



# LAMBDA SEMICONDUCTORS

LSH 6335, LSH 6435, LSH 6535  
3 AMP DC-TO-DC MICROCONVERTERS

## FEATURES

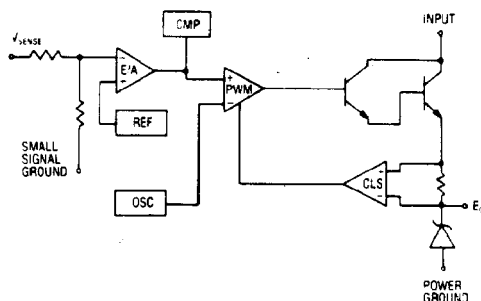
- o Complete DC-to-DC converter
- o 70% minimum efficiency
- o 70kHz switching frequency
- o Programmable output voltage from 5 to 35 volts
- o Preset output voltage of 5.05 Volts  $\pm$  1.5%
- o Current limit and thermal shutdown

## 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

10000 DIVE

CORPUS CHRISTI, TEXAS 78410

TELEPHONE

**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	$\theta_{JC}$	7	$^{\circ}C/W$
Operating Junction Temperature Range	$T_J$	-25 to 125	$^{\circ}C$
Storage Tempera- ture Range	$T_{STG}$	-65 to 150	$^{\circ}C$
Lead Temperature (Soldering, 10 Seconds)	$T_{LEAD}$	260	$^{\circ}C$

**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 <sup>1</sup>	$V_O$	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 <sup>1</sup>	$REG_{(LINE)}$	12V to $V_{IN(MAX)}$				90		mV
Load Regulation <sup>1</sup>	$REG_{(LOAD)}$		0.3A to 3A			45		mV
System Efficiency	$\eta$			- 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 <sup>4</sup>	$V_N$					50		mV <sub>pk-pk</sub>
LSH 6335		30V + 5V <sub>pk-pk</sub>						
LSH 6435		35V + 5V <sub>pk-pk</sub>						
LSH 6535		40V + 5V <sub>pk-pk</sub>						
Turn On Overshoot			0.5A to 3A			0		mV
Unit Step Load Change			0A to 3A 3A to 0.05A			0 250 <sup>2</sup>		mV mV <sub>pk</sub>
Programming Resistance <sup>3</sup>		12V to $V_{IN(MAX)}$		- 25 to 125°C		0.2		Volts/k $\Omega$

<sup>(1)</sup> Low duty cycle, pulse testing with Kelvin connections required.

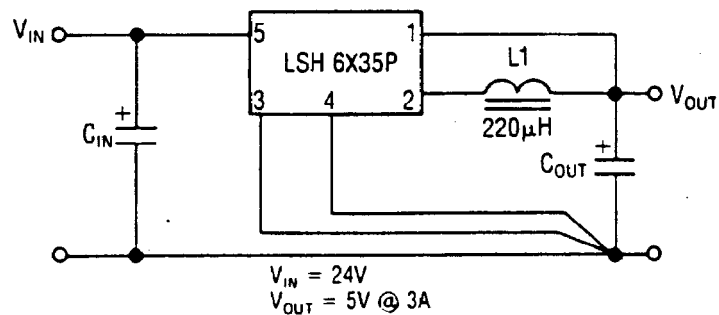
<sup>(2)</sup> 10mS duration.

<sup>(3)</sup>  $V_O$  programming above 5.05V.

<sup>(4)</sup> 120 Hz input ripple.

## TYPICAL APPLICATION

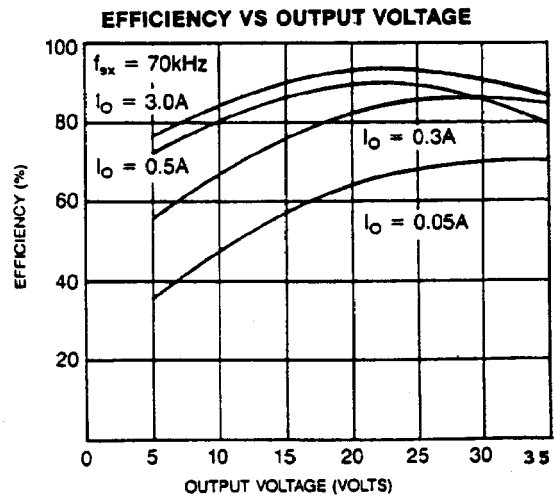
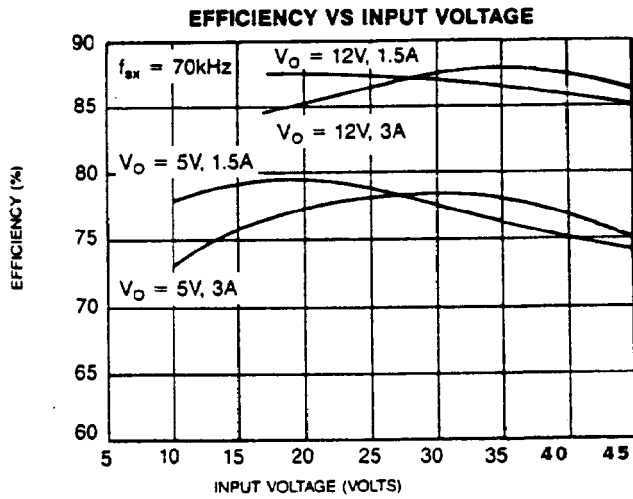
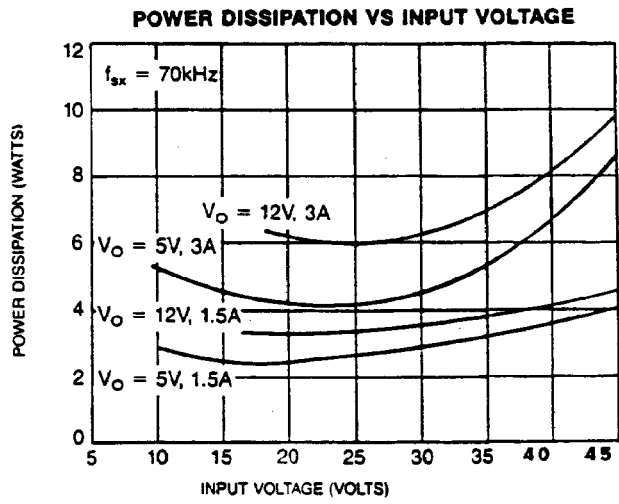
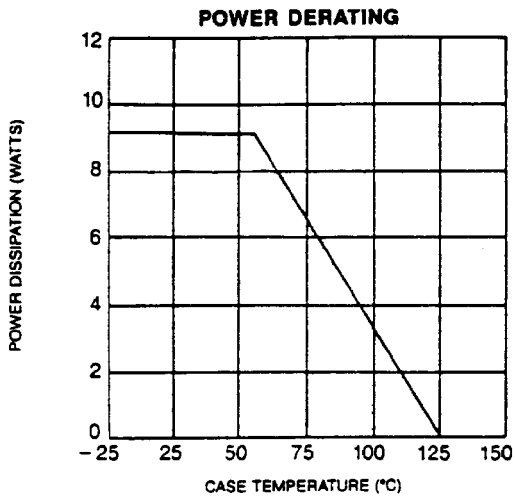
### DC-TO-DC STEP-DOWN CONVERTER<sup>1,2</sup>



<sup>1</sup>  $C_{IN} = 330\mu\text{F}$ ;  $C_{OUT} = 1000\mu\text{F}$

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

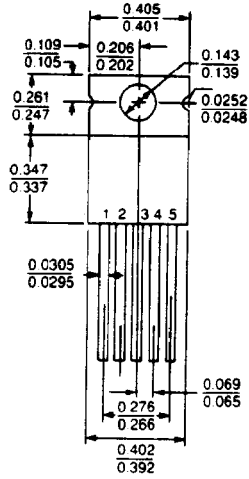
## OPERATIONAL DATA



## DEVICE OUTLINE

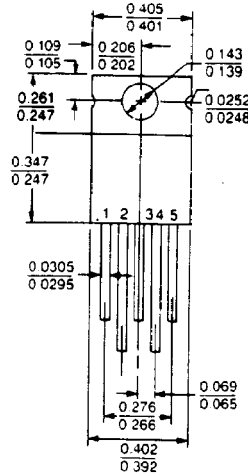
**LSH 6X35P**

(Front View)



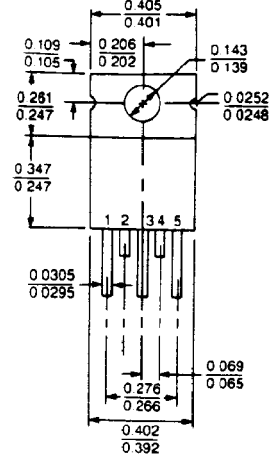
**LSH 6X35PV**

(Front View)

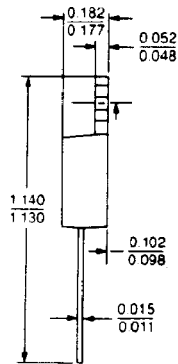


**LSH 6X35PH**

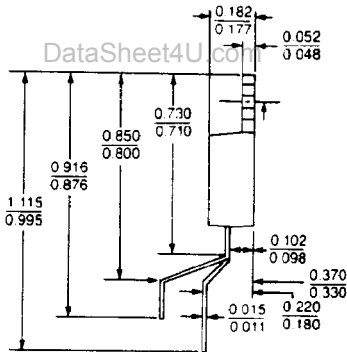
(Front View)



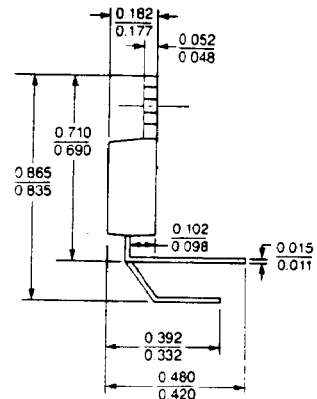
(Side View)



(Side View)



(Side View)



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

NOTE: All dimensions are in inches.