



FEATURES

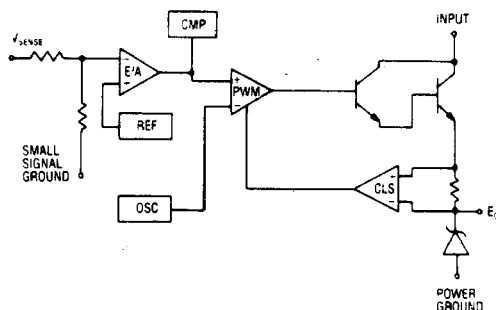
- o Complete DC-to-DC converter
- o 70% minimum efficiency
- o 70kHz switching frequency
- o Programmable output voltage from 5 to 35 volts
- o Preset output voltage of 5.05 Volts \pm 1.5%
- o Current limit and thermal shutdown

DESCRIPTION

The LSH 6335/6435/6535 switching regulator is a micro-hybrid circuit designed for use in step-down applications requiring accurate output voltages over combined variations of line, load and temperature. This unique product greatly simplifies switching power supply design. The LSH 6335/6435/6535 microconverter includes a switching regulator, catch diode and compensation network within a TO-220 style package. Just add a choke and two capacitors to obtain an efficient DC-to-DC converter for 5 Volts at 3 Amps. To increase the output voltage, simply add a programming resistor. The current limit and thermal shutdown features of the LSH 6335/6435/6535 fully protect the device against overstress conditions.

The LSH 6335/6435/6535 TO-220 style plastic package is available in three options to accommodate various mounting requirements. Available lead formations are straight in-line, staggered for vertical mount and staggered for horizontal mount.

BLOCK DIAGRAM



PRELIMINARY
9/12/88

ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MAXIMUM | UNITS |
|---|---------------|--------------------|-------|
| Input Voltage LSH 6335 LSH 6435 LSH 6535 | V_{IN} | 35 40 45 | Volts |
| Power Dissipation | P_D | Internally Limited | Watts |
| Thermal Resistance Junction to Case | θ_{JC} | 7 | °C/W |
| Operating Junction Temperature Range | T_J | -25 to 125 | °C |
| Storage Temperature Range | T_{STG} | -65 to 150 | °C |
| Lead Temperature (Soldering, 10 Seconds) | T_{LEAD} | 260 | °C |

DEVICE SELECTION GUIDE

| DEVICE | V_{IN} MAX | V_{OUT} MAX | LEADS |
|------------|--------------|---------------|----------------------|
| LSH 6335P | 35 | 27 | Straight in-line |
| LSH 6335PV | 35 | 27 | Vertical staggered |
| LSH 6335PH | 35 | 27 | Horizontal staggered |
| LSH 6435P | 40 | 31 | Straight in-line |
| LSH 6435PV | 40 | 31 | Vertical staggered |
| LSH 6435PH | 40 | 31 | Horizontal staggered |
| LSH 6535P | 45 | 35 | Straight in-line |
| LSH 6535PV | 45 | 35 | Vertical staggered |
| LSH 6535PH | 45 | 35 | Horizontal staggered |

ELECTRICAL CHARACTERISTICS

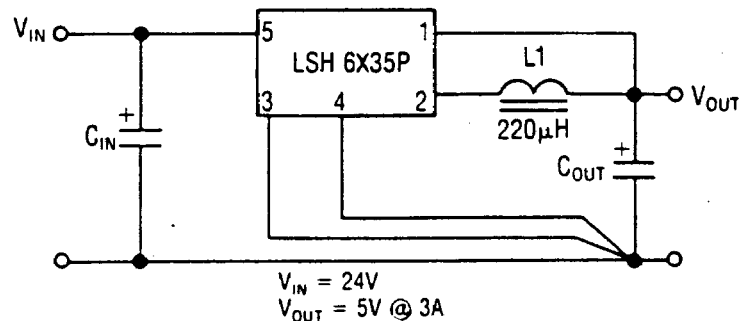
Input test conditions are as follows: $V_{IN} = 24\text{VDC}$, $V_O = 5\text{VDC}$,
 $I_O = 3\text{A}$, $T_J = 25^\circ\text{C}$, unless otherwise specified.

| Parameter | Symbol | Test Conditions | | | Test Limits | | | Units |
|--------------------------------------|----------------|---------------------------|-------------------------|---------------|--------------|-----------------------|--------------|------------------------|
| | | V_{IN} | I_O | T_J | Minimum | Typical | Maximum | |
| Output Voltage ¹ | V_O | 12V to $V_{IN(MAX)}$ | 0A 0.3A to 3A | - 25 to 125°C | 4.97 4.80 | 5.05 | 5.13 5.30 | Volts |
| Line Regulation ¹ | $REG_{(LINE)}$ | 12V to $V_{IN(MAX)}$ | | | | 90 | | mV |
| Load Regulation ¹ | $REG_{(LOAD)}$ | | 0.3A to 3A | | | 45 | | mV |
| System Efficiency | η | | | - 25 to 125°C | 70 | 75 | | % |
| Switching Frequency | f_{SX} | | 50mA | | 58 | 70 | 86 | kHz |
| Quiescent Current | I_O | $V_{IN(MAX)}$ | 0A | | | 18 | 30 | mA |
| Peak Current Limit Threshold | I_{CL} | | | - 25 to 125°C | 3.3 | | 5.5 | Amps |
| Output Noise and Ripple ⁴ | V_N | | | | | 50 | | mV _{pk-pk} |
| LSH 6335 | | 30V + 5V _{pk-pk} | | | | | | |
| LSH 6435 | | 35V + 5V _{pk-pk} | | | | | | |
| LSH 6535 | | 40V + 5V _{pk-pk} | | | | | | |
| Turn On Overshoot | | | 0.5A to 3A | | | 0 | | mV |
| Unit Step Load Change | | | 0A to 3A 3A to 0.05A | | | 0 250 ² | | mV mV _{pk} |
| Programming Resistance ³ | | 12V to $V_{IN(MAX)}$ | | - 25 to 125°C | | 0.2 | | Volts/k Ω |

- (1) Low duty cycle, pulse testing with Kelvin connections required.
 (2) 10mS duration.
 (3) V_O programming above 5.05V.
 (4) 120 Hz input ripple.

TYPICAL APPLICATION

DC-TO-DC STEP-DOWN CONVERTER^{1,2}

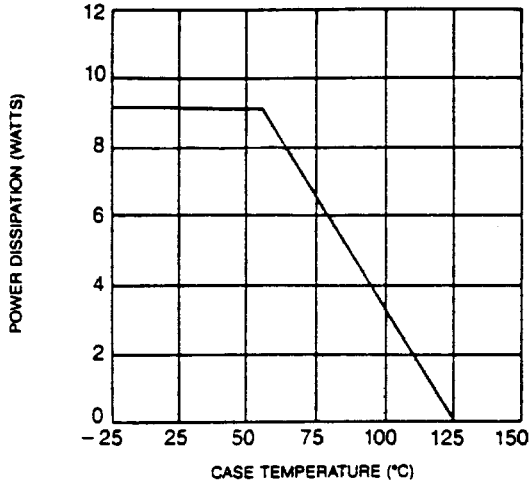


¹ $C_{IN} = 330\mu\text{F}$; $C_{OUT} = 1000\mu\text{F}$

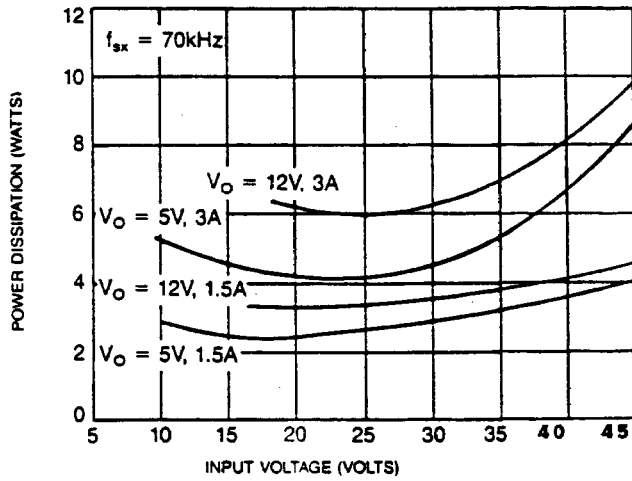
² For output voltages above 5V, add programming resistor between Pin 1 and V_{OUT} .

OPERATIONAL DATA

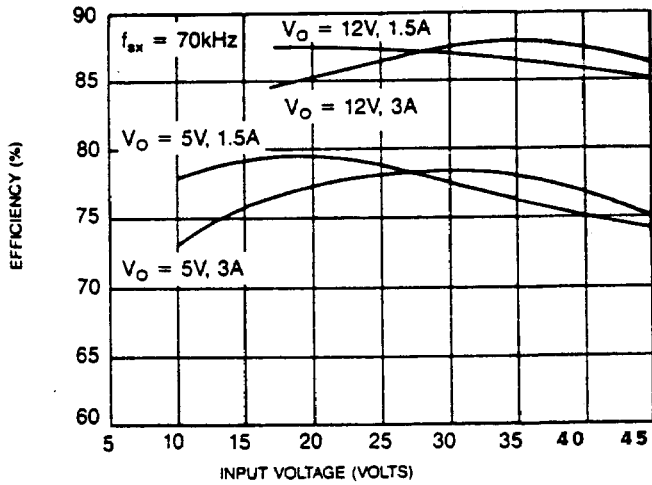
POWER DERATING



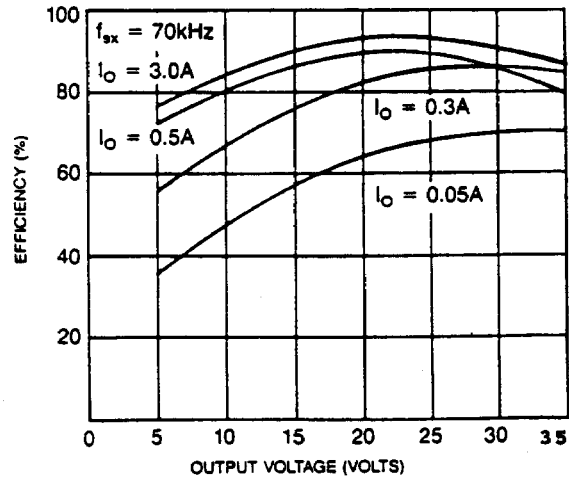
POWER DISSIPATION VS INPUT VOLTAGE



EFFICIENCY VS INPUT VOLTAGE

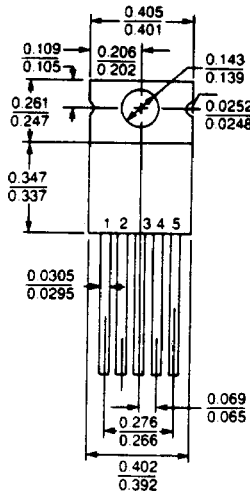


EFFICIENCY VS OUTPUT VOLTAGE

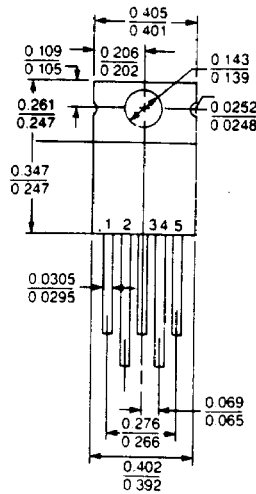


DEVICE OUTLINE

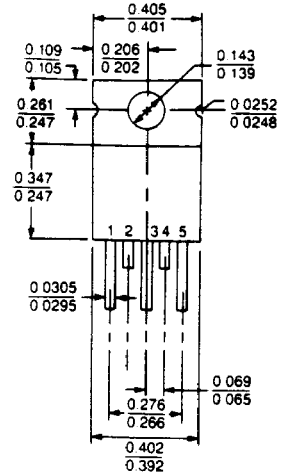
LSH 6X35P
(Front View)



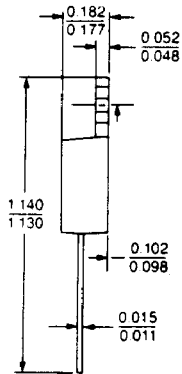
LSH 6X35PV
(Front View)



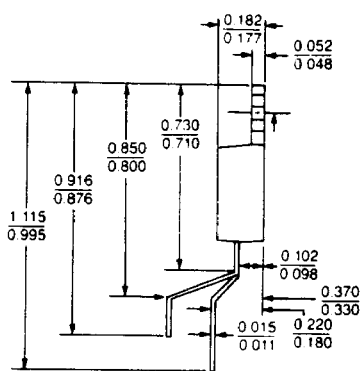
LSH 6X35PH
(Front View)



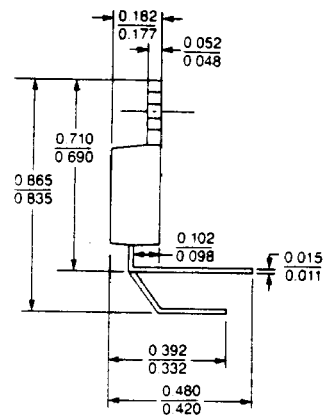
(Side View)



(Side View)



(Side View)



- | | |
|-----|--------------------------|
| 1 | - V_{SENSE} |
| 2 | - E_o |
| 3 | - Small Signal Ground |
| 4 | - Power Ground |
| 5 | - Input |
| Tab | - is Small Signal Ground |

NOTE: All dimensions are in inches.