Induction Motor Speed Control
Inverter Module (IMSCIM-V1)

Features:

Support Motor Type	3-phase Induction Motor, 220V, 50/60Hz, up to 2.2 KW (3 horsepower)
Control method	Scalar (V/F) Control
Power	+310V DC, up to 15A for motor drive and
	+15V DC, up to 0.15A for control circuit
Motor Current	Up to 15A
Main Controller	MC3PHAC (Freescale Semiconductor)
IGBT module	FSBF15CH60BT (Fairchild Semiconductor)
Protection / Fault	Over-voltage, Under-voltage, Over-heating, Over-current
Fault recovery delay	3 sec
PWM frequency	5/10/15/20 kHz (10 kHz default / recommended)
Size	43 x 75 x 95 mm
Weight	110 gram

Safety instructions

Warning: **During assembly and operation, the Induction Motor Speed Control Power Module board poses several inherent hazards, including bare wires, moving or rotating parts and hot surfaces. Serious personal injury and damage to property may occur if the kit or its components are used or installed incorrectly.**

Introduction

Open-frame, single-board Induction Motor Speed Control Inverter Module (IMSCIM-V1) provides easy to install complete solution for 220 V Tree Phase AC motor Speed Control. The Inverter Module need two voltage source with common ground: +310 V DC and +15 V DC for control circuit. Inverter Module PCB and main components description represents at Fig. 1.

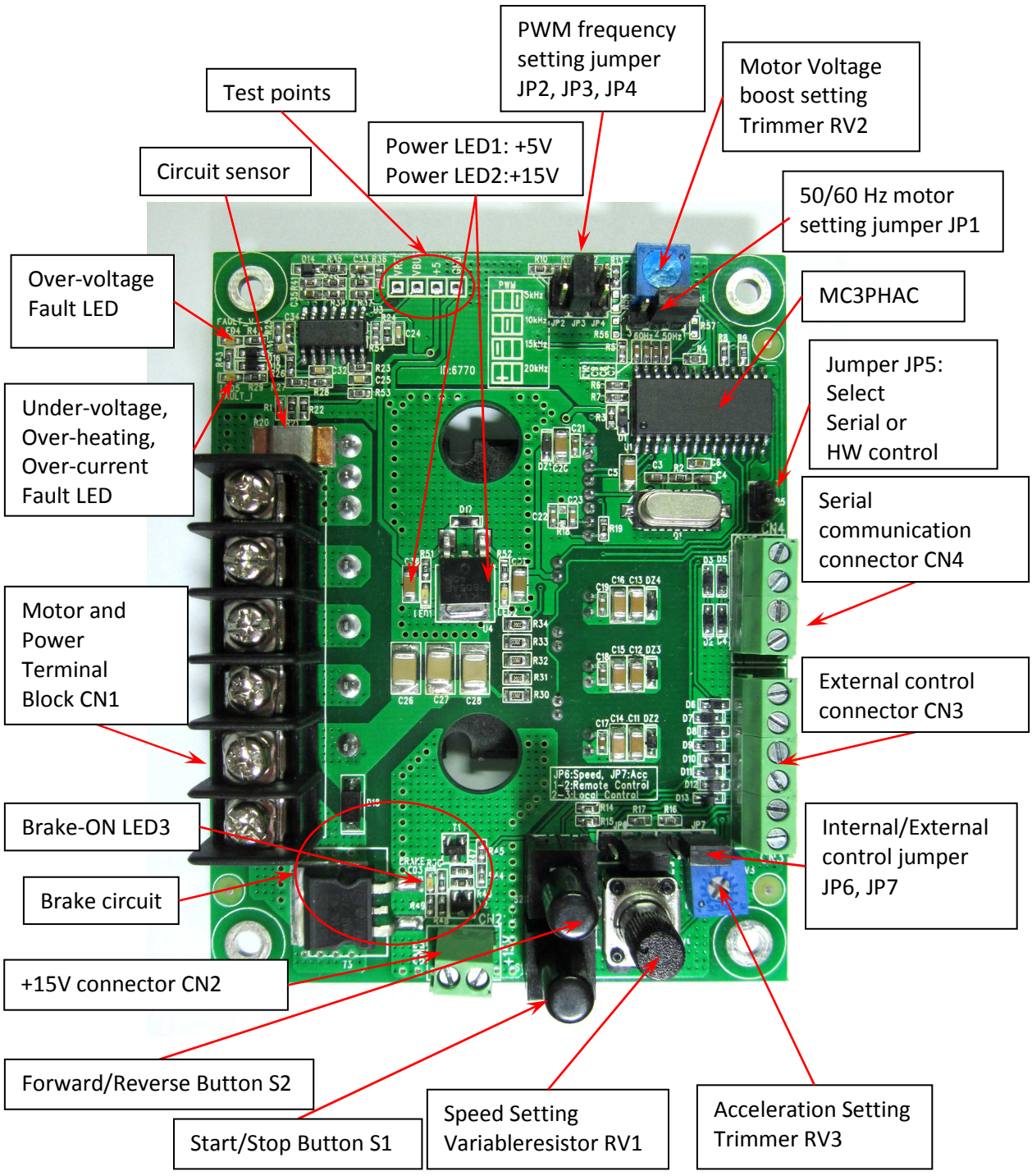

Fig. 1.IMSCIM-V1

Motor and Power Wiring

Warning: **All connectors have no isolation**

General motor and power supply connection represents at Fig.2.

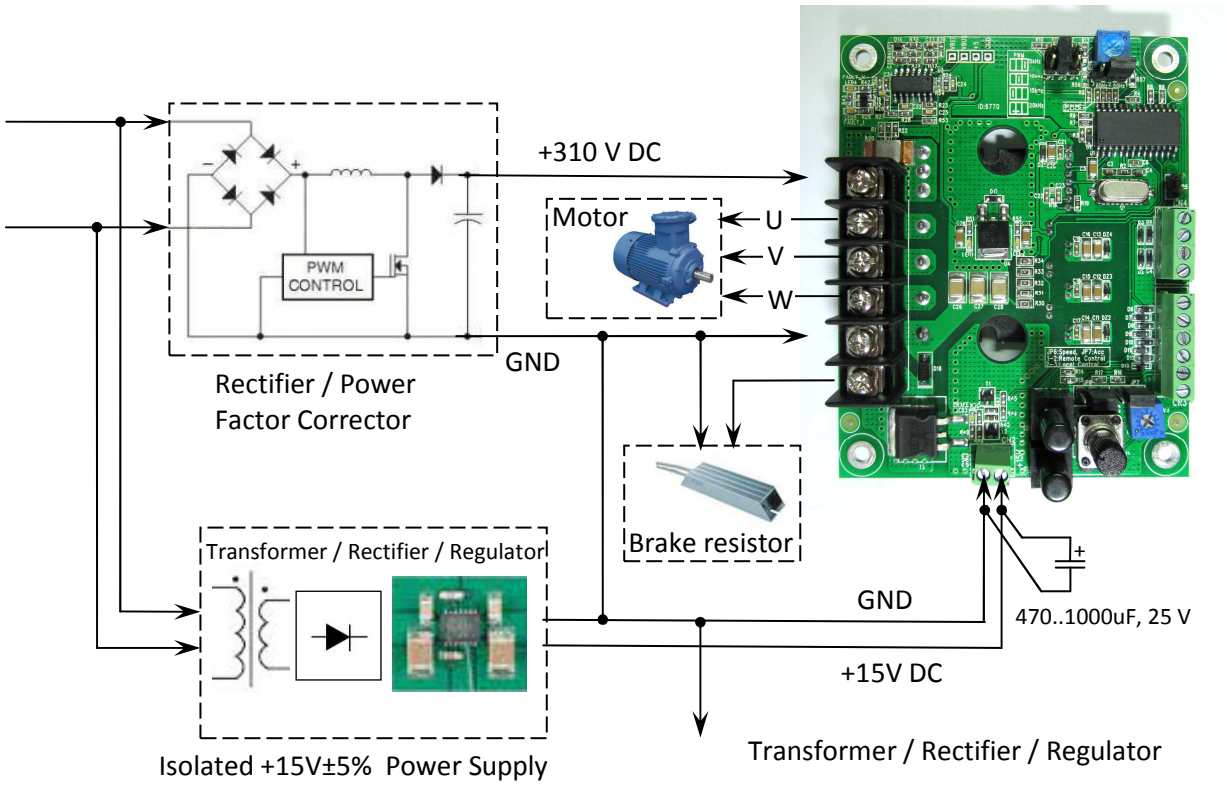

Fig. 2. Motor and Power Supply Wiring

Power Supply +15 V

Power supply +15 Volts must be isolated and must provide stable voltage in range +13.5 to 16.5 volts, output current 150 mA or more. If voltage is less than 12 volts Alarm will happen (refer Table 3). If voltage is over 20 volts IGBT module might be damaged.It is recommend to connect additional aluminum electrolytic capacitor 470..1000uF, 25V close to connector CN2 to avoid voltage reducing during motor start.

Power supply +310V

Various type of Power supply +310 V can be used. It can be simple rectifier and corresponded capacitor or Power Factor Corrector. Inverter Module has protection: Over-voltage Fault if voltage over 407V DC and Under-voltage Fault if voltage under 175V DC (Refer Table 1).

If voltage going over 390V due to back-EMF generation during motor bracing(Refer Table 1) brace circuit (refer Fig. 1) is turning on and power will discharge to eternal Brake resistor (refer Fig. 2).

Table 1.

Voltage	Description
over 407 V	Over-voltage Fault:
390V	Brake On Voltage:
+280V to +350V	Recommended range is
under175 V	Under-voltage Fault

Motor Adjustment

Default settings allow running any 220V induction motor without any damage of equipment or motor and can be acceptable for most types of motors. However, adjustment parameters can increase performance of system itself. Below are default settings (Table 2) and several adjustment steps described.

Table 2.

Default settings	Description
Jumper JP1 at 1-2 position	Position 1-2 suitable for 50 Hz motors. If motor 60 Hz used with Inverter Module change JP1 to 2-3 position
Jumper JP2, JP3, JP4 at 10kHz position	PWM frequency influence to motor noise and power losses. At high frequency PWM motor not make any sound, but motor and Inverter Module power losses increased. At low PWM frequency motor can make noise. It is recommended to use default PWM frequency 10kHz.
Jumper JP5 is open	Jumper JP5 is open for HW control (control speed by Variableresistor RV1, Acceleration by Trimmer RV3, Start/Stop and Forward/Reverse by Button S1 and S2) Jumper JP5 is closed for control via serial communication connector CN4. If Jumper JP5 is closed, setting for RV1, RV3, S1, S2, JP1, JP2, JP3, JP4, JP6, JP7 are ignored.
Jumper JP6 and JP7 at 2-3 position	Jumper JP6 at 2-3 position for speed control by internal Variableresistor RV1 Jumper JP6 at 1-2 position for speed control by external Variableresistor, connected to CN3 (refer "External Control" below) Jumper JP7 at 2-3 position for acceleration control by internal Trimmer RV3 Jumper JP7 at 1-2 position for acceleration control by external Variableresistor, connected to CN3 (refer "External Control" below) Note: settings for Jumper JP6 and JP7 are ignored if Jumper JP5 is closed.
Trimmer RV2 (Motor Voltage Boost) turn left (0%)	Trimmer RV2 set Motor Voltage Boost in range 0 to 24%. Motor Voltage Boost has to be increase for increase motor torque at low speed. Note: New value is applies after controller reboot.
Trimmer RV3 (Motor asseveration) turn middle point (middle asseveration)	Trimmer RV3 set a motor acceleration/deceleration during motor start, stop and any motor speed thanes.
Variable resistor RV1 (Motor Speed) turn middle point	Variable resistor RV1: motor speed control

Adjustment steps:

1. To change motor rotation direction, just reversing the connectionof any two motor wires.
2. Set 50/60 Hz motor setting jumper (JP1)
3. Set PWM frequency setting jumper (JP2, JP3, JP4) at 5, 10, 15 or 20 kHz. LowPWM frequency makes motor noise; High PWM frequency makes more IGBT module power losses and high temperature. PWM frequency 10kHz is recommended (default setting).
4. Set Motor Voltage boost setting Trimmer (RV2) in percent in range from 0 to 20%. (0% - left position is default setting)

External Control

It is possible to use external (remote) motor control using external variable resistors and buttons, connected to External control connector CN3. If external "Start/Stop" and "Forward/Reverse"button are used, internal buttons S1 and S2 must be at release(non-pushed) status.

Warning: **All components and wires, connected to CN3 must be isolated, no any signal isolation on Inverter Module**

Circuit diagram for external buttons and variable resistors connection via CN3 represents at Fig.3.

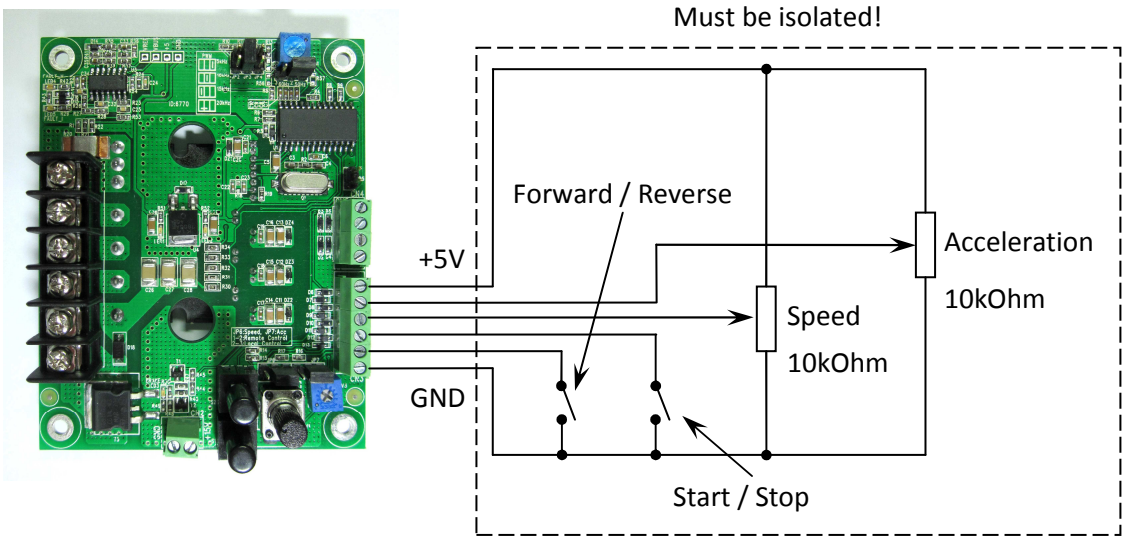

Fig. 3. CN3 Wiring

To use external variable resistors for speed and acceleration control set jumpers JP6 and JP7 at 1-2 position (refer Table 2).It is possible to use just one external variable resistor, for example Speed control only, in this case JP6 have to be set at 1-2 position and JP7 have to be set at 2-3 position. Same for buttons, it is possible to use just one external button, for example "Start/Stop", in this case "Start/Stop" button in the board must be at release(non-pushed) status.

Serial Communication

It is possible to use alternate motor control method via serial communication. To activate serial communication control jumper JP5 must be closed.

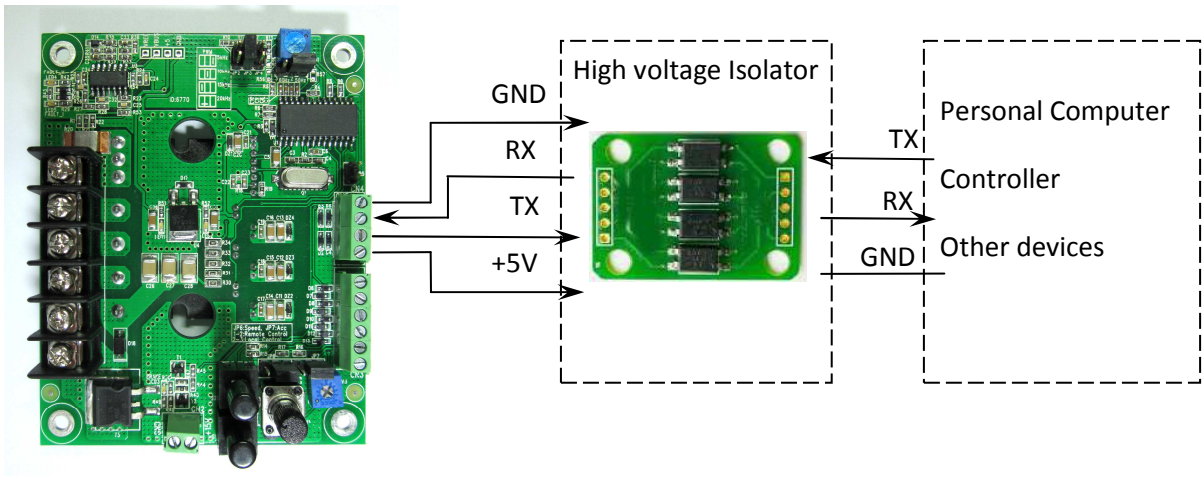

Fig. 4. CN4 Wiring

For data protocol description refer to MC3PHAC manual and application notes at http://www.freescale.com/

Alarm

List of Alarm and fault reason represents at **Table 3**.

Table 3.

Alarm	Description	LED
Over-voltage	Power supply +310V more than +407 Volts	LED 4, LED 5
Under-voltage	Power supply +15V less than +12 Volts Power supply +310V less than +175 Volts	LED 5
Over-current	Motor current more than 17 A	LED 5
Over-heating	IGBT module over-heating	LED 5

Fault recovery delay is 3 second.

Mounting

PCB size: x=75, y=95 mm, PCB thickness: 1.6 mm

PCB / front panel hole location (Origin: left, bottom PCB corner)

Table 4.PCB Mounting holeposition (in mm):

№	Position X	Position Y	Drilling diameter
1	5.0	5.0	3.2
2	70.0	5.0	3.2
3	70.0	90.0	3.2
4	5.0	90.0	3.2

Table 5. HeatsinkMounting holeposition (in mm):

№	Position X	Position Y	Drilling diameter [mm]
1	32.2	70.0	3.2
2	32.2	30.0	3.2

Table 6. Button holeposition (in mm)

№	Position X	Position Y	Drilling diameter	Remark
1	45.0	15.0	6.2	Forward / Reverse
2	45.0	5.0	6.2	Start / Stop

Table 7. Variable resistor / Trimmerhole position (in mm)

№	Position X	Position Y	Drilling diameter	Remark
1	55.0	10.0	4.0	Speed
2	65.0	13.0	4.0	Acceleration
3	58.0	91.0	4.0	Boost

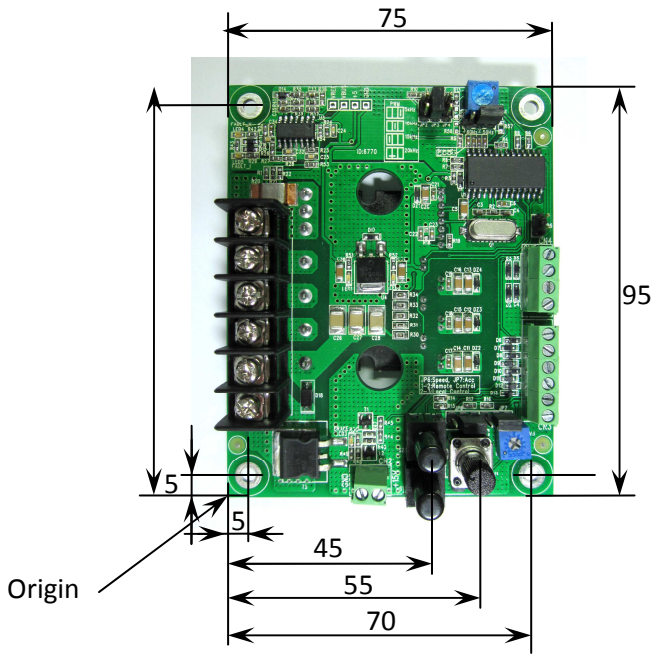

Fig. 5. Top view dimension

PCB to Front Panel spacer: 15 mm
PCB to Heatsinkspacer: 10 mm

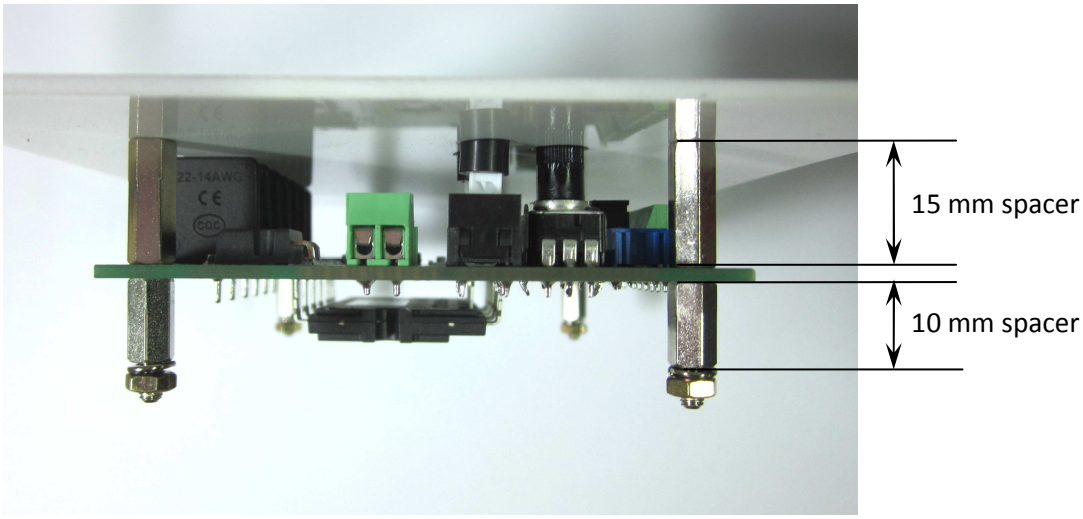

Fig. 6. Side view dimension

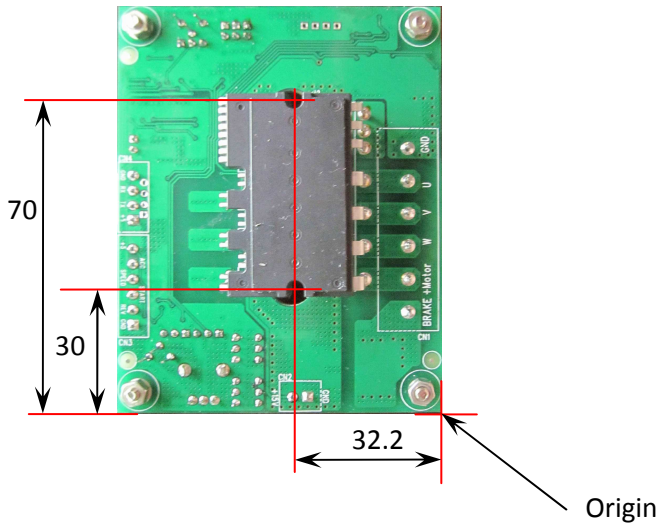

Fig. 7. Bottom view dimension

Additional information about Heatsink size and mounting refer to FSBF15CH60BT manual and application notes at http://www.fairchildsemi.com/

Errata

PCB holes wrong position
Description: PCB holes for FSBF15CH60BT mounting screw are shifted 2.8 mm (refer fig. 8)

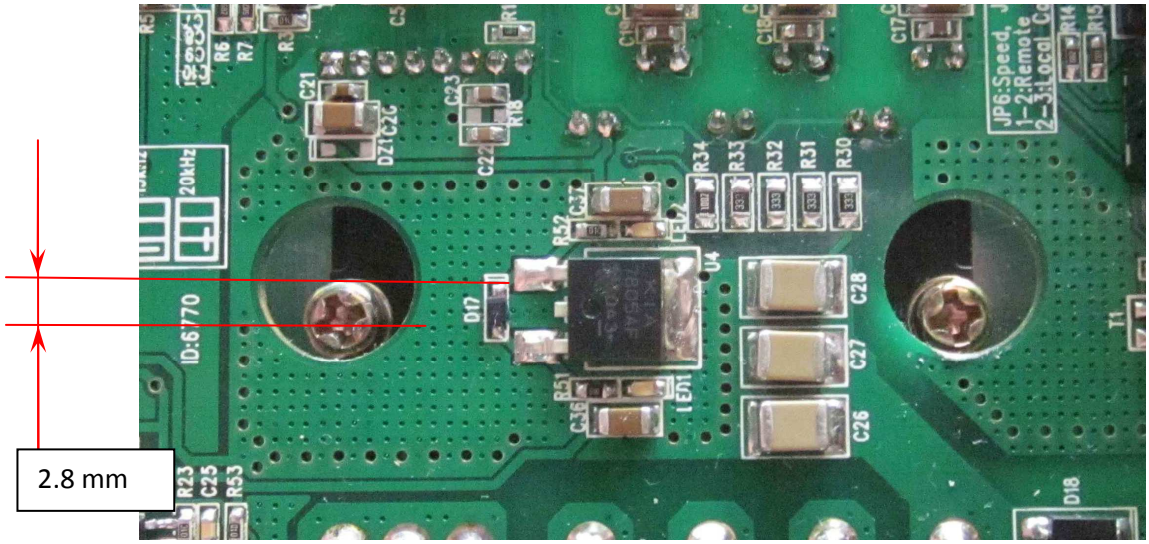

fig. 8. PCB hole wrong position

Workaround: None
Fixed: will fix in next revision