HESC104 Manual

High Efficiency & Smart Charging
Vehicle Power Supply
DC to DC Convertor

Manufactured by
TRI-M ENGINEERING
Engineered Solutions for Embedded Applications

Technical Manual

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PREFACE

This manual is for integrators of applications of embedded systems. It contains information on hardware requirements and interconnection to other embedded electronics.

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CHAPTER 1 - INTRODUCTION

1.1 GENERAL DESCRIPTION

The HESC104 is a high efficiency, high performance DC to DC 60 watt converter that supplies +5V, -5V, +12V & -12V outputs. The HESC104 also includes a flash based microcontroller that supplies advanced power management, smart battery charger and PC/104 bus. The HESC104 is designed for low noise embedded computer systems, has a wide input range of 6-40V(>6:1) and is ideal for battery or unregulated input applications. The HESC104 is specifically designed for vehicular applications and has heavy-duty transient suppressors (5000W) that clamp the input voltage to safe levels, while maintaining normal power supply operation.

The HESC104 is a state-of-the-art Mosfet based design that provides outstanding line and load regulation with efficiencies up to 95 percent. Organic Semiconductor Capacitors provide filtering that reduces ripple noises below 20mV. The low noise design makes the HESC104 ideal for use aboard aircraft or military applications or wherever EMI or RFI must be minimized. The +5VDC and +12VDC outputs are controlled by a constant off-time current-mode architecture regulator that provides excellent line and load transient response.

The HESC104 provides up to four stages of battery charging and can charge Lead-Acid, NiCd, and NiMh batteries and level two and level three SMBus compatible batteries. Charge currents are up to 4A, and battery charging voltages from 9.5 to 19.5V.

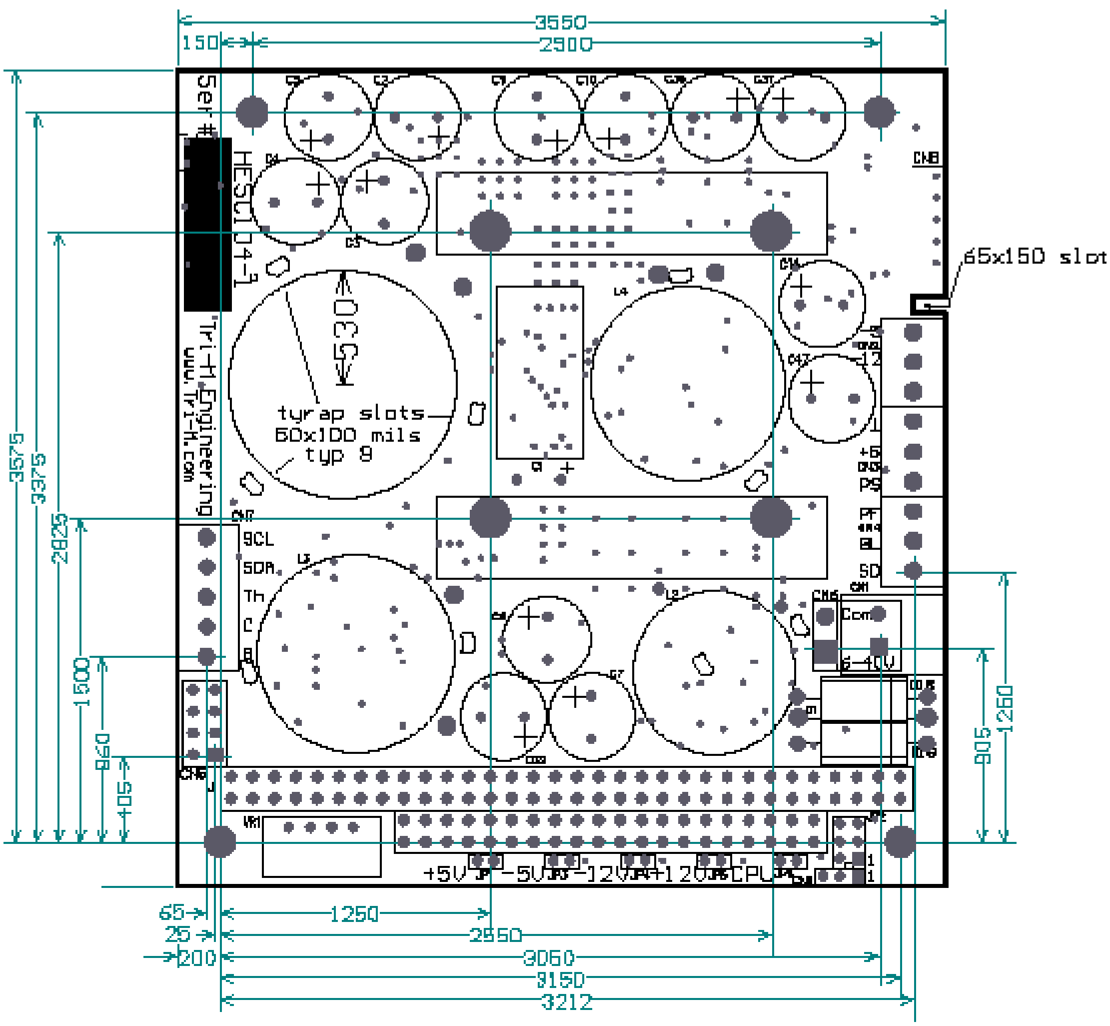
The HESC104 has advanced power management functions that allows timed on/off control of the HESC104, notification of changes to main power and changes in the battery status. For example, the HESC104 can be programmed to power off the main outputs in 60 seconds and then turn them on again 12 hours later.

The HESC104 is PC/104 compliant with a 16-bit PC/104 bus. All generated voltages are provided to a connector block. A removable main input power plug allows the HESC104 to be easily installed.

The HESC104 can be configured to meet almost any power supply and battery charging need for embedded applications, whether that be a simple +5V application, or providing power for back lighted LCD panels, or a full UPS (un-interruptible power supply configuration).

1.2 FEATURES

- DC to DC converter for embedded applications.
- “Load Dump” transient suppression on input power supply.
- Operates from 6VDC to 40VDC input.
- PC/104 size and mounting holes.
- 60 watt power supply outputs.
- 5V, 12V, -12V, -5V, and battery charger outputs.
- Temperature range -40 to 85C.
- Monitors up to 16 external temperatures using I2C digital temperature sensors.
- Optocoupled inputs for ignition, and system "shut-down" pushbutton.



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1.3 SPECIFICATIONS

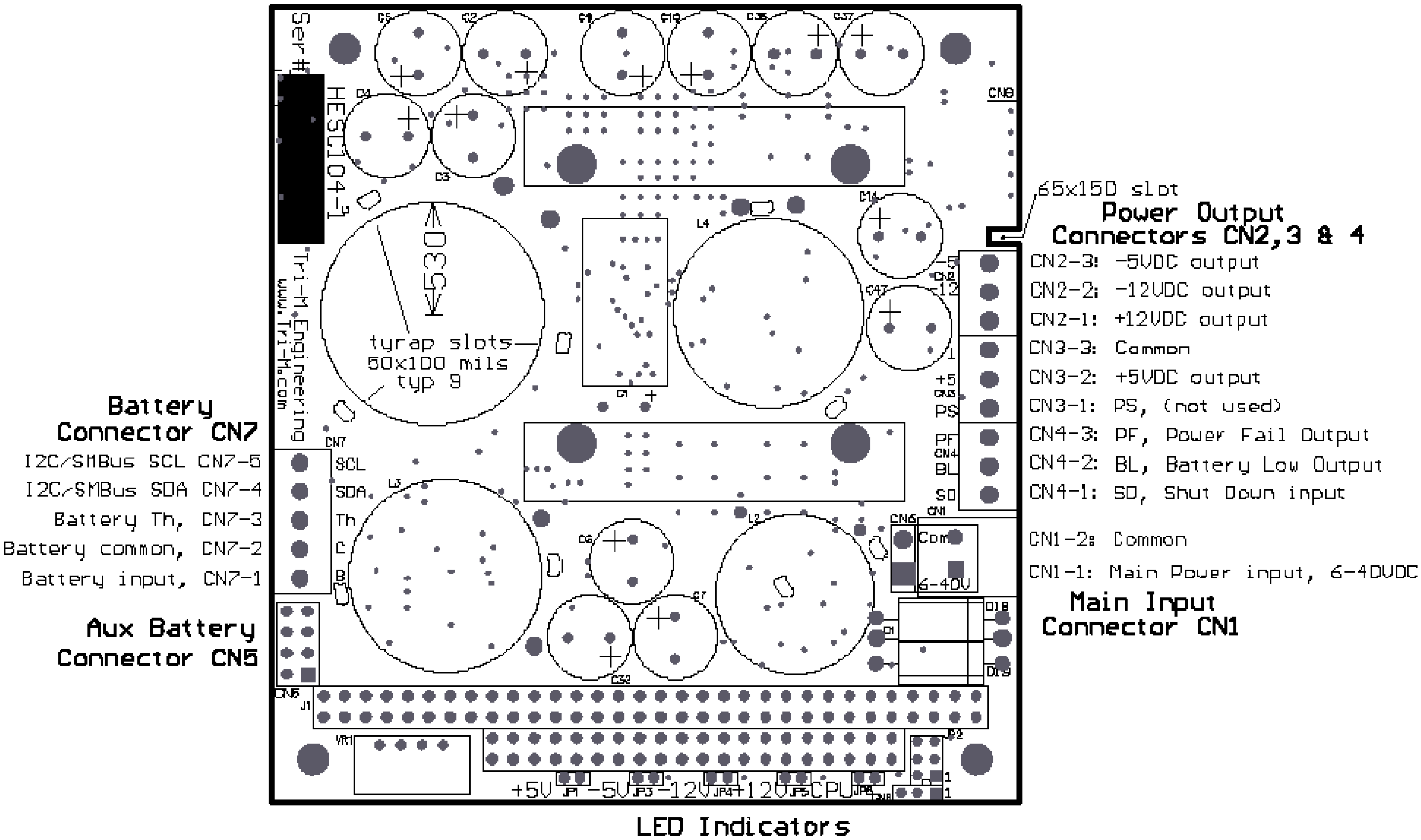
Power Supply Specifications	
Model	**HESC104**
5V output*	12 A
12V output	2.5 A
-5V output	400mA
-12V output	500mA
Input Voltage Range	6 to 40V
Load Regulation **	<60mV
Line Regulation **	±40mV
Output temp. drift **	<40mV
Switching Freq.	75kHz
Max. Input Transient	125V for 100msec
Output Ripple**	<20mV
Conducted Susceptibility **	>57db
Efficiency**	up to 95%
Temp Range	-40 to 85C
Quiescent current***	2mA
Size, PC/104 form factor compliant****	3.55"W. x 3.75"L x 0.6"Height

*Current rating includes current supplied to 12V, -12V, & -5V regulators.
**Measured on the 5V output.
***LEDs disabled,

CHAPTER 2 - CONFIGURATION AND INSTALLATION

2.1 Introduction

This chapter describes the configuration and installation of the HESC104 power supply. In addition, section 2.2 provides a formula to calculate the available +5VDC. Figure 2-1 shows the HESC104 connectors, jumpers and other options.



2.2 Power Considerations.

The +5V switching regulator is rated at 12A maximum output, however the +5V output supplies power to the +12, -5, and -12VDC regulators. To obtain the usable range of +5V output, "derate" according to the use of +12, -5, and -12VDC. Use the following formulae to calculate the maximum usable output.

$$Usable + 5Voutput = 12A - \frac{(I[-5] + I[-12]*2.4 + I[12]*2.4)}{0.9}$$

Where: I[-5] = -5VDC current load
I[-12] = -12VDC current load
I[12] = 12VDC current load
Assuming 90 percent converter efficiency (actual efficiency may vary).

2.2.1 Main Input Power Connector

Input power is connected to the HESC104 by a removable connector block CN6. The power supply accepts DC input voltages in the range of 6VDC to 40VDC.

Unregulated vehicle power is connected as follows:

- Terminal 1:"hot" polarity
- Terminal 2: Common (0VDC)

2.2.2 Output Power Connector

Output power is available for use via connector blocks CN2, CN3 & CN4 which are immediately side-by-side.

- CN4-1: Position 1, SD (Ignition input, ie maintained contact closure) *TTL logic level
- CN4-2: Position 2, BL (Battery Low signal output) TTL logic level; active low
- CN4-3: Position 3, PF (Power Fail signal output) TTL logic level; active low
- CN3-1: Position 4, PS (Momentary contact closure) TTL logic level, active low
- CN3-2: Position 5, +5VDC output
- CN3-3: Position 6, common
- CN2-1: Position 7, +12VDC output
- CN2-2: Position 8, -12VDC output
- CN2-3: Position 9, -5VDC output

* The logic level to activate SD is programmable

2.2.3 Battery Connector

Batteries are connected via the connector block, CN7. The HESC104 accepts DC battery voltages in the range 6.5V to 35VDC through the Battery Power Connector.

- CN7-1: Battery Positive
- CN7-2: Common
- CN7-3: TH, thermistor/safety input
- CN7-4: SDA, I2C/SMBus data input/output signal
- CN7-5: SCL, I2C/SMBus clock input/output signal

2.2.4 Aux Battery Connector

Tri-M Engineering battery packs such as the BAT104-NiCd, BAT104-NiMh, BAT104-SLA25 and BAT104-SLA45 can be directly plugged into the HESC104 through connector CN5. Connector CN5 is a two row by four-pin header, with the BAT104 battery packs having a mating female connector.

- CN5-1: Battery Positive
- CN5-2: Common
- CN5-3: Battery Positive
- CN5-4: Common
- CN5-5: SDA, I2C/SMBus data input/output signal
- CN5-6: SCL, I2C/SMBus clock input/output signal
- CN5-7: +5VC, +5V for digital temperature sensor and battery enable
- CN5-8: BE, Battery Enable output

2.2.5 PC/104 Parallel Port Interface

The HESC104 provides a memory mapped "parallel" PC/104 port for remote control, monitoring and data logging. In addition, a 2mm jumper block allows selection of the I/O memory-mapped address. A three-pin header allows selection of the HESC104 service request flag to either IRQ5 or IRQ7 interrupt line. Please refer to section 2.3.3 for jumper selections.

The table below lists the signals used on the PC/104 bus.

Pin #	Signal	Pin #	Signal	Pin #	Signal	Pin #	Signal
A1	N/A	B1	GND	C0	GND	D0	GND
A2	SD7	B2	N/A	C1	N/A	D1	N/A
A3	SD6	B3	+5V	C2	N/A	D2	N/A
A4	SD5	B4	N/A	C3	N/A	D3	N/A
A5	SD4	B5	-5V	C4	N/A	D4	N/A
A6	SD3	B6	N/A	C5	N/A	D5	N/A
A7	SD2	B7	-12V	C6	N/A	D6	N/A
A8	SD1	B8	N/A	C7	N/A	D7	N/A
A9	SD0	B9	+12V	C8	N/A	D8	N/A
A10	N/A	B10	N/A	C9	N/A	D9	N/A
A11	AEN	B11	N/A	C10	N/A	D10	N/A
A12	N/A	B12	N/A	C11	N/A	D11	N/A
A13	N/A	B13	/IOW	C12	N/A	D12	N/A
A14	N/A	B14	/IOR	C13	N/A	D13	N/A
A15	N/A	B15	N/A	C14	N/A	D14	N/A
A16	N/A	B16	N/A	C15	N/A	D15	N/A
A17	N/A	B17	N/A	C16	N/A	D16	+5V
A18	N/A	B18	N/A	C17	N/A	D17	N/A
A19	N/A	B19	N/A	C18	N/A	D18	GND
A20	N/A	B20	N/A	C19	N/A	D19	GND
A21	N/A	B21	IRQ7				
A22	SA9	B22	N/A				
A23	SA8	B23	IRQ5				
A24	SA7	B24	N/A				
A25	SA6	B25	N/A				
A26	SA5	B26	N/A				
A27	SA4	B27	N/A				
A28	SA3	B28	N/A				
A29	SA2	B29	+5V				
A30	SA1	B30	N/A				
A31	SA0	B31	GND				
A32	GND	B32	GND				

2.3 Jumper Selection

This section describes the function of each jumper, the location of it, the default setting, and how to change it.

2.3.1 LED Jumper Enable/Disable

These jumpers allow the LEDs to be disabled. This is most likely to be used when absolute minimum power consumption must be maintained, such as when operating off a limited battery source.

The location of each LED jumper shown in the diagram below.

Each LED is enabled by factory default. To disable any LED, remove the LED jumper (or cut the small PCB trace if no jumper is installed) associated with the LED. To re-enable any LED, re-install the associated jumper (or solder a short jumper wire between each of the jumper pads).

2.3.2 Interrupt Service Request Jumpers

Jumper CN9 sets the interrupt service request to either IRQ5 or IRQ7.
- Pin 1 to 2, IRQ5
- Pin 2 to 3, IRQ7

2.3.3 PC/104 Memory Mapped Address Jumper

Jumper J2 sets the PC/104 I/O Memory Mapped Address Jumper.
- Pin 1 to 3, Address 0x300 (300 hex)
- Pin 2 to 4, Address 0x310 (310 hex)
- Pin 5 to 3, Address ox320 (320 hex)
- Pin 6 to 4, Address ox360 (360 hex)

CHAPTER 3 - Power Management Features

3.1 Introduction

The HESC104 has extensive power management feature when it is loaded with the HESC-UPS firmware including:

- Debounce timers on the main input.
- Debounce timers on the Shutdown input (SD).
- Separate start up and shutdown timers for the main input, SD input, PS (momentary contact input), and the PC/104 Host interface.
- Shut down timer for the low battery voltage or capacity.

Please refer to the HESC-UPS manual for details on the power management functions of the HESC-UPS firmware.

3.2 Input and output active polarity

The HESC monitors the main input, maintained contact input, momentary contact input, battery input, SMBus, and the PC/104 bus and is capable of alerting the host through the PF, and BL output or the Host CPU can poll the HESC104 through the PC/104 interface.

The SD input can be configured to be active high or active low. The polarity is set by changing bit 3 at location 80 in the HESC104 EEprom. Tri-M Engineering supplies a free utility called the Smart Charger Utility (SCU) that simplifies making changes to the HESC104 configuration. Figure 3-1 is a "snap-shot" of a SCU display, which shows the "Charger Flags" page. If the flag is checked SD is active high, and vice-versa when the flag is unchecked.

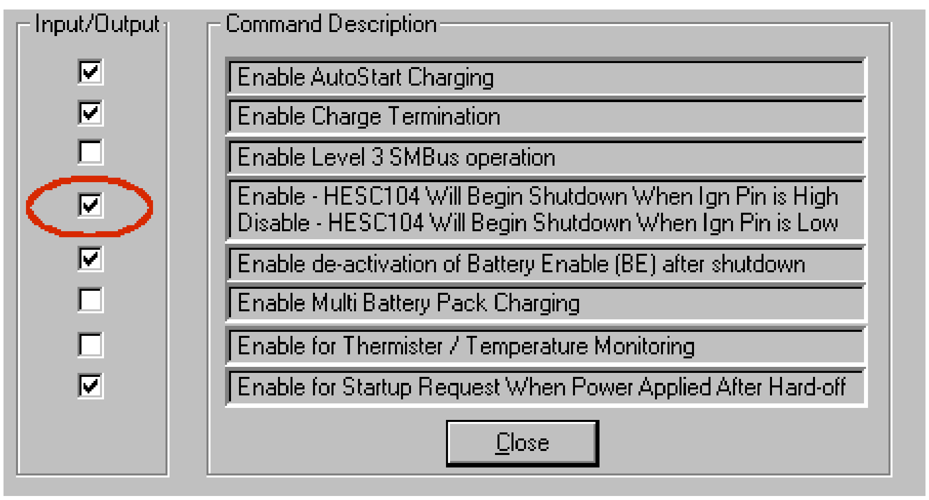


Figure 3-1

BL is driven low when the battery voltage is below the Minimum Battery Operating Voltage EEprom setting. Figure 3-2 shows this setting under the SCU “OTHER” EEprom setpoints page. Please note the unit of 9400 is in millivolts.

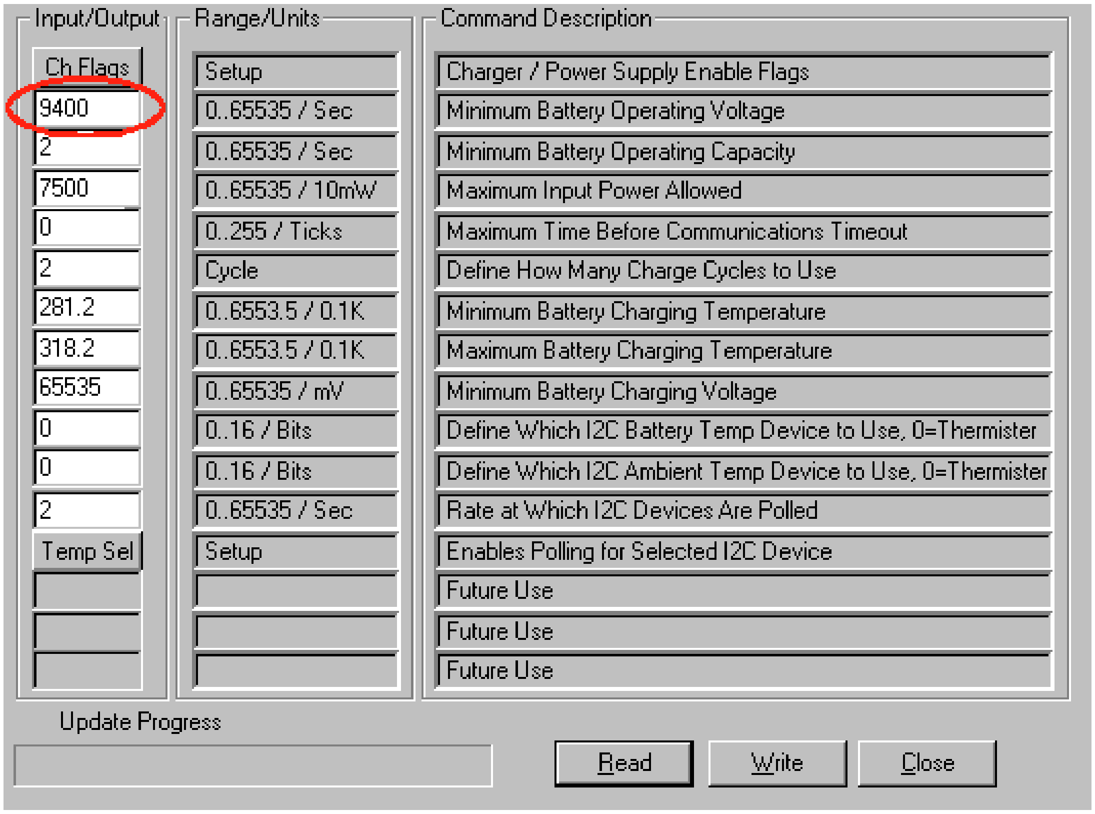


Figure 3-2

PF is driven active low after the main input power is removed and the “debounce” interval is completed or whenever there is a pending shutdown of the main outputs.

BL and PF can be used to signal the host CPU to prepare for shutdown. It is critical that operating systems such as Linux and Windows are shutdown gracefully otherwise corruption of the OS and the file system may result.

CHAPTER 4 : External Battery Design

1.1 Battery Isolation

The HESC series products allow an external backup battery to be connected. For applications where long periods of power interruption may occur, a Mosfet isolation circuit should be used to prevent deep cycling the batteries. Below is a circuit complete with typical component values.

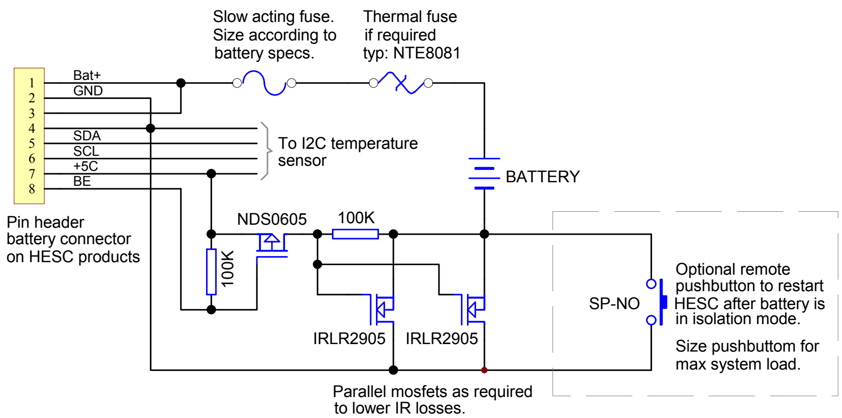


Figure A1: Battery Mosfet Isolation Circuit

1.2 Digital Sensor Interface

The HESC series support I^2C digital temperatures of Microchip (TCN75) and National (LM75CIM). These I^2C are "two wire" devices and require connection of a bi-directional data line (SDA) and a bidirectional clock line (SCL). In addition, 5V power and Gnd are required. Both SDA and SCL along with 5V and Gnd are available through the eight-pin battery header connector (see Figure A1) on HESC products. SDA and SCL are also available on the five-position screw terminal block (see section 2.3.3) on the HESC104.

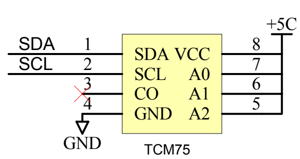


Figure A2: Digital Temperature Sensor