

Be28 3-Phase ATS Controller OEM's Manual

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Warranty

Bernini Design SRL (hereinafter "BD") warrants that Be28 shall be free from defect in material or workmanship for a period of 3 years from the BD delivery date. BD shall, at its option, repair or replace the product without charge. BD shall return the Be28 to the buyer with the Default parameters at no extra charge. The buyer shall furnish sufficient information on any alleged defects in the product, so as to enable BD to determine their cause and existence. If the Be28 is not defective, or the product is defective for reason other than covered by this warranty, the buyer will be charged accordingly. This warranty shall not apply if the Be28 has not been used in accordance with the User Manual and other operating instruction, particularly if any defects are caused by misuse, improper repair attempts, negligence in use or handling.
This purchase is non-refundable.



This equipment complies with the EMC protection requirements

WARNING!! High voltage is present inside the Be28. To avoid electric-shock hazard, operating personnel must not remove the protective cover. The Be28 can start the engine at anytime. Do not work on equipment, which is controlled by the Be28. When servicing the engine, disconnect the battery and battery charger. We recommend that warning signs be placed on equipment indicating the above.

!! WARNING !! Relays and solenoids connected to the Be28 must be suppressed using flywheel diodes or suppression devices as indicated in section 15.0.

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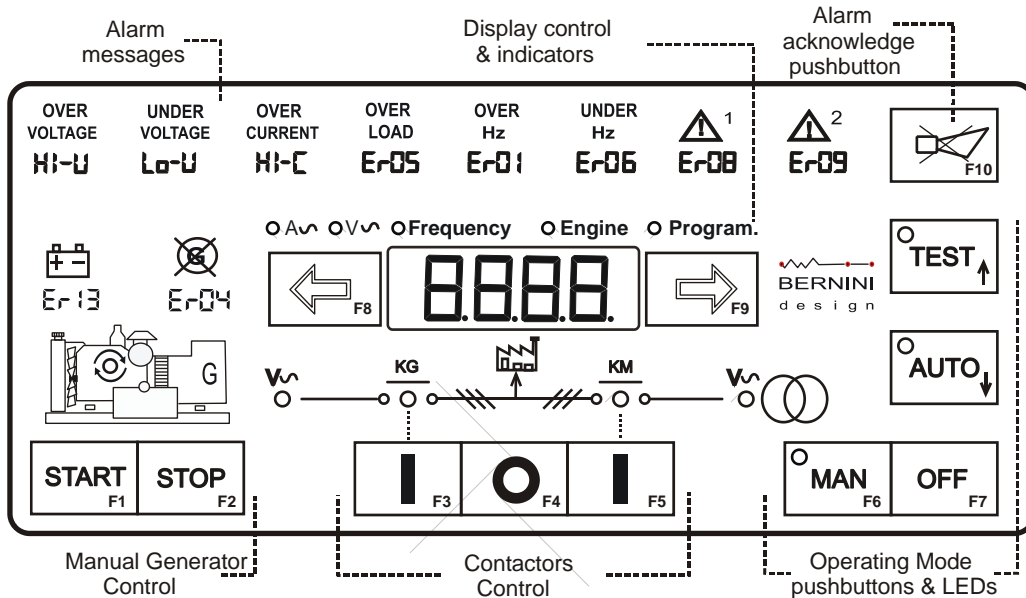
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Section 1.0 Introduction

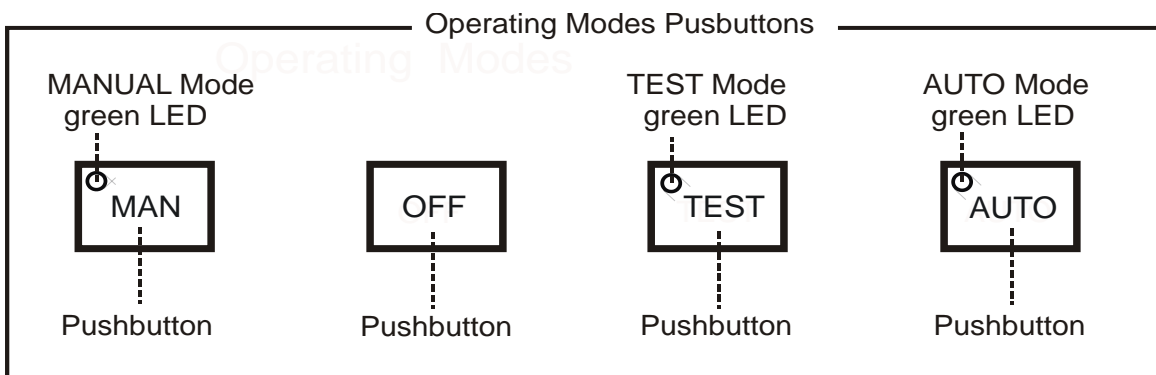
The Be28 integrates a 3-Phase Automatic Mains Failure (A.M.F.) module and an Automatic Transfer Switch controller. The Be28 monitors 3 phases (voltages and currents) of the generator. It provides indication by means of LEDs and Display for Alarms and status of the contactors. The Be28 features programmable parameters and complies with NFPA110 CAN/CSA-C282-M89 regulations. Be28 features a RS485 interface for remote control & monitoring. Figure 1 presents the panel layout.

Figure 1: Be28 Front Panel layout



Section 2.0 Selection of the mode of operation

The modes of operations are selected by pushbuttons and indicated by means of green LEDs:



Every time the power supply is switched on, the Be28 enters the "AUTO" mode, if the Be28 was in TEST or AUTO prior to power down. In the other cases, the Be28 will enter the OFF mode. The following table indicates the available modes of operation.

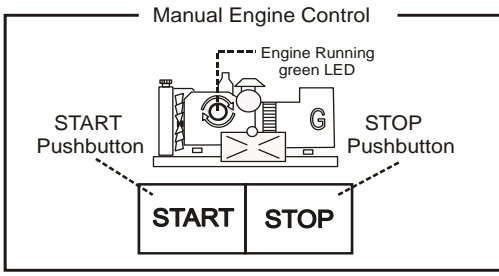
Mode of operation	Pushbutton	Indication	Section
OFF	[OFF]	Dot on display	2.1
MANUAL	[MAN]	Green LED on the button	2.2
AUTO	[AUTO]	Green LED on the button	2.3
TEST	[TEST]	Green LED on the button	2.4
PROGRAMMING	Combined action of buttons	The display shows [ProG]	6.0
CALIBRATION		The display shows [-CAL]	9.0
TROUBLESHOOTING		See section 10.0	

2.1 OFF mode

The OFF mode clears the fault alarms and allows you to read or program the parameters. The Display and LEDs are turned off and a dot on the display will blink slowly. Push one of the pushbuttons on the front panel to turn on the display.

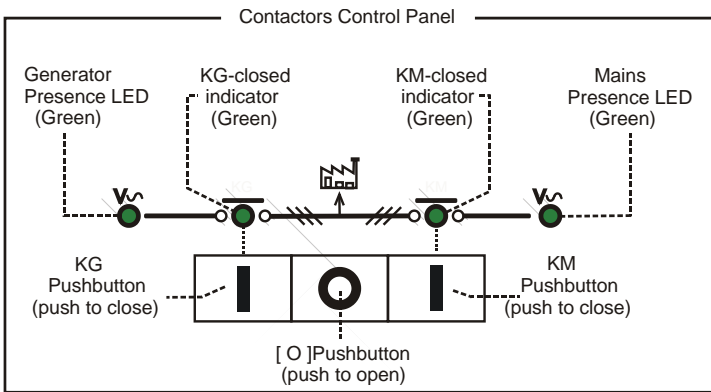
2.2 MANUAL mode

The MANUAL mode allows you to manually control the engine and Contactors.

Manual Engine Control	Instructions
	<p>Push the [MAN] pushbutton to select the MANUAL mode. Push the [START] pushbutton: the Be28 maintains the command to start the engine to controller of the engine for one minute. If the engine fails to start you can try to start again.</p> <p>When the engine is running, the green LED turns on. To stop the engine, push the [STOP] pushbutton until the [StOP] message appears on the display. If the engine has already stopped, it is possible to reset the STOP sequence by pressing the [STOP] pushbutton.</p>

2.2.1 Manual Contactor Control

To control the contactors follow the instructions:

Contactors Control Panel	Instructions
	<p>Select the MANUAL mode, start the engine (see above) and wait until the 'Generator Presence' green LED turns on.</p> <p>Push the [I] (KG) pushbuttons to close the contactor of the Generator. The alarms of Under/Over voltage and frequency are enabled if the Be28 works according to NFPA-110 (parameter P23=ON). To transfer the load to the Mains, push the [I] (KM) pushbutton (the [KG] will open). To open a contactor, push the [O] pushbutton. In manual mode the changeover timer is one second.</p>

2.3 AUTO mode

Push the [AUTO] pushbutton until the green LED will illuminate. The message [Auto] will appear for a second on display. The engine starts when the Be28 detects a Mains failure. The contactor of the MAINS (KM) opens after the [P.0] (Breaker) timing. Then the timer [P.01] takes palce to delay the start of the engine. Once started, after the warm-up ([P23]) time (Voltage and Frequency must be within the settings), the contactor of the GENERATOR (KG) will close. If the Mains restores, after the [P.02] the KG will open. The KM will close after a programmable changeover timing ([P.3]). The Engine will stop after a cooling down time ([P24]). If the engine shuts down, the KM closes independently of the Mains status if the [P.23] is [ON] (NFPA-110 mode), otherwise the KM will close only if the Mains is within the programmed settings. In AUTO mode, the Be28 can start and stop the engine according to programmed inputs (see Table 7.06 and 7.07).

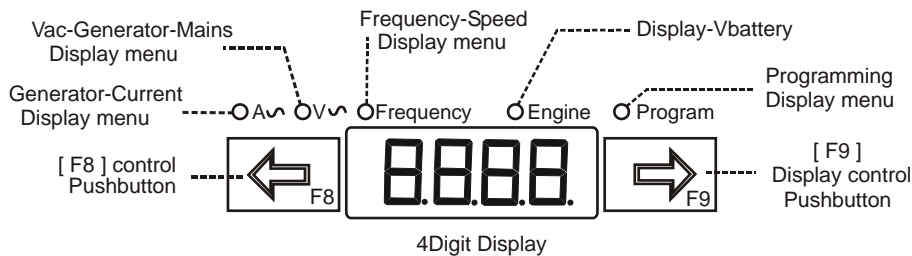
Note: the BE28 turns on the alarm [Er.11] (Fail to start) if the engine does not start within 8 minutes after the engine start request.

2.4 TEST mode

Push the [TEST] pushbutton until the green LED illuminates; the display will indicate the message [Test] for a second. The Be28 starts the engine and transfers the load to the generator if the [P.17] is [on]. To stop the engine, select the AUTO mode (if the Mains is present) or select the OFF mode. If you push the [STOP] pushbutton when the Be28 is in AUTO or TEST, the [Er.09] will energise. To clear the alarm, select the OFF mode (section 8.0).

Section 3.0 Display measurements

The Be28 features a 4 Digit display, two pushbuttons and 5 yellow LEDs as indicated below.



Use [←F8] and [F9→] to select a menu. Use [ACK-F10] (see the layout in section 1.0) to display the name of the parameter. The OFF mode shuts down the display and turns on the dot on the right side of it. Push a button to turn on the panel. The following table lists the functions of the display.

Display Function	Display indications (*)	Pushbutton(s)	Menu & Led indicator	
Current of the Generator (0 up to 999A). Phases L1-L2 & L3.	[A XXX][- XXX] [_XXX]	[←F8] or [F9→]	Aac menu	Yellow
	[A -G]	[ACK-F10]		
Voltage of the Generator (60V up to 600V). Phases L1-L2 & L3.	[GXXX] [-XXX] [_XXX]	[←F8] or [F9→]	Vac menu	Yellow
	[U -G]	[ACK-F10]		
Voltage of the Mains (60V up to 600V). If the Mains is simulated (see option [15] in table 7.07) the display will show the message [n-on]	[nXXX] (V R-S) [-XXX] (V S-T) [_XXX] (V T-R)	[←F8] or [F9→]	Hz/RPM menu	Yellow
	[U -n]	[ACK-F10]		
Generator Frequency (20Hz up to 70Hz)	[GXXX] Hz	[←F8] or [F9→]	Hz/RPM menu	Yellow
	[H - G]	[ACK-F10]		
Mains Frequency (20Hz up to 70Hz)	[nXXX] Hz	[←F8] or [F9→]	Hz/RPM menu	Yellow
	[H - n]	[ACK-F10]		
	[SPd]	[ACK-F10]		
Battery Voltage (5,5 Vdc up to 36Vdc)	[bXX.X] Vdc	[←F8] or [F9→]	Engine	Yellow
	[batt]	[ACK-F10]		
Voltage of the Charger Alternator (5,5 -36Vdc)	[cXX.X] Vdc	[←F8] or [F9→]		

(*)NOTE: X indicates a numerical digit, if the measurement is out of range, the display will indicate [- - -]

Section 4.0 Display messages

The Be28 shows alarms (table 4.10) and messages (table 4.20). The presence of an alarm is indicated by the blinking message [ALAr.]. Push the [→F9] pushbuttons to display the alarm. Push the [←F8] pushbutton to display additional information about alarm (section 8.0).

Table 4.10-A: Alarm messages (these messages are recorded in the 'Log Events' also. See 13.30)

Display Message	Description of the Alarm	Display Message	Description of the Alarm
[Er.01]	Over Frequency Shutdown	[Er.08]	Emergency Shutdown
[Er.04]	Alternator Failure Shutdown	[Er.09]	Emergency Shutdown from the Front Panel
[Er.05]	Overload warning	[Er.11]	The engine failed to start
[Er.06]	Under Frequency Shutdown	[Er. 13]	Battery Voltage Warning. Push [←F8] to display

Table 4.10-B: Alarm messages (these messages are recorded in the 'Log Events' also. See 13.30)

Display Message	Description of the Alarm	Display Message	Description of the Alarm
[Hi-C]	Over Current Shutdown or Warning	[InP.1]	Input 1 Shutdown / Warning (see 7.07)
[Hi-U]	Over Voltage Shutdown	[InP.2]	Input 2 Shutdown / Warning (see 7.07)
[Lo-U]	Under Voltage Shutdown	[InP.3]	Input 3 Shutdown / Warning (see 7.07)
[FAIL]	There is an internal failure or memory error in the Be28 controller (see 9.3)	[InP.4]	Input 4 Shutdown / Warning (see 7.07)

4.20 Operational messages

Message	Description	Message	Description
[. . .]	The Be28 is starting the engine	[ProG]	Program mode
[n-on]	MAINS Simulated. A programmable input simulates the presence of the Mains (see option [10] in the table 7.07).	[-CAL]	Calibration mode
		[- - -]	The measurement is not available.
[StoP]	The Be28 is stopping the engine	[tEst]	Test mode
[AUTO]	The message appears for one second when you enter the AUTO mode	[MAN]	The message appears for one second when you enter the MAN mode
[- P0]	This message appears when the Be28 counts the mains breaker timing (*)	[- P1]	This message appears when the Be28 counts the mains failure timing (*)
[- P2]	This message appears when the Be28 counts the mains restore timing (*)	(*) Push [ACK-F10] to display the status of the count down of the timer.	

Section 5.0 LED indicators

To test the LEDs and DISPLAY push the [OFF] pushbutton; the display turns off. Push and hold the [←F8] and [F9→] pushbuttons simultaneously. The LEDs and DISPLAYs remain tuned on as long as the pushbuttons are pressed and held together.

Section 6.0 Programming / Reading Parameters

To enter the Programming Mode, use the following instructions. Sections 6.40, 6.50 and 6.60 indicate how to use the password.

6.10 Enter the Programming Mode

- 1) - Provide a voltage battery supply *over 11.5V*. Push the [OFF] pushbutton to enter the OFF mode; the LEDs and display turn OFF and a dot on the right side of the display will start to blink.
- 2) - Push and hold the [F9→] and [ACK-F10] pushbuttons simultaneously, for about 5 seconds, until the yellow Led [h/Prog.] starts to blink. When the display indicates [ProG], release the buttons.
- 3) - If the Be28 is ***password protected*** (*), the messages [PASS] and [42.42] will appear in sequence; you are required to follow the instructions of Table 6.11. If the Be28 is ***not password protected***, the parameter [P.0] will be displayed and the Be28 is ready for programming (section 6.12, step-2).

(*) Note: the password consists of 2 groups of digits ranging from 0 to 99. Example: [12.34]; 12 is the 2-digit code on the left, and 34 is the 2-digit code on the right.

TABLE 6.11: Enter the PASSWORD

- 1) - Push [TEST] or [AUTO] in order to choose the proper code (between 00 and 99, except the code42).
- 2) - Push [F9] to select the 2 digits on the right side.
- 3) - Push [TEST] or [AUTO] in order to choose the proper code (between 00 and 99, except the code 42).
- 4) - Push [ACK-F10] to confirm the password; if the password is ok, the Be28 will indicate [P.0] and the unit is ready for programming. If the password is wrong, the display will indicate [4242] and you are required to insert a proper password.

If you loose the password, the unit must be returned for service.

6.12 Programming

- 1) - Enter the Programming mode (see section 6.10).
- 2) - Press the [←F8] or [F9→] pushbutton to select a parameter (see the list in section 7.0).
- 3) - To adjust the parameter, press [START-F1] and [TEST ↑] (or [AUTO ↓]) simultaneously.
(example: [P.10] = [500]; the Overvoltage limit is set to 500Volt. If you want to set 450, push and hold [START-F1] and [AUTO ↓] until the display will indicate 450)
- 4) - To adjust the sub-parameters (example the bypass time of Overvoltage), press [STOP-F2] and [TEST ↑] (or [AUTO ↓]) simultaneously (example: default of the sub-parameter [P.10] is [2"]; you can program it to 10 seconds)
- 5) - Press the [←F8] or [F9→] pushbutton to select another parameter.
- 6) - Follow the instructions of section 6.13 or 6.14 according to your needs.

6.13 Saving

Press and hold the [ACK-F10] and [F9→] pushbuttons simultaneously until the [SAVE] message appears (approximately 5 seconds); the Be28 saves the settings and will enter the OFF mode. After that, you can select an operational mode (section 2.0).

Note: if the memory fails, the message [FAIL] will appear. Try again to save or remove the power supply. If the message persists, the Be28 is damaged and should be returned to Bernini Design for repair.

6.14 Exit without Saving

Press the [OFF] pushbutton to enter the OFF mode without saving the parameters. You can select an operational mode as indicated in section 2.0.

6.20 Re-programming Default settings

The parameters of the Be28 are factory programmed with default settings (section 7.0). To restore them, enter the Programming Mode (section 6.10). When the message [P.0] appears, follow the instructions:

- 1) - Press and hold the [←F8] and [F9→] pushbuttons simultaneously until the display blinks twice. Select the option 2A or 2B according to your needs.

2A) - Press the [OFF] pushbutton to exit the procedure without saving the parameters.

2B) - Press and hold the [ACK-F10] and [F9→] pushbuttons simultaneously until the [SAVE] message appears (approximately 5 seconds); the Be28 saves the Defaults and the display will indicate [P0]. Push the [OFF] pushbutton in order to enter the OFF mode.

6.30 Reading the parameters

To read the setting of the parameters, follow the instructions:

- 1) - Press the [OFF] pushbutton until the LEDs and display turn OFF.
- 2) - Push the [←F8] or [F9→] pushbutton to select a parameter (section 7.0).
- 3) - Push [START-F1] to display the setting of the parameter (example: [P.10] = [450]; the Overvoltage limit is set to 450Volt).
- 4) - Push [STOP-F2] to display the setting of the sub-parameter (example: [P.10] = [2"]). The timing delay of Overvoltage is set to 2 seconds).
- 5) - Push the [←F8] or [F9→] pushbutton to select another parameter.

NOTE: if the pushbuttons remain inoperative for more than 5 minutes, the Be28 enters the OFF mode.

6.40 Activating the password

- 1) - Enter the programming mode as indicated in section 6.10.
- 2) - When the display shows [P.0], push the [ACK-F10] pushbutton for about 10 seconds until the display shows [PP.PP]. When the display indicates [4242], release the button. The two digits on the right will blink.
- 3) - Push [TEST] or [AUTO] in order to choose a code.
- 4) - Push [←F8] to select the 2 digits on the left side. Repeat step 3) in order to choose a code
- 5) - Press the [OFF] pushbutton if you want to exit the procedure without activating the password.
- 6) - Press and hold the [ACK-F10] and [F9→] pushbuttons simultaneously until the [SAVE] message appears ; the Be28 saves the password and remains in PROGRAM mode. To exit, push the OFF pushbutton. You can change the password when you want as indicated in the section 6.50.

6.50 Changing the password

- 1) - Enter the programming as indicated in section 6.10 and table 6.11. When the display indicates the parameter [P.0], push and hold the [ACK-F10] pushbutton for about 10 seconds until the message [PP.PP] and [4242] will appear. The two digits on the left side of the display will blink.
- 2) - Push [TEST] or [AUTO] in order to choose a code.
- 3) - Push [←F8] to select the 2 digits on the right side. Repeat step 3) in order to choose a code
- 4) - Press the [OFF] pushbutton if you want to exit the procedure without activating the password.
- 5) - Press and hold the [ACK-F10] and [F9→] pushbuttons simultaneously until the [SAVE] message appears (approximately 2 seconds); the Be28 saves the password and remains in PROGRAM mode. To exit, push the OFF pushbutton.

6.60 Removing the password

- 1) - Enter the programming mode as indicated in section 6.10 part 3 (you are required to use the old password).
- 2) - When the display indicates the parameter [P.0], push and hold the [ACK-F10] pushbutton, for about 10 seconds until the display will indicate in sequence [PP.PP] and [4242]. The two digits on the right side will start to blink. The code [4242] disables the use of the password. Follow step 3 of 4 according to your needs.
- 3) - Press the [OFF] pushbutton if you do not want to remove the password (you exit the procedure).
- 4) - Press and hold the [ACK-F10] and [F9→] pushbuttons simultaneously until the [SAVE] message appears (approximately 2 seconds); the Be28 saves the code [4242] that disables the password. The Be28 remains in PROGRAM mode. To exit, push the OFF pushbutton.

Section 7.0 Programmable Parameters

Table 7.01 - Mains Failure Control		Note: [xx "] = seconds, [xx '] = minutes, [xxh] = hours			
Parameter Code & Description		Default	Min	Max	Options
P.0	Mains Breaker control. If the Mains Failure persists for more than [P.0] (seconds or minutes), the Mains contactor will open and the [P.1] timer will start to count. The Mains contactor will close only after the [P.2] timing.	[5'']	0	59 mins	-
P.1	Mains Failure time. After the [P.0] timing (see above), the engine will start if the Mains Failure persists for the [P.1] time.	[5'']	0	23h	-
P.2	Mains Restore time. The Be28 transfers the Load to the Mains once the MAINS is stable for at least [P.2] (seconds, minutes or hours) . During [P.2] , the engine will continue to run ON-LOAD. After [P.2], the [P.20] timer will take place to run the engine OFF-LOAD (the contactor of the generator will open)	[5'']	0	23h	-
P.3	Contactors changeover. This timing introduces a delay between the switching of the contactors.	[2'']	0.1secs	15.0secs	-
P.4	Under voltage limit. If the Phase-to-Phase voltage falls under this limit, the [P.0] timer will energise.	[320]	60V	998V	[oFF]
P.5	Over voltage limit. If the Phase-to-Phase voltage rises above the limit, the [P.0] timer will energise.	[500]	60V	998V	[oFF]
P.6	Under Hz limit. If the Phase-to-Phase voltage falls under the limit, the [P.0] timer will energise.	[47.0]	20.0Hz	70.0Hz	[oFF]
P.7	Over Hz limit. If the Phase-to-Phase voltage rises above the limit, the [P.0] timer will energise.	[53.0]	20.0Hz	70.0Hz	[oFF]
P.8	Phase Selection. It allows 3-Phase or Single Phase control. The following options are available: [0] 3 Phase V Mains & 3 Phase V/C Generator (*) [1] 3 Phase V Mains & 1 Phase V/C Generator (*) [2] 1 Phase V Mains & 3 Phase V/C Generator (*) [3] 1 Phase V Mains & 1 Phase V/C Generator (*) See section 16.30 for details and connections	[0]	[0]	[3]	-
		(*) V/C means Voltages and Currents			

Table 7.02A - GENERATOR PARAMETERS		Note: [xx "] = seconds, [xx '] = minutes, [oFF] = disabled			
Parameter Code & Description		Default	Min	Max	Options
P.9	Under voltage (parameter)	[320]	60V	998V	[oFF]
	Under voltage delay (sub-parameter)	[6"]	1sec	15secs	-
P.10	Over voltage (parameter)	[500]	60V	998V	[oFF]
	Over voltage delay (sub-parameter)	[2"]	1sec	15secs	-

Table 7.02B - GENERATOR PARAMETERS Note: [xx "] = seconds, [xx '] = minutes, [oFF] = disabled					
Parameter Code & Description		Default	Min	Max	Options
P.11	Under Frequency (parameter)	[47.0]	20.0Hz	70.0Hz	[oFF]
	Under Frequency delay (sub-parameter)	[6"]	1sec	15secs	-
P.12	Over Frequency (parameter)	[53.0]	20.0Hz	70.0Hz	[oFF]
	Over Frequency delay (sub-parameter)	[1"]	1sec	15secs	-
P.13	Warning current limit (parameter)	[oFF]	10A	2000A	[oFF]
	Warning current delay (sub-parameter)	[1"]	1sec	15mins	-
P.14	Over current shut down (parameter)	[oFF]	10A	2000A	[oFF]
	Over current shut down delay	[1"]	1sec	15mins	-
P.15	Alternator failure options. The alarm [E04] energises if the voltage (or the frequency) is lower than the setting for more than 150 seconds.	[oFF]	-	-	[on] [oFF]
P.16	Alternator number of Poles. Options [2] or [4] allow you to display the engine speed.	[4]	2	4	-
P.17	Contactors Control in test mode. The option [off] inhibits the transfer of the load to the generator in TEST mode when the MAINS is present.	[oFF]	-	-	[on] [oFF]
P.18	CT size (/5Aac).	[500]	50A	1000A	-

Table 7.03 - ENGINE PARAMETERS Note: [xx "] = seconds, [xx '] = minutes, [oFF] = disabled					
Parameter Code & Description		Default	Min	Max	Options
(Note: P19/20/21/22 and P29/30/31/32/33/34 are not used)					
P.23	Engine Warm up time	[15"]	0	59mins	-
P.24	Engine Cooling time	[15"]	0	59mins	-
P.25	Stop Solenoid timing (Energized to stop)	[15"]	1sec	59mins	-
P.26	Crank termination setting (Charger Alternator parameter) see 13.20	[Off]	3.0V	30.0V	[oFF]
P.27	Crank termination setting (Generator Voltage)	[70]	60V	998V	[oFF]
P.28	Crank termination (GeneratorFrequency)	[25.0]	20.0Hz	70.0Hz	[oFF]

Table 7.04 - ALARM OPTIONS Note: [xx "] = seconds, [xx '] = minutes, [oFF] = disabled					
Parameter Code & Description (Note: P29/30/31/32/33/34, P36/37/39/40/41/42/43, Ser.1...3, P47 and P51 are not used)		Default	Min	Max	Options
P.35	Emergency contact type (Input #36). It generates the alarm [Er.08]	[n.c.]	-	-	[n.o. / n.c.]

Table 7.05 – Miscellaneous settings					
P.48	NFPA - 110 Level 1&2	[on]	-	-	[on]/[oFF]
P.49	RS485 Node Address	[1]	1	127	-
P.50	Horn timeout (see section 8.0). The option [oFF] disables the timeout.	[5"]	5secs	15mins	[oFF]

Table 7.06 - Programmable inputs (see options list in table 7.07)							
Parameter		Options	Default	Parameter		Options	Default
[InP.1]	Option	[0] - - - [28]	[2]	[InP.3]	Option	[0] - - - [28]	[11]
	Contact	[n.o.][n.c.]	[n.o.]		Contact type	[n.o.][n.c.]	[n.o.]
[InP.2]	Option	[0] - - - [28]	[13]	[InP.4]	Option	[0] - - - [28]	[15]
	Contact	[n.o.][n.c.]	[n.o.]		Contact type	[n.o.][n.c.]	[n.o.]

Table 7.07 - Input Options List			
Option		Option	
[0]	The setting '0' disables the input	[14]	Generator simulation ON
[1]	Immediate Stop	[15]	Mains Simulated ON
[2]	Bypass and Stop; it ignores the alarm during the Bypass time (15 seconds)	[16]	Front panel LEDs test
[3]	Cooling and Stop; it stops the engine after the cooling down time.	[17]	Horn silence
[4]	Bypass+Cooling and Stop; it ignores the alarm during the Bypass time (15 seconds) and stops the engine after the cooling down time.	[18]	Display Right Pushbutton
[5]	Warning only	[19]	Display Left Pushbutton
[6]	Bypass and Warning; it ignores the alarm during the Bypass time (15 seconds).	[20]	Overload Input Warning
[7]	Remote Manual Mode (^)	[21]	Overload Input Shutdown
[8]	Remote Auto Mode (^)	[22]	KG Forced closed
[9]	Remote Off Mode (^)	[23]	KM Forced closed
[10]	Remote Engine Test	[24]	KG LED Feedback
[11]	Remote Generator Test	[25]	KM LED Feedback
[12]	Not used	[26]	Not used
[13]	Remote LOCK	[27]	Manual START pushbutton
		[28]	Manual STOP pushbutton

(^) We recommend to use an 'AUTO-OFF-MAN' switch.

7.08 - Programmable Outputs						
Parameter Code & description		Default	Parameter Code & description		Default	Options
[Out.1]	Output 1 (External Horn)	[39]	[Out.3]	Output 3 (Be28 is in AUTO mode)	[54]	see 7.09
[Out.2]	Output 2 (Fail to Start)	[28]	[Out.4]	Output 4 (Presence of the Mains)	[41]	see 7.09

Table 7.09 – Output Options Table			
Option & description		Option & description	
[0]	The Output is disabled	[32]	Alarm form Input 2: Shutdown/Warning
[1]	Under Frequency Shutdown	[33]	Alarm form Input 3: Shutdown/Warning
[2]	Over Frequency Shutdown	[34]	Alarm form Input 4: Shutdown/Warning
[3]	Over Current Shutdown	[35]	Not used
[4]	Over Current Warning	[36]	Not used
[5]	Overload Warning or Shutdown (^^^)	[37]	Common of all alarms of the Alternator
[6]	Over Voltage Shutdown	[38]	Not used
[7]	Under Voltage Shutdown	[39]	Horn Output (See table 7.05 [P50])
[8]	Alternator Failure Shutdown	[40]	Not used
[9]	Not used	[41]	Presence of Nominal Mains Parameters
[10]	Not used	[42]	Mains Failure Timing
[11]	Not used	[43]	Mains Restore Timing
[12]	Not used	[44]	KG Status
[13]	Not used	[45]	KM Status
[14]	Not used	[46]	Not used
[15]	Low Battery Voltage Warning	[47]	Not used
[16]	High Battery Voltage Warning	[48]	Not used
[17]	Not used	[49]	Not used
[18]	Not used	[50]	Engine Running Status
[19]	Not used	[51]	Presence of Nominal Generator Voltage
[20]	Not used	[52]	Be28 in OFF MODE (Status)
[21]	Not used	[53]	Be28 in MANUAL MODE (Status)
[22]	Emergency Stop Shutdown (Er08)	[54]	Be28 in AUTO MODE (Status)
[23]	Stop Pushbutton Used in AUTO (Er09)	[55]	Be28 in TEST MODE (Status)
[24]	Maintenance SERVICE 1 (Er10)	[56]	Be28 in LOCK MODE (Status)
[25]	Not used	[57]	Not used
[26]	Not used	[58]	Cooling Timing
[27]	Not used	[59]	Warm up Timing
[28]	Fail to START Shutdown	[60]	Not used
[29]	Fail to STOP Alarm	[61]	Not used
[30]	Indication of Parameter Error warning	-	--
[31]	Alarm form Input 1: Shutdown/Warning	-	--

(^^^) If an input is configured with option [20] or [21] (see table 7.07)

Section 8.0 - Alarms, Warnings and Shutdowns

The Be28 features Shutdowns (the engine stops) and Warnings (the engine will continue to run) and provides:

- A)** - a general indication of alarm presence by means of the message [ALAr.] on the display
- B)** - 4 configurable outputs for specific alarm indication with programmable options (see 7.08 and 7.09)
- C)** - symbols on the front panel to indicate the alarms
- D)** - display messages indicating warnings and shutdowns (see Table 4.1)
- E)** - a pushbutton to silence the Horn ([ACK-F10]).
- F)** - a memory able to record 100 EVENTS (see section 13.30)

The terminal #6 (Output 1) is configured with option 39; you can connect a horn via a relay. To silence it, push the [ACK-F10] pushbutton or wait for the **[P.25]** to expire (see section 7.05). If you set **[P.25]** to **[OFF]** you disable the timeout; to silence the horn you have to push the [ACK-F10] pushbutton.

To browse the alarm memory push the [→F9] pushbutton. Push the [←F8] pushbutton to display details about the alarm. To clear the alarm from the panel, remove the cause of the alarm and then press the [OFF] pushbutton. The Table 4.10 in the section 4.0 indicates all alarms.

Section 9.0 - Calibration and Memory Reset

9.1 - Enter the calibration Follow the instructions.

- 1)** - Make sure the Battery voltage is over 11,5Vdc and select the MAN mode. Start the engine if you need to calibrate a parameter of the generator or,
- 2)** - Push and hold the [F9→] and [ACK-F10] pushbuttons simultaneously, for about 2 seconds, until the yellow Led [h/Prog.] starts to blink; release the buttons.
- 3)** - If the Be28 programming is password protected, the message [42.42] will appear; follow the instructions on the table 6.11. If the Be28 is not password protected, the parameter [n1.n2] will appear on the display and you can proceed as indicated in the section 12.2.

9.2 - Calibrating a measurement (Note: to exit the procedure push the [OFF] pushbutton at anytime)

- 1)** - Press the [←F8] or [F9→] pushbutton to select a 'Parameter' (see Table 9.2).
- 2)** - Press the [ACK-F10] pushbutton to display the reading of the measurement (example 395V).
- 3)** - Press the [TEST ↑] (or [AUTO ↓]) to adjust the reading according to an external reference (example 400V).
- 4)** - When finished, push the [ACK-F10] again to display the 'Parameter'. Select another 'Parameter' to calibrate by pushing the [←F8] or [F9→] pushbutton. When finished, you have 3 options: 5A, 5B or 5C.
- 5 A)** - Exit the procedure without saving by pushing the [OFF] pushbutton.
- 5 B)** - Restore the factory original calibration: press and hold the [←F8] and [F9→] pushbuttons simultaneously until the display will blink once. You are required to save the setting as indicated in step 5C).
- 5 C)** - Save the calibration: push and hold the [ACK] and [F9→] pushbuttons simultaneously until the [SaVe] message appears (approximately 5 seconds); the Be28 saves the calibrations, stops the engine if running and will enter the OFF mode.

Table 9-2: List of the Measurements

'Parameter'	Description	Unit	Recommended Calibration Range
[n1.n2] [n2.n3] [n1.n3]	Mains Voltage L1-L2.....	Volt	300 up to 400Vac
[FrEq]	Frequency (Mains/Generator)	Hz.	45 up to 55 Hz
[L1.L2]	Generator Voltage L1.L2	Volt	300 up to 400Vac
[C 1] [C 1] [C 1]	Generator Current	Amp	4 up to 5Aac (C.T. output)
[bAtt]	Battery voltage	Vdc	Voltage of the battery

9.3 - To clear the Memory

note: you are required to stop the engine before clearing the memory

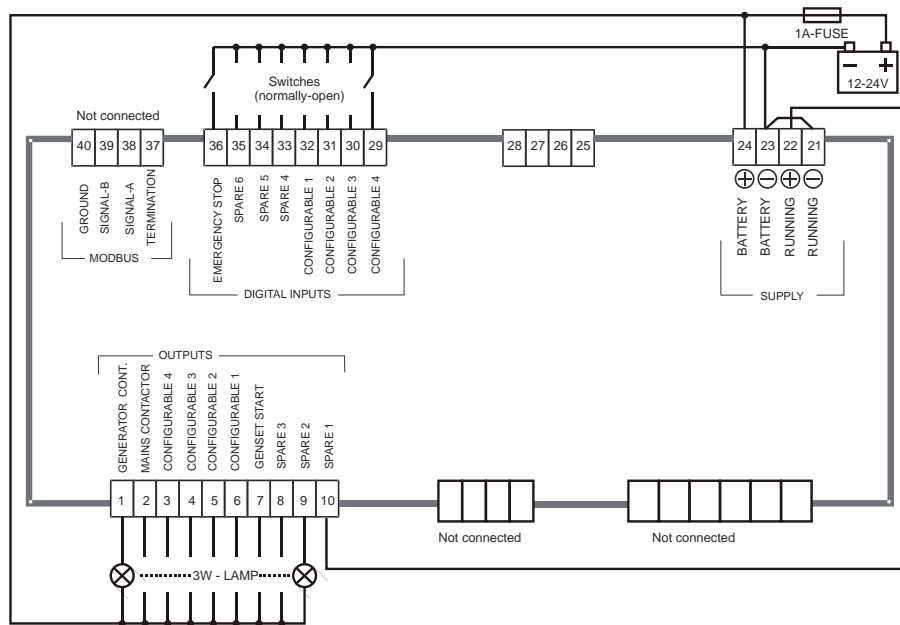
- Remove the supply. Push and hold [I-F3] & [I-F5] pushbuttons simultaneously and apply the Vdc supply; hold on the [I-F3] & [I-F5] pushbuttons until the message [F1] appears on display; release the buttons.
- Push [F1]...[F2] according to the message that appears on display.
- After pushing the last pushbutton [AUTO], the message [init] will appear. Wait at least one minute.
- Remove the supply and re-program the controller according to your need.

Section 10.0 Troubleshooting Guide

The Basic Troubleshooting Guide provides you with a guide to solve problems that you may experience with the Be28. We recommend that you disconnect the unit from the panel and set up the troubleshooting application circuit as indicated in section 10.1. This procedure should be carried out by qualified personnel only.

Section 10.1

Be28 3Phase-ATS Troubleshooting circuit



! WARNING! High voltage is present inside this instrument. To avoid electric-shock hazard, operating personnel must not remove the protective cover. Do not disconnect the grounding connection. Any interruption of the grounding connection can create an electric shock hazard. Before making external connections, always ground the Be28 first by connecting the control panel to ground.

Follow the instructions:

- A)** - Remove the battery power supply; disconnect all connectors
- B)** - Push and hold the [ACK-F10] pushbutton, apply the Vdc power supply; all LEDs and Display turn on.
- C)** - Release the button when you verified all indicators; the LEDs will turn off and the message [- - -] will be displayed.

NOTE - At this stage of the TEST, if the display indicates one of the codes contained in Table10.1 or 10.2, the Be28 is damaged and should be returned to Bernini Design.

10.1 Testing the Pushbuttons

A) - Push the pushbuttons on the front panel one by one. The display will show a message according to Table 10.1. As soon as you release all buttons, the message [- - -] will be displayed.

Table 10.1: Pushbuttons true table

Pushbutton	Display Code	Pushbutton	Display Code
[START-F1]	[F1]	[OFF-F7]	[F7]
[STOP-F2]	[F2]	[AUTO↓]	[auto]
[I-F3]	[F3]	[TEST↑]	[tESt]
[O-F4]	[F4]	[DISPLAY-F8]	[F8]
[I-F5]	[F5]	[DISPLAY-F9]	[F9]
[MAN-F6]	[F6]	[ACK-F10]	[F10]

10.2 Testing the Inputs

D) - Plug the input connector (#29 up to #36). Switch, one by one, to the battery minus, the inputs #29 to #36 . For each input, a code will be displayed according to Table 10.1. If more than one input are connected together (or some of them in short circuit), the display indicates the messages in sequence.

Table 10.1

Terminal number (function)	Display Code
#29 (Input 4)	[InP4]
#30 (Input 3)	[InP3]
#31 (Input 2)	[InP2]
#32 (Input 1)	[InP1]
#36 (EMERGENCY)	[EMER]

Table 10.3: Outputs true table

Pushbutton	Display Code	Terminal Output	Pushbutton	Display Code	Terminal Output
[START-F1]	[KG]	# 1	[OFF-F7]	[FUEL]	# 7
[STOP-F2]	[KM]	# 2	[DISPLAY-F8]	[StoP]	# 8
[I-F3]	[out 4]	# 3	[DISPLAY-F9]	[Star]	# 9
[O-F4]	[out 3]	# 4	[AUTO]	[-out]	NONE
[I-F5]	[out 2]	# 5	[TEST]	[-out]	NONE
[MAN-F6]	[out 1]	# 6	[ACK-F10]	[-out]	NONE

10.5 Testing the Measurements

If the above procedures indicated that the unit is failure free follow the instructions:

- A)** - Fit the Be28 into the panel and plug in all connectors. Program the unit if necessary.
- B)** - Turn on the Be28 and select the MANUAL mode.
- C)** - Verify the measurements of the Mains and V Battery (note 1)
- D)** - Start the engine and wait for the generator to stabilize.
- E)** - Verify the reading of the Voltage, Current and Frequency of the Generator (note 1)

Note 1: If the readings are within a +/- 3% tolerance, the Be28 is working well. You can increase the precision by using the calibration (see section 9.0). Vice versa if the reading are outside the +/- 3% tolerance, the Be28 is damaged and should be returned for service.

Section 11.0 General Specifications

Supply Voltage [*]:** 5.5Vdc to 36Vdc. **Protection:** internal 700mA thermal fuse. **Supply Current:** 50 mA up to 150mA

Dimensions: 224mm X 105mm X 68mm, **Panel Cut-out:** 190mm X 93mm, indoor operation
Operating Temperature range: -30 deg C up to +70 deg C. **Humidity Range:** 5% up to 95% non-condensing.
Weight: 560 gr., **Vibration:** 40mm/sec
General Design: 89/336 EEC, 89/392 EEC, 73/23 EEC, 93/68 EEC, IEC 68-2-6 **Certification:** CE

Static Outputs Characteristics [*]

Output Current: 300mA/100Vdc (internal AUTO-reset 700mA Fuse is provided). Logic: negative.

Mains and Generator Voltage Input

Nominal Voltage input: 70 Vac up to 600Vac
 Over voltage: 2KVac phase to neutral. Measurement precision: +/- 2% [**]. Input impedance: 2 Mega Ohm

Current Transformer Input

Size: 50/5Aac up to 1000/5Aac. Maximum Current: 8Aac for 10 seconds.
 Measurement precision: +/- 2% [**]. Internal resistance: 0.05 Ohm

Digital Inputs

Open circuit voltage: 10Vdc (12V supply) or 22Vdc (24V supply) - Closed circuit current: 15mAdc maximum.
 Trigger level: < 2Vdc.

[*] **NOTE: the sum of the total output current (# 1- # 10) may not exceed 2A at 70°C**

[**] **NOTE: errors can be reduced by using the calibration (section 9.0)**

[***] **NOTE: operations with memory (storing parameters, hours, etc) are allowed only if the Vdc is over 11.5V.**

Section 12.0 Software Upgrades & Revisions

Software Versions	Date	Description
1.00.4	Jan. 2013	Production version. First release

Section 13.0 Application Notes

13.10 - Single Phase operation

Program the parameter [P.8] with the proper option as indicated in section 7.01B. Connect the Mains to terminals 'R' (Phase) and 'S'(Neutral). Connect the Generator to terminals 'L1' (Phase) and 'L2'(Neutral). Connect the current transformer to terminals 'COM' and 'CT1'. Do not forget to set P4, P5, P9 and P10 (Over/Under Voltage settings) according to your needs.

13.20 – Crank termination, Engine running detect

The connection of the terminals 21/22 and programming of the parameter [P.26] are not mandatory, but they allow you to turn ON or OFF the green LED 'Engine running'. In other words you know if engine is running or not, even if Be28 panel is far away from the generator. The status of engine running is important information for Be28 in order to activate, if necessary, the alarm [Er.04] (Alternator failure).

13.30 LOG EVENTS

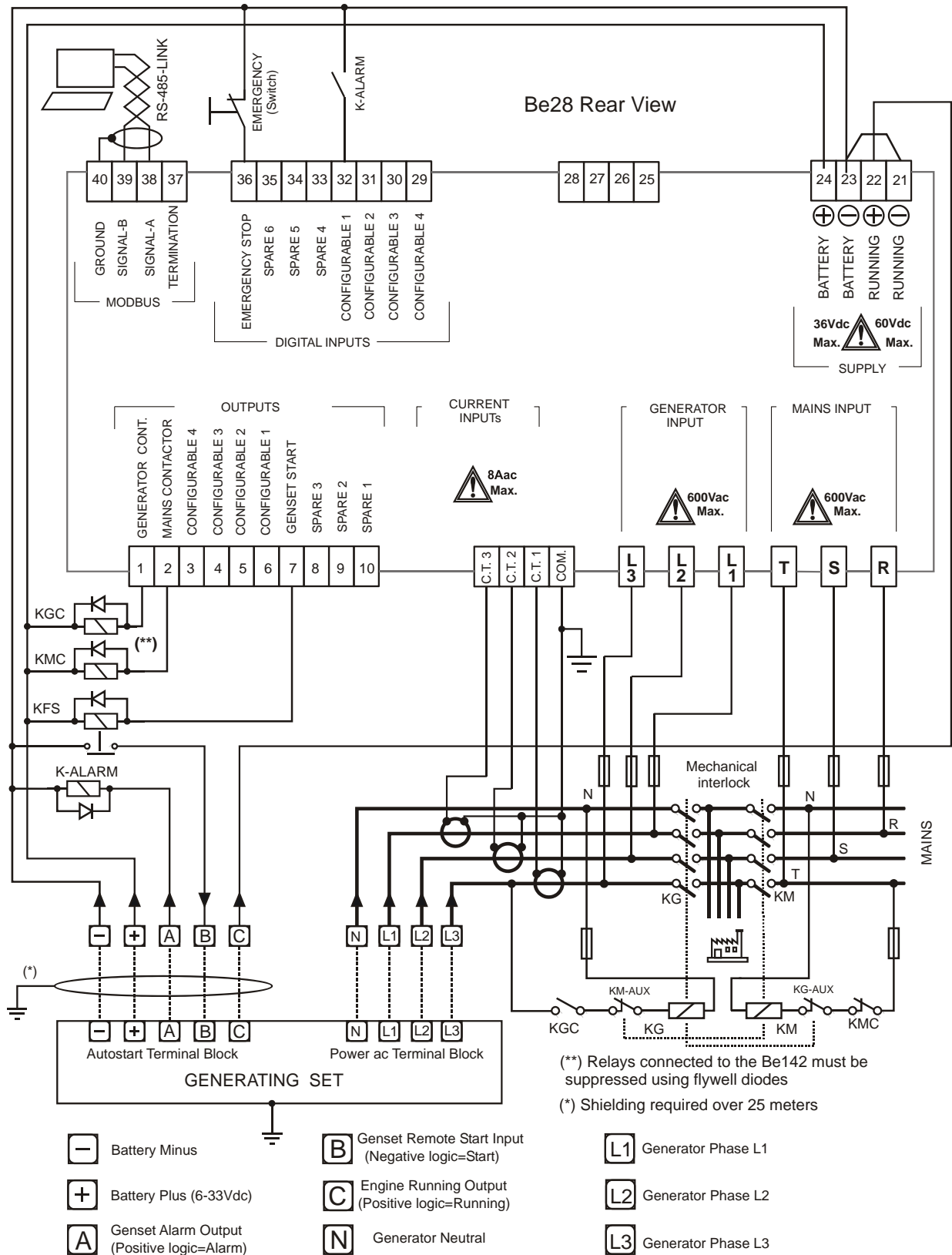
To have access to the LOG events follow the instructions:

- Push the [OFF] button.
- Push and hold the [STOP] button until the message [Hist.] appears on display (approx. 10 seconds).
- Release the [STOP] button.
- Using [←F8] and [F9→] you can browse the events E01 up to E100.
- Push the [STOP] button to display the code of the EVENT (see table 4.10). The message [---] indicates 'No Event' in the memory.
- To quit the LOG EVENTS push the [OFF] button.

Note: to cancel the LOG EVENTS push [←F8] and [F9→] simultaneously until the display blinks (approx. 10 seconds).

Section 14.0 Panel Builder Notes

Section 15.0: Typical application



Section 16.0: Connections description

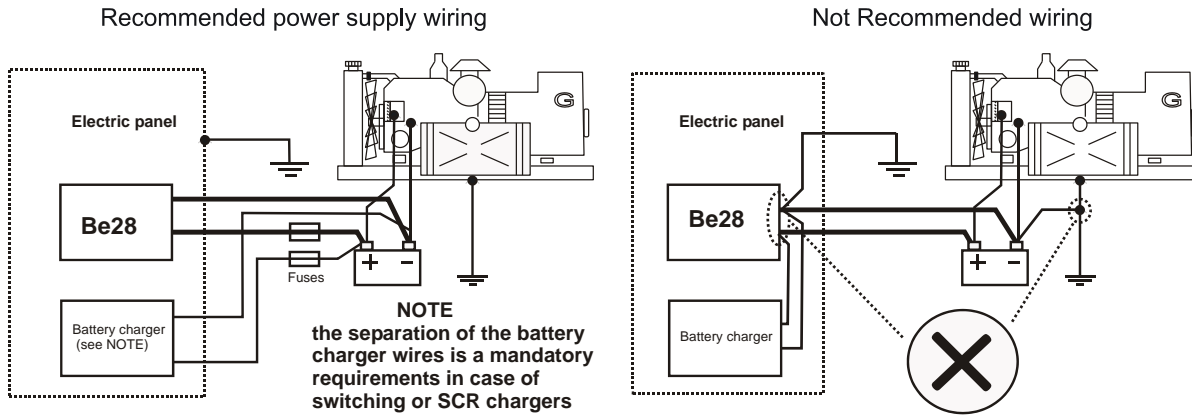
!! W A R N I N G !! Relays and solenoids connected to the Be28 must be suppressed using flywheel diodes or suppression devices as indicated in the wiring diagram.

Terminal	Description	Note
1	Generator Contactor driver output	300mA Active 'Low'
2	Mains Contactor driver output	
3	Programmable output '4'	
4	Programmable output '3'	
5	Programmable output '2'	
6	Programmable output '1'	
7	Genset Start output command	
8	Not used (Spare 3)	-
9	Not used (Spare 2)	-
10	Not used (Spare 1)	-
CTL3	Current Transformer 'L3' S1 input	5Aac nominal; Max 8Aac (the CT size is programmable from 50A up to 1000A)
CTL2	Current Transformer 'L2' S1 input	
CTL1	Current Transformer 'L1' S1 input	
COM	Current Transformer: all common S2	
GEN L3	Generator Voltage 'Phase L3' input	600Vac rated
GEN L2	Generator Voltage 'Phase L2' input	
GEN L1	Generator Voltage 'Phase L1' input	
MAINS T	Mains Voltage 'Phase T' input	
MAINS S	Mains Voltage 'Phase S' input	
MAINS R	Mains Voltage 'Phase R' input	
21	Engine Running Minus detect	Connect to ground
22	Engine Running Plus detect	D+ or W.L. sensing
23	Supply Battery minus connection	-
24	Supply +12 or +24V Battery connection (*)	Internal 700mA fuse
25 to 28	Not used	-
29	Programmable input Switch '4'	Active Low (<2Vdc)
30	Programmable input Switch '3'	
31	Programmable input Switch '2'	
32	Programmable input Switch '1'	
33	Not used (Spare 4)	
34	Not used (Spare 5)	
35	Not used (Spare 6)	
36	Emergency Stop Switch input	
37	RS485 Termination	See the specification of the RS485 standard
38	RS485 Signal A	
39	RS485 Signal B	
40	RS485 Common Ground	

!! W A R N I N G !! Relays and solenoids connected to the Be28 must be suppressed using flywheel diodes or suppression devices as indicated in section 15.0.

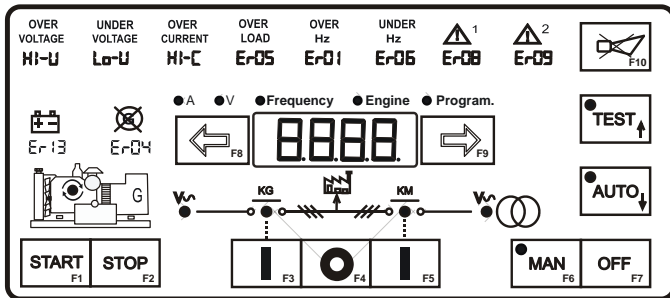
(*) NOTE We recommend that you connect a 2A Fuse (fast-blow type) in series to the terminal #24; it will protect the controller against large spikes on the power supply.

Section 17.0: Wiring recommendations



Section 18: Dimensions & Miscellaneous

Front view



Miscellaneous

Shipping Dimensions: 130x250x60mm

Shipping Weight: 560Gr.

Connectors: removable Plug & Socket

Rear view

