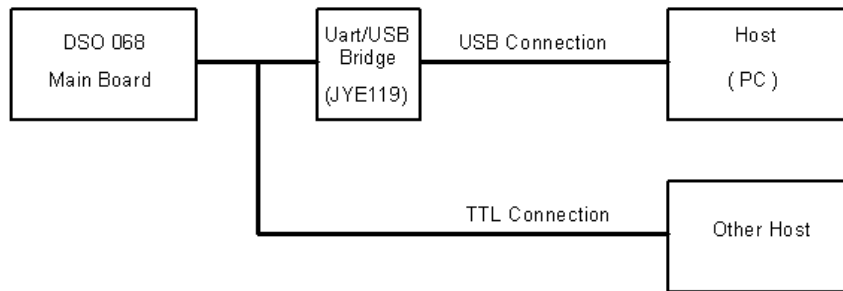


# The Data Interface of DSO 068

**Applicable firmware version: 113-06801-050 or later**

The Data Interface of DSO 068 is a portion of firmware that allows a host to access captured data directly via the UART port of MCU (this port becomes a virtual COM port on USB if the JYE119 Uart-USB bridge board is installed). This interface features two modes, USB Scope Mode and Data Logger Mode. In USB Scope Mode user can change various capture parameters (sampling rate, trigger mode, capture size, etc.) and obtain captured data in block or in individual samples. In Data Logger Mode users can receive up to 8-channel simultaneously sampled higher resolution (10-bit) data at a fixed sampling rate (200 Samples/second). Fig. 1 shows the typical connection of the Data Interface.



**Fig. 1**

Before going through details of the modes we first introduce the communication formats briefly.

## 1. Communication Formats

The data and commands transferred over the Data Interface are in frames. The general frame structure is shown in Table 1.

Offset	Field Name(size)	Remarks
-1	Sync character (1 byte)	Value fixed to 0xFE
0	Frame ID (1 byte)	Frame type
1	Frame Size (2 bytes)	Little endian 16-bit number counting from the frame ID to the end of frame.
3	Data	Frame payload begin
4	Data	
...	...	
n	Data	End of frame

**Tabel. 1**

The hex number 0xFE is the synchronous character that marks the beginning of a frame. To avoid ambiguity if a frame contains a byte with value 0xFE in its body an extra 0x00 byte must be inserted right after 0xFE at transmitting. Accordingly at the reception end if a 0xFE is detected followed by a 0x00 the 0x00 must be dropped. Obviously the frame ID can't take the value of zero.

The data rate of the interface is fixed to 115200 bps. Data format is 8 data bits, 1 stop bits,

and no parity check.

## 2. Enter/Exit Data Interface Modes

The Data Interface can work in USB Scope Mode or Data Logger Mode. In order to enter these modes a connection command sent from host is required. There are two methods to exit Data Interface modes and return to standalone operation, 1 ) Send a disconnection command from host, or 2 ) hit the [HOLD] button on scope panel. Fig. 1 illustrates the mode relationships.

### 1) Command for entering USB Scope Mode

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xE1
1	Frame Size (2 bytes)	0x0004
3	Connection Type (1 byte)	0xC0 (for USB Scope)

Tabel. 2

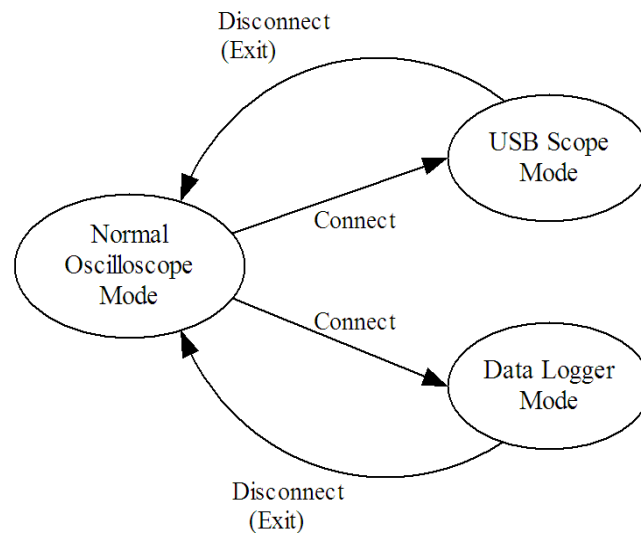


Fig. 2

### 2) Command for entering Data Logger Mode

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xE1
1	Frame Size (2 bytes)	0x0005
3	Connection Type (1 byte)	0xC2 (for Data Logger )
4	Reference voltage and data adjustment selection	See Section 4: "Data Logger Mode".

Tabel. 3

### 3) Command for exit and returning to standalone mode

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xE9
1	Frame Size (2 bytes)	0x0004
3	Reserved	

Tabel. 4

### 3. USB Scope Mode

USB Scope mode is primarily for making DSO 068 a PC oscilloscope via USB connection. But it can do more than this. The USB Scope mod is actually a general interface that makes the captured data accessible to other devices. It can be used, for example, in situations where waveform monitoring is needed.



Fig. 3

The USB Scope mode can work in Auto state or Manual state. In Auto state the 068 sends the data (in block or in single sample) automatically as soon as capture is done. In Manual mode the 068 only sends data upon reception of the GetData command.

Note that when the timebase is set between 20ms/div – 0.5us/div (inclusive) the whole buffer of data is sent (as DataBlock frame) after each capture. When the timebase is set between 10min/div and 50ms/div (inclusive) single sample is sent (as DataSample frame) after each sampling.

#### Summary of Command/Data Frames in USB Scope Mode

- ∅ Frames sent by host
  - 1) **GetConfig** – Request configuration information of DSO 068
  - 2) **GetParam** – Request parameters of DSO 068
  - 3) **SetParam** – Set DSO 068 parameters
  - 4) **GetData** – Request data from DSO 068
  - 5) **SetState** – Change the state of USB Scope mode.
  
- ∅ Frames sent by DSO 068
  - 6) **CurrConfig** – Current configuration of DSO 068 sent in response to GetConfig command.
  - 7) **CurrParam** – Current parameters of DSO 068 sent in response to GetParam command.
  - 8) **DataBlock** – Captured data sent in block. Block size is specified by the record length parameter.
  - 9) **DataSample** – Captured data sent as single sample.
  - 10) **USBscopeReady** – USB Scope mode ready. Usually sent at entering USB Scope mode.

### Details of Command/Data Frames in USB Scope Mode

#### 1) GetConfig

Function: Request configuration information of DSO 068

Direction: From host to DSO 068

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0004
3	Frame sub-ID (1 byte)	0x20

Tabel. 5

#### 2) GetParam

Function: Request current parameter setting of DSO 068

Direction: From host to DSO 068

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0004
3	Frame sub-ID (1 byte)	0x21

Tabel. 6

#### 3) SetParam

Function: Set parameters of DSO 068

Direction: From host to DSO 068

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0024
3	Frame sub-ID (1 byte)	0x22
4 - 11	Reserved	
12	Timebase (1 byte)	Refer to Table 15
13 - 15	Reserved	
16	Trigger mode (1 byte)	Refer to Table 16
17	Trigger slope (1 byte)	Refer to Table 17
18	Trigger level (2 bytes)	From 0 to 255
20	Trigger position (1 byte)	From 1 - 100
21 - 23	Reserved	
24	Record length (4 bytes)	
28 - 35	Reserved	

Tabel. 7

**4) GetData**

Function: Request data from DSO 068. This command is usually used when DSO 068 is in Manual state.

Direction: From host to DSO 068

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0004
3	Frame sub-ID (1 byte)	0x23

Tabel. 8

**5) SetState**

Function: Change the state of DSO 068

Direction: From host to DSO 068

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0005
3	Frame sub-ID (1 byte)	0x24
4	State setting (1 byte)	Bit[1]: 0 – Auto state 1 – Manual state All other bits reserved. They should be set to 0's for future compatibility.

Tabel. 9

**6) CurrConfig**

Function: Send DSO 068 current configuration information to host in response to the command of GetConfig form host.

Direction: From DSO 068 to host

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0038
3	Frame sub-ID (1 byte)	0x30
4	Channel configuration (1 byte)	Bit[0]: 0 – Channel 1 is not present; 1 – Channel 1 is present. Bit[1]: 0 – Channel 2 is not present; 1 – Channel 2 is present. All the rest bits are reserved.

5	Sensitivity and couple configuration (1 byte)	Bit[0]: 0 – Sensitivity is not changeable by host; 1 – Sensitivity is changeable by host. Bit[1]: 0 – Couple is not changeable by host; 1 – Couple is changeable by host. All the rest bits are reserved.
6 - 7	Reserved	
8	Maximum vertical sensitivity (1 byte)	Refer to Table
9	Minimum vertical sensitivity (1 byte)	Refer to Table
10	Maximum couple setting (1 byte)	Refer to Table
11	Minimum couple setting (1 byte)	
12	Maximum vertical position (2 bytes)	
14	Minimum vertical position (2 bytes)	
16 - 23	Reserved	
24	Maximum timebase setting (1 byte)	
25	Minimum timebase setting (1 byte)	
26 - 29	Reserved	
30	Maximum trigger mode setting (1 byte)	
31	Minimum trigger mode setting (1 byte)	
32	Maximum trigger slope setting (1 byte)	
33	Minimum trigger slope setting (1 byte)	
34	Maximum trigger level (2 bytes)	
36	Minimum trigger level (2 bytes)	
38	Maximum trigger position (1 byte)	
39	Minimum trigger position (1 byte)	
40 - 45	Reserved	
46	Maximum record length (4 bytes)	
50	Minimum record length (4 bytes)	
54 – 55	Reserved	

Tabel. 10

**7) CurrParam**

Function: Send DSO 068 current parameters to host. This command is sent in response to the command of GetParam from host.

Direction: From DSO 068 to host

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0020
3	Frame sub-ID (1 byte)	0x31
4	Vertical sensitivity (1 byte)	Refer to Table 19
5	Couple (1 byte)	Refer to Table 18
6	Vertical position (2 byte)	
8 - 11	Reserved	
12	Timebase (1 byte)	Refer to Table 15
13 - 15	Reserved	
16	Trigger mode (1 byte)	Refer to Table 16
17	Trigger slope (1 byte)	Refer to Table 17
18	Trigger level (2 bytes)	
20	Trigger position (1 byte)	
21 - 23	Reserved	
24	Record length	
28 - 31	Reserved	

**Tabel. 11**

**8) DataBlock**

Function: Data block

Direction: From DSO 068 to host

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	N + 8, where N is the current record length
3	Frame sub-ID (1 byte)	0x32
4	Data sample 1	
5	Data sample 2	
...	...	
N + 3	Data sample N	
N + 4	Reserved	
N + 5	Reserved	
N + 6	Reserved	
N + 7	Reserved	

**Tabel. 12**

**9) DataSample**

Function: Data sample

Direction: From DSO 068 to host

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0x000C
1	Frame Size (2 bytes)	N + 8, where N is the current record length
3	Frame sub-ID (1 byte)	0x33
4	Data sample (1 byte)	
5 - 11	Reserved	

Tabel. 13

**10) USBscopeReady**

Function: This command is sent when USB Scope mode has been entered.

Direction: From DSO 068 to host

Format:

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC0
1	Frame Size (2 bytes)	0x0004
3	Frame sub-ID (1 byte)	0x34

Tabel. 14

**Coded Values of Parameter Settings**

Oscilloscope parameter settings are represented by values. The following tables list the pre-defined values for various parameter settings that are used in the Data Interface of DSO 068.

**1) Values of Timebase Setting**

Setting	Values
10min/div	0x03
5min/div	0x04
2min/div	0x05
1min/div	0x06
50s/div	0x07
20s/div	0x08
10s/div	0x09
5s/div	0x0A
2s/div	0x0B
1s/div	0x0C
0.5s/div	0x0D
0.2s/div	0x0E



0.1s/div	0x0F
50ms/div	0x10
20ms/div	0x11
10ms/div	0x12
5ms/div	0x13
2ms/div	0x14
1ms/div	0x15
0.5ms/div	0x16
0.2ms/div	0x17
0.1ms/div	0x18
50us/div	0x19
20us/div	0x1A
10us/div	0x1B
5us/div	0x1C
2us/div	0x1D
1us/div	0x1E
0.5us/div	0x1F

Tabel. 15

## 2) Values of Trigger Mode Setting

Setting	Values
Auto	0x00
Normal	0x01
Single	0x02

Tabel. 16

## 3) Values of Trigger Slope Setting

Setting	Values
Falling	0x00
Rising	0x01

Tabel. 17

## 4) Values of Couple Setting

Setting	Values
DC	0x00
AC	0x01
GND	0x02

Tabel. 18

## 5) Values of Vertical Sensitivity Setting

Setting	Values
5V/div	0x05
2V/div	0x06
1V/div	0x07
0.5V/div	0x08
0.2V/div	0x09
0.1V/div	0x0A
50mV/div	0x0B
20mV/div	0x0C
10mV/div	0x0D

Tabel. 19

## 4. Data Logger Mode

The main controller ATmega64 (U4) contains a 10-bit A/D converter with 8 input channels (PORTF of U4). This resource is mostly not used in the oscilloscope. The Data Logger Mode makes use of this spare resource and outputs 8 channel of data at the rate of 200samples/second/channel with 10-bit resolution on each channel.

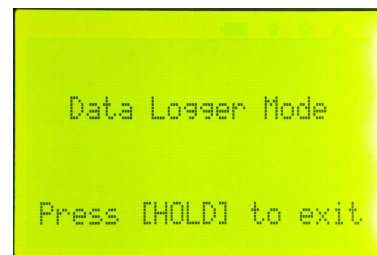


Fig. 4

### Data Logger Input

Of the 8 input channels the channel 4 (PF4) has been connected to the analogue channel output (refer to schematic). So the channel 4 output reflects the oscilloscope input. The rest seven inputs have been brought to J7 at the board edge (Fig. 3). User can use these inputs for different measurements.

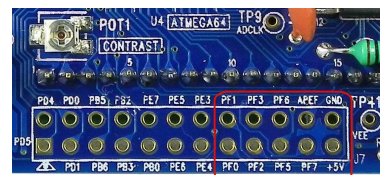


Fig. 5

The ADC conversion range is reference voltage dependent. When connecting external signals to the pins a protection resistor should be added in series with the signal to protect chip from being damaged. The resistor value depends on maximum input voltage. Usually 1K ohm is enough for most applications.

### Reference Voltage and Data Adjustment Selection

The ADC reference voltage and data adjustment are determined by 4<sup>th</sup> byte of connection command that brings up the Data Logger Mode (see Section 2: “Enter/Exit Data Interface Modes”). Bit 7 and Bit 6 of the byte select reference voltage. Bit 5 selects data adjustment. The following two tables show the relationship.

Bit [7:6]	Reference Voltage Selection
00	AREF. Internal Vref turned off
01	AVCC with external capacitor at AREF pin
10	Reserved
11	Internal 2.56V Voltage Reference with external capacitor at AREF pin

Tabel. 20

Bit [5]	Data Adjustment
0	Right adjusted
1	Left adjusted

Tabel. 21

### Output Data Format

Table 22 shows the output format of the data logger.

Offset	Field Name(size)	Values
-1	Sync character (1 byte)	0xFE
0	Frame ID (1 byte)	0xC2
1	Frame Size (2 bytes)	0x001A
3	Frame sub-ID (1 byte)	0x23
4	Analogue channel setting (1 byte)	Bit [7:5] reflect couple setting (Table 18). Bit [4:0] reflect sensitivity setting (Table 19)
5	ADC settings (1 byte)	Bit [7:6] reflect reference voltage selection (Table 20). Bit [5] reflects data adjustment selection (Table 21). Bit [2:0] reflect the Bit [2:0] of ADCSRA in ATmega64 (see ATmega64 datasheet).
6	Channel 0 data (2 bytes)	
8	Channel 1 data (2 bytes)	
10	Channel 2 data (2 bytes)	
12	Channel 3 data (2 bytes)	
14	Channel 4 data (2 bytes)	
16	Channel 5 data (2 bytes)	
18	Channel 6 data (2 bytes)	
20	Channel 7 data (2 bytes)	
22 – 25	Reserved	

Tabel. 22

**Revision History**

<b>Version</b>	<b>Date</b>	<b>Summary</b>
v01	2014.02.11	First created