



7CH4Q107

MICROPROCESSOR FOUR QUADRANT CONTROLLER FOR PM DC MOTORS EXTERNAL PROGRAMMER



- USER'S GUIDE -



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INTRODUCTION

The controller 7CH4Q107 is a 4 quadrant chopper for PMDC motors powered by battery 24/36V for traction applications.

The chopper is equipped with a powerful microprocessor for digital control of the speed, current regulation and failures of the motor ; an efficient diagnostics of the failures and wrong wiring connections, programmability of the main parameters .

The MOSFET power stage is an "H bridge" configuration operating with PWM.

The ripple of the current is very low so the efficiency of the system is very high .

The chopper is designed in accordance with the most important EC standards.

FEATURES

POWER SUPPLY BATTERY	24 – 36 V
RATED CURRENT	30A
MAX CURRENT (Ta = 25°C)	120
FREQUENCY	16 KHz
MAX HEATSINK TEMPERATURE	90 °C
OPERATING TEMPERATURE	-10°C / 40°C
SPEED REFERENCE	Voltage (0,5-4,5Vdc) or potentiometer 1-10 KΩ
ON BOARD MAIN CONTACTOR	24V-80A CONTINUOS
REGENERATIVE BRAKING	
PARAMETERS PROGRAMMABLE	

<u>SAFETY:</u>	<ul style="list-style-type: none"> • OUTPUT SHORT CIRCUIT PROTECTION • MOSFET SHORT CIRCUIT PROTECTION • THERMAL PROTECTION • LOW VOLTAGE AND OVERVOLTAGE PROTECTION • REVERSE BATTERY PROTECTION • OVERCURRENT PROTECTION FUNCTION OF TEMPERATURE • POTENTIOMETER AND WIRINGS FAULT
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MECHANICAL DRAWING

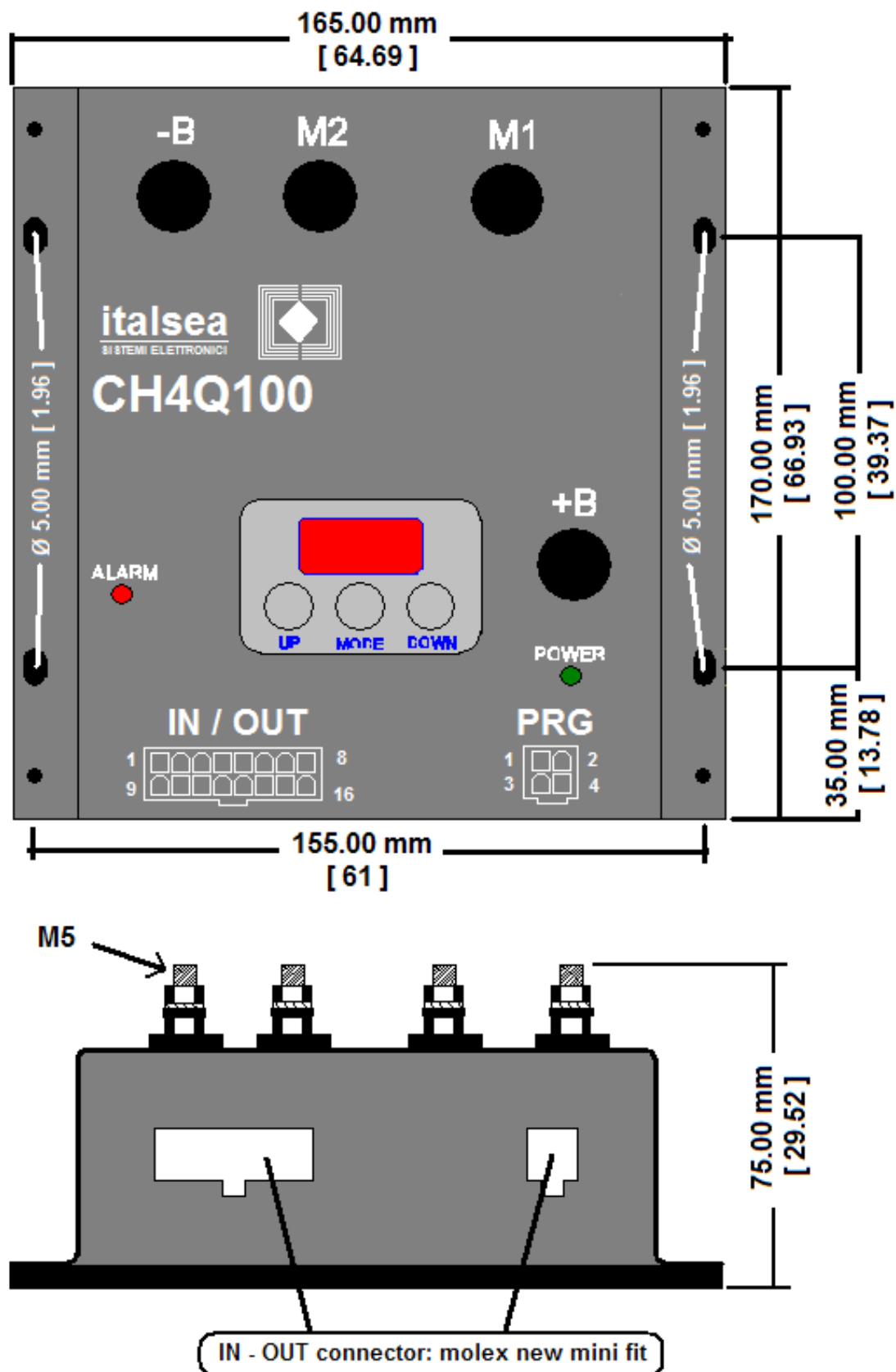


fig.1

INSTALLATION

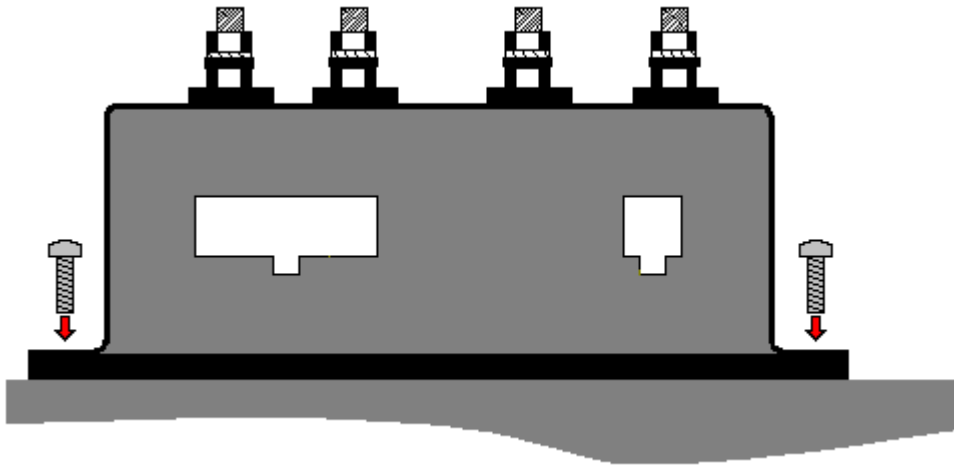


fig.2

Locate the chopper in a place protected against mechanical abuse, water and dirty.
Fix it with all the screws on a metal surface (aluminum if possible) to reduce the heat and so for longer period of work.

If during the standard operations the thermal protection is activated very often an additional heat-sink or fan is requested to assure longer periods of work.

I/O CONNECTOR

16v Molex connector (Molex p/n.39012160, contacts p/n.39000038)

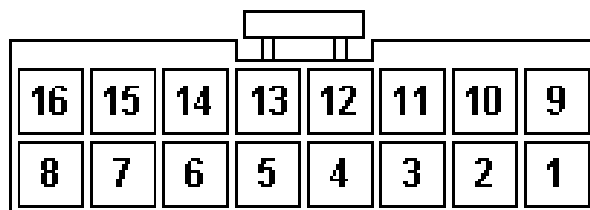


fig.4

Pin 1: HI -POT. INPUT

Positive Potentiometer Supply

Pin 2: C-POT.INPUT

Central Potentiometer, or Voltage (0,5-4,5Vdc) Speed Reference Input

Pin 3: LO-POT.INPUT

Negative Potentiometer Supply, or Gnd Voltage Speed Reference Input

Pin 4: Pin 2:V_MAX (OPTIONAL)

Max speed input potentiometer (>100 KΩ).

Pin 5: PUSH

Default N.O. input contact (+V_Batt/Pin14) for Backward safety. This input is active when close.

Pin 6: DISABLE

Default N.C. input contact. When the contact is open the controller will decelerate (Neutral Ramp) , will check if the motor voltage is near zero (motor stopped) and after the electro-brake delay will inhibit the motor : appear the alarm A12 (to reset switch-off and on again the key). If the contact will be close before the motor stop, the machine will restart at the desired speed.

Pin 7: ELECTROBRAKE COIL (-)

Output active low 2 Amps max (short circuit protected) and internal diode.

Pin 8: ELECTROBRAKE / HORN COIL (+)

Common +V battery for electro-brake and horn coils.

Pin 9: HORN (-)

Output active low (close to -Battery) for the horn or light backward direction (2 Amps max, short circuit protected, and internal diode).

Pin 10: ALARM

Connection for the diagnostic Blinking Led indicator (5Vdc-10mA) output : the number of blinks means the alarm type (example 5 blinks means Alarm 5).

Pin 11: MODE 1

Default N.O. input to +V battery.

Pin 12: FORWARD SWITCH

N.O. input to +V battery.

Pin 13: BACKWARD SWITCH

N.O. input to +V battery.

Pin 14: COMMON HIGH

+V battery output for switches.

Pin 15: KEY IN

Key switch input (+V battery).

Pin 16: HOURMETER

Hour-meter output (+V battery when running, 100mA max).

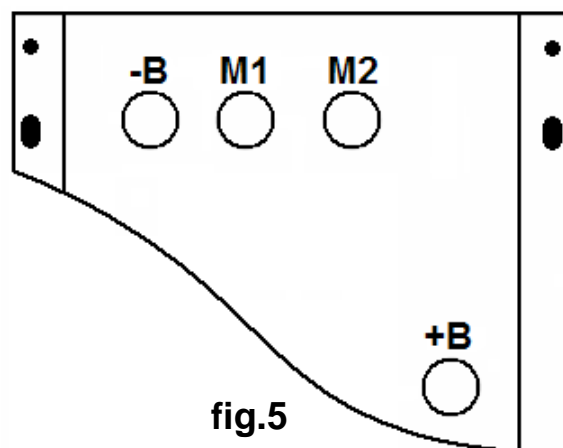
4v Molex connector (Molex p/n.3901240, contacts p/n. 39000038)

Used for handheld programmer

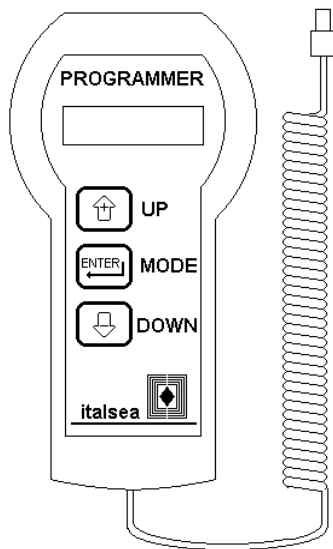
M5 power screws (M5)

- + B:** Positive DC power supply input,
- B:** Negative DC power supply input,
- M1:** Positive Motor output
(*in forward direction*),
- M2:** Negative Motor output
(*in forward direction*)

- F1:** Power fuse 150A.
- F2:** Fuse 10A.



7PROGLCD HANDHELD PROGRAMMER:



LCD 16X2:

Displays parameters, alarms and measures (description and value).

UP Key:

Rolls up parameters and increases values.

MODE Key:

Confirms a selection and the change of value.

DOWN Key:

Rolls down parameters and decreases values.

fig.8

At power-on, handheld programmer displays the “Tester Mode” page. In this pages , you’ll find the motor current and voltage, speed reference input, internal aluminum heat-sink temperature, battery voltage, hour-meter and software release.

To start the programming function push the button “MODE” .Will appear the first parameter; pushing the “UP” button the number of the parameter will be increased and with the “DOWN” button the number will be decreased. When a parameter is selected , push the button “MODE” to enter in the change menu, change the value with the buttons “UP” and “DOWN”, then confirm the parameter with the button “MODE”. To return to the TESTER menu push together the buttons “MODE “and “UP”, or wait few seconds.

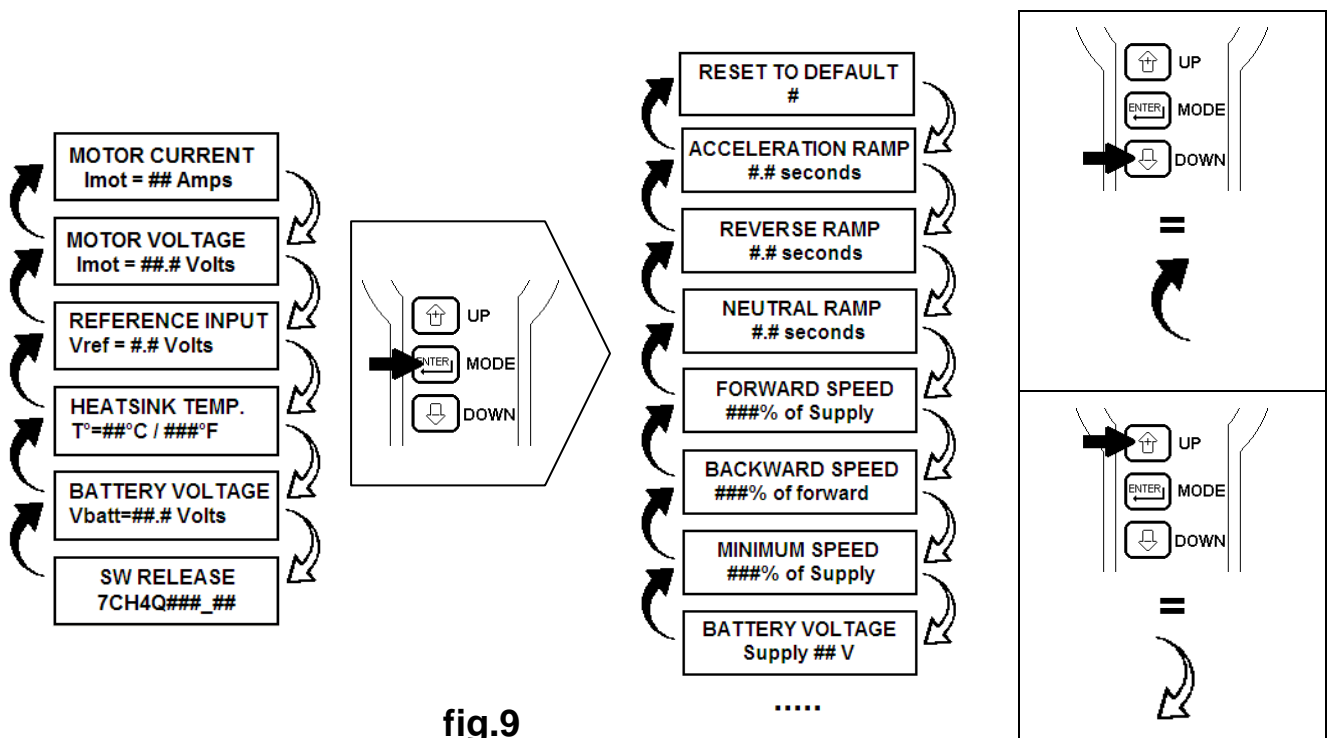


fig.9

HANDHELD TESTER MODE**MOTOR CURRENT**
I_{mot}= ## Amps

Motor current measure (measure unit=Amperes).

MOTOR VOLTAGE
V_{mot} = ##.# Volts

Motor voltage measure (measure unit=Volts).

REFERENCE INPUT
V_{ref} = ##.##VoltsSpeed reference voltage (measure unit=Volts);
potentiometer or voltage (0-5V) speed reference.**HEATSINK TEMP.**
T° = ##°C / ####°FInternal heat-sink temperature (measure unit C° and F°
degrees)**BATTERY VOLTAGE**
V_{batt}= ##.# Volts

Battery supply voltage (measure unit=Volts)

SW RELEASE
7CH4Q###_#

Software's release number.

ALARMS

Onboard programmer can display the failures or alarms: in the following table there is the list, the meaning of this alarms, and how to solve the problem.

	HANDHELD PROGRAMMER	ALARM	WHAT TO DO
	ALARM A1 FORW. SW CLOSED	Forward switch closed at power-on	Put the speed reference to zero and open the FW switch.
	ALARM A2 BACK SW CLOSED	Backward switch closed at power-on	Put the speed reference to zero and open the BW switch.
	ALARM A3 POT FAULT	Potentiometer fault	Check the potentiometer's wires.
	ALARM A4 POTI OUT OF ZERO	Potentiometer out of neutral position at power-on	Move the potentiometer to neutral position or, if it is in neutral position yet, calibrate the speed reference.
	ALARM A5 OVERTEMPERATURE	Thermal protection	Wait few minutes and check the motor current.
	ALARM A6 POWER STAGE	Controller's power stage damaged	Change the controller.
	ALARM A7 OVERCURRENT 1	Overcurrent 1: short circuit	Check the motor's wires: if ok, and the controller repeats this alarm, change it.

	HANDHELD PROGRAMMER	ALARM	WHAT TO DO
	ALARM A8 OVERCURRENT 2	Overcurrent 2: short circuit	Check the motor's wires: if ok, and the controller repeats this alarm, change it.
	ALARM A9 UNDERVOLTAGE	Undervoltage.	Check battery's charge.
	ALARM A10 OVERVOLTAGE	Overvoltage.	Battery voltage upper than 45V: check the battery.
	ALARM A11 OVERLOAD CURRENT	Overload protection.	Check the motor working current and parameters "rated current" and "overload time".
	ALARM A12 DISABLE ON	Disable switch on.	Check the input switch: this alarm will reset by power-off.
	ALARM A13 KEY-OFF	Key-off sequence detected.	Check the key switch connections.
	ALARM A14 EEPROM FAIL	E² prom fail.	Check your settings: if the controller repeats this alarm, change it.

HANDHELD PROGRAMMER PARAMETERS

Parameter	Default	Min	Max	Description
F0	0	0	2	Default parameters (F0=2) SWITCH-OFF AND ON THE KEY TO CONFIRM
F5	3.0	0.5	5.0	Acceleration ramp [s]
F6	1.5	0.5	5.0	Reverse deceleration ramp [s]
F7	1.0	0.5	5.0	Neutral deceleration ramp [s]
F8	120	0	120	Current limit [A] - I _{max}
F9	60	0	100	Backward speed reduction [%]
F10	s-en	s-en	w-w2	Speed reference s-en =single ended potentiometer with FW,BW switches w-w1=wig-wag potentiometer with EN switch w-w2=wig-wag potentiometer without EN switch
F15	2.0	0.0	10.0	Brake delay [s]
F16	0	0	20	Min speed (% of max speed)
F17	25	0	40	Motor's rated current – I _n
F18	60	0	60	Motor's overload time [s] – t
F19	200	50	500	Dead band of the speed reference [V]
F21	0	0	100	Backward safety time
F22	100	0	100	Forward maximum speed [%]
F24	50	0	100	Multimode input = speed reduction [%]
F25	60	0	120	Multimode input = current limit [A]
F26	0.0	0.0	10.0	R _{xl} [100=10% at 120A (5% 60A)]
F27	0	0	100	Backward safety speed [% of max speed]
F28	V24	V24	V36	Battery voltage AFTER CHANGE SWITCH-OFF AND ON THE KEY
---	no	no	---	Enable potentiometer calibration
---	ITAL.	ITAL.	ENGL.	Selected language SWITCH-OFF AND ON THE KEY TO CONFIRM
F30	---	---	---	Access key for engineering parameters

RESET TO DEFAULT:

To reset all the parameters, set 2 and power-off; at the next power-on, the controller will update the defaults settings.

RESET TO DEFAULT
F0= #

DEFAULT: 0
MIN: 0
MAX: 2

GENERAL SETTINGS:

ACCELERATION RAMP:

Acceleration ramp: time in seconds from stop position to max settled speed.

ACCELERATION RAMP
F5= #.#s

DEFAULT: 3.0
MIN: 0.5
MAX: 5.0

REVERSE RAMP:

Reverse direction deceleration ramp: time in seconds from the current direction to reverse direction.

REVERSE DEC RAMP
F6= #.#s

DEFAULT: 1.5
MIN: 0.5
MAX: 5.0

NAUTRAL RAMP:

Deceleration ramp: time in seconds from max settled speed to stop position.

NEUTRAL DEC RAMP
F7= #.#s

DEFAULT: 1.0
MIN: 0.5
MAX: 5.0

FORWARD SPEED:

Forward direction maximum speed: value in percent of battery voltage.

FW MAX SPEED
F22= ###%

DEFAULT: 100
MIN: 0
MAX: 100

BACKWARD SPEED:

Backward direction maximum speed: value in percent of forward direction max speed.

BACKWARD SPEED
F9= ###%

DEFAULT: 60
MIN: 0
MAX: 100

MINIMUM SPEED:

Minimum speed: value in percent of battery voltage.

MIN. SPEED
F16= ##%

DEFAULT: 0
MIN: 0
MAX: 20

BATTERY VOLTAGE:

Battery supply voltage: set the value between options 24V or 36V

NOMINAL VOLTAGE
F28= V##

DEFAULT: V24
MIN: V24
MAX: V36

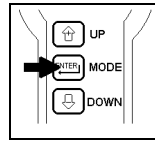
RxI COMPENSATION (further improve) :

RxI
F26= ###%

DEFAULT: 0
MIN: 0
MAX: 100

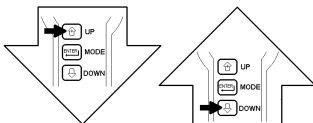
SPEED REFERENCE SETTINGS:

SPEED REFERENCE
F10: #####



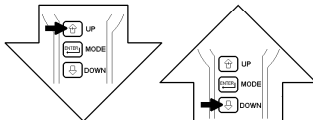
Choose "SPEED REFERENCE" page, and confirm it by "MODE" button

CALIBRATION
single-ended



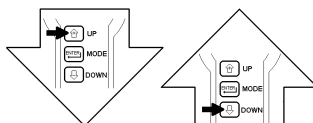
- **Single-ended potentiometer:**
 potentiometer with two direction switches,

CALIBRATION
wigwag 1



- **Wigwag1 potentiometer:**
 potentiometer with middle stop position
 and enable switches,

CALIBRATION
wigwag 2



- **Wigwag2 potentiometer:**
 potentiometer with middle stop position
 without enable switches,

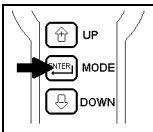
HANDHELD PROGRAMMER SINGLE-ENDED CALIBRATION:

Step 1:

POTI COURSE

→ no

+



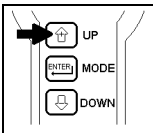
Choose “poti course” option, and confirm it by “MODE” button.

Step 2:

POTI COURSE

no ←

+



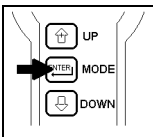
Choose “tar to set poti course” option, and confirm it by “UP” button.

Step 3:

POTI CALIBR.

Vzero = #. # V

+



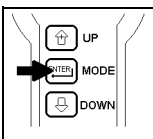
Set the potentiometer or throttle at **STOP / NEUTRAL** position, and confirm it by “MODE” button.

Step 4:

POTI CALIBR.

+Vmax = #. # V

+



Set the potentiometer or throttle at **MAX** position, and confirm it by “MODE” button.

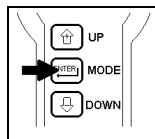
The single-ended reference range is calibrated.

HANDHELD PROGRAMMER WIGWAGS CALIBRATION:

Step 1:

SPEED REFERENCE
→ F10 = s-en

+

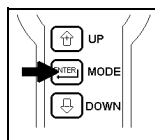


Choose “single-ended” option, and confirm it by “MODE” button.

Step 2:

SPEED REFERENCE
F10= w-w1 o w-w2 ←

+

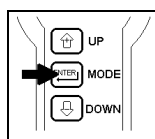


Choose “wigwag 1” or “2” or “3” option, and confirm it by “MODE” button.

Step 3:

POTI COURSE
→ no

+

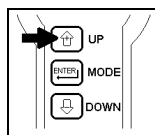


Choose “poti course” option, and confirm it by “MODE” button.

Step 4:

POTI COURSE
no ←

+

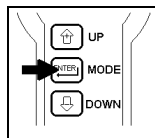


Choose “tar to set poti course” option, and confirm it by “UP” button.

Step 5:

POTI CALIBR.
Vzero = ## V

+

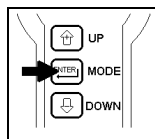


Set the potentiometer or throttle at **STOP / NEUTRAL** position, and confirm it by “MODE” button.

Step 6:

POTI CALIBR.
-Vmax = ## V

+

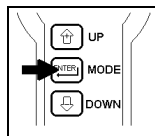


Set the potentiometer or throttle at **MAX BACKWARD** position, and confirm it by “MODE” button.

Step 7:

POTI CALIBR.
+Vmax = ## V

+



Set the potentiometer or throttle at **MAX FORWARD** position, and confirm it by “MODE” button.

The wigwag reference range is calibrated.

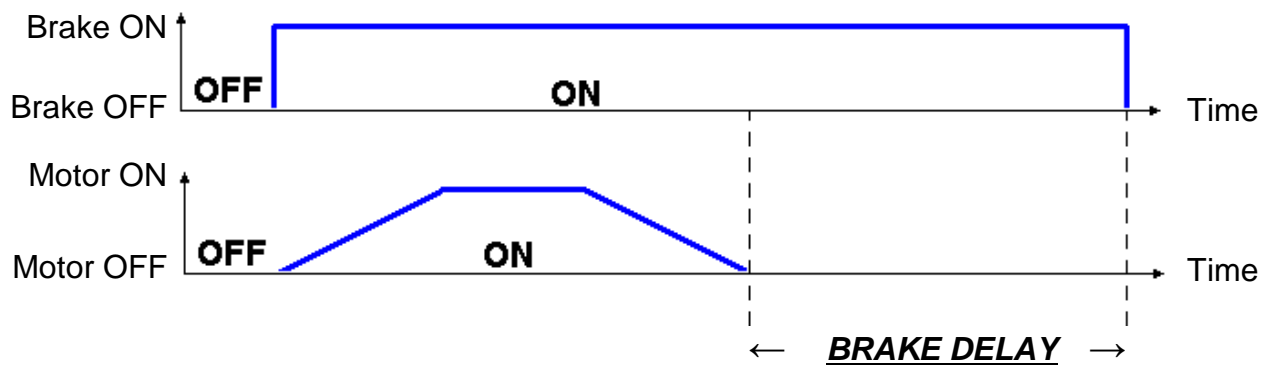
REFERENCE'S DEADBAND:

REF. DEADBAND
mV

DEFAULT: 2.0
MIN: 0.0
MAX: 10.0

ELECTROBRAKE OUTPUT SETTING:

Controller supplies the electro-brake coil when the motor is running: the coil is powered-off with delay when the speed reference and direction switches are in stop position .



BRAKE DELAY
seconds

DEFAULT: 2.0
MIN: 0.0
MAX: 10.0

MULTIMODE INPUT SETTINGS:

The input on pin 11 of the connector when closed activates a reduced speed or current. This input activates:

- maximum motor speed;
- maximum motor current.

The input is always active.

Note: In the controller with handlhed programmer, the input on pin 11 activates

MULTIMODE SPEED

F24= ### %

DEFAULT: 50

MIN: 0

MAX: 100

MULTIMODE CURR.

F25= ## A

DEFAULT: 60

MIN: 0

MAX: 120

BACKWARD SAFETY SETTINGS (PUSH):

The function operate in the backward direction as a safety function for the operator. It is realized by mean of a contact that activates the function when switched: the machine will decelerate, will reverse the direction at a programmed speed for the programmed time, then will stop.

The normal operation will be obtained resetting the input, the direction switches if present and speed reference. The function is inhibit with the safety speed equal 0.

BW SAFETY TIME

F21= ## s

DEFAULT: 0

MIN: 0

MAX: 100

BW SAFETY SPEED

F27= ### %

DEFAULT: 0

MIN: 0

MAX: 120

OVERLOAD PROTECTION

In the programming mode set the rated current and overload time for the motor:

RATED CURRENT F17= ## A	DEFAULT: 25 MIN: 0 MAX: 40
OVERLOAD TIME F18= ### s	DEFAULT: 60 MIN: 0 MAX: 60

The protection will be activated each time the current overcome the value $I_n + 10\%$ and the overload time is as shorter as higher is the overload according to the function. After the integration time the controller will stop the machine and an alarm (A11) will be activated.

First of all, the ammeter constant (K) has to be calculated using the heat-sink temperature, the maximum current and the rated current as follow:

$$K = (I_{max}^2 - I_n^2) * t$$

I_n = rated motor current,
 I_{max} = max motor current,
 t = overload time at the max current,

Once calculated the "K", is possible to calculate the ammeter time protection at your working current:

$$t_{wrk} = \frac{K}{(I_{wrk}^2 - I_n^2)}$$

I_n = rated motor current,
 I_{wrk} = max motor current,
 K = ammeter constant.

Example:

- Current limit = I_{max} = 90 Amps,
- Rated current = 30 Amps,
- Overload time = t = 30 seconds,
- Working current = I_{wrk} = 50 Amps,

Step1: K calculation:

$$K = (I_{max}^2 - I_n^2) * t = (90^2 - 30^2) * 30 = 182250$$

Step2: protection (ammeter) time:

$$t = \frac{K}{(I_{wrk}^2 - I_n^2)} = \frac{182250}{(50^2 - 30^2)} = 114 \text{ seconds}$$

The application can work at 50 Amps for 114 seconds before the Alarm 11 is activated.

ENGINEERING PROTECTED PARAMETERS

IGSL: **DEFAULT: 0**
 MIN: 0
 MAX: 99

PGSL: **DEFAULT: 0**
 MIN: 0
 MAX: 99

IGCL: **DEFAULT: 0**
 MIN: 0
 MAX: 99

PGCL: **DEFAULT: 0**
 MIN: 0
 MAX: 99

LPOT: **DEFAULT: 0**
 MIN: 0
 MAX: 99

CPOT: **DEFAULT: 0**
 MIN: 0
 MAX: 99

CPOT: **DEFAULT: 0**
 MIN: 0
 MAX: 99