

Technical Reference PMBus BMR492

This appendix contains a detailed reference of the PMBus commands supported by the product.

Data Formats

The products make use of a few standardized numerical formats, along with custom data formats. A detailed walkthrough of the above formats is provided in AN304, as well as in sections 7 and 8 of the PMBus Specification Part II. The custom data formats vary depending on the command, and are detailed in the command description.

Standard Commands

The functionality of commands with code 0x00 to 0xCF is usually based on the corresponding command specification provided in the PMBus Standard Specification Part II (see Power System Management Bus Protocol Documents below). However there might be different interpretations of the PMBus Standard Specification or only parts of the Standard Specification applied, thus the detailed command description below should always be consulted.

Forum Websites

The System Management Interface Forum (SMIF)

http://www.powersig.org/

The System Management Interface Forum (SMIF) supports the rapid advancement of an efficient and compatible technology base that promotes power management and systems technology implementations. The SMIF provides a membership path for any company or individual to be active participants in any or all of the various working groups established by the implementer forums.

Power Management Bus Implementers Forum (PMBUS-IF)

http://pmbus.org/

The PMBus-IF supports the advancement and early adoption of the PMBus protocol for power management. This website offers recent PMBus specification documents, PMBus articles, as well as upcoming PMBus presentations and seminars, PMBus Document Review Board (DRB) meeting notes, and other PMBus related news.

PMBus – Power System Management Bus Protocol Documents

These specification documents may be obtained from the PMBus-IF website described above. These are required reading for complete understanding of the PMBus implementation. This appendix will not re-address all of the details contained within the two PMBus Specification documents.

Specification Part I - General Requirements Transport And Electrical Interface

Includes the general requirements, defines the transport and electrical interface and timing requirements of hard wired signals.

Specification Part II - Command Language

Describes the operation of commands, data formats, fault management and defines the command language used with the PMBus.

SMBus – System Management Bus Documents

System Management Bus Specification, Version 2.0, August 3, 2000

This specification specifies the version of the SMBus on which Revision 1.2 of the PMBus Specification is based. This specification is freely available from the System Management Interface Forum Web site at: http://www.smbus.org/specs/



PMBus Command Summary and Factory Default Values of Standard Configuration

The factory default values provided in the table below are valid for the Standard configuration. Factory default values for other configurations can be found using the Flex Power Designer tool.

| Code | Name | Data Format | Factory Default Value Standard | | Min Set | Max Set | Unit |
|------|---------------------------|-------------|-----------------------------------|---------|---------|---------|------|
| | | | | | Value | Value | |
| | | | Configuration BMR492XX11 | | | | |
| 0x01 | OPERATION | R/W Byte | 0x80 | /OTT KT | | | |
| 0x02 | ON_OFF_CONFIG | R/W Byte | 0x1F | | | | |
| 0x03 | CLEAR FAULTS | Send Byte | | | | | |
| 0x12 | RESTORE_DEFAULT_ALL | Send Byte | | | | | |
| 0x15 | STORE_USER_ALL | Send Byte | | | | | |
| 0x16 | RESTORE_USER_ALL | Send Byte | | | | | |
| 0x19 | CAPABILITY | Read Byte | | | | | |
| 0x1B | SMBALERT_MASK_VOUT | SMBAlert | 0x00 | | | | |
| Ì | (STATUS_VOUT) | Mask | | | | | |
| 0x1B | SMBALERT_MASK_IOUT | SMBAlert | 0x00 | | | | |
| İ | (STATUS_IOUT) | Mask | | | | | |
| 0x1B | SMBALERT_MASK_INPUT | SMBAlert | 0x00 | | | | |
| | (STATUS_INPUT) | Mask | | | | | |
| 0x1B | SMBALERT_MASK_TEMPERATU | SMBAlert | 0x00 | | | | |
| | RE (STATUS_TEMPERATURE) | Mask | | | | | |
| 0x1B | SMBALERT_MASK_CML | SMBAlert | 0x00 | | | | |
| | (STATUS_CML) | Mask | | | | | |
| 0x1B | SMBALERT_MASK_OTHER | SMBAlert | 0x00 | | | | |
| | (STATUS_OTHER) | Mask | | | | | |
| Ox1B | SMBALERT_MASK_MFR_SPECIFI | SMBAlert | 0x00 | | | | |
| | C (STATUS_MFR_SPECIFIC) | Mask | | | | | |
| 0x20 | VOUT_MODE | Read Byte | 0x15 | | | | |
| 0x21 | VOUT_COMMAND | R/W Word | 0x6000 | 12.00 | 8 | 13.2 | V |
| 0x22 | VOUT_TRIM | R/W Word | 0x0000 | 0.00 | | | V |
| 0x23 | VOUT_CAL_OFFSET | R/W Word | Unit Specific | | | | |
| 0x24 | VOUT_MAX | R/W Word | 0x7333 | 14.40 | 0 | 16 | V |
| 0x25 | VOUT_MARGIN_HIGH | R/W Word | 0x699A | 13.20 | 0 | 16 | V |
| 0x26 | VOUT_MARGIN_LOW | R/W Word | 0x5666 | 10.80 | 0 | 16 | V |
| 0x27 | VOUT_TRANSITION_RATE | R/W Word | 0xE810 | 2.00 | | | V/ms |
| 0x28 | VOUT_DROOP | R/W Word | 0x0000 | 0.00 | | | mV/ |
| | | | | | | | Α |
| 0x2B | VOUT_MIN | R/W Word | 0x0000 | 0.00 | | | V |
| 0x32 | MAX_DUTY | R/W Word | 0xF186 | 97.50 | | | % |
| 0x33 | FREQUENCY_SWITCH | R/W Word | 0xF2A8 | 170.00 | | | kHz |
| 0x35 | VIN_ON | R/W Word | 0xE228 | 34.50 | 26 | 75 | V |
| 0x36 | VIN_OFF | R/W Word | 0xE208 | 32.50 | 26 | 75 | V |
| 0x37 | INTERLEAVE | R/W Word | 0x0000 | | | | |
| 0x39 | IOUT_CAL_OFFSET | Read Word | Unit Specific | 1 | | | |
| 0x40 | VOUT_OV_FAULT_LIMIT | R/W Word | 0x7CCD | 15.60 | 0 | 16 | V |
| 0x41 | VOUT_OV_FAULT_RESPONSE | R/W Byte | 0xB8 | | | | |
| 0x42 | VOUT_OV_WARN_LIMIT | R/W Word | 0x7800 | 15.00 | 0 | 16 | V |
| 0x43 | VOUT_UV_WARN_LIMIT | R/W Word | 0x0001 | 0.00 | 0 | 16 | V |
| 0x44 | VOUT_UV_FAULT_LIMIT | R/W Word | 0x0000 | 0.00 | 0 | 16 | V |
| 0x45 | VOUT_UV_FAULT_RESPONSE | R/W Byte | 0x00 | | | | |
| 0x46 | IOUT_OC_FAULT_LIMIT | R/W Word | 0x0038 | 56.00 | 0 | 255 | Α |
| 0x47 | IOUT_OC_FAULT_RESPONSE | R/W Byte | 0xF8 | | | | |



| 0x48 | IOUT_OC_LV_FAULT_LIMIT | R/W Word | 0x1800 | 3.00 | | | V |
|------|------------------------|-------------|---------------|-----------|-----|------|----------|
| 0x4A | IOUT_OC_WARN_LIMIT | R/W Word | 0x0032 | 50.00 | 0 | 255 | A |
| 0x4B | IOUT_UC_FAULT_LIMIT | R/W Word | 0x07D8 | -40.00 | | 255 | A |
| 0x4C | IOUT_UC_FAULT_RESPONSE | R/W Byte | 0x80 | 40.00 | | | / / |
| 0x4F | OT_FAULT_LIMIT | R/W Word | 0x0082 | 130.00 | -50 | 150 | °C |
| 0x50 | OT FAULT RESPONSE | R/W Byte | 0xC0 | 100.00 | 30 | 130 | |
| 0x51 | OT_WARN_LIMIT | R/W Word | 0x005A | 90.00 | -50 | 150 | °C |
| 0x52 | UT WARN LIMIT | R/W Word | 0x0FEC | -40.00 | -50 | 150 | °C |
| 0x53 | UT_FAULT_LIMIT | R/W Word | 0x0FE7 | -50.00 | -50 | 150 | °C |
| 0x54 | UT FAULT RESPONSE | R/W Byte | 0x00 | 00.00 | 00 | 100 | |
| 0x55 | VIN_OV_FAULT_LIMIT | R/W Word | 0xEA80 | 80.00 | 0 | 128 | V |
| 0x56 | VIN_OV_FAULT_RESPONSE | R/W Byte | 0xB8 | 00.00 | | 120 | <u>'</u> |
| 0x57 | VIN_OV_WARN_LIMIT | R/W Word | 0xEA70 | 78.00 | 0 | 128 | V |
| 0x58 | VIN_UV_WARN_LIMIT | R/W Word | 0xE218 | 33.50 | 0 | 128 | V |
| 0x59 | VIN_UV_FAULT_LIMIT | R/W Word | 0xE208 | 32.50 | 0 | 128 | V |
| 0x5A | VIN_UV_FAULT_RESPONSE | R/W Byte | 0x38 | 02.00 | | 120 | <u> </u> |
| 0x5E | POWER_GOOD_ON | R/W Word | 0x4000 | 8.00 | 0 | 16 | V |
| 0x5F | POWER_GOOD_OFF | R/W Word | 0x2800 | 5.00 | 0 | 16 | V |
| 0x60 | TON_DELAY | R/W Word | 0x000F | 15.00 | 0 | 1023 | ms |
| 0x61 | TON RISE | R/W Word | 0xF028 | 10.00 | 0 | 1023 | ms |
| 0x62 | TON MAX FAULT LIMIT | R/W Word | 0xE320 | 50.00 | | .020 | ms |
| 0x63 | TON_MAX_FAULT_RESPONSE | R/W Byte | 0xF8 | 33.33 | | | |
| 0x64 | TOFF_DELAY | R/W Word | 0x0000 | 0.00 | 0 | 1023 | ms |
| 0x65 | TOFF FALL | R/W Word | 0xF028 | 10.00 | 0 | 1023 | ms |
| 0x66 | TOFF MAX WARN LIMIT | R/W Word | 0xF0FF | 63.75 | | | ms |
| 0x6A | POUT OP WARN LIMIT | R/W Word | 0x13FF | 4092.00 | | | W |
| 0x6B | PIN_OP_WARN_LIMIT | R/W Word | 0x13FF | 4092.00 | | | W |
| 0x78 | STATUS_BYTE | Read Byte | 57.1011 | 1072.00 | | | |
| 0x79 | STATUS_WORD | Read Word | | | | | |
| 0x7A | STATUS_VOUT | Read Byte | | | | | |
| 0x7B | STATUS_IOUT | Read Byte | | | | | |
| 0x7C | STATUS_INPUT | Read Byte | | | | | |
| 0x7D | STATUS_TEMPERATURE | Read Byte | | | | | |
| 0x7E | STATUS_CML | Read Byte | | | | | |
| 0x7F | STATUS_OTHER | Read Byte | | | | | |
| 0x80 | STATUS_MFR_SPECIFIC | Read Byte | | | | | |
| 0x88 | READ_VIN | Read Word | | | | | |
| 0x8B | READ_VOUT | Read Word | | | | | |
| 0x8C | READ_IOUT | Read Word | | | | | |
| 0x8D | READ_TEMPERATURE_1 | Read Word | | | | | |
| 0x94 | READ_DUTY_CYCLE | Read Word | | | | | |
| 0x95 | READ_FREQUENCY | Read Word | | | | | |
| 0x98 | PMBUS_REVISION | Read Byte | | | | | |
| 0x99 | MFR_ID | R/W Block12 | Unit Specific | • | | | |
| 0x9A | MFR_MODEL | R/W Block20 | Unit Specific | | | | |
| 0x9B | MFR_REVISION | R/W Block12 | Unit Specific | | | | |
| 0x9C | MFR_LOCATION | R/W Block12 | Unit Specific | | | | |
| 0x9D | MFR_DATE | R/W Block12 | Unit Specific | | | | |
| 0x9E | MFR_SERIAL | R/W Block20 | Unit Specific | | | | |
| 0xB0 | USER_DATA_00 | R/W Block16 | Unit Specific | | | | |
| 0xC5 | FW_CONFIG_REGULATION | R/W Block14 | 0xF800F800C | | | | |
| | | | 000000C200 | | | | |
| 0xC8 | FW_CONFIG_FAULTS | R/W Block25 | 0x000000000 | 000000000 | | | |
| | | | 00000000000 | | | | |
| | | | 00000000000 | 00 | | | |



| 0xC9 | FW_CONFIG_PMBUS | R/W Block11 | 0x00000000B800000001 1000 | | | |
|------|----------------------------------|-------------|------------------------------|----|--|---|
| 0xCA | MFR_IOUT_OC_FAST_FAULT_RE SPONSE | R/W Byte | 0xF8 | | | |
| 0xD1 | MFR_IOUT_OC_FAST_FAULT_LI | R/W Word | 0x0042 | 66 | | А |
| 0xDC | MFR_SELECT_TEMPERATURE_SE NSOR | R/W Byte | 0x01 | | | |
| 0xE8 | MFR_FILTER_COEFF | R/W Block4 | 0x38359922 | | | |
| 0xEA | MFR IOUT APC | Read Word | Unit Specific | | | |



PMBus Command Details

OPERATION (0x01)

Description: Sets the desired PMBus enable and margin operations.

| Bit | Function | Description | Value | Function | Description |
|-----|--|--|-------|------------------|---|
| 7:6 | Enable | Make the device enable or disable. | 00 | Immediate Off | Disable Immediately without sequencing. |
| | | | 01 | Soft Off | Disable "Softly" with sequencing. |
| | | | 10 | Enable | Enable device to the desired margin state. |
| 5:4 | Margin | sin Select between margin high/low states or nominal | 00 | Nominal | Operate at nominal output voltage. |
| | | output. | 01 | Margin Low | Operate at margin low voltage set in VOUT_MARGIN_LOW. |
| | | | 10 | Margin High | Operate at margin high voltage set in VOUT_MARGIN_HIGH. |
| 3:2 | 3:2 Act on Fault Set 10b to act on fault of 01b to ignore fault. | Set 10b to act on fault or set to 01b to ignore fault. | 01 | Ignore Faults | Ignore Faults when in a margined state. The device will ignore appropriate overvoltage/undervoltage warnings and faults and respond as programmed by the warning limit or fault response command. |
| | | | 10 | Act on Faults | Act on Faults when in a margined state. The device will handle appropriate overvoltage/undervoltage warnings and faults and respond as programmed by the warning limit or fault response command. |

ON_OFF_CONFIG (0x02)

Description: Configures how the device is controlled by the CONTROL pin and the PMBus.

| Bit | Function | Description | Value | Function | Description |
|-----|----------------------|---|-------|------------------------|--|
| 4 | Powerup Operation | Sets the default to either operate any time power is present or for the on/off to be controlled by CONTROL pin and serial bus commands. | 0 | Enable Always | Unit powers up any time power is present regardless of state of the CONTROL pin, taking the RC configuration into account, see command 0xE3. |
| | | | 1 | Enable pin or PMBus | Unit does not power up until commanded by the CONTROL pin and OPERATION command. |
| 3 | PMBus Enable Mode | Controls how the unit responds to commands received via the serial bus. | 0 | Ignore PMBus | Unit ignores the on/off portion of the OPERATION command from serial bus. |



| | | | 1 | Use PMBus | To start, the unit requires that the on/off portion of the OPERATION command is instructing the unit to run. |
|---|------------------------|---|---|-------------|---|
| 2 | Enable Pin Mode | Controls how the unit responds to the CONTROL pin. | 0 | Ignore pin | Unit ignores the CONTROL/Enable pin. |
| | | | 1 | Use pin | Unit requires the CONTROL pin to be asserted to start the unit. |
| 1 | Enable Pin Polarity | Polarity of the CONTROL pin. | 0 | Active High | Enable pin will cause device to enable when driven high. |
| | | | 1 | Active Low | Enable pin will cause device to enable when driven low. |
| 0 | Disable Action | CONTROL pin action when commanding the unit to turn | 0 | Soft Off | Use the programmed turn off delay and fall time. |
| | | off. | 1 | Imm. Off | Turn off the output and stop transferring energy to the output as fast as possible. The device's product literature shall specify whether or not the device sinks current to decrease the output voltage fall time. |

CLEAR_FAULTS (0x03)

Description: Clears all fault status bits

RESTORE_DEFAULT_ALL (0x12)

Description: Commands the device to restore its configuration from the Default Store.

STORE USER ALL (0x15)

Description: Stores, at the USER level, all PMBus values that were changed since the last restore command.

RESTORE_USER_ALL (0x16)

Description: Restores PMBus settings that were stored using STORE_USER_ALL. This command is automatically performed at power up.

CAPABILITY (0x19)

Description: This command provides a way for a host system to determine some key capabilities of a PMBus device.

| Bit | Function | Description | Value | Function | Description |
|-----|--------------|------------------------|-------|-------------|----------------------------|
| 7 | Packet Error | Packet error checking. | 00 | Not | Packet Error Checking not |
| | Checking | | | Supported | supported. |
| | | | 01 | Supported | Packet Error Checking is |
| | | | | | supported. |
| 6:5 | Maximum Bus | Maximum bus speed. | 00 | 100kHz | Maximum supported bus |
| | Speed | | | | speed is 100 kHz. |
| | | | 01 | 400kHz | Maximum supported bus |
| | | | | | speed is 400 kHz. |
| | | | 11 | 1MHz | Maximum supported bus |
| | | | | | speed is 1 MHz. |
| 4 | Smbalert | SMBALERT | 00 | No Smbalert | The device does not have a |
| | | | | | SMBALERT# pin and does not |
| | | | | | support the SMBus Alert |
| | | | | | Response protocol. |



| | | | 01 | Have Smbalert | The device does have a SMBALERT# pin and does support the SMBus Alert Response protocol. |
|---|-------------------|-----------------|----|--|--|
| 3 | Numeric Format | Numeric format. | 0 | LINEAR or DIRECT Format | Numeric data is in LINEAR or DIRECT format. |
| | | | 1 | IEEE Half Precision Floating Point Format | Numeric data is in IEEE half precision floating point format. |
| 2 | AVSBus Support | AVSBus support. | 0 | AVSBus Not Supported | AVSBus not supported. |
| | | | 1 | AVSBus Supported | AVSBus supported. |

SMBALERT_MASK_VOUT (0x1B)

Status Registers: STATUS_VOUT (0x7A)

Description: SMBALERT_MASK bits for the STATUS_VOUT command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|---------------|-------------|-------|-------------|-------------|
| 7 | Vout | | 0 | Pull SALERT | |
| | Overvoltage | | 1 | Ignore | |
| | Fault | | | | |
| 6 | Vout | | 0 | Pull SALERT | |
| | Overvoltage | | 1 | Ignore | |
| | Warning | | | | |
| 5 | Vout | | 0 | Pull SALERT | |
| | Undervoltage | | 1 | Ignore | |
| | Warning | | | | |
| 4 | Vout | | 0 | Pull SALERT | |
| | Undervoltage | | 1 | Ignore | |
| | Fault | | | | |
| 3 | Vout Max | | 0 | Pull SALERT | |
| | Warning | | 1 | Ignore | |
| 2 | Ton Max Fault | | 0 | Pull SALERT | |
| | | | 1 | Ignore | |
| 1 | Toff Max | | 0 | Pull SALERT | |
| | Warning | | 1 | Ignore | |

SMBALERT_MASK_IOUT (0x1B)

Status Registers: STATUS_IOUT (0x7B)

Description: SMBALERT_MASK bits for the STATUS_IOUT command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|---|-------------|-------|-------------|-------------|
| 7 | lout | | 0 | Pull SALERT | |
| | Overcurrent Fault | | 1 | Ignore | |
| 6 | lout | | 0 | Pull SALERT | |
| | Overcurrent And Low Voltage Fault | | 1 | Ignore | |
| 5 | | | 0 | Pull SALERT | |



| | lout Over Current Warning | 1 | Ignore | |
|---|---------------------------------|---|-------------|--|
| 4 | lout | 0 | Pull SALERT | |
| | Undercurrent Fault | 1 | Ignore | |

SMBALERT_MASK_INPUT (0x1B)

Status Registers: STATUS_INPUT (0x7C)

Description: SMBALERT_MASK bits for the STATUS_INPUT command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|-------------------------|-------------|-------|-------------|-------------|
| 7 | Vin | | 0 | Pull SALERT | |
| | Overvoltage Fault | | 1 | Ignore | |
| 6 | Vin | | 0 | Pull SALERT | |
| | Overvoltage Warning | | 1 | Ignore | |
| 5 | Vin | | 0 | Pull SALERT | |
| | Undervoltage Warning | | 1 | Ignore | |
| 4 | Vin | | 0 | Pull SALERT | |
| | Undervoltage Fault | | 1 | Ignore | |
| 3 | Insufficient | | 0 | Pull SALERT | |
| | Vin | | 1 | Ignore | |

SMBALERT_MASK_TEMPERATURE (0x1B)

Status Registers: STATUS_TEMPERATURE (0x7D)

Description: SMBALERT_MASK bits for the STATUS_TEMPERATURE command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|--------------|-------------|-------|-------------|-------------|
| 7 | Overtempera | | 0 | Pull SALERT | |
| | ture Fault | | 1 | Ignore | |
| 6 | Overtempera | | 0 | Pull SALERT | |
| | ture Warning | | 1 | Ignore | |
| 5 | Undertemper | | 0 | Pull SALERT | |
| | ature | | 1 | Ignore | |
| | Warning | | | | |
| 4 | Undertemper | | 0 | Pull SALERT | |
| | ature Fault | | 1 | Ignore | |

SMBALERT_MASK_CML (0x1B)

Status Registers: STATUS_CML (0x7E)

Description: SMBALERT_MASK bits for the STATUS_CML command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|-------------|-------------|-------|-------------|-------------|
| 7 | Invalid Or | | 0 | Pull SALERT | |
| | Unsupported | | 1 | Ignore | |
| | Command | | | | |
| | Received | | | | |
| 6 | | | 0 | Pull SALERT | |



| | Invalid Or Unsupported | 1 | Ignore | |
|---|---------------------------|---|-------------|---|
| | Data Received | | | |
| 5 | Packet Error | 0 | Pull SALERT | |
| | Check Failed | 1 | Ignore | |
| 4 | Memory Fault | 0 | Pull SALERT | |
| | Detected | 1 | Ignore | |
| 3 | Processor | 0 | Pull SALERT | |
| | Fault | 1 | Ignore | |
| | Detected | | | |
| 1 | Other | 0 | Pull SALERT | |
| | Communicati | 1 | Ignore | |
| | on Fault | | | |
| 0 | Memory Or | 0 | Pull SALERT | · |
| | Logic Fault | 1 | Ignore | |

SMBALERT_MASK_OTHER (0x1B)

Status Registers: STATUS_OTHER (0x7F)

Description: SMBALERT_MASK bits for the STATUS_OTHER command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Description | Value | Function | Description |
|-----|-------------|-------|-------------|-------------|
| 0 | | 0 | Pull SALERT | |
| | | 1 | Ignore | |

SMBALERT_MASK_MFR_SPECIFIC (0x1B)

Status Registers: STATUS_MFR_SPECIFIC (0x80)

Description: SMBALERT_MASK bits for the STATUS_MFR_SPECIFIC command. The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SALERT output signal.

| Bit | Function | Description | Value | Function | Description |
|-----|---------------------|-------------|-------|-------------|-------------|
| 7 | Sync Fault | | 0 | Pull SALERT | |
| | | | 1 | Ignore | |
| 6 | lout Average | | 0 | Pull SALERT | |
| | Overcurrent Fault | | 1 | Ignore | |
| 5 | lout Fast | | 0 | Pull SALERT | |
| | Overcurrent Fault | | 1 | Ignore | |
| 4 | Short Circuit | | 0 | Pull SALERT | |
| | Protection Fault | | 1 | Ignore | |

VOUT_MODE (0x20)

Description: Controls how future VOUT-related commands parameters will be interpreted.

| Bit | Function | Description | Format |
|-----|----------|---|----------------|
| 4:0 | | Five bit two's complement EXPONENT for the MANTISSA delivered as | Integer Signed |
| | | the data bytes for VOUT_COMMAND in VOUT_LINEAR Mode, five bit | |
| | | VID code identifier per in VID Mode or always set to 00000b in Direct | |
| | | Mode. | |

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|----------|---------------------|
| 7:5 | | | 000 | Linear | Linear Mode Format. |
| | | | 001 | VID | VID Mode. |



| Set to 000b to select VOUT_LINEAR Mode (F | ive bit 010 | Direct | Direct Mode. |
|--|-------------|--------|--------------|
| two's complement exp for the MANTISSA deliv | | | |
| the data bytes for an voltage related comm | | | |
| to 001b to select VID N | * | | |
| (Five bit VID code ider or set to 010b to selec | ' ' | | |
| Mode (Always set to 0 | | | |

VOUT_COMMAND (0x21)

Description: Commands the device to transition to a new output voltage.

| Bit | Description | Format | Unit |
|------|---|-------------|------|
| 15:0 | Sets the nominal value of the output voltage. | Vout | ٧ |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_TRIM (0x22)

Description: Configures a fixed offset to be applied to the output voltage when enabled.

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | Sets VOUT trim value. The two bytes are formatted as a two's complement binary | Vout | ٧ |
| | mantissa, used in conjunction with the exponent set in VOUT_MODE. | Mode | |
| | | Signed | |
| | | (Exp = -11) | |

VOUT_CAL_OFFSET (0x23)

Description: Vout calibration value. It is a signed number in Vout linear mode. The setting will be applied output voltage.

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | Vout calibration value. It is a signed number in Vout linear mode. The setting will be | Vout | V |
| | applied output voltage. | Mode | |
| | | Signed | |
| | | (Exp = -11) | |

VOUT_MAX (0x24)

Description: Configures the maximum allowed output voltage.

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | Sets the maximum possible value setting of VOUT. The maximum VOUT_MAX setting is | Vout | V |
| | 110% of the pin-strap setting. | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_MARGIN_HIGH (0x25)

Description: Configures the target for margin-up commands.

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | Sets the value of the VOUT during a margin high. | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |



VOUT_MARGIN_LOW (0x26)

Description: Configures the target for margin-down commands.

| Bit | Description | Format | Unit |
|------|---|-------------|------|
| 15:0 | Sets the value of the VOUT during a margin low. | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_TRANSITION_RATE (0x27)

Description: Configures the transition time for margins and VCOMMAND output changes.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Sets the transition rate during margin or other change of VOUT. | Linear | V/ms |

VOUT DROOP (0x28)

Description: Configures the Isense voltage to load current ratio.

| Bit | Description | Format | Unit |
|------|--|--------|------|
| 15:0 | Sets the effective load line (V/I slope) for the device. | Linear | mV/ |
| | | | Α |

VOUT_MIN (0x2B)

Description: This command is used to limit the minimum output voltage, irrespective of whatever voltage is commanded by a combination of VOUT_COMMAND (or VOUT_MARGIN_HIGH or VOUT_MARGIN_LOW) and VOUT_TRIM. The intent of this command is to provide a safeguard against a user accidentally setting the output voltage to a possibly destructive level rather than to be the primary output overprotection. The exponent is set by VOUT_MODE. If an attempt is made to program the output voltage lower than the limit set by this command, this will flag a WARNING condition, but NOT a fault.

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | This command is used to limit the minimum output voltage | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

MAX_DUTY (0x32)

Description: Configures the maximum allowed duty-cycle.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Sets the maximum allowable duty cycle of the switching frequency. | Linear | % |

FREQUENCY_SWITCH (0x33)

Description: Controls the switching frequency in 1kHz steps.

| Bit | Description | Format | Unit |
|------|-------------------------------|--------|------|
| 15:0 | Sets the switching frequency. | Linear | kHz |

VIN_ON (0x35)

Description: The VIN_ON command sets the value of the input voltage, in volts, at which the unit should start power conversion.

| Bit | Description | Format | Unit |
|------|----------------------------|--------|------|
| 15:0 | Sets the VIN ON threshold. | Linear | V |



VIN_OFF (0x36)

Description: The VIN_OFF command sets the value of the input voltage, in volts, at which the unit, once operation has started, should stop power conversion.

| Bit | Description | Format | Unit |
|------|-----------------------------|--------|------|
| 15:0 | Sets the VIN OFF threshold. | Linear | ٧ |

INTERLEAVE (0x37)

Description: Configures the phase offset with respect to a common SYNC clock. When multiple products share a common DC input supply, spreading of the switching phases between the products can be utilized. This reduces the input capacitance requirements and efficiency losses, since the peak current drawn from the input supply is effectively spread out over the whole switch period. If two or more units have their outputs connected in parallel, interleaving will reduce ripple currents. This requires that the products are synchronized using the SYNC pin.

| Bit | Function | Description | Format |
|------|--------------------|---|------------------|
| 11:8 | Group ID Number | Value 0-15. Sets an ID number to a group of interleaved rails. | Integer Unsigned |
| 7:4 | Number of Rails | Value 0-15. Sets the number of units in the group, including the SYNC OUT product. | Integer Unsigned |
| 3:0 | Rail Position | Value 0-15. Sets the interleave order for this unit. The product configured to SYNC OUT shall be assigned to number 0 | Integer Unsigned |

IOUT_CAL_OFFSET (0x39)

Description: Sets the current-sense offset.

| Bit | Description | Format | Unit |
|------|--|--------|------|
| 15:0 | Sets an offset to IOUT readings. Use to compensate for delayed measurements of | Linear | Α |
| | current ramp. | | |

VOUT_OV_FAULT_LIMIT (0x40)

Description: Output over voltage fault limit.

| Bit | Description | Format | Unit |
|------|----------------------------------|-------------|------|
| 15:0 | Output over voltage fault limit. | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_OV_FAULT_RESPONSE (0x41)

Description: Output over voltage fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|---------------------------------------|---|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |



| | | Describes the device interruption operation. 00b - The PMBus device continues operation without interruption. 01b - The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). 10b - The device shuts down (disables the output) and responds according to the Retry Setting in bits [5:3]. 11b - The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. | 11 | Disable and retry Disable, Resume When OK | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
|-----|---------|---|-----|--|---|
| 5:3 | Retries | The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting continuously. | 000 | Do Not Retry Retry Once | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of |
| | | | | | each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|-----------------------|--|
| 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |



| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
|-----|------------|----------------------------------|---|-----|--|
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to | 5 | 32 | |
| | | restart. The time unit is set in | 6 | 64 | |
| | | register 0xC8. | 7 | 128 | |

VOUT_OV_WARN_LIMIT (0x42)

Description: Output over voltage warning limit.

| Bit | Description | Format | Unit |
|------|------------------------------------|-------------|------|
| 15:0 | Output over voltage warning limit. | Vout | ٧ |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_UV_WARN_LIMIT (0x43)

Description: Output under voltage warning limit.

| Bit | Description | Format | Unit |
|------|-------------------------------------|-------------|------|
| 15:0 | Output under voltage warning limit. | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_UV_FAULT_LIMIT (0x44)

Description: Output under voltage fault limit.

| Bit | Description | Format | Unit |
|------|-----------------------------------|-------------|------|
| 15:0 | Output under voltage fault limit. | Vout | V |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

VOUT_UV_FAULT_RESPONSE (0x45)

Description: Output under voltage fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|---------------------------------------|---|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |



| | | Describes the device interruption operation. 00b - The PMBus device continues operation without interruption. 01b - The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). 10b - The device shuts down (disables the output) and responds according to the Retry Setting in bits [5:3]. 11b - The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. | 11 | Disable and retry Disable, Resume When OK | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
|-----|---------|---|-----|--|---|
| 5:3 | Retries | The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting continuously. | 000 | Do Not Retry Retry Once | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of |
| | | | | | each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| , | | | |
|---|-----|-----------------------|--|
| | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |



| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
|-----|------------|----------------------------------|---|-----|--|
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to | 5 | 32 | |
| | | restart. The time unit is set in | 6 | 64 | |
| | | register 0xC8. | 7 | 128 | |

IOUT_OC_FAULT_LIMIT (0x46)

Description: Output over current limit.

| Bit | Description | Format | Unit |
|------|----------------------------------|--------|------|
| 15:0 | Output over current fault limit. | Linear | Α |

IOUT_OC_FAULT_RESPONSE (0x47)

Description: Output over current fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|---|-------|--|---|
| 7:6 | Response | For all values of bits [7:6], the device: Sets the corresponding fault bit in the status registers and If the device supports notifying the host, it does so. | 00 | Ignore Fault | The PMBus device continues to operate indefinitely while maintaining the output current at the value set by IOUT_OC_FAULT_LIMIT without regard to the output voltage (known as constant-current or brickwall limiting). |
| | | | 01 | Conditioned constant current | The PMBus device continues to operate indefinitely while maintaining the output current at the value set by IOUT_OC_FAULT_LIMIT as long as the output voltage remains above the minimum value specified by IOUT_OC_LV_FAULT_LIMIT. If the output voltage is pulled down to less than that value, then the PMBus device shuts down and responds according to the Retry setting in bits [5:3]. |
| | | | 10 | Delay w/ Const. Current & Retry | The PMBus device continues to operate, maintaining the output current at the value set by IOUT_OC_FAULT_LIMIT without regard to the output voltage, for the delay time set by bits [2:0] and the delay time units for specified in the IOUT_OC_FAULT_RESPONSE. If the device is still operating in current limiting at the end of the delay time, the device responds as programmed by the Retry Setting in bits [5:3]. |



| | | | 11 | Disable, Resume When OK | The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
|-----|---------------|--|------------|---|--|
| 5:3 | Retries | The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
| | continuously. | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. | |
| | | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| | | | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|---------------------------------|--|---------------------------------|---|--|
| | | | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |
| 2:0 | Retry Time and Delay Time | Number of delay time units. Used for either the amount of time the device is to continue operating after a fault is detected or for the amount of time between attempts to restart. The time unit is set in register 0xC8. | 0 1 2 3 4 5 6 | 1 2 4 8 16 32 64 128 | |

IOUT_OC_LV_FAULT_LIMIT (0x48)
Description: Set the output over-current low-voltage fault threshold.



| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | Set the output over-current low-voltage fault threshold. | Vout | ٧ |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

IOUT_OC_WARN_LIMIT (0x4A)

Description: Output over current warning limit.

| Bit | Description | Format | Unit |
|------|------------------------------------|--------|------|
| 15:0 | Output over current warning limit. | Linear | Α |

IOUT_UC_FAULT_LIMIT (0x4B)

Description: Sets the output under-current peak limit.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Sets the IOUT under-current peak fault threshold. | Linear | Α |

IOUT_UC_FAULT_RESPONSE (0x4C)

Description: Configures the output undercurrent fault response. The command format is the same as the PMBus standard responses for voltage and temperature faults except that it sets the undercurrent status bit.

| Bit | Function | Description | Value | Function | Description |
|-----|---------------|---|-------|---------------------------------------|---|
| 7:6 | Response | Describes the device interruption operation. For all modes set by bits [7:6], the | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | device pulls SALERT low and sets the related fault bit in the status registers. | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |
| | | | 10 | Disable and Retry | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. |
| | | | 11 | Disable, Resume When OK | The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
| 5:3 | Retry Setting | The device attempts to restart the number of times set by these bits. | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared. |



| | | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared. The time between the start of each attempt to restart is set by the value in bits [2:0] along with the delay time unit specified for that particular fault. |
|-----|------------|---|-----|-----------------------|---|
| | | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. |
| | | | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. |
| | | | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. |
| | | | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. |
| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. |
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until output is DISABLED, bias power is removed, or another fault condition causes the output to shut down. |
| 2:0 | Retry Time | Number of delay time units. | 0 | 0 | |
| | and Delay | Used for either the amount of | 1 | 1 | |
| | Time | time the device (10 ms/unit) is to continue operating after a | 3 | 3 | |
| | | fault is detected or for the | 4 | 4 | |
| | | amount of time (8.2 ms/unit) | 5 | 5 | |
| | | between attempts to restart. | 6 | 6 | |
| | | | 7 | 7 | |

OT_FAULT_LIMIT (0x4F)

Description: Over temperature fault limit.

| Bit | Description | Format | Unit |
|------|-------------------------------|--------|------------|
| 15:0 | Over temperature fault limit. | Linear | $^{\circ}$ |

OT_FAULT_RESPONSE (0x50)
Description: Over temperature fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|--------------|----------------------------|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues |
| | | | | | operation without |
| | | | | | interruption. |



| | | | 10 | Perform Retries while Operating Disable and retry | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). The device shuts down (disables the output) and responds according to the |
|-----|---------|-----|------------|---|--|
| | | | 11 | Disable, Resume When OK | retry setting in bits [5:3]. The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
| 5:3 | Retries | | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
| | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. | |
| | | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| , | | | |
|---|-----|-----------------------|--|
| | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |



| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
|-----|--------------|--|---|-----|--|
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | time between | detected or for the amount of | 4 | 16 | |
| | | time between attempts to restart. The time unit is set in register 0xC8. | 5 | 32 | |
| | | | 6 | 64 | |
| | | | 7 | 128 | |

OT_WARN_LIMIT (0x51)

Description: Over temperature warning limit.

| Bit | Description | Format | Unit |
|------|---------------------------------|--------|------|
| 15:0 | Over temperature warning limit. | Linear | Ŝ |

UT_WARN_LIMIT (0x52)

Description: Under temperature warning limit.

| В | 8it | Description | Format | Unit |
|---|-----|----------------------------------|--------|------|
| | 5:0 | Under temperature warning limit. | Linear | °C |

UT_FAULT_LIMIT (0x53)

Description: Under temperature fault limit.

| | Bit | Description | Format | Unit |
|---|------|--------------------------------|--------|------|
| Ī | 15:0 | Under temperature fault limit. | Linear | °C |

UT_FAULT_RESPONSE (0x54)

Description: Under temperature fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|---------------------------------------|---|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |
| | | | 10 | Disable and retry | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. |
| | | | 11 | Disable, Resume When OK | The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |



| E, 2 | Retries | 000 | Do Not Doto: | A zoro valuo for the Detail |
|------|---------|-----|---------------|--|
| 5:3 | Refiles | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
| | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| | | | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|------------|---|-----|-----------------------|--|
| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |
| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to restart. The time unit is set in | 5 | 32 | |
| | | register 0xC8. | 6 | 64 | |
| | | register oxeo. | 7 | 128 | |

VIN_OV_FAULT_LIMIT (0x55)

Description: Input over voltage fault limit.

| Bit | Description | Format | Unit |
|------|---------------------------------|--------|------|
| 15:0 | Input over voltage fault limit. | Linear | ٧ |

VIN_OV_FAULT_RESPONSE (0x56)
Description: Input over voltage fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|--------------|----------------------------|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues |
| | | | | | operation without |
| | | | | | interruption. |



| | | 10 | Perform Retries while Operating Disable and retry | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). The device shuts down (disables the output) and responds according to the | |
|-----|---------|-----|--|--|--|
| | | | 11 | Disable, Resume When OK | retry setting in bits [5:3]. The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |
| 5:3 | Retries | | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
| | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. | |
| | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. | |



| 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|-----------------------|--|
| 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |



| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
|-----|------------|--|---|-----|--|
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to restart. The time unit is set in register 0xC8. | 5 | 32 | |
| | | | 6 | 64 | |
| | | | 7 | 128 | |

VIN_OV_WARN_LIMIT (0x57)

Description: Input over voltage warning limit.

| Bit | Description | Format | Unit |
|------|-----------------------------------|--------|------|
| 15:0 | Input over voltage warning limit. | Linear | ٧ |

VIN_UV_WARN_LIMIT (0x58)

Description: Input under voltage warning limit.

| Bit | Description | Format | Unit |
|------|------------------------------------|--------|------|
| 15:0 | Input under voltage warning limit. | Linear | V |

VIN_UV_FAULT_LIMIT (0x59)

Description: Input under voltage fault limit.

| Bit | Description | Format | Unit |
|------|----------------------------------|--------|------|
| 15:0 | Input under voltage fault limit. | Linear | V |

VIN_UV_FAULT_RESPONSE (0x5A)

Description: Input under voltage fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|---------------------------------------|---|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |
| | | | 10 | Disable and retry | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. |
| | | | 11 | Disable, Resume When OK | The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |



| 5:3 | Retries | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
|-----|---------|-----|---------------|--|
| | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| | | | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|------------|---|-----|-----------------------|--|
| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |
| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to restart. The time unit is set in | 5 | 32 | |
| | | restart. The time unit is set in register 0xC8. | 6 | 64 | |
| | | regisiei uxco. | 7 | 128 | |

POWER_GOOD_ON (0x5E)

Description: Sets the output voltage threshold for asserting PG (Power Good).

| Bit | Description | Format | Unit |
|------|--|-------------|------|
| 15:0 | The POWER_GOOD_ON command sets the output voltage at which an optional | Vout | V |
| | POWER_GOOD signal should be asserted. | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

POWER_GOOD_OFF (0x5F)

Description: If the output voltage is lower than this one, negate power good if power good is enabled through MFR_MULTI_PIN_CONFIG and set the power good bit to 1 in PMBUS status.

| Bit Description Format Unit |
|-----------------------------|
|-----------------------------|



| Ī | 15:0 | If the output voltage is lower than this one, negate power good if power good is | Vout | ٧ |
|---|------|--|-------------|---|
| | | enabled through MFR_MULTI_PIN_CONFIG and set the power good bit to 1 in PMBUS | Mode | |
| | | status. | Unsigned | |
| | | | (Exp = -11) | |

TON_DELAY (0x60)

Description: Sets the turn-on delay time

| Bit | Description | Format | Unit |
|------|--|--------|------|
| 15:0 | Sets the delay time from ENABLE to start of VOUT rise. | Linear | ms |

TON_RISE (0x61)

Description: Sets the turn-on transition time.

| Bit | Description | Format | Unit |
|------|--|--------|------|
| 15:0 | Sets the rise time of VOUT after ENABLE and TON_DELAY. | Linear | ms |

TON_MAX_FAULT_LIMIT (0x62)

Description: Sets an upper limit, in milliseconds, on how long the unit can attempt to power up the output without reaching the output undervoltage fault limit.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | A value of 0 milliseconds means that there is no limit and that the unit can attempt to | Linear | ms |
| | bring up the output voltage indefinitely. | | |

TON_MAX_FAULT_RESPONSE (0x63)

Description: Only some of the response types are supported.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|-------------|-------|---------------------------------------|---|
| 7:6 | Response | | 00 | Ignore Fault | The PMBus device continues operation without interruption. |
| | | | 01 | Perform Retries while Operating | The PMBus device continues operation for the delay time specified by bits [2:0] and the delay time unit specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit responds as programmed in the Retry Setting (bits [5:3]). |
| | | | 10 | Disable and retry | The device shuts down (disables the output) and responds according to the retry setting in bits [5:3]. |
| | | | 11 | Disable, Resume When OK | The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists. |



| 5:3 | Retries | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
|-----|---------|-----|---------------|--|
| | | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| | | | 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|------------|---|-----|-----------------------|--|
| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |
| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue operating after a fault is | 2 | 8 | |
| | | detected or for the amount of | 3 | 16 | |
| | | time between attempts to | 5 | 32 | |
| | | restart. The time unit is set in | 6 | 64 | |
| | | register 0xC8. | 7 | 128 | |
| | | TON_MAX_FAULT_RESPONSE time unit is referenced to VOUT FAULT time unit. | ĺ | . 20 | |

TOFF_DELAY (0x64)
Description: Sets the turn-off delay.

| I | Bit | Description | Format | Unit |
|---|------|---|--------|------|
| Ī | 15:0 | Sets the delay time from DISABLE to start of VOLIT fall | Linear | ms |

TOFF_FALL (0x65)Description: Sets the turn-off transition time.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Sets the fall time for VOUT after DISABLE and TOFF_DELAY. | Linear | ms |



TOFF_MAX_WARN_LIMIT (0x66)

Description: Sets an upper limit, in milliseconds, on how long the unit can attempt to power down the output without reaching 12.5% of the output voltage programmed at the time the unit is turned off.

| Bit | Description | Format | Unit |
|------|-------------|--------|------|
| 15:0 | | Linear | ms |

POUT_OP_WARN_LIMIT (0x6A)

Description: Sets the output over-power warning limit.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Sets the output over-power warning threshold. | Linear | W |

PIN_OP_WARN_LIMIT (0x6B)

Description: Sets the input over-power warning limit.

| Bit | D | Description Description | Format | Unit |
|-----|------|---|--------|------|
| 15: | :O S | ets the input over-power warning threshold. | Linear | W |

STATUS_BYTE (0x78)

Description: Returns a brief fault/warning status byte.

| Bit | Function | Description | Value | Description |
|-----|-------------------|--|-------|-------------|
| 6 | Off | This bit is asserted if the unit is not providing | 0 | No fault |
| | | power to the output, regardless of the reason, including simply not being enabled. | 1 | Fault |
| 5 | Vout Overvoltage | An output overvoltage fault has occurred. | 0 | No fault |
| | Fault | | 1 | Fault |
| 4 | Iout Overcurrent | An output overcurrent fault has occurred. | 0 | No fault |
| | Fault | | 1 | Fault |
| 3 | Vin Undervoltage | An input undervoltage fault has occurred. | 0 | No fault |
| | Fault | | 1 | Fault |
| 2 | Temperature | A temperature fault or warning has occurred. | 0 | No fault |
| | | | 1 | Fault |
| 1 | Communication/Lo | A communications, memory or logic fault has | 0 | No fault |
| | gic | occurred. | 1 | Fault |
| 0 | None of the Above | A fault or warning not listed in bits [7:1] has | 0 | No fault |
| | | occurred. | 1 | Fault |

STATUS_WORD (0x79)

Description: Returns an extended fault/warning status byte.

| Bit | Function | Description | Value | Description |
|-----|--------------|---|-------|-------------|
| 15 | Vout | An output voltage fault or warning has | 0 | No fault |
| | | occurred. | 1 | Fault |
| 14 | lout/Pout | An output current or output power fault or | 0 | No Fault. |
| | | warning has occurred. | 1 | Fault. |
| 13 | Input | An input voltage, input current, or input power | 0 | No Fault. |
| | | fault or warning has occurred. | 1 | Fault. |
| 12 | Mfr Specific | A manufacturer specific fault or warning has | 0 | No fault. |
| | | occurred. | 1 | Fault. |
| 11 | Power-Good | The Power-Good signal, if present, is negated. | 0 | No Fault. |
| | | | 1 | Fault. |
| 9 | Other | A bit in Status-Other is set. | 0 | No fault |



| | | | 1 | Fault |
|---|-------------------|--|---|-----------|
| 6 | Off | This bit is asserted if the unit is not providing | 0 | No fault |
| | | power to the output, regardless of the reason, including simply not being enabled. | 1 | Fault |
| 5 | Vout Overvoltage | An output overvoltage fault has occurred. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 4 | lout Overcurrent | An output overcurrent fault has occurred. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 3 | Vin Undervoltage | An input undervoltage fault has occurred. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 2 | Temperature | A temperature fault or warning has occurred. | 0 | No Fault. |
| | | | 1 | Fault. |
| 1 | Communication/Lo | A communications, memory or logic fault has | 0 | No fault. |
| | gic | occurred. | 1 | Fault. |
| 0 | None of the Above | A fault or warning not listed in bits [7:1] has | 0 | No fault. |
| | | occurred. | 1 | Fault. |

STATUS_VOUT (0x7A)

Description: Returns Vout-related fault/warning status bits.

| Bit | Function | Description | Value | Description |
|-----|-------------------|--|-------|-------------|
| 7 | Vout Overvoltage | Vout Overvoltage Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 6 | Vout Overvoltage | Vout Overvoltage Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 5 | Vout Undervoltage | Vout Undervoltage Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 4 | Vout Undervoltage | Vout Undervoltage Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 3 | Vout Max Warning | Vout Max Warning (An attempt has been | 0 | No Warning. |
| | | made to set the output voltage to value higher | 1 | Warning. |
| | | than allowed by the Vout Max command | | |
| | | (Section 13.5). | | |
| 2 | Ton Max Fault | Ton-Max Fault. | 0 | No Fault |
| | | | 1 | Fault. |
| 1 | Toff Max Warning | Toff Max Warning. | 0 | No Warning. |
| | | | 1 | Warning. |

STATUS_IOUT (0x7B)

Description: Returns lout-related fault/warning status bits.

| Bit | Function | Description | Value | Description |
|-----|-------------------|---|-------|-------------|
| 7 | lout Overcurrent | lout Overcurrent Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 6 | lout Overcurrent | lout Overcurrent and low voltage fault. | 0 | No Fault. |
| | And Low Voltage | | 1 | Fault. |
| | Fault | | | |
| 5 | lout Over Current | lout Overcurrent Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 4 | lout Undercurrent | lout Undercurrent Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |

STATUS_INPUT (0x7C)

Description: Returns VIN/IIN-related fault/warning status bits.



| Bit | Function | Description | Value | Description |
|-----|------------------|---|-------|---------------------------|
| 7 | Vin Overvoltage | Vin Overvoltage Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 6 | Vin Overvoltage | VIN Overvoltage Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 5 | Vin Undervoltage | Vin Undervoltage Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 4 | Vin Undervoltage | Vin Undervoltage Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 3 | Insufficient Vin | Asserted when either the input voltage has | 0 | No Insufficient VIN |
| | | never exceeded the input turn-on threshold | | encountered yet. |
| | | Vin-On, or if the unit did start, the input voltage decreased below the turn-off threshold. | 1 | Insufficient Unit is off. |

STATUS_TEMPERATURE (0x7D)

Description: Returns the temperature-related fault/warning status bits

| Bit | Function | Description | Value | Description |
|-----|------------------|---------------------------|-------|-------------|
| 7 | Overtemperature | Overtemperature Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |
| 6 | Overtemperature | Overtemperature Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 5 | Undertemperature | Undertemperature Warning. | 0 | No Warning. |
| | Warning | | 1 | Warning. |
| 4 | Undertemperature | Undertemperature Fault. | 0 | No Fault. |
| | Fault | | 1 | Fault. |

STATUS_CML (0x7E)

Description: Returns Communication/Logic/Memory-related fault/warning status bits.

| Bit | Function | Description | Value | Description |
|-----|--------------------|---|-------|------------------------|
| 7 | Invalid Or | Invalid Or Unsupported Command Received. | 0 | No Invalid Command |
| | Unsupported | | | Received. |
| | Command | | 1 | Invalid Command |
| | Received | | | Received. |
| 6 | Invalid Or | Invalid Or Unsupported Data Received. | 0 | No Invalid Data |
| | Unsupported Data | | | Received. |
| | Received | | 1 | Invalid Data Received. |
| 5 | Packet Error Check | Packet Error Check Failed. | 0 | No Failure. |
| | Failed | | 1 | Failure. |
| 4 | Memory Fault | Memory Fault Detected. | 0 | No Fault. |
| | Detected | | 1 | Fault. |
| 3 | Processor Fault | Processor fault detected. | 0 | No Fault. |
| | Detected | | 1 | Fault. |
| 1 | Other | A communication fault other than the ones | 0 | No Fault. |
| | Communication | listed in this table has occurred. | 1 | Fault. |
| | Fault | | | |
| 0 | Memory Or Logic | Other Memory Or Logic Fault has occurred. | 0 | No Fault. |
| | Fault | | 1 | Fault. |

STATUS_OTHER (0x7F)

Description: Returns a brief other fault/warning status bits.

| Bit | Description | Value | Description |
|-----|--|-------|-------------|
| 0 | The device was the first to assert SMBALERT. | | |



STATUS_MFR_SPECIFIC (0x80)

Description: Returns manufacturer specific status information.

| Bit | Function | Description | Value | Description |
|-----|-------------------|---------------------------------|-------|-------------|
| 7 | Sync Fault | Sync fault. | 0 | No fault. |
| | | | 1 | Fault. |
| 6 | lout Average | lout average overcurrent fault. | 0 | No fault. |
| | Overcurrent Fault | | 1 | Fault. |
| 5 | lout Fast | lout fast overcurrent fault. | 0 | No fault. |
| | Overcurrent Fault | | 1 | Fault. |
| 4 | Short Circuit | Short circuit protection fault. | 0 | No fault. |
| | Protection Fault | | 1 | Fault. |

READ_VIN (0x88)

Description: Returns the measured input voltage.

| В | sit | Description | Format | Unit |
|---|-----|------------------------------------|--------|----------|
| 1 | 5:0 | Returns the input voltage reading. | Linear | V |

READ_VOUT (0x8B)

Description: Returns the measured output voltage.

| Bit | Description | Format | Unit |
|------|--------------------------------------|-------------|------|
| 15:0 | Returns the measured output voltage. | Vout | ٧ |
| | | Mode | |
| | | Unsigned | |
| | | (Exp = -11) | |

READ_IOUT (0x8C)

Description: Returns the measured output current.

| Bit | Description | Format | Unit |
|------|--------------------------------------|--------|------|
| 15:0 | Returns the measured output current. | Linear | Α |

READ_TEMPERATURE_1 (0x8D)

Description: Reads temperature from the temperature sensor chosen in MFR_SELECT_TEMPERATURE_SENSOR (0xDC) command.

| Bit | Description | Format | Unit |
|------|-------------|--------|------|
| 15:0 | | Linear | Ŝ |

READ_DUTY_CYCLE (0x94)

Description: Returns the actual duty cycle in percent.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Returns the actual duty cycle in percent. | Direct | % |

READ_FREQUENCY (0x95)

Description: Returns the actual switching frequency.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | Returns the actual switching frequency. | Linear | kHz |



PMBUS_REVISION (0x98)

Description: Returns the PMBus revision number for this device.

| Bit | Function | Description | Value | Function | Description |
|-----|-----------------|-------------------|-------|----------|-----------------------|
| 7:4 | Part I Revision | Part I Revision. | 0x0 | 1.0 | Part I Revision 1.0. |
| | | | 0x1 | 1.1 | Part I Revision 1.1. |
| | | | 0x2 | 1.2 | Part I Revision 1.2. |
| | | | 0x3 | 1.3 | Part I Revision 1.3. |
| 3:0 | Part II | Part II Revision. | 0x0 | 1.0 | Part II Revision 1.0. |
| | Revision | | 0x1 | 1.1 | Part II Revision 1.1. |
| | | | 0x2 | 1.2 | Part II Revision 1.2. |
| | | | 0x3 | 1.3 | Part II Revision 1.3. |

MFR_ID (0x99)

Description: Sets the Manufacturers ID

| Bit | Description | Format |
|------|---------------------------|--------|
| 95:0 | Maximum of 12 characters. | ASCII |

MFR_MODEL (0x9A)

Description: Sets the MFR MODEL string.

| Bit | Description | Format |
|-------|---------------------------|--------|
| 159:0 | Maximum of 20 characters. | ASCII |

MFR_REVISION (0x9B)

Description: Sets the MFR revision string.

| Bit | Description | Format |
|------|---------------------------|--------|
| 95:0 | Maximum of 12 characters. | ASCII |

MFR_LOCATION (0x9C)

Description: Sets the MFR location string.

| I | Bit | Description | Format |
|---|------|---------------------------|--------|
| Ī | 95:0 | Maximum of 12 characters. | ASCII |

MFR_DATE (0x9D)

Description: This command returns the date the regulator was manufactured.

| Bit | Description | Format |
|------|---------------------------|--------|
| 95:0 | Maximum of 12 characters. | ASCII |

MFR_SERIAL (0x9E)

Description: This command returns a string of 13 characters and numbers that provides a unique identification of the regulator.

| Bit | Description | Format |
|-------|---------------------------|--------|
| 159:0 | Maximum of 20 characters. | ASCII |

USER_DATA_00 (0xB0)

Description: This command is available as generic read/write storage for customers.

| Bit | Description | Format |
|-------|------------------------|------------|
| 127:0 | 16 bytes of user data. | Byte Array |



FW_CONFIG_REGULATION (0xC5)

Description: FW CONFIG REGULATION parameter

| Bit | Description | Value | Function | Description |
|-----|-------------------------------------|-------|----------|-------------|
| 0 | 0 Enable diode emulation at startup | | Disabled | |
| | | 1 | Enabled | |

FW CONFIG FAULTS (0xC8)

Description: FW CONFIG FAULTS parameter

| Bit | Function | Description | Value | Function | Description |
|-----|--------------|--|-------|----------------|---|
| 7:6 | Vout Delay | Vout_Delay_Unit Time unit for | 00 | 1ms/unit | Vout Delay Unit Time unit for |
| | Unit | retry responses. 0: 1ms, 1: 4ms, 2: 16ms, 3: 256ms | | | retry responses |
| | | | 01 | 4ms/unit | Vout Delay Unit Time unit for |
| | | | | | retry responses |
| | | | 10 | 16ms/unit | Vout Delay Unit Time unit for |
| | | | | | retry responses |
| | | | 11 | 256ms/unit | Vout Delay Unit Time unit for |
| | | | | | retry responses |
| 5:4 | Vin Delay | Vin_Delay_Unit Time unit for | 00 | 1ms/unit | Vin Delay Unit Time unit for |
| | Unit | retry responses. 0: 1ms, 1: 4ms, | | | retry responses |
| | | 2: 16ms, 3: 256ms | 01 | 4ms/unit | Vin Delay Unit Time unit for |
| | | | | | retry responses |
| | | | 10 | 16ms/unit | Vin Delay Unit Time unit for |
| | | | | | retry responses |
| | | | 11 | 256ms/unit | Vin Delay Unit Time unit for |
| 0.0 | 1 15 1 | LOUIT D. L. LILLIE | 00 | 7 / 1 | retry responses |
| 3:2 | lout Delay | IOUT_Delay_Unit Time unit for | 00 | 1ms/unit | IOUT Delay Unit Time unit for |
| | Unit | retry responses. 0: 1ms, 1: 4ms, | 0.1 | 4 / | retry responses |
| | | 2: 16ms, 3: 256ms | 01 | 4ms/unit | IOUT Delay Unit Time unit for |
| | | | 10 | 16ms/unit | retry responses IOUT Delay Unit Time unit for |
| | | | 10 | 16ms/Unit | , |
| | | | 11 | 256ms/unit | retry responses |
| | | | | 256ms/Unii | IOUT Delay Unit Time unit for retry responses |
| 1:0 | Temperature | Temperature_Delay_Unit Time | 00 | 1ms/unit | Temperature Delay Unit Time |
| 1.0 | Delay Unit | unit for retry responses. 0: 1ms, | 00 | 11113/01111 | unit for retry responses |
| | Dolay of iii | 1: 4ms, 2: 16ms, 3: 256ms | 01 | 4ms/unit | Temperature Delay Unit Time |
| | | 1. 4113, 2. 10113, 0. 200113 | 01 | 41113/01111 | unit for retry responses |
| | | | 10 | 16ms/unit | Temperature Delay Unit Time |
| | | | | 1 311137 31111 | unit for retry responses |
| | | | 11 | 256ms/unit | Temperature Delay Unit Time |
| | | | '' | 23011137 31111 | unit for retry responses |

FW_CONFIG_PMBUS (0xC9)

Description: The GPIO selection for the fault select, Power good select, and enable select has to be unique, please choose different values for these configurations. The overall I2C address (Base + offset or XADDR1/XADDR2) and PMBus (Base + offset or XADDR1/XADDR2) can not be same, please configure different address either base or offset.

| Bit | Function | Description | Format |
|-------|----------------------|---|------------------|
| 31:24 | PMBus Base Addr | Base Address for PMBus offset to start from | Integer Unsigned |
| 23:17 | PMBus Addr Offset | PMBUS Address offset when resistor offset Not enabled | Integer Unsigned |



| Bit | Function | Description | Value | Function | Description |
|-----|-------------|--------------------------------|-------|-------------|-------------|
| 39 | Power good | Power good polarity (1:active | 0 | Active low | |
| | polarity | high; 0: active low). | 1 | Active high | |
| 32 | Control pin | Control pin polarity (1:active | 0 | Active low | |
| | polarity | high; 0: active low). | 1 | Active high | |
| 16 | PMBus Addr | PMBus_addr_offset_enable | 0 | Disabled | |
| | Offset | Enable PMBUS Address Offset | 1 | Enabled | |
| | Resistor | via resistor | | | |
| | Enable | | | | |

MFR_IOUT_OC_FAST_FAULT_RESPONSE (0xCA)

Description: Output over current fault response.

| Bit | Function | Description | Value | Function | Description |
|-----|----------|---|-------|-----------------------|--|
| 7:6 | Response | For all values of bits [7:6], the device: Sets the corresponding fault bit in the status registers and If the device supports notifying the host, it does so. | 00 | Ignore Fault | The PMBus device continues to operate indefinitely while maintaining the output current at the value set by IOUT_OC_FAULT_LIMIT without regard to the output voltage (known as constant-current or brickwall limiting). |
| | | | 11 | Shutdown and Retry | The PMBus device continues to operate, maintaining the output current at the value set by IOUT_OC_FAST_FAULT_LIMIT without regard to the output voltage, for the delay time set by bits [2:0] and the delay time units for specified in the IOUT_OC_FAST_FAULT_RESPO NSE. If the device is still operating in current limiting at the end of the delay time, the device responds as programmed by the Retry Setting in bits [5:3]. |
| 5:3 | Retries | The device attempts to restart the number of times set by these bits. 000b means the device does not attempt a restart. 111b means the device attempts restarting | 000 | Do Not Retry | A zero value for the Retry Setting means that the unit does not attempt to restart. The output remains disabled until the fault is cleared (Section 10.7). |
| | | continuously. | 001 | Retry Once | The PMBus device attempts to restart 1 time. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| 010 | Retry Twice | The PMBus device attempts to restart 2 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|---------------|--|
| 011 | Retry 3 times | The PMBus device attempts to restart 3 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 100 | Retry 4 times | The PMBus device attempts to restart 4 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
| 101 | Retry 5 times | The PMBus device attempts to restart 5 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |



| | | | 110 | Retry 6 times | The PMBus device attempts to restart 6 times. If the device fails to restart, it disables the output and remains off until the fault is cleared as described in Section 10.7. The time between the start of each attempt to restart is set by the value in bits [2:] along with the delay time unit specified for that particular fault. |
|-----|------------|---|-----|-----------------------|--|
| | | | 111 | Retry Continuously | The PMBus device attempts to restart continuously, without limitation, until it is commanded OFF (by the CONTROL pin or OPERATION command or both), bias power is removed, or another fault condition causes the unit to shut down. |
| 2:0 | Retry Time | Number of delay time units. | 0 | 1 | |
| | and Delay | Used for either the amount of | 1 | 2 | |
| | Time | time the device is to continue | 2 | 4 | |
| | | operating after a fault is | 3 | 8 | |
| | | detected or for the amount of | 4 | 16 | |
| | | time between attempts to restart. The time unit is set in | 5 | 32 | |
| | | register 0xC8. | 6 | 64 | |
| | | register oxeo. | 7 | 128 | |

MFR_IOUT_OC_FAST_FAULT_LIMIT (0xD1)

Description: The MFR_IOUT_OC_FAST_FAULT_LIMIT command sets or retrieves lout fast overcurrent fault threshold, in Amperes.

| Bit | Description | Format | Unit |
|------|--|----------|------|
| 15:0 | Sets lout fast over-current fault threshold. | Integer | Α |
| | | Unsianed | |

MFR_SELECT_TEMPERATURE_SENSOR (0xDC)

Description: Select which temperature sensor, internal one or external remote temperature sensor, is used.

| Bit | Function | Description | Value | Function | Description |
|-----|--------------------------------------|---|-------|----------------|--|
| | Fault Source Select | Select which temperature sensor, internal one or external remote temperature sensor, is used. | 00 | Temp A | Temp A temperature sensor selected. |
| | | | 01 | Temp B | Temp B temperature sensor selected. |
| | | | 10 | Temp I | Temp I temperature sensor selected. |
| 2:0 | READ_TEMPE RATURE_1 READ_TEMPE | READ_TEMPERATURE_1 READ_TEMPERATURE_2 Source Select. | 000 | TempA TempB | TempA (External Temperature sensor A) TempB (External Temperature sensor B). |
| | RATURE_2 Source Select | | 001 | TempA Templ | TempA (External Temperature sensor A) Templ (Internal Temperature sensor). |



| | 010 | TempB TempA | TempB (External Temperature sensor B) TempA (External |
|--|-----|----------------|---|
| | 011 | T D | Temperature sensor A). |
| | 011 | TempB | TempB (External Temperature |
| | | Templ | sensor B) Templ (Internal |
| | | | Temperature sensor). |
| | 100 | Templ TempA | Templ (Internal Temperature |
| | | | sensor) TempA (External |
| | | | Temperature sensor A). |
| | 101 | Templ TempB | Templ (Internal Temperature |
| | | | sensor) TempB (External |
| | | | Temperature sensor B). |

MFR_FILTER_COEFF (0xE8)
Description: Mfr. pid coefficients

| Bit | Function | Description | Format |
|-------|------------------|------------------------------|------------------|
| 30:24 | PID KD | PID derivative coefficient | Integer Unsigned |
| 23:18 | PID KI | PID integral coefficient | Integer Unsigned |
| 17:12 | PID KP | PID proportional coefficient | Integer Unsigned |
| 11:6 | PID pre-filter 2 | PID pre-filter 2 coefficient | Integer Unsigned |
| 5:0 | PID pre-filter 1 | Pid pre-filter 1 coefficient | Integer Unsigned |

MFR_IOUT_APC (0xEA)

Description: The iout apc gain.

| Bit | Description | Format | Unit |
|------|---|--------|------|
| 15:0 | SSet the iout apc gain. the format is Linear 11, Exponent is -9 or -8 (User selection | Linear | Α |
| | possible). The LSB varies with isen_gain_mode - ISEN_LSB/Secondary current sense resistor (Rsense). | | |