XDPP1100 PMBus command set

About this document

Scope and purpose

This document describes all the PMBus commands supported by the **XDPP1100** digital power supply controller.

Intended audience

The user manual is intended for XDPP1100 users.

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1 PMBus commands – standard

1.1 00h – PAGE

The page command provides the ability to configure, control and monitor through only one physical address either:
- multiple outputs on one unit, or
- multiple non-PMBus devices through a PMBus device to non-PMBus device adapter or bridge.

Table 1 PAGE

Command code	Command name	Write Tx	Read Tx	Bytes	Range/Res
00h	PAGE	Write byte	Read byte	1	0x00, 0x01, 0xFF

1.2 01h – OPERATION

The OPERATION command is used to configure the operational state of the converter, in conjunction with input from the CONTROL pin. The OPERATION command is used to:
- turn the PMBus device output on and off with commands sent over the PMBus
- select the margin state of the device (margin off, margin high, margin low)
- select whether fault conditions caused by margining are ignored or acted upon
- select whether the output voltage is set by commands over the PMBus or AVSBus
- select whether the converter powers down immediately or follows the programmed TOFF_DELAY and TOFF_FALL commands when commanded to turn off the output.

Table 2 OPERATION command data byte

7	6	5:4	3:2	1:0
On-/Off-state 0: Off 1: On	Turn-off behavior 1x: Ignore 00: Immediate off 01: Soft off	Voltage command source 00: VOUT_COMMAND 01: VOUT_MARGIN_LOW 10: VOUT_MARGIN_HIGH	Margin fault response 01: Ignore margin fault 10: Act on margin fault	Reserved

Table 3 OPERATION

Command code	Command name	Write Tx	Read Tx	Bytes
01h	OPERATION	Write byte	Read byte	1

1.3 02h – ON_OFF_CONFIG

The ON_OFF_CONFIG command configures the combination of CONTROL pin input and serial bus commands needed to turn the unit on and off. This includes how the unit responds when power is applied.

Table 4 ON_OFF_CONFIG command data byte

Bit number	Purpose	Value and meaning
[7:5]		Reserved
4	Sets the default to either operate any time power is present or for the on/off to be	0: Unit powers up any time power is present regardless of state of the CONTROL pin 1: Unit does not power up until commanded

PMBus commands – standard

Bit number	Purpose	Value and meaning
	controlled by CONTROL pin and serial bus commands	by the CONTROL pin and OPERATION command (as programmed in bits [3:0])
3	Controls how the unit responds to commands received via the serial bus	0: Ignore the ON/OFF portion bit [7] of OPERATION command 1: To start, the unit requires that the ON/OFF portion of the OPERATION command is instructing the unit to run
2	Controls how the unit responds to the CONTROL pin	0: Unit ignores the CONTROL pin (on/off controlled only the OPERATION command) 1: Unit requires the CONTROL pin to be asserted to start the unit
1	Polarity of the CONTROL pin	0: Active low 1: Active high
0	CONTROL pin action when commanding the unit to turn off	0: Soft turn-off, use the programmed TOFF_DELAY and TOFF_FALL 1: Turn-off immediately (hard stop)

Table 5 ON_OFF_CONFIG

Command code	Command name	Write Tx	Read Tx	Bytes
02h	ON_OFF_CONFIG	Write byte	Read byte	1

1.4 03h – CLEAR_FAULTS

The CLEAR_FAULTS command is used to clear any fault bits that have been set. This command clears all bits in all status registers simultaneously. At the same time, the device negates (clears, releases) its SMBALERT# signal output if the device is asserting the SMBALERT# signal.

Table 6 CLEAR_FAULTS

Command code	Command name	Write Tx	Read Tx	Bytes
03h	CLEAR_FAULTS	Send byte		0

1.5 10h – WRITE_PROTECT

The WRITE_PROTECT command is used to control writing to the PMBus device. The intention of this command is to provide protection against accidental changes. This command is not intended to provide protection against deliberate or malicious changes to a device's configuration or operation.

Table 7 WRITE_PROTECT command data byte

Data byte value	Meaning
0x00	Enable writes to all commands
0x20	Disable all writes except to the WRITE_PROTECT, OPERATION, PAGE, ON_OFF_CONFIG and VOUT_COMMAND commands

Data byte value	Meaning
0x40	Disable all writes except to the WRITE_PROTECT, OPERATION and PAGE commands
0x80	Disable all writes except to the WRITE_PROTECT command

Table 8 WRITE_PROTECT

Command code	Command name	Write Tx	Read Tx	Bytes
10h	WRITE_PROTECT	Write byte	Read byte	1

1.6 11h – STORE_DEFAULT_ALL

The STORE_DEFAULT_ALL command instructs the PMBus device to copy the entire contents of the operating memory to the matching locations in the non-volatile default store memory. Any items in operating memory that do not have matching locations in the default store are ignored.

Table 9 STORE_DEFAULT_ALL

Command code	Command name	Write Tx	Read Tx	Bytes
11h	STORE_DEFAULT_ALL	Send byte		0

1.7 12h – RESTORE_DEFAULT_ALL

The RESTORE_DEFAULT_ALL command instructs the PMBus device to copy the entire contents of the non-volatile default store memory to the matching locations in the operating memory. The values in the operating memory are overwritten by the value retrieved from the default store. Any items in the default store that do not have matching locations in the operating memory are ignored.

Table 10 RESTORE_DEFAULT_ALL

Command code	Command name	Write Tx	Read Tx	Bytes
12h	RESTORE_DEFAULT_ALL	Send byte		0

1.8 15h – STORE_USER_ALL

The STORE_USER_ALL command instructs the PMBus device to copy the entire contents of the operating memory to the matching locations in the non-volatile user store memory. Any items in operating memory that do not have matching locations in the user store are ignored.

Table 11 STORE_USER_ALL

Command code	Command name	Write Tx	Read Tx	Bytes
15h	STORE_USER_ALL	Send byte		0

1.9 16h – RESTORE_USER_ALL

The RESTORE_USER_ALL command instructs the PMBus device to copy the entire contents of the non-volatile user store memory to the matching locations in the operating memory. The values in the operating memory are overwritten by the value retrieved from the user store. Any items in the user store that do not have matching locations in the operating memory are ignored.

Table 12 RESTORE_USER_ALL

Command code	Command name	Write Tx	Read Tx	Bytes
16h	RESTORE_USER_ALL	Send byte		0

1.10 17h – STORE_USER_CODE

The STORE_USER_CODE command instructs the PMBus device to copy the parameter whose command code matches value in the data byte from the operating memory to the matching location in the non-volatile user store memory.

Table 13 STORE_USER_CODE

Command code	Command name	Write Tx	Read Tx	Bytes
17h	STORE_USER_CODE	Write byte		1

1.11 18h – RESTORE_USER_CODE

The RESTORE_USER_CODE command instructs the PMBus device to copy the parameter whose command code matches the value in the data byte from the non-volatile user store memory to the matching location in the operating memory. The value in the operating memory is overwritten by the value retrieved from the user store.

Table 14 RESTORE_USER_CODE

Command code	Command name	Write Tx	Read Tx	Bytes
18h	RESTORE_USER_CODE	Write byte		1

1.12 19h – CAPABILITY

This command provides a way for a host system to determine some key capabilities of a PMBus device. This is a read-only command.

Table 15 CAPABILITY

Command code	Command name	Write Tx	Read Tx	Bytes
19h	CAPABILITY		Read byte	1

1.13 1Bh – SMBALERT_MASK

The SMBALERT_MASK command may be used to prevent a warning or fault condition from asserting the SMBALERT# signal.

Table 16 SMBALERT_MASK

Command code	Command name	Write Tx	Read Tx	Bytes
1Bh	SMBALERT_MASK	Write word	Block write/Block read proc. call	2

1.14 20h – VOUT_MODE

The data byte for the VOUT_MODE command is one byte that consists of a three-bit mode and a 5-bit parameter, as shown in **Figure 1**. The three-bit mode sets whether the device uses the ULINEAR16, half-precision IEEE 754 floating point, VID or DIRECT modes for output voltage related commands. The XDPP1100 only supports ULINEAR16 mode, bit [7:5] = 000. The five-bit parameter N is a 5-bit two's complement binary integer, and defines the exponent of the output voltage (**Figure 2**).

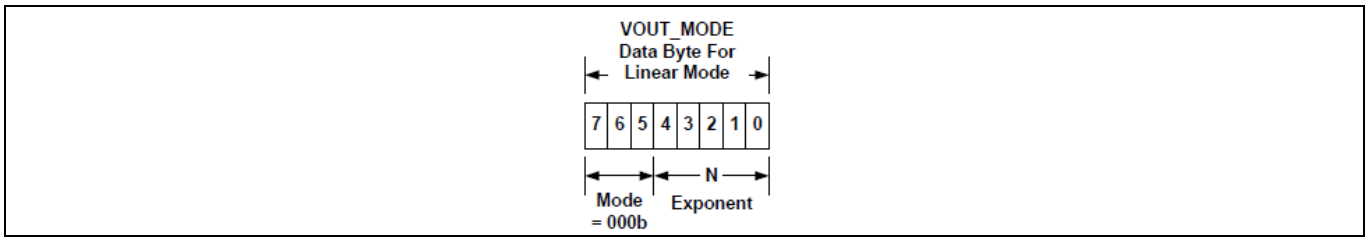


Figure 1 VOUT_MODE command data byte

The setting of VOUT_MODE determines the mode and exponent of the following commands:

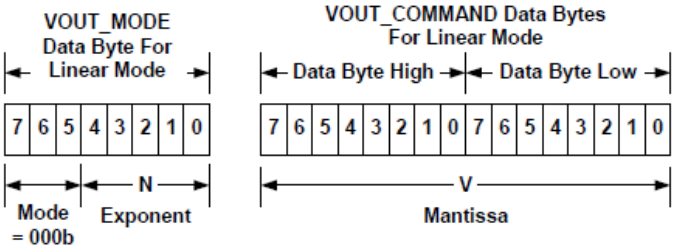
- VOUT_COMMAND
- VOUT_TRIM
- VOUT_CAL_OFFSET
- VOUT_MAX
- VOUT_MIN
- VOUT_MARGIN_HIGH
- VOUT_MARGIN_LOW
- VOUT_OV_WARN_LIMIT
- VOUT_OV_FAULT_LIMIT
- VOUT_UV_WARN_LIMIT
- VOUT_UV_FAULT_LIMIT
- IOUT_OC_LV_FAULT_LIMIT
- READ_VOUT
- POWER_GOOD_ON
- POWER_GOOD_OFF
- MFR_VOUT_MAX
- MFR_VOUT_MIN

Table 17 VOUT_MODE

Command code	Command name	Write Tx	Read Tx	Bytes	Range/Resolution
20h	VOUT_MODE	Write byte	Read byte	1	0x14 – 0x18

1.15 21h – VOUT_COMMAND

VOUT_COMMAND sets the output voltage of the device when selected by the OPERATION command.



ULINEAR16 Format Data Bytes

The Mode bits are set to 000b.

The Voltage, in Volts, is calculated from the equation:

$Voltage = V \times 2^{N}$

Where:

Voltage is the parameter of interest in Volts;

V is a 16 bit unsigned binary integer; and

N is a 5 bit two's complement binary integer.

Figure 2 VOUT_MODE and VOUT_COMMAND data byte format

Table 18 VOUT_COMMAND

Command code	Command name	Write Tx	Read Tx	Bytes	Format
21h	VOUT_COMMAND	Write word	Read word	2	vout_mode

1.16 22h – VOUT_TRIM

The VOUT_TRIM command is used to apply a fixed offset voltage to the output voltage command value. It is most typically used by the end user to trim the output voltage at the time the PMBus device is assembled into the end user's system.

Table 19 VOUT_TRIM

Command code	Command name	Write Tx	Read Tx	Bytes	Format
22h	VOUT_TRIM	Write word	Read word	2	vout_mode_signed

1.17 23h – VOUT_CAL_OFFSET

The VOUT_CAL_OFFSET command is used to apply a fixed offset voltage to the output voltage command value. It is most typically used by the PMBus device manufacturer to calibrate a device in the factory.

Table 20 VOUT_CAL_OFFSET

Command code	Command name	Write Tx	Read Tx	Bytes	Format
23h	VOUT_CAL_OFFSET	Write word	Read word	2	vout_mode_signed

1.18 24h – VOUT_MAX

The VOUT_ MAX command sets an upper limit on the output voltage the unit can command regardless of any other commands or combinations. The intention 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 overvoltage protection.

Table 21 VOUT_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
24h	VOUT_MAX	Write word	Read word	2	vout_mode

1.19 25h – VOUT_MARGIN_HIGH

This VOUT_MARGIN_HIGH command loads the unit with the voltage to which the output is to be changed when the OPERATION command is set to margin high.

Table 22 VOUT_MARGIN_HIGH

Command code	Command name	Write Tx	Read Tx	Bytes	Format
25h	VOUT_MARGIN_HIGH	Write word	Read word	2	vout_mode

1.20 26h – VOUT_MARGIN_LOW

This VOUT_MARGIN_LOW command loads the unit with the voltage to which the output is to be changed when the OPERATION command is set to margin low.

Table 23 VOUT_MARGIN_LOW

Command code	Command name	Write Tx	Read Tx	Bytes	Format
26h	VOUT_MARGIN_LOW	Write word	Read word	2	vout_mode

1.21 27h – VOUT_TRANSITION_RATE

When a PMBus device receives either a VOUT_COMMAND or OPERATION (margin high, margin low, margin off) that causes the output voltage to change, this command sets the rate in mV/µs at which the output should change voltage. This commanded rate of change does not apply when the unit is commanded to turn on or to turn off. This command has two data bytes in the LINEAR11 data format. An exponent of -3 is supported. The resolution is 0.125 mV/µs and the range is 0 to 63.875 mV/µs.

Table 24 VOUT_TRANSITION_RATE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
27h	VOUT_TRANSITION_RATE	Write word	Read word	2	U6.3

1.22 28h – VOUT_DROOP

The VOUT_DROOP sets the rate, in mV/A (mΩ), at which the output voltage decreases (or increases) with increasing (or decreasing) output current for use with adaptive voltage positioning requirements and passive current sharing schemes. This command has two data bytes in LINEAR11 data format. The maximum droop resistance is limited by 15.9922 mΩ/VOUT_SCALE_LOOP.

Table 25 VOUT_DROOP

Command code	Command name	Write Tx	Read Tx	Bytes
28h	VOUT_DROOP	Write word	Read word	2

1.23 29h – VOUT_SCALE_LOOP

The VOUT_SCALE_LOOP command scales VOUT_COMMAND, etc. for the external resistor divider on the voltage sense input to the device. The vout_scale register has LSB 2^-16, range 0.0 to 0.99998.

For example, for resistor divider ratio 0.1, set VOUT_SCALE_LOOP = 0.1 * 2^16 = 6554 (D) = 199 A (H). Write VOUT_SCALE_LOOP = 0x199 A would set the scale to 0.1.

D: Data in decimal

H: Data in hex

Table 26 VOUT_SCALE_LOOP

Command code	Command name	Write Tx	Read Tx	Bytes	Format
29h	VOUT_SCALE_LOOP	Write word	Read word	2	U0.16

1.24 2Bh – VOUT_MIN

The VOUT_ MIN command sets a lower limit on the output voltage the unit can command regardless of any other commands or combinations. The intention 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 undervoltage protection.

Table 27 VOUT_MIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
2Bh	VOUT_MIN	Write word	Read word	2	vout_mode

1.25 32h – MAX_DUTY

The MAX_DUTY command sets the maximum duty cycle, in percent, of the unit’s power conversion stage. This command has two data bytes in the LINEAR11 data format.

Table 28 MAX_DUTY

Command code	Command name	Write Tx	Read Tx	Bytes	Format
32h	MAX_DUTY	Write word	Read word	2	U7.2

1.26 33h – FREQUENCY_SWITCH

The FREQUENCY_SWITCH command sets the switching frequency in kHz. This command has two data bytes in the LINEAR11 data format.

Table 29 FREQUENCY_SWITCH

Command code	Command name	Write Tx	Read Tx	Bytes	Format
33h	FREQUENCY_SWITCH	Write word	Read word	2	U11.0, U11.-1

1.27 34h – POWER_MODE

The POWER_MODE command is used to set or read the PMBus device power conversion mode of operation.

Table 30 POWER_MODE

Command code	Command name	Write Tx	Read Tx	Bytes	Value/Meaning
34h	POWER_MODE	Write byte	Read byte	1	0x00: Max. efficiency 0x03: Max. power

1.28 35h – VIN_ON

The VIN_ON command sets the value of the input voltage, in volts, at which the unit should start power conversion. This command has two data bytes in the LINEAR11 data format.

Table 31 VIN_ON

Command code	Command name	Write Tx	Read Tx	Bytes	Format
35h	VIN_ON	Write word	Read word	2	U6.2, U7.1

1.29 36h – VIN_OFF

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. This command has two data bytes in the LINEAR11 data format.

Table 32 VIN_OFF

Command code	Command name	Write Tx	Read Tx	Bytes	Format
36h	VIN_OFF	Write word	Read word	2	U6.2, U7.1

1.30 37h – INTERLEAVE

The INTERLEAVE command is used to arrange multiple units so that their switching periods can be distributed in time. This may be used to facilitate paralleling of multiple units or to reduce AC currents injected into the power bus.

Table 33 INTERLEAVE command data byte

Byte	High byte		Low byte	
Bit number	**7:4**	**3:0**	**7:4**	**3:0**
Contents	Not used	Group ID number	Number in group	Interleave order
Default value	00	00	00	00

If the Group ID number is zero, then Number in group and Interleave order number are zeroes and the programming of these numbers is disabled. If the Group ID number is non-zero, the user can set Number in group and Interleave order.

The phase shift (lag) is defined by: $360° \times \frac{Interleave\_order}{Number\_in\_group}$

Table 34 INTERLEAVE

Command code	Command name	Write Tx	Read Tx	Bytes
37h	INTERLEAVE	Write word	Read word	2

1.31 39h – IOUT_CAL_OFFSET

The IOUT_CAL_OFFSET is used to null out any offsets in the output current sensing circuit. This command is used to minimize the offset error of the current sensing circuit. This command has two data bytes in the LINEAR11 data format.

Table 35 IOUT_CAL_OFFSET

Command code	Command name	Write Tx	Read Tx	Bytes	Format
39h	IOUT_CAL_OFFSET	Write word	Read word	2	S5.3

1.32 40h – VOUT_OV_FAULT_LIMIT

The VOUT_OV_FAULT_LIMIT command sets the value of the output voltage measured at the sense or output pins that causes an output overvoltage fault.

Table 36 VOUT_OV_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
40h	VOUT_OV_FAULT_LIMIT	Write word	Read word	2	vout_mode

1.33 41h – VOUT_OV_FAULT_RESPONSE

The VOUT_OV_FAULT_RESPONSE command instructs the device on what action to take in response to an output overvoltage fault. This command returns one data byte with contents as follows:

Table 37 VOUT_OV_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 38 VOUT_OV_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
41h	VOUT_OV_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 37**

1.34 42h – VOUT_OV_WARN_LIMIT

The VOUT_OV_WARN_LIMIT command sets the value of the output voltage at the sense or output pins that causes an output voltage high warning. This value is typically less than the output overvoltage threshold. The warning limit is used by firmware (FW) as the hysteresis of the VOUT_OV fault.

Table 39 VOUT_OV_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
42h	VOUT_OV_WARN_LIMIT	Write word	Read word	2	vout_mode

1.35 43h – VOUT_UV_WARN_LIMIT

The VOUT_UV_WARN_LIMIT command sets the value of the output voltage at the sense or output pins that causes an output voltage low warning. This value is typically greater than the output undervoltage fault threshold. The warning threshold is used by FW as the hysteresis of the VOUT_UV fault.

Table 40 VOUT_UV_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
43h	VOUT_UV_WARN_LIMIT	Write word	Read word	2	vout_mode

1.36 44h – VOUT_UV_FAULT_LIMIT

The VOUT_UV_FAULT_LIMIT command sets the value of the output voltage at the sense or output pins that causes an output undervoltage fault.

Table 41 VOUT_UV_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
44h	VOUT_UV_FAULT_LIMIT	Write word	Read word	2	vout_mode

1.37 45h – VOUT_UV_FAULT_RESPONSE

The VOUT_UV_FAULT_RESPONSE command instructs the device on what action to take in response to an output undervoltage fault. This command returns one data byte with contents as follows:

Table 42 VOUT_UV_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously

Bit	Meaning
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 43 VOUT_UV_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
45h	VOUT_UV_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 42**

1.38 46h – IOUT_OC_FAULT_LIMIT

The IOUT_OC_FAULT_LIMIT command sets the value of the output current, in amperes, that causes the overcurrent detector to indicate an overcurrent fault condition. This command has two data bytes in the LINEAR11 data format.

Table 44 IOUT_OC_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
46h	IOUT_OC_FAULT_LIMIT	Write word	Read word	2	U8.0

1.39 47h – IOUT_OC_FAULT_RESPONSE

The IOUT_OC_FAULT_RESPONSE command instructs the device on what action to take in response to an output overcurrent fault. This command returns one data byte with contents as follows:

Table 45 IOUT_OC_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Continues to operate while maintaining the output current (CC) 01: Continues to operate while maintaining the output current, with overcurrent low voltage protection 10: Continues to operate while maintaining the output current for delay time 11: Shut down and retry
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 46 IOUT_OC_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
47h	IOUT_OC_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 45**

1.40 48h – IOUT_OC_LV_FAULT_LIMIT

In the case where the response to an overcurrent condition is to operate in a constant current mode unless the output voltage is pulled below the specified value, the IOUT_OC_LV_FAULT_LIMIT specifies that voltage threshold.

Table 47 IOUT_OC_LV_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
48h	IOUT_OC_LV_FAULT_LIMIT	Write word	Read word	2	vout_mode

1.41 4Ah – IOUT_OC_WARN_LIMIT

The IOUT_OV_WARN_LIMIT command sets the value of the output current that causes an output overcurrent warning. The IOUT_OC warning threshold is used by FW as the fault hysteresis. This command has two data bytes in the LINEAR11 data format.

Table 48 IOUT_OC_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
4Ah	IOUT_OC_WARN_LIMIT	Write word	Read word	2	U8.0

1.42 4Bh – IOUT_UC_FAULT_LIMIT

For units with a synchronous rectifier in the output, current can flow from the unit to the load or from the load into the output. When current is flowing from the unit to the load the unit is said to be sourcing current and the output current is declared to be positive. When current is flowing into the unit from the load, the unit is said to be sinking current and the current is declared to be negative.

Table 49 IOUT_UC_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
4Bh	IOUT_UC_FAULT_LIMIT	Write word	Read word	2	S8.0

1.43 4Ch – IOUT_UC_FAULT_RESPONSE

The IOUT_UC_FAULT_RESPONSE command instructs the device on what action to take in response to an output undercurrent fault. This command returns one data byte with contents as follows:

Table 50 IOUT_UC_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable SR and resume SR when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number

Bit	Meaning
	111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 51 IOUT_UC_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
4Ch	IOUT_UC_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 50**

1.44 4Fh – OT_FAULT_LIMIT

The OT_FAULT_LIMIT command sets the temperature of the unit, in degrees Celsius, at which it should indicate an overtemperature fault. This command has two data bytes in the LINEAR11 data format.

Table 52 OT_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
4Fh	OT_FAULT_LIMIT	Write word	Read word	2	U8.0

1.45 50h – OT_FAULT_RESPONSE

The OT_FAULT_RESPONSE command instructs the device on what action to take in response to an overtemperature fault. This command returns one data byte with contents as follows:

Table 53 OT_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 54 OT_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
50h	OT_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 53**

1.46 51h – OT_WARN_LIMIT

The OT_WARN_LIMIT command sets the temperature of the unit, in degrees Celsius, at which it should indicate an overtemperature (OT) warning alarm. The OT warning threshold is used by FW as hysteresis of the OT fault. This command has two data bytes in the LINEAR11 data format.

Table 55 OT_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
51h	OT_WARN_LIMIT	Write word	Read word	2	U8.0

1.47 52h – UT_WARN_LIMIT

The UT_WARN_LIMIT command sets the temperature of the unit, in degrees Celsius, at which it should indicate an undertemperature (UT) warning alarm. The UT warning threshold is used by FW as hysteresis of the UT fault. This command has two data bytes in the LINEAR11 data format.

Table 56 UT_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
52h	UT_WARN_LIMIT	Write word	Read word	2	S9.-1

1.48 53h – UT_FAULT_LIMIT

The UT_FAULT_LIMIT command sets the temperature of the unit, in degrees Celsius, at which it should indicate an UT fault. This command has two data bytes in the LINEAR11 data format.

Table 57 UT_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
53h	UT_FAULT_LIMIT	Write word	Read word	2	S9.-1

1.49 54h – UT_FAULT_RESPONSE

The UT_FAULT_RESPONSE command instructs the device on what action to take in response to an UT fault. This command returns one data byte with contents as follows:

Table 58 UT_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously

Bit	Meaning
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 59 UT_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
54h	UT_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 58**

1.50 55h – VIN_OV_FAULT_LIMIT

The VIN_OV_FAULT_LIMIT command sets the value of the input voltage that causes an input overvoltage fault. This command has two data bytes in the LINEAR11 data format.

Table 60 VIN_OV_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
55h	VIN_OV_FAULT_LIMIT	Write word	Read word	2	U7.2

1.51 56h – VIN_OV_FAULT_RESPONSE

The VIN_OV_FAULT_RESPONSE command instructs the device on what action to take in response to an input overvoltage fault. This command returns one data byte with contents as follows:

Table 61 VIN_OV_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 62 VIN_OV_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
56h	VIN_OV_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 61**

1.52 57h – VIN_OV_WARN_LIMIT

The VIN_OV_WARN_LIMIT command sets the value of the input voltage that causes an input voltage high warning. This value is typically less than the input overvoltage fault threshold. The VIN_OV warning threshold is

used by FW as the hysteresis of the VIN_OV fault. This command has two data bytes in the LINEAR11 data format.

Table 63 VIN_OV_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
57h	VIN_OV_WARN_LIMIT	Write word	Read word	2	U7.2

1.53 58h – VIN_UV_WARN_LIMIT

The VIN_UV_WARN_LIMIT command sets the value of the input voltage that causes an input voltage low warning. The VIN_UV warning threshold is used by FW as the hysteresis of the VIN_UV fault. This command has two data bytes in the LINEAR11 data format.

Table 64 VIN_UV_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
58h	VIN_UV_WARN_LIMIT	Write word	Read word	2	U6.2

1.54 59h – VIN_UV_FAULT_LIMIT

The VIN_UV_FAULT_LIMIT command sets the value of the input voltage that causes an input undervoltage fault. This command has two data bytes in the LINEAR11 data format.

Table 65 VIN_UV_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
59h	VIN_UV_FAULT_LIMIT	Write word	Read word	2	U6.2

1.55 5Ah – VIN_UV_FAULT_RESPONSE

The VIN_UV_FAULT_RESPONSE command instructs the device on what action to take in response to an input undervoltage fault. This command returns one data byte with contents as follows:

Table 66 VIN_UV_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 67 VIN_UV_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Ah	VIN_UV_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 66**

1.56 5Bh – IIN_OC_FAULT_LIMIT

The IIN_OC_FAULT_LIMIT command sets the value of the input current, in amperes, that causes an input overcurrent fault. This command has two data bytes in the LINEAR11 data format.

Table 68 IIN_OC_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Bh	IIN_OC_FAULT_LIMIT	Write word	Read word	2	U6.2

1.57 5Ch – IIN_OC_FAULT_RESPONSE

The IIN_OC_FAULT_RESPONSE command instructs the device on what action to take in response to an input overcurrent fault. This command returns one data byte with contents as follows:

Table 69 IIN_OC_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 70 IIN_OC_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Ch	IIN_OC_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 69**

1.58 5Dh – IIN_OC_WARN_LIMIT

The IIN_OC_WARN_LIMIT command sets the value of the input current, in amperes, that causes an input overcurrent warning. The input OC warning threshold is used by FW as the input OC fault hysteresis. This command has two data bytes in the LINEAR11 data format.

Table 71 IIN_OC_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Dh	IIN_OC_WARN_LIMIT	Write word	Read word	2	U6.2

1.59 5Eh – POWER_GOOD_ON

The POWER_GOOD_ON command sets the output voltage at which an optional POWER_GOOD signal should be asserted, indicating that the output voltage is valid. Note that depending on the choice of the device manufacturer a device may drive a POWER_GOOD signal high or low to indicate that the signal is asserted.

Table 72 POWER_GOOD_ON

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Eh	POWER_GOOD_ON	Write word	Read word	2	vout_mode

1.60 5Fh – POWER_GOOD_OFF

The POWER_GOOD_OFF command sets the output voltage at which an optional POWER_GOOD signal should be negated, indicating that the output voltage is not valid. Note that depending on the choice of the device manufacturer a device may drive a POWER_GOOD signal high or low to indicate that the signal is negated.

Table 73 POWER_GOOD_OFF

Command code	Command name	Write Tx	Read Tx	Bytes	Format
5Fh	POWER_GOOD_OFF	Write word	Read word	2	vout_mode

1.61 60h – TON_DELAY

The TON_DELAY command sets the time, in milliseconds, from when a start condition is received (as programmed by the ON_OFF_CONFIG command) until the output voltage starts to rise. This command has two data bytes in the LINEAR11 data format.

Table 74 TON_DELAY

Command code	Command name	Write Tx	Read Tx	Bytes	Format
60h	TON_DELAY	Write word	Read word	2	U8.2, U9.1, U10.0

1.62 61h – TON_RISE

The TON_RISE command sets the time, in milliseconds, from when the output starts to rise until the voltage has entered the regulation band. This command has two data bytes in the LINEAR11 data format.

Table 75 TON_RISE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
61h	TON_RISE	Write word	Read word	2	U8.2, U9.1, U10.0

1.63 62h – TON_MAX_FAULT_LIMIT

The TON_MAX_FAULT_LIMIT command 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. This command has two data bytes in the LINEAR11 data format.

Table 76 TON_MAX_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
62h	TON_MAX_FAULT_LIMIT	Write word	Read word	2	U8.2, U9.1, U10.0

1.64 63h – TON_MAX_FAULT_RESPONSE

The TON_MAX_FAULT_RESPONSE command instructs the device on what action to take in response to a TON_MAX fault. This command returns one data byte with contents as follows:

Table 77 TON_MAX_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Ignore 01: Operate for delay time then shut down if fault condition is still present 10: Disable and retry 11: Disable and resume when OK
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 78 TON_MAX_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
63h	TON_MAX_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 77**

1.65 64h – TOFF_DELAY

The TOFF_DELAY command sets the time, in milliseconds, from when a stop condition is received (as programmed by the ON_OFF_CONFIG command) until the unit stops transferring energy to the output. This command has two data bytes in the LINEAR11 data format.

Table 79 TOFF_DELAY

Command code	Command name	Write Tx	Read Tx	Bytes	Format
64h	TOFF_DELAY	Write word	Read word	2	U8.2, U9.1, U10.0

1.66 65h – TOFF_FALL

The TOFF_FALL command sets the time, in milliseconds, from the end of the turn-off delay time until the voltage is commanded to zero. Note that this command can only be used with a device whose output can sink enough current to cause the output voltage to decrease at a controlled rate. This command has two data bytes in the LINEAR11 data format.

Table 80 TOFF_FALL

Command code	Command name	Write Tx	Read Tx	Bytes	Format
65h	TOFF_FALL	Write word	Read word	2	U8.2, U9.1, U10.0

1.67 66h – TOFF_MAX_WARN_LIMIT

The TON_MAX_WARN_LIMIT command sets an upper limit, in milliseconds, on how long the unit can attempt to power down the output without reaching 12.5 percent of the output voltage programmed at the time the unit is turned off. This command has two data bytes in the LINEAR11 data format.

Table 81 TOFF_MAX_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
66h	TOFF_MAX_WARN_LIMIT	Write word	Read word	2	U8.2, U9.1, U10.0

1.68 6Ah – POUT_OP_WARN_LIMIT

The POUT_OP_WARN_LIMIT command sets the value of the output power, in watts, that causes a warning that the output power is high. This command has two data bytes in the LINEAR11 data format.

Table 82 POUT_OP_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
6Ah	POUT_OP_WARN_LIMIT	Write word	Read word	2	U10.0, U11.-1, U12.-2

1.69 6Bh – PIN_OP_WARN_LIMIT

The PIN_OP_WARN_LIMIT command sets the value of the input power, in watts, that causes a warning that the input power is high. This command has two data bytes in the LINEAR11 data format.

Table 83 PIN_OP_WARN_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
6Bh	PIN_OP_WARN_LIMIT	Write word	Read word	2	U10.0, U11.-1, U12.-2

1.70 78h – STATUS_BYTE

The STATUS_BYTE command returns one byte of information with a summary of the most critical faults.

Table 84 STATUS_BYTE data format

Bit	Bit name	Meaning
7	BUSY	A fault was declared because the device was busy and unable to respond.

Bit	Bit name	Meaning
6	OFF	This bit is asserted if the unit is not providing power to the output, regardless of the reason, including simply not being enabled.
5	VOUT_OV_FAULT	An output overvoltage fault has occurred.
4	IOUT_OC_FAULT	An output overcurrent fault has occurred.
3	VIN_UV_FAULT	An input undervoltage fault has occurred.
2	TEMPERATURE	A temperature fault or warning has occurred.
1	CML	A communications, memory or logic fault has occurred.
0	NONE_OF_THE_ABOVE	A fault or warning not listed in bits [7:1] has occurred.

Table 85 STATUS_BYTE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
78h	STATUS_BYTE	Write byte	Read byte	1	See **Table 84**

1.71 79h – STATUS_WORD

The STATUS_WORD command returns two bytes of information with a summary of the unit's fault condition. Based on the information in these bytes, the host can get more information by reading the appropriate status registers.

Table 86 STATUS_WORD data format

Bit	Bit name	Meaning
15	VOUT	An output voltage fault or warning has occurred.
14	IOUT/POUT	An output current or output power fault or warning has occurred.
13	INPUT	An input voltage, input current, or input power fault or warning has occurred.
12	MFRSPECIFIC	A manufacturer-specific fault or warning has occurred.
11	PG_STATUS#	The POWER_GOOD signal, if present, is negated.
10	FANS	A fan or airflow fault or warning has occurred.
9	OTHER	A bit in STATUS_OTHER is set.
8	UNKNOWN	A fault type not given in bits [15:1] of the STATUS_WORD has been detected.
7	BUSY	A fault was declared because the device was busy and unable to respond.
6	OFF	This bit is asserted if the unit is not providing power to the output, regardless of the reason, including simply not being enabled.
5	VOUT_OV_FAULT	An output overvoltage fault has occurred.
4	IOUT_OC_FAULT	An output overcurrent fault has occurred.
3	VIN_UV_FAULT	An input undervoltage fault has occurred.
2	TEMPERATURE	A temperature fault or warning has occurred.
1	CML	A communications, memory or logic fault has occurred.
0	NONE_OF_THE_ABOVE	A fault or warning not listed in bits [7:1] of this byte has occurred.

Table 87 STATUS_WORD

Command code	Command name	Write Tx	Read Tx	Bytes	Format
79h	STATUS_WORD	Write word	Read word	2	See **Table 86**

1.72 7Ah – STATUS_VOUT

The STATUS_VOUT command returns one data byte with contents as follows:

Table 88 STATUS_VOUT data format

Bit	Meaning
7	VOUT_OV_FAULT (output overvoltage fault)
6	VOUT_OV_WARNING (output overvoltage warning)
5	VOUT_UV_WARNING (output undervoltage warning)
4	VOUT_UV_FAULT (output undervoltage fault)
3	VOUT_MAX_MIN warning
2	TON_MAX_FAULT
1	TOFF_MAX_WARNING
0	Reserved

Table 89 STATUS_VOUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Ah	STATUS_VOUT	Write byte	Read byte	1	See **Table 88**

1.73 7Bh – STATUS_IOUT

The STATUS_IOUT command returns one data byte with contents as follows:

Table 90 STATUS_IOUT data format

Bit	Meaning
7	IOUT_OC_FAULT (output overcurrent fault)
6	IOUT_OC_LV_FAULT (output overcurrent and low voltage fault)
5	IOUT_OC_WARNING (output overcurrent warning)
4	IOUT_UC_FAULT (output undercurrent fault)
3	Current share fault
2	In power limiting mode
1	Reserved
0	POUT_OP_WARNING (output overpower warning)

Table 91 STATUS_IOUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Bh	STATUS_IOUT	Write byte	Read byte	1	See **Table 90**

1.74 7Ch – STATUS_INPUT

The STATUS_INPUT command returns one data byte with contents as follows:

Table 92 STATUS_INPUT data format

Bit	Meaning
7	VIN_OV_FAULT (input overvoltage fault)
6	VIN_OV_WARNING (input overvoltage warning)
5	VIN_UV_WARNING (input undervoltage warning)
4	VIN_UV_FAULT (input undervoltage fault)
3	Unit off for insufficient input voltage
2	IIN_OC_FAULT (input overcurrent fault)
1	IIN_OC_WARNING (input overcurrent warning)
0	PIN_OP_WARNING (input overpower warning)

Table 93 STATUS_INPUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Ch	STATUS_INPUT	Write byte	Read byte	1	See **Table 92**

1.75 7Dh – STATUS_TEMPERATURE

The STATUS_TEMPERATURE command returns one data byte with contents as follows:

Table 94 STATUS_TEMPERATURE data format

Bit	Meaning
7	OT_FAULT (overtemperature fault)
6	OT_WARNING (overtemperature warning)
5	UT_WARNING (undertemperature warning)
4	UT_FAULT (undertemperature fault)
3	Reserved
2	Reserved
1	Reserved
0	Reserved

Table 95 STATUS_TEMPERATURE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Dh	STATUS_TEMPERATURE	Write byte	Read byte	1	See **Table 94**

1.76 7Eh – STATUS_CML

The STATUS_CML command returns one data byte with contents as follows:

Table 96 STATUS_CML data format

Bit	Meaning
7	Invalid or unsupported command received
6	Invalid or unsupported data received
5	Packet error check failed
4	Memory fault detected
3	Processor fault detected
2	Reserved
1	A communication fault other than the ones listed in this table has occurred
0	Reserved

Table 97 STATUS_CML

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Eh	STATUS_CML	Write byte	Read byte	1	See **Table 96**

1.77 7Fh – STATUS_OTHER

The STATUS_OTHER command returns one data byte with contents as follows:

Table 98 STATUS_OTHER data format

Bit	Meaning
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	First to assert SMBALERT#

Table 99 STATUS_OTHER

Command code	Command name	Write Tx	Read Tx	Bytes	Format
7Fh	STATUS_OTHER	Write byte	Read byte	1	See **Table 98**

1.78 80h – STATUS_MFR_SPECIFIC

The STATUS_MFR_SPECIFIC command returns one data byte with contents as follows:

Table 100 STATUS_MFR_SPECIFIC data format

Bit	Meaning
7	Sync fault
6	Manufacturer defined (unused)

Bit	Meaning
5	IOUT_OC fast fault
4	Common fault (see fault common registers for status)
3	External fault
2	Manufacturer defined (unused)
1	Manufacturer defined (unused)
0	Manufacturer defined (unused)

Table 101 STATUS_MFR_SPECIFIC

Command code	Command name	Write Tx	Read Tx	Bytes	Format
80h	STATUS_MFR_SPECIFIC	Write byte	Read byte	1	See **Table 100**

1.79 88h – READ_VIN

The READ_VIN command returns the input voltage in volts. This command has two data bytes in the LINEAR11 data format. The READ_VIN exponent is configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 102 READ_VIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
88h	READ_VIN		Read word	2	Exp. configured by FW_CONFIG_TELEMETRY

1.80 89h – READ_IIN

The READ_IIN command returns the input current in amperes. This command has two data bytes in the LINEAR11 data format. The READ_IIN exponent is configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 103 READ_IIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
89h	READ_IIN		Read word	2	Exp. configured by FW_CONFIG_TELEMETRY

1.81 8Bh – READ_VOUT

The READ_VOUT command returns the actual, measured (not commanded) output voltage in the same format as set by the VOUT_MODE command.

Table 104 READ_VOUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
8Bh	READ_VOUT		Read word	2	Vout_mode

1.82 8Ch – READ_IOUT

The READ_IOUT command returns the measured output current in amperes. This command has two data bytes in the LINEAR11 data format. The READ_IOUT exponent is configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 105 READ_IOUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
8Ch	READ_IOUT		Read word	2	Exp. configured by FW_CONFIG_TELEMETRY

1.83 8Dh – READ_TEMPERATURE_1

The READ_TEMPERATURE1 command returns the temperature at sensor 1 in degrees Celsius. This command has two data bytes in the LINEAR11 data format.

Table 106 READ_TEMPERATURE_1

Command code	Command name	Write Tx	Read Tx	Bytes	Format
8Dh	READ_TEMPERATURE_1		Read word	2	S10.0

1.84 8Eh – READ_TEMPERATURE_2

The READ_TEMPERATURE2 command returns the temperature at sensor 2 in degrees Celsius. This command has two data bytes in the LINEAR11 data format.

Table 107 READ_TEMPERATURE_2

Command code	Command name	Write Tx	Read Tx	Bytes	Format
8Eh	READ_TEMPERATURE_2		Read word	2	S10.0

1.85 90h – READ_FAN_SPEED_1

The READ_FAN_SPEED_1 command returns the speed of FAN1 in RPM. This command has two data bytes in the LINEAR11 data format. The exponent is configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 108 Read fan speed exponent range

READ_FAN_EXP (PMBus command FW_CONFIG_TELEMETRY)	Speed range
3	0 to 7.5k RPM
4	7.5k to 15k RPM
5	15k to 30k RPM

Table 109 READ_FAN_SPEED_1

Command code	Command name	Write Tx	Read Tx	Bytes	Format
90h	READ_FAN_SPEED_1		Read word	2	Exp. configured by FW_CONFIG_TELEMETRY

1.86 91h – READ_FAN_SPEED_2

The READ_FAN_SPEED_2 command returns the speed of FAN2 in RPM. This command has two data bytes in the LINEAR11 data format. The exponent is configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 110 READ_FAN_SPEED_2

Command code	Command name	Write Tx	Read Tx	Bytes	Format
91h	READ_FAN_SPEED_2		Read word	2	Exp. configured by FW_CONFIG_TELEMETRY

1.87 94h – READ_DUTY_CYCLE

The READ_DUTY_CYCLE command returns the duty of the PMBus device's main power converter in percent. This command has two data bytes in the LINEAR11 data format.

Table 111 READ_DUTY_CYCLE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
94h	READ_DUTY_CYCLE		Read word	2	U7.3

1.88 95h – READ_FREQUENCY

The READ_FREQUENCY command returns the switching frequency of the PMBus device's main power converter in kilohertz. This command returns the actual switching frequency and not the commanded switching frequency. This command has two data bytes in the LINEAR11 data format.

Table 112 READ_FREQUENCY

Command code	Command name	Write Tx	Read Tx	Bytes	Format
95h	READ_FREQUENCY		Read word	2	U11.-1

1.89 96h – READ_POUT

The READ_POUT command returns the output power, in watts, of the PMBus device. Format configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 113 READ_POUT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
96h	READ_POUT		Read word	2	U10.0, U11.-1, U12.-2, U9.1, U8.2 Configured by FW_CONFIG_TELEMETRY

1.90 97h – READ_PIN

The READ_PIN command returns the input power, in watts, of the PMBus device. Format configured by 0xC6 FW_CONFIG_TELEMETRY command.

Table 114 READ_PIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
97h	READ_PIN		Read word	2	U10.0, U11.-1, U12.-2, U9.1, U8.2 Configured by FW_CONFIG_TELEMETRY

1.91 98h – PMBUS_REVISION

PMBUS_REVISION command stores or reads the revision of the PMBus with which the device is compliant.

Table 115 PMBUS_REVISION

Bits [7:4]	Part I revision	Bits [3:0]	Part II revision
0000b	1.0	0000b	1.0
0001b	1.1	0001b	1.1
0010b	1.2	0010b	1.2
0011b	1.3	0011b	1.3

Table 116 PMBUS_REVISION

Command code	Command name	Write Tx	Read Tx	Bytes
98h	PMBUS_REVISION		Read byte	1

1.92 99h – MFR_ID

The MFR_ID command is used to either set or read the manufacturer's ID (name, abbreviation or symbol that identifies the unit's manufacturer). Each manufacturer chooses its identifier. MFR_ID is typically only set once, at the time of manufacture.

Table 117 MFR_ID

Command code	Command name	Write Tx	Read Tx	Bytes
99h	MFR_ID	Block write	Block read	12

1.93 9Ah – MFR_MODEL

The MFR_MODEL command is used to either set or read the manufacturer's model number. MFR_MODEL is typically set once, at the time of manufacture.

Table 118 MFR_MODEL

Command code	Command name	Write Tx	Read Tx	Bytes
9Ah	MFR_MODEL	Block write	Block read	20

1.94 9Bh – MFR_REVISION

The MFR_REVISION command is used to either set or read the manufacturer's revision number. Each manufacturer uses the format of its choice for the revision number. MFR_REVISION is typically set at the time of manufacture or if the device is updated to a later revision.

Table 119 MFR_REVISION

Command code	Command name	Write Tx	Read Tx	Bytes
9Bh	MFR_REVISION	Block write	Block read	12

1.95 9Ch – MFR_LOCATION

The MFR_REVISION command is used to either set or read the manufacturing location of the device. Each manufacturer uses the format of its choice for the location information. MFR_REVISION is typically only set once, at the time of manufacture.

Table 120 MFR_LOCATION

Command code	Command name	Write Tx	Read Tx	Bytes
9Ch	MFR_LOCATION	Block write	Block read	12

1.96 9Dh – MFR_DATE

The MFR_DATE command is used to either set or read the date the device was manufactured. While each manufacturer uses the format of its choice for the revision number, the recommended MFR_DATE format is YYMMDD where Y, M and D are integer values from 0 to 9, inclusive. MFR_DATE is typically only set once, at the time of manufacture.

Table 121 MFR_DATE

Command code	Command name	Write Tx	Read Tx	Bytes
9Dh	MFR_DATE	Block write	Block read	12

1.97 9Eh – MFR_SERIAL

The MFR_SERIAL command is used to either set or read the manufacturer's serial number of the device. Each manufacturer uses the format of its choice for the serial number. MFR_SERIAL is typically only set once, at the time of manufacture.

Table 122 MFR_SERIAL

Command code	Command name	Write Tx	Read Tx	Bytes
9Eh	MFR_SERIAL	Block write	Block read	20

1.98 A0h – MFR_VIN_MIN

The MFR_VIN_MIN command sets or retrieves the minimum rated value, in volts, of the input voltage. This command has two data bytes in the LINEAR11 data format.

Table 123 MFR_VIN_MIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A0h	MFR_VIN_MIN	Write word	Read word	2	U7.0

1.99 A1h – MFR_VIN_MAX

The MFR_VIN_MAX command sets or retrieves the maximum rated value, in volts, of the input voltage. This command has two data bytes in the LINEAR11 data format.

Table 124 MFR_VIN_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A1h	MFR_VIN_MAX	Write word	Read word	2	U7.0

1.100 A2h – MFR_IIN_MAX

The MFR_IIN_MAX command sets or retrieves the maximum rated value, in amperes, of the input current. This command has two data bytes in the LINEAR11 data format.

Table 125 MFR_IIN_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A2h	MFR_IIN_MAX	Write word	Read word	2	U7.0

1.101 A3h – MFR_PIN_MAX

The MFR_PIN_MAX command sets or retrieves the maximum rated value, in watts, of the input power. This command has two data bytes in the LINEAR11 data format.

Table 126 MFR_PIN_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A3h	MFR_PIN_MAX	Write word	Read word	2	U10.0, U11.-1, U12.-2

1.102 A4h – MFR_VOUT_MIN

The MFR_VOUT_MIN command sets or retrieves the minimum rated value, in volts, to which the output voltage may be set.

Table 127 MFR_VOUT_MIN

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A4h	MFR_VOUT_MIN	Write word	Read word	2	Vout_mode

1.103 A5h – MFR_VOUT_MAX

The MFR_VOUT_MAX command sets or retrieves the maximum rated value, in volts, to which the output voltage may be set.

Table 128 MFR_VOUT_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A5h	MFR_VOUT_MAX	Write word	Read word	2	Vout_mode

1.104 A6h – MFR_IOUT_MAX

The MFR_IOUT_MAX command sets or retrieves the maximum rated value, in amperes, to which the output may be loaded. This command has two data bytes in the LINEAR11 data format.

Table 129 MFR_IOUT_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A6h	MFR_IOUT_MAX	Write word	Read word	2	U8.0

1.105 A7h – MFR_POUT_MAX

The MFR_POUT_MAX command sets or retrieves the maximum rated output power, in watts, that the unit is rated to supply. This command has two data bytes in the LINEAR11 data format.

Table 130 MFR_POUT_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A7h	MFR_POUT_MAX	Write word	Read word	2	U10.0, U11.-1, U12.-2

1.106 A8h – MFR_TAMBIENT_MAX

The MFR_TAMBIENT_MAX command sets or retrieves the maximum rated ambient temperature, in degrees Celsius, in which the unit may be operated. This command has two data bytes in the LINEAR11 data format.

Table 131 MFR_TAMBIENT_MAX

Command code	Command name	Write Tx	Read Tx	Bytes	Format
A8h	MFR_TAMBIENT_MAX	Write word	Read word	2	U8.0

1.107 ADh – IC_DEVICE_ID

The IC_DEVICE_ID command is used to either set or read the type or part number of an IC embedded within a PMBus that is used for the PMBus interface. Each manufacturer uses the format of its choice for the IC device identification. IC_DEVICE_ID is typically only set once, at the time of manufacture.

Table 132 IC_DEVICE_ID

Command code	Command name	Write Tx	Read Tx	Bytes	Format
ADh	IC_DEVICE_ID		Read word	2	

1.108 AEh – IC_DEVICE_REV

The IC_DEVICE_REV command is used to either set or read the revision of the IC whose type or part number is set or read with the IC_DEVICE_ID command. Each manufacturer uses the format of its choice for the IC device revision. IC_DEVICE_REV is typically only set once, at the time of manufacture.

Table 133 IC_DEVICE_REV

Command code	Command name	Write Tx	Read Tx	Bytes	Format
AEh	IC_DEVICE_REV		Read word	2	

1.109 B0h – USER_DATA_00

Generic user scratchpad. This command is for the user to keep any of their own model tracking/serial information.

Table 134 USER_DATA_00

Command code	Command name	Write Tx	Read Tx	Bytes	Format
AEh	USER_DATA_00	Block write	Block read	16	

2 PMBus commands – non-standard

2.1 C4h FW_CONFIG_PWM

FW_CONFIG_PWM defines the PWMx mask of primary FETs and secondary SR FETs. The PWM mask is handled by FW and is automatically programmed by the device topology tool in the GUI. Take the FB-FB example; the PWMs are mapped per **Figure 3**. PWM1 to 4 are mapped to primary FETs, thus the last two bytes of FW_CONFIG_PWM are 0x000F. PWM5 to 8 are mapped to SR FETs, thus the first two bytes are 0x00F0. It is not recommended to manually change PWM mask with this command, unless non-standard topology is used and the user wants to manually configure the PWM mask.

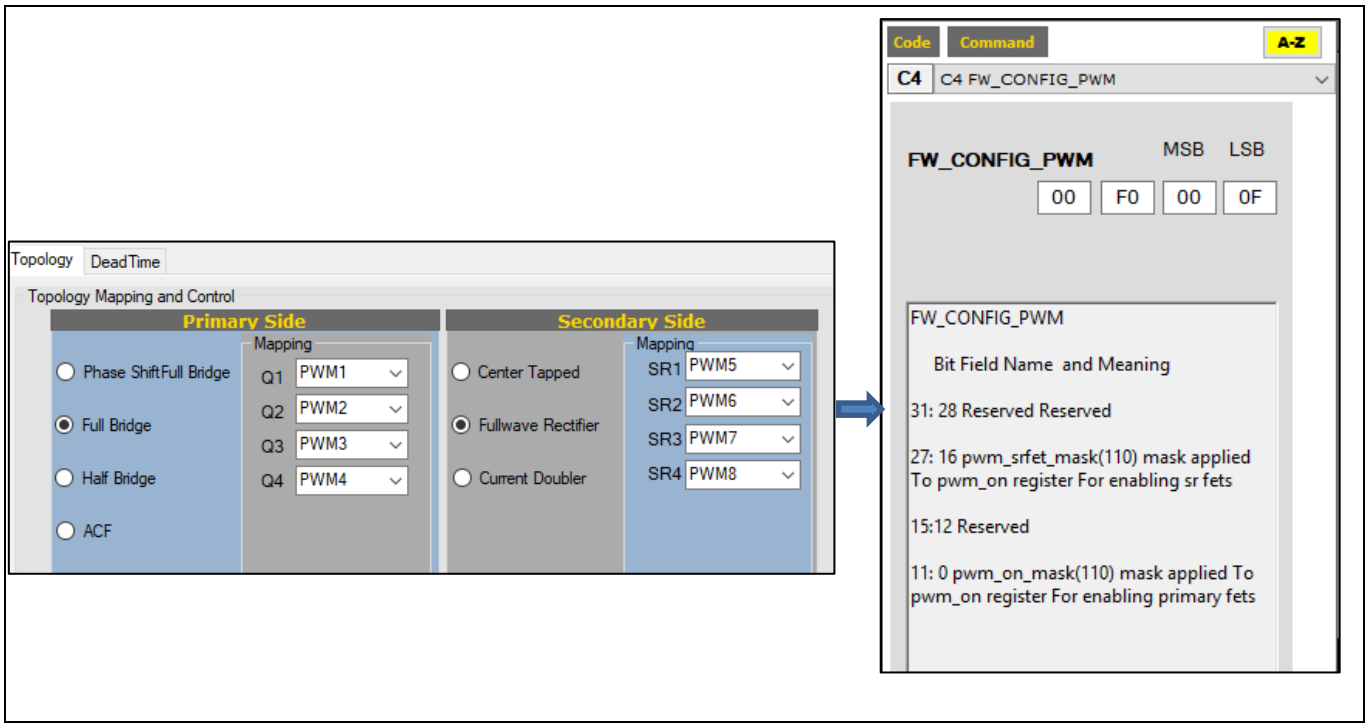


Figure 3 FW_CONFIG_PWM

Table 135 FW_CONFIG_PWM data format

Bit	Field name	Meaning
31:28	Reserved	Reserved
27:16	pwm_srfet_mask[11:0]	Mask applied to pwm_on register for enabling SR FETs
15:12	Reserved	Reserved
11:0	pwm_on_mask[11:0]	Mask applied to pwm_on register for enabling primary FETs

Table 136 FW_CONFIG_PWM

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C4h	FW_CONFIG_PWM	Block write	Block read	4	See **Table 135**

2.2 C5h FW_CONFIG_REGULATION

FW_CONFIG_REGULATION (**Figure 4**) configures multi-segment droop parameters and flexible start-up/shutdown functions. These features can also be configured in “Design Tools” under “System Settings”.

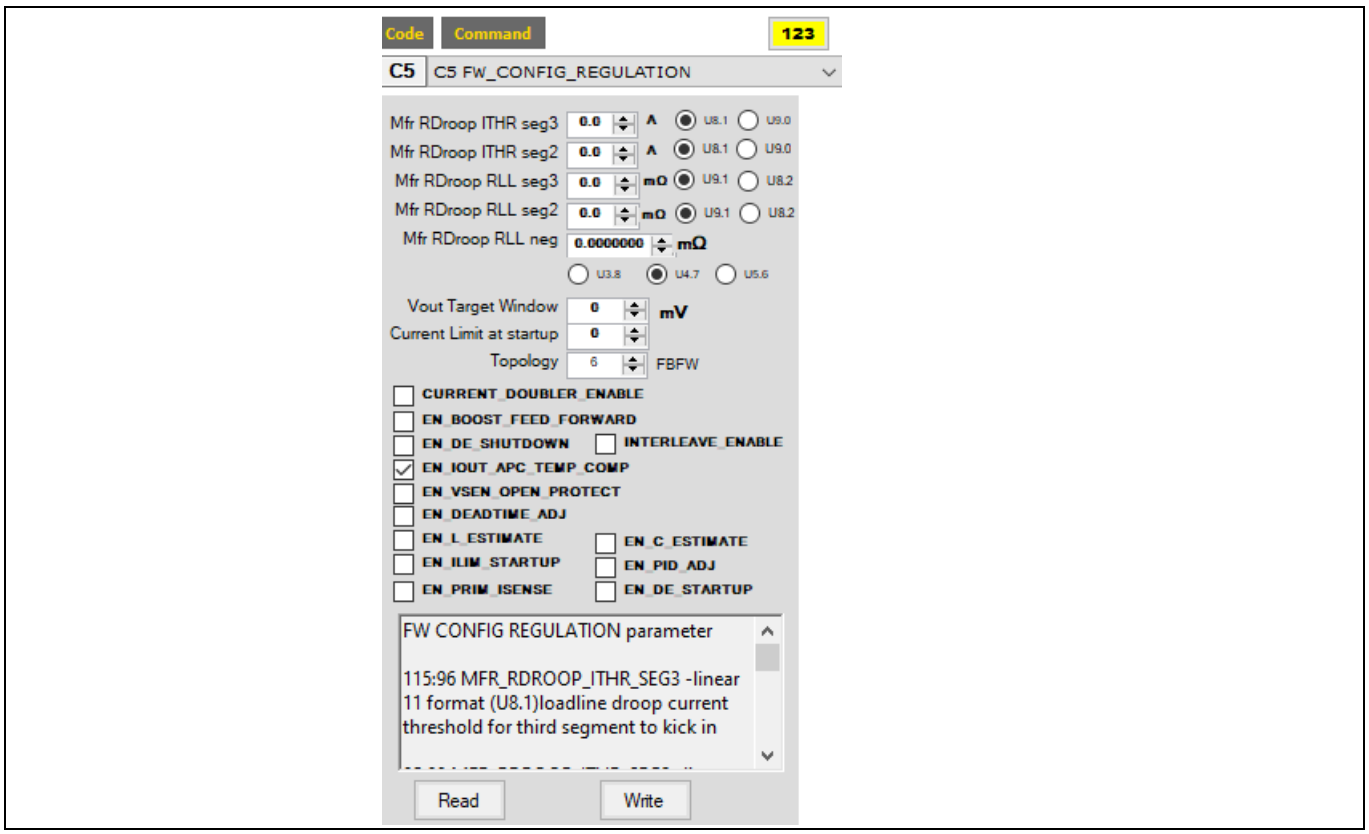


Figure 4 FW_CONFIG_REGULATION

Table 137 FW_CONFIG_REGULATION data format

Bit	Field name	Meaning
111:96	MFR_RDROOP_ITHR_SEG3	LINEAR11 format load-line droop current threshold for third segment to kick in
95:80	MFR_RDROOP_ITHR_SEG2	LINEAR11 format load-line droop current threshold for second segment to kick in
79:64	MFR_RDROOP_RLL_NEG	LINEAR11 format load-line droop for negative segment of three-segment piecewise linear curve
63:48	MFR_RDROOP_RLL_SEG3	LINEAR11 format load-line droop for third segment of three-segment piecewise linear curve
47:32	MFR_RDROOP_RLL_SEG2	LINEAR11 format load-line droop for second segment of three-segment piecewise linear curve
31:24	VOUT_TARGET_WINDOW	-8 exponent 8-bit format window for when interrupt is created for target voltage reached
23:16	CURRENT_LIMIT_AT_STARTUP	Codes per period current limit delta. Current limit will start from 0 and increase to OTP value of current_limit register at the rate of this register. 0 disables feature.

PMBus commands – non-standard

Bit	Field name	Meaning
15:13	TOPOLOGY	ACF = 0, PSCT = 1, HBCT = 2, HBFW = 3, PSFW = 4, FBCT = 5, FBFW = 6, BUCK, BOOST, BUCK-BOOST = 7
12	CURRENT_DOUBLER_ENABLE	Enable current doubling for two inductors in circuit
11	EN_BOOST_FEED_FORWARD	Enables feed-forward calculation from FW for buck-boost topology only
10	EN_DE_SHUTDOWN	Enable diode emulation on shutdown
9	EN_IOUT_APC_TEMP_COMP	Enable temperature compensation on current sense gain
8	INTERLEAVE_ENABLE	Enable multi-phase operation. Interleave mode.
7	EN_DEADTIME_ADJ	Enable PWM dead-time adjustment from max. dead-time to set-point at target voltage (not implemented)
6	EN_VSEN_OPEN_PROTECT	Enable voltage sense pin open protection at start-up (not implemented, the open sense fault is enabled by setting the open sense threshold vspX_osp_thresh to non-zero value)
5	EN_L_ESTIMATE	Enable inductance estimations at start-up (not implemented)
4	EN_LC_ESTIMATE	Enable capacitance and I_{OUT} leakage estimations at start-up (not implemented)
3	EN_ILIM_STARTUP	Enable current-limited start-up
2	EN_PID_ADJ	Enable PID adjustment at start-up (not implemented)
1	EN_PRIM_ISENSE	Enable both I_{SENSE} channels to support simultaneous primary and secondary current sense on a single-loop, single-phase topology
0	EN_DE_STARTUP	Enable diode emulation at start-up

The note “not implemented” indicates that the particular function or feature is not implemented in ROM code. The features are reserved to be implemented in a FW patch.

Table 138 FW_CONFIG_REGULATION

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C5h	FW_CONFIG_REGULATION	Block write	Block read	14	See **Table 137**

2.3 C6h FW_CONFIG_TELEMETRY

FW_CONFIG_TELEMETRY offers telemetry gain and offset correction (**Figure 5**). The definition, LSB and range of each parameter can be found in **Table 139**. The telemetry equation of I_{OUT} is shown below. Other telemetry follows the same concept.

READ_IOUT = (1+ IOUT_GAIN_BASE) * IOUT_GAIN * tlm_iout + IOUT_OFFSET

The GAIN_OFFSET_FAULT_THRESH_EN will update fault threshold per the gain and offset adjustment. It is recommended to enable the feature if any gain or offset in this command is changed to keep the fault protection threshold aligned with telemetry.

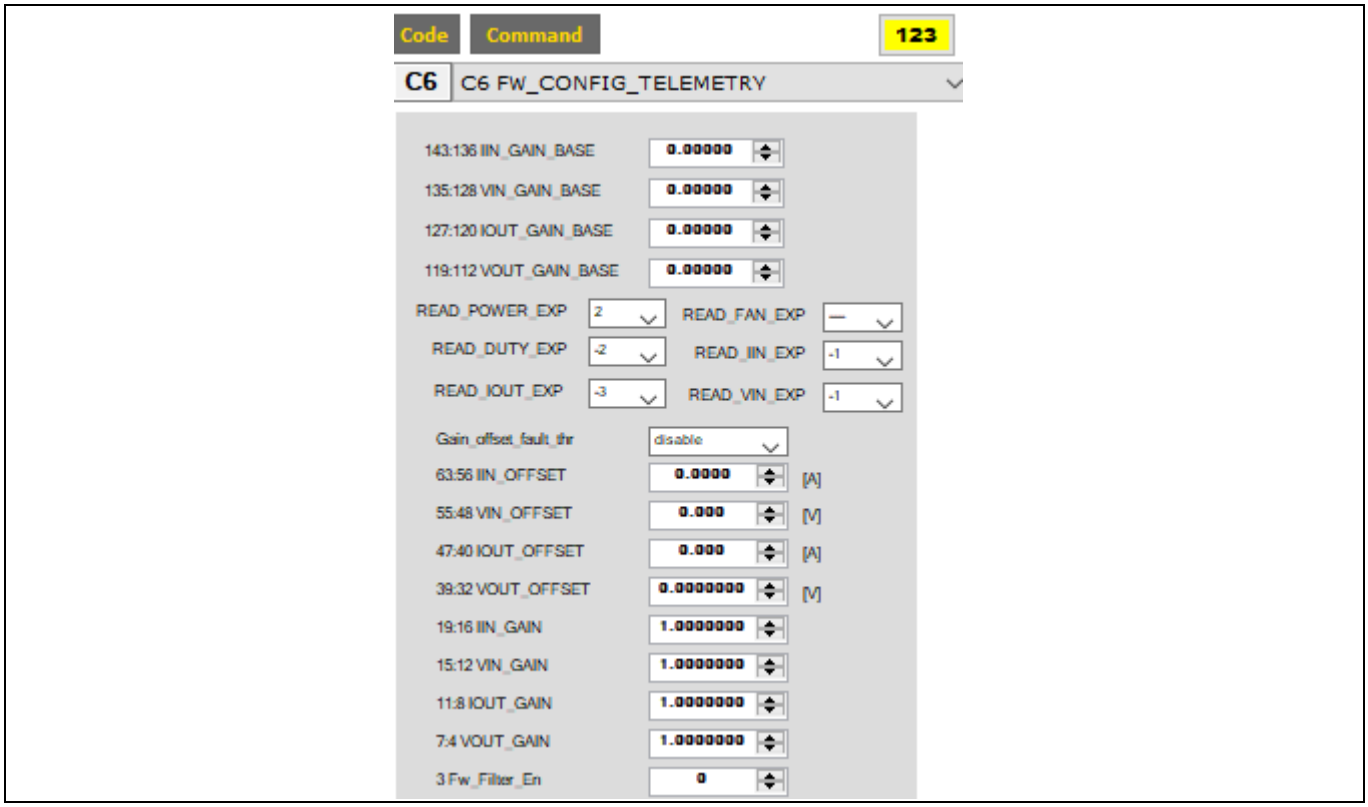


Figure 5 FW_CONFIG_TELEMETRY

Table 139 FW_CONFIG_TELEMETRY data byte format

Bit(s)	Parameter	Meaning	LSB and range
167:160	TEMPI_GAIN_BASE	Gain correction for tempi telemetry (not implemented)	s4.4
159:152	TEMPB_GAIN_BASE	Gain correction for tempb telemetry (not implemented)	s4.4
151:144	TEMPA_GAIN_BASE	Gain correction for tempa telemetry (not implemented)	s4.4
143:136	IIN_GAIN_BASE	Gain correction for I_{IN} telemetry	s4.4, 1/16, 7.9375 to -8.0000
135:128	VIN_GAIN_BASE	Gain correction for V_{IN} telemetry	s4.4, 1/16, 7.9375 to -8.0000
127:120	IOUT_GAIN_BASE	Gain correction for I_{OUT} telemetry	s4.4, 1/16, 7.9375 to -8.0000
119:112	VOUT_GAIN_BASE	Gain correction for V_{OUT} telemetry	s4.4, 1/16, 7.9375 to -8.0000
111:109	Reserved	Reserved	
108	GAIN_OFFSET_FAULT _THRESH_EN	Enables gain offset for fault thresholds	
107:104	READ_FAN_EXP	Exponent for READ_FAN	
103:100	READ_DUTY_EXP	Exponent for READ_DUTY	
99:96	READ_IIN_EXP	Exponent for READ_IIN	
95:92	READ_IOUT_EXP	Exponent for READ_IOUT	
91:88	READ_VIN_EXP	Exponent for READ_VIN	
87:80	TEMPI_OFFSET	Offset correction for tempi telemetry (not implemented)	

79:72	TEMPB_OFFSET	Offset correction for tempb telemetry (not implemented)	
71:64	TEMPA_OFFSET	Offset correction for tempa telemetry (not implemented)	
63:56	IIN_OFFSET	Offset correction for I_{IN} telemetry	0.0625 A, -8 A ~7.9375 A
55:48	VIN_OFFSET	Offset correction for V_{IN} telemetry	0.25 V, -32 V ~ 31.75 V
47:40	IOUT_OFFSET	Offset correction for I_{OUT} telemetry	0.25 A, -32 A ~ 31.75 A
39:32	VOUT_OFFSET	Offset correction for V_{OUT} telemetry	By VOUT_MODE, -0.5 V~0.496 V
31:28	TEMPI_GAIN	Gain correction for tempi telemetry (not implemented)	s-5.9
27:24	TEMPB_GAIN	Gain correction for tempb telemetry (not implemented)	s-5.9
23:20	TEMPA_GAIN	Gain correction for tempa telemetry (not implemented)	s-5.9
19:16	IIN_GAIN	Gain correction for I_{IN} telemetry	1/512, 0.984375 to 1.013671875
15:12	VIN_GAIN	Gain correction for V_{IN} telemetry	1/512, 0.984375 to 1.013671875
11:8	IOUT_GAIN	Gain correction for I_{OUT} telemetry	1/512, 0.984375 to 1.013671875
7:4	VOUT_GAIN	Gain correction for V_{OUT} telemetry	1/512, 0.984375 to 1.013671875
3	Fw_Filter_En	Enables firmware filter for read telemetry from PMBus	0 (disable) or 1 (enable)
2:0	read_power_exp	Exponent for READ_POUT and READ_PIN	0 (1 W, 1024 W), -1 (0.5 W, 512 W), -2 (0.25 W, 256 W)

Table 140 FW_CONFIG_TELEMETRY

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C6h	FW_CONFIG_TELEMETRY	Block write	Block read	21	See **Table 139**

2.4 C8h FW_CONFIG_FAULTS

Table 141 FW_CONFIG_FAULTS data byte format

Bit	Field name	Meaning
199:168	Fault_t2_shut_mask_loop_hw	Masking for loop hardware (HW) faults shutdown on t2
167:136	Fault_enable_mask_loop_common	Masking for loop common faults enable
135:104	Fault_enable_mask_loop_fw	Masking for loop FW faults enable
103:72	Fault_enable_mask_loop_hw	Masking for loop HW faults enable
71:40	Fault_pin_mask_fw	Masking for FW faults
39:8	Fault_pin_mask_hw	Masking for HW faults
7:6	Vout_Delay_Unit	Time unit for retry responses. 0: 1 ms, 1: 4 ms, 2: 16 ms, 3: 256 ms
5:4	Vin_Delay_Unit	Time unit for retry responses. 0: 1 ms, 1: 4 ms, 2: 16 ms, 3: 256 ms
3:2	Iout_Delay_Unit	Time unit for retry responses. 0: 1 ms, 1: 4 ms, 2: 16 ms, 3: 256 ms

1:0	Temperature_Delay_Unit	Time unit for retry responses. 0: 1 ms, 1: 4 ms, 2: 16 ms, 3: 256 ms

The fault pin mask, fault enable mask and fault_t2_shut_mask are defined in **Table 141**.

Use 0xC8 FW_CONFIG_FAULTS to define the delay unit for each fault response (**Figure 6**). Select from 1 ms, 4 ms, 16 ms and 256 ms from the drop-down list.

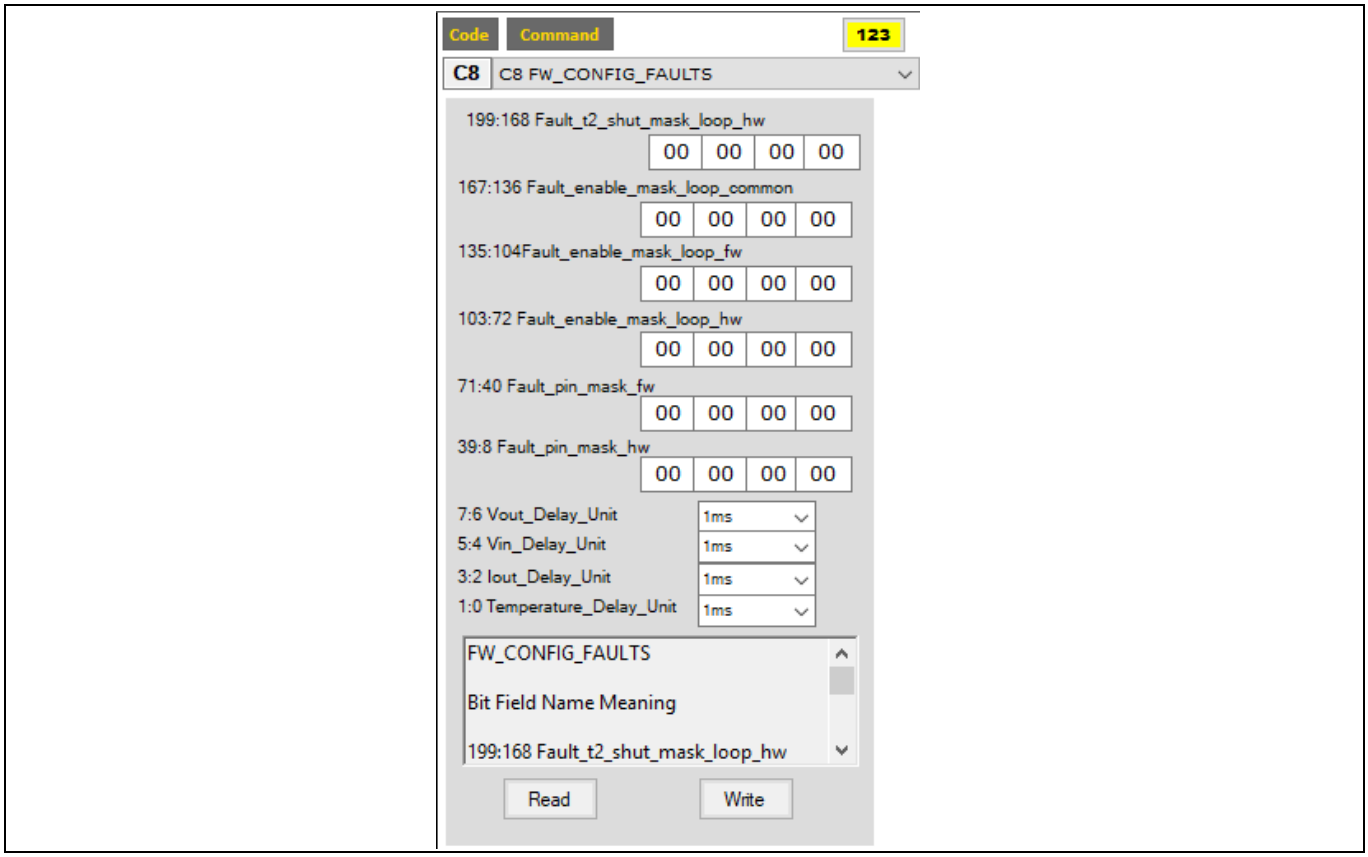


Figure 6 FW_CONFIG_FAULTS

The Fault_pin_mask_hw and Fault_pin_mask_fw are used to disable a particular fault to trigger the fault pin. The list of faults and corresponding bit is shown in **Table 142** (hardware-driven fault) and **Table 143** (firmware-driven fault).

Table 142 HW fault

Bit	Fault	Bit	Fault
0	Reserved	1	VOUT_OV_FAULT
2	VOUT_OV_WARN	3	VOUT_UV_FAULT
4	VOUT_UV_WARN	5	VIN_OV_FAULT
6	VIN_OV_WARN	7	VIN_UV_FAULT
8	VIN_UV_WARN	9	IOUT_OC_FAULT
10	IOUT_OC_LV_FAULT	11	IOUT_OC_WARN
12	IOUT_UC_FAULT	13	MFR_IOUT_OC_FAST
14	IIN_OC_FAULT	15	IIN_OC_WARN

PMBus commands – non-standard

Bit	Fault	Bit	Fault
16	OT_FAULT	17	OT_WARN
18	UT_FAULT	19	UT_WARN
20	POWER_LIMIT_MODE	21	ISHARE_FAULT
22	VOUT_MAX_MIN_WARN	23	SYNC_FAULT
24	FLUX_BAL_FAULT	25 to 31	Unused

Table 143 FW Fault

Bit	Fault	Bit	Fault
0	RESERVED_FW_NO_FAULT	1	FAULT_TYPE_COMMON_SHUTDOWN
2	TON_MAX_FAULT	3	TOFF_MAX_WARN
4	PIN_OP_WARN	5	POUT_OP_WARN
6	VIN_INSUFFICIENT	7 to 31	Spare for user

For example, to disable the fault pin responding to UT_WARN, set bits 19 to 1 by writing 0x 00 08 00 00 to fault_pin_mask_hw. The fault pin will not response upon UT warning, but status still reports the UT_WARN fault when it is triggered. The user could read STATUS_TEMPERATURE and see the UT_WARNING.

Fault_enable_mask_loop_hw and fault_enable_mask_loop_fw are used to disable any fault (both response and PMBus reporting) by setting the corresponding bit to 1.

For example, to disable the POUT_OP_WARN, set bit 5 of fault_enable_mask_loop_fw to 1 by writing 0x 00 00 00 20.

The Fault_t2_shut_mask_loop_hw is used to enable a particular hardware fault to trigger the shutdown event at the next falling edge of the PWM, so that the operation is ceased at the peak of inductor current, ensuring that there is no negative current in the system during shutdown in case of low-load condition. In case the current is completely negative with this feature we will have the best possible way (lowest negative current) to shut down with the least negative current.

The Fault_enable_mask_loop_common disables the individual common fault if the corresponding bit of fault_enable_mask_loop_common is high.

Table 144 Common fault mask bit assignment

Bit	Fault	Bit	Fault
0	Unused	1	Unused
2	IS1 (ISEN) tracking fault	3	IS2 (BISEN) tracking fault
4	Fbal1 fault	5	IS1 (ISEN) PCL fault
6	IS1 (ISEN) SCP fault	7	Fbal2 fault
8	IS2 (BISEN) PCL fault	9	IS2 (BISEN) SCP fault
10	Unused	11	VREF open fault
12	VSEN open fault	13	Unused
14	VRREF open fault	15	VRSEN open fault
16	Unused	17	BVREF_BVRREF open fault
18	BVSEN_BVRSEN open fault	19 to 31	Unused

Table 145 FW_CONFIG_FAULTS

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C8h	FW_CONFIG_FAULTS	Block write	Block read	25	See **Table 141**

2.5 C9h FW_CONFIG_PMBUS

Table 146 explains the meaning of FW_CONFIG_PMBUS.

Table 146 FW_CONFIG_PMBUS data byte format

Bit(s)	Field name	Meaning	Example (loop0)
87:58	feature_select	Reserved	
57:57	require_pec	When set master must always send pec or else cml	
56:54	fault_select	GPIO bit to map to fault	Default 2: map GPIO0_2 to Fault1
53:51	power_good_select	GPIO bit to map to power good	Default 1: map GPIO0_1 to PWRGD
50:48	enable_select	GPIO bit to map to enable	Default 0: map GPIO0_0 to EN
47:40	gpio_direction	Direction of given pin	Define input or output (not used)
39:32	gpio_polarity	Polarity of PMBus GPIO driver	Define active low or high, set to 1 for active high
31:24	pmbus_addr	Base address for PMBus offset to start from	Default: 64 (x40)
23:17	pmbus_addr_offset	PMBus address offset when resistor offset not enabled	
16	pmbus_addr_offset_en	Enable PMBus address offset via resistor	
15:8	i2c_addr	Base address for I^2C offset to start from	Default: 16 (x10)
7:1	i2c_addr_offset	I^2C address offset when resistor offset not enabled	
0	i2c_addr_offset_en	Enable I^2C address offset via resistor	

If this PMBus command is not configured, the following mapping will be assigned as default:

fault_select = 2, power_good_select = 1, enable_select = 0 for GPIO0 and GPIO1 of the respective loop0 and loop1

To enable XADDR1 resistor offset, bit 0 and bit 16 of FW_CONFIG_PMBUS should be set to 1, and the configuration must be stored in OTP. This is because XDPP1100 only checks XADDR resistor offset at IC power-up. The base address of PMBus and I^2C should be set to different values to avoid conflict. Once the configuration is stored in OTP, recycle 3.3 V V_{DD} and use the auto-populate function of the GUI to find the device. The GUI could scan the I^2C and PMBus address and identify the address offset defined by the FW_CONFIG_PMBUS.

PMBus commands – non-standard

Table 147 FW_CONFIG_PMBUS

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C9h	FW_CONFIG_PMBUS	Block write	Block read	11	See **Table 146**

2.6 CAh MFR_IOUT_OC_FAST_FAULT_RESPONSE

The MFR_IOUT_OC_FAST_FAULT_RESPONSE command instructs the device to take a defined action in response to a fast output overcurrent fault (exceeding 0xD1 MFR_IOUT_OC_FAST_FAULT_LIMIT). Similar to the regular overcurrent protection, this protection is also based on output average current, but with no filter to the signal, so it could act faster. The format of this command is the same as IOUT_OC_FAULT_RESPONSE.

Table 148 MFR_IOUT_OC_FAST_FAULT_RESPONSE data format

Bit	Meaning
7:6	Response: 00: Continues to operate while maintaining the output current (CC) 11: Shut down and retry
5:3	Retry setting: 000: No retry 001 to 110: Retry 1 to 6 times based on retry number 111: Retry continuously
2:0	Delay time in ms. Delay time, ms = (2^delay time) * Vout_Delay_Unit (configured by FW_CONFIG_FAULTS)

Table 149 MFR_IOUT_OC_FAST_FAULT_RESPONSE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CAh	MFR_IOUT_OC_FAST_FAULT_RESPONSE	Write byte	Read byte	1	See **Table 148**

2.7 CBh FW_CONFIG_DE_THRESH

This command sets the output current threshold in S9.2 amps format, below which diode emulation will be engaged and SR_FETs disabled. A value of 0 disables functionality and will not disable SR_FETS in regulation. This DE feature is not implemented in the ROM code and can be done in the FW patch. This command is also used to configure the burst mode entry threshold pid_burst_mode_ith.

Table 150 FW_CONFIG_DE_THRESH

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CBh	FW_CONFIG_DE_THRESH	Write word	Read word	2	S9.2

2.8 CDh MFR_VRECT_SCALE

Scales the V_{RECT} input voltage computation for the external resistor divider between V_{RECT} and VRSEN. The format is LINEAR11 with recommended exponents -10, -11 and -12.

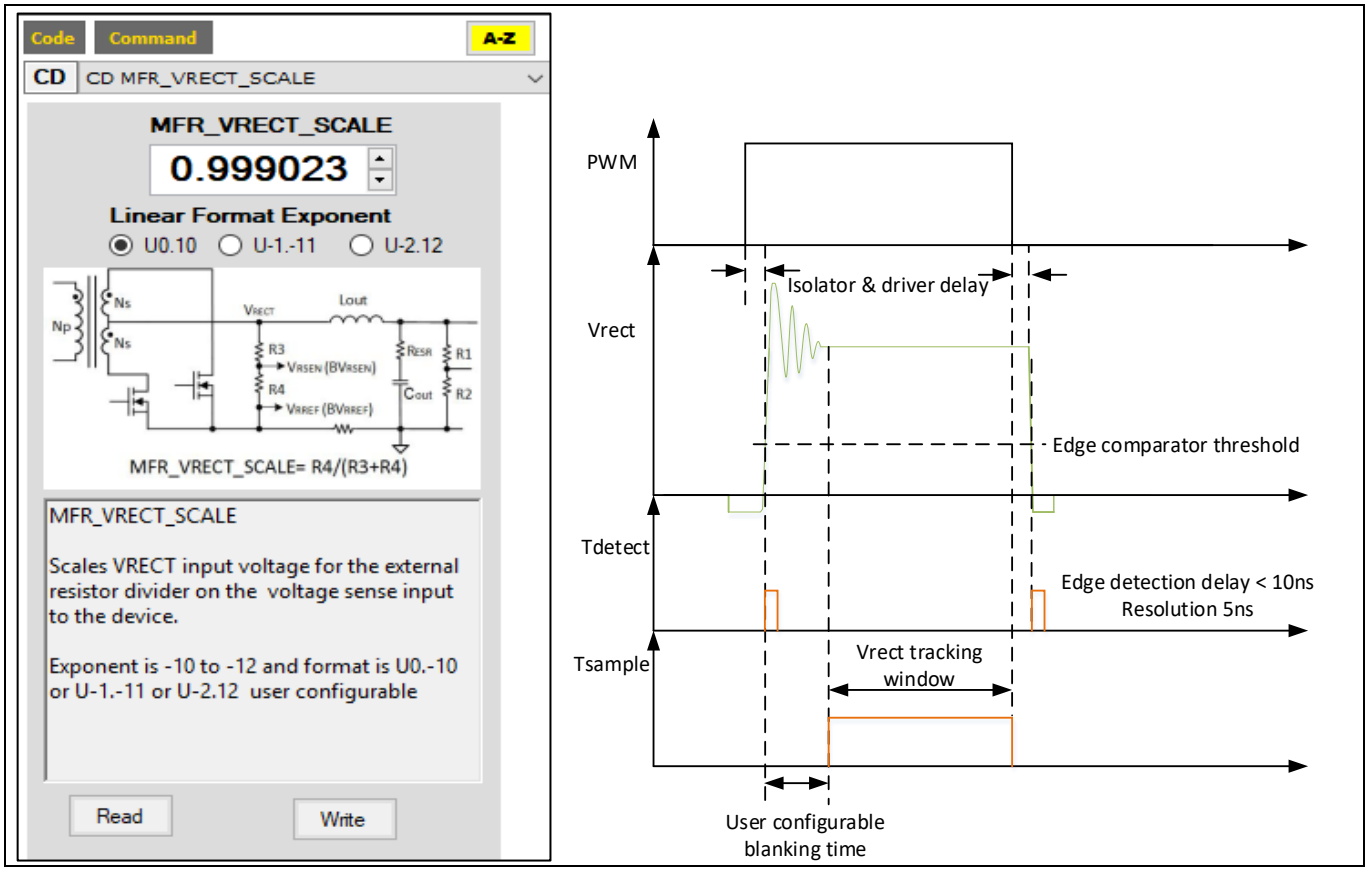


Figure 7 MFR_VRECT_SCALE

For a secondary controller in an isolated converter, one way to sense input voltage is to sense the transformer secondary rectified voltage (V_{RECT}), and then calculate primary voltage based on transformer turns ratio. The V_{RECT} signal should be scaled down by the resistor divider and fed to the VRSEN or BVRSEN input (**Figure 7**).

Table 151 MFR_VRECT_SCALE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CDh	MFR_VRECT_SCALE	Write word	Read word	2	U0.10, U-1.11, U-2.12

2.9 CEh MFR_TRANSFORMER_SCALE

Defines the transformer turns ratio, $N_{turn\_sec}/N_{turn\_prim}$. The format is LINEAR11 with recommended exponents -10, -11 and -12.

Table 152 MFR_TRANSFORMER_SCALE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CEh	MFR_TRANSFORMER_SCALE	Write word	Read word	2	U0.10, U-1.11, U-2.12

2.10 CFh PWM_DEADTIME

The PWM dead-time can be set by PMBus command 0xCF PWM_DEADTIME (**Figure 8**). The dead-time of PWM rise and fall time can be set separately. As it defines the dead-time of all 12 PWMx, the PWM_DEADTIME is a

common command and applies to both loops. In the XDPP1100 GUI, the active primary and secondary PWMs will be highlighted in green and blue respectively, as shown in **Figure 8**. Writing inactive PWM is not allowed in the GUI to prevent accidentally setting the dead-time of the other loop.

The maximum dead-time can be set to 318.75 ns with a resolution of 1.25 ns.

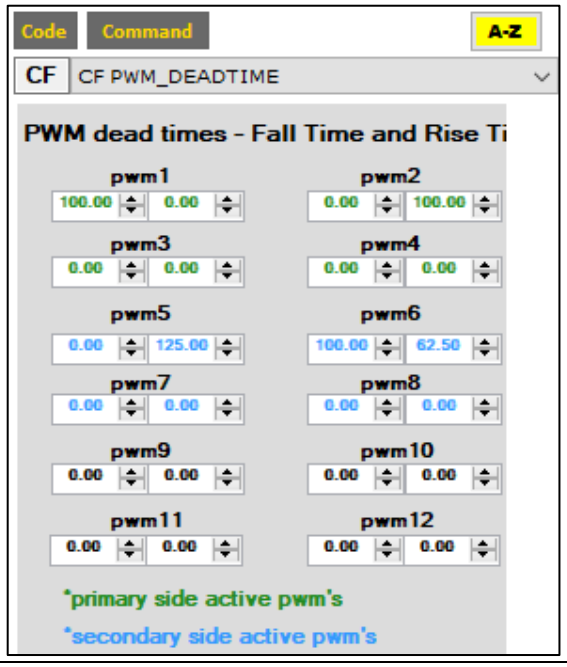


Figure 8 PWM_DEADTIME

Table 153 PWM_DEADTIME data byte format

Bit(s)	Field name	Meaning
191:184	PWM12_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
183:176	PWM12_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
175:168	PWM11_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
167:160	PWM11_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
159:152	PWM10_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
151:144	PWM10_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
143:136	PWM9_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
135:128	PWM9_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
127:120	PWM8_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
119:112	PWM8_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
111:104	PWM7_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
103:96	PWM7_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
95:88	PWM6_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
87:80	PWM6_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
79:72	PWM5_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
71:64	PWM5_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
63:56	PWM4_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
55:48	PWM4_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns

PMBus commands – non-standard

Bit(s)	Field name	Meaning
47:40	PWM3_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
39:32	PWM3_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
31:24	PWM2_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
23:16	PWM2_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
15:8	PWM1_dr	Rising edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns
7:0	PWM1_df	Falling edge dead-time u6.2 LSB = 1.25 ns, 0 to 318.75 ns

Table 154 PWM_DEADTIME

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CFh	PWM_DEADTIME	Block write	Block read	24	See **Table 153**

2.11 D1h MFR_IOUT_OC_FAST_FAULT_LIMIT

This command defines the threshold of fast overcurrent protection. The fast overcurrent fault response is configured by PMBus command 0xCA MFR_IOUT_OC_FAST_FAULT_RESPONSE. This command has two data bytes in the LINEAR11 data format.

Table 155 MFR_IOUT_OC_FAST_FAULT_LIMIT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D1h	MFR_IOUT_OC_FAST_FAULT_LIMIT	Write word	Read word	2	U8.0

2.12 D6h PWM_DEADTIME_ADJUSTMENT

This command defines another set of dead-time which allows the control loop to choose based on load current. The current threshold is programmed by 0xE4 FW_CONFIG_DEADTIME_ADJUSTMENT. This feature is not implemented and is reserved for FW patch.

Table 156 PWM_DEADTIME_ADJUSTMENT

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D6h	PWM_DEADTIME_ADJUSTMENT	Block write	Block read	24	See **Table 153**

2.13 DCh MFR_SELECT_TEMPERATURE_SENSOR

Use MFR_SELECT_TEMPERATURE_SENSOR to configure the temperature sensor. XDPP1100 can handle up to two external temperature sensors – tempa and tempb – for loop0 and loop1 respectively. It also has an internal temperature sensor, tempi.

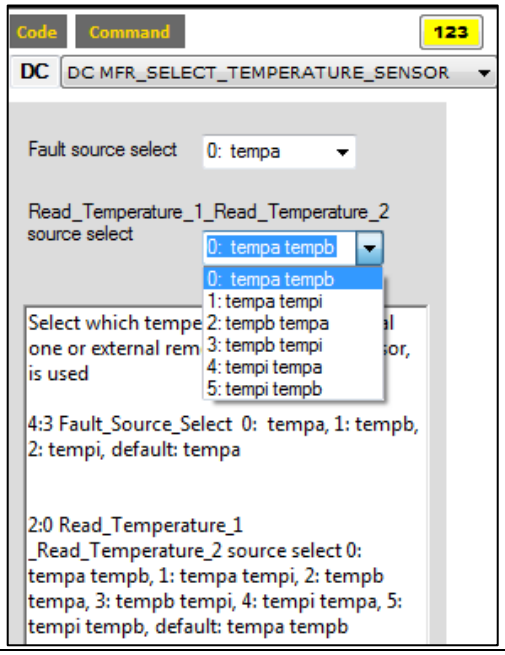


Figure 9 MFR_SELECT_TEMPERATURE_SENSOR

Fault_Source_Select chooses the temperature fault from the following sources: temperature sensor a (tempa), temperature sensor b (tempb), and internal temperature sensor (tempi). Register fault_temp_src_sel will be set based on the configuration of bit [5:3].

Table 157 MFR_SELECT_TEMPERATURE_SENSOR data byte format

Bit(s)	Field name	Meaning
5:3	Fault_Source_Select	0: tempa NTC, 1: tempb NTC 2: tempi, 3: tempa PTC 4: tempb PTC Default: tempa NTC
2:0	Read_Temperature_1_Read_Temperature_2_source_select	0: tempa tempb, 1: tempa tempi 2: tempb tempa, 3: tempb tempi 4: tempi tempa, 5: tempi tempb Default: tempa tempb

Table 158 MFR_SELECT_TEMPERATURE_SENSOR

Command code	Command name	Write Tx	Read Tx	Bytes	Format
DCh	MFR_SELECT_TEMPERATURE_SENSOR	Write byte	Read byte	1	See **Table 157**

2.14 E4h FW_CONFIG_DEADTIME_ADJUSMENT_THRESHOLD

Current threshold in S9.2 amps format at above which we use PWM_DEADTIME_ADJUSTMENT instead of PWM_DEADTIME. This feature is not implemented and is reserved for FW patch.

Table 159 FW_CONFIG_DEADTIME_ADJUSMENT_THRESHOLD

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CBh	FW_CONFIG_DEADTIME_ADJUSMENT_THRESHOLD	Write word	Read word	2	S9.2

2.15 EAh MFR_IOUT_APC

Current sense amps per code. Linear11 format amps/code unit. The calculation of MFR_IOUT_APC is shown below:

$$MFR\_IOUT\_APC = ISEN\_LSB/R_{SNS}$$

The ISEN_LSB is the resolution of I_{ADC} which is determined by the isenX_gain_mode register. XDPP1100 offers two levels of gain: 100 µV, and 1.45 mV, which reference to ground (GND); and one IPS mode, whose resolution is 1.45 mV and reference to a DC bias range from 1.11 V to 1.6 V.

Table 160 MFR_IOUT_APC

Command code	Command name	Write Tx	Read Tx	Bytes	Format
EAh	MFR_IOUT_APC	Write word	Read word	2	U1.9, U2.8

2.16 EBh MFR_MIN_PW

MFR_MIN_ PW defines the minimum primary PWM pulse width, which sets register ramp_pw_min (U8.0). LSB is 5 ns. The maximum register value is 255, i.e., the minimum pulse width could be set up to 1275 ns.
Note: Loop 0 MFR_MIN_PW is associated with PWM ramp 0 and Loop 1 MFR_MIN_PW is associated with PWM ramp 1 even in the case that both PWM ramps are used on Loop 0.

Table 161 MFR_MIN_PW

Command code	Command name	Write Tx	Read Tx	Bytes	Format
EBh	MFR_MIN_PW	Write byte	Read byte	1	

2.17 F0h MFR_DEBUG_BUFF

Table 162 MFR_DEBUG_BUFF data byte format

Bit(s)	Field name	Meaning
31:16	Timestamp	A timestamp for the log
15:8	Length	The number of 32-bit words of the log's payload
7:4	Severity	

Table 163 MFR_DEBUG_BUFF

Command code	Command name	Write Tx	Read Tx	Bytes
F0h	MFR_DEBUG_BUFF		Block read	8

2.18 F1h MFR_SETUP_PASSWORD

Table 164 MFR_SETUP_PASSWORD

Command code	Command name	Write Tx	Read Tx	Bytes
F1h	MFR_SETUP_PASSWORD	Block write	Block read	6

A write is a new password (6 bytes); if this command was protected it will ignore write use MFR_SECURITY_BIT_MASK_HIGH to protect this after setup. Length can vary by user selection in the spreadsheet, but hash will be 4 bytes.

The XDPP1100 GUI provides a PMBus protection feature which restricts write action over selected PMBus commands. The user can set up a password with MFR_SETUP_PASSWORD command to protect selected PMBus commands that are defined by 0xF4 and 0xF5 security mask.

2.19 F2h MFR_DISABLE_SECURITY_ONCE

This is the PMBus command for password entry. It has a limit of four attempts before being locked. A read returns 0x000000000000 if security is off; 0x000000000001 if security is on; 0x000000000002 if security setup is locked due to incorrect password entry.

Read MFR_DISABLE_SECURITY_ONCE, if returns 0x000000000000, the user could go to MFR_SETUP_PASSWORD to set up a new password. If it returns 0x000000000001, the user has to write the correct password here to turn off the security. Read MFR_DISABLE_SECURITY_ONCE after writing the correct password, and it should return 0x000000000000 indicating that the security is turned off.

Table 165 MFR_DISABLE_SECURITY_ONCE

Command code	Command name	Write Tx	Read Tx	Bytes
F2h	MFR_DISABLE_SECURITY_ONCE	Block write	Block read	6

Once the security is turned on, use commands 0xF4 MFR_SECURITY_BIT_MASK_LOW and 0xF5 MFR_SECURITY_BIT_MASK_HIGH to set the security mask of 255 PMBus commands.

2.20 F4h MFR_SECURITY_BIT_MASK_LOW

0xF4 MFR_SECURITY_BIT_MASK_LOW mask bits for command numbers 0 to 127, 0xF5 MFR_SECURITY_BIT_MASK_HIGH mask bits for command numbers 128 to 255. A 1 in the bit position indicates that the respective PMBus is protected, 0 indicates it's unprotected. The command under protection will not allow the user to execute write action.

Table 166 MFR_SECURITY_BIT_MASK_LOW

Command code	Command name	Write Tx	Read Tx	Bytes
F4h	MFR_SECURITY_BIT_MASK_LOW	Block write	Block read	16

2.21 F5h MFR_SECURITY_BIT_MASK_HIGH

0xF4 MFR_SECURITY_BIT_MASK_LOW mask bits for command numbers 0 to 127, 0xF5 MFR_SECURITY_BIT_MASK_HIGH mask bits for command numbers 128 to 255. A 1 in the bit position indicates that the respective PMBus is protected, 0 indicates it's unprotected. The command under protection will not allow the user to execute write action.

Table 167 MFR_SECURITY_BIT_MASK_HIGH

Command code	Command name	Write Tx	Read Tx	Bytes
F5h	MFR_SECURITY_BIT_MASK_HIGH	Block write	Block read	16

2.22 FDh MFR_FIRMWARE_COMMAND_DATA

The MFR_FIRMWARE_COMMAND_DATA works together with command 0xFE MFR_FIRMWARE_COMMAND. In Table 168 the value corresponds to each configuration of MFR_FIRMWARE_COMMAND, and input data defines the value that needs to be configured prior to writing the MFR_FIRMWARE_COMMAND; output data is the result or output status after writing MFR_FIRMWARE_COMMAND.

Table 168 MFR_FIRMWARE_COMMAND_DATA

Value	Name	Input data	Output data
0x0	NOP	N/A	N/A
0x1	GET_REV_ID	module_name	ID
0x2	TESTMODE_ENTER	N/A	N/A
0x3	STORE_TRIM	N/A	N/A
0x4	STORE_CONFIG	xvalent	N/A
0x5	CONFIGURATOR_STATUS_GET	N/A	Status
0x6	STORE_FW_PATCH	patch_config	Status
0x7	RESTORE_TRIM	N/A	N/A
0x8	RESTORE_CONFIG	N/A	N/A
0x9	RESTORE_USER	N/A	N/A
0xa	RESTORE_FW_PATCH	N/A	N/A
0xb	UNINITIALIZE_DRIVER	module_name	N/A
0xc	INITIALIZE_DRIVER	module_name	N/A
0xd	FORCE_FIRMWARE_FAULTS	fault_mask	N/A
0xe	SYSTEM_RESET	N/A	N/A
0xf	DISABLE_I2C_BUS	0: enable, 1: disable	N/A
0x10	CONFIGURATOR_REMAINING_SIZE	[24-31]: OTP partition, see Otp_Partition_Selector-t for details, should be a number between 0 and 15	Size in bytes
0x11	OTP_FS_COMMAND_STORE	Bits 0 to 10: number of bytes in buffer to store in OTP, max. of 1024 Bits 11 to 23: reserved Bits 24 to 31: OTP partition, number between 0 and 15	Status
0x12	OTP_FS_INVALIDATE	Bits 0 to 15: file system image type	Status

PMBus commands – non-standard

Value	Name	Input data	Output data
		Bits 16 to 23: reserved Bits 24 to 31: OTP partition number, between 0 and 15	
0x13	TRIM_PROTECT	0: disable protect, !=0: enable protect	N/A
0x14	STORE_PARTIAL_CONFIG	7:0 xvalent 23:8 size 31:24 reserved	N/A
0x15	RESTORE_PARTIAL_CONFIG	N/A	N/A
0x16	EXECUTE_PATCH_FROM_RAM	Partition	N/A
0x17	READ_COMMON_FAULTS_STATUS	N/A	Status
0x18	GET_LOOP_OTP_SIZE		Size in bytes
0x19	READ_OPEN_SENSE_COMMON_FAULTS_STATUS	N/A	Status

Common fault bit assignment see **Table 144**.

OPEN_SENSE_COMMON_FAULTS bit assignment see **Table 169**.

Table 169 OSP common fault bit assignment

Bit	Fault	Bit	Fault
0	VSEN	1	VREF
2	VRSEN	3	VRREF
4	BVSEN_BVRSEN	5	BVREF_BVRREF

Table 170 MFR_FIRMWARE_COMMAND_DATA

Command code	Command name	Write Tx	Read Tx	Bytes
FDh	MFR_FIRMWARE_COMMAND_DATA	Block write	Block read	4

2.23 FEh MFR_FIRMWARE_COMMAND

Table 171 MFR_FIRMWARE_COMMAND data byte format

Value	Meaning
0x0	NOP
0x1	GET_REV_ID
0x2	TESTMODE_ENTER
0x3	STORE_TRIM
0x4	STORE_CONFIG
0x5	CONFIGURATOR_STATUS_GET
0x6	STORE_FW_PATCH

PMBus commands – non-standard

Value	Meaning
0x7	RESTORE_TRIM
0x8	RESTORE_CONFIG
0x9	RESTORE_USER
0xa	RESTORE_FW_PATCH
0xb	UNINITIALIZE_DRIVER
0xc	INITIALIZE_DRIVER
0xd	FORCE_FIRMWARE_FAULTS
0xe	SYSTEM_RESET
0xf	DISABLE_I2C_BUS
0x10	CONFIGURATOR_REMAINING_SIZE
0x11	OTP_FS_COMMAND_STORE
0x12	OTP_FS_INVALIDATE
0x13	TRIM_PROTECT
0x14	STORE_PARTIAL_CONFIG
0x15	RESTORE_PARTIAL_CONFIG
0x16	EXECUTE_PATCH_FROM_RAM
0x17	READ_COMMON_FAULTS_STATUS
0x18	GET_LOOP_OTP_SIZE
0x19	READ_OPEN_SENSE_COMMON_FAULTS_STATUS

Table 172 MFR_FIRMWARE_COMMAND

Command code	Command name	Write Tx	Read Tx	Bytes
F5h	MFR_FIRMWARE_COMMAND	Write byte		1

3 Patched commands

The following PMBus commands are patch commands. The user can enable the patched commands by implementing the FW patch (example code available), or redefining the MFR commands for different usage.

3.1 3Ah – FAN_CONFIG_1_2

The FAN_CONFIG_1_2 is used to configure up to two fans associated with one PMBus device.

Table 173 FAN_CONFIG_1_2 data byte format

Bit(s)	Value	Meaning
7	1	A fan is installed in position 1
	0	No fan is installed in position 1
6	1	Fan 1 is commanded in RPM
	0	Fan 1 is commanded in duty cycle
5:4	00b to 11b	Fan 1 tachometer pulses per revolution
3	1	A fan is installed in position 2
	0	No fan is installed in position 2
2	1	Fan 2 is commanded in RPM
	0	Fan 2 is commanded in duty cycle
1:0	00b to 11b	Fan 2 tachometer pulses per revolution

Bit 6 and bit 2, the XDPP1100 only supports duty-cycle mode.

Bit 5:4 and 1:0 of the command tells the PMBus device the number of tachometer pulses per revolution. This information is needed for commanding and reporting fan speed in RPM. Two bits are provided for each fan. These settings do not have to be the same for Fan 1 and Fan 2. The binary values of these bits map to pulses per revolution as follows:

- 00b = one pulse per revolution
- 01b = two pulses per revolution
- 10b = three pulses per revolution
- 11b = four pulses per revolution.

Table 174 FAN_CONFIG_1_2

Command code	Command name	Write Tx	Read Tx	Bytes	Format
3Ah	FAN_CONFIG_1_2	Write byte	Read byte	1	See **Table 173**

3.2 3Bh – FAN_COMMAND_1

The FAN_COMMAND_1 and FAN_COMMAND_2 commands are used to adjust the operation of up to two fans contained in the PMBus device or in the host system. For fans contained in the PMBus device, the host system may override the commanded values if necessary to maintain proper system temperatures. This command has two data bytes in the LINEAR11 data format.

Table 175 FAN_COMMAND_1

Command code	Command name	Write Tx	Read Tx	Bytes	Format
3Bh	FAN_COMMAND_1	Write word	Read word	2	

3.3 3Ch – FAN_COMMAND_2

The FAN_COMMAND_1, and FAN_COMMAND_2 commands are used to adjust the operation of up to two fans contained in the PMBus device or in the host system. For fans contained in the PMBus device, the host system may override the commanded values if necessary to maintain proper system temperatures. This command has two data bytes in the LINEAR11 data format.

Table 176 FAN_COMMAND_2

Command code	Command name	Write Tx	Read Tx	Bytes	Format
3Ch	FAN_COMMAND_2	Write word	Read word	2	

3.4 81h – STATUS_FANS_1_2

The STATUS_FANS_1_2 command reports on the status of any fans installed in position 1 or position 2. This command returns one data byte with contents as follows:

Table 177 STATUS_FANS_1_2 data format

Bit	Meaning
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	Reserved
2	Reserved
1	Reserved
0	Reserved

3.5 C7h – MFR_FREQUENCY_DITHER

Table 178 MFR_FREQUENCY_DITHER data byte format

Bit(s)	Field name	Meaning
7:4	step_rate	The number of 16 f_{sw} units to wait between steps
3:0	percentage	Percentage of frequency to modulate between +/-0 and 15 percent

When MFR_FREQUENCY_DITHER is set to a non-zero value, frequency dithering is enabled. The switching frequency will sweep within the percentage defined by bit [3:0], with 20 ns resolution per step; the duration of each step is defined by bit 7:4, (step_rate +1) *16*tsw.

Table 179 MFR_FREQUENCY_DITHER

Command code	Command name	Write Tx	Read Tx	Bytes	Format
C7h	MFR_FREQUENCY_DITHER	Write byte	Read byte	1	See **Table 178**

3.6 CCh – MFR_BOARD_TRIM

Table 180 MFR_BOARD_TRIM data byte format

Bit(s)	Field name	Meaning
15:11	mfr_lo_clk_trim_fine	U5.0
10:7	mfr_lo_clk_trim_coarse	S4.0, -12 to +10.5 MHz
6:1	mfr_vout_offset_trim	-40 to +38.75 mV LSB 1.25 mV, s6.0
0	trim_enable	Enable post-solder trimming

Table 181 MFR_BOARD_TRIM

Command code	Command name	Write Tx	Read Tx	Bytes	Format
CCh	MFR_BOARD_TRIM	Write word	Read word	2	See **Table 180**

3.7 D0h – MFR_SNAPSHOT_DATA

Table 182 MFR_SNAPSHOT_DATA

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D0h	MFR_SNAPSHOT_DATA	Block write	Block read	31	

3.8 D2h – MFR_VDD_SCALE

Table 183 MFR_VDD_SCALE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D2h	MFR_VDD_SCALE	Write word	Read word	2	

3.9 D3h – MFR_VIN_SCALE

Table 184 MFR_VIN_SCALE

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D3h	MFR_VIN_SCALE	Write word	Read word	2	

3.10 D4h – MFR_FW_CONFIG_UART

Table 185 MFR_FW_CONFIG_UART

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D4h	MFR_FW_CONFIG_UART	Block write	Block read	8	

3.11 D5h – MFR_SS_RAMP_FSW

Table 186 MFR_SS_RAMP_FSW data byte format

Bit(s)	Field name	Meaning
7:1	reserved	Reserved
0	enable_pcmc_fsw_ramp	When 1 enables peak current mode control (PCMC) f_{SW} ramp on start-up

Table 187 MFR_SS_RAMP_FSW

Command code	Command name	Write Tx	Read Tx	Bytes	Format
D5h	MFR_SS_RAMP_FSW	Write byte	Read byte	1	See **Table 186**

3.12 DAh – MFR_ISHARE_THRESHOLD

Current sharing dead-zone in LINEAR11 format, amps units.

Table 188 MFR_ISHARE_THRESHOLD

Command code	Command name	Write Tx	Read Tx	Bytes	Format
DAh	MFR_ISHARE_THRESHOLD	Write word	Read word	2	

3.13 FCh – MFR_ADDED_DROOP_DURING_RAMP

This command set added droop resistance for start-up ramp. LINEAR11 format.

Table 189 MFR_ADDED_DROOP_DURING_RAMP

Command code	Command name	Write Tx	Read Tx	Bytes	Format
FCh	MFR_ADDED_DROOP_DURING_RAMP	Write word	Read word	2	U3.7, U4.6

Revision history

Document version	Date of release	Description of changes
V 1.0	2021-06-18	First release
V 1.1	2022-01-07	Updated 1.43 IOUT_UC_FAULT_RESPONSE description. When bit [7:6] is set to 10, the response is “disable and retry”. Disable both primary and SR, not only disable SR.

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