CAN BRANCH
POWER MONITORING BOX

PMB

ATLAS
DCS

USER MANUAL
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ABSTRACT

The CAN Branch Power and Monitoring Box can supply power to a CAN branch consisting of about 32 ELMBs consuming a total current of up to 2.2A. The power is supplied on two separate pairs, one for the CAN part and one for the combined Digital and Analog part of the ELMB. The voltage and the current in each power supply can be monitored by a built-in auxiliary ELMB. The power of the CAN branch can be switched on or off via a CAN bus message to the auxiliary ELMB.

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1. Introduction and block diagram

The aim of the CAN Branch Power Monitor Box (PMB) is to monitor the power consumption at a CAN branch. Slowly increasing currents are a sign of radiation damage while a SEE latch-up would cause a sudden increase of the current. In this case power cycling is needed in order to restore normal operation. The PMB consists of a regulated power supply, an ELMB for monitoring of voltages and currents, power switching circuits and number of connectors for the connections to the CAN branch and computer interfaces.
A block diagram is shown in Figure 1. The connector J1 is a 19 pin round connector (CERN SCEM 09.31.05.452.7) for the connection of the CAN bus cable to be monitored. In parallel to this there is a connector J3 of D-sub 9pol type. The power lines of both connectors J1 and J3 can be switched ON/OFF via an auxiliary CAN bus and the built-in ELMB. The CAN bus of connectors J1 and J3 are also connected to J2 and J4. The connector J2 is always powered and can be used to power a CANbus PC card interface. The connector J4 has no power connection and can be used for a CAN analyzer. The auxiliary CAN bus is connected to connectors J5 and J6 both and can be used for a second CAN port on an interface card

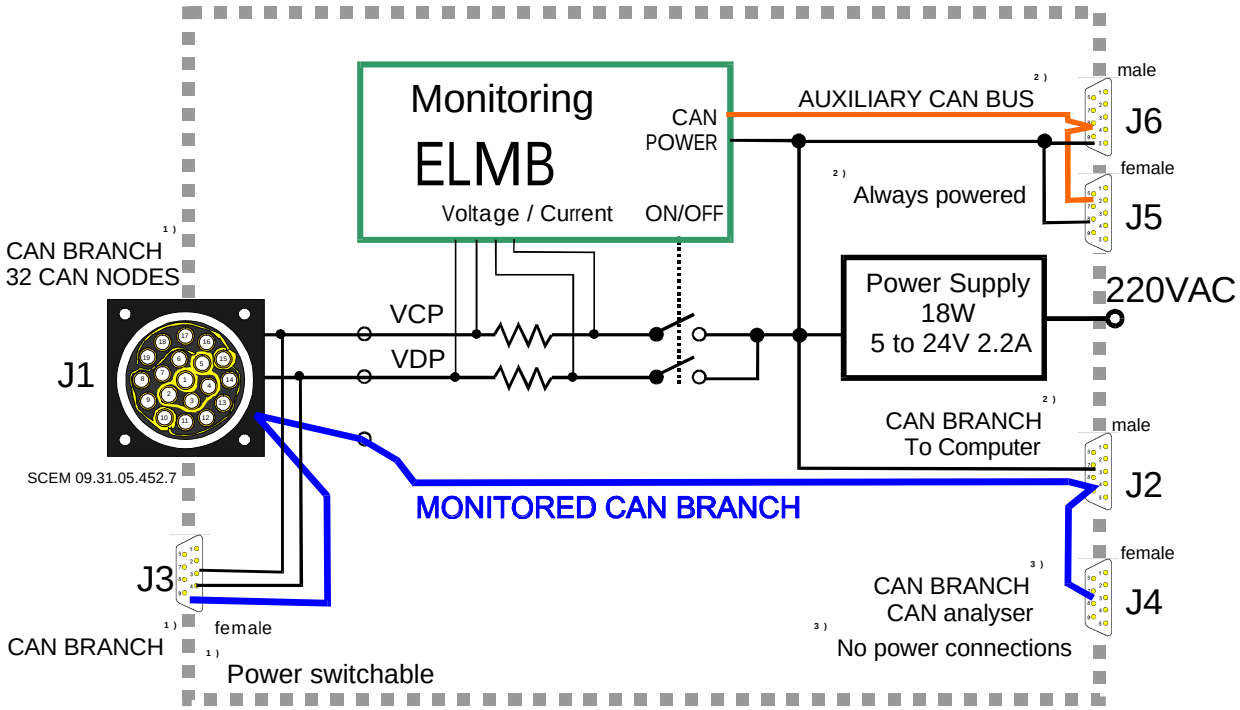


Figure 1 Block diagram of CAN Branch Power Monitor Box

2.0 Programming of the monitoring ELMB

4 channels of the monitoring ELMB are used. Each channel is connected via resistive attenuators to the line being monitored. The channels 1 and 2 measure the CAN voltage and current respectively. The channel 2 and 3 are used for the combined analog and digital voltage and currents consumed on the monitored CAN branch. The ADC settings to be used are 25 mV and 3.76 Hz and unipolar reading. Please note **the default node ID = 1** for the monitoring ELMB.

Index (hex)	Sub Index	Description	Data/ Object	Attr	Value (hex)	Comment
2100	0	ADC configuration for Monitor Box		RO		
2100	1	Number of input channels	U8	RW	4	
2100	2	Conversion Word Rate	U8	RW	6	3.76 Hz
2100	3	Input Voltage Range	U8	RW	2	25 mV
2100	4	Unipolar/Bipolar mode	U8	RW	1	Unipolar

2.1 Conversion of voltage readings channel 0 and 2.

The raw ADC readings (counts) must be converted to volts. Multiplying each channel reading with 0.025V and dividing this value with the full-scale counts 65535 does this. The final values are obtained by multiplying the ADC voltage readings of channel 0 and 2 with the attenuation factor 675.513. Offsets for channels 0 and 2 can be neglected.

2.2 Current measurements channel 1 and 3.

When measuring the currents large offsets have to be taken into account. The offsets or pedestals are due to miss matching of resistors used in attenuators but also due to currents drawn by the front-panel LED's. The calibration is done by measuring the ADC readings without any node connected on the CAN branch. Table 1 below shows the typical readings.

Table 1: Typical readings of the monitor ELMB with no nodes connected on the CAN branch.

Channel	Byte 0	Byte 1	Counts	Volt	Conversion		Results		
0	DD	B6	46813	0.017858	675.513	1/Attenuation	**12.063**	**V**	CAN
1	D6	16	5846	0.002230		mA/mV			CAN
2	E8	B6	46824	0.017862	675.513	1/Attenuation	**12.066**	**V**	A+D
3	95	17	6037	0.002303		mA/mV			A+D

The currents of the CAN and A+D are then found by subtracting the values of channel 1 and 3 of Table 1 from the respectively values in Table 2 and multiplying the result with the conversion factors 46900 respectively 47800.

Table 2: Readings with 2 ELMBs are connected on the CAN branch.

Channel	Byte 0	Byte 1	Counts	Volt	Conversion		Results		
0	68	B6	46696	0.017813	675.513	1/Attenuation	**12.033**	**V**	CAN
1	10	1F	7952	0.003033	46900	mA/mV	**37.7**	**mA**	CAN
2	47	B6	46663	0.017801	675.397	1/Attenuation	**12.022**	**V**	A+D
3	AE	22	8878	0.003387	47800	mA/mV	**51.8**	**mA**	A+D

Table 2 shows that the current consumption on the CAN power line is about 19 mA while the combined Analog and Digital power consumes about 26 mA per ELMB.

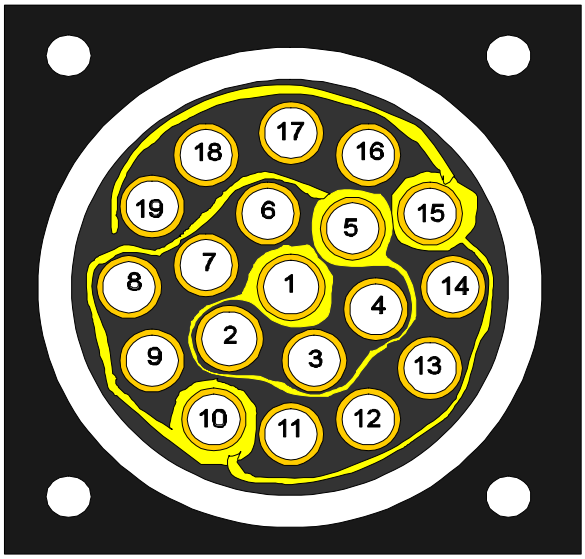
2.3 Switching of the power to the CAN Branch

The CAN branch can be turned ON or OFF with the following CANopen commands to the ELMB with the Node ID=1. The value 1 to the PORT C turns the CAN Branch power OFF while the value 0 turns it ON.

Index (hex)	Sub Index	Description	Data/ Object	Attr	Value (hex)	Comment
6200	0	Digital Output	U8	RO		PORT C
6200	1	Write Output	U8	RW	***1***	TURN OFF
6200	0	Digital Output	U8	RO		
6200	1	Write Output	U8	RW	***0***	TURN ON

3.0 Connectors

3.1 Connectors for CAN Branch



Pin	Name	Description
1	VCP	Power lines for CAN
2	VCP	Power lines for CAN
3	VCP	Power lines for CAN
4	VCP	Power lines for CAN
5	VCG	Power lines for CAN
6	VCG	Power lines for CAN
7	VCG	Power lines for CAN
8	VCG	Power lines for CAN
9	VDP	Power lines for A + D
10	VDP	Power lines for A + D
11	VDP	Power lines for A + D
12	VDP	Power lines for A + D
13	VDG	Power lines for A + D
14	VDG	Power lines for A + D
15	VDG	Power lines for A + D
16	VDG	Power lines for A + D
17	CAN-H	CAN bus line HIGH
18	CAN-L	CAN bus line LOW
19	SHIELD	Outer shielding

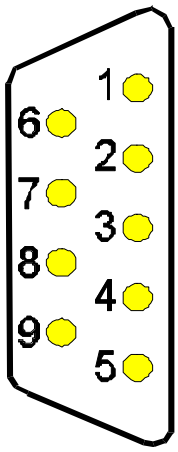
Connector J1 Burndy SCEM 09.31.05.452.7 . Suitable cables see below:

			I)	**II)**		
SCEM	**Nb**	**n x Ø mm**	**mm2**	**mm**	**TYPE**	**CHF**
04.21.52.010.3	9 x 2	14 x 0,15	0,25	12,0	ND 18 P	3.60
04.21.52.130.6	9 x 2	16 x 0,20	0,5	13,5	NE 18 P	4.30
04.21.52.218.9	2 x 9	30 x 0,20	1,0	16,5	NG 18 P	5.10

I) Section of conductor II) Outer diameter of cable

Connector J3

J3

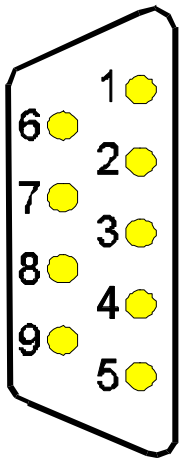


Pin	Description
1	Not used
2	CAN-L
3	GND
4	VDG
5	Shield
6	VCG
7	CAN-H
8	VDP
9	VCP

This connector is in parallel with J1. In can be used to put in a termination for the CAN bus.

Connector J2

J2



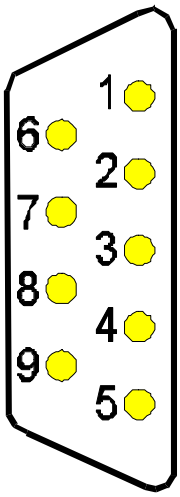
Pin	Description
1	Not used
2	CAN-L
3	GND
4	Not used
5	Shield
6	GND
7	CAN-H
8	Not used
9	Pos +12V

This connector is connected to the CAN Branch which is monitored but it is constantly powered. It is suitable to connect to PC CAN bus card to drive the CAN Bus segment to be monitored.

Connector J4

The connector J4 is intended for a CAN bus analyzer. It has no power connections. It can be used for interconnecting the control CAN bus and the CAN bus segment to be monitored.

J4

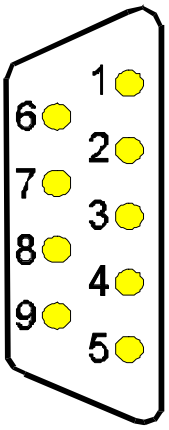


Pin	Description
1	Not used
2	CAN-L
3	GND
4	Not used
5	Shield
6	GND
7	CAN-H
8	Not used
9	Not used

Connectors J5 and J6

The connectors J5 and J6 are connected to the auxiliary CAN bus, which drives the ELMB, built in into the Power Monitoring Box.

J5 and J6



Pin	Description
1	Not used
2	CAN-L
3	GND
4	VDG
5	Shield
6	VCG
7	CAN-H
8	VDP
9	VCP

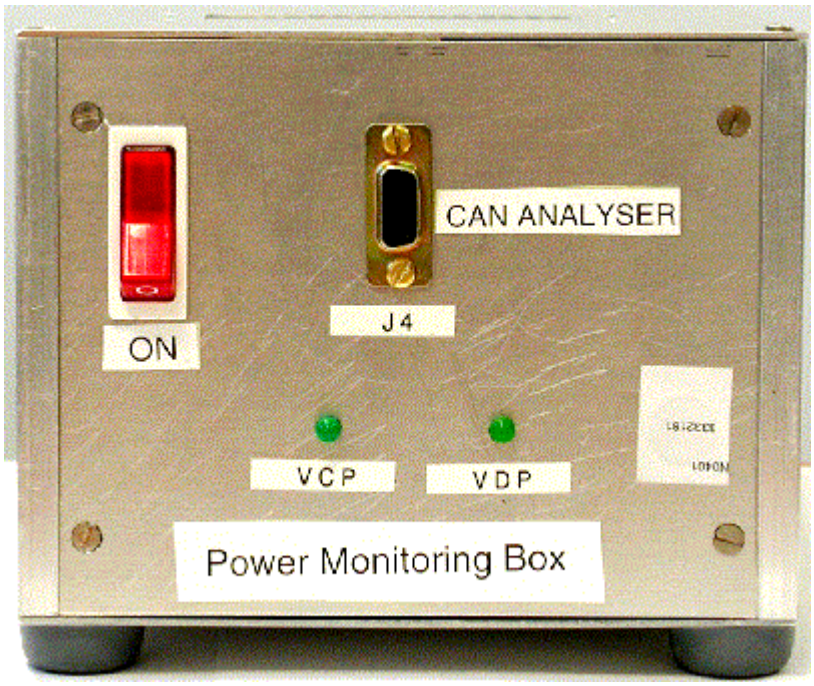


Figure 2 Front side of the Power Monitor Box

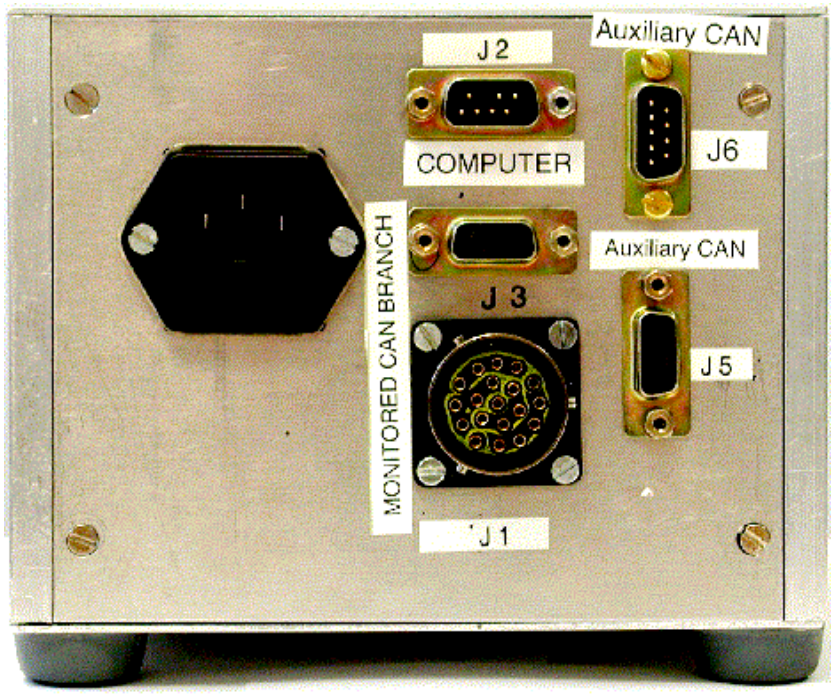
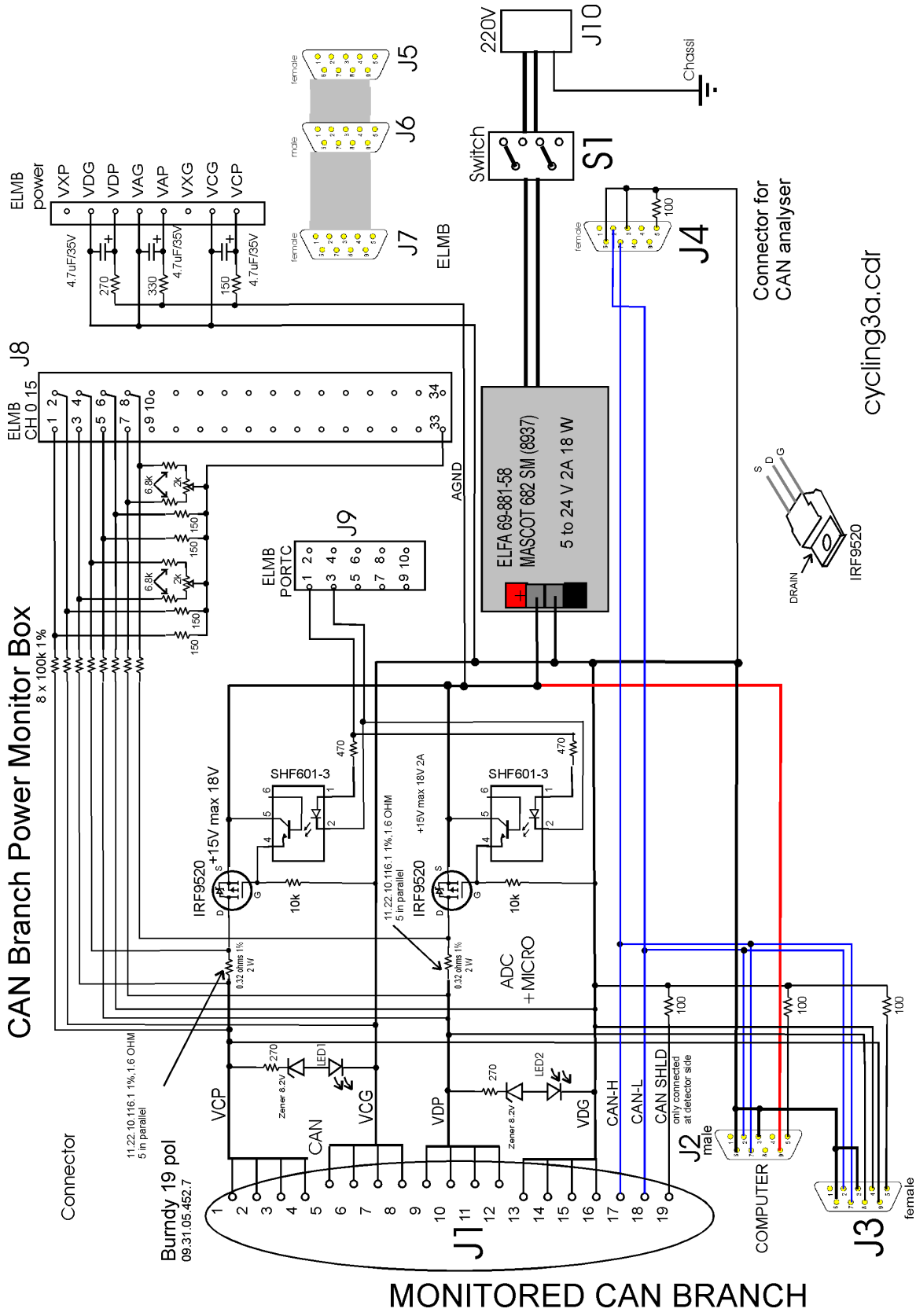


Figure 3 Back side of the Power Monitor Box


CAN Branch Power Monitor Box
8 x 100k 1%
ELMB power
VXP
VDG
VDP
VAG
VAP
VXG
VCG
VCP
4.7uF/35V
270
330
150
ELMB CH 0 15
J8
AGND
ELMB PORTC
J9
J5
J6
J7
ELMB
220V
J10
Chassi
Switch
S1
ELFA 69-881-58
MASCOT 682 SM (8937)
5 to 24 V 2A 18 W
J4
Connector for CAN analyser
cycling3a.cdr
IRF9520
DRAIN
SHF601-3
+15V max 18V
+15V max 18V 2A
470
10k
11.22.10.116.1 1%,1.6 OHM
5 in parallel
0.32 ohms 1% 2 W
ADC +MICRO
Zener 8.2v
LED1
LED2
CAN
VCP
VCG
VDP
VDG
CAN-H
CAN-L
CAN SHLD
only connected at detector side
J2
male
COMPUTER
J3
female
Connector
Burndy 19 pol
09.31.05.452.7
J1
MONITORED CAN BRANCH