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ES1392.1 High Current Switch Board

User's Guide

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R1.0.1 EN - 02.2003 TTN F 00K 102 735

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1 Introduction

This section contains information about the basic features and applications of the ES1392.1 High Current Switch Board. A block diagram is also included here to show the schematic layout of the board.

note

Some components of the ES1392.1 High Current Switch Board may be damaged or destroyed by electrostatic discharges. Please keep the board in its storage package until it is installed.
The ES1392.1 High Current Switch Board should only be taken from its package, configured and installed at a working place that is protected against static discharge.

note

The components, connectors and conductors of the ES1392.1 High Current Switch Board may carry dangerous voltages.
These voltages may even exist when the ES1392.1 is not installed in the ES4100 or ES4300 or the ES4100 or ES4300 is powered off.
Make sure that the ES1392.1 is protected against contact during operation. Disconnect all connections to the ES1392.1 before removing the board.

1.1 Applications

The ES1392.1 High Current Switch Board is used to switch five high current battery nodes to +UBatt (five nodes) or -UBatt (one node).

The ES1391.1 Power Supply Controller Board is used to control the ES1392.1 High Current Switch Board with TTL signals. An ES1391.1 Power Supply Controller Board can control up to two ES1392.1 High Current Switch Boards and at the same time up to two battery voltage power supplies.

Five battery nodes can be switched per voltage when two ES1392.1 High Current Switch Boards and two power supplies (for example 12 V and 42 V) are used.

An example of this kind of scenario is shown in Fig. 1-1.

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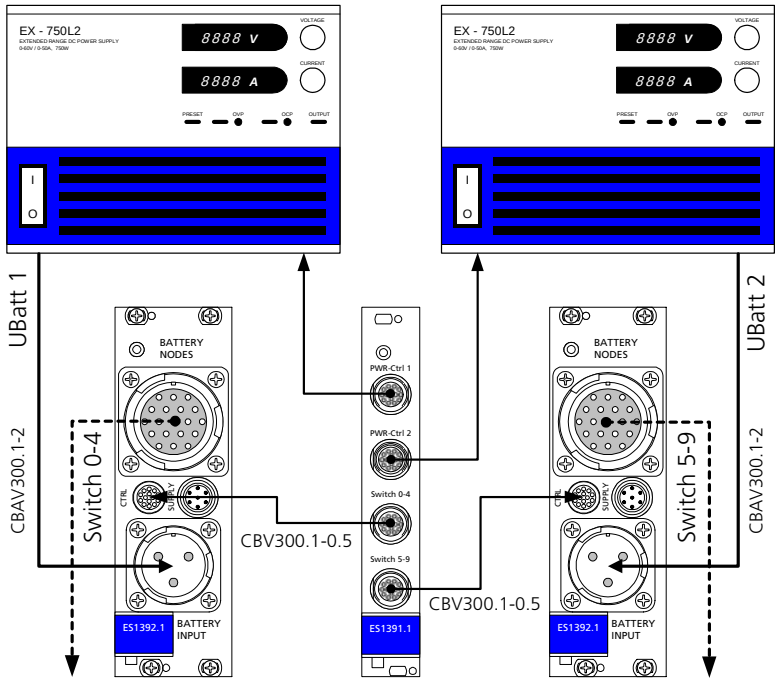


Fig. 1-1 Use of Two ES1392.1 High Current Switch Boards to Switch Two Battery Voltages

The ES1392.1 High Current Switch Board does not have a VMEbus interface - it is controlled by TTL signals which have to be connected to a front-facing connector. In the LabCar environment, these TTL signals are generated by the ES1391.1 Power Supply Controller Board which communicates with the back-plane of the ES4100 or ES4300 Signal Box via a VMEbus interface.

1.2 Features

The ES1392.1 High Current Switch Board has the following features:

- Two high current switches for currents of up to 20 A
  - Switch 0 switches to +UBatt or -UBatt
  - Switch 1 switches to +UBatt
- Three high current switches for currents of up to 12 A
  - Switches 2 - 4 switch to +UBatt

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- Maximum overall current of 40 A
- Input voltage range of 6 - 60 V
- Control connector on the front panel ("CTRL") (digital TTL signals)
- Power supply input on the front panel
- Overcurrent protection
- Overcurrent status is routed to the "CTRL" status output on the front panel
- Versioning information (version/type of board) available via front-facing "CTRL" connector (1-Wire®)
- Supply voltages are routed to the front panel ("SUPPLY") (+5 V (2 A), +12 V (1,5 A), -12 V (1,5 A))

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The following figure shows the front panel of the ES1392.1 High Current Switch Board.

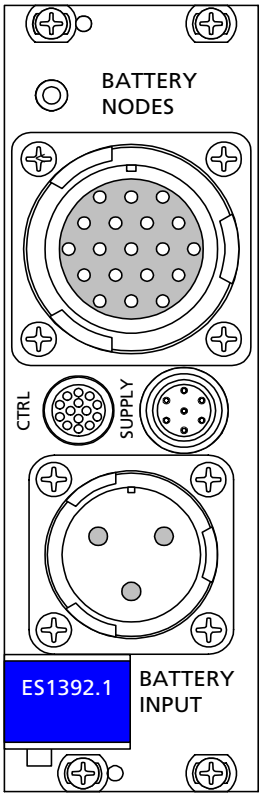


Fig. 1-2 Front Panel of the ES1392.1 High Current Switch Board

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1.3 Block Diagram

Fig. 1-3 shows the block diagram of the ES1392.1 High Current Switch Board. The battery voltages are supplied via "BATTERY INPUT". The battery nodes connected via "BATTERY NODES" can be switched to these battery voltages via the switches.

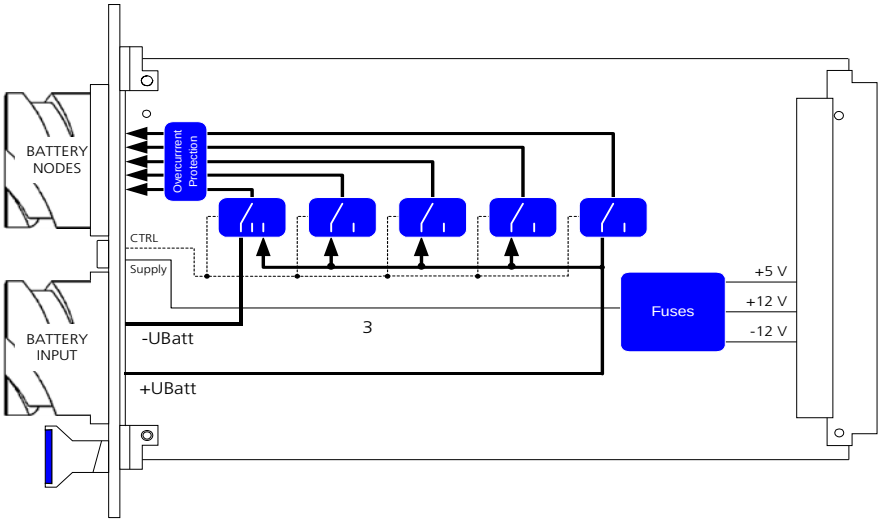


Fig. 1-3 Block Diagram of the ES1392.1 High Current Switch Board

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2 Hardware

This chapter contains the hardware descriptions of the ES1392.1 High Current Switch Board. It consists of the following sections:

- "Functional Description" on page 11
- "Configuring Battery Node 0" on page 12
- "Controlling the Switches" on page 13
- "Overcurrent Protection with the Status Output" on page 13
- "EEPROM" on page 13
- "Battery Voltage at the "CTRL" Connector" on page 14
- "MRC Signal" on page 14
- "Reverse-Connect Protection of the Battery Node Switches" on page 14
- "Parallel Switching of Several Battery Nodes" on page 15
- "Potential Difference between Ground and -UBatt" on page 15
- "Battery Voltage at the "BATTERY NODES" Connector" on page 15
- "Protective Measures" on page 15

2.1 Functional Description

The ES1392.1 High Current Switch Board has two groups of switch channels which differ in terms of their maximum current rating. Battery node 0 can be switched to either +UBatt or -UBatt whereas the other battery nodes can only be switched to +UBatt (see Tab. 2-1).

Battery Node	Switch to		Permissible Current
	+UBatt	-UBatt	
0	Yes	Yes	20 A
1	Yes	No	20 A
2	Yes	No	12 A
3	Yes	No	12 A
4	Yes	No	12 A

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Tab. 2-1 Switching Possibilities and Permissible Currents

2.2 Configuring Battery Node 0

Battery node 0 can be configured to be switched to either +UBatt or -UBatt. Once the configuration has been changed, both switches remain open until, after a delay, the new configuration becomes active. This makes it impossible to use battery node 0 as a half bridge for fast signals.

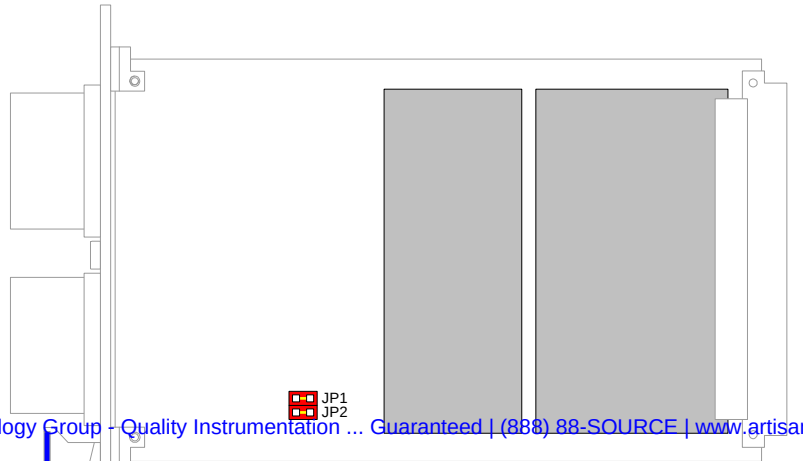
Battery node 0 can be configured using jumpers or via the "configuration switch 0" control signal of the "CTRL" connector (see Tab. 3-3 on page 22).

Please consult Tab. 2-2 for more details on the jumper configuration or the control signal for the relevant configuration

JP1	JP2	Control Signal	Configuration
1	0	Any	+UBatt
0	1	Any	-UBatt
1	1	L/open	+UBatt
1	1	H	-UBatt

Tab. 2-2 Jumper Configuration and Control Signals for Configuring Battery Node 0

The position of the jumpers on the board is shown in Fig. 2-1.



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2.3 Controlling the Switches

The switches are controlled using the "control signal switch *n*" control signals (see Section 3.3 on page 21).

Control Signal	Switch
L/open	Open
H	Closed

Tab. 2-3 Control Signal and Switch Position

2.4 Overcurrent Protection with the Status Output

If an overcurrent is detected on one of the battery nodes, the relevant switch is opened. After a delay of max. 800 ms, the switch is automatically closed again to check whether the error has been recovered. If the overcurrent can still be detected, the switch is opened again immediately. This is repeated until there is no longer an overcurrent.

note

The cyclical current impulses which occur with an overcurrent may overstrain the current limitation of some power supplies. In this case, the battery voltage should be buffered with a large capacitor at the output of the power supply or a low-impedance power resistor should be added to the battery voltage line to limit the current.

The user is made aware of one of the switches being switched off because of an overcurrent by the "signal switch error" status signal at the "CTRL" connector (see Fig. 3-3 on page 21).

Overcurrent	Status Signal
Normal operation	L
Error	H

Tab. 2-4 Status Signal for Overcurrent Errors

For more details on protective measures, please refer to Section 2.12 on page 15.

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2.6 Battery Voltage at the "CTRL" Connector

-UBatt and +UBatt are available at the "CTRL" connector. Both voltages are protected (see Section 2.12.2 on page 17).

2.7 MRC Signal

To keep the wiring harnesses as simple as possible, the main relay control signal (MRC signal) is routed from the "BATTERY NODES" connector to the "CTRL" connector. The signal is protected (see section 2.12.3 on page 17).

It is not used for any other purpose on the ES1392.1 High Current Switch Board.

2.8 Reverse-Connect Protection of the Battery Node Switches

The switches to +UBatt are protected against voltages at the battery node which are above the battery voltage.

This may occur, for example, in a system with two battery voltages (12 V/42 V) if a short occurs between battery nodes of the two different battery voltages.

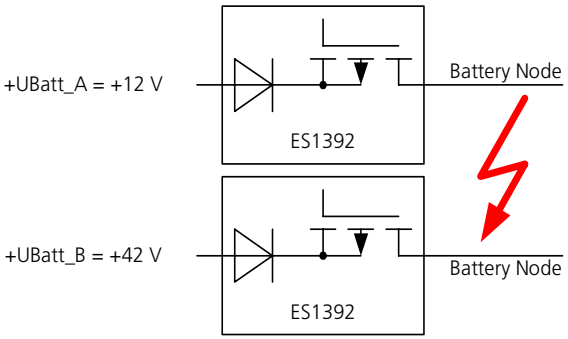


Fig. 2-2 Reverse-Connect Protection

Without this protection, the MOS-FET switches would still conduct current with this kind of error without being able to be switched off. This could result in the lower battery voltage being increased and connected consumers being destroyed; alternatively the switch itself could be destroyed because of an overcurrent.

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2.9 Parallel Switching of Several Battery Nodes

To increase the maximum current of the battery nodes, the two 20-A battery nodes, BN0 and BN1, can be switched in parallel. The overcurrent protection of the switches to +UBatt of these two battery nodes is synchronized, i.e. they are both switched off (simultaneously) when an overcurrent is detected and then are both switched on again simultaneously.

To increase the maximum current of the battery nodes, two or all of the 12-A battery nodes, BN2, BN3 and BN4, can be switched in parallel. The overcurrent protection of the switches to +UBatt of these three battery nodes is synchronized, i.e. they are all switched off (simultaneously) when an overcurrent is detected and then are all switched on again simultaneously.

note

Only the same type of battery node can be switched in parallel. 20-A and 12-A channels cannot be combined.
The maximum overall current of 40 A must not be exceeded.

2.10 Potential Difference between Ground and -UBatt

The potential difference between ground and -UBatt must not exceed ±2 V. Otherwise the functionality of the board can no longer be guaranteed and the board may even be damaged.

2.11 Battery Voltage at the "BATTERY NODES" Connector

-UBatt and +UBatt are available at the "BATTERY NODES" connector. Both voltages are protected.

2.12 Protective Measures

The battery voltages +UBatt and -UBatt supplied by the power supply to "BATTERY INPUT" are protected by fuses in their individual current paths.

The battery node switches themselves are protected electronically against overcurrent. The battery voltages, supply voltages and the MRC signal at the front-facing connectors are protected by fuses.

There is no fuse protection of the overall current of +UBatt. The overall current of +UBatt must not exceed 40 A.

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The position of the fuses on the board is shown in Fig. 2-3 on page 16 - their specifications can be found in the following sections.

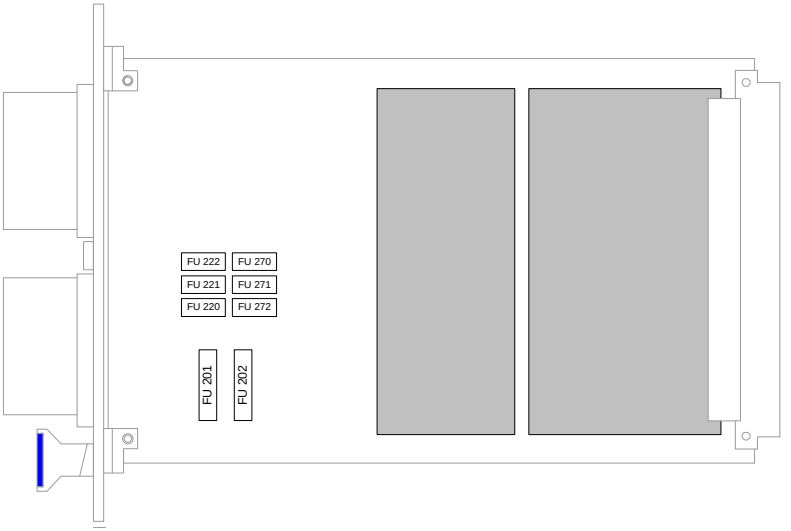


Fig. 2-3 Position of the Fuses (Component Side)

2.12.1 +UBatt and -UBatt at "BATTERY NODES"

The battery voltages output at the front-facing "BATTERY NODES" connector are protected as follows:

Fuse	Specification	Type	Manufacturer/Order No.
FU201	20 A 80V	Blade Fuse Link	Pudenz / 166.7000.520
FU202	20 A 80V	Blade Fuse Link	Pudenz / 166.7000.520

Tab. 2-5 Fuse Protection of Battery Voltages +UBatt and -UBatt

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2.12.2 +UBatt and -UBatt at "CTRL"

The battery voltages output at the front-facing "CTRL" connector are protected as follows:

Fuse	Specification	Type	Manufacturer/Order No.
FU220	1 A, slow-blowing	NANO2 SMD Fuse	Littelfuse 154.001T
FU221	1 A, slow-blowing	NANO2 SMD Fuse	Littelfuse 154.001T

Tab. 2-6 Fuse Protection of +UBatt and -UBatt at "CTRL"

2.12.3 MRC Signal between "BATTERY NODES" and "CTRL"

The MRC signal fed-through between the front-facing connectors "BATTERY NODES" and "CTRL" is protected as follows:

Fuse	Specification	Type	Manufacturer/Order No.
FU222	1 A, slow-blowing	NANO2 SMD Fuse	Littelfuse 154.001T

Tab. 2-7 Fuse Protection of the MRC Signal

2.12.4 Supply Voltages at "SUPPLY"

The supply voltages routed from the backplane to the front-facing "SUPPLY" connector are protected as follows:

Fuse	Specification	Type	Manufacturer/Order No.
FU271	2 A	NANO2 SMD Fuse	Littelfuse 154.002T

Tab. 2-8 Fuse Protection of the +5 V Supply Voltage

Fuse	Specification	Type	Manufacturer/Order No.
FU270	1.5 A	NANO2 SMD Fuse	Littelfuse 154.01.5T

Tab. 2-9 Fuse Protection of the +12 V Supply Voltage

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Fuse	Specification	Type	Manufacturer/Order No.
FU272	1.5 A	NANO2 SMD Fuse	Littelfuse 154.01.5T

Tab. 2-10 Fuse Protection of the -12 V Supply Voltage

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3 Pin Assignment

This chapter explains the pin assignment of the connectors of the ES1392.1 High Current Switch Board.

These are:

- ""BATTERY NODES" Connector" on page 19
- ""BATTERY INPUT" Connector" on page 21
- ""CTRL" Connector" on page 21
- ""SUPPLY" Connector" on page 22

3.1 "BATTERY NODES" Connector

Type: ITT Cannon CA02COM-E20A-48SB

Fig. 3-1 shows the pin assignment of the jack (view from the front).

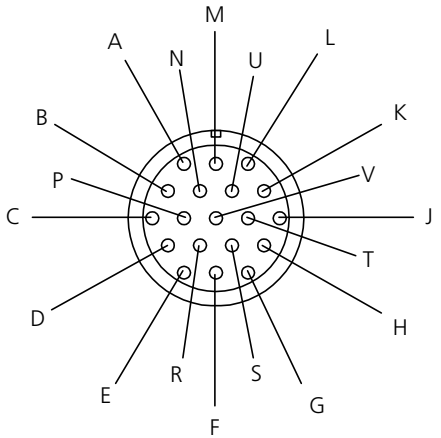


Fig. 3-1 "BATTERY NODES" Connector

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Pin	Signal
A	-UBatt
B	-UBatt
C	MRC signal in
D	+UBatt
E	+UBatt
F	CH4 out
G	CH4 out
H	CH3 out
J	CH2 out
K	CH1 out
L	CH0 out
M	CH0 out
N	-UBatt
P	Not assigned
R	+UBatt
S	CH3 out
T	CH2 out
U	CH1 out
V	Not assigned

Tab. 3-1 "BATTERY NODES" Pin Assignment

The counterpart connector is an" ITT Cannon CA06COM-E20A-48PB".

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3.2 "BATTERY INPUT" Connector

Type: ITT Cannon CA02COM-E16-10PB

Fig. 3-2 shows the pin assignment of the connector (view from the front).

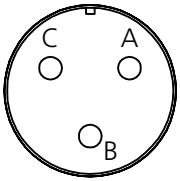


Fig. 3-2 "BATTERY INPUT" Connector

Pin	Signal
A	+UBatt
B	-UBatt
C	+UBatt

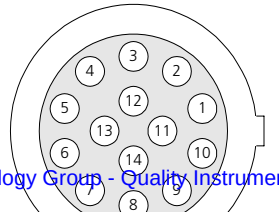
Tab. 3-2 "BATTERY INPUT" Pin Assignment

The counterpart connector is an "ITT Cannon CA06COM-E16-10SB".

3.3 "CTRL" Connector

Type: Lemo EPG.1B.314.LLN

Fig. 3-3 shows the pin assignment of the connector (view from the front).



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Pin	Signal
1	Control signal switch 0 in
2	Control signal switch 1 in
3	Control signal switch 2 in
4	Control signal switch 3 in
5	Control signal switch 4 in
6	Not assigned
7	Signal switch error out
8	+UBatt out
9	-UBatt out
10	Configuration switch 0 in
11	MRC signal out
12	Switch 0-4 ground
13	ES1392.1 EEPROM signal
14	ES1392.1 EEPROM ground

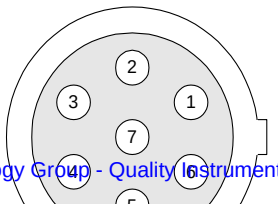
Tab. 3-3 "CTRL" Pin Assignment

The counterpart connector is a "Lemo FGG.1B.314.CLAD76".

3.4 "SUPPLY" Connector

Type: LEMO EGG.1B.307.CLL

Fig. 3-4 shows the pin assignment of the connector (view from the front).



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Pin	Signal
1	-12 V
2	Ground
3	Not assigned
4	+5 V
5	Ground
6	+12 V
7	Not assigned

Tab. 3-4 "SUPPLY" Pin Assignment

The counterpart connector is a "Lemo FGG.1B.307.CLAD76".

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4 Accessories

4.1 Cables

To connect the ES1392.1 High Current Switch Board to the Power Supply and to the Controller Board two cables are required, which are described below.

4.1.1 Cable CBAV300.1-2: Connection between ES1392.1 and Power Supply (Battery Voltages)

Product Data	
Short description	CBAV300.1-2
Long description	Cable ITT CA06COM - Ring Tongue (3fc - 2xM8)
Product part number	F 00K 103 223

Specification	
Length	2 m
Type	2 wires, 6 mm^2

Connectors	
To ES1392.1	ITT Cannon CA06COM-E16-10SB
To power supply	2 ring tongue (RT1+RT2): DIN 46237, insulated, M8

Function	**ES1392.1 ITT Connector**	**Ring Tongue Connector**
+UBatt	A, C	brown
-UBatt	B	blue

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4.1.2 Cable CBV300.1-0.5: Connection between ES1391 and ES1392

Product Data	
Short description	CBV300.1-0.5
Long description	Cable Lemo 1B FGG - Lemo 1B FGG (14mc - 14mc, 0.5m)
Product part number	F 00K 103 217

Specification	
Length	0.5 m
Type	14 wires

Connectors	
To ES1392.1	Lemo FGG.1B.314.CLAD76 (plug, solder version)
To ES1391.1	Lemo FGG.1B.314.CLAD76 (plug, solder version)

Function	ES1391.1 LEMO FGG Connector	ES1392.1 LEMO FGG Connector
Control signal switch 0	1	1
Control signal switch 1	2	2
Control signal switch 2	3	3
Control signal switch 3	4	4
Control signal switch 4	5	5
Not assigned	6	6
Signal switch error	7	7
+UBatt	8	8
-UBatt	9	9
Configuration switch 0	10	10
MRC signal	11	11

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Function	ES1391.1 LEMO FGG Connector	ES1392.1 LEMO FGG Connector
Switch 0-4 ground	12	12
ES1392.1 EEPROM signal	13	13
ES1392.1 EEPROM ground	14	14
PE	Front panel	Front panel

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5 Technical Data

This chapter contains the technical data on the ES1392.1 High Current Switch Board.

Battery Inputs

Input voltage range	6 - 60 V
Input current	Max. 40 A

High Current Switches

Overcurrent protection	Yes
Automatic recovery after overcurrent detection	> 500 ms, < 800 ms (periodically)
Settling time	< 50 µs
Configuration switch 0	Switch to +UBatt or -UBatt
Configuration switch 1 - switch 4	Switch to +UBatt
Current rating switch 0 and switch 1	20 A
Current rating switch 1 - switch 4	12 A
Overall current	Max. 40 A
Resistance of switches to +UBatt (at 10 A)	< 30 mΩ
Resistance of switches to -UBatt (at 10 A)	< 40 mΩ
Battery voltage	+6 V .. +60 V
Maximum permissible potential difference between ground and -UBatt	±2 V
Minimum voltage between +UBatt and ground	+6 V

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High Current Switch Interface

Configuration	1 interface
Digital output channels	1
Digital output level	TTL (0/5 V)
Maximum digital output current	10 mA
Digital input channels	5
Digital input level	TTL (0/5 V)
Digital input current	< 100 µA (I_{IH}), < -1 µA (I_{IL})
Digital galvanic isolation	No
Digital overvoltage protection	Yes (60 V)
Interface for versioning data	1
Type of versioning interface	1-Wire®
Galvanic isolation of the versioning interface	Yes
Overvoltage protection for versioning interface	No

Power Supply Interface

Configuration	1 interface
Output voltages	5 V, ±12 V
Maximum currents	2 A at 5 V 1.5 A at +12 V 1.5 A at -12 V
Protection	Fuses

Environmental Conditions

Operating temperature	0 °C to 70 °C (32 °F to 158 °F)
Storage temperature	-55 °C to +85 °C (-67 °F to 185 °F)
Relative humidity	0 to 95% (non-condensing)

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Power Supply

Power consumption	+5 V DC ± 5 %, 300 mA max. ±12 V DC -5% .. ±15 V +5%, 50 mA max.

Dimensions

Height	3 U
Width	8 HP (occupies 2 VME slots)

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