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M425 INTRODUCTION

What is it designed to do?
The latest technology Datum Electronics Series M425 non-contact rotary Torque Transducers have been designed to fit with most applications and solutions requiring rotary torque measurement. The Torque Transducer fits in line with the drive train or test bed, using standard keyway shafts.

A non-contact transmission system provides data directly proportional to torque. In this variant it is supplied as a complete transducer with bearings to support the stator unit on the rotating shaft. It is suitable for most general test rig applications.

The M425 Torque Transducer utilises a strain gauged shaft for accurate and reliable torque measurement and a set of rotating on-shaft conditioning electronics. The digital signals are transmitted to the non-rotating part of the system or stator providing a reliable and highly accurate torque measurement solution.

The M425 has a torque measuring element design with an optimum length to maximise overall accuracy and give a high degree of tolerance to mounting offset.

The M425 also has a legacy mode so that it can be used as a direct replacement for the previous M420 Transducer.

SYSTEM OUTLINE

The key features of the M425 system are:

- Complete torque transducer
- Designed to be mounted in line with the drivetrain
- Torque transducer body supported on rotary shaft with bearings
- Ideal for test rig applications
- Keyway shaft for easy fit and rig design
- Torque measurement available up to 60,000Nm in a range of model sizes
- Analogue output options

SYSTEM ITEMS SUPPLIED

It is recommended that all hardware, consumables, tools and software are checked and present before preparation and installation commences.

CHECK LIST

Included as standard with the M425 Torque Transducer:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>QUANTITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - M425 Torque Transducer</td>
<td>1</td>
</tr>
<tr>
<td>2 - M425 handbook</td>
<td>1</td>
</tr>
<tr>
<td>3 - Quick-start guide</td>
<td>1</td>
</tr>
<tr>
<td>4 - Test certificate</td>
<td>1</td>
</tr>
<tr>
<td>5 - Datum software</td>
<td>1</td>
</tr>
<tr>
<td>6 - Transducer cable</td>
<td>1</td>
</tr>
<tr>
<td>7 - Power supply</td>
<td>1</td>
</tr>
</tbody>
</table>

Optional extras available from Datum Electronics:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Interface</td>
</tr>
<tr>
<td>Versatile bulkhead mounted indicator</td>
</tr>
<tr>
<td>M425 Transducer to universal interface data cable</td>
</tr>
</tbody>
</table>
FAMILIARISATION

SIMPLE DIAGNOSTICS, TESTING AND CONNECTION

Before installing your M425 Transducer into the rig or machine we would advise you to familiarise yourself with its connections and operation by performing a bench test.

By connecting the Transducer directly to a Datum Universal Interface (example A below), or to a PC via the Datum Universal Interface (example B opposite), you will be able to rotate the shaft to generate an output signal of RPM. By applying a small torque by hand to the shaft you will also be able to see the change in the torque signal output on the Universal Interface display or in the Datum Data Logging PC software.

If you are connecting to a PC without a Datum Universal Interface and using your own instrumentation (example C opposite) you will be able to test your instrumentation in the same way by simulating a signal to the interface or indicator model you are using. The M425 supports a variety of universal interface models.

Once you are familiar with the transducer and its outputs continue to install as normal. If any questions arise at this stage please call our product support team for advice.

The Datum Universal Interface display

The Datum Universal Interface has a built-in display which you can use for familiarisation with a direct connection to the M425 Torque Transducer (diagram A below).

The Universal Interface display can show the following data from the M425 Torque Transducer:

- TORQ: \(0.0\) Nm
- SPEED: \(0.0\) RPM
- POWER: \(0.0\) W
- STATUS OK SUPPLY OK

Connection example (A)
M425 to the Datum Universal Interface.

Connection example (B)
M425 to PC via the Datum Universal Interface.

Connection example (C)
Direct connection from M425 to an alternative interface or indicator.

See electrical connection guide on page 7 for further information on connecting your own instrumentation.
MECHANICAL INSTALLATION

OBJECTIVE OF THE MOUNTING

The objective is to align the shaft of the M425 Torque Transducer (sensor) with the torque. The torque should where possible be driven through the centre line of the shaft.

Unlike Disk Transducers that require very fine alignment tolerances when mounting, the M425’s longer shaft allows a greater degree of flexibility in terms of alignment.

THINGS TO AVOID

The series M425 Torque Transducers are designed to withstand a level of overload.

The load levels quoted within tolerances (see table 8 on page 16) should not have any effect on the calibration or zero setting of the Transducers. Each Transducer has been subjected to the proof load level within its testing cycle.

Loading the Transducer above the proof level will offset the Transducer zero and will damage the Transducer. Regular loading beyond the proof level will start to show progressive zero movement and may effect both the gain and the hysteresis of the Transducer. The shaft absolute load is the maximum before the shaft will yield.

You should avoid any side loads or bending loads across the shaft. As the M425 Transducer series have relatively long shafts they are more tolerant to a small degree of misalignment than short flange transducers (sensors), however misalignment can change the loading on the internal bearings of the device and should be avoided where possible.

Consider large dynamic or transient torques when designing your test system.

When designing the test rig or test system that will use the M425 Transducer you should consider the effect of any large inertial / kinetic loads such as flywheels or brakes. If the system is to drive to a high level of torque, and then a brake is applied, the dynamic torque in the test rig can be much higher than that of the output of the drive motor. The fast deceleration torque may exceed the limits above causing damage.

Overload = 150% the rating of the transducer. Loads at this level should be avoided as they will decrease the fatigue life of the Transducer. If you are likely to see large overloads at the same time as wishing to see high resolution data for much smaller torques please consult our sales team.

Ultimate Load = at the ultimate loads quoted for the Transducer shaft (see table 8, page 16) the sensing element will be damaged and large offsets will occur. At this level the shaft will be well beyond its design limits and may mechanically fail. If you have loaded a Transducer above the Proof Load/Overload level it should be checked before continued use.

Where the installation will see a larger degree of misalignment you should consider the use of flexible couplings in the drive line. If misalignment is very likely consider the Datum Electronics RS and FF ranges which are bearing-less transducers (see page 18). Talk with our sales team who can advise on this type of installation.
 WHICH WAY ROUND TO MOUNT?

The M425 Transducer will operate in both a clockwise or anti-clockwise direction.

The M425 Transducer is calibrated to give a positive output for clockwise torque and a negative output for counter clockwise torque. The M425 Transducer will also output torque data while static.

ANTI-ROTATION POINT

The M425 Transducers have an anti-rotation anchor point on the underside of their casing. This is to be used to secure the static body of the Transducer and prevent rotation during operation.

Pass a strong cable or tie through the hole in the anti-rotation anchor point and secure the tie to a solid structure on the test rig, ensuring the tie has clearance from the rotating drive shaft and moving parts to avoid snagging.

You should use the anti-rotation anchor point for this rather than the data cable as using the data cable may damage the connection. The data cable is not designed to take a load.

KEYWAY FIT SIZE

Keyway sizes are generally in accordance with BS4235-2:1977.

See table No. 9 on page 17 for the keyway size options available on the M425 model range.
ELECTRICAL CONNECTION

CABLE AND SOCKET CONNECTORS WIRING GUIDE

The M425 Transducer is supplied with a standard 3 metre signal cable. This cable is terminated with a standard 9-way D connector to interface to any of the Datum Electronics Signal Interfaces or Indicators.

The connections within this cable are detailed below should you wish to connect the M425 Transducer directly into your own instrumentation and software.

The default signal output from the Transducer is RS485 Serial Data (see protocol section for data output details on page 11).

We have also provided the Triad 4-way plug wiring arrangement in diagram No. 10 below for the Transducer end of the cable. On some occasions a cable may need to be assembled after laying through tight bulkhead access which may require the removal of the connectors.

The maximum cable length for the M425 Transducer is normally 200 metres. For special applications with the right cable conditions this can increase to 500 metres depending on the sample rate and baud rate.

The data cable from the M425 Transducer to an interface must meet the following specification: 4 core wire, braided, screened, 7/02mm PVC Sheathed cable or equivalent.

The M425 Transducer current consumption is less than 250mA with a 12Vdc supply. The M425 Transducer complete with its Universal Signal Interface will consume below 450mA.

Diagram No. 9

Transducer signal cable wiring guide

Diagram No. 10

Triad 4-way Plug T01-550-P04 wiring guide

<table>
<thead>
<tr>
<th>Pin Out</th>
<th>Function</th>
<th>Cable Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>+12Vdc supply to Transducer</td>
<td>RED</td>
</tr>
<tr>
<td>Pin 2</td>
<td>Supply ground</td>
<td>BLUE</td>
</tr>
<tr>
<td>Pin 3</td>
<td>RS485 A: -ve data</td>
<td>YELLOW</td>
</tr>
<tr>
<td>Pin 4</td>
<td>RS485 B: +ve data RS232 TX/RX (option)</td>
<td>GREEN</td>
</tr>
</tbody>
</table>

PIN numbering viewed from solder/cable side of the connector

Diagram No. 11

9-way D connector RS485 wiring guide

<table>
<thead>
<tr>
<th>Pin Out</th>
<th>Function</th>
<th>Cable Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1</td>
<td>RS485 A: -ve data</td>
<td>YELLOW</td>
</tr>
<tr>
<td>Pin 2</td>
<td>RS485 B: +ve data RS232 TX/RX (option)</td>
<td>GREEN</td>
</tr>
<tr>
<td>Pin 5</td>
<td>Supply ground</td>
<td>BLUE</td>
</tr>
<tr>
<td>Pin 9</td>
<td>+12Vdc supply to Transducer</td>
<td>RED</td>
</tr>
</tbody>
</table>

PIN numbering viewed from solder/cable side of the connector
SYSTEM CONNECTIONS

When supplied with the Universal Transducer Interface the Datum M425 Torque Transducers provide simple connections to logging, monitoring and control system through both analogue and serial interfaces. Software is provided to access the primary Ethernet setup interface for the M425.

M425 Transducer, Universal Interface and PC connections guide

Optional power supply: 15-24V dc 500mA

Diagram No. 12

Universal Interface connections guide

*The 12V Output and the Serial IN Copy are screw terminals that duplicate the connections for the serial torque sensor ‘D’ connector.

**Alternative power input terminal.

Diagram No. 13
USER INTERFACES

Datum Electronic’s Universal Interface provides options for different operating environments.

Datum Electronics can provide the universal interface package for either control enclosure application or heavy industrial applications.

GRAPHIC USER INTERFACE

Datum data logging software

The Datum data logging and configuration software provides a wide range of control functions of the M425 including set-up and configuration options plus data logging.

UNIVERSAL INTERFACE

The universal interface will connect directly to the M425 Torque Transducer. It supplies 12Vdc to power the Transducer and converts the torque and RPM signal into the outputs you require.

The outputs that can be configured are:

- 4 analogue outputs as either 4-20mA (4-12-20mA):
  - +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc, for shaft torque, RPM, Power and Spare
- RS485/RS232 serial data
- Ethernet
- MODBUS
- USB Type Mini B

The interface will also accept an input from an external tachometer sensor, the output from this sensor can be directly linked into the torque and power data.
VERSATILE (400260) BULKHEAD MOUNTED INDICATOR

Designed for use in industrial and marine environments the Heavy Duty Indicator provides all of the facilities of the Universal Indicator plus an extended graphical display.

It is housed in a weatherproof enclosure with waterproof protector glands & connector and is designed to meet IP67 ingress protection standard.

ALTERNATE CONNECTION OPTIONS

The M425 is compatible with a variety of other universal interfaces or indicators by correct cable and PIN configuration. This allows direct connection to their user software and customers own software. See page 7 for a guide to wiring connector configuration.

The M425 will also accept configuration commands to enable connection to legacy Datum Electronics interfaces and indicators. When set in compatibility mode the M425 can be used with Torque Log Software, the Datum Electronics type 300 and Type 370 Indicators and the Type 400150 USB / analogue or 400152 USB interfaces.
DATA OUTPUT

Data output from the Datum M425 series is available is either readable ASCII or Hex formats. This allows a wide range of interface options using either the Datum Interfaces or Software or even simple terminal programs to read the data.

THE M425 TRANSDUCER HAS THREE OPERATIONAL MODES:

MODE 1: In this mode the Transducer will transmit Zeroed data in the format of the $ZR strings below.
$ZR,0.0002,0.0002,0.0002,0.0002,0.0002,0.44,CS
The number of torque values per second (resolution) can be varied by setting the baud rate either through the Datum PowerKit software or by using the “baud” command if using your own software.

MODE 2: Mode 2 is a non-transmit mode and will only respond to commands. Sending a “help” command in this mode will list the commands available.

MODE 3: This is a legacy binary mode in which the transducer will transmit the 6-byte binary format used in earlier Datum products and the M420. The mode can be set using the Datum PowerKit software or the command “mode” when using your own software. See the following section for more information on command options.

DATA OUTPUT FORMAT:
The Series M425 Transducer can provide data either as an individual reading or as parts of data packets. These can be configured using the interface software to suit most applications.

The following two standard formats (String type A and String type B) are provided as a guide:

String type A

$ZR,0.0492,25.6,CS
Where:
$ZR is the string identifier,
0.0492 is the mV/V value from the sensor,
25.6 is the RPM,
CS is the data checksum

This type of string containing multiple mV/V signal value is used where the baud rate of the receiving device is limited and a higher data rate is required.

String type B:

$ZR,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492,0.0492,24.1,21.6,CS
Where:
$ZR is the string identifier,
0.0492 are the last 10 signal values in mV/V from the sensor,
25.6 is the RPM,
21.6 is the shaft temperature indication,
CS is the data checksum.

This type of string containing multiple mV/V signal value is used where the baud rate of the receiving device is limited and a higher data rate is required.

RAW DATA TORQUE CALCULATION:

i.e. $1.7560 \text{ mV/V} = 500 \text{Nm}$ (see calibration certificate for this value) the torque will be \((0.0492 \div 1.7560 \times 500) \text{ Nm} = 14.00 \text{Nm}.

SOFTWARE COMMANDS DIRECT TO THE M425 STATOR:
The following commands can be used with your own software to configure the M425 Transducer and set the data output.

“Detail” returns the following string format:
$DT,0.0001,-0.0015,0.00,21.312,4.995,0.175,CS
The string format is made of the following data elements:
$DT is the identifier,
0.0001 is the zeroed strain,
-0.0015 is the raw strain mV/V,
0.00 is the RPM,
21.312 is the rotor temperature deg C,
4.995 is the rotor voltage,
0.175 is the power supply current,
CS is the checksum.

“Baud” sets the host baud rate and reboots the system.

“Offset” signed offset in nV/V applied to the rotor output.

“Gain” signed gain in pV/V/quanta.

“Mode”
1 = Normal.
2 = Command mode.
3 = Compatibility mode.

“Normal” start Transmission of rotor data string $RZ.$

“Help” lists the commands available in this mode.

“Reset” resets the Transducer to a default setting of (56700 baud, 1 torque value, 1 RPM value, 128 samples per second, mode 2 [awaiting a command]).
HOW CHECKSUM IS CALCULATED:

The checksum is calculated and implements the CCITT 16-bit CRC used by IEEE 802.15.4, using a Modulo 256 calculation.

A detailed description and software examples are available in Technical Bulletin 1007.

SAMPLE RATES AND RESOLUTION

The M425 can output torque data at sample rates from 4 up to 4000 samples per second. The lower data rates provide resolution up to 1:560,000, at highest data rates the noise free resolution reduces 1:11,000. See table 3 on page 13.

The sample rates that can be transmitted from the stator to your instrumentation or computer are listed in tables 1 and 2 on page 13. These table show the rates for a range of standard output strings.

PC PORT LIMITATIONS:

Note: the M425 Transducer is capable of transmitting at the rates above. Some PC’s have limited port configurations that may not be able to cater for data rates at this level.

The maximum data rate at a given baud rate can be calculated as: The basic string with a single torque value and an RPM value has 22 characters, each character is 10 bits. Therefore running serial communications at 9600 baud you are limited to 43 samples per second (9600 ÷ (22 x 10)).

By running at 115,200 baud this is increased to 525 samples per second [115,200 ÷ (22 x 10)].

By sending the data in packets containing 10 torque values the message becomes 94 characters long [115,200 ÷ (94 x 10)] as each packet contains 10 samples. The data rate becomes 1225 samples per second.
OUTPUT PERFORMANCE

MAXIMUM SAMPLE RATES FOR TYPICAL OUTPUT DATA STRING INCLUDING RPM

Based on 24bit strain/torque samples, resolution of 1:2,000 (inc. RPM)

<table>
<thead>
<tr>
<th>At a Baud rate of:</th>
<th>9600</th>
<th>19200</th>
<th>38400</th>
<th>57600</th>
<th>115200</th>
<th>256000</th>
<th>460800</th>
<th>921600</th>
<th>3000000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of torque values:</td>
<td>Torque readings per second:</td>
<td>Example of the output string:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 1 = 1 per packet</td>
<td>43 87 174 260 525 1100 2000 4000 4000</td>
<td>$ZR,T,R,C,V,CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 2 = 5 per packet</td>
<td>88 177 355 533 1066 2000 4000 4000 4000</td>
<td>$ZR,T,T,T,T,T,R,C,V,CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 3 = 10 per packet</td>
<td>102 204 408 612 1225 2000 4000 4000 4000</td>
<td>$ZR,T,T,T,T,T,T,T,T,T,T,T,R,C,V,CS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The M425 will provide you with accurate torque data. The following graphs show examples of some data output possibilities of the M425 Torque Transducer.

Within this data we can often see valuable characteristics at higher sample rates that show Torsional information that will indicate system wear, vibration and changes in efficiency. The raw data can also be viewed in a spreadsheet as columns.
**SPECIFICATIONS**

**M425 performance information**

<table>
<thead>
<tr>
<th>PERFORMANCE</th>
<th>Table No. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Linearity</td>
<td>+/-0.1% FSD</td>
</tr>
<tr>
<td>Non-Repeatability</td>
<td>+/-0.05% FSD</td>
</tr>
<tr>
<td>Noise-free Resolution</td>
<td>20 bit to 13.5 bit (dependent on sample rate)</td>
</tr>
<tr>
<td>Sample Rate</td>
<td>1 to 4000 samples per second</td>
</tr>
<tr>
<td>Output Baud Rate</td>
<td>9600 to 3Mbaud (see table 13)</td>
</tr>
</tbody>
</table>

**RPM:**

| Size 1 & 2 | 60 pulses per rev |
| Size 3, 4, 5 & 6 | 30 pulses per rev |

**Transducer output interfaces:**

- Serial data via RS485
- RS232 (option)

**Transducer output data:**

- Torque
- Shaft RPM
- Shaft Temp.
- Diagnostics

<table>
<thead>
<tr>
<th>SIGNAL INTERFACE OUTPUTS</th>
<th>Table No. 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital:</td>
<td></td>
</tr>
<tr>
<td>RS485</td>
<td>Serial data</td>
</tr>
<tr>
<td>RS232</td>
<td>Serial data</td>
</tr>
<tr>
<td>Ethernet</td>
<td>Data and configuration</td>
</tr>
<tr>
<td>MODBUS UDP</td>
<td>Serial data</td>
</tr>
<tr>
<td>USB Type Mini B</td>
<td>Serial data</td>
</tr>
<tr>
<td>USB Type A</td>
<td>Data logging</td>
</tr>
</tbody>
</table>

**Analogues:**

All four of the M425 Transducer’s analogue output channels can be configured for any of the following settings by the user:

- 4-20mA configured 4-20mA (4-12-20mA): +/-10Vdc, +/-5Vdc, 0-10Vdc or 0-5Vdc

A typical configuration arrangement would be as follows:

- Channel 1 - Torque from 0-500Nm as 4-20mA
- Channel 2 - Speed RPM from 0-100-rpm as 0-5Vdc
- Channel 3 - Power from 0-5000W as 4-20mA
- Channel 4 - Spare

**Display:**

- Torque
- Speed RPM
- Power
- Status

**ENVIRONMENT**

<table>
<thead>
<tr>
<th>Table No. 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Stability of Gain per 10°C</td>
</tr>
<tr>
<td>Thermal Stability of Zero per 10°C</td>
</tr>
<tr>
<td>Normal Specification Range</td>
</tr>
<tr>
<td>Operating Range</td>
</tr>
<tr>
<td>Storage Range</td>
</tr>
<tr>
<td>Environmental Protection</td>
</tr>
<tr>
<td>Electromagnetic Compatibility</td>
</tr>
</tbody>
</table>

**POWER SUPPLY**

<table>
<thead>
<tr>
<th>Table No. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transducer</td>
</tr>
<tr>
<td>Transducer and Interface</td>
</tr>
</tbody>
</table>

**M425 block diagram**

Diagram No. 14
## M425 shaft stiffness and load parameters

### Table No. 8

<table>
<thead>
<tr>
<th>M425 model size</th>
<th>Rated load (Nm)</th>
<th>Rated load (Lbft)</th>
<th>Standard max RPM</th>
<th>Overall length (mm)</th>
<th>Moment length</th>
<th>Bending loads at the moment length (N)</th>
<th>Shaft proof load (Nm)</th>
<th>Shaft ultimate (breaking) load (Nm)</th>
<th>Axial loads (N)</th>
<th>Total stiffness (Rad/Nm)</th>
<th>Total stiffness (Nm/Rad)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size 1 - A</td>
<td>10</td>
<td>7.4</td>
<td>0-10000</td>
<td>184</td>
<td>154</td>
<td>8</td>
<td>18</td>
<td>32</td>
<td>442</td>
<td>2.06E-03</td>
<td>485</td>
</tr>
<tr>
<td>Size 1 - B</td>
<td>20</td>
<td>14.8</td>
<td>0-10000</td>
<td>184</td>
<td>154</td>
<td>14</td>
<td>31</td>
<td>55</td>
<td>636</td>
<td>1.12E-03</td>
<td>891</td>
</tr>
<tr>
<td>Size 1 - C</td>
<td>50</td>
<td>36.9</td>
<td>0-10000</td>
<td>184</td>
<td>154</td>
<td>33</td>
<td>74</td>
<td>131</td>
<td>1131</td>
<td>5.25E-04</td>
<td>1904</td>
</tr>
<tr>
<td>Size 1 - D</td>
<td>100</td>
<td>73.8</td>
<td>0-10000</td>
<td>184</td>
<td>154</td>
<td>65</td>
<td>144</td>
<td>257</td>
<td>1767</td>
<td>3.62E-04</td>
<td>2761</td>
</tr>
<tr>
<td>Size 2 - A</td>
<td>250</td>
<td>184</td>
<td>0-8000</td>
<td>240</td>
<td>175.5</td>
<td>153</td>
<td>389</td>
<td>694</td>
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### Bending loads

Diagram No. 15

Where possible moments at the end on the shaft should be avoided. The table contains values for the moments that can be exerted without damage with the transducer not rotating. These values should be reduced if the shaft is rotating.

### Axial loads

Diagram No. 16

Direct Axial loads will have little effect on performance, however offset Axial loads that apply a cross moment to the shaft will have an effect on the smaller size 1 transducers below 50Nm and should be avoided.
### M425 mass and dimensions (mm)

#### Table No. 9

<table>
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<tr>
<th>M425 model size</th>
<th>Total mass Kgs</th>
<th>Rotor mass Kgs</th>
<th>Overall length</th>
<th>Body length</th>
<th>Body dia.</th>
<th>Output module length</th>
<th>Output module height</th>
<th>Exposed shaft length</th>
<th>Shaft dia. G6 fit</th>
<th>Keyway length</th>
<th>Keyway width</th>
<th>Keyway depth off centre</th>
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<td>137</td>
<td>38</td>
<td>N = 0.5 - 1, O = 1.1 - 1.3</td>
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</tbody>
</table>

#### Alphabet key for M425 model sizes 1 to 5

#### Letter designation key for M425 model size 6

#### Diagram No. 17

**3D models and STEP files are available from Datum Electronics to assist project planning. Please contact Datum Electronics for more information.**

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This drawing and its associated design is the property of Datum Electronics Ltd. and may not be copied or used for any purpose other than that for which it is supplied, without the express written authority from Datum Electronics Ltd.
The M425 Series Torque Transducer is calibrated on test rigs traceable to UK National Standards

The Transducers will be subjected to a series of test cycles starting with a proof load cycle(s) and then followed by a series of calibration cycles.

Loads are applied from zero torque to the maximum working torque of the Transducer.

The data shown on the test certificate:

- The test equipment used
- Calibration date
- A table of the actual loads applied against the output
- The output is described in either:
  - mV/V - this is the raw strain signal from the torque shaft
  - Nm/Lbft - this is the calibrated output of the transducer

Some Transducers are supplied with a raw output that is processed and displayed in the instrumentation or user software.

Other Transducers store their calibration settings and have an output in the units required, Nm/Lbft. These Transducers can also output the raw mV/V values where required.

- Example of cal sheet annotated
- RPM - Calibration

The Interfaces and Indicators

Where supplied with an indicator or a signal interface the outputs of the interface and the Transducer will both be calibrated and detailed on a systems test certificate.

The outputs calibrated will be the +/-10Vdc, +/--5Vdc and the 4-20mA signals.

The indicators and serial data outputs for the Ethernet, USB and MODBUS ports are directly sent from the Transducer. Interface options allow a scaling factor(s) for these signals to be entered into the Interface.

In addition to the M425 range Datum Electronics Limited manufacture a wide range of complimentary torque sensors.

The RS and FF425 ranges are non-contact and non-bearing sensors that can be tailored to fit a test rig or drive application.

Within these ranges the Series 425 Electronics are engineered to fit a shaft coupling of a section of an existing drive shaft. These are fitted by Datum Electronics in the factory. They have advantages where space is at a premium and a standard transducer cannot replace an existing component without major engineering work. They have further advantages in that they can operate at higher speeds for longer duty cycles. When used in harsh environments the RS/FF425 ranges can be supplied full encapsulated.

With the sensor added to an existing shaft the dynamics of the drive line will remain substantially the same.
DIAGNOSTICS

GUIDE TO STATUS CODES

INCORRECT TORQUE
Check the scaling of the output device.

If using the user software on a PC look at the torque calibration tab.

The certificate issued with the transducer will have a value for its output signal in mV/V at a given torque. The software set up should match this (i.e. 1.756mV/V = 250Nm)

If using the Universal Interface use the GU interface connected via the Ethernet port and check the same tab.

Check the torque reading with no torque applied. If the Transducer output is showing a torque reading at zero this will be added to all readings. The torque calibration tab of the software has an option to zero the torque reading. The Universal Interface also has a torque zero button. Pressing and holding this for 10 seconds will take the current torque reading as zero.

When checking or setting the zero check to see if any torque is locked into the transducer by the machine or rig on which it is used. It is ideal to check the zero with the transducer disconnected from the rig.

SIGNAL NOISE
The M425 Transducer is designed to be a sensitive device and will show any variation in torque applied. The noise level on the data from your Transducer should be very low but will vary with sampling rates and averaging. The faster the Transducer reads the torque data the more signal noise you will see. (See table 3 on page 13). This table assumes that no averaging has been applied in the instrument or software interface. From the table you will see that at 4 samples per second the noise levels are very low at less than 1 part in 120,000 and at 4000 samples per second they are below 1 part in 10,000.

To differentiate between signal noise and mechanical input it is worth plotting the output data. At times the minor fluctuations in torque will show valuable diagnostics data and element of torsional vibration.

If you conclude that the noise is a true mechanical reading but you require a steady display, either increase the damping level of the display software or decrease the sampling rate.

Although designed to reject electrical noise, and designed/tested to EMC Standards, the Transducer may be affected by large varying electrical fields. Review all local switching, generating or drive machinery.

If unsure of the status of the data we may be able to assist if you send a log file and a brief description of any effects you are seeing to: support@datum-electronics.co.uk

ZERO OFFSET
The factory zero of the M425 Transducer will be declared on the calibration sheet. If the reading you have at zero differs from this value, look at the raw signal value from the Transducer (either using the user interface software or the detail command). Small offsets can be removed using the zero command on the software interface or the zero button on the Universal Interface. If the offsets continue to appear refer back to the original offset value on your certificate to check that you are not applying an ongoing series of small offsets.

If the offset is large (greater than 0.2mV/V) it is likely that the Transducer has been subjected to a significant torque overload and has a permanent offset. If this is the case and repeated overloads are applied, the Transducer will become inaccurate and may ultimately mechanically fail. You should review your application and consider a higher rating of Transducer.

If the keyways of the Transducer are visually out of line this is a very good indicator that the Transducer has suffered a significant and damaging overload.

NO DATA
If you have no data being transmitted from the Transducer check the LED on top of the Transducer at the opposite end to the cable exit. This LED should be green and on. If the LED is not on check all connections and the supply to the Transducer.

If this LED is on and you have no data check the output:

(1) Universal Interface - this will show a STATUS on line 4 of the display.

(2) (No Serial Data out from the Universal Interface to your device) - if the display on the Universal Interface is reading and showing changing torque and speed values as you apply loads to the Transducer, check the Interface to your system.

2A Baud Rate - the baud rate requested for output can be seen and changed using the software provided.

2B Signal Reversal - some communications over RS485 are described differently and may be reversed.

(3) Bad Data - if you are seeing data from either the Transducer or the Interface that appears invalid, check the connections to your system and the baud rate. The data when streaming in Mode 1 should appear on a simple terminal programme.
MAINTENANCE

SERVICEABLE ITEMS: BEARINGS

The bearings are the only component on the M425 that may require servicing depending on operating conditions. The following provides information on the bearing life under load conditions.

The M425 Transducer has a balanced rotor running between your couplings. The body of the Transducer is supported by two bearings. The life of the bearings at normal running RPM of half the rated RPM is 10 years continuous use.

If you have requirements for high duty sensors where bearing life may be a concern due to other external loads, ask our support team for additional information on our bearing less RS425 and FF425 ranges. These RS/FF designs provide a high degree of flexibility with regard to mounting tolerances and maintenance free operation.

If the shaft of the Transducer is bent the balance of the Transducer will be disturbed and the bearing life will be greatly reduced. Excessive load or mounting misalignment will also affect the life of the bearings. Bearings can be service by return to Datum Electronics.

GLOSSARY OF TERMS

Engineering Units

The transducers/sensors are calibrated in engineering units of either Nm or Lbft.

Full Scale Output

The mV/V is the output from the transducer when the rated load is applied.

mV/V

To measure torque we use a bridge network of resistive strain gauges. These change resistance with the applied strain. The output they give is a ratio of the voltage applied and the mV change in signal from the bridge.

This mV/V ratio is normally quoted in the form

\[ \frac{1.55 \text{mV/V}}{1000 \text{Nm}} \]

The mV/V value is established at calibration by applying a known torque to the shaft. This ratio will remain constant for the life of the transducer/sensor unless damaged.

Noise

Irregular fluctuations that accompany a transmitted electrical signal but are not part of the data generated from the sensor.

Proof Load

The proof load is the load to which the transducer/sensor has been tested - occasional loading to this level should not damage the transducer. Repeated loading to this level will reduce the fatigue life of the transducer and may cause small zero offset over time (usually measured in either Nm or Lbft).

Rated Load

The Rated Load is the design full load of the transducer/sensor (measured in either Nm or Lbft).

Raw Data

Raw data is the raw strain level from the torque shaft. It will include any zero offset.

The scaling of the raw data will require:

\[ \text{Torque} \ [\text{Nm}] = (\text{raw data} \ [\text{mV/V}] - \text{zero offset} \ [\text{mV/V}]) \times \frac{\text{rated torque} \ [\text{Nm}]}{\text{full scale output} \ [\text{mV/V}]}. \]

Sensor

A sensor measures a physical quantity and converts this into a signal. The physical quantity is torque or torsional strain, this is converted into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Span

This is the value of output at the rated load. Either given in terms of mV/V signal or Nm or Lbft when in engineering units.

STEP files

A STEP file is a widely adopted CAD file format used to share 3D models between users with different CAD systems.

Torque

The twisting force on the shaft created by the driving force (motor) and the resisting force (brake or gear).

Transducer

A transducer is defined as a device that converts one form of energy to another. In terms of the M425 Torque Transducer the transducer converts torque into serial data.

NOTE: The words transducer and sensor are often used in this context to mean the same thing.

Zero

This is the value of the signal when the shaft is completely unloaded. Normally quoted in mV/V.