![maxim integrated™ logo]

MAX20754 PMBus
User Guide

UG6257; Rev 2; 9/19

Abstract

This User Guide complements the official PMBus Power System Management Protocol Specification including descriptions of the PMBus commands specific to the MAX20754 dual-output, multiphase DC-DC controller.

Introduction

This document lists and describes the PMBus™ commands implemented in the MAX20754 dual-output, multiphase DC-DC controller. PMBus commands are used to control and monitor the MAX20754 using a two-wire serial digital interface.

This User Guide complements the official PMBus Power System Management Protocol Specification with details specific to the MAX20754. Commands implemented exactly per the PMBus specification are not described in detail unless there are deviations from the PMBus specification functionality. All Maxim manufacturer-specific commands are fully described in this document.

References for this document are found on the PMBus and SMBus organization websites. The command functionality is based on the revision 1.3 PMBus specifications.

> http://pmbus.org/specs.html
> http://smbus.org/specs/

The information in this User's Guide is valid for the following Maxim root part numbers:

- MAX20754
- MAX20756

The commands in this document are presented in the following format:

<COMMAND_NAME>

Reference:	<"Standard Command" or "Maxim Specific">	**Stored in OTP:**	<yes/no>
Command Code:	<hex value>	**Format:**	<data format>
Data Bytes:	<byte count>	**Units:**	<unit of measure>
Transfer:	<SMBus transaction type>	**Factory Value:**	<Maxim setting>
Dual-Rail:	<"Independent" or "Shared">		
Description/Notes:	<Command definition if Maxim-specific, or notes on command functionality where it differs from the PMBus specification.>		

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Communication Protocols and Features

The device supports the following protocols and features:

- SMBus Alert Response Address (ARA)[a]
- PMBus Group Command protocol
- General Call address is supported for the OPERATION and ON_OFF_CONFIG commands
- Clock stretching is supported and required
- SMBus device timeout

The following protocols and features are not supported:

- ZONE_READ and ZONE_WRITE protocols
- SMBus Address Resolution protocol

On, Off, and Margin Testing Related Commands

OPERATION

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x01	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x00 (see Description)
Dual-Rail:	Independent		
Description/Notes:	See Section 12.1 of the PMBus Specification Part II.		

Useful values for the OPERATION command:

0x00   Immediate-off, no sequencing. *(Default setting)*
(0x01-0x3F are equivalent)[b]

0x40   Soft-off, with sequencing.
(0x41-0x7F are equivalent)

0x80   Output enabled, if allowed by ON_OFF_CONFIG setting
(0x81-0x8F are equivalent)

0x98   Margin low, act on faults.
(0x99-0x9B are equivalent)

0xA8   Margin high, act on faults.
(0xA9-0xAB are equivalent)

Invalid values for the OPERATION command:
0x90-0x93   *No fault handling mode indicated*

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[a] It is necessary to immediately read the STATUS_WORD or STATUS_BYTE registers from any MAX20754 slave address that is returned in response to the Alert Response Address before reading from the ARA again. Do not send CLEAR_FAULTS to any responding MAX20754 device until all MAX20754 devices asserting ALERT have responded to ARA and the ARA no longer returns slave addresses.

[b] In this application note, a "soft-off," "soft-stop," or "ramp-down" shutdown means the device actively controls the output voltage along a decreasing linear ramp per the TOFF_DELAY and TOFF_FALL values.

OPERATION

	0x94	Margin low, ignore faults. *(Mode not supported)* (0x95-0x97 are equivalent)
	0x9C-0x9F	*Conflicting fault handling modes.*
	0xA0-0xA3	*No fault handling mode indicated.*
	0xA4	Margin high, ignore faults. *(Mode not supported)* (0xA5-0xA7 are equivalent)
	0xAC-0xFF	*Conflicting fault handling modes.*
		These invalid data bytes trigger an "Invalid or Unsupported Data" response per section 10.9.3 of the PMBus specification.

ON_OFF_CONFIG

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x02	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read/Write Byte	Factory Value:	0x16 (see Description)
Dual-Rail:	Independent		
Description/Notes:	See Section 12.2 of the PMBus Specification Part II.		

Useful Values for the ON_OFF_CONFIG command:

0x02   Output always enabled.
(0x00-0x0F are equivalent, but changes ENx polarity, etc.)

0x12   Output always disabled.
(0x10-0x13 are equivalent, but changes ENx polarity, etc.)

0x14   Ignore bit 7 of [OPERATION](), require ENx low, soft-off on loss of ENx[c].

0x15   Ignore bit 7 of OPERATION, require ENx low, immediate-off on loss of ENx.

0x16   Ignore bit 7 of OPERATION, require ENx high, soft-off on loss of ENx.
(Default setting)

0x17   Ignore bit 7 of OPERATION, require ENx high, immediate-off on loss of ENx.

0x1A   Require bit 7 of OPERATION, ignore ENx.
(0x18-0x1B are equivalent, but changes ENx polarity, etc.)

0x1C   Require bit 7 of OPERATION *and* ENx low, soft-off on loss of ENx.

0x1D   Require bit 7 of OPERATION *and* ENx low, immediate-off on loss of ENx.

0x1E   Require bit 7 of OPERATION *and* ENx high, soft-off on loss of ENx.

0x1F   Require bit 7 of OPERATION *and* ENx high, immediate-off on loss of ENx.

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[c] The device has input pins designated EN1 and EN2, which are equivalent to the PMBus CONTROL pin, one for each controller. The pins are collectively referred to as ENx in this document.

ON_OFF_CONFIG

In general, odd values of ON_OFF_CONFIG that require a valid ENx signal have an immediate-off shutdown when ENx is not valid; even values that require ENx have a soft-off shutdown when ENx is not valid. It is important to note that ON_OFF_CONFIG and OPERATION both have bits to set the type of shutdown, and they can be set to different values. For example, values of ON_OFF_CONFIG that require bit 7 of OPERATION to enable the output will shut down according to bit 6 of OPERATION when bit 7 is cleared. Because of this, it is possible to trigger different shutdown types depending on how the output is disabled.

Note that bit 1 of ON_OFF_CONFIG, which sets the polarity of the ENx input pin, should only be changed when the output is disabled.

VIN_ON

Reference:	Standard Command	**Stored in OTP:**	No
Command Code:	0x35	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	V
Transfer:	Read Word	**Factory Value:**	0xD8A5 (5.156V)
Dual-Rail:	Shared		
Description/Notes:	See Section 14.5 of the PMBus Specification Part II.		

The VIN_ON command reports the UV_IN input pin rising threshold, divided by the value of VIN_SCALE_MONITOR. This is the minimum rising voltage at which the controller allows the outputs to be enabled.

This command is read-only, because the rising threshold at the UV_IN pin is fixed. If the external voltage divider at the UV_IN pin is altered, and the VIN_SCALE_MONITOR command is set to the new divider value, the VIN_ON command indicates the new rising undervoltage lockout threshold.

VIN_OFF

Reference:	Standard Command	**Stored in OTP:**	No
Command Code:	0x36	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	V
Transfer:	Read Word	**Factory Value:**	0xD899 (4.781V)
Dual-Rail:	Shared		
Description/Notes:	See Section 14.6 of the PMBus Specification Part II.		

The VIN_OFF command reports the UV_IN pin falling threshold, divided by the value of VIN_SCALE_MONITOR. This is the falling voltage at which the controller no longer allows the outputs to be enabled.

This command is read-only because the falling threshold at the UV_IN pin is fixed. If the external voltage divider at the UV_IN pin is altered, and the VIN_SCALE_MONITOR command is set to the new divider value, the VIN_OFF command indicates the new falling undervoltage lockout threshold.

Output Voltage Related Commands

VOUT_MODE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x20	**Format:**	See Description
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x16 (ULINEAR16, N = -10)
Dual-Rail:	Shared		
Description/Notes:	See Section 8.2 of the PMBus Specification Part II.		

The device supports either ULINEAR16 Mode or VID Mode values for output voltage related commands. The VOUT_MODE command accepts only these two values:

0x16   ULINEAR16 Mode, N = -10
0x2C   VID Mode, Intel VR 12.0 values

VOUT_MODE should not be changed while regulating. After changing the VOUT_MODE value, it is necessary to send STORE_USER_ALL or STORE_DEFAULT_ALL and power cycle the device. Again, the VOUT_MODE value must be set and stored to nonvolatile memory, and the device power-cycled, to guarantee reliable operation in the new mode.

If VOUT_MODE is set to 0x16, the device receives and returns output voltage data as a two-byte integer mantissa in the PMBus ULINEAR16 format. The 5-bit exponent for Linear Mode output voltage data is -10, or binary two's-complement 10110. This means that voltage command data sent to and from the device must be divided by 1024 to determine the actual voltage value.

If VOUT_MODE is set to 0x2C, the device receives and returns output voltage data as a 2-byte VID code that follows the Intel® VR 12.0 standard:

$$Voltage = (VOUT\_COMMAND - 1) / 200 + 0.25V$$

Note that the VOUT_MODE setting is the same for both controllers; changing it for one also changes it for the other.

VOUT_COMMAND

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x21	**Format:**	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	Set by external resistor value
Dual-Rail:	Independent		
Description/Notes:	See Section 8.2 of the PMBus Specification Part II.		

The device can be configured to receive either Intel VID codes per the VR 12.0 specification, or PMBus ULINEAR16 values, according to the setting of VOUT_MODE.

When using ULINEAR16 mode, VOUT_COMMAND mantissa data sent to and from the device must be divided by 1024 to determine the actual voltage value.

In VID mode, the device receives and returns output voltage data as a 2-byte VID code that follows the Intel VR 12.0 standard:

$$Voltage = (VOUT\_COMMAND - 1) / 200 + 0.25V$$

VOUT_COMMAND

	Note that if VOUT_COMMAND is set below 250mV, regulation is disabled. Also refer to the VOUT_MIN command.
	The initial value of VOUT_COMMAND is determined by external resistors connected to the PGMB, PGMC, and PGMD pins. This value is placed in operating memory unless a VOUT_COMMAND value is received and saved to the nonvolatile memory. The value of the pin-strap resistance is measured only once during initialization (power-up).
	VOUT_COMMAND accepts values from +0.25V to +2.0V.

VOUT_TRIM

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x22	Format:	SLINEAR16
Data Bytes:	2	Units:	V
Transfer:	Read/Write Word	Factory Value:	0x0000 (0V)
Dual-Rail:	Independent		

Description/Notes:	See Section 13.3 of the PMBus Specification Part II.
	Per the PMBus specification, VOUT_TRIM is only valid when VOUT_MODE is set for ULINEAR16 mode.
	In the device, the value of VOUT_COMMAND is summed with the value of VOUT_TRIM and VOUT_CAL_OFFSET, and the result is sent to the control loop as the output voltage setpoint.
	For telemetry purposes, the value of VOUT_TRIM is not subtracted from READ_VOUT, so non-zero VOUT_TRIM values result in a difference between VOUT_COMMAND and READ_VOUT.
	This command is intended to allow an end user of a PMBus device to tailor a specific supply to the performance requirements of a specific load IC, while retaining use of a "nominal" voltage setpoint for all similar load ICs.
	VOUT_TRIM accepts values from -0.1V to +0.1V.

VOUT_CAL_OFFSET

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x23	Format:	SLINEAR16
Data Bytes:	2	Units:	V
Transfer:	Read/Write Word	Factory Value:	0x0000 (0V)
Dual-Rail:	Independent		

Description/Notes:	See Section 13.4 of the PMBus Specification Part II.
	Per the PMBus specification, VOUT_CAL_OFFSET is only valid when VOUT_MODE is set for ULINEAR16 mode.
	In the device, the value of VOUT_COMMAND is summed with the value of VOUT_CAL_OFFSET and VOUT_TRIM, and the result is sent to the control loop as the output voltage setpoint.

VOUT_CAL_OFFSET

For telemetry purposes, the value of VOUT_CAL_OFFSET is subtracted from READ_VOUT. Therefore, VOUT_CAL_OFFSET values never result in a difference between VOUT_COMMAND and READ_VOUT.

This command is intended to allow a PMBus device manufacturer or an end user to calibrate the output voltage of a module (or other power-supply assembly) to match an external reference instrument during their final-test process.

VOUT_CAL_OFFSET accepts values from -0.1V to +0.1V.

VOUT_MAX

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x24	**Format:**	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 1.10
Dual-Rail:	Independent		
Description/Notes:	See Section 13.5 of the PMBus Specification Part II.		

The initial value of VOUT_MAX is set during initialization to VOUT_COMMAND x 1.10, unless a specific value has been written and saved to the User Store.

VOUT_MAX must be set above VOUT_MIN; values equal to or less than VOUT_MIN are rejected as invalid data.

VOUT_MAX accepts values from +0.25V to +2.0V.

VOUT_MARGIN_HIGH

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x25	**Format:**	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 1.05
Dual-Rail:	Independent		
Description/Notes:	See Section 13.6 of the PMBus Specification Part II.		

The initial value of VOUT_MARGIN_HIGH is set during initialization to VOUT_COMMAND x 1.05, unless a specific value has been written and saved to the User Store.

If the device is set for margin-high operation prior to the output being enabled, the output rises directly to VOUT_MARGIN_HIGH at the rate determined by VOUT_COMMAND/TON_RISE. Likewise, if the output is disabled from margin-high operation, the output falls at a rate determined by -VOUT_COMMAND/TOFF_FALL.

VOUT_MARGIN_HIGH accepts values from +0.25V to +2.0V.

VOUT_MARGIN_LOW

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x26	Format:	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	Units:	V
Transfer:	Read/Write Word	Factory Value:	VOUT_COMMAND x 0.95
Dual-Rail:	Independent		
Description/Notes:	See Section 13.7 of the PMBus Specification Part II.		

Description/Notes: See Section 13.7 of the PMBus Specification Part II.

The initial value of VOUT_MARGIN_LOW is set during initialization to VOUT_COMMAND x 0.95, unless a specific value has been written and saved to the User Store.

If the device is set for margin-low operation prior to the output being enabled, the output rises directly to VOUT_MARGIN_LOW at the rate determined by VOUT_COMMAND/TON_RISE. Likewise, if the output is disabled from margin-low operation, the output falls at a rate determined by -VOUT_COMMAND/TOFF_FALL.

VOUT_MARGIN_LOW accepts values from +0.25V to +2.0V.

VOUT_TRANSITION_RATE

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x27	Format:	LINEAR11
Data Bytes:	2	Units:	mV/µs (or V/ms, kV/s)
Transfer:	Read/Write Word	Factory Value:	0xBA80 (1.25mV/µs, see Description)
Dual-Rail:	Independent		
Description/Notes:	See Section 13.8 of the PMBus Specification Part II.		

Description/Notes: See Section 13.8 of the PMBus Specification Part II.

The device supports output voltage slew rates from 0.039mV/µs to 9.96mV/µs, with a resolution of 39.0625V/s.

VOUT_MIN

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x2B	Format:	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	Units:	V
Transfer:	Read/Write Word	Factory Value:	0x0200 (0.500V)
Dual-Rail:	Independent		
Description/Notes:	See Section 13.12 of the PMBus Specification Part II.		

Description/Notes: See Section 13.12 of the PMBus Specification Part II.

VOUT_MIN must be set below VOUT_MAX; values equal to or greater than VOUT_MAX are rejected as invalid data.

Also see the manufacturer-specific MFR_VOUT_MIN command for PMBus Specification Revision 2 legacy application support.

VOUT_MIN accepts values from +0.25V to +2.0V.

MFR_VOUT_MIN

Reference:	Maxim Specific	Stored in OTP:	Yes
Command Code:	0xA4	Format:	ULINEAR16 or VID code per VR 12.0
Data Bytes:	2	Units:	V
Transfer:	Read/Write Word	Factory Value:	0x0200 (0.500V)
Dual-Rail:	Independent		
Description/Notes:	MFR_VOUT_MIN is a mirror of the standard VOUT_MIN command included for support of PMBus Specification Revision 2 legacy applications, wherein the standard command was not yet defined. Changes to MFR_VOUT_MIN alters the value of VOUT_MIN, and vice-versa; this is simply a second PMBus command code that accesses the same function. MFR_VOUT_MIN accepts values from +0.25V to +2.0V.		

Switching Frequency and PWM Commands

FREQUENCY_SWITCH

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x33	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	kHz
Transfer:	Read/Write Word	**Factory Value:**	0x0258 (600kHz)
Dual-Rail:	Independent		

Description/Notes:	See Section 14.4 of the PMBus Specification Part II.

The factory value of 0x0258 (600kHz) is overridden during initialization by the hardware (pin-strap) value determined by the resistance to ground detected at the PGMA, PGMB, PGMC, and PGMD pins, unless a specific value has been written to the User Store. The values of the pin-strap resistances are measured only once during initialization (power-up).

The device only supports eight possible switching frequency settings, as follows:

Switching Frequency, kHz	LINEAR11 Value (typical)
300	0xFA58
350	0xFABC
400	0xFB20
450	0xFB84
500	0xFBE8
600	0x0258
700	0x02BC
800	0x0320

Other LINEAR11 values not listed above are rounded to the nearest supported setting.

Output Voltage Sequencing Commands

TON_DELAY

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x60	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	ms
Transfer:	Read/Write Word	**Factory Value:**	0x0000 (0ms)
Dual-Rail:	Independent		

Description/Notes:	See Section 16.1 of the PMBus Specification Part II.
	The TON_DELAY command sets the delay time between a valid enable condition and the beginning of the output ramp. The nominal factory value is 0ms.
	TON_DELAY has a maximum value of 128ms.

TON_RISE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x61	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	ms
Transfer:	Read/Write Word	**Factory Value:**	0xF002 (0.5ms)
Dual-Rail:	Independent		

Description/Notes:	See Section 16.2 of the PMBus Specification Part II.
	The TON_RISE command sets the ramp-up time from 0.25V to regulation at VOUT_COMMAND. The nominal factory value is 5ms.
	TON_RISE accepts values from 0.25ms to 10ms, and has a voltage slew-rate resolution of 39.0625V/s.

TOFF_DELAY

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x64	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	ms
Transfer:	Read/Write Word	**Factory Value:**	0x0000 (0ms)
Dual-Rail:	Independent		

Description/Notes:	See Section 16.5 of the PMBus Specification Part II.
	The TOFF_DELAY command sets the delay time between loss of enable condition and the beginning of the output ramp-down. The nominal factory value is 0ms.
	TOFF_DELAY has a maximum value of 128ms.

TOFF_FALL

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x65	Format:	LINEAR11
Data Bytes:	2	Units:	ms
Transfer:	Read/Write Word	Factory Value:	0xF002 (0.5ms)
Dual-Rail:	Independent		
Description/Notes:	See Section 16.6 of the PMBus Specification Part II.		

The TOFF_FALL command sets the ramp-down time from regulation at VOUT_COMMAND to 0.25V. The nominal factory value is 5ms.

TOFF_FALL accepts values from 0.25ms to 10ms, and has a voltage slew-rate resolution of -39.0625V/s.

Fault Related Commands

CLEAR_FAULTS

Reference:	Standard Command	**Stored in OTP:**	No
Command Code:	0x03	**Format:**	N/A
Data Bytes:	0	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 15.1 of the PMBus Specification Part II.		

SMBALERT_MASK

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x1B	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Write Word, Block Write-Block Read Process Call	**Factory Value:**	See Description
Dual-Rail:	Independent		
Description/Notes:	See Section 15.1 of the PMBus Specification Part II.		

Assertion of the /ALERT\ output can be selectively masked for all supported faults represented in the following status registers:

Register Name	Command (Hex)	Factory Mask Setting
STATUS_VOUT	0x7A	0xFF
STATUS_IOUT	0x7B	0xFF
STATUS_INPUT	0x7C	0xFF
STATUS_TEMPERATURE	0x7D	0xFF
STATUS_CML	0x7E	0xFF
STATUS_MFR_SPECIFIC	0x80	0xFF

All sources are masked in the factory settings.

VOUT_OV_FAULT_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x40	**Format:**	ULINEAR16, or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 1.15
Dual-Rail:	Independent		
Description/Notes:	See Section 15.2 of the PMBus Specification Part II.		

The initial value of VOUT_OV_FAULT_LIMIT is set during initialization to VOUT_COMMAND x 1.15, unless a specific value has been written and saved to the User Store.

VOUT_OV_FAULT_LIMIT accepts values from +0.25V to +2.3V; however, the output voltage telemetry ADC has a range of VOUT_COMMAND ± 230mV. Setting a limit outside this range effectively disables the fault protection.

VOUT_OV_FAULT_RESPONSE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x41	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x80 (Stop regulating and remain off)
Dual-Rail:	Independent		
Description/Notes:	See Sections 10.5.1 and 15.3 of the PMBus Specification Part II.		

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Ignore the fault condition.
01	Not supported.
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
11	Not supported.

Bits [5:3] determine the number of retry attempts. <u>The device supports only a subset of the full PMBus functionality for this portion of the command</u>:

000	Do not attempt to restart. *(Default setting)*
001-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down.

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the VOUT_OV_FAULT_RESPONSE command only take effect when the output is disabled.

VOUT_TRK_FAULT_RESPONSE

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xDF	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x80 (Stop regulating and remain off)
Dual-Rail:	Independent		
Description/Notes:	The device has an analog overvoltage fault limit that is always set at (VOUT_COMMAND + 205mV). Bits [7:6] determine the basic fault-response mode. The device has the following modes: ...		

The device has an analog overvoltage fault limit that is always set at (VOUT_COMMAND + 205mV).

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Not supported.
01	Not supported.
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
11	Not supported

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart. *(Default setting)*
000-110	Not supported
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down.

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the VOUT_TRK_FAULT_RESPONSE command only take effect when the output is disabled.

VOUT_UMB_FAULT_RESPONSE

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xE0	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x80 (Stop regulating and remain off)
Dual-Rail:	Independent		
Description/Notes:	The device has an analog "umbrella" overvoltage fault limit at 2.7V.		

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Not supported.
01	Not supported.
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
11	Not supported

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart. *(Default setting)*
000-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down.

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the VOUT_UMB_FAULT_RESPONSE command only take effect when the output is disabled.

VOUT_OV_WARN_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x42	**Format:**	ULINEAR16, or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 1.10
Dual-Rail:	Independent		
Description/Notes:	See Section 15.4 of the PMBus Specification Part II.		

The initial value of VOUT_OV_WARN_LIMIT is set during initialization to VOUT_COMMAND x 1.10, unless a specific value has been written and saved to the User Store.

VOUT_OV_WARN_LIMIT accepts values from +0.25V to +2.3V; however, the output voltage telemetry ADC has a range of VOUT_COMMAND ±230mV. Setting a limit outside this range disables the warning function.

VOUT_UV_WARN_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x43	**Format:**	ULINEAR16, or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 0.90
Dual-Rail:	Independent		
Description/Notes:	See Section 15.5 of the PMBus Specification Part II.		

The initial value of VOUT_UV_WARN_LIMIT is set during initialization to VOUT_COMMAND x 0.90, unless a specific value has been written and saved to the User Store.

VOUT_UV_WARN_LIMIT accepts values from +0.25V to +2.3V; however, the output voltage telemetry ADC has a range of VOUT_COMMAND ±230mV. Setting a limit outside this range disables the warning.

VOUT_UV_FAULT_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x44	**Format:**	ULINEAR16, or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read/Write Word	**Factory Value:**	VOUT_COMMAND x 0.85
Dual-Rail:	Independent		
Description/Notes:	See Section 15.6 of the PMBus Specification Part II.		

The initial value of VOUT_UV_FAULT_LIMIT is set during initialization to VOUT_COMMAND x 0.85, unless a specific value has been written and saved to the User Store.

VOUT_UV_FAULT_LIMIT accepts values from +0.25V to +2.3V; however, the output voltage telemetry ADC has a range of VOUT_COMMAND ±230mV. Setting a limit outside this range disables the fault protection.

VOUT_UV_FAULT_RESPONSE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x45	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x00 (Ignore undervoltage faults)
Dual-Rail:	Independent		
Description/Notes:	See Sections 10.5.1 and 15.7 of the PMBus Specification Part II.		

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Ignore the fault condition. *(Default setting)*
01	Not supported.
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3].
11	Not supported.

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart. *(Default setting)*
001-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down.

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the VOUT_UV_FAULT_RESPONSE command only take effect when the output is disabled.

IOUT_OC_FAULT_LIMIT

Reference:	Standard Command	**Stored in OTP:**	No
Command Code:	0x46	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	A
Transfer:	Read/Write Word	**Factory Value:**	IOUT_MAX x 0.85
Dual-Rail:	Independent		
Description/Notes:	See Section 15.8 of the PMBus Specification Part II.		

IOUT_OC_FAULT_LIMIT accepts values from +5A to +300A.

IOUT_OC_FAULT_RESPONSE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x47	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0xFF (Shut down, retry indefinitely)
Dual-Rail:	Independent		
Description/Notes:	See Sections 10.5.2 and 15.9 of the PMBus Specification Part II.		

See Sections 10.5.2 and 15.9 of the PMBus Specification Part II.

The device only supports three options for overcurrent fault response:

Data Value	Fault Response
0x00	Continue operating without interruption. *(Ignore fault)*
0xC0	Shut down with no retry attempts
0xFF	Shut down and retry indefinitely. *(Default setting)*

The IOUT_OC_FAULT_RESPONSE command data comprises three bit-fields:

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Ignore the fault condition.
01	Not supported.
10	Not supported.
11	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart.
001-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down. *(Default setting)*

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the IOUT_OC_FAULT_RESPONSE command only take effect when the output is disabled.

IOUT_UMB_FAULT_RESPONSE

Reference:	Maxim Specific	Stored in OTP:	Yes
Command Code:	0xE1	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read/Write Byte	Factory Value:	0xFF (Shut down, retry indefinitely)
Dual-Rail:	Independent		

Description/Notes:	The device has an analog "umbrella" overcurrent protection limit at the maximum output current established by the selection of R_{DES} in the application circuit (reported by the IOUT_MAX command).
	Bits [7:6] determine the basic fault-response mode. The device supports the following modes:
	00 Not supported.
	01 Not supported.
	10 Not supported.
	11 Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
	Bits [5:3] determine the number of retry attempts.
	000 Do not attempt to restart.
	001-110 Not supported.
	111 Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down. *(Default setting)*
	Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.
	Changes to the IOUT_UMB_FAULT_RESPONSE command only take effect when the output is disabled.

IOUT_OC_WARN_LIMIT

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x4A	Format:	LINEAR11
Data Bytes:	2	Units:	A
Transfer:	Read/Write Word	Factory Value:	IOUT_MAX x 0.80
Dual-Rail:	Independent		

Description/Notes:	See Section 15.12 of the PMBus Specification Part II.
	IOUT_OC_WARN_LIMIT accepts values from +5A to +300A.

OT_FAULT_LIMIT

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x4F	Format:	LINEAR11
Data Bytes:	2	Units:	°C
Transfer:	Read/Write Word	Factory Value:	0xF258 (150°C)
Dual-Rail:	Independent		
Description/Notes:	See Section 15.17 of the PMBus Specification Part II.		

The OT_FAULT_LIMIT applies to the combined power-stage temperature signal, as reported by READ_TEMPERATURE_2.

OT_FAULT_LIMIT accepts values from -40°C to +150°C.

OT_FAULT_RESPONSE

Reference:	Standard Command	Stored in OTP:	Yes
Command Code:	0x50	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read/Write Byte	Factory Value:	0x00 (Ignore the fault)
Dual-Rail:	Independent		
Description/Notes:	See Sections 10.5.1 and 15.18 of the PMBus Specification Part II.		

The OT_FAULT_RESPONSE command data comprises three bit-fields.

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Ignore the fault condition.
01	Not supported. *(Shut down and monitor)*
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
11	Not supported. *(Wait for abate)*

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart. *(Default setting)*
001-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down.

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

The default setting is to ignore overtemperature events because the power-stage devices typically have integrated overheat protection. If the OT_FAULT_RESPONSE is changed, the OT_FAULT_LIMIT should be set below the built-in overtemperature limit of the power-stage device.

Changes to the OT_FAULT_RESPONSE command only take effect when the output is disabled.

OT_WARN_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x51	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	°C
Transfer:	Read/Write Word	**Factory Value:**	0xF21C (135°C)
Dual-Rail:	Independent		
Description/Notes:	See Section 15.19 of the PMBus Specification Part II.		
	The OT_WARN_LIMIT applies to the combined power-stage temperature signal, as reported by READ_TEMPERATURE_2.		
	OT_WARN_LIMIT accepts values from -40°C to +150°C.		

UT_WARN_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x52	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	°C
Transfer:	Read/Write Word	**Factory Value:**	0xE580 (-40°C)
Dual-Rail:	Independent		
Description/Notes:	See Section 15.19 of the PMBus Specification Part II.		
	The UT_WARN_LIMIT applies to the combined power-stage temperature signal, as reported by READ_TEMPERATURE_2.		
	UT_WARN_LIMIT accepts values from -40°C to +150°C.		

TON_MAX_FAULT_LIMIT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x62	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	ms
Transfer:	Read/Write Word	**Factory Value:**	0ms
Dual-Rail:	Independent		
Description/Notes:	See Section 16.3 of the PMBus Specification Part II.		
	The timer for TON_MAX_FAULT_LIMIT is started when TON_DELAY elapses and the ramp-up begins (coincident with the beginning of TON_RISE.)		
	TON_MAX_FAULT_LIMIT accepts values from 0ms to 200ms.		

TON_MAX_FAULT_RESPONSE

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x63	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x80 (Shut down, no retry attempts)
Dual-Rail:	Independent		
Description/Notes:	See Section 16.4 of the PMBus Specification Part II.		

The device only supports two options for the "maximum startup time" fault response:

Data Value   Fault Response
0x00   Continue operating without interruption. *(Default setting)*
0x80   Shut down with no retry attempts.

The TON_MAX_FAULT_RESPONSE command data comprises three bit-fields:

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00   Ignore the fault condition. *(Default setting)*
01   Not supported.
10   Stop regulating immediately, and do not attempt to restart.
11   Not supported. *(Wait for abate)*

Bits [5:3] determine the number of retry attempts.

000   No attempt is made to restart after a fault shutdown. *(Default setting)*
001-111   Not supported.

Bits [2:0] determine the fault-tolerance and retry-delay timing. The device does not support automatic retry or the associated delay timing, so these bits are always 000.

Changes to the TON_MAX_FAULT_RESPONSE command only take effect when the output is disabled.

SLV_FAULT_RESPONSE

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xD9	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0xBF (Shut down and retry)
Dual-Rail:	Independent		

Description/Notes:	The device can detect and respond to faults and protective actions that occur in the power-stage devices. The fault response options are a subset of those listed in section 10.5.1 of the PMBus Specification.

Bits [7:6] determine the basic fault-response mode. The device has the following modes:

00	Not supported. *(Ignore)*
01	Not supported. *(Delay, then shut down)*
10	Stop regulating immediately, delay for the time specified in bits [2:0], then attempt to restart according to bits [5:3]. *(Default setting)*
11	Not supported. *(Wait for abate)*

Bits [5:3] determine the number of retry attempts.

000	Do not attempt to restart.
000-110	Not supported.
111	Attempt to restart continuously until commanded off, or until another fault condition causes the unit to shut down. *(Default setting)*

Bits [2:0] determine the retry-delay timing. The time increment is 50ms per LSB. Because the fault-retry timer is "free-running" with a 10ms tick interval, the first time increment can be as little as 40ms, but subsequent increments are always 50ms each.

Changes to the SLV_FAULT_RESPONSE command only take effect when the output is disabled.

Unit Status Commands

STATUS_BYTE

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x78	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes:	See Section 17.1 of the PMBus Specification Part II.

Bit	Meaning
7	Busy
6	Off
5	VOUT OV Faults *(Telemetry)*
4	IOUT OC Faults *(Telemetry)*
3	VIN UV Fault (Telemetry) *(Not Supported)*
2	TEMPERATURE Faults *(Telemetry)*
1	CML Faults
0	NONE OF THE ABOVE: A fault or warning not listed in bits [7:1] of STATUS_BYTE has occurred.

STATUS_WORD

Reference:	Standard Command	Stored in OTP:	N/A
Command Code:	0x79	Format:	Bit field
Data Bytes:	2	Units:	N/A
Transfer:	Read Word	Factory Value:	N/A
Dual-Rail:	Independent		

Description/Notes:	See Section 17.2 of the PMBus Specification Part II.		

<table>
<tr><th colspan="2"></th><th>Bit</th><th>Meaning</th></tr>
<tr><td rowspan="8">High Byte</td><td></td><td>15</td><td>VOUT Faults and Warnings, TON Max Fault</td></tr>
<tr><td></td><td>14</td><td>IOUT Faults and Warnings</td></tr>
<tr><td></td><td>13</td><td>VIN Faults and Warnings</td></tr>
<tr><td></td><td>12</td><td>VOUT_OV_TRK, IOUT_OC_UMB, and VOUT_OV_TRK Faults, Firmware Fault, Configuration Fault, Power-stage Fault</td></tr>
<tr><td></td><td>11</td><td>POWER_GOOD# <i>(Power Good signal</i> not <i>asserted)</i></td></tr>
<tr><td></td><td>10</td><td>—</td></tr>
<tr><td></td><td>9</td><td>—</td></tr>
<tr><td></td><td>8</td><td>UNKNOWN: A fault type not given in bits (15:1] of the STATUS_WORD has been detected.</td></tr>
<tr><td rowspan="8">Low Byte</td><td></td><td>7</td><td>Busy</td></tr>
<tr><td></td><td>6</td><td>Off</td></tr>
<tr><td></td><td>5</td><td>VOUT OV Faults: Telemetry, Tracking, and Umbrella</td></tr>
<tr><td></td><td>4</td><td>IOUT OC Faults: Telemetry and Umbrella</td></tr>
<tr><td></td><td>3</td><td>VIN UV Fault: Telemetry <i>(Not Supported)</i></td></tr>
<tr><td></td><td>2</td><td>TEMPERATURE Faults: Telemetry</td></tr>
<tr><td></td><td>1</td><td>CML Faults</td></tr>
<tr><td></td><td>0</td><td>NONE OF THE ABOVE: A fault or warning not listed in bits [7:1] of STATUS_BYTE has occurred.</td></tr>
</table>

STATUS_VOUT

Reference:	Standard Command	Stored in OTP:	N/A
Command Code:	0x7A	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read Byte	Factory Value:	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 17.3 of the PMBus Specification Part II.		

Bit	Meaning
7	VOUT OV Fault
6	VOUT OV Warning
5	VOUT UV Warning
4	VOUT UV Fault
3	VOUT MAX and MIN Warnings
2	TON MAX Fault
1	—
0	—

STATUS_IOUT

Reference:	Standard Command	Stored in OTP:	N/A
Command Code:	0x7B	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read Byte	Factory Value:	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 17.4 of the PMBus Specification Part II.		

Bit	Meaning
7	IOUT OC Fault
6	—
5	IOUT OC Warning
4	IOUT UC Fault
3	—
2	—
1	—
0	—

STATUS_INPUT

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x7C	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes: See Section 17.5 of the PMBus Specification Part II.

Bit	Meaning
7	—
6	—
5	—
4	—
3	Unit Off for Insufficient Input Voltage
2	—
1	—
0	—

STATUS_TEMPERATURE

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x7D	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes: See Section 17.6 of the PMBus Specification Part II.

Bit	Meaning
7	OT Fault
6	OT Warning
5	UT Warning
4	—
3	—
2	—
1	—
0	—

STATUS_CML

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x7E	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes: See Section 17.7 of the PMBus Specification Part II.

Bit	Meaning
7	Invalid or Unsupported Command Received
6	Invalid or Unsupported Data Received
5	Packet Error Check Failed
4	Nonvolatile Memory Fault Detected *(User or Default Store Failure)*
3	—
2	*(Reserved per PMBus specification)*
1	A communication fault other than the ones listed in this table has occurred
0	—

STATUS_MFR_SPECIFIC

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x80	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes: See Section 17.9 of the PMBus Specification Part II.

STATUS_MFR_SPECIFIC is a standard PMBus command, but the functions of the individual bits are defined by the IC manufacturer. The flags are as follows:

Bit	Name	Description
7	—	Not implemented/reserved
6	—	Not implemented/reserved
5	VOUT_OV_TRK	Output "tracking" overvoltage fault
4	IOUT_OC_UMB	Maximum output current ("umbrella" fault limit) exceeded
3	VOUT_OV_UMB	Output "umbrella" overvoltage fault
2	FIRMWARE	Firmware fault or error detected
1	CONFIG_FAULT	Incorrect PWMx or CSx connection detected
0	BAD_SLAVE	TSx pin went low during or prior to initialization

HARDWARE_FLAGS

Reference:	Maxim Specific	Stored in OTP:	N/A
Command Code:	0xD7	Format:	Bit field
Data Bytes:	2	Units:	N/A
Transfer:	Read Word	Factory Value:	0x0000
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. The HARDWARE_FLAGS command returns two data bytes containing the following bit flags:

Bit #	Name	Description
15	WATCHDOG_RESET_OCCURRED	Watchdog timeout detected
14	MESSAGE_QUEUE_WARNING	Contact Maxim Integrated for assistance
13	MESSAGE_QUEUE_EXCEEDED	Contact Maxim Integrated for assistance
12	IN_LOCKDOWN_STATE	Contact Maxim Integrated for assistance
11	UNDEFINED11	—
10	UNDEFINED10	—
9	UNDEFINED09	—
8	UNDEFINED08	—
7	UNDEFINED07	—
6	UNDEFINED06	—
5	UNDEFINED05	—
4	UNDEFINED04	—
3	UNDEFINED03	—
2	OTP_WRITE_OTP_FULL	Contact Maxim Integrated for assistance
1	OTP_WRITE_VERIFICATION_FAIL	Contact Maxim Integrated for assistance
0	BIST_RAMTEST_FAIL	Contact Maxim Integrated for assistance

FAULT_LOG

Reference:	Maxim Specific	**Stored in OTP:**	N/A
Command Code:	0xE2	**Format:**	Bit field
Data Bytes:	5	**Units:**	N/A
Transfer:	Read Block	**Factory Value:**	0x00 (all five bytes)
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. The device has five 8-bit log registers that record the last five chronological states of the fault indicators listed below:

Bit #	Name
7	slave2_fault_pe
6	Watchdog Fault
5	IOUT OC Fault
4	VDDH (VIN) Fault
3	—
2	VOUT OV Umbrella Fault
1	—
0	VOUT OV Tracking Fault

Any time a new fault condition occurs, the resulting state is recorded in the first byte of the FAULT_LOG data, and older records are incremented to the subsequent bytes.

The FAULT_LOG command returns five sequential fault-log results in chronological order, with the oldest state returned first and most recent state returned last.

If more than five fault conditions occur before the log registers are cleared, the log stops recording.

Send the CLEAR_FAULT_LOG command to clear these fault logs.

CLEAR_FAULT_LOG

Reference:	Maxim Specific	**Stored in OTP:**	N/A
Command Code:	0xE7	**Format:**	N/A
Data Bytes:	N/A	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. The CLEAR_FAULT_LOG command is used to clear and reset the FAULT_LOG data.

Telemetry Commands

READ_VIN

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x88	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	V
Transfer:	Read Word	**Factory Value:**	N/A
Dual-Rail:	Shared		
Description/Notes:	See Section 18.1 of the PMBus Specification Part II.		

READ_VOUT

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x8B	**Format:**	ULINEAR16, or VID code per VR 12.0
Data Bytes:	2	**Units:**	V
Transfer:	Read Word	**Factory Value:**	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 18.4 of the PMBus Specification Part II.		

Description/Notes:

See Section 18.4 of the PMBus Specification Part II.

The value of VOUT_CAL_OFFSET is subtracted from READ_VOUT, so VOUT_CAL_OFFSET values never result in a difference between VOUT_COMMAND and READ_VOUT.

Note that the output voltage telemetry ADC has a range of VOUT_COMMAND ± 230mV.

READ_IOUT

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x8C	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	A
Transfer:	Read Word	**Factory Value:**	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 18.5 of the PMBus Specification Part II.		

Description/Notes:

See Section 18.5 of the PMBus Specification Part II.

READ_IOUT must be calibrated by means of IOUT_CAL_GAIN and IOUT_CAL_OFFSET to achieve accurate results.

READ_TEMPERATURE_1

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x8D	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	°C
Transfer:	Read Word	**Factory Value:**	N/A
Dual-Rail:	Shared		
Description/Notes:	See Section 18.6 of the PMBus Specification Part II.		

Description/Notes:

See Section 18.6 of the PMBus Specification Part II.

The device uses READ_TEMPERATURE_1 to report its internal (i.e., die) temperature.

READ_TEMPERATURE_2

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x8E	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	°C
Transfer:	Read Word	**Factory Value:**	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 18.6 of the PMBus Specification Part II.		

Description/Notes: See Section 18.6 of the PMBus Specification Part II.

The device uses READ_TEMPERATURE_2 to report the highest temperature from its power-stage devices.

The READ_TEMPERATURE_2 data can be calibrated for different power-stage devices using the TEMPERATURE_2_GAIN and TEMPERATURE_2_OFFSET commands.

The programmable OT_FAULT_LIMIT, OT_FAULT_RESPONSE, and OT_WARN_LIMIT commands pertain only to the READ_TEMPERATURE_2 data.

Note that hardware over-temperature protection is also implemented in the power-stage devices, and these power-stage faults are conveyed to the device through the TS1 and TS2 inputs.

Calibration and Tuning Commands

IOUT_CAL_GAIN

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x38	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	mΩ
Transfer:	Read/Write Word	**Factory Value:**	Set by R_{DES} (see Description)
Dual-Rail:	Independent		
Description/Notes:	See Section 14.8 of the PMBus Specification Part II.		

The device sums reported load current analogs (10µA/A gain) from up to six power-stage devices and measures this combined signal at a common resistor R_{DES}. The IOUT_CAL_GAIN command provides a gain adjustment of the R_{DES} summing resistor value, represented as a "virtual" sense resistance in series with the output.

The initial value of IOUT_CAL_GAIN is set after the R_{DES} resistance is measured, according to:

$$IOUT\_CAL\_GAIN = R_{DES} / 100{,}000 = R_{DES} \times 10µA/A$$

IOUT_CAL_GAIN accepts values from 1mΩ to 30mΩ.

IOUT_CAL_OFFSET

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x39	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	A
Transfer:	Read/Write Word	**Factory Value:**	0x0000 (0A)
Dual-Rail:	Independent		
Description/Notes:	See Section 14.9 of the PMBus Specification Part II.		

IOUT_CAL_OFFSET accepts values from -50A to +50A.

VIN_SCALE_MONITOR

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xD1	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	N/A
Transfer:	Read/Write Word	**Factory Value:**	0x9A2F (0.068237305)
Dual-Rail:	Shared		
Description/Notes:	This Maxim-specific command calibrates the READ_VIN signal by informing the device of the external resistor divider ratio that is present at the UV_IN pin. This command is analogous to the standard command VOUT_SCALE_MONITOR, except it is applied to the input voltage.		

The default value is approximately 0.06824, appropriate for the typical application circuit resistor values of 34.0kΩ and 2.49kΩ. (These values were chosen to provide the best possible match between the LINEAR11 numerical value and actual divider ratio using standard E96 resistors.) Note that this sets an input undervoltage lockout rising threshold of approximately 5.13V.

VIN_SCALE_MONITOR accepts values from 0.03 to 0.09 inclusive.

IOUT_MAX

Reference:	Maxim Specific	**Stored in OTP:**	N/A
Command Code:	0xDE	**Format:**	LINEAR11
Data Bytes:	2	**Units:**	A
Transfer:	Read Word	**Factory Value:**	Set by R_{DES} (see Description)
Dual-Rail:	Independent		

Description/Notes:	A maximum output current limit is set by selection of the R_{DES} resistance in the application circuit. This limit is determined according to:

$$IOUT\_MAX = 500mV / \underline{IOUT\_CAL\_GAIN} = 500mV \times 100{,}000 / R_{DES}$$

This maximum current is the absolute maximum load current that can be drawn, and coincides with the "umbrella" overcurrent protection limit described in the IOUT_UMB_FAULT_RESPONSE command.

MRAMP

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xD4	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	Set by external resistor value
Dual-Rail:	Independent		

Description/Notes: This is a manufacturer-specific command unique to Maxim. This command sets the MRAMP (slope compensation) DAC value from 0x00 to 0x3F.

Bit #	Setting	Meaning
7:6	00	Reserved
5:0	0-63	Allowed MRAMP settings[d] LSB: 56.2mV/µs Range: 56.2mV/µs to 3597mV/µs
	0x09	Low setting (LL)
	0x10	Medium-Low setting (ML)
	0x25	Medium-High setting (MH)
	0x34	High setting (HH)

The MRAMP DAC current reference is proportional to input voltage to provide feed-forward compensation. The actual slope compensation value in V/µs is determined according to:

$$\text{slope compensation} = ((MRAMP + 1) \times 2.46 \times 10^6 \times V_{UV\_IN}) / (0.56 \times 64)$$

Where V_{UV_IN} is the voltage at the UV_IN pin of the device.

---

[d] The MRAMP least significant bit (LSB) and range values are given for V_{IN} = 12V and the UV_IN divider (i.e., VIN_SCALE_MONITOR) is at the default configuration of 0.068237 (e.g., 2.49kΩ and 34.0kΩ divider circuit).

OCR_GAIN

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xF1	**Format:**	Unsigned integer
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x02 (see Description)
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. This command is used to configure the orthogonal current rebalance gain in the device phase-current balance-control system.

Setting	Orthogonal Current Rebalance Gain
0	0
1	1.8
2	3.5 *(Default setting)*
3	4.4

MXIM_CORE_CONFIG

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xF2	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x02 (see Description)
Dual-Rail:	Shared		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. This command sets the fixed on-time for the on-chip switching bias regulator, and enables or disables the "forced PEC" mode of operation. The "Force PEC" mode provides additional PMBus transaction security by rejecting any write operation that is not followed by a valid PEC byte. If this feature is not enabled, write transactions can be sent with or without a PEC byte.

Bit #	Description	Value	Meaning
7	Reserved	1	—
		0	*(Default setting)*
6	Reserved	1	—
		0	*(Default setting)*
5	Reserved	1	—
		0	*(Default setting)*
4	Force Packet Error Check (Force PEC)	1	All writes require a valid PEC byte
		0	PEC byte with write is optional *(default setting)*
3	Reserved	1	—
		0	*(Default setting)*
2	Reserved	1	—
		0	*(Default setting)*
1:0	On-Chip Switcher On-Time Setting	11	2.70µs
		10	1.90µs *(Default setting)*
		01	1.30µs
		00	0.65µs

MXIM_RAIL_CONFIG

Reference:	Maxim Specific	Stored in OTP:	Yes
Command Code:	0xF3	Format:	Bit field
Data Bytes:	1	Units:	N/A
Transfer:	Read/Write Byte	Factory Value:	0x11 (see Description)
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. This command enables and disables special features of the controller as shown below.

Bit #	Description	Value	Meaning
7	Reserved	1	—
		0	*(Default setting)*
6:4	Power-Good Rising Threshold Setting	111	VOUT_COMMAND - 102mV
		110	VOUT_COMMAND - 102mV
		101	VOUT_COMMAND - 102mV
		100	VOUT_COMMAND - 125mV
		011	VOUT_COMMAND - 148mV
		010	VOUT_COMMAND - 182mV
		001	VOUT_COMMAND - 227mV *(default setting)*
		000	VOUT_COMMAND - 284mV
3	Reserved	1	—
		0	*(Default setting)*
2	Reserved	1	—
		0	*(Default setting)*
1	Reserved	1	—
		0	*(Default setting)*
0	Advanced Modulation Scheme Control	1	Enabled *(Default setting)*
		0	Disabled

TEMPERATURE_2_GAIN

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xF8	**Format:**	Unsigned Integer
Data Bytes:	2	**Units:**	$(°C)^{-1}$
Transfer:	Read/Write Word	**Factory Value:**	0x64B8 (see Description)
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. The TEMPERATURE_2_GAIN command sets the gain calibration term for READ_TEMPERATURE_2 data. Appropriate values for various power-stage devices are listed below.

Power-stage Part Number	Power-stage Gain, mV/°C	TEMPERATURE_2_GAIN
MAX20768 *(default)*	3.223	0x64B8 (decimal 25784)
MAX20766	3.010	0x5E10 (decimal 24080)
MAX20788	3.020	0x5E60 (decimal 24160)
MAX16604	3.197	0x63E8 (decimal 25576)
MAX20779, MAX20790	3.083	0x6058 (decimal 24664)

In general, the gain values are calculated according to:

$$TEMPERATURE\_2\_GAIN = (Power\text{-}stage\ Gain) \times 9375 \times 512 / 0.6V$$

TEMPERATURE_2_OFFSET

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xF9	**Format:**	Signed Integer
Data Bytes:	2	**Units:**	N/A
Transfer:	Read/Write Word	**Factory Value:**	0xF20B (see Description)
Dual-Rail:	Independent		

Description/Notes:	This is a manufacturer-specific command unique to Maxim. The TEMPERATURE_2_OFFSET command sets the offset calibration term for READ_TEMPERATURE_2 data. Appropriate values for various power-stage devices are listed below.

Power-stage Part Number	Power-stage Offset, mV	TEMPERATURE_2_OFFSET
MAX20768 *(default)*	894.7	0xF20B (decimal -3573)
MAX20766	832.0	0x05A0 (decimal 1440)
MAX20788	829.0	0x0690 (decimal 1680)
MAX16604	810.0	0x0C80 (decimal 3200)
MAX20779, MAX20790	821.0	0x0910 (decimal 2320)

In general, the offset values are calculated according to:

$$TEMPERATURE\_2\_OFFSET = (850mV - Power\text{-}stage\ Offset) \times 9375 \times 512 / (100 \times 0.6V)$$

Inventory Information and Device Identification Commands

CAPABILITY

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x19	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	0xD0
Dual-Rail:	Shared		

Description/Notes:	See Section 11.12 of the PMBus Specification Part II.

The following features are supported:

- Packet Error Checking
- 1MHz bus speed
- SMBALERT#
- LINEAR11 numeric format

QUERY

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x1A	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Block Write-Block Read Process Call	**Factory Value:**	N/A
Dual-Rail:	Shared		

Description/Notes:	See Section 11.13 of the PMBus Specification Part II.

PMBUS_REVISION

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x98	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read Byte	**Factory Value:**	0x33 (Revision 1.3, Part I & II)
Dual-Rail:	Shared		

Description/Notes:	See Section 22.1 of the PMBus Specification Part II.

Bits [7:4] describe the PMBus specification Part I revision level as follows:

    0000 Revision 1.0
    0001 Revision 1.1
    0010 Revision 1.2
    0011 Revision 1.3

Bits [3:0] describe the PMBus specification Part II revision level as follows:

    0000 Revision 1.0
    0001 Revision 1.1
    0010 Revision 1.2
    0011 Revision 1.3

MFR_ID

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x99	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Shared		
Description/Notes:	See Section 22.2.1 of the PMBus Specification Part II.		
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.		

MFR_MODEL

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x9A	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Shared		
Description/Notes:	See Section 22.2.2 of the PMBus Specification Part II.		
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.		

MFR_REVISION

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x9B	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Shared		
Description/Notes:	See Section 22.2.3 of the PMBus Specification Part II.		
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.		

MFR_LOCATION

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x9C	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Shared		

Description/Notes:	See Section 22.2.4 of the PMBus Specification Part II.
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.

MFR_DATE

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x9D	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Shared		

Description/Notes:	See Section 22.2.5 of the PMBus Specification Part II.
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.
	The recommended format is YYMMDD where Y, M, and D are integer values from 0 to 9, inclusive.

MFR_SERIAL

Reference:	Standard Command	Stored in OTP:	Yes (see Description)
Command Code:	0x9E	Format:	ASCII string
Data Bytes:	1-24	Units:	N/A
Transfer:	Read/Write Block	Factory Value:	Null
Dual-Rail:	Independent		

Description/Notes:	See Section 22.2.6 of the PMBus Specification Part II.
	The byte length of this text string is arbitrary, and up to 24 characters may be stored to suit manufacturer requirements.

IC_DEVICE_ID

Reference:	Standard Command	Stored in OTP:	N/A
Command Code:	0xAD	Format:	ASCII string
Data Bytes:	13	Units:	N/A
Transfer:	Read Block	Factory Value:	MAX20754ETM10 (or MAX20755ETM10)
Dual-Rail:	Independent		
Description/Notes:	See Section 22.2.7 of the PMBus Specification Part II.		

IC_DEVICE_REV

Reference:	Standard Command	Stored in OTP:	N/A
Command Code:	0xAE	Format:	ASCII string
Data Bytes:	8	Units:	N/A
Transfer:	Read Block	Factory Value:	Firmware revision (see Description)
Dual-Rail:	Shared		
Description/Notes:	See Section 22.2.8 of the PMBus Specification Part II. The default value is the firmware revision number stored as an ASCII string, typically a 4-digit number. The Maxim PowerTool™ GUI uses this information to identify the supported command set for a particular PMBus device.		

Security Commands

WRITE_PROTECT

Reference:	Standard Command	**Stored in OTP:**	Yes
Command Code:	0x10	**Format:**	Bit field
Data Bytes:	1	**Units:**	N/A
Transfer:	Read/Write Byte	**Factory Value:**	0x00
Dual-Rail:	Independent		
Description/Notes:	See Section 11.1 of the PMBus Specification Part II.		
	Note that Send Byte commands are still accepted even when WRITE_PROTECT is set to a non-zero value, which allows storing the state of WRITE_PROTECT in nonvolatile memory.		

Memory and Storage Commands

STORE_DEFAULT_ALL

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x11	**Format:**	N/A
Data Bytes:	0	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes:	See Section 11.2 of the PMBus Specification Part II.
	The device features 16KB of One-Time Programmable memory (OTP) for nonvolatile storage of PMBus command values.
	In general, when the STORE_DEFAULT_ALL command is sent, the contents of the working PMBus memory (volatile RAM) are written into the Default store.
	To successfully execute the STORE_DEFAULT_ALL command, there must be at least one unit of OTP memory available, as reported by the OTP_REMAINING command. If any of the Inventory Information commands (Section 22.2 of the PMBus Specification Part II) have been altered since the last STORE_DEFAULT_ALL command, then there must be at least 2 units of OTP memory available.
	The STORE_DEFAULT_ALL command can only be sent when both outputs of the device are disabled.

RESTORE_DEFAULT_ALL

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x12	**Format:**	N/A
Data Bytes:	0	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes:	See Section 11.3 of the PMBus Specification Part II.
	Sending this command causes the device to return all PMBus command values in operating memory to the values last saved in the Default store.
	To make this set of PMBus command values persist through a power cycle, it is necessary to follow RESTORE_DEFAULT_ALL with the STORE_USER_ALL command.
	The RESTORE_DEFAULT_ALL command can only be sent when both outputs of the device are disabled.

STORE_USER_ALL

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x15	**Format:**	N/A
Data Bytes:	0	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		
Description/Notes:	See Section 11.6 of the PMBus Specification Part II.		

Description/Notes: See Section 11.6 of the PMBus Specification Part II.

The device features 16KB of One-Time Programmable memory (OTP) for nonvolatile storage of PMBus command values.

In general, when the STORE_USER_ALL command is sent, the contents of the working PMBus memory (volatile RAM) are written into the User store.

To successfully execute the STORE_USER_ALL command, there must be at least one unit of OTP memory available, as reported by the OTP_REMAINING command. If any of the Inventory Information commands (Section 22.2 of the PMBus Specification Part II) have been altered since the last STORE_USER_ALL command, then there must be at least 2 units of OTP memory available.

The STORE_USER_ALL command can only be sent when both outputs of the device are disabled.

RESTORE_USER_ALL

Reference:	Standard Command	**Stored in OTP:**	N/A
Command Code:	0x16	**Format:**	N/A
Data Bytes:	0	**Units:**	N/A
Transfer:	Send Byte	**Factory Value:**	N/A
Dual-Rail:	Independent		

Description/Notes: See Section 11.7 of the PMBus Specification Part II.

The contents of the User store are loaded into working memory every time input power is applied to the device. The User store can also be loaded to working memory at any time by sending the RESTORE_USER_ALL command.

The RESTORE_USER_ALL command can only be sent when both outputs of the device are disabled.

STRAP_DISABLE

Reference:	Maxim Specific	**Stored in OTP:**	Yes
Command Code:	0xDC	**Format:**	Bit field
Data Bytes:	2	**Units:**	N/A
Transfer:	Read/Write Word	**Factory Value:**	0x0000
Dual-Rail:	Independent		

Description/Notes:

Several commands in the device can be set directly by resistor value connected to a device pin, or are set indirectly according to the value of other pin-configurable commands. The STRAP_DISABLE command keeps track of these commands when they have been directly altered by PMBus command write.

When one of the commands in the table below is written, the corresponding bit-flag in STRAP_DISABLE is set, and this flag prevents the device from automatically setting the value of that command in the future, preserving the user-set value instead.

Note that the STRAP_DISABLE command is saved in the nonvolatile memory. In order to disable pin-configuration of a command, the flag for that command must be 1, and a STORE_USER_ALL or STORE_DEFAULT_ALL operation must have been performed to ensure that the device powers up with the flag set in the working-memory version of STRAP_DISABLE. (This process is handled automatically.)

To restore pin-configuration capability for a command, clear the corresponding bit in STRAP_DISABLE and send the STORE_USER_ALL or STORE_DEFAULT_ALL command.

Bit #	Command	Comments
15	TEMPERATURE_2_GAIN, TEMPERATURE_2_OFFSET	Commands set by C_{REF} capacitor value
14	TON_RISE, TOFF_FALL	Commands set by R_{PGMx} resistor values
13	VOUT_MAX	Command set indirectly according to VOUT_COMMAND x 110%
12	IOUT_CAL_GAIN	Command set by R_{DES} resistor value
11	FREQUENCY_SWITCH	Command set by R_{PGMx} resistor value
10	MRAMP	Command set by R_{PGMx} resistor values
9	IOUT_OC_FAULT_LIMIT, IOUT_OC_WARN_LIMIT	Command set indirectly according to IOUT_MAX x 85% Command set indirectly according to IOUT_MAX x 80%
8	VOUT_MARGIN_LOW	Command set indirectly according to VOUT_COMMAND x 95%
7	VOUT_MARGIN_HIGH	Command set indirectly according to VOUT_COMMAND x 105%
6	Reserved	
5	Reserved	
4	VOUT_UV_WARN_LIMIT	Command set indirectly according to VOUT_COMMAND x 90%
3	VOUT_UV_FAULT_LIMIT	Command set indirectly according to VOUT_COMMAND x 85%
2	VOUT_OV_WARN_LIMIT	Command set indirectly according to VOUT_COMMAND x 110%
1	VOUT_OV_FAULT_LIMIT	Command set indirectly according to VOUT_COMMAND x 115%
0	VOUT_COMMAND	Command set by $R_{PGMx\_}$ resistor values

OTP_REMAINING

Reference:	Maxim Specific	Stored in OTP:	N/A
Command Code:	0xDD	Format:	Unsigned integer
Data Bytes:	2	Units:	Bytes
Transfer:	Read Word	Factory Value:	0x006C (108 Decimal)
Dual-Rail:	Shared		

Description/Notes:	The devices feature 16KB of One-Time Programmable memory (OTP) for nonvolatile storage of PMBus command values.
	The OTP_REMAINING command returns a count of the remaining units of OTP memory, where each unit can contain one User or Default set of PMBus command values, or one set of Inventory Information command values.

RESTORE_MAXIM_ALL

Reference:	Maxim Specific	Stored in OTP:	N/A
Command Code:	0xEA	Format:	N/A
Data Bytes:	0	Units:	N/A
Transfer:	Send Byte	Factory Value:	N/A
Dual-Rail:	Independent		

Description/Notes:	This command restores all PMBus commands to their "factory" values in working memory (volatile RAM).
	To make these "factory" PMBus command values persist through a power cycle, it is necessary to follow RESTORE_MAXIM_ALL with the STORE_USER_ALL or STORE_DEFAULT_ALL command.
	The RESTORE_MAXIM_ALL command can only be sent when both outputs of the device are disabled.

Trademarks

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Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	2/16	Initial release	—
1	6/17	Changed output voltage range for VOUT_COMMAND, VOUT_MAX, VOUT_MIN, VOUT_MARGIN_HIGH, VOUT_MARGIN_LOW, and MFR_VOUT_MIN	8, 10, 11, 12
		SLV_FAULT_RESPONSE: Changed the factory value from "0x80 (Stop regulating and remain off)" to "0xBF (Shut down and retry)"; Bits [5:3]: changed the default setting from "000" to "111"	27
		VIN_SCALE_MONITOR: Changed stored in OTP from "N/A" to "Yes"	37
		Revised MRAMP equation to match device data sheet	38
2	9/19	Corrected the "write" transaction type for SMBALERT_MASK	16
		Updated the TEMPERATURE_2_GAIN and TEMPERATURE_2_OFFSET table data for new Maxim power-stage ICs; corrected TEMPERATURE_2_GAIN for MAX20766 and MAX20788	41