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INSTRUMENT DRTS.3
FOR TESTING PROTECTIVE RELAYS, ENERGY METERS AND TRANSDUCERS

REVISIONS			SUMMARY	VISA
N.	PAG.	DATE		
1	All	15-02-2000	Issued	Lodi
2	Par. 5, 6	22/06/2000	AMIV-33 and AMI-33: added the –3I selection	Lodi
3	Par. 1	24/08/2000	Deleted the description of X.TEST: it is found on doc. MSE10060	Lodi
4	13	07/04/2001	No frequency gradient on V4. Removed the 1 V range on 300 V option.	Lodi
5	Par. 4	17/09/2001	Added the option paragraph, with options: OUT 32; SHA-1; IN1A; SHA1; transit case	Lodi
6	Par. 4	28/03/2002	Re-organized the options	Lodi
7	8	1/12/2003	Modified to 1.4 kV the dielectric rigidity	Lodi
8	6	2/12/2005	Added the mains synchronizer option and the USB interface	Lodi
9	24	30/1/2008	Added he I50 option	Lodi

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1 GENERAL

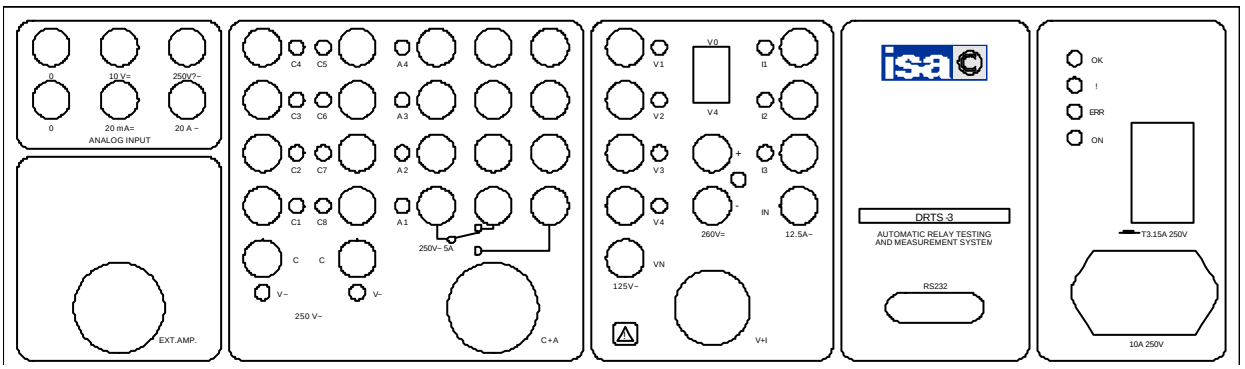
1.1 The instrument

The instrument DRST.3 (digital relay test system, three 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, the model DRTS.3 version offers the following improvements:
. Current and voltage output power doubled;
. The instrument has four voltages and three currents.
. Fourth voltage V4 a.c. - d.c. or zero sequence (instead of d.c. or zero sequence);
. D.C. supply independent from V4 and much more performing;
. Optionally, voltage outputs can be 300 V instead of 125 V.
Note that the power increase is available also on options AMIV-33 and AMI-33.

The test bench is enclosed in a case 3 U high, that contains: the power supply, the interface circuits, the control boards, the voltage and current amplifiers. The rack 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 or the USB interface. The firmware FWH2, 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.3 FRONT PANEL

1.2 Options

1) DRTS.3 maximum voltage outputs can be 300 V; for details, see DRTS.3 voltage specs.

2) Relay connection cables: set of cables for the connection to the relay to be tested; code ZII15150.

3) MISU current and voltage measurement, realised by a card to be installed inside the DRTS.3. Four inputs are available: two ranges for current (high and low); two ranges for voltage (high and low). The option allows testing transducers of any type. The option changes the code of the instrument, that becomes ZII20153.

4) Expansion of logic signals model IO6432, installed inside the instrument: it increases the number of digital inputs (64) and of digital outputs (32): this allows testing complex logic devices. Code ZII14150.

5) OUT32 option, to be ordered with IO6432: it boosts the output of IO6432. Code: ZII19150.

6) GPS synchronizer. It allows to synchronize at the microsecond two DRTS.3, for the end-to-end test of relays such as cable differential. Code: ZII10161.

7) SHA-1 reading head, for the test of energy meters, both rotating wheel or LED output. Code ZII10162.

8) IN1-CGD option, for the test of 1 A- rated high-burden relays, and of the relay CDG of G.E. Code ZII99156.

9) SEI option for the series connection of current outputs. Code ZII33150.

10) PAV option for the parallel connection of voltage outputs. Code ZII34150.

11) TCC option for connection to the relay under test, taking advantage of auxiliary connectors; code ZII35150.

12) Transit case. Code ZII18150.

13) I50 current booster, for three outputs at 50 A.

14) External current and voltage amplifier AMIV-33, that includes three current amplifiers and three voltage amplifiers. This option allows either to double the test current by paralleling outputs, or to control six currents or six voltages at the meantime, for the test of differential relays or synchronism relays. Optionally the maximum voltage can be 300 V. Codes: ZII13153 for 125 V; ZII23153 for 300 V.

15) External current and voltage amplifier AMI-33, that includes three current amplifiers of the same type of the DRTS.3. This option allows either to double the test current by paralleling outputs, or to control six currents at the meantime, for the test of differential relays. Code: ZII17153.

16) External current and voltage amplifier AMV-33, that includes three voltage amplifiers. This option allows either to control six voltages at the meantime, for the test of synchronism relays. Optionally the maximum voltage can be 300 V. Code: ZII16353 for 125 V.

17) Mains synchronizer option. 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.

NOTE: options 1, 3 and 4 are to be specified at order.

1.3 TDMS, the software for DRTS.3

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

2 APPLICABLE STANDARDS

The test set DRTS.3 ant the optional modules conform to the EEC directives regarding Electromagnetic Compatibility and Low Voltage instruments.

2.1 Electromagnetic Compatibility

Directive no. 89/336/CEE dated may 3, 1989, modified by the directive 92/31/CEE dated may 5, 1992. Applicable Standard : EN61326 + 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 ± 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 dops. Test value: 1 cycle; 100% drop.

2.2 Low voltage directive

Directive n. 73/23/CEE, modified by the directive 93/68/CEE.
Applicable standards, for a 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 - CEI 70-1.

-Operating temperature: 0 - 45°C; storage: -25°C to 70°C.

- Relative humidity : 5 - 95%, without condensing.

- Vibration: IEC 68-2-6 (20 m/s^2 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.3 and PC.

In separate documents are described:
. The DRTS.3 user's guide;
. The resident program FWH2;
. The software TDMS.

On the instrument the following connections are available:
. Mains power supply (2 phase with ground);
. Three voltage outputs V1-V3, with a common neutral point;
. The fourth voltage output V4 or zero sequence component, with the same neutral;
. Three current outputs I1-I3, with a common neutral point;
. The auxiliary d.c. supply, Vaux, isolated from other outputs;
. Eight input trip contacts, divided in two groups C1-C4 and C5-C8, of four inputs each, with two zero references;
. Four auxiliary output contacts A1-A4, without a common point;
. Serial interface RS232;
. USB interface;
. Four measurement inputs: two for currents (low and high) and two for voltages (low and high), for the optional board;
. The V+I 12-way female connector with all currents and voltages;
. The C+A 28-way male connector with all trip inputs and auxiliary outputs;
. The EXT. AMPL. 23-pole female connector with low-power analog signals output, for external booster or zero-power mode.
Note: connectors are always present even if the option 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 the DRTS.3 to the portable PC, using the supplied serial cable;
. Connect the DRTS.3 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.

3.2 Three phase current generator

- Three independent current sources, with a common neutral.

- Type of connection: safety banana plugs or 12 way connector (V+I).

- 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)	RESOL.
1	3 X	DIRECT	0…12,5	80	0.51	760 µA
2	3 X	DIRECT	0…1.25		0.51	100 µA
3	3 X	DIRECT	0…0.125		0.51	10 µA
4	1 X	2 IN PARALLEL	0…25	160	0.26	1.5 mA
5	1 X	TWO IN SERIES	0…12.5	160	1.02	760 µA

- Automatic switch to the range closest to the output, and independent range selection.

- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.

- Waveform resolution: 24 bit (14 for the amplitude, 10 for the shape).

- 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 current. Rate of change programmable between ± 0.001 A/s and ± 999 A/s.

- Output accuracy.
. Typical: ± 0.05% of the regulated value ± 0.01% of the full scale range.
. Maximum: ± 0.1% of the regulated value ± 0.02% of the full scale range.

- Gradient accuracy: ± 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 Three phase voltage output

- Three independent voltage sources, with a common neutral.

- Type of connection: safety banana plugs or 12 way connector (V+I).

- Output ranges, and corresponding power and resolution.

RANGE	OUTPUTS	CONNECTION	VOLTAGE (V)	POWER (VA)	Z MAX (Ohm)	RISOLUT.
1	4 X	DIRECT	0…125	85	195	7.6 mV
2	3 X	DIRECT	0…12,5			760 µV
3	3 X	DIRECT	0…1			100µV
4	1 X	2 IN SERIES	0…250	160	390	15.2mV
5	1X	2 IN PARALLEL	0…125	160	97.5	7.6 mV
OPTIONAL 300 V OUTPUT						
1	4X	DIRECT	0…300	85	1125	18.2mV
2	3X	DIRECT	0…125	85	195	7.6mV
3	3X	DIRECT	0… 12.5			760 µV
4	1X	2 IN SERIES	0…600	160	2250	36.4 mV
5	1X	2 IN PARALLEL	0…300	160	562	18.2mV

- Automatic range switch to the range closest to the output, and independent range selection.

- 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.

- Waveform resolution: 24 bit (14 for the amplitude, 10 for the shape).

- 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.
. Typical: ± 0.05% of the regulated value ± 0.01% of the full scale range.
. Maximum: ± 0.1% of the regulated value ± 0.02% of the full scale range.

- Voltage gradient accuracy: ± 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 by a switch to act as:

. Fourth voltage output V4;
. Zero-sequence component VO of the other three voltages V1, V2 V3: **VO** = (**V1**+**V2**+**V3**)/3 (bolded stays for vectorial sum).

- Connection: to safety banana plug, or to V+I 12-way connector. The reference of V4 is VN, the same as other voltages.

- For the fourth voltage V4 specifications are the same as other voltages, unless that there is only the maximum range available.

- For the zero-sequence output, the following specifications apply.
. Range: 125 V – Optionally 300 V.
. Output power: 80 VA, continuous duty.
. Output accuracy: ± 0.5% of the adjusted value ± 0.1% of the range.

3.5 Auxiliary D.C. supply

- Output connection: two safety banana sockets or V+I connector.

- Output voltage range: 260 V D.C..

- Output programmable from 0 to maximum vale, 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: 50 W or 2 A; continuous duty.

- Output accuracy: ± 1% of the regulated value ± 0.1% of the full scale, with load of 25% to 100%.

- Gradient accuracy: ± 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 the outputs: V1; V2; V3; V4; I1; I2; I3, in the field between zero and ± 360° (phase angle).

- Possibility of slewing all the angles. Variation range: 0.1°/s to 999 °/s.

- Angle resolution: 0.01°.

- Angle accuracy: typical ± 0.02°; maximum ± 0.05°.

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 select the output frequency on:
. All outputs;
. V1 only;
. I1 plus voltages;
. All voltages (V1-V3);
. All outputs unless V4;
. V1 and V2.
With all selections unless the first one, not selected outputs have the pre-fault frequency.

- Maximum frequency error: 50 uHz (1 ppM).

- 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. The slewing is not available on output V4.

- Slew accuracy: 0.01 Hz/s, with a minimum of 0.1 Hz/s.

3.8 Waveform

- Possibility to program, for outputs V and I, the following waveform (other than the fundamental).
A) Saturated C.T. (sinusoid interrupted at 60° or 90°), on current outputs, while voltages are not modified;
B) Sinusoid with superimposed a second harmonic distortion equal to: 10% ; 20% ; 30% ; 40% ; 50% ; 60% ; 70%, on current outputs, while voltages are not modified;
C) Sinusoid with superimposed a third harmonic distortion equal to: 6%; 12%; 18%; 24%; 30%, on voltage outputs, while currents are not modified.

Output waveform cannot have a peak output greater than the corresponding fundamental one; as a consequence, second harmonic distorted wave-forms cannot generate outputs higher than 200 V and 40 A.

3.9 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.
- Only one range for voltage and currents.
- 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%.

3.10 Intervention time measurements

- Digital inputs: 8 inputs, either clean or with voltage, from 4.5 to 250 V d.c. (24 to 250 V a.c.), divided in two groups of four 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.

- Connections: on safety banana plugs, marked C1 - C4 and C5 - C8, or on the C+A 28 way connector (Inputs + outputs).

- 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.

- 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.

- Timer accuracy: 0.025% of the measure ± 0.1 ms, for input changes lasting more than 1 ms.

3.11 Counter inputs

These inputs allow testing energy meters, with high frequency outputs.

-Number of inputs: 2; with no common zero point.

- Connection: on the 28 way C+A connector.

- Selection of the type of input: same as per time measurement.

- No debounce.

- Selection of rise or fall edge.

- Measurement available:
. Count of transitions in a given time;
. Time corresponding to N transitions; N programmable from 1 to 9,999,999.

- Frequency range: 0 to 50 kHz.

3.12 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.

3.13 Interface connections

- Interface 1: RS232.
. Transmission rate: 19,200 baud.
. Serial interface cable: 2 meters, included.
. Protocol: BUSY/READY.

- Interface 2: USB (from September 2005).
. Transmission rate: 3x minimum.
. Interface cable: 2 meters, included.

3.14 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.

3.15 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 the DRTS.3 by the serial interface;
. The DRTS.3 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 the DRTS.3 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 1 ms to 999999.9999 s;

- Accuracy of the cycle duration: 0.2 ms.

- Delay between two cycles: 1 ms maximum.

3.16 Reproduction of faults

- 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; 16 kWord per channel; maximum sampling frequency 50 kHz.

3.17 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.

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

3.18 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: 1000 W.

3.19 Enclosure

- Instrument: 3U rack.

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

3.20 Accessories

The following items are supplied with the DRTS.3:
. Protection bag;
. Mains supply cable;
. Serial 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.

3.21 Weight and dimensions

- Weight: 14 kg.

- Dimensions: 170 (h) x 470 (w) x 360 (d) mm.

4 DRTS.3 OPTIONS

4.1 Output voltage

The output voltage can be up to 300 V instead of 125 V.

4.2 Relay connection cables; code ZII15150

This option includes 24 cables, with different colours, with banana plugs, 2 m long, that allow for the connection to the relay under test to the following sockets:
- Current outputs (4 cables);
- Voltage outputs (4 cables);
- Auxiliary d.c. supply (2 cables);
- Trip inputs (10 cables);
- Auxiliary outputs (4 cables).

4.3 Optional current and voltage measurements; code PII20150

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

- DC Current measuring Input, Low
. Measuring range: ± 20 mA
. Accuracy: 0.02% of range ± 0.01% of value.

- DC Voltage measuring input, Low
. Measuring range ± 10 V
. Accuracy: 0.02% of range ± 0.01% of value.

- AC/DC Current measuring Input, High
. Measuring range: ± 20 A
. AC accuracy: 0.2% of range ± 0.1% of value.
. DC accuracy: 0.1% of range ± 0.1% of value.

- AC/DC Voltage measuring input, High
. Measuring range ± 250 V
. AC accuracy: 0.1% of range ± 0.1% of value.
. DC accuracy: 0.05% of range ± 0.05% of value.

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 the DRTS.3. It is made of a board that is mounted on the rear of the DRTS.3; 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.3. 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.

4.5 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.3;
- 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.3: with a cable I 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.

4.6 GPS synchronizer; code ZII10161

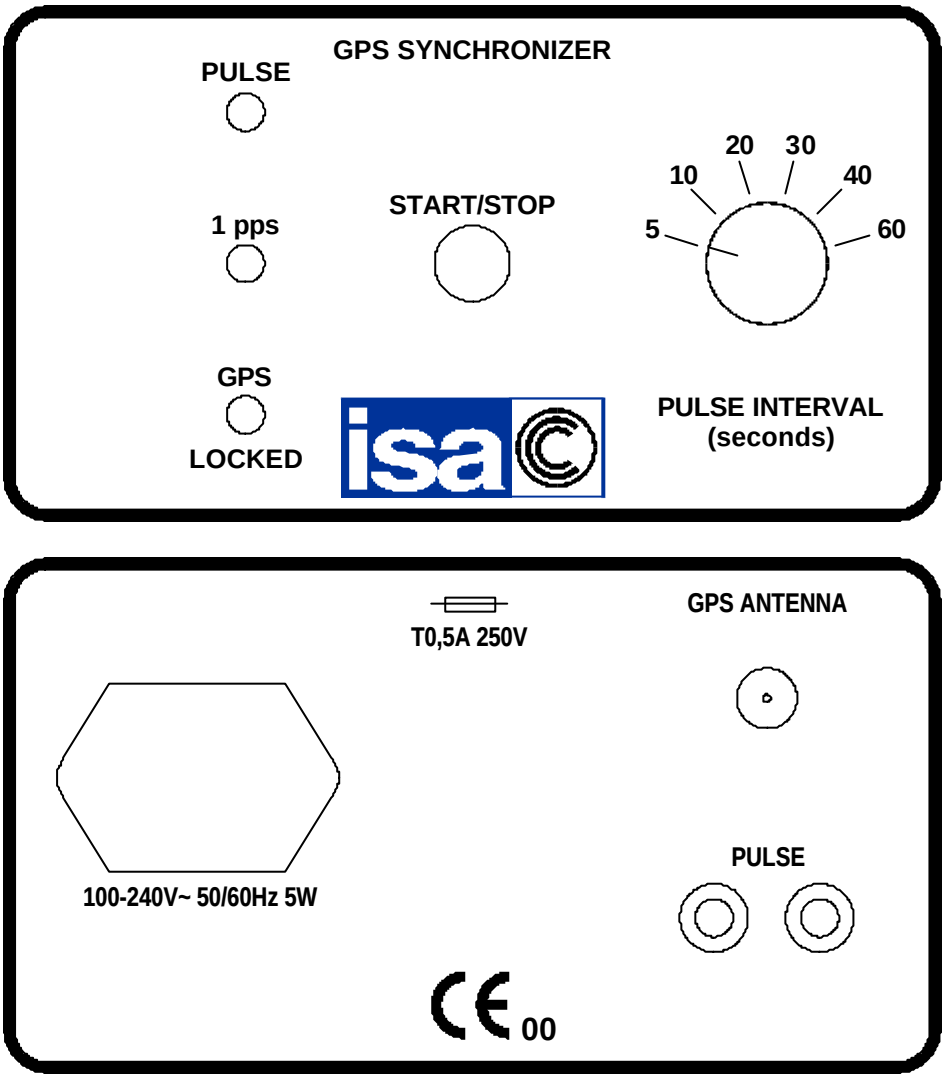
The GPS synchronizer is an external module that allows to synchronize test start of two DRTS.3.

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, 25 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

4.7 SHA-1 energy meters universal scanning head; code 10162

SHA-1 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;
- The power supply transformer, for the power of 220 Vac, to supply the scanning head.
- The connector to the C+A connector.

4.8 IN2-CDG current booster for 1 A rated relays and for the CDG relay of GE; code 99156

With DRTS.3 the full power of 80 VA is available only at the current of 12.5 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 are do not have a common neutral; this eases the star or delta connection. Included is a bridge for star connection.

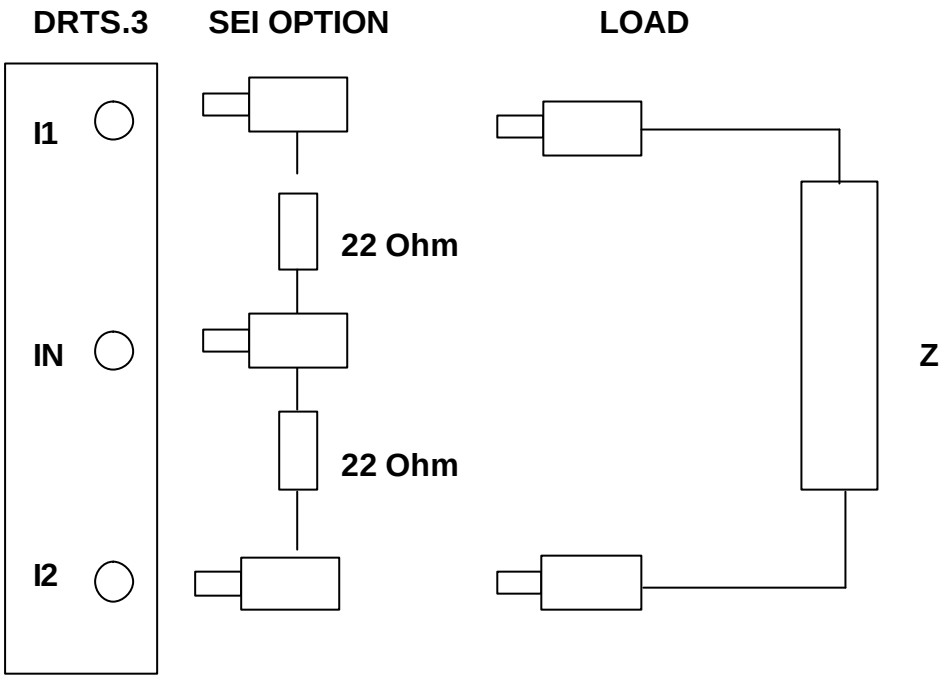
NOTE: the software takes into account the transformers ratio.

4.9 SEI option for the series connection of currents; code ZII33150

DRTS.3 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.3 and for AMI-33 or AMIV-33 options. 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.



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

DRTS.3 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.3 and of AMV-33 or AMIV-33 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.

4.11 TCC option for the connection to the relay under test; code ZII35150

Using loose wires for the connection to the relay under test implies a possibility of errors that would cause a waste of time. This likelihood can be reduced by using the auxiliary connectors provided in the front of the test set.

The option is made of the following two cables.

1. Cable from connector V+I. It carries: voltages, currents, auxiliary d.c. supply. Eleven wires in all. Cables cross-section is 1 sq.mm; for currents it is 2.5 sq. mm.
2. Cable from connector C+A. It carries: trip inputs; auxiliary outputs; impulse inputs. Twenty-four wires in all. Cables cross-section is 1 sq.mm

Cable length is 2 m. All wires are terminated with safety banana plugs-sockets of different colors; all wires are marked.

4.12 Transit case; code ZII18150

The protection of DRTS.3 from delivery problems is provided by this robust transit case, that features the following.

- Molded-case construction;
- Handles top and side;
- Wheels;
- Dimensions: 30 x 50 x 80 cm.

4.13 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.

4.14 I50A current booster

- The option I50A is set of three current transformers, with the following characteristics:
. Primary: 3x12.5 A;
. Secondary: 3x50 A, that can be put in parallel, to form 1x150 A;
. Nominal power: 3x50 VA @ 50 A, steady, corresponding to a maximum burden of 20 mOhm, or 1x150 VA @ 150 A, corresponding to a maximum burden of 6 mOhm (cable length 1 m, cross section 10 sq. mm);
. Current ratio error: 0.5;
. Frequency range: 40 Hz to 2 kHz.
- Case: plastic.
- Connections:
. Four primary side banana sockets (direct connections to DRTS.3);
. Three independent outputs: IA, IB, IC, on 6 sockets;
. Three additional sockets for paralleling outputs;
. Jumpers for paralleling outputs;
. Four connecting cables to DRTS.3: length 1 m, cross section 2.5 sq. mm;

. Six connection cables to the relay under test: length 1 m, cross section 6 sq. mm;
. Dimensions: 30 x 23 x 11 cm.
. Weight: 11 kg.

With this options, it is possible to perform tests:
- With DRTS.6 only, 3x50 A;
- With AMI-99, 6X50 A (differential relays) or 3x100 A (over-current relays).

5 THREE PHASE CURRENT AND VOLTAGE AMPLIFIER AMIV-33

5.1 Introduction

The three phase current and voltage amplifier AMIV-33 is an additional device to the DRTS.3, that features four selectable operating modes:
. Mode 3I+3V. The three voltage and the three current outputs of AMIV-33 are identical to those generated by DRTS.3: this allows paralleling current outputs, thus doubling output current and power; test programs foresee the current doubling. It is also possible to put in parallel voltage outputs, to double output power.
. Mode -3I+3V. The three current outputs of AMIV-33 are opposite in sign with respect to those generated by DRTS.3: this allows putting in series current outputs, thus doubling output power. It is also possible to put in parallel voltage outputs, to double output power.
. Modes 6I and 6V respectively allow to have six currents or seven voltages at the meantime. This feature allows testing of differential relays with six independent currents or synchronising devices with six independent voltages.

The connection between DRTS.3 and AMIV-33 is made by means of 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 connector.
- Output ranges:

1) AMIV-33 ALONE						
RANGE	**OUTPUTS**	**CONNECTION**	**CURRENT (A)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	3 X	DIRECT	0…12,5	80	0.51	760 µA
2	3 X	DIRECT	0…1.25		0.51	100 µA
3	3 X	DIRECT	0…0.125		0.51	10 µA
4	1 X	2 IN PARALLEL	0…25	160	0.26	1.5 mA
5	1 X	TWO IN SERIES	0…12.5	160	1.02	760 µA
2) AMIV-33 WITH DRTS.3						
RANGE	**OUTPUTS**	**CONNECTION**	**CURRENT (A)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	6 X	DIRECT	0…12,5	80	0.51	760 µA
2	6 X	DIRECT	0…1.25		0.51	100 µA
3	6 X	DIRECT	0…0.125		0.51	10 µA
4	3 X	2 IN SERIES (-I)	0…12,5	160	1.02	760 µA
5	3 X	2 IN PARALL. (I)	0…25	160	0.26	1.5 mA
6	1 X	2 IN SERIES OF 2 IN PARALLEL	0…25	320	0.51	1.5 mA
7	1 X	4 IN PARALLEL	0…50	320	0.13	3 mA

- Automatic range switch and independent range selection.

- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.
- Waveform resolution: 24 bit (14 for the amplitude, 10 for the shape).
- Output accuracy: ± 0.1% of the range.
- Distortion: 0.1% total maximum, with any load.
- Automatic protection for overloads.
- Angle accuracy: ± 0.1°.

5.2.2 Three phase voltage output

- Three independent voltage sources, with a common neutral.

- Type of connection: safety banana plugs or 8 way connector (V+I).

- Voltage outputs ranges:

1) AMIV-33 ALONE						
RANGE	**OUTPUTS**	**CONNECTION**	**VOLTAGE (V)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	4 X	DIRECT	0…125	80	195	7.6 mV
2	3 X	DIRECT	0…12,5			760 µV
3	3 X	DIRECT	0…1			100µV
4	1 X	2 IN SERIES	0…250	160	390	15.2mV
5	1X	2 IN PARALLEL	0…125	160	97.5	7.6 mV
OPTIONAL 300 V OUTPUT						
1	4X	DIRECT	0…300	80	1125	18.2mV
2	3X	DIRECT	0…125	80	195	7.6mV
3	3X	DIRECT	0… 12.5			760 µV
4	1X	2 IN SERIES	0…600	160	2250	36.4 mV
5	1X	2 IN PARALLEL	0…300	160	562	18.2mV
2) AMIV-33 WITH DRTS.3						
RANGE	**OUTPUTS**	**CONNECTION**	**VOLTAGE (V)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	7 X	DIRECT	0…125	80	195	7.6 mV
2	6 X	DIRECT	0…12,5			760 µV
3	6 X	DIRECT	0…1			100µV
4	3 X	2 IN PARALLEL	0…125	160	97.5	7.6 mV
5	1 X	2 IN PARALLEL IN SERIES	0…250	320	195	15.2mV
6	1X	4 IN PARALLEL	0…125	320	49	7.6 mV
OPTIONAL 300 V OUTPUT						
1	7X	DIRECT	0…300	80	1125	18.2 mV
2	6X	DIRECT	0…125	80	195	7.6mV
3	6X	DIRECT	0… 12.5			760 µV
4	3X	2 IN PARALLEL	0…300	160	562	18.2 mV
5	1X	2 IN PARALLEL IN SERIES	0…600	320	1125	36.4 mV
6	1X	4 IN PARALLEL	0…300	320	281	18.2 mV

NOTE: the 300 V option must be available both on DRTS.3 and on AMIV-33.

- Automatic range switch and independent range selection.

- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.

- Waveform resolution: 24 bit (14 for the amplitude, 10 for the shape).

- Voltage accuracy: ± 0.1% of the range.

- Distortion: 0.1% total maximum, with any load.

- Automatic protection for overloads.

- Angle accuracy: ± 0.1°.

5.2.3 Power supply

- Power supply voltage: 90 ... 264 Vac single phase.
- Frequency: 47/63 Hz.
- Power consumption, maximum load: 1000 W.

5.2.4 Enclosure

- Instrument: 3U rack.
- Case: aluminium, with carrying handle.
- Accessories supplied with the unit:
. Protective plastic bag.
. Interconnecting cable to DRTS.3
. Mains supply cable;

5.2.5 Weight and dimensions

- Weight: 13 kg.

- Dimensions without the handle: 170 (h) x 470 (w) x 360 (d) mm.

- Dimensions with the handle: 170 (h) x 520 (w) x 430 (d) mm.

5.2.6 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.

6 THREE PHASE CURRENT AMPLIFIER AMI-33

6.1 Introduction

The three phase current amplifier AMI-33 is an additional device to the DRTS.3, that features four selectable operating modes:
. Mode 3I. The three current outputs of AMI-33 are identical to those generated by DRTS.3: this allows paralleling current outputs, thus doubling output current and power; test programs foresee the current doubling.
. Mode -3I. The three current outputs of AMI-33 are opposite in sign with respect to those generated by DRTS.3: this allows putting in series current outputs, thus doubling output power.
. Mode 6I allows to have six currents at the meantime. This feature allows testing of differential relays with six independent currents.

The connection between DRTS.3 and AMI-33 is made by means of 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:

1) AMI-33 ALONE						
RANGE	**OUTPUTS**	**CONNECTION**	**CURRENT (A)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	3 X	DIRECT	0…12,5	80	0.51	760 µA
2	3 X	DIRECT	0…1.25		0.51	100 µA
3	3 X	DIRECT	0…0.125		0.51	10 µA
4	1 X	2 IN PARALLEL	0…25	160	0.26	1.5 mA
5	1 X	TWO IN SERIES	0…12.5	160	1.02	760 µA
2) AMI-33 WITH DRTS.3						
RANGE	**OUTPUTS**	**CONNECTION**	**CURRENT (A)**	**POWER (VA)**	**Z MAX (Ohm)**	**RISOLUT.**
1	6 X	DIRECT	0…12,5	80	0.51	760 µA
2	6 X	DIRECT	0…1.25		0.51	100 µA
3	6 X	DIRECT	0…0.125		0.51	10 µA
4	3 X	2 IN SERIES (-I)	0…12,5	160	1.02	760 µA
5	3 X	2 IN PARALL. (I)	0…25	160	0.26	1.5 mA
6	1 X	2 IN SERIES OF 2 IN PARALLEL	0…25	320	0.51	1.5 mA
	1 X	4 IN PARALLEL	0…50	320	0.13	3 mA

- Automatic range switch and independent range selection.
- Output frequency: from d.c. to 2000 Hz; transient 5 kHz.
- Waveform resolution: 24 bit (14 for the amplitude, 10 for the shape).
- Output accuracy: ± 0.1% of the range.
- Distortion: 0.1% total maximum, with any load.

- Automatic protection for overloads.
- Angle accuracy: ± 0.1°.

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: 500 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.3.
- Interconnecting cable to DRTS.3

6.2.5 Weight and dimensions

- Weight: 7 kg.
- Dimensions without the handle: 170 (h) x 230 (w) x 360 (d) mm.
- Dimensions with the handle: 170 (h) x 280 (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.