duagon
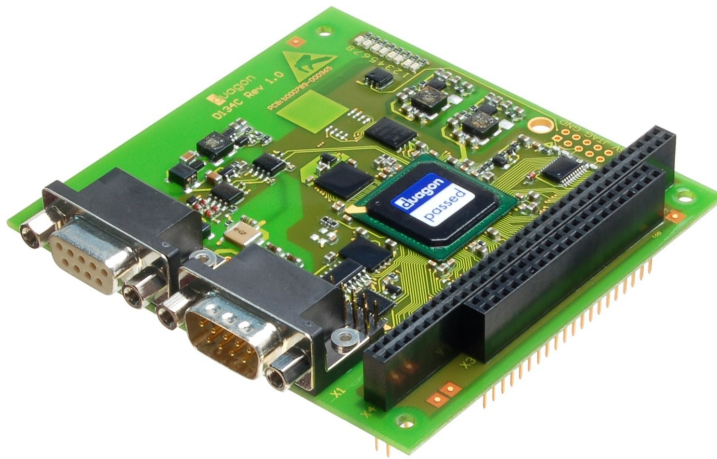
The D134C is a multi-purpose CAN interface on a PC/104 footprint supporting all CAN operating modes and baud rates. It is available in two configurations:

- **Passive CAN interface with a CAN controller.**

- **Active CAN interface including arbitrary CAN communication stacks.**

Duagon Data Sheet Preamble

On having purchased products described in this data sheet, the customer acquires the right to use the products according to its specified purpose and in accordance with all operation, service and maintenance instructions. All other rights to the product, Duagon's intangible assets rights in particular, belong solely to Duagon and may not be deemed to have been assigned along with the sale of the products.

All product properties are fully described in the data sheet under express exclusion of any warranty for other properties. Of decisive relevance is the data sheet valid at the time of the order being placed. Duagon provides a warranty that the product properties are retained during the period of warranty. Evidence that the properties of the product have been retained will be brought, always and exclusively, on Duagon premises by means of a test construction pursuant to the type test.

The customer is obliged to inspect whether the products themselves are suitable for the application intended. In particular, that inspection must include the integration of the products into the intended system configuration and a check on whether the properties as per data sheet can be fulfilled once integrated into the system configuration as planned by the customer. Since the products are not certificated for operation with security applications, the customer must take appropriate measures to ensure that any malfunctions that may occur in a system configuration with other products will be absorbed by supplementary security measures.

The period of warranty for the products is 24 months and it begins on the date the products are shipped from the factory.

The warranty that Duagon assumes for the products will, at Duagon's discretion, be limited either to the repair of or the replacement of the products at the Duagon factory. The warranty solely covers the products or parts thereof which, despite professional handling, have become defective or unusable and which arrive at the Duagon factories for repair or replacement during the period of warranty. The extent of Duagon's warranty is fully set out in this data sheet. Duagon cannot be held liable for consequential damage caused by a defect or for indirect damage or for consequential damage of any kind. Therefore the customer bears all and any costs that occur due to production downtime, for example, or due to the installation or dismantling of products or due to their transportation to Duagon and back.

Duagon's liability and warranty do not obtain if evidence cannot be brought that the products were being operated according to its specified purpose and in accordance with all operation, service and maintenance instructions as issued by Duagon.

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This data sheet is to be evaluated in accordance with **Swiss** law. The court of jurisdiction is the **seat of the vendor**. The applicability of the UN agreement as to international sales of goods (also known as "Viennese Purchasing Convention") is herewith expressly excluded.

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Document history

Rev.	Date	Author	Comments	Ident-Number
1	August 19th, 2008	Klauser	See chapter „Document History"	d-002282-005780
2	Sept. 07th, 2009	Milani		d-002282-007515
3	Sept. 2nd, 2010	Klauser		d-002282-008854
4	Oct. 19th, 2011	Eberli		d-002282-011384
5				
6				
7				

Table of Contents

Introduction

The D134C is a multi-purpose CAN interface on a PC/104 footprint support-
ing all CAN operating modes and baud rates It is available in two configura-
tions:

- Passive CAN interface with a CAN controller.

- Active CAN interface including arbitrary CAN communication stacks
  (see also section "CAN Software Protocols" on page 21). This ap-
  proach minimizes the CPU requirements of the host system, be-
  cause the major part of the communication software is running on
  the Duagon interface.

The D134C is designed for the harsh traction environment and conforms to
the EN 50121 / EN 50155 / EN 61373 standards, e.g. by:

- -40 to +85°C operating temperature

- coating against humidity

- enhanced EMI and vibration robustness

Other Members of the PC/104 Interface Family

The PC/104 interface family covers modules with connections to the follow-
ing vehicle bus systems:

- D134E: PC/104 Ethernet interface

- D134C: PC/104 CAN interface (this document)

This Document

This document has a preliminary status. Therefore, several technical details
are not finally defined, yet. These details are marked with "tbd", "to be
defined". In a next version of this document, the "tbd" will be replaced by the
final product properties.

How to Get Started?

This data sheet describes the properties and functions of the D134C CAN in-
terface. It includes the essential information required for the integration of
the D134C into a host system.

For detailed information about the integration and how to proceed step by
step, please refer to the "PC/104 Integration – User's Guide", d-002310-
nnnnnn.

All driver software related documentation and source code is contained in
the host driver packages (see Chapter "Links to other Duagon Documents"
on page 34).

When using the Duagon D221 PCI-Express Adapter Card (see D221 Data
Sheet, d-002530-nnnnnn), the D134C can be plugged in any PC system for
fast software development. The purpose of the D221 – in combination with
the D134C – is to support the integration into a customer controller plat-
form. The application engineer can start implementation of the MVB applic-
ation software before the final hardware platform is ready.

Online Support

For additional information, please visit our web page www.duagon.com.
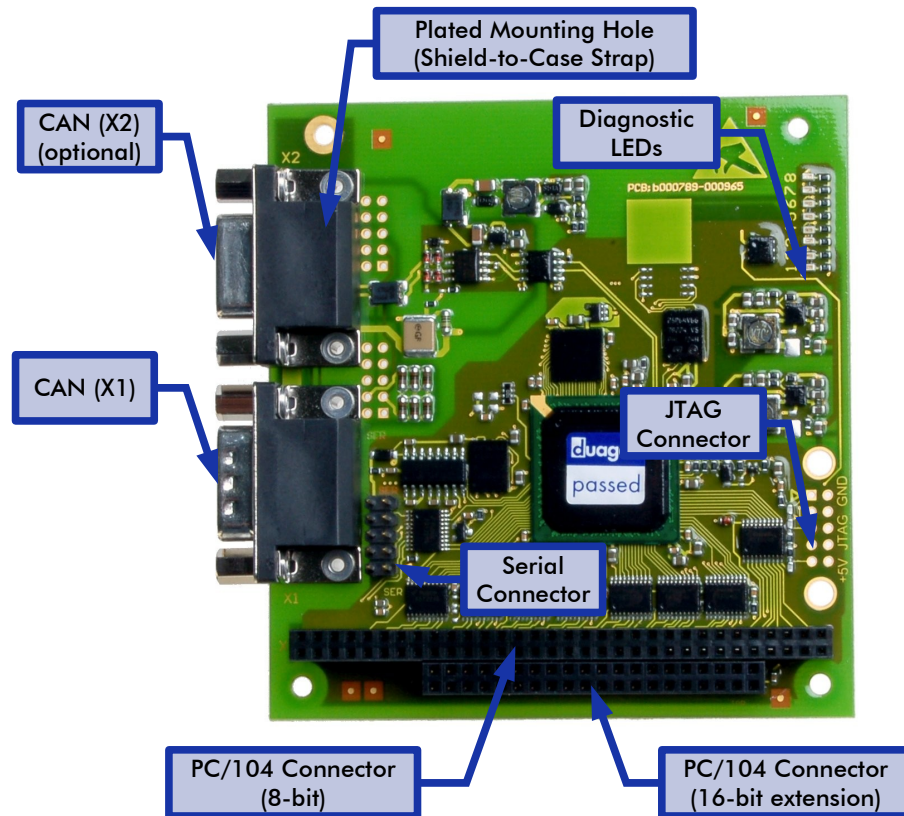
There you will find:

- up to date documents
- frequently asked questions
- description of new product versions

On our web page it is also possible to subscribe to an email news service providing notifications about all kind of news.
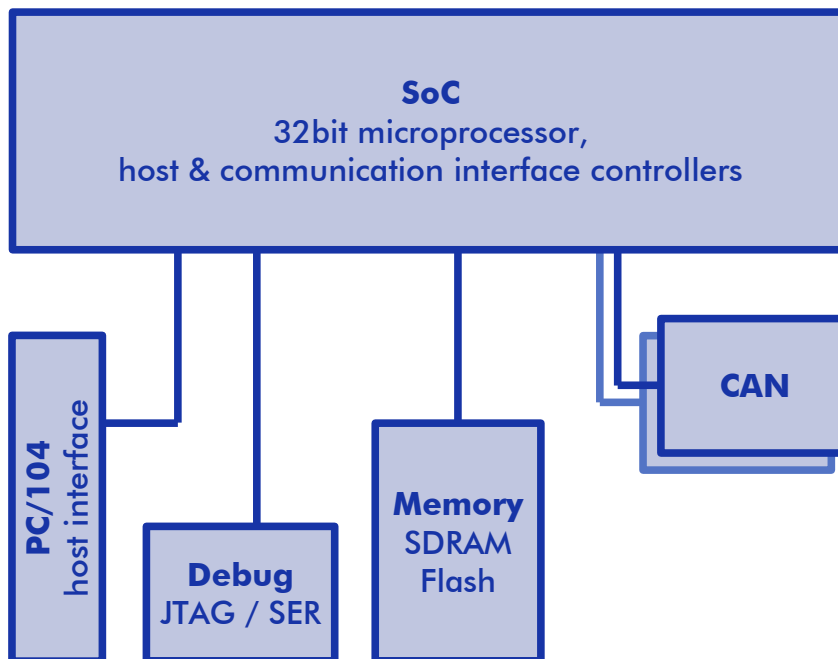
Architecture

Hardware Structure

The figure below shows the top view of a D134C equipped with two CAN SUB-D connectors.

Basic Function Blocks

The basic function blocks within the D134C are shown in the drawing below:

```
┌─────────────────────────────────────────────┐
│                    SoC                         │
│            32bit microprocessor,               │
│   host & communication interface controllers  │
└─────────────────────────────────────────────┘
                                              CAN

  PC/104      Debug      Memory
host interface JTAG / SER  SDRAM
                          Flash
```

The **"System on a Chip SoC"** contains the local microprocessor and all relevant logic circuitry, like CAN controller, memory controller, host interface controller, etc.
This component is implemented as a programmable logic device. This ensures the versatile change of e.g. controller specifications, bug fixes after hardware production and future portability to new silicon technologies.

The **PC/104 host interface** ensures a data communication path between the D134C and the CPU of the host system.

Host Interface

The D134C behaves like a UART device, i.e. it maps UART register sets into the host system. These register sets are used for communication between the host processor and the communication interface. For details about the register map see the "PC/104 Integration – User's Guide", d-002310-nnnnnn.

Typically, there are two communication channels, each having its own register set. One channel is used for "fast" real time critical data (process data), the other is used for "slower" data (message data, file system access, etc).
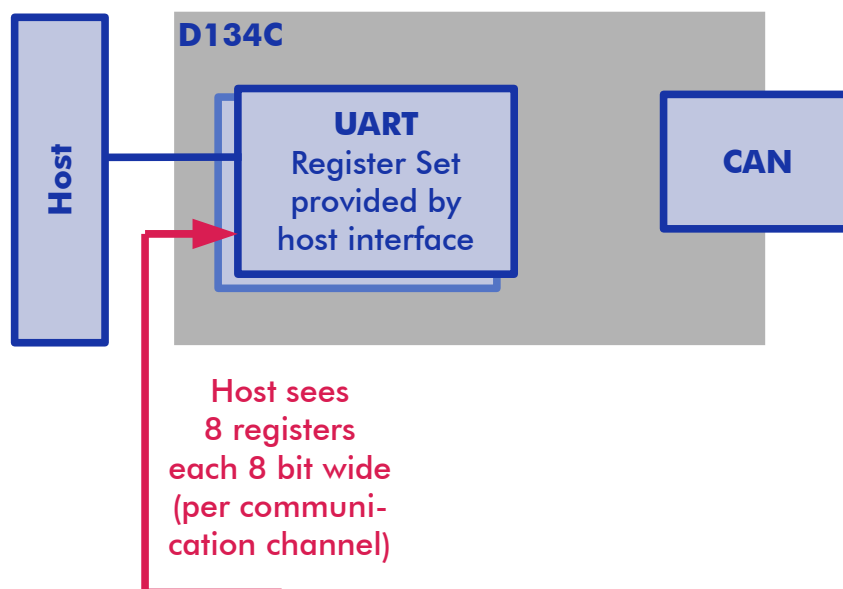
Communication with the D134C over the Duagon UART device basically means transferring data "as if it was sent through a serial line"; i.e. data bytes are sent and received in a sequential manner.

The communication does not really pass a serial line, just the registers of the Duagon UART device. Therefore the transmission is very fast (depending on the host microprocessor: approx. 1 to 8 Mbaud).

For more information about hardware integration, please refer to the Duagon document "PC/104 Integration – User's Guide", d-002310-nnnnnn.

Memory

The D134C local microprocessor includes memory spaces as follows:

Memory Type	Size
Flash (YAFFS flash file system, see also page 23)	2 MByte [1]
SDRAM (RAM file system, see also page 23)	100 kByte

Remark:
1) This is the size of the flash file system available to the user. Extension to up to 8 MByte possible. Please call Duagon for more information.
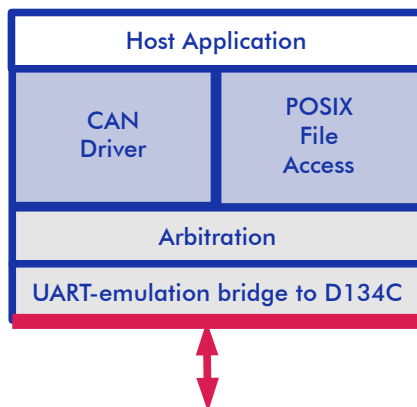
Software Structure

The software structure depends on the chosen configuration D134C passive interface or D134C Server:

Passive CAN Interface

In case of the passive D134C CAN interface, the CANpie Driver Software running on the host (see also section "CAN Software Protocols" on page 21) directly accesses the CAN controller on the D134C:

The D134C just contains the CAN controller and a small operating system to serve the diagnostic serial line and to access the local flash file system.
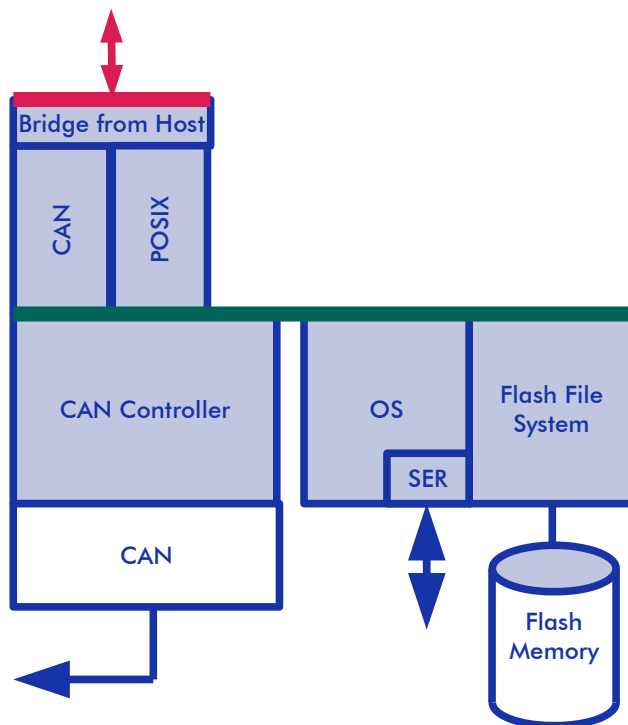
Active CAN Interface – D134C Server

On the D134C Server, the overall concept follows the **"Client-Server Model"**:
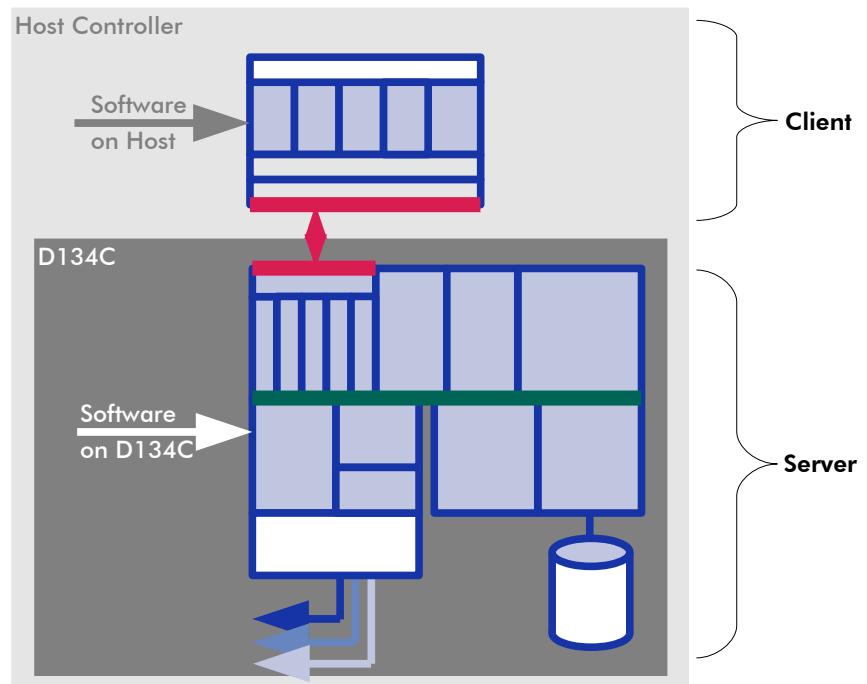
- **Client**: a small client software is installed on the host

- **Server**: the major parts of the communication stack are included in the D134C.

"Client" Software Running on the Host System

The drivers shown below are installed on the host side. The software itself as well as the interface description is included in the Host Driver packages and may need simple adaptations in order to run on the host's operating system.
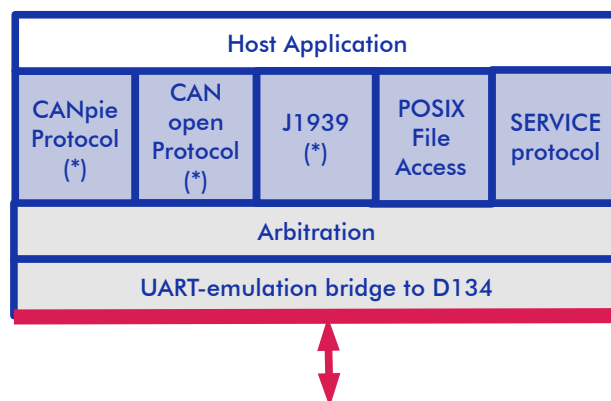
(*) These parts of the interface are optional and depend on the option ordered (see also the order information on page 37). Only one of the listed CAN stacks is available at a time.

The "Client" is very "thin", i.e. there are no complex requirements for the host system to fulfill:

- No real-time operating system needed. All real-time requirements needed for communication are covered within the D134C. The host system is free from real-time requirements.

- The "Host Client" driver software is available as ANSI C source files, which allows an easy porting to any host/operating system combination.
  In addition samples of driver software ported to PC based OS are available. These binary libraries allow a quick usage of the D134C. For more information, please refer to the Host Driver packages.

- Integration of the "Client" to a customer's system typically needs a few days of work.

"Server" Software Running on the D134C

The structure shown below is running on the D134C. The software is installed on the D134C during delivery and may be changed by downloading other software parts.
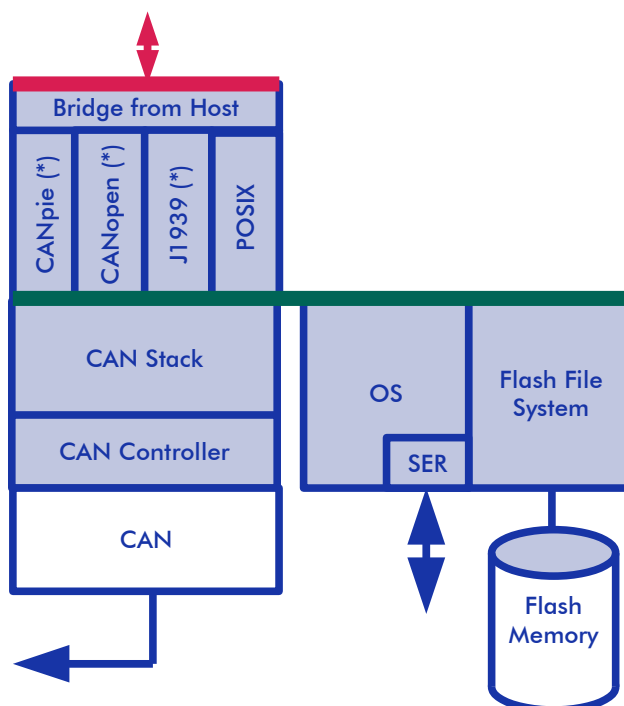

(*) These parts of the interface are optional and depend on the option ordered (see also the order information on page 37). Only one of the listed CAN stacks is available at a time.

For more information about the different software stacks (CANpie, CANopen, J1939, etc.) and protocols, please refer to the chapter "CAN Software Protocols" on page 21.

Physical Interfaces

PC/104 Host Interface (J1 and J2)

The D134C is compatible to the PC/104 Standard (see section "Standards Reference" on page 32), conformance level "compliant". "PC/104" is a trademark of the PC/104 Consortium.
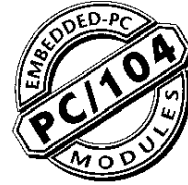
Notes:

- The connector rows C and D are used for 16 bit operation.
  Please note: On D134C, the connector rows C and D are omitted by default (because they are not required for the UART emulation). If the second connector is required, please add it as an option with your order. See order information on page 39.

- Signal source/sink current may differ from P996 (ISA) values, according to Section 3.4. of PC/104 standard.

PC/104 Bus Definition

Pin Number	J1			
	Row A		Row B	
	Name	Notes	Name	Notes
0	--	nc	--	nc
1	/IOCHCHK	out $	GND	power
2	SD7	bidir $	RESETDRV	in $
3	SD6	bidir $	+5V	power
4	SD5	bidir $	IRQ9	out $
5	SD4	bidir $	-5V	nc
6	SD3	bidir $	DRQ2	nc
7	SD2	bidir $	-12V	nc
8	SD1	bidir $	/ENDXFR	nc
9	SD0	bidir $	+12V	nc
10	IOCHRDY	out $	(KEY)	
11	AEN	in $	/SMEMW	in $
12	SA19	in $	/SMEMR	in $
13	SA18	in $	/IOW	in $
14	SA17	in $	/IOR	in $
15	SA16	in $	/DACK3	nc
16	SA15	in $	DRQ3	nc
17	SA14	in $	/DACK1	nc
18	SA13	in $	DRQ1	nc
19	SA12	in $	/REFRESH	in $
20	SA11	in $	SYSCLK	nc
21	SA10	in $	IRQ7	out $
22	SA9	in $	IRQ6	out $
23	SA8	in $	IRQ5	out $
24	SA7	in $	IRQ4	out $
25	SA6	in $	IRQ3	out $
26	SA5	in $	/DACK2	nc
27	SA4	in $	TC	nc
28	SA3	in $	BALE	in $
29	SA2	in $	+5V	power
30	SA1	in $	OSC	nc
31	SA0	in $	GND	power
32	GND	power	GND	power

| | J2 | | | |
| Pin Number | Row C | | Row D | |
	Name	Notes	Name	Notes
0	GND	power	GND	power
1	/SBHE	in $	/MEMCS16	in $
2	LA23	in $	/IOCS16	in $
3	LA22	in $	IRQ10	out $
4	LA21	in $	IRQ11	out $
5	LA20	in $	IRQ12	out $
6	LA19	nc	IRQ15	out $
7	LA18	nc	IRQ14	out $
8	LA17	nc	/DACK0	nc
9	/MEMR	in $	DRQ0	nc
10	/MEMW	in $	/DACK5	nc
11	SD8	bidir $	DRQ5	nc
12	SD9	bidir $	/DACK6	nc
13	SD10	bidir $	DRQ6	nc
14	SD11	bidir $	/DACK7	nc
15	SD12	bidir $	DRQ7	nc
16	SD13	bidir $	+5V	power
17	SD14	bidir $	/MASTER	nc
18	SD15	bidir $	GND	power
19	(KEY)		GND	power

- Inverted or "active low" signals are indicated by a slash '/'.
- "in" and "out" directions are stated as seen from the D134C.

- Signals with a "$" in the column "notes" are generic IO pins and may be redefined to a random function for customer specific versions of the D134C.

- Be aware about the pin numbering. It starts at 1 (J1) respectively at 0 (J2).

- The signals LA17 to LA19 are not supported. We recommend to use the signals SA17 to SA19 instead, in most cases they have an identical meaning.

Operating Conditions

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	Supply voltage	with respect to GND	4.75	5.25	V
t_{pu}	Power up ramp	0 .. 4.75V; monotonic rise		100	ms
V_{IN}	Input voltage	with respect to GND	-0.3	$V_{CC} + 0.3$	V
V_{OUT}	Output voltage		0	V_{CC}	V
V_{IH}	High level input voltage		1.7	$V_{CC} + 0.3$	V
		Recommended to keep for better compatibility:	2.0	$V_{CC} + 0.3$	V
V_{IL}	Low level input voltage		-0.3	0.8	V
V_{OH}	High level output voltage	I_{OH}=-4.0mA DC, V_{CC}=min.	2.4		V
V_{OL}	Low level output voltage	I_{OL}=4mA DC, V_{CC}=min.		0.45	V
I_{IN}	Input leakage current	V_{IN}=GND or V_{CC}	-10	10	µA
I_{OZ}	Tristated output leakage current	V_{OUT}=GND or V_{CC}	-10	10	µA
I_{SC}	Output short circuit current (1 output only, less than 1sec)	V_{CC}=max., V_{OUT}=0.5V	-30	-130	mA
I_{CC}	V_{CC} supply current [1]	V_{IN}=V_{CC} or GND, no load	200 (1W)	400 (2W)	mA
t_R	input rise time			40	ns
t_F	input fall time			40	ns
R_{CONF}	I/O pin pull-up resistor during PLD configuration	After Reset, for 450ms (PLD load time)	10	50	kOhm
C_{IN}	I/O pin capacitance	V_{IN}=0V, f=1.0MHz		10	pF

Remark:

1) Use the typical current in the "min" column to calculate average power requirements. This is a D134C specific property. Other products may have different "min" and "max" values.
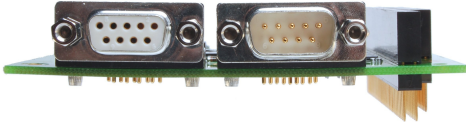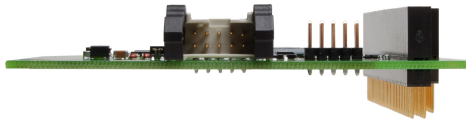
Timings

For a detailed description of the timings, please refer the document "PC/104 Integration – User's Guide", d-002310-nnnnnn.

CAN Interface (X1 and X2)

The D134C can be equipped with up to two CAN interfaces. The connector X1 is always assembled, the connector X2 as an option. All CAN signals of both connectors X1 and X2 are internally interconnected.

For both CAN connectors either 9-pin SUB-D or 10-pin header connectors are available (see also order information on page 39).

D134C equipped with two **SUB-D connectors.**	
D134C equipped with one **header connector.**	

Other types of CAN connectors are available on request.

The D134C supports virtually all CAN operating modes and baud rates: Version 2.0a and 2.0b, with up to 1 Mbaud. The CAN controller is compatible to the Philips SJA1000 widely used in the industry.

For more information about the software running on the CAN interface, refer to section "CAN Software Protocols" on page 21.

Pin Definition

The pin assignment conforms to the recommendation of the CAN in Automation (CiA) Draft Standard 102:

Pin # SUB-D	Pin # Header	Pin Shortcut	Description
1	1	NC	-
2	3	CAN_L	CAN signal line (dominant low)
3	5	CAN_GND	CAN Ground
4	7	NC	-
5	2	NC	-
6	6	NC	-
7	4	CAN_H	CAN signal line (dominant high)
8	8	NC	-
9	9	NC	-
-	10	NC	-
shell		Shield	Connection to shield resp. housing

All CAN pins (CAN_H, CAN_L, CAN_GND) are galvanically insulated from the digital logic. These signals are routed from X1 to X2.

CAN Termination

By default, there is no termination on the CAN interface. As an option, the following termination is available:

Issue	Description	Option
Termina-tion	Define the resistance of the terminator in Ω. (Usual values are 120Ω, 150Ω)	e.g. 120Ω, 150Ω **Default: no termination**

For more information call duagon.

This hardware selectable options must be defined prior to manufacturing / delivery of the product.

CAN Cabling

The D134C is by default configured to 1MBaud operation. For this mode, shielded CAN cables are recommended in order to reduce trouble with emitted EMI.

Header Option

In some applications, the D134C is mounted somewhere in the middle of a bigger mechanical enclosure; i.e. the connectors located on the D134C do not directly pass to the outside of the enclosure.

In this case, short cables are used to route the CAN lines from the outer surface to the D134C. Due to the fact, that SUB-D connectors end up in a very space-consuming size, the smaller solution of "headers" is available.

The headers have a 2.54mm pin raster, 10 pins in two rows of 5 pins. They are polarized and comply to DIN41651. The mating connectors are available in a very wide range of different manufacturers and products. The most spread version is the IDC technique (insulation displacement connector).

The header pinout is prepared to use flat ribbon cables directly connecting the header on the D134C and the IDC SUB-D connectors.

However, the IDC technique can be recommended for very short CAN cables, only (a few cm). A mismatch of impedance and shielding is introduced to the CAN lines. Much better behavior is achieved with shielded cables, twisted wires and crimped connectors, being recommended for distances beyond 10 to 20 cm.

The connectors are delivered with cable locks matching an IDC connector without strain relief. This is the most space saving arrangement and fits within the mechanical limits of the PC/104 definition.

If an IDC connector with strain relief is to be used, the cable locks must be somewhat larger. They can be ordered for this connector size as an option (see order information on page 39)

JTAG Interface

The D134C uses the JTAG connector for debugging and loading the flash memory (at virgin state after production).

The connector is a 10 pin header (without plastic frame).

The picture below shows a D134C with connected JTAG adapter (note the pin 1 localization):

Important Remark:

As a matter of fact, new firmware versions may occur. In order to avoid dis-mounting and mounting for reprogramming, we strongly recommend to keep access to the JTAG connector free (when the D134C is mounted in your system).

Pin Definition

Pin # JTAG	Signal Name	Comment
1	TCK	JTAG signal line
2	GND	Local power reference
3	TDO	JTAG signal line
4	+3.3V	Local power line
5	TMS	JTAG signal line
6	+3.3V	Local power line
7	Not connected	
8	Reserved	For Duagon internal test purposes, only
9	TDI	JTAG signal line
10	GND	Local power reference

Remarks:

- The pin number 1 has a "square" pad, all other pins have a round pad. The pin 1 is sometimes marked by a red stripe of the flat cable connector.

- The V_{CC} pins are connected to the internal 3.3V. Do not load the D134C internal 3.3V power supply with excessive current; use a separate power supply for the external debugging devices.

- All voltages are 3.3V low voltage logic compatible.

Serial Line Interface SER

There is one serial line interface (RS232) implemented. It has no galvanic insulation to the digital logic.

It provides a command line interface (see page 23) and it is intended for software debugging, only. It is recommended to use this serial line for no other purposes.

Default serial line transmission parameters are 115kBaud, no parity, one stop bit, no hardware handshake.

Pin Definition

Pin #	Signal Name	Input / Output as seen from the D134C	Description
1	nc	-	Not connected
2	nc	-	
3	RxD	Input	Receive data input
4	RTS	Output	Request To Send (not used by default)
5	TxD	Output	Transmit data output
6	CTS	Input	Clear To Send (not used by default)
7	nc	-	Not connected
8	nc	-	
9	GND	(power line)	Reference potential.
10	+5V	(power line)	Power line, internally connected to the PC/104 +5V power line. May be used to power the D134C in certain situations.

Application Hint

The picture shows a flat ribbon cable connected to the SER header.
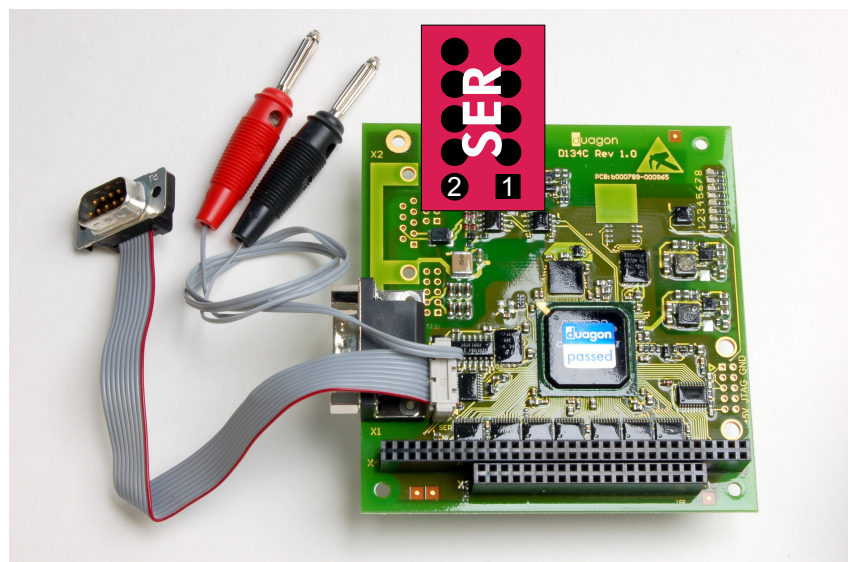
The pinout is made in a way that it directly matches male SUB-D connectors of the IDC type. This leads to a similar behavior like a standard PC COM line. In order to connect to a PC, a "null modem" cable (female connectors on both ends) must be used.

On the right side of the picture, you can see an example of how to power the board e.g. for programming purposes. Connect pins 9 and 10 according to the pinout description before.

In this example, it is the same flat ribbon cable passing through the header connector on both sides. On the SUB-D side, pin 10 is ripped off. On the power side, the pins 1 to 8 are ripped off.
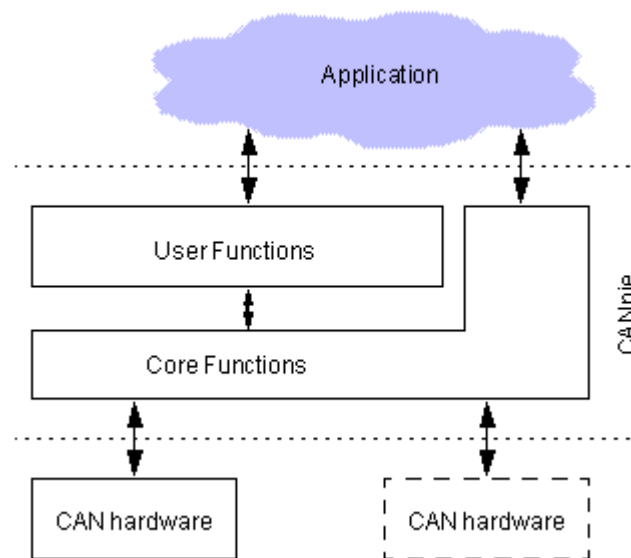
Software Protocols

CAN Software Protocols

CANpie Driver Software for Passive CAN Interface

The D134C is delivered with the CANpie Driver Software package. The CANpie Driver Software provides a low-level API to the CAN Controller of the D134C.

Note: CANpie can be replaced by any other CAN communication stack running on the host system.

CANpie provides a two-level API, consisting of core functions and user functions.

User Functions

The user functions always call the core functions, they never access the hardware directly. That means the user functions do not have to be modified when implementing the CANpie on an existing hardware. A typical user function is the writing of a CAN message to the FIFO buffer.

Core Functions

The core functions access the hardware directly, so an is necessary when implementing on a piece of hardware. Core functions may also be called by the application (in that case the application engineer must have a good knowledge about the CAN hardware). A typical core function is reading from a CAN controller register.

CAN Communication Stacks for D134C Server

The D134C can run arbitrary CAN communication stacks, such as CANopen, J1939, etc. This approach minimizes the CPU requirements of the host system, because the major part of the communication software is running on the Duagon interface.

CANopen

The D134C-O provides the host system with the CAN open protocol stack and enables the host system to connect to a CAN open network, as an NMT slave. The D134C-OM provides the host system with the additional NMT master functionality.

For more information, please refer to the "CANopen Stack API of Duagon Interfaces – Data Sheet", d-005267-nnnnnn.

CANpie

The D134C-P runs the CANpie protocol stack and enables the host system to access CAN networks. The protocol stack runs on the interface card, lowering the resource consumption on the host system.

For more information about the D134C-P, please call Duagon.

J1939

Please contact Duagon for further information.

POSIX File System Access

The D134C's local file system consists of

- a non volatile YAFFS flash file system (to store configuration and logging data)
- a volatile RAM file system (for fast data exchange)

The entire local file system can be accessed from the host by POSIX commands. The API supports file and directory functions, and is mostly compatible to the standard POSIX functions.

For more information, please refer to the "POSIX File System Access on Duagon Interfaces – Data Sheet", d-001829-nnnnnn.

Service Protocol

The Duagon Service Protocol provides a simple mechanism to access configuration and other data on the Duagon interface.

For more information, please refer to the "Service Protocol – Data Sheet", d-002751-nnnnnn.

Command Line Interface (SER)

The D134C is equipped with a RS232 serial line interface (see page 19). This serial line provides a Command Line Interface (CLI) for diagnostics, debugging and maintenance. The following functions are available:

- Access to the local flash file system
- Download and Upload of product firmware using Xmodem protocol

Default serial line transmission parameters are 115kBaud, no parity, one stop bit, no hardware handshake.

For more information about the CLI, please refer to the data sheet "Command Line Interface – Data Sheet", d-002357-nnnnnn.

Mechanical Data

PC/104 Mechanical Data

The figure below shows the drawing as it is distributed by the PC/104 Consortium (see chapter "Standards Reference" on page 32).

In general, the D134C complies to the PC/104 mechanical specification. **Version specific information is listed on the following pages.**
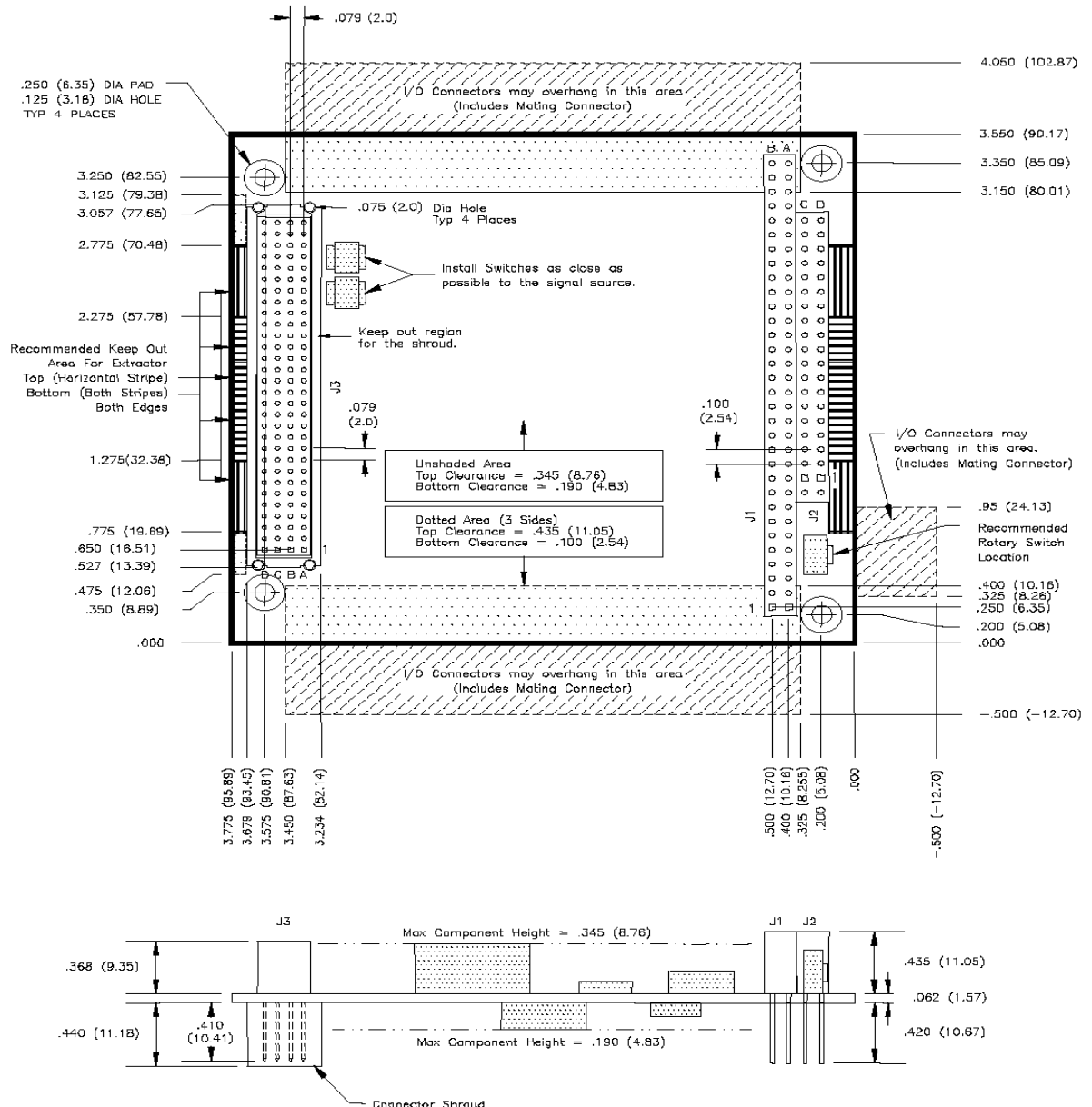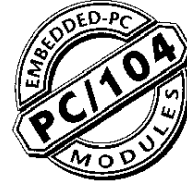
(The dimensions are in inches / (millimeters).)

Note: The drawing shows the PC/104-**Plus** standard, i.e. the new specification which additionally includes a PCI connector (situated on the left side). Even though, this extension does not have a direct importance to the D134C board series (compliance to the PC/104 Standard), we recommend our customers to take the PC/104-Plus standard as a guideline for future developments.

Mechanical Dimensions and Weight

Item	Value	Remark
Maximum component height, top side [1]	14mm	SUB-D connectors
	8.8mm	other components (PC/104 connector excluded)
Maximum component height, bottom side [1]	2.5mm	component height (PC/104 stackthrough connector excluded)
PCB thickness, nominal	1.6mm	
Weight of board [2]	90g	Fully equipped

Remarks:

1) Absolute maximum height of the D135EML. Add some millimeters of "safety" margin.

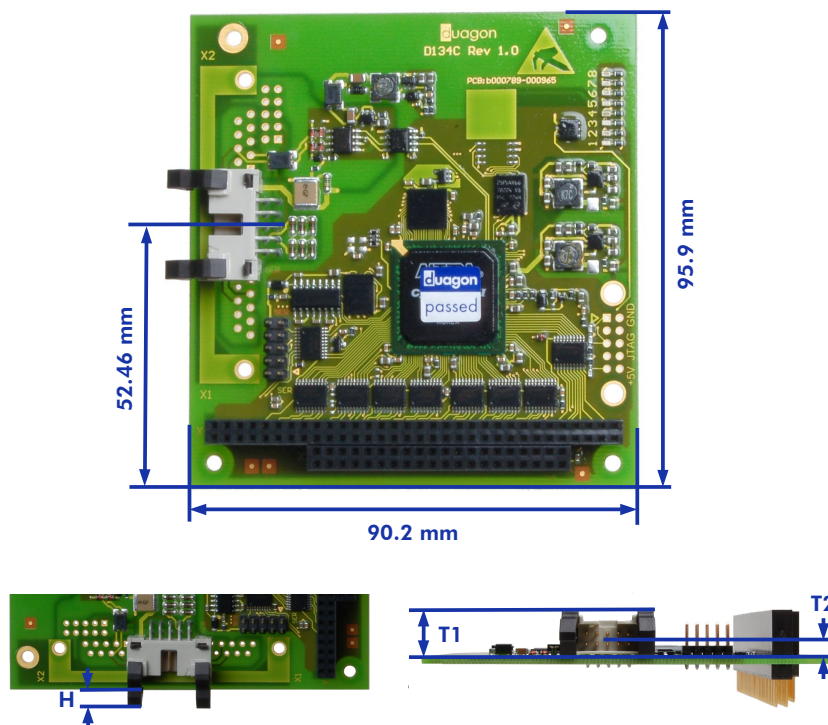2) The precise weight of the board may vary according to the selected connector options.

SUB-D Connectors
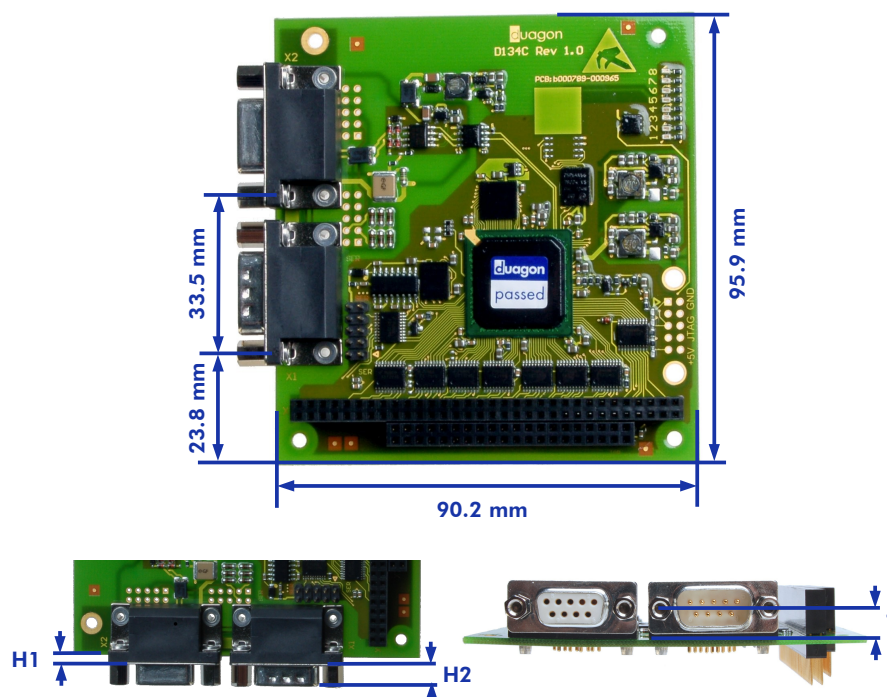
SUB-D type (see order information on page 40)	H1	H2	T
Standard SUB-D connectors (default)	0.5	6.0	7.3
SUB-D connectors with long hangover (order code "H")	2.3	6.0	6.3

(all measures are in mm)

Header Connectors

| Header type (see order information on page 40)	H	T1 [1]	T2
Standard Header connectors (default)	5.3	17.5	5.0
Header connectors with long cable locks (order code "L")	8.8	20.2	5.0

(all measures are in mm)

Remark:

1) The maximum height is stated for fully open (unlocked) cable locks. It is possible to connect the cables without fully opening the cable locks. This allows to connect and disconnect cables without dis-mounting the D134C from your system.
In locked position the header easily complies to the maximum component height defined in the PC/104 Standard.

PC/104 Mounting

The D134C is proposed to be mounted like standard PC/104 modules. The drawing below shows the situation for "stackthrough" and "non-stack-through" modules. Not shown in the drawing are the four standing bolts which screw the stack together.
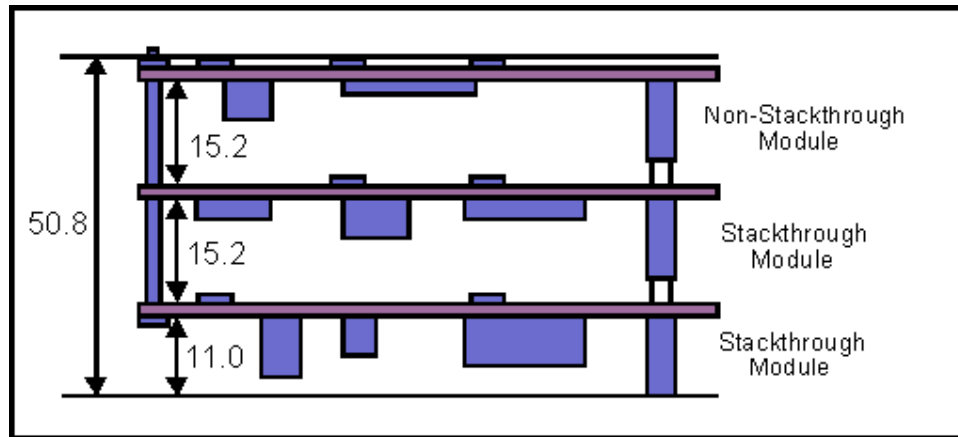
The drawing shows the distance between the modules as defined in the PC/104 standard.

It depends on the particular application respectively the component height of any adjacent board, what module distance is to be chosen.

- Four sets of screws respectively standing bolts are required for fixture to the host board (not part of D135EML scope of delivery).

- If a front plate is used, it must have appropriate cutouts.

By default, stackthrough pins are delivered to stack several PC/104 boards on top of each other.

Stackthrough Pins
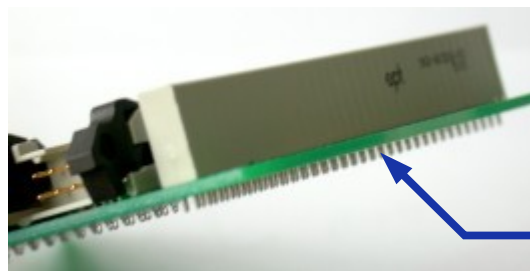
As an option, non-stackthrough pins can be ordered, too (see order information on page 39)

Non-Stackthrough Pins

Shield-to-Case Strap

The single plated mounting hole can be used to connect the fieldbus connector's shields (CAN) to the device housing.
This allows the user to realize individual shielding concepts.

The picture shows the D134C from the bottom side (solder side); close to the plated mounting hole (the other three mounting holes do not connect the screw to anything else).
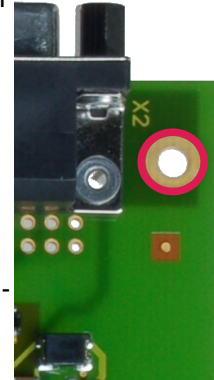
Cabling / Cable Locks

The CAN cables on the outside are usually very stiff and heavy. From the mechanical point of view the SUB-D connectors are not strong enough to keep vibration or bending stress without any strain relief. The solder junctions are not able to carry this high mechanical stress. Instead any other fixture must be used (e.g. front plate, or other strain relief).

The screw locks have an inner threading M3. Do not try to mount the wrong connectors, it will destroy the thread!

The maximum torque for the screw locks is 40cNm. A higher torque may destroy the thread!

Alternatives:

- Optionally, the SUB-D connectors can be chosen without screw locks (option "N", see order information on page 39).

- The thread on the SUB-D connectors can optionally be chosen to be UNC-4 40 (option "U", see order information on page 39).

For more information see the "Material and Components for Wiring – Technical Note", d-000842-nnnnnn.

Environmental Data

Issue	min.	typ.	max.	Unit	Remarks
Operational temperature range	-40	+25	+85	°C	EN50155:2007 4.1.2: Class TX
Temperature rise of directly surrounding air after power-on		1	5	°C	measurement 10min after power on
Altitude above sea level			1800	m	EN50155:2007 4.1.1 For derating of maximum temperature with respect to altitude levels in excess please call Duagon.
Relative humidity		<75%	95%		Typical value for yearly average, max value for 30 consecutive days per year. Short term moisture condensation without malfunction (DIN EN 60068-2-30:2006-05)
Vibration			2 50	mm m/s^2	EN50155:2007 12.2.11 for 5-25 Hz for 25- 150 Hz
Shock			50	m/s^2	duration 50ms
RFI susceptibility from 0.15 to 2000 MHz.	20			V/m	

Application Hints

Diagnostic by LEDs

A set of eight general purpose diagnostic LEDs is used for self test purposes. When an error is encountered during self tests, the LEDs display the test number. This can be used in order to find the reason for the failure more efficiently.

The particular meaning of the LED diagnostic codes is highly application specific. Please refer to the related documentation in the host driver packages.
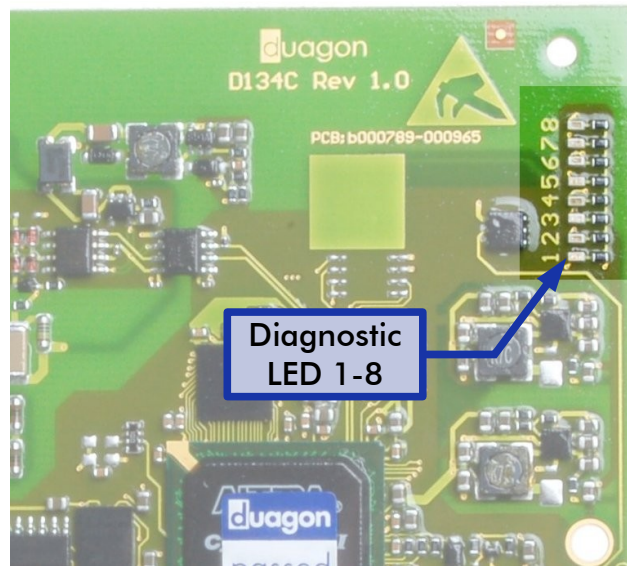
Panic Recovery

The D134C supports a workaround solution, when the usual download via service serial line (see also page 23) does not work any more. This could be the case, when the download procedure is stopped too early or when the downloaded application does not work properly.

For low level programming, the module does not need to be removed from the mounting location. For more information about the JTAG interface, see page 17.

However, since the JTAG connector is not equipped with a galvanic insulation, a problem may arise. Be sure, that none of the debugging tools (notebook? JTAG debugging box?) touch sensitive contact areas (even protective ground may damage the devices...).

Reset Mechanism

The D134C board generates its own under voltage supervision circuitry on-board. The switching level for the internal RESET is far below the lower V_{CC} limit. This enables fully stand-alone function, i.e. no external reset signal is needed.

The pin "RESETDRV" of the ISA bus is monitored by the onboard CPU in order to correctly reflect the system reset status.

We therefore recommend our customers to keep the RESETDRV pin controllable from both software and their own under voltage detection.

Assumed this is not done, a tricky situation may arise, if –

- the host detects an under voltage situation and the D134C does not (the reset levels are never perfectly matched)

- and RESETDRV is not driven by the host in case of an host under voltage condition

 – then it could happen, that the D134C "does not know anything" about this condition and continues to communicate with the CAN. This is definitely wrong!

Another tricky situation could theoretically arise "mirrored" from before:

- The D134C dives through a reset, the host does not. The host software faces a "lost" D134C board.

This situation is not very likely, since the D134C internal under voltage detection is fairly low (approx. 4V), i.e. the host supervision should have reset the host CPU in any case before this condition.

Power Up (PLD Loading)

On the D134C the PLD chip has to be loaded after power-on. This procedure takes up to approx. 1 second and is automatically performed. However, the device is completely passive during this time, "as if nothing is plugged in".

If a host CPU tries to access the D134C directly after power on, it will not find it. In order to avoid any wrong conclusions ("D134C defective ..."), the host CPU has to wait for the PLD being ready.

For more information, please refer to the "PC/104 Integration – User's Guide", d-002310-nnnnnn.

EMI Considerations

We assume the following implementation for the D134C:

- The supply is filtered before any conversion of the voltage. This topology makes the host immune against any coupling of noise and prevents the broadcast of noise on the supply. It also could be useful to add a folding ferrite.

- The power supply of the host is galvanically insulated from the battery and the case.

- Connect all power pins in a way, that the overall impedance of the power lines is reduced to a minimum.

Standards Reference

The D134C complies to the standards EN50155 and EN50121-3-2 in general. For exceptions, not applicable subclauses etc. please refer to the following paragraphs and, in more detail, to the "D134C Type Test Report" with the document number d-002311-nnnnnn:

Electromagnetic Compatibility

EN50121-3-2:2006: The D134C product line complies to EN50121 under the precondition, that it is used in an environment being on acceptable technical level. The reason for this restriction is, that our product cannot be tested according to the mentioned standard as it is (it is a board level product, not a device). EMI effects are influenced by e.g. housing and cabling. We do not have an influence on these parameters. In addition, these parameters change from application to application, which voids the statements from previously made tests; i.e. the tests have to be repeated. The statements apply in a similar way to both emission and immunity.

For a typical CAN interface application, most of the statements about **"transients"** have no influence to the D134C. There are no battery referenced inputs or outputs from the D134C available on the outside of the devices. We assume, that the D134C power supply is galvanically insulated and/ or the D134C signal lines have no connection with unshielded cables to the outside.

Please note, that the CAN must be used with shielded cables. This leads to the fact, that the successful survival under these tests depends from a well working grounding structure. We therefore highly recommend to have a low impedance path from the CAN cable shield to the housing ground.

Insulation

EN50155:2007 12.2.9: Insulation measurement test / Voltage withstand test. CAN physical layer, according to IEC60571, $500V_{rms}$, $1M\Omega$ for 1 minute. Each individual device is tested prior to shipment (routine testing). During routine testing, the testing is optionally changed to sinusoidal $708V_{rms}$ or $1000V_{dc}$, $1M\Omega$ for 10sec.

Note: From EN50155:2007 7.2.1 it is assumed that the power supply for the D134C is galvanically insulated from the vehicle battery.

Useful Life

EN50155:2007 6.2: There are reprogrammable components used in the D134C. These are specified from the manufacturer with 20 years data retention at 125° Celsius, which fits clause 6.2. The actual "useful life" can be extended by reprogramming these devices.
There are no other components with a limited useful life. Particularly, there are no electrolytic capacitors, which typically introduce a limitation to useful life.

Components

EN50155:2007 8.1.5 and 8.1.7: There may be specialized components/ single source components included in the product. Contact Duagon for more information about repair and long term shipment procedures.

Shock and Vibration

EN50155:2007 4.1.3: The D134C product line complies to EN50155 under the precondition, that it is used in an environment being on acceptable technical level. The reason for this restriction is, that our product cannot be tested according to the mentioned standard as it is (it is a board level product, not a device). Resonance effects are influenced by the housing. We do not have an influence on these parameters. In addition, these parameters change from application to application, which voids the statements from previously made tests; i.e. the tests have to be repeated.

EN61373:1999: There is no specific definition of the mounting direction in the vehicle, i.e. the highest requirement is to be applied to all directions of the D134C. The D134C applies to mounting location "Category 1, Class B".

CAN

ISO11898-2:2006: Controller Area Network (CAN): The D134C complies to the standard in general.

CANopen

IEC61375-3-3: Electronic Railway Equipment - Train Communication Network - Part 3-3: CCN – CANopen Consist Network. The D134C-O(M) complies to the standard in general.

Manufacturing

The manufacturing of the PCB assembly is done according to **IPC-A-610D:2005 level 2.**

The product complies to the European Union directive **EC/2002/95** (**RoHS** compliance).

REACH

Concerning the European Union directive **EC/1907/2006** (**REACH** compliance), Duagon does not need to register any substance. Duagon's products do not use quantities of more than 1 ton of a certain substance and the substances are not released under normal conditions of use. For a registration, both criteria would have to be fulfilled.

PC/104

PC/104 Specification, Version 2.3, June 1996, Copyright 1992-96, PC/104 Consortium, 849B Independence Ave, Mountain View, CA 94043

Fire and Smoke

EN45545-2:2010: The D134C falls in the category of "not-listed" products. There are no special requirements for products with a mass lower than 100g (interior location) and 400g (exterior location).
The mass of the D134C is approximately 90g.

NF F16-102:1992: According to the French standard NF F16-102 no requirements are necessary for electrical systems with a mass lower than 300g, which are situated in a technical compartment, in the open air, a box, a cabinet or as a block equipment. The mass of the D134C is approximately 90g.

Humidity

EN60068-2-30:2006: Provides a composite test procedure, primarily intended for component type specimens, to determine, in an accelerated manner, the resistance of specimens to the deteriorative effects of high temperature/humidity and cold conditions.

Links to other Duagon Documents

In general, most of the documents are located on www.duagon.com, and may be downloaded from there in the most up to date version.

D134C Type Test – Report, d-002311-nnnnnn

This document covers the type testing performed with the D134C device.

Host Driver CANopen, d-005284-nnnnnn

The Host Driver provides an easy way to implement your application on the D134C CAN interface. It contains the source code of the host driver software and documentation. This package is intended for the D134C-O CANopen.

Configuration – User's Guide, d-001785-nnnnnn

This document describes the configuration options on Duagon interfaces. The configuration mainly includes fieldbus and host-interface related parameters.

PC/104 Integration – User's Guide, d-002310-nnnnnn

This document is intended for developers of control electronics, who want to integrate a D134C. It describes how to modify the PC/104 bus interface in order to make it fit with other bus systems (i.e. configuration of host interface, which maps a UART register set into the host system). It also describes the mechanical integration on a custom specific carrier board.

CANopen Stack API of Duagon Interfaces – Data Sheet, d-005267-nnnnnn

This documents describes the API available on the host system to interact with the CANopen protocol stack on the interface card.

POSIX File System Access on Duagon Interfaces – Data Sheet, d-001829-nnnnnn

This document describes the POSIX file system API, which makes the FLASH file system on Duagon interface boards accessible over the host interface. The API supports file and directory functions, and is mostly compatible to the standard POSIX functions.

Service Protocol – Data Sheet, d-002751-nnnnnn

This document describes the features and the API of the service protocol available on Duagon communication interfaces.

Command Line Interface – Data Sheet, d-002357-nnnnnn

This document describes the Command Line Interface on the service serial line of Duagon products.

D221 PCI-Express Adapter Card – Data Sheet, d-002530-nnnnnn

The D221 is a PCI-Express Card providing slots for Duagon PC/104 and PC/30 interface cards. This adapter card allows you to access Duagon Ethernet, MVB and CAN interface cards through PCI-Express.

Labeling and Packaging – Specification, d-000778-nnnnnn

This document describes all product labels (e.g. serial number label) used in relation with customers. It describes furthermore how Duagon packs the products for shipment.

Quality Plan for Duagon Products – Specification, d-000796-nnnnnn

This document is a specification about test procedures for series testing of Duagon products. It is valid for all Duagon products in general. For each

specific product an applicable subset of the described tests is selected; according to the procedures specified here.

Life Cycle of Duagon's Products – Technical Note, d-000526-nnnnnn

Opens up some MTBF and Life Cycle considerations. In a very general way, the "Life Cycle"- document may be used for planning the life time repair stock in order to ensure long support times.

Material and Components for Wiring – Technical Note, d-000842-nnnnnn

This document is intended for engineers to help them select the right components.

D134C Order Information

The basic architecture of the D134C allows a large number of different options. In order to find out the right option profile for your application, follow these three steps:

Step 1:   Select the desired functions: Passive interface or server with communication stack.

Step 2:   Select the desired integration properties (connector options, etc).

The options from step 1 and 2 are required to be specified prior to manufacturing (normally at order time). These options may have an influence on pricing.
Any changes at a later date may cause significant trouble with respect to cost and / or delivery time.

Step 3:   Customer or project specific software options (communication parameters for CAN, definitions of data sets, etc).
These options are downloadable to the hardware, and come readily programmed with the shipped devices. Their selection is required prior to delivery of boards, i.e. possibly after hardware manufacturing.

D134C	-L	- P4	BB	2X

CAN Function:

passive Interface	**-L**
CANopen Slave	**-O**
CANopen Master	**-OM**
CANpie	**-P**
J1939	**-J**

Form Factor:

PC/104	**-P4**

CAN Connector Type:

1x Header	**A**
2x Header	**AA**
1x SUB-D	**B**
2x SUB-D	**BB**

Connector Options: (Add all Characters that apply)

|	
With 64-pin AND 40-pin PC/104 connectors	**2**
PC/104 no stackthrough pins	**X**
Header with long cable locks	**L**
SUB-D with long hangover	**H**
SUB-D with UNC4/40 screw locks	**U**
SUB-D without screw locks	**N**
defaults	**<empty>**

Step 1: Select Your Functions / Features
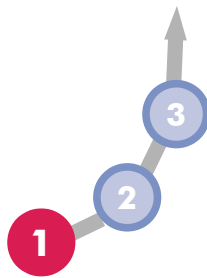
Decide on the type of CAN interface:

- **D134C-L:** Passive CAN interface with a CAN controller.

- **D134C-O:** Active CAN interface including a CANopen communication stack

- **D134C-OM:** Active CAN interface including CANopen master communication stack

- **D134C-P:** Active CAN interface including CANpie communication stack

- **D134C-J:** Active CAN interface including a J1939 communication

Other CAN communication stacks are available on request. Please contact Duagon for further information.

D134C	-L	-P4	BB	2X
CAN Function:				
passive Interface	**-L**			
CANopen	**-O**			
CANopen Master	**-OM**			
CANpie	**-P**			
J1939	**-J**			
Form Factor:				
PC/104		-P4		
CAN Connector Type:				
1x Header			A	
2x Header			AA	
1x SUB-D			B	
2x SUB-D			BB	
Connector Options: (Add all Characters that apply)				
With 64-pin AND 40-pin PC/104 connectors				2
PC/104 no stackthrough pins				X
Header with long cable locks				L
SUB-D with long hangover				H
SUB-D with UNC4/40 screw locks				U
SUB-D without screw locks				N
defaults				<empty>

Step 2: Select Your Integration Properties
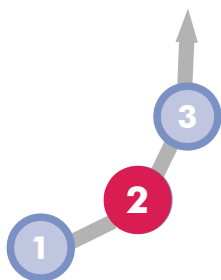
First, decide on the number and style of connector for CAN:

- either one or two SUB-D connector(s)

- or one or two header connector(s).

Then, make your choice about the PC/104- connector options:

- The selection of "stack through" or "non stack through" depends upon your mounting environment (Option X).

- The second PC/104- connector may be used for 16-bit access ("2"). Note: The second connector may be used to route the 16-bit signals to another PC/104- module being stacked on top of the D134C.

If you have chosen header connectors for CAN, decide on the length of the cable locks:
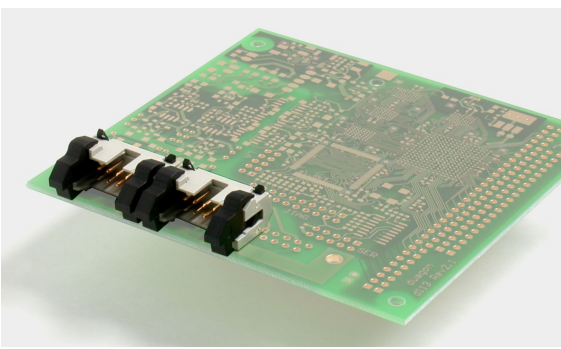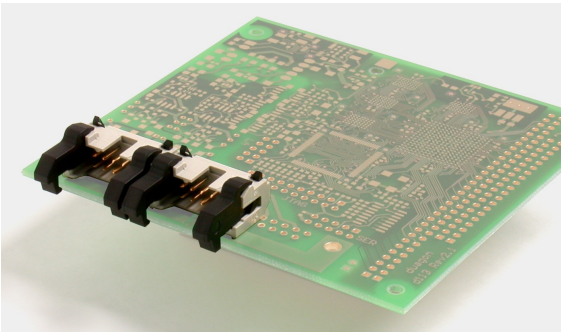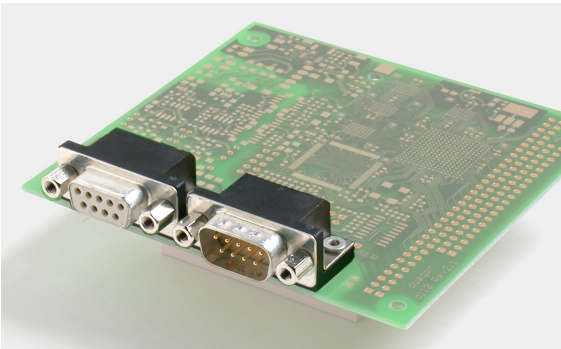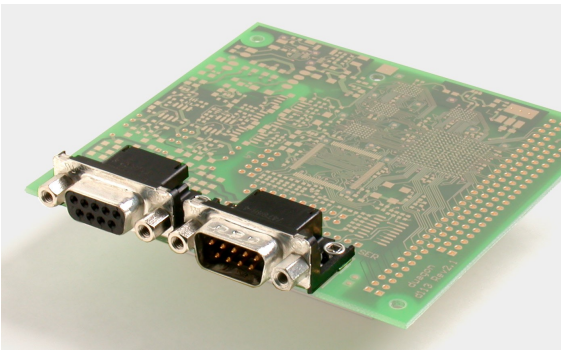
- default is short cable locks

- "L" for long cable locks

If you have chosen SUB-D connectors for CAN, decide on the type of screw locks on the SUB-D:

- default is M3

- "U" for UNC4/40
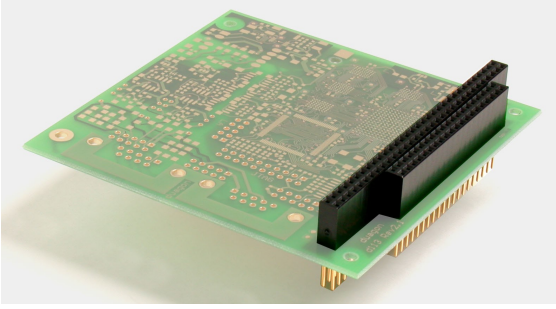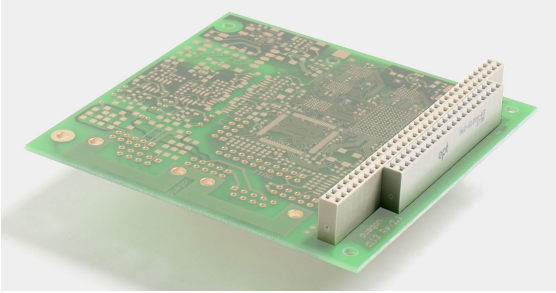
- "N" for no screw locks at all
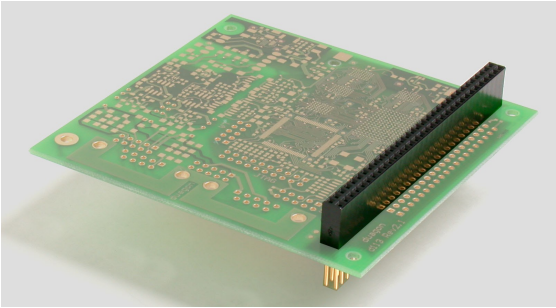
D134C	-L	-P4	BB	2X
CAN Function:				
passive Interface	-L			
CANopen	-O			
CANopen Master	-OM			
CANpie	-P			
J1939	-J			
Form Factor:				
PC/104		-P4		
CAN Connector Type:				
1x Header			A	
2x Header			AA	
1x SUB-D			B	
2x SUB-D			BB	
Connector Options: (Add all Characters that apply)				
With 64-pin AND 40-pin PC/104 connectors				2
PC/104 no stackthrough pins				X
Header with long cable locks				L
SUB-D with long hangover				H
SUB-D with UNC4/40 screw locks				U
SUB-D without screw locks				N
defaults				\<empty\>

CAN Connector Examples

Connect-or Type	Connect-or Options	Picture and Description
AA	-	Header (order code "–P4AA")
AA	L	Header with long cable locks (order code "–P4AAL")
BB	-	SUB-D (order code "–P4BB")
BB	H	SUB-D with long hangover (order code "–P4BBH")

PC/104 Connector Examples

Connect-or Type	Connect-or Op-tions	Picture and Description
-P4	-	64-pin stackthrough PC/104 connector, only
-P4	2	64- *and* 40-pin stackthrough PC/104 connectors **Note**: The "2" stands for the second PC/104 con-nector (40 pins).
-P4	2X	64- and 40-pin *non-stackthrough* PC/104 connectors

Step 3: Project Specific Software Options ("OP" number)
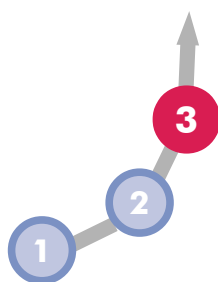
There are a large number of software configuration options on the D134C:

- CAN communication parameters such as baud rates, timeouts, etc. For a detailed list and default values of all CAN configuration parameters refer to the "D134C Configuration Guide".

- Definition of the data sets to be exchanged over CAN. The structure of these definitions is given by the CAN communication stack and the data set definitions are project specific. For more information please refer to the data sheet of the desired communication stack.

The configuration files containing all these parameters are stored D134C's local flash file system. Unless otherwise specified, the D134C is shipped with default configuration parameters and the customer may download new configuration files with appropriate configuration.

The selection of all options may become a rather complex process. This process does not have to be repeated for each commercial order! All application specific features (including the configuration files) are concluded within a single identification number, the so called "OP".

How to get such a project specific OP number?

- Make your selections and submit all information (including your configuration files) to Duagon, e.g. by email.

- Duagon will archive this information and release an OP number for it.

- The customer introduces this number into his commercial ordering system; any future orders will refer to this identification.

Examples for options related to Host Interface

When you need a custom specific adaptation to the bus type, please refer to the document "Integration Guide for Duagon 2nd Generation PC/104 Products", d-002310-nnnnnn.

Some of the possible options:

Option related to host interface	Default value
Bus type	PC/104 (ISA)
Data bus size	8 bit
Address type	IO mapped
Address range	0x04F8-0x4FF

For any additional custom specific modifications, please call Duagon. We will submit an offer about your implementation.

Please note: Testing of the products after production will be done with a standard configuration, i.e. the hardware sanity is confirmed. However, in special custom configurations features may not be tested since there is no test equipment, that emulates the customer's hardware. In these cases, we recommend our customers, to submit one of his target systems to Duagon.

Preferred Option Set Combinations ("OP")

The functionality as described (no customer specific changes) can be identified with the following document numbers:

Intended for hardware...	Document number downloadable options (also known as "OP")	Description
D134C-L	to be defined	Passive CAN, POSIX
D134C-O	to be defined	CANopen Slave, POSIX
D134C-OM	to be defined	CANopen Master, POSIX
D134C-P	to be defined	CANpie, POSIX

Document History

d-002282-011384

- Changed GmbH to AG
- Adapted description of CANopen communication stack
- Adapted description of CANpie communication stack
- Added ordering options for: CANopen master (-OM) and CANpie (-P)

d-002282-008854

- REACH statement added
- company address and phone number updated
- Various minor changes, mainly editorial

d-002282-007515

- Regrouping of chapters
- multiple minor changes, mainly editorial
- EMI hints added
- Humidity standard added
- extended chapter Mechanical Data (plated hole..)
- added Service Protocol

d-002282-005780

- First release of "preliminary data sheet".

Index

Appendix A: Document Numbering System

All Duagon documents have a unique identification number. The identification number has a certain internal structure in order to ease the tracking of different documents. In general, there are two parts:

Prefix	Document number	Filing number
d	-000310	-001952
Always constant	Specifies a certain purpose of a document with the intention to link several documents with different filing number. Please note, that the purpose of the document number is not stored for each document number, but can be derived from the document title, which is stored for each Filing number. The format is either 6 digits or not available.	Unique number, that identifies a particular document. Released in sequential manner as the documents are filed in the archive. A duagon internal data base contains exactly one document title text for each filing number. Always 6 digits.

Examples for identification numbers

Identification number	Document Title / Remarks
d-000310-001606 d-000310-001952	"DXIO data sheet Rev 2.2" "DXIO data sheet Rev 2.3" A document, that is updated from time to time: the document number has the purpose to link several versions of the "DXIO data sheet" together. The filing number distinguishes between different versions. Please note, that the document number part is kept the same, as long as the basic intention of the early versions is still kept, for example during revisions due to debugging or manufacturing updates. In case a significant change happens, another document number would be applied.
d-000719	"Notes from prototype meeting …" A document, that is obviously not updated after release. The "document number" part is missing and the filing number remains the only used part for identification.

Recommendation:
In your order, you may specify for example "d-000584-nnnnnn" in order to get the "newest" version of a specific product. When you do not want to follow the sequence of newer versions, i.e. you want to stick to a specific version, then specify the full identification number like "d-000584-002043".

Appendix B: Software Licensing

The software components used on the D134C are subject to specific license agreements. The following sections describe the relevant issues in a generalized form for duagon products:

eCos - RTOS Real-Time Operating System

The RTOS eCos is a registered trademark of Red Hat, Inc. The eCos source code and the "eCos license" agreement are available for public download on Sourceware Web Site (http://ecos.sourceware.org/).

The packages below are delivered under the terms of the "eCos license":

- The "eCos Library for D134C" is based on a public available eCos release and Duagon's eCos Package Distribution "NIOS2-DUAGON" both configured using eCos template "duagon_D134C".

YAFFS Flash File System

YAFFS is distributed under the terms of the license between Duagon GmbH (http://www.duagon.com) and Aleph One Ltd (http://www.yaffs.net/). Please contact Duagon GmbH for more information about this license.

Bootloader and other Internal Drivers

Altera driver and headers:

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Host Server, Client Driver, Demo Applications

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- Host Interface drivers (server and client)
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Note: The Original CANpie Software is available for public download on MicroControl's Web Site (http://canpie.sourceforge.net/).