



Differential Comparator – LM311

Differential Comparator with Strobe in bare die form

Rev 1.1
21/02/19

Description

The LM311 voltage comparator operates over a wide range of supply voltages; from standard $\pm 15V$ Op-Amp supplies down to a single 3V supply and with low input currents. Device output is compatible with RTL, DTL, and TTL as well as MOS circuits. The device can drive lamps or relays, switching voltages up to 40V at currents as high as 50mA. Both the inputs and the outputs of the LM311 can be isolated from system ground, and the output can drive loads referred to ground, the positive supply, or the negative supply. Offset balancing and strobe capability are provided and outputs can be wire-ORed.

Features:

- Operates from single 5V supply
- Input bias current: 150nA max over temperature
- Offset current: 20nA max over temperature
- Differential input voltage range: $\pm 30V$
- Power consumption: 135mW at $\pm 15V$
- Offset voltage null capability
- Strobe capability
- Characterized over industrial temperature range.

Ordering Information

The following part suffixes apply:

- No suffix - MIL-STD-883 /2010B Visual Inspection

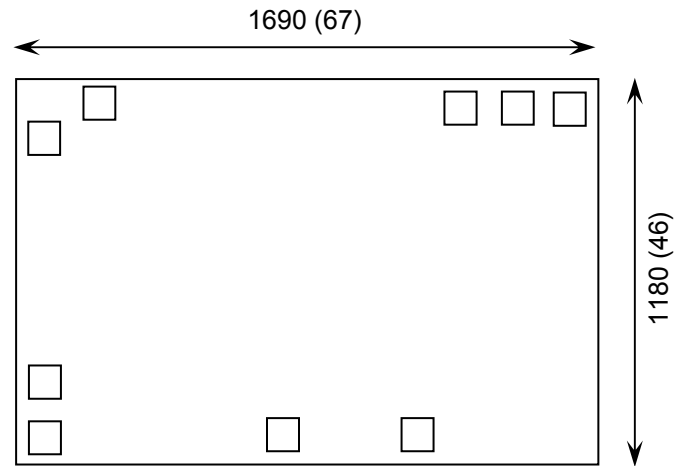
For a higher electrical grade version of this product please see

[LM211](#)

For High Reliability version of this product please see

[LM111](#)

Die Dimensions in μm (mils)



Supply Formats:

- Default – Die in Waffle Pack (100 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness \leftrightarrow 280 μm (11 Mils) – On request
- Assembly into Metal or Ceramic Package – On request

Mechanical Specification

Die Size (Unsawn)	1690 x 1180 67 x 46	μm mils
Minimum Bond Pad Size	90 x 90 3.54 x 3.54	μm mils
Die Thickness	280 (± 20) 11.02 (± 0.79)	μm mils
Top Metal Composition	Al 1%Si 1.1 μm	
Back Metal Composition	N/A – Bare Si	

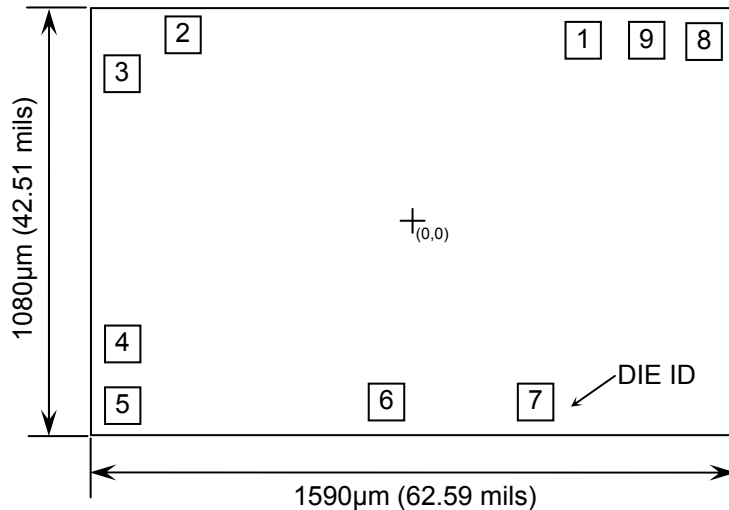




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Pad Layout and Functions

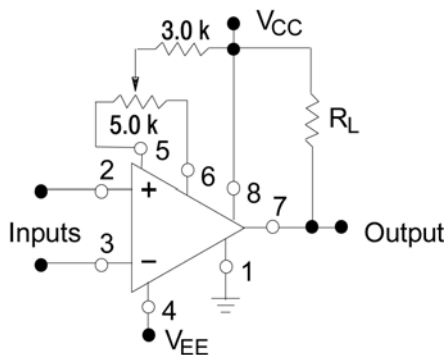


NOTE: EITHER PAD 7 OR PAD 8 CAN BE USED AS OUTPUT FOR FLEXIBILITY IN LAYOUT

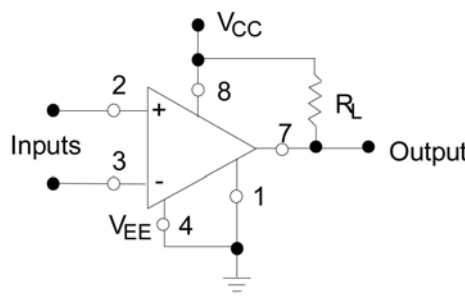
PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	GND	424	461
2	INPUT +	-574	469
3	INPUT -	-724	376
4	V _{EE}	-724	-319
5	BALANCE	-724	-469
6	BAL/STROBE	-69	-463
7	OUTPUT	298	-469
8	OUTPUT	724	455
9	V _{CC}	574	461

CHIP BACK POTENTIAL IS FLOAT

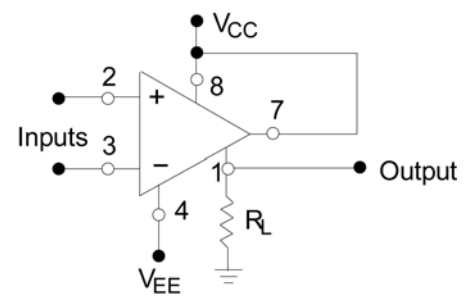
Typical Configurations



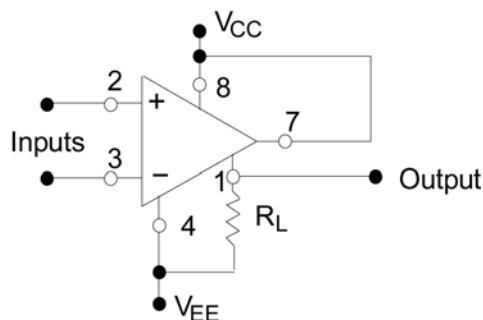
Split Power Supply with Offset Balance



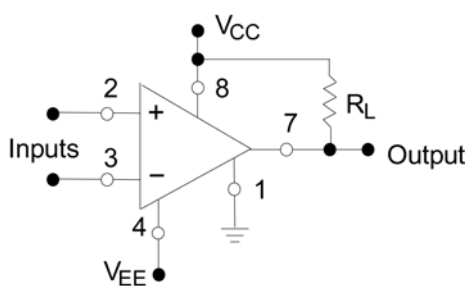
Single Supply



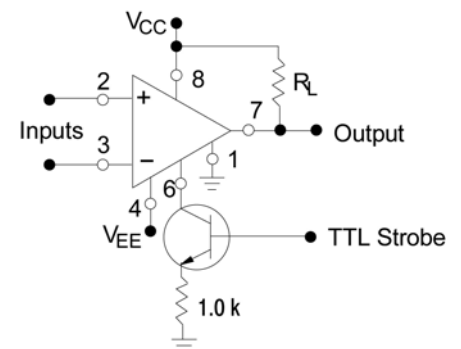
Ground Referred Load
(Input polarity reversed if GND is output)



Load Referred to Negative Supply
(Input polarity reversed if GND is output)



Load Referred to Positive Supply



Strobe Capability





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Absolute Maximum Ratings¹

PARAMETER	SYMBOL	VALUE	UNIT
Total Supply Voltage	$V_{CC} + V_{EE} $	36	V
Output to Negative Supply Voltage	$V_O - V_{EE}$	40	V
Ground to Negative Supply Voltage	V_{EE}	30	V
Input Differential Voltage	V_{ID}	± 30	V
Input Voltage ²	V_{IN}	± 15	V
Voltage at Strobe Pin	-	V_{CC} to $V_{CC}-5$	V
Junction Temperature	T_J	175	°C
Power Dissipation in Still Air	P_D	810	mW

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.
2. This rating applies for $\pm 15V$ supplies. The positive input voltage limit is 30V above the negative supply. The negative input voltage limit is equal to the negative supply voltage or 30V below the positive supply, whichever is less.

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNITS
DC Supply Voltage	V_S	± 3.5 or +5	± 15	V
Operating Temperature	T_A	0	70	°C

DC Electrical Characteristics ($V_{CC} = +15V$, $V_{EE} = -15V$, $T_A = 25^\circ C$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Input Offset Voltage ³	V_{IO}	$R_S \leq 50k\Omega$	25°C	-	2	7.5	mV
			Full range	-	-	10	
Input Bias Current	I_B	$R_S \leq 50k\Omega$	25°C	-	100	250	nA
			Full range	-	-	300	
Input Offset Current ³	I_{IO}	-	25°C	-	6	50	nA
			Full range	-	-	70	
Input Common Mode Voltage Range	V_{ICR}	-	25°C	-14.5	+13.8,-14.7	+13	V
			Full range	-	-	-	
Positive Supply Current	I_{CC}	-	-	5.1	7.5	mA	
Negative Supply Current	I_{EE}	-	-	4.1	5		
Voltage Gain	A_V	-	40	200	-	V/mV	
Response Time	t_{re}	100 mV input step with 5 mV overdrive	-	200	-	ns	

3. The offset voltages and offset currents given are the maximum values required to drive the output within a volt of either supply with a 1.0 mA load. Thus, these parameters define an error band and take into account the "worst case" effects of voltage gain and input impedance.





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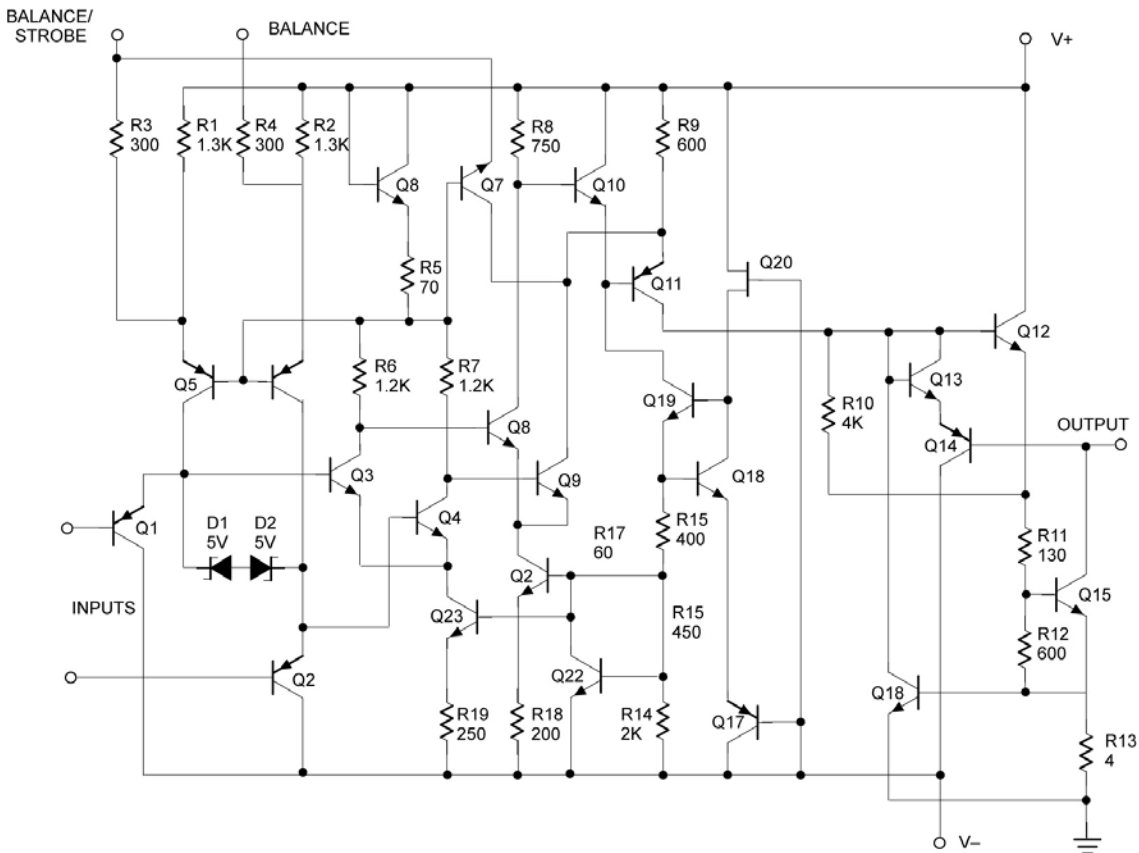
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DC Electrical Characteristics ($V_{CC} = +15V$, $V_{EE} = -15V$, $T_A = 25^\circ C$ unless otherwise specified)

PARAMETER	SYMBOL	CONDITIONS	LIMITS			UNITS	
			MIN	TYP	MAX		
Saturation Voltage	V_{SAT}	$V_{IN} \leq -10mV$ $I_{OUT} = 50mA$	25°C	-	0.75	1.5	V
		$V_{CC} \geq 4.5V$, $V_{EE} = 0$, $V_{IN} \leq -10mV$, $I_{OUT} \leq 8mA$	Full range	-	0.23	0.4	V
Strobe ON Current ⁴	I_{STROBE}	-	25°C	-	2	5	mA
Output Leakage Current	I_{OL}	$V_{IN} \geq 10mV$, $V_{OUT} = 35V$, $I_{STROBE} = 3Ma$ $V_{EE} = Pin 1 = -5V$	25°C	-	0.2	50	nA

4. Do not short the strobe pin to ground; it should be current driven at 3.0 mA to 5.0 mA

Schematic





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Typical Characteristics

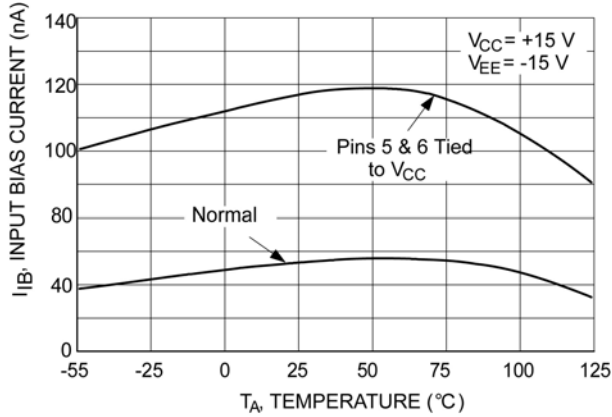


FIGURE 1. Input Bias Current versus Temperature

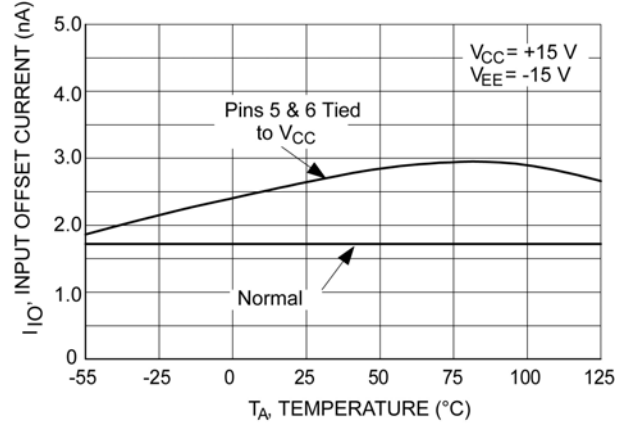


FIGURE 2. Input Offset Current versus Temperature

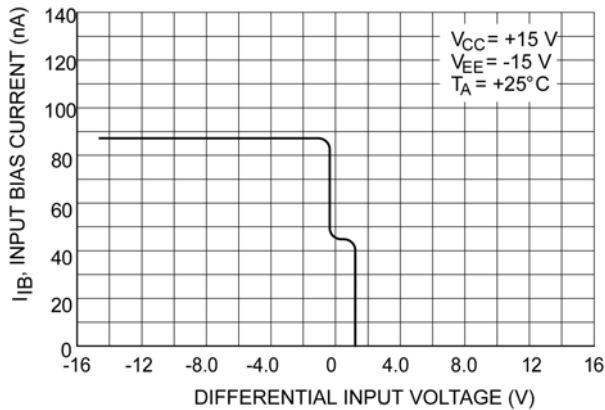


FIGURE 3. Input Bias Current versus Differential Input Voltage

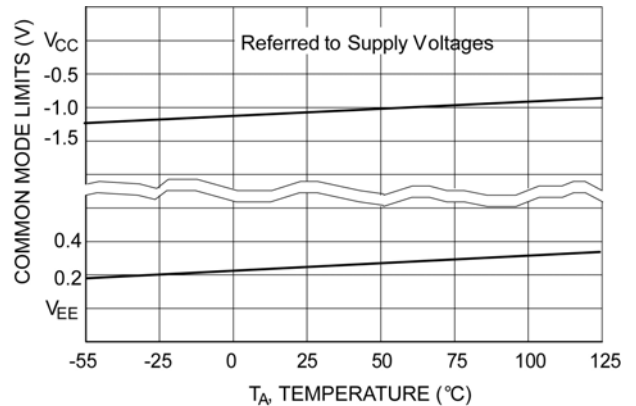


FIGURE 4. Common Mode Limits versus Temperature

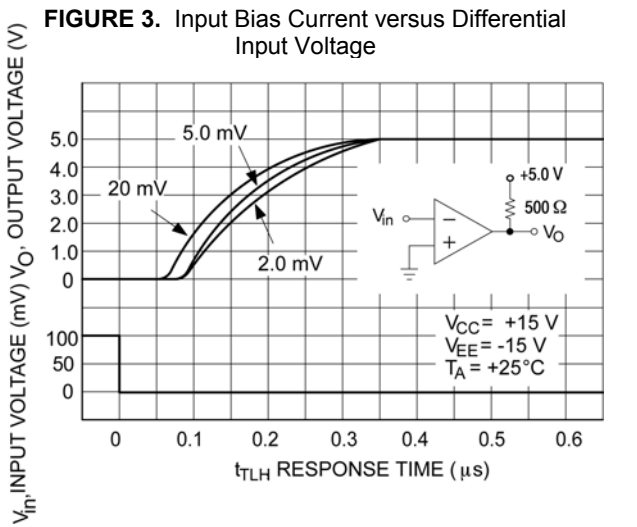


FIGURE 5. Response Time for Various Input Overdrives

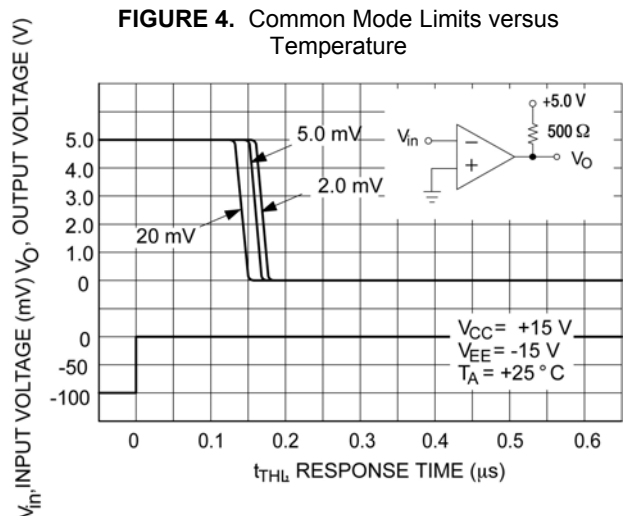


FIGURE 6. Response Time for Various Input Overdrives





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Typical Characteristics continued

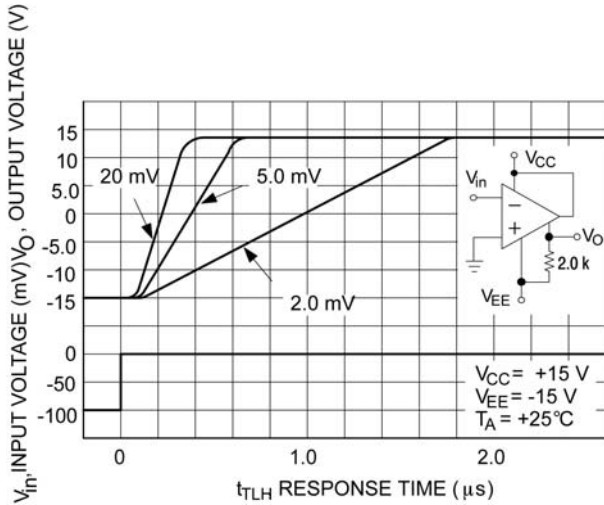


FIGURE 7. Response Time for Various Input Overdrives

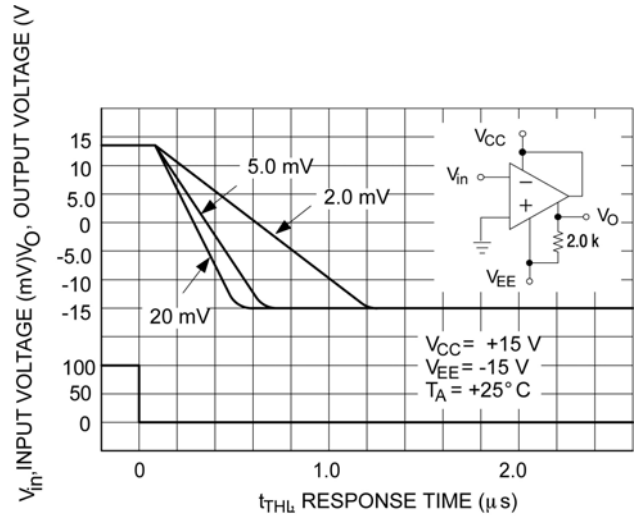


FIGURE 8. Response Time for Various Input Overdrives

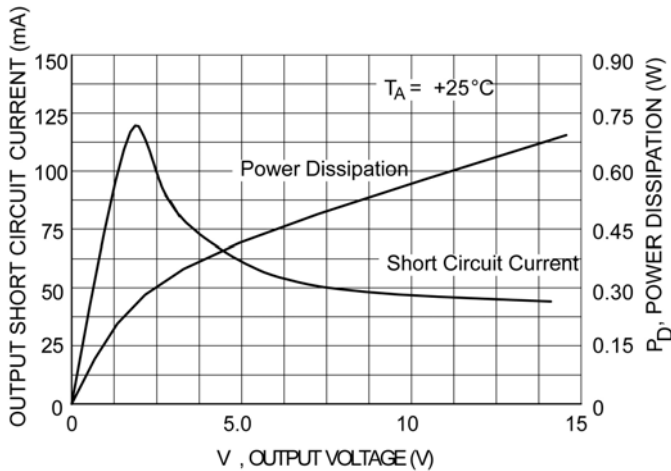


FIGURE 9. Output Short Circuit Current characteristics

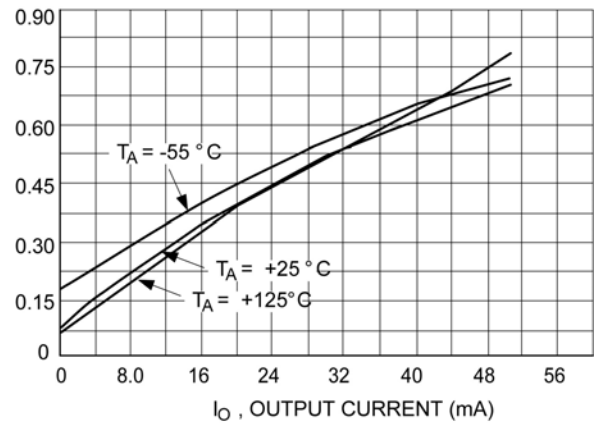


FIGURE 10. Output Saturation Voltage versus Output Current

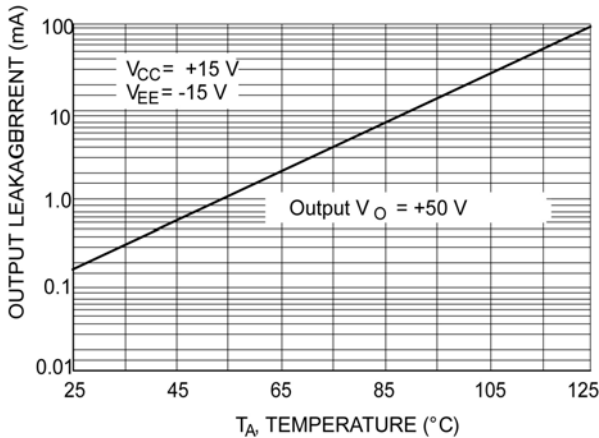


FIGURE 11. Output Leakage Current versus Temperature

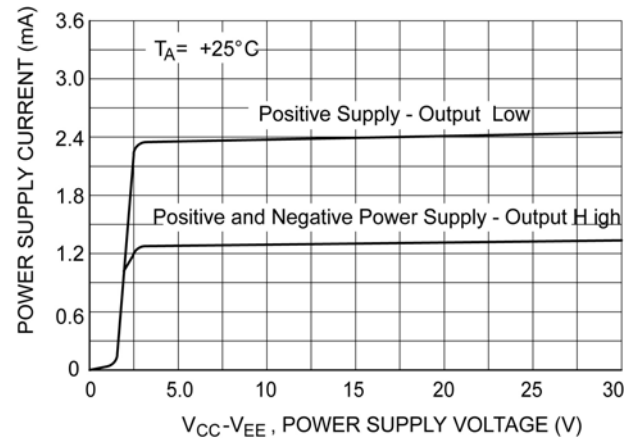


FIGURE 12. Power Supply Current versus Supply Voltage





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Typical Characteristics continued

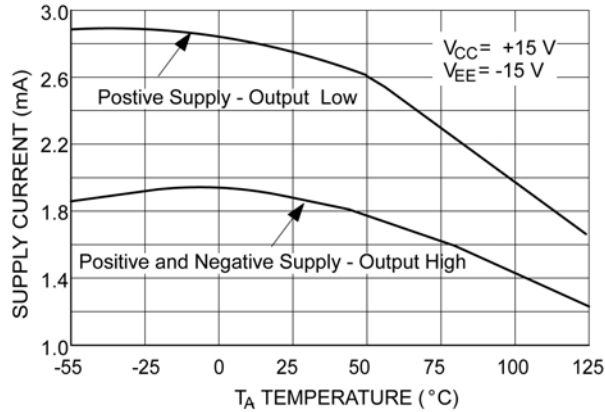


FIGURE 13. Power Supply Current versus Temperature

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