ES4441.1 Compact Error Simulation Module with Breakout Frontpanel

User's Guide

Copyright

R1.2.4 EN - 10.2019

Contents

1 General Information

This chapter contains information on the following topics:

1.1 Basic Safety Instructions

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

1.1.1 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.

1.1.2 General Safety Information

Please read the product safety advice ("ES4441 Safety Advice") as well as the following safety instructions to avoid injury to yourself and others as well as damage to the device.

Note

Please read the documentation accompanying the product ("ES4441 Safety Advice" and this User's Guide) carefully before using the product.

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

1.1.3 Connecting/Removing Devices

Please take the following precautionary measures to avoid any injuries and damage to hardware:

- Do not apply any voltages to the ports of the ES4441.1 which do not correspond to the specifications of the relevant port. Refer to the corresponding boards' manuals for the exact specification of the I/O hardware.
- Do not connect or disconnect any devices while the ES4441.1 or external devices are powered on.
  First, power off the ES4441.1 using the on/off switch on the back of the device, and detach all power plugs.
- When inserting any connectors, please make sure they are absolutely straight and that none of the pins are bent.

1.1.4 Opening the Housing

The ES4441.1 must only be opened by qualified technical personnel!

DANGER!

As long as the ES4441.1 is not completely disconnected, there is a danger of electrocution!
Disconnect the device from the mains by removing the mains cable – then wait a few minutes until all components (e.g. power pack, capacitors) are discharged.

1.1.5 Requirements for Users and duties for Operators

Make sure you only assemble, operate and maintain the product if you have the relevant qualification for and experience with this product. Incorrect usage or operation by users without an appropriate qualification can lead to serious or even fatal injuries as well as damage to property.

Note

Responsibility for the safety of the system into which the ES4441.1 was integrated lies with the person who assembled the system!

General Occupational Health and Safety

The existing regulations on occupational health and safety as well as accident prevention must be adhered to.

1.1.6 Intended Use

The ES4441.1 Compact Error Simulation Module is a 19” housing with a height of 9 HU which can be assembled in a rack using the corresponding mounts.

WARNING!

The ES4441.1 must always be integrated in the ETAS LABCAR system and must not be used as a "standalone" unit.

The ES4441.1 is intended to be used as follows:

- In industrial lab facilities or at industrial workplaces,
- As a hardware interface for ECUs in a Hardware-in-the-Loop test system,
- In conjunction with ETAS software supported by the ES4441.1,
- As an interface together with software programs that serve the standardized, documented and open APIs of ETAS software products.

The ES4441.1 is not intended to be used:

- In a vehicle on the road,
- As part of a life support system,
- As part of a medical application,
- In applications in which misuse can lead to injury or damage,
- In environments with conditions outside the specified ranges (see "Environmental Conditions" on page 78).

Requirements for Operation

The following requirements are made to ensure safe operation:

- Only use the product in accordance with the specifications in the relevant User’s Guide. Product safety is not guaranteed if the device is used other than intended.
- Observe all applicable regulations on site concerning electrical safety as well as the rules and regulations on occupational health and safety!
- Never use the product in a wet or damp environment.
- Never use the product in areas subject to explosions.
- Make sure you keep the surface of the product clean and dry.

Transport

WARNING!

The ES4441 weighs at least 25.9kg. Always ensure there are two people to lift and carry the transport box or the housing itself.

Ventilation

If the ES4441.1 is being operated in the ETAS LABCAR system casing (see "Intended Use" on page 9) make sure you observe the following points:

- The casing and particularly the air vents must be at least 15 cm away from walls and objects in the environment.
- Leave the casing open at the back.

When the ES4441.1 is being operated in a 19" rack, make sure you observe the following points:

- The air vents must be at least 15 cm away from walls and objects in the environment. Make sure there is a gap of at least 1 U to the next component, both above and below.
- The ambient temperature in the rack must not exceed the permissible maximum value (see "Environmental Conditions" on page 78) of 40 °C / 104° F.

Rack System

The ES4441.1 is intended exclusively for operation inside a suitable rack system. The rack system must have the following properties to ensure protection against the spread of fire and to prevent contact with a possibly hot-to-the-touch ES4441.1housing:

- Rack with closed bottom board or bottom with "UL perforation"*. Alternatively, the bottom may be covered with drip protection boards. The area to be covered is defined in EN 61010-1:2010 + Cor.:2011, §9.3 (see in particular §9.3.2/Image 12 „drip protection"). The drip protection boards must be installed with overlaps to create a completely covered bottom of the rack. The bottom board or the drip protection boards must be metal or another fire-retardant material according to IEC 60695-11-10 V1 (or better). The bottom board or drip protection boards must be sufficiently sturdy.
- Closed sides and rear, i.e. fully closed rear door and fully closed panels on both sides of the rack.
- Sufficient active ventilation. Adequate ventilation must be assured and verified. If necessary, a suitable temperature sensor in connection with an power-off switch must be installed to interrupt the power supply in case of overheating. This power-off mechanism must be fail-safe.

All above properties must be fulfilled and guaranteed. Further it must be ensured that there are no combustible materials/parts in the vicinity of bottom, lid, side panels, or pack panel.

*UL Perforation: This refers to perforation according to the guidelines in table 16 „Permissible hole size in the bottom of a housing" of IEC EN 61010-1:2010 + Cor.:2011, §9.3 "Containment of fire within the equipment, should it occur "

Demands for the Technical State of the Product

This state-of-the-art product adheres to all recognized safety-related regulations. The product must only be used if it is in full working order, with the relevant personal only using the device as it was intended, taking all security issues and risks into account as well as taking into consideration the relevant documentation at all times. If the product is not used correctly, the protection of the product may be impaired.

Maintenance and Cleaning

Before cleaning any parts of the housing, disconnect the power cable. To clean the outside of the device, use a clean, dry cloth. Do not use any cleaning agents or solvents. Clean the filter of the rear ventilation opening once a year.

1.2 Identifications on the Product

The following symbols are used for identifying the product:

Symbol	Description
	Before using the product, carefully read the user's guide!
	Identification for CE (see "CE Marking" on page 11)
	Identification for China RoHS (see "RoHS Conformity" on page 11)
	Identification for WEEE directive (see "Taking the Product Back and Recycling" on page 12)

Observe the information in chapter "Technical Data" on page 75.

1.3 CE Marking

ETAS confirms that the product meets the product-specific applicable European Directives with the CE marking affixed to the product or its packaging. The CE Declaration of Conformity for the product is available upon request.

1.4 RoHS Conformity

1.4.1 European Union

The EU Directive 2011/65/EU limits the use of certain dangerous materials for electrical and electronic devices (RoHS conformity).

ETAS confirms that the product corresponds to this directive which is applicable in the European Union.

1.4.2 China

ETAS confirms that the product meets the product-specific applicable guidelines of the China RoHS (Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation) applicable in China with the China RoHS marking affixed to the product or its packaging.

The concluding chapter "ETAS Contacts" gives you information about the international ETAS sales and service branch offices.

1.5 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 set up throughout the EU for the collection, treatment 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.

Abb. 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 79).

1.5.1 Using This Manual

Representation of Information

All activities to be carried out by the user are shown in what we call a "Use-Case" format, i.e. the target to be achieved is defined briefly in the title and the individual steps necessary to achieve this target are then listed. The information is displayed as follows:

Target definition

Any introductory information...

1. Step 1

   Possibly an explanation of step 1...
2. Step 2

   Possibly an explanation of step 2...

Any concluding remarks...

Concrete example:

To create a new file

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

1. Select **File** → **New**.
   The "Create file" dialog box appears.
2. Enter a name for the file in the "File name" field.
   The file name must not exceed 8 characters.
3. 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 commands 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.

2 Introduction

This User's Guide contains a description of the ES4441.1 Compact Error Simulation Module with Breakout Frontpanel.

It consists of the following chapters:

- Introduction
- "Hardware Features" on page 43

  This chapter contains a detailed description of the features of the ES4441.1 Compact Error Simulation Module.
- "Mechanical Construction" on page 53

  This chapter contains a detailed description of the mechanical construction of the ES4441.1 Compact Error Simulation Module.
- "Pin Assignment Back Side" on page 63

  This chapter contains a description and assignment of all connectors on the rear of the housing.
- "Pin Assignment Front Side" on page 65

  This chapter contains a description and assignment of all connectors on the front panel of the housing.
- "Technical Data" on page 75

  This contains details of the technical data of the ES4441.1 Compact Error Simulation Module.
- "Accessories" on page 78.

2.1 Applications

The ES4441.1 Compact Error Simulation Module with Breakout Frontpanel is used for real-time error simulation for ECUs. It is intended for use in a HiL system, e.g. for

- tests on engine test beds
- tests on roller dynamometers
- error simulation in a stationary vehicle.

WARNING!

The ES4441.1 Compact Error Simulation Module is not intended for operation in a traveling vehicle!

WARNING!

The ES4441.1 Compact Error Simulation Module must not be operated over 2000m!

The ES4441.1 Compact Error Simulation Module is a 19" housing with a height of 9 HU which can be assembled in a rack using the corresponding mounts.

The Breakout Frontpanel of the ES4441.1 Compact Error Simulation Module is used to divide the signals between the control unit and the ETAS LABCAR allowing the user to simulate a cable break simply by pulling a jumper. The center tabs of the jumpers make it possible to access the individual control unit signals externally.

All connectors of the Breakout Frontpanel are printed versions. Standard connectors have been selected to ensure compatibility with other products within the ES46xx series and the coupling boards of the ES4500 component rack.

Using a project-specific front panel, the labels of the individual signal channels can be customized, and it is possible to mask certain jumpers to avoid faulty or erroneous connections.

The ES4441.1 Compact Error Simulation Module is addressed via the Ethernet interface. The PINCONTROL software provided, offers simple and user-friendly interfaces for operating and configuring the ES4441.1 via Ethernet.

The individual functions are described in detail in the following section.

WARNING!

Danger of overheating and fire caused by exceeding the specified values.
Due to overheating, the short circuit bar's plastic parts can melt and may drop.
Make sure that the product is only operated in the specified range.
In case that plastic drops due to unplanned faulty operation, ensure that the dropping material is collected by special assembly measures for the LABCAR system.

2.2 Functions and Features

This section provides a short overview of the functions and features of the ES4441.1 Compact Error Simulation Module. A detailed description can be found in the chapter "Hardware Features" on page 43.

2.2.1 Error Simulation

The ES4441.1 Compact Error Simulation Module makes it possible to simulate errors in real time for 255 ECU channels (per ES4441.1).

Error Channels

The 255 failure simulation channels are for voltages up to 30 V and currents up to 40 A.

- 40 A, 30V for 1 channel
- 20 A, 30V for 4 channel
- 15 A, 30V for 2 channel
- 7,5 A, 30V for 31 channel
- 3 A, 30V for 15 channel
- 1 A, 30V for 202 channel

Error Types

The following errors can be simulated for these 255 channels:

- "Open load"
- "Short cut" to +UBATT1, -UBATT1, +UBATT2, -UBATT2 for several signals
- "Pin to pin" with or without resistor
- "Resistor in line"
- Pull up/down resistor to +UBATT1, -UBATT1, +UBATT2, -UBATT2 for several signals ("Leakage Current")
- "Loose Contacts"
- "Ground shift"
- "Loose Ground contact" (channel 340)
- "Loose Power contact" (channel 339)

Load can be disconnected while performing an error via relay or jumper.

Error Paths

There is a special low current path available for simulating errors with very low current (50mA or less). In this path special low current MOSFETs are used in order to reduce channel resistance and parasitic capacity. The path has to be chosen before activating the error simulation by sending the ChooseCurrentPath command. If you do not send this command the high current path will be used for error simulation.

Time Response

Errors can be switched via relay or MOSFET. The difference between switching an error via a relay or via MOSFET is particularly seen in the time response. Whereas MOSFETs have negligible switch times (approx. 50 µs), relays have high switch

times (the time it takes from activating the error in the software to acknowledging the error, approx. 5 ms). The disadvantage when using MOSFETs is to do with the leakage currents which occur; these do not occur with relays.

If conventional relays are used for an error type, the delay between setting the error and closing the corresponding relay is measured on a reference relay and then sent to the application. This enables the precise measuring of the time the error actually occurs and also, for example, the duration of the error state.

Resistor Cascade

To simulate, for example, contact corrosion in a line and crosstalk between lines, there is a resistor cascade with which the corresponding resistances (line resistance and finite resistance between lines) can be simulated.

This is a 18-bit cascade with resistors from 0,5 Ω to 65536 Ω, with which resistances from 0,5 Ω to approx. 128 kΩ can be displayed in 0,5 Ω intervals. For more information on the resistor cascade, refer to the section "General Resistor Cascade" on page 48.

Ground Shift Cascade

A high current resistor cascade is used to simulate a ground shift on the ground channel (340). The Cascade is realised with resistors linked in parallel. The following resistor values are available: 0.50, 0.57, 0.66, 0.80, 1.00, 1.33, 2.00 and 4.00Ω.

A melting fuse in the ground channel is protecting only the wire and not the resistors. The protection of the resistors is done by measuring the current and controlling the relays and MOSFETs.

2.2.2 Connectors, Displays and Fuses

Connectors on the Front Panel and Rear

The ES4441.1 Compact Error Simulation Module has several connectors on the front and rear for connecting the ECU and loads, addressing the ES4441.1 and for master/slave operation.

CAUTION!

All external I/O-lines must be less than 3m.

The following connectors are on the front panel:

- DLM5-260 connector for Load (LOAD 1)
- KPTC22-55 connector for Load (LOAD 2)
- DLM5-260 connector for ECU (ECU 1)
- KPTC22-55 connector for ECU (ECU 2)
- Jumper for measurement and cutting for 268 channel
- Labels for Jumpers (easy customizable)
- Fuses

Abb. 2-1 shows the front of the housing (with mounts for rack assembly).

Abb. 2-1 Front View of the ES4441.1 Compact Error Simulation Module

The following connectors are on the rear:

- Connector for Rail1 and Rail2, to cascade two or more ES4441 (two green screw pads)
- Connector for +UBATT1, –UBATT1, +UBATT2 and –UBATT2 (two red and two black screw pads)
- Connector for current measurement (two yellow screw pads)
- Connector for optional LC-Bridge (DSUB)
- Connector for external Synchronisation and Trigger (DSUB)
- Ethernet interface (RJ45)
- Powerline connector

Abb. 2-2 shows the back of the housing.

Abb. 2-2 Back View of the ES4441.1 Compact Error Simulation Module

Status Displays via LEDs on the Front Panel

There are several LEDs on the front panel of the ES4441.1 Compact Error Simulation Module which provide information on operating states of the ES4441.1 and the communication interfaces. For more details on the LEDs, refer to the section "Status Displays via LEDs on the Front Panel" on page 49.

2.2.3 Application Environment

Master/Slave Operation of Several ES4441.1 Systems

If greater demands are made of the number of channels than can be catered for with one ES4441.1 Compact Error Simulation Module, you can use several ES4441.1s. A dedicated master synchronizes error simulation on the connected slave systems.

Note

This feature is not implemented in version ES4441.1!

This takes place by connecting the error rails and the synchronization lines of the ES4441.1s involved and assigning corresponding IP addresses in the operating software PINCONTROL.

Note

It is not possible to cascade an ES4440.1 Module together with ES4441.1 Compact Error Simulation Modules in one System.

Communication Interfaces

The ES4441.1 Compact Error Simulation Module has an interface for communication via the Ethernet protocol.

In addition, it is also possible to realize complex hardware configurations in a HiL system with a real-time PC as simulation target.

Note

Using the PINCONTROL software requires communication by Ethernet between the host and the ES4441.1.

PINCONTROL

PINCONTROL provides an easy-to-use user interface in which all errors can be activated and reset.

PINCONTROL has, in particular, the following features:

- Creating and managing failure sets. A failure set is a group of ECU signals (e.g. all signals of the oxygen sensor)
- Signal lists with all signals of a selected failure set. This is where the signal is selected for which an error is to be simulated.
- Display of all available errors for a selected signal in one window
- Errors are selected in this window by mouse click
- Settings of the desired error duration
- Triggering the error by mouse click
- Configuration of the Ethernet interface
- Configuration for master/slave operation

2.3 Block Diagram

The following figure shows a principle overview of the jumpers, the error switches and the connectors of the ES4441.1 Compact Error Simulation Module

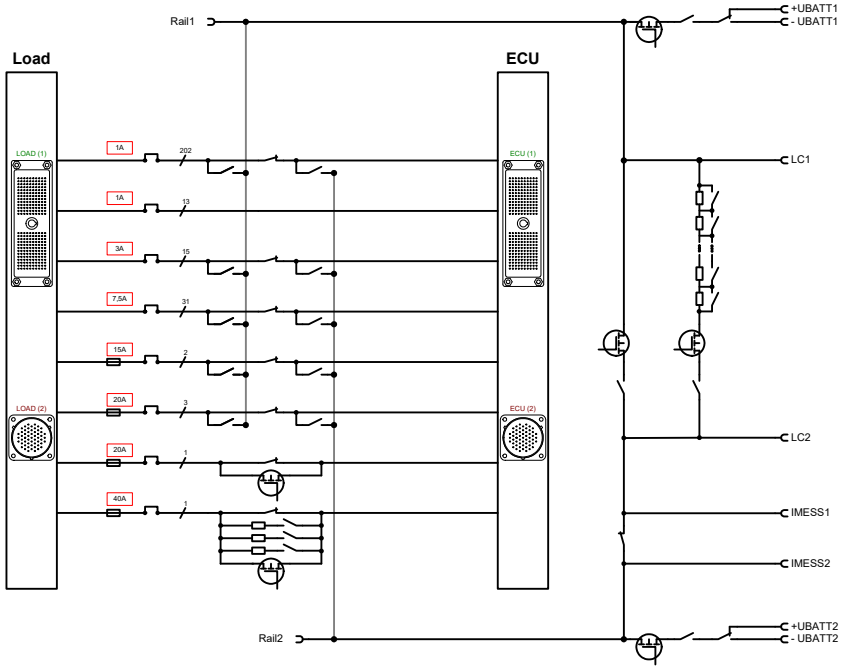


Abb. 2-3 Block Diagram of the ES4441.1 Compact Error Simulation Module

2.4 Control Unit

The core of the ES4441.1 Compact Error Simulation Module is a microcontroller (µC) with an integrated Ethernet controller – the µC is connected directly to Ethernet-PHY.

A serial, non-volatile EEPROM saves a range of specific parameters such as MAC address and IP address. PLDs with subsequent relay drivers address the relays and MOSFETs.

2.5 General Instructions on Operating the ES4441.1

Please note the following when operating the device:

Ventilation

Never cover the ventilation slots of the device! When installing in a 19" rack, forced cooling may have to be carried out.

Cleaning the Device

Only clean the device with a dry cloth. Do not use any detergents or solvents.

Maintenance

The device requires no servicing by the user. If the device is faulty, switch it off, prevent it from being used again and send it to the manufacturer for repair.

2.6 Table of possible Errors the ES4441.1

The following table shows the errors that can be simulated with the ES4441.1 Compact Error Simulation Module.

Er. Nr.	Comm. Nr.	Type of Error	Switch	Multi. Error	Comment
1	0x1	Open load	Relay	Possible	Possible error numbers for multiple errors: 1-9
2	0x3	Short cut to + UBATT1 on rail2, load connected	Relay	Possible	Possible error numbers for multiple errors: (1,2,3)
3	0x3	Short cut to +UBATT1 on rail2, load disconnected	Relay	Possible	Possible error numbers for multiple errors: (1,2,3)
4	0x3	Short cut to –UBATT1 on rail2, load connected	Relay	Possible	Possible error numbers for multiple errors: (1,4,5)
5	0x3	Short cut to –UBATT1 on rail2, load disconnected	Relay	Possible	Possible error numbers for multiple errors: (1,4,5)
6	0x3	Short cut to +UBATT2 on rail2, load connected	Relay	Possible	Possible error numbers for multiple errors: (1,6,7)
7	0x3	Short cut to +UBATT2 on rail2, load disconnected	Relay	Possible	Possible error numbers for multiple errors: (1,6,7)
8	0x3	Short cut to –UBATT2 on rail 2, load connected	Relay	Possible	Possible error numbers for multiple errors: (1,8,9)
9	0x3	Short cut to –UBATT2 on rail 2, load disconnected	Relay	Possible	Possible error numbers for multiple errors: (1,8,9)
10	0x2	Open load	MOSFET	No	For this kind of error both rails will be needed
11	0x4	Short cut to +UBATT1 on rail2, load connected	MOSFET	No	For this kind of error both rails will be needed
12	0x4	Short cut to +UBATT1 on rail2, load disconnected	MOSFET	No	For this kind of error both rails will be needed
13	0x4	Short cut to –UBATT1 on rail2, load connected	MOSFET	No	For this kind of error both rails will be needed

Er. Nr.	Comm. Nr.	Type of Error	Switch	Multi. Error	Comment
14	0x4	Short cut to –UBATT1 on rail2, load disconnected	MOSFET	No	For this kind of error both rails will be needed
15	0x4	Short cut to +UBATT2 on rail2, load connected	MOSFET	No	For this kind of error both rails will be needed
16	0x4	Short cut to +UBATT2 on rail2, load disconnected	MOSFET	No	For this kind of error both rails will be needed
17	0x4	Short cut to –UBATT2 on rail2, load connected	MOSFET	No	For this kind of error both rails will be needed
18	0x4	Short cut to –UBATT2 on rail2, load disconnected	MOSFET	No	For this kind of error both rails will be needed
19	0x7 and 0x8	Pin to pin without resistor, load is connected	MOSFET	No	For this kind of error both rails will be needed
20	0x5 and 0x6	Pin to pin without resistor, load is disconnected	Relay	No	No fuse is in the circuit of the ES4441 for this error!!!
21	0x7 and 0x8	Pin to pin with resistor, load is connected	MOSFET	No	For this kind of error both rails will be needed
22	0x9	Resistor in line	MOSFET	No	For this kind of error both rails will be needed
23	0xB	Pull up resistor to +UBATT1 for ECU pin, load pin is connected	MOSFET	No	For this kind of error both rails will be needed
24	0xB	Pull up resistor to +UBATT1 for ECU pin, load pin is disconnected	MOSFET	No	For this kind of error both rails will be needed
25	0xB	Pull down resistor to –UBATT1 for ECU pin, load pin is connected	MOSFET	No	For this kind of error both rails will be needed
26	0xB	Pull down resistor to –UBATT1 for ECU pin, load pin disconnected	MOSFET	No	For this kind of error both rails will be needed

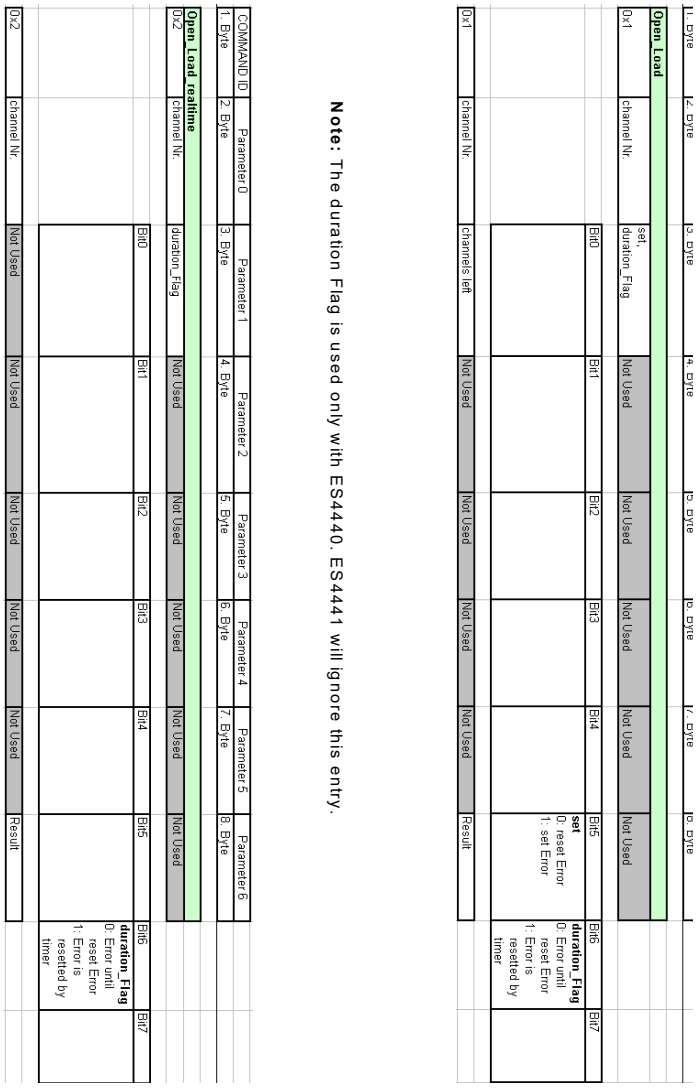
Er. Nr.	Comm. Nr.	Type of Error	Switch	Multi. Error	Comment
27	0xB	Pull up resistor to +UBATT2 for ECU pin, load pin is connected	MOS-FET	No	For this kind of error both rails will be needed
28	0xB	Pull up resistor to +UBATT2 for ECU pin, load pin disconnected	MOS-FET	No	For this kind of error both rails will be needed
29	0xB	Pull down resistor to –UBATT2 for ECU pin, load pin is connected	MOS-FET	No	For this kind of error both rails will be needed
30	0xB	Pull down resistor to –UBATT2 for ECU pin, load pin is disconnected	MOS-FET	No	For this kind of error both rails will be needed
31	0x15	Extern connection for current measurement			Two rails will be needed. The changeover must be done without interrupt of ECU load line
45	0x24	Ground shift		Possible	M7 should normally be closed. To prepare the error K11 has to be opened. And the cascade has to be set. To activate the error M7 will open. At reset, over temp. or over current vice versa. This error can be set as multiple error with every other error type.

Er. Nr.	Comm. Nr.	Type of Error	Switch	Multi. Error	Comment
46	0x24	Loose Ground contact (channel 340)		Possible	Duty cycle and frequency of “Loose Ground contact” and “Loose Power contact” are not independent. If they are used at the same time these parameters must be equal. This error can be set as multiple error with every other error type.
47	0x24	Loose Power contact (channel 339)		Possible	Duty cycle and frequency of “Loose Ground contact” and “Loose Power contact” are not independent. If they are used at the same time these parameters must be equal. This error can be set as multiple error with every other error type.
50	0x10	Reset all errors			All errors will be reset to default

Tab. 2-1 Errors that can be simulated with the ES4441

3 Commands

The following tables are describing the structure of the ES4441.1 Compact Error Simulation Module.

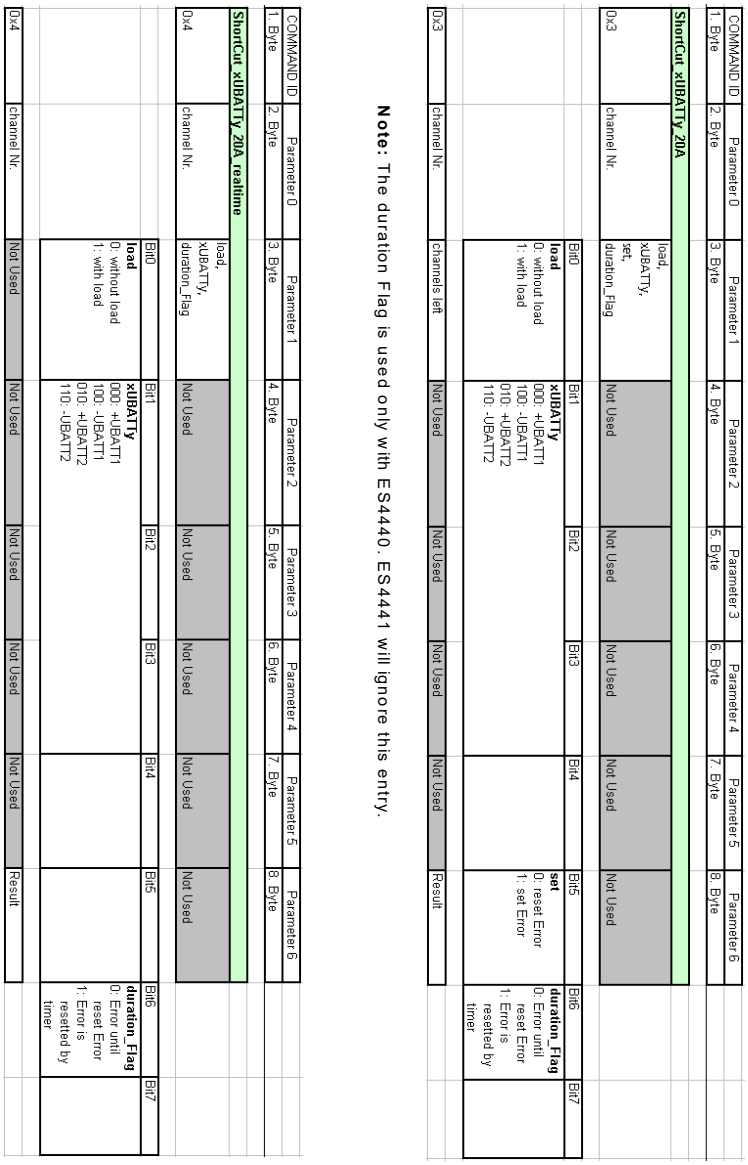


1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
Open Load							
0x1	channel Nr.	set, duration_Flag	Not Used	Not Used	Not Used	Not Used	Not Used
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5
							set 0: reset Error 1: set Error
							Bit6
							duration_Flag 0: Error until reset Error 1: Error is resetted by timer
							Bit7
0x1	channels left	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Note: The duration Flag is used only with ES4440. ES4441 will ignore this entry.

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
Open_Load_realtime							
0x2	channel Nr.	duration_Flag	Not Used	Not Used	Not Used	Not Used	Not Used
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5
							Bit6
							duration_Flag 0: Error until reset Error 1: Error is resetted by timer
							Bit7
0x2	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-1 ES4441.1 Compact Error Simulation Module



COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
ShortCut_xUBATTy_20A							
0x3	channel Nr.	load, xUBATTy, set, duration_Flag	Not Used	Not Used	Not Used	Not Used	Not Used

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	load 0: without load 1: with load	**xUBATTy** 000: +UBATT1 100: -UBATT1 010: +UBATT2 110: -UBATT2				**set** 0: reset Error 1: set Error	**duration_Flag** 0: Error until reset Error 1: Error is resetted by timer	

0x3	channel Nr.	channels left	Not Used	Not Used	Not Used	Not Used	Result

Note: The duration Flag is used only with ES4440. ES4441 will ignore this entry.

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
ShortCut_xUBATTy_20A_realtime							
0x4	channel Nr.	load, xUBATTy, duration_Flag	Not Used	Not Used	Not Used	Not Used	Not Used

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	load 0: without load 1: with load	**xUBATTy** 000: +UBATT1 100: -UBATT1 010: +UBATT2 110: -UBATT2					**duration_Flag** 0: Error until reset Error 1: Error is resetted by timer	

0x4	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-2 ES4441.1 Compact Error Simulation Module

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
Pin2PinFirstChWithoutLoad									
0x5	channel Nr. 1	duration_Flag	Not Used	Not Used	Not Used	Not Used	Not used		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
								duration_Flag 0: Error until reset Error 1: Error is resetted by timer	
0x5	channel Nr. 1	Not Used	Not Used	Not Used	Not Used	Not Used	Result		

Note: The duration Flag is used only with ES4440. ES4441 will ignore this entry.

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
Pin2PinSecondChWithoutLoad									
0x6	channel Nr. 2	duration_Flag	Not Used	Not Used	Not Used	Not Used	Not used		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
								duration_Flag 0: Error until reset Error 1: Error is resetted by timer	
0x6	channel Nr. 2	Not Used	Not Used	Not Used	Not Used	Not Used	Result		

Tab. 3-3 ES4441.1 Compact Error Simulation Module

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
Pin2PinFirstChRealtimeWithLoad									
0x7	channel Nr. 1	current, duration_Flag	Not Used	Resistance [mΩ] Byte 0 (LSB)	Resistance [mΩ] Byte 1	Resistance [mΩ] Byte 2	Resistance [mΩ] Byte 3 (MSB)		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
						current 0: measurement off 1: measurement on		**duration_Flag** 0: Error until reset Error 1: Error is resetted by timer	
0x7	channel Nr. 1	Not used	Not Used	Not Used	Not Used	Not Used	Result		

Note: The duration Flag is used only with ES4440. ES4441 will ignore this entry.

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
Pin2PinSecondChRealtimeWithLoad									
0x8	channel Nr. 2	duration_Flag	Not Used	Not Used	Not Used	Not Used	Not Used		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
								duration_Flag 0: Error until reset Error 1: Error is resetted by timer	
0x8	channel Nr. 2	Not used	Not Used	Not Used	Not Used	Not Used	Result		

Tab. 3-4 ES4441.1 Compact Error Simulation Module

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
RInline_realtime									
0x9	channel Nr. 1	current, duration_Flag	Not Used	Resistance [mΩ] Byte 0 (LSB)	Resistance [mΩ] Byte 1	Resistance [mΩ] Byte 2	Resistance [mΩ] Byte 3 (MSB)		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
						current 0: measurement off 1: measurement on		**duration_Flag** 0: Error until reset Error 1: Error is resetted by timer	
0x9	channel Nr. 1	Not Used	Not Used	Not Used	Not Used	Not Used	Result		

Note: The duration Flag is used only with ES4440. ES4441 will ignore this entry.

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6		
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte		
Pullup_Pulldown_xUBATTy_20A_realtime									
0xB	channel Nr.	load, xUBATTy, current, duration_Flag,	Not Used	Resistance [mΩ] Byte 0 (LSB)	Resistance [mΩ] Byte 1	Resistance [mΩ] Byte 2	Resistance [mΩ] Byte 3 (MSB)		
		Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
		load 0: without load 1: with load	**xUBATTy** 000: +UBATT1 100: -UBATT1 010: +UBATT2 110: -UBATT2			**current** 0: measurement off 1: measurement on		**duration_Flag** 0: Error until reset Error 1: Error is resetted by timer	
0xB	channel Nr.	Not used	Not Used	Not Used	Not Used	Not Used	Result		

Tab. 3-5 ES4441.1 Compact Error Simulation Module

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
Reset all errors							
0x10	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
0x10	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-6 ES4441.1 Compact Error Simulation Module

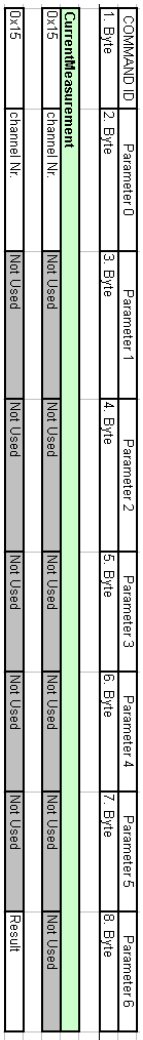
COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6	
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	
Activate_relay (modified)								
0x12	HWTrigger, Edge, duration unit	Duration Time [duration unit] Byte 0 (LSB)	Duration Time [duration unit] Byte 1 (MSB)	Not Used	Not Used	Not Used	Not Used	
	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
		HWTrigger 0: off 1: on	**Edge** 0: rise 1: fall	**duration unit** 00: us 10: ms 01: s				
0x12	HWTrigger, Edge	used Relais	Not Used	Not Used	Not Used	Not Used	Result	

Note: By setting Parameter 1 (Duration Time Byte 0) and Parameter 2 (Duration Time Byte 1) to a value of 255, the errors are pending until an error reset.

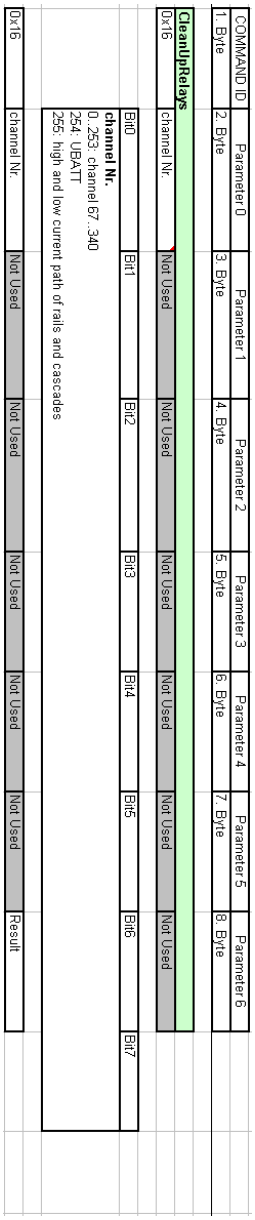
COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6	
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte	
Activate_realtime_switch (modified)								
0x13	Loosecontact, HWTrigger, Edge, duration unit	Duration Time [duration unit] Byte 0 (LSB)	Duration Time [duration unit] Byte 1 (MSB)	Not Used	duty_cycle of loose Contact 0..100, step size 1	frequency of loose contact Byte 0 (LSB) 0..25kHz	frequency of loose contact Byte 1 (MSB) step size 1 Hz	
	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	Loosecontact 0: off 1: on	**HWTrigger** 0: off 1: on	**Edge** 0: rise 1: fall	**duration unit** 00: us 10: ms 01: s				
0x13	Loosecontact, HWTrigger, Edge	Duration Time [us] Byte 0 (LSB)	Duration Time [us] Byte 1	Duration Time [us] Byte 2	Duration Time [us] Byte 3 (MSB)	Not Used	Result	

Note: By setting Parameter 1 (Duration Time Byte 0) and Parameter 2 (Duration Time Byte 1) to a value of 255, the errors are pending until an error reset.

Tab. 3-7 ES4441.1 Compact Error Simulation Module

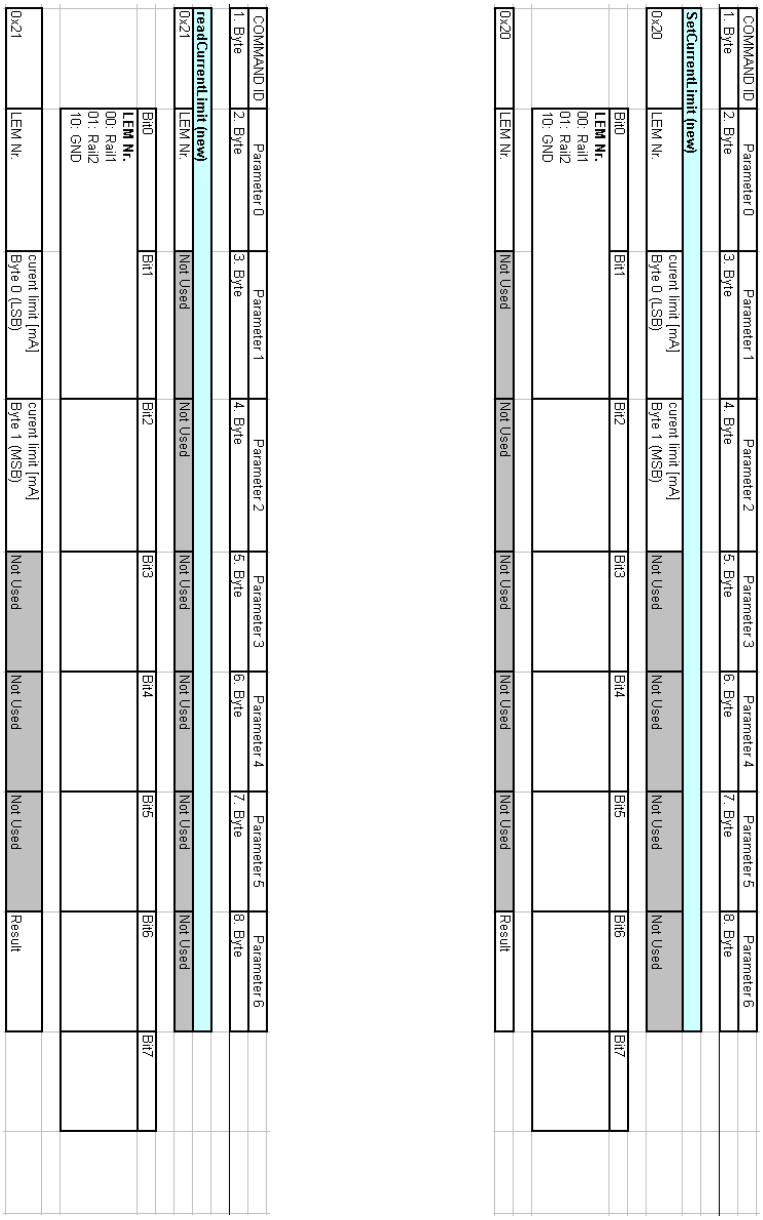


COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
CurrentMeasurement							
0x15	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
0x15	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Result



COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
CleanUpRelays							
0x16	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	channel Nr. 0..253: channel 67..340 254: UBATT 255: high and low current path of rails and cascades							
0x16	channel Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-8 ES4441.1 Compact Error Simulation Module



COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
SetCurrentLimit (new)							
0x20	LEM Nr.	curent limit [mA] Byte 0 (LSB)	curent limit [mA] Byte 1 (MSB)	Not Used	Not Used	Not Used	Not Used

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
LEM Nr. 00: Rail1 01: Rail2 10: GND								

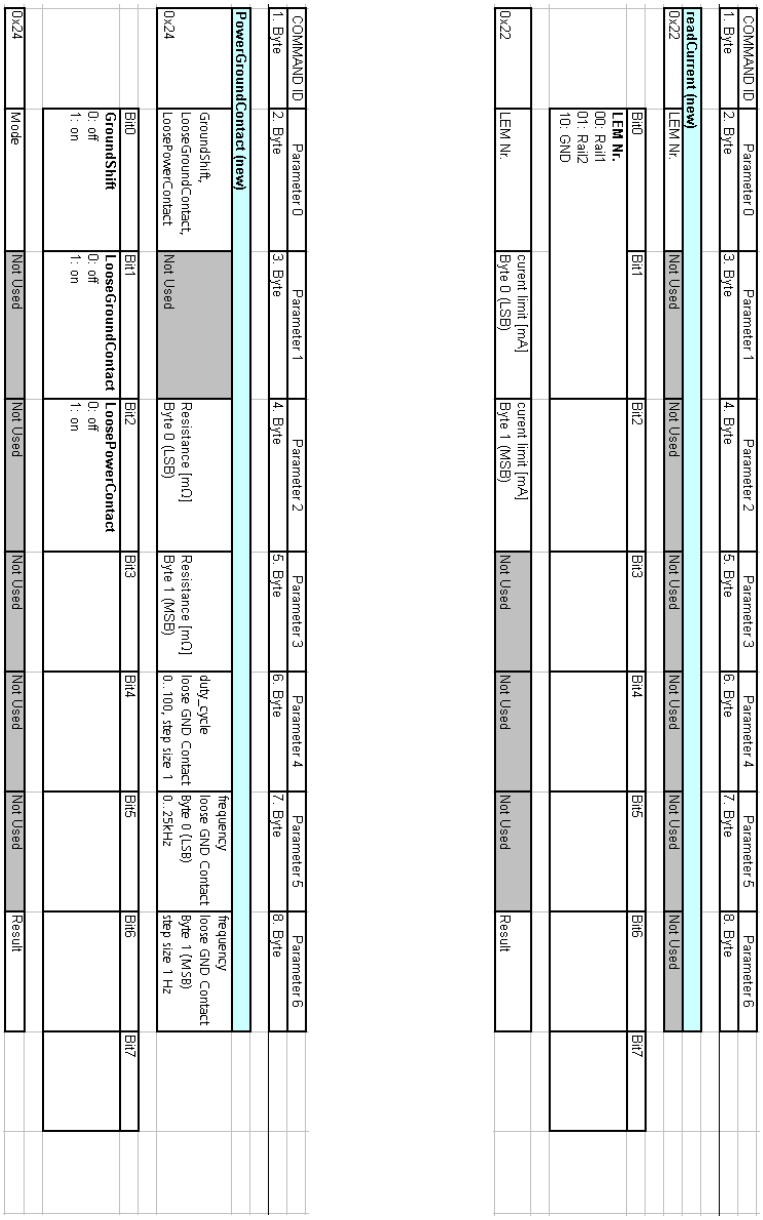
0x20	LEM Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Result	

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
readCurrentLimit (new)							
0x21	LEM Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
LEM Nr. 00: Rail1 01: Rail2 10: GND								

0x21	LEM Nr.	curent limit [mA] Byte 0 (LSB)	curent limit [mA] Byte 1 (MSB)	Not Used	Not Used	Not Used	Result	

Tab. 3-9 ES4441.1 Compact Error Simulation Module



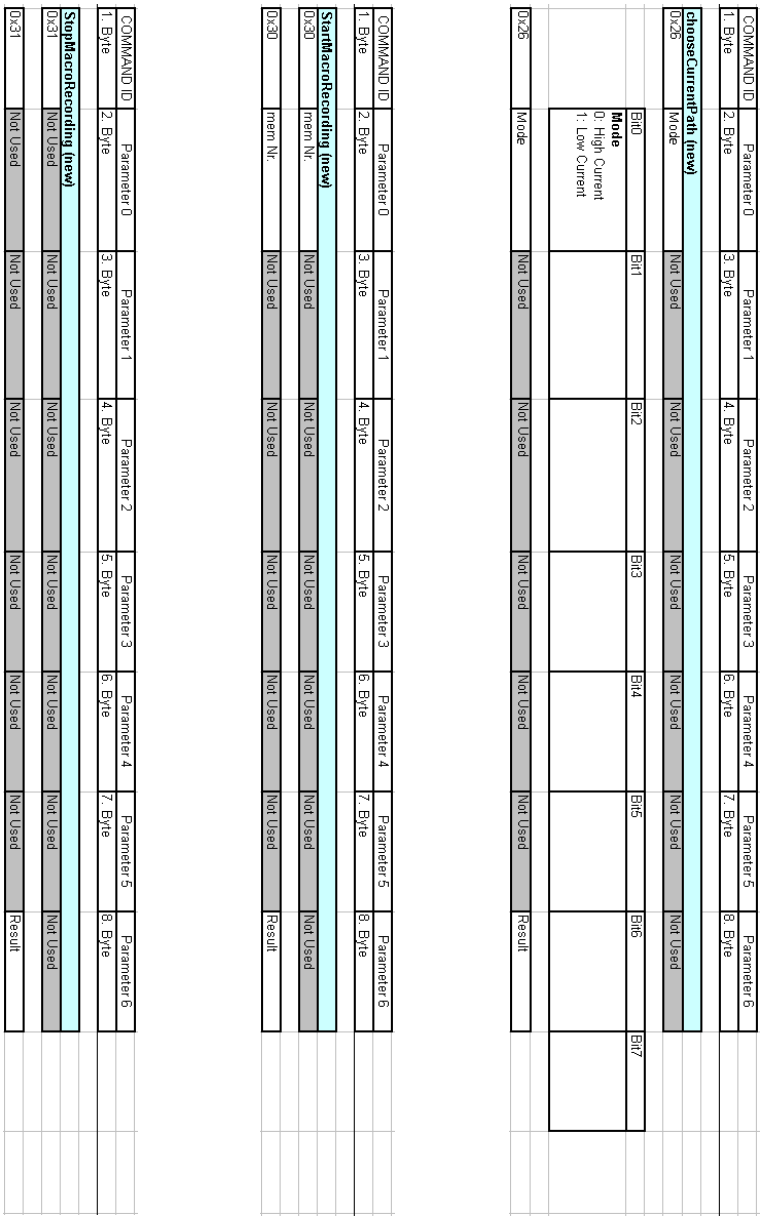
COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
readCurrent (new)							
0x22	LEM Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	LEM Nr. 00: Rail1 01: Rail2 10: GND							

0x22	LEM Nr.	curent limit [mA] Byte 0 (LSB)	curent limit [mA] Byte 1 (MSB)	Not Used	Not Used	Not Used	Result

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
PowerGroundContact (new)							
0x24	GroundShift, LooseGroundContact, LoosePowerContact	Not Used	Resistance [mΩ] Byte 0 (LSB)	Resistance [mΩ] Byte 1 (MSB)	duty_cycle loose GND Contact 0...100, step size 1	frequency loose GND Contact Byte 0 (LSB) 0...25kHz	frequency loose GND Contact Byte 1 (MSB) step size 1 Hz
	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	GroundShift 0: off 1: on	**LooseGroundContact** 0: off 1: on	**LoosePowerContact** 0: off 1: on					

0x24	Mode	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-10 ES4441.1 Compact Error Simulation Module



COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
chooseCurrentPath (new)							
0x26	Mode	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Mode 0: High Current 1: Low Current							

0x26	Mode	Not Used	Not Used	Not Used	Not Used	Not Used	Result

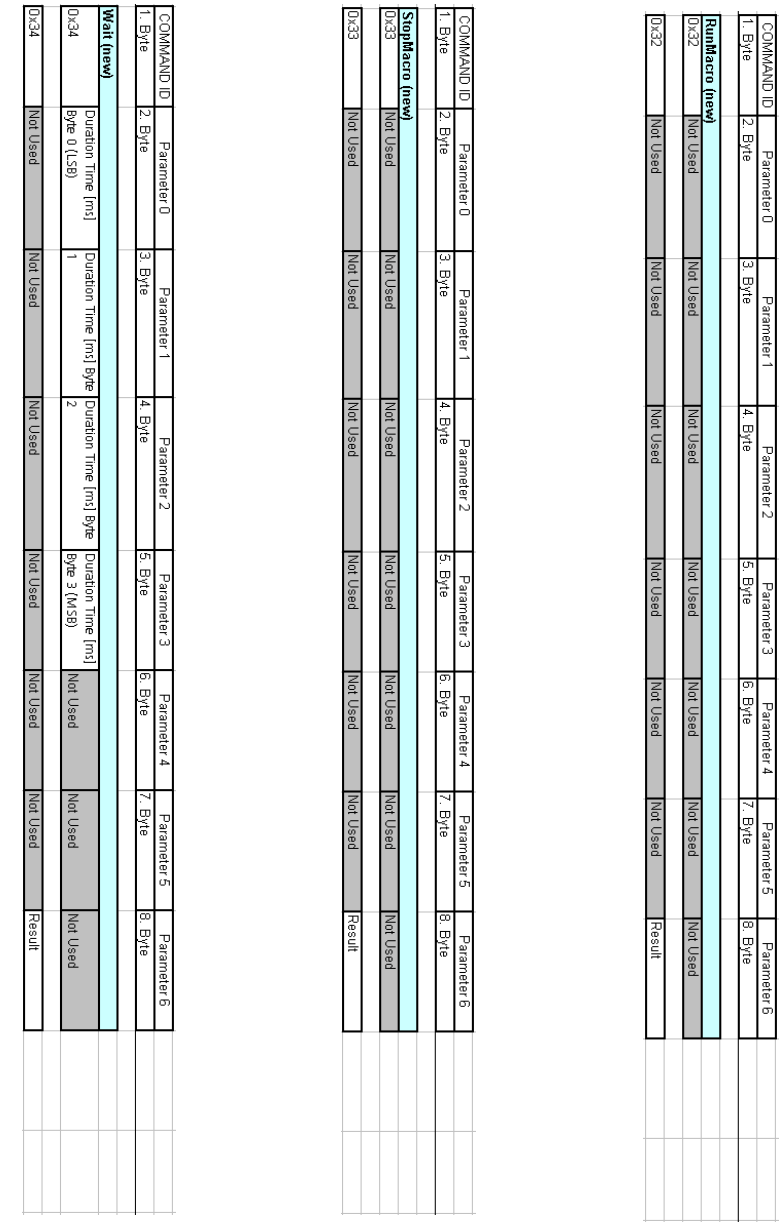
COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
StartMacroRecording (new)							
0x30	mem Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

0x30	mem Nr.	Not Used	Not Used	Not Used	Not Used	Not Used	Result

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
StopMacroRecording (new)							
0x31	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used

0x31	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-11 ES4441.1 Compact Error Simulation Module

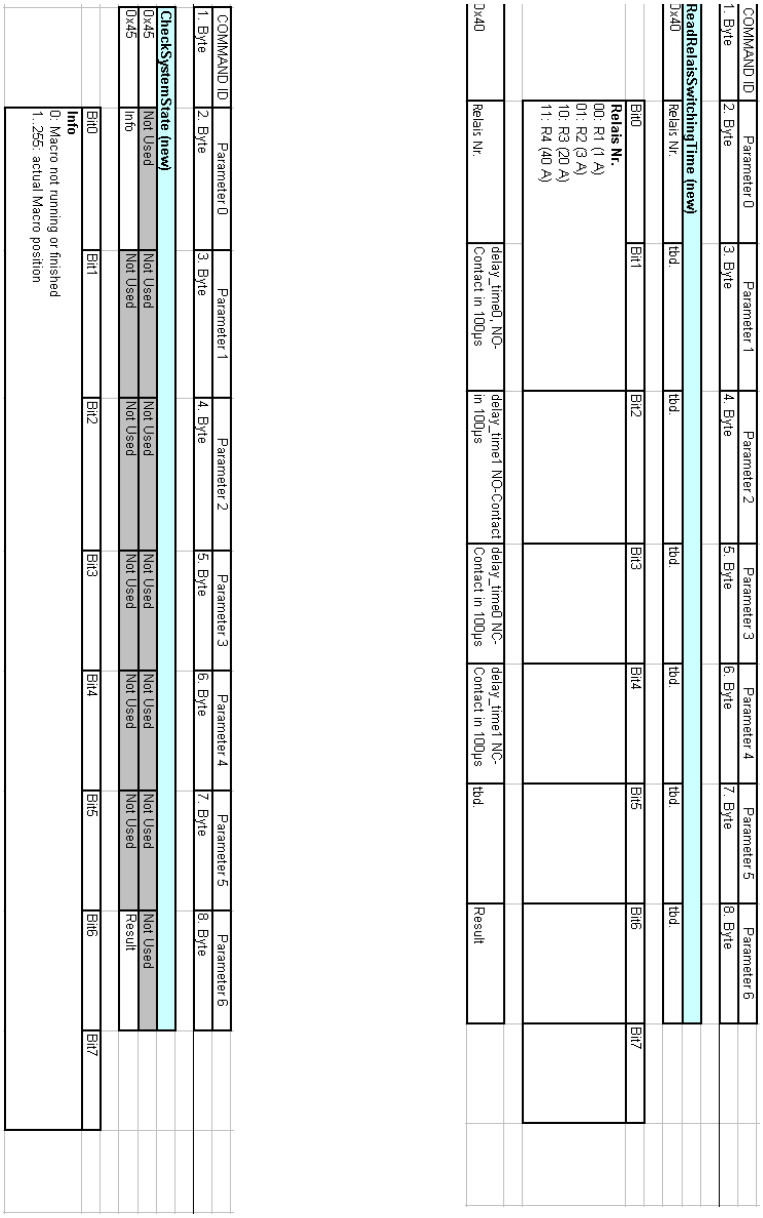


COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
RunMacro (new)							
0x32	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
0x32	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
StopMacro (new)							
0x33	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
0x33	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
Wait (new)							
0x34	Duration Time [ms] Byte 0 (LSB)	Duration Time [ms] Byte 1	Duration Time [ms] Byte 2	Duration Time [ms] Byte 3 (MSB)	Not Used	Not Used	Not Used
0x34	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Result

Tab. 3-12 ES4441.1 Compact Error Simulation Module



COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
ReadRelaisSwitchingTime (new)							
0x40	Relais Nr.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	Relais Nr. 00: R1 (1 A) 01: R2 (3 A) 10: R3 (20 A) 11: R4 (40 A)							

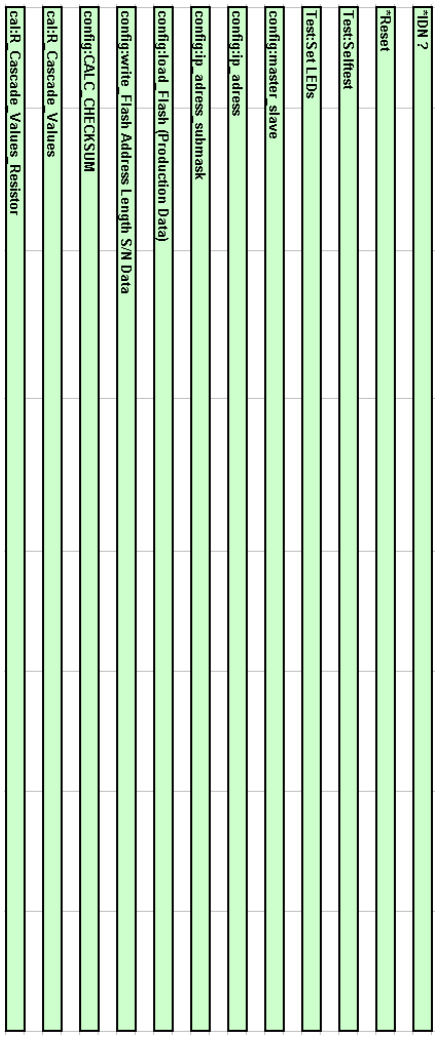
0x40	Relais Nr.	delay_time0 NC-Contact in 100µs	delay_time1 NC-Contact in 100µs	delay_time0 NC-Contact in 100µs	delay_time1 NC-Contact in 100µs	tbd.	Result

COMMAND ID	Parameter 0	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
1. Byte	2. Byte	3. Byte	4. Byte	5. Byte	6. Byte	7. Byte	8. Byte
CheckSystemState (new)							
0x45	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used	Not Used
0x45	Info	Not Used	Not Used	Not Used	Not Used	Not Used	Result

	Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
	Info 0: Macro not running or finished 1..255: actual Macro position							

Tab. 3-13 ES4441.1 Compact Error Simulation Module

The following table is showing the Control Commands that are available for the ES4441.1.



Tab. 3-14 ES4441.1 Control Commands

4 Hardware Features

This chapter contains detailed information on the features of the ES4441.1 Compact Error Simulation Module.

These are:

4.1 Error Simulation for 255 channels

The ES4441.1 Compact Error Simulation Module has 255 error channels.

The text that follows describes which types of error can be simulated for which channels.

4.2 Error Types

4.2.1 Error Channels

The following figure shows

- whether a channel is switched by relay or MOSFET
- whether several errors can be activated simultaneously (multiple) or only individually (single)
- the settable duration of the error state
- whether an error can also be realized in PWM control as a loose contact.

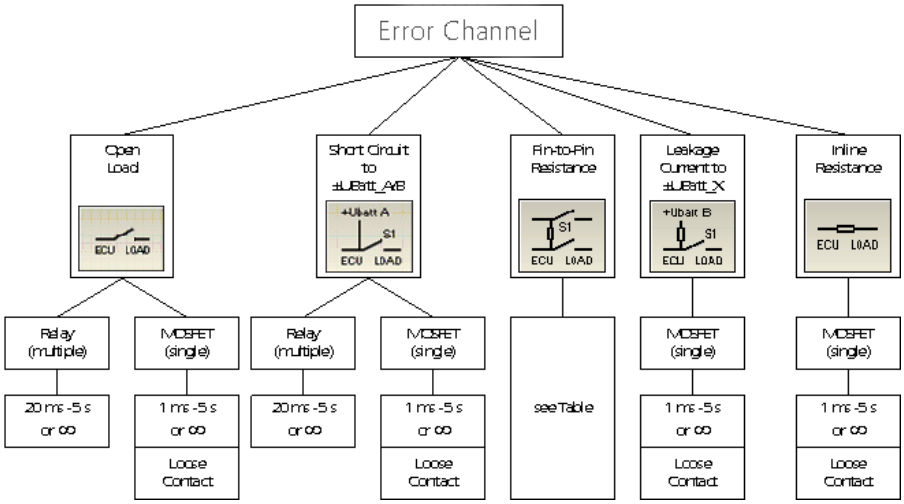


Abb. 4-1 Error Channels

4.2.2 Pin-to-Pin Resistance

There are underlying conditions for the error type "Pin-to-Pin Resistance" – depending on whether the load is connected and whether there is finite resistance between the pins. Tab. 4-1 shows the underlying conditions for the possible configurations.

Resistance	Load Connected	Switched with	Loose Contact
Finite	Yes	MOSFET	Possible
0 Ω	Yes	MOSFET	Possible
Finite	No	This configuration is not possible	
0 Ω	No	Relay	Not possible

Tab. 4-1 Possible Configurations with Pin-to-Pin Resistance

The first column shows whether there is a finite resistance for the contact between the lines or not; the second whether the load is connected during error simulation or not.

The fourth column tells you whether a loose contact can be simulated or not in each particular case.

4.2.3 Relay or MOSFET

Using MOSFETs has the advantage of disappearing switching times – minimal leakage currents are usually no problem for most types of error. If, however, they are, you can use relays to generate errors.

Please note, however, that error types which are switched via MOSFETs, can only be realized individually (see Abb. 4-1 on page 44).

4.2.4 Duration of the Error State

The period of time for which an error is active can be of interest for measuring latencies of the diagnostic system. For example, the ES4441.1 can simulate a specific error for 20 ms, but the ECU software requires at least 30 ms to generate an error memory entry.

The required duration of the error state is set in the PINCONTROL user interface. The selectable duration is between 45 ms and 65534 s for relays and between 1 µs and 65534 s for MOSFETs – it can be set in intervals of 1 ms for relays or 1 µs for MOSFETs.

4.2.5 Simulating Loose Contacts

Certain types of error on error channels can not only be realized as errors with a defined duration but also as loose contacts. These errors are controlled by a pulse-width modulation with a switching frequency up to 25 kHz and a duty cycle of 0% - 100%.

With the ES4441.1 Compact Error Simulation Module is possible to simulate a loose ground contact (channel 340) and a loose power contact (channel 339).

4.2.6 Number of Possible Active Error States

Errors which are switched by MOSFETS can only be activated individually.

With errors which are switched by relays, a maximum of ten errors can be activated simultaneously (e.g. open loads on ten channels).

For the shorts to the battery voltages, it is also possible to simulate other errors at the same time (e.g. open loads) – these cannot, however, be selected freely. It is not possible to select more than one short circuit to one of the four battery voltages (+UBATT1, -UBATT1, +UBATT2, -UBATT2) at the same time.

If you are using PINCONTROL for error simulation, errors which cannot be selected are excluded from the selection in the user interface.

If, however, you address the ES4441.1 automatically by Ethernet, you should ensure that the selected types of error are also possible simultaneously as otherwise an error message will be issued.

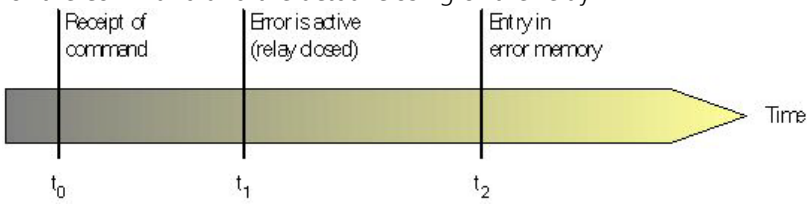
4.2.7 Measuring the Current

When errors are simulated in which both error rails are used (line resistance, short or resistance between two lines or leakage current), the current flowing via the rails can be measured. For this purpose, a current measuring device is connected to the "Current" connector on the back panel (two yellow screw pads).

4.3 Time Response

If you are using mechanical relays and have to determine how long an error has to be active ((t_2 - t_1) in the figure) until an entry is made in the error memory, the finite activation time of the mechanical relays has to be taken into consideration.

In the following figure, this is the time (t_1 - t_0), i.e. the time between the receipt of the command and the actual closing of the relay.



Once the error is set, measuring this activation time is executed on a reference relay and transferred to the host in the command response.

For errors which are switched by MOSFETs, this kind of measuring is not necessary due to fast activation.

4.4 General Resistor Cascade

To simulate contact corrosion and crosstalk between ECU channels, the ES4441.1 Compact Error Simulation Module has a serial resistor cascade of 18 resistors with which resistances of 0,5 Ω to approx. 128 kΩ can be generated (in 0,5 Ω intervals).

The individual resistors are activated (relay open) or bridged by relays. The cascade consists of the following resistance values: 0,5, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192, 16384, 32768 and 65536 Ω.

The maximum permissible current depends on the voltage drop over the cascade.

The following table shows the Current Limit **(I max [A] @ current limit)** for the individual resistor values.

R [Ohm]	P [W]	I_{max} [A] @ P_{max}	I_{max} [A] @ 30V	I_{max} [A] @ current limit
0,5	100	14,142	60,000	12,00
1	50	7,071	30,000	6,00
2	50	5,000	15,000	4,00
4	50	3,536	7,500	3,00
8	50	2,500	3,750	2,00
16	50	1,768	1,875	1,00
32	50	1,250	0,938	0,50
64	16	0,500	0,469	0,50
128	10	0,280	0,234	0,50
256	5	0,140	0,117	0,50
512	3	0,077	0,059	0,50
1.024	1	0,031	0,029	0,50
2.048	1	0,022	0,015	0,50
4.096	1	0,016	0,007	0,50
8.192	1	0,011	0,004	0,50
16.384	0,1	0,002	0,002	0,50
32.768	0,1	0,002	0,001	0,50
65.536	0,1	0,001	0,000	0,50

Tab. 4-2 Current Limit of the general resistor cascade

If, however, overheating does occur, temperature sensors cause an error message to be issued, the occurrence of which results in a system reset (see "Resetting on Excess Temperature" on page 50).

4.5 Ground Shift Resistor Cascade

To simulate a ground shift on the ground channel (340), the ES4441.1 Compact Error Simulation Module has a parallel resistor cascade with a minimum resistor 0,5 Ω and a maximum resistor of 4,0 Ω.

The resistors are controlled by a 40 A relay.

The following resistance values are possible: 0,5, 0,57, 0,66, 0,80, 1,00, 1,33, 2,00 and 4,00 Ω.

The following table shows the Current Limit **(I max [A] @ current limit)** for the the individual resistor values.

R [Ohm]	P [W]	I_{max} [A] @ P_{max}	I_{max} [A] @ 30V	I_{max} [A] @ current limit
0,50	400	28,284	60,000	26,00
0,57	350	24,780	52,632	24,00
0,66	300	21,320	45,455	20,00
0,80	250	17,678	37,500	16,00
1,00	200	14,142	30,000	12,00
1,33	150	10,620	22,556	10,00
2,00	100	7,071	15,000	6,00
4,00	50	3,536	7,500	3,00

Tab. 4-3 Current Limit of the ground shift resistor cascade

4.6 Status Displays via LEDs on the Front Panel

There are several LEDs on the front panel of the ES4441.1 Compact Error Simulation Module, the meaning of which is described in this section.

Abb. 4-2 LEDs on the Front Panel

Name	Color	Meaning
+24 V	Green	+24 V OK
+5 V	Green	+5 V OK
+3.3 V	Green	+3.3 V OK
Reset	Yellow	A reset takes place
System Error	Red	ES4441 system error
Failure Active	Green	An failure state is active
Ethernet Link	Green	Ethernet connection to host available
Ethernet TX	Yellow	Transmit (data transfer is currently taking place)

Tab. 4-4 The Meaning of the LEDs on the Front Panel

4.7 Master/Slave Operation of Several ES4441.1 Systems

An ES4441.1 Compact Error Simulation Module has 255 error simulation channels. If this number is not sufficient, up to 15 slave systems can be connected to a master system.
For this purpose, the lines of the error rails 1 and 2 (two green screw pads on the rear of the device) must be connected to the error rails 1 and 2 of the slave systems.
Multiple errors in an ES4441.1 are always switched simultaneously – in addition, the synchronization of all systems used in master/slave operation also ensures the simultaneous switching of the errors on all systems.
The synchronisation is realized via signals that are distributed from a master system to slave systems over the "Trigger" connector (see chapter 6.6 on page 63).

4.8 External Triggering of the ES4441.1

It is possible to activate an error of the ES4441.1 Compact Error Simulation Module via external triggering. The Trigger input is TTL compliant and has a galvanic separation. It is possible to select trigger edge (rise or fall) and trigger level. The trigger signal is distributed from an external trigger source to the ES4441.1 Compact Error Simulation Module over the "Trigger" connector (see chapter 6.6 on page 63).

4.9 IP Addresses

If you are operating one or more ES4441.1 Compact Error Simulation Modules with the operating software PINCONTROL provided, you can assign (freely selectable) IP addresses for the individual modules there.

4.10 Safety Concept

The ES4441.1 Compact Error Simulation Module has protective mechanisms against excess temperature and overcurrents.

4.10.1 Resetting on Excess Temperature

When in operation, the temperature of the ES4441.1 Compact Error Simulation Module is monitored at various points in the housing. If an excess temperature is detected at any one of these points, a reset is executed which is indicated via the yellow "Reset" LED on the front panel (see Abb. 4-2 on page 49).

All relays are reset during a reset, i.e. all errors set are cancelled. Set errors are not executed and acknowledged with an error message as long as the excess temperature condition applies.

4.10.2 Protecting the Rails and the Ground Channel Resistor Cascade

The over current protection of the ES4441 is realised by current measurement in each of the two rails and in the ground channel (340). If the current through one or both rails and in the ground channel exceeds the range for more than 100µs, all MOSFETs and relays are switched off.
In each case, the limit for the rail current depends on the selected channel with the lowest maximum current (1.2x the lowest maximum current is set as current limit). It is possible to set a lower current limit manually.
If the error is simulated on the low current path, the current limit will be initially

set to 1.2A.
The maximum configurable limit for the ground current depends on the selected ground shift resistor and its maximum current.

Note

The over current protection only protects the resistors of the ground shift resistor cascade. The ground channel itself is protected by a melting fuse.

4.11 Power cord

Due to regional differences in the power supply, no power cords are provided for the ES4441.1 Housing. The respective requirements and the ETAS order number are located in the following table. Use only power cords that are specified there.

Region	Description	Order number
General	Voltage supply cables with a IEC 60320 C13 plug at one end and a non-locking plug that meets the national safety requirements (equipped with grounding contacts) at the other end. Plugs and cable must be dimensioned at least for 250 VAC/10 A or 125 VAC/15 A.	-
China	Voltage supply cables for China for various ETAS devices with PRC/3 and IEC 60320 C13 plugs. Rating of 250 VAC/10 A, 2.50 m long	F-04A-109-512
Europe / Korea	Voltage supply cables for Europe and Korea for various ETAS devices with CEE7/ 7 and IEC 60320 C13 plugs. Rating of 250 VAC / 10 A, 2.50 m long	F-04A-109-513
India	Voltage supply cables for India for various ETAS devices with IS 1293 (D) and IEC 60320 C13 plugs. Rating of 250 VAC/10 A, 2.50 m long	F-04A-109-514
Japan	Voltage supply cables for Japan for various ETAS devices with JIS C 8303 and IEC 60320 (C)13V plugs. Rating of 125 VAC/15 A, 2.50 m long	F-04A-109-515
North America	Voltage supply cables for North America for various ETAS devices with NEMA 5/15 - IEC 60320 C13M plugs. Rating of 125 VAC/ 15 A, 2.50 m long	F-04A-109-445
United Kingdom	Voltage supply cables for the UK for various ETAS devices with BS 1363/A and IEC 60320 C13 plugs. Rating of 250 VAC/10 A, 2.50 m long	F-04A-109-516

CAUTION!

To avoid injury and damage, observe the following: Connect the ES4441 to a protective contact socket using only power cords that are specified in the table above.

5 Mechanical Construction

5.1 Overview

The breakout frontpanel of theES4441.1 Compact Error Simulation Module is mechanically and signal-logically divided into three areas. The connectors to the control unit ("ECU") are mounted on the right-hand side (see Figure "Front View of the ES4441.1 Compact Error Simulation Module" on page 53). The connectors to the ES4500 Component Rack (“LOAD”) or signal box are located on the left.
The jumpers are arranged in the center section. The jumpers are designed based on the current specification of each signal channel. Some signals in the range of higher currents are protected specially (see Chapter "Safety Measures" on page 58).

Abb. 5-1 Front View of the ES4441.1 Compact Error Simulation Module

5.2 Connectors LOAD (1) and ECU (1)

ITT Cannon DLM5-260 connectors are used for signals carrying a maximum current of 3 A. This connector type is a so-called zero-insertion force connector with 260 pins. Plugging this connector requires no insertion force for connecting the female and male contacts. A tight connection is ensured by simply pressing the related contacts against each other. The female and male connectors are locked by turning the lever on the cable plug (see Figure "Fixing the DLM5-260 Connector (Example)" on page 54).

DLM5-260
position "open"

DLM5-260
position "closed"

Abb. 5-2 Fixing the DLM5-260 Connector (Example)

Note

The connectors LOAD (load/signal box side connectors) and ECU (ECU side connectors) are not protected against erroneous insertion (wrong side, etc.). The user has to take care to insert the connectors on the correct sides. ***It is not allowed to connect an ECU to the LOAD connector or to connect a load/signal box to the ECU connector.***

5.3 Connectors LOAD (2) and ECU (2)

KPTC22-55 type connectors from ITT Cannon are used for signals up to 40 A. The mating connector has a bayonet catch. Safe contact is only ensured after the bayonet has been locked.

Note

The connectors LOAD (load/signal box side connectors) and ECU (ECU side connectors) are not protected against erroneous insertion (wrong side, etc.). The user has to take care to insert the connectors on the correct sides.
It is not allowed to connect an ECU to the LOAD connector or to connect a load/signal box to the ECU connector.

5.4 Jumpers

Different jumpers – 2 mm and 4 mm contacts – are employed depending on the current specification of the signals. The 2 mm system is used for signals up to 7,5 A while the 4 mm system is used for signals exceeding 7,5 A.

In both systems, the jumpers include center tabs that enable the user to short-circuit signals via cable jumpers or to connect external measuring systems.

5.4.1 Signal Channel Labels

As the breakout frontpanel of the ES4441.1 Compact Error Simulation Module is designed for use in combination with the ETAS ES4500 Component Rack, the standard labels of the individual signal channels are based on the layout of the ES4500 backplane. The signal channels relevant to the control unit start at channel #67. The labels of the individual signal channels are located below (signals up to 7,5 A) or above (signals exceeding 7,5 A) of the associated jumper (see Figure "Location of the Channel Label" on page 56).

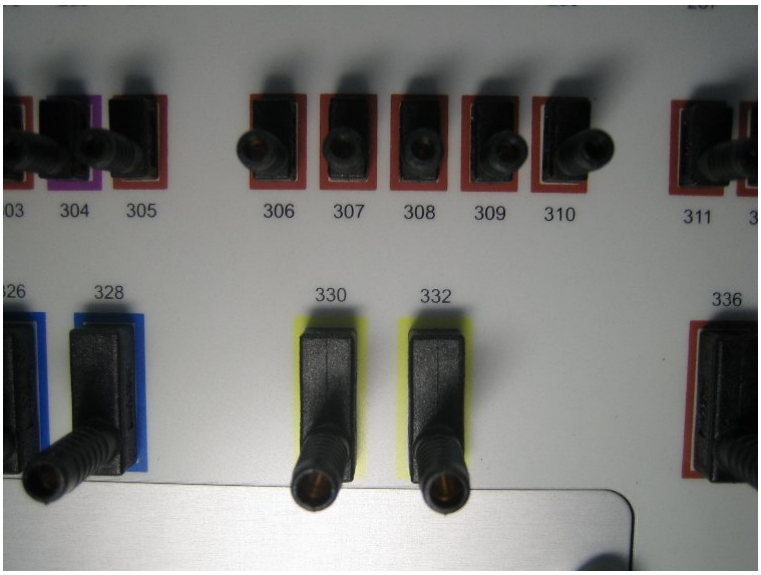


Abb. 5-3 Location of the Channel Label

A customized front panel can be mounted if the user prefers different labels. Depending on the particular type, lab jacks that are not in use can be masked. The panel is made of 1 mm thick anodized aluminum. The labels are printed. The panel is mounted using the existing screws.

The customized front panel is available as an option.

5.4.2 Layout of the Lab Jacks

Two lab jacks are used for each signal channel and jumper. The upper lab jack connects the control unit (ECU) while the lower lab jack connects the component rack (LOAD) / signal box (see Figure "Layout of the Lab Jacks" on page 57).

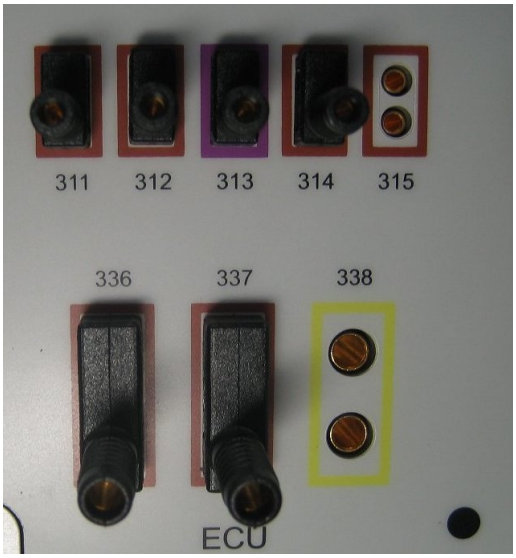


Abb. 5-4 Layout of the Lab Jacks

5.5 Safety Measures

The over current protection of the 15A, 20A and 40A channels of the ES4441.1 Compact Error Simulation Module is realised by fuses. These are standard blade fuses used commonly in the automotive environment.

5.5.1 Overview Fuses:

Be sure to use only the following fuses:

Type	Littelfuse MINI Blade Fuse 32 V
Voltage rating	32 V
Part numbers	0297015 (15 A) 0297020 (20 A)

CAUTION!

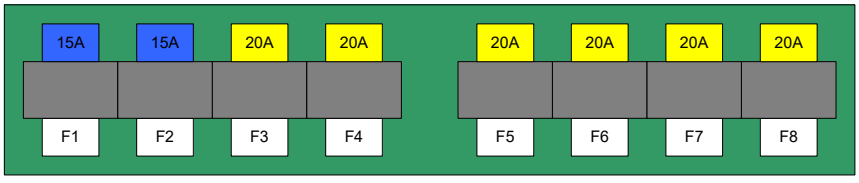
To avoid injury and damage, observe the following: Only use the silver plated and certified variant of the above described fuses.

The following table shows the assignment of the Fuses to the error channels of the ES4441.1.

Fuse*	Function	Specification
F1	Protects channel 326	15 A
F2	Protec ts channel 328	15 A
F3	Protects channel 332	20 A
F4	Protects channel 330	20 A
F5	Protects channel 338	20 A
F6	Protects channel 339	20 A
F7	Protects channel 340	20 A
F8	Protects channel 340	20 A

* For details on the position of the fuses, please refer to the figure in the section "To change fuses" on page 60.

The fuses have sockets and can be replaced easily. The fuse compartment has a 1 mm aluminum cover. The mounting position of the fuse holders in use compartment is shown in the following figure.



5.5.2 Changing Fuses

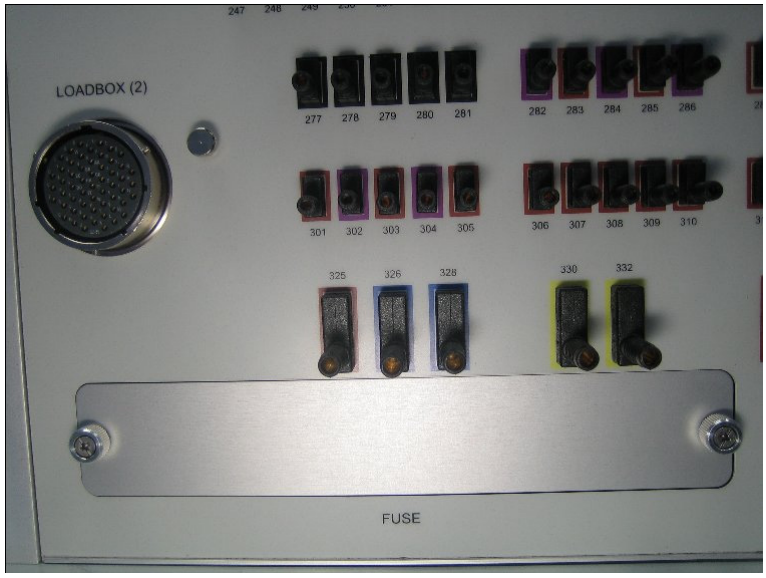
If you discover that one of the fuses is defective, proceed as follows:

Before opening the housing

1. Switch off the device.
2. Remove all connected lines.

To remove the fuse compartment from the front plate

1. Remove the two screws shown in the figure from the fuse compartment cover.



2. Remove the fuse compartment cover.

   The eight fuses of the error channels can now be easily accessed.

To change fuses

1. Use a flat-nose plier to remove the defective fuse from its mount (see figure).

2. Slide the new fuse into the holder.

To mount the fuse compartment cover on the front plate

1. Place the use compartment cover panel in the position intended.
2. Now tighten the screws you removed before.

Note

Be sure to use 15 A and 20 A rated fuses only. Using fuses with higher ratings will void the warranty.

5.6 Signal Routing

In general, all connections between the LOAD(1),(2) and ECU(1),(2) connectors of the ES4441.1 Compact Error Simulation Module are point-to-point links that can be opened with the use of jumpers and relays.

Note

It is not possible to use error channels 327, 329, 331 and 333, because this channels are combined with other channels (see "Table of the High Current Signals" on page 73).

5.6.1 Channels 262 to 274

The connections of error channel 262 to 274, between the LOAD(1) and ECU(1) connectors can only be opened with the use of jumpers and not with the use of relays.

5.6.2 Channel 326

The Error Channel 326 is combined with Error Channel 327. The Error Channel 326 is routed over the 326 lab jack and split to two contacts on each of the LOAD(2) and ECU(2) Connectors (see "Table of the High Current Signals" on page 73). In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.

5.6.3 Channel 328

The Error Channel 328 is combined with Error Channel 329. The Error Channel 328 is routed over the 328 lab jack and split to two contacts on each of the LOAD(2) and ECU(2) Connectors (see "Table of the High Current Signals" on page 73). In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.

5.6.4 Channel 330

The Error Channel 330 is combined with Error Channel 331. The Error Channel 330 is routed over the 330 lab jack and split to four contacts on each of the LOAD(2) and ECU(2) Connectors (see "Table of the High Current Signals" on page 73). In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.

5.6.5 Channel 332

The Error Channel 332 is combined with Error Channel 333. The Error Channel 332 is routed over the 332 lab jack and split to four contacts on each of the LOAD(2) and ECU(2) Connectors (see "Table of the High Current Signals" on page 73). In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.

5.6.6 Channel 338

The Error Channel 338 is routed to the 338 lab jack and split to three contacts on each of the LOAD(2) and ECU(2) Connectors. In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.

5.6.7 Channel 339 (+UBatt)

The Error Channel 339 is routed to the +UBatt lab jack and split to three contacts on each of the LOAD(2) and ECU(2) Connectors. In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.
It is possible to simulate a loose contact of power channel (339) by switching the channel (setting of duty cycle and frequency) with the use of a MOSFET.

5.6.8 Channel 340 (-UBatt)

The Error Channel 340 is routed to two -UBatt lab jacks and split to six contacts on each of the LOAD(2) and ECU(2) Connectors. In addition, the LOAD(2) side can be disconnected from the ECU(2) side with the use of an relay.
It is possible to simulate a loose contact of ground channel (340) by switching the channel (setting of duty cycle and frequency) with the use of a MOSFET.
It is possible to simulate ground shift for channel 340 by setting the value of a resistor cascade.

Note

The error channels 334 and 335 do not exist (see "Table of the High Current Signals" on page 73)

6 Pin Assignment Back Side

This chapter contains the description of the pin assignment of the connectors of the ES4441.1 Compact Error Simulation Module.

These are:

6.1 "RAIL 1 & RAIL 2" Connectors

The Rail1 and Rail2 connector are used to cascade two or more ES4441.1 Compact Error Simulation Modules.

Type: Green Banana Jack (female)

6.2 "+UBATT 1 & -UBATT 1" Connectors

The +UBATT1 and –UBATT1 connectors are used for the connection of the first UBATT source.

Type: Red and Black Banana Jack (female)

6.3 "+UBATT 2& -UBATT 2" Connectors

The +UBATT2 and –UBATT2 connectors are used for the connection of the second UBATT source.

Type: Red and Black Banana Jack (female)

6.4 "IMESS 1 & IMESS 2" Connector

The current between the two error rails can be measured at the "Current" connectors. The direction of the current is unimportant which is why the two jacks are not defined more precisely.

Type: Yellow Banana Jack (female)

6.5 "LC-BRIDGE" Connector

The LC-BRIDGE connector is used as connector for an optional LC-Bridge.

Type: 17-Pin Power-DSUB Connector

6.6 "TRIGGER" Connector

The trigger signal for external triggering of errors and the synchronization signal for the master/slave operation of several ES4441.1 Compact Error Simulation Modules are pending at the "TRIGGER" connector.

Type: DSub 9-pin (male)

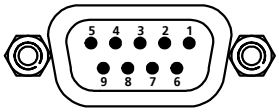


Abb. 6-1 "TRIGGER" Pin Assignments (View from Front of Housing)

Pin	Assignment	Pin	Assignment
1	Reserved	6	n.c.
2	n.c.	7	TRIGGER SIGNAL
3	n.c.	8	SYNC SIGNAL
4	TRIGGER GND	9	n.c.
5	SYNC GND	Hou-sing	PE

Tab. 6-1 "TRIGGER" Connector Pin Assignment

6.7 "Ethernet" Connector

The "Ethernet" connector is used for the Ethernet connection to the host system or an Ethernet switch. An Ethernet crossover cable has to be used for this connection.

Type: RJ45 FEMALE CONNECTOR

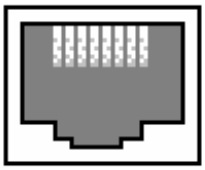


Abb. 6-2 "Ethernet" Connector

7 Pin Assignment Front Side

The following Chapter describes the pin allocations of the connectors to the ES4500 Component Rack (“LOADBOX”) or signal box, and the connectors to the control unit ("ECU").

7.1 Connector Pin Allocations

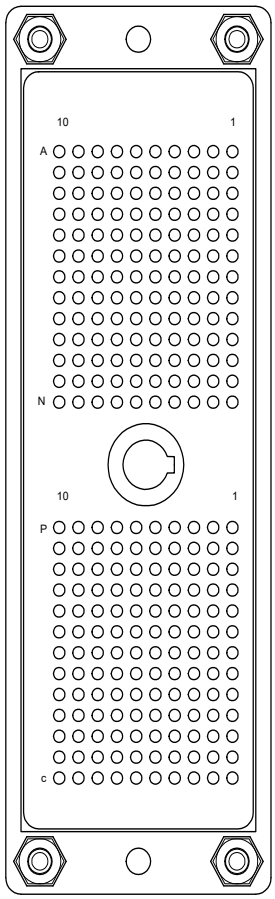


Fig. 7-1 260-pin ITT Cannon DLM5-260 Connector

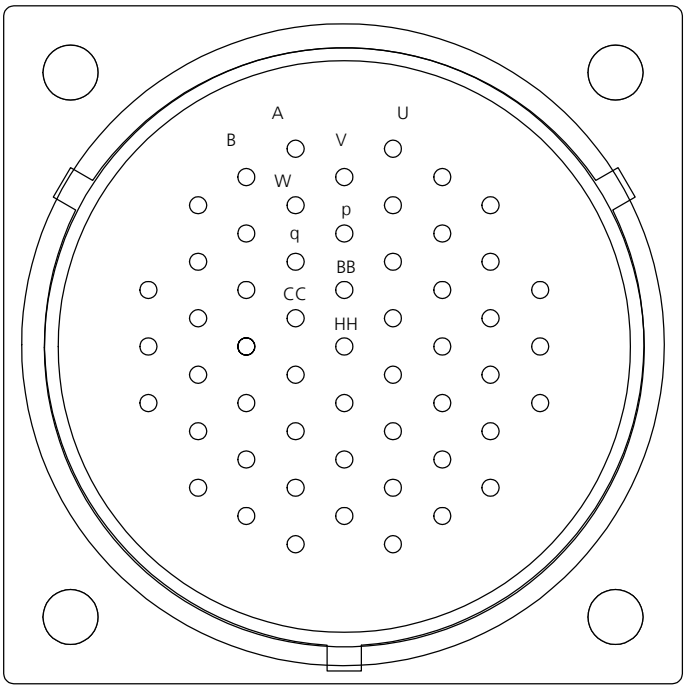


Fig. 7-2 ITT Cannon KPTC22-55 Connector

The following table shows the allocation of the signal channels to the corresponding connector pins:

Channel	Max. Current [A]	ITT Cannon DLM5-260
67	1	C10
68	1	C9
69	1	C8
70	1	C7
71	1	C6
72	1	C5
73	1	C4
74	1	C3
75	1	C2
76	1	C1
77	1	D10
78	1	D9
79	1	D8
80	1	D7
81	1	D6
82	1	D5

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
83	1	D4
84	1	D3
85	1	D2
86	1	D1
87	1	E10
88	1	E9
89	1	E8
90	1	E7
91	1	E6
92	1	E5
93	1	E4
94	1	E3
95	1	E2
96	1	E1
97	1	F10
98	1	F9
99	1	F8
100	1	F7
101	1	F6
102	1	F5
103	1	F4
104	1	F3
105	1	F2
106	1	F1
107	1	G10
108	1	G9
109	1	G8
110	1	G7
111	1	G6
112	1	G5
113	1	G4
114	1	G3
115	1	G2
116	1	G1
117	1	H10
118	1	H9

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
119	1	H8
120	1	H7
121	1	H6
122	1	H5
123	1	H4
124	1	H3
125	1	H2
126	1	H1
127	1	J10
128	1	J9
129	1	J8
130	1	J7
131	1	J6
132	1	J5
133	1	J4
134	1	J3
135	1	J2
136	1	J1
137	1	K10
138	1	K9
139	1	K8
140	1	K7
141	1	K6
142	1	K5
143	1	K4
144	1	K3
145	1	K2
146	1	K1
147	1	L10
148	1	L9
149	1	L8
150	1	L7
151	1	L6
152	1	L5
153	1	L4
154	1	L3

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
155	1	L2
156	1	L1
157	1	M10
158	1	M9
159	1	M8
160	1	M7
161	1	M6
162	1	M5
163	1	M4
164	1	M3
165	1	M2
166	1	M1
167	1	N10
168	1	N9
169	1	N8
170	1	N7
171	1	N6
172	1	N5
173	1	N4
174	1	N3
175	1	N2
176	1	N1
177	1	P10
178	1	P9
179	1	P8
180	1	P7
181	1	P6
182	1	P5
183	1	P4
184	1	P3
185	1	P2
186	1	P1
187	1	R10
188	1	R9
189	1	R8
190	1	R7

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
191	1	R6
192	1	R5
193	1	R4
194	1	R3
195	1	R2
196	1	R1
197	1	S10
198	1	S9
199	1	S8
200	1	S7
201	1	S6
202	1	S5
203	1	S4
204	1	S3
205	1	S2
206	1	S1
207	1	T10
208	1	T9
209	1	T8
210	1	T7
211	1	T6
212	1	T5
213	1	T4
214	1	T3
215	1	T2
216	1	T1
217	1	U10
218	1	U9
219	1	U8
220	1	U7
221	1	U6
222	1	U5
223	1	U4
224	1	U3
225	1	U2
226	1	U1

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
227	1	V10
228	1	V9
229	1	V8
230	1	V7
231	1	V6
232	1	V5
233	1	V4
234	1	V3
235	1	V2
236	1	V1
237	1	W10
238	1	W9
239	1	W8
240	1	W7
241	1	W6
242	1	W5
243	1	W4
244	1	W3
245	1	W2
246	1	W1
247	1	X10
248	1	X9
249	1	X8
250	1	X7
251	1	X6
252	1	X5
253	1	X4
254	1	X3
255	1	X2
256	1	X1
257	1	Y10
258	1	Y9
259	1	Y8
260	1	Y7
261	1	Y6
262	1	Y5

Tab. 7-1 Table of Low Current Signals

Channel	Max. Current [A]	ITT Cannon DLM5-260
263	1	Y4
264	1	Y3
265	1	Y2
266	1	Y1
267	1	Z10
268	1	Z9
269	1	Z8
270	1	Z7
271	1	Z6
272	1	Z5
273	1	Z4
274	1	Z3
275	1	Z2
276	1	Z1
277	1	a8
278	1	a7
279	1	a6
280	1	a5
281	1	a4

Tab. 7-1 Table of Low Current Signals

Chan-nel	Max. current [A]	ITT Cannon DLM5-260	ITT Cannon KPTC22-55
282	3	a1	
283	7,5		A
284	3	a10	
285	7,5		U
286	3	b1	
287	7,5		B
288	3	b9	
289	7,5		V
290	3	b10	
291	7,5		T
292	3	c1	
293	7,5		C
294	3	c2	
295	7,5		W
296	3	c3	
297	7,5		n
298	3	c4	
299	7,5		S
300	3	c5	
301	7,5		X
302	3	c6	
303	7,5		p
304	3	c7	
305	7,5		m
306	7,5		Y
307	7,5		q
308	7,5		AA
309	7,5		k
310	7,5		D
311	7,5		r
312	7,5		BB
313	3	c8	
314	7,5		z
315	7,5		R
316	3	c9	

Tab. 7-2 Table of the High Current Signals

Chan-nel	Max. current [A]	ITT Cannon DLM5-260	ITT Cannon KPTC22-55
317	7,5		Z
318	7,5		CC
319	3	c10	
320	7,5		GG
321	7,5		i
322	7,5		E
323	7,5		s
324	7,5		HH
325	7,5		y
326	15		P
327	combined w. Ch. 326		a
328	15		DD
329	combined w. Ch. 328		FF
330	20		i ; N
331	combined w. Ch. 330		x ; EE
332	20		t ; F
333	combined w. Ch. 332		b ; u
334			
335			
336	7,5		w
337	7,5		h
338	20		c ; v ; g
339	20		G ; d ; H
340	40		J ; e ; f ; K ; L ; M

Tab. 7-2 Table of the High Current Signals

8 Technical Data

This chapter contains the technical data of the ES4441.1 Compact Error Simulation Module.

8.1 General Technical Data

Error Channels

Number	255
Maximum permissible voltage	30 V
Maximum permissible current	
	1 A (Channel: 67 – 281) 3.0 A (Channel: 282 – .. – 319) 7.5 A (Channel: 283 – .. – 337) 15.0 A (Channel: 326, 328) 20.0 A (Channel: 330, 332, 338, 339) 40.0 A (Channel: 340)

General Resistor Cascade

Number of resistors	18
Smallest resistor	0.5 Ω
Largest resistor	64 kΩ
Accuracy low current path	±3% + 0.2 Ω
Accuracy high current path	±3% + 0.7 Ω
Max power dissipation	250 W (Sum of General and Ground Shift cascade)
Max. total resistance	Approx. 128 kΩ
Maximum permissible current through the cascade	12 A with R less than or equal to 0.5 Ω 6 A with R less than or equal to 1.0 Ω 4 A with R less than or equal to 2.0 Ω 3 A with R less than or equal to 4.0 Ω 2 A with R less than or equal to 8.0 Ω 1 A with R less than or equal to 16.0 Ω 0.5 A with resistance > 16.0 Ω

Ground Shift Resistor Cascade

Number of resistors	8
Smallest resistor	0.5 Ω
Largest resistor	4 Ω
Accuracy between LOAD and ECU connector	±3% + 0.2 Ω
Max power dissipation	250 W (Sum of General and Ground Shift cascade)
Max. total resistance	4 Ω
Maximum permissible current through the cascade	26 A with R = 0.5 Ω 24 A with R = 0.57 Ω 20 A with R = 0.66 Ω 16 A with R = 0.80 Ω 12 A with R = 1.0 Ω 10 A with R = 1.33 Ω 6 A with R = 2.0 Ω 3 A with R = 4.0 Ω

Channel Crosstalk

Max. crosstalk to a channel:	
	100 mV (40 A channels) 250 mV (20 A channels) 200 mV (15 A channels) 150 mV (7.5 A channels) 100 mV (3 A channels) 50 mV (1 A channels)1

Accuracy of the Current Measurement and Protection

Low current in rails	±3% of actual value ±20 mA
High current in rails	±3% of actual value ±400 mA
Current in channel 340	±3% of actual value ±800 mA

Channel Capacitance

The following table shows the maximum allowable capacitance between two channels

	1 A	3 A	7,5 A	15 A	20 A	40 A
1 A	500 pF	500 pF	1000 pF	1000 pF	1500 pF	1500 pF
3 A	500 pF	500 pF	1000 pF	1000 pF	1500 pF	1500 pF
7,5 A	1000 pF	1000 pF	1000 pF	1000 pF	1500 pF	1500 pF
15 A	1000 pF	1000 pF	1000 pF	1000 pF	1500 pF	1500 pF
20 A	1500 pF	1500 pF	1500 pF	1500 pF	1500 pF	1500 pF
40 A	1500 pF	1500 pF	1500 pF	1500 pF	1500 pF	1500 pF

Simulation of Loose Contacts

Duty cycle	0% - 100% at up to 25 kHz

Communication Interfaces

Ethernet	100 MBaud

Fuses

F1, F2	15 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
F3, F4, F5, F6, F7, F8,	20 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)

WARNING!

The device must not be operated with fuse cover open!

Electrical Data

Input voltage (mains frequency)	100 - 240 VAC (50 / 60 Hz)
Power input	250 W
Overvoltage category	II
Pollution degree	2

Mechanical Data

Height of the front panel	9 U
Width of the front panel	19"
Depth (incl. connectors)	490 mm
Weight	25.9 kg

Environmental Conditions

Environment	Use only inside enclosed and dry rooms
Permissible storage temperature	-20 °C to +85 °C (-4 °F to 149 °F)
Relative humidity	0 to 95 % (non-condensing)
Operating temperature	5 °C to 40 °C (41 °F to 104 °F)
Operating altitude	max. 2000 m / 6500 ft

8.1.1 Fuses

The fuses to be employed are "Minifuse" types manufactured by Littlefuse. The following ratings are used:

- 20 A (yellow)
- 15 A (blue)

8.1.2 Fuse power supply

The power supply features two 4AT glass pipe fuses (fine-wire fuse, Ø x L = 5 mm x 20 mm, 4 A, 250 V slow), which can be replaced by the user.

8.2 Accessories

- Connection cable ES4441.1 to ES4510
- Connection chord with 2 mm banana plug (black)
- Plug-in bridge 2 mm
- Plug-in bridge 4 mm
- Fuse 20 A
- Fuse 15 A
- Customized front panel
- English Manual:

  ES4441.1 Compact Error Simulation Module User's Guide

The accessories are available on request.

9 ETAS Contact Addresses

ETAS HQ

ETAS GmbH

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

ETAS Subsidiaries and Technical Support

For details of your local sales office as well as your local technical support team and product hotlines, take a look at the ETAS website:

ETAS subsidiaries	WWW:	www.etas.com/en/contact.php
ETAS technical support	WWW:	www.etas.com/en/hotlines.php

Index