IRS POWER CONTROLLER FOR IR. OVENS

NS IRS

TECHNICAL MANUAL V 1.2

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CE relevant European directives

Low Voltage compliance

The NS-IRS products carry the CE mark in compliance with the essential requirements of the European Low Voltage Directive 73/23/EEC of 19/2/73, amended by the directive 93/68/EEC of 22/7/93.

The NS-IRS products installed and used in compliance with the procedures described in the present document meet the essential requirements of the European Low Voltage Directive.

EMC compliance

The NS-IRS products are compliant with the EMC requirements with respect to the European directives 89-336/EEC of the 05//03/89 amended by the 91-263/EEC, 92-31/EEC, 93-68/EEC, 93-97/EEC. The enforcement of this directive is done by standards: EN60204, EN50081-2 and EN50081-3

EM compliance has been certified by an approved EMC testing laboratory. Certificates are available upon request.

More details about EM compliance are given later in this document.

CE Label

By fulfilling the requirements of the Low voltage and EMC regulations, the NS-IRS products are compliant with the CE directives.

CSA / CUS® Marking

The NS-IRS products CSA/UL compliance has been investigated by the CSA laboratories in Toronto, Canada. (May 2007). File number 1871799.

Profibus® standard compliance

The NS-IRS carries the Profibus-DP compliance label and is listed by the PNO organization under reference IRPC1012 with id number 0594Hex.

Safety and security aspects

Symbols :

This symbol means that failure to take note of the information given in this manual may have serious consequences for the safety of the personnel or may result in electrocution.

This symbol means that failure to take note of the information given in this manual may have serious consequences for the installation, lead to incorrect operation of the product, or may damage the product.

Safety:

The installation, configuration, commissioning and maintenance of the NS-IRS products must only be carried out by personnel qualified and trained to work with low voltage electrical equipment in an industrial environment.

The front door should not be opened except by competent technicians when connecting or disconnecting the device. Electrical isolation must be ensured between the equipment and the power supply.

In both off and on modes, the NS-IRS regulator doesn't ensure isolation from the power supply. One should pay attention to the fact that electrical shock may occure when touching the lamps or the cables coming from the NS-IRS.
It is thus recommended to turn off the power supply (400 V) within 2 sec following the end of regulation.

PART 1 : DISCOVERING THE NS IRS

What is the NS-IRS system ?

The NS-IRS is the top of the art solution to control power on IR ovens.

The NS-IRS system aims to control up to 10 InfraRed lamps, or 9 infrared lamps +1 fan.
Its modular design turns to be optimised for the control of IR ovens on blow molding machines.

The NS-IRS is designed a IP65 cabinet that can be mounted in the machine nearby the oven.

The NS-IRS replaces the successful PWR and IRS systems that has been widely used on blow moulding machines since 2002. More than 45'000 PWRs and IRSs actually run around the world.

The **NS-IRS**
- 10 channels. 10 resistive loads x 3kW or 9 resistive loads x 3kW + 1 fan (400 vac)
- Single phase input + ground (185- 530 VAC 50 / 60 Hz)
- I Max Total : 65 A
- I Max / channel : 7.5 A RMS

Advanced features :
- Voltage or power regulation (+-0.5% accuracy)
- Phase angle and advanced single cycle modes (zero crossing)
- Dead Lamps detection and Load Resistance monitoring
- Closed loop regulation (Power regulation based on Voltage and Current)
- Warm-up ramps for tungsten lamps
- Profibus DP communications
- Voltage limitation to protect the lamps
- Online Lamps resistance measurement
- Power supply quality monitoring
- Monitoring and recording of power supply variations.
- Possibility to power and command the oven fan using channel 10.

Installation is simplified by the means of :
- Fast connecting terminators
- 3 points fixation

Options :
- Bluetooth communications
- DataLog event recorder
- Coooling system

How do the NS-IRS systems compare to existing solutions

Totally integrated solution :

The NS-IRS system is a complete power cabinet by itself. It includes the regulation controller, the power regulation stage (thyristors), and an integrated overload protection, all integrated in an IP65 cabinet.
This concept makes it easy to connect and to mount. Maintenance is also greatly facilitated by suppressing complex electrical cabinets by small plug and play single units.

Closed loop regulation for power regulation (V^2_{RMS} / R_{Lamps})

The power regulation maintains an even and accurate process even when the temperature of the lamps is affected by external factors (fan, dust, other lamps…)

On-line Load fault detection :

By measuring the load resistance and the system is able to detect load faults. This point is especially important for the blow moulding machines with a large number of lamps.

Load impedance on-line monitoring and recording :

The system is able to record the changes in the lamps resistance. This information may be used to survey the aging of the lamp.

Multi-channels :

The NS-IRS controls up to 10 channels

Oven Fan powering :

One of the output channels can be used to power the Oven fan (400 Vac fan).
By doing this the machine manufacturer can save the cost of cabling an extra line for the oven fan.

Power supply monitoring :

In the 2013 version of the NS-IRS, the electrical characteristics of the power supply are monitored to record the variations of the Voltage and current, to detect transient signals and abnormal events.

Scalability and modularity :

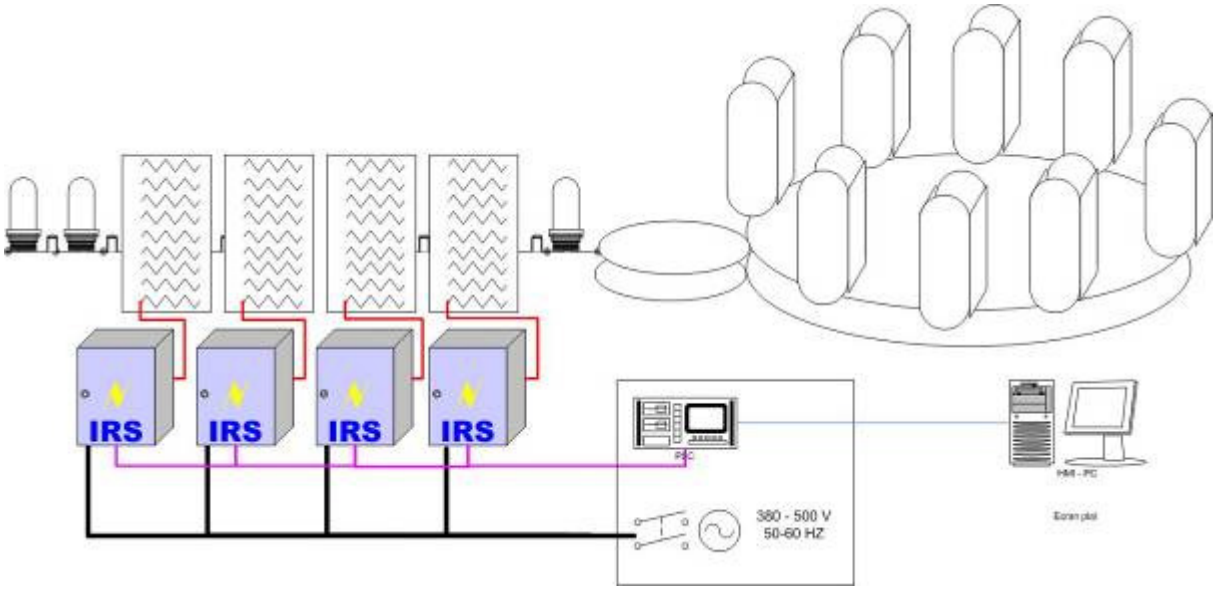
The NS-IRS system is designed to be mounted directly onto the machine nearby the oven.

Profibus-DP Communications :

The NS-IRS modules are certified Profibus-DP slaves and can both receive settings and send alerts from/to the PLCs connected to this field-bus.

Multiple regulation algorithms :

The NS-IRS system currently supports phase angle, zero crossing and advanced single cycle.



NS-IRS brings a total control on the heating process

- Power and voltage regulation
- Closed loop on supply voltage
- Closed loop on lamps resistance
- Lamps controlled individually
- Possibility to power up the oven fan

- Lamps resistance monitoring
- logging of changes in the lamps resistance to ease the determination of their lifetime.

- Fast detection of dead lamps
- deterministic overload protection

- Running from 185 up to 530 VAC
- Possibility to use low voltage lamps on higher voltage supplies.

- Over-voltage protection
- Data logging, monitoring, consumption follow up
- harmonics suppressor

OUTPUT to Oven
10 Loads 3 kW 400V or
9 Loads + 1 FAN

Profibus DP
In and Out
24 DC CPU 0.28A
24 DC cooling 0.32A

POWER IN
100 A Max 530VAC

Hardware and software versions

NS-IRS10 versions :

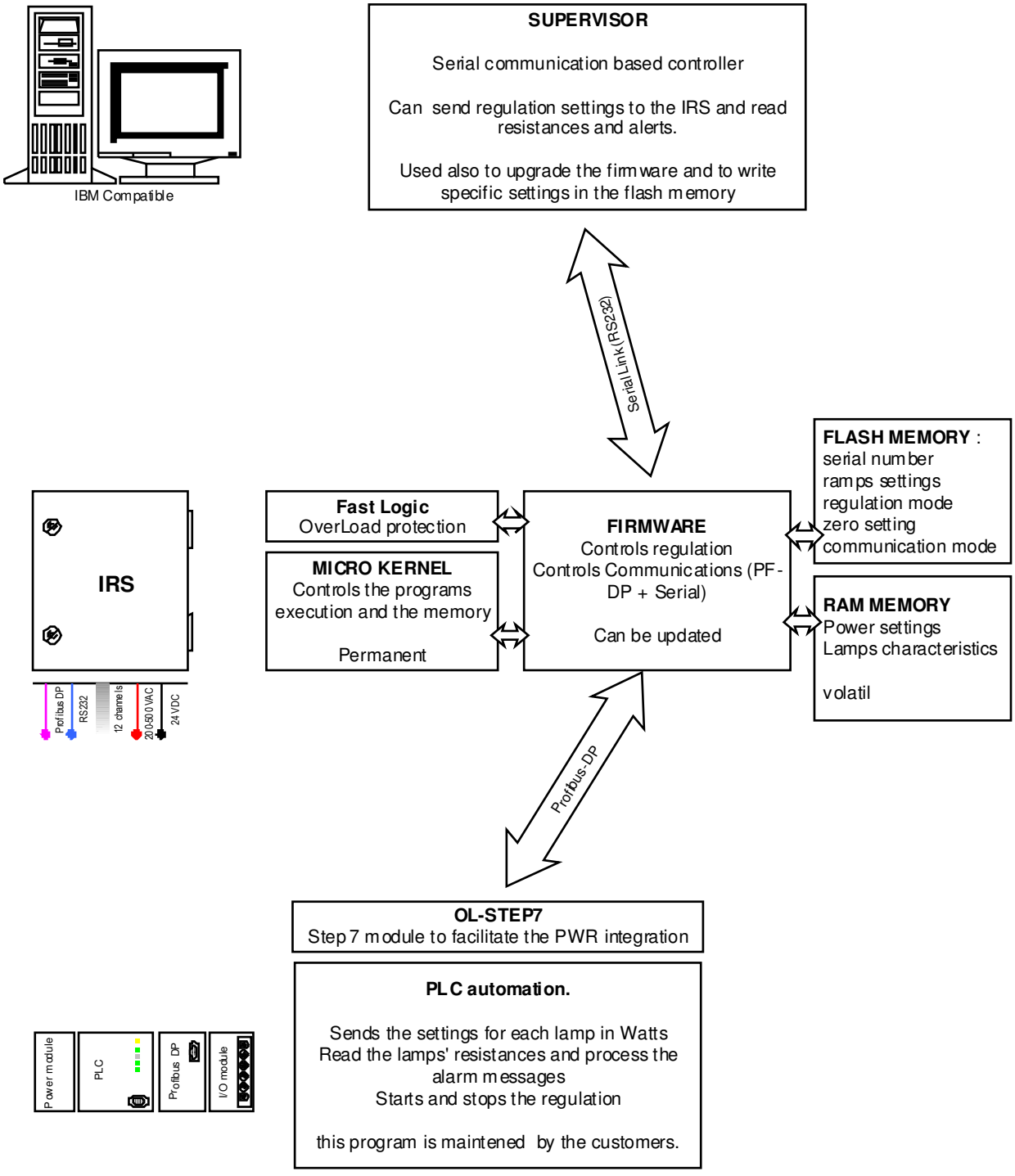
One Hardware, Two Software
The NS-IRS operates 2 programs :
The version 5.x used on standard blow molding machines
The version 20.x used on Sidel® machines

From 06-2013, ALL former 10 channels models will be replaced by the WO25.X version.
PWR24B → WO25.X Software V5.X
PWRSDL → WO25.X Software V20.X
IRS10 STD → WO25.X Software V5.X
IRS10 SDL → WO25.X Software V20.x

Features	WO 2.1 IRS 12	WO 25.x NS IRS
	STD	SIDEL and STD
Release date	Mar 2009	01 2013
Firmware	V5.18	V5.18 or V20.18
$I_{supply\ (A)}$	70	70
$I_{max\text{-}thy\ (A)}$	7.5	7.5
$N_{channel}$	12	10
Channel 10 used for oven fan	No	Yes
V_{supply}	185-530 VAC	
Frequency.	47-63 Hz	
24DC voltage to power the unit		
$V_{controller\ –\ (1+\ 2-)}$	24 VDC +/- 10%	
$I_{controller\ (A)}$	0.25	0.28 A
Desina Cabling Max current rating	24DC /10 A ie Max 36 IRS	
24DC voltage for optional cooling		
$V_{optional\ cooling\ –\ (3+\ 4-)}$	-	24VDC +-10%
$I_{cooling}$ (A)		0.325 A
Desina Cabling Max current rating	24DC /10 A ie Max 32 IRS	
$I_{overload}$	200 A	
Additional breaker for back line protection	32A C curve	
Interrupting capacity	6KA	
Running conditions (Non confined)	5-45°C	5-55°C with T-5°C RMS over 24h, 8-80% HR n.c
Storage	-20-60 °C, 5-95% HR	
Accel.	10G, 11ms, 2 times/s	
Protection	IP65	

Temperature rise inside the cabinet at full power with respect to outside.	23°C	9.5°C
Power loss	70 W	55 W
Size HxWxD	430X312X188 mm	430x312x150mm
Weight	15.4 kg	12.5 kg
Stainless steel	X	X
Static cooling	X	X
Fan Cooling	Option	Option
Single hardware configuration for both regulation modes	X	X
Phase angle	X	X
Advanced single cycle	X	X
Adjustable ramps for lamps pre-warming	X	X
Power regulation $V_{RMS}xI_{Inst}$	X	X
Voltage regulation V^2_{RMS}	X	X
Overload and surge protection	X	-
Dead lamp detection	X	X
Temperature survey	X : Turns off the regulation if $T_{inside} > 70°C$	
Power supply survey	Yes, and an alarm is sent if the power to the lamp is not reached	
GSD	2.0	2.0
Min power / lamp	10%	10%
Max power / lamp	Nom	Nom
Serial control	X	X
USB control	-	X
Bluetooth control	-	Option
Datalog	-	Option
Update firmware soft	X	X
Upgrade features soft	X	X
POWER PLUG	Fast plug terminator – HAN100A from HARTING®	
OVEN PLUG	Fast plug terminator – HAN32 from HARTING®	
24 DC PROFIBUS DP	Ecofast from HARTING	

Software architecture :



To ensure the maximal flexibility, the different programs used with the NS-IRS are distributed between :

- **The NS-IRS itself to retain recurrent settings or store special algorithms**
- **The machine's PLC that starts/stops the regulation and sends the desired settings.**
- **A PC or LapTop that can be used for maintenance purpose**

PC based software :

SUPERVISOR :

This program is used to connect a PC to a single NS-IRS using a serial or USB link. The program is used to test the NS-IRS, to monitor the status of the regulator and to upgrade the firmware.

The NS-IRS intrinsic settings can also be set using this program.

More information is given later in this document and in the SUPERVISOR User's manual

Blue Tooth communication :

The NS-IRS can be optionally equipped with a Bluetooth dongle allowing to connect to the NS-IRS using wireless communications.

PLC Program :

This program synchronises the regulation (start/stop) with the machine cycle and sends the power settings (Watts) to the NS-IRS according to the users' needs.

Different communication modes are available over profibus-DP, and thus, different PLC programming strategies can be used.

More information is given later in this document.

PART 2 : NS-IRS SYSTEM FEATURES

Cabling and lamps strategy :

It is possible to use the NS-IRS cabinet with several types of lamps and with different cabling topologies.

- **The NS-IRS automatically limits the Voltage sent to the lamp according to the type of lamp. It is thus possible to use 400 VAC lamps on 480 VAC supply.**

- **The total current regulated by the power cabinet cannot exceed 65A for NS-IRS and 75 A for the IRS12.**
- **The total current / channel cannot exceed 7.5 A / channel for both products.**
- **The Overload current is set to 200 A.**

NS-IRS Absolute maximum ratings :

The NS-IRS is accepting input voltage between 185 VAC and 530 VAC, with frequencies ranging between 47 and 63 Hz.

	Power supply Voltage (VAC) +/-10%					
Lamp Nominal Voltage (Vrms)	208	230	400	415	440	480
230	----------	1700	1000	950	900	820
360	----------	----------	2400	2300	2200	2000
400	----------	----------	3000	2900	2700	2500

Green : Maximal power (W) for lamps for a given Power supply voltage and lamp nominal voltage.

The minimal setting per channel is 10% of the nominal power of the lamp in power regulation mode. This limit is set to avoid current bursts with tungsten lamps as the Resistance of the lamp may slightly decrease when running at low power.

Using the Channel 10 to power the Oven FAN :

In order to reduce the machine cabling cost, the channel 10 has been adapted to optionally power the fan used of the IR oven.
Any 400 VAC standard fan can be connected directly to the output 10 of the box.

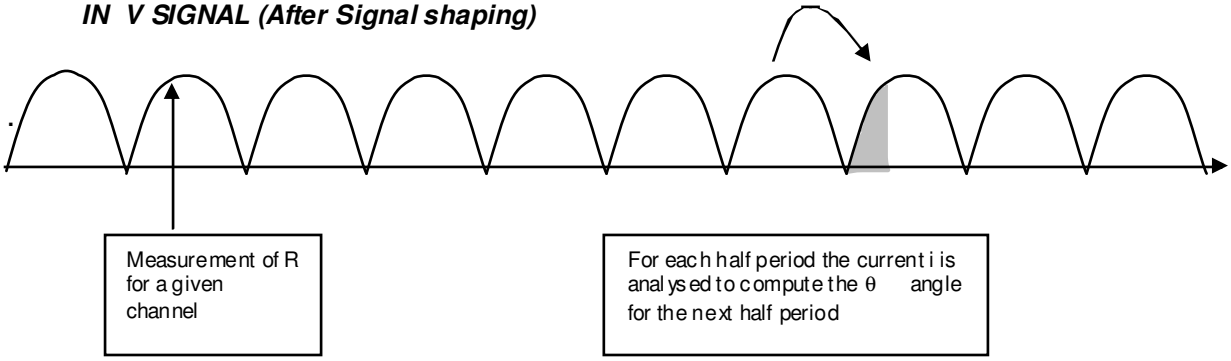
REGULATION MODES :

Phase angle regulation

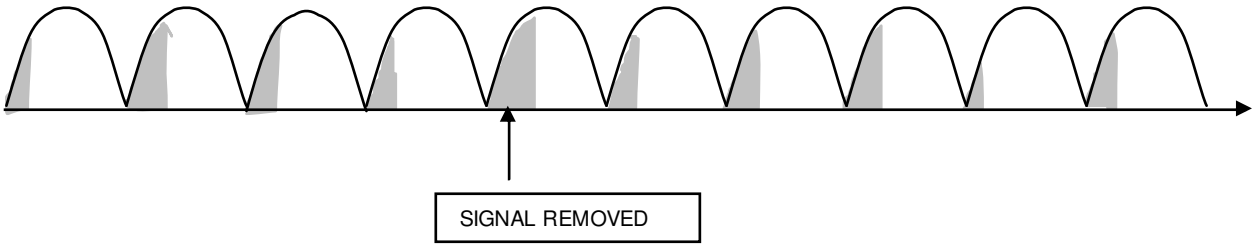
The phase angle regulation relies on a powerful algorithm that monitors both the voltage and the current going through each load and then calculate the power dissipated in these loads.
By knowing this exact power, the system is able to evaluate the ratio of the signal which should be removed to reach the targeted power in the lamps.
Moreover, this online monitoring of the current and voltage is used to compute the exact resistance of the lamps and then to detect dead lamps.

The phase angle is defined as θ, which is the delay while the circuit must remain opened for each half period. The greater θ is, the less energy remains in the signal.

IN V SIGNAL (After Signal shaping)



OUT I SIGNAL :



This method is accurate and one can achieve a precision of less than 0.3%.. The θ angle can be controlled with an accuracy of 1 µs.
A filter must be integrated into the NS-IRS cabinet for the EMC compliance.

Benefits from phase angle regulation :

- High accuracy
- Almost no variation of the temperature of the filament along the time
- Possibility to run with European and American power supplies indifferently
- Possibility to run with 220, 400 and 480 VAC lamps indifferently
- Possibility to use 220 V lamps onto 400 and 480 supplies and 400 V lamps onto 480 V supplies

Problems related to phase angle regulation :

The main problem related to phase angle regulation is the EMC compliance. For small systems the use of a dedicated EM filter ensures the compliance with EMC standard.
Above 200kW, when using several NS-IRS modules, we have to consider also the machine design. For instance, a machine with poorly shielded cables from the regulators to the ovens may cause pick-up and correlated effects that could spoil the EM characteristics of the machine.
A new type of power stage is actually tested. It uses a microsecond shifting algorithm between the different systems to reduce the correlated effects and ensure a fully E M compliance up to the MW even for poorly shielded machines.

More information is available in the EMC section and in the regulation algorithms section.

Zero crossing and advanced single cycle regulation

In this mode, the regulation is done by removing an entire number of half-periods, evenly distributed onto a 1s period (100 half periods).
The commutation of the thyristors is synchronous with the power to avoid EMC perturbations.
The regulation accuracy is over 1%. The lamps may flicker.

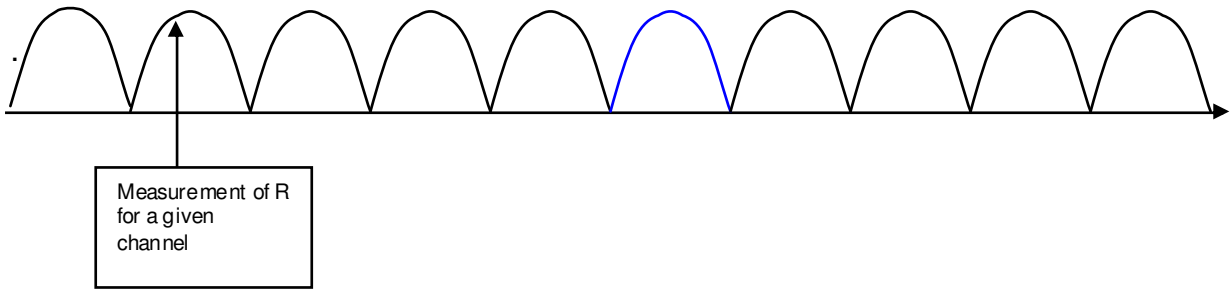
Basic description of the algorithm :

The regulation is done using two quantities :

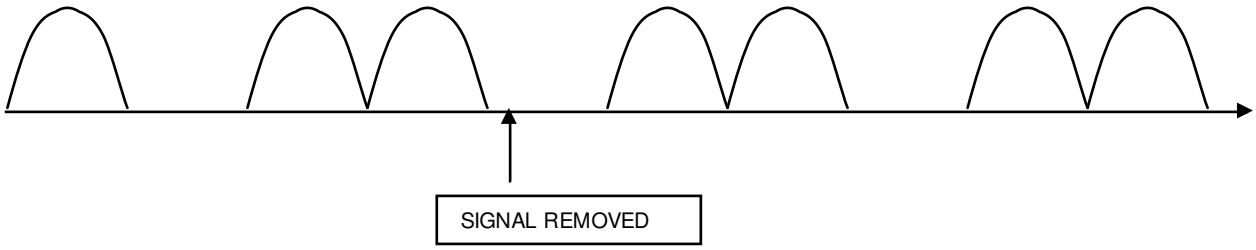
- $P_{1/2\,period}$: Integrated power during ½ period
- $\Sigma_{100}(P_{period})$: Energy in the latest 100 periods

Using these two quantities, the number of periods to be removed within the next 100 periods is calculated. The $\Sigma_{100}(P_{period})$ gives the global number of periods to be removed, while the $P_{1/2\,period}$ is used to correct low frequencies fluctuation of the input signal.
The removed half period are distributed evenly to smooth the temperature variation of the filament along the time.

IN V SIGNAL (After Signal shaping)



OUT I SIGNAL



Applications :

The accuracy of the advanced single cycle is poor compared to the phase angle regulation. It can hardly be better than 1%.

However this accuracy is good enough for the basic PET process.

The main problems are related to the removal of several successive half periods.
These "holes" are responsible for the flickering effect which occurs because of the lamps' temperature fluctuation over the time. The flickering has a negative effect on the lamps lifetime as well as on the lighting homogeneity.
Removing one ½ period corresponds to a signal shutdown during 10ms in the load. Depending on the lamps geometry the temperature of the load will fall from a few Kelvins, which is enough to cause a small flickering.

It is thus really important to work with lamps adapted to the process. We recommend strongly to choose the lamps with a nominal power close to the expected settings..

Conclusion :

By taking into account these different points it appears that the phase angle regulation which keeps an even filament temperature along the time, is certainly the best alternative for regulation.
But, as the phase angle affects EMC compliance, and induces additional costs related to EMC filtering, it can be necessary to use advanced single cycle instead.

This second way to regulate the power is also efficient when the expected power is close to the lamp's nominal power. But, when the power is decreasing, flickering effects will occur and spoil the spectrum.

We thus suggest to use it to save money and ensure EMC compliance, but we also recommend to adapt the lamps' nominal power with respect to the settings that will be applied to these lamps. The best results will be achieved if the setting remains over 80% of the nominal power.

Integrated WARM-UP ramps :

As a consequence of the cold lamps' low resistance, the current at start-up may rise quickly leading to an overload (> 200 A) if all lamps are turned on simultaneously.

To solve this problem one a warm-up algorithm included in the firmware.

This feature should be configured according to the lamps used in the oven.

In Supervisor program, it is possible to set 2 parameters :

Power : The Power applied to the lamp during the warm up phase
Threshold : Duration of the warm-up expressed in half Sine cycles.

Exemple : 3 KW 400 VAC lamps
Power = 3000 W, Threshold = 200

During 200 half periods (2 seconds at 50Hz) the first lamp will be warmed up with 3000 W. Then it will switch to the desired power with the standard regulation mode (phase angle or adv. single cycle) and it will start to warm the second lamp with 3000 W during 200 half periods….

SIDEL Specific configuration

On SIDEL machines, a specific optimized setting it programmed in the box.
To select SIDEL warm-up mode, use Power = 1. Threshold=600.

This option is available only on the systems running the firmware 20.X.

Shortcuts and overloads :

Overload message

Whenever the total admitted current goes above 200 A, the system will emit an Overload alarm and stop the regulation.

Before turning the system on again you have to follow this procedure :

- Take care that the power supply is off (no power)
- Check that there is not physical default on the electric circuitry
- Check the state of breakers inside the cabinet, and turn them ON.
- Turn the Power supply on
- Reset the alarm on the NS-IRS by turning the regulation off
- Start regulation again.

- **The system should NOT be reset and restarted automatically ! You MUST check the origin of the problem before starting again the power. If not, you may :**
  - **Endanger the technicians working around the machine**
  - **Damage the system by applying to much thermal stress onto the components**

CutOut message :

The breaker will turn off when more than 32 A is applied to a group of 4 lamps.

Remark : the breaker is C curve breaker. Fast transient states with high current will not turn the breaker off.

Before turning the system on again you have to follow this procedure :

- Take care that the power supply is off (no power)
- Check that there is not physical default on the electric circuitry
- Check the state of breakers inside the cabinet, and turn them ON.
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- Start regulation again.

- **You MUST check the origin of the problem before starting again the power. If not, you may :**
  - **Endanger the technicians working around the machine**
  - **Damage the system by applying to much thermal stress onto the components**

Resistance measurement, closed loop regulation and dead lamps detection.

Why do we need to measure the resistance ?

As it has been written in previous sections, the lamps resistance is quickly changing according to the temperature of the filament.

This temperature will strongly be related to the RMS voltage applied to the lamp.

For a more accurate process, it is necessary to account for these variation in the regulation.

What is done by the NS-IRS ?

The purpose of the NS-IRS is to regulate power.

The NS-IRS measures continuously both the voltage and the current applied to the different lamps. From this measurement, the NS-IRS calculates the RMS Voltage that should be sent to the lamps with the purpose to control accurately the RMS Power dissipated in the lamps.

From the instantaneous Current and Voltage it is possible to compute the instantaneous value of the resistance for each lamp.
In the standard implementation of the NS-IRS software, this value is transmitted to the Profibus DP, for further monitoring.

It is also possible to use only the nominal resistance of the lamps in the power regulation algorithm. To do so, one has to select the “Use Rnom option” when configuring the NS-IRS internal settings (PC supervisor setting).

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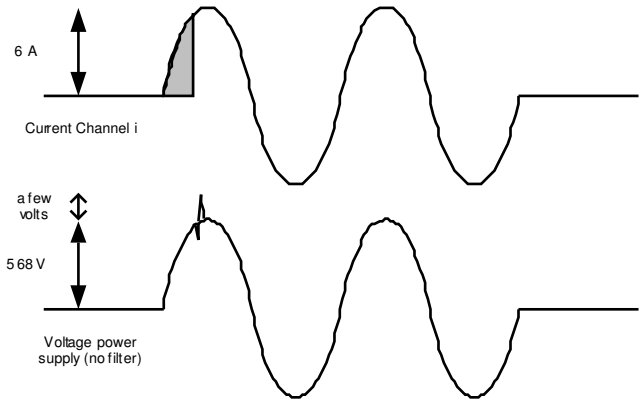
EMC compliance

Harmonics and Flicker standards.

As from Jan 1st 2001, compliance with the Harmonics and Flicker standards becomes a mandatory part of the EMC Directive. This applies to all products within the scope of these standards.
For rated currents from 16A to 75A per phase, IEC/EN61000-3-4 applies.

Harmonics :

The Harmonics are generated by brutal changes in the current shape due to circuits closure or opening.

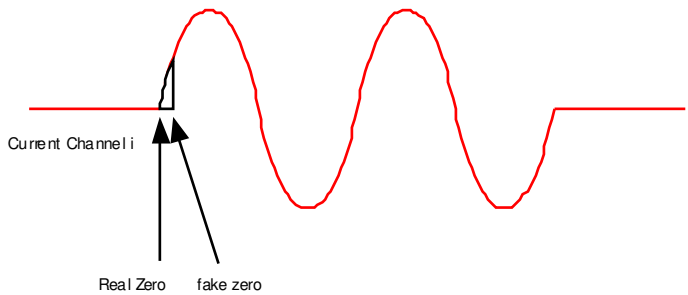


The phase angle regulation mode is highly affected by the harmonics problem, especially when the current is turned on near the top of the phase. A Specific EMC filter must be added to ensure EMC compliance. Contact our technical support center for more information.

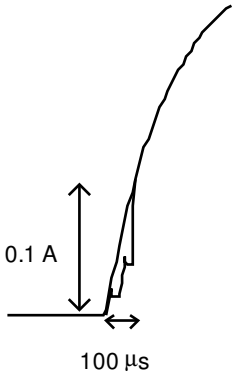
But the harmonics may have more subtile causes. For instance, with zero crossing or advanced single cycle, a bad synchronisation of the command with the power supply zero will induce some harmonics.

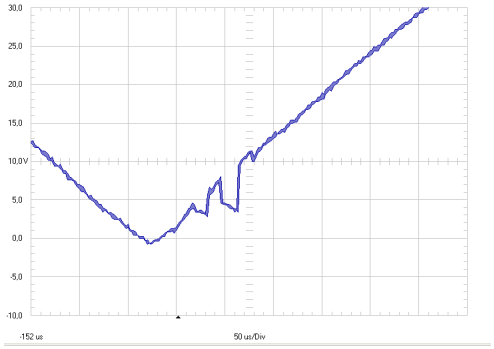
Even without any error on the localisation of the zero, there could be some harmonics due to the thyristors themselves when they are started with a really low signal level. This effect is really small but could be increased by correlation effects between the different channels.

Bad synchronisation of the zero.



Thyristors oscillation at startup





To suppress these effects we have introduced a highly accurate zero detection algorithm which is able to set the zero with 1 µs accuracy.
As it, the NS-IRS is EMC compliant with the zero crossing and advanced single cycle algorithms for currents ranging from 16 A to 75 A, even without any filtering stage.

In the future, the thyristors will be replaced by a new type of component that will suppress also the oscillation at startup. By doing that, we will obtain even more better results that will allow us to work with higher currents and to suppress the filtering for zero crossing and advanced single cycle regulation.

Flickering :

The other negative effect that could occur, is the flickering. This effect is different from the "lamp flickering" mentioned earlier in this document. Lamps flickering is the variation of luminance of the lamp due to the alternative cooling and warming of the filament when the current is on or off during zero crossing and in a limited way during advanced single cycle. The present flickering is related to the variation of power supply voltage due to the variation of the load……

The power regulation affects in several ways the power supply :

- the total load on the supply when lamps are on will affect the supply voltage. This effect depends on the power consumed by the ovens and on the quality (strength) of the supply. This effect is constant along the time and doesn't affect the EM compliance.
- The variation of the load along the time, related to the variation of the power settings, will also affect the supply voltage and introduce some variations related to the change of the settings.. This effect is slow (usually for the PET process the settings are quite even along time) and doesn't affect the EM compliance.
- The regulation itself may affect the supply when many lamps are shut down or started simultaneously in the regulation algorithm.
  For instance, in the zero crossing regulation mode, several lamps may be off simultaneously during several periods and induce an effect onto the power supply. Moreover, in this type of regulation the temperature of the filament will have enough time to cool down… With a cooler filament, the resistance will fall quickly , leading to a huge current at the next active period….

The NS-IRS system are already optimised with respect to these problems. First, we propose the advanced single cycle mode that ensures an even distribution of the periods to reduce filament cooling effects. Secondly, our algorithm avoids correlations between the different channels by shifting the off period for each lamp. The total load on the supply is thus quite even.

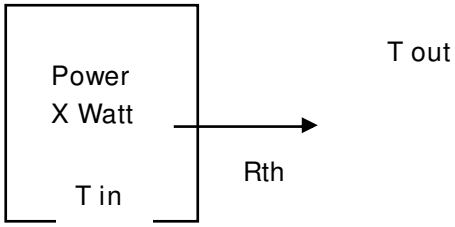
Running conditions and cooling :

Performances :

Like any electrical device the NS-IRS systems have power losses.
The power loss in the NS-IRS is around 0.15% of the nominal power (30kW)
P(loss IRS) =55 W

Rth :

Any thermodynamics system is characterized by its thermal resistance Rth.
The Rth gives the temperature rise of an isolated system with respect to the outside when a given energy is released in this system.



Tin = Tout + X . Rth

Exemple : If Rth = 0.2 °C/W and the loss in the system is 100 W, then Tin = Tout+20°C.

The NS-IRS has 2 different Rth depending on the usage of the fan cooling option. .

Model	Rth °C/W
NS IRS with cooling option	0.17
NS IRS Standard with no cooling option	0.28

Maximum internal temperature

Electronics systems usually run at temperatures ranging from 70 to 85°c for digital electronics and higher for power electronics.

The limiting elements in the NS-IRS are the electromechanical breakers used to protect the cables from the NS-IRS to the ovens.
This limit is 70°C for the breaker used in the NS-IRS.

Running conditions

Model	Power loss At 30 kW	Rth	Temp Rise	Max temp On breaker	Max temp On heatsink	Max outside temp
NS IRS	55	0.28	15.4	70	70	54
NS IRS Fan	55	0.17	9.4	70	70	60

The maximum temperature outside given in the previous table is valid if the mechanical integration of the system in the machine is done in good conditions. By good conditions we mean that the system must be installed in a non confined volume to allow natural convection to occur. If the box is enclosed in a cabinet or a closed volume, some additional test in real conditions should be performed.

Using the cooling unit option

The additional cooling unit can be ordered from OLICORP.

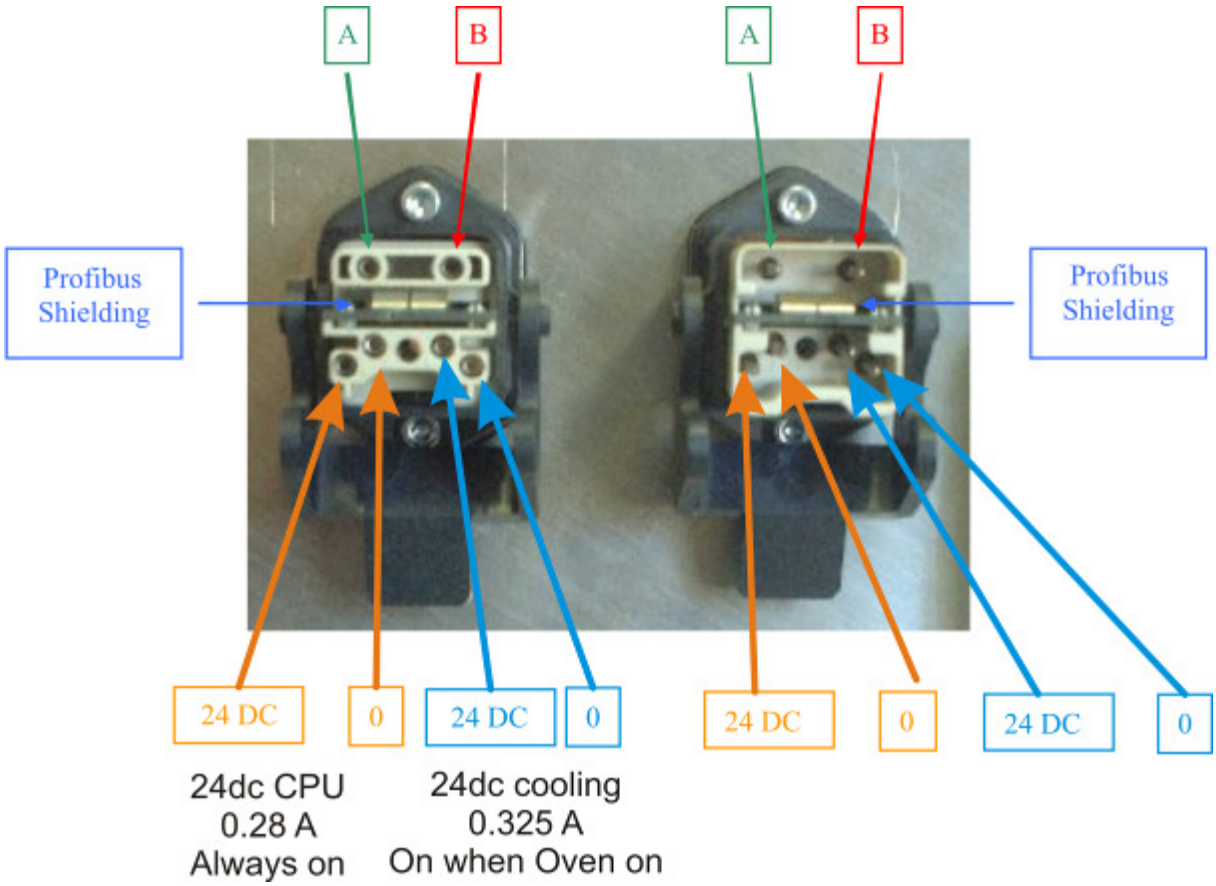
The cooling unit is powered from the second set of 24DC cables from the Profibus DP DESINA hybride cable.

The DESINA cable and the Profibus terminators have 6 Terminators :

PRofibus DP A and B
24VDC for CPU powering : 1+ and 2-
24VDC for Cooling unit : 3+ and 4-

Each 24VDC pair on the DESINA cable can sustain up to 10 A.

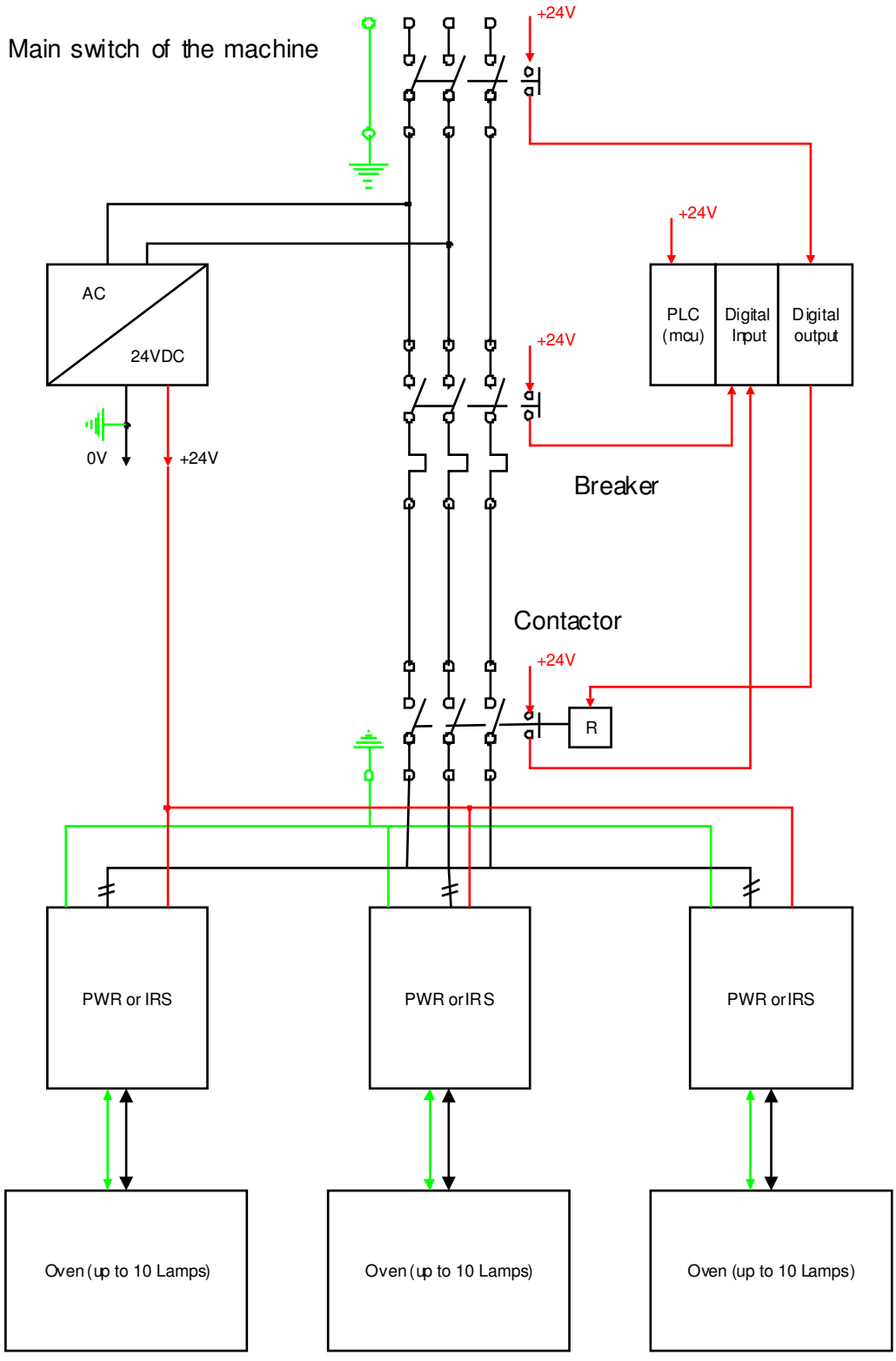
The consumption of the cooling unit is 0.325 A.
A maximum of 32 NS IRS can be powered using the same cable.



PART 3 : USING THE NS-IRS in 6 STEPS

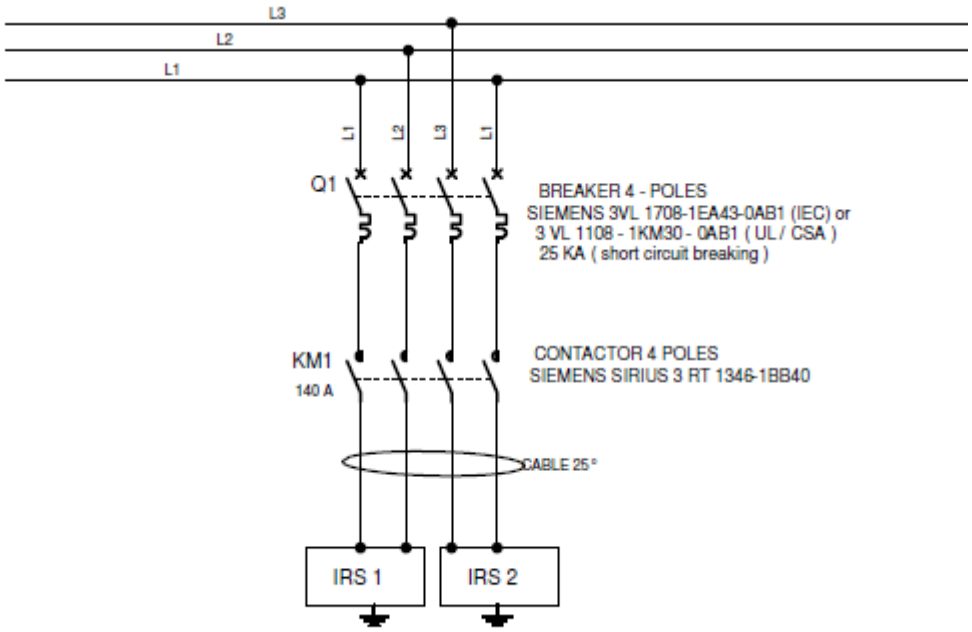
Step 0 : Machine cabling :

The following scheme describes the usual architecture of the electrical supply in the machine for the IRS and NS-IRS systems



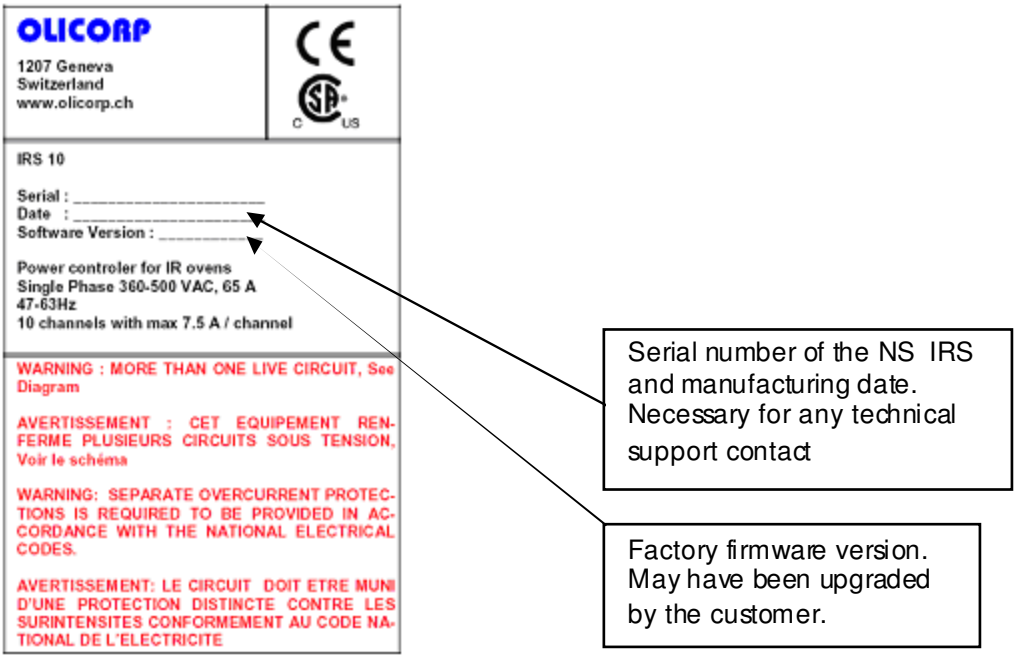
www.olicorp.ch

Advised circuitry and cabling for NS-IRS :



Step 1 : Product Identification :

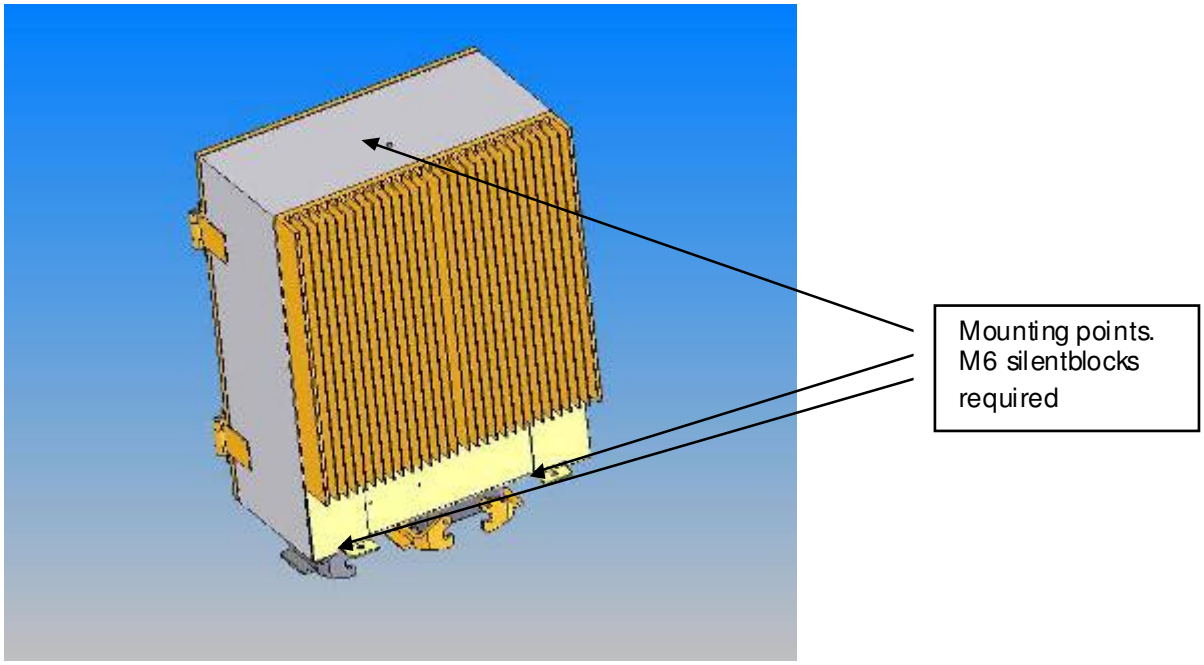
The product identification is located inside the NS-IRS cabinet on the outer side of the door :



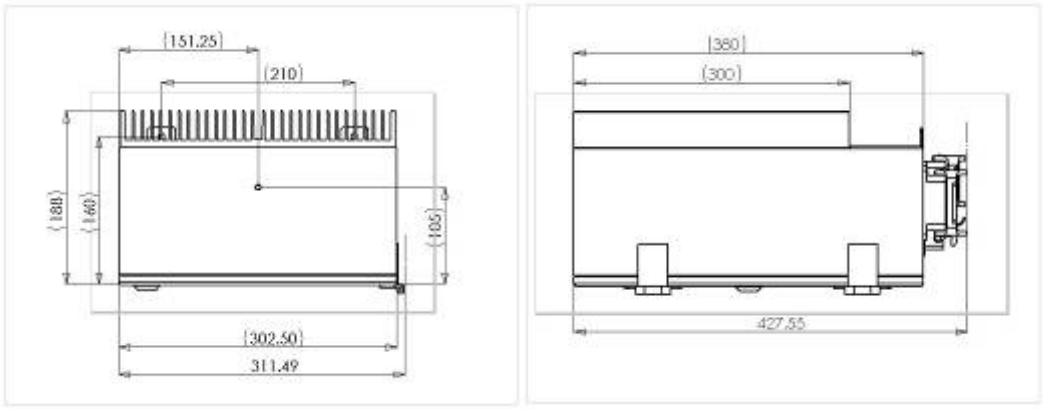
Step 2 : Mechanical mounting :

Mechanical configuration of the NS-IRS for integration into machines :

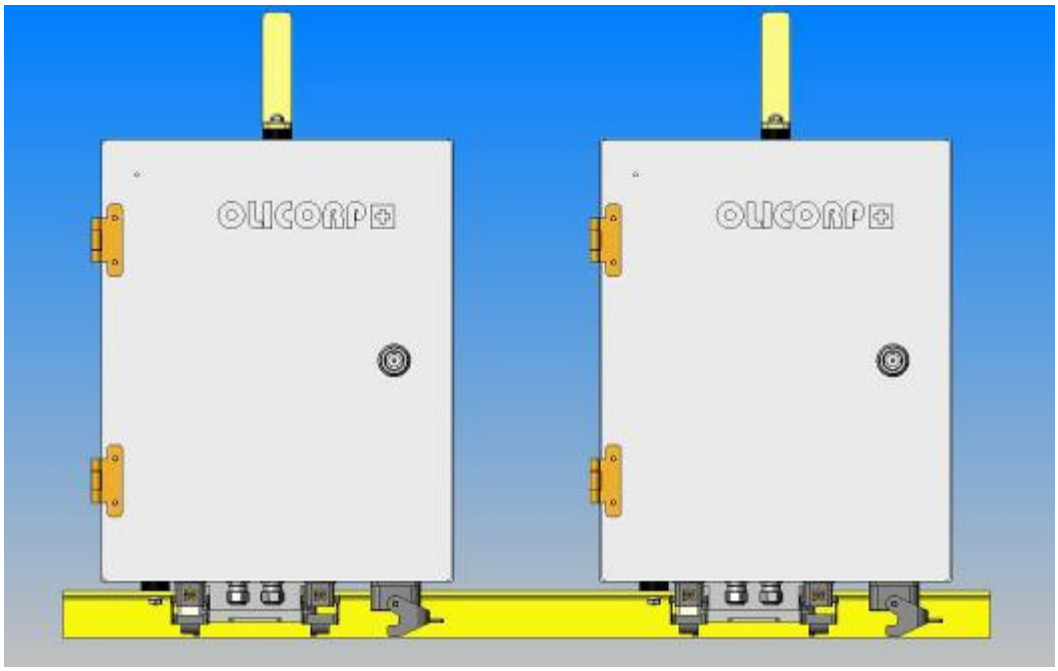
The following diagram describes the NS-IRS mechanical design.

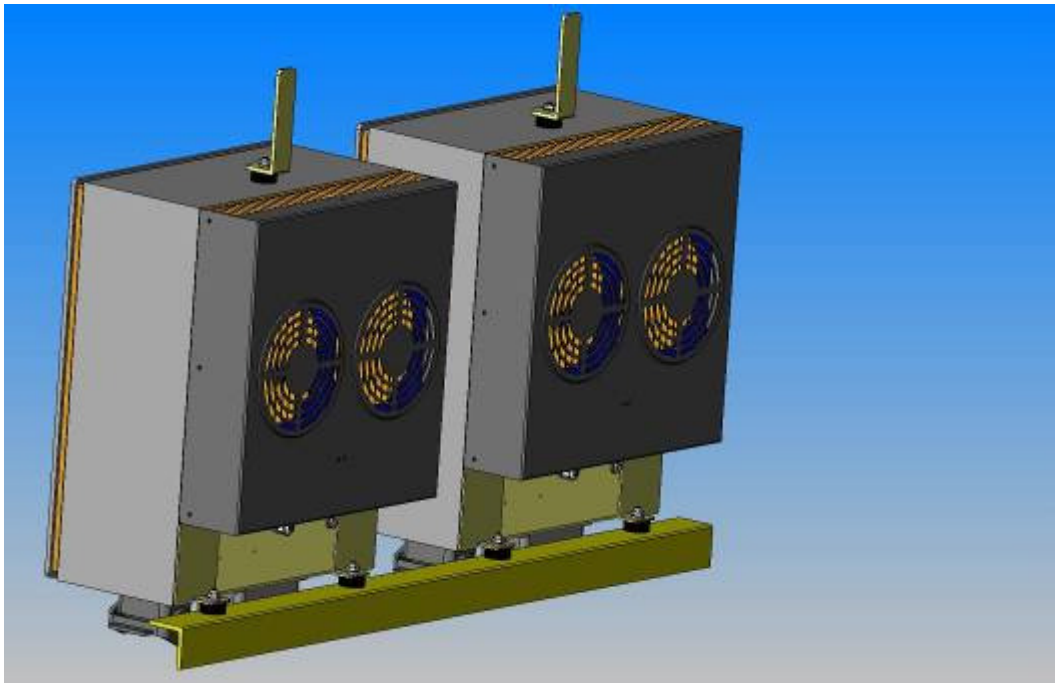


Dimensions. Please note that IGES model is available from our Website.



Attention : The NS-IRS system must be installed in a non confined place so that natural convection will ensure a sufficient cooling of the system.


OLICORP
OLICORP



Step 3 : Electrical connections :

AC Power supply :

The NS-IRS modules are single phase devices. They sustain up to 96 amps under 185-530 VAC 47-63 Hz.

The NS-IRS terminators are compatible with HARTING® HANAXIAL 100A terminators.

If you need to purchase directly the terminators, please use the following BOM :

http://www.olicorp.ch/support/

Available from HARTING AG. www.harting.com

Connection to the Oven :

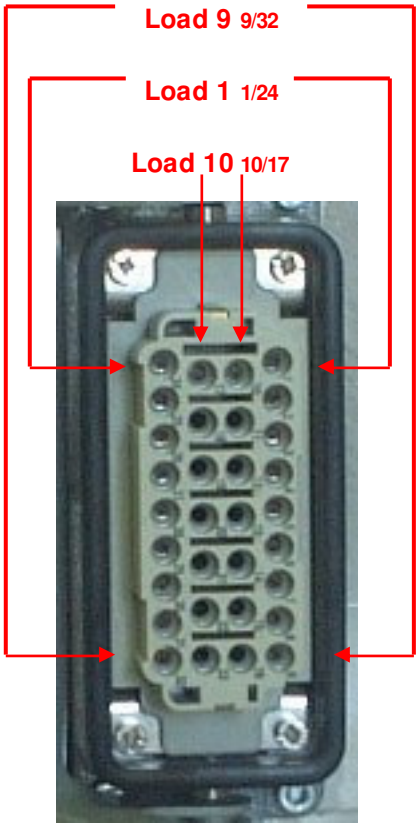
The NS-IRS modules are using HAN32 terminator from HARTING.
If you need to purchase directly the terminators, please use the following BOM :

http://www.olicorp.ch/support/

Available from HARTING AG. www.harting.com

The Pin connection is done as follow .

Lamp	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
In	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Out	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**17**	**18**	**19**

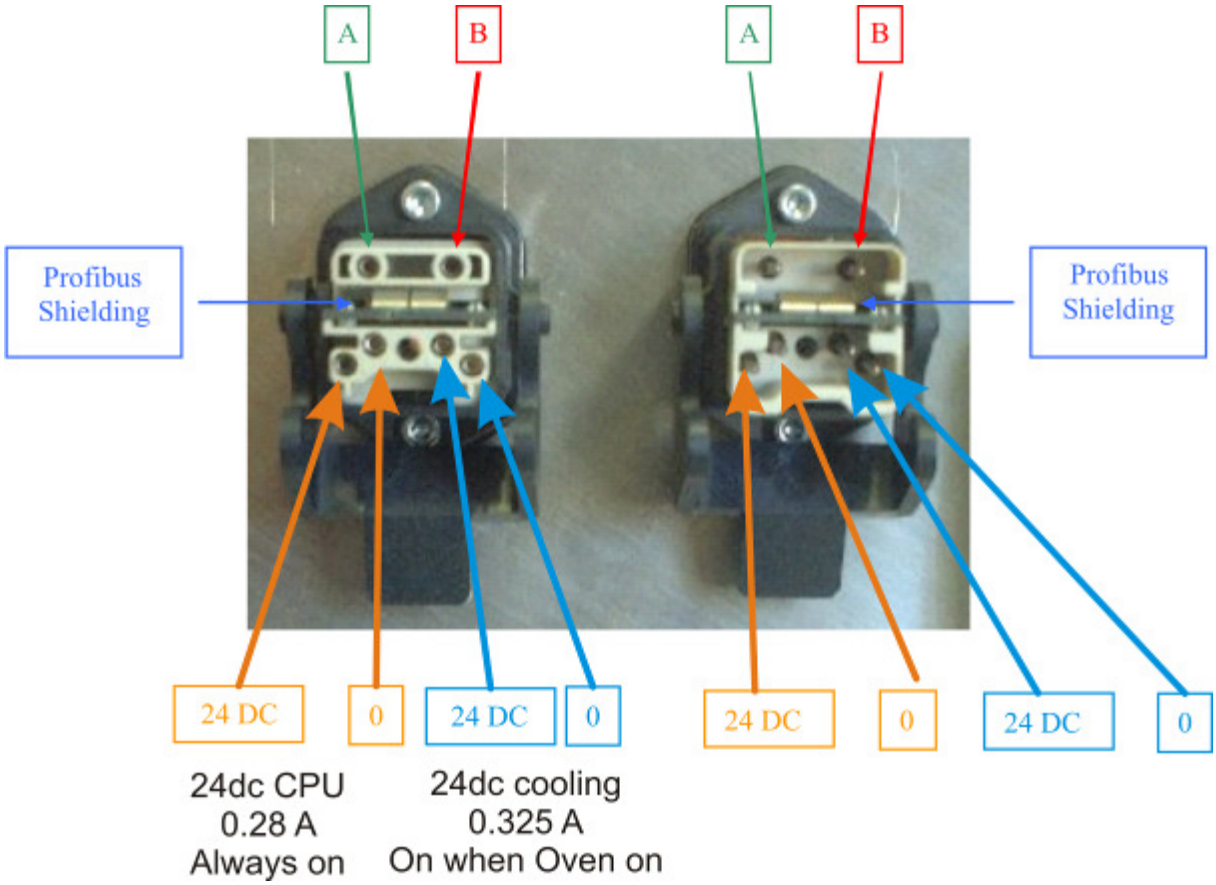


Powering the oven fan

If the oven is equipped with a 400 VAC FAN, it is possible to use the pins 10/17 corresponding to load 10, to power it.

DC Power supply and Profibus terminators

The 24 VDC, 220-350 mA power supply and the Profibus connection come all in a single Harting® terminator. Each NS-IRS has 2 connectors, one for input, the second to chain to the next device.

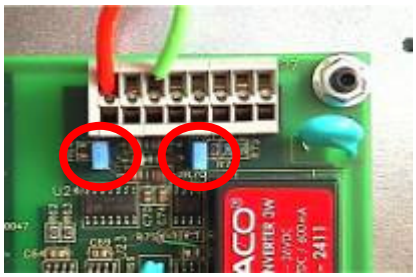


The blue 24DC is powered only if the cooling option is installed.

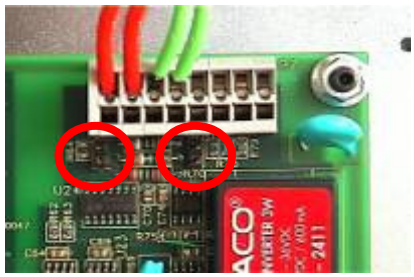
If you need to purchase directly the terminators, please use the following BOM :
http://www.olicorp.ch/support/pdf/bom_harting.pdf
Available from HARTING AG. www.harting.com

Profibus termination:

Depending on the position of the NS-IRS slave on the bus, you will have to set the two jumpers, as shown on the following diagram, to terminate the bus using the right impedance. In that case, the wires between the MPU and the remaining unused connector should be unplugged.



The Jumpers are set – The bus is terminated



The Jumpers are not set – The bus is not terminated

As an alternative, a bus terminator can be plugged outside of the cabinet. In that case, the wires may stay plugged, but the jumpers on the MPU shouldn't be set.

Profibus ID:

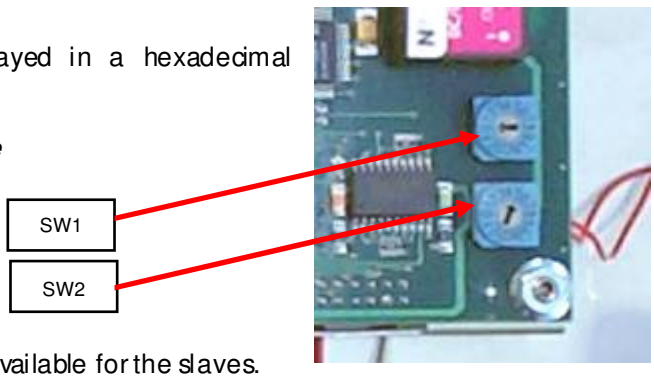
The Profibus ID is set using the two wheels on the left of the MPU:

The PROFIBUS_DP address is displayed in a hexadecimal format.

*PFBaddr = (SW1value * 16) + SW2value*

Example:

*PFBaddr = (1 * 16) + 5*
PFBaddr = 21



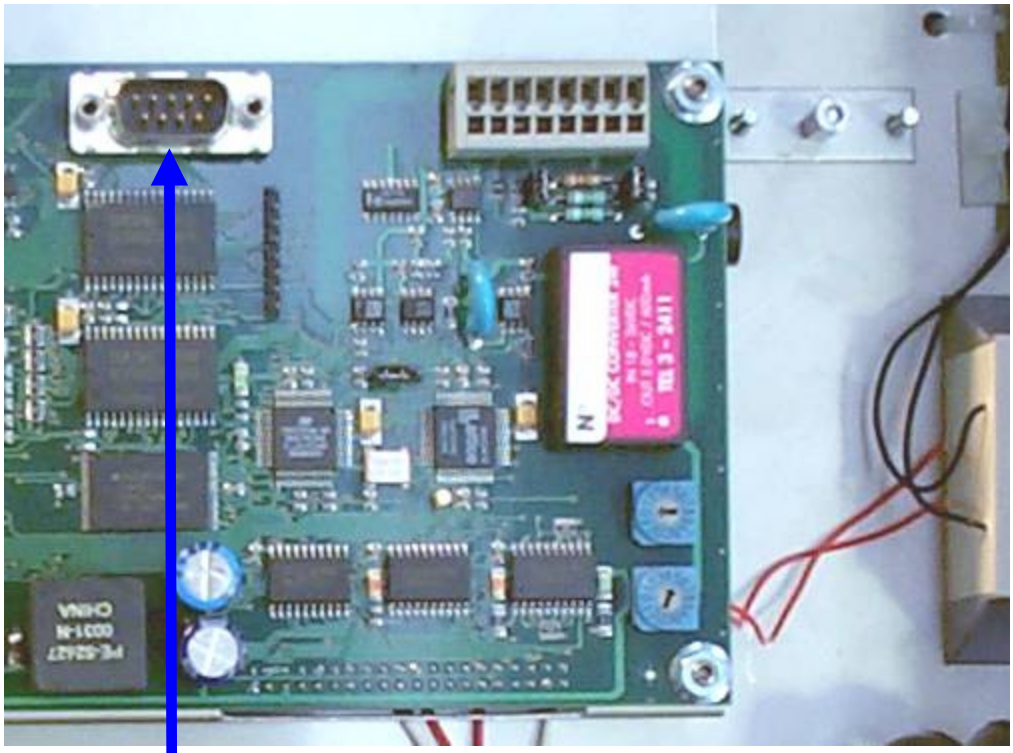
The addresses between 1 and 125 are available for the slaves.

NOTE: The address is read during the boot. So, after change to the Profibus address, one has to turn off/on the 24 DC supply before using it.

Step 4: Checking the NS-IRS configuration.

To do so, one has to install the latest version of the SUPERVISOR program onto a PC (windows 95-XP) and connect to the NS-IRS using a null modem cable.

The SUPERVISOR is available in the support section of our web site: http://www.olicorp.ch

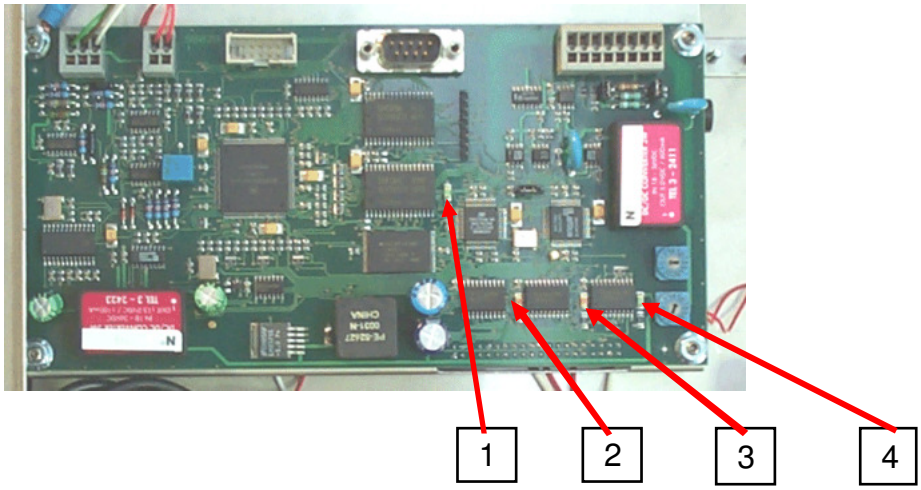


DB9 connector for the RS232 connection or USB connector for USB connection

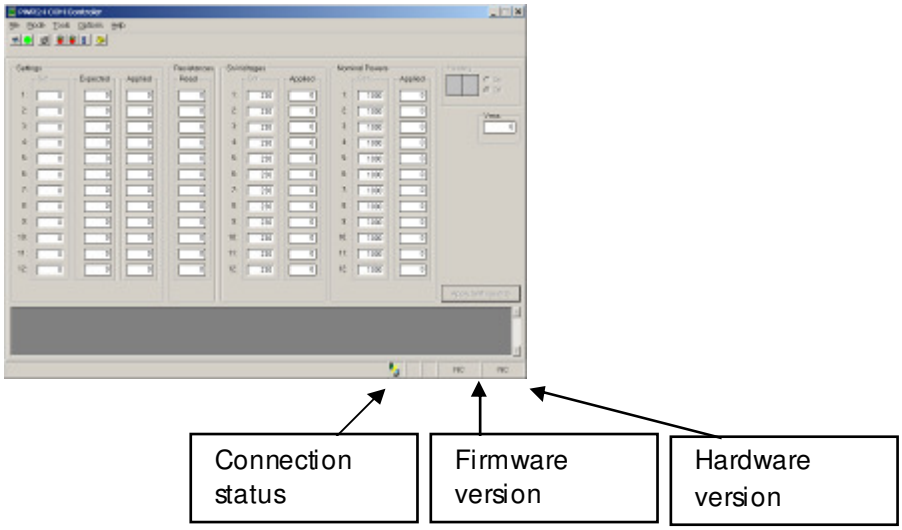
Procedure:

1) Start the SUPERVISOR program
2) Connect a null modem cable or USB cable to the NS-IRS
3) Turn the 24VDC on

On the NS-IRS, the LEDs 2 and 4 must be ON.



On the SUPERVISOR, The 'informative Icons" should appear on the lower right of the window.



Check that the NS-IRS is well connected and that the firmware version is the right one.

List of firmware versions according to the model and usage :

Model	Use	Firmware	Hardware
NS IRS	Standard	5.18	20
NS IRS	SDL	20.18	101
IRS 12	Standard	5.18	20

See : SUPERVISOR User's manual for information about firmware upgrade and product configuration.

Step 5: Automation strategy for 20.X Programs – Voltage regulation mode.

The automation strategy describes the different possible solutions to control the power system with the PLC:

- Starting the regulation (oven on/off)
- Sending the power settings for the oven
- Treating the data from the NS-IRS (alarms).

System calibration

The calibration is done by OLICORP at factory.

Starting the regulation

To start the regulation, the PLC has to send:

- The desired power (% of nominal power) applied for each lamp: Pe (%)
- The start/stop command (Which should be set to “Start”, of course)

Treating the information back from the NS-IRS

The PLC has to treat the information coming back from the NS-IRS:

- The supply Voltage: SV (Volts)
- The alarms:
  - Overload
  - Cutout
  - Overheat
  - Sector default
- The lamps states (Broken or not) for the ones that are ON.

Stopping the regulation

To stop the regulation, the PLC has to send:

- The start/stop command (Which should be set to “Stop”, of course)

System Shutdown

The main supply must be switched off first. Otherwise, this step doesn’t require any specific action.

Exceptions

		Exception	Effects
Software treatment of the exception	An alarm is emitted The regulation can be stopped	Critical sector default V_{supply} < 320 V	The regulation stops, An alarm is sent to the Master. The system needs a software reset to restart (regulation off and then on again)
		Sector Default: V_{supply} < 360 V	An alarm is sent to the PLC.
		Dead lamp	An alarm is sent to the Master. The regulation is stopped on this channel.
		Overload I > 200 A	The regulation stops. An alarm is sent to the Master. The system needs a software reset to restart (regulation off and then on)
		Temperature to high	The regulation stops. An alarm is sent to the Master.
	No alarm	Profibus down	The regulation is stopped and will start again when the Profibus DP will be back.
		24 VDC down	Should never happen when main supply is on. The regulation stops.
		PLC failure	If the Profibus watchdog is not affected, the NS-IRS cannot see it. The regulation goes on.
		24 VDC starts after the HV supply	Should never happen. Non-deterministic. It can damage the electronics.
		The current in one channel is higher than 10 A continuously but the total current remains below 200 A	We cannot detect that. After a while the related thyristor will be damaged.

Step 5 : Automation strategy for 5.X Programs – Power regulation mode

The automation strategy describes the different possible solutions to control the power system with the PLC :

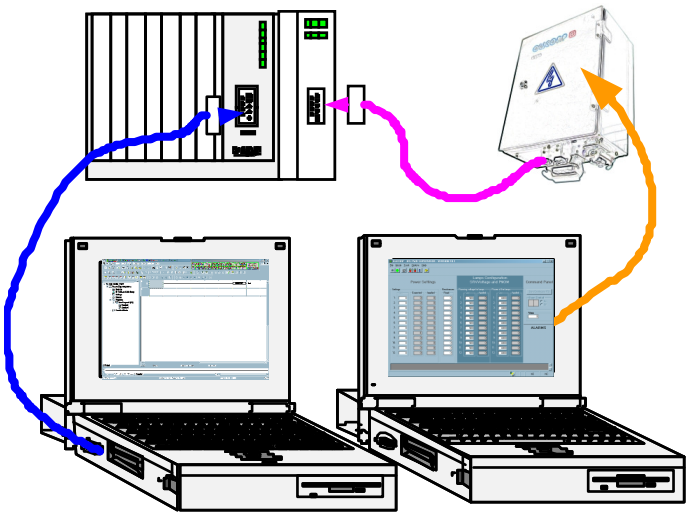
- Starting the regulation (oven on/off)
- Sending the power settings for the oven
- Treating the data from the NS-IRS (alarms, measured resistances….)

System configuration

Before doing anything with the NS-IRS regulator, it will be necessary to configure the basic functions of the device :

- Regulation mode : Phase angle, advanced single cycle
- Ramps : Validation of the integrated ramping function to warm the lamps
- Turning on or off the resistance measurement
- Voltage and current calibration
- *Optional* : Preseting the regulation parameters (lamps service voltage, lamps nominal power)

This configuration is either done by OLICORP at factory according to users'specifications, or can be done while mounting the NS-IRS using the serial bus or USB connexion and the SUPERVISOR program.



The system configuration MUST be done from the PC using the SUPERVISOR or OLPWR24COM programs

The Other steps can be done either from the PLC or from the PC

System initialisation at start-up

If not done during initial system configuration, at system start-up the basic parameters used by the regulator must be sent by the PLC (or PC) to the NS-IRS
These parameters are :

- the lamps service voltage : SRVV (Volts)
- the lamps nominal power : MaxP (Watts)

they are related to the basic configuration of the oven

This step can be avoided, if one stores these values directly on the control board. The SUPERVISOR software, used to configure the settings of the NS-IRS, has an option to set SRVV and MaxP in the ROM memory of the NS-IRS.
If this option is used, it is even possible to select a simplified Profibus DP protocole (IRSPWR_STD_SHORT instead of IRSPWR_STD) to ease the programming of the PLC by suppressing the parameters SRVV and MaxP in the Profibus Protocole.
More about that in the ProfibusDP section.

Starting the regulation

To start the regulation, the PLC has to send :

- the desired power for each lamp : PW (Watts)
- the start/stop command

Treating the information back from the NS-IRS

The PLC has to treat the information coming back from the NS-IRS :

- Measured resistances : RM (Ohms)
- The Applied Power : PWE (Watt)
- The supply Voltage : SV (Volts square)
- The alarms :
  - Overload
  - Overheat
  - sector default
  - Dead lamp

System Shutdown

This step doesn't require any specific action

Exceptions

		Exception	Effect
Software treatment of the exception	An alarm is emitted The regulation can be stopped	Sector Default : Vsupply < 100V during more than 1 second	The regulation stops, An alarm is sent to the PLC. The system needs a software reset to restart (regulation off and then on)
		Power not reach : Power applied < power expected	The regulation goes on, an alarm is sent to the PLC
		Dead lamp	The regulation goes on, an alarm is sent to the PLC
		OverLoad I > 200 A	The regulation stops. An alarm is sent to the PLC. The system needs a software reset to restart (regulation off and then on)
		Temperature to high	The regulation stops. An alarm is sent to the PLC
	No alarm	Profibus down	The regulation is stopped and will start again when the Profibus DP will be back
		24 VDC down	Should never happen when main supply is on. The regulation stops.
No treatment		PLC failure	If the Profibus watch dog is not affected, the NS-IRS can not see it. The regulation goes on.
		24 VDC starts after the HV supply	Should never happen. Non deterministic. It can damage the electronics.
		The current in one channel is higher than 7.5 A continuously but the total current remains below 200 A	We can not detect that. After a while the thyristor will be damaged.

(1) Available only with fw2.45 and >. Prior to this firmware the regulation was stopped...

Part 4 : Technical complements

RS232 and USB connection : Firmware update and NS-IRS serial control

Overview :

The RS232 connection is used for maintenance purpose.
To use the RS232 connection, **you need a null-modem cable** with an RS232, DB9 male connector on the IRS side and the OL-PWR24COM program.

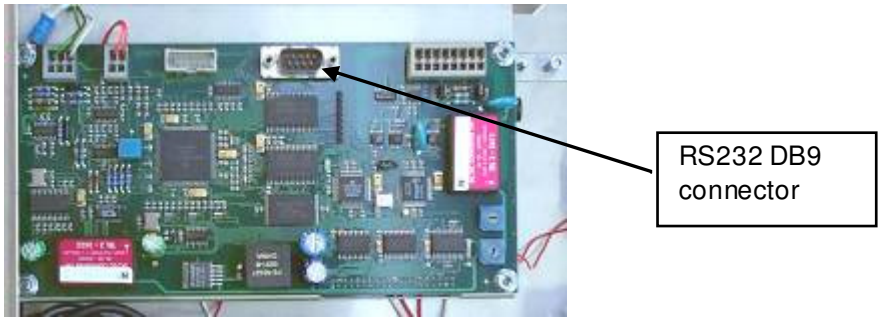
The USB connexion is available with CPU board with version higher than WE4.4. To connect to the NS-IRS simply plug an USB cable between the PC and CPU.

While connected it will be possible to :

- control the regulation for test purpose
- upload/download the firmware
- set the NS-IRS main parameters

Hardware connection :

When connecting the computer to the NS-IRS module through the serial link, you have to pay attention to have both devices wired to the same ground to avoid any electrical discharge that could damage either device.



To connect the cable you have to open the cabinet and then to plug to the female connector onto the MPU card. Pay attention to push softly when you plug the connector.

If necessary, the cable can be connected/disconnected while the MPU is on (24 VDC on).

Installing the software :

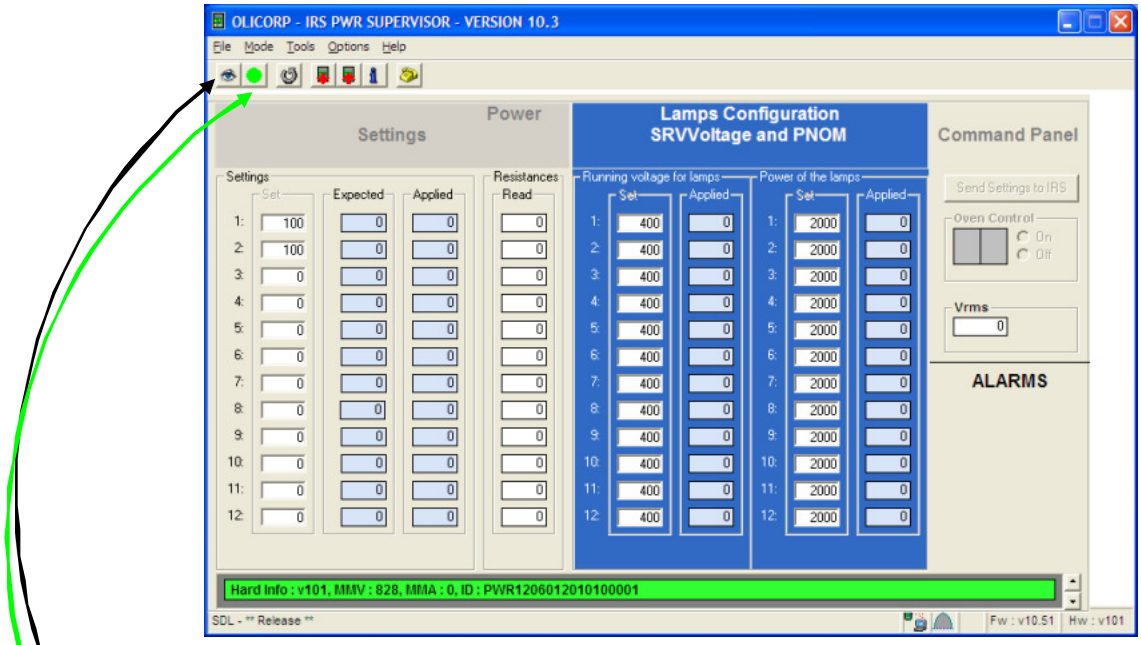
The SUPERVISOR is available from our Website.
Once unzipped, run the setup.exe program to install it onto you Windows system.

Configuring the software :

There is only one thing to configure. You have to choose in the option → Com Port menu the COM Port which connects the PC to the NS-IRS.

Using the software :

The SUPERVISOR interface looks like the following figure :



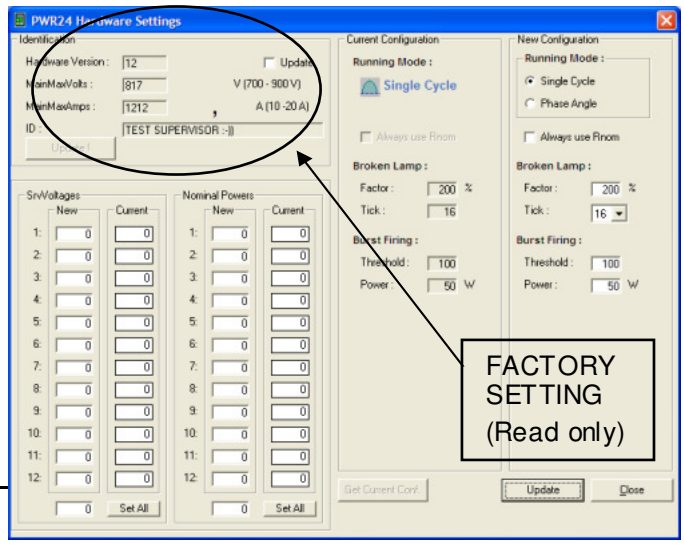
The connection status is summarized on the lower right part of the window.
Once started the program tries to connect to the NS-IRS… It takes a few seconds to connect.

The program has two modes (mode menu):
- The monitor mode
- The control mode

The monitor mode is used to monitor the settings of the NS-IRS. This function can be used once or in a repetitive way (pooling)…
In this mode, the program returns the power applied to each lamp (PWE), the resistance measured for each lamp (RM), the service voltage set for each lamp (SRVV), the nominal power set for each lamp (MAXP), the status of the oven (On/off), the measured supply voltage (SV).

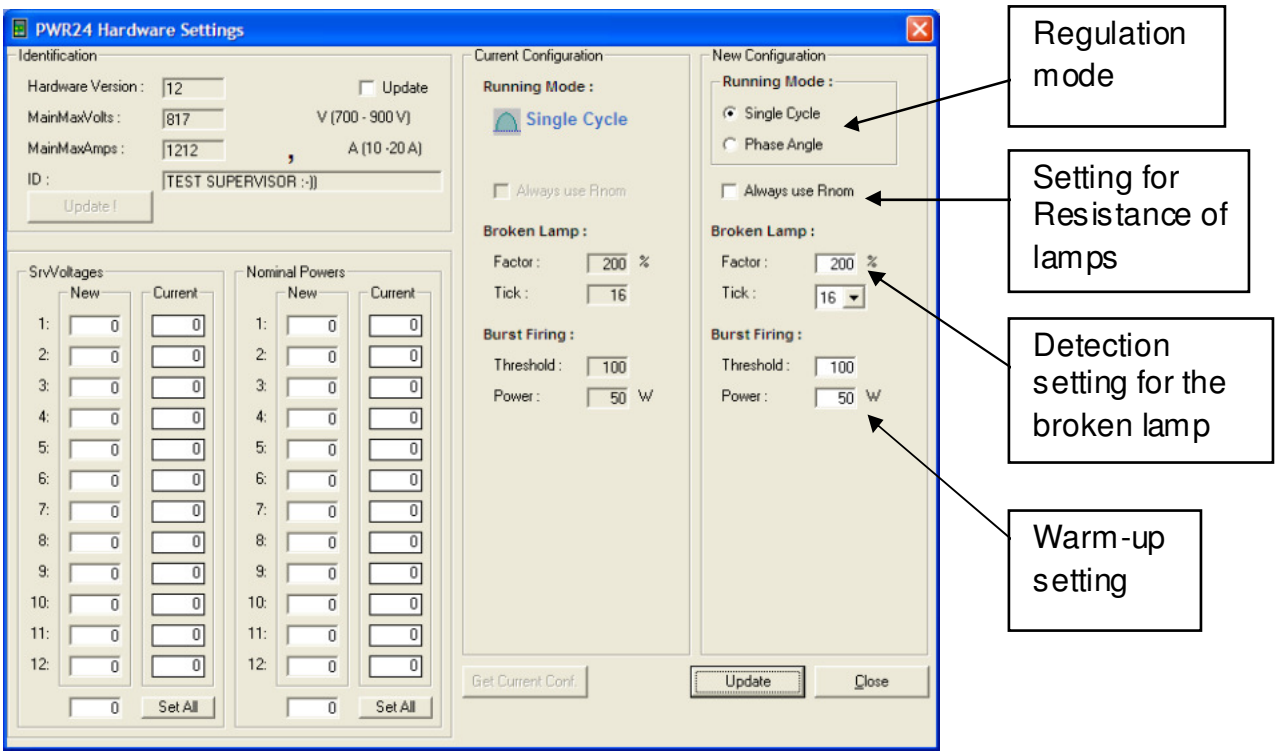
In the control mode, it is possible to control the regulation by sending the different settings to the NS-IRS (SRVV, MAXP, PW, run on/off).

Beside these standard uses, the program is also used to configure the NS-IRS or to get factory information (menu tools→ hardware information) :



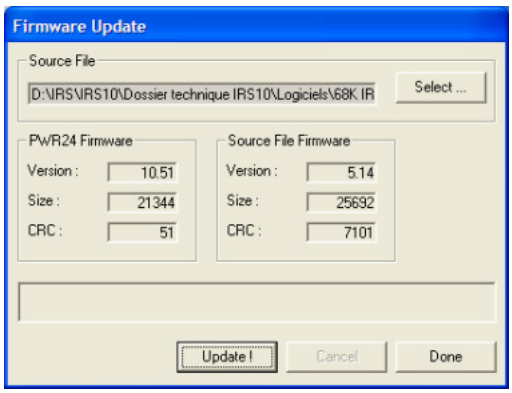
Read only :
- Hardware version
- MainMaxVolts and MainMaxamps are constants used to tune the NS-IRS
- ID : Serial number

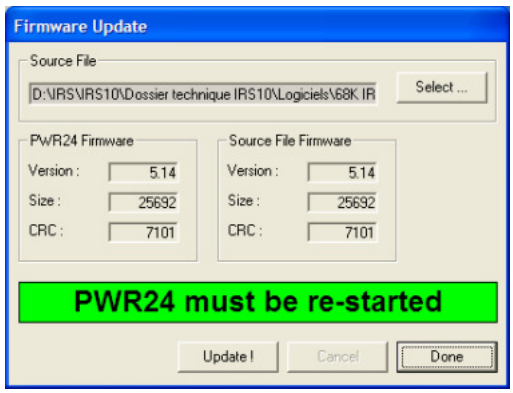
Read/Write :
- Current configuration for the regulation mode and of the lamps pre-warming (ramps).



Firmware update :

The latest versions of the firmware are available on our web site from the download section. From the update window you can select the desired firmware (.olc file) and transfer it to the NS-NS-IRS. It takes about 10 sec to transfer the olc file to the NS-IRS. The NS-IRS must be rebooted once the installation is finished.





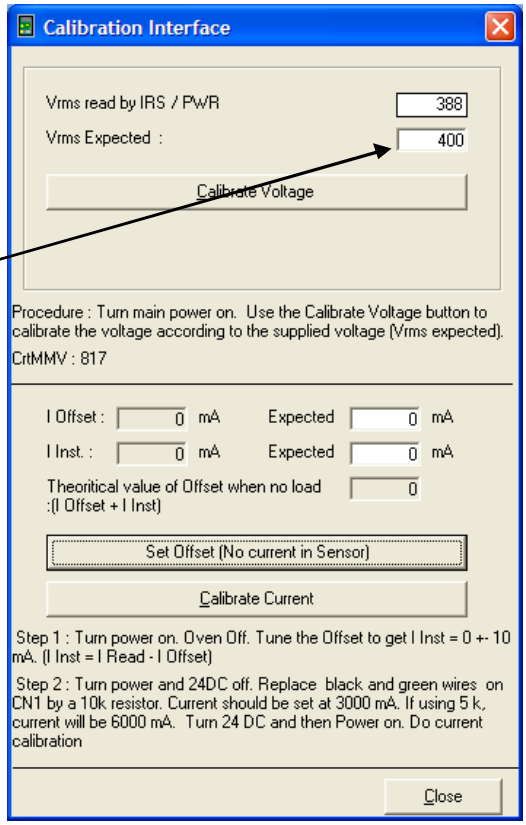
Calibration :

To ensure a good process quality the NS-IRS calibration have to be check

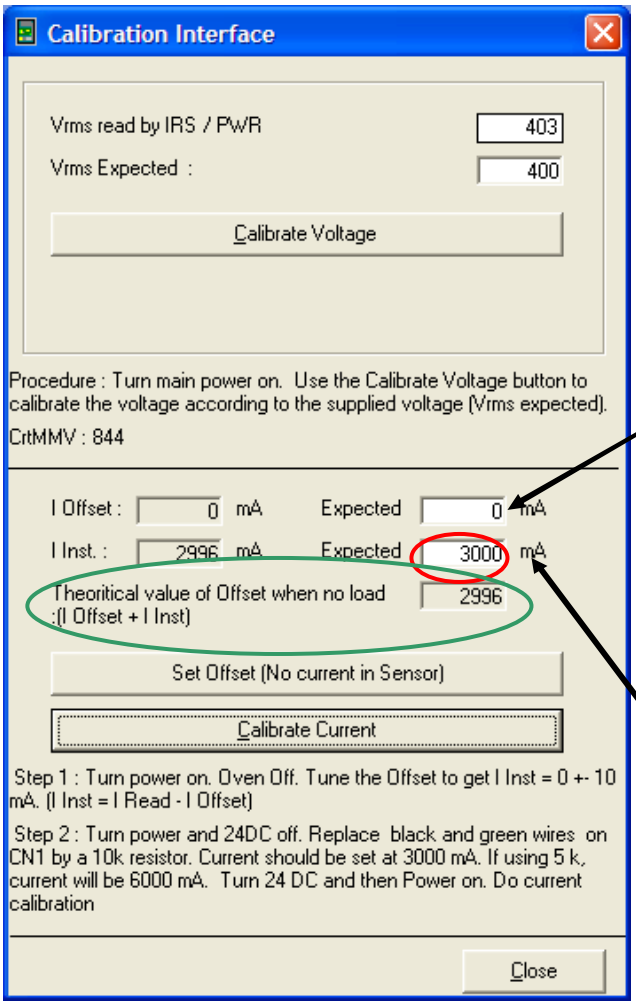
Voltage calibration :

Use a calibrate VRMS Voltmeter
Measure the voltage between the two phases inside the NS-IRS
Enter the value and tick “Calibrate voltage”
Vrms read and Vrms expected mus be the same

enter the value



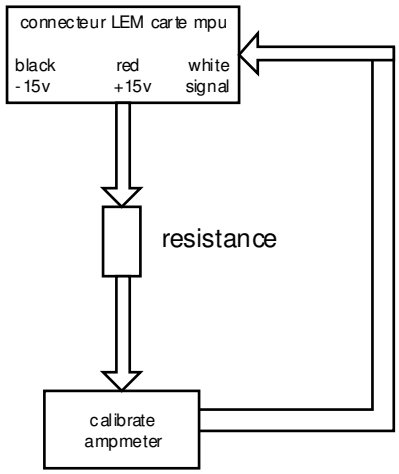
Current calibration :



1st AC power on, set the I Offset Expected the way is to obtain Iinst = 0

2nd Plug the Current Calibrator and enter the value 3000 in I inst expected then set Calibrate Current

With the current calibrator WO12.1 you have 1% precision



Instead of using the current calibrator you can use a calibrate Arms ampmeter and measure the current through a resistance

Profibus DP : For PROGRAMS 5.X

Overview

The NS-IRS power regulator from OLICORP is a PROFIBUS-DP slave which runs accordingly to the Profibus-DP specifications defined in the standards EN 50170 / DIN 19245 / Part 3.

On this type of network, the MASTER DEVICES control the data communication on the bus while the SLAVES DEVICES only answer the requests from the masters.

The master may be :
A Programmable Logical controller (PLCs)
A PC with a Profibus-DP interface.

The OLICORP NS-IRS module has been successfully tested with several masters:
Siemens PLCs *"SIMATIC 400"*,
Siemens PLCs *"SIMATIC 300"*,
B&R PLCs
Omron CJ1M
SST profibus master card (PC solution) with a windows based user-interface
SST-PFB SLC profibus scanner module for Allen Bradley SLC PLCs.

Procedure to use a NS-IRS regulator with a PLC :

1. Initialisation :

The GSD file provided by OLICORP contains a standardized description of the NS-IRS regulator, which enables the automatic detection of the NS-IRS regulator by the master.
The GSD file, olic0594.gsd from our web site should be used.
Note : The name of the GSD must be olic0594.gsd to work properly. When downloading the latest version of the gsd from our site, please rename it if necessary.

2. incoporate the different slaves in the project.

With the Siemens environment it is simply done by the NS-IRS slave from the slave list to the profibus network in the STEP7 programming interface.

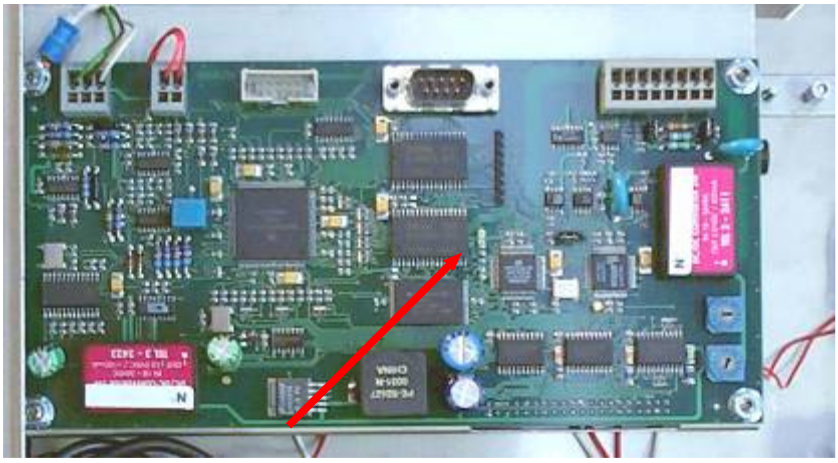
According to the GSD :

The type of the slave is : IRPC12-60
The profibus identification is : 0x0594

Two protocols can be selected :
IRS_PWR_STD12
IRS_PWR_STD12_SHORT

The slave ID is set using the ID wheels on the main MPU board. Turn off/on the 24 DC supply to reload the new address.

At this point, the Profibus-DP network should be initialised and should work correctly.
The master is starting to exchange empty datagrams with the NS-IRS slaves. If this exchange is successful the profibus LED onto the MPU card turns to green.



3. Start communication by sending commands and receiving data to/from the NS-IRS.

Then the communication is done through simple datagram exchanges between the master and the slaves.
See next section.

Protocol description and datagram format :

Configuration datagram

The configuration datagram is built according to the GSD description :
Two type of protocols are available on the NS-IRS and PWR systems:
IRS_PWR_STD12
IRS_PWR_STD12_SHORT

The SHORT version is used to simplify and optimize the exchange by suppressing the information about SRVV and Pmax (2 x 12 words are suppressed in the datagram).
To work with this version, on has to set these values manually with the OLPWR24COM software and to save them in the ROM memory of the NS-IRS during system installation.

IRS_PWR_STD12 - INPUT 5 WORDS – OUTPUT 37 WORDS

```
0xD4, 0xEC, 0xEB, 0xEB

0xD4 = 11010100
       ||||||||
       ||||++++- Data Length 0100 == 5
       ||++----- Input (Slave->Master)
       |+------- Type = Word
       +-------- Coherent check

0xEC = 11101100
       ||||||||
       ||||++++  Longueur données 1011 == 13
       ||++----- Output (M->S)
       |+------- Unité = Word
       +-------- Cohérence sur données complètes
```

```
0xEB = 11101011
       ||||||||
       ||||++++- Longueur données 1011 == 12
       ||++----- Output (M->S)
       |+------- Unité = Word
       +-------- Cohérence sur données complètes


0xEB = 11101011
       ||||||||
       ||||++++- Longueur données 1011 == 12
       ||++----- Output (M->S)
       |+------- Unité = Word
       +-------- Cohérence sur données complètes
```

IRS_PWR_STD12_SHORT – INPUT 5 WORDS – OUTPUT 13 WORDS

```
0xD4, 0xE0, 0xEB

0xD4 = 11010100
       ||||||||
       ||||++++- Data Length 0100 == 5
       ||++----- Input (Slave->Master)
       |+------- Type = Word
       +-------- Coherent check

0xE0 = 11100000
       ||||||||
       ||||++++  Data Length 0000 == 1
       ||++----- Output (M->S)
       |+------- Type = Word
       +-------- Coherent check

0xEB = 11101011
       ||||||||
       ||||++++- Data Length 1011 == 12
       ||++----- Output (M->S)
       |+------- Type = Word
       +-------- Coherent check
```

Input Datagram (S -> M) (5 words)

Command	*Reserved.*	P not Ok		BL		Sqr(Vrms)			
0	1	2	3	4	5	6	7	8	9

Byte 0 : Command byte content :

bit	Meaning
1	*Reserved*
10	*Reserved*
100	*Reserved*
1000 *Read Only*	1 = **Alarm "Overload"** 0 = **Normal state**.
10000	1 = **Regulation ON** (ON Command acknowledge) 0 = **Regulation OFF**
100000 *Read Only)*	1 = **Alarm "CutOut"** (Breaker) 0 = **Normal state.**
1000000 *Read Only*	1 = **Alarm "OverHeat"** 0 = **Normal state**
10000000 *Read Only*	1 = **Alarm "SectorDefault"** 0 = **Normal state.**

Byte 2 and 3 : P not Ok byte content :

1 bit per lamp. The bit is turned to 1 when the Ns-IRS can not apply the required power to the given lamp. 4 bits reserved.

V1	V2	...	V12	*Rs1*	...	*Rs4*
bit0	*bit1*		*11*	*12*		*15*

Byte 4 and 5 : BL Dead Lamp byte content :

1 bit per lamp. The bit is turned to 1 when the NS-IRS detects a load fault

L1	L2	...	L12	*Rs1*	...	*Rs4*
bit0	*bit1*		*11*	*12*		*15*

Byte 6-9 : Sqr(Vrms) byte content :

Square V(rms) read by the NS-IRS. .

Output datagram (M -> S) (37 Word)

WORD 1 . Byte 0 : Command byte content :

bit	Meaning
1	*Reserved*
10	*Reserved*
100	*Reserved*
1000 *Read Only*	Not used
10000	1 = **Regulation ON** 0 = **Regulation OFF**
100000 *Read Only)*	Not used
1000000 *Read Only*	Not used
10000000 *Read Only*	Not used

WORD 1. Byte 1 : NOT USED

WORD 2 – WORD 13 : Power expressed in Watts, to be applied to each channel.

WORD 14- 25 : Service voltage of the lamps

WORD 26-37 : Nominal power (W) of the lamps.

In version IRSPWR_STD_SHORT, the words 14-37 are not used.

Summary : Basic steps to start the regulation (STD12 protocol) :

- Set the Service voltage for the loads.
- Set the nominal power for the loads.
- Set the desired power for the loads
- Start the regulation.
- Set the power for other lamps or modify the desired power.

Profibus DP: For Programs 20.X

Overview

The NS-IRS power regulator from OLICORP is a PROFIBUS-DP slave which runs accordingly to the Profibus-DP specifications defined in the standards EN 50170 / DIN 19245 / Part 3. The Profibus-DP certification is pending.

On this type of network, the MASTER DEVICES control the data communication on the bus while the Slaves devices only answer the requests from the masters.

The master may be:
A Programmable Logical controller (PLCs)
A PC with a Profibus-DP interface.

The OLICORP NS-IRS module is a Profibus slave that has been successfully tested with several masters:
Siemens PLCs *"SIMATIC 400"*,
Siemens PLCs *"SIMATIC 300"*,
SST profibus master card (PC solution) with a windows based user-interface
SST-PFB SLC profibus scanner module for Allen Bradley SLC PLCs.

Procedure to use a NS-IRS regulator with a PLC:

4. Initialisation:

The GSD file provided by OLICORP contains a standardized description of the NS-IRS regulator, which enables the automatic configuration of the NS-IRS regulator by the master.
The GSD file, "olic0594.gsd" from our web site should be used.

Note: The name of the GSD must be "olic0594.gsd" to work properly. When downloading the latest version of the GSD from our site, please rename it if necessary.

5. Incorporate the different slaves in the project.

With the Siemens environment it is simply done by the NS-IRS slave from the slave list to the Profibus network in the STEP7 programming interface.

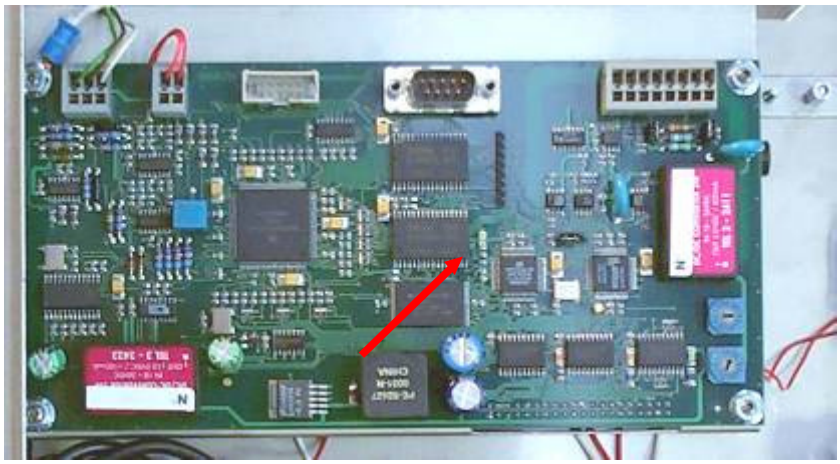
According to the GSD:

The type of the slave is: IRPC12-60
The Profibus identification is: 0x0594
The length of users parameters is: 5 bytes but are not used
No extended diagnostic is used
The length of data exchange datagrams is :

- 6 bytes IN (Slave → Master)
- 11 bytes OUT (Master → Slave)

The slave ID is set using the ID wheels on the main MPU board. Turn off/on the 24 DC supply to reload the new address.

At this point, the Profibus-DP network should be initialised and should work correctly.
The master is starting to exchange empty datagrams with the NS-IRS slaves. If this exchange is successful the Profibus LED onto the MPU card turns to green.



6. Start communication by sending commands and receiving data to/from the NS-IRS.

Then the communication is done through simple datagram exchanges between the master and the slaves.

Protocol description and datagram format:

- Input Datagram (S → M) (6 bytes)

Command	*Reserved.*	Vrms		Dead Lamps	
0	*1*	*2*	*3*	*4*	*5*

Byte 0: Command byte content:

SCT_D	OVRHT	C_OUT	ON/OFF	OVRL	OUT_R	*Reserved*	
7	*6*	*5*	*4*	*3*	*2*	*1*	*0*

Bits	Meaning
OUT_R	1 = **Notif. "Sector Out of Range"** (Sector < 360Vrms) 0 = **Normal state.**
OVRL	1 = **Alarm "Overload"** (Electronic Breaker) 0 = **Normal state**.
ON/OFF	1 = **Regulation ON** (ON Command acknowledge) 0 = **Regulation OFF**
C_OUT	1 = **Alarm "CutOut"** (Breaker) 0 = **Normal state.**
OVRHT	1 = **Alarm "OverHeat"** 0 = **Normal state**
SCT_D	1 = **Alarm "SectorDefault"** 0 = **Normal state.**

Byte 1: reserved:

This byte is not used.

Byte 2-3: Vrms byte content:

The supply voltage measured by the NS-IRS.

Byte 4 and 5: Dead Lamps bytes content:

1 bit per lamp. The bit is turned to 1 when the NS-IRS detects a load fault

L8	L7	L6	L5	L4	L3	L2	L1	*Reserved*						L10	L9
15	*14*	*13*	*12*	*11*	*10*	*9*	*8*	*7*	*6*	*5*	*4*	*3*	*2*	*1*	*0*
Byte4								*Byte5*							

- Output datagram (M → S) (11 bytes)

Cmd.	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10
0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*

Byte 0 : Command byte content :

Reserved			ON/OFF	*Reserved*			
7	*6*	*5*	*4*	*3*	*2*	*1*	*0*

Bits	Meaning
ON/OFF	1 = **Regulation ON** 0 = **Regulation OFF**

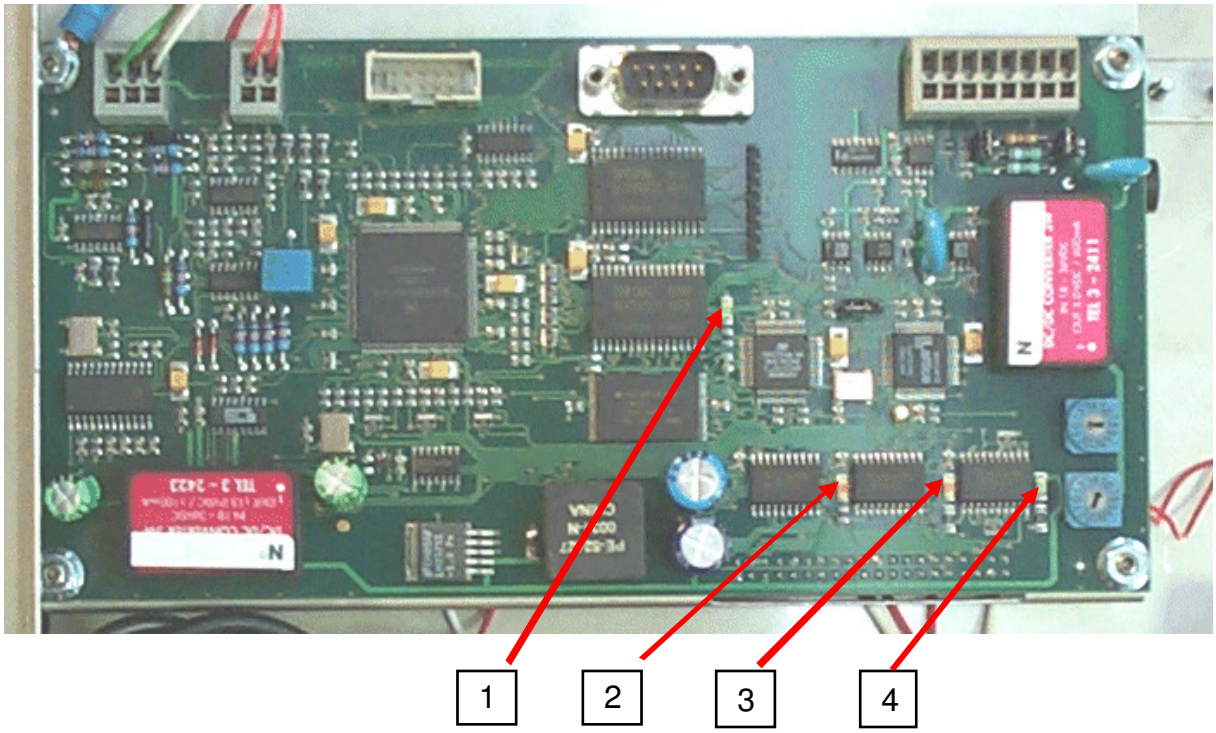
***Byte 1-10: Settings in Percents,* to be applied to each channel.**

These values should not exceed 100%. If it does, the setting 100% is applied.

Summary: Basic steps to start the regulation:

- Set the desired power for the loads
- Start the regulation.
- Set the power for other lamps or modify the desired power.

LEDs



LED	ON	OFF
(1)	Profibus-DP running	No datagram exchange
(2)	MPU running	MPU error (firmware)
(3)	400 V ON	400 V OFF
(4)	24 VDC on	24 VDC off