

PROPRIETARY NOTICE

All rights reserved by Janz Tec AG.

No parts of this technical manual may be modified, copied or reproduced in any form or by any means for commercial use without the prior written permission of Janz Tec AG, Germany.

All instructions, information and specification contained in this manual are for reference only and remain subject to change without announcement.

emPC-A/iMX6

embedded PC

(Hardware Manual)

Version 1.6

refers to product revision no.

x.x

Title: emPC-A/iMX6 embedded PC
File: j:\as\entwicklung\projekte\hw\empc\empc-a600\doc>manual_empc-
aimx6_hardware.doc
Pattern: \\ntserv5\janzgrp\as\entwicklung\formulare\entwicklung (ew)\ew_manual.dot
Created: Stefan Althöfer, 21.05.2014
Last Update: Stefan Althöfer, 15.02.2019

© Janz Tec AG 2018

Im Dörener Feld 8
D-33100 Paderborn, Germany

Tel.: +49-5251-1550-0
FAX: +49-5251-1550-190
email: support@janztec.com
Internet: www.janztec.com

Contents

1	Introduction	7
1.1	Features	7
1.1.1	Standard Products	7
1.1.2	Hardware Customization	7
1.1.3	Software	7
1.2	Ordering Information	8
1.2.1	Standard Systems.....	8
1.2.2	OEM Variants.....	8
1.3	Functional Overview	9
2	Safety Instructions	10
2.1	Installation and Maintenance	10
2.2	Ambient and Environmental Conditions.....	11
3	Intended use	12
3.1	Disposal and Recycling.....	12
3.1.1	Germany	12
4	Installation	13
4.1	Mounting	13
4.2	Connectors and Operators.....	14
4.2.1	POWER IN.....	15
4.2.2	Graphics connector (DVI)	15
4.2.3	Ethernet Interfaces (Ethernet1 and Ethernet2).....	15
4.2.4	USB type A receptacle (USB0-USB1)	16
4.1	RS232 (Console).....	16
4.2	RS232 (UART)	16
4.3	RS485	17
4.4	CAN.....	17
4.5	Digital IO	18
4.6	Analog IO	19
5	Maintenance	21
5.1	CFast Card Replacement	21
5.2	SDcard Replacement.....	22
5.3	Battery Replacement (English)	23
5.4	Changer la pile (Français).....	24
6	Open Source Licensing	25
6.1	Disclaimer	25
6.2	How to obtain the source code	25
6.3	Software packages	25
6.4	Verbatim License Texts	26
6.4.1	BSD 2-clause "Simplified" License	26
6.4.2	BSD 3-clause "New" or "Revised" License	27
6.4.3	GNU General Public License v2.0	28
6.4.4	GNU Library General Public License v2	32
6.4.5	GNU Lesser General Public License v2.1	38
6.4.6	eCos license version 2.0.....	44
6.4.7	IBM PowerPC Initialization and Boot Software.....	45
7	Appendices	46
7.1	Technical Data	46

7.2	References.....	49
7.3	Dimensions	50
7.4	Product History.....	51
7.5	Manual History	51

List of Figures

figure 1: block diagram (2 PCB variant shown)	9
figure 2: emPC-A/iMX6 mounting options	13
Figure 3: emPC-A/iMX6/0 interfaces	14
Figure 4: emPC-A/iMX6/1 interfaces	14
Figure 5: emPC-A/iMX6/2 interfaces	14
Figure 6: emPC-A/iMX6/4 interfaces	14
Figure 7: emPC-A/iMX6 with IO expansion	14
Figure 8: Power connector	15
figure 9: RS485 signaling	17
figure 10: digital IO input/output schematic	18
figure 11: emPC-A/iMX6 back panel removal	21
figure 12: Removing and replacing coin cell battery	23
graphique 13: Retirer et remplacer la pile au lithium	24
figure 14: housing dimensions (2 DSUB system shown)	50

List of Tables

Table 1: Interfaces connected to D-SUB	14
Table 2: Power connector pin assignment	15
table 3: DVI-D connector	15
table 4: Ethernet connector	16
table 5: USB connector	16
table 6: RS232 (Console) connector	16
table 7: RS232 connector	16
table 8: RS232 connector	17
table 9: CAN connector	17
table 10: digital IO connector	18
table 11: digital IO connector	19

About this Manual

This is the hardware manual for the emPC-A/iMX6 embedded PC.

Throughout the manual, the term emPC-A/iMX6 is used to identify the all systems. When required, the letters S/D/Q are appended for Solo, Dual or Quad.

For more detailed programming information refer to the ix-Bus System Reference Manual.

Conventions

If numbers are specified in this manual, they will be either decimal or hexadecimal. We use C-notation to identify hexadecimal numbers (the 0x prefix).

If we refer to low active signal names, they will suffixed by a “#” character.

Some parts of the document contain notices you have to observe to ensure your personal safety, or to prevent damage to property. These are visually marked with the following alert symbols:



DANGER / DANGER

Indicates that death or severe personal injury *will* result if proper precautions are not taken.

Indique que des blessures corporelles graves, voire fatales, seront causées si les précautions nécessaires ne sont pas prises.



WARNING / AVERTISSEMENT

Indicates that death or severe personal injury *may* result if proper precautions are not taken.

Indique que des blessures corporelles graves, voire fatales, *peuvent* être causées si les précautions nécessaires ne sont pas prises.



CAUTION / ATTENTION

Indicates that *minor* personal injury can result if proper precautions are not taken.

Indique que des blessures corporelles *mineures* peuvent être causées si les précautions nécessaires ne sont pas prises.



NOTICE / REMARQUE

Indicates that damage to equipment can result if proper precautions are not taken.

Indique que des dommages matériels peuvent être causés si les précautions nécessaires ne sont pas prises.



Indicates information that we think you should have read to save your time by avoiding common problems. Important suggestions that should be followed will also be marked with this sign.

Acronyms and Abbreviations

EMC	Electromagnetic capability.
ESD	Electrostatic discharge.
GND	System ground potential. Inside the product this is connected to the metal housing, which might be connected to protective earth by the installation. There exist some isolated reference grounds for communication interfaces or IO. These reference signals are referred to as GND-x, where x indicates function.
SELV	Safety extra low voltage.

1 Introduction

1.1 Features

1.1.1 Standard Products

- Freescale i.MX6 application processor
- Single-, Dual- or Quad-Core CPU based on ARM Cortex-A9 800 MHz, with ARMv7™, Neon, VFPv3 and Trustzone support
- Fanless cooling concept
- 32 kB instruction and data L1 caches and 256 kB to 1 MB of L2 cache
- System memory 2 GB DDR3 (1GB with Solo)
- 128 kB of MRAM which does not require battery backup
- Internal CFast Socket for SATA SSD (not available for Single-Core CPU type)
- Internal SDcard socket
- Superior 3D graphics performance with up to quad shaders performing 200 Mt/s and OpenGL support
- Separate 2D and/or Vertex acceleration engines for an optimal user interface experience
- DVI-D graphic interface on front panel (Single Link)
- internal LVDS display interface
- Single channel LVDS on internal connector
- 2 x 10/100/1000 Mbit/s Ethernet
- 2 x USB 2.0 interface (480Mbit/s)
- Battery backed up RTC
- System Power supply 9..34 VDC
- Reset Push Button and Power LED
- 2 male 9pin D-SUB connectors, utilized by serial ports or CAN
- Power supply monitor

1.1.2 Hardware Customization

Due to its flexible system architecture, the emPC-A/iMX6 can be customized if the standard products do not provide optimum features or price. Customization is possible even at moderate quantities. Ask sales department for details.

Following you find a (non-complete) list of possible customizations:

- Internal eMMC with up to 16 GByte. Soldered to PCB for improved mechanical reliability.
- Without MRAM for price reduction.
- Serial ports can be modified for RS485 physical layer (optionally isolated)
- More CAN ports are possible by using expansion cards (in a larger housing)
- More serial ports are possible
- Digital/Analog-IO expansion card
- Customer specific expansion cards
- Other mounting options (e.g. flange mount)

1.1.3 Software

Supported by

- Linux

Contact Janz Tec for more information about the available software packages.

The emPC-A/iMX6 is equipped with the u-boot bootloader software.

1.2 Ordering Information

1.2.1 Standard Systems

Material Number	Name/Type	
SY-EPC-6X00Y	emPC- yyyy/z	Generic number
KD-KKK-6X00Y	emPC- yyyy/z	Generic number
SY-EPC-62000	emPC-A/iMX6D/0	Dual Core, 2xRS232
SY-EPC-64000	emPC-A/iMX6Q/0	Quad Core, 2xRS232
SY-EPC-64001	emPC-A/iMX6Q/1	Quad Core, 1xCAN/1xRS232
SY-EPC-64002	emPC-A/iMX6Q/2	Quad Core, 2xCAN
SY-EPC-64005	emPC-A/iMX6Q/5	Quad Core, 1xCAN/1xRS232, analog/dig. IO

- **yyyy** can be A/iMX6S or A/iMX6D or A/iMX6Q (type of processor Single, Dual or Quad)
- **z** can be 0,1,2,3,... Interface variant (CAN/RS485/RS232, digital IO)
- **X** can be 1,2,4 System variant (CPU Model).
- **Y** can be 0,1,2,3,... Interface variant (CAN/RS485/RS232, digital IO)
- **KKK** can be customer specific variant

1.2.2 OEM Variants

OEM Material Number	Name/Type	
KD-VOI-6LS0C	BlueBox	Base System
KD-VOI-6LS1C	BlueBox	System with digitale I/O
KD-VOI-6LS2C	BlueBox	System with digital und analoge I/O

- **S**: can be 0,1,2,3,... Software variant
- **C**: can be 1,2,3,4,... Interface variant (CAN/RS485/RS232)
- **L**: can be 4 (standard) or 5 (coated PCB)

1.3 Functional Overview

The emPC-A/iMX6 is built upon a couple of standard building blocks, as shown in figure 1.

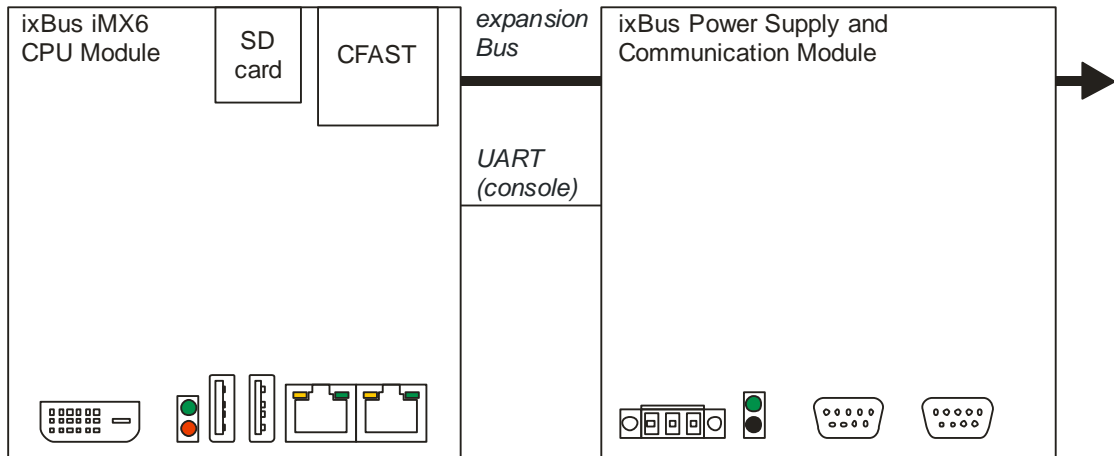


figure 1: block diagram (2 PCB variant shown)

The system consists of the following building blocks:

- Janz Tec ix-Bus i.MX6 CPU module
- Janz Tec ix-Bus power supply and communication module
- Optionally additional IO modules

Refer to Janz Tec ixBus System Reference Manual for details on the Janz Tec specific building blocks.

2 Safety Instructions

Refer to page iv for explanation of the warning notice system.

The product described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation for the specific task, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products.

2.1 Installation and Maintenance



NOTICE / REMARQUE

The product is intended to be used in industrial environments. Typical applications are process visualization or as a controller for industrial automation.

Ce produit est destiné à être utilisé dans un environnement industriel. Les applications typiques sont la visualisation de processus ou comme contrôleur pour l'automatisation industrielle.



DANGER / DANGER : Electrical Shock / Risque d'électrocution

Danger to life.

This product operates with 9..34 V DC SELV power supply. Do not connect this product to an improper power supply.

Danger de mort :

Ce produit fonctionne avec une alimentation 9..34 V CC SELV. Ne branchez pas cet appareil à une alimentation électrique inadéquate.



DANGER / DANGER : Electrical Shock / Risque d'électrocution

Danger to life.

The IO interfaces (connectors) of the product are only suited to be connected to SELV circuits. Use interfaces (connectors) for their intended use only.

Danger de mort :

Les interfaces d'E/S (connecteurs) du produit ne peuvent être raccordées qu'à des circuits SELV. N'utilisez les interfaces (connecteurs) qu'aux fins prévues.



CAUTION / ATTENTION : Explosiv Risk / Risque Explosif

The installed computer board is equipped with a Lithium battery.

Danger of explosion if battery is incorrectly replaced. Replace only with battery of the same or equivalent type.

Le boîtier de l'ordinateur installé est équipé d'une batterie au lithium.

Risque d'explosion si la batterie n'est pas remplacée de façon conforme. Remplacer uniquement par une batterie de type identique ou équivalent.



CAUTION / MISE EN GARDE : Fire Risk / Risque d'incendie

The digital IO must be powered by a SELV power supply, that complies with the requirements of a limited energy source (LPS) (By using an appropriate supply or an external fuse).

L'E/S numérique doit être alimenté par une alimentation SELV, conforme aux exigences d'une source d'énergie limitée (LPS) (en utilisant une alimentation appropriée ou un fusible externe).

**WARNING / ATTENTION : Burns Hazard / Risque de brûlures**

The product generates considerable amount of heat. The housing transports this heat to the environment and therefore gets hot. **Caution when touching the housing, burns hazard!**

Le produit génère une quantité considérable de chaleur. Le boîtier transmet cette chaleur à l'environnement et devient très chaud. **Attention en touchant le boîtier, risque de brûlures !**

2.2 Ambient and Environmental Conditions

**CAUTION / ATTENTION : Damage / Dommage**

Do not operate the product beyond the specified ambient conditions. Do not cover the ventilation holes/slots of the product.

Ne pas faire fonctionner le produit au-delà des conditions ambiantes indiquées. Ne pas recouvrir les trous/fentes d'aération du produit.

**DANGER / DANGER : Explosive Risk / Risque Explosif**

Do not operate the product in potentially explosive atmosphere.

Ne pas faire fonctionner le produit dans une atmosphère potentiellement explosive.

**NOTICE / REMARQUE : EMI / IEM**

This product is a class A device. This product may cause radio interference. In this case the user must take adequate measures.

Ce produit est un appareil de classe A. Ce produit peut générer des interférences radio. Dans ce cas, l'utilisateur doit prendre les mesures adéquates.

3 Intended use

The emPC-A/iMX6 is designed for computing purposes in industrial environments. It is destined to be used indoor only.

3.1 Disposal and Recycling

Janz Tec products are manufactured to satisfy environmental protection requirements where possible. Some of the components used are capable of being recycled. Final disposal of this product after its service life must be accomplished in accordance with applicable country-, state-, or local-laws or -regulations.



This product contains a lithium battery. This should be removed before disposal and be returned separately

3.1.1 Germany

All Janz Tec products are registered as B2B custom at the german EAR. Hence Janz Tec products **must not be** disposed to *public collection points for used electronic equipment*. Refer to §14 of General Terms & Conditions of Janz Tec AG for the details regarding the mutual obligations as to the disposal of Janz Tec products.

The Lithium battery included in the product is registered at “GRS Batterien” and can be disposed to *public collecting points for used batteries*.

4 Installation

**WARNING / ATTENTION : Burns Hazard / Risque de brûlures**

The product generates considerable amount of heat. The housing transports this heat to the environment and therefore gets hot. **Caution when touching the housing, burns hazard!**

Le produit génère une quantité considérable de chaleur. Le boîtier transmet cette chaleur à l'environnement et devient très chaud. **Attention en touchant le boîtier, risque de brûlures !**

The product can be operated with DC power supply from 9 to 34 V.

4.1 Mounting

The emPC-A/iMX6 is intended for DIN rail mount. Refer to figure 2 for the recommended mounting orientation.

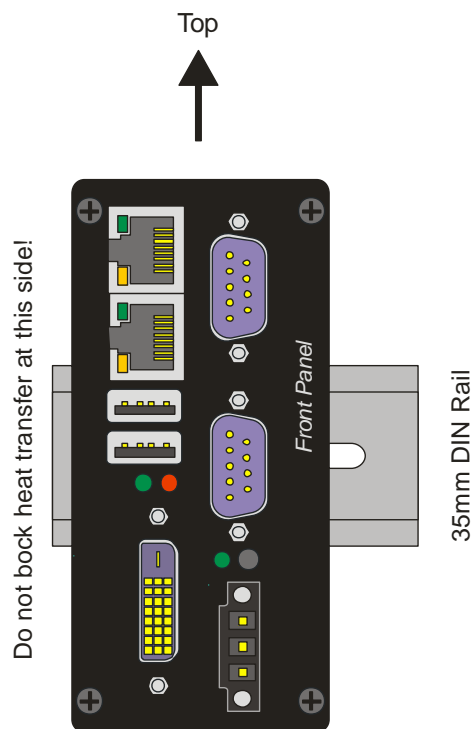


figure 2: emPC-A/iMX6 mounting options

4.2 Connectors and Operators

The emPC-A/iMX6 is equipped with differing interfaces. The following interfaces are common for all systems: DVI-D, 2 x USB 2.0, 2 x 10/100/1000 Mbit/s Ethernet. Depending on which alternative was ordered additional interfaces are available. The following table shows the standard systems.

Product	Interface	Linux	Address
emPC-A/iMX6/0	Serial-0 (Console)	/dev/ttymx0	
	Serial-1 (Console)	/dev/ttymx1	
emPC-A/iMX6/1	Serial (Console)	/dev/ttymx0	
	CAN	/dev/pcan_0	MOD_BASE
emPC-A/iMX6/2	CAN0	/dev/pcan_0	MOD_BASE
	CAN1	/dev/pcan_1	MOD_BASE + 0x200
emPC-A/iMX6/4	CAN0	/dev/pcan_0	MOD0_BASE
	CAN1	/dev/pcan_1	MOD0_BASE + 0x200
	CAN2	/dev/pcan_2	MOD1_BASE
	CAN3	/dev/pcan_3	MOD1_BASE + 0x200

Table 1: Interfaces connected to D-SUB

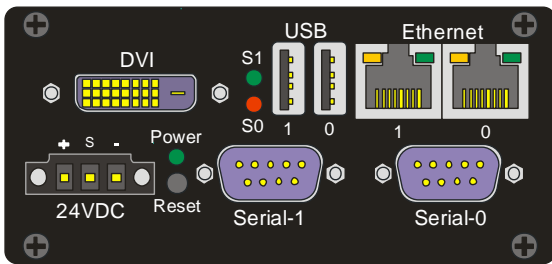


Figure 3: emPC-A/iMX6/0 interfaces

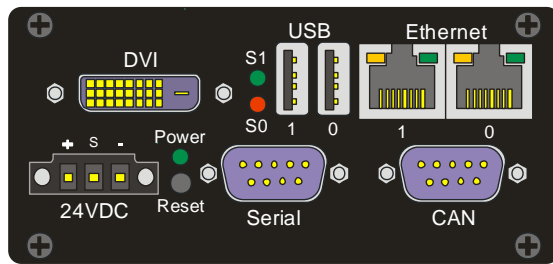


Figure 4: emPC-A/iMX6/1 interfaces

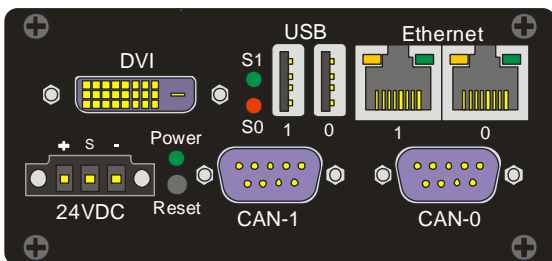


Figure 5: emPC-A/iMX6/2 interfaces

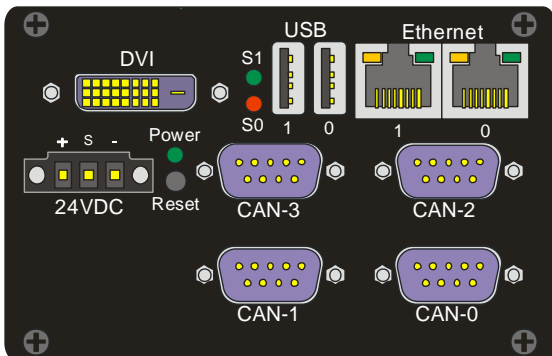


Figure 6: emPC-A/iMX6/4 interfaces

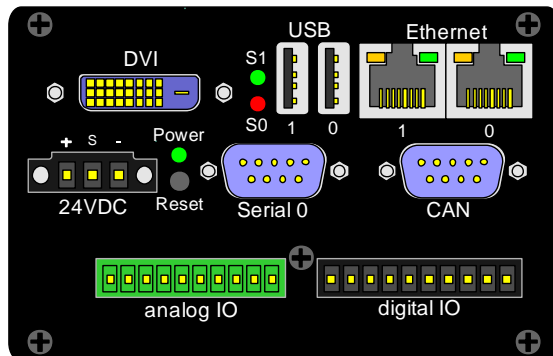
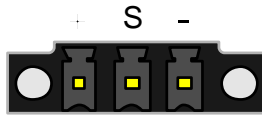


Figure 7: emPC-A/iMX6 with IO expansion

4.2.1 POWER IN

The system power supply is connected with a 3 pin screw terminal with 5.08 mm pitch.



Pin	Description
1 (+)	+9 ..34 VDC
2 (S)	Control input (0 .. 34 V)
3 (-)	GND

Figure 8: Power connector

Table 2: Power connector pin assignment

A suitable mating connector is Phoenix Contact 1900895. Equivalent Models exist from other vendors.



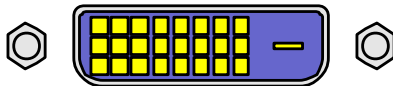
DANGER / DANGER : Electrical Shock / Risque d'électrocution

The product may only be operated with power supplies which can be considered SELV circuits.

Ce produit ne peut être utilisé qu'avec des alimentations qui peuvent être considérées comme des circuits SELV.

4.2.2 Graphics connector (DVI)

Combined digital and analog graphics connectors. The digital interface provides single link only.

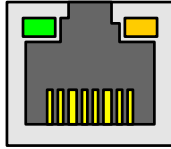


1	TMDS 2-	13	N/C
2	TMDS 2+	14	+5V
3	SHIELD	15	GND
4	N/C	16	Hotplug detect
5	N/C	17	TMDS 0-
6	DDC clock	18	TMDS 0+
7	DDC data	19	SHIELD
8	N/C	20	N/C
9	TMDS 1-	21	N/C
10	TMDS 1+	22	SHIELD
11	SHIELD	23	TMDS C+
12	N/C	24	TMDS C-

table 3: DVI-D connector

4.2.3 Ethernet Interfaces (Ethernet1 and Ethernet2)

Ethernet interfaces of the motherboard. The Ethernet physics is 10/100/1000BaseT, available through the shielded modular jack at the connector panel. Twisted pair cable can be used to connect to this port.

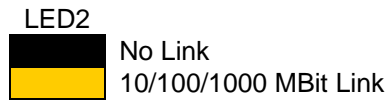


1	MDIO+	5	MDI2+
2	MDIO-	6	MDI2-
3	MDI1+	7	MDI3+
4	MDI1-	8	MDI3-

1

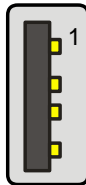
table 4: Ethernet connector

The two LEDs indicate Ethernet status as follows:



4.2.4 USB type A receptacle (USB0-USB1)

Two USB interfaces are available at the connector panel.

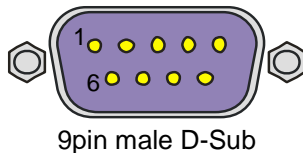


1	+5V, I _{MAX} = 500 mA
2	USB-
3	USB+
4	GND

table 5: USB connector

4.1 RS232 (Console)

The RS232 (Console) serial interface is provided by the i.MX6 CPU. The connector is a standard 9 pin D-SUB plug, but the interface is connected with four wires only, table 6 shows the pin out.

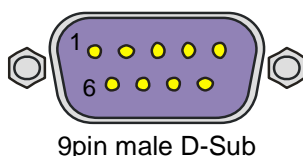


1	n.c.	6	n.c.
2	RxD	7	RTS
3	TxD	8	CTS
4	n.c.	9	n.c.
5	GND		

table 6: RS232 (Console) connector

4.2 RS232 (UART)

Additional serial interfaces might be implemented by a XR16V2750 dual UART chip. This type of serial port has proprietary implementation over the internal expansion bus. Hence it needs special software driver. For a description of UART registers refer to the EXAR manual. The UART clock input is 14,7456MHz to allow error free generation of standard baud rates. This RS232 variant provides all 8 interface signals as shown in table 7.

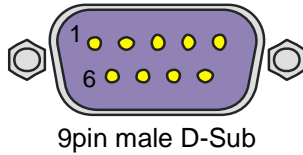


1	DCD	6	DSR
2	RxD	7	RTS
3	TxD	8	CTS
4	DTR	9	RI
5	GND		

table 7: RS232 connector

4.3 RS485

In the RS485 variant, there are only the differential signals D+ and D- provided. The transceiver is enabled to send data, when RTS# of the corresponding UART is low. Hardware can be customized to either receive or not-receive (standard) the transmitted data on the UART's RxD input. Ask Janz Tec for customization regarding this option.



1	n.c.	6	GND
2	D+	7	D-
3	GND	8	n.c.
4	n.c.	9	n.c.
5	n.c.		

table 8: RS485 connector

The bidirectional differential signals D+ and D- are provided. When the transmitter is enabled, and no data is send (1=MARK), then $D+ > D-$ (refer to figure 9).

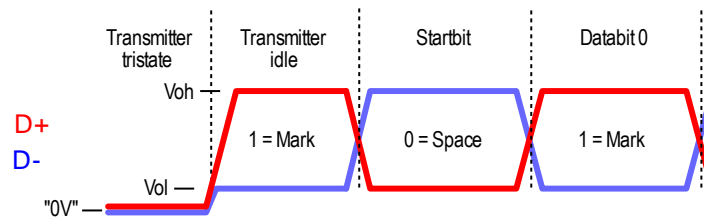


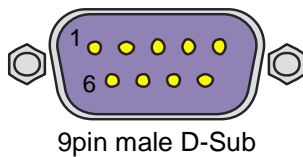
figure 9: RS485 signaling

Note that D+ corresponds to pin "A" of the transceiver chip. However, this is signal B according to the EIA-485 or Profibus standards.

The receiver has the failsafe input feature, which ensures that no data is received when D+ and D- are floating or are shorted (e.g. by the termination resistor).

4.4 CAN

The CAN interface is implemented with a SJA1000 controller chip. The connector is a standard 9 pin D-SUB plug with a pin out shown in table 9. The CAN interface is isolated and has a software switchable 120 Ohm termination.



1	n.c.	6	GND
2	CANL	7	CANH
3	GND	8	n.c.
4	n.c.	9	VEXT ¹
5	n.c.		

table 9: CAN connector

¹ This signal is optionally available to provide power to supply an external transceiver module

4.5 Digital IO



10 1

10pin 3.81mm connector

1	DIGIO-0
2	DIGIO-1
3	DIGIO-2
4	DIGIO-3
5	EXTVCC (24VDC nom.)
6	EXTGND
7	DIGIO-4
8	DIGIO-5
9	DIGIO-6
8	DIGIO-7

table 10: digital IO connector



CAUTION / MISE EN GARDE : Fire Risk / Risque d'incendie

The digital IO must be powered by a SELV power supply, that complies with the requirements of a limited energy source (LPS) (By using an appropriate supply or an external fuse).

L'E/S numérique doit être alimenté par une alimentation SELV, conforme aux exigences d'une source d'énergie limitée (LPS) (en utilisant une alimentation appropriée ou un fusible externe).

The digital inputs and outputs are isolated from system power supply. Refer to figure 10 for detailed schematic.

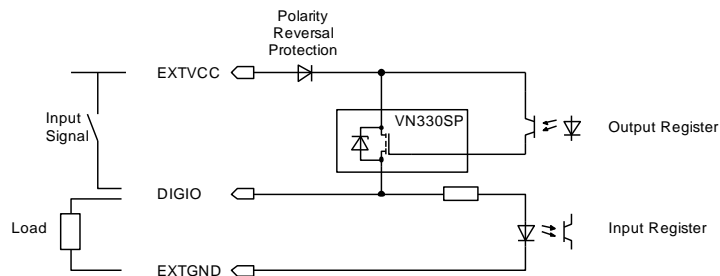


figure 10: digital IO input/output schematic

When used as digital input signals, DIGIO-X refer to EXTGND and have an input impedance of about 10 kOhm. Switching level for *low* is ≤ 4.5 V and *high* ≥ 10 V.



The digital inputs do not require EXTVCC to be present (can be left open). However, if EXTVCC is left open, the digital inputs back-power the output driver, resulting in increased input current.



NOTICE / REMARQUE

When channels are used as inputs, make sure the voltage at DIGIO-X never exceeds the voltage at EXTVCC.

Lorsque des canaux sont utilisés comme entrées, assurez-vous que la tension sur DIGIO-X ne soit jamais supérieure à la tension sur EXTVCC.

When used as digital outputs, DIGIO-X drive EXTVCC power to the output pins (high side switch). The load must be connected between the output pin and the return of the VIO power supply. This return has to be connected to EXTGND as well.

Digital outputs can source 500mA per output. The output current sum of all digital outputs should be limited to 2500 mA. This is only a thermal limit to reduce power dissipation.

Digital outputs are powered by two output drivers (DIGIO-7..4 and DIGIO-3..0). High current loads should be distributed if possible. Two or more digital outputs can be used in parallel to enable switching higher currents.

The output driver supports resistive and inductive loads.



NOTICE / REMARQUE

When using inductive loads, the output driver has internal clamping to demagnetize the load. This clamps the output pin to about 55 V below VIN. When using this feature, very carefully evaluate that the demagnetization energy does not overheat the output driver. Parameters to check are the switching frequency, the load current, the load inductance and VIO voltage. Refer to the VN330SP datasheet for more information. If in doubt, add external clamping circuits.

Lors de l'utilisation de charges inductives, le pilote de sortie dispose d'un serrage interne pour démagnétiser la charge. La broche de sortie est ainsi bloquée à environ 55 V sous le NIV. Si vous utilisez cette fonction, veuillez contrôler que l'énergie de démagnétisation ne surchauffe pas le pilote de sortie. Les paramètres à vérifier sont la fréquence de commutation, le courant de charge, l'inductance de charge et la tension VIO. Pour plus d'informations, consulter la fiche technique du VN330SP. En cas de doute, ajouter des circuits de serrage externes.



NOTICE / REMARQUE

When outputs are turned on, they source power from EXTVCC to the output pin. If you use a channel as input, make sure you never turn on the corresponding output.

Lorsque les sorties sont activées, elles alimentent la broche de sortie à partir de l'EXTVCC. Si vous utilisez un canal comme entrée, assurez-vous de ne jamais activer la sortie correspondante.

4.6 Analog IO



10 1

10pin 3.5mm connector

1	AOUT1
2	AOUT2
3	AOUT3
4	AOUT4
5	AGND
6	AIN1
7	AIN2
8	AIN3
9	AIN4
10	AGND (internally connected to pin 5)

table 11: digital IO connector

AGND is isolated from iX-Bus power supply, however analog inputs and outputs share the same ground reference.

The multi IO module provides 4 analog voltage input-ports with a voltage range from -10V to 10V. The inputs are isolated from digital ground. Input resistance is 1 MOhm.

The multi IO module provides 4 analog voltage output-ports with a voltage range from -10V to 10V. The outputs are isolated from digital ground.

**NOTICE / REMARQUE**

Make sure not to exceed the nominal 24mA load for all output-ports combined.

Assurez-vous de ne pas dépasser la charge nominale de 24mA pour tous les ports de sortie combinés.

5 Maintenance



NOTICE / REMARQUE

Always follow common ESD practice when you service the product!

Pour réaliser la maintenance du produit, respectez toujours les pratiques ESD courantes !

To open the housing, you can remove the back panel or the front panel. Different maintenance tasks require one of them to be removed, others require full disassembly.

Task	Back Panel		Remarks
Replace CFast	remove		
Replace SD-card	remove		
Replace Battery			Complete disassemble

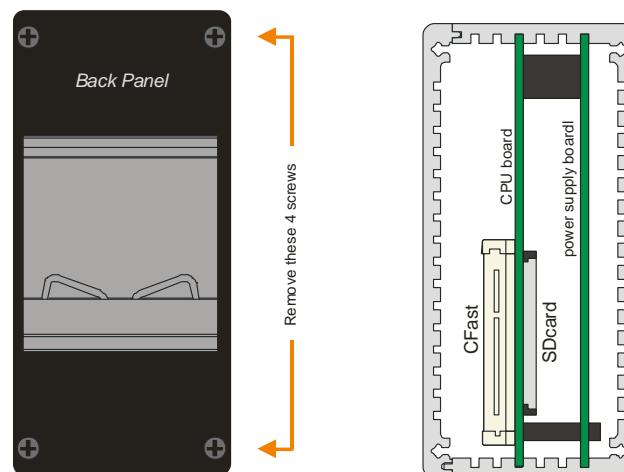


figure 11: emPC-A/iMX6 back panel removal

5.1 CFast Card Replacement



NOTICE / REMARQUE

Power must be turned off before removing or inserting the CFast card.

Couper l'alimentation avant de retirer ou d'insérer la carte CFast.

Refer to figure 11 to identify the location of the CFast card.

5.2 SDcard Replacement

**NOTICE / REMARQUE**

Power must be turned off before removing or inserting the SDcard.

Couper l'alimentation avant de retirer ou d'insérer la carte SD.

Refer to figure 11 to identify the location of the SDcard.

5.3 Battery Replacement (English)



CAUTION : Fire Risk

The installed computer board is equipped with a Lithium battery. Danger of explosion if battery is incorrectly replaced. Replace only with battery of the same or equivalent type (3-volt lithium coin cell battery).

- Do not attempt to recharge the battery.
- Do not disassemble, crush, puncture, short external contacts, or dispose of in fire or water.



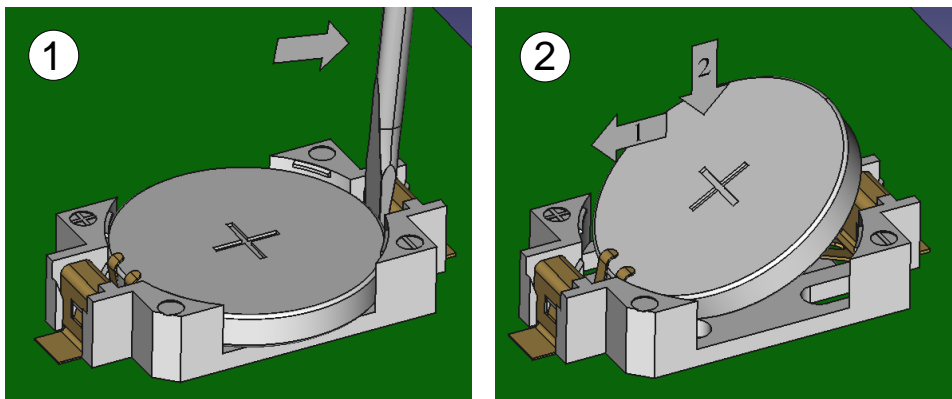
NOTICE: Battery approval

The battery must be a compatible battery type: CR2032 (3 Volt lithium coin cell battery). The replacement battery must have a NRTL approval.

Compatible battery type: CR2032 (3 Volt lithium coin cell battery) with temperature range -40 .. +85°C or better (Recommended: Murata CR2032X or CR2032W).

The battery is used for backing up the system time when the power supply is removed.

1. Turn off the computer properly through the operating system, then turn off any external devices.
2. Disconnect the power supply from the power inlet and disconnect any external devices.
3. Disassemble the housing and locate the battery on the power supply board
4. Remove the battery from the holder (See figure 12)
5. Insert the new battery (See figure 12)
6. Reassemble the housing



1. Removal: Insert screwdriver at right side and bend so that the battery pops out. Use only gentle force, otherwise the battery holder might be damaged.
The use a plastic tool is preferred to avoid shorting the battery
2. Insertion: Align new battery to the left side of the holder and gently press down on the right side of the battery until the battery snaps into the holder.

figure 12: Removing and replacing coin cell battery

5.4 Changer la pile (Français)



MISE EN GARDE : Risque d'incendie

La carte informatique intégrée est équipée d'une pile au lithium.
Risque d'explosion en cas de positionnement incorrect de la pile. Ne remplacer la pile qu'avec une pile du même type ou d'un type équivalent (pile au lithium de 3 volts).

- N'essayez pas de recharger la pile.
- Ne pas démonter, écraser, perforer, court-circuiter les contacts externes ou jeter dans l'eau ou le feu.



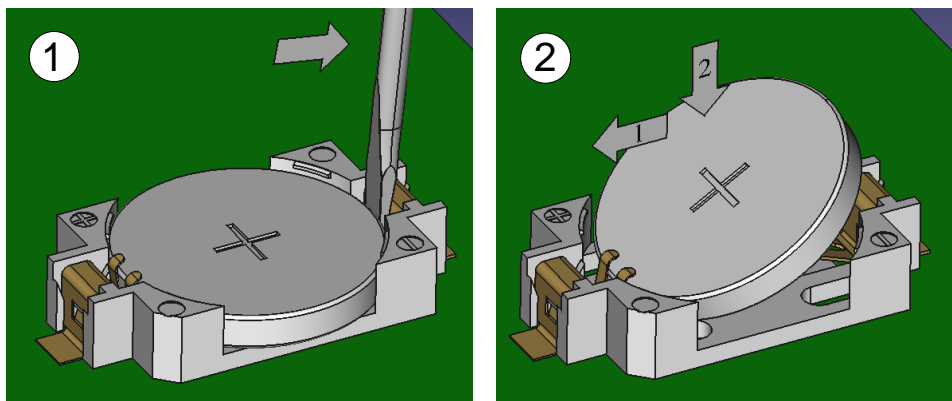
REMARQUE : Homologation de la pile

La pile doit être compatible : CR2032 (pile au lithium de 3 volts). La pile de remplacement doit être homologuée NRTL.

Type de pile compatible : CR2032 (pile au lithium de 3 volts) avec une plage de température de -40 .. + 85 ° C ou supérieure. (Recommandé: Murata CR2032X ou CR2032W).

La batterie sert à sauvegarder l'heure du système lorsque l'alimentation électrique est coupée.

7. Éteignez correctement l'ordinateur via le système d'exploitation, puis éteignez tous les appareils externes.
8. Débranchez l'alimentation électrique de l'arrivée d'alimentation et débranchez tous les appareils externes.
9. Démontez le boîtier et placez la pile sur la carte d'alimentation.
10. Retirez la pile de son support (voir graphique 13).
11. Insérez la nouvelle pile (voir graphique 13).
12. Remonter le boîtier.



3. Changement de la pile : Insérez un tournevis sur le côté droit et abaissez-le de façon à ce que la pile sorte. N'exercez qu'une faible pression de sorte que le boîtier de la pile ne puisse pas être endommagé.
Utilisez de préférence un outil en plastique pour ne pas risquer de court-circuiter la pile.
4. Insertion de la pile : Alignez la pile neuve sur le côté gauche du boîtier puis appuyez doucement sur le côté droit de la pile jusqu'à ce que la pile s'enclenche dans le boîtier.

graphique 13: Retirer et remplacer la pile au lithium

6 Open Source Licensing

This product uses a number of open source software packages which are listed below. The open source software is provided free of charge. You are entitled to use the open source software in accordance with the respective license conditions as provided in the following chapters.

6.1 Disclaimer

The open source software is distributed WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. The respective licenses may contain more details

6.2 How to obtain the source code

The software included in this product contains copyrighted software that is licensed under the GPL and other open source licenses. Copies of those licenses are found below. You may obtain the complete Corresponding Source code from us:

Open Source Compliance Division
 Janz Tec AG
 Im Dörener Feld 8
 D-33100 Paderborn

Email: opensource@janztec.com

This offer is valid to anyone in receipt of this information.

6.3 Software packages

The software contained in this product makes use of the following open source software packages.

Package	License
u-boot	BSD-2-Clause BSD-3-Clause eCos-2.0 GPL-2.0 IBM-pibs LGPL-2.0 LGPL-2.1

The u-boot software is stored in the SPI flash of the emPC-A/iMX6 and is required to boot software that is stored on the CFast, SD card or the internal eMMC.

As the u-boot can be replaced by the skilled end user, we have no control of which version of u-boot is installed on which device. You can check the u-boot version by checking the u-boot startup messages. Please indicate this version when you request the source code.

This license Agreement does NOT cover any software that is installed on the CFast, SD card or the internal eMMC.

6.4 Verbatim License Texts

All license texts can be found electronically on <http://spdx.org/licenses>.

6.4.1 BSD 2-clause "Simplified" License

Copyright (c) <year> <owner> All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

6.4.2 BSD 3-clause "New" or "Revised" License

Copyright (c) <year> <owner> . All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

6.4.3 GNU General Public License v2.0

GNU GENERAL PUBLIC LICENSE

Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation, Inc.
51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and

disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,

c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will

automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND

FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the program's name and an idea of what it does. Copyright (C) yyyy name of author

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA. Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'. This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w' and `show c'; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program `Gnomovision' (which makes passes at compilers) written by James Hacker.

signature of Ty Coon, 1 April 1989 Ty Coon, President of Vice

6.4.4 GNU Library General Public License v2

GNU LIBRARY GENERAL PUBLIC LICENSE

Version 2, June 1991

Copyright (C) 1991 Free Software Foundation, Inc.
51 Franklin St, Fifth Floor, Boston, MA 02110-1301, USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the library GPL. It is numbered 2 because it goes with version 2 of the ordinary GPL.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Library General Public License, applies to some specially designated Free Software Foundation software, and to any other libraries whose authors decide to use it. You can use it for your libraries, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library, or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link a program with the library, you must provide complete object files to the recipients so that they can relink them with the library, after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

Our method of protecting your rights has two steps: (1) copyright the library, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the library.

Also, for each distributor's protection, we want to make certain that everyone understands that there is no warranty for this free library. If the library is modified by someone else and passed on, we want its recipients to know that what they have is not the original version, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that companies distributing free software will individually obtain patent licenses, thus in effect transforming the program into proprietary software. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License, which was designed for utility programs. This license, the GNU Library General Public License, applies to certain designated libraries. This license is quite different from the ordinary one; be sure to read it in full, and don't assume that anything in it is the same as in the ordinary license.

The reason we have a separate public license for some libraries is that they blur the distinction we usually make between modifying or adding to a program and simply using it. Linking a program with a library, without changing the library, is in some sense simply using the library, and is analogous to running a utility program or application program. However, in a textual and legal sense, the linked executable is a combined work, a derivative of the original library, and the ordinary General Public License treats it as such.

Because of this blurred distinction, using the ordinary General Public License for libraries did not effectively promote software sharing, because most developers did not use the libraries. We concluded that weaker conditions might promote sharing better.

However, unrestricted linking of non-free programs would deprive the users of those programs of all benefit from the free status of the libraries themselves. This Library General Public License is intended to permit developers of non-free programs to use free libraries, while preserving your freedom as a user of such programs to change the free libraries that are incorporated in them. (We have not seen how to achieve this as regards changes in header files, but we have achieved it as regards changes in the actual functions of the Library.) The hope is that this will lead to faster development of free libraries.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, while the latter only works together with the library.

Note that it is possible for a library to be covered by the ordinary General Public License rather than by this special one.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License Agreement applies to any software library which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Library General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table

used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also compile or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution

displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)
- b) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.
- c) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.
- d) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

- a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.
- b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Library General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the library's name and an idea of what it does.

Copyright (C) year name of author

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Library General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Library General Public License for more details.

You should have received a copy of the GNU Library General Public License along with this library; if not, write to the Free Software Foundation, Inc., 51 Franklin St, Fifth Floor, Boston, MA 02110-1301, USA.

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in
the library `Frob' (a library for tweaking knobs) written
by James Random Hacker.

signature of Ty Coon, 1 April 1990

Ty Coon, President of Vice

That's all there is to it!

6.4.5 GNU Lesser General Public License v2.1

GNU LESSER GENERAL PUBLIC LICENSE

Version 2.1, February 1999

Copyright (C) 1991, 1999 Free Software Foundation, Inc.
51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages--typically libraries--of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it; that you can change the software and use pieces of it in new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.

To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over

competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) The modified work must itself be a software library.

b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.

c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.

d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself.

6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)
- b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.
- c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.
- d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.
- e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:

- a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.
- b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.

8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.

10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply, and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A

FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the library's name and an idea of what it does.

Copyright (C) year name of author

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in
the library `Frob' (a library for tweaking knobs) written
by James Random Hacker.

signature of Ty Coon, 1 April 1990

Ty Coon, President of Vice

That's all there is to it!

6.4.6 eCos license version 2.0

The eCos license version 2.0

This file is part of eCos, the Embedded Configurable Operating System. Copyright (C) 1998, 1999, 2000, 2001, 2002 Red Hat, Inc.

eCos is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 or (at your option) any later version.

eCos is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with eCos; if not, write to the Free Software Foundation, Inc., 51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA.

As a special exception, if other files instantiate templates or use macros or inline functions from this file, or you compile this file and link it with other works to produce a work based on this file, this file does not by itself cause the resulting work to be covered by the GNU General Public License. However the source code for this file must still be made available in accordance with section (3) of the GNU General Public License.

This exception does not invalidate any other reasons why a work based on this file might be covered by the GNU General Public License.

Alternative licenses for eCos may be arranged by contacting Red Hat, Inc. at <http://sources.redhat.com/ecos/ecos-license>

6.4.7 IBM PowerPC Initialization and Boot Software

This source code has been made available to you by IBM on an AS-IS basis. Anyone receiving this source is licensed under IBM copyrights to use it in any way he or she deems fit, including copying it, modifying it, compiling it, and redistributing it either with or without modifications. No license under IBM patents or patent applications is to be implied by the copyright license.

Any user of this software should understand that IBM cannot provide technical support for this software and will not be responsible for any consequences resulting from the use of this software.

Any person who transfers this source code or any derivative work must include the IBM copyright notice, this paragraph, and the preceding two paragraphs in the transferred software.

COPYRIGHT I B M CORPORATION 2002
LICENSED MATERIAL - PROGRAM PROPERTY OF I B M

7 Appendices

7.1 Technical Data

Processing Core

CPU	emPC-A/iMX6S: i.MX6 Solo ARM Cortex A9, 1 x 800 MHz, 512 KB L2 Cache
	emPC-A/iMX6D: i.MX6 Dual ARM Cortex A9, 2 x 800 MHz, 1 MB L2 Cache
	emPC-A/iMX6Q: i.MX6 Quad ARM Cortex A9, 4 x 800 MHz, 1 MB L2 Cache

Memory

Main Memory	1 GB DDR3 1066 for Solo 2 GB DDR3 1066 for Dual and Quad
Nonvolatile RAM	128 kB MRAM

Storage

CFast	1 x internal socket with SATA 3 GB/s (not available for Solo)
SDcard	1 x internal socket

Video

Controller	i.MX6 defined
Memory	Shared with main memory
Interface	1 x DVI-D single link connector on front panel, up to 1920x1200 1 x Single channel LVDS on internal connector, up to 1366x768

External Interfaces (connector panel)

Video	1 x DVI-D
Ethernet	1 x 10/100/1000 Mbit/s Ethernet (Ethernet 0: i.MX6 ENET) 1 x 10/100/1000 Mbit/s Ethernet (Ethernet 1: Intel i210)
USB	2 x USB2.0
CAN (Option)	SJA1000 controller <ul style="list-style-type: none"> • ISO/DIS 11898-2 (isolated from logic), • software switchable 120 Ohm termination resistor
Serial Port (Option)	i.MX6 UART <ul style="list-style-type: none"> • RS232 (4 wire) • RS485, optionally isolated from logic Exar 16V2750 (Port expansion) <ul style="list-style-type: none"> • RS232 (full featured) • RS485, optionally isolated from logic

Expansion

iX-Bus	Internal 8/16 bit interface for IO and low speed peripherals
--------	--

Indicators and Switches

Reset	Pushbutton
Status	LED for power supply status (green)
User LEDs	2 programmable LEDs (S0 – red and S1 - green)

System

Housing	Aluminium, passivated, outside painted
Battery	CR 2032, for real time clock

Watchdog Yes, implemented in i.MX6

Power Requirements

Power Supply DC power, 9 .. 34 V (lower limit with adjustable UVL)
 Current rating max. 2.5 A (limited by internal fuse, depending on part variant)
 Inv.-pol. protection Yes
 Fuse Internal 2.5A melting fuse in DC in, GND is unfused
 potential separation No, GND (Pin 3 in Table 2) is connected to case
 Inrush Current (max) TBD
 Overvoltage Category I
 Power Dissipation Without external load or expansion cards
emPC-A/iMX6Q: 9W (max)
Digital IO Option: + 0.7 W
Analog IO Option: + 3 W

External Load Capabilities

+5V (USB) Max. 0.5 A per USB port

Environmental Specifications

Operating Ambient Temperature **emPC-A/iMX6Q base unit⁵⁾: -40 °C .. + 65 °C**
Parts with digital IO: -40 °C .. + 60 °C
Parts with analog IO: 0 °C to 50 °C ¹⁾
 (with TÜV/NRTL approval) at sea level, derating of 1 °C per 300 m above sea level to a maximum of 2000 m.
 Operating Ambient Temperature **emPC-A/iMX6Q: -40 °C ... +70 °C (up 75 °C with limited load) ³⁾**
Parts with digital IO: -40 °C to 70 °C
Parts with analog IO: 0 °C to 50 °C ¹⁾
 (without TÜV/NRTL approval) at sea level, derating of 1 °C per 300 m above sea level to a maximum of 2000 m.
 Storage Temperature -40..+75 °C ²⁾
 Humidity 5%..95% r.H., non condensing
 Ingress Protection IP20
 Pollution Degree 2
 Altitude max.2000m

Physical Dimensions

Size (WxHxD) Including connectors and rail mounting bracket
2 DSUB: 52 x 105 x 117 mm
4 DSUB: 72 x 105 x 117 mm
 Weight **2 DSUB: 600 g**
4 DSUB: 720 g

Notes

- 1 Accuracy limits not guaranteed over full operating temperature range
- 2 Operation and storage at high temperature will shorten RTC battery lifetime
- 3 Operation above 70 °C:
 - Total power consumption must be limited to 6W
 - Load to USB ports must be limited to 100 mA per port

Operation at 70 °C was verified using Linux with these conditions:

- `stress-ng --matrix 0 --matrix-method copy --matrix-size 256`
- external DVI Monitor (1920x1080) connected (frame buffer console only)
- Power Consumption w.o. ext. load: 7.4 W

Operation at 75 °C was verified using Linux with these conditions:

- `stress-ng --matrix 3 --matrix-method copy --matrix-size 128`
- external DVI Monitor (1920x1080) connected (frame buffer console only)
- Power Consumption w.o. ext. load: 6.0 W

System Idle (70 °C) w.o. ext. load and no monitor: ~ 4 W

System Idle (70 °C) w.o. ext. load and DVI Monitor (1920x1080): ~ 4.8 W

Stress-ng matrix copy is a high power CPU stressor. The `-matrix` option specifies the number of cores on which the test is executed in parallel (0 = all cores)

4 Tested in climatic chamber

5 With 2 D-SUB and no analog/digital IO

7.2 References

These references direct you to manuals and specifications that you might need to know when you attempt to program the product. Most of the documents can be downloaded from the Internet. Look for the WWW servers of the component/chip manufacturers.

- [1] **SJA1000 Product specification**, Philips Semiconductor, Jan 04, 2000
- [2] **ixBus System Reference Manual**, Janz Tec AG

WWW-References

Janz Tec AG
Freescale

www.janztec.com
www.freescale.com

7.3 Dimensions

Refer to figure 14 for the housing dimensions.

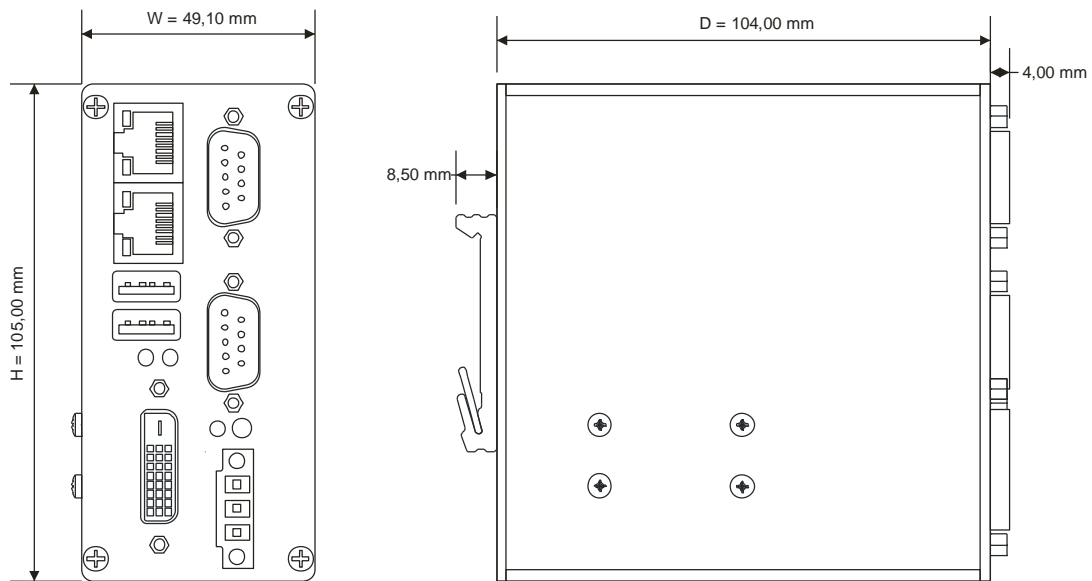


figure 14: housing dimensions (2 DSUB system shown)

emPC-A/iMX6 Systems with different IO options just differ in dimension W

Slot Variant	W
2 DSUB	49.1 mm
4 DSUB	69.5 mm
2 DSUB + analog/digital IO	69.5 mm

7.4 Product History

Version	Release Date	Name	Changes
			•

7.5 Manual History

Version	Release Date	Name	Changes
V1.0	2014-01-16	As	<ul style="list-style-type: none"> Initial release
V1.1	2014-01-20	As	<ul style="list-style-type: none"> Technical Data: Removed system controller and changed DVI-I do DVI-D Removed "operating with hazardous voltages". Typographic changes
V1.2	2015-05-22	ime	<ul style="list-style-type: none"> Added Intended use
V1.3	2015-10-05	As	<ul style="list-style-type: none"> Added chapter Open Source Licensing
V1.4	2018-07-20	As	<ul style="list-style-type: none"> RS485: improved description of output signal D+/D- vs A/B Added analog/digital IO description Updated ambient temperature limits
V1.5	2018-11-07	fhu	<ul style="list-style-type: none"> Multi IO Module <ul style="list-style-type: none"> Reduced digital IO Vmax to 31 V due to limits of EMC components. This is a specification change. This limit has been present on all previously shipped units. Units with higher voltage tolerance can be made on request. Clarified drawbacks when not connection EXTVCC in input only applications Added note that DIGIO voltage must not exceeded EXTVCC
V1.6	2019-02-07	As	<ul style="list-style-type: none"> Operating conditions for +75 °C defined Revised technical data Added french safety notes Changes for TÜV/NTRL approval Changed RS485 self-receipt to non-standard behaviour