



## FX29 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

### 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

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 100lbf (50N to 500N). 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.

**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         |

**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>IEC55032 Class A |     |     |       | mV Output only              |
| Ingress protection            | IP             | 43  |     |     |       |                             |
| Media compatibility           |                | External exposed surfaces: 17-4 and 304 stainless steel   |     |     |       | Excluding cable & connector |

**Schematic Diagram – mV output (Analog)**



**Block Diagram – 0.5 to 4.5V output (Analog)**



**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         |

**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)**



$$OUTPUT \text{ (decimal counts)} = \frac{14000}{LOAD \text{ RANGE}} * FORCE + 1000$$

| Force Sensor Output |                  |              |
|---------------------|------------------|--------------|
| %Output             | Counts (decimal) | Counts (hex) |
| 0%                  | 1000             | 0x3E8        |
| 5%                  | 1700             | 0x6A4        |
| 10%                 | 2400             | 0x960        |
| 50%                 | 8000             | 0x1F40       |
| 90%                 | 13600            | 0x3250       |
| 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**



General Working Mode



**Outline Drawing and Connections**



**CONNECTIONS INFORMATION:**

| PIN | WIRE COLOR | OUTPUT SIGNAL |          |                  |
|-----|------------|---------------|----------|------------------|
|     |            | mV            | 0.5~4.5V | I <sup>2</sup> C |
| 1   | RED        | V+            | V+       | V+               |
| 2   | YELLOW     | O+            | O+       | SCL              |
| 3   | WHITE      | O-            | N/A      | SDA              |
| 4   | 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**



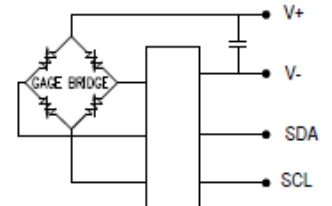
**0.5~4.5V OUTPUT**

**WIRING INFORMATION**



**I<sup>2</sup>C OUTPUT**

**WIRING INFORMATION**



**Ordering Information**

FX29 **x x** - **xxx x** - **xxxx** - **x**

| Output Signal |                                   |             |
|---------------|-----------------------------------|-------------|
| Code          | Output                            | Output Type |
| <b>2</b>      | <b>20 mV/V*</b>                   | mV          |
| <b>3</b>      | <b>0.5 – 4.5V*</b>                | Amplified   |
| <b>J</b>      | <b>I<sup>2</sup>C (No sleep)*</b> | Digital     |
| <b>K</b>      | <b>I<sup>2</sup>C (Sleep)</b>     | Digital     |

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

| Cable Length |                |
|--------------|----------------|
| Code         | Length         |
| <b>040</b>   | 40 mm          |
| <b>100</b>   | <b>100 mm*</b> |
| <b>XXX</b>   | Custom Length  |

| Measurement Units |                            |
|-------------------|----------------------------|
| <b>L</b>          | <b>Pounds-force (lbf)*</b> |
| <b>N</b>          | Newtons                    |

| Load Range   |         |
|--------------|---------|
| LBF          | Newtons |
| <b>0010*</b> | 0050    |
| <b>0025*</b> | 0125    |
| <b>0050*</b> | 0250    |
| <b>0100*</b> | 0500    |

| Cable & Connector |   |
|-------------------|---|
| Code              | Cable and Connector                           |
| <b>A</b>          | <b>4-wire ribbon cable without connector*</b> |
| <b>B</b>          | 4-wire ribbon cable with connector            |

**Note:**  
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. Contact customer service for details.

| REVISION HISTORY |                     |            |          |
|------------------|---------------------|------------|----------|
| Revision Number  | Change Description  | Date       | Approval |
| A0               | Initial release     | 05/13/2019 | PRS      |
| A3               | Minor corrections ; | 06/24/2019 | MH       |

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