# Table of Contents

**MTE™ Sensor Installation**

## Introduction
- Introduction (Precautions, Patents, Manual Revisions) .................................................................3
- Recommendations for Power, Installation Consideration .................................................................4
- Items Required for Sensor Installation ..................................................................................................5

## MTE, Top Mount Configuration
- System Overview Diagram ...............................................................................................................6
- Sensor Head Installation .......................................................................................................................7
- Sensor Head Alignment .......................................................................................................................8

## MTE, Side Mount Configuration
- System Overview Diagram ...............................................................................................................9
- Sensor Head Installation .......................................................................................................................10
- Sensor Head Alignment .......................................................................................................................12

## Appendix
- A. Specifications ..................................................................................................................................13
- B. Wiring Diagrams ...............................................................................................................................14
- C. Interface Cable Requirements .........................................................................................................15,16
- D. RS-422 Compliance ........................................................................................................................17
- E. Troubleshooting ..............................................................................................................................18
- F. Order Guide ..................................................................................................................................19

## Contacting MicroE Systems
- Contact MicroE..................................................................................................................................20
LASER SAFETY INFORMATION: MTE Series

This product is sold solely for use as a component (or replacement) in an electronic product; therefore it is not required to, and does not comply with, 21 CFR 1040.10 and 1040.11 which pertain to complete laser products. The manufacturer of the complete system-level electronic product is responsible for complying with 21 CFR 1040.10 and 1040.11 and for providing the user with all necessary safety warnings and information.

MicroE encoders contain an infrared laser diode or diodes. Emitted invisible laser radiation levels have been measured to be within the CDRH Class 1 range, which is not considered hazardous; however, to minimize exposure to the diverging beam, the encoder sensor should be installed in its operational configuration in close proximity to the encoder scale before power is applied.

- Invisible laser radiation; wavelength: 850 nm
- Max power 2.4 mW CW
- **CAUTION** – The use of optical instruments with this product will increase eye hazard. **DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS (MICROSCOPES, EYE LOUPES OR MAGNIFIERS).**
- All maintenance procedures such as cleaning must be performed with the MicroE encoder turned off.
- Do not insert any reflective surface into the beam path when the encoder is powered.
- Do not attempt to service the MicroE encoder.

**Precautions**

1. Follow standard ESD precautions. Turn power off before connecting the sensor. Do not touch the electrical pins without static protection such as a grounded wrist strap.
2. Do not touch the tape/glass scale unless you are wearing talc-free gloves or finger cots. Please read this installation manual for full instructions.

**Related Documents**
- MTE Data Sheet
- MTE Interface Drawing
- Compact Encoder Tape (CET™) Scale Installation for MTE Series Encoders

**Patents**
Covered by the following patents: US 5,991,249; EP 895,239; JP 3,025,237; US 6,897,435; and EP 1,451,933. Additional patents and patents pending may apply.

**RoHS**
MTE models are CE and RoHS compliant.
Recommendations for Power; Installation Considerations

MTE™ Series Encoders

1. Recommendations for Power
MTE™ encoders require a minimum of 4.75VDC continuously. When designing circuits and extension cables, be sure to account for voltage loss over distance and tolerances from the nominal supply voltage so that at least 4.75VDC is available to the MTE encoder under all operating conditions. The input voltage should not exceed 5.25VDC.

2. Installation Considerations
The MTE encoder is a precision electronic instrument. It has been designed to function in a wide range of applications and environments. To take full advantage of the modular system design, considerations should be made to allow easy access to the sensor for service and/or replacement.

For optimal performance and reliability:
DO follow standard ESD precautions while handling the sensor and interpolator.
DO allow proper alignment clearance for sensor head alignment.
DO follow setup instructions for the encoder system.
DO, where possible, install the scales in an “upside down” or vertical position to minimize accumulation of dust.
DO consider redundant encoders or additional feedback devices as part of an overall risk management program for medical applications.
DO NOT store sensors in an uncontrolled environment.
DO NOT electrically overstress the sensor (Power supply ripple/noise).
DO NOT intentionally “hot swap” the sensor if the device is energized.
DO NOT use in high contamination applications (dust, oil, excessive humidity, or other airborne contaminants.).
System Overview

MTE™ Series Encoders

Refer to encoder model data sheets for detailed ordering guide and more information about MicroE Part Numbers.

Items Recommended for MTE Encoder Installation Using Compact Encoder Tape (CET) Scales

- Hex wrench (M2.5 for Top Mount, 5/64”, M3.5 and M2.5 for Side Mount).
- For MTE, Top Mount configuration
  - Z height spacer Model Number: ZG-CET (sold separately).
- For MTE Side Mount
  Side Mount Bracket Kit, Model Number: BK-SM-MTE.
  - Z height spacer shim, ships with each bracket kit - 1.00mm (red) for use with CET scales.
- Optional: MK-FFA bracket kit for installation into industry-standard mounting hole patterns.
System Overview, (Top Mount Configuration)

MTE™ Series Encoders

**MTE™ Series**

**System View**

![Diagram of System View]

- **Sensor** (shown attached on a linear slide base with mounting bracket)
- **Compact Encoder Tape scale** (shown mounted on a stationary surface)

**Expanded View**

![Diagram of Expanded View]

- **Sensor mounting screws (2)** and flat washers (2)
- **Typical user-supplied sensor mounting bracket**
Sensor Head Installation (Top Mount Configuration)

MTE™ Series Encoders

1. Verify Sensor Mounting Surface Height

Verify that the distance between the mounting surface of the sensor and the top of the scale is as follows:

Tape scale after blue protective film is removed: 3.84 mm ± 0.15 mm.

MicroE's Z-axis height gauge can be used to easily verify this distance. (P/N: ZG-CET)

Use the gauge to check that there are no gaps between:

1. The mounting surface of the gauge and the mounting bracket, or
2. The bottom surface of the gauge and the scale.

Place the gauge in position and use the mounting screws as guides. If the bottom of the gauge hits the tape, you will see the gap between the gauge bottom mounting surface and your mounting bracket surface.

If you hand tighten the sensor mounting screws, there should be no gap between the tape scale and the bottom of the plastic gauge tool.

2. Install Sensor

Install the sensor on the mounting surface referencing the appropriate datum surface as shown on the Interface Drawing. Use two M2 or 2-56 screws to loosely affix the sensor.

A benching edge is recommended to locate the sensor to meet the mechanical mounting tolerances. Refer to the Interface Drawing for recommended location and height of edge.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Alignment Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Direction of Motion</td>
</tr>
<tr>
<td>Y</td>
<td>± 0.15mm</td>
</tr>
<tr>
<td>Z</td>
<td>± 0.15mm</td>
</tr>
<tr>
<td>θx</td>
<td>± 1.0°</td>
</tr>
<tr>
<td>θy</td>
<td>± 2.0°</td>
</tr>
<tr>
<td>θz</td>
<td>± 2.0°</td>
</tr>
</tbody>
</table>

Note: Tolerance for each axis is specified independently, assuming nominal alignment in all other axes.
Sensor Head Alignment (Top Mount Configuration)

MTE™ Series Encoders

1. Proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the sensor's LED indicator.

The red, yellow, or green Signal LEDs will light depending on sensor alignment. Slowly move the sensor by allowing it to slide on the mounting surface until the green Signal LED, is illuminated. Optimal alignment will be displayed as a “bright green” Signal LED.

Confirm that the green Signal LED blinks when passing over the index. If not, readjust the sensor in the Y direction and repeat the above procedure.

When alignment is completed, tighten the sensor mounting screws (0.37Nm [3.3 inch-lbs.] maximum torque).

2. Confirm that the Signal LED remains green over the full range of motion by sliding the scale past the sensor. The green Signal LED must remain on over the entire range. If not aligned over the entire range of motion, loosen the sensor mounting screws and repeat steps 1 and 2.

The LED will, and should, blink when passing the index mark.
System Overview, (Side Mount Configuration)
MTE™ Series Encoders

MTE™ Series
System View

Compact Encoder Tape scale
(shown mounted on a stationary surface)

Typical user-supplied sensor mounting fixture

Index track

“D” tape scale datum edge
(see MTE Interface Drawing)

Expanded View

Typical user-supplied sensor mounting fixture

Sensor mounting screws
(2) and flat washers (2)

MTE Side Mount Bracket Kit,
Model Number: BK-SM-MTE
Sensor Head Installation (Side Mount Configuration)

MTE™ Series Encoders

Sensor Mounting Orientation and Tolerances

Axis diagram (Side mount bracket not shown.)

MTE Sensor Alignment Tolerances

<table>
<thead>
<tr>
<th>Axis</th>
<th>Alignment Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Direction of Motion</td>
</tr>
<tr>
<td>Y</td>
<td>± 0.15mm</td>
</tr>
<tr>
<td>Z</td>
<td>± 0.15mm</td>
</tr>
<tr>
<td>θX</td>
<td>± 1.0°</td>
</tr>
<tr>
<td>θY</td>
<td>± 2.0°</td>
</tr>
<tr>
<td>θZ</td>
<td>± 2.0°</td>
</tr>
</tbody>
</table>

1. Install the Sensor

Use a wrench and M2, M3 screws to install the sensor and Side Mount Bracket Kit. Refer to the interface drawing to make sure sensor is oriented properly with reference to the scale.

1.1 Install the Side Mount Bracket Kit on to the customer mounting fixture.

1.2 Install the sensor into the Side Mount Bracket Kit.

Customer mounting fixture

Side Mount Bracket Kit, Model Number: BK-SM-MTE

Customer mounting fixture

Side Mount Bracket Kit
Sensor Head Installation (Side Mount Configuration)

MTE™ Series Encoders

2.
Verify Sensor Mounting Surface Height

Refer to the MTE interface drawing for detailed dimensions.

Use the Z-Height red spacer shim (1.00mm) to set the proper Z-height distance between the bottom surface of the Side Mount Bracket Kit/MTE Sensor and the top of the scale.

2.1 Loosen the Mounting Fixture in the Y-axis.

2.2 Place shim between the bottom of the Bracket Kit Adaptor and the top of the scale.

2.3 Press down gently in the Z-axis and tighten the mounting fixture screws.

2.4 Carefully remove the shim by rotating it off the scale with the shim’s handle.
Sensor Head Alignment (Side Mount Configuration)

MTE™ Series Encoders

1. Proper sensor alignment may require minor adjustments to the sensor position with respect to the scale. This can be performed easily using the sensor’s LED indicator.

The red, yellow, or green Signal LEDs will light depending on sensor alignment. Optimal alignment will be displayed as a “bright green” Signal LED.

Confirm that the green Signal LED blinks when passing over the index. If not, readjust the sensor in the Y-direction and repeat the above procedure.

When alignment is completed, tighten the sensor mounting screws (0.37Nm [3.3 inch-lbs.] maximum torque).

2. Confirm that the Signal LED remains green over the full range of motion by sliding the scale past the sensor. The green Signal LED must remain on over the entire range. If not aligned over the entire range of motion, loosen the sensor mounting screws and repeat step 1.

The LED should blink when passing the index mark.
Appendix A
Specifications

System
MTE sensors are compatible with PurePrecision™ Compact Encoder Tape (CET™) Scale.

Scale Pitch 20µm

System Resolution 5µm, 2.5µm, or 1µm (specify at time of ordering)

Linearity
Compact Encoder Tape Scale Linearity \( \leq 10\mu m/m^{*} \)

*After two point correction in the customer’s controller.

Sensor Size & Weight
<table>
<thead>
<tr>
<th>Height</th>
<th>Width</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.33 [8.4mm]</td>
<td>0.50 [12.7mm]</td>
<td>0.81 [20.6mm]</td>
</tr>
</tbody>
</table>

Weight 5g (without cable)

Reliability Information
5 Year Expected Reliability >99.8% under normal operating conditions

Operating and Electrical Specifications

Power Supply 5VDC ±5% @ 135mA max. when used with recommended termination, 80mA max. unterminated

Temperature
Operating 0 to 70°C
Storage -20 to 85°C

Humidity 10 to 90% RH non-condensing

Agency Standards Conformance: In accordance with Electromagnetic Compatibility Directive 2004/108/EC:
EN 55011:2007
EN 61000-4-2, -3, -4, -6

Shock 300G 0.5 ms half sine
Vibration 30G at 17Hz

Sensor Cable Double Shield
Diameter 3.6mm (0.142")
Flex Life 20x10^6 cycles @ 20mm bending radius
Standard 9 pin D-sub connector

Outputs
Digital A-quad-B, Index Window; A, B and IW outputs are differential. Alarm is single ended open drain.

Signal Level
A/B/I (differential): RS-422 compatible
A/B/I (single ended): High >4.2VDC, Low <0.2VDC
Alarm: 0.2VDC-Vcc

Digital Output Signals

<table>
<thead>
<tr>
<th>Quadrature</th>
<th>Index</th>
<th>Alarm</th>
</tr>
</thead>
</table>

Inverse signals are not shown for clarity.

Open drain, requires external pull-up.
Appendix B
Wiring Diagrams

Connector Pin Configuration

### MTE 9P D-Sub Pinouts

<table>
<thead>
<tr>
<th>Pin#</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Alarm</td>
</tr>
<tr>
<td>2</td>
<td>Index Window +</td>
</tr>
<tr>
<td>3</td>
<td>B+</td>
</tr>
<tr>
<td>4</td>
<td>A+</td>
</tr>
<tr>
<td>5</td>
<td>5V</td>
</tr>
<tr>
<td>6</td>
<td>Index Window -</td>
</tr>
<tr>
<td>7</td>
<td>B-</td>
</tr>
<tr>
<td>8</td>
<td>A-</td>
</tr>
<tr>
<td>9</td>
<td>GND/Inner Shield</td>
</tr>
</tbody>
</table>

NOTE: GND and INNER SHIELD ARE INTERNALLY CONNECTED.

**Recommended Signal Termination**

**Digital Outputs:**

- **Alarm:**
  - Alarm output is an open drain, N-channel MOSFET. Drain circuit is normally closed (current flows) and opens when the encoder signal is too low. Alarm requires the use of an external pull-up resistor. See customer supplied circuit example on right.

- **Max cable length:** 5m. Contact MicroE Applications Engineering if longer length required.

**Grounding Considerations**

- **Sensor mounted with good electrical contact to well grounded surface (preferred):**
  - Inner Shield: Insulated from outer shield, sensor case, and connector housing. Connected to circuit common internally as supplied by MicroE Systems.
  - Outer Shield: Connected to sensor and connector housing. Electrically conductive mechanical connection (as supplied by MicroE Systems).

- **Sensor mounted to poorly grounded or non-conducting surface:**
Appendix C

Interface Cable Requirements

1. Customer Interface Cable Requirements
Customer cables that interface to MTE™ series encoders must have the following characteristics:

- Twisted pair signal wiring.
- Characteristic impedance of 100-120 ohms.
- Sufficient wire gauge to meet the minimum voltage requirement at the encoder, for example 24AWG gauge wire for a 2m length cable. Examples of acceptable cables with 24AWG gauge wire and 4 twisted pairs are Belden 9831, 8104, and 9844 or other manufacturer’s equivalents.
- Single shield cable with a minimum of 90% coverage. Note that a double shielded cable may be required in high-noise applications.

2. Signal Wiring
Each differential signal should be connected to a corresponding twisted pair as follows:

<table>
<thead>
<tr>
<th>MTE</th>
<th>Signal</th>
<th>Twisted Pair</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A+</td>
<td>Pair 1</td>
</tr>
<tr>
<td></td>
<td>A-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>B+</td>
<td>Pair 2</td>
</tr>
<tr>
<td></td>
<td>B-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Index+</td>
<td>Pair 3</td>
</tr>
<tr>
<td></td>
<td>Index-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+5V</td>
<td>Pair 4</td>
</tr>
<tr>
<td></td>
<td>GND</td>
<td></td>
</tr>
</tbody>
</table>

3. Shield Termination:
The customer’s cable shield should be in 360° contact with the connector shroud and the connector shell to provide complete shielding. The connector shell should be metal with conductive surfaces. Suggested metal connector shells for use with MTE™ encoders: AMP 748676-1 or equivalent. The shield should be terminated as illustrated in the following diagram.

Fold braided shield back over jacket. Example shows double-shielded cable. Dimensions shown are for illustration only.
Appendix C

Interface Cable Requirements

4. Grounding:

The diagrams below show how to make the connections when the encoder's connector is plugged into the customer's controller chassis. If a customer-supplied extension cable is used, it should be a double shielded cable with conductive connector shells and must provide complete shielding over the conductors contained within it over its entire length. Furthermore, the shields should be grounded at the connection to the controller chassis the same way as the encoder connectors in the diagrams below.

NOTE:
For best performance, isolate the encoder outer shield from motor cable shields and separate the encoder cable as far possible from motor cables.

4.1 Sensor mounted with good electrical contact to a well-grounded surface (preferred)

9-pin D-sub connector grounding: The encoder's connector shell must be in contact with the customer-supplied mating connector, which must be isolated from the controller's ground. If a customer-supplied shielded cable connects the encoder to the controller, then the outer shield on the customer-supplied cable must be isolated from the controller's ground.

The sensor mounting surface must have a low impedance (DC/AC) connection to ground. The encoder sensor mounting surface may have to be masked during painting or anodizing to insure good electrical contact with the sensor.

![Diagram showing sensor mounted with good electrical contact to a well-grounded surface](image)

4.2 Sensor mounted to a surface that is grounded through bearings or a poorly-grounded surface, or mounted to a non-conducting surface

9-pin D-sub connector grounding: The encoder's connector shell must be in contact with the customer-supplied mating connector, which must be connected to the controller's ground. If a customer-supplied shielded cable connects the encoder to the controller, then the outer shield on the customer-supplied cable must be connected to the controller's ground. The controller must be grounded to earth at the point of installation.

The encoder sensor must be mounted so that it is electrically isolated from ground.

![Diagram showing sensor mounted to a surface that is grounded through bearings or a poorly-grounded surface](image)
The MTE is RS-422 compatible. Encoder signals are “sending end terminated.” Therefore customer receiving terminations are not required. If you elect to use them, the supply current will increase.

Optional RS-422 compliant circuitry for long cable runs in harsh electrical environments is illustrated below.
Appendix E
Troubleshooting

Problem
*The Sensor LED indicator won’t turn on.*

Solution
- Make sure that the MTE Series electronics’ 9-pin D-sub connector is fully seated and connected.
- Confirm that +5 Volts DC is being applied to the MTE Sensor. Refer to the MTE interface drawing for proper pinouts.

Problem
*Can't get the MTE Series electronics’ “Signal” LED better than red or yellow; or the green, “Proper Alignment” indicator doesn't stay illuminated over the full length of the scale.*

Solution
- Verify that the sensor is mounted in the correct orientation with reference to the scale and scale mounting reference edge. Refer to the Interface Drawing.
- Verify that the sensor has been aligned to the scale and that the mounting screws are tight. Check the dimensions for the mechanical mounting holes (and clamps if any) to make sure that the sensor is correctly located over the scale in the Y and Z dimensions. Refer to the Interface Drawing.
- Check that the scale is firmly mounted and can’t jiggle or move in any direction.
- Make sure that the scale is clean over its entire length or circumference.
Appendix F
Order Guide

How to Order

**Sensor**

MTE – 20 – 2

<table>
<thead>
<tr>
<th>Cable Length*</th>
<th>Interpolation (Resolution)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = 1.0m</td>
<td>4 = x4 (5µm)</td>
</tr>
<tr>
<td>2 = 2.0m</td>
<td>8 = x8 (2.5µm)</td>
</tr>
<tr>
<td>5 = 5.0m</td>
<td>20 = x20 (1µm)</td>
</tr>
</tbody>
</table>

*I Custom cable lengths and connectors are available. Contact MicroE Applications Engineering.*

**Sensor Installation Tools**

ZG-CET  Z-Height Gauge, Compact Encoder Tape, top mount configuration

**MTE Side Mount Bracket Kit**

BK-SM-MTE  Side Mount Bracket Kit. Reference design is available upon request.

**FlexFit™ Adaptor**

MK-FFA  FlexFit Adaptor Mounting Kit. Reference design is available upon request.

**Scales**

**Compact Encoder Tape (CET™)**

CET20 – N – A – I – xxxx – C

| I = Individual Lengths |
| C = Continuous reel with index and cut marks (unless otherwise specified) |
| Length in mm (10mm-30,000mm) |
| For length >5000mm, contact MicroE for custom P/N. |
| Index |
| I = Center Index |
| C = Custom Index |

Example 1: CET20-N-A-I-4550-C

= 4550mm long, single center index (2775mm from cut marks), continuous

Example 2: CET20-N-A-C-5xxx-I

= Multiple indexes, individually cut, with index dimensions per factory issued part # 5xxx (e.g., index at 50mm and 350mm, segment length 400mm)

Example 3: CET20-N-A-C-5xxx-C

= Single index which is offset from center of segment, continuous, with index dimensions per factory issued part # 5xxx (e.g., index at 50mm from left cut mark, segment length 400mm)

**CET™ Tape Scale Applicator Tools (use for lengths >1m)**

TSAT-CET  Tape Applicator Tool for MTE, top mount configuration

TSAT-SM-PPT  Tape Applicator Tool for MTE, side mount configuration

**End Cap Kit, PurePrecision Tape Scales**

EC  Optional Tape Scale End Caps
MicroE Systems is a world leader in optical encoder technology with offices in major industrial centers around the globe.

To learn more about MicroE Systems products, visit: www.microesystems.com.

Our products have been used by thousands of companies worldwide to solve a wide range of motion control applications. Our advanced encoder technology and application expertise has driven innovations in the design of machinery, equipment and instrumentation in many industries, including medical, industrial, robotics, automation, metrology, semiconductor manufacturing, packaging equipment, entertainment, energy, military, and scientific research.