



## Features

- Compact Design
- mV or Amplified Analog Outputs
- Optional I<sup>2</sup>C Digital Interface
- High Over Range Capability

## Applications

- Medical Infusion Pumps
- Analog & Digital Scales
- Fitness & Exercise Equipment
- Payload Weighing
- Power Tools
- Robotics
- Surgical & Dental Tools
- Battery Powered Devices
- Manufacturing Equipment

# FX29

## Compact Compression Load Cell

### Versatile Miniature Force Sensor

### mV, Amplified, and Digital Outputs

### Low Power Consumption

### Rugged Microfused Sensing Element

### Stainless Steel Enclosure

### Several Load Ranges

TE Connectivity's (TE) FX29 is a compact compression load cell that offers exceptional price-to-performance in a robust sensor package. Optimized for embedded force sensing applications from disposable medical devices to durable appliances and exercise equipment. The FX29 allows design flexibility with mV, amplified, and digital output options.

The FX29 incorporates the high reliability Microfused technology and is offered in ranges from 10lbf to 200lbf (50N to 1000N). Microfused technology provides excellent span and zero stability, outstanding cycle life, superior resolution, high over-range capabilities, and an unamplified span sensitivity of 20mV/V.

The FX29 utilizes a two-piece construction of stainless steel materials. The combination of a metal injection molded flexure and micro miniaturized MEMS strain gauges allows flexibility of force range options for a lower cost sensor. These improvements over previous load cell designs give the FX29 more precise dimensional control and better performance.

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Absolute Maximum Ratings (Analog) <sup>(1)</sup>

| Parameter           | Symbol           | Min  | Typ | Max  | Units | Notes/Conditions       |
|---------------------|------------------|------|-----|------|-------|------------------------|
| Supply voltage      | V <sub>dd</sub>  |      |     | 6.0  | V     | Analog mV Output       |
|                     |                  |      |     | 5.25 | V     | Analog 0.5-4.5V Output |
| Storage temperature | T <sub>s</sub>   | -40  |     | +85  | °C    |                        |
| Compressive load    | L <sub>max</sub> |      |     | 2.5X | Rated |                        |
| ESD                 |                  | -4.0 |     | 4.0  | kV    | Human Body Model       |

<sup>(1)</sup> Maximum limits the device will withstand without damage

## Standard Load Ranges

| Pounds-Force (lbf) | Newtons (N) |
|--------------------|-------------|
| 10                 | 50          |
| 25                 | 125         |
| 50                 | 250         |
| 100                | 500         |
| 200                | 1000        |

## Electrical Specifications (Analog)

(Unless otherwise specified, all parameters are measured at 25°C @ 5.0V applied)

| Parameter                             | Symbol           | Min  | Typ | Max  | Units   | Notes/Conditions     |
|---------------------------------------|------------------|------|-----|------|---------|----------------------|
| Supply voltage (V <sub>supply</sub> ) | V <sub>dd</sub>  | 1.00 |     | 6.0  | V       | mV Output only       |
|                                       |                  | 4.75 |     | 5.25 | V       | 0.5-4.5V Output only |
| Operating current                     | I <sub>dd</sub>  |      |     | 3    | mA      | 0.5-4.5V Output only |
| Input resistance                      | R <sub>in</sub>  | 2.4  | 3.0 | 3.6  | kΩ      | mV Output only       |
| Output resistance                     | R <sub>out</sub> | 1.76 | 2.2 | 2.64 | kΩ      | mV Output only       |
| Rise time                             | T <sub>r</sub>   |      |     | 2.0  | ms      | 10% to 90%           |
| Maximum output current                | I <sub>o</sub>   | 2.2  |     |      | mA      | 0.5-4.5V Output only |
| Output short circuit duration         | T <sub>s</sub>   |      |     | ∞    | seconds | 0.5-4.5V Output only |
| Insulation resistance                 |                  | 50   |     |      | MΩ      | @250VDC              |
| Bandwidth                             |                  |      |     | 1.0  | kHz     |                      |

## Operating Specifications (Analog)

(Unless otherwise specified, all parameters are measured at 25°C @ 5.0V applied)

| Parameter                    | Symbol | Min   | Typ  | Max  | Units    | Notes/Conditions                                |
|------------------------------|--------|-------|------|------|----------|-------------------------------------------------|
| Zero offset <sup>1</sup>     |        | -15   |      | 15   | mV/V     | mV Output only                                  |
|                              |        | 300   | 500  | 700  | mV       | 0.5-4.5V Output only                            |
| Full scale span <sup>1</sup> |        | 16    | 20   | 24   | mV/V     | mV Output only                                  |
|                              |        | 3800  | 4000 | 4200 | mV       | 0.5-4.5V Output only                            |
| Non-linearity                |        | -1    |      | 1    | %Span    | BFSL                                            |
| Hysteresis                   |        | -0.8  |      | 0.8  | %Span    |                                                 |
| Zero repeatability           |        | -0.8  |      | 0.8  | %Span    |                                                 |
| Span repeatability           |        | -0.8  |      | 0.8  | %Span    |                                                 |
| Thermal shift for zero       |        | -0.05 |      | 0.05 | %Span/°C | Reference to 25°C, over compensated temperature |
| Thermal shift for span       |        | -0.05 |      | 0.05 | %Span/°C |                                                 |
| Cycle life                   |        | 1E+6  |      |      |          | 0 to full scale cycles                          |
| Deflection at rated load     |        |       |      | 0.03 | mm       |                                                 |
| Weight                       |        |       | 6.0  |      | grams    | Without ribbon cable                            |

<sup>(1)</sup> Span and zero offset are ratiometric to power supply voltage

## Environmental Specifications (Analog)

(Unless otherwise specified, all parameters are measured at 25°C @ 5.0V applied)

| Parameter                     | Symbol         | Min                                                                                                  | Typ | Max | Units | Notes/Conditions            |
|-------------------------------|----------------|------------------------------------------------------------------------------------------------------|-----|-----|-------|-----------------------------|
| Compensated temperature range | T <sub>o</sub> | 0                                                                                                    |     | 50  | °C    | 0.5-4.5V Output only        |
| Storage temperature           | T <sub>s</sub> | -40                                                                                                  |     | 85  | °C    |                             |
| Ambient humidity              |                | 0                                                                                                    |     | 85  | %RH   | Non-condensing              |
| EMI/RFI/ESD protection        |                | IEC61000-4-2 (8kV <sub>air</sub> /4kV <sub>contact</sub> )<br>IEC61000-4-3 (3V/m)<br>EN55032 Class A |     |     |       | mV Output only              |
| Ingress protection            | IP             | 43                                                                                                   |     |     |       |                             |
| Media compatibility           |                | External exposed surfaces: 17-4 and 304 stainless steel                                              |     |     |       | Excluding cable & connector |



Absolute Maximum Ratings (Digital) <sup>(1)</sup>

| Parameter           | Symbol           | Min  | Typ | Max  | Units | Notes/Conditions |
|---------------------|------------------|------|-----|------|-------|------------------|
| Supply voltage      |                  |      |     | 5.50 | V     |                  |
| Storage temperature | T <sub>s</sub>   | -40  |     | +85  | °C    |                  |
| Compressive load    | L <sub>max</sub> |      |     | 2.5X | Rated |                  |
| ESD                 |                  | -4.0 |     | 4.0  | kV    | Human Body Model |

<sup>(1)</sup> Maximum limits the device will withstand without damage

## Standard Load Ranges

| Pounds-Force (lbf) | Newtons (N) |
|--------------------|-------------|
| 10                 | 50          |
| 25                 | 125         |
| 50                 | 250         |
| 100                | 500         |
| 200                | 1000        |

## Electrical Specifications (Digital)

(Unless otherwise specified, all parameters are measured at 25°C @ 3.0V applied)

| Parameter                             | Symbol           | Min | Typ | Max | Units | Notes/Conditions |
|---------------------------------------|------------------|-----|-----|-----|-------|------------------|
| Supply voltage (V <sub>supply</sub> ) | V <sub>dd</sub>  | 2.7 |     | 5.5 | V     |                  |
| Operating current                     | I <sub>dd</sub>  |     |     | 3   | mA    |                  |
| Sleep mode current                    | I <sub>slp</sub> |     | 0.5 | 5   | µA    |                  |
| Insulation resistance                 |                  | 50  |     |     | MΩ    | @250VDC          |

## Force Operating Specifications (Digital)

(Unless otherwise specified, all parameters are measured at 25°C @ 3.0V applied)

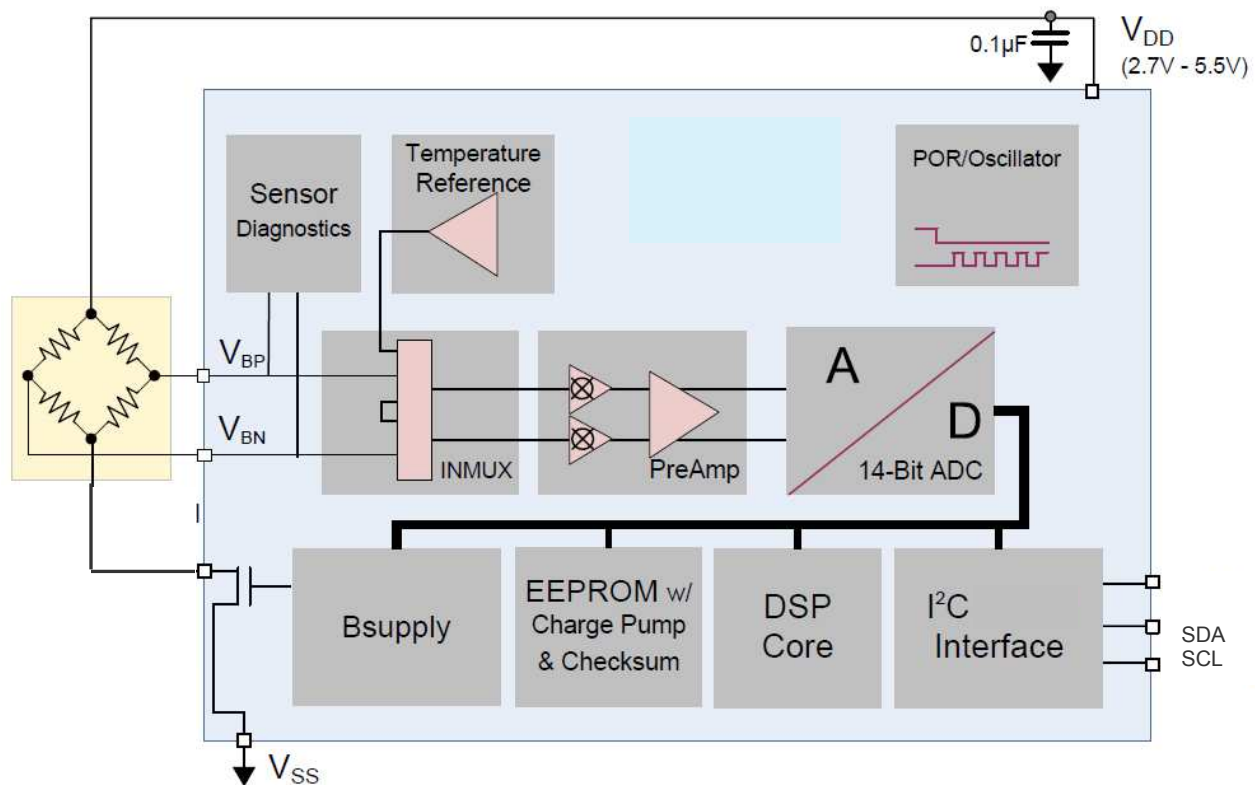
| Parameter                | Symbol | Min   | Typ   | Max   | Units    | Notes/Conditions                                |
|--------------------------|--------|-------|-------|-------|----------|-------------------------------------------------|
| Zero offset              |        | 300   | 1000  | 1700  | Counts   | Base <sub>10</sub>                              |
| Full scale span          |        | 14300 | 15000 | 15700 | Counts   | Base <sub>10</sub>                              |
| Non-linearity            |        | -1    |       | 1     | %Span    | BFSL                                            |
| Hysteresis               |        | -0.8  |       | 0.8   | %Span    |                                                 |
| Zero repeatability       |        | -0.8  |       | 0.8   | %Span    |                                                 |
| Span repeatability       |        | -0.8  |       | 0.8   | %Span    |                                                 |
| Thermal shift for zero   |        | -0.05 |       | 0.05  | %Span/°C | Reference to 25°C, over compensated temperature |
| Thermal shift for span   |        | -0.05 |       | 0.05  | %Span/°C |                                                 |
| Cycle life               |        | 1E+6  |       |       |          | 0 to full scale cycles                          |
| A/D resolution           |        |       | 14    |       | Bits     |                                                 |
| Response time            |        |       |       | 3     | mS       | 4MHz, non-sleep mode                            |
|                          |        |       |       | 8.4   | mS       | 4MHz, sleep mode                                |
| Deflection at rated load |        |       |       | 0.03  | mm       |                                                 |
| Weight                   |        |       | 6.0   |       | grams    | Without ribbon cable                            |

## Environmental Specifications (Digital)

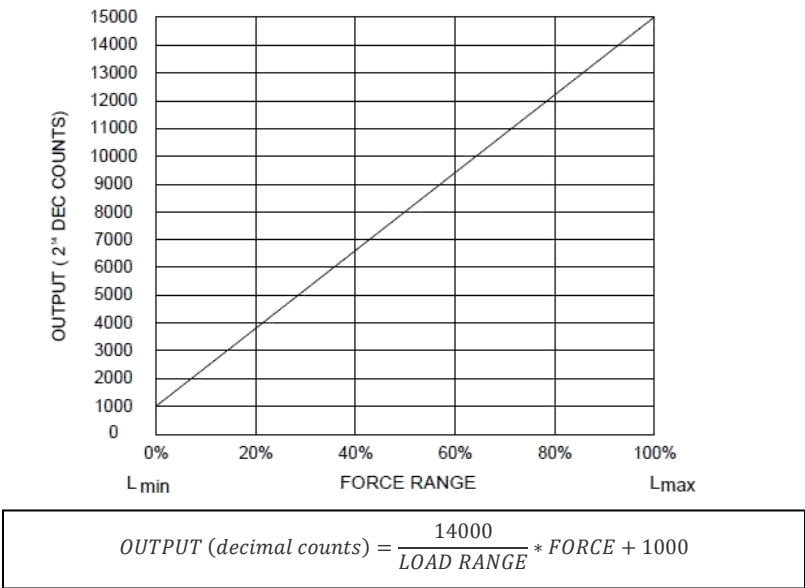
(Unless otherwise specified, all parameters are measured at 25°C @ 3.0V applied)

| Parameter                     | Symbol         | Min                                                     | Typ | Max | Units | Notes/Conditions            |
|-------------------------------|----------------|---------------------------------------------------------|-----|-----|-------|-----------------------------|
| Compensated temperature range | T <sub>o</sub> | 0                                                       |     | 50  | °C    |                             |
| Storage temperature           | T <sub>s</sub> | -40                                                     |     | 85  | °C    |                             |
| Ambient humidity              |                | 0                                                       |     | 85  | %RH   | Non-condensing              |
| Ingress protection            | IP             | 43                                                      |     |     |       |                             |
| Media compatibility           |                | External exposed surfaces: 17-4 and 304 stainless steel |     |     |       | Excluding cable & connector |

## Block Diagram – I<sup>2</sup>C Digital Output (Digital)

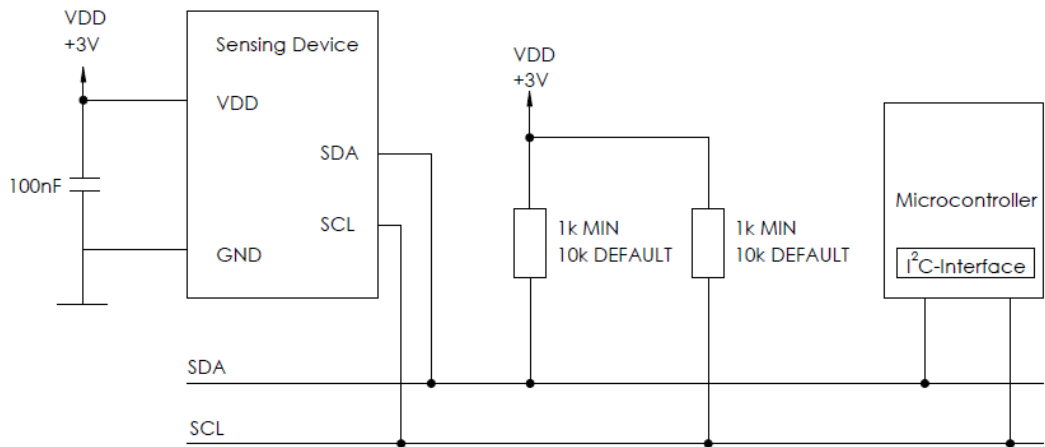


Force Output Graph (Digital)



| Force Sensor Output |                  |              |
|---------------------|------------------|--------------|
| %Output             | Counts (decimal) | Counts (hex) |
| 0%                  | 1000             | 0x3E8        |
| 5%                  | 1700             | 0x6A4        |
| 10%                 | 2400             | 0x960        |
| 50%                 | 8000             | 0x1F40       |
| 90%                 | 13600            | 0x3520       |
| 95%                 | 14300            | 0x37DC       |
| 100%                | 15000            | 0x3A98       |

I<sup>2</sup>C Typical Circuit

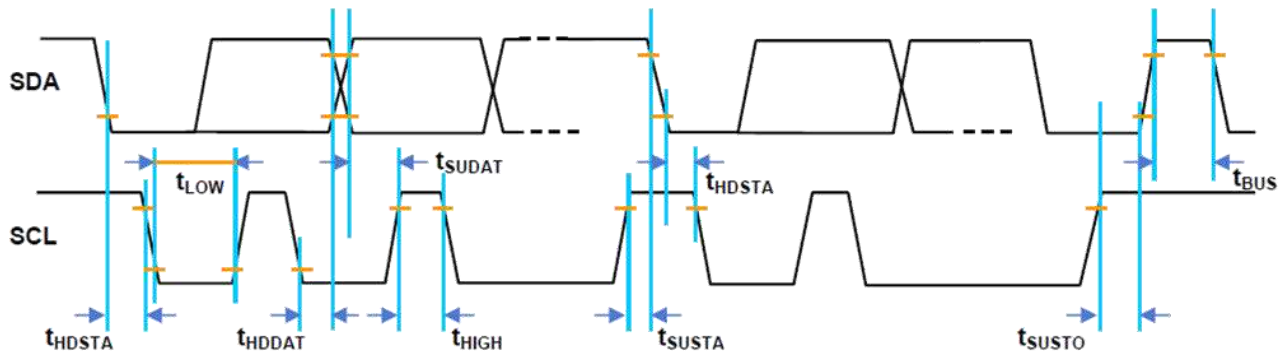


Note: only one pair of pull up resistors are needed for multiple sensing devices.

## I<sup>2</sup>C Interface

| Parameter                                         | Symbol             | Min | Typ | Max | Units | Notes/Conditions |
|---------------------------------------------------|--------------------|-----|-----|-----|-------|------------------|
| SCLK clock frequency                              | F <sub>SCL</sub>   | 100 |     | 400 | kHz   |                  |
| Start condition hold time relative to SCL edge    | t <sub>HOSTA</sub> | 0.1 |     |     | μS    |                  |
| Minimum SCL clock low width <sup>1</sup>          | t <sub>LOW</sub>   | 0.6 |     |     | μS    |                  |
| Minimum SCL clock high width <sup>1</sup>         | t <sub>HIGH</sub>  | 0.6 |     |     | μS    |                  |
| Start condition startup time relative to SCL edge | t <sub>SUSTA</sub> | 0.1 |     |     | μS    |                  |
| Data hold time on SDA relative to SCL edge        | t <sub>HDDAT</sub> | 0   |     |     | μS    |                  |
| Data setup time on SDA relative to SCL edge       | t <sub>SUDAT</sub> | 0.1 |     |     | μS    |                  |
| Stop condition setup time on SCL                  | t <sub>SUSTO</sub> | 0.1 |     |     | μS    |                  |
| Bus free time between stop and start condition    | t <sub>BUS</sub>   | 2   |     |     | μS    |                  |

## I<sup>2</sup>C Interface Timing Diagram



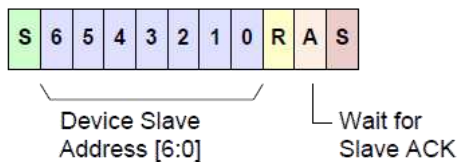
## Digital Input and Output Parameters

(Unless otherwise specified, all parameters are measured at 25°C @ 3.0V applied)

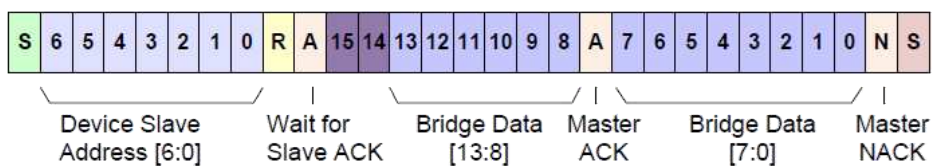
| Parameter                    | Symbol          | Min  | Typ | Max | Units             | Notes/Conditions |
|------------------------------|-----------------|------|-----|-----|-------------------|------------------|
| Input high voltage           | V <sub>IH</sub> | 0.8  |     | 1.0 | x V <sub>dd</sub> |                  |
| Input low voltage            | V <sub>IL</sub> | 0.0V |     | 0.2 | x V <sub>dd</sub> |                  |
| Output low level             |                 |      |     |     | x V <sub>dd</sub> |                  |
| Load capacitance @ SDA       |                 |      |     | 200 | pF                | @400 kHz         |
| Input capacitance (each pin) |                 |      |     | 10  | pF                |                  |

## I<sup>2</sup>C Measurement Packet Read Sequence

- (1) I<sup>2</sup>C Read\_MR – Measurement Request:  
Slave starts a measurement and DSP calculation cycle.

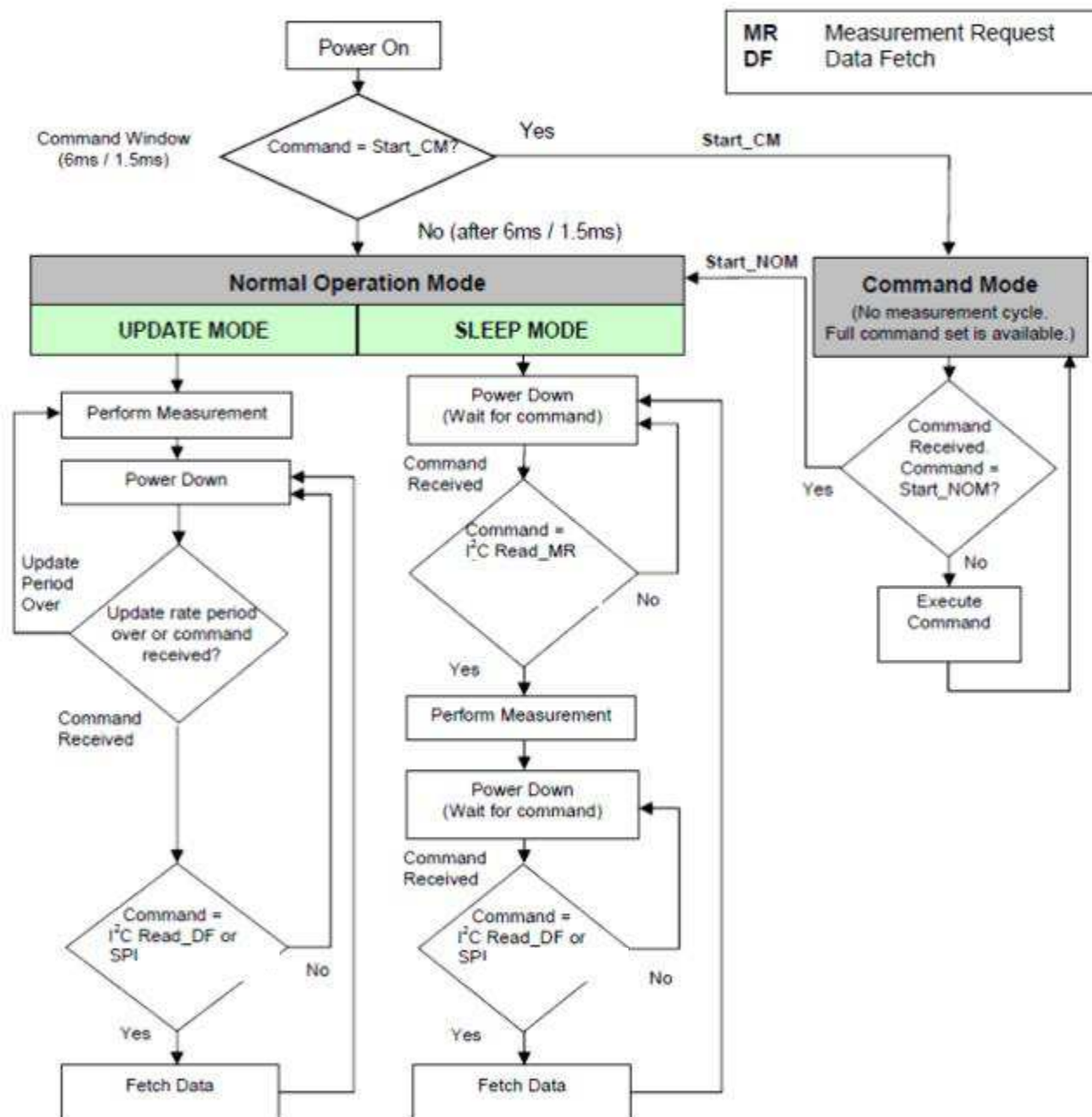


- (2) I<sup>2</sup>C Read\_DF2 – Data Fetch 2 Bytes:  
Slave returns only bridge data to the master in 2 bytes.



|   |                                       |
|---|---------------------------------------|
| S | Start Condition                       |
| 6 | Device Slave Address (example: Bit 5) |
| 5 | Device Slave Address (example: Bit 5) |
| 2 | Data Bit (example: Bit 2)             |
| R | Read/Write Bit (example: Read=1)      |
| A | Acknowledge (ACK)                     |
| N | No Acknowledge (NACK)                 |
| S | Stop Condition                        |
|   | Status Bit                            |

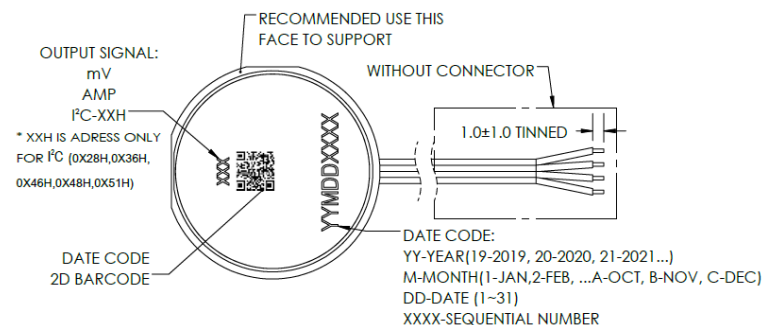
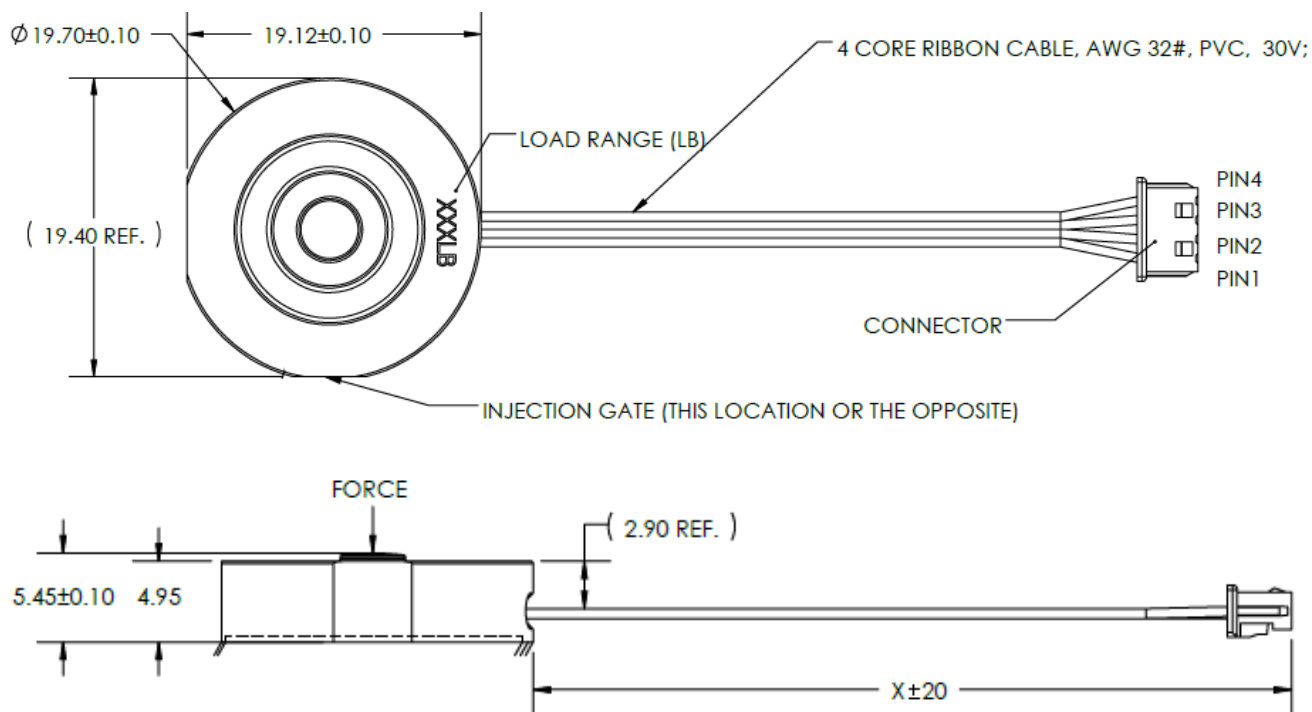
## General Working Mode



## FX29

Compact Compression Load Cell

### Outline Drawing and Connections



#### CONNECTIONS INFORMATION:

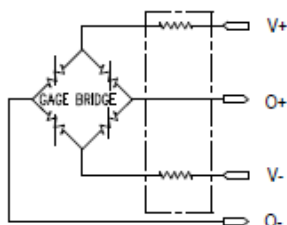
| PIN | WIRE COLOR | OUTPUT SIGNAL |          |     |
|-----|------------|---------------|----------|-----|
|     |            | mV            | 0.5~4.5V | I²C |
| 4   | RED        | V+            | V+       | V+  |
| 3   | YELLOW     | O+            | O+       | SCL |
| 2   | WHITE      | O-            | N/A      | SDA |
| 1   | BLACK      | V-            | COMMON   | V-  |

#### CONNECTOR INFORMATION:

| BRAND | PART     | DESCRIPTION                                     | MATING RECOMMENDATION                         |
|-------|----------|-------------------------------------------------|-----------------------------------------------|
| TE    | HOUSING  | TE: # 440146-4, CONN RCPT 4POS SGL 1.25MM NATRL | TE: # 1734598-4, CONN HEADER VERT 4POS 1.25MM |
|       | TERMINAL | TE: # 1734193-1, CONN SOCKET 28-32AWG CRIMP TIN |                                               |

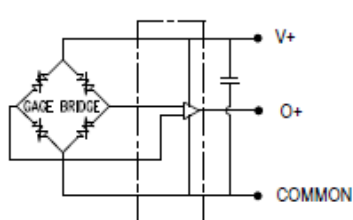
#### mV OUTPUT

##### WIRING INFORMATION



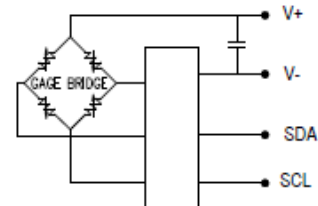
#### 0.5~4.5V OUTPUT

##### WIRING INFORMATION



#### I²C OUTPUT

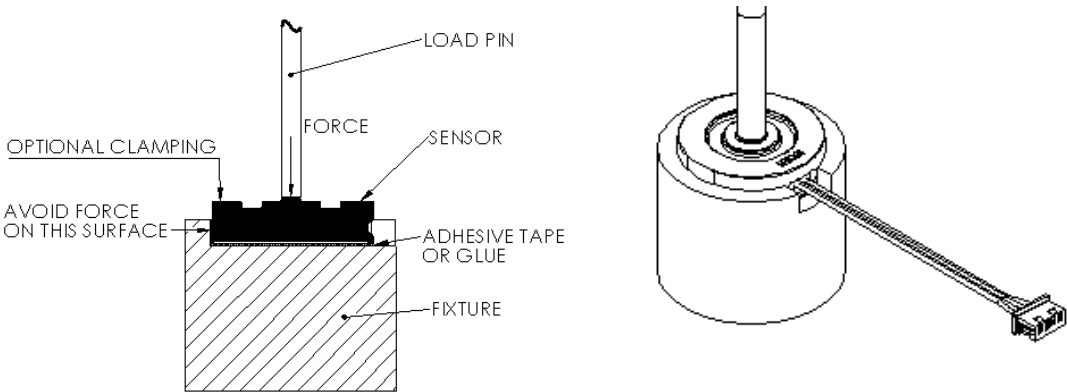
##### WIRING INFORMATION



**Mounting Recommendation**

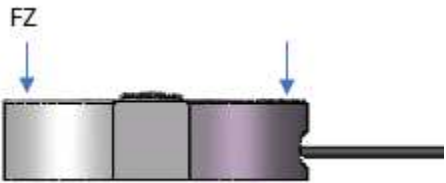
The sensor can be put into a simple slot fixture for load testing. The load should be applied to the spherical face of center boss. Recommended to stick the sensor with double face 3M adhesive or glue. Some feature to clamp the sensor from top to down can be optional.

See below for reference:



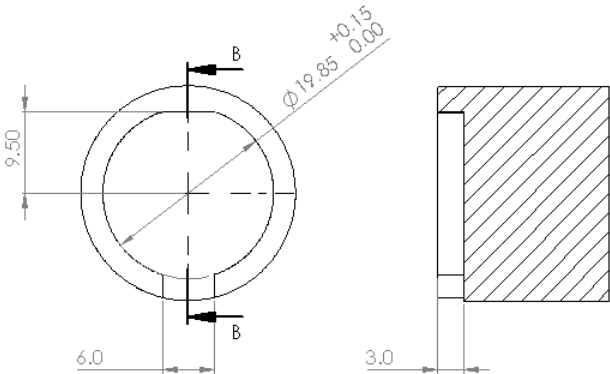
NOTE: Clamping force may shift the zero reading slightly. Re-zero if needed.

Below table shown the Zero change difference when loaded 5 Lbf from the top. (For reference only)



| Load Range             | 10L     | 25L     | 50L      | 100L     |
|------------------------|---------|---------|----------|----------|
| Changing for reference | ±0.5%FS | ±0.4%FS | ±0.35%FS | ±0.25%FS |

Dimension for reference:



## FX29

Compact Compression Load Cell

### Ordering Information

FX29 X X - XXX X - XXXX - X

| Output Signal |                                  |             |
|---------------|----------------------------------|-------------|
| Code          | Output                           | Output Type |
| 2             | 20 mV/V*                         | mV          |
| 3             | 0.5 – 4.5V*                      | Amplified   |
| J             | I <sup>2</sup> C<br>(None Sleep) | Digital     |
| K             | I <sup>2</sup> C (Sleep)*        | Digital     |

| I <sup>2</sup> C Address |                      |
|--------------------------|----------------------|
| Code                     | Device Address (hex) |
| X                        | Analog Output*       |
| 0                        | 0x28*                |
| 1                        | 0x36                 |
| 2                        | 0x46                 |
| 3                        | 0x48                 |
| 4                        | 0x51                 |

| Cable Length |               |
|--------------|---------------|
| Code         | Length        |
| 040          | 40 mm*        |
| 100          | 100 mm*       |
| XXX          | Custom Length |

| Measurement Units |                     |
|-------------------|---------------------|
| L                 | Pounds-force (lbf)* |
| N                 | Newtons             |

| Load Range           |         |
|----------------------|---------|
| LBF                  | Newtons |
| 0010*                | 0050    |
| 0025*                | 0125    |
| 0050*                | 0250    |
| 0100*                | 0500    |
| 0200*<br>(MACHINING) | 1000    |

| Cable & Connector                                                                    |                                       |
|--------------------------------------------------------------------------------------|---------------------------------------|
| Code                                                                                 | Cable and Connector                   |
| A                                                                                    | 4-wire ribbon cable without connector |
| B                                                                                    | 4-wire ribbon cable with connector*   |
| <b>Note:</b> For digital output, ensure custom cable length does not exceed 1 meter. |                                       |

\*Sensor features shown in **bold** are typically stocked by our distribution partners, or available with short lead times from the factory depending on availability. For customizing cable length, require 500 pcs of MOQ. Contact customer service for details.

#### Caution:

For the digital sensor. User can change the address along with the guide as below link.

**Please notice, any data changed by users means users give up the quality assurance terms. TE will not guarantee the sensor performance any more.**

[https://www.te.com/commerce/DocumentDelivery/DDEController?Action=showdoc&DocId=Specification+Or+Standard%7FDIGITAL\\_MODEL\\_S\\_CHANGING\\_I2C\\_SLAVE\\_ADDRES%7FA1%7Fpdf%7FEnglish%7FENG\\_SS\\_DIGITAL\\_MODELS\\_CHANGING\\_I2C\\_SLAVE\\_ADDRES\\_A1.pdf%7FCAT-PTT0015](https://www.te.com/commerce/DocumentDelivery/DDEController?Action=showdoc&DocId=Specification+Or+Standard%7FDIGITAL_MODEL_S_CHANGING_I2C_SLAVE_ADDRES%7FA1%7Fpdf%7FEnglish%7FENG_SS_DIGITAL_MODELS_CHANGING_I2C_SLAVE_ADDRES_A1.pdf%7FCAT-PTT0015)

## FX29

### Compact Compression Load Cell

#### REVISION HISTORY

| Revision Number | Change Description                            | Date       | Approval |
|-----------------|-----------------------------------------------|------------|----------|
| A3              | Minor corrections ;                           | 06/24/2019 | MH       |
| A4              | Correct pin numerical to be same as connector | 07/29/2020 | MH       |
| A5              | Mounting Recommendation and Caution added;    | 10/27/2020 | MH       |
| A6              | Add MOQ requirement for cable length option ; | 4/12/2022  | MH       |

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