7CH4Q45C
and
7CH4Q90C

MICROPROCESSOR FOUR QUADRANT CONTROLLER FOR PM DC MOTORS

- USER'S GUIDE -

- <u>CONTENTS</u> -

- <u>INTRODUCTION</u> -

The controller 7CH4Q45C / 90C 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.

- <u>FEATURES</u> -

POWER SUPPLY BATTERY	24 – 36 V
RATED CURRENT	15A (7CH4Q45C) – 35A (7CH4Q90C)
MAX CURRENT (Ta = 25°C)	45A (7CH4Q45C) – 90A (7CH4Q90C)
FREQUENCY	16 KHz
MAX HEATSINK TEMPERATURE	85 °C
OPERATING TEMPERATURE	-10°C / 40°C
SPEED REFERENCE	VOLTAGE (0-5Vdc)/POTENTIOMETER 1-10 KΩ
ON BOARD MAIN CONTACTOR	24V-40A CONTINUOS
REGENERATIVE BRAKING	
PARAMETERS PROGRAMMABLE	

<u>**SAFETY:**</u>	• **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**

- <u>MECHANICAL DRAWING</u> -

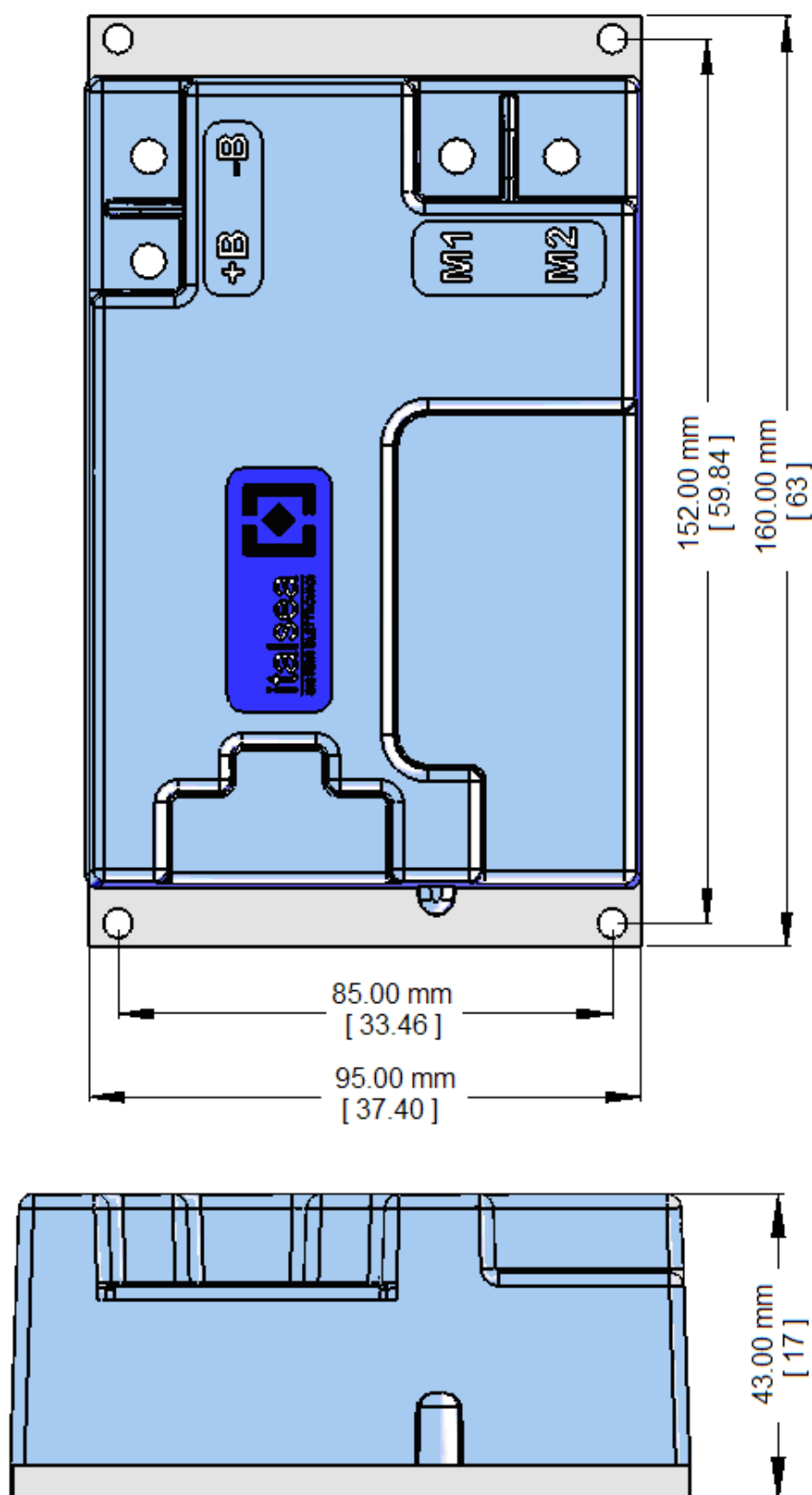**fig. 1**

fig.3a

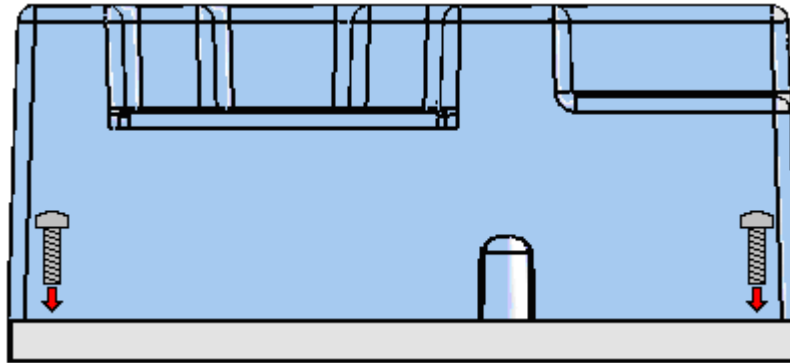Locate the chopper in a place protected against mechanical abuse, water and dirty.
Fix it with all the screws on a metal surface (aluminum if possible) to reduce the heath and so for longer period of work.
If during the standard operations the thermal protection is activated very often an additional heath-sink or fan is requested to assure longer periods of work.
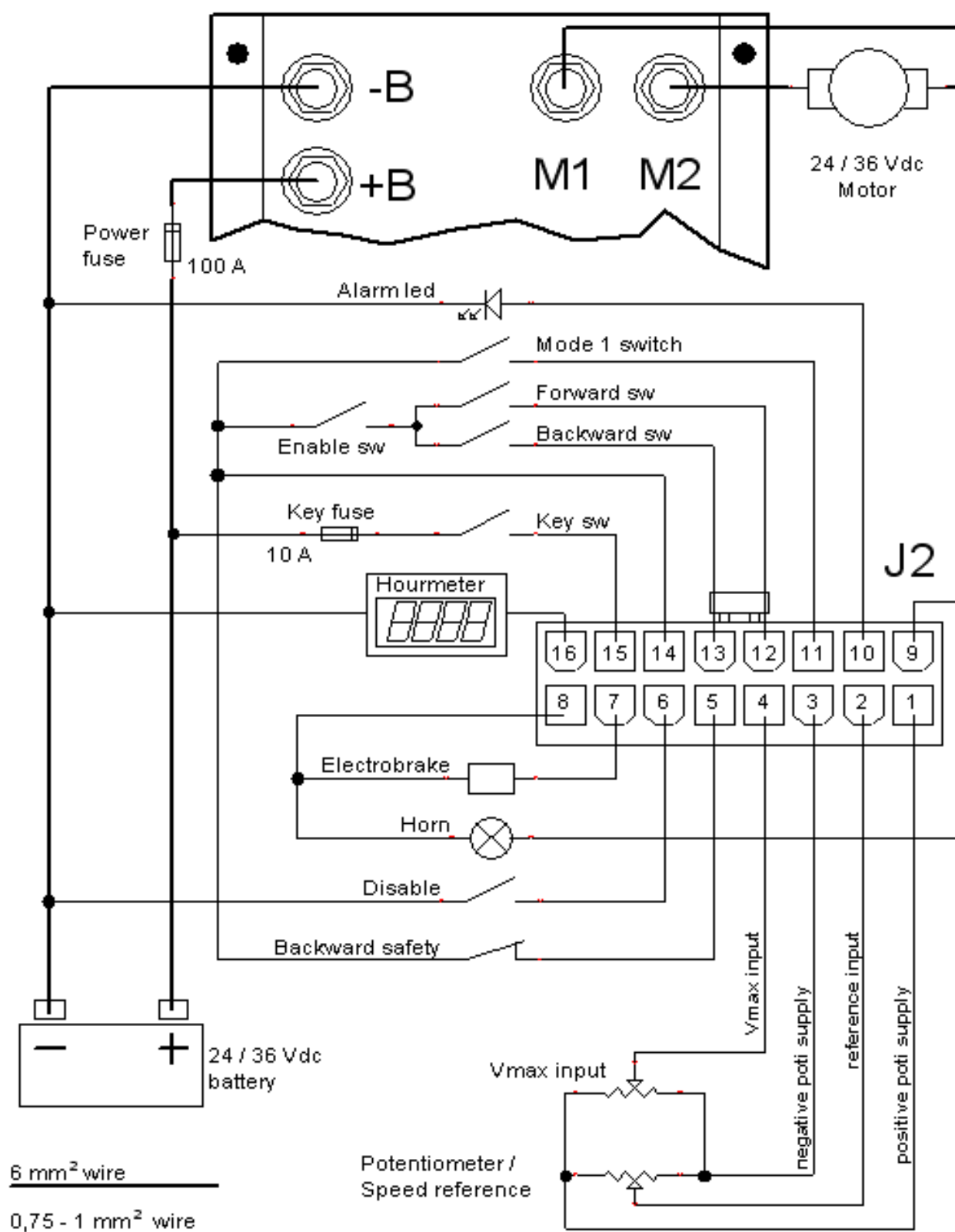
- WIRING DIAGRAM -

fig.3

- I/O CONNECTOR -

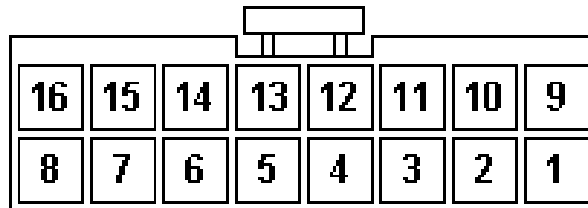**16v Molex connector** (Molex p/n.39012160, contacts p/n.39000038)

fig.4

Pin 1: POSITIVE POTI INPUT
Positive Potentiometer Supply

Pin 2: REFERENCE INPUT
Central Potentiometer, or Voltage (0-5Vdc) Speed Reference Input
To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"

Pin 3: NEGATIVE POTI INPUT
Negative Potentiometer Supply, or Gnd Voltage Speed Reference Input

Pin 4: V_MAX (OPTIONAL)
Max speed input potentiometer (>100 KΩ).

Pin 5: BACKWARD SAFETY
Default N.C. input contact to +V_Batt for Backward safety. This input is active
when open.
To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"

Pin 6: DISABLE
When the input is active 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 open before the motor stop , the machine will restart at
the desired speed.
To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"

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).

6

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: MODE1

> Default N.O. input to +V battery; when active, this input changes set of maximum speed and/or maximum motor current.
> *To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"*

Pin 12: FORWARD SWITCH

> N.O. input to +V battery. Controller drives positive voltage on M1 output and negative on M2 output.
> *To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"*

Pin 13: BACKWARD SWITCH

> N.O. input to +V battery. Controller drives positive voltage on M2 output and negative on M1 output
> *To change the input configuration see chapter "DIGITAL INPUTS CONFIGURATION"*

Pin 14: COMMON HIGH

> +V battery output for switches.

Pin 15: KEY IN

> Logic stage positive supply 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)

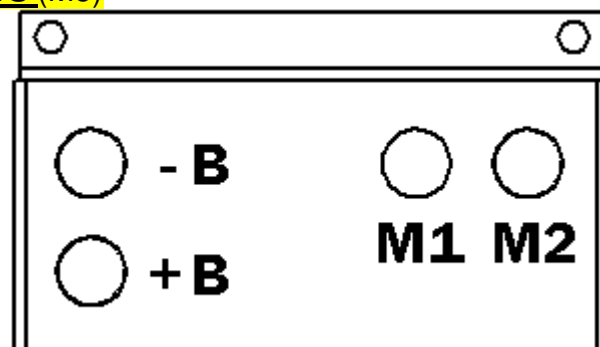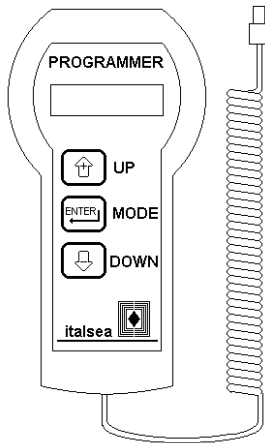**Used for handheld programmer or communication to pc.**

M5 power screws (M5)

fig.5

+ 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),***

- <u>CONTROLLER SETTING</u> -

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.

UP Key:
Rolls down parameters and decreases values.

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.
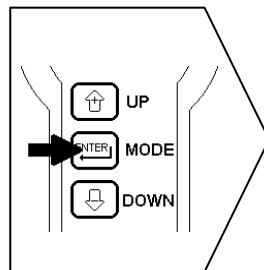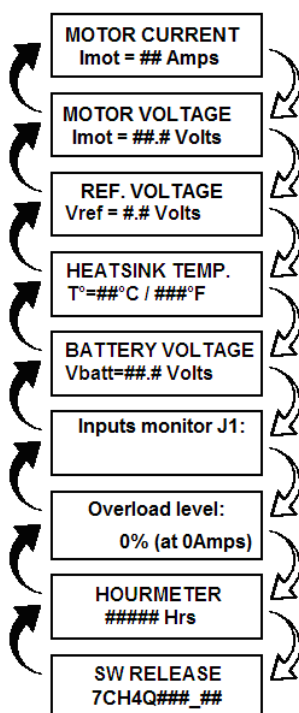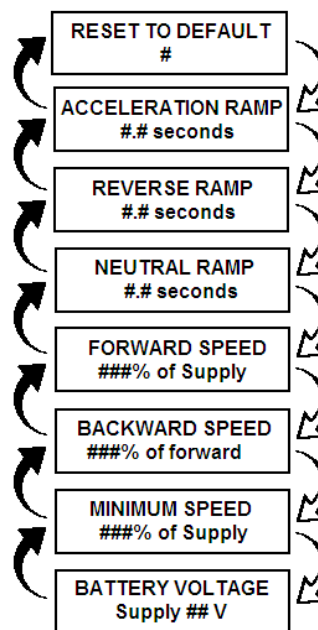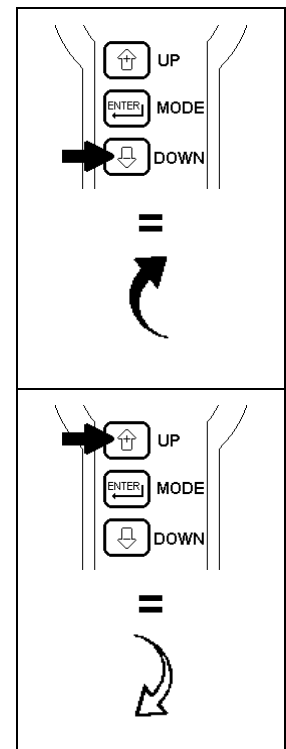
MOTOR CURRENT
Imot = ## Amps

MOTOR VOLTAGE
Imot = ##.# Volts

REF. VOLTAGE
Vref = #.# Volts

HEATSINK TEMP.
T°=##°C / ###°F

BATTERY VOLTAGE
Vbatt=##.# Volts

Inputs monitor J1:

Overload level:
0% (at 0Amps)

HOURMETER
Hrs

SW RELEASE
7CH4Q###_##

UP
MODE
DOWN

RESET TO DEFAULT
#

ACCELERATION RAMP
#.# seconds

REVERSE RAMP
#.# seconds

NEUTRAL RAMP
#.# seconds

FORWARD SPEED
###% of Supply

BACKWARD SPEED
###% of forward

MINIMUM SPEED
###% of Supply

BATTERY VOLTAGE
Supply ## V

.....

fig.6

UP
MODE
DOWN
=

UP
MODE
DOWN
=

SW RELEASE **7CH4Q###_#**	Software's release number.
MOTOR CURRENT **Imot= ## Amps**	Motor current measure (measure unit=Amperes).
MOTOR VOLTAGE **Vmot = ##.# Volts**	Motor voltage measure (measure unit=Volts).
REF. VOLTAGE **Vref = #.#Volts**	Speed reference voltage (measure unit=Volts); potentiometer or voltage speed reference.
HEATSINK TEMP. **T°= ##°C / ###°F**	Internal heat-sink temperature (measure unit C° and F° degrees)
BATTERY VOLTAGE **Vbatt= ##.# Volts**	Battery supply voltage (measure unit=Volts)
Inputs monitor **J1:#,#,##,##,##**	Connector's J1 Inputs status (pin active when its number is displayed)
Overload level: **##% (at ##Amps)**	Ammeter protection (overload) level; at 100% alarm A10 is active.
HOURMETER **#### hrs, ## min**	Measure of worked time (when motor is running).

SERIAL COMMUNICATION TESTER

Main Window

The Serial Communication Tester (SCT) is a Windows executable software utility that connects the controller to a PC/Laptot using an USB port (Italsea's 7RS2USB# cable is required).
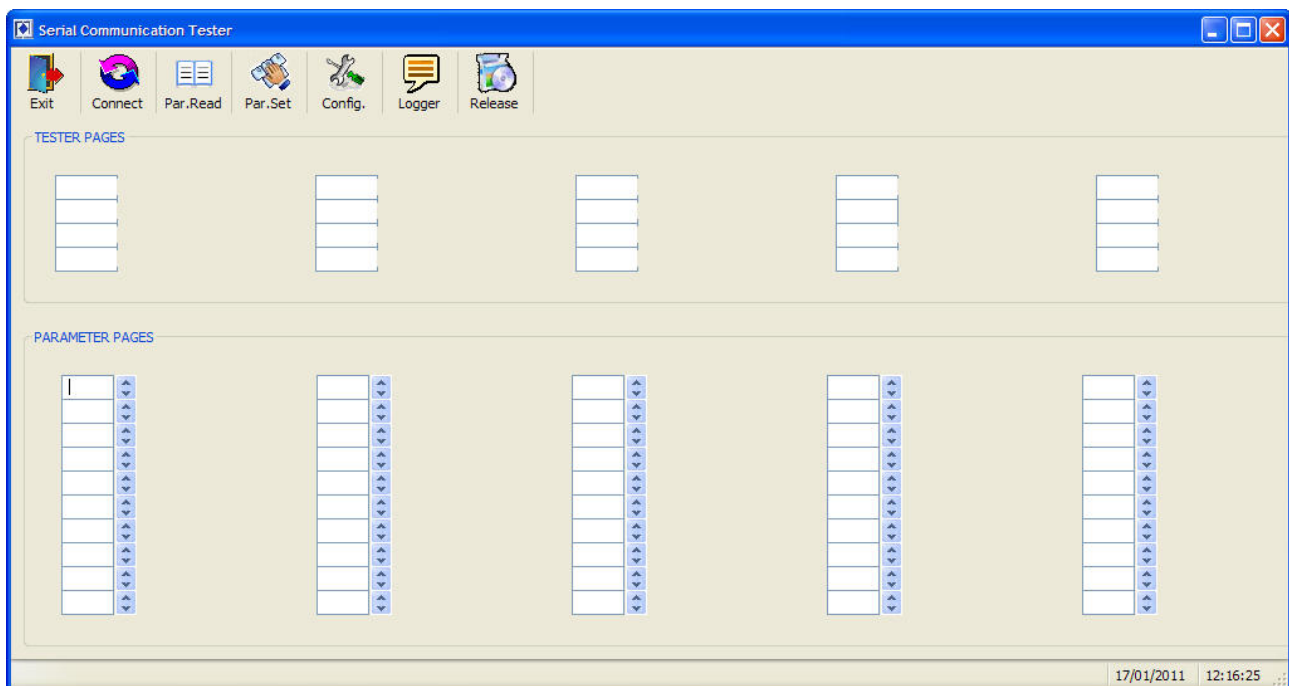Once open the utility by double click on icon, will appear the main window.

fig.7

In the top side of the window is shown the **toolbar**; in toolbar are present the main commands to operate with this application.
"**Tester Pages**" windows show in real time the controller's measure as motor current and voltage, heatsink temperature and so on.
"**Parameters Pages**" controls show and set the present and the new set value of internal controller parameters; to set the parameter is necessary set before the correct password value.
When the SCT software is just open, it doesn't show the labels close the tester and parameters windows; this labels will appear once connect the PC to controller.

![italsea logo] ![amer group logo amergroup.it]

Toolbar

Toolbar is locate on tupper-left side in the main window.

 fig.8

Exit	**Exit:** Aborts program and return to other windows applications

Connect	**Connect:** Connects the controller to PC.
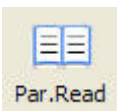
Par.Read	**Par. Read.:** Uploads/reads the parameters set inside the controller to SCT's window. *NOTE: before Read parametrs:* *1) connect the device to SCT utility,* *2) wait until SCT utility reads the "Tester Pages",* *3) disconnect SCT utility,* *4) Click on "Par.Read." button.*

Par.Set	**Par. Set:** Writes/send the new parameters set on SCT's utility inside the controller.

Config.:
Modifies the SCT's default initializations. This utility is used mainly to change the communications port setting; when clicked, will appear the following window:
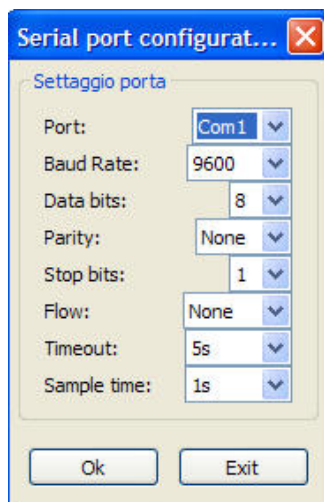
Communication Port,
Communication Speed (do not change),
Do not change,
Do not change,
Do not change,
Do not change,
Do not change,
Do not change,

fig.9

Exit and re-open the SCT utility is suggest after communication sets. The new sets are stored in a ".ini" file in same SCT folder.

| ![Logger icon] Logger | Logger:
Displays the communications data (use by engineering tests). |

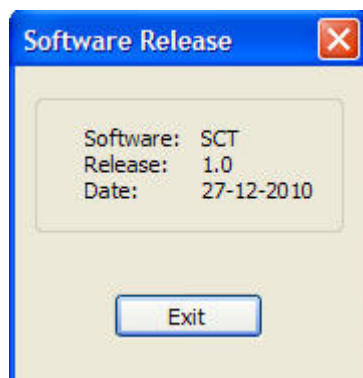| ![Release icon] Release | Release:
Views the SCT's release.

Software Release

Software: SCT
Release: 1.0
Date: 27-12-2010

Exit

fig.10 |

Connect PC to Controller

To connect the SCT utility to controller, power-on the controller and than push "Connect" on toolbar. At power-on, the controller checks for 10 seconds if PC is connected or not. If the SCT utility is unread, after 10 seconds the controller enables only the communication to 7PROGLCD.

Connection sequence:
1) Connect PC/Laptop to Controller using 7RS2USB# cable,

2) start-up SCT utility (double click on icon),

3) check serial port #ID (COM1, COM2…) by "Config." on toolbar.

4) Power on the controller and than click on "Connect" on toolbar. If the SCT utility doesn't connect to controller, an error message will show. In this case, switch-off the controller, close SCT utility, check connection and retry.

5) After few seconds, main window will refresh the labels close tester and parameters pages.

Tester Pages

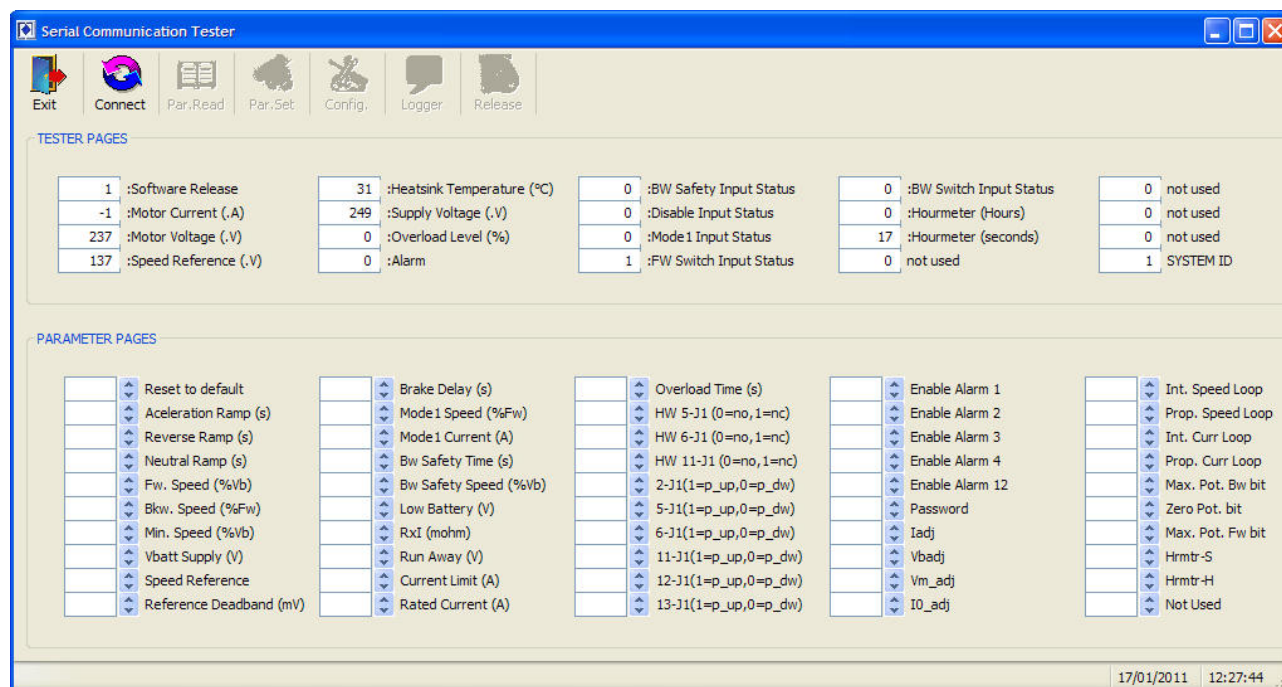When the PC/SCT utility is connected, on toolbar are enabled only the "Connect" and the "Exit" button.

fig.11

In "Tester Pages" are shown:
- **Software Release:** Controller's firmware release.
- **Motor Current:** Actual Motor Current (1/10 Ampere) .
- **Motor Voltage:** Actual Motor Voltage (1/10 Volt).
- **Speed Reference:** Actual Speed Reference (1/10 Volt).
- **Heatsink Temperature:** Measure of heatsink aluminium plate (°C degrees).
- **Supply Voltage:** Battery voltage (/10 Volt).
- **Overload Level:** Percentage of current overload status (%).
- **Alarm:** Actual Alarm (if present).
- **BW Safety Input Status:** BackWard Safety Input status (1=active,0=not active).
- **Disable Input Status:** Disable Input status (1=active,0=not active).
- **Mode1 Input Status:** Mode1 Input status (1=active,0=not active).
- **FW Switch Input Status:** ForWard Input status (1=active,0=not active).
- **BW Switch Input Status:** BackWard Input status (h1=active,0=not active)
- **Hourmeter (Hours):** Count of worked time (hours count).
- **Hourmeter (minutes):** Count of worked time (minutes count).
- **System ID:** system management only.

Parameters Pages

To modify values of internal parameters, set the value in password parameter before send new sets to controller. User can modify only parameter form "Reset to default" parameter to "Password" parameter; ask to Italsea for access to others parameter and for password value.
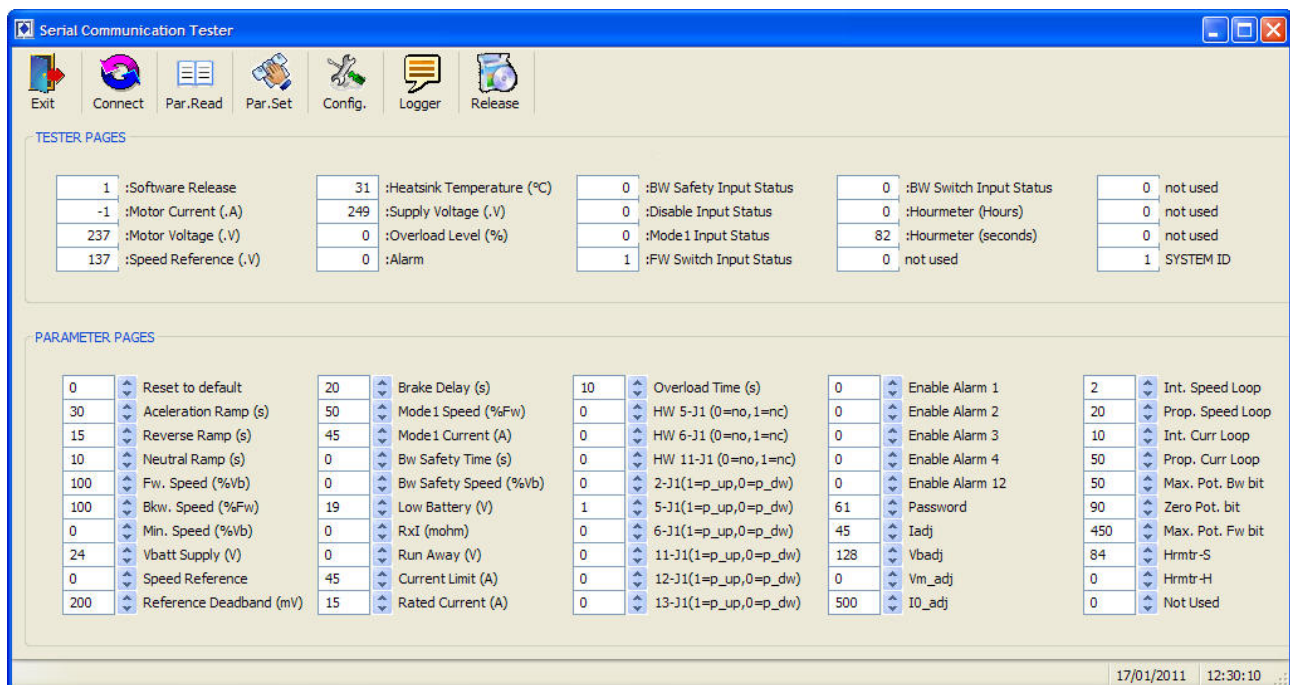

fig.12

The setting range of every parameter is clamped by SCT software if set by control window (increase/decrease by mouse); if the value is set by PC's numeric keyboard, out of range value is not accept by Controller and error message is shown.
Speed Reference parameter is not enabled in this connection mode.

PARAMETER	DESCRIPTION	DEFAULT	
		7CH4Q45C	**7CH4Q90C**
RESET TO DEFAULT	Reset to default parameters	**DISABLE**	**DISABLE**
ACCELERATION RAMP	Acceleration ramp	**3.0**	**3.0**
REVERSE RAMP	Reverse deceleration ramp	**0.5**	**0.5**
NEUTRAL RAMP	Neutral deceleration ramp	**2.0**	**2.0**
FORWARD SPEED	Forward maximum speed	**85**	**100**
BACKWARD SPEED	Backward maximum speed	**100**	**100**
MINIMUM SPEED	Minimum speed	**0**	**0**
BATTERY VOLTAGE	Battery Voltage	**24**	**24**
SPEED REFERENCE	Speed Reference	**single-ended**	**single-ended**
REF. DEADBAND	Reference Dead-band	**0.100**	**0.100**
BRAKE DELAY	Brake delay	**0.5**	**0.5**
MULTIMODE SPEED	Speed in Multimode	**60**	**60**
MULTIMODE CURRENT	Current in Multimode	**45**	**60**
BW SAFETY TIME	Backward safety time	**2.0**	**2.0**
BW SAFETY SPEED	Backward safety speed	**60**	**60**
LOW BATTERY	Low battery limit	**23.0**	**23.0**
RxI FUNCTION	RxI function	**50**	**50**
RUN-AWAY	Run-Away function	**no**	**no**
CURRENT LIMIT	Controller's current limit	**45**	**70**
RATED CURRENT	Motor's rated current	**15**	**35**
OVERLOAD TIME	Motor's overload time	**60**	**60**
BOOST CURRENT	Motor's boost current	**45**	**70**
5-J1 HW CONFIG	Pin 5 – J1 hardware config.	**N.C. switch**	**N.O. switch**
6-J1 HW CONFIG	Pin 6 – J1 hardware config.	**N.O. switch**	**N.O. switch**
11-J1 HW CONFIG	Pin 11 – J1 hardware config.	**N.O. switch**	**N.O. switch**
2-J1 P.up-down	Pin 5 – J1 hardware config.	**Pull down**	**Pull down**
5-J1 P.up-down	Pin 6 – J1 hardware config.	**Pull down**	**Pull down**
6-J1 P.up-down	Pin 11 – J1 hardware config.	**Pull up**	**Pull up**
11-J1 P.up-down	Pin 5 – J1 hardware config.	**Pull down**	**Pull down**
12-J1 P.up-down	Pin 6 – J1 hardware config.	**Pull down**	**Pull down**
13-J1 P.up-down	Pin 11 – J1 hardware config.	**Pull down**	**Pull down**
SELF CUT-OFF	System self cut-off	**10**	**10**
ENABLE ALARM 1	A1 alarm enabling.	**ENABLE**	**ENABLE**
ENABLE ALARM 2	A2 alarm enabling.	**ENABLE**	**ENABLE**
ENABLE ALARM 3	A3 alarm enabling.	**ENABLE**	**ENABLE**
ENABLE ALARM 4	A4 alarm enabling.	**ENABLE**	**ENABLE**
ENABLE ALARM 12	A12 alarm enabling.	**ENABLE**	**ENABLE**

RESET TO DEFAULT PARAMETER

RESET TO DEFAULT
**###### **

DEFAULT: 0
MIN: no
MAX: Default3

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

GENERAL SETTINGS

ACCELERATION RAMP
#.# seconds

DEFAULT: 3.0
MIN: 0.5
MAX: 10.0

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

REVERSE RAMP
#.# seconds

DEFAULT: 1.5
MIN: 0.5
MAX: 10.0

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

NEUTRAL RAMP
#.# seconds

DEFAULT: 1.0
MIN: 0.5
MAX: 10.0

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

FORWARD SPEED
% of Supply

DEFAULT: ---
MIN: 20
MAX: 100

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

BACKWARD SPEED
% of forward

DEFAULT: 100
MIN: 10
MAX: 100

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

MINIMUM SPEED
% of Supply

DEFAULT: 0
MIN: 0
MAX: 20

Minimum speed: value in percent of battery voltage.

BATTERY VOLTAGE
Supply ## V

DEFAULT: 24
MIN: 24
MAX: 36

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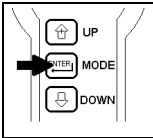
SPEED REFERENCE SETTINGS

SPEED REFERENCE'S TYPE:

Speed reference's type and range may be set by the sequences that follow:

SPEED REFERENCE
##########

+

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

The controller can work mainly with 6 kinds of speed reference:

CALIBRATION
single-ended
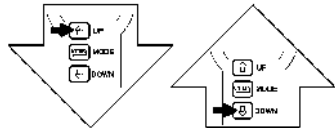
- Single-ended potentiometer:
potentiometer with two direction switches,

CALIBRATION
voltage 0-max
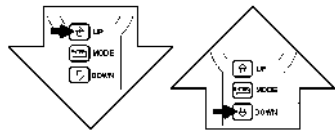
- Voltage 0-max:
analogue signal with direction switches,

CALIBRATION
wigwag 1
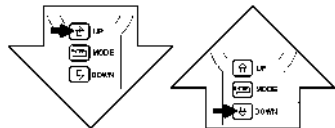
- Wigwag1 potentiometer:
potentiometer with middle stop position and enable switches,

CALIBRATION
wigwag 2
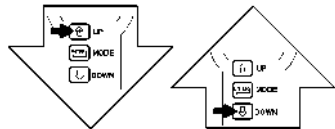
- Wigwag2 potentiometer:
potentiometer with middle stop position without enable switches,

CALIBRATION
FW/BW

- Fw/Bw switches:
internal speed reference (controller uses internal parameters "forward speed" and "backward speed): only direction switches are used

SINGLE ENDED CALIBRATION:

Step 1:
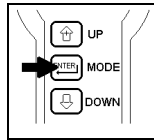
| SPEED REFERENCE
single-ended | **+** | [UP / MODE / DOWN] | Choose "single-ended" option, and confirm it by "MODE" button. |

Step 2:
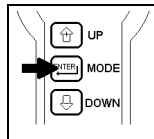
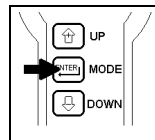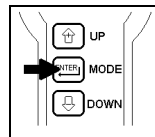| CALIBRATION
Stop pos = #.# V | **+** | [UP / MODE / DOWN] | Set the potentiometer or throttle at **STOP / NEUTRAL** position, and confirm it by "MODE" button. |

Step 3:
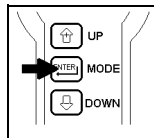
| CALIBRATION
Max pos = #.# V | **+** | [UP / MODE / DOWN] | Set the potentiometer or throttle at **MAX** position, and confirm it by "MODE" button. |

The single-ended reference range is calibrated.

VOLTAGE 0-MAX CALIBRATION:

Step 1:

| SPEED REFERENCE
voltage 0-max | **+** | [UP / MODE / DOWN] | Choose "voltage 0-max" option, and confirm it by "MODE" button. |
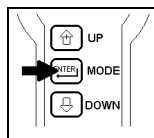
Step 2:
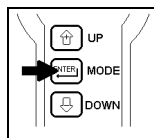
| CALIBRATION
Stop pos = #.# V | **+** | [UP / MODE / DOWN] | Set the voltage reference at **STOP / NEUTRAL** position, and confirm it by "MODE" button. |

Step 3:
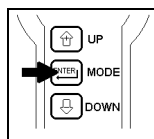
| CALIBRATION
Max pos = #.# V | **+** | [UP / MODE / DOWN] | Set the voltage reference at **MAX** position, and confirm it by "MODE" button. |

The voltage 0-max reference range is calibrated.

WIGWAGS CALIBRATION:

Step 1:

SPEED REFERENCE **wigwag #**	**+**	Choose "wigwag 1" or "2" or "3" option, and confirm it by "MODE" button.
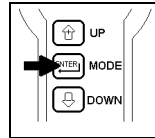
Step 2:
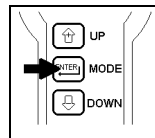
CALIBRATION **Stop pos = #.# V**	**+**	Set the potentiometer or throttle at central **STOP / NEUTRAL** position, and confirm it by "MODE" button.

Step 3:

CALIBRATION **Max BW pos = #.# V**	**+**	Set the potentiometer or throttle at **MAX BACKWARD** position, and confirm it by "MODE" button.

Step 4:

CALIBRATION **Max FW pos = #.# V**	**+**	Set the potentiometer or throttle at **MAX FORWARD** position, and confirm it by "MODE" button.

The wigwag reference range is calibrated.

FW/BW CALIBRATION:

Step 1:

SPEED REFERENCE **FW/BW**	**+**	Choose "FW/BW" option, and confirm it by "MODE" button.
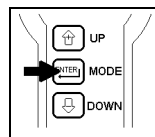
NOTE:
The controller will drive motor at the speed percentages set in pages **"FORWARD SPEED"** and **"BACKWARD SPEED".**

REFERENCE'S DEADBAND

REF. DEADBAND ### mV	DEFAULT: 100 MIN: 50 MAX: 500	Use this parameter to increase, or decrease the speed reference stop position range.

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 .
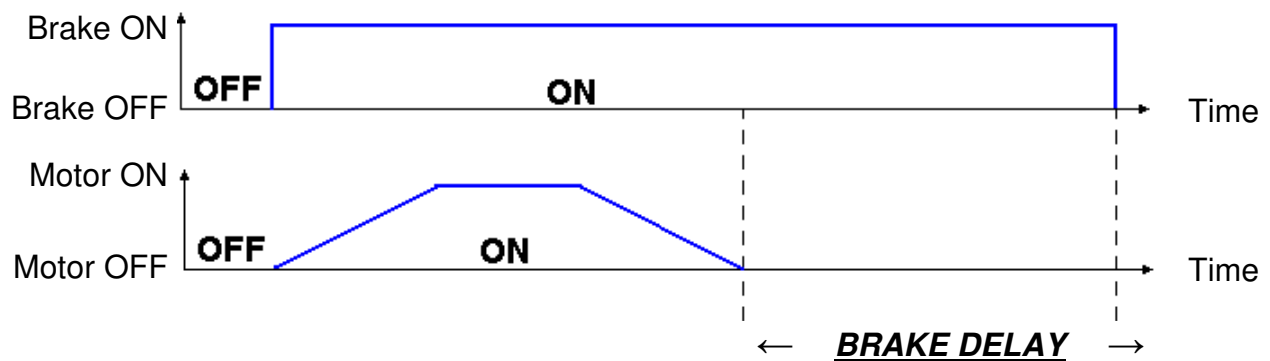

fig.13

BRAKE DELAY #.# seconds	DEFAULT: 0.5 MIN: 0 MAX: 30.0

Note:
-   If the value is set to 0, the controller drives both motor's wires to minus battery.

MODE1 INPUT SETTINGS

This input activates:
- maximum motor speed set at parameter "MODE1 SPEED"
- maximum motor current set at parameter "MODE1 CURRENT".

The input is always active.

MODE1 SPEED ### % of Supply	DEFAULT: 60 MIN: 0 MAX: 100

MODE1 CURR. ## Amperes	DEFAULT: --- MIN: --- MAX: ---

BACKWARD SAFETY SETTINGS

The function operates 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 switch if present and speed reference. The function is inhibit with the safety speed equal 0.

BW SAFETY TIME #.# seconds	DEFAULT: 2.0 MIN: 0.0 MAX: 9.9

BW SAFETY SPEED ### % of Supply	DEFAULT: 60 MIN: 0 MAX: 100

LOW BATTERY LEVEL

LOW BATTERY ##.# Volts	DEFAULT: 23.0 MIN: 19.0 MAX: 28.0

Low battery level: if battery voltage is lower than this value, after 5 seconds controller reduces the motor maximum speed and current as Mode1 function.

Note:
- once activated this protection, reset it only by switch-off sequence.

RxI COMPENSATION:

RxI FUNCTION ### mohm

DEFAULT: 50
MIN: 0
MAX: 500

Speed (voltage) compensation by motor current: it is possible to increase motor voltage when motor current increases.

Note:
- this is a "positive reaction": check value starting from low sets. A wrong set value may cause oscillations on voltage regulation.

RUN-AWAY FUNCTION

RUN-AWAY ## Volts

DEFAULT: no
MIN: 10
MAX: 15

Machine's free-run protection: if the machine moves itself, when it runs at set speed (voltage) the controller stops the machine.

Note:
- the protection/function is active only if battery are connected,
- if the machine is off, the controller switches on, it brakes the motor, after 20 seconds it switches off.
- If the machine is on, it brakes to stop motor; after stop sequence if the machine moves again, the controller brakes again.

MOTOR CURRENT SETTING

CURRENT LIMIT ### Amperes

DEFAULT: ---
MIN: ---
MAX: ---

Maximum output motor's current: this value is used also to calculate the ammeter/overload protection.

OVERLOAD PROTECTION

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

RATED CURRENT ## Amperes	**DEFAULT:** 35 MIN: 5 MAX: 35

OVERLOAD TIME ### seconds	**DEFAULT:** 60 MIN: 1 MAX: 60

The protection will be activated each time the current overcome the value In +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:

$$K = (Imax^2 - In^2)*t$$

In = rated motor current,
Imax = 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:

$$t = \frac{K}{(Iwrk^2 - In^2)}$$

In = rated motor current,
Iwrk = working motor current,
K = ammeter constant,

NOTE: ammeter time depends on heatsink temperature too; if the temperature is higher than 50°C the protection time is reduced (at 80°C is about 1/4 of calculated time).

Example:
- Current limit = Imax = 45 Amps,
- Rated current = 15 Amps,
- Overload time = t = 10 seconds,

- Working current = Iwrk = 25 Amps,
- Heatsink temperature = T°diss = 50°C

Step1: K calculation:
$$K = (Imax^2 - In^2)*t = (45^2-15^2)*10 = 18000$$

Step2: protection (ammeter) time:
$$t = \frac{K}{(Iwrk^2 - In^2)} = \frac{18000}{(25^2 - 15^2)} = 45 \text{ seconds}$$

The application can work at 25 Amps (heatsink temperature lower than 50°C) for 63 seconds before the Alarm 11 is activated.

![italsea logo] ![amer group logo amergroup.it]

Ammeter protection diagram (@ Imax=45A, In=15A, Tn=10s, T°=50°, 65° and 80°C)

fig.14
Chart shows ammeter response at 3 different heatsink temperature (50°C,65°C and 80°C).

AMMETER PROTECTION
(Imax=45A, In=15A, Tn=10s)

— T°=50   — T°=65   — T°=80
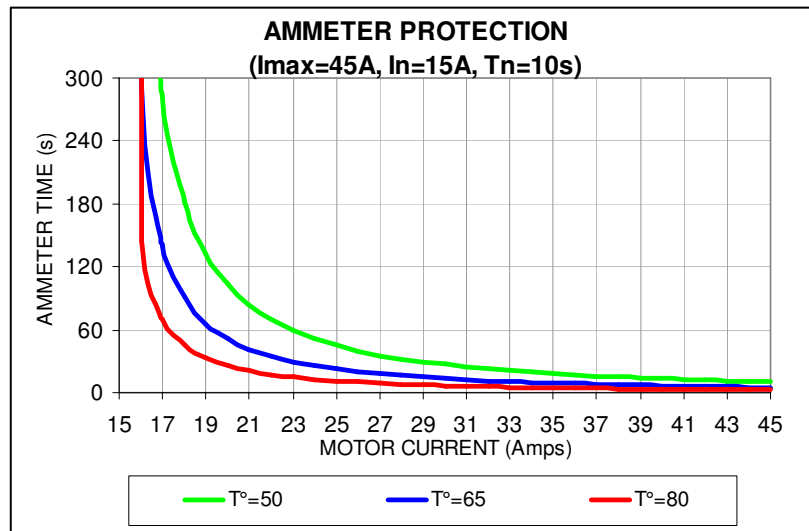
fig.14.a
Zoom of the lower motor current range.

AMMETER PROTECTION (17-25Amps zoom)

— T°=50   — T°=65   — T°=80
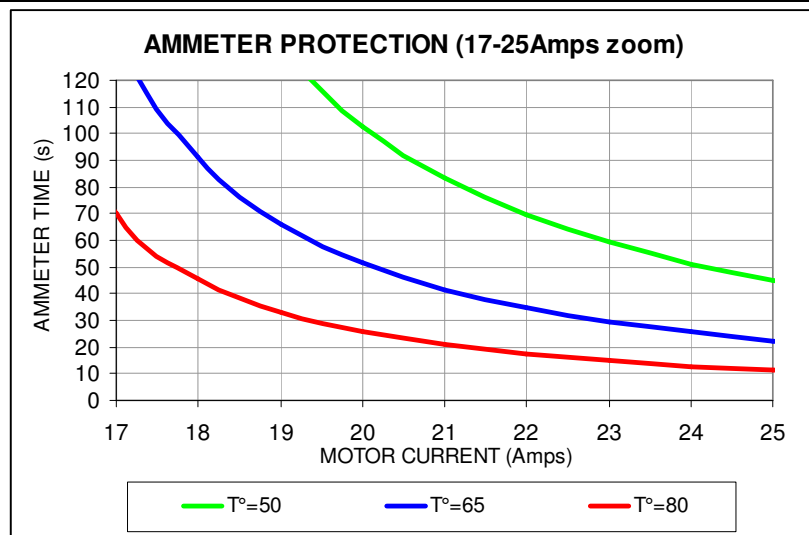
fig.11.b
Zoom of the higher motor current range.

AMMETER PROTECTION (25-45Amps zoom)

— T°=50   — T°=65   — T°=80
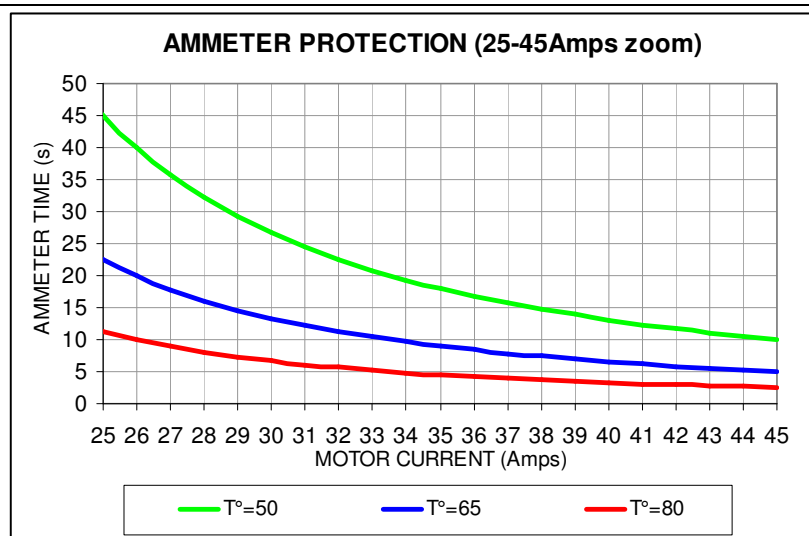
BOOST CURRENT FUNCTION

BOOST CURRENT ### Amperes	DEFAULT: --- MIN: --- MAX: ---

A boost current function is available on controller: the parameter sets the level of this temporary higher current limit.
If the parameter is set equal or less the current limit parameter the function is not active.
To enable the boost, set the boost value (for example 110Amps).
If the motor requires more than 90Amps (for instance to start uphill), the controller changes its current limit to boost current value for maximum 10 seconds.
Once used all the boost time (10 seconds), this time is "refill" of 1 second each 10 seconds at motor current lower than current limit. This means that the boost is used for 5 seconds, the controller can supply other 5 seconds in boost condition or if not necessary, wait other 50 seconds to have all the 10 seconds.
Boost current is available only if heat sink temperature is lower than 60°C.

DIGITAL INPUTS CONFIGURATION

Each pin 5, 6 and 11 hardware configuration (pin normally closed or open) can be set by user as need by further parameters.
Once changed, power off to enable the changes.

Pin 5 hardware configuration (Backward safety input):

Stand-by input   Active input

5-J1 HW CONFIG. N.O. switch
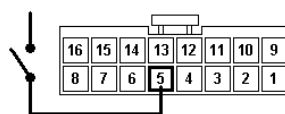
Stand-by input   Active input
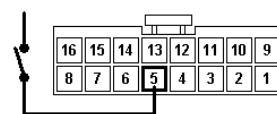
5-J1 HW CONFIG. N.C. switch
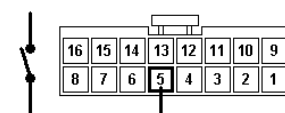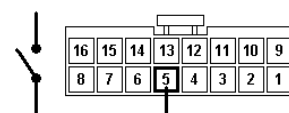
Pin 6 hardware configuration (Disable input):

Stand-by input   Active input

6-J1 HW CONFIG. N.O. switch
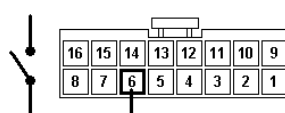
Stand-by input   Active input
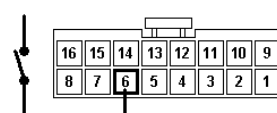
**6-J1 HW CONFIG.
N.C. switch**
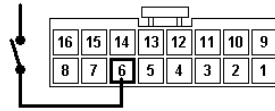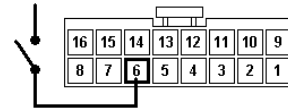
Pin 11 hardware configuration (Mode 1 input):

Stand-by input   Active input

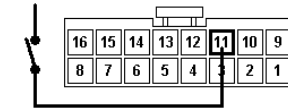**11-J1 HW CONFIG.
N.O. switch**
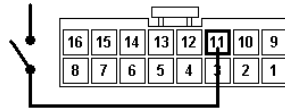
Stand-by input   Active input

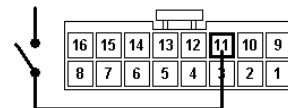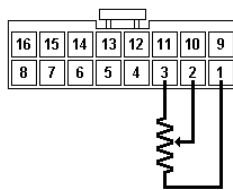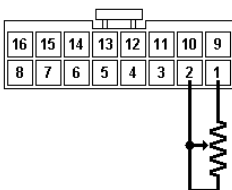**11-J1 HW CONFIG.
N.C. switch**
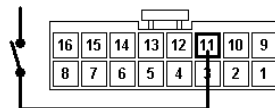
Pin's 2, 5, 6, 11, 12 and 13 internal pull-up or pull-down may be activate by next parameters.
Once changed, power off to enable the changes.
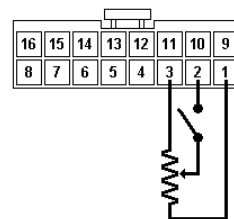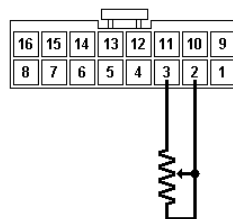
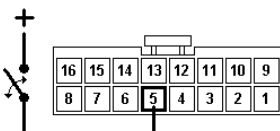**Pin 2 internal pull up/down selection (speed reference input):**

**2-J1 P.up-down
pull-down active**

**2-J1 P.up-down
pull-up active**

Pin 5 internal pull up/down selection (Backward safety input):

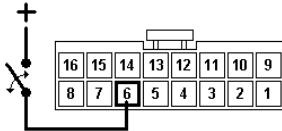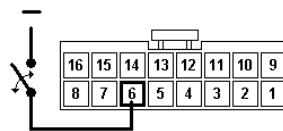**5-J1 P.up-down
pull-down active**

**5-J1 P.up-down
pull-up active**
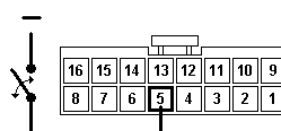
Pin 6 internal pull up/down selection (Disable input):
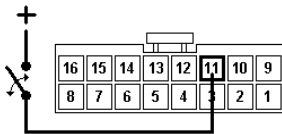
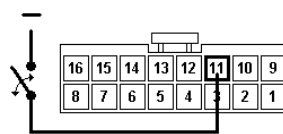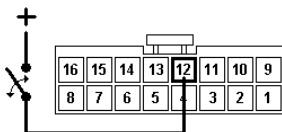| 6-J1 P.up-down pull-down active	6-J1 P.up-down pull-up active

Pin 11 internal pull up/down selection (Mode1 input):

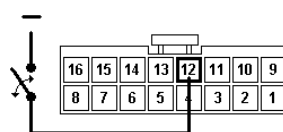| 11-J1 P.up-down pull-down active	11-J1 P.up-down pull-up active

Pin 12 internal pull up/down selection (Forward switch input):
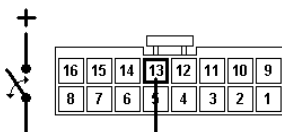
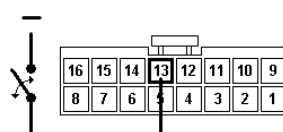| 12-J1 P.up-down pull-down active	12-J1 P.up-down pull-up active

Pin 13 internal pull up/down selection (Backward switch input):

13-J1 P.up-down pull-down active	13-J1 P.up-down pull-up active

27

SELF CUT-OFF TIME

| SELF CUT-OFF
minutes | DEFAULT: 10
MIN: 0
MAX: 60 |

If the system is on and not used for the Self Cut-Off time (minutes), the controller switches-off itself.
To reset, switch-off the key switch, wait few seconds and switch-on again.
To disable the function, set "self cut-off" time to 0.

ALARMS ENABLE

| ENABLE ALARM A1
ENABLE alarm | DEFAULT: ENABLE
MIN: ENABLE
MAX: DISABLE |

| ENABLE ALARM A2
ENABLE alarm | DEFAULT: ENABLE
MIN: ENABLE
MAX: DISABLE |

| ENABLE ALARM A3
ENABLE alarm | DEFAULT: ENABLE
MIN: ENABLE
MAX: DISABLE |

| ENABLE ALARM A4
ENABLE alarm | DEFAULT: ENABLE
MIN: ENABLE
MAX: DISABLE |

| ENABLE ALARM A12
ENABLE alarm | DEFAULT: DISABLE
MIN: ENABLE
MAX: DISABLE |

- <u>ALARMS</u> -

Handheld programmer, SCT utility ("Alarm" on Tester Pages) and Alarm led (onboard and/or external by counting flashes) display the failures or alarms: in the following table there is the list, the meaning of this alarms, and how to solve the problem.

ALARM 1:   Forward switch closed at power-on.

ALARM A1 FW Switch ON

Led alarm status = 1 blinks.

Controller has detected the Forward switch on at the power on; to reset the alarm, put speed reference to zero position and open the FW switch. If the application needs the switch on at power-on, it is possible to disable the alarm by setting parameter "ENABLE ALARM 1 ".

ALARM 2:   Backward switch closed at power-on.

ALARM A2 BW Switch ON

Led alarm status = 2 blinks.

Controller has detected the Backward switch on at the power on; to reset the alarm, put speed reference to zero position and open the BW switch. If the application needs the switch on at power-on, it is possible to disable the alarm by setting parameter "ENABLE ALARM 2".

ALARM 3:   Potentiometer fault..

ALARM A3 Pot. FAULT

Led alarm status = 3 blinks.

Controller has detected the Speed Reference voltage out of maximum range. Check Speed Reference/potentiometer wires. If the application opens one or more potentiometer wires (for instance at the zero position), it is possible to disable the alarm by setting parameter "ENABLE ALARM 3".

ALARM 4:   Potentiometer out of neutral position at power-on.

ALARM A4 Ref OUT Neutral

Led alarm status = 4 blinks.

Controller has detected the Speed Reference voltage out of stop position at power-on. Move the potentiometer to neutral position or if it is in neutral position yet, calibrate the speed reference; it is possible to disable the alarm by setting parameter "ENABLE ALARM 4".

ALARM 5:   Thermal protection.

ALARM A5 Overtemperature

Led alarm status = 5 blinks.

Heatsink temperature is higher than 85°C. Power-off, wait few minutes and check motor consumption.

ALARM 6 / ALARM 6b: Controller's power stage damaged

ALARM A6 POWER STAGE

Led alarm status = 6 blinks.

Controller's self-check has detected a failure on internal power-stage. Change the controller.

ALARM 7:   Overcurrent (**short circuit)**

ALARM A7 OVERCURRENT

Led alarm status = 7 blinks.

Controller has protected itself by an external short circuit; check the motor's wires and if ok and the controller repeats this alarm, change it.

ALARM 8:   Power fuse or on-board contactor damaged.

ALARM A8 POWER FUSE/RELAY

Led alarm status = 8 blinks.

Controller detects a failure on the external power fuse or power connections. If the controller repeats this alarm and the power connections are ok, change it.

ALARM 9:   Undervoltage.

ALARM A9 UNDERVOLTAGE

Led alarm status = 9 blinks.

Battery voltage lower than value 18,0V; check battery's charge.

ALARM 10: Overvoltage.

ALARM A10 OVERVOLTAGE

Led alarm status = 10 blinks.

Battery voltage upper than 45V: check the battery status.

ALARM 11: Overload protection.

ALARM A11 Overload Current

Led alarm status = 11 blinks.

Check the motor working current, parameters "rated current" and "overload time".

ALARM 12: Disable switch on.

ALARM A12 DISABLE ON

Led alarm status = 12 blinks.

Disable input switch is active: this alarm will reset by power-off. It is possible to disable this alarm by setting parameter "ENABLE ALARM 12".

ALARM 13: Key-off sequence detected.

ALARM A13 KEY-OFF

Led alarm status = 13 blinks.

Key switch was opened: check the key switch connections.

ALARM 14: internal memory fail..

ALARM A14 EEPROM FAIL

Led alarm status = 14blinks.

Check your parameter settings: if the controller repeats this alarm, change it.

- <u>SOFTWARE UPDATES</u> -

To upgrade the controller's management firmware (**7ch4q###.mot**), FDT#.#.exe application with 7RS2USB# cable must to be used.
To install cable's drivers and FDT#.#.exe application, read 7RS2USB#'s user guide.
In this chapter is explained how to set FDT application for this controller.

UPDATE SEQUEQUENCE

Step 1: execute FDT#.#.exe
Double click on FDT's icon; will appear main window or simple interface. If main window is shown, choose on menu "Tools" the option "Simple Interface.." as shown.
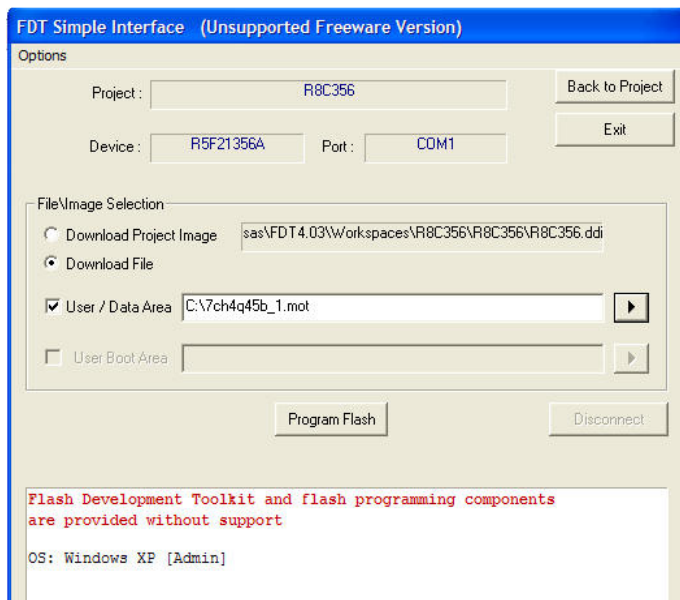
fig.12.a: FDT#.#'s Simple Interface	**fig.12.b: FDT#.#'s Main window**
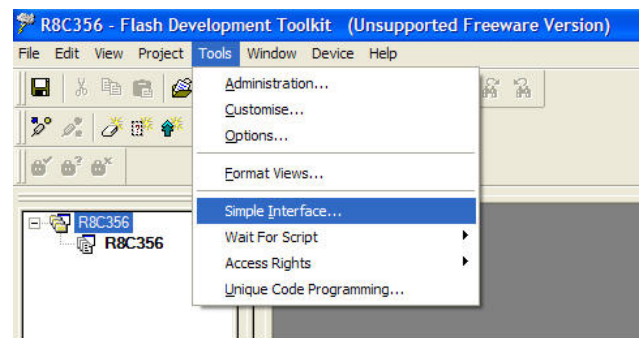
Step 2: Check Settings
On FDT's Simple Interface check the communication and new firmware settings as shown in fig.13. To change settings refer to chapter "PORT AND DEVICE SETTINGS"
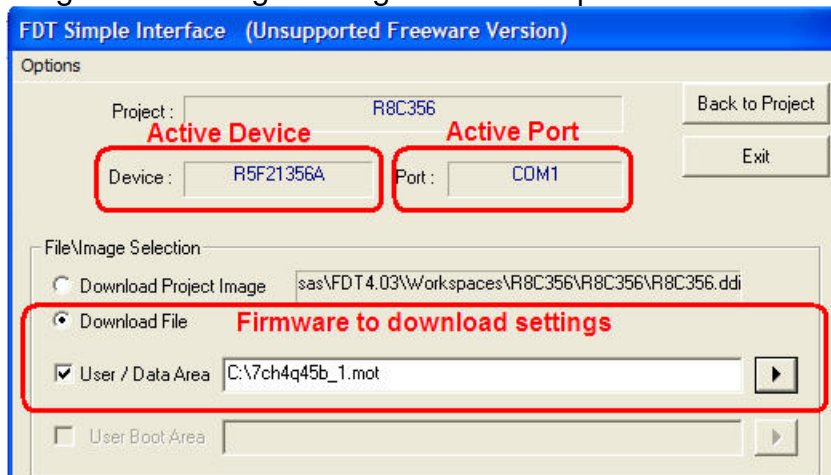
fig.13: settings

Active Device: R5F21356A.

Active Port: COM#.
(check on Windows System Management where the USB cable is connected).

Firmware to download..:
Check "Download File" and browse to select the new ".mot" file.

Step 3: Download Firmware

1) if controller is off, connect the program cable to PC/Laptop, to Controller and then switch-on the Controller.
2) Click "Program Flash" on FDT's Simple Interface,
3) When will appear the window "Block Erase Check", check default settings (fig.14) and click on "OK" button.
4) Wait the complete writing of memory (fig.15) and click on "Disconnect" button(fig.16).
5) Power-off the controller and then disconnect cable from it.
6) To update another controller, repeat sequence.

fig.14: Block Erase Check
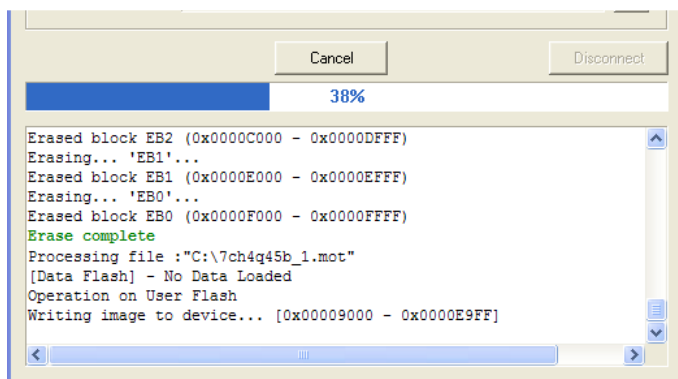
fig.15: Download in progress….
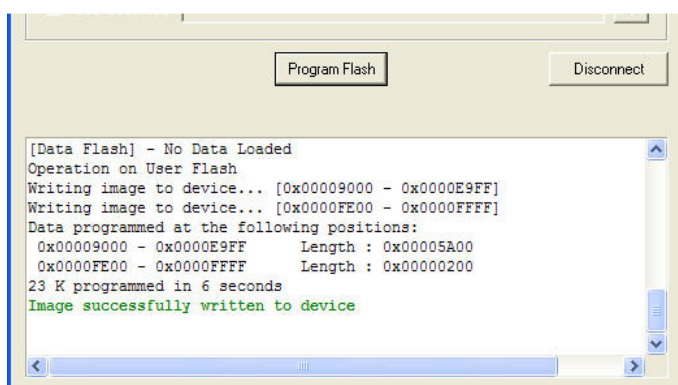
fig.16: Download complete, disconnect button active.

PORT AND DEVICE SETTINGS

To change Port or Device settings, click on "Back to Project", when main window appears choose on menu "Configure Flash Project" (fig.17).

Notes:
- New sets are immediately available,
- When you close FDT utility from Main window, next time FDT will be execute, main window will appear,
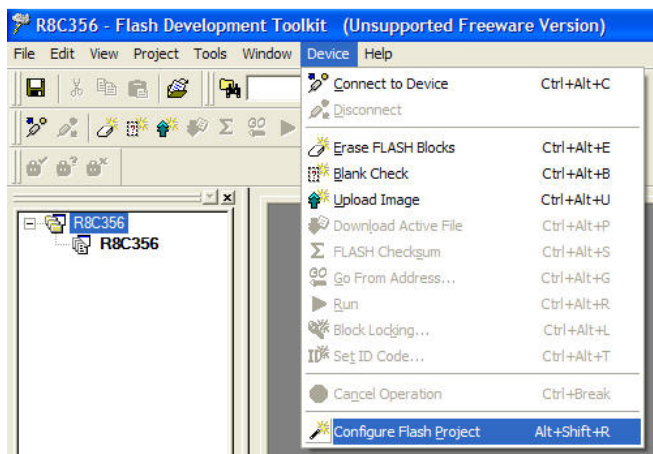- Check port id each time you use FDT; in fact the connected port id changes if you change plugged USB port.
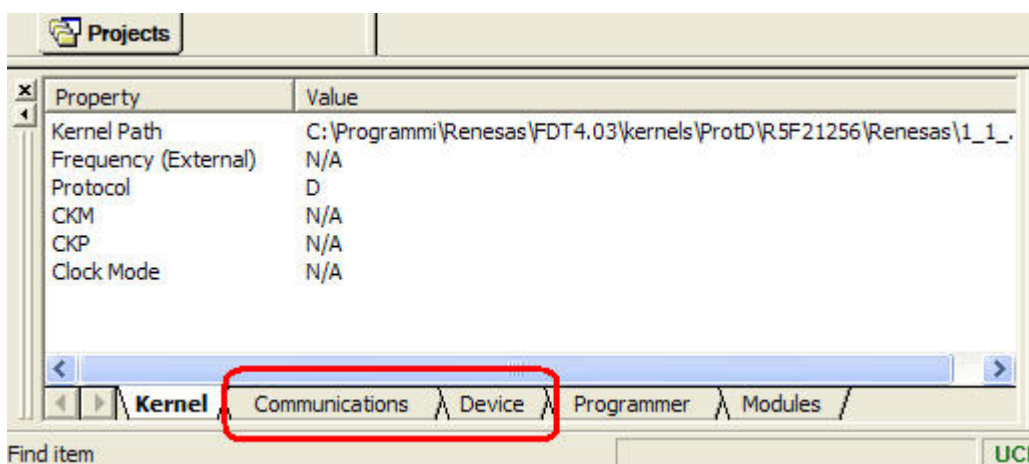

fig.17:
Access to Port and Device settings

fig.18: "Communication" and "Device" options location.

- Option "Communication" is used to change Port settings,
- Option "Device" is used to change Device setting.

PORT SETTINGS

1) Double click on COM# label (COM4 in example on fig.19.a)

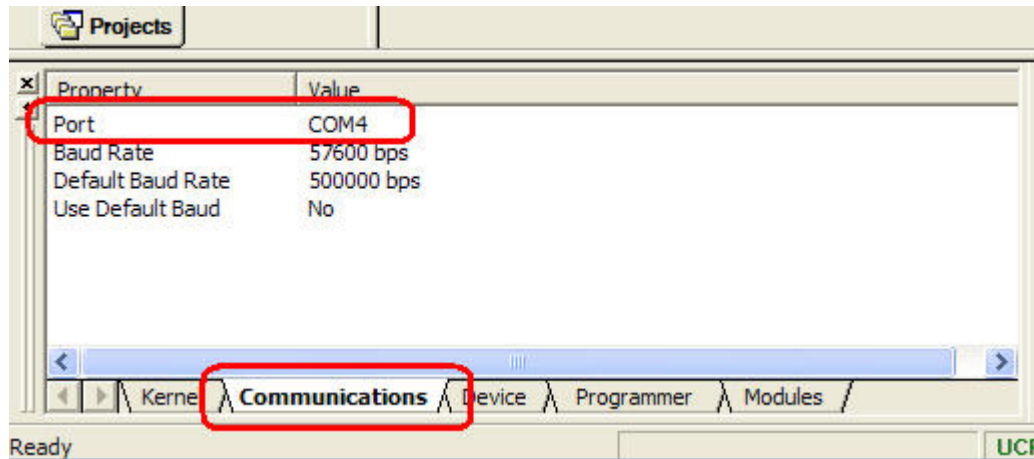**fig.19.a**

2) On window "Communication Port" select where USB cable is plugged (fig.19.b), then click on "Next" button,
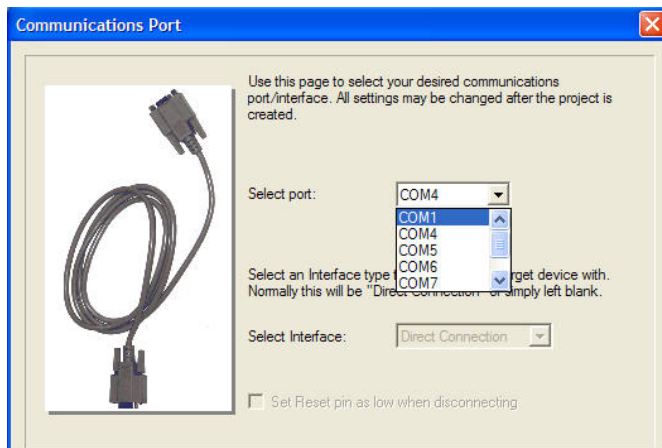3) On window "Connection Type" set all items as shown in fig.19.c, then click on "Next" button,
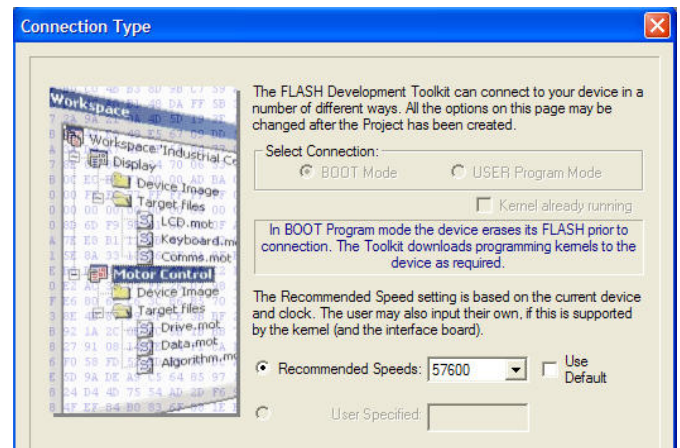

fig.19.b

fig.19.c

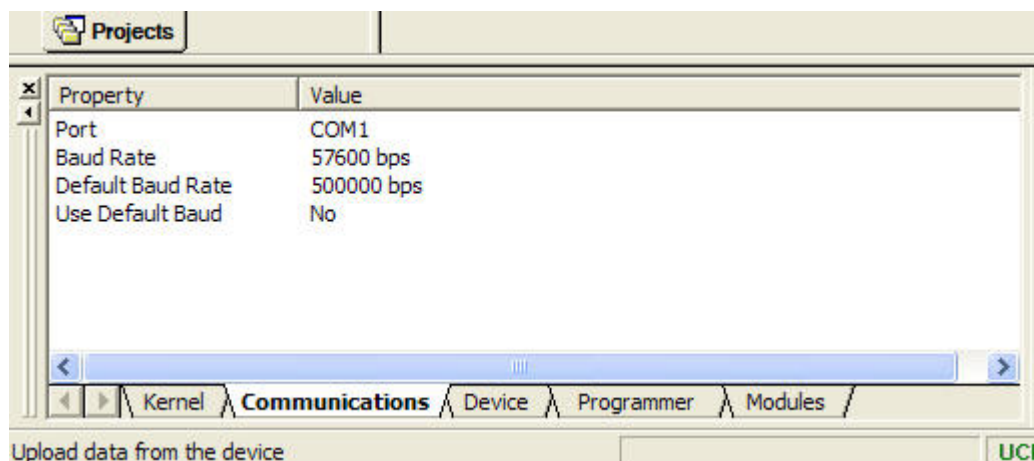4) Verify new sets on "Communications" (fig.19.d)

fig.19.d

DEVICE SETTINGS

1) Double click on Device's value (R5F21256 in example on fig.20.a)
2) On window "**Choose Device And Kernel**" select **R5F21356A** (fig.20.b); use the filter window to point immediately the right device name
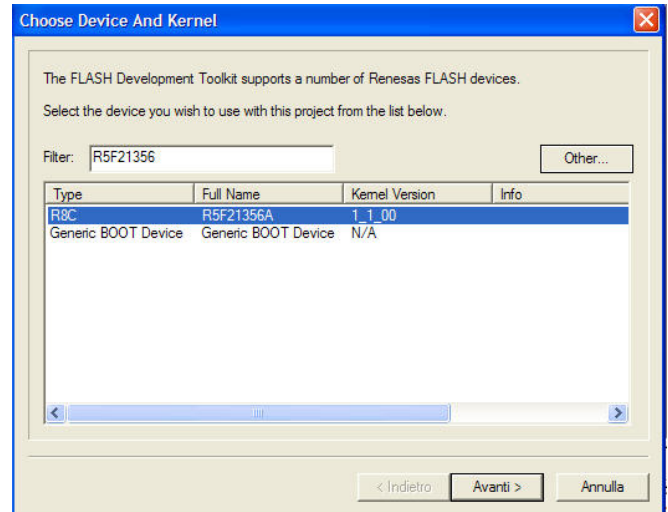

fig.20.a

fig.20.b

3) Click on "**Next**" Button to confirm the Port Settings or modify them as explained in chapter "**PORT SETTINGS**"
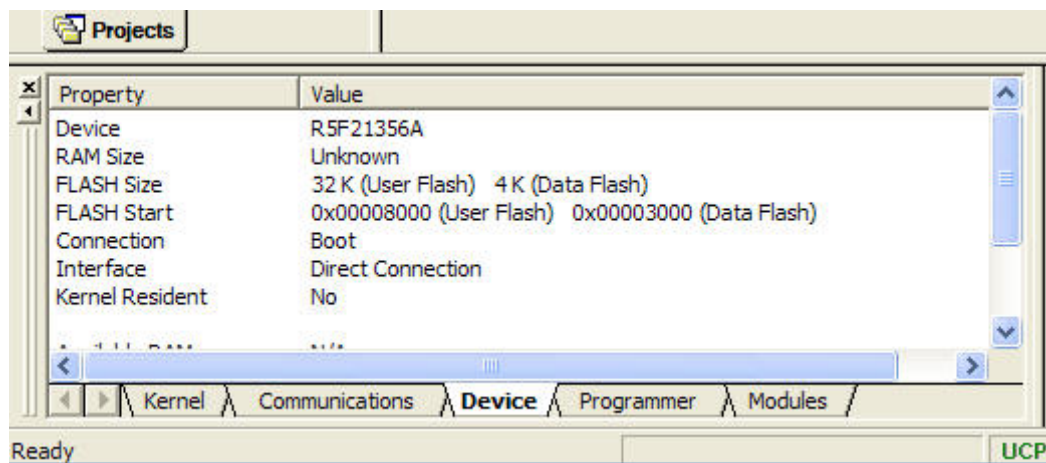4) Verify new sets on "**Device**" (fig.20.c)

fig.20.c