



**Specifications for**

**Electronic Cards**

**OF**

**IGBT based modules**

**PI: 740730023**

Specification No. : PS313061

Revision No. : Rev 00

Date : 03/06/2013

# BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL CONTROL EQUIPMENT ENGINEERING DIVISION



## 1. GENERAL

This specification covers the requirements of certification, infrastructure, quality of manpower considered essential for quality and reliability of design, development, manufacturing testing & supply of various high tech Electronics cards/modules involving multilayer PCBs, ASICs, SMT components and digital electronics components like DSP, Micro controllers, Micro processors etc.

The supplier should confirm availability of the required infrastructure and manpower in technical bid as given in this specification.

### a. INFRASTRUCTURE FACILITIES

The supplier should have the following manufacturing facilities:

1. Dust free environment for card assembly.
2. Stencil Printer.
3. Automatic Glue Dispenser
4. High speed component placement machine  
Following features would be preferred:
  - Board size capability - 400 mm x 300 mm min.
  - Placement Range - 0603 to SOIC's, 0402 compatible
5. Dual wave Soldering machine
6. 4 zone Reflow oven
7. Digital / Analog Temperature controlled solder stations.
8. Component lead forming machines.
9. Details of Electrostatic discharge protection & ESD procedure adopted to be submitted with offer.
10. Semi Automatic component insertion machines.

### b. TESTING FACILITIES:

The supplier should have the following test facilities:

- (a) Digital oscilloscope Dual channel, BW 100MHZ.

The oscilloscopes having following advance features would be Preferred.

- Advanced signal processing
- TDR measurement
- Eye pattern analyzer
- Cross talk and ringing analysis

- (c) Spectrum analyzer with following features

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- Electromagnetic Interference Analysis.
- High frequency analysis.
- Harmonic Distortion Measurement.
- AM / FM Measurement

- (d) Multi channels, 100 MHZ band width logic analyzer
- (e) Multi Channel, 100 MHz Digital Pattern Generator.
- (h) Computer added Functional Testing facilities for electronic card.

g) Burn –in test chamber:

### c. **PCB design capabilities:**

The supplier should have best in the class PCB design capabilities including the software for the same. At least one product designed and manufactured by the supplier should be in regular railway service.

### d. **Qualified Manpower**

Supplier should have engineering graduates (electronics) who would be responsible for execution of order. Experience in multilayer PCB manufacturing using latest state of art technology components like SMT, digital electronics components, FPGA, ASICS & microcontrollers would be preferred.

Based on technical bid received from supplier, BHEL may depute their team of engineers for on spot inspection at supplier works for confirmation of infrastructure facilities available with the party before considering them for assigning the contract.

Supplier should also agree for evaluation of their facility by BHEL customers like Railways, NTPC, ONGC, Oil India, Defense and any other being specified based on project.

### e. **Experience**

Supplier to confirm at least 2 orders have been executed by them involving latest state of art components as mentioned in the specification. Supplier to submit copies of purchase order /contract of such orders executed in past involving SMT components, microcontroller/DSP or ASIC based cards. Supplier dealing with designing & manufacturing of PCB and assembled card with SMT components, microcontroller/DSP or ASIC for exporting to Europe & USA shall be preferential advantage.

### f. **Willingness for Confidentiality Agreement**

Supplier to confirm their willingness for unconditional confidentiality agreement on stamp paper stating that “Any information received from BHEL against the enquiry and purchase order (if placed) would not be shared with any other party in part or in full without written permission from BHEL Bhopal. Moreover, we agree

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the documents generated during the process of execution would be the property of BHEL and shall be provided to BHEL free of charge to BHEL. We also agree that parts developed/manufactured against the order will not be offered/supplied to any other party at (any form in parts or in full) without written permission from BHEL Bhopal. BHEL holds all rights for the items from conceptual design to the final products". This is prerequisite to qualify for their consideration in technical scrutiny of tender..

### **g. Willingness for bank guarantee**

Bidder to confirm their willingness for submission of bank guarantee for the amount indicated by BHEL before placement of order in lieu of components cost which would be issued by BHEL as per the conditions of the Enquiry.

## **2. SCOPE OF WORK**

### **a. Manufacturing of PCB, Assembly of cards and Test certificate**

Bidder to assemble the electronic cards as mentioned in documents provided by BHEL and testing of modules to be done as per BHEL's test schedule (Test schedule shall be made available to successful bidder only)

Test Certificate shall be provided by the party along with consignment for each of the module supplied by them after assembly and testing .

### **b Certification of Conformance and General Supplier Commitment**

The supplier shall supply a certification of conformance (C of C), signed by a responsible official, preferably from Quality Assurance, attesting that the materials or parts supplied fulfill all requirements of the Purchase Order. At a minimum, the C of C will contain the information listed below:

Drawing/Document reference no.

Manufacturer of part/assembly.

Part number and Revision Level

Purchase Order Number

Serial numbers of product supplied, (serialized products only).

### **c Static Sensitive Devices**

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The items must be packaged in conductive material or must be packaged in material which is inherently anti-static or which has been coated or treated with an anti-static material to prevent buildup of static charge.

### **d. Foreign Object Debris/Damage Prevention**

Supplier shall manufacture, distribute, or maintain products in such a way to eliminate or reduce foreign object debris/damage (FOD) in items delivered. That tooling, test equipment, and fixtures as required in the supplier's processes are maintained in a manner to prevent FOD. BHEL shall consider received items to be verified by the supplier to be free of foreign materials

### **e. ISO 9001**

Quality System of assembler of the PCB's should preferably comply with and be certified to ISO 9001.

### **a. Documentation**

Prior approval from BHEL shall be required in case of replacing any component that has become obsolete from assembly and/or bringing required modifications in design. Documentation for any engineering changes shall be provided to BHEL free of cost.

### **b. Testing**

All the cards should essentially be tested as per IEC60571 clause no. 10.2.3, 10.2.4 and 10.2.5 and certificate to be provided at the time of supply of the same.

## **3. DOCUMENTS WITH ENQUIRY**

Following documents are attached herewith:

- a. Annexure 1 for item 1 of enquiry
- b. Annexure 2 for item 2 of enquiry
- c. Annexure 3 for item 3 of enquiry
- d. Annexure 4 for item 4 of enquiry
- e. Annexure 5 for item 5 of enquiry

## **4. INSPECTION**

BHEL engineer would be deputed for inspection of manufactured PCB and shall witness testing at supplier works.

## **5. Document to be submitted with technical Bid**

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Following document duly filled must be submitted by the bidder party as annexure to their **technical bid** (to be kept in separate sealed envelope) . Otherwise bid will be technically rejected.

**1. Infrastructure details**

<b>SL</b>	<b>Description/Equipment</b>	<b>Make/details</b>
1	Dust Free environment for card assembly	Area to be specified with temperature & humidity information.
2	Automatic Glue Dispenser	
3	High speed component placement machine	
4	Dual wave Soldering machine	
5	4 zone Reflow oven	
6	Digital / Analog Temperature controlled solder stations	
7	Component lead forming machine	
8	Details of Electrostatic discharge protection & ESD procedure	
9	Semi Automatic component insertion machines	
10	Digital oscilloscope with BW 100MHZ	Make with features details as required in spec
11	2.2.GHZ band width Spectrum analyzer	-do-
12	Multi channel 100 MHZ band width logic analyzer	
13	Multi channel Digital Pattern Generator.	
14	Computer added Functional Testing facilities for electronic card.	Details to be given

2. Qualified manpower details

3. Willingness for Confidentiality agreement

4. Willingness for bank guarantee



**Annexure 1**  
**FOR**  
**6 channel Gate interface card**  
**As per BHEL drg no.: 36680900710**

Revision No. : Rev 00

Date : 09.03.2013

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## Introduction:

The 6 channel interface electronics card is used in traction application. Therefore it is required to have proper EMI/EMC protection as per IEC 60571. This electronics card is responsible for conditioning of the input firing pulse for IGBT from the main electronics control unit. It is also responsible for implementation of precise dead band in the pulses which can be calibrated and also pulse interlocking as a measure of protection. This card includes a 40W DC to DC converter with over voltage, under voltage and over current detection capability to convert +/- 24V to +/-15V and 5V to be distributed along the card. The power supply must have input filter for elimination of common mode noise and to compatible with EMI/EMC. Provision for a fixed point processor Snap-On board has to be included in the card for future up gradation of the system. Fault monitoring and protection circuit is also put in the card for short circuit and other error conditions.

## Technical details:

Following technical functionalities have to be implemented in the card:

### 1. Feedback processing:

- a. Three phase voltage feedback – continuous monitoring and processing of the voltage feedback from the output voltage sensor.
- b. Three phase current feedback - continuous monitoring and processing of the voltage feedback from the output current sensor.
- c. IGBT feedback - continuous monitoring and processing of the voltage feedback from IGBT driver.

### 2. Fault monitoring

- a. Output short circuit monitoring
- b. Output over/under voltage monitoring
- c. Control supply over/under voltage monitoring
- d. DC-DC converter over current monitoring
- e. Supply short circuit monitoring
- f. External fault monitoring
- g. Firing pulse interlocking and resolution monitoring
- h. Dead band monitoring
- i. Enable signal monitoring
- j. Internal error monitoring
- k. Error reporting and shutdown/reset capability

### 3. The entire fault monitoring and processing in the card should be executed at a frequency of 12 MHz

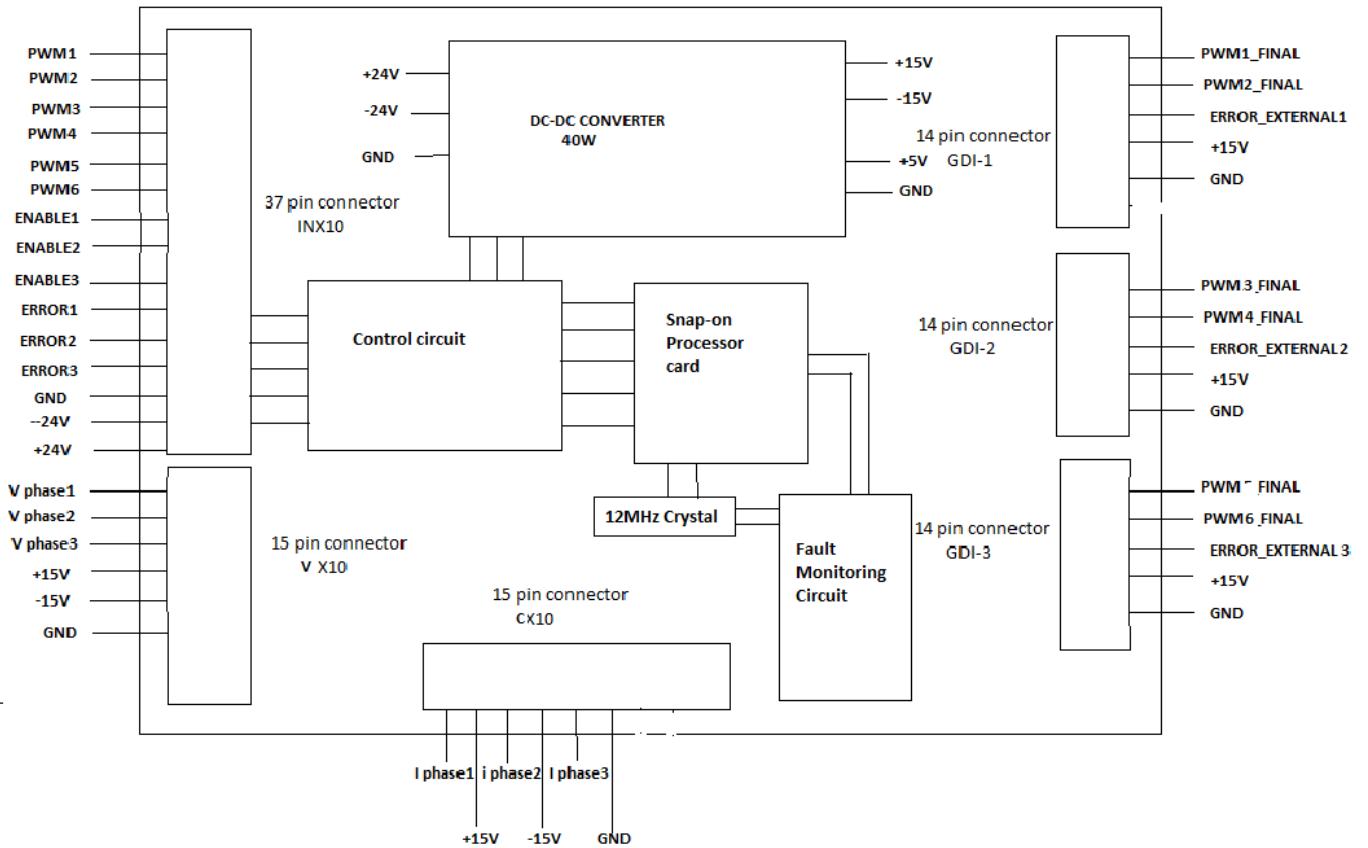


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4. All the resistors used in the card should be of 200V grade or more.
5. All the capacitors used should have a temperature grade of 105deg Celsius or more and should have an operational life of at least 5000 hours.
6. All the components to be used as per the BOM generated by BHEL Bhopal (BOM would be made available only after the PO is placed).

**Fig.1 :- Input/output schematic of the card**





**Annexure 2**  
**FOR**  
**SMD based Gate interface card**  
**As per BHEL drg no.: 3668000077**

Revision No. : Rev 00

Date : 09.03.2013

## Introduction:

The 2 channel SMD based gate interface electronics card is used in traction applications. Therefore it is required to have EMI/EMC protection as per IEC 60571. This electronics card is responsible for conditioning of the input firing pulse for IGBT from the main electronics control unit. It is also responsible for implementation of precise dead band in the pulses which can be calibrated and also pulse interlocking as a measure of protection. It should also be equipped with the capability of generating sine wave PWM complimentary pulses from input square wave. This card should have a provision to fit a Snap-on power supply card having 40W DC to DC converter with over voltage, under voltage and over current detection capability to convert +/- 24V to +/-15V and 5V to be distributed along the card. The power supply must have input filter for elimination of common mode noise and to compatible with EMI/EMC. Provision for a fixed point processor Snap-On board has to be included in the card for future up gradation of the system. Fault monitoring and protection circuit is also put in the card for short circuit and other error conditions.

## Technical details:

Following technical functionalities have to be implemented in the card:

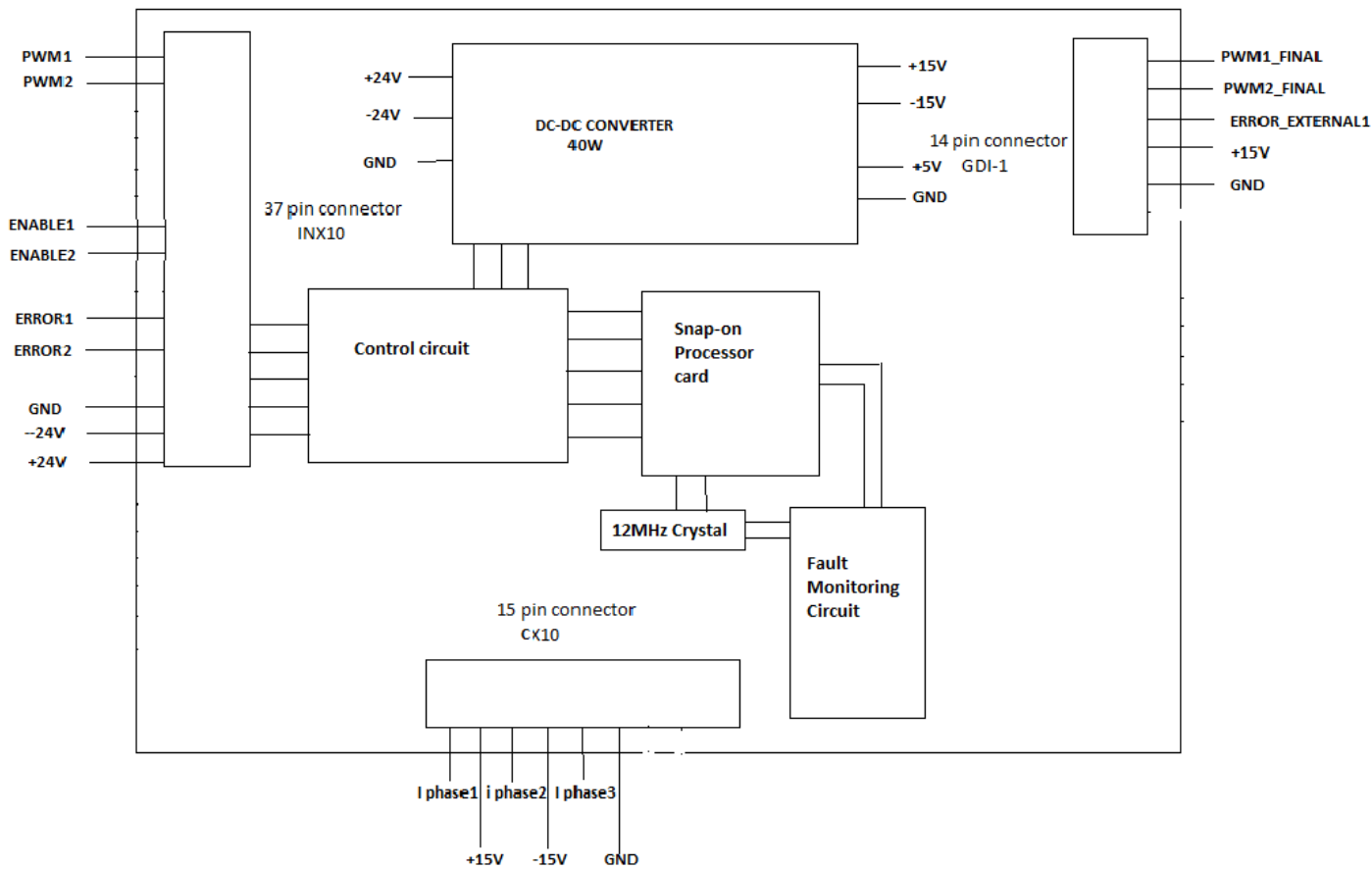
1. Feedback processing:
  - a. Current feedback - continuous monitoring and processing of the voltage feedback from the output current sensor.
  - b. IGBT feedback - continuous monitoring and processing of the voltage feedback from IGBT driver.
2. Fault monitoring
  - a. Output short circuit monitoring
  - b. Output over/under voltage monitoring
  - c. Control supply over/under voltage monitoring
  - d. DC-DC converter over current monitoring
  - e. Supply short circuit monitoring
  - f. External fault monitoring
  - g. Firing pulse interlocking and resolution monitoring
  - h. Dead band monitoring
  - i. Enable signal monitoring
  - j. Internal error monitoring
  - k. Error reporting and shutdown/reset capability
3. The entire fault monitoring and processing in the card should be executed at a frequency of 12 MHz

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4. All the resistors used in the card should be of 200V grade or more.
5. All the capacitors used should have a temperature grade of 105deg Celsius or more and should have an operational life of at least 5000 hours.
6. All the components to be used as per the BOM generated by BHEL Bhopal (BOM would be made available only after the PO is placed).

**Fig.1 :- Input/output schematic of the card**





**Annexure 3**  
**FOR**  
**Aux gate distribution card GDC 800-2**  
**As per BHEL drg no.: 36680000061**

Revision No. : Rev 00

Date : 09.03.2013

## Introduction:

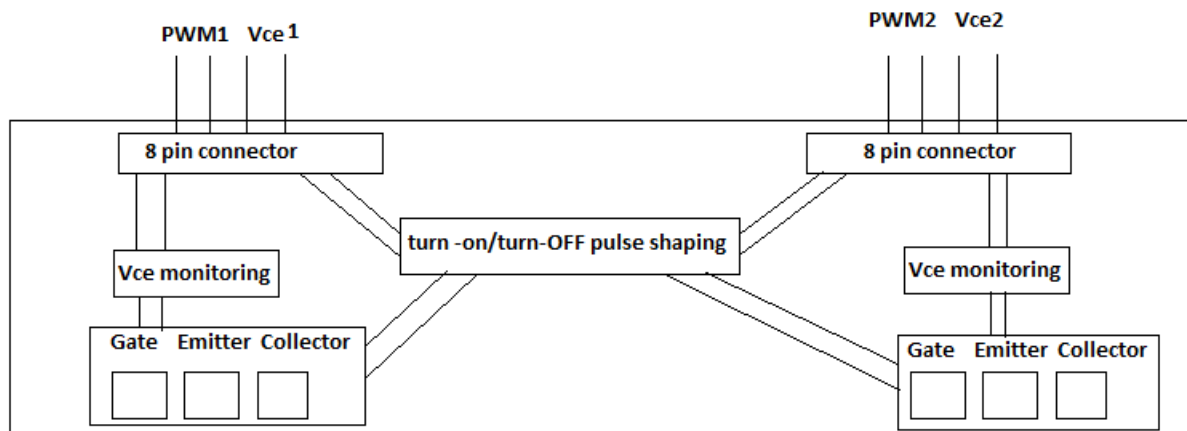
The auxiliary gate distribution card GDC 800-2 is used in traction applications. Therefore it is required to comply with the EMI/EMC specification as per IEC 60571. This card is mounted directly on the IGBT supplying it with the firing pulse to the gate-emitter terminals and connected to its collector terminal to continuously monitor the VCE. This card provides proper protection to across the gate-emitter of IGBT against the surges/noise that can be generated during its operation.

## Technical details:

Following technical functionalities have to be implemented in the card:

1. The physical dimension and the placement of the input/output snap on connectors are critical and have to be maintained.
2. The power circuit and the control circuit should be properly isolated from each other.
3. Continuous Vce monitoring
4. Final shaping of the turn-ON and the turn-OFF pulses.
5. All the resistors used in the card should be of 200V grade or more.
6. All the components to be used as per the BOM generated by BHEL Bhopal (BOM would be made available only after the PO is placed).
- 7.

**Fig.1 :- Input/output schematic of the card**





**Annexure 4**  
**FOR**  
**Aux gate driver card**  
**As per BHEL drg no.: 3668000058**

Revision No. : Rev 00

Date : 09.03.2013

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## Introduction:

The auxiliary gate driver card is used in traction applications. Therefore it is required to comply with the EMI/EMC specification as per IEC 60571. Function of this card is to condition the PWM signals from the input and relay it to the output through proper electrical isolation. The card should also have a constant Vce monitoring function. Fault diagnostics is another important feature of the card.

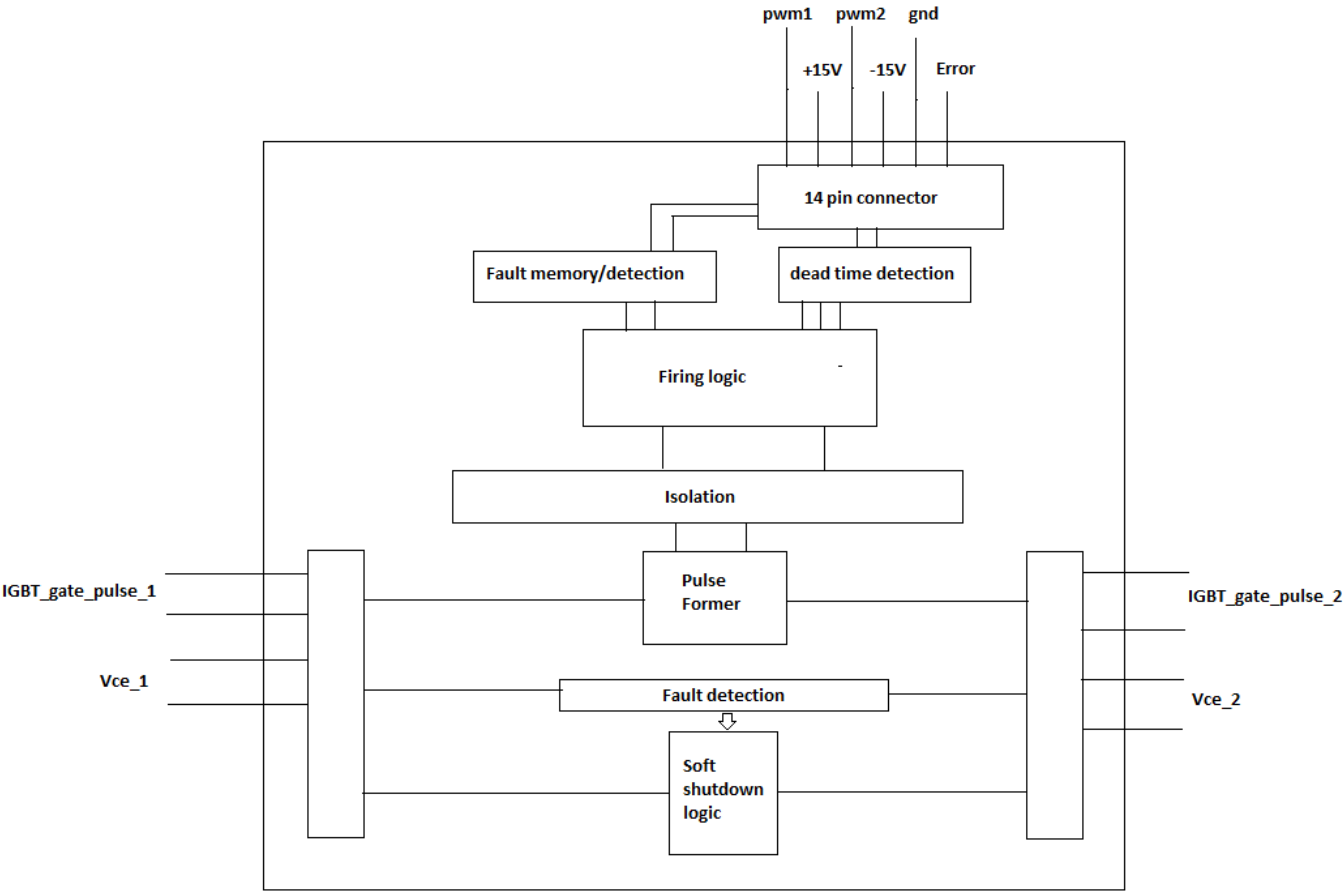
## Technical details:

Following technical functionalities have to be implemented in the card:

1. The physical dimension and the placement of the input/output snap on connectors are critical and have to be maintained.
2. Precise dead band monitoring of the pulses.
3. Input and the output of the cards should be properly isolated electrically.
4. Fault monitoring
  - a. Over current monitoring
  - b. Connection check
  - c. Supply short circuit monitoring
  - d. External fault monitoring
  - e. Error reporting and shutdown/reset capability
5. All the resistors used in the card should be of 200V grade or more.
6. All the capacitors used should have a temperature grade of 105deg Celsius or more and should have an operational life of at least 5000 hours.
7. All the components to be used as per the BOM generated by BHEL Bhopal (BOM would be made available only after the PO is placed).



**Fig.1 :- Input/output schematic of the card**





**Annexure 5**  
**FOR**  
**Power supply card with protection circuit**  
**As per BHEL drg no.: 3668000076**

Revision No. : Rev 00  
Date : 09.03.2013

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### Introduction:

The power supply card with protection circuit is used in compliment with SMD based gate interface card. Therefore it is required to comply with the EMI/EMC specification as per IEC 60571. This card has a 40W DC to DC converter with over voltage, under voltage and over current detection capability to convert +/- 24V to +/-15V and 5V to be distributed to the mother board. The power supply must have input filter for elimination of common mode noise and to compatible with EMI/EMC. SMD based Fault monitoring and protection circuit is also put in the card for short circuit and other error conditions.

### Technical details:

Following technical functionalities have to be implemented in the card:

1. The physical dimension and the placement of the input/output snap on connectors are critical and have to be maintained.
2. Fault monitoring
  - a. Control supply over/under voltage monitoring
  - b. DC-DC converter over current monitoring
  - c. Supply short circuit monitoring
  - d. External fault monitoring
  - e. Error reporting and shutdown/reset capability
3. All the resistors used in the card should be of 200V grade or more.
4. All the capacitors used should have a temperature grade of 105deg Celsius or more and should have an operational life of at least 5000 hours.
5. All the components to be used as per the BOM generated by BHEL Bhopal (BOM would be made available only after the PO is placed).
6. The efficiency of the DC-DC converter should be at least 90% or more and MTBF should be greater than 1,000,000 hours. Its operating temperature range should be 40deg to 85deg Celsius. Its dimension should be 2"X2" precisely eith 1.5 kVDC Isolation.

**Fig.1 :- Input/output schematic of the card**

