



I.S.A. Istrumentazioni Sistemi Automatici S.r.l.
Via Prati Bassi 22 - 21020 Taino (VA) - ITALIA
tel +39 0331 956081 - fax +39 0331 957091
e-mail: isa@isatest.com - www.isatest.com

DOC.SIE10156

DATE: 20/05/2010

REV. 15

**INSTRUMENT DRTS.6
FOR TESTING PROTECTIVE RELAYS,
ENERGY METERS AND TRANSDUCERS**

1 GENERAL	5
1.1 THE INSTRUMENT	5
1.2 OPTIONS	6
1.3 TDMS, THE SOFTWARE FOR DRTS.6.....	6
2 APPLICABLE STANDARDS	7
2.1 ELECTROMAGNETIC COMPATIBILITY	7
EMISSION.....	7
IMMUNITY	7
2.2 LOW VOLTAGE DIRECTIVE	7
3 CHARACTERISTICS OF THE UNIT.....	9
3.1 GENERAL	9
3.2 SIX PHASE CURRENT GENERATOR.....	10
3.3 FOUR PHASE VOLTAGE OUTPUT	11
3.4 FOURTH VOLTAGE OUTPUT V4.....	12
3.5 BATTERY SIMULATOR	12
3.6 ANGLES.....	13
3.7 OUTPUT FREQUENCY	13
3.8 LOW VOLTAGE OUTPUTS	13
3.9 TIME MEASUREMENTS AND COUNTING.....	14
3.10 AUXILIARY OUTPUTS	15
3.11 INTERFACE CONNECTION	15
3.12 OPERATOR'S LIGHTS	15
3.13 SEQUENCE OF COMMANDS	15
3.14 TRANSIENT FILES REPRODUCTION	16
3.15 PROTECTIONS.....	16
3.16 POWER SUPPLY	17
3.17 ENCLOSURE	17
3.18 ACCESSORIES.....	17
3.19 WEIGHT AND DIMENSIONS	17
4 DRTS.6 OPTIONS.....	18
4.1 OUTPUT VOLTAGE; CODE ZII30156	18
4.2 OPTIONAL CURRENT AND VOLTAGE MEASUREMENTS; CODE ZII20156.....	18
4.3 HIGH PRECISION OPTION ; CODE ZII12156	18
4.4 OPTIONAL IO6432 DIGITAL INPUT AND OUTPUT EXPANSION; CODE ZII14150	19
4.5 RELAY CONNECTION CABLES; CODE ZII15156	20
4.6 OPTION OUT32 FOR THE IO6432 OPTION; CODE ZII19150.....	20
4.7 GPS SYNCHRONIZER; CODE ZII10161	20
4.8 SHA-6 ENERGY METERS UNIVERSAL SCANNING HEAD; CODE ZII20162	21
4.9 IN2-CDG CURRENT BOOSTER FOR 1 A RATED RELAYS AND FOR THE CDG RELAY OF GE; CODE ZII99156	22
4.10 SEI OPTION FOR THE SERIES CONNECTION OF CURRENTS; CODE ZII35150.....	22
4.11 PAV OPTION FOR THE PARALLEL CONNECTION OF VOLTAGES; CODE ZII34150.....	23
4.12 PAI OPTION FOR THE USE AT 30 A, THREE PHASE; CODE ZII36156	23
4.13 TRANSIT CASE.....	24
4.14 MANUAL CONTROLLER; CODE ZPC10098	24
4.15 MAINS SYNCHRONISER OPTION, CODE PII24156.....	24
4.16 I100A CURRENT BOOSTER	25
4.17 IEC61850 OPTION; CODE PII80156.....	25
5 THREE PHASE CURRENT AMPLIFIER AND TWO VOLTAGE AMPLIFIER AMIV-66	27
5.1 INTRODUCTION	27
5.2 TECHNICAL CHARACTERISTICS	27
5.2.1 Three phase current generator	27
5.2.2 Two phase voltage generator	28
5.2.3 Power supply	28
5.2.4 Enclosure	29
5.2.5 Accessories supplied with the unit	29
5.2.6 Weight and dimensions	29
5.2.7 Protections	29

6 THREE PHASE CURRENT AMPLIFIER AMI-99 30

- 6.1 INTRODUCTION 30
- 6.2 TECHNICAL CHARACTERISTICS 30
 - 6.2.1 Three phase current generator 30*
 - 6.2.2 Power supply 31*
 - 6.2.3 Enclosure 31*
 - 6.2.4 Accessories supplied with the unit 31*
 - 6.2.5 Weight and dimensions 31*
 - 6.2.6 Protections 31*

7 TWO PHASE VOLTAGE AMPLIFIER AMV-66..... 32

- 7.1 INTRODUCTION 32
- 7.2 TECHNICAL CHARACTERISTICS 32
 - 7.2.1 Two-phase voltage output 32*
 - 7.2.2 Power supply 33*
 - 7.2.3 Enclosure 33*
 - 7.2.4 Accessories supplied with the unit 33*
 - 7.2.5 Weight and dimensions 33*
 - 7.2.6 Protections 33*

1 GENERAL

1.1 The instrument

The instrument DRTS.6 (digital relay test system, six phase systems) is a programmable and automatic relay test set, that permits for the automatic verification of digital protection relays, such as those used in Medium and High voltage networks.

As compared to the former DRTS.3, the DRTS.6 version offers the following improvements:

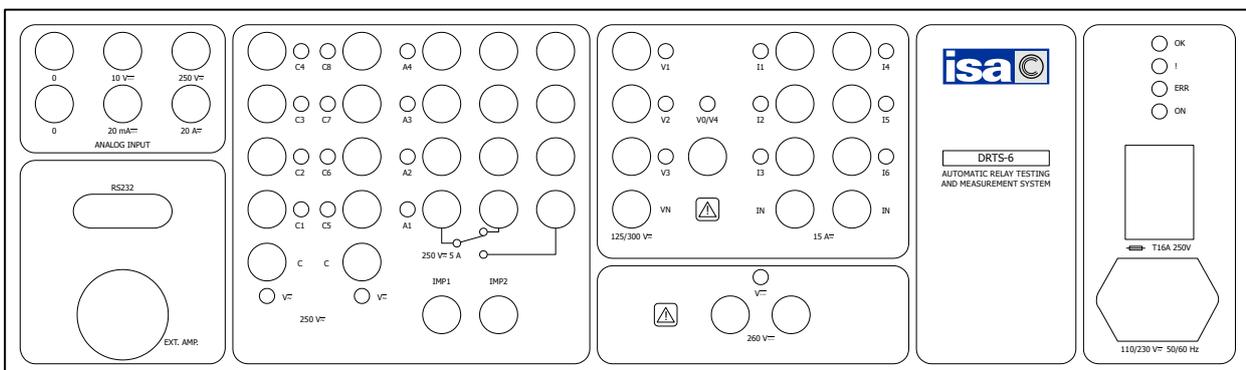
- . Six currents outputs instead of three: in all, four voltages and six currents, plus the auxiliary d.c. voltage supply. The current range is 15 A instead of 12.5 A;
- . With the optional AMIV-66, it is possible to control nine currents: this permits to test differential protections of transformers having two secondary;
- . With AMV-66 or AMIV-66, it is possible to control at the meantime six currents and six voltages.

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 instrument operates in connection with a computer, that controls it via the RS232 serial port; from May 2004, also via the USB port. The firmware FWH6, contained in a FLASH EPROM resident into the instrument, allows the instrument to interpret all commands received from the computer and to transmit test results.

Software running on the P.C. allow 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.



DRTS.6 FRONT PANEL

1.2 Options

There are many options available for DRTS.6: they are described in detail on chapter 4.

1.3 TDMS, the software for DRTS.6

All controls of the instrument are performed by the software TDMS, which is described in document MSE10015.

2 APPLICABLE STANDARDS

The test set DRTS.6 and optional modules conform to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

2.1 *Electromagnetic Compatibility*

Directive no. 2004/108/EC. Applicable Standard : EN61326-1 + A1 + A2.

EMISSION

- EN 61000-3-3: Limitation of voltage fluctuations and flicker. Acceptable limits: basic.
- CISPR16 (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.

2.2 *Low voltage directive*

Directive n. 2006/95/EC. Applicable standard, class I instrument, pollution degree 2, Installation category II: CEI EN 61010-1.

In particular:

- Dielectric Rigidity: 1.4 kV, 1 minute.
- Isolation resistance: > 2 MOhm.
- Earth resistance : < 0.1 Ohm.
- Dispersion current: < 5 mA.
- Inputs/outputs protection: IP 2X - IEC 60529.
- Operating temperature: 0 - 50°C; storage: -25°C to 70°C.
- Relative humidity : 5 - 95%, not condensing.

- Vibration: IEC 68-2-6 (20 m/s² at 10 – 150 Hz);
- Shock: IEC 68-2-27 (15 g; 11 ms; half-sine).
- Altitude: less than 2000 m.

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. For each parameter are reported the regulation ranges, and also the control parameter format, as it is exchanged between DRTS.6 and PC.

In separate documents are described:

- The DRTS.6 user's guide;
- The resident program FWH6;
- The software TDMS.

On the instrument the following connections are available:

- Mains power supply (2 phase with ground);
- Four voltage outputs V1-V4, with a common neutral point;
- Six current outputs I1-I6, with a common neutral point;
- The battery simulator, Vaux, isolated from other outputs;
- Ten input trip contacts, divided in two groups C1-C4-IMP1 and C5-C8-IMP2, with two zero references;
- Four auxiliary output contacts A1-A4, without a common point;
- Serial interface RS232 and USB interface;
- Four measurement inputs: two for currents (low and high) and two for voltages (low and high), for the optional board;
- The EXT. AMP female connector with low-power analog signals output, for external booster or zero-power mode.

Note: connectors are always present even if the optional circuits aren't present into the module.

Besides, on the front panel are available :

- Power-on switch;
- Four lights indicating the status of the instrument;
- Eight lights for the status of trip input (turn on when closed);
- Four lights for the status of auxiliary output (turn on when closed);
- One light per output, that turns on when it is active.

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.

The principal operation are as follows:

- Connect DRTS.6 to the portable PC, using the supplied cable;
- Connect DRTS.6 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;
- Execute the test;
- Test results are examined one at a time on the screen 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:

- User's guide;

- Electrical drawings;
- Diagnostic information, failure area, intervention procedures.

NOTE: all accuracies in the next paragraphs are referred to the following operating conditions:

- . Temperature: 20 °C to 25°C;
- . Power supply: 210 to 240 V;
- . Burden: less than 30% of the maximum, with p.f. more than $\pm 0,8$.

3.2 Six phase current generator

- Six independent current sources, with a common neutral.
- Type of connection: safety banana sockets.
- For each output, a light turns on when the output is applied.
- Output ranges, and corresponding power and resolution.

RANGE	OUTPUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	6 X	DIRECT	0...15	80	0.35	1 mA
2	6 X	DIRECT	0...1.5		0.35	0,1 mA
3	6 X	DIRECT	0...0.15		0.35	0,1 mA
4	3 X	DIRECT	0...15	100	0.44	1 mA
5	3 X	DIRECT	0...1.5		0.44	0,1 mA
6	3 X	DIRECT	0...0.15		0.44	0,1 mA
7	3 X	2 IN PARALLEL	0...30	160	0.18	2 mA
8	3 X	2 IN PARALLEL	0...3		0.18	0,2 mA
9	3 X	2 IN PARALLEL	0...0.3		0.18	0,2 mA
10	3 X	2 IN SERIES	0...15	160	0.71	1 mA
11	2 X	3 IN PARALLEL	0...45	240	0.12	3 mA
12	1 X	6 IN PARALLEL	0...90	480	0.06	6 mA
13	1 X	SERIES OF 2 IN PARALLEL	0...30	320	0.35	2 mA

- Independent adjustment of current outputs.
- Duty cycle, at 20°C ambient temperature: 3*15 A continuous; 6*7.5 A continuous; 6*15 A 3 minutes.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output frequency: 0 to 2 kHz; 5 kHz on reproductions.
- Output adjustable from zero to the maximum value.
- Possibility of step changing the value of the output within 0.1 ms.
- Possibility of current ramping. Rate of change programmable between ± 0.001 A/s and ± 999 A/s.
- Output accuracy; 40 to 60 Hz; 23 °C ± 5 °C.
 - . Typical: $\pm 0.05\%$ of the regulated value $\pm 0.01\%$ of the full scale range (ranges 1.5 and 15 A), or ± 0.5 mA (range 0.15 A).
 - . Maximum: $\pm 0.1\%$ of the regulated value $\pm 0.02\%$ of the full scale range (ranges 1.5 and 15 A), or ± 1 mA (range 0.15 A).
- Output accuracy; 0 to 40 Hz.: $\pm 0.5\%$ of the regulated value ± 1 mA (range 150 mA); ± 4 mA (range 1,5 A); ± 10 mA (range 15 A).
- 1 kHz maximum attenuation: 3% (0,3 dB).
- 2 kHz maximum attenuation: 5% (0,5 dB).
- Temperature coefficient: $\pm 0,01\%/^{\circ}\text{C}$, at 50 to 60 Hz; $\pm 0,02\%/^{\circ}\text{C}$, for other frequencies.

- Power supply variation: zero.
- Accuracy with: burden from 30% to 100%, and power factor less than 0.8: maximum 0,2% of the regulated value $\pm 0.05\%$ of the full scale range.
 - Gradient accuracy: $\pm 0.5\%$ of the selected value, with minimum rate of 200 mA/s.
 - Distortion: 0.1% .
 - Automatic protection for overloads (including open circuit). In this case, the output is taken to zero and the ! LED turns on.

3.3 Four phase voltage output

- Four independent voltage sources, with a common neutral.
- Type of connection: safety banana sockets.
- For each output, a light turns on when the output is applied.
- Output ranges, and corresponding power and resolution.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	4 X	DIRECT	0...125	85	200	1.9 mV
2	3 X	DIRECT	0...125	100	160	1.9 mV
3	3 X	DIRECT	0...12,5	10	160	190 μ V
4	3 X	DIRECT	0...1	1	160	19 μ V
5	1 X	2 IN SERIES	0...250	200	320	3.8 mV
6	1X	2 IN PARALLEL	0...125	200	80	1.9 mV
OPTIONAL 300 V OUTPUT						
1	4X	DIRECT	0...300	85	1125	4.6 mV
2	3X	DIRECT	0...300	100	900	4.6 mV
3	3X	DIRECT	0...125	100	160	1.9 mV
4	3X	DIRECT	0... 12.5	10	160	190 μ V
5	1X	2 IN SERIES	0...600	200	1800	9.2 mV
6	1X	2 IN PARALLEL	0...300	200	450	4.6 mV

- Independent adjustment of voltage outputs.
- Duty cycle: continuous.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output frequency: 0 to 2 kHz; 5 kHz on reproductions, for the 125 V output; 0 to 700 Hz, 5 kHz on reproductions, for the optional 300 V output.
- Output adjustable from zero to the maximum value.
- Possibility of step changing the value of the output within 0.1 ms.
- Possibility of ramping the voltage. Rate of change programmable between ± 0.001 V/s and ± 999 V/s.
- Output accuracy, 40 to 60 Hz; $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.
 - . Typical: $\pm 0.05\%$ of the regulated value $\pm 0.01\%$ of the full scale range (ranges 12.5, 125 and 300 V), or ± 1 mV (range 1 V).
 - . Maximum: $\pm 0.1\%$ of the regulated value $\pm 0.02\%$ of the full scale range (ranges 12.5, 125 and 300 V), or ± 2 mV (range 1 V).
- Output accuracy; 0 to 40 Hz.: $\pm 0.5\%$ of the regulated value ± 2 mV (range 1 V); ± 10 mV (range 12,5 V); ± 50 mV (range 125 V); ± 120 mV (range 300 V).
- 700 Hz maximum attenuation (300 V model): 1% (0,1 dB).

- 1 kHz maximum attenuation: 3% (0,3 dB).
- 2 kHz maximum attenuation: 5% (0,5 dB).
- Temperature coefficient: $\pm 0,01\%/^{\circ}\text{C}$, at 50 to 60 Hz; $\pm 0,02\%/^{\circ}\text{C}$, for other frequencies.
- Power supply variation: zero.
- Accuracy with: burden from 30% to 100%, and power factor less than 0.8: maximum 0,2% of the regulated value $\pm 0.05\%$ of the full scale range.
- Voltage gradient accuracy: $\pm 0.5\%$ of the selected value, with minimum gradient of 200 mV/s.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads (short circuit included). In this case, the output is taken to zero and the ! LED turns on.

3.4 Fourth voltage output V4

- The fourth voltage output can be selected via software to act as:
 - . Fourth voltage output V4;
 - . Zero-sequence component VO of the other three voltages V1, V2 V3. Via software the output can be selected to be: $\mathbf{VO} = (\mathbf{V1}+\mathbf{V2}+\mathbf{V3})/3$ or $\mathbf{VO} = (\mathbf{V1}+\mathbf{V2}+\mathbf{V3})/1.73$ (bolded stays for vector sum). Note that with last two selections the zero sequence component is limited to 125 V (or 300 V if the optional range is available).
- For the zero-sequence output, the following specifications apply.
 - . Range: 125 V – Optionally 300 V.
 - . Output accuracy: $\pm 0.5\%$ of the value $\pm 0.1\%$ of the range.

3.5 Battery simulator

- Output connection: two safety banana sockets.
- A light turns on when the output is applied.
- Output voltage range: 260 V D.C..
- Output programmable from 0 to maximum value, with resolution of 1/2047rd of the range, corresponding to 63 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 2 A.
- Possibility to ramp the voltage. Velocity of variation is between ± 0.1 V/s and ± 999 V/s. Voltage changes occurs every 10 ms.
- Output power: 100 W or 2 A; continuous duty.
- Output accuracy: $\pm 1\%$ of the regulated value $\pm 0.1\%$ of the full scale, with load of 25% to 100%.
- Gradient accuracy: $\pm 1\%$ of the nominal, with a minimum of ± 200 mV/s.
- Self protected 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; I1; I2; I3; I4; I5; I6, in the field between zero and $\pm 360^\circ$ (phase angle).
- Possibility of slewing all the angles. Variation range: 0.1°/s to 999 °/s.
- Angle resolution: 0.01°.
- Angle accuracy (40 to 60 Hz): typical $\pm 0.02^\circ$; maximum $\pm 0.1^\circ$.
- Angle accuracy (5 to 40 Hz): maximum $\pm 1^\circ$.
- Angle accuracy (60 to 2 kHz): maximum $\pm 5^\circ$.

3.7 Output frequency

- Possibility of selecting the output frequency between 0.0000 and 1999.9999 Hz; for the 300 V option, the frequency is limited to 700 Hz.
- Possibility to set the fault frequency on:
 - . All outputs;
 - . V1 only;
 - . Voltages V1-V2 -V3;
 - . I1 plus V1 – V2 – V3;
 - . All outputs unless V4;
 - . V1 and V2.With all selections unless the first one, not selected outputs stay at pre-fault frequency.
- Maximum frequency error: 0.5 ppM (25 uHz @ 50 Hz).
- Temperature drift of the oscillator frequency: 0,1 ppM/°C.
- Resolution: 0.1 mHz.
- Possibility of step switching the output frequency, separately or together with the amplitude change.
- Possibility of slewing the frequency, with a slope from 0.001 Hz/s to 999.999 Hz/s. Resolution: 0.001 Hz/s.
- Slew accuracy: 0.01 Hz/s, with a minimum of 0.1 Hz/s.

3.8 Low voltage outputs

The purpose of these low voltage outputs is to allow testing newest protection relays with low voltage inputs, and to control the external boosters, thus providing the following features:

- . to increase the power output, or:
- . to control six currents or six voltages at the meantime.

A connector carries six analog signals, that correspond to the three voltages and to the three currents. When the supplied male connector is fit into the socket, power outputs are automatically cut.

- Number of outputs: 6.
- Connection: 23 way connector.
- Full range voltage output: 7.26 Vrms. *
- Full range current output: 0.726 or 7.26 Vrms. *
- Output current: 5 mA max.
- Resolution: 0.43 mV or 0.043 mV. *
- Accuracy: 0.1% of range. *
- Distortion: 0.1%. *
- Frequency bandwidth
 - up to 10kHz for 6 channels
 - up to 20kHz for 3 channels: V1, V2 and I1. The others are disabled.

* In the range 40 to 60 Hz.

- Output accuracy; 0 to 40 Hz.: $\pm 0.2\%$ of the regulated value $\pm 0.04\%$ of the full scale range.
- 700 Hz maximum attenuation (300 V model): 1% (0,1 dB).
- 1 kHz maximum attenuation: 3% (0,3 dB).
- 2 kHz maximum attenuation: 5% (0,5 dB).

3.9 Time measurements and counting

- Digital inputs: 10 inputs, either clean or with voltage, from 4.5 to 600 V d.c. (24 to 425 V a.c.), divided in two groups of five input each, with two common points isolated at 1 kVac. This feature allows the measurement of polarized trip contacts with two 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.
- Connections: to safety banana sockets, marked C1 - C4 and IMP1; C5 - C8 and IMP2.
- For each input, a light turns on when the input is closed (or the voltage applied).
- Selection of the type of input: Voltage clean; 5 V; 24 V; 48 V; 100 V; software controlled. The selection clean/voltage is displayed by two warning lights (one per group) : the light turns on if the group is under voltage.
- Input impedance: 1 MOhm.
- Selection of the input debounce duration, from 0 us to 2 ms, in 64 steps of 32 us each, program controlled.
- For all selections, inputs are protected against voltages up to the maximum specified above.
- Indication of the state of the inputs by lights mounted on the operator panel.
- Selection N.O./N.C., independent for each input.
- Time measurements available:
 - Timing from the start of the test (injection) until the change of state or the reset of the selected input;
 - Timing from the change of state or the reset of an input in respect to any other input.
- Timer range: 0 - 999,999.9999 s (277 hours); resolution: 0.1 ms. In cycles: 0 to 50,000,000 cycles (50 Hz), or 0 to 60,000,000 cycles (60 Hz); resolution: 0.005 cycles (50 Hz).
- Timer accuracy: 0.025% of the measure ± 0.1 ms, for input changes lasting more than 1 ms.
- Impulse time measurements available:
 - 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 50 kHz.

3.10 Auxiliary outputs

- Four auxiliary contacts (A1, A2, A3, A4), timed, voltage clean, not polarized, whose termination C, N.O., N.C. are connected to safety banana connectors or to the A+C 28 way connector.
- For each output, a light turns on when it is closed.
- Characteristics of the contacts with a resistive load:
 - . A.C.: 300 V; 8 A; 2400 VA;
 - . D.C.: 300 V; 8 A; 250 W.
- Range of programmable delay: from 0 to 999.99 s.

3.11 Interface connection

- Type of interface: RS232 and USB.
- Characteristics of RS232 interface:
 - . Transmission rate: 57,600 baud.
 - . Serial interface cable: 2 meters, included.
 - . Protocol: BUSY/READY.
- Characteristics of USB interface:
 - . Transmission rate: 3x minimum.
 - . Interface cable: 2 meters, included.

3.12 Operator's lights

- The following lights are mounted on the operator panel of the instrument:
 - . OK: it turns on after power-on and after self-check.
 - . !: it turns on when an output (V or I) detects an overload, or in case of an internal failure of the instrument.
 - . ERR: it turns on in case of a failure of the internal logic circuits.
 - . ON: it turns on whenever there is a voltage or current on the outputs of the instrument.
- Below the USB interface a light confirms that data are being exchanged with the PC.

3.13 Sequence of commands

- The PC software allows controlling the instrument for the execution of automatic or manual tests.
- The elementary operations which compose all tests are:
 - . Measurement of the time delay from parameters step change;
 - . Search of the threshold, slewing parameters and memorize the value at the instant of the tripping of the input;
 - . Step change of parameters during a fixed time, reporting inputs that have changed their state (pause).
- Tests are executed in the following way:
 - . The PC defines the parameters to inject or vary;

- . At the command of the operator, parameters are transmitted to DRTS.6 by the serial interface;
 - . DRTS.6 generates the specified values, waits for the trip of the selected input contacts, and then transmits the results to the PC by the same serial interface;
 - . The PC examines the results, performs calculations and then displays them to the operator.
-
- During the execution of the test DRTS.6 is self-controlled and does not depend on the serial 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: 49.
 - Duration of the cycle: from 5 ms to 999999.9999 s;
 - Accuracy of the cycle duration: 1 ms.
 - Delay between two cycles: 1 ms maximum.

3.14 Transient files reproduction

- Possibility to reproduce a fault that has been recorded with a COMTRADE format, by means of the software R-PRO.
- Maximum recording dimension: 16 word; 64 kWord per channel; maximum sampling frequency 50 kHz.
- Transient files bandwidth: 0 to 5 kHz.

3.15 Protections

- Fuse on the mains supply.
- Electronic protections on the internal d.c. supplies of the instrument and alert to the program.
- Electronic protection for overload on the current (open circuit) or voltage outputs (short circuit), with immediate release of the output and lighting of the alarm light. The program resets the fault condition.
- Electronic protection in case of counter-feed of current outputs. If a voltage is applied to current sockets, the circuit opens, and the overload alarm is displayed.
- Electronic protection in case of counter-feed of voltage outputs. In this instance, the ! alarm light turns on, and the counter-feed alarm message is displayed.
- Electronic protection sensing if the test set is not properly grounded: in this instance, the operator is warned.
- Protection against over-temperature, on all outputs.

- Diagnostic messages for the setting of wrong data, mistakes on the inputs etc.

3.16 Power supply

- Mains power supply: 90 to 132 and 180 to 264 V a.c., sinusoidal, single phase.
- Frequency: 47 to 63 Hz.
- Power consumption:
 - . at rest: less than 150 W;
 - . maximum load: 1600 W.

3.17 Enclosure

- Instrument: 3U rack.
- Case: Aluminum, with carrying handle. The instrument may be operated in the horizontal or vertical positions.

3.18 Accessories

The following items are supplied with the DRTS.6:

- . Protection bag;
- . Mains supply cable;
- . Serial and USB cable;
- . Relay connection cables kit: 12 in all, 4 red, 4 black, 2 blue, 2 yellow; length 2 m, cross section 1 sq. mm.
- . Ground connection cable: 2 m, yellow/green, terminated with crocodile clamp.

3.19 Weight and dimensions

- Weight: 18 kg.
- Dimensions: 170 (h) x 470 (w) x 430 (d) mm.

4 DRTS.6 OPTIONS

4.1 Output voltage; code ZII30156

The output voltage can be up to 300 V instead of 125 V; specifications are given in the voltage outputs paragraph. This option is to be specified at order.

4.2 Optional current and voltage measurements; code ZII20156

Optionally it is possible to measure currents and voltages. Connections: to safety banana plugs.

- DC Current measuring Input, Low
 - . Measuring range: ± 20 mA
 - . Resolution: 10 nA.
 - . Accuracy: 0.02% of range $\pm 0.01\%$ of value.
 - . Temperature drift: $\pm 0.01\%/^{\circ}\text{C}$ of value $\pm 0.03\%/^{\circ}\text{C}$ of range
- DC Voltage measuring input, Low
 - . Measuring range ± 10 V
 - . Resolution: 10 μV .
 - . Accuracy: 0.02% of range $\pm 0.01\%$ of value.
 - . Temperature drift: $\pm 0.005\%/^{\circ}\text{C}$ of value $\pm 0.02\%/^{\circ}\text{C}$ of range
- AC/DC Current measuring Input, High
 - . Measuring range: ± 20 A
 - . Resolution: 10 mA.
 - . AC accuracy: 0.2% of range $\pm 0.1\%$ of value.
 - . Temperature drift: $\pm 0.05\%/^{\circ}\text{C}$ of value $\pm 0.01\%/^{\circ}\text{C}$ of range
 - . DC accuracy: 0.1% of range $\pm 0.1\%$ of value.
 - . Temperature drift: $\pm 0.05\%/^{\circ}\text{C}$ of value $\pm 0.02\%/^{\circ}\text{C}$ of range
- AC/DC Voltage measuring input, High
 - . Measuring range ± 250 V
 - . Resolution: 10 mV.
 - . AC accuracy: 0.1% of range $\pm 0.1\%$ of value.
 - . Temperature drift: $\pm 0.05\%/^{\circ}\text{C}$ of value $\pm 0.01\%/^{\circ}\text{C}$ of range
 - . DC accuracy: 0.05% of range $\pm 0.05\%$ of value.
 - . Temperature drift: $\pm 0.05\%/^{\circ}\text{C}$ of value $\pm 0.02\%/^{\circ}\text{C}$ of range

NOTE: AC specification applies to frequencies between 48 and 62 Hz.

Option codes:

- . MISU with standard DRTS.6: code ZII20156;
 - . MISU with 300 V DRTS.6: code ZII40156.
- This option is to be specified at order.

4.3 High Precision option ; code ZII12156

This option has enhanced characteristics with respect to the standard model. This model is conceived for the test of class 0.2 energy meters. The following table summarizes the performances of the DRTS.6-HP (High Precision) version with respect to the standard one.

	STANDARD DRTS.6	DRTS.6-HP
OUTPUT CURRENT	Typical: $\pm 0.05\% \pm 0.01\%$ of range	Typical: $\pm 0.02\%$ from 0.1 to 15 A
	Maximum: $\pm 0.1\% \pm 0.02\%$ of range	Maximum: $\pm 0.05\%$ from 0.1 to 15 A
OUTPUT VOLTAGE	Typical: $\pm 0.05\% \pm 0.01\%$ of range	Typical: $\pm 0.02\%$ from 50 to 300 V
	Maximum: $\pm 0.1\% \pm 0.02\%$ of range	Maximum: $\pm 0.05\%$ from 50 to 300 V
PHASE ANGLE	Typical: $\pm 0.02^\circ$	Typical: $\pm 0.01^\circ$
	Maximum: $\pm 0.1^\circ$	Maximum: $\pm 0.02^\circ$
POWER; SEE TABLE	Typical: $\pm 0.05\%$	Typical: $\pm 0.05\%$
	Maximum: $\pm 0.2\%$	Maximum: $\pm 0.1\%$

NOTES

1) The above accuracies are obtained in the following operating conditions:

- . Output frequency: 40 to 60 Hz;
- . Temperature: 20 °C to 25°C;
- . Power supply: 210 to 240 V;
- . Burden: less than 30% of the maximum.

2) The rated power accuracy applies to p.f. = 1; the accuracy at other p.f. is shown here below.

p.f.	1	0,8	0,5	0,1	0
Max. error for std. DRTS.6, %	0,2	0,25	0,27	1,1	Infinite
Max error for DRTS.6-HP, %	0,1	0,125	0,135	0,55	Infinite

3) The rated power accuracy applies for currents greater than 0,1 A and voltages greater than 10 V.

Option codes:

- . HP with standard DRTS.6: code ZII12156;
- . HP with MISU: code ZII22156;
- . HP with 300 V DRTS.6: code ZII32156;
- . HP with MISU and 300 VDRTS.6: code ZII42156.

This option is to be specified at order.

4.4 Optional IO6432 digital input and output expansion; code ZII14150

The option IO6432 allows to increase the number of logic inputs and outputs that can be monitored by DRTS.6. It is made of a board that is mounted on the rear of DRTS.6; connection is performed by two connectors, one for inputs and the other one for outputs. The option adds to inputs and outputs that are located on the front of DRTS.6. This feature can be exploited by test programs prepared with EDITOR, but not by MAN. Option characteristics are the followings.

- Number of inputs: 64, by 4 groups of 16.
- Inputs: logic, voltage from 5 to 130 V d.c.; maximum current 3 mA.
- Input and output groups are isolated among them; they are also isolated from the rest of the instrument, from the mains supply and from the ground.
- It is possible to program separately each input as Normal Open or Normal Closed or Disabled.
- It is possible to program separately the timer stop of each programmed input at Trip or Reset.

- Timer range: XXXX.XXX s.
 - Logic input time measurement resolution: 1 ms.
 - Logic input time measurement accuracy: 2 ms.

 - Number of outputs: 32, by 4 groups of 8.
 - Outputs: open collector; maximum voltage 130 V; minimum current 15 mA.
 - It is possible to program separately each logic output as Normal Open or Normal Closed.
 - It is possible to delay separately each logic output with respect to currents and voltages. Delay range: 0 to XXXX.XX s.
 - Logic output time accuracy: 1 ms.
- This option is to be specified at order.

4.5 Relay connection cables; code ZII15156

This option includes 29 cables, with different colours, with banana plugs, 2 m long, cross section 1.5 sq. mm unless for current connections, that allow for the connection to the relay under test to the following sockets:

- Current outputs (8 cables, cross section 6 sq. mm);
- Voltage outputs (5 cables; 4 red and 1 blue for the neutral);
- Auxiliary d.c. supply (2 cables; 1 red and 1 black);
- Trip inputs (10 cables; 8 red and 2 black for the common);
- Auxiliary outputs (4 cables; 2 black and 2 yellow).

4.6 Option OUT32 for the IO6432 option; code ZII19150

IO6432 outputs drive the load to zero. If the output must be driven with the voltage, or if the current is not sufficient, it is available the module OUT32, that has the following characteristics:

- Inputs: 32, from IO6432 of DRTS.6;
- Outputs: 32 relay contacts (both ends), with the following characteristics.
 - . Vmax: 250 V;
 - . Imax: 0.5 A;
 - . Outputs protected against over-voltage;
 - . Time delay: less than 10 ms.
- Connection to DRTS.6: with a cable 1 m long, provided.
- Lights that turn on when the relay is closed.
- Output connection: by two 50-way connectors.
- Power supply: from the mains; 220 V 50 Hz.
- Weight: 3 kg.
- Dimensions: 25 * 19 * 11 cm.
- Container: plastic, with graved front face.

4.7 GPS synchronizer; code ZII10161

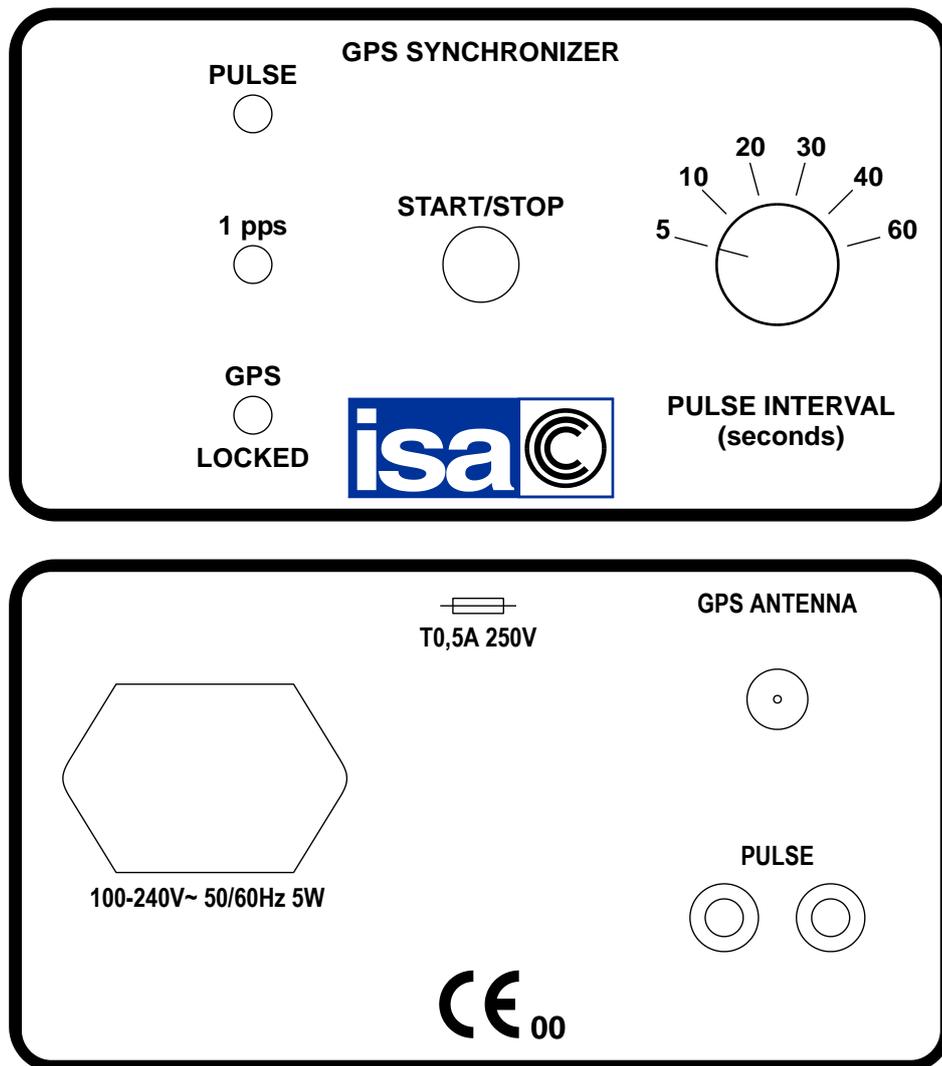
The GPS synchronizer is an external module that allows to synchronize test start of two DRTS.6.

Features are:

- . 1 digital output 0-24 Vdc, 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 us.
- . 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 50 us.



GPS front and rear view

4.8 SHA-6 energy meters universal scanning head; code ZII20162

SHA-6 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 any type of mark.

With LED recognition the following specification applies:

- . Impulse duration: more than 60 us;
- . 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 the DRTS.6;
- The power supply transformer, for the power of 220 Vac, to supply the scanning head.
- Two safety banana plugs for the connection to DRTS.6.

4.9 IN2-CDG current booster for 1 A rated relays and for the CDG relay of GE; code ZII99156

With DRTS.6 the full power of 100 VA is available only at the current of 15 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;
- . Secondaries: 0.5 A; 1 A; 2.5 A; 5 A;
- . Nominal power: 100 VA;
- . 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 DRTS.6 current outputs, 1 m long, 2.5 sq. mm cross section. Outputs do not have a common neutral; this eases the star or delta connection. Included is a bridge for star connection.

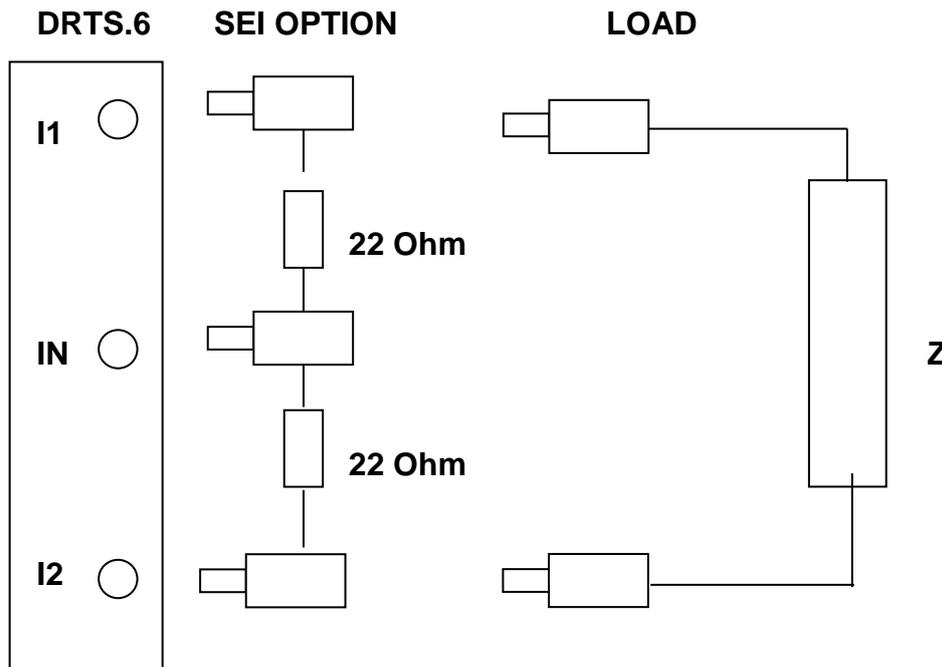
NOTE: the software takes into account the transformers ratio.

4.10 SEI option for the series connection of currents; code ZII35150

DRTS.6 has a power output of 80 VA on current outputs. If it is necessary to have more than 80 VA, it is possible to connect two amplifiers in series. In this situation it is possible to have 160 VA;

however, minor differences of current outputs tend to overload the amplifier; this would make it impossible to get the desired power.

To overcome this problem the option is made of a set of three burdens that equalize the load for current outputs of DRTS.6. Each burden includes two resistors rated 22 Ohm 1 W; at maximum load it causes an error of -1.6% . The burden is easily connected to current outputs by means of three safety banana sockets plus plugs, that ease connections. The following drawing explains how SEI is connected.



4.11 PAV option for the parallel connection of voltages; code ZII34150

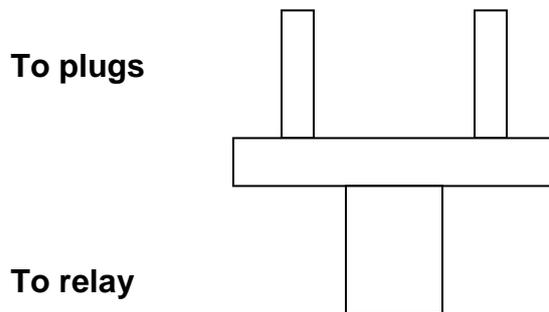
DRTS.6 has a power output of 80 VA on voltage outputs. If it is necessary to have more than 80 VA, it is possible to connect two amplifiers in parallel. In this situation it is possible to have 160 VA; however, minor differences of voltage outputs tend to overload the amplifier; this would make it impossible to get the desired power. To overcome this problem the option includes small resistors to be connected in series to voltage outputs of DRTS.6 and of AMV-66 or AMIV-66 options. Burden is 1 Ohm for tests up to 125 V and 5.7 Ohm for tests at 300 V; at maximum load it causes an error of -0.5% .

- Case: plastic.
- Dimensions: 22 x 45 x 85 mm.
- Connections to the instrument: two wires 0.2 m long, with safety banana plugs.
- Connection to the load: by a safety banana plug.
- 125 V or 300 V selection: by switch.

4.12 PAI option for the use at 30 A, three phase; code ZII36156

DRTS.6 has six current outputs rated 15 A each. When three phases are sufficient and higher currents are required, it is possible to use it as a three phase current generator with outputs rated 30 A, and power 160 VA per output. The software eases this selection.

The option PAI is made of four jumpers, that ease the paralleling of output sockets: I1 and I4; I2 and I5; I3 and I6, and of the two IN sockets: this eases the connection to the relay under test. The jumper has a socket where the current can be connected: three are red and one is black. The jumper looks like this.



4.13 Transit case

The protection of DRTS.6 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 for transport;
- Dimensions: 24 x 57 x 58 cm.

4.14 Manual controller; code ZPC10098

Manual controller. This option is made of a pocket Personal Data Assistant, where is installed our Mobile XPRO software. MobileXpro is a smart solution for the quick test of electrical relays without the need of a laptop or PC computer. Running on handheld devices (PDA Personal Data Assistant) with Windows Pocket PC 2003, it gives the highest degree of flexibility to end-users.

It is extremely easy to use and features:

- graphical user interface;
- manual control of voltages and currents of ISA automatic test sets;
- saving of results into .MOB files.

4.15 Mains synchroniser option, code PII24156

The option is made of a plug that fits into the mains, and that has two banana sockets for the connection to the test set counting input. The purpose is to synchronize the outputs of two test sets to the mains: as the synchronisation is repeated every 2 minutes, the test set stays locked to the mains for the infinity.

The option includes a circuit that squares the sinusoidal mains waveform; the isolated output is a square-wave with an amplitude of 18 V nominal, running at the mains frequency.

There are two instances where the option can be necessary:

- . Generating a current or voltage into a device that is also taking a signal from the mains;
- . Synchronising two test sets to the mains, and then using them to test line differential relays.

4.16 I100A current booster

- The option I100A is set of six current transformers, with the following characteristics:
 - . Primary: 3x(2x15) +3x30 A;
 - . Secondary: 6x50 A, that can be put in parallel, to form 3x100 A;
 - . Nominal power: 6x120 VA @ 50 A, or 3x240 VA, steady;
 - . Current ratio error: 0.5;
 - . Frequency range: 40 Hz to 2 kHz.
- Case: plastic.
- Connections:
 - . Eight primary side banana sockets (Direct connections to DRTS.6);
 - . Four primary side sockets (Direct connections to AMI-99);
 - . Six independent outputs: IA, IB, IC, IX, IY, IZ, on 8 sockets;
 - . Four additional sockets for paralleling outputs;
 - . Jumpers for paralleling outputs.
- Dimensions: 400 x 300 x 175 mm.
- Weight: 12 kg.

Inputs from DRTS.6 are put in parallel inside the option: all transformers have 30 A on the primary and 50 A on the secondary.

The option includes twelve connecting cables to DRTS.6 and AMI-99 current outputs, 1 m long, 6 sq. mm cross section.

With this options, it is possible to perform the following tests:

- With DRTS.6 only, 3x50 A;
- With AMI-99, 6X50 A (differential relays) or 3x100 A (over-current relays).

4.17 IEC61850 option; code PII80156

The IEC61850 Interface option for DRTS-6 allows relay testing with Ethernet-based substation communication protocol. The option, and the associated software, provides the following features:

- . Capability of monitoring the Goose List and the Goose details of the messages 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 can and does produce 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 from 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 gose 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.

The Ethernet connector type RJ-45 for the IEC61850 Interface is mounted directly on the front panel of the DRTS-6. The option is to be specified at order. It is possible to upgrade old DRTS-6 units in the ISA facility. NOTE: with this option, if the booster is present the serial interface is not available.

With the option are also provided two ETHERNET cables: one for the connection to a switch on the Station bus; the other one for the direct connection to the relay.

The option is exclusive of the serial interface.
This option is to be specified at order.

5 THREE PHASE CURRENT AMPLIFIER AND TWO VOLTAGE AMPLIFIER AMIV-66

5.1 Introduction

The three phase current amplifier and two voltage amplifier AMIV-66 is an additional device to the DRTS.6. This option offers the following features:

- . To multiply by two the three-phase test current by paralleling outputs (from 3x30 A to 3x60 A);
- . To multiply by two the six-phase test current (from 6x15 A to 6x30 A);
- . To control nine currents at the meantime, for the test of two-secondary transformer protection relays;
- . To control six voltages, so that it is possible to have 6 currents and 6 voltages at the meantime.

The connection between DRTS.6 and AMIV-66 is made by a control cable to be connected to the 23 way connector.

5.2 Technical characteristics

5.2.1 Three phase current generator

- Three independent current sources, with a common neutral.
- Type of connection: safety banana plugs or 8 way connector (V+I).
- Output ranges, and corresponding power and resolution of AMIV-66 alone.

RANGE	OUTPUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	3 X	DIRECT	0...15	80	0.35	230 μ A
2	3 X	DIRECT	0...1.5		0.35	23 μ A
3	3 X	DIRECT	0...0.15		0.35	2.3 μ A
4	1 X	2 IN SERIES	0...15	160	0.71	230 μ A
5	1 X	3 IN PARALLEL	0...45	240	0.12	0.69 mA

- Output ranges, and corresponding power and resolution of AMIV-66 connected to DRTS.6.

RANGE	OUT	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	9 X	DIRECT	0...15	80	0.35	230 μ A
2	9 X	DIRECT	0...1.5			23 μ A
3	9 X	DIRECT	0...0.15			2.3 μ A
4	3 X	PARALLEL	0...45	240	0.12	690 μ A
5	3 X	PARALLEL	0...4.5			69 μ A
6	3 X	PARALLEL	0...0.45			6.9 μ A
7	1 X	ALL IN PARALLEL	0...135	720	0.04	2 mA

- Automatic range switch and independent range selection.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output accuracy: $\pm 0.1\%$ of the output $\pm 0.02\%$ of the range.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads.

- Angle accuracy: $\pm 0.05^\circ$.

NOTE: the accuracy range and the accuracy variations are the same as specified for DRTS.6.

5.2.2 Two phase voltage generator

- Two independent voltage sources, with a common neutral.
- Type of connection: safety banana plugs.
- Output ranges, and corresponding power and resolution of AMIV-66 alone.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	2 X	DIRECT	0...125	100	160	1.9 mV
2	2 X	DIRECT	0...12,5	10	160	190 μ V
3	2 X	DIRECT	0...1	1	160	19 μ V
4	1 X	2 IN SERIES	0...250	200	320	3.8 mV
5	1X	2 IN PARALLEL	0...125	200	80	1.9 mV
OPTIONAL 300 V OUTPUT						
1	2X	DIRECT	0...300	100	900	4.6 mV
2	2X	DIRECT	0...125	100	160	1.9 mV
3	2X	DIRECT	0...12.5	10	160	190 μ V
4	1X	2 IN SERIES	0...600	200	1800	9.2 mV
5	1X	2 IN PARALLEL	0...300	200	450	4.6 mV

- Output ranges, and corresponding power and resolution of AMIV-66 with DRTS.6.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	6 X	DIRECT	0...125	85	185	1.9 mV
2	6 X	DIRECT	0...12,5	8	185	190 μ V
3	6 X	DIRECT	0...1	1	185	19 μ V
4	1 X	2 IN SERIES-PAR.	0...250	400	200	3.8 mV
5	1X	4 IN PARALLEL	0...125	400	50	1.9 mV
OPTIONAL 300 V OUTPUT						
1	6X	DIRECT	0...300	85	1060	4.6 mV
2	6X	DIRECT	0...125	85	185	1.9 mV
3	6X	DIRECT	0...12.5	8	185	190 μ V
4	1X	4 IN SERIES-PAR.	0...600	400	200	9.2 mV
5	1X	4 IN PARALLEL	0...300	400	50	4.6 mV

- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output accuracy: $\pm 0.1\%$ of the output $\pm 0.02\%$ of the range.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads and counter-feed.
- Angle accuracy: $\pm 0.05^\circ$.

NOTE: the accuracy range and the accuracy variations are the same as specified for DRTS.6.

5.2.3 Power supply

- Mains power supply: 90 to 264 V a.c., single phase.
- Frequency: 47 to 63 Hz.
- Power consumption:
 - . at rest: less than 100 W;
 - . maximum load: 500 W.

5.2.4 Enclosure

- Instrument: half rack; 3U high.
- Case: aluminium, with carrying handle.

5.2.5 Accessories supplied with the unit

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

5.2.6 Weight and dimensions

- Weight: 18 kg.
- Dimensions without the handle: 170 (h) x 470 (w) x 430 (d) mm.

5.2.7 Protections

- Electronic protections on the internal d.c. supplies of the instrument and alert to the program.
- Electronic protection for overload, with immediate release of the output and lighting of the alarm light. The program resets the fault condition.
- Protection against over-temperature, on all outputs.

6 THREE PHASE CURRENT AMPLIFIER AMI-99

6.1 Introduction

The three phase current amplifier AMI-99 is an additional device to the DRTS.6. With respect to AMI-66, this option allows to have two three phase current generators at 30 A per phase, or one three phase generator at 60 A per phase.

The connection between DRTS.6 and AMI-99 is made by a control cable to be connected to the 23 way connector.

6.2 Technical characteristics

6.2.1 Three phase current generator

- Three independent current sources, with a common neutral.
- Type of connection: safety banana plugs or 8 way connector (V+I).
- Output ranges, and corresponding power and resolution of AMI-99 alone.

RANGE	OUTPUTS	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOLUT.
1	3 X	DIRECT	0...30	160	0.18	460 μ A
2	3 X	DIRECT	0...3		0.18	46 μ A
3	3 X	DIRECT	0...0.3		0.18	4.6 μ A
4	1 X	2 IN SERIES	0...30	320	0.35	460 μ A
5	1 X	3 IN PARALLEL	0...90	480	0.06	1.38 mA

- Output ranges, and corresponding power and resolution of AMI-99 connected to DRTS.6.

RANGE	OUT	CONNECTION	CURRENT (A)	POWER (VA)	Z MAX (Ohm)	RESOL.
1	6 X	DIRECT	0...15	80	0.35	230 μ A
	3 X		0...30	160	0.18	460 μ A
2	6 X	DIRECT	0...1.5			23 μ A
	3 X		0...3			46 μ A
3	6 X	DIRECT	0...0.15			2.3 μ A
	3 X		0...0.3			4.6 μ A
4	6 X	DRTS.6: PARALLEL	0...30	160	0.18	460 μ A
5	6 X	DRTS.6: PARALLEL	0...3		0.18	46 μ A
6	6 X	DRTS.6: PARALLEL	0...0.3		0.18	4.6 μ A
7	3 X	PARALLEL	0...60	320	0.09	920 μ A
8	3 X	PARALLEL	0...6		0.09	92 μ A
9	3 X	PARALLEL	0...0.6		0.09	9.2 μ A
10	1 X	ALL IN PARALLEL	0...180	960	0.029	2.8 mA

- Automatic range switch and independent range selection.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output accuracy: $\pm 0.1\%$ of the output $\pm 0.02\%$ of the range.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads.
- Angle accuracy: $\pm 0.05^\circ$.

NOTE: the accuracy range and the accuracy variations are the same as specified for DRTS.6.

6.2.2 Power supply

- Mains power supply: 90 to 264 V a.c., single phase.
- Frequency: 47 to 63 Hz.
- Power consumption:
 - . at rest: less than 100 W;
 - . maximum load: 1000 W.

6.2.3 Enclosure

- Instrument: half rack; 3U high.
- Case: aluminium, with carrying handle.

6.2.4 Accessories supplied with the unit

- Protective plastic bag.
- Mains supply cable to DRTS.6.
- Interconnecting cable to DRTS.6

6.2.5 Weight and dimensions

- Weight: 16 kg.
- Dimensions without the handle: 170 (h) x 470 (w) x 430 (d) mm.

6.2.6 Protections

- Electronic protections on the internal d.c. supplies of the instrument and alert to the program.
- Electronic protection for overload, with immediate release of the output and lighting of the alarm light. The program resets the fault condition.
- Protection against over-temperature, on all outputs.

7 TWO PHASE VOLTAGE AMPLIFIER AMV-66

7.1 Introduction

The two-phase voltage amplifier AMV-66 is an additional device to the DRTS.6. This option offers the following features:

- . To control six voltages, for the test of synchronism relays;
- . To control or six currents and six voltages at the meantime.

The connection between DRTS.6 and AMV-66 is made by means of a control cable to be connected to the 23 way connector.

7.2 Technical characteristics

7.2.1 Two-phase voltage output

- Two independent voltage sources, with a common neutral.
- Type of connection: safety banana plugs.
- Output ranges, and corresponding power and resolution of AMV-66 alone.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RISOLUT.
1	2 X	DIRECT	0...125	80	195	1.9 mV
2	2 X	DIRECT	0...12,5		195	190 μ V
3	2 X	DIRECT	0...1		195	19 μ V
4	1 X	2 IN SERIES	0...250	160	390	3.8 mV
5	1X	2 IN PARALLEL	0...125	160	97	1.9 mV
OPTIONAL 300 V OUTPUT						
1	2X	DIRECT	0...300	80	1125	4.6 mV
2	2X	DIRECT	0...125	80	195	1.9 mV
3	2X	DIRECT	0... 12.5		195	190 μ V
4	1X	2 IN SERIES	0...600	160	390	9.2 mV
5	1X	2 IN PARALLEL	0...300	160	97	4.6 mV

- Output ranges, and corresponding power and resolution of AMV-66 with DRTS.6.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RISOLUT.
1	6 X	DIRECT	0...125	80	195	1.9 mV
2	6 X	DIRECT	0...12,5		195	190 μ V
3	6 X	DIRECT	0...1		195	19 μ V
4	1 X	2 IN SERIES-PAR.	0...250	320	195	3.8 mV
5	1X	4 IN PARALLEL	0...125	320	50	1.9 mV
OPTIONAL 300 V OUTPUT						
1	6X	DIRECT	0...300	80	1125	4.6 mV
2	6X	DIRECT	0...125	80	195	1.9 mV
3	6X	DIRECT	0... 12.5		195	190 μ V
4	1X	4 IN SERIES-PAR.	0...600	320	195	9.2 mV
5	1X	4 IN PARALLEL	0...300	320	50	4.6 mV

- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.
- Waveform resolution: 28 bit (16 for the amplitude, 12 for the shape).
- Output accuracy: $\pm 0.1\%$ of the output $\pm 0.02\%$ of the range.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads and counter-feed.
- Angle accuracy: $\pm 0.05^\circ$.

NOTE: the accuracy range and the accuracy variations are the same as specified for DRTS.6.

7.2.2 Power supply

- Power supply voltage: 90 ... 264 Vac single phase.
- Frequency: 47/63 Hz.
- Power consumption, maximum load: 500 W.

7.2.3 Enclosure

- Instrument: 3U rack.
- Case: aluminium, with carrying handle.

7.2.4 Accessories supplied with the unit

- . Protective plastic bag.
- . Interconnecting cable to DRTS.6.
- . Mains supply cable

7.2.5 Weight and dimensions

- Weight: 7 kg.
- Dimensions: 170 (h) x 230 (w) x 360 (d) mm.

7.2.6 Protections

- Fuse on the mains supply.
- Electronic protections on the internal d.c. supplies of the instrument and alert to the program.
- Electronic protection for overload on the current (open circuit) or voltage outputs (short circuit), with immediate release of the output and lighting of the alarm light. The program resets the fault condition.
- Electronic protection in case of counter-feed of voltage outputs. In this instance, the ! alarm light turns on.
- Protection against over-temperature, on all outputs.