CS Series

Static Inverters

Technical proposal

General Information

Specific information

1. Introduction

The new generation of "IS" and "ISC" inverters have been designed by SALICRU ELECTRONICS to attend and offer solutions to the needs of control and power of the alternating current from a supply of direct current in highly diverse applications.

The "IS" and "ISC" series Inverters are the ideal solution for needs to transform direct current into alternating current by means of a process of modulation, filtering and control, finally giving an optimal voltage adapted to the special needs of each application.

The effective filtering of the disturbances of the mains, the options of including suitable filters, safety static By-pass, LCD display, RS-232 serial port, remote control or a large range of input voltages and output powers, make the "IS" and "ISC" series Inverters a product range of great versatility for practically all applications in today's modern industry.

MAIN APPLICATIONS

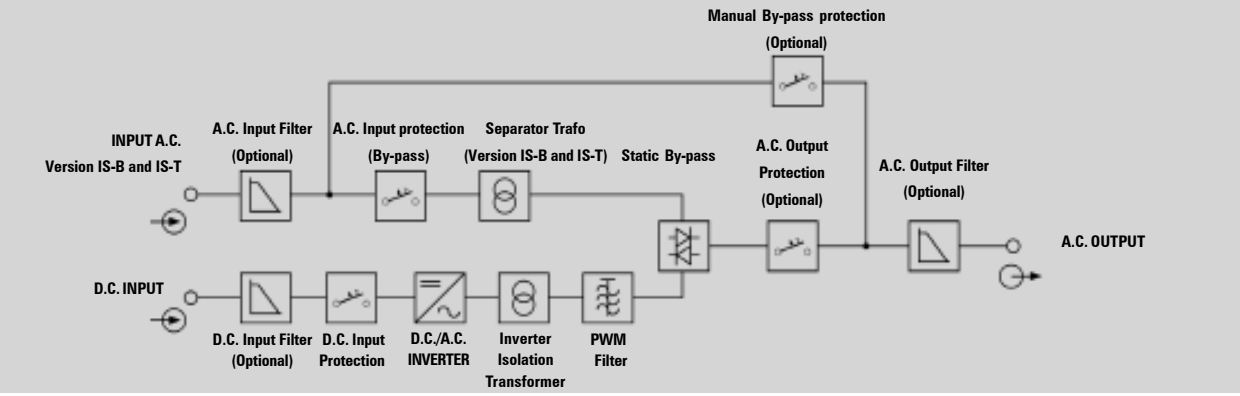
When the only voltage source available comes from a battery or another source of direct current, the "IS" and "ISC" series Inverters by SALICRU ELECTRONICS give the alternating supply current that is best for the needs of the unit to be supplied.

Among the most outstanding characteristics we might mention the broad regulation margin of the input, together with its high precision, stability and the absence of harmonics on the output, and also its safety in the event of any failure in the direct supply of the installation, thus enabling quality alternating voltage to be supplied to any critical load.

Therefore, among other possible applications, we might highlight:

- TELECOMMUNICATIONS
- COMPUTER CONTROL SYSTEMS IN SECONDARY POWER STATIONS
- PANELS IN GAS GENERATOR PLANTS
- SOLAR POWER
- WIND POWER
- NAVIGATION
- TELEPHONY
- DOMOTICS
- INFORMATION TECHNOLOGY
- MOBILE SYSTEMS
- RAILWAYS, ETC.

2. Working principle



Block Diagram

The working principle of the IS series voltage INVERTERS consists of transforming DC input into AC sinusoidal output (IS) or AC trapezoidal output (IS-C).
Using a high performance fast-action IGBT or MOSFET transistor bridge governed by electronic control commuted to 20 kHz, the direct input from a direct current source or batteries is modulated using the PWM technique. On the output of this inaudible system, we obtain a signal with a high frequency component that we must filter. This is done by the so-called PWM filter, which comprises a separator transformer with dispersion and a capacitor, which filters this high frequency component, giving the alternating output voltage at the required 50 or 60 Hz.

All the optionals appearing in the block diagram are obviously only applicable to the INVERTERS with sinusoidal output (IS), except for the DC input and AC output filters, which are applicable to both.
The INVERTERS may be supplied with static By-pass (IS-B), which protect the critical loads from any possible stoppages caused by overloads or faults in the converter itself, and also include a separator transformer (IS-T) in the same unit, which will give galvanic isolation attenuating electrical noise from the mains. It is also possible to incorporate a manual By-pass for routine maintenance or repair work.

The distribution and layout of the connection and handling elements may differ at times from those of the equipment, amongst other reasons because these show the most frequent optionals and not all of the units have them. Furthermore, the unit is delivered entirely labelled, so special attention must be paid to this.

3. Description of the inverter

Parts of the INVERTER:

3.1 FILTERS (Optional)

3.2 DC/AC INVERTER

3.3 STATIC BY-PASS COMMUTER SWITCH (Optional)

3.4 ISOLATION TRANSFORMER (Optional)

3.5 MANUAL BY-PASS COMMUTER SWITCH (Optional)

3.6 CONTROL PANEL

3.7 COMMUNICATIONS PORT

3.1. FILTERS (Optional)

The following rules must be borne in mind:

1. On the direct current input:

1.1 DC input filter.

Unless the input source is a battery of accumulators installed in the same metal cabinet as the INVERTER, the SALICRU ELECTRONICS DC Input RF Filter must generally be installed to keep the radio frequency emission demands within the limits of the regulations.

1.2 DC Input Harmonic Filter.

When the input source of the INVERTER is high impedance and common to other apparatuses (especially audio frequency linear amplifiers), there may be an intermodulation of 100 Hz and its multiple couples, because the input current of the INVERTER has such components. To correct this phenomenon, the additional installation of a DC Input Harmonic Filter may be necessary.

2. On the output:

Generally it will be necessary to install the Output Filter provided by SALICRU, unless the output line is confined in a metal cabinet along with the loads, or the line is carefully screened. If the filter is not installed, the following must be checked:

· That the radiation is kept within the limits required by the regulations.

· That the apparatuses supplied by the INVERTER are immune to its emissions.

3. On the By-pass Input:

With high impedance lines, it may be necessary to install the By-pass Filter provided by SALICRU ELECTRONICS. If this filter is not used, the following must be checked:

· That the radiation is kept within the limits required by the regulations.

· That the apparatuses installed in the vicinity of the INVERTER, and supplied by the mains, are immune to its emissions.

Summary:

The filters indicated as DC Input RF Filter, Output Filter and By-pass Filter are those that SALICRU ELECTRONICS has developed to comply with the C.E.M. 89/336/CEE Directive, which allows the product to be CE marked.

3. Description of the inverter

When the installation does not include them, it is the responsibility of the Projector, the Installer or both to replace them with devices or other components that enable the whole of the installation to comply with the demands of the C.E.M. Directive.
In installations where the INVERTER is supplied with a battery line common to other equipment with reduced immunity to harmonics, it may be necessary to install the DC Input Harmonic Filter. This filter appreciably attenuates the current harmonic content on the input, but the effective elimination of intermodulation phenomena will essentially depend on the common impedances of the supply lines and the susceptibility of the audio units.

3.2. DC/AC INVERTER

The latest component and construction topology technologies have been used in designing the INVERTER:

- The conversion technique used for the inverter bridges is Pulse Width Modulation (PWM)

- The type of semiconductors used in the inverter bridges is the IGBT (Insulated Bipolar Transistor) or the MOSFET, depending on the DC voltage and the power of the unit. These are medium sized, high power semiconductors, robust and reliable.

The application of the inverter with the design and construction characteristics mentioned in the previous paragraphs provides a performance that is hard for other inverter systems to match. By way of example, we can see the following:

- Great dynamic and static stability.
- Low output distortion with non linear loads.
- Silent working.
- High yield.
- Digital regulation technique.
- Powerful user interface.
- Enormous communication possibilities by channels:
  - To relays
  - RS-232
  - RS-485

3.3. STATIC BY-PASS SWITCH (Optional)

The static switch comprises two double thyristor modules in anti-parallel or two alternistors, depending on the power. Its function consists of performing the transfers from the By-pass line to the inverter and vice versa.

The transfers are carried out without interrupting or disturbing any of the critical loads connected to the INVERTER output.

The conditions that can cause a transfer of the load to the By-pass line are:

- Overload
- Overheating
- Inverter failure

The retransfer of the load to the inverter is automatic when the normal working conditions are re-established, except in the case of inverter failure, when the blockage is permanent.

Commuting is instant between the two supply lines thanks to the sophisticated sensors that control the voltage of the supplies and allow the control circuits to work fast and effectively.

3. Description of the inverter

The use of the static switch means that high peaks of current can be accepted without any need to overload the inverter, by using the by-pass whenever necessary.

3.4. BY-PASS SEPARATOR TRANSFORMER (Optional)

The separator transformer gives galvanic separation that allows the use of the By-pass line to be totally isolated.

The placing of an electrostatic screen between the primary and secondary coils of the transformer gives great attenuation of electrical noise.

The By-pass separator transformer is an optional that is available for cases where the output load has to be galvanically isolated from the By-pass network.

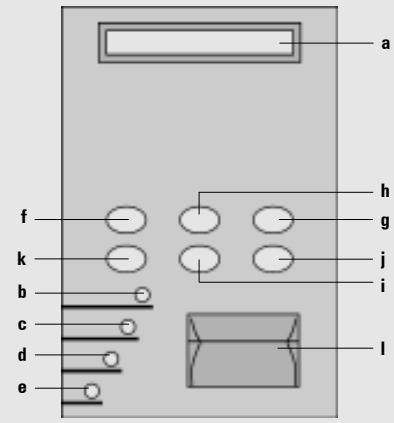
3.5. MANUAL BY-PASS (Optional)

The purpose of this optional is to electrically isolate the unit from the network and the critical loads without cutting the supply from the loads connected to the output of the INVERTER; in this way it is possible to perform maintenance and repair operations without interrupting the power supply to the protected system, whilst also avoiding unnecessary risks for the technical personnel.

3.6. CONTROL PANEL

The control panel of the "IS" and "ISC" Inverter comprises an alphanumerical display, indicator leds and pushbuttons.

The control panel gives information on all measurements, statuses and alarms in the unit.



Contrl Panel:

(a) Display.
(b) INVERTER led up and running.
(c) Output led from INVERTER.
(d) Output led from mains (By-pass).
(e) Alarm led.

Functions keypad:

(f) Enter -Ent-.
(g) Escape -Esc-.
(h) Previous screen / increase parameters.
(i) Next screen / decrease parameters.
(j) Cursor right.
(k) Cursor left.
(l) Start / Stop switch of the INVERTER.

The dialogue with the control panel is carried out through the keypad and the alphanumerical screen, and may be summed up in the following functions:

Measurements.- This function monitors the measurements of the most important parameters of the INVERTER. The measurements available are:

By-pass input voltage
Output voltage
Output frequency
Battery voltage
Output current
Apparent power (kVA)
Ambient temperature
Heatsinker temperature

3. Description of the inverter

Alarms and messages.- This function monitors the alarms active at any time. The possible alarms and messages are :

- Mains failure
- Overload
- High ambient temperature
- High heatsinker temperature
- Inverter failure
- Low battery
- By-pass unavailable
- High AC input voltage

3.7. COMMUNICATIONS PORT

Interface to relays.

- The interface to relays provides digital signals in the form of contacts free of potential, which may have different uses depending on the application. The interface makes it possible for the INVERTER to dialogue with the outside world. When the respective alarm is caused, it is supplied in the form of closed contact, furthermore, the connector has a "Shutdown" input that enables the unit to be turned off when we have at least a voltage of 5 V (5 mA) on the input.
- The communications line (interface) is a circuit with a very low safety voltage. It must be installed separate from other lines that have dangerous voltages (power distribution lines).

Interface to relays in SUB-D9 connector

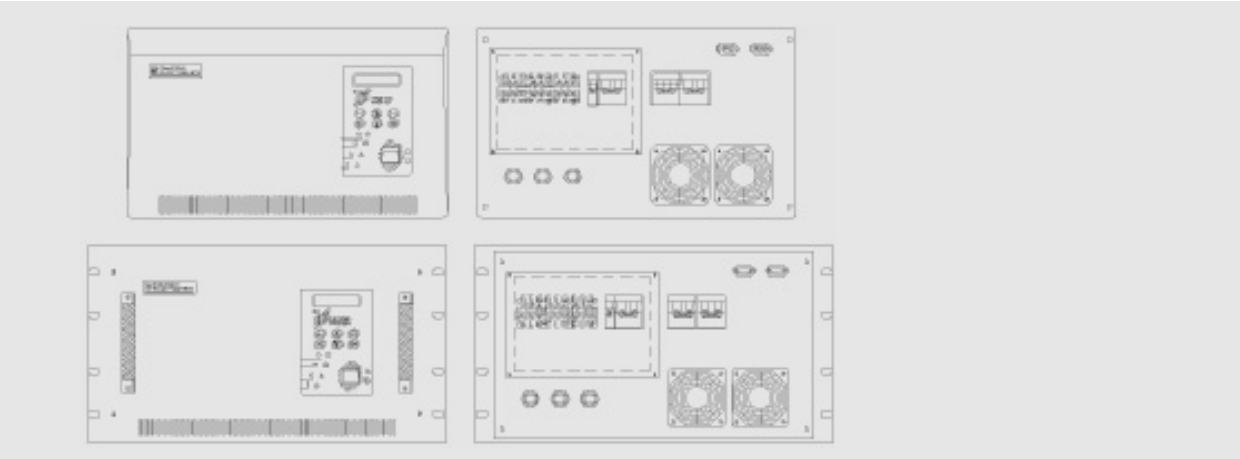
- Shutdown.
- Output from AC mains (By-pass).
- Low battery voltage.

RS-232 and RS-485 Interfaces.

The system has a single serial communication channel with two outputs, RS-232 and RS-485. Either of the two outputs may be used, but not both at the same time.

RS-232 Interface.

The RS-232 interface is another system for the INVERTER to communicate with the outside world. It consists in the transmission of serial data, sending a large amount of information through a communications cable of only 3 or 5 wires.
Physical structure of the RS-232 interface.



Views of Inverter

3. Description of the inverter

- The RS-232 Interface consist of a SUB-D9 connector where only 5 wires are occupied:

TXD: Series data transmission.
RXD: Series data reception.
GND: Ground.
CTS: Clear to Send data (Active = low).
RTS: Request to send data (Active = high).

Communication is possible using only the first three signals. In this case it will be necessary to make a bridge between RTS and CTS.
The transmission speed is programmable and may be 1200, 2400 or 4800 Bauds. The rest of the parameters are fixed.
No. Information Bits: 8 bits.
No. Stop Bits: 1 Stop Bits.
Parity: NO.
Parity (None).

Communication protocol of the RS-232

The communication protocol that is used is "MASTER/SLAVE".
The computer or computer system ("MASTER") asks about a certain data, and the ("SLAVE") immediately answers with the requested data.
First we will program the communication channel of the computer with the same parameters as the communication channel of the INVERTER.
Before beginning the communication, it is best to initialize the communication channel by sending any sequence of 4 characters separated from each other by one second.
If we have any problem in the middle of the communication, it will be advisable to repeat the channel initialisation sequence.
If we wish to use the RS-232 channel, ask for the protocol where is detailed the necessary dialogue for a correct link with the control panel.

RS-485 Interface.

Physical structure of the RS-485 interface ("R.C. aux" remote control.).

- Unlike other serial communications links, this only uses 3 wires for dialogue between the systems connected to the mains. The communication will be established by sending and receiving signals in differential mode, which gives the system great immunity to noise as well as a long range (approx. 500 m).

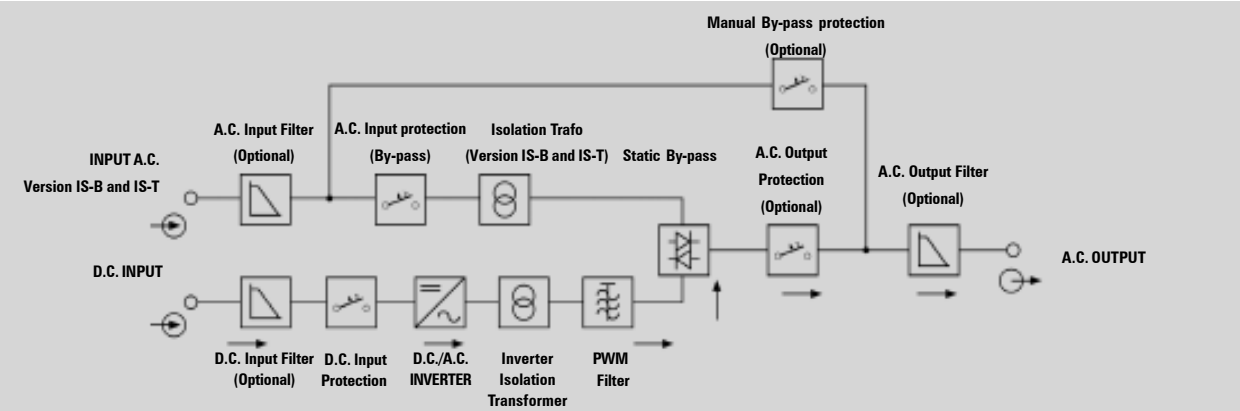
The communication parameters are fixed (not programmable) and are the following:

Speed: 4800 Bauds
No. Information Bits: 8 bits.
No. Stop Bits: 1 Stop Bit.
Parity: NO.
Parity (None).

4. Inverter working status

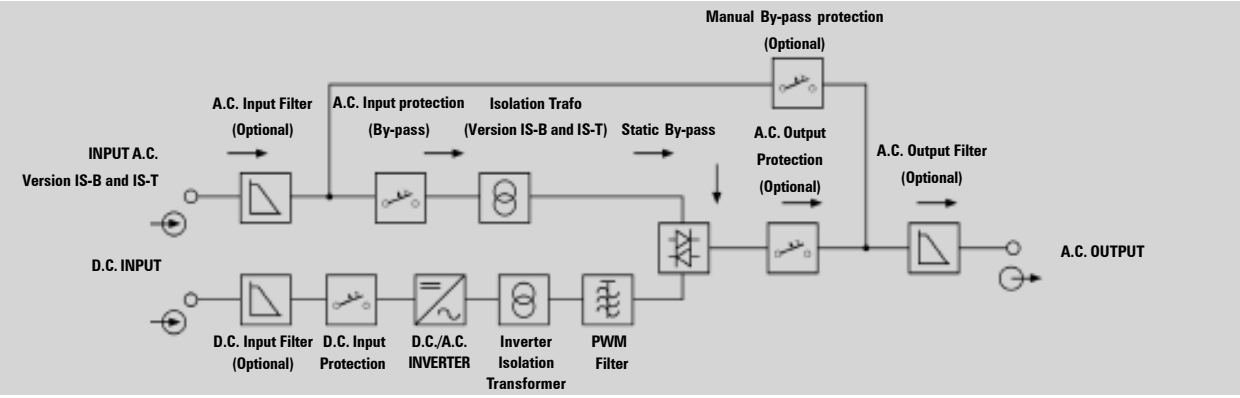
4.1 NORMAL WORKING

A.C. output voltage from D.C. input



4.2 WORKING ON STATIC BY-PASS (ONLY IN VERSIONS IS-B AND IS-T) (OPTIONAL)

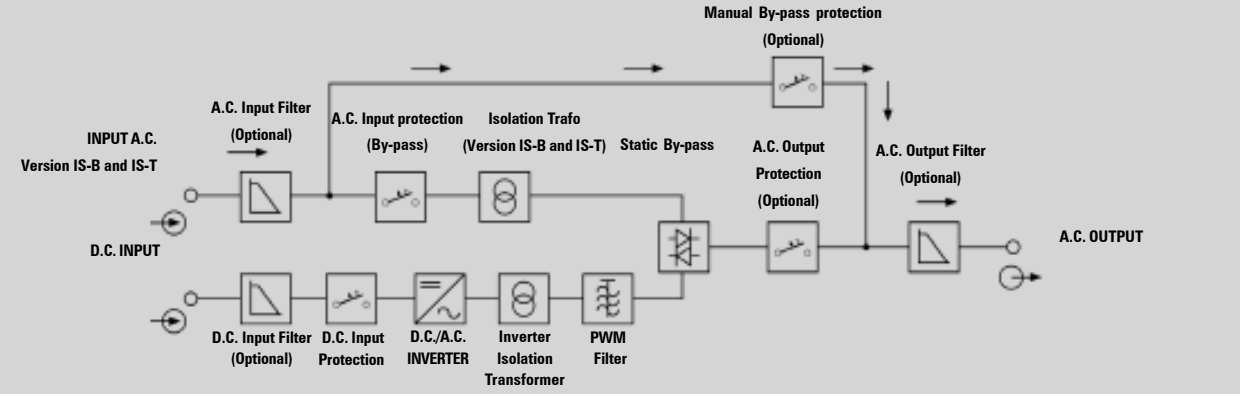
A.C. Output voltage from A.C. Input (Static By-pass).



4. Inverter working status

4.3 WORKING ON MANUAL BY-PASS (OPTIONAL)

A.C. output voltage direct from the mains through the manual by-pass.



5. Regulations and safety

The INVERTER has been designed, manufactured and commercialised in accordance with the EN ISO 9001 Quality Assurance certificate. The CE marking indicates conformity with the Directive of the EEC (quoted between brackets) by the application of the following regulations:

- EN 60950: 1992 + A1 + A2:1993 + A3 + Corr.: 1995.
  Safety of information technology equipment, including electrical business equipment. (Low Voltage Directive 73/23/CEE).
- EN 41003: 1993. Particular safety requirements to be connected to telecommunication networks. (Low Voltage Directive 73/23/CEE).

- EN 50081-1: 1992.- Electromagnetic compatibility. Generic emission standard.
  Part 1: Residential, commercial and light industry. (Electromagnetic Compatibility Directive 89/336/CEE).

- EN 50082-1: 1992.- Electromagnetic compatibility. Generic immunity standard.

Part 1: Residential, commercial and light industry. (Electromagnetic Compatibility Directive 89/336/CEE).

When an INVERTER is used as a component for a complex installation or system, it is necessary to apply the Generic Regulations or Product regulations corresponding to the specific installation or system.
It is possible that when elements are added, or being subject to the requirements of certain regulations, the unit must be subject to corrections to ensure conformity with the European Directives and corresponding national legislation. It is the responsibility of the Projector and / or Installer to comply with the regulations, giving the installation all necessary corrective elements.
There is also the phenomenon of interference from harmonic current on the input, which, though not regulated, must be corrected in some installations.
Depending on the installation conditions of the INVERTER, the corrective actions must be taken that are described below in the section Electromagnetic Compatibility. For all variants and concerning Safety (EN 60950 and EN 41003), the following aspects of the product must be taken into account:

L.T. SAFETY

1. The INVERTER is a Class I protected electric unit. The ground connection to the corresponding junction is essential to ensure protection against electric shocks. The protection ground socket must be independent of the telecommunications network (if there is one), which may be connected to the input of the INVERTER (accumulator battery line) through other units.

2. The unit (in common mode) has protection on the input against overload peaks of 5 kV (pulsations of 8/20 μs). If higher disturbance is expected, additional protection must be employed.

3. The minimum isolation distances have been provided for pollution up to Contamination degree 2, in accordance with the standard HD 625.1 S1 (IEC 664-1 mod.). For work in highly contaminated atmospheres, additional protection must be provided.

5. Regulations and safety

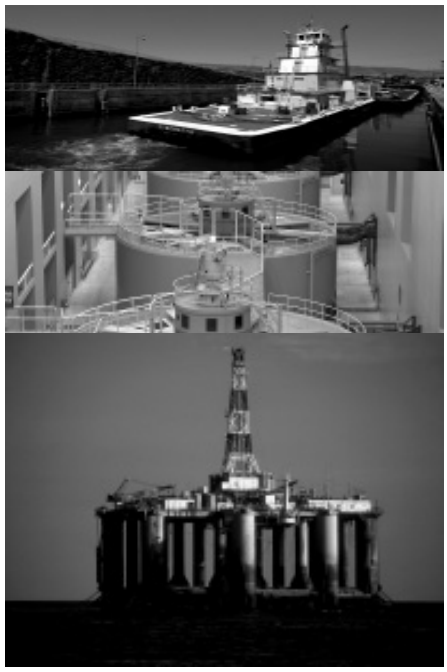
4. The safety level of the input circuit of an INVERTER is the Telecommunication Network Voltage Circuit, that is, the input has the isolation characteristics required to be able to connect to a Telecommunications Network in accordance with the referred standard EN 41003. Care must be taken that the rest of the installation connected to this input (accumulator battery line) also fulfils these requirements if the conformity is to be maintained.

ELECTROMAGNETIC COMPATIBILITY (E.M.C.).

Concerning conducted or radiated emissions, the exterior supply and connection of the INVERTER will be decisive in complying with the requirements of the standards. Care must be taken to use short connections, separating the input lines as far as possible from the output lines. The ground connection may be a conflictive point if there is excessive impedance in the radio frequencies.
In installations where there are audio frequency units supplied by the same accumulators battery as the one used by the INVERTER, it is possible that there might be phenomena of intermodulation to the frequency of the input harmonics of the INVERTER (100 Hz and its multiplications). Such interference is not regulated by the E.M.C regulations, but should be eliminated for correct service. To do this, two different actions must be performed:

- On the installation: Must be avoided the use of audio frequency units supplied by the same accumulator battery as the one used for the INVERTER and the susceptible critical units (falls in voltage caused by the harmonics must not enter the supply to critical equipment).

- In the INVERTER: The addition of an input harmonics filter will notably reduce the disturbing harmonic currents, however, without the first action there might be residual interference. The result depends largely on the susceptibility of the audio units and the common impedance of the supply lines.



6. General characteristics

CS Series

Input

Voltage	12, 24, 36, 48, 60, 96, 120, 144, 168, 192, 216, 240, 264, 288, 312 Y 336 D.C. (other voltages to order)
By-pass A.C. supply	± 12,5%
Efficiency	70% to 93% depending on the model

Output

Voltage	230 A.C. ±2% (sinusoidal wave)
Harmonic distortion	<2% for linear loads <3% for non linear loads (F.P.=0.8)
Technology	PWM
Frequency	50 Hz ± 0.05%
Overload	Up to 150% for 20s
Admissible power factor	0.7 inductive to 0.7 capacitive
Crest Factor	3
Short-circuitable output	Yes

General

Protection	Against peaks of 5 Kv (pulsations 8/20 us)
Dielectric rigidity	3000 V A.C., 1 min
Isolation	>10MW
Ventilation	Forced
Acoustic noise at 1m	< 45 DB
Protection a/c UNE 20 324 78 IR	IP 20
Working temperature	-20ºC a 40ºC
Storage temperature	-40ºC a 85ºC
Maximum working height	1000 m.s.n.m.
Humidity	Up to 95% without condensation
Mean Time Between Failures	120000 hours
Mean Time To Repair	30 min.
Conformity to standards	:EN 60950, EN 41003, Annexe ZA of EN 60950, EN 50081-1992, EN 50082-1:1992 Chap. 2 of UNE 50081-1 and 50082-1. page 5

6. General characteristics

Indications

Optical indications on the front panel	
Synoptic to leds	Input
	: By-pass activated
	: Battery correct / low
	: Overload
	: Inverter failure
	: Output
LCD Display	: Input / output voltage, output current, output power,
	input / output frequency, battery charging / discharging
	intensity and voltage, interior / heatsinker temperature,
	alarm menus, calibration screens, etc.
Acoustics	For overload and / or Inverter failure
Interface to relays	Shutdown
	Low battery
	Unit in Inverter / By-pass

Communication

Interface to relays	
Serial port	RS 485 or RS 232

Communication Protections

Mains	Circuit Breaker
Batteries	Circuit Breaker
	Low battery voltage detector
Output	Electronic overload detector
	Electronic short circuit detector
	Electronic output voltage detector off margins

Optionals

Static By-pass
Filters: input, output, batteries, By-pass and anti-harmonics
Protection against polarity inversion (IS series)
Isolation transformer on the By-pass line

6. General characteristics

Dielectric and environment parameters

Dielectric strength	2500 Vac during 1min
Protection degree UNE 20324781R	IP20
Insulation	>10M ohms
Noise level	<55dB
Cooling	Forced
Operating temperature:	0º ÷ +40ºC
Storage temperature:	-20ºC ÷ +40ºC with batteries, -20ºC ÷ +60ºC without batteries
Altitude:	2400 m above sea level
Humidity:	Up to 95% non-condensing

Indications

Visual:	Line, bypass, fault, output, load overload, battery off, float, discharge and charge
Acoustic:	Bypass, Discharge, fault and low battery