ETAS

DRIVING EMBEDDED EXCELLENCE

ETAS ETK-S21.1 Emulator Probe for MPC57xx/ EMU57xx MCU Family

User Guide

www.etas.com

Copyright

ETK-S21.1 - User Guide R12 EN - 11.2021

Contents

1 About this Document . . . 6
1.1 Classification of Safety Messages . . . 6
1.2 Presentation of Instructions . . . 6
1.3 Typographical Conventions . . . 7
1.4 Presentation of Supporting Information . . . 7
2 Basic Safety Notices . . . 8
2.1 General Safety Information . . . 8
2.2 Requirements for Users and Duties for Operators . . . 8
2.3 Intended Use . . . 8
2.4 Identifications on the Product . . . 12
2.5 Taking the Product Back and Recycling . . . 13
2.6 Declaration of Conformity . . . 13
2.6.1 CE Declaration of Conformity (European Union) . . . 13
2.6.2 UKCA Declaration of Conformity (Great Britain) . . . 13
2.7 RoHS Conformity . . . 14
2.7.1 European Union . . . 14
2.7.2 China . . . 14
2.8 Declarable Substances . . . 14
2.9 Use of Open Source Software . . . 14
3 Introduction . . . 15
3.1 Applications . . . 15
3.2 Features . . . 15
4 Hardware Description . . . 17
4.1 Architecture . . . 17
4.2 ECU Interface . . . 18
4.3 Serial ETK Interface . . . 19
4.4 Debug Interface . . . 19
4.5 Power Supply . . . 20
4.6 ECU Voltage Supervisor . . . 20
4.7 Status LEDs . . . 21
4.8 Data Emulation and Data Measurement . . . 22
4.9 JTAG and LFAST Interface . . . 23
4.9.1 Layout Recommendation for LFAST Mode . . . 23
4.9.2 Debugger and MC Support . . . 23
4.10 Trigger Modes: Overview . . . 24
4.11 Pinless Triggering . . . 24
4.11.1 Startup Handshake . . . 24
4.11.2 ETK Trigger Generation . . . 24
4.12 Timer Triggering . . . 25

4.13 Reset . . . 25
4.14 Pull CalWakeUp until Startup Handshake . . . 25
4.15 Firmware Update . . . 25
4.16 ETK-S21.1 Usage at ES89x Modules . . . 26
4.16.1 Microcontroller Compatibility . . . 26
4.16.2 Wiring . . . 26
4.16.3 Getting Started . . . 26
4.16.4 A2L File . . . 26
5 Installation . . . 27
5.1 Connection to the ECU . . . 27
5.2 Connecting to the Power Supply . . . 29
5.2.1 Permanent Power Supply inside ECU available . . . 29
5.2.2 Permanent Power Supply inside ECU not available . . . 30
5.3 Connection to the Debugger . . . 32
6 ETK Configuration . . . 33
6.1 Overview . . . 33
6.2 Configuration Parameter . . . 34
7 Technical Data . . . 35
7.1 System Requirements . . . 35
7.1.1 ETAS Hardware . . . 35
7.1.2 PC with one Ethernet Interface . . . 35
7.1.3 Software Support . . . 36
7.2 ETK Firmware (HDC) Update . . . 37
7.3 Data Emulation Memory and Microcontroller Support . . . 37
7.4 Measurement Data Memory . . . 38
7.5 Configuration . . . 38
7.6 Serial ETK Interface for Application System . . . 38
7.7 Environmental Conditions . . . 38
7.8 Power Supply . . . 39
7.9 Microcontroller Interface . . . 39
7.10 Test Characteristics . . . 40
7.11 JTAG Timing Characteristics . . . 41
7.11.1 JTAG Timing Diagram . . . 41
7.11.2 JTAG Timing Parameter . . . 41
7.11.3 Debugger Arbitration Timing Diagram . . . 42
7.11.4 Debugger Arbitration Parameter . . . 42
7.12 Electrical Characteristics . . . 43
7.12.1 Debugger Interface Connector CON5 . . . 43
7.12.2 ECU Interface Connector CON1 (JTAG Mode) . . . 44
7.12.3 ECU Interface Connector CON1 (Differential JTAG Mode / LFAST Mode) . . . 45
7.13 Pin Assignment . . . 46
7.13.1 ECU Interface Connector CON1 . . . 46
7.13.2 ECU Power Connector CON2 . . . 46

7.13.3 Power Connector CON3 . . . 46
7.13.4 Debugger Interface Connector CON5 . . . 46
7.14 Mechanical Dimensions . . . 48

8 Cables and Accessories . . . 49
8.1 Interface Cables . . . 49
8.1.1 Cable KA54 . . . 49
8.1.2 Cable KA55 . . . 51
8.1.3 Cable CBAM200 . . . 51
8.1.4 Cable CBAM261 . . . 52
8.1.5 Cable CBAM281 . . . 52
8.1.6 Cable CBAE360.1 . . . 52
8.2 Power Supply Cables . . . 53
8.2.1 Cable K70.1 . . . 53
8.2.2 Cable KA50 . . . 53
8.2.3 Cable ETV3 . . . 53
8.3 Combined Interface and Power Supply Cables . . . 54
8.3.1 Cable CBAM210 . . . 54
8.3.2 Cable CBAM220 . . . 54
8.3.3 Cable CBAM260 . . . 55
8.4 Adapters . . . 56
8.4.1 ETK - ECU Adapter ETAL1 . . . 56
8.4.2 ETK - ECU Adapter ETAL2 . . . 56
8.4.3 ETK - ECU Adapter ETAL3 . . . 56
8.4.4 ETK - ECU Adapter ETAL5 . . . 57
8.4.5 ETK - ECU Adapter ETAL6 . . . 57
8.4.6 ETK - ECU Adapter ETAL7 . . . 57
8.4.7 Debug Adapter ETAF11 . . . 58
8.5 Water proofed Case ETKS_C3 . . . 59

9 Ordering Information . . . 60
9.1 ETK-S21.1 . . . 60
9.2 ETK - ECU Adapter . . . 60
9.3 Debug Adapter . . . 60
9.4 Cables . . . 60
9.4.1 Interface Cables . . . 62
9.4.2 Combined Interface and Power Supply Cables . . . 62
9.4.3 Power Supply Cables . . . 63
9.5 Waterproof Case . . . 63

10 ETAS Contact Addresses . . . 64

Figures . . . 65

Index . . . 67

1 About this Document

1.1 Classification of Safety Messages

The safety messages used here warn of dangers that can lead to personal injury or damage to property:

 **DANGER**

indicates a hazardous situation with a high risk of death or serious injury if not avoided

 **WARNING**

indicates a hazardous situation of medium risk which could result in death or serious injury if not avoided.

 **CAUTION**

indicates a hazardous situation of low risk which may result in minor or moder-ate injury if not avoided.

NOTICE

indicates a situation which may result in damage to property if not avoided.

1.2 Presentation of Instructions

The target to be achieved is defined in the heading. The necessary steps for this are in a step-by-step guide:

Target definition

1. Step 1
2. Step 2
3. Step 3

> Result

1.3 Typographical Conventions

Software

`OCI_CANTxMessage msg0 =`	Code snippets are presented on a gray background and in the Courier font. Meaning and usage of each command are explained by means of comments. The comments are enclosed by the usual syntax for comments.
Choose **File → Open**.	Menu commands are shown in boldface.
Click **OK**.	Buttons are shown in boldface.
Press <ENTER>.	Keyboard commands are shown in angled brackets.
The "Open File" dialog box is displayed.	Names of program windows, dialog boxes, fields, etc. are shown in quotation marks.
Select the file `setup.exe`.	Text in drop-down lists on the screen, program code, as well as path- and file names are shown in the Courier font.
A *distribution* is always a one-dimensional table of sample points.	General emphasis and new terms are set in italics.

Hardware

Bold	Menu commands, buttons, labels of the product
Italic	Emphasis on content and newly introduced terms

1.4 Presentation of Supporting Information

NOTE

Contains additional supporting information.

2 Basic Safety Notices

This chapter contains information about the following topics:

2.1 General Safety Information

- General Safety Information 8
- Requirements for Users and Duties for Operators 8
- Intended Use 8
- Identifications on the Product 12
- Taking the Product Back and Recycling 13
- Declaration of Conformity 13
- RoHS Conformity 14
- Declarable Substances. 14
- Use of Open Source Software. 14

Please observe the Product Safety Notices ("ETAS Safety Notice") and the following safety notices to avoid health issues or damage to the device.

NOTE

Carefully read the documentation (Product Safety Advice and this User Guide) that belongs to the product prior to the startup.

ETAS GmbH does not assume any liability for damages resulting from improper handling, unintended use or non-observance of the safety precautions.

2.2 Requirements for Users and Duties for Operators

The product may be assembled, operated and maintained only if you have the necessary qualification and experience for this product. Improper use or use by a user without sufficient qualification can lead to damages or injuries to one's health or damages to property.
The safety of systems using the product is the responsibility of the system integrator.

General Safety at Work

The existing regulations for safety at work and accident prevention must be followed. All applicable regulations and statutes regarding operation must be strictly followed when using this product.

2.3 Intended Use

An ETK is an electronic component that is installed in a vehicle control unit (ECU) to read data from the ECU or write data to the ECU.

Application Area of the Product

This product was developed and approved for automotive applications. For use in other application areas, please contact your ETAS contact partner.

Requirements for Operation

The following requirements are necessary for safe operation of the product:

- Use the product only according to the specifications in the corresponding User Guide. With any deviating operation, the 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 work safety!
- Do not apply any voltages to the connections of the product that do not correspond to the specifications of the respective connection.
- Connect only current circuits with safety extra-low voltage in accordance with EN 61140 (degree of protection III) to the connections of the product.
- The power supply for the product must be safely disconnected from the supply voltage. For example, use a car battery or a suitable lab power supply.
- Use only lab power supplies with double protection to the supply system.
- Ensure that the connections of the power supply are easily accessible.
- The module does not have an operating voltage switch.
  - Switch on the product by connecting the power supply cable with the power supply or by switching on the power supply.
  - Switch off the product by disconnecting it from the power supply or by switching off the power supply.

DANGER

Connect the power cord only with a vehicle battery or with a lab power supply! A connection to power outlets is prohibited.

Route the power cord in such a way that it is protected against abrasion, damages, deformation and kinking. Do not place any objects on the power cord.

Never apply force to insert a plug into a socket. Ensure that there is no contamination in and on the connection, that the plug fits the socket, and that you correctly aligned the plugs with the connection.

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.

Potential Equalization

CAUTION

Danger from inadvertent current flow!

Depending on the design, the shield of the Ethernet cables can be connected with the housing of the module. Install the products only on components with the same electrical potential or isolate the products from the components.

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.

Maintenance and Cleaning

The product is maintenance-free. Use a lightly moistened, soft, lint-free cloth for cleaning the product. Ensure that no moisture can enter. Never spray cleaning agents directly onto the product. Do not user any sprays, solvents or abrasive cleaners which could damage the product.

Transport and Installation

CAUTION

The ETK can be damaged or destroyed!

Some components of the ETK board may be damaged or destroyed by electrostatic discharges. Please keep the ETK in its storage package until it is installed.

The board should only be taken from its package, configured, and installed at a work place that is protected against static discharge.

CAUTION

During installation and removal, ECU and ETK must be in a de-eenergized state!

CAUTION

Risk of short circuiting the internal signals of the ETK!

When you mount the ETK to the ECU, you must ensure that the screws and washers used will not penetrate the ETK printed circuit board.

CAUTION

Differences in case ground potentials can cause high currents to flow through the shields of the cables that connect various system modules.

Ensure that the module mounting surfaces are at the same electrical potential or insulate the modules from their mounting surfaces.

Cabling

Use exclusively ETAS cables at the connections of the product! Adhere to the maximum permissible cable lengths! Observe the assignment of the cables to the connectors! Detailed information about cabling is located in the ETK User Guides.

2.4 Identifications on the Product

Fig. 2-1 Adhesive Label (Example: Label for XETK-S14.0)

The following symbols are used for identifications of the product: (

Symbol	Description
	The User Guide must be read prior to the startup of the product!
	WEEE symbol, see chapter 2.5 on page 13
	CE conformity symbol (European Union), see chapter 2.6.1 on page 13
	UKCA conformity symbol (Great Britain), see chapter 2.6.2 on page 13)
	China RoHS symbol, see chapter 2.7.2 on page 14
	China RoHS symbol, see chapter 2.7.2 on page 14
	Symbol for electrostatic sensitive components
XETK-S14.0A	Product designation (example)
F 00K 110 722	Order number of the product (example)
SN: yyxxxxx	Serial number (7-digit)
XXXX/YY	Product version
ZZZZ	Year of manufacture
ETAS GmbH, PO Box 300220, 70442 Stuttgart, Germany	Manufacturer's address

NOTE

For symbols and product information one or several adhesive labels can be used.

2.5 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 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. 2-2 WEEE-Symbol

The WEEE symbol (see Fig. 2-2 on page 13) 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 software, contact the ETAS sales and service locations.

2.6 Declaration of Conformity

2.6.1 CE Declaration of Conformity (European Union)

With the CE mark attached to the product or its packaging, ETAS confirms that the product corresponds to the applicable product-specific European Directives. The CE Declaration of Conformity for the product is available upon request.

2.6.2 UKCA Declaration of Conformity (Great Britain)

With the UKCA mark attached to the product or its packaging, ETAS confirms that the product corresponds to the product-specific, applicable standards and directives of Great Britain. The UKCA declaration of conformity for the product is available on request.

2.7 RoHS Conformity

2.7.1 European Union

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

This product does not contain any of the restricted substances specified in the EU Directive 2011/65/EU or exceeds the maximum concentrations stipulated therein. For individual electronic components used in our products, there are currently no equivalent alternative substances, which is why we make use of the exception 7A and 7C-I in Annex III of this Directive.

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

2.7.2 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.

2.8 Declarable Substances

European Union

Some products from ETAS GmbH (e.g. modules, boards, cables) use components with substances that are subject to declaration in accordance with the REACH regulation (EU) 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.

2.9 Use of Open Source Software

The product uses Open Source Software (OSS). This software is installed in the product at the time of delivery and does not have to be installed or updated by the user. Reference shall be made to the use of the software in order to fulfill OSS licensing terms. Additional information is available in the document "OSS Attributions List" at the ETAS website www.etas.com.

3 Introduction

This chapter contains information about the following topics:

- Applications 15
- Features 15

3.1 Applications

The ETK-S21.1 is an emulator probe for the Freescale MPC57xx and for the STMicroelectronics EMU57xx microcontroller family. It is a typical serial ETK with a specific JTAG interface. This serial ETK can be used for measurement and calibration applications.

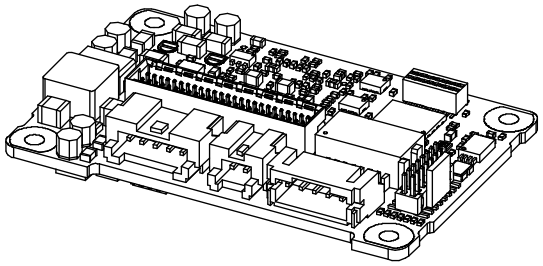

Fig. 3-1 ETK-S21.1

It is compatible with the ETAS calibration and development system interface (e.g. ES590, ES591, ES592, ES593-D, ES595, ES89x, ES910 and ES1000.2/ ES1000.3 with ES1232-A). Earlier systems (e.g. MAC2, ES1000.1 with ES1201 board, ES1120.1, ES690) are not supported.

3.2 Features

- Measurement interface
  - Serial ETK interface with 100 Mbit/s to the calibration and development system
- ECU interface
  - JTAG interface reference clock configurable:
    20 MHz, 30 MHz, 40 MHz, 50 MHz
  - LFAST interface reference clock configurable:
    10 MHz, 20 MHz

NOTE

LFAST only with adapter ETAL6 possible.

NOTE

LFAST is not recommended with ES590 or ES1000. With these ES modules and LFAST only short term measurements are possible (some minutes, depending on the experiment).

  - Data rate160 Mbit/s, 320 Mbit/s

> **NOTE**
>
> The max. allowed JTAG clock depends on the core frequency of the microcontroller. Max. clock speed is 1/4 of the core frequency.

  - 3.3 V ECU interface voltage level
  - ETK powers Emulation Device RAM
  - 50 pin ERNI plus 5 pin JST
- Trigger interface
  - Pinless trigger via JTAG or LFAST (32 total measurement rasters)
  - 4 triggers generated by internal timers
- Debugger interface (JTAG mode only)
  - additional connector for external debug hardware
  - ETK hardware is prepared to be used simultaneously with a debugger
- Startup protocol for ETK/ ECU synchronization
  - via JTAG pins
  - via JTAG Data Communication (JDC) feature
- Supports special coldstart mechanism ("Calibration Wake Up")
  - Calibration Wake Up: Wake up mechanism to wake up the power supply of the ECU via the Calibration Wake up pin
  - Pull CalWakeUp until Startup Handshake: duration of the Wake up mechanism is configurable
- Permanent storage of configuration in EEPROM
- Configuration of ETK via XCT Configuration Tool
- ETK firmware update (update of the ETK hardware definition code [HDC]) supports by service software HSP
- Mounting possibilities inside or on top of ECU
- Temperature range suitable for automotive applications

For more technical data on the ETK-S21.1 consult the chapter “Technical Data” on page 35.

4 Hardware Description

This chapter contains information about the following topics:

- Architecture 17
- ECU Interface 18
- Serial ETK Interface 19
- Debug Interface 19
- Power Supply 20
- ECU Voltage Supervisor 20
- Status LEDs 21
- Data Emulation and Data Measurement 22
- JTAG and LFAST Interface 23
- Trigger Modes: Overview 24
- Pinless Triggering 24
- Timer Triggering 25
- Reset 25
- Pull CalWakeUp until Startup Handshake 25
- Firmware Update 25
- ETK-S21.1 Usage at ES89x Modules 26

4.1 Architecture

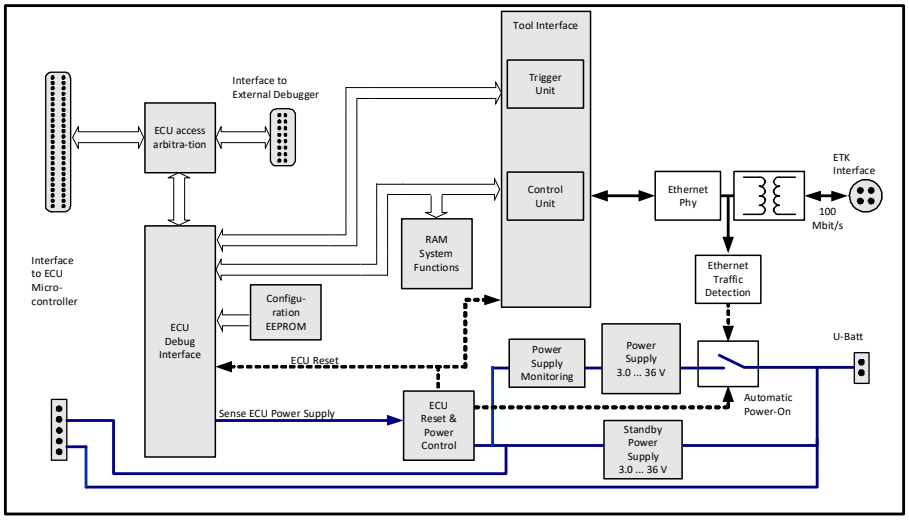

Fig. 4-1 ETK-S21.1 Architecture

The microcontroller can communicate with the memories or peripheral components of the development ECU. The ETK-S21.1 is connected to the serial debug interface (JTAG). It converts these interface to the 100 MBit/s serial ETK interface and extends in this way the length of the connection line.

While the microcontroller accesses the data out of the data emulation memory, the content of the data emulation memory can simultaneously be modified by the calibration and development system through the serial ETK interface. This process enables adjustments of parameters, characteristic lines and maps through the calibration and development system. Using an additional measurement data memory area, the ECU microcontroller can send data to the calibration and development system which receives, buffers and processes this measured data (e.g. DISTAB13).

The 100 Mbit/s serial interface provides communication with the calibration and development system.

The power supply for the ETK-S21.1 is provided by a switch mode power supply, to minimize power dissipation.

4.2 ECU Interface

The ECU interface can be flexibly configured for several applications. For a HDC update, it is not necessary to unmount or disconnect the ETK-S21.1 from the ECU.

For currently supported microcontrollers refer to chapter 7.1.3 on page 36.

The ETK-S21.1 is connected via CON1 and CON2 to the ECU with two adapter cables (refer to Fig. 4-2 on page 18). The pin definition depends on the application and the microcontroller type. In general the ECU interface consists of

- 1 ECU voltage line, which is not used for ETK power supply but only for detection of the ECU status, therefore the power consumption on these line is negligible (refer to chapter 4.5 on page 20)
- 1 Reset line to control the system reset
- 1 Reset line to detect e.g. a Softreset
- 7 Debug Interface lines for the communication between the ETK-S21.1 and the microcontroller
- 2 ground lines for a proper shielding of the ECU interface lines.

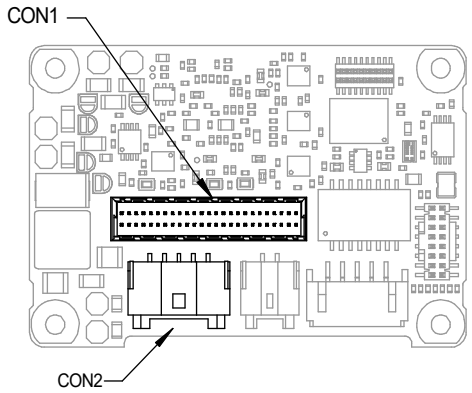

Fig. 4-2 Location of the ECU Interfaces (ETK-S21.1)

4.3 Serial ETK Interface

The interface utilizes a 100Base-TX transmission to achieve a transmission performance of 100 Mbit/s.

> **NOTE**
>
> To ensure stable communication only 100 Mbit cables delivered by ETAS shall be used.

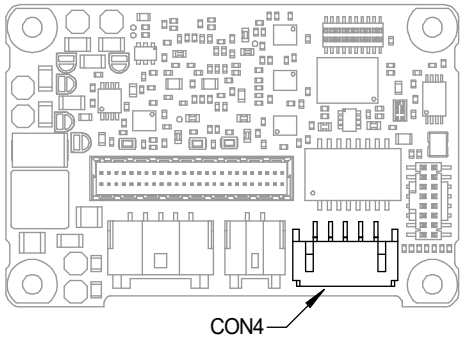

Fig. 4-3 Location of the Serial ETK Interface (ETK-S21.1)

4.4 Debug Interface

The ETK-S21.1 features a JTAG debugging interface connector CON5 (Samtec 16 pin). This connector can be used to attach debug tools (e.g. Lauterbach or PLS debugger, if available). We recommend to use ETAS Debug - Adapter (e.g. ETAF11) to connect the debugger to the ETK (refer to chapter 5.3 on page 32).

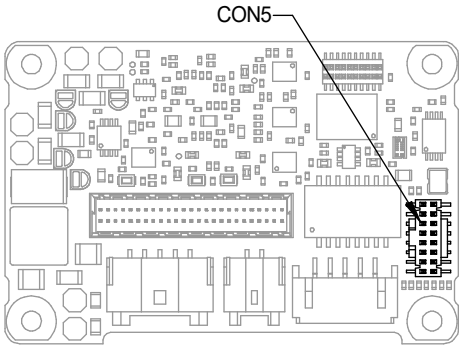

Fig. 4-4 Location of the Debugger Interface (ETK-S21.1)

By using the debug interface at the ECU board for serial ETK connection, it is not available for debugging tools anymore. Arbitration mechanisms are required to simultaneously work e.g. with measurement and calibration tools as well as with debugging tools. The ETK-S21.1 supports a hardware arbitration unit for the JTAG interface. This enables parallel use of tools for debugging and ETAS tools for measurement and calibration.

4.5 Power Supply

The ETK-S21.1 needs a permanent power supply. It is powered directly from the car battery. The input voltage may vary between 5 V and 36 V (3 V drops for 3 seconds). In case of higher input voltages to the ETK an additional voltage converter is required.

All necessary voltages are created through switching power supplies which minimizes power dissipation. The power supply of the ECU is not affected by the ETK-S21.1. An automatic switch ensures that the power supply of the ETK-S21.1 is automatically switched on and off when the ETK enters and leaves its sleep mode.

The ETK-S21.1 can be supplied with power through five pins connector CON7. The 2 pin JST connector CON3 can be used additionally to connect a power supply U_{Batt2}. The power supply on CON3 must use the GND of CON2 (refer to chapter 5.2.2).

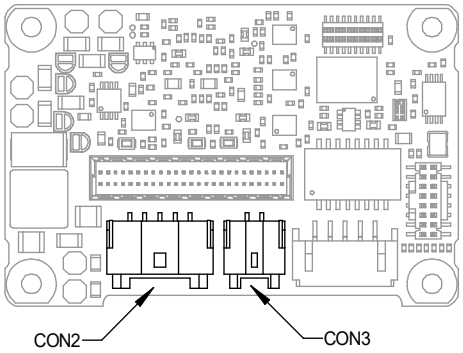

Fig. 4-5 Location of the Power Supply Connectors (ETK-S21.1)

4.6 ECU Voltage Supervisor

The ECU voltage (VDDP) is monitored by the ETK to recognize whether the ECU is switched on or off. The ETK-S21.1 supplies the ECU EDRAM and monitores this voltage.

NOTE

The ETK-S21.1 allows switching between reference page and working page only, if there is a valid voltage at the sense pin detected.

4.7 Status LEDs

There are three LEDs displaying the operating status of the ETK-S21.1 (Fig. 4-6 on page 21).

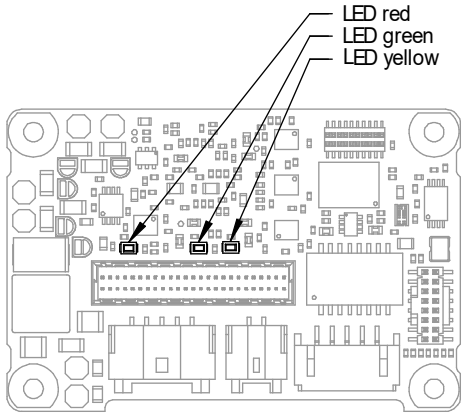

Fig. 4-6 Status LEDs (ETK-S21.1)

LED	State	Definition
Red	On	ETK-S21.1 is supplied with power and active (i.e. the ECU is switched on or the ETAS calibration and development system is connected and ready to communicate with the ETK-S21.1)
Green	Off	Working Page contains data and is accessible from INCA
	Flashing	ETK-S21.1 is in boot configuration mode: - measurement and calibration are not possible, - after first initialization with INCA flashing stops
	On	Power supply has dropped under selected threshold: - data retention of the calibration data in the ECU is no longer ensured - as soon as the ETK-S21.1 switches on again, the ECU switches to the Reference Page. Green LED stays lit until the calibration and development system downloads data into the calibration data memory. Otherwise switching to the Working Page is not possible.
Yellow	Off	ETK-S21.1: no link to calibration system established
	On	100 Mbit/s communication to calibration system established

4.8 Data Emulation and Data Measurement

In the case of a serial ETK the measurement RAM is part of the ECU and is not accessible until the ECU is powered up and the basic initialization has been performed. The goal must be to perform the download into the ECU after the ETK's startup message was sent.

All serial ETKs have a system of Reference and Working Page (ETAS two pages ETK concept). The Reference Page is located in the ECU flash and can not be modified by a simple write access. As with all serial ETK's this change must be done via Flash programming.

The Working Page is implemented with internal RAM overlaying the flash by using microcontroller internal mechanisms. The overlay RAM used for the emulation of calibration data must not be used by the ECU software directly. The ETK/INCA has the complete control over this RAM and it's contents. When enabling a data emulation or after power loss INCA establishes a basic start-up configuration of the data in the RAM by copying the corresponding data in the Flash to the emulation space.

In contrast to a parallel ETK no flash memory for permanent storage of the adjusted parameters (program data) is available on the ETK.

The switching between Reference and Working Page is performed by switching the data emulation on and off. It is done by modifying overlay registers of the microcontroller, which are dedicated only to the ETK. The microcontroller must change the values of these registers after the startup handshake with the ETK has been performe and after the INCA request.

The page switching is performed via a communication method with the ECU software. A small software protocol between the ECU and the host is needed to get the current page status and perform the switching. The access to the micro controller registers and the real page switching is completely under the control of the ECU software.

Another important restriction is that no access to memory is possible, while the ECU is not running. To enable a cold start measurement in spite of this restriction, a special procedure was defined to give the user the feeling of a parallel ETK.

NOTE

If the Boot Mode Header is not valid or program flash which contains the Boot Mode Header is erased completly it is not possible to access the microcontroller neither via ETK nor via debugger. In this case a Boot Mode Header must be programmed over ASC or CAN interface. For detailed information see the "MPC57x Microcontroller Reference Manual".

4.9 JTAG and LFAST Interface

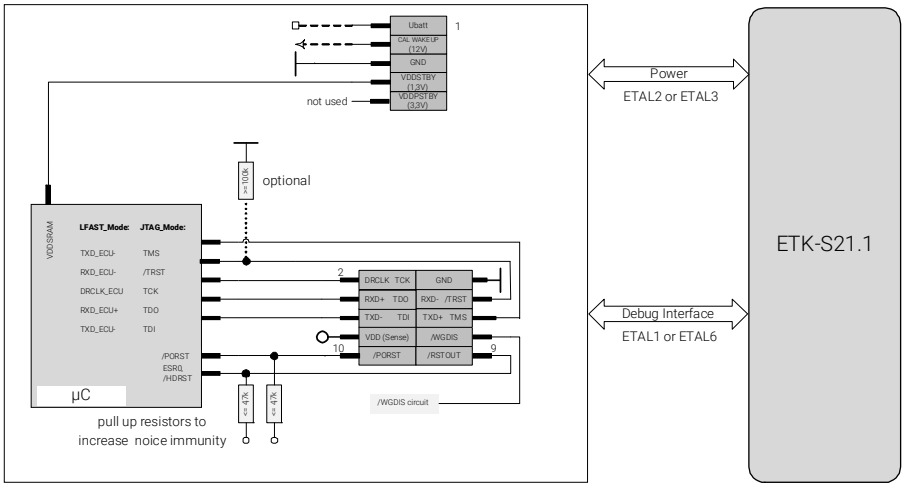

Fig. 4-7 Equivalent Circuitry of the ECU JTAG/ LFAST Interface (ECU)

4.9.1 Layout Recommendation for LFAST Mode

The wires /TRST, TDO should be closed together, with the same length, single ended impedance 50Ohm.

The wires TMS, TDI should be closed together, with the same length, single ended impedance 50Ohm

4.9.2 Debugger and MC Support

The ETK-S21.1 supports the JTAG mode for debugger arbitration, test and calibration.

Mode	Debugger support	MC support
JTAG	Yes	Yes
LFAST	No	Yes

For LFAST mode the ETK-S21.1 starts at first in JTAG mode to switch into LFAST mode automatically.

NOTE

LFAST is not recommended with ES590 or ES1000. With these ES modules and LFAST only short term measurements are possible (some minutes, depending on the experiment).

4.10 Trigger Modes: Overview

The ETK-S21.1 supports the following trigger modes:

- Pinless triggering
- Timer triggering

The trigger mode "Pinless Triggering" uses an internal Development Trigger Semaphore (DTS) for register triggerring (see also chapter “Pinless Triggering” on page 24).

The trigger mode "Timer Triggering" uses four internal timers of the ETK for triggering (see also chapter “Timer Triggering” on page 25).

4.11 Pinless Triggering

4.11.1 Startup Handshake

The JTAG Data Communication .(JDC) feature is used for the ETK startup handshake. The ECU must ensure that all memory ECC initializations have been completed prior to the start-up handshake.

4.11.2 ETK Trigger Generation

For generating triggers, the ECU software write index in the trigger register "DTS_SEMAPHORE" by writing the index of the trigger in the trigger setting register "DTS_SEMAPHORE".

NOTE

The selective setting of trigger bits is accomplished in hardware by the microcontroller and requires no Read-Modify-Write sequence by the ECU software.

The first 32 indexes of the trigger setting register "DTS_SEMAPHORE" corresponds to an index in the same position in the trigger register "DTS_SEMAPHORE", each of them corresponding to an ETK hardware trigger.

NOTE

Only the index 0 to 31 corresponding to the first 32 triggers are supported by ETK-S21.1.

The ETK periodically polls the trigger register "DTS_SEMAPHORE". The ETK sends a corresponding trigger message e.g. to the ES590 which starts acquisition of appropriate measurement data. The polling rate is determined by the fastest measurement raster and is configurable in a 10 µs to 2 ms range with a 50 µs default.

Active bits in trigger register "DTS_SEMAPHORE" are automatically cleared by CPU when register is read by ETK.

4.12 Timer Triggering

The trigger mode "Timer Triggering" uses four internal timers of the ETK for triggering. The trigger period of these timers is configurable by the user.

If trigger mode "Timer Triggering" is used handshake will be not executed. The handshake is operated by an timeout defined in the A2L file.

The time intervals between trigger events are in accordance with the configured timer values. The period of the time trigger has to be defined in the A2L file. The maximum period duration is 1 second.

The timers works in an asynchronous manner to the ECU.

If variables are measured from ECC protected memories the ECU software must ensure the proper initialization of these locations. A time-out period can be set in the ETK configuration to allow for the ECU to initialize the memories before the measurement begins.

4.13 Reset

The requirement for ETK reset mechanism is to ensure that power-up and power-down behavior of ECU is clean and smooth. The ETK-S21.1 normally drives /PORST low during ECU power up or upon INCA request.
The signal /RESETOUT of the microcontroller is used by the ETK-S21.1 to detect when the ECU is in reset.

The ETK-S21.1 senses the switched ECU power supply. This allows it to detect when the ECU is off and forward this information to INCA. In addition, it allows the ETK to enter the power save mode with the calibration system (ES590/ ES591) unplugged.

4.14 Pull CalWakeUp until Startup Handshake

The ETK has the ability to wake up the ECU by applying voltage to the CalWakeUp pin of the ECU connector. This allows to configure a measurement while the ECU is off.

When waking up the ECU via the CalWakeUp pin it can be configured if the pin is pulled until the microcontroller core voltage (VDDP) is high or the pin should be kept on high state until the start-up handshake between ECU and ETK signals the ETK that the ECU has finished its initialisation.

4.15 Firmware Update

The firmware of the ETK can be updated by the user so that future versions of the ETK can also be implemented. The firmware is updated on the connected PC using service software "Hardware Service Pack" (HSP).

NOTE

Neither the power supply nor the Ethernet connection must not be interrupted during a firmware update!

4.16 ETK-S21.1 Usage at ES89x Modules

4.16.1 Microcontroller Compatibility

Not all ETK-S21.1 versions with all microcontrollers are compatible for usage with ES89x modules. Please check the microcontroller support in chapter “Software Support” on page 36.

4.16.2 Wiring

To connect the ETK-S21.1 with ES89x modules the CBE260 cable and the CBAE360 adapter are needed (see chapter “Connecting to the Power Supply” on page 29.

4.16.3 Getting Started

The LED at the FETK / Gigabit interface of the ES891 lights red, if the connected ETK is not prepared to use at ES89x modules. A HSP update is needed.

Check for update

1. Connect the ETK-S21.1 to an ES89x module.
   - If the FETK / Gigabit interface LED at the ES891 front panel lights red, the connected ETK is not prepared to use at ES89x modules.
     A HSP update is needed.
   - If the FETK / Gigabit interface LED at the ES891 front panel lights green, the connected ETK is prepared to use at ES89x modules.
     A HSP update is not needed.

Special HSP Update

1. Connect the ETK to another ETAS module (only ES59x or ES910 are suitable).
2. Update the ETK with HSP.

NOTE

If the power supply or the Ethernet connection will be interrupted during this (first) special firmware update the ETK will be corrupted! Please contact ETAS.

NOTE

If once updated, the ETK-S21.1 can be used as DualMode ETK both at ES89x modules and at ES59x modules.

4.16.4 A2L File

Regardless of the used module (ES59x, ES910, ES89x) the same A2L file at the ETK will be working.

5 Installation

This chapter contains information about the following topics:

- Connection to the ECU 27
- Connecting to the Power Supply 29
- Connection to the Debugger 32

CAUTION

Some components of the interface board may be damaged or destroyed by electrostatic discharges. Please keep the board in its storage package until it is installed.

The board should only be taken from its package, configured, and installed at a work place that is protected against static discharge.

5.1 Connection to the ECU

CAUTION

Risk of short circuiting the internal signals of the ETK!
When you mount the ETK to the ECU, you must ensure that the screws and washers used will not penetrate the ETK printed circuit board.

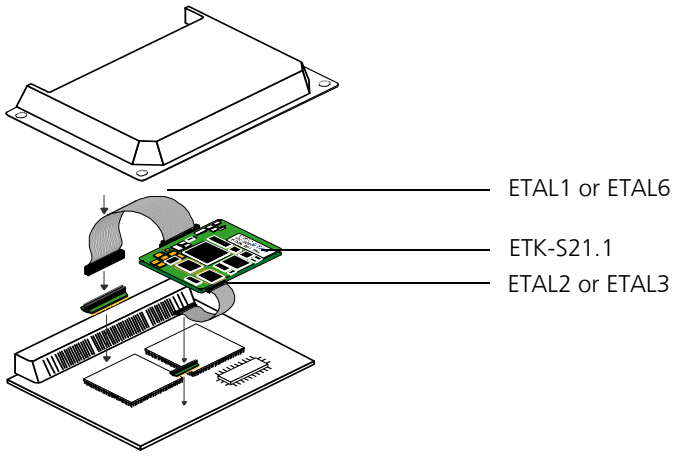

Fig. 5-1 ETK-S21.1 Connection to the ECU

For connecting the ETK-S21.1 to the ECU the ETK two adapters are recommended

Mode	Adapter at CON1	Adapter at CON2
JTAG	ETAL1 or ETAL6	ETAL2 or ETAL3
LFAST	ETAL6 (required)	ETAL2 or ETAL3

NOTE

Please refer to the ETAL6 User's Guide for the different pin assignment valid for LFAST and valid for JTAG mode.

NOTE

The ETAL1/ ETAL6 adapter and the ETAL2/ ETAL3 adapter need to be ordered separately (refer chapter "Ordering Information" on page 60).

The suitable connector SAMTEC bit "TMF-105" should have been populated onto the ECU PCB for adapter ETAL1 or ETAL6.

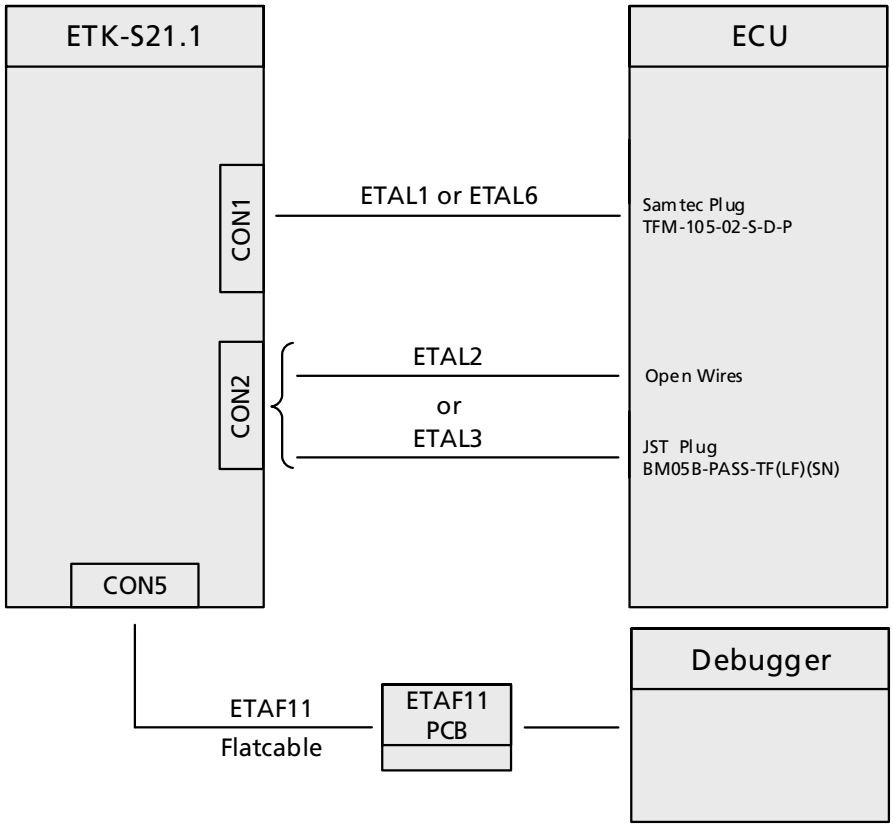

Fig. 5-2 ETK-S21.1 Connection to the ECU and to the Debugger

5.2 Connecting to the Power Supply

NOTE

The ETK-S21.1 needs a permanent power supply (refer chapter “Power Supply” on page 20). There are different versions to ensure it.

5.2.1 Permanent Power Supply inside ECU available

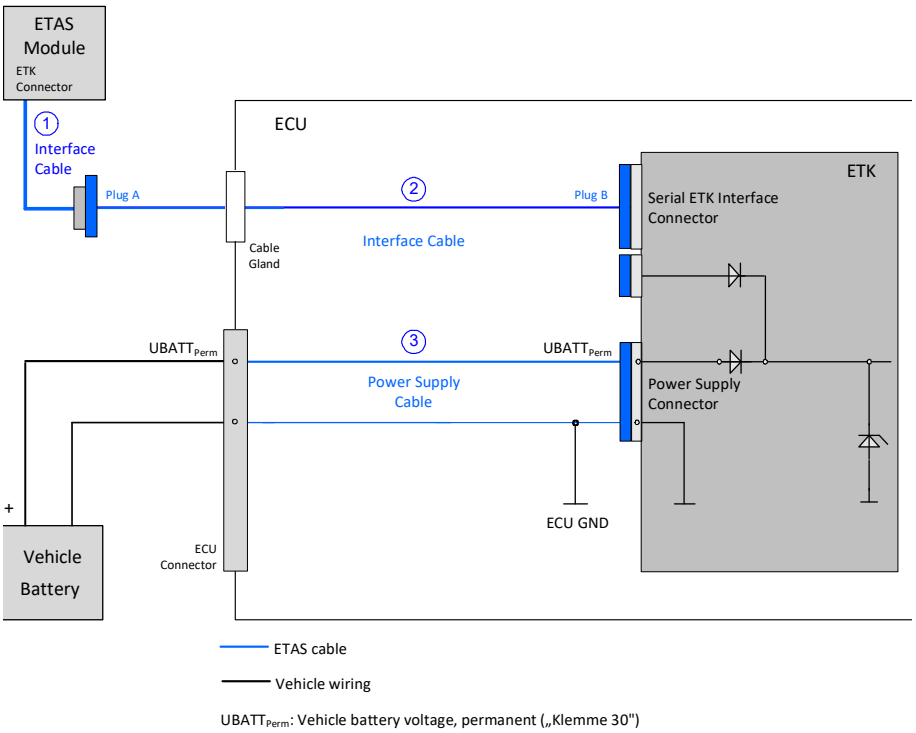

Fig. 5-3 Permanent Power Supply inside ECU available

Cable in Fig. 5-3	Function	Short name
1	Interface cable (ETK connected to ES59x, ES910)	CBM150
	Interface cable (ETK connected to ES89x)	CBAE360 connected to cable CBM150
2	Interface cable	KA55
	Interface cable (screwed in ECU case)	KA54, CBAM200
	Interface cable (used with ETKS_C3 case)	CBAM261
3	Power supply cable (ETK - ECU adapter)	ETAL2, ETAL3, ETV3

5.2.2 Permanent Power Supply inside ECU not available

5.2.2.1 Wiring with Interface Cable and Power Supply Cable

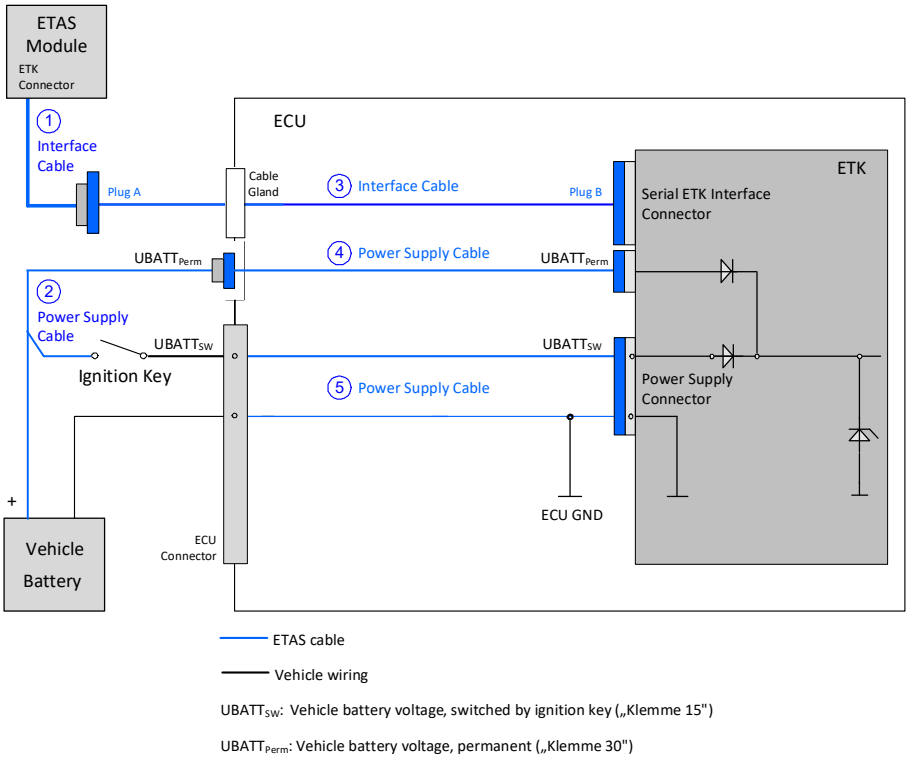

Fig. 5-4 Permanent Power Supply inside ECU not available

Cable in Fig. 5-4	Function	Short name
1	Interface cable (ETK connected to ES59x, ES910)	CBM150
	Interface cable (ETK connected to ES89x)	CBAE360 connected to cable CBM150
2	Power supply cable	K70.1
3	Interface cable	KA55
	Interface cable (screwed in ECU case)	KA54, CBAM200
	Interface cable (used with ETKS_C3 case)	CBAM261
4	Power supply cable (screwed in ECU case)	KA50
5	Power supply cable (ETK - ECU adapter)	ETAL2, ETAL3, ETV3

5.2.2.2 Wiring with combined Interface and Power Supply Cable

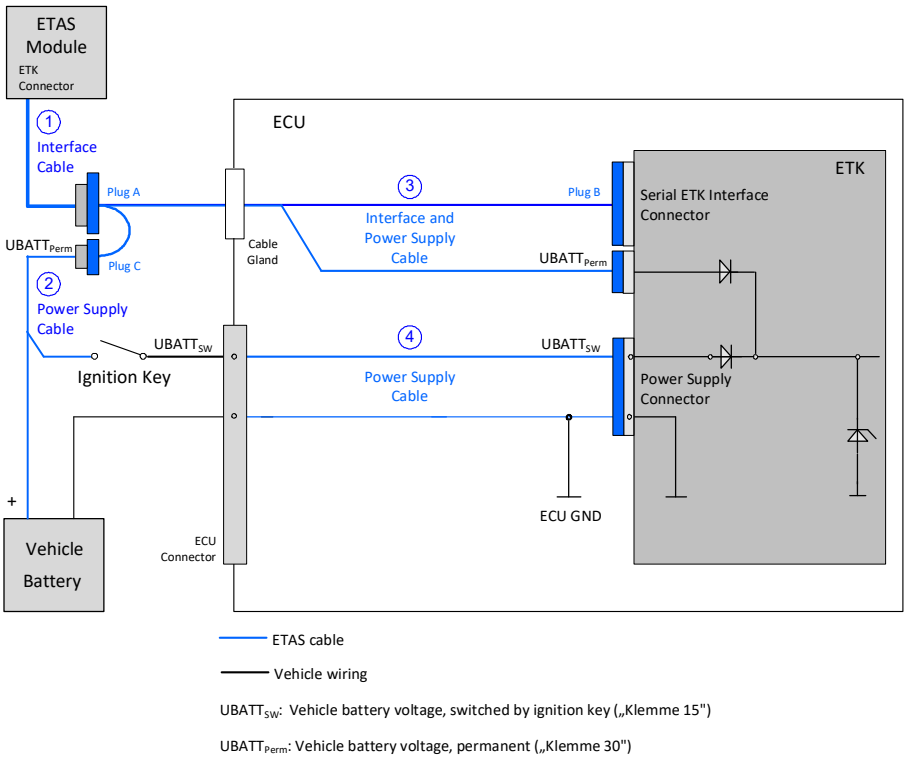

Fig. 5-5 Permanent Power Supply inside ECU not available

Cable in Fig. 5-5	Function	Short name
1	Interface cable (ETK connected to ES59x, ES910)	CBM150
	Interface cable (ETK connected to ES89x)	CBAE360 connected to cable CBM150
2	Power supply cable	K70.1
3	Combined interface and power supply cable	CBAM210, CBAM220
	Combined interface and power supply cable (used with ETKS_C3 case)	CBAM260
4	Power supply cable (ETK - ECU adapter)	ETAL2, ETAL3, ETV3

5.3 Connection to the Debugger

For connecting the ETK-S21.1 to the debugger the ETK adapter ETAF11 (including ETAF11 PCB and ETAF11 flatcable) is required. Its needs to be ordered seperately (refer chapter “Ordering Information” on page 60). A debugger specific cable has to be used to connect the debugger with the ETAF11 PCB.

NOTE

If automatic debugger detection and watchdog disable features are required an ETAF11 must be used.

For connecting the ETK-S21.1 to the debugger refer to Fig. 5-2 on page 28.

6 ETK Configuration

This chapter contains information about the following topics:

- Overview 33
- Configuration Parameter 34

6.1 Overview

As already mentioned in previous chapters, some project-specific adjustments are necessary. Configuration data is stored permanently in a serial Flash.

Generating a valid configuration data set is supported by the "(X)ETK Configuration Tool" (XCT). The "(X)ETK Configuration Tool" contains information on all available XETKs and ETKs like ETK-S20 and ETK-S21. The user is supported through a graphical interface.

The configuration is done in two steps:

A Generation of the special address offset for the emulation and measurement data memory.

The location of data areas, measured data output areas, trigger segment addresses etc. are familiar to the ECU software developer, or can be generated automatically. If an ECU description database (ASAP, ...) with the corresponding input exists, these inputs can be downloaded from this database. If necessary, a plausibility check is performed.

B Connection of the ETK to the ECU.

The ECU hardware developer defines the connection of the ETK to the ECU. The corresponding signals usually have to be adjusted for each microcontroller. All inputs are checked for plausibility, to make sure that a valid configuration is generated.

The "(X)ETK Configuration Tool" can create the following output:

A Direct ETK configuration

B Storage of the configuration in a data file

C The corresponding ASAP2 input

The most important outputs are the entries for the ASAP2 file. All A2L definitions necessary for configuring an ETK will be created. These are:

- Overlay Region definitions
- Memory Segment definitions
- ETK configuration features
- Raster definitions

If this parameters are entered correctly in the corresponding ECU description file, it guarantees that every time the calibration system is started, the ETK is checked for the appropriate configuration. If necessary, the ETK will be configured appropriately to the corresponding project.

6.2 Configuration Parameter

The "(X)ETK Configuration Tool" provides support concerning hardware configuration parameters and their possible values.

They are described for the different ETK types in the help document of the "(X)ETK Configuration Tool".

Starting the "(X)ETK Configuration Tool" help

1. Start the "(X)ETK Configuration Tool".

   The main window of the XCT tool opens.
2. Select in the menu bar **?** → **Contents**.

   The "(X)ETK Configuration Tool" help window opens.
3. Choose **Reference to User Interface** → (**X)ETK Hardware Configuration Parameters**.
4. Choose the topic **ETK-S21.1**.

   The topic **ETK-S21.1** contains information about the ETK-S21.1 hardware configuration parameters and their possible values.

7 Technical Data

This chapter contains information about the following topics:

- System Requirements 35
- ETK Firmware (HDC) Update 37
- Data Emulation Memory and Microcontroller Support 37
- Measurement Data Memory 38
- Configuration 38
- Serial ETK Interface for Application System 38
- Environmental Conditions 38
- Power Supply 39
- Microcontroller Interface 39
- Test Characteristics 40
- JTAG Timing Characteristics 41
- Electrical Characteristics 43
- Pin Assignment 46
- Mechanical Dimensions 48

7.1 System Requirements

7.1.1 ETAS Hardware

ETAS VME Hardware

ES1000.2/ES1000.3 with ES1120.2/1120.3 and ES1232 (ES1120.1 is not supported)

ETAS Compact Modules

ES590, ES591, ES592, ES593-D, ES595, ES89x, ES910 (ES690 is not supported)

ES89x ECU Interface Modules

ETK-S21.1 in DualMode (refer to chapter 4.16 on page 26 and chapter 7.1.3 on page 36).

7.1.2 PC with one Ethernet Interface

A PC with one open Ethernet interface (1 Gbit/s) with RJ45 connection is required. Ethernet interfaces that are implemented with an additional network card in the PC must feature a 32-bit data bus.

7.1.2.1 Requirement to ensure successful Initialization of the Module

NOTE

It is imperative you disable the function which automatically switches to power-saving mode on your PC network adapter when there is no data traffic on the Ethernet interface!

To deactivate the Power saving Mode

Choose in Windows System Control Center / Device Manager / Network Adapter the used network adapter by double-click. Deactivate the "Allow the computer to turn off this device to save power" option in the "Power Management" register. Confirm your configuration.

The manufacturers of network adapter have different names for this function.

Example:

- "Link down Power saving"
- "Allow the computer to turn off this device to save power"

7.1.3 Software Support

You need following software versions to support the ETK-S21.1 at ETAS hardware with the exception of ES89x modules:

Microcontroller	HSP	INCA	ETK Drivers and Tools	ASCET-RP	INTECRIO
MPC5746M-ED	V9.9.1	V7.0	V3.8.0	V6.1.3	V4.2
EMU57EM80xy	V9.9.1	V7.0	V3.8.0	V6.1.3	V4.2
MPC5744K-ED	V10.0.0	V7.0	V3.9.0	V6.1.3	V4.2
EMU574K72xy	V10.0.0	V7.0	V3.9.0	V6.1.3	V4.2
MPC5777M-ED	V10.1	V7.0	V3.10.0	V6.1.3	V4.2
EMU57HM90	V10.1	V7.0	V3.10.0	V6.1.3	V4.2
MPC5746R-ED	V10.3.0	V7.1.3	V3.12.0	V6.1.3	V4.2

You need following software versions to support the ETK-S21.1 at ES89x modules:

Microcontroller	HSP	INCA	ETK Drivers and Tools	ASCET-RP	INTECRIO
MPC5746M-ED	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
EMU57EM80xy	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
MPC5744K-ED	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
EMU574K72xy	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
MPC5777M-ED	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.

Micro-controller	HSP	INCA	ETK Drivers and Tools	ASCET-RP	INTECRIO
EMU57HM90	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
MPC5746R-ED	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.
PPC57xx_Gener-ic_Cfg1	V10.9.1	V7.1 SP9	V4.0.5	n.a.	n.a.

As of INCA 7.1.4, a generic A2L configuration for several microcontroller families and ETKs is available.

This generic configuration *<[microcontroller family]_Generic_Cfg[index]>* enables measurement, calibration and bypass tasks immediately after the release of a microcontroller.

Most likely, an update of the ETAS tool chain is not mandatory after the initial release of an ETK. Please contact the INCA Hotline for this configuration file and additional hints.

Operating the ETK-S21.1 with older software versions is not possible.

EMU57xx: STMicroelectronics microcontroller device

MPC57xx: Freescale microcontroller device

7.2 ETK Firmware (HDC) Update

The ETK firmware update (update of the ETK hardware definition code [HDC]) is supported by the service software HSP instead of ETK Configuration Tool. Removal of ETK or ECU is not necessary. The service software HSP is running on the connected PC.

NOTE

Please note hints for using the ETK-S21.1 at ES89x modules (refer to chapter 4.16 on page 26).

7.3 Data Emulation Memory and Microcontroller Support

The ETK-S21.1 uses the internal overlay RAM of all in the table listed microcontrollers to emulate data in internal flash.

Microcontroller	Max. RAM [1)]	Standby powered
MPC5746M-ED	1 Mbyte	Yes
EMU57EM80xy	1 Mbyte	Yes
MPC5744K-ED	1 Mbyte	Yes
EMU574K72xy	1 Mbyte	Yes
MPC5746R-ED	1 Mbyte	Yes
MPC5777M-ED	2 Mbyte	Yes
EMU57HM90	1 Mbyte	Yes

[1)]: Max. RAM as working page (kByte)

7.4 Measurement Data Memory

Item	Characteristics
Location	Within the emulation memory when using DISTAB hooks

7.5 Configuration

Item	Characteristics
Configuration	Project-specific configuration for - different microcontrollers or - memory configurations stored in EEPROM
Update	Logic devices updated through software

7.6 Serial ETK Interface for Application System

Item	Characteristics
Transmission speed	100 Mbit/s
Cable length	max. 30 m / 100 ft
Serial Interface	DC decoupling

7.7 Environmental Conditions

Item	Characteristics
Temperature range (operation)	- 40 °C to +110 °C/ - 40 °F to +230 °F
Temperature range (storage)	0 °C to +50 °C/ - 18 °F to +122 °F
Relative humidity (non-condensing)	0 to 95%
Operating altitude	max. 5000 m/ 16400 ft
Contamination level	2
Degree of protection	Determined by installation in ECU
Overvoltage category (AC mains supply)	II

7.8 Power Supply

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Permanent power supply	U_{Batt}	Vehicle usage [1)]	4.3	12	36	V
			[all values ±0%]			
Cranking voltage	U_{Batt}	< 3 seconds	3			V
Standby current	I_{STBY}	U_{Batt} = 12 V; ECU off; no load from ECU; T = 20 °C	10	38	42	mA
Operating current	I_{Batt}	U_{Batt} = 12 V; no load from ECU; T = 20 °C	50	100	220	mA
Power dissipation	P_{Batt}	U_{Batt} = 12 V; I = 0 mA at pin ECU_SBRAM; T = 20 °C		1.2		W
Power dissipation	P_{Batt}	U_{Batt} = 12 V; I = 500 mA at pin VDDSTBY; I = 80 mA at pin VDDPSTBY; T = 20 °C		2.6		W

[1)] The ETK-S21.1 implements reverse voltage protection in the same range and may be used only with central load dump protection.
24 V vehicles require U_{Batt} disturbing pulse reduction to 12 V vehicle system.
12 V vehicles don't require special disturbing pulse reductions.

NOTE

The ETK-S21.1 will accept permanent power supply voltage dips (for additional details of 3 V low voltage operation, see ISO standard 16750).

7.9 Microcontroller Interface

	Symbol	Condition	Min	Typ	Max	Unit
VDDSTBY Output Voltage	VDDSTBY	max 500 mA load	1.19	1.25	1.31	V
ECU ED-RAM Power Supply Supervision Voltage. 1.3 V nominal	VDDSTBY	Powerfail	1.13			
VDDPSTBY Output Voltage	VDDP-STBY	max 130 mA load	3.14	3.3	3.46	V
CalWakeup Output Voltage	CALL-WAKEUP	U_{Batt} = 6 - 36 V; load = 0 - 50 mA	U_{Batt} - 1V		U_{Batt}	V

	Symbol	Condition	Min	Typ	Max	Unit
ECU Power Supply Supervision Voltage 3.3 V / 5 V nominal	VDDP	ECU on	2.46	2.56	2.66	V
	VDDP	ECU off	2.29	2.39	2.49	V
	IDDP	Sense current at 5 V			150	µA

7.10 Test Characteristics

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Reset delay 1 [1)]	t_{Reset1}	U_{Batt} = 12 V VDDP = 0 V ↑ 3.3 V/ 2.5 V without transferring FPGA	29		40	ms
Reset delay 2 [2)]	t_{Reset2}	U_{Batt} = 0 V ↑ 12 V transfer FPGA	360		440	ms

[1)] Delay of ECU reset through ETK without transferring the FPGA (U_{Batt} present, VDDP will be switched on)

[2)] max. delay of ECU reset through ETK (U_{Batt} and VDDP will be switched on)

7.11 JTAG Timing Characteristics

The following diagrams show the timings the ETK-S21.1 can process.

NOTE

JTAG timing parameters in this chapter refer to the JTAG interface (CON1/ CON6) of the ETK-S21.1. The JTAG wiring to the ECU (ETAF1/ ETAL1) must be taken account additionally.
All timings are measured at a reference level of 1.5 V. Output signals are measured with 20 pF to ground and 50 Ω to 1.5 V.

7.11.1 JTAG Timing Diagram

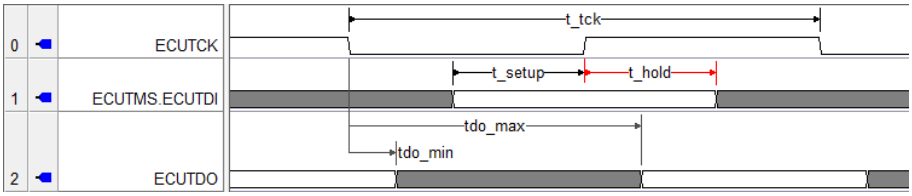

Fig. 7-1 JTAG Timing Diagram

7.11.2 JTAG Timing Parameter

Parameter	Symbol	Value [ns]	Comment
Nexus Clock Period (ETK –> Target)	t_{tck}	50	20 MHz Nexus JTAG Clock Frequency
		33.3	30 MHz Nexus JTAG Clock Frequency
		20	50 MHz Nexus JTAG Clock Frequency
		25	40 MHz Nexus JTAG Clock Frequency
TMS/TDI setup time (ETK –> Target)	t_{setup}	7 (min.)	Minimum 5 ns required for microcontroller
TMS/TDI hold time (ETK –> Target)	t_{hold}	7 (min.)	Minimum 5 ns required for microcontroller
TDO clock-to-out time (Target –> ETK)	t_{do_min}	2.25 (min.)	Minimum 2.25 ns required by microcontroller specification
	t_{do_max}	16 (max)	Minimum 12.5 ns required by microcontroller specification

7.11.3 Debugger Arbitration Timing Diagram

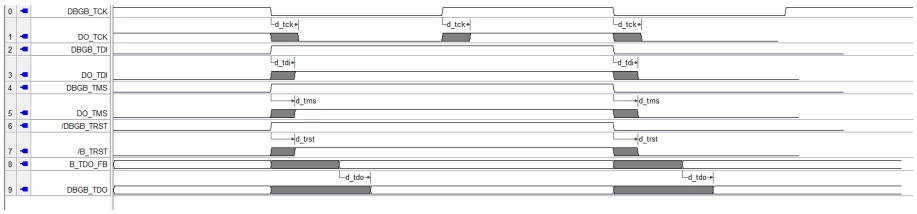

Fig. 7-2 Debugger Arbitration Timing Diagram

7.11.4 Debugger Arbitration Parameter

Parameter	Value [ns]
d_tck (Debugger --> Target)	9
d_tdi (Debugger --> Target)	7
d_tms (Debugger --> Target)	7
d_trst (Debugger --> Target)	7
d_tdo (Target --> Debugger)	9

7.12 Electrical Characteristics

7.12.1 Debugger Interface Connector CON5

Signal	Pin Type	V_{OL} (min) [V]	V_{OH} (min) [V]	V_{OH} (max) [V]	V_{IL} (max) [V]	V_{IH} (min) [V]	V_{IH} (max) [V]	Leakage current [µA]	Additional load by ETK (typ) [pF][1)]
VREF	XO [2)]	-	2.3	3.3	-	-	-	-	-
TCK	I	-	-	-	0.8	2	5.5	+350 [3)]/ +220 [4)]	8
TMS	I	-	-	-	0.8	2	5.5	+370 [3)]/ +200 [4)]	15
TDO	XO [2)]	0.7	2.3	3.3	-	-	-	-370 [3)]/ -195 [4)]	15
JCOMP; RSV1; TDI; /BREQ	I	-	-	-	0.8	2	5.5	-350 [3)]/ -215 [4)]	8
/RESETOUT; RSV2; /BGRANT	XO [2)]	0.7	2.3	3.3	-	-	-	-350 [3)]/ -215 [4)]	12
/STCON	I	-	-	-	0.8	2	3.6	-340 [3)]/ -225 [4)]	15
WGDIS	I	-	-	-	0.8	2	5.5	+350 [3)]/ +220 [4)]	8
/PORST	connected to /PORST ECU connector								

Pin Type:
I: Input, X: Tristate, O: Output, OD: Open Drain

[1)] Adapter cable and Samtec connector not considered; PCB 1 pF/cm
[2)] max 12 mA
[3)] max
[4)] min

7.12.2 ECU Interface Connector CON1 (JTAG Mode)

Signal	Pin Type	V_{OL} (min) [V]	V_{OH} (min) [V]	V_{OH} (max) [V]	V_{IL} (max) [V]	V_{IH} (min) [V]	V_{IH} (max) [V]	Leakage current [µA]	Additional load by ETK (typ) [pF] [1]
TCK	XO [2]	0.7	2.3	3.3	-	-	-	+3340 [3]/ +2360 [4]	8
TMS	XO [2]	0.7	2.3	3.3	-	-	-	+3340 [3]/ +2360 [4]	20
TDO	I	-	-	-	0.8	2	5.5	-370 [3]/ -195 [4]	18
/JCOMP; TDI	XO [2]	0.7	2.3	3.3	-	-	-	+3320 [3]/ +2380 [4]	15
/RSTOUT	IXOD [5]	0.7	-	-	0.8	2	5.5	+25 [3]/ -20 [4]	22
/PORST	IXOD [5]	0.7	-	-	0.8	2	5.5	+25 [3]/ -20 [4]	22
WGDIS	XO [2]	0.7	2.3	3.3	-	-	-	+20 [3]/ -20 [4]	10
RSV1	I	-	-	-	0.8	2	5.5	-335 [3]/ -230 [4]	10
AUTODETECT	I	-	-	-	0.8	2	3.6	-540 [3]/ -475 [4]	10

Pin Type:
I: Input, X: Tristate, O: Output, OD: Open Drain

[1] Adapter cable and Samtec connector not considered; PCB 1 pF/cm
[2] max 12 mA
[3] max
[4] min
[5] max 0.2 A

7.12.3 ECU Interface Connector CON1 (Differential JTAG Mode / LFAST Mode)

Signal	Pin Type	V_{OL} (min) [V]	V_{OH} (min) [V]	V_{OH} (max) [V]	V_{IL} (max) [V]	V_{IH} (min) [V]	V_{IH} (max) [V]	Leakage current [µA]	Additional load by ETK (typ) [pF][1)]
JCOMP	XO [2)]	0.7	2.3	3.3	-	-	-	+3320 [3)]/ +2380 [4)]	15
/RSTOUT	IXOD [5)]	0.7	-	-	0.8	2	5.5	+25 [3)]/ -20 [4)]	22
/PORST	IXOD [5)]	0.7	-	-	0.8	2	5.5	+25 [3)]/ -20 [4)]	22
WGDIS	XO [2)]	0.7	2.3	3.3	-	-	-	+20 [3)]/ -20 [4)]	10
RSV1	I	-	-	-	0.8	2	5.5	-335 [3)]/ -230 [4)]	10
AUTODETECT	I	-	-	-	0.8	2	3.6	-540 [3)]/ -475 [4)]	10
OE_JTAG	O [2)]	0.7	2.3	3.3	-	-	-	+3340 [3)]/ +2360 [4)]	20
OE_DIGRF	O [2)]	0.7	2.3	3.3	-	-	-	+3320 [3)]/ +2380 [4)]	15

		V_{OD} (min) [mV]	V_{OD} (max) [mV]	V_{ID} (min) [mV]	V_{ID} (max) [mV]
TCK±; TDI±; TMS±; RXD±	O	247	600	-	-
TDO±; TCK_FB±; TMS_FB±; TXD±	I	-	-	100	700

Pin Type: I: Input. X: Tristate, O: Output, OD: Open Drain

[1)] Adapter cable and Samtec connector not considered; PCB 1 pF/cm
[2)] max 12 mA, [3)] max, [4)] min, [5)] max 0.2 A

7.13 Pin Assignment

7.13.1 ECU Interface Connector CON1

NOTE

Please refer to the ETAL6 User's Guide for the different pin assignment valid for LFAST and valid for JTAG mode.

7.13.2 ECU Power Connector CON2

Pin	Signal	Direction	Comment
1	Ubatt	Input	Car Battery
2	Cal_Wakeup	Output	Switch to Ubatt. ECU wake-up signal (for measurement preparation)
3	GND	Input	Power GND
4	VDDSTBY (1.25 V Supply)	Output	Permanent power supply of ECU EDRAM, 1.25 V
5	VDDPSTBY (3.3 V Supply)	Output	Permanent power supply of ECU JTAG/ LFAST interface, 3.3 V

7.13.3 Power Connector CON3

Pin	Signal	Direction	Comment
1	Ubatt	Input	Additional Car Battery Input
2	Reserved		not connected

7.13.4 Debugger Interface Connector CON5

Pin	Signal	Direction	Comment
1	TMS	Input	JTAG Signal
2	VREF	Output	Target supply for sensing
3	TDO	Output	JTAG Signal
4 = 6	GND	Power	Signal Ground
5	RSV0	Output	N.C.
6 = 4	GND	Power	Signal Ground
7	TDI	Input	JTAG Signal
8	/PORST	Bidir	Directly connected to ECU /PORST
9	JCOMP	Input	JTAG Signal
10	BRKOUT	Output	N.C.
11	TCK	Input	JTAG Signal
12	/STCON	Input	Debugger Detect Signal
13	BRKIN	Input	N.C.

Pin	Signal	Direction	Comment
14	/BREQ	Input	Bus Request
15	/BGRANT	Output	Bus Grant
16	RSV1	Input	Reserved Input

7.14 Mechanical Dimensions

The reference measure for all drawings is millimeter.

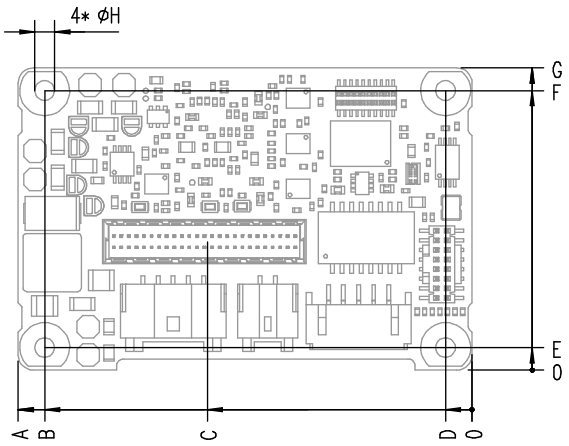

Fig. 7-3 ETK-S21.1 Dimensions - Top View

Item	Dimension [Millimeters]	Tolerance [Millimeters]	Dimension [Inches]	Tolerance [Inches]
A	60.00	+0.2/-0.2	2.362	+0.008/-0.008
B	56.50	+0.1/-0.1	2.224	+0.004/-0.004
C	35.00	+0.2/-0.2	1.380	+0.008/-0.008
D	3.50	+0.1/-0.1	0.138	+0.004/-0.004
E	3.00	+0.1/-0.1	0.118	+0.004/-0.004
F	37.00	+0.1/-0.1	1.457	+0.004/-0.004
G	40.00	+0.2/-0.2	1.575	+0.008/-0.008
H	2.60	+0.1/-0.0	0.102	+0.004/-0.000

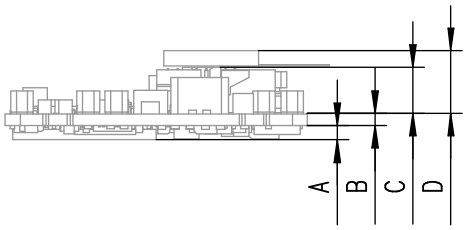

Fig. 7-4 Mechanical Dimensions ETK-S21.1: Microcontroller with Socket Adapter mounted

Item	Dimension [Millimeters]	Tolerance [Millimeters]	Dimension [Inches]	Tolerance [Inches]
A	2.10	+0.1/-0.1	0.083	+0.004/-0.004
B	1.60	+0.16/-0.16	0.063	+0.006/-0.006
C	6.00	+0.1/-0.1	0.236	+0.004/-0.004
D *)	8.00	+0.1/-0.1	0.315	+0.004/-0.004

*) including ETAL1 adapter

8 Cables and Accessories

8.1 Interface Cables

8.1.1 Cable KA54

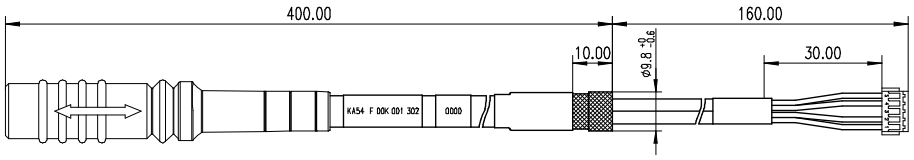

Fig. 8-1 Interface Cable KA54

NOTE

Cable glands are not included in the delivery. Refer to the cable descriptions for manufacturers and order numbers.

8.1.1.1 Cable KA54 with PG Cable Gland, Proposal 1

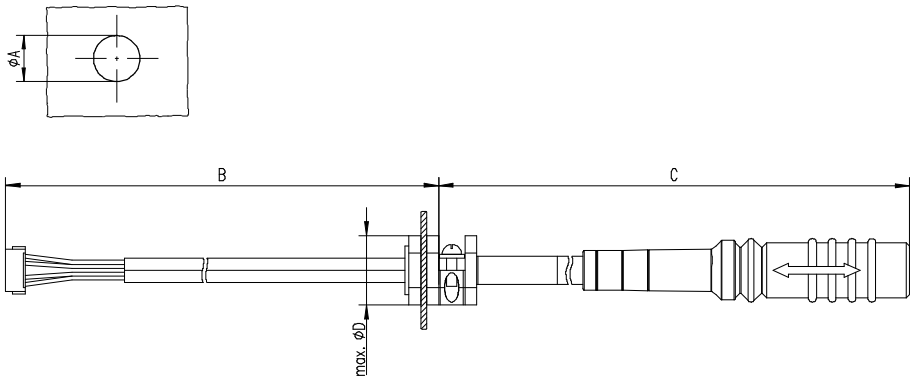

Fig. 8-2 Interface Cable KA54, Proposal 1

Dim	Millimeters	Inches	Dim	Millimeters	Inches
A	12.50	0.492	**C**	400.00	15.748
B	160.00	6.299	**D**	19.00	0.748

NOTE

Shield **connected** to ECU housing.

SKINDICHT compact screwing; Manufacturer: Lapp; Description: SH7; Order-No.: 5200 0830

Nut for compact screwing; Manufacturer: Lapp; Description: SM7; Order-No.: 5200 3490

8.1.1.2 Cable KA54 with PG Cable Gland, Proposal 2

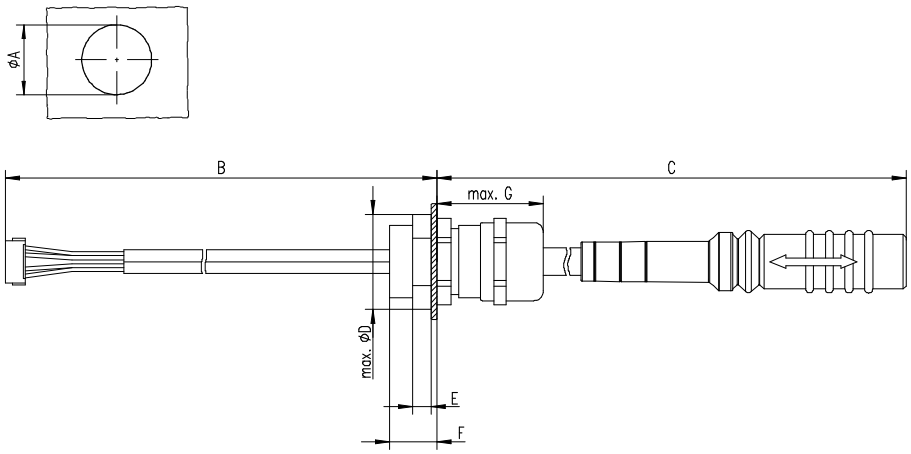

Fig. 8-3 Interface Cable KA54, Proposal 2

Dim	Millimeters	Inches
A	18.80	0.740
B	160.00	6.299
C	400.00	15.748
D	24.25	0.955
E	4.70	0.185
F	12.00	0.472
G	27.00	1.063

NOTE

Shield **connected** *to ECU housing.*

SKINTOP compact screwing; Manufacturer: Lapp; Description: MS-SC 11 ; Order-No.: 5311 2320

Nut for compact screwing; Manufacturer: Lapp; Description: SM-PE 11 ; Order-No.: 5210 3220

8.1.2 Cable KA55

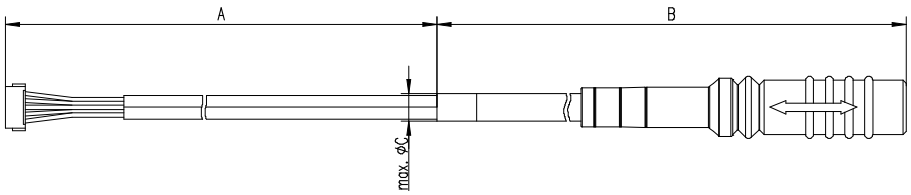

Fig. 8-4 Interface Cable KA55

Dim	Millimeters	Inches
A	160.00	6.299
B	400.00	15.748
C	9.00	0.3543

NOTE

Strain relief on ECU cover necessary. Shield **not connected** to ECU housing.

8.1.3 Cable CBAM200

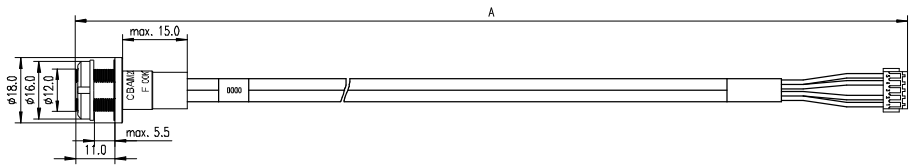

Fig. 8-5 Interface Cable CBAM200-0m38

Dim	Millimeters	Inches
A	380.00	14.96
B	30.00	1.18

NOTE

Shield connected to ECU housing, allows for ECU housing flush mounting.

8.1.4 Cable CBAM261

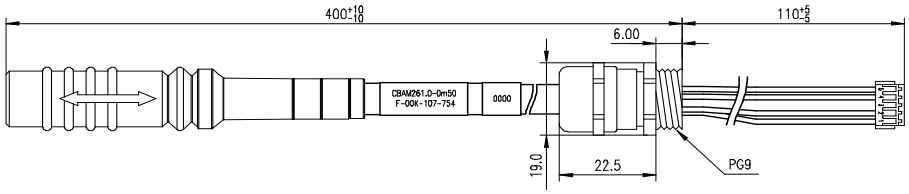

Fig. 8-6 Interface Cable CBAM261

ETK interface cable (100 MBit) for the ETKS_C3 water proofed case with shield pre-mounted in PG9 screwing.

NOTE

Shield **connected** *to ECU housing.*

8.1.5 Cable CBAM281

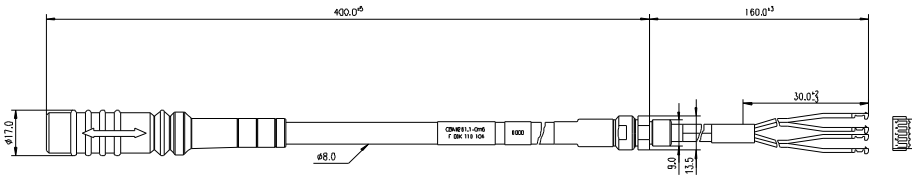

Fig. 8-7 Interface Cable CBAM261

ETK ECU Adapter Cable. Cable is pre-assembled in a LEMO GSC.1S screwing (M9x0,6), with a connected shield on screwing.

NOTE

Shield **connected** *to ECU housing.*

8.1.6 Cable CBAE360.1

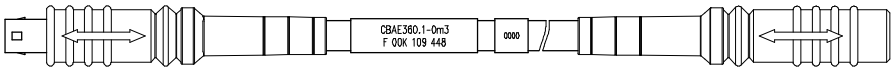

Fig. 8-8 Interface Cable CBAE360

GBit Ethernet Connection Adapter Cable for conncection of Dual Mode ETKs (CBM150) to ES891. 0m3

8.2 Power Supply Cables

8.2.1 Cable K70.1

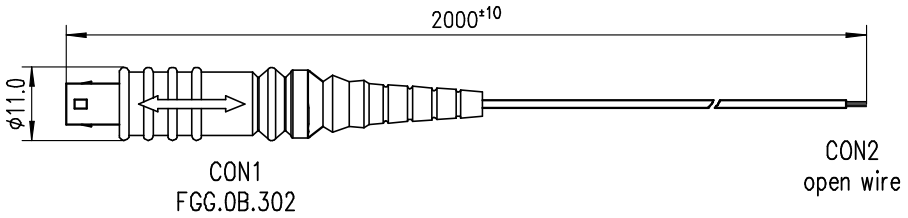

Fig. 8-9 Power Supply Cable K70.1

Dim	Millimeters	Inches
A	2000	78.74

8.2.2 Cable KA50

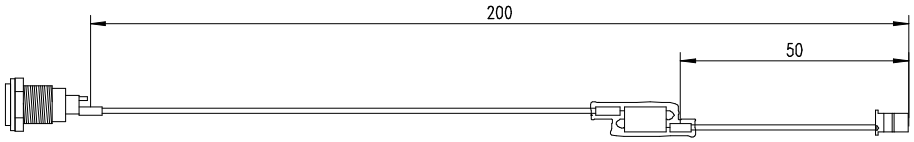

Fig. 8-10 Power Supply Cable KA50

Dim	Millimeters	Inches
A	200	7.87
B	50	1.97

8.2.3 Cable ETV3

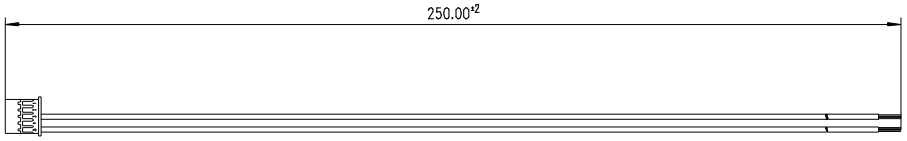

Fig. 8-11 Power Supply Cable ETV3

Dim	Millimeters	Inches
A	250	

8.3 Combined Interface and Power Supply Cables

8.3.1 Cable CBAM210

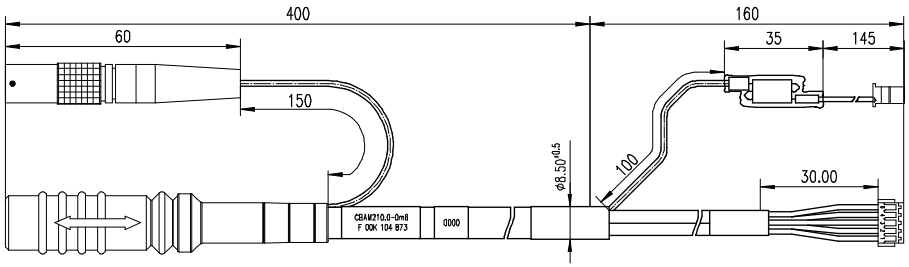

Fig. 8-12 Combined Interface and Power Supply Cable CBAM210

NOTE

Shield **not connected** to ECU housing.

8.3.2 Cable CBAM220

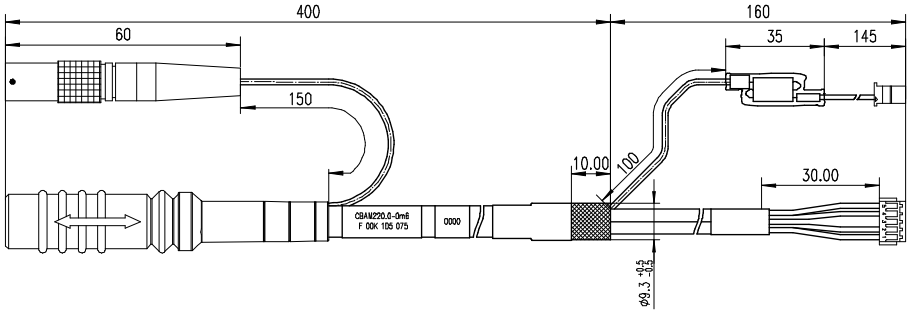

Fig. 8-13 Combined Interface and Power Supply Cable CBAM220

NOTE

Shield ***connected*** *to ECU housing.*

8.3.3 Cable CBAM260

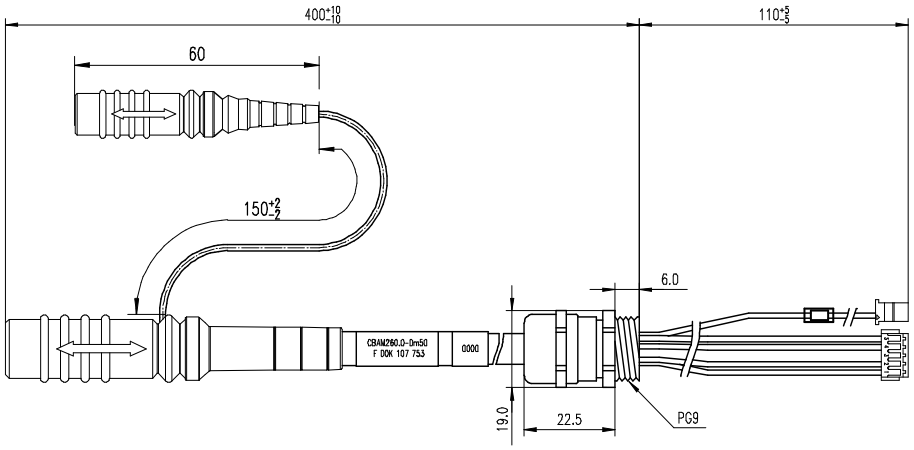

Fig. 8-14 Combined Interface and Power Supply Cable CBAM260

Combined ETK interface and power supply cable (100 Mbit/s) for the ETKS_C3 water proofed case with shield pre-mounted in PG9 screwing.

NOTE

Shield **connected** *to ECU housing.*

8.4 Adapters

8.4.1 ETK - ECU Adapter ETAL1

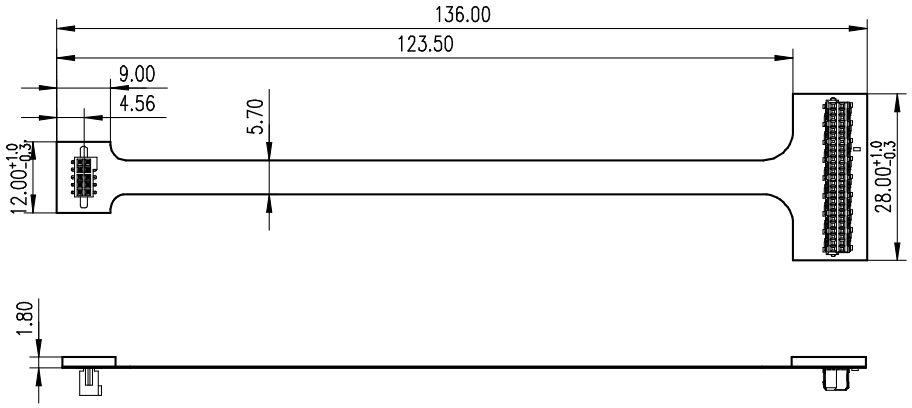

Fig. 8-15 ETK - ECU Adapter ETAL1

In order to be able to use the ETK adapter ETAL1 in the ECU, a 10 pin SAMTEC connector (e.g. TFM-105-02-S-D-P) must be available on the ECU.

8.4.2 ETK - ECU Adapter ETAL2

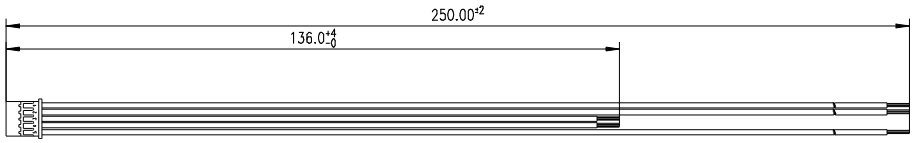

Fig. 8-16 ETK - ECU Adapter ETAL2

The ETAL2 is an open wire adapter to connect the ETK power signals to several points at the ECU PCB. GND and VDDSTBY are shorter to minimize the voltage drop.

8.4.3 ETK - ECU Adapter ETAL3

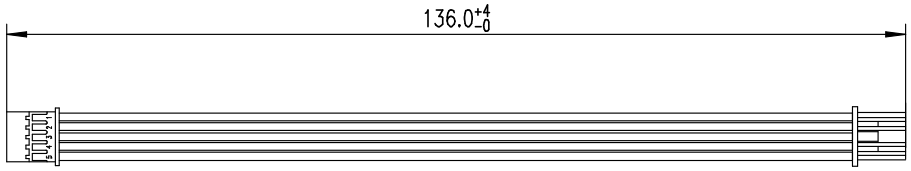

Fig. 8-17 ETK - ECU Adapter ETAL3

The ETAL3 is an 5 pin JST 1:1 cable to adapt ETK-S21.1 power signals to an ECU. To fit with the ETAI3 adapter cable in the ECU an 5 pin JST connector (order number BM05B-PASS-TB(LF)(SN) or a similar type must be installed.

8.4.4 ETK - ECU Adapter ETAL5

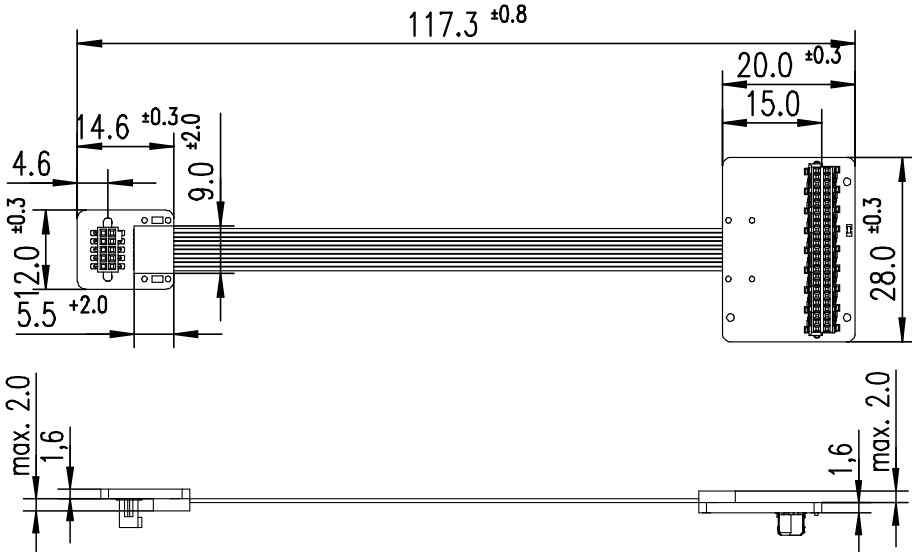

Fig. 8-18 ETK - ECU Adapter ETAL5

8.4.5 ETK - ECU Adapter ETAL6

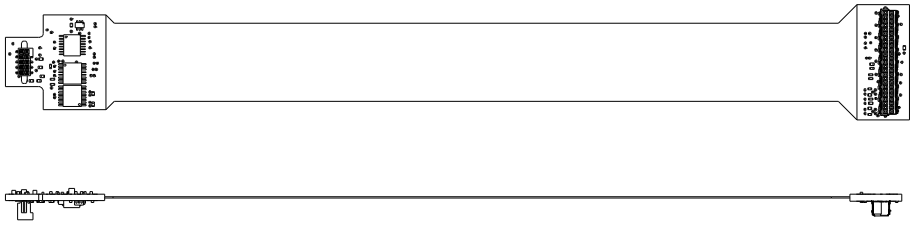

Fig. 8-19 ETK - ECU Adapter ETAL6

8.4.6 ETK - ECU Adapter ETAL7

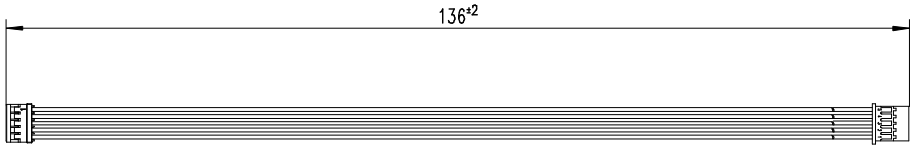

Fig. 8-20 ETK - ECU Adapter ETAL7

The ETAL7 is an adapter (MOLEX - JST PAP (5fc - 5fc)) to connect the ETK to the ECU (additional ETAL1 adapter cable is needed).

8.4.7 Debug Adapter ETAF11

The ETAF11.0 adapts OCDS1 or Unified Automotive Debug Cable for debugger connection. The ETAF11 bottom side is isolated (no parts and vias).

There are two specific applications:

- adapt the ECU-ETK connector to the Debugger
- adapt the ETK-Debugger conector to the Debugger

8.4.7.1 ETAF11 Flatcable

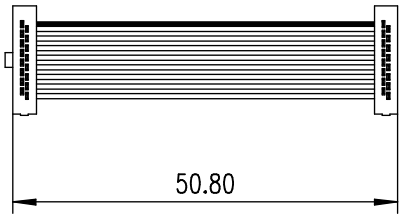

Fig. 8-21 ETAF11 Flatcable

8.4.7.2 ETAF11 Component Placement

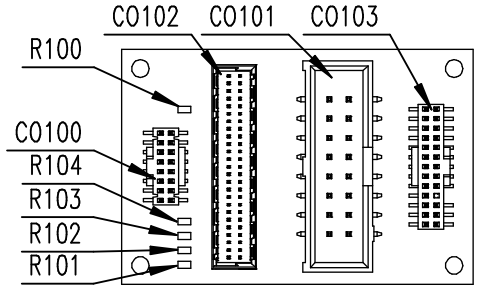

Fig. 8-22 ETAF11 Component Placement

8.4.7.3 ETAF11 PCB

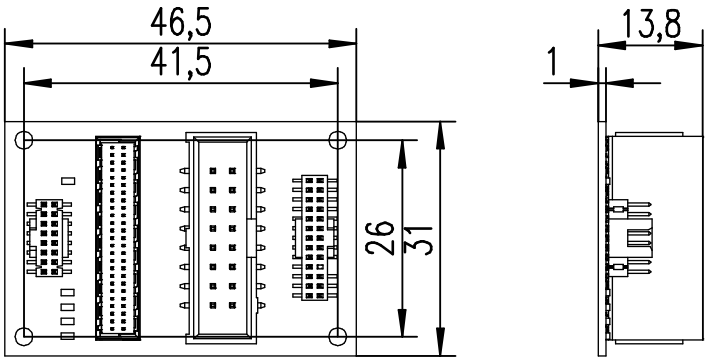

Fig. 8-23 ETAF11 - Mechanical Dimensions and Component Placement

8.5 Water proofed Case ETKS_C3

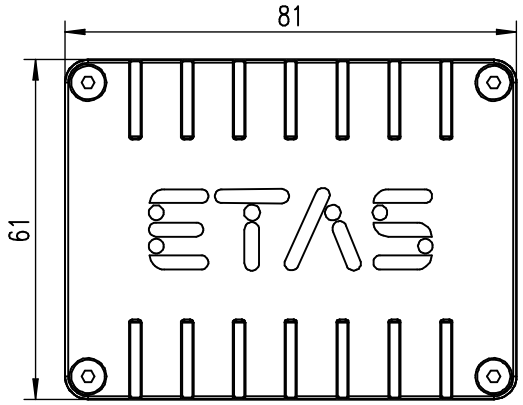

Fig. 8-24 ETKS_C3 Top View

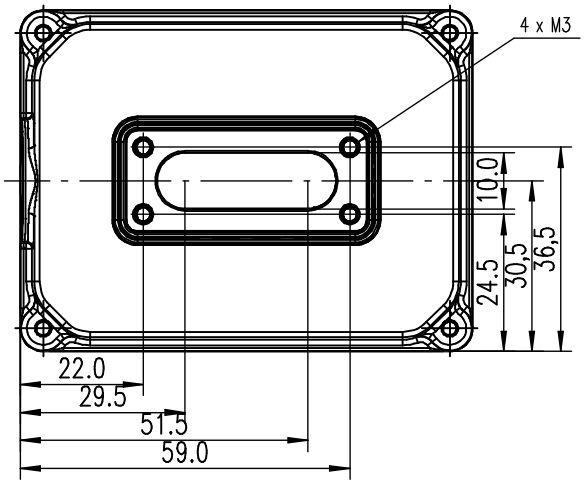

Fig. 8-25 ETKS_C3 Bottom View

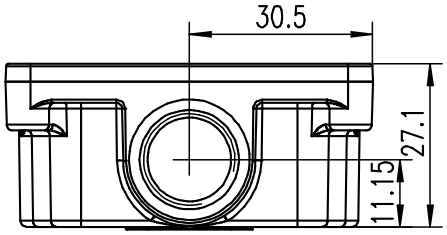

Fig. 8-26 ETKS_C3 Side View

9 Ordering Information

9.1 ETK-S21.1

Order Name	Short Name	Order Number
ETK-S21.1 Emulator Probe for MPC57xx and EMU57xx MCU Family	ETK-S21.1	F 00K 109 140

Package Contents

- ETK-S21.1 Emulator Probe for MPC57xx and EMU57xx MCU Family
- List "Content of this Package"
- ETK Safety Advice
- China-RoHS-leaflet_Compact_cn

9.2 ETK - ECU Adapter

Order Name	Short Name	Order Number
ETAL1 ETK ECU Adapter, Erni - Samtec (50fc - 10fc), 0m136	ETAL1	F00K 107 679
ETAL2 ETK ECU Adapter with short ED supply and GND lines, JST PAP - open wires (5fc - 2c+3c), 0m136 / 0m25	ETAL2	F00K 107 680
ETAL3 ETK ECU Adapter, JST PAP - JST PAP (5fc - 5fc), 0m136	ETAL3	F00K 107 681
ETAL5 ETK ECU Adapter, Erni - SAMTEC (50fc - 10fc), 0m1	ETAL5	F00K 109 414
ETAL6 ETK ECU LFAST Adapter, Erni - SAMTEC (50fc - 10fc), 0m21	ETAL6	F00K 109 558
ETAL7 ETK ECU Adapter, MOLEX - JST PAP (5fc - 5fc), 0m136	ETAL7	F00K 110 103

9.3 Debug Adapter

Order Name	Short Name	Order Number
Debug Adapter from Debugger to ETK-S2x	ETAF11	F00K 107 682

9.4 Cables

Please contact your local ETAS representative for further cable information.

NOTE

The cables showed in chapter “Cables and Accessories” on page 49 are not included in the ETK-S21.1 delivery.

NOTE

The screws for mounting ECU adapter cables are not included in the cable delivery. They need to be ordered separately.

9.4.1 Interface Cables

Order Name	Short Name	Order Number
ETK ECU Adapter Cable, Shield on ECU-Housing, Lemo 1B PHG JST PHR (4fc-5fc), 0m6 [1)]	KA54	F 00K 001 302
ETK ECU Adapter Cable, Lemo 1B PHG JST PHR (4fc-5fc), 0m6 [2)]	KA55	F 00K 001 303
ETK ECU Adapter Cable, Shield on ECU-Housing, Lemo 1B HMG – JST PHG (4fc-5fc), 0m085	CBAM200.2-0m085	F 00K 104 312
ETK ECU Adapter Cable, Shield on ECU-housing, Lemo 1B HMG – JST PHG (4fc-5fc), 0m130	CBAM200-0m130	F 00K 104 852
ETK ECU Adapter Cable, pre-assembled into PG9 screwing, shield on ECU- Housing, Lemo 1B PHG - JST PHR (4fc-5fc), 0m50	CBAM261-0m5	F 00K 107 754
ETK ECU Adapter Cable, pre-assembled into GSC.1S screwing (M9x0,6), shield on ECU-Housing, Lemo 1B PHG - JST PHR (4fc-5fc), 0m60	CBAM281.1-0m6	F00K 110 104
GBit Ethernet Connection Adapter Cable for Dual Mode ETK, Lemo 1B FGH - Lemo 1B PHG (10mc-4fc), 0m3	CBAE360.1-0m3	F 00K 109 448

[1)]: ETK grounded via ECU housing
[2)]: ETK grounded via cable

9.4.2 Combined Interface and Power Supply Cables

Order Name	Short Name	Order Number
ETK ECU Adapter and Power Supply Cable, Lemo 1B PHG - JST PHR (4fc-5fc) / Lemo 0B PHG - open wires (2fc-2c), 0m6	CBAM210-0m6	F 00K 104 873
ETK ECU Adapter and Power Supply Cable, Shield on ECU-Housing, Lemo 1B PHG - JST PHR (4fc-5fc) / Lemo 0B PHG - open wires (2fc-2c), 0m60	CBAM220-0m6	F 00K 105 075
ETK ECU Adapter and Power Supply Cable, pre-assembled into PG9 screwing, shield on ECU-Housing, Lemo 1B PHG - JST PHR (4fc-5fc) / Lemo 0B PHG - JST PAP (2fc-2fc), 0m50	CBAM260-0m5	F 00K 107 753

9.4.3 Power Supply Cables

Order Name	Short Name	Order Number
ETK Power Supply Cable, JST PAP – open wires (5fc-2c), 0m25	ETV3	F 00K 109 141
External Power Supply Cable fo ETKs, Lemo 0B - FGG open wires (2fc-1c), 2m	K70.1	F 00K 109 270
ETK Power Supply Cable for External Supply, with Filter Coil, Lemo 0B EGG - open wire (2fc-1c), 0m2	KA50	F 00K 000 940

9.5 Waterproof Case

Order Name	Short Name	Order Number
Water proofed case, designed for ETK-S4.x, ETK-S6.x and ETK-S2x	ETKS_C3	F 00K 107 683

10 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

Figures

Fig. 2-1 Adhesive Label (Example: Label for XETK-S14.0) 12
Fig. 2-2 WEEE-Symbol 13
Fig. 3-1 ETK-S21.1 15
Fig. 4-1 ETK-S21.1 Architecture 17
Fig. 4-2 Location of the ECU Interfaces (ETK-S21.1) 18
Fig. 4-3 Location of the Serial ETK Interface (ETK-S21.1) 19
Fig. 4-4 Location of the Debugger Interface (ETK-S21.1) 19
Fig. 4-5 Location of the Power Supply Connectors (ETK-S21.1) 20
Fig. 4-6 Status LEDs (ETK-S21.1) 21
Fig. 4-7 Equivalent Circuitry of the ECU JTAG/ LFAST Interface (ECU) 23
Fig. 5-1 ETK-S21.1 Connection to the ECU 27
Fig. 5-2 ETK-S21.1 Connection to the ECU and to the Debugger 28
Fig. 5-3 Permanent Power Supply inside ECU available 29
Fig. 5-4 Permanent Power Supply inside ECU not available 30
Fig. 5-5 Permanent Power Supply inside ECU not available 31
Fig. 7-1 JTAG Timing Diagram 41
Fig. 7-2 Debugger Arbitration Timing Diagram 42
Fig. 7-3 ETK-S21.1 Dimensions - Top View 48
Fig. 7-4 Mechanical Dimensions ETK-S21.1: Microcontroller with Socket Adapter mounted 48
Fig. 8-1 Interface Cable KA54 49
Fig. 8-2 Interface Cable KA54, Proposal 1 49
Fig. 8-3 Interface Cable KA54, Proposal 2 50
Fig. 8-4 Interface Cable KA55 51
Fig. 8-5 Interface Cable CBAM200-0m38 51
Fig. 8-6 Interface Cable CBAM261 52
Fig. 8-7 Interface Cable CBAM261 52
Fig. 8-8 Interface Cable CBAE360 52
Fig. 8-9 Power Supply Cable K70.1 53
Fig. 8-10 Power Supply Cable KA50 53
Fig. 8-11 Power Supply Cable ETV3 53
Fig. 8-12 Combined Interface and Power Supply Cable CBAM210 54
Fig. 8-13 Combined Interface and Power Supply Cable CBAM220 54
Fig. 8-14 Combined Interface and Power Supply Cable CBAM260 55
Fig. 8-15 ETK - ECU Adapter ETAL1 56
Fig. 8-16 ETK - ECU Adapter ETAL2 56

Fig. 8-17 ETK - ECU Adapter ETAL3 56
Fig. 8-18 ETK - ECU Adapter ETAL5 57
Fig. 8-19 ETK - ECU Adapter ETAL6 57
Fig. 8-20 ETK - ECU Adapter ETAL7 57
Fig. 8-21 ETAF11 Flatcable 58
Fig. 8-22 ETAF11 Component Placement 58
Fig. 8-23 ETAF11 - Mechanical Dimensions and Component Placement 58
Fig. 8-24 ETKS_C3 Top View 59
Fig. 8-25 ETKS_C3 Bottom View 59
Fig. 8-26 ETKS_C3 Side View 59

Index

A

Accident prevention 8
Adapter, ETK - ECU 60
Adapters 56
Applications 15
Architecture 17

C

Cable
  Comb. Interface and Power Supply 54
  Interface 49
  Power Supply 53
Comb. Interface and Power Supply Cables 54
Configuration 38
Configuration Parameter 34

D

Data Emulation 22
Data Emulation Memory 37
Data Measurement 22
Debug Adapter 60
Documentation 8

E

ECU Interface 18
ECU Voltage Supervisor 20
Electrical Characteristics 43
Environmental Conditions 38
ETAF11 Component 58
ETAF11 Flatcable 58
ETAF11 PCB 58
ETAS Contact Addresses 64
ETK - ECU Adapter 60
ETK Configuration 33

F

Features 15

H

Hardware Description 17

I

Identifications on the product 12
Interface
  Debug 19
  ECU 18
  ETK 19
  Serial 19
Interface Cables 49, 62
Introduction 15

J

JTAG Interface 23

L

LED 21

M

Measurement Data Memory 38
Mechanical Dimension 48

O

Ordering Information 60

P

PC network adapter 36
Pin Assignment 46
Power Supply 20, 29, 60
Power Supply Cables 63
Power Supply Connector 20
Product
  Exclusion of liability 8
Product Back 13
Pull CalWakeUp 25

Q

Qualification, required 8

R

REACH regulation (EU) 14
Recycling 13
Reset 25
RoHS conformity
  China 14
  European Union 14

S

Safety at work 8
Safety precautions 8
Serial ETK Interface 19, 38
Software Support 36
Startup Handshake 25
Status LED 21
Supported Microcontrollers 18
System Requirements 35

T

Test Characteristics 40

U

UKCA conformity 13
Use, intended 8

V

Voltage Supervisor 20

W

Waste Electrical and Electronic Equipment 13
Waterproof Case 63
WEEE 13
WEEE take-back system 13