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HYDRA Series INVERTERS / CHARGERS

1. Introduction

HYDRA series products are advanced technology, high efficiency power inverters / chargers which include an automated load transfer switch, a charge control logic and also diesel generator control capabilities . They are specifically designed to support installations where the electric energy is stored in batteries and is consumed from normal appliances working with alternating current.

HYDRA products are built around a latest technology, high speed, large program memory RISC microcontroller. The operating software offers the user with simple and user friendly way, using a multiple message LED display and two push buttons (MENU and ENTER), full information and continuous control of the ***HYDRA*** operation, the state of the connected accumulators, of the connected alternating power source, of the load. Additionally, all the functional parameters are user programmable and stored in a non-volatile memory.

HYDRA series includes also :

- Single phase lead-acid battery chargers.
- Three phase lead-acid battery chargers.
- Uninterruptable power supplies **(UPS)**.

2. Operating modes

HYDRA starts operating by setting the main switch in the active **(ON)** position. There are two distinct **operating modes**:

- The power inverter mode **(Inverter)**
- The battery charger mode **(Charger)**

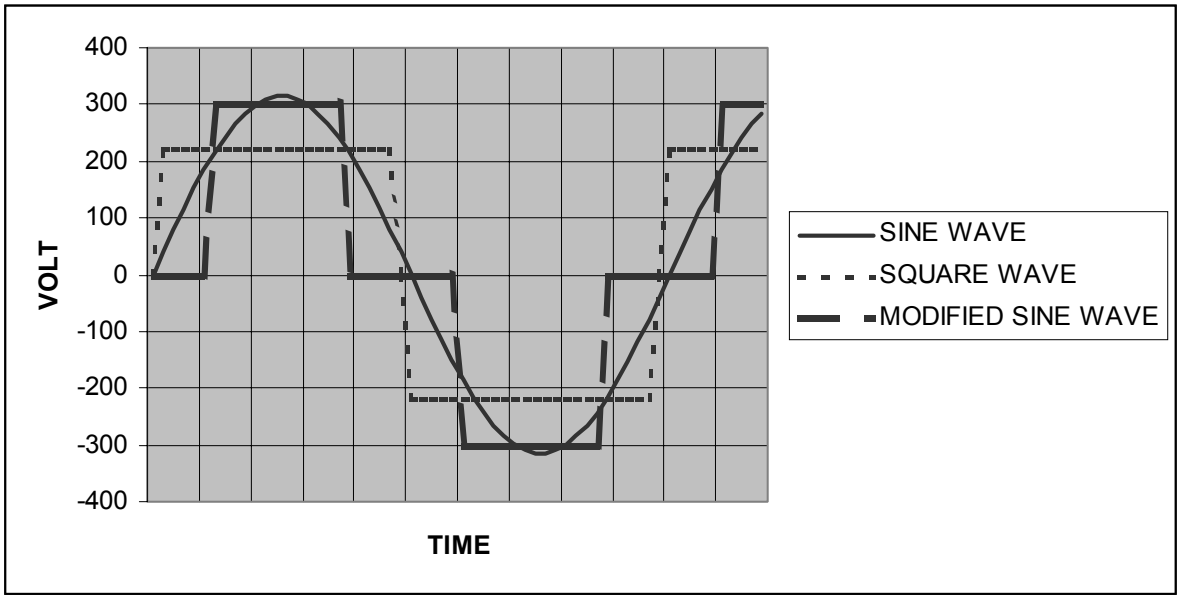
The default condition that automatically sets one of the above **operating modes**, is the existence or not of an external AC power source in the ***HYDRA*** input.

In order to enter the charger mode, the external AC power source, connected at the ***HYDRA*** input, must have acceptable electrical quality. Both the frequency and the RMS voltage of the power source are examined. In case of acceptance, ***HYDRA*** is automatically set to the charger mode, and the load is automatically transferred to the external power source, synchronously, and within a typical transfer time of **20msec**.

2.1. Power Inverter mode

HYDRA includes a load scanning circuit, in order to start operation only when the connected load is greater than the desired, as selected by the external **Starting Load** potentiometer. In this way the self consumption while idle, is practically eliminated. During the load scanning mode **(Scanning Load)**, short voltage pulses are produced at the output every **0.5sec**, and simultaneously the **Inverter led** blinks with the same rhythm, while the multi-message display remains inactive. As soon as a suitable load is detected, the inverter starts up delivering power at its output. If the load is removed, the inverter automatically returns to the scanning mode within **1sec**.

The output voltage waveform is a **pure sine wave.** This waveform, which is shown in the picture below, is suitable for all applications.



picture 2.1

The microcontroller continuously adjusts the duration of the output waveform in order to keep the effective output voltage **(Vout rms)** equal to **220Volt**. This is important in order to power the load with constant alternating current, independent from the battery voltage.

The inverter is designed to provide up to five times the nominal power, for a duration of 0.2 sec. The inverter shuts down when the output power exceeds 200% of the nominal power for more than 5 sec. These important power margins enable the inverter to start normally electric refrigerators, pumps, circulators, motors, or incandescent lamps, or other loads which necessitate 3 to 10 times their rated current to start. Additionally, ***HYDRA*** includes specialized power circuitry with the capability to absorb the returned energy from inductive or capacitive loads. This enables the inverter to power normally even highly reactive loads.

The operating software offers the user with simple and user friendly way, using a multiple message LED display and two push buttons (MENU and ENTER), full information and continuous control of the ***HYDRA*** operation, the state of the connected accumulators, of the connected alternating power source, of the load.

The microcontroller continuously monitors the state of the batteries, the internal and external temperature, the internal cooling system, the stability of the output voltage, and the load. In case of output short circuit it reacts instantly to protect the inverter as well as the load.

The microcontroller issues two levels of warnings and one level of errors for the above parameters.

The microcontroller warns in the first level the user, through coded visual and slowly varying audible messages **(Alarm - warnings)**, without interrupting the operation of the inverter, for any deviation from the usual operating limits of the following parameters:

- Temperature of the internal transformer **Tint.**
- Temperature of the power module **T2.**
- Output **Load.**
- Battery voltage **Vbat.**
- Effective output voltage in Volt rms **Vout.**

If the above parameters continue to deviate from their usual operating limits and are about to exceed their tolerated values, then second level warnings are issued, accompanied by fast varying audible signals.

If the problem persists for more than 5 seconds, then the inverter senses an **Error** and shuts down to protect the battery, the internal circuits, or the load.

After an automated shut down on **Error**, the inverter checks at regular time intervals all the operating parameters, and if the cause of the error is removed, or the parameter regained its acceptable operating limit (eg lower temperature), then the inverter restarts automatically its operation. If not, then the inverter repeats the above procedure after a programmable time interval **(restart time, Pr01)**.

Any error that caused an automated shut down is memorized and presented on the multi message display, with its own code number. Therefore the user can easily identify the error, even if the inverter automatically restarted after its removal.

ALARM				**Cause**					**ERROR**		
Code	First level warning	Second level warning	Alarm relay activation						**Code**	automatic restart	bypass activation
					Vcell	12V	24V	48V			
AL14	•			<	1.8V	10.8V	21.6V	43.2V			
AL13		•		<	1.58V	9.5V	19V	38V	Er10	•	•
AL16		•		>	2.85V	17.1V	34.2V	68.4V	Er19	•	•
AL36	•			Load > 130%							
AL37	•		•	Load > 180%							
AL38		•	•	Load > 200%					Er39	•	•
AL56	•			Tint > 85°C							
AL57		•		Tint > 105°C					Er59	•	•
AL66	•			T2 > 70°C							

AL67		•		T2 > 80°C	Er69	•	•
AL73		•	•	Vout < 180Vac	Er70	•	•
AL74	•		•	Vout < 190Vac			
AL76	•		•	Vout > 250Vac			
AL77		•	•	Vout > 260Vac	Er79	•	•
---				Output short circuit (Fault)	Er01		•
---				Presence of external ac voltage in the **output** of the **INVERTER** (during start up)	Er02		
---				Extremely high output load	Er03		•
---				Transient Max Idc - Very high transient output load	Er06		•
---				Continuous Max Idc - Very high continuous output load	Er07	•	•

Table 2.1 Alarms & Errors in INVERTER MODE

The ALARM relay is also activated when the battery voltage lies below **1.66 Volt/cell** for a duration of more than **5 sec**, or when *HYDRA* failed to start the external power generator.

In the case of error **Er02**, the inverter will **not** try to restart automatically, unless you switch off and on the main switch. However, it is highly recommended to **check again** your connections to *HYDRA,* **before restarting the system !**

In the following table we present the values of the battery voltage which correspond to the issued alarms for a 12, 24 , 48 and 60 Vdc system.

	Alarms	**per Cell**	**12 Volt**	**24 V**	**48 V**	**60 V**
Low battery limit	first level	1,8	10,8	21,6	43,2	54
	second level	1,58	9,5	19	38	47,4
High battery limit		2,85	17,1	34,2	68,4	85,5

Table 2.2

During the operation of the inverter, the user has the option to monitor in a successive and cyclic way, by pressing momentarily the **MENU** push button, the data of the following table. For some data we may visualize an additional information by pushing momentarily the Enter button :

pushing **MENU** button	**Primary displayed data**	pushing **ENTER** button	**Secondary displayed data**	
	Display or Function		**Display or Function**	**pushing steadily ENTER**
0	**Display off** Reduction by **100 mA** of the current consumption of *Hydra*	—	—	—
1	Effective value in **Volt rms** of the Inverter output **(Vout)**.	—	—	—
2	Load in **%** of the nominal one, actually connected to the inverter output **(Load)**.	Change to ↔	Current drawn from the battery in A dc	—
3	Voltage in **Volt dc** of the battery connected to Hydra (**Vbatt)**.	—	—	—
4	Temperature **Tint** of the power transformer **(°C)**.	—	—	—
5	Effective value in **Volt rms** of the input voltage provided by an external ac source **(Vline)**.	Change to ↔	frequency of the input voltage **(Vline)**.	—
6	Last **Alarm** code number. Valid actually in the system if **blinking**.	—	—	—
7	Last detected **Error** number. Valid actually in the system if **blinking**.	—	—	—
8	**'hour'**	Change to ↔	Estimation of the **Inverter** autonomy in hours, under the current load.	—
9	**'I–Ah'** Consumed Ah counter	Change to ↔	Energy in **Ahours** drawn from the battery	Zero counter
10	**'C–Ah'** Stored Ah counter	Change to ↔	Energy stored in the battery in **Ahours**, during the last charging mode.	Zero counter
11	**'SoC–'** **S**tate **o**f **C**harge	—	—	—
12	**'Ch–S' Standard** charging or **'Ch–E' Equalizing** charging	→	Selection between these two charging modes	—
13	**'bu–1'** Buzzer On or **'bu–0'** Buzzer Off	→	Selection or deselection of the activation of the **Buzzer,** in case of an **Alarm.**	—
14	**'dL–S' Standard** messages or **'dL–E' Extended** messages	→	Selection or deselection of the **Extended** message display	—

Table 2.3 Standard displayed messages

pushing **MENU** button	**Primary displayed data**	pushing **ENTER** button	**Secondary displayed data**	
	Display or Function		**Display or Function**	**pushing steadily ENTER**
15	Temperature **Tint** of the power transformer **(ºC)**.	—	—	—
16	Temperature **T2** of the power module **(ºC)**.	—	—	—
17	External temperature, used to sense the battery temperature for charging compensation **Text (ºC)**.	—	—	—
18	**' –UP– '**	Change to ↔	Peak voltage **Volt p** of the external ac power source **(Vpeak)**.	—
19	Manual control of the external power source **EP - I** or **EP - 0**	→	Activation **EP - I** or Deactivation **EP - 0**	—
20	Programming mode **Pro**	—	—	Enter the programming mode
21	**Time hh.mm**	→		Time of the day adjust
22	**Version** of the software	—	—	—

Table 2.4 Extended display messages

The Alarm or Error indication is blinking to identify an actually happening event, is stable when showing the last memorized event and is blank (--) when no event was detected since the last main switch starting of the system.

2.2 Charger Mode

HYDRA is also a three stage electronic lead acid battery charger, built around a high technology RISC microcontroller. The maximum charging current is continuously selectable by the user.

The operation starts with the main switch in the **ON** position, and the charging starts only if the batteries and a valid AC source are connected at the input terminals of Hydra.

The **charging current (Idc)** rises smoothly up to the selected charging current **(Iset),** which is set by the front panel potentiometer **Charge Rate (Iset).**

Hydra provides two charging modes, the standard and the equalizing, notified as **Ch-S** or **Ch-E**. The selection is done using the multi message display. The default charging mode is the standard one, Ch - S.

- The **Ch-S, Standard** charging mode implements the **IUoU** DIN characteristic, which has three discrete stages, namely the constant current, constant voltage and maintenance stage, notified in the multi message display as SoC 1, 2 or 3 respectively.
    1. **SoC-1**. The battery is charged with constant current, as selected by the Iset potentiometer. The battery voltage is allowed to gradually rise, until it reaches the selected value, programmed by the **Pr11** parameter, which automatically leads the charging process to the next stage.
    2. **SoC-2**. The battery is charged with constant voltage, as selected by the programmable **Pr11** parameter. The battery is allowed to gradually absorb less current, until the charging current reaches 10 % of the Iset value, which automatically leads the charging process to the next stage. The maximum allowed duration of the SoC-2 stage is limited to the programmable time set by the **Pr13** parameter. This guarantees the switch to the next stage even when an external load, or other functional parameters of the battery do not allow the limitation of the current to the expected value.
    3. **SoC-3** is the maintenance stage of charging, where the battery voltage is kept constant at **2,3 Volt** per cell.

The start of a new charging cycle is automatic, when the necessary conditions are met, as explained further in the text.

- The **Ch-E, Equalizing** charging mode implements the above three stage **IUoU** DIN characteristic, but with augmented transfer limits from one stage to another, and is mainly needed to equalize the density of the electrolyte among the cells. This charging mode is manually selectable by the user, at time intervals as required by the battery manufacturer.

    1. **SoC-1**. The battery is charged with constant current, as selected by the Iset potentiometer. The battery voltage is allowed to gradually rise, until it reaches the selected value, programmed by the **Pr12** parameter, which automatically leads the charging process to the next stage.

    2. **SoC-2**. The battery is charged with constant voltage, as selected by the programmable **Pr12** parameter. The switch to the next stage is automatically done when the maximum selected duration of the SoC-2

stage is reached. This duration is programmable and set by the **Pr14** parameter.

2. Soc-3 is the maintenance stage of charging, common to both charging modes, where the battery voltage is kept constant at **2,3 Volt** per cell.

In the table below are shown the **default** transfer limits between charging stages for the two charging methods, and for a 12, 24, 48, and 60 Volt battery, as well as per cell.

Battery voltage in Volt	Standard Charging SoC - 2	Equalizing charging SoC - 2	Standard and Equalizing charging SoC -3
12	15	15,5	13.8
24	30	31	27.6
48	60	62	55.2
60	75	77	69
per cell	2.5	2.583	2.3

Table 2.5

The above values are valid for a battery temperature of 25°C. When the provided temperature sensor **(Text)** is connected to the Hydra terminals, the microcontroller compensates the above values by a factor of **- 4mVolt per degree** and **per cell**.

The operating software offers the user in a simple and friendly way complete and continuous monitoring of the charging process and of the battery status. The microcontroller monitors continuously the charging current, the battery voltage, the dissipated temperature inside the charger and in the vicinity of the batteries, the internal cooling system, even the eventual battery failure, and issues two levels of warnings or alarms concerning the charging process. The first level of warning activates a slowly varying audible signal. The second level activates a fast varying audible signal, and warns the user that a forced interruption of the charging process will follow if within 5 sec the monitored variable does not regain an acceptable value. The forced interruption generates an **error** which is memorized for monitoring purposes. Any warning generates an **alarm** which is also memorized. Both messages can be displayed using the multi-purpose display, as follows:

ALARM				**Cause**					**ERROR**		
Code	First level warning	Second level warning	Alarm relay activation						**Code**	automatic restart	bypass activation
					Vcell	12V	24V	48V			
AL26		•		>	2.86V	17.2V	34.4V	68.8V	**Er29**	•	•
AL46		•		Current > 125%					**Er49**	•	•
AL56	•			Tint > 85°C							
AL57		•		Tint > 105°C					**Er59**	•	•
AL66	•			T2 > 70°C							
AL67		•		T2 > 80°C					**Er69**	•	•

Table 2.6 Alarms & Errors in CHARGER MODE

Additionally, the ALARM relay is activated when the battery voltage lies below **1.66 Volt/cell** for a duration of more than **5 sec**, or when Hydra fails to start the external generator **(FAIL),** as explained further in the text.

During the operation of the inverter, the user has the option to monitor in a successive and cyclic way, by pressing momentarily the **MENU** push button, the data of the following table. For some data we may visualize an additional information by pushing momentarily the Enter button :

pushing **MENU** button	**Primary displayed data**	pushing **ENTER** button	**Secondary displayed data**	
	Display or Function		**Display or Function**	**pushing steadily ENTER**
0	**Display off** Reduction by **100 mA** of the current consumption of *Hydra*	—	—	—
1	Charging current in A **Idc**	—	—	—
2	Selected maximum charging current in A **Iset**	—	—	—
3	Voltage in **Volt dc** of the battery (**Vbatt)**.	—	—	—
4	External temperature, used to sense the battery temperature for charging compensation **Text (°C)**	—	—	—
5	Effective value in **Volt rms** of the input voltage provided by an external ac source **(Vline)**.	Change to ↔	frequency of the input voltage in **Hz (Vline)**.	—
6	Last **Alarm** code number. Valid actually in the system if **blinking**.	—	—	—
7	Last detected **Error** number. Valid actually in the system if **blinking**.	—	—	—
8	**'I–Ah'** Consumed Ah counter	Change to ↔	Energy in **Ahours** drawn from the battery	Zero counter
9	**'C–Ah'** Stored Ah counter	Change to ↔	Energy stored in the battery in **Ahours**, during the last charging mode.	Zero counter
10	**"SoC1 or Soc2 or SoC3"** **S**tate **o**f **C**harge	Change to ↔	—	—
11	**'Ch–S' Standard** charging or **'Ch–E' Equalizing** charging	→	Selection between these two charging modes	—
12	**'bu–1'** Buzzer On or **'bu–0'** Buzzer Off	→	Selection or deselection of the activation of the **Buzzer,** in case of an **Alarm.**	—

13	**'dL–S' Standard** messages or **'dL–E' Extended** messages	→	Selection or deselection of the **Extended** message display	—

Table 2.7 Standard displayed messages

pushing **MENU** button	**Primary displayed data**	pushing **ENTER** button	**Secondary displayed data**	
	Display or Function		**Display or Function**	**pushing steadily ENTER**
14	Temperature **Tint** of the power transformer **(°C)**.	—	—	—
15	Temperature **T2** of the power module **(°C)**.	—	—	—
16	External temperature, used to sense the battery temperature for charging compensation **Text (°C)**.	—	—	—
17	**' –UP– '**	Change to ↔	Peak voltage **Volt p** of the external ac power source **(Vpeak)**.	—
18	**I AC**	Change to ↔	Load current in %	
19	Manual control of the external power source **EP - I** or **EP - 0**	→	Activation **EP - I** or Deactivation **EP - 0**	—
20	Programming mode **Pro**	—	—	Enter the programming mode
21	**Version** of the software	—	—	—

Table 2.8 Extended display messages

The Alarm or Error indication is blinking to identify an actually happening event, is stable when showing the last memorized event and is blank (--) when no event was detected since the last main switch starting of the system.

3. Programming mode.

HYDRA series products have internal non volatile EEPROM memory to store many operating parameters. This function allows the user to adapt **HYDRA** at his

own environment, providing very advanced operational flexibility and product adaptability to practical all (un)expected conditions.

For each programmable operational parameter there is a default, factory preset value, which fully satisfies most of the common installations.

The programming of the parameters is done using the multi message display and the two push buttons of the front panel, by observing the following steps:

1. By pressing the **MENU** push button we display the **'Pro'** message**.** By pressing steadily the **ENTER** push button we select the programming mode. **All other Hydra functions are interrupted during this mode**. We may alternatively enter the programming mode by pressing momentarily both MENU and ENTER push buttons shortly after an activation of the main ON/OFF switch.
2. By successively pressing the **MENU** button, we may display in a circular way all the programmable parameters, starting from parameter '**Pr00'** followed by **'Pr01'** and so on.
3. After displaying the desired parameter, we may monitor its current value by momentarily pressing the **ENTER** button.
4. By successively pressing the **ENTER,** button we may change its value within the allowed limits **(MIN , MAX)** as described in **table 3.1**
5. When the desired value is reached, a steady push of the **ENTER** button memorises the new selected value. The successful programming is acknowledged by a short audible signal and by a short blinking of the display. To skip to the next parameter we may press the MENU button at any time.
6. By repeating steps 2 to 5 we may program all the available parameters.
7. To exit the programming mode a restart of **HYDRA** using the main **ON/OFF** switch is necessary.

By displaying the **'dEFL'** message, last choice in the Programmable parameters, and selecting it through a steady press of the **ENTER** button, the user may regain and memorize the default factory preset values for all the parameters of Hydra.

	Parameter name	Parameter description	Min value	Factory preset value (default)	Max value
Pr00	Select230Vout	Selection of the output voltage	220Vac	220Vac	230Vac
Pr01	Frequency selection	Select 50 or 60 Hz	-	50 Hz	-
Pr02	Vline1HighLevel	Max acceptable voltage of the external power source	250Vrms	260Vrms	270Vrms
Pr03	Vline1LlowLevel	Min acceptable voltage of the external power source	120Vrms	150Vrms	170Vrms
Pr04	MaxVlinesDeviation	Max allowed line voltage deviation between phases in the case of a three phase charging system	5%	15%	30%
Pr05	BPSEnable	Refuse **(1)** the load bypass to the external power source when the battery voltage is higher than the value set in **Pr06,** or allow it **(0).**	-	0	-
Pr06	VbattBPSLevel	Low limit of the battery voltage for which a load bypass to the external power source is refused. (Must be activated by the Pr05 parameter)	1.66V/cell 10(12V) 19.9(24V) 39.8(48V) 49.8(60V)	1.83V/cell 11(12V) 22(24V) 43.9(48V) 54.9(60V)	1.99V/cell 12(12V) 24(24V) 48(48V) 60(60V)
Pr07	Restart_WaitTime	Time to wait before trying to restart	1min	2min	30min
Pr08	-	-	-	-	-
Pr09	-	-	-	-	-
Pr10	-	-	-	-	-
Pr11	Bcapacity	Battery capacity in **Ahours** **C= 5 Inominal inverter**	4C	C	C/12.5
Pr12	VhighLimit	Voltage limit to switch to SOC2 (Standard Mode)	2.43V/cell 14.6(12V) 29.16(24V)	2.5V/cell 15(12V) 30(24V)	2.58V/cell 15.48(12V) 31(24V)

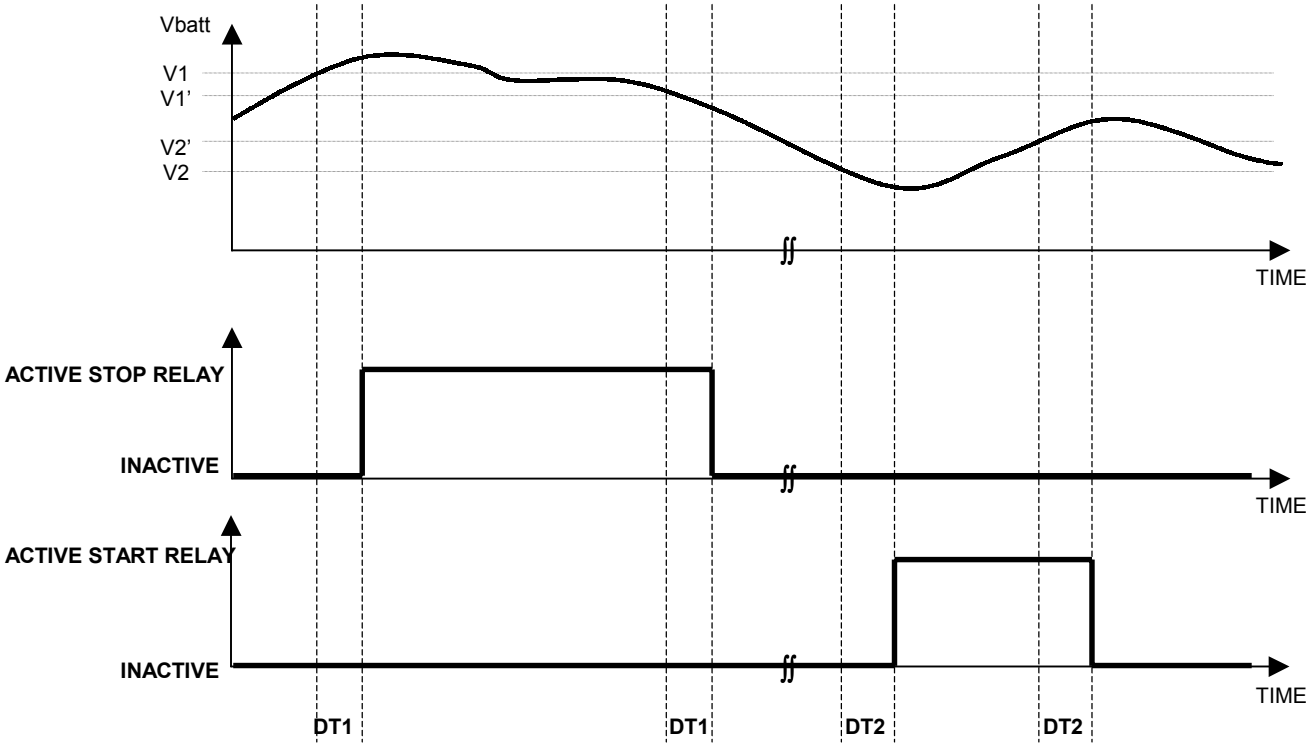
			58.32(48V) 72.9(60V)	60(48V) 75(60V)	61.9(48V) 77.4(60V)
Pr13	VupperLimit	Voltage limit to switch to SOC2 (Equalize Mode)	2.5V/cell 15(12V) 30(24V) 60(48V) 75(60V)	2.58V/cell 15.48(12V) 31(24V) 61.9(48V) 77.4(60V)	2.67V/cell 16(12V) 32(24V) 64.1(48V) 80.1(60V)
Pr14	SOC2SmaxTime	Max allowed time of the SOC2 stage when in Standard Mode	0.1Hours	2Hours	10Hours
Pr15	SOC2EmaxTime	Max allowed time of the SOC2 stage when in Equalize Mode	0.1Hours	2Hours	10Hours
Pr16	-	-	-	-	-
Pr17	-	-	-	-	-
Pr18	-	-	-	-	-
Pr19	-	-	-	-	-
Pr20	SGProfile	Selection of the external power generator remote control profile (0,1,2,3).	0	1	3
Pr21	EnableSGOnlyManual	Selection of **only** manual control of the external power generator **(1)** or also automatically by the Inverter **(0).**	-	0	-
Pr22	StartGen_VbattLimit	Low limit of the battery voltage below which the external power generator will automatically start (if allowed by **Pr21 = 0**).	1.66V/cell 10(12V) 19.9(24V) 39.8(48V) 49.8(60V)	1.73V/cell 10.38(12V) 20.76(24V) 41.52(48V) 51.9(60V)	1.83V/cell 11(12V) 22(24V) 43.9(48V) 54.9(60V)
Pr23	StartGen_MaxRetry	Maximum starting retries of the external power generator	1	5	10
Pr24	DisableOil_WaitTime	Time duration of the relay activation which stops the external power generator using a fuel choke (valid when profile **Pr20 = 1**).	10sec	90sec	180sec
Pr25	VbattStopR_Alevel	Max battery voltage beyong which the stop relay will be activated (valid when profile **Pr20 = 0**). **Solar charger control function - on**	2.41V/cell 14.46(12V) 28.92(24V) 57.84(48V) 72.3(60V)	2.58V/cell 15.48(12V) 30.96(24V) 61.92(48V) 77.4(60V)	2.75V/cell 16.5(12V) 33(24V) 66(48V) 82.5(60V)
Pr26	DVbattStopR_InALevel	Negative voltage hysterisis below the value of the **Pr25** parameter, below which the Stop Relay will be de-activated (valid when profile **Pr20 = 0**). **Solar charger control function - off**	42mV/cell 0.25(12V) 0.5(24V) 1(48V) 1.25(60V)	84mV/cell 0.5(12V) 1(24V) 2(48V) 2.5(60V)	168mV/cell 1(12V) 2(24V) 4(48V) 5(60V)
Pr27	DtimeStopRelay	Min allowed time between activation and de-activation of the Stop Relay (valid when profile **Pr20 = 0**).	2sec	10sec	60sec
Pr28	VbattStartR_Alevel	Low voltage limit of the battery below which the Start Relay will be activated (valid when profile **Pr20 = 0**).	1.66V/cell 10(12V) 19.9(24V) 39.8(48V) 49.8(60V	1.83V/cell 11(12V) 22(24V) 43.9(48V) 54.9(60V)	2V/cell 12(12V) 24(24V) 48(48V) 60(60V)
Pr29	DVbattStartR_InALevel	Positive voltage hysterisis above the value of the **Pr28** parameter, above which the Start Relay will be de-activated (valid when profile **Pr20 = 0**).	42mV/cell 0.25(12V) 0.5(24V) 1(48V) 1.25(60V)	84mV/cell 0.5(12V) 1(24V) 2(48V) 2.5(60V)	168mV/cell 1(12V) 2(24V) 4(48V) 5(60V)
Pr30	DtimeStartRelay	Min allowed time between activation and de-activation of the Start Relay (valid when profile **Pr20 = 0**).	2sec	10sec	60sec
Pr31	EnableGenMaxTime	Selection **(1)** or not **(0)** of a limited time operation of the external power generator		0	
Pr32	GenMaxTime	Max allowed operation time of the external power generator. (valid when **Pr31 = 1**).	0.1Hours	10Hours	25Hours
Pr33	Enable Gen start with timer	Enable the external generator according to the time of the day (0 or 1)		0	
Pr34	Start Gen time	The exact time to start the Gen (hh:mm)	00:00	8:00	23:00

Table 3.1

4. Functional description of the auxiliary START , STOP relays .

There are four idependent, programmable function profiles of the auxiliary START and STOP relays. The selection is done using the parameter **Pr20.**

4.1. Solar charger controller mode. Profile 0, parameter Pr20=0 : The system activates the **START , STOP** relays according to the battery voltage. The stop relay is used to implement the solar (or wind generator) charger control function, and the start relay to interface to existing automated diesel power generator controls, or to implement other automation functions. The system activates the relays while either in Inverter or Charger Mode.

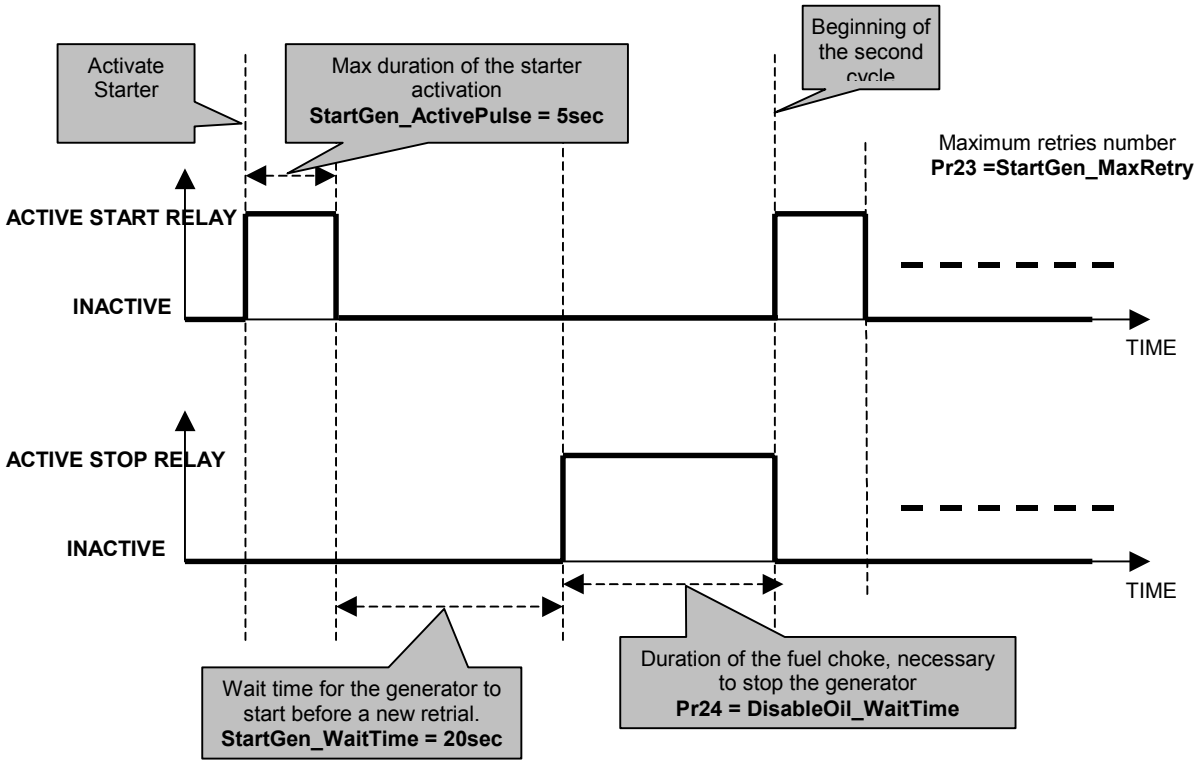


The battery voltage limits **(V1 , V1')** and **(V2 , V2')** as well as the time delays **DT1** and **DT2** are user programmable.
The upper limit **(V1),** above which the **Stop Relay** is activated is determined by parameter **25 (Pr25).** The low limit **(V1'),** below which the **Stop Relay** will be de-activated, is derived by subtracting the value **V1 (Pr25)** from the programmable parameter **DV1 (Pr26).** That is: **V1' = V1 – DV1.** The time delay to flip the Stop relay after a crossing of any limit, **DT1,** is also programmable, determined by the parameter **(Pr27).**

The low battery voltage limit **(V2),** below which the **Start Relay** will be activated**,** is determined by parameter **28 (Pr28).** The upper limit **(V2'),** beyong which the **Start Relay** will be de-activated, is derived by adding the value **V2** of the parameter **(Pr28)** to the value of the programmable parameter **DV2 (Pr29).** That is: **V2' = V2 + DV2.** The time delay to flip the Start relay after a crossing of any limit, **DT2,** is programmable, determined by the parameter **(Pr30).**

4.2. Diesel generator mode. Profile 1, parameter Pr20=1 : The **START** relay is used to activate the starter of the external power generator. The **STOP** relay is used to stop the generator by choking the fuel.

START GENERATOR PROCEDURE DESCRIPTION



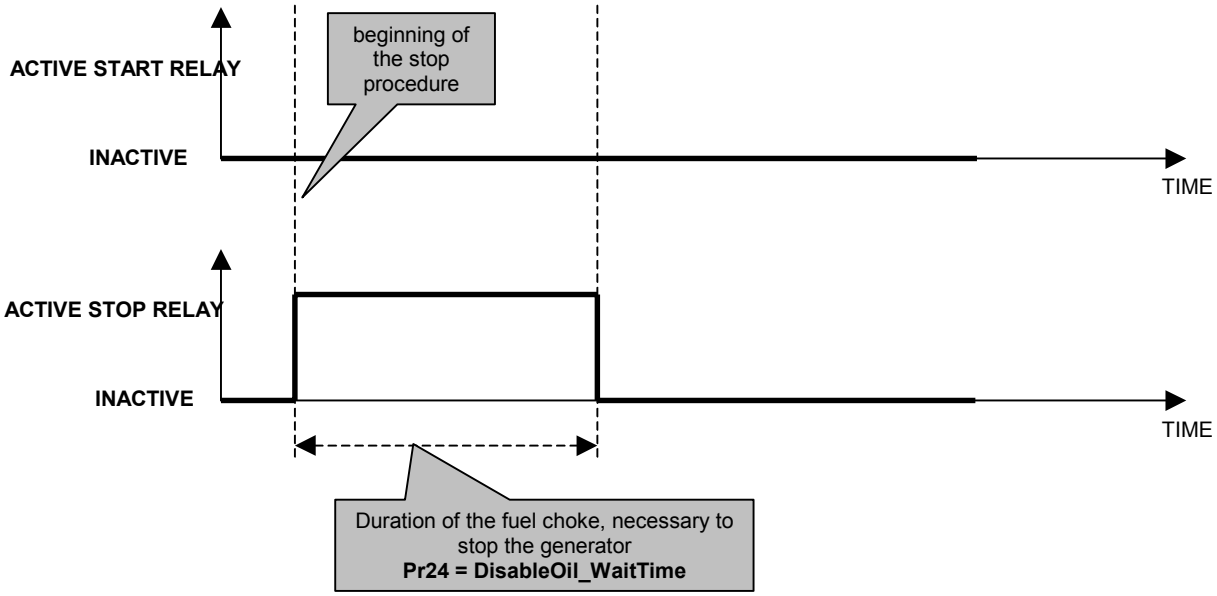
The generator starting procedure is initiated automatically or manually, only when the system is in **Inverter** mode**.**

To manually start the generator, we select the **'EP-0'** message, found in the **Extended Display** selections. The zero data indicates that no acceptable external ac source (**E**xternal **P**ower) is actually connected to the system. A one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We start the generator by pressing momentarily the ENTER button. The data value is set to 1, **'EP-1',** and the number one is blinking until the generator has properly started.

The generator starts automatically, if this profile is selected, when the battery voltage lyies below the programmed limit **StartGen_VbattLimit (Pr22)** for more than 10 consecutive seconds.

In both cases, the microcontroller performs a pre-programmed number of retries, until the generator starts. If the generator fails to start, this is signaled by activating the alarm relay and by setting X, (**'FAIL')** in the data field of the external power **'EP-X'**.

STOP GENERATOR PROCEDURE DESCRIPTION



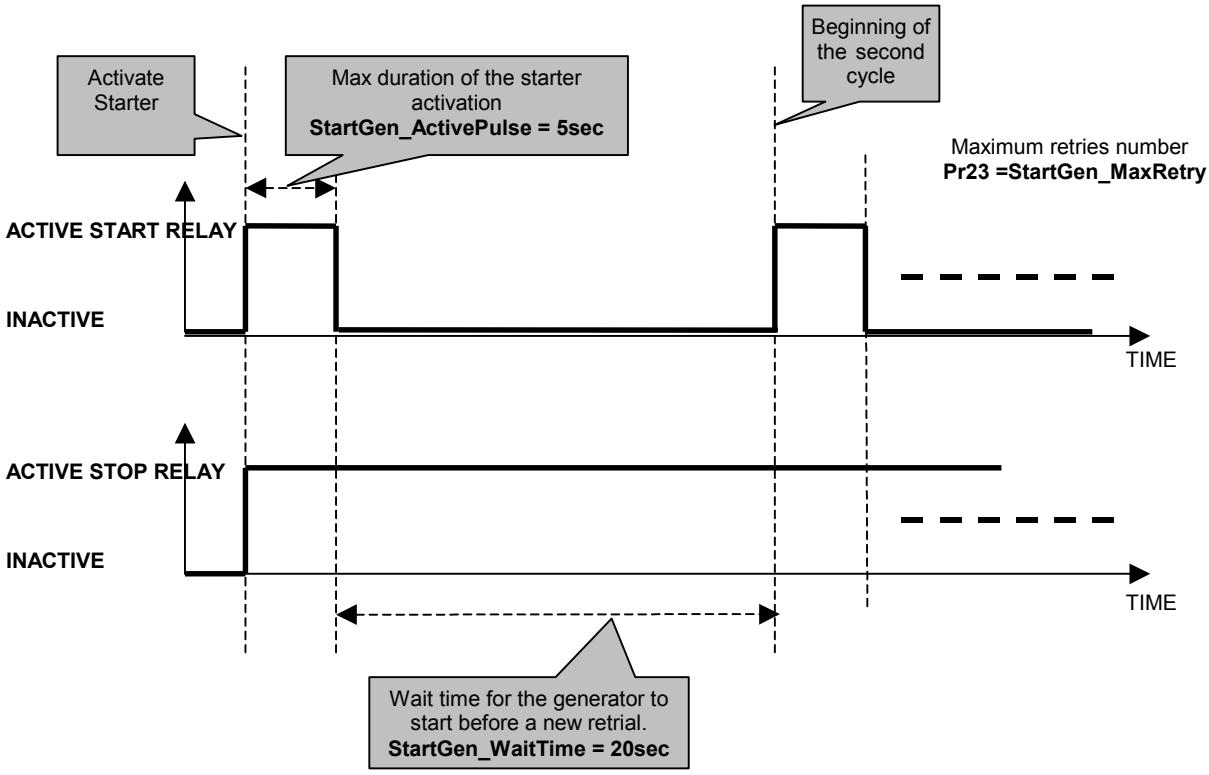
The stop generator procedure is manually or automatically initiated, only if the suystem is in **Charger Mode.**

To manually stop the generator, we select the **'EP-1'** message, found in the **Extended Display** selections. The one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We stop the generator by pressing momentarily the ENTER button. The data value is set to 0, **'EP-0',** and the zero is blinking until the generator stops.

The generator stops automatically, when this profile is selected, when the battery reaches the **SoC3** charging stage**.** If the generator fails to stop, then there will be continuous repetitions of the above stop procedure, with a delay of approximately 1 sec between them.

4.3. Diesel generator mode. Profile 2, parameter Pr20=2 : The **START** relay is used to activate the starter of the external power generator. The **STOP** relay is used to activate the electrical system of the generator

START GENERATOR PROCEDURE DESCRIPTION



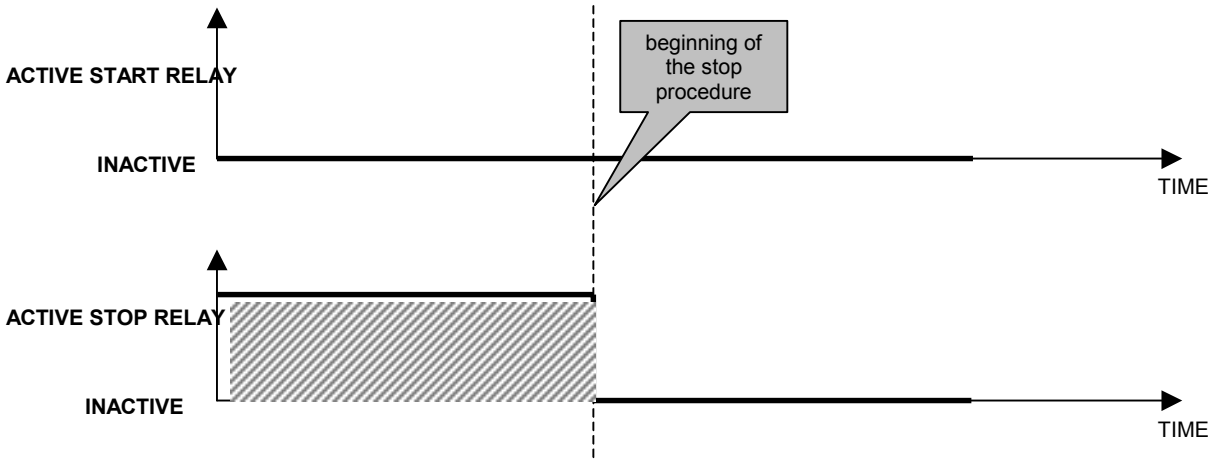
The generator starting procedure is initiated automatically or manually, only when the system is in **Inverter** mode**.**

To manually start the generator, we select the **'EP-0'** message, found in the **Extended Display** selections. The zero data indicates that no acceptable external ac source(**E**xternal **P**ower) is actually connected to the system. A one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We start the generator by pressing momentarily the ENTER button. The data value is set to 1, **'EP-1',** and the number one is blinking until the generator has properly started.

The generator starts automatically, is this profile is selected, when the battery voltage lyies below the programmed limit **StartGen_VbattLimit (Pr22)** for more than 10 consecutive seconds.

In both cases, the microcontroller performs a pre-programmed number of retries, until the generator starts. If the generator fails to start, this is signaled by activating the alarm relay and by setting X, (**'FAIL')** in the data field of the external power **'EP-X'**. Also, both start and stop relays remain inactive.

STOP GENERATOR PROCEDURE DESCRIPTION



The stop generator procedure is manually or automatically initiated, only if the suystem is in **Charger Mode.**

To manually stop the generator, we select the **'EP-1'** message, found in the **Extended Display** selections. The one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We stop the generator by pressing momentarily the ENTER button. The data value is set to 0, **'EP-0',** and the zero is blinking until the generator stops.

The generator stops automatically when the battery reaches the **SoC3** charging stage.

4.4. Diesel generator mode. Profile 3, parameter Pr20=3:

START GENERATOR PROCEDURE DESCRIPTION

The **START RELAY** is activated for **30 sec**.

The generator starting procedure is initiated automatically or manually, only when the system is in **Inverter** mode**.**

To manually start the generator, we select the **'EP-0'** message, found in the **Extended Display** selections. The zero data indicates that no acceptable external ac source(**E**xternal **P**ower) is actually connected to the system. A one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We start the generator by pressing momentarily the ENTER button. The data value is set to 1, **'EP-1',** and the number one is blinking until the generator has properly started.

The generator starts automatically when the battery voltage lyies below the programmed limit **StartGen_VbattLimit (Pr22)** for more than 10 consecutive seconds.
In the manual start, the system makes only one retry. In automatic start, the system will perform consecutive retries if the battery voltage lyies below the limit set by parameter **Pr22.**

STOP GENERATOR PROCEDURE DESCRIPTION

The **STOP RELAY** is activated for **30 sec**.

The stop generator procedure is manually or automatically initiated, only if the suystem is in **Charger Mode.**

To manually stop the generator, we select the **'EP-1'** message, found in the **Extended Display** selections. The one data value is set when the external power source is actually working and its voltage characteristics are acceptable. We stop the generator by pressing momentarily the ENTER button. The data value is set to 0, **'EP-0',** and the zero is blinking until the generator stops.

The generator stops automatically when the battery reaches the **SoC3** charging stage**.** If the generator fails to stop, then there will be continuous repetitions of the above stop procedure, with a delay of approximately 1 sec between them. In the manual stop the system makes only one retry.

5. Instructions for connecting *HYDRA* inverters / chargers

All the connections should be done while ***HYDRA*** is not functioning, using the best practice and according the following instructions. It is recommended to check periodically the tightening of the terminal connectors.

5.1. Connection with the battery.

The battery is connected to ***HYDRA*** using the provided cables, observing the correct polarity.

BLACK CABLE	CONNECT TO THE **NEGATIVE** BATTERY TERMINAL
RED LABELED CABLE	CONNECT TO THE **POSITIVE** BATTERY TERMINAL

A wrong connection will destroy the internal protection fuse. The replacement of this fuse is highly recommended to be done only by an authorized technician, and only with the same type and rating fuse. Hydra electronic circuits will not suffer from an inverse polarity connection.

ATTENTION TO THE CORRECT POLARITY

5.2. Connection with the load

These connections are to be done in the interior of ***HYDRA***, by removing the metallic cover which supports the feed-through hoses. The cover is attached to the case with four screws.

The load is connected to the terminals with the indication **OUT** as follows:

L	**Live**
N	**Neutral**
PE	**Protective Earth**

The largest accepted cable cross-section is 4 mm2

The ***HYDRA*** output is fully isolated from the battery terminals. The metallic case of ***HYDRA*** is connected to the protective earth terminal, according to the regulations.

5.3. Connection with the external power source

These connections are to be done in the interior of ***HYDRA***, by removing the metallic cover which supports the feed-through hoses. The cover is attached to the case with four screws.

The external alternating current power source, such as a power generator, or public grid, is connected to the **IN** terminals as follows:

L	**Live**
N	**Neutral**
PE	**Protective Earth**

The largest accepted cable cross-section is 4 mm2

5.4. Connection with the auxiliary relays.

These connections are to be done in the interior of ***HYDRA***, by removing the metallic cover which supports the feed-through hoses. The cover is attached to the case with four screws.

The signal relays, which provide voltage free contacts, are connected to the terminals with the indication **relay** as follows:

relay name	function	contacts	maximum current in A
ALARM	activation of an external or remote alarm	NO - normally open C - common NC - normally closed	8
START	activation of a power generator starter (see text)	NO - normally open C - common NC - normally closed	8
STOP	activation of the power generator, and solar charger control function (see text)	NO - normally open C - common NC - normally closed	8

Table 5.1 Auxiliary relays

- The external temperature sensor is attached to the RJ 45 terminal provided for.

ELECTRICAL SPECIFICATIONS

	HYDRA 24 – 800	HYDRA 24 – 1500	HYDRA 24 – 2400	HYDRA 24 – 3600
Output Voltage	220 / 230 Vac (true Rms) ± 2 Vac Programmable			
Output Frequency	50 Hz ± 0.1 Hz			
Nominal input Voltage	24 Vdc			
Allowed limits of the input Volt	19.8 to 34.2 Vdc			
Nominal power (100%) @ 20 °C	800 VA	1500 VA	2400 VA	3600VA
Overload capability @ 20 °C	130 % for 1/2 hour			
	200% with thermal limitation			
	500% for 0.2 sec			
Response time	<0.1 sec in extreme voltage steps			
Low battery voltage warning	21.6 Vdc,			
Low battery voltage cut-off	19 Vdc			
High battery voltage limit	34.2 Vdc			
Idle current – no load	0.28 A	0.4 A	0.5 A	0.6 A
Efficiency	94% max.	94% max.	94% max.	94% max
Cooling method	Forced air stream			
By-pass switch current capacity	15 A	20 A	20 A	20 A
Charging current	0 – 20 A	0 – 40 A	0 – 65 A	0 – 100 A
Acceptable power generator voltage limits	180 to 260 Vac			
Acceptable power generator frequency	43 to 57 Hz			
Refuse to connect external power generator if	>270 Vac < 170 to 120 Vac (programmable parameter)			
Dimensions H x W x D in cm	53 × 28 × 22			