## MECHANICAL SPECIFICATIONS

0.125 (3.18) DIA.
(4 PLACES)

3.775 (95.86)

3.375 (85.73)

0.20 (5.08)

J3

B A

C D

1 IPH

**Case C46**

3.55 (90.17)

2.900 (73.66)

3.150 (80.01)

J2

J1

D C B A

0.25 (6.35)

P2

0.35 (8.89)

0.65 (16.51)

0.079 TYP. (2.00)

0.100 TYP. (2.54)

0.40 (10.16)

0.20 (5.08)

0.368 (9.35)

0.345 MAX. (8.76)
MAXIMUM
COMPONENT HEIGHT

0.437 (11.10)

0.062 (1.57)

0.440 (11.18)

0.190 (4.83)
MAXIMUM
COMPONENT HEIGHT

0.419 (10.64)
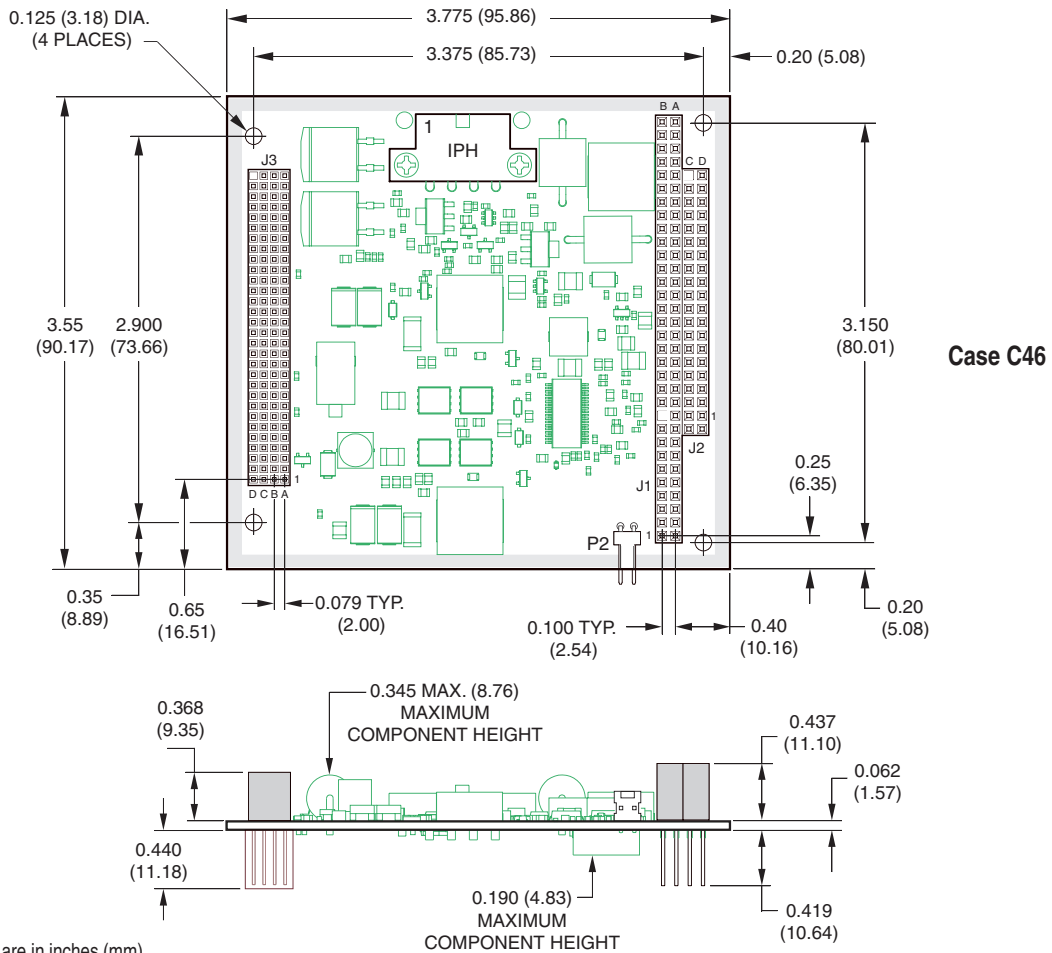
Dimensions are in inches (mm)

PIN 1
GROUND

PIN 2
+5Vdc POWER OUT

0.295 (7.49)

0.025 (0.64)
SQUARE POSTS,
2 POSITIONS

0.10 (2.54)

0.10 (2.54)

0.718 (18.24)

0.10 (2.54)

0.10 (2.54)

**5 Volt Auxiliary Power Connector, P2 (Optional)**

1  2  3  4

IPH

TOP VIEW
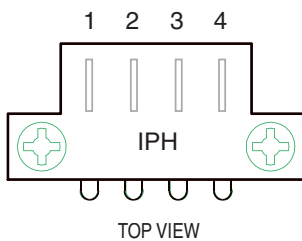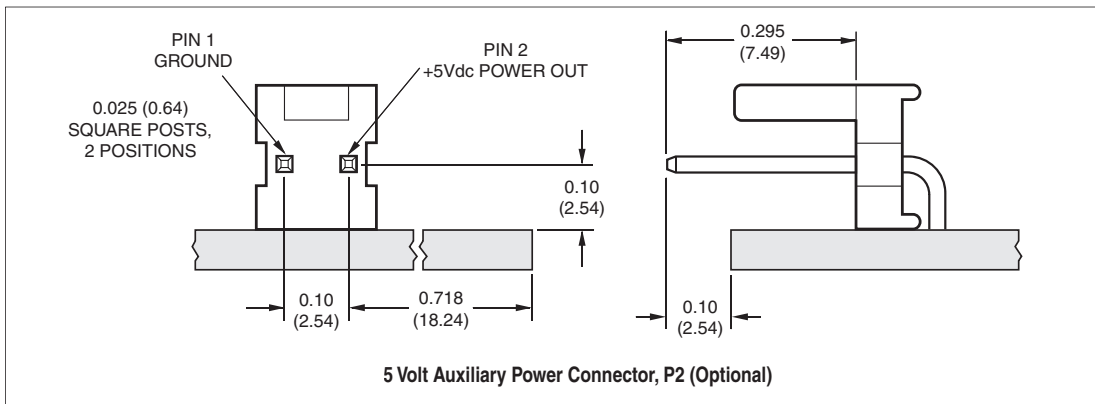
**Table 1. MAPC-104 Input Power Header**

| IPH Mating Connector: Molex 5557 (39-01-4040) | | |
|---|---|---|
| Pin | Assignment | Functional Description |
| 1 | OT_Warn Out | Overtemperature Warning |
| 2 | Pwr_LED_Drive Out | External Power Good LED Driver |
| 3 | VIN− | Input Ground |
| 4 | VIN+ | Positive Input |

**Table 2. MAPC-104 (PC/104-*plus*) Bus Signal Assignments**

| Pin | A | B | C | D |
|---|---|---|---|---|
| | **J3/P3** | | | |
| 1 | GND ② | Reserved | +5.1V | AD00 |
| 2 | VI/O | AD02 | AD01 | +5.1V |
| 3 | AD05 | GND | AD04 | AD03 |
| 4 | C/BE0* | AD07 | GND | AD06 |
| 5 | GND | AD09 | AD08 | GND |
| 6 | AD11 | VI/O | AD10 | M66EN |
| 7 | AD14 | AD13 | GND | AD12 |
| 8 | +3.3V | C/BE1* | AD15 | +3.3V |
| 9 | SERR* | GND | SB0* | PAR |
| 10 | GND | PERR* | +3.3V | SDONE |
| 11 | STOP* | +3.3V | LOCK* | GND |
| 12 | +3.3V | TRDY* | GND | DEVSEL* |
| 13 | FRAME* | GND | IRDY* | +3.3V |
| 14 | GND | AD16 | +3.3V | C/BE2* |
| 15 | AD18 | +3.3V | AD17 | GND |
| 16 | AD21 | AD20 | GND | AD19 |
| 17 | +3.3V | AD23 | AD22 | +3.3V |
| 18 | IDSEL0 | GND | IDSEL1 | IDSEL2 |
| 19 | AD24 | C/BE3* | VI/O | IDSEL3 |
| 20 | GND | AD26 | AD25 | GND |
| 21 | AD29 | +5.1V | AD28 | AD27 |
| 22 | +5.1V | AD30 | GND | AD31 |
| 23 | REQ0* | GND | REQ1* | VI/O |
| 24 | GND | REQ2* | +5.1V | GNT0* |
| 25 | GNT1* | VI/O | GNT2* | GND |
| 26 | +5.1V | CLK0 | GND | CLK1 |
| 27 | CLK2 | +5.1V | CLK3 | GND |
| 28 | GND | INTD* | +5.1V | RST* |
| 29 | +12V | INTA* | INTB* | INTC* |
| 30 | NA (–12V) ③ | Reserved | Reserved | 3.3V KEY ② |

**Table 3. MAPC-104 (PC/104-Reference) Bus Signal Assignments**

| Pin | A | B |
|---|---|---|
| | **J1/P1** | |
| 1 | IOCHCK* | GND |
| 2 | D7 | RSTDRV |
| 3 | D6 | +5.1V |
| 4 | D5 | IRQ9 |
| 5 | D4 | NA (–5V) ③ |
| 6 | D3 | DRQ2 |
| 7 | D2 | NA (–12V) ③ |
| 8 | D1 | ENDXFR* |
| 9 | D0 | +12V |
| 10 | IOCHRDY | KEY ② |
| 11 | AEN | SMEMW* |
| 12 | A19 | SMEMR* |
| 13 | A18 | IOW* |
| 14 | A17 | IOR* |
| 15 | A16 | DACK3* |
| 16 | A15 | DRQ3 |
| 17 | A14 | DACK1* |
| 18 | A13 | DRQ1 |
| 19 | A12 | REFRESH* |
| 20 | A11 | SYSCLK |
| 21 | A10 | IRQ7 |
| 22 | A9 | IRQ6 |
| 23 | A8 | IRQ5 |
| 24 | A7 | IRQ4 |
| 25 | A6 | IRQ3 |
| 26 | A5 | DACK2* |
| 27 | A4 | TC |
| 28 | A3 | BALE |
| 29 | A2 | +5.1V |
| 30 | A1 | OSC |
| 31 | A0 | GND |
| 32 | GND | GND |

| Pin | D | C |
|---|---|---|
| | **J2/P2** | |
| 0 | GND | GND |
| 1 | MEMCS16* | SBHE* |
| 2 | IOCS16* | LA23 |
| 3 | IRQ10 | LA22 |
| 4 | IRQ11 | LS21 |
| 5 | IRQ12 | LS20 |
| 6 | IRQ15 | LS19 |
| 7 | IRQ14 | LA18 |
| 8 | DACK0* | LA17 |
| 9 | DRQ0 | MEMR* |
| 10 | DACK5* | MEMW* |
| 11 | DRQ5 | SD8 |
| 12 | DACK6* | SD9 |
| 13 | DRQ6 | SD10 |
| 14 | DACK7* | SD11 |
| 15 | DRQ7 | SD12 |
| 16 | +5.1V | SD13 |
| 17 | MASTER* | SD14 |
| 18 | GND | SD15 |
| 19 | GND | KEY ② |

① The shaded area denotes power or ground signals.
② The KEY pins are to guarantee proper module installation:
   J3/P3, pin A1 is electrically connected to GND for shielding
   J3/P3, pin D30 is removed and the female side is plugged for 3.3V I/O
   J2/P2, pin C19 is keyed, pin is removed and the female side is plugged
   J1/P1, pin B10 is keyed, pin is removed and the female side is plugged
③ J3/P3, pin A30 and J1/P1, pins B5 and B7 are not used. Pin assignments for –5V and –12V are for reference only.

## Auxiliary 5V Power Connector, P2

**Specifications**   (typical unless noted)

| | |
|---|---|
| **Power Output** ① | +5 Vdc at 1 Amp maximum |
| **Power Characteristics** | See MAPC-104 Specifications |
| **P2 Header Type** | AMP/Tyco Electronics 640455-2 |
| **Contact Dimensions** | Two 0.025" square posts, 0.3" long, 0.10" spacing on centers. See drawings. |
| **Contact Material** | Tin plating over copper alloy |
| **Contact Assembly Force** | 3 lbs. (13N) |
| **Mating Connector** ② | Single-row, 2-position IDC on 0.10" spacing |
| **Environmental** | Compatible with host MAPC-104 system |

① The contacts are rated at 5 Amps 250Vac. However, whatever current is drawn must be *summed* with current powering the PC-104 system.
② A suggested mating connector is AMP / Tyco Electronics MTA-100 Series, part number 647000-2. See also the CST-100 Series..

For the MAPC-104-5V model version, spare +5 Vdc power may be taken from the P2 connector which is adjacent to the pin 1 end of the J1 connector (see drawings). Be aware that this power is generated on the MAPC-104 and therefore is in addition to whatever 5V current is used by the host PC-104 system. All power characteristics (regulation, tempco, ripple, etc.) are derived from the MAPC-104.

## Performance/Functional Specifications

Typical @ $T_A$ = +25°C under nominal line voltage and nominal-load conditions unless noted. ①

| Input | |
|---|---|
| **Input Voltage Range** | 9-32 Volts (12V or 24V Battery) |
| **Transient Voltage Protection** | 125V/100ms (30kVA) |
| **Overvoltage Shutdown** | 32-36 Volts (34V typical) |
| **Overvoltage Protection** | 48V/5 minutes |
| **Start-Up Threshold** ② | 9-10 Volts (9.4V typical) |
| **Undervoltage Shutdown** ② | 7-9 Volts (8.2V typical) |
| **Input Current** | See Performance Specifications |
| **Input Reflected Ripple Current** ③ | 45mVp-p |
| **Internal Filter Type** | Pi |
| **Reverse Polarity Protection** | Yes (external fuse mandatory) |
| **Output** | |
| **Minimum Loading Per Output** | No load |
| **Maximum Capacitive Loading** | 2000µF (+3.3V) <br> 1000µF (+5.1V) <br> 500µF (+12V) |
| **$V_{OUT}$ Accuracy** (50% Load) | ±3% maximum |
| **Temperature Coefficient** | ±0.02%/°C |
| **Ripple/Noise** (20MHz BW) | See Performance Specifications |
| **Line/Load Regulation** | See Performance Specifications |
| **Efficiency** | See Performance Specifications |
| **Current Limit Inception** ④ <br> (97% $V_{OUT}$, each other <br> output @ 0 Amps) | 7-9 Amps (+3.3V) <br> 8.5-11 Amps (+5.1V) <br> 0.2-0.5 Amps (+12V) |
| **Short Circuit Current** <br> (Zener) | 2.65 Amps (+3.3V) <br> 3.24 Amps (+5.1V) <br> 0.12 Amps (+12V) |
| **Overvoltage Protection** ⑨ | 3.9V (+3.3V) <br> 6V (+5.1V) <br> 13V (+12V) |
| **Power Good** <br> within 7-10% of $V_{OUT}$ | See Tech Notes <br> (LED and external Signal) |
| **Dynamic Characteristics** | |
| **Dynamic Load Response** ⑤ <br> (50-100% step to within 1% of $V_{OUT}$) | 200µsec max. (+3.3V & +5.1V) <br> 100µsec max. (+12V) |
| **Power-up Sequencing** ⑥ <br> (5.1V power-up before 3.3V) | 2-6msec |
| **Power-down Sequencing** <br> (5.1V power-down before 3.3V) | 1-4msec |
| **Switching frequency** | 320kHz (+3.3V & +5.1V) <br> 1120kHz (+12V) |
| **Environmental** | |
| **Calculated MTBF** ⑦ | TBC million hours |
| **Operating Ambient Temperature** ⑧ <br> with 100 lfm Air Flow, no Derating | −40 to +85°C |
| **Board Temperature** | −40 to +105°C |
| **Thermal Shutdown** | +112 to +118°C |
| **Thermal Shutdown Warning** | 27 to 33 seconds |
| **2nd Level Thermal Shutdown** | +122 to +128°C |
| **Storage Temperature** | −40 to +105°C |
| **Physical** | |
| **Dimensions** | See Mechanical Dimensions |
| **Connector and Pin Material** | According to PC/104-*plus* Spec |
| **Weight** | 3.6 ounces (102 grams) |
| **Insulation Level** | Non-isolated |

① All models are tested and specified with a single, external, 0.1µF, multi-layer ceramic output capacitor on each output and no external input capacitors, unless otherwise noted. All models will effectively regulate under no-load conditions (with perhaps a slight increase in output ripple/noise).

② See Technical Notes/Performance Curves for additional explanations and details.

③ Input Ripple Current is tested/specified over a 5-20MHz bandwidth with an external 33µF input capacitor and a simulated source impedance of 220µF and 12µH. See I/O Filtering, Input Ripple Current and Output Noise for details.

④ The Current-Limit-Inception point is the output current level at which the converter's power-limiting circuitry drops the output voltage 3% from its initial value. See Output Current Limiting and Short-Circuit Protection for more details.

⑤ See Dynamic Load Response for detailed results including switching frequencies.

⑥ For Start-Up-Time specifications, output settling time is defined as the output voltage having reached ±1% of its final value and the load current having reached at least 80% of its final value.

⑦ MTBF is calculated using TELCORDIA SR-332 Method 1 Case 3, ground fixed, +25°C ambient air and full-load conditions. Contact DATEL for demonstrated life test data.

⑧ All models are fully operational and meet all published specifications, including "cold start," at −40°C.

⑨ The highly unlikely, simultaneous failure of several specific on-board components could result in the MAPC-104's input voltage appearing at its output, despite the unit's output overvoltage protection mechanisms. In this rare situation, the Power Good signal (IPH pin 2, Pwr_LED_Drive) will be deactivated and systems monitoring Power Good will eventually shut down. If you are using an MAPC-104 to power a load that must be protected against any and all possible overvoltages, no matter how rare, you will have to provide the protection external to the MAPC-104. Please contact DATEL for recommendations.

| Absolute Maximum Ratings | |
|---|---|
| **Input Voltage:** | |
| Continuous | 36V |
| Up to 5 minutes maximum | 48V |
| Transient (100ms) | 125V (30kVA) |
| **Input Reverse Polarity Protection** | External Fuse mandatory |
| **Output current** | Current limited. Devices can withstand an indefinite output short circuit. |

These are stress ratings. Exposure of devices to any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied, nor recommended.

## Ordering Guide

| Model Number | Auxiliary Power Connector (P2) |
|---|---|
| MAPC-104 | Not installed |
| MAPC-104-5V | Installed |
| MAPC-104-Y | RoHS-5 hazardous substance compliance, no P2 |

**Connector Designations**

The official PC/104 bus specification identifies the standard interboard bus connections as paired J1/P1 and J2/P2 on one side and J3/P3 on the other side. However, J1/P1/J2/P2 is physically all one big 4-row connector with J1/J2 bus receptacle sockets (female) on the top side and P1/P2 pins (male) on the bottom. This arrangement provides interboard pass-through connections between PC/104 boards. DATEL refers to this single connector as "J1."

DATEL's auxiliary connectors (the IPH and the 5V Auxilliary Power Connector) are internally designated P1 and P2 respectively and this nomenclature may appear on the board silkscreening. This is purely an artifact of automated sequential part numbering in our CAD system and has no relation to the standard PC/104 interboard bus connectors. Don't get the connectors confused since they are all very different types and locations!
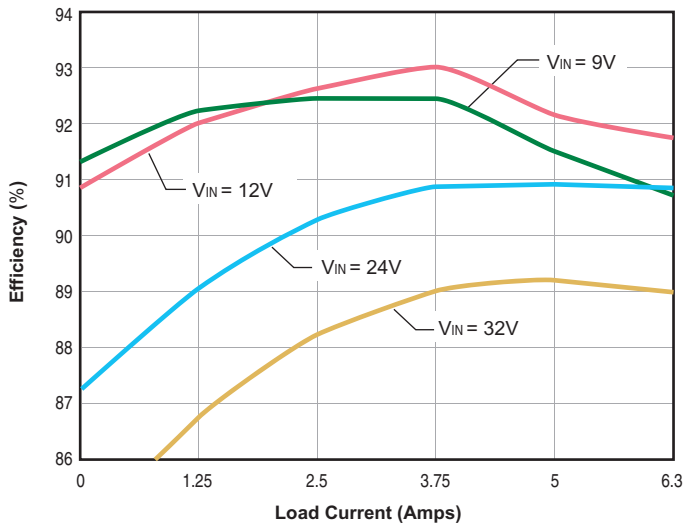
## Typical Performance Curves for MAPC-104 Series
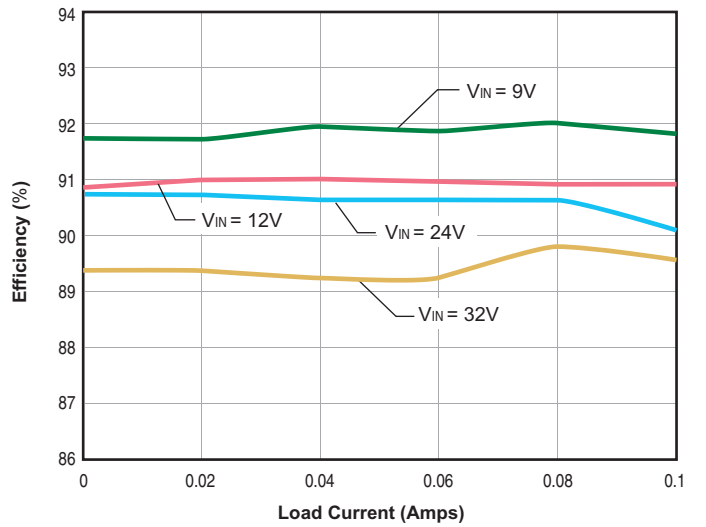
**Efficiency vs. Line @ 46W**
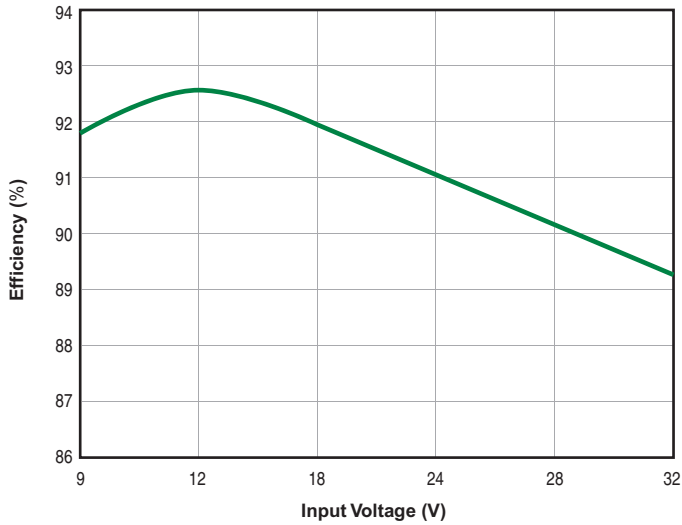


**3.3V$_{OUT}$ Efficiency vs. Line Voltage and Load Current
(5.1V @ 5.46A and 12V @ 0.07A)**
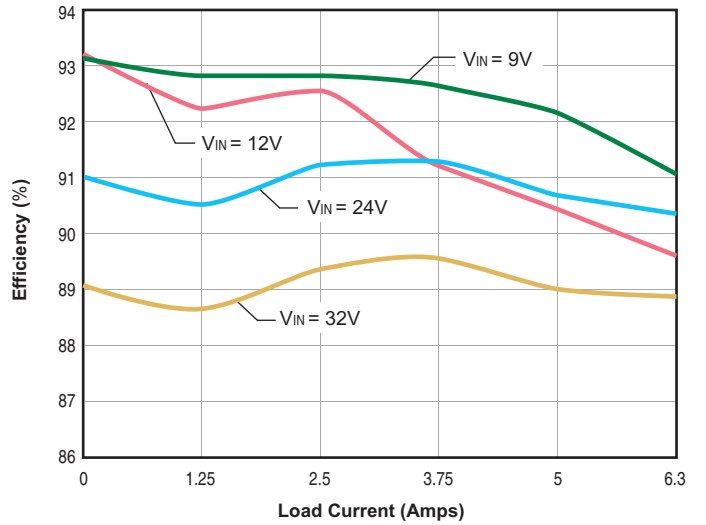


**5.1V$_{OUT}$ Efficiency vs. Line Voltage and Load Current
(3.3V @ 5A and 12V @ 0.07A)**



**12V$_{OUT}$ Efficiency vs. Line Voltage and Load Current
(5.1V @ 5.46A and 3.3V @ 5A)**



5

### Self-Protection Features

The MAPC-104 contains two systems for protection of out-of-limit voltages, currents and temperature. These systems control two output lines located on the Input Power Header connector. Both systems operate independently and concurrently. The MAPC-104 will respond to both temperature and voltage/current simultaneously.

The output circuits for both these controls are shown below. Both of them will drive either an external LED lamp and/or a logic circuit. The Overtemperature Warning Circuit assumes that an external pullup resistor is supplied by the user. The Power Good Circuit ("Pwr_LED_Drive Out") includes an on-board pullup resistor to drive an external LED with about 15mA.

*Typical External Logic Wiring*

*Typical OT Warning External LED Lamp Wiring*

**Figure 1. Overtemperature Warning Circuit**
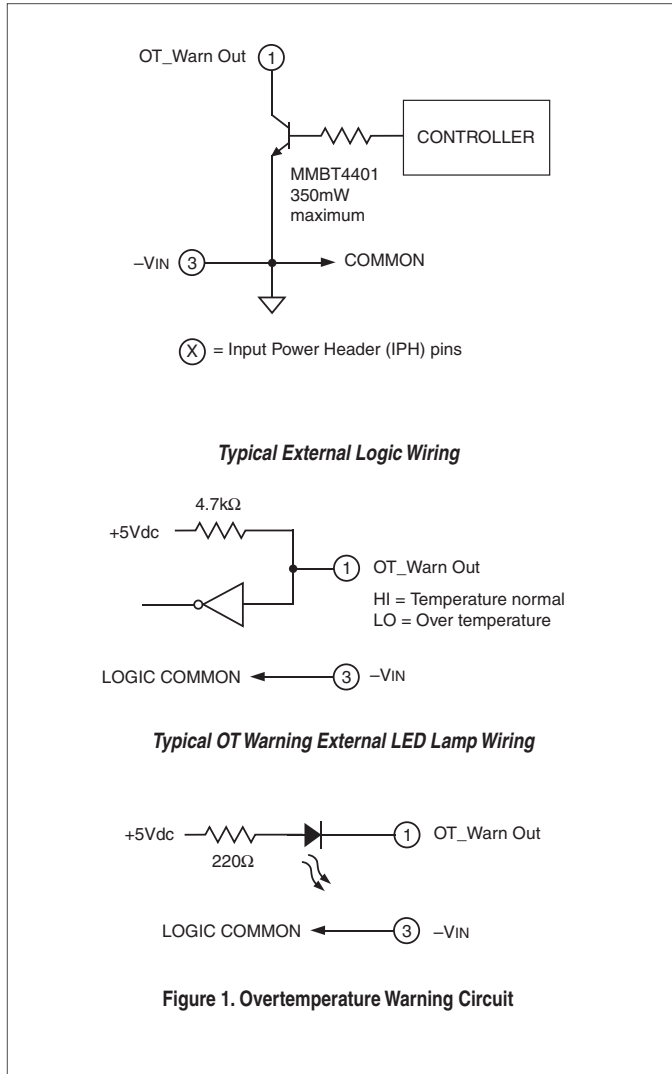
The transistors in these outputs are either on (typically less than 0.4 Volts out) or off (high impedance state). Depending on how the user wires the external circuit, these indicators have the following sense:

OT_Warn Out (pin 1):

   HI (transistor off) = temperature is normal

   LO (transistor on) = Over temperature condition

Pwr_LED_Drive Out (pin 2, pullup to internal +5V):

   HI (transistor off) = Power is normal. LED lamp is illuminated.

   LO (transistor on) = Power fault, LED lamp is dark

### Overtemperature Operation

The overtemperature system includes a on-board temperature sensor, a local microcontroller with A/D inputs, a timer and hysteresis so that the user may take steps to prevent inadvertant shut down. Operation proceeds as follows:

If the on-board temperature exceeds +115°C, the OT_Warn Output is asserted (LO) by the microcontroller and an internal 30 second software timer is started. The outputs remain powered on.

If the 30-second timer has not expired and the on-board temperature cools below +110°C, the OT_Warn Output will be deasserted (HI) and operation will continue unchanged.

If the 30-second timer has expired and the temperature still exceeds +115°C, the outputs will shut down. As soon as the on-board temperature cools to less than +110°C, the MAPC-104 will automatically restart and power will be restored to the outputs.

The 5 degree hysteresis between 110 and 115°C prevents rapid cycling of the OT_Warn Output.

If the on-board temperature reaches +125°C, the outputs will shut down, regardless of the state of the 30-second timer. The temperature must cool to less than +110°C for autorestart.

*Typical Power Good External LED Lamp Wiring*

**Figure 2. Power Good Circuit**
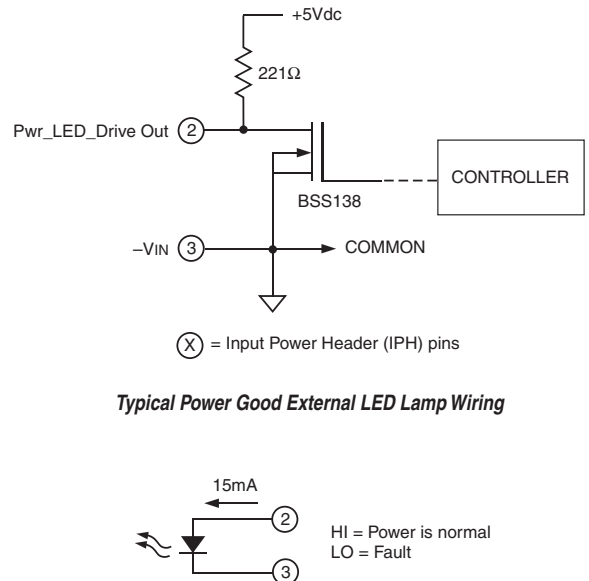
**Power Good Operation**

Local power is measured by several circuits shared with the overtemperature system. The Pwr_LED_Drive Output is indirectly controlled by the on-board microcontroller. The on-board PWM switching controller measures +3.3V and +5V output voltages and all output currents. The microcontroller measures input voltage and the +12V output voltage. The system requires that the input voltage is within normal tolerances at all times. If the input voltage is too high very briefly at startup (but not exceeding the absolute input voltage), the system will start normally if the input voltage reaches acceptable limits quickly (under half a second). This typically occurs as a load is applied.

When the system first starts, the Power Good LED (if installed) remains dark briefly until all on-board startup conditions are met (less than half a second) at which point the LED is illuminated. Operation proceeds as follows:

If the outputs on any lines deviate from approximately ±7% of nominal and/or the output current is excessive, the outputs are all shut down and the Pwr_LED_Drive Output is desasserted (LO, lamp dark). The system will attempt to restart in about half a second by briefly turning on all outputs. If successful and the fault is eliminated, the Pwr_LED_Drive Output will be asserted (HI, lamp lit) and operation continues.

If the fault condition remains, the system will attempt to restart two more times, spaced about half a second apart. If the fault remains for the third time, the system will shut down and will not retest the fault. The system must now be restored by fully cycling the input power.

The 3-fault countdown only occurs if the fault does not recover continuously throughout the attempted restart interval. An occasional random shutdown and successful restart will not trigger the 3-fault counter. However, external logic should record the frequency and quantity of such shutdowns.

**RoHS-5 compliance** refers to the exclusion of the six hazardous substances in the RoHS specification with the excepion of lead. C&D Technologies' RoHS-5 products use all the conforming RoHS materials, however our solders are Sn63/Pb37.