

kitCON-167

Hardware-Manual

Edition June 1999

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Preface

This kitCON-167 User's Manual describes the board's design and functions. Precise specifications for the C167 microcontroller family can be found in the enclosed microcontroller Data Sheet/User's Manual. If software is included please also refer to additional documentation for this software.

In this hardware manual and in the attached schematics, low active signals are denoted by a "/" in front of the signal name (i.e.: /RD). A "0" indicates a logic-zero or low-level signal, while a "1" represents a logic-one or high-level signal.

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PHYTEC kitCON Single Board Computers (henceforth „products“) are designed for installation in electrical appliances or as dedicated Evaluation Boards (i.e.: for use as a test and prototype platform for hardware/software development) in laboratory environments.

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The kitCON-167 is one of a series of PHYTEC kitCONs that can be fitted with different controllers and, hence, offers various functions and configurations. PHYTEC supports all common Infineons' 8- and 16-bit controllers in two ways:

- (1) as the basis for Starter Kits in which user-designed hardware can be implemented on a wrap-field around the controller and
- (2) as universal, insert-ready, fully functional micro- and mini-MODULS that can be embedded directly into the user's peripheral hardware design.

PHYTEC's microcontroller modules allow engineers to shorten development horizons, reduce design costs and speed project concepts from design to market. Please contact PHYTEC for additional information:

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1 Introduction to the kitCON-167

The kitCON-167 is a EURO-sized (160 x 100 mm) Evaluation Board for the Infineon C167x microcontroller of the C16x-microcontroller family in a MQFP-144 package. The kitCON-167 is pre-configured and equipped with all necessary connectors required for immediate start-up (refer to *Figure 2* and *Figure 3*).

The kitCON-167 offers the following features:

- Evaluation Board in EURO-card format 160 x 100 mm, including wrap-field (90x60 mm) for easy layout of user circuitry
- Improved interference safety through multi-layer technology
- Requires single unregulated 8 V= to 12 V=/500 mA power source
- 256 kByte Flash on-board (PLCC-package)(optionally expandable to up to 2 MB)¹
- on-board Flash-programming
- No need for a dedicated programming voltage through use of 5 V-Flash devices
- 64 kByte SRAM on board (optionally expandable to up to 2 MB) ¹
- 512 Byte serial EEPROM
- On-chip Bootstrap Loader
- All controller ports, as well as data and address lines, extend from the controller to the pins of the kitCON-Connector in the middle of the board
- RS-232 serial interface, available at DB9-socket P1
- Supplemental debug-interface (RS-232), available at DB9-plug P2
- If equipped with a C167Cx controller, a CAN-Interface is available at DB9-plug P2, too
- Two LED's to display the boards status
- Sixteen freely programmable LED's at port P2
- Real-Time Clock²
- Up to three free Chip-Select signals for easy connection of peripheral devices (controller-dependent)

¹: For more information about additional configurations see the PHYTEC product catalog

²: The Real-Time-Clock is not available on boards included in Infineon' Starter Kits

- Provision for operating the board with an ICE/connect-16x for easy emulation of the controller
- Provision for operating the board with a Quad-Connector for easy emulation of the controller

1.1 Block Diagram

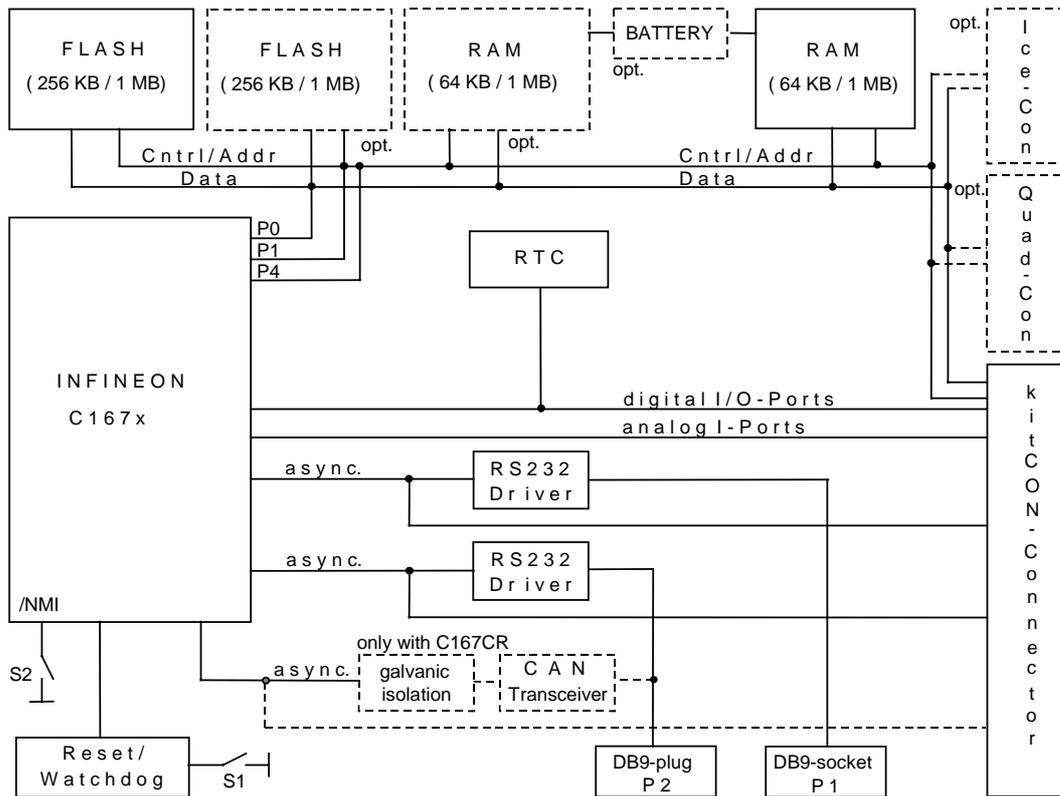


Figure 1: Block Diagram

1.2 Overview of the kitCON-167

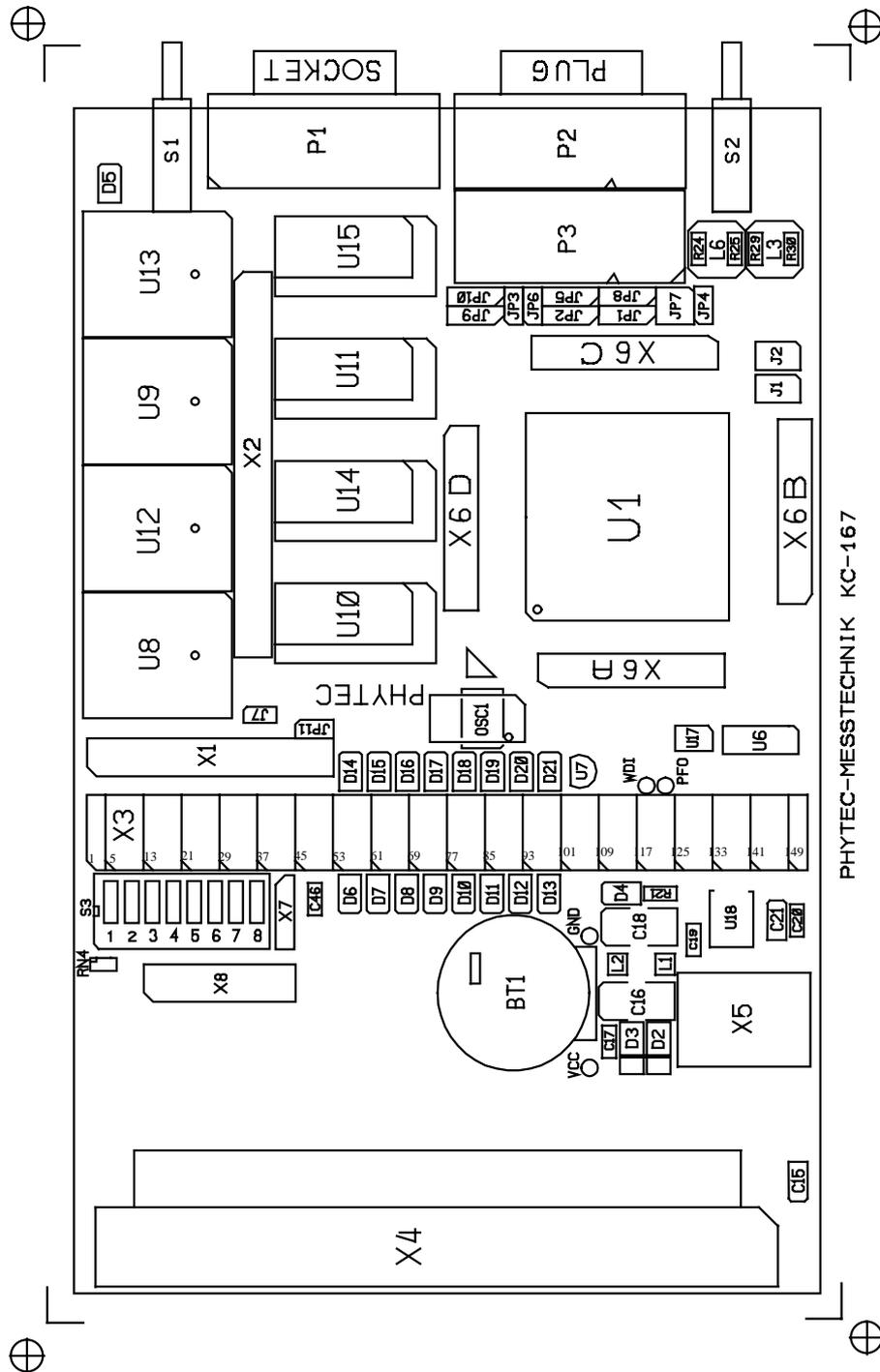


Figure 2: Overview of the kitCON-167 (component side)

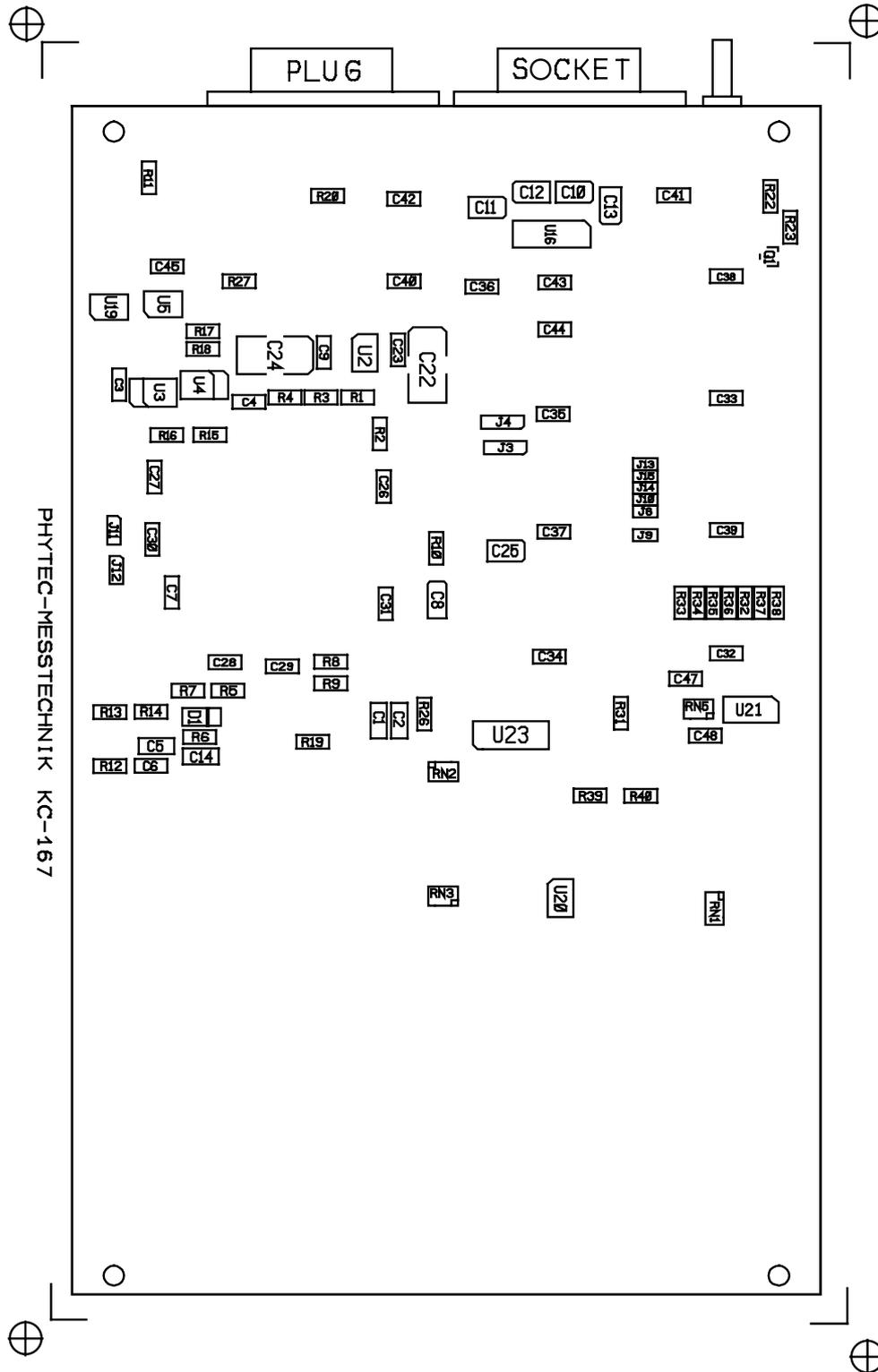


Figure 3: Overview of the kitCON-167 (soldering side)

2 Quickstart Instructions

This chapter provides step-by-step instructions for putting the kitCON-167 into operation. Please note that the following instructions refer to the current versions of the FlashTools and the Monitor-program from Keil Elektronik GmbH as of the pressing of this manual. To ensure putting the kitCON-167 quick and safe into operation, the use of the PC-software is described only for the DOS environment. Using it in conjunction with other operating systems or environments might result in improper operation, especially in regards to the serial communication.

The standard-version of the kitCON-167 houses the C167Cx micro-controller, which includes an on-chip Bootstrap Loader.

Generally the Bootstrap Loader allows downloading and starting of any program suitable for the target controller. Depending on the terminal-program used, different applications and tools will be loaded and executed. For instance when executing the PHYTEC terminal program *FLASHT.EXE*, routines for programming the Flash (the so called FlashTools¹) will automatically be loaded and started. This is in contrast to the terminal-program *MONI66.EXE* from Keil Elektronik GmbH, which downloads a Monitor program enabling simple debugging of user code.

The following sections provide a step by step description for starting the kitCON-167 using the FlashTools as well as for starting the kitCON using the Monitor program².

¹: Software-tool for on-board Flash-programming, will be automatically loaded if the terminal-program *FLASHT.EXE* is used

²: The monitor program is only available on boards included in Infineon Starter Kits

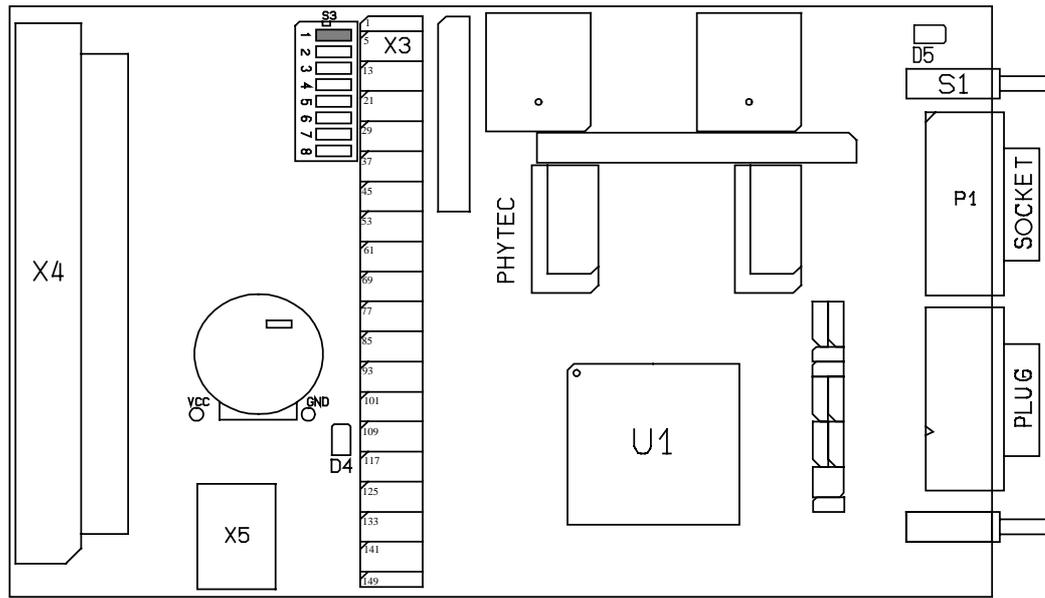


Figure 4: Important Jumpers and Connectors for Start-up

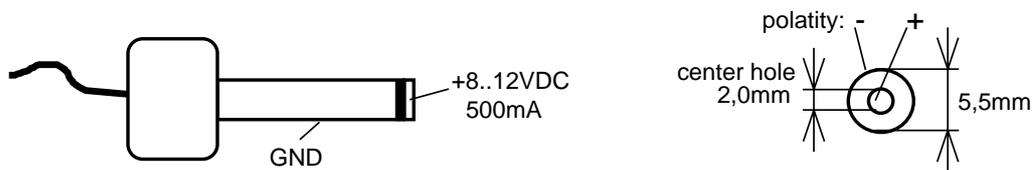


Figure 5: The Power Plug

2.1 Starting the kitCON using a Monitor program

- Use of the Monitor program requires a kitCON-167 and an IBM-PC or a compatible system, as well as an unregulated power supply for 8 V= - 12 V= /500 mA. Typically, all jumpers for configuring the kitCON-167 have been correctly set upon delivery of the board.
- Connect your Host-PC (COM1 or COM2) to the DB9-socket P1 on the kitCON-167 using a serial cable as shown below.

PC DB9-plug COM1,2		kitCON-167 DB9-socket P1
RxD PIN 2	to	TxD PIN 2
TxD PIN 3	to	RxD PIN 3
GND PIN 5	to	GND PIN 5

No Hardware-Handshake-Line is required to invoke communication between the kitCON-167 and the Host-PC, as the firmware contains a transmission protocol to ensure fault-free data transmission between the PC and the kitCON-167.

- Ensure that switch 1 of DIP switch S3 (to the left of the kitCON-Connector) is turned ON.
- Attach a power supply to the power connector X5. An unregulated 8 V= to 12 V=/500 mA power source can be used to supply the board. Use only a fixed voltage power supply and no power supply with variable voltage. Double check the correct polarity of the plug as shown in *Figure 5*. If the power supply is attached correctly the red LED D4 will light up.
- Push switch S1 to perform a Reset and to start the Bootstrap Loader on the kitCON-167.
- Invoke the terminal program **MON166.EXE** on your Host-PC by entering the following at the DOS prompt:

```
mon166 [BR(Baudrate)] [COM port number]
```

Other communication or terminal programs are not suitable for data transmission to and from the Monitor program on the kitCON-167, as a special transmission protocol is required. Ensure that only DOS is active at the time of the invocation.

Attention:

Ensure that the directory in which *MONI66.EXE* is started contains the two files 'boot' and 'monitor' for the Controller C167.

- The Monitor program will automatically load after invoking *MONI66.EXE* and the green LED D5 will light up. The loading procedure can be viewed on the monitor screen of the Host-PC.
- After successfully loading, the Monitor program will automatically start and its '#' prompt will appear on the screen of the Host-PC.
- Enter '*load* Pathname*hello167*' now in order to load the demo program.
- Once downloading has finished and the '#' prompt reappears, enter the command '*g*' to execute the demo program. Successful execution results in the character string 'Hello World !...' appearing on the screen of the Host-PC.
- To leave the monitor program press <F1>.

Quickstart Instructions for using a Monitor program - Summary

- Connect the kitCON-167 to an IBM-PC or a compatible system using a serial cable (P1 to COM1 or COM2)
- Turn **ON** switch 1 of DIP-switch S3
- Attach an unregulated power supply with 8 V= to 12 V=/500 mA to X5 on the kitCON-167. **Double check the correct polarity.**
- Press switch S1 to perform a RESET
- Start **MON166.EXE** on your Host- PC (*mon166 [2 (for COM2)]*) from the DOS environment
- After the '#' prompt appears, enter '*load Pathname\hello167*'
- Press <ENTER>
- After the '#' prompt reappears enter 'g'
- Press <ENTER>
"Hello World !..." appears on the screen of your Host-PC.
- To leave the Monitor program press <F1>

2.2 Starting the kitCON and programming the Flash

- Use of the FlashTools requires a kitCON-167 and an IBM-PC or a compatible system, as well as an unregulated power supply for 8 V= - 12 V= /500 mA. Typically, all jumpers for configuring the kitCON-167 have been correctly set upon delivery of the board.
- Connect your Host-PC (COM1 or COM2) to the DB9-socket P1 on the kitCON-167 using a serial cable as shown below.

PC DB9-plug COM1,2		kitCON-167 DB9-socket P1
RxD PIN 2	to	TxD PIN 2
TxD PIN 3	to	RxD PIN 3
GND PIN 5	to	GND PIN 5

No Hardware-Handshake-Line is required to invoke communication between the kitCON-167 and the Host-PC, as the firmware contains a transmission protocol to ensure fault-free data transmission between the PC and the kitCON-167.

- Ensure that switch 1 of DIP switch S3 (left of the kitCON-Connector) is turned ON.
- Attach a power supply to the power connector X5. An unregulated 8 V= to 12 V=/500 mA power source can be used to supply the board. Use only a fixed voltage power supply and no power supply with variable voltage. Double check the correct polarity of the plug as shown in *Figure 5.* If the power supply is attached correctly the red LED D4 will light up.
- Push switch S1 to perform a Reset and to start the Bootstrap Loader on the kitCON-167.
- Invoke the terminal program **FLASHT.EXE** on your Host-PC by entering the following at the DOS prompt:

```
flasht [BR(Baudrate)] [COM port number]
```

Other communication or terminal programs are not suitable for data transmission to and from the FlashTools on the kitCON-167, as a special transmission protocol is required. **Ensure that only DOS is active at the time of the invocation.**

Attention:

Ensure that the directory in which *FLASHT.EXE* is started contains the two files 'boot' and 'flash' for the Controller C167.

- The FlashTools will automatically be loaded after invoking *FLASHT.EXE*. The loading procedure can be viewed on the monitor screen of the Host-PC.
- After successfully loading the FlashTools will automatically start and the green LED D5 will light up. Now the FlashTools main menu will appear on the monitor screen of the Host-PC.

```

=====
FLASH-Utility for 80C16X V 2.5
=====
(c) 1994, PHYTEC Meßtechnik GmbH, D-55129 Mainz

Flash-Devices:          AMD 29F010
Flash-Area:             000000H-03FFFFH
Software-Protected-Areas #1: none
                        #2: none
                        #3: none
No-Access-Areas       #1: 00EF00H-00FFFFH
                        #2: none
                        #3: none

(1) Flash status information
(2) Erase entire Flash-Area
(3) Erase partial Flash-Area
(4) Load INTEL-Hexfile
(5) Software-Reset
(6) Run from address
(7) Erase, Load and Software-Reset

> Command:

```

Figure 6: The main menu of the FlashTools

- All FlashTools menu options are intuitive. Select menu option 7, 'Erase, Load and Software-Reset' to download a demo program. Confirm that the unprotected sectors (i.e. the sectors available for user-applications) of the Flash can be erased by entering "Y".

- Following erasure of the unprotected Flash sectors, the next menu will automatically appear on the monitor screen of the Host-PC. Please press <F2> to indicate the name of the hexfile to be downloaded into the Flash (specify the full pathname). To download the demo program enter 'Pathname\hello167.h86'. Press <Enter> to start the download.
- HELLO167.H86 will automatically start following download. Successful execution results in the character string 'Hello World !...!' appearing on the screen of the Host-PC. The program can also be executed by pressing the RESET button on the kitCON-167 after turning OFF switch 1 of DIP-switch S3 (i.e.: toggling the kitCON-167 into execution mode).
- To leave FLASHT.EXE press <F1>

If any difficulties should occur during start-up, please contact the PHYTEC Technical Support hotline.

Quickstart Instructions for Flash-programming - Summary

- Connect the kitCON-167 to an IBM-PC or a compatible system using a serial cable (P1 to COM1 or COM2).
- Turn **ON** switch 1 of DIP-switch S3
- Attach an unregulated power supply with 8 V= to 12=/500 mA to X5 on the kitCON-167. **Double check the correct polarity.**
- Press switch S1 to perform a RESET
- Start **FLASHT.EXE** on your Host- PC (*flasht [2 (for COM2)]*) from the DOS environment
- Select menu option '7'
- Press <Y> to confirm 'Erase'
- Press <F2>
- Enter 'Pathname\hello167.h86'
- Press <ENTER>

An automatic software reset will execute the program following download.

"Hello World!..." appears on the screen of your Host-PC.

- To leave the FlashTools press <F1>

To start the demo program again execute the following steps:

- Disconnect the power source
- Turn **OFF** switch 1 of DIP-switch S3
- Reconnect the power source

3 Pinout

Please note that all module connections are not to exceed their expressed maximum voltage or current. Maximum input values are indicated in the corresponding controller manuals/data sheets. As damage from improper connections varies according to use and application, it is the user's responsibility to take appropriate safety measures to ensure that the module connections are protected from overloading through connected peripherals.

As shown in *Figure 7*, all relevant controller signals are brought out to the kitCON-Connector (X3) in the middle of the board (*refer to section 3.2*). The kitCON-167 is also prepared to accommodate an ICE/connect-16x (X2) (*refer to section 3.3*). This special connector enables easy emulation of the processor. The Quad-Connector-System (X6) provides an additional option for connecting an emulator to the board (*refer to section 3.4*). DB9-connectors P1 and P2 serve as RS-232 and CAN-interface. *Sections 3.5 and 3.6* describe the pinout. The following section describes the power connectors X4 and X5, while connector X7 for the serial EEPROM is described in *section 3.7*. Additional signal inputs and outputs are provided through the connectors PFO and WDI which are described in *section 3.8*.

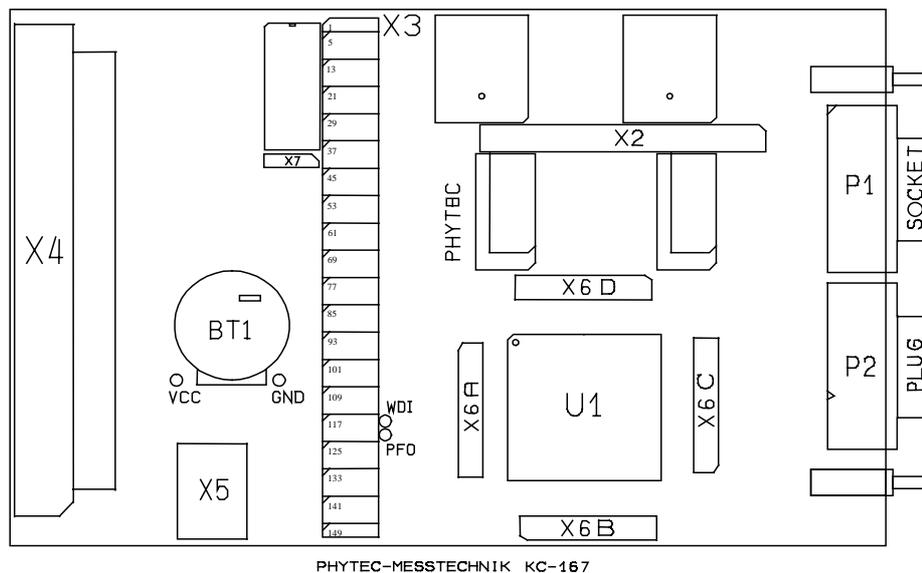


Figure 7: Location of the connectors

3.2 The kitCON-Connector

Supply Voltage	PI N 1	VCC	2	VCC	3	GND	4	GND
Data-Bus	5	D0	6	D2	7	D4	8	D6
	9	D1	10	D3	11	D5	12	D7
	13	D8	14	D10	15	D12	16	D14
	17	D9	18	D11	19	D13	20	D15
Address-Bus	21	A0	22	A2	23	A4	24	A6
	25	A1	26	A3	27	A5	28	A7
	29	A8	30	A10	31	A12	32	A14
	33	A9	34	A11	35	A13	36	A15
	37	A16	38	A18	39	A20/RXDC1	40	A22/TXDC0
	41	A17	42	A19	43	A21/RXDC0	44	A23/TXDC1
Control-Signals	45	/RD-U	46	/RD-U	47	/RESO-U	48	/RES-U
	49	/WRL	50	ALE	51	/EA	52	/NMI-U
	53	P6.0/CS0	54	P6.2/CS2	55	P6.4/CS4	56	P6.6
	57	P6.1/CS1	58	P6.3/CS3	59	/HLD-U	60	P6.7
Special Purpose	61	VREF	62	VGND	63	P2.8	64	
	65	VREF	66	VGND	67	VPP	68	
Analog Input	69	P5.0	70	P5.2	71	P5.4	72	P5.6
	73	P5.1	74	P5.3	75	P5.5	76	P5.7
	77	P5.8	78	P5.10	79	P5.12	80	P5.14
	81	P5.9	82	P5.11	83	P5.13	84	P5.15
Digital-Port P2	85	P2.0	86	P2.2	87	P2.4	88	P2.6
	89	P2.1	90	P2.3	91	P2.5	92	P2.7
	93	P2.8	94	P2.10	95	P2.12	96	P2.14
	97	P2.9	98	P2.11	99	P2.13	100	P2.15
Digital-Port P3	101	P3.0	102	P3.2	103	P3.4	104	P3.6
	105	P3.1	106	P3.3	107	P3.5	108	P3.7
	109	P3.8	110	P3.10/TXD0	111	/WRH	112	/RDY-U
	113	P3.9	114	P3.11/RXD0	115	P3.13	116	P3.15
Digital-Port P7	117	P7.0	118	P7.2	119	P7.4	120	P7.6
	121	P7.1	122	P7.3	123	P7.5	124	P7.7
Digital-Port P8	125	P8.0	126	P8.2	127	P8.4	128	P8.6
	129	P8.1	130	P8.3	131	P8.5	132	P8.7
	133		134		135		136	
	137		138		139		140	
	141		142		143		144	
	145		146		147		148	
Supply Voltage	149	VCC	150	VCC	151	GND	152	GND

Table 1: Pinout of the kitCON-Connector (X3)

3.3 The ICE/connect-16x

The ICE/connect-16x provides an easy possibility for connecting a standard emulator, which uses the controller on board, to the kitCON-167. It can be mounted at position X2 (*refer to Figure 7*). It carries all data- and address signals. The control signals coming from the controller extend via pre-connections at the ICE/connect-16x to the peripheral devices. When using an emulator the control signals are generated by the emulator. In this case the pre-connections must be opened.

Table 2 shows the pinout of the ICE/connect-16x.

Attention:

Pins 41+42, 43+44, 45+46, 47+48, 49+50 and 53+54 are pre-connected on the component side. When using an ICE/connect-16x these pre-connections have to be opened.

Pin	Description	Description	Pin
1	GND	D0	2
3	D1	D2	4
5	D3	D4	6
7	D5	D6	8
9	D7	GND	10
11	D9	D8	12
13	D11	D10	14
15	D13	D12	16
17	D15	D14	18
19	GND	A0	20
21	A1	A2	22
23	A3	A4	24
25	A5	A6	26
27	A7	GND	28
29	A9	A8	30
31	A11	A10	32
33	A13	A12	34
35	A15	A14	36
37	GND	ALE	38
39	GND	XT1	40
41	/RES_P	/RES_U	42
43	/HLD_P	/HLD_U	44
45	/RDY_P	/RDY_U	46
47	/RESO_P	/RESO_U	48
49	/NMI-P	/NMI-U	50
51	GND	GND	52
53	/RD_P	/RD_U	54
55	/WRL	/WRH	56
57	P6.6	VCC	58
59	A16	A17	60
61	GND	GND	62
63	A18	A19	64
65	A20	A21	66
67	A22	A23	68
69	GND	GND	70
71	P6.0 (CS 0)	P6.1 (CS 1)	72
73	P6.2 (CS 2)	P6.3 (CS 3)	74
75	P6.4 (CS 4)	NC	76
77	NC	NC	78
79	GND	GND	80

Table 2: Pinout of the ICE/connect-16x (X2)

3.4 The Quad-Connector

The kitCON-167 is also prepared to house a Quad-Connector at X6. In contrast to the ICE/connect-16x this connector system can be used to adapt bondout based emulators or measuring systems.

Table 3 shows the pinout of the Quad-Connector.

Quad-Connector X6 A

Pin	Description	Description	Pin
1	NC	NC	2
3	P6.0	P6.1	4
5	P6.2	P6.3	6
7	P6.4	/HLD-P	8
9	P6.6	P6.7	10
11	P8.0	P8.1	12
13	P8.2	P8.3	14
15	P8.4	P8.5	16
17	P8.6	P8.7	18
19	VCC	GND	20
21	P7.0	P7.1	22
23	P7.2	P7.3	24
25	P7.4	P7.5	26
27	P7.6	P7.7	28
29	P5.0	P5.1	30
31	P5.2	P5.3	32
33	P5.4	P5.5	34
35	P5.6	P5.7	36
37	P5.8	P5.9	38
39	NC	NC	40

Quad-Connector X6 B

Pin	Description	Description	Pin
41	NC	NC	42
43	VREF	VGND	44
45	P5.10	P5.11	46
47	P5.12	P5.13	48
49	P5.14	P5.15	50
51	GND	VCC	52
53	P2.0	P2.1	54
55	P2.2	P2.3	56
57	P2.4	P2.5	58
59	P2.6	P2.7	60
61	GND	VCC	62
63	P2.8	P2.9	64
65	P2.10	P2.11	66
67	P2.12	P2.13	68
69	P2.14	P2.15	70
71	P3.0	P3.1	72
73	P3.2	P3.3	74
75	P3.4	P3.5	76
77	GND	VCC	78
79	NC	NC	80

Quad-Connector X6 C

Pin	Description	Description	Pin
81	NC	NC	82
83	P3.6	P3.7	84
85	P3.8	P3.9	86
87	P3.10	P3.11	88
89	/WRH	P3.13	90
91	P3.15	VCC	92
93	GND	VPP	94
95	A16	A17	96
97	A18	A19	98
99	A20	A21	100
101	A22	A23	102
103	VCC	GND	104
105	/RD-P	/WRL	106
107	/RDY-P	ALE	108
109	/EA	D0	110
111	D1	D2	112
113	D3	D4	114
115	D5	D6	116
117	D7	D8	118
119	NC	NC	120

Quad-Connector X6 D

Pin	Description	Description	Pin
121	NC	NC	122
123	VCC	GND	124
125	D9	D10	126
127	D11	D12	128
129	D13	D14	130
131	D15	A0	132
133	A1	A2	134
135	A3	A4	136
137	A5	A6	138
139	A7	VCC	140
141	GND	A8	142
143	A9	A10	144
145	A11	A12	146
147	A13	A14	148
149	A15	VCC	150
151	XTO	XTI	152
153	GND	/RES-P	154
155	/RESO-P	/NMI-P	156
157	GND	VCC	158
159	NC	NC	160

Table 3: Pinout of the Quad-Connector (X6)

3.5 The DB9-socket P1

The DB9-socket P1 serves as RS-232-interface. The pinout is shown below.

DB9-socket P1: RS-232 interface

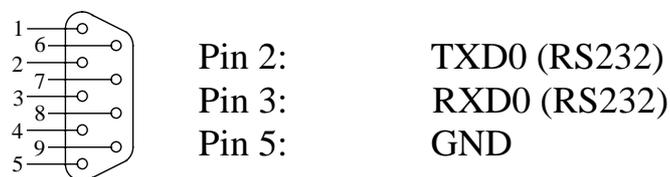


Figure 10: Pinout of the DB9-socket P1 (front view)

3.6 The DB9-plug P2

The DB9-plug P2 carries either the CAN-signals or signals of an additional debug interface. This debug interface is used from several Monitor programs. For data transmission according to RS232 special software drivers are required which are part of the monitor programs. The pinout of the DB9-plug P2 is shown for both modes in the following.

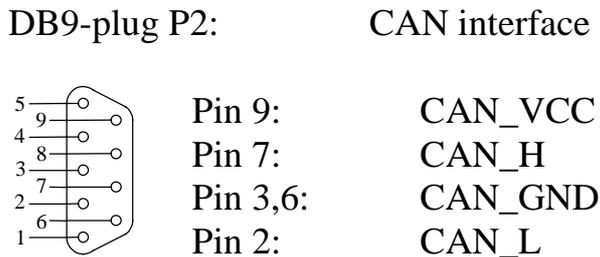


Figure 11: Pinout of the DB9-plug P2 (CAN-Interface)(front view)

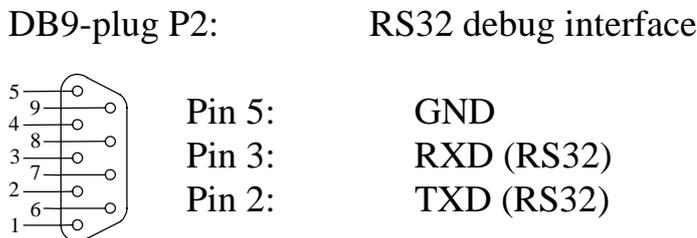


Figure 12: Pinout of the DB9-plug P2 (RS232 Debug-Interface)(front view)

Attention:

Note that DB9-plug P2 can only be used as RS232 interface with special software drivers. Usually these are part of several Monitor programs.

3.7 The connectors X7 for the serial EEPROM

The serial EEPROM on U20 is not connected to the High-Speed Synchronous Interface (SSC) of the controller. In order to utilize the serial EEPROM it has to be connected to the SSC via connector X7. The pin out of connector X7 is shown below.

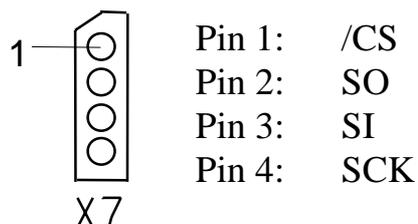


Figure 13: Pinout of connector X7 (SSC for serial EEPROM)

3.8 The connectors WDI and PFO

The connectors WDI and PFO provide two additional signal inputs/outputs. They are carried out as soldering holes in order to enable the mounting of test pins.

The WDI connector extends directly to the watchdog input of the watchdog device 694. The watchdog controls the Watchdog Timer. As long as this connector is left open (i.e. the WDI pin is floating) the Watchdog Timer is disabled. If WDI is driven to either high or low level the Watchdog Timer is started. Reset is executed, if there is no further transition for the watchdog time-out period (see the LTC694 data sheet for further information on the exact timing of the Watchdog Timer).

The PFO connector extends directly to the power failure output of the watchdog device 694. PFO can be used to monitor the condition of the supporting battery or to indicate a power failure at VCC (i.e. VCC is below the battery voltage) (see the LTC694 data sheet for further information on the exact functioning of PFO and the trigger-levels).

4 Jumper

To configure the module, the kitCON-167 has 18¹ insertable and solderable jumpers and an 8-bit DIP-switch. In order to ensure immediate use of the board the jumpers have been configured prior to delivery. *Figure 14* illustrates the numbering of the solderable jumper-pads, while *Figure 15* and *Figure 16* indicate the location of the jumpers on the board.

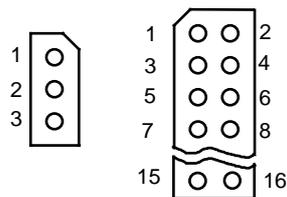


Figure 14: Numbering of the Jumper-Pads

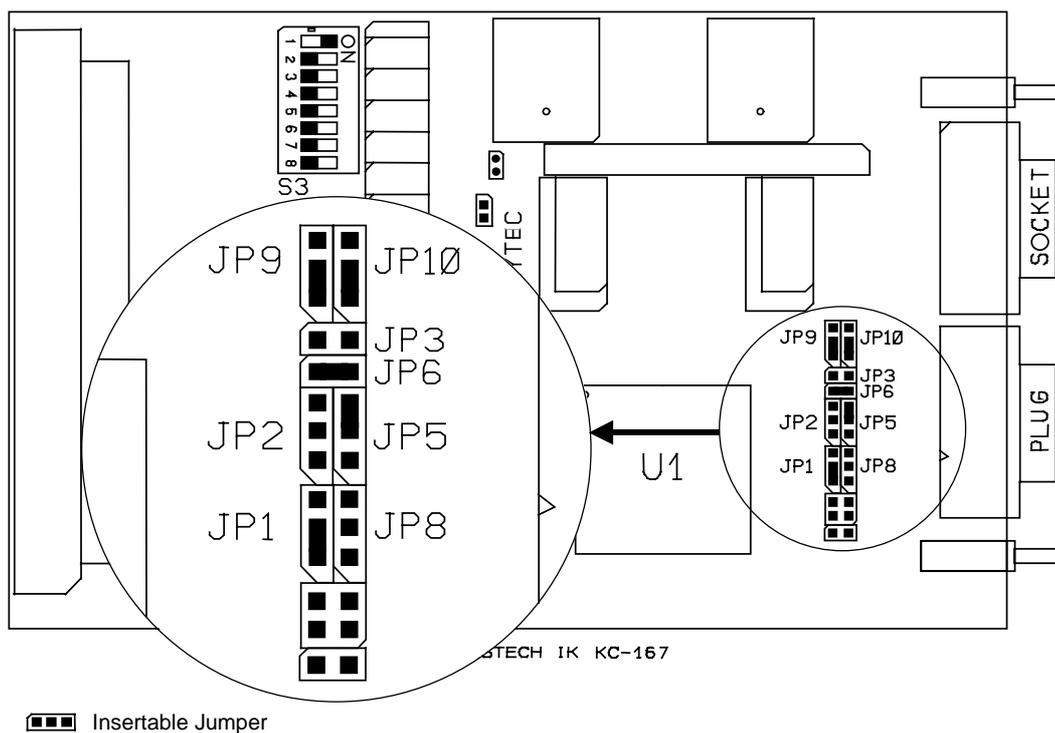
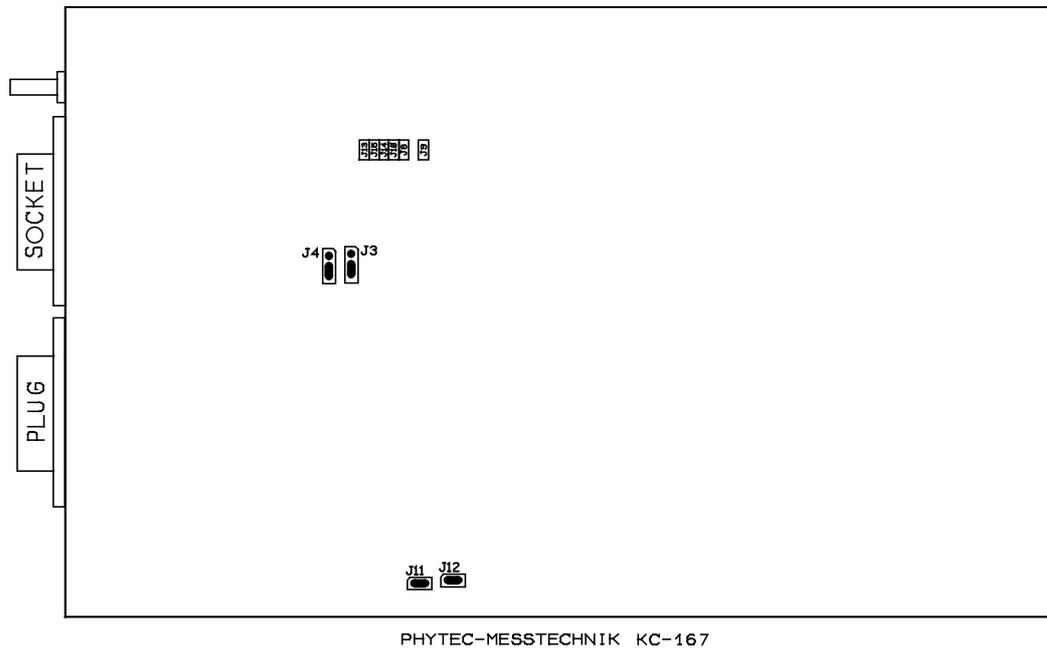


Figure 15: Position of the Jumpers (component side) and default-setting (standard version of the kitCON-167)

¹ Some of the boards' features are not available due to new specifications of the target controller. Hence jumpers for these features are not described in this section.



●●● Solderable Jumper

Figure 16: Location of the jumpers (soldering side) and default-setting (standard version of the kitCON-167)

The jumpers (S3 = DIP-switch S3, JP = insertable jumper, J = solderable jumper) have the following functions:

	Default-Setting	Alternate-Setting
JP1	(1+2) external ROM/ Flash active	(2+3) internal ROM/Flash ac- tive
JP2	(open) P3.9 freely available	(2+3) P3.9 as RS232 Debug- Interface
JP3	(open) CAN 120 Ω termi- nation not active	(closed) CAN 120 Ω termi- nation active
JP5, JP6	(2+3) CAN-VCC derived (closed) from supply voltage	(1+2) CAN-VCC derived from (open) CAN-network via DB9-plug P2
JP8	(open) P3.8 freely available	(closed) P3.8 as RS232 Debug- Interface
JP9, JP10	(1+2) DB9-plug P2 (1+2) for CAN	(2+3) DB9-plug P2 (2+3) for Debug-Interface
J3	(2+3) RAM-memory at U10/11 less or equal 256 kByte	(1+2) RAM-memory at U10/11 more than 256 kByte
J4	(2+3) RAM-memory at U14/U15 less or equal 256 kByte	(1+2) RAM-memory at U14/U15 more than 256 kByte
J7	(open) Pin 84 connected to Pin 67 of the kitCON-Connector (for programming of on-chip Flash)	(closed) no function
J11	(closed) VAGND derived from digital ground GND	(open) VAGND from external ground via kitCON- Connector X3
J12	(closed) VAREF derived from supply voltage VCC	(open) VAREF from external voltage source via kit- CON-Connector X3

S3 switch 1	(on)	Bootstrap Mode	(off)	normal Program Execution Mode
S3 switch 2 switch 3	(offn) (off)	five /CS-Signals available at port P6		Number of /CS-Signals at port P6 (0, 2 or 3)
S3 switch 4 switch 5	(off) (off)	two Segment Address Lines (A17, A16) at port P4 available		Number of Segment Address Lines at port P4 (0, 4 or 8)
S3 switch 6 switch 7 switch 8	(open) (open) (open)	System Clock Speed = XT1 * 4		Prescaler to generat the System Clock Speed from XT1 (*1, *2, *3 or *5)

Table 4: Jumper Settings

4.1 Program Storage JP1

At the time of delivery, Jumper JP1 is pre-connected between pads 1+2. This default configuration means that the program stored in the external program memory is executed after Reset. In order to allow the execution of a specific controller's internal program memory, jumper JP1 must be closed at 2+3

Code-Access	JP1
external Program Storage	1+2*
internal Program Storage	2+3

* = Default-Setting

4.2 Memory Size J3

Jumpers J3 and J4 configure the memory size, which is dependent upon the specific memory devices mounted at U10/U11 and U14/U15 on the board. The standard memory of the kitCON-167 offers 64 kByte RAM¹ mounted at U10 and U11.

Memory Size of U10/U11	J3
1 MB RAM	1+2
256 or 64 kByte	2+3*

Memory Size of U14/U15	J3
1 MB RAM	1+2
256 or 64 kByte	2+3

* = Default-Setting

4.3 Supply voltage of the CAN-Interface JP5, JP6

The CAN-driver on the kitCON-167 can be optically isolated using the optocouplers on U3 and U4. In order to achieve a complete isolation of the CAN-bus, the CAN-circuitry should be supplied through the CAN-interface - DB9-plug P2 (12 V on pin 9, GND on pin 3 and 6). This requires that jumper JP6 be opened and jumper JP5 be connected between pads 1+2. If jumper JP6 is closed and JP5 is connected between 2+3 the supply voltage of the CAN-circuitry is supplied from the kitCON-167's supply voltage.

Supply Voltage of the CAN-circuitry	JP6	JP5
derived from CAN-network via DB9-plug P2	open	1+2
derived from the supply voltage of the kitCON-167	closed*	2+3*

* = Default-Setting

¹: Information about additional configurations can be found in the PHYTEC product catalog

4.4 On-Chip Flash J7

Some derivatives of the C167-Controller provide on-chip Flash-Memory. To program this memory a programming voltage of 12 V is necessary. This has to be connected to pin 84 on the controller when the Flash is programmed. During normal operation this pin must be left open. Leaving jumper J7 open connects pin 84 to pin 67 on the kitCON-Connector X3 where the 12 V programming voltage can be fed. During normal operation pin 67 on the kitCON-Connector X3 must be left open.

Pin 84 (VPP) of the Controller	J7
no function	closed
connected to pin 67 of the kit-CON-Connector X3	open*

* = Default-Setting

4.5 Debug-Interface JP8

The DB9-plug P2 is used from several Monitor programs as an additional interface. Use of the Debug-Interface requires port P3.8 and P3.9 to be connected to the RS232-driver, which can be done with jumpers JP8 and JP2. For data transmission according to RS232 special software drivers are required which are part of the Monitor programs.

Debug-Interface	JP8	JP9
P3.8 freely available	open*	
P3.9 freely available		open*
Debug-Interface enabled (P3.8 and P3.9 at RS-232)	closed	

* = Default-Setting

Attention:

DB9-plug P2 can only be used as RS232 interface with special software drivers. Usually these are part of several Monitor programs.

4.6 Serial Interface P2 JP9, JP10

If the kitCON-167 houses a C167Cx Controller the DB9-plug P2 carries either the CAN-Signals or the signals of the Debug-Interface. Jumper JP9 and JP10 determine which signals are available at DB9-plug P2.

Signals at DB9-plug P2	JP9	JP10
CAN	1+2*	1+2*
Debug-Interface	2+3	2+3

* = Default-Setting

4.7 Reference Voltage of the A/D Converter J11, J12

The A/D converter of the controller requires a reference voltage (V_{AREF} , V_{AGND}) applied at pins 37 and 38 of the controller. This reference voltage can be derived either from an external source connected to the kitCON-Connector pins 61/65 and 62/66 or from the internal supply voltage of the kitCON-167. The source of the reference voltage can be chosen with the jumpers J11 and J12.

Reference Voltage of the A/D Converter	J11 (VAGND)	J12 (VAREF)
external reference voltage connected to kitCON-Connector X3 pins 61/65 and 62/66	open	open
derived from the internal supply voltage of the kitCON-167	closed*	closed*

* = Default-Setting

4.8 Configuration during System Reset S3

Most of the programmable features of the C167 are either selected during the initialization phase or repeatedly during program execution. However there are some features that must be selected earlier, because they are used for the first access of the program execution. These selections are made during reset via the pins of Port P0, which are read at the end of the internal reset sequence. During reset, internal pullup devices are active at Port P0 meaning that high input levels are the default configuration on Port P0. To change the configuration external pulldown devices have to be connected to the respective port pins. This can be done with the help of DIP-Switch S3, as DIP-Switch S3 allows the configuration of the board during system reset (for more information about the configuration during system reset refer also to the C167 User's manual, section "System Reset"). Some configurations which are usually made once can be changed by installing optional resistors.

The following figure shows Port P0, the function of the pins during reset and how they can be changed (either with jumper JP2 or with optional resistors). The shaded pins are fixed and cannot be changed with DIP-Switch S3.

Function of Port P0 during System Reset (High-Byte)							
Bit H7	H6	H5	H4	H3	H2	H1	Bit H0
CLKCFG <i>S3 switch 6, 7 and 8</i>			SALSEL <i>S3 switch 4 and 5</i>		CSSEL <i>S3 switch 2, 3</i>		WRC <i>0</i>

Function of Port P0 during System Reset (Low-Byte)							
Bit L7	L6	L5	L4	L3	L2	L1	Bit L0
BUSTYP <i>1</i>	<i>0</i>	R	BSL <i>S3 switch 1</i>	R	R	ADP <i>R3</i>	EMU <i>R4</i>

Reserved pins must remain high in order to ensure proper operation
The configuration of these pins must not be changed

The following sections contain a more detailed description of the configuration done with DIP-Switch S3.

4.8.1 Boot-Switch S3 (switch 1)

The C167 houses an on-chip Bootstrap Loader which can be activated with switch 1 of DIP-Switch S3. The Bootstrap Loader is started if pin 4 of port P0 is low during reset. This is accomplished by turning ON switch 1 of DIP-Switch S3.

Boot-Jumper	S3 switch 1
Bootstrap mode	ON*
normal Program Execution	OFF

* = Default-Setting

4.8.2 Chip-Select Signals S3 (switch 2 and 3)

The C167 Controller provides up to five Chip-Select Signals at Port P6. The number of Chip-Select Signals active can be defined during system reset through configuring P0.9 and P0.10. This configuration can be done with DIP-Switch S3 (switch 2 and 3). These pins are open in the default configuration meaning that all Chip-Select Signals are active. Please note that /CS0 is used to control the Flash devices on U8 and U9 whereas /CS1 is used to control the RAM on U10 and U11. Hence 3 Chip-Select Signals are available for other purposes. Only one Chip-Select Signal is freely available if additional Flash devices on U12/U13 and RAM on U14/U15 is installed.

Chip-Select Signals	S3 switch 2	S3 switch 3
five (/CS0-/CS4)	OFF*	OFF*
three (/CS0-/CS2)	ON	ON
two (CS0-/CS1)	OFF	ON
none	ON	OFF

* = Default-Setting

4.8.3 Segment Address Lines S3 (switch 4 and 5)

The C167 controller family allows user configuration of the number of address-lines available for segment addressing at port P4. The configuration of port P0.11 and P0.12 during system reset specifies the number of active address lines. This configuration can be done with DIP-Switch S3 (switch 4 and 5).

Segment Adress Lines	S3 switch 4	S3 switch 5
only A16 and A17 are active	OFF*	OFF*
four A16 - A19 are active	ON	ON
all A16 - A23 are active	ON	OFF
none are active	OFF	ON

* = Default-Setting

4.8.4 Clock MODE S3 (switch 6, 7 and 8)

The CPU-clock can be derived either directly from the oscillator clock or from the on-chip PLL which allows definition of a prescaler. To determine the clock source and the prescaler port P0.13 -P0.15 must be configured with DIP-Switch S3 (switch 6, 7 and 8) during system reset. The standard version of the kitCON-167 is equipped with a 5 MHz quartz meaning that the frequency of the CPU clock is 20 MHz with the default jumper setting.

Clock - Mode	S3 switch 6	S3 switch 7	S3 switch 8
XT1 x 4(2,5-6,25 MHz)	OFF*	OFF*	OFF*
XT1 x 3 (3,3-8,3 MHz)	ON	OFF	OFF
XT1 x 2(5-12,5 MHz)	OFF	ON	OFF
XT1 x5(2-5 MHz)	ON	ON	OFF
OSC1 x 1(1-25 MHz) direct drive	ON / OFF	ON / OFF	ON

* = Default-Setting

4.9 Jumper Settings for the most important modes

1. Monitor Mode

In Monitor Mode applications are downloaded and debugged in external RAM.

S3 switch 1	Boot-Switch
ON	Bootstrap mode

All other jumpers in default mode.¹

2. External Flash Programming Mode

In external Flash programming mode applications are downloaded into the external Flash.

S3 switch 1	Boot-Switch
ON	Bootstrap mode

All other jumpers in default mode.¹

3. Normal Program Execution out of external Flash

In this mode the code/ application programmed into external Flash (under Point 2) will be executed

S3 switch 1	Boot-Switch
OFF	normal Program Execution

All other jumpers in default mode.¹

¹: For information on the default setting see Table 4 and Figure 12 and Figure 13

5 Memory Models

The C167 Controller provides up to five Chip-Select Signals at port P6 for easy selection of external peripherals or memory banks. Depending on the number of memory devices installed on the kitCON-167 up to four Chip-Select Signals are used internally. /CS0 (P6.0) selects the Flash-Memory installed on U8/U9 (Flash bank 1) with a total memory of either 256 kByte or 1 MB. /CS3 (P6.3) selects Flash bank 2 on U12/U13 which can be equipped with either 256 kByte or 1 MB total memory optionally. The external memory consists of the two RAM banks on U10/U11 and U14/U15. Both can house memory devices of type 32 kByte, 128 kByte or 512 kByte within a SO28-32 package. /CS1 (P6.1) selects RAM bank 1 on U10/U11 whereas /CS2 (P6.2) selects RAM bank 2 on U14/U15.

In order to use the Chip-Select Signals they have to be enabled during reset (*refer to 4.8.2*). The assignment of the Chip-Select Signals to specific address areas is done with the corresponding ADDRESELx and BUSCONx register. Note that ADDRESELx has to be configured prior activating of the Chip-Select Signal with BUSCONx. Take care that the memory areas do not conflict.

Prior definition of the ADDRESELx and the BUSCONx register only /CS0 is active in the entire address space and remains active for all areas not assigned to another Chip-Select Signal.

By configuring the memory cycle wait state ($T_c = 50\text{ns}$) and the R/W-Delay it is possible to use memory devices with access times up to 100ns at a bus cycle time of 150ns. To run the controller without wait state memory devices with 55ns access time have to be installed. The bus cycle time then is 100ns. The R/W-Delay should be always active (*refer to the C167-User's manual for more information*).

In the following are important timing characteristics. All information refers to a C167Cx Controller with a 16-bit bus, non-multiplexed, at 20 MHz CPU-clock time (F_{osz}).

Tc = 50ns * Waitstates-Control (MCTC in BUSCON)

Tf = 50ns * Tri-State-Control (MTTC in BUSCON).

Addresses stabil until data valid:	max. 70ns + Tc	SR ¹⁾
/RD low until data valid:	max. 55ns + Tc	SR ¹⁾
/RD low until data valid (R/W-Delay):	max. 30ns + Tc	SR ¹⁾
/RD high until databus high-Z:	max. 15ns + Tf	SR ¹⁾
/RD high until data high-Z (R/W-Delay):	max. 35ns + Tf	SR ¹⁾
/CSx until data valid:	max. 55ns + Tc	SR ¹⁾
/RD and /WR low:	min. 65ns + Tc	CC ²⁾
/RD and /WR low (R/W-Delay):	min. 40ns + Tc	CC ²⁾
Data valid until /WR high:	min. 25ns + Tc	CC ²⁾
/WR high until data valid:	min. 15ns + Tf	CC ²⁾

1) SR = System Time (Time has to be kept from external circuitry),

2) CC = Controller Characteristic (The Controller ensures this time for external peripheral circuitry)

Below you will find two examples for configuring the memory area. These examples match the needs of most standard applications.

Example a)

ADDRESEL1: 0404h = Memory area 04:0000h - 04:FFFFh
(64 kByte RAM Bank 1 on U10/11)

ADDRESEL2: 0806h = Memory area 08:0000h - 0B:FFFFh
(256 kByte RAM bank 2 on U14/15)

ADDRESEL3: 0C06h = Memory area 0C:0000h - 0F:FFFFh
(256 kByte Flash bank 2 on U12/13)

ADDRESEL4: 1000h = Memory area 10:0000h - 10:0FFFh
(4 kByte free I/O area)

BUSCON0: 04AFh : Bus active for /CS0 (Flash bank 1 U8/9)

BUSCON1: 04AFh : Bus active for /CS1 (RAM bank 1 U10/11)

BUSCON2: 04AFh : Bus active for /CS2 (RAM bank 2 U14/15)

BUSCON3: 04AFh : Bus active for /CS3 (Flash bank 2 U12/13)

BUSCON4: 068Ch : Bus active for /CS4 (free I/O)

BUSCON0 - 3: for all 55ns memory devices (0 Waitstate, R/W-Delay, no Tri-state, short ALE, 16-Bit Demultiplexed)

BUSCON4: for free I/O area (3 Waitstate, RW-Delay, Tri-state Wait 300ns, long ALE, 16-Bit Demultiplexed)

Example b)

- ADDRESEL1: 0006h = Memory area 00:0000h - 03:FFFFh
 (256 kByte RAM Bank1 on U10/11)
- ADDRESEL2: 0806h = Memory area 08:0000h - 0B:FFFFh
 (256 kByte RAM Bank2 on U14/15)
- ADDRESEL3: 0C06h = Memory area 0C:0000h - 0F:FFFFh
 (256 kByte Flash bank2 on U12/13)
- ADDRESEL4: 1006h = Memory area 10:0000h - 13:FFFFh
 (256 kByte free I/O)
- BUSCON0: 04AFh : Bus active for /CS0 (Flash bank1 U8/9)
- BUSCON1: 04AFh : Bus active for /CS1 (RAM bank1 U10/11)
- BUSCON2: 04AFh : Bus active for /CS2 (RAM bank 2U14/15)
- BUSCON3: 04AFh : Bus active for /CS3 (Flash bank2 U12/13)
- BUSCON4: 068Ch : Bus active for /CS4 (free I/O)
- BUSCON0-3: for all 55ns memory devices active (0 Waitstate, RW-Delay, no Tri-state, short ALE, 16-Bit Demultiplexed)
- BUSCON4: for free I/O area (3 Waitstate, RW-Delay, Tri-state, long ALE, 16-Bit Demultiplexed)

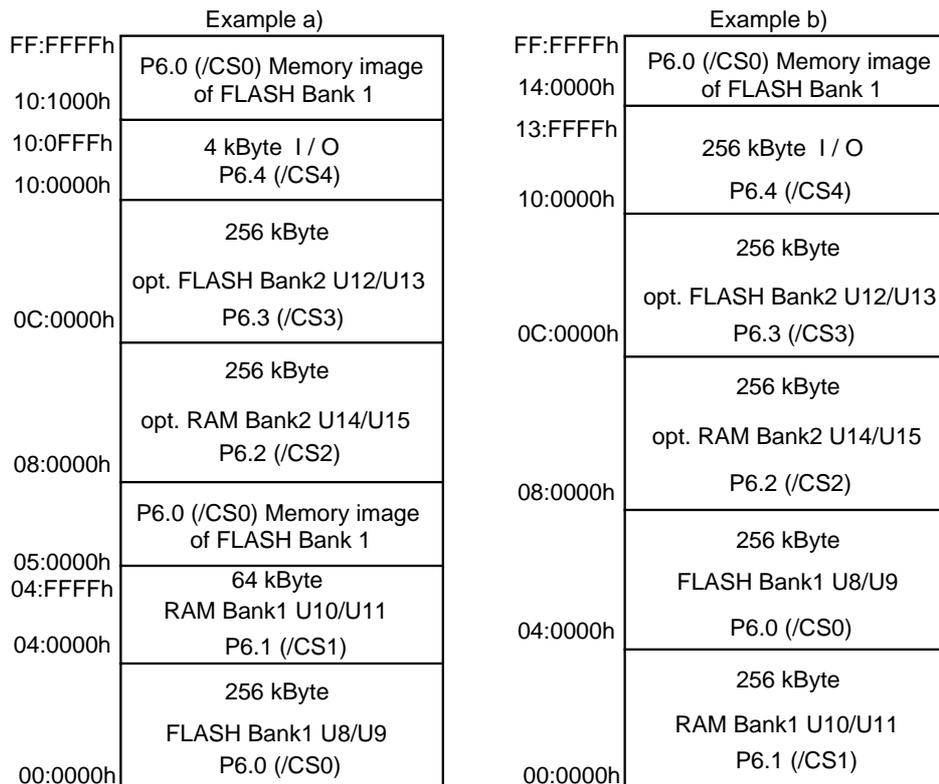


Figure 17: Memory Model Examples

6 Flash-Memory

Flash is a highly functional means of storing non-volatile data. The kitCON-167 can house Flash devices of type 29F010 (128 kByte memory) or of type 29F040 (512 kByte memory) as Flash-Memory. Either two or four Flash devices can be mounted on U8, U9, U12 and U13. This gives a minimum memory of 256 kByte (two 29F010) and a maximum of 2 MB (four 29F040). Use of 5 V Flash device means that no dedicated programming voltage is required on-board.

On-board programming is done with a utility program developed by PHYTEC, so called "FlashTools" (*refer to section 13: ".FlashTools"*). FlashTools must be loaded with the Bootstrap Loader prior to use.

Use of a Flash device as the only means of code storage results in no or limited usability of the Flash-Memory as non-volatile memory for data. This is due to the internal structure of the Flash device, as during the Flash-internal programming process the reading of data from Flash is not possible. Hence, for Flash-programming, program execution must be transferred out of Flash (such as into von-Neumann RAM). This usually equals the interruption of a "normal" program execution cycle.

As of the printing of this manual, Flash devices generally have a life expectancy of at least 100,000 Erase-/Program-cycles.

7 The CAN-Interface

The kitCON-167 can be equipped with a C167Cx controller. One of the special features of this controller is the on-chip Full-CAN-Controller which enables the kitCON-167 to be run within a CAN-network. Running the C167 controller at 20 MHz CPU clock, a bit rate of up to 1 MB can be achieved.

When utilising the CAN-interface the portpins P4.5 (RXDC) and P4.6 (TXDC) should not be connected to any other circuitry. The CAN-bus can be connected directly to DB9-plug P2. The pinout of the DB9-plug P2 is shown in *Figure 18*. The CAN-signals from the controller are also present at pin 40 and pin 43 of the kitCON-connector.

The DB9-plug P2 can also be used for the additional debug-interface. Hence make sure that jumper JP9 and JP10 are both closed at pins 1+2 in order to have the CAN-signals available at DB9-plug P2.

The programming of the CAN-controller is done by means of control-registers, which are mapped into segment 0 of the normal memory area of the controller at the addresses 00:EF00h through 00:EFFh.

A detailed description of the registers and how to program the controller can be read in the corresponding controller manual of the C167Cx.

DB9-plug P2

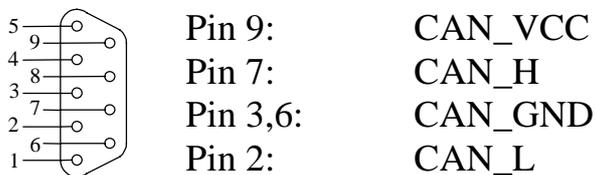


Figure 18: Pinout of the DB9-plug P2 (CAN-interface)(front view)

8 The LEDs

8.1 The Status LEDs D4 and D5

The kitCON-167 is fitted with two LEDs, D4 and D5, that indicate the status of the board.

The red LED D4 simply indicates proper connection to the power source.

The green LED D5 gives the status of the initialisation of the controller done by software. At the end of the basic initialisation in any program a 'EINIT' command should be executed. Following execution of this command the SYSCON-register is protected and cannot be changed accidentally. The green LED D5 lights up after this command is executed to indicate the end of the basic initialisation (see the 'Instruction Set Manual' for further information about 'EINIT').

These LEDs are automatically controlled by hardware.

8.2 General Purpose LEDs D7 - D14 at Port P1

In addition to the status LEDs the kitCON-167 is equipped with 16 red LEDs at D6 – D21. These are connected to Port P2.0 to P2.15 and can be controlled by software. Writing a low-level to one of the ports will activate the corresponding LED.

The general purpose LEDs D6-D21 can only be activated by a user-application.

D21	D20	D19	D18	D17	D16	D15	D14
P2.0	P2.1	P2.2	P2.3	P2.4	P2.5	P2.6	P2.7

D13	D12	D11	D10	D9	D8	D7	D6
P2.8	P2.9	P2.10	P2.11	P2.12	P2.13	P2.14	P2.15

9 The Battery Buffer

To prevent loss of data in case of sudden power failure the kitCON-167 can be equipped with a battery. This battery buffers the memory devices on U10, U11, U14 and U15, as well as the Real-Time-Clock. However, this battery buffer is not otherwise essential to the functioning of the kitCON-167.

Position BT1 on the component side of the module is provided for mounting a battery type CR2032. As of the pressing of this manual, a lithium battery is recommended as it offers relatively high capacity at low self-discharge. In the event of a power failure at VCC, the RAM memory blocks will be buffered by a connected battery via VBAT.

The current consumption depends on the components populating the board and memory size. For the standard devices used on the board the draw is typically 1 μA (max. 100 μA) per RAM-device. The power consumption of the Real-Time-Clock is 50 μA

Regarding data and code integrity, please be advised that despite the battery buffer, changes in the data content within the RAM can occur given disturbances. The battery-buffer does not completely remove the danger of data destruction.

Attention:

Note that utilizing the battery buffer for the RAMs and the real-time clock the storage temperature is only 0°C to +70°C.

10 The Real-Time Clock RTC-85831

For real-time applications the kitCON-167 the board houses a Real-Time Clock of type RTC_8583. This real-time clock device provides the following features:

- Serial input/output bus (I²C)
- operating current (f = 0Hz) max. 50µA (important for battery buffer)
- Clock function with four year calendar
- Universal timer with alarm and overflow indication
- 24- and 12-hour format
- automatic word address incrementing
- Programmable alarm, timer and interrupt functions

If the kitCON-167 is equipped with a battery the Real-Time Clock runs independently of the board.

Programming the Real-Time Clock is done via the I²C-bus which is connected to port P2.1 (SCL) and port P2.2 (SDA). The Real-Time Clock also provides an interrupt output which is connected to port P2.0. An interrupt occurs in case of a clock alarm, timer alarm timer overflow and event counter alarm. It has to be cleared by software. With the interrupt function the Real-Time Clock can be utilized in various applications. The software shipped with the kitCON-167 includes a library with functions to program the shipped Real-Time Clock via the I²C-bus as well as example programs (for more information about the registers of the Real-Time Clock refer to the data-sheet).

¹ The real-time clock is not available on boards included in a Infineon' Starter Kit

11 Technical Specifications

The physical dimensions of the kitCON-167 are represented in *Figure 19*. The board's profile is about 17mm thick, including the DB9 sockets. The components on the soldering side have a maximum height of 3.5 mm and approximately 12 mm on the component side. The board itself is approximately 1.5 mm thick.

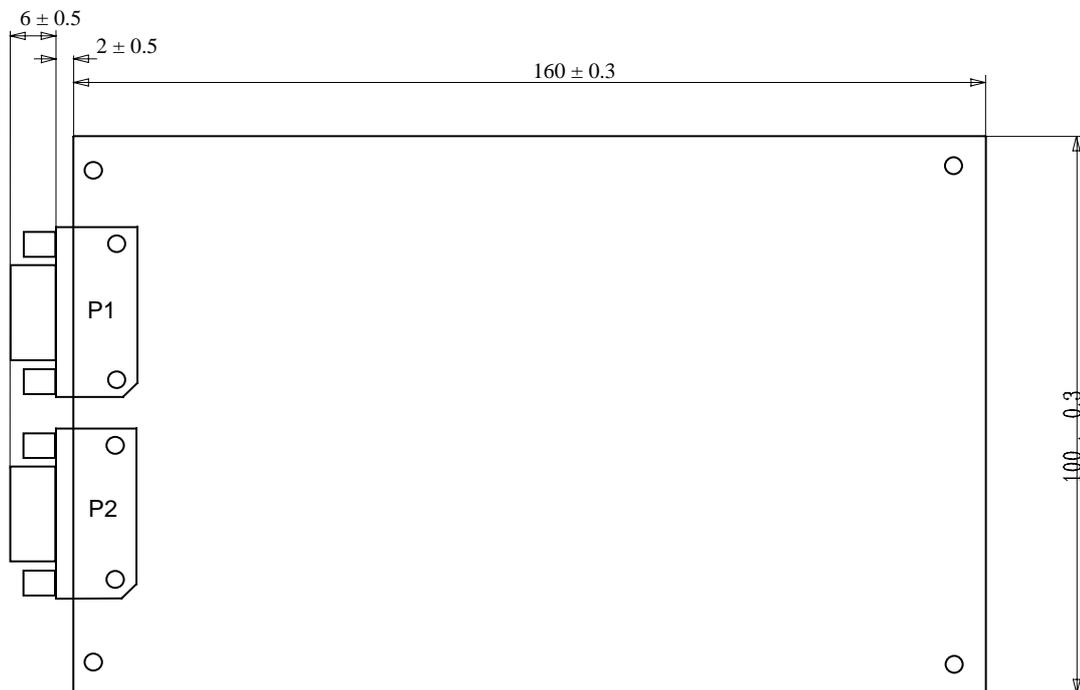


Figure 19: Physical Dimensions

Additional specifications:

- Dimensions: 160 x 100 mm., ± 0.03 mm.
- Weight: approximately 125g, if fitted with 2 MB RAM device and 2 MB Flash
- Storage temperature: -40°C to $+90^{\circ}\text{C}$, using the battery buffer 0°C to $+70^{\circ}\text{C}$
- operating temperature: 0°C to $+70^{\circ}\text{C}$, extended -40°C to $+85^{\circ}\text{C}$
- humidity: 90% r.F. not condensed
- Operating voltage: 5 V $\pm 10\%$
- Supply voltage: 8 V to 12 V ± 500 mA, VBAT 3 V $\pm 20\%$
- Power consumption:: 300 mA. at 20 MHz CPU-clock.

These specifications describe the standard configuration of the kitCON-167 as of the pressing of this manual.

Typically the current consumption is less than 150 mA with 64 kByte SRAM memory and 256 kByte Flash-Memory at 20°C .

Please note that utilizing the battery buffer for the RAMs and the real-time clock the storage temperature is only 0°C to $+70^{\circ}\text{C}$.

12 Hints for Handling the kitCON-167

Removal or exchange of components on the kitCON-167 (controller, memory, quartz etc.) is not advisable given the compact nature of the kitCON-167. Should this nonetheless be necessary, please ensure that the board, as well as surrounding components and sockets, remain undamaged during removal. Overheating the board can cause the solder pads to loosen, rendering the module inoperable. Carefully heat neighbouring connections in pairs. After a few alternations, components can be removed with the solder-iron tip. Alternatively, a hot air gun can be used to heat and loosen the bonds.

When changing the controller ensure that the controller to be used is pin-compatible to the C167 Controller and that special hardware features are compatible with the layout of the board.

13 FlashTools

Flash is a highly functional means of storing non-volatile data. With the kitCON-167 equipped with at least two Flash devices this modern technique is at your disposal. One of the main advantages of using Flash devices is the on-board programming capability. On-board programming can be easily done with a special utility program, the 'FlashTools', described in this section.

The FlashTools do not resist permanently on the board. They have to be loaded with the Bootstrap Loader prior programming of the Flash.

The following section describes the use of the Bootstrap Loader as well as of the FlashTools. These description are valid only for the use of the enclosed FlashTools and is not intended as guidelines for use with any other Flash utility program.

13.1 Starting FlashTools

To load the FlashTools the Bootstrap Loader has to be started first after reset. Once activated, the Bootstrap Loader awaits the start of a terminal program on the Host-PC to which the kitCON-167 is connected. Depending on the terminal-program started, a specific program will be downloaded into the external RAM and executed. To use the FlashTools the terminal program FLASHT.EXE has to be invoked.

Programming the Flash devices with the help of the FlashTools can be done as described below.

Turn ON switch 1 of DIP-switch S3

Connect the kitCON-167 to a Host- PC (using either the COM1 or COM2 serial communication port) with a serial cable as shown below:

Host-PC (COM1 or 2)		kitCON-167	DB9	socket	P1
RxD Pin 2	to	TxD		Pin	2
TxD Pin 3	to	RxD		Pin	3
GND Pin 5	to	GND		Pin 5	

Attach a power supply to the power-connector X5. An unregulated 8 V= to 12 V=/500 mA power source can be used to supply the board. Use only a fixed voltage power supply and no power supply with variable voltage. Double check the correct polarity of the plug as shown in *Figure 5*. If the power supply is attached correctly the red LED D4 will shine.

Push switch S1 to perform a reset. and to start the Bootstrap Loader on the kitCON-167.

Invoke the included terminal program using the following syntax:

```
flasht [BR(Baudrate)] [COM port number]
```

Ensure that the directory from where FLASHT.EXE is started, contains the two files 'boot' and 'flash' for the C167 controller.

The Bootstrap Loader determines the baud rate automatically. Hence, only after starting the Bootstrap Loader on the kitCON-167, the terminal program can be started with a baud rate of your choice. Thereafter, the Bootstrap Loader will automatically configure the serial port for this baud rate.

Please note that some controllers are only able to generate specific baud rates. Hence, it is possible that a baud rate specified by the invocation of the terminal program can not be generated by the controller and transmission fails. In this case the terminal program should be invoked again specifying a lower baud rate.

Once FLASHT.EXE has been successfully invoked, loading of the FlashTools starts and the green LED D5 shines. The downloading can be viewed on the Host-PC monitor screen. FlashTools start immediately following loading and the main menu appears on the screen. You can leave the FlashTools at any time except during a download by pressing <F1>.

13.2 Downloading into Flash

The main menu gives access to the different functions of the FlashTools. The tools enable the partial or total erasure of the Flash device, as well as programming of the device. They also allow device status information to be read from the Flash. All menu options are intuitive. Only Intel hexfiles can be used for programming purposes.

After user code has been downloaded into the Flash, it can be executed following a software reset. Alternatively, switch 1 of DIP-Switch S3 can be turned OFF in order to switch the kitCON-167 into execution mode following a hardware reset.

FLASHT.EXE can always be exited, except during downloading of user code, with the special-function key <F1>.

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