NEC

User's Manual

3 Phase Motor Control High Voltage Inverter Module

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Notes for CMOS Devices

1. **VOLTAGE APPLICATION WAVEFORM AT INPUT PIN**
   Waveform distortion due to input noise or a reflected wave may cause malfunction. If the input of the CMOS device stays in the area between VIL (MAX) and VIH (MIN) due to noise, etc., the device may malfunction. Take care to prevent chattering noise from entering the device when the input level is fixed, and also in the transition period when the input level passes through the area between VIL (MAX) and VIH (MIN).

2. **HANDLING OF UNUSED INPUT PINS**
   Unconnected CMOS device inputs can result in malfunction. If an input pin is unconnected, it is possible that an internal input level may be generated due to noise, etc., causing malfunction. CMOS devices behave differently than Bipolar or NMOS devices. Input levels of CMOS devices must be fixed high or low by using pull-up or pull-down circuitry. Each unused pin should be connected to VDD or GND via a resistor if there is a possibility that it will be an output pin. All handling related to unused pins must be judged separately for each device and according to related specifications governing the device.

3. **PRECAUTION AGAINST ESD**
   A strong electric field, when exposed to a MOS device, can cause destruction of the gate oxide and ultimately degrade the device operation. Steps must be taken to stop generation of static electricity as much as possible, and to quickly dissipate it should it occur. Environmental control must be adequate. When it is dry, a humidifier should be used. It is recommended to avoid using insulators that easily build up static electricity. Semiconductor devices must be stored and transported in an anti-static container, static shielding bag or conductive material. All test and measurement tools including work benches and floors should be grounded. The operator should be grounded using a wrist strap. Semiconductor devices must not be touched with bare hands. Similar precautions need to be taken for PW boards with mounted semiconductor devices.

4. **STATUS BEFORE INITIALIZATION**
   Power-on does not necessarily define the initial status of a MOS device. Immediately after the power source is turned ON, devices with reset functions have not yet been initialized. Hence, power-on does not guarantee output pin levels, I/O settings or contents of registers. A device is not initialized until the reset signal is received. A reset operation must be executed immediately after power-on for devices with reset functions.

5. **POWER ON/OFF SEQUENCE**
   In the case of a device that uses different power supplies for the internal operation and external interface, as a rule, switch on the external power supply after switching on the internal power supply. When switching the power supply off, as a rule, switch off the external power supply and then the internal power supply. Use of the reverse power on/off sequences may result in the application of an overvoltage to the internal elements of the device, causing malfunction and degradation of internal elements due to the passage of an abnormal current. The correct power on/off sequence must be

judged separately for each device and according to related specifications governing the device.

6. **INPUT OF SIGNAL DURING POWER OFF STATE**
Do not input signals or an I/O pull-up power supply while the device is not powered. The current injection that results from input of such a signal or I/O pull-up power supply may cause malfunction and the abnormal current that passes in the device at this time may cause degradation of internal elements. Input of signals during the power off state must be judged separately for each device and according to related specifications governing the device.

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- Product release schedule
- Availability of related technical literature
- Development environment specifications (for example, specifications for third-party tools and components, host computers, power plugs, AC supply voltages, and so forth)
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Preface

Readers This manual is intended for users who want to understand the functions of the 3-Phase Inverter Starter Kit Module supporting NEC Electronics' range of Motor Control ASSPs.

Purpose This manual presents the hardware manual of the 3-Phase Inverter Starter Kit Module supporting NEC Electronics' range of Motor Control ASSPs.

Organization This system specification describes the following sections:

- Inverter module
- IGBT module
- Opto isolation
- Power supplies
- User connections

Legend Symbols and notation are used as follows:

- Weight in data notation: Left is high order column, right is low order column
- Active low notation: $\overline{xxx}$ (pin or signal name is over-scored) or /xxx (slash before signal name)
- Memory map address: High order at high stage and low order at low stage
- Note:
- Caution:

Note Additional remark or tip

Caution Item deserving extra attention

Numeric Notation

- Binary: xxxx or xxxB
- Decimal: xxxx
- Hexadecimal: xxxxH or 0x xxxx

Prefixes representing powers of 2 (address space, memory capacity):

- K (kilo): 210 = 1024
- M (mega): 220 = 10242 = 1,048,576
- G (giga): 230 = 10243 = 1,073,741,824

Table of Contents

Chapter 1 Introduction

This document details the operation, interfaces and cautions for the 3Φ Inverter Starter Kit Module supporting NEC Electronics' range of Motor Control ASSPs.

The module is designed to support 3Φ Brushless DC, 3Φ PMAC and 3Φ AC Induction motor types.

1.1 Warnings

This high voltage starter kit Inverter unit operates in an environment that includes dangerous voltages and rotating machinery. Care should be taken when using the unit especially if the unit is removed from the case.

- When switching off the mains supply, stored energy will remain in the high voltage capacitors. It is necessary to wait at least 50 seconds after disconnecting the mains supply, before disconnecting any of the attached equipment (i.e. The Motor or Control Boards), or before opening the case.
- Switching on the module without ensuring that the high voltage supplies have fully discharged and that the drive signal are in the "OFF" state is liable to cause damage to the unit. Bias resistors are provided to ensure correct polarity of these signals if the unit is inadvertently switched on without any control boards connected.
- Ensure that the input voltage selector is set for the correct AC Mains voltage range. Incorrect setting of the switch for the mains supply used will cause damage to the unit
- For continued protection against risk of fire only replace fuses with the same type and rating (T6.3A / 250V).
- Repairs may only be attempted by authorised personnel. Repairs performed inappropriately and changes or modifications not explicitly allowed by the equipment's manufacturer may cause damage to the unit and severe danger to the user.
- The Power Module and the motor can reach temperatures hot enough to cause burns. Care should be taken to avoid touching the motor or removing the case after prolonged operation.

1.2 Precautions

The following precautions should be taken and used in conjunction with the following sections of this document

- The intended use of this inverter module is as test and measuring equipment for use in electronic development offices or laboratories and used by appropriate professionals
- When operating from an AC Mains supply without an Isolation Transformer, please be aware that the Power Stage grounds and external ground (i.e. oscilloscope, Control Board etc.) will be at different potentials.
  Note that if an un-earthed oscilloscope is used, the probe ground references and the case can be subject to dangerous voltages.
- Before moving scope probes, making connections, etc., it is generally advisable to power down the high-voltage supply and ensure that it is fully discharged.
- Care should be taken with Jewellery and other loose items and the use of a protective shield is advisable.
- Operation in lab setups that have grounded tables and / or chairs should be avoided.
- The power cord plug must be easily accessible at any time so that it can be disconnected immediately in case of danger.
- If the circuit board has been removed from the case, ensure that the cables are reconnected to the correct connectors when it is re-assembled.

Note The Inverter units is not intended for use without the case

- All applications should utilise the Over Current and Thermal Protection capabilities to protect the IGBT module and motor.
- Ensure that all connections and settings to the unit are correct before operation, to avoid possible damage to the components and / or the motor.
- Ensure that the correct settings are used for the appropriate Motor rating ("*see section Equipment Ratings*")

Chapter 2 Definitions

2.1 Overview

The high voltage Inverter unit forms part of the overall Motor Control starter kit products, which consist of 3 component parts (see figure 1).

1. A Motor control ASSP microcontroller board
2. A user interface and I/O board
3. A 3Φ high voltage Inverter Module including Power supplies and Opto-Isolation

The boards are designed in such a way that they maybe used individually or as a kit.

Please note that the high voltage unit will only available separately. The other component parts can be purchased separately.

Figure 2-1 3Φ Motor Control Starter Kit – Inverter Module

Connection to the Microcontroller and I/O boards is via the 40 way interface connector shown on the side of the case.

All interfaces, mains power input, motor connections and selectable options provided ensure that the user is protected from the high voltage areas. The unit is not intended for use without the case.

2.2 Equipment Ratings

The unit is designed to operate over the following electrical and environmental conditions

Table 2-1 Mains Input Ratings

Specification	Rating
Input voltage	100 VAC to 240 VAC
Input current	3 A
Mains Frequency	50 - 60 Hz
Mains connection	Appliance inlet (Type - IEC320)

Table 2-2 Output Ratings

Specification	Rating
Output voltage	130 Vdc to 350 Vdc
Output power	300 / 600 W (max.)

Table 2-3 Protection Levels

Specification	Rating
Protection	Class 1
Transient voltage	Category 2
Pollution degree	Level 2

Table 2-4 Operating Conditions

Specification	Rating
Operating temperature range	+5°C to +35°C
Storage temperature range	-40 to +70°C
Operating relative humidity	20% to 80%
Storage relative humidity	5% to 85%

Chapter 3 Inverter Module

The high voltage Inverter unit contains the following sections:

1. The High Voltage 3Φ IGBT Bridge Module
2. All the necessary Power Supplies
3. Opto-isolation for the logic drive and logic level sensor signals
4. Opto-isolation for the analogue sensor signals

This unit includes all of the necessary power supplies and inverter circuitry for controlling a 3Φ motor. It provides all necessary current and voltage measurement circuits and signal conditioning circuits required for motor control.

The module rectifies 100V to 220V AC mains voltage to the high voltage unregulated DC supply for the Inverter bridge module. The +5V and +15V regulated DC supplies for the control and interface circuits are generated from the unregulated DC supply

The inverter bridge uses an integrated 6 transistor IGBT module, which includes high side drivers and protection circuitry.

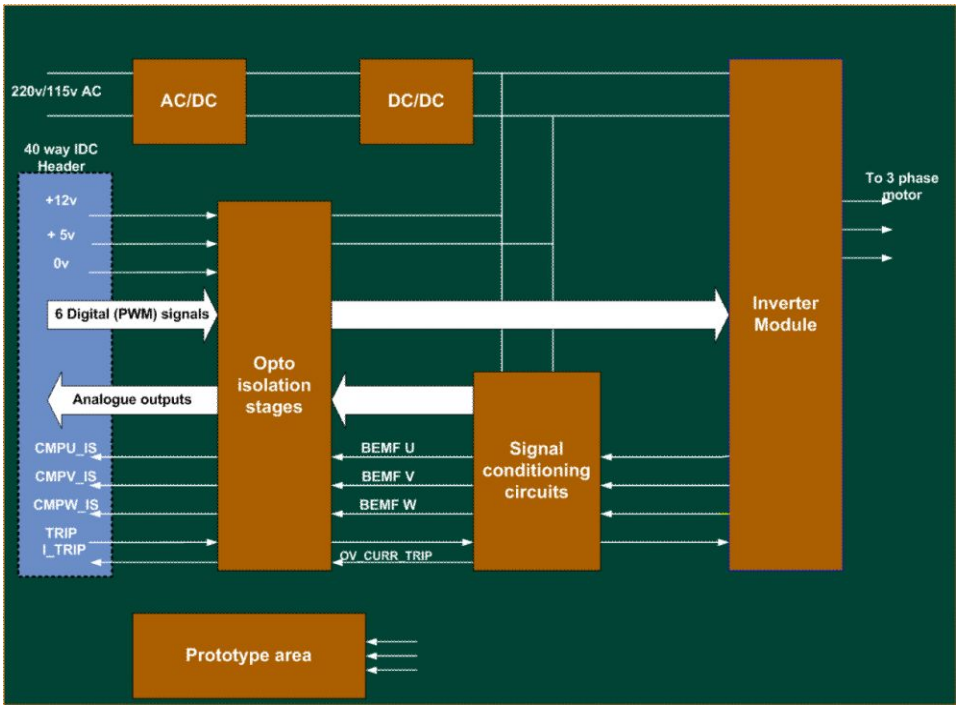

Figure 3-1 Inverter Module block diagram

Chapter 4 IGBT Module

The 3Φ IGBT module provides all of the six transistor drive for the Motor together with the integrated high side driver and protection functions.

The IGBT module used on the is supplied by International Rectifier, part number “IRAMS10UP60A”

Features

- Integrated Gate Drivers and Bootstrap Diodes
- Temperature Monitor
- Temperature and Over current shutdown
- Fully Isolated Package
- Low VCE (on) Non Punch Through IGBT Technology
- Under-voltage lockout for all channels
- Matched propagation delay for all channels
- Low side IGBT emitter pins for current control
- Schmitt-triggered input logic
- Cross-conduction prevention logic
- Lower di / dt gate driver for better noise immunity

4.1 Specifications

A summary of the specifications of the IGBT module is as follows.

(For full specifications and recommended use of the IGBT module specifications, please refer to manufacturer’s data sheet and the Inverter module reference schematics)

4.1.1 IGBT Driver Maximum Operating Conditions

Table 4-1 Maximum IGBT Module Operating Conditions

Symbol	Definition	Min	Max	Units
Vh	High Side Floating Supply Voltage	Vs + 12	Vs + 20	V
Vs	High Side Supply Offset Voltage		450	V
Vdd	Low Side Logic / Fixed Supply Voltage	12	20	V
V_{trip}	T/I_{trip} input voltage	Vss	Vss +5	V
Vin	Logic Input Voltage (Lin / Hin)	Vss	Vss +5	V

Typical IGBT Driver Switching Characteristics

$V_{DD}=V_{BS}=V_{BIAS}=15V$, $I_o=1A$, $V_D=9V$, $T_A=25°C$

Table 4-2 Typical IGBT Module Switching Conditions

Symbol	Definition	Value (Typ)	Units
Ton	Input to Output turn On delay time	470	nS
Toff	Input to Output turn off delay time	615	nS
Dt	Dead time	300	nS
I_{trip}	T/I_{trip} turn off delay time	750	nS
T	Post I_{trip} to turn off clear time	9	mS

Table 4-3 IGBT Module Pin Connections

Pin	Name	Description
1	VB3	High Side Floating Supply Voltage 3
2	W, VS3	Output 3 - High Side Floating Supply Offset Voltage
3	na	None
4	VB2	High Side Floating Supply Voltage 2
5	V, VS2	Output 2 - High Side Floating Supply Offset Voltage
6	na	None
7	VB1	High Side Floating Supply Voltage 1
8	U, VS1	Output 1 - High Side Floating Supply Offset Voltage
9	na	None
10	V+	Positive Bus Input Voltage
11	na	None
12	LE1	Low Side Emitter Connection - Phase 1
13	LE2	Low Side Emitter Connection - Phase 2
14	LE3	Low Side Emitter Connection - Phase 3
15	HIN1	Logic Input High Side Gate Driver - Phase 1
16	HIN2	Logic Input High Side Gate Driver - Phase 2
17	HIN3	Logic Input High Side Gate Driver - Phase 3
18	LIN1	Logic Input Low Side Gate Driver - Phase 1
19	LIN2	Logic Input Low Side Gate Driver - Phase 2
20	LIN3	Logic Input Low Side Gate Driver - Phase 3
21	T/I_{trip}	Temperature Monitor and Shut-down Pin
22	VCC	+15V Main Supply
23	VSS	Negative Main Supply

Note The PWM drive input from the Microcontroller / I/O board should be set to “Active Low”. All 6 channels of the PWM timer should be used (i.e. Hi**U**, Lo**U**, Hi**V**, Lo**V**, Hi**W**, Lo**W**)
The circuit schematic for the IGBT module is as shown in Appendix B

4.1.2 IGBT Module Thermal Characteristics

As can be seen in figure 3 below, the IGBT module provides an internal over temperature monitor which can be combined with a hardware shutdown function.

The module may need to be shutdown for either of the following reasons

1. Over temperature
2. Over current detection

Current detection and monitoring is described later in this document. The use of the

TSENSE / ITRIP pin can be used to protect the IGBT module for both over temperature or over current events.

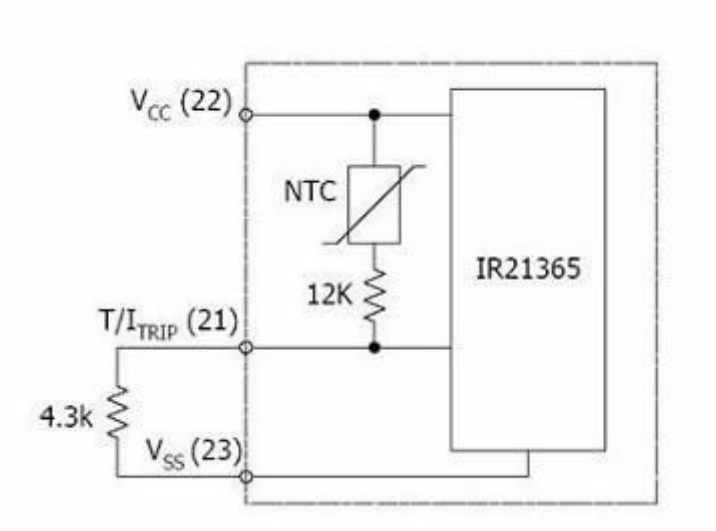

Figure 4-1 Internal NTC–Connection Diagram

Temperature Sensing and Measurement

The temperature output (TSENSE / ITRIP) from the IGBT module (shown in *Figure 4-1*), is provided to the user interface as an isolated analogue signal (TEMP – ST1 pin 9) in the range 0V to 3.3V.

The isolation circuit provides a unity gain stage, so that the temperature can effectively be monitored directly from the IGBT module (See the graph of *Figure 4-2*). This enables the control system to monitor this parameter to ensure that the IGBT module does not overheat.

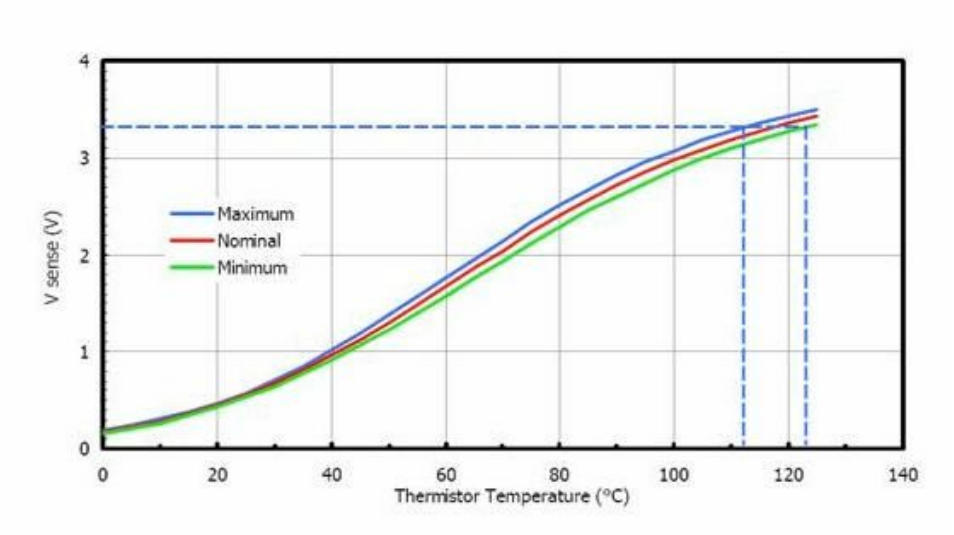

Figure 4-2 Internal NTC-Thermistor Characteristics

Please note that the Analogue reference voltages of the A/D converter on the microcontroller ASSP boards are set to Vdd (5V). So the maximum threshold of the analogue input (TEMP) is 66% of the analogue reference voltage (i.e. 3.3V / 5V).

To change the ADC reference voltage, please refer to the Microcontroller ASSP board circuit schematics.

4.1.3 Module Shutdown

The module can be shut down by the control system either with the hardware shutdown signal (TRIP – ST1 pin 19), or stopping the PWM drive signals to the IGBT module by software (Ideally both methods should be used).

The Inverter unit employs an automatic over current /temperature detection circuit which is designed shutdown the IGBT module automatically. Please note that this function is designed as “latching” circuit, so once tripped (i.e. shutdown) it will remain unit the main power to the unit is switched off and the high voltage capacitors discharged.

The automatic IGBT shutdown function is enabled as the default manufacturing condition. It can be disabled by removing Jumper “W5”.

Chapter 5 Opto Isolation

Overview

Isolation is provided for all digital and Analogue signals between the low voltage Microcontroller / I/O boards and the high voltage power electronics for the motor.

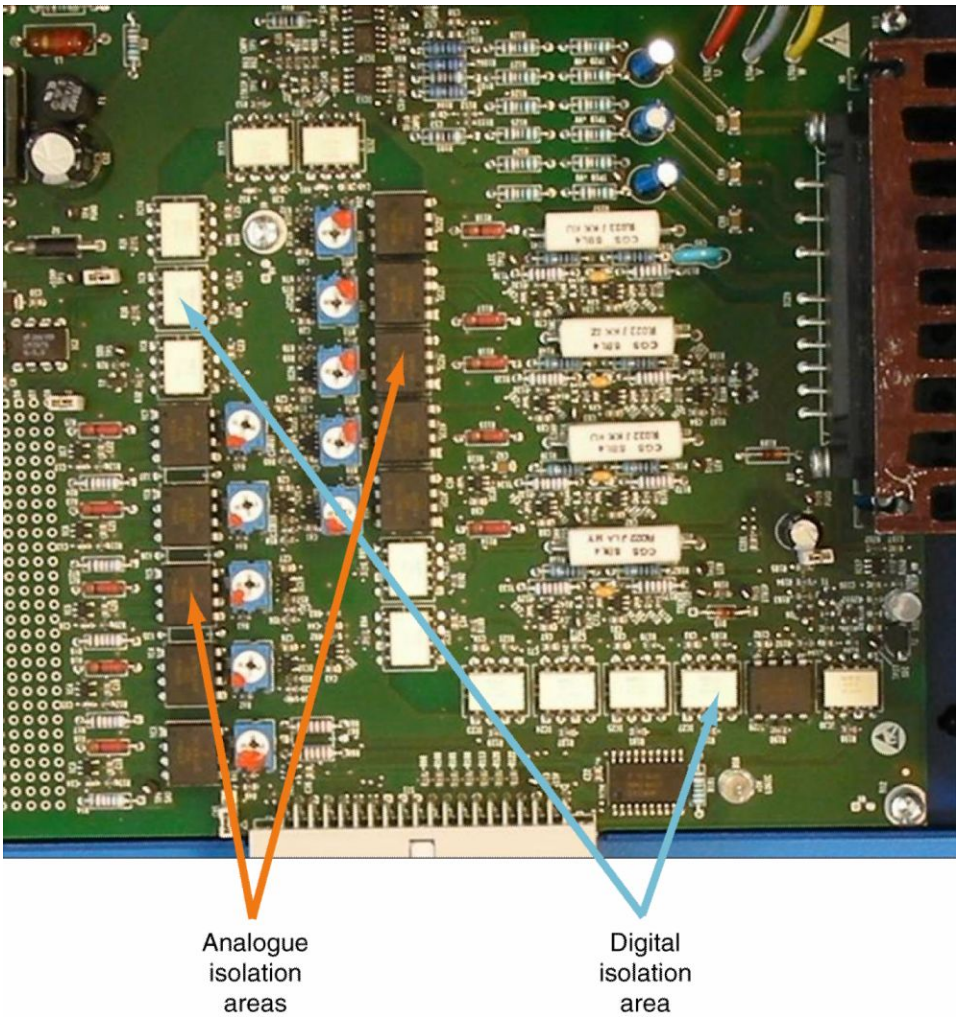

Figure 5-1 Opto-Isolation

The PCB layout in *Figure 5-1* above is shown removed from the case for illustration purposes only. Operation of the unit should always be with the PCB mounted inside the case.

The circuit schematics for the Analogue and Digital isolation are shown in Appendices B and C

The isolation scheme is as shown in *Figure 5-2* below.

5.1 Isolation Block Diagrams

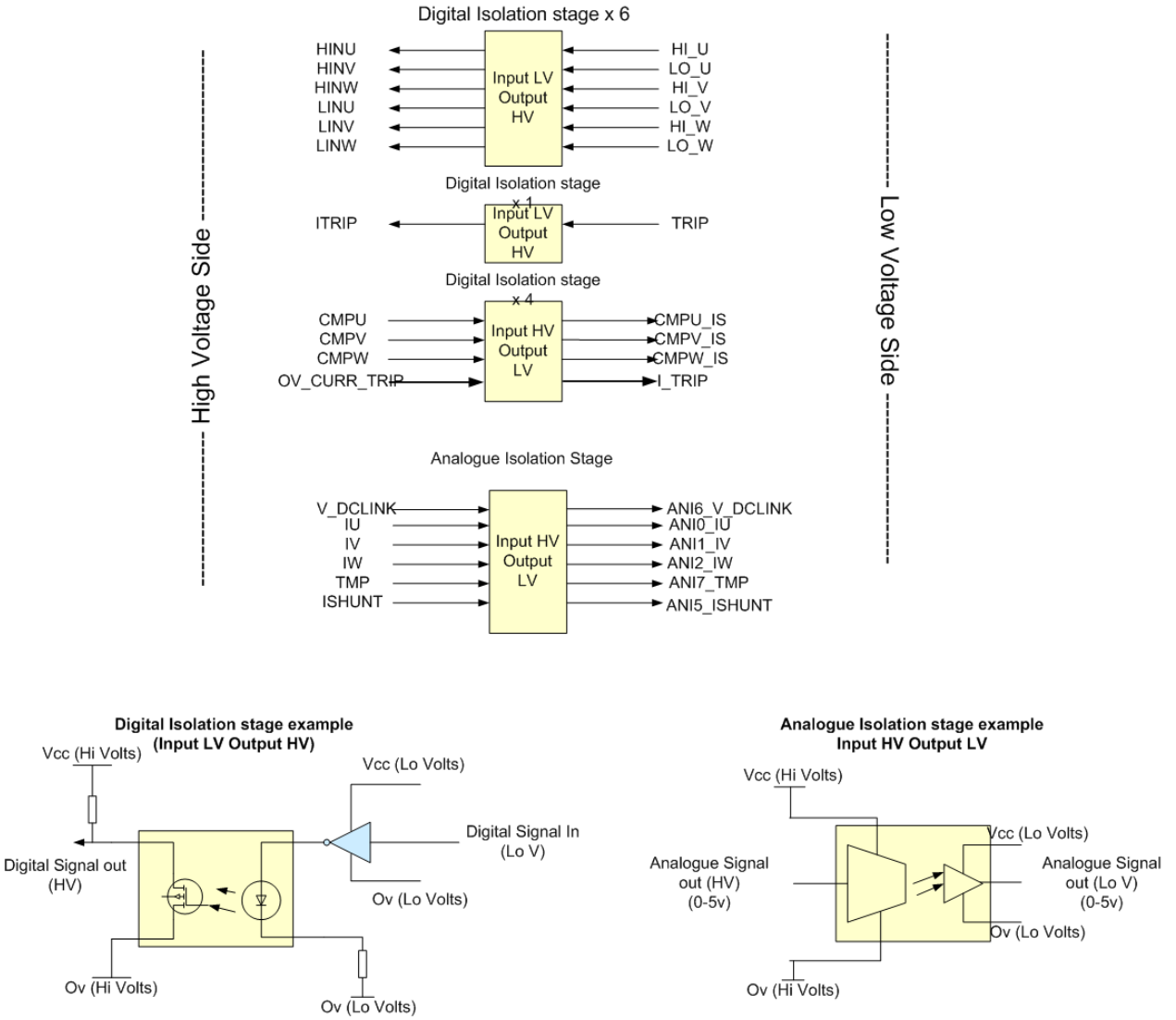

Figure 5-2 Analogue and Digital Opto-isolation Stages

The Opto-isolation for the digital I/O signals provide a “Non Inverting” signal conversion.

5.2 Analogue Isolation Circuit Description

The following section describes the functions and operation of the analogue isolation circuitry providing feedback and monitoring functions to the microcontroller control system.

The functions provided by the analogue isolation circuits are as follows

1. Three zero crossing detection comparator circuits for BLDC Sensor less control

2. An isolated over current input to the control system (Digital Input to the control system). (This function can also be used for automatic hardware over current shutdown of the IGBT module.)
3. Current measurement of each phase
4. Total current monitor (combined with item 2 above)
5. IGBT module Temperature sensor output
6. Voltage monitor for each phase
7. High Voltage monitor (+350 VP)

5.2.1 Functional Description - Current Measurement

The current measurement circuits provide an analogue “shunt” measurement for each phase together with a total current measurement function.

The individual current measurement circuits operate over a range of 0A to 3A per phase, which is converted to an output voltage in the range of 0V to 5V full scale.

This provides an output conversion ratio of 600mA / V

The total current measurement circuit provides an input range of 0A to 3A, providing an output range of 0V to 5V full scale.

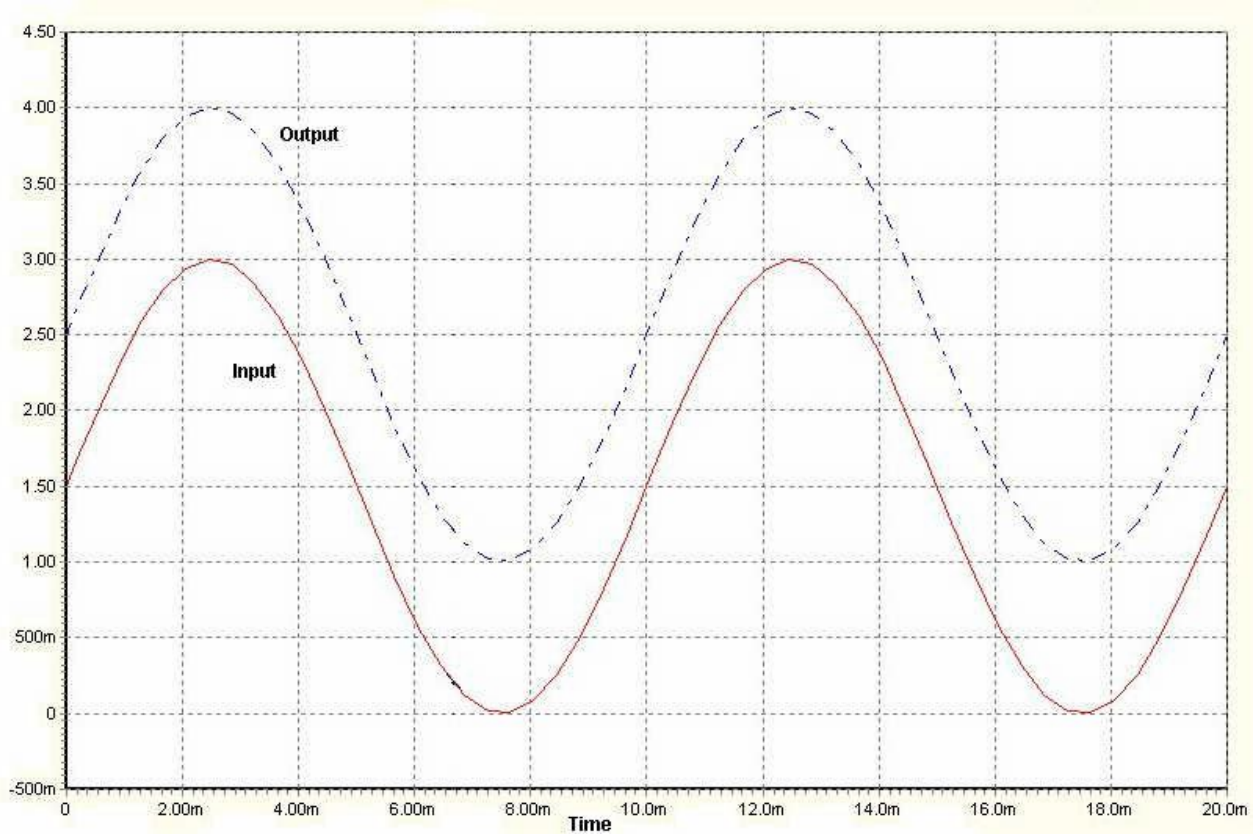

Figure 5-3 Current Measurement Transfer Function

The total current measurement is also converted into a digital output (ITRIP), to provide a hardware shutdown signal for the 6 PWM outputs from the Microcontroller.

The polarity of the “ITRIP” signal is

1. 0V Normal Operation
2. 5V Over current (i.e. Shutdown condition @ 3A)

Automatic shut down of the IGBT module is provided by ensuring that Jumper "W5" is connected (Default manufacture setting). This is a "latching" function, so that once triggered (i.e. Shutdown), the mains power to the unit must be switched off and allowed to discharge. Once fully discharged, the mains power can be re applied to the unit. (Assuming that the cause of the fault condition has been fixed)

It is advisable to stop the operation of the Microcontroller ASSP during this operation

Note The hardware PWM shutdown input of the micro controller needs to be set for +Ve edge triggering, or active high level.

The signals are provided on the 40 way interface connector (ST1) are as shown below

	Signal	Pin Number	Comments
1.	IW	ST1 pin 36	(Phase W current Analogue Output)
2.	IV	ST1 pin 38	(Phase V current Analogue Output)
3.	IU	ST1 pin 40	(Phase U current Analogue Output)
4.	ISHUNT	ST1 pin 34	(Total current Analogue Output)
5.	ITRIP	ST1 pin 39	(Over current Digital Output)

5.2.2 Functional Description - Zero Crossing Detection

The zero crossing detection circuits consist of comparator circuits with input signal conditioning and filtering components.

The design of these circuits is to provide a zero crossing detection of the motor BEMF signals (The schematic diagrams of these functions are included in Appendix C).

The output of the isolated signals provides a logic level drive (0v – 5V) for the control system.

These signals are provided on the interface connector as shown below.

	Signal	Pin Number	Comments
1.	CMPW	ST1 pin 24	(Phase W Zero Crossing)
2.	CMPV	ST1 pin 26	(Phase V Zero Crossing)
3.	CMPU	ST1 pin 28	(Phase U Zero Crossing)

5.2.3 Functional Description - Inverter Motor Terminal Voltages

The isolation circuits for the three Motor Phase voltages provide input signal conditioning and conversion from the high voltage PWM inverter voltage to that of an analogue output. This also includes an output indicating the High Voltage inverter supply level. These signals in the range of

1. Input Voltage Range 0V to 375V
2. Isolated Output Voltage Range 0V to 5V

This provides a conversion ratio of 75V / V

The schematic diagrams for these circuits are included in Appendix C

These signals are provided on the interface connector as shown below

	Signal	Pin Number	Comments
1.	V-W	ST1 pin 2	(Phase W Terminal Voltage)
2.	V-V	ST1 pin 4	(Phase V Terminal Voltage)

3.	V-U	ST1 pin 6	(Phase U Terminal Voltage)
4.	V_DCLINK	ST1 pin 37	(Inverter Supply Voltage +350VP)

5.2.4 Functional Description - IGBT Temperature Sensor

The output from the IGBT module is converted into an analogue voltage with unity gain levels.
The output level is in the range of 0V to 3.3V. The maximum operating level is 3.3V.
This provides an approximate conversion of 36.3oC per Volt. (See *Figure 4-2*)

	Signal	**Pin Number**	**Comments**
1.	TEMP	ST1 pin 32	(IGBT Temperature Voltage)

Chapter 6 Power Supplies

6.1 Overview

The power supply is designed to provide the unregulated DC supply for the IGBT and motor, as well as regulated DC supplies for the isolated side of the inverter unit.
The regulated supplies provide power for the, Opto-isolation circuits and the low voltage supply for the IGBT module (+15V).

Supplies available on the module are:

1. Regulated +5V and +15V DC 330mA Total
2. Unregulated +350V DC 3A Total

The on board power supplies only provide power to the un-isolated (i.e. high voltage) side of the unit. An external +5V DC supply is needed to supply power to the isolated side. This can be supplied directly from the Microcontroller / I/O boards or the users target control system via the interface connector ST1.

The unit is able to support 100V, 110V and 240V mains input voltages, while designed to supply the maximum motor voltage. The Inverter unit employs a voltage doubler circuit, so it is important that the correct mains supply setting is selected using switch “S1” to avoid damage to the Inverter and possibly the motor.

The circuit schematic for the Power supply is as shown in Appendix A

Note The +5V DC supply is derived from the +15V supply, thus the maximum power supply current indicated above is a combined total.

6.2 Mains Input

The power input is designed to be connected using a standard Mains cable to the IEC320 switched appliance inlet, as shown in *Figure 6-1* below.

Figure 6-1 Mains Power Input

The AC mains input provides a switched, filtered and fused supply to the board.

Please ensure that if it is necessary to replace either of the two fuses, that they are replaced with the same type and rating. (T6.3A / 250V)

In order to select the correct mains input voltage a switch (S1) is provided on the side of the case as shown in *Figure 6-2* .

Warning ! Ensure that the mains selection switch (S1) is set to the correct setting before connecting and switching on the unit. An incorrect setting of this switch could cause damage to the unit.

See "*section*" below and *Table 6-1* below for the correct settings.

6.2.1 Mains Selection Options

The module is designed to provide the maximum motor voltage from either a 100V, 110V or 240V mains supply. The power supply includes an AC voltage doubler circuit, so it is important that the correct AC voltage setting is used when operating the units outside of Europe or when using lower rated motors that require a lower AC supply voltage.

The location of the switch is a shown in *Figure 6-2* below

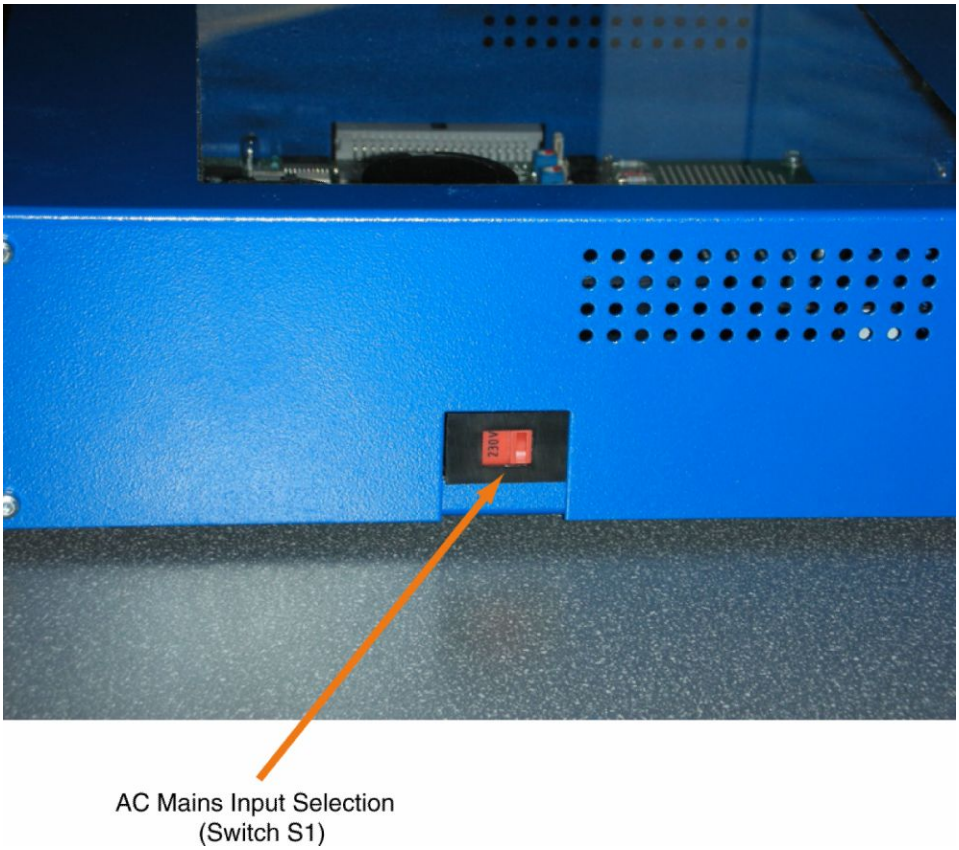

Figure 6-2 AC Mains Input Selection

If a motor is used that that requires a lower voltage (i.e. 150Vdc (110Vac)), then the Inverter board should be set for 240V mains input (no doubling) via the switch S1.

If necessary, an external step down transformer should be used to provide the appropriate mains input supply.

Other valid input combinations are available for the selection of AC Mains voltage and rectified DC motor voltage. The table below shows the possible options for AC mains input and rectified DC voltage

Table 6-1 AC Mains and DC Motor Voltage Valid Switch Combinations

AC Mains Input	Switch (S1) Selection	Equivalent AC Voltage	DC Motor Voltage
100V	110V	~200V	283V
100V	240V	100V	142V
110V	110V	~220V	311V
110V	240V	110V	156V
240V	240V **	240V	340V
240V	110V**	Not Allowed	Not Allowed

Caution The only option for 240V AC mains input is with the Switch (S1) set to 240V. Any other setting will damage the unit.

Chapter 7 User Connections

The main connection between the Inverter unit and the Microcontroller / IO board (or user control board) is as shown in *Figure 7-1* below.

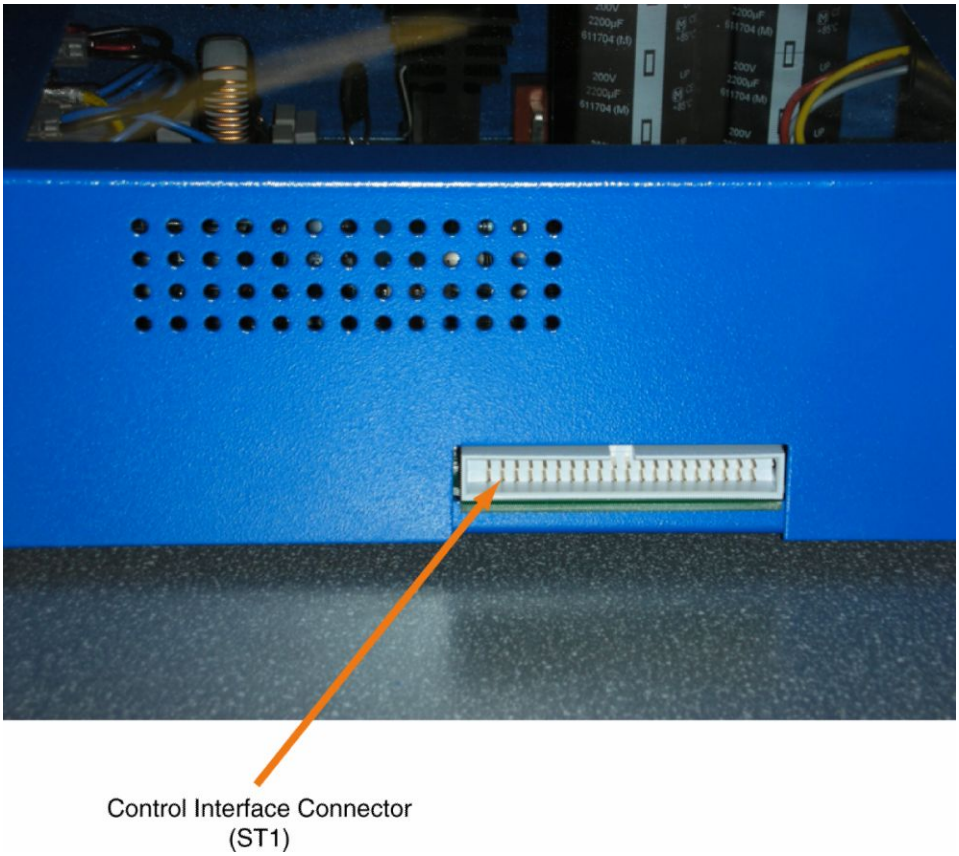

Figure 7-1 Control Interface

The signal connection between the Inverter module and the microcontroller / IO board is as shown in *Figure 7-2* below.

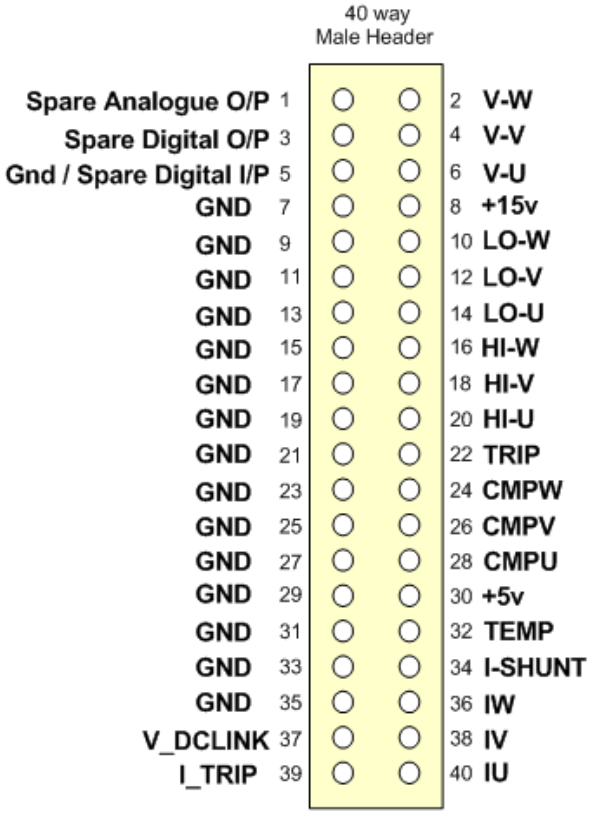

Figure 7-2 Control Interface Signal Allocation (ST1)

7.1 Motor Terminal Connections

The connections to the Motor are provided via connector located on the Inverter unit as shown below. The connector provides full mechanical isolation from the high motor voltages

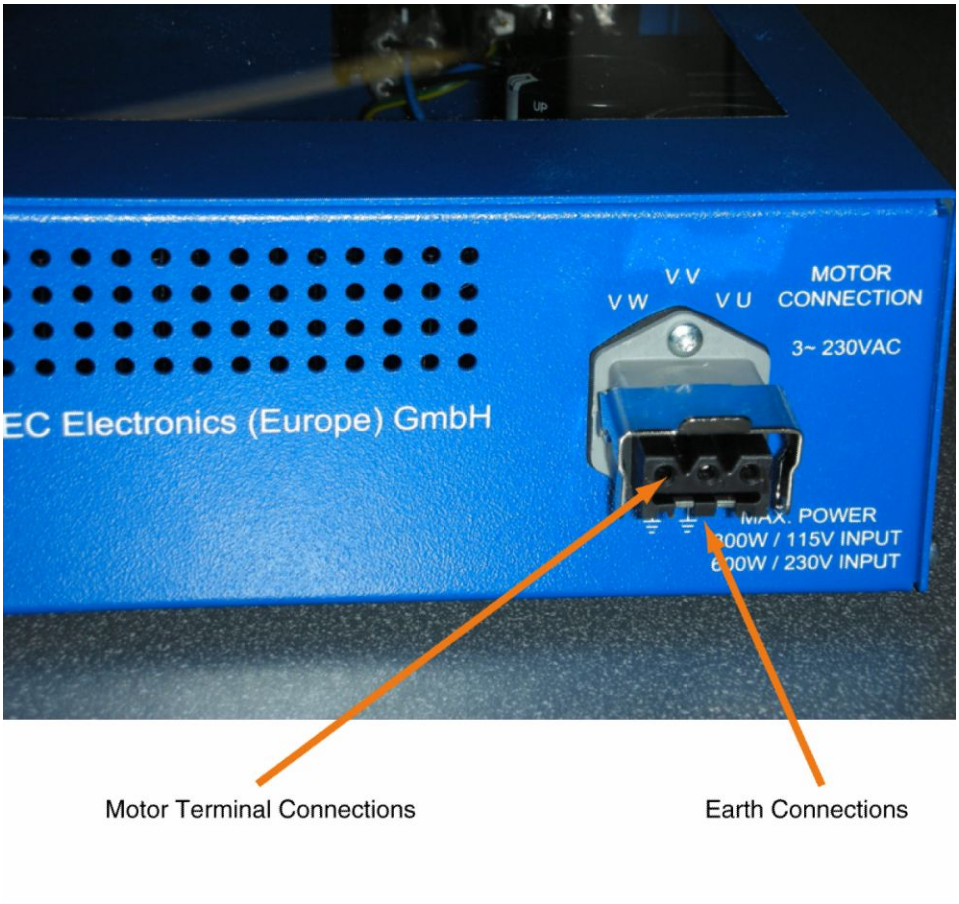

Figure 7-3 Motor Terminal Interface

The connections to the motor are as shown in *Table 7-1* below

Table 7-1 Motor Terminal Connections

Pin Number	Function
Pin 1	Phase Voltage W (Vw)
Pin 2	Phase Voltage V (Vv)
Pin 3	Phase Voltage U (Vu)

7.2 Motor Selection

Detailed below are the two reference 3Φ motors that were used to develop application examples for the Inverter module. The motors are not included with the Inverter unit, but can be supplied by the appropriate manufacturer or distributor, as required. The user is able to use an alternative motor, which may be more suited to their end application.

Note No changes need to be made on the Inverter unit from the default (Factory) settings in order to use the example motors and associated software.
If alternate 3Φ motors are used the demonstration software available will need to be adapted to the new motor parameters

7.2.1 Induction Motor

A Reference 3Φ Induction motor was used with the Inverter module, to provide an example application using Space Vector Modulation. The Speed feedback is provided by an external Incremental Encoder added to the Rotor spindle, in order to show the capability of the appropriate microcontrollers. Please note that the example application software is liable to change as more Motor control microcontrollers are developed.

An outline of the reference motor parameters are described below

1. ABB 3Φ 2 pole, General Purpose Squirrel Cage Induction Motor
2. Motor Type - M2VA56A (Product Code- 3GVA051 001-ASA)
3. 400V, 50Hz
4. Maximum Rated Speed 4,000 RPM

The incremental encoder used with the ABB reference motor is

1. Hohner Automation Incremental Encoder type: 0710-13DR-0256
2. 256 Pulses per Revolution

The encoder was used primarily to provide speed indication of the motor.
It can however, be used in conjunction with an appropriate timer on the Microcontroller as a full “incremental encoder function” (i.e. both direction and speed measurement)

7.2.2 Brushless DC Motor

A reference 3Φ Brushless DC motor was used with the Inverter module, to provide an example Sensored and Sensorless demonstration application.

The sensored application uses the three Hall sensors mounted in the motor, providing speed and position feedback for the Microcontroller.

The Sensorless application uses the same control software design, but uses the three zero crossing comparators instead of the Hall sensors to provide as the speed and position feedback to the Microcontroller.

An outline of the motor parameters are described below

1. Oriental 3Φ BLDC Motor - 4 pole, 75 Watt
2. Part Number:- FBLM575W-A
3. 150V
4. Maximum Rated Speed 4,000 RPM
5. 3 x Integrated Hall Sensors (2 pulses per revolution / sensor)

Chapter 8 Appendices

This document contains file attachments. Use the *Attachments* tab to see them.