100/1000BASE-T1 Media Converter
Communication Protocol Specification

For firmware v1.3

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Changes

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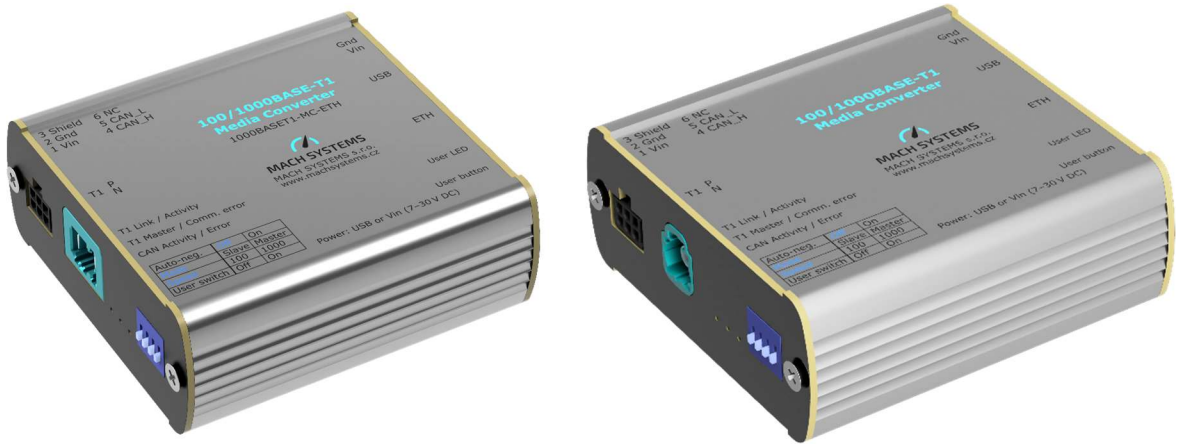
Contents

1 Introduction

The **100/1000BASE-T1 Media Converter** product offers configuration and diagnostic over USB and CAN(FD). The devices feature a USB Type-C connector and act as a virtual serial port (USB VCP) when plugged in a computer.



The Media Converter features the 100/1000 BASE-T1 Single-Pair Ethernet available at either the TE MATEnet or Rosenberer H-MTD connector, depending on the converter variant. The 100BASE-TX/1000BASE-T Ethernet is available through an RJ-45 connector. The device can be configured by the four on-board DIP switches or remotely by the communication protocol.

This document describes the communication protocol that can be used to access the media converter over USB or CAN(/FD). The protocol allows to remotely read status and configure both T1 and standard Ethernet ports, or to use the device as a USB-CAN(FD) interface (available over USB only).

2 Communication Protocol

The communication between the media converter and other systems is based upon a binary protocol. The same message structure is used for both directions - to and from the device.

2.1 USB

This protocol consists of Message Id and Data, and is encapsulated by Start Byte, Data Length, Checksum and End Byte.

USB configuration: Virtual COM port (VCP), 115200 Baud, 8 data bits, no parity, 1 stop bit.

STX (1B)	ID (1B)	DATALEN (2B)	DATA (X B)	CHECKSUM (1B)	ETX (1B)
0x02	Message Id	Number of data bytes	Data bytes Number of bytes = DATALEN	1-byte sum of ID, DATALEN and all DATA bytes	0x03

The rest of the documentation refers to DATA part only. The user is then responsible for encapsulating it with the rest of the protocol fields, namely STX, Id, DataLen, Checksum, and ETX.

2.2 CAN bus

If the device's CAN port is not used as a USB-CAN(/FD) interface, it is possible to use the CAN bus for

diagnostic purposes, similarly to USB. The device receives via CANID_RX and transmits over CANID_TX.
For CAN bus, the protocol is placed into the data bytes of a CAN frame.
Both CAN identifiers can be changed per device – see **Chyba! Nenalezen zdroj odkazů. Chyba! Nenalezen zdroj odkazů.** and 3.4.2 Read and Write CAN Protocol Tx Id. For other CAN configurations see **Chyba! Nenalezen zdroj odkazů. Chyba! Nenalezen zdroj odkazů.**.

Default CAN configuration:

CANID_RX = 0x123 Std Id
CANID_TX = 0x321 Std Id
CAN baud = 500 KBd, sample point: 80%
Frame format: Classical CAN (can be reconfigured to CAN FD)

CAN Frame – data part:

CAN DATA 0 (1 B)	**CAN DATA** **(0 to 7 B for CAN)** **(0 to 63 B for CAN FD)**
Message Id	Protocol data bytes

Data Byte 0 is always used as Message Id (just like in USB), the rest of the data bytes carry the message content.

2.3 Message Overview

The following tables describe message of the communication protocol over the serial line. The CAN setting messages (id 0x50-0x53 and 0x60-0x68) are available over USB VCP only. The ability to set up device over CAN is disabled when CAN channel is enabled (message id 0x67).

ID	Name	Request Data Length (bytes)	Response Data Length (bytes)	Description
0x01	BOOT_UP	- (no request needed)	0B ACK	A notification that the gateway was powered up. Sent only to USB.
Product information				
0x11	READ_SN	0	4	Read device serial number
0x12	READ_HW_INFO	0	6	Read device HW info
0x13	READ_SW_INFO	0	2	Read device SW info
Device configuration				
0x14	WRITE_DEVICE_CONFIGURATION	2	0B ACK	Set device configuration (override dipswitches)
0x15	READ_ DEVICE_CONFIGURATION	0	1	
0x16	SAVE_DEVICE_CONFIGURATION	0	0B ACK	
0x17	LOAD_ DEVICE_CONFIGURATION	0	0B ACK	
0x18	DEFAULT_ DEVICE_CONFIGURATION	0	0B ACK	
Device diagnostic				
0x20	READ_STATUS	0	2	Read device status register
0x21	READ_T1REG	3	2	Read register from 1000BASE-T1 PHY
0x22	READ_T1000REG	1	2	Read register from 1000BASE-T PHY
0x23	READ_SQI	0	1	Read Signal Quality Indicator 1000BASE-T1
0x24	READ_CQI	0	4	Cable Quality Indicator 1000BASE-T1
0x25	DO_CABLE_TEST_T1	0	2	
0x26	DO_CABLE_TEST_T1000	0	1	
0x27	T1_100_TEST_MODE	1	0B ACK	Enable 1000BASE-T1 test mode
0x28	T1_1000_TEST_MODE	1	0B ACK	Enable 100BASE-T1 test mode
Device configuration – CAN protocol				
0x50	CAN_READ_ RXID	0	4	Read CAN RX ID for conf. msg.
0x51	CAN_WRITE_ RXID	4	1	Write CAN RX ID for conf. msg.
0x52	CAN_READ_ TXID	0	4	Read CAN TX ID for conf. msg.
0x53	CAN_WRITE_ TXID	4	1	Write CAN TX ID for conf. msg.
CAN communication control				
0x60	CAN_CHANNEL_CONFIGURATION	4	1B ACK	Configure CAN channel
0x61	CAN_WRITE_CONFIG_TIM	6	1B ACK	Configure CAN channel set time quanta
0x62	CAN_READ_CONFIGURATION	1	13	Read CAN channel configuration

0x63	CAN_SAVE_CONFIGURATION	1	1B ACK	Save CAN configuration to EEPROM
0x64	CAN_LOAD_CONFIGURATION	1	1B ACK	Load CAN configuration from EEPROM
0x65	CAN_DEFAULT_CONFIGURATION	1	1B ACK	Load CAN default configuration
0x66	CAN_ECHO_CONF	2	1B ACK	Enable/Disable Tx echo
0x67	CAN_START_CHANNEL	1	1B ACK	Start CAN channel
0x68	CAN_STOP_CHANNEL	1	1B ACK	Stop CAN channel
0x69	CAN_GET_TIMESTAMP	1	9	Get time in microseconds from startup of channel
0x6A	CAN_SEND_MESSAGE	5 to 71	1B ACK	Send CAN message / CAN message was sent
0x6B	CAN_RECEIVED_MESSAGE	N/A	13 to 79	Received CAN message
0x6C	CAN_ERROR_FRAME	N/A	10	Some error on CAN bus
0xFE	RESTART_BOOT	0	0	Restart gateway to bootloader
0xFF	GENERAL_ERROR	N/A	2 to 3	An error occurred, see Error Codes

2.4 Error Codes

The following table describes error codes. General structure of error message is described **Chyba! Nenalezen zdroj odkazů.**.

Error Code	Data length	Comment
Communication protocol error Messages contain: Error Code and Message ID		
0xA0	2	Incorrect end byte on the protocol
0xA1	2	Bad checksum on the protocol
0xA2	2	Unknown message ID
0xA3	2	Too large or incorrect data length
0xA4	2	Invalid data
General bus errors Messages contain: Error Code, Message ID and Channel Number		
0xF0	2-3	Configuration Error
0xF1	2-3	Channel running, channel should be stopped when it is being configured
0xF2	2-3	Invalid channel selected – index out of bounds
0xF3	2-3	Channel is not running
0xF4	2-3	Hardware FIFO is full (should not happen in normal operation)

3 Message Specification

3.1 General Response

Device responds with a message acknowledgement after receiving a valid message. The acknowledgement does not contain any data. If there is some problem, the response is Error Response.

3.2 Error Response

MessageId = 0xFF

Device responds with an error if the command could not be processed correctly.
Response:

DATA 0
Error code

When bus channel number is not relevant

OR

DATA 0	DATA 1
Error code	Channel number

See the table above for meaning of the first byte. Note that the message is two-byte only for errors where channel number is relevant. Otherwise, it is one-byte.

3.3 Device Messages

3.3.1 Device Serial Number

MessageId = 0x11
This command is used for reading device serial number.
Request:
No data

Response:

DATA 0 – DATA 3
Device serial number

Example S/N: 02030106

DATA 0	DATA 1	DATA 2	DATA 3
06	01	03	02

3.3.2 Device Hardware Information

MessageId = 0x12
This command is used for reading device hardware number.
Request:
No data

Response:

DATA 0 – DATA 5
Device hardware number

Example HW Info: 000400030002

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5
02	00	03	00	04	00

3.3.3 *Device Software Information*

MessageId = 0x13

This command is used for reading software version number.

Request:

No data

Response:

DATA 0	DATA 1
VERSION MINOR	VERSION MAJOR

3.3.4 *Write Device Configuration*

MessageId = 0x14

This command is used to set the device configuration. By default, the device configuration is set by 4 dipswitches on the front panel of the device. The dipswitch configuration can be overridden by this command.

Request:

DATA 0	DATA 1
Configuration register 1	Configuration register 2

Configuration register 1:

bit 7							bit 0
Reserved	Reserved	Speed	Speed	Master/Slave	Master/Slave	Auto neg.	Auto neg.

Bit 6..7 **Reserved**

Bit 4..5 **Speed selection**
00 – Value is set by a dip switch
01 – Both PHY's speed is set to 100 Mb/s
10 – Both PHY's speed is set to 1000 Mb/s
11 – Reserved

Bit 2..3 **Master / Slave selection T1**
00 – Value is set by a dip switch
01 – T1 is set up as slave
10 – T1 is set up as master
11 – Reserved

Bit 0..1 **Auto-negotiation**
00 – Value is set by a dip switch
01 – Auto-negotiation disabled
10 – Auto-negotiation enabled
11 – Reserved

Configuration register 2:

bit 7							bit 0
Reserved	Reserved	Packet generator	Packet generator	Legacy mode	Legacy mode	User switch mapping	User switch mapping

Bit 6..7 **Reserved**

Bit 4..5 **Packet generator - forcing**
00 – Value is set by a dip switch (disabled if switch is not mapped on function)
01 – Packet generator disabled
10 – Packet generator enabled
11 – Reserved

Bit 2..3 **Legacy mode - forcing**
00 – Value set by User switch (disabled if switch is not mapped on this function)
01 – Legacy mode disabled (IEEE Mode)
10 – Legacy mode enabled
11 – Reserved

Bit 0..1 **User switch**
00 – No function assigned
01 – Legacy mode is set by a switch
10 – Packet generator is set by a switch
11 – Reserved

Note:
The frame generated by packet generator contains no specific MAC source or destination. All bytes have the same pattern: 0xA5 and 0x5A in alternation.

Response:
No data

3.3.5 Read Device Configuration

MessageId = 0x15
This command is used to read the Configuration register 1 and 2.
Request:
No data

Response:

DATA 0	DATA 1
Configuration register 1	Configuration register 2

3.3.6 Save Configuration

MessageId=0x16

This command saves the User switch mapping (Bits 0..1 from the Configuration register 2) to the EEPROM.

Request:
No data

Response:
No data

3.3.7 Load Configuration

MessageId=0x17

This command loads the User switch mapping (Bits 0..1 from the Configuration register 2) from the EEPROM.

Request:
No data

Response:
No data

3.3.8 Default Configuration

MessageId=0x18

This command loads the default value (0x0) to the Configuration registers 1 and 2.
Request:
No data

Response:
No data

3.3.9 Read Device Status

MessageId=0x20

This message reads the status of device.

Request:
No data

Response:

DATA 0	DATA 1
T1_STATUS	T1000_STATUS

T1_STATUS:

bit 7							bit 0
Legacy mode	T1 Packet gen.	T1 Master/ Slave	T1 polarity	T1 aneg. done	T1 aneg. enable	T1 link 1000	T1 link 100

Bit 7 **Legacy mode**
0 – Legacy mode disabled (IEEE Mode)
1 – Legacy mode enable

Bit 6 **1000BASE-T1 packet generator**
0 – Packet generator disabled
1 – Packet generator enable

Bit 5 **1000BASE-T1 Master/Slave**
0 – Slave
1 – Master

Bit 4 **1000BASE-T1 polarity**
0 – Normal polarity
1 – Inversed polarity detected

Note:
The device cannot detect the polarity when the speed is set to 100Mbit/s and selected mode is master. In this situation this bit is not valid.

Bit 3 **1000BASE-T1 auto-negotiation done**
0 – Auto-negotiation unperformed

1 – Auto-negotiation completed successfully

Bit 2 **1000BASE-T1 auto-negotiation**
0 – Auto-negotiation disabled
1 – Auto-negotiation enabled

Bit 1 **1000BASE-T1 link**
0 – Link down
1 – Link up

Bit 0 **100BASE-T1 link**
0 – Link down
1 – Link up

T1000_STATUS:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	T1000 Mater/Slave status	T1000 link 1000	T1000 link 100

Bit 3..7 **Reserved**

Bit 2 **1000BASE-T Slave/Master**
(Valid only if 1000BASE-T link is up.)
0 – Slave
1 – Master

Bit 1 **1000BASE-T link**
0 – Link down
1 – Link up

Bit 0 **100BASE-TX link**
0 – Link down
1 – Link up

3.3.10 Read 1000BASE-T1 PHY register

MessageId=0x21

Request:

DATA 0	DATA 1	DATA 2
Device	Register Address (LSB)	Register Address (MSB)

Response:

DATA 0	DATA 1
Register Value (LSB)	Register Value 1 (MSB)

1000BASE-T1 PHY register examples

Device	Register	Start Bit	Bit Length	Name	Description
1	0x0901	0	1	Link Status	1 = 1000BASE-T1 link up
3	0x8109	2	1	Link Status	1 = 100BASE-T1 link up

1	0x0834	14	1	Master/Slave	1 = PHY is Master
1	0x0901	2	1	Polarity Detect	1 = polarity inversion detected on T1 port (valid only when 1000BASE-T1 link up)
3	0x8109	1	1	Polarity Detect	1 = polarity inversion detected on T1 port (Valid only when 100BASE-T1 link up)
3	0x8120	0	8	Link Drop Counter Register	This counter increments every time the link transitions from up to down. The counter saturates at 0xFF (maximum value) and is cleared when read. when the counter overflows, the value of FFh is retained. The counter is reset when the register is read.
3	0x8224	0	16	Rx Error Counter Register	The counter counts each event of RX_ER assertion in the BAD ESD2, BAD END, and Rx ERROR states.

3.3.11 Read 1000BASE-T PHY register

MessageId=0x22

Request:

DATA 0
Register

Response:

DATA 0	DATA 1
Register Value (LSB)	Register Value 1 (MSB)

1000BASE-T PHY register examples

Register	Start Bit	Bit Length	Name	Description
1	2	1	Link Status	1 = link is up
10	0	8	1000BASE-T Idle Error Count	Cumulative count of the errors detected when the receiver is receiving idles.
31	0	1	Link Status Check Fail	1 = Fail 0 = Not Failing

3.3.12 Read SQI

MessageId=0x23

Measures a Signal Quality Indicator on the 1000BASE-T1 channel.

Request:

No data

Response:

DATA 0
SQI

DATA 0:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	SQI3	SQI2	SQI1	SQI0

Bit 4..7 **Reserved**

Bit 0..3 **Signal quality indicator**
0000 – the worst SQI (unstable link)
…
1000 – SQI (good link; bit error rate < 1e-10)?
…
1111 – the best SQI (very good link)

3.3.13 Read CQI

MessageId=0x24

Measures a Cable Quality Indicator on the 1000BASE-T1 channel. CQI provide Insertion Loss (IL) and Return Loss (RL). The value is 16bit and the Loss unit is dB. The link must be established, before measurement of the cable quality. If the measurement fails the return value of all bytes is 0xFF.

Request:

No data

Response:

DATA 0	DATA 1	DATA 2	DATA 3
Insertion Loss (LSB)	Insertion Loss (MSB)	Return Loss (LSB)	Return Loss (MSB)

3.3.14 Cable Test 1000BASE-T1

MessageId=0x25

Carries out a cable test on the 1000BASE-T1 channel.

Request:

No data

Response:

DATA 0	DATA 1
Result	Distance to fault (MSB)

DATA 0:

bit 7							bit 0
DIST.	DIST.	DIST.	DIST.	DIST.	DIST.	RESULT	RESULT

Bit 2..7 **Distance to fault (LSB) (centimetres)**

Bit 0..1 **Cable test result**
00 – Ok
01 – Open circuit
10 – Short circuit
11 – Test fail

DATA 1:

bit 7							bit 0
DIST.	DIST.	DIST.	DIST.	DIST.	DIST.	DIST.	DIST.

Bit 0..7 **Distance to fault (MSB) (centimetres)**

3.3.15 Cable Test 1000BASE-T

MessageId=0x26

Carries out a cable test on the 1000BASE-T channel.

Request:

No data

Response:

DATA 0
Result

DATA 0:

bit 7							bit 0
Pair D	Pair D	Pair C	Pair C	Pair B	Pair B	Pair A	Pair A

Bit 6..7 **Pair D cable test result**
00 – Ok
01 – Open circuit
10 – Short circuit
11 – Test Failed

Bit 4..5 **Pair C cable test result**
00 – Ok
01 – Open circuit
10 – Short circuit
11 – Test Failed

Bit 2..3 **Pair B cable test result**
00 – Ok
01 – Open circuit
10 – Short circuit
11 – Test Failed

Bit 0..1 **Pair A cable test result**
00 – Ok
01 – Open circuit
10 – Short circuit
11 – Test Failed

3.3.16 Test modes 100BASE-T1

MessageId=0x27

Request:

DATA 0
Result

The device must be configured in 100BASE-T1 mode to run this test. Can be used to generate Test symbols on the 100BASE-T1 channel.

Response:

No data

DATA 0:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	MODE2	MODE1	MODE0

Bit 3..7 **Reserved**

Bit 0..2 **Test mode selection:**
000 – No test mode
001 – 100BASE-T1 test mode 1
010 – 100BASE-T1 test mode 2
011 – Test mode 3
100 – 100BASE-T1 test mode 4
101 – 100BASE-T1 test mode 5
110 – Scrambler and descrambler bypassed
111 – Reserved

Mode	Description
Test mode 1	Test mode 1 is used to test transmitter droop. In Test mode 1, the PHY transmits '+1' symbols for 600 ns followed by '-1 ' symbols for a further 600 ns. This sequence is repeated continuously.
Test mode 2	Test mode 2 is used to test transmitter timing jitter in Master mode. In Test mode 2, the PHY transmits the data symbol sequence {+1, −1} repeatedly. The transmission of the symbols is synchronized with the local external oscillator
Test mode 3	Same as test mode 2 only use Slave mode.
Test mode 4	Test mode 4 is used to test transmitter distortion. In Test mode 4, the PHY transmits the sequence of symbols generated by the scrambler polynomial gs1 = 1 + x9 + x11.
Test mode 5	Test mode 5 is used to test the transmit PSD mask. In Test mode 5, the PHY transmits a random sequence of PAM-3 symbols.

3.3.17 Test modes 1000BASE-T1

MessageId=0x28

Can be used to generate Test symbols on the 1000BASE-T1 channel. The device must be configured in 1000BASE-T1 mode to run this test.

Request:

DATA 0
Result

Response:

No data

DATA 0:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	MODE2	MODE1	MODE0

Bit 3..7 **Reserved**

Bit 0..2 **Test mode selection:**
000 – Normal operation
001 – Test mode 1
010 – Test mode 2
011 – Reserved
100 – Test mode 4
101 – Test mode 5
110 – Test mode 6
111 – Test mode 7

Mode	Description
Test mode 1	Setting MASTER and SLAVE PHYs for transmit clock jitter test in normal mode.
Test mode 2	Transmit MDI jitter test in MASTER mode.
Test mode 4	Transmit distortion test.
Test mode 5	Normal operation in Idle mode. This is for the PSD Mask test.
Test mode 6	Transmitter droop test.
Test mode 7	Normal operation with zero data pattern. This is for BER monitoring.

3.4 CAN Communication Protocol Configuration

3.4.1 Read and Write CAN protocol Rx Id

(Available over USB VCP only)

Message ID = 0x50 for read, 0x51 for write

Reading and changing the CAN Id which is used for configuration messages. Default setting is 0x123 (standard Id).

Request 0x52:

DATA 0	DATA 1	DATA 2	DATA 3
New CAN Id for Rx LSB	New CAN Id Byte 1	New CAN Id Byte 2	New CAN Id MSB + information

New CAN Id MSB + information:

bit 7							
EXTId	FDF	Reserved	ID28	ID27	ID26	ID25	ID24

Bit 7 **EXTId** – determines if configuration messages are received with extended Id
0 – Protocol messages must have Standard Id
1 – Protocol messages must have Extended Id

Bit 6 **FDF** – CAN or CAN FD frame
0 – Protocol messages must not have FDF flag set (CAN frame)
1 – Protocol messages must have FDF flag set (CAN FD frame). Valid only when channel operates in CAN FD mode

Bit 5 Reserved
Bits 0..4 Bits [28:24] of extended CAN Id of configuration messages (if applicable)

Response: No data when success

Response to 0x51 has the same structure as request for 0x52 above.

3.4.2 Read and Write CAN Protocol Tx Id

(Available over USB VCP only)

Message ID = 0x52 for read, 0x53 for write

Reading and changing the CAN Id which is used for configuration messages. Default setting is 0x321.

Request 0x54:

DATA 0 – DATA 3	DATA 1	DATA 2	DATA 3
New CAN Id for Tx LSB	New CAN Id Byte 1	New CAN Id Byte 2	New CAN Id MSB + information

New CAN Id MSB + information:

bit 7							
EXTId	FDF	BRS	ID28	ID27	ID26	ID25	ID24

Bit 7 **EXTId** – determines if configuration messages are sent with extended Id
0 – Protocol messages have Standard Id
1 – Protocol messages have Extended Id

Bit 6 **FDF** – CAN or CAN FD frame

0 – Protocol messages do not have FDF flag set (CAN frame)
1 – Protocol messages have FDF flag set (CAN FD frame). Valid only when channel operates in CAN FD mode

Bit 5 **BRS** – Bit Rate Switch
0 – Protocol messages do not have BRS flag set
1 – Protocol messages have BRS flag set (relevant when FDF = 1 and channel operates in CAN FD mode)

Bits 0..3 Bits 28..24 of extended CAN Id of configuration messages (if applicable)

Response: No data when success

Response to 0x53 has the same structure as request for 0x54 above.

3.5 CAN and CAN FD Messages

The following messages are available in order to use the device as a USB-CAN interface.
Note: Messages in this section (3.9) are available only over USB VCP

3.5.1 Channel Configuration

(Available over USB VCP only)
MessageId=0x60

This message configures a CAN(/FD) channel. The time quanta for CAN FD controller are chosen by given sample point and baud rate. Sample point cannot always be set exactly to the desired value. The closest value is used instead of it. The actual time quanta setting can be obtained by **Read Configuration** command. The CAN FD controller clock is 72 MHz.

Request:

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5
Channel and SAVE bit	Configuration Register 1	Configuration Register 2	Configuration Register 3	Configuration Register 4 **(CAN FD mode)**	Configuration Register 5 **(CAN FD mode)**

Channel number and SAVE bit:

bit 7							
SAVE	Reserved	Reserved	Reserved	Reserved	Reserved	CHNL1	CHNL0

Bit 7 **Save**
Flag to tell if configuration will be saved right away.
0 – Do not save the configuration
1 – Store device configuration to EEPROM immediately after reconfiguration.

Bit 2..6 **Reserved**

Bit 0..1 **Channel**
00 – CAN 1
10 – Reserved
10 – Reserved
11 – Reserved

Configuration CHANNEL N Register 1:

bit 7							bit 0
PROTOCOL1	PROTOCOL0	AUTOSTART	ACK	ASP3	ASP2	ASP1	ASP0

Bit 6..7 **Protocol**
00 – CAN 2.0B
01 – ISO CAN FD
10 – Reserved
11 – Reserved

Bit 5 **AutoStart**
0 – CAN channel is NOT automatically started on power-up
1 – CAN channel is automatically started on power-up

Bit 4 **Acknowledge mode**
0 – Normal mode
1 – Silent mode

Bit 0..3 **Arbitration Sample Point**
0000 – 60%
0001 – 62,5%
0010 – 65%
0011 – 67,50%
0100 – 70%
0101 – 72,50%
0110 – 75%
0111 – 77,50%
1000 – 80%
1001 – 82,50%
1010 – 85%
1011 – 87,50%
1100 – 90%
1101 – Reserved
1110 – Reserved
1111 – Reserved

Configuration CHANNEL N Register 2:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	ABAUD2	ABAUD1	ABAUD0

Bit 3..7 **Reserved**

Bit 0..2 **Arbitration baud rate**
000 – 125 kBd
001 – 250 kBd
010 – 500 kBd
011 – 1 MBd
100..111 – Reserved

Configuration CHANNEL N Register 3:

bit 7							bit 0
Reserved	ASJW6	ASJW5	ASJW4	ASJW3	ASJW2	ASJW1	ASJW0

Bit 7 **Reserved**

Bit 0..6 **Arbitration jump width**
0000000 – 1
0000001 – 2
0000010 – 3
0000011 – 4
…
1111111 – 128

Configuration CHANNEL N Register 4 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	DBAUD2	DBAUD1	DBAUD0	DSJW3	DSJW2	DSJW1	DSJW0

Bit 4..6 **Data baud rate**
000 – 1 MBd
001 – 2 MBd
010 – 4 MBd
011 – 8 MBd
100..111 – Reserved

Bit 0..3 **Data Synchronization jump width**
0000 – 1
0001 – 2
0010 – 3
0011 – 4
…
1111 – 16

Configuration CHANNEL N Register 5 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	DSP3	DSP2	DSP1	DSP0

Bit 0..3 **Data Sample Point**
0000 – 60%
0001 – 62,5%
0010 – 65%
0011 – 67,50%
0100 – 70%
0101 – 72,50%
0110 – 75%
0111 – 77,50%
1000 – 80%
1001 – 82,50%
1010 – 85%

1011 – 87,50%
1100 – 90%
1101 – Reserved
1110 – Reserved
1111 – Reserved

Response:

DATA 0
Channel number (always 0)

Possibilities for error: CAN channel cannot be reconfigured - wrong arbitration or data jump width.

Default configuration

Channel 1

- ISO CAN FD
- Normal mode
- Arbitration speed 500 kBd
- Arbitration SJW 8
- Arbitration Sample Point 80%
- Data speed 2 MBd
- Data SJW 4
- Data Sample Point 80 %
- Autostart disable

3.5.2 Channel Configuration Time Quanta Timing

(Available over USB VCP only)

MessageId=0x61

Request:

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4
Channel and SAVE bit	Configuration Register 1	Configuration Register 6	Configuration Register 7	Configuration Register 8
DATA 5	**DATA 6**	**DATA 7**	**DATA 8**	
Configuration Register 9	Configuration Register 10 **(CAN FD mode)**	Configuration Register 11 **(CAN FD mode)**	Configuration Register 12 **(CAN FD mode)**	

Channel number and SAVE bit:

bit 7							
SAVE	Reserved	Reserved	Reserved	Reserved	Reserved	CHNL1	CHNL0

Bit 7 **Save**
Flag to tell if configuration will be saved right away.
0 – Do not save the configuration
1 – Store device configuration to EEPROM immediately after reconfiguration.

Bit 2..6 **Reserved**

Bit 0..1 **Channel**
00 – CAN 1
10 – Reserved

10 – Reserved
11 – Reserved

Configuration CHANNEL N Register 1:

bit 7							bit 0
PROTOCOL1	PROTOCOL0	AUTOSTART	ACK	Reserved	Reserved	Reserved	Reserved

Bit 6..7 **Protocol**
00 – CAN 2.0B
01 – ISO CAN FD
10 – Reserved
11 – Reserved

Bit 5 **AutoStart**
0 – CAN channel is NOT automatically started on power-up
1 – CAN channel is automatically started on power-up

Bit 4 **Acknowledge mode**
0 – Normal mode
1 – Silent mode

Bit 0..3 **Reserved**

Configuration CHANNEL N Register 6:

bit 7							bit 0
ATSEG1_7	ATSEG1_6	ATSEG1_5	ATSEG1_4	ATSEG1_3	ATSEG1_2	ATSEG1_1	ATSEG1_0

Bit 0..7 **Arbitration time segment 1**
0000 0000 – 1
0000 0001 – 2
0000 0010 – 2
0000 0011 – 3
…
1111 1111 – 256

Configuration CHANNEL N Register 7:

bit 7							bit 0
Reserved	ATSEG2_6	ATSEG2_5	ATSEG2_4	ATSEG2_3	ATSEG2_2	ATSEG2_1	ATSEG2_0

Bit 7 **Reserved**

Bit 0..6 **Arbitration time segment 2**
000 0000 – 1
000 0001 – 2
000 0010 – 3
000 0011 – 4
…
111 1111 – 128

Configuration CHANNEL N Register 8:

bit 7							bit 0
APRESC_7	APRESC_6	APRESC_5	APRESC_4	APRESC_3	APRESC_2	APRESC_1	APRESC_0

Bit 0..7 **Arbitration prescaler**

0000 0000 – 1
0000 0001 – 2
0000 0010 – 2
0000 0011 – 3
…
1111 1111 – 256

Configuration CHANNEL N Register 9:

bit 7							bit 0
Reserved	ASJW6	ASJW5	ASJW4	ASJW3	ASJW2	ASJW1	ASJW0

Bit 7 **Reserved**

Bit 0..6 **Arbitration jump width**

000 0000 – 1
000 0001 – 2
000 0010 – 3
000 0011 – 4
…
111 1111 – 128

Configuration CHANNEL N Register 10 (**relevant for CAN FD mode only)**:

bit 7							bit 0
Reserved	Reserved	Reserved	DTSEG1_4	DTSEG1_3	DTSEG1_2	DTSEG1_1	DTSEG1_0

Bit 5..7 **Reserved**

Bit 0..4 **Data time segment 1**

0 0000 – 1
0 0001 – 2
0 0010 – 2
0 0011 – 3
…
1 1111 – 32

Configuration CHANNEL N Register 11 (**relevant for CAN FD mode only)**:

bit 7							bit 0
DSJW3	DSJW2	DSJW1	DSJW0	DTSEG2_3	DTSEG2_2	DTSEG2_1	DTSEG2_0

Bit 4..7 **Data Synchronization jump width**

0000 – 1
0001 – 2
0010 – 3
0011 – 4
…
1111 – 16

Bit 0..3 **Data time segment 2**
0000 – 1
0001 – 2
0010 – 3
0011 – 4
…
1111 – 16

Configuration CHANNEL N Register 12 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	DPRESC4	DPRESC3	DPRESC2	DPRESC1	DPRESC0

Bit 5..7 **Reserved**

Bit 0..4 **Data prescaler**
0 0000 – 1
0 0001 – 2
0 0010 – 3
0 0011 – 4
…
1 1111 – 32

Response:

DATA 0
Channel number (always 0)

Possible errors: CAN channel cannot be reconfigured - wrong arbitration or data jump width.

3.5.3 Read Configuration

This command reads CAN interface settings. If configuration is set by precise timing message, 0xF values are set instead of Sample point and Baud rate values.

MessageId=0x62

(Available over USB VCP only)

Request:

DATA 0
Channel

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

Response:

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5
Channel	Configuration Register 1	Configuration Register 2	Configuration Register 3	Configuration Register 6	Configuration Register 7
DATA 6	**DATA 7**	**DATA 8**	**DATA 9**	**DATA 10**	**DATA 11**
Configuration Register 8	Configuration Register 4 **(CAN FD mode)**	Configuration Register 5 **(CAN FD mode)**	Configuration Register 10 **(CAN FD mode)**	Configuration Register 11 **(CAN FD mode)**	Configuration Register 12 **(CAN FD mode)**

DATA 12
Echo configura-tion Register 13

Channel number

bit 7							
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	CHNL1	CHNL0

Bit 2..7 **Reserved**

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

Configuration CHANNEL N Register 1:

bit 7							bit 0
PROTO-COL1	PROTO-COL0	AUTO-START	ACK	ASP3	ASP2	ASP1	ASP0

Bit 6..7 **Protocol**
00 – CAN
01 – ISO CAN FD
10 – Reserved
11 – Reserved

Bit 5 **AutoStart**
0 – CAN channel is NOT automatically started on power-up
1 – CAN channel is automatically started on power-up

Bit 4 **Acknowledge mode**
0 – Normal mode
1 – Silent mode

Bit 0..3 **Arbitration sample point**
0000 – 60%
0001 – 62,5%
0010 – 65%
0011 – 67,50%
0100 – 70%
0101 – 72,50%
0110 – 75%
0111 – 77,50%
1000 – 80%
1001 – 82,50%
1010 – 85%
1011 – 87,50%
1100 – 90%
1101 – Reserved
1110 – Reserved

1111 – Reserved

Configuration CHANNEL N Register 2:

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	ABAUD2	ABAUD1	ABAUD0

Bit 3..7 **Reserved**

Bit 0..2 **Arbitration baud rate**
000 – 125 kBd
001 – 250 kBd
010 – 500 kBd
011 – 1 MBd
100..111 – Reserved

Configuration CHANNEL N Register 3:

bit 7							bit 0
Reserved	ASJW6	ASJW5	ASJW4	ASJW3	ASJW2	ASJW1	ASJW0

Bit 7 **Reserved**

Bit 0..6 **Arbitration jump width**
0000000 – 1
0000001 – 2
0000010 – 3
0000011 – 4
…
1111111 – 128

Configuration CHANNEL N Register 6:

bit 7							bit 0
ATSEG1_7	ATSEG1_6	ATSEG1_5	ATSEG1_4	ATSEG1_3	ATSEG1_2	ATSEG1_1	ATSEG1_0

Bit 0..7 **Arbitration time segment 1**
0000 0000 – 1
0000 0001 – 2
0000 0010 – 2
0000 0011 – 3
…
1111 1111 – 256

Configuration CHANNEL N Register 7:

bit 7							bit 0
Reserved	ATSEG2_6	ATSEG2_5	ATSEG2_4	ATSEG2_3	ATSEG2_2	ATSEG2_1	ATSEG2_0

Bit 7 **Reserved**

Bit 0..6 **Arbitration time segment 2**
000 0000 – 1
000 0001 – 2
000 0010 – 3
000 0011 – 4
…
111 1111 – 128

Configuration CHANNEL N Register 8:

bit 7							bit 0
APRESC_7	APRESC_6	APRESC_5	APRESC_4	APRESC_3	APRESC_2	APRESC_1	APRESC_0

Bit 0..7 **Arbitration prescaler**
0000 0000 – 1
0000 0001 – 2
0000 0010 – 2
0000 0011 – 3
…
1111 1111 – 256

Configuration CHANNEL N Register 4 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	DBAUD2	DBAUD1	DBAUD0	DSJW3	DSJW2	DSJW1	DSJW0

Bit 7 **Reserved**

Bit 4..6 **Data baud rate**
000 – 1 MBd
001 – 2 MBd
010 – 4 MBd
011 – 8 MBd
100..111 – Reserved

Bit 0..3 **Data Synchronization jump width**
0000 – 1
0001 – 2
0010 – 3
0011 – 4
…
1111 – 16

Configuration CHANNEL N Register 5 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	DSP3	DSP2	DSP1	DSP0

Bit 4..7 **Reserved**

Bit 0..3 **Data sample point**
0000 – 60%
0001 – 62,5%
0010 – 65%
0011 – 67,50%

0100 – 70%
0101 – 72,50%
0110 – 75%
0111 – 77,50%
1000 – 80%
1001 – 82,50%
1010 – 85%
1011 – 87,50%
1100 – 90%
1101 – Reserved
1110 – Reserved
1111 – Reserved

Configuration CHANNEL N Register 10 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	DTSEG1_4	DTSEG1_3	DTSEG1_2	DTSEG1_1	DTSEG1_0

Bit 5..7 **Reserved**

Bit 0..4 **Data time segment 1**
0 0000 – 1
0 0001 – 2
0 0010 – 2
0 0011 – 3
…
1 1111 – 32

Configuration CHANNEL N Register 11 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	DTSEG2_3	DTSEG2_2	DTSEG2_1	DTSEG2_0

Bit 4..7 **Reserved**

Bit 0..3 **Data time segment 2**
0000 – 1
0001 – 2
0010 – 3
0011 – 4
…
1111 – 16

Configuration CHANNEL N Register 12 (**relevant for CAN FD mode only**):

bit 7							bit 0
Reserved	Reserved	Reserved	DPRESC4	DPRESC3	DPRESC2	DPRESC1	DPRESC0

Bit 5..7 **Reserved**

Bit 0..4 **Data prescaler**
0 0000 – 1
0 0001 – 2
0 0010 – 3

0 0011 – 4
…
1 1111 – 32

Echo configuration CHANNEL N register 13:

bit 7						bit 0	
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	TXECHO	RXECHO

Bit 2..7 **Reserved**

Bit 1 **TX Echo on/off**

0 – Echo Off

1 – Echo On (default)

Bit 0 **RX Echo on/off**

0 – Echo Off

1 – Echo On (default)

3.5.4 Save Configuration

(Available over USB VCP only)
MessageId=0x63

Request 0x63:

DATA 0
Channel

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

Response:

DATA 0
Channel number

Acknowledgement when configuration was saved, general error message in case of error.

3.5.5 Load Configuration

(Available over USB VCP only)
MessageId=0x64

Request 0x64:

DATA 0
Channel

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

Response:

DATA 0
Channel number

Acknowledgement when configuration was loaded, general error message in case of error.

3.5.6 Default Configuration

(Available over USB VCP only)
MessageId=0x65

Request 0x65:

DATA 0
Channel

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

Type of response:
Default configuration was saved

Response:

DATA 0
Channel number

3.5.7 Frame Echo Configuration

(Available over USB VCP only)
MessageId=0x66

Request 0x66:

DATA 0	DATA 1
Channel	Echo configuration

bit 7							bit 0
Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	TXECHO	RXECHO

Bit 1 **TX Echo on/off**

0 – Echo Off

1 – Echo On (default)

Bit 0 **RX Echo on/off**

0 – Echo Off

1 – Echo On (default)

Response:

DATA 0
Channel number

Acknowledgement when echo configuration was changed, general error message in case of error.
Reasons for error: wrong channel selected, CAN channel is already running.

3.5.8 Start Channel

(Available over USB VCP only)
MessageId=0x67

Request 0x67:

DATA 0
Channel

DATA 0

Bit 0..7 **Channel**

0x0 – CAN 1
0x1 – Reserved
…
0xFF –Reserved

Response:

DATA 0
Channel number

Acknowledgement when channel was started, general error message in case of error.
Reasons for error: wrong channel selected, CAN channel is already running

3.5.9 Stop Channel

(Available over USB VCP only)
MessageId=0x68

Request:

DATA 0
Channel

Bit 0..7 **Channel**

0x0 – CAN 1
0x1 – Reserved
…
0xFF – Reserved

Response:

DATA 0
Channel number

Acknowledgement when channel was stopped, general error message in case of error.
Reasons for error: wrong channel selected, CAN channel is not running

3.5.10 Get Channel Timestamp

(Available over USB VCP only)
MessageId=0x69

Request:

DATA 0
Channel

Bit 0..7 **Channel**

0x0 – CAN 1
0x1 – Reserved
…
0xFF – Reserved

Channel number must always be set to 0.

Response:

DATA 0	DATA 1 - 8
Channel number	Timestamp byte 0 – 7

Channel number: always 0.
Timestamp: microsecond timestamp LSB first.

3.5.11 Transmit Frame

(Available over USB VCP only)
MessageId=0x6A

This message transmits CAN frame. The structure of frame is different when Extended ID is set. Without extended ID frame is header is 5 bytes long. With Extended ID is 7 bytes long. The format of ID is LSB.

Request:
IF EXTId==0

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA n
Channel	MESSAGE_INFO	ID0	ID1	DLC	DATA

IF EXTId==1

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5	DATA 6	DATA n
Channel	MESSAGE_INFO	ID0	ID1	ID2	ID3	DLC	DATA

Timestamp represents the time from startup of CAN(/FD) channel to transmit the frame in microseconds.
Channel:

Bit 0..1 **Channel**
00 – CAN 1
01 – Reserved
10 – Reserved
11 – Reserved

MESSAGE_INFO:

bit 7							bit 0
Reserved	Reserved	Reserved	FDF	ESI	BRS	RTR	EXTId

Bit 5..7 **Reserved**

Bit 4 **FDF**
0 – Frame transmitted in Classic CAN format
1 – Frame transmitted in FDCAN format

Bit 3 **ESI**
0 – Transmitting node is error active
1 – Transmitting node is error passive

Bit 2 **BRS**
0 – FDCAN frames transmitted/received without bit rate switching
1 – FDCAN frames transmitted/received with bit rate switching

Bit 1 **RTR**
0 – Data frame
1 – Remote frame

Bit 0	**EXTId** 0 – Standard ID 1 – Extended ID	

Timestamp
Timestamp is 64-bit number that represents the time from startup of CAN(/FD) channel in microseconds. The bit order in message is LSB.

Response:

DATA 0
Channel number

Acknowledgement if the frame was successfully passed to the controller for transmission, general error message in case of error.
Possible reasons for error: wrong bit configuration.

IF the TX echo is enabled this message is received after the CAN frame is transmitted (EXTId==0):

DATA 0	DATA 1	DATA 2...9	DATA 10	DATA 11	DATA 12	DATA n
Channel	MESSAGE_INFO	Timestamp byte 0…7	ID0	ID1	DLC	DATA

IF the TX echo is enabled this message is received after the CAN frame is transmitted (EXTId==1):

DATA 0	DATA 1	DATA 2...9	DATA 10	DATA 11	DATA 12	DATA 13
Channel	MESSAGE_INFO	Timestamp byte 0…7	ID0	ID1	ID2	ID3

DATA 14	DATA n
DLC	DATA

3.5.12 Receive Frame

(Available over USB VCP only)
MessageId=0x6B

Message response has similar structure as Transmit Frame. It only differs with added timestamp bytes (bytes 2…9). Timestamp represents the time from startup of CAN(/FD) channel to receiving the frame in microseconds. For this message no request is needed, it appears when frame from another CAN unit arrived. Upon reception of CAN error frame, protocol error frame message is sent **Chyba! Nenalezen zdroj odkazů. Chyba! Nenalezen zdroj odkazů.**.

Request:
IF EXTId==0

DATA 0	DATA 1	DATA 2...9	DATA 10	DATA 11	DATA 12	DATA n
Channel	MESSAGE_INFO	Timestamp byte 0…7	ID0	ID1	DLC	DATA

IF EXTId==1

DATA 0	DATA 1	DATA 2...9	DATA 10	DATA 11
Channel	MESSAGE_INFO	Timestamp byte 0…7	ID0	ID1

DATA 12	DATA 13	DATA 14	DATA n
ID2	ID3	DLC	DATA

3.5.13 CAN Error Frame

MessageId = 0x6C

(Available over USB VCP only)

This message is sent asynchronously when there is some error on CAN.

Response:

DATA 0	DATA 1	DATA 2…9
Channel number	Error type	Timestamp byte 0 – 7

Channel number: Always 0

Error type:

- 0: Bit Stuff Error
- 1: Form Error
- 2: Acknowledge Error
- 3: Bit Error
- 4: CRC Error

Timestamp: 64-bit number representing duration in microseconds from channel start.

4 Message Examples

4.1 Device Setting and Info

Command	Bytes [hex]
Read serial number	02 5A 00 5A 03 Gateway response: 02 5A 04 40 01 07 05 6F 03
Read status 100BASE-TX link is up, 100BASE-T1 link is down, 100BASE-T1 no activity, 100BASE-T1 polarity no inversion	02 5D 00 5D 03 Gateway response: 02 5D 04 01 00 00 00 62 03
Read 100BASE-T1 PHY register Link down	02 01 01 01 03 03 Gateway response: 02 01 02 E1 01 E5 03
Read 100BASE-TX PHY register Link up	02 0A 01 01 0C 03 Gateway response: 02 0A 02 6D 78 F1 03
Read SQI class G SQI (very good link)	02 10 00 10 03 Gateway response: 02 10 01 07 18 03

4.2 USB – CAN interface

Command	Bytes [hex]
Configure CAN channel Channel 0, CAN, AutoStart, Normal mode, Arbitration SP = 80%, Arbitration Baud = 500 kBd, Arbitration SJW = 2, Data Baud = 2MBd, Data SJW= 1, Data SP = 80%	02 60 06 00 00 28 02 01 10 08 A9 03 Gateway response: 02 60 00 00 60 03
Configure CAN channel timing Channel 0, CAN, Normal mode, Arbitration T_seg1 = 15, Arbitration T_seg2 = 4, Arbitration Prescaler = 4, Arbitration SJW = 2, Data T_seg1 = 5, Data T_seg2 = 1, Arbitration SJW = 1, Data Prescaler = 1	02 61 09 00 00 00 0E 03 03 01 04 00 00 83 03 Gateway response: 02 61 00 00 61 03
Start CAN channel Channel 0	02 67 01 00 00 68 03 Gateway response: 02 67 02 00 00 00 69 03
Transmit CAN Frame Channel 0, format = CAN, ID = 0x01FF, DLC = 7, Data (hex) = 05 04 50 06 06 08 14	02 6A 0C 00 00 00 FF 01 07 05 04 50 06 06 08 14 FE 03 Gateway response: 02 6A 00 00 6A 03
Stop CAN channel Channel 0	02 68 01 00 00 69 03 Gateway response: 02 68 02 00 00 00 6A 03

4.3 USB – CAN FD interface

Command	Bytes [hex]
Configure CAN FD channel Channel 0, CAN FD, AutoStart, Normal mode, Arbitration SP = 80%, Arbitration Baud = 500 kBd, Arbitration SJW = 8, Data Baud = 2MBd, Data SJW= 4, Data SP = 80%	02 60 06 00 00 68 02 07 13 08 F2 03 Gateway response: 02 60 00 00 60 03
Configure CAN FD channel timing Channel 0, CANFD, AutoStart,	02 61 09 00 00 60 0E 03 03 01 0E 13 00 00 03 Gateway response: 02 61 00 00 61 03

Normal mode, Arbitration T_seg1 = 15, Arbitration T_seg2 = 4, Arbitration Prescaler = 8, Arbitration SJW = 6, Data T_seg1 = 5, Data T_seg2 = 1, Arbitration SJW = 1, Data Prescaler = 1	
Start CAN FD channel Channel 0	02 67 01 00 00 68 03 Gateway response: 02 67 02 00 00 00 69 03
Transmit CAN FD Frame Channel 0, format = CAN FD, BRS, ID = 0x01FF, DLC = 7, Data (hex) = 05 04 50 06 06 08 14	02 6A 0C 00 00 14 FF 01 07 05 04 50 06 06 08 14 12 03 Gateway response: 02 6A 00 00 6A 03
Stop CAN FD channel Channel 0	02 68 01 00 00 69 03 Gateway response: 02 68 02 00 00 00 6A 03

5 Contact

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