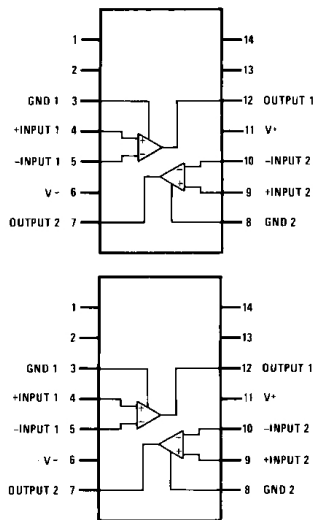


LMx19 High Speed Dual Comparator

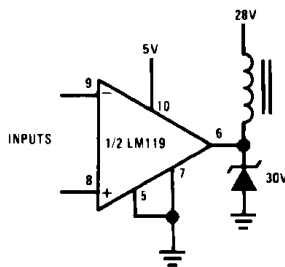
1 Features

- Two Independent Comparators
- Operates from a Single 5-V Supply
- Typically 80-ns Response Time at ± 15 V
- Minimum Fan-out of 2 Each Side
- Maximum Input Current of 1 μ A Over Temperature
- Inputs and Outputs can be Isolated from System Ground
- High Common-Mode Slew Rate

Connection Diagram



Typical Application - Relay Driver



2 Description

The LM119 series are precision high-speed dual comparators fabricated on a single monolithic chip. They are designed to operate over a wide range of supply voltages down to a single 5-V logic supply and ground. They have higher gain and lower input currents than devices such as the LM710. The uncommitted collector of the output stage makes the LM119 compatible with RTL, DTL, and TTL, as well as capable of driving lamps and relays at currents of up to 25 mA.

The LM319A offers improved precision over the standard LM319, with tighter tolerances on offset voltage, offset current, and voltage gain.

Although designed primarily for applications requiring operation from digital logic supplies, the LM119 series are fully specified for power supplies up to ± 15 V. The series features faster response than the LM111, at the expense of higher power dissipation. However, the high-speed, wide operating voltage range and low package count make the LM119 more versatile than older devices such as the LM711.

The LM119 is specified from -55°C to $+125^{\circ}\text{C}$, the LM219 is specified from -25°C to $+85^{\circ}\text{C}$, and the LM319A and LM319 are specified from 0°C to $+70^{\circ}\text{C}$.

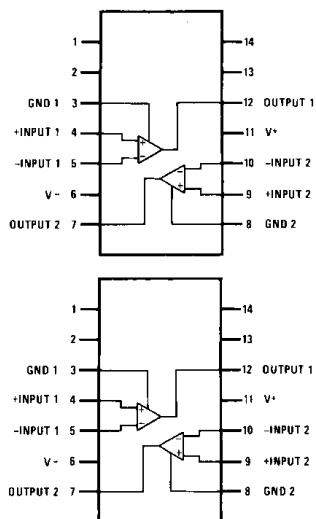
Device Information⁽¹⁾

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM119, LM219, LM319	TO-100 (10)	8.96 mm \times 8.96 mm
	CDIP (14)	6.67 mm \times 19.56 mm

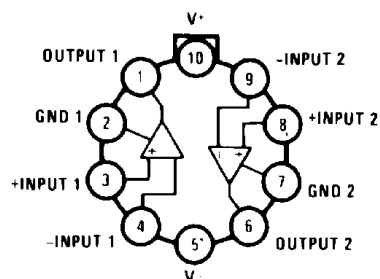
(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 Pin Configuration and Functions

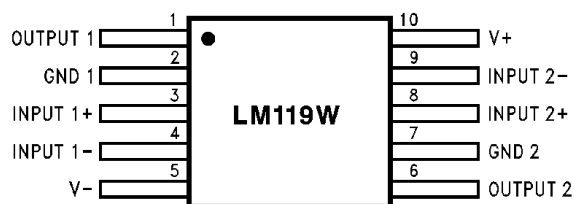
**D, J, or NFF Package
14-Pins CDIP and PDIP
Top View**



**LME Package
10-Pins TO-100 (Metal Can Package)
Top View**



**NAD Package
10-Pins CFP
Top View**



Pin Functions

NAME	PIN			I/O	DESCRIPTION
	NO. (D, J, NFF 14)	NO. (LME 10)	NO. (NAD 10)		
OUTPUT 1	1	12	1	O	Comparator 1 output
GND 1	2	3	2	G	Comparator 1 ground connection
INPUT 1+	3	4	3	I	Comparator 1 input
INPUT 1-	4	5	4	I	Comparator 1 input
V-	5	6	5	P	Negative supply voltage
OUTPUT 2	6	7	6	O	Comparator 2 output
GND 2	7	8	7	G	Comparator 2 ground connection
INPUT 2+	8	9	8	I	Comparator 2 input
INPUT 2-	9	10	9	I	Comparator 2 input
V+	10	11	10	P	Positive supply voltage
NC	1,2,13,14				No connect. Do not connect to ground.

5 Specifications

5.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)⁽¹⁾⁽²⁾⁽³⁾

		MIN	MAX	UNIT
Total supply voltage			36	V
Output to negative supply voltage			36	V
Ground to negative supply voltage			25	V
Ground to positive supply voltage			18	V
Differential input voltage		-5	+5	V
Input voltage ⁽⁴⁾		-15	+15	V
Power dissipation ⁽⁵⁾			500	mW
Output short circuit duration			10	sec
Lead temperature (soldering, 10 sec.)			260	°C
Soldering information ⁽⁶⁾	Dual-In-Line Package Soldering (10 seconds)		260	°C
	Small Outline Package Vapor Phase (60 seconds)		215	
	Small Outline Package Infrared (15 seconds)		220	
Operating temperature	LM119	-55	125	°C
	LM219	-25	85	
	LM319A, LM319	0	70	
Storage temperature, T _{stg}		-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) If Military/Aerospace specified devices are required, please contact the Texas Instruments Sales Office/ Distributors for availability and specifications.
- (3) Refer to RETS119X for LM119H/883 and LM119J/883 specifications.
- (4) For supply voltages less than ± 15 V the absolute maximum input voltage is equal to the supply voltage.
- (5) The maximum junction temperature of the LM119 is 150°C, while that of the LM219 is 110°C. For operating at elevated temperatures, devices in the H10 package must be derated based on a thermal resistance of 160°C/W, junction to ambient, or 19°C/W, junction to case. The thermal resistance of the J14 and N14 packages is 100°C/W, junction to ambient.
- (6) See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

5.2 ESD Ratings

			VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±800	V

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

5.3 Thermal Information

THERMAL METRIC ⁽¹⁾	LM119, LM219, LM319			UNIT
	TO-100 (LME)	PDIP (NFF)	CDIP (J)	
	10 PINS	14 PINS	14 PINS	
R _{θJA} Junction-to-ambient thermal resistance	160	100	100	°C/W
R _{θJC(top)} Junction-to-case (top) thermal resistance	19	NA	NA	°C/W

- (1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application report, [SPRA953](#).

5.4 Electrical Characteristics LM119, LM219

These specifications apply for $V_S = \pm 15\text{ V}$, and the Ground pin at ground, and $-55^\circ\text{C} \leq T_A \leq +125^\circ\text{C}$, unless otherwise stated. With the LM219, all temperature specifications are limited to $-25^\circ\text{C} \leq T_A \leq +85^\circ\text{C}$. The offset voltage, offset current and bias current specifications apply for any supply voltage from a single 5-V supply up to $\pm 15\text{-V}$ supplies. Do not operate the device with more than 16 V from ground to V_S .

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input Offset Voltage ⁽¹⁾	$T_A = 25^\circ\text{C}$, $R_S \leq 5\text{k}$		0.7	4	mV
Input Offset Current ⁽¹⁾	$T_A = 25^\circ\text{C}$		30	75	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		150	500	nA
Voltage Gain	$T_A = 25^\circ\text{C}$ ⁽²⁾	10	40		V/mV
Response Time ⁽³⁾	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		80		ns
Saturation Voltage	$V_{IN} \leq -5\text{ mV}$, $I_{OUT} = 25\text{ mA}$ $T_A = 25^\circ\text{C}$		0.75	1.5	V
Output Leakage Current	$V_{IN} \geq 5\text{ mV}$, $V_{OUT} = 35\text{ V}$ $T_A = 25^\circ\text{C}$		0.2	2	μA
Input Offset Voltage ⁽¹⁾	$R_S \leq 5\text{k}$			7	mV
Input Offset Current ⁽¹⁾				100	nA
Input Bias Current				1000	nA
Input Voltage Range	$V_S = \pm 15\text{ V}$	-12	± 13	+12	V
	$V^+ = 5\text{ V}$, $V^- = 0$	1		3	
Saturation Voltage	$V^+ \geq 4.5\text{ V}$, $V^- = 0$ $V_{IN} \leq -6\text{ mV}$, $I_{SINK} \leq 3.2\text{ mA}$ $T_A \geq 0^\circ\text{C}$		0.23	0.4	V
	$T_A \leq 0^\circ\text{C}$			0.6	
Output Leakage Current	$V_{IN} \geq 5\text{ mV}$, $V_{OUT} = 35\text{ V}$, $V^- = V_{GND} = 0\text{ V}$		1	10	μA
Differential Input Voltage				± 5	V
Positive Supply Current	$T_A = 25^\circ\text{C}$, $V^+ = 5\text{ V}$, $V^- = 0$		4.3		mA
Positive Supply Current	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		8	11.5	mA
Negative Supply Current	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		3	4.5	mA

- (1) 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-mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.
- (2) Output is pulled up to 15 V through a 1.4-k Ω resistor.
- (3) The response time specified is for a 100-mV input step with 5-mV overdrive.

5.5 Electrical Characteristics LM319, LM319A

These specifications apply for $V_S = \pm 15\text{ V}$, and $0^\circ\text{C} \leq T_A \leq 70^\circ\text{C}$, unless otherwise stated. The offset voltage, offset current, and bias current specifications apply for any supply voltage from a single 5-V supply up to $\pm 15\text{-V}$ supplies. Do not operate the device with more than 16 V from ground to V_S .

PARAMETER	TEST CONDITIONS	LM319A			LM319			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Input Offset Voltage ⁽¹⁾	$T_A = 25^\circ\text{C}$, $R_S \leq 5\text{k}$		0.5	1		2	8	mV
Input Offset Current ⁽¹⁾	$T_A = 25^\circ\text{C}$		20	40		80	200	nA
Input Bias Current	$T_A = 25^\circ\text{C}$		150	500		250	1000	nA
Voltage Gain	$T_A = 25^\circ\text{C}$ ⁽²⁾	20	40		8	40		V/mV
Response Time ⁽³⁾	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		80			80		ns
Saturation Voltage	$V_{IN} \leq -10\text{ mV}$, $I_{OUT} = 25\text{ mA}$ $T_A = 25^\circ\text{C}$		0.75	1.5		0.75	1.5	V
Output Leakage Current	$V_{IN} \geq 10\text{ mV}$, $V_{OUT} = 35\text{ V}$ $V^- = V_{GND} = 0\text{ V}$, $T_A = 25^\circ\text{C}$		0.2	10		0.2	10	μA
Input Offset Voltage ⁽¹⁾	$R_S \leq 5\text{k}$			10			10	mV
Input Offset Current ⁽¹⁾				300			300	nA
Input Bias Current				1000			1200	nA
Input Voltage Range	$V_S = \pm 15\text{ V}$		± 13			± 13		V
	$V^+ = 5\text{ V}$, $V^- = 0$	1		3	1		3	
Saturation Voltage	$V^+ \geq 4.5\text{ V}$, $V^- = 0$ $V_{IN} \leq -10\text{ mV}$, $I_{SINK} \leq 3.2\text{ mA}$		0.3	0.4		0.3	0.4	V
Differential Input Voltage			± 5			± 5		V
Positive Supply Current	$T_A = 25^\circ\text{C}$, $V^+ = 5\text{ V}$, $V^- = 0$		4.3			4.3		mA
Positive Supply Current	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		8	12.5		8	12.5	mA
Negative Supply Current	$T_A = 25^\circ\text{C}$, $V_S = \pm 15\text{ V}$		3	5		3	5	mA

(1) 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-mA load. Thus, these parameters define an error band and take into account the worst case effects of voltage gain and input impedance.

(2) Output is pulled up to 15 V through a 1.4-k Ω resistor.

(3) The response time specified is for a 100-mV input step with 5-mV overdrive.

5.6 Typical Characteristics

5.6.1 Typical Characteristics – LM119, LM119A, LM219

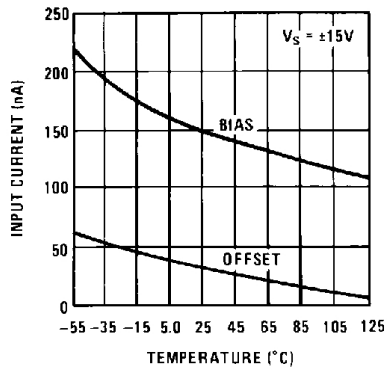


Figure 1. Input Currents

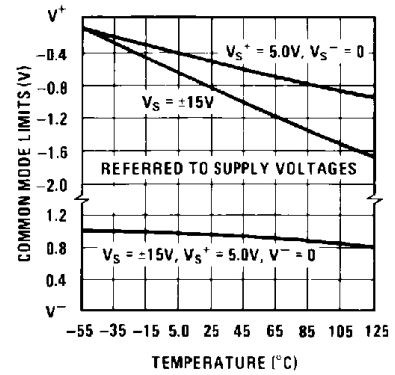


Figure 2. Common-Mode Limits

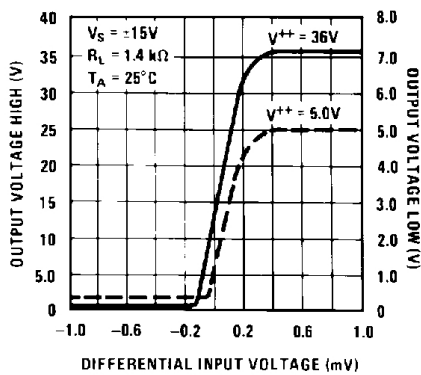


Figure 3. Transfer Function

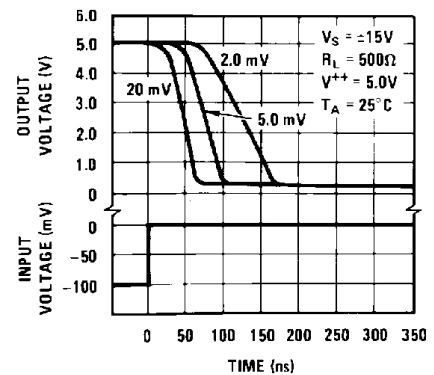


Figure 4. Response Time for Various Input Overdrives

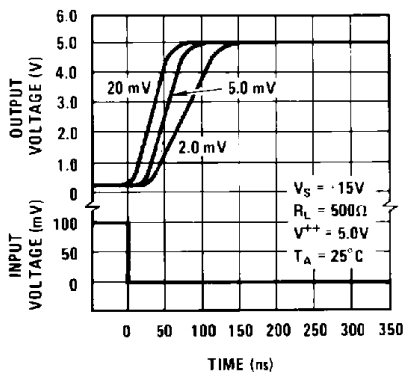


Figure 5. Response Time for Various Input Overdrives

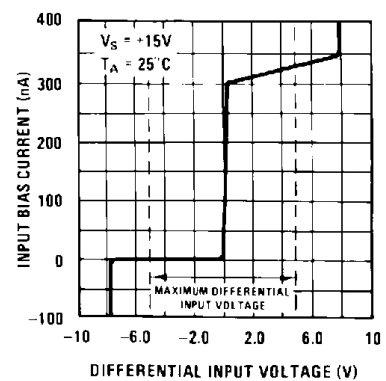


Figure 6. Input Characteristics

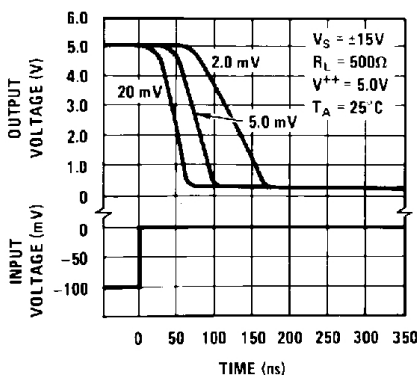


Figure 7. Response Time for Various Input Overdrives

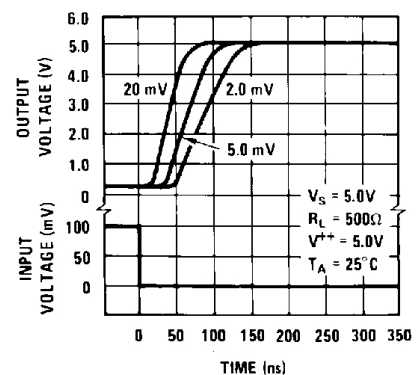


Figure 8. Response Time for Various Input Overdrives

Typical Characteristics – LM119, LM119A, LM219 (continued)

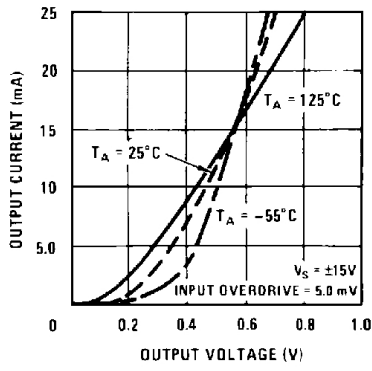


Figure 9. Output Saturation Voltage

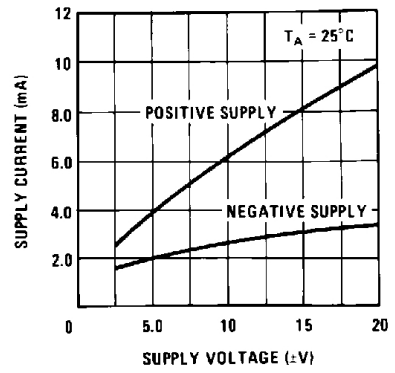


Figure 10. Supply Current

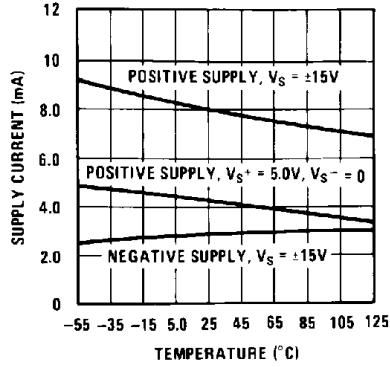


Figure 11. Supply Current

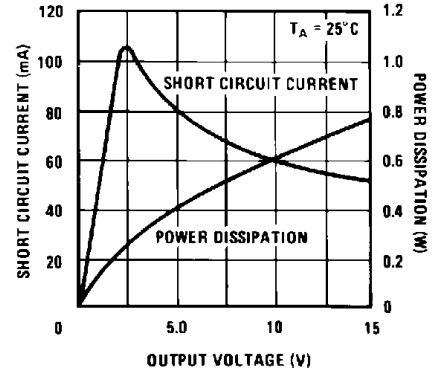


Figure 12. Output Limiting Characteristics

5.6.2 Typical Characteristics – LM319, LM319A

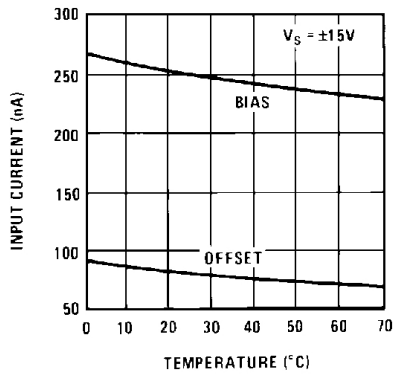


Figure 13. Input Currents

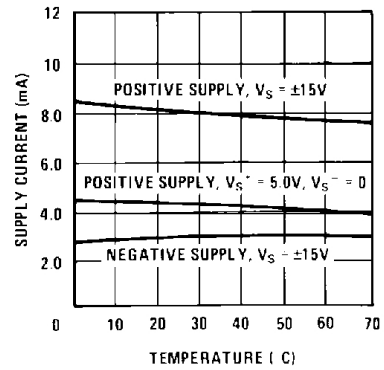


Figure 14. Supply Currents

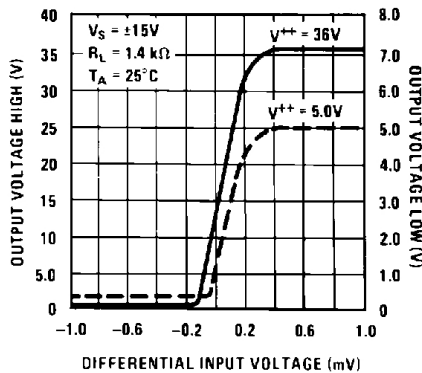


Figure 15. Transfer Function

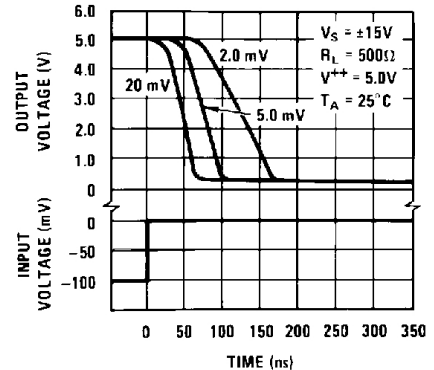


Figure 16. Response Time for Various Input Overdrives

Typical Characteristics – LM319, LM319A (continued)

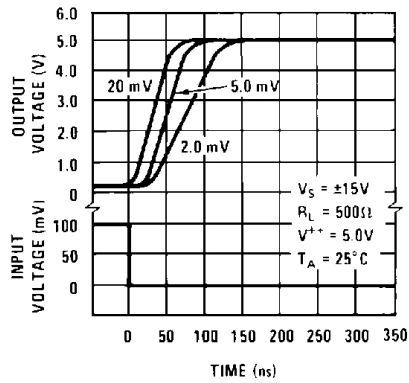


Figure 17. Response Time for Various Input Overdrives

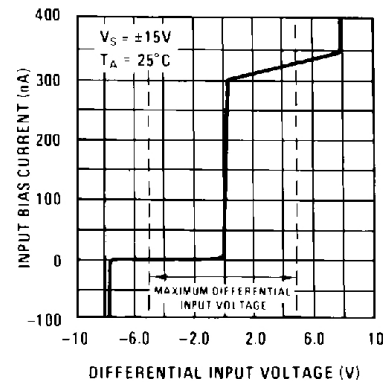


Figure 18. Input Characteristics

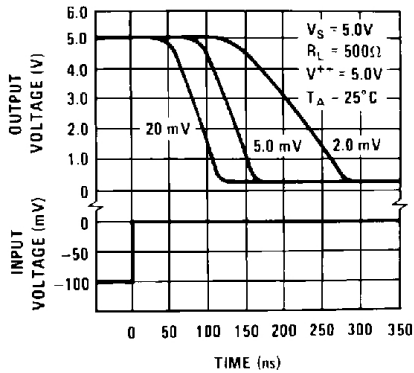


Figure 19. Response Time for Various Input Overdrives

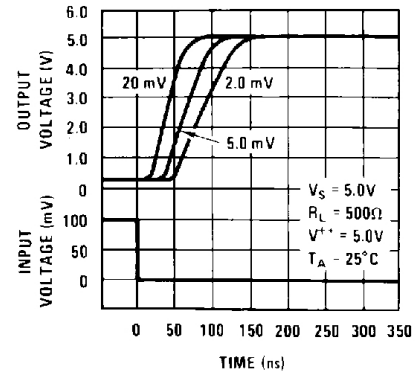


Figure 20. Response Time for Various Input Overdrives

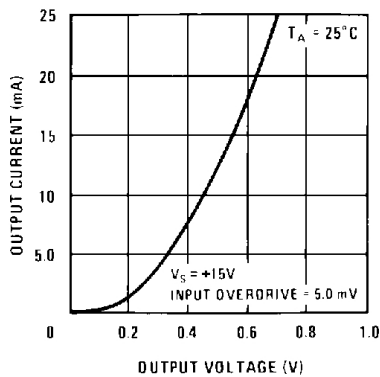


Figure 21. Output Saturation Voltage

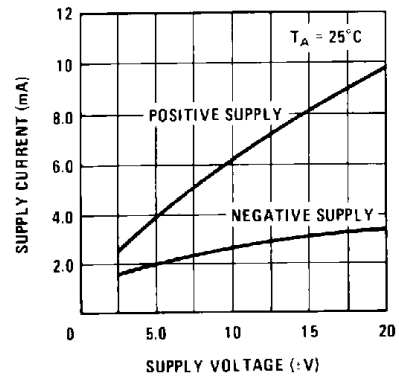


Figure 22. Supply Current

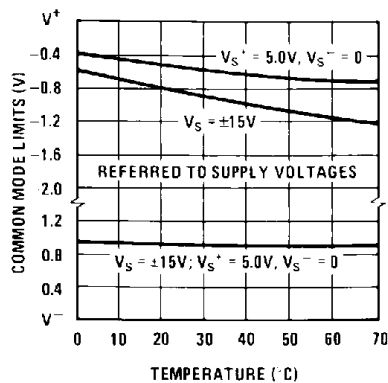


Figure 23. Common-Mode Limits

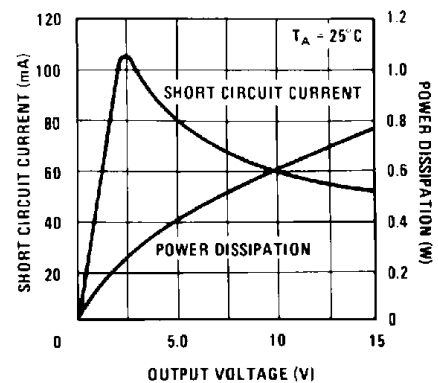
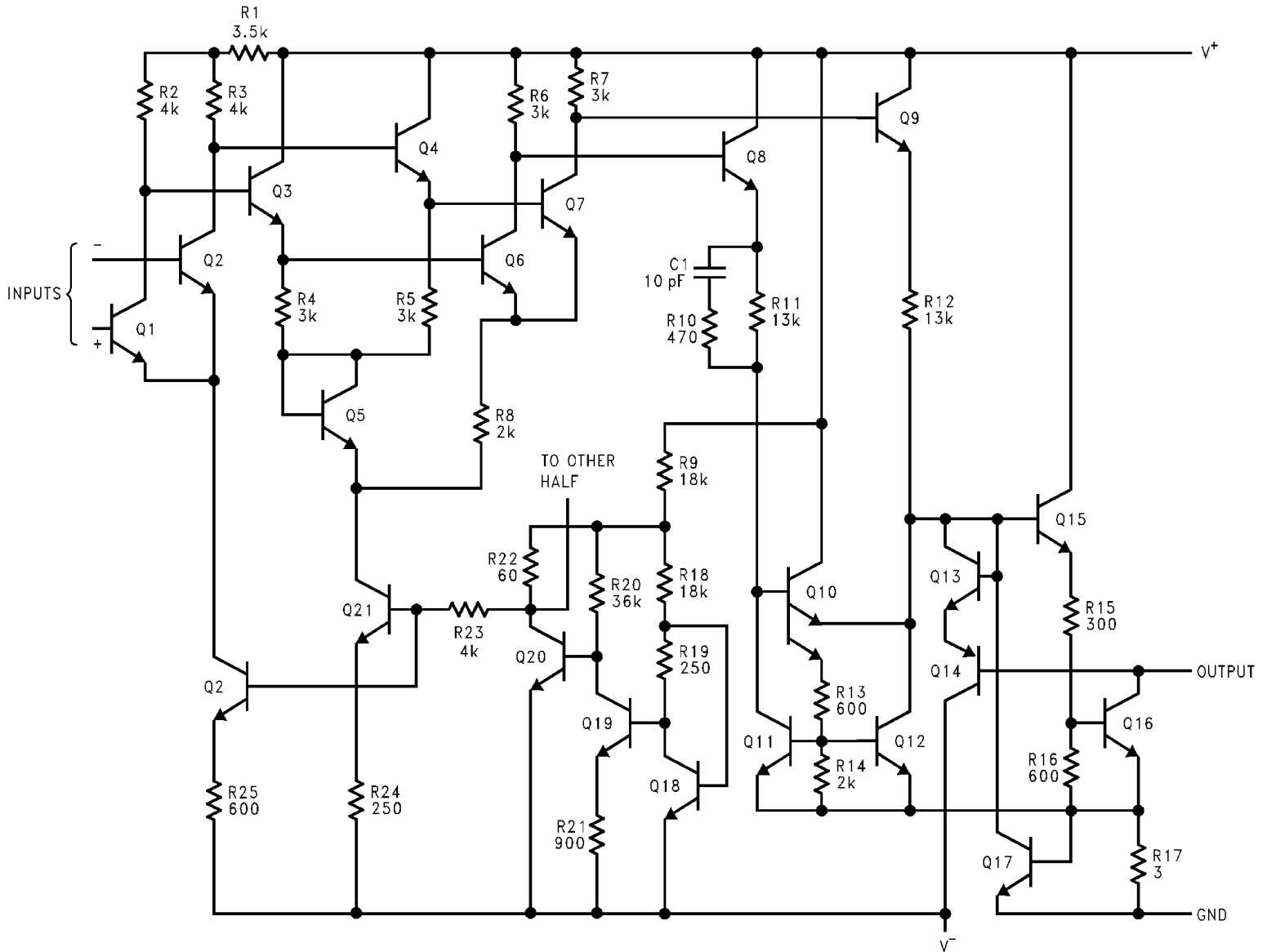


Figure 24. Output Limiting Characteristics

6 Detailed Description

6.1 Functional Block Diagram



*Do not operate the LM119 with more than 16V between GND and V⁺

7 Application and Implementation

7.1 Typical Applications

7.1.1 Relay Driver

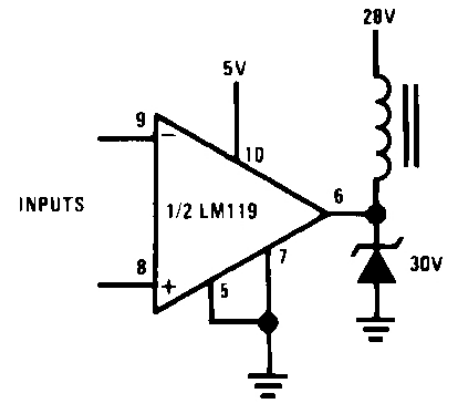


Figure 25. Relay Driver

7.1.2 Window Detector

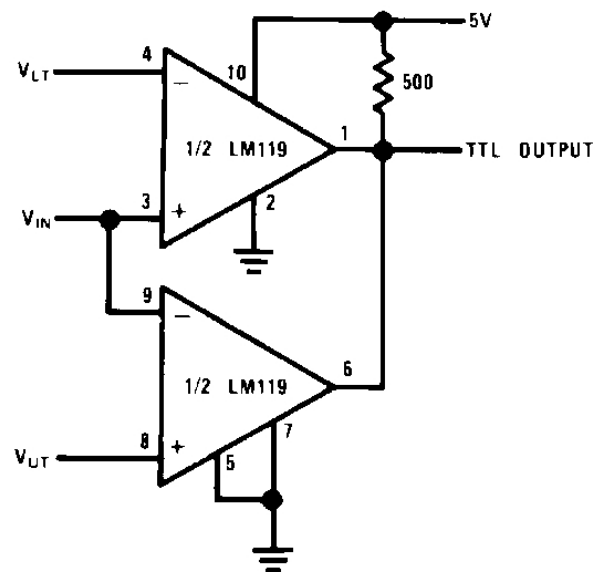


Figure 26. Window Detector