



Istrumentazioni Sistemi Automatici S.r.l.

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**INSTRUMENT DRTS 66  
FOR TESTING PROTECTIVE RELAYS,  
ENERGY METERS AND TRANSDUCERS**



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## 1 GENERAL

### 1.1 *The instrument family*

The digital relay and meters test system type DRTS66 is a programmable and automatic current and voltage source, that permits for the automatic test of digital protection relays, such as those used in Medium and High voltage networks, and of energy meters, power quality meters and transducers.

The test set can be controlled locally, without the connection to a PC, by means of a graphical colour display, a keypad, a rotary switch and function keys. The unit can be controlled also by and advanced test software running on a PC.

Current and voltage amplifiers are linear, class AB types: this ensures the best, noiseless output quality.

DRTS66 is the top of a family, that includes also DRST64 (6 currents and 4 voltages), and DRTS34 (3 currents and 4 voltages).

**In the following, all specifications, unless differently specified, apply to all models.**

As compared to the former DRTS 6, the DRTS 66 version offers the following improvements:

- . Current outputs: 6\*32 A, instead of 6\*15 A in DRTS 6.
- . Current power: 6\*430 VA at 32 A, with respect to 6\*80 VA at 15 A on DRTS 6.
- . Six voltages instead of 4, on the model DRTS 66.
- . All outputs: 32 bit control; accuracy  $\pm 0.04\%$  of reading  $\pm 0.015\%$  of range. (one half with respect to DRTS 6). This implies the capability of testing Class 0.1 energy meters.
- . All outputs: Digital to Analog Converters operate at the sample frequency of 50 kHz, rather than 10 kHz: this ensures a superior waveform design and therefore a much better angle accuracy and distortion control.

The following performances are not available on DRTS.6.

- . Local control with a 5.7 in colour screen, plus digital wheel with switch, 12 input buttons and 5 function select buttons.
- . Voltage outputs are isolated from current outputs.
- . Frequency: each output is independently controlled.
- . 12 digital inputs, up to 300 V, standard; 10 digital inputs, up to to 600 V, with the “Transcope” option.
- . 10 analog inputs “Transcope” option, up to 600 V.
- . Extended diagnostic features, data logging.
- . Pen drive interface, to upload or download test parameters and results.
- . ETHERNET interface to the PC.

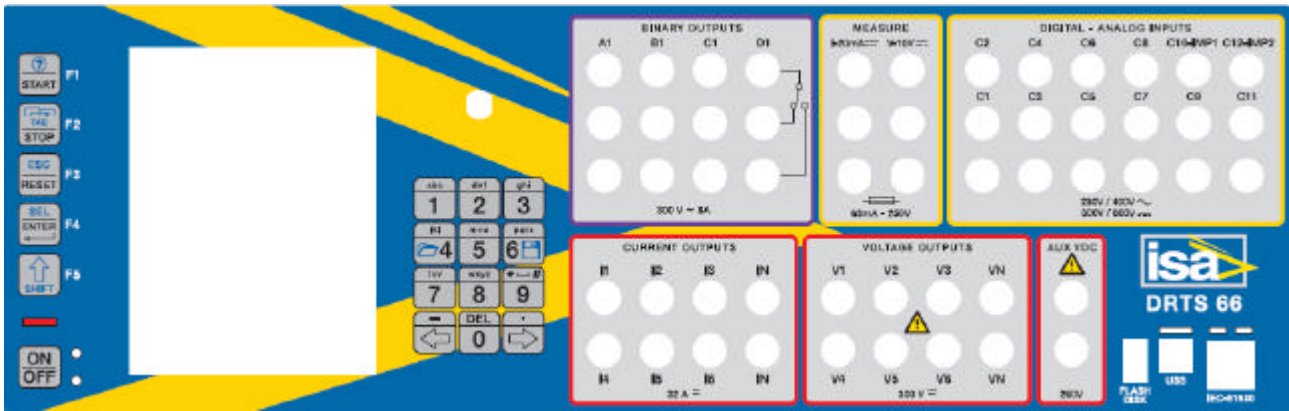
The test bench is housed in a case 3 U high, that contains: the power supply, the interface circuits, the control boards, the voltage and current amplifiers. The set is housed into an aluminium container with handle for ease of transportation; the instrument is supplied with a plastic bag for protection during transit.

The TDMS software, running on the P.C., allows the user to:

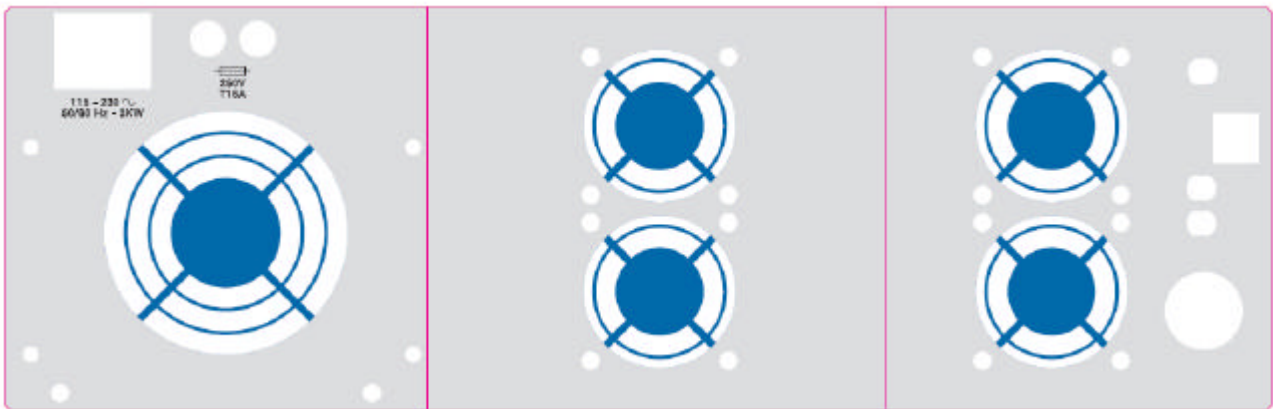
- . Control all current and voltage outputs, for the simulation of all types of faults: in particular, faults that are produced on a distribution network with the neutral connected to ground;
- . Change the output in a ramp or step mode;

- . Define the state of inputs and outputs between two fault simulations;
- . Simulate complex evolution, with faults that change during the test.

The followings are the pictures of the front and of the rear of DRTS 66.



**DRTS66 FRONT VIEW**



**DRTS 66 REAR VIEW (3 PANELS)**

**1.2 Options**

There are many options available for DRTS 66: they are described in detail on chapter 4.

**1.3 TDMS, the software for DRTS 66**

All controls of the instrument are performed by the software TDMS, which is described in document MSE10015. With TDMS, it is possible to test the relays of the following table, plus: transducers, energy meters, quality meters.

RELAY TYPE	IEEE NO
DISTANCE RELAY	21
SYNCHRONIZING DEVICE	25
UNDER/OVER-VOLTAGE RELAY	27/59
DIRECTIONAL POWER RELAY	32

UNDERCURRENT – UNDERPOWER RELAY	37
FIELD RELAY	40
REVERSE PHASE CURRENT RELAY	46
PHASE SEQUENCE VOLTAGE RELAY	47
INCOMPLETE SEQUENCE RELAY	48
INSTANTANEOUS OVER-CURRENT RELAY	50
INVERSE TIME OVER-CURRENT RELAY	51
POWER FACTOR RELAY	55
VOLTAGE BALANCE RELAY	60
GROUND DETECTOR RELAY	64
DIRECTIONAL OVER-CURRENT RELAY	67
DC OVERCURRENT RELAY	76
PHASE ANGLE OUT OF STEP RELAY	78
AUTOMATIC RECLOSING RELAY	79
FREQUENCY RELAY	81
PILOT WIRE RECEIVER RELAY	85
LOCKOUT RELAY	86
DIFFERENTIAL PROTECTION RELAY	87
VOLTAGE DIRECTIONAL RELAY	91
POWER DIRECTIONAL RELAY	92
TRIPPING RELAY	94

Besides, it is also possible to create test plans that can test multi-function relays.

## 2 APPLICABLE STANDARDS

The test set and optional modules conform to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

### 2.1 Electromagnetic Compatibility

European directive no. 2004/108/EC. Applicable Standard : EN61326:2006.

#### EMISSION

- EN 61000-3-2: Harmonic content caused by the supply. Acceptable limits: basic.
- EN 61000-3-3: Limitation of voltage fluctuations and flicker. Acceptable limits: basic.
- CISPR11 (EN 55011 class A): Limits and measurement methods of radio-electric disturbances for industrial, medical and scientific instruments at radio-electric frequencies.

Acceptable limits for conducted emission:

- . 0.15-0.5 MHz: 79 dB pk; 66 dB avg.
- . 0.5-5 MHz: 73 dB pk; 60 dB avg.
- . 5-30 MHz: 73 dB pk; 60 dB avg.

Acceptable limits for radiated emission:

- . 30-230 MHz: 40 dB (30 m)
- . 230-1000 MHz: 47 dB (30 m)

#### IMMUNITY

- EN 61000-4-2: Immunity tests for ESD. Test values: 8 kV in air; 4 kV in contact.
- EN 61000-4-3: Immunity tests for radio frequency interference. Test values ( $f = 900 \pm 5$  MHz): field 10 V/m, modulated AM 80%; 1 kHz
- EN 61000-4-4: Immunity tests for high speed transients (burst). Test values: 2 kV peak; 5/50 ns.
- EN 61000-4-5: Immunity tests for surge. Test values: 1 kV peak differential mode; 2 kV peak common mode; 1.2/50 us.
- EN 61000-4-6: immunity to low-voltage sinusoidal waveform. Test values: 0.15-80 MHz, 3 Vrms, 80% AM 1 kHz.
- EN 61000-4-8: Immunity tests for low frequency magnetic fields. Test values: 30 Arms/m.
- EN 61000-4-11: Immunity test for power supply drops. Test value: 1 cycle; 100% drop.

### 1.2 Low voltage directive

European directive n. 2006/95/EC. Applicable standard, for a class I instrument, pollution degree 2, installation category II: CEI EN 61010-1. In particular:

- Dielectric Rigidity: 1.4 kV AC, 1 minute.
- Isolation resistance: > 2 MOhm.
- Earth resistance : < 0.1 Ohm.
- Dispersion current: < 5 mA.
- Inputs/outputs protection: IP 2X - IEC 60529.

### 1.3 Environmental

- Operating temperature: 0 - 50°C; storage: -25°C to 70°C.
- Relative humidity : 5 - 95%, not condensing.
- Vibration: IEC 60068-2-6 (20 m/s<sup>2</sup> at 10 – 150 Hz);
- Shock: IEC 60068-2-27 (15 g; 11 ms; half-sine).
- Altitude: less than 2000 m.
- Noise: less than 75 dB.

### 3 CHARACTERISTICS OF THE UNIT

#### 3.1 General

This section resumes the characteristic and the performances of the instrument. Listed characteristics are all used when the instrument is connected to a computer, with the corresponding commands.

In separate documents are described:

- The DRTS 66 introductory guide, with the product description and the troubleshooting procedure;
- The DRTS 66 local control;
- The DRTS 66 user's guide;
- The TDMS software.

On the instrument DRTS 66 the following connections are available:

A) On the front:

- Six current outputs I1-I6, with a common neutral point (on two sockets), isolated from voltage outputs;
- Six voltage outputs V1-V6, with a common neutral point (on two sockets);
- The battery simulator, isolated from other outputs;
- Twelve trip inputs, divided in six groups: C1-C2, C3-C4, C5-C6, C7-C8, C9-C10 (IMP1); C11-C12 (IMP2), with six zero references. Inputs IMP1 and IMP2 perform also the high frequency counting mode. These sockets are used for the TRANSCOPE option, when it is installed;
- Two measurement inputs: current (two ranges) with protection fuse, and voltage, also with protection fuse;
- Four auxiliary output relay contacts A1-D1, with C, NO, NC contacts, and without a common point;
- Connector for the IEC61850 interface, with lights;
- USB interface connector, with light;
- USB flash disk connector;
- Five function keys;
- TFT display;
- Rotating wheel with switch, for the menu control;
- 12-keys keyboard;
- Power ON – OFF pushbutton, with light;
- Two LED's with power supply alerts: missing ground; Voltage supply too high.

B) On the rear:

- Mains power supply plug (2 phase with ground);
- Two mains protection fuses: T16A, 250 V;
- One protection fuse for the auxiliary DC voltage, rated T1A, 250 V;
- One optical connector for the synchronization to IRIG-B signal;
- One ETHERNET interface connector;
- Optionally, one female connector, with: low-power outputs; logic signals for an external optional amplifier module and for the external IN-OUT logic signals expansion module; four transistor digital outputs, with a common reference.

When the instrument is turned on it performs a self-diagnostic check of all of the logic and analog circuits. During the use, the instrument watches continuously the outputs, checking that they do not deviate from the nominal, and records transient problems in a non volatile memory.

The principal operations are as follows:

- Power-on;
- Connect DRTS 66 to the relay that is to be tested. The input trip contacts can be either clean or with voltage, polarized using the D.C. voltage output, or the D.C. voltage of the site;
- If you want, connect DRTS 66 to the portable PC, else, proceed with the local controls;
- Execute the test. During PC operation, output values are displayed on the screen;
- Test results are examined one at a time on the screen of the test set or of the PC, and printed later on, after they have been saved.

In the user manual, furnished with the instrument, are contained the following information:

- Test set description;
- How to use it;
- Internal realization;
- Diagnostic information, failure area, intervention procedures.

The application manual explains how to perform the tests of all types of relays.

### 3.2 Six phase current generator

- Six independent current sources, with a common neutral (3 with DRTS 34).
- Type of connection: safety banana sockets.
- Output ranges, and corresponding power and resolution.

#### FOR DRTS66 OR 64:

RANGE	OUT PUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	6 X	DIRECT	0...32 AC	430 @ 32 A	0.4 @ 32 A	0.1 mA
2	3 X	2 IN PARALLEL	0...64 AC	860 @ 64 A	0.2 @ 64 A	0.2 mA
3	1 X	ALL IN PARALLEL	0...128 AC	600 @ 128 A 800 @ 90 A 1000 @ 64 A	0.036 @ 128 A 0.1 @ 90 A 0.24 @ 64 A	0.6 mA
4	3 x	DIRECT	0...32 AC	430 @ 32 A	0.4 @ 32 A	0.1 mA
5	1 X	ALL IN PARALLEL	0...85 DC	270 @ 85 A 500 @ 60 A	0.07 @ 85 A 0.14 @ 60 A	0.6 mA
6	1 X	2 IN SERIES	0...32 AC	860 @ 32 A	0.8 @ 32 A	0.1 mA
7	1 X	2P IN SERIES TO 2P	0...64 AC	1000 @ 64 A	0.24 @ 64 A	0.2 mA

#### NOTES:

1. For 6X mode, the specification applies to two symmetrical three-phase outputs. The power is available on any two outputs at the meantime.
2. For the 3X mode, two outputs are put in parallel; the output is one symmetrical three-phase system. The power is available on any output pair at a time.
3. With all outputs in phase, the maximum current per phase is 21 A.
4. When the operation is three-phase, the maximum power is available on any output at a time, and at the meantime.
5. In DC current mode all outputs are in parallel.
6. In this mode, two outputs, in opposition between them, are put in series: the current is the same, the power is doubled.

7. In this mode, two outputs, in phase between them, are in parallel, and are in series to two more in parallel, that are in opposition with respect to the first ones.

**FOR DRTS34:**

RANGE	OUT PUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	3 X	DIRECT	0...32 AC	430 @ 32 A	0,4 @ 32 A	0.1 mA
2	1 X	ALL IN PARALLEL	0...96 AC	700 @ 96 A	0,075 @ 96 A	0.3 mA
3	1 X	ALL IN PARALLEL	0...85 DC	270 @ 85 A 500 @ 60 A	0.07 @ 85 A 0.14 @ 60 A	0.6 mA
4	1 X	2 IN SERIES	0....32 AC	860 @ 32 A	0,8 @ 32 A	0.1 mA

The above power is available when the test set generates only currents; the contemporary generation of AC and DC voltages implies a power reduction as a function of the total output power.

In particular, the total power absorbed by the test set is limited to 1600 VA when it is supplied at 115 V. As a consequence, when generating currents only, power changes as follows; above notes apply.

RANGE	OUT PUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)
1	6 X	DIRECT	0...32 AC	430 @ 32 A	0.4 @ 32 A
2	3 X	2 IN PARALLEL	0...64 AC	500 @ 64 A	0.12 @ 64 A
3	1 X	6 IN PARALLEL	0...128 AC	300 @ 90 A	0.037 @ 90 A
4	3 x	DIRECT	0...32 AC	430 @ 32 A	0.4 @ 32 A
5	1 X	ALL IN PARALLEL	0...85 DC	340 @ 45 A	0.16 @ 45 A
6	1 X	2 IN SERIES	0....32 AC	500 @ 32 A	0.5 @ 32 A
7	1 X	2P IN SERIES TO 2P	0....64 AC	320 @ 32 A	0.3 @ 32 A

**NOTE:** The available power changes as a function of the output current. The duration of current generation is a function of the current and of the total generated power.

- Type of amplifier: linear, class AB. This ensures extremely low noise.
- Independent adjustment of current outputs.
- Waveform resolution: 32 bit (16 for the amplitude, 16 for the shape).
- Waveform construction: generation DAC's operate at 50 kHz: this ensures superior waveform design, angle accuracy and distortion control.
- Output frequency: 0 to 3 kHz; 5 kHz on reproductions.
- Output adjustable from zero to the maximum value.
- Possibility of step changing the value of the output within 0.2 ms.
- Oscillation after the step change: maximum 10% of the peak.
- Possibility of current ramping. The rate of change is programmable between  $\pm 0.01$  A/s and  $\pm 999$  A/s. The amplitude change is implemented every 100  $\mu$ s. At the maximum rate of 999 A/s, the maximum step is 99,9 mA/100  $\mu$ s.
- The specified output power is available at 25°C maximum of external temperature. For higher temperatures, the maximum power decreases of 2 VA/°C.
- Output accuracy and frequency response, at 25 °C  $\pm$  2 °C, resistive load, burden less than 20% of the maximum, currents up to 16 A: see the table. With currents up to 32 A, errors are twice as bigger.

RANGE	45 to 65 Hz	0 to 45 Hz	1 kHz	3 kHz
Typical	$\pm 0.02\%$ of rdg $\pm$ $0.01\%$ of range	$\pm 0.2\%$ of rdg $\pm$ $0.1\%$ of range	-	-
Maximum	$\pm 0.04\%$ of rdg $\pm$ $0.01\%$ of range	$\pm 0.4\%$ of rdg $\pm$ $0.1\%$ of range	Attenuation: 3% (0.3 dB)	Attenuation: 6% (0.6 dB)

- Temperature coefficient:  $\pm 0,01\%/^{\circ}\text{C}$ , at 50 to 60 Hz;  $\pm 0,02\%/^{\circ}\text{C}$ , for other frequencies.
- Influence of power supply variation on the accuracy: zero.
- Accuracy with: inductive burden with power factor from 1 to 0.8, and power consumption from 0% to 100%: maximum twice the above values
- Gradient accuracy:  $\pm 0.5\%$  of the selected value.
- Distortion, with: resistive load, power consumption less than 20% of the maximum: 0.05% typical, 0.15% maximum.
- Distortion, with: inductive burden with power factor from 1 to 0.8, and power consumption from 0% to 100%: 0.5 % maximum.
- Automatic protection for overloads (including open circuit). In this case, the output is opened, and the operator is warned.
- The display shows the programmed output currents.

### 3.3 Six phase voltage output

- Six independent voltage sources, with a common neutral (4 with DRTS64 and DRTS34).
- Type of connection: safety banana sockets.
- Output ranges, and corresponding power and resolution.

#### DRTST66

RANGE	OUT PUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MIN (Ohm)	RESOLUT.
1	6X	DIRECT	0...300	50 @ 125 to 300 V	1800 @ 300 V	10 mV
2	6X	DIRECT	0... 12.5	5	30	0,4 mV
3	4X	DIRECT	0...300	85 @ 125 to 300 V	1060 @ 300 V	10 mV
4	3X	DIRECT	0... 300	100 @ 125 to 300 V	900 @ 300 V	10 mV
5	1X	2 IN SERIES	0...600	200 @ 250 to 600 V	1800	20 mV
6	3X	2 IN PARALLEL	0...300	200 @ 125 to 300 V	450 @ 300 V	10 mV
7	1X	2+2 IN PARALLEL	0..± 300 DC	300 @ ± 125 to ± 300 V	1200 @ ± 300 V	10 mV

#### NOTES:

- 1,2 For 6X mode, the specification applies to two symmetrical three-phase outputs.
- 3 For the 4X mode, three output make one symmetrical three-phase system; the fourth one is in any phase relationship with the three phases.
- 4 When the operation is three-phase, the maximum power doubles (DRTS66).
- 5 In this mode, two outputs, in opposition, are put in series: voltage and power are doubled.

6 In this mode, two outputs, in phase, are put in parallel: the voltage is the same, the power doubles.

7 In DC current mode all outputs, with the same polarity, are put in parallel.

#### DRTST64 AND 34

RANGE	OUT PUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MIN (Ohm)	RESOLUT.
1	4X	DIRECT	0...300	85 @ 125 to 300 V	1060 @ 300 V	10 mV
2	4X	DIRECT	0... 12.5	5	30	0,4 mV
3	3X	DIRECT	0... 300	100 @ 125 to 300 V	900 @ 300 V	10 mV
4	1X	2 IN SERIES	0...600	200	1800	20 mV
5	3X	2 IN PARALLEL	0...300	200 @ 125 to 300 V	450 @ 300 V	10 mV
6	1X	2+2 IN PARALLEL	0...± 300 DC	300 @ ± 125 to ± 300 V	1200 @ ± 300 V	10 mV

The specified power is available in continuous mode and on all outputs at the meantime.

The total power sunk by the test set is limited to 1600 VA when it is supplied at 115 V.

- Type of amplifier: linear, class AB. This ensures extremely low noise.
- Independent adjustment of voltage outputs.
- Waveform resolution: 32 bit (16 for the amplitude, 16 for the shape).
- Waveform construction: generation DAC's operate at 50 kHz: this ensures superior waveform design, angle accuracy and distortion control.
- Output frequency:
  - . 0 to 3 kHz @ 60 V;
  - . Up to 2 kHz @ 100 V;
  - . Up to 700 Hz @ 300 V;
  - . 5 kHz on reproductions, for outputs up to 100 V;
  - . 1 kHz on reproductions, for outputs up to 300 V.
- Output adjustable from zero to the maximum value.
- Possibility of step changing the value of the output within 0.15 ms.
- No oscillation after the step change.
- Possibility of ramping the voltage. The rate of change is programmable between  $\pm 0.01$  V/s and  $\pm 999$  V/s. The amplitude change is implemented every 100  $\mu$ s. At the maximum rate of 999 V/s, the maximum step is 99,9 mV/100  $\mu$ s.
- Output accuracy and frequency response, at  $25 \text{ }^\circ\text{C} \pm 2 \text{ }^\circ\text{C}$ , resistive load, burden less than 20% of the maximum: see the table.

RANGE	45 to 65 Hz	0 to 45 Hz	1 kHz	3 kHz
Typical	$\pm 0.02\%$ of rdg $\pm$ 0.01% of range	$\pm 0.2\%$ of rdg $\pm$ 0.1% of range	-	-
Maximum	$\pm 0.04\%$ of rdg $\pm$ 0.01% of range	$\pm 0.4\%$ of rdg $\pm$ 0.1% of range	Attenuation: 3% (0.3 dB)	Attenuation: 15% (1.5 dB)

- Temperature coefficient:  $\pm 0,01\%/^\circ\text{C}$ , at 50 to 60 Hz;  $\pm 0,02\%/^\circ\text{C}$ , for other frequencies.

- Influence of power supply variation on the accuracy: zero.
- Accuracy with: inductive burden with power factor from 1 to 0.8, and power consumption up to the maximum: maximum twice the above values.
- With a three phase current and voltage generation (I1-I3, V1-V3), symmetrical vectors,  $25\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ , resistive load, burden less than 20% of the maximum, p.f. = 1, voltages more than 50 V, currents more than 1 A and less than 10 A, the total power error is 0.05% typical, 0.1% maximum. The total power error doubles with:
  - . The total current and voltage range;
  - . Inductive burden with power factor from 1 to 0.8;
  - . Power consumption up to the maximum.

For p.f. different from 1, the active power accuracy changes as follows.

<b>p.f.</b>	1	0,8	0,5	0,1	0
<b>Max error</b>	0,1	0,125	0,135	0,55	Infinite

- Voltage gradient accuracy:  $\pm 0.5\%$  of the selected value.
- Distortion, with: resistive load, power consumption less than 20% of the maximum: 0.05% typical; 0.15% maximum.
- Distortion, with: inductive burden with power factor from 1 to 0.8, and power consumption from open circuit to minimum impedance: 0.5% maximum.
- Automatic protection for overloads (short circuit included). In this case, the output is opened, and the operator is warned.
- The display shows the programmed output voltages.

### 3.4 Voltage output V4

- The voltage output V4 can be selected via software to act as:
  - . Fourth voltage output V4;
  - . Zero-sequence component **V0** of the other three voltages **V1, V2 V3**. Via software the output can be selected to be: **V0 = (V1+V2+V3)/3** or **V0 = (V1+V2+V3)/1.73** (bolded stays for vector sum). Note that with the second selection the zero sequence component is limited to 300 V.
- For the zero-sequence output, the guaranteed output accuracy is:  $\pm 0.5\%$  of the value  $\pm 0.1\%$  of the range.

### 3.5 Battery simulator

- Output connection: two safety banana sockets.
- Output voltage: 12 to 260 V D.C..
- Output resolution: 127 mV.
- Possibility of stepping the selected value. NOTE: the velocity of variation is affected by the capacitance of the load, that is charged with the current output of 1 A maximum.
- Possibility to ramp the voltage. Velocity of variation is between  $\pm 0.1\text{ V/s}$  and  $\pm 999\text{ V/s}$ .
- Output power: 50 W, continuous duty, or 1 A, whichever greater.
- Output accuracy:  $\pm 2\%$  of the regulated value  $\pm 0.2\%$  of the full scale, with load up to 100%.
- Gradient accuracy:  $\pm 2\%$  of the nominal, with a minimum of  $\pm 200\text{ mV/s}$ .
- Current limited in case of an overload greater than 50 W.

### 3.6 Angles

- All angles are referred to the same absolute reference.
- Possibility to set independently the angle of all outputs: V1; V2; V3; V4; V5; V6; I1; I2; I3; I4; I5; I6, in the field between zero and  $\pm 360.000^{\circ}$  (phase angle).

- Possibility of slewing all the angles. Variation range: 0.1°/s to 999 °/s. The angle change is implemented every 100 µs. At the maximum rate of 999 °/s, the maximum step is 0,0999 °/100 µs.
- Angle resolution: 0.001°.
- Angle accuracy (40 to 70 Hz); resistive burden, less than 20% of the maximum: ± 0.005° typical; ± 0.015° maximum.
- Angle accuracy (40 to 70 Hz); burden with p.f. down to 0.8 and value up to the maximum: ± 0.02° maximum.
- Angle accuracy (5 to 40 Hz): maximum ± 1°.
- Angle accuracy (70 Hz to 3 kHz): maximum ± 5°.
- Possibility to define the angle of the waveform to be generated (point on wave).
- Point on wave value selectable between 0° and 360°, on any output.
- Point on wave accuracy: maximum ± 2°.

### **3.7 Output waveform**

- Besides the sinusoidal waveform, it is possible to generate waveforms with harmonic distortions.
- Each harmonic can have any amplitude and any phase with respect to the fundamental.
- Fundamental frequency: selectable from 5 Hz to 60 Hz, in steps of 0.1 Hz. Maximum frequency error: 0.1 Hz.
- Selected harmonics: from the second to the 100<sup>th</sup>.

### **3.8 Transient files reproduction**

- Possibility to reproduce a fault that has been recorded with a COMTRADE or format, by means of the software TDMS.
- Maximum recording dimension: 16 bits word; 640 kWord per channel on 6 channels.
- Maximum sampling frequency: 100 kHz; maximum reproduction frequency: 50 kHz.
- Transient files bandwidth: 0 to 5 kHz.
- Key features of the program: repeat recording infinite times, glue records, change phase angle for any trace, change the amplitude for any portion of any trace.

### **3.9 Output frequency**

- Possibility of selecting the output frequency between 0.0000 and 2999.9999 Hz (see the limitations on voltage outputs). Transients reproduction: 5 kHz.
- Possibility to program 12 different frequencies on all outputs.
- Maximum frequency error: 0.5 ppM (25 µHz @ 50 Hz).
- Temperature drift of the oscillator frequency: 0.1 ppM/°C.
- Resolution: 5 µHz.
- Possibility of step switching the output frequencies, separately or together with the amplitude change.
- Possibility of slewing the frequencies, with a slope from 0.001 Hz/s to 999.999 Hz/s. Resolution: 0.001 Hz/s. The frequency change is implemented every 100 µs. At the maximum rate of 999 Hz/s, the maximum step is 99,9 mHz/100 µs.
- Slew accuracy: 0.01 Hz/s, with a minimum of 0.1 Hz/s.
- The display shows the programmed output frequencies.

### **3.10 Time measurements and counting**

- Digital inputs: 12 inputs, either clean or with voltage, from 4.5 to 300 V DC (24 to 230 V AC), divided in six groups of two inputs each, with six common points isolated among them. This feature allows the measurement of polarized trip contacts with six different zeroes that can't be

put in common. All of them perform time measurements; two (called IMP1 and IMP2) measure also the time taken by a programmable number of impulses.

- If the TRANSCOPE option is present, the maximum voltage is 600 V DC (425 V AC), and the number of inputs is reduced to 10.
- Connections: to safety banana sockets, marked C1 – C9, C10-IMP1, C11 and C12-IMP2.
- For each input, the display shows when the input is closed (or the voltage is applied).
- Selection of the type of input: Voltage clean; 5 V; 24 V; 48 V; 100 V; software controlled. The selection clean/voltage is shown on the display (one per group).
- For all selections, inputs are protected against voltages up to the maximum specified above.
- Anti noise and programmable de-bounce functions. De-bounce range: from 40  $\mu$ s to 2 ms.
- Selections: Close (N.O.), Open (N.C.), Boolean, independent for each input.
- Time measurements available:
  - Timing from the start of the test (injection) until the AND or OR of Close or Open of the selected inputs;
  - Timing from any selected input to the AND or OR of Close or Open of the selected inputs.
- Timer range: 0 to infinite; resolution: 0.01 ms. Cycles measurement, with resolution of 0.01 cycles, both at 50 Hz or 60 Hz.
- Timer accuracy: 0.001% of the measure  $\pm$  0.1 ms, for input changes lasting more than 1 ms.
- Impulse time measurements available on IMP1 and IMP2 independently:
  - Count of transitions in a given time;
  - Time corresponding to N transitions; N programmable from 1 to 9,999,999.
- Frequency range for impulses: 0 to 100 kHz.

### **3.11 Auxiliary outputs**

- Four auxiliary relay contacts (A1, B1, C1, D1), timed, voltage clean, whose make and break terminations are connected to safety banana connectors.
- The open or closed state of the relay is shown on the display.
- Characteristics of the contacts with a resistive load:
  - . AC: 300 V; 8 A; 2400 VA;
  - . DC: 300 V; 8 A; 50 W.
- Range of programmable delay with respect to test start: from 0 to 999,999.999 s.
- Nominal switch delay with respect to test start: 5 ms.

### **3.12 Current and voltage measurements**

The following measurements are available. Connections: to safety banana plugs.

- DC Current measuring Inputs
  - . Measuring range:  $\pm$  5 mA DC and  $\pm$  20 mA DC.
  - . Resolution: 10 nA.
  - . 5 mA range accuracy:  $\pm$  0.05% of value  $\pm$  0.02% of range.
  - . 20 mA range accuracy:  $\pm$  0.02% of value  $\pm$  0.01% of range.
  - . Input impedance: 200 Ohm.
- DC Voltage measuring input
  - . Measuring range  $\pm$  10 V DC.
  - . Resolution: 10  $\mu$ V.
  - . Accuracy:  $\pm$  0.02% of value  $\pm$  0.01% of range.
  - . Input impedance: 400 kOhm.

NOTE: specifications apply at  $25\text{ °C} \pm 2\text{ °C}$ . Temperature drift:  $\pm 0.001\%/^{\circ}\text{C}$ . AC currents and voltages cannot be measured.

### **3.13 Interface connections**

- Available interfaces: USB and ETHERNET.

- Characteristics of the USB interface:

- . Transmission rate: 3x minimum.
- . Interface cable: 2 meters, included.

- Characteristics of the ETHERNET interface:

- . Connector type: RJ-45.
- . Interface cable: 2 meters, included.

### **3.14 Internal memory**

The test set has an internal memory of 256 Mbytes; it hosts approximately up to 2000 test results.

### **3.15 Pen drive interface**

It allows connecting a standard USB pen drive, for the saving and restoring of test set-up and test results.

### **3.16 Local test set control**

The test set is locally controlled via a digital knob, keys and display. The test selection is performed via menu, that selects the control parameters: voltage, current, angle, frequency, and also the impedance parameters for the distance relay tests. During the test, all output values are displayed.

Characteristics of the devices:

- . Digital knob: digital encoder with switch.
- . Keyboard: 12 keys. Data input as with mobile phones.
- . Function keys: five.
- . Display: 256 colours, type TFT, graphic, 320 x 240 pixel; dimension 5.7 in.

### **3.17 Sequence of commands**

- The elementary operations which compose all tests are:

- . Measurement of the time delay from test start, i.e. when parameters change from pre-fault to fault values;
- . Search of the threshold, slewing parameters and memorizing the value at the instant of the tripping of the input;
- . Generation of parameters during a fixed time, reporting inputs that have changed their state.

- When connected to a PC, tests are executed in the following way:

- . The PC defines the parameters to inject or change;
- . At the command of the operator, parameters are transmitted to DRTS 66 via the interface connection;
- . DRTS 66 generates the specified values, waits for the trip of the selected input contacts, and then transmits the results to the PC by the same interface. During this time, DRTS 66 continuously informs the PC about the generated outputs, so that values on the display are refreshed in real time;

. The PC examines the results and displays them to the operator; then, it performs calculations and issues a new test command.

- During the execution of the test DRTS 66 is self controlled and does not depend on the PC communication.
- The simulation of the fault can be made of single or multiple tests (case of evolving failures).
- Between two simulations parameters may return to zero, return to the healthy value or maintain the last injected value.
- Maximum number of elementary tests (cycles) in a multiple test: 499.
- Duration of the cycle: from 1 ms to 999,999.999 s;
- Accuracy of the cycle duration: 2 ms.
- Delay between two cycles: 2 ms maximum.

### **3.18 Protections**

- Fuse on the mains supply.
- Protected against too high voltage supply, from 275 V up to 400 V. In this situation the test set gives an alarm message, and turns on an alarm light.
- Protection against the lack of ground connection. In this situation the test set gives an alarm message, and turns on an alarm light.
- Electronic protections on the internal DC supplies of the instrument and alert to the operator.
- Electronic protection for overload on the current (open circuit) or voltage outputs (short circuit), with immediate release of the outputs and warning message to the operator. The program resets the fault condition.
- Electronic protection in case of counter-feed of current or voltage outputs. If a voltage is applied to output sockets, the circuit opens, and the counter-feed alarm is displayed.
- Protection against over-temperature, on all outputs.
- If an output is diagnosed as faulty, the test set allows the operator to un-select it, and to select another, healthy, output in its place.
- Diagnostic messages for the setting of wrong data, mistakes on the inputs etc.
- Diagnostic data logging.
- In case of fault, the faulty module is indicated to the operator at an accuracy of more than 95%.
- The test set measures the power sunk from the supply, and limits it, giving an alert message to the operator.
- The resident program (firmware) can be updated to the latest issue, which is freely available on the ISA WEB site. [www.isatest.com](http://www.isatest.com)

### **3.19 Power supply**

- Mains power supply: 85 to 132 and 180 to 264 V AC, sinusoidal, single phase.
- Frequency: 45 to 65 Hz.
- Power consumption:
  - At rest: less than 150 W;
  - Maximum load, 115 V supply: 1600 W;
  - Maximum load, 230 V supply: 2700 W.
- Connection: standard 20 A AC plug.

### **3.20 Enclosure**

- Instrument: 3U rack.

- Case: Aluminum, with carrying handle. The instrument may be operated in the horizontal or vertical positions.

### **3.21 Accessories**

The following items are supplied with the DRTS 66:

- . Protection bag;
- . Mains supply cable;
- . USB and ETHERNET cables;
- . Relay connection cables kit: 12 in all, 4 red, 4 black, 2 blue, 2 yellow; length 2 m, cross section 1 sq. mm;
- . High current connection cables: no. 2, 2 m long, 6 sq. mm.
- . Ground connection cable: 2 m, yellow/green, terminated with crocodile clamp.

### **3.22 Weight and dimensions**

- Weight: 20 kg (DRTS66); 20 kg (DRTS64); 18 kg (DRTS34).
- Dimensions: 150 (h) x 466 (w) x 423 (d) mm.

## 4 DRTS 66 OPTIONS

### 4.1 Analog measurements TRANSCOPE option

Optionally the test set can be provided with the feature of measuring up to 10 voltage inputs, and to act as a:

- . Multimeter: voltages, currents (with external shunts), phase angles, wattmeters, frequency meter;
- . Oscilloscope;
- . Data logger;
- . Oscilloperturbographic recorder.

**This option is to be specified at order.**

The connection is performed to ten of the C1 – C12 inputs. Option characteristics:

- Ten input sockets: C1, C2; C3, C4; C5; C6,C9; C10, C11; C12, divided in five isolated groups of two each, with 5 isolated zero references.
- Measurement ranges: 0.14; 1; 14; 140; 600 V DC, corresponding to 0.1; 1; 10; 100; 425 V AC (RMS values).
- Phase angle range: 0.0° to 360.0°.
- Frequency range: 48.00 to 62.00 Hz.
- Input impedance: 500 kOhm, 50 pF.
- Overload protection.
- Measurement accuracy, at 25 °C ± 2 °C: 0.06% of range typical, 0.15% of range guaranteed, unless for the 100 mV range, where the accuracy is 0.15% of range typical, 0.3% of range guaranteed.
- Bandwidth (- 3 dB): 10 kHz, at 50 kHz of sampling frequency.
- Temperature drift: ± 0.005 %/°C.
- Phase angles between inputs. Maximum phase error, with inputs more than 10% of the selected range, sinusoidal wave form, frequency 48 to 62 Hz: 0.2°.
- Frequency. It is computed on the selected input. Maximum frequency error, with inputs more than 10% of the selected range, sinusoidal waveform, frequency 48 to 62 Hz: 10 mHz.
  
- Computed measurements; errors at 25 °C ± 2 °C.
  - . Current AC or DC, once it is specified the shunt value or the clamp ratio V/A, primary or secondary side. Measurement error is the error of the shunt or of the current clamp plus the voltage measurement error.
  - . Active and reactive power. Maximum measurement error, with p.f. more than 0.8, sinusoidal waveform, frequency 48 to 62 Hz: ± 0.2% of the reading ± 0.1% of the range ± the shunt or current clamp error.
  - . Harmonic content. Measurements of the Total Harmonic Distortion, and of the distortion of all harmonic components up to the 40<sup>th</sup>. Accuracy, sinusoidal waveform, frequency 48 to 62 Hz: ± 0.5% of the reading ± 0.2% of the range.
  
- Oscilloscope feature: it is possible to select the trace to be viewed, and to view it on the display. The oscilloscope can be triggered on any trace.
  
- Recording feature: it is possible to use the test set as an oscilloperturbograph.
  - . Triggering capability: on a logic input, plus positive and negative trigger thresholds on any of the voltage or current inputs.
  - . Sampling frequency: 500 Hz, 1 kHz, 2 kHz, 5 kHz, 10 kHz, 20 kHz, 50 kHz, software selection.

- . The maximum product of: (sampling frequency) X (number of channels) is 50 kHz.
- . Total buffer size: 4 Mbytes, corresponding to 2 Mwords. At 5 kHz sampling frequency, it corresponds to a total recording length of: 40 s on 10 channels, 60 s on 6 channels, 200 s on 2 channels, 400 s on one channel. The sampling duration is inversely proportional to the sampling frequency. The table below gives the recording duration as a function of the sample frequency and number of channels.

FREQUENCY kHz	1 CHANNEL	2 CHANNELS	3 CHANNELS	6 CHANNELS	10 CHANNELS
5	400	200	120	60	40
10	200	100	60	-	-
20	100	50	-	-	-
50	40	-	-	-	-

Optionally, we can provide a clip-on current transformer, code PII29166, with the following characteristics.

- . Metering: AC and DC currents.
- . DC measurement null with a knob.
- . Ranges: 10 mV/A, 80 A DC, 40 A AC maximum, and 1 V/A, 2 A DC, 1.5 A AC maximum.
- . Low battery indicator.
- . External field zeroing knob.
- . Measurement errors: 4% of reading + 20 mA for the 80 A range; 2% of reading + 5 mA for the 2 A range.
- . Phase angle reproduction error (up to 65 Hz): maximum 1°.
- . Maximum working voltage: 600 V rms.
- . Power supply: alkaline 9 V battery, type 6 LR 61.
- . Service life: 70 h typical.
- . Maximum cable diameter: 10 mm.
- . Weight: 330 g.
- . Dimensions: 65 mm wide (clamp closed); 36 mm thick; 230 mm long.

#### **4.2 IEC61850-8 option**

The IEC61850-8 Interface option for DRTS 66 allows relay testing with Ethernet-based substation communication protocol.

**This option is to be specified at order.**

The option, and the associated software, provides the following features:

- . Capability of monitoring the Goose List and the Goose details transmitted by the relay under test. The grid displays for each Goose:
  - Source Mac Address: physical address of the generator of the message;
  - Destination Mac Address: physical address of the destination of the message;
  - Goose ID: Identifier of the Message;
  - Data Set Reference: Identifier of the type of message created by the IED;
  - Event Time Stamp: Universal Time that identifies the Goose.
- . Capability of filtering Gooses, based upon IED or TIMESTAMP.
- . During the test, trip commands are connected from the relay to the test set. In addition to this, the option allows to define up to 8 Virtual Contacts, i.e. Gooses that will be captured in real time: the test set will measure and display the corresponding timing from test start. A virtual contact is identified by a:

- Name: it can be given by the user by editing the relative box in the grid. The same name will appear in the lower frame that represent the Trip condition for the Virtual contact.
  - Dataset Reference: it represents the exact goose that serves as the basis for the virtual contact. The same device produces more than one Goose ID, so in order to set the virtual contact it is not enough to define the Goose ID, but the selection has to be made on the Dataset Reference.
  - Type: it can be Boolean, BitString, Unsigned, Signed, Float or UTCTime.
  - Condition: depending on the type of the data it can be: Equal to, Less than, Greater than or Not Equal to. It is set by default to Equal to, but it can be changed according to the data type. Select the appropriate condition form the menu that appears when clicking on the condition column.
  - Value: together with the condition field, it defines the actual condition of the Virtual Contact. In case of data type Boolean, it can only assume value True or False.
  - Time: represents the actual 'trip time' of the virtual contact, or the time interpreted from the goose that the device produces when the condition is verified. It cannot be modified, it is automatically set by the software when a test is performed and a virtual contact has tripped.
- . Capability of publishing Gooses. The operation is the following.
- Capture a Goose (during exploring, or after test start) that you want to modify and send into the network.
  - Create (edit) the message. Up to 16 messages can be published.
  - Select the publish mode as Continuous or During test. In continuous mode, during the program running the instrument starts sending messages every 5 s. If the selection is During Test, the publishing will be synchronized to the fault development when a test is performed.

The Ethernet connector type RJ-45 for the IEC61850 Interface is mounted directly on the front panel of the DRTS 66.

The option comes with two ETHERNET cables: one, direct, for the connection to the station bus; the other one, crossed, for the connection to the relay under test.

### **4.3 Relay connection cables**

This option includes 31 cables, with different colours, with banana plugs, 2 m long, cross section 1.5 sq. mm, that allow for the connection to the relay under test of all test set sockets. Six more cables have a cross section of 6 sq. mm. Last, 20 adapters convert from banana to terminator.

- Voltage outputs (4 cables: red, yellow, blue, black);
- Trip inputs (15 cables; 10 red, 5 black);
- Auxiliary outputs (8 cables; 4 black and 4 red);
- Trip inputs commons connection: the six banana connectors cable allows connecting among them the six trip inputs reference sockets;
- Three shunting bridges to perform the paralleling of the three current outputs;
- Current outputs (6 cables, cross section 6 sq. mm);
- 20 banana to terminator adapters: 10 red, 10 black.

### **4.4 Transit cases**

Two types of transit cases are available: molded and aluminum.

#### **4.4.1 Molded case**

The protection of DRTS 66 from delivery problems is provided by this robust transit case, that features the following.

- Molded-case construction;

- Handle on the top and on the side;
- Wheels;
- Dimensions: 400 x 580 x 850 mm ;
- Weight : 15 kg.



#### **4.4.2 Aluminum case**

In alternative to the above, it is possible to use the following aluminum case, that is lighter and smaller.

- Aluminum metal sheet construction;
- Handles on the side;
- Wheels;
- Dimensions: 250 x 580 x 580 mm ;
- Weight : 9.5 kg.

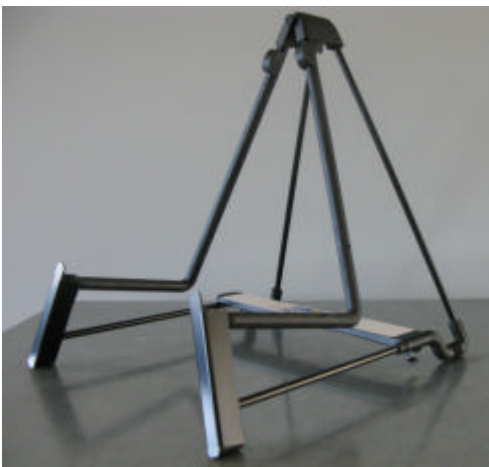


#### **4.5 Stand-up support**

The stand-up support allows using the test set in a stand-up position. This is very useful in case of too small room or no support for the test set. There is enough room for the power supply cord, and for the cooling air to flow in.



Closed support



Open support

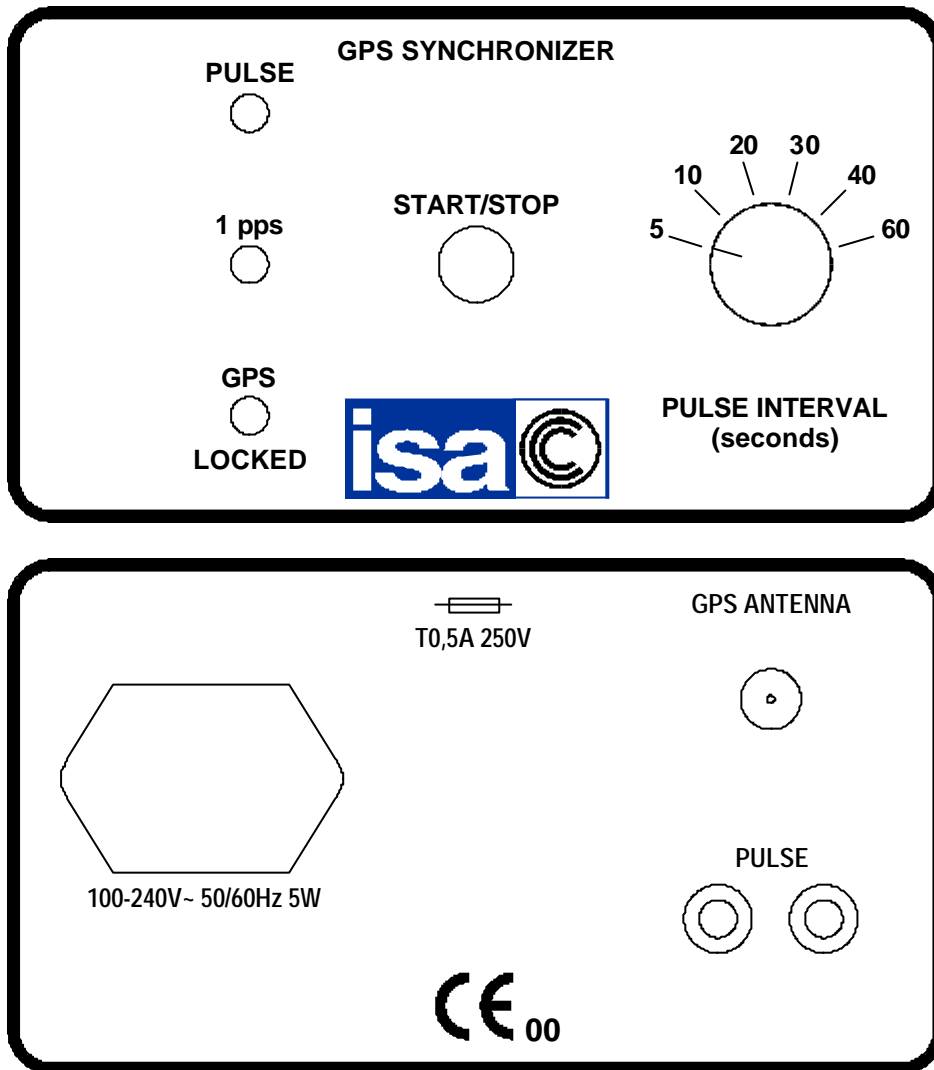
#### **4.6 GPS synchronizer; code ZII10161**

The GPS synchronizer is an external module that allows to synchronize test start of two DRTS.6.

Features are:

- . 1 digital output 0-24 V DC, for synchronisation.
- . 1 selector to program the following pulse intervals: 5 s; 10 s; 20 s; 30 s; 40 s; 60 s.
- . Maximum timing error with respect to nominal: 2  $\mu$ s.
- . Lights to confirm: power-on; Locked; Pulse available.
- . 1 START and STOP push-button.
- . Power supply: 110/220 Vac.
- . The option includes:
  - The antenna;
  - An extension cable for the antenna, 20 m long;
  - Two cables, red and black, 2 m long, with banana terminations, for the connection to the test set trip input;
  - The power supply cable.
- . Weight: 1.7 kg.
- . Dimensions: width = 150 mm; height = 100 mm, depth = 240 mm.
- . Realisation: aluminium case.

Two test sets synchronized with GPS produce the maximum error of 10  $\mu$ s.



GPS front and rear view

#### 4.7 SH-2003 energy meters universal scanning head; code ZII20162

SH-2003 is a scanning head that eases the test of energy meters. It is an universal scanning head because it can be used both with LED impulse electronic meters and Ferraris rotating disk meters; selection is performed via a switch located on the scanning head. In addition to this, a knob allows to adjust the sensitivity of the head.

With rotating disk the sensor uses a green light beam that optimizes the recognition of red or black or gloss marks.

With LED recognition the following specification applies:

- . Impulse duration: more than 60  $\mu$ s;
- . With an LED signal having a space ratio 1:2, the frequency must be less than 500 Hz.;
- . Light wavelength: 500 to 960 nm (red).

The option includes:

- The support that allows to keep the scanning head in front of the energy meter: maximum height 175 mm;
- The cable, 2 m long, from the scanning head to DRTS 66;
- The power supply transformer, for the power of 220 V AC, to supply the scanning head.
- Two safety banana plugs for the connection to DRTS 66.

#### **4.8 IN2-CDG current booster for 1 A rated relays and for the CDG relay of GE**

With DRTS 66 the full power current output is available only at 32 A. This is good for the test of relays with the nominal current of 5 A; if relays are rated 1 A the available power can be not adequate to perform the test. In addition to this, relay CDG of GE has very low current settings.

The option IN2-CDG solves this problem, by means of a set of three current transformers, with the following characteristics:

- . Primaries: 12.5 A and 15 A;
- . Secondary: 0.5 A; 1 A; 2.5 A; 5 A;
- . Nominal power: 100 VA;
- . Power loss: 30 VA at the maximum current;
- . Current ratio error: 0.2.
- Case: plastic.
- Connections:
  - . Seven primary side sockets (I1, I2, I3, IN);
  - . Three independent outputs, with one socket per current range;
  - . Ease of connecting outputs in star or delta configuration.
  - . For the single phase test of the CDG relay it is possible to have three times the above power, connecting current outputs in series.
  - . Dimensions: 30 x 23 x 11 cm.
  - . Weight: 11 kg

The option includes four connecting cables to DRTS66 current outputs, 1 m long, 6 sq. mm cross section. Outputs are do not have a common neutral; this eases the star or delta connection. Included is a bridge for star connection.

NOTE: the software takes into account the transformers ratio.

#### **4.9 IN-3 CDG: current booster for very high burden relays**

With DRTS 66 the full power is available only at the current of 32 A. For very high burden relays, the power at 5 A can be too low.

The option solves this problem, by means of a current transformer with the following characteristics:

- . Primaries: six; 10 A nominal; total primary current 60 A.
- . Secondary: 2.5 A; 5 A.
- . Nominal output power: 320 VA;
- . Current ratio error: 0.2.
- Case: plastic.
- Connections:
  - . Eight primary side sockets (I1, I2, I3, IN, I4, I5, I6, IN).
  - . Two outputs, with three output sockets (2.5 A, 5 A, 0).
  - . Dimensions: 30 x 23 x 11 cm.

. Weight: 17 kg

The option includes:

- . Eight connecting cables to DRTS 66 current outputs, 1 m long, 2.5 sq. mm cross section;
- . One short circuit, with 5 banana connectors, to short circuit the unused inputs (case of three phase tests).

NOTE: the software takes into account the transformers ratio.

#### **4.10 IRIG-B synchronization or output extension module**

The module provides the following features. The option has to be specified at order.

##### **4.10.1 Test sets synchronization**

Two different units can be synchronized using the optional IRIG-B built-in interface or the optional external GPS module. Characteristics of the IRIG-B connection:

- . Fiber optic connector, ST type;
- . Time accuracy: 10  $\mu$ s.

##### **4.10.2 Binary outputs, transistor**

- Four transistor open collector outputs, voltage clean, connected to a dedicated connector.
- The open or closed state of the transistor is displayed on the screen.
- Characteristics of the outputs: 24 V, 5 mA.
- Short circuit protection.
- Protection for voltages higher than 24 V.
- Range of programmable delay: from 0 to 999,999.999 s.
- Timing accuracy with respect to test start: less than 50  $\mu$ s.

##### **4.10.3 Low level voltage outputs**

The purpose of these low level voltage outputs is to allow testing newest protection relays with low voltage inputs. The dedicated connector carries six analog signals, that correspond to the three voltages and to the three currents. When these outputs are selected, power outputs are not generated.

- Number of outputs: 6.
- Connection: multi pole connector.
- Full range voltage output: 7.26 Vrms. \*
- Full range current output: 7.26 Vrms. \*
- Output current: 5 mA max.
- Resolution: 0.43 mV . \*
- Accuracy: 0.015% of range typical, 0.05% of range guaranteed. \*
- Distortion: 0.1%. \*
- Frequency bandwidth: 0 to 20kHz.

\* Temperature range: 25  $\pm$  2  $^{\circ}$ C; frequency range 40 to 70 Hz.

- Output accuracy; full temperature range, frequency 0 to 40 Hz.:  $\pm$  0.2% of the regulated value  $\pm$  0.04% of the full scale range.
- Output accuracy; full temperature range, 1 kHz maximum attenuation: 1% (0,3 dB).
- Output accuracy; full temperature range, 3 kHz maximum attenuation: 3% (0,5 dB).

- The display shows the programmed output values.

#### **4.10.4 Connection to external modules AMI332, AMI632, I/O EXP**

The option includes the circuits that allow the connection to the above external modules.

#### **4.11 IEC61850-9 option**

The IEC 61850-9 option allows generating measurement messages on the system bus.

**The option has to be specified at order.**

The option, and the associated software, provides the following features.

- . Possibility to inject Sampled Values on the system bus, corresponding to CT and VT measurements;
- . Possibility to test relays connected to the system bus, by the generation of Sampled Values and the monitoring of the relay tripping, as described above.

The connection is performed via an optical fiber connector, mounted on the rear of the test set.

## 5 THREE PHASE CURRENT AMPLIFIER AMI 332

### 5.1 Introduction

The three phase current amplifier AMI 332 is an additional device to the DRTS 66. The option includes three current generators at 32 A each. In connection with the DRTS 66, the option offers the following features:

- .Nine currents at 32 A each at the meantime, for the test of two-secondary transformer protection relays;
- . Three phase generator, at 96 A per phase.

The connection between DRTS 66 and AMI 332 is made by a control cable to be connected to DRTS 66.

### 5.2 Technical characteristics

#### 5.2.1 Three phase current generator

All characteristics are the same as the DRTS34 current generators.

Characteristics of AMI 332 with DRTS66.

RANGE	OUT PUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	9 X	DIRECT	0...32	430 @ 32 A	0.4 @ 32 A	1 mA
2	3 X	3 IN PARALLEL	0...96	1290 @ 96 A	0.13 @ 96 A	3 mA
3	1 X	9 IN PARALLEL	0...224	900 @ 224 A	0.018 @ 224 A	6 mA

#### 5.2.2 Accessories supplied with the unit

- Protective plastic bag.
- Mains supply cable.
- Interconnecting cable to DRTS 66.
- Cable for the connection of current neutrals: 1 m long, 6 sq. mm cross section.
- Relay connection cables kit: 8 in all, 4 red, 4 black; length 2 m, cross section 1 sq. mm.

#### 5.2.3 Weight and dimensions

- Weight: 16 kg.
- Dimensions without the handle: 150 (h) x 466 (w) x 423 (d) mm.

## 6 THREE PHASE CURRENT AMPLIFIER AMI 632

### 6.1 Introduction

The three phase current amplifier AMI 632 is an additional device to the DRTS 66. The option includes six current generators at 32 A each. In connection with the DRTS 66, the option offers the following features:

- . To control twelve currents at 32 A;
- . To have a six phase generator at 64 A per phase;
- . To have a three phase generator at 128 A per phase;
- . To have a single phase generator at 256 A.

The connection between DRTS 66 and AMI 632 is made by a control cable to be connected to DRTS 66.

### 6.2 Technical characteristics

#### 6.2.1 Six phase current generator

All characteristics are the same as the DRTD 66 current generators.

Characteristics of AMI 632 with DRTS 66.

RANGE	OUT PUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	12 X	DIRECT	0...32	430 @ 32 A	0.4 @ 32 A	1 mA
2	6 X	2 IN PARALLEL	0...64	860 @ 64 A	0.2 @ 64 A	2 mA
3	3 X	4 IN PARALLEL	0...128	1720 @ 128 A	0.1 @ 128 A	4 mA
4	1 X	12 IN PARALLEL	0...256	1200 @ 256 A	0,018 @ 256 A	8 mA

All other characteristics are the same as the DRTD 66 current generators.

#### 6.2.2 Accessories supplied with the unit

- Protective plastic bag.
- Mains supply cable.
- Interconnecting cable to DRTS 66.
- Cable for the connection of current neutrals: 1 m long, 6 sq. mm cross section.
- Relay connection cables kit: 8 in all, 4 red, 4 black; length 2 m, cross section 1 sq. mm.

#### 6.2.3 Weight and dimensions

- Weight: 18 kg.
- Dimensions without the handle: 150 (h) x 466 (w) x 423 (d) mm.

## **7 IO-66 INPUT / OUTPUT EXPANSION MODULE**

### **7.1 Introduction**

This module extends the capability of time measuring and digital output of DRTS66. The module includes a power supply, and seven slots where it is possible to fit the input board IN24 or the output board OUT16R or the output board OUT16T. Possible configurations: 144 inputs (dry or wet), or 96 outputs (relay or electronic), or 72 inputs and 64 outputs.

### **7.2 Technical characteristics**

#### **7.2.1 Input module IN24**

- Digital inputs: 24 inputs, either clean or with voltage, from 4.5 to 300 V DC (24 to 230 V AC), divided in four groups of six inputs each, with four common points isolated among them. This feature allows the measurement of polarized trip contacts with four different zeroes that can't be put in common. All of them perform time measurements.
- Connections: multi-pole connector, positioned on the rear of the instrument.
- Selection of the type of input: Voltage clean; 5 V; 24 V; 48 V; 100 V; software controlled.
- For all selections, inputs are protected against voltages up to the maximum specified above.
- Anti noise and programmable de-bounce functions. De-bounce range: from 40  $\mu$ s to 2 ms.
- Selections: Close (N.O.), Open (N.C.), independent for each input.
- Timer range: 0 to infinite; resolution: 0.1 ms.
- Timer accuracy: 0.001% of the measure  $\pm$  0.1 ms, for input changes lasting more than 1 ms.

#### **7.2.2 Output module OUT16R**

- Sixteen auxiliary relay contacts, timed, voltage clean.
- Connections: multi-pole connector, positioned on the rear of the instrument.
- Characteristics of the contacts with a resistive load:
  - . AC: 300 V; 8 A; 2400 VA;
  - . DC: 300 V; 8 A; 50 W.
- Range of programmable delay with respect to test start: from 0 to 999,999.99 s.
- Nominal switch delay with respect to test start: 5 ms.

#### **7.2.3 Output module OUT16T**

- Sixteen transistor open collector outputs, voltage clean.
- Connections: multi-pole connector, positioned on the rear of the instrument.
- Characteristics of the outputs: 24 V, 5 mA.
- Short circuit protection.
- Protection for voltages higher than 24 V.
- Range of programmable delay: from 0 to 999,999.999 s.
- Timing accuracy with respect to test start: less than 50  $\mu$ s.

#### **7.2.4 Weight and dimensions**

- Weight: 10 kg.
- Dimensions, without the handle: 150 (h) x 466 (w) x 423 (d) mm.