Overview on iseg Multi-Channel High Voltage system

Document: **isegHVSystem** Version: **1.11** Date: **12.11.2003 17:53**

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Spezialelektronik GmbH

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System Overview on iseg Multi-Channel High Voltage Sources

1   iseg system of multichannel highvoltage sources

The basic system idea of iseg Multi-Channel High Voltage (HV) sources is the realisation of high grade HV sources with small dimensions and high flexibility. Beside the actual highvoltage sources, that are pooled in groups to 8, 16 or 32 HV sources into one module, further components like crates, crate controllers and the control software belong to the iseg HV system.

The Multi-Channel HV modules give the possibility to use them in crates or to use them standalone. In small systems or test equipment, the modules are applied without crates. In bigger systems the use of crates is recommended.
By this way small systems can be build without expensive initial costs. While these systems grow up, the cost of the needed crates negligible increase the price per channel.

In order to control both the modules and the crate controllers the serial CAN Interface is used (CAN = controller area network, also named CAN bus).

In applications without using crates the needed supply voltages and the CAN bus signals have to be connected at the rear panel system connector (96pin) directly. The connections, needed in such cases, can be done by the customer in a simple way direct at the connector. A special adapter (named "test adapter HV module") is produced by iseg, which provides the needed connections (voltage cables, CAN bus connector) for use in laboratory equipment.

Applying the modules in crates, the needed supply voltages come from the crate. The CAN bus connections between the modules are done over the back plane of the crate to the front side of the crate controller.

The crate controller has to observe the functions of the crate (correct values of i.e. voltage, current, temperature). It has a separate CAN bus connection, witch is been lead to two CAN bus connectors at the front side of the crate controller too.

Small systems - having a single CAN bus segment only - the back plane CAN segment can be coupled to the CAN segment of the controller. In big systems the setting and monitoring of high voltage parameters can be separated from controlling the crates by dividing the back plan CAN bus from the CAN bus of the crate controller.

2   Addressing of iseg devices in the CAN bus

Data transmission between iseg devices (HV modules, crate controller, I/O modules) uses the CAN bus corresponding to standard CAN 2.0B (passive). Data exchange is done by data grams according to the rules of the iseg firm device control protocol DSP. Detailed information about the control functions of modules and devices is given in the manuals.

At this point the focus is set to the whole system, especially the addressing has to be shown.

Addressing of a data gram is done in the identifier of a CAN data frame. The CAN standard describes an identifier of 11 bits. These bits are used as follows:

Table 1: Identifier of the iseg device control protocol

	dominant (0)	recessive (1)
ID 10	HV module	crate controller
ID 9	module sends an alarm	normal data transmission
ID 8	address 5	
ID 7	address 4	
ID 6	address 3	
ID 5	address 2	
ID 4	address 1	
ID 3	address 0	
ID 2	reserved	reserved
ID 1	basic function	extended function
ID 0	write	read

The higher 8 bit (ID10..ID3) contain the acceptance filter of the CAN bus. These 8 bit allow a hardware filter of all CAN frames. Only those frames matching the acceptance filter are processed in the module. The lower bits ID2..ID0 contain extended information to the module commands. These dare detailed described in the manuals.

Like seen in table 1, there can be addressed up to 64 CAN nodes of each type (module or controller) in one CAN bus segment. Participating in the bus the nodes can be passive (ID9 = recessive) or active (ID9 = dominant). The last case is needed for fast reactions on alarm events. Then such a node can actively send a message to the administrating unit (like a look-at-me LAM).

The identifier bits ID8..ID3 hold the information, which node has to process the frame or from which node the frame comes. A detailed description of the setting of these identifier bits in iseg Multi-Channel HV modules and crate controller is given in the next paragraphs.

2.1 Addresses of modules

The setting of the addresses of the iseg Multi-Channel HV modules is done by setting the 6 address pins at the system connector. From these address pins (A5..A0) the module gets the basic information to process the relating identifier bits ID8..ID3.

In the iseg system crate the 6 address pins are set in two parts The first part (A5..A3) is constant for all modules in the crate. It is set via a so called "Bank Select" switch at the front side of the crate controller. The second part is to divide the modules in the crate. Therefor each station a module can be plugged in (a so called "Slot") has it's own combination of the bits A2..A0.

This is shown by the picture 1.

By other words, the crate gives the module 6 address bits (called BS2..BS0, SL2..SL0 in the crate; called A5..A0 in the module). These bits are interpreted by the module into the identifier bits ID8..ID3. These identifier bits are the address bits for the communication of the modules via CAN bus.
This algorithm for computing the identifier bits depends on the type of the module. It is described in the following article.

Crate
(schematic)

M0	M1	M2	M3	M4	M5	M6	M7	CC
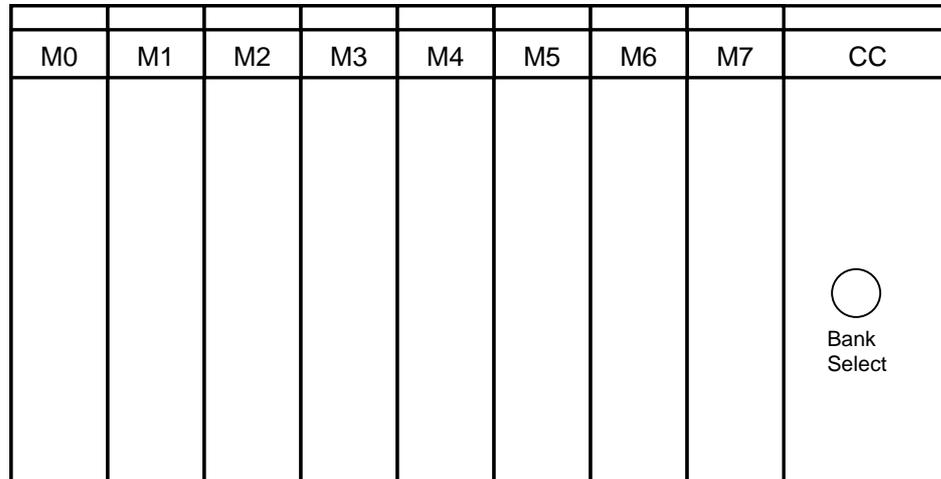
Bank
Select

module pin									
A0	0	1	0	1	0	1	0	1	fix, named SL0
A1	0	0	1	1	0	0	1	1	fix, named SL1
A2	0	0	0	0	1	1	1	1	fix, named SL2
A3	BS0	BS0	BS0	BS0	BS0	BS0	BS0	BS0	set by the
A4	BS1	BS1	BS1	BS1	BS1	BS1	BS1	BS1	switch
A5	BS2	BS2	BS2	BS2	BS2	BS2	BS2	BS2	"Bank Select"

Pict. 1: Coding of the address pins at crate positions

2.1.1 Generation of identifier bits ID8..ID3 in the iseg Multi-Channel HV modules

The iseg Multi-Channel HV modules can contain one or two CAN nodes. Actually there are produced 8- and 16-channel modules containing one CAN node, and 16- and 32-channel modules containing two CAN nodes. Both the module types differ vital in the way they generate the identifier bits out of the address pins. The reason is that there is only one slot address per slot, but it can be one or two nodes – as one module - plugged into the slot.

2.1.1.1 Modules containing one CAN node

In modules containing one CAN node generate their identifier bits ID8..ID3 directly from the information they get from module pin A5..A0. This information is given from the crate signals BS2..BS0 and SL2..SL0. Table 2 shows this in detail:
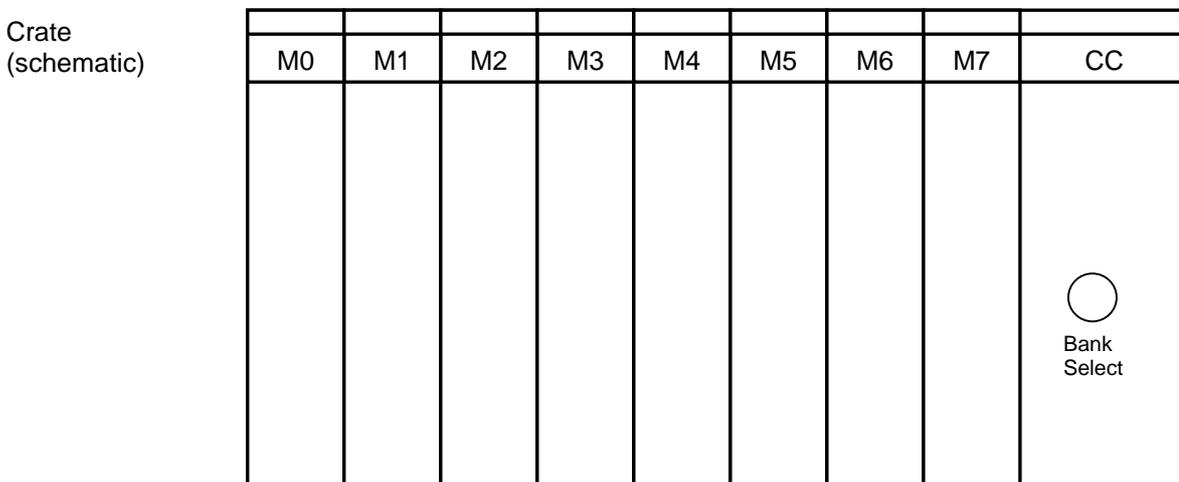
Table 2: Generation of the identifier address information inside a one-node CAN module

module pin	A5	A4	A3	A2	A1	A0
signal of the crate	BS2	BS1	BS0	SL2	SL1	SL0
identifier bit	ID8	ID7	ID6	ID5	ID4	ID3

Picture 2 shows the identifiers of a crate which is filled with one-node CAN modules.

The bank select switch is set to 2. To get a simple example the other Identifier bits should set to:

ID10	dominant	HV module
ID9	recessive	normal data transmission
ID2	dominant	reserved
ID1	dominant	basic function
ID0	dominant	write

Crate
(schematic)

M0	M1	M2	M3	M4	M5	M6	M7	CC

Bank
Select

module pin									
A0	0	1	0	1	0	1	0	1	fix SL0
A1	0	0	1	1	0	0	1	1	fix SL1
A2	0	0	0	0	1	1	1	1	fix SL2
A3	0	0	0	0	0	0	0	0	set by the
A4	1	1	1	1	1	1	1	1	switch
A5	0	0	0	0	0	0	0	0	"Bank Select"
ID (hex)	**280**	**288**	**290**	**298**	**2A0**	**2A8**	**2B0**	**2B8**	

<u>Pict. 2:</u> identifiers in a crate with one-node CAN modules

<u>Detail:</u> Generation of the ID of module M0

ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
HVM	norm	BS2	BS1	BS0	SL2	SL1	SL0	res	Basis	Schr.
0	1	0	1	0	0	0	0	0	0	0
2			8				0			

2.1.1.2   Modules containing two CAN nodes

Like shown before, there is only one slot information per slot. To realise a consecutive addressing of the CAN nodes in the crate one slot position gets two sequenced identifier addresses. Having in mind that there only 6 identifier bits can be used for addressing, one of the 6 address bits of the crate (BS2..BS0, SL2..SL0) can't be used. This unused bit is the bank select bit BS0. A module containing two CAN nodes interprets the signals A5..A0 as follows:

The highest address bits A5 and A4 (Signals BS2 and BS1) are directed to the identifier bits ID8 and ID7. The bit A3 (this is the bank select bit BS0) is not taken into account. Any problems resulting from this are discussed in following paragraphs.
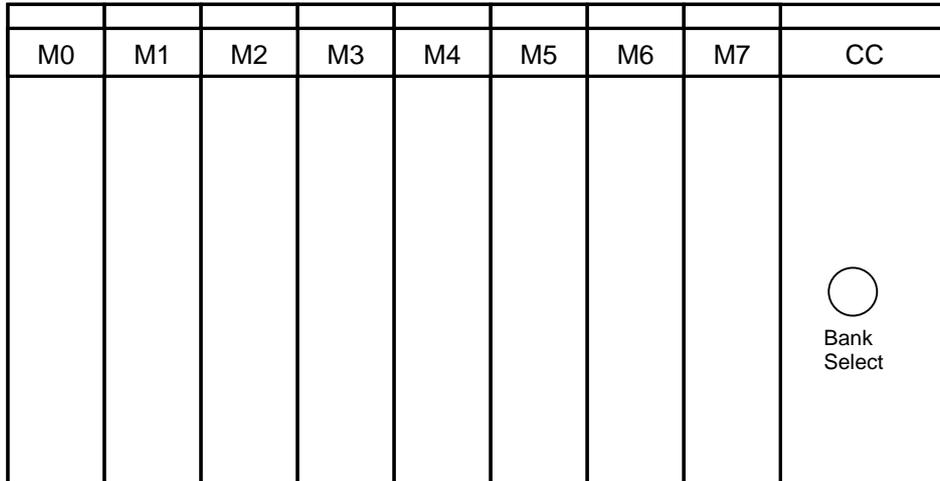
The next three bits A2, A1 and A0 (the slot bits SL2..SL0) are interpreted as the next identifier bits ID6, ID5 and ID4. The last identifier bit ID3 is used to separate both the nodes in the module. Node 1 (controlling the lower channels) has ID3=0, node 2 (controlling the upper channels) has ID3=1. The following table gives an overview:

<u>Table 3:</u> Generation of the identifier address bits of a two-node CAN module

	ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
			A5	A4	A2	A1	A0				
node 1			BS2	BS1	SL2	SL1	SL0	0			
node 2			BS2	BS1	SL2	SL1	SL0	1			

Picture 3 shows the identifiers in a crate which is filled with two-node CAN modules. All non-address identifier bits are set like in the example of picture 2. The bank select switch is also set to 2.

Crate
(schematic)

	M0	M1	M2	M3	M4	M5	M6	M7	CC

Bank Select

module pin									
A0	0	1	0	1	0	1	0	1	fix SL0
A1	0	0	1	1	0	0	1	1	fix SL1
A2	0	0	0	0	1	1	1	1	fix SL2
A3	0	0	0	0	0	0	0	0	set by the
A4	1	1	1	1	1	1	1	1	switch
A5	0	0	0	0	0	0	0	0	"Bank Select"
ID (hex) n 1	**280**	**290**	**2A0**	**2B0**	**2C0**	**2D0**	**2E0**	**2F0**	
ID (hex) n 2	**288**	**298**	**2A8**	**2B8**	**2C8**	**2D8**	**2E8**	**2F8**	

Pict. 3: Identifiers in a crate filled with two-node CAN modules

Detail: Generation of the identifier of the node 1 of module M1

ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
HVmod	norm	BS2	BS1	SL2	SL1	SL0		res	basic	write.
0	1	0	1	0	0	1	0	0	0	0
2			9				0			

Detail: Generation of the identifier of the node 1 of module M1

ID10	ID9	ID8	ID7	ID6	ID5	ID4	ID3	ID2	ID1	ID0
HVmod	norm	BS2	BS1	SL2	SL1	SL0		res	basic	write
0	1	0	1	0	0	1	1	0	0	0
2			9				8			

2.1.2 Problems

Mixing one-node CAN modules with two-node CAN modules in the same CAN segment the different generation rules for ID bits must be observed.

It isn't possible to plug in a one-node CAN module direct at the right side of a two-node module.

2.1.3 Tips

In applications with multiple crates and modules with two-CAN-nodes has to take account that are allowed even bank select numbers (0,2,4,6) only.

Mixing both modules with one-CAN-node and two-CAN-nodes has to take account that the one-node modules have to be plugged in into the lower slot numbers (the left side of the crate). The two-node modules have to be plugged in right of them.

2.2   Addressing of the crate controller

Different to the geographic address method of the HV modules is that the identifier of the crate will be stored inside of these controller. You can change it by the use of an implemented software service. Please note that it comes not to overlaps if the crate controller work together in a segment of HV modules.

Tip: The crate controller with the lowest serial number get for Sub-ID 0x600 and the Emergency-ID (EMCY-ID) get 0x400 with the higher priority. The crate controller with the next serial number get for Sub-ID 0x608 and for the EMCY-ID 0x408. It does fit without any problems to segments with a combination of crate controllers and EHQ Multi-Channel HV modules.

Generation of the identifier:

	Sub-ID		EMCY-ID	
ID10	1	crate controller	1	crate controller
ID9	1	normal data transmission	0	alarm
ID8	0	A5 of HV modules	0	A5 of HV modules
ID7	0	A4 of HV modules	0	A4 of HV modules
ID6	0	A3 of HV modules	0	A3 of HV modules
ID5	0	A2 of HV modules	0	A2 of HV modules
ID4	0	A1 of HV modules	0	A1 of HV modules
ID3	0	A0 of HV modules	1	A0 of HV modules
ID2	0		0	
ID1	0		0	
ID0	0		0	
ID (hex)	**600**		**400**	