

CAPI2 BV NETHERLANDS

ACT 3.0.x service manual

*Distributed power
systems*

Get into the bus.....



**CAPI2 BV
NETHERLANDS**

Spiegel 29
5674CE Nuenen
Netherlands

Tel: 0031 40 2847001
Fax: 0031 40 2834101
E-mail: info@capi2.com

Content

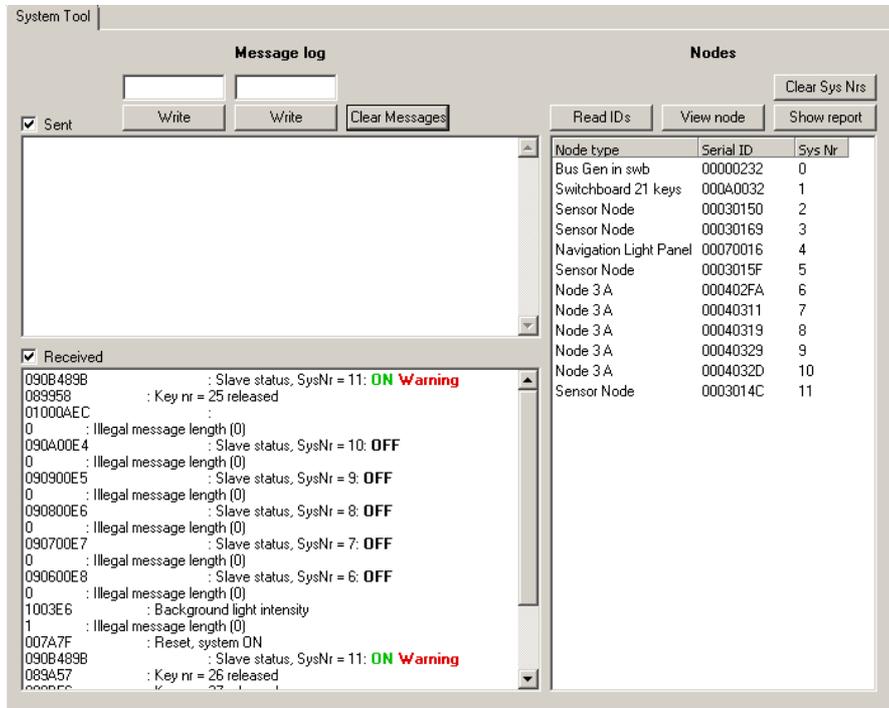
1. Test system tool
2. View node
3. Reports
4. System testing
5. Controlling the nodes
6. How does the bus works
7. Capi2 addressing
8. FAQ's

NOTE:

Before starting to work with the tools mentioned in the following manual be aware of the following.
Never change the settings in view node, this can cause serious damage to the node.

1 Test System Tool

The Capi2 system can be monitored online using the system tool. During the monitoring you can see the commands and message's transferred over the communication. With this possibility of monitoring you can actually see what is happening during the operation of the system. This is a important tool to use to determine if a problem is Capi2 related or in the hardware.



Read ID's

- To be identified

Identification tem)

- Serial ID: **00040311** (Visual identification on hardware)
- Sysnr: **7** (Unique number in the system for commands)

find all the nodes that are setup in the system:
- Type: **Node 3A** (for each node on the sys-

View node

- To have a look into the software of the selected node. Here you can find more detailed information regarding calibration value's and operating settings. We discuss them later in this manual.

Show report

- It shows you all the nodes, the firmware version and the Serial ID. This form can be print direct for use.

Clear Sys Nrs

- This will put all the Sysnr's and Keynr's to the default setting. The default setting is 255

Write

- This is for entering commands to operate the nodes

Clear message's

- This is to clear the message window

Send/received

- For reading out all the message's and commands sent out and received during the operation.

-2 View node

View node can be used if a rare problem is found and you need more detailed information.

NOTE: Never change the settings in view node, this can cause serious damage to the node.

Read EEPROM:

- To read the node for the last status overview

Write EEPROM:

- To write the node if any change has been made in the settings

SysNr:

- System number of this node

Used for the recognition in the sw to control a node

RecAdr:

- Incoming message address

MyKeyNR

- Keyboard key number for on/off

Needed for the node to react on commands from this button

SndAdr

- Address for sending load status

ModStAdr

- Address for requesting module status

Toggle

- 0=direct 1=toggle 2=dimmer 3=off 4=on 5=emergency on +8=working in standby

OnOff

- To remember status after reset
Remembers the status of the node during standby, so when it's 8 = on and 0 = off

CurLim

- Limit for open circuit indication, normally 40
Needed for feedback in case of a loose contact to the node (broken bulb)

RecoverPrio

- Recover priority 0-15. 0=highest
To switch on in case of a pbp failure or low voltage on system

ClickTime

- Max switch hold down time before dimming starts, default 06

I2t current Surge capacity

- I2t, Range 1-255, normally 255

MyKey1/5

- Alternative input key number

Needed for the node to react on commands from this button

KeyMode1/5

- Operating mode of MyKey1, 0=direct 1=toggle 2=dimmer 3=off 4=on 5=emergency on +8=working in standby

ToggleOutKey

- Keynumber of outgoing toggle signal

This is for toggle groups. The topmost node in a toggle group will send out a toggle signal with that keynumber, to indicate how the rest of the units should toggle

TempOk

- Temperature at which warning is reset, 0xA0~50C

TempWarn

- Temperature at which warning is sent, 0x90~62C

TempOff

- Temperature at which device is turned off, 0x80~75C

ULim

- Below this voltage short circuit is indicated, normally 40

Ucall

- Calibrated load voltage at 14V

TempC

- Calibrated temperature value att 20 C

ICall

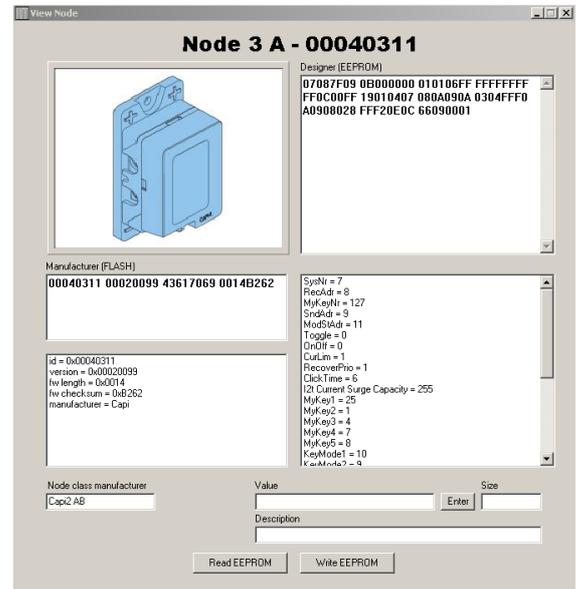
- Calibrated current at nominal load

ILim

- $iCal * iCal / 16$

WorkingInStndb

- 1=Continued operation in stand by mode



-3 Reports

As you know you can open in the auto configuration tool the report list.

In this list you can find some more details in the Extended node list like the SysNr and Switch Nr, this data can be use full for finding information in the system tool during testing. So it Is always good to have the printed version available during testing.

Reports

Node list

Node type	Comment	Serial number
Bus Generator		00000232
Push Button Panel 21K	PBP Deck	000A0032
Sensor Node Switch	Stern	00030150
Sensor Node Switch	Fan timer	00030169
Navigation Light Motor		00070016
Power Node 3A	Alarm horn	000402FA
Power Node 3A	Stern light	00040311
Power Node 3A	Starboard light	00040319
Power Node 3A	Fan	00040329
Power Node 3A	Fan indication	0004032D
Sensor Node Open/Close	Window sensor	0003014C
Sensor Node Switch		0003015F

Push Button Panels summary

Switch number	Comment
- Push Button Panel 21K	- PBP Deck -
24	Alarm
1	Stern toggle
2	Starboard
3	Fan toggle
4	Stern dimmer
5	Starboard timer
6	Fan timer delay
7	Off only
8	On only
9	Window sensor
10	
11	

Extended node list

Position	Node	Sys Nr	Node type	Switch nr	Serial nr	Feedb.	Mode	Prio	Function inputs	During standby	Timer	Comment
Aft	1	2	SNX (s)	(25)	00030150							Stern
Aft	2	7	3A	1, 4, 7, 8 a	00040311	Green/i	Toggle	1	Multi			Stern light
Aft	3	10	3A	3, 6 and 26	0004032D	Green/i	Toggle	3	Multi	Yes	5	Fan indication
Aft	4	5	SNX (s)	(27)	0003015F							
Deck	1	1	PBP21K	(1 - 24)	000A0032							PBP Deck
Deck	2	4	NLM		00070016							
Deck	3	6	3A	24	000402FA	Green/i	Instant	3				Alarm horn
Engine comp.	1	0	BG		00000232							
Engine comp.	2	3	SNX (s)	(26)	00030169							Fan timer
Engineroom	1	9	3A	3, 6, 7, 8 a	00040329	Green/i	Toggle	1	Multi	Yes	5	Fan
Front cabin	1	8	3A	2, 5, 7, 8 a	00040319	Green/i	Toggle	1	Multi	Yes	5	Starboard light
Saloon	1	11	SNX (o/c)	9	0003014C	Green/i						Window sensor

All the needed information is being displayed in the extended node list. It gives you the overview of each node with all the details like Sys Nr, Node type, Serial nr, Feedback, Mode, Priority, Function inputs, Standby, Timer and comments.

-4 System Testing

In the system tool we can read what is happening on the bus. Because of the continues monitoring al information send and received over the bus can be read out. We can see for example that a node is:

- Off: The node is off
- On: The node is on
- Overload: The node is on his maximum current
- High current: The current is over the maximum current
- Overload high current: The maximum current has exceeded
- Shorted overload: A short has been detected or a high surge.
- Bus generator warm: The maximum temp has been reached
- Bus generator hot: The maximum temp is over the limit
- Busgenerator was turned off too hot: The maximum temp has been exeeded
- Battery low:<11,00V: The battery power is too low priority 1
- Low volt warning<11.5V: The battery has reached priority 2
- Low volt warning<12 V: The battery has reached priority 3

Al these message's are giving you the indication what is happening or might be wrong in the system, it is also giving the details of the node where the problem is occurring. As you can see her Sysnr 8 has a shorted overload, that is a Node 3A and has serial 00040319. Now we can check the connection to the consumer and measure if we need a higher current on the node.

See examples below:

090803E3	: Slave status, SysNr = 8: Shorted Overload	Node 3 A	000402FA	6
090901E4	: Slave status, SysNr = 9: Overload	Node 3 A	00040311	7
090A00E4	: Slave status, SysNr = 10: OFF	Node 3 A	00040319	8
090608E0	: Slave status, SysNr = 6: ON	Node 3 A	00040329	9
		Node 3 A	0004032D	10
		Sensor Node	0003014C	11

The same for pressing a button on the PBP, you can see which button is pressed and which node is turned on. Here you can see that button 1 is pressed and that Sysnr 7 (Node 3A 00040311) is turned on

```
088170 : Key nr = 1 released
0 : Illegal message length (0)
090708DF : Slave status, SysNr = 7: ON
0 : Illegal message length (0)
0801F0 : Key nr = 1 pressed
0 : Illegal message length (0)
```

And when button 1 is pressed again you can see that sysnr 7 is turned off

```
090700E7 : Slave status, SysNr = 7: OFF
088170 : Key nr = 1 released
0 : Illegal message length (0)
0801F0 : Key nr = 1 pressed
```

So when looking to the message's you can see exactly if things are working as planned. In the example below you can see that a switchnode is turning on 2 nodes. The nodes and serials can found in the Reports Keynr 26

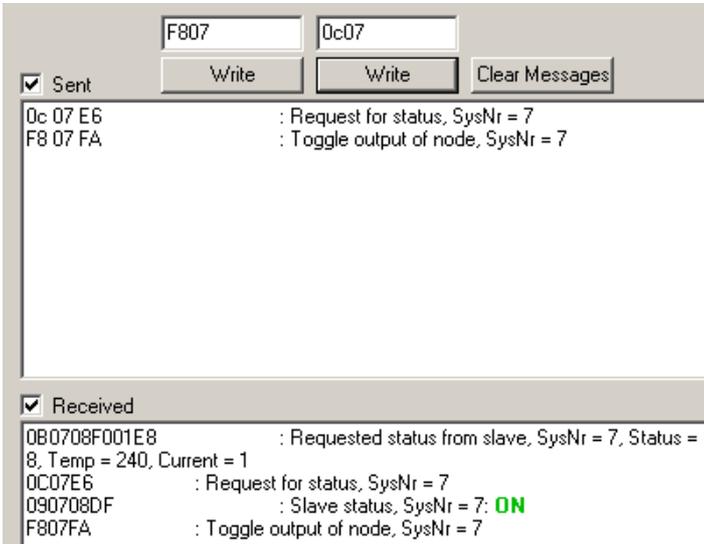
```
090A08DC : Slave status, SysNr = 10: ON
090908DD : Slave status, SysNr = 9: ON
0 : Illegal message length (0)
087C75 : Key nr = 124 pressed
081AD7 : Key nr = 26 pressed
```

-5 Controlling the nodes

For testing the system it is possible to use the system tool to control and check the system very easy.

The most common codes are written down below and easy to understand.

It is just a matter of entering the code and select write. Then you can see at received the message that has been send back.



For using this option see the example's below.

08xx is used for switching a node direct from a button on the PBP

0801 PBP button 1 aan/uit "send"

0802 PBP button 2 aan/uit "send"

0803 PBP button 4 aan/uit "send"

F8xx is used for switching a node without the PBP

F802 PN sysnr 7 aan/uit "send"

F803 PN sysnr 8 aan/uit "send"

F812 PN sysnr 9 aan/uit "send"

F8xx toggle node

0C07 read current, temp, status of sysnr 7

0C08 read current, temp, status of sysnr 8

0C09 read current, temp, status of sysnr 9

In this way you can control and check the whole system, determining either a problem is in the hardware or software.

-6 How does the bus works

Capi2 bus communication

"Capi2" is short for "Communication And Power In 2 wires": The Capi2 bus sends messages on the same wire pair that may be used for transfer of 12/24V up to 10 A. This power may be used to supply nodes with lower power consumption, like displays, sensor nodes and LED lamps. If more than 10 A is needed, 3 wires are used: 2 wires of 16 mm² for battery plus and minus up to 50A and one 1.5 mm² for communication and 10 A power.

What does a bus message look like?

On the Capi2 data bus, messages are sent as packages ("frames" or "telegrams") containing a number of data bytes. They usually start with one or several address bytes (sometimes called a "label") telling which unit (node) on the bus, this message is intended for. After the address follows some bytes with the content of the message, for example the temperature of a sensor or the status of a switch. Last there are usually one or more checksum bytes. This is the sum of all previous bytes and is used for checking that everything has been received correctly.

The Capi2 bus is basically "event driven". This means that messages are only sent when there has been an "event" in some part of the system. A typical event could be that a button is pressed on a panel, a bilge pump has started or a hatch has been opened.

At each event, as above, a message is initiated from a node. In the above examples the push button panel node, the bilge motor driver node or the node connected to a hatch sensor switch respectively, initiates a message.

A message from nodes, consist of a number of very short electrical current pulse in the bus wire. During such a pulse, the node draws about 0.5 amps from the bus during approximately 10 microseconds (0.000010 seconds). The next short pulse will be sent after a certain time. This time varies depending on byte content. If the byte is transferring a low number, for example zero, this time will be short, 200 microseconds. If the number is bigger, for example 15, this time will be 440 microseconds. This way of transferring information is called "pulse width modulation" or "pulse distance modulation". The advantage of this technique is that very few pulses can transfer a large amount of information. This results in low radio interference.

Messages, current pulses, from nodes are received only by the so called "bus generator". The bus generator reflects each current pulse as a short voltage pulse. The 12 or 24 V on the bus, drops 8 V in a slope and rises again during 10 microseconds. This short drop has normally no effect on the devices powered by the bus, and is normally filtered away in the node.

All nodes receive the voltage pulses from the bus generator. The bus generator also sends out calibration and start pulses. A calibration pulse consists of 2 voltage pulses with a time interval of 512 microseconds. The nodes use this pulse to calibrate their timers. Each calibration pulse also marks the beginning of a new message.

The sending node also senses the reflected voltage pulses. The node checks that the received data is the same as the sent. If an error has occurred during the transmission, the node will retransmit its message.

Collisions on the bus

Sometimes it happens that two or more system events coincide. Then more nodes try to send a message at the same time. This is called a collision. But collisions are resolved by the system without losing any messages.

In most cases "colliding" messages have different addresses. This means that the current pulses start at different times. The node, sending to the lowest address, starts first. Then this node gets priority (is winning the bus arbitration) and other nodes stop sending. Other nodes wait until the winning message is finished, and then try again.

In rare cases, two or more messages, with the same address, starts sending at the same time. Even in such a case the collision is resolved. Then all involved nodes continue to send. But as soon as one node has a byte with lower data content than an other, it will send next current pulse before the others. At his point, the other nodes give up, and only the node with the lower data content finishes its message. The other nodes will try again, as soon as the winning message is finished.

-7 Capi2 Adressing

LABELS AND CODES ON THE CAPI2 BUS

LABEL	BASIC ADDRESS /TYPE	MESSAGE TYPE	RANGE	DATA LENGTH	Byte 1	Byte 2...5
IbSysReset	00	System reset. All nodes shall restart.		1	Reset type (A7)	Checksum (52)
IbResTimer	00	Reset system timers in all nodes		1	D3	26
IbErrMsgAdr	01	Address of error message		2	SysNr	ErrCode
IbModEnable	04	Module enable	256	1	SysNr	Checksum
	05	X+Y joystick	2 (+-127)	2	X	Y
IbKeyBoard	08	Keyboard key on/off	128 keys	1	KeyNr bit 7= on/off	Checksum
IbSlaveStatus	09	Status to keyboard from keyboard controlled module		2	SysNr	Bitmap, status
IbModuleStat	0B	Module status		4	SysNr	slaveflgs
IbReqMS	0C	Request for module status		1	SysNr	
	0F	String, error message		4	Char 0	char 1 ..3
	10	signed char	+ - 127	1	Data	Checksum
	11	signed int	+ -32K	2	Data	Data, cs
	12	signed long	+ - 2G	4	Data	Data...
	16	float	+ -1.175e-38 ..3.40e+38	4	Data	Data...
	17	String, general messages	256x4 chars	4	Char 0	char 1 ..3
		SYSTEM MESSAGES				
	E9	Debug timer every 16777 ms		2	SysNr	Time
	EB	Data change		4	time64ms	Data..
	EC	Boot loader feed back		1		
	EF	Boot loader data		4		
	F0	Set Boot loader state		1	0=boot, 1= in boot, 2= stay in boot, 3=go out of boot	
	F1			2		
	F2			3		
	F3	Prepare current pulse offset (for test)		4		
	F4	Set/read bus pw. Response by F5		1	bus pw (0=auto pw)	
	F5	Pw output from monitor		2	pw time, ck	
	F6	Prepare voltage pulse offset		3		
IbRepDat	F7	Reply data from node		4	Data0	Data1...3
IbSysCtrl	F8	Sytem ctrl. Toggle output		1	SysNr	Checksum
	F9					
	FA			3		
IbSetUpD	FB	Set up data to alerted node		4	Data0	Data1...3

lbResp	FC	Response from alerted node after node has received data		1	Destination address	
lbSendId	FD	Send your ID (Call to all nodes)		2	01	00
lbSetUp	FD	Order to alerted node to send data to, or receive data from configuration tool. FD 00 00 FA=send ID		2	(00=send ID) 01=send ID 02=send ee 22=receive ee 40=send prog 42=reciv prog	Record number (Record=4bytes) Record =1 page 4*64
	FE			3		
lbAlertId	FF	Alert ID. Call to alert node, to make it ready to accept set up data and send stored data. Node will reply by ID (see FB)		4		

Address

Addresses above are the addresses used for the high priority version of each message type. Within each message type (except for F7-FF), more addresses may be used by adding hexadecimal 40, 80 or C0 to the address above. Addresses higher than F6 may not be used, except for system messages.

Data length

All messages start with a 1 byte label and end with a 1 byte check sum. These 2 bytes are not included in the "Data length" in the above table.

The 2 least significant bits in the address contain information about the data length of the message:

- 0, 4, 8, C means 1 data byte
- 1, 5, 9, D means 2 data bytes
- 2, 6, A, E means 3 data bytes
- 3, 7, B, F means 4 data bytes

Null nibble

If a nibble is left without any reply from a module, it is presented by the monitor as "-". This is called a "null nibble". The modules shall store its value as 0xF, but special rules apply for the checksum, see below!

NODE ID

Each node has a unique serial number that identifies the node before it is set up. The node ID is requested by sending the message labeled lbSendId. All nodes will now be ready to reply with their serial numbers. But they will not answer until the numbers are requested by sending the label lbRepDat. The node with the lowest serial number will get the highest priority on the bus and answer first. The others will follow in order of serial numbers. Repeat the request until no node is replying any more.

ALERT ID

The node ID (serial number) is used for contacting one node at a time. Send the label lbAlertId followed by the node ID, to alert the node. From now on this node will listen to and respond to requests for data and set up orders (lbSetUp and lbSetUpD). The node will be alerted until another node is alerted (or a dummy node is alerted).

ALERT ALLOWANCE

Before a device is allowed to send alert messages, it has to ask for allowance. This is done by sending a "Request to alert". The bus generator will answer with "Allowed alert", telling which device may send alert messages. If an other device has the allowance, it has to send a "Busy" message within 1 second. The requesting device has to wait.

When a device has finished its task, using the alert allowance, it has to send a "Request to alert" with the device number set to zero. Other devices, interested in taking over the alert allowance, shall listen for this message, so that they know when it is possible to take over.

Label code	Data byte 1	Data byte 2	Meaning
49	00	Device nr	Request to send alert
49	01	Device nr	Permission to send alert
49	02	Device nr	Busy

Device nr 0 System is free
 Device nr 1 Bus generator
 Device nr 2 Monitor
 Device nr 3 VE.NET

1. Device X requests permission to alert nodes. (Device X sends msg 49 00 0X)
2. Permission is granted (Bus generator sends msg 49 01 0X)
3. Device Y requests permission (Device Y sends msg 49 00 0Y)
4. Device X replies "Busy" (Device X sends msg 49 02 0X)
5. Device X finishes and releases control (Device X sends msg 49 00 00)
6. Device Y detects this and requests permission (Device Y sends msg 49 00 0Y)
 Permission is granted (Bus generator sends msg 49 01 0Y)

If for some reason device X does not reply within 1 second of step 3, it can be assumed that device X has been disconnected/reset. At this point the bus generator will send a "System is free" message (49 00 00). Now device Y may restart from point 6 above.

SET UP DATA TO AND FROM ALERTED NODE, IbSetUp

Before these messages can be used, the node has to be alerted, see above!

The configuration tool may read Manufacturer data or read configuration data that the designer already have put into the module. The alerted node is replying with the label IbSetUpD.

Label code	Data byte 1	Data byte 2	Meaning
FD	00	Record nr	Old version. Do not use it!
FD	01	Record nr	Send 4 bytes of Manufacturers Data from module
FD	02	Record nr	Send 4 bytes of EEPROM data (designers configuration data) from module
FD	22	Record nr	Sending 4 bytes of EEPROM data to module

STATUS FROM NODE, IbStatus

Label code	Data byte 1	Data byte 2 meaning
0x0C	SysNr of module	bit 0: 1 Check sum error. bit 1: 2 The cRxBuffer is full bit 2: 4 Puls was too short bit 3: 8 Puls was too long bit 4: 1 Puls was very long bit 5: 2 Sync problems. No calibration puls found bit 6: 4 Checksum error in EEPROM bit 7:

The node may be set up to send this message automatically when an error occurs.

Data may be requested by sending IbStatus followed by System number. The node will immediately answer by filling in data byte 2 with flag data.

RESET IbSysRes

The reset message has 1 data byte

Label code	Data byte 1	Checksum	Meaning
00	A7	52	Reset all modules in the system. System OFF
00	7A	7F	Reset all modules in the system. System ON
00	D3	26	Reset timers in all modules (synchronize all timers)
00	D7		Put the nodes to sleep. Wake up by power on reset
00	F1		Enable Idle mode (ON)
00	F2		Enable Stand by mode (OFF)
00	F0		Enable High speed mode (For configuration)

Error messages lbErrMsgAdr

SysNr	ErrCode	Meaning
00	01	Bus generator warm (remove warning)
00	02	Bus generator hot, warn!
00	03	Bus generator was turned off because it was too hot. Bus line was overloaded.
00	04	Busgenerator was turned of because bus line was shorted
00	05	Irms in bus is high, warn!
00	06	Bus generator was turned of because of hi Irms
00	07	Battery voltage to low <11V
00	08	Low battery voltage warning <11.5 V
00	09	Low battery voltage warning <12 V
00	0x0A	Battery voltage ok >12V

SysNr= 0xFF is used for adresssing all nodes

SysNr	ErrCode	Meaning
0xFF	02	Shut down nodes with priority 2-9
0xFF	03	Shut down nodes with priority 3-9

Keyboard Communication

MESSAGE FROM KEYBOARD, lbKeyBoard

Label code	Data byte 1
0x08	bit 0-6: KeyNr bit 7: 1=on , 0=off

Every time a key is pressed or released on the keyboard a message will be sent:

KeyNr is the number of the key on the keyboard (for example 0-23) plus an offset BasNr.
 BasNr is fetched from the EEPROM of the keyboard with the function GetEEdat(eBasNr), see below!
 BasNr is given to the keyboard during system configuration and enables the system to have more keyboards (128 keys for each label)
 unsigned char GetEEdat(unsigned char ePos); (Not ready!)

STATUS TO KEYBOARD, lbSlaveStatus

Label code	Data byte 1	Data byte 2 meaning
09	SysNr	bit 0: Slave overloaded (too hot or too high Irms) Red blink +beep, has to be reset by turning of the node bit 1: 2 Slave short circuited. Red blink+ beep, has to be reset by turning of the node bit 2: 4 Slave output circuit open (no load present) Green Blink bit 3: 8 Slave is on. Green 100% bit 4: 1 Slave is hot Green 80%, red 20% bit 5: 2 Current is high (RMS) As above. bit 6: 4 Switch open. Red 100% (sensor node)

Every time a slave (lamp module, pump module etc) is changing status, it will send a status message to the keyboard.

Every slave is given a sSysNr at configuration. Every red/gren LED on the keyboard is adressed using the SysNr of its corresponding slave.

The corresponding SysNr for each LED is stored in the keyboard EEPROM at configuration. Every time this slave status message is received, the keyboard program has to scan its EEPROM, to see if the received SysNr corresponds with any of its configured numbers. If the SysNr is found, the LEDs of this key has to be lit according to this table:

Bit 0 and 1 are reset when the key is pressed (The node is not turned on at this moment. But other nodes, reacting on the same key are, turned off. So now all nodes, with this key, are off!)

The other bits are reset when the state of the node changes (not hot, no high Irms etc).

Bit 0 (overload) is set just ones. At the same time the node is turned off by itself. To remove the overload flag, the user has to press the key, that normally turns on or toggles the node. The overload LED is on as long as the overload bit is set. The beeping is stopped when any key is pressed.

Bit pattern	Meaning	LED pattern
bit 0 or 1	Overload	Blink red 50%, beep, has to be re-set.
bit 3 and 5 = 0x28	High Irms warning	Green 80%, red 20%
bit 3 and 4 = 0x18	Hot warning	As above
bit 2 and 3 = 0xC	Open circuit	Blink 50% green
bit 3 = 0x8	On, ok	Continuous green
bit 6 only = 0x40	Continuos red (used by sensor node)	Red 100%

lbReqMS

lbReqMS may be used for requesting certain information from a node. The node will answer by sending lbModuleStat

Label code	Data byte 1	Data byte 2 meaning
0x0C	SysNr of node that shall answer	Checksum

lbModuleStat

Answer from node that has received a request by lbReqMS, see above!

Label code	Data byte 1	Data byte 2	Data byte 3	Data byte 4
0x0B	SysNr of node	Same meaning as byte 2 of lbSlaveStatus	Temperature	Current

lbSysCtrl

lbSysCtrl is used for toggling the output of a power node, directly by using only its system number.

Label code	Data byte 1	Data byte 2 meaning
0xF8	SysNr of node that shall answer	Checksum

Communicating with the Capi2 Bus Monitor

38 kbaud, 1 start and 1 stop bit

Data are sent with ASCII signs. The above reset message, for example, is sent as the ASCII string 00A752
 A message saying that key number 2 is pressed is sent as 0802EF
 and released as 08826F

The string is ended with a "space". Upper case is always used for A,B,C,D,E and F.

The bus monitor will reply with exactly the same string, ended with a space, when the message has gotten priority and has been sent on the bus.

When an error occurs on the bus, an ASCII "e" is sent from the bus monitor (without trailing space)

If some of the bytes or nibbles in a message are not used by any member on the bus, they will be written by the bus monitor as "-".

CHECKSUM

The checksum byte, at the end of each message, is calculated like this:

1. Sum address and all data bytes (do not add the carry bit).
 2. For each nibble received, add 1. (Add 6, 8, 0xA or 0xC for 1, 2, 3 or 2 data byte messages respectively)
- Checksum = 0xFF minus the above sum. (When all bytes, including checksum, are added the result shall be 0xFF.)

If a request is sent by one module and another module is replying within the same message frame, the other module shall send the checksum.

If a message contains a null nibble, its value is stored as 0. But one bit is always added to the checksum for each nibble.

The receiver shall sum all bytes, including the checksum byte, according to point 1 and 2 above. The sum will be 0xFF if the message is correct.

The Bus Monitor may be identified by sending ?<space> . The monitor will answer by sending C.

EEPROM data

Data in the EEPROM of each node has the following meaning

Address	Label	Default	Meaning
00	eSysNr: 0xFF	(Start up)	System number
01	eMyAdr:	0x08	My address for keyboard messages
02	eMyKeyNr:	0x7F	;My key number
03	eMySAdr:	0x09	;Address for sending Slave Status
04	eModStAdr:	0x0B	;Address for sending Module Status
05	eToggle:.DB	0x01	;Bit 0=1:toggle, else no toggle
06	eCurLim:.DB	0x02	;Current limit for no load. 0,5A/bit

-8 FAQ installation

For what I need a PBP

- This you need for the main control of the system, from this panel you can switch the nodes.

For what I need the navigation light panel?

- This is for an easy and quick overview on the navigation lights to see if any failure occurred.

For what I am using a fuse node?

- A fuse node is a hardware node with a thermal fuse. It is used to ensure that at anytime when a node might break down direct power to the connected consumer is ensured. (back-up system is also required for CE norm) Also it can be used for consumers that always might be connected to the power, for example a 12 volt socket

For what I am using a SNX node?

- You can use it as a remote switch to switch a light or pump, timer and as a sensor.

For what I need a condenser node?

- You need one condenser node to flatten the drops and the peaks of the power.

For what I need a branche node?

- The branche node is for connecting a slave panel, navigation light panel or the RS232.

For what I am using a power node?

- This is needed for switching on and off the consumers; also the dim function, feedback and electronic fuse are built in functions.

Why do I need the Monitor RS232?

- You need the monitor to communicate with the Capi2 buss and program the system. It is recommended to keep the monitor in the boat.

How many nodes can the Capi2 system handle?

- Depending on the functions you can use 254 nodes on the system, when using the multiple function the total amount of nodes will be less.

What is the supply voltage Capi2 can handle?

- Capi2 as it is now is designed for handling 12 and 24-volt systems.

How can I get the programming software?

- When buying a system we supply you a password to install it from the Internet.

Are updates included?

- Ones having installed the auto configuration software it automatically checks for updates.

Do your Nodes handle surge capacity? If so, how much?

- PN3 = 70A
- PN10 = 90A
- PN16 = 130A

Can two Nodes be "paralleled" together for more amperage capacity?

- Yes

What % of rating can we use on a continuous basis? In other words can we draw 16 amps from a 16 Amp and still have a bit of room before tripping the node?

- We give a 10% rating on the nodes.

- FAQ

What is a fuse node and what is it used for?

- A fuse node is a hardware node with a thermal fuse. It is used to ensure that at anytime when a node might break down direct power to the connected consumer is ensured. (back-up system is also required for CE norm) Also it can be used for consumers that always might be connected to the power, for example a 12-volt socket.

How is a fuse node connected? Directly to the battery so that it always has power even if the switch panel or cable bus goes bad?

- No, it is connected directly to the power of the bus system; it will stay operational when the PBP breaks down. When the bus cable goes bad it might cause a problem.

Do the fuse nodes have a circuit breaker so you can reset it at the node instead of the panel?

- Yes, correct

What is different about a fuse node form a regular node?

- The fuse node is only hardware and not related to any kind of software. The fuse node is only hardware and controlled manually, a power node is software controlled.

Does the fuse nodes still be paralleled for additional amp capacity like the regular nodes?

- Yes, that is correct

If the main 50-amp breaker is tripped, how is it reset?

- The main fuse is a circuit breaker and has to be manually reset. Notice that with a length of 10-meter bus cables the main fuse can be 80A.

Is it for an amateur also easy to install the system and maintain it?

- The advantage is in opposite to other systems very simple to understand.
- No difficult installation regulations or complex setup procedures for programming.
- Just place the cable strings where you want to have the connection points for the consumers.
- Connect them to the nodes and program the system.
- In case of a failure of a node to a critical consumer you can connect a fuse node to it. If the main intelligence (PBP) breaks down, we have the selection of the priority 1, this will activate all the nodes which are having priority 1. So you will always be sure of power on the boat in case of a emergency.

Does Capi2 supply the drop cable connectors and the cables to the nodes or must we supply them our selves? Are the needed connectors a standard design?

- Capi2 does not supply the cables from the nodes to the loads. You need for the 3A/10A nodes 1.5 mm² and for the 16A node 2.5mm² cables. The connectors we advise to use are: Faston 0-0160314-2 AMP, Tyco Electronics

I have a consumer, which draw 25 and 20 Amp respectively. The maximum power node is 16A can we still control this consumer with Capi2?

- Yes, you can use a PN3A node to control the relays. You can open or close the relays with the node, but not control the equipment. Also it is possible to use 2 PN16 nodes parallel connected to this consumer.

If the cabling bus exceeds 15 m and the conductor size increases, can the nodes accommodate the larger conductor size?

- The nodes can accommodate that; the problem is the busload on the current. 15 meter is good for 50A, 10 meter for 80A

255 nodes are possible on the system. How does the 21 key control board work when the node numbers exceed 21?

- You can add more nodes (max 8) under 1 button, and you can add slave panels to the PBP

We are using 48V power systems in our applications; does your system operate with 48V?

No at the moment we only can handle 12 and 24 volt

- Are larger capacity Nodes available? It would seem impossible to completely wire a boat on the Capi2 system unless you had 20, 25, and 30 amp nodes. While, many 12 volt items fit under the limit of 16 amps, the key items on a vessel don't: macerator heads, bilge pumps, pump-out macerator pumps, etc. are larger.
- As a maximum on the PN we have 16A. There is no problem to place two in parallel.

- FAQ Comfort

Is there any way of switching several loads from remote areas? (Cabin lights, head)?

- Yes, with 1 or more SNX nodes

Is there a ability to monitor when a pump is operating on the boat (fuel transfer pump, water pump, bilge pump, etc.)

- Feedback is shown if a pump is running with the illumination of the assigned button to this function.

Can a anchor winch (120A) be direct wired to a node assigned to a switch in the cockpit so I can operate the winch from there.

- The anchor winch load is to 'heavy' so you can only activate relays for the winch.

If we connect it to the bus, can we operate it from the cockpit? Or do you think we should wire it separately from the bus?

- You cannot actuate the winch directly from the bus because it is 120A. 16A is the maximum you can handle with a node. We recommend relays for this situation.

Do you have a sensor, which can close a circuit (as of a switch)

- We have the SNX node, which can be used as a sensor. You can then get a feed back (green led if closed or red in case open) on the push button board.

Is it possible to install a switch between node and consumer?

- Yes, you can connect a switch in series with a node and consumer.

Can your "dimmers" dim LED lights?

- We can dim LED lights, which are voltage regulated, we are not able to dim the current regulated LED's

We are using LED cabin lights. This are current regulated LED's which cannot be dimmed, is switching now also not possible?

- If they are not dimmable you can always switch them on and off with the node.

Is it easy to update an existing system later with more consumers or functions?

- Yes, you always can update or add functions to a system afterwards.

Is it possible to connect some of the lights, for example, in series so that 1 node covers 2 lights?

- Yes, you can program different lights at one node but you cannot cross the max. Amperage. The usage of feedback must be disabled because it does not work then.

- FAQ safety

Several loads (e.g. navigation, plotter, bilge pumps) are connected to more than one node. What is the rationale behind this?

- For one bilge pump you need 1 power node and a fuse node. BUT: to back-up the bilge you place another power node on the bus to provide power in case the node fails. (CE regulation)

Is a fuse node the same as a power node?

- The fuse node is a hardware node and the power node is a software node. The fuse node you need to operate by hand. It is mainly for safety.

What happens to the system in event of a direct or indirect lightning strike?

- In event of a direct or indirect lightning strike the system will go flat like all other (conventional) systems. The advantage of our system is that it is very easy in case this happens to make a direct connection to the power by a fuse node or placing a cable direct on ring cable. This is pure a solution to get in save waters.

Is it common or necessary to have more than one main fuse box?

- No it is not needed; this is depending on the construction of the electrical system.

- FAQ software

Are the physical ECB and its intelligence hidden underneath the black sealant in the cover? Is that where the Capi2 intelligence is hidden or is the intelligence in the control panel?

- Intelligence is indeed underneath the black sealant in the cover. The electronics in the cover (the node) is in contact with the other brain of the system; the control panel. Here configuration finds place in a very simple way with the node.

What is the programming principle for these panels?

- We deliver the software for programming Capi2. We can also program it custom made (push-button panel and the nodes). So you have a plug and play system. That's also a advantage of Capi2; very easy to install.

- FAQ certification

Is the system approved by American Bureau Shipping Standards?

- Yes, Capi2 is ABYC approved

Which certifications are on the Capi2 product?

- 94/25 EC
- 89/336/EEC
- ISO 10133
- EN 61 000-6-2 (2001)
- EN 61 000-6-3 (2001)
- IEC 60533
- CE approved
- ABYC

Is there a reason you would recommend 10 M 80 AMP cable?

- According to the European Standards are we maximized to 80 Amp on a 10M cable we are here not allowed to take out 80 A on a longer cable. According to the European Standard do all appliances need to be on also toilets etc then we are allowed for a 10% voltage drop? In America is it different as of the ABYC rules this means that you might be allowed to use longer cable than 10 M and a fuse of 80A.

What technical specifications are known for Capi2 ?

- System voltage 12-24V
- Voltage range 9-36V
- Power consumption in standby <10Ma
- Power consumption in use approx 100Ma
- Storage temperature -20° C to +70° C
- Operation temperature -4° C to +50° C
- Max length of bus cable 100 meter
- Max number of nodes 255
- Recommended length of powercable 15 meter
- Max load with 15 meter powercable 50A
- Recommended length of powercable 10 meter
- Max load with 10 meter powercable 80A
- Max number of bus cables indefinite

- FAQ others

We have an 18ft boat; is this too small for a Capi2 system?

- No. Capi2 is also perfect for small boats (fleet range in length from 0 to 25')

How do we get prices and delivery times?

- Depending on the country you are from we can supply the details of our distributor for that country or if there is no distributor we can give you a quotation.

Who is responsible for installing it?

- The system can be installed by the installers who already installing the conventional wiring into the boats. If wished for we can supply assistance for the first boats.

Could you send a schematic for a "typical" 60' yacht with multiple bilge pumps, 2 water pumps, 4 elect toilets as an example?

- In case we receive all details for the boat you want to fit with Capi2, we always can make a proposal diagram of the Capi2 system on that boat.

Is Capi2 a two pole protected system?

- We are looking into this and we will answer you when we have more details.

Is it possible to get a list of references?

- Yes, we always can send you a list with references.