M16C/6S

User Manual for the EVB08-EU CENELEC band

Abstract

This User Manual describes the usage and setup of the EVB08-EU evaluation board. The EVB08-EU is an evaluation board for PLC communication within the CENELEC band. The EVB08-EU incorporates the Renesas M16C/6S microcontroller including the YITRAN IT800 physical layer.

Target Device

Target device is the Renesas M16C/6S microcontroller, a member of the huge M16C microcontroller family.

Figure1: The EVB08-EU reference board

Contents

1. Precautions for Safety

Naturally, if you talk of power line communication you talk also about high voltages. Therefore you should be aware about the risk of accidentally touching high voltages. Please handle this evaluation product with care, because it is not protected against touching.

Warning
If the requirements shown in the "WARNING" sentences are ignored, the equipment may cause serious personal injury or death.

Caution
If the requirements shown in the "CAUTION" sentences are ignored, the equipment may malfunction.

Important
It means important information on using this product.

In addition to the three above, the following are also used as appropriate.

means WARNING or CAUTION.

Example: **CAUTION AGAINST AN ELECTRIC SHOCK**

means PROHIBITION

Example: **DISASSEMBLY PROHIBITED**

means A FORCIBLE ACTION

Example: **UNPLUG THE POWER CABLE FROM THE RECEPTACLE.**

The following pages describe the symbols "WARNING", "CAUTION", and "IMPORTANT".

Warnings for AC Power Supply:

• If the attached AC power cable does not fit the receptacle, do not alter the AC power cable and do not plug it forcibly. Failure to comply may cause electric shock and/or fire.

• When using outside Europe, use AC power cable which complies with the safety standard of the country.

• When it is not possible to prepare for the AC power cable, contact your local distributor.

• Do not touch the plug of the AC power cable when your hands are wet. This may cause electric shock.

• This product is connected signal ground with frame ground. If your developing product is transform less (not having isolation transformer of AC power), this may cause electric shock. Also, this may give an unrepairable damage to this product and your developing one. While developing, connect AC power of the product to commercial power through isolation transformer in order to avoid these dangers.

• If other equipment is connected to the same branch circuit care should be taken not to overload the circuit. Refer to nameplate for electrical ratings.

• When installing this equipment, insure that a reliable ground connection is maintained.

• If you smell a strange odor, hear an unusual sound, or see smoke coming from this product, then disconnect power immediately by unplugging the AC power cable from the outlet. Do not use this as it is because of the danger of electric shock and/or fire. In this case, contact your local distributor.

Warnings to Be Taken for This Product:

• Do not disassemble or modify this product. Personal injury due to electric shock may occur if this product is disassembled and modified.

• Make sure nothing falls onto the product, especially liquids, metal objects, or anything combustible.

Warning for Installation:

• Do not set this product in water or areas of high humidity. Make sure that the product does not get wet. Spilling water or some other liquid into the product may cause unrepairable damage.

Warning for Use Environment:

• This equipment is to be used in an environment with a maximum ambient temperature of 35°C. Care should be taken that this temperature is not exceeded.

Cautions for AC Adapter:

• Use only the AC adapter included in this product package.

• The included AC adapter is for this product. Do not use it for other product.

• Before installing this equipment or connecting it to other equipment, disconnect the AC power cable from its outlet to prevent injury or accident.

• The included AC adapter has not power supply switch. The AC adapter is always active while connecting the AC power cable.

Cautions to Be Taken for This Product:

• Use caution when handling this product. Be careful not to apply a mechanical shock.

• Do not touch the interface connector pins directly with your hand.

• Do not pull the product unit by the cable which is connected to this product.

Caution for AC Power Supply:

• When installing or connecting this product with other equipment, shut down AC power or disconnect the AC power cord from the equipment to prevent personal injury or damage to the equipment.

Caution for Installation:

• When in use do not replace the product from its side.

Caution for Communication Interface:

• Always make sure that the interface cable for communication to your host application is matching.

Warnings for usage:

• Normal usage condition

In case the kit is used as a bundle as supplied with all components, the external power supply supplies the needed voltages and the line coupler functionality. So the main high voltage is not directly supplied to the EVB08-EU main board, making the handling with the uncovered PCB safer.

• Usage under other conditions

In case the main board would be used as standalone PLC module and no external line coupler exist, a line coupler can be assembled on the optional pads provide on the PCB. In that case connect the high voltage AC230 to the connector J11 the neutral phase to pin 1 and the L phase to pin 2. Please make sure that your handling with high voltage is following the related standards, because the main board is not protected against touching.

Warning concerning EMC Directive

• The EVB08-EU kit is only intended for use in a laboratory or classroom environment. A safe separation distance of 20m should be used between this and any sensitive equipment.

• Its use outside the laboratory, classroom, study area or similar such area invalidates conformity with the protection requirements of the Electromagnetic Compatibility Directive and could lead to prosecution.

2. Content of EVB08-EU

The Renesas EVB08-EU consists of:

- 1pcs EVB08-EU main board
- 1pcs EVB08-EU interface board
- 1pcs YITRAN IT800CA power supply
- 1pcs serial cross over cable

3. Introduction

Power line communication (PLC) is a method of communication using the existing electric power transmission and electricity distribution lines in and outside home. The carrier can communicate data by superimposing an analogue signal over the standard 50 or 60Hz main voltage frequency. Each room in a residence provides one, two, or more outlets. These nodes are already available throughout the household, which makes PLC to a low-cost solution, by offering this number of possible gateways. Any device requiring power is already attached to the power line network making PLC convenient and accessible for every user.

The four major features for a successful communication solution are:

- Ease to use
- Ubiquitous node availability
- Reliable
- Cost effective

The Renesas M16C/6S PLC solution delivers all four.

In Europe the CENELEC standard EN50065-1 defines frequency bands for the data transmittion on low-voltage electrical installations. These four bands are located in the frequency range from 3kHz to 148,5kHz.
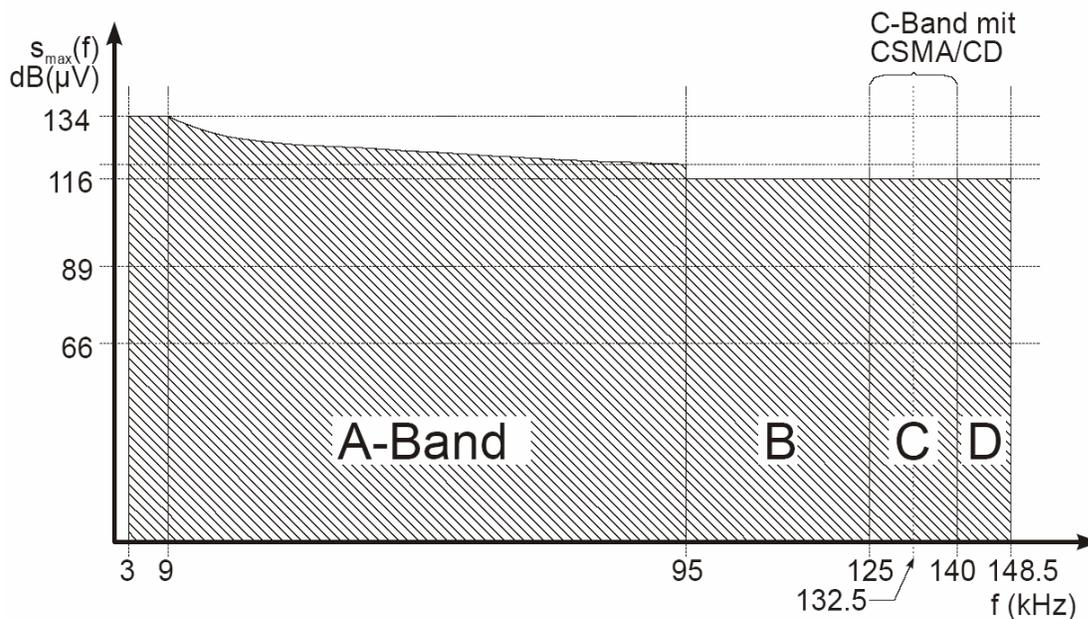
Figure2: CENELEC band overview

Band	Frequency	Usage	Access protocol
A	3kHz - 95kHz	Outdoor, reserved for energy suppliers	No
B	95kHz – 125kHz	Indoor without access protocol	No
C	125kHz – 140kHz	Indoor with access protocol	CSMA/CD
D	140kHz – 148,5kHz	Indoor for alarm and security systems	No

Table1:Usage of CENELEC band

In America and Japan other requirements for the signaling in that lower frequency bands exist.

Anyway, the Renesas M16C/6S PLC microcontroller does support the European CENELEC A and B band standard, the American FCC standard and also the Japanese ARIB standard, by one chip. Only external component have to be modified to adapt to the selected standard. With the Renesas M16C/6S PLC microcontroller, world wide customers can be supported by only one platform.

4. Hardware overview

In general the EVB08-EU kit consists of two PCBs:

- The upper main board
- Lower interface board.

Both PCBs are connected together by a 24 pin header connector.

Furthermore a socket power supply is provided with the kit package.
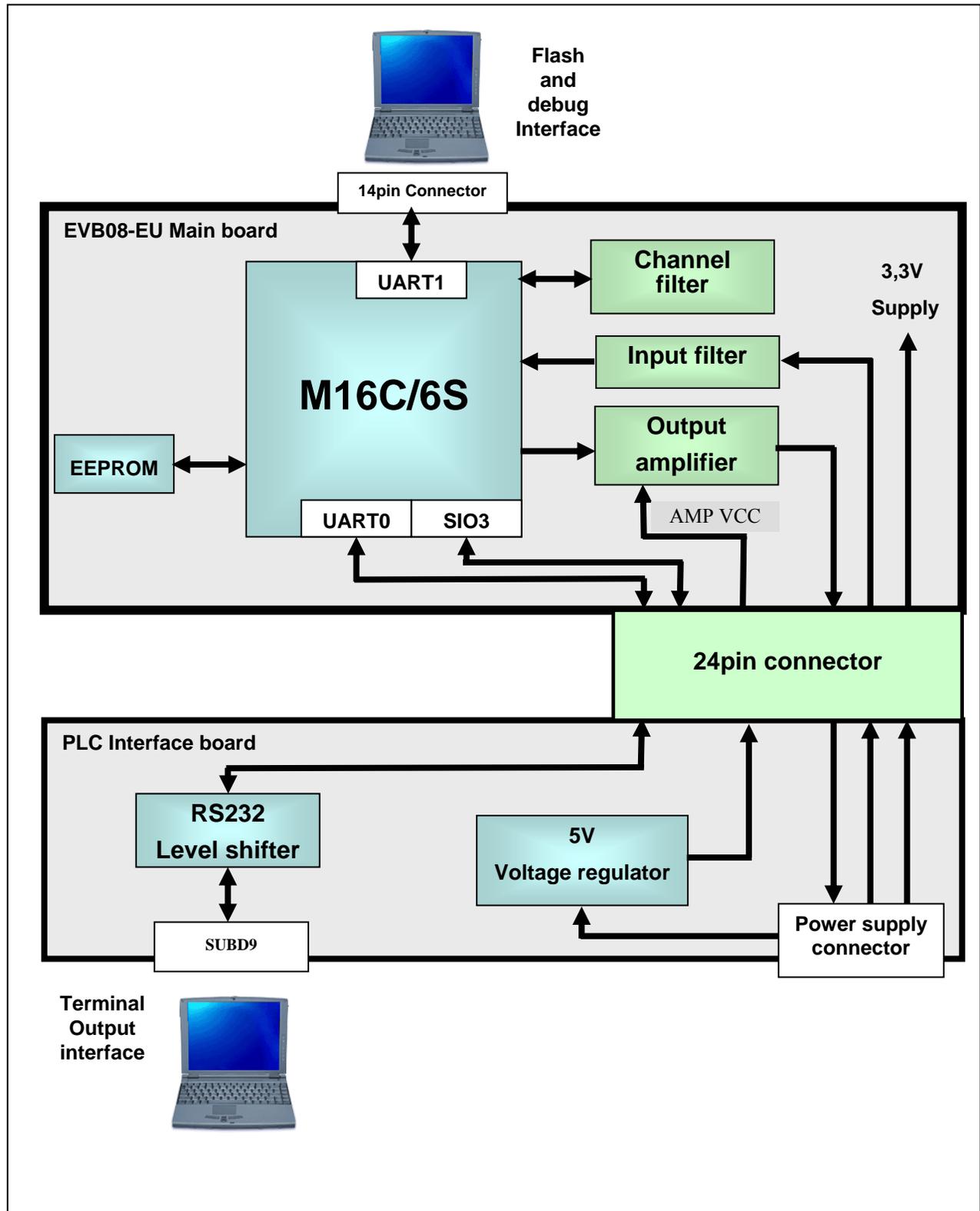
Figure3: Block diagram of EVB08-EU

4.1   EVB08-EU main board

The heart of the four layer EVB08-EU main board PCB is the M16C/6S PLC microcontroller. Mounted around this centre some external circuit of the Analogue Front End for the PLC physical layer, an EEPROM and a 14 pin connector for flashing and debugging tasks are arranged. A 24 pin connector makes this board to a module, which can be plugged easily to any application board.
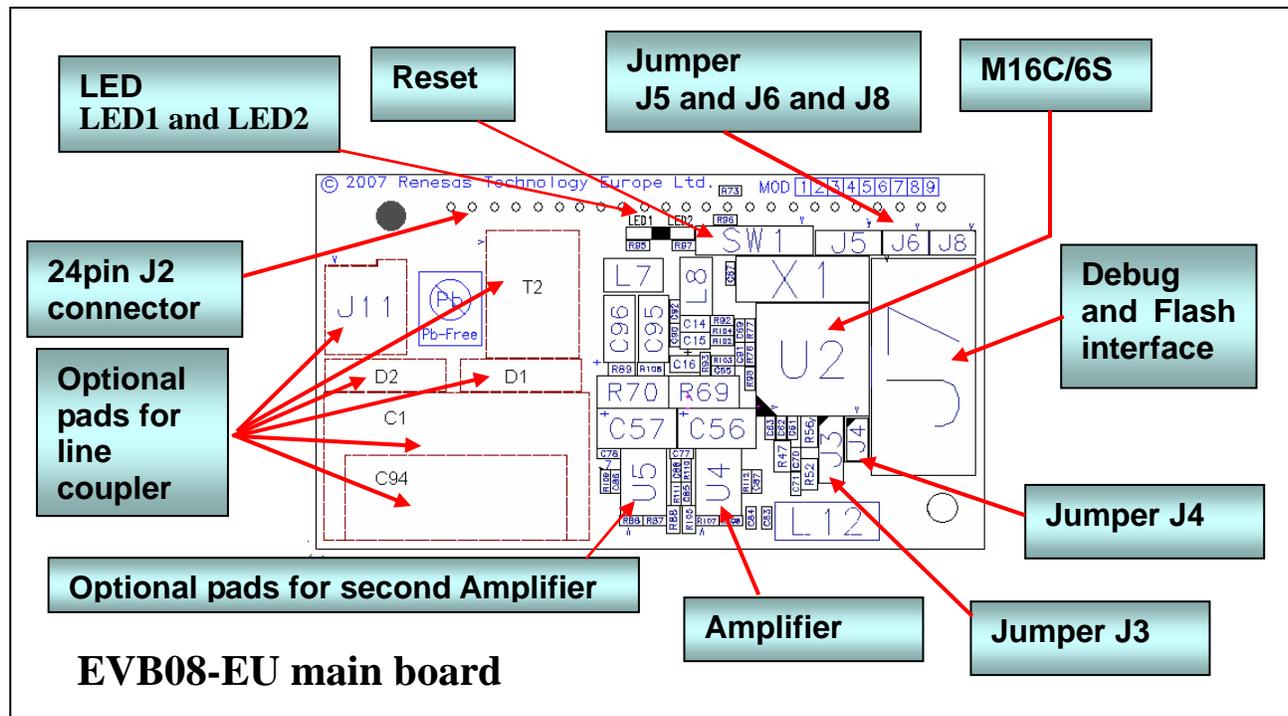
Figure4: Top view of EVB08-EU main board
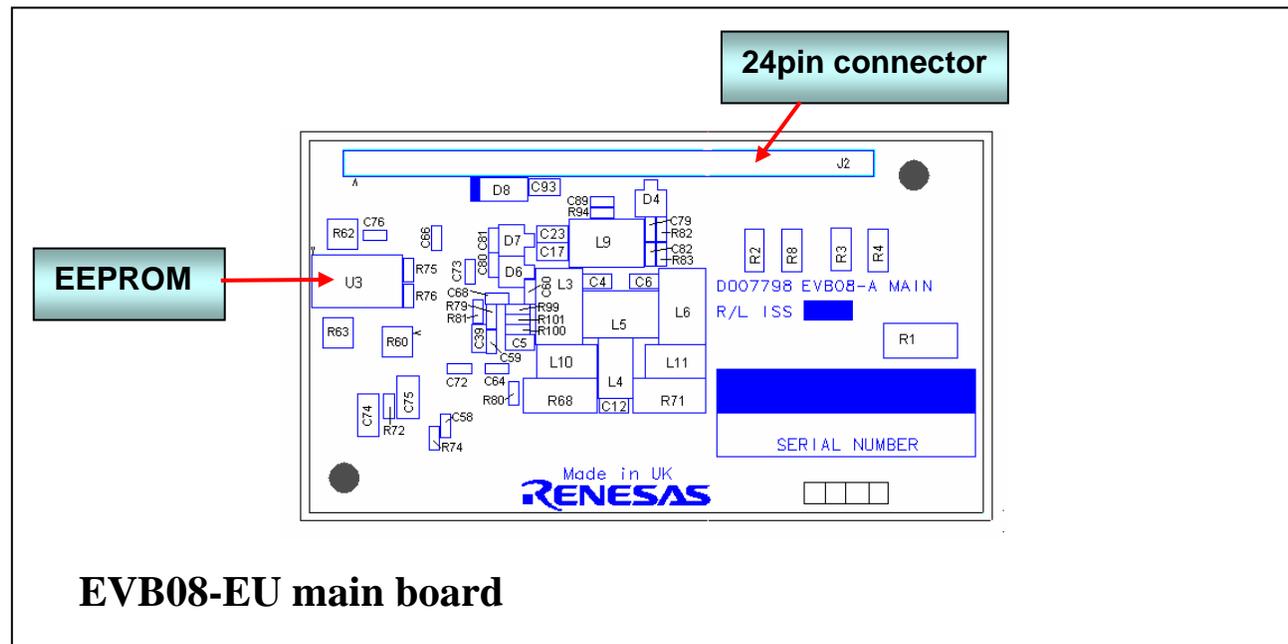
Figure5: Bottom view of EVB08-EU main board

4.1.1　M16C/6S Microcontroller

The M16C/6S is a single chip microcomputer, built using the high-performance silicon gate CMOS process using a M16C/60 Series CPU core and is packaged in a 64-pin plastic molded LQFP. These single-chip microcomputers operate using sophisticated instructions featuring a high level of instruction efficiency, capable to execute instructions at high speed. The M16C/6S is suitable for PLC networking, because it includes the advanced technology IT800 developed by YITRAN Corporations. With an embedded Flash memory of 96kByte and 24kBytes of RAM M16C/6S is suitable even for larger protocol stacks and additional applications.
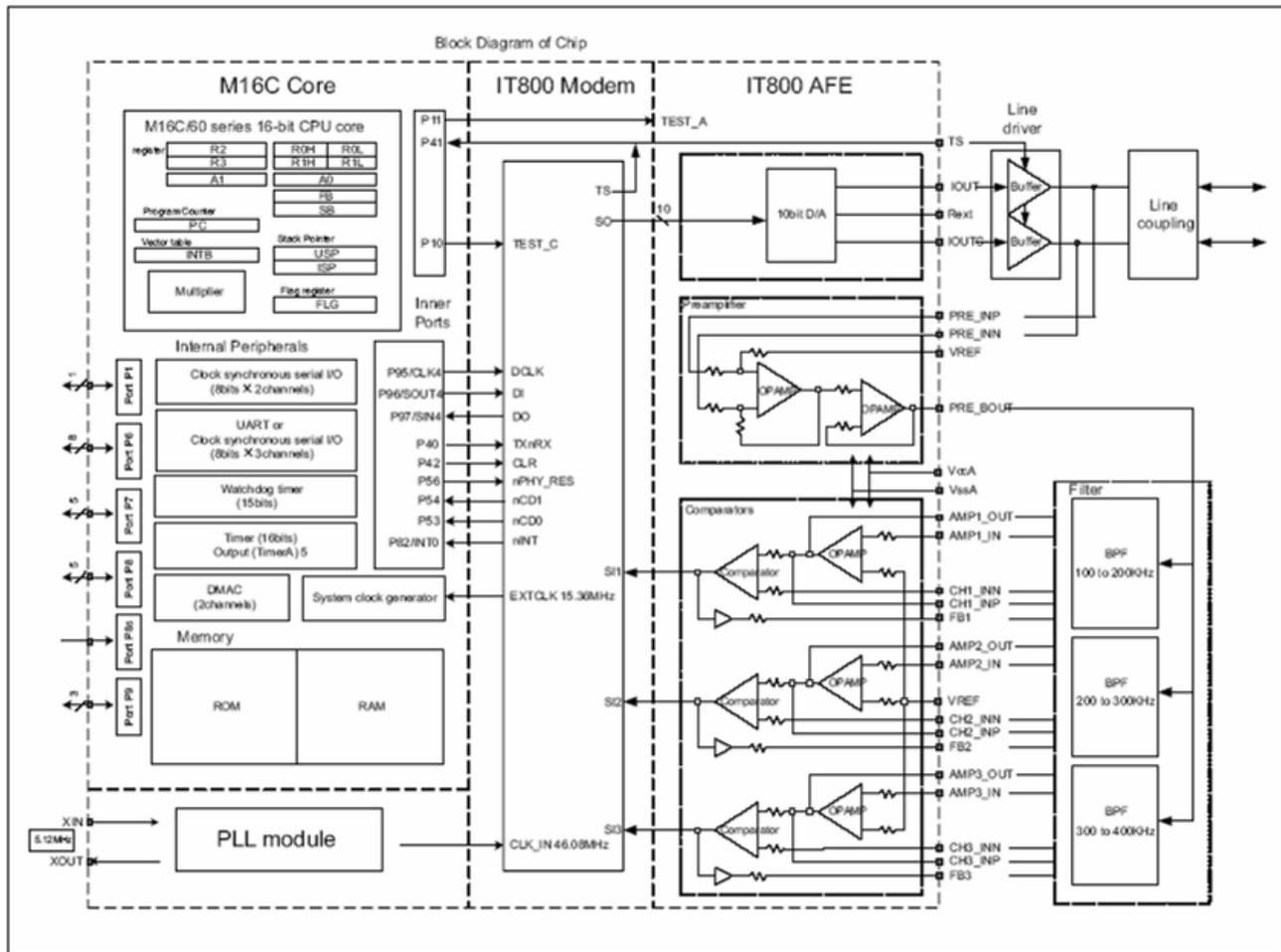
Figure6: Block diagram of M16C/6S chip

4.1.2 Analog Front End

The Analogue Front End (AFE) circuit includes reception and transmission paths and is located between Line Coupler and M16C/6S. Some of the AFE circuits are on chip, some are external circuits. The following figure provides a general description of the AFE block diagram.
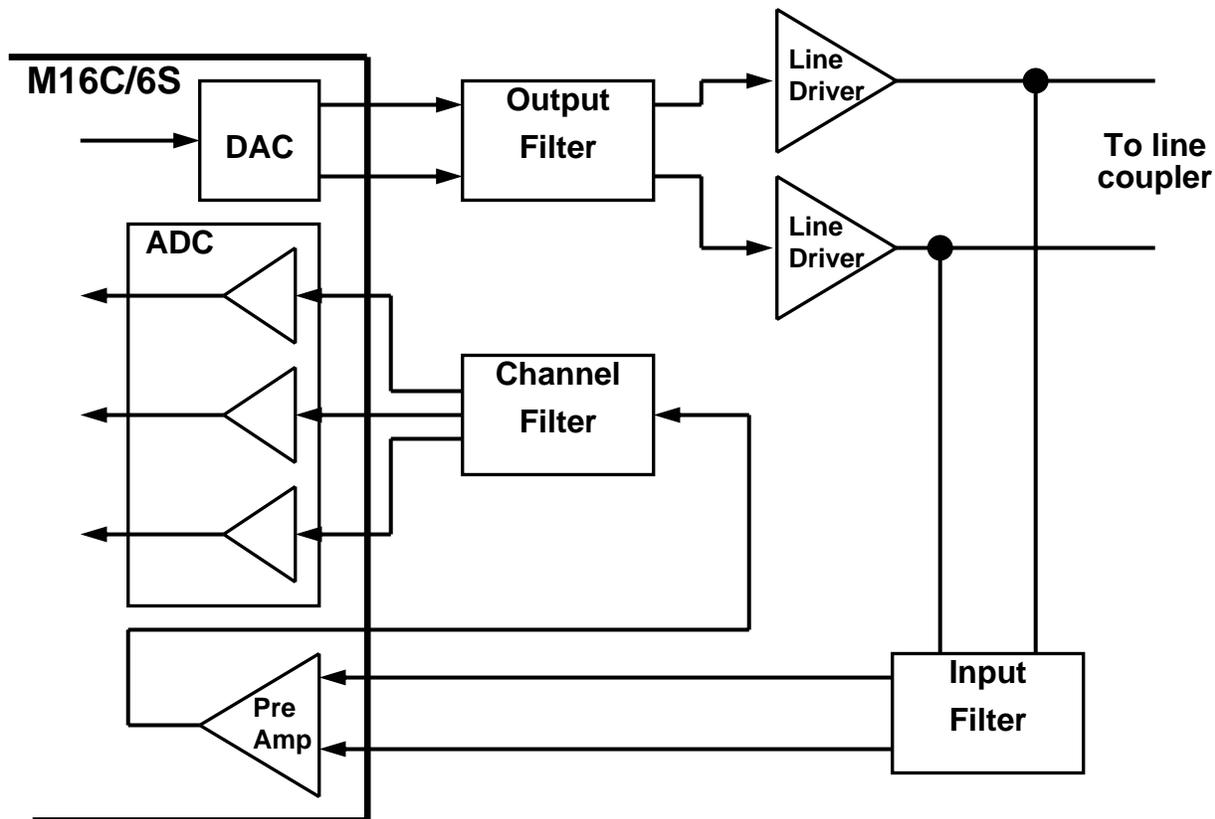
Figure7: AFE General Block diagram

The on-chip AFE includes a Digital to Analogue Converter (DAC) in the transmission path, a pre-amplifier and an Analogue to Digital Converter (ADC) in the reception path.

The DAC is part of the transmission path. This block is a current mode 10-Bit DAC which uses an internal current reference to generate two complementary current outputs.

The external Input Filter is connected to the pre-amplifier, which is part of the reception path.

The output of each external channel filter in the reception path is connected to a 1-bit ADC input. There are three similar ADC units incorporated in the chip. The ADC is built of an amplifier stage followed by a comparator stage.

4.1.3 EEPROM

The M16C/6S requires an external EEPROM (24Cxx serial EEPROM) connected by a two wire interface. The EEPROM is used to store Dynamic Link Layer (DLL) parameters. The M16C/6S may also use the EEPROM to store application data. A 128kBit version is mounted on the EVB08-EU board.

4.1.4 24 pin Connector

Usually the 24 pin connector will be used to plug the main board to the lower interface board supplied with this package. Anyway, as mentioned before, it is also possible to use the main PCB as standalone module, therefore the module has to be supplied with the below mentioned signals.

Please note that the main line signals at pin 22 and pin 24 are usually low voltage signals, because of the line coupler inside of the socket power supply. In case the main board would be used as standalone PLC module and no external line coupler exist, a line coupler can be assembled on the optional pads provided on the PCB. In that case pin 22 and pin 24 should be connected to the high voltage 230V main lines. Please make sure that your handling with high voltage is following the related standards, because the main board is not protected against touching.

Pin	Pin name	Description
1	P76 or P84	Not used (adjustable on Board)
2	P81	Not used
3	+3.3V	+3,3V digital supply voltage
4	GND	Digital ground
5	P74	Not used
6	RxD0	RxD for RS232 (Convert to RS232-level by external circuit)
7	TxD0	TxD for RS232 (Convert to RS232-level by external circuit)
8	CNVss	
9	TA3OUT	
10	GND	Digital ground
11	MISO	SPI data output (M16C/6S → Host)
12	BSNYC	SPI data ready output
13	NSS	SPI chip select (active low)
14	MOSI	SPI data input (Host → M16C/6S)
15	SPCK	SPI Serial Clock
16	+3.3V_AN	+3,3V analogue supply voltage
17	AMP VCC	amplifier supply voltage
18	GNDA	Analogue ground
19	RESET	RESET (active low)
20	P73	Not used
21	NC	Not connected
22	AC230VN_M	Main neutral connection (only if line coupler is assembled on PCB)
23	NC	Not connected
24	AC230VL_M	Main line connection (only if line coupler is assembled on PCB)

Table2: EVB08 Main Board 24 pin connector

4.1.5 Miscellaneous Peripherals

The EVB08-EU main board provides a few switches and jumpers to interact in the functionality of the board. Two LEDs are assembled to PCB to indicate the current PLC communication status. Additionally a 14 pin Mil connector interface for flashing and debugging of the M16C/6S is placed on top of the board.

J5	Description
1-2	P84 INT2 connect to J2
3-4	P/& TA3OUT connect to J2

J6	Description
open	MCU in run mode CNVSS pull down
shorted	MCU in flash mode CNVSS pull up

J8	Description
shorted	CLK1 feed to J7

LED1	Description
RED blinking	Sending data over PLC

LED2	Description
Green blinking	Receiving data over PLC

SW1	Description
pressed	RESET

J11	Connection
1	AC230VN
2	AC230VL

J3	Description
1-2	VDCCN pull up normal mode
2-3	VDCCN pull down test mode

J4	Description
open	INT3 pull up
shorted	INT3 pull down

J7	Deskription
1	P65 (SLCK)
2	Ground
3	CNVSS
4	N.C.
5	P67 (TXD1)
6	N.C.
7	P15(CE)
8	N.C.
9	P64(BUSY)
10	+3V3
11	P66(RXD1)
12	N.C.
13	RESETn
14	Ground

Figure8: Switches, jumpers, connectors and LEDs on the EVB08-EU main board

4.2 EVB08-EU interface board

The two layer EVB08-EU interface board PCB provides the needed connectors for:

- Power supply connection

- Terminal RS232 connection
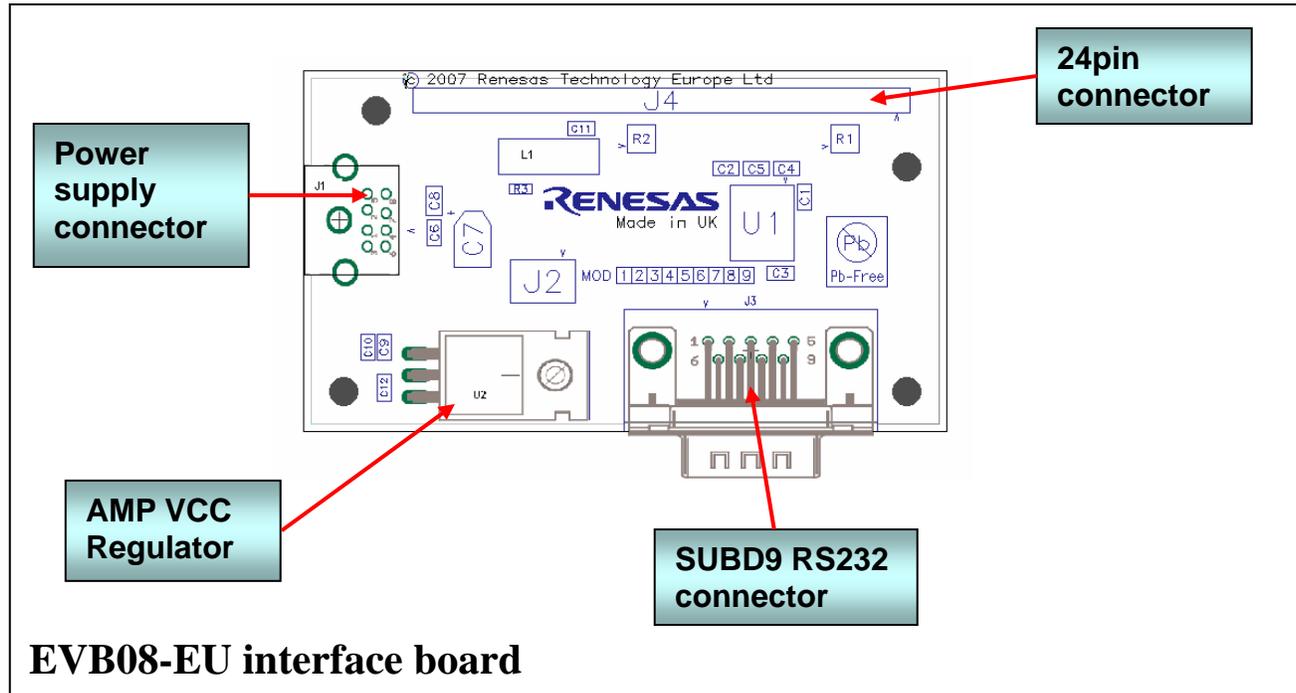
Figure9: Top view of EVB08-EU interface board

4.2.1   Interface board 24 pin Connector

To connect it with the main board a 24 pin connector exists.

Pin	Pin name	Description J4
1	Pull down	
2	Pull down	
3	+3.3V	+3,3V digital supply voltage
4	GND	Digital ground
5	Pull down	Not used
6	RxD	RxD for RS232 (Convert to RS232-level by external circuit)
7	TxD	TxD for RS232 (Convert to RS232-level by external circuit)
8	EN1	Enable for RS232
9	CTS	CTS for RS232
10	RTS	RTS for RS232
11	Pull down	
12	Pull down	
13	Pull down	
14	Pull down	
15	Pull down	
16	+3.3V_AN	+3,3V analogue supply voltage
17	AMP VCC	Amplifier supply voltage
18	GNDA	Analogue ground
19	RESET	RESET (active low)
20	Pull down	
21	NC	Not connected
22	AC230VN	Main neutral connection (only if line coupler is assembled on PCB)
23	NC	Not connected
24	AC230VL	Main line connection (only if line coupler is assembled on PCB)

Table3: Interface Board 24 pin connector

J2	Description
1-2 jumper	**For EVB04** AMP_VCC 12V
2-4 jumper	**For EVB08** AMP_VCC 5V
5-6 jumper	**AMP_VCC 5V** from external power supply

J1	Pin name	
1	GND	Ground signal
2	GND	Ground signal
3	+3.3V	+3.3V power supply
4	+12V	+12V power supply
5	+5V	+5V power supply
6	AC230VL_M	Main line connection
7	AC230VN_M	Main line connection
8	nc	

J3	Pin name	
1	nc	
2	RxD	RxD at RS232 level
3	TxD	TxD at RS232 level
4	nc	
5	GND	Ground signal
6	nc	
7	RTS	RTS at RS232 level
8	CTS	CTS at RS232 level
9	nc	

Figure10: Switches and connectors on the EVB08-EU interface board

4.3 Power supply

The AFE includes reception and transmission paths, with the required amplification. The line coupler couples the data to the power line. In case of the EVB08-EU design the line coupler is included in the IT800CA power supply device itself. Therefore, main voltage is not directly supplied to the EVB08-EU main board, making the handling with the uncovered PCB safer.

Additional, the power supply includes a 12V, a 5V and a 3.3V regulation circuit, supplying the EVB08-EU board with the required voltages.

Figure11: The YITRAN power supply including line coupler

5. Software overview

The EVB08-EU will support different software options:

- The standalone VB08-EU is pre-programmed with the minimum test software.

- The EVB08-EU inside the PLC development kit is pre-programmed as RUN-M node, concentrator or sniffer. Please refer to the RUN-M user manual for details.

5.1 Minimum test software

The low end test software does not include any protocol layer as well as no DLL. Error correction and other features supported by the upper protocol layers are not included. This minimal test software is generating a menu via UART0 (connecter J3 of the interface board) at a HyperTerminal application running on a PC. The menu offers different options to send test data from one node to another node. Therefore this software can be used excellently to test the M16C/6S device.
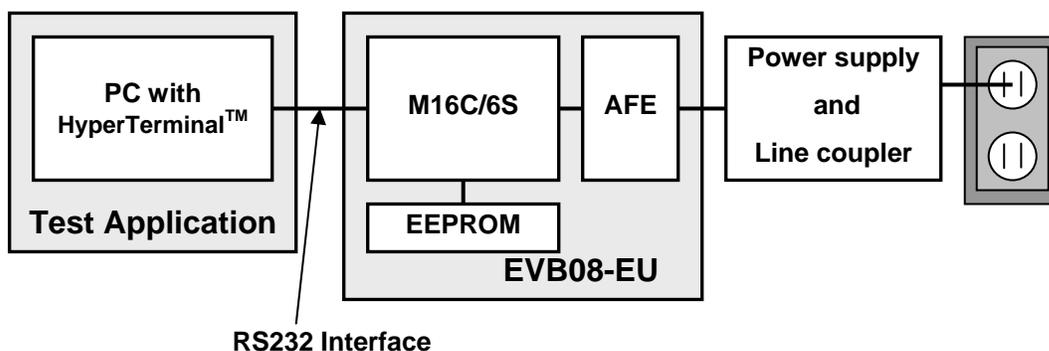
Figure12: M16C/6S system concept with minimum test software

6.   Getting started

Plug the EVB08-EU main board and the EVB08-EU interface board together. Connect the YITRAN power supply to the lower interface board and connect it to a main line socket. To make sure the EVB08-EU bundle is working properly you should press the reset button. The M16C/6S microcontroller on the EVB08-EU standalone version is already flashed with suitable minimal test software by default. If you need other driver or protocol software please contact your local Renesas sales office.

6.1   Using the minimum Test Software

The minimal test Software enables you to setup two nodes within your power line network. Depending on your selection in a menu, one node will be the sender of information and the other one will be the receiver. The transmitting node is sending a given number of data packets at a specific transfer speed and the receiving node is counting the received number of packets. Before continuing, please make sure that the EVB08 board is configured as described in the table below:

J8	J3	J6	J5	J4
shorted	1-2 shorted	open	Any position	Any position

Table3: Default setting for running test software

Now perform the following steps:

1.   Plug two EVB08-EU kits using the YITRAN power supply LSE0206CE into two separate wall outlets.

2.   Connect the J3 SUBD9 connector to a PC COM port via a R232 cross over cable with a running Terminal program as e.g. HyperTerminal.

3.   Please select following setting for the terminal software:

    i.   19200 baud

    ii.   Data bits: 8

    iii.   Parity: none

    iv.   Stop bits: 1

    v.   Flow control: none

4.   Connect PC with running terminal software to the EVB08-EU kit node by serial cross over cable.

5.   Press the reset button

6.   Some information should appear on your PC terminal screen.

Figure14: Terminal output of the minimum Test program

7. You have to choose manually the source node ID and destination node ID.

8. E.g. choose for one node source node ID = 1 and destination node ID = 2.

9. For the other node choose it the other way round.

10. A menu with 7 items will appear on your terminal screen.

11. For the transmitter node you have to select between items 1 to 6, depending on your needs.

12. For the receiver node you just select item 7, so counting of incoming data packets will be started.

13. The green LED of the receiver node is blinking during reception.

14. The red LED of the transmitter node is blinking during transmission.

15. If transmission of packets is finalized by the transmitter, it is possible to press any key on the receiver side terminal to display the number of received data packets.

6.2 Flashing the M16C/6S

The EVB08-EU and the M16C/6S can be programmed with E8 and FDT3.07

6.2.1 Flashing with E8 and FDT

Please use the Flash development toolkit FDT version 3.07 or higher in combination with the E8 debugger.

You can download FDT at

http://eu.renesas.com/fmwk.jsp?cnt=flash_development_toolkit_tools_product_landing.jsp&fp=/products/tools/flash_prom_programming/fdt/

The hardware should be set into following status:

J8	J3	J6	J5	J4
Shorted	1-2 shorted	open	Any position	open

Table4: Default setting for synchronous flashing

Following steps should be taken for flash programming with E8:

1. Connect the E8 to the EVB

2. Open FDT Basic from your Renesas folder and select the device M306S0FA:
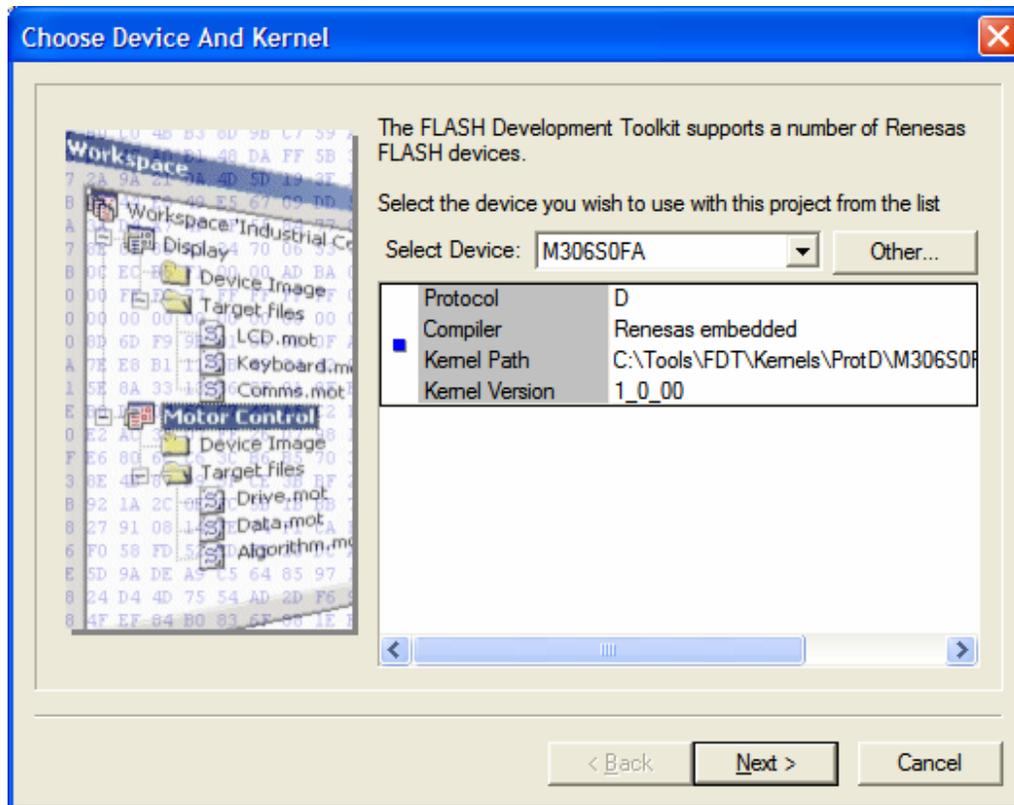
Figure15: FDT device selection

3. select port E8:
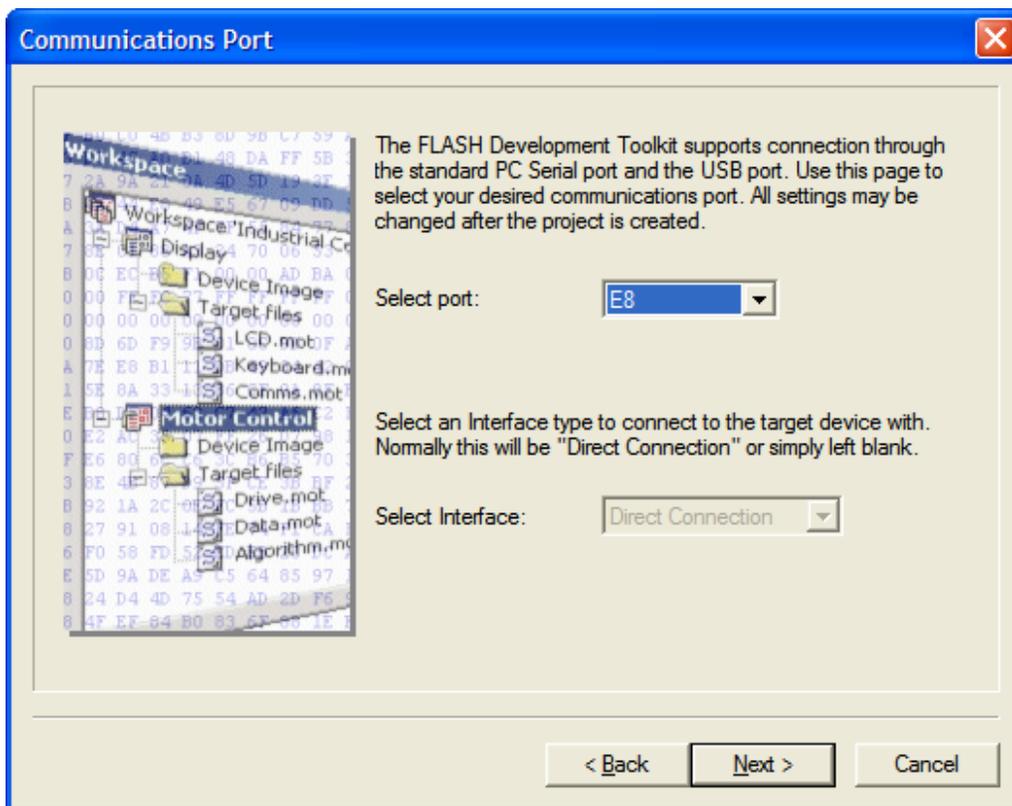
Figure16: FDT communication port selection

4. Keep default connection settings and programming options:
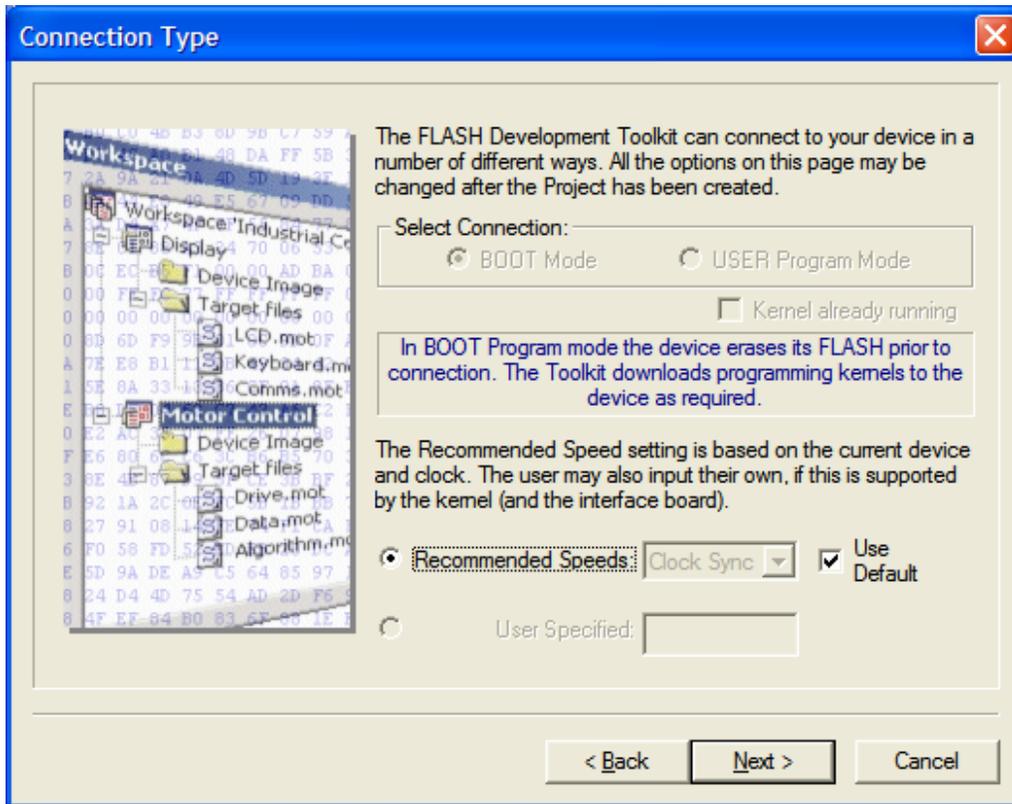
Figure16: FDT connection type settings
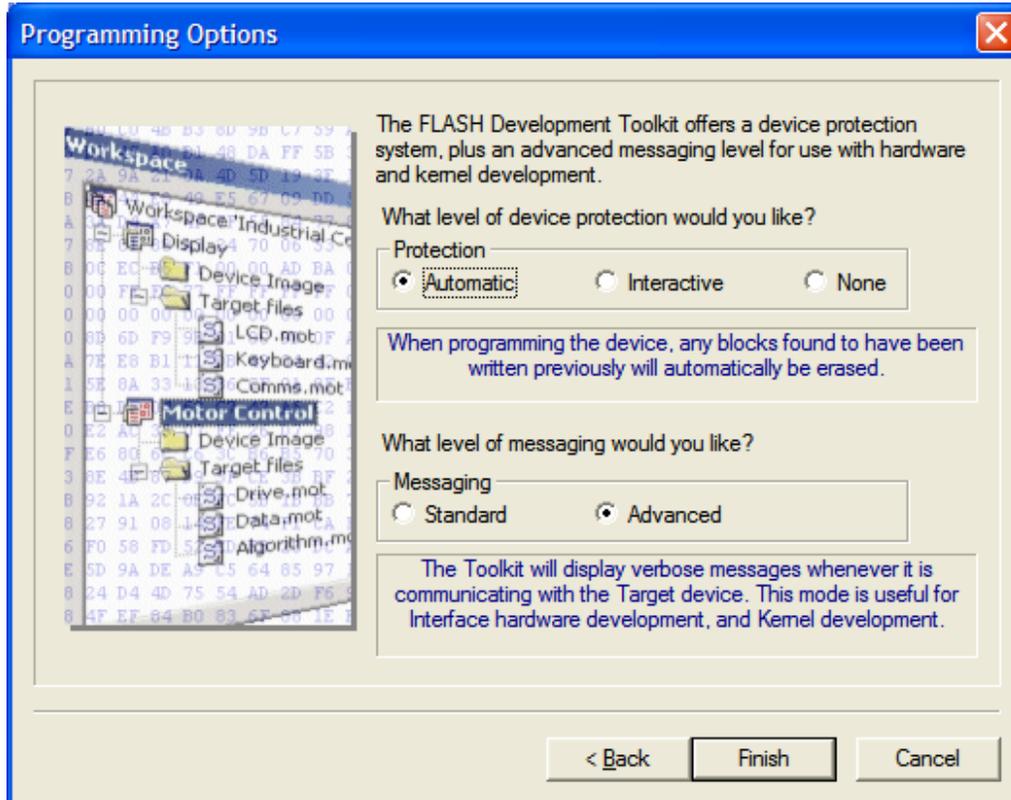
Figure17: FDT programming options

5. select the checkbox 'User / Data Area'
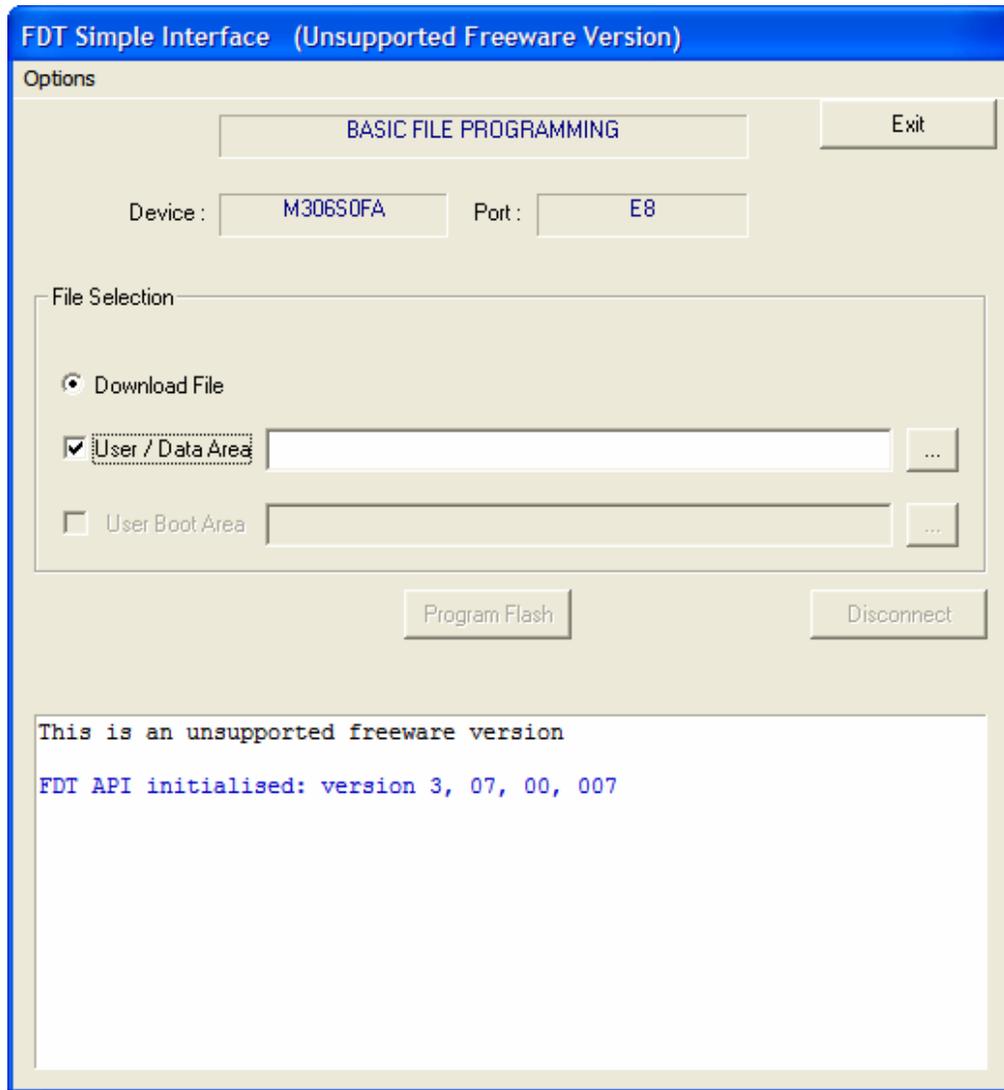
Figure18: FDT programming interface

6. Select the mot-file to be flashed
7. press 'program flash'
8. when the window 'target power from E8' appears press OK (E8 does not power the target)

6.3 Debugging the M16C/6S

For the debugging of the M16C/6S it is recommended to use:

- The full M16C/62P emulation system PC7501 plus the additional signal converter board M306S0T-PRB in cooperation with the PD30F debugger software (standalone integrated into HEW).

- E8 debugger with the E8 debugger software (integrated into HEW)

The below steps describe the usage of the first debugging system only. Please note that in this case, the UART1 of the M16C/6S cannot be used in your application software, if you like to debug the SW with KD30.

The hardware should be set into following status:

J8	J3	J6	J5	J4
shorted	1-2 shorted	open	Any position	open

Table7: Default setting for debugging of M16C/6S

For further information on how to use the E8 debugger in HEW please refer to the RUN-M user manual.

7. Schematics

To change the CENELEC A to CENELEC B
This parts must be changed

	CENELEC A	CENELEC B
R100	330R	DNF
R101	330R	DNF
R104	820R	DNF
R93	1K	DNF
R78	10K	DNF
R98	12K	DNF
R102	DNF	10K
R103	DNF	10K
C4	18nF	2.7nF
C5	5.6nF	DNF
C6	3.9nF	DNF
C92	33nF	15nF
C12	27nF	DNF
C90	22nF	DNF
C14	220nF	220nF
C15	1uF	DNF
C16	1uF	DNF
C91	220F	DNF
C65	10pF	DNF
L3	1800uH	820uH
L5	1800uH	DNF
L6	1200uH	DNF
L10	1000uH	150uH
L4	390uH	DNF
L11	220uH	DNF

RENESAS TECHNOLOGY EUROPE LTD
Dukes Meadow, Bourne End, Buckinghamshire
UNITED KINGDOM

SIZE A4

SCHEMATIC TITLE	EVB08-EU		
SHEET TITLE	channel filter		
DRAWN BY	DATE	REV	DRAWING NUMBER	PAGE
WRA	23.02.2007	1A	D007789_04	4 of 4

AMP1_OUT ⟨1B2
AMP1_IN ⟩1B2
AMP2_OUT ⟨1B2
AMP2_IN ⟩1B2
AMP3_OUT ⟨1B2
AMP3_IN ⟩1B2

GNDA

BUF_OUT ⟩1B5

Output Amplifier
Input Filter

	CENELEC A	CENELEC B
C84	100nF	47nF
C83	100nF	47nF
C89	15nF	27nF
C95	4.7µF	3.3µF
C96	4.7µF	3.3µF
C79	100nF	10nF
C82	100nF	10nF
L9	1200µH	82µH
L7	150µH	220µH
L8	150µH	220µH

To change the CENELEC A to CENELEC B
change this parts

	1*ACPL	2*ACPL
R88	0R	DNF
R89	0R	DNF
R105	DNF	0R
R106	DNF	0R
R107	10k	20k
R108	10k	20k
R111	27k	47k
R112	27k	47k
C95	10µF	4.7µF
C96	10µF	4.7µF

RENESAS TECHNOLOGY EUROPE LTD
Dukes Meadow, Bourne End, Buckinghamshire
UNITED KINGDOM

SCHEMATIC TITLE	EVB08-EU
SHEET TITLE	Output Amplifier Input Filter

DRAWN BY	DATE	REV	DRAWING NUMBER	PAGE
WRA	23.02.2007	1A	D007791_04	4/4

SIZE A4

8. Floor plans

Figure19: EVB08-EU main board top floor plan
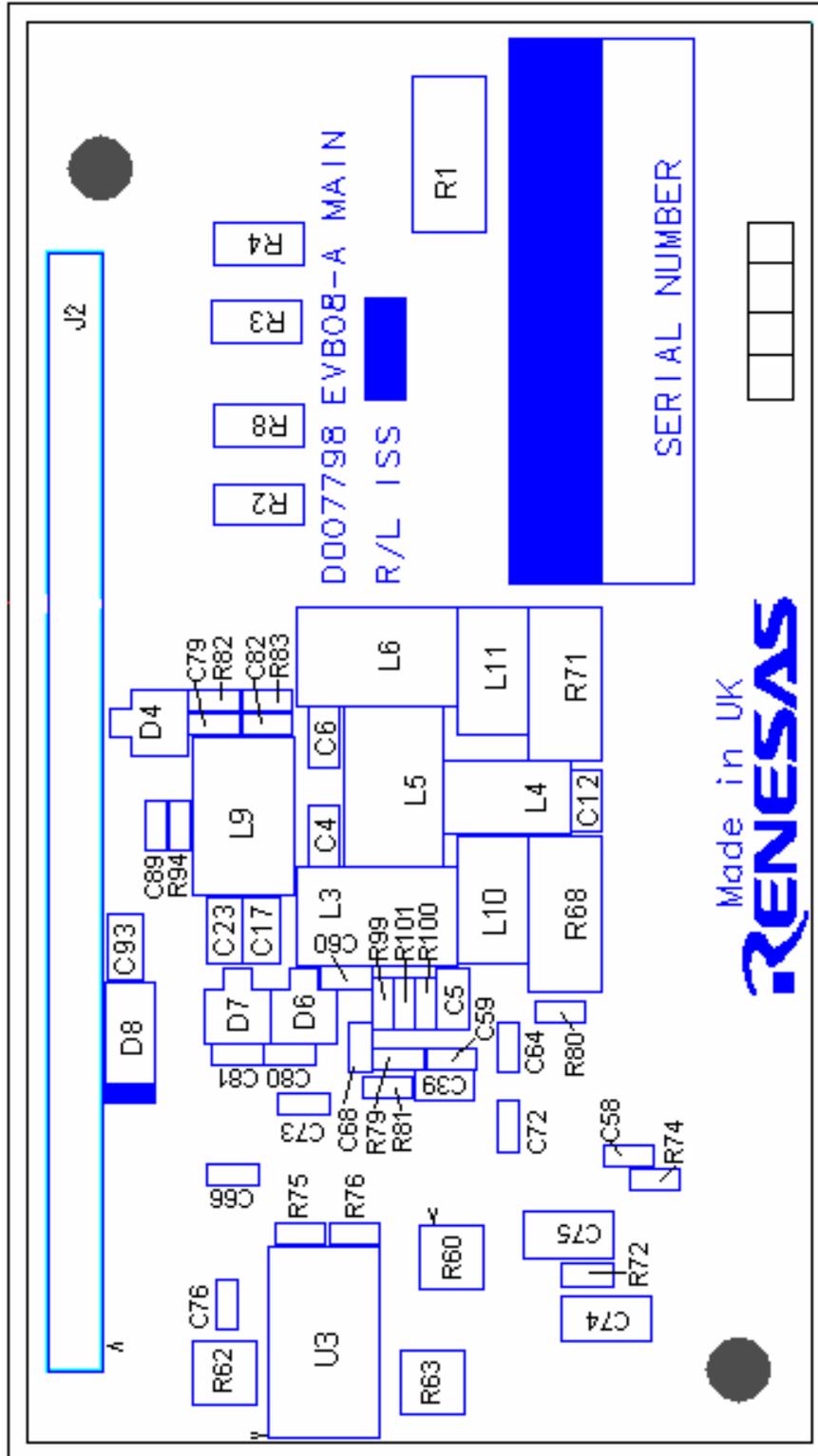
Figure20: EVB08-EU main board bottom floor plan
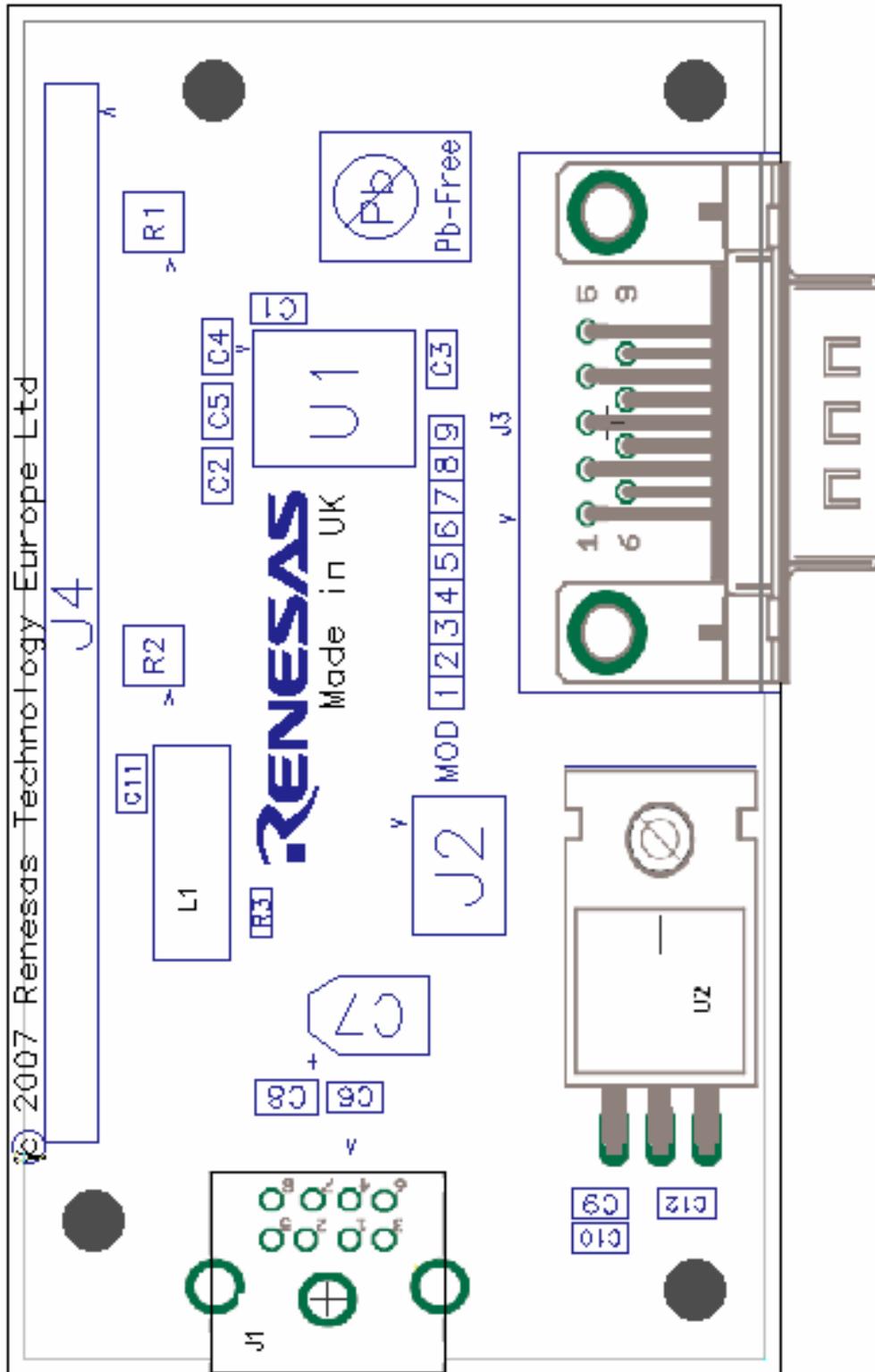
Figure21: EVB08-EU interface board top floor plan

9. Abbreviations

ADC (Analog to Digital Converter)

AFE (Analog Front End)

ARIB (Association of Radio Industries and Businesses)

CENELEC (European Committee for Electrotechnical Standardization)

DAC (Digital to Analog Converter)

DLL (Dynamic Link Layer)

FCC (Federal Communications Commission)

PLC (Power Line Communication)

10. References

Renesas Technology Corporation

http://www.renesas.com

Contact for Renesas Technical Support

E-mail: support_apl@renesas.com

Data Sheet & User's Manual

M16C/6S Datasheet, User's Manual, other documents

(Use the latest version, please check: http://www.renesas.com)

YITRAN Communications Ltd.

http://www.yitran.com

Microsoft Corporation

http://www.microsoft.com

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CENELEC

EN50065-1; „Signaling on low-voltage electrical installations in the frequency range 3kHz to 148,5kHz"

Revision Record

Rev.	Date	Description		
		Section	**Changed by**	**Summary**
Rev.1A	27.03.2007.	all	WRA	First edition issued
Rev.1	19.04.2007	all	ASC	Initial version released

Keep safety first in your circuit designs!

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Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (i) placement of substitutive, auxiliary circuits, (ii) use of nonflammable material or (iii) prevention against any malfunction or mishap.

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