Distributor VME High Voltage Power Supply with Common Floating-GND

VDS 81 30x)1 8 channels with 3kV / 500µA
VDS 181 30x)1 24 channels with 3kV / 500µA

)1 x=p: polarity positive
)1 x=n: polarity negative

Operator's Manual

⚠

Attention!

-It is not allowed to use the unit if the covers have been removed.

-We decline all responsibility for damages and injuries caused by an improper use of the module. It is highly recommended to read the operators manual before any kind of operation.

Note

The information in this manual is subject to change without notice. We take no responsibility whatsoever for any error in the document. We reserve the right to make changes in the product design without reservation and without notification to the users.

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1. General Information

The VDS modules are High Voltage power supplies in 6U VME format, 164 mm deep, the 8 channel (VDS 80x) in single width (up to 3 kV), the 24 channel (VDS 180x) in double width. The units are controlled exclusively via the VME bus system.
The high voltage supplies provide a high precision output voltage with very low ripple and noise, even under full load. A separate hardware setting for voltage and current limits protects connected sensitive devices. Additionally, the maximal output current per channel is programmable via the interface.
The maximum output voltage for the channels 0 to 23 is defined through the position of the potentiometer V_{max}.
The maximum output current for the channels 0 to 23 is defined through the position of the potentiometer I_{max}.
It is possible to measure the hardware voltage and current limit, which have been set with reference to the maximum possible value at the socket below. 100 % V_{max} and I_{max} corresponds to 2,5 V.
The output voltage and current will be limited to the setting value (when KillEnable is not active) or will be shut off (KillEnable is active)

The green LED OK on the front panel is an over-all indicator for the status of all channels and the module. When Module is in good state, the LED is ON. If there is an abnormal state (e.g. any limit or bounds is exceeded or any output is shut off in KillEnable active mode) this LED is ‘OFF‘.
When a VME cycle addresses the module, the LED flashes.

The high voltage outputs are protected against overload and short circuit. The HV-GND is connected to the chassis and the GND.

The safety loop connector SL on the front panel is an interface to the global interlock signal. If the safety loop is active, output voltage is only present if a current in a range of 4 to 20 mA of any polarity is flowing at the safety loop connection point (i.e. safety loop is closed). If the safety loop is opened during operation then the output voltages are shut off without ramp and the corresponding bit in the ‘ModuleStatus’ will be cancelled respectively the corresponding bit in the ModuleEventStatus will be set. When loop is closed again the ModuleEventStatus bits have to be reset before channels can be switched ‘ON’ .
The pins of the loop are potential free, the internal voltage drop is ca. 3 V.
Coming from the factory the safety loop is not active (the corresponding bit is always set). Removing of an internal jumper activates the loop. The removing jumper “ILK” can be found on the topside of the board.

Coming from the factory the VME base address is set to 0x4000 (byte-wise, respective 0x2000 word-wise) with help of setting the internal jumper “ADR” on the topside of the board (see 4.4.1 Setting of Base Address).

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2. Technical data

	VDS 8 130x)1	VDS 18 130x)1
Channels	8	24
Output current I_O	max. 500 µA	
per channel at V_O	)1x = p: 0 to + 3000 V	
	)1x = n: 0 to - 3000 V	
Ripple and noise *)	f = 10 Hz to 100 MHz: < 20 mV (at max. load)	
Hardware current trip	Potentiometer I_{max} for all channels	
Hardware voltage limit	Potentiometer V_{max} for all channels	
Interface	VME interface, potential free	
Data format	floating-point single precision (setting and measurement)	
Voltage setting *)	Resolution better than 50 mV	
Voltage measurement *)	Resolution better than 50 mV	
	Accuracy: ± (0,01% ∗ V_O + 0,02% ∗ V_{nom}) for one year only guarantied in the setting range **1% ∗ V nom** < $V_O \leq V_{nom}$ Temperature coefficient: < 5 ∗ $10^{-5}/_K$	
Current measurement *)	Resolution: better than 100 nA	
	Accuracy: ± (0,1% ∗ I_O + 0,4% ∗ I_{nom}) for one year only guarantied in the setting range **1% ∗ V nom** < $V_O \leq V_{nom}$ Temperature coefficient: < 2 ∗ $10^{-3}/_K$	
	)* under following conditions: - the different voltage between the channels must be less than 600 V_O, e.g. $V_{O\,CH0}$ = 3000 V ⇒ $V_{O\,CHn} \geq$ 2400 V; (n= 1 to 7 resp. 24) - with standard sample rate 500/s and digital filter 64	
Stability	< 5 ∗ 10^{-5} (no load/load and Δ V_{IN})	
Rate of voltage change	up to 600 V/s , optional up to 2250 V/s via software	
Operating mode	Full module and channel control via VME	
Module status	green LED at all channels will work with status ready	
Protection loop (I_s) (2 pin Lemo-socket)	5 mA < I_s < 20 mA ⇒ module on I_s < 0,5 mA ⇒ module off	
Power requirements V_{IN}	± 12 V and + 5 V	
Packing	8 channels in VME cassette single width, 24 channels in VME cassette double width	
Connector	96-pin connector according to DIN 41612	
HV connectors	**8 channel version** SHV connectors	**16 channel version** 51-pin Redel Multipin-Connector 24 pins HV-out, ch **0** to ch **23** 4 pins Floating Common-GND, **C-RTN** 4 pins Common Crate-GND, **CCG** 2 pins Safety Loop, **SL PIN 22**, **SL PIN 30**

Pin assignment Multipin Redel HV connector:

3. Operating principle

The functionality of the module is achieved by hard and software in narrow interaction. Pure hardware functions are used there where none or only low temporal delays are authorized. All further functions are executed by firmware algorithms under control.

3.1 Hardware functions

3.1.1 Front panel indicators

3.1.2 Interlock input

The Interlock signal is an external signal. It can be used for fast switching the high voltage off e.g. in critical system states. At activation of the signal the high tension production is immediately switched off.

- global Interlock signal for switching off the whole module,
  - is made as a current loop (safety loop),
  - can be de-activated by a jumper;
- optional: single-channel switch off via individual TTL-inputs ;
  - input open or at high level: channel works normal
  - input connected to ground or at low level: channel is switched off

3.1.3 KillEnable / Kill / ClearKill

The signal SetKillEnable is a global control signal of the module. It defines how the module shall react in the case of an exceeding of the predefined voltage limit (Vmax) and the predefined current (Imax/Iset/Itrip). If KillEnable is active, then in the case of exceeding of Imax/Iset in the correlative channel a signal Kill is generated. This signal leads switches off the channel immediately without ramp. The signal Kill refers to the respective channel. An active signal Kill prevents distributing the high tension in the appropriate channel.
Is KillEnable inactive, so is changed in the case of reaching of Imax/Iset from the voltage control mode into the current control mode.
The signal ClearKill is also a module-wide acting signal. The signals Kill stored in the channels are set back with activation of ClearKill. Without this reset a new switch on isn't possible for the high voltage.

3.1.4 Modus: Voltage regulation / Current trip

Into dependence of the signal SetKillEnable just described and of the operating point of the channel output 2 work modes can be established:

<u>Voltage regulation (CV)</u>
In the mode Voltage regulation the module works as a constant voltage source. It has to be made sure that the predefined current value Iset or Itrip is greater than the output current adapting.

<u>Current trip</u>
This is a special case of the voltage regulation. The module usually provides a constant output voltage. With the help of Itrip a maximum current limit is provided. If this value is reached or exceeded (e.g. by arcs), a switching the channel off immediately is carried out.

3.2 Software functions

The qualities and functions described below are determined by the internal control of the module substantially. Main item is a microcontroller, which can measure or provide the analogous condition quantities over analogous I/O assemblies (ADC or DAC) and which determines the switching states of the hardware over digital I/O ports. The microcontroller controls and supervises the function of the voltage generation in the channels, the compliance with the limiting values, the occurence of certain events. Furthermore the communication on the interface is incumbent the microprozessor. Details to this are described in section 0.
Single module and channel characteristics are described in the following

3.2.1 Analogous values

Control items as well as status items come under this category
Analogous control items of the module

- voltage ramp speed
- restart time after recall set values
- voltage maximum set
- current maximum set
- ADC samples per second
- digital filter set

Analogous control items of a channel

- voltage set
- current trip set
- voltage bounds
- voltage interlock maximum set
- voltage interlock minimum set
- current bounds
- current interlock maximum set
- current interlock minimum set

Analogous status items of the module

- power supply voltages
- temperature
- maximum voltage
- maximum current

Analogous status items of a channel

- voltage out
- current out
- voltage nominal
- current nominal

3.2.1.1 Voltage bounds / Voltage interlock maximum set / Voltage interlock minimum set Current bounds / Current interlock maximum set / Current interlock minimum set

This function of the module can be used for a largely autonomous business. With the help of the control variables VoltageBounds, Voltage interlock maximum set, Voltage interlock minimum set and CurrentBounds, Current interlock maximum set, Current interlock minimum set tubes are formed around the specification values VoltageSet and CurrentSet. If the measured condition sizes output voltage or output current is within these tubes, the condition is as interpreted well. If the condition values leave the specification area, a corresponding fault event is registered.

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3.2.2 Digital values

The digital control and state variables serve the setting or re-registration of single module or channel functions.

3.2.2.1 Status and event

You distinguish at the condition items in status and event. In status words the current status of the item is given. Depending on current condition the bits are set or reset by the controller. Unlike this a event is registered in event words without resetting it when the event has finished. A reset of stored events is made by a specific write on the event word.

status	Summary of actual condition of module, channel or group
event	Event, that characterizes a former or actual special condition of module, channel or group

3.2.2.2 Event status and event mask

So that all event sources don't always have to be checked by events on arriving, the module has a hierarchical chain for the combination of the events to a single status bit which represents the short-term condition of the event hierarchy.
This structure for the event processing is built up uniformly for events from the module status, the status of the channels and the group status. An event status register and an event mask register exists respectively.

Event status	Combination of the events arrived till now
Event mask	Filter which checks the combination of individual events to sum events

A bit in the event mask is assigned to every event bit in the event status register. If the mask bit is set, the occurring of the accompanying event leads sum event to the activation. In turn these sum events are collected in an event status register and connected with an event mask register at this higher level.

⚠ A check of EventStatus and EventMask is made before the HV will be switched on. When bits are set in the EventStatus and the corresponding bits are set in the EventMask the HV cannot be switched on again before the EventStatus bits are reset by writing “1” on the corresponding bit positions.

The individual event in the channels sources are starting point of the event logic. Every appearing event (status = 1) is stored in a bit of the event status register of the channel. Bits in a mask register are assigned to these event bits in the channel event status register. A logical AND condition (bit wise) between the event bit and the accompanying mask bit is achieved that a result arises only there where the mask bit is set. A following logical OR of all these result bits yields the event status of the channel.

```
EventChannelStatus[n] =   (Channel[n].EventVoltageLimit AND Channel[n].MaskEventVoltageLimit) OR
                          (Channel[n].EventCurrentLimit AND Channel[n].MaskEventCurrentLimit) OR
                          (Channel[n].EventCurrentTrip AND Channel[n].MaskEventCurrentTrip) OR
                          (Channel[n].EventExtInhibit AND Channel[n].MaskEventExtInhibit) OR
                          (Channel[n].EventVoltageBounds AND Channel[n].MaskEventVoltageBounds) OR
                          (Channel[n].EventCurrentBounds AND Channel[n].MaskEventCurrentBounds) OR
                          (Channel[n].EventControlledVoltage AND Channel[n].MaskEventControlledVoltage) OR
                          (Channel[n].EventEmergency AND Channel[n].MaskEventEmergency) OR
                          (Channel[n].EventEndOfRamp AND Channel[n].MaskEventEndOfRamp) OR
                          (Channel[n].EventOnToOff AND Channel[n].MaskEventOnToOff ) OR
                          (Channel[n].EventInputError AND Channel[n].MaskEventInputError)
```

The condition of all event statuses of the channels is summarized in the register EventChannelStatus. For the choice or filtration of the channel events a mask register is also assigned (EventChannelMask) here. By means of the AND or ODER combination described in the channel the global signal AnyChannelEventActive of the channels is caused.

```
EventChannelActive =      (EventChannelStatus[0] AND EventChannelMask[0]) OR
                          (EventChannelStatus[1] AND EventChannelMask[1]) OR
                          ...
                          (EventChannelStatus[n] AND EventChannelMask[n])
```

Besides the channel based events special conditions can be registered of qualities of the complete module as an event. The following scheme applies to these module events:

EventModuleActive = (EventTemperatureNotGood AND MaskEventTemperatureNotGood) OR
(EventSupplyNotGood AND MaskEventSupplyNotGood) OR
(EventSafetyLoopNotGood AND MaskEventSafetyLoopNotGood)

Parallel to these evaluation structures, events of the groups are supervised. Are described how later, different groups (monitor group, time out group) also can cause events. These stored group events are summarized in the status word EventGroupStatus. With the help of the mask register EventGroupMask the event-collecting signal of the groups EventGroupActive is formed from these group events.

EventGroupActive = (EventGroupStatus[0] AND EventGroupMask[0]) OR
(EventGroupStatus[1] AND EventGroupMask[1]) OR
...
(EventGroupStatus[32] AND EventGroupMask[32])

All summarized events are summarized to the bit IsEventActive of the register ModuleStatus:
IsEventActive = EventChannelActive OR EventModuleActive OR EventGroupActive

3.2.3 Summarizing of channel characteristics into groups

The module shows a flexible group function. With the first one there is the possibility to set single specification values in all channels of the module with the help of Fix Groups. Furthermore Variable Groups can be defined. They allow to customize the logical structure of the module to the logical structure of the application. For these Variable Groups group types were pre-defined for whose application there isn't any restriction apart from the maximum number of groups (32). In particular got predefined:

- Set Group:
    - puts the condition of a channel characteristic for selected channels
    - no event generation
- Status Group:
    - represents the status (condition) of a channel characteristic for all channels
    - no event generation
- Monitor Group
    - monitors the condition of a channel characteristic for selected channels
    - event generation in condition change
    - reaction selectable (e.g.switch off)
- Timeout Group:
    - monitors the current trip in selected channels
    - It is prerequisite that the signal KillEnable is turned off
    - Event generation only after expiry of a predefined time within which the trip condition must be active
    - reaction selectable (e.g.switch off)

3.2.4 Reactions after events (Soft-Kill features)

In the event generating groups there is a choice between 4 reactions that have to be executed after the event is generated:

- switch off of the whole module, without ramp
    - high voltage of all channels of the module is switched off
- switch off of all members of the group, without ramp
    - high voltage of all channels of the group is switched off
- switch off of all members of the group, with ramp
    - high voltage of all channels of the group is ramped down
- no reaction
    - no change
    -

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3.2.5 Autostart

The Autostart is a functionality which allows a recall/reload of stored values to the corresponding set values. A delayed switch On of the high voltages can be configured. The delay time for a delayed switch ON will configured in RestartTimeAfterRecallSetValues.

The following set values can be stored permanently for

the channels:	ChannelControl
	ChannelEventMask
	VoltageSet
	CurrentTrip
	VoltageBounds/VoltageIlkMaxSet
	CurrentBounds/CurrentIlkMaxSet
	VoltageIlkMinSet
	CurrentIlkMinSet
	VoltageMaxSet
	CurrentMaxSet
the module:	ModuleControl
	ModuleEventMask
	ModuleEventChannelMask
	ModuleEventGroupMask
	VoltageRampSpeed
	CurrentRampSpeed
	RestartTimeAfterRecallSetValues
	ADCSamplesPerSecond
	DigitalFilter

Once a configuration of set values has been stored permanently, it can be “recalled/reloaded” anytime. For this purpose control and status bits are available in the ModulControl, ModulStatus and ModulEventStatus. The detailed explanation is made in chapter 4.2.1. Module registers, ModulStatus, ModulControl, ModuleEventStatus and RestartTimeAfterRecallSetValues.

4. VME-Interface

Access Mode:

Short supervisory access	(AM=0x2D)
Short non privileged access	(AM=0x29)

Command execution time:

The command execution times are 1 µs typically.

Memory space:

The control of the module is working via a data exchange in the RAM memory of the VME module. This is working with a space of 2048 bytes or 1024 words of 16-bit each.

The description of RAM addressing in this document is done both in a word addressing type and in a byte addressing type for simple memory count. The word addressing (addressing of a 2 byte = 1 word of 16 bit) is chosen because the access mode of the VME bus is word-wise. The access to any property of the module have to be done with two sequentially words. All properties such as VoltageSet or ModuleStatus are 32 bit information.

⚠ The VME decoder of the module accept a 32 bit information after the second word has been written. Other words can be transmitted in between.

The RAM memory space begins at the base address (BA). This is a 16bit address, where the 11 LSB bits are 0. The 5 MSB bits can be set by the customer to insert the module's RAM into the VME space.

in words:

binary:	BA	=	0bbbbb00 00000000	(with b={0|1})
hexadezimal:	BA	=	xy00	(with x={0..7}, y={0,4,8,C}.

in bytes:

binary:	BA	=	bbbbb000 00000000	(with b={0|1})
hexadezimal:	BA	=	xy00	(with x={0..F}, y={0,8}.

The MSB byte of the base address is stored in the non-volatile memory. It can be changed with help of a special write command (see special commands).

The factory setting is BA=0x2000 (addressing words in VME short access) resp. BA=0x4000 in Bytes

Partition of the memory (given in 16 bit words (in respect to VME short access)):

BA+0x0000 .. BA+0x004f	:	module data range of 80 words	48 words used
BA+0x0050 .. BA+0x006f	:	control registers for special use	
BA+0x0068 .. BA+0x007f	:	fixed groups range of 24 words 8 fixed groups ea. 2 words	16 words used
BA+0x0080 .. BA+0x037f	:	24 channel data blocks ea. 32 words 28 word used in ea. Block	768 words in total 672 words used
BA+0x0380 .. BA+0x03ff	:	32 variable groups (set, status, monitoring or timeout groups) data block ea. 4 words	128 Words

Partition of the memory (given in bytes):

BA+0x0000 .. BA+0x009f	:	module data . 160 bytes	64 Bytes
BA+0x00a0 .. BA+0x00bf	:	control registers for special use	
BA+0x00d0 .. BA+0x00e7	:	8 fixed groups ea. 4 bytes	32 Bytes
BA+0x03a0 .. BA+0x03ff	:	24 channel data blocks ea. 48 bytes	576 Bytes
BA+0x02c0 .. BA+0x033f	:	32 variable groups (set, status, monitoring or timeout groups)	

data block ea. 8 bytes	256 Bytes

4.1 Memory space

Module data

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0000	0x0000	ModuleStatus	uint32	r
0x0002	0x0004	ModuleEventStatus	uint32	r/w
0x0004	0x0008	ModuleEventMask	uint32	r/w
0x0006	0x000c	ModuleControl	uint32	r/w
0x0008	0x0010	ModulEventChannelStatus	uint32	r/w
0x000a	0x0014	ModulEventChannelMask	uint32	r/w
0x000c	0x0018	ModuleEventGroupStatus	uint32	r/w
0x000e	0x001c	ModuleEventGroupMask	uint32	r/w
0x0010	0x0020	VoltageRampSpeed	float	r/w
0x0012	0x0024	CurrentRampSpeed	float	r/w
0x0014	0x0028	VoltageMax	float	r
0x0016	0x002c	CurrentMax	float	r
0x0018	0x0030	SerialNumber	uint32	r
0x001a	0x0034	FirmwareRelease	uint8[4]	r
0x001c	0x0038	PlacedChannels	uint32	r
0x001e	0x003c	ChannelNumber_DeviceClass	uint16[2]	r
0x0020	0x0040	SupplyP5	float	r
0x0022	0x0044	SupplyP12	float	r
0x0024	0x0048	SupplyN12	float	r
0x0026	0x004c	Temperature	float	r
0x0028	0x0050	RestartTimeAfterRecallSetValues	uint32	r/w
0x002a	0x0054	ADCSamplesPerSecond	uint32	r/w
0x002c	0x0058	DigitalFilter	uint32	r/w
0x002e	0x005C	VendorId: const 'i','s','e','g' = 0x69736567	uint8[4]	r

Channels

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	
0x0080	0x0100	ChAddr[0]	begin of channel 0
0x00a0	0x0140	ChAddr[1]	begin of channel 1
0x00c0	0x0180	ChAddr[2]	begin of channel 2
0x00e0	0x01c0	ChAddr[3]	begin of channel 3
0x0100	0x0200	ChAddr[4]	begin of channel 4
0x0120	0x0240	ChAddr[5]	begin of channel 5
0x0140	0x0280	ChAddr[6]	begin of channel 6
0x0160	0x02c0	ChAddr[7]	begin of channel 7
0x0180	0x0300	ChAddr[8] [1]	begin of channel 8
0x0340	0x0680	ChAddr[22] [1]	begin of channel 22
0x0360	0x06c0	ChAddr[23] [1]	begin of channel 23

[1] only in module type VDS 18xx

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Channel data

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name	Data type	Access
0x00	0x00	ChannelStatus	uint16[2]	r
0x02	0x04	ChannelEventStatus	uint16[2]	r/w
0x04	0x08	ChannelEventMask	uint16[2]	r/w
0x06	0x0c	ChannelControl	uint16[2]	r/w
0x08	0x10	VoltageSet	float	r/w
0x0a	0x14	CurrentSet / CurrentTrip [2]	float	r/w
0x0c	0x18	VoltageMeasure	float	r
0x0e	0x1c	CurrentMeasure	float	r
0x10	0x20	VoltageBounds / VoltageIlkMaxSet [3]	float	r/w
0x12	0x24	CurrentBounds / CurrentIlkMaxSet [4]	float	r/w
0x14	0x28	VoltageIlkMinSet	float	r/w
0x16	0x2c	CurrentIlkMinSet	float	r/w
0x18	0x30	VoltageNominal / VoltageMaxSet [5]	float	r/(w)
0x1a	0x34	CurrentNominal / CurrentMaxSet [5]	float	r/(w)

2 when KilEnable=active
3 the addressed item are multiplexed by the ModuleControl bit setAVBND(0) – VoltageBounds, setAVBND(1) - VoltageIlkMaxSet
4 the addressed item are multiplexed by the ModuleControl bit setACBND(0) – CurrentBounds, setACBND(1) – CurrentIlkMaxSet
5 can be written in mode ModuleStatus IsStop = 1

Group data

Fixed Groups

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0068	0x00d0	SetVoltageAllChannels	float	r/w
0x006a	0x00d4	SetCurrentAllChannels	float	r/w
0x006c	0x00d8	SetVoltageBoundsAllChannels	float	r/w
0x006e	0x00dc	SetCurrentBoundsAllChannels	float	r/w
0x0070	0x00e0	SetEmergencyAllChannels	uint32	r/w
0x0072	0x00e4	SetOnOffAllChannels	uint32	r/w
0x0074	0x00e8	SetVoltageIlkMinSetAllChannels	float	r/w
0x0076	0x00ec	SetCurrentIlkMinSetAllChannels	float	r/w

Variable Groups

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	
0x0380	0x0700	GrAddr[0]	begin of group 0
0x0384	0x0708	GrAddr[1]	begin of group 1
0x0388	0x0710	GrAddr[2]	begin of group 2
0x038c	0x0718	GrAddr[3]	begin of group 3
0x0390	0x0720	GrAddr[4]	begin of group 4
0x0394	0x0728	GrAddr[5]	begin of group 5
0x0398	0x0730	GrAddr[6]	begin of group 6
0x039c	0x0738	GrAddr[7]	begin of group 7
0x03a0	0x0740	GrAddr[8]	begin of group 8
...	...	...	...
0x03fc	0x07f8	GrAddr[31]	begin of group 31

Hardware defined nominal values (ModuleControl SetStop(1), ModuleStatus IsStop(1))

Offset Words (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0380	0x0700	VoltageNominal channel 0	float	r
0x0382	0x0704	CurrentNominal channel 0	float	r
0x0384	0x0708	VoltageNominal channel 1	float	r
0x0386	0x070C	CurrentNominal channel 1	float	r
0x03d8	0x07b8	VoltageNominal channel 23	float	r
0x03de	0x07bC	CurrentNominal channel 23	float	r

If the module is in mode STOP the values of VoltageNominal and CurrentNominal appear.

Special Registers

Offset Words (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0050	0x00a0	NewBaseAddress	uint16	r/w
0x0051	0x00a2	NewBaseAddressXor	uint16	r/w
0x0052	0x00a4	OldBaseAddress	uint16	R
0x0053	0x00a6	OldBaseAddressXor	uint16	R
0x0054	0x00a8	NewBaseAddressAccepted	uint16	R
0x0055	0x00aa	NewBaseAddressAccepted	uint16	R
0x0056	0x00ac	SpecialControlStatus	uint32	R
0x0058	0x00b0	SpecialControlCommand	uint32	r/w

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4.2 Details to the memory space

4.2.1 Module registers

ModuleStatus

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0000	0x0000	ModuleStatus	uint32	r

ModuleStatus2 (reservation)

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ModuleStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
isKILE	isTMPG	isSPLYG	isMODG	isEVNTA	isSFLPG	isnRMP	isnSERR	isCCMPL	isSPMD	isIERR	ndSRVC	res	isSTOP	isILKO	isADJ

isKILE	IsKillEnable	Kill enable (1); Kill disable (0)
isTMPG	IsTemperatureGood	Module temperature good
isSPLYG	IsSupplyGood	Power supply good
isMODG	IsModuleGood	Module in state good
isEVNTA	IsEventActive	Any event is active and mask is set
isSFLPG	IsSafetyLoopGood	Safety loop closed
isnRMP	IsNoRamp	All channels stable, no ramp active .
isnSERR	IsNoSumError	Module without failure
isCCMPL	IsCommandComplete	All commands complete
isSPMD	IsSpecialMode	Module is in SpecialMode
isIERR	IsInputError	Input error in connection with a module access
ndSRVC	IsServiceNeeded	Module shows that a factory service is needed
isSTOP	IsStop	Modules is in state STOP, all high voltages are off
isILKO	IsInterlockOutput	InterlockOutput is active
isADJ	IsAdjustment	Activation of fine adjustment
Res	Reserved	

The status bits as there are IsTemperatureGood, IsSupplyGood, IsModuleGood, IsEventActive, IsSafetyLoopGood, IsNoRamp, IsNoSumError and IsServiceNeeded indicate the single status for the complete module.

The status bit IsCommandComplete indicates that all VME commands given to the module have been executed.

The condition bit IsEventActive is set, if at least one event is active in the channel, groups or module area and the corresponding masking bits are set.

The signal IsStop(1) shows that module is in mode STOP. In mode STOP it is possible to change the user defined nominal values VoltageMaxSet, CurrentMaxSet to a value lower or equal to the nominal values of hardware - VoltageNominal, CurrentNominal. When a user defined nominal value has been set, the module firmware will operate with it instead of the nominal value of hardware. In addition the Autostart function can be configured in this mode.

The signal IsAdjustment(1) shows that the high voltage is locked under fine adjustment. That means after a switch ON the high voltage will ramp to the value of set voltage followed by steps of adjustment until the measured value fits the set value and only bit wise correction of temperature drifts are necessary.

ModuleEventStatus

ModuleEventStatus

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0002	0x0004	ModuleEventStatus	uint32	r/w

ModuleEventStatus2 (reservation)

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ModuleEventStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	ETMPngd	ESPLYngd	res	res	ESFLPngd	res	res	res	res	EIERR	ESRVC	res	res	ERSTA	res

ETMPngd	EventTemperatureNotGood	Event: Temperature is above 55°C
ESPLYngd	EventSupplyNotGood	Event: at least one of the supplies is not good
ESFLPngd	EventSafetyLoopNotGood	Event: Safety loop is open
EIERR	EventInputError	Event: Input error in connection with a module access
ESRVC	EventServiceNeeded	Event: Module needs a factory service
ERSTA	EventRestart	Event: Restart of HV after the RestartTimerAfterRecallSetValues
res	Reserved	

These bits are set when the condition occurs. They can be reset individually by writing ones. If the triggering event is still active, a reset isn't possible.

ModuleEventMask

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0004	0x0008	ModuleEventMask	uint32	r/w

ModuleEventMask1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	METMPngd	MESPLYngd	res	res	MESFLPngd	res	res	res	res	MEIERR	res	res	res	MERSTA	res

METMPngd	MaskEventTemperatureNotGood	MEventMask: Temperature is above 55°C
MESPLYngd	MaskEventSupplyNotGood	MEventMask: at least one of the supplies is not good
MESFLPngd	MaskEventSafetyLoopNotGood	MEventMask: Safety loop (SL) is open
MEIERR	MaskEventInputError	MEventMask: Input error in connection with a module access
MERSTA	MaskEventRestart	MEventMask: Restart of HV after the RestartTimeAfterRecallSetValues
res	Reserved	

This register decides whether a pending event leads to the sum event flag of the module or not. If the a bit of the mask is set and the corresponding event in the ModuleEventStatus is active the bit IsEventActive in the ModuleStatus register is set.

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ModuleControl

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0006	0x000c	ModuleControl	uint3216	r/w

ModuleControl2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ModuleControl1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
doSVSV	setKILE	res	setADJ	res	ILVL2	ILVL1	ILVL0	res	doCLEAR	res	res	setAON	setSTOP	doRCSV	setSPMD
0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0

doSVSV	DoSaveSetValues	DoSaveSetValues(1); no action (0)
setKILE	SetKillEnable	Kill enable SetKillEnable(1); Kill disable SetKillEnable(0)
setADJ	SetAdjustment	Activation of fine adjustment
ILVL[2..0]	IntLevel[2..0]	Code for VME-Interrupt-Level (1 to 7); Level 0 means: no VME Interrupt
doCLEAR	DoClear	Clears Kill (hardware) signals and all event signals of module and channels
setAON	SetActionOn	SetActionOn(1) activate a time delayed switch ON of the high voltages after a recall of the stored values when ChannelControl SetON(1)
setSTOP	SetStop	SetStop(1);
doRCSV	DoRecallSetValues	DoRecallSetValues(1); no action (0)
setSPMD	SetSpecialMode	Set into SpecialMode, for special tasks only Attention: Return from SpecialMode only with SpecialControlCommands e.g. EndSpecial
res	Reserved	

The signal SetAdjustment is used to enable an adjustment of the HV precisely in case of temperature drifts.

The signal SetKillEnable controls the reaction of the channels to extraordinary events, e.g. overcurrent. The signal is set module-wide, while the reaction (e.g. turn off the high voltage) is done in the correlating channel.

The signals SetStop, SetActionOn, DoSaveSetValues and DoRecallSetValues will be used to realize the Autostart functionality which allows a store and recall/reload of stored values. A time delay of switch ON high voltages is configurable.

SetStop(1) The high voltage of all channels will be decreased with the VoltageRamp and switched OFF. The module firmware goes in the state IsStop(1),ModuleStatus when all channels are OFF.

doSaveSetValues(1) –when setStop(1) only
will start a task to store the set values permanently, listed in chapter 3.2.5 Autostart, when the module is in state IsStop(1). When the task is finished the bit is reset to zero.

SetStop(0) A software restart will be executed whereas the stored set values are reloaded from flash memory. Depending from the bit SetActionOn a delayed switch ON of high voltage will realized.

DoRecallSetValues(1)
execute a recall of the stored set values. The high voltages will be switched on after the value RestartTimeAfterRecallSetValues when a delayed switch ON has been configured SetActionOn(1).

SetActionOn(1)
A recall of the stored values with time delayed switch ON of the high voltages will cause the bit set ERSTA of ModuleEventStatus.

Short overview about reaction in dependency of KillEnable:

	Vout >= Voltage limit	Iout >= Current limit	Iout >= Iset
SetKillEnable=1 (ON)	Kill =1;Vout -> 0; Vset=0;	Kill=1; Vout -> 0; Vset=0;	Vout -> 0, Vset=0
SetKillEnable=0 (OFF)	Vout = Voltage limit	Iout = Current limit	Iout = Iset

The signal SetAdjustment switches on the fine justification of the high voltage, around temperature drifts compensate by the DAC. It is activated after reset.

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ModuleEventChannelStatus

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
`0x0008`	`0x0010`	ModuleEventChannelStatus	uint32	r/w

ModuleEventChannelStatus2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

ModuleEventChannelStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

The n-th bit of the register is set, if an event is active in the n-th channel and the associated bit in the EventMask register of the n-th channel is set too.

CHn = EventStatus[n] & EventMask[n]

The bits can be reset individually by writing ones. If the triggering event is still active, a reset isn't possible.

ModuleEventChannelMask

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
`0x000a`	`0x0014`	ModuleEventChannelMask	uint32	r/w

ModuleEventChannelMask2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

ModuleEventChannelMask1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

This register decides whether a pending event leads to the sum event flag of the module or not. If the n-th bit of the mask is set and the n-th channel has an active event in the ModuleEventChannelStatus the bit isEventActive in the ModuleStatus register is set.

ModuleEventGroupStatus

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x000c	0x0018	ModuleEventGroupStatus	uint32	r/w

ModuleEventGroupStatus2

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
GR31	GR30	GR29	GR28	GR27	GR26	GR25	GR24	GR23	GR22	GR21	GR20	GR19	GR18	GR17	GR16

ModuleEventGroupStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
GR15	GR14	GR13	GR12	GR11	GR10	GR9	GR8	GR7	GR6	GR5	GR4	GR3	GR2	GR1	GR0

The n-th bit of this double word register is set, if an event is active in the n-th group.

ModuleEventGroupMask

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x000e	0x001c	ModuleEventGroupMask	uint32	r/w

ModuleEventGroupMask2

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
GR31	GR30	GR29	GR28	GR27	GR26	GR25	GR24	GR23	GR22	GR21	GR20	GR19	GR18	GR17	GR16

ModuleEventGroupMask1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
GR15	GR14	GR13	GR12	GR11	GR10	GR9	GR8	GR7	GR6	GR5	GR4	GR3	GR2	GR1	GR0

This register decides whether a pending event leads to the sum event flag of the module or not. If the n-th bit of the mask is set and the n-th group has an active event in the ModuleEventGroupStatus the bit isEventActive in the ModuleStatus register is set.

VoltageRampSpeed

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0010	0x0020	VoltageRampSpeed	float	r/w

The speed of the voltage ramp in percent of the nominal voltage of the channel. The upper limit is 20%. The lower limit is equivalent to 1mV/s.

CurrentRampSpeed (reservation)

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0012	0x0024	CurrentRampSpeed	float	r/w

not realized in VDS x0x

VoltageMax

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0014	0x0028	VoltageMax	float	r

VoltageMax is the actual value of the trim potentiometer of the front panel, given in per cent. In conjunction with the nominal voltage VoltageNominal of a channel one can calculate the actual maximal output voltage of the channel.

VoltageLimit = VoltageNomial * VoltageMax

This voltage value VoltageLimit is the reference for setting the status bit IsVoltageLimitExceeded.

CurrentMax

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0016	0x002c	CurrentMax	float	r

CurrentMax is the current value of the trim potentiometer of the front panel, given in per cent. In conjunction with the nominal current CurrNom of a channel one can calculate the actual maximal output current of the channel.

CurrentLimit = CurrentNomial * CurrentMax

This current value CurrentLimit is the reference for setting the status bit IsCurrentLimitExceeded.

SerialNumber

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0018	0x0030	SerialNumber	uint32	r

The Serial number of the module as long integer value.

FirmwareRelease

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x001a	0x0034	FirmwareRelease	uint8[4]	r

The firmware release as a sequence of four unsigned short integer values.

PlacedChannels

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x001c	0x0038	PlacedChannels	uint16	r

For each existent channel the corresponding bit is set in this word.
For example, a fully equipped 4 channel module VHS 40x has PlacedChannels = 0x000f, a fully equipped 12 channel module VHS C0x has PlacedChannels = 0x0fff .

ChannelNumber_DeviceClass

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x001F	0x003E	ChannelNumber DeviceClass	uint16[2]	r

ChannelNumber: 8 or 24
It exists two kinds of VDS modules. One kind in single width for a number of 8 HV channels and a second one in double width for a number of 24 HV channels.

DeviceClass 29
This is a constant value to divide device families in iseg firmware and applications.
For VDS x0x this value is 29 (0x1d).

SupplyP5

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0020	0x0040	SupplyP5	float	r

The actual value of the +5 line of the power supply, given in V.

SupplyP12

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0022	0x0044	SupplyP12	float	r

The actual value of the +12 line of the power supply, given in V.

SupplyN12

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0024	0x0048	SupplyN12	float	r

The actual value of the -12 line of the power supply, given in V.

Temperature

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0026	0x004c	Temperature	float	r

The actual temperature of the board, given in °C.

RestartTimeAfterReloadSetValues

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0028	0x0050	RestartTimeAfterRecallSetValues	uint32	r/w

This is value for a delay until restart the HV - activation of the stored setON of the corresponding channels – after the control command doRecallSetValues has been sent.
RestartTimeAfterRecallSetValues unit [ms]

ADC SamplesPerSecond SPS

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x002a	0x0054	ADCSamplesPerSecond	uint32	r/w

Adjusts the number of averages of the programmable ADC filter of the HV module. Possible values are 500, 100, 60 and 50 SPS. Notch should be set with 60 SPS using a 110V line with 60Hz and 50 SPS using a 230V line with 50Hz in order to improve the common-mode rejection of these frequencies. However a SPS value of the ADC will increase the main loop time by 4*1/SPS multiplied with the number of channels for device.
Factory settings: 500 SPS

DigitalFilter

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x002c	0x0058	**DigitalFilter**	uint32	r/w

The digital filter in the firmware of the processor reduces the white noise of the analog values of channel VoltageMeasure, channel CurrentMeasure. The digital filtering gives the possibility to get a higher precision and to react fast on changes of the measured values. The filter is not used during a voltage ramp. The filter is restarted after a significant change of the signal. The value DigitalFilter represents the number of filter steps.
Factory settings: 64

VendorId

Offset Words (rel to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x002E	0x005C	VendorId	Uint8[4]	r

This is a constant value to identify the vendor / manufacturer. The value is {0x69;0x73;0x65;0x67}, or in ASCII {“i”;”s”;”e”;”g”}.

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4.2.2 Channel registers

The channel Status and Control information will allow to monitor and control output voltage, output current, control and status information of each channel. These detailed information can be collected in groups and several channel can be set and/ or controlled with help of group commands).

ChannelStatus

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name	Data type	Access
0x00	0x00	ChannelStatus	uint32	R

ChannelStatus2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ChannelStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
isVLIM	isCLIM	isTRIP	isEINH	isVBNDs	isCBNDs	res	res	isCV	isCC	isEMCY	isRAMP	isON	isIERR	res	res

isVLIM	IsVoltageLimitExceeded	Hardware- voltage limit has been exceeded (when KillEnable=0)
isCLIM	IsCurrentLimitExceeded	Hardware- current limit has been exceeded (when KillEnable=0)
isTRIP	IsTripSet	Trip is set when Iset has been exceeded (when KillEnable=1)
isEINH	IsExtInhibit	External Inhibit
isVBNDs	IsVoltageBoundsExceeded	Voltage out of bounds
isCBNDs	IsCurrentBoundsExceeded	Current out of bounds
isCV	IsControlledVoltage	Voltage control active
isCC	IsControlledCurrent	Current control active
isEMCY	IsEmergency	Emergency off without ramp
isON	IsOn	On
isRAMP	IsRamping	Ramp is running
isIERR	IsInputError	Input error
res	Reserved	

The channel status register describes the actual status. Depending on the status of the module the bits will be set or reset.
The bit IsInputError is set if the given parameter isn't plausible or it exceeds the module parameters (e.g. if the command Vset=4000V is given to a module with NomianalVoltage=3000V). The bit IsInputError isn't set if the given values are temporarily not possible (e.g. Vset=2800 at a module with NominalVoltage=3000V, but HardwareLimitVoltage=2500V). A certain signature which kind of input error it is does not yet happen.

The status bits isVoltageBoundsExceeded resp. isCurrentBoundsExceeded are set:

if (| Vmeas – Vset | > Vbounds) isVoltageBoundsExceeded =1;
if (| Imeas – Iset | > Ibounds) isCurrentBoundsExceeded =1;

ChannelEventStatus

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name	Data type	Access
0x02	0x04	ChannelEventStatus	uint32	r/w

ChannelEventStatus2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ChannelEventStatus1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
EVLIM	ECLIM	ECTRP	EEINH	EVBNDs	ECBNDs	res	res	ECV	ECC	EEMCY	EEOR	Eon2Off	EIER	res	res

EVLIM	EventVoltageLimit	Event: Hardware- voltage limit has been exceeded
ECLIM	EventCurrentLimit	Event: Hardware- current limit has been exceeded
ETRIP	EventTrip	Event: Trip is set when Iset has been exceeded (when KillEnable=1)
EEINH	EventExtInhibit	Event external Inhibit
EVBNDs	EventVoltageBounds	Event: Voltage out of bounds
ECBNDs	EventCurrentBounds	Event: Current out of bounds
ECV	EventControlledVoltage	Event: Voltage control
ECC	EventControlledCurrent	Event: Current control
EEMCY	EventEmergency	Event: Emergency
EEOR	EventEndOfRamp	Event: End of ramp
EOn2Off	EventOnToOff	Event: Change from state "On" to "Off" without ramp [1]
EIER	EventInputError	Event: Input Error
res	Reserved	

An event bit is permanently set if the status bit is 1 or changes to 1. Different to the status bit an event bit isn't reset automatically. A reset has to be done by customer by writing an 1 to this event bit.

ChannelEventMask

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name	Data type	Access
0x04	0x08	ChannelEventMask	uint32	r/w

ChannelEventMask2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ChannelEventMask1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
MEVLIM	MECLIM	MECTRP	MEEINH	MEVBNDs	MECBNDs	res	res	MECV	MECC	MEEMCY	MEEOR	MEOn2Off	MEIERR	res	res

MEVLIM	MaskEventVoltageLimit	EventMask: Hardware- voltage limit has been exceeded
MECLIM	MaskEventCurrentLimit	EventMask: Hardware- current limit has been exceeded
METRIP	MaskEventTrip	EventMask: Voltage limit or Current limit or Iset has been exceeded (when KillEnable=1)
MEEINH	MaskEventExtInhibit	EventMask: External Inhibit
MEVBNDs	MaskEventVoltageBounds	EventMask: Voltage out of bounds
MECBNDs	MaskEventCurrentBounds	EventMask: Current out of bounds
MECV	MaskEventControlledVoltage	EventMask: Voltage control
MECC	MaskEventControlledCurrent	EventMask: Current control
MEEMCY	MaskEventEmergency	EventMask: Emergency off
MEEOR	MaskEventEndOfRamp	EventMask: End of ramp
MEOn2Off	MaskEventOnToOff	EventMask: Change from state on to off without ramp
MEIER	MaskEventInputError	EventMask: Input Error
res	Reserved	

ChannelControl

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name	Data type	Access
0x06	0x0c	ChannelControl	uint16	r/w

ChannelControl2

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

ChannelControl1

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
res	res	res	res	setAVBND	setACBND	res	res	res	res	setEMCY	res	setON	res	res	res

setEMCY	SetEmergency	Set “Emergency”: shut off the channel without ramp, clear the Vset value
setON	SetOn	Set On, if 1; set Off if 0: ramp the output to Vset or to Zero
setAVBND	SetAsymmetricVoltageBounds	Set setAVBND, if 1 - set asymmetric voltage bounds; if 0 - set symmetric voltage bounds
setACBND	SetAsymmetricCurrentBounds	Set setACBND, if 1 - set asymmetric current bounds; if 0 - set symmetric current bounds
res	Reserved	

The signals SetOn and SetEmergency control basic functions of the channel. The signal SetOn is switching ON the HV of the channel and is a precondition for giving voltage to the output. As far as a VoltageSet has been set and no event has occurred and is not registered yet (in minimum, bit 5 and bit 10 to 15 of ChannelEventStatus register must be 0), a start of a HV ramp will be synchronized (a ramp is a software controlled, time proportionally increase / decrease of the output voltage).

There are methods to observe the high voltage via the measured values of voltage and current in stable state outside of a ramp. For this purpose the set values VoltageBounds, VoltageMinIlkSet, CurrentBounds and CurrentMinIlkSet are used to define a tolerance bounds for the measurement values. When the measured values crossing the defined bounds an event will be generated.
The ChannelControl bits setAVBND and setACBND define whether the tolerance bounds are asymmetric setA[V/C]BND(1) to the set value as an absolute value or symmetric setA[V/C]BND(0) as a relative value to the set value.

setAVBND(1)
VoltageIlkMaxSet ≤ VoltageMeasure ≤ VoltageIlkMaxSet — No event!

VoltageIlkMaxSet > VoltageMeasure or
VoltageMeasure > VoltageIlkMaxSet — IsVoltageBoundsExceeded(1), ModuleStatus
EventVoltageBounds(1), ModuleEventStatus

setAVBND(0)
VoltageSet-VoltageBounds ≤ VoltageMeasure ≤ VoltageSet+VoltageBounds — No event!

VoltageSet-VoltageBounds > VoltageMeasure or
VoltageMeasure > VoltageSet+VoltageBounds — IsVoltageBoundsExceeded(1), ModuleStatus
EventVoltageBounds(1), ModuleEventStatus

setACBND(1)
CurrentIlkMaxSet ≤ CurrentMeasure ≤ CurrentIlkMaxSet — No event!

CurrentIlkMaxSet > CurrentMeasure or
CurrentMeasure > CurrentIlkMaxSet — IsCurrentBoundsExceeded(1), ModuleStatus
EventCurrentBounds(1), ModuleEventStatus

setACBND(0)
CurrentSet-CurrentBounds ≤ CurrentMeasure ≤ CurrentSet+CurrentBounds — No event!

CurrentSet-CurrentBounds > CurrentMeasure or
CurrentMeasure > CurrentSet+CurrentBounds — IsCurrentBoundsExceeded(1), ModuleStatus
EventCurrentBounds(1), ModuleEventStatus

A special feature is the correct changeover from symmetric to asymmetric bounds or from asymmetric to symmetric bounds:

setA[V/C]BND(0) to setA[V/C]BND(1)

Voltage: VoltageIlkMaxSet=VoltageSet+VoltageBounds
VoltageIlkMinSet=VoltageSet-VoltageBounds

Current: when ChannelStatus isCC(1)
CurrentIlkMaxSet=CurrentSet+CurrentBounds
CurrentIlkMinSet=CurrentSet-CurrentBounds
ChannelStatus isCC(0), ChannelStatus isON(1), ChannelStatus isRAMP(0)
CurrentIlkMaxSet=CurrentMeasure+CurrentBounds
CurrentIlkMinSet=CurrentMeasure-CurrentBounds

setA[V/C]BND(1) to setA[V/C]BND(0)

Voltage: VoltageBounds=(VoltageIlkMaxSet- VoltageIlkMinSet)/2

Current: CurrentBounds=(CurrentIlkMaxSet-CurrentIlkMinSet)/2

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VoltageSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x08	0x10	VoltageSet	Vset	float	r/w

The value of VoltageSet (Vset) is the preset for voltage regulation. Valid values are between 0 and the actual hardware limit value. This actual hardware limit value computes as follows:

voltage limit = VoltageNominal * VoltageMax

When writing values between the actual hardware limit and the nominal value, then the module reduces these values to the value of the actual hardware limit. When writing values above the nominal data or smaller than 0 an input error is indicated by setting the bit IsInputError.

CurrentTrip

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x0a	0x14	CurrentTrip	Iset/Itrip	float	r/w

The value of CurrentTrip is used for a current compare by software. Valid values are between 0 and the actual hardware limit value. This actual hardware limit value computes as follows:

current limit of channel x = CurrentNominal * CurrentMax

When writing values between the actual hardware limit and the nominal value, then the module reduces these values to the value of the actual hardware limit. When writing values above the nominal data or smaller than 0 an input error is indicated by setting the bit IsInputError.
In case of KillEnable=1 there no current regulation in the module active. Then the item CurrentSet (Iset) is replaced by CurrentTrip (Itrip). When exceeding this value a current trip event is registered ad the voltage output is set to 0V.

VoltageMeasure

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x0c	0x18	VoltageMeasure	Vmeas	float	r/w

VoltageMeasure (Vmeas) is the actual measured value of voltage, in V.

CurrentMeasure

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x0e	0x1c	CurrentMeasure	Imeas	float	r/w

CurrentMeasure (Imeas) is the actual measured value of current, in A.

VoltageBounds
VoltageIlkMaxSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x10	0x20	VoltageBounds	Vbounds	float	r/w
0x10	0x20	VoltageIlkMaxSet	VIlkMaxSet	float	r/w

VoltageBounds:
By the help of VoltageBounds (Vbounds) there is defined a region around VoltageSet (Vset), where the actual values are interpreted as good. This region is defined as follows:

| Vmeas – Vset | ≤ Vbounds

If this area is left, a corresponding event is registered.VoltageIlkMaxSet:
By the help of VoltageIlkMaxSet (VIlkMaxSet) and VoltageIlkMinSet (VIlkMinSet) there is defined a region around VoltageSet (Vset), where the actual values are interpreted as good. This region is defined as follows:

VIlkMinSet ≤ Vmeas ≤ VIlkMaxSet

If this area is left, a corresponding event is registered.

CurrentIlkMaxSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x12	0x24	CurrentIlkMaxSet	IIlkMaxSet	float	r/w

CurrentIlkMaxSet:
By the help of CurrentIlkMaxSet (IIlkMaxSet) and CurrentIlkMinSet (IIlkMinSet) there is defined a region around CurrentSet (Iset), where the actual current are interpreted as good. This region is defined as follows:

IIlkMinSet ≤ Imeas ≤ IIlkMaxSet

If this area is left, a corresponding event is registered.

VoltageIlkMinSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x14	0x28	VoltageIlkMinSet	VIlkMinSet	float	r/w

see VoltageIlkMaxSet above

CurrentIlkMinSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x16	0x2c	CurrentIlkMinSet	IIlkMinSet	float	r/w

see CurrentIlkMaxSet above

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VoltageNominal / VoltageMaxSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x18	0x30	VoltageNominal / VoltageMaxSet	Vnom	float	r/(w)

This is the maximal possible output voltage of the channel. Normally this is the fixed value of the HV channel hardware (given by the technical specifications of the module). If the user writes a lower VoltageMaxSet, this value appears here. VoltageMaxSet is writeable in mode ModuleStatus IsStop = 1
in the range (0 < VoltageMaxSet ≤ VoltageNominal)

CurrentNominal / CurrentMaxSet

Offset Words (rel to ChAddr)	Offset Bytes (rel. to ChAddr)	Name		Data type	Access
0x1a	0x34	CurrentNominal / CurrentMaxSet	Inom	float	r/(w)

This is the maximal possible output current of the channel. Normally this is the fixed value of the HV channel hardware (given by the technical specifications of the module). If the user writes a lower CurrentMaxSet, this value appears here. CurrentMaxSet is writeable in mode ModuleStatus IsStop = 1
in the range (0 < CurrentMaxSet ≤ CurrentNominal)

Groups
The Multi Channel VME module offers an extended and flexible range of group functions. There are both well defined Fix Groups and free configurable variable groups.
Each definition of a group consists of 2 words (4 bytes).
In the Fix Groups these 2 words hold the value of a floating point value or a logical information. In Variable Groups is one word an identifier for the group. The other word holds the information about the group members (which channel is a member of the group) or it gives an overview over a characteristic in all channels.

Caution!
In order to avoid a malfunction both words of a group have to be written, even in case just one has been changed.

Four different groups have been established:

- Set group
- Status group
- Monitoring group
- Timeout group

4.2.2.1 Fix Groups

The functions and characteristics of the groups are fix defined.

SetVoltageAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0068	0x00d0	SetVoltageAllChannels	float	r/w

The value of the set voltage in V for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

SetCurrentAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x006a	0x00d4	SetCurrentAllChannels	float	r/w

The value of the set current in A for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

SetVoltageBoundsAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x006c	0x00d8	SetVoltageBoundsAllChannels	float	r/w

The value of the voltage bounds in V for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

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SetCurrentIlkMaxSetAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x006e	0x00dc	SetCurrentIlkMaxSetAllChannels	float	r/w

The value of the SetCurrentIlkMinSetAllChannels in A for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

SetEmergencyAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0070	0x00e0	SetEmergencyAllChannels	uint32	r/w

Is worth without coding. Writing any information to this group triggers an alarm switching off in all channels of the module.

SetOnOffAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0072	0x00e4	SetOnOffAllChannels	uint32	r/w

The data word holds the function of the command:
data = 1: Switch on all channels of the module
data = 0: Switch off all channels of the module

SetVoltageIlkMinSetAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0074	0x00e8	SetVoltageIlkMinSetAllChannels	float	r/w

The value of the SetVoltageIlkMaxSetAllChannels in V for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

SetCurrentIlkMinSetAllChannels

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0076	0x00ec	SetCurrentIlkMinSetAllChannels	float	r/w

The value of the SetCurrentIlkMinSetAllChannels in A for all channels will be submitted to the group as a floating point number in the 4 bytes. This value is accepted, if the corresponding channel characteristics permit it. Otherwise it's ignored.

4.2.2.2 Variable Groups

4.2.2.2.1 Set group

Set groups will be used in order to set channels to a same value, which happen to carry the identical channel value. Therefore within the group will be defined:

- Member of the group
  - Each member will be activated in the member list
- Type of the group
  - constant: SetGroupType
- Channel characteristics
  - Coding of characteristics , which are to be set commonly
- Control mode
  - Divides between a one-time setting of the slave channel property and a permanently copying of the Master channel's property to the slave channels
- Master channel
  - Number of the channel, which characteristics will be transferred to the other channels.
  - Is just necessary for Set groups which set a value.
    If functions have to be initialized e.g. start of ramp then there is no Master channel

SetGroup

Offset Words (rel to GrAddr)	Offset Bytes (rel. to GrAddr)	Name	Data type	Access
0	0	MemberList	uint16[2]	r/w
2	4	TypeSet2	uint16	r/w
3	6	TypeSet1	uint16	r/w

MemberList2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

MemberList1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

TypeSet2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	res	res	res	MCH4	MCH3	MCH2	MCH1	MCH0

TypeSet1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TYPE1	TYPE0	Res	res	res	res	res	MOD0	SET3	SET2	SET1	SET0	res	res	res	res

TYPE1	TYPE0	Value	
0	0	SetGroupType	Group is defined as Set group

MOD0	Value	
0	0	The group function is done one time
1	1	The group function is done permanently

SET3	SET2	SET1	SET0	Value	
0	0	0	1	SetVset	Copy Vset from MCH to all members
0	0	1	0	SetIset	Copy Iset from MCH to all members
0	1	0	0	SetVbnds	Copy Vbounds from MCH to all members
0	1	0	1	SetIbnds	Copy Ibounds from MCH to all members
0	1	1	0	SetVIlkMinSet	Copy VIlkMinSet from MCH to all members
0	1	1	1	SetIIlkMinSet	Copy IIlkMinSet from MCH to all members
1	0	1	0	SetOn	Switch ON/OFF all members depending on setON in MCH
1	0	1	1	SetEmrgCutOff	Switch OFF all members (Emergeny OFF)
1	1	1	1	Cloning	Set all properties of members like MCH properties *(in preparation)*

MCH4	MCH3	MCH2	MCH1	MCH0	Value	
0	0	0	0	0	0	1: Channel 0 is MasterChannel MCH
0	0	0	0	1	1	1: Channel 1 is MasterChannel MCH
...	...	...	...	...	...	...
0	0	0	1	1	3	1: Channel 3 ist MasterChannel MCH

4.2.2.2.2 Status group

Status groups are used to report the status of a single characteristic of all channels simultaneously. No action is foreseen. Therefore within the group has to be defined :

- type of the group
  - constant: StatusGroupType
- channel characteristics
  - coding of characteristics , which is to be reported

StatusGroup

Offset Words (rel to GrAddr)	Offset Bytes (rel. to GrAddr)	Name	Data type	Access
0	0	ChannelStatusList	uint16[2]	r/w
2	4	TypeStatus2	uint16	r/w
3	6	TypeStatus1	uint16	r/w

ChannelStatusList2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

ChannelStatusList1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

TypeStatus2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

TypeStatus1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TYPE1	TYPE0	res	res	res	res	res	res	STAT3	STAT2	STAT1	STAT0	res	res	res	res

TYPE1	TYPE0	Value	
0	1	StatusGroupType	Group will be defined as Status group

STAT3	STAT2	STAT1	STAT0	Value	
0	0	1	1	ChkIsOn	check channel Status.isON (is on)
0	1	0	0	ChkIsRamping	check channel Status.isRAMP (is ramping)
0	1	1	0	ChkIsControlledCurrent	check channel Status.isCC (is current control)
0	1	1	1	ChkIsControlledVoltage	check channel Status.isCV (is voltage control)
1	0	1	0	ChkIsCurrentBounds	check channel Status.isCBNDs (is current bounds)
1	0	1	1	ChkIsVoltageBounds	check channel Status.isVBNDs (is voltage bounds)
1	1	0	0	ChkIsExternalInhibit	check channel Status.isEINH (is external inhibit)
1	1	0	1	ChkIsTrip	check channel Status.isTRIP(is trip)
1	1	1	0	ChkIsCurrentLimit	check channel Status.isCLIM (is current limit exceeded)
1	1	1	1	ChkIsVoltageLimit	check channel Status.isVLIM (is voltage limit exceeded)

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4.2.2.2.3 Monitoring group

Monitoring groups are used to observe a single characteristic of selected channels simultaneously and in case of need take action. Therefore the group has to be defined :

- members of the group
  - each member will be activated in the member list
- type of the group
  - constant: MonitoringGroupType
- channel characteristics
  - coding of characteristics , which is to be monitored
- control mode
  - coding of the control function, i.e. which kind of change in the group-image shall cause a signal.
- activity
  - define , which activity has to happen after the event

MonitoringGroup

Offset Words (rel to GrAddr)	Offset Bytes (rel. to GrAddr)	Name	Data type	Access
0	0	MemberList	uint32	r/w
2	4	TypeMonitoring2	uint16	r/w
3	6	TypeMonitoring1	uint16	r/w

MemberList2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

MemberList1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

TypeMonitoring2:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	res	res	res	res	res	res	res	res

TypeMonitoring1:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TYPE1	TYPE0	ACT1	ACT0	res	res	res	MOD0	MON3	MON2	MON1	MON0	res	res	res	res

TYPE1	TYPE0	Value	
1	0	MonitoringGroupType	Group will be defined as Monitoring group

MON3	MON2	MON1	MON0	Value	
0	0	1	1	MonitorIsOn	monitor channel Status.isON (is on)
0	1	0	0	MonitorIsRamping	monitor channel Status.isRAMP (is ramping)
0	1	1	0	MonitorIsControlledCurrent	monitor channel Status.isCC (is current control)
0	1	1	1	MonitorIsControlledVoltage	monitor channel Status.isCV (is voltage control)
1	0	1	0	MonitorIsCurrentBounds	monitor channel Status.isCBNDs (is current bounds)
1	0	1	1	MonitorIsVoltageBounds	monitor channel Status.isVBNDs (is voltage bounds)
1	1	0	0	MonitorIsExternalInhibit	monitor channel Status.isEINH (is external inhibit)
1	1	0	1	MonitorIsTrip	monitor channel Status.isTRIP (is trip)
1	1	1	0	MonitorIsCurrentLimit	monitor channel Status.isCLIM (is current limit exceeded)
1	1	1	1	MonitorIsVoltageLimit	monitor channel Status.isVLIM (is voltage limit exceeded)

MOD0	Value	
0	0	event will happen if at least one Channel == 0
1	1	event will happen if at least one Channel == 1

ACT1	ACT0	Value	
0	0	0	No special action ; EventGroupStatus[grp] will be set
0	1	1	Ramp down of group; EventGroupStatus[grp] will be set
1	0	2	Switch OFF of group without ramp; EventGroupStatus[grp] will be set
1	1	3	Switch OFF of module without ramp; EventGroupStatus[grp] will be set

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4.2.2.2.4 *Timeout group*

Timeout groups are necessary to keep the timing for the time controlled Trip function and to define the action which has to happen after a Trip.

Therefore in the group will be defined:
- members of group
  - each member will be activated in a word MemberList
- type of the group
  - constant: TimeOutGroupType
- activity
  - define , which activity has to happen after time controlled Trip
- timeout
  - coding of Timeout-time as 12 Bit Integer

TimeOutGroup:

Offset Words (rel to GrAddr)	Offset Bytes (rel. to GrAddr)	Name	Data type	Access
0	0	MemberList	uint16[2]	r/w
2	4	TypeTimeOut2	uint16	r/w
1	2	TypeTimeOut1	uint16	r/w

MemberList1:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
res	res	res	res	res	res	res	res	CH23	CH22	CH21	CH20	CH19	CH18	CH17	CH16

MemberList2:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
CH15	CH14	CH13	CH12	CH11	CH10	CH9	CH8	CH7	CH6	CH5	CH4	CH3	CH2	CH1	CH0

TypeTimeOut1:

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24	Bit23	Bit22	Bit21	Bit20	Bit19	Bit18	Bit17	Bit16
TOT15	TOT14	TOT13	TOT12	TOT11	TOT10	TOT9	TOT8	TOT7	TOT6	TOT5	TOT4	TOT3	TOT2	TOT1	TOT0

TOT[15..0]: Binary coded Timeout-time in ms (0..65535ms)

TypeTimeOut2:

Bit15	Bit14	Bit13	Bit12	Bit11	Bit10	Bit9	Bit8	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
TYPE1	TYPE0	ACT1	ACT0	res	res	res	res	res	res	res	res	res	res	res	res

TYPE1	TYPE0	Value	
1	1	TimeOutGroupType	Group will be defined as Timeout group .

ACT1	ACT0	Value	
0	0	0	No special action ; EventGroupStatus[grp] will be set
0	1	1	Ramp down of group EventGroupStatus[grp] will be set
1	0	2	Switch OFF of group without ramp; EventGroupStatus[grp] will be set
1	1	3	Switch OFF of module without ramp; EventGroupStatus[grp] will be set

4.3 Events and interrupts

Remark: The activation of interrupts at the VME bus is not realized yet. The event handling is realized

The module provides an extended event collecting and interrupt logic. This is necessary to monitor extraordinary events and forward them to the host.

Events can be generated by:

- occurrence of special conditions in the module status (e.g. safety loop open, temperature too high)
- occurrence of special conditions in a channel (e.g. over-voltage, over-current, current-trip)
- occurrence of events in channel status (e.g. end of a ramp)
- occurrence of events in a monitoring group
- occurence of events in a timeout group

The occurence of such single events will be stored in the EventStatus registers:

- ModuleEventStatus
- ChannelEventStatus
- ModuleEventGroupStatus

Since every appearing event doesn't have inevitably to lead to a report to the host, the EventMask registers exist parallel to the EventStatus registers. These decide whether an occurred event leads to a report to the host or not. If the event shall be reported, the responsible bit must be set in the mask register.

⚠ A check of EventStatus and EventMask is made before the HV will be switched on. When bits are set in the EventStatus and the corresponding bits are set in the EventMask the HV cannot be switched on again before the EventStatus bits are reset by writing “1” on the corresponding bit positions.

The report to the host can be made by queries of the bit "IsEventActive" in the ModuleStatus register. This bit is set if an event has occurred and the setting of the event mask enables the passing.
Independent of the being of the reason for an event, these remain stored further in the accompanying event status register.

The reset of the individual events is done by a re-write of a 1 to the event bit in the accompanying EventStatus register. It's possible to reset more then one event at the same time. If there is still the reason for the event, the reset is prevented or a new set of an event is immediately carried out.

4.3.1 Events in channels

Main origin of the event logic are the single event sources in the channels. The occurrence of an event is stored in the register ChannelEventStatus of the channel. The accompanying register ChannelEventMask decides if the event is to be reported. An event is reported if the accompanying bit in the mask register is set. To generate a global information about the existence of any event to be reported a sum signal is made. All these sum signals of all channels are stored in the status register ModuleEventChannelStatus

ModuleEventChannelStatus [n] =
(EventVoltageLimit[n] AND MaskEventVoltageLimit[n]) OR
(EventCurrentLimit[n] AND MaskEventCurrentLimit[n]) OR
(EventTrip[n] AND MaskEventTrip[n]) OR
(EventExtInhibit[n] AND MaskEventExtInhibit[n]) OR
(EventVoltageBounds[n] AND MaskEventVoltageBounds[n]) OR
(EventCurrentBounds[n] AND MaskEventCurrentBounds[n]) OR
(EventControlledVoltage[n] AND MaskEventControlledVoltage[n]) OR
(EventEmergency[n] AND MaskEventEmergency[n]) OR
(EventEndOfRamp[n] AND MaskEventEndOfRamp[n]) OR
(EventOnToOff[n] AND MaskEventOnToOff [n]) OR
(EventInputError[n] AND MaskEventInputError[n])

where is:

ModuleEventChannelStatus[n]:	ch-th bitof the register ModuleEventChannelStatus
EventVoltageLimit[n]:	bit EventVoltageLimit of register ChannelEventStatus of thr ch-th channel
MaskEventVoltageLimit[n]:	bit MaskEventVoltageLimit of register ChannelEventMask of thr ch-th channel

The selection of channels is done by the register ModuleEventChannelMask. Only those channels can report an event that have a set bit in this mask register. The sum event of all channel events is the (internal) signal EventChannelActive:

EventChannelActive = (ModuleEventChannelStatus[0] AND ModuleEventChannelMask[0]) OR
(ModuleEventChannelStatus[1] AND ModuleEventChannelMask[1]) OR
...
(ModuleEventChannelStatus[n] AND ModuleEventChannelMask[n])

4.3.2 Events in groups

Like written before groups are also able to generate Events. These events will be collected in the status word ModuleEventGroupStatus. This status word is 32 bits wide. It consists of the status registers ModuleEventGroupStatusHigh and ModuleEventGroupStatusLow, each 16bit wide. With help of the accompanying mask register ModuleEventGroupMask the events are filtered and the (internal) signal of the groups EventGroupActive will be generated.

EventGroupActive = (ModuleEventGroupStatus[0] AND ModuleEventGroupMask[0]) OR
(ModuleEventGroupStatus[1] AND ModuleEventGroupMask[1]) OR
...
(ModuleEventGroupStatus[23] AND ModuleEventGroupMask[24])

4.3.3 Events in characteristics of the whole module

These events are events of single characteristics of the module. An event is stored in the register EventModuleStatus. This register also has a mask register for filtering. The sum signal of this type of events is the (internal) signal EventModuleActive.

EventModuleActive = (EventTemperatureNotGood AND MaskEventTemperatureNotGood) OR
(EventSupplyNotGood AND MaskEventSupplyNotGood) OR
(EventSafetyLoopNotGood AND MaskEventSafetyLoopNotGood) OR
(EventRestart AND MaskEventResart) OR

4.3.4 Event status of the module

The event status of the module is summarized out of the event status of the channels, of the groups and of the module single characteristics. This sum signal IsEventActive is part of the register ModuleStatus:

IsEventActive = EventChannelActive OR
EventGroupActive OR
EventModuleActive

4.4 Special registers

4.4.1 Setting of Basis Address

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0050	0x00A0	NewBaseAddress	uint16	r/w
0x0051	0x00A2	NewBaseAddressXor	uint16	r/w
0x0052	0x00A4	OldBaseAddress	uint16	r
0x0054	0x00A8	NewBaseAddressAccepted	uint16	r

As shown in the preliminary remarks to section 4, the module is bound into the VME address room by defining the Basis Address BA. This address is the begin of a 2kByte wide memory segment. the address BA is free in the bits A15 to A10, the bits A9 to A1 are fixed to 0.

in words:
binary: BA = 0bbbbb00 00000000 (with b={0|1})
hexadezimal: BA = xy00 (with x={0..7}, y={0,4,8,C}.

in bytes:
binary: BA = bbbbb000 00000000 (with b={0|1})
hexadezimal: BA = xy00 (with x={0..F}, y={0,8}.

The default value (factory setting and setting when started with jumper “ADR” on the topside of the board has been set) is BA=0x4000 (in bytes) resp. BA=0x2000 in words.

New address setting is done using four registers:
In register "NewBaseAddress" the new base address (byte counting) is to write. In register "NewBaseAddressXor" the complementary value of "NewBaseAddress" is to write.

NewBaseAddressXor = NewBaseAddress XOR 0xFFFF

When both values are written, and the condition is fulfilled, the new address is accepted. If the new address doesn't point to the beginning of a 2kByte segment, it is corrected to the beginning of the next smaller segment.
After that, the value is stored into EEPROM.
This new Base Address is used after the next reset (e.g. after PowerOn, SYSRESET or a special command). Until this the old address is valid.

⚠ When the jumper "ADR" is set the Base Address of the module will reset to the default address 0x4000 after a power up. This function can be used when there is no communication for instance the Base Address is unknown.
When the jumper is not set the stored address inside of the module will be used as Base Address.

4.4.2 Special Control Register

Offset Worte (rel. to BA)	Offset Bytes (rel. to BA)	Name	Data type	Access
0x0056	0x00ac	SpecialControlStatus	uint16	r
0x0058	0x00b0	SpecialControlCommand	uint16	r/w

Both these registers "SpecialControlStatus" and "SpecialControlCommand" are used for maintenance and service purposes. Their usage is explained in a separate manual.

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