

# Safety Evaluation Within a Magnetic Field Environment

## Exposure Level Tester ELT-400



- Direct evaluation of field exposure in comparison with major standards
- Automatic exposure evaluation for various waveforms
- Eliminates the overestimation that occasionally occurs with FFT-based evaluation
- Ultra wide frequency range (1 Hz to 400 kHz)
- Wide measurement range (up to 80 mT, dependent on type)
- Standard-compliant isotropic 100 cm<sup>2</sup> probe and 3 cm<sup>2</sup> probe
- Three-axis analog signal output

### APPLICATIONS



The ELT-400 is an innovative exposure level meter for measuring magnetic fields in the workplace and in public spaces. The model is designed for health and safety professionals in industry, the insurance business and service industries. The instrument can simply and precisely handle practically any level measurement required in the low and medium-frequency range. It is comparable to the sound level meters that are commonly used in the assessment of noise at the workplace.



#### Production Areas

The ELT-400 is useful for checking fields caused by various manufacturing plant, including induction heating, melting and hardening equipment. Thanks to its extremely low frequency limit and high power capability, it can also be used to check most magnetic stirrers.

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

The different types of electronic article surveillance systems generate complex fields in public spaces. Most electromagnetic and magnetoacoustic gates operate within the frequency range of the ELT-400.



## EMC Test House

The magnetic fields generated by household appliances or other electrical devices have become the focus of increased attention. Some new standards such as EN 50366 describe how to investigate such products. The ELT-400 is the ideal measuring device when it comes to compliance with these standards. Benefits include the perfectly matched frequency range and implementation of the specified transfer function.

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

## BASIC OPERATION

The ELT-400 covers the wide frequency range of 1 Hz to 400 kHz. The measurement range of the ELT-400 is far wider than the reference limits of common guidelines. The instrument has an external isotropic magnetic field probe with a 100 cm<sup>2</sup> cross-sectional area. This is suitable for standards-compliant measurement even in non-homogeneous fields. The ELT-400 has a rugged housing and is easy to operate using only six buttons. The measurement result and the instrument settings are clearly displayed on a backlit LCD panel.

The optional probe extension cable is specially designed for low influence on the frequency response and sensitivity of the instrument. The cable is a good choice in cases where the probe and instrument must be handled separately. Variants of the ELT-400 are available with different operating mode combinations, e.g. "Exposure STD" or "Field Strength". Please refer to the 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 method employed can be compared to sound level meters that are commonly used to determine noise in the workplace. The variation with frequency specified in the standard is normalized by means of an appropriate filter. Users no longer need to know the frequency or the frequency-dependent limits. The standard is easily selected by pressing just one button. Multifrequency signals are just as easy to measure as single frequencies.

The 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. Users no longer need any knowledge about the waveform or the duty cycle. Measurements on pulsed signals are also possible. Different evaluation patterns are occasionally specified in the standard for certain 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 signal components down to 1 Hz that are relevant in assessing such a situation.



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 is necessary to obtain 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 other problems may occur. For example, FFT spectrum analysis tends to overestimate results for the ICNIRP standard. The ELT-400 continuously monitors the field, and the results are constantly updated. Any change in the field, e.g. due to a power reduction, can be evaluated immediately.

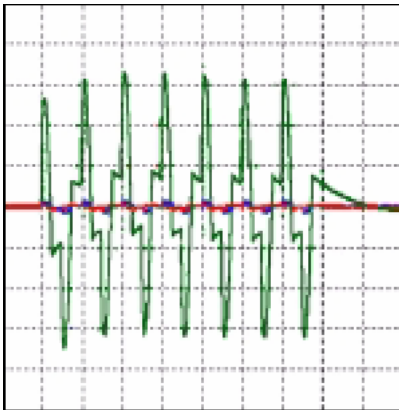
Proper evaluation in a personal safety context is achieved quickly and reliably using the STD technique.

## FIELD STRENGTH MODE

### Broadband Field Strength Measurements

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

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



## ACTIVE FIELD PROBE

### Three-Axis Analog Signal Output

For scientific studies or advanced signal-shape / frequency analysis, a scope or an FFT analyzer can 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 for simple operation.

## SPECIFICATIONS <sup>a</sup>

<b>ELT – 400 with 100 cm<sup>2</sup> probe</b>						
Frequency range (-3dB), 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).				
	Peak	226 mT The damage level reduces linearly with increasing frequency above 620 Hz (1/f). 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)				
<b>EXPOSURE STD MODE</b>						
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		160 %	1 600 %	160 %	1 600 %	160 % 1 600 %
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				
<b>FIELD STRENGTH MODE</b>						
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				
<b>OUTPUT</b>						
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 = 800mV / overload limit) (ELT-400 output impedance = 50 Ω, load impedance ≥ 10 k Ω)				
Interface (remote control and readout)		RS-232 (19200 baud, 8n1, XON/XOFF), 3-wire, 2.5 mm stereo jack				
<b>GENERAL SPECIFICATIONS</b>						
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		910 g (with probe)				
Dimensions, typical		180 x 100 x 55 mm (without probe) / 300 x 125 Ø mm (probe)				
Display type		LCD with backlight; refresh rate 4 times per second				
Battery		NiMH batteries (4 x Mignon, AA), exchangeable				
	Operating life, typical	12 h				
	Charger unit	100 to 240 V AC / 47 to 63 Hz, fits all AC line connectors				
	Charging time, typical	2 h				
Calibration interval, recommended		24 months				

<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> Depends on type; see under 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.

<b>ELT – 400 with 3 cm<sup>2</sup> probe</b>							
Frequency range (-3dB), 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).					
	Peak	2121 mT The damage level reduces linearly with increasing frequency above 240 Hz (1/f). The damage level (peak) applies for pulse duration $\leq 15.6$ ms and duty cycle $\leq 1/64$ .					
Measurement uncertainty <sup>d</sup>		$\pm 6$ % (50 Hz to 120 kHz)					
Mounting thread		1/4-20UNC-2B (standard thread)					
<b>EXPOSURE STD MODE</b>							
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		1 500 %	15 000 %	1 500 %	15 000 %	1 500 %	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					
<b>FIELD STRENGTH MODE</b>							
Frequency response		Flat					
MODE <sup>b</sup>		320 $\mu$ T		8 mT		80 mT	
RANGE		LOW	HIGH	LOW	HIGH	LOW	HIGH
Overload limit		300 $\mu$ T	3 mT	7.5 mT	75 mT	75 mT	750 mT
Noise level, typical <sup>e</sup>		600 nT	3.2 $\mu$ T	10 $\mu$ T	80 $\mu$ T	100 $\mu$ T	800 $\mu$ T
Resolution (RANGE: LOW)		1 nT					
Detection, selectable		RMS (averaging time 1 s) or Peak Value					
Display mode, selectable		Instantaneous or Max Hold					
<b>OUTPUT</b>							
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 = 800mV / overload limit) (ELT-400 output impedance = 50 $\Omega$ , load impedance $\geq 10$ k $\Omega$ )					
Interface (remote control and readout)		RS-232 (19200 baud, 8n1, XON/XOFF), 3-wire, 2.5 mm stereo jack					
<b>GENERAL SPECIFICATIONS</b>							
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		840 g (with probe)					
Dimensions, typical		180 x 100 x 55 mm (without probe) / 250 x 32 $\varnothing$ mm (probe)					
Display type		LCD with backlight; refresh rate 4 times per second					
Battery		NiMH batteries (4 x Mignon, AA), exchangeable					
	Operating life, typical	12 h					
	Charger unit	100 to 240 V AC / 47 to 63 Hz, fits all AC line connectors					
	Charging time, typical	2 h					
Calibration interval, recommended		24 months					

<sup>a</sup> Unless otherwise stated, these specifications apply for the reference condition: ambient temperature 23  $\pm$ 3 °C, relative air humidity 40 % to 60 %, continuous wave signal (CW), RMS detection (frequency range: 30 Hz to 400 kHz)

<sup>b</sup> Depends on type; see under 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  $\pm 1$  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.



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## ORDERING INFORMATION

<b>ELT-400 Set</b>		<b>Ordering Number</b>
Calibrated Basic Unit and B-field probe (100 cm <sup>2</sup> ), with calibration certificate, charger unit (fits all AC line connectors), operating / programming manual, and rechargeable batteries		
<b>MODES (included in instrument)</b>		
<ul style="list-style-type: none"> <li>• EXPOSURE STD: ICNIRP gen. pub.</li> <li>• EXPOSURE STD: ICNIRP occ.</li> </ul>	<ul style="list-style-type: none"> <li>• FIELD STRENGTH: 320 µT</li> <li>• FIELD STRENGTH: 80 mT</li> </ul>	<b>2304/101</b>
<ul style="list-style-type: none"> <li>• EXPOSURE STD: BGV B11 EXP2</li> <li>• EXPOSURE STD: BGV B11 EXP1</li> </ul>	<ul style="list-style-type: none"> <li>• EXPOSURE STD: BGV B11 2H/D</li> <li>• FIELD STRENGTH: 8 mT</li> </ul>	<b>2304/102</b>
<ul style="list-style-type: none"> <li>• EXPOSURE STD: EN 50366</li> <li>• EXPOSURE STD: ICNIRP occ.</li> </ul>	<ul style="list-style-type: none"> <li>• FIELD STRENGTH: 320 µT</li> <li>• FIELD STRENGTH: 80 mT</li> </ul>	<b>2304/103</b>

<b>Optional Accessories</b>	<b>Ordering Number</b>
Probe extension cable (length 1 m)	<b>2300/90.30</b>
Serial interface cable (length 2 m) – Stereo jack / DB9	<b>2260/90.51</b>
Analog interface cable (length 3 m) – D-SUB15 / 3 x BNC	<b>2260/90.80</b>
Tripod, non-conductive (height 1.65 m)	<b>2244/90.31</b>
Tripod extension, non-conductive (height 0.5 m)	<b>2244/90.45</b>
Transport case	<b>2245/90.07</b>
B-field probe 3 cm <sup>2</sup> <i>(Upgrade required for all ELT-400 with Firmware Version below 2.1 or Serial Number A-0001 till H-9999)</i>	<b>2300/90.20</b>



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