# ES1651.1 Carrier Board

User's Guide

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# Contents

# 1 Introduction

This User's Guide contains the description of the ES1651.1 Carrier Board.

It consists of the following chapters:

- "Applications and Features" on page 6

  The introduction contains an overview of the characteristics of the ES1651.1 Carrier Board and also includes a block diagram.

- "Hardware Features" on page 10

  This is where the properties of the ES1651.1 Carrier Board are described in detail. These are:

  – "Carrier Board for Piggybacks" on page 10
  – "Synchronization Bus" on page 10
  – "Crankshaft Angle Clock Bus (CAC Bus)" on page 11
  – "Generating an Interrupt" on page 15
  – "Inspection and Versioning Data" on page 16

- "CAN Interfaces (Optional)" on page 17

  This section contains information on the CAN interfaces.

- "Configuration" on page 20

  This section contains a description of the configuration possibilities of the ES1651.1 Carrier Board and their presettings.

- "Addressing the ES1651.1 at the VMEbus (SW1 and SW2)" on page 23

  This section describes addressing the ES1651.1 at the VMEbus.

- "Installing I/O Modules" on page 26

  This section describes how to assemble I/O modules on the ES1651.1 Carrier Board and any necessary preparatory steps:

  – "Assembling the Front Panel to the PB4350XXX Module" on page 26
  – "Mounting the CAN Transceivers" on page 29
  – "Mounting the I/O Modules" on page 30

- "Pin Assignments and Display Elements" on page 34

  This section contains a description of all connectors on the front panel and on the board as well as the meaning of the LED displays.

- "Technical Data" on page 40
  contains the technical data of the ES1651.1 Carrier Board.

**Note**

*Some components of the ES1651.1 Carrier Board may be damaged or destroyed by electrostatic discharges. Please keep the board in its storage package until it is installed.*
*The ES1651.1 Carrier 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 ES1651.1 Carrier Board may carry dangerous voltages.*
*These voltages may even exist when the board is not installed in the VMEbus system or the VMEbus system is powered off.*
*Make sure that the board is protected against contact during operation. Disconnect all connections to the ES1651.1 Carrier Board before removing the board from the VMEbus system.*

## 1.1 Applications and Features

The ES1651.1 Carrier Board acts as a carrier board for up to four I/O modules in VMEbus systems. All modules of types "PB4350XXX" and "PB1651XXX" can be used in any combination. An SPI control unit realized in the FPGA of the board converts the parallel data flow of the processor into a serial bit flow for the SPI interfaces of the I/O modules.

The ES1651.1 Carrier Board has a crankshaft angle clock bus for testing engine ECUs in LABCAR projects; this can be used to synchronize I/O modules with a central crankshaft angle clock for speed-synchronous signal acquisition and signal generation. The crankshaft angle clock bus is routed to the 9-pin Sub-D connector on the front panel of the board so that the crankshaft angle clock can be both supplied externally as well as routed to the outside.

### *Synchronization Bus*

The ES1651.1 has a synchronization bus to synchronize the I/O modules of an ES1651.1 Carrier Board with each other. It consists of four lines which can be configured independently of each other. The bus is also routed to the 9-pin Sub-D connector on the front panel of the board so that the signals can be

supplied externally or routed to the outside to synchronize I/O modules on other carrier boards. The synchronization lines can also be stimulated from within the simulation model.

*CAN Interfaces*

There are two identical CAN channels on the ES1651.1 Carrier Board for connecting the board to the CAN bus. The transceiver functionality is realized on piggybacks so that, if necessary, different transceivers can be used than those intended, i.e. than the PCA82C251 transceiver by Philips for high-speed CAN applications [1] and the MAX3055 transceiver by Maxim for low-speed CAN applications[2].

The ETAS PB1651CAN1 transceiver module is a combined high-speed/low-speed CAN transceiver module[3] with galvanic isolation of the CAN channels. Relays are used to toggle between high-speed and low-speed functionality. The CAN controller functionality is realized in the MPC555 processor of the board which has two CAN channels on board.

*VMEbus Interface*

The ES1651.1 Carrier Board has a VMEbus slave interface and reacts to "A24 non privileged data access" accesses (VMEbus address modifier 39 hex).

The position of the 64-kByte VMEbus address space of the board can be set either dynamically or statically. Data is exchanged with VMEbus master boards via a 32-kByte DPRAM. The board can trigger interrupts at the VMEbus.

*Inspection and Versioning Data*

Inspection and versioning data of the board are stored in a serial non-volatile data memory. PB1651CAN1 transceiver modules also have serial data memories for version and inspection data.

*Processor*

In addition to the CAN channels listed, the MPC555 processor of the board also has a 448-kByte ROM memory which is large enough for program code and data; this is why the optional external ROM memory is not assembled.

1. High-speed CAN systems (data rates between 125 kBaud and 1 MBaud) are used e.g. for engine and transmission controls, ESP, ASR, ACC and ABS.
2. Low-speed CAN systems (data rates up to 125 kBaud) are used in the field of convenience electronics.
3. The terms fault-tolerant CAN and low-speed CAN are synonymous.

Fig. 1-1 shows the front panel of the ES1651.1 Carrier Board.

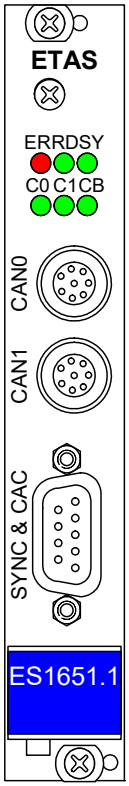



**Fig. 1-1** Front Panel of the ES1651.1 Carrier Board

## 1.2 Block Diagram

Fig. 1-2 shows a block diagram with all important functional units of the ES1651.1 Carrier Board.

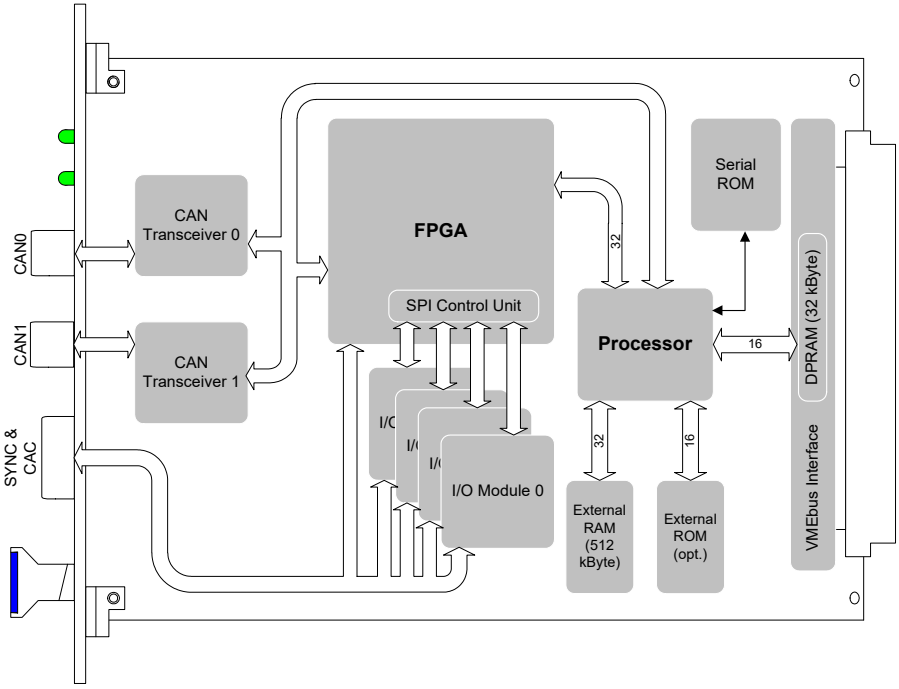



**Fig. 1-2** Block Diagram of the ES1651.1 Carrier Board

# 2 Hardware Features

This section contains a description of the different hardware features of the ES1651.1 Carrier Board.

These are:



## 2.1 Carrier Board for Piggybacks

The ES1651.1 Carrier Board is used as a carrier board for I/O modules in VME-bus systems. I/O modules are available for various tasks, such as the generation and measuring of ECU signals in real time.

All modules of types "PB4350XXX" and "PB1651XXX" can be used. This means that the LABCAR test system can be equipped both with the standard I/O modules for the ES1651.1 Carrier Board (VME system) and with the highly precise I/O modules for the ES4350 Carrier Board. Up to four I/O modules of both types mentioned above can be used per ES1651.1 Carrier Board.

The I/O modules are connected using ribbon cable. There are four connectors on the ES1651.1 Carrier Board for this purpose. For more details on how to assemble I/O modules, please refer to section 5 on page 26.

## 2.2 Synchronization Bus

The ES1651.1 Carrier Board has a synchronization bus for synchronizing

- the I/O modules mounted on the carrier board with each other,
- I/O modules with the carrier board,
- I/O modules with other I/O modules which are installed on other ES1651.1 Carrier Boards or ES4350 Carrier Boards in the same or other VMEbus systems,
- with other external hardware which can generate or interpret the relevant synchronization signals.

The synchronization bus has four identical synchronization channels. A block diagram of a single channel is shown in Fig. 2-1.

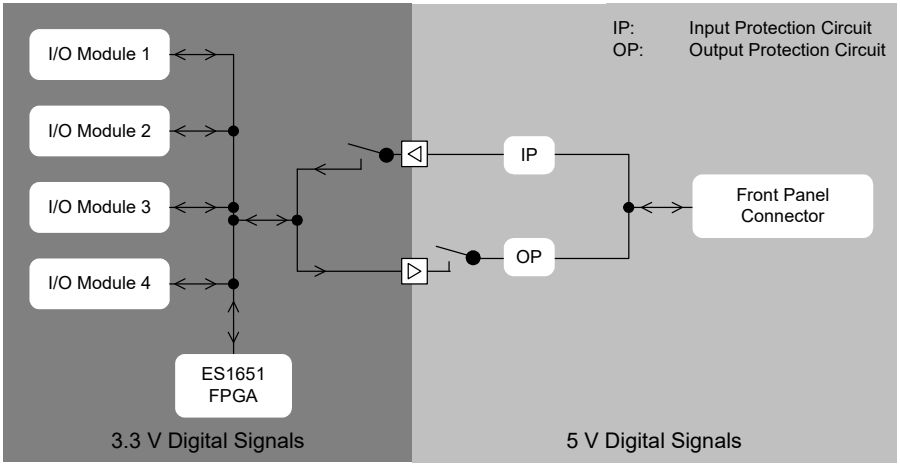



**Fig. 2-1** Block Diagram of a Synchronization Channel

The front panel connector can be configured as

- an input which provides the synchronization signals for the carrier board hardware and the I/O modules,
- an output which provides the synchronization signals for external hardware

or can be disconnected from the synchronization bus.

Internally the synchronization bus works with 3.3 V digital signals. To reduce interference sensibility, the signals are transferred to and from external hardware with 5 V digital signals. The direction of an individual synchronization channel can be selected independently of the other synchronization channels.

The input and output stages are protected against overvoltage from -14 V to +19 V (with reference to VMEbus ground).

For more details of the input and output stages, please refer to the section "Technical Data" on page 40.

## 2.3 Crankshaft Angle Clock Bus (CAC Bus)

The ES1651.1 Carrier Board has a crankshaft angle clock bus (CAC bus) for LABCAR projects which include the stimulation and testing of engine ECUs bus (CAC bus).

Like the synchronization bus, the CAC bus is also connected to the I/O modules and the FPGA of the carrier board. It is connected to I/O modules which are assembled on other ES1651.1 Carrier Boards or ES4350 Carrier Boards, or to other external hardware which can provide or process crankshaft angle clock signals via the 9-pin Sub-D connector on the front panel.

The CAC bus can be driven by the CAC generators on ES1332.1 and ES4320 boards (an I/O module for CAC generation is currently under development). The crankshaft angle clock cannot be generated in the FPGA of the ES1651.1.

The CAC bus of the ES1651.1 consists of the following three signals (refer to Fig. 2-4 on page 14):

- CAC-SYNC signal: Synchronization signal for 0 °CA
- CAC-CLK signal: The actual crankshaft angle clock signal
- CAC-DOR signal: Signal for displaying the direction of rotation

The following two figures show block diagrams of the channel for the synchronization signal (Fig. 2-2) and the CAC signal (Fig. 2-3) respectively. The channel for the direction signal is identical to the channel for hardware synchronization (see Fig. 2-1 on page 11).

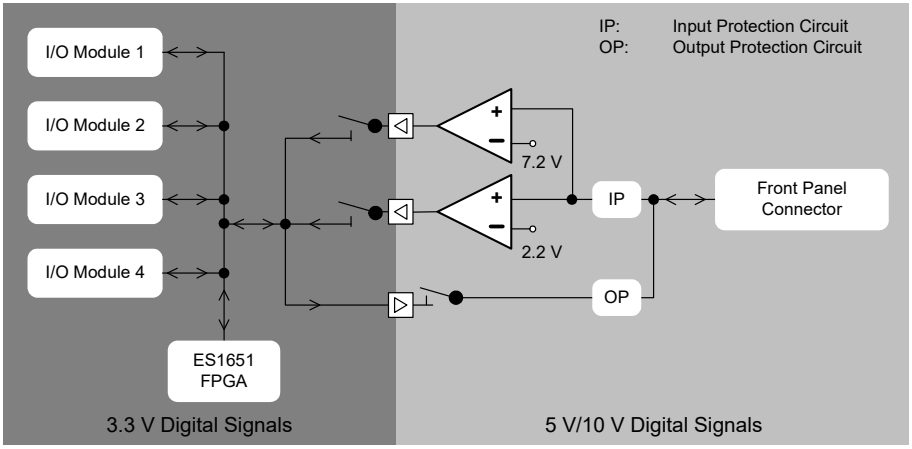



**Fig. 2-2** Block Diagram of the CAC Bus Synchronization Channel

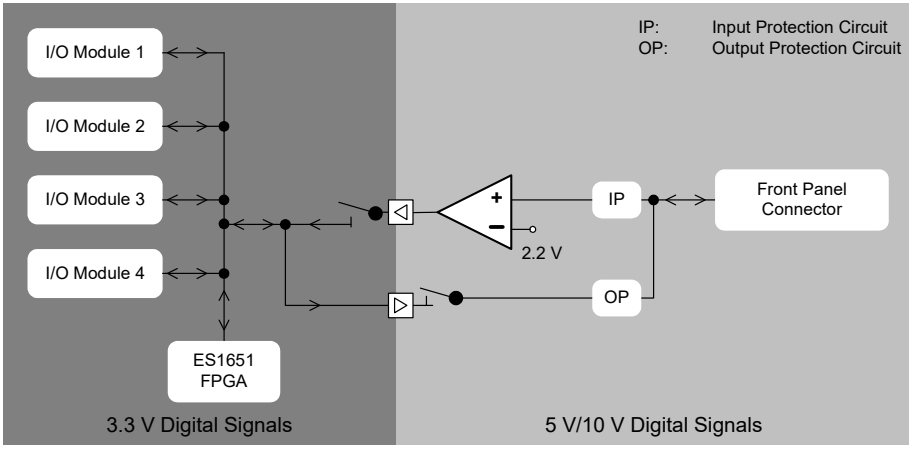



**Fig. 2-3** Block Diagram of the CAC Bus Crankshaft Angle Clock Channel

The CAC bus front panel connector can be configured as

- an input which provides the CAC signals for the carrier board hardware and the I/O modules,
- an output which provides the CAC signals for external hardware

or can be disconnected from the crankshaft angle clock.

The input and output stages are protected against overvoltage from -14 V to +19 V (with reference to VMEbus ground).

Internally the synchronization bus works with 3.3 V digital signals – the levels of the output signals of the CAC bus on the front panel are shown in Fig. 2-4 on page 14.

The CAC bus inputs can process two types of CAC signal:

- The combined CAC synchronization and clock signal as generated by ES1332 boards (see Fig. 2-5 on page 15).

  This signal must be connected to the pin of the CAC synchronization signal as well as to the pin of the CAC clock signal of the Sub-D front panel connector for this purpose. In this case, the "Input ES1332 CAC" option must be set in the option box "CAC Port Mode" in the "ES1651-CTRL" RTIO element of the ES1651-RTIO integration. This results in the switch at the output of the 7.2 V comparator (Fig. 2-2 on page 12) and the switch at the output of the 2.2 V comparator (Fig. 2-3 on page 13) being closed.

- Input signals of the type shown in Fig. 2-4.

  The signals are connected to the relevant pins of the Sub-D front panel connector. In this case, the "Input" option must be set in the option box "CAC Port Mode" in the "ES1651-CTRL" RTIO element of the ES1651-RTIO integration. This results in the switch at the output of the 2.2 V comparator (Fig. 2-2 on page 12) and the switch at the output of the 2.2 V comparator (Fig. 2-3 on page 13) being closed.

**Note**

*The pin assignment of the 9-pin Sub-D connector is contained in the section "Synchronization Bus and CAC Bus Connection "SYNC & CAC" (CO2)" on page 35.*

The direction of the CAC bus signals (input or output) can only be selected for the bus as a whole.

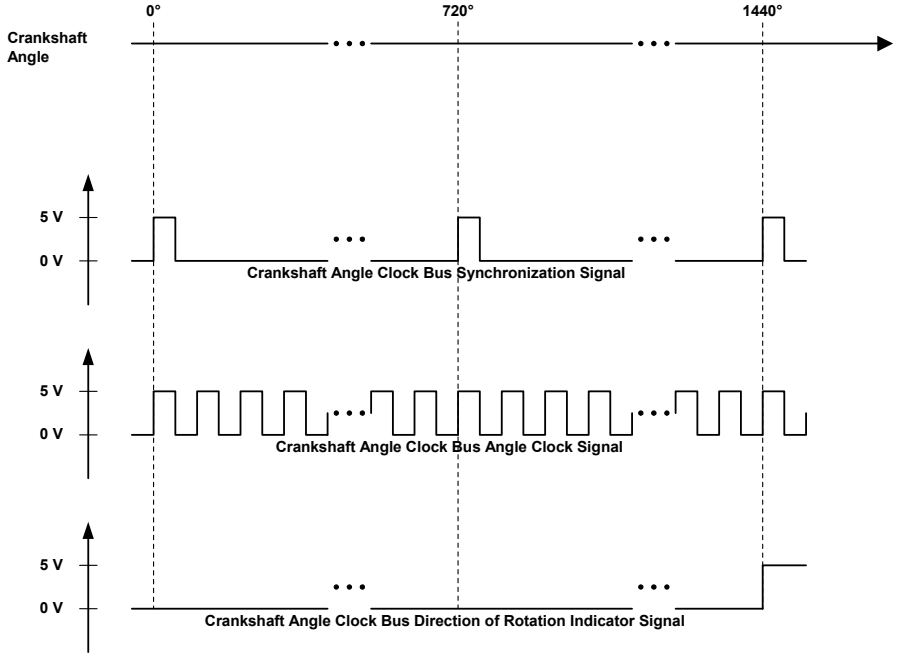



**Fig. 2-4** CAC Bus Output Signals

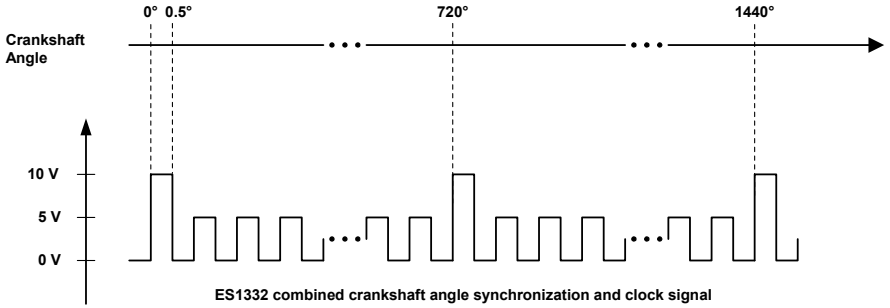



**Fig. 2-5** Combined CAC Synchronization and Clock Signal (ES1332)

For more details of the input and output stages, please refer to the section "Technical Data" on page 40.

## 2.4 Generating an Interrupt

The ES1651.1 Carrier Board has eight interrupt lines which, connected via a logical "OR" operation, generate a common interrupt request on the VMEbus.

Each of these eight interrupt lines can be activated or deactivated using the software. If a line is activated, an interrupt request is generated by a falling signal edge on the interrupt line. The VMEbus interrupt handler then determines which of the interrupt lines was the source of the request.

The interrupt lines PB0_IRQ to PB3_IRQ of the I/O modules are connected to interrupt lines 0 to 3 of the VMEbus interface. The ES1651.1 Carrier Board also makes it possible to connect one of the synchronization bus lines to interrupt line 4 – this is selected using the software.

Interrupt lines 5 to 7 are not assigned to date.

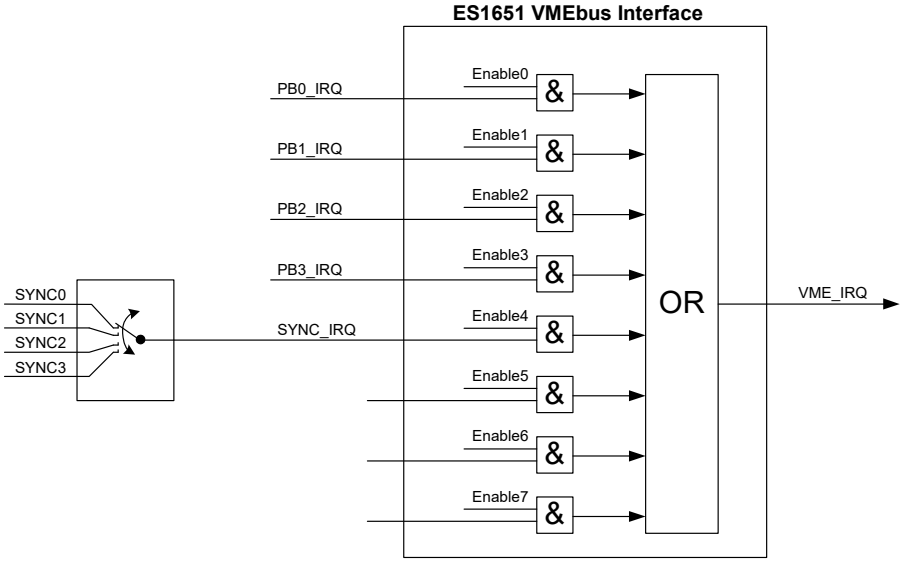



**Fig. 2-6** The Interrupt Concept of the ES1651.1

## 2.5 Inspection and Versioning Data

Inspection and versioning data of the board are stored in a serial non-volatile data memory which is addressed via the processor's SPI (Serial Peripheral Interface). The data can be read out via the operating software LABCAR-OPERATOR.

# 3 CAN Interfaces (Optional)

There are two identical CAN channels on the ES1651.1 Carrier Board for connecting the board to the CAN bus. The transceiver functionality is realized on piggybacks so that, if necessary, different transceivers can be used than those intended, i.e. than the PCA82C251 transceiver by Philips for high-speed CAN applications and the MAX3055 transceiver by Maxim for low-speed CAN applications.

The ETAS PB1651CAN1 transceiver module is a combined high-speed/low-speed CAN transceiver module with galvanic isolation of the CAN channels. Relays are used to toggle between high-speed and low-speed functionality. A 120 Ohm bus termination of the high-speed CAN interface can also be activated and deactivated using a relay switch.

The relay switches can be controlled using the LABCAR-OPERATOR operating software. The CAN controller functionality is realized in the MPC555 processor of the board which has two CAN channels on board.

The PB1651CAN1 transceiver modules have a serial non-volatile data memory for inspection and versioning data which is addressed via the processor's SPI interface. The data can be read out via the operating software LABCAR-OPERATOR.

The block diagram of a PB1651CAN1 transceiver module is shown in Fig. 3-1.

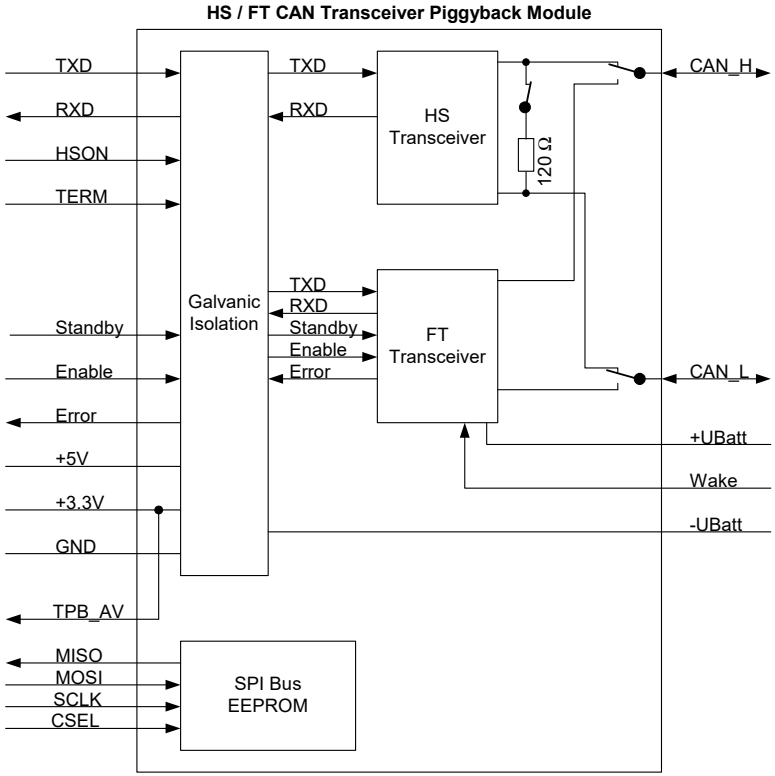



**Fig. 3-1** Block Diagram of a PB1651CAN1 Transceiver Module

## 3.1 Features

The PB1651CAN1 transceiver modules have the following features:

- Galvanic isolation from the VMEbus
- ±36 V on CAN_H and CAN_L
- Toggling between high-speed and low-speed CAN interface via relays
- The high-speed CAN transceiver is fully compatible with the ISO 11898-24 V standard
- 120 Ω terminating resistor of the high-speed CAN interface can be switched using relays

- Full support of the operating modes "Standby" and "Sleep" of the fault-tolerant CAN transceiver as well as error monitoring
- Switch technology for reducing electromagnetic emission and improving the electromagnetic compatibility of the CAN channel
- SPI bus EEPROM for versioning, inspection and maintenance data
- Automatic detection of the transceiver module with the LABCAR-OPERATOR operating software
- The bus lines CAN_H and CAN_L are each terminated on the low-speed CAN transceiver with 2.2 kΩ.

## 3.2 Pin Assignment and Signals

The CAN transceiver module and the ES1651.1 Carrier Board are connected using an 8-pin and a 16-pin connector. For more details on the pin assignment, please refer to the section "Connectors for CAN Transceiver Modules" on page 36.

# 4 Configuration

Fig. 4-1 shows the position of all connectors and switches for configuring the ES1651.1 Carrier Board - in addition to important components and connectors for orientation purposes.

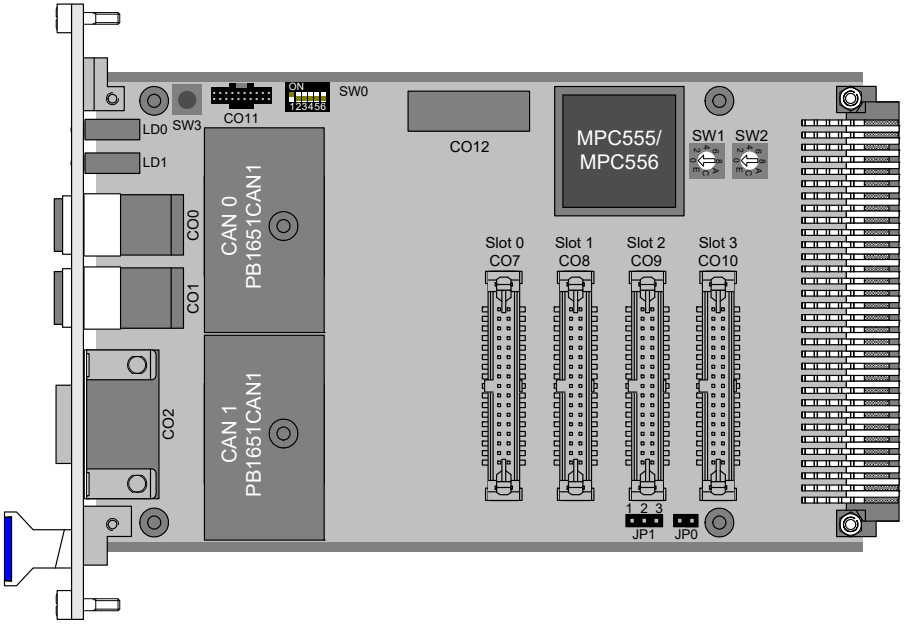



**Fig. 4-1** Position of the Connectors, Jumpers and Switches (Component Side)

## 4.1 Configuration of the Debug Port Connections of the Processor (JP0)

| JP0 Jumper | Meaning |
|---|---|
| set | Debug port connections |
| open | JTAG interface (preset) |

**Tab. 4-1** JP0 Jumper

## 4.2 JTAG Chain Configuration (JP1)

Use the JP1 jumper to set whether the I/O modules are included in the JTAG chain or not.

| JP1 Jumper | Meaning |
|---|---|
| Pos. 1-2 | JTAG chain bypasses I/O modules (preset) |
| Pos. 2-3 | I/O moduls are included in the JTAG chain |

**Tab. 4-2** JP1 Jumper

**Note**

*The jumper at JP1 must be in one of the positions listed in Tab. 4-2. Otherwise the JTAG chain is open which leads to errors.*

## 4.3 Boot Configuration (SW0)

The boot configuration is determined using the SW0 switch.

| DIL switch | Meaning | Presetting |
|---|---|---|
| 1 | Flash enable – determines whether the MPC555 Flash memory is activated or deactivated after a reset.<br>OFF: Flash disabled – the system is booted from the external memory<br>ON: Flash enabled | ON |
| 2 | Determines the base address of the MPC555-internal memory space<br>OFF: 0x0000 0000<br>ON: 0x0100 0000 | OFF |
| 3 | Boot port size<br>OFF: 32-bit port<br>ON: 16-bit port | OFF |
| 4 | Hard reset configuration word<br>OFF: Configuration word is read by external data bus<br>ON: The internal configuration word is used | OFF |
| 5,6 | Source for boot code<br>OFF, OFF: Internal flash memory<br>OFF, ON: External SRAM<br>ON, OFF: Dual-Ported RAM<br>ON, ON: External Flash memory | OFF, OFF |

**Tab. 4-3** DIL Switch SW0 for Boot Configuration

## 4.4 Reset Switch (SW3)

Results in a reset of the ES1651.1 Carrier Board, but not a VMebus reset.

## 4.5 Addressing the ES1651.1 at the VMEbus (SW1 and SW2)

The ES1651.1 Carrier Board can be operated both in (standard) VMEbus systems with 96-pin backplane connectors and in VME64x systems with geographical addressing. With two HEX switches, SW1 and SW2, (see Fig. 4-1 on page 20), the board is addressed in the setting "0x00" in "geographical addressing mode" and in all other settings in the relevant address spaces.

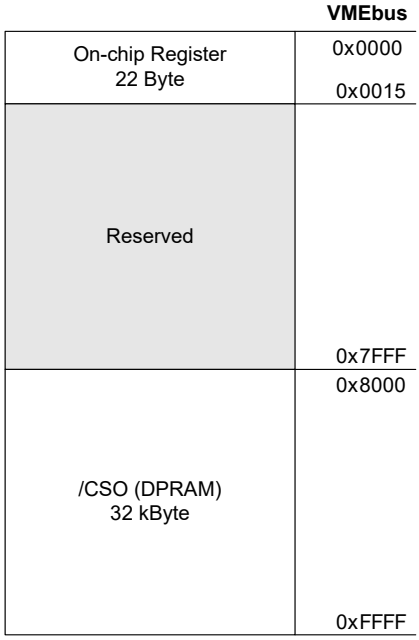



**Fig. 4-2** Address Map

In the "0x00" setting, the ES1651.1 Board maps 256 bytes into the A24 address space depending on the slot position. Depending on the available memory area, the 64 kB address space is then assigned dynamically by the system controller.

| Slot Position | Address | VME Interface (Control Register) |
|---|---|---|
| 1 | E0E000 - E0E0FF | 256 bytes |
| 2 | E0E100 - E0E1FF | 256 bytes |
| 3 | E0E200 - E0E2FF | 256 bytes |
| 4 | E0E300 - E0E3FF | 256 bytes |
| 5 | E0E400 - E0E4FF | 256 bytes |
| 6 | E0E500 - E0E5FF | 256 bytes |
| 7 | E0E600 - E0E6FF | 256 bytes |
| 8 | E0E700 - E0E7FF | 256 bytes |
| 9 | E0E800 - E0E8FF | 256 bytes |
| 10 | E0E900 - E0E9FF | 256 bytes |
| 11 | E0EA00 - E0EAFF | 256 bytes |
| 12 | E0EB00 - E0EBFF | 256 bytes |
| 13 | E0EC00 - E0ECFF | 256 bytes |
| 14 | E0ED00 - E0EDFF | 256 bytes |
| 15 | E0EF00 - E0EFFF | 256 bytes |
| 16 | E0F000 - E0F0FF | 256 bytes |
| 17 | E0F100 - E0F1FF | 256 bytes |
| 18 | E0F200 - E0F2FF | 256 bytes |
| 19 | E0F300 - E0F3FF | 256 bytes |
| 20 | E0F400 - E0F4FF | 256 bytes |
| 21 | E0F500 - E0F5FF | 256 bytes |

**Tab. 4-4** Slot Position and Address

**Note**

*VMEbus backplanes can have a maximum of 21 slots.*

The 64 kB address space is assigned statically with every other setting of the hex switches (≠ 0x00).

| Switch Setting | Address Space |
|---|---|
| 0x01 | 010000 - 01FFFF |
| 0x02 | 020000 - 02FFFF |
| 0x03 | 030000 - 03FFFF |
| .. | . |
| 0xFF | FF0000 - FFFFFF |

**Tab. 4-5** Setting the Address Spaces

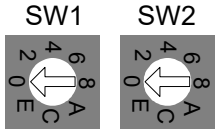



**Fig. 4-3** Switch for Address Setting

| SW1 | SW2 |
|---|---|
| 0x**n**0 | 0x0**n** |
| Address A23 - A20 | Address A16 - A19 |

**Tab. 4-6** Meaning of the Switches SW1 and SW2

**Example:**

Required: base address A24 at 0xC20000

Settings: SW1=0xC, SW2=0x2

**Note**

*The default setting is: SW1=0x0, SW2=0x0*

# 5 Installing I/O Modules

This section describes how to install I/O modules.

**Note**

*I/O modules of the type "PB1651XXX" are delivered with the front panel assembled; modules of the type "PB4350XXX" come with a front panel which is not assembled. If you want to mount a module of type "PB4350XXX" on the ES1651.1 Carrier Board, you first have to assemble its front panel.*

## 5.1 Assembling the Front Panel to the PB4350XXX Module

Proceed as follows to assemble the front panel on a module of the type "PB4350XX":

- Tighten the printed board brackets as shown in Fig. 5-1 with the Pozidrive flathead screws M2.5x10 provided on the module.

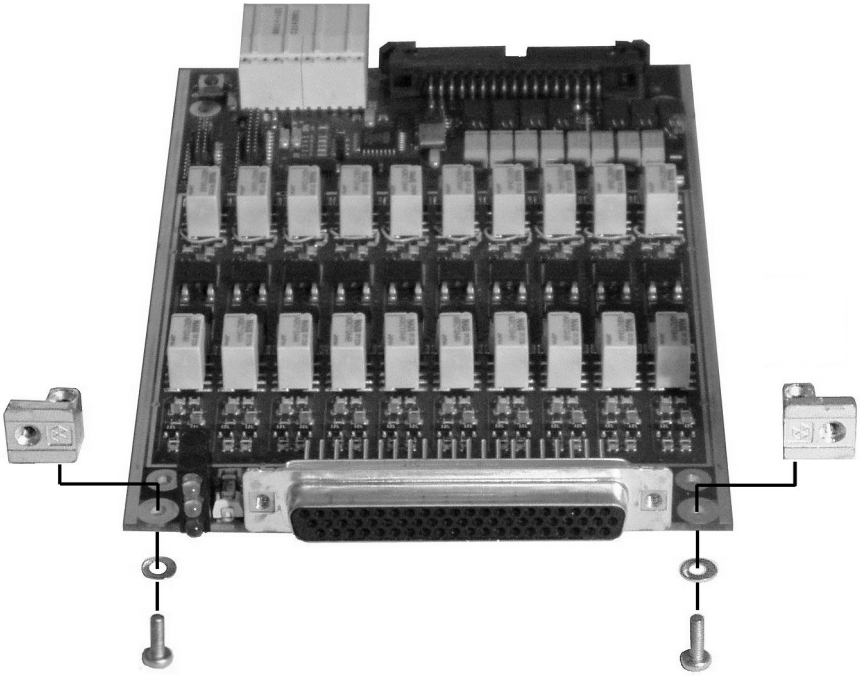


**Fig. 5-1** Tightening the Printed Board Brackets

- Fasten the front panel with the hexagon head screws above and below the "OUTPUT 0-9" connector (Fig. 5-2).

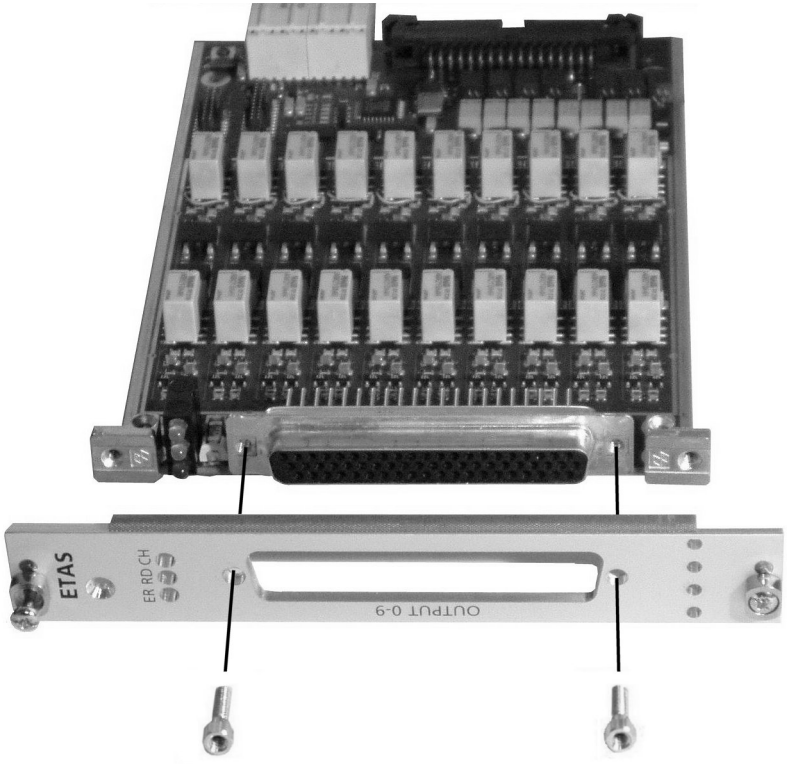



**Fig. 5-2** Fastening the Front Panel at the Connector

- Fasten the front panel at the top with the raised countersunk head screw M2.5x8 to the bracket attached previously.
- Fasten the front panel at the bottom and the front panel handle to the bracket attached previously using the Pozidrive flathead screw M2.5x16 (Fig. 5-3).

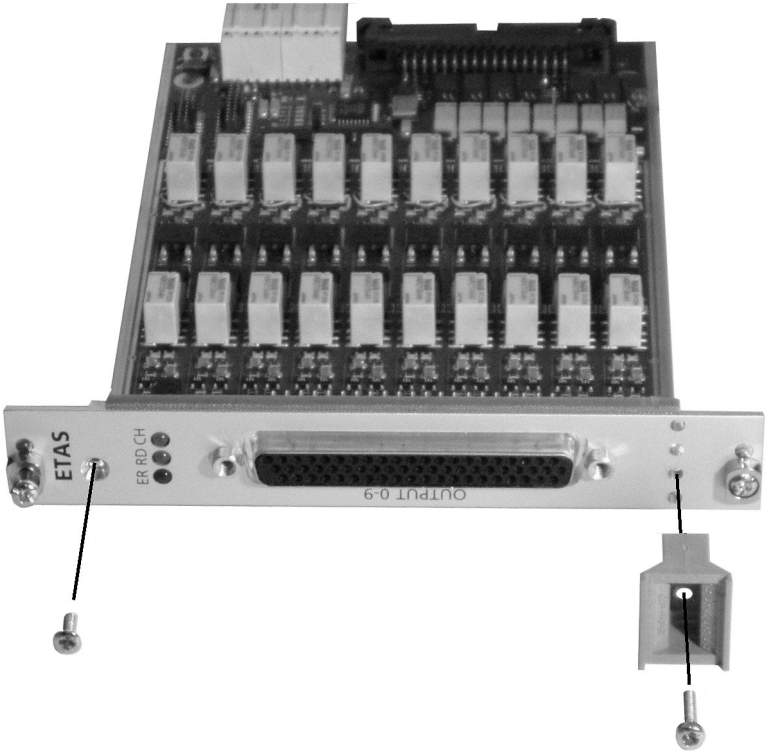



**Fig. 5-3** Attaching the Upper and Lower Fastening Screws

- Finally press the identification plate into the extraction handle.

You have now mounted the front panel for a PB4350XXX module.

## 5.2 Mounting the CAN Transceivers

**Note**

*The ES1651.1 Carrier Board is normally delivered with its CAN transceivers already assembled. The following description is purely for the sake of completeness.*

Proceed as follows to mount the piggybacks with the CAN transceivers:

- Position the piggyback on the two female headers intended.
- Make sure the pins of the module match the corresponding contacts exactly.
- Press the module pins into the female headers by pressing left and right alternately (see arrows in Fig. 5-4).

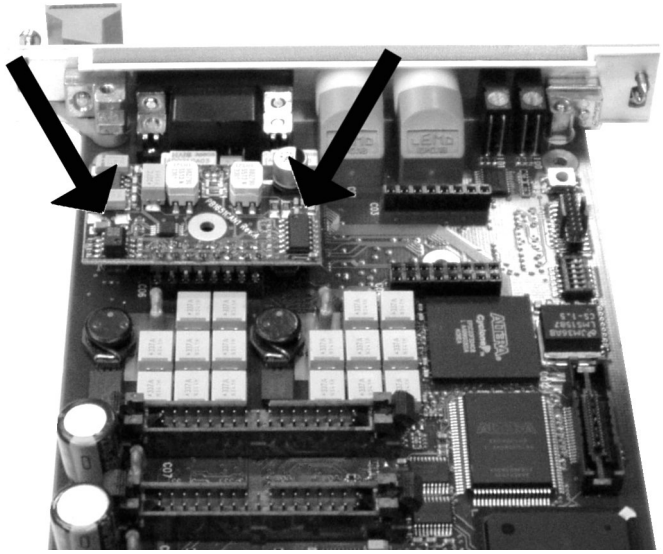


**Fig. 5-4** Mounting the CAN Transceivers

- Then tighten the piggyback on the ES1651.1 Carrier Board with the M2.5x13 screw provided.

## 5.3 Mounting the I/O Modules

Proceed as follows to mount the I/O modules.

**To mount distance pins on the ES1651.1 Carrier Board**

- Make sure you have four distance pins at hand which have an internal thread on both sides.
- Get out four screws.
- Screw all four distance pins onto the ES1651.1 Carrier Board (distance pins on the component side, screws on the solder (dip) side, see Fig. 5-5)

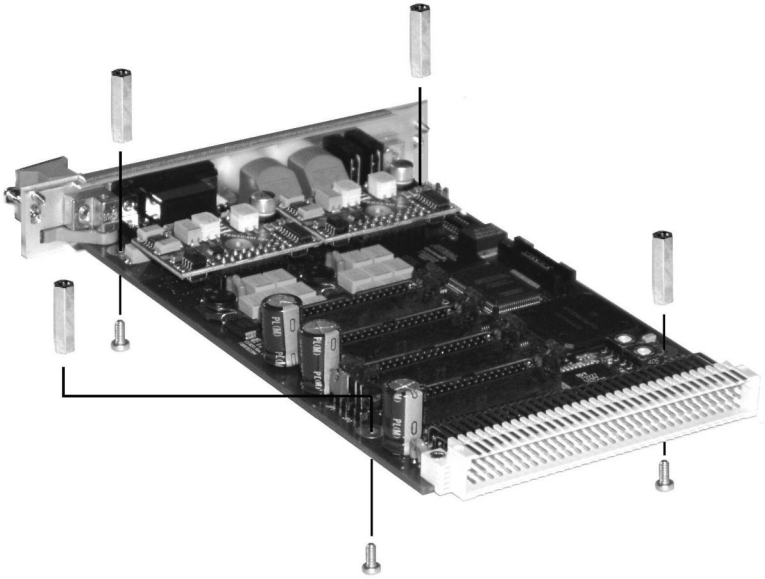


**Fig. 5-5** Mounting Distance Pins on the ES1651.1 Carrier Board

**To insert ribbon cable in box headers on the ES1651.1 Carrier Board**

- Insert the ribbon cable delivered with the corresponding I/O module into Slot 0.
- If you want to mount further I/0 modules, insert the ribbon cable correspondingly into Slot 1, then Slot 2, Slot 3 etc.

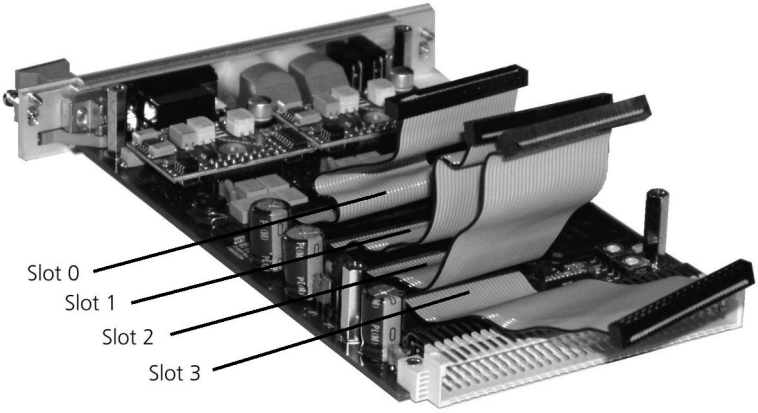



**Fig. 5-6** Inserting the Ribbon Cable

**To mount I/O modules**

**Note**

*If you only want to mount one I/0 module, continue with "To mount the last I/O module" on page 32.*

- Make sure you have four distance pins at hand which have an external thread on one side.
- Lie the I/0 module on the distance pins you have just mounted on the Carrier Board.
- Tighten the I/O module with the distancepins (see Fig. 5-7 on page 32).
- Slot the connector of the relevant ribbon cable into the box header of the I/O module.

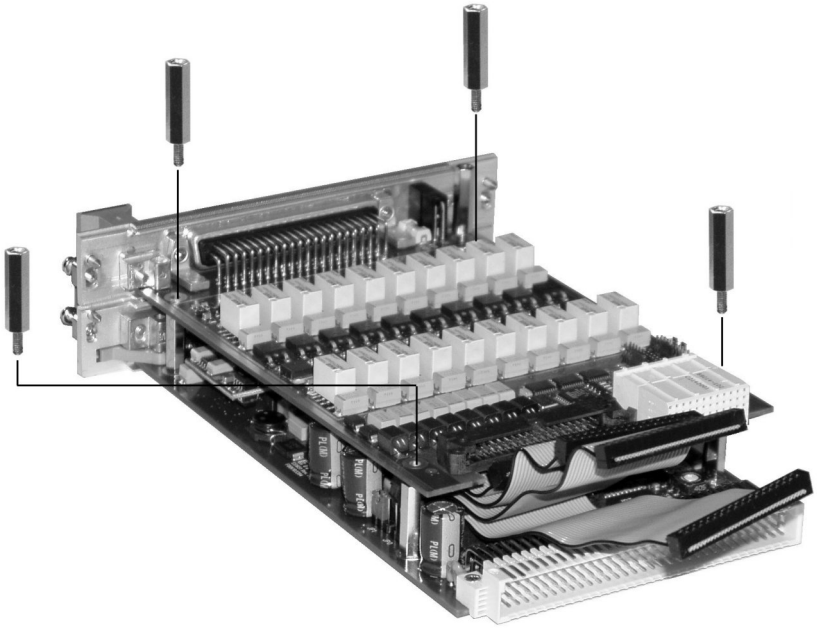


**Fig. 5-7** Mounting the I/O Module

- Mount further I/O modules in the same way.

  The mounting of the last module is described in the following section.

### To mount the last I/O module

- Mount the last I/O module as described above – it is tightened, however, with four screws (see Fig. 5-8 on page 33).

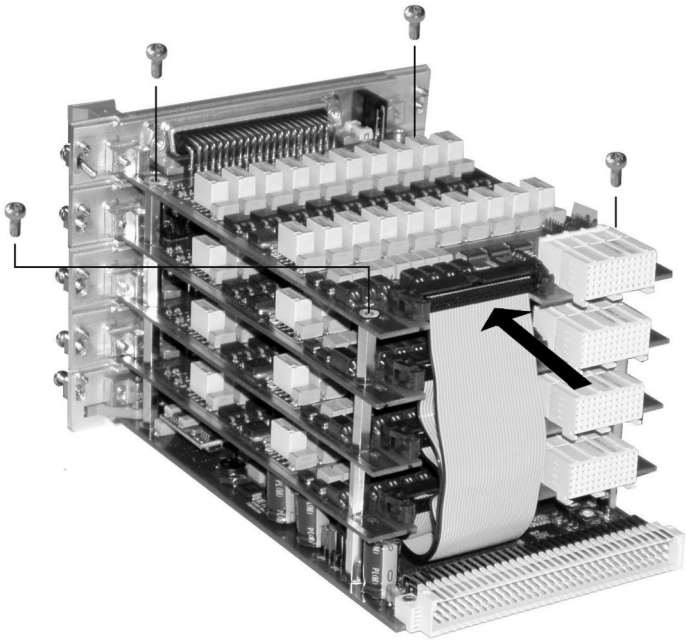


**Fig. 5-8** Mounting the Last I/O Module

# 6 Pin Assignments and Display Elements

This section contains a description of the pin assignments of the connectors on the front panel and on the board itself and the meaning of the display elements on the front panel.

The position and name of the individual elemenets is shown in Fig. 4-1 on page 20.

These are:



## 6.1 CAN Ports CAN0 and CAN1 (CO0, CO1)

Socket - LEMO 8-pin. Type: Lemo EPC.1B.308.HLN

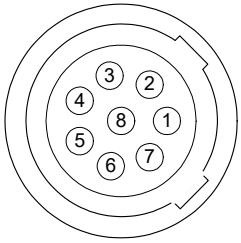



**Fig. 6-1** CO0 ("CAN0") and CO1 ("CAN1") Connectors (View from the Plug-In Side)

The mating connector is of type Lemo FGC.1B.308.CLA052.

| Pin | Assignment | Pin | Assignment |
|---|---|---|---|
| 1 | Wake | 5 | n.c. |
| 2 | CAN Low | 6 | CAN ground/-UBatt |
| 3 | CAN ground/-UBatt | 7 | CAN High |
| 4 | n.c. | 8 | +UBatt |

**Tab. 6-1** "CAN0" and "CAN1" Pin Assignment

## 6.2 Synchronization Bus and CAC Bus Connection "SYNC & CAC" (CO2)

Socket - Sub-D 9-pin.

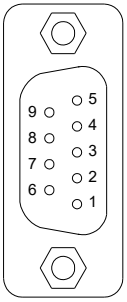



**Fig. 6-2** "SYNC & CAC" Socket (View from the Plug-In Side)

| Pin | Signal | Direction | Function |
|---|---|---|---|
| 1 | SYNC0 | Bi-directional | Synchronization line 0 |
| 2 | SYNC1 | Bi-directional | Synchronization line 1 |
| 3 | SYNC2 | Bi-directional | Synchronization line 2 |
| 4 | SYNC3 | Bi-directional | Synchronization line 3 |
| 5 | Ground | - | VMEbus ground |
| 6 | CAC_SYNC | Bi-directional | Crankshaft angle clock:<br>Synchronization signal for 0° CA |
| 7 | CAC_CLK | Bi-directional | Crankshaft angle clock:<br>Crankshaft angle signal |
| 8 | CAC_DOR | Bi-directional | Crankshaft angle clock:<br>Direction of rotation signal |
| 9 | Ground | - | VMEbus ground |

**Tab. 6-2** "SYNC & CAC" Pin Assignment

## 6.3 Connectors for CAN Transceiver Modules

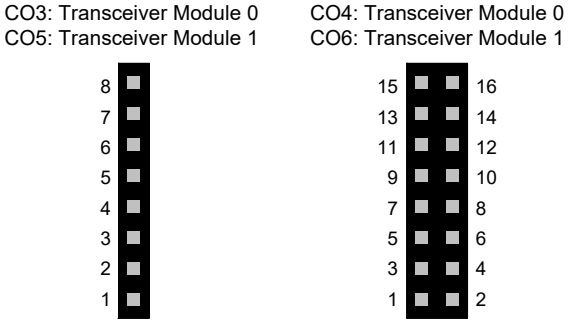



**Fig. 6-3** Female Headers for the CAN Transceiver Modules (View of Component Side)

### 6.3.1 8-Pin Female Header (CO3, CO5)

| Pin | Assignment |
|---|---|
| 1 | Housing ground |
| 2 | +3.3 V |
| 3 | /Wake |
| 4 | CAN_L |
| 5 | CAN_H |
| 6 | +UBatt |
| 7 | -UBatt/CAN ground |
| 8 | VMEbus ground |

**Fig. 6-4** CO3/CO5 Pin Assignment

### 6.3.2 16-Pin Female Header (CO4, CO6)

| Pin | Assignment | Pin | Assignment |
|---|---|---|---|
| 1 | TxD | 2 | RxD |
| 3 | HsON | 4 | HsTERM |
| 5 | /FtStandby | 6 | FtEnable |
| 7 | /FtError | 8 | MOSI |
| 9 | MISO | 10 | SCLK |
| 11 | /CSEL | 12 | USR0 |
| 13 | USR1 | 14 | TPB_AV |
| 15 | +5 V | 16 | VMEbus ground |

**Tab. 6-3** CO4/CO6 Pin Assignment

## 6.4 Box Headers for I/O Modules (CO7 - CO10)

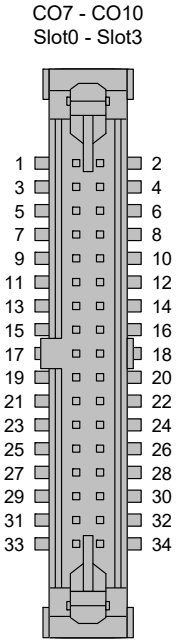



**Fig. 6-5** Box Headers for Connecting I/O Modules

| Pin | Assignment | Pin | Assignment |
|---|---|---|---|
| 1 | /RESET | 2 | SOUT |
| 3 | SDIN | 4 | SCLK |
| 5 | /SCS0 | 6 | /SCS1 |
| 7 | TDO | 8 | TDI |
| 9 | TMS | 10 | TCK |
| 11 | /IRQ | 12 | PROG_DONE |
| 13 | CAC_CLK | 14 | CAC_SYNC |
| 15 | CAC_DOR | 16 | SYNC0 |
| 17 | SYNC1 | 18 | SYNC2 |
| 19 | SYNC3 | 20 | PB_AV |
| 21 | GND | 22 | +5 V |
| 23 | +5 V | 24 | +3.3 V |
| 25 | +3.3 V | 26 | +2.5 V |
| 27 | GND | 28 | GND |
| 29 | AGND | 30 | AGND |
| 31 | +12 V | 32 | +12 V |
| 33 | -12 V | 34 | -12 V |

**Tab. 6-4** CO7 - CO10 Pin Assignment

## 6.5 ETAS-Internal Service Connection (CO11)

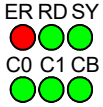
CO11 provides various access possibilities for ETAS-internal purposes such as e.g. RS232, Debug, JTAG, Boundary Scan.

## 6.6 Interface for Logic Analyser (CO12)

A further debug interface for ETAS-internal purposes.

## 6.7 LEDs

There are 6 LEDs on the front panel of the ES1651.1 Carrier Board, the meaning of which is described below.




| LED | Color | Meaning |
|---|---|---|
| ER | Red | Error |
| RD | Green | Ready |
| SY | Green | There are modules on the ES1651.1 Carrier Board which work in synchronization mode. |
| C0 | Green | CAN interface 0 takes part in communication on the CAN bus |
| C1 | Green | CAN interface 1 takes part in communication on the CAN bus |
| CB | Green | The CAN channels are connected to the CAN bus of the ES1651.1 Carrier Board. |

**Tab. 6-5** Significance of the LEDs

# 7 Technical Data

This chapter contains the technical data of the ES1651.1 Carrier Board.

| | |
|---|---|
| Number of slots | 4 |
| Supported types of I/O modules | PB1651XXX and PB4350XXX |
| Configuration of the I/O modules | PB1651XXX and PB4350XXX, mixed |
| Synchronization of I/O modules | Yes |
| Number of synchronization signals | 4 |
| Sources of the synchronization signals | - I/O module<br>- ES4350.1 processor/FPGA<br>- ES4300 backplane |

*Synchronization Bus: Outputs*

| | |
|---|---|
| Logic level | TTL (5 V) |
| Maximum output current | 6 mA |
| Cutoff frequency $f_{max}$ | 1.2 MHz |
| Overvoltage protection | -14 V ... +19 V |

*Synchronization Bus: Inputs*

| | |
|---|---|
| Logic level | TTL (5 V) |
| Input impedance | > 200 kΩ |
| Cutoff frequency $f_{max}$ | 1.2 MHz |
| Overvoltage protection | -14 V ... +19 V |

*CAC Bus: Output (All CAC Bus Signals)*

| | |
|---|---|
| Logic level | TTL (5 V) |
| Maximum output current | 6 mA |
| Cutoff frequency $f_{max}$ | 1.2 MHz |
| Overvoltage protection | -14 V ... +19 V |

*CAC Bus: Input (CAC-SYNC and CAC_CLK Signal)*

| | |
|---|---|
| Supported CAC signal forms | - Combined CAC synchronization and clock signal in acc. with Fig. 2-5 on page 15<br>- CAC bus signals in acc. with Fig. 2-4 on page 14 |
| Input impedance | > 200 kΩ |
| Cutoff frequency $f_{max}$ | 1.2 MHz |
| Overvoltage protection | -14 V ... +19 V |

*CAC Bus: Input (CAC-DOR Signal)*

| | |
|---|---|
| Logic level | TTL (5 V) |
| Input impedance | > 200 kΩ |
| Cutoff frequency $f_{max}$ | 1.2 MHz |
| Overvoltage protection | -14 V ... +19 V |

*Power Supply*

| | |
|---|---|
| Current consumption* | 1 A @ +5 V DC<br>0.1 A @ +12 V DC<br>0.1 A @ -12 V DC |
| * Underlying conditions: No I/O moduls assembled – CAN transceiver moduls assembled and CAN in operation. | |

*Environmental Conditions*

| | |
|---|---|
| Operating temperature | 5 °C to 35 °C (5.00 °C to 35.00 °C) |
| Relative humidity | 0 to 95% (non-condensing) |

*Physical Dimensions*

| | |
|---|---|
| Printed circuit board (L x W) | 145 mm x 100 mm |
| Front panel | Height: 3 U<br>Width: 4 HP |

# 8 ETAS Contact Addresses

*ETAS HQ*


ETAS GmbH

| | | |
|---|---|---|
| Borsigstraße 24 | Phone: | +49 711 3423-0 |
| 70469 Stuttgart | Fax: | +49 711 3423-2106 |
| Germany | WWW: | www.etas.com |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