DESCRIPTION

The AO331V is Low-voltage, low-power, high-speed comparator with internal hysteresis, optimized for systems powered from a 3V or 5V supply.

The AO331V features high-speed response, low power consumption, low offset voltage, and rail-to-rail input and output range.

Propagation delay is 70ns (100mV overdrive), while supply current is 46uA per comparator. The internal input hysteresis eliminates output switching due to internal input noise voltage. The maximum input offset voltage is 3mV, and the operating range is from 1.8V to 5.5V.

The AO331V is available in SOT-25 and SC70-5 packages.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	AO331VE5R
		AO331VE5VR
SC70-5 SPQ: 3,000pcs/Reel	C5	AO331VC5R
		AO331VC5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

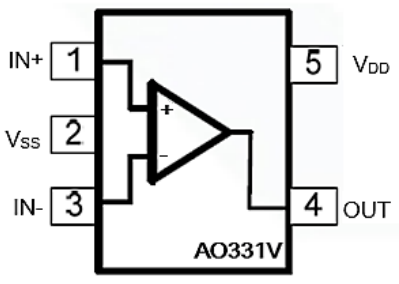
FEATURES

- 46uA (Typ) Low Power Consumption
- Fast, 70ns Propagation Delay
- Single-Supply Operation from +1.8V ~ +5.5V
- Low Offset Voltage: 3mV (Max)
- Rail-to-Rail Input and Output
- CMOS/TTL-Compatible Output
- Internal Hysteresis for Clean Switching
- No Phase Reversal for Overdriven Inputs
- Operating Temperature: -40°C ~ +85°C

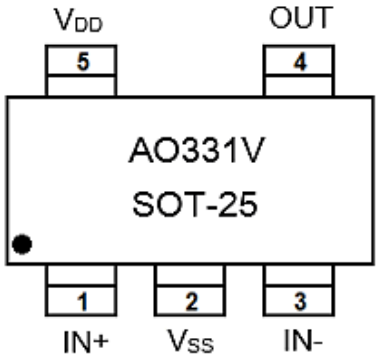
APPLICATION

- Hysteresis Comparators
- Oscillators
- Window Comparators
- Industrial Equipment
- Test and Measurement
- Alarm and Monitoring Circuits
- Peak and Zero-crossing Detectors
- Logic Level Shifting or Translation
- RC Timers
- Window Comparators
- IR Receivers
- Portable Systems

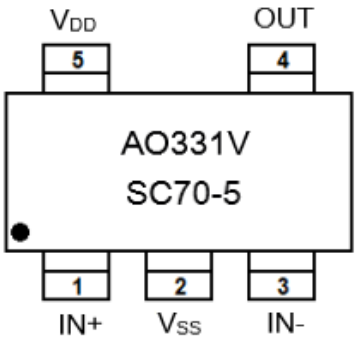
SIMPLIFIED SCHEMATIC



PIN DESCRIPTION



SOT-25, E5
Top View



SC70-5, C5
Top View

Pin #		Symbol	Function
SOT-25	SC70-5		
1	1	IN+	Analog Positive Input
2	2	V_{SS}	Ground or Negative Power Supply Input
3	3	IN-	Analog Inverting Input
4	4	OUT	Output
5	5	V_{DD}	Positive Power Supply Input

ABSOLUTE MAXIMUM RATINGS

Power Supply Voltage (V_{DD} to V_{ss})	-0.5V~7.5V
Analog Input Voltage (IN+ or IN-)	Vss-0.5V~V_{DD}+0.5V
PDB Input Voltage	Vss-0.5V~+7V
Operating Temperature Range	-40°C ~ 85°C
Junction Temperature	160°C
Storage Temperature Range	-55°C ~ 150°C
Lead Temperature (soldering, 10sec)	260°C
Package Thermal Resistance (T_A=+25°C)	
θ_{JA}, SOT-25	190°C/W
θ_{JA}, SC70-5	333°C/W
ESD Susceptibility	
HBM	4KV
MM	300V

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability

ELECTRICAL CHARACTERISTICS

At V_S = +14V, T_A=25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
Input Offset Voltage	V_{OS}	V_{CM} = 0V	0.5	-	3	mV
Input Bias Current	I_B		6	-	-	nA
Input Offset Current	I_{OS}		4	-	-	nA
Input Hysteresis	V_{hys}		6	-	-	
Common-Mode Voltage Range	V_{CM}	V_S = 5.5V	0.1 to +5.6	-	-	V
Common-Mode Rejection Ratio	CMRR	V_{CM} = 0V to Vs-1.5V	70	50	-	dB
OUTPUT CHARACTERISTICS						
Output Voltage Swing from Rail	V_{OH}	Vs=5V, I_O = 1mA	Vs - 0.05	-	Vs - 0.3	V
	V_{OL}		57	-	300	mV
Output Current	I_{SOURCE}	V_S = 5V, Out to V_S/2	35	-	-	mA
	I_{SINK}		33	-	-	
POWER SUPPLY						
Operating Voltage Range			1.8	-	-	V
			5.5	-	-	V
Power Supply Rejection Ratio	PSRR	V_S = 1.6V to +5.5V V_{CM} = 0V	75	60	-	dB
Quiescent Current/Amplifier	I_Q		46	-	-	mA
DYNAMIC PERFORMANCE (C_L = 15pF)						
Propagation Delay (Low to High)	T_{dLH}	V_S = 3V, Overdrive = 10mV	98.6	-	-	ns
		V_S = 3V, Overdrive = 100mV	77.5	-	-	ns
Propagation Delay (High to Low)	T_{dHL}	V_S = 3V, Overdrive = 10mV	114.7	-	-	ns
		V_S = 3V, Overdrive = 100mV	59.4	-	-	ns
Rise Time	T_r	V_S = 3V, Overdrive = 10mV	5	-	-	ns
		V_S = 3V, Overdrive = 100mV	5	-	-	ns
Fall Time	T_f	V_S = 3V, Overdrive = 10mV	5	-	-	ns
		V_S = 3V, Overdrive = 100mV	5	-	-	ns

TYPICAL PERFORMANCE CHARACTERISTICS

Fig1. Supply Current vs. Temperature

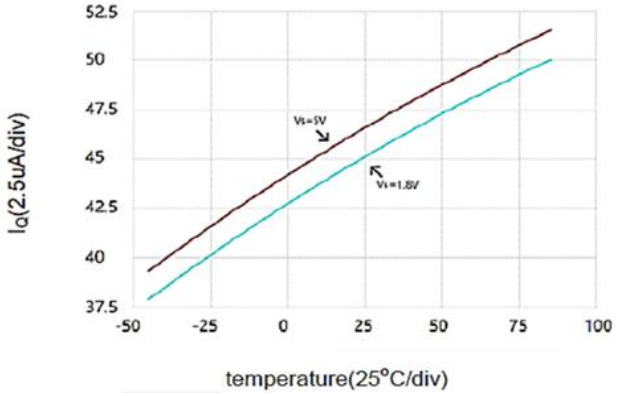


Fig2. Sinusoid Response at 0.2MHz

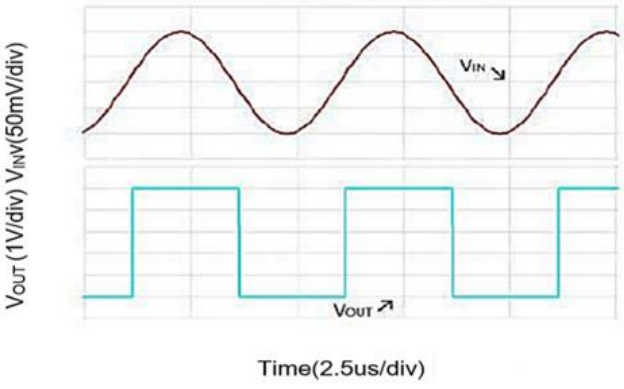


Fig3 Output Short-Circuit (Source) Current vs. Temperature

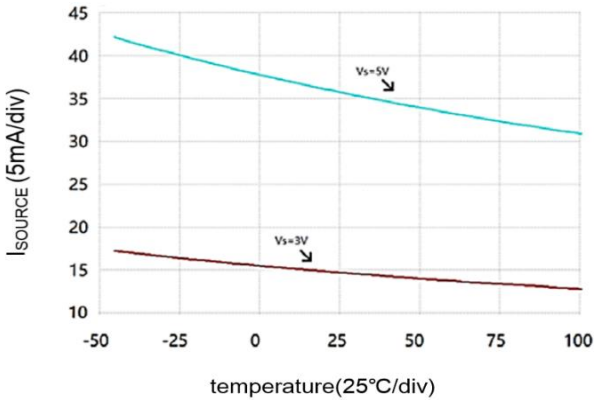
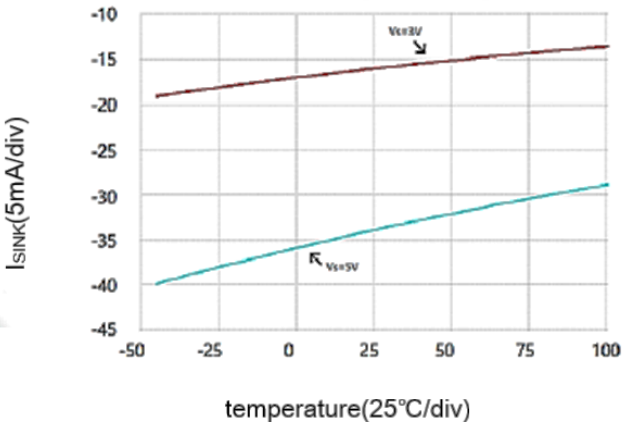
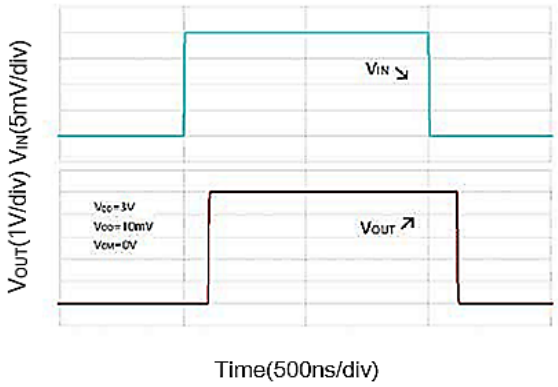
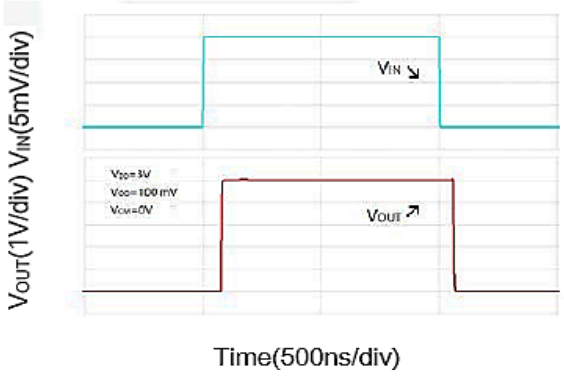


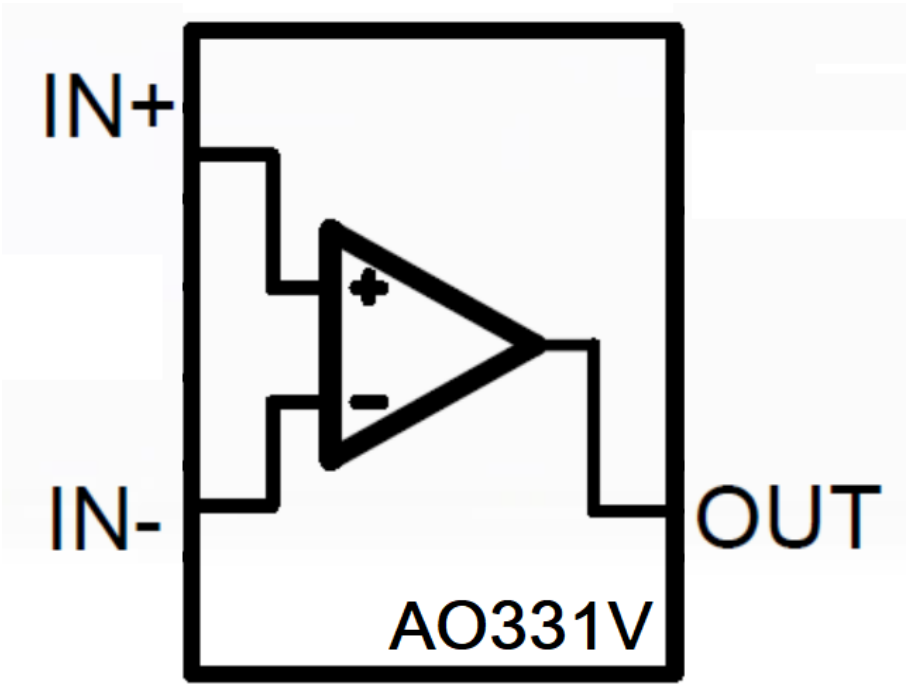
Fig4 Output Short-Circuit (Sink) Current vs. Temperature







BLOCK DIAGRAM



DETAILED INFORMATION

Application Note

AO331V comparator is low-power, high-speed and suitable for a wide range of general-purpose applications. The small footprints of the AO331V package saves space on printed circuit boards and enable the design of smaller electronic products. The AO331V interfaces directly to CMOS and TTL logics.

Power Supply Bypassing and Board Layout

AO331V operates from a single 1.8V to 5.5V supply or dual ±0.9V to ±2.75V supplies. For best performance, a 0.1μF ceramic capacitor should be placed close to the V_{DD} pin in single supply operation. For dual supply operation, both V_{DD} and V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors.

Low Supply Current

The low supply current (typical 46uA per channel) of AO331V will help to maximize battery life. They are ideal for battery powered systems.

Operating Voltage

AO331V operates under wide input supply voltage (1.8V to 5.5V). In addition, all temperature specifications apply from -40℃to +85℃ Most behavior remains unchanged throughout the full operating voltage range. These guarantees ensure operation throughout the single Li-Ion battery lifetime

Rail-to-Rail Input

The input common-mode range of AO331V extends 100mV beyond the supply rails (V_{SS}-0.1V to V_{DD}+0.1V). Its achieved by using complementary input stage. For normal operation, inputs should be limited to this range.

Internal Hysteresis

Because of noise or undesired parasitic feedback, high-speed comparators oscillate in the linear region. Oscillation tends to occur when the voltage on one input is at or equal to the voltage on the other input. The AO331V eliminates this undesired oscillation by integrating an internal hysteresis of 6mV.

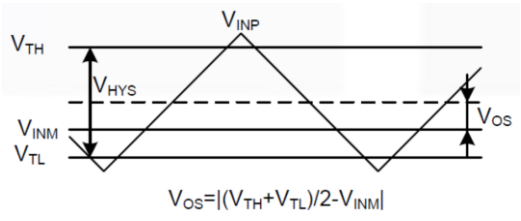


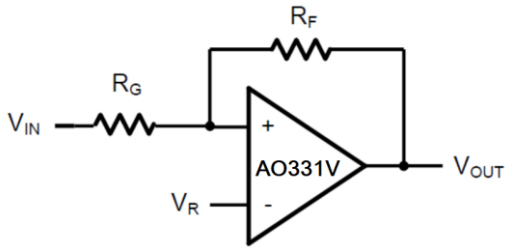
Figure1 Comparator's hysteresis and offset

The hysteresis in a comparator creates two trip points: one for the rising input voltage and one for the falling input voltage (Figure1). The difference between two trip points is the hysteresis, while the average of two trip points is the offset voltage. When the comparator's input voltages are equal, the hysteresis effectively causes one comparator input voltage to move quickly past the other, thus taking the input out of the region where oscillation occurs.

External Hysteresis

Greater flexibility in selecting hysteresis is achieved by using external resistors. Hysteresis reduces output chattering when one input is slowly moving past the other.

A non-inverting comparator with hysteresis requires a two-resistor network, as shown in Figure2 and a voltage reference (V_R) at the inverting input.



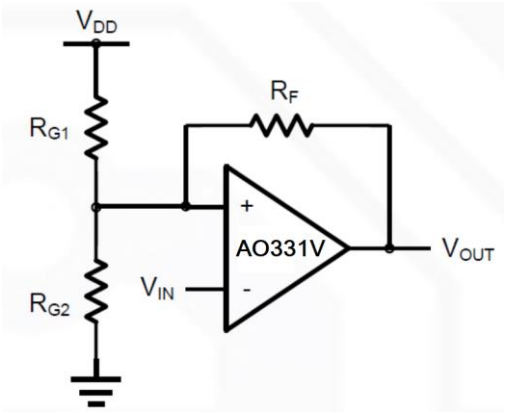
$$V_{TH}=\frac{R_G+R_F}{R_F}\times V_R$$

$$V_{TL}=\frac{R_G+R_F}{R_F}\times V_R-\frac{R_G}{R_F}\times V_{DD}$$

$$V_{HYS}=\frac{R_G}{R_F}\times V_{DD}$$

Figure 2 Non-Inverting Comparator with Hysteresis

Inverting Comparator with Hysteresis



The inverting comparator with hysteresis requires a three-resistor network that is referenced to the comparator supply voltage (V_{DD}), as shown in Figure3

$$V_{TH}=\frac{R_{G2}}{R_{G1}\parallel R_F+R_{G2}}\times V_{DD}$$

$$V_{TL}=\frac{R_{G2}\parallel R_F}{R_{G2}\parallel R_F+R_{G1}}\times V_{DD}$$

$$V_{HYS}=\frac{R_{G1}\parallel R_{G2}}{R_{G1}\parallel R_{G2}+R_F}\times V_{DD}$$

Figure3 Inverting Comparator with Hysteresis

TYPICAL APPLICATION CIRCUITS

Line Receiver

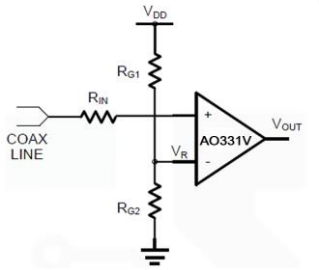


Figure4 Line Receiver

A Line Receiver using AO331V is shown in Figure 5. Resistors RG1 and RG2 set the bias point at the comparator's inverting input. RIN should be same as RG1||RG2 to get a better match. AO331V detects the voltage of the Coax Line, and outputs logic high or logic low quickly with no glitch.

IR Receiver

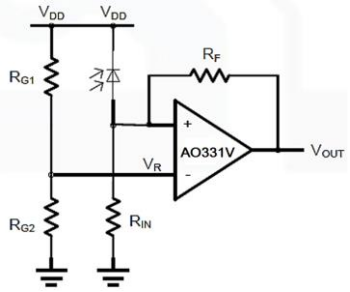


Figure5 IR Receiver

AO331V is an ideal candidate to be used as an infrared receiver shown in Figure5. The infrared photo diode creates a current relative to the amount of infrared light present. The current creates a voltage across RIN. When this voltage level cross the voltage applied by the voltage divider to the inverting input, the output transitions. Optional RF provides additional hysteresis for noise immunity.

Oscillator

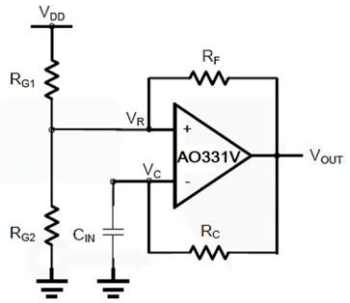


Figure6 Oscillator

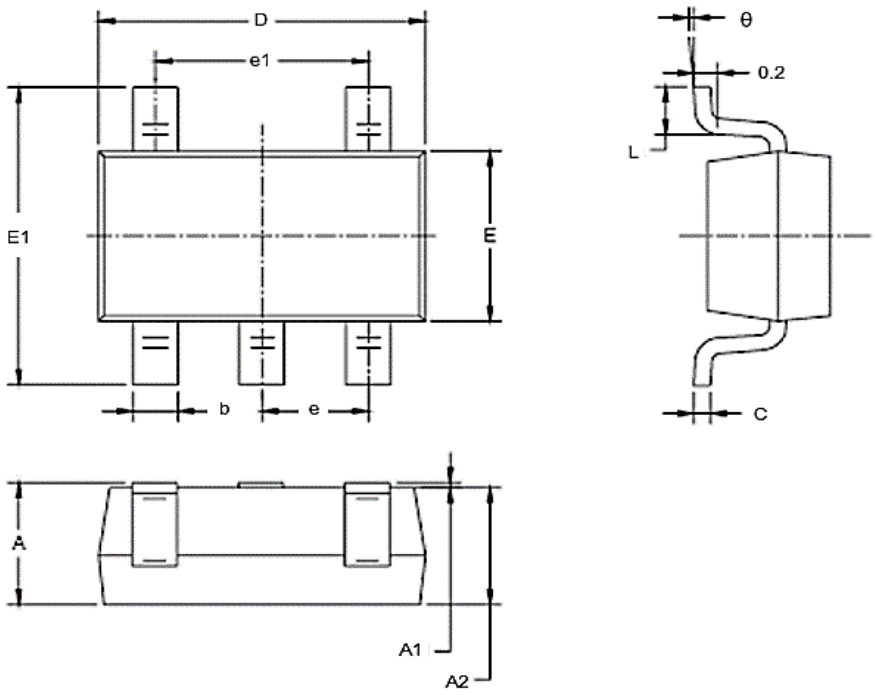
A oscillator using AO331V is shown in Figure6. Resistors RG1 and RG2 set the bias point at the comparator's inverting input. The period of oscillator is set by the time constant of RC and CIN. The maximum frequency is limited by the large signal propagation delay of the comparator. AO331V is low propagation delay guarantees the high frequency oscillation.

If RG1=RG2= RF, then the frequency of the oscillator is:

$$f_{OSC}=\frac{1}{2\times In2\times R_C\times C_{IN}}$$

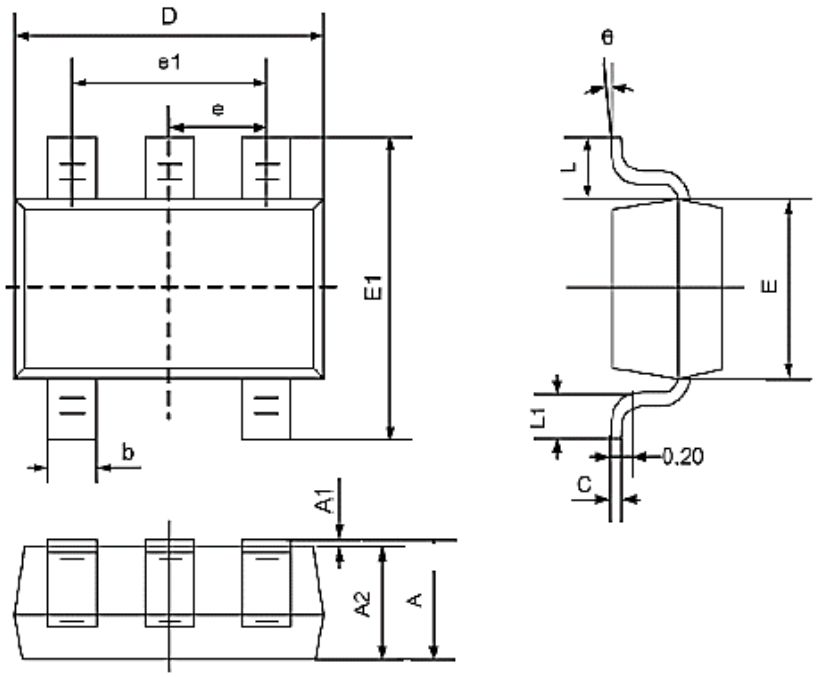
PACKAGE INFORMATION

Dimension in SOT-25 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950 BSC	
	1.900 BSC	
L	0.300	0.600
θ	0°	8°

Dimension in SC70-5 (Unit: mm)



Symbol	Millimeters	
	Min	Max
A	0.900	1.100
A1	0.000	0.100
A2	0.900	1.000
b	0.150	0.350
c	0.080	0.150
D	2.000	2.200
E	1.150	1.350
E1	2.150	2.450
e	0.650 TYP	
e1	1.200	1.400
L	0.525 REF	
L1	0.260	0.460
θ	0°	8°

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