flex.
Power Modules
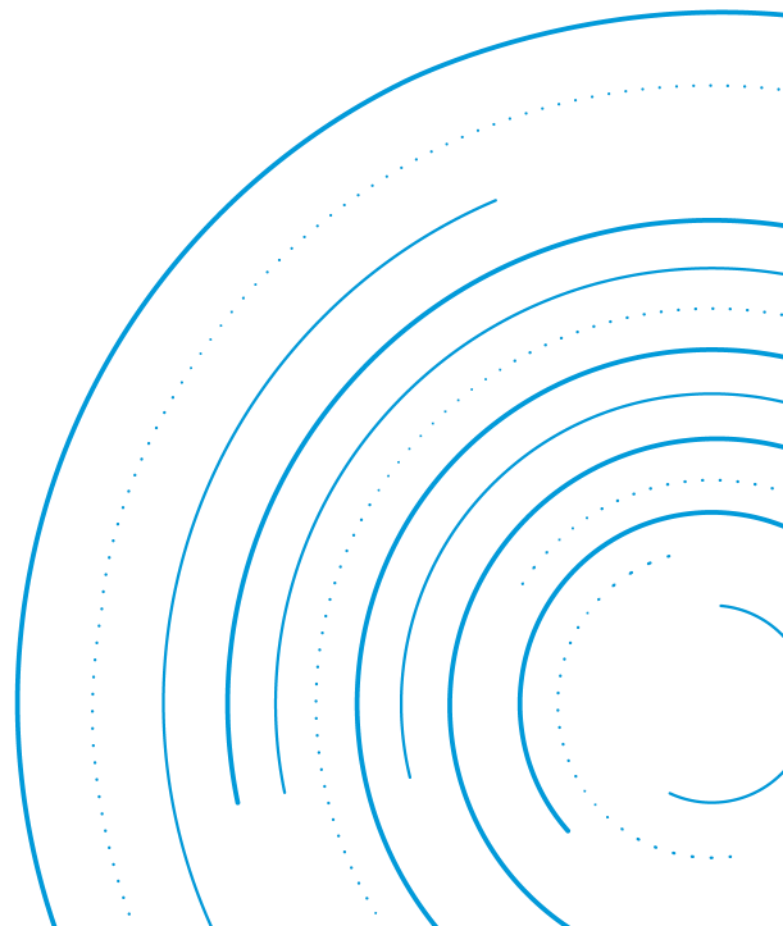
Event recorder for digital Intermediate Bus Converters

Abstract

This application note provides information on how to use our Flex Power Designer in order to read the event recorder for selected digital products.

This application note applies to the following products:

- **BMR490**

- **BMR491**

- **BMR310**

- **BMR458**

- **BMR480**

Contents

Introduction

The event recorder described in this document is available in firmware CAR 112130 R4. This firmware is incorporated in BMR310 series, BMR491 series and some upgraded versions of previous BMR458, BMR480 & BMR490.

Scope

This document provides an overview how to use Flex Power Designer (4.5.0 or above) to extract information from the event recorder and some examples on how to interpret it.

Event Recorder

Overview

A black box, or history event recorder, is provided to capture brick data at the time of fault occurrence. The intent is to assist in fault diagnosis.

- 48 life cycle & fault events
    - status flags according to PMBus spec part II rev 1.3 [1]

- life cycle events such as

    - boot
    - fault event recorder erased
    - VinOff/VinOn
    - Vin drop out
- 24 event slots are dedicated for faults
- Fault events are defined by setting SMBALERT_MASK
- First in - first out (in case the event recorder was not erased the oldest event gets discarded as new events are recorded)
- When either of the bank memory (fault or life) is full, the oldest 4 events are erased. A "full" event recorder therefore contains a minimum of 20 fault events and 20 life cycle events.
- Ability to clear the section of the event recorder that are dedicated for faults.

An event contains following information:
- EventID# < 2^16
- Time stamp 100 ms resolution < 13.6 years
- Status Word, non-sticky bits
- Status bytes for all PMBus status registers, non-sticky bits
- Telemetry for Vin, Vout, Iout and temperature (resolution below)

Resolution for telemetry

Vin: 0.5 V

Vout: $2^{(VoutMode+8)}$ V

- e.g. if VoutMode = -11, Vout resolution is $2^{(-11+8)}$ = 2^{-3} = 125 mV

Iout: Resolution depends on IOUT_OC_FAULT_LIMIT

- if IOUT_OC_FAULT_LIMIT < 85.4 A, Iout resolution is 0.5 A)

- if IOUT_OC_FAULT_LIMIT < 170.7 A, Iout resolution is 1 A)

- if IOUT_OC_FAULT_LIMIT >= 170.7 A, Iout resolution is 2 A)

Temperature: 1 °C

Unit off status codes

The above mentioned code applies only to the life cycle section of the event recorder

When the Status Word in an event is 0x0040 (Unit off) the StatusMfr byte indicates if the unit was turned on or off and with what source.

- – 0: Unit off, Source is internal configuration
- – 1: Unit off, Source is Primary RC
- – 2: Unit off, Source is Secondary RC
- – 3: Unit off, Source is PMBus
- – 4: Unit on, Source is internal configuration
- – 5: Unit on, Source is Primary RC
- – 6: Unit on, Source is Secondary RC
- – 7: Unit on, Source is PMBus

Power Good status codes

Power Good status applies only to the life cycle section of the event recorder.

When the Status Word in an event is 0x0800 (Power Good) the StatusMfr byte indicates if PG was asserted or de-asserted. 0 means power is not good, 1 means power is good

Manufacturer status codes (StatusMfr)

When status word is 0x0001 a system event is reported in the StatusMfr byte:

- – 0: BOOT_EVENT
- – 1: INPUT_LOW_ EVENT
- – 2: CANCEL_EVENT
- – 3: ERASE_EVENT
- – 4: CLR_EVENT
- – 5: ERASE_OVFL_EVENT
- – 6: TIME_ERASE_EVENT

All codes apply to the life cycle section of the event recorder. Only INPUT_LOW_DETECT, CANCEL_EVENT and ERASE_OVFL_EVENT apply to the fault section of the event recorder.

The BOOT_EVENT records time data when needed.

An INPUT_LOW_ EVENT might be recorded at shut down. The purpose of this event is to store time data at shutdown unless it has already been stored.

The maximum time between two events is 2.1 years. A time out will be recorded as a CANCEL_EVENT

An ERASE_EVENT is recorded in the life cycle section when the fault section is cleared.

A CLR_EVENT is recorded in the life cycle section when a CLEAR_FAULTS command is sent to the unit.
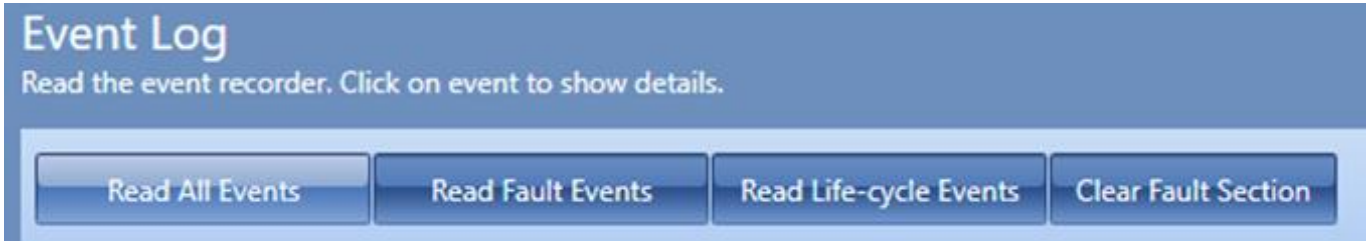
An ERASE_OVFL_EVENT indicates that the event recorder was overloaded while erasing old records but did recover.

A TIME_ERASE_EVENT indicates that the time stamp memory has been refreshed

Reading the event recorder

Reading all events

Clicking "Read All Events" will display every event stored in the event recorder.

Picture 1: event log in FPD

The latest fault events are displayed first, life cycle events are displayed next.

In the picture we see that 2 fault events are stored (id 0 & 1) and then follows the life cycle events (starting with id 22)

	Event ID	Timestamp	Vin[V]	Vout[V]	Iout[A]	Temperature[°C]	STATUS_WORD	VOUT	IOUT	INPUT	TEMP	CML	OTHER	MFR
⚠	1	0d 07h 27m 59.80s	30.00	0.00	0.00	0.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
❌	0	0d 07h 27m 53.80s	69.50	1.13	-1.00	25.00	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟢
⚠	22	0d 09h 17m 14.30s	30.00	0.00	0.00	0.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
⚠	21	0d 09h 17m 03.30s	37.00	0.50	1.00	25.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴

Picture 2: Reading all events

Read fault events

Click "Read Fault Events" will only display the faults

	Event ID	Timestamp	Vin[V]	Vout[V]	Iout[A]	Temperature[°C]	STATUS_WORD	VOUT	IOUT	INPUT	TEMP	CML	OTHER	MFR
⚠	1	0d 07h 27m 59.80s	30.00	0.00	0.00	0.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
❌	0	0d 07h 27m 53.80s	69.50	1.13	-1.00	25.00	🔴	🟢	🟢	🔴	🟢	🟢	🟢	🟢

Picture 3: Reading fault event

Normally there will be no faults recorded. A few might be displayed if the unit was subjected to testing.

In this case, a VinOverVoltage fault (id 0) was generated. Then by clicking the red dot under the "Input" column, the specific code can be read:

Event ID 1 is a system event ("INPUT_LOW_ EVENT", described above in section *Manufacture status codes*) used to keep track when voltage to the CPU is about to disappear.
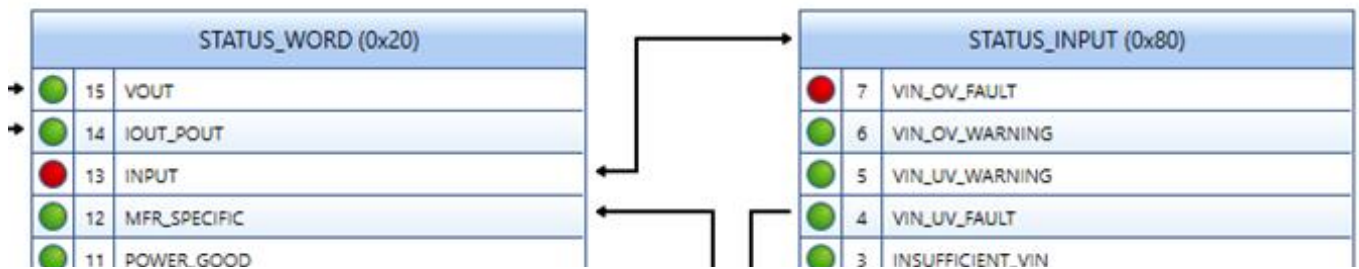
Picture 4: Detailed view - INPUT-VIN_OV_FAULT

Read life cycle events

Clicking "Read Life cycle Events" will only display Life cycle events:

Normally the list will be full and only the latest 20-24 events are displayed. Id 106 in this case is a BOOT_EVENT. This timestamp is generated within the current power cycle .

	Event ID	Timestamp	Vin[V]	Vout[V]	Iout[A]	Temperature[°C]	STATUS_WORD	VOUT	IOUT	INPUT	TEMP	CML	OTHER	MFR
⚠	106	0d 04h 21m 22.40s	0.00	0.00	-35.00	0.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
⚠	105	0d 04h 21m 22.00s	30.00	0.00	0.00	0.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
⚠	104	0d 04h 21m 09.00s	48.50	11.88	0.00	36.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
⚠	103	0d 04h 21m 01.60s	47.50	8.63	0.00	35.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
⚠	102	0d 04h 21m 01.60s	47.50	0.38	0.00	35.00	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴

Picture 5: Life cycle events

By finding boot events the different power cycles can be identified. BOOT_EVENT's are easily spotted since only the STATUS_WORD dot is red. The lower window gives additional information:

Picture 6: Example for INPUT_LOW_EVENT

Event id 106 is an "INPUT_LOW_ EVENT". As for event id 1 in the fault section, this event keeps track of supply voltage and some preparation before the CPU goes down.

Event id 102 is "Unit On by Primary RC".

Picture 7: Example for Unit on by Primary IC

Note that a time stamp preceding a boot event might have a time stamp close to the boot event. This is because there is no real time clock in the unit so time during power off cannot be specified.

Clearing the fault section

Click "Clear Fault Section" will clear the fault section of the event recorder.

Notes on clearing

When clearing the fault section of the event recorder, the event id number is reset but time stamp data is kept.

Clearing the fault section of the event recorder takes typically 121 ms. During this time fault handling is disabled and a PMBus host must not access the unit.

The Life cycle section cannot be cleared by the end user.

Limitations

A failure could easily lead to a "hiccup" mode whereas the memory quickly would be filled with the same error with time stamps only separated by fractions of a second. This would flush the memory from information possibly showing what led up to the failure.

To preserve memory in these situations a scheme is implemented that tries to limit what is recorded. Basically, a fault is never recorded twice unless another fault is reported, the unit is commanded off and on or power is cycled.

Events are only recorded when the output is on.

References

[1]   PMBus Power System Management Protocol Specification
        System management interface forum
        Revision 1.3 18 March 2014

Abbreviations

FPD   Flex Power Designer

I2C   Inter-Integrated Circuit (two wire interface)

IBC   Intermediate bus converter

MCU   Microcontroller Unit

NL   Non-linear

OCP   Over Current Protection

OVP   Over Voltage Protection

OTP   Over Temperature Protection

PMBus   Power Management Bus

PWM   Pulse Width Modulation

UCP   Under Current Protection

UVP   Under Voltage Protection

UTP   Under Temperature Protection
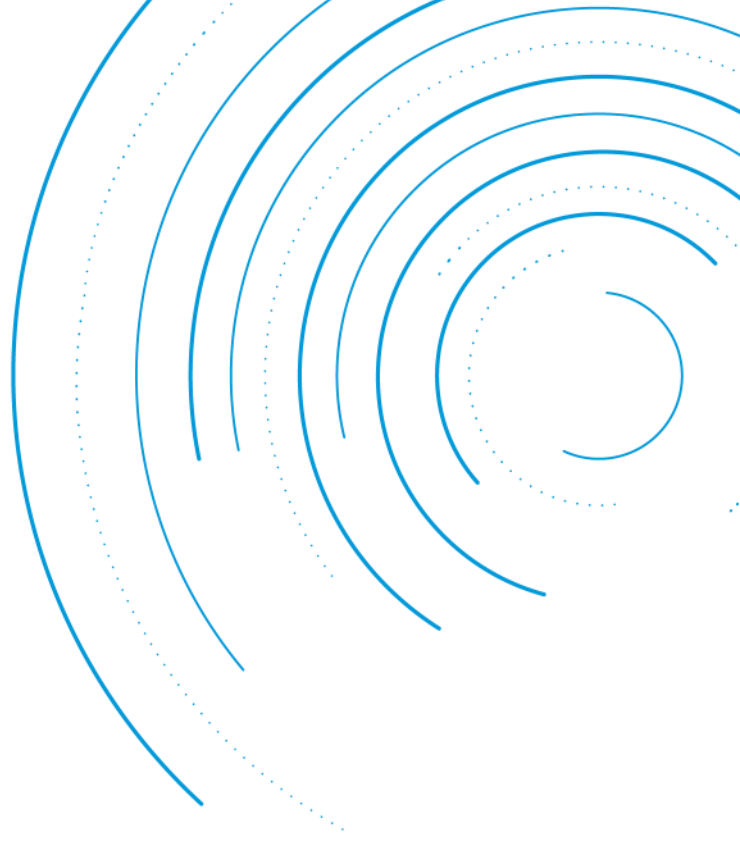
flex. Power Modules

Flex Power Modules, a business line of Flex, is a leading manufacturer and solution provider of scalable DC/DC power converters primarily serving the data processing, communications, industrial and transportation markets. Offering a wide range of both isolated and non-isolated solutions, its digitally-enabled DC/DC converters include PMBus compatibility supported by the powerful Flex Power Designer.

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