TANDO 700

Technical Data

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1 Technical data

1.1 Care and cleaning

TANDO 700, *MCU1* and *SHT1* do not require any special maintenance or care. Clean the devices from time to time or as necessary.

WARNING

Death or severe injury caused by high voltage or current possible

- ► Switch off the high voltage before disconnecting the system.
- ► Always observe the five safety rules (see 1.2.2 "Safety rules" on page 6).

To clean *TANDO 700*, use a cloth dampened with isopropanol alcohol or water.

1.2 *TANDO 700* acquisition unit

1.2.1 Specification standard system

Table 1-1: Specification of the standard system

Value	Condition	Accuracy[1)]
Dissipation factor / Power factor	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.1 % rdg. + 1 x 10^{-4}
Capacitance (DUT)	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.1 % rdg. + 0.1 pF
Current	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.1 % rdg. + 0.1 nA
Voltage	10 pF ≤ C_{Ref} ≤ 10 nF	0.5 % rdg. + 1 V
Frequency	5 Hz … 400 Hz	0.0025 % rdg.

1) The accuracies are given without errors depending on C_{Ref}, input combination and parasitic capacitances (see Table 1-3: "Additional specifications" on page 5). The specified accuracies are valid for the frequency of the test voltage at 50/60 Hz, SINAD of power source < 12 dB and a temperature range of 23 °C ±5 °C.

Note: Calibration of the *TANDO 700* is recommended every 2 years.

1.2.2 Specification advanced system

Table 1-2: Specification of the advanced system

Value	Condition	Guaranteed accuracy[1)]	Typical accuracy[1)]
Dissipation factor/ Power factor	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.1 % rdg. + 2 x 10^{-5}	< 5 x 10^{-6}
Capacitance (DUT)	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.05 % rdg. + 0.05 pF	0.005 %
Current	Auto mode 5 µA ≤ I_{IN} ≤ 1 A	0.05 % rdg. + 0.05 nA	< 0.02 %
Voltage	10 pF ≤ C_{Ref} ≤ 10 nF	0.2 % rdg. + 1 V	< 0.02 %
Frequency	5 Hz … 400 Hz	0.001 % rdg.	< 0.001 % rdg.

1) The accuracies are given without errors depending on C_{Ref}, input combination and parasitic capacitances (see Table 1-3: "Additional specifications" on page 5). The specified accuracies are valid for the frequency of the test voltage at 50/60 Hz, SINAD of power source < 12 dB and a temperature range of 23 °C ±5 °C.

Note: Calibration of the *TANDO 700* is recommended every 2 years.

1.2.3 Additional specifications

Accuracies (see Table 1-1: on page 3 and Table 1-2: on page 4) are not influenced if the occurring parasitic capacitances are within the given values:

Table 1-3: Additional specifications

Measuring range	Max. parasitic capacitances
1.2 mA	750 pF
200 mA	250 pF
1 A	2.3 nF
SHT1 version A: 4 A	25 nF
SHT1 version B: 15 A	250 nF
SHT1 version C: 28 A	850 nF

The influence of the parasitic capacitance on the dissipation factor is calculated according to the formula:
$Err_{\tan\text{-}\delta\ (parasitic)} = \omega R_i C_{parasitic}$

Table 1-4: Additional error depending on test frequency (error = 0 at 55 Hz)

	ΔC	Δtan-δ
Typical coefficient	$4 \times 10^{-6} \frac{\%}{Hz}$	$2.5 \times 10^{-6} \frac{\%}{Hz}$

Table 1-5: Additional error depending on ambient temperature (error = 0 at 25 °C)

	ΔC	Δtan-δ
Typical coefficient	$1 \times 10^{-4} \frac{\%}{°C}$	$3 \times 10^{-7} \frac{\%}{°C}$

Table 1-6: Additional error depending on temperature difference between sensors (error = 0 at 0 K)

	ΔC	Δtan-δ
Typical coefficient	$1.5 \times 10^{-4} \frac{\%}{K}$	$8 \times 10^{-6} \frac{\%}{K}$

1.2.4 Resolution / display / measuring range

Table 1-7: Resolution / display / measuring range

Value	Measuring range	Standard system	Advanced system
Phase angle	-π … π	0.1×10^{-4}	1×10^{-8}
Capacitance (DUT)	See Table 1-8: "System data" on page 6	1 pF 5 digits	0.01 pF 6 digits
Current	1 nA … 1 A	0.1 pA 5 digits	0.1 pA 6 digits
Voltage	0 V … 1 MV	1 µV 5 digits	1 µV 6 digits
Frequency	5 Hz … 400 Hz	0.01 mHz 5 digits	0.01 mHz 6 digits

1.2.5 System data

Table 1-8: System data

Direct input:		
1.2 mA	Impedance	17 Ω (±15 %)
	Current range	0.5 µA … 1.2 mA
	Capacitance (DUT)[2] range	C_{min}[1] … 3 nF
Internal shunt input:		
200 mA input	Impedance	50 Ω (±2 %)
	Current range	1 mA … 200 mA
	Capacitance (DUT)[2] range	C_{min}[1] … 30 nF
1 A input	Impedance	5.4 Ω (±2 %)
	Current range	10 mA … 1 A
	Capacitance (DUT)[2] range	C_{min}[1] … 300 nF
Connection to *MCU1*:		
Fiber-optic	Wave length	1300 nm
	Mode	Multimode 50 / 125 µm
	Fiber length	Up to 2 km
Others:		
Data acquisition	Sampling rate	7.812 kS/s
Reference capacitor	Capacitance range	10 pF … 10 nF

1) $C_{min} = I_{min} / (\omega\ U_{test})$

2) Without external shunt

1.2.6 Power data

Table 1-9: Power data

Parameter	Value
Supply voltage (Power input)	9 V … 24 V DC, 24 W
External power supply unit FW7362M/18/OM	Input range: 100 V … 240 V 50 Hz … 60 Hz 10 °C … 55 °C[1)]
Power consumption	< 100 mW active < 1 mW standby < 15 W charging
Internal battery pack Battery exchange Internal battery charge period Typical charging duration	Rechargeable lithium battery 3.7 V / 11.6 Ah Every 4 years Minimum 21 days Maximum 4 h (7 h charging by *RBP1*)

1) For charging, note that the temperature limits of the internal battery have to be considered.

1.2.7 Mechanical data

Table 1-10: Mechanical data

Characteristic	Rating
Dimensions (W x D x H)	115 mm x 175 mm x 55 mm
Weight	0.92 kg
Connections	Front: Two ST connectors for fiber-optic network One 4 pin DC input socket, LEMO FFA
	Rear: Two 4 mm banana red/black plug One 4 pin shunt socket, LEMO FGG
Indicator	Bar graph display with status indicator

1.2.8 Environmental conditions

Table 1-11: Environmental conditions

Characteristic	Rating
Operating temperature	-10 °C … +50 °C
Storage temperature	-20 °C … +60 °C
Long term storage temperature (max.1 year)	-20 °C … +30 °C
Charging temperature	0 °C … +40 °C
Humidity	5 % … 85 % (non-condensing)
Max. operating altitude	4000 m

1.2.9 Standards

Table 1-12:

EMC, safety		
EMC	IEC/EN 61326-1 (industrial electromagnetic environment) FCC subpart B of part 15, class A	
Safety	IEC/EN/UL 61010-1, IEC/EN/UL 61010-2-030 IEC 62133, UL 2054, UN 38.3	
Other		
Shock	IEC/EN 60068-2-27 (15 g/11 ms (150 m/s2/11 ms), half-sinusoid, 3 shocks in each axis)	
Vibration	IEC/EN 60068-2-6 (frequency range 10 Hz … 150 Hz, acceleration 2 g continuous (20 m/s^2/65 ft/s^2), 10 cycles per axis)	
Humidity	IEC/EN 60068-2-78 (5%…95% relative humidity, no condensation, tested at 40 ºC/104 ºF for 48 hours	
Ingress protection (connectors mated)	IEC/EN 60529 IP 4x	

1.3 *MCU1* multi-device control unit

1.3.1 Power data

Table 1-13: Power data

Parameter	Value
Supply voltage (Power input)	USB 2.0, bus powered
Power consumption	< 2.5 W

1.3.2 Mechanical data

Table 1-14: Mechanical data

Characteristic	Rating
Dimensions (W x D x H)	115 mm x 175 mm x 38 mm
Weight	0.52 kg
Connections	Front: 1 x USB 2.0
	Rear: 6 x ST connectors for fiber-optic network
Indicator	1 x LED, USB connection/error indicator
Additional features	1 x light sensitive trigger, 50 Hz … 60Hz

1.3.3 Environmental conditions

Table 1-15: Environmental conditions

Characteristic	Rating
Operating temperature	-20 °C … +65 °C
Storage temperature	-40 °C … +85 °C
Humidity	5 % … 85 % (non-condensing)
Max. operating altitude	4000 m

1.4 *SHT1* external shunt

1.4.1 System data

Table 1-16: System data

Parameter	Value		
Maximum current	4 A	15 A	28 A
Minimum current with *TANDO 700* system	100 mA	1 A	3 A
Typical nominal resistance[1)]	500 mΩ	50 mΩ	15 mΩ
Typical temperature coefficient	2 ppm	2 ppm	2 ppm
Initial resistance accuracy	±0.04 %		
Long term resistance deviation (1000 full load cycle / 2 years)	< ±0.15 %		
Absolute phase deviation	tan-δ < 2 x 10^{-5}		

1) This indicates the deviation from the resistance value measured during *SHT1* calibration, which is stored in the *SHT1* and will be used by the *TANDO 700* software. The initial resistance value may differ up to 1 % from the mentioned typical nominal value.

1.4.2 Mechanical data

Table 1-17: Mechanical data

Characteristic	Rating
Dimensions (W x D x H)	120 mm x 175 mm x 45 mm
Weight	0.68 kg
Connections	Front: One 4 pin shunt socket, LEMO FGG
	Rear: Two 4 mm banana red/black plug

1.4.3 Environmental conditions

Table 1-18: Environmental conditions

Characteristic	Rating
Operating temperature	-20 °C … +60 °C
Storage temperature	-20 °C … +60 °C
Humidity	5 % … 85 % (non-condensing)
Max. operating altitude	4000 m