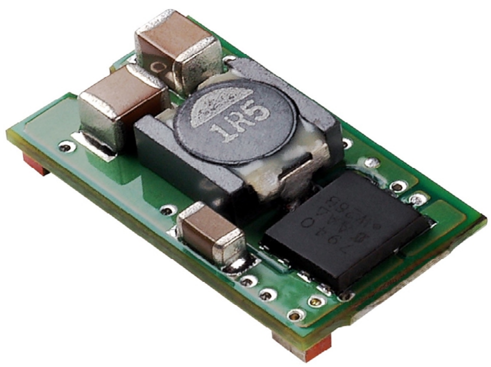
Advance Data Sheet
October 2002

Austin MicroLynx^{TM} SMT Non-isolated Power Modules: 3.0 – 5.5 Vdc Input; 0.75Vdc to 3.63 Vdc Output; 5A Output Current



Applications

- Intermediate Bus architecture
- Workstations, Servers, Desktop computers
- Distributed power architecture
- Telecommunications equipment
- Latest generation Ics (DSP, FPGA, ASIC) and microprocessor based applications
- LANs/WANs
- Data processing equipment

Features

- Delivers 5A output current
- High efficiency: 94.0% at 3.3V full load (Vin=5.0V)
- Small size and low profile:
  20.3 mm x 11.4 mm x 5.97 mm
  (0.80 in x 0.45 in x 0.235 in)
- Cost-efficient open frame design
- High reliability:
  Calculated MTBF > TBD hours at 25°C
- Remote On/Off
- Programmable output voltage via external resistor from 0.75Vdc to 3.63Vdc
- Tightly regulated output voltage, ±1% typical
- Load Regulation ± 0.2%
- Line Regulation ± 0.1%
- Constant switching frequency
- Auto-reset overcurrent protection (non-latching)
- Surface mount package
- *UL** 60950 Recognized, *CSA*† C22.2 No. 60950-00 Certified, and *VDE*‡ 0805 (IEC60950, 3rd edition) Licensed

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† *CSA* is a registered trademark of Canadian Standards Association.
‡ *VDE* is a trademark of Verband Deutscher Elektrotechniker e.V.
should be followed. (The CE mark is placed on selected products.)

Description

Austin MicroLynx^{TM} SMT (surface mount technology) power modules are non-isolated dc-dc converters that can deliver 5A of output current with full load efficiency of 94.0% at 3.3V output. These modules provide precisely regulated output voltage programmable via external resistor from 0.75Vdc to 3.63Vdc. The open frame construction and small footprint enable designers to develop cost- and space-efficient solutions. Features include remote On/Off and overcurrent protection.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operations sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect the device reliability.

Parameter	Device	Symbol	Min	Max	Unit
Input Voltage Continuous	All	V_I	0	6.5	Vdc
Operating Ambient Temperature	All	T_A	-40	85	°C
Storage Temperature	All	T_{stg}	-55	125	°C

Electrical Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions.

Table 1. Input Specifications

Parameter	Device	Symbol	Min	Typ	Max	Unit
Operating Input Voltage	Vout ≤ 2.75V dc Vout > 2.75V dc	V_I V_I	3.0 4.5	3.3 5.0	5.5 5.5	Vdc Vdc
Maximum Input Current (V_I=0V to $V_{I, max}$; I_O=$I_{O, max}$)		$I_{I, max}$			6	Adc
Inrush Transient		I^2t	—	—	0.1	A^2s
Input Reflected Ripple Current (5Hz to 20 MHz, 12uH source impedance See Test configuration section)		I_I	—	30		mA_{p-p}
Input Ripple Rejection (120Hz)		—	—	40	—	dB

Fusing Considerations

CAUTION: This power module is not internally fused. An input line fuse must always be used.

This power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To preserve maximum flexibility, internal fusing is not included however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a time-delay fuse with a maximum rating of 15A (see Safety Considerations section). Based on the information provided in this data sheet on inrush energy and maximum dc input current, the same type of fuse with a lower rating can be used. Refer to the fuse manufacturer’s data sheet for further information.

Electrical Specifications (continued)

Table 2. Output Specifications

Parameter	Output	Symbol	Min	Typ	Max	Unit
Output Voltage Set-point (V_I = 5V, I_O= $I_{O, min}$ to $I_{O, max}$, T_A=25°C)		$V_{O,set}$	$V_{O,set}$ – 1%	$V_{O,set}$	$V_{O,set}$ + 1%	Vdc Vdc
Output Voltage (Over all operating input voltage, resistive load, and temperature conditions at Steady state until end of life		$V_{O,set}$	$V_{O,set}$ – 3%	—	$V_{O,set}$ + 3%	Vdc
Output Regulation Line (V_I= $V_{I,min}$ to $V_{I,max}$) Load (I_O=$I_{O, min}$ to $I_{O, max}$) Temperature (T_A = $T_{A, min}$ to $T_{A, max}$)			 — — —	 0.01 0.1 0.5	 0.1 0.2 1	 %, $V_{O, set}$ %, $V_{O, set}$ %, $V_{O, set}$
Output Ripple and Noise Measured across 10µF Tantalum, 1µF Ceramic, V_I = $V_{I,nom}$ T_A = 25°C, Io = Io,max See Test Configuration section RMS (5Hz to 20 MHz bandwidth) Peak-to-peak (5Hz to 20MHz bandwidth)			 — —	 — —	 35 50	 mV_{rms} mV_{p-p}
External Load Capacitance		$C_{O,max}$	0	—	3000	µF
Output Current		I_o	0	—	5	Adc
Output Current-Limit Inception (Vo = 90% of $V_{O, set}$)		$I_{o,lim}$	5.25	—	6.25	Adc
Output Short-circuit Current (Average) Vo = 0.25V		$I_{o,sc}$	—	3	—	Adc
Efficiency (V_I = 5V; Io = Io, max) T_A=25°C	Vo = 0.9 Vdc Vo = 1.0 Vdc Vo = 1.2 Vdc Vo = 1.5 Vdc Vo = 1.8 Vdc Vo = 2.0 Vdc Vo = 2.5 Vdc Vo = 3.3 Vdc	η η η η η η η η	— — — — — — — —	80 84 85 87 89 89 91 94	— — — — — — — —	% % % % % % % %
Switching Frequency		f_{sw}	—	300	—	kHz
Dynamic Response (di/dt =2.5A/µs, V_I= 5V, T_A=25°C) Load change from I_O = 100% to 50% of $I_{O, max}$, Peak Deviation Settling Time (V_O<10% of peak deviation) Load change from I_O=100% to 50% of $I_{O, max}$, Peak Deviation Settling Time (V_O<10% of peak deviation)		 — —	 — —	 200 0.2 200 0.2	 — — —	 mV msec mV msec

Electrical Specifications (continued)

Table 3. General Specifications

Parameter	Device	Min	Typ	Max	Unit
Calculated MTBF (I_O= $I_{O,\ max}$, T_A=25°C) Tyco RIN (Reliability Information Notebook) Method			TBD		Hours
Weight		—	TBD	TBD	g (oz.)

Feature Specifications

Unless otherwise indicated, specifications apply over all operating input voltage, resistive load, and temperature conditions. See Feature Descriptions section of this data sheet for additional information.

Parameter	Device	Symbol	Min	Typ	Max	Unit
Remote On/Off Signal interface (V_I = $V_{I,min}$ to $V_{I,\ max}$; Open collector pnp or equivalent Compatible, Von/off signal referenced to GND. See Figure 21 and feature description section)						
Logic Low (On/Off Voltage pin open - Module ON)						
Ion/Off = 0.0 uA		Von/Off	—	—	0.3	V
Von/Off = 0.3		Ion/Off	—	—	10	µA
Logic High (Von/Off > 2.5V – Module Off)						
Ion/Off = 1 mA	All	Von/Off	—	—	6.5	V
Von/off = 0.3V	All	Ion/off	—	—	1	mA
Turn-On Delay and Rise Times (Io = 80% of Io,max, T_A=25°C)						
Case 1: On/Off input is set to Logic Low (Module ON) and then input power is applied (delay from instant at which V_I = $V_{I,min}$ until Vo = 10% of Vo, set)	All	Tdelay	—	TBD	—	msec
Case 2: Input power is applied for at least one second and then the On/Off input is set to logic Low (delay from instant at which Von/Off = 0.3V until Vo = 10% of Vo, set)	All	Tdelay	—	TBD	—	msec
Output voltage Rise time (time for Vo to rise from 10% of Vo, set to 90% of Vo, set)	All	Trise	—	TBD	—	msec
Output voltage overshoot (Io = 80% of Io,max, V_I = 12Vdc T_A=25°C)	All		—	—	TBD	mV
Output voltage adjustment (See Feature description section)						
Output voltage Set-point adjustment range (trim)			0.7	—	3.63	Vdc
Input Undervolatge Lockout						
Turn-on Threshold	All		1.95	2.05	2.15	V
Turn-off Threshold	All		1.87	1.91	1.95	V

Characteristic Curves

The following figures provide typical characteristics curves for Austin MicroLynx at room temperature (T_A = 25°C)

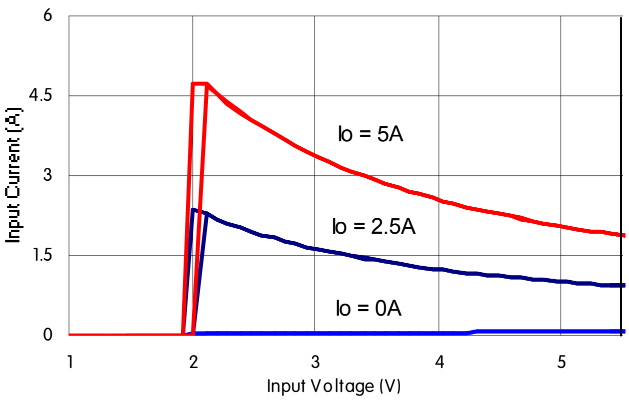


Figure 1. Typical input voltage and current characteristics AXH005A0X-SR (Vo = 1.8 V)

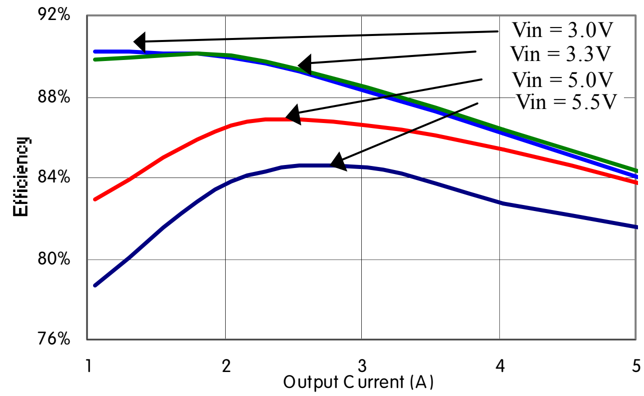


Figure 4. Converter efficiency vs. output current AXH005A0X-SR (Vo = 1.0V)

TBD

Figure 2. Typical Output voltage and Output current characteristics

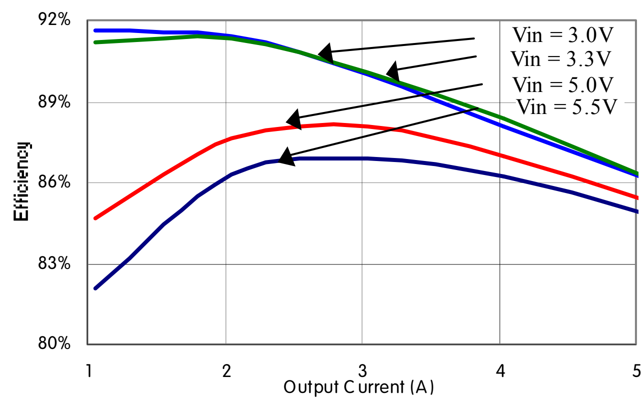


Figure 5. Converter efficiency vs. output current AXH005A0X-SR (Vo = 1.2V)

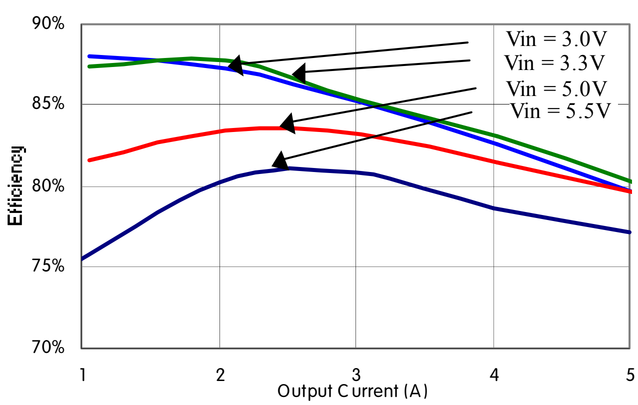


Figure 3. Converter efficiency vs. output current AXH005A0X-SR (Vo = 0.75V)

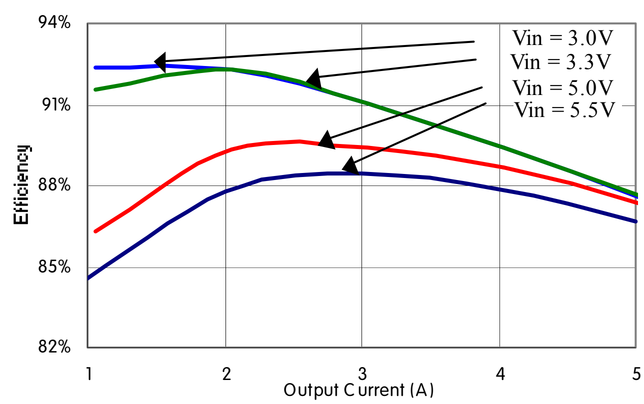


Figure 6. Converter efficiency vs. output current AXH005A0X-SR (Vo = 1.5V)

Characteristic Curves (continued)

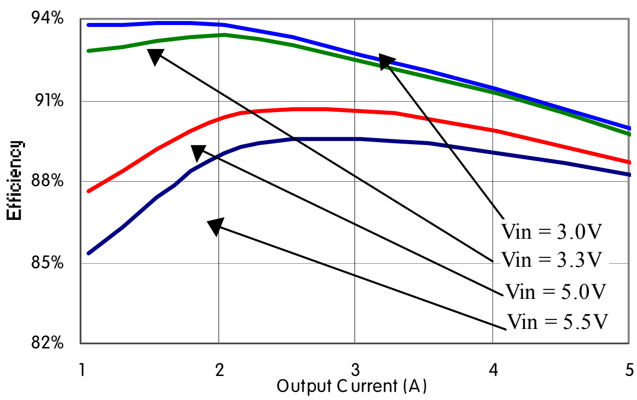


Figure 7. Converter efficiency vs. output current AXH005A0X-SR (Vo = 1.8V)

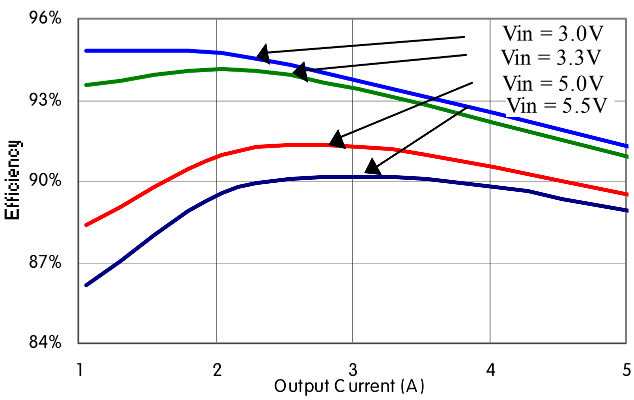


Figure 8. Converter efficiency vs. output current AXH005A0X-SR (Vo = 2.0V)

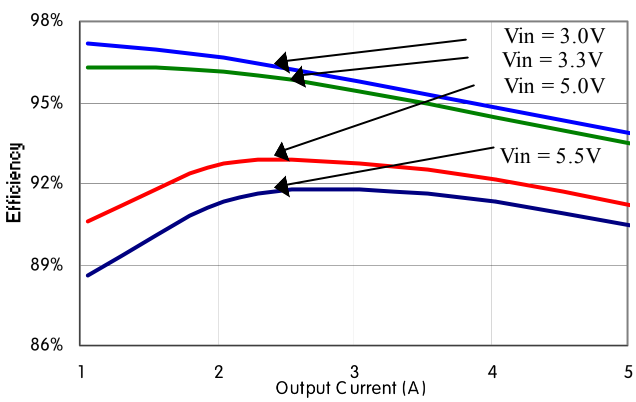


Figure 9. Converter efficiency vs. output current AXH005A0X-SR (Vo = 2.5V)

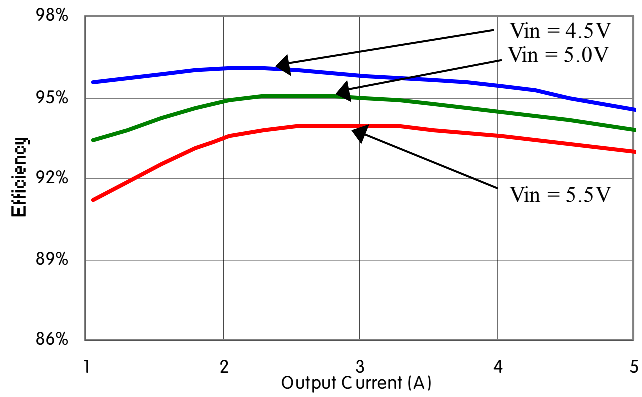


Figure 10. Converter efficiency vs. output current AXH005A0X-SR (Vo = 3.3V)

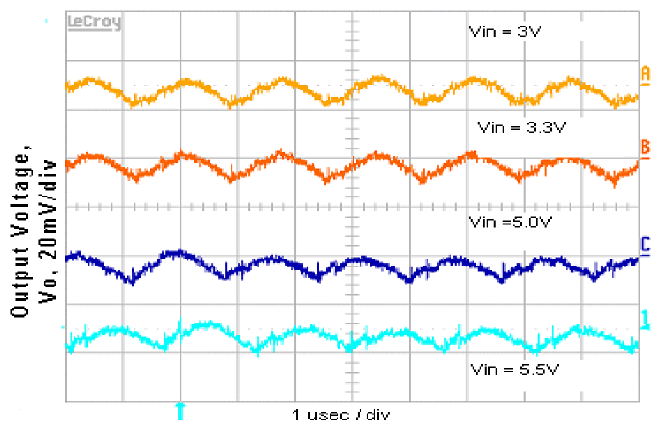


Figure 11. Typical Output Ripple Voltage AXH005A0X-SR (Vo = 0.75 V,, Io = 5A)

Figure 12. Typical Start-Up Voltage Waveform AXH005A0X-SR

(Vo = 3.3V, Vin =5V, Io = 5A)

Characteristics Curves (continued)

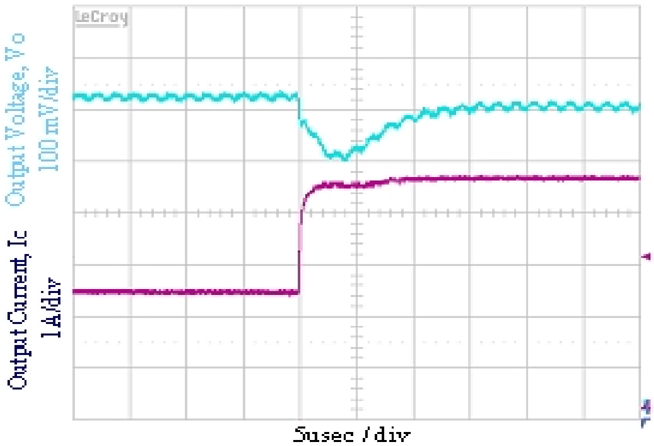


Figure 13. Typical Transient Response to Step load change at 2.5 A/usec from 50% to 100% of Io,max
AXH005A0X-SR (Vo = 1.8V)

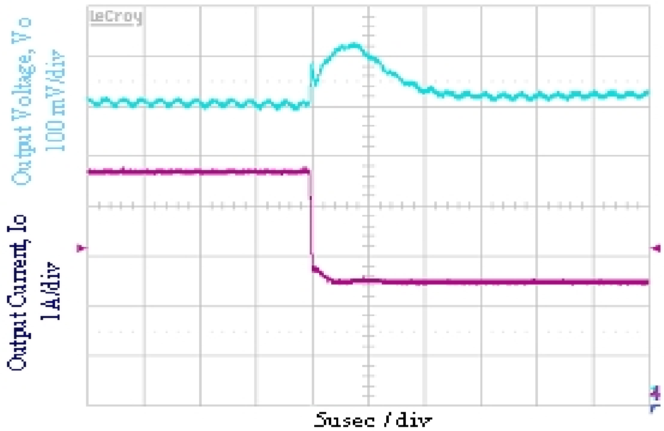
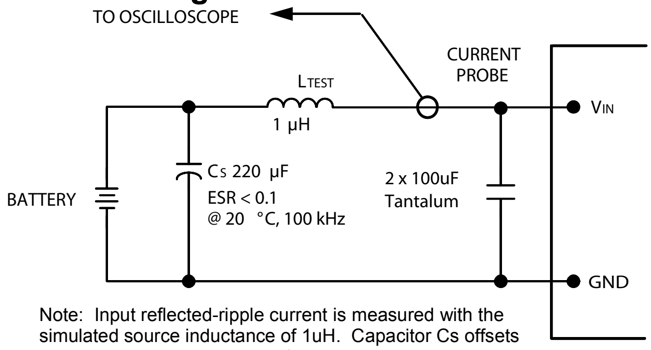


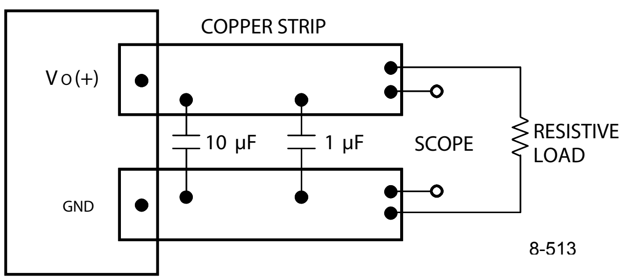
Figure 14. Typical Transient Response to Step load change at 2.5 A/usec from 100% to 50% of Io,max
AXH005A0X-SR (Vo = 1.8V)

Test Configurations



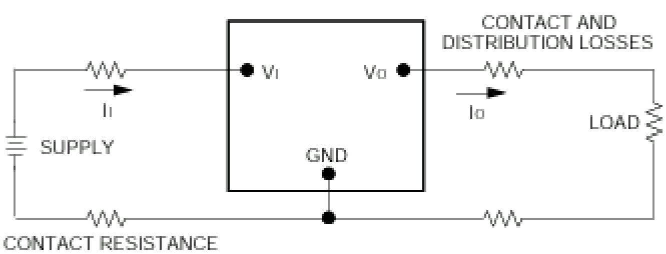
Note: Input reflected-ripple current is measured with the simulated source inductance of 1uH. Capacitor Cs offsets possible battery impedance. Current is measured at the input of the module

Figure 15. Input Reflected-Ripple Test Set-up



Note: Use a 10uF tantalum and a 1uF ceramic capacitor. Scope measurement should be made using BNC socket. Position the load between 51 mm and 76mm (2 in. and 3 in.) from the module

Figure 16. Peak-to-Peak Output noise and start-up Transient measurement Test Set-up



Note: All measurements are taken at the module terminals. When socketing, place Kelvin connections at module terminals to avoid measurement errors due to socket contact resistance.

$$\eta = (\frac{VoxIo}{VixIi})x100 \quad \%$$

Figure 17. Output Voltage and Efficiency Measurement Test Set-up

Design Considerations

Input Source Impedance

To maintain low-noise and ripple at the input voltage, it is critical to use low ESR capacitors at the input to the module. Figure 18 shows the input ripple voltage (mV p-p) for various output volatges using a 150μF low ESR polymer capacitor (Panasonic p/n: EEFUE0J151R, Sanyo p/n: 6TPE150M) in parallel with 47μF ceramic capacitor (Panasonic p/n: ECJ-5YB0J476M, Taiyo Yuden p/n: CEJMK432BJ476MMT). Figure 19 depicts much lower input voltage ripple when input capacitance is increased to 450μF (3x150μF) polymer capacitors in parallel with 94μF (xx47μF) ceramic capacitor.

The input capacitance should be able to handle an AC ripple current of at least:

$$Irms = Iout \times \sqrt{\frac{Vout}{Vin} \times \left[1 - \frac{Vout}{Vin}\right]} \quad \text{Arms}$$

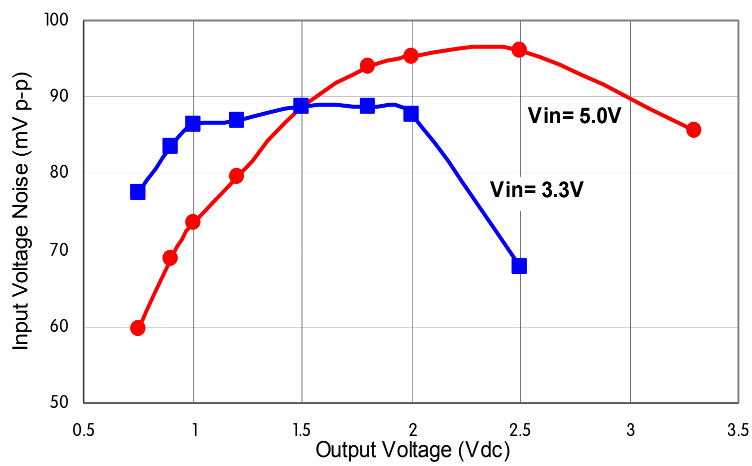


Figure 18. Input Voltage Ripple for various output Voltages (Io=5A) C_{IN} = 150uF polumer//47uF Ceramic

Figure 19. Input Voltage Ripple for various output Voltages (Io=5A) C_{IN} = 3x150uF polymer// 2 x 47uF Ceramic

Design Considerations (continued)

Safety Considerations

For safety agency approval the power module must be installed in compliance with the spacing and separation requirements of the end-use safety agency standards, i.e., UL 60950, CSA C22.2 No. 60950-00, EN60950 (VDE 0850) 0805 (IEC60950, 3rd edition) Licensed.

For the converter output to be considered meeting the requirements of safety extra-low voltage (SELV), the input must meet SELV requirements. The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

The input to these units is to be provided with a maximum of 15 A time-delay fuse in the ungrounded lead.

Feature Descriptions

Remote On/Off

The Austin MicroLynx™ SMT power modules feature an On/Off pin for remote On/Off operation. If not using the remote On/Off pin, leave the pin open (module will be on). The On/Off pin signal (Von/Off) is referenced to ground. To switch module on and off using remote On/Off, connect an open collector pnp transistor between the On/Off pin and the V_I pin (See Figure 20).

During a logic-low when the transistor is in the Off state, the power module is ON and the maximum Von/off of the module is 0.3 V. The maximum leakage current of the transistor when Von/off = 0.3V and V_I = 5.5V is 10uA. During a logic-high when the transistor is in the active state, the power module is OFF. During this state VOn/Off = 2.5V to 5.5V and the maximum IOn/Off = 1mA.

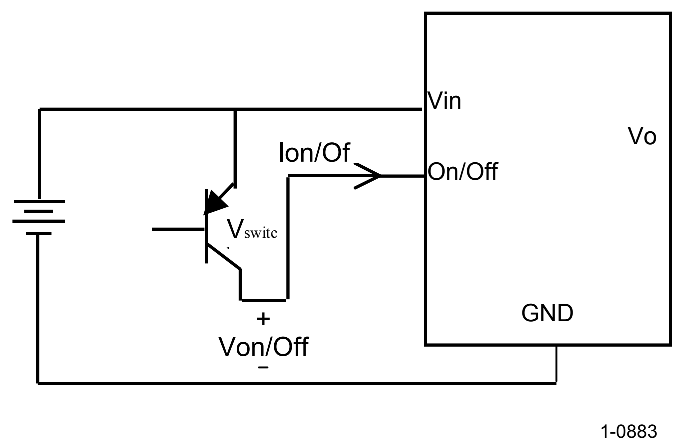


Figure 21. Remote On/Off Implementation

Feature Descriptions (continued)

Output Voltage Programming

The output voltage of the Austin MicroLynx™ SMT can be programmed to any voltage from 0.75 Vdc to 3.3 Vdc by connecting a single resistor (shown as Rtrim in Figure 22) between the TRIM and GND pins of the module. Without an external resistor between TRIM pin and the ground, the output voltage of the module is 0.75 Vdc. To calculate the value of the resistor *Rtrim* for a particular output voltage Vo, use the following equation:

$$Rtrim = \left[\frac{21070}{Vo - 0.75} - 5110\right] k\Omega$$

For example, to program the output voltage of the Austin MicroLynx™ module to 1.8 Vdc, *Rtrim* is calculated is follows:

$$Rtrim = \left[\frac{21070}{1.8 - 0.75} - 5110\right]$$

$$Rtrim = 14.957 k\Omega$$

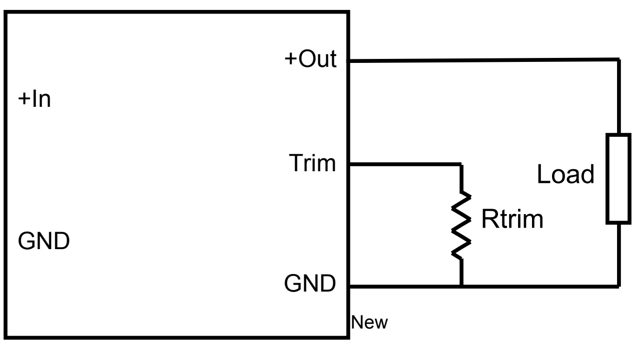


Figure 22. Circuit configuration for programming output voltage using an external resistor

The Austin MicroLynx™ can also be programmed by applying a voltage between TRIM and GND pins (Figure 23). The following equation can be used to determine the value of *Vtrim* needed to obtain a desired output voltage Vo:

$$Vtrim = (0.7 - 0.1698 \times \{Vo - 0.75\})$$

For example, to program the output voltage of a MicroLynx™ module to 3.3 Vdc, *Vtrim* is calculated as follows:

$$Vtrim = (0.7 - 0.1698 \times \{3.3 - 0.75\})$$
$$Vtrim = 0.2670V$$

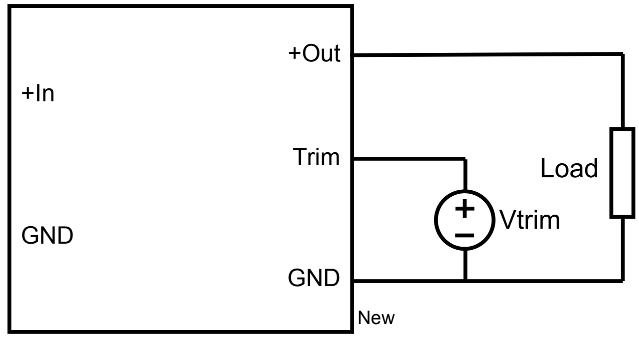


Figure 23. Circuit Configuration for programming Output voltage using external voltage source

Table 4 provides *Rtrim* values required for most common output voltages. Table 5 provides values of external voltage source, *Vtrim* for various output voltages.

Table 4

Vo,set (V)	*Rtrim* KΩ
0.75	Open
0.9	135.36
1.0	79.17
1.2	41.71
1.5	22.98
1.8	14.96
2.0	11.75
2.5	6.93
3.3	3.15

Table 5

Vo,set (V)	*Vtrim* (V)
0.75	Open
0.9	0.6745
1.0	0.6575
1.2	0.6236
1.5	0.5726
1.8	0.5047
2.0	0.4878
2.5	0.403
3.3	0.2670

Feature Descriptions (Continued)

Overcurrent Protection

To provide protection in a fault condition, the unit is equipped with internal non-latching internal overcurrent protection. The unit operates normally once the fault condition is removed.

Input Undervoltage Lockout

At input voltages below the input undervoltage lockout limit, the module operation is disabled. The module will begin to operate at an input voltage above the undervoltage lockout turn-on threshold.

Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection and radiation to the surrounding environment.

The thermal data presented is based on measurement taken in a wind tunnel. The test set-up is shown in Figure 25 was used to collect data for Figures 26 and 27. Note that the airflow is parallel to the short axis of the module as shown in Figure 24. The derating data applies to airflow along either direction of the module's short axis.

Figure 24. Temperature measurement location

The temperature at Pin Y of X1 or X2 should not exceed zzz°C. The output power of the module should not exceed the rated power of the module (Vo,set x Io,max).

Convection Requirements for Cooling

To predict the approximate cooling needed for the module, refer to power derating curve in Figures 26 and 27.

The derating curve is approximation of the ambient temperatures and airflows required to keep the power module temperature below rating. Once the module is assembled in the actual system, the module's temperature should be checked as shown in Figure 25 to ensure it does not exceed zzz°C. Proper cooling can be verified by measuring the power module's temperature at x1-pin y and x2-piny as shown in Figure 24.

Thermal Considerations (continued)

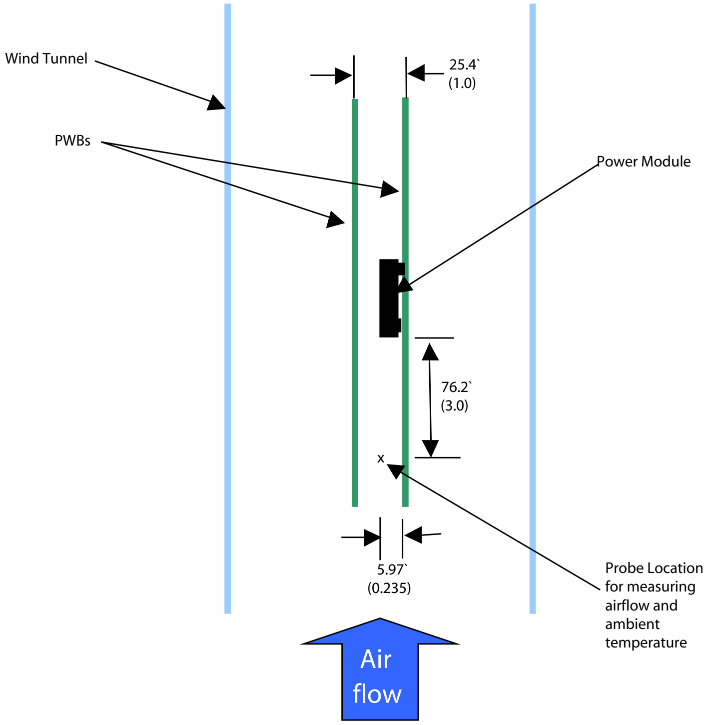


Figure 25. Thermal Test set-up

TBD

Figure 26. Typical Power Derating Curve vs. Output Current AXH005A0X-SR (Vo = 2.5V, Vin = 3.3V)

TBD

Figure 27. Typical Power Derating Curve vs. Output Current for AXH005A0X-SR (Vo= 3.3V, Vin =5V)

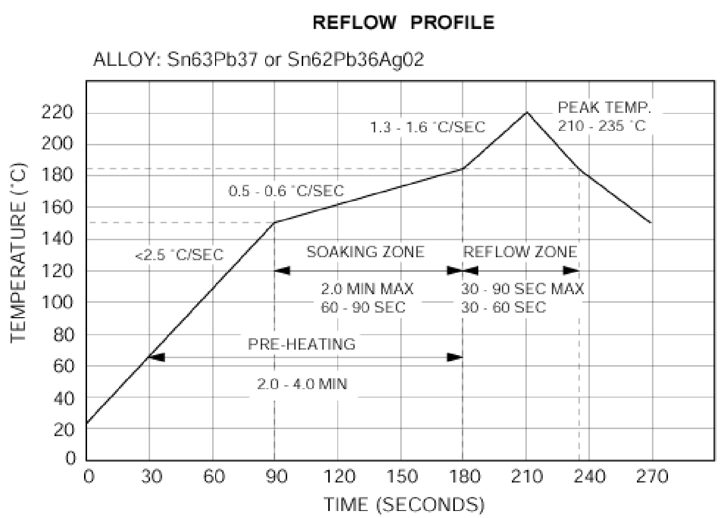
Layout Considerations

Copper paths should not be routed directly underneath the module.

Reflow Profile

An example of a reflow profile (using 63/37 solder) for Austin MicroLynx™ SMT power module is :

- Pre-heating zone: room temperature to 183 °C (2.0 to 4.0 minutes maximum)
- Initial ramp rate: < 2.5 °C per second
- Soaking Zone: 155 °C to 183 °C – 60 to 90 seconds typical (2.0 minutes maximum)
- Reflow zone ramp rate: 1.3 °C to 1.6 °C per second
- Reflow zone: 210 °C to 235 °C peak temperature – 30 to 60 seconds (90 seconds maximum)



Pick and Place Location

Although the module weight is minimized by using open-frame construction, the modules have relatively large mass compared to conventional surface- mount- technology components. To optimize the pick-and-place process, automated vacuum equipment variables such as nozzle size, tip style, vacuum pressue, and placement speed should be considered. Austin MicroLynx™ SMT modules have a flat surface which serves as a pick-and-place location for automated vacuum equipment. The module's pick-and-place location is identified by the target symbols on the top label as shown in Figure 28.

Figure 28. Pick and Place Location

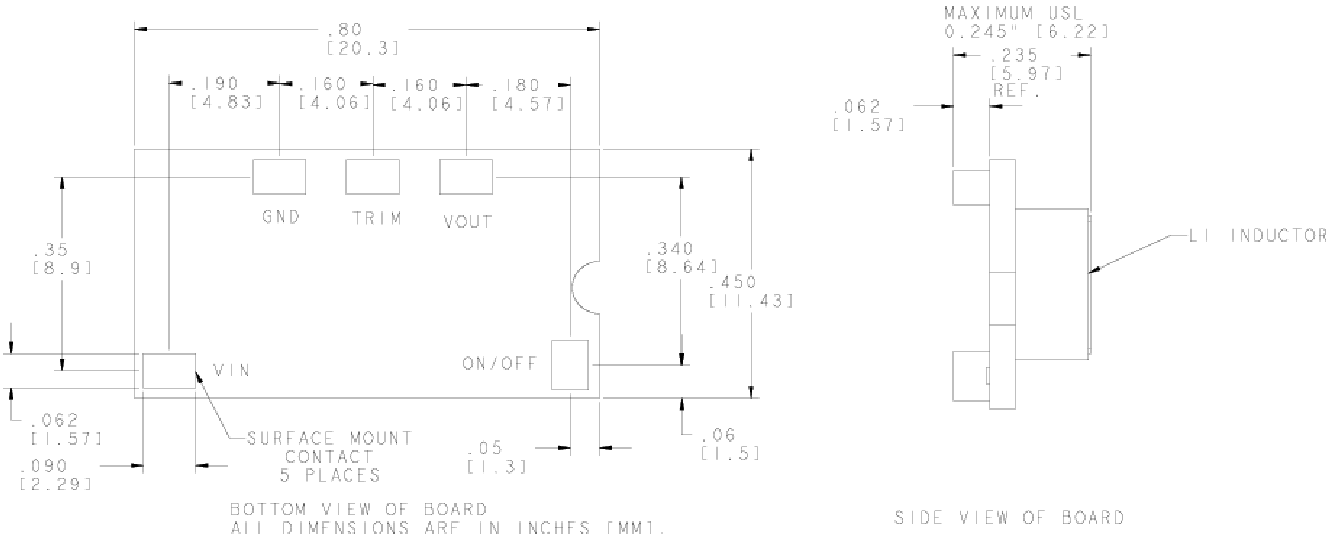
Surface-Mount Tape & Reel

Figure 29. Tape Dimensions

Mechanical Outline Diagram

Dimensions are in millimeters and (inches).

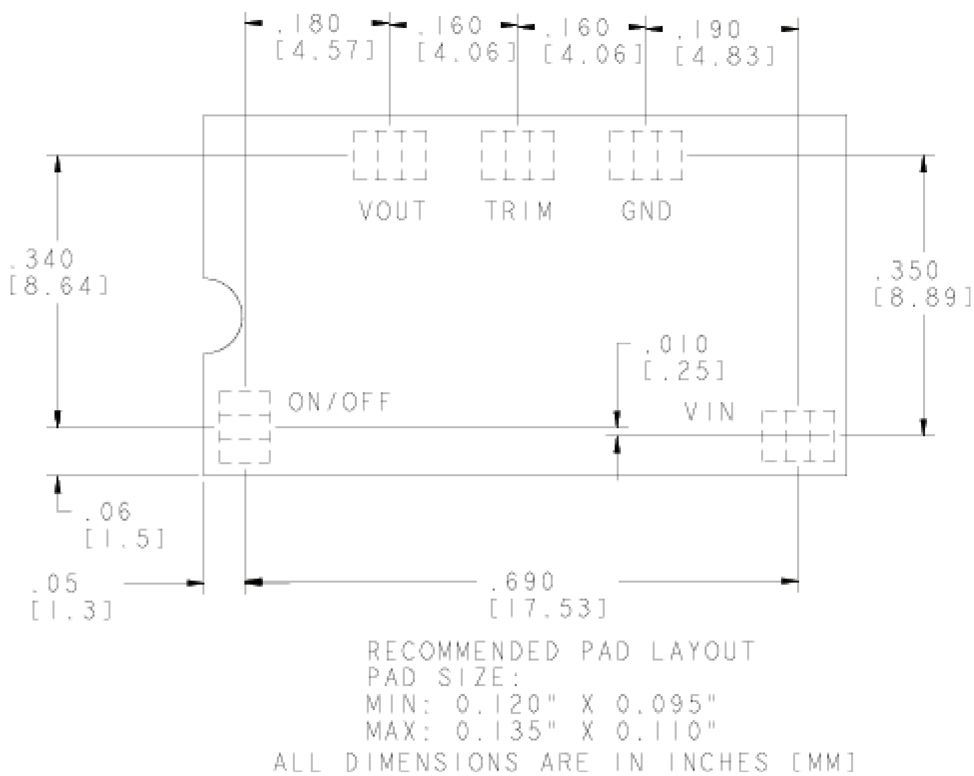
Tolerances: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.), unless otherwise noted.



Recommended Pad Layout

Dimensions are in millimeters and (inches).

Tolerances: x.x ± 0.5 mm (0.02 in.), x.xx ± 0.25 mm (0.010 in.), unless otherwise noted.



Ordering Information

Please contact your Tyco Electronics' Account Manager or Field Application Engineer for pricing and availability.

Table 6. Device Codes

Device Code	Input Voltage	Output Voltage	Output Current	Efficiency 3.3V @ 5A	Connector Type	Packaging	Comcode
AXH005A0X-SR	3.0 – 5.5 Vdc	0.75 – 3.63 V	5A	94.0%	SMT	Tape & Reel	108979667

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