DESCRIPTION | AUTOMATIC PANEL (AC-01)

GENERATING SETS PRAMAC POWER ENGINEERING STAR SERIES (>10kVA)

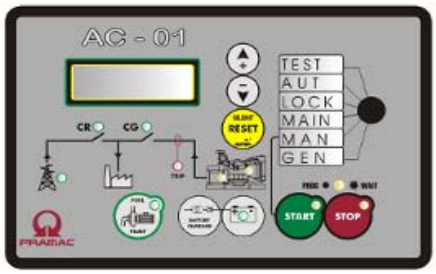


Fig. 1

Main features:

Automatic control panel for automatic starting of the Genset. The panel is provided with a control unit based on microprocessor mod. **AC-01** for control, monitoring and protection of the generating set. It also manages the change over switching Mains/Genset (when change over contactors are included): the load is transferred from Mains to Genset in case of Mains failure or voltage out of limits, and once the Mains voltage returns into the rated values, the load is transferred from Genset to Mains. All delays are programmable on the AC-01.

Fig.1: Control unit AC-01 with digital display for monitoring all parameters.

CONTINUOUS USE

The **ACP** panel can be used as manual panel for continuous running by means of both START/STOP push buttons and the selector switch positioned on MANUAL START mode.

STANDBY USE

There are two versions of control panel available for standby use:

○ **ACP + LTS**: complete with an Automatic Control Panel (ACP) completely integrated or mounted on the genset, and a Load Transfer Switch panel (LTS) built in a separated metal cabinet (supplied loose). The LTS panel is delivered with 5m of control cable.

○ **AMF**: single control panel complete with all devices for control, monitoring, protection, and change over contactors for the transferring of load. It is supplied loose from the genset for wall mounting. The AMF panel is delivered with 5m of control cable.

Below (fig. 2 and 3) are shown both versions of automatic control panel available for Standby use:

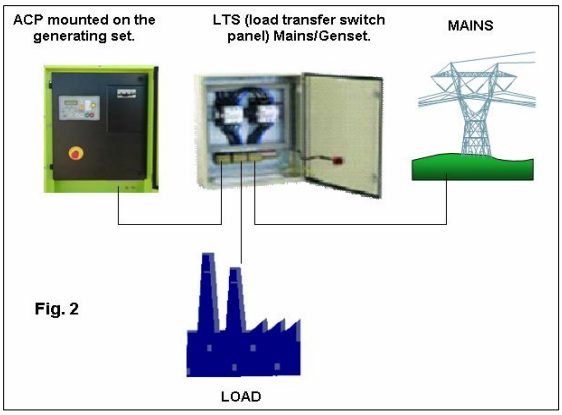


Fig. 2

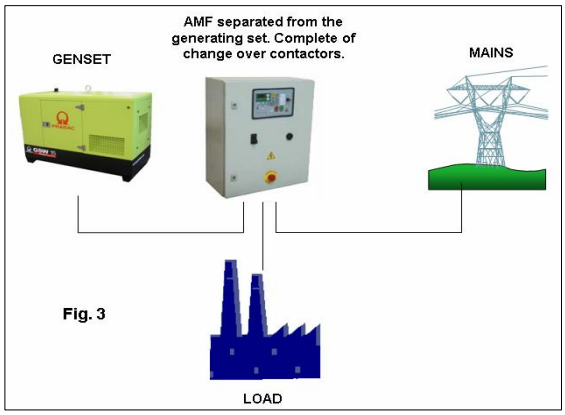


Fig. 3

System Operation:

The AC-01 (mounted on the front of the panel) shows continuously the Mains source voltage **(3 phases sensing)**; in case of Mains failure or voltage out of margin the AC-01 operates as follows:

1. Opening of the Mains contactor (mounted into the LTS or AMF panel).
2. Starting of the generating set and closing of the genset contactor (mounted into the LTS or AMF panel); since this moment on, the load is supplied by the generating set.
3. When the Mains is restored into the rated values, the AC-01 opens the Genset contactor (after an adjustable delay) and closes the Mains contactor; since this moment on, the power is supplied by the Mains source.
4. The Generating set keeps running for an adjustable period of time to cool down the engine.

MAIN COMPONENTS SUPPLIED WITH THE "ACP" PANEL:

- ► **CONTROL AND PROTECTION MODULE (AC-01).**
- ► **MAIN CIRCUIT BREAKER.**
- ► **EMERGENCY STOP BUTTON.**
- ► **AUTOMATIC BATTERY CHARGER.**
- ► **DIFFERENTIAL PROTECTION.**

MAIN COMPONENTS SUPPLIED WITH THE "AMF" PANEL:

- ► **CONTROL AND PROTECTION MODULE (AC-01).**
- ► **EMERGENCY STOP BUTTON.**
- ► **AUTOMATIC BATTERY CHARGER.**
- ► **CHANGE OVER CONTACTORS.**

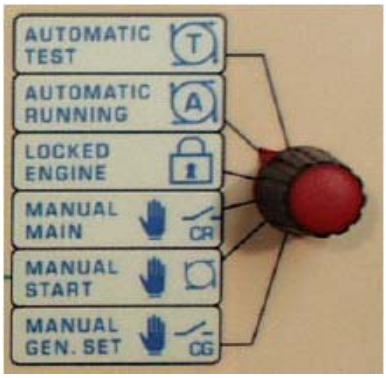
CONTROL AND PROTECTION MODULE (AC-01). Complete of:

- 6 positions selector switch for selection of the operation mode of the generating set.
- Manual start push-button.
- Manual stop push-button.
- Push-button reset/enter (unlock of acoustic alarm, programmation, reset).
- Up-down push-buttons for selection of the measurements reading on the display.
- Alphanumeric three-digital display for monitoring of parameters and description of alarms.
- Visual synoptic for the following indications by means of led's: CR (Mains contactor situation), CG (Genset contactor situation), Mains alive, Engine working, Generator working, Differential trip.
- Manual command for the automatic fuel pump.
- Indications by led's for: battery charger and battery state.

OPERATION MODE SELECTOR SWITCH

On the front of the AC-01 module there is a 6 positions selector switch to change the type of operating mode:

Automatic test: Automatic starting of the genset without desconnecting the Mains power supply from the utility. When the it switched again to AUTOMATIC position, the genset stops following a delay (1 minute approx.). In case of Mains failure during the running test, the logic system will carry out the load transfer switching by transferring the load from the Mains to the Genset. *Application: useful for periodic tests or running test for maintenance.*
Automatic running: when a Mains failure take place, the AC-01 disconnect the load by opening the CR (Mains contactor). If the genset does not run at the first attempt, other 4 attempts will follow the starting sequence. Once the genset is started, and 10 seconds after (approx.) the genset powers the utility by closing the CG (genset contactor). During the genset running, the AC-01 controls any anomaly, failure or alarm (shown on the display); in case of any failure, the genset will stop following the established steps. When the Mains source returns within the rated values, the load is switched back to Mains and the genset stops after a cooling down period (adjustable delay). *Application: common way of functioning.*
Locked engine: the genset stays in a blocked state, and every possibility of starting is dissabled when the Mains is powering the utility. This mode of operation is used to work on the system in complete safety even if there is a Mains failure. *Application: useful for maintenance works.*
Manual Mains: this mode enables a forced supply by the Mains by closing the CR (Mains contactor) even if there is a failure on commands or control electonic devices. *Application: useful for periods of time in which the genset remains disabled.*
Manual start: this mode enables the genset to be started and stopped manually by means of both START and STOP push-buttons. The position allows the direct command of the starting without interposition of electronic components, to warrant the operativeness of genset with electronics not in use too. *Application: useful for manual emergency controls, manual operation or maintenance purposes.*
Manual genset: this mode enables a forced supply by genset. *Application: useful for manual procedures or in case of problems with the automatic functions.*



MANUAL START/STOP PUSH-BUTTON

Once selected the "MANUAL START" position on the selector switch, both START and STOP manual push buttons are enabled to manage the running of the generating set manually by disabling the automatic start in case of Mains failre.

PUSH BUTTON SILENT RESET/ENTER

Used to reset the functions and to stop an alarm state (RESET). It is also used to confirm parameters related to programming works (ENTER). By pushing once the acoustic alarm gets disabled and the signalling alarm is enabled; pushing twice for RESET.

UP-DOWN PUSH BUTTONS

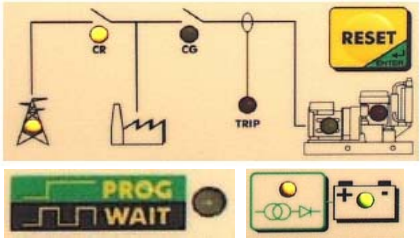
Display reading push button. Are used to select the reading page required and to programm the weekly timer as well. Another function obtained by these button is the DIFFERENTIAL TEST: with the selector switch in BLOCK position and pushing both +/- buttons during 2 seconds the TEST LED starts. If we push at the same time the RESET button, the differential protection is tested.

DIGITAL DISPLAY

Alphanumeric display for visualization of all parameters measured by the AC-01, and literal descriptions of the type of alarms. See the lists below for parameters and alarms.

SYNOPTIC FOR STATUS MONITORING

The visual synoptic shows the state of the plant by lighting the following LED's:
- Mains source tower: indication of power supplied by the Mains.
- CR: indication of Mains contactor closed.
- CG: indication of Genset contactor closed.
- Trip: indication of differential trip intervention.
- Generator: indication of power supplied by the Generator.
- Engine: indication of engine running.
- Battery: indication of AC-01 powered by the battery/ies.
- Battery charging: indication of battery/ies powered by the battery charger.
- Prog/Wait: indication of microprocessor in progress.



MANUAL COMMAND FOR AUTOMATIC FUEL PUMP

The AC-01 is provided as standard with an automatic command for an electric fuel transfer pump. When the led of this button is on, a manual command for the pump is enabled.

Measurements, alarms and shutdowns shown on display.

Parameters measured on display

- Mains status, volts, frequency and 1 phase amperes
- R-S-T Line Mains voltage.
- RN-SN-TN Mains star voltage.
- Three phases Mains current.
- kVA, kW and kVAr Mains powers.
- Mains power factor and frequency.
- Genset status, volts, frequency and 1 phase amperes.
- X-Y-Z Line Generator voltage.
- XN-YN-ZN Generator star voltage.
- Three phases Generator current.
- kVA, kW and kVAr Genset powers.
- Generator kWh.
- Generator power factor and frequency.
- Differential trip switch, programmed current, dispersion current and programmed time.
- Battery voltage and charging current.
- Status of the inputs.
- Status of the outputs.
- Start counter.
- Weekly timer to programm the automatic test.
- Operation active, automatic test, forced starting, pilot GE, etc.
- Supplier name and telephone number.
- Maintenance with programmed hours and working hours remaining before service.

Alarms with signalling (without shutdown).

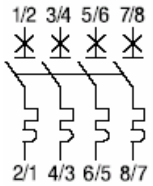
- Start failure.
- Stop failure.
- Minimum oil pressure (pre-alarm).
- Low water level.
- High water temperature (pre-alarm).
- Lack of fuel.
- Low fuel level (pre-alarm).
- Minimum temperature.
- High battery voltage.
- Low battery voltage.
- Generator phase sequence.
- Mains phase sequence.
- CR Mains contactor anomaly.
- CG Genset contactor anomaly.

Alarms with shutdown.

- Low oil pressure.
- High water temperature.
- Alternator battery charger.
- High generator voltage.
- Low generator voltage.
- Overload.
- Short-circuit.
- High generator frequency.
- Low generator frequency.
- Inverse power.
- Differential trip switch (earth failure).
- Mains overload.
- Emergency push button pressed.

MAIN CIRCUIT BREAKER.

Pramac Generating Sets **Series Star** are equipped with **GENERAL ELECTRIC** as standard on **MCP** and **ACP** panels. The main circuit breaker is used for protection against overloads and short-circuits.



On all the range **10A-125A** (In) of Generating Sets supplied by Pramac the circuit breakers follow the features below:

- 4 poles (from 10A to 63A) and 3 poles (from 80A to 125A).
- Automatic breaking.
- Fixed circuit breaker (type of construction).
- B breaking curve.
- Overload (thermal protection relays) not adjustable.
- Short-circuit (magnetic protection relays) not adjustable.
- Standard application rule: IEC 60898 (thermal-magnetic circuit breakers).

Circuit breaker model: EP & HTI

On all the range **160A-1.250A** (In) of Generating Sets supplied by Pramac the circuit breakers follow the features below:

- 3 Poles.
- Automatic breaking.
- Fixed circuit breaker (type of construction).
- B breaking curve.
- Overload (thermal protection relays) by adjustable thresold.
- Short-circuit (magnetic protection relays) by adjustable thresold.
- Standard application rule: IEC 60898 (thermal-magnetic circuit breakers).

Circuit breaker model: RECORD

NOTE: Pramac reserves all rights to change the thermal-magnetic circuit breakers by other brand with the same characteristics (**Bticino**) according with the availability of material.

EMERGENCY STOP BUTTON

Built on the panel by means of a mushroon red button for an easy and quick access. The machine is directly stopped though the emergency stop button by opening the generating set contactor.

AUTOMATIC BATTERY CHARGER

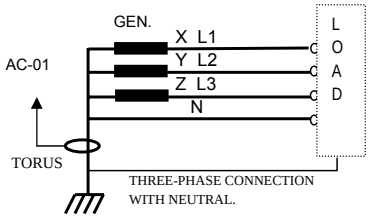
The battery charger is completely controlled by the microprocessor. It keeps the starting battery charged with a maximum load of 8A by means of a self-adjusted charging to compensate the consumption and avoid the discharge of the battery.
The voltage of the battery and the current as well can be shown on the display of the control unit AC-01.
The transformer is supplied for external fixation (inside the panel) to the AC-01.
The battery charger is equipped with:

- Automatic breaking of the charge during the cranking period and operation of the Genset.
- Electronic current restriction to avoid loads too high.
- Electronic voltage restriction to limit the maximum load levels.
- Protection against short-circuits.
- Protection against inverted polarity.
- Protection against high input voltage.
- Auto-programming of the voltmeter thresholds on the battery voltage.
- Protection against low battery voltage for excessive discharge.

DIFFERENTIAL PROTECTION (TRIP)

It is used as protection against direct contacts as long as there is any leakage of current to earth.
The differential relay is **integrated on the AC-01** together with a **control coil**, and it is able to show on display the following parameters: dispersion current programmed current and programmed delay.
The differential relay is compete with a **toroidal transformer** placed around the earth (connected to neutro) and wired to the differential relay for tripping in case of a leakage of current through the earth. The toroidal is also used to show everytime the values of outgoing and return currents.
The differential protection can be tested by pushing +/- buttons and REST at the same time.
Main features:

- Sensitive to sinusoidal waveforms, choked sinusoidal, pulse and pulses with continuous component up to 6mA.
- Operating frequency: 47 - 63 Hz.
- Tripping current ($I\Delta n$) programmable from 0,1 to 5A, or OFF (excluded).
- Tripping time programmable from 0,5 to 5 seconds.
- Instantaneous tripping within 60 msec.
- Adjustable to torus with 500/1-750/1-1000/1 shading coils, and with test wrapping.
- Reset by using the RESET push button if the leakage is less than 50% Δn.



CHANGE OVER CONTACTORS FOR LOAD SWITCHING

Change over contactors are supplied to allow the stand-by use (Emergency to Mains) of the Genset. In this case, and with the selector switch positioned on AUTOMATIC mode, the Genset is able to start automatically by Mains failure following the sequence detailed at the beginning of this document.
Pramac gives the availability of control panels for Emergency use equipped with change over contactors through 2 different types of panels:

► **LTS**: Load Transfer Switch panel. It must be ordered as an accessory for gensets with ACP control panel mounted. The LTS is delivered loose from the genset in a metal cabinet for wall mounting.

► **AMF**: Automatic Mains Failure panel. It must be ordered together with pre-wired gensets. The AMF panel is delivered loose from the genset in a metal cabinet for wall mounting.

Both LTS and AMF panels are provided with the following equipment to permit the transferring of load MAINS/GENSET and GENSET/MAINS:

- 4 Poles automatic change over contactors of proper capacity: AC-1 Amperes(IEC).
- Mechanic and electric interlock between Genset and Mains contactors.
- Internal plinth row for connection (control cables) between genset and LTS/AMF panel.
- Internal terminal box to connect (power cables): GENSET - LOAD - MAINS.
- 5 meters of control cable for connection between genset and LTS/AMF panel.
- Emergency stop button.

NOTE

The following equipment is not included on the standard scope of supply:

- Power cables from pre-wired genset to AMF panel.
- Power cables from ACP panel to LTS panel.
- Protection lines for Mains, utilization and auxiliary services.
- Current transformers (CT) for measurement from Mains.