



The Interface Measurement Analysis of the G-Sensor

The Application Prospect of G-Sensor

With the hot-selling of the Wii Game Console, the electronic manufacturers and suppliers start to pay attention to the Application and Market Demand of the MEMS (Micro-electromechanical Systems). More and more products need the G-Sensor, such as the Game Console, for adding the G-Sensor function can increase the immersive feeling when players operate the game with the swing of the body.

Certainly, the application of the G-Sensor isn't only used for the above. It also can be used on the mobile phone, for instance, the Touch Diamond of the HTC is a good application example. According to the built-in G-sensor, it will make the mobile phone adjust the previewing direction of the picture automatically with the verticality and horizontality of the mobile phone when viewing the pictures. It also can be built in the lap-top to detect the state of present Hard Disk; the Disk Head and Disk will be separated automatically to protect the Hard Disk when the lap-top has a sudden fall.

The application of G-Sensor will make a great impact on the market of 3C products; the fresh operation mode replaces the past Button Sensor. The G-Sensor can be divided into Analog Transmission Mode or Digital Transmission Mode. For the G-Sensor with X, Y and Z Axes, the output of Analog Transmission Mode needs three IC Pins to denote the change of the X, Y and Z Axes according to the voltage change, however, the output of the Digital Transmission Mode uses the Protocol Analyzer IIC or SPI to denote the change of X, Y and Z Axes.

We take the SMB380 (Three-Axis Digital G-Sensor) of Bosch (<http://www.bosch-sensortec.com>) to know more about the operation mode of G-Sensor.

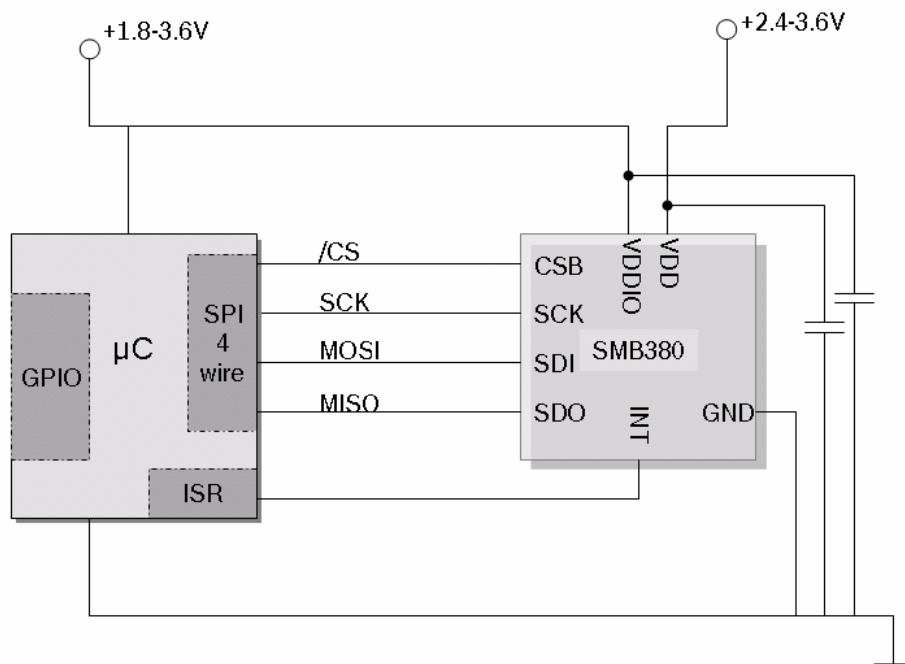


Figure1: Bosch SMB380



The Measurement Analysis of G-Sensor

Here we use the 4-wire SPI of the SMB380 to start the measurement analysis for the transmission mode. Connect the MCU and SMB380 with the 4-wire SPI (Refer to *Figure 2*); then connect the signal lines to ZeroPlus Logic Analyzer according to the SMB380 Pin Table (Figure3): firstly, the A0 is connected to CSB (PIN5) ; the A1 is connected to SCK (PIN6) ; the A2 is connected to SDO (PIN7) ; the A3 is connected to SDI (PIN8) and the GND is connected to GND (PIN3) , and then, after the connection is finished, the software of the ZeroPlus Logic Analyzer can be activated to start the measurement analysis (Refer to *Figure 4*); the setting conditions of the software: Sampling Frequency is 50MHz; RAM Size is 1Mbits.



Connection Diagram for use with 4-wire SPI interface

Figure 2: Connection Diagram of MCU and SMB380 with 4-wire SPI



Pin No.	Name	Function
1	reserved	
2	VDD	Analog power supply
3	GND	Ground
4	INT	Interrupt
5	CSB	Chip select
6	SCK	Do not connect
7	SDO	Serial data out
8	SDI	Serial data in / out
9	VDDIO	Digital interface power supply
10	reserved	

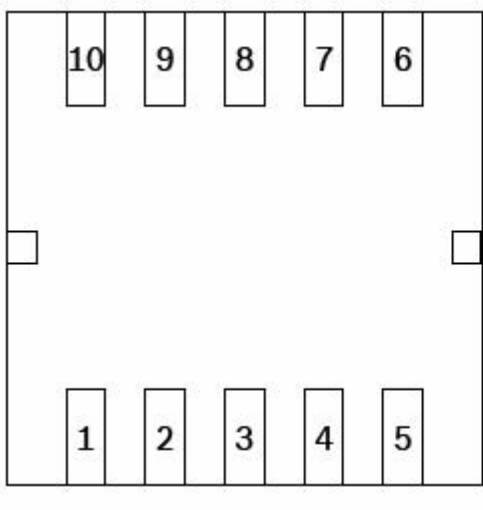


Figure 3: SMB380 Pin Table

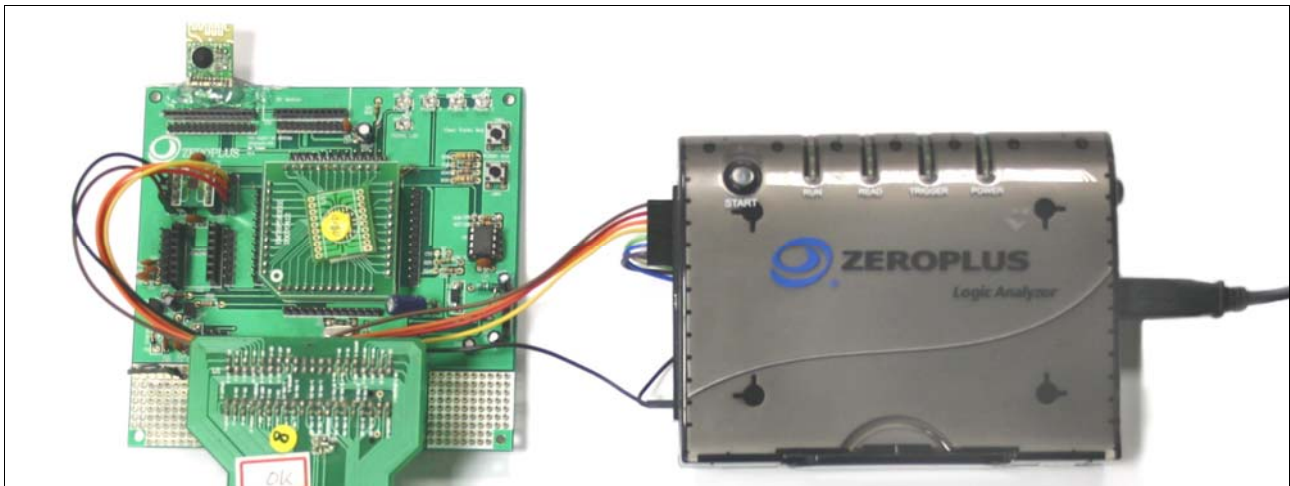


Figure 4: Connection Diagram of the Development Board of the Game Handle and ZeroPlus Logic Analyzer



According to the ZeroPlus Logic Analyzer, we can see the SPI Signal which is transmitted by the G-Sensor. However, because the function of Protocol Analyzer Decoding is not activated and the length of the capture time is too short (The total length is 20.972ms; refer to *Figure 5*), using the patent Compression technology of ZeroPlus Technology can prolong the capture time. Activate the functions of the Protocol Analyzer Decoding and Compression to capture again; the length of the capture time will be prolonged to 1.06s after opening the Compression (Refer to *Figure 6*). And it can see clearly the value of SPI which is transmitted by the G-Sensor according to the Protocol Analyzer Decoding.

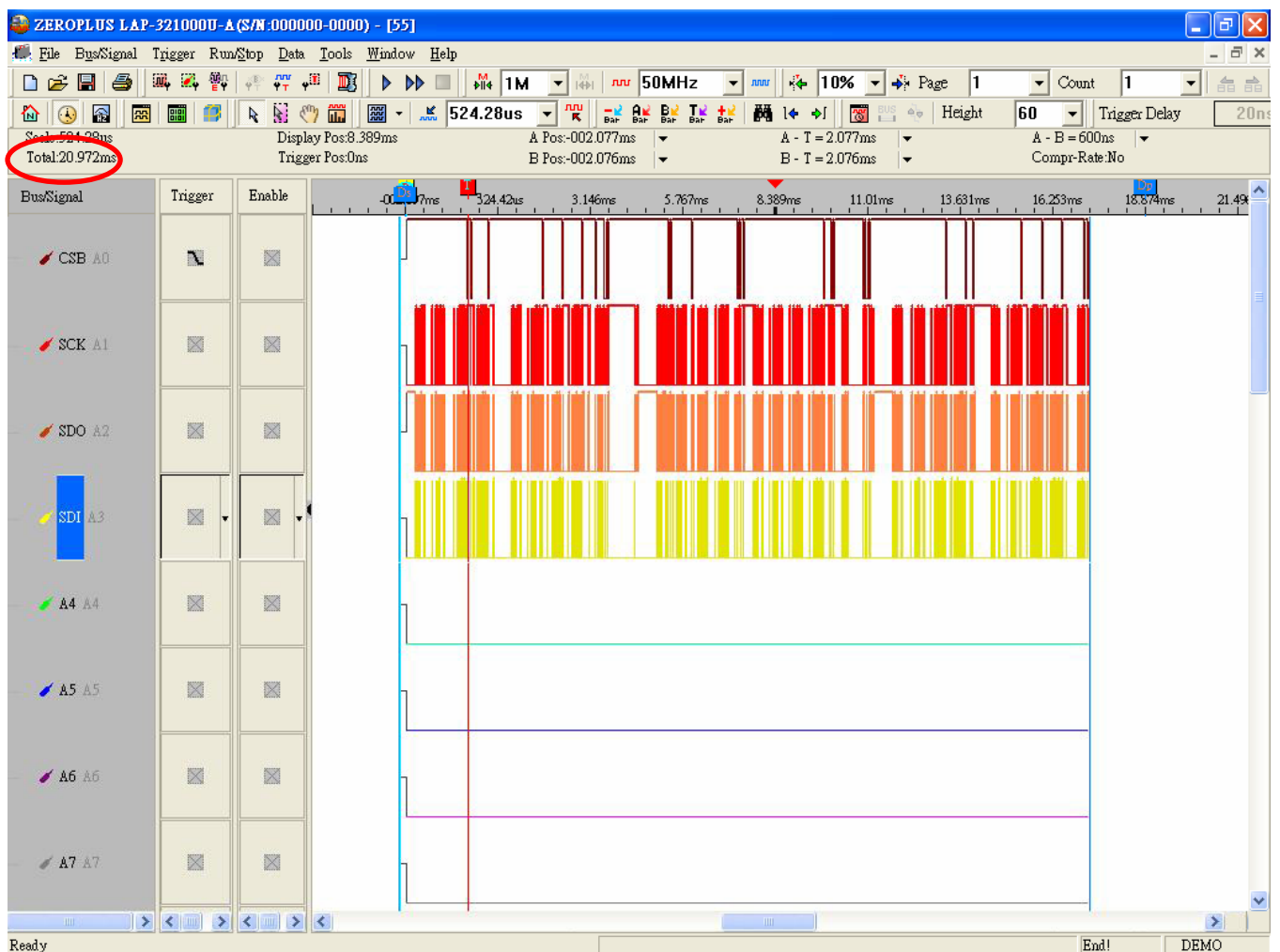


Figure 5: LA Display Image Without Activating the Functions of Compression and Protocol Analyzer

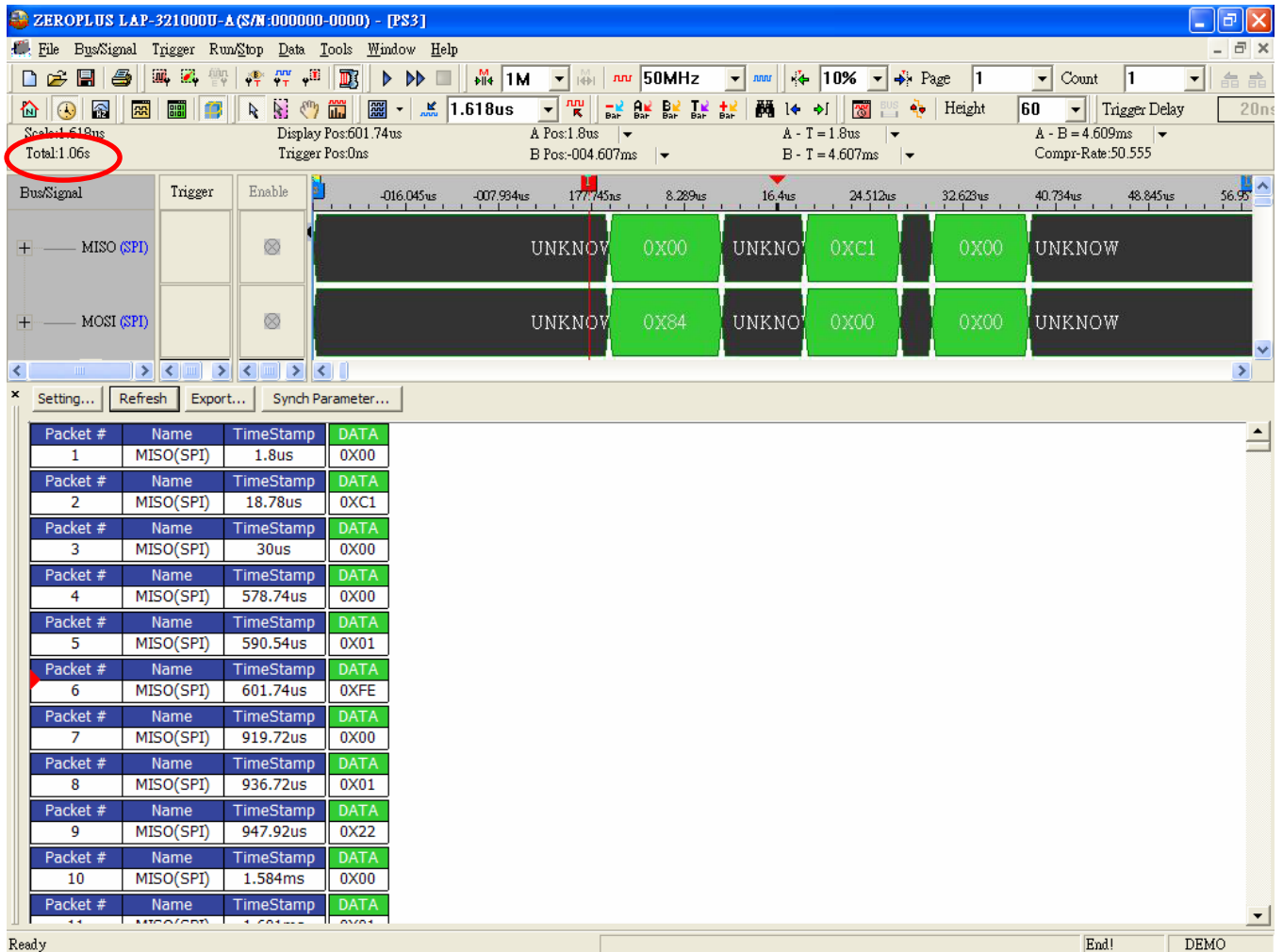


Figure 6: LA Display Image With Activating the Functions of Compression and Protocol Analyzer Decoding

The 4-wire SPI includes MOSI Transmission and MISO Transmission. In order to see the data conveniently, it needs to be grouped into two Buses when using the ZeroPlus Logic Analyzer, therinto, the SDI, SCK and CSB is a Bus (MOSI) and the SDO, SCK and CSB is the other Bus (MISO). When the MCU sends out the 0X84 Command by the MOSI, it denotes the data of 04h Address is read. At that moment, the G-Sensor will send back the corresponding data (0XC1 and 0X00) by the MISO.



The $0X84_{(16)}$ can be converted into the Binary data, $10000100_{(2)}$. According to the Specifications provided by Bosch, we know that Bit7 denotes the Read or Write statuses of the Command (Write = 0, Read = 1); the followings are the Address, and the $0XC1$ and $0X00$ denote the G value from the G-Sensor.

Four wire SPI bit transfer

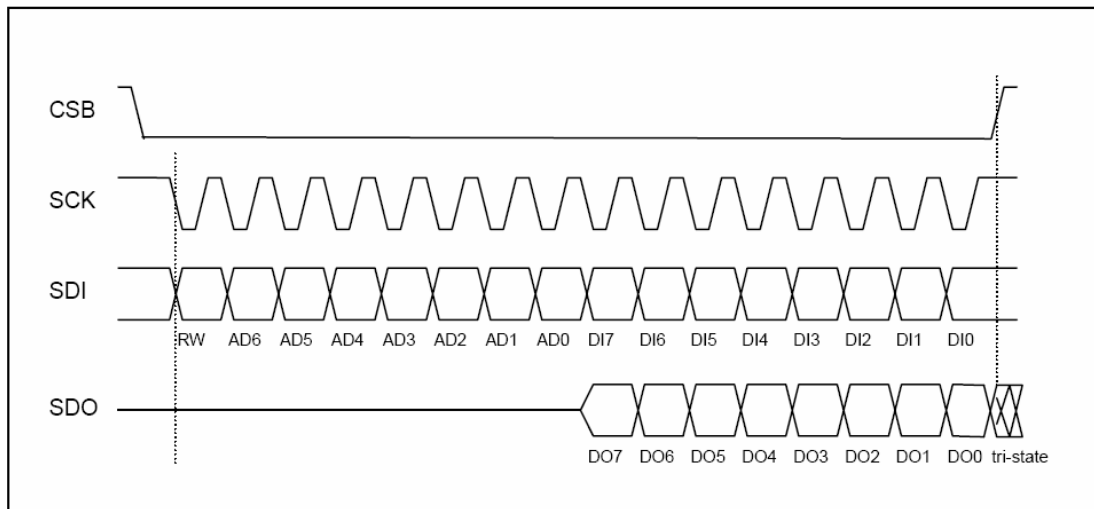


Figure 7: 4-wire SPI Bit Diagram



Protocol Analyzer Trigger of Protocol Packet

ZeroPlus Logic Analyzer provides the function of the Protocol Analyzer Trigger of Protocol Packet in the LAP-322000U-A. Users can set the value or status of the Protocol Analyzer as the Trigger condition; the great Trigger function can analyze the signal quickly.

For the example of this passage, MISO is the Protocol Analyzer of the G-sensor which is read by MCU, however, if the value of the Protocol Analyzer is equal to 0X82, 0X84 and 0X86 which are the value of X-Axis, Y-Axis and Z-Axis in sequence, users can set the 0X86 of SPI as the Trigger condition to capture signal (Refer to *Figure 8*). It can quickly analyze the relative Z-Axis Data of the 0X86 Address according to the Protocol Analyzer Trigger Function of the Protocol Packet; the 0X41 and 0X23 Data can be seen according to the display of the Protocol Analyzer (Refer to *Figure 9*).

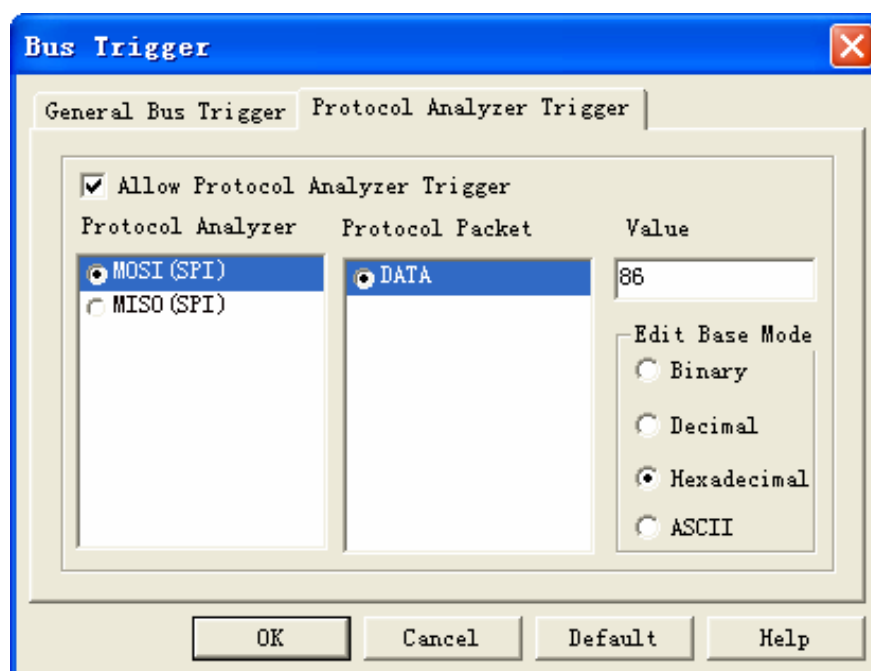


Figure 8: Protocol Analyzer Trigger Setting Dialog Box

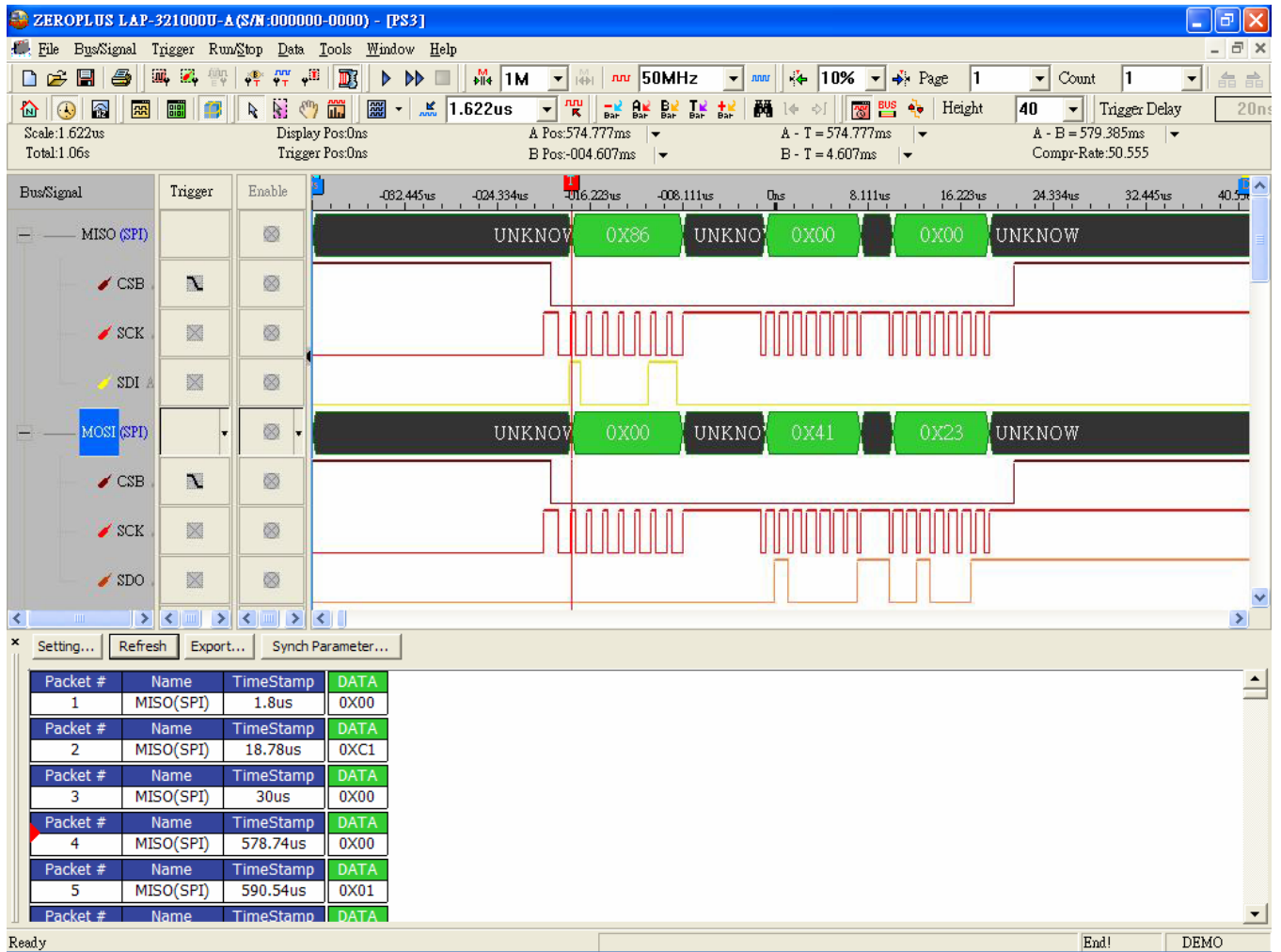


Figure 9: Specify "DATA is 0X86" as the Protocol Analyzer SPI Trigger Condition



Conclusion

In the times of information development, the used 3C products are also progressing continuously in our daily life, for example, the volume of the early mobile phone is very large, and the stand-by time is also short. According to the assistance of the different Protocol Analyzers, the parts of the product are improved. So the volume of the current mobile phone is small and the function is very powerful.

The G-Sensor is an innovative break. Used in our daily life, it not only can provide much more funny multimedia entertainment, but also can make sure the safety for people in the traffic navigation. With the trend, the application of G-sensor will take great business opportunities. However, in order to seize the market opportunities, we also need the corresponding development tools when developing products, which will help us get twice the result with half the effort. So ZeroPlus Logic Analyzer which owns various functions is the first choice for engineers. If you want to know more about the ZeroPlus Logic Analyzer, you can visit our website: www.zeroplus.com.tw.

Reference:

SMB 380 from www.bosch-sensortec.com