M8128 User's Manual

This document is the User's Manual for M8128, the interface box for the force/torque sensor (loadcell) manufactured by SRi, Sunrise Instruments Co., Ltd. It's strongly recommended that anyone who uses M8128 should read this document before any operation. Please do not hesitate to contact SRi if there is any question.

Contents

1. Introduction

The Interface Box M8128 provides bridge excitation, signal conditioning, data acquisition and digital communication to the user's controller or PC via RS232 , CAN Bus or Ethernet. The interface box has six analog input channels with programmable gains to allow for low voltage such as strain gage bride signal. A 24 bit sigma-delta AD converter (16 bit effective) is used to provide high resolution (1/5000 to 1/10000 of full scale) digital signal. The data rate is up to 2KHz. A 6 axis loadcell is connected to the Interface Box via a 19 pin LEMO connector.

Specifications:

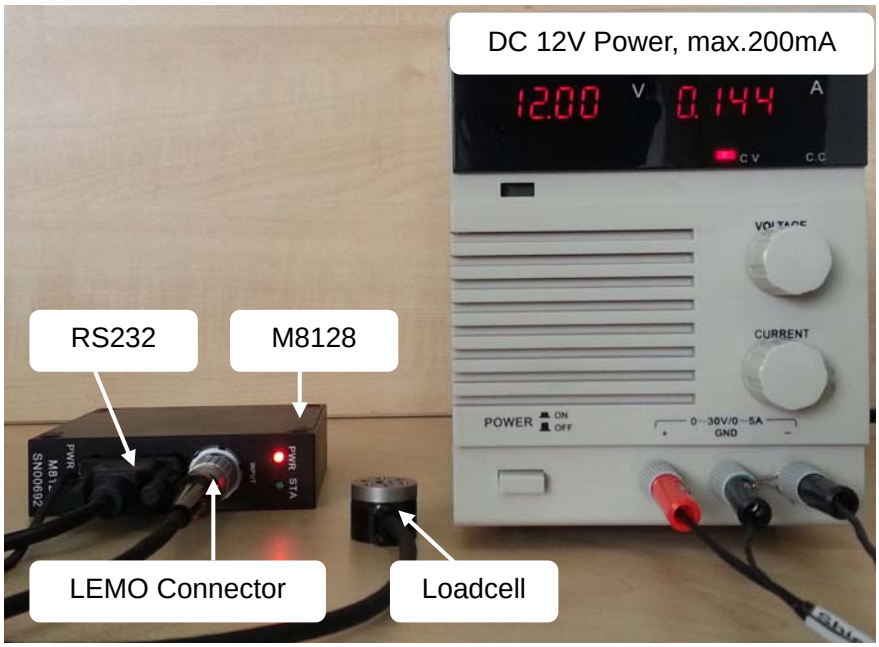
- Analog
  - # of Channels: 6
  - Programmable gain
  - Automatically adjusting sensor's zero offset
  - Low noise instrumentation amplifiers

- Digital
  - RS232 , CAN Bus and Ethernet
  - 24 bit sigma-delta ADC (16 bit effective), Sampling rate: up to 2 kHz
  - Resolution: 1/5000 to 1/10000 of full scale, when connected to SRI's sensors
  - Programmable system parameters

- Frontal Panel
  - Loadcell connector: LEMO FGG.2B.319.CLAD52Z
  - Digital: Standard RS232 connector
  - Power supply: 12 to 36V, 200mA. Power cable - Diameter 3.5mm & Length 2m
  - Indicated lights: Power & Status

2. Quick start

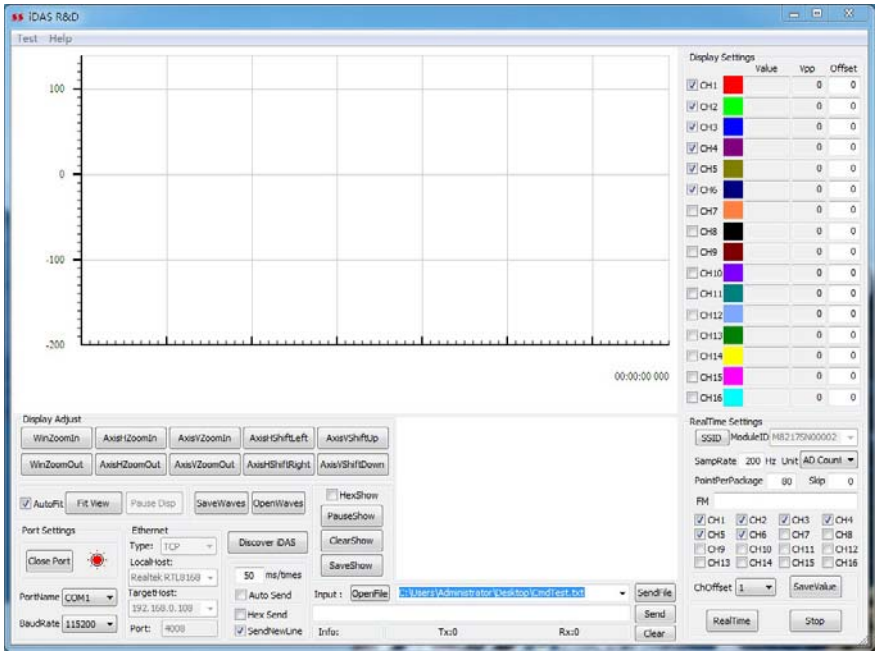
Step1. Connect the loadcell to M8128 via a LEMO connector and connect M8128 to PC via RS232, as shown in the following figure



Step2. Connector Power Supply, DC 12V to 36V. The maximal dissipated current by M8128 is 200mA at 12V DC.

Step3. Uncompressed the *.rar file “iDAS RD”(contained in the CD-ROM) to install software in Win7 system.

Step4. Open Debugging software iDAS RD. Set PortName as COMx, where “x” depends on user’s PC. Set “BaudRate” as 115200. Click “Open Port” to open RS232 communication port, and the indicated light next to the Open Port button will be red when the port is working.



Step5. Obtain the decoupling matrix in calibration report of each loadcell.

Matrix Decoupling Loadcell:

The matrix is contained in the calibration report.

Structurally Decoupled Loadcell:

1. Find sensitivities in the calibration report.
2. If sensitivity unit is mV/V/Eu or mV/Eu, the reciprocal of each channel's sensitivity should be fill in a 6x6 diagonal matrix.
3. If sensitivity unit is V/V/Eu or V/Eu, 1 divided by (1000* sensitivity) (i.e. 1/ (1000*sensitivity)) should be fill in a 6x6 diagonal matrix.

For example, a Structurally Decoupled Loadcell with sensitivity unit in V/Eu, as shown in the following figure.

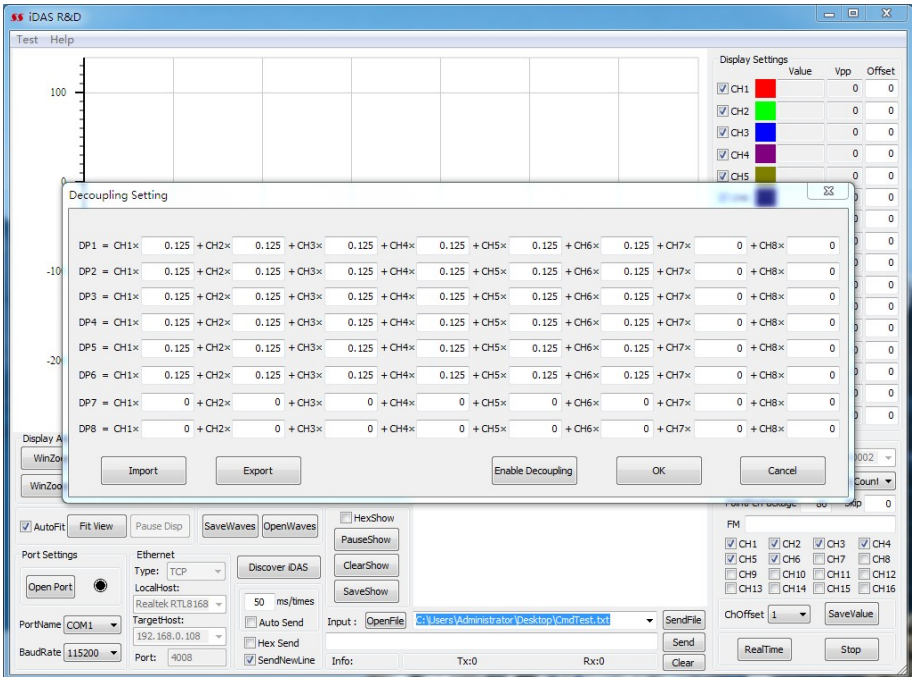
Voltage Calibration

Bridge	Capacity	Zero Offset	Nonlinearity	Hysteresis	Output	Sensitivity	Change
	N/Nm	V	%FS	%FS	V	V/EU	%
FX	-165	-0.0108	-0.53	-0.95	-1.7815	1.0797E-02	0.00
FY	165	0.0175	0.55	0.57	1.7546	1.0634E-02	0.00
FZ	-495	0.0331	-0.44	-0.36	-1.8365	3.7101E-03	0.00
MX	-15	0.0152	-0.93	-0.89	-1.8050	1.2034E-01	0.00
MY	-15	-0.0213	-0.75	-0.79	-1.8927	1.2618E-01	0.00
MZ	15	0.0060	0.94	0.45	1.9111	1.2741E-01	0.00

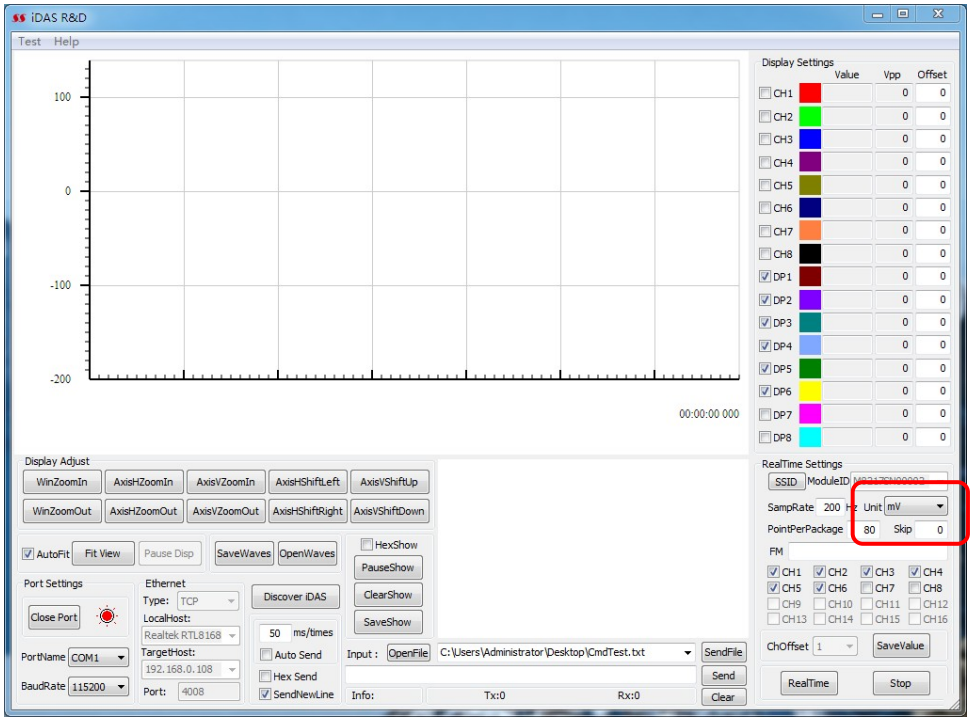
It's matrix should be:

0.092618	0	0	0	0	0
0	0.094038	0	0	0	0
0	0	0.269535	0	0	0
0	0	0	0.00831	0	0
0	0	0	0	0.007925	0
0	0	0	0	0	0.007849

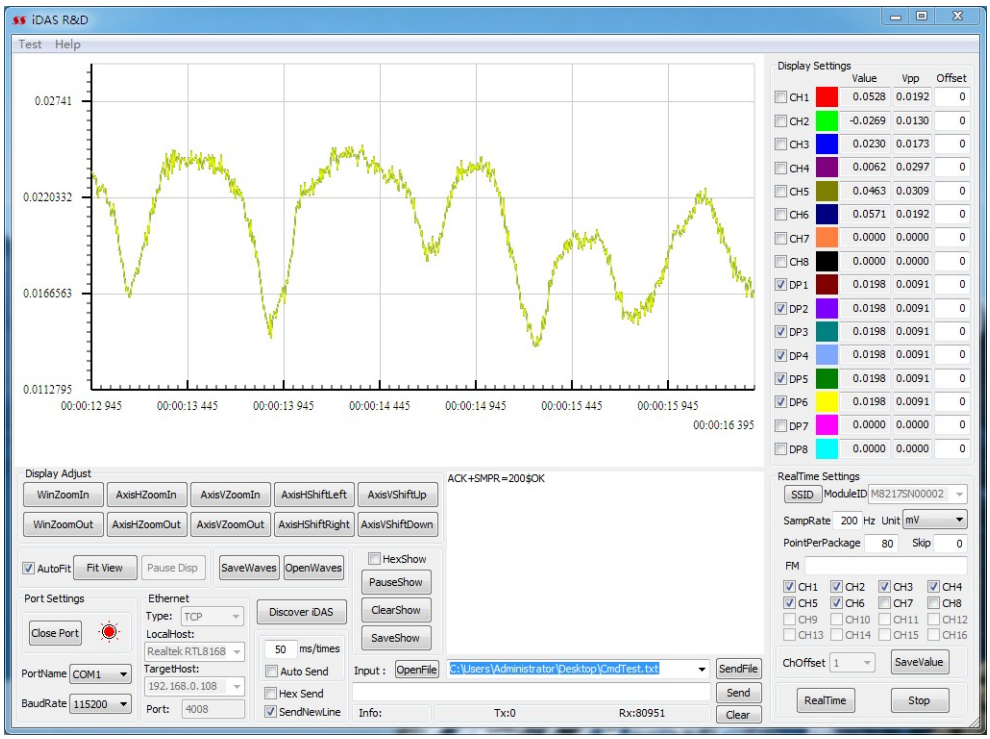
Step6. Click "Test" at the upper left corner and fill in the 6x6 decoupling matrix got by Step5. Coefficients in Columns CH7 & CH8 and Rows DP7 & DP8 should be set to zero. Click "Enable Decoupling" button to activate the decouple algorithm. Click OK to return to the main window.



Step7. Select “Unit” . There are two types of loadcells: A and B, depending on the electronics within the sensor. The specific type of the sensor is indicated in the calibration report. For Type A, “Unit” should be set to “mV/V”. For Type B, “Unit” should be set to “mV”.



Step8. Select “CH1” through “CH6” at the lower right corner on the screen. Click “RealTime” button and the engineering unit data will be shown in the curve window.
Note: “DP1” through ”DP6” are the decoupled data in engineering unit. Typically, DP1 =FX, DP2=FY, DP3=FZ, DP4=MX, DP5=MY,DP6=MZ. “CH1” through “CH6” are the raw data in the unit as selected in Step7.

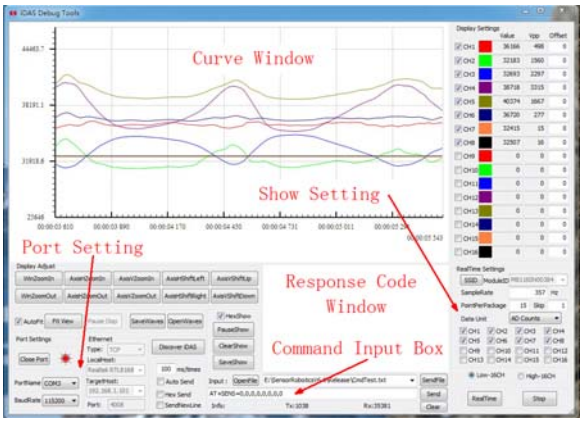


3. iDAS RD: Debugging Software

- iDAS RD is a debugging software that supports the commands of M8128, which can be used for the user to send a series of commands to M8128 to achieve a special application.

☑ **PC Requirement:**
Win7

☑ **Installation Procedures:**
Uncompressed iDAS RD

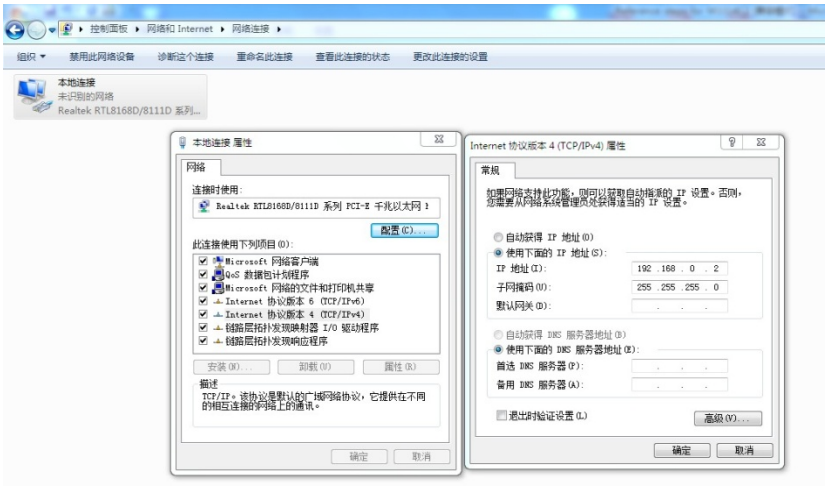


3.1 Set RS232

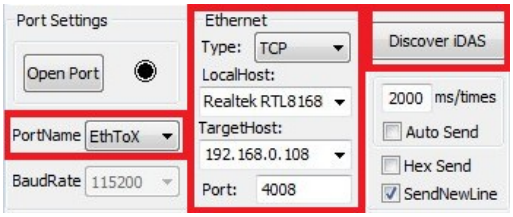
1. Set PortName as COMx, x depends on user's computer.
2. Set BaudRate as 115200. Make sure RS232 of PC has a same baud rate for M8128. The default baud rate of M8128 is 115200bps.

3.2 Set Ethernet

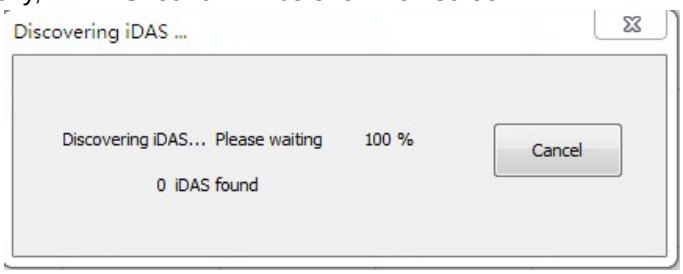
1. Set Ethernet IP of your PC as 192.168.0.2, set subnet mask as 255.255.255.0



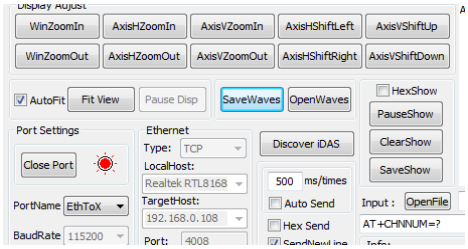
2. Open IDAS RD. As shown in the following figure, set PortName as EthToX, set Ethernet Type as TCP, select LocalHost (your PC's Ethernet card), set Port as 4008.



3. Click Discover iDAS button, software will connect to M8128 automatically. If communication is set up successfully, "1 iDAS found" will be shown on screen.



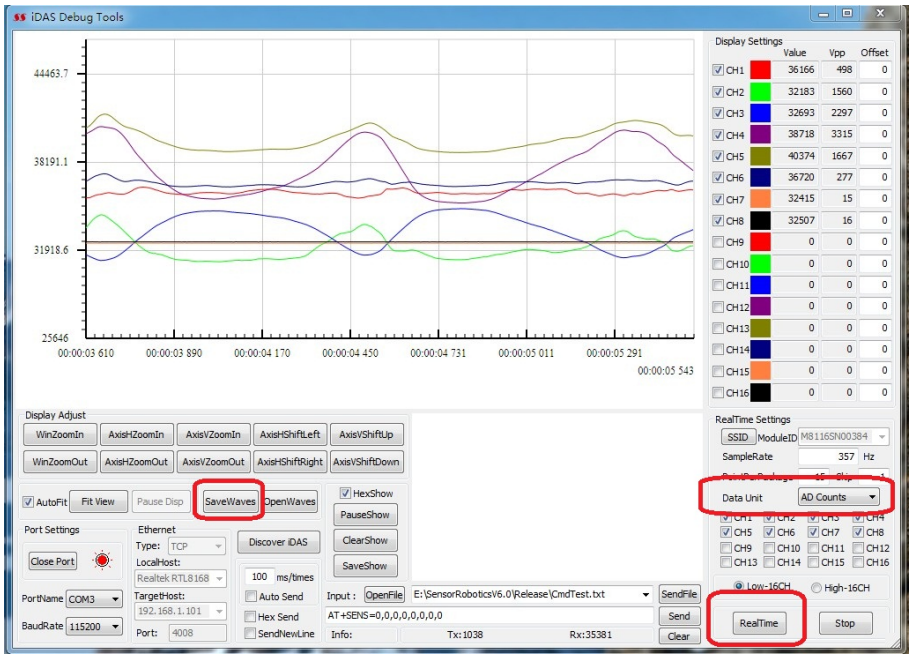
4. Click Open Port button, the indicated light will be red when Ethernet is working properly.



3.3 Send Commands

Input command to Command Input Box, it can be sent to M8125 by clicking “Send” button.

3.4 Get Real-time Data



1. Select CH1 through CH6 at the lower right corner on screen.
2. Click “Data Unit” to select the data unit:”AD Count”, “mV” , “mv/V” or “N or Nm”.
3. Click “Realtime” to get data from M8128, the real time data will be shown in the window. Note that if data in engineering unit want to be shown, please refer Step5 through Step8 in Quick start (chapter 2).
4. Click “SaveWaves” to export data to a *.txt file.

3.5 Get engineering unit data for Structurally Decoupled Loadcell

This is another method to get engineering unit data for Structurally Decoupled Loadcell.

1. Send command “ AT+SENS=sen1;sen2;sen3;sen4;sen5;sen6 ” to M8128, where sen1 through sen6 are each channel’s sensitivity of sensor. Sensitivities can be fund in the calibration report. Note:
   1) If sensitivity unit is mV/V/Eu or mV/Eu, sen1 through sen6 should be sent to M8128 directly.
   2) If sensitivity unit is V/V/Eu or V/Eu, sen1 through sen6 should be divided by 1000.
2. If sensitivity unit is “mV/V/Eu”, send command “AT+SERLA=1;1;1;1;1;1” to M8128.
   If sensitivity unit is “mV/Eu”, send command “AT+SERLA=0;0;0;0;0;0” to M8128.
3. Click “Data Unit” to set the data unit as “N or Nm”.
4. Click “Realtime” to get data in engineering unit from M8128.

4. Connectors and LED lights

4.1 Connector

4.1.1 19 pin LEMO Connector

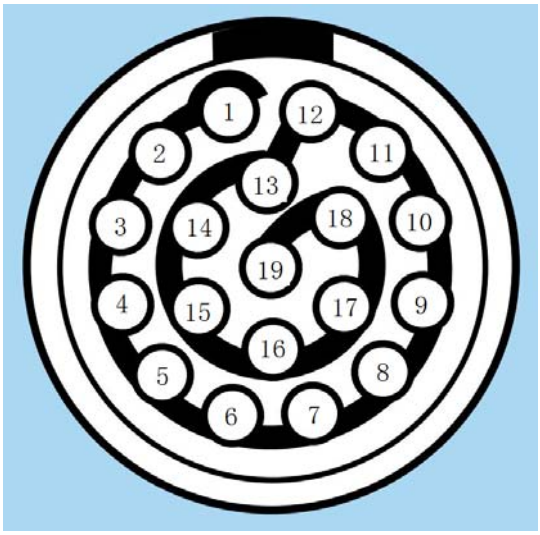


Figure 4.1 LEMO-19 pin order

Table 4.1 LEMO-19 pin definition

LEMO Connector Pin #	Definition	Note
1	CH1+	
2	CH1-	
3	CH2+	
4	CH2-	
5	CH3+	
6	CH3-	
7	CH4+	
8	CH4-	
9	CH5+	
10	CH5-	
11	CH6+	
12	CH6-	
13		
14		
15		
16		
17	-E	The negative excitation
18	+E	The positive excitation
19	GND	
Shield	Shield line	The shield line of cable, it's recommended that connect the shield line to ground.

4.1.2 Ethernet / RS232 / CAN Bus connector

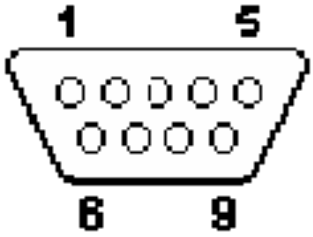


Table 4.2 Definition of Ethernet/RS232/CAN Pin

Pin Num#	Definition	Note
1	TDP	Ethernet
2	RX	RS232
3	TX	RS232
4	CANH	CAN BUS
5	GND	
6	CANL	CAN BUS
7	TDN	Ethernet
8	RDP	Ethernet
9	RDN	Ethernet

4.1.3 Power cable

M8128 has a 2 meters long power cable. It operates on DC 12～36V(not included) and requires 200mA maximum supply current. The cable color codes are defined as follows:

Table 4.3 Definition of the power cable

Color	Definition	Note
Red, Blue, Orange	PWR	The red clip
Black, Brown, Yellow, Green	GND	The black clip
Shield	Shield line	The power cable shield is connected to the external case of M8128. To reduce noise, it is recommended to connect the shield to the true ground in your test lab.

4.2 Indicated Lights

There are two indicated lights: PWR (Power) and STA (Status). The conditions of these lights are defined in Table4.4:

Table 4.4 Indicated lights

PWR	STA	Definition	What should do
ON		Power is on	
ON	Flicker	System is working properly	
ON	ON	Sensor excitation is abnormal	Check the sensor cable
OFF	Flicker	System works ok. PWR light may get damaged	Either ignore or repair PWR light
OFF	ON	Sensor excitation is abnormal and PWR light may get damaged	Check the sensor cable

5. Communication BUS

5.1 RS232

M8128 supports RS232 communication with the default Baud Rate 115200bps. The baud rate can be changed to 921600bps,460800bps,256000bps,230400bps, 57600bps, 56000bps, 38400bps, 19200bps, 14400bps or 9600bps by Command UARTCFG.

5.2 CAN Bus

M8128 supports CAN 2.0, and the maximum baud rate is 1Mb/s.

5.3.1 ID

M8128 uses a CAN Bus with standard 11-bits ID or extended 29-bits ID. The default ID is 0 and ID can be configured by Command CIDT and CFIDL. Please note that the configured ID is unavailable until M8128 is restarted. One M8128 can have up to 14 IDs.

5.3.2 Baud Rate

The default Baud Rate of CAN Bus in M8128 is 1Mb/s, and the Baud Rate can be changed by Command CRATE in two ways.

One method is to send “AT+CRATE=BR:rate” to set the Baud Rate, where the rate should be 1Mb/s, 0.8Mb/s, 0.75Mb/s, 0.6Mb/s, 0.5Mb/s, 0.45Mb/s, 0.25Mb/s or 0.125Mb/s.

The other method is to send “AT+CRATE=RP:BS1,BS2,Prescaler” to set the Baud Rate. More Baud Rate can be achieved by this method. The Baud Rate is defined as follows:

Baud Rate = 36/((1+ BS1+ BS2)*(1+Prescaler))Mbps

📖 Note: The configured Baud Rate is unavailable until M8128 is restarted.

5.3 Ethernet

M8128 also supports Ethernet, IP address 192.168.0.108, Port 4008. M8128 can communicate with PC when computer IP is192.168.0.2.

6. How to configure system and get realtime data

6.1 System initialization

The indicated light STA does not flicker until M128 is initialized successfully. At the same time, “System Init OK!” will be sent to user’s controller or PC via RS232 Or CAN Bus. Do not perform any operation until the initialization process is completed.

6.2 System parameters

All internal parameters in M8128 can be configured by commands in Table6.1 and they are still available after restarting.

Table 6.1 System parameters and commands

System Parameters	Command	Note
Sampling Rate	**SMPR**	Sampling rate of each channel is 500HZ.
Gain	**CHNAPG**	To obtain the actual gain, an additional command “CHNAPG=?” need to be sent to M8128.
Sensor sensitivity	**SENS**	
Amplifier zero offset of each channel	**AMPZ**	
Mode to receive data	**SGDM**	To set the mode to receive data
RS232 Baud rate	**UARTCFG**	
CAN Baud rate	**CRATE**	
CAN ID	**CFIDL**	
CAN ID type	**CIDT**	
Ethernet IP	**EIP**	
Ethernet MAC	**EMAC**	
Ethernet Gateway Address	**EGW**	
Ethernet Netmask	**ENM**	

6.3 Get realtime data

In default mode, the data are uploaded in AD Counts. Other units (mV or mV/V or Engineering unit) are also possible (configured by Command SGDM). Data in AD Counts is comprised with 2 characters, data in mV or mV/V or Engineering unit is comprised with 4 characters. Therefore, to achieve high data rate, it’s recommended to get data in AD Counts.

There are two kinds of multi-axis loadcell: structurally decoupled and matrix decoupled. For structurally decoupled loadcell, engineering unit data can be obtained by formula 6.3.1. For matrix decoupled loadcell, engineering unit data can be got by formula 6.3.2.

An example with C++ source code (M812x-Demo.sln) and executable file (M812x-Demo.exe) is supplied by SRI. It can be found in the CD-ROM.

6.3.1 For structurally decoupled loadcell

Recommended steps:

Step1: Get system parameters.

1. Send command AT+EXMV=?\r\n to get sensor excitation Ex.
2. Send command AT+AMPZ=?\r\n to get amplifier zero offset of each channel AmpZero.
3. Send command AT+CHNAPG=?\r\n to get channel gains Gain.

Step2: Send command AT+GOD=?\r\n or command AT+GSD=?\r\n to get real time data in AD Counts unit, convert it to voltage by the following formula:

If sensitivity unit is mV/V/Eu, formula should be:

Engineering unit =1000*((AD Counts – AmpZero) / 65535 * 5/Gain) /(Sensitivity*Ex)

If sensitivity unit is V/V/Eu, formula should be:

Engineering unit = ((AD Counts –AmpZero) / 65535 * 5/Gain) /(Sensitivity*Ex)

If sensitivity unit is V/Eu, formula should be:

Engineering unit = ((AD Counts –AmpZero) / 65535 * 5/Gain) /(Sensitivity)

If sensitivity unit is mV/Eu, formula should be:

Engineering unit = 1000*((AD Counts –AmpZero) / 65535 * 5/Gain) /(Sensitivity)

Where，

- AD Counts is the data received from M8128.
- Gain is the actual gain of each channel, which is obtained from the command CHNAPG.
- The sensitivity of a sensor is typically reported in the sensor's calibration document. A typical unit for a loadcell is mV/V/Eu, where Eu is N or Nm.
- Ex is the actual excitation voltage which is obtained from Command EXMV.
- AmpZero is the amplifier zero offset of each channel, it is obtained from Command AMPZ.

6.3.2 For matrix decoupled loadcell

Method to decouple a 6 axis load cell is described in it's calibration report. The following figure is an example.

[DECOUPLED] =

-5.26023	-0.82822	-7.26005	-282.60288	-4.48842	284.01162
-3.99885	-329.09963	-2.06366	161.62996	-7.02214	164.61785
-896.25932	-6.78126	-895.94760	4.17719	-917.06987	0.75944
0.03227	-0.01827	48.71672	-0.19332	-49.63531	0.13131
-57.14424	-0.42225	27.22186	0.13688	27.51720	-0.14478
0.33726	19.16262	0.17452	19.20376	-0.30048	19.36831

The six axis loads can be decoupled as follows:

Step 1: Obtain the raw data of Channels 1 through 6 into Volt
[RAW] = {rawchn1, rawchn2, rawchn3, rawchn4, rawchn5, rawchn6}
where rawchn1, rawchn2, rawchn3, rawchn4, rawchn5 and raw chn6 are in V

Step 2: Convert the raw data into mv/V
Assume the raw data output in Volt, Excitation voltage = EXC, Amplifier gain = GAIN
[DAT] = {chn1, chn2, chn3, chn4, chn5, chn6} *1000 / (EXC*GAIN)
where chn1, chn2, chn3, chn4, chn5 and chn6 are in mv/V

Step 3: To calculate decoupled loads
$[RESULT]^T = [DECOUPLED]*[DAT]^T$
where [RESULT] = {FX,FY,FZ,MX,MY,MZ}. Force Unit: N. Moment Unit: Nm
[DECOUPLED] is the above decoupled matrix

Recommended steps:

Step1: Get system parameters.

1. Send command AT+EXMV=?\r\n to get sensor excitation Ex.
2. Send command AT+AMPZ=?\r\n to get amplifier zero offset of each channel AmpZero.
3. Send command AT+CHNAPG=?\r\n to get channel gains Gain.

Step2: Send command AT+GOD=?\r\n or command AT+GSD=?\r\n to get real time data in AD Counts unit, convert it to voltage by the following formula.

According to different loadcell calibration reports, the matrix decoupled loadcell is classified into types A and type B.

For Type A:

Data =1000* (AD Counts –AmpZero) / 65535*5 / Gain / Ex

For Type B:

Data = 1000*(AD Counts –AmpZero) / 65535*5 / Gain

Step3: Execute step3 described in calibration report to calculate FX FY…MZ.

7. Command

Definitions：

Master：The equipment that send commands to M8128, such as PC or the user's control system. M8128 is called as Slave Equipment.

ASCII Code：America Standard Code for Information Interchange，refer to ISO 646.

M8128 commands are comprised of ASCII codes.

Command structures are shown as follows：
Send to Slave Equipment：
AT+CMD=Parameter\r\n
Response from Slave Equipment：(Except for the command GOD and GSD)
ACK+CMD=Parameter$ResponseCode\r\n

All data that sent to slave equipment must be ASCII code.
All data that received from slave equipment are ASCII code.
Before sent or after received, the data must be converted to or from ASCII

Descriptions：

AT：Frame Header when sending data. All data that are sent to Slave Equipment must be started with AT.

ACK：Frame Header when receiving data. All data that are received from Slave Equipment are started with ACK.

CMD：Command，such as SMPR, etc,.

Parameter：Parameters follow a command.

\r\n：Enter. It denotes the end of Command.

ResponseCode：Response code，such as OK or ERROR.

$：Interval symbols.

Note：

- Parameter '?' denotes that Master is asking for response data from Slave Equipment. Otherwise, Master is sending data to Slave Equipment.
- Response will be sent from Slave Equipment just after the command is executed.

M8128 Command Index

Command	Function	Note
To configure RS232 or CAN Bus or Ethernet		
UARTCFG	To read or set parameters of RS232	
CRATE	To read or set baud rate of CAN Bus	Become available after restart M8128
CIDT	To read or set ID type of CAN Bus	Become available after restart M8128
CFIDL	To read or set ID of CAN Bus	Become available after restart M8128
EIP	Ethernet IP address	Become available after restart M8128
EMAC	Ethernet MAC address	Become available after restart M8128
EGW	Ethernet gateway	Become available after restart M8128
ENM	Ethernet netmask	Become available after restart M8128
System parameters		
CHNAPG	To read the gain of each channel	
SMPR	To read or set sampling rate	
SENS	To read or set the sensitivity of sensor	It is saved to the embedded memory
AMPZ	To read amplifier zero offset of each channel	
To get real-time data from M8128		
SGDM	To set the mode to receive data	
GSD	To get data from M8128 repeatedly	
GOD	To get one package data from M8128	

7.1 Commands to configure RS232/CAN

7.1.1 Parameters of RS232

Description: To read or set parameters of RS232
Command Syntax: AT+**UARTCFG**=RATE:rate

Command	Possible response(s)
AT+**UARTCFG**=?	RATE:rate
AT+**UARTCFG**=RATE:rate	OK/ERROR

Note:
The Master Equipment will receive messy codes after sending a new Baud Rate(X) to Slave Equipment by command UARTCFG. This situation is caused by the different Baud Rate between Master Equipment and Slave Equipment. Therefore, it's recommended that the Baud Rate for the Master Equipment is changed to X and the command UARTCFG is sent to M8128 again to get a correct response.

Parameters

Parameter	Variable Type (Valid Range)	Description
RATE	String	RATE is the key word of Baud Rate, it can't be left out.
rate	Unsigned long int ($0 \sim 2^{32}-1$)	Baud Rate of RS232 in bps. For example 115200bps. Baud Rate of RS232 in M8128 can be 115200bps, 921600bps,460800bps,256000bps,230400bps, 57600bps, 56000bps, 38400bps, 19200bps, 14400bps or 9600bps.

Example:
Send：AT+UARTCFG=?\r\n
Response：ACK+UARTCFG=RATE:115200$OK\r\n
Send：AT+UARTCFG=RATE:57600\r\n
Response：Messy code

Master Equipment Baud Rate is changed to the new one:
Send：AT+UARTCFG=RATE:57600\r\n
Response：ACK+UARTCFG=RATE:57600$OK\r\n

7.1.2 ID type for CAN Bus

Description: To read or set ID type for CAN Bus
Command Syntax: AT+**CIDT**=Type

Command	Possible response(s)
AT+**CIDT**=?	Type
AT+**CIDT**=Type	OK/ERROR

Note:
The configured ID type will be available after M8128 is restarted.

Parameters

Parameter	Variable Type (Valid Range)	Description
Type	String	The Type can be STD or EXT.STD denotes the standard 11 bits ID and EXT denotes the extended 29 bits ID.

Example:
Send：AT+CIDT=?\r\n
Response：ACK+CIDT=STD$OK \r\n

7.1.3 Baud Rate of CAN Bus

Description: To read or set baud rate of CAN Bus.
Command Syntax: 1. AT+**CRATE**=BR:rate
2. AT+**CRATE**=RP:BS1,BS2,Prescaler

Command	Possible response(s)
AT+**CRATE**=?	1. BR:rate 2. RP:BS1,BS2,Prescaler
1. AT+**CRATE**=BR:rate 2. AT+**CRATE**=RP:BS1,BS2,Prescaler	OK/ERROR

Note:

1. The default Baud Rate of CAN Bus in M8128 is 1Mb/s, and the baud rate can be changed by the command CRATE through two ways.

   1.1 One method is to send "AT+CRATE=BR:rate" to set the Baud Rate, where the rate should be 1Mb/s, 0.8Mb/s, 0.75Mb/s, 0.6Mb/s, 0.5Mb/s, 0.45Mb/s, 0.25Mb/s or 0.125Mb/s.

   1.2 The other method is to send "AT+CRATE=RP:BS1,BS2,Prescaler" to set the Baud Rate. More Baud Rate can be achieved by this method. The Baud Rate is defined as following:

   Baud Rate = 36/((1+ BS1+ BS2)*(1+Prescaler))Mbps

2. Only one method can be used each time.
3. It will be available after M8128 is restarted.

Parameters

Parameter	Variable Type (Valid Range)	Description
BR	String	Keyword
RP	String	Keyword
rate	Unsigned long int ($0\sim2^{32}$-1)	Baud Rate in bps. This parameter can be 1000000, 800000, 750000, 600000, 500000, 450000, 250000 or 125000.
BS1	Unsigned short int (0～65535)	An integer which is through 1 to 16.
BS2	Unsigned short int (0～65535)	An integer which is through 1 to 8.
Prescaler	Unsigned short int (0～65535)	An integer which is through 1 to 1024.

Example:
Send：AT+CRATE=?\r\n
Response：ACK+CRATE=BR:1000000$OK\r\n

Send：AT+CRATE=?\r\n
Response：ACK+CRATE= RP:7,8,20$OK\r\n
Send：AT+CRATE=BR:125000\r\n
Response：ACK+CRATE=BR:125000$OK\r\n

Send：AT+CRATE=RP:7,8,20\r\n
Response：ACK+CRATE=RP:7,8,20$OK\r\n

7.1.4 ID of CAN Bus

Description: To read or set ID of CAN Bus
Command Syntax: AT+**CFIDL**=id1,id2,id3,…,idn

Command	Possible response(s)
AT+**CFIDL**=?	id1,id2,id3,…,idn
AT+**CFIDL**=id1,id2,id3,…,idn	OK/ERROR
Note: One M8128 can have maximum 14 IDs. It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
idn	$0\sim2^{11}$ or $0\sim2^{29}$	Decimal number

Example:
Send：AT+CFIDL=128\r\n
Response：ACK+CFIDL=128$OK \r\n
Send：AT+CFIDL=?\r\n
Response：ACK+CFIDL=0,125,126,127,128$OK \r\n

7.1.5 Interval time between frames of CAN Bus

Description: To set (or read) interval time between frames of CAN Bus.
Command Syntax: AT+**CFI**=IntervalTime

Command	Possible response(s)
AT+**CFI**=?	IntervalTime
AT+**CFI**=IntervalTime	OK/ERROR
Note: It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
IntervalTime	0～10000	Interval time in us. The default value in firmware is 0us.

Example:
Send：AT+CFI=10\r\n
Response：ACK+CFI=10$OK \r\n
Send：AT+CFI=?\r\n
Response：ACK+CFI=10$OK \r\n

7.1.6 Ethernet IP Address

Description: To set Ethernet IP address.
Command Syntax: AT+**EIP**=addr0.addr1.addr2.addr3

Command	Possible response(s)
AT+**EIP**=?	addr0.addr1.addr2.addr3
AT+**EIP**= addr0.addr1.addr2.addr3	OK/ERROR
Note: It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
addr		IP address,eg.192.168.0.108

Example:
Send：AT+EIP=192.168.0.108\r\n
Response：ACK+EIP=192.168.0.108$OK \r\n
Send：AT+EIP=?\r\n

Response：ACK+EIP=192.168.0.108$OK \r\n

7.1.7 Ethernet MAC

Description: To set Ethernet MAC.
Command Syntax: AT+**EMAC**=addr0-addr1-addr2-addr3-addr4-addr5

Command	Possible response(s)
AT+**EMAC**=?	addr0-addr1-addr2-addr3-addr4-addr5
AT+**EMAC**= addr0-addr1-addr2-addr3-addr4-addr5	OK/ERROR
Note: It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
addr	String	Ethernet MAC address,eg.12-13-14-15-16-17

Example:
Send：AT+EMAC=12-13-14-15-16-17\r\n
Response：ACK+EMAC=12-13-14-15-16-17$OK \r\n
Send：AT+EMAC=?\r\n
Response：ACK+EMAC=12-13-14-15-16-17$OK \r\n

7.1.8 Ethernet Gateway address

Description: To set Ethernet gateway address.
Command Syntax: AT+**EGW**= addr0.addr1.addr2.addr3

Command	Possible response(s)
AT+**EGW**=?	addr0.addr1.addr2.addr3
AT+**EGW**= addr0.addr1.addr2.addr3	OK/ERROR
Note: It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
addr	String	Ethernet gateway address,eg.192.168.0.1

Example:
Send：AT+EGW=192.168.0.1\r\n
Response：ACK+EGW=192.168.0.1$OK \r\n
Send：AT+EGW=?\r\n
Response：ACK+EGW=192.168.0.1$OK \r\n

7.1.9 Ethernet netmask

Description: To set Ethernet netmask.
Command Syntax: AT+**ENM**= addr0.addr1.addr2.addr3

Command	Possible response(s)
AT+**ENM**=?	addr0.addr1.addr2.addr3
AT+**ENM**= addr0.addr1.addr2.addr3	OK/ERROR
Note: It will be available after M8128 is restarted.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
addr	String	Ethernet netmask,eg.255.255.255.0

Example:
Send：AT+ENM=255.255.255.0\r\n
Response：ACK+ENM=255.255.255.0$OK \r\n

Send：AT+ENM=?\r\n
Response：ACK+ENM=255.255.255.0$OK \r\n

7.2 System parameters

7.2.1 Channel gain

Description：To read the gain of each channel
Command Syntax：AT+**CHNAPG**=?

Command	Possible response(s)
AT+**CHNAPG**=?	GV-Ch1;GV-Ch2;…;GV-Chn
Note:	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
GV-Chn	Float (-3.4E38～3.4E38)	The actual gains of M8128.

Example:
Send：AT+CHNAPG=?\r\n
Response：ACK+CHNAPG=123.94;123.92;124.05;124.11;124.03;124.03;124.01;123.85$OK\r\n

7.2.2 Sampling Rate

Description: To read or set sampling rate.
Command Syntax: AT+**SMPR**=SampleRate

Command	Possible response(s)
AT+**SMPR**=?	SampleRate
AT+**SMPR**=SampleRate	OK/ERROR
Note:	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
SampleRate	Unsigned short int (0～65535)	Sampling rate in Hz. For example, 200.

Example:
Send：AT+SMPR=?\r\n
Response：ACK+SMPR=300$OK\r\n

Send：AT+SMPR=200\r\n
Response：ACK+SMPR=200$OK\r\n

7.2.3 Sensor Excitation Voltage

Description: To read excitation voltage of sensor.
Command Syntax: AT+**EXMV**=?

Command	Possible response(s)
AT+**EXPOS**=?	V1;V2;….Vn
Note:	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
Vn	Float (-3.4E38～3.4E38)	Excitation voltage of Channel N. The unit is in volt.

Example:
Send：AT+EXMV=?\r\n
Response：ACK+EXMV=5.007853; 5.007853; 5.007853; 5.007853; 5.007853; 5.007853$OK\r\n

7.2.4 Sensor Sensitivity

Description: To read or set the sensitivity of sensor.
Command Syntax: AT+**SENS**=Sen-1;Sen-2;Sen-3;…;Sen-n

Command	Possible response(s)
AT+**SENS**=?	Sen-1;Sen-2;Sen-3;…;Sen-n
AT+**SENS**= Sen-1;Sen-2;Sen-3;…;Sen-n	OK/ERROR
Note: After the sensitivities of sensor are configured by the command SENS, the real-time data in engineering unit can be obtained from M8128.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
Sen-n	Float (-3.4E38～3.4E38)	The sensitivity of Channel #n. It's a floating point number.

Example:
Send： AT+SENS=0.324;0.286;0.324;0.286;0.324;0.286;0.324;0.286\r\n
Response： ACK+SENS=0.324;0.286;0.324;0.286;0.324;0.286;0.324;0.286$OK\r\n

7.2.5 Amplifier Zero offset

Description: To read amplifier zero offset of each channel.
Command Syntax: AT+**AMPZ**=?

Command	Possible response(s)
AT+**AMPZ**=?	AmpZero1; AmpZero2;…; AmpZeron
Note:	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
AmpZeron	Float (-3.4E38～3.4E38)	The amplifier zero offset of Channel #n. It's a floating point number.

Example:
Send： AT+AMPZ=?\r\n
Response: ACK+AMPCZTB= 32688.000000;32657.000000;32565.000000;32409.000000;32717.000000;32714.000000$OK\r\n

7.3 Get Real-time Data

7.3.1 Set the mode to receive data

Description: To set the mode to receive data.
Command Syntax: AT+**SGDM**=(CHx,CHx,…,CHx);DataUnit;PNpCH;(FM:p1,p2,p3,…,pn)

Command	Possible response(s)
AT+**SGDM**=(CHx,CHx, …,CHx);DataUnit;PNpCH;(FM:p1,p2,p3,…,pn)	OK/ERROR

Note:
The default parameter is (A01,A02,A03,A04,A05,A06);C;1;(WMA:1).

Parameters

Parameter	Variable Type (Valid Range)	Description
(CHx,CHx,…,CHx)	String	The relevant analog channels. CHx is comprised of three ASCII codes. Note that the parentheses is necessary. For example, if channel 2,5 and 1 are required,(CHx) must be written as (A02,A05,A01), and the uploaded data will be in the order of Channel 2 , Channel 5 and Channel 1.
DataUnit	Character (0～255)	The unit of uploaded data. It's comprised of one character E, V, M or C which denote Engineering unit, mV/V, mV or AD Counts respectively. The method to convert data to Engineering unit value is shown in Section 3.5.
PNpCH	Character (0～255)	Number of data which are desired. PNpCH is comprised of three ASCII codes, and is less than 80. For example, if 20 data points are desired, Num must be written as 20.
(FM:p1,p2,p3,…,pn)		Filter model and relevant parameters. The Weighted Mean Algorithm is supported by M8128. Every sampling point will be averaged with previous N (N<=17) points. FM: Filter model. Set to WMA. p1,p2,p3,…,pn：The weight of each point, where pn is the weight of the latest sampling point. They must be integer. For example,(WMA:1,1,1,2,4) means that the average will be got from five points(D1, D2, D3, D4, D5). The average is defined as: (D5*4+D4*2+D3*1+D2*1+D1*1)/(4+2+1+1+1) Note: Please input (WMA:1) if the Weighted Mean Algorithm is not needed.

7.3.2 To get one package data every time

Description: To get one package data from M8128.
Command Syntax: AT+**GOD**

Command	Possible response(s)
AT+**GOD**	DataFormat
Note: If it's necessary, please use command SGDM to set the mode to receive data.	

Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
DataFormat		Data package, refer to the following for details.

7.3.3 To get data repeatedly

Description: To get data from M8128 repeatedly.
Command Syntax: AT+**GSD**

Command	Possible response(s)
AT+**GSD**	DataFormat
Note: 1. If it's necessary, please use command SGDM to set the mode to receive data. 2. To stop receiving data, send "AT+GSD=STOP\r\n" to M8128.	

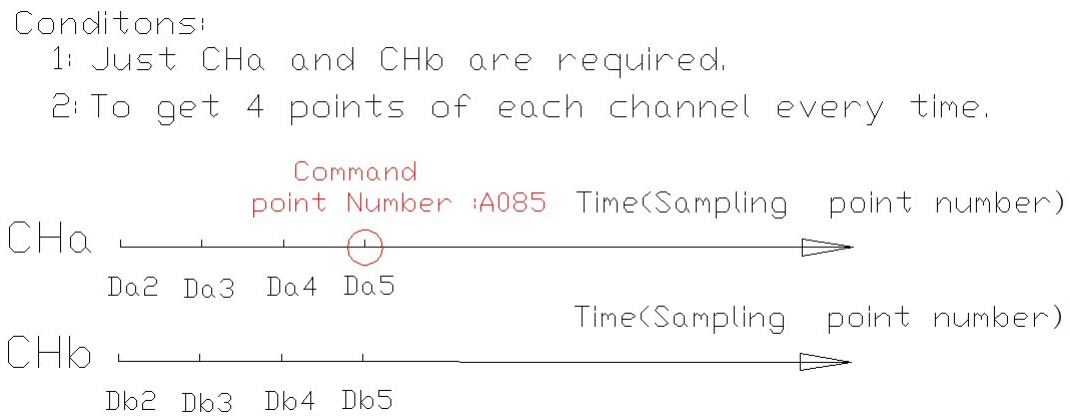
Parameters		
Parameter	**Variable Type (Valid Range)**	**Description**
DataFormat		Data package, refer to the following for details.

"DataFormat" is defined as follows：

Frame Header	Package Length	Data Number	Data	CRC32
0xAA ,0x55	HB,LB	2Byte	(ChNum*N*DNpCH) Byte	4Byte

Note:

- 0xAA ,0x55：Frame header of data package.
- PackageLength：The length of data of each channel. It equals to
  2+ChNum*N*DNpCH+1
  Where,
  ChNum is the number of required channel.
  N equals to 2 if the data unit is in AD Counts, and equals to 4 if the data unit is in engineering unit or mV/V.
  DNpCH is the number of sampling points to upload.
- The resolution of AD chip is 16-bits. Each sampling point has two bytes with the high 8-bits followed by the low 8-bits if the data unit is AD Counts. Each sampling point has four bytes if the data unit is engineering unit or mV/V.
- Each sampling point is labeled by MCU in M8128. Therefore, each point has a unique ID, i.e. "DataNo". "DataNo" is comprised of two Bytes with the high 8-bits followed by the low 8-bits. The actual clock time can be calculated from the sampling rate and the # of points. The "DataNo" also can be used to determine if missing points occur. For example, in the condition of DNpCH equals to 20, "DataNo" of the latest data package is 512, "DataNo" of the next package will be less than 532 if no missing point occur. Similarly, missing point occur when "DataNo" is more than 532.
- CRC32 is the the CRC32 check of "Data".
  CRC32 function (MyCRC_GetCRC32(uint8_t *pData,uint16_t Length)) in C program is including in the CD-ROM.
- As shown in the following figure:



When M8128 received the command AT+GOD, assume that the DataNo of the latest sampling data(Da5 and Db5) is “0xA085”. Therefore, Da2 to Da5 and Db2 to Db5 will be sent to Master Equipment by M8128 with the following format:

Frame Header	Package Length	DataNo	Data	Crc32
0xAA ,0x55	HB,LB	A085	Da2 Db2 Da3 Db3 Da4 Db4 Da5 Db5	4Byte

Appendix：Dimension of M8128