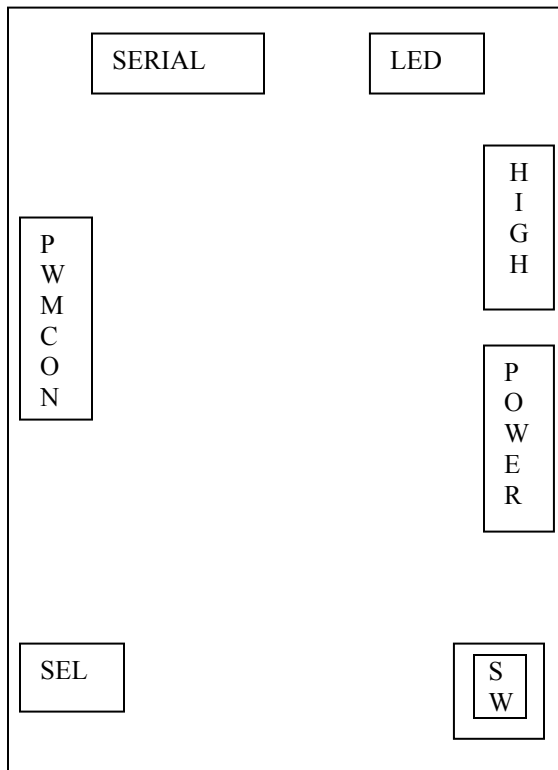


A. Description of mechanical aspects and connectors

The DEMO board is 100 x 160 mm two-layer board with SMT components and, where inevitable, the PTH (electrolytic and similar). The board form with most important connectors and components is given below:



SERIAL: 9-pin female standard shell (DB9) connector provides for an opto-isolated RS232 serial link with the PC computer at a fixed rate of 2400 Baud, no parity, 1S + 1S.

LED: Three LED diodes (red, green, yellow) reflect the drive status. Yellow diode blinks when the bus voltage is present, red diode lights on fault and the green one when the drive is ON.

PWMCON is the strip of pins with low voltage (TTL) signals on them.

HIGH is the strip of pins with high voltage PWM signals (i.e. the motor voltages) on it.

POWER is the main connector with the AC 115/230V power supply, earth connections and the motor (A-B-C) connections.

SEL and **SW** are the selector switch (115V/230V input) and the power ON/OFF switch.

SERIAL LINK CONNECTOR:

The pins used on this connector are the RxD, TxD, GND, RTS, and DTR signals. Notice that the RS232 cables with 3 wires only won't work. Hence, use a standard 9-wire serial link cable. The RTS and DTR signals are used for the opto-coupler bias current. The current drawn from these pins is far below permissible limits for the RS232 drivers. The board will communicate with the GUI tool supplied with the board wherein all the serial link settings are already provided for. Notice that either COM1 or COM2 port of your PC has to be available, the code won't work with COM3 or COM4. You may connect or disconnect the serial link cable at any time (whether drive is ON or OFF).

LED:

Yellow, Green and Red LED diodes are aligned at the edge of the board. Upon the power-up, if the input voltage exceeds 85% of the rated voltage, the SMPS will start to provide the auxiliary voltages. Yellow LED will go blinking until the bus voltage goes below 60V DC. Hence, this yellow blinking LED signals "DC bus voltage present".

If the drive is enabled and the motor is supplied, the green LED stays ON. On the occasion of a short circuit faults (SC), overvoltage faults (OV), undervoltage (UV), long term overcurrent (I2T) or the heatsink fault, the RED LED diode will light, and the drive will stop, turning the green diode OFF. The drive RESET (either through the serial link reset command or the reset pushbutton) or the power cycling is the only way to exit from fault conditions.

RESET PUSHBUTTON is located close to the serial link connector. By pressing and holding this button depressed for approximately 0.8 sec, the processor will restart.

PWMCON pin strip makes available to the user the following signals (! NOTICE ! all the following signals are referred to DC-bus minus rail and therefore at a dangerous voltage; electric shock hazard)

pin 1:	Phase A upper switch ON command, inverted
pin 2:	Phase B upper switch ON command, inverted
pin 3:	Phase C upper switch ON command, inverted
pin 4:	Phase A lower switch ON command, inverted
pin 5:	Phase B lower switch ON command, inverted
pin 6:	Phase C lower switch ON command, inverted
pin 7:	ITRIP signal
pin 8:	SP1 spare digital input
pin 9:	SP2 spare digital input
pin 10:	GROUND (0V) referred to – DC bus
pin 11:	Spare analog input referred to –DC bus rail.
pin 12:	+5V auxiliary power supply referred to – DC bus rail

HIGH is the strip of pins having the motor voltages and the DC bus voltage on it.

pin 1:	Phase A motor voltage
pin 3:	Phase B motor voltage
pin 5:	Phase C motor voltage
pin 7:	MINUS DC bus rail
pin 10:	PLUS DC bus rail

POWER connector provides the input AC power and the motor connections.

pin 1:	Input AC voltage (115V or 220V) phase
pin 2:	Input AC voltage (115V or 220V) neutral
pin 3:	EARTH connection
pin 4:	EARTH connection
pin 5:	Phase C motor connection
pin 6:	Phase B motor connection
pin 7:	Phase A motor connection

SEL and SW are the selector switch (115V/230V input) and the power ON/OFF switch. Please use correct setting on the SEL selector. Please commutate the selector only when the drive is OFF. Erroneous handling may damage the board and may be life threatening for the user.

B. The board connections

Provide the 3-phase induction motor with the rated voltage 3 x 115V or 3 x 220V. (Notice: you may make a use of 3 x 400V wound motor with Y-connected windings, if you take this one, put its windings in Delta (D) connection and use 3 x 220V option once you start the DEMO and GUI).

Provide a 4-wire, 2A rated cable for the motor connection, and a 3-wire 2A rated cable for the mains connection. Make sure you attach the EARTH connections as well. The PHASE/NEUTRAL positioning makes no difference. The same way, you may attach the motor phases in an arbitrary order, this will only affect the direction of the motor CW rotation.

Make all the necessary connections, including the serial link with the PC where the GUI is installed. While making connections, keep the power switch in OFF position. Make the proper selection of 115V/230V selector. Press the selector slider firmly towards desired position.

C. Running the motor through the GUI tool

Having all the cables connected and settings done, press the SW power ON switch into “1” position. After several seconds, provided the mains voltage is within tolerances, the yellow LED diode will start to blink denoting the presence of the DC-bus voltage.

Start the GUI tool. The first screen will prompt you for the COM port used for PC to DEMO board communication. Select either COM1 or COM2 for this purpose. This will lead you to the next screen.

Observe on the left-top a white field with the “DRIVE STATUS” label. Pressing “REFRESH SCREEN” button will read the drive status (ON, OFF, eventual SC, OV, UV, I2T, and heatsink overtemperature) and print a message in the top-left white field.

Below the “DRIVE STATUS” field, another white field is observed with the caption “DC-link current average value over 5 seconds”. Pressing “REFRESH SCREEN” button will read the drive DC-link current averaged over 5 seconds and display the value in [mA] units.

Further below, in the same leftmost column, another white field is observed with the caption “Heatsink temperature”. Pressing “REFRESH SCREEN” button will read the drive heatsink (or the module surface) temperature and display the value in degrees Centigrade.

Below said field, at the bottom left, observe the slider with caption “Temperature limit – default 85”. Using this slider you may adjust the temperature threshold for the thermal protection. A default value is 85 degrees Centigrade, but you may want to change this value.

Notice: When using sliders for the parameter adjustment, bring the mouse pointer over the slider handle, press and keep depressed the mouse button, move the handle observing small yellow-framed numbers that will appear indicating the current slider handle position, place the handle precisely to the position wanted and release the mouse button. Carrying the slider handle away from the range and releasing the mouse button there will have NO effect on the drive parameter change.

In the middle of the form, you have 5 command buttons.

“RESET MICRO” button will reset the microprocessor when pressed, restarting the board after a fault conditions. You may want to use this button to stop the motor immediately when a dangerous situation occur.

“TURN ON” button will enable the inverter and set the green LED diode ON (unless a fault is present).

“REFRESH SCREEN” button is used for updating the drive variables visualized on the screen.

“EXIT” button is used to exit the GUI tool and go back to the operating system.

“GO CYCLE” will bring you to the next form, wherein the drive cycle control may be adjusted, programmed, started and stopped.

Observe on the right side of the screen the 5 sliders used for adjusting:

- The drive acceleration constant
- The drive frequency (i.e. speed) command expressed in [Hz]
- The IGBT PWM frequency selection (5 kHz or 10 kHz)
- The IGBT inverter lockout time selection (800ns or 1600 ns)
- The motor rated voltage and frequency selection.

All these sliders are in their default position at start. Moving relevant slider handles into new position will automatically activate the serial link and pass the new parameter to the drive.

Notice: When using sliders for the parameter adjustment, bring the mouse pointer over the slider handle, press and keep depressed the mouse button, move the handle observing small yellow-framed numbers that will appear indicating the current slider handle position, place the handle precisely to the position wanted and release the mouse button. Carrying the slider handle away from the range and releasing the mouse button there will have NO effect on the drive parameter change.

D. Cycle control

“GO CYCLE” command button of the GUI tool will bring you to the next form, wherein the drive cycle control may be adjusted, programmed, started and stopped.

Observe 4 time intervals (t_1 , t_2 , t_3 , t_4) and the frames where their duration may be adjusted by editing the number written in appropriate fields. When adjusting these numbers, make sure you enter an integer number of seconds not exceeding 30.

For the time intervals t_1 and t_3 , assumed speed reference is zero.

Intervals t_2 and t_4 will have a non-zero speeds. Their speeds W_2 and W_4 , expressed in [Hz] may be adjusted by editing the fields pointed by W_2 [Hz] and W_4 [Hz] labels. Make sure you enter an integer number below 0 and 100. For both intervals, direction of rotation is adjusted by writing into CW/CCW fields. When a CW string is found in said fields (default), the CW direction of the motor shaft is commanded. Otherwise, for whatever string other than CW, the drive assumes CCW direction.

The cycle begins by pressing the “RUN” button. Whenever the user wants to stop the cycle, the STOP button has to be pressed. The “STOP” button will initiate the motor deceleration, while going towards the zero speed a “WAIT !!!” message will appear across the form, and the GUI will switch into the previous frame once the speed reaches zero.

While the cycle is running, the user may observe the DC-link current and the heatsink temperature.

E. RUN-IN procedure for newly assembled boards.

This paragraph outlines the instructions on how to test and run-in the REV 1.0 IRAM Board after the assembly completion. Prerequisites are the board assembled according to schematic diagram and the component placement as defined by PCB file, along with the microprocessor containing the code placed into its socket or soldered directly on the PCB.

E1. The first power up

Make all the drive connections: Connect the motor, the input AC power source (115V or 230V RMS AC) and the serial link. For the input power source, use a variac with the output voltage adjustable in 0V – 300V RMS AC range, 50Hz or 60Hz. Use a 4A slow blow fuse on the board.

Put the SEL selector on the board in 230V position, adjust the variac so as to obtain the supply voltage of 200V RMS and turn the power switch (SW) on. The auxiliary SMPS should start to operate and the yellow LED diode should start to blink.

E2. Check the SMPS auxiliary voltages

From this moment, be very careful touching the board since certain points are at a dangerous voltage (> 300V DC). Use a multimeter adjusted to DC-voltage measurement, adjust the range so as to measure the voltages of 0-25V DC. The zero volts level is available at the pin 10 of PWM pin-strip (or, alternatively, at 7805 or 7815 TO220 linear voltage regulators case). First measure the non-stabilized voltage available at the cathode of D8 diode (close to the RED LED diode). (Cathode is the D8 pin connected to C22). This voltage should be in +17.5V to +23.2V range. Then, check the stabilized +15V, readily available at pin 3 of U4 (7815). This should measure a voltage between +14.3 and +15.1V. At the end, check the voltage of +5V rated, on the pin 12 of PWM pin-strip, this voltage should be from +4.8V to +5.2V.

E3. Start the serial link

Start the GUI on the PC computer, select appropriate COM1/COM2 button. In the main screen, press the button “RESET THE MICRO”. Watch the yellow LED, it should stop blinking for a while, than go on after 1-2 sec.

All the settings are on their default value, ready to run a 3 x 220V induction motor.

Press the button “TURN ON”. The green LED should be ON. If it is not, the red LED is lit. In the event of this error, read the fault type by pressing “REFRESH” button, read the drive status / fault type and interrupt there the running in procedure (in this case, there exists a hardware fault on the board).

Pull the “FREQUENCY COMMAND” slider towards right, set a frequency of 20 – 50 Hz. The motor should start running.

E4. Change the PWM frequency, lockout time and the motor rated voltage.

Read the module/heatsink temperature and the DC-link current by pressing the “REFRESH” button.

Pull left and right the PWM frequency slider, the lockout time slider and the motor rated voltage slider while your 3 x 220V motor is running at 20-50 Hz. You should notice the changes in the audible noise. Replace the sliders into their original position.

Set the acceleration slider to its minimum value. Attempt to change the frequency reference and notice much slower changes in the motor speed. Replace the acceleration slider in its original position.

Read again the module/heatsink temperature. You should notice a smaller or larger increase (depending on whether you use the heatsink or not). If the temperature is NOT changing after 3-4 minutes, interrupt the test by turning the power OFF; in this case the temperature measuring system is not working and further tests are potentially dangerous.

If you run the drive without the heatsink and the stator current is 1.5-2A, after several minutes of operation, the module temperature will reach 85 degrees and the overtemperature fault is going to be generated. Red LED is going to be ON, and the “REFRESH” button will report the “Heatsink overtemperature fault”. In this case, let the drive cool down for a while, press the “RESET” button and restart the drive by pressing “TURN ON”.

While the drive is being cooled down, reduce the input voltage by adjusting the variac. When you go down below 40V RMS, the yellow LED diode will stop blinking (but the SMPS will continue to operate and the serial link is going to be alive). Increasing the voltage will bring the yellow LED back to life. This verifies that the yellow LED function of giving the warning about the bus level being higher than 60V is fully functional.

E5. Undervoltage and overvoltage test.

Press the RESET button on the DEMO board (close to the serial link connector). the effect is the same as sending the “RESET” command over the serial link. Notice: the button is to be depressed for more than 0.8 seconds.

Turn the drive ON as explained before. Set the frequency reference to c.c.a. 30-40Hz. Now reduce gradually the variac voltage. At approximately 140V AC, the red LED

should turn ON, the motor will stop and the “REFRESH” button will report the drive status “Undervoltage fault”.

!!! Proceed with extreme caution !!!

Replace the variac in 200-220V position. Reset the drive and turn the drive ON through the serial link and set the speed to 20-50Hz. Now increase the variac voltage in small steps observing the voltage RMS value on the dial / multimeter. The drive should STOP operating before you reach 290V RMS. “REFRESH” button will report “DC-bus overvoltage. DO NOT INCREASE the variac voltage any further !!! Disconnect the power, replace the variac in zero volts condition.

E6. Short circuit test.

For this test, prepare a 22 Ohm 10W wirewound resistor and make the necessary wiring to allow for the subsequent connection of said resistor across any of the two motor phases. RESET the drive, turn it ON with motor only connected (no 22 Ohm resistor) and set the speed to 20-50 Hz.

Connect the resistor across the motor phases. The drive would stop, and the “REFRESH” button would report a short circuit fault.

!! NOTICE !! If the motor goes ON for more than 1.5 – 2 seconds, remove the 22 Ohm resistor and interrupt the test. In this case, either the short circuit protection does not work or your connections were loose.

E7. Testing 115V functionality.

Reduce the variac voltage to zero. Disconnect the power by turning the SW switch OFF (0). Place the SEL selector into 115V position. Adjust the variac to 115V. Turn the SW switch ON. Using serial link GUI, RESET the board, turn it ON and set the speed to 20-50 Hz. The board should be running O.K.

Reduce the variac voltage to zero. Disconnect the power by turning the SW switch OFF (0). Place the SEL selector into 230V position.

WARNING:

No wires, coins, tools or similar metal objects should fall on the board during all these tests. The consequence of inadvertent connections or loose connections may be the

board failure, explosions, and damage to the personnel. Unwanted connection between the primary and secondary side of photocouplers used for the serial link isolation may damage you PC computer as well.

WARNING:

When running in the boards, it is compulsory to wear safety glasses.

NOTICE: