SAE J2716 Gateway

CAN bus, RS-232 and USB
Communication Protocol Specification

Changes

Date	Firmware Version	Description	By
24.11.2023	1.11	Clarifications – CRC, Pulse Pause in RX	Karel Hevessy
8.8.2022	1.9	Possibility to transmit a rolling counter (RCNT) in Fast messages.	Karel Hevessy
15.6.2021	1.7	Possibility of CRC fault injection for transmission of slow messages (2.1). Data nibble order for analogue outputs can be set (2.7). Tick time (UT) can be set down to 0.5 us	Miroslav Machacek
9.9.2020	1.6	SENT-USB gateway added. Serial line baud rate can be changed for SENT-USB and SENT-RS232 (3.1.1). Data nibbles can be swapped within a byte (see *SwapFastDataNibbles* in 2.1 and 2.2).	Miroslav Machacek
4.2.2020	1.5	Cyclic message buffers for transmission of Slow Messages (2.6). SENT-CAN: possible to transmit SENT RX messages over separated CAN Ids (3.2.1).	Miroslav Machacek

26.8.2019	1.4	Negative values for Analogue Multiplier and Offset are clarified	Miroslav Machacek
26.4.2019	1.3	Minimal Pause Pulse lowered to 282 ticks	Miroslav Machacek
3.4.2019	1.2	Pause Pulse clarified Communication examples added	Miroslav Machacek
7.1.2019	1.1	Configuration of analogue outputs CAN Alternative configuration removed	Miroslav Machacek
15.8.2018	1.0	Clarifications	Miroslav Machacek
14.2.2018	1.0	Initial Version	Miroslav Machacek

Table of Contents

1. Introduction

This document describes the communication protocol used by the SENT-CAN, SENT-RS232 and SENT-USB gateways so that the device can be integrated into a user's system.

The SENT gateway features two independent SENT channels and allows the user to configure SENT parameters, receive and transmit SENT frame including Short Serial and Enhanced Serial formats via the communication protocol. The device can also automatically transmit Slow messages with different Message Id over a SENT channel with the help of message buffers for slow message.

The SENT-CAN and SENT-RS232 gateway feature two analogue output channels (12-bit DAC) with precise internal voltage reference (range 0-4.095 V). Each analogue channel (AO1, AO2) can be mapped either on SENT1 or SENT2 channel. The conversion settings is configurable by the user – start bit, bit length, nibble order, linear transfer function: Multiplier, Offset, Min/Max voltage limits.

The SENT-CAN device can be configured to transmit SENT Fast and Slow Data frames over separated CAN identifiers, allowing a measurement system to easily process the data.

There are two types of messages - configuration and data. Configuration can be saved and load into a non-volatile memory (EEPROM).

Advanced functions:

- TX buffers for multiple slow messages
- Slow message CRC fault injection
- Rolling counter transmission in Fast messages

1.1. Nibble Endianness and Start Bit

Throughout this document the nibble endianness specifies the nibble order (E.g. not bit order). The following example depicts the endianness on 6 data nibbles when there is a variable *FOO*: Length=12-bit, Start bit=0.

Note that the Start bit order also differs between little and big-endian formats.

Little-endian

Nibble	0				1				2				3				4				5			
Bit Position	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
FOO bits	0	1	2	3	4	5	6	7	8	9	10	11												

Big-endian

Nibble	0				1				2				3				4				5			
Bit Position	20	21	22	23	16	17	18	19	12	13	14	15	8	9	10	11	4	5	6	7	0	1	2	3
FOO bits													8	9	10	11	4	5	6	7	0	1	2	3

2. Configuration

The gateway is configured by the communication protocol described below. The configuration is split into virtual registers that are stored in RAM.

If the user wants to save the configuration from RAM into a non-volatile memory, he transmits SAVE_CONFIGURATION message to the device. Similarly, LOAD_CONFIGURATION message is used to load a configuration into registers in RAM. If a valid configuration is present in a non-volatile memory, it is automatically loaded on power-up.

The registers / data structures are described below.

2.1. SENT Channel Configuration

Byte	Bit	Name	Length in bits	Description	Range	Default value
0	0	AutoStart	1	1 = Channel is started on power-up		1
	1	Reserved	1			
	2	Direction	1	0=TX, 1=RX		1
	3,4	CrcMode	2	0 = hwCRC off, 1 = hwCRC on, 2 =swCRC		1
	5-7	DataNibbleCount	3	Number of data nibbles	1 - 6	6
1	0	PulsePauseEnabled see *PulsePauseFramePeriod* *note: For RX, when enabled, framing errors that may originate from detecting two successive Sync Pulses are ignored*	1	1 = Transmit frames with pulse pause		0
	1,2	RxForwardMode / TxEchoMode	2	0 = Fast as possible / No echo (for Tx) 1 = Fixed 100ms 2 = On change + 1s		1
	3,4	SlowChannelMode	2	0 = Fast Channel Only 1 = Short Serial 2 = Enhanced Serial		0
	5	Reserved	1			
	6	SlowChannelTxCrcFault *relevant when SlowChannelMode is 1 or 2*	1	TX Slow message CRC fault injection 0 = Disabled 1 = Enabled		0
	7	SPCEnabled	1	SPC mode 1=Enabled, 0=Disabled		0
2,3		UnitTime	16	Tick Time [hundreds of ns] 3us= 300	3 - 90 us	300
4,5		PulsePauseFramePeriod valid if *PulsePauseEnabled* is set *note: valid for TX only*	16	TX SENT frame length in us	see below	0

6	0	SwapFastDataNibbles *(Data nibble order within a byte – nibble endianness)* *See 2.2*	1	0 = Data nibble order is unchanged 1 = Data nibbles are swapped within a byte		0

When CrcMode is set to hwCRC off (value 0), incorrect CRC in received Fast Frame does not generate an error. CRC and CRC Calculated fields in the forwarded frame are still valid (CRC is calculated by the specification).

A SENT channel has to be stopped before writing configuration.

TX Pause Pulse Range:

Number of Data Nibbles	Min. Frame Time [ticks]	Max. Frame Time [ticks]
1	147	860
2	174	872
3	201	884
4	228	896
5	255	908
6	282	920

FrameTime = Tframe (us) / Ttick
120 + 27*N <= FrameTime <= 848 + 12*N

N is number of data nibbles: 1 to 6

2.2. SENT Data Frame

Depending on SENT channel configuration field *SwapFastDataNibbles*, the data nibbles can be swapped within a byte. Swapping is useful when the user needs to parse 12-bit values based on a DBC file.
It should be noted that *SwapFastDataNibbles* configuration bit is considered for both directions. E.g. not only when a SENT frame is forwarded onto CAN/RS-232/USB but also when the user writes TX buffers for SENT transmission (Message Ids 41 and 51).

When *SwapFastDataNibbles* is 0:

Byte	Bit	Name	Length in bits	Description
0	0-3	StatusNibble	4	
	4-7	DataNibbleCount	4	Number of following data nibbles
1	0-3	DataNibble 0	4	
	4-7	DataNibble 1	4	
2	0-3	DataNibble 2	4	Byte not sent if NibbleCount<3
	4-7	DataNibble 3	4	
3	0-3	DataNibble 4	4	Byte not sent if NibbleCount<5
	4-7	DataNibble 5	4	
4(2,3)	0-3	CRC	4	Byte 2 if NibbleCount<3, byte 3 if NibbleCount<5 for SENT TX frame: - SwCRC: Field CRC is sent onto the SENT
	4-7	CRC Calculated	4	

				bus - Otherwise: This field is ignored.

When *SwapFastDataNibbles* is 1:

Byte	**Bit**	**Name**	**Length in bits**	**Description**
0	0-3	StatusNibble	4	
	4-7	DataNibbleCount	4	Number of following data nibbles
1	0-3	DataNibble 1	4	
	4-7	DataNibble 0	4	
2	0-3	DataNibble 3	4	Byte not sent if NibbleCount<3
	4-7	DataNibble 2	4	
3	0-3	DataNibble 5	4	Byte not sent if NibbleCount<5
	4-7	DataNibble 4	4	
4(2,3)	0-3	CRC	4	Byte 2 if NibbleCount<3, byte 3 if NibbleCount<5 for SENT TX frame: - SwCRC: Field CRC is sent onto the SENT bus - Otherwise: This field is ignored.
	4-7	CRC Calculated	4	

2.3. SENT Slow Data Frame

Byte	**Bit**	**Name**	**Length in Bits**	**Description**
0	0-7	MessageId	8	
1,2		Data	16	Intel coding (LSB first)
3	0-5	CRC Received	6	ignored for TX
	6	Slow Frame Type 0 = Short Serial 1 = Enhanced Serial	1	
	7	Enhanced Serial Format Configuration Bit 0 = 8-bit MessageId, 12-bit Data 1 = 4-bit MessageId, 16-bit Data Value of 0 also for the *Short Serial type*	1	Valid for *Slow Frame Type*==1
4	0-5	CRC Calculated	6	ignored for TX

2.4. SENT Error Frame

Byte	Bit	Name	Length in Bits	Description
0	0-3	ErrorCode	4	1 = Status Nibble / Sync error 2 = Data Nibble 0 error 3 = Data Nibble 1 error 4 = Data Nibble 2 error 5 = Data Nibble 3 error 6 = Data Nibble 4 error 7 = Data Nibble 5 error 8 = CRC Nibble error
	4-5	ErrorType	2	0 = OK 1 = CRC 2 = FRAMING 3 = SYNC

Note that when CrcMode in channel configuration is set to hwCRC off (value 0), incorrect CRC in received Fast Frame does not generate an error (see above).

2.5. SENT Slow Error Frame

Byte	Bit	Name	Length in Bits	Description
0	0-3		4	unused
	4-5	ErrorType	2	0 = OK 1 = CRC 2 = FRAMING 3 = SYNC

2.6. SENT Slow Message TX Buffers

The gateway allows for a a cyclic transmission of Slow messages with different Message Ids. This is useful for sensor simulations when the user needs to multiplex between several Slow messages.

By enabling several message buffers, the particular SENT TX channel will automatically transmit the Slow messages in a cyclic order. The *SlowChannelMode* in SENT channel configuration has to be set to either Short Serial or Enhanced serial mode.

Byte	Bit	Name	Length in Bits	Description
0	0-4	Buffer Index	5	
	5	Buffer Enabled	1	Enable or disable the buffer
	6	EnhancedConfigBit	1	Relevant for Enhanced Serial Format *Not relevant when Buffer Enabled==0*
	7	Reserved		
1		Message Id	8	Slow message identifier *Not relevant when Buffer Enabled==0*
2,3		Data	16	Intel coding (LSB first) *Not relevant when Buffer Enabled==0*

A message buffer can be enabled or disabled even whilst a SENT channel is running. Transmitting a single slow message (Message Id 42 and 52) will switch back to single slow message buffer mode even when at least one message buffer above is enabled.

All message buffers are cleared when a SENT channel is stopped. The user can configure the buffers before a SENT channel is started so that a cyclic transmission begins once the first Fast message is sent (Message Ids 41 and 51).

2.7. Analogue Output Configuration

An analogue output channel (12-bit, 0-4.095 V) can be mapped on any RX SENT channel. Bit position and bit length within the SENT data nibbles, and nibble order (endianness) are configurable. So is the linear transfer function and voltage Min and Max limits.

Byte	Bit	Name	Length in Bits	Description	Default Value
0	0-4	Start bit	5	Start bit in the Data field of a SENT frame	0
	5	Nibble order (endianness)	1	0 = Big endian (MSN first) 1 = Little endian (LSN first)	0
	6-7	SENT channel 0=Disabled (HighZ) 1=SENT 1 2=SENT 2	2	SENT channel selection; *E.g. what SENT channel is this analogue output mapped onto.*	0
1	0-4	Length	5	Bit length in bits	12
2,3		Offset	16	**Signed** value Intel coding (LSB first)	0
4,5		Multiplier	16	**Signed** value Intel coding (LSB first)	1024

The Nibble order specifies what order are the nibbles from a SENT data frame taken in. E.g. how a raw value is calculated out of the nibbles. Apparently, the Nibble order value is relevant when Length >= 5 bits. See 0 for endianness description.

Please be aware the **Start bit** also depends on the endianness.

Conversion:

Uout [mV] = (RawValue * Multiplier / 1024) + Offset

Note: Apart from the physical range of the DAC (which is 0-4.095 V), the voltage range can further be limited by software. See next paragraph for voltage limits.

2.8. Analogue Output Limits

This limits the range of the analogue channel.

Byte	Bit	Name	Length in Bits	Description	Default Value
0,1		Minimum voltage [mV]	16	Intel coding (LSB first)	0
2,3		Maximum voltage [mV]	16	Intel coding (LSB first)	4095

2.9. Rolling Counter Configuration

A transmission of a rolling counter (RCNT) in the data nibbles of Fast message can be configured. The device then automatically transmits the RCNT and increments its value every time a Fast message has been transmitted. The RCNT configuration has the priority of its data field over a standard Transmit Fast Frame. Hence Transmit Fast Frame does not overwrite the RCNT data field when the RCNT is enabled.

SENT channel number relevant for the RCNT is determined by the Message Id (see 4.1). The RCNT can be enabled or disabled on-the-fly by its Enable bit.

Byte	Bit	Name	Length in Bits	Description
0	0-4	Start bit	5	Start bit in the Data field of a SENT frame
	5	Nibble order	1	0 = Big endian (MSN first) 1 = Little endian (LSN first)
	6	Enable	1	Enable or disable the counter
1	0-4	Length	5	Bit length of the counter

Please be aware the **Start bit** also depends on the endianness. See 0 for endianness description.

3. Communication Protocol

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

The communication protocol consists of Message Id and Data. For RS-232 and USB product variants, the protocol is encapsulated by Start, Length, Checksum and End. For CAN bus, the protocol is placed into the data bytes of a CAN frame.

3.1. RS-232 and USB

The protocol contains delimiters for start and end of a message, a Message Id, Data with variable length and a Checksum.

STX (1B)	**LEN (1B)**	**ID (1B)**	**DATA (X B)**	**CHKSUM (1B)**		**ETX (1B)**
0x02	Length of the message in bytes 0 - 8	Message Id	… Number of bytes = LEN-1	Checksum - a byte sum of LEN+ID+(DATA0+DATA1…+DATAN)		0x03

LEN value is the length of ID + DATA

3.1.1. Serial Line Baud Rate

8 data bits, no parity, 1 stop bit. Baud rate is user selectable, default 115200.

Baud rate Selector Value	**Baud rate**	**SENT-RS232**	**SENT-USB**
0	19200	+	+
1	115200	+	+
2	230400	+	+
3	460800		+
4	921600		+

User can select different baud rate by writing command with Message ID 65 (0x41) and Baud rate Selector value in Data[0]. Both SENT channels have to be disabled before calling this command. Gateway acknowledges command and then changes baud rate settings.

3.2. CAN

The SENT Gateway receives via CANID_RX and transmits over CANID_TX. Both CAN identifiers can be changed per device - see Message Ids 84 - 87.

Default configuration:

CANID_RX = 0x123 Std Id.

CANID_TX = 0x321 Std Id.

CAN Baud = 500 KBaud

CAN Frame

CAN	Data Bytes 0 - 8	
ID	Message Id	Data
11 bit	8 bit	0 – 56 bit (0 – 7 bytes)

Data Byte 0 is always used as Message Id (just like in RS-232), the rest of the data bytes carry the message content.

Note: Grey parts are automatically generated by a CAN controller.

3.2.1. CAN Configuration

Byte	Bit	Name	Length in Bits	Description	Range
0-3		BaudRate	32	default 500000	
4		Sample point [%]	8	default 80	70 - 90

3.2.2. CAN IDs for SENT RX Messages

For some data acquisition systems, it is easier to receive SENT data messages over a CAN frame with a CAN identifier different from the one used for the Communication Protocol (see 3.2 CAN). This will help the measurement system to process incoming CAN frames without checking the *Message Id* at Data[0] of each CAN frame.

This feature is enabled for a SENT channel by Message Id 82 and 83. When enabled, the gateway will transmit Fast RX SENT frames (2.2 and 2.4) and Slow RX SENT frames (2.3 and 2.5) for the particular SENT channel over CAN messages with separated CAN identifiers. *RxForwardMode* is still applied.

Byte	Name	Length in Bits	Description
0-3	CAN Id of SENT Fast Data Frame *Notes:* • *CAN Id of SENT Fast Error Frame is configured implicitly to "(*CAN Id of SENT Fast Data Frame*) + 1"* • *CAN Id of SENT Slow Data Frame is configured implicitly to "(*CAN Id of SENT Fast Data Frame*) + 2"* • *CAN Id of SENT Slow Error Frame is configured implicitly to "(*CAN Id of SENT Fast Data Frame*) + 3"*	32	0 = Disabled (default) Otherwise: Bit 0 - 28 = CAN Id (Intel coding) Bit 31 (MSB) = Extended Id Flag

Note: Even when this feature is enabled, the gateway will still transmit these messages over the main CAN identifiers (Message Ids 100 - 103). This means the information will be doubled.

4. Messages

4.1. To Gateway

PC to Device					
Message Id	**Name**	**Description**	**LEN value**	**Response**	
1	Read SENT 1 channel Configuration		1	Data	
2	Write SENT 1 channel Configuration 1	Configure channel SENT	8	0 = ERR 1 = OK	
11	Read SENT 2 channel Configuration		1	Data	
12	Write SENT 2 channel Configuration 1	Configure channel SENT	8	0 = ERR 1 = OK	
21	Start SENT 1 channel		1	0 = ERR 1 = OK	
22	Stop SENT 1 channel		1	0 = ERR 1 = OK	
31	Start SENT 2 channel		1	0 = ERR 1 = OK	
32	Stop SENT 2 channel		1	0 = ERR 1 = OK	
41	Transmit SENT 1 Fast frame	See 2.2	3-5	0 = ERR 1 = OK	
42	Write SENT 1 Slow frame buffer (no multiplexing)	See 2.3	5	0 = ERR 1 = OK	
43	Write SENT 1 Slow frame buffers (with multiplexing)	See 2.6	4	0 = ERR 1 = OK	
44	Configure rolling counter transmission for SENT1	See 2.9	3		
51	Transmit SENT 2 Fast frame	See 2.2	3-5	0 = ERR 1 = OK	
52	Write SENT 2 Slow frame buffer (no multiplexing)	See 2.3	5	0 = ERR 1 = OK	
53	Write SENT 2 Slow frame buffers (with multiplexing)	See 2.6	4	0 = ERR 1 = OK	
54	Configure rolling counter transmission for SENT2	See 2.9	3		
60	LOAD_CONFIGURATION	Load configuration from non-volatile memory to RAM	1	0 = ERR 1 = OK	
61	SAVE_CONFIGURATION	Save current configuration into non-volatile memory	1	0 = ERR 1 = OK	

62	LOAD_DEFAULT_CONFIGURATION	Load			
65	Write Serial Line Baud rate	See 3.1.1 *RS232 and USB variant only*	1	0 = ERR 1 = OK	
70	Read AO1 Configuration		1	Data	
71	Write AO1 Configuration		7	0 = ERR 1 = OK	
72	Read AO1 Limits		1	Data	
73	Write AO1 Limits		5	0 = ERR 1 = OK	
74	Read AO2 Configuration		1	Data	
75	Write AO2 Configuration		7	0 = ERR 1 = OK	
76	Read AO2 Limits		1	Data	
77	Write AO2 Limits		5	0 = ERR 1 = OK	
80	Read CAN Configuration	See 3.2.1 *CAN variant only*	1	Data	
81	Write CAN Configuration	See 3.2.1 *CAN variant only*	8	0 = ERR 1 = OK	
82	Write SENT 1 Alternative CAN Id Configuration	See 3.2.2 *CAN variant only*	8	0 = ERR 1 = OK	
83	Write SENT 2 Alternative CAN Id Configuration	See 3.2.2 *CAN variant only*	8	0 = ERR 1 = OK	
84	Read CANID_RX	*CAN variant only* *Bit 31 (MSB) = Extended Id Flag*	1	ID_RX 4 Bytes	
85	Write CANID_RX	*CAN variant only* *Bit 31 (MSB) = Extended Id Flag*	5	0 = ERR 1 = OK	
86	Read CANID_TX	*CAN variant only* *Bit 31 (MSB) = Extended Id*	1	ID_TX 4 Bytes	
87	Write CANID_TX	*CAN variant only* *Bit 31 (MSB) = Extended Id*	5	0 = ERR 1 = OK	
90	READ_SER_NO	Serial No *Intel byte order*	1	Serial No 4 Bytes	
91	READ_HW_INFO	HWID/VariantId/Product Id	1	6 Bytes	
92	READ_SW_INFO	FW version (X.Y) Byte 0 = Y Byte 1 = X		2 Bytes	
93	READ_STATUS	byte 0: Bit 0 = Channel 1 running Bit 1 = Channel 2 running		4 Bytes	

		Byte 1 - 3: reserved			
99	RESTART_BOOT	Reboot into bootloader	1		

4.2. From Gateway

Gateway to PC					
Message Id	**Name**	**Description**	**LEN value**	**Response**	
100	SENT 1 Frame Received	See 2.2 SENT Data Frame	3-5		
101	Slow SENT 1 Frame Received	Short Serial Message or Enhanced Serial Message See 2.3 SENT Slow Data Frame	4		
102	SENT 1 Error Received	See 2.4 SENT Error Frame	2		
103	SENT 1 Slow Error Received	See 2.5 SENT Slow Error Frame	2		
110	SENT 1 Tx Echo	See 2.2 SENT Data Frame	3-5		
200	SENT 2 Frame Received	See 2.2 SENT Data Frame	3-5		
201	Slow SENT 2 Frame Received	Short Serial Message or Enhanced Serial Message See 2.3 SENT Slow Data Frame	4		
202	SENT 2 Error Received	See 2.4 SENT Error Frame	2		
203	SENT 2 Slow Error Received	See 2.5 SENT Slow Error Frame	2		
210	SENT 2 Tx Echo	See 2.2 SENT Data Frame	3-5		
250	Boot Up	Device was powered up or restarted	1		
255	Error		2	ErrorCode: 2 = Wrong Checksum 10 (dec) = Unknown Message Id	

5. Command Examples

5.1. Transmission over SENT Channel

5.1.1. Fast Message

Transmit a fast message over SENT 1 channel.

Command	Description	Message Id
Stop	A SENT channel has to be stopped before writing its configuration	22
Configure	Write channel configuration	2
Start	Start Channel	21
Transmit	Transmit a Fast Message	41
	The gateway will begin to transmit the fast message continuously.	

5.1.2. Slow Message

Transmit a fast message and slow message over SENT 1 channel.

Command	Description	Message Id
Stop	A SENT channel has to be stopped before writing its configuration	22
Configure	Write channel configuration (make sure you enable the Slow Channel mode by *SlowChannelMode*)	2
Start	Start Channel	21
Write Slow frame	Prepare the Slow Message buffer	42
Transmit	Transmit a Fast Message	41
	The gateway will begin to transmit the fast and slow message continuously.	

5.1.3. Slow Messages - Multiplexing

Transmit a fast message and multiple slow messages over SENT 1 channel.

Command	Description	Message Id
Stop	A SENT channel has to be stopped before writing its configuration	22
Configure	Write channel configuration (make sure you enable the Slow Channel mode by *SlowChannelMode*)	2
Start	Start Channel	21
Write Slow message buffers	Enable and configure Slow Message buffers	43
Write Slow message buffers	…… up to 32 slow message buffers	43
Transmit	Transmit a Fast Message	41
	The gateway will begin to transmit the fast and slow messages continuously whilts the configured slow message buffers will be transmitted cyclically.	

6. Communication Examples

6.1. RS-232 and USB

Read Serial Number:

02 01 5A 5B 03

Gateway Response: *02 05 5A **FF FF FF FE** 5A 03*

where 0xFEFFFFFF (coded in Intel/Little-Endian) is the Gateway's serial number

6.2. CAN bus

6.2.1. SENT Channel 1 Configuration

Property	**SENT 1**
Auto Start	☑
Direction	Tx
Crc Mode	HwCrc
Nibble Count	5
Pulse Pause	☐
Pulse Pause Frame Period	0 Min: 527 Max: 2724
Rx Forward Mode / Tx Echo Mode	Fixed 100ms
Slow Channel mode	Fast Channel only
SPC Enabled	☐
Unit Time	3

Frame Id	Frame Type	Data Length	Data
0x123	Std. Frame	7	0x02 0xA9 0x02 0x2C 0x01 0x00 0x00
0x321	Std. Frame	2	0x02 0x01

6.2.2. Start Channel 1

Frame Id	Frame Type	Data Length	Data
0x123	Std. Frame	1	0x15
0x321	Std. Frame	2	0x15 0x01

6.2.3. Stop Channel 1

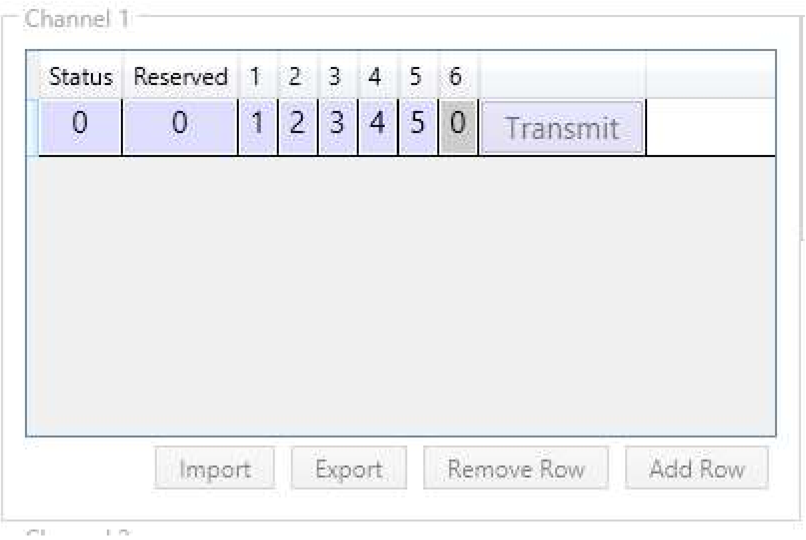
Frame Id	Frame Type	Data Length	Data
0x123	Std. Frame	1	0x16
0x321	Std. Frame	2	0x16 0x01

6.2.4. Start Both Channels

Frame Id	Frame Type	Data Length	Data	Other Properties
0x123	Std. Frame	1	0x15	
0x321	Std. Frame	2	0x15 0x01	
0x123	Std. Frame	1	0x1F	
0x321	Std. Frame	2	0x1F 0x01	
0x123	Std. Frame	1	0x5D	
0x321	Std. Frame	5	0x5D 0x03 0x00 0x00 0x00	

Recommended practice is to check channel status after channel start. This can be done easily by sending a request with Id=0x5D

6.2.5. Transmit on Channel 1



Frame Id	Frame Type	Data Length	Data
0x123	Std. Frame	5	0x29 0x00 0x21 0x43 0x00
0x321	Std. Frame	2	0x29 0x01

7. Contact

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