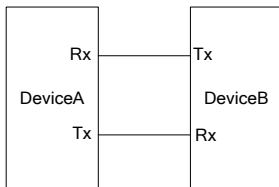
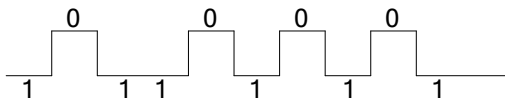


RS232 Decoding (Option)

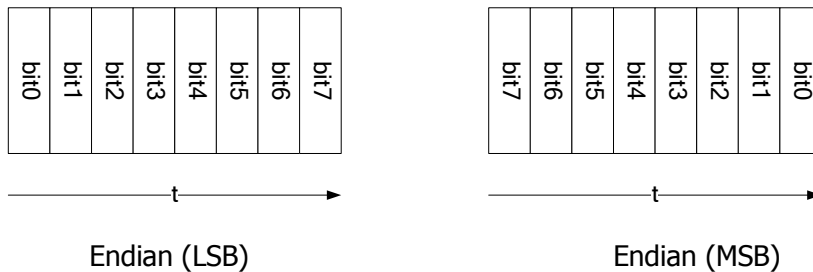
RS232 serial bus consists of the transmitting data line (TX) and the receiving data line (RX).



The industry standard of RS232 uses "Negative Logic", namely high level is logic "0" and low level is logic "1".

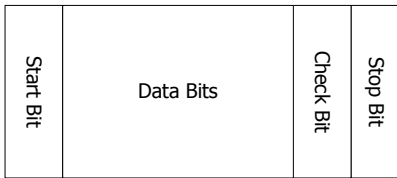


By default, RS232 uses LSB (Least Significant Bit) transmission sequence, namely the lowest bit of the data is transmitted first. While for MSB (Most Significant Bit), the highest bit of the data is transmitted first.



In RS232, baud rate is used to represent the transmitting rate (namely bits per second) of the data. The commonly used baud rates include 4800bps, 9600bps, 19200bps, 38400bps, 57600bps and 115200bps.

In RS232, you need to set the start bit, data bits, check bit (optional) and stop bit of each frame of data.



Start Bit: represent when the data starts outputting. Setting the **Polarity** is equivalent to specifying the "Start Bit".

Data Bits: represent the number of data bits actually contained in each frame of data.

Even-OddCheck: be used to check the correctness of the data transmission.

- Odd-Check: the number of "1" in the data bit and check bit is an odd. For example, when 0x55 (01010101) is sent, a 1 needs to be filled in the check bit to make the number of 1 to be an odd.
- Even Check: the number of "1" in data bit and check bit is an even. For example, when 0x55 (01010101) is sent, a 0 should be filled in the check bit.
- None: there would not be check bit during the transmission.

Press **Decode1** → **Decode** to select "RS232" to open the RS232 decoding function menu.

1. TX and RX Channel Setting

Press **TX** to select any channel (CH1 to CH4) as the transmitting channel and when "OFF" is selected, no transmitting channel is set. Use the same method to set the **RX** channel. What's more, you need to set the thresholds of the input channels of **TX** and **RX**. Switch the menu page and press **TXThreshold** and **RXThreshold** respectively to input the desired threshold values.

2. Polarity Setting

Press **Polarity** to select "-" (negative polarity) or "+" (positive polarity) and the default is negative polarity. The oscilloscope will select the rising or falling edge as the start position during decoding.

3. Endian Setting

Press **Endian** to select "LSB" or "MSB" and the default is "LSB".

4. Baud Rate Setting

Press **Baud** to select the desired baud rate and the default is 9600bps.

5. Data Packet Setting

As mentioned before, in RS232, you need to set the start bit, data bits, check bit (optional) and stop bit of each frame of data. "Start Bit" is specified by the "Polarity Setting". The setting methods of other parameters are as follows:

- Press **Data Bits** to set the data width of each frame. It can be set to 5, 6, 7, 8 or 9 and the default is 8.
- Press **Stop Bit** to set the stop bit after each frame of data. It can be set to 1 bit, 1.5 bits or 2 bits.
- Press **Even-OddCheck** to set the even-odd check mode of the data transmission. It can be set to None, Odd Check or Even Check.
- Press **Packet** to enable or disable the packet end. When packet end is enabled, several data blocks are combined according to the packet end.
- Press **PacketEnd** to set the packet end during data transmission and it can be set to 00 (NULL), 0A (LF), 0D (CR), 20 (SP) or FF.

6. Display-related Setting

Press **Format** to set the display format of the bus to Hex, Decimal, Binary or ASCII.

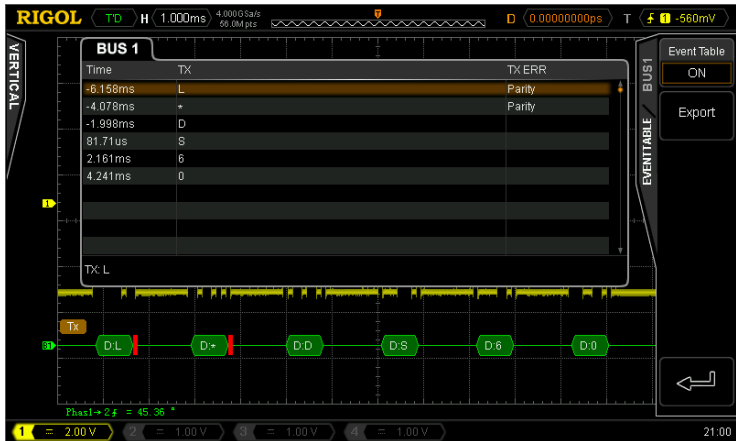
Press **Offset** and use  to adjust the vertical display position of the bus.

Press **BusStatus** to turn the bus display on or off.

7. Decoding Table

The decoding table displays the decoded data, the corresponding time and error information on TX and RX data lines in table format. It can be used to observe relatively longer decoded data to solve the problem that some data could not be seen clearly on the screen.



Press **Event Table** → **Event Table** to select "ON" (note that this operation is only available when **BusStatus** is set to "ON") to enter the decoding table interface as shown in the figure below. The decoding table lists the decoded data in time order. If error occurs during the decoding, the corresponding error information is displayed. If an USB storage device is currently connected to the instrument, press **Export** to export the data table to the external USB storage device in CSV format.

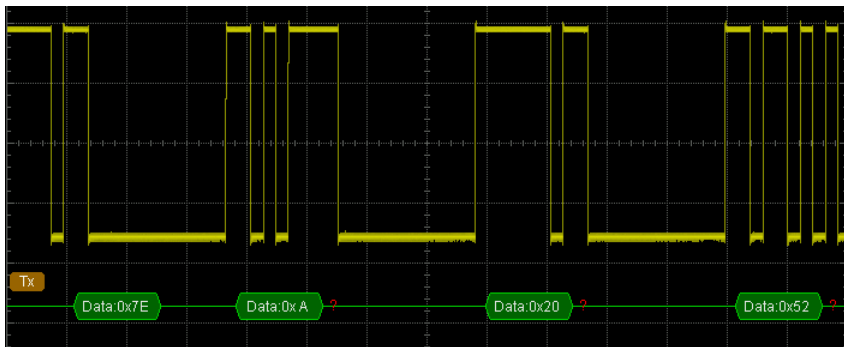


8. The Error Expression during Decoding

DS4000 makes full use of the resources such as color and view to express the results of the protocol decoding effectively so as to let users find the desired information quickly.

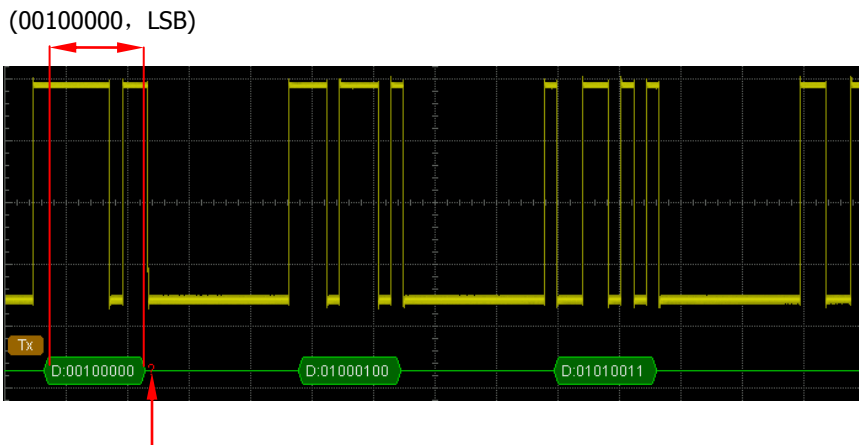
End Frame Error:

Errors generated when the end frame condition is not met. When the stop bit is set to 1.5, red error mark (note that the red mark is displayed in different modes according to the horizontal time base setting; when the horizontal time base is relatively smaller,  is displayed; otherwise,  is displayed) will be displayed if the stop bit is less than 1.5.



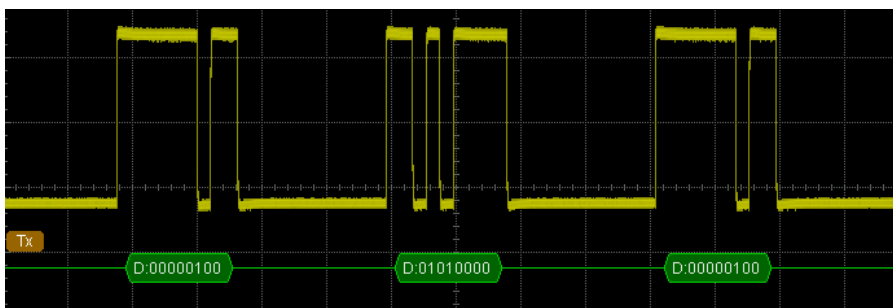
Check Error:

When check bit error is detected during the decoding, red error mark will be displayed. For example, when the transmitting terminal is set to none check and the decoder is set to odd check, the following check error occurs:



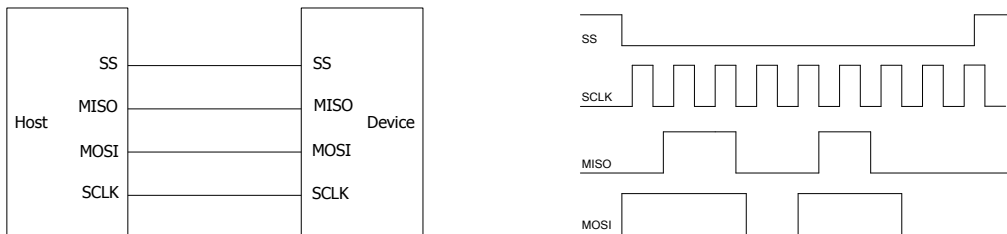
Wherein, there are odd number (1) of 1 in the 8 bits data 00100000 and the check bit should be 0; but the check bit detected on the TX is 1, thus check error occurs.

After the decoder is set to none check, the decoding becomes normal.



SPI Decoding (Option)

SPI serial bus consists of chip select line (SS), clock line (SCLK), MISO and MOSI.



SS: set the polarity to "Low" or "High". When SS selection is valid, the SPI bus samples data from MISO and MOSI at the jumping point of SCLK.

SCLK: sample data from MISO and MOSI on the clock rising edge or falling edge.

MISO: master input/slave output. Set the polarity to "Low" or "High".

MOSI: master output/slave input. Set the polarity to "Low" or "High".

Press **Decode1** → **Decode** to select "SPI" and open the SPI decoding function menu.

1. SS Setting

Press **SS** to turn the chip select line setting interface on.

- Press **Channel** to select any channel (CH1 to CH4) as the chip select channel. When "OFF" is selected, the sample of MISO and MOSI occurs at the jumping point of SCLK.
- Press **Polarity** to set the polarity of the chip select channel to "Low" or "High".
- Press **Threshold** to set the threshold of the selected channel.

2. SCLK Setting

Press **SCLK** to turn on the clock line setting interface.

- Press **Channel** to select any channel (CH1 to CH4) as the clock channel.
- Press **Slope** to set the instrument to sample MISO and MOSI on the rising edge or falling edge of SCLK.
- Press **Threshold** to set the threshold of the clock channel.

3. MISO Setting

Press **MISO** to enter the MISO data line setting interface.

- Press **Channel** to select any channel (CH1 to CH4) as the MISO data channel. When "OFF" is selected, this data line is not set.
- Press **Polarity** to set the polarity of the MISO data line to "Low" or "High".
- Press **Threshold** to set the threshold of the MISO data channel.

4. MOSI Setting

Press **MOSI** to enter the MOSI data line setting interface.

- Press **Channel** to select any channel (CH1 to CH4) as the MOSI data channel. When "OFF" is selected, this data line is not set.
- Press **Polarity** to set the polarity of the MOSI data line to "Low" or "High".
- Press **Threshold** to set the threshold of the MOSI data channel.

5. Data Bits Setting


Press **Data Bits** to set the number of bits of each frame of data. The range available is from 4 to 32.

6. Endian Setting

Press **Endian** to select "LSB" or "MSB" and the default is "MSB".

7. Display-related Setting

Press **Format** to set the display format of the bus to Hex, Decimal, Binary or ASCII.

Press **Offset** and use  to adjust the vertical display position of the bus.

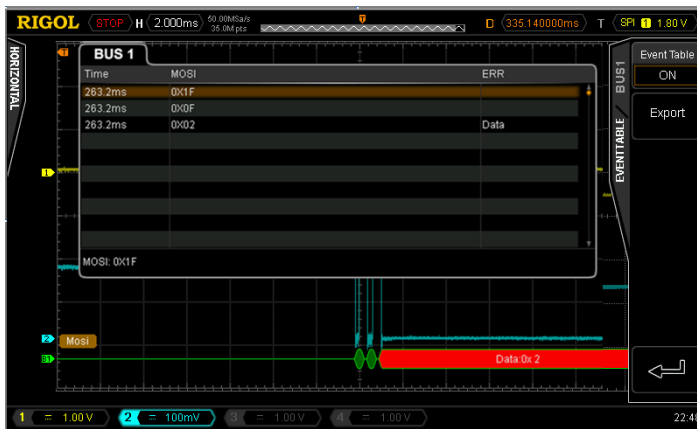
Press **BusStatus** to turn the bus display on or off.

8. Decoding Table

The decoding table displays the decoded data, the corresponding time and error information on the MOSI or MISO data line in table format. It can be used to observe relatively longer decoded data to solve the problem that some data could not be seen clearly on the screen.

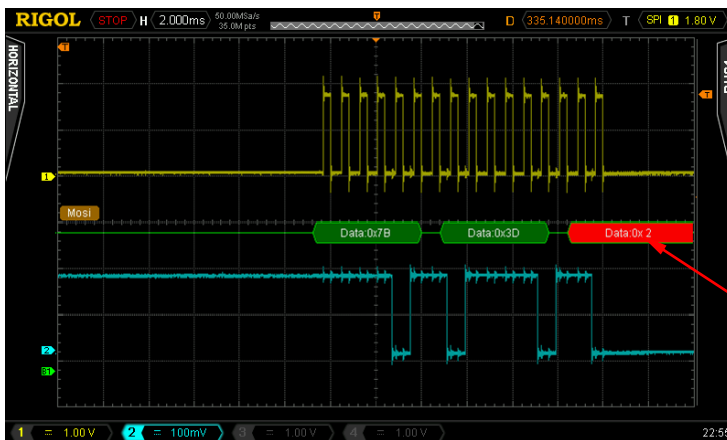
Press **Event Table** → **Event Table** to select "ON" (note that this operation is only available when **BusStatus** is set to "ON") to enter the decoding table interface as shown in the figure below. If an USB storage device is currently connected to the instrument, press **Export** to export the data table to the

external USB storage device in CSV format.



9. Error Expressions during Decoding

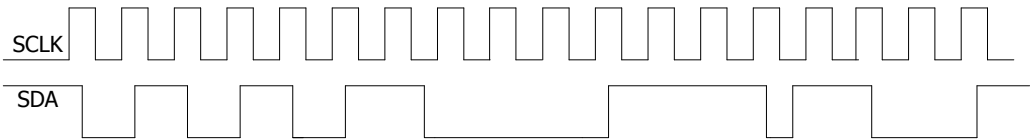
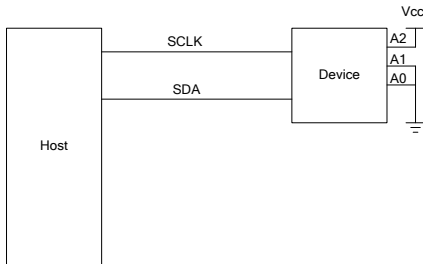
When the clock for a frame in SPI is not enough, the data is filled with red patches. For example, when Data Bits is set to 7 and SCLK slope is set to rising edge, decoding error will be generated.



Not enough
for 7 bits

I2C Decoding (Option)

I2C serial bus consists of the clock line (SCLK) and the data line (SDA).



SCLK: sample the SDA on the clock rising edge or falling edge.

SDA: denote the data channel.

Press **Decode1** → **Decode** to select "I2C" and open the I2C decoding function menu.

1. SCLK Setting

Press **SCLK** to select any channel (CH1 to CH4) as the clock channel.

Press **SCLKThreshold** to set the threshold of the clock channel.

2. SDA Setting

Press **SDA** to select any channel (CH1 to CH4) as the data channel.

Press **SDAThreshold** to set the threshold of the data channel.

3. Display-related Setting

Press **Format** to set the display format of the bus to Hex, Decimal, Binary or ASCII.

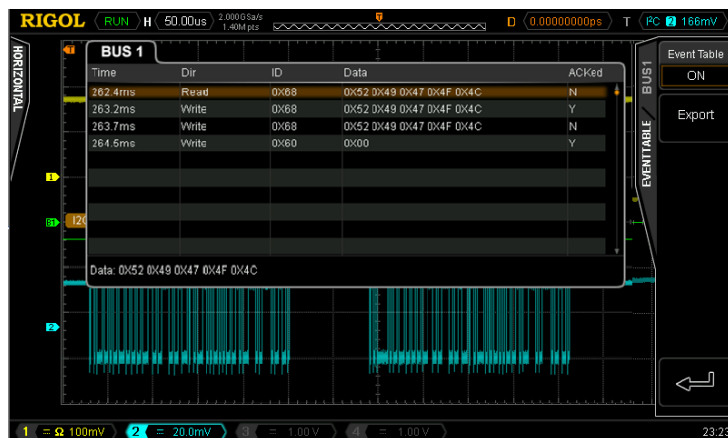
Press **Offset** and use ↻ to adjust the vertical display position of the bus.

Press **BusStatus** to turn the bus display on or off.

4. Decoding Table

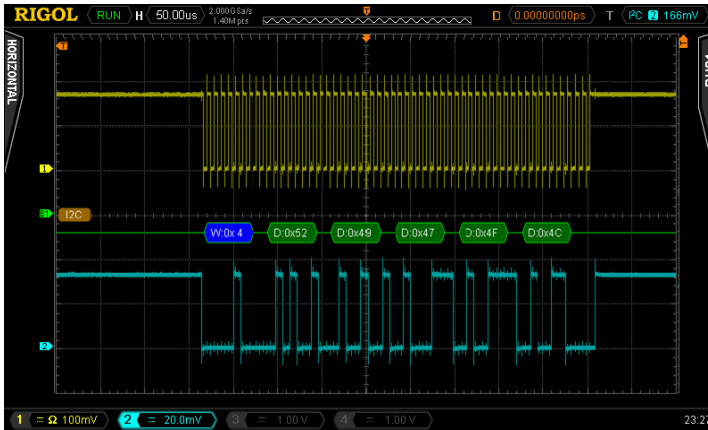
The decoding table displays the decoded data, the correspondint time, data direction, ID and ACK information in table format.

Press **Event Table** → **Event Table** to select "ON" (note that this operation is only available when **BusStatus** is set to "ON") to enter the decoding table interface as shown in the figure below. If an USB storage device is currently connected to the instrument, press **Export** to export the data table to the external USB storage device in CSV format.

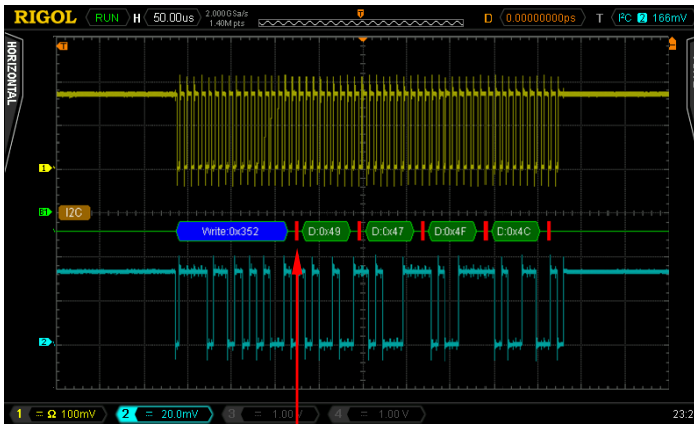


5. Error Expressions during Decoding

In I2C bus, the front part of each frame of data contains the address information and blue patches are used to represent address ID. In the ID, "Write" is used to represent writing address and "Read" is used to represent reading address.



When the ACK (ACKnowledge Character) is not met, the red error marks as shown in the figure below will be displayed.



ACK=1

CAN Decoding (Option)

Press **Decode1** → **Decode** and select "CAN" to open the CAN decoding function menu.

1. Source

Press **Source** and select any channel (CH1 to CH4) as the source channel.

2. Signal Type

Press **Signal Type** to select the desired signal type.

- **CAN_H:** the actual CAN_H bus signal.
- **CAN_L:** the actual CAN_L bus signal.
- **Differential:** the CAN differential bus signals connected to an analog channel using a differential probe. The positive lead of the probe connects CAN_H and the negative lead connects CAN_L.

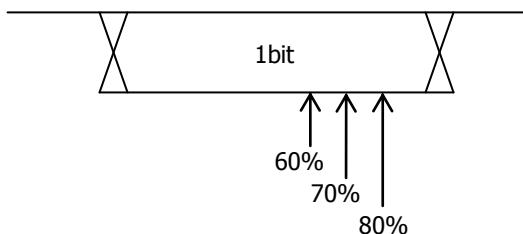
3. Baud

Press **Baud** to select a baud rate (100 kb/s, 125 kb/s, 250 kb/s, 400 kb/s, 500 kb/s, 800 kb/s, 1 Mb/s or User) that matches the CAN bus signal. When "User" is selected, press **Setup** and use ↻ to enter the desired rate, the range is from 10 kb/s to 1 Mb/s.

4. Sample Point

The Sample point is the point within the bit's time. The oscilloscope samples the bit level at this point. "Sample point" is represented by the percentage of "the time from the start of the bit's time to the sample point time" in the "bit's time".

Press **Sample Point** and use ↻ to adjust this parameter with a step of 1%. The range is from 5% to 95%.



5. Threshold

Refer to the introduction in “**Parallel Decoding**”.

6. Display-related Setting

Press **Format** to set the bus display format to Hex, Decimal, Binary or ASCII.

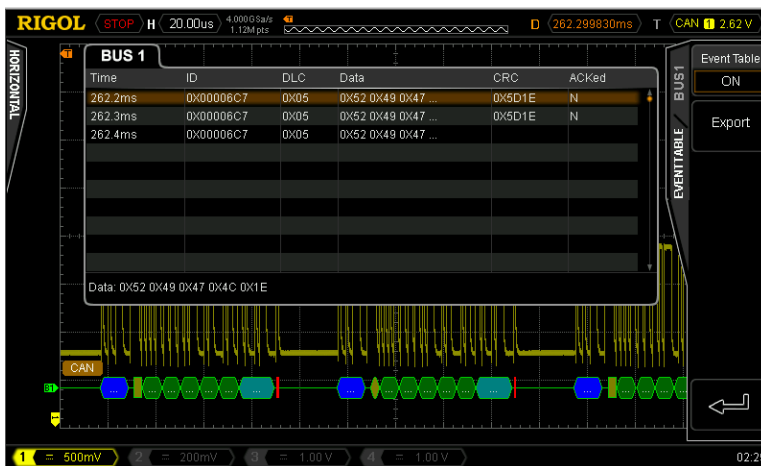
Press **Offset** and use ↻ to adjust the vertical display position of the bus.

Press **BusStatus** to enable or disable bus display.

7. Decoding Table

The decoding table displays the decoded data, the corresponding time, frame ID, DLC, CRC and ACK information in table format.

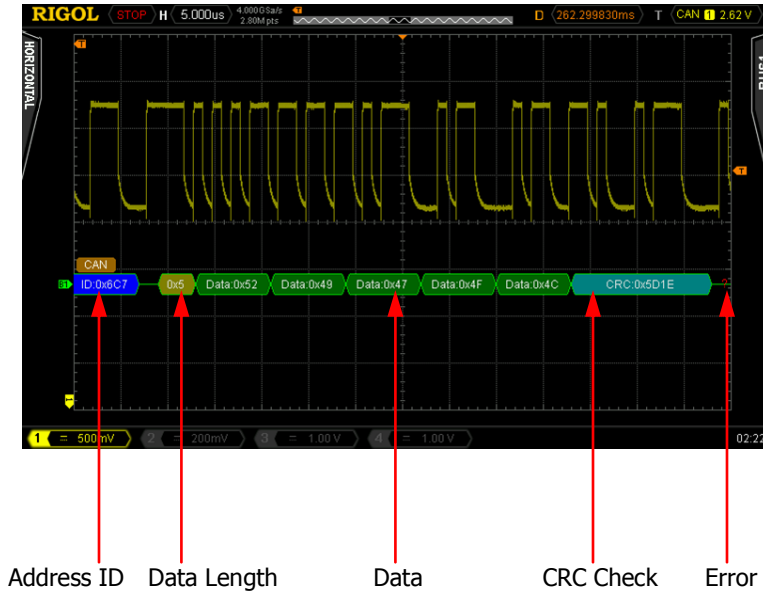
Press **Event Table** → **Event Table** to select “ON” (note that this operation is only available when **BusStatus** is set to “ON”) to enter the decoding table interface as shown in the figure below. If an USB storage device is currently connected to the instrument, press **Export** to export the data table to the external USB storage device in CSV format.



8. Decoded CAN Data Interpretation

- Frame ID: displayed in hex digits in blue.
- Data Length code (DLC): displayed in chartreuse patch.
- Data Frame: displayed in green patches and in red patches if data frame is lost.
- Cyclic Redundancy Check (CRC): displayed in light blue patch when valid

and red error mark is displayed when error occurs.



FlexRay Decoding (Option)

Press **Decode1** → **Decode** and select "FlexRay" to open the FlexRay decoding function menu.

1. Source

Press **Source** to select any channel (CH1 to CH4) as the signal source channel.

2. Signal Path

Press **Signal Path** to select the signal path (A or B) that matches the FlexRay bus signal.

3. Signal Type


Press **Signal Type** to select the type of signal that matches the FlexRay bus. The signal types available include BP, BM and TX/RX.

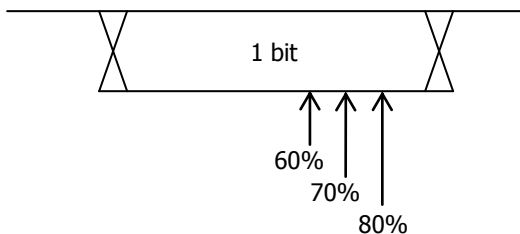
4. Baud

Press **Baud** to set the signal rate (2.5Mb/s, 5Mb/s or 10Mb/s) that matches the FlexRay bus signal.

5. Sample Point Position

The sample point is the point within the bit's time. The oscilloscope samples the bit level at this point. "Sample Point" is expressed by the percentage of "the time from the start of bit to the sample bit time" in "bit's time".

Press **Sample Point** and use  to adjust this parameter with a step of 1% and the range is from 5% to 95%.



6. Threshold

Refer to the introduction in "**Parallel Decoding**".

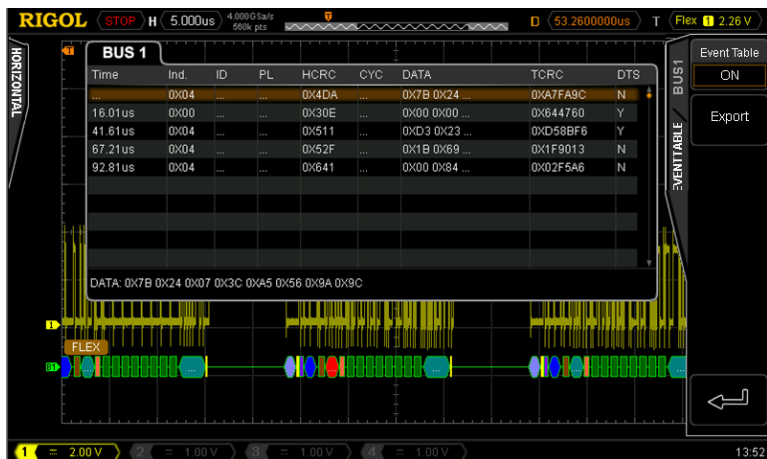
7. Display-related Setting

Press **Package** to set whether to display the FlexRay in package.
Press **Format** to set the display format of the bus to Hex, Decimal, Binary or ASCII.
Press **Offset** and use ↻ to adjust the vertical display position of the bus.
Press **BusStatus** to enable or disable bus display.

8. Decoding Table

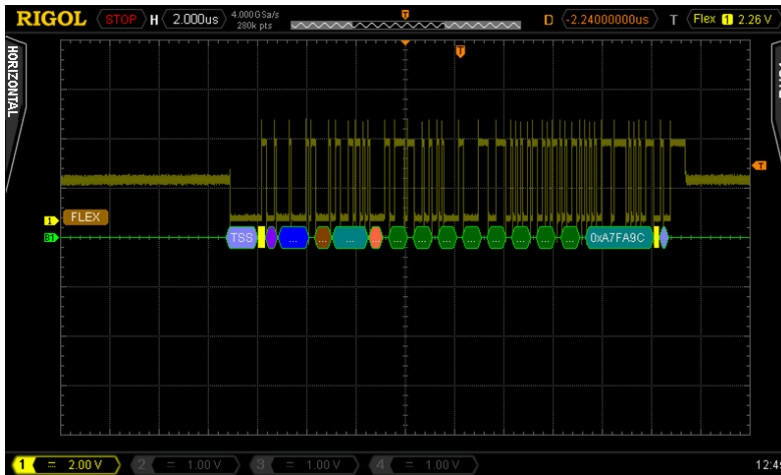
The decoding table lists the decoded data, the corresponding time and error information in table format. It can be used to observe relatively longer decoded data to solve the problem that some data could not be seen clearly on the screen.

Press **Event Table** → **Event Table** to select "ON" (note that this operation is only available when **BusStatus** is set to "ON") to enter the decoding table interface as shown in the figure below. If an USB storage device is currently connected to the instrument, press **Export** to export the data table to the external USB storage device in CSV format.

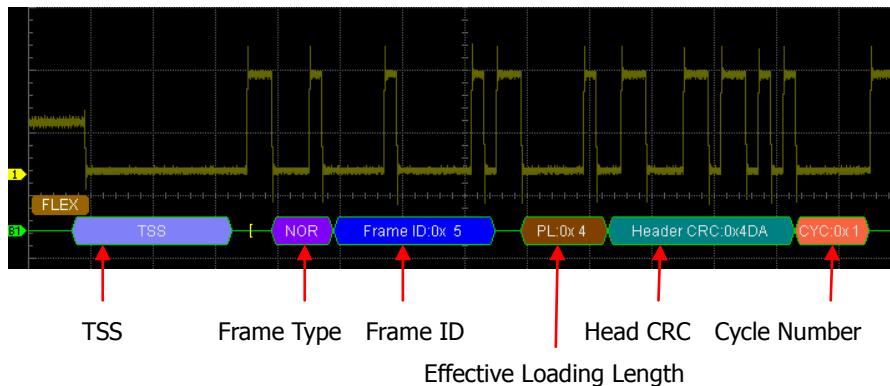


9. Explanation of the Decoded FlexRay Frame Data

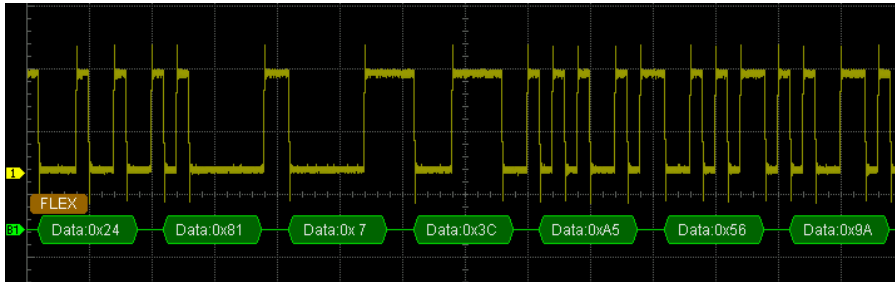
The decoded FlexRay frame data is as shown in the figure below.



- TSS: transmission start sequence and is expressed by light purple patch.
- Frame Type: FlexRay frame can be NORMAL, SYNC, SUP or NULL. The frame type in the figure above is “NOR” and is expressed by purple patch.
- Frame ID: decimal number and is expressed by blue patch.
- Effective Loading Length: decimal number and is expressed by brown patch.
- Head CRC: hexadecimal number and is expressed by blue-green patch. When CRC is invalid, it is expressed by red patch.
- Cycle Number: decimal number and is expressed by pink patch.



- Data: displayed in the format (Hex, Decimal, Binary or ASCII) specified in **Format** and expressed by green patch.



- End CRC: hexadecimal number and is expressed by blue-green patch. When CRC is invalid, it is expressed by red patch.
- DTS: dynamic end sequence and is expressed by light purple patch.

