

## 1. Description

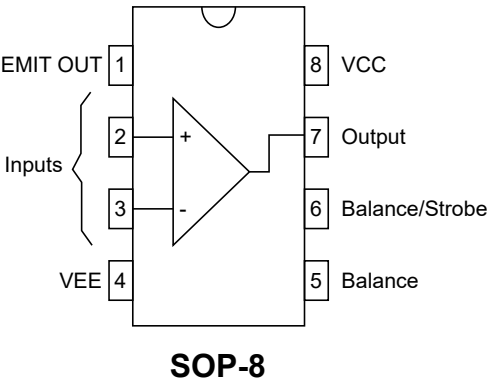
LM311DR and LM211DR can work on a single power supply of 5V to 30V or a dual power supply of  $\pm 15V$ . Like the commonly used comparator, LM311 can become a real universal comparator. The input of LM311DR and LM211DR can be isolated from the system, and the output can be referenced to ground power supply or VEE. This flexibility can drive DTL, RTL, TTL or MOS level logic. When the output current is 50mA, the output can switch the voltage to 50V, which can be used to drive relays, lamps or solenoids.

## 2. Features

- Fast Response Time: 165ns
- Strobe Capability
- Maximum Input Bias Current: 300nA
- Maximum Input Offset Current: 70nA
- Can Operate From Single 5-V Supply
- Available in Q-Temp Automotive High-Reliability Automotive Applications
- Configuration Control and Print Support
- Qualification to Automotive Standards
- On Products Compliant to MIL-PRF-38535 All Parameters Are Tested Unless Otherwise Noted. On All Other Products, Production Processing Does Not Necessarily Include Testing of All Parameters



3.Pinning Information



Outlet function

| Pin              |       | I/O <sup>(1)</sup> | Description                 |
|------------------|-------|--------------------|-----------------------------|
| Name             | SOP-8 |                    |                             |
| IN+              | 2     | I                  | Noninverting comparator     |
| IN-              | 3     | I                  | Inverting input comparator  |
| BALANCE          | 5     | I                  | Balance                     |
| BAL/STRB         | 6     | I                  | Strobe                      |
| COL OUT          | 7     | O                  | Output collector comparator |
| EMIT OUT         | 1     | O                  | Output emitter comparator   |
| V <sub>CC-</sub> | 4     | -                  | Negative supply             |
| V <sub>CC+</sub> | 8     | -                  | Positive supply             |

(1) I=Input, O=Output



#### 4.Limit parameter (T<sub>A</sub>=+25°C, untitled otherwise.)

| Parameter                                                                                                      | Symbol            | LM211                  | LM311                  | Units |
|----------------------------------------------------------------------------------------------------------------|-------------------|------------------------|------------------------|-------|
| Total supply voltage                                                                                           | $V_{CC}+ V_{EE} $ | 36                     | 36                     | V     |
| Output to negative supply voltage                                                                              | $V_O-V_{EE}$      | 50                     | 40                     | V     |
| Ground to negative power supply                                                                                | $V_{EE}$          | 30                     | 30                     | V     |
| Input differential voltage                                                                                     | $V_{ID}$          | ±30                    | ±30                    | V     |
| Input voltage (Note 2)                                                                                         | $V_{in}$          | ±15                    | ±15                    | V     |
| Strobe pin voltage gating                                                                                      |                   | $V_{CC}$ to $V_{CC}-5$ | $V_{CC}$ to $V_{CC}-5$ | V     |
| Power consumption and thermal characterstics plastic package DIP T <sub>A</sub> decreases when it exceeds 25°C | $P_D$             | 625                    |                        | mW    |
|                                                                                                                |                   | 5                      |                        | mW/°C |
| Operating ambient temperature                                                                                  | $T_A$             | -40 to +85             | 0 to +70               | °C    |
| Operating junction temperature range                                                                           | $T_{J(max)}$      | 150                    | 150                    | °C    |
| Storage temperature                                                                                            | $T_{STG}$         | -65 to +150            | -65 to +150            | °C    |



## 5. Electrical characteristics

$V_{CC}=+15\text{ V}$ ,  $V_{EE}=-15\text{ V}$ ,  $T_A=25^\circ\text{C}$ , Unless Otherwise Noted (Note 1).

| Parameter                                       | Symbol           | Conditions                                                             |                        | LM211 |       |       | LM311 |       |       | Units |
|-------------------------------------------------|------------------|------------------------------------------------------------------------|------------------------|-------|-------|-------|-------|-------|-------|-------|
|                                                 |                  |                                                                        |                        | Min   | Typ   | Max   | Min   | Typ   | Max   |       |
| Input offset voltage (Note 3)                   | V <sub>IO</sub>  | T <sub>A</sub> =+25°C                                                  |                        |       | 0.7   | 3     |       | 2     | 7.5   | mV    |
|                                                 |                  | T <sub>low</sub> ≤T <sub>A</sub> ≤T <sub>high</sub> *                  |                        |       |       | 4     |       |       | 10    | mV    |
| Input Offset current (Note 3)                   | I <sub>IO</sub>  | T <sub>A</sub> =+25°C                                                  |                        |       | 5     | 10    |       | 7     | 50    | nA    |
|                                                 |                  | T <sub>low</sub> ≤T <sub>A</sub> ≤T <sub>high</sub> *                  |                        |       |       | 20    |       |       | 70    | nA    |
| Input bias current                              | I <sub>IB</sub>  | T <sub>A</sub> =+25°C                                                  |                        |       | 80    | 100   |       | 105   | 250   | nA    |
|                                                 |                  | T <sub>low</sub> ≤T <sub>A</sub> ≤T <sub>high</sub> *                  |                        |       |       | 150   |       |       | 300   | nA    |
| Large-signal differential-voltage amplification | A <sub>VD</sub>  | 5V≤V <sub>O</sub> ≤ 35V<br>R <sub>L</sub> =1kΩ                         |                        | 40    | 200   |       | 40    | 200   |       | V/mV  |
| Response time (Note 4)                          |                  |                                                                        |                        |       | 200   |       |       | 200   |       | ns    |
| Low-level (collector-toemitter) output voltage  | V <sub>OL</sub>  | I <sub>OL</sub> =50mA                                                  | V <sub>ID</sub> =-5mV  |       | 0.75  | 1.5   |       |       |       | V     |
|                                                 |                  |                                                                        | V <sub>ID</sub> =-10mV |       |       |       |       | 0.75  | 1.5   | V     |
|                                                 |                  | V <sub>CC+</sub> =4.5V<br>V <sub>CC-</sub> =0V<br>I <sub>OL</sub> =8mA | V <sub>ID</sub> =-6mV  |       | 0.23  | 0.4   |       |       |       | V     |
|                                                 |                  |                                                                        | V <sub>ID</sub> =-10mV |       |       |       |       | 0.23  | 0.4   | V     |
| Gated on current (Note 5)                       | I <sub>S</sub>   |                                                                        |                        |       | 3     |       |       | 3     |       | mA    |
| High-level (collector) output leakage current   | I <sub>OH</sub>  | I <sub>(stroke)</sub> =-3mA                                            | V <sub>OH</sub> =35V   |       | 0.2   | 10    |       |       |       | nA    |
|                                                 |                  | V <sub>ID</sub> =5mV                                                   |                        |       |       | 0.5   |       |       |       | μA    |
|                                                 |                  | V <sub>ID</sub> =5mV, V <sub>OH</sub> =35V                             |                        |       |       |       |       | 0.2   | 50    | nA    |
| Common-mode input-voltage range                 | V <sub>ICR</sub> | Lower range                                                            |                        |       | -14.7 | -14.5 |       | -14.7 | -14.5 | V     |
|                                                 |                  | Upper range                                                            |                        | 13    | 13.8  |       | 13    | 13.8  |       | V     |
| Positive supply current                         | I <sub>CC</sub>  |                                                                        |                        |       | 2.4   | 6     |       | 2.4   | 7.5   | mA    |
| Negative supply current                         | I <sub>EE</sub>  |                                                                        |                        |       | -1.3  | -5    |       | -1.3  | -5    | mA    |



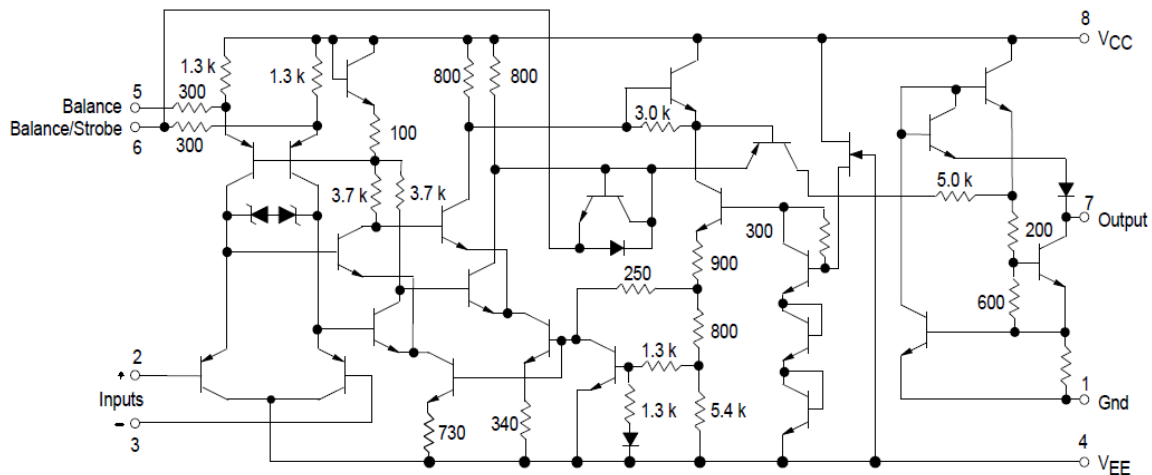
\*  $T_{low} = -25^{\circ}\text{C}$  corresponds to Im 211, and  $t_{low} = 0^{\circ}\text{C}$  corresponds to LM311.

\*  $T_{high} = 85^{\circ}\text{C}$  corresponds to Im 211, and  $T_{high} = 75^{\circ}\text{C}$  corresponds to LM311.

#### NOTES:

1. The specifications of offset voltage, offset current and bias current correspond to the power supply voltage of 5V to  $\pm 15\text{V}$ .
2. This rating is for the case of  $\pm 15\text{V}$  power supply. The positive input voltage limit is 30V higher than the negative power supply, and the negative input limit is equivalent to the negative power supply voltage, or 30V lower than the power supply, or whichever is smaller.
3. Given offset voltage and offset current, it is required to drive a load with a maximum value of 1mA in any power supply voltage range, and these parameters define the error range, thus taking the worst case of voltage gain and input impedance into account.
4. The specified response time is 100Mv input plus 5MV overdrive signal.
5. Don't directly ground the STROBE pin, it needs to be driven by 3mA~5mA current.

## 6. Schematic Circuit Diagram





## 7.1 Typical Characteristics

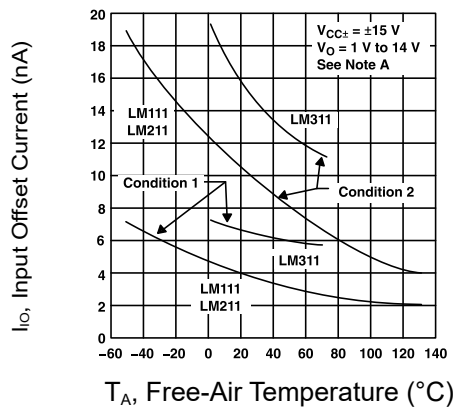


Figure 1: Input Offset Current vs Free-Air Temperature

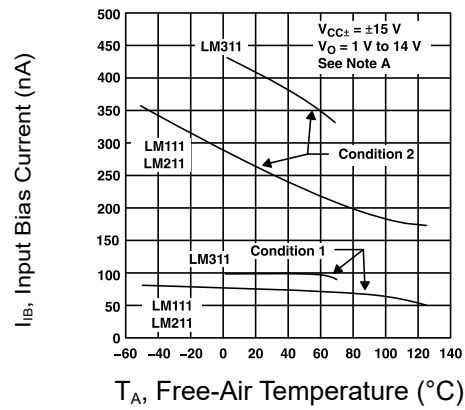


Figure 2: Input Bias Current vs Free-Air Temperature

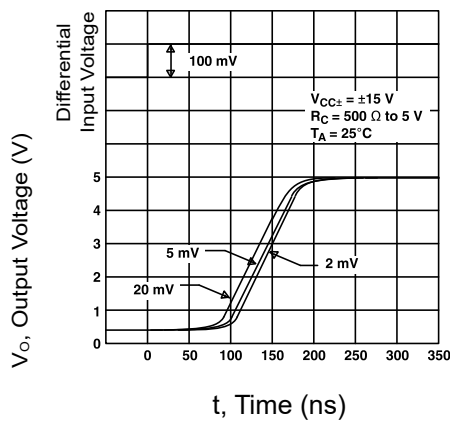


Figure 3: Output Response for Various Input Overdrives

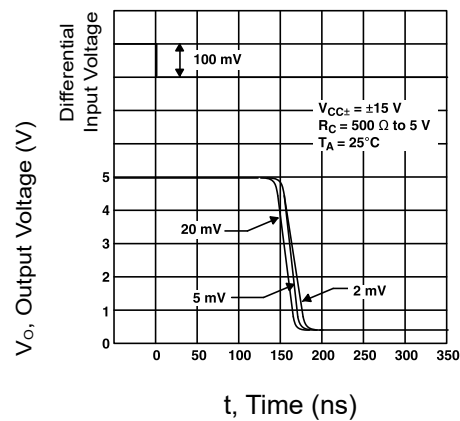


Figure 4: Output Response for Various Input Overdrives

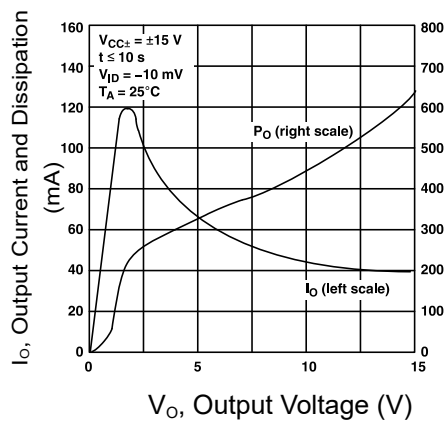


Figure 5: Output Current and Dissipation vs Output Voltage

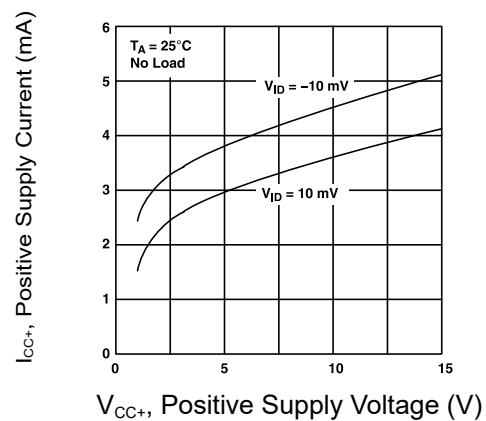
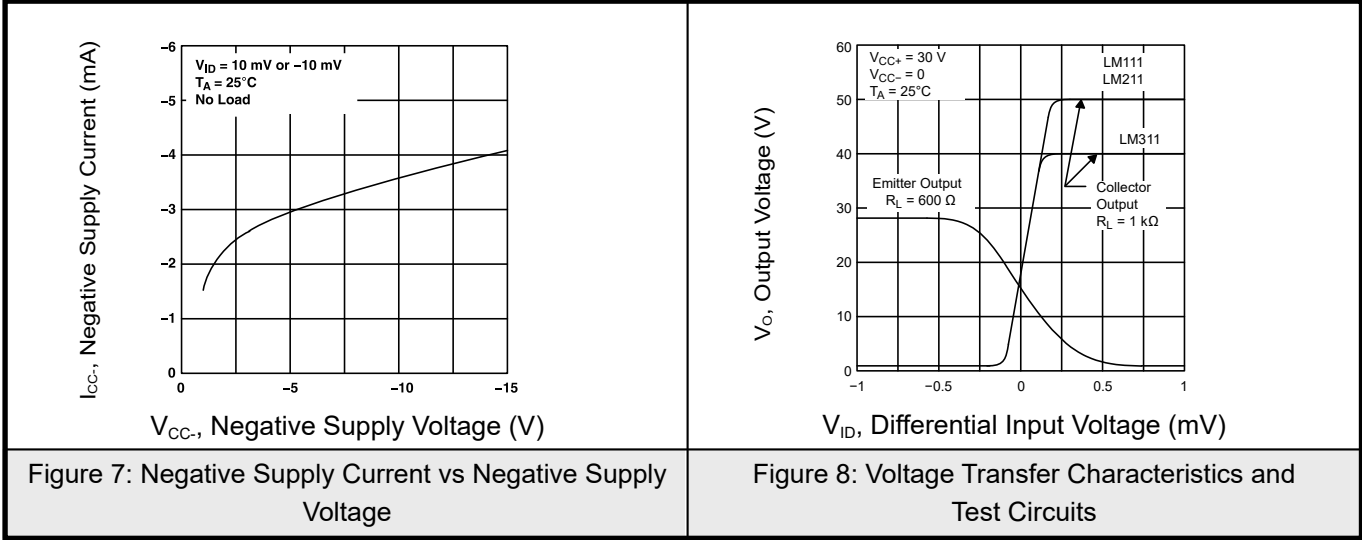


Figure 6: Positive Supply Current vs Positive Supply Voltage



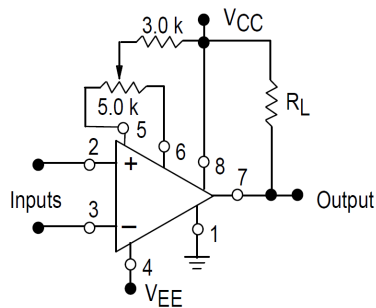
7.2 Typical Characteristics



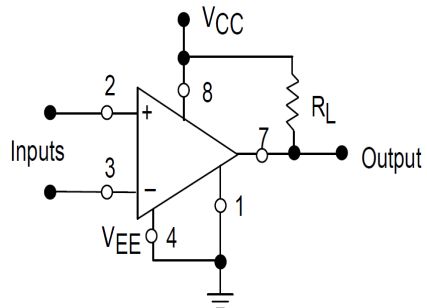


## 8. Typical Comparator Design Scheme

Separate power

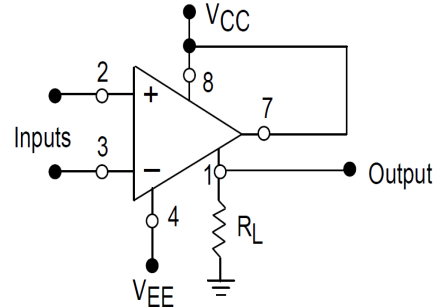


Single

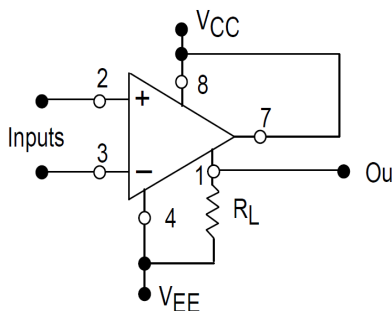


(When GND is the output,  
the input polarity is reversed.)

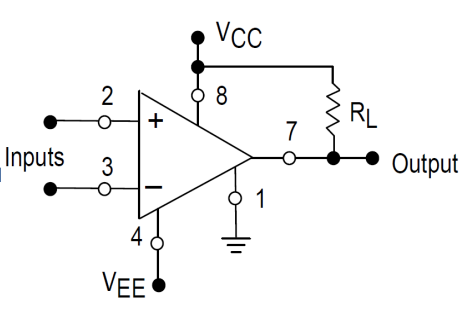
Load with



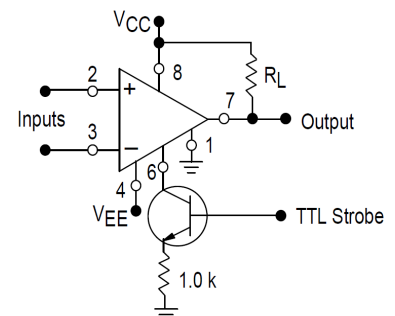
(When GND is the output,  
the input polarity is reversed.)

Load referenced to negative  
power supply positive power supply

Gating ability

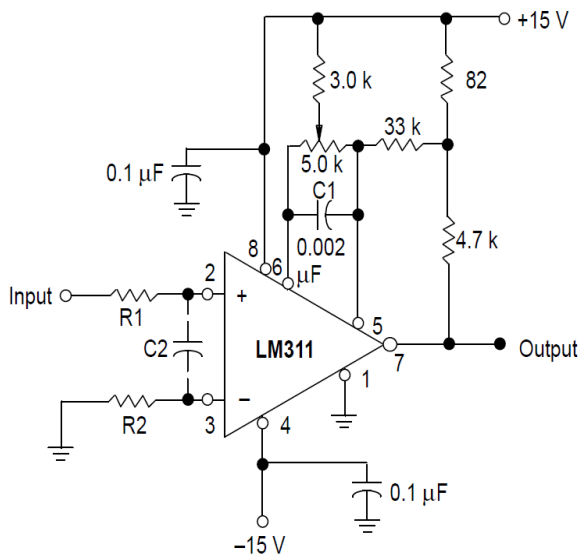


Load with reference to

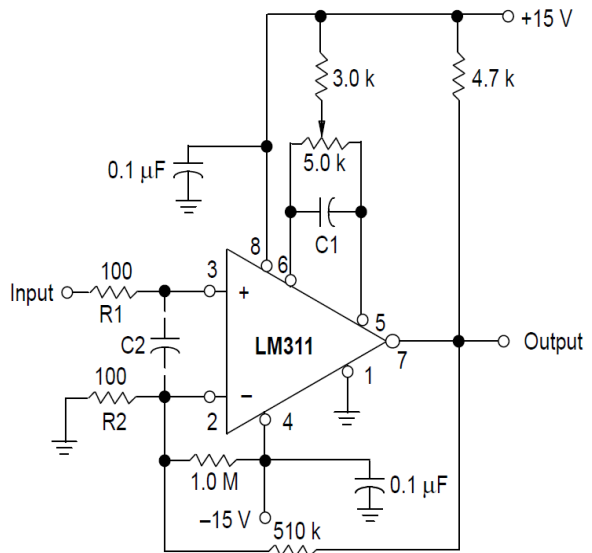




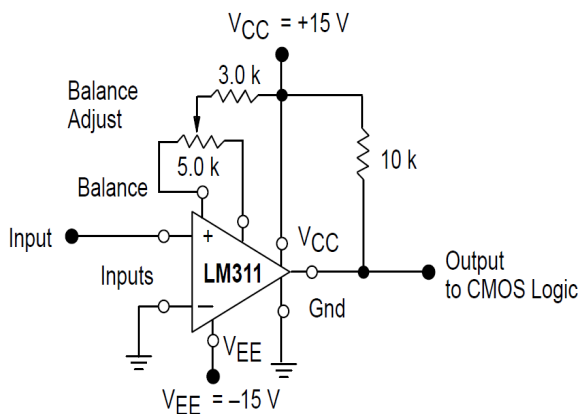
An improved method without input positive feedback and lag/hysteresis



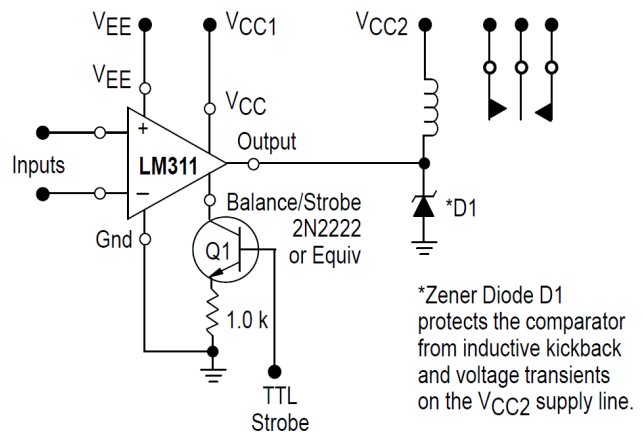
Techniques for adding



Zero-crossing detector driving CMOS logic

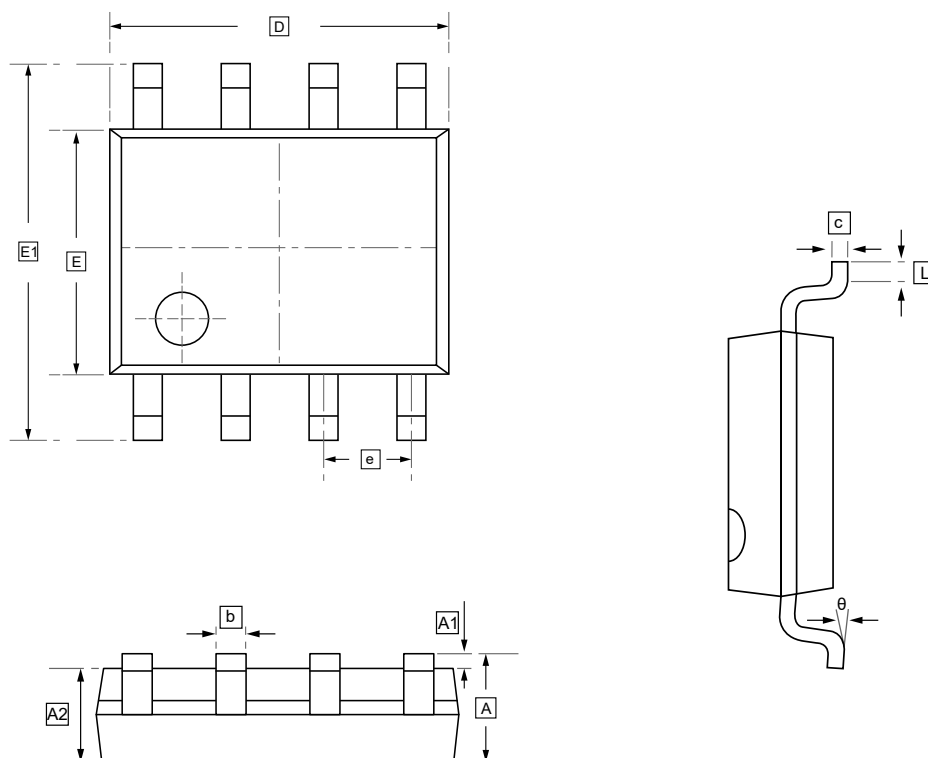


Relay driver with gating capability





## 9.SOP-8 Package Outline Dimensions

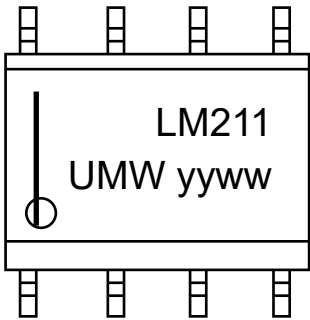


### DIMENSIONS (mm are the original dimensions)

| Symbol | A     | A1    | A2    | b     | c     | D     | E     | E1    | e     | L     | θ  |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|
| Min    | 1.350 | 0.000 | 1.350 | 0.330 | 0.170 | 4.700 | 3.800 | 5.800 | 1.270 | 0.400 | 0° |
| Max    | 1.750 | 0.100 | 1.550 | 0.510 | 0.250 | 5.100 | 4.000 | 6.200 | BSC   | 1.270 | 8° |



## 10.Ordering information



yy: Year Code  
ww: Week Code

| Order Code  | Marking | Package | Base QTY | Delivery Mode |
|-------------|---------|---------|----------|---------------|
| UMW LM211DR | LM211   | SOP-8   | 2500     | Tape and reel |
| UMW LM311DR | LM311   | SOP-8   | 2500     | Tape and reel |



## 11.Disclaimer

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