

GY-DVS-ETH-100-2

Dual Channel DVS High Speed Demodulator Card

Version 1.22



1. Summary

As a high-speed data acquisition card for DVS, DVS-ETH-100M-2 adopts Gigabit Ethernet interface to communicate with the host computer, avoiding complicated driver installation and supporting cross-platform use, which is convenient for users to integrate and use.

The acquisition card adopts dual-channel 12bit high-speed ADC, the highest sampling rate support 100MSps, the highest support more than 100km DVS data acquisition, built-in average, differential demodulation algorithms, can directly upload differential demodulation data, the user can be used directly as the vibration data, you can also upload the original sampling data, for the user to demodulate their own.

Specification

- 12bits dual-channel synchronized real-time sampling
- 100MSps sampling rate
- DC coupling, 50Ω input impedance
- 2Vpp input voltage range, 0-50MHz analog bandwidth
- ±1V bias programmable to fully utilize ADC range
- Up to 88dBc SFDR
- Trigger Output Pulse
- Gigabit Ethernet high-speed transmission interface
- Built-in fiber optic sensing demodulation algorithm

Power Supply and Consumption

- Power supply: 12V, 0.6A
- Power consumption: 5W (Max)

Temperature range

- Working Temperature: -20~60°C
- Storage temperature: -40~85°C

Mechanical dimensions

- 100mm(L)x70mm(W)x20mm(D)

2. Interface definition

- Ethernet 1: Gigabit Ethernet port for data transfer and parameterization
- Ethernet 2: Gigabit Ethernet port, reserved for non-use
- Power supply: 12V power supply
- Ch1: Acquisition channel 1
- Ch2: Acquisition channel 2
- Trig: capture trigger output, 3.3V/5V selectable



Interface Definitions

3. IP address

The acquisition card uses UDP transmission protocol to communicate with the host computer. Before communication, you need to set the host computer's IP address and port according to the following parameters:

FPGA IP:192.168.137.2 port: 6789

PC IP:192.168.137.3 data port: 6788, command port: 6787

Data and command sampling are received separately on different ports for easy processing by the host computer.

4. UDP message format

4.1. PC to FPGA (send)

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital
0xA55AAA5555 AA	0x0001:issue orders 0x0002:read data	Send commands according to the instructions in section 4	Length of the data to be sent	reservation	pending data

Each time the PC sends a command to the FPGA, the FPGA will return the query result of the corresponding command, if it does not return the query result command, it is considered that the sending command fails, and the program can be written to do a timeout to receive it, and if the sending command fails to be retransmitted once.

Example 1 (Setting the number of samples to 1024):

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Data (8 bytes)
0xA55AAA5555AA	0x0001	0x0002	0x00000008	0x0000	0x0000000000000400 (1024)

Example 2 (Querying the number of sampling points):

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Data (8 bytes)
0xA55AAA5555AA	0x0002	0x0002	0x00000008	0x0000	0x0000000000000000

4.2. FPGA to PC (receive)
4.2.1. Receive command query results (receive port: 6003)

Header (6 bytes)	Functionality (2 bytes)	Reservations (2 bytes)	Data length (2 bytes)	Data	
				Command (2 bytes)	Result (2 bytes)
0x5AA555AAAA55	0x0002	0x0001	Data length	Query command	Inquiry results

Example (Querying Sampling Points Results):

Header (6 bytes)	Functionality (2 bytes)	Reservations (2 bytes)	Data length (2 bytes)	Data	
				Command (2 bytes)	Result (2 bytes)
0x5AA555AAAA55	0x0002	0x0001	0x0004	0x0002	0x1000

4.2.2. Receiving Sampling Data (Receive Port: 6001)

Header (6 bytes)	Functionality (2 bytes)	Reservations (2 bytes)	Data symbol (2 bytes)	Package number (2 bytes)	Packet length (2 bytes)	Data
0x5AA555AAA A55	0x0003	0x0000	0x0011:Normal data 0x1100:End of data	Current UDP message sequence number, which can be used to determine packet loss (sequence +1)	Packet length (Maximum 1024+16)	Sampling data (uint16)

Data Description: The sampling data is stored in unsigned short int format, and one sampling point occupies 2Bytes. A UDP message can upload 1024 Bytes of sampling data at most, i.e., 512 sampling points. When the number of sampling points is greater than 512 sampling points, a group of pulse-triggered sampling data will be divided into multiple UDP messages to be uploaded, and the message flags are differentiated by the data flags. When the 0x1100 flag is detected, it indicates that a group of complete sampling data sampling is completed, and the packet signal is used to determine whether a packet loss is generated, and the

sequence of packet signals is increased by 1.

For example, if the number of sampling points is 4000, then one trigger sampling will be divided into $4000/512=7.8125\approx 8$ UDP messages to upload, the first 7 message data length is 1024Bytes (512 sampling points), data flag bit 0x0011, packet sequence number is 0-6, the last message data length is 832Bytes (416 sampling points), data flag bit 0x1100, packet sequence number is 7, subsequent trigger sampling as above.

When dual-channel acquisition, the total number of points of each triggered sample is 2 times of the sample length, and the data is stored alternately according to ch1|ch2|ch1|ch2.....

5. Command Description

5.1. Start/End command (0x0001)

Definition: start or stop sampling, after starting sampling, sampling data will be uploaded continuously, stopping sampling will end uploading data

Header (6 bytes)	Functionality (2 bytes)	Command (2bytes)	Data length (4bytes)	Standby (2bytes)	Digital (8bytes)
0xA55AAA5555AA	0x0001	0x0001	0x00000008	0x0000	0x0000000000000001:Start collecting 0x0000000000000000:Stop collecting

5.2. Sampling length (0x0002)

Definition: the number of data points sampled by one pulse trigger, must be a multiple of 4, default value: 4096, maximum value 32000

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0002	0x00000008	0x0000	0x00000000000001000

5.3. Sampling delay points (0x0010)

Definition: number of delayed sampling points after the rising edge of trigger pulse, default value: 100

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0010	0x00000008	0x0000	0x0000000000000064

5.4. Pulse frequency (0x0004)

Definition: Trigger output pulse frequency issued by the sampling card, default value: 2000

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0004	0x00000008	0x0000	0x0000000000000000

0xA55AAA5555AA	0x0001	0x0004	0x00000008	0x0000	0x00000000000007D0
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5.5. Pulse width (0x0011)

Definition: Trigger output pulse width (ns) issued by the sampling card, default value: 100

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0011	0x00000008	0x0000	0x0000000000000064

5.6. Setting the average (0x0008)

Definition: the sampling card averages the data collected for each trigger, default value: 0, default off

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0008	0x00000008	0x0000	0x0000000000000000: cloture 0x0000000000000001:open

The acquisition card averages the data obtained from m pulse-triggered samples and compresses the data to one pulse-triggered data.

$$\begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \xrightarrow{\text{average}} [y_1 \quad \cdots \quad y_n]$$

Where "m" is the number of trigger pulses collected, "n" is the number of points collected per trigger, and the average number of times "m" can be set for the averaged pulse-triggered data for final upload.

5.7. Average number of times (0x0020)

Definition: the average number of times to trigger the acquisition of data, default value: 64, can be set: 8, 16, 32, 64, 128

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0020	0x00000008	0x0000	0x0000000000000040

5.8. Setting up differential (0x0021)

Definition: the sampling card differentiates the data for each average, default value: 0

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0021	0x00000008	0x0000	0x0000000000000000: cloture

					0x0000000000000001:open
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Assuming that “ $x_1, x_2, x_3, \dots, x_n$ ” is the last averaging result and “ $y_1, y_2, y_3, \dots, y_n$ ” is the current averaging result, the differential result uploaded by the acquisition card will be “ $z_1, z_2, z_3, \dots, z_n = x_1 - y_1, x_2 - y_2, x_3 - y_3, \dots, x_n - y_n$ ”, Differential signals can be used as vibration signals by taking the absolute value directly. The differential setting is only valid after the average setting.

5.9. Sample Rate Setting (0x0022)

Definition: Set the sampling rate of the capture card, default value: 5, can be set: 1, 2, 3, 4, 5, 6.

The parameter value corresponds to the sampling rate:

- 1: 10MSps, corresponding to a sampling resolution of 10m;
- 2: 20MSps, corresponding to a sampling resolution of 5m;
- 3: 40MSps, corresponding to a sampling resolution of 2.5m;
- 4: 50MSps, corresponding to a sampling resolution of 2m;
- 5: 100MSps, corresponding to a sampling resolution of 1m;

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0022	0x00000008	0x0000	0x0000000000000005

5.10. Bias Voltage Setting (0x0023)

Definition: Set ADC sampling bias voltage, default value: 0, can be set: 0-4096mv, 1000mv corresponds to 0 bias, 0mv corresponds to +1v bias, 2000mv corresponds to -1v bias.

Header (6 bytes)	Functionality (2 bytes)	Command (2 bytes)	Data length (4 bytes)	Standby (2 bytes)	Digital (8 bytes)
0xA55AAA5555AA	0x0001	0x0023	0x00000008	0x0000	0x0000000000000000

6. Notes:

- 6.1、The sampling rate, pulse re-frequency and the number of sampling points should satisfy the following relationship:

$$f_{pulse} < \frac{f_{sample}}{N_{sample}}$$

Where f_{pulse} is the pulse re-frequency, f_{sample} is the sampling rate, and N_{sample} is the number of sampling points.

For example, the fiber length of 40km, sampling rate of 50MPS, corresponding to the sampling resolution of 2m, then the number of sampling points should be $40\text{km}/2\text{m} = 20000$, in order to cover the entire cable, so the pulse frequency should meet:

$$f_{pulse} < \frac{f_{sample}}{N_{sample}} = \frac{50000000}{20000} = 2500$$

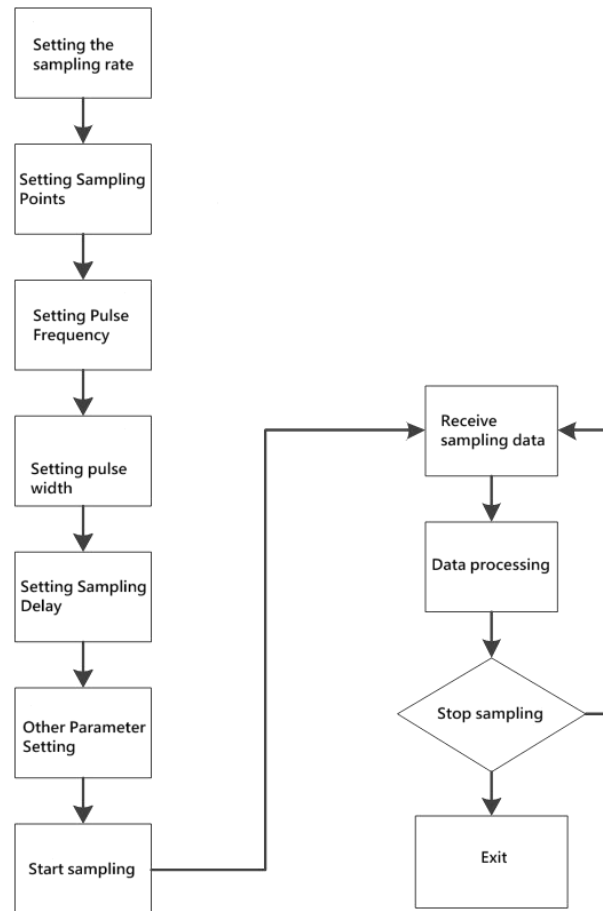
In addition, the number of sampling points and reclocking should also be satisfied in order to meet the Gigabit Ethernet transmission bandwidth:

$$f_{pulse} * N_{sample} < 50000000$$

Usually used as a DVS acquisition, it is recommended that the pulse re-frequency should not exceed 2000, the number of sampling points multiplied by the sampling resolution is slightly higher than the length of the fiber optic cable.

6.2、At present, the capture card only opens channel one Functionality, channel two is not available for the time being.

6.3、Capture card calling process:

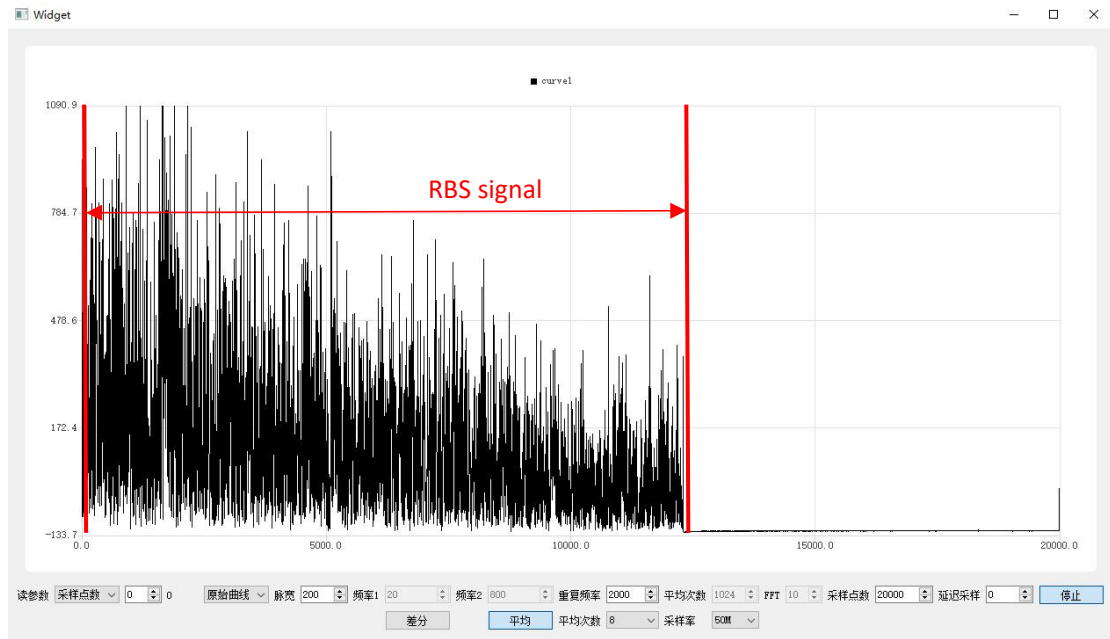


Command invocation flow

It is best to set all the parameters once before the sampling starts to ensure that the parameters of the acquisition card are consistent with the expectations, and after the start of the acquisition, you can adjust the parameters and query the parameter values of the acquisition card in real time halfway through the process.

7. Test results

Original curve



Vibration curve

