Model MF100

USB SENSOR INTERFACE WITH MESUR®FLEX SOFTWARE

User's Guide

MESUR®Flex

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Thank you…

Thank you for purchasing a Mark-10 MF100 USB sensor interface + MESUR®Flex software, used for adapting common force and torque sensors to a PC.

With proper usage, we are confident that you will get many years of great service with this product. Mark-10 products are ruggedly built for many years of service in laboratory and industrial environments.

This User's Guide provides setup, safety, and operation instructions. For additional information or answers to your questions, please do not hesitate to contact us. Our technical support and engineering teams are eager to assist you.

Before use, each person who is to use this product should be fully trained in appropriate operation and safety procedures.

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1 OVERVIEW

1.1 List of included items

Qty.	Item
1	Model MF100 USB sensor interface
1	Strain relief
1	Quick start guide

1.2 General Overview

Model MF100 adapter interfaces a user-supplied force or torque sensor to a PC.

The interface may be programmed to the appropriate load capacity with a software utility through USB communication. Through MESUR®Flex software, all configuration and calibration information are saved within the interface.

1.3 Compatible Equipment

MF100 is compatible with sensors meeting the following specifications:

- Type: Full bridge
- Resistance: 300 – 1000 ohms
- Sensitivity: 1 – 3 mV/V full scale

2 MECHANICAL SETUP

2.1 Sensor Wire Connection

1. Access the circuit board inside the MF100 by loosening four screws and removing the cover, as shown below:

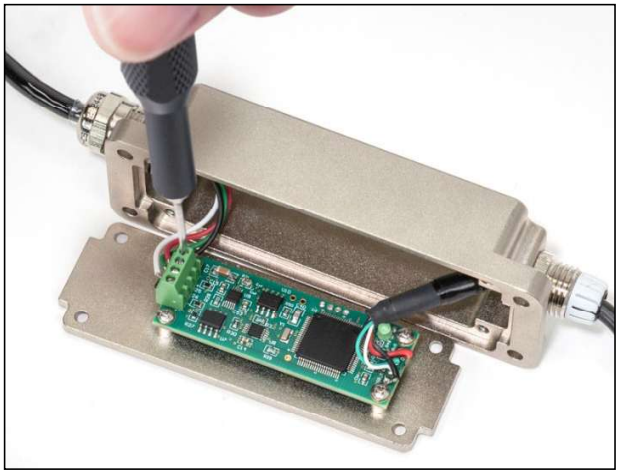
The green screw terminal block will be visible, with the following labeled connections:

EXCITATION +
EXCITATION –
SIGNAL +
SIGNAL –

Sensors are supplied with a cable with four leads, typically color coded. Verify the lead assignments with the manufacturer.

Note: Ensure that the signal leads have been installed into the appropriate terminal blocks. Some sensor manufacturers consider SIGNAL+ to be a compression or clockwise value, while others consider it to be a tension or counter-clockwise value. If these leads are installed oppositely, the measurements will have incorrect polarity and calibration cannot take place.

2. Feed the four leads through the supplied strain relief and into the housing. Using a flat screwdriver, loosen the four screws in the terminal block until the sensor leads can be inserted into the appropriate receptacles. After inserting the leads, tighten the screws, as shown below:



3. Tighten the strain relief and reinstall the cover.

3 SOFTWARE INSTALLATION

3.1 PC requirements

- Windows 10 or later operating system
- Minimum screen resolution of 1024 x 768
- USB port

3.2 Installation instructions

1. Go to www.mark-10.com/resources/software-drivers.

2. Install the USB driver. Click the link, *Mark-10 USB Driver – Windows*, then unzip/extract the folder. Follow the instructions in the user's guide, located within the folder.

3. Install MESUR®Flex. Click the link, *MESUR®Flex Software*, then unzip/extract the folder. Follow the prompts on the screen to install the software.

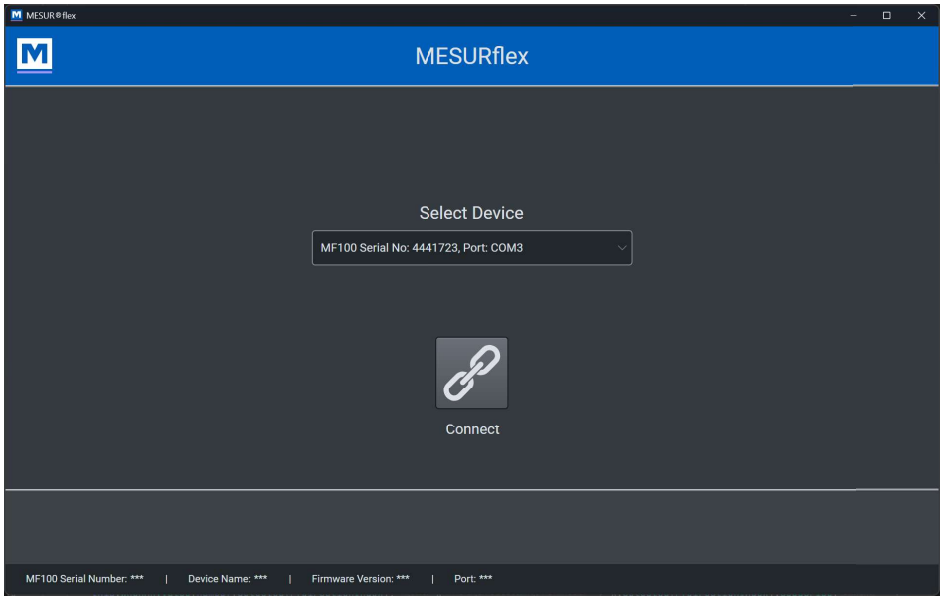
3.3 Running the software

When the installation is complete, the program can be found in:
Programs > Mark-10 Software > MESURFlex

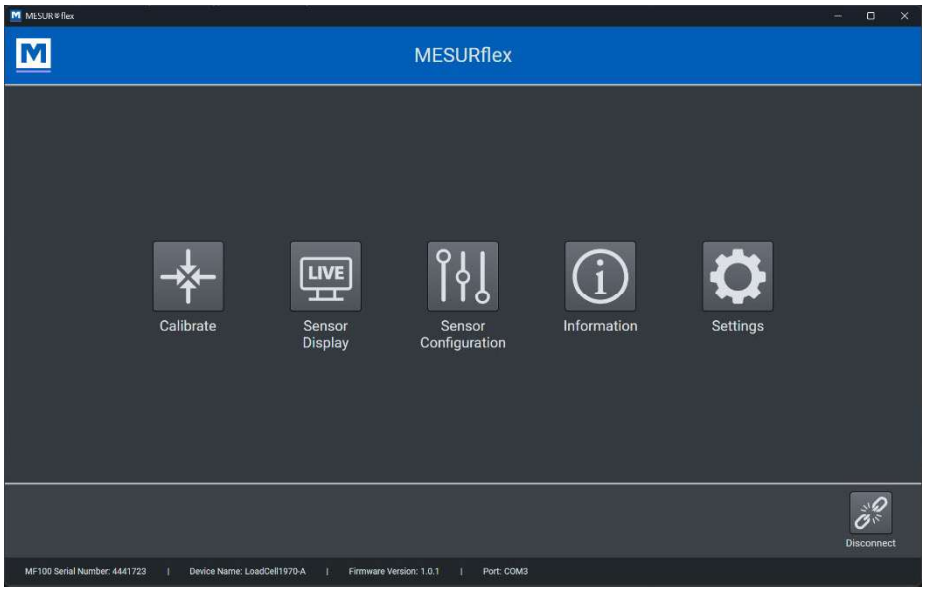
4 SOFTWARE STARTUP

After installing the software, plug MF100 into the PC via the tethered USB cable.

The initial screen appears as follows:



Select your device from the drop-down menu, then select **Connect**. You will be directed to the homepage, which appears as follows:

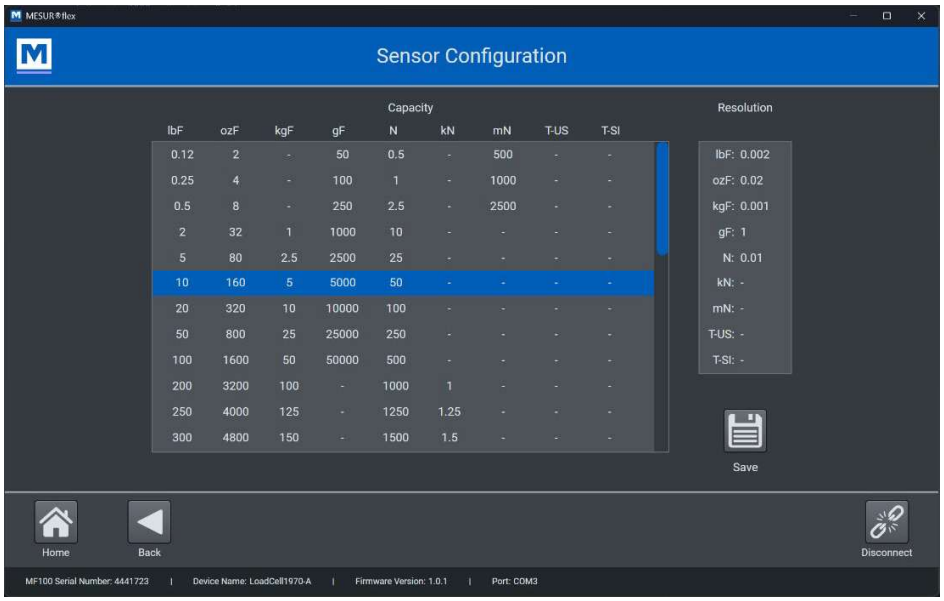


End communication between the PC and sensor at any time by selecting **Disconnect** in the lower right corner.

5 SENSOR CONFIGURATION

To configure the MF100 to the sensor, go to the home page and select **Sensor Configuration**. Then select **Force** or **Torque** as appropriate for the sensor. Set the device name by selecting **Device Name** and typing the desired name. See below for more information.

The display appears as follows for a force sensor (a similar table appears for torque capacities):



Identify and select the desired capacity. The resolution data is provided on the right side of the screen.

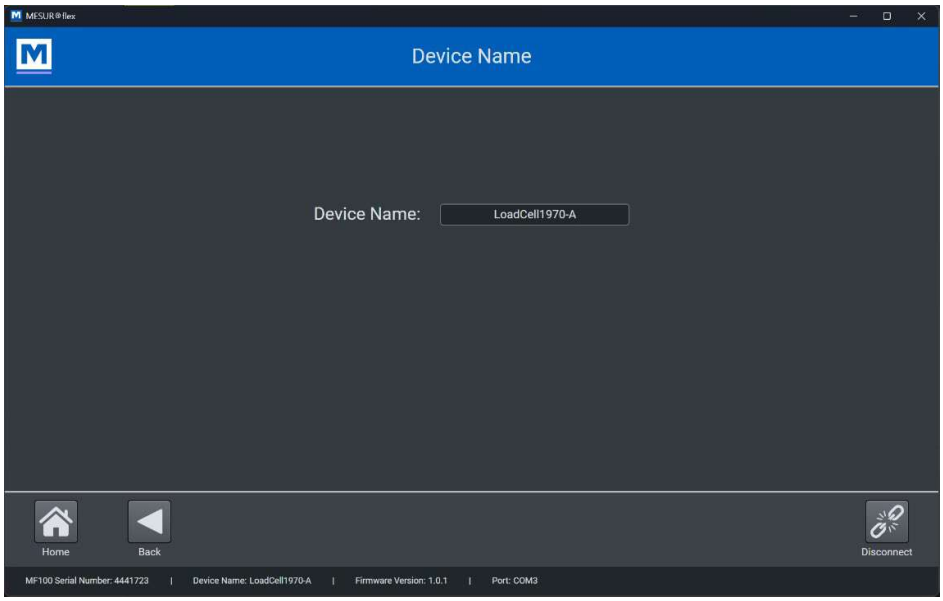
Then, select **Configure** to complete the process.

> **Note:** Do not click away or unplug the sensor until the **Settings Saved** message appears.

Select **OK** to continue.

The MF100 and sensor are fully configured and may now be controlled by a third-party application.

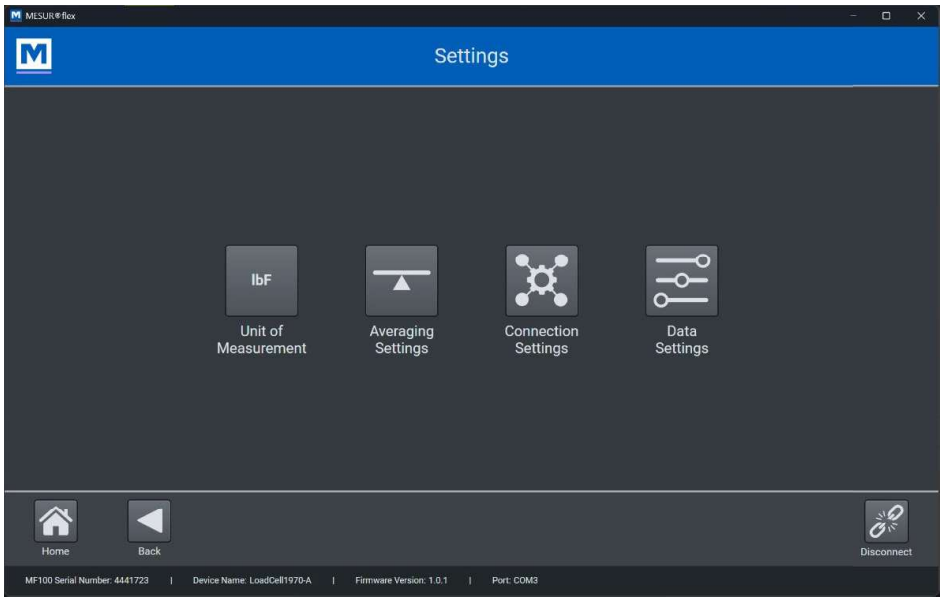
The **Device Name** screen appears as follows:



This name will appear in the bottom footer of the software and may be interrogated via a serial command. See the **Communication with a Third-Party Application** section for more information.

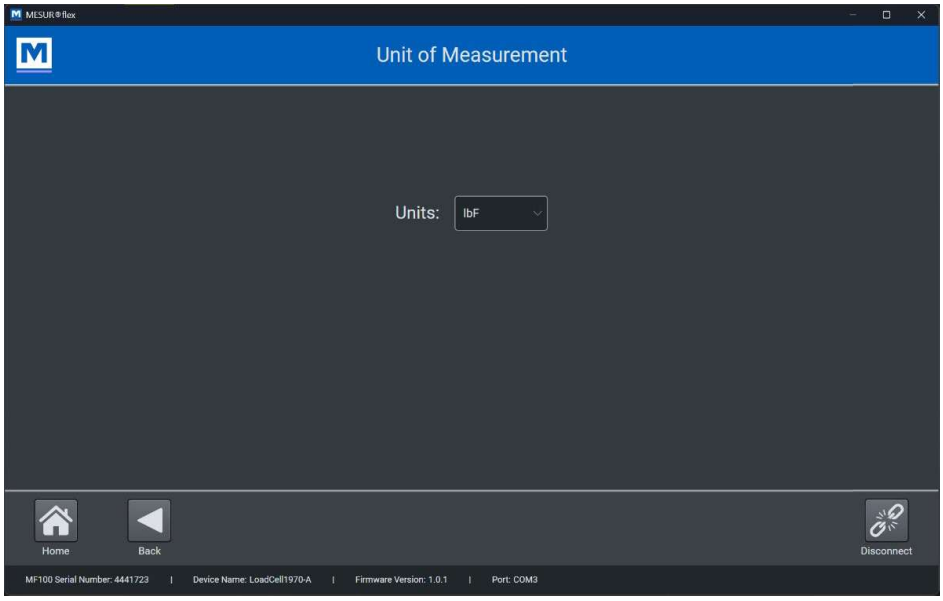
6 SETTINGS

The screen appears as follows:



6.1 Unit of Measurement

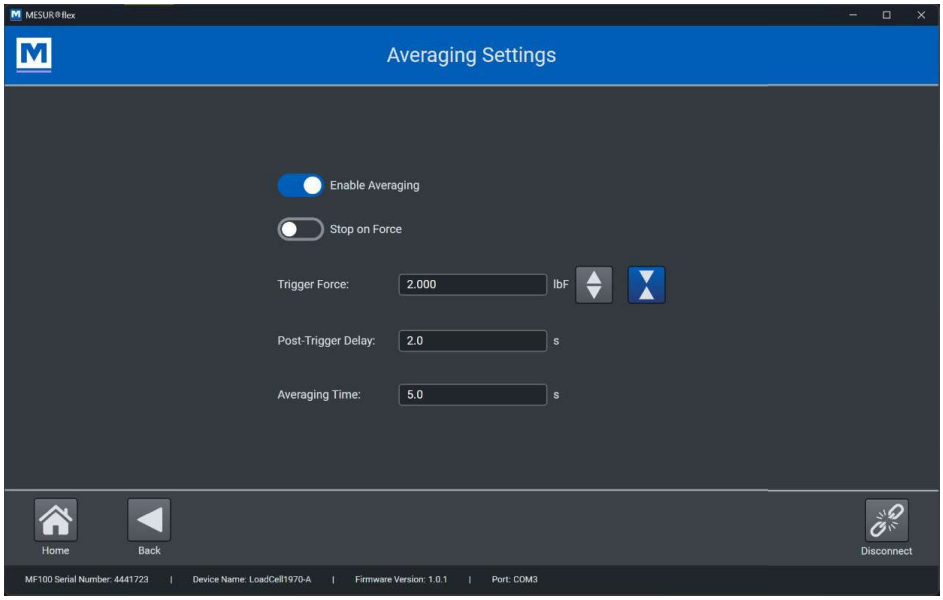
Select the desired unit of measurement. The screen appears as follows:



The available units depend upon whether the sensor measures force or torque, and the supported capacities. Refer to the **Capacity x Resolution** section to see available units for each capacity.

6.2 Averaging Mode Settings

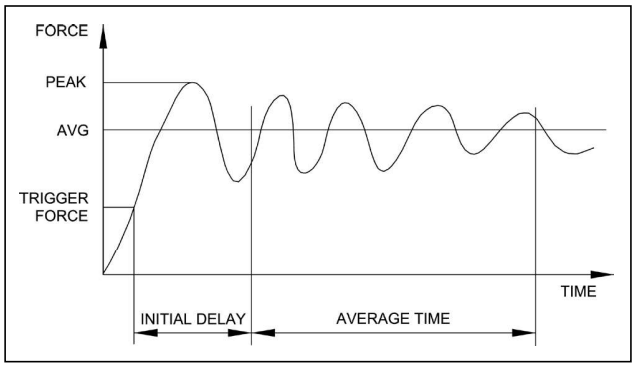
Averaging Mode is used to obtain an average load over time. The screen appears as follows:



Enable **Averaging** by making the appropriate selection, then configure the following parameters:

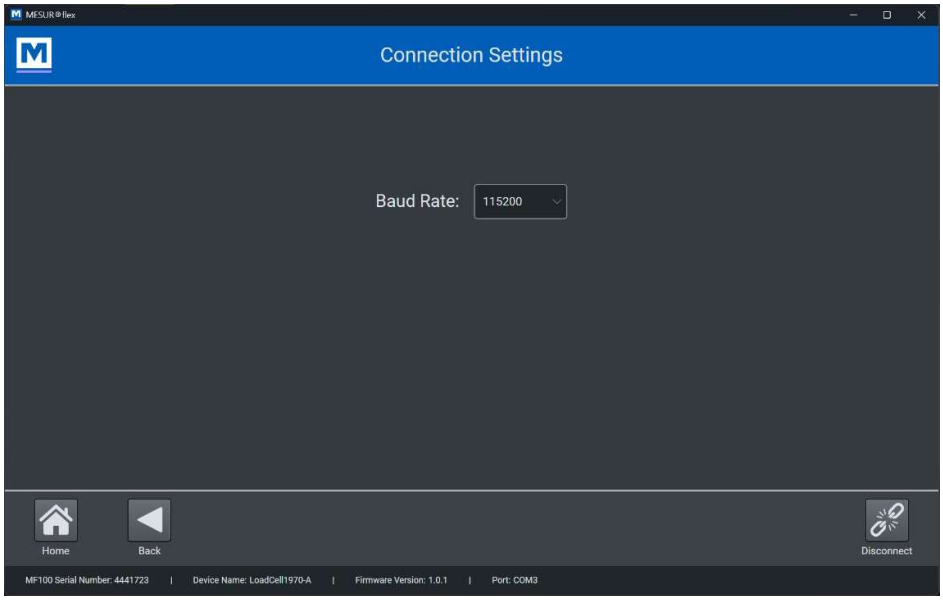
Parameter	Description
Trigger Load	The minimum load required to start the averaging sequence. Enter the value and direction.
Post-Trigger Delay	The time delay, after the trigger load, before the averaging sequence commences. *Available settings: 0.0 – 300.0 sec., in 0.1 sec. increments*
Averaging Time	The time duration of the averaging sequence. *Available settings: 0.1 – 300.0 sec., in 0.1 sec. increments*
Stop on Load	When enabled, the **Trigger Load** field is replaced by **Start/Stop Load**. The averaging sequence commences when this load is reached, then stops when the load decreases to this same value.

A graphical representation of these parameters is shown below:



6.3 Connection Settings

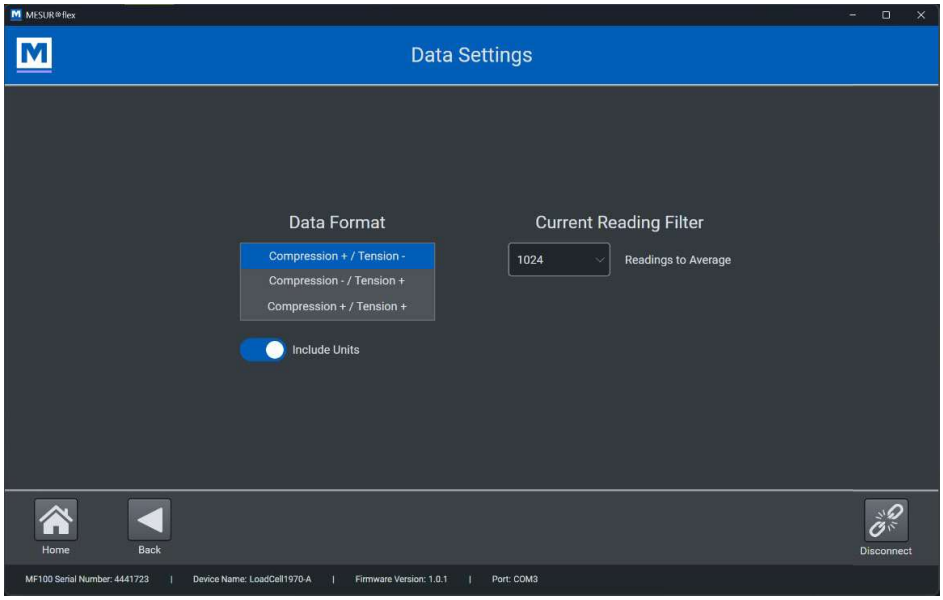
Specify the baud rate for the MF100. The screen appears as follows:



MESUR®Flex will recognize any baud rate, however, this setting allows the user to match the baud rate of a PC running a third-party application.

6.4 Data Settings

Specify how the load reading is displayed within MESUR®Flex by selecting preferences for displayed unit of measurement and polarity. The screen appears as follows:



6.4.1 Data Format

Select the desired data format:

Polarity Options	Description
Compression + / Tension -	Compression values have positive polarity, tension values have negative polarity.
Compression - / Tension +	Compression values have negative polarity, tension values have positive polarity.
Compression + / Tension +	Both directions are formatted with positive polarity.

Include Units	Description
Selected	Data format includes the value and unit of measure.
Not selected	Data format includes the value only.

For torque sensors, the terms clockwise and counter-clockwise replace compression and tension, respectively.

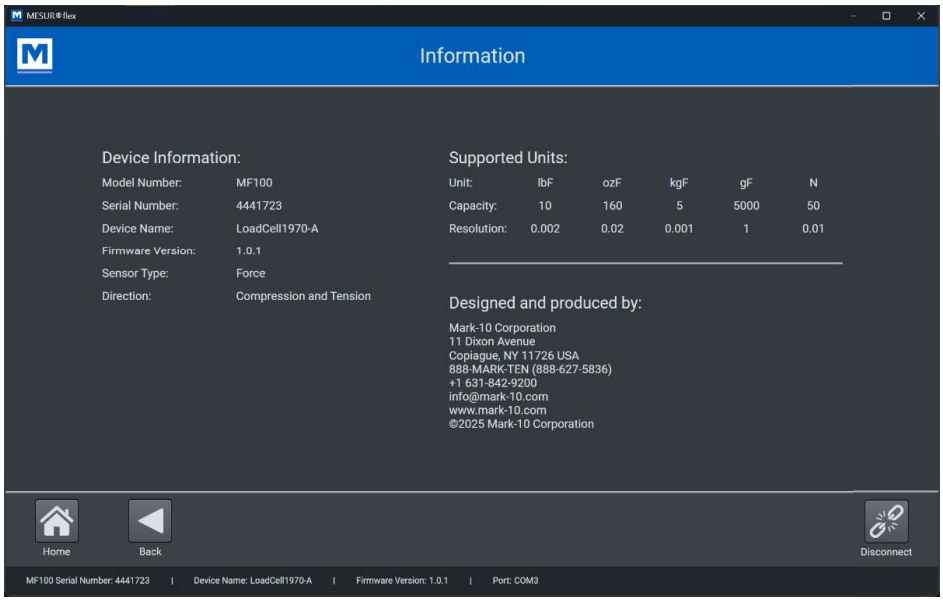
6.4.2 Current Reading Filter

This filter helps to smooth out readings in situations where there is mechanical interference in the work area or test sample. This filter utilizes a moving average technique in which consecutive readings are pushed through a buffer and the displayed reading is the average of the buffer contents. By varying the length of the buffer, a variable smoothing effect can be achieved.

It is recommended to keep the setting at the lowest possible value for best performance.

7 INFORMATION

Select **Information** to view the model number, serial number, device name, firmware version, sensor type, sensor direction(s), and supported sensor capacities and resolutions.



8 SENSOR DISPLAY

The screen displays live, peak, and average loads, as illustrated below:

If the MF100 has not yet been configured, the Load display will default to a 10 lbF / 50 N force capacity.

8.1 Button Functions

Button or Label	Function
Primary Reading	Refers to the live, peak, or average load, depending on the selected mode.
Load Bar	Indicates when approaching an overload. The bar increases to the right for compression or clockwise readings, and to the left for tension or counter-clockwise readings. The bar colors are as follows: **Green** 0 - 80% of force sensor capacity **Yellow** 80 to 100% of force sensor capacity **Red** 100+% of force sensor capacity At 120% of sensor capacity, the load reading is replaced by the word, "**OVER**", which indicates an overload. The status window background color turns red.
MAX	Refers to the compression / clockwise and tension / counter-clockwise peak values.
Zero/Arm	Zeroes the primary reading and peaks. In **Average Load** mode, this button arms the software to start averaging when the trigger load has occurred.
Clear Peaks	Zeroes the peak readings, but retains the primary reading.
Mode	Toggles between measurement modes, including Live Load, Peak Compression / Clockwise Load, Peak Tension / Counter-Clockwise Load, and Average Load

8.2 Averaging Mode

To measure an average load, select **Mode** until select **Average Load** appears (if enabled in the **Average Mode Settings** screen).

Then, select **Zero/Arm**. Average mode is now armed, and the averaging sequence will commence when the trigger load has occurred. The current status of the averaging sequence is displayed below the load bar, as follows:

Step	Status	Description
1	Waiting for Trigger	The trigger load has not yet occurred.
2	Initial Delay	The initial delay is currently taking place. The status will be flashing until the delay has completed.
3	Averaging	Collecting readings. The status will be flashing until averaging has been completed.
4	Averaging Complete	Averaging has been completed. The average load is displayed in the primary reading.

At the completion of the averaging sequence, the peak values are retained until **Zero/Arm** is selected. Another averaging sequence may be started after **Zero/Arm** has been selected. To exit Averaging mode, select another mode.

9 COMMUNICATING WITH A THIRD-PARTY APPLICATION

9.1 Command Set

MF100 may be controlled by an external device through USB. The following is a list of supported commands and their explanations. All commands must be terminated by a CR (Carriage Return) character, 0x0D, or a CR-LF (Carriage Return – Line Feed) pair, where the Line Feed, 0x0A, is ignored.

Request Readings

?	Request the active mode reading
?C	Request the current (real time) reading
?PT	Request the peak tension reading
?PC	Request the peak compression reading
?PCW	Request the peak tension reading
?PCCW	Request the peak compression reading
?A	Request the average reading obtained during the Average mode

Units

LB	Switch unit to pound
OZ	Switch unit to ounce
KG	Switch unit to kilogram
G	Switch unit to gram
N	Switch unit to Newton
KN	Switch unit to Kilo-Newton
MN	Switch unit to Milli-Newton
LBIN	Switch unit to pound-inch
OZIN	Switch unit to ounce-inch
LBFT	Switch unit to pound-foot
NCM	Switch unit to Newton-centimeter
NM	Switch unit to Newton-meter
NMM	Switch unit to Newton-millimeter
KGMM	Switch unit to kilogram-millimeter
GCM	Switch unit to gram-centimeter
KGM	Switch unit to kilogram-meter
KGCM	Switch unit to kilogram-centimeter
TUS	Switch unit to US ton
TSI	Switch unit to SI ton

Basic Functions

CUR	Set Current mode (real time mode)
PT	Set Peak Tension mode
PC	Set Peak Compression mode
PKCW	Set Peak Clockwise mode
PKCCW	Set Peak Counter-Clockwise mode
CLR	Clear peak readings
Z	Zero reading and perform the CLR function

Filter

FLTCn	Digital filter for current readings n= 0-10, filter = 2^n, ex: n=0= no filter, n=10=1024 samples averaged

USB/RS-232 Communication

FULL	USB/RS-232 transmission with units
NUM	USB/RS-232 transmission without units (only numeric values)
AOUTn	Auto-transmit n times per second n=1,2,5,10,25,50,125,250,500. 0=disabled **Note the following exception:** n=1 yields 50 times per second.

IPOLn	Invert polarity of output. n=1=invert polarity. n=0=normal (default) **Note:** Normal polarity is positive for compression and clockwise and negative for tension and counter-clockwise.
OPOLn	Omit polarity of output. n=1=omit polarity. n=0=include polarity (default) **Note:** The "+" sign is always omitted. A "–" sign is sent when polarity is enabled.

Averaging

A	Enable Average mode
AD	Disable Average mode
AM	Select Average mode (if enabled)
ATn	Average time. n=0.1-300.0 seconds
DELn	Initial delay. n=0.1-300.0 seconds
TRFn	Trigger load. n=value (+ for compression/clockwise, - for tension/counter-clockwise)

Personality

RN	Read product name
RM	Read model number
RV	Read firmware version number
RS	Read serial number
WID <ID string>	Write user ID. Example: "WID Sensor08" (31 characters maximum)
RID	Read user ID. Example response: "Sensor08"

Other Commands

SAVE	Save current settings in nonvolatile memory
LIST	List current settings and status

9.2 Command Responses

In response to a reading request command (those which begin with '?') MF100 will return a string with the load data, followed by a space, then the load unit (if enabled under the **Serial/USB Settings → Data format** sub-menu). It will be terminated by a CR-LF pair.

Example response strings:

-0.486 lbF<CR><LF>	0.486 lbF of tension force
1.724 Nm<CR><LF>	1.724 Nm of clockwise torque

The number of digits after the decimal point is dependent on the sensor's capacity and resolution.

By default, the minus sign (-) indicates tension or counter-clockwise, and the absence of a sign indicates compression or clockwise. However, positive / negative polarity may be inverted or omitted under the **Serial/USB Settings → Data Format** sub-menu.

Following is an example LIST output: V1.00;LBF;CUR;FLTC8;FLTP1;AOUT00;FULL;IPOL0;OPOL0;POL

All fields are separated by ";". The first field shows the firmware version. All other fields show the status of settings and features using the same abbreviations as the commands to set them.

Any detected errors are reported back by means of the following error codes:

*10 Illegal command
*11 Not applicable
*21 Invalid specifier
*22 Value too large
*51 Command string too long (25 characters maximum)

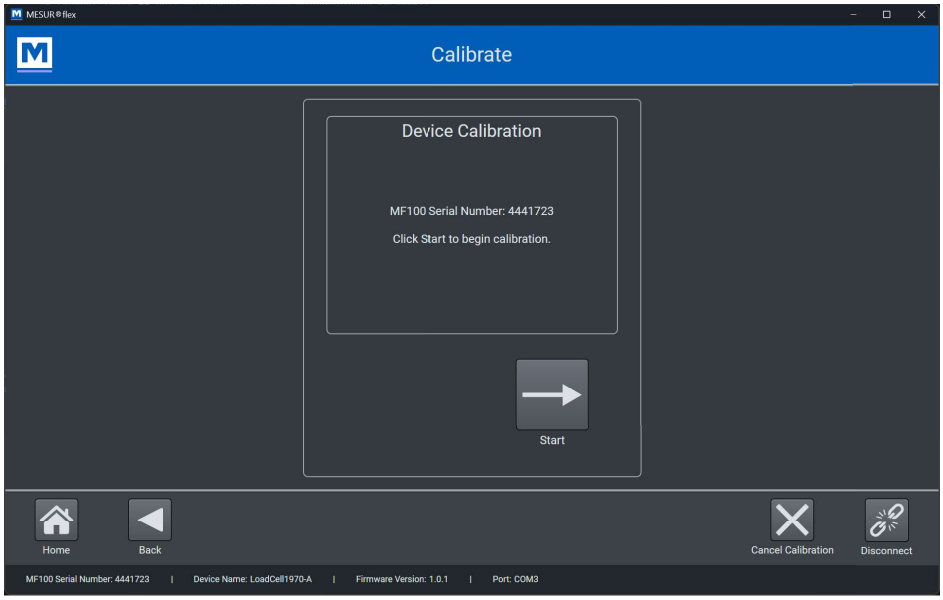
10 CALIBRATION

10.1 Initial Physical Setup

The sensor should be mounted vertically to a rig or fixture rugged enough to withstand a load equal to the full capacity of the sensor. Certified deadweights or master load cells should be used, along with appropriate mounting brackets and fixtures. Caution should be taken while handling such equipment.

10.2 Calibration Procedure

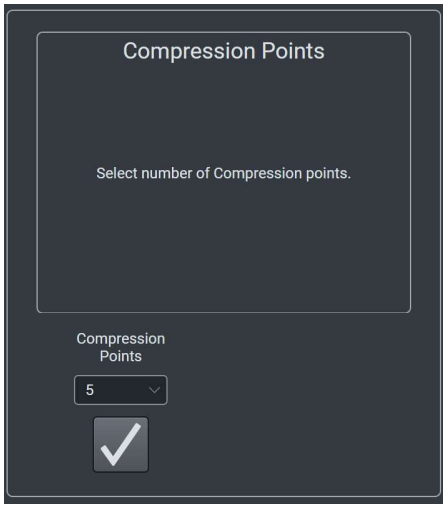
1. Select **Calibrate**. The screen appears as follows:

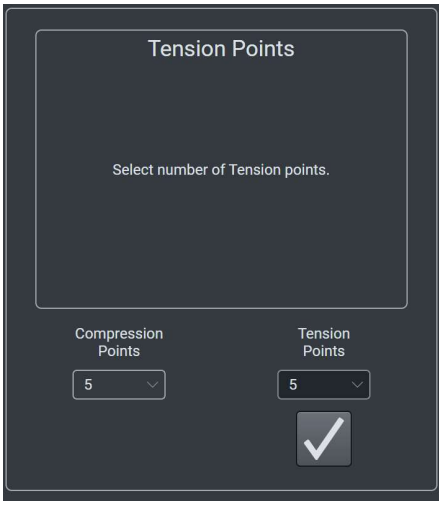


Select **Cancel Calibration** at any time to exit calibration without saving.

Select **Start**. The next screens of the calibration wizard appear as follows:

2. Select number of compression (or clockwise) and tension (or counter-clockwise) calibration points.



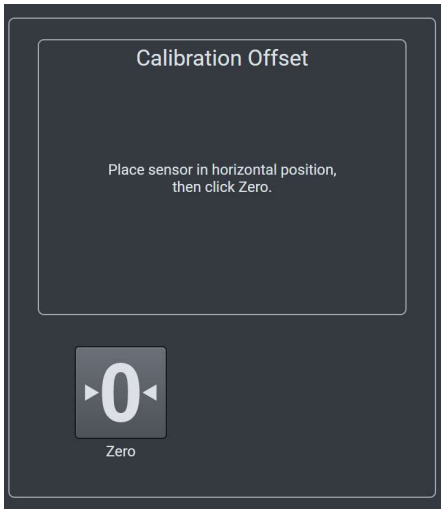


Enter the number of calibration points for each direction, up to 10. At minimum, the sensor must be calibrated at full scale in both directions for bi-directional sensors and full scale in one direction for uni-directional sensors.

Note: To achieve highest possible accuracy, it is recommended to calibrate the sensor at five or more even intervals in both directions. For example, a force sensor with a capacity of 10 lbF should be calibrated at 2, 4, 6, 8, and 10 lbF loads in each direction.

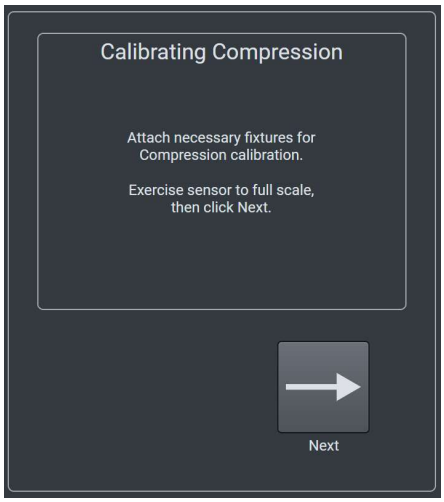
Select **Proceed** (the "check" icon). The screen appears as follows:

3. Calibration Offset



Place the sensor horizontally or in an otherwise neutral position on a level surface free from vibration, then select **Zero**. MF100 will calculate internal offsets, and the screen appears as follows:

4. Attach fixtures for compression calibration.

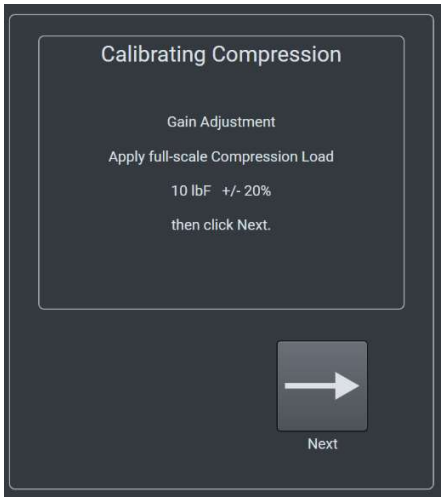


Attach weight fixtures (brackets, hooks, etc.), as required. Exercise the sensor to full-scale (10 lbF compression in this example). Select **Next**. The screen appears as follows:

5. Compression fixture tare

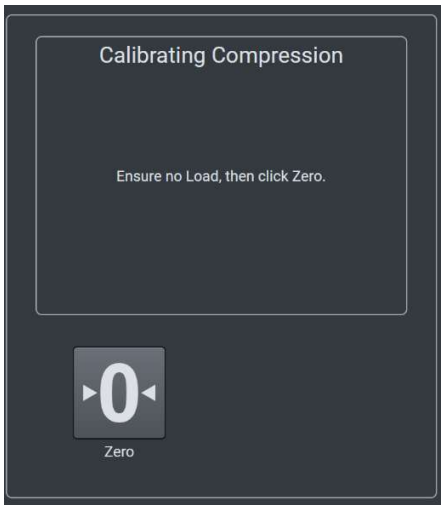
Remove load but keep the calibration fixtures in place. Select **Zero**. The screen appears as follows:

6. Gain adjustment



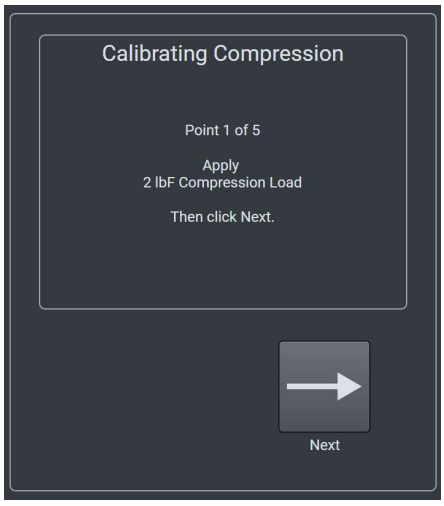
Apply a weight equal to the full scale of the sensor, then select **Next**. After the gain adjustment is calculated, the screen appears as follows:

7. Zero after gain adjustment



Remove load from the previous step but keep calibration fixtures in place. Select **Zero**. The screen appears as follows:

8. First compression point



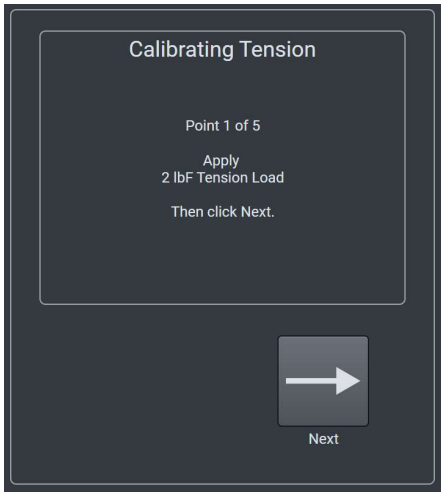
Apply the calibration load specified in the step, select **Next**, then repeat the process until all loads in the direction are complete. The next screen appears as follows:

9. Attach fixtures for tension

Prepare the sensor for tension calibration by exercising it to full-scale tension load. Select **Next**. The screen appears as follows:

10. Tension fixture tare

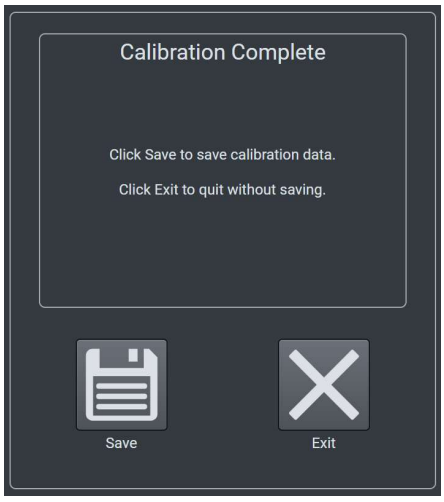
Remove the calibration weights and select **Zero**. The screen appears as follows:
11. First tension point



The following screens step through the same procedure as with the compression direction. Proceed in the same manner.

After the final tension point is completed, the screen appears as follows:

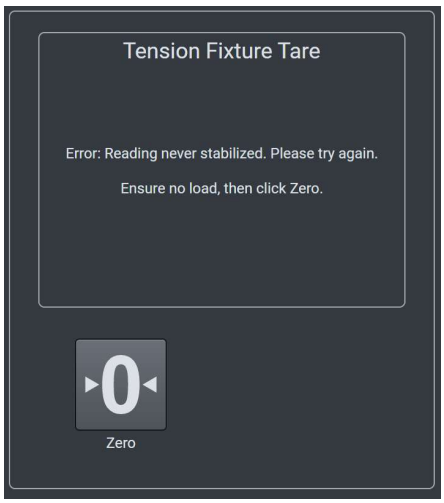
12. Save calibration data

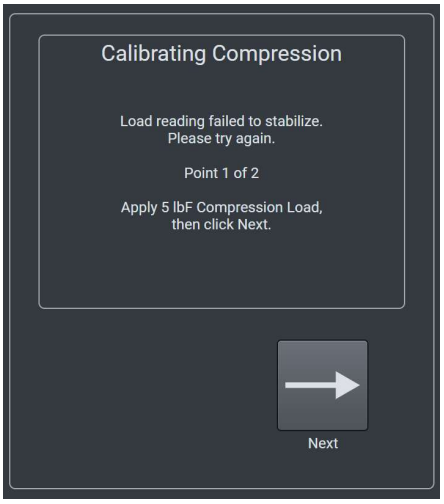


Select **Save** to complete the calibration process or **Exit** to quit calibration without saving.

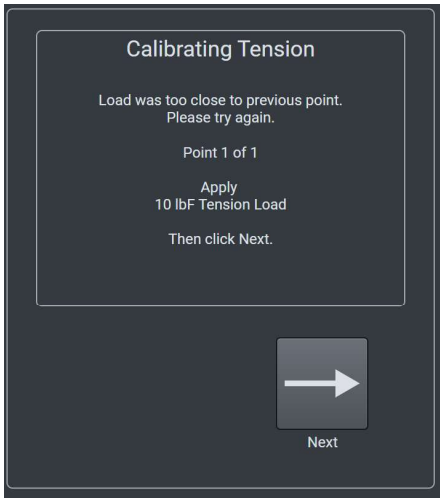
10.2 Error Reporting

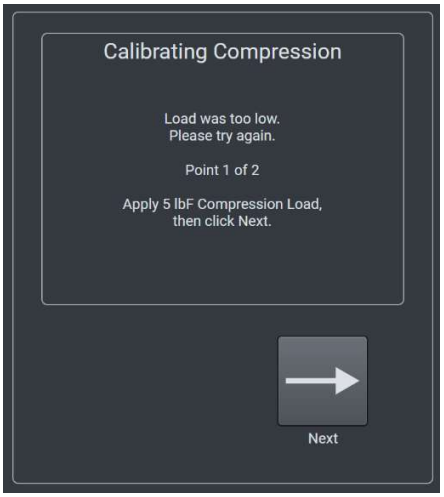
If the device encounters an error during a calibration step, an error message will be displayed providing an explanation of the issue, and instructions for how to proceed. In the example shown below, the device was unable to collect a stable reading from the sensor during the first compression point. In this case, the operator should ensure that the load is not swinging, oscillating, or vibrating in any manner, then try again.





Similar error messages will be displayed if the load reading is too low or too close to the load applied for the previous calibration point, for example:





11 CAPACITIES & RESOLUTIONS

11.1 Force Capacities & Resolutions

lbF	ozF	gF	kgF	N	kN	mN	T-US (US ton)	T-SI (metric ton)
0.12 x 0.00002	2 x 0.0005	50 x 0.01	-	0.5 x 0.0001	-	500 x 0.1	-	-
0.25 x 0.00005	4 x 0.001	100 x 0.02	-	1 x 0.0002	-	1000 x 0.2	-	-
0.5 x 0.0001	8 x 0.002	250 x 0.05	-	2.5 x 0.0005	-	2500 x 0.5	-	-
2 x 0.0005	32 x 0.005	1000 x 0.2	1 x 0.0002	10 x 0.002	-	-	-	-
5 x 0.001	80 x 0.02	2500 x 0.5	2.5 x 0.0005	25 x 0.005	-	-	-	-
10 x 0.002	160 x 0.02	5000 x 1	5 x 0.001	50 x 0.01	-	-	-	-
20 x 0.005	320 x 0.05	10000 x 2	10 x 0.002	100 x 0.02	-	-	-	-
50 x 0.01	800 x 0.2	25000 x 5	25 x 0.005	250 x 0.05	-	-	-	-
100 x 0.02	1600 x 0.2	50000 x 10	50 x 0.01	500 x 0.1	-	-	-	-
200 x 0.05	3200 x 0.5	-	100 x 0.02	1000 x 0.2	1 x 0.0002	-	-	-
250 x 0.05	4000 x 1	-	125 x 0.02	1250 x 0.2	1.25 x 0.0002	-	-	-
300 x 0.05	4800 x 1	-	150 x 0.02	1500 x 0.2	1.5 x 0.0002	-	-	-
500 x 0.1	8000 x 2	-	250 x 0.05	2500 x 0.5	2.5 x 0.0005	-	-	-
750 x 0.2	12000 x 2	-	375 x 0.1	3750 x 1	3.75 x 0.001	-	-	-
1000 x 0.2	16000 x 2	-	500 x 0.1	5000 x 1	5 x 0.001	-	-	-
1500 x 0.2	24000 x 5	-	750 x 0.2	7500 x 2	7.5 x 0.002	-	-	-
2000 x 0.5	32000 x 5	-	1000 x 0.2	10000 x 2	10 x 0.002	-	-	-
5000 x 1	-	-	2500 x 0.5	-	25 x 0.005	-	2.5 x 0.0005	2.5 x 0.0005
10000 x 2	-	-	5000 x 1	-	50 x 0.01	-	5 x 0.001	5 x 0.001
15000 x 2	-	-	7500 x 2	-	75 x 0.02	-	7.5 x 0.002	7.5 x 0.002
20000 x 5	-	-	10000 x 2	-	100 x 0.02	-	10 x 0.002	10 x 0.002
25000 x 5	-	-	10000 x 2	-	100 x 0.02	-	10 x 0.002	10 x 0.002
30000 x 5	-	-	15000 x 2	-	150 x 0.02	-	15 x 0.002	15 x 0.002
50000 x 10	-	-	25000 x 5	-	250 x 0.05	-	25 x 0.005	25 x 0.005
75000 x 20	-	-	40000 x 10	-	400 x 0.1	-	40 x 0.01	40 x 0.01
100000 x 20	-	-	50000 x 10	-	500 x 0.1	-	50 x 0.01	50 x 0.01
150000 x 20	-	-	75000 x 20	-	750 x 0.2	-	75 x 0.02	75 x 0.02
200000 x 50	-	-	100000 x 20	-	1000 x 0.2	-	100 x 0.02	100 x 0.02
250000 x 50	-	-	100000 x 20	-	1000 x 0.2	-	100 x 0.02	100 x 0.02
300000 x 50	-	-	150000 x 20	-	1500 x 0.2	-	150 x 0.02	150 x 0.02
500000 x 100	-	-	250000 x 50	-	2500 x 0.5	-	250 x 0.05	250 x 0.05
750000 x 200	-	-	400000 x 100	-	4000 x 1	-	400 x 0.1	400 x 0.1
1000000 x 200	-	-	500000 x 100	-	5000 x 1	-	500 x 0.1	500 x 0.1

11.2 Torque Capacities & Resolutions

lbFin	ozFin	lbFft	Ncm	Nm	Nmm	kgFmm	gFcm	kgFm
-	10 x 0.002	-	7 x 0.001	-	70 x 0.01	7 x 0.001	700 x 0.1	-
-	20 x 0.005	-	14 x 0.002	-	140 x 0.02	14 x 0.002	1400 x 0.2	-
-	50 x 0.01	-	35 x 0.005	-	350 x 0.05	35 x 0.005	3500 x 0.5	-
-	100 x 0.02	-	70 x 0.01	-	700 x 0.1	70 x 0.01	7000 x 1	-
-	1000 x 0.2	-	700 x 0.1	-	7000 x 1	700 x 0.1	70000 x 10	-
12 x 0.002	192 x 0.05	-	135 x 0.02	1.35 x 0.0002	-		-	-
20 x 0.005	320 x 0.05	-	220 x 0.05	2.2 x 0.0005	-		-	-
25 x 0.005	400 x 0.1	-	290 x 0.05	2.9 x 0.0005	-		-	-
50 x 0.01	800 x 0.2	-	570 x 0.1	5.7 x 0.001	-		-	-
100 x 0.02	1600 x 0.2	-	1150 x 0.2	11.5 x 0.002	-		-	-
150 x 0.02	-	12.5 x 0.002	1700 x 0.2	17 x 0.002	-	1700 x 0.2	-	-
200 x 0.05	-	16 x 0.002	2200 x 0.5	22 x 0.005	-	2200 x 0.5	-	-
250 x 0.05	-	20 x 0.005	2900 x 0.5	29 x 0.005	-	2900 x 0.5	-	-
400 x 0.1	-	32 x 0.005	4500 x 1	45 x 0.01	-	4500 x 1	-	-
500 x 0.1	-	40 x 0.01	5700 x 1	57 x 0.01	-	5700 x 1	-	-
600 x 0.1	-	50 x 0.01	6900 x 1	69 x 0.01	-	6900 x 1	-	-
1000 x 0.2	-	80 x 0.02	11500 x 2	115 x 0.02	-	11500 x 2	-	-
1500 x 0.2	-	125 x 0.02	17000 x 2	170 x 0.02	-	17000 x 2	-	-
2000 x 0.5	-	150 x 0.02	22000 x 5	220 x 0.05	-	22000 x 5	-	-
2500 x 0.5	-	200 x 0.05	29000 x 5	290 x 0.05	-	29000 x 5	-	-
5000 x 1	-	400 x 0.1	57000 x 10	570 x 0.1	-	57000 x 10	-	-
6000 x 1	-	500 x 0.1	69000 x 10	690 x 0.1	-	69000 x 10	-	-
10000 x 2	-	800 x 0.2	115000 x 20	1150 x 0.2	-	-	-	115 x 0.02
15000 x 2	-	1250 x 0.2	170000 x 20	1700 x 0.2	-	-	-	170 x 0.02
20000 x 5	-	2000 x 0.5	220000 x 50	2200 x 0.5	-	-	-	220 x 0.05
50000 x 10	-	4000 x 1	570000 x 100	5700 x 1	-	-	-	570 x 0.1
100000 x 20	-	8000 x 2	-	11500 x 2	-	-	-	1150 x 0.2
150000 x 20	-	12500 x 2	-	17000 x 2	-	-	-	1700 x 0.2
200000 x 50	-	15000 x 2	-	22000 x 5	-	-	-	2200 x 0.5
500000 x 100	-	40000 x 10	-	57000 x 10	-	-	-	5700 x 1

12 SPECIFICATIONS

Sensor Requirements:	Type: Full bridge Resistance: 300 - 1000 ohms Sensitivity: 1 – 3 mV/V full scale
Force range:	0.12 lbF - 500 T [0.5 N - 5,000 kN]
Torque range:	10 ozFin - 40,000 lbFft [7 Ncm - 57,000 Nm]
Load accuracy:	±0.1% of full scale + sensor
Load sampling rate:	7,000 Hz
Data output rate:	Up to 500 Hz, user-configurable
Weight:	0.4 lb [0.2 kg]
Shipping weight:	2.0 lb [0.9 kg]
Environmental requirements:	40 - 100°F, max. 96% humidity, non-condensing
Conformance:	CE, UKCA
Warranty:	3 years (see individual statement for further details)