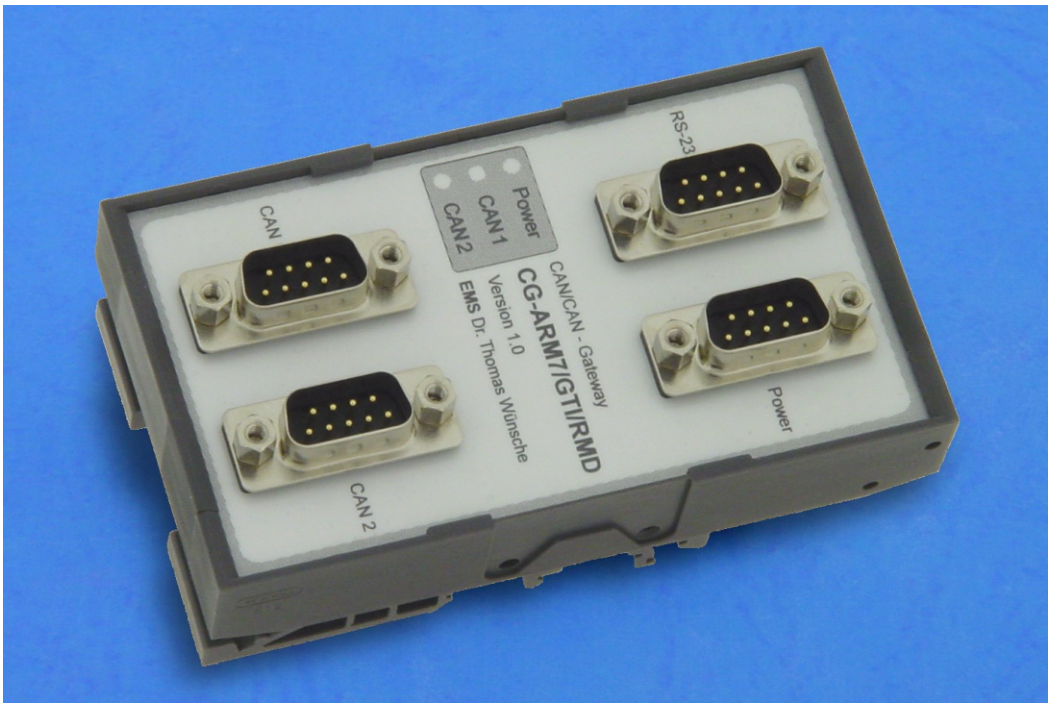

CAN/CAN Gateway

CG-ARM7/GTI

User Manual

EMS
Thomas Wünsche

User manual CG-ARM7/GTI

Document version: 1.04
Documentation date: June 15th, 2026

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FCC: **This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.**

WARNING: **EMS hardware and software may not be used in applications where damage to life, health or private property may result from failures in or caused by these components.**

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1 Overview

1.1 Features

- Connection of CAN subnetworks with differing data rates
- Filtering and buffering of data traffic
- Support for 11 bit and 29 bit identifier
- Microcontroller NXP LPC2119 with 2 internal CAN controllers
- Serial interface for configuration
- Galvanic separation between CAN channels
- Galvanic separation between CAN channels and power supply
- Optional (Version HS/LS) with 1 high speed (82C251) and one low speed (TJA1054) transceiver available
- Optional (Version Listen Only) with one transceiver without TX

1.2 General Description

The CAN/CAN gateway CG-ARM7/GTI transmits CAN signals between subsystems. CG-ARM7/GTI allows a flexible design of the wiring topology. Star and tree structures as well as extensive line structures can be realised. The galvanic separation between the CAN channels allows the use with diverging ground potentials. Among the available functions are data rate adaption, message filtering as well as identifier conversion between the coupled busses. The restriction of the maximum data rate depending on cable length for single CAN segments can be abolished for the over-all system by the use of CG-ARM7/GTI.

CG-ARM7/GTI obtains its potential by using a 32bit microcontroller with 48MHz clock. High speed processing and low latencies allow the use with high data rates and bus loads.

The configuration of the device functions can take place either through CAN or through the built-in RS232 interface. Download software for the configuration is available for Windows PCs as well as Linux PCs .

For special tasks, like modification of the data content of the CAN messages, we over a development kit to write custom specific firmware for CG-ARM7/GTI.

1.3 Ordering Information

12-20-413-xx	CG-ARM7/GTI
12-20-416-xx	CG-ARM7/GTI Version HS/LS
12-20-418-xx	CG-ARM7/GTI Version LO

Note: xx denotes language of delivery:

10 German
20 English

2 Handling

2.1 Connection

CG-ARM7/GTI has two male SUB-D 9 plugs to connect the two CAN segments. A male SUB-D 9 plug is intended for the configuration purpose. Power is supplied by another SUB-D 9 male connector. For the HS/LS version the CAN connection has a slightly different connection scheme. The assignment is described in chapter "3.1 Pin assignment".

2.2 Operation

To start up the gateway just connect the power supply, the device starts up automatically. As soon as the automatic diagnostic process is successfully completed the green power LED gets on permanently.

Important note: Ex factory the device offers no configuration and must be configured before its first run. Configuration instructions for the gateway are located in chapter "2.3 Configuration".

2.2.1 Listen Only Version

On the Listen Only version the TX pin of the CAN 2 transceiver is not connected. Hence this channel is not able to initiate a CAN frame on CAN2 or to provide the acknowledge signal. For a working CAN system on CAN2 at least two nodes on that side are mandatory.

2.3 Configuration

The gateway configuration process consists of two steps:

- Creating a configuration file
- Loading the configuration into the device

2.3.1 Configuration File

The configuration file is a text file with the extension *.gcf. This file holds all data needed by the gateway for operation. A complete sample configuration is located in chapter "4.1 Configuration File Example".

The values can either be entered in decimal or hexadecimal notation. Using the hexadecimal notation, the character 'x' has to be entered directly before the particular value.

Some parameters are optional. If they are not defined, the gateway uses default settings.

In the following all parameters are listed and described.

#	comment

The configuration file can be provided with comments. Comments are prefaced with the character '#' and they end with the particular line.

Example:

```
# 1st comment
key = value    # 2nd comment
```

version	version

The version number indicates the file format of the configuration file. It must be 1 for the actual version.

Example:

```
version=1
```

name	For easier identification of the programmed settings, the name assigned to the configuration

configuration can be labeled. The configuration name must not have more than 32 characters and must not contain space characters or tabs. If this key is missing, no name will be assigned. This name can be read out and displayed by the configuration software.

Example:

```
configname=MyOwnConfig
```

btr1, btr2	CAN bit timing

The bit timing key indicates the speed of the particular CAN channel. BTR1 indicates the baud rate for CAN channel 1, BTR2 the baudrate for CAN channel 2. Both keys must exist in each configuration file. This keys are directly related to the CANBTR registers of the used controller LPC2119. This allows most flexible customization of the baudrate settings. The basic CAN clock is 48 MHz.

Example:

```
# CAN channel 1: 1Mbit/s
btr1 = x00140005
# CAN channel 2: 500KBit/s
btr2 = x001C0005
```

Standard baud rates recommended by CiA are listed in chapter 4.2 Standard Baudrates.

pidin, pidout	program identifier

The program identifiers (PIDs) are required for the gateway configuration via CAN. If you do not want to program the gateway via CAN, you can remove this keys from your configuration file.

The PIDs determine which identifiers will be used for programming the gateway. "pidin” defines the identifier the configuration software uses to send requests to the gateway. The key "pidout” defines the identifier which the gateway uses to reply to the configuration software.

For CAN channel 1 and CAN channel 2 different PIDs can be set. But it is also possible to program the gateway just via one CAN channel. To set the identifiers for CAN channel 1 use the keys "pidin1” and "pidout1". For CAN channel 2 use the keys "pidin2” and "pidout2".

To use a 29-bit identifier prepend the character 'x' before the particular key. Without prefix 11-bit identifiers will be sent.

Example:

```
# PIDs for CAN channel 1
# CAN 1: 11-bit IN-Id: 0x5
pidin1 = x5
# CAN 1: 29-bit OUT-Id: 0xA00
xpidout1 = xA00

# PIDs for CAN channel 2
# CAN 2: 29-bit IN-Id:0x6E
# xpidin2 = x6E
# CAN 2: 29-bit OUT-Id: 0x1FFE
# xpidout2 = x1FFE
```

deviceid	device identifier

During the configuration process via CAN it is needed that the device can clearly be identified in the network. This process is based on the serial number of the device.

If there is the need to have the configuration process independent of the the serial number, a device id can be assigned. Then the identification of the device depends on the device id and not on the serial number.

Care must be taken to use a particular device id just once in a network, if more than one gateway is used.

The device id can have values beween 1 and 99999999.

Example:

```
deviceid = 50
```

password	password

Using a password, the gateway can be protected against unauthorized access. If the key is not defined or the value is set to 0, password protection is disabled. The password is an up to 14-digit hexadecimal value.

The password protection supports two security levels.

For the highest level the most significant bit (56th bit) of the password must be 1. This security level prevents any communication with the gateway, if the device has not been unlocked with the correct password before.

If the most significant bit is 0, reading out information about the gateway is enabled. Changing the configuration however is not possible.

Example:

```
# Security: high
password=80 07 05 AF D6 B0 D1
# Security: normal
password=00 07 05 AF D6 B0 D1
```

busoff	bus off behavior

This key specifies the period of time in milliseconds, which will pass by until the gateway gets bus on again after a bus off condition has occured. If this value is not defined, the device remains in bus off state. If a bus off time of 0 milliseconds is set, the gateway tries immediately to get bus on again.

Example:

```
busoff=100
```

fil	routing

The routing settings contain the filtering and mapping rules for a single identifier or a range of identifiers. Only specified identifier or ranges of identifiers are transmitted and, if existing, a mapping rule is applied. All incoming messages with identifiers to which no rule applies are ignored (defined programming identifiers excepted). Additionally the frame format must be set within the filtering rule.

On the left side of the assignment there are three parameters:

[*inff*] fil *channel* [*outff*] = ...

inff: Defines the frame format to be accepted for incoming messages. If *inff* is set to 's' standard frame format is specified. When set to 'x' extended frame format is specified.

channel: Defines the number of the CAN channel to which the rule is applied for incoming messages; *channel* may be set to 1 or 2.

outff: Defines the frame format for outgoing messages. If *outff* is set to 's' standard frame format is specified. When set to 'x' extended frame format is specified.

On the right side of the assignment up to three parameters specify the identifier of the outgoing CAN message.

... = *sid* [- *eid*] [: *mid*]

sid: Defines the identifier the filtering rule is applied to. If a range of identifiers is defined, *sid* is the start identifier. If the prefix 'x' is added before the value the identifier is interpreted as a hexadecimal number.

eid: Defines the end identifier for a range of identifiers. If only a single identifier is to be specified this value may be missing. If the prefix 'x' is added before the value the identifier is interpreted as a hexadecimal number.

mid: Defines the mapping identifier. This value defines to which start identifier a single or a range of identifiers is mapped. If no mapping is needed, this value may be missing. If the prefix 'x' is added before the value the identifier is interpreted as a hexadecimal number.

Examples:

```
# The received extended identifiers in the range of
# 0x30 to 0x40 via CAN channel 1 are sent via CAN
# channel 2 as standard identifiers in the range of
# 0x400 to 0x410.
xfil1s = x30 - x40 : x400

# The via CAN channel 2 received extended identifier
# 0x1FFFFFFF is sent via CAN channel 1 as extended
# identifier with the value 0x01.
xfil2x = x1FFFFFFF : x1

# The via CAN channel 1 received standard identifiers
# in the range of 0x100 to 0x200 are sent via CAN
# channel 2 as standard identifiers without remapping.
sfil1s = x100 - x200
```

2.3.2 Programming the Device

CG-ARM7/GTI is programmed by means of the configuration software. It offers the possibility to configure the gateway via serial connection or via CAN. For the configuration a serial cable or a PC/CAN Interface from EMS Dr. Thomas Wuensche is needed.

The "Program Settings" have to be set to:

- CG-ARM7
- Program configuration
- A configuration file

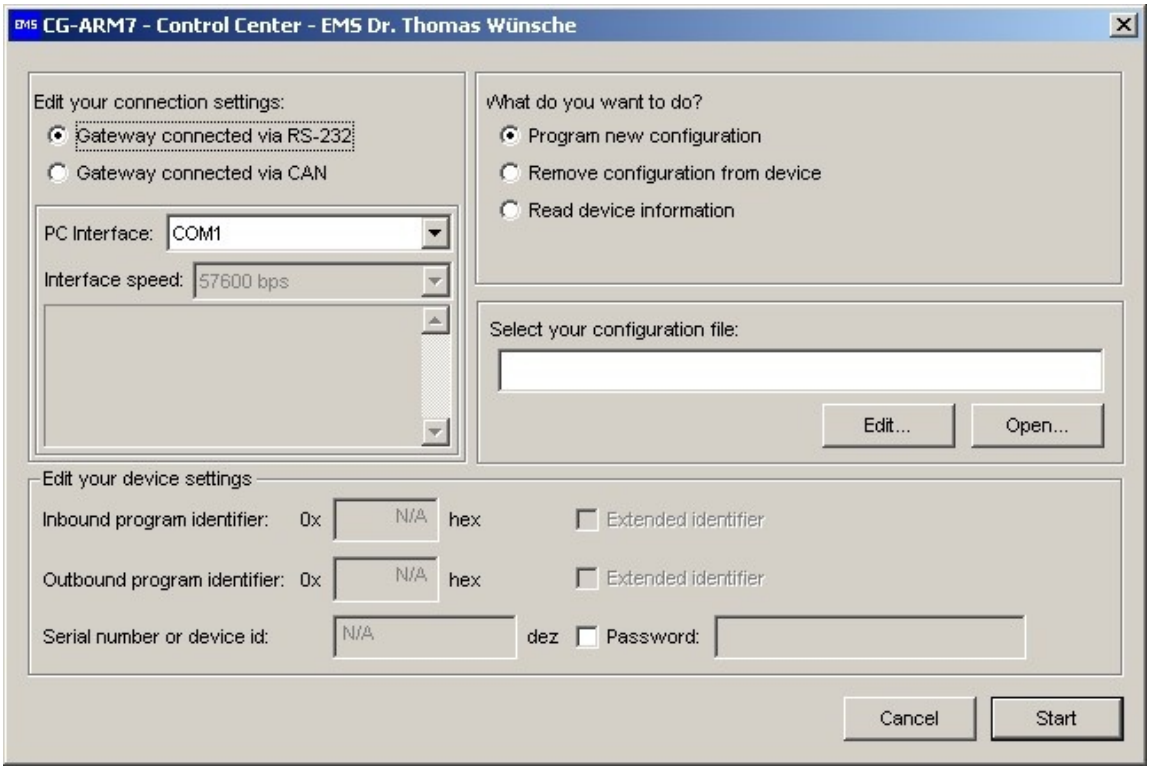
The "Interface Settings" have to be set to:

- Use RS232 interface
- The used PC serial interface port
- The serial baudrate used by the CG-ARM7/GTI device

Within the "Device Settings" the serial number of the CG-ARM7/GTI has to be set. The serial number can be found on the label of the device.

After all settings are made a click on the "Process" button starts the download. Do not remove power from the device until the process has finished.

Screenshot of the download tool:



2.4 LED

The device status is displayed by three LEDs.

CAN1 Active	If LED is on there is CAN bus activity on channel 1
CAN2 Active	If LED is on there is CAN bus activity on channel 2
Power	If ON the device is supplied with power and has initialized. If BLINKING device is in configuration mode.

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3 Technical Data

3.1 Pin Assignment

High speed CAN

Pin	Signal	Description
1, 4, 5, 6, 8, 9	nc	not connected
2	CAN_L	CAN low bus line
3	GND	Ground
7	CAN_H	CAN high bus line

Low speed CAN

Pin	Signal	Description
1	RTL	Connected with Pin 2 by a 5k6 resistor and RTL pin of TJA1054 CAN transceiver
2	CAN_L	CAN low bus line
3	GND	Ground
4, 5, 6, 9	nc	not connected
7	CAN_H	CAN high bus line
8	RTH	Connected with Pin 7 by a 5k6 resistor and RTH pin of TJA1054 CAN transceiver

Power Connector

Pin	Signal	Description
1,2,4,5,6,7,8	nc	not connected
3	GND	Ground connection of power supply
9	VCC	Power supply

Serial Connector

Pin	Signal	Description
1, 4, 6, 9	nc	not connected
2	RX	RX line of device
3	TX	TX line of device
5	GND	GND of serial interface. Identical as GND of CAN1
7	RTS	RTS output line, not used
8	CTS	CTS input line, not used

3.2 Limiting Values

Parameter	Min.	Max.	Unit
Storage temperature	-40	+80	°C
Operating temperature	0	+60	°C
Supply voltage	-40	+30	V

3.3 Nominal Values

Parameter	Min.	Typ.	Max.	Unit
Supply voltage	10	24	30	V
Supply consumption (running idle)	-	40	-	mA
CAN Baudrates	10	10	1000	kBit/s

4 Appendix

4.1 Configuration File Example

```
# Gateway CG-ARM7 configuration file

# Baudrate CAN interface 1 - 1000 kbps
btr1=x00140005

# Baudrate CAN interface 2 - 500 kbps
btr2=x001C0005

# Version number of configuration file
version=1

# Device ID
deviceid=120000

# Set bus off recovery time to 1000 ms
busoff=1000

# Password protection: security level
# normal
password=11 AA 33 BC

# Configuration name
name=router

# Program identifier CAN channel 1
pidin1=x1      # Standard identifier 0x01
xpidout1=x2    # Extended identifier 0x02

# Program identifier CAN channel 2
xpidin2=x10    # Extended identifier 0x10
xpidout2=x20   # Extended identifier 0x20

# Filter settings
# All standard identifiers from CAN channel
# 1 are sent as standard identifiers to CAN
# channel 2
sfil1s=x0-x7FF
```

```
# All standard identifiers from CAN channel
# 2 are sent as standard identifiers to CAN
# channel 1
sfil2s=x0-x7FF

# All extended identifiers from CAN channel
# 1 are sent as extended identifiers to CAN
# channel 2
xfil1x=x0-x1FFFFFFF

# All extended identifiers from CAN channel
# 2 are sent as extended identifiers to CAN
# channel 1
xfil2x=x0-x1FFFFFFF
```

4.2 Standard CAN Baud Rates

Bitrate	Bit Timing Register
1000 kBaud	0x00140005
800 kBaud	0x00160005
500 kBaud	0x001C0005
250 kBaud	0x001C000B
125 kBaud	0x001C0017
100 kBaud	0x001C001D
50 kBaud	0x001C003B
50 kBaud	0x001C0095
10 kBaud	0x001C012B

4.3 Instruction for Disposal

Electronic Equipment Act (WEEE)

EMS is selling its products exclusively to commercial customers. This is the reason why all devices are designed for commercial use and have to be disposed appropriately. In accordance to § 10 para. 2 clause 3 Electronic Equipment Act (WEEE) the disposal of EMS products is regulated the following way.

The equipment must not be disposed at the public collection points. In accordance with the applicable law the disposal has to be done by the customer for own account. The same applies to products, which have been sold to third parties, if those parties do not take care of a disposal in accordance to the applicable law. As an alternative the products can be returned to EMS free of charge.

4.4 FCC Statement

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

4.5 CE Conformity

Declaration of Conformity

CE

The manufacturer

EMS Dr. Thomas Wünsche e.K.
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85304 Ilmmünster
Germany

hereby declares, that the following products:

Name	Article Number
CG-ARM7/GTI	12-20-413-xx
CG-ARM7/GTI Version HS/LS	12-20-416-xx
CG-ARM7/GTI Version LS/LS	12-20-417-xx
CG-ARM7/GTI Version LO	12-20-418-xx

meet the requirements of the following standards:

Electromagnetic Immunity
EN 55035:2018-04; VDE 0878-35:2018-04 – Electromagnetic compatibility of multimedia equipment – Immunity requirements (CISPR 35:2016, modified); German version EN 55035:2017

Electromagnetic Emission
EN 55032:2016-02; VDE 0878-32:2016-02 – Electromagnetic compatibility of multimedia equipment – Emission Requirements (CISPR 32:2015); German version EN 55032:2015

and therefore conform with the EU requirements on:

Electromagnetic compatibility (2014/30/EU)

In accordance with the above mentioned EU directives, the EC declarations of conformity and the associated documentation are held at the disposal of the competent authorities.

RoHS 3

The RoHS 3 (EU 2015/863) commits manufacturers of „Electrical and Electronic Equipment" (EEE) to secure compliance with the RoHS Directive before placing a CE mark.

Based on technical documentation and to the best of our knowledge, we hereby confirm that the above mentioned products do not contain any of the restricted substances according to Article 4 of the RoHS Directive in excess of the maximum concentration values tolerated by weight in any of their homogeneous materials.

Ilmmünster, 24.09.20

Dr. Thomas Wünsche

EMS
Thomas Wünsche