PT-LABCAR
Launch and Configuration

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V1.0.0 R09 EN - 11.2016

Contents

1 Introduction

This manual contains information on the configuration and launch of PT-LABCAR. For an overview of PT-LABCAR please refer to the chapter "PT-LABCAR – System Overview" on page 17.

This introductory chapter is structured as follows:

- "Basic Safety Instructions" on page 8

  This section explains the safety instructions.
- "Taking the Product Back and Recycling" on page 9

  This section contains information on recycling the product.
- "About This Manual" on page 10

  This section contains a short overview of the contents and provides information on the user profile and on how to use this manual.
- "Version History" on page 12

  This section lists changes made to this document in comparison to the previous version in as far as they are of technical importance for the user.
- "Documentation on PT-LABCAR Components" on page 14

  This section contains an overview of the documentation available on the basic components as well as the optional components of PT-LABCAR.

1.1 Basic Safety Instructions

Please adhere to the following safety instructions to avoid injury to yourself and others as well as damage to the device.

1.1.1 Correct Use

ETAS GmbH cannot be made liable for damage which is caused by incorrect use and not adhering to the safety instructions.

1.1.2 Labeling of Safety Instructions

The safety instructions contained in this manual are shown with the standard danger symbol shown below:

The following safety instructions are used. They provide extremely important information. Please read this information carefully.

CAUTION!

indicates a low-risk danger which could result in minor or less serious injury or damage if not avoided.

WARNING!

indicates a possible medium-risk danger which could lead to serious or even fatal injuries if not avoided.

DANGER!

indicates a high-risk, immediate danger which could lead to serious or even fatal injuries if not avoided.

1.1.3 Demands made regarding the Technical State of the Product

To ensure safe operation of PT-LABCAR, read and adhere to the information in the section "Safety Measures" on page 21.

1.2 Taking the Product Back and Recycling

The European Union has passed a directive called Waste Electrical and Electronic Equipment, or WEEE for short, to ensure that systems are setup throughout the EU for the collection, treating and recycling of electronic waste.

This ensures that the devices are recycled in a resource-saving way representing no danger to health or the environment.

Fig. 1-1 WEEE Symbol

The WEEE symbol on the product or its packaging shows that the product must not be disposed of as residual garbage.

The user is obliged to collect the old devices separately and return them to the WEEE take-back system for recycling.

The WEEE directive concerns all ETAS devices but not external cables or batteries.

For more information on the ETAS GmbH Recycling Program, contact the ETAS sales and service locations (see "ETAS Contact Addresses" on page 81).

1.3 About This Manual

This section contains a short overview of the contents and provides information on the user profile and on how to use this manual.

1.3.1 Content

This manual, "PT-LABCAR - Configuration and Operation", consists of the following chapters:

- "Introduction" on page 7

  This chapter

- "PT-LABCAR – System Overview" on page 17

  This chapter contains an overview of the properties of the PT-LABCAR system.

- "Getting Started" on page 21

  This chapter describes the safety precautions to be taken when installing and operating PT-LABCAR as well as how to connect the user PC to PT-LABCAR.

- "Hardware Configuration" on page 27

  This chapter contains information on the hardware and the signals of PT-LABCAR which you need for the specification of your wiring harness.

- "Pin Assignments and LEDs" on page 65

  This chapter describes the connectors and LEDs of PT-LABCAR.

- "ES1395.1 Load Conditioning Board" on page 81

  The ES1395.1 Load Conditioning Board (previously referred to as "AS_41LC") is used in PT-LABCAR to simulate pull-up/pull-down loads (ignition signals etc.).

1.3.2 User Profile

This manual is intended for specialists who develop and test automotive ECUs. Specialist knowledge of measuring and ECU technology is assumed.

1.3.3 Using This Manual

Representation of Information

All activities to be executed by the user are presented in what is referred to as a "Use-Case" format. I.e. the aim is defined in brief as a title and the relevant steps necessary to achieve this aim are then listed. The information is displayed as follows:

Target definition

Any introductory information...

- Step 1

  Possibly an explanation of step 1...

- Step 2

  Possibly an explanation of step 2...

- Step 3

  Possibly an explanation of step 3...

Any concluding remarks...

Specific example:

To create a new file

If you want to create a new file, no other file may be open.

- Select **File** → **New**.

  The "Create File" dialog box appears.
- Enter a name for the file in the "File name" box.

  The file name must not be more than 8 characters long.
- Click **OK**.

The new file is created and saved under the name specified. You can now work with the file.

Typographic Conventions

The following typographic conventions are used:

Select **File** → **Open**.	Menu functions are shown in boldface/blue.
Click **OK**.	Buttons are shown in boldface/blue.
Press <ENTER>.	Keyboard commands are shown in angled brackets in block capitals.
The "Open File" dialog box appears.	Names of program windows, dialog boxes, fields etc. are shown in quotation marks.
Select the file `setup.exe`.	Text in drop-down lists, program code, as well as path and file names are shown in the `Courier` font.
A conversion between the file types logical and arithmetic is *not* possible.	Content markings and newly introduced terms are shown in *italics*

Important notes for the user are shown as follows:

Note

Important note for the user.

1.4 Version History

This section lists changes made to this document in comparison to the previous version in as far as they are of technical importance for the user.

Note

*Specifying the version using Rx.y.z refers to the manual and **not** the product version!*

1.4.1 Changes in Version R1.0.2

This section lists changes which have been made to this document since publication of the original version R1.0.1 in as far as they are of technical importance for the user.

Errata

- In Tab. 5-18 on page 79, "PWM" was replaced by the correct term, "DAC".
- Tab. 4-16 on page 50 contained incorrect designations.
- The K-Line and L-Line assignment at the "CARB" connector was corrected (see ""CARB" Pin Assignment" on page 71).

Renaming

- The "SW_Ig" signal has been renamed "SW_Inj".
- 41SC (signal conditioning) has been renamed AS_41SC.
- 41LC (dummy loads) has been renamed AS_41LC.

Hardware Changes

- Tab. 4-14 on page 47: "+12 V (ECU:H25)" has been replaced by "BN1 (ECU1:H26)"
- Tab. 4-18 on page 51: "+12 V (ECU:H25)" has been replaced by "BN1 (ECU1:H26)"
- -12 V available at the "Power Supply" connector (see Tab. 5-17 on page 78)

New Hardware

- Preparation for ES1336.1 Angle Synchronous Measurement Board described (see "Arbitrary Signals (Measuring)" on page 45)
- Availability of the 1392.2 High Current Switch Board taken into consideration (see "Power Supply and Battery Nodes" on page 57)

Extension of the Documentation

- The section "Oxygen Sensor Emulation" on page 33 has been rewritten.
- The use of resistor channels in oxygen sensor emulation has been documented in "Resistor Cascade" on page 55.
- Fixed connections of channels/signals to battery nodes were documented in "Fixed Connections to Battery Nodes" on page 58.
- The AS_41LC has been described in more detail in "ES1395.1 Load Conditioning Board" on page 81.

1.4.2 New Features in Version R1.0.3

Changes in comparison to the previous version (R1.0.2) of this document are listed in this section if they are of technical significance to the user.

Changes

In addition to minor improvements to texts and graphics, the following changes are of particular importance:

- The ES4640.1 Connector Box (without breakout box) does not exist any more - only the ES4640.1-B (with breakout box) is offered.
- The figure "The Signals of Oxygen Sensor Emulation" on page 35 has been extended.
- The use of the ES1336.1 Angle Synchronous Measurement Board instead of the ES1334.2 Measurement Board is taken into consideration.
- The section "Failure Simulation" on page 61 has been extended.
- A note has been added on the connector kit available from ETAS (see ""ECU1" and "ECU2" ECU Connectors" on page 66).
- The assignment of ECU1:H5 and ECU1:D6 (see Tab. 5-1 on page 66 and Tab. 5-2 on page 66) has been changed.
- The assignment of the "CARB" connector (see Tab. 5-10 on page 71) has been changed.

1.4.3 New Features in Version R1.0.4

The only changes which have taken place in comparison to the previous version R1.0.3 are extensions and adaptations (new software versions etc.) in the section "Documentation on PT-LABCAR Components" on page 14.

1.4.4 New Features in Version R1.0.5

Changes in comparison to the previous version (R1.0.4) of this document are listed in this section if they are of technical significance to the user.

Errata

- In the section "CARB" on page 56, the assignment of K- and L-Line to the bridges 233 and 234 has been corrected.

Hardware Changes

- The ES1321.1 PWM I/O Board has replaced the PB1651PWM1 module (see "PWM Channels" on page 41)
- AS_41LC (load emulation) has become the ES1395.1 Load Conditioning Board.

Extension of the Documentation

- The connection of an ES4440.1 Compact Failure Simulation Module is described in more detail (see "Failure Simulation" on page 61).
- The documentation of the ES1395.1 Load Conditioning Board (previously AS_41LC) has been extended with a section on pin assignment (see "Connectors on the Front Panel" on page 86).

1.4.5 New Features in the Version (R1.0.6)

Changes in comparison to the previous version (R1.0.5) of this document are listed in this section if they are of technical significance to the user.

Erratum

- In Tab. 5-4 on page 67, the pin assignment for K- and L-Line has been corrected. The correct signal path between „ECU1“, bridges and „CARB“ reads as follows:
  - K-Line: ECU1:G24 ⇔ 233 ⇔ CARB:7
  - L-Line: ECU1:G25 ⇔ 234 ⇔ CARB:15

Addendum

- A note has been added concerning the usage of pin "ECU1:H26" (see Tab. 5-5 on page 68).

1.4.6 New Features in the Current Version (V1.0.0 R07)

The only changes which have taken place in comparison to the previous version R1.0.6 are extensions and adaptations in the section "Safety Measures" on page 21. Please read this section carefully!

1.5 Documentation on PT-LABCAR Components

This section contains an overview of the documentation available on the basic components as well as the optional components of PT-LABCAR.

The documentation of the hardware and software components consists of a range of documents which are provided as a PDF file with the relevant product. These are:

- PT-LABCAR - Configuration and Operation

  This manual
- Documentation on the following software products:
  - LABCAR-OPERATOR or higher (see section 1.5.1 on page 15)
  - LABCAR-RTPC or higher (see section 1.5.2 on page 15)
  - LABCAR-AUTOMATION or higher (see section 1.5.3 on page 15)

  These documents can be accessed during installation as well as when in use.
- Documentation on the following hardware products:
  - ES4440 Compact Failure Simulation Module (see section 1.5.5 on page 16)

    The documentation on the LABCAR-PINCONTROL V2.0 user software is provided as a PDF file on the installation CD.
  - I/O hardware (see section 1.5.4 on page 15)

1.5.1 LABCAR-OPERATOR

The LABCAR-OPERATOR documentation comprises the following manuals:

- **LABCAR-OPERATOR - Getting Started**

  This manual contains information on the product and installation as well as a tutorial.

- **LABCAR-OPERATOR - User's Guide**

  This manual contains a complete description of all functions of LABCAR-OPERATOR and the add-ons.

- **LABCAR-RTC - User's Guide**

  This manual describes the software configuration of the hardware in the PT-LABCAR.

1.5.2 LABCAR-RTPC

The documentation of the user software for the real-time simulation target Real-Time PC consists of the following document:

- **LABCAR-RTPC - User's Guide**

  This manual describes the installation of the LABCAR-RTPC operating system and how to operate the web interface (on the user PC) for configuration and diagnostics.

1.5.3 LABCAR-AUTOMATION (optional)

The documentation of the optional automation tool LABCAR-AUTOMATION consists of the following document:

- **LABCAR-AUTOMATION - User's Guide**

  This manual describes how to operate LABCAR-AUTOMATION.

1.5.4 I/O Hardware Documentation

There is a PDF file included on the installation CD for every I/O hardware board used in PT-LABCAR.

The following hardware documentation is provided depending on the exact configuration of your PT-LABCAR.

LCSY_PT_BASE

- ES4100.1 Chassis VME64x - User's Guide
- ES1130.3 Simulation Controller Board - User's Guide
- ES1391.1 Power Supply Controller - User's Guide
- ES1392.2 High Current Switch Board - User's Guide

LCSY_PT_EIO

- ES1334.2 Measurement Board (16-CH) - User's Guide
- ES1335.1 Arbitrary Signal Generator Board - User's Guide
- ES1385.1-B Resistor Cascade Board - User's Guide
- ES1651.1 Carrier Board - User's Guide
- PB1651ADC1 A/D Module - User's Guide

- PB1651PWM1 I/O Module - User's Guide
- PB4350DAC1 D/A Module - User's Guide

LCSY_PT_EIO.2

- ES1336.1 Angle Synchronous Measurement Board - User's Guide
- ES1335.1 Arbitrary Signal Generator Board - User's Guide
- ES1385.1-B Resistor Cascade Board - User's Guide
- ES1651.1 Carrier Board - User's Guide
- PB1651ADC1 A/D Module - User's Guide
- PB4350DAC1 D/A Module - User's Guide
- ES1321.1 PWM I/O Board - User's Guide

Note

The manuals for the IXXAT iPC-I XC16/PCI CAN Board (English and German) and the Lambda Genesys power supply (only in English) are also on the product CD.

1.5.5 ES4440 Compact Failure Simulation Module (optional)

The documentation for the optional ES4440.1 comprises manuals on both the hardware itself:

- ES4440 Compact Failure Simulation Module - User's Guide

and the user software LABCAR-PINCONTROL:

- LABCAR-PINCONTROL V2.0 - User's Guide

2 PT-LABCAR – System Overview

Hardware-in-the-loop test systems simulate a vehicle and its environment and thus provide an ideal laboratory environment for testing ECUs.

The advantages of HiL systems are obvious:

- Automated tests provide much better test coverage than manual tests can.
- Root causes of complex failure types can be found early in development.
- Any driving profile can be run repeatedly with the same level of precision and without danger to humans or vehicles.

Overall, HiL systems provide a means toward efficient quality assurance of ECU software.

2.1 PT-LABCAR

PT-LABCAR (see Fig. 2-1) is an open and scalable HiL system designed for closed-loop testing of ECUs in the powertrain segment.

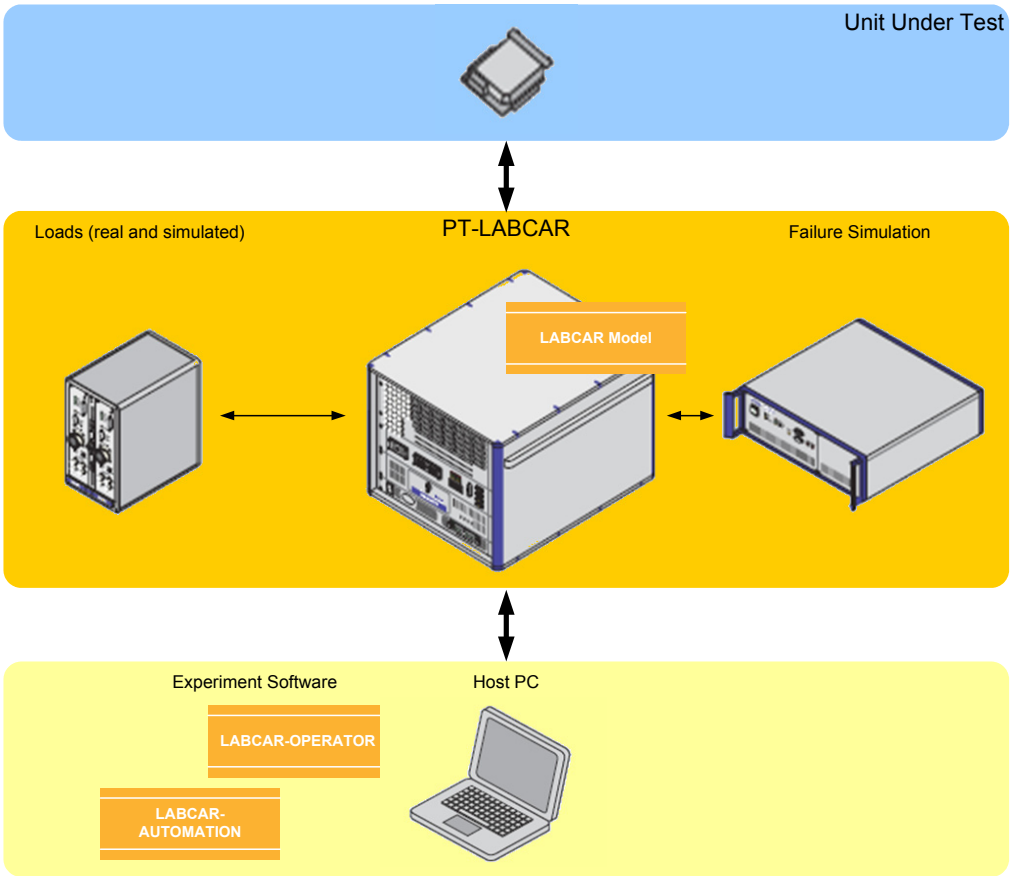


Fig. 2-1 PT-LABCAR and Its Environment

The system can be used to run automated regression tests for the release of software variants as well as for the validation of control and diagnostic functions in early phases of ECU development. PT-LABCAR systems can also be used for ECU precalibration in the lab leaving only fine-tuning for road tests.

A typical PT-LABCAR system configuration is designed for testing ECUs that control gasoline or diesel engines with up to 8 cylinders. The system can optionally be extended, e.g. for failure simulation or the integration with measurement and calibration tools. The system configuration can be adjusted for testing other powertrain ECUs.

ETAS developed PT-LABCAR in coordination with leading OEMs and suppliers in the automotive industry. Integrated system configurations leverage established technologies in a modular and flexible architecture. PT-LABCAR reduces the effort for project-specific engineering and simplifies the configuration, launch, and maintenance of HiL solutions. The solution's overall utilization is thus high and initial investments as well as operational costs are low.

Proven Technology

PT-LABCAR is built on reliable LABCAR technology (hardware and software) that proves itself daily in worldwide applications. High performance technical features provide for the system's versatility. For example, the galvanic separation of the signal generation channels supports the exact simulation of an engine's knock sensors, while the ECU can be accessed in real time.

Sophisticated software functions support the special requirements of the ECU development process by providing, e.g., efficient variant handling. The system's interaction with LABCAR-AUTOMATION further simplifies its integration into complex process- and tool landscapes.

Reduced Engineering Efforts with Standardized Wiring

As a key component of PT-LABCAR, the ES4640.1-B Connector Box standardizes the wiring harness of the entire system.

The ES4640.1-B reduces the effort for system integration by providing all external connections required for powertrain applications. Real loads and dummy loads can be flexibly connected in response to test requirements and ECU properties.

In addition, the breakout box covers the requirements for manual testing by providing access to all ECU pins.

Modular System for Great Scalability

PT-LABCAR was designed with outstanding scalability: 300 signal pins and 50 additional high-current pins enable sophisticated testing projects involving advanced ECUs. The signal box can accommodate up to 21 boards for generating and measuring ECU signals.

The basic system can thus be easily extended for handling tests of ECUs that control 10-, 12-, or 16-cylinder engines. The optional failure simulation component produces faults for up to 80 channels. If an even higher channel count is required, several failure simulation components can be cascaded.

To satisfy exceptional power requirements, the standard power supply can be replaced with a more powerful model.

PC-Empowered Simulation

By integrating a standard PC with a Pentium processor and the realtime operating system LABCAR-RTPC, PT-LABCAR features a powerful architecture for model calculation. Unlike a proprietary architecture, this open approach allows users to take advantage of the favorable trend in the PC market (ever more com-

puting power at a low price). Now and in future, PT-LABCAR thus enables users to run precise simulations with the best possible breadth and depth of test coverage.

Safe Investment

Boards for generating and measuring signals that are external to the ECU are accommodated within the system using the standard VME-bus. The boards can be acquired as needed and are exchangeable between PT-LABCAR systems. The simulation PC can be exchanged without reconfiguration or extensive modifications, as higher-performance models become available on the market.

The standard PC also provides PCI as well as PCI Express busses. Additional boards – that use the CAN bus for ECU communication, for example – can be integrated into the overall system using these busses.

Simplified System Launch and Maintenance

The software package designed for PT-LABCAR includes LABCAR-OPERATOR, add-ons for a seamless integration of MATLAB®/Simulink®, and LABCAR-RTPC. Preconfigured software projects simplify project-specific modifications, such as setting model parameters or mapping the pins from model to ECU.

3 Getting Started

Before you start the set-up procedure, read the following sections carefully, paying particular attention to all notes and warnings:

- "Safety Measures" on page 21

  This section describes general safety measures which you must adhere to when setting up and operating PT-LABCAR.

- "Configuring the User PC" on page 24

  To operate your PT-LABCAR, you require a user PC with various software and a connection to the simulation target. This section describes how to configure the PC.

3.1 Safety Measures

This section describes general safety measures which you must adhere to when setting up and operating PT-LABCAR.

3.1.1 General Safety Instructions for Operating PT-LABCAR

Before you launch PT-LABCAR, please read this section carefully.

Ground Connection/Protective Contact

The ground connection of the overall system is ensured via the protective earth conductor of the power cable. Avoid electric shocks when touching housing parts by ensuring that the mains socket used has correctly connected protective contacts.

Note

During a thunderstorm, disconnect PT-LABCAR from the power supply or install corresponding safety devices.

Ventilation

Never block the cooling vents – these are absolutely necessary to ensure sufficient ventilation inside the housing. Make sure there is a space of at least 15 cm between PT-LABCAR and walls or any other objects.

Note

The edges of the housing are also used for ventilation purposes!

Positioning

When choosing a place to set-up PT-LABCAR, please take the following into consideration:

- Only position PT-LABCAR on stable surfaces (desks, tables, shelves or similar bases).

  Note

  Take the weight into consideration – a PT-LABCAR weighs at least 75 kg.

- Also make sure that there are no heat sources in the vicinity, e.g. radiators or other heat-producing devices.

- PT-LABCAR and its components are not waterproof. Avoid contact with water and any other liquids.
- Lay cables so that nobody can step on them or trip over them and make sure that they cannot be jammed or caught up in any other way.
- For the ES4640.1-B Connector Box please observe the following note:

Note

The ES4640.1-B (F-00K-105-182) is intended exclusively for operation inside an ETAS 19" rack system or in the ETAS casing specially designed for this purpose (ES4015.2 Housing 9U, F-00K-107-884).

Connecting Cables

When creating wiring harnesses (e.g. when connecting the ECU and external loads) only use permissible cables (UL-certified).

Cleaning

Before cleaning the housing parts, remove the power cable. Only clean the device with a damp cloth. Never use detergents or solvents.

3.1.2 Opening the Doors of PT-LABCAR

If you open the front door or the rear cover of the PT-LABCAR, whether powered on or off, you must take precautions against possible static discharge.

This kind of discharge can lead to instabilities but could also damage the system.

3.1.3 Connecting/Removing Devices

To avoid injury and damage to the hardware, please observe the following precautionary measures:

- Do not apply any voltages to the connectors of PT-LABCAR which do not correspond to the specification of the relevant connector. For details of the exact specification of the I/O hardware, consult the manual of the relevant board.
- Please observe the maximum permissible currents of the individual signal lines. The specifications are listed at the end of the relevant sections with the signal description (see "The Signals of PT-LABCAR" on page 30).
- Do not connect or remove any devices when PT-LABCAR or external devices are powered on.
  First power off PT-LABCAR by shutting down the Real-Time PC and disconnect from the mains.
- Make sure that all connectors are inserted straight to ensure that the pins are not bent.

3.1.4 Opening Components

The components of PT-LABCAR must only be opened by qualified, technical personnel!

DANGER!

The power plug is used to disconnect the system from the supply circuit. The PT-LABCAR must be set up so that you can reach the plug easily !
As long as PT-LABCAR is connected to the power supply, you risk getting an electric shock!
Disconnect from the power supply by removing the power cable; then wait a few minutes until all components (e.g. power supply unit, capacitors) are discharged.

3.1.5 Installing and Removing Hardware

To avoid the hardware being damaged by electrostatic discharge, please observe the following precautionary measures:

- The PT-LABCAR boards can be damaged or even destroyed by electrostatic discharge.
- Boards should only be taken from their package, configured and installed at a working place that is protected against static discharge. Avoid touching the board's connectors and any conductors on it.

3.1.6 The PT-LABCAR Power Supply

The PT-LABCAR can be operated at 240 V/50 Hz, 16 A or at 100 V/60 Hz, 20 A.

Master-Slave Connection

Power is supplied to the individual components by a master: If the Real-Time PC is powered on, all other components, such as the power supply and signal box, are also powered on.

Note

The master/slave socket in PT-LABCAR is designed for a maximum current of 16 A!

Similarly the components are powered off again when the Real-Time PC is shut down.

3.1.7 Environmental Conditions

Only operate PT-LABCAR under the following environmental conditions:

Environment	Only use indoors
Operating temperature	5 °C bis 40°C (41 °F bis 104 °F)
Relative humidity	0 to 95% (non-condensing)
Power supply	100 VAC (20 A) - 240 VAC (16 A) / 50 - 60 Hz

Note

The PT-LABCAR system comes in two versions: one for 240 V and one for 110 V power supply. The nameplate on the rear of the device specifies the version.

3.2 Configuring the User PC

To operate your PT-LABCAR, you require a user PC with various software and a connection to the simulation target. This section describes how to configure the PC.

This consists of:

- Installing the Software on the User PC
- Establishing the Ethernet Connection to the Simulation Target Real-Time PC

3.2.1 Installing the Software on the User PC

The CD-ROM supplied contains, in particular, the latest version of LABCAR-OPERATOR, the basic software for operating PT-LABCAR.

Depending on the particular application, you may have purchased additional software (e.g. LABCAR-AUTOMATION, LABCAR-PINCONTROL, INCA). These products are supplied on separate installation CDs.

Checking the System Requirements

The system requirements vary according to the software used – for more information, please refer to the manuals of the repective software.

Software Installation

To install LABCAR-OPERATOR software proceed as follows:

- Insert the installation CD into the CD-ROM drive of your user PC.
- The start screen is displayed.

  In addition to the link **Installation**, which takes you to the installation of LABCAR-OPERATOR and the current Hardware Service Pack (HSP), you will also find further links with important information:

  – **Version Info**

    Up-to-date information and release notes

  – **Documentation**

    All manuals on the hardware and software of PT-LABCAR

  – **Tools and Utilities**

    Example and other programs (e.g. .NET Framework)

  – **Support**

    The telephone numbers and e-mail addresses of customer support worldwide.
- Start installing and follow the instructions on the screen.

Once you have completed installation, the next step is to establish the connection to the simulation target.

3.2.2 Establishing the Ethernet Connection to the Simulation Target Real-Time PC

Make sure that your user PC has an Ethernet interface and a network connection has been configured correctly (IP address: 192.168.40.240, subnet mask: 255.255.255.0).

Connect the Ethernet crossover cable (2x RJ45 socket) supplied to your user PC and to the back of the Real-Time PC (Ethernet connector "Eth0 (Host)").

Note

Crossover cables have crossover connections and are often indicated on one or both ends with yellow or orange connectors.

Testing the Connection to the Real-Time PC

To test the connection, please proceed as follows:

To start the Real-Time PC

- Power on the Real-Time PC by pressing the on/off switch on the front.
- Wait a few seconds until you hear an ascending sequence of notes.
- Launch a web browser on the user PC.
- Invoke the URL http://192.168.40.14.
- When the LABCAR-RTPC configuration dialog opens, your user PC is successfully connected to the simulation target.

Note

If the connection does not work, consult the chapter "Troubleshooting" in the LABCAR-RTPC manual.

To stop the simulation controller

- Click the **Stop Simulation Controller** button.
- Click the **Main Page** link.

To shut down the Real-Time PC

- Press the on/off switch on the Real-Time PC.

or

- Click the **Power Control** link.

  If the on/off switch on the Real-Time PC is not accessible or does not exist, PT-LABCAR can be shut down or rebooted using this web interface link.

For more detailed information on LABCAR-RTPC – particularly on the web interface mentioned above – refer to the "LABCAR-RTPC – User's Guide".

4 Hardware Configuration

This chapter contains the information you need to connect the ECU and loads and failure simulation to PT-LABCAR.

- "The ES4640.1-B Connector Box as Interface to the ECU" on page 28

  This section contains an overview of the PT-LABCAR interfaces to the ECU and loads.

- "The Signals of PT-LABCAR" on page 30

  This section describes the various types of signals of PT-LABCAR in detail (access to the signals at the connectors, signal routing, load measuring etc.). You need this information to customize your wiring harness.

- "Power Supply and Battery Nodes" on page 57

  This section contains the description of the supply voltages and the switchable battery nodes of PT-LABCAR.

- "Connecting Loads" on page 60

  This section describes which kinds of loads you can apply to at which connectors.

- "Failure Simulation" on page 61

  This section contains information on the connection of the ES4440.1 Compact Failure Simulation Module for failure simulation.

4.1 The ES4640.1-B Connector Box as Interface to the ECU

The ES4640.1-B Connector Box as interface to the ECU provides standardized wiring for HiL test systems in the powertrain segment.

Note

The ES4640.1-B (F-00K-105-182) is intended exclusively for operation inside an ETAS 19" rack system or in the ETAS casing specially designed for this purpose (ES4015.2 Housing 9U, F-00K-107-884).

The front panel features connectors for the ECU, CAN communication, OBD and LEDs for ignition and injection signals. You can also connect loads to the back of the device and – after lifting up the front panel – feed in signals which are routed via the ES4440.1 Compact Failure Simulation Module.

A typical application for the ES4640.1-B Connector Box are closed-loop HiL systems with ECUs for eight-cylinder gasoline and diesel engines.

Properties

The following figure shows a front view of the ES4640.1-B Connector Box with its connectors, bridges, LEDs and fuses.

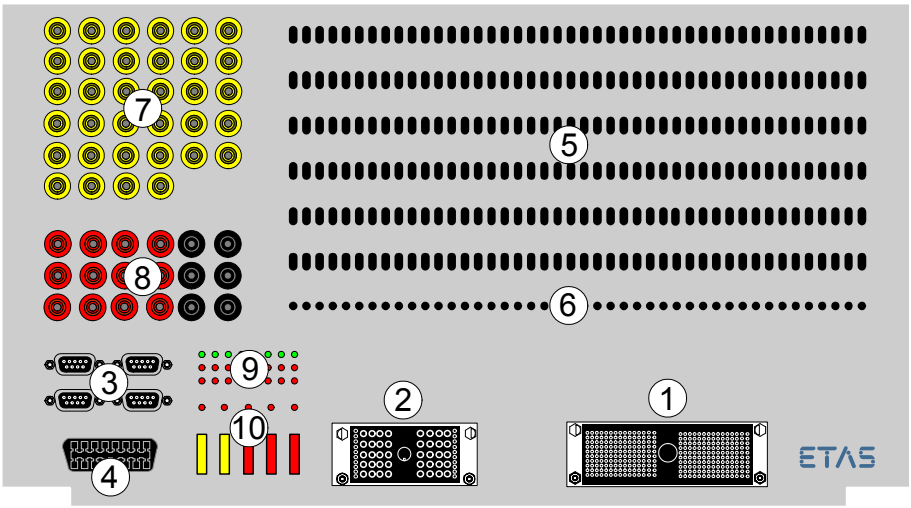


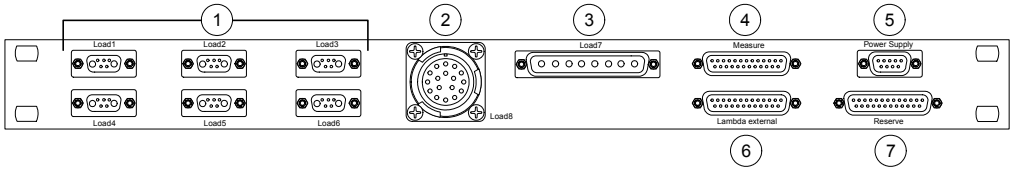
Fig. 4-1 Front View of the ES4640.1-B Connector Box (see Text)

The ES4640.1-B Connector Box has the following properties:

- 300 signal lines for ECU signals (1)
- 50 lines for high currents (2)
- Connectors for CAN (bypass, monitoring) (3)
- CARB connector for diagnostics (4)
- 264 bridges for I/O signals (5)
- 44 measure points for grounds and voltage references (6)
- 17 power bridges for signals to external loads (injection, ignition) (7)
- 9 power bridges for battery nodes, continuous plus and ground (8)
- LEDs for ignition and injection (9):
  - 8 LEDs for internal ignition output stages

  - 8 LEDs for external ignition output stages
  - 8 LEDs for injection
  - 5 LEDs for battery nodes
- 5 fuses for battery nodes (10)
- Simple integration of the ES4440.1 Compact Failure Simulation Module

The connectors for real and dummy loads are on the rear.



- Six connectors "Load1" ... "Load6" with 6 channels for actuators (throttle, EGR) (1)
- One "Load8" connector with 17 signals for injectors or emulations (2)
- One "Load7" connector for up to 8 single loads (3)
- One "Measure" connector for measuring a total of 20 angle-synchronous signals (injection/ignition) (4)
- One "Power Supply" connector for the power supply (+5 V/+12 V/-12 V) of external devices (5)
- One "Lambda external" connectorfor the external emulation of oxygen sensors (6)
- One "Reserve" connector for 25 additional channels (7)

4.2 The Signals of PT-LABCAR

This section contains a description of the signal types of PT-LABCAR for specifying your wiring harness. It is described in accordance with the following criteria:

- Type of signal (analog, digital, PWM etc.) and its name
- Number of signals available and possibly a description of special internal assignments and functions (e.g. measuring parallel to a load)
- Accessibility at the ES4640.1-B Connector Box
  - at the ECU connectors (ECU1, ECU2, etc.)
  - at the breakout box (bridge, measure point)
  - at the load connectors
- Current rating

This section contains information on:

4.2.1 Signal Paths in PT-LABCAR

Basically, there are five types of signal paths in PT-LABCAR between the ECU, CAN and CARB connectors on the front panel on the one hand and the I/O hardware or load connectors on the other:

- Type 1: via 264 bridges (and optional failure simulation) to I/O boards
- Type 2: via 44 measure points to I/O boards
- Type 3: via 9 power bridges from I/0 boards to battery voltages
- Type 4: via 17 power bridges on load connectors (with optional failure simulation)
- Type 5: from measure connectors to I/O boards

These signal paths are shown schematically in Fig. 4-2.

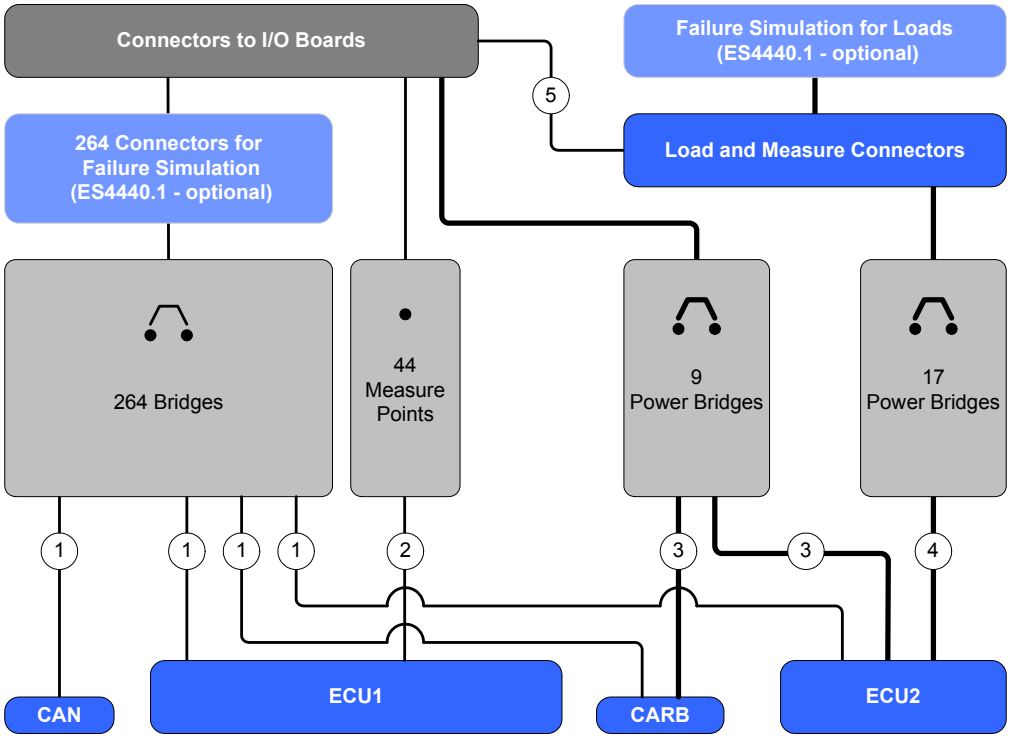


Fig. 4-2 Signal Paths in PT-LABCAR (see Text)

4.2.2 DA Channels

The basic version of PT-LABCAR includes two PB4350DAC1 D/A Modules which together have 20 analog outputs: the addition of a further, optional module increases the number of outputs to 30.

From these 20(30) channels, 2 are specifically used to simulate oxygen sensors (see "Oxygen Sensor Emulation" on page 33); these are not routed via the breakout box. Two further channels can be used either to simulate oxygen sensors or as analog channels (routed via the breakout box).

This leaves a total of 18(28) free analog output channels.

Note

The terms "input" and "output" are seen from the point of view of the I/O hardware (and thus of the model) – an analog output channel therefore supplies an analog signal for an ECU input.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	DACx_nn (mm)
DAC	Analog output channel *
x	Number of the board in the system (1,2(,3))
nn	Number of the DAC channel (0..9)
mm	Number of the connector on ES4640.1-B**
Example	DAC1_00 (81)
* see note further up ** this number corresponds to the number of the bridge on the front panel	

Tab. 4-1 Name of the DA Channels

The signals of a DA channel are named as follows

Signal Name	Meaning	Access on Breakout Box
Out_CHn	Output channel n	28 bridges
Ref_CHn	External reference channel n	30 bridges
GND_CHn	External Ground channel n	30 measure points

Tab. 4-2 The Signals of a DA Channel

Signals at the ECU Connector

All signals of a DA channel are routed via the "ECU1" connector.

Rating of the Channels

The maximum permissible currents per channel ("Out_CHn", "Ref_CHn", "GND_CHn") are 1 A – for the path via the ES4440.1 Compact Failure Simulation Module, the rating increases to 3 A (without load!).

4.2.3 Oxygen Sensor Emulation

The DVE model used usually supplies a lambda value which is converted into an analog value in the DAC module.

In oxygen sensor emulation, this results in the generation of the three ECU signals pump current IP, Nernst voltage UN and compensation current IA which are transferred at the connector "ECU1".

A total of four oxygen sensors can be simulated – two channels of the second DAC module are specifically assigned for this purpose ("Out_CH08" and "Out_CH09").

Note

If only two linear oxygen sensors are required, the channels "Out_CH06" and "Out_CH07" can also be used as DAC channels.

The AS_41SC accommodates a piggyback for conditioning four signals (lambda values). Fig. 4-3 on page 34 shows how the signals are switched from the DAC module via the AS_41SC (and the ES1385.1-B) to the ECU connector.

Corresponding setting of the jumpers determines whether a narrow band sensor or a broad band sensor is to be simulated (see "The Jumpers JP 101 ... JP 104" on page 35).

Note

If broad band sensors are to simulated, "UNx" and "Resx+" have to be connected in the ECU connector (see the dashed lines in Fig. 4-3 on page 34).

Tab. 4-3 on page 35 contains the signals which are generated for narrow band sensors or broad band sensors and how these are connected to the "ECU1" connector.

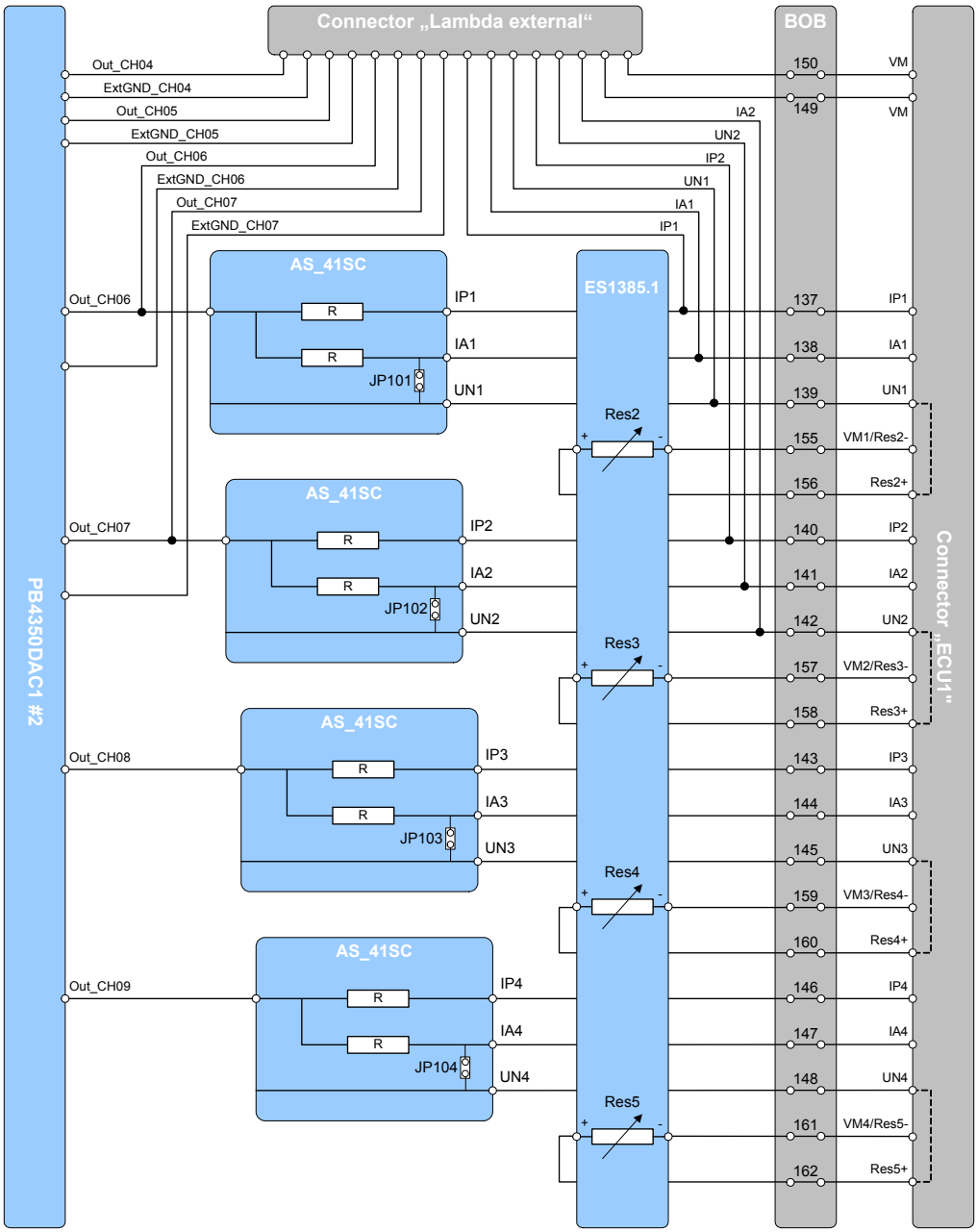


Fig. 4-3 Oxygen Sensor Emulation with AS_41SC and ES1385.1-B

Refer to Tab. 4-4 on page 36 for information on which resistors or signals of the ES1385.1-B (against the virtual ground of the ECU) are used to generate the Nernst voltage UN.

	ECU Narrow Band Sensor	ECU Broad Band Sensor	PT-LABCAR Signal
Sensor 1	Lambda signal	Pump current IP	IP1
		Sense current IA	IA1
		Nernst voltage UN	UN1
	Virtual ground	Virtual ground	ExtGND _CH06*
	Sensor heating	Sensor heating	In_CH0_1**
Sensor 2	Lambda signal	Pump current IP	IP2
		Sense current IA	IA2
		Nernst voltage UN	UN2
	Virtual ground	Virtual ground	ExtGND _CH07*
	Sensor heating	Sensor heating	In_CH1_1**
Sensor 3	Lambda signal	Pump current IP	IP3
		Sense current IA	IA3
		Nernst voltage UN	UN3
	Virtual ground	Virtual ground	ExtGND _CH08*
	Sensor heating	Sensor heating	In_CH2_1**
Sensor 4	Lambda signal	Pump current IP	IP4
		Sense current IA	IA4
		Nernst voltage UN	UN4
	Virtual ground	Virtual ground	ExtGND _CH09*
	Sensor heating	Sensor heating	In_CH3_1**

* These channels must be connected to the virtual ground of the ECU (for the names see Tab. 4-2 on page 32).
** The signals "In_CH16_1" ... "In_CH19_1" can also be used (for the names see Tab. 4-9 on page 41) – any load necessary can be connected to "Load7".

Tab. 4-3 The Signals of Oxygen Sensor Emulation

The Jumpers JP 101 ... JP 104

These jumpers (see Fig. 4-3 on page 34) already exist on delivery and are required for the simulation of broad band sensors.

If you are only interested in simulating narrow band sensors, the two output signals "IA" and "UN" are of no significance and the jumpers have to be removed. The resistor cascades 2 - 5 of the ES1385.1-B can then be used for other purposes.

Fig. 4-4 shows the position of jumpers "JP 101" ... "JP 104" on the piggyback.

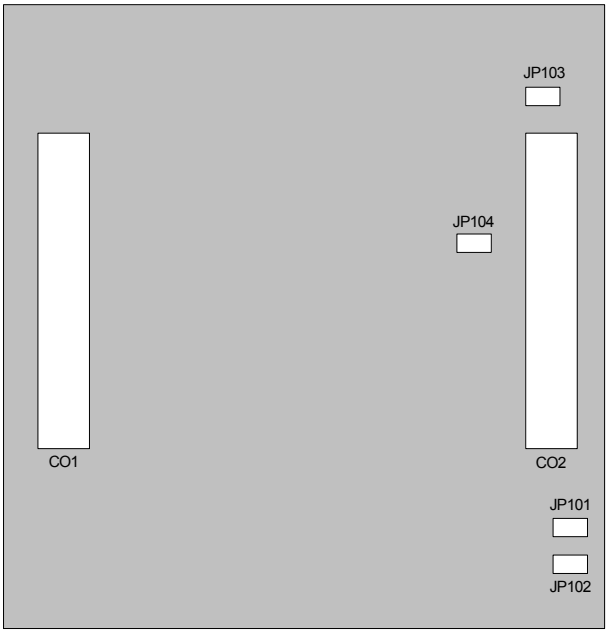


Fig. 4-4 Position of the Jumpers

	ECU	PT-LABCAR Signal
Sensor 1	Nernst voltage UN1	ES1385.1-B: Res2+
	Virtual ground	ES1385.1-B: Res2-
Sensor 2	Nernst voltage UN2	ES1385.1-B: Res3+
	Virtual ground	ES1385.1-B: Res3-
Sensor 3	Nernst voltage UN3	ES1385.1-B: Res4+
	Virtual ground	ES1385.1-B: Res4-
Sensor 4	Nernst voltage UN4	ES1385.1-B: Res5+
	Virtual ground	ES1385.1-B: Res5-

Tab. 4-4 Resistor Channels for the Nernst Voltage of the Sensors

External Emulation

If you do not want to use internal oxygen sensor emulation, you will find the relevant signals routed to the "Lambda external" connector on the back of the ES4640.1-B Connector Box (see "”Lambda external” Connector" on page 79).

For external emulation, the channels ”Out_CH04” and ”Out_CH05” are used as well as the channels which can be used for internal emulation ”Out_CH06” and ”Out_CH07”.

Note

If you use external emulation, you must ensure that any internal assignment of the channels ”Out_CH06” and ”Out_CH07” does not interfere with your external allocation!

4.2.4 AD Channels

PT-LABCAR is supplied with a PB1651ADC1 A/D Module which has 16 (differential) analog inputs.

These channels are used as follows

- Two differential channels each are switched parallel to the six load connectors for measuring throttle, EGR etc.

  How to measure the connected loads is described in the section "Description of the Circuit" on page 38.

- The four remaining differential channels are freely available.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	ADCx_nn (mm)
ADC	Analog input channel *
x	Number of the board in the system (1)
nn	Number of the ADC channel (0..15)
mm	Number of the connector on ES4640.1-B**
Example	ADC1_00 (163)
* see note on page 32 ** this number corresponds to the number of the bridge on the front panel	

Tab. 4-5 Name of the AD Channels

The signals of an AD channel are named as follows

Signal Name	Meaning	Access on Breakout Box
VN*n*+	+ input channel n	16 bridges
VN*n*-	– input channel n	16 bridges

Tab. 4-6 The Signals of an AD Channel

Description of the Circuit

Fig. 4-5 shows the circuit of a load at the connectors "Load1" ... "Load6"

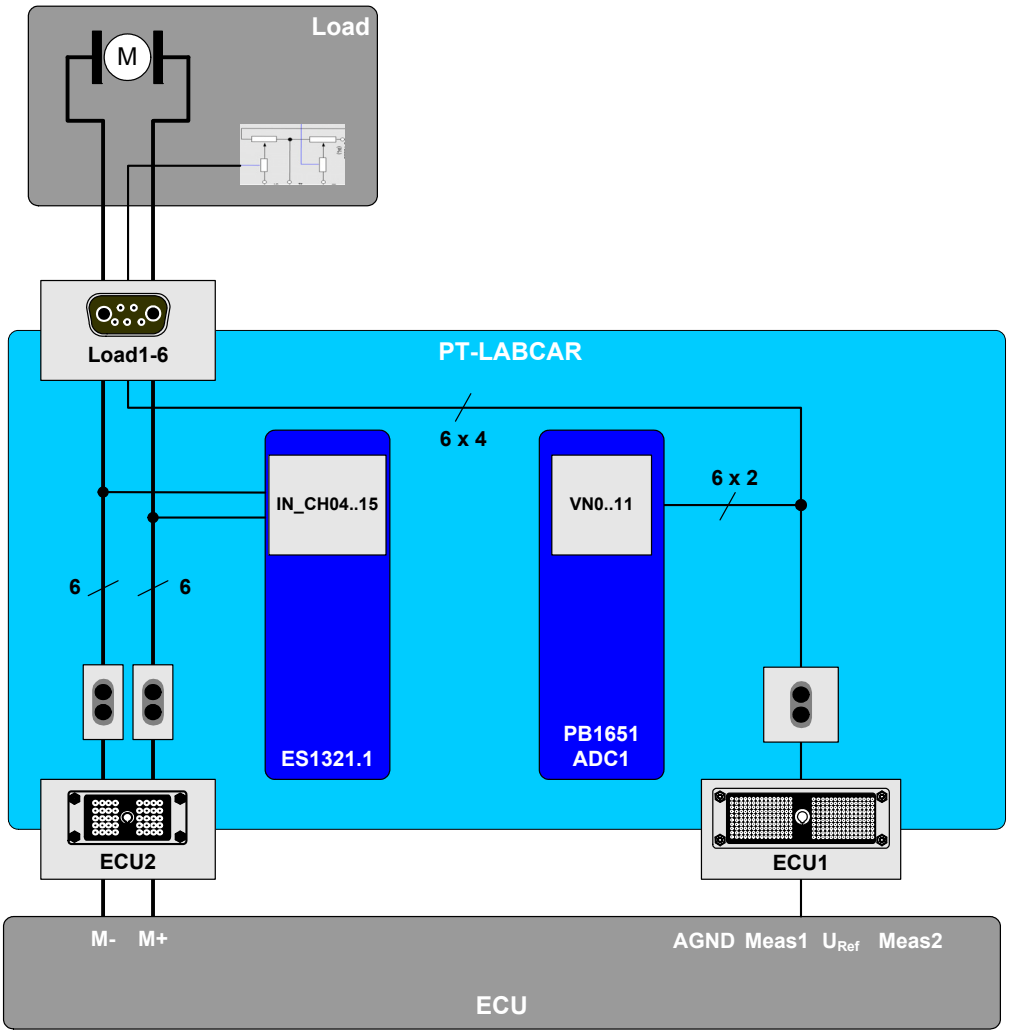


Fig. 4-5 Measuring Sensor Signals (of Loads) with an ADC Module

The loads are connected to the connectors "Load1" ... "Load6" (for details of the assignment of these connectors see ""Load1" ... "Load6" Connectors" on page 74) – the ECU signals for addressing the loads are applied at the "ECU2" connector (signals "Load_Ch04" ... "Load_Ch15") and also measured at a PWM input (see "PWM Channels" on page 41 and especially "Use of the 1st ES1321.1 PWM I/O Board" on page 42).

Measuring the current position (e.g. of the throttle) usually takes place via two potentiometers the position of which can be measured via two inputs of the ADC module.

The pair-wise connected (with channels 0 ... 11) VN*n*- are connected with the ECU's AGND.

The following table describes which loads and which sensors are measured with which channels.

Connector	Pin	Actuator Signals	PWM Input	Sensor Signals	ADC Inputs
Load1	A1	Load1+	In_CH04_1		
	A2	Load1-	In_CH05_1		
	1			U1_1	VN0+
	2			U1_2	VN1+
	3			Common sensor ground	VN0/1-
	4	Reference voltage from the ECU (U_{Ref})			
Load2	A1	Load2+	In_CH06_1		
	A2	Load2-	In_CH07_1		
	1			U2_1	VN2+
	2			U2_2	VN3+
	3			Common sensor ground	VN2/3-
	4	Reference voltage from the ECU (U_{Ref})			
Load3	A1	Load3+	In_CH08_1		
	A2	Load3-	In_CH09_1		
	1			U3_1	VN4+
	2			U3_2	VN5+
	3			Common sensor ground	VN4/5-
	4	Reference voltage from the ECU (U_{Ref})			
Load4	A1	Load4+	In_CH10_1		
	A2	Load4-	In_CH11_1		
	1			U4_1	VN6+
	2			U4_2	VN7+
	3			Common sensor ground	VN6/7-
	4	Reference voltage from the ECU (U_{Ref})			

Tab. 4-7 Assignment: Load Connector → Measuring of Actuator/Sensor

Connector	Pin	Actuator Signals	PWM Input	Sensor Signals	ADC Inputs
Load5	A1	Load5+	In_CH12_1		
	A2	Load5-	In_CH13_1		
	1			U5_1	VN8+
	2			U5_2	VN9+
	3			Common sensor ground	VN8/9-
	4	Reference voltage from the ECU (U_{Ref})			
Load6	A1	Load6+	In_CH14_1		
	A2	Load6-	In_CH15_1		
	1			U6_1	VN10+
	2			U6_2	VN11+
	3			Common sensor ground	VN10/11-
	4	Reference voltage from the ECU (U_{Ref})			

Tab. 4-7 Assignment: Load Connector → Measuring of Actuator/Sensor

For details of the load connector assignment, refer to the section ""Load1" ... "Load6" Connectors" on page 74.

Signals at the ECU Connector

All signals of an AD channel are routed via the "ECU1" connector.

Rating of the Channels

The maximum permissible current per channel is 1 A.

4.2.5 PWM Channels

The basic version of PT-LABCAR includes a ES1321.1 PWM I/O Board (formerly: PB1651PWM1 PWM Module) which has 24 PWM inputs and 16 PWM outputs – the addition of a further, optional ES1321.1 increases the number of inputs to 48 and the number of outputs to 32.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	PWMx_[dir]_nn (mm)
PWM	PWM channel
x	Number of the board in the system (1,2)
dir	Signal direction (IN or OUT) *
nn	Number of the PWM channel (0..15 for outputs, 0..23 for inputs)
mm	Number of the connector on ES4640.1-B**
Example	PWM1_In_00 (1); PWM1_Out_00 (25)

* see note on page 32
** this number corresponds to the number of the bridge on the front panel

Tab. 4-8 Name of the PWM Channels

The signals of a PWM input/output channel are named as follows

Signal Name	Meaning	Access on Breakout Box
In_CHn_1	PWM input n of the 1st ES1321.1	24 bridges
In_CHn_2	PWM input n of the 2nd ES1321.1	24 bridges
Out_CHn_1	PWM output n of the 1st ES1321.1	16 bridges
Out_CHn_2	PWM output n of the 2nd ES1321.1	16 bridges
In_Ref2_n	2nd reference voltage* for input of the nth ES1321.1	2 measure points
Out_Ref2_*n*	2nd reference voltage* for output of the nth ES1321.1	2 measure points
In_GND and Out_GND of both ES1321.1 boards are at -UBatt!		
* The first reference voltage both for inputs and outputs of both ES1321.1 boards is at +BN4!		

Tab. 4-9 The Signals of a PWM Channel

Note

The specifically connected signals (1st reference voltage at BN4 and GND at -UBatt) remain connected even if the relevant bridge for BN4 or GND is removed!

Use of the 1st ES1321.1 PWM I/O Board

PWM1_IN_0..19: For parallel measuring of signals for load addressing (at connectors "Load1" ... "Load6", "Load7") (see "Description of the Circuit for Load Measuring" on page 43)

PWM1_IN_20..23: Free

PWM1_OUT_0..15: Free

Use of the (Optional) 2nd ES1321.1 PWM I/O Board

PWM2_IN_0..23: Free

PWM2_OUT_0..15: Free

Loads for Open-Collector Outputs of the ECU

The channels of two ES1395.1 Load Conditioning Boards are connected parallel to the inputs of the PWM boards 1 and 2.

Description of the Circuit for Load Measuring

Four loads (e.g. actuators) or eight single loads can be connected to the "Load7" connector. The parallel measuring of the actuator signal takes place via the inputs PWM1_IN_0..3 and PWM1_IN_16..19.

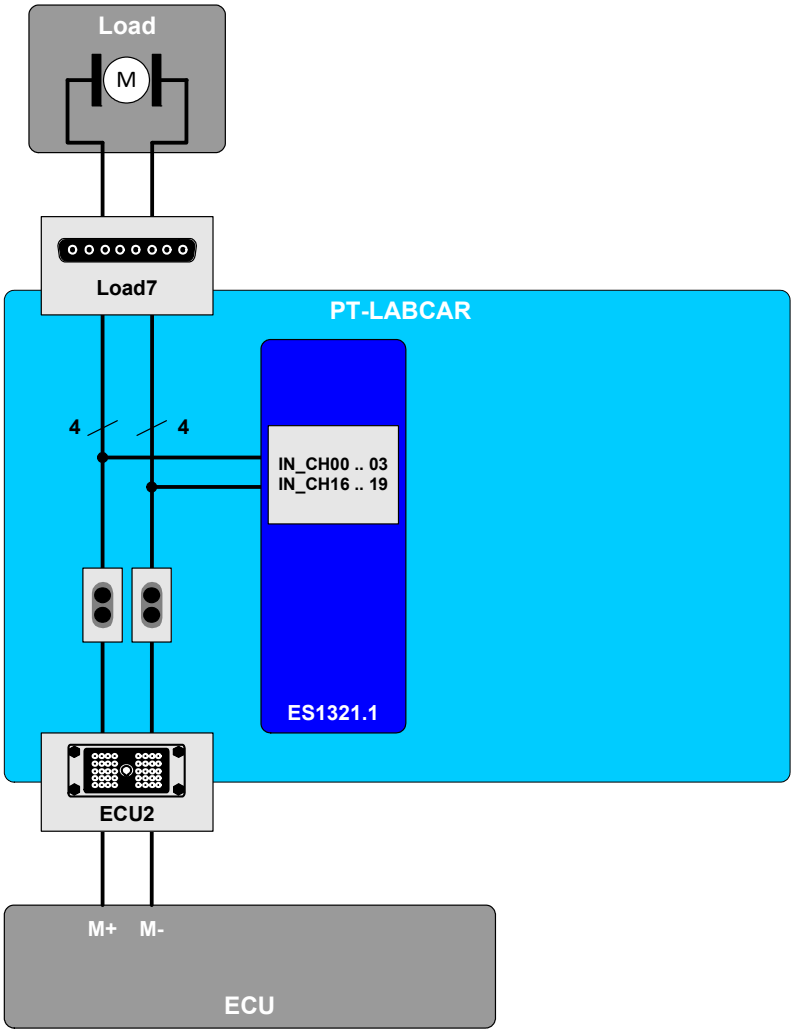


Fig. 4-6 Measuring Loads (Actuator Signals) with PWM Inputs

For details of the assignment of "Load7" with the individual PWM inputs, refer to Tab. 5-15 on page 76.

The measuring of loads at "Load1" ... "Load6" is described in the section "AD Channels" on page 37.

Signals at the ECU Connector

The free signals of a PWM board are routed via the "ECU1" connector.

Reference Voltages and Grounds

Every module has two reference voltages for In and Out, an "In_GND" and an "Out_GND".

Signal	Wiring
In_Ref1_1	Specifically connected to BN4
In_Ref1_2	Specifically connected to BN4
In_Ref2_1	Can be applied at "ECU1" connector
In_Ref2_2	Can be applied at "ECU1" connector
Out_Ref1_1	Specifically connected to BN4
Out_Ref1_2	Specifically connected to BN4
Out_Ref2_1	Can be applied at "ECU1" connector
Out_Ref2_2	Can be applied at "ECU1" connector
In_GND_1	Specifically connected to -UBatt
In_GND_2	Specifically connected to -UBatt
Out_GND_1	Specifically connected to -UBatt
Out_GND_2	Specifically connected to -UBatt

The names of the channels with the reference voltages are as follows: [In|Out]_Ref*No_Board*

Tab. 4-10 Reference Voltages and Grounds of the PWM Boards

Rating of the Channels

The maximum permissible currents per channel are as follows:

- PWM1_IN_nn: 9 A
- PWM1_OUT_nn: 1 A
- PWM2_IN_nn: 5 A
- PWM2_OUT_nn: 1 A

4.2.6 Arbitrary Signals (Measuring)

For the acquisition and evaluation of digital ECU signals, PT-LABCAR has an ES1336.1 Angle Synchronous Measurement Board with 20 digital inputs.

Note

As long as you use an ES1334.2 Measurement Board, the connectors ECU1:B30 (bridge 205), ECU1:B31 (bridge 206), ECU1:K32 (bridge 263) and ECU1:K35 (bridge 264) will not be used, but should not be assigned otherwise.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	ASMx_nn (mm)
ASM	Arbitrary input channel *
x	Number of the board in the system (1)
nn	Number of the measure channel (0..19) (ES1334.2: 0..15)
mm	Number of the connector on ES4640.1-B**
Example	ASM1_00 (189)
* see note on page 32 ** this number corresponds to the number of the bridge on the front panel	

Tab. 4-11 Names of the Measure Channels for Arbitrary Signals

The signals of an input channel are named as follows

Signal Name	Meaning	Access on Breakout Box
IN_CHn	Measure input n	16 bridges (ES1336.1: 20)
IN_REF0..7, IN_REF8..15	Reference voltages* for threshold comparison for channels 0..7 and 8..15	2 measure points
UBatt_A, UBatt_B	Battery voltages for threshold comparison	Connected to BN4
-UBatt	Ground	Connected to -UBatt

* Not used in ES1336.1

Tab. 4-12 The Signals of a Measure Channel

Measuring Ignition Signals

The inputs "IN_CH8..15" are intended to be used to measure ignition signals – these inputs are routed out at the "Measure" connector on the rear of the ES4640.1-B Connector Box (see Tab. 4-13 on page 46).

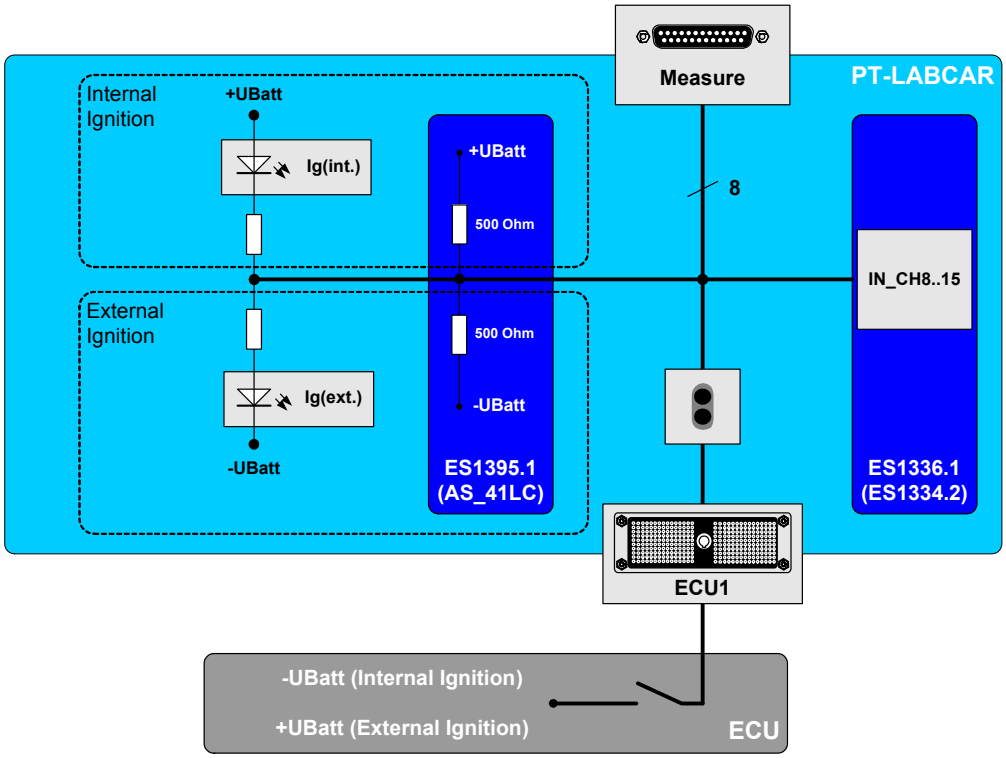


Fig. 4-7 Measuring Ignition Signals

The ignition signals are generated either internally in the ECU (signal low-active) or externally (signal high-active). To ensure that a current flows, loads (ES1395.1) can be switched against +UBatt or -UBatt. In addition, LEDs are connected for visualization – also to the relevant voltages (see Fig. 4-7).

Signal*	"ECU1" Connector	Bridge	IN_CHn ES1336.1 (ES1334.2)	"Measure" Connector
Ig 1	C21	197	8	9
Ig 2	B23	198	9	10
Ig 3	B24	199	10	11
Ig 4	B25	200	11	12
Ig 5	B26	201	12	13
Ig 6	B27	202	13	14
Ig 7	B28	203	14	15
Ig 8	B29	204	15	16

* Name on LED field

Tab. 4-13 Signal Paths When Measuring Ignition Signals

Note

"IN_CH8"... "IN_CH19" ("IN_CH8" ... "IN_CH15" in the case of the ES1334.2) are always connected to the "Measure" connector without a relays being in the signal path (unlike "IN_CH0" ... "IN_CH7" – see Fig. 4-9 on page 49).

Configuration of the LEDs

Note

The LEDs are only connected permanently with the particular measurement channels on one side – for them to light up, the other side must be connected to the relevant potential (+UBatt or -UBatt)!

The LEDs are connected to the relevant voltage in a 4-2-2 grouping depending on whether there are 4, 6 or 8 cylinders. The "ECU1" connector has the pins "Ig-4 Int", "Ig-6 Int", "Ig-8 Int" (plus the same pins for external ignition) which have to be connected to the "BN1" or "GND" pins at the "ECU1" connector when the wiring harness is created (see Tab. 4-14).

Pin at "ECU1"	for	Connect with	LEDs
Ig-4 Int	4 cylinders	BN1 (ECU1:H26)	Ig(int.) 1 ... Ig(int.) 4
Ig-6 Int	6 cylinders	BN1 (ECU1:H26)	Ig(int.) 5 ... Ig(int.) 6
Ig-8 Int	8 cylinders	BN1 (ECU1:H26)	Ig(int.) 7 ... Ig(int.) 8
Ig-4 Ext	4 cylinders	GND (ECU1:H27)	Ig(ext.) 1 ... Ig(ext.) 4
Ig-6 Ext	6 cylinders	GND (ECU1:H27)	Ig(ext.) 5 ... Ig(ext.) 6
Ig-8 Ext	8 cylinders	GND (ECU1:H27)	Ig(ext.) 7 ... Ig(ext.) 8

Tab. 4-14 Configuration of the LEDs for Ignition Signals

Configuration of the Loads

Depending on the type of ignition signal, the loads must be connected to +UBatt (or more generally: to a battery node) or -UBatt (see Fig. 4-7 on page 46), which takes place by setting jumpers on the board.

To configure loads for internal or external ignition

- Power off PT-LABCAR by shutting down the real-time PC.
- Disconnect from the mains (by unplugging).
- Open the rear door.
- Remove the two mounting screws of the ES1395.1 and remove the board.

Note

Be extremely careful to ensure that you do not touch the components and the board if they are not at a workplace protected against static discharge!

- Put the jumpers of the channels used[1] (see Fig. 4-8) into the position which connects the load to the relevant battery voltage (BN0..BN4 or -UBatt, see Tab. 4-15 on page 48).

Note

For more information on the ES1395.1 please refer to the Appendix under "ES1395.1 Load Conditioning Board" on page 81.

- Re-integrate the board.

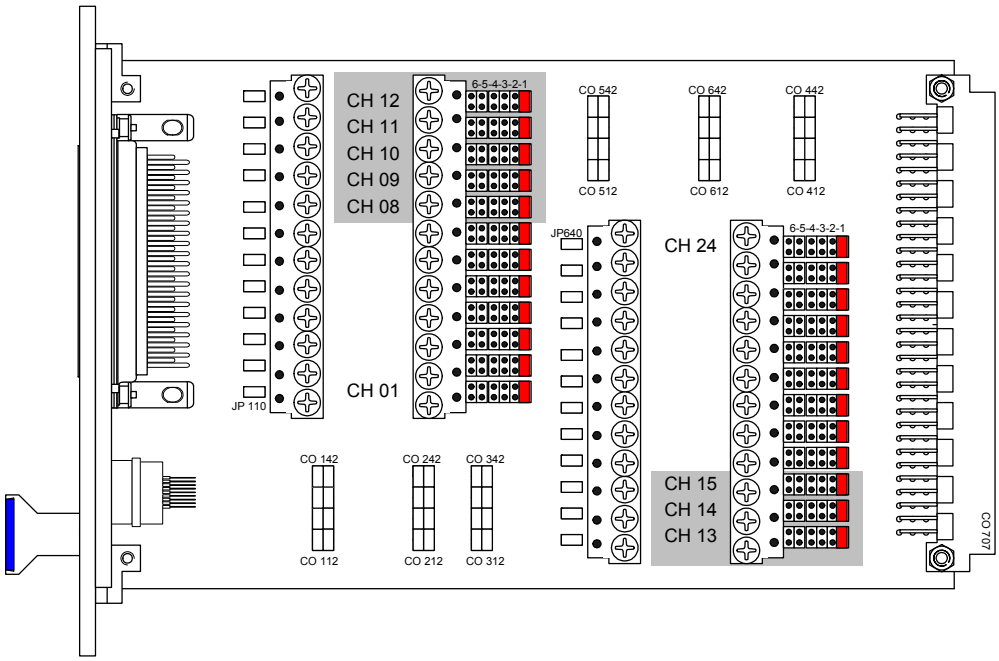


Fig. 4-8 Jumpers on ES1395.1

Please consult the following table for information on which jumper is connected to which battery node.

Jumper in Position	Connects the relevant channel of the ES1395.1 to
1	BN0
2	BN1
3	BN2
4	BN3
5	BN4
6	-UBatt

Tab. 4-15 Jumper Position for Connection to Battery Voltage

[1] IN-CH**n** of the ES1336.1 (ES1334.2) is connected to channel **n** of the ES1395.1

For more information on the ES1395.1, refer to the section "ES1395.1 Load Conditioning Board" on page 81.

Measuring Injection Loads or Load Emulations

1. Direct injection.

The connection and measuring of injection loads and their emulations are shown in Fig. 4-9.

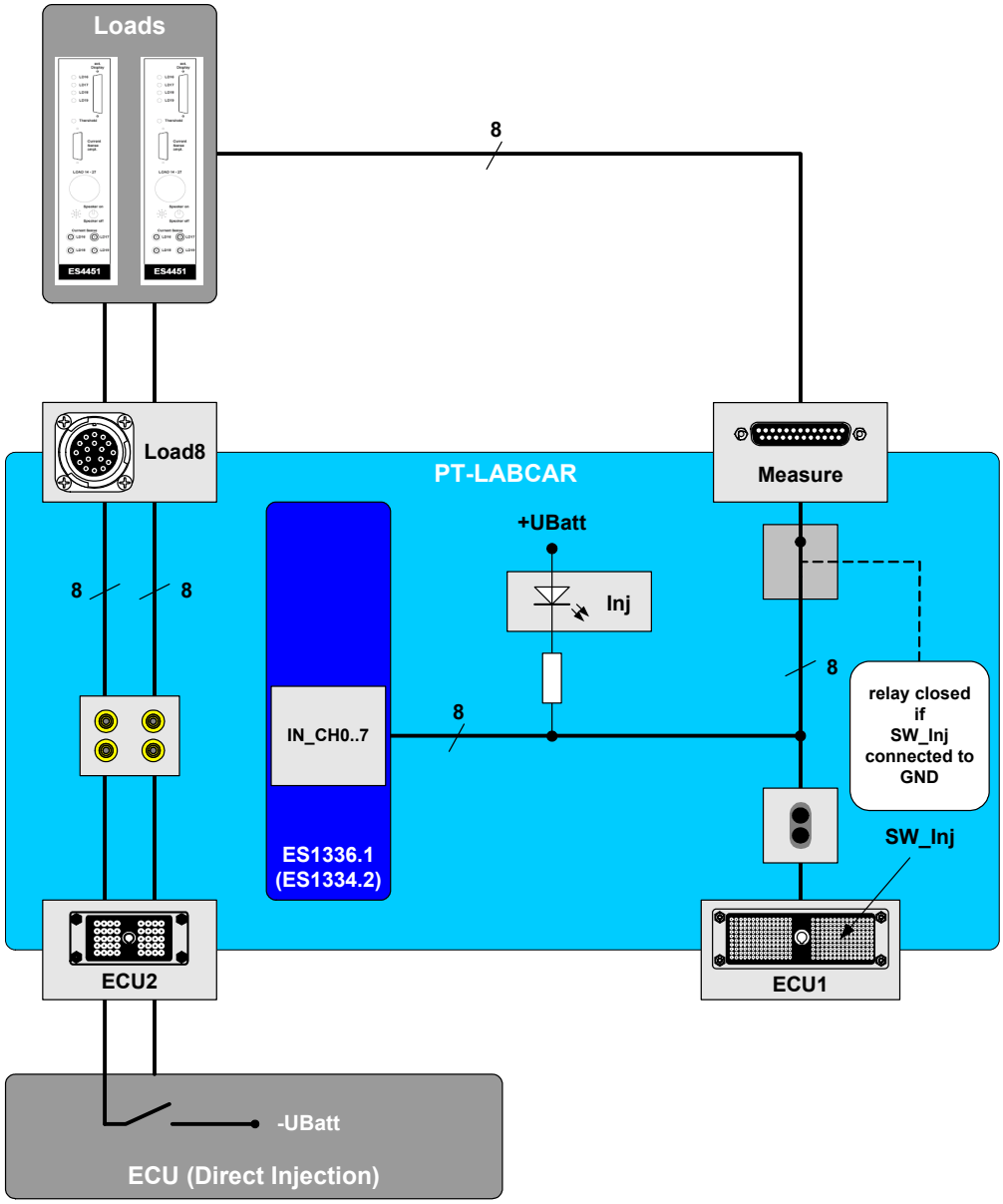


Fig. 4-9 Measuring of Injection Loads with Direct Injectors

The ECU signals are applied at the "ECU2" connector and are connected to the "Load8" connector on the back via power bridges (A..T) (see Tab. 4-16 on page 50).

Signal*	Signal Line**	"ECU2" Connector	Power Bridge	"Load8" Connector
Inj 1	Inj_Ch0	A6/7, B6/7	A	A
	Inj_Ch2	E6/7, F6/7	C	C
Inj 2	Inj_Ch4	J6/7, K6/7	E	E
	Inj_Ch6	C8/9, D8/9	G	G
Inj 3	Inj_Ch1	C6/7, D6/7	B	B
	Inj_Ch3	G6/7, H6/7	D	D
Inj 4	Inj_Ch5	A8/9, B8/9	F	F
	Inj_Ch7	E8/9, F8/9	H	H
Inj 5	Inj_Ch8	G8/9, H8/9	J	J
	Inj_Ch10	A15/16, B15/16	L	L
Inj 6	Inj_Ch12	E15/16, F15/16	N	N
	Inj_Ch14	J15/16, K15/16	R	R
Inj 7	Inj_Ch9	J8/9, K8/9	K	K
	Inj_Ch11	C15/16, D15/16	M	M
Inj 8	Inj_Ch13	G15/16, H15/16	P	P
	Inj_Ch15	A17/18, B17/18	S	S
Ground	Inj_Ch16	C17/18, D17/18	T	T

* Name on LED field
** 4 signals are routed twisted in 4 groups

Tab. 4-16 Signal Paths During Measuring of Injection Signals at "ECU2"

Either an original load (possibly with the relevant measuring electronics) or an emulation (e.g. ES4451.2 Gasoline Direct Injection Load) can be connected there.

The measure signals from the load or an emulation can be applied again at the "Measure" connector. The measuring of these signals takes place with channels IN_CH0..7 of the ES1336.1 (ES1334.2).

Adhere to the specifications in the following table to ensure that the measurement of signal "Inj n" takes place at the right input of the ES1336.1 (ES1334.2).

Signal* from	Connect to "Measure"	→ Measuring at IN_CHn ES1336.1 (ES1334.2)
Inj 1	Pin 1	0
Inj 2	Pin 2	1
Inj 3	Pin 3	2
Inj 4	Pin 4	3
Inj 5	Pin 5	4
Inj 6	Pin 6	5

Tab. 4-17 "Measure" Wiring to ES1336.1 (ES1334.2) Input

Signal* from	Connect to "Measure"	→ Measuring at IN_CHn ES1336.1 (ES1334.2)
Inj 7	Pin 7	6
Inj 8	Pin 8	7

* Name on LED field

Tab. 4-17 "Measure" Wiring to ES1336.1 (ES1334.2) Input

For the "Measure" connector to be connected to the inputs of the ES1336.1 (ES1334.2), the relays have to be closed (see Fig. 4-9 on page 49). This is achieved by the "SW_Inj" (ECU1:H28) pin being connected to the "GND" (ECU1:H27) pin.

Configuration of the LEDs

Note

The LEDs are only connected permanently with the particular measurement channels on one side – for them to light up, the other side must be connected to the relevant potential (+UBatt or -UBatt)!

For the relevant LEDs to light up, the signals "Inj-4", "Inj-6" and "Inj-8", as with the ignition signals, have to be connected to an adequate voltage.

Pin at "ECU1"	for	Connect with	LEDs
Inj-4 (J8)	4 cylinders	BN1 (ECU1:H26)	Inj 1 ... Inj 4
Inj-6 (J9)	6 cylinders	BN1 (ECU1:H26)	Inj 5 ... Inj 6
Inj-8 (J10)	8 cylinders	BN1 (ECU1:H26)	Inj 7 ... Inj 8

Tab. 4-18 Configuration of the LEDs for Injection Signals

2. Intake manifold injection.

The connection and measuring of injection signals (intake manifold injection) are shown in Fig. 4-10.

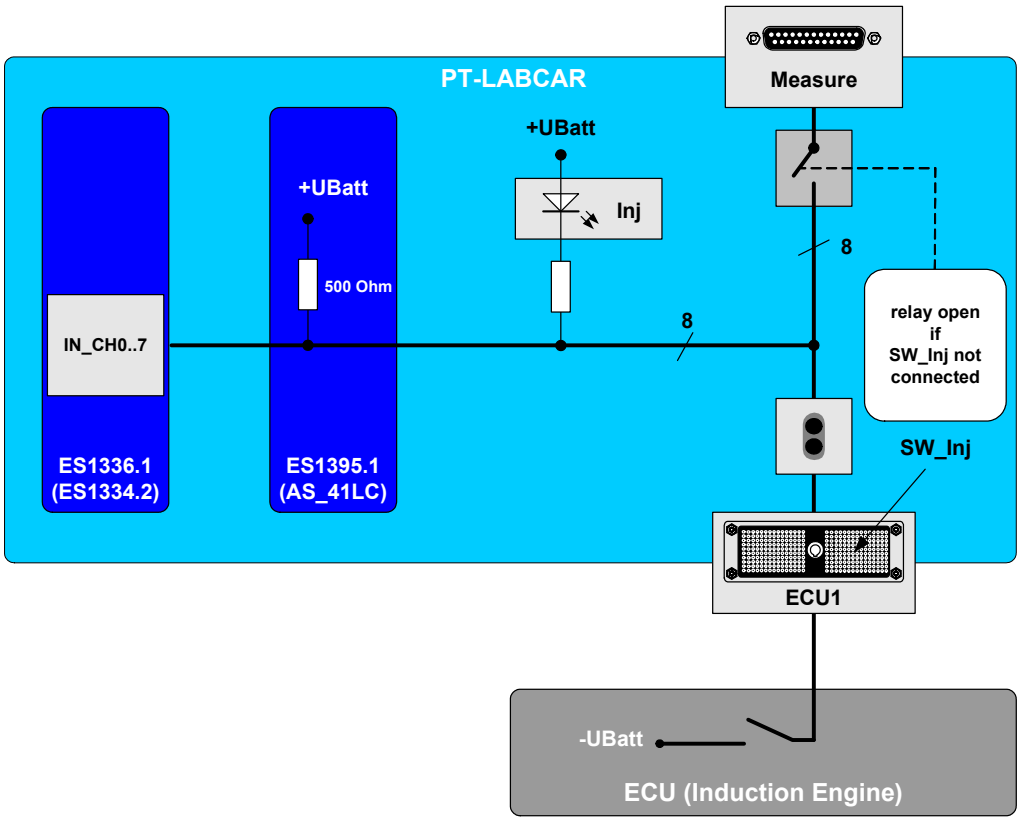


Fig. 4-10 Measuring of Injection Signals with Induction Engines

The measuring of these signals also takes place with channels "IN_CH0..7" of the ES1336.1 (ES1334.2).

To avoid shorts with any signals connected to "Measure", the relays must be open, i.e. the "SW_Inj" (ECU1:H28) pin must not be connected to "GND"!

Signal*	"ECU1" Connector	Bridge	IN_CHn ES1336.1 (ES1334.2)
Inj 1	B9	189	0
Inj 2	B10	190	1
Inj 3	B11	191	2
Inj 4	B12	192	3
Inj 5	B13	193	4
Inj 6	C15	194	5
Inj 7	D15	195	6
Inj 8	D21	196	7

* Name on LED field

Tab. 4-19 Signal Paths During Measuring of Injection Signals at "ECU1"

Configuration of the LEDs

Note

The LEDs are only connected permanently with the particular measurement channels on one side – for them to light up, the other side must be connected to the relevant potential (+UBatt or -UBatt)!

For the relevant LEDs to light up during active injection, the connections described in Tab. 4-18 on page 51 have to have been created.

Reference Voltages (ES1334.2 Measurement Board Only)

The reference voltage for the threshold comparison can be configured using software. You can choose from the following four possibilities:

- Comparison to 5 V/2 for TTL input signals
- Comparison to UBatt_A/2
- Comparison to UBatt_B/2
- Comparison to external threshold value

"In_Ref_0" ... "In_Ref_7": Can be applied at the "ECU1" connector

"In_Ref_8" ... "In_Ref_15": Can be applied at the "ECU1" connector

The inputs "+UBatt_A " and "+UBatt_B" are connected permanently to BN4.

The "-UBatt" input is connected permanently to -UBatt.

Rating of the Channels

If the ECU is connected to the "ECU2" connector, the maximum current rating per channel is 9 A. When it is connected to the "ECU1" connector, this is reduced to 5 A (for injection and ignition signals).

4.2.7 Arbitrary Signals (Generation)

To generate speed-synchronous signals PT-LABCAR is equipped with an ES1335.1 Arbitrary Signal Generator Board with six independent generators.

All generators are freely available and cannot be connected further internally.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	ASGx_nn (mm)
ASG	Arbitrary output channel *
x	Number of the board in the system (1)
nn	Number of the signal generator (00 .. 05)
mm	Number of the connector on ES4640.1-B**
Example	ASG1_00 (207)
* see note on page 32 ** this number corresponds to the number of the bridge on the front panel	

Tab. 4-20 Names of the Output Channels for Arbitrary Signals

The signals of an output channel are named as follows:

Signal Name	Meaning	Access on Breakout Box
Out_SG*n*	Output of the signal generator n	6 bridges
ExtGND_SG*n*	External analog ground of the signal generator n	6 bridges
ExtRef_SG*n*	External reference for signal generator n	6 bridges

Tab. 4-21 The Signals of a Channel

Signals at the ECU Connector

All signals of the ES1335.1 are routed via the "ECU1" connector.

Rating of the Channels

The maximum admissible current per signal is 1 A – for the path via the ES4440.1 Compact Failure Simulation Module, the rating increases to 3 A (without load!).

4.2.8 Resistor Cascade

To simulate resistors (e.g. temperature sensors or internal resistors of oxygen sensors), PT-LABCAR is equipped with an ES1385.1-B Resistor Cascade Board with six independent resistor cascades.

Name

The names of the channels (as used in the "ECU" tab of the Signal Center in LABCAR-OPERATOR) are as follows:

Channel Name:	Resx_n(mm,mm)
Res	Resistor channel
x	Number of the board in the system (1)
n	Number of the resistor cascade (00 .. 05)
mm,mm	Number of the connector on ES4640.1-B*
Example	Res1_00 (151,152)
* this number corresponds to the number of the bridge on the front panel	

Tab. 4-22 Name of the Resistor Channels

The signals of an output channel are named as follows:

Signal Name	Meaning	Access on Breakout Box
Res*n*+	1st connection of the nth cascade	6 bridges
Res*n*-	2nd connection of the nth cascade	6 bridges

Tab. 4-23 The Signals of a Resistor Channel

Note

The signals "Res2+" ... "Res5+" are connected parallel to the Nernst voltages UN1 ... UN4 of the oxygen sensor emulation (see Tab. 4-4 on page 36). If broad band sensors are simulated, cascades 02 ... 05 are no longer available (see "The Jumpers JP 101 ... JP 104" on page 35)!

Signals at the ECU Connector

All signals of the ES1385.1-B are routed via the "ECU1" connector.

Rating of the Channels

The maximum permissible current per signal is 1 A.

4.2.9 CAN Signals

The real-time PC is supplied with one PCI CAN interface boards making two CAN controllers available. It can be extended with a second CAN board making four CAN controllers available.

The signals of a CAN controller are named as follows:

Signal Name	Meaning	Access on Breakout Box
CAN*n*_L	CAN-Low of the nth controller	4 bridges
CAN*n*_H	CAN-High of the nth controller	4 bridges

Tab. 4-24 The Signals of a CAN Controller

Signals at the ECU Connector

All CAN signals are routed via the "ECU1" connector.

CAN Connectors on the ES4640.1-B Connector Box

In addition there are four D-Sub connectors on the ES4640.1-B Connector Box to tap the CAN signals (see ""CAN1" .... "CAN4" Connectors" on page 70). These signals are routed parallel to the path between CAN board and connector "ECU1" – which allows for feeding in messages to or reading messages from the CAN bus.

Rating of the Channels

The maximum permissible current per signal is 1 A.

4.2.10 CARB

In addition to the connectors for OBD ("K-Line" and "L-Line signals") and "CAN1_H"/"CAN1_L", two battery nodes (BN0 and BN1) and the vehicle ground are routed to the connector on the front panel (see ""CARB" Connector" on page 71).

The "K-Line" and "L-Line" signals are routed via bridges (K-Line: 233, L-Line: 234)

Signals at the ECU Connector

All signals are routed via the "ECU1" connector.

Rating of the Channels

The maximum permissible current for K- and L-Line is 1 A.

4.3 Power Supply and Battery Nodes

To switch five battery nodes to +UBatt, an ES1392.2 High Current Switch Board is used. To address the ES1392.2 High Current Switch Board with TTL signals, an ES1391.1 Power Supply Controller Board is used.

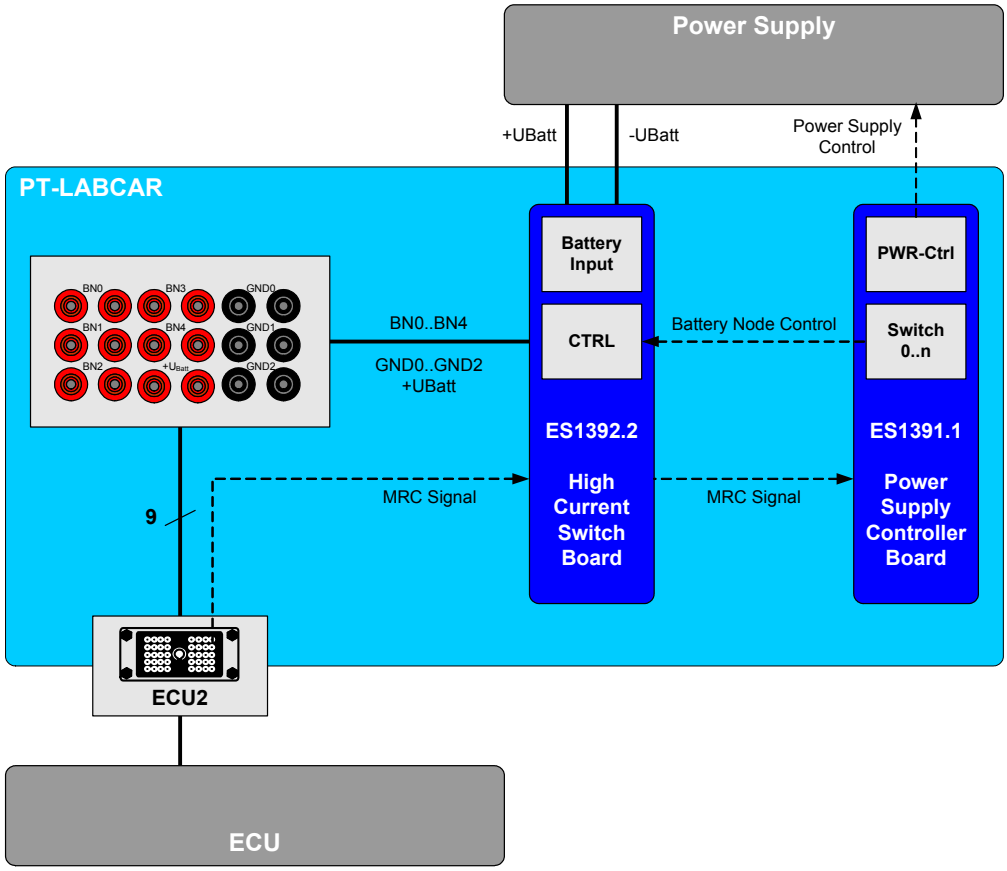


Fig. 4-11 The Path of the Battery Voltage from the Power Supply to the ECU

4.3.1 Signals at the ECU Connector

The battery voltages are all routed via bridges on the Connector Box and (including the MRC signal "REL_CTRL") via the "ECU2" connector.

4.3.2 Access on Connector Box

The battery nodes BN0..4, grounds GND0..3 and continuous plus +UBatt can be accessed on the front panel of the ES4640.1-B Connector Box via bridges.

The following figure also shows the circuit with fuse and LED.

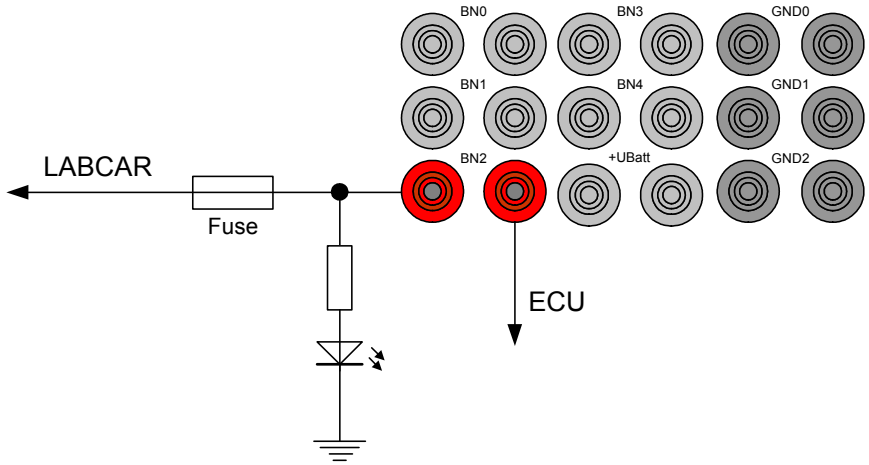


Fig. 4-12 Bridges and Circuit of an Individual Battery Node

4.3.3 LEDs

The LEDs (red) for the five battery nodes are above the row with the fuses (see Fig. 4-13). If an LED does not light up, either the relevant battery node is not switched or its fuse is defective.

4.3.4 Fixed Connections to Battery Nodes

A range of signals of the PT-LABCAR have fixed connections to individual battery nodes. The following table lists these connections:

BN	Connected to	See:
BN0	**"CARB"** connector **Pin 16**	Tab. 5-10 on page 71
BN1	**"CARB"** connector **Pin 1**	Tab. 5-10 on page 71
	ECU1:H26	page 66
BN2	n.c.	
BN3	n.c.	
BN4	**In_Ref1_n**: 1st reference voltage for the input of the nth PWM board	Tab. 4-10 on page 44
	Out_Ref1_n: reference voltage for the output of the nth PWM board	Tab. 4-10 on page 44
	ES1336.1 (ES1334.2): **+UBatt_A**	Tab. 4-12 on page 45

Tab. 4-25 Fixed Connections to Battery Nodes

BN	Connected to	See:
GND0 **GND1** **GND2**	**In_GND_n**: input ground of the nth PWM board	Tab. 4-10 on page 44
	Out_GND_n: output ground of the nth PWM board	Tab. 4-10 on page 44
	ES1336.1 (ES1334.2): **-UBatt**	Tab. 4-12 on page 45
	"CARB" connector **Pin 4** and **Pin 5**	Tab. 5-10 on page 71

Tab. 4-25 Fixed Connections to Battery Nodes

4.3.5 Fuses

The battery node fuses are protected by ATO blade fuses which are under the LEDs for the battery nodes.

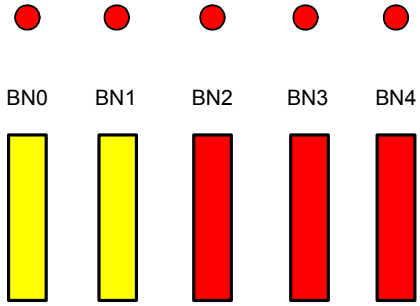


Fig. 4-13 LEDs and Fuses for the Battery Voltages on the ES4640.1-B Connector Box

The assignment and specification is as follows:

Fuse	Function	Rating
BN0	Fuse protection for battery node 0	FKS ATO 20 A/80 V
BN1	Fuse protection for battery node 1	FKS ATO 20 A/80 V
BN2	Fuse protection for battery node 2	FKS ATO 10 A/80 V
BN3	Fuse protection for battery node 3	FKS ATO 10 A/80 V
BN4	Fuse protection for battery node 4	FKS ATO 10 A/80 V

Tab. 4-26 The Fuses for the Battery Voltages

Note

The overall current of +UBatt must not exceed 40 A! For more detailled information refer to the ES1392.2 High Current Switch Board User's Guide.

4.4 Connecting Loads

There are a number of connection possibilities for different kinds of loads or their emulations on the back of the ES4640.1-B Connector Box.

Below, there is an overview of these loads – an exact description of measuring can be found in the sections on the different types of signal of the PT-LABCAR.

4.4.1 Loads with Position Feedback

At connectors "Load1" ... "Load6", actuators (e.g. throttle) or emulations can be connected – the control signals are measured at a parallel PWM input.

The sensors which return the setting of the actuator can be measured with two (per load) ADC inputs.

For more details on measuring, refer to the section "AD Channels" on page 37.

4.4.2 Loads without Position Feedback

Eight single loads can be connected at connector "Load7" and measured with PWM channels connected in parallel.

For more details, refer to the section "PWM Channels" on page 41.

4.4.3 Injectors

Eight injectors or their emulations (with two lines each) can be connected to the connector "Load8" (overall 17 lines).

For more details of measuring injector loads, refer to the section "Measuring Injection Loads or Load Emulations" on page 49.

4.5 Failure Simulation

To simulate failures (line breaks, shorts, etc), the ES4440.1 Compact Failure Simulation Module can be fed into the path of the signals which are routed via the 264 bridges on the ES4640.1-B Connector Box.

They are fed in on the rear of the ES4640.1-B by removing bridges and then connecting the ES4440.1.

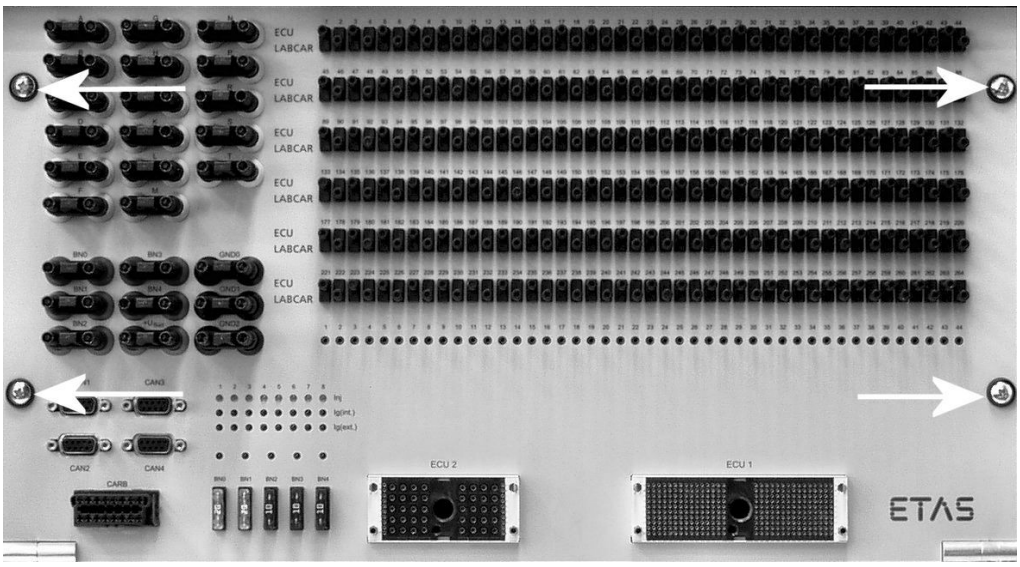
Note

You can obtain a preformed cable set for this purpose from ETAS: ask for "AC4440CA1.1"!

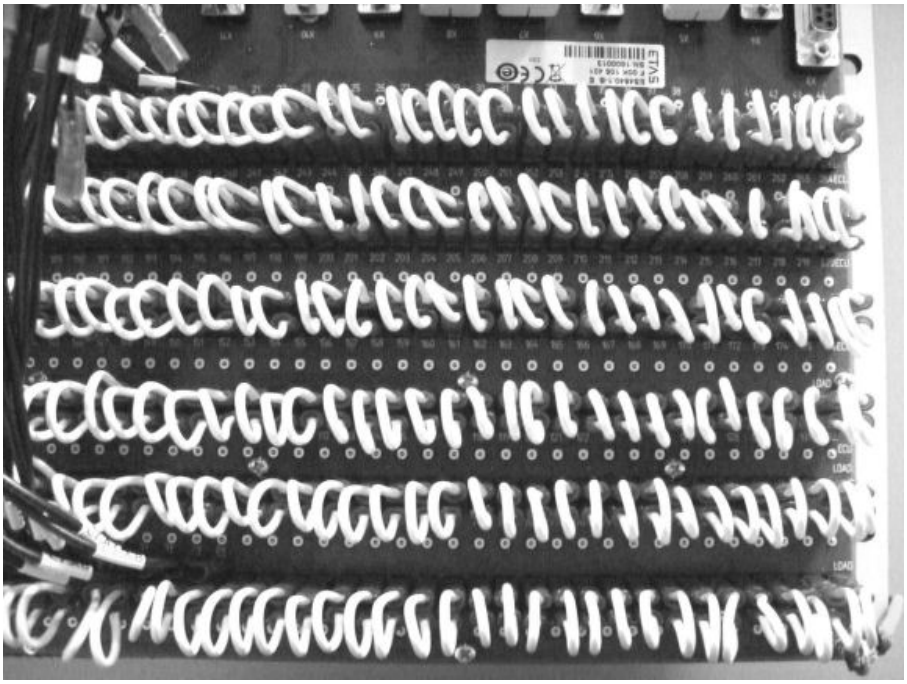
However, the failure simulation of loads (usually injectors) is carried out by interconnecting the ES4440.1 between the "Load8" connector and the corresponding loads. The cable for connecting the ES4440.1 between PT-LABCAR and injector laods is as well part of the AC4440CA1.1 cable set.

Connecting the ES4440.1

- Remove the four screws on the front of the Connector Box.



- Fold down the front panel.



- Remove the relevant bridging lines.
- Connect the lines of your ES4440.1 wiring harness to where you have removed lines.

The following figure contains details on connecting cables.

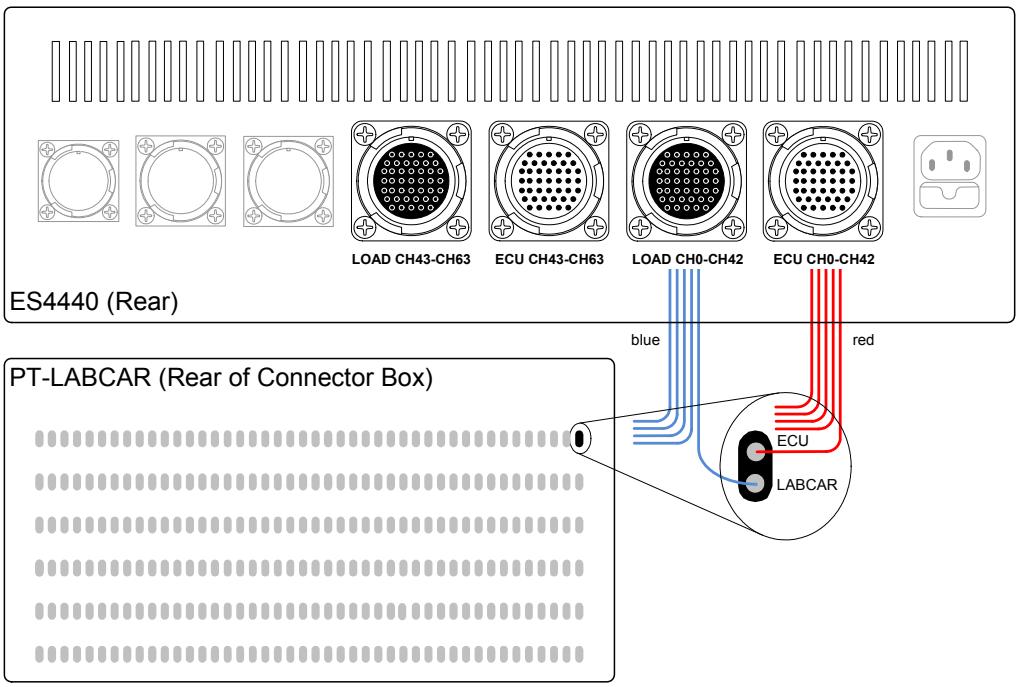


Fig. 4-14 The Connection between PT-LABCAR and ES4440

When the front panel is open, the top connectors of the bridges are labeled "ECU" – the red cables must be connected to these (from the connectors "ECU CH0-CH42" or "ECU CH43-CH63").

The blue cables (from the connectors "LOAD CH0-CH42" or "LOAD CH43-CH63") must be connected to the lower connectors of the bridges (labeled "LABCAR").

5 Pin Assignments and LEDs

There are a whole range of connectors and LEDs on both the front and back of the ES4640.1-B Connector Box; these are described in this chapter.

Here, you will find information on:

5.1 Connectors on the Front

The connectors on the front panel are mainly used for connections to the ECU. In addition to the bridges and measure points, there are also four CAN connectors and one CARB connector.

5.1.1 "ECU1" and "ECU2" ECU Connectors

A kit with the male connectors for the ECU connectors "ECU1" and "ECU2" of the PT-LABCAR can be obtained from ETAS by ordering "AC4640CK1.1" (TTN: F-00K-105-352).

"ECU1" Connector

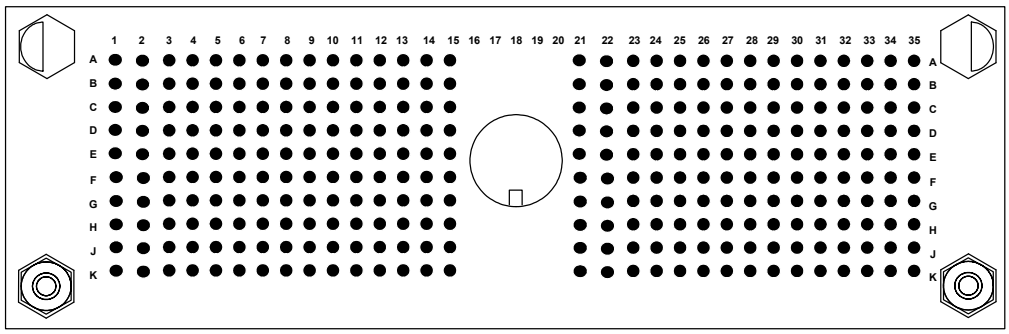


Fig. 5-1 "ECU1" Connector

Pin assignment is as follows:

	1	2	3	4	5
A	In_CH11_2	In_CH12_2	In_CH13_2	In_CH14_2	In_CH15_2
B	In_CH10_2	VN12-	VN13+	VN13-	VN14+
C	In_CH9_2	VN12+	DA_Ch1_3	Ref_Ch1_3	DA_Ch2_3
D	In_CH8_2	VN10/11-	Ref_Ch0_3	Lambda - IA4	Lambda - UN4
E	In_CH7_2	VN11+	DA_Ch0_3	Lambda - IP4	Res1-
F	In_CH6_2	VN10+	Ref_Ch9_1	Lambda - UN3	Res0+
G	In_CH5_2	VN8/9-	DA_Ch9_1	Lambda - IA3	Res0-
H	In_CH4_2	Ref_Ch5_1	Ref_Ch8_1	Lambda - IP3	Lambda13.
J	DA_Ch5_1	Ref_Ch7_1	DA_Ch8_1	Lambda - UN2	Lambda - IA2
K	DA_Ch7_1	Ref_Ch6_1	DA_Ch6_1	Ref_Ch4_1	DA_Ch4_1

Tab. 5-1 "ECU1" Pin Assignment (Part 1)

	6	7	8	9	10
A	In_CH16_2	In_CH17_2	In_CH18_2	In_CH19_2	In_CH20_2
B	VN14-	VN15+	VN15-	IN_CH0	IN_CH1
C	Ref_Ch2_3	DA_Ch3_3	Ref_Ch3_3	Out_CH0_2	Out_CH1_2
D	Lambda14.	DA_Ch4_3	Ref_Ch4_3	DA_Ch5_3	Ref_Ch5_3

Tab. 5-2 "ECU1" Pin Assignment (Part 2)

	6	7	8	9	10
E	Res1+	Res2-	Res2+	Res3-	Res3+
F	Ref_Ch7_2	Lambda - IP1	Lambda - IA1	Lambda - UN1	Lambda - IP2
G	DA_Ch7_2	ExtGND_SG5	ExtRef_SG5	CAN1_L	CAN1_H
H	Ref_Ch6_2	Out_SG5	GND_CH8_1	GND_CH9_1	GND_CH0_3
J	DA_Ch6_2	ExtRef_SG4	Inj-4	Inj-6	Inj-8
K	GND_Ch4_1	GND_Ch3_1	GND_Ch2_1	GND_Ch1_1	GND_Ch0_1

Tab. 5-2 "ECU1" Pin Assignment (Part 2)

	11	12	13	14	15
A	În_CH21_2	În_CH22_2	În_CH23_2	În_CH20	În_CH21
B	ÎN_CH2	ÎN_CH3	ÎN_CH4	În_CH20	În_CH21
C	Out_CH2_2	Out_CH3_2	Out_CH4_2	Out_CH5_2	ÎN_CH5
D	DA_Ch6_3	Ref_Ch6_3	DA_Ch7_3	Ref_Ch7_3	ÎN_CH6
E	DA_Ch6_3	Ref_Ch6_3	DA_Ch7_3	Ref_Ch7_3	GND_Ch0_2
F	Res4-	Res4+	Res5-	Res5+	GND_Ch8_3
G	Out_SG0	ExtGND_SG0	ExtRef_SG0	Out_SG1	Reserve8
H	GND_CH1_3	GND_CH2_3	GND_CH3_3	GND_CH4_3	Reserve6
J	Ig-4 Int	Ig-6 Int	Ig-8 Int	Ig-4 Ext	Reserve5
K	Out_Ref2_2	In_Ref2_2	Out_Ref2_1	GND_Ch7_1	Ig-8 Ext

Tab. 5-3 "ECU1" Pin Assignment (Part 3)

	21	22	23	24	25
A	In_CH22	In_CH23	OUT_CH0_1	OUT_CH1_1	OUT_CH2_1
B	In_CH22	In_CH23	IN_CH9	IN_CH10	IN_CH11
C	IN_CH8	OUT_CH6_2	OUT_CH7_2	OUT_CH8_2	OUT_CH9_2
D	IN_CH7	DA_Ch8_3	Ref_Ch8_3	DA_Ch9_3	Ref_Ch9_3
E	GND_Ch1_2	VN0+	VN1+	VN0/1-	VN2+
F	GND_Ch2_2	ExtGND_SG1	ExtRef_SG1	Out_SG2	ExtGND_SG2
G	GND_Ch9_3	CAN4_L	CAN4_H	K-Line	L-Line
H	Reserve9	GND_Ch9_2	IN_REF0-7	IN_REF8-15	+12 V
J	Ig-6 Ext.	GND_Ch6_3	GND_Ch7_3	GND_Ch3_2	GND_Ch4_2
K	Reserve7	GND_Ch6_1	GND_Ch5_1	In_Ref2_1	GND_Ch5_3

Tab. 5-4 "ECU1" Pin Assignment (Part 4)

	26	27	28	29	30
A	Out_CH3_1	Out_CH4_1	Out_CH5_1	Out_CH6_1	Out_CH7_1
B	IN_CH12	IN_CH13	IN_CH14	IN_CH15	IN_CH16
C	Out_CH10_2	Out_CH11_2	Out_CH12_2	Out_CH13_2	Out_CH14_2
D	DA_CH0_2	Ref_CH0_2	DA_CH1_2	Ref_CH1_2	DA_CH2_2
E	VN3+	VN2/3-	VN4+	VN5+	VN4/5-
F	ExtRef_SG2	Out_SG3	ExtGND_SG3	ExtRef_SG3	Out_SG4
G	Ref1	Ref2	Ref3	Ref4	ExtGND_SG4
H	BN1	GND	Sw_Inj	Reserve22	Ref5
J	GND_CH5_2	GND_CH6_2	GND_CH7_2	GND_CH8_2	Ref6
K	Reserve4	Reserve3	Reserve2	Reserve1	Reserve23

Tab. 5-5 "ECU1" Pin Assignment (Part 5

CAUTION!

The "ECU1:H26" (BN1) pin provides the voltages for the status LEDs "Ig/Inj". It must never be used as a voltage source for other applications!
This pin can tolerate a current of max. 2 A. Internal fuse protection for this pin will be available with models delivered as of mid-2013!

	31	32	33	34	35
A	Out_CH8_1	Out_CH9_1	Out_CH10_1	Out_CH11_1	Out_CH12_1
B	IN_CH17	Reserve10	Reserve11	Reserve12	Out_CH13_1
C	Out_CH15_2	DA_Ch0_1	Ref_Ch0_1	Reserve13	Out_CH14_1
D	Ref_Ch2_2	DA_Ch3_2	DA_Ch1_1	Reserve14	Out_CH15_1
E	VN6+	Ref_Ch3_2	Ref_Ch1_1	Reserve15	In_CH0_2
F	VN7+	DA_Ch4_2	DA_Ch2_1	Reserve16	In_CH1_2
G	VN6/7-	Ref_Ch4_2	Ref_Ch2_1	Reserve17	In_CH2_2
H	VN8+	DA_Ch5_2	DA_Ch3_1	Reserve18	In_CH3_2
J	VN9+	Ref_Ch5_2	Ref_Ch3_1	Reserve19	Reserve25
K	Reserve24	IN_CH18	Reserve21	Reserve20	IN_CH19

Tab. 5-6 "ECU1" Pin Assignment (Part 6)

"ECU2" Connector

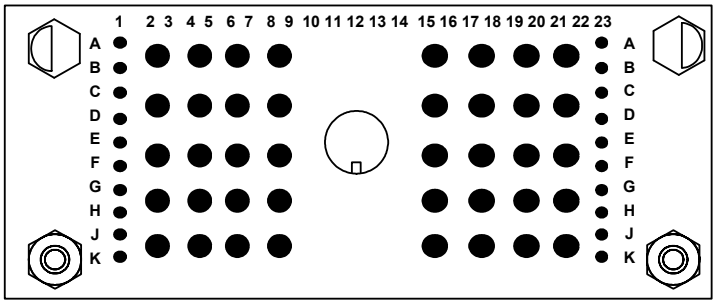


Fig. 5-2 "ECU2" Connector

Pin assignment is as follows:

	1	2	3	4	5	6	7	8	9
A	Load_Ch4	Load_Ch5		Load_Ch10		Inj_Ch0		Inj_Ch5	
B	Load_Ch4								
C	Load_Ch3	Load_Ch6		Load_Ch11		Inj_Ch1		Inj_Ch6	
D	Load_Ch3								
E	Load_Ch2	Load_Ch7		Load_Ch12		Inj_Ch2		Inj_Ch7	
F	Load_Ch2								
G	Load_Ch1	Load_Ch8		Load_Ch13		Inj_Ch3		Inj_Ch8	
H	Load_Ch1								
J	Load_Ch0	Load_Ch9		Load_Ch14		Inj_Ch4		Inj_Ch9	
K	Load_Ch0								

Tab. 5-7 "ECU2" Pin Assignment (left-hand part)

	15	16	17	18	19	20	21	22	23
A	Inj_Ch10		Inj_Ch15		BN1		BN1		Load_Ch15
B									Load_Ch15
C	Inj_Ch11		Inj_Ch16		BN0		BN2		Load_Ch16
D									Load_Ch16
E	Inj_Ch12		+UBatt		BN0		BN3		Load_Ch17
F									Load_Ch17
G	Inj_Ch13		-UBatt1		-UBatt3		BN4		Load_Ch18
H									Load_Ch18
J	Inj_Ch14		-UBatt2		-UBatt3		REL_CTRL		Load_Ch19
K									Load_Ch19

Tab. 5-8 "ECU2" Pin Assignment (right-hand part)

5.1.2 "CAN1" .... "CAN4" Connectors

You can access the signals of the 2(4) CAN controllers via these connectors.

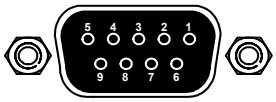


Fig. 5-3 "CAN1" .... "CAN4" Connectors

Type: D-Sub, 9-pin (DE-09) (female)

Mating connector: D-Sub, 9-pin (male)

Pin assignment is as follows:

Pin	Signal	Pin	Signal
1	n.c.	6	n.c.
2	CAN Low	7	CAN High
3	n.c.	8	n.c.
4	n.c.	9	n.c.
5	n.c.	Housing	PE

Tab. 5-9 "CAN1" .... "CAN4" Pin Assignment

5.1.3 "CARB" Connector

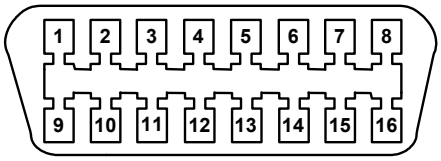


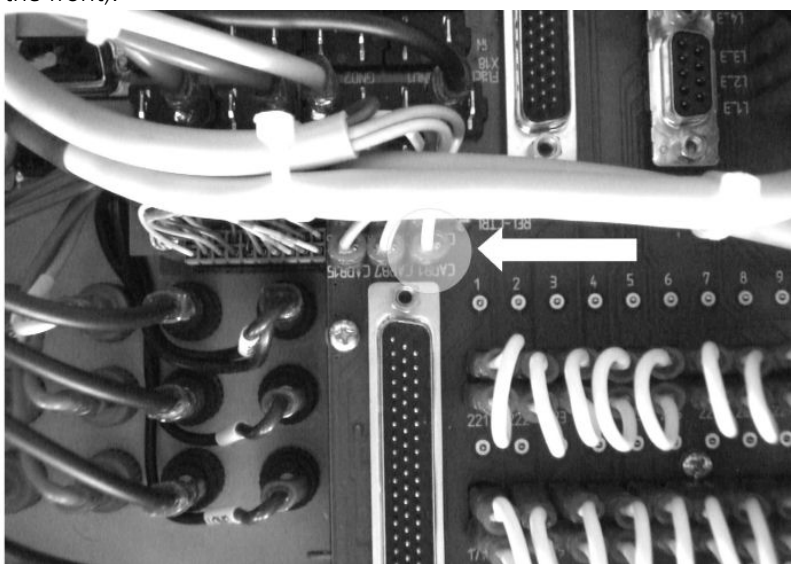
Fig. 5-4 CARB Connector

Pin assignment is as follows:

Pin	Signal	Pin	Signal
1	Manufacturer specific (BN1)*	9	n.c.
2	n.c.	10	n.c.
3	n.c.	11	n.c.
4	Vehicle ground (-UBatt)	12	n.c.
5	Vehicle ground (-UBatt)	13	n.c.
6	CAN1 High	14	CAN1 Low
7	K-Line	15	L-Line
8	n.c.	16	Battery + (BN0)

Tab. 5-10 "CARB" Pin Assignment

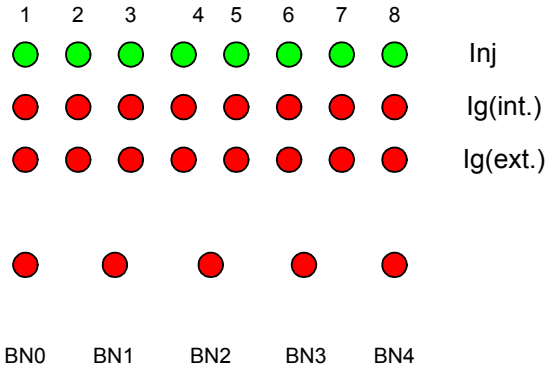
* If you do not want pin 1 to be connected to BN1 (default configuration), you can interrupt this connection by removing the "CARB1" cable from the board. Fold down the front panel (see "Connecting the ES4440.1" on page 61) and you will find this cable on the back of the Connector Box at the top left (seen from the front).



5.2 LEDs and Fuses on the Front Panel

5.2.1 LEDs

There are various LEDs on the front panel of the Connector Box; they display the status.



Tab. 5-11 The LED Field on the ES4640.1-B Connector Box

The LEDs indicate the following:

LEDs	Meaning (LED on)
Inj 1 ... Inj 8 (upper row)	Injection cyl. 1 ... cyl. 8
Ig(int.) 1 ... Ig(int.) 8 (second row)	Internal ignition cyl. 1 ... cyl. 8
Ig(ext.) 1 ... Ig(ext.) 8 (third row)	External ignition cyl. 1 ... cyl. 8
BN0 ... BN4	Battery node switched

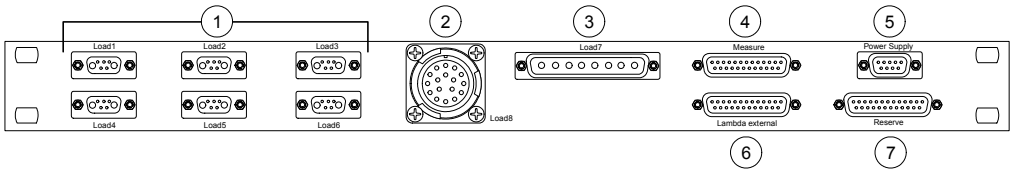
Tab. 5-12 Meaning of the LEDs

5.2.2 Fuses

For more details on the function and specification of the fuses on the Connector Box, refer to the section "Fuses" on page 59.

5.3 Connectors on the Rear

On the back of the Connector Box, there are mainly connections for original or dummy loads.



These are:

1. "”Load1” ... ”Load6” Connectors" on page 74

   These connectors are designed for six loads which deliver return signals to the ECU.

2. "”Load8” Connector" on page 75

   The ”Load8” connector is used for connecting eight injectors or their simulations.

3. "”Load7” Connector" on page 76

   Actuator signals for eight single loads (e.g. oxygen sensor heating) can be connected to the ”Load7” connector.

4. "”Measure” Connector" on page 77

   The ignition and injection signals measured by the ES1336.1 (ES1334.2) are fed in at this connector.

5. "”Power Supply” Connector" on page 78

   Voltages for external use are provided at the ”Power Supply” connector.

6. "”Lambda external” Connector" on page 79

   If you are using an external oxygen sensor emulation, this connector provides the relevant inputs and outputs (see "Oxygen Sensor Emulation" on page 33.

7. "”Reserve” Connector" on page 80

   This connector is used to access customized signals which can be connected to the ECU at the ”ECU1” connector.

5.3.1 "Load1" ... "Load6" Connectors

These connectors are designed for six loads which deliver return signals to the ECU.

For more information on using these connectors in PT-LABCAR refer to the section "AD Channels" on page 37.

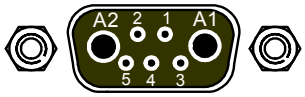


Fig. 5-5 "Load1" ... "Load6" Connectors

Type: Hybrid-D-Sub 7W2 (female)

Mating connector: Hybrid-D-Sub 7W2 (male)

Pin assignment is as follows:

Pin	Signal
A1	Actuator+
A2	Actuator-
1	Sensor1
2	Sensor2
3	GND
4	Reference voltage from the ECU
5	n.c.
Housing	Protective earth

Tab. 5-13 Assignment of the "Load*n*" Connector

Please refer to Tab. 4-7 on page 39 for a detailed representation of the assignment of the actuator signals to PWM inputs and the sensor signals to ADC inputs.

5.3.2 "Load8" Connector

The "Load8" connector is used for connecting eight injectors or their simulations.

For more information on using these connectors in PT-LABCAR refer to the section "Measuring Injection Loads or Load Emulations" on page 49.

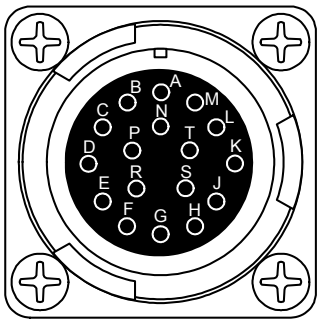


Fig. 5-6 "Load8" Connector

Type: ITT Cannon CA02COM-E20-29S-B (female)

Mating connector: ITT Cannon CA06COM-E20-29P-B (male)

Pin assignment is as follows:

Pin	Signal	Bridge	Front Connector	"ECU2" Pin
A	Inj_Ch0	A	ECU2	A6/7, B6/7
B	Inj_Ch1	B	ECU2	C6/7, D6/7
C	Inj_Ch2	C	ECU2	E6/7, F6/7
D	Inj_Ch3	D	ECU2	G6/7, H6/7
E	Inj_Ch4	E	ECU2	J6/7, K6/7
F	Inj_Ch5	F	ECU2	A8/9, B8/9
G	Inj_Ch6	G	ECU2	C8/9, D8/9
H	Inj_Ch7	H	ECU2	E8/9, F8/9
J	Inj_Ch8	J	ECU2	G8/9, H8/9
K	Inj_Ch9	K	ECU2	J8/9, K8/9
L	Inj_Ch10	L	ECU2	A15/16, B15/16
M	Inj_Ch11	M	ECU2	C15/16, D15/16
N	Inj_Ch12	N	ECU2	E15/16, F15/16
P	Inj_Ch13	P	ECU2	G15/16, H15/16
R	Inj_Ch14	R	ECU2	J15/16, K15/16
S	Inj_Ch15	S	ECU2	A17/18, B15/16
T	Inj_Ch16	T	ECU2	C15/16, D15/16
Housing	Protective earth			

The signals are routed twisted in four groups of four – see Tab. 4-16 on page 50

Tab. 5-14 "Load8" Pin Assignment

5.3.3 "Load7" Connector

Actuator signals for eight single loads (e.g. oxygen sensor heating) can be connected to the "Load7" connector.

For more information on using these connectors in PT-LABCAR refer to the section "PWM Channels" on page 41.

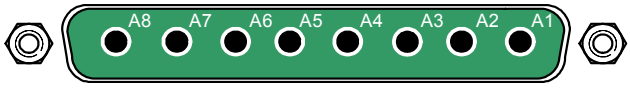


Fig. 5-7 "Load7" Connector

Type: Hybrid-D-Sub 8W8 (female)

Mating connector: Hybrid-D-Sub 8W8 (male)

Pin assignment is as follows:

Pin	Signal
A1	Actuator_1+ (In_Ch00_1)*
A2	Actuator_1- (In_Ch01_1)*
A3	Actuator_2+ (In_Ch02_1)*
A4	Actuator_2- (In_Ch03_1)*
A5	Actuator_3+ (In_Ch16_1)*
A6	Actuator_3- (In_Ch17_1)*
A7	Actuator_4+ (In_Ch18_1)*
A8	Actuator_4- (In_Ch19_1)*
Housing	Protective earth
* The naming of the PWM inputs is explained in Tab. 4-9 on page 41.	

Tab. 5-15 "Load7" Pin Assignment

5.3.4 "Measure" Connector

The ignition and injection signals measured by the ES1336.1 (ES1334.2) are fed in at this connector.

For more information on using these connectors in PT-LABCAR refer to the sections "Measuring Ignition Signals" on page 46 and "Measuring Injection Loads or Load Emulations" on page 49.

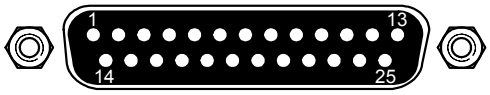


Fig. 5-8 "Measure" Connector

Type: D-Sub, 25-pin (DB-25) (male)

Mating connector: D-Sub 25-pin (female)

Pin assignment is as follows:

Pin	Signal (ES1336.1)	Pin	Signal (ES1336.1)
1	IN_CH0	14	IN_CH13
2	IN_CH1	15	IN_CH14
3	IN_CH2	16	IN_CH15
4	IN_CH3	17	IN_CH16 *
5	IN_CH4	18	IN_CH16 *
6	IN_CH5	19	IN_CH17 *
7	IN_CH6	20	IN_CH17 *
8	IN_CH7	21	IN_CH18 *
9	IN_CH8	22	IN_CH18 *
10	IN_CH9	23	IN_CH19 *
11	IN_CH10	24	IN_CH19 *
12	IN_CH11	25	n.c.
13	IN_CH12	Housing	Protective earth
* Not with ES1334.2			

Tab. 5-16 "Measure" Pin Assignment

5.3.5 "Power Supply" Connector

Voltages for external use are provided at the "Power Supply" connector.

These voltages can be used to supply an external circuit, e.g. of a load emulation, or another external circuit.

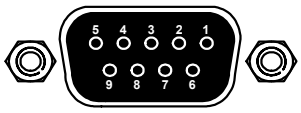


Fig. 5-9 "Power Supply" Connector

Type: D-Sub 9-pin (DE-09) (female)

Mating connector: D-Sub, 9-pin (male)

Pin assignment is as follows:

Pin	Signal (Max. Current)	Pin	Signal (Max. Current)
1	-12 V.	6	+12 V (1.5 A)
2	GND	7	n.c.
3	n.c.	8	n.c.
4	+5 V (2 A)	9	n.c.
5	GND	Housing	Protective earth

Tab. 5-17 "Power Supply" Pin Assignment

5.3.6 "Lambda external" Connector

If you are using an external oxygen sensor emulation, this connector provides the relevant inputs and outputs (see "Oxygen Sensor Emulation" on page 33.

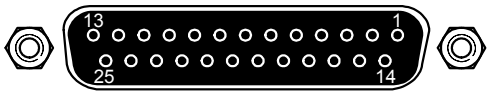


Fig. 5-10 "Lambda external" Connector

Type: D-Sub 25-pin (DB-25) (female)

Mating connector: D-Sub 25-pin (male)

Pin assignment is as follows:

Pin	Signal	Pin	Signal
1	DAC: OUT_CH04	14	AS41SC-OUT 4 (IP2)
2	DAC: GND_CH04	15	AS41SC-OUT 5 (IA2)
3	DAC: OUT_CH05	16	AS41SC-OUT 6 (UN2)
4	DAC: GND_CH05	17	Virtual Ground (ECU)
5	DAC: OUT_CH06 (to: AS41SC-IN 1)	18	Virtual Ground (ECU)
6	DAC: GND_CH06	19	n.c.
7	DAC: OUT_CH07 (to: AS41SC-IN 2)	20	n.c.
8	DAC: GND_CH07	21	n.c.
9	n.c.	22	n.c.
10	n.c.	23	n.c.
11	AS41SC-OUT 1 (IP1)	24	n.c.
12	AS41SC-OUT 2 (IA1)	25	n.c.
13	AS41SC-OUT 3 (UN1)	Housing	Protective earth

Tab. 5-18 "Lambda external" Pin Assignment

5.3.7 "Reserve" Connector

This connector is used to access customized signals which can be connected to the ECU at the "ECU1" connector.

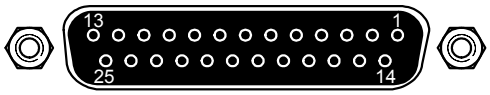


Fig. 5-11 "Reserve" Connector

Type: D-Sub, 25-pin (DB-25) (female)

Mating connector: D-Sub, 25-pin (male)

Pin assignment is as follows:

Pin	Signal	"ECU1" Pin	Pin	Signal	"ECU1" Pin
1	Reserve1	K29	14	Reserve14	D34
2	Reserve2	K28	15	Reserve15	E34
3	Reserve3	K27	16	Reserve16	F34
4	Reserve4	K26	17	Reserve17	G34
5	Reserve5	J15	18	Reserve18	H34
6	Reserve6	H15	19	Reserve19	J34
7	Reserve7	K21	20	Reserve20	K34
8	Reserve8	G15	21	Reserve21	K33
9	Reserve9	H21	22	Reserve22	H29
10	Reserve10	B32	23	Reserve23	K30
11	Reserve11	B33	24	Reserve24	K31
12	Reserve12	B24	25	Reserve25	J35
13	Reserve13	C34	Housing	Protective earth	

Tab. 5-19 "Reserve" Pin Assignment

6 ETAS Contact Addresses

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