Datasheet
Rev 0, 12/2005
Preliminary

ACT6305

ACT6305 LOW INPUT HIGH EFFICIENCY SYNCHRONOUS STEP-UP CONVERTER

FEATURES

- Up to 0.9V Startup Voltage
- Up to 94% Efficiency
- Internal Power Switch
- 3.3V and 5V Fixed or Adjustable Output Voltage
- Zero Supply Current Shutdown Mode
- Tiny SOT 23-5 Package

APPLICATIONS

- Hand-Held Devices
- One to Three Cell Battery Operated Devices
- PDAs
- Cellular Phones
- Digital Cameras
- GPS

GENERAL DESCRIPTION

The ACT6305 Low Input High Efficiency Synchronous Step-Up Converter is capable of delivering more than 400mA output current using only three external components.

Typical startup voltage is 0.95V and the device can operate down to a 0.6V input voltage. Incorporating an internal synchronous rectifier, the ACT6305 can achieve high efficiency of up to 94%. Variable switching frequency operation results in high efficiency for a wide range of loads.

The output voltage is selectable between 3.3V and 5V, or can be externally set to any voltage between 2V and 5V. The ACT6305 is available in the tiny SOT23-5 Package.

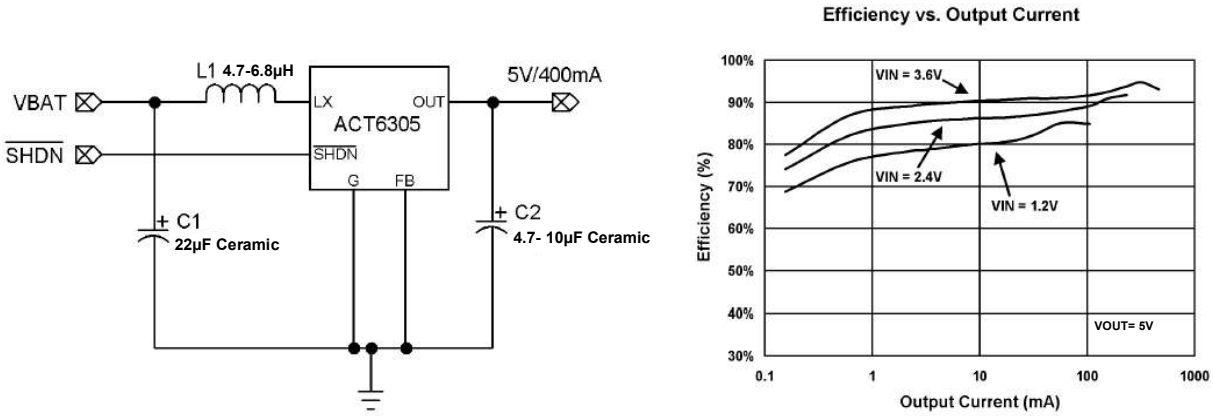
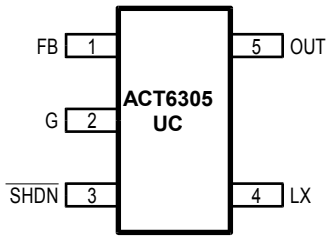


Figure 1. Typical Application Circuit

ORDERING INFORMATION

PART NUMBER	TEMPERATURE RANGE	PACKAGE	PINS	TOP MARK
ACT6305UC	-40°C to 85°C	SOT23-5	5	HBCA

PIN CONFIGURATION



SOT23-5

PIN DESCRIPTION

PIN NUMBER	PIN NAME	PIN DESCRIPTION
1	FB	Output Voltage Selected and Feedback Input. Connect to G to select V_{OUT} = 3.3V. Connect to OUT to select V_{OUT} = 3.3V. Connect to a resistor divider to set output voltage between 2V and 5V.
2	G	Ground
3	$\overline{SHDN}$	Shutdown Input. A low level puts IC in shutdown and a high level activates the IC.
4	LX	Inductor Connection
5	OUT	Output. This pin is always used as the supply rail for internal circuitry.

ABSOLUTE MAXIMUM RATINGS

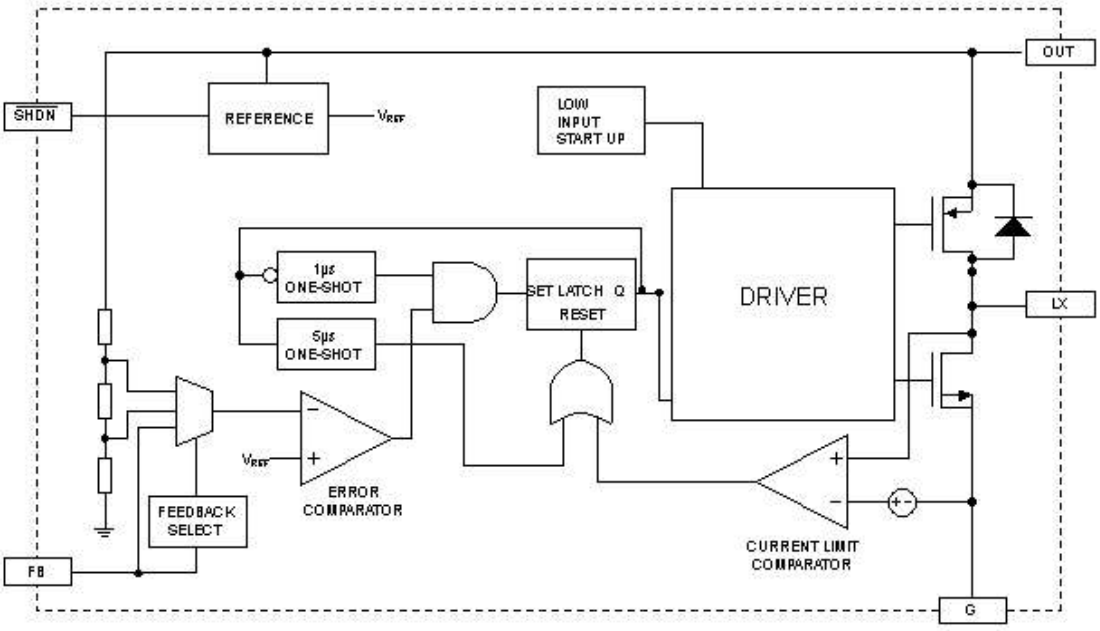
(Note: Do not exceed these limits to prevent damage to the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

PARAMETER	VALUE	UNIT
OUT Supply Voltage	-0.3 to 6	V
$\overline{SHDN}$ Voltage	-0.3 to 6	V
FB, LX Voltage	-0.3 to V_{OUT} + 0.3	V
Continuous LX Current	Internally Limited	A
Maximum Power Dissipation (derate 5mW/°C above T_A = 50°C)	0.53	W
Junction to Ambient Thermal Resistance (θ_{JA})	190	°C/W
Operating Junction Temperature	-40 to 150	°C
Storage Temperature	-55 to 150	°C
Lead Temperature (Soldering, 10 sec)	300	°C

ELECTRICAL CHARACTERISTICS

(Circuit of Figure 1, V_{IN} = 1.5V, V_{OUT} = 3.3V, T_A = 25°C unless otherwise specified.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Minimum Operating Input Voltage				0.6		V
Startup Voltage				0.95	1.1	V
Output Voltage	V_{OUT}	FB = OUT	3.2	3.3	3.4	V
		FB = G	4.85	5	5.15	
Startup to Normal Transition Voltage Threshold				1.85		V
FB Feedback Voltage	V_{FB}	V_{OUT} = 2V to 5V	1.16	1.18	1.2	V
FB Input Current		FB = 1.3V			0.1	µA
Power Switch Current Limit	I_{LIM}		1	1.2	1.4	A
Power Switch On Resistance	R_{ONN}	I_{LX} = 100mA		0.15	0.3	Ω
Synchronous Rectifier On Resistance	R_{ONP}	I_{LX} = 100mA		0.25	0.5	
LX Leakage Current		$\overline{SHDN}$ = G, V_{LX} = 0 or 3.3V		0.1	1	µA
Output Voltage Range		External Feedback divider	2		5	V
Quiescent Current at OUT	I_Q	V_{FB} = 1.3V		17	34	µA
Shutdown Supply Current	I_{SD}	$\overline{SHDN}$ = G		0.1	1	µA
Maximum On Time	t_{ONMAX}	V_{OUT} = 2V to 5.5V	1	50	5	ns
Programming High Time					75	µs
Finish High Time	t_{FINISH}		500			µs
Off Timeout	t_{OFF}			300	500	µs
Input Current					1	µA



FUNCTIONAL DESCRIPTION

The ACT6305 comprises a reference, feedback select error comparator, control logic and timers, internal power MOSFETs and current comparators. The Functional Block Diagram is shown in Figure 2.

MAIN CONTROL LOOP

The ACT3605 uses the maximum ON time/minimum OFF time step-up architecture. An error comparator monitors the FB voltage. When FB is below the reference voltage and the 1µs minimum OFF time is exceeded, the latch is set and an ON cycle is initiated. During this period, the N-channel power switch is turned on to connect the LX node to ground. By doing so, the energy is transferred from supply to the inductor. Once the 5µs maximum ON time is exceeded or the 1A current limit is reached, the N-channel power switch is turned off and the OFF cycle begins. During OFF cycle the energy stored in the inductor is released into the load through the synchronous rectifier. After the minimum OFF time, if FB voltage drops below the reference voltage, the IC transitions to the ON cycle again.

LIGHT LOAD OPERATION

At light load, the IC enters power-saving mode by extending the OFF time, resulting in high efficiency across a wide load range.

START UP

The ACT6305 uses a proprietary start-up scheme to ensure device start up at a very low supply voltage down to 0.95V. The device stays in the startup mode until V_{OUt} passes 1.85V. During this start-up period, the maximum ON and minimum OFF times are extended.

SHUTDOWN

In shutdown, all internal circuits are disabled. The power switch and the synchronous rectifier are turned off. A DC path from the input supply to the output still exists in shutdown due to the body diode of the synchronous rectifier when output is lower than input by one diode drop.

APPLICATION INFORMATION

OUTPUT VOLTAGE SELECTION

By connecting FB differently, three options are available for output voltages: fixed 3.3V, 5V or an adjustable voltage set by an external resistive divider. (Figure 3).

FB = OUT	V_{OUT} = 3.3V
FB = G	V_{OUT} = 5V
FB connected to resistive divider	V_{OUT} = 1.18V (1+R1/R2)

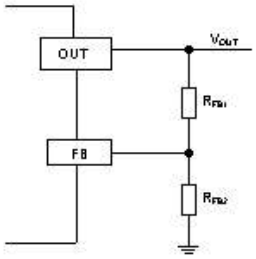


Figure 3.

OUTPUT CAPACITOR SELECTION

The output capacitor value should be in the range of 22µF to 100µ. A minimum value of capacitance is required to maintain loop stability and normal operation of the IC. To obtain small output ripple, use a large capacitor with low ESR. Ceramic capacitors should be used for highest performance. If a tantalum capacitor is used, choose only low ESR types. For a non-ceramic capacitors a smaller low ESR capacitor of about 1µF can be used in parallel to filter high frequency noise.

INDUCTOR SELECTION

The inductor value determines its ripple current. For most applications with this device, the inductor value should be in the range of 10µH to 47µH. Smaller inductors provide faster load transient response while having a smaller physical size. But they also generate higher ripple current, which reduces the maximum output current available to the load. Inductors with low series resistance are recommended to obtain highest efficiency.

BOARD LAYOUT

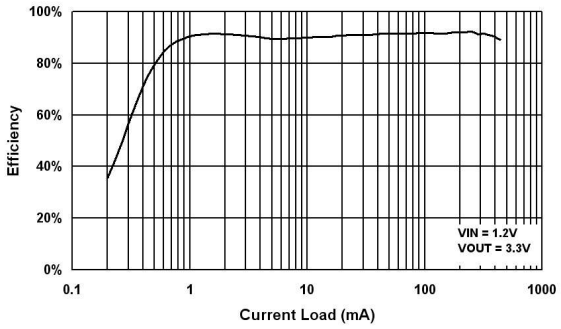
To reduce noise and increase efficiency, the traces for high current paths should be large and an extended ground plane used.

In order to reduce electromagnetic radiation, the switching current paths should be as short as possible. In other words, the input and output capacitors should be very close to the IC.

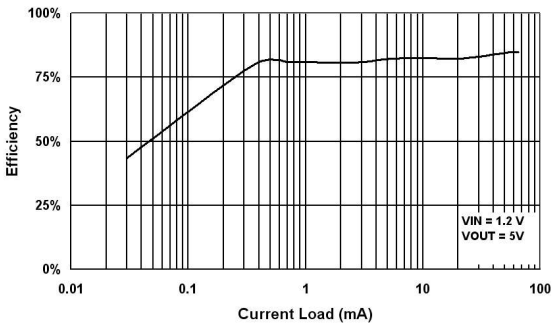
If the external resistor divider is used, it should be very close to the FB and G pins and the high switching current paths.

TYPICAL PERFORMANCE CHARACTERISTICS

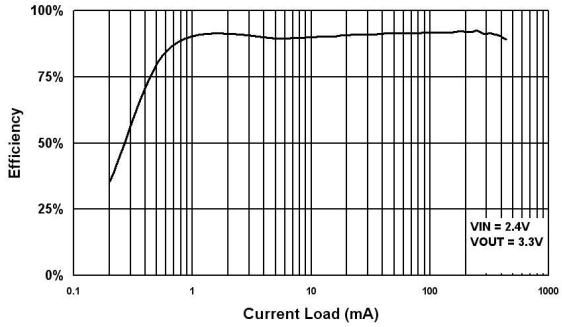
Efficiency vs. Current Load



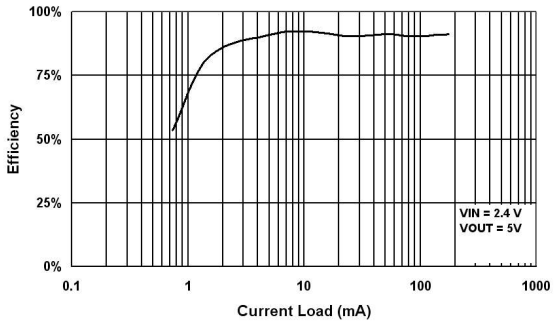
Efficiency vs. Current Load



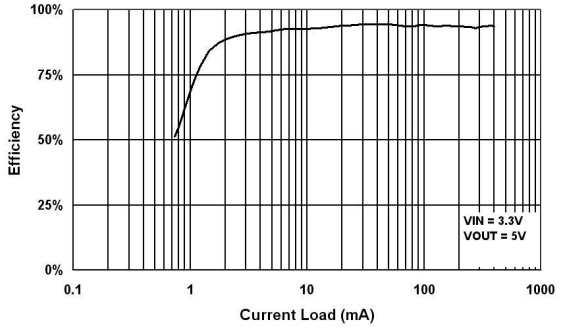
Efficiency vs. Load Current



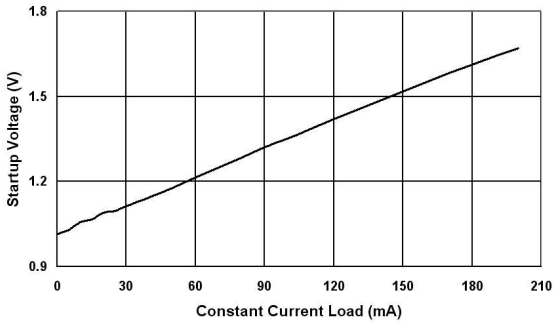
Efficiency vs. Current Load



Efficiency vs. Current Load

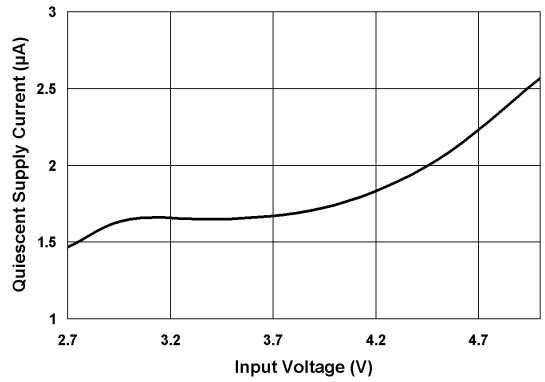


Startup Voltage vs. Output Current

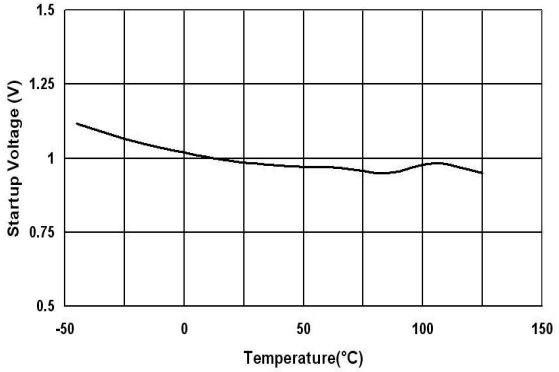


TYPICAL PERFORMANCE CHARACTERISTICS CONT'D

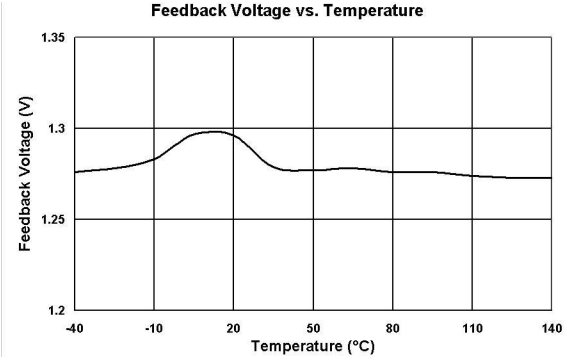
Quiescent Supply Current vs. Input Voltage



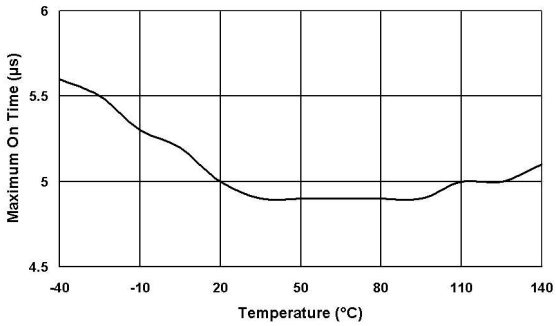
Startup Voltage vs. Temperature



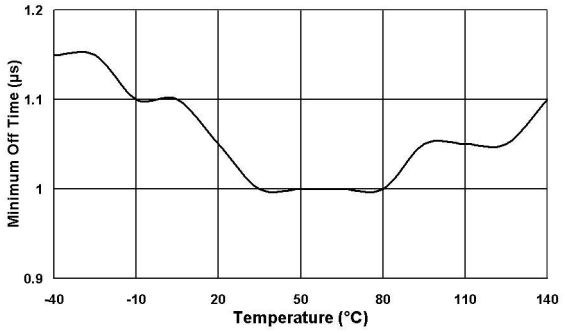
Feedback Voltage vs. Temperature



Maximum On Time vs. Temperature

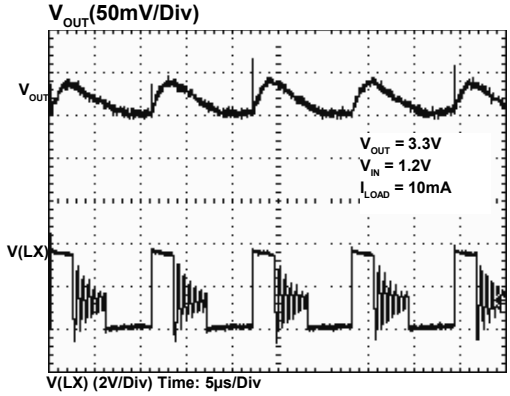


Minimum Off Time vs. Temperature



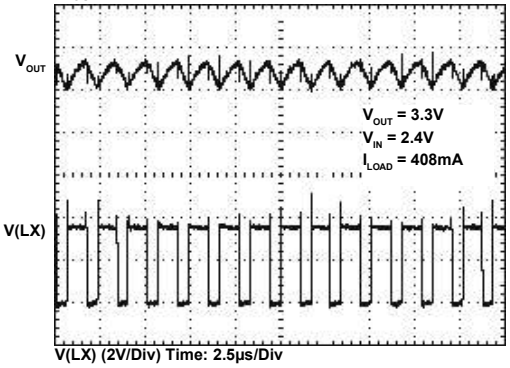
TYPICAL PERFORMANCE CHARACTERISTICS CONT'D

DCM Mode Connection
Low ESR Output Capacitor
V_{OUT}(50mV/Div)



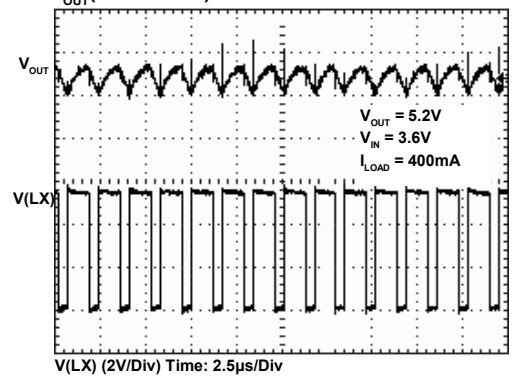
V(LX) (2V/Div) Time: 5µs/Div

Current Limit Condition
Low ESR Output Capacitor
V_{OUT} (100mV/Div)



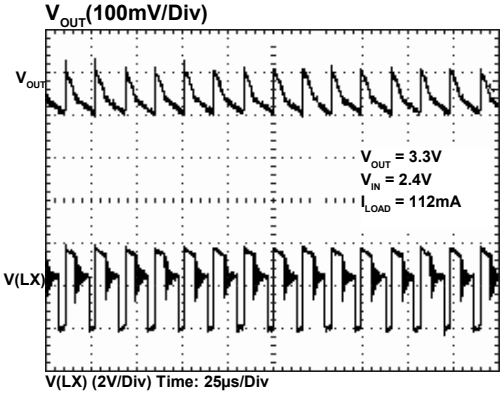
V(LX) (2V/Div) Time: 2.5µs/Div

Heavy Load Condition
Low ESR Output Capacitor
V_{OUT}(100mV/Div)



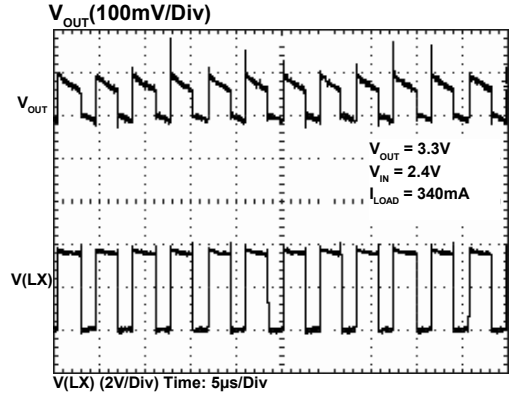
V(LX) (2V/Div) Time: 2.5µs/Div

DCM Mode Connection
High ESR Output Capacitor
V_{OUT}(100mV/Div)



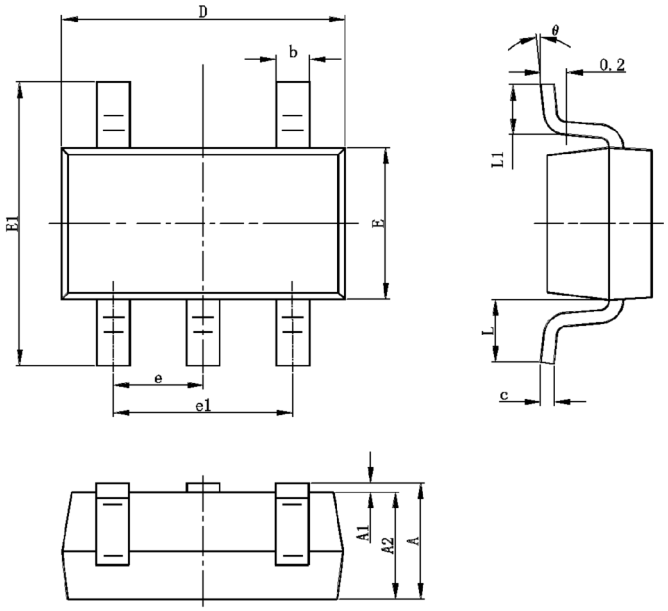
V(LX) (2V/Div) Time: 25µs/Div

Heavy Load Condition
High ESR Output Capacitor
V_{OUT}(100mV/Div)



V(LX) (2V/Div) Time: 5µs/Div

SOT23-5 PACKAGE OUTLINE AND DIMENSIONS



SYMBOL	DIMENSION IN MILLIMETERS		DIMENSION IN INCHES	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.400	0.012	0.016
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.700 REF		0.028 REF	
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°