

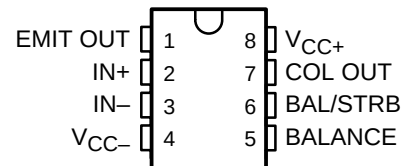
LM211-EP DIFFERENTIAL COMPARATOR WITH STROBES

SLCS140 – DECEMBER 2002

- **Controlled Baseline**
 - One Assembly/Test Site, One Fabrication Site
- **Extended Temperature Performance of –40°C to 125°C**
- **Enhanced Diminishing Manufacturing Sources (DMS) Support**
- **Enhanced Product Change Notification**
- **Qualification Pedigree†**
- **Fast Response Times**
- **Strobe Capability**
- **Maximum Input Bias Current . . . 300 nA**
- **Maximum Input Offset Current . . . 70 nA**
- **Can Operate From Single 5-V Supply**

† Component qualification in accordance with JEDEC and industry standards to ensure reliable operation over an extended temperature range. This includes, but is not limited to, Highly Accelerated Stress Test (HAST) or biased 85/85, temperature cycle, autoclave or unbiased HAST, electromigration, bond intermetallic life, and mold-compound life. Such qualification testing should not be viewed as justifying use of this component beyond specified performance and environmental limits.

LM211 . . . D PACKAGE
(TOP VIEW)



description/ordering information

The LM211 is a single high-speed voltage comparator. This device is designed to operate from a wide range of power-supply voltages, including ± 15 -V supplies for operational amplifiers and 5-V supplies for logic systems. The output levels are compatible with most TTL and MOS circuits. This comparator is capable of driving lamps or relays and switching voltages up to 50 V at 50 mA. All inputs and outputs can be isolated from system ground. The outputs can drive loads referenced to ground, V_{CC+} or V_{CC-} . Offset balancing and strobe capabilities are available, and the outputs can be wired-OR connected. If the strobe is low, the output is in the off state, regardless of the differential input.

ORDERING INFORMATION

T _A	V _{IO} max AT 25°C	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 125°C	3 mV	SOIC – D	Tape and reel	LM211QDREP	LM211E

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS
INSTRUMENTS**

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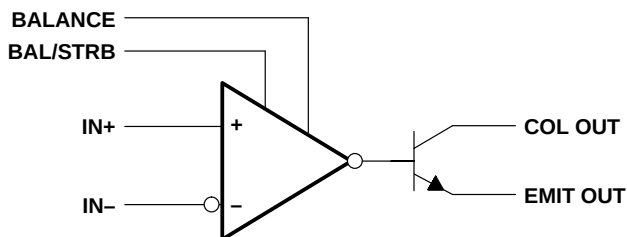
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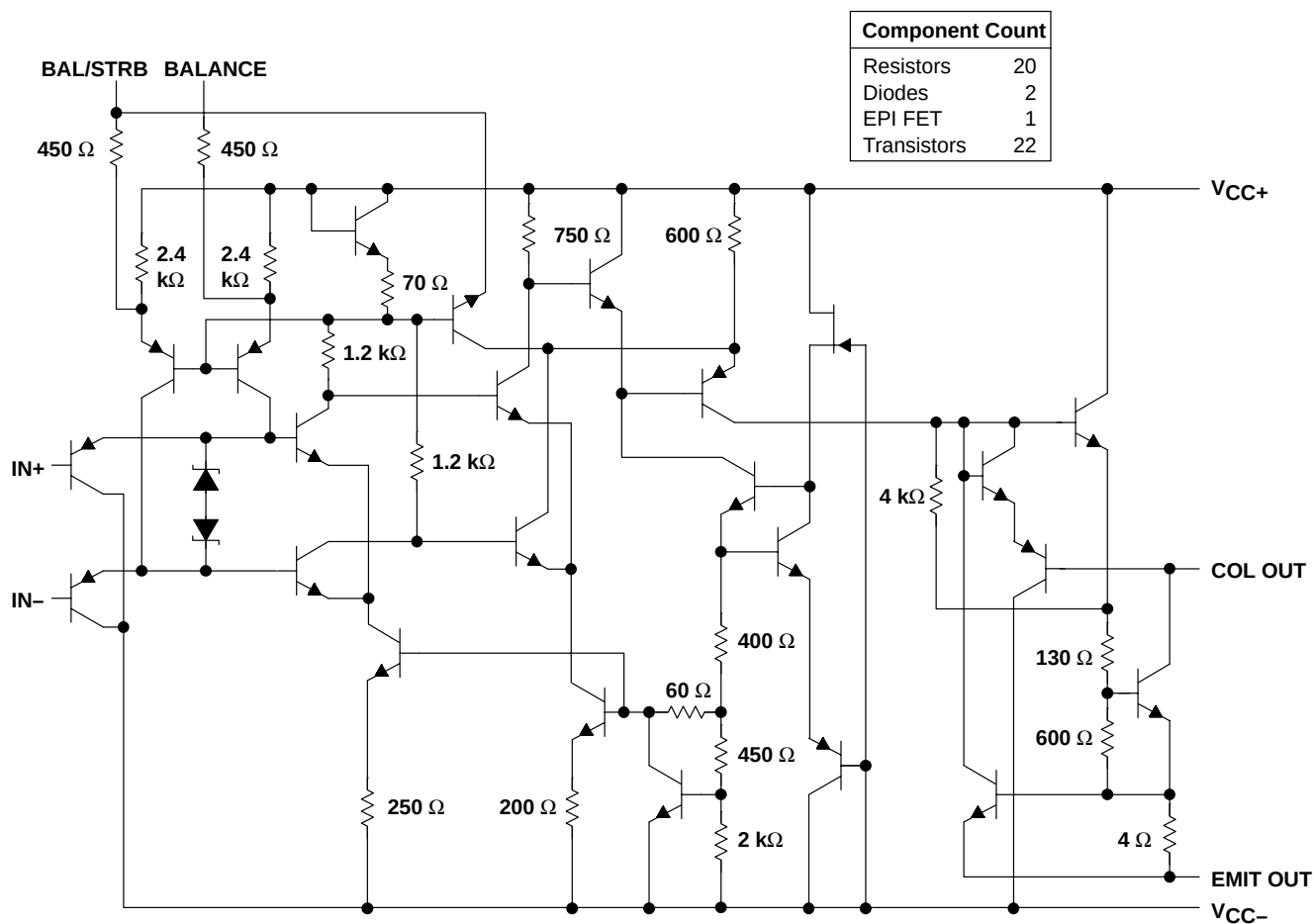
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functional block diagram



schematic



All resistor values shown are nominal.

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absolute maximum ratings over operating free-air temperature range (unless otherwise noted)[†]

Supply voltage: V_{CC+} (see Note 1)	18 V
V_{CC-} (see Note 1)	–18 V
$V_{CC+} - V_{CC-}$	36 V
Differential input voltage, V_{ID} (see Note 2)	±30 V
Input voltage, V_I (either input, see Notes 1 and 3)	±15 V
Voltage from emitter output to V_{CC-}	30 V
Voltage from collector output to V_{CC-}	50 V
Duration of output short circuit (see Note 4)	10 s
Junction temperature, T_J	148°C
Package thermal impedance, θ_{JA} (see Note 5)	97°C/W
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{stg}	–65°C to 150°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values, unless otherwise noted, are with respect to the midpoint between V_{CC+} and V_{CC-} .
 2. Differential voltages are at $IN+$ with respect to $IN-$.
 3. The magnitude of the input voltage must never exceed the magnitude of the supply voltage or ±15 V, whichever is less.
 4. The output may be shorted to ground or either power supply.
 5. The package thermal impedance is calculated in accordance with JESD 51-7.

recommended operating conditions

	MIN	MAX	UNIT
$V_{CC+} - V_{CC-}$ Supply voltage	3.5	30	V
V_I Input voltage ($ V_{CC\pm} \leq 15$ V)	$V_{CC-} + 0.5$	$V_{CC+} - 1.5$	V
T_A Operating free-air temperature range	–40	125	°C



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electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_A^\dagger$	MIN	TYP [‡]	MAX	UNIT
V_{IO} Input offset voltage	See Note 6	25°C		0.7	3	mV
		Full range			4	
I_{IO} Input offset current	See Note 6	25°C		4	10	nA
		Full range			20	
I_{IB} Input bias current	$V_O = 1\text{ V to } 14\text{ V}$	25°C		75	100	nA
		Full range			150	
$I_{IL(S)}$ Low-level strobe current (see Note 7)	$V_{(strobe)} = 0.3\text{ V}, V_{ID} \leq -10\text{ mV}$	25°C		–3		mA
V_{ICR} Common-mode input voltage range		Full range	13 to –14.5	13.8 to –14.7		V
A_{VD} Large-signal differential voltage amplification	$V_O = 5\text{ V to } 35\text{ V}, R_L = 1\text{ k}\Omega$	25°C	40	200		V/mV
I_{OH} High-level (collector) output leakage current	$I_{(strobe)} = -3\text{ mA}, V_{OH} = 35\text{ V}, V_{ID} = 5\text{ mV}$	25°C		0.2	10	nA
		Full range			0.5	μA
V_{OL} Low-level (collector-to-emitter) output voltage	$I_{OL} = 50\text{ mA}, V_{ID} = -5\text{ mV}$	25°C		0.75	1.5	V
	$V_{CC+} = 4.5\text{ V}, V_{CC-} = 0, I_{OL} = 8\text{ mA}, V_{ID} = -6\text{ mV}$	Full range		0.23	0.4	
I_{CC+} Supply current from V_{CC+} , output low	$V_{ID} = -10\text{ mV}, \text{No load}$	25°C		5.1	6	mA
I_{CC-} Supply current from V_{CC-} , output high	$V_{ID} = 10\text{ mV}, \text{No load}$	25°C		–4.1	–5	mA

[†] Unless otherwise noted, all characteristics are measured with BALANCE and BAL/STRB open and EMIT OUT grounded.

Full range for LM211Q is –40°C to 125°C.

[‡] All typical values are at $T_A = 25^\circ\text{C}$.

NOTES: 6. The offset voltages and offset currents given are the maximum values required to drive the collector output up to 14 V or down to 1 V with a pullup resistor of 7.5 kΩ to V_{CC+} . These parameters actually define an error band and take into account the worst-case effects of voltage gain and input impedance.

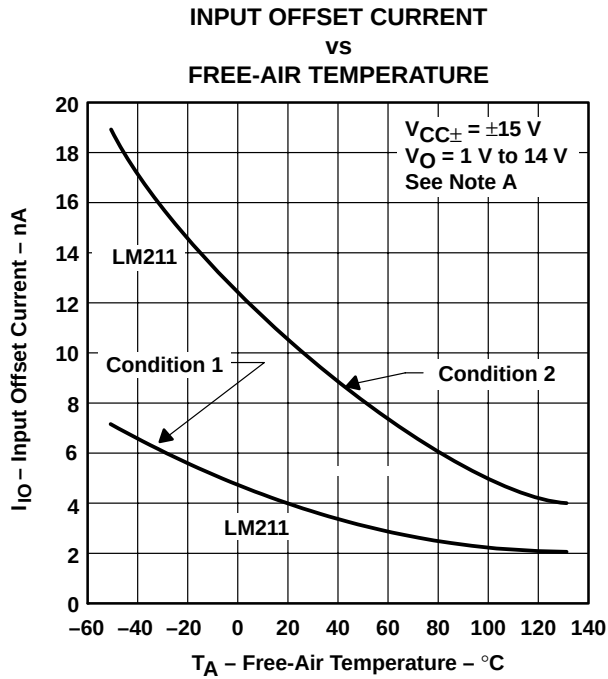
7. The strobe should not be shorted to ground; it should be current driven at –3 mA to –5 mA (see Figures 13 and 27).

switching characteristics, $V_{CC\pm} = \pm 15\text{ V}, T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
Response time, low-to-high-level output	$R_C = 500\ \Omega \text{ to } 5\text{ V}, C_L = 5\text{ pF}, \text{See Note 8}$	115	ns
Response time, high-to-low-level output		165	ns

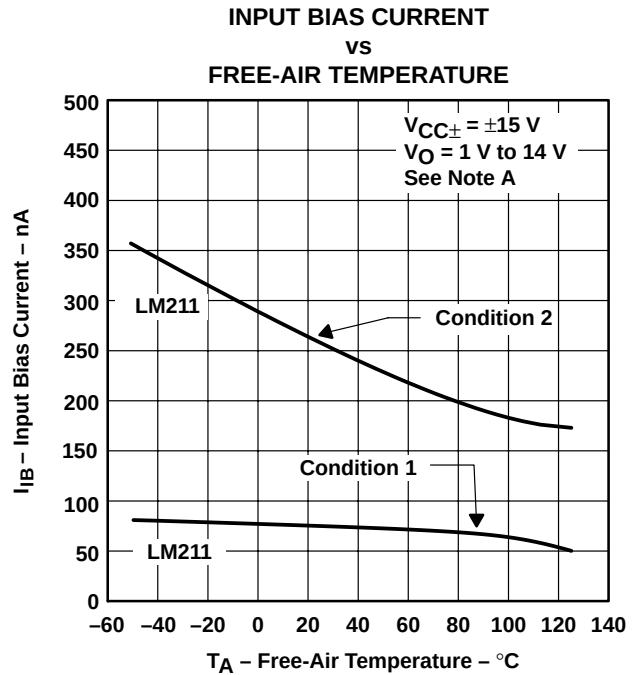
NOTE 8: The response time specified is for a 100-mV input step with 5-mV overdrive and is the interval between the input step function and the instant when the output crosses 1.4 V.

TYPICAL CHARACTERISTICS†



NOTE A: Condition 1 is with BALANCE and BAL/STRB open.
Condition 2 is with BALANCE and BAL/STRB connected to V_{CC+} .

Figure 1



NOTE A: Condition 1 is with BALANCE and BAL/STRB open.
Condition 2 is with BALANCE and BAL/STRB connected to V_{CC+} .

Figure 2

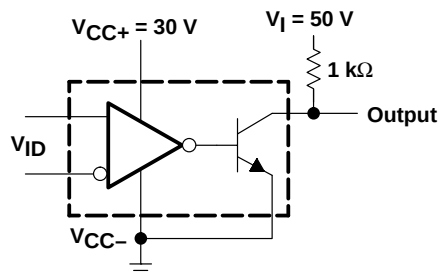
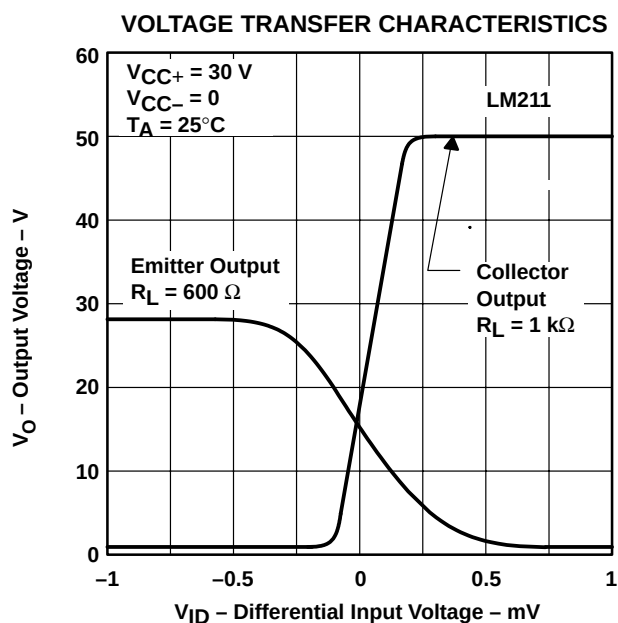
† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

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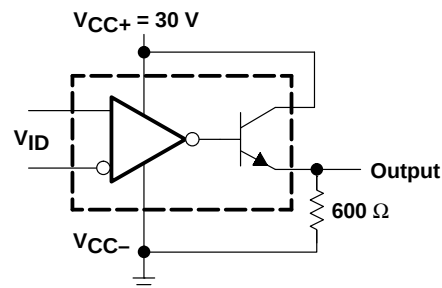
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TYPICAL CHARACTERISTICS†



COLLECTOR OUTPUT TRANSFER CHARACTERISTIC TEST CIRCUIT FOR FIGURE 3



EMITTER OUTPUT TRANSFER CHARACTERISTIC TEST CIRCUIT FOR FIGURE 3

Figure 3

† Data at high and low temperatures are applicable only within the rated operating free-air temperature ranges of the various devices.

TYPICAL CHARACTERISTICS

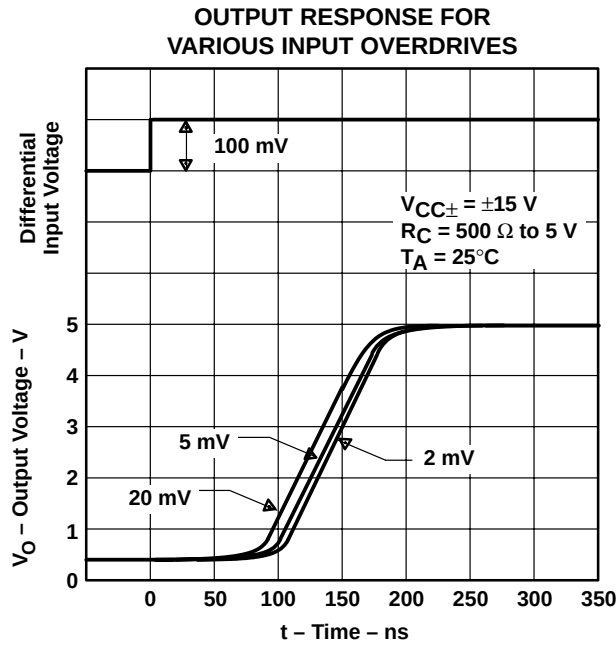


Figure 4

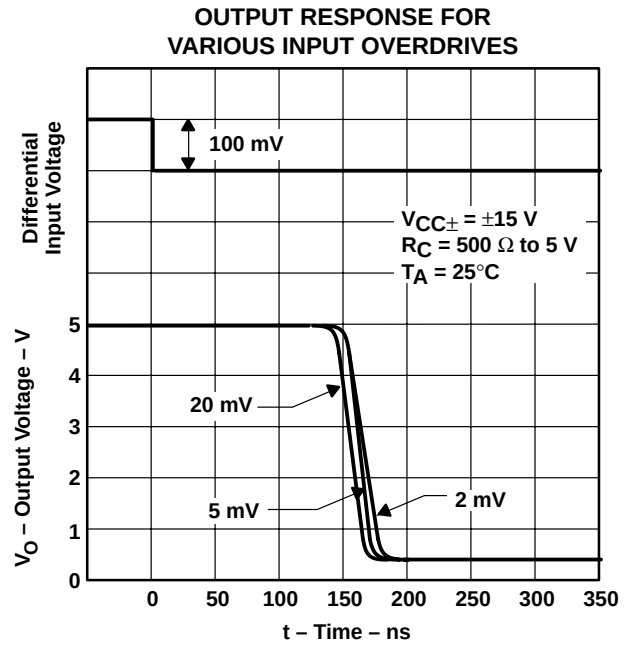
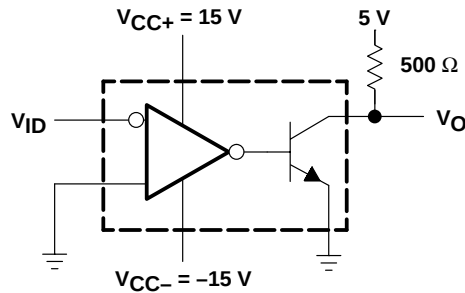


Figure 5



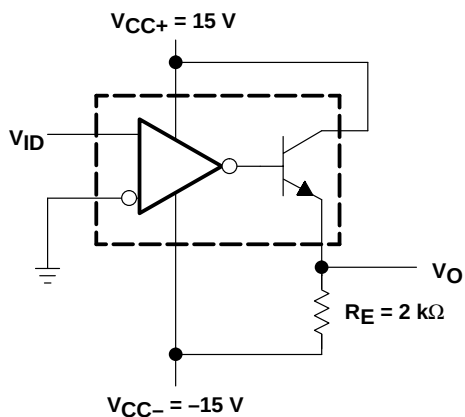
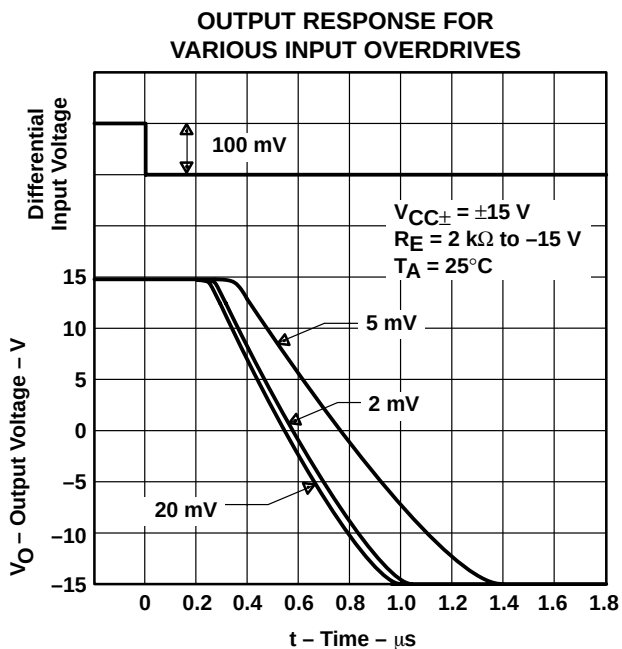
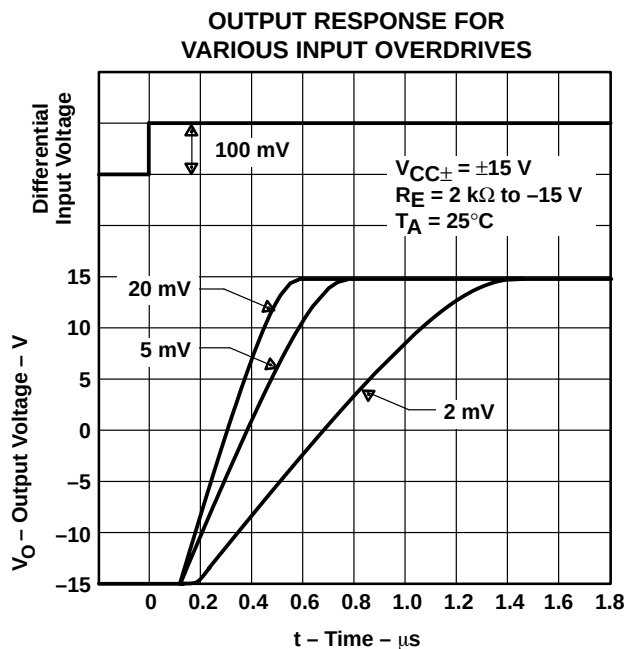
TEST CIRCUIT FOR FIGURES 4 AND 5

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TYPICAL CHARACTERISTICS



TEST CIRCUIT FOR FIGURES 6 AND 7

TYPICAL CHARACTERISTICS

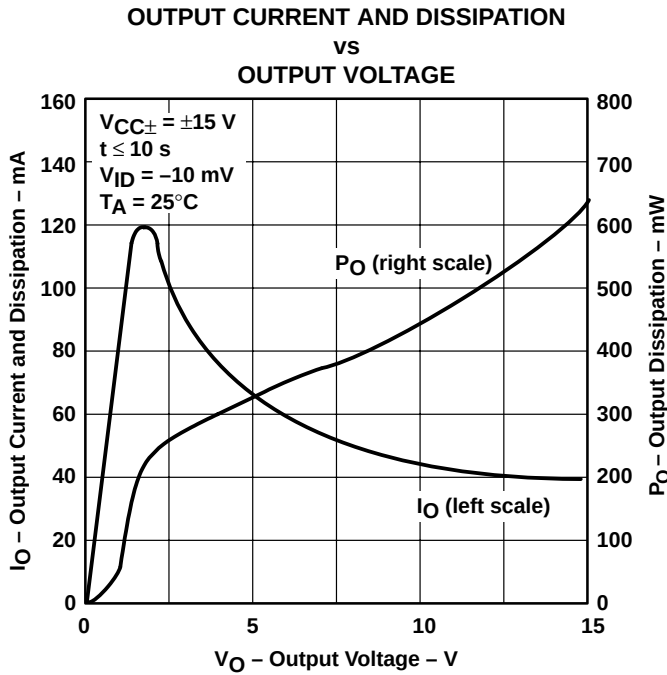


Figure 8

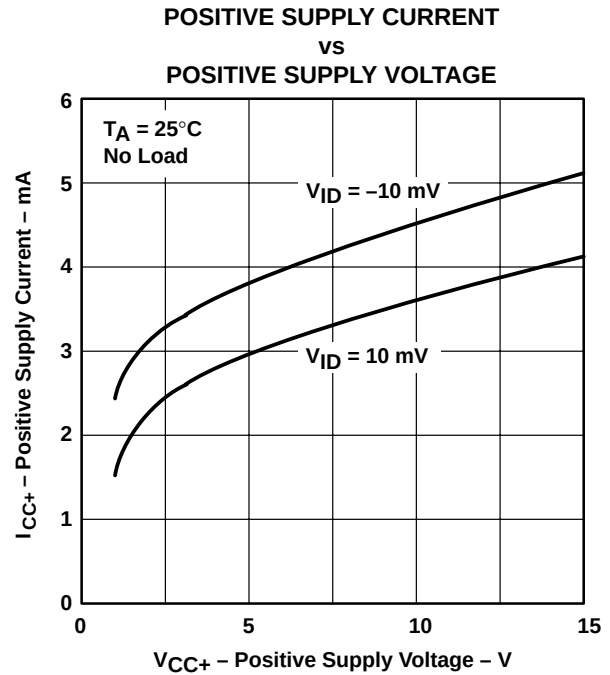


Figure 9

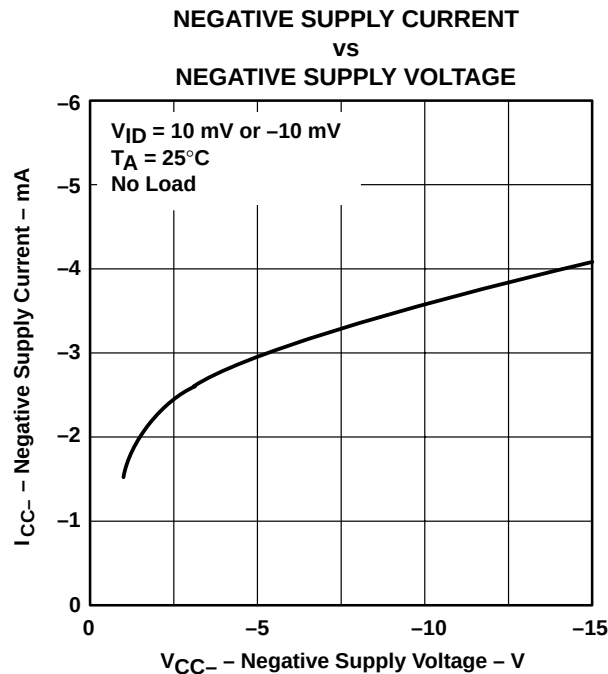


Figure 10

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APPLICATION INFORMATION

Figure 11 through Figure 29 show various applications for the LM211 comparator.

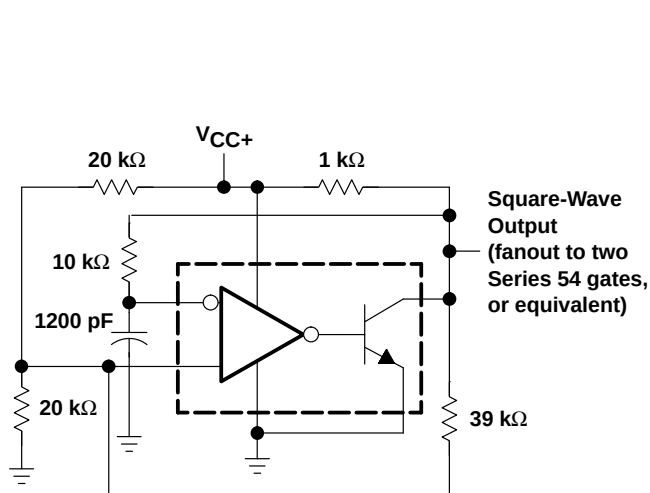
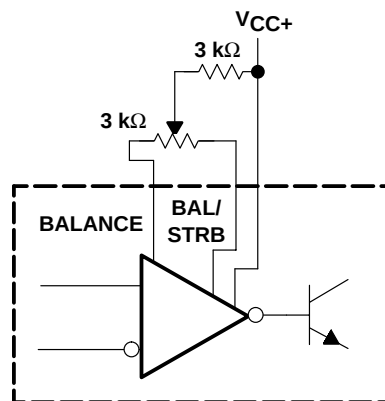


Figure 11. 100-kHz Free-Running Multivibrator



NOTE: If offset balancing is not used, the BALANCE and BAL/STRB pins should be shorted together.

Figure 12. Offset Balancing

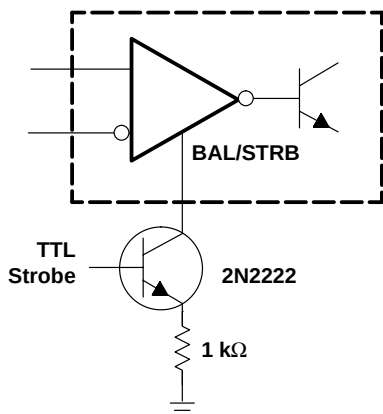


Figure 13. Strobging

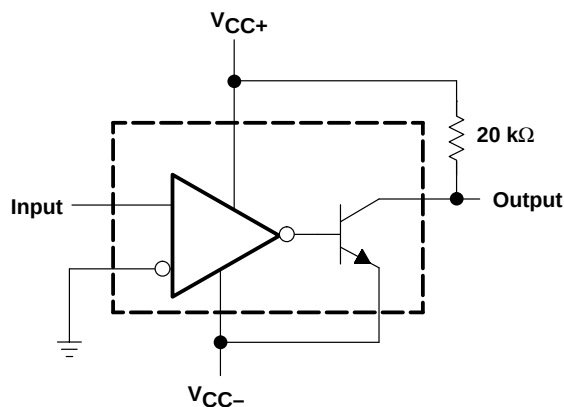
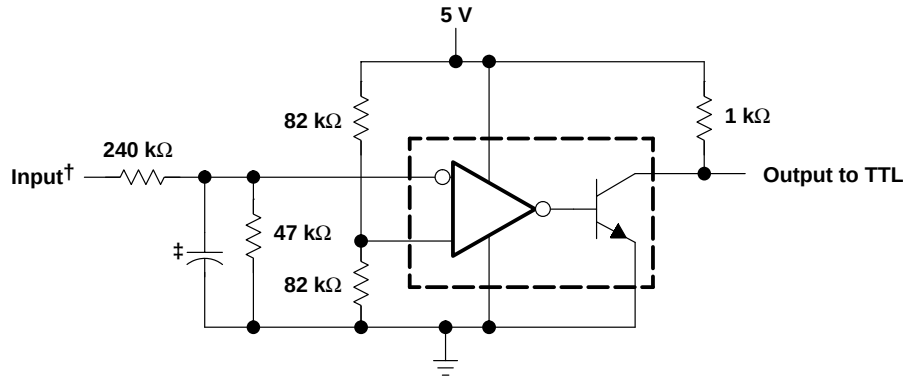


Figure 14. Zero-Crossing Detector

APPLICATION INFORMATION



† Resistor values shown are for a 0-to-30-V logic swing and a 15-V threshold.

‡ May be added to control speed and reduce susceptibility to noise spikes

Figure 15. TTL Interface With High-Level Logic

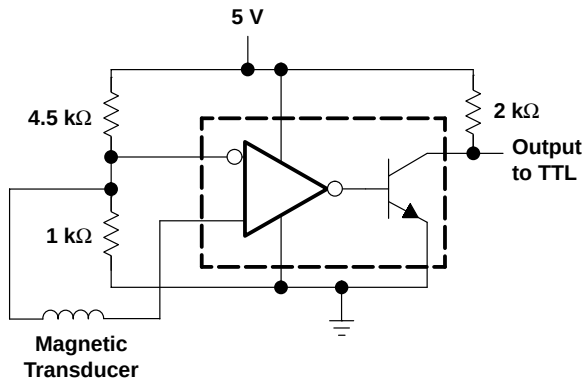


Figure 16. Detector for Magnetic Transducer

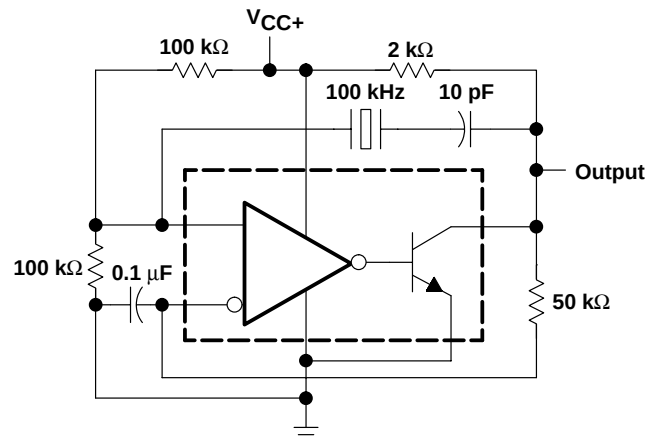


Figure 17. 100-kHz Crystal Oscillator

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APPLICATION INFORMATION

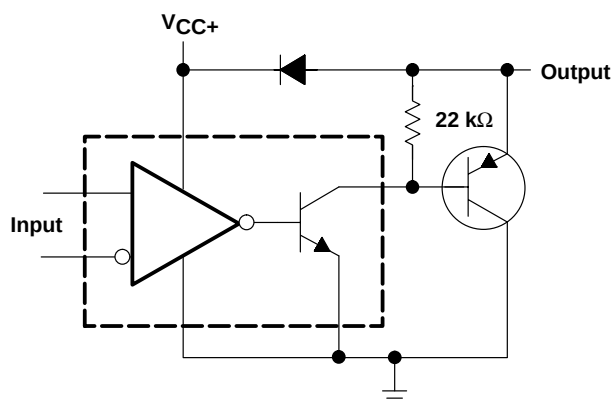
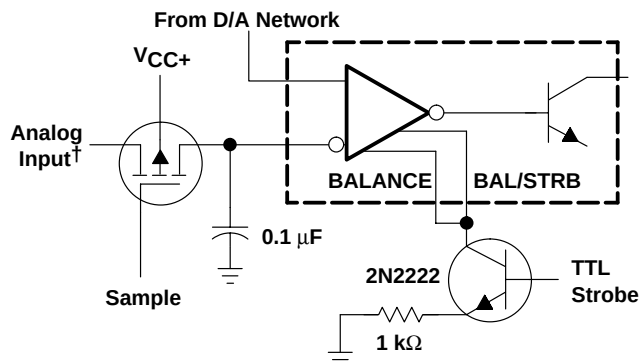


Figure 18. Comparator and Solenoid Driver



† Typical input current is 50 pA with inputs strobed off.

Figure 19. Strobing Both Input and Output Stages Simultaneously

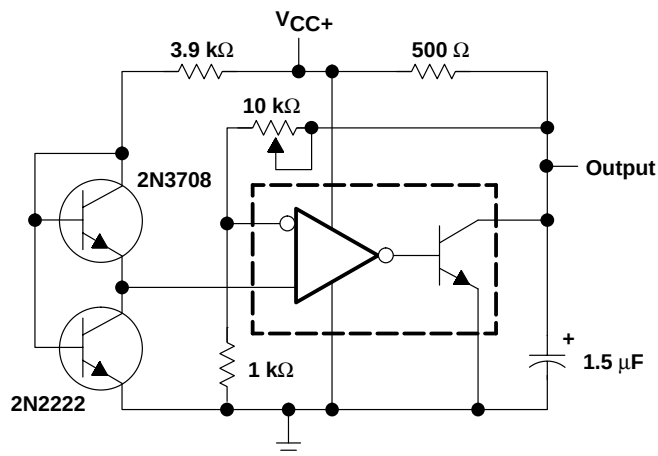


Figure 20. Low-Voltage Adjustable Reference Supply

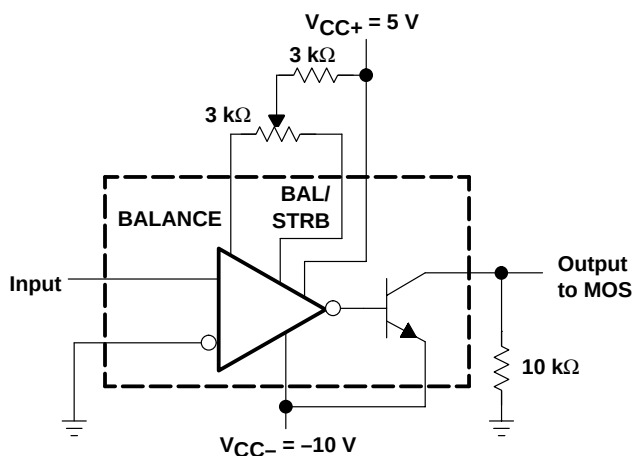


Figure 21. Zero-Crossing Detector Driving MOS Logic

APPLICATION INFORMATION

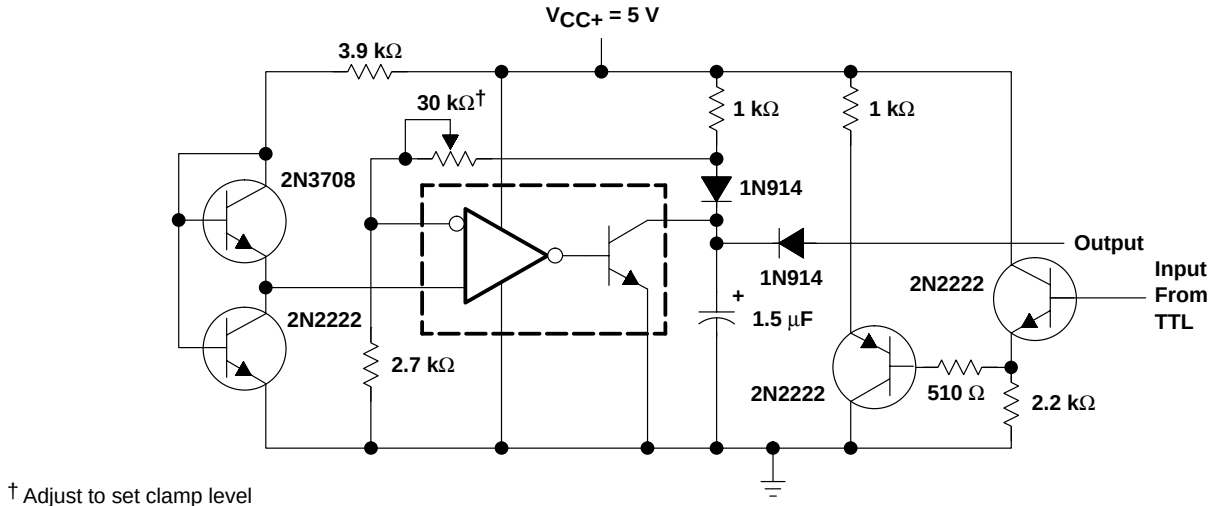


Figure 22. Precision Squarer

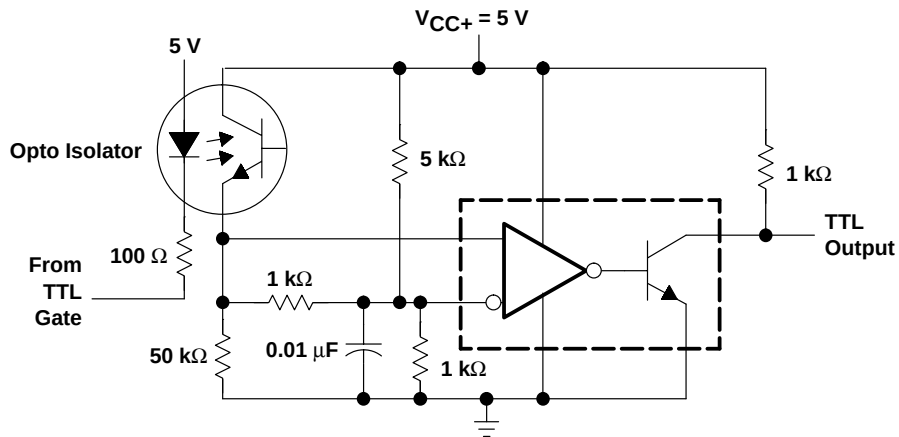


Figure 23. Digital Transmission Isolator

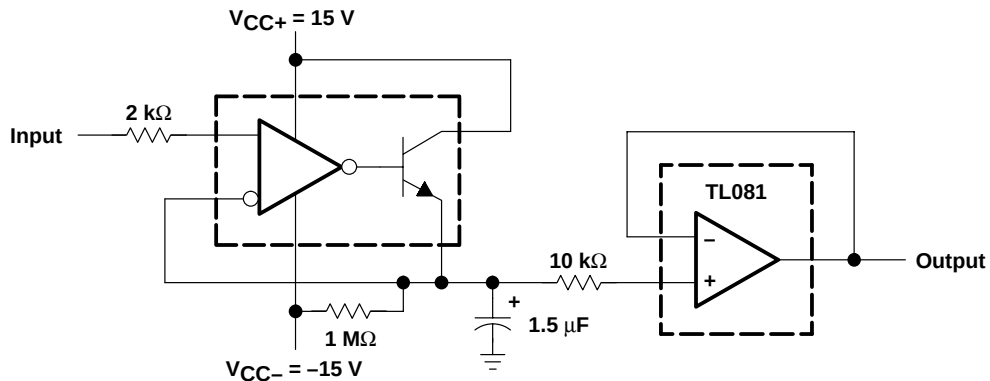


Figure 24. Positive-Peak Detector

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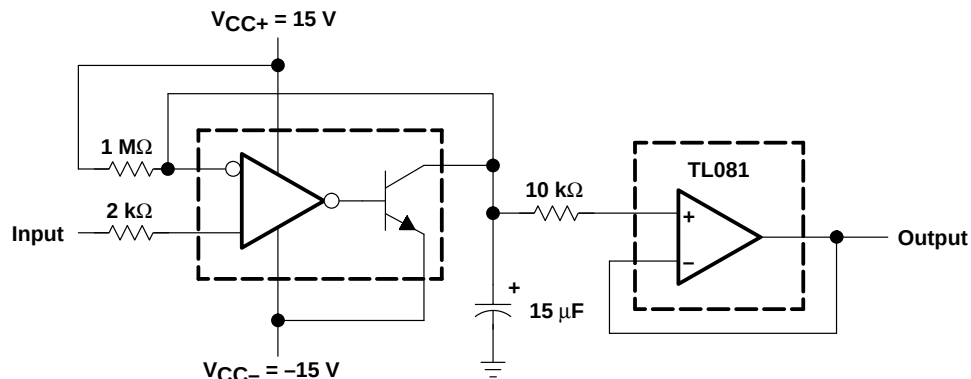
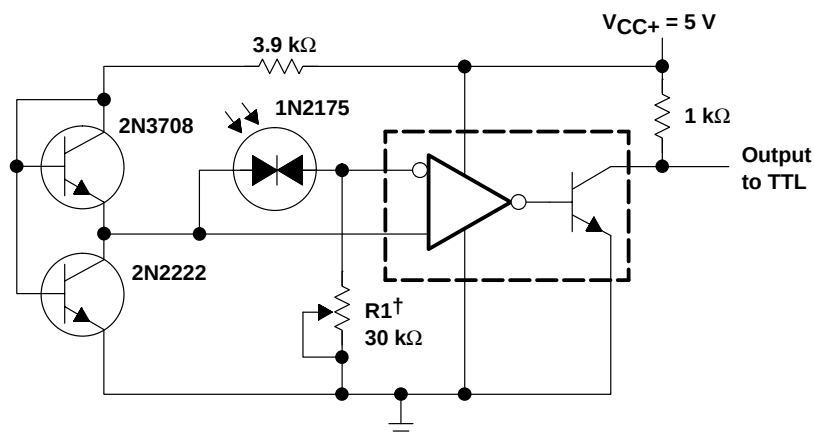
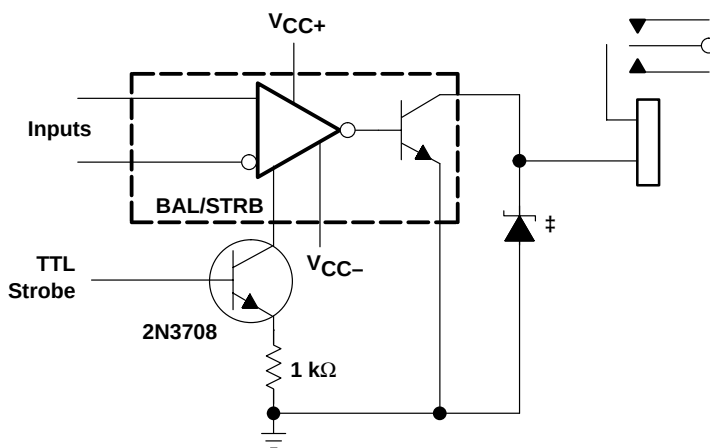


Figure 25. Negative-Peak Detector



† R1 sets the comparison level. At comparison, the photodiode has less than 5 mV across it, decreasing dark current by an order of magnitude.

Figure 26. Precision Photodiode Comparator



‡ Transient voltage and inductive kickback protection

Figure 27. Relay Driver With Strobe

APPLICATION INFORMATION

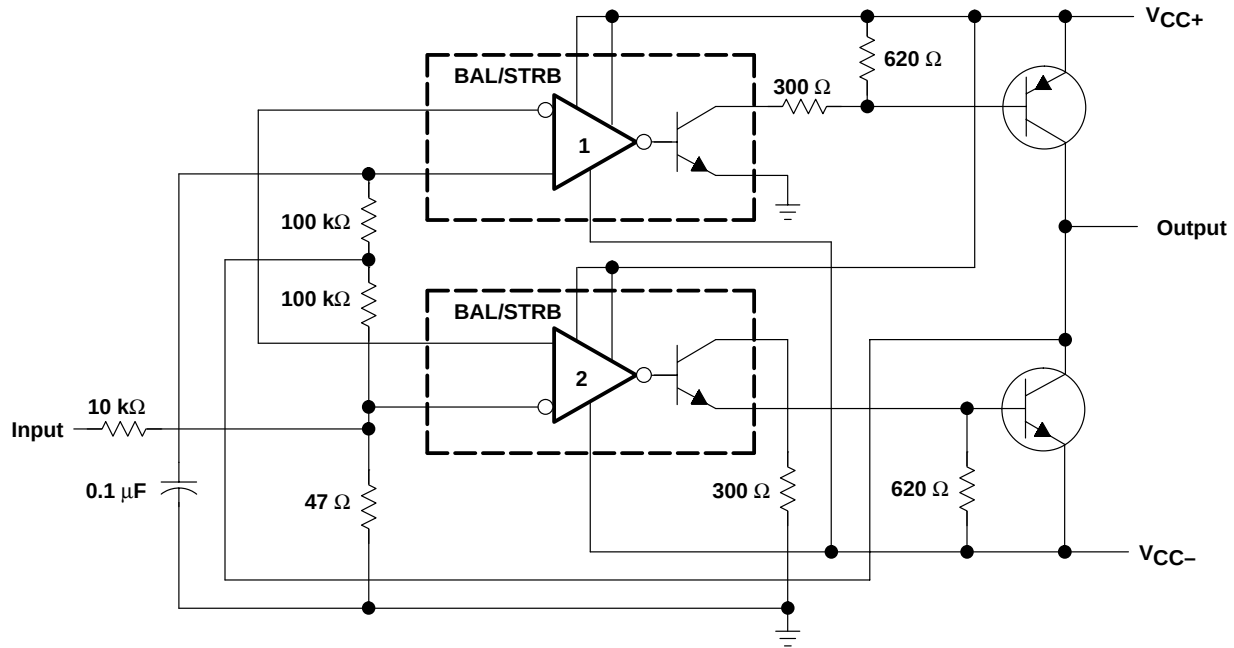


Figure 28. Switching Power Amplifier

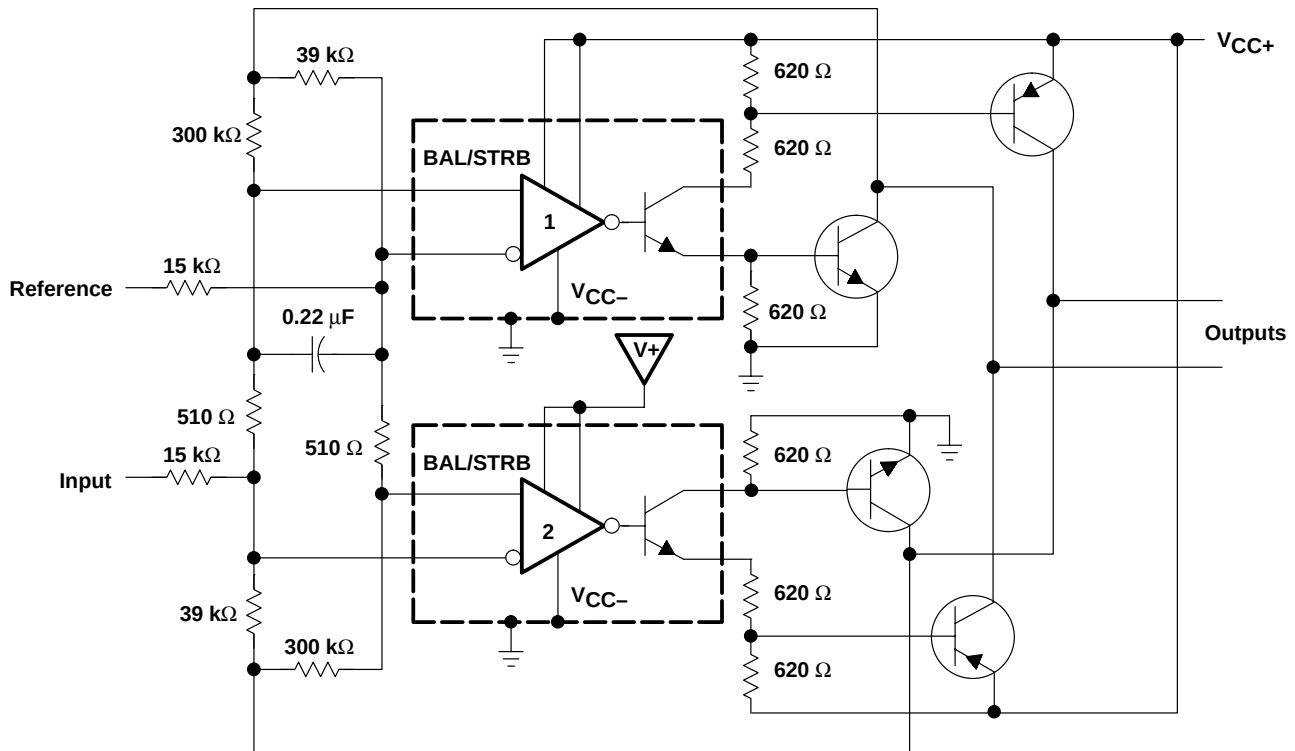


Figure 29. Switching Power Amplifiers

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