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M8126 User's Manual

This document is the User's Manual for M8126, the interface box for the force/torque sensor (loadcell) manufactured by SRI (Sunrise Instruments Co., Ltd). It's strongly recommended that anyone who uses M8126 should read this document before any operation. SRI reserves all the rights of this document. Please do not hesitate to contact SRI if there is any question.

Content

1. Introduction

The interface box M8126 provides bridge excitation, signal conditioning, data acquisition and digital communication to the user's controller or PC via EtherCAT or RS232,. A 24 bit sigma-delta AD converter (16 bit effective) is used to provide high resolution (1/5000 to 1/10000 of full scale) analog to digital converting. The data rate is up to 2 kHz. 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
  - EtherCAT and RS232
  - 24 bit sigma-delta ADC (16 bit effective), Sampling rate: 10~2k Hz
  - Resolution: 1/5000 to 1/10000 of full scale
  - Programmable system parameters

- Frontal Panel
  - Loadcell connector: LEMO FGG.2B.319.CLAD52Z
  - Digital: RJ45(EtherCAT)、DB-9 (RS232)
  - Power supply: 12 to 36V, 200mA. Power cable - Diameter 3.5mm& Length 2m
  - Indicated lights: Power & Status

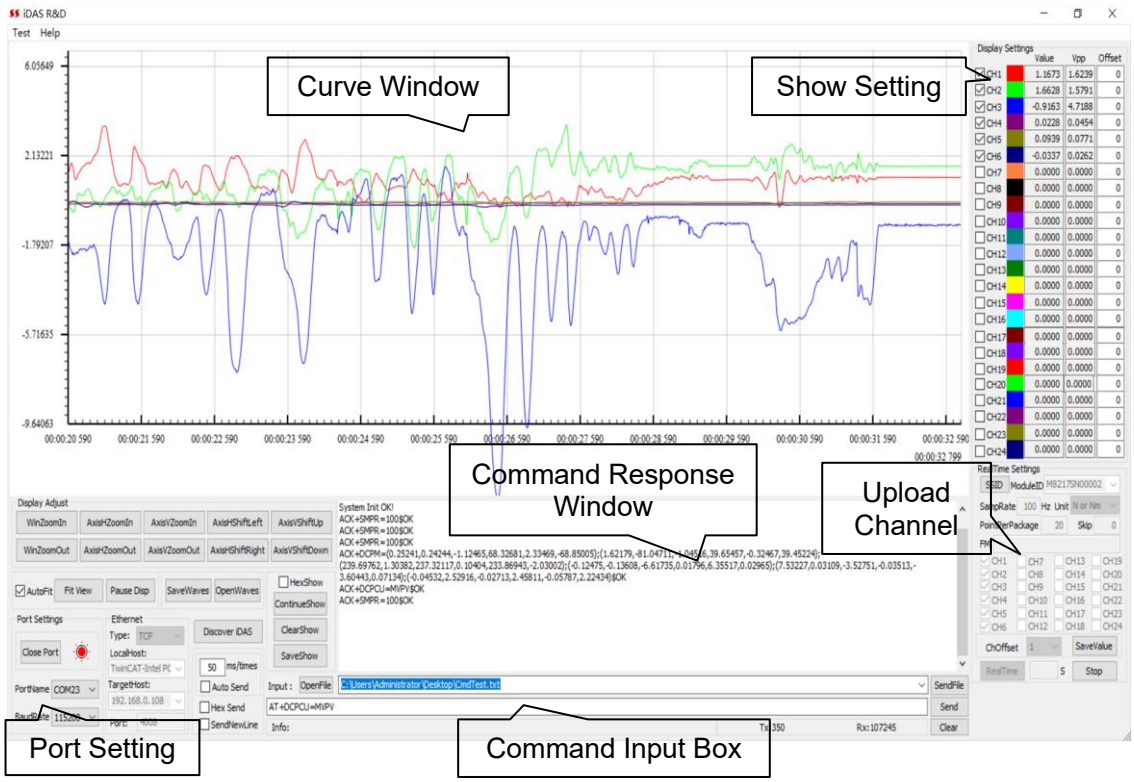
- Software
  - iDAS RD: Debugging software to display real-time sampling curve via RS232.
  - The dictionary file(*.xml) is supplied, can be connected into EtherCAT easily.

2. Configure

M8126 and sensor were configured in SRI factory, and it can be connected to EtherCAT directly by the dictionary file(*.xml).
Re-configuration may needed some times.
RS232 is supplied to configure M8126 by software iDAS RD.

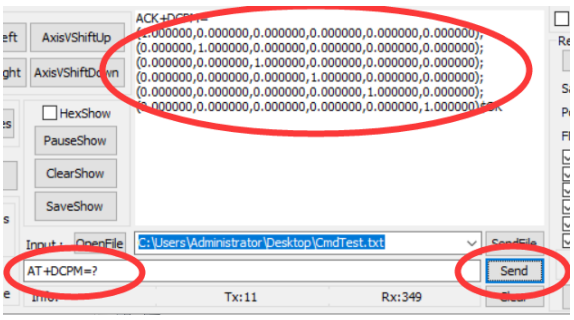
- PC Requirement：WIN 7 or above
- Installation Procedure：Uncompressed iDAS RD

2.1 iDAS RD software



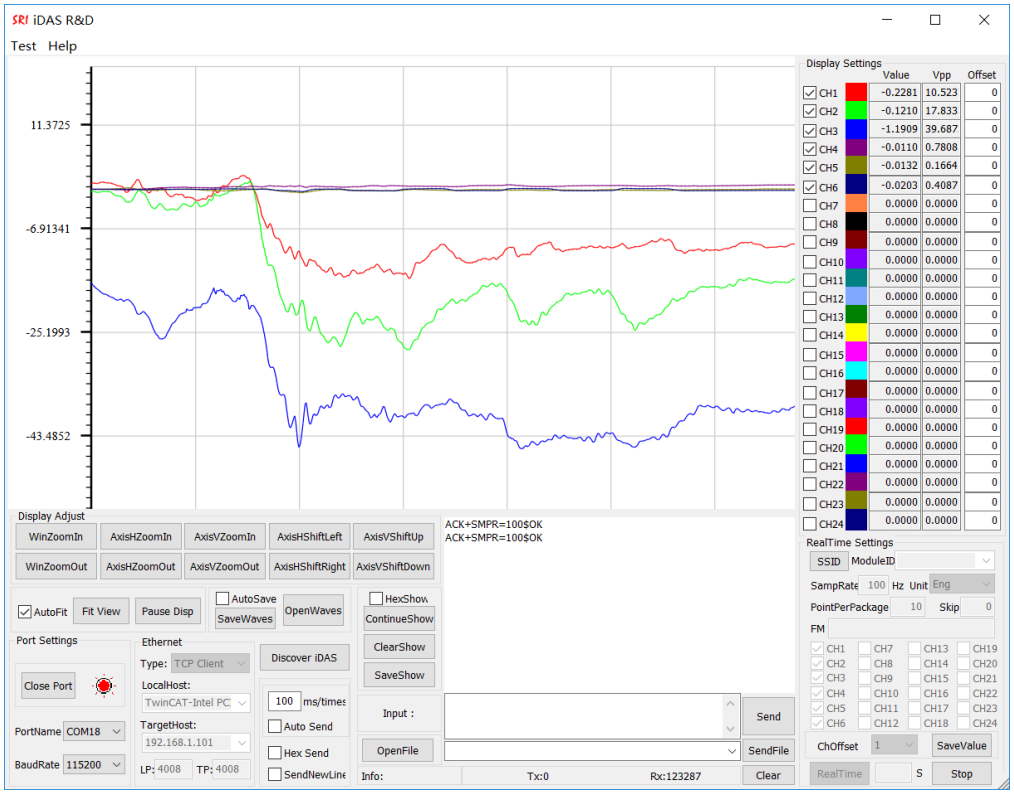
2.2 Send Commands

Type in a command to the Command Box, and click Send. The response information will be shown in the command response window. Error will be prompted or no response will be given if the input command is wrong or is not supported by M8126.



2.3 Get real-time data via RS232

Step 1: Open Port correctly.
Step 2: Select CH1 through CH6 at the lower right corner on screen.
Step 3: Set SampRate to 100Hz, set Unit to N or Nm.
Set PointPerPackage to 10, and put in 0 at Skip.
Step 4: Select CH1 through CH6 at the top right corner on screen.
Step 5: Click “Realtime” to get data from M8126, the real time data will be shown in the window.



Note:
With RS232 communication, SampRate is up to 300 Hz for 6-channel data upload and 1 kHz for 1-channel data upload at BaudRate 115200bps.

With Ethernet communication, SampRate is up to 2K Hz for 6-channel data upload

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If the real-time data shown by iDAS R&D is incorrect, please click Stop and send Commands DCPM and DCPCU to make sure that current matrix coefficients and calculation unit match the sensor calibration report.

3. Power Cable, Connectors and LED Lights

3.1 Power cable

M8128 comes with a 2-meters power cable, allowing for DC input of 12～36V, with DC24V recommended. Note that DC power supply is not included. If connected with a SRI six axis loadcell, the consumed power is about 4.5W. The cable color codes are defined as follows:

Color	Definition	Note
Red, Blue, Orange	+24V	+Power, red clip
Black, Brown, Yellow, Green	GND	-Power, black clip
Shield	Shield	The power cable shield is connected to the external case of M8128. To reduce noise, it is recommended to connect the shield to both -Vin (black clip) and the true ground in your test lab.

3.2 Connector definition

3.2.1 19 pin LEMO connector

Pin #	Definition	Note
1	CH1+	Channel 1
2	CH1-	
3	CH2+	Channel 2
4	CH2-	
5	CH3+	Channel 3
6	CH3-	
7	CH4+	Channel 4
8	CH4-	
9	CH5+	Channel 5
10	CH5-	
11	CH6+	Channel 6
12	CH6-	
13~16	N/A	
17	-E	Negative excitation (if support)
18	+E	Positive excitation
19	GND	

3.2.2 RS232 connector

Ethernet/RS232/CAN bus are included the same DB9 connector.
The pin assignments are as follows:

Pin #	Definition	Note
1	N/A	
2	RX	RS232
3	TX	RS232
4	N/A	
5	GND	Ground
6	N/A	
7	N/A	
8	N/A	
9	N/A	

3.3 Indicated lights

There are two indicated lights: PWR (Power) and STA (Status). The conditions of these lights are defined as follows:

PWR	STA	Definition	Instruction
ON		Power is on	
ON	Flickering	System is working properly	
ON	ON	Excitation is abnormal	Check the loadcell cable
OFF	Flickering	System works ok. PWR light may get damaged	Either ignore or repair PWR light
OFF	ON	Excitation is abnormal and PWR light may get damaged	Check the loadcell cable or contact us

4. Commands

Commands are supplied to configure M8126 via RS232 by software iDAS RD.

Command	Function	Note
SMPF	Read or set sampling rate	
DCPM	Read or set decoupling matrix coefficient	
DCPCU	Read or set matrix calculation unit	(mV or mV/V)
SFWV	Read firmware version	

4.1 SFWV / Search Firmware version

Description: To search firmware version.
Command Syntax:AT+SFWV=?

Example:

Send： AT+SFWV=?

Response： ACK+SFWV=V11.00$OK

4.2 DCPM / Read or set decoupled matrix

Description: To read or set decoupled matrix
Command Syntax:AT+DCPM=Matrix

Example:

Send： AT+DCPM=?

Response： ACK+DCPM=(0.000041,-0.020164,-0.000348,0.020287,-0.000145,-0.000047);(-0.000160,-0.011703,-0.000089,-0.011668,-0.000217,0.023526);(-0.031415,-0.000185,-0.032273,0.000010,-0.031708,-0.000481);(-0.000888,-0.000014,0.000951,-0.000006,0.000029,0.000009);(-0.000521,0.000011,-0.000531,-0.000009,0.001061,0.000015);(0.000002,0.000754,-0.000008,0.000753,-0.000007,0.000768)$OK

Send： AT+DCPM=(0.000041,-0.020164,-0.000348,0.020287,-0.000145,-0.000047);(-0.000160,-0.011703,-0.000089,-0.011668,-0.000217,0.023526);(-0.031415,-0.000185,-0.032273,0.000010,-0.031708,-0.000481);(-0.000888,-0.000014,0.000951,-0.000006,0.000029,0.000009);(-0.000521,0.000011,-0.000531,-0.000009,0.001061,0.000015);(0.000002,0.000754,-0.000008,0.000753,-0.000007,0.000768)

Response： ACK+DCPM=(0.000041,-0.020164,-0.000348,0.020287,-0.000145,-0.000047);(-0.000160,-0.011703,-0.000089,-0.011668,-0.000217,0.023526);(-0.031415,-0.000185,-0.032273,0.000010,-0.031708,-0.000481);(-0.000888,-0.000014,0.000951,-0.000006,0.000029,0.000009);(-0.000521,0.000011,-0.000531,-0.000009,0.001061,0.000015);(0.000002,0.000754,-0.000008,0.000753,-0.000007,0.000768)$OK

4.3 DCPCU / Calculation unit for decoupled data

Description: To set or read calculation unit.
Command Syntax:AT+DCPCU=Unit
Example:

Send: AT+DCPCU=?

Response: ACK+DCPCU=MV$OK

Send: AT+DCPCU=MVPV

Response: ACK+DCPCU=MVPV$OK

4.4 SMPF / Read or set sampling rate

Description: To read or set sampling rate.
Command Syntax: AT+**SMPF**=SampleFreq

Example:

Send: AT+SMPF=?

Response: ACK+SMPF=300$OK

Send: AT+SMPF=200

Response: ACK+SMPF=200$OK

5. Decoupled Calculation

If the M8126 is purchased together with SRI sensor, the decoupled matrix and calculation unit of SRI sensor have been configured in the M8126. The decoupled matrix and calculation unit can be updated by Command DCPM and DCPCU when necessary.

Decoupled matrix and calculation unit can be found in the calibration report. Two different reports formats will be provided according to the sensor's structure.

5.1 Matrix decoupled loadcell

The decoupled matrix and calculation unit are provided in the calibration report, as shown below:

[DECOUPLED] =

-0.03220	0.49984	0.00136	-1.01398	-0.01208	0.50908
0.00046	0.84855	0.01531	0.02114	-0.03126	-0.86432
1.19167	0.00028	1.20748	0.00224	1.19808	0.00320
-0.06386	-0.00097	0.13028	-0.00009	-0.06523	0.00012
-0.11090	0.00016	-0.00049	0.00075	0.11138	-0.00019
-0.00046	0.08401	-0.00067	0.08304	-0.00089	0.08433

The six axis loads can be decoupled as follows:

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

Step 2: 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

The Commands to input the matrix coefficients and to set the calculation unit are as follows:

AT+DCPM=(-0.03220,0.49984,0.00136,-1.01398,-0.01208,0.50908);(0.00046,0.84855,0.01531,0.02114,-0.03126,-0.86432);(1.19167,0.00028,1.20748,0.00224,1.198078,0.00320);(-0.06386,-0.00097,0.13028,-0.00009,-0.06523,0.00012);(-0.11090,0.00016,-0.00049,0.00075,0.11138,-0.00019);(-0.00046,0.08401,-0.00067,0.083040,-0.00089,0.08433)
AT+DCPCU=MV

5.2 Structurally decoupled loadcell

The sensitivity provided in the calibration report needs to be converted into a matrix as shown below:

Voltage Calibration

Bridge	Capacity	Zero Offset	Nonlinearity	Hysteresis	Output @ Capacity	Sensitivity	Change
	N/Nm	mV/V	%FS	%FS	mV/V	mV/V/EU	%
FX	-5400	0.0131	-0.08	-0.33	-3.0269	5.6054E-04	0.00
FY	5400	0.0007	0.08	0.27	3.0500	5.6481E-04	0.00
FZ	-10800	0.0001	-0.09	-0.18	-0.7369	6.8230E-05	0.00
MX	-540	-0.0027	-0.09	-0.10	-1.8703	3.4636E-03	0.00
MY	-540	-0.0090	-0.09	-0.09	-1.9014	3.5210E-03	0.00
MZ	432	-0.0099	0.05	0.08	1.9603	4.5378E-03	0.00

Sensitivity unit is mV/V/Eu,. The diagonal elements of the matrix are the inverse of the sensitivities (1/Sensitivity). The calculation unit is mV/V.

1783.9940	0	0	0	0	0
0	1770.5069	0	0	0	0
0	0	14656.3095	0	0	0
0	0	0	288.7169	0	0
0	0	0	0	284.0102	0
0	0	0	0	0	220.3711

The Commands to input the matrix coefficients and to set the calculation unit are as follows:

AT+DCPM=(1783.9940,0,0,0,0,0);(0,1770.5069,0,0,0,0);(0,0,14656.3095,0,0,0)
;(0,0,0,288.7169,0,0); (0,0,0,0,284.0102,0); (0,0,0,0,0,220.3711)
AT+DCPCU=MVPV

Four possible conversion formula:

1) Sensitivity unit is mV/V/Eu. The conversion formula is 1/Sensitivity. Calculation unit is mv/V: AT+DCPCU=MVPV.
2) Sensitivity unit is mV/Eu. The conversion formula is 1/Sensitivity. Calculation unit is mv: AT+DCPCU=MV.
3) Sensitivity unit is V/V/Eu. The conversion formula is 1/Sensitivity/1000. Calculation unit mv/V: AT+DCPCU=MVPV.
4) Sensitivity unit is V/Eu. The conversion formula is 1/Sensitivity/1000. Calculation unit is mv: AT+DCPCU=MV.

5.3 Other Loadcells

Except 6 axis loadcells, other sensors with voltage out put can also be connected to M8126.For calculation in M8126, a matrix is also needed.
Please follow the method described below to get the matrix.

3 Axis loadcell

Voltage Calibration

Bridge	Capacity	Zero Offset	Nonlinearity	Hysteresis	Output @ Capacity	Sensitivity	Change
	N/Nm	mV/V	%FS	%FS	mV/V	mV/V/EU	%
FX	-20000	0.0101	-0.13	-0.28	-2.8941	1.4471E-04	0.00
FY	20000	-0.0027	0.11	0.19	2.8894	1.4447E-04	0.00
FZ	-20000	0.0175	-0.07	-0.27	-0.5441	2.7207E-05	0.00

Sensitivity unit is mV/V/Eu. The diagonal elements of the matrix are the inverse of the sensitivities (1/Sensitivity).

6910.3725	0	0	0	0	0
0	6921.8523	0	0	0	0
0	0	36755.2468	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

The Commands to input the matrix coefficients and to set the calculation unit are as follows:
AT+DCPM=(6910.3725,0,0,0,0,0);(0,6921.8523,0,0,0,0);(0,0,36755.2468,0,0,0)
;(0,0,0,0,0,0);(0,0,0,0,0,0); (0,0,0,0,0,0)
AT+DCPCU=MVPV

Torque Sensor

Voltage Calibration

Bridge	Capacity	Zero Offset	Nonlinearity	Hysteresis	Output @ Capacity	Sensitivity	Change
	Nm	V	%FS	%FS	V	V/EU	%
MZ	100	-0.0049	0.04	0.27	2.0445	2.0445E-02	0.00

Sensitivity unit is V/Eu.
The first row and the first column equal to 1/sensitivity/1000.
Calculation unit is mV.

The Commands to input the matrix coefficients and to set the calculation unit are as follows:
AT+DCPM=(0.048913,0,0,0,0,0);(0,0,0,0,0,0);(0,0,0,0,0,0);(0,0,0,0,0,0);(0,0,0,0,0,0
);(0,0,0,0,0,0)
AT+DCPCU=MV