

**lococube**<sup>®</sup> GT-900  
**Art. No. 0895-0900**

**MANUAL**



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## SAFETY INSTRUCTIONS

This manual contains notices which you should observe to ensure your own personal safety, as well as to protect the product and the connected equipment. These notices are highlighted in the manual by a warning symbol and are marked as follows according to the level of danger:



**Only qualified personnel should be allowed to install and work on this equipment. Qualified persons are defined as persons who are authorized to commission, to ground and to tag circuits, equipment and systems in accordance with established safety practices and standards.**



**Turn off the power supply before performing any wiring operations! Short circuits can be harmful, critical and can cause explosions and serious burns!**



**Please read this manual carefully and observe all safety instructions!**

## DESTINATED USE

The lococube<sup>®</sup> is designed for universal measuring, controlling and regulating applications.

## DISCLAIMER

BARTH<sup>®</sup> assumes no liability for usage and functionality of the lococube<sup>®</sup> in case of disregarding this manual. The strict accordance of this manual is important since the installation methods, peripheral connections, usage and maintenance can not be controlled by BARTH<sup>®</sup>. Therefore BARTH<sup>®</sup> assumes no liability for any claim.

## 1 Product description

### 1.1 Features

- Highly flexible mini-PLC for OEM solutions
- High-Performance 32 Bit ARM<sup>®</sup> Cortex<sup>®</sup> M4
- 1-Wire
- CAN 2.0A/B, CAN FD
- RS232
- Comprehensive Fail Safe Functions
- Open Source 'C' Programming
- Wide Operating Voltage Range 7 to 32 VDC
- Wide Operating Temp. Range -40 to +70°C
- Vibration resistant and rugged due to potting
- CE conformity
- Engineered and manufactured in Germany

### 1.2 Applications

- Industrial and process control
- Test and control systems
- Automotive and maritime technology
- Technical education
- White goods

### 1.3 Delivery content

- 1x lococube<sup>®</sup> GT-900
- 1x Connector for supply and CAN
- 1x Connector for Communication interface

## 2 Installation

### 2.1 Mounting

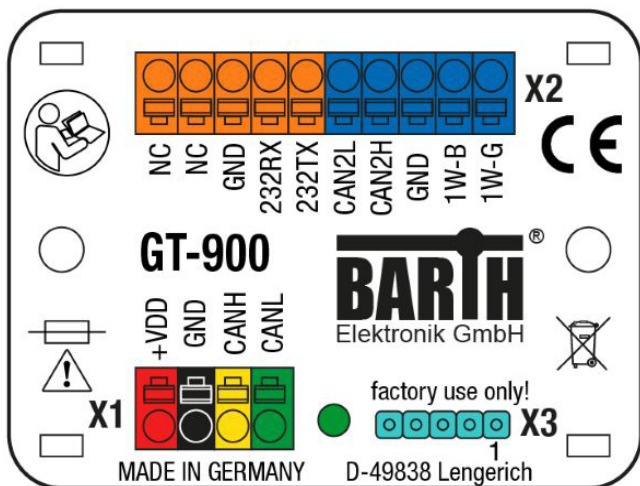


**The lococube® must be installed and wired by a trained technician who knows and complies with both the universally applicable engineering rules and the regulations and standards that apply in specific cases.**

Fastening the GT-900 follows using either the integrated mounting holes for screws or the holes for cable ties. The cable tie installation method is recommended for fastening the lococube® on wiring harness, tubes or other mechanical parts.

### 2.2 Wiring

#### 2.2.1 Overview



#### X1 connector: Power supply and CAN pins

1	VDD	positive supply terminal
2	GND	ground terminal
3	CANH	CAN high terminal
4	CANL	CAN low terminal

#### X2 connector: Interface connector

1	1W-G	1-Wire Ground
2	1W-B	1-Wire Bus
3	GND	Ground
4	CAN2H	CAN Bus 2 / high
5	CAN2L	CAN Bus 2 / low
6	232TX	serial port transmit
7	232RX	serial port receive
8	GND	Ground
9	NC	Not used
10	NC	Not used

### 2.2.2 Connecting the power supply

The GT-900 features an outstandingly wide supply voltage range from 7 to 32 VDC at lowest current consumption. So the lococube® can be integrated within battery supplied 12V or 24V DC systems (cars, trucks, battery powered cars, forklifts and diggers, for example).



**Turn off the power supply before performing any wiring operations!**



**False electrical connection, voltage reversal or disregarding the electrical specifications may cause irreversible damage of the lococube®!**

Connect the supply voltage of 7 to 32 VDC to the 4-pole terminal X1 of the lococube®. Wire the positive supply to the ,VDD' marked connection. The negative (ground) will be wired to the ,GND' connection. All terminals are carried out as plugable spring terminal connectors for a wire gauge of 0.25 to 1.5mm<sup>2</sup>.



**Ensure correct power supply voltage range and polarisation! External fusing of 6A max. is mandatory! Disregarding may cause irreversible damage of the lococube®!**

### 2.2.3 Connecting the CAN interface

The X1 connector of the lococube® contains the CAN-specific pins ,CANH' and ,CANL'.



**The voltage at CANH or CANL must not exceed -55 or +55 VDC referred to ground (GND). Higher voltages may cause irreversible damage of the lococube®!**

There is no termination resistor (120R) integrated in the lococube®. Please add a 120R resistor at both ends (2) for CAN bus termination.

### 2.2.4 Connecting the VK-46

Please connect the STLINK-V3MINIE to your computer via the provided USB-C cable.

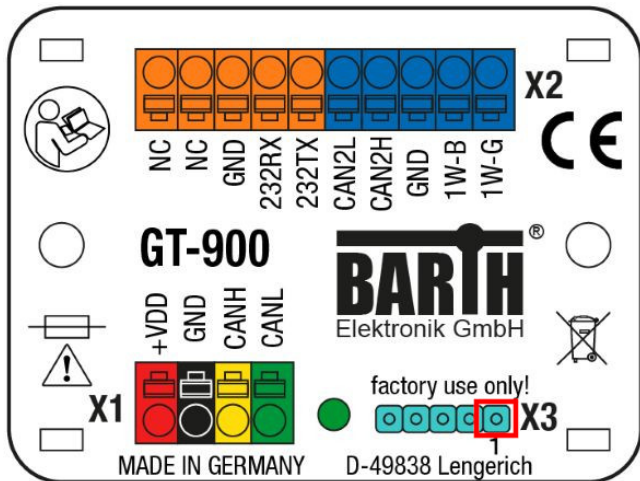
The jumper are pushed onto the VK-46 in the configuration „Setting A“ as shown below.



The VK-46 is plugged into the GT-900 via the X3 connector in the orientation shown below. Please use the provided connector extension and ensure that the jumper are positioned correctly.



Pin 1 of the VK-46 connects to the Pin 1 on the X3 connector on the GT-900.



### 3 Programming

#### 3.1 Programming requirements

**Mandatory requirements:**

2	VK-46 (Connection adapter)	<a href="http://barth-elektronik.com">barth-elektronik.com</a>
3	Any 'C' programming environment	-

**Example program requirements:**

1	GT-900 Example Program	<a href="http://barth-elektronik.com">barth-elektronik.com</a>
2	lococube STG-800	<a href="http://barth-elektronik.com">barth-elektronik.com</a>
3	Harness KS-85 (optional)*	<a href="http://barth-elektronik.com">barth-elektronik.com</a>
4	STM32CubeIDE	<a href="http://st.com">st.com</a>
5	miCon-L	<a href="http://micon-l.de">micon-l.de</a>

*A KS-85 wiring harness is not required, but offers an easy way to power and connect the GT-900 and the STG-800, comes with a 12V power supply and has CAN termination resistors already integrated.*

If the example programs is used, the GT-900 and and STG-800 need to have the CANH and CANL terminals connected via the X1 connector. Please ensure proper termination resistance!

#### 3.2 Programming options

The lococube GT-900 is programmed „open-source“ in C. STM32CubeIDE is the recommended programming environment, featuring an easy-to-use graphical Pinout & Configuration menu.

Before miCon-L is set up, the ST-LINK should be connected to the computer via a USB port, so the correct COM port can be chosen.

### 4 Example programs

The example program requires an additional STG-800 with miCon-L installed on a windows computer.

The example program showcases the GT-900's gateway functions, by taking the CAN message that the STG-800 sends to it, and transmitting it using a different communication protocol, depending on the CAN ID that is selected in the provided miCon-L program. According to that, the LED on the GT-900 will change its behavior as well.

1	BASE ID	0x600	-
2	CAN	0x610	RED ON
3	1-Wire	0x620	RED FLASHING
4	RS232	0x630	GREEN FLASHING

By default the following baudrates apply:

1	FDCAN1	250 Kbit
2	FDCAN2	500 Kbit
3	1-Wire	100 Kbit
4	RS232	115,200 Bit

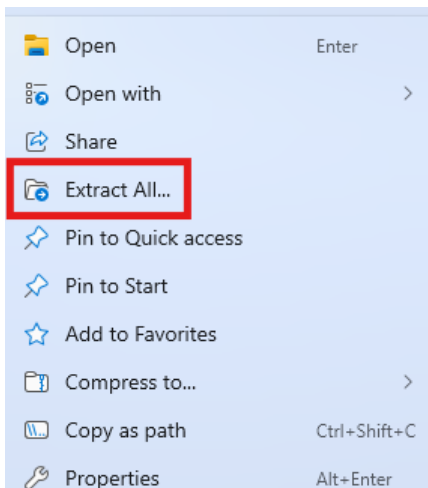
STM32CubeIDE features are handy Pinout & Configuration menu, which makes changing baudrates easy and it also generates much of the initialization code, making it easy to get started in.

#### 4.1 Unpacking the example programs

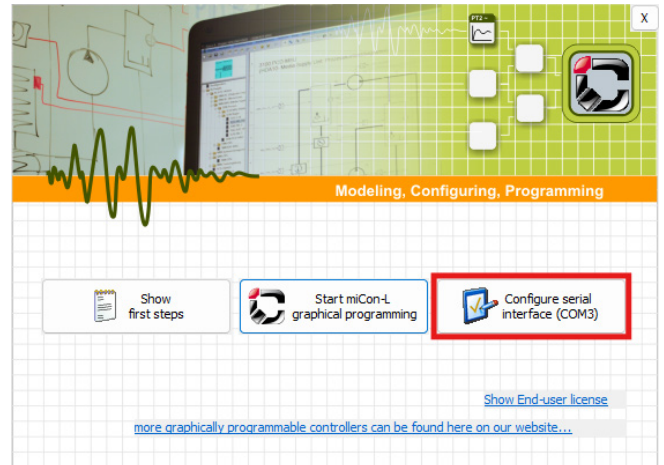
STM32CubeIDE and miCon-L both need to be installed on a Windows computer.

The example program package can be downloaded on the GT-900's product page or the download link in the table above.

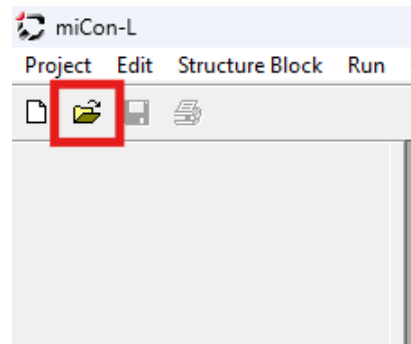
After the example package has been downloaded, it can be unpacked at a suitable location.



The correct COM port needs to be chosen by clicking on „Configure serial interface“.



The miCon-L part of the example project can be opened by clicking on the folder icon in the top left corner.

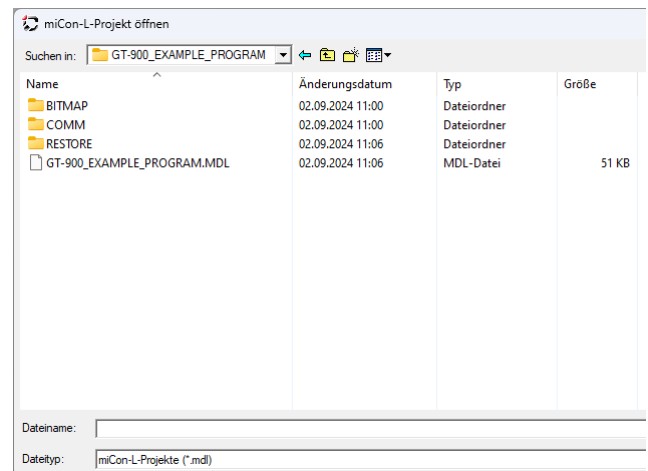


#### 4.2 Setting up miCon-L

miCon-L is started by navigating into the install directory and clicking on the „StartMe.exe“.

Name	Date
License	14/12/2
miCon-L	14/12/2
autorun.inf	01/02/2
micon-l.ico	01/02/2
miCon-L_First_Steps.pdf	03/04/2
<b>StartMe.exe</b>	<b>24/02/2</b>

The example miCon-L project can be opened by navigating into the unpacked folder and selecting the „GT-900\_EXAMPLE\_PROGRAM.MDL“.



The miCon-L program will be downloaded onto the STG-800.

Below is an overview of the miCon-L program.

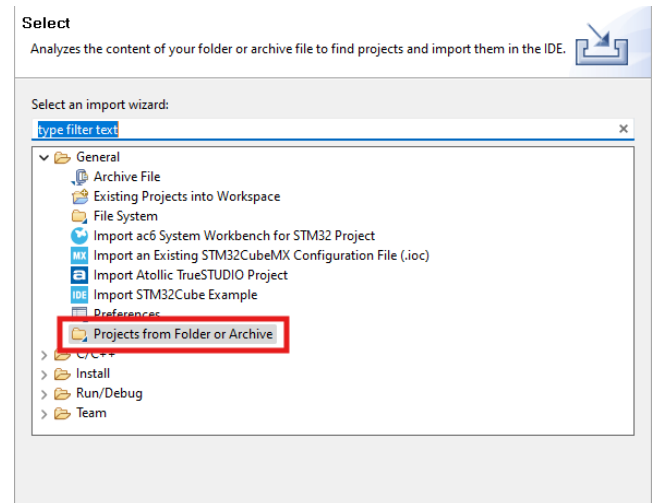
Depending on which CAN address is used, a different BUS will output the transmitted CAN data and the LED on the GT-900 will show a different behavior.

GT-900 Addresses

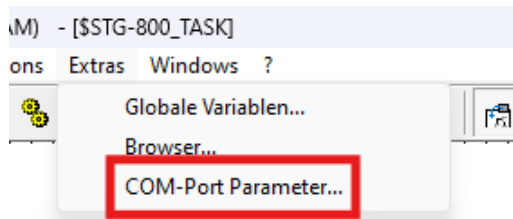
Base ID: 0x600	Red LED on
FDAN2 ID: 0x610	Red LED flashing
OneWire ID: 0x620	Green LED on
RS232 ID: 0x630	

Send	
1	Byte 1
2	Byte 2
3	Byte 3
4	Byte 4
5	Byte 5
6	Byte 6
7	Byte 7
8	Byte 8

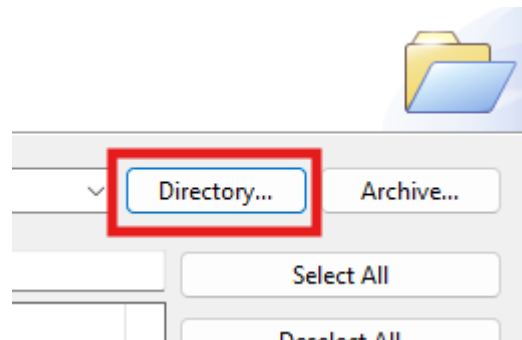
The project folder can be imported by choosing „Projects from Folder or Archive“.



After the miCon-L project has successfully been opened, the COM port needs to be selected again for the project.

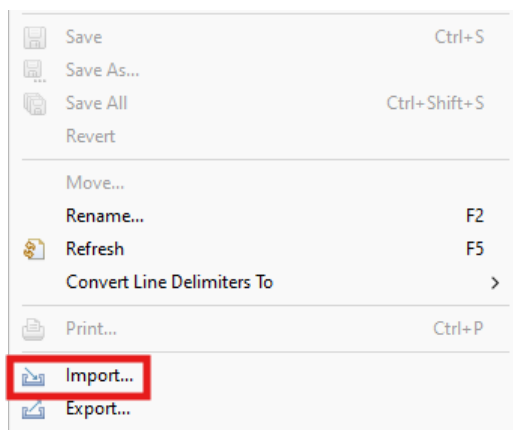


The folder can be selected by clicking on „Directory“.

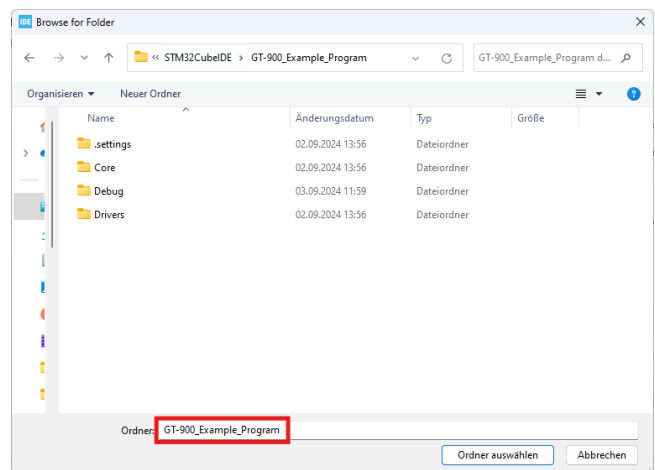


### 4.3 Setting up STM32CubeIDE

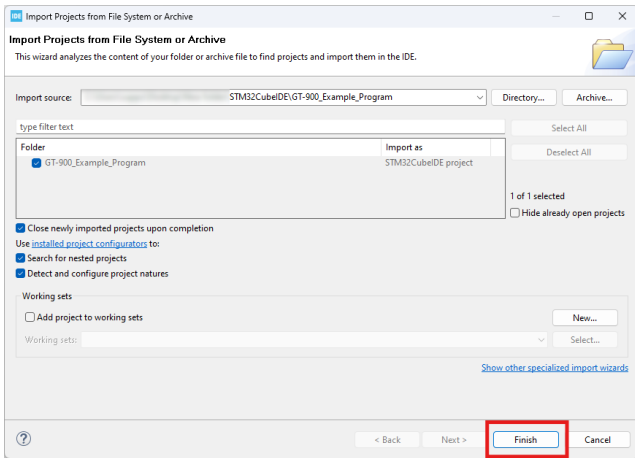
After installing STM32CubeIDE and starting it, the example project can be opened by clicking on „Import“ under the „File“ menu.



After navigating to the unpacked example project directory, the folder „GT-900\_Example\_Programs“ needs to be selected.



The import is completed by clicking on the „Finish“ button.

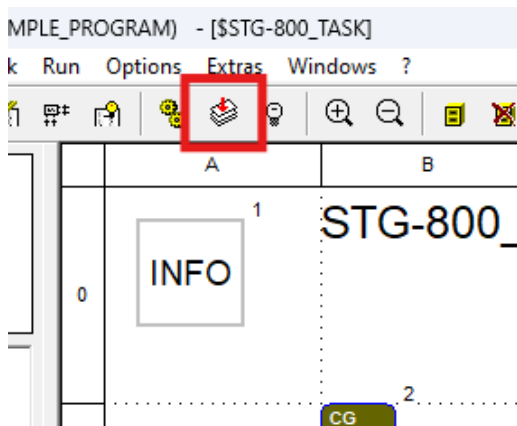


#### 4.4 Running the example program

Both programs need to be download onto both PLCs respectively.

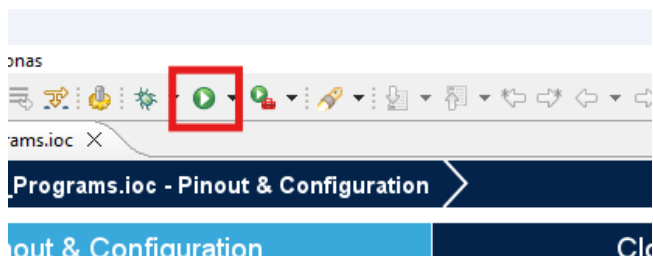
Proper connection of ST-LINK v3 & VK-46 needs to be ensured, before downloading the program in miCon-L to the STG-800.

It can be downloaded by clicking on the icon depicting a paper stack with a red arrow pointing down.

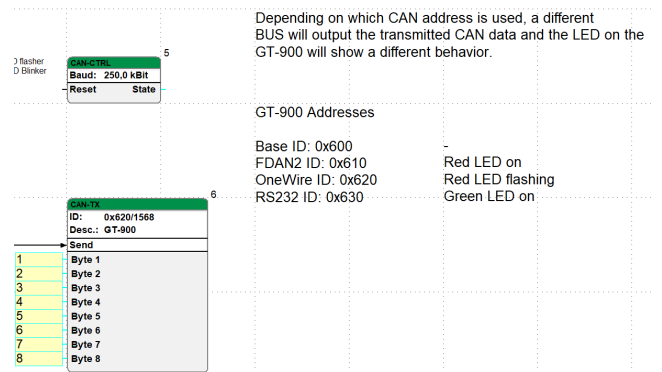


To download the STM32CubeIDE program to the GT-900, the GT-900 is connected to the computer via the VK-46 & ST-LINK v3.

The green play button is used to download the program onto the GT-900.

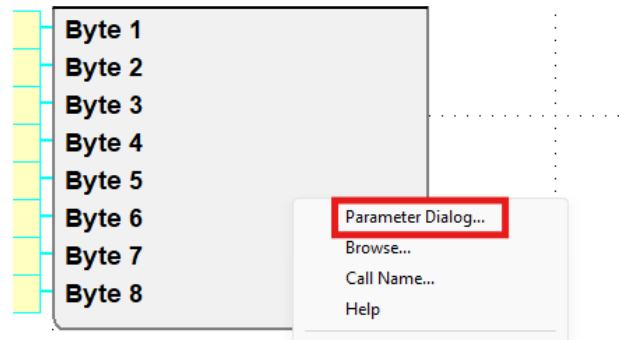


#### 4.5 Changing the communication interface

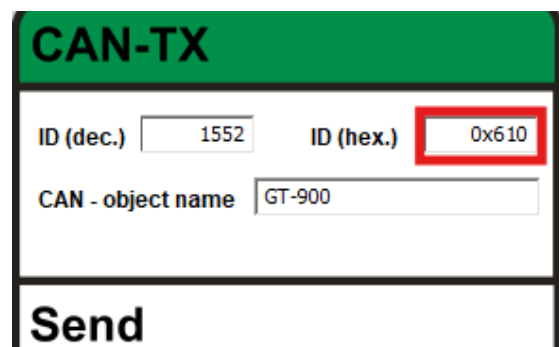


This is an overview of the miCon-L program. The CAN ID can be changed to use the corresponding communication interface on the GT-900.

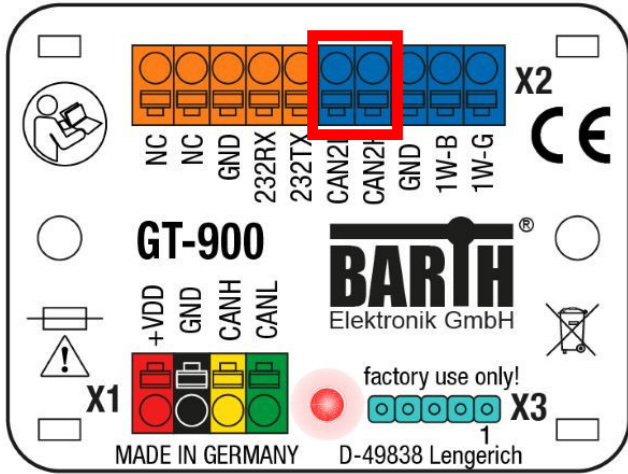
By right-clicking on the CAN-TX function block, „Parameter Dialog...“ can be chosen to open up the configuration menu.



Any of the listed CAN IDs can be entered to use a different communication protocol on the GT-900.



In this case, CAN ID „0x610“ is entered, corresponding to FDCAN2 on the GT-900 and the LED on the GT-900 will light up red.

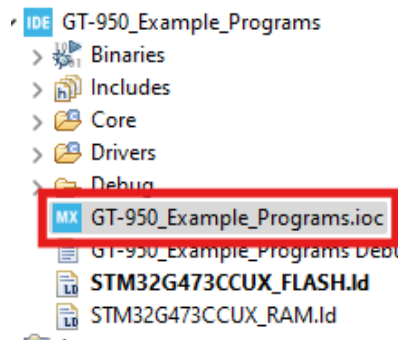


The CAN message from the miCon-L program is now send to the GT-900 via the STG-800. Show below is a snippet out of PCAN-View, showing the message sent over CAN2H and CAN2L.

CAN-ID	Type	Length	Data	Cycle Time
610h		8	01 02 03 04 05 06 07 08	352,0

## 4.6 Changing the baudrates

Changing baudrates is realized by navigating to the „GT-900\_Example\_Programs.ioc“ and double clicking on it.



This will open up the „Pinout & Configuration“ menu. Navigate to the category „Connectivity“ and expand it.



FDCAN1 will be used as an example.



These are the „Parameter Settings“ where among other things, the baudrate can be changed.

mode	normal mode
Auto Retransmission	Disable
Transmit Pause	Enable
Protocol Exception	Disable
Nominal Sync Jump Wi...	1
Data Prescaler	4
Data Sync Jump Width	1
Data Time Seg1	7
Data Time Seg2	2
Std Filters Nbr	0
Ext Filters Nbr	0
Tx Fifo Queue Mode	FIFO mode
▼ Bit Timings Parameters	
Nominal Prescaler	40
Nominal Time Quantum	250.0 ns
Nominal Time Seg1	12
Nominal Time Seg2	3
Nominal Time for one Bit	4000 ns
Nominal Baud Rate	250000 bit/s

The FDCAN baudrate is changed by adjusting the „Nominal Prescaler“. Changing it to ‚20‘ will double the baudrate.

Bit Timings Parameters	
Nominal Prescaler	20
* Nominal Time Quantum	125.0 ns
Nominal Time Seg1	12
Nominal Time Seg2	3
* Nominal Time for one Bit	2000 ns
* Nominal Baud Rate	500000 bit/s

USART and I<sup>2</sup>C baudrates can be entered manually and do not need to be adjusted with a prescaler. Please refer to the standards of each communication protocol for baudrates. This is the USART3 or RS232 baudrate for example.

Basic Parameters	
Baud Rate	115200 Bits/s
Word Length	8 Bits (including Parity)
Parity	None
Stop Bits	1
Advanced Parameters	
Data Direction	Receive and Transmit
Over Sampling	16 Samples
Single Sample	Disable
ClockPrescaler	1
Fifo Mode	Disable



## 5 Appendix

### 5.1 Specifications

#### 5.1.1 General

<b>Hardware design</b>	BARTH® lococube® gateway-fully enclosed in proprietary PU resin, tiny and rugged housing with plugable spring terminal connectors, ultra-lightweight
<b>Programming options</b>	Open Source ‚C‘ Programming
<b>Interfaces</b>	CAN 2.0A/B, CAN FD, RS232, 1-Wire

#### 5.1.2 Power supply

<b>Operating voltage</b>	7 to 32 VDC
<b>Current consumption</b>	nominal 10 mA at 55 VDC (depending on configuration)
<b>Fusing</b>	5 A max. (external) mandatory for voltage reversal protection
<b>Voltage reversal protection</b>	yes (combined with external fuse)
<b>ESD/TVS protection</b>	yes, integrated
<b>Heat dissipation air (at full load)</b>	normally < 2 W

#### 5.1.3 Interfaces

<b>232RX/TX</b>	Meets or Exceeds the Requirements of TIA/EIA-232-F and ITU v.28 Standards VCC Supply Operates up to 250 kbit/s
<b>1-Wire</b>	I <sup>2</sup> C Master Supports 100kHz and 400kHz I <sup>2</sup> C communication speeds
<b>CAN</b>	CAN 2.0A/B: 11/29 bit ID, base frame format Baud rates: 50, 100, 125, 250, 500 kbit, 1Mbit CAN FD Baud rates: 2, 5, 8Mbit Meets or exceeds the requirements of applications ISO 11898-2, loss of ground protection from -55 V to +55 V, thermal shutdown protection

#### 5.1.4 Security features

<b>Security Features</b>	System and independent watchdog Fail safe oscillator Power on/down reset Supply voltage supervisor
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#### 5.1.5 Program and data memory

<b>Memory</b>	Flash program memory: 1MB + 512 kB (on board + µC) SRAM: 128 kB (µC) EEPROM: 8kB (on board; >1M write cycles)
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#### 5.1.6 Timebase (oscillator)

<b>Primary Oscillator</b>	Crystal quartz MEMS unit (precise ‚micro-electro-mechanical system‘)
<b>Nominal Frequency</b>	16 MHz
<b>Frequency tolerance</b>	±50 × 10 <sup>-6</sup>
<b>Frequency aging</b>	±5 × 10 <sup>-6</sup> / year max.

#### 5.1.7 Electrical connection

<b>Electrical Connection</b>	plugable spring terminal connectors 0.25 to 1.5 mm <sup>2</sup> Manufacturer: Phoenix Contact Series: COMBICON Type: FMC1,5/x-ST-3,5-BK
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#### 5.1.8 Electromagnetic compatibility (EMC)

<b>Electrostatic discharge (ESD) on communication interface</b>	20 kV air discharge 30 kV contact discharge (IEC/EN 61 000-4-2, level 3)
<b>Electromagnetic fields</b>	Field strength 10 V/m (IEC/EN 61000-4-3)
<b>CAN bus terminals (CANH, CANL to GND)</b>	IEC 61000-4-2: Unpowered Contact Discharge ±15000 V IEC 61000-4-2: Powered Contact Discharge ±8000 V

#### 5.1.9 Environmental conditions

<b>Operation temperature</b>	-40 to +70 °C (IEC 60068-2-1/2)
<b>Storage temperature</b>	-40 to +70 °C (IEC 60068-2-1/2)
<b>Relative humidity</b>	5 to 95% non-condensing (IEC 60068-2-30)
<b>Air pressure (in operation)</b>	500 to 1500 hPa
<b>Shock resistance</b>	min. 300 m/s <sup>2</sup> (IEC 60068-2-27)
<b>Vibration resistance</b>	min. 80 m/s <sup>2</sup> @ 10..100 Hz (IEC 60068-2-6)
<b>Degree of protection</b>	IP 20 (not evaluated by UL) (EN 50178, IEC 60529)
<b>Drop</b>	Drop height: 1000 mm (IEC 60068-2-31)
<b>Free fall (packaged)</b>	1500 mm (IEC 60068-2-32)



### 5.1.10 Weight and dimensions

<b>Weight</b>	85 g (without connectors)
<b>Dimensions</b>	60 x 45 x 21 mm (LxWxH) Height housing: 11 mm
<b>Mounting</b>	via two M4 screws or 3.6mm cable ties

### 5.1.11 MTTF and MTTFd

<b>Calculation basis</b>	DIN EN ISO 13849-1:2008 (@T=25°C)
<b>Calculation formula</b>	DIN EN ISO 13849-1:2008 Annex C.5: MTTF, MTTFd data of electrical components (typical and worst case) D.1: Parts count method (worst case with safety factor 10)  $MTTF = \frac{1}{\sum_1^n \frac{1}{MTTF_n}}$  $MTTFd = MTTF \cdot 2$  $MTTFd = \frac{MTTF \cdot 2}{10}$  (worst case)
<b>MTTF [years]</b>	195
<b>MTTFd [years]</b>	390
<b>MTTFd worst case [years]</b>	39
<b>Explanation</b>	This information is given without any guarantee. The indicated product is no safety component according to the machine directive 2006/42/EC (subject to modifications).


### 5.1.12 Certifications & Approvals

	2004/108/EG 2004/108/EC 2014/30/EU
	CANopen® Vendor ID: 46Ah

### 5.2 Documents, videos and software



Detailed information, additional documents, application notes and videos relating to this product are downloadable from [www.barth-elektronik.de](http://www.barth-elektronik.de).

### 5.3 Disposal

	<b>If you wish to finally dispose of the product, ask your local recycling centre or dealer for details about how to do this in accordance with the applicable disposal regulations.</b>
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#### 5.3.1 Conformity declaration

For the following designated product it is hereby confirmed, that the construction in that technical design brought by us in traffic corresponds to the standards specified below. In the event of any alternation which has not been approved by us being made to any device as designated below, this statement shall thereby be made invalid.

<b>Description</b>	lococube® mini-PLC
<b>Type</b>	GT-900
<b>Art. No.</b>	0895-0900
<b>Directive 2004/108/EG relating to electromagnetic compatibility (EMC)</b>  	Applied norms: 2004/108/EG 2004/108/EC 2014/30/EU
<b>RoHS Directive 2011/65EU</b>	We hereby declare that our product is compliant to the RoHS Directive on restriction of the use of certain hazardous substances in electrical and electronic appliances.
	BARTH Elektronik GmbH declares conformity of the product for which this manual is intended with the UKCA equivalents of the aforementioned CE regulations. We therefore deem the product to be in full compliance with UKCA regulations and take full legal responsibility for it. This declaration was issued on 30.11.2021.

BARTH® Elektronik GmbH  
Lengerich, 20.12.2021

*D. Barh*

Dipl.-Ing. (FH) D. Barh, CEO