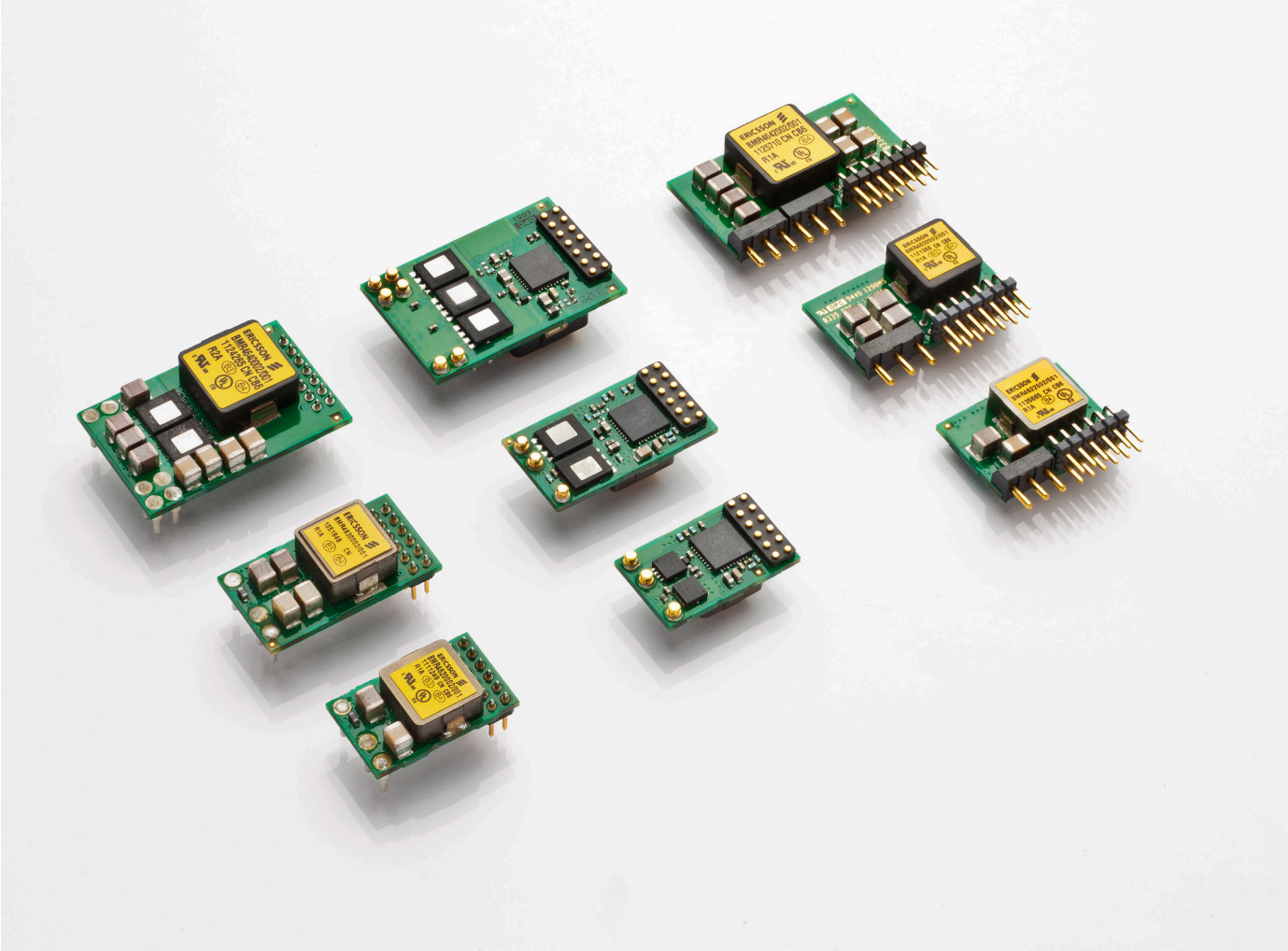
ERICSSON



PMBUS COMMAND SET - 3E POINT OF LOAD REGULATORS

APPLICATION NOTE 302

Ericsson Power Modules

Abstract

This document, to be used in conjunction with the PMBus specifications and the Technical Specifications for each product, provides a detailed description of each PMBus command available in the 3E POL regulators. For each available command, the applicable products are identified, a brief description of the command's function is given, and the details of the command data needed to program the device are provided.

Introduction

Ericsson's 3E Point-Of-Load (POL) regulators are designed with state-of-the-art digital controllers. This provides the user with superior electrical performance and a broad capability to configure, control and monitor the products in the engineering lab, in the factory, and in the field. This capability is provided by the use of the open-standard PMBus™ digital power management protocol.

The PMBus protocol was created by the System Management Interface Forum (SMIF) and Power Management Bus (PMBus) Implementers Forum to standardize communication with a wide range of power conversion devices. The resulting PMBus standard is written in two parts. The first, "Specification Part I – General Requirements Transport and Electrical Interface", specifies the transport including the physical layer, addressing, and packet structure. The second, "Specification Part II – Command Language", specifies the command language to be used when communicating with PMBus compliant devices. The PMBus specifications are freely available at the PMBus Web site:

http://www.pmbus.org.

In addition to the capabilities provided by the PMBus,

Ericsson's 3E POL regulators feature the Group Command Bus (GCB). The GCB is an inter-device communication bus that provides addition capabilities like digital current sharing and fault propagation management.

Contents

Forum Websites

The System Management Interface Forum (SMIF)

http://www.powersig.org/

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

Power Management Bus Implementers Forum (Pmbus-If)

http://pmbus.org/

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

PMBus - Power System Management Bus Protocol Documents

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

Specification Part I – General Requirements Transport And Electrical Interface

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

Specification Part Ii – Command Language

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

SMBus - System Management Bus Documents

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

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

BMR 462 SERIES 12 A

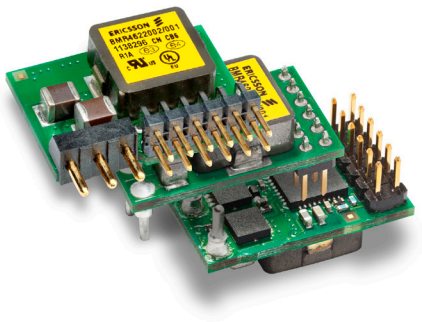
Digitally controlled 3E POL regulator

Efficiency, typ. 97.1%

Input voltage range, 4.5-14 V

Output power 60 W

Size (LxWxH): 21.0 x 12.7 x 8.2 mm
(0.83 x 0.50 x 0.32 Inch)



BMR 463 SERIES 20 A

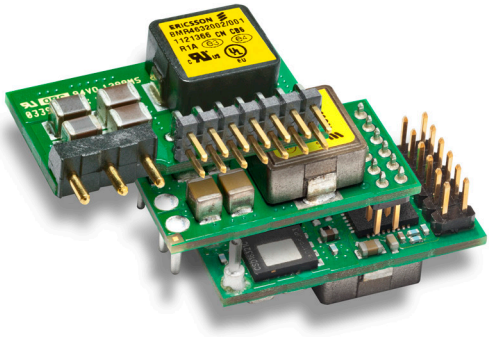
Digitally controlled 3E POL regulator

Efficiency, typ. 97.1%

Input voltage range, 4.5-14 V

Output power 66 W

Size (LxWxH): 25.6 x 13.8 x 8.2 mm
(1.01 x 0.54 x 0.32 Inch)



BMR 464 SERIES 40 A

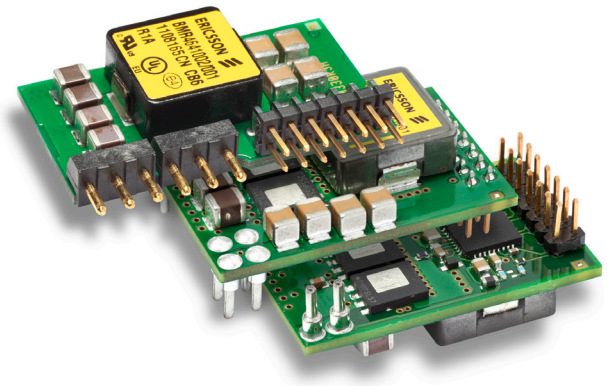
Digitally controlled 3E POL regulator

Efficiency, typ. 97.2%

Input voltage range, 4.5-14 V

Output power 132 W

Size (LxWxH): 30.8 x 20.0 x 8.2 mm
(1.22 x 0.79 x 0.32 Inch)



Notes On Using The PMBus Interface With Ericsson 3E POL Regulators

Applicability

This document applies to the BMR450 regulator, the BMR451 regulator, and all members of the BMR46x family of regulators.

Most PMBus commands have the same data format and effect for these regulators. However, there are some exceptions. For example, a command may be available for the BMR450 and BMR451 regulators but not the BMR46x regulators. In other cases the same command code may have different meanings and effects depending on the specific model. The details of these differences are listed with each PMBus command described in this document.

PMBus Command Description

Each available PMBus command is described below in the following format:

PMBUS_COMMAND_NAME

Applies To: <list of converters that support this command>

Command Code: <in hex>

Type: <SMBus transfer type>

Data Length In Bytes: <number>

Data Format: <PMBus data format>

Factory Value: <in hex and (decimal)>

Units: <data units>

Reference: <reference to related command or application note>

Definition: <brief description of command's operation>

Memory, Configuration Management, And Security

POWER ON CONFIGURATION

When operating, the 3E regulators maintain configuration information, such as the output voltage setting, in RAM in the controller IC. When the regulator is initially powered on, the RAM is loaded in the order specified by the PMBus specifications.

First, the controller IC will check the pin-strap settings and load the appropriate settings into RAM. Then the controller will copy the saved configuration information from the non-volatile memory to RAM. If the values retrieved from the non-volatile memory are different than the values set by pin-strapping, the pin-strapped values are overwritten.

At this point the regulator is operating as programmed and ready to accept an enable signal from the CTRL pin and start receiving commands from the PMBus.

PIN STRAP SETTINGS

The BMR450, BMR451, and BMR46x regulators offer the user additional flexibility through the use of pin-strapping. For example, the output voltage might be set by attaching a fixed resistor from a specified pin to ground. The descriptions of some PMBus commands refer to the pin-strap settings. These settings are different in the BMR450/BMR451 and BMR46x products as described below.

Pin-strapping The BMR450 and BMR451 3E Regulators

The BMR450 and BMR451 regulators feature the FLEX pin. The FLEX pin can be used to either set the output voltage or for frequency synchronization. How to configure the FLEX pin is given below in the description of the

POLA_VADJ_CONFIG and USER_CONFIG commands.

Additional information is given in the Technical Specifications of these products.

Pin-strapping the BMR46x 3E Regulators

The BMR46x regulators allow the output voltage to be set by connecting a fixed resistor between the VSET and PREF pins. The details are given in the Technical Specification for these products.

NON-VOLATILE MEMORY

BMR450 and BMR451

The BMR450 and BMR451 3E regulators have one non-volatile memory bank called the DEFAULT_STORE. Settings for any PMBus command supported by the BMR450 and BMR451 can be saved here. When the regulator is powered on, the settings saved in the DEFAULT_STORE will be loaded into the controller IC RAM.

The STORE_DEFAULT_ALL PMBus command is used to save the current contents of the device RAM to the DEFAULT_STORE. To move the settings into RAM on command, the RESTORE_DEFAULT_ALL command is used.

Saving to the DEFAULT_STORE is only allowed if the device is at the Security Level 3, which is set by sending the PRIVATE_PASSWORD command with the password already saved in the DEFAULT_STORE.

Note that saving customized settings to the DEFAULT_STORE overwrites the values set at the Ericsson factory. Once these values have been overwritten, the regulator cannot be restored to the same settings as when it came from the factory.

BMR46x

The BMR46x regulators have two non-volatile memory banks: USER_STORE and DEFAULT_STORE. The

DEFAULT_STORE is reserved for Ericsson's use. It contains all of the settings programmed into the regulator at the time of manufacture. This allows a BMR46x regulator to be

restored to "factory condition" with the RESTORE_

DEFAULT_ALL command.

The USER_STORE is made available to customers to store their customized settings. For example, when a 3E regulator is installed on a circuit board with its load, the output voltage and output voltage trim values may be adjusted by automatic test equipment (ATE). These values can be permanently saved with the STORE_USER_ALL command. The settings saved in the USER_STORE can also be copied to the regulator's RAM with the RESTORE_USER_ALL command.

In order for the current settings to be saved to the USER_ STORE, the regulator must be set to Security Level 2. This is done by sending the PRIVATE_PASSWORD command with the password already in the USER_STORE.

Settings in USER_STORE will override settings in DEFAULT_ STORE.

PROTECTING COMMANDS AGAINST CHANGES

Individual commands can be protected against changes with the UNPROTECT command. The data for the UNPROTECT command is a string of 256 bits (32 bytes) – one for each PMBus command code. Bit 0, the least significant bit, corresponds to PMBus command code 0x00/

Setting the bit corresponding to a given PMBus command code to 1 in the regulator's non-volatile memory

(USERS_STORE for the BMR46x and DEFAULT_STORE for the BMR450 and BMR451) allows the command to written with new data ("unprotected"). Setting the bit to 0 prevents the regulator from accepting a new value for that command.

This command protection is in place regardless of the regulator's security level. In order to change the UNPROTECT command settings, the regulator must be at the appropriate Security Level (Level 3 for the BMR450 and BMR451 and Level 2 for the BMR46x regulators). Once the UNPROTECT command has been written to the regulator, it must be saved in the non-volatile memory as described above.

PASSWORDS AND SECURITY LEVELS

As mentioned above, the 3E regulators have different security levels that are accessed by the use of passwords.

BMR450 and BMR451

The BMR450 and BMR451 have Security Levels available to the user: Level 0 and Level 3.

In Level 0 the regulator is protected against all changes (read only mode). The only command that will be accepted for writing is the PRIVATE_PASSWORD command with the password that matches the one stored in the DEFAULT_ STORE.

Writing the PRIVATE_PASSWORD command with the password that matches the one already stored in the DEFAULT_ STORE sets the regulator to Security Level 3. At this level the device is unprotected. A new PRIVATE_PASSWORD can be written and changes can be made to the UNPROTECT command settings.

To exit Security Level 3 to Security Level 0, write the

PUBLIC_PASSWORD with a value that does not match the PUBLIC_PASSWORD in the DEFAULT_STORE.

For both the PUBLIC_PASSWORD and PRIVATE_

PASSWORD commands, a value of 0 (0x00000000 for the PUBLIC_PASSWORD and 0x00000000000000000 for the PRIVATE_PASSWORD) is a special case. If the Security Level is 3 and the given password is 0, then writing the password command with a non-zero value will set the password to that value. Also, if the Security Level is 3, and then a password command is written with the zero value, the password is set to zero.

This means to change the password it must first be set to 0, then to the new value, and then saved into the DEFAULT_ STORE with the STORE_DEAULT_ALL command.

BMR46x

The BMR46x regulators have both a USER_STORE and a DEFAULT_STORE. However, the DEFAULT_STORE is reserved for Ericsson's use to store factory settings. Security Level 3, needed to access the DEFAULT_STORE, is not available in the BMR46x regulators.

The BMR46x regulators have available Security Levels 0, 1, and 2.

In Level 0 the regulator is protected against all changes (read only mode). Writing the PUBLIC_PASSWORD with the public password already in the USER_STORE sets the regulator to Security Level 1. Writing the PRIVATE_PASSWORD with the private password already in the USER_STORE set the regulator to Security Level 2.

When the regulator is at Security Level 1, write access is granted to commands for which the UNPROTECT bit is set in both the USER_STORE and the DEFAULT_STORE. The regulator can be taken back to Security Level 0 by writing the PUBLIC_PASSWORD command with a password that does not match the password in the USER_STORE.

Security Level 2 is intended for the user of the BMR46x regulators. Write access is granted for all commands for which the UNPROTECT bit is set in both the USER_STORE and DEFAULT_STORE. To prevent changes made at Security Level 1 from being saved, the UNPROTECT bit for the STORE_USER_ALL command should be cleared. The regulator can be taken back to Security Level 0 by writing the PUBLIC_PASSWORD command with a password that does

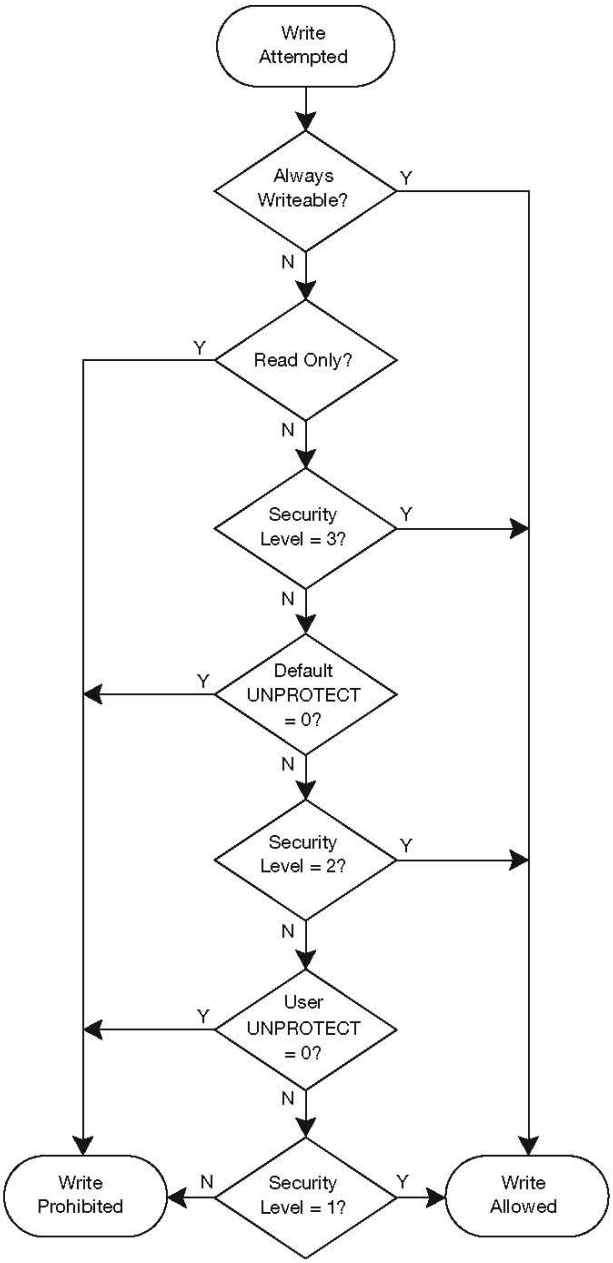
not match the password in the USER_STORE.

For both the PUBLIC_PASSWORD and PRIVATE_

PASSWORD commands, a value of 0 (0x00000000 for the PUBLIC_PASSWORD and 0x0000000000000000 for the PRIVATE_PASSWORD) is a special case. If the regulator is at Security Level 1 or 2, and a PUBLIC_PASSWORD or

PRIVATE_PASSWORD command is sent with a password equal to 0, the password is set to 0. Once a password is set to 0, it can be set to a new value by writing a non-zero value.

This means to change a password it must first be set to 0, then to the new value, and then saved to the USER_STORE with the STORE_USER_ALL command.



PMBus Commands

Control Commands

OPERATION

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x01

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: N/A

Units: N/A

Reference: Section 12.1 - PMBus Spec Part II

Definition: The OPERATION command is used, in conjunction with the hardwired CTRL pin, to turn the regulator output on and off. It also used to set the margin state (margin high, margin low, no margin) of the output voltage.

NOTE: All margin settings are “Act on Fault” type. “Ignore Fault” settings are ignored and “Act on Fault” is used.

ON_OFF_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x02

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x16

Units: N/A

Reference: Section 12.2 - PMBus Spec Part II

Definition: Configures the interpretation and coordination of the OPERATION command and the Control pin.

Output Commands

VOUT_MODE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x20

Type: Read Byte

Data Length In Bytes: 1

Data Format: Mode + Exponent Format

Factory Value: 0x13 (Linear Mode, Exponent = -13)

Units: N/A

Reference: Section 8 - PMBus Spec Part II

Definition: Preset to define the data format of the output voltage related commands (example: VOUT_COMMAND).

VOUT_COMMAND

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x21

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT linear mode

Factory Value: Pin-strap setting value (FLEX pin on BMR450 and BMR451; VSET pin on the BMR46x)

Units: Volts (V)

Reference: Section 8 - PMBus Spec Part II - VOUT_MODE

Definition: Sets the nominal value of the output voltage. The output voltage will be set to:

$$Output\_Voltage = VOUT\_COMMAND \times 2^{-13}$$

For example, sending the VOUT_COMMAND command with the data bytes of 0x5000 will set the output to approximately 2.50 V:

$$\begin{aligned} Output\_Voltage &= VOUT\_COMMAND \times 2^{-13} \\ &= 0x5000 \times \left(122.07 \times 10^{-6}\right) \\ &= 20,480 \times \left(122.07 \times 10^{-6}\right) \\ &= 2.500 \end{aligned}$$

Please note that the output voltage cannot be set greater than the lesser of:

- 110% of the pin-strap voltage setting or
- The voltage set by the VOUT_MAX command.

VOUT_TRIM

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x22

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Signed VOUT linear mode (see definition)

Factory Value: 0x0000

Units: Volts (V)

Reference: Section 13.3 - PMBus Spec Part II - VOUT_MODE

Definition: Sets output voltage trim value. The two bytes are formatted as a two's complement binary mantissa, used in conjunction with the exponent set in VOUT_MODE.

VOUT_CAL_OFFSET

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x23

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Signed VOUT linear mode (see definition)

Factory Value: 0x0000

Units: Volts (V)

Reference: Section 13.4 - PMBus Spec Part II - VOUT_MODE

Definition: Sets the output voltage calibration offset (same function as VOUT_TRIM). The two bytes are formatted as a two's complement binary mantissa, used in conjunction with the exponent set in VOUT_MODE.

NOTE: This command was previously known as VOUT_CAL.

VOUT_MAX

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x24

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 1.10 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 13.5 - PMBus Spec Part II - VOUT_MODE

Definition: Sets the maximum possible value setting of the output voltage. The maximum VOUT_MAX setting is 110% of the pin-strap setting (FLEX pin on the BMR450 and BMR451; VSET pin on the BMR46x).

VOUT_MARGIN_HIGH

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x25

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 1.05 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 13.6 - PMBus Spec Part II - VOUT_MODE

Definition: Sets the value of the output voltage during a margin high.

VOUT_MARGIN_LOW

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x26

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 0.95 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 13.7 - PMBus Spec Part II - VOUT_MODE

Definition: Sets the value of the output voltage during a margin low.

VOUT_TRANSITION_RATE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x27

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 0xBA00 (1)

Units: Volts (V)/ms

Reference: Section 13.8 - PMBus Spec Part II

Definition: Sets the output voltage transition rate during margin or other change of VOUT.

VOUT_DROOP

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x28

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 0x0000

Units: mV/A

Reference: AN307, Parallel Operation with Load Sharing and PMBus Spec Part II

Definition: Sets the effective load line (V/I slope) of the output voltage.

MAX_DUTY

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x32

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 0xEAF8 (95)

Units: %

Reference: Section 14.3 - PMBus Spec Part II

Definition: Sets the maximum allowable duty cycle of the switching frequency.

NOTE: MAX_DUTY should not be used to set the output voltage of the device. VOUT_COMMAND is the proper method to set the output voltage.

FREQUENCY_SWITCH

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x33

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 320 kHz

Units: kHz

Reference: Section 14.4 - PMBus Spec Part II

Definition: Sets the switching frequency. The switching frequency can be set to any value from 200 kHz to 1.4 MHz based on the following formula:

$$F_{SWITCH} = \frac{8\ \text{MHz}}{N};\ 6 \le \text{N} \le 40$$

IOUT_CAL_GAIN

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x38

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Individually calibrated at the factory

Units: mΩ

Reference: Section 14.8 - PMBus Spec Part I

Definition: This command tells the controller IC the value of the resistance used to monitor the output current. It is recommended that this value not be changed.

IOUT_CAL_OFFSET

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x39

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Individually calibrated at factory

Units: Amperes (A)

Reference: Section 14.9 - PMBus Spec Part II

Definition: When calibrating the current sense circuit, this command provides the controller IC with the value the offset correction to be applied to the measured output current. It is recommended that this value not be changed.

Fault Limit Commands

POWER_GOOD_ON

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x5E

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 0.9 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 15.32.1 - PMBus Spec Part II

Definition: Sets the voltage threshold for Power-Good indication. Power-Good asserts when the output voltage exceeds POWER_GOOD_ON and de-asserts when the output voltage is less than VOUT_UV_FAULT_LIMIT.

VOUT_OV_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x40

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 1.15 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 15.2 - PMBus Spec Part II

Definition: Sets the output overvoltage fault threshold.

VOUT_UV_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x44

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: 0.85 × VOUT_COMMAND

Units: Volts (V)

Reference: Section 15.6 - PMBus Spec Part II

Definition: Sets the output undervoltage fault threshold.

IOUT_OC_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x46

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent

Units: Amperes (A)

Reference: Section 15.8 - PMBus Spec Part II

Definition: In the 3E Digital POL converters, this command sets a peak current level that avoids saturating the output inductor. For limiting the average output current, please see the IOUT_AVG_OC_FAULT_LIMIT command.

IOUT_AVG_OC_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xE7

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent

Units: Amperes (A)

Reference:

Definition: This command sets the average output current overcurrent fault threshold. Shares the fault bit operation and OC fault response with IOUT_OC_FAULT_LIMIT.

IOUT_UC_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x4B

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent.

Units: Amperes (A)

Reference: Section 15.13 - PMBus Spec Part II

Definition: This command sets the peak limit when the converter's synchronous rectifier output is sinking current from the load (undercurrent operation). For limiting the average output sink current, please see the IOUT_AVG_UC_FAULT_LIMIT command.

IOUT_AVG_UC_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xE8

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent

Units: Amperes (A)

Reference:

Definition: This command sets the average output sink current (undercurrent) fault threshold. Shares the fault bit operation and UC fault response with IOUT_UC_FAULT_LIMIT.

OT_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x4F

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent. This is set by design so that the converter's hot spot temperature does not exceed

120 °C worst case.

Units: °C

Reference: Section 15.17 - PMBus Spec Part II

Definition: Sets the over-temperature fault threshold.

OT_WARN_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x51

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Model dependent.

Units: °C

Reference: Section 15.19 - PMBus Spec Part II

Definition: Sets the over-temperature warning threshold.

UT_WARN_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x52

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: -50 °C

Units: °C

Reference: Section 15.20 - PMBus Spec Part II

Definition: Sets the undertemperature warning threshold.

UT_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x53

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: -55 °C

Units: °C

Reference: Section 15.21 - PMBus Spec Part II

Definition: Sets the undertemperature fault threshold.

VIN_OV_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x55

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 16 V

Units: Volts (V)

Reference: Section 15.23 - PMBus Spec Part II

Definition: Sets the VIN overvoltage fault threshold.

VIN_OV_WARN_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x57

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 13.5 V BMR450, BMR451; 15 V BMR46x

Units: Volts (V)

Reference: Section 15.25 - PMBus Spec Part II

Definition: Sets the VIN overvoltage warning threshold.

VIN_UV_WARN_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x58

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 1.03 × VIN_UV_FAULT_LIMIT BMR450, BMR451; 4.2 V BMR46x

Units: Volts (V)

Reference: Section 15.26 - PMBus Spec Part II

Definition: If enabled, sets the input voltage level at which the output voltage is turned on.

VIN_UV_FAULT_LIMIT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x59

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: Equal to the input undervoltage lockout voltage, 4.25 V BMR450, BMR451; 3.85 V BMR46x

Table 1. Fault response command functions and data format

Bits	Description	Value	Meaning
7:6	Response: For all modes set by bits [7:6], the device: • Pulls SALERT low • Sets the related fault bit in the status regiters. Fault bits are onlt cleared by the CLEAR_FAULTS command.	00	Continuous operation. (Ignore fault)
		01	Delay, Disable and Retry The delay time is specified by bits [2:0] and the delay time unit is specified for that particular fault. If the fault condition is still present at the end of the delay time, the unit retries according to the setting in bits [5:3].
		10	Disable and Retry according to the setting in bits [5:3].
		11	The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists.
5:3	Retry Setting	000	No Retry. The output remains disabled.
		001 to 110	The PMBus device attempts to restart the number of times set by these bits. The minimum number is 1 and the maximum number is 6. If the device fails to restart in the allowed number of retries, it disables the output and remains disabled. The time between the start of each attempt to retry is set by the value in bits [2:0] along with the delay time unit specified for that particular fault.
		111	The PMBus device attempts retry continuously until it is commanded to disable (by the Enable pin or OPERATION command), input power is removed, or another fault condition causes the unit to shut down.
2:0	Retry Time and Delay Time	000 to 111	This time count is used for both the amount of time between retry attempts and for the amount of time a rail is to delay its response after a fault is detected. The retry time and delay time units are defined by the type of fault within each device.

NOTE: The delay time is the time between restart attempts.

Units: Volts (V)

Reference: Section 15.27 - PMBus Spec Part II

Definition: Sets the VIN undervoltage fault threshold.

Fault Response Commands

All 3E POL regulators' fault responses, including current faults, are defined by Table 1. If a device is used in a current sharing rail, the device will not attempt a retry until the entire current share rail attempts a retry following a disable event.

VOUT_OV_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x41

Type: R/W ByteR/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.3 - PMBus Spec Part II

Definition: Configures the output overvoltage fault response. Note that the two most significant bits can be written as 01 or 00. However, upon an overvoltage fault, these two bits will be set to 1:0 (i.e. bits (7:6) = 1:0). Thus an overvoltage fault cannot be set to be ignored.

VOUT_UV_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x45

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.7 - PMBus Spec Part II

Definition: Configures the output undervoltage fault response.

MFR_IOUT_OC_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xE5

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.3 - PMBus Spec Part II

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

Note: The delay time is the time between restart attempts.

MFR_IOUT_UC_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xE6

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.7 - PMBus Spec Part II

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

Note: The delay time is the time between restart attempts.

OT_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x50

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 32 ms/LSB, Delay = 80 ms/LSB

Reference: Section 15.18 - PMBus Spec Part II

Definition: Configures the over-temperature fault response.

Note: The delay time is the time between restart attempts.

UT_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x54

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 32 ms/LSB, Delay = 80 ms/LSB

Reference: Section 15.22 - PMBus Spec Part II

Definition: Configures the undertemperature fault response.

Note: The delay time is the time between restart attempts.

VIN_OV_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x56

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.24 - PMBus Spec Part II

Definition: Configures the VIN overvoltage fault response.
Note: The delay time is the time between restart attempts

VIN_UV_FAULT_RESPONSE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x5A

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Section 10.5.1 - Custom (PMBus Spec Part II)

Factory Value: 0xBF (Retry always, max delay)

Units: Retry time = 8.2 ms/LSB, Delay = 10 ms/LSB

Reference: Section 15.28 - PMBus Spec Part II

Definition: Configures the VIN undervoltage fault response.
Note: The delay time is the time between restart attempts

OVUV_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD8

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom (See Table 2)

Factory Value: 0x80 BMR450, BMR451; 0x8F BMR46x (Sets the output to turn on the synchronous rectifier as a crowbar when an overvoltage fault is detected.)

Units: N/A

Reference:

Definition: Configures the output voltage OV and UV fault detection feature as given in Table 2.

Table 2. OV And UV Fault Detection Feature Configuration

Bits	Purpose	Value	Description
7	Controls how an OV fault response shutdown sets the output driver state	0	An OV fault does not enable the low-side power device
		1	An OV fault enables the low-side power device
		10	Disable and Retry according to the setting in bits [5:3].
		11	The device's output is disabled while the fault is present. Operation resumes and the output is enabled when the fault condition no longer exists.
6:4	Reserved	—	
3:0	Defines the number of consecutive limit violations required to declare an OV or UV fault	N	N+1 consecutive OV or UV violations initiate a fault response

Time Setting Commands

TON_DELAY

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x60

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 10 ms

Units: ms

Reference: Section 16.1 - PMBus Spec Part II

Definition: Sets the delay time from ENABLE to start of the rise of the output voltage. The delay time can range from 0 ms up to 500 s, in steps of 125 ns.

TON_RISE

Applies to: BMR450, BMR451, BMR46x

Command Code: 0x61

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 10 ms

Units: ms

Reference: Section 16.2 - PMBus Spec Part II

Definition: Sets the rise time of the output voltage after ENABLE and TON_DELAY. The delay time can range from 0 ms to 200 ms, in steps of 12.5 µs.

TOFF_DELAY

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x64

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 1 × TON_DELAY

Units: ms

Reference: Section 16.5 - PMBus Spec Part II

Definition: Sets the delay time from DISABLE to start of the fall of the output votlage. The delay time can range from 0 ms up to 500 s, in steps of 125 ns.

TOFF_FALL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x65

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 1 × TON_RISE

Units: ms

Reference: Section 16.6 - PMBus Spec Part II

Definition: Sets the fall time of the output voltage after DISABLE and TOFF_DELAY. The delay time can range from 0 ms to 200 ms, in steps of 12.5 µs.

POWER_GOOD_DELAY

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD4

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: 1 × TON_RISE

Units: ms

Reference:

Definition: Sets the delay time between the output voltage exceeding the power good threshold (set by the POWER_GOOD_ON command) and clearing the POWER_GOOD# bit in STATUS_WORD (note that if the POWER_GOOD# bit is set, then power is not good). The POWER_GOOD_DELAY time can range from 0 ms to 500 ms in steps of 125 ns. A 1 ms minimum configured value is recommended to adequately debounce the detection of a power good condition.

Status Commands

CLEAR_FAULTS

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x03

Type: Send Byte

Data Length In Bytes: 0

Data Format: N/A

Factory Value: N/A

Units: N/A

Reference: Section 15.1 - PMBus Spec Part II

Definition: Clears fault indications.

STATUS_BYTE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x78

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.1 - PMBus Spec Part II

Definition: Returns an abbreviated status for fast reads.

STATUS_WORD

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x79

Type: Read Word

Data Length In Bytes: 2

Data Format: Custom

Factory Value: 0x0000

Units: N/A

Reference: Section 17.2 - PMBus Spec Part II

Definition: Returns the general status information used to indicate subsequent status to be read for more detail.

STATUS_VOUT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x7A

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.3 - PMBus Spec Part II

Definition: Returns the output voltage related status.

STATUS_IOUT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x7B

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.4 - PMBus Spec Part II

Definition: Returns the output current related status.

STATUS_INPUT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x7C

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.5 - PMBus Spec Part II

Definition: Returns specific status specific to the input.

STATUS_TEMPERATURE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x7D

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.6 - PMBus Spec Part II

Definition: Returns the temperature specific status.

STATUS_CML

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x7E

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: Section 17.7 - PMBus Spec Part II

Definition: Returns the Communication, Logic and Memory specific status.

STATUS_MFR_SPECIFIC

Applies To: BMR46x

Command Code: 0x80

Type: Read Byte

Data Length In Bytes: 1

Data Format: Custom (See Table 3)

Factory Value: 0x00

Units: N/A

Reference: Section 17.9 - PMBus Spec Part II

Definition: Returns manufacturer specific status information. See tabble 3.

Table 3. STATUS_MFR_SPECIFIC data byte specification

Bit	Fault meaning
7	Reserved
6	Reserved
5	Reserved
4	Reserved
3	CLOCK_FAIL[1]
2	Reserved
1	Reserved
0	Reserved

Note 1: The controller firmware monitors the switching period. If this period is longer than expected, the CLOCK_FAIL bit is set. If the regulator is configured to operate from an external switching frequency clock through the FLEX (BMR450 and BMR451) or SYNC (BMR46x) pin, then the controller will switch over to the internal clock and keep the regulator switching.

Monitor Commands

READ_VIN

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x88

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: N/A

Units: Volts (V)

Reference: Section 18.1 - PMBus Spec Part II

Definition: Returns the measured value of the input voltage. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, input voltage information is not available and the regulator will NACK (Not ACKnowledge) this command.

READ_VOUT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x8B

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 8.3.1 - PMBus Spec Part II - VOUT Linear Mode

Factory Value: N/A

Units: Volts (V)

Reference: Section 18.4 - PMBus Spec Part II

Definition: Returns the measured value of the output voltage. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, output voltage information is not available and the regulator will NACK (Not ACKnowledge) this command.

READ_IOUT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x8C

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: N/A

Units: Amperes (A)

Reference: Section 18.5 - PMBus Spec Part II

Definition: Returns the measured value of the output current. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, output current information is not available and the regulator will NACK (Not ACKnowledge) this command.

READ_TEMPERATURE_1

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x8D

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: N/A

Units: °C

Reference: Section 18.6 - PMBus Spec Part II

Definition: Returns the measured value of the regulator's internal temperature. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, internal temperature information is not available and the regulator will NACK (Not ACKnowledge) this command.

READ_DUTY_CYCLE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x94

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: N/A

Units: %

Reference: Section 18.9 - PMBus Spec Part II

Definition: Returns the measured value of the duty cycle. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, duty cycle information is not available and the regulator will NACK (Not ACKnowledge) this command.

READ_FREQUENCY

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x95

Type: Read Word

Data Length In Bytes: 2

Data Format: Section 7.1 - PMBus Spec Part II - Linear Data Format

Factory Value: N/A

Units: kHz

Reference: Section 18.10 - PMBus Spec Part II

Definition: Returns the measured value of the switching frequency. If the regulator is not enabled, and has been put into low power standby mode with the USER_CONFIG command, switching frequency information is not available and the regulator will NACK (Not ACKnowledge) this command.

SNAPSHOT_CONTROL

Applies To: BMR46x

Command Code: 0xF3

Type: R/W Byte

Data Length In Bytes: 1

Data Format: Custom

Factory Value: N/A

Units: N/A

Definition: Used to save a set of current information about the operation of the regulator (see the SNAPSHOT command description below). Sending the SNAPSHOT_CONTROL command with the data byte equal to 0x01 causes the current SNAPSHOT values to be copied to the data registers used by the SNAPSHOT command. Sending the SNAPSHOT_CONTROL command with the data byte equal to 0x02 causes the current SNAPSHOT values to be stored in set location in flash memory. Any other data values (0x00, 0x03-0xFF) are ignored.

SNAPSHOT

Applies To: BMR46x

Command Code: 0xEA

Type: Block Read

Data Length In Bytes: 32

Data Format: Custom (See Table 4)

Factory Value: N/A

Units: N/A

Definition: The SNAPSHOT command is a 32-byte read-back of parametric and status values. See table 4.

Table 4. SNAPSHOT command data byte specification

Bite number	Value	Format
31:22	Reserved	0x00
21	Manufacturer Specific Status Byte	Byte
20	STATUS_CML byte	Byte
19	STATUS_TEMPERATURE byte	Byte
18	STATUS_VIN byte	Byte
17	STATUS_IOUT byte	Byte
16	STATUS_VOUT byte	Byte
15:14	Switching Frequency	Linear Data Format
13:12	Reserved	N/A
11:10	Internal Temperature	Linear Data Format
9:8	Duty Cycle	Linear Data Format
7:6	Peak Current	Linear Data Format
5:4	Load Current	Linear Data Format
3:2	Output Voltage	VOUT Linear Format
1:0	Input Voltage	Linear Data Format

Identification Commands

DEVICE_ID

Applies To: BMR46x

Command Code: 0xE4

Type: Block Read (Read Only)

Data Length In Bytes: 16

Data Format: ASCII

Factory Value: The part number, die revision and firmware revision of the controller IC.

Units: N/A

Reference: N/A

Definition: Returns the 16-byte (character) device identifier string.

PMBUS_REVISION

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x98

Type: Read Byte (Read Only)

Data Length In Bytes: 1

Data Format: Hex

Factory Value: The PMBus revision implemented in this unit.

Units: N/A

Reference: Section 22.1 - PMBus Spec Part II

Definition: Returns the revision of the PMBus implemented in the device.

MFR_ID

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x99

Type: Block R/W (Read Only)

Data Length In Bytes: 22

Data Format: ASCII

Factory Value: Ericsson Power Modules

Units: N/A

Reference: Section 22.2 - PMBus Spec Part II

Definition: This command returns the name of the regulator manufacturer, Ericsson Power Modules.

MFR_MODEL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x9A

Type: Block R/W (Read Only)

Data Length In Bytes: 14

Data Format: ASCII

Factory Value: Ericsson model number

Units: N/A

Reference: Section 22.2.2 - PMBus Spec Part II

Definition: This command returns the model number of the regulator.

MFR_REVISION

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x9B

Type: Block R/W (Read Only)

Data Length In Bytes: 22

Data Format: ASCII

Factory Value: Ericsson product revision number

Units: N/A

Reference: Section 22.2.3 - PMBus Spec Part II

Definition: This command returns the name of the configuration file used at the factory to program the device. The last ASCII character of the string the revision level of the regulator.

MFR_LOCATION

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x9C

Type: Block R/W - Protectable

Data Length In Bytes: 7

Data Format: ASCII

Factory Value: Typically EAB/SEC

Units: N/A

Reference: Section 22.2.4 - PMBus Spec Part II

Definition: This command returns Ericsson's identification for the location where the regulator was manufactured.

MFR_DATE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x9D

Type: Block R/W - Protectable

Data Length In Bytes: 10

Data Format: ASCII

Factory Value: Manufacturing date code formatted as YYYY-MM-DD

Units: N/A

Reference: Section 22.2.5 - PMBus Spec Part II

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

MFR_SERIAL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x9E

Type: Block R/W - Protectable

Data Length In Bytes: 13

Data Format: ASCII

Factory Value: Ericsson serial number

Units: N/A

Reference: Section 22.2.6 - PMBus Spec Part II

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

USER_DATA_00

Applies To: BMR46x

Command Code: 0xB0

Type: Block R/W - Protectable

Data Length In Bytes: Up to 32

Data Format: ASCII

Factory Value: null

Units: N/A

Reference: Section 23 - PMBus Spec Part II

Definition: Sets a user defined data. The maximum number of bytes that can be stored is 32.

Other Configuration Commands

MFR_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD0

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom

Factory Value: Model dependent.

Definition: Configures several manufacturer-level features. The data field is defined in Tables 5 and 6.

Table 5. MFR_CONFIG command data byte specification for the BMR450 and BMR451

Bits	Purpose	Value	Description
15:11	Current Sense Blanking Delay	D	Sets the delay, D, in 32 ns steps
10:8	Current Sense Fault Count	C	Sets the number of consecutive OC or UC violations required for a fault to 2C+1.
7:6	Reserved	0	N/A
5:4	Current Sense Control	00	Current sense uses GND-referenced, down-slope sense
		01	Current sense uses output voltage referenced, down-slope sensing
		10	Current sense uses output voltage referenced, up-slope sensing
		11	Current sense uses VOUT-referenced, up/down slope selected by the nominal duty cycle
3:0	Reserved	0	N/A

Table 6. MFR_CONFIG command data byte specification for the BMR46x

Bits	Purpose	Value	Description
15:11	Current Sense Blanking Delay	D	Sets the delay, D, in 32 ns steps
10:8	Current Sense Fault Count	C	Sets the number of consecutive OC or UC violations required for a fault to 2C+1.
7:6	Reserved	0	N/A
5:4	Current Sense Control	00	Current sense uses GND-referenced, down-slope sense
		01	Current sense uses output voltage referenced, down-slope sensing
		10	Current sense uses output voltage referenced, up-slope sensing
		11	Reserved
3	NLR During Ramp	0	Wait for power good (PG)
		1	Always on
2	Alternate Ramp Control	0	Alternate Ramp Disabled
		1	Alternate Ramp Enabled
1	Reserved	0	N/A
0	SYNC Pin Output Control	0	SYNC is open-drain
		1	SYNC is push-pull

USER_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD1

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom

Factory Value: Model dependent.

Units: N/A

Reference: N/A

Definition: Configures several user-level features. The data field is defined Table 7 and 8. This command overrides the pinstrap settings.

Table 7. USER_CONFIG command data specification for the BMR450 and BMR451

Bits	Purpose	Value	Description
15:12	Reserved	–	Reserved
11:10	Reserved	–	Reserved
9	PID Feed-Forward Control	0	PID Coefficients are corrected for VDD variation
		1	PID Coefficients are not corrected for VDD variations
8	Fault Spreading Control	0	Received faults are ignored
		1	Received faults cause a shut-down
7	SMBus Master Clock Rate	0	Operate at 100 kHz in master mode
		1	Operate at 400 kHz in master mode
6	SYNC utilization control	0	Auto-configure using the SYNC pin and FREQUENCY_SWITCH parameter
		1	Switch using the SYNC input (device waits for external sync signal before regulation)
5	Reserved	–	Reserved
4	SMBus Transmit Inhibit	0	SMBus master transmissions are allowed
		1	SMBus master transmissions are not allowed
3	SMBus Timeout Inhibit	0	SMBus Idle and Fault timeouts are enabled
		1	SMBus Idle and Fault timeouts are inhibited
2	OFF low-side control	0	The low-side drive is off when device is disabled
		1	The low-side drive is on when device is disabled
1:0	Standby Mode	00	Enter low-power mode when device is disabled. No READ_xxxx data is available in this mode.
		01	Monitor for faults when device is disabled. READ_xxxx data is available.
		10	Reserved
		11	Monitor for faults using pulsed mode. READ_xxxx data is available.

Table 8. USER_CONFIG command data byte specification for the BMR46x

Bits	Purpose	Value	Description
15:14	Minimum Duty Cycle	N	Sets the minimum duty cycle ((N+1)/(2^8)) during a ramp when “Minimum Duty Cycle” (Bit 13) is enabled. For example, if Minimum Duty Cycle input N is set to 3, the minimum duty cycle is (3+1)/(28) = (1/64).
13	Minimum Duty Cycle	0	Minimum Duty Cycle is Disabled
		1	Minimum Duty Cycle is Enabled
12	Alternate Ramp Down	0	Output follows TOFF_FALL ramp time
		1	Output is set to high impedance/open mode during ramp down VOUT_UV
11	SYNC Time-out Enable	0	SYNC output remains on after device is disabled
		1	SYNC turns off 500 ms after device is disabled
10	Reserved	-	Reserved
9	PID Feed-Forward Control	0	PID Coefficients are corrected for VDD variation
		1	PID Coefficients are not corrected for VDD variations
8	Fault Spreading Mode	0	If sequencing is disabled, this device will ignore faults from other devices. If sequencing is enabled, the devices will sequence down from the failed device outward.
		1	Faults received from any device selected by the DDC_GROUP command will cause this device to shut down immediately.
7	Reserved	0	Reserved
6	SYNC Utilization Control	0	Auto-configure using the SYNC pin and FREQUENCY_SWITCH parameter
		1	Switch using the SYNC input
5	SYNC Output Control	0	Configure the SYNC pin as an input-only
		1	Drive the switch clock out of SYNC when using the internal oscillator
4:3		0	Reserved
2	OFF Low-side Control	0	The low-side drive is off when device is disabled
		1	The low-side drive is on when device is disabled
1:0	Standby Mode	00	Enter low-power mode when device is disabled (no READ_xxxx data available)
		01	Monitor for faults when device is disabled (READ_xxxx data available)
		10	Reserved
		11	Monitor for faults using pulsed mode. (READ_xxxx data available upon read command)

MISC_CONFIG

Applies To: BMR46x

Command Code: 0xE9

Type: R/W Word – Protectable

Data Length In Bytes: 2

Data Format: Custom

Factory Value: 0x0000

Definition: This command sets a few options pertaining to ramp timing accuracy and current-driven control. The format of this command is shown in Table 9.

Table 9. MISC_CONFIG command data specification

Bits	Purpose	Value	Description
15	Broadcast Margin (see GCB_CONFIG)	0	Disabled
		1	Enabled
14	Broadcast Enable (see GCB_CONFIG)	0	Disabled
		1	Enabled
13	Adaptive Compensation	0	Disabled
		1	Enabled
12	Reserved	0	Reserved
11:10	Current sense gain factor (current sensing resistance)	00	DCR = 25 mV, RDS(ON) = 25 mV
		01	DCR = 35 mV, RDS(ON) = 50 mV
		10	DCR = 50 mV, RDS(ON) = 100 mV
		11	Reserved
9:8	Reserved	0	Reserved
7	Precise Ramp-Up Delay	0	Monitor mode enabled creating a more accurate delay time. This mode also enables certain circuits that may affect standby power.
		1	Normal, low standby power, delay operation
6	Diode Emulation	0	Disabled
		1	Enabled, enter diode emulation at low current loads to improve efficiency
5:3	Reserved		
2	Minimum GL Pulse	0	Disabled
		1	Enabled, limited to 10% × 1/Fswitch
1	Snapshot	0	Disabled
		1	Enabled
0	Adaptive Frequency	0	Disabled, Switching frequency is fixed
		1	Enabled

PID_TAPS

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD5

Type: Block R/W - Protectable

Data Length In Bytes: 9

Data Format: Custom

Factory Value: Model dependent

Units: N/A

Reference: AN305, Control Loop Design

Definition: Configures the linear control loop filter coefficients. The PID algorithm implements the following Z-domain function in below equation:

$$\frac{A + Bz^{-1} + Cz^{-2}}{1 - z^{-1}}$$

The coefficients A, B, and C are represented using a pseudo-floating point format similar to the output voltage related parameters (with the addition of a sign bit), defined as:

$$(-1)^S \times 2^E \times M$$

where M is a two-byte unsigned mantissa, S is a sign-bit, and E is a 7-bit two's-complement signed integer. The 9-byte data field is defined in Table 10. S is stored as the MSB of the E byte.

PID_TAPS Command For The BMR450 And BMR451

The PID_TAPS command data is only read at startup. Changes made while the regulator is operating will not take effect until the regulator is powered off and restarted.

PID_TAPS Command For The BMR46x

For BMR46x family of regulators, the PID_TAPS command sets the baseline value for the control loop compensation. The data for this command is read only at startup. Changes made while the regulator is operating will not take effect until the regulator is powered off and restarted.

If data has been written to the PID_TAPS_CALC command, the data in the PID_TAPS_CALC command is used to compensate the control loop and the PID_TAPS data is ignored. Description of the PID_TAPS_CALC command is shown i table 10.

Table 10. PID_TAPS command data specification

Byte	Purpose	Definition
8	Tap C - E	Coefficient C exponent + S
7	Tap C - M [15:8]	Coefficient C mantissa, high-byte
6	Tap C - M [7:0]	Coefficient C mantissa, low-byte
5	Tap B - E	Coefficient B exponent + S
4	Tap B - M [15:8]	Coefficient B mantissa, high-byte
3	Tap B - M [7:0]	Coefficient B mantissa, low-byte
2	Tap A - E	Coefficient A exponent + S
1	Tap A - M [15:8]	Coefficient A mantissa, high-byte
0	Tap A - M [7:0]	Coefficient A mantissa, low-byte

NOTE: Data bytes are transmitted on the PMBus in the order of Byte 0 through Byte 8.

PID_TAPS_CALC

Applies To: BMR46x

Command Code: 0xF2

Type: Block R/W – Protectable

Data Length In Bytes: 9

Data Format: Custom (See PID_TAPS above)

Factory Value: Model dependent

Units: N/A

Reference: AN305, Control Loop Design

Definition: The use may store customized values of the PID_TAPS settings (see the PID_TAPS command above) using this command

Data written to this command takes effect immediately if the PID Feed-Forward Control bit of the USER_CONFIG command is set. This means that the loop compensation can be changed while the regulator is operating. Great care must be taken when changing the compensation while the regulator is operating to avoid introducing unstable operation.

If the data written to the PID_TAPS_CALC command is saved in the USER_STORE memory, on power up, the PID_TAPS_CALC data will be used to compensate the control loop and any data saved for the PID_TAPS command will be ignored.

POLA_VADJ_CONFIG

Applies To: BMR450, BMR451

Command Code: 0xD6

Type: R/W Word - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: Pin-strap setting value (V0)

Units: N/A

Reference: N/A

Definition: Configures the Device's voltage pin-straps to either conform to the POLA standard or to follow Ericsson's method. The command format is shown in Table 11.

Table 11. POLA_VADJ_CONFIG command data specification

Field	Purpose	Value	Description
15:0	POLA Config	0x00	The output voltage is set to 5.0 V. It can be adjusted through the VOUT_COMMAND PMBus command. The FLEX pin is configured as a SYNC pin in auto-detect mode. On power up, the controller will check the FLEX pin for an external clock. If one is found, the controller will synchronize with it. If no external clock is detected on the FLEX pin at power up, the controller reverts to either its nominal frequency of 400 kHz or the value set by the FREQUENCY_SWITCH command.
		0x01	This puts the converter output voltage settings into the POLA Mode. In this mode the output voltage, maximum output voltage, and output voltage fault limits are set by connecting a resistor from the FLEX pin to GND. Refer to the product Technical specifications for details. These values may be overridden by the use of the appropriate PMBus commands.
		0x02	This puts the converter output voltage settings into the POLA Mode. In this mode the output voltage, maximum output voltage, and output voltage fault limits are set by connecting a resistor from the FLEX pin to GND. Refer to the product Technical specifications for details. These values may be overridden by the use of the appropriate PMBus commands. This is the same as sending data 0x01.

NLR_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xD7

Type: Block R/W - Protectable

Data Length In Bytes: 4

Data Format: Product dependent (For the BMR450 and BMR451, See Table 12. For the BMR46x, see Table 13)

Factory Value:

Units: N/A

Reference: AN306, NLR Configuration

Definition: Configures the non-linear response (NLR) control parameters.

Table 12. NLR_CONFIG command data specification for the BMR450 and BMR451

Bits	Purpose	Value	Description
15	Controls the NLR enable	0	The NLR feature is disabled
		1	The NLR feature is enabled
14:12	Sets the high-side (control FET) NLR threshold	HT	Sets the high-side comparator threshold to approximately 0.005 × (HT+1) × Vout
11	Controls the outer NLR comparators	0	The outer NLR comparators are disabled
		1	The outer NLR comparators are enabled
10:8	Sets the low-side (sync FET) NLR threshold	LT	Sets the low-side comparator threshold to approximately 0.005 × (LT+1) × Vout
7:6	Sets the maximum high-side correction time	HC	Sets the maximum high-side correction time to Tsw × ((2×HC) +1)/64
5:4	Sets the maximum low-side correction time	LC	Sets the maximum low-side correction time to Tsw × ((2×LC) + 1)/64
3:0	NLR Blanking time control	B	Adds to the NLR blanking time by B×Tsw / 64

Table 13. NLR_CONFIG command data specification for the BMR46x

Bits	Purpose	Value	Description
31:30	Outer threshold multiplier	O	The NLR feature is disabled The NLR feature is enabled
29:27	NLR threshold: Load-Inner	LI	Sets the high-side comparator threshold to approximately 0.005 × (HT+1) × Vout
26:24	NLR threshold: Unload-Inner	UI	Sets the inner comparator threshold for an unloading event to approximately 0.005×(UI+1)×VOUT
23:20	Max time: Load-Outer threshold correction time	LOT	Sets the outer threshold, maximum correction time for a loading event to LOT×Tsw/64 (s)
19:16	Max time: Load-Inner threshold correction time	LIT	Sets the inner threshold, maximum correction time for a loading event to LOT×Tsw/64 (s)
15:12	Max time: Unload-Outer threshold correction time	UOT	Sets the outer threshold, maximum correction time for an unloading event = UOT×Tsw/64 (s)
11:8	Max time: Unload-Inner threshold correction time	UIT	Sets the inner threshold, maximum correction time for an unloading event = UIT×Tsw/64 (s)
7:4	Load Blanking time control	LB	Sets the NLR blanking time for a loading event as described in Table 14.
3:0	Unload Blanking time control	UB	Sets the NLR blanking time for an unloading event as described in Table 14.

Table 14. NLR blanking time as a function of LB or UB

LB OR UB	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
tSW/64 UNITS	1	2	3	5	9	17	33	49	65	81	97	129	161	177	193	225

TEMPCO_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xDC

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: Model Dependent

Definition: Configures the correction factor when performing temperature coefficient correction for current sense. This value is set at the factory and should not be changed.

DEADTIME

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xDD

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom – two 2's complement bytes

Factory Value: Model Dependent.

Units: ns

Reference:

Definition: Sets the non-overlap between PWM transitions. This value is set at the factory and should not be changed.

DEADTIME_CONFIG

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xDE

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom

Factory Value: Model Dependent

Units: N/A

Reference:

Definition: Configures the deadtime optimization mode. Also sets the minimum deadtime value for the adaptive deadtime mode range. This value is set at the factory and should not be changed.

DEADTIME_MAX

Applies To: BMR46x

Command Code: 0xBF

Type: R/W Byte - Protectable

Data Length In Bytes: 4

Data Format: Custom

Factory Value: Model Dependent

Units: N/A

Reference:

Definition: Sets the maximum deadtime value for the adaptive deadtime mode range. This value is set at the factory and should not be changed.

Group Commands

SEQUENCE

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xE0

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom

Factory Value:

BMR450, BMR451: 0x0000 (Sequencing disabled)

BMR46x: 0x0000 (Sequencing disabled)

Units: N/A

Reference:

SEQUENCE Command for the BMR450 and BMR451

Definition: The SEQUENCE command sets the serial interface address of the prequel and sequel devices when using group sequencing. The device will enable its output (using the programmed delay values in table 15) when its EN or OPERATION enable state, as defined by ON_OFF_CONFIG, is set and the prequel device has issued a Power Good event on the serial bus. The device will disable its output (using the programmed delay values) when the sequel device has issued a Power Down event on the serial bus.

The data field is a two-byte value. The most-significant byte contains the serial interface address of the prequel device (left-justified). The least-significant byte contains the address of the sequel device. The unused least-significant bit of both addresses must be 0 (i.e., the data byte for the five bit address 0x21 would be 0x42). An address byte value of 0x00 for the prequel defines that device as the first device in a sequence. An address byte value of 0x00 for the sequel defines the device to be the last device in a sequence.

A SEQUENCE command value of 0x0000 disables device sequencing, unless defined by pin-straps.

This command overrides the corresponding factory pinstrap settings.

SEQUENCE Command For The BMR46x

Definition: The SEQEUNCE command identifies the Rail GCB ID of the prequel and sequel rails when performing multi-rail sequencing. The device will enable its output (using the programmed delay values in Table 16) when its EN or OPERA-

TION enable state, as defined by ON_OFF_CONFIG, is set and the prequel device has issued a Power-Good event on the GCB bus. The device will disable its output (using the programmed delay values) when the sequel device has issued a Power-Down event on the GCB bus.

The data field is a two-byte value. The most-significant byte contains the 5-bit Rail GCB ID of the prequel device. The least-significant byte contains the 5-bit Rail GCB ID of the sequel device. The most significant bit of each byte contains the enable of the prequel or sequel mode.

This command overrides the corresponding sequence configuration set by the factory pinstrap settings.

TRACK_CONFIG

Applies To: BMR46x

Command Code: 0xE1

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference:

Definition: Configures the voltage tracking modes of the device. The data field is described in Table 17.

GCB_CONFIG

Applies To: BMR46x

Command Code: 0xD3

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom (See Table 18)

Factory Value: Lowest five bits of the converter's SMBus Address.

Units: N/A

Reference:

Definition: Configures the GCB bus

GCB_GROUP

Applies To: BMR46x

Command Code: 0xE2

Type: R/W Block - Protectable

Table 15. SEQUENCE command data specification for the BMR450 and BMR451

Bits	Purpose	Value	Description
15:9	Prequel Device	Varies	The 7 bit PMBus address of the prequel device in the sequencing order
8	Sequel Device	0	Must be 0
7:1	Reserved	Varies	The 7 bit PMBus address of the sequel device in the sequencing order
	Sets the low-side (sync FET) NLR threshold	0	Must be 0

Table 16. SEQUENCE command data specification for the BMR46x

Bits	Purpose	Value	Description
15	Prequel Enable	0	Disable, no prequel preceding this rail
		1	Enable, prequel to this rail is defined by bits 12:8
14:13	Reserved	0	Reserved
12:8	Prequel Rail GCB ID	0 to 31 (0x00 to 0x1F)	Set to the Rail GCB ID of the rail that should precede this device's rail in a sequence order.
7	Sequel Enable	0	Disable, no sequel following this rail
		1	Enable, sequel to this rail is defined by bits 12:8
6:5	Reserved	0	Reserved
4:0	Sequel Rail GCB ID	0 to 31 (0x00 to 0x1F)	Set to the Rail GCB ID of the rail that should follow this device's rail in a sequence order.

Data Length In Bytes: 4

Data Format: Custom

Factory Value: 0x00000000

Units: N/A

Reference:

Definition: This command sets which rail GCB IDs should be listened to for fault spreading information. The data sent is a 4-byte, 32-bit, bit vector where every bit represents a rail's GCB ID. A bit set to 1 indicates a device GCB ID to which the configured device will respond upon receiving a fault spreading event. In this vector, bit 0 of byte 0 corresponds to the rail with GCB ID 0. Following through, Bit 7 of byte 3 corresponds to the rail with GCB ID 31.

Note: The device/rail's own GCB ID should not be set within the GCB_GROUP command for that device/rail.

All devices in a current share rail must shutdown for the rail to report a shutdown.

If fault spread mode is enabled in USER_CONFIG (Bit 8 set to 1), the device will immediately shut down if one of its GCB_GROUP members fail. The device/rail will attempt its configured restart only after all devices/rails within the GCB_GROUP have cleared their faults.

If fault spread mode is disabled in USER_CONFIG (Bit 8 cleared to 0) and sequencing is enabled, the device will perform a sequenced shutdown as defined by the SEQUENCE command setting. The rails/devices in a sequencing set only attempt their configured restart after all faults have cleared within the GCB_GROUP.

If fault spread mode is disabled and sequencing is also disabled, the device will ignore faults from other devices and stay enabled.

ISHARE_CONFIG

Applies To: BMR46x

Command Code: 0xD2

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom

Table 17. TRACK_CONFIG command data specification

Bits	Purpose	Value	Description
7	Enables Voltage Tracking	0	Tracking is disabled
		1	Tracking is enabled
6:3	Reserved	-	Reserved
2	Controls the tracking ratio	0	Output tracks 100% of VTRK
		1	Output tracks 50% of VTRK
1	Controls Upper Track Limit	0	Output is limited by target voltage
		1	Output is limited by VTRK pin
0	Controls ramp-up behavior	0	The output is not allowed to track VTRK down before power-good
		1	The output is allowed to track VTRK down before power-good

Table 18. GCB_CONFIG command data specification

Bits	Purpose	Value	Description
15:13	Reserved	0	Reserved
1:8	Broadcast Group	0 to 31	Group number used for broadcast events. (i.e. Broadcast Enable and Broadcast Margin) Set this number to the same value for all rails/devices that should respond to each other's broadcasted event. This function is enabled by the bits 15 and 14 in the MISC_CONFIG command.
7:6	Reserved	-	Reserved
5	GCB TX Inhibit	0	GCB Transmission Inhibited
		1	GCB Transmission Enabled
4:0	GCB ID	0 to 31	Sets the rail's GCB ID for sequencing and fault spreading. This ID is set the same for all devices when they are implemented in a current share rail.

Factory Value: 0x0000

Units: N/A

Reference: AN307, Parallel Operation with Load Sharing

Definition: Configures the device for current sharing communication over the GCB bus. The command format is described in Table 19.

INTERLEAVE

Applies To: BMR450, BMR541, BMR46x

Command Code: 0x37

Type: R/W Word - Protectable

Data Length In Bytes: 2

Data Format: Custom (See Table 20)

Factory Value: 0x0000. The Default Group Number is 0x00 and the Default Number in the group is 0x00. The Default Position in the group is the Modulo 8 value of the four least significant bits of the 7 bit SMBus Address.

Units: N/A

Reference: Section 14.7 - PMBus Spec Part I

Definition: Configures the phase offset of a device that is sharing a common SYNC clock with other devices. Note that for Ericsson devices, a value of 0 for the Number in Group field is interpreted as 16, to allow for phase spreading groups of up to 16 devices.

The value of INTERLEAVE is not strictly adhered to when used in devices of a current sharing rail. For current sharing rails, INTERLEAVE is used to set the initial phase of the rail. The current share devices then automatically distribute their phase relative to the INTERLEAVE setting. Refer to AN307 for the phase control rules of a current shared rail.

PHASE_CONTROL

Applies To: BMR46x

Command Code: 0xF0

Type: R/W Byte - Protectable

Data Length In Bytes: 1

Data Format: Custom

Factory Value: 0x00

Units: N/A

Reference: AN307, Parallel Operation with Load Sharing

Definition: This command controls the adding and shedding of phases when the device is set up for current sharing. Writing a data value equal to 0x01 causes the device to be active (supplying power to the load). Writing a data value equal to 0x00 disables the devices and stops power transfer to the load. Any other data value is ignored.

Table 19. ISHARE_CONFIG command data specification

Bits	Purpose	Value	Description
15:8	IShare GCB ID	0 to 31 (0x00 to 0x1F)	Sets the current share rail's GCB ID for each device within a current share rail. Set to the same GCB ID as in GCB_CONFIG. This GCB ID is used for sequencing and fault spreading when used in a current share rail.
7:5	Reserved	0 to 7	Number of devices in current share rail -1. Example: 3 device current share rail, use 3 – 1 = 2
4:2	GCB TX Inhibit	0 to 7	Position of device within current share rail
1	GCB ID	0	Reserved
0		1	Device is a member of a current share rail
		0	Device is not a member of a current share rail

Table 20. INTERLEAVE command data specification

Bits	Purpose	Value	Description
15:12	Reserved	0	Reserved
11:8	Group Number	0 to 15	Sets a number to a group of interleaved rails
7:4	Number in Group	16, 1 to 15 (0 = 16)	Sets the number of rails in the group A value of 0 is interpreted as 16
3:0	Position in Group	0 to 15	Sets position of the device's rail within the group

Supervisory Commands

STORE_DEFAULT_ALL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x11

Type: Send Byte

Data Length In Bytes: 0

Data Format: N/A

Factory Value: N/A

Units: N/A

Reference: Section 11.2 - PMBus Spec Part II

Definition: Stores, at the DEFAULT level, all PMBus values that were written since the last restore command. To add to the DEFAULT store, perform a RESTORE_DEFAULT_ALL, write commands to be added, then STORE_DEFAULT_ALL. Wait 20 ms after a STORE_DEFAULT_ALL command before issuing another PMBus command.

RESTORE_DEFAULT_ALL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0x12

Type: Send Byte

Data Length In Bytes: 0

Data Format: N/A

Factory Value: N/A

Units: N/A

Reference: Section 11.3 - PMBus Spec Part I

Definition: Restores PMBus settings that were stored using STORE_DEFAULT_ALL. This command is automatically performed at power up. The security level is changed to level 1 following this command. Wait 20 ms after a RESTORE_DEFAULT_ALL command before issuing another PMBus command.

STORE_USER_ALL

Applies To: BMR46x

Command Code: 0x15

Type: Send Byte

Data Length In Bytes: 0

Data Format: N/A

Factory Value: N/A

Units: N/A

Reference: Section 11.6 - PMBus Spec Part I

Definition: Stores, at the USER level, all PMBus values that were changed since the last restore command. To add to the USER store, perform a RESTORE_USER_ALL, write commands to be added, then STORE_USER_ALL. Wait 20 ms after a STORE_USER_ALL command before issuing another PMBus command.

RESTORE_USER_ALL

Applies To: BMR46x

Command Code: 0x16

Type: Send Byte

Data Length In Bytes: 0

Data Format: N/A

Factory Value: N/A

Units: N/A

Reference: Section 11.7 - PMBus Spec Part I

Definition: Restores PMBus settings that were stored using STORE_USER_ALL. This command is automatically performed at power up. The values restored will overwrite the values previously loaded by the RESTORE_DEFAULT_ALL command. The security level is changed to Level 1 following this command. Wait 20 ms after a RESTORE_USER_ALL command before issuing another PMBus command.

PRIVATE_PASSWORD

Applies To: BMR46x

Command Code: 0xFB

Type: Block R/W

Data Length In Bytes: 9

Data Format: Custom

Factory Value: Product dependent

Units: N/A

Reference:

Definition: Sets the private password string for the USER_STORE. Password strings have the same format as the MFR_ID parameters.

PUBLIC_PASSWORD

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xFC

Type: Block R/W

Data Length In Bytes: 4

Data Format: Custom

Factory Value: 0x0000

Units: N/A

Reference:

Definition: Sets the public password string.

UNPROTECT

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xFD

Type: Block R/W

Data Length In Bytes: 32

Data Format: Custom

Factory Value: Model dependent

Units: N/A

Reference:

Definition: Sets a 256-bit (32-byte) parameter which identifies which commands are to be protected against write-access at lower security levels. Each bit in this parameter corresponds to a command according to the command's code. The command with a code of 0x00 (PAGE) is protected by the least-significant bit of the least- significant byte, followed by the command with a code of 0x01 and so forth. Note that all possible commands have a corresponding bit regardless of whether they are protectable or supported by the device. Clearing a command's UNPROTECT bit indicates that write-access to that command is only allowed if the device's security level has been raised to an appropriate level.

Although the UNPROTECT command is writeable at any security level, it only takes effect when it is stored in the Default or User store (storing in the Default store requires a security level of 3, and storing in the User store requires a security level of 2 or higher).

SECURITY_LEVEL

Applies To: BMR450, BMR451, BMR46x

Command Code: 0xFA

Type: Read Byte

Data Length In Bytes: 1

Data Format: Hex

Factory Value: 0x01

Units: N/A

Reference:

Definition: This command returns the current security level of the 3E regulator.

Glossary

Protectable: The data available in these commands are protectable. The UNPROTECT command is used for the protect function.

Linear Format: The linear format is defined in the PMBus specification. The data is a two byte value consisting of an exponent and a mantissa.

V_{OUT} Linear Mode format: The V_{OUT} Linear Mode is defined in the PMBus specification for a number of output voltage related commands. The Ericsson 3E Digital converters use the V_{OUT} Linear Mode with an exponent of -13. Thus the value of the commanded output voltage will be:

$$\text{Commanded Output Voltage} = \text{VOUT\_COMMAND Data} \times 2^{-13}$$

Custom Format: The custom format describes the command data as being a collection of single bits or sets of bits.

Reference documents

Ericsson Technical Specifications

BMR450 3E POL Regulators,
Document number EN/LZT 146 400
BMR451 3E POL Regulators,
Document number EN/LZT 146 401
BMR462 3 E POL Regulators,
Document number EN/LZT 146 436
BMR463 3 E POL Regulators,
Document number EN/LZT 146 434
BMR464 3 E POL Regulators,
Document number EN/LZT 146 435

Quick Reference Table

PMBus Commando	Command Code	Data bytes	PMBus Data Format	Data Units	Type	Factory Value Hex (Decimal)	AN302 page
OPERATION	0x01	1	CUSTOM		R/W Byte	N/A	8
ON_OFF_CONFIG	0x02	1	CUSTOM		R/W Byte	0x16	8
CLEAR_FAULTS	0x03	0	N/A		Send Byte	N/A	16
STORE_DEFAULT_ALL	0x11	0	N/A		Send Byte	N/A	33
RESTORE_DEFAULT_ALL	0x12	0	N/A		Send Byte	N/A	33
STORE_USER_ALL	0x15	0	N/A		Send Byte	N/A	33
RESTORE_USER_ALL	0x16	0	N/A		Send Byte	N/A	33
VOUT_MODE	0x20	1	CUSTOM		Read Byte	0x13	8
VOUT_COMMAND	0x21	2	VOUT LINEAR		Read Word	Model dependent	8
VOUT_TRIM	0x22	2	SIGNED VOUT LINEAR	V	Read Word	0x0000 (0)	9
VOUT_CAL_OFFSET	0x23	2	SIGNED VOUT LINEAR	V	Read Word	0x0000 (0)	9
VOUT_MAX	0x24	2	VOUT LINEAR	V	Read Word	1.1 × VOUT_COMMAND	9
VOUT_MARGIN_HIGH	0x25	2	VOUT LINEAR	V	Read Word	1.05 × VOUT_COMMAND	9
VOUT_MARGIN_LOW	0x26	2	VOUT LINEAR	V	Read Word	0.95 × VOUT_COMMAND	9
VOUT_TRANSITION_RATE	0x27	2	LINEAR	V	Read Word	0xBA00 (1.0)	9
VOUT_DROOP	0x28	2	LINEAR	mV/A	Read Word	0x0000 (0)	9
MAX_DUTY	0x32	2	LINEAR	%	Read Word	0xEAF8 (95)	10
FREQUENCY_SWITCH	0x33	2	LINEAR	kHz	Read Word	0xFA80(320)	10
INTERLEAVE	0x37	2	CUSTOM		Read Word	0x01	32
IOUT_CAL_GAIN	0x38	2	LINEAR	mV/A	Read Word	0xC200 (2)	10
IOUT_CAL_OFFSET	0x39	2	LINEAR	A	Read Word	0	10
VOUT_OV_FAULT_LIMIT	0x40	2	VOUT LINEAR	V	Read Word	1.15 x VOUT_COMMAND	10
VOUT_OV_FAULT_RESPONSE	0x41	1	CUSTOM		R/W Byte	0xBF	14
VOUT_UV_FAULT_LIMIT	0x44	2	VOUT LINEAR	V	Read Word	0.85 × VOUT_COMMAND	11
VOUT_UV_FAULT_RESPONSE	0x45	1	CUSTOM		R/W Byte	0xBF	14
IOUT_OC_FAULT_LIMIT	0x46	2	LINEAR	A	Read Word	Model dependent	11
IOUT_UC_FAULT_LIMIT	0x4B	2	LINEAR	A	Read Word	Model dependent	11
OT_FAULT_LIMIT	0x4F	2	LINEAR	C	Read Word	Model dependent	11
OT_FAULT_RESPONSE	0x50	1	CUSTOM		R/W Byte	0xBF	14
OT_WARN_LIMIT	0x51	2	LINEAR	C	Read Word	Model dependent	12
UT_WARN_LIMIT	0x52	2	LINEAR	C	Read Word	Model dependent	12
UT_FAULT_LIMIT	0x53	2	LINEAR	C	Read Word	Model dependent	12
UT_FAULT_RESPONSE	0x54	1	CUSTOM		R/W Byte	0xBF	14
VIN_OV_FAULT_LIMIT	0x55	2	LINEAR	V	Read Word	16 V	12

PMBus Commando	Command Code	Data bytes	PMBus Data Format	Data Units	Type	Factory Value Hex (Decimal)	AN302 page
VIN_OV_FAULT_RESPONSE	0x56	1	CUSTOM		R/W Byte	0xBF	15
VIN_OV_WARN_LIMIT	0x57	2	LINEAR	V	Read Word	15 V	12
VIN_UV_WARN_LIMIT	0x58	2	LINEAR	V	Read Word	1.03 × VIN_UV_FAULT_LIMIT	12
VIN_UV_FAULT_LIMIT	0x59	2	LINEAR	V	Read Word	UVLO	12
VIN_UV_FAULT_RESPONSE	0x5A	1	CUSTOM		R/W Byte	0xBF	15
POWER_GOOD_ON	0x5E	2	VOUT LINEAR	V	Read Word	0.9 × VOUT_COMMAND	10
TON_DELAY	0x60	2	LINEAR	ms	Read Word	0xD280 (10)	16
TON_RISE	0x61	2	LINEAR	ms	Read Word	0xD280 (10)	16
TOFF_DELAY	0x64	2	LINEAR	ms	Read Word	1 × TON_DLY	16
TOFF_FALL	0x65	2	LINEAR	ms	Read Word	1 × TON_RISE	16
STATUS_BYTE	0x78	1	CUSTOM		Read Byte	N/A	17
STATUS_WORD	0x79	2	CUSTOM		Read Word	N/A	17
STATUS_VOUT	0x7A	1	CUSTOM		Read Byte	N/A	17
STATUS_IOUT	0x7B	1	CUSTOM		Read Byte	N/A	17
STATUS_INPUT	0x7C	1	CUSTOM		Read Byte	N/A	17
STATUS_TEMPERATURE	0x7D	1	CUSTOM		Read Byte	N/A	17
STATUS_CML	0x7E	1	CUSTOM		Read Byte	N/A	17
STATUS_MFR_SPECIFIC	0x80	1	CUSTOM		Read Byte	N/A	18
READ_VIN	0x88	2	LINEAR	V	Read Word	N/A	18
READ_VOUT	0x8B	2	VOUT LINEAR	V	Read Word	N/A	18
READ_IOUT	0x8C	2	LINEAR	A	Read Word	N/A	18
READ_TEMPERATURE_1	0x8D	2	LINEAR	C	Read Word	N/A	18
READ_DUTY_CYCLE	0x94	2	LINEAR	%	Read Word	N/A	19
READ_FREQUENCY	0x95	2	LINEAR	kHz	Read Word	N/A	19
PMBUS_REVISION	0x98	1	HEX		Read Byte	N/A	20
MFR_ID	0x99		ASCII		Block R/W	<null>	20
MFR_MODEL	0x9A		ASCII		Block R/W	<null>	20
MFR_REVISION	0x9B		ASCII		Block R/W	<null>	21
MFR_LOCATION	0x9C		ASCII		BlockR/W	<null>	21
MFR_DATE	0x9D		ASCII		BlockR/W	<null>	21
MFR_SERIAL	0x9E		ASCII		BlockR/W	<null>	21
USER_DATA_00	0xB0		ASCII		BlockR/W	<null>	21
MFR_CONFIG	0xD0	2	CUSTOM		Read Word	Model dependent	21
USER_CONFIG	0xD1	2	CUSTOM		Read Word	Model dependent	23
ISHARE_CONFIG	0xD2	2	CUSTOM		Read Word	0x0000	31
GCB_CONFIG	0xD3	2	CUSTOM		Read Word	5-bit LSB of SMBus Address	30

PMBus Commando	Command Code	Data bytes	PMBus Data Format	Data Units	Type	Factory Value Hex (Decimal)	AN302 page
POWER_GOOD_DELAY	0xD4	2	LINEAR	ms	Read Word	0xD280 (10)	16
PID_TAPS	0xD5	9	CUSTOM		BlockR/W	Model dependent	26
NLR_CONFIG	0xD7	2	CUSTOM		Read Word	FC1	28
OVUV_CONFIG	0xD8	1	CUSTOM		R/W Byte	0x80	15
TEMPCO_CONFIG	0xDC	1	CUSTOM		R/W Byte	0x2C	29
DEADTIME	0xDD	2	LINEAR	ns	Read Word	Factory Value	29
DEADTIME_CONFIG	0xDE	2	CUSTOM		Read Word	Factory Value	29
DEADTIME_MAX	0xBF	4	CUSTOM		Block R/W	Factory Value	29
SEQUENCE	0xE0	2	CUSTOM		Read Word	0x0000	29
TRACK_CONFIG	0xE1	1	CUSTOM		R/W Byte	0x00	30
GCB_GROUP	0xE2	4	CUSTOM		BlockR/W	0x000000 0	30
DEVICE_ID	0xE4	16	ASCII		Block read	N/A	20
MFR_IOUT_OC_FAULT_RESPON-SE	0xE5	1	CUSTOM		R/W Byte	0xBF	14
MFR_IOUT_UC_FAULT_RESPON-SE	0xE6	1	CUSTOM		R/W Byte	0xBF	14
IOUT_AVG_OC_FAULT_LIMIT	0xE7	2	LINEAR	A	Read Word	Model Dependent	11
IOUT_AVG_UC_FAULT_LIMIT	0xE8	2	LINEAR	A	Read Word	Model Dependent	11
MISC_CONFIG	0xE9	2	CUSTOM		Read Word	0x0000	25
SNAPSHOT	0xEA	32	CUSTOM		Block read	N/A	19
PHASE_CONTROL	0xF0	1	CUSTOM		R/W Byte	0x00	32
SNAPSHOT_CONTROL	0xF3	1	CUSTOM		R/W Byte	N/A	19
SECURITY_LEVEL	0xFA	1	HEX		Read Byte	N/A	34
PRIVATE_PASSWORD	0xFB	9	ASCII		BlockR/W	0x000000 00000000000	33
PUBLIC_PASSWORD	0xFC	4	ASCII		BlockR/W	0x00000000	33
UNPROTECT	0xFD	32	CUSTOM		BlockR/W	0xFF…FF	34

NOTE: “Factory Values” refers to hard coded values or pin-strap values that are loaded upon a “FACTORY_RESTORE”

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