ES4440.2 Compact Failure Simulation Module

User's Guide

Copyright

V1.2.0 R10 EN 11.2019

Contents

1 Introduction

This User's Guide contains a description of the ES4440.2 Compact Failure Simulation Module.

It consists of the following chapters:

- Introduction

  This chapter
- "Hardware Features" on page 19

  This chapter contains a detailed description of the features of the ES4440.2 Compact Failure Simulation Module.
- "Pin Assignment" on page 31

  This chapter contains a description and assignment of all connectors on the front panel and on the rear of the housing.
- "Technical Data" on page 49

  This contains details of the technical data of the ES4440.2 Compact Failure Simulation Module.

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 Identification of Safety Information

The safety instructions contained in this manual are identified by the general danger symbol shown below:

The safety instructions shown below are used for this purpose. They provide notes about extremely important information. Please read this information very carefully.

DANGER!

Identifies an immediate danger with high risk, which could result in death or severe bodily injury if it is not avoided.

WARNING!

Identifies a possible danger with medium risk, which could result in death or (severe) bodily injury if it is not avoided.

CAUTION!

Identifies a danger with low risk that could result in slight or moderate bodily injuries or property damage if it is not avoided.

1.1.2 General Safety Information

Please read the product safety advice ("ETAS 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 ("ETAS Safety Advice Housing" 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 Requirements for Users and Duties for Operators

The product may be assembled, operated and maintained only if you have the necessary qualifications and experience for this product. Improper use or use by a user without sufficient qualifications can put life at risk or cause damage to health or property.

Note

The safety of the system in which the ES4440.2 Compact Failure Simulation Module was installed is the responsibility of the person who assembled the system!

General Safety at Work

The existing regulations for safety at work and accident prevention must be followed.

1.1.4 Intended Use

The ES4440.2 Compact Failure Simulation Module is a standalone unit which electrically simulates faults in automotive ECUs in real time. The unit can also be installed as part of a hardware-in-the-loop test system.

The ES4440.2 Compact Failure Simulation Module consists of:

- A microcontroller which is part of the ES4440.2
  - The microcontroller is programmed with ETAS software
- An Ethernet and a CAN interface for the configuration and control of the ES4440.2
- Interfaces to feed in ECU signals
- An interface to synchronize several ES4440.2
- An interface for the connection of different voltages (e.g. T15, T30, T31,…)
  - The ES4440.2 can not generate these voltages
- A resistor cascade which is part of the ES4440.2

The ES4440.2 Compact Failure Simulation Module can be installed in a 19" rack system or can be used as a standalone unit.

The intended purpose of the ES4440.2 Compact Failure Simulation Module is for it to be used:

- To electrically simulate faults in ECUs.
- In industrial lab facilities or workplaces.
- For tests on engine test benches.
- For tests on chassis dynamometers.
- In stationary vehicles.
  - On private land.
- As an electric fault simulation unit for ECUs in a hardware-in-the-loop test system.
- In conjunction with ETAS software that supports the ES4440.2.
- As an interface together with software programs that operate the standardized, documented and open APIs of ETAS software products.

The ES4440.2 Compact Failure Simulation Module is **not** to be used:

- Within a vehicle on public roads.
- As part of a life support system.
- As part of a medical application.
- In applications in where misuse can lead to injuries or property damage.
- In environments in which conditions prevail that fall outside the specified ranges (see "Ambient Conditions" on page 52)

Requirements for Operation

The following requirements are made to ensure safe operation:

- Only use the product according to the specifications in the corresponding user manual. If the product is used in any other way, product safety is no longer ensured.
- Observe the regulations applicable at the operating location concerning electrical safety as well as the laws and regulations concerning occupational safety.
- Do not use the product in a wet or damp environment.
- Do not use the product in potentially explosive atmospheres.
- Keep the surfaces of the product clean and dry.

Requirements for the Technical State of the Product

The product is designed in accordance with state-of-the-art technology and recognized safety rules. The product may be operated only in a technically flawless condition and according to the intended purpose and with regard to safety and dangers as stated in the respective product documentation. If the product is not used according to its intended purpose, the protection of the product may be impaired.

In order to operate the ES4440.2 Compact Failure Simulation Module safely, you must observe the section "General Instructions on Operating the ES4440.2" on page 8.

1.2 General Instructions on Operating the ES4440.2

Please note the following when operating the device:

Transport/Installation

The ES4440.2 Compact Failure Simulation Module weighs 14 kg. Only lift or carry the housing with two people.

Power Supply Cord

The respective requirements for the power supply cord, which vary according to regional differences in the power supply, and the ETAS order number can be found in the user manual. To avoid injuries and damage to hardware, please only use the power supply cord specified here.
Use only primary power cables in accordance with IEC 60320 with a C13 plug at one end and a non-locking plug approved according to national safety standards at the other end. Plug and cable must be rated for at least 250 VAC/10 A or 125 VAC/15 A.

Insulation requirements for lab power supplies to circuits connected to the HIL system:

- The power supply to connected circuitry must be safely separated from the supply voltage. For example, use a car battery or a suitable lab power supply.
- Only use lab power supplies with dual protection for the supply network (with double/reinforced insulation (DI/RI)). This requirement is met by lab power supplies which comply with IEC/EN 60950 or IEC/EN 61010.
- The lab power supply must be approved for use at a height of 2000 m and in ambient temperatures of up to 40 °C.

Connecting Cables

Use only approved cables for creating cable assemblies (e.g. for connecting the ECU and external loads).

Note

The cables used must be suitable particularly for the occurring currents, voltages and temperatures and flame-retardant in accordance with one of the following standards IEC60332-1-2, IEC60332-2-2, UL2556/UL1581VW-1.

Grounding/Grounding Contact

The ES4440.2 is grounded by the protective conductor of the power supply cord. Avoid the danger of electric shock when touching housing components by ensuring that the power connection used has properly connected grounding contacts.

DANGER!

Risk of electric shock!
If no proper grounding via the PE conductor is available, housing components that can be touched could be live. This can cause serious or fatal injuries! For this reason, it must be ensured that the power cable features correctly connected grounding contacts!

Supply Voltage Disconnect Device

The power cord serves as a supply voltage disconnect device.

Note

The power cord must be easy to access! It must not be longer than 3 m.

Opening the Housing

DANGER!

Risk of electric shock!
There could be extremely dangerous high voltages at the individual pins of the "ECU HV" and "LOAD HV" connections. Therefore you should only open the housing when the device has been disconnected from the mains power and all other connections have been removed.

Fuses

The module must not be operated when the fuse box lid is open. To avoid injuries and damage, only fuses specified in the user manual may be used. The corresponding requirements and the ETAS order numbers can be found in the section "Safety Concept" on page 27.

Air Supply

Do not cover the ventilation slots of the device under any circumstances! If required, forced cooling must be implemented when the device is installed in a 19" rack. The ventilation openings must have a distance of at least 15 cm to walls or objects in the environment. Keep a distance of at least 1 RU to the next module at the top and bottom.

Cleaning

Clean the device only with a dry cloth. Do not use any cleaning agents or solvents.

Maintenance

The device does not require any separate maintenance from the user.

Repairs

In the case of a malfunction, the device needs to be shut down, secured against being switched on again and sent to ETAS to be repaired.

1.3 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 10)
	Marking for KCC conformity (see "KC Mark" on page 10)
	Identification for China RoHS (see "RoHS Conformity" on page 10)
	Identification for WEEE directive (see "Taking the Product Back and Recycling" on page 12)

Observe the information in chapter "Technical Data" on page 49.

1.3.1 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.

1.3.2 KC Mark

With the KC mark attached to the product and its packaging, ETAS confirms that the product has been registered in accordance with the product-specific KCC guidelines of the Republic of Korea.

1.3.3 RoHS Conformity

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.

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.

1.4 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 55).

1.5 Materials Subject to Declaration

Some products from ETAS GmbH (e.g. modules, boards, cables) use components with materials that are subject to declaration in accordance with the REACH regulation (EC) no.1907/2006. Detailed information is located in the ETAS download center in the customer information "REACH Declaration" (www.etas.com/Reach). This information is continuously being updated.

1.6 Applications

The ES4440.2 Compact Failure Simulation Module is used for real-time failure simulation for ECUs. It is intended for use in a HiL system, but can also be used as a stand-alone system, e.g. for

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

WARNING!

The ES4440.2 Compact Failure Simulation Module is not intended for operation in a traveling vehicle!

The ES4440.2 Compact Failure Simulation Module is a 19" housing with 3 U which can be assembled in a rack using the corresponding mounts. Fig. 1-2 shows the front panel (with mounts for rack assembly) and the rear of the ES4440.2.

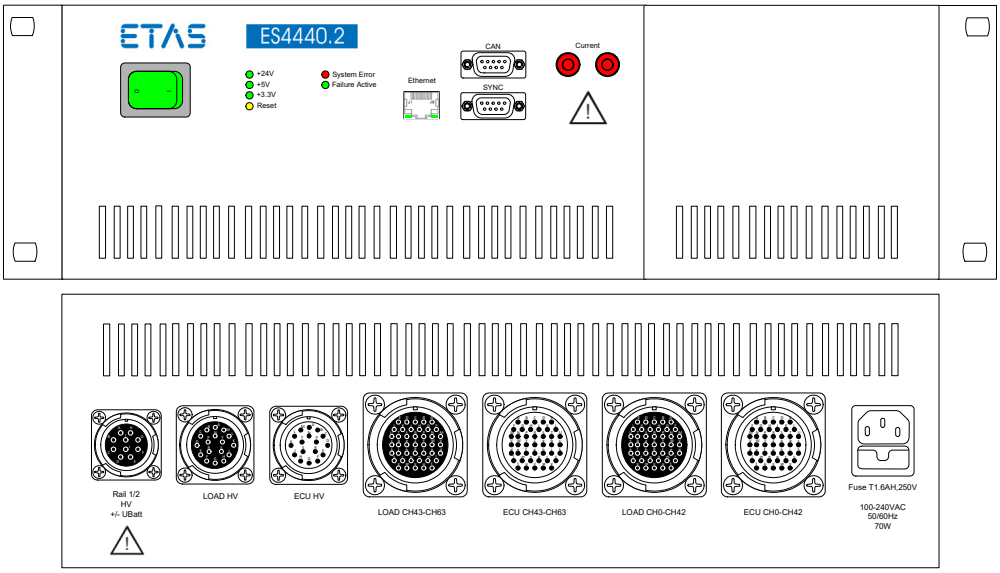


Fig. 1-2 Front View (Top) and Rear View (Bottom) of the ES4440.2 Compact Failure Simulation Module

The ES4440.2 Compact Failure Simulation Module is addressed via the Ethernet or CAN interface. The LABCAR-PINCONTROL software provided offers simple and user-friendly interfaces for operating and configuring the ES4440.2 via Ethernet.

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

1.7 Functions and Features

This section provides a short overview of the functions and features of the ES4440.2 Compact Failure Simulation Module. A detailed description can be found in the chapter "Hardware Features" on page 19.

1.7.1 Failure Simulation

The ES4440.2 Compact Failure Simulation Module makes it possible to simulate failures in real time for 80 ECU channels (per ES4440.2).

High-Current Channels

64 of these channels are for voltages up to 30 V and currents up to 20 A – the following failures can be simulated for these 64 channels:

- Open load
- Short to +UBatt_A, -UBatt_A, +UBatt_B, -UBatt_B with or without connected load
- Contacts between lines with and without resistance ("Pin-to-Pin") with or without connected load
- Line resistance ("In-Line")
- Pull-up resistance to +UBatt_A or +UBatt_B with or without connected load
- Pull-down resistance to -UBatt_A or -UBatt_B with or without connected load

Note

An failure can only be applied for a maximum of five minutes – after this time, the overtemperature protection facility may be activated. When using the resistor cascade, please ensure that the ratio "power-on time/cooling time" is 25% or less.

High-Voltage Channels

A further 16 channels are for voltages up to 80 V RMS and currents up to 10 A – the following failures can be simulated for these 16 channels:

- Open load
- Short to +UBatt_C and -UBatt_C with or without connected load
- Contacts between lines ("Pin-to-Pin") with or without connected load

Note

The high-voltage channels are only suitable for connecting magnetic valves and piezo injectors (pulsating direct current voltage)! The maximum permissible voltage is 250 V with a maximum pulse duration of 100 ms.

Time Response

The difference between switching an failure 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 failure in the software to switching: MOSFET 200 µs, relay 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 a failure mode, the delay between setting the failure 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 failure actually occurs and also, for example, the duration of the failure 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 14-bit cascade with resistors from 2 Ω to 16384 Ω, with which resistances from 2 Ω to approx. 32 kΩ can be displayed in 2 Ω intervals. For more information on the resistor cascade, refer to the section "Resistor Cascade" on page 24.

1.7.2 Connectors, Displays and Fuses

Connectors on the Front Panel and Rear

The ES4440.2 Compact Failure Simulation Module has several connectors on the front and rear for connecting the ECU and loads, addressing the ES4440.2 and for master/slave operation.

The following connectors are on the front panel:

- Connector for synchronization signals when using several ES4440.2s in master/slave operation ("”SYNC” Connector" on page 31)
- Connector for CAN bus ("”CAN” Connector" on page 32)
- Connector for Ethernet ("”Ethernet” Connector" on page 32)
- Connector for measuring currents between the two failure rails with the failure modes ”Pin-to-Pin Resistance”, ”Inline Resistance” and ”Leakage Current” ("”Current” Connector" on page 33)

The following connectors are on the rear:

- Connector for connecting the failure rails when using several ES4440.2s in master/slave operation ("”Rail 1/2” Connector" on page 33)
- Connector for the 16 high-voltage ECU signals ("”ECU HV” Connector" on page 33)
- Connector for the load to the channels above ("”LOAD HV” Connector" on page 35)
- Connector for the 64 high-current ECU signals ("”ECU CH0-CH42” / ”ECU CH43-CH63” Connector" on page 36)
- Connector for the load to the channels above ("”LOAD CH0-CH42” / ”LOAD CH43-CH63” Connector" on page 40)
- Mains connection with integrated fuse

Status Displays via LEDs on the Front Panel

There are several LEDs on the front panel of the ES4440.2 Compact Failure Simulation Module which provide information on operating states of the ES4440.2 and the communication interfaces. For more details on the LEDs, refer to the section "Status Displays via LEDs on the Front Panel" on page 24.

Fuses

The ES4440.2 Compact Failure Simulation Module is protected against overcurrents with fuses. When a reset[1] takes place, the fuse state is queried and transferred to the control software. The fuse monitor is designed so that there are no disturbing influences on the ECU signals.

For more details on the fuses used and how to change them, refer to the section "Safety Concept" on page 27.

1.7.3 Application Environment

Master/Slave Operation of Several ES4440.2 Systems

If greater demands are made of the number of channels than can be catered for with one ES4440.2 Compact Failure Simulation Module (64 + 16), you can use several ES4440.2s. A dedicated master synchronizes failure simulation on the connected slave systems.

This takes place by connecting the failure rails and the synchronization lines of the ES4440.2s involved and assigning corresponding IP addresses in the operating software LABCAR-PINCONTROL.

Communication Interfaces

The ES4440.2 Compact Failure Simulation Module has interfaces for communication via the Ethernet and CAN protocol. The relevant APIs are described in the LABCAR-PINCONTROL User's Guide.

When using the LABCAR-PINCONTROL software on a host system, communication takes place by Ethernet – otherwise the ES4440.2 can also be controlled using a CANbus.

In addition, it is also possible to realize complex hardware configurations in a HiL system with a real-time PC as simulation target and an ES600 Network Module (see the chapter "Accessories" on page 45).

Note

Using the LABCAR-PINCONTROL software requires communication by Ethernet between the host and the ES4440.2.

LABCAR-PINCONTROL

LABCAR-PINCONTROL (Version 2.0 and higher) provides an easy-to-use user interface in which all failures can be activated and reset.

LABCAR-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)

1. When a reset takes place, all relays are set to a state in which no failures are switched any more.

- Signal lists with all signals of a selected failure set. This is where the signal is selected for which an failure is to be simulated.
- Display of all available failures for a selected signal in one window
- Failures are selected in this window by mouse click
- Settings of the desired failure duration
- Triggering the failure by mouse click
- Configuration of the Ethernet and CAN interface
- Configuration for master/slave operation
- Self-test and fuse test
- Automated control (with the LABCAR-PINCONTROL controller)

1.7.4 Block Diagram

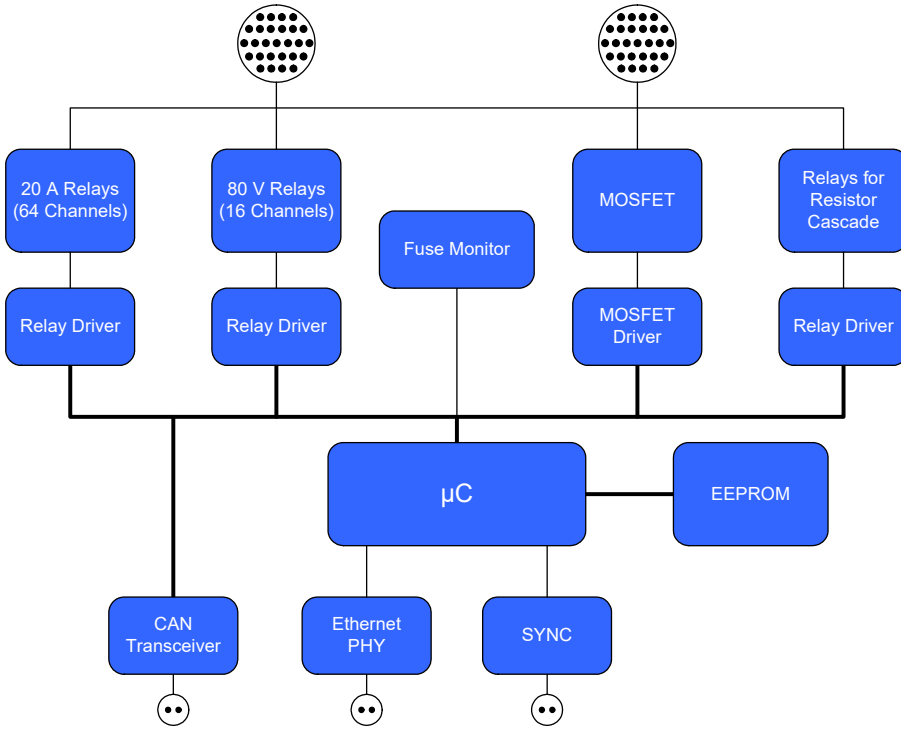


Fig. 1-3 Block Diagram of the ES4440.2 Compact Failure Simulation Module

The core of the ES4440.2 Compact Failure Simulation Module is a micro-controller (µC) with an integrated Ethernet controller – the µC is connected directly to Ethernet-PHY. A CAN transceiver acts as a second interface to control the ES4440.2.

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

A further feature is the fuse monitoring by the µC.

2 Hardware Features

This chapter contains detailed information on the features of the ES4440.2 Compact Failure Simulation Module.

These are:

2.1 Failure Simulation for 80 Channels

The ES4440.2 Compact Failure Simulation Module has 64 channels which are equipped for a continuous current of 20 A (at 30 V) and 16 channels for a voltage of 80 V RMS at 10 A current rating.

This number of ECU channels is sufficient if only outputs of engine ECUs (gasoline or diesel) have to be tested. If, however, inputs are to be tested simultaneously, two or more ES4440.2s are used in master/slave operation (see section 2.6 on page 25).

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

2.2 Failure modes

In the following description of all available failures, the failures are shown separately according to the type of channel (high-voltage or high-current channels).

2.2.1 Failures for High-Voltage Channels

The following figure shows

- the failures which can be realized on the 16 high-voltage channels,
- whether several failures can be activated simultaneously,
- the settable duration of the failure state and
- whether this failure can also be realized in PWM control as a loose contact.

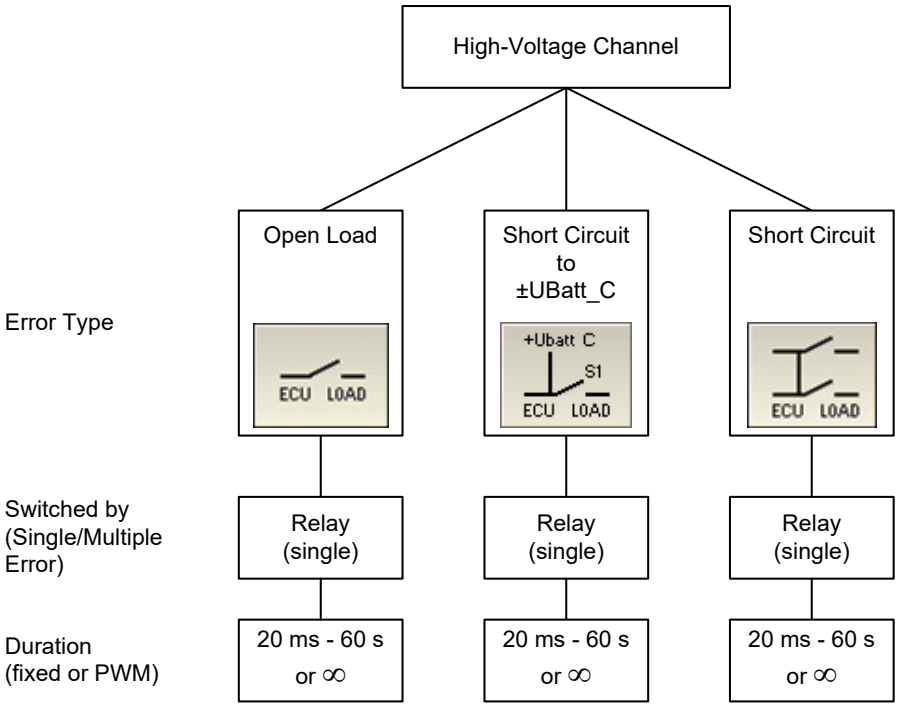


Fig. 2-1 Failures for High-Voltage Channels

2.2.2 Failures for High-Current Channels

The following figure shows

- the failures which can be realized on the 64 high-current channels,
- whether these are switched by relay or MOSFET,
- whether several failures can be activated simultaneously,
- the settable duration of the failure state and
- whether this failure can also be realized in PWM control as a loose contact.

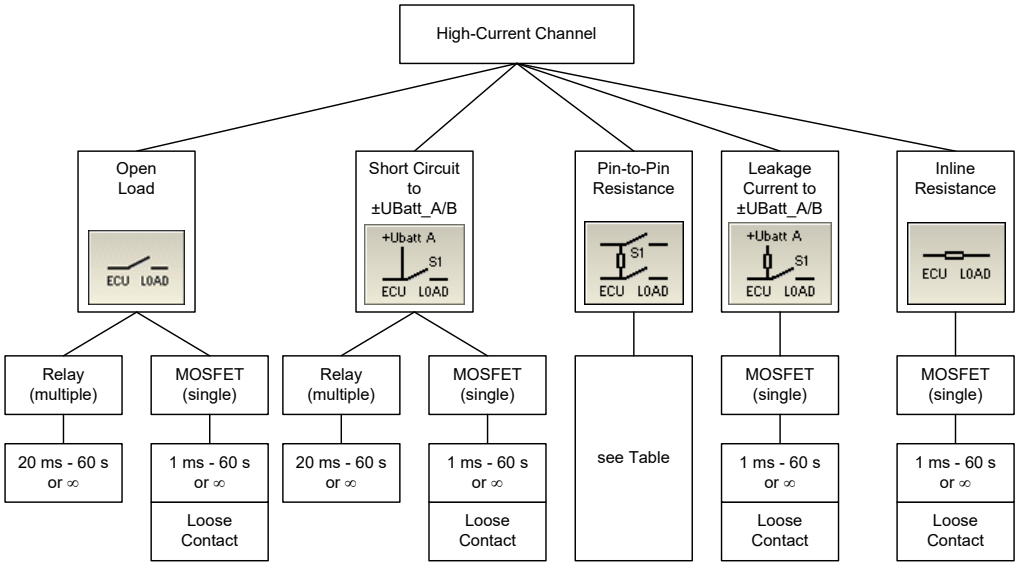


Fig. 2-2 Failures for High-Current Channels

The situation is slightly more complicated for the failure mode "Pin-to-Pin Resistance" – depending on whether the load is connected and whether there is finite resistance between the pins. Tab. 2-1 shows the underlying conditions for the possible configurations.

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

Tab. 2-1 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 failure simulation or not.

The fourth column tells you whether a loose contact can be simulated or not in each particular case. The last column lists whether the current path has a fuse for each particular case. In a non-protected case, make sure that the maximum permissible current of 20 A is not exceeded, e.g. by a current limitation in the power supply or by protecting the output stages accordingly.

2.2.3 Relay or MOSFET

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

Please note, however, that failure modes which are switched via MOSFETs, can only be realized individually (see Fig. 2-1 on page 20 and Fig. 2-2 on page 21).

Relay Specifications

The relays and the conductors of the ES4440.2 are designed to simulate failures with ECUs – usually, the corresponding output stages are disabled only a few µs after an failure has occurred.

Currents of 20 A (high-current channels) are possible in continuous operation – in addition, the current paths are protected with fuses (exception: see row 4 in Tab. 2-1).

2.2.4 Duration of the Failure State

The period of time for which an failure is active can be of interest for measuring latencies of the diagnostic system. For example, the ES4440.2 can simulate a specific failure for 20 ms, but the ECU software requires at least 30 ms to generate an failure memory entry.

The required duration of the failure state is set in the LABCAR-PINCONTROL user interface. The selectable duration is between 20 ms and 60 s for relays and between 1 ms and 60 s for MOSFETs – it can be set in intervals of 20 ms for relays or 1 ms for MOSFETs.

2.2.5 Simulating Loose Contacts

Certain types of failure on high-current channels can not only be realized as failures with a defined duration but also as loose contacts. These failures are controlled by a pulse-width modulation with a switching frequency of 3 Hz - 100 Hz and a duty cycle of 1% - 99% (2 Hz with a duty cycle of 50%).

2.2.6 Number of Possible Active Failure States

With failures which are switched by relays, a maximum of ten failures 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 failures at the same time – these cannot, however, be selected freely. If you are using LABCAR-PINCONTROL for failure simulation, failures which cannot be selected are excluded from the selection in the user interface.

If, however, you address the ES4440.2 automatically by Ethernet or CAN, you should ensure that the selected types of failure are also possible simultaneously as otherwise an failure message will be issued. Take a look at Fig. 2-3 to see which failures can be activated at the same time.

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

Open Load	-	●	●	●	●
Short Circuit to +UBatt_A (Rail 1)	Load connected	●			
	Load disconnected	●			
Short Circuit to +UBatt_B (Rail 2)	Load connected		●		
	Load disconnected		●		
Short Circuit to -UBatt_A (Rail 1)	Load connected			●	
	Load disconnected			●	
Short Circuit to -UBatt_B (Rail 2)	Load connected				●
	Load disconnected				●

Fig. 2-3 Failures Which Can Be Simulated Simultaneously

2.2.7 Decoupling the Load before Failure Activation

Normally the ES4440.2 is switched between the ECU and the LABCAR or between the ECU and the real vehicle. The following takes place to ensure that no channels of the LABCAR or components of the real vehicle are destroyed by shorts: if an failure is switched *without a load*, the connection to the load is interrupted *before* the failure is activated.

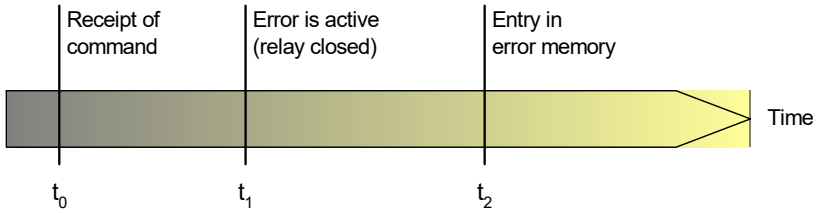
2.2.8 Measuring the Current

When failures are simulated in which both failure 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 front panel and measuring is activated with the command `CurrentMeasurement()`
(see "LABCAR-PINCONTROL V–User's Guide").

2.3 Time Response

If you are using mechanical relays and have to determine how long an failure has to be active ($(t_2 - t_1)$ in the figure) until an entry is made in the failure 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 failure is set, measuring this activation time is executed on a reference relay and transferred to the host in the command response.

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

2.4 Resistor Cascade

To simulate contact corrosion and crosstalk between ECU channels, the ES4440.2 Compact Failure Simulation Module has a cascade of 14 resistors with which resistances of 2 Ω to approx. 32 kΩ can be generated (in 2 Ω intervals).

The individual resistors are activated (relay open) or bridged by 20 A relays. The cascade consists of the following resistance values: 2, 4, 6, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096, 8192 and 16384 Ω.

The maximum permissible current depends on the voltage drop over the cascade – it is 3 A with a voltage drop of 14 V and 1 A with a voltage drop of 30 V. As an failure state is normally only ever active for a very short time, it is not a problem if these values are exceeded briefly.

If, however, overheating does occur, temperature sensors cause an failure message to be issued, the occurrence of which results in a system reset (see "Resetting on Overtemperature" on page 27).

2.5 Status Displays via LEDs on the Front Panel

There are several LEDs on the front panel of the ES4440.2 Compact Failure Simulation Module, the meaning of which is described in this section.

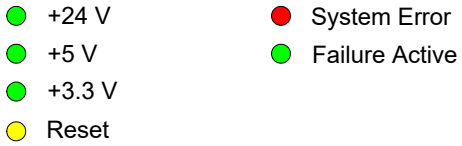


Fig. 2-4 LEDs on the Front Panel

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 Failure	Red	ES4440 system failure
Failure Active	Green	An failure state is active

Tab. 2-2 The Meaning of the LEDs on the Front Panel

2.6 Master/Slave Operation of Several ES4440.2 Systems

An ES4440.2 Compact Failure Simulation Module has 80 channels – this number is sufficient if, for example, failures are to be simulated for the outputs of an engine ECU.

If, however, inputs and outputs of an ECU are to be tested simultaneously, a second ES4440.2 Compact Failure Simulation Module is required.

In extreme cases, up to 15 slave systems can be connected to a master system. For this purpose, the following lines/signals of the master must be connected to the slave systems:

- The synchronization signals of the multiplexer relays ("SYNC" connector on the front panel, see Fig. 2-5 on the left)

  For details of the pin assignment of this connector, refer to section ""SYNC" Connector" on page 31.

- The lines of the failure rails ("Rail 1/2" connector on the rear of the device (Fig. 2-5 on the right)

  For details of the pin assignment of this connector, refer to section ""Rail 1/2" Connector" on page 33.

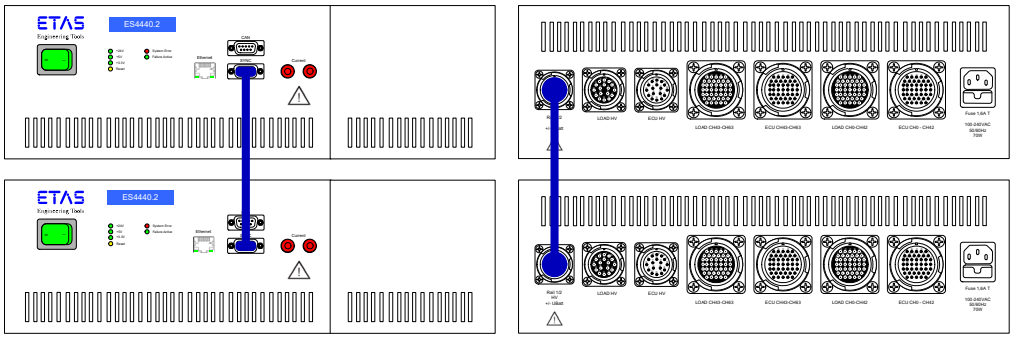


Fig. 2-5 Connecting the "SYNC" Lines and the Failure Rails

Multiple failure modes in an ES4440.2 are always switched simultaneously – in addition, the synchronization of all systems used in master/slave operation also ensures the simultaneous switching of the failure modes on all systems.

Note

In master/slave operation, either the reference voltages or the battery voltages must be connected to master and slave. Otherwise not all failure modes will be carried out correctly.

Note

Multiple failures of relays are also possible in master/slave operation. Send the respective configuration to the master and the slave. Then activate the failures.

Note

In case of relays failures, send also the command "Reset_all_errors" Otherwise the failure-LED of the slave might be on even after deactivation.

Note

Note that only one real time failure is allowed to be active in the system at a time. Otherwise pins can be short-circuited through the rail already during configuration.

Note

In master/slave operation the resistor cascade of the ES4440.2 is used, in which the failure occurred. In case of multiple failures the resistor cascade of the first failure pin is used.

2.6.1 IP Addresses and CAN Identifiers

If you are operating one or more ES4440.2 Compact Failure Simulation Modules with the operating software LABCAR-PINCONTROL provided, you can assign (freely selectable) IP addresses for the individual modules there and assign CAN identifiers for read and write operations.

In addition, 120 Ω terminating resistors for CAN can be activated via LABCAR-PINCONTROL in individual systems via relays.

2.7 Safety Concept

The ES4440.2 Compact Failure Simulation Module has protective mechanisms against overtemperature and overcurrents.

2.7.1 Resetting on Overtemperature

Note

When in operation, the temperature of the ES4440.2 Compact Failure Simulation Module is monitored at various points in the housing. If an overtemperature 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 Fig. 2-4 on page 24).
All relays are reset during a reset, i.e. all failures set are canceled. Set failures are not executed and acknowledged with an failure message as long as the overtemperature condition applies.
When software monitoring of the temperature fails, the internal power supply and all LEDs are powered off. If the temperature falls back under the threshold, the device is powered on again and a reset executed.

2.7.2 Protecting the Rails/Relays

To protect the relays and the entire circuit, the ES4440.2 Compact Failure Simulation Module has five fuses. These are standard blade fuses used commonly in the automotive environment.

Fuse*	Function	Specification
E1	Protects rail 2 against ±UBatt_B	20 A/32 V
E2	Protects rail 1 against rail 2	20 A/32 V
E3	Protects rail 1 against ±UBatt_A	20 A/32 V
E4	Protects the resistor cascade	3 A/32 V
E5	Protects the 80 V rail	10 A/80 V

* For details on the position of the fuses, please refer to the figure in the section "To change fuses" on page 29.

The 80 V channels are intended for injector or ignition signals. These signals are pulsed direct voltages with a pulse width of just a few milliseconds and with voltage peaks of up to 250 V. As the root mean square values of the voltages are under 80 V, a 10 A/80 V fuse can be used.

2.7.3 Automatic Monitoring of the Fuses

The state of the fuses can be monitored by an automatic application on the host system. The information is transferred via Ethernet or CAN (command: `test fuses()`)

This kind of automated monitoring takes place as follows:

1. Checking the state of the fuses
2. Applying an failure
3. Resetting the failure
4. Checking the state of the fuses

This procedure ensures that the fuses are intact during failure simulation.

To ensure that checking the fuses does not have any effect on the signals between the ECU and the load, the test circuit is only activated when the ES4440.2 is in reset mode.

2.7.4 Changing Fuses

DANGER!

Risk of electric shock!
There could be extremely dangerous high voltages at the individual pins of the "ECU HV" and "LOAD HV" connections. Therefore you should only open the housing when the device has been disconnected from the mains power and all other connections have been removed.

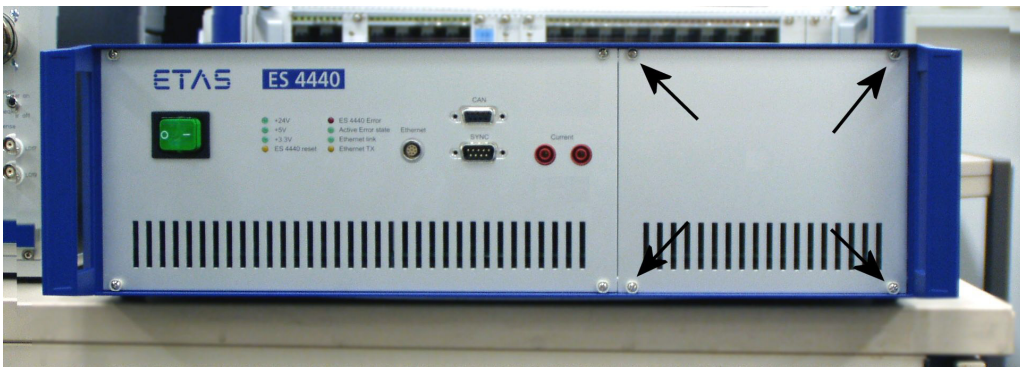
If you discover that one of the fuses is defective, proceed as follows:

Before opening the housing

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

To remove the right-hand front panel

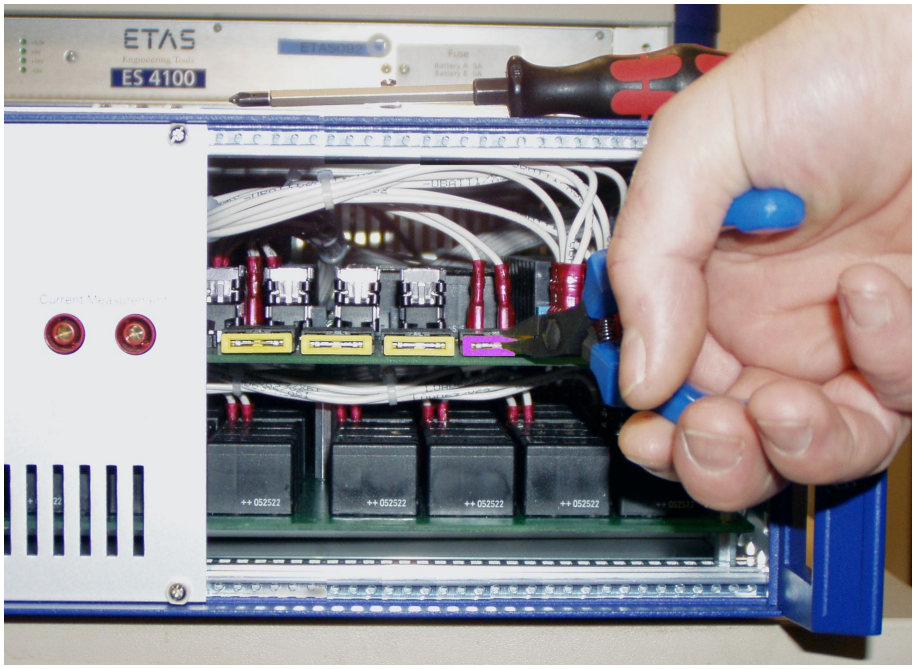
3. Remove the four screws shown in the figure from the right-hand front panel with a Phillips screwdriver.
4. Remove the front panel cover.



The five fuses of the failure rails can now be easily accessed (see the following figure).

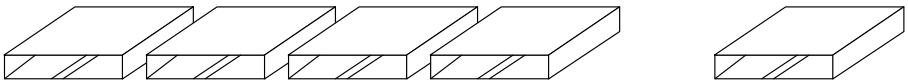
To change fuses

5. Use flat-nose pliers to remove the defective fuse from its mount (see figure).



6. Slide the new fuse into the holder.

   The mounting position of the fuse holders is shown in the following figure.



To replace the right-hand front panel

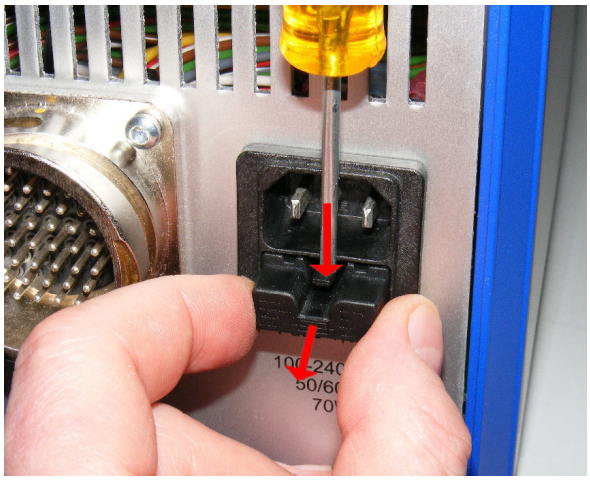
7. Place the front panel cover in the position intended.
8. Now tighten the screws you removed before.

2.7.5 Changing the Mains Fuses

The mains fuses (for the specification see "Fuses" on page 51) are on the back of the device in the IEC appliance inlet C14.

1. Remove the power cord.

2. Push down the tab (with a screwdriver) and pull out the fuse holder.



3. Change the defective fuse(s).
4. Slide the fuse holder back in until it clicks into position.
5. Reconnect the power cord.

3 Pin Assignment

This chapter contains the description of the pin assignment of the connectors of the ES4440.2 Compact Failure Simulation Module.

These are:

3.1 ”SYNC” Connector

The synchronization signals for the master/slave operation of several ES4440.2 Compact Failure Simulation Modules are pending at the ”SYNC” connector.

Type: DSub 9-pin (male)

Counterpart: DSub 9-pin (female)

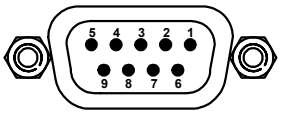


Fig. 3-1 ”SYNC” Pin Assignments (View from Front of Housing)

Pin	Assignment	Pin	Assignment
1	Reserved	6	n.c.
2	n.c.	7	n.c.
3	n.c.	8	Sync
4	n.c.	9	n.c.
5	GND	Housing	PE

Tab. 3-1 ”SYNC” Pin Assignment

3.2 "CAN" Connector

The signals for communication via the CANbus are pending at the "CAN" connector.

Type: DSub 9-pin (female)

Counterpart: DSub 9-pin (male)

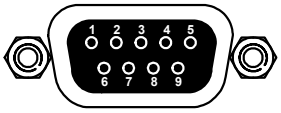


Fig. 3-2 "CAN" Pin Assignments (View from Front of Housing)

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

Tab. 3-2 "CAN" Pin Assignment

3.3 "Ethernet" Connector

The "Ethernet" connector is used for the Ethernet connection to the host system or an Ethernet switch.

Type: RJ45

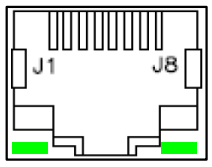


Fig. 3-3 "Ethernet" Pin Assignments (View from Front of Housing)

Pin	Signal	Meaning
1	TX+	send data, plus
2	TX-.	send data, minus
3	RX+	receive data, plus
4	n.c.	reserved
5	n.c.	reserved
6	RX-	receive data, minus
7	n.c.	reserved
8	n.c.	reserved

Tab. 3-3 "Ethernet" Pin Assignment

3.4 "Current" Connector

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

Type: Banana jacks

3.5 "Rail 1/2" Connector

The "Rail 1/2" connector is used to connect the two failure rails of a master to those of the connected slave systems and to connect to +/- U_Batt (A/B/C).

Type: ITT Cannon CA02COM-E18-1S-B-01 (female)

Counterpart: ITT Cannon CA06COM-E18-1P-B-01 (male)

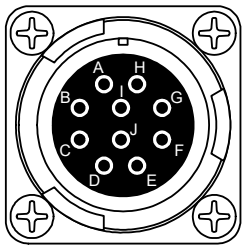


Fig. 3-4 "Rail 1/2" Pin Assignments

Pin	Assignment	Pin	Assignment
A	Rail 1	F	-UBatt_B
B	Rail 2	G	internal use
C	+UBatt_A	H	+UBatt_C
D	-UBatt_A	I	-UBatt_C
E	+UBatt_B	J	n.c.

Tab. 3-4 "Rail 1/2" Pin Assignment

3.6 "ECU HV" Connector

DANGER!

Risk of electric shock!
There could be extremely dangerous high voltages at the individual pins of the "ECU HV" and "LOAD HV" connections. Therefore you should only open the housing when the device has been disconnected from the mains power and all other connections have been removed.

The 16 high-voltage channels of the ECU are connected via these two connectors.

Type: ITT Cannon CA02COM-E20-29P-B (male)

Counterpart: ITT Cannon CA06COM-E20-29S-B (female)

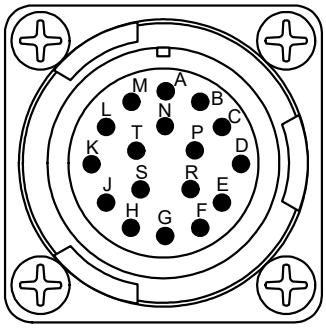


Fig. 3-5 "ECU HV" Pin Assignments

Note

The lines of the signals "ECU0" and "ECU1" ... "ECU14" and "ECU15" are all "twisted pairs"!

Pin	Signal	Internally Connected to Connector "LOAD HV" - Pin:
A	ECU0	LOAD0
B	ECU1	LOAD1
C	ECU2	LOAD2
D	ECU3	LOAD3
E	ECU4	LOAD4
F	ECU5	LOAD5
G	ECU6	LOAD6
H	ECU7	LOAD7
J	ECU8	LOAD8
K	ECU9	LOAD9
L	ECU10	LOAD10
M	ECU11	LOAD11
N	ECU12	LOAD12
P	ECU13	LOAD13
R	ECU14	LOAD14
S	ECU15	LOAD15
T	*	*

* The pins T of „ECU HV" and „LOAD HV" are directly connected with each other

Tab. 3-5 "ECU HV" Pin Assignment

3.7 "LOAD HV" Connector

DANGER!

Risk of electric shock!
There could be extremely dangerous high voltages at the individual pins of the "ECU HV" and "LOAD HV" connections. Therefore you should only open the housing when the device has been disconnected from the mains power and all other connections have been removed.

The 16 high-voltage channels of the ECU are connected to the loads via these two connectors.

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

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

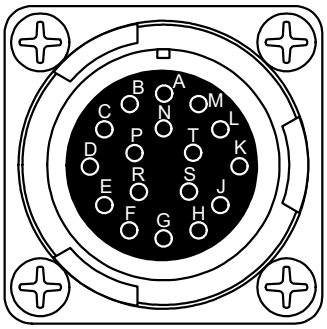


Fig. 3-6 "LOAD HV" Pin Assignments

Note

The lines of the signals "LOAD0" and "LOAD1" ... "LOAD14" and "LOAD15" are all "twisted pairs" within the ES4440.2!

Pin	Signal	Internally Connected to Connector "ECU HV" - Pin:
A	LOAD0	ECU0
B	LOAD1	ECU1
C	LOAD2	ECU2
D	LOAD3	ECU3
E	LOAD4	ECU4
F	LOAD5	ECU5
G	LOAD6	ECU6
H	LOAD7	ECU7
J	LOAD8	ECU8
K	LOAD9	ECU9
L	LOAD10	ECU10
M	LOAD11	ECU11

Tab. 3-6 "LOAD HV" Pin Assignment

Pin	Signal	Internally Connected to Connector "ECU HV" - Pin:
N	LOAD12	ECU12
P	LOAD13	ECU13
R	LOAD14	ECU14
S	LOAD15	ECU15
T	*	*
* The pins T of „LOAD HV“ and „ECU HV“ are directly connected with each other		

Tab. 3-6 "LOAD HV" Pin Assignment (Forts.)

3.8 "ECU CH0-CH42" / "ECU CH43-CH63" Connector

The 64 high-current channels of the ECU are connected via these two connectors.

Type: ITT Cannon CA02COM-E28A51P-B-01 (male)

Counterpart: ITT Cannon CA06COM-E28A51S-B-01 (female)

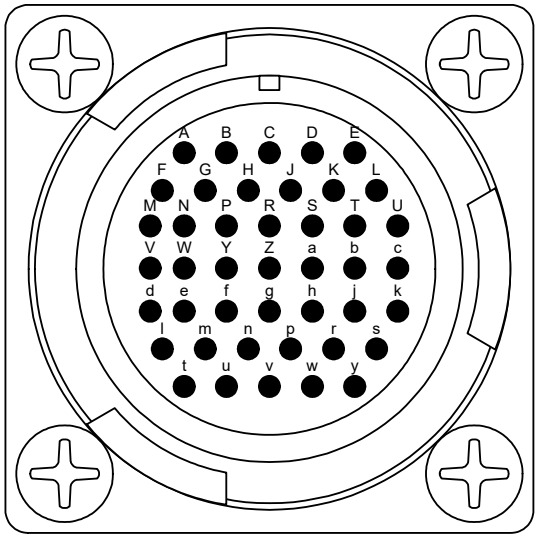


Fig. 3-7 "ECU CH0-CH42" and "ECU CH43-CH63" Pin Assignments

Pin	Signal	Internally Connected to Connector "LOAD CH0-CH42" - Pin:
A	ECU0	LOAD0
B	ECU1	LOAD1
C	ECU2	LOAD2
D	ECU3	LOAD3
E	ECU4	LOAD4
F	ECU5	LOAD5

Tab. 3-7 "ECU CH0-CH42" Pin Assignment

Pin	Signal	Internally Connected to Connector "LOAD CH0-CH42" - Pin:
G	ECU6	LOAD6
H	ECU7	LOAD7
J	ECU8	LOAD8
K	ECU9	LOAD9
L	ECU10	LOAD10
M	ECU11	LOAD11
N	ECU12	LOAD12
P	ECU13	LOAD13
R	ECU14	LOAD14
S	ECU15	LOAD15
T	ECU16	LOAD16
U	ECU17	LOAD17
V	ECU18	LOAD18
W	ECU19	LOAD19
Y	ECU20	LOAD20
Z	ECU21	LOAD21
a	ECU22	LOAD22
b	ECU23	LOAD23
c	ECU24	LOAD24
d	ECU25	LOAD25
e	ECU26	LOAD26
f	ECU27	LOAD27
g	ECU28	LOAD28
h	ECU29	LOAD29
j	ECU30	LOAD30
k	ECU31	LOAD31
l	ECU32	LOAD32
m	ECU33	LOAD33
n	ECU34	LOAD34
p	ECU35	LOAD35
r	ECU36	LOAD36
s	ECU37	LOAD37
t	ECU38	LOAD38
u	ECU39	LOAD39

Tab. 3-7 "ECU CH0-CH42" Pin Assignment (Forts.)

Pin	Signal	Internally Connected to Connector "LOAD CH0-CH42" - Pin:
v	ECU40	LOAD40
w	ECU41	LOAD41
y	ECU42	LOAD42

Tab. 3-7 "ECU CH0-CH42" Pin Assignment (Forts.)

Pin	Signal	Internally Connected to Connector "LOAD CH43-CH63" - Pin:
A	ECU43	LOAD43
B	ECU44	LOAD44
C	ECU45	LOAD45
D	ECU46	LOAD46
E	ECU47	LOAD47
F	ECU48	LOAD48
G	ECU49	LOAD49
H	ECU50	LOAD50
J	ECU51	LOAD51
K	ECU52	LOAD52
L	ECU53	LOAD53
M	ECU54	LOAD54
N	ECU55	LOAD55
P	ECU56	LOAD56
R	ECU57	LOAD57
S	ECU58	LOAD58
T	ECU59	LOAD59
U	ECU60 *	LOAD60
V	ECU61 *	LOAD61
W	ECU62 *	LOAD62
Y	ECU63 *	LOAD63
Z	Shield 1 (shielding for ECU60/ECU61) *	Shield 1
a	Shield 2 (shielding for ECU62/ECU63) *	Shield 2
b	n.c.	n.c.
c	n.c.	n.c.
d	n.c.	n.c.

Tab. 3-8 "ECU CH43-CH63" Pin Assignment

Pin	Signal	Internally Connected to Connector "LOAD CH43-CH63" - Pin:
e	n.c.	n.c.
f	n.c.	n.c.
g	n.c.	n.c.
h	n.c.	n.c.
j	n.c.	n.c.
k	n.c.	n.c.
l	n.c.	n.c.
m	n.c.	n.c.
n	n.c.	n.c.
p	n.c.	n.c.
r	n.c.	n.c.
s	n.c.	n.c.
t	n.c.	n.c.
u	n.c.	n.c.
v	n.c.	n.c.
w	n.c.	n.c.
y	n.c.	n.c.
* The lines of the signals "ECU60", "ECU61" (pins U,V) and "ECU62", "ECU63" (pins W,Y) are routed to "LOAD CH43-CH63" as "twisted pairs". Together with the two "Shield" lines (pins Z and a), these are thus suitable to be used as CAN lines, but can also be used as normal channels.		

Tab. 3-8 "ECU CH43-CH63" Pin Assignment (Forts.)

3.9 "LOAD CH0-CH42" / "LOAD CH43-CH63" Connector

The 64 high-current channels of the ECU are connected to the loads via these two connectors.

Type: ITT Cannon CA02COM-E28A51S-B-01 (female)

Counterpart: ITT Cannon CA06COM-E28A51P-B-01 (male)

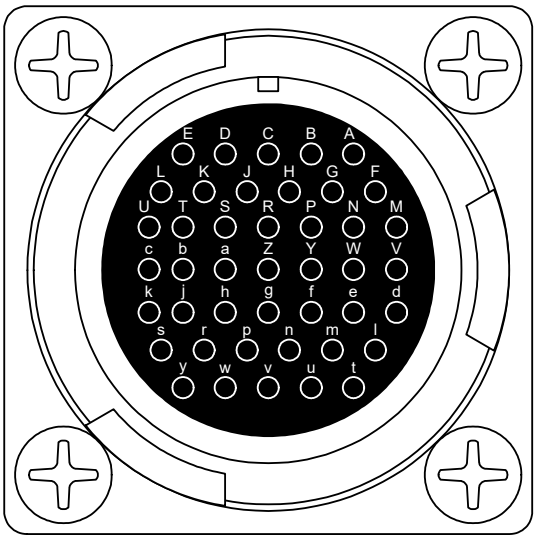


Fig. 3-8 "LOAD CH0-CH42" and "LOAD CH43-CH63" Pin Assignments

Pin	Signal	Internally Connected to Connector "ECU CH0-CH42" - Pin:
A	LOAD0	ECU0
B	LOAD1	ECU1
C	LOAD2	ECU2
D	LOAD3	ECU3
E	LOAD4	ECU4
F	LOAD5	ECU5
G	LOAD6	ECU6
H	LOAD7	ECU7
J	LOAD8	ECU8
K	LOAD9	ECU9
L	LOAD10	ECU10
M	LOAD11	ECU11
N	LOAD12	ECU12
P	LOAD13	ECU13
R	LOAD14	ECU14
S	LOAD15	ECU15
T	LOAD16	ECU16

Tab. 3-9 "LOAD CH0-CH42" Pin Assignment

Pin	Signal	Internally Connected to Connector "ECU CH0-CH42" - Pin:
U	LOAD17	ECU17
V	LOAD18	ECU18
W	LOAD19	ECU19
Y	LOAD20	ECU20
Z	LOAD21	ECU21
a	LOAD22	ECU22
b	LOAD23	ECU23
c	LOAD24	ECU24
d	LOAD25	ECU25
e	LOAD26	ECU26
f	LOAD27	ECU27
g	LOAD28	ECU28
h	LOAD29	ECU29
j	LOAD30	ECU30
k	LOAD31	ECU31
l	LOAD32	ECU32
m	LOAD33	ECU33
n	LOAD34	ECU34
p	LOAD35	ECU35
r	LOAD36	ECU36
s	LOAD37	ECU37
t	LOAD38	ECU38
u	LOAD39	ECU39
v	LOAD40	ECU40
w	LOAD41	ECU41
y	LOAD42	ECU42

Tab. 3-9 "LOAD CH0-CH42" Pin Assignment (Forts.)

Pin	Signal	Internally Connected to Connector "ECU CH43-CH63" - Pin:
A	LOAD43	ECU43
B	LOAD44	ECU44
C	LOAD45	ECU45
D	LOAD46	ECU46
E	LOAD47	ECU47
F	LOAD48	ECU48

Tab. 3-10 "LOAD CH43-CH63" Pin Assignment

Pin	Signal	Internally Connected to Connector "ECU CH43-CH63" - Pin:
G	LOAD49	ECU49
H	LOAD50	ECU50
J	LOAD51	ECU51
K	LOAD52	ECU52
L	LOAD53	ECU53
M	LOAD54	ECU54
N	LOAD55	ECU55
P	LOAD56	ECU56
R	LOAD57	ECU57
S	LOAD58	ECU58
T	LOAD59	ECU59
U	LOAD60 *	ECU60
V	LOAD61 *	ECU61
W	LOAD62 *	ECU62
Y	LOAD63 *	ECU63
Z	Shield 1 (shielding for LOAD60/LOAD61) *	Shield 1
a	Shield 2 (shielding for LOAD62/LOAD63) *	Shield 2
b	n.c.	n.c.
c	n.c.	n.c.
d	n.c.	n.c.
e	n.c.	n.c.
f	n.c.	n.c.
g	n.c.	n.c.
h	n.c.	n.c.
j	n.c.	n.c.
k	n.c.	n.c.
l	n.c.	n.c.
m	n.c.	n.c.
n	n.c.	n.c.
p	n.c.	n.c.
r	n.c.	n.c.
s	n.c.	n.c.
t	n.c.	n.c.

Tab. 3-10 "LOAD CH43-CH63" Pin Assignment (Forts.)

Pin	Signal	Internally Connected to Connector "ECU CH43-CH63" - Pin:
u	n.c.	n.c.
v	n.c.	n.c.
w	n.c.	n.c.
y	n.c.	n.c.

* The lines of the signals "LOAD60", "LOAD61" (pins U,V) and "LOAD62", "LOAD63" (pins W,Y) are routed to "ECU CH43-CH63" as "twisted pairs". Together with the two "Shield" lines (pins Z and a), these are thus suitable to be used as CAN lines, but can also be used as normal channels.

Tab. 3-10 "LOAD CH43-CH63" Pin Assignment (Forts.)

4 Accessories

This chapter contains information on important accessories for the ES4440.2 Compact Failure Simulation Module.

4.1 Power Supply Cord

Due to regional differences in the power supply, ETAS does not supply power cords with the ES4440.2 Compact Failure Simulation Module. The following table contains details of the relevant requirements and the ETAS order numbers.

Region	Description	Order Number
General	AC supply cable with IEC 60320 C13 plug on one end and a non-locking plug approved by the national safety standards (with earth contacts) on the other end. Plugs and cable must be rated for min. 250 VAC/10 A or 125 VAC/15 A.	-
China	AC supply cable China for various ETAS devices with PRC/3 and IEC 60320 C13 plug. Rated for 250 VAC/10 A, 2.50 m length	F-04A-109-512
Europe / Korea	AC supply cable for Europe and Korea for various ETAS devices with CEE7/7 and IEC_60320 C13 plug. Rated for 250 VAC/10 A, 2.50 m length	F-04A-109-513
India	AC supply cable India for various ETAS devices with IS 1293 (D) and IEC 60320 C13 plug. Rated for 250 VAC/10 A, 2.50 m length	F-04A-109-514
Japan	AC supply cable Japan for various ETAS devices with JIS C 8303 and IEC 60320 (C)13V plug. Rated for 125 VAC/15 A, 2.50 m length	F-04A-109-515
North America	AC supply cable North America for various ETAS devices with NEMA 5/15 - IEC 60320 C13M plug. Rated for 125 VAC/15 A, 2.50 m length	F-04A- 109-445
United Kingdom	Power cord cable UK for various ETAS devices with BS 1363/A and IEC 60320 C13 plug. Rated for 250 VAC/10 A, 2.50 m length	F-04A-109-516

4.2 ES600 Network Module

The ES600 Network Module is used as an Ethernet switch for connecting the simulation target and possibly several ES4440.2s to an Ethernet board of the user PC.

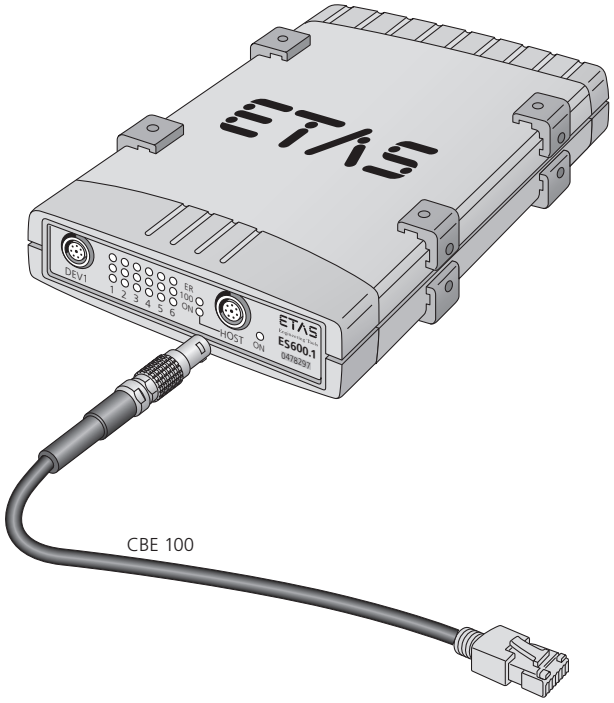


Fig. 4-1 ES600 Network Module

The following is an overview of the most important features of the ES600 Network Module:

- Ethernet switch with 10/100 MBit/s data rate
- Six Ethernet ports (1 x front, 5 x rear)
- One host port
- Cascadable to eight levels
- Status display for every port
- Stable and functional metal housing

Ordering Information

Order Name	Short Name	Order Number
ES600 Module, Cable CBP120-2, 4 T-Brackets for ES600 Housing, User's Guide (German and English)	ES600	F 00K 102 712

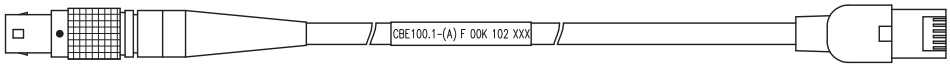
4.3 Cables

Note

Only ETAS cables can be used at the ES600 interfaces. The maximum permissible cable lengths must be adhered to.

4.3.1 Ethernet Cable (RJ-45 Connector – Lemo Connector)

This cable is used to connect an ES600 Network Module to the host.



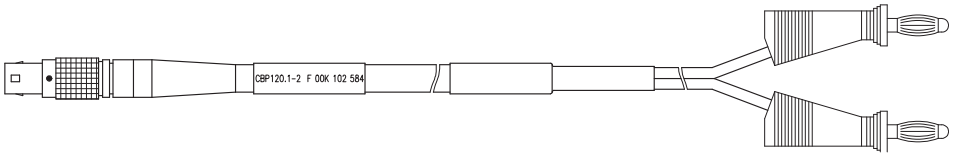
Side A Side B

Fig. 4-2 CBE100-x Cable

Connectors	Length	Short Name	Order Number
RJ-45 connector – Lemo connector	3 m	CBE100-3	F-00K-102-559
	8 m	CBE100-8	F-00K-102-571
	20 m	CBE100-20	F-00K-102-570

4.3.2 Power Cable

This cable is required for the power supply of an ES600 Network Module.



Side A Side B

Fig. 4-3 CBE120-2 Cable

Connectors	Length	Short Name	Order Number
Banana connector – Lemo connector	2 m	CBP120-2	F-00K-102-584

5 Technical Data

This chapter contains the technical data of the ES4440.2 Compact Failure Simulation Module.

High-Current Channels

"LOAD CH0-CH42"/"LOAD CH43-CH63" connectors and "ECU CH0-CH42"/ "ECU CH43-CH63" connectors

Number	64
Maximum permissible voltage	30 V
Maximum permissible current	20 A
Total resistance between in- and outputs (after "clean-up" of the relays)	25 mΩ

High-Voltage Channels

"LOAD HV" connectors and "ECU HV" connectors

Number	16
Maximum permissible voltage	80 V RMS/250 V Peak
Maximum permissible current	10 A
Total resistance between in- and outputs (after "clean-up" of the relays)	25 mΩ
Maximum pulse width	100 ms

Resistor Cascade

Number of resistors	14
Smallest resistance	2 Ω
Largest resistance	16384 Ω
Accuracy	2 Ω ±3%
Max. total resistance	Approx. 32 kΩ
Maximum permissible current through the cascade	3 A with 14 V voltage drop 1 A with 30 V voltage drop
Maximum permissible voltage	30 V
Maximum fault duration	5 minutes, 25% duty cycle

Relays

	High-Current Channels	**High-Voltage Channels**
Number	205	20
Maximum permissible voltage	30 VDC	80 V RMS, max. 250V pulse voltage
Maximum permissible current	30 A	16 A
Contact resistance	Approx. 1.5 mΩ	Approx. 3 mΩ

MOSFETs

Max. permissible voltage	30 VDC
Max. permissible current	70 A
Resistance	Approx. 14 mΩ

Time Response

	Relay	**MOSFET**
Duration from receipt of switch command at the ES4440.2 to conclusion of the switch procedure	5 ms	200 µs
Failure duration	20 ms - 60 s or ∞	1 ms - 60 s or ∞
Accuracy of failure duration	±15 ms	±15 ms
Maximum number of simultaneous faults	10	10

Simulation of Loose Contacts

Duty cycle	1% - 99% at 3 Hz to 100 Hz 50% at 2 Hz
Accuracy of duty cycle	±0,1%

Communication Interfaces

Ethernet	10 MBaud
CAN	High Speed CAN (CAN2.0B) to 1 MBaud Transceiver: MCP2515

Fuses

E1, E2, E3*	20 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
E4*	3 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
E5*	10 A, 80 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
Mains circuit breaker **	2 x 1.6 AH slow-blow, 250 V, glass fuse 5x20 (IEC60127-2/3)
* For information on the position of the fuses see "To change fuses" on page 29	
** see "Changing the Mains Fuses" on page 29	

The hardware revisions 1.10 and 1.11 have different fuse specifications from those described above. The table below contains the correct specification for these revisions:

E1, E3, E4	20 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
E2	3 A, 32 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)
E5	10 A, 80 V in acc. with ISO 8820-3 (e.g. Pudenz, FKS series)

Note

The hardware revision number is on the back of the ES4440.1.

Electrical Data

Input voltage (mains frequency)	100 - 240 VAC (50 Hz /60 Hz)
Power input	70 W
Overvoltage category	II
Pollution degree	2

Mechanical Data

Height of the front panel	3 U
Width of the front panel	19”
Depth (incl. connectors)	455 mm
Weight	14 kg/31 lbs

Ambient Conditions

Environment	Use only inside enclosed and dry rooms
Max. contamination level	2
Permissible ambient temperature during operation	5 °C to 35 °C (41 °F to 95 °F)
Permissible storage temperature	-20 °C to +85 °C (-4 °F to 185 °F)
Relative humidity	0 to 95% (non-condensing)
Operating altitude	Max. 2000 m / 6500 ft

6 Ordering Data

The ordering data for the ES4440.2 are as follows:

Ordering name	Short name	Ordering number
ES4440.2 Compact Failure Simulation Module	ES4440.2	F-00K-107-497
Scope of delivery		
ES4440.2 Compact Failure Simulation Module		

7 ETAS Contact Addresses

ETAS HQ

ETAS GmbH

Borsigstraße 24 Phone: +49 711 3423-0

70469 Stuttgart Fax: +49 711 3423-2106

Germany WWW: www.etas.com

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