



## 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.

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## 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. Configuration

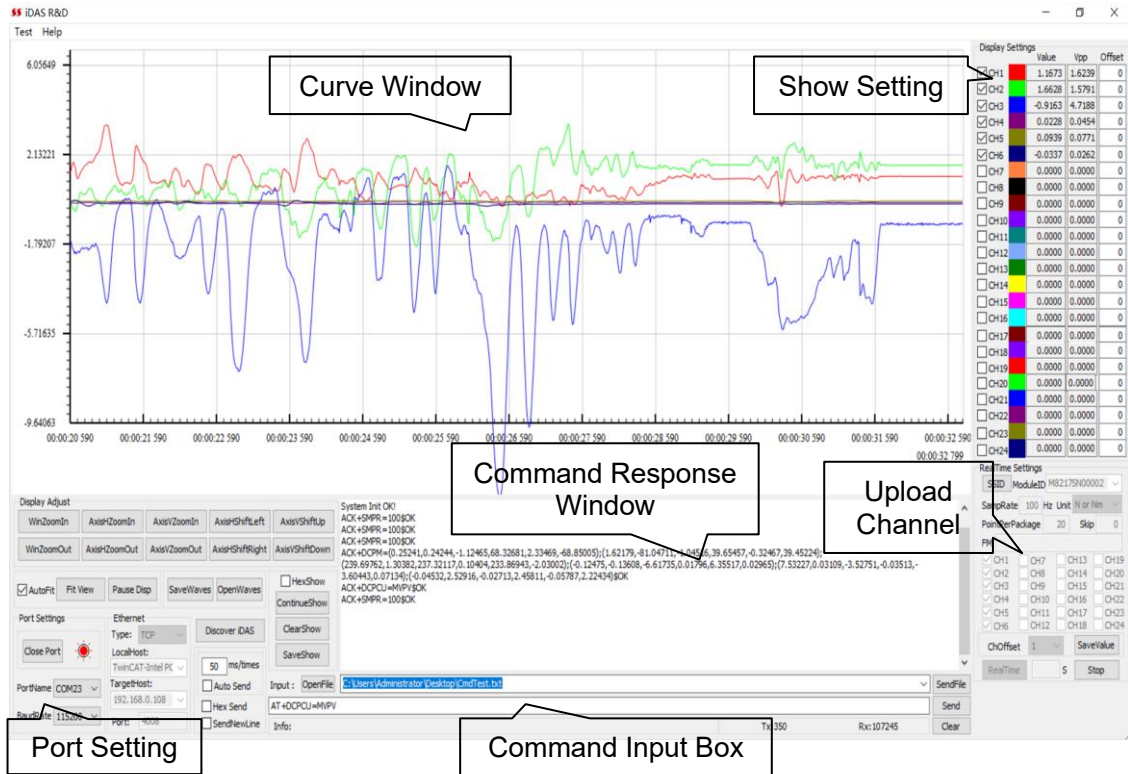
M8126 and sensor were configured in SRI factory, and it can be connected to EtherCAT directly by the dictionary file(\*.xml).

Re-configuration may needed some times.

RS232 is supplied to configure M8126 by software iDAS RD.

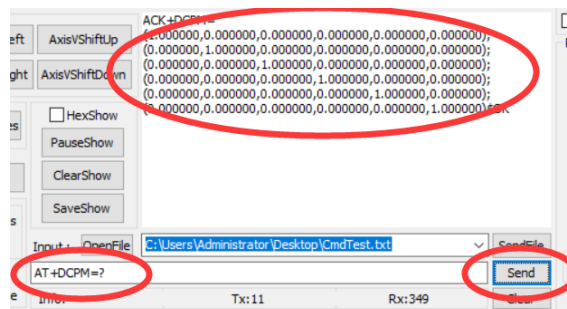
- PC Requirement: WIN 7 or above
- Installation Procedure: Uncompressed iDAS RD

### 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.

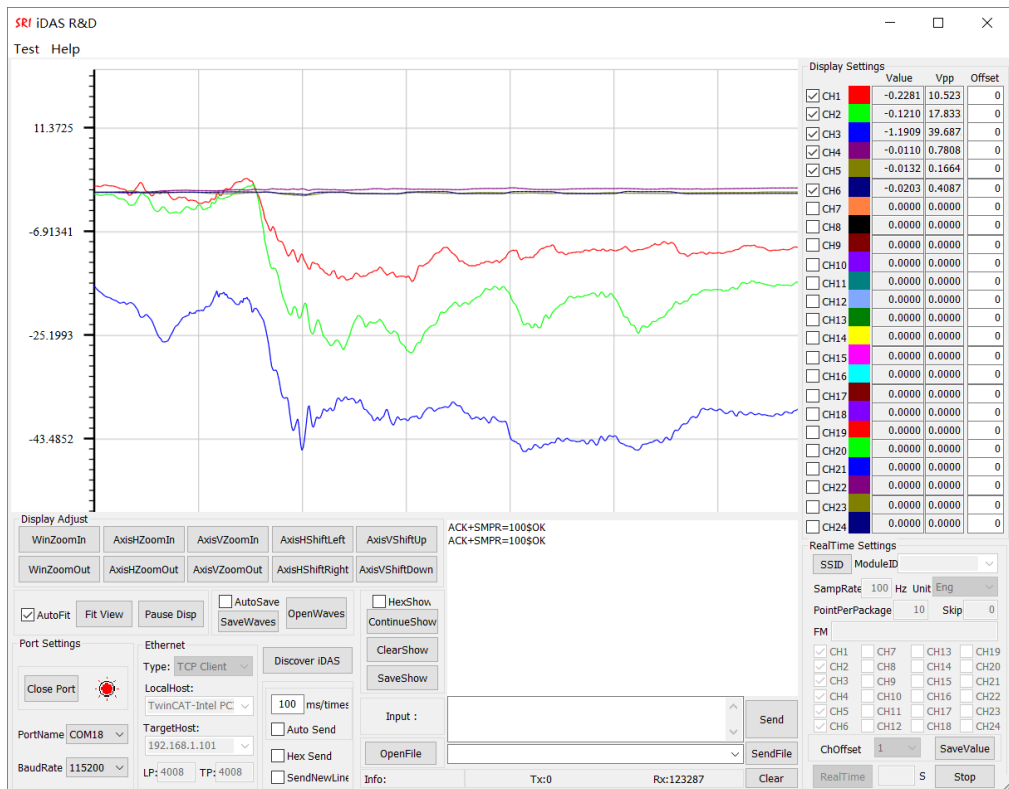
Step 2: Select CH1 through CH6 at the lower right corner on screen.

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



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.

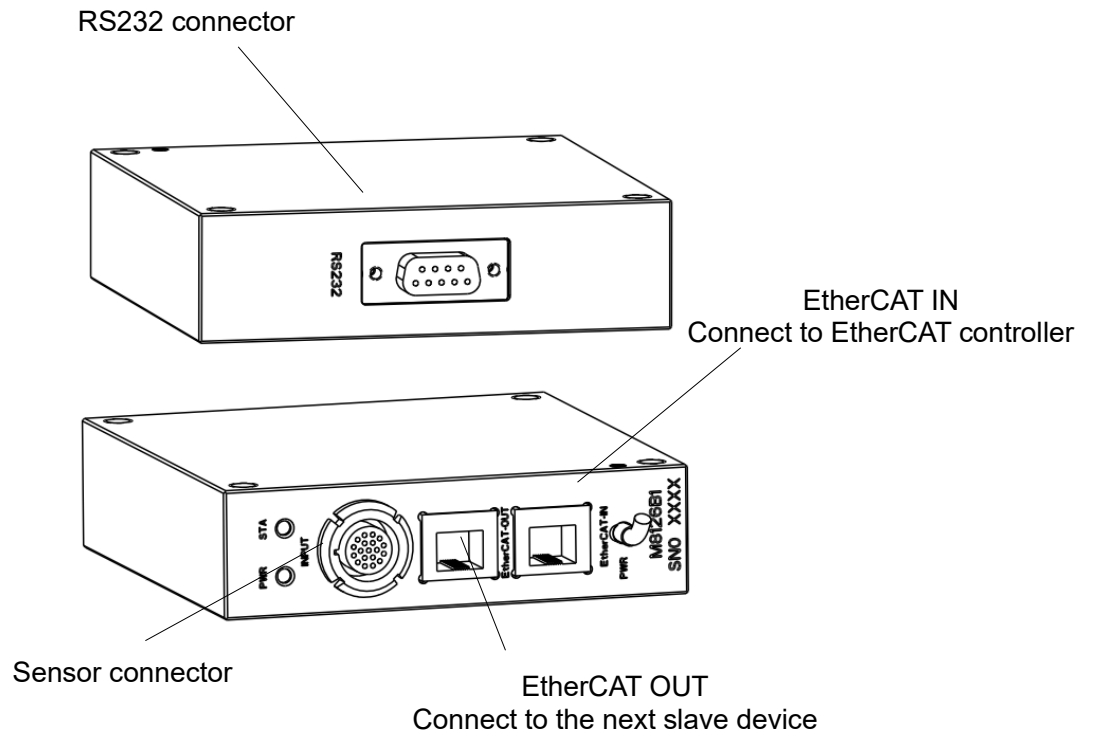
### 3. Power Cable, Connectors and LED Lights

#### 3.1 Power cable

M8126 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, Yellow, Green	+24V	+Power, red clip
Black, White, Orange	GND	-Power, black clip
Shield	Shield	The power cable shield is connected to the external case of M8126. 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 Sensor connector

Sensor is connected to M8126 via this 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
<b>SMPF</b>	Read or set sampling rate	
<b>DCPM</b>	Read or set decoupling matrix coefficient	
<b>DCPCU</b>	Read or set matrix calculation unit	(mV or mV/V)
<b>SFWV</b>	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 rawchn6 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);(1.19167,0.00028,1.20748,0.00224,1.19808,0.00320);(-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)
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

Three axis and uni-axial loadcells from SRI can also be connected to M8126. Please follow the method described below to get the matrix.

#### Three 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).

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

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

So, send the following commands to M8126 to set decoupled matrix and unit.

```
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							
<u>Bridge</u>	<u>Capacity</u>	<u>Zero Offset</u>	<u>Nonlinearity</u>	<u>Hysteresis</u>	<u>Output @ Capacity</u>	<u>Sensitivity</u>	<u>Change</u>
	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 equals to 1/sensitivity/1000.

Calculation unit is mV.

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

So, send the following commands to M8126 to set decoupled matrix and unit.

```
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
```

## 6. EtherCAT Dictionary

Object	Name	Data Type	W/R	Discription
0x1000	Device Type	UINT32	RO	
0x1008	Manufacturer Device Name	STRING	RO	
0x1009	Hardware Version	STRING	RO	
0x100A	Software Version	STRING	RO	
0x1018	Identity Object	RECORD	RO	
0x1018.01	Vendor ID	UINT32	RO	
0x1018.02	Product Code	UINT32	RO	
0x1018.03	Revision Number	UINT32	RO	
0x1018.04	Serial Number	UINT32	RO	
0x1601	RPDO	UINT32	RO	
0x1A03	TPDO	UINT32	RO	
0x1A02	TPDO	UINT32	RO	
0x1C12	SM2 PDO	REC	RW	
0x1C13	SM3 PDO	REC	RW	
0x6030.01	DataNo	UINT16	RO	unsigned int 16bit 0~65535 increment each sample.
0x6030.02	Fx	REAL	RO	float 32bit eng. unit: N
0x6030.03	Fy	REAL	RO	float 32bit eng. unit: N
0x6030.04	Fz	REAL	RO	float 32bit eng. unit: N
0x6030.05	Mx	REAL	RO	float 32bit eng. unit: Nm
0x6030.06	My	REAL	RO	float 32bit eng. unit: Nm
0x6030.07	Mz	REAL	RO	float 32bit eng. unit: Nm
0x6020.01	DataNo	UINT16	RO	unsigned int 16bit 0~65535 increment each sample.
0x6020.02	Fx	INT32	RO	Fx = INT32/10000 eng. unit: N
0x6020.03	Fy	INT32	RO	Fy = INT32/10000 eng. unit: N
0x6020.04	Fz	INT32	RO	Fz = INT32/10000 eng. unit: N
0x6020.05	Mx	INT32	RO	Mx = INT32/10000 eng. unit: Nm
0x6020.06	My	INT32	RO	My = INT32/10000 eng. unit: Nm
0x6020.07	Mz	INT32	RO	Mz = INT32/10000 eng. unit: Nm
0x7010.01	Para1	UINT16	RW	NA, reserved for future use
0x7010.02	Para2	INT16	RW	NA, reserved for future use
0x7010.03	Para3	INT16	RW	NA, reserved for future use

## 7. Dimensions

