
ETKP7.0

**Emulator Probe for MPC561/562 and
MPC563/564**

Data Sheet

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Contents

1	Overview	5
1.1	Features	5
1.2	Architecture	5
1.3	Connection to the ECU	7
2	Function Blocks	9
2.1	Processor Interface	9
2.2	BGA Connector	10
2.3	Data Emulation and Measurement Data Memory	10
2.3.1	Data Emulation Memory	10
2.3.2	Measurement Data Memory	11
2.3.3	Triggering of Measurement Data Capture	11
2.3.4	Data Retention in Data Emulation Memory	13
2.3.5	ETKP7.0 Deactivation	13
2.4	Data Flash Memory	13
2.5	Code Flash Memory	14
2.6	ETK Configuration	14
2.7	Power Supply	15
2.8	Serial ETK Interface	16
2.9	Status LEDs	17

2.10	Chip Select Configuration Bridge	18
3	Technical Data	19
3.1	CPU Interface	19
3.2	Configuration	19
3.3	Serial ETK Interface	19
3.4	Power Supply	20
3.5	Environmental Conditions	20
3.6	Testcharacteristics	21
3.7	Electrical Characteristics	21
3.7.1	3.3 V Signals	21
3.7.2	2.6 V Signals	22
3.7.3	Switching Characteristics	22
3.8	Mechanical Dimensions	24
4	Cables	27
4.1	Interface Cables	27
4.1.1	Interface Cable KA41 for Insert Socket, Proposal 1	27
4.1.2	Interface Cable KA41 for Insert Socket, Proposal 2	28
4.1.3	Interface Cable KA54 with PG-screwing	29
4.1.4	Interface Cable KA55	31
4.2	Power Supply Cables	32
4.2.1	Cable ETV	32
4.2.2	Cable with Filtercoil ETV2	32
5	Ordering Information	33
5.1	ETKP7.0	33
5.2	Sockets	33
5.3	Adapters	33
5.4	Cables	34
6	ETAS Contact Addresses	35
	List of Figures	37
	Index	39

1 **Overview**

The ETKP7.0 is an emulator probe especially for the Motorola PowerPC MPC561/562 "Silver Oak" and for the Motorola PowerPC MPC563/564 "Green Oak" (MPC) processors.

It is compatible with earlier ETKs through the calibration and development system interface. Therefore earlier calibration and development systems MAC2 can be used. The ES1000.1 (ES1111) will not be supported. New developments in the ES1000 (ES1232-A board) and compact (ES690) field provide a massive increase in capability regarding the transfer rates to the calibration and development system. The ETKP7.0 fully supports for this expansion.

1.1 **Features**

- Applicable for an external MPC 16-bit microcontroller bus
- Supports 16- and 8-bit access to the data emulation memory
- Usable in 3.3 V systems (no 5 V tolerant data bus)
- Two pages of data emulation/measurement data memory available, each with 512 kByte
- Permanent storage of emulation data in FLASH memory
- Serial interface with 8/100 MBit/s to the calibration and development system
- Permanent storage of configuration in E²PROM
- Firmware update (programming of the logic device) through software; removal of ETK or ECU not necessary.
- Power supply: 4.3 V to 18 V DC
- Temperature range: -40 °C to +110 °C
- Dimensions: ca. 61 mm x 64 mm x 10 mm

1.2 **Architecture**

Fig. 1-1 "ETKP7.0 Architecture" shows the blockdiagram of the ETKP7.0. The connection to the ECU is made by an BGA connector.

The processor can read directly from one of the two pages of the data emulation memory and can write its data directly to the measurement data memory. These two memories (data emulation memory, measurement data memory) are using the same address space and are realized inside the same DPRs.

Through the BGA connector the processor can communicate with other external memories or peripheral components too. All processor signals are accessible on the BGA connector.

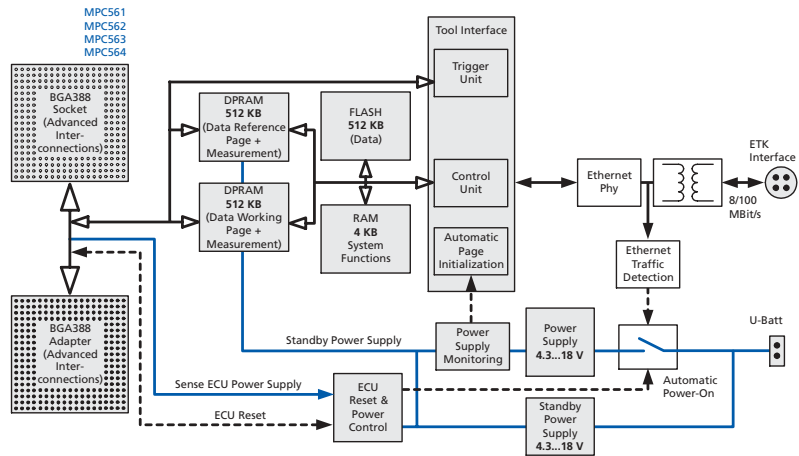


Fig. 1-1 ETKP7.0 Architecture

While the processor accesses the program data (not the program code) 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 processor can send data to the calibration and development system which receives, buffers and processes this measured data.

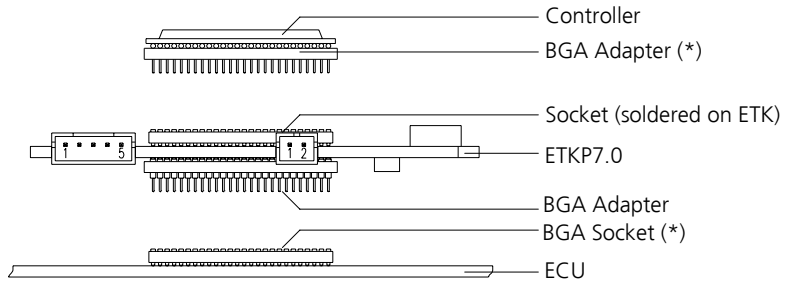
A flash memory is available for permanent storage of the adjusted parameters (program data).

The 8/100 MBit/s serial interface provides communication with the calibration and development system.

The ETKP7.0 uses a 3 V technology. The power supply for the ETKP7.0 is provided by a switched power supply, to minimize power dissipation.

1.3

Connection to the ECU



(*) Not delivered with ETKP7.0

Fig. 1-2 ETKP7.0 Connection to the ECU

note

Some of the BGA sockets and adapters are not included in ETKP7.0 delivery. They need to be ordered separately (refer chapter "Ordering Information" on page 33).

Type	Supported Controller
ETKP7.0	Motorola PowerPC MPC561/562 "Silver Oak"
	Motorola PowerPC MPC563/564 "Green Oak"

2.2 BGA Connector

The BGA connector interfaces the processor with the ECU. All signals of the processor are directly connected to the BGA connector. Also the clock signal must be provided through the connector to the MPC.

2.3 Data Emulation and Measurement Data Memory

The complete data emulation and measurement data memory consists of two 512 kByte pages (Fig. 2-2 "Data Emulation and Measurement Data Memory: 2 Pages with 512 kByte each"). The address range of the used chip select to address the data emulation and measurement memory must be 512 kByte and it must be defined at a 512 kByte limit.

Data emulation memory and measurement data memory must be located inside this 512 kByte address range.

The segmentation of this address range between both memory parts is variable.

So the measurement data memory and data emulation memory can have variable size and offset addresses inside this fixed address range.

2.3.1 Data Emulation Memory

During operation of an ECU, only program data, not program code, can be modified by using the data emulation memory. Modification of program code would inevitably lead to a system crash. The program code is continuously processed out of the internal or external memory. Motorola PowerPC controllers support this concept.

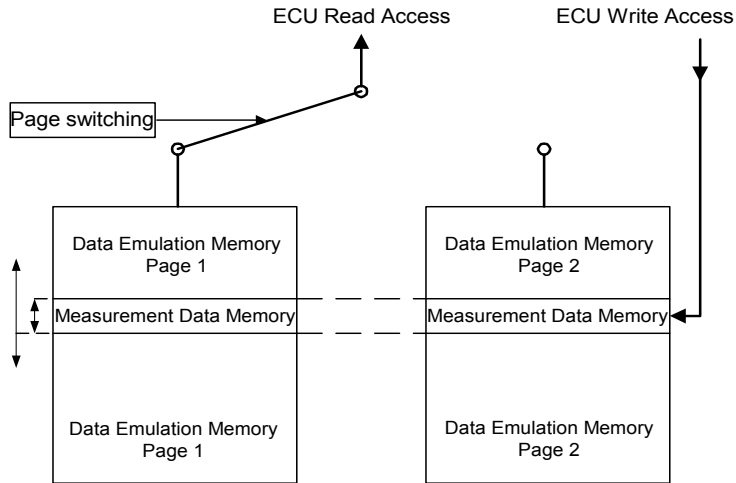


Fig. 2-2 Data Emulation and Measurement Data Memory: 2 Pages with 512 kByte each

Reference data can be stored on one page ("Reference page") while the data on the other page ("Working page") can be modified. It is possible to switch between the two pages during operation through the application software.

2.3.2 Measurement Data Memory

The measurement data memory must be located within the address space of the data emulation and measurement data memory. It can have variable size.

The measured data stored here can be transferred to the calibration and development system via the serial ETK interface.

note

Because there is no write protection of the data emulation memory possible, it must be taken care not to override emulation data.

2.3.3 Triggering of Measurement Data Capture

The exact procedure for capturing measured data is explained in the documentation Display Tables 12 and 13; only the hardware-specific features are mentioned here. The ETKP7.0 contains a trigger comparator which selects a segment of 64 Byte out of the measurement data memory address space (at a

64 Byte limit). This limit is known as the trigger segment address. Fig. 2-3 "Division of the 64 Byte Trigger Segment" shows the configuration of the 64 Byte trigger segment.

3Eh	trigger 16
3Ch	trigger 15
3Ah	trigger 14
38h	trigger 13
36h	trigger 12
34h	trigger 11
32h	trigger 10
30h	trigger 9
2Eh	trigger 8
2Ch	trigger 7
2Ah	trigger 6
28h	trigger 5
26h	trigger 4
24h	trigger 3
22h	trigger 2
20h	trigger 1
	RESERVED
0Ah	no Flash->DPR
08h	RESERVED
	ETK_Disable
02h	ETK_Enable
00h	

Fig. 2-3 Division of the 64 Byte Trigger Segment

Within the basic and the compatibility trigger mode are only two trigger addresses available: trigger B and trigger A. The new ES1232 board for the ES1000.2 system and the ES690 will support several triggers. To achieve downward compatibility, odd-numbered triggers have been put into group trigger B and the even-numbered triggers into group trigger A. Within the advanced trigger mode 16 hardware triggers will be available.

note

The unused address areas are reserved for future applications and must not be used for other purposes.

2.3.4 Data Retention in Data Emulation Memory

The data emulation and measurement data memory physically consists of a static Dual Port RAM and is permanently supplied with power from the car battery, to guarantee that data is preserved even when the ignition is switched off. If the ECU with ETK is isolated from the battery, all data will be lost. For brief power interruptions, e.g. during a cold start procedure, buffering is guaranteed through capacitors for several milliseconds.

2.3.5 ETKP7.0 Deactivation

It can be necessary that the ETK does not respond to read or write accesses of the processor. Therefore the processor can switch off the ETKP7.0 chip select. To indicate to the calibration and development system that the processor has "switched on" or "switched off" the ETK a write access before switching off the ETK and after switching on the ETK to the trigger segment (see Fig. 2-3 "Division of the 64 Byte Trigger Segment") must occur.

Through writing to the address ETK_Disable (trigger segment address + 0x02h) the "switching off" will be indicated. Through writing to the address ETK_Enable (trigger segment address) the reactivation of the ETK will be indicated. The data used during the write accesses are meaningless.

note

These two addresses are not protected against accidental write access. Due to the fact that they belong to the trigger segment, they are allocated in the address space of the measurement data memory.

2.4 Data Flash Memory

Flash memory is provided on the ETKP7.0 for permanent storage of emulation data. Users can copy the contents of the data emulation and measurement data memory into the flash memory using the operating software. It is recommended that an updated data set is always stored in the flash memory.

The ETKP7.0 has a circuit which recognizes and stores power failures. If this circuit detects a longer power failure, and therefore a possible inconsistency of the emulation data, the ETK controller initiates a copying procedure Flash memory → DPR upon restart. The Flash memory data is copied to both emulation pages. A green LED on the ETK displays the procedure. The operating software announces the procedure by a message in the status line.

If the ETKP7.0 is used as a normal RAM it may be useful that this copying procedure is switched off. This can be done by doing a write cycle to a dedicated address in the trigger segment (trigger segment address + 0x08h, see Fig. 2-3 "Division of the 64 Byte Trigger Segment"). The green LED on the ETK will be switched off.

note

The Flash memory on the ETKP7.0 only stores data which exists in the data emulation and measurement data memory of the ETKP7.0. The program code is stored only in the ECU Flash memory.

2.5 Code Flash Memory

The program code is not emulated by the ETKP7.0. The program code is stored in the ECU Flash memory ("on chip" and/or external) and is not modified by the ETKP7.0. Only the accessible emulation data areas are emulated by the ETKP7.0. The ECU Flash memory can be programmed with the normal Flash memory programming tools.

2.6 ETK Configuration

As already mentioned in previous chapters, some project-specific adjustments are necessary. Configuration data is stored permanently in a serial E²PROM. Generating a valid configuration data set is supported by the "ETK Configuration Tool". The "ETK Configuration Tool" contains information on all available ETKs. The user is supported through a graphical interface.

The "ETK Configuration Tool" can create the following output:

1. Direct ETK configuration
2. Storage of the configuration in a data file

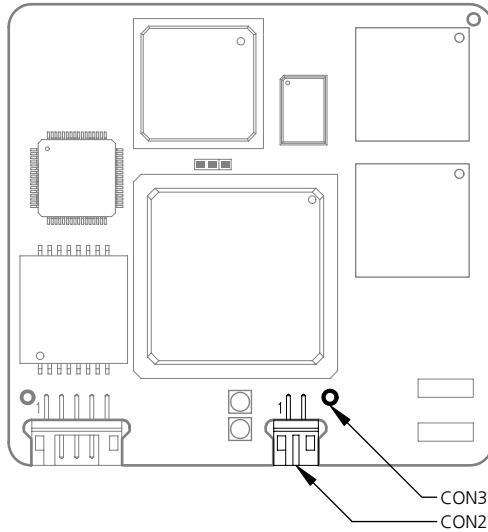


Fig. 2-4 Power Supply Connectors

The ETKP7.0 is powered directly from the car battery (permanent supply). The input voltage varies between 4.3 V and 18 V. The ECU voltage (USG3) is monitored by the ETK to recognize whether the ECU is switched on or off. 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 heat build-up. The power supply of the ECU is not affected by the ETKP7.0. An automatic switch ensures that the power supply of the ETKP7.0 is automatically switched on and off.

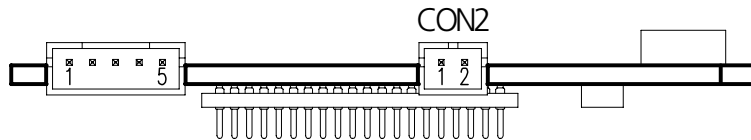


Fig. 2-5 Power Supply Connector CON2

The ETKP7.0 can be supplied with power through the 2-pin power supply connector and additionally through CON3 a through-hole solder pad to connect a power supply $U_{\text{Batt}2}$. The power supply on CON3 must use the GND of CON2.

Pin CON2	Signal	Description
1	U _{Batt1}	Battery Supply Voltage for ETK
2	GND	Ground

2.8 Serial ETK Interface

The serial 8/100 MBit/s ETKP7.0 interface creates the link to the calibration and development system. The ES1232 plug-in board for the ES1000 high-end system will support the 100 Mbit/s interface.

The interface utilizes a 100BASE-TX transmission to achieve an outstanding transmission performance of 100 MBit/s. The ETK interface is also able to handle the 8 MBit/s interface of "old" calibration and development systems. The new interface requires a new double-shielded twisted-pair cable (maximum length: 30 m).

It is not possible to use the old interface cable (for 8 MBit/s) with the new interface in the 100 MBit/s mode. The new interface cable can be used with the old interface.

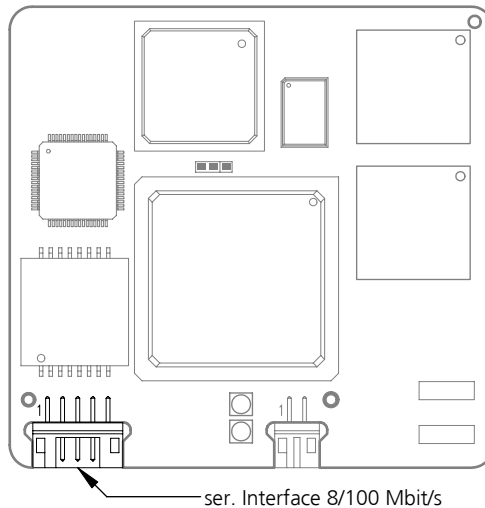


Fig. 2-6 Location of the Serial ETK Interface

2.9

Status LEDs

There are two LEDs displaying the operating status of the ETKP7.0 (Fig. 2-7 on page 17). Every LED has a separate function, there is no additional information about ETKP7.0 by observing the LEDs in combinations..

LED	State	Meaning
Red	On	ETKP7.0 is supplied with power and either the ECU and/or the calibration and development system (MAC, ES1232 or ES690) is connected and ready to communicate with the ETKP7.0
Green	Off	Working page is different to reference page
	On	Power supply decline under 3.5 V: - data retention of the DPRs is no longer ensured - as soon as the ETKP7.0 switches on again, the content of the Flash will be copied into the RAMs - until the calibration and development system copies new data into the RAMs

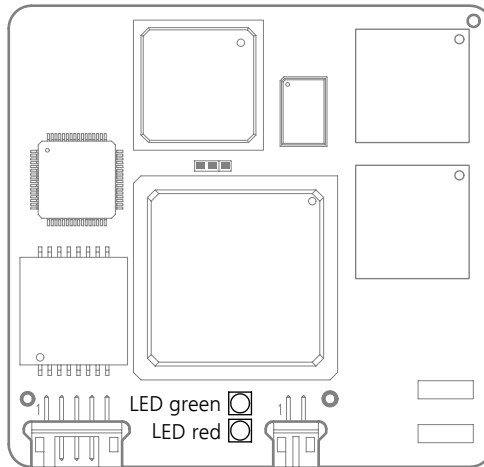


Fig. 2-7 Status LEDs

2.10 Chip Select Configuration Bridge

B100 is a solder bridge to configure the used chip select.

Solder bridge	Solder pads	Meaning
B100	1 - 2 shortened	the processor must use /CS0 to address the ETKP7.0 memory
B100	2 - 3 shortened	the processor must use /CS2 to address the ETKP7.0 memory (default is /CS2)

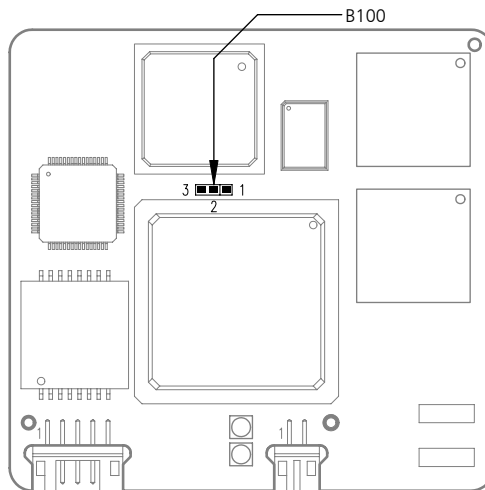


Fig. 2-8 Chip Select Configuration Bridge

3 Technical Data

3.1 CPU Interface

Item	Characteristics
Supported Motorola microprocessors	Motorola PowerPC MPC 561/562: - "Silver Oak" Motorola PowerPC MPC 563/564: - "Green Oak"

3.2 Configuration

Item	Characteristics
Configuration	Project-specific configuration for - memory configurations stored in EEPROM
Update	Logic devices updated through soft- ware

3.3 Serial ETK Interface

Item	Characteristics
Transmission performance	8 MBit/s, 100 MBit/s
Cable type	Double-shielded twisted-pair
Cable length	max. 30 m / 100 ft
Serial Interface	DC decoupling

3.4 Power Supply

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Permanent Power Supply from car battery	U_{Batt1}		4.3	12	18	V
Permanent Power Supply from car battery (Standby)	U_{Batt1}		3.5	12	18	V
Standby Current	I_{STBY}	$U_{\text{Batt1}} = 12 \text{ V};$ ECU off; $t = 20 \text{ }^\circ\text{C}$		15	30	mA
Supply Current	I_{Batt1}	$U_{\text{Batt1}} = 4.3 \text{ V};$ ECU on; $t = 20 \text{ }^\circ\text{C}$		160	320	mA
Supply Current	I_{Batt1}	$U_{\text{Batt1}} = 12 \text{ V};$ ECU on; $t = 20 \text{ }^\circ\text{C}$		60	90	mA
Supply Current	I_{Batt1}	$U_{\text{Batt1}} = 18 \text{ V};$ ECU on; $t = 20 \text{ }^\circ\text{C}$		40	60	mA
Power Supply from ECU (sense)	$U_{\text{SG2.6}}$	$>2.00 \rightarrow$ ECU on $<1.94 \rightarrow$ ECU off		2.6		V

3.5 Environmental Conditions

Item	Characteristics
Temperature range	- 40 °C to +110 °C - 40 °F to +230 °F

3.6 Test characteristics

Parameter	Symbol	Condition	Min	Max	Unit
Reset delay 1	t_{Reset1}	$U_{\text{Batt1}}=12\text{ V}$ $U_{\text{SG}}=0\text{ V} \uparrow 3.3\text{ V}$ without transferring Flash	15	35	ms
Reset delay 2	t_{Reset2}	$U_{\text{Batt1}}=12\text{ V}$ $U_{\text{SG}}=0\text{ V} \uparrow 3.3\text{ V}$ with transferring Flash	28	48	ms
Reset delay 3	t_{Reset3}	$U_{\text{Batt1}}=0\text{ V} \uparrow 12\text{ V}$ transfer FPGA and Flash	228	518	ms

note

t_{Reset1} : Delay of ECU reset through ETK without transferring the Flash (U_{Batt1} present, USG will be switched on)

t_{Reset2} : Delay of ECU reset through ETK with transferring the Flash (U_{Batt1} present, transfer active, USG will be switched on)

t_{Reset3} : max. delay of ECU reset through ETK (U_{Batt1} and USG will be switched on)

3.7 Electrical Characteristics

3.7.1 3.3 V Signals

3.3 V Signals are DATA[15..0].

Type	Parameter	Conditions	Min	Max
Input	V_{IH}		2.0 V	3.8 V
	V_{IL}			0.8 V
	I_{I}	Leakage Current		20 μA
Output*	V_{OH}	$I_{\text{OH}} = -4\text{ mA}$	2.2 V	
	V_{OL}	$I_{\text{OL}} = 4\text{ mA}$		0.4 V
Parameter	Conditions		Typ.	
C_{IO}	DATA [15..0]		20 pF	

3.7.2 2.6 V Signals

2.6 V Signals are /CS-ETK, /OE, RD_W/R, /WE_AT[1..0], /HRESET, /PORESET, ADDR[30..14].

Type	Parameter	Conditions	Min	Max
Input	V_{IH}		2.2 V	3.8 V
	V_{IL}			0.8 V

Parameter	Conditions	Typ.
C_I	ADDR [30..14], RD_W/R, /WE_AT[1..0], /CS-ETK	30 pF
C_I	/OE	22 pF
C_I	/HRESET	10 pF
C_I	/PORESET	19 pF

note

*:/SGRES: opendrain FET; $I_{Dmax} = 0.2 A$

Capacitance only with ETK-logic, without MPC, PCB and BGA socket

3.7.3 Switching Characteristics

The following diagrams show the timings the ETKP7.0 can process.

Para.	Description	Min	Max	Unit
t_4	Access Cycle Time	20		ns
t_6	Chip Select Valid to Data Valid		20	ns
t_9	Address Valid to Data Valid		20	ns
t_{10}	Read Low to Data Valid		12	ns
t_{11}	Read Low Z-Time	3		ns
t_{12}	Read High Z-Time		12	ns
t_{16}	Chip Select Setup Time	0		ns
t_{17}	Chip Select Hold Time	0		ns
t_{21}	Address Valid to End of Write	16		ns
t_{22}	Data Setup Time	12		ns
t_{23}	Data Hold Time	0		ns
t_{24}	Read/Write Setup Time	0		ns
t_{25}	Read/Write Hold Time	0		ns

Para.	Description	Min	Max	Unit
t ₃₁	Byte Enables Setup Time	0		ns
t ₃₂	Byte Enables Width	17		ns
t ₃₃	Byte Enables Hold Time	0		ns
t ₄₆	Chip Select Invalid to High Z-Time		12	ns
t ₄₇	Byte Enables Valid to Data Valid		20	ns
t ₄₈	Byte Enables Invalid to High Z-Time		12	ns

note

All timings are measured at a reference level of 1.5 V. Output signals are measured with 10 pF to ground and 50 Ω to 1.5 V.

Read Timing: Data Emulation and Measurement Data DPR

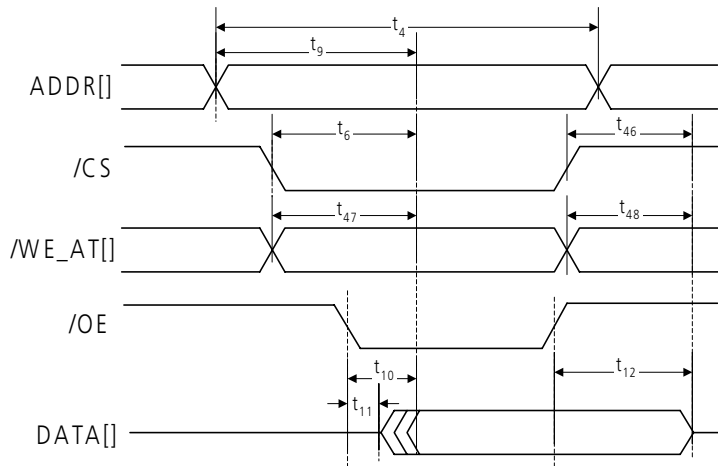


Fig. 3-1 Read Cycle: Data Emulation and Measurement Data DPR

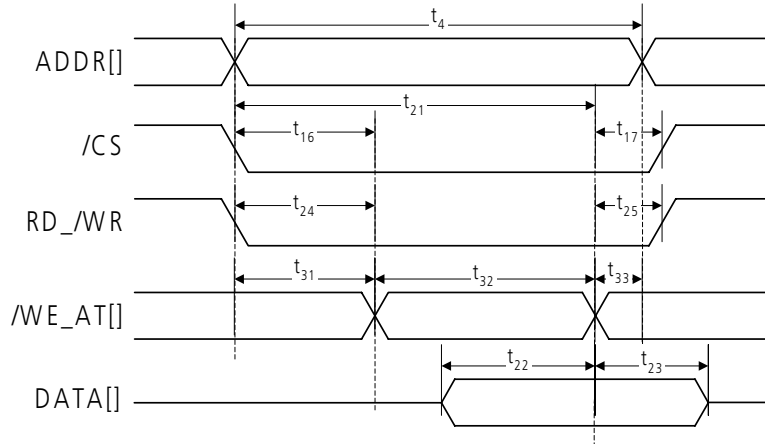


Fig. 3-2 Write Cycle: Data Emulation and Measurement Data DPR

3.8 Mechanical Dimensions

The reference measure for all drawings is millimeter.

Dimensions	Millimeters	Inches
Length	64.00	2.520
Width	61.00	2.402
Thickness of PCB	1.70	0.067
Height of component (upper side)	3.00	0.118
Height of component (lower side)	2.00	0.079

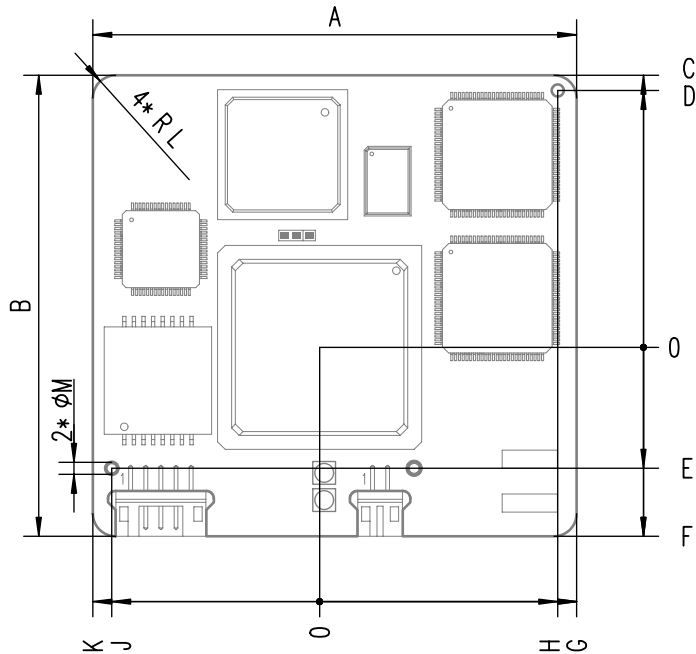


Fig. 3-3 ETKP7.0 Dimensions - Top View

Dim	Millimeters	Inches	Dim	Millimeters	Inches
A	64.00	2.520	G	34.00	1.339
B	61.00	2.402	H	31.00	1.240
C	36.00	1.417	J	27.50	1.083
D	34.00	1.339	K	30.00	1.181
E	16.00	0.630	L	3.00	0.118
F	25.00	0.984	M	1.50	0.059

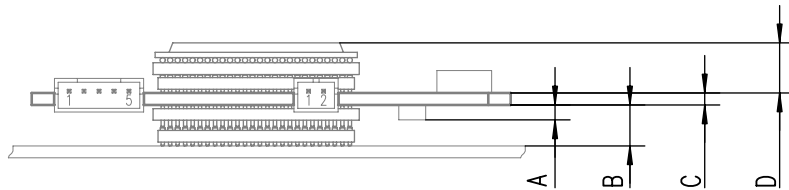


Fig. 3-4 Mechanical Dimensions ETKP7.0: Micro with Socket Adapter mounted

For mounting the ETK on the ECU, and for mounting the MPC on the ETK, the Advanced Interconnect Socket is required (see ordering information).

Dim	Millimeters	Inches
A	2.10	0.083
B	5.50	0.217
C	1.80	0.071
D	7.20	0.283

4 Cables

note

The cables shown in chapter "Cables" on page 27 are not included in the ETKP7.0 delivery. They need to be ordered separately. For order numbers refer to chapter "Ordering Information" on page 33.

4.1 Interface Cables

4.1.1 Interface Cable KA41 for Insert Socket, Proposal 1

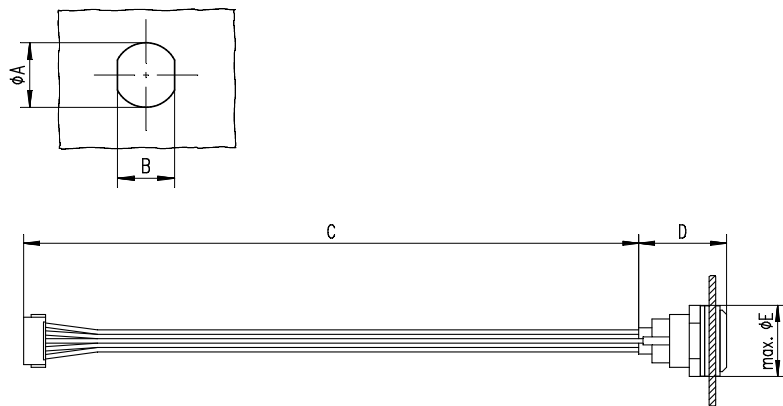


Fig. 4-1 Interface Cable KA41, Prop. 1

Dim	Millimeters	Inches	Dim	Millimeters	Inches
A	13.90	0.547	D	20.00	0.787
B	12.30	0.484	E	16.20	0.636
C	140.00	5.512			

note

Shield not connected to ECU housing.

4.1.2 Interface Cable KA41 for Insert Socket, Proposal 2

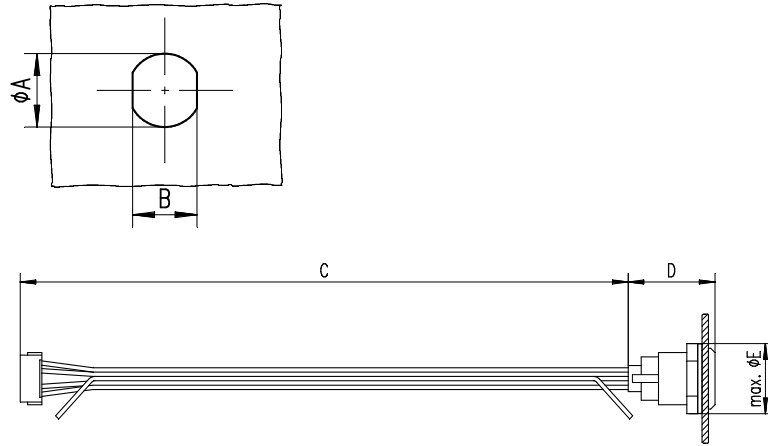


Fig. 4-2 Interface Cable KA41, Prop. 2

Dim	Millimeters	Inches	Dim	Millimeters	Inches
A	12.10	0.476	D	20.00	0.787
B	10.60	0.417	E	16.20	0.636
C	140.00	5.512			

note

Shield connected to ECU housing. Insulating disc must be removed.

4.1.3 Interface Cable KA54 with PG-screwing

note

The screws for mounting cables KA54 showed in chapter "Interface Cable KA54 with PG-screwing" on page 29 are not included in the KA54 delivery. They need to be ordered separately. For screw manufacturers and order numbers refer to the description of the cables.

Interface Cable KA54 with PG-screwing, Proposal 1

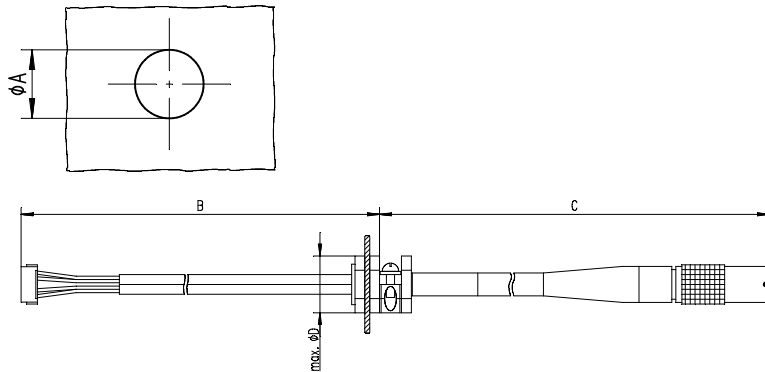


Fig. 4-3 Interface Cable KA54, Prop. 1

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

Interface Cable KA54 with PG-screwing, Proposal 2

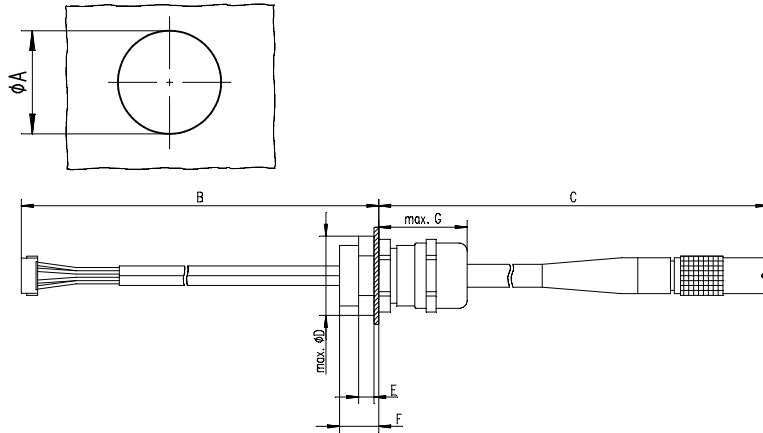


Fig. 4-4 Interface Cable KA54, Prop. 2 (long thread)

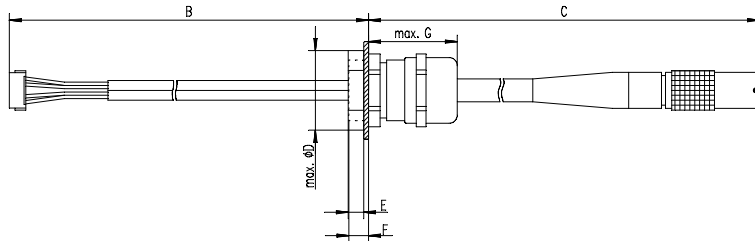


Fig. 4-5 Interface Cable KA54, Prop. 2 (short thread)

Dim	Millimeters	Inches	Dim	Millimeters	Inches
A	18.80	0.740	E	4.70	0.185
B	160.00	6.299	F _{Long}	12.00	0.472
C	400.00	15.748	F _{Short}	6.00	0.263
D	24.25	0.955	G	27.00	1.063

note

Shield connected to ECU housing.

SKINTOP compact screwing; **Manufacturer:** Lapp; **Description:** MS-SC 11 ;
Order-No.: 5311 2320 (long thread) or 5311 2220 (short thread)

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

4.1.4 Interface Cable KA55

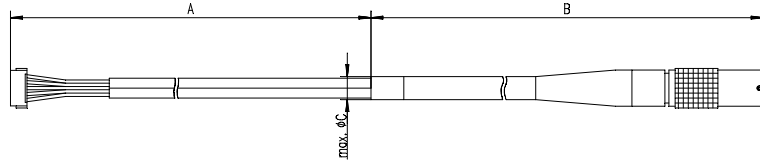


Fig. 4-6 Interface Cable KA55

Dim	Millimeters	Inches
A	160.00	6.299
B	400.00	15.748
C	7.50	0.295

note

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

4.2 Power Supply Cables

4.2.1 Cable ETV

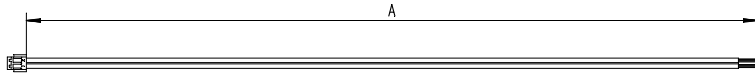


Fig. 4-7 Power Supply Cable ETV

Dim	Millimeters	Inches
A	190.00	7.480

4.2.2 Cable with Filtercoil ETV2

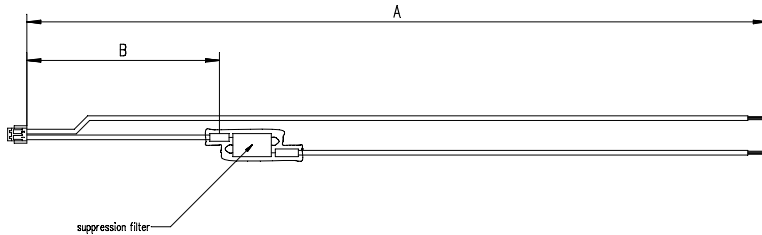


Fig. 4-8 Power Supply Cable with Filtercoil ETV2

Dim	Millimeters	Inches
A	190.00	7.480
B	50.00	1.969

5 Ordering Information

5.1 ETKP7.0

Type	Order-No.	Note
ETKP7.0-A	F 00K 103 197	ETK with selected memory /CS0
ETKP7.0-K	F 00K 103 199	ETK with selected memory /CS2

note

Some of the BGA sockets and adapters are not included in ETKP7.0 delivery (refer to "Connection to the ECU" on page 7). They need to be ordered separately (refer chapter "Ordering Information" on page 33).

5.2 Sockets

note

For mounting the ETK on the ECU, one of the following Advanced Interconnect Sockets must be used. Please do not use other sockets.

Type	Note
Advanced Interconnect Socket (7112TR)	available from local Advanced Interconnect distributors
Advanced Interconnect BGA Socket for MPC 5xx (1FHS388-716GG)	available from local Advanced Interconnect distributors

5.3 Adapters

note

For mounting the μ C on the ETK the following Advanced Interconnect Adapter must be used. Please do not use other adapters.

Type	Note
Advanced Interconnect BGA Adapter for MPC 5xx (1FHA388-715G)	available from local Advanced Interconnect distributors

note

The cables shown in chapter "Cables" on page 27 are not included in the ETKP7.0 delivery. They need to be ordered separately.

note

The screws for mounting cables KA54 shown in chapter 4.1.3 on page 29 are not included in the KA54 delivery. They need to be ordered separately. For screw manufacturers and order numbers refer to the description of the cables.

Type	Order-No.	Note
Interface Cables:		
KA41, Prop. 1 / Prop. 2	Y 261 A24 729	
KA54, Prop. 1 / Prop. 2	F 00K 001 302	Delivery without PG-screwing
KA55	F 00K 001 303	
Power Supply Cables:		
ETV	Y 261 A24 446	
ETV2	F 00K 000 593	

6 **ETAS Contact Addresses**

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List of Figures

Fig. 1-1	ETKP7.0 Architecture	6
Fig. 1-2	ETKP7.0 Connection to the ECU	7
Fig. 2-1	System with internal and external Memory.....	9
Fig. 2-2	Data Emulation and Measurement Data Memory: 2 Pages with 512 kByte each.....	11
Fig. 2-3	Division of the 64 Byte Trigger Segment	12
Fig. 2-4	Power Supply Connectors	15
Fig. 2-5	Power Supply Connector CON2	15
Fig. 2-6	Location of the Serial ETK Interface	16
Fig. 2-7	Status LEDs	17
Fig. 2-8	Chip Select Configuration Bridge	18
Fig. 3-1	Read Cycle: Data Emulation and Measurement Data DPR.....	23
Fig. 3-2	Write Cycle: Data Emulation and Measurement Data DPR	24
Fig. 3-3	ETKP7.0 Dimensions - Top View	25
Fig. 3-4	Mechanical Dimensions ETKP7.0: Micro with Socket Adapter mounted ...	26
Fig. 4-1	Interface Cable KA41, Prop. 1	27
Fig. 4-2	Interface Cable KA41, Prop. 2	28
Fig. 4-3	Interface Cable KA54, Prop. 1	29
Fig. 4-4	Interface Cable KA54, Prop. 2 (long thread)	30
Fig. 4-5	Interface Cable KA54, Prop. 2 (short thread)	30

Fig. 4-6	Interface Cable KA55	31
Fig. 4-7	Power Supply Cable ETV	32
Fig. 4-8	Power Supply Cable with Filtercoil ETV2	32

Index

A

Architecture 6

B

BGA Connector 10

Blockdiagram 5

C

Cable 27

 Interface 27

 Power Supply 32

Code

 Flash Memory 14

Code Flash Memory 14

Configuration 14

D

Data Emulation Memory 10

Data Flash Memory 13

Data Retention 13

Deactivation 13

E

Electrical Characteristics 21

F

Features 5

Function Blocks 9

I

Interface

 ETK 16

 Processor 9

 Serial 16

Interface Cable 27

L

LED 17

M

Measurement Data

 Capture 11

Measurement Data Memory 11

Mechanical Dimension 24

Memory
Code 14

O

Ordering Information 33

P

Power Supply 15
Power Supply Connector 15
Processor Interface 9
Program Code 14

R

Read Timing 23

S

Serial ETK Interface 16
Status LED 17
Switching Characteristic 22

T

Timing
 Read 23
 Write 24
Trigger Segment 12
Triggering 11

W

Write Timing 24