max	B7	mWs	Maximum wideband reactive power measured (per second) on all outlets.	If the largest wideband VARs measured on all outlets is 300VARs)B7?<CR> Returns: +300.000
VAs_wb T Min	B8	mW	Minimum wideband apparent power measured (per second) on all outlets.	If the smallest wideband VAs measured on all outlets is 80 VARs)B8?<CR> Returns: +80.000
VAs_wb T Max	B9	mWs	Maximum wideband apparent power measured (per second) on all outlets.	If the largest wideband VAs measured on all outlets is 300VARs)B9?<CR> Returns: +300.000
Unused	BA-BF		Unused	

Table 3 lists the narrowband measurement outputs.

Table 3: MPU Outputs for Narrowband Method

Output	Location (hex)	LSB	Comment	Example
Delta Temperature	100	0.1 °C	Temperature difference from 22 °C.	If external temperature is 32 °C)100?<CR> Returns: +10.0
Line Frequency	101	0.01 Hz	Line Frequency.	If the line frequency is 60 Hz:)101?<CR> Returns: +60.00
Alarm Status (Common)	102		**Definition for Status Register** Bit 0 – Minimum Temperature Alarm. Bit 1 – Maximum Temperature Alarm. Bit 2 – Minimum Frequency Alarm. Bit 3 – Maximum Frequency Alarm. Bit 4 – SAG(A) Voltage Alarm for VA. Bit 5 – MINVA – under minimum voltage on VA input. Bit 6 – MAXVA – over maximum voltage on VA input. Bit 7 –SAG(B) Voltage Alarm for VB. Bit 8 – MINVB – under minimum voltage on VB input. Bit 9 – MAXVB – over maximum voltage on VB input. Bit 10 – Line/Neutral Reversal Bits 11:15 – Unused. Bit 16 – Creep Alert for Outlet 1 (IA). Bit 17 – Creep Alert for Outlet 2 (IB). Bit 18– Creep Alert for Outlet 3 (IC). Bit 19 – Creep Alert for Outlet 4 (ID). Bit 20 – Creep Alert for Outlet 5 (IE). Bit 21 – Creep Alert for Outlet 6 (IF). Bit 22 – Creep Alert for Outlet 7 (IG). Bit 23 – Creep Alert for Outlet 8 (IH). Bits 24:31 – Unused.	Alarms become “1” when thresholds exceeded. Note: When AC voltage input is less than or equal to 10 V_{RMS}, • Only MINVA alarm is active. • All measurements are forced to 0 except power factor, which is forced to 1. Note: The frequency measurement is forced to 0 as long as the SAG voltage alarm is active.

Output	Location (hex)	LSB	Comment	Example
Alarm Status (Outlet Specific)	103		**Definition for Status Register** Bit 0 – Maximum Outlet 1 Current Bit 1 – MIN Outlet 1 Power Factor Bit 2 – MAX Outlet 1 Power Factor Bit 3 – Maximum Outlet 2 Current Bit 4 – MIN Outlet 2 Power Factor Bit 5 – MAX Outlet 2 Power Factor Bit 6 – Maximum Outlet 3 Current Bit 7 – MIN Outlet 3 Power Factor Bit 8 – MAX Outlet 3 Power Factor Bit 9 – Maximum Outlet 4 Current Bit 10 – MIN Outlet 4 Power Factor Bit 11 – MAX Outlet 4 Power Factor Bit 12 – Maximum Outlet 5 Current Bit 13 – MIN Outlet 5 Power Factor Bit 14 – MAX Outlet 5 Power Factor Bit 15 – Maximum Outlet 6 Current Bit 16 – MIN Outlet 6 Power Factor Bit 17 – MAX Outlet 6 Power Factor Bit 18 – Maximum Outlet 7 Current Bit 19 – MIN Outlet 7 Power Factor Bit 20 – MAX Outlet 7 Power Factor Bit 21 – Maximum Outlet 8 Current Bit 22 – MIN Outlet 8 Power Factor Bit 23 – MAX Outlet 8 Power Factor Bit 24 – Maximum Total Current Bits 25:31 – Unused.	Alarms become “1” when thresholds exceeded. Note: When AC current input is less than or equal to Creep threshold, respective measurements are forced to 0 except power factor, which is forced to 1.
Irms Over Current Event Count	104	1	Counter increments on each edge event.	If four over current events have occurred:)104?<CR> Returns: +4
Vrms Under Voltage Event Count	105	1	Counter increments on each edge event.	If four under voltage events have occurred:)105?<CR> Returns: +4
Vrms Over Voltage Event Count	106	1	Counter increments on each edge event.	If four over voltage events have occurred:)106?<CR> Returns: +4
Vrms	107	mVrms	Vrms voltage.	If the line voltage is 120 V)107?<CR> Returns: +120.000

OUTLET 1 (IA)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts A	108	mW	Outlet 1 active power measurement (per second).	If 120 Watts are measured on Outlet 1)108?<CR> Returns: +120.000
Wh A	109	mWh	Outlet 1 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 1)109?<CR> Returns: +120.000
Total Cost A	10A	mUnits	Outlet 1 cost of Wh A.	If the cost is 102.536 units on Outlet 1)10A?<CR> +102.536
Irms_nb A	10B	mArms	Outlet 1 narrowband rms current measurement.	If narrowband current measured on Outlet 1 is 12 Amps)10B?<CR> Returns: +12.000
VARs_nb A	10C	mW	Outlet 1 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 1)10C?<CR> Returns: +120.000
VAs_nb A	10D	mW	Outlet 1 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 1)10D?<CR> Returns: +120.000
Power Factor_nb A	10E	–	Outlet 1 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 1 is 0.95)10E?<CR> Returns: +0.950
Phase Angle_nb A	10F	–	Outlet 1 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 1 is 60 degrees)10F?<CR> Returns: +60.000

OUTLET 2 (IB)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts B	110	mW	Outlet 2 active power measurement (per second).	If 120 Watts are measured on Outlet 2)110?<CR> Returns: +120.000
Wh B	111	mWh	Outlet 2 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 1)111?<CR> Returns: +120.000
Total Cost B	112	mUnits	Outlet 2 cost of Wh B.	If the cost is 102.536 units on Outlet 2)112?<CR> +102.536
Irms_nb B	`113	mArms	Outlet 2 narrowband rms current measurement.	If narrowband current measured on Outlet 2 is 12 Amps)113?<CR> Returns: +12.000
VARs_nb B	114	mW	Outlet 2 narrowband reactive power measurement (per second).	If widewband 120 VARs are measured on Outlet 2)114?<CR> Returns: +120.000
VAs_nb B	115	mW	Outlet 2 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 2)115?<CR> Returns: +120.000
Power Factor_nb B	116	–	Outlet 2 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 2 is 0.95)116?<CR> Returns: +0.950
Phase Angle_nb B	117	–	Outlet 2 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 2 is 60 degrees)117?<CR> Returns: +60.000

OUTLET 3 (IC)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts C	118	mW	Outlet 3 active power measurement (per second).	If 120 Watts are measured on Outlet 3)118?<CR> Returns: +120.000
Wh C	119	mWh	Outlet 3 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 3)119?<CR> Returns: +120.000
Total Cost C	11A	mUnits	Outlet 3 cost of Wh C.	If the cost is 102.536 units on Outlet 3)11A?<CR> +102.536
Irms_nb C	11B	mArms	Outlet 3 narrowband rms current measurement.	If narrowband current measured on Outlet 3 is 12 Amps)11B?<CR> Returns: +12.000
VARs_nb C	11C	mW	Outlet 3 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 3)11C?<CR> Returns: +120.000
VAs_nb C	11D	mW	Outlet 3 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 3)11D?<CR> Returns: +120.000
Power Factor_nb C	11E	–	Outlet 3 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 3 is 0.95)11E?<CR> Returns: +0.950
Phase Angle_nb C	11F	–	Outlet 3 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 3 is 60 degrees)11F?<CR> Returns: +60.000

OUTLET 4 (ID)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts D	120	mW	Outlet 4 active power measurement (per second).	If 120 Watts are measured on Outlet 4)120?<CR> Returns: +120.000
Wh D	121	mWh	Outlet 4 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 4)121?<CR> Returns: +120.000
Total Cost D	122	mUnits	Outlet 4 cost of Wh D.	If the cost is 102.536 units on Outlet 4)122?<CR> +102.536
Irms_nb D	123	mArms	Outlet 4 narrowband rms current measurement.	If narrowband current measured on Outlet 4 is 12 Amps)123?<CR> Returns: +12.000
VARs_nb D	124	mW	Outlet 4 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 4)124?<CR> Returns: +120.000
VAs_nb D	125	mW	Outlet 4 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 4)125?<CR> Returns: +120.000
Power Factor_nb D	126	–	Outlet 4 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 4 is 0.95)126?<CR> Returns: +0.950
Phase Angle_nb D	127	–	Outlet 4 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 4 is 60 degrees)127?<CR> Returns: +60.000

OUTLET 5 (IE)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts E	128	mW	Outlet 5 active power measurement (per second).	If 120 Watts are measured on Outlet 5)128?<CR> Returns: +120.000
Wh E	129	mWh	Outlet 5 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 5)129?<CR> Returns: +120.000
Total Cost E	12A	mUnits	Outlet 5 cost of Wh E.	If the cost is 102.536 units on Outlet 5)12A?<CR> +102.536
Irms_nb E	12B	mArms	Outlet 5 narrowband rms current measurement.	If narrowband current measured on Outlet 5 is 12 Amps)12B?<CR> Returns: +12.000
VARs_nb E	12C	mW	Outlet 5 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 5)12C?<CR> Returns: +120.000
VAs_nb E	12D	mW	Outlet 5 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 5)12D?<CR> Returns: +120.000
Power Factor_nb E	12E	–	Outlet 5 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 5 is 0.95)12E?<CR> Returns: +0.950
Phase Angle_nb E	12F	–	Outlet 5 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 5 is 60 degrees)12F?<CR> Returns: +60.000

OUTLET 6 (IF)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts F	130	mW	Outlet 6 active power measurement (per second).	If 120 Watts are measured on Outlet 6)130?<CR> Returns: +120.000
Wh F	131	mWh	Outlet 6 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 6)131?<CR> Returns: +120.000
Total Cost F	132	mUnits	Outlet 6 cost of Wh F.	If the cost is 102.536 units on Outlet 6)132?<CR> +102.536
Irms_nb F	133	mArms	Outlet 6 narrowband rms current measurement.	If narrowband current measured on Outlet 6 is 12 Amps)133?<CR> Returns: +12.000
VARs_nb F	134	mW	Outlet 6 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 6)134?<CR> Returns: +120.000
VAs_nb F	135	mW	Outlet 6 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 6)135?<CR> Returns: +120.000
Power Factor_nb F	136	–	Outlet 6 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 6 is 0.95)136?<CR> Returns: +0.950
Phase Angle_nb F	137	–	Outlet 6 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 6 is 60 degrees)137?<CR> Returns: +60.000

OUTLET 7 (IG)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts G	138	mW	Outlet 7 active power measurement (per second).	If 120 Watts are measured on Outlet 7)138?<CR> Returns: +120.000
Wh G	139	mWh	Outlet 7 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 7)139?<CR> Returns: +120.000
Total Cost G	13A	mUnits	Outlet 7 cost of Wh G.	If the cost is 102.536 units on Outlet 7)13A?<CR> +102.536
Irms_nb G	13B	mArms	Outlet 7 narrowband rms current measurement.	If narrowband current measured on Outlet 7 is 12 Amps)13B?<CR> Returns: +12.000
VARs_nb G	13C	mW	Outlet 7 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 7)13C?<CR> Returns: +120.000
VAs_nb G	13D	mW	Outlet 7 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 7)13D?<CR> Returns: +120.000
Power Factor_nb G	13E	–	Outlet 7 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 7 is 0.95)13E?<CR> Returns: +0.950
Phase Angle_nb G	13F	–	Outlet 7 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 7 is 60 degrees)13F?<CR> Returns: +60.000

OUTLET 8 (IH)				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts H	140	mW	Outlet 8 active power measurement (per second).	If 120 Watts are measured on Outlet 8)140?<CR> Returns: +120.000
Wh H	141	mWh	Outlet 8 active accumulated energy measurement (per hour).	If 120 Wh are measured on Outlet 8)141?<CR> Returns: +120.000
Total Cost H	142	mUnits	Outlet 8 cost of Wh H.	If the cost is 102.536 units on Outlet 8)142?<CR> +102.536
Irms_nb H	143	mArms	Outlet 8 narrowband rms current measurement.	If narrowband current measured on Outlet 8 is 12 Amps)143?<CR> Returns: +12.000
VARs_nb H	144	mW	Outlet 8 narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on Outlet 8)144?<CR> Returns: +120.000
VAs_nb H	145	mW	Outlet 8 narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on Outlet 8)145?<CR> Returns: +120.000
Power Factor_nb H	146	–	Outlet 8 narrowband power factor. The output will be between -0.950 and 1.000. Positive power factor is defined as current lagging voltage (inductive). Negative power factor is defined as voltage lagging current (capacitive).	If the narrowband power factor on Outlet 8 is 0.95)146?<CR> Returns: +0.950
Phase Angle_nb H	147	–	Outlet 8 narrowband phase angle. The output will be between 180.000 and -180.000.	If the narrowband phase angle measured on Outlet 8 is 60 degrees)147?<CR> Returns: +60.000

TOTAL OUTLETS				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts T	148	mW	Active power measurement (per second) on all outlets.	If 120 Watts are measured on all outlets)148?<CR> Returns: +120.000
Wh T	149	mWh	Active accumulated energy measurement (per hour) on all outlets.	If 120 Wh are measured on all outlets)149?<CR> Returns: +120.000
Total Cost T	150	mUnits	Total Cost of Wh for all outlets.	If the total cost is 102.536 units on all outlets)150?<CR> +102.536
Irms_nb T	151	mArms	Combined outlet narrowband rms current measurement.	If narrowband current measured on all outlets is 12 Amps)151?<CR> Returns: +12.000
VARs_nb T	152	mW	Combined outlet narrowband reactive power measurement (per second).	If narrowband 120 VARs are measured on all outlets)152?<CR> Returns: +120.000
VAs_nb T	153	mW	Combined outlet narrowband apparent power measurement (per second).	If narrowband 120 VAs are measured on all outlets)153?<CR> Returns: +120.000

MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Vrms Min	150	mV	Minimum Vrms measured.	If the minimum line voltage measured was 105 V)150<CR> Returns: +15.000
Vrms Max	151	mV	Maximum Vrms measured.	If the maximum line voltage measured was 130 V)151<CR> Returns: +130.000

OUTLET 1 (IA) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts A Min	152	mW	Minimum Outlet 1 active power measured (per second).	If the minimum power measured on Outlet 1 is 80 Watts)152?<CR> Returns: +80.000
Watts A Max	153	mW	Maximum Outlet 1 active power measured (per second).	If the maximum power measured on Outlet 1 is 200 Watts)153?<CR> Returns: +200.000
Irms_nb A Min	154	mArms	Outlet 1 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 1 is 1 Amp)154?<CR> Returns: +1.000
Irms_nb A Max	155	mArms	Outlet 1 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 1 is 30 Amps)155?<CR> Returns: +30.000
VARs_nb A Min	156	mW	Outlet 1 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 1 is 80 VARs)156?<CR> Returns: +80.000
VARs_nb A Max	157	mWs	Outlet 1 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 1 is 300VARs)157?<CR> Returns: +300.000
VAs_nb A Min	158	mW	Outlet 1 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 1 is 80 VARs)158?<CR> Returns: +80.000
VAs_nb A Max	159	mWs	Outlet 1 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 1 is 300VARs)159?<CR> Returns: +300.000
Power Factor_nb A Min	15A	–	Outlet 1 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 1 is -0.6)15A?<CR> Returns: -0.600
Power Factor_nb A Max	15B	–	Outlet 1 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 1 is 0.9)15B?<CR> Returns: +0.900
Phase Angle_nb A Min	15C	–	Outlet 1 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 1 is 10 degrees)15C?<CR> Returns: +10.000
Phase Angle_nb A Max	15D	–	Outlet 1 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 1 is 70 degrees)15D?<CR> Returns: +70.000

OUTLET 2 (IB) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts B Min	15E	mW	Minimum Outlet 2 active power measured (per second).	If the minimum power measured on Outlet 2 is 80 Watts)15E?<CR> Returns: +80.000
Watts B Max	15F	mW	Maximum Outlet 2 active power measured (per second).	If the maximum power measured on Outlet 2 is 200 Watts)15F?<CR> Returns: +200.000
Irms_nb B Min	160	mArms	Outlet 2 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 2 is 1 Amp)160?<CR> Returns: +1.000
Irms_nb B Max	161	mArms	Outlet 2 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 2 is 30 Amps)161?<CR> Returns: +30.000
VARs_nb B Min	162	mW	Outlet 2 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 2 is 80 VARs)162?<CR> Returns: +80.000
VARs_nb B Max	163	mWs	Outlet 2 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 2 is 300VARs)163?<CR> Returns: +300.000
VAs_nb B Min	164	mW	Outlet 2 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 2 is 80 VARs)164?<CR> Returns: +80.000
VAs_nb B Max	165	mWs	Outlet 2 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 2 is 300VARs)165?<CR> Returns: +300.000
Power Factor_nb B Min	166	–	Outlet 2 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 2 is -0.6)166?<CR> Returns: -0.600
Power Factor_nb B Max	167	–	Outlet 2 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 1 is 0.9)167?<CR> Returns: +0.900
Phase Angle_nb B Min	168	–	Outlet 2 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 2 is 10 degrees)68?<CR> Returns: +10.000
Phase Angle_nb B Max	169	–	Outlet 2 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 2 is 70 degrees)169?<CR> Returns: +70.000

OUTLET 3 (IC) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts C Min	16A	mW	Minimum Outlet 3 active power measured (per second).	If the minimum power measured on Outlet 3 is 80 Watts)16A?<CR> Returns: +80.000
Watts C Max	16B	mW	Maximum Outlet 3 active power measured (per second).	If the maximum power measured on Outlet 3 is 200 Watts)16B?<CR> Returns: +200.000
Irms_nb C Min	16C	mArms	Outlet 3 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 3 is 1 Amp)16C?<CR> Returns: +1.000
Irms_nb C Max	16D	mArms	Outlet 3 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 3 is 30 Amps)16D?<CR> Returns: +30.000
VARs_nb C Min	16E	mW	Outlet 3 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 3 is 80 VARs)16E?<CR> Returns: +80.000
VARs_nb C Max	16F	mWs	Outlet 3 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 3 is 300VARs)16F?<CR> Returns: +300.000
VAs_nb C Min	170	mW	Outlet 3 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 3 is 80 VARs)170?<CR> Returns: +80.000
VAs_nb C Max	171	mWs	Outlet 3 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 3 is 300VARs)171?<CR> Returns: +300.000
Power Factor_nb C Min	172	–	Outlet 3 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 3 is -0.6)172?<CR> Returns: -0.600
Power Factor_nb C Max	173	–	Outlet 3 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 3 is 0.9)173?<CR> Returns: +0.900
Phase Angle_nb C Min	174	–	Outlet 3 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 3 is 10 degrees)174?<CR> Returns: +10.000
Phase Angle_nb C Max	175	–	Outlet 3 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 3 is 70 degrees)175?<CR> Returns: +70.000

OUTLET 4 (ID) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts D Min	176	mW	Minimum Outlet 4 active power measured (per second).	If the minimum power measured on Outlet 4 is 80 Watts)176?<CR> Returns: +80.000
Watts D Max	177	mW	Maximum Outlet 4 active power measured (per second).	If the maximum power measured on Outlet 4 is 200 Watts)177?<CR> Returns: +200.000
Irms_nb D Min	178	mArms	Outlet 4 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 4 is 1 Amp)178?<CR> Returns: +1.000
Irms_nb D Max	179	mArms	Outlet 4 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 4 is 30 Amps)179?<CR> Returns: +30.000
VARs_nb D Min	17A	mW	Outlet 4 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 4 is 80 VARs)17A?<CR> Returns: +80.000
VARs_nb D Max	17B	mWs	Outlet 4 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 4 is 300VARs)17B?<CR> Returns: +300.000
VAs_nb D Min	17C	mW	Outlet 4 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 4 is 80 VARs)17C?<CR> Returns: +80.000
VAs_nb F Max	17D	mWs	Outlet 4 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 4 is 300VARs)17D?<CR> Returns: +300.000
Power Factor_nb D Min	17E	–	Outlet 4 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 4 is -0.6)17E?<CR> Returns: -0.600
Power Factor_nb D Max	17F	–	Outlet 4 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 4 is 0.9)7F?<CR> Returns: +0.900
Phase Angle_nb D Min	180	–	Outlet 4 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 4 is 10 degrees)180?<CR> Returns: +10.000
Phase Angle_nb D Max	181	–	Outlet 4 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 4 is 70 degrees)181?<CR> Returns: +70.000

OUTLET 5 (IE) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts E Min	182	mW	Minimum Outlet 5 active power measured (per second).	If the minimum power measured on Outlet 5 is 80 Watts)182?<CR> Returns: +80.000
Watts E Max	183	mW	Maximum Outlet 5 active power measured (per second).	If the maximum power measured on Outlet 5 is 200 Watts)183?<CR> Returns: +200.000
Irms_nb E Min	184	mArms	Outlet 5 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 5 is 1 Amp)184?<CR> Returns: +1.000
Irms_nb E Max	185	mArms	Outlet 5 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 5 is 30 Amps)185?<CR> Returns: +30.000
VARs_nb E Min	186	mW	Outlet 5 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 5 is 80 VARs)186?<CR> Returns: +80.000
VARs_nb E Max	187	mWs	Outlet 5 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 5 is 300VARs)187?<CR> Returns: +300.000
VAs_nb E Min	188	mW	Outlet 5 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 5 is 80 VARs)188?<CR> Returns: +80.000
VAs_nb E Max	189	mWs	Outlet 5 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 5 is 300VARs)189?<CR> Returns: +300.000
Power Factor_nb E Min	18A	–	Outlet 5 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 5 is -0.6)18A?<CR> Returns: -0.600
Power Factor_nb E Max	18B	–	Outlet 5 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 5 is 0.9)18B?<CR> Returns: +0.900
Phase Angle_nb E Min	18C	–	Outlet 5 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 5 is 10 degrees)18C?<CR> Returns: +10.000
Phase Angle_nb E Max	18D	–	Outlet 5 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 5 is 70 degrees)18D?<CR> Returns: +70.000

OUTLET 6 (IF) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts F Min	18E	mW	Minimum Outlet 6 active power measured (per second).	If the minimum power measured on Outlet 6 is 80 Watts)18E?<CR> Returns: +80.000
Watts F Max	18F	mW	Maximum Outlet 6 active power measured (per second).	If the maximum power measured on Outlet 6 is 200 Watts)18F?<CR> Returns: +200.000
Irms_nb F Min	190	mArms	Outlet 6 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 6 is 1 Amp)190?<CR> Returns: +1.000
Irms_nb F Max	191	mArms	Outlet 6 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 6 is 30 Amps)191?<CR> Returns: +30.000
VARs_nb F Min	192	mW	Outlet 6 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 6 is 80 VARs)192?<CR> Returns: +80.000
VARs_nb F Max	193	mWs	Outlet 6 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 1 is 300VARs)193?<CR> Returns: +300.000
VAs_nb F Min	194	mW	Outlet 6 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 1 is 80 VARs)194?<CR> Returns: +80.000
VAs_nb F Max	195	mWs	Outlet 6 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 6 is 300VARs)195?<CR> Returns: +300.000
Power Factor_nb F Min	196	–	Outlet 6 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 6 is -0.6)15A?<CR> Returns: -0.600
Power Factor_nb F Max	197	–	Outlet 6 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 6 is 0.9)15B?<CR> Returns: +0.900
Phase Angle_nb F Min	198	–	Outlet 6 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 6 is 10 degrees)15C?<CR> Returns: +10.000
Phase Angle_nb F Max	199	–	Outlet 6 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 6 is 70 degrees)15D?<CR> Returns: +70.000

OUTLET 7 (IG) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts G Min	19A	mW	Minimum Outlet 7 active power measured (per second).	If the minimum power measured on Outlet 7 is 80 Watts)19A?<CR> Returns: +80.000
Watts G Max	19B	mW	Maximum Outlet 7 active power measured (per second).	If the maximum power measured on Outlet 7 is 200 Watts)19B?<CR> Returns: +200.000
Irms_nb G Min	19C	mArms	Outlet 7 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 7 is 1 Amp)19C?<CR> Returns: +1.000
Irms_nb G Max	19D	mArms	Outlet 7 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 7 is 30 Amps)19D?<CR> Returns: +30.000
VARs_nb G Min	19E	mW	Outlet 7 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 7 is 80 VARs)19E?<CR> Returns: +80.000
VARs_nb G Max	19F	mWs	Outlet 7 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 7 is 300VARs)19F?<CR> Returns: +300.000
VAs_nb G Min	1A0	mW	Outlet 7 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 7 is 80 VARs)1A0?<CR> Returns: +80.000
VAs_nb G Max	1A1	mWs	Outlet 7 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 7 is 300VARs)1A1?<CR> Returns: +300.000
Power Factor_nb G Min	1A2	–	Outlet 7 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 7 is -0.6)1A2?<CR> Returns: -0.600
Power Factor_nb G Max	1A3	–	Outlet 7 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 7 is 0.9)1A3?<CR> Returns: +0.900
Phase Angle_nb G Min	1A4	–	Outlet 7 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 7 is 10 degrees)1A4?<CR> Returns: +10.000
Phase Angle_nb G Max	1A5	–	Outlet 7 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 7 is 70 degrees)1A5?<CR> Returns: +70.000

OUTLET 8 (IH) MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts H Min	1A6	mW	Minimum Outlet 8 active power measured (per second).	If the minimum power measured on Outlet 8 is 80 Watts)1A6?<CR> Returns: +80.000
Watts H Max	1A7	mW	Maximum Outlet 8 active power measured (per second).	If the maximum power measured on Outlet 8 is 200 Watts)1A7?<CR> Returns: +200.000
Irms_nb H Min	1A8	mArms	Outlet 8 minimum narrowband rms current measured.	If the smallest narrowband current measured on Outlet 8 is 1 Amp)1A8?<CR> Returns: +1.000
Irms_nb H Max	1A9	mArms	Outlet 8 maximum narrowband rms current measured.	If the largest narrowband current measured on Outlet 8 is 30 Amps)1A9?<CR> Returns: +30.000
VARs_nb H Min	1AA	mW	Outlet 8 minimum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 8 is 80 VARs)1AA?<CR> Returns: +80.000
VARs_nb H Max	1AB	mWs	Outlet 8 maximum narrowband reactive power measured (per second).	If the largest narrowband VARs measured on Outlet 8 is 300VARs)1AB?<CR> Returns: +300.000
VAs_nb H Min	1AC	mW	Outlet 8 minimum narrowband apparent power measured (per second).	If the smallest narrowband VAs measured on Outlet 8 is 80 VARs)1AC?<CR> Returns: +80.000
VAs_nb H Max	1AD	mWs	Outlet 8 maximum narrowband apparent power measured (per second).	If the largest narrowband VAs measured on Outlet 8 is 300VARs)1AD?<CR> Returns: +300.000
Power Factor_nb H Min	1AE	–	Outlet 8 minimum narrowband power factor measured. Minimum is defined as the most negative or least positive number.	If minimum narrowband power factor measured on Outlet 8 is -0.6)1AE?<CR> Returns: -0.600
Power Factor_nb H Max	1AF	–	Outlet 8 maximum narrowband power factor measured. Maximum is defined as the most positive or least negative number.	If maximum narrowband power factor measured on Outlet 8 is 0.9)1AF?<CR> Returns: +0.900
Phase Angle_nb H Min	1B0	–	Outlet 8 minimum narrowband phase angle measured.	If the minimum narrowband phase angle measured on Outlet 8 is 10 degrees)1B0?<CR> Returns: +10.000
Phase Angle_nb H Max	1B1	–	Outlet 8 maximum narrowband phase angle measured.	If the maximum narrowband phase angle measured on Outlet 8 is 70 degrees)1B1?<CR> Returns: +70.000

TOTAL MIN/MAX DATA				
Output	**Location (hex)**	**LSB**	**Comment**	**Example**
Watts T Min	1B2	mW	Minimum active power measured on all outlets (per second).	If the minimum power measured on all outlets is 80 Watts)1B2?<CR> Returns: +80.000
Watts T Max	1B3	mW	Maximum active power measured on all outlets (per second).	If the maximum power measured on all outlets is 200 Watts)1B3?<CR> Returns: +200.000
Irms_nb T Min	1B4	mArms	Minimum narrowband rms current measured on all outlets.	If the smallest narrowband current measured on all outlets is 1 Amp)1B4?<CR> Returns: +1.000
Irms_nb T Max	1B5	mArms	Maximum narrowband rms current measured on all outlets.	If the largest narrowband current measured on all outlets is 30 Amps)1B5?<CR> Returns: +30.000
VARs_nb T Min	1B6	mW	Minimum narrowband reactive power measured (per second) on all outlets.	If the largest narrowband VARs measured on all outlets is 80 VARs)1B6?<CR> Returns: +80.000
VARs_nb T Max	1B7	mWs	Maximum narrowband reactive power measured (per second) on all outlets.	If the largest narrowband VARs measured on all outlets is 300VARs)1B7?<CR> Returns: +300.000
VAs_nb T Min	1B8	mW	Minimum narrowband apparent power measured (per second) on all outlets.	If the smallest narrowband VAs measured on all outlets is 80 VARs)1B8?<CR> Returns: +80.000
VAs_nb T Max	1B9	mWs	Maximum narrowband apparent power measured (per second) on all outlets.	If the largest narrowband VAs measured on all outlets is 300VARs)1B9?<CR> Returns: +300.000
Unused	1BA – 1BF		Unused	

6 Configuration Parameter Entry

6.1 MPU Parameters

Table 4 lists the MPU parameters configurable by Firmware 6618_PDU_S8_URT_V1_00. Refer to Section 4.3.6 for saving MPU parameters to internal non-volatile flash memory.

Table 4: MPU Parameters

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
SENSOR CONFIGURATION					
VMAX A	200	mVrms	+471.500	External rms voltage corresponding to 250 mVpk at the VA input of the 78M6618. It must be set high enough to account for overvoltages.	VMAX on channel A is +471.5V for headroom. If only using a 120V AC system, additional headroom can be added as follows:)200=+240.00<CR>
VMAX B	201	mVrms	+471.500	Same as VMAX A, but at VB.	
IMAX Outlet 1 (IA)	202	mArms	+30.000	External rms current corresponding to 250 mVpk at the IA input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 1:)202=+44.190<CR>
IMAX Outlet 2 (IB)	203	mArms	+30.000	External rms current corresponding to 250 mVpk at the IB input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 2:)203=+44.190<CR>
IMAX Outlet 3 (IC)	204	mArms	+30.000	External rms current corresponding to 250 mVpk at the IC input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 3:)204=+44.190<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
IMAX Outlet 4 (ID)	205	mArms	+30.000	External rms current corresponding to 250 mVpk at the ID input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 4:)205=+44.190<CR>
IMAX Outlet 5 (IE)	206	mArms	+30.000	External rms current corresponding to 250 mVpk at the IE input of the 78M6618.	The default is set to 52 Amps for overhead. For added margin, in a system using current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} For a 4 mΩ current shunt IMAX=44.19 Amps To set IMAX Outlet 5:)206=+44.190<CR>
IMAX Outlet 6 (IF)	207	mArms	+30.000	External rms current corresponding to 250 mVpk at the IF input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 6:)207=+44.190<CR>
IMAX Outlet 7 (IG)	208	mArms	+30.000	External rms current corresponding to 250 mVpk at the IG input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 7:)208=+44.190<CR>
IMAX Outlet 8 (IH)	209	mArms	+30.000	External rms current corresponding to 250 mVpk at the IH input of the 78M6618.	The default is set to 30 Amps. In a system using a 4 mΩ current shunts IMAX could be changed as follows: IMAX= (Vpk/√2)/R_{shunt} IMAX=44.19 Amps To set IMAX Outlet 8:)209=+44.190<CR>
Reserved	20A – 20D	–		Reserved	

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
APPLICATION CONFIGURATION					
Cost/kWh	20E	mUnits	+0.150	Cost per kWh (kilowatt hour) in milliunits.	If the cost per kWh is to be 10 units:)20E=10.000<CR>
Units of Cost	20F	N/A	USD	4-byte string describing the unit of cost (e.g. USD, EURO etc.). There must be 4 characters. If entering US dollars, USD, there needs to be a space after the D to make it a four character string.	To enter US Dollars:)20F="USD "<CR> To enter Euros:)20F="EURO"<CR>
Relay Configuration	210	–	0	Bit 1 (Relay Polarity) 0 = Normal Polarity 1 = Inverted Polarity Bit 0 (Relay Type) 0 = non-latched 1 = latched	
Sequence Delay	211	0.01s	+0.10	Time delay between closing of relays Allows a single write command to the Control Relay register 288	If the user desires a 1 second delay between the *closing* of each relay, then enter the following: >)211=+1<CR>
Energize Delay	212	ms	+0.000	Parameter given in relay manufacturer's data sheet is entered here. The amount of delay will be 1 ms plus the value entered in)AE.	If the user desires 8 ms of delay then enter the following: >)212=+0.007<CR>
De-Energize Delay	213	ms	+0.000	Parameter given in relay manufacturer's data sheet is entered here. The amount of delay will be 1 ms plus the value entered in)AF.	If the user desires 8 ms of delay then enter the following: >)213=+0.007<CR>
Reserved	214 – 21C	–	0	Reserved	Reserved

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Calibration Status	21D	–	0	Bit 0 – WPULSE enable Bit 1 – Voltage Cal failed (A) Bit 2 – Voltage Cal failed (B) Bit 3 – Phase Cal failed (A) Bit 4 – Current Cal failed (A) Bit 5 – Watt Cal failed (A) Bit 6 – Phase Cal failed (B) Bit 7 – Current Cal failed (B) Bit 8 – Watt Cal failed (B) Bit 9 – Phase Cal failed (C) Bit 10 – Current Cal failed (C) Bit 11 – Watt Cal failed (C) Bit 12 – Phase Cal failed (D) Bit 13 – Current Cal failed (D) Bit 14 – Watt Cal failed (D) Bit 15 – Phase Cal failed (E) Bit 16 – Current Cal failed (E) Bit 17 – Watt Cal failed (E) Bit 18 – Phase Cal failed (F) Bit 19 – Current Cal failed (F) Bit 20 – Watt Cal failed (F) Bit 21 – Phase Cal failed (G) Bit 22 – Current Cal failed (G) Bit 23 – Watt Cal failed (G) Bit 24 – Phase Cal failed (H) Bit 25 – Current Cal failed (H) Bit 26 – Watt Cal failed (H) Bit 27-31 – Unused	Bit 0 is only user input; Enables a Watt Pulse output at DIO6. All other bits are R/O and are set when the respective calibration routine fails
Reserved	21E	–	0	Reserved	Reserved
Tolerance on Phase	21F	mDegrees	0.100	Measured value to fall within this set tolerance of the target value (Calibration Phase entry) for the calibration to be complete.	If the tolerance to the target phase is desired to be more coarse, to within 0.5 degrees, the user can enter the following: >)21F=+0.500<CR>
Calibration Type	220	–	0	Reserved. Only type 0 at this time	
Calibration Voltage	221	mVrms	+120.000	Target line voltage (rms) used for calibration.	If the target line voltage for calibration is 220V, enter the following: >)221=+220<CR>
Calibration Current	222	mArms	+1.000	Target load current (rms) used for calibration.	If the target load current for calibration is 2A, enter the following: >)222=+2<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Calibration Phase	223	0.1°	0	Target Phase (voltage to current). Normally set to zero.	
Tolerance on Voltage	224	mVrms	+0.010	Measured value to fall within this set tolerance of the target value (Calibration Voltage entry) for the calibration to be complete.	If the tolerance to the target voltage is desired to be more coarse, to within 0.1V, the user can enter the following: >)224=+0.100<CR>
Tolerance on Current	225	mArms	+0.010	Measured value to fall within this set tolerance of the target value (Calibration Current entry) for the calibration to be complete.	If the tolerance to the target current is desired to be more coarse, to within 0.1A, the user can enter the following: >)225=+0.100<CR>
Average Count for Voltage	226	1	+3	Number of voltage measurements taken and averaged to be compared to the target value (Calibration Voltage entry).	If the amount of averaging for the voltage measurement is desired to increase to 10 enter the following: >)226=+10<CR>
Average Count for Current	227	1	+3	Number of current measurements taken and averaged to be compared to the target value (Calibration Current entry).	If the amount of averaging for the current measurement is desired to increase to 10 enter the following: >)227=+10<CR>
Max Iteration for Voltage	228	1	+10	Number of attempts to reach the target value (Calibration Voltage entry) within the programmed tolerance.	If maximum number of iterations to be tried for obtaining the target value of voltage within the set tolerance (at C4) is to be reduced to 5, then enter: >)228=+5<CR>
Max Iteration for Current	229	1	+10	Number of attempts to reach the target value (Calibration Voltage entry) within the programmed tolerance.	If maximum number of iterations to be tried for obtaining the target value of power within the set tolerance (at C5) is to be reduced to 5, then enter: >)229=+5<CR>
Tolerance on Watts	22A	mW	+0.010	Measured value to fall within this set tolerance of the target value (Calibration Voltage multiplied by the calibration current entries) for the calibration to be complete.	If the tolerance to the target power is desired to be more coarse, to within 0.1W, the user can enter the following: >)22A=+0.100<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Average Count for Watts	22B	1	+3	Measured value to fall within this set tolerance of the target value (Calibration Voltage multiplied by the calibration current entries) for the calibration to be complete.	If the amount of averaging for the power measurement is desired to increase to 10 enter the following: >)22B=+10<CR>
Max Iteration for Watts	22C	1	+10	Number of attempts to reach the target value (Calibration Voltage multiplied by the calibration current entries) within the programmed tolerance.	If maximum number of iterations to be tried for obtaining the target value of power within the set tolerance (at 22A) is to be reduced to 5, then enter: >)22C=+5<CR>
Calibration WRATE	22D	1	+2840	Entry for WRATE during the calibration step only. After calibration, WRATE returns to the value entered in]23.	
Calibration Temperature	22E	0.1°C	+22.0	Target nominal temperature for calibration.	If the user desires the target nominal temperature to be 25°C, then set as follows: >)22E=+25.0<CR>
Calibration Watts	22F	mW	+120.000	Target Watts used for calibration (CALW or CLW).	If the target Watts for calibration is 240W, enter the following: >)22F=+240<CR>
Voltage A	230	mVrms	+10.000	Minimum voltage value to be measured on the VA input. Voltages below this value are ignored. Also known as CREEP VA.	If the desired minimum voltage value to be measured on the VA input is 50Vrms then set: >)230=+50
Voltage B	231	mVrms	+10.000	CREEP VB.	If the desired minimum voltage value to be measured on the VB input is 50Vrms then set: >)231=+50
Starting Current Outlet 1 (IA)	232	mArms	+0.015	Minimum current value to be measured on the IA input. Currents below this value will be ignored. Also known as CREEP IA.	Default setting is 15 mA. If start current on Outlet 1 desired is 10 mA:)232=+0.010<CR>
Starting Current Outlet 2 (IB)	233	mArms	+0.015	CREEP IB	Default setting is 15 mA. If start current on Outlet 2 desired is 10 mA:)233=+0.010<CR>
Starting Current Outlet 3 (IC)	234	mArms	+0.015	CREEP IC	Default setting is 15 mA. If start current on Outlet 3 desired is 10 mA:)234=+0.010<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Starting Current Outlet 4 (ID)	235	mArms	+0.015	CREEP ID	Default setting is 15 mA. If start current on Outlet 4 desired is 10 mA:)235=+0.010<CR>
Starting Current Outlet 5 (IE)	236	mArms	+0.015	CREEP IE	Default setting is 15 mA. If start current on Outlet 5 desired is 10 mA:)236=+0.010<CR>
Starting Current Outlet 6 (IF)	237	mArms	+0.015	CREEP IF	Default setting is 15 mA. If start current on Outlet 6 desired is 10 mA:)237=+0.010<CR>
Starting Current Outlet 7 (IG)	238	mArms	+0.015	CREEP IG	Default setting is 15 mA. If start current on Outlet 7 desired is 10 mA:)238=+0.010<CR>
Starting Current Outlet 8 (IH)	239	mArms	+0.015	CREEP IH	Default setting is 15 mA. If start current on Outlet 8 desired is 10 mA:)239=+0.010<CR>
Frequency	23A	mVrms	+49.824	Voltage at input VA under which frequency is set to zero (0). CREEP VF	
Unused	23B-23F	–		Unused	

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
ALARM THRESHOLDS - COMMON					
Temp Alarm Min Threshold	240	0.1°C	+0.0	Minimum Temperature Alarm Threshold. A temperature below this threshold will set the alarm (bit 0 of the Alarm Status Register).	If the minimum temperature threshold is to be change to 10°C then set as follows: >)240=+10.0
Temp Alarm Max Threshold	241	0.1°C	+70.0	Maximum Temperature Alarm Threshold. A temperature above this threshold will set the alarm (bit 1 of the Alarm Status Register).	If the maximum temperature threshold is to be change to 50°C then set as follows: >)241=+50.0
Frequency Minimum Threshold	242	0.01Hz	+59.00	Minimum Frequency Alarm Threshold. A frequency below this threshold will set the alarm (bit 2 of the Alarm Status Register).	If the minimum frequency threshold is to be changed to 59.5 Hz then enter the following: >)242=+59.50
Frequency Maximum Threshold	243	0.01Hz	+61.00	Maximum Frequency Alarm Threshold. A frequency above this threshold will set the alarm (bit 3 of the Alarm Status Register).	If the maximum frequency threshold is to be changed to 60.5 Hz then enter the following: >)243=+60.50
SAG Voltage VA Alarm Threshold	244	mVpk	+80.000	Sets an alarm (bit 4 of the Alarm Status) if voltage drops below the SAG threshold. See CESTATE register 22 in the CE Parameters for SAG timing	
Min Voltage VA Alarm Threshold	245	mVrms	+100.001	Sets an alarm (bit 5 of the Alarm Status) if voltage drops below the Minimum threshold	To change the minimum voltage threshold from the 100 Volt default to 80 Volts:)245=+80.000<CR>
Max Voltage VA Alarm Threshold	246	mVrms	+140.001	Sets an alarm (bit 6 of the Alarm Status) if voltage exceeds the Maximum threshold	To change the peak voltage threshold from the default 140 Volts to 280 Volts:)246=+280.000<CR>
SAG Voltage VB Alarm Threshold	247	mVpk	+80.000	Sets an alarm (bit 7 of the Alarm Status) if voltage drops below the SAG threshold. See CESTATE register 22 in the CE Parameters for SAG timing	

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Min Voltage VB Alarm Threshold	248	mVrms	+100.001	Sets an alarm (bit 8 of the Alarm Status) if voltage drops below the Minimum threshold	To change the minimum voltage threshold from the 100 Volt default to 80 Volts:)248=+80.000<CR>
Max Voltage Alarm Threshold	249	mVrms	+140.001	Sets an alarm (bit 9 of the Alarm Status) if voltage exceeds the Maximum threshold	To change the peak voltage threshold from the default 140 Volts to 280 Volts:)249=+280.000<CR>
Unused	24A-24F	–		Unused	
ALARM THRESHOLDS – OUTLET 1 WIDEBAND					
Max IA_WB Alarm Threshold	250	mArms	+15.000	Sets an alarm (bit 0 of the Alarm Status B) if Wideband Outlet 1 current (IA input to 6618) exceeds the Maximum threshold	If the maximum wideband current threshold on Outlet 1 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)250=+30.000<CR>
Min PFA_WB Alarm Threshold	251	–	-0.700	Sets an alarm (bit 1 of the Alarm Status B) if Wideband Outlet 1 current (IA input to 6618) power factor drops below the Minimum threshold	If the min wideband power factor threshold on Outlet 1 is to be changed from the default to -0.6 then set as follows:)251=-0.600<CR>
Max PFA_WB Alarm Threshold	252	–	+0.700	Sets an alarm (bit 2 of the Alarm Status B) if Wideband Outlet 1 current (IA input to 6618) power factor exceeds the Maximum threshold	If the max wideband power factor threshold on Outlet 1 is to be changed from the default to +0.600 then set as follows:)252=+0.600<CR>
ALARM THRESHOLDS – OUTLET 2 WIDEBAND					
Max IB_WB Threshold	253	mArms	+15.000	Alarm threshold (bit 3 of the Alarm Status B) for Wideband IB channel Max current	If the maximum wideband current threshold on Outlet 2 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)253=+30.000<CR>
Min PFB_WB Threshold	254	–	-0.700	Alarm threshold (bit 4 of the Alarm Status B) for Wideband IB channel Min power factor	If the min wideband power factor threshold on Outlet 2 is to be changed from the default to -0.6 then set as follows:)254=-0.600<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Max PFB_WB Threshold	255	–	+0.700	Alarm threshold (bit 5 of the Alarm Status B) for Wideband IB channel Max power factor	If the max wideband power factor threshold on Outlet 2 is to be changed from the default to +0.600 then set as follows:)255=+0.600<CR>
ALARM THRESHOLDS – OUTLET 3 WIDEBAND					
Max IC_WB Threshold	256	mArms	+15.000	Alarm threshold (bit 6 of the Alarm Status B) for Wideband IC channel Max current	If the maximum wideband current threshold on Outlet 3 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)256=+30.000<CR>
Min PFC_WB Threshold	257	–	-0.700	Alarm threshold (bit 7 of the Alarm Status B) for Wideband IC channel Min power factor	If the min wideband power factor threshold on Outlet 3 is to be changed from the default to -0.6 then set as follows:)257=-0.600<CR>
Max PFC_WB Threshold	258	–	+0.700	Alarm threshold (bit 8 of the Alarm Status B) for Wideband IC channel Max power factor	If the max wideband power factor threshold on Outlet 3 is to be changed from the default to +0.600 then set as follows:)258=+0.600<CR>
ALARM THRESHOLDS – OUTLET 4 WIDEBAND					
Max ID_WB Threshold	259	mArms	+15.000	Alarm threshold (bit 9 of the Alarm Status B) for Wideband ID channel Max current	If the maximum wideband current threshold on Outlet 4 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)259=+30.000<CR>
Min PFD_WB Threshold	25A	–	-0.700	Alarm threshold (bit 10 of the Alarm Status B) for Wideband ID channel Min power factor	If the min wideband power factor threshold on Outlet 4 is to be changed from the default to -0.6 then set as follows:)25A=-0.600<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Max PFD_WB Threshold	25B	–	+0.700	Alarm threshold (bit 11 of the Alarm Status B) for Wideband ID channel Max power factor	If the max wideband power factor threshold on Outlet 4 is to be changed from the default to +0.600 then set as follows:)25B=+0.600<CR>
ALARM THRESHOLDS – OUTLET 5 WIDEBAND					
Max IE_WB Threshold	25C	mArms	+15.000	Alarm threshold (bit 12 of the Alarm Status B) for Wideband IE channel Max current	If the maximum wideband current threshold on Outlet 5 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)25C=+30.000<CR>
Min PFE_WB Threshold	25D	–	-0.700	Alarm threshold (bit 13 of the Alarm Status B) for Wideband IE channel Min power factor	If the min wideband power factor threshold on Outlet 5 is to be changed from the default to -0.6 then set as follows:)25D=-0.600<CR>
Max PFE_WB Threshold	25E	–	+0.700	Alarm threshold (bit 14 of the Alarm Status B) for Wideband IE channel Max power factor	If the max wideband power factor threshold on Outlet 5 is to be changed from the default to +0.600 then set as follows:)25E=+0.600<CR>
ALARM THRESHOLDS – OUTLET 6 WIDEBAND					
Max IF_WB Threshold	25F	mArms	+15.000	Alarm threshold (bit 15 of the Alarm Status B) for Wideband IF channel Max current	If the maximum wideband current threshold on Outlet 6 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)25F=+30.000<CR>
Min PFF_WB Threshold	260	–	-0.700	Alarm threshold (bit 16 of the Alarm Status B) for Wideband IF channel Min power factor	If the min wideband power factor threshold on Outlet 6 is to be changed from the default to -0.6 then set as follows:)260=-0.600<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Max PFF_WB Threshold	261	–	+0.700	Alarm threshold (bit 17 of the Alarm Status B) for Wideband IF channel Max power factor	If the max wideband power factor threshold on Outlet 6 is to be changed from the default to +0.600 then set as follows:)261=+0.600<CR>
ALARM THRESHOLDS – OUTLET 7 WIDEBAND					
Max IG_WB Threshold	262	mArms	15.000	Alarm threshold (bit 18 of the Alarm Status B) for Wideband IG channel Max current	If the maximum wideband current threshold on Outlet 7 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)262=+30.000<CR>
Min PFG_WB Threshold	263	–	-0.700	Alarm threshold (bit 19 of the Alarm Status B) for Wideband IG channel Min power factor	If the min wideband power factor threshold on Outlet 7 is to be changed from the default to -0.6 then set as follows:)263=-0.600<CR>
Max PFG_WB Threshold	264	–	+0.700	Alarm threshold (bit 20 of the Alarm Status B) for Wideband IG channel Max power factor	If the max wideband power factor threshold on Outlet 7 is to be changed from the default to +0.600 then set as follows:)264=+0.600<CR>
ALARM THRESHOLDS – OUTLET 8 WIDEBAND					
Max IH_WB Threshold	265	mArms	+15.000	Alarm threshold (bit 21 of the Alarm Status B) for Wideband IH channel Max current	If the maximum wideband current threshold on Outlet 8 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)253=+30.000<CR>
Min PFH_WB Threshold	266	–	-0.700	Alarm threshold (bit 22 of the Alarm Status B) for Wideband IH channel Min power factor	If the min wideband power factor threshold on Outlet 8 is to be changed from the default to -0.6 then set as follows:)254=-0.600<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Max PFH_WB Threshold	267	–	+0.700	Alarm threshold (bit 23 of the Alarm Status B) for Wideband IH channel Max power factor	If the max wideband power factor threshold on Outlet 8 is to be changed from the default to +0.600 then set as follows:)255=+0.600<CR>
ALARM THRESHOLD – TOTAL WIDEBAND CURRENT					
Max Total WB Threshold	268	mArms	+20.000	Alarm threshold (bit 24 of the Alarm Status B) for Wideband Total Max current	
ALARM THRESHOLDS – OUTLET 1 NARROWBAND					
Max IA_NB Alarm Threshold	269	mArms	+15.000	Sets an alarm (bit 0 of the Alarm Status B) if Narrowband IA channel current exceeds the Maximum threshold	If the maximum narrowband current threshold on Outlet 1 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)269=+30.000<CR>
Min PFA_NB Alarm Threshold	26A	–	-0.700	Sets an alarm (bit 1 of the Alarm Status B) if Narrowband IA channel power factor drops below the Minimum threshold	If the min narrowband power factor threshold on Outlet 1 is to be changed from the default to -0.6 then set as follows:)26A=-0.600<CR>
Max PFA_NB Alarm Threshold	26B	–	+0.700	Sets an alarm (bit 2 of the Alarm Status B) if Narrowband IA channel power factor exceeds the Maximum threshold	If the max narrowband power factor threshold on Outlet 1 is to be changed from the default to +0.600 then set as follows:)26B=+0.600<CR>
ALARM THRESHOLDS – OUTLET 2 NARROWBAND					
Max IB_NB Threshold	26C	mArms	+15.000	Alarm threshold (bit 3 of the Alarm Status B) for Narrowband IB channel Max current	If the maximum narrowband current threshold on Outlet 2 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)26C=+30.000<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Min PFB_NB Threshold	26D	–	-0.700	Alarm threshold (bit 4 of the Alarm Status B) for Narrowband IB channel Min power factor	If the min narrowband power factor threshold on Outlet 2 is to be changed from the default to -0.6 then set as follows:)26D=-0.600<CR>
Max PFB_NB Threshold	26E	–	+0.700	Alarm threshold (bit 5 of the Alarm Status B) for Narrowband IB channel Max power factor	If the max narrowband power factor threshold on Outlet 2 is to be changed from the default to +0.600 then set as follows:)26E=+0.600<CR>
ALARM THRESHOLDS – OUTLET 3 NARROWBAND					
Max IC_NB Threshold	26F	mArms	+15.000	Alarm threshold (bit 6 of the Alarm Status B) for Narrowband IC channel Max current	If the maximum narrowband current threshold on Outlet 3 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)26F=+30.000<CR>
Min PFC_NB Threshold	270	–	-0.700	Alarm threshold (bit 7 of the Alarm Status B) for Narrowband IC channel Min power factor	If the min narrowband power factor threshold on Outlet 3 is to be changed from the default to -0.6 then set as follows:)270=-0.600<CR>
Max PFC_NB Threshold	271	–	+0.700	Alarm threshold (bit 8 of the Alarm Status B) for Narrowband IC channel Max power factor	If the max narrowband power factor threshold on Outlet 3 is to be changed from the default to +0.600 then set as follows:)271=+0.600<CR>
ALARM THRESHOLDS – OUTLET 4 NARROWBAND					
Max ID_NB Threshold	272	mArms	+15.000	Alarm threshold (bit 9 of the Alarm Status B) for Narrowband ID channel Max current	If the maximum narrowband current threshold on Outlet 4 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)272=+30.000<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Min PFD_NB Threshold	273	–	-0.700	Alarm threshold (bit 10 of the Alarm Status B) for Narrowband ID channel Min power factor	If the min narrowband power factor threshold on Outlet 4 is to be changed from the default to -0.6 then set as follows:)273=-0.600<CR>
Max PFD_NB Threshold	274	–	+0.700	Alarm threshold (bit 11 of the Alarm Status B) for Narrowband ID channel Max power factor	If the max narrowband power factor threshold on Outlet 4 is to be changed from the default to +0.600 then set as follows:)274=+0.600<CR>
ALARM THRESHOLDS – OUTLET 5 NARROWBAND					
Max IE_NB Threshold	275	mArms	+15.000	Alarm threshold (bit 12 of the Alarm Status B) for Narrowband IE channel Max current	If the maximum narrowband current threshold on Outlet 5 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)275=+30.000<CR>
Min PFE_NB Threshold	276	–	-0.700	Alarm threshold (bit 13 of the Alarm Status B) for Narrowband IE channel Min power factor	If the min narrowband power factor threshold on Outlet 5 is to be changed from the default to -0.6 then set as follows:)276=-0.600<CR>
Max PFE_NB Threshold	277	–	+0.700	Alarm threshold (bit 14 of the Alarm Status B) for Narrowband IE channel Max power factor	If the max narrowband power factor threshold on Outlet 5 is to be changed from the default to +0.600 then set as follows:)277=+0.600<CR>
ALARM THRESHOLDS – OUTLET 6 NARROWBAND					
Max IF_NB Threshold	278	mArms	+15.000	Alarm threshold (bit 15 of the Alarm Status B) for Narrowband IF channel Max current	If the maximum narrowband current threshold on Outlet 6 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)278=+30.000<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Min PFF_NB Threshold	279	–	-0.700	Alarm threshold (bit 16 of the Alarm Status B) for Narrowband IF channel Min power factor	If the min narrowband power factor threshold on Outlet 6 is to be changed from the default to -0.6 then set as follows:)279=-0.600<CR>
Max PFF_NB Threshold	27A	–	+0.700	Alarm threshold (bit 17 of the Alarm Status B) for Narrowband IF channel Max power factor	If the max narrowband power factor threshold on Outlet 6 is to be changed from the default to +0.600 then set as follows:)27A=+0.600<CR>
ALARM THRESHOLDS – OUTLET 7 NARROWBAND					
Max IG_NB Threshold	27B	mArms	+15.000	Alarm threshold (bit 18 of the Alarm Status B) for Narrowband IG channel Max current	If the maximum narrowband current threshold on Outlet 7 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)27B=+30.000<CR>
Min PFG_NB Threshold	27C	–	-0.700	Alarm threshold (bit 19 of the Alarm Status B) for Narrowband IG channel Min power factor	If the min narrowband power factor threshold on Outlet 7 is to be changed from the default to -0.6 then set as follows:)27C=-0.600<CR>
Max PFG_NB Threshold	27D	–	+0.700	Alarm threshold (bit 20 of the Alarm Status B) for Narrowband IG channel Max power factor	If the max narrowband power factor threshold on Outlet 7 is to be changed from the default to +0.600 then set as follows:)27D=+0.600<CR>
ALARM THRESHOLDS – OUTLET 8 NARROWBAND					
Max IH_NB Threshold	27E	mArms	+15.000	Alarm threshold (bit 21 of the Alarm Status B) for Narrowband IH channel Max current	If the maximum narrowband current threshold on Outlet 8 is to be changed from the default value of 15 Amps to 30 Amps then set as follows:)27E=+30.000<CR>

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
Min PFH_NB Threshold	27F	–	-0.700	Alarm threshold (bit 22 of the Alarm Status B) for Narrowband IH channel Min power factor	If the min narrowband power factor threshold on Outlet 8 is to be changed from the default to -0.6 then set as follows:)27F=-0.600<CR>
Max PFH_NB Threshold	280	–	+0.700	Alarm threshold (bit 23 of the Alarm Status B) for Narrowband IH channel Max power factor	If the max narrowband power factor threshold on Outlet 8 is to be changed from the default to +0.600 then set as follows:)280=+0.600<CR>
ALARM THRESHOLD – TOTAL NARROWBAND CURRENT					
Max Total NB Threshold	281	mArms	+20.000	Alarm threshold (bit 24 of the Alarm Status B) for Narrowband Total Max current	
ALARM MASK SETTINGS					
Common Alarm Mask_Reg	282	–	0xFFFFFFFF	Alarm mask for bits in the Alarm Status register. A "0" masks the bit.	If bits 0 and 1 are to be masked then set as follows: >)282=FFFFFFFC
Common Alarm Mask_DIO	283	–	0xFFFFFFFF	Alarm mask for an alarm pin. A "0" masks the bit from DIO4	If bits 0 and 1 are to be masked then set as follows: >)284=FFFFFFFC
WB Alarm Mask_Reg	284	–	0xFFFFFFFF	Alarm mask for bits in the Alarm Status register. A "0" masks the bit.	If bits 0 and 1 are to be masked then set as follows: >)284=FFFFFFFC
WB Alarm Mask_DIO	285	–	0xFFFFFFFF	Alarm mask for an alarm pin. A "0" masks the bit from DIO4	If bits 0 and 1 are to be masked then set as follows: >)284=FFFFFFFC
NB Alarm Mask_Reg	286	–	0xFFFFFFFF	Alarm mask for bits in the Alarm Status register. A "0" masks the bit.	If bits 0 and 1 are to be masked then set as follows: >)286=FFFFFFFC
NB Alarm Mask_DIO	287	–	0xFFFFFFFF	Alarm mask for an alarm pin. A "0" masks the bit from DIO4	If bits 0 and 1 are to be masked then set as follows: >)284=FFFFFFFC

MPU Parameter	Location (hex)	LSB	Default	Comment	Example
MISC CONTROLS					
Control Relay	288	–	0	Bit 7 (Relay for Outlet 8 {IH }) DIO7 = Bit 7 Bit 6 (Relay for Outlet 7 {ID }) DIO8 = Bit 6 Bit 5 (Relay for Outlet 6 {IG }) DIO9 = Bit 5 Bit 4 (Relay for Outlet 5 {IC }) DIO10 = Bit 4 Bit 3 (Relay for Outlet 4 {IF }) DIO11 = Bit 3 Bit 2 (Relay for Outlet 3 {IB }) DIO13 =Bit 2 Bit 1 (Relay for Outlet 2 {IE }) DIO14 = Bit 1 Bit 0 (Relay for Outlet 1 {IH }) DIO15 = Bit 0 Note: 210[1] = 1 inverts the bits above.	
Min/Max Control	289	–	0	BIT1 – 1 Start/Stop MIN/MAX monitoring/recording. 1 = Start 0 = Stop BIT0 – 1 Reset MIN/MAX registers. Bit auto-clears. Note: BIT0 must be set first before setting BIT1 to start the MIN/MAX monitoring.	)285$ 0 Start MIN/MAX recording.)285=2<CR> Resets the MIN/MAX registers.)285=1<CR>
Clear Control	28A	–	0	Clear Control Register: Bit1 – Clears Counts Bit 0 – Clears Accumulators.	

6.2 CE Parameters

Table 5 lists the CE parameters. With the exception of CESTATE at address 22 (hex), the user does not typically need to alter any of these registers as most values are set by the calibration routine(s) in firmware 6618_PDU_S8_URT_V1_00,

Table 5: CE Parameters

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
CAL IA	10	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2.	+16384	Scaled Gain for IA input.	If current on Outlet 1 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]10=+16549<CR> If current on channel A is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]10=+16222<CR>
CAL IB	11	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IB input.	If current on Outlet 2 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]11=+16549<CR> If current on Outlet 2 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]11=+16222<CR>
CAL IC	12	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IC input.	If current on Outlet 3 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]12=+16549<CR> If current on Outlet 3 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]12=+16222<CR>
CAL ID	13	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for ID input.	If current on Outlet 4 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]13=+16549<CR> If current on Outlet 4 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]10=+16222<CR>

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
CAL IE	14	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IE input.	If current on Outlet 5 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]14=+16549<CR> If current on Outlet 5 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]14=+16222<CR>
CAL IF	15	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IF input.	If current on Outlet 6 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]15=+16549<CR> If current on Outlet 6 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]15=+16222<CR>
CAL IG	16	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IG input.	If current on Outlet 7 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]16=+16549<CR> If current on Outlet 7 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]16=+16222<CR>
CAL IH	17	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for IH input.	If current on Outlet 8 is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]17=+16549<CR> If current on Outlet 7 is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]17=+16222<CR>

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
CAL VA	18	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for VA input.	If voltage on the VA input (usually line voltage measurement) is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]18=+16549<CR> If voltage on the VA input is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]18=+16222<CR>
CAL VB	19	16384 is the default and is a gain of 1. 32767 is max giving a gain of 2	+16384	Gain for VB input.	If voltage on the VB input is low by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]19=+16549<CR> If voltage on the VA input is high by 1% scale the nominal number, 16384 by 1/(1+0.01). Number to be entered would be 16222:]19=+16222<CR> Normally set CAL VB = CAL VA
PHASE_ ADJ_IA	1A	-16384 ≤ PHASE_ADJ_IA ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IA * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_IB	1B	-16384 ≤ PHASE_ADJ_IB ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IB * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_IC	1C	-16384 ≤ PHASE_ADJ_IC ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IC * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_ID	1D	-16384 ≤ PHASE_ADJ_ID ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_ID * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_IE	1E	-16384 ≤ PHASE_ADJ_IE ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IE * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_IF	1F	-16384 ≤ PHASE_ADJ_IF ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IF * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
PHASE_ ADJ_IG	20	-16384 ≤ PHASE_ADJ_IG ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IG * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
PHASE_ ADJ_IH	21	-16384 ≤ PHASE_ADJ_IH ≤ +16384	+0	Outlet 1 Phase adjustment =15 * PHASE_ADJ_IH * 2^{-14} (degrees)	No adjustment should be necessary when using current shunts.
CESTATE	22		5005h	Pulse Selection Bit 23:16 Bit x-15 selects which outlet does Watt pulsing. SAG CNT Bits 15:8 – determines the consecutive voltage samples below SAG_Threshold before a sag alarm is declared. The maximum value is 255. Reserved Bit 4:3 Voltage Sensor Configuration Bit 2 0 – Selects isolated mode (pseudo-differential voltage measurement) 1- Selects standard single ended Pulse gain factor Bits 1:0 00 – 6x 01 – (6/64)x 10 – 96x 11 – 1.5x	]22=5005 Selects at least 80 (50h) consecutive voltage samples below SAG_Threshold before SAG alarm. Select Outlet 1 as pulse source. Selects Pulse Gain Factor equal to 6/64.
WRATE	23	Kh = VMAX A * IMAX A / (WRATE * X) 1.6826E+01 WattSec	+2840	Controls the number of pulses that are generated per measured Wh and VARh measurements.	]23=+4860 Kh = 0.32 * Wh / pulse with X = 6/64, VMAX =600 V and IMAX A= 52 A
Reserved	24			Reserved	

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
QUANTA	25	VMAX A * IMAX A * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 1. Used for compensation at low current levels. Keep below 10000d.	
QUANTB	26	VMAX A * IMAX B * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 2. Used for compensation at low current levels. Keep below 10000d	
QUANTC	27	VMAX A * IMAX C * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 3. Used for compensation at low current levels. Keep below 10000d	
QUANTD	28	VMAX A * IMAX D * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 4. Used for compensation at low current levels. Keep below 10000d	
QUANTE	29	VMAX A * IMAX E * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 5. Used for compensation at low current levels. Keep below 10000d	
QUANTF	2A	VMAX A * IMAX F * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 6. Used for compensation at low current levels. Keep below 10000d	
QUANTG	2B	VMAX A * IMAX G * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 7. Used for compensation at low current levels. Keep below 10000d	
QUANTH	2C	VMAX A * IMAX H * 1.8541E-10 (Watt)	+0	Compensation added to the Watt calculation for Outlet 8. Used for compensation at low current levels. Keep below 10000d	

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
RESERVED	2D-34			Reserved	
QUANT IA	35	$(IMAX\ A)^2$ * 4.6351E-11 (A^2)	+0	IA input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT IB	36	$(IMAX\ B)^2$ * 4.6351E-11 (A^2)	+0	IB input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT IC	37	$(IMAX\ C)^2$ * 4.6351E-11 (A^2)	+0	IC input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT ID	38	$(IMAX\ D)^2$ * 4.6351E-11 (A^2)	+0	ID input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT IE	39	$(IMAX\ E)^2$ * 4.6351E-11 (A^2)	+0	IE input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT IF	3A	$(IMAX\ F)^2$ * 4.6351E-11 (A^2)	+0	IF input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	

CE Parameter	Addr (hex)	LSB	Default	Comment	Example
QUANT IG	3B	$(IMAX\ G)^2$ * 4.6351E-11 (A^2)	+0	IG input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
QUANT IH	3C	$(IMAX\ H)^2$ * 4.6351E-11 (A^2)	+0	IH input compensation added for input noise and truncation in the squaring calculation for I^2. Used for compensation at low current levels. Keep below 10000d.	
Temperature Gain Adjust	3D	16384 is the default and is a gain of 1.	+16256	32767 is max giving a gain of 2.	To increase all channels equally by 1% scale the nominal number, 16384 by 1 / (1 - 0.01). Number to be entered would be 16549:]3D=+16549<CR> To decrease all channels 1% scale the nominal number, 16384 by 1 / (1 + 0.01). Number to be entered would be 16222:]3D=+16222<CR>
SAG VA Threshold on	3E		+3350164		
SAG VB Threshold	3F		+3350164		
Reserved	40			Reserved	
PPMC	41	ppm/°C	+33	ppm per °C.	Do not change the default setting.
$PPMC^2$	42	ppm/°C^2	-511	ADC temperature compensation ppm per °C^2.	Do not change the default setting.
Temperature Calibration Status	43	1	0	Set when temperature calibration is complete	

7 Address Content Summary

Table 6: MPU Input Summary

Basic Configuration			
Sensor Related	**Voltage - V(A)** **Voltage - V(B)** **Current -Outlet 1** **Current - Outlet 2** **Current - Outlet 3** **Current - Outlet 4** **Current - Outlet 5** **Current - Outlet 6** **Current - Outlet 7** **Current - Outlet 8**	200 201 202 203 204 205 206 207 208 209 20A – 20D	VMAX A VMAX B IMAX Outlet 1 (IA) IMAX Outlet 2 (IB) IMAX Outlet 3 (IC) IMAX Outlet 4 (ID) IMAX Outlet 5 (IE) IMAX Outlet 6 (IF) IMAX Outlet 7 (IG) IMAX Outlet 8 (IH) Reserved
Cost Related	**Cost**	20E 20F	Cost per KWh Cost Unit string
Relay Related	**Relay Configuration**	210 211 212 213 214-21C	Polarity, Latch type Sequence Delay Energize Delay De-energize Delay Unused
Calibration Related	**Calibration Configuration Parameters**	21D 21E 21F 220 221 222 223 224 225 226 227 228 229 22A 22B 22C 22D 22E 22F	Calibration Status Unused Tolerance on Phase Calibration Calibration Type Calibration Voltage (Target) Calibration Current (Target) Calibration Phase (Target) Tolerance on Voltage Calibration Tolerance on Current Calibration Average Count for Voltage Average Count for Current Max Iterations for Voltage Max Iterations for Current Tolerance on Watts Calibration Average Count for Watts Max Iterations for Watts Calibration WRATE Calibration Temperature Calibration Wattage (Target)
Creep Threshold	**Voltage (VA)** **Voltage (VB)** **Current -Outlet 1** **Current - Outlet 2** **Current - Outlet 3** **Current - Outlet 4** **Current - Outlet 5** **Current - Outlet 6** **Current - Outlet 7** **Current - Outlet 8** **Frequency**	230 231 232 233 234 235 236 237 238 239 23A 23B-23F	VA creep VB creep Imin(IA) - "creep" or squelch level Imin(IB) - "creep" or squelch level Imin(IC) - "creep" or squelch level Imin(ID) - "creep" or squelch level Imin(IE) - "creep" or squelch level Imin(IF) - "creep" or squelch level Imin(IG) - "creep" or squelch level Imin(IH) - "creep" or squelch level VA min for Freq creep Unused

Alarm Settings				
Common Alarm Threshold	**Temperature**	240 241		Min Temperature Alarm Threshold Max Temperature Alarm Threshold
	Frequency	242 243		Min Frequency Alarm Threshold Max Frequency Alarm Threshold
	Voltage (A) **Voltage (B)** **Unused**	244 245 246 247 248 249 24A-24F		SAG (A) Voltage Alarm Threshold Min Voltage (A) Alarm Threshold Max Voltage (A) Alarm Threshold SAG (B) Voltage Alarm Threshold Min Voltage (B) Alarm Threshold Max Voltage (B) Alarm Threshold Unused
Wideband (WB) / Narrowband (NB) Outlet Specific Thresholds		*WB*	*NB*	
	Current - Outlet 1	250	269	Max Current Alarm Threshold
	Power Factor - Outlet 1	251 252	26A 26B	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 2	253	26C	Max Current Alarm Threshold
	Power Factor - Outlet 2	254 255	26D 26E	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 3	256	26F	Max Current Alarm Threshold
	Power Factor - Outlet 3	257 258	270 271	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 4	259	272	Max Current Alarm Threshold
	Power Factor - Outlet 4	25A 25B	273 274	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 5	25C	275	Max Current Alarm Threshold
	Power Factor - Outlet 5	25D 25E	276 277	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 6	25F	278	Max Current Alarm Threshold
	Power Factor - Outlet 6	260 261	279 27A	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 7	262	27B	Max Current Alarm Threshold
	Power Factor - Outlet 7	263 264	27C 27D	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Current - Outlet 8	265	27E	Max Current Alarm Threshold
	Power Factor - Outlet 8	266 267	27F 280	Power Factor Alarm - Threshold Power Factor Alarm + Threshold
	Total Current	268	281	Max Current Alarm Threshold
Alarm Masks	**Common Alarm Mask for Status Registers**	282		Alarm Mask for Common Status
	Common Alarm Mask for Alarm DIO4	283		Alarm Mask for Common Alarm DIO4
	WB Alarm Mask for Status Registers	284		Alarm Mask for WB Status
	WB Alarm Mask for Alarm DIO4	285		Alarm Mask for WB Alarm DIO4
	NB Alarm Mask for Status Registers	286		Alarm Mask for NB Status
	NB Alarm Mask for Alarm DIO4	287		Alarm Mask for NB Alarm DIO4

MISC Controls			
	Relay Controls	288	Relay On/Off Control
	Min/Max Controls	289	Min/Max Controls
	Clear Control	28A	Accumulator and Counter Clear

If the rows in the sections below are shaded, the information in the table cells is different between narrowband and wideband measurements.

Table 7: MPU Output Summary

Common Data		***Wideband***		***Narrowband***
Common Data	00	Delta Temp	100	Delta Temp
	01	Line Frequency	101	Line Frequency
	02	Alarm Status (common)	102	Alarm Status (common)
	03	Alarm Status (chan specific)	103	Alarm Status (chan specific)
	04	Over Current Event Count	104	Over Current Event Count
	05	Under Voltage Event Count	105	Under Voltage Event Count
	06	Over Voltage Event Count	106	Over Voltage Event Count
	07	Volts	107	Volts
Outlet 1		***Wideband***		***Narrowband***
Common Data	08	Watts (A)	108	Watts (A)
	09	Energy (A)	109	Energy (A)
	0A	Cost (A)	10A	Cost (A)
BW Specific Data	0B	Current (A)	10B	Current (A)
	0C	VAR (A)	10C	VAR (A)
	0D	VA (A)	10D	VA (A)
	0E	Power Factor (A)	10E	Power Factor (A)
	0F	Phase (A)	10F	Phase (A)
Outlet 2		***Wideband***		***Narrowband***
Common Data	10	Watts (B)	110	Watts (B)
	11	Energy (B)	111	Energy (B)
	12	Cost (B)	112	Cost (B)
BW Specific Data	13	Current (B)	113	Current (B)
	14	VAR (B)	114	VAR (B)
	15	VA (B)	115	VA (B)
	16	Power Factor (B)	116	Power Factor (B)
	17	Phase (B)	117	Phase (B)
Outlet 3		***Wideband***		***Narrowband***
Common Data	18	Watts (C)	118	Watts (C)
	19	Energy (C)	119	Energy (C)
	1A	Cost (C)	11A	Cost (C)
BW Specific Data	1B	Current (C)	11B	Current (C)
	1C	VAR (C)	11C	VAR (C)
	1D	VA (C)	11D	VA (C)
	1E	Power Factor (C)	11E	Power Factor (C)
	1F	Phase (C)	11F	Phase (C)
Outlet 4		***Wideband***		***Narrowband***
Common Data	20	Watts (D)	120	Watts (D)
	21	Energy (D)	121	Energy (D)
	22	Cost (D)	122	Cost (D)
BW Specific Data	23	Current (D)	123	Current (D)
	24	VAR (D)	124	VAR (D)
	25	VA (D)	125	VA (D)
	26	Power Factor (D)	126	Power Factor (D)
	27	Phase (D)	127	Phase (D)

Outlet 5		***Wideband***		***Narrowband***
Common Data	28	Watts (E)	128	Watts (E)
	29	Energy (E)	129	Energy (E)
	2A	Cost (E)	12A	Cost (E)
BW Specific Data	2B	Current (E)	12B	Current (E)
	2C	VAR (E)	12C	VAR (E)
	2D	VA (E)	12D	VA (E)
	2E	Power Factor (E)	12E	Power Factor (E)
	2F	Phase (E)	12F	Phase (E)
Outlet 6		***Wideband***		***Narrowband***
Common Data	30	Watts (F)	130	Watts (F)
	31	Energy (F)	131	Energy (F)
	32	Cost (F)	132	Cost (F)
BW Specific Data	33	Current (F)	133	Current (F)
	34	VAR (F)	134	VAR (F)
	35	VA (F)	135	VA (F)
	36	Power Factor (F)	136	Power Factor (F)
	37	Phase (F)	137	Phase (F)
Outlet 7		***Wideband***		***Narrowband***
Common Data	38	Watts (G)	138	Watts (G)
	39	Energy (G)	139	Energy (G)
	3A	Cost (G)	13A	Cost (G)
BW Specific Data	3B	Current (G)	13B	Current (G)
	3C	VAR (G)	13C	VAR (G)
	3D	VA (G)	13D	VA (G)
	3E	Power Factor (G)	13E	Power Factor (G)
	3F	Phase (G)	13F	Phase (G)
Outlet 8		***Wideband***		***Narrowband***
Common Data	40	Watts (H)	140	Watts (H)
	41	Energy (H)	141	Energy (H)
	42	Cost (H)	142	Cost (H)
BW Specific Data	43	Current (H)	143	Current (H)
	44	VAR (H)	144	VAR (H)
	45	VA (H)	145	VA (H)
	46	Power Factor (H)	146	Power Factor (H)
	47	Phase (H)	147	Phase (H)
Total of Outlets		***Wideband***		***Narrowband***
Common Totals	48	Total Watts	148	Total Watts
	49	Total Energy	149	Total Energy
	4A	Total Cost	14A	Total Cost
BW Specific Totals	4B	Total Current	14B	Total Current
	4C	Total VARs	14C	Total VARs
	4D	Total VA's	14D	Total VA's
	4E	(Reserved for Future)	14E	(Reserved for Future)
	4F	(Reserved for Future)	14F	(Reserved for Future)

Min/Max Data		***Wideband***		***Narrowband***
Common Data	50	Vrms Min	150	Vrms Min
	51	Vrms Max	151	Vrms Max
Outlet 1		***Wideband***		***Narrowband***
Common Data	52	Watts Min (A)	152	Watts Min (A)
	53	Watts Max (A)	153	Watts Max (A)
BW Specific Data	54	Current Min (A)	154	Current Min (A)
	55	Current Max (A)	155	Current Max (A)
	56	VAR Min (A)	156	VAR Min (A)
	57	VAR Max (A)	157	VAR Max (A)
	58	VA Min (A)	158	VA Min (A)
	59	VA Max (A)	159	VA Max (A)
	5A	Power Factor Max (A)	15A	Power Factor Max (A)
	5B	Power Factor Min (A)	15B	Power Factor Min (A)
	5C	Phase Max (A)	15C	Phase Max (A)
	5D	Phase Min(A)	15D	Phase Min(A)
Outlet 2		***Wideband***		***Narrowband***
Common Data	5E	Watts Min (B)	15E	Watts Min (B)
	5F	Watts Max (B)	15F	Watts Max (B)
BW Specific Data	60	Current Min (B)	160	Current Min (B)
	61	Current Max (B)	161	Current Max (B)
	62	VAR Min (B)	162	VAR Min (B)
	63	VAR Max (B)	163	VAR Max (B)
	64	VA Min (B)	164	VA Min (B)
	65	VA Max (B)	165	VA Max (B)
	66	Power Factor Max (B)	166	Power Factor Max (B)
	67	Power Factor Min (B)	167	Power Factor Min (B)
	68	Phase Max (B)	168	Phase Max (B)
	69	Phase Min(B)	169	Phase Min(B)
Outlet 3		***Wideband***		***Narrowband***
Common Data	6A	Watts Min (C)	16A	Watts Min (C)
	6B	Watts Max (C)	16B	Watts Max (C)
BW Specific Data	6C	Current Min (C)	16C	Current Min (C)
	6D	Current Max (C)	16D	Current Max (C)
	6E	VAR Min (C)	16E	VAR Min (C)
	6F	VAR Max (C)	16F	VAR Max (C)
	70	VA Min (C)	170	VA Min (C)
	71	VA Max (C)	171	VA Max (C)
	72	Power Factor Max (C)	172	Power Factor Max (C)
	73	Power Factor Min (C)	173	Power Factor Min (C)
	74	Phase Max (C)	174	Phase Max (C)
	75	Phase Min (C)	175	Phase Min (C)

Outlet 4		***Wideband***		***Narrowband***
Common Data	76	Watts Min (D)	176	Watts Min (D)
	77	Watts Max (D)	177	Watts Max (D)
BW Specific Data	78	Current Min (D)	178	Current Min (D)
	79	Current Max (D)	179	Current Max (D)
	7A	VAR Min (D)	17A	VAR Min (D)
	7B	VAR Max (D)	17B	VAR Max (D)
	7C	VA Min (D)	17C	VA Min (D)
	7D	VA Max (D)	17D	VA Max (D)
	7E	Power Factor Max (D)	17E	Power Factor Max (D)
	7F	Power Factor Min (D)	17F	Power Factor Min (D)
	80	Phase Max (D)	180	Phase Max (D)
	81	Phase Min(D)	181	Phase Min(D)
Outlet 5		***Wideband***		***Narrowband***
Common Data	82	Watts Min (E)	182	Watts Min (E)
	83	Watts Max (E)	183	Watts Max (E)
BW Specific Data	84	Current Min (E)	184	Current Min (E)
	85	Current Max (E)	185	Current Max (E)
	86	VAR Min (E)	186	VAR Min (E)
	87	VAR Max (E)	187	VAR Max (E)
	88	VA Min (E)	188	VA Min (E)
	89	VA Max (E)	189	VA Max (E)
	8A	Power Factor Max (E)	18A	Power Factor Max (E)
	8B	Power Factor Min (E)	18B	Power Factor Min (E)
	8C	Phase Max (E)	18C	Phase Max (E)
	8D	Phase Min (E)	18D	Phase Min (E)
Outlet 6		***Wideband***		***Narrowband***
Common Data	8E	Watts Min (F)	18E	Watts Min (F)
	8F	Watts Max (F)	18F	Watts Max (F)
BW Specific Data	90	Current Min (F)	190	Current Min (F)
	91	Current Max (F)	191	Current Max (F)
	92	VAR Min (F)	192	VAR Min (F)
	93	VAR Max (F)	193	VAR Max (F)
	94	VA Min (F)	194	VA Min (F)
	95	VA Max (F)	195	VA Max (F)
	96	Power Factor Max (F)	196	Power Factor Max (F)
	97	Power Factor Min (F)	197	Power Factor Min (F)
	98	Phase Max (F)	198	Phase Max (F)
	99	Phase Min (F)	199	Phase Min (F)

Outlet 7		***Wideband***		***Narrowband***
Common Data	9A	Watts Min (G)	19A	Watts Min (G)
	9B	Watts Max (G)	19B	Watts Max (G)
BW Specific Data	9C	Current Min (G)	19C	Current Min (G)
	9D	Current Max (G)	19D	Current Max (G)
	9E	VAR Min (G)	19E	VAR Min (G)
	9F	VAR Max (G)	19F	VAR Max (G)
	A0	VA Min (G)	1A0	VA Min (G)
	A1	VA Max (G)	1A1	VA Max (G)
	A2	Power Factor Max (G)	1A2	Power Factor Max (G)
	A3	Power Factor Min (G)	1A3	Power Factor Min (G)
	A4	Phase Max (G)	1A4	Phase Max (G)
	A5	Phase Min (G)	1A5	Phase Min (G)
Outlet 8		***Wideband***		***Narrowband***
Common Data	A6	Watts Min (H)	1A6	Watts Min (H)
	A7	Watts Max (H)	1A7	Watts Max (H)
BW Specific Data	A8	Current Min (H)	1A8	Current Min (H)
	A9	Current Max (H)	1A9	Current Max (H)
	AA	VAR Min (H)	1AA	VAR Min (H)
	AB	VAR Max (H)	1AB	VAR Max (H)
	AC	VA Min (H)	1AC	VA Min (H)
	AD	VA Max (H)	1AD	VA Max (H)
	AE	Power Factor Max (H)	1AE	Power Factor Max (H)
	AF	Power Factor Min (H)	1AF	Power Factor Min (H)
	B0	Phase Max (H)	1B0	Phase Max (H)
	B1	Phase Min (H)	1B1	Phase Min (H)
Total of Outlets		***Wideband***		***Narrowband***
Common Totals	B2	Total Watts Max	1B2	Total Watts Max
	B3	Total Watts Min	1B3	Total Watts Min
BW Specific Totals	B4	Total Current Max	1B4	Total Current Max
	B5	Total Current Min	1B5	Total Current Min
	B6	Total VAR Max	1B6	Total VAR Max
	B7	Total VAR Min	1B7	Total VAR Min
	B8	Total VA Max	1B8	Total VA Max
	B9	Total VA Min	1B9	Total VA Min
	BA-BF	Unused	1BA-1BF	Unused

Table 8: CE Input Summary

Calibration	10	Calibration Gain IA (Outlet 1)
	11	Calibration Gain IB (Outlet 2)
	12	Calibration Gain IC (Outlet 3)
	13	Calibration Gain ID (Outlet 4)
	14	Calibration Gain IE (Outlet 5)
	15	Calibration Gain IF (Outlet 6)
	16	Calibration Gain IG (Outlet 7)
	17	Calibration Gain IH (Outlet 8)
	18	Calibration Gain VA
	19	Calibration Gain VB
Phase Adjust	1A	Phase Adjust IA
	1B	Phase Adjust IB
	1C	Phase Adjust IC
	1D	Phase Adjust ID
	1E	Phase Adjust IE
	1F	Phase Adjust IF
	20	Phase Adjust IG
	21	Phase Adjust IH
CE Configuration	22	CE State
Pulse Rate	23	Wrate
	24	Reserved
Quantization Corrections	25	Quantization offset Outlet 1
	26	Quantization offset Outlet 2
	27	Quantization offset Outlet 3
	28	Quantization offset Outlet 4
	29	Quantization offset Outlet 5
	2A	Quantization offset Outlet 6
	2B	Quantization offset Outlet 7
	2C	Quantization offset Outlet 8
	2D-34	Reserved
	35	Quantization offset IA (Outlet 1)
	36	Quantization offset IB (Outlet 2)
	37	Quantization offset IC (Outlet 3)
	38	Quantization offset ID (Outlet 4)
	39	Quantization offset IE (Outlet 5)
	3A	Quantization offset IF (Outlet 6)
	3B	Quantization offset IG (Outlet 7)
	3C	Quantization offset IH (Outlet 8)
Temperature Compensation	3D	Temperature Gain Adjust
SAG Detection	3E	SAG Threshold on VA
	3F	SAG Threshold on VB
More Temperature Compensation	40	Degree Scale
	41	ppm / ˚c
	42	ppm / ˚c^2
	43	Temperature Calibration Value
	44-46	Reserved

8 Contact Information

For more information about Teridian Semiconductor products or to check the availability of the 78M6618, contact us at: http://www.teridian.com/contact-us/

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Revision History

Revision	Date	Description
1.0	4/28/2010	First publication.
1.1	10/11/2010	Added Section 4.5.2, Setting Target and Tolerance Parameters. Added Section 4.6, Relay Control Command. Added Section 4.6.1, TC Command.
1.2	4/28/2011	Corrected the description of the CESTATE parameter in Section 6.2.