



### *Safety Evaluation within a Magnetic Field Environment*

## **Exposure Level Tester ELT-400**



- ◆ **Direct Evaluation of Field Exposure Compared to Major Standards (IEEE C95.6)**
- ◆ **Automatic Exposure Evaluation for Various Waveforms**
- ◆ **Eliminates the Overestimation that Can Occur with FFT-based Evaluation**
- ◆ **Ultra-Wide Frequency Range (1 Hz to 400 kHz)**
- ◆ **Wide Measurement Range (up to 80 mT, type-dependent)**
- ◆ **Isotropic 100 cm<sup>2</sup> and 3 cm<sup>2</sup> Probe (complies with standards)**
- ◆ **Three-Channel Scope Output**

### **Applications**

The ELT-400 is an innovative exposure level meter for measuring magnetic fields in the workplace and public spaces. It is designed for health and safety professionals in manufacturing, the insurance business and the service industry. This instrument handles virtually any level measurement in the low and medium-frequency range, simply and precisely. It is comparable to sound level meters commonly used in noise assessment at the workplace.

#### **PRODUCTION AREA**

The ELT-400 is ideal for use with diverse manufacturing machinery, including induction heating, melting, and hardening equipment. Also, due to the extremely low frequency limit and high power capability, most magnetic stirrers can be measured. Special demands often occur with machinery in production areas where non-sinusoidal signals are common, e.g., in industrial applications that use resistance welding machinery (pulse waveform, phase angle control) with traditional 50/60 Hz systems as well as in newer medium-frequency switching units.

#### **GENERAL ENVIRONMENT**

In public spaces, complex fields occur with several kinds of electronic surveillance systems. Most of the electromagnetic and acousto-magnetic gates are operated in the frequency range of the ELT-400.

#### **EMC TEST HOUSE**

Magnetic fields generated by household appliances or other electrical devices are receiving increased attention. Some new standards such as EN 50366 (IEC 62233) describe how to evaluate such products. The ELT-400 is the ideal measuring device for compliance with these standards. Benefits include the perfectly matched frequency range and implementation of the specified transfer function.



## ELT-400 Exposure Level Tester

This new generation ELT-400 greatly simplifies the assessment process. With the EXPOSURE STD (Shaped Time Domain) mode, the instrument achieves a new standard in the simple but reliable measurement of magnetic fields, whether straightforward or in complex field environments. Time-consuming and easily-misinterpreted measurements with a spectrum analyzer or a scope are rendered obsolete. Detailed knowledge about the evaluation procedure, field waveform or frequency is no longer needed. The results are reliable and speed and ease of use are significantly improved over all traditional methods.

### Basic Operation

The ELT-400 covers the wide frequency range of 1 Hz to 400 kHz which is far beyond the reference limits of common guidelines. This instrument has an external isotropic magnetic field probe with a 100 cm<sup>2</sup> cross-sectional area, making it suitable for standards-compliant measurement even in inhomogeneous fields.

The ELT-400 has a rugged housing and is easy to operate using only six buttons. The instrument settings and measurement results are clearly displayed on a backlit LCD display.

An optional probe extension cable is especially designed for low influence on the frequency response and sensitivity of the instrument. This cable is a good choice in cases where the probe and instrument must be handled separately. The ELT-400 is available with different operating mode combinations, e.g., "Exposure STD" or "Field Strength." See *Ordering Information* section for details.

### Exposure Std (Shaped Time Domain) Mode

#### SIGNAL-SHAPE-INDEPENDENT FIELD EVALUATION

In EXPOSURE STD mode, the level of the magnetic (B) field is directly displayed as a "Percent of Standard" regardless of the signal shape and frequency. The numeric result clearly reflects the current situation and the remaining safety margin. The implemented method can be compared to sound level meters that are commonly used to determine noise in the workplace.

A standard's variation with frequency is normalized through an appropriate filter. Knowledge about the frequency or the frequency-dependent limits is no longer needed. The standard is easily selected with a single keypress. Signals with one

or more frequencies are no problem. Newer safety standards and guidelines also specify waveform-specific evaluation procedures. For example, stationary sinusoidal and pulsed fields are differentiated. With the ELT-400 the waveform is automatically taken into account. The user no longer needs any knowledge about the waveform or the duty cycle. Pulse signal measurements are also possible. Different evaluation patterns are occasionally specified in the standard for some selected pulse waveforms. These patterns (valid for all imaginable waveforms) are directly handled by EXPOSURE STD mode. This completely eliminates the need to analyze the waveform in the time domain using a scope.

Even when faced with pulses that include DC fields, the EXPOSURE STD method provides valuable results. The ELT-400 covers all the relevant signal components down to 1 Hz so that correct assessments can be made.

Occasionally, both the RMS value and the peak value are critical for assessing exposure in the low-frequency range. Both detector types are provided and are simultaneously activated in the default setting. Depending on the incoming signal and standard selected, the most suitable detector is automatically employed at all times. The necessary weighting factors are also taken into account. The detectors may also be selected independently for further interpretation of the signal.

Detailed knowledge of the field, the test equipment, and other auxiliary conditions are necessary for insight into the degree of exposure when using traditional analysis instruments. The exposure level is derived through extensive calculation. Results can be easily misinterpreted or can have problems. For example – with ICNIRP standard – FFT spectrum analysis tends to overestimate results. The ELT-400 eliminates misinterpretation. It continuously monitors the field and the results are permanently updated. Any change in the field, e.g., due to a power reduction, can be immediately evaluated. Proper evaluation in a personal safety context is achieved quickly and reliably using the STD technique.

### Field Strength Mode

#### BROADBAND FIELD STRENGTH MEASUREMENTS

If the field under test has essentially a single-frequency component, the broadband mode is also a good choice.



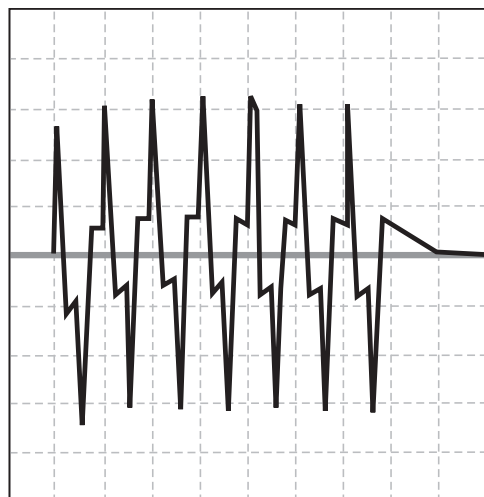
The ELT-400 provides an ultra-wideband, flat frequency response. The measurement range can handle extremely high field strength levels. Both RMS and peak detectors are available for broadband measurement. The field strength result is displayed in "Tesla."

### Active Field Probe

#### THREE-AXIS ANALOGUE SIGNAL OUTPUT

In scientific studies or advanced signal-shape / frequency analysis, a scope or an FFT analyzer may be connected to the analog output. The output signal ensures proper phase within the three axes and covers the full bandwidth of the instrument.

The buffered output provides an adequate voltage swing to allow simple operation.





# Electric and Magnetic Field Measurement

## ELT-400 Exposure Level Tester

### Specifications<sup>a</sup>

| ELT - 400 with 100 cm <sup>2</sup> Probe |   |        |         |       |          |       |
|--|---|--------|---------|-------|----------|-------|
| Frequency Range (-3 dB), selectable      | 1 Hz to 400 kHz, 10 Hz to 400 kHz, 30 Hz to 400 kHz   |        |         |       |          |       |
| Antenna Type                             | Magnetic (B) Field  |        |         |       |          |       |
| Sensor Type                              | Isotropic Coil 100 cm <sup>2</sup>  |        |         |       |          |       |
| Damage Level RMS                         | 160 mT The damage level reduces linearly with increasing frequency above 77.5 Hz (1/f)  |        |         |       |          |       |
| Damage Level Peak                        | 226 mT The damage level reduces linearly with increasing frequency above 620 Hz (1/f)<br>The damage level (peak) applies for pulse duration ≤15.6 ms and duty cycle ≤1/64   |        |         |       |          |       |
| Measurement Uncertainty <sup>d</sup>     | ±4% (50 Hz to 120 kHz)  |        |         |       |          |       |
| Mounting Thread                          | 1/4-20UNC-2B (standard thread)  |        |         |       |          |       |
| EXPOSURE STD MODE                        |   |        |         |       |          |       |
| Exposure Evaluation                      | Comparison with Standard (see Ordering Information)   |        |         |       |          |       |
| MODE <sup>b</sup>                        | ICNIRP  |        | BKV B11 |       | EN 50366 |       |
| RANGE                                    | LOW   | HIGH   | LOW     | HIGH  | LOW      | HIGH  |
| Overload Limit                           | 160%  | 1600%  | 160%    | 1600% | 160%     | 1600% |
| Noise Level <sup>c</sup> , typical       | 1%  | 5%     | 0.4%    | 2%    | 0.4%     | 2%    |
| Resolution (Range: Low)                  | 0.001%  |        |         |       |          |       |
| Detection, selectable                    | Automatic according to Selected Standard or RMS (averaging time 1 s) or Peak Value  |        |         |       |          |       |
| Display Mode, selectable                 | Instantaneous or Max Hold   |        |         |       |          |       |
| FIELD STRENGTH MODE                      |   |        |         |       |          |       |
| Frequency Response                       | Flat  |        |         |       |          |       |
| MODE <sup>b</sup>                        | 320 μT  |        | 8 mT    |       | 80 mT    |       |
| RANGE                                    | LOW   | HIGH   | LOW     | HIGH  | LOW      | HIGH  |
| Overload Limit                           | 32 μT   | 320 μT | 800 μT  | 8 mT  | 8 mT     | 80 mT |
| Noise Level, typical <sup>e</sup>        | 60 nT   | 320 nT | 1 μT    | 8 μT  | 10 μT    | 80 μT |
| Resolution (RANGE: LOW)                  | 1 nT  |        |         |       |          |       |
| Detection, selectable                    | RMS (averaging time 1 s) or Peak Value  |        |         |       |          |       |
| Display Mode, selectable                 | Instantaneous or Max Hold   |        |         |       |          |       |
| OUTPUT                                   |   |        |         |       |          |       |
| Analog Scope Output                      | Three Channel (X-Y-Z)   |        |         |       |          |       |
| Analog Output Level                      | The open-circuit analog output voltage is 800 mV when the field strength value corresponds to the overload limit (sensitivity = 800 mV / overload limit)<br>(ELT-400 output impedance = 50 Ω, load impedance ≥ 10 kΩ) |        |         |       |          |       |
| Interface (Remote Control and Readout)   | RS-232 (19200 baud, 8n1, XON/XOFF), 3-Wire, 2.5 mm Stereo Jack  |        |         |       |          |       |
| GENERAL SPECIFICATIONS                   |   |        |         |       |          |       |
| Operating Temperature Range              | -10°C to +50°C  |        |         |       |          |       |
| Operating Humidity Range                 | <95% (30°C) or <29 g/m <sup>3</sup> , non-condensing  |        |         |       |          |       |
| Weight, Typical                          | 2 lbs. (910 g) with probe   |        |         |       |          |       |
| Dimensions, Typical                      | 7.1 x 3.9 x 2.2 inches (180 x 100 x 55 mm) without probe / probe 11.8 x 4.9 Ø inches (300 x 125 Ø mm)   |        |         |       |          |       |
| Display Type                             | LCD with Backlight; refresh rate 4 times per second   |        |         |       |          |       |
| Battery                                  | NiMH Batteries (4 x Mignon, AA), exchangeable   |        |         |       |          |       |
| Operating Life, Typical                  | 12 hours  |        |         |       |          |       |
| Charger Unit                             | 100 to 240 V AC / 47 to 63 Hz, fits all AC line connectors  |        |         |       |          |       |
| Charging Time, Typical                   | 2 hours   |        |         |       |          |       |
| Calibration Interval, recommended        | 24 Months   |        |         |       |          |       |



### Specifications (con't) <sup>a</sup>

| ELT - 400 with 3 cm <sup>2</sup> Probe |   |         |         |         |          |         |
|--|---|---------|---------|---------|----------|---------|
| Frequency Range (-3 dB), selectable    | 1 Hz to 400 kHz, 10 Hz to 400 kHz, 30 Hz to 400 kHz   |         |         |         |          |         |
| Antenna Type                           | Magnetic (B) Field  |         |         |         |          |         |
| Sensor Type                            | Isotropic Coil 3 cm <sup>2</sup>  |         |         |         |          |         |
| Damage Level RMS                       | 1500 mT The damage level reduces linearly with increasing frequency above 30 Hz (1/f)   |         |         |         |          |         |
| Damage Level Peak                      | 2121 mT The damage level reduces linearly with increasing frequency above 240 Hz (1/f)<br>The damage level (peak) applies for pulse duration ≤15.6 ms and duty cycle ≤1/64  |         |         |         |          |         |
| Measurement Uncertainty <sup>d</sup>   | ±6% (50 Hz to 120 kHz)  |         |         |         |          |         |
| Mounting Thread                        | 1/4-20UNC-2B (standard thread)  |         |         |         |          |         |
| EXPOSURE STD MODE                      |   |         |         |         |          |         |
| Exposure Evaluation                    | Comparison with Standard (see Ordering Information)   |         |         |         |          |         |
| MODE <sup>b</sup>                      | ICNIRP  |         | BGV B11 |         | EN 50366 |         |
| RANGE                                  | LOW   | HIGH    | LOW     | HIGH    | LOW      | HIGH    |
| Overload Limit                         | 1500%   | 15,000% | 1500%   | 15,000% | 1500%    | 15,000% |
| Noise Level <sup>c</sup> , typical     | 10%   | 50%     | 4%      | 20%     | 4%       | 20%     |
| Resolution (Range: Low)                | 0.001%  |         |         |         |          |         |
| Detection, selectable                  | Automatic according to Selected Standard or RMS (averaging time 1 s) or Peak Value  |         |         |         |          |         |
| Display Mode, selectable               | Instantaneous or Max Hold   |         |         |         |          |         |
| FIELD STRENGTH MODE                    |   |         |         |         |          |         |
| Frequency Response                     | Flat  |         |         |         |          |         |
| MODE <sup>b</sup>                      | 320 μT  |         | 8 mT    |         | 80 mT    |         |
| RANGE                                  | LOW   | HIGH    | LOW     | HIGH    | LOW      | HIGH    |
| Overload Limit                         | 300 μT  | 3 mT    | 7.5 mT  | 75 mT   | 75 mT    | 750 mT  |
| Noise Level, typical <sup>e</sup>      | 600 nT  | 3.2 μT  | 10 μT   | 80 μT   | 100 μT   | 800 μT  |
| Resolution (RANGE: LOW)                | 1 nT  |         |         |         |          |         |
| Detection, selectable                  | RMS (averaging time 1 s) or Peak Value  |         |         |         |          |         |
| Display Mode, selectable               | Instantaneous or Max Hold   |         |         |         |          |         |
| OUTPUT                                 |   |         |         |         |          |         |
| Analog Scope Output                    | Three Channel (X-Y-Z)   |         |         |         |          |         |
| Analog Output Level *                  | The open-circuit analog output voltage is 800 mV when the field strength value corresponds to the overload limit (sensitivity = 800 mV / overload limit)<br>(ELT-400 output impedance = 50 Ω, load impedance ≥ 10 kΩ) |         |         |         |          |         |
| Interface (Remote Control and Readout) | RS-232 (19200 baud, 8n1, XON/XOFF), 3-Wire, 2.5 mm Stereo Jack  |         |         |         |          |         |
| GENERAL SPECIFICATIONS                 |   |         |         |         |          |         |
| Operating Temperature Range            | -10°C to +50°C  |         |         |         |          |         |
| Operating Humidity Range               | <95% (30°C) or <29 g/m <sup>3</sup> , non-condensing  |         |         |         |          |         |
| Weight, Typical                        | 1.9 lbs. (840 g) with probe   |         |         |         |          |         |
| Dimensions, Typical                    | 7.1 x 3.9 x 2.2 inches (180 x 100 x 55 mm) without probe / probe 9.8 x 1.3 Ø inches (250 x 32 Ø mm)   |         |         |         |          |         |
| Display Type                           | LCD with Backlight; refresh rate 4 times per second   |         |         |         |          |         |
| Battery                                | NiMH Batteries (4 x Mignon, AA), exchangeable   |         |         |         |          |         |
| Operating Life, Typical                | 12 hours  |         |         |         |          |         |
| Charger Unit                           | 100 to 240 V AC / 47 to 63 Hz, fits all AC line connectors  |         |         |         |          |         |
| Charging Time, Typical                 | 2 hours   |         |         |         |          |         |
| Calibration Interval, recommended      | 24 Months   |         |         |         |          |         |



## ELT-400 Exposure Level Tester

### NOTES (for Spec Tables on 2 previous pages)

- <sup>a</sup> Unless otherwise stated, these specifications apply for the reference condition: ambient temperature 23±3°C, relative air humidity 40% to 60%, continuous wave signal (CW), RMS detection (frequency range: 30 Hz to 400 kHz)
  - <sup>b</sup> Type-dependent, see Ordering Information
  - <sup>c</sup> Detection: automatic according to selected standard
  - <sup>d</sup> Includes flatness, isotropy, absolute and linearity variations (frequency range: 1 Hz to 400 kHz or 10 Hz to 400 kHz). The uncertainty increases at the frequency band limits (10 Hz, 30 Hz, 400 kHz) to ±1 dB based on the nominal frequency response.
  - <sup>e</sup> For Frequency Range 1 Hz to 400 kHz and 10 Hz to 400 kHz only
- \* Preliminary guide values. The overload limit will be specified more precisely to allow specification of the analog output.

## Ordering Information

| ELT-400 SET   | ORDERING NUMBER |
|---|-----------------|
| Calibrated Basic Unit and B-Field Probe (100 cm <sup>2</sup> ), Certificate of Calibration, Charger (fits all AC line connectors), Operating/Programming Manual, and Rechargeable Batteries<br><br>EXPOSURE STD: EN 50366 (IEC 62233)<br>EXPOSURE STD: ICNIRP occ.<br>FIELD STRENGTH: 320 µT<br>FIELD STRENGTH: 80 mT | 2304/103/USA    |
| <b>ACCESSORIES SUPPLIED:</b>  |                 |
| Probe Extension Cable (length 1 m)  | 2300/90.30      |
| Serial Interface Cable (length 2 m) – Stereo Jack / DB9   | 2260/90.51      |
| Analog Interface Cable (length 3 m) – D-SUB15 / 3xBNC   | 2260/90.80      |
| Transport Case  | 2245/90.07      |
| <b>OPTIONAL ACCESSORIES:</b>  |                 |
| Tripod, non-conductive (height 1.65 m)  | 2244/90.31      |
| Tripod Extension, non-conductive (height 0.5 m)   | 2244/90.45      |
| B-field Probe 3 cm <sup>2</sup><br><i>(Upgrade required for all ELT 400 with Firmware Version below 2.1 or Serial Number A-0001 til H-9999)</i>   | 2300/90.20      |