MOTOROLA

L4949

Advanced Information

Multifunction Very Low Dropout Voltage Regulator

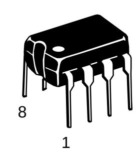
The L4949 is a monolithic integrated 5.0 V voltage regulator with a very low dropout and additional functions such as power–on reset and input voltage sense.

It is designed for supplying the micro–computer controlled systems especially in automotive applications.

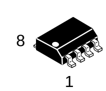
- Operating DC Supply Voltage Range 5.0 V to 28 V
- Transient Supply Voltage Up to 40 V
- Extremely Low Quiescent Current in Standby Mode
- High Precision Standby Output Voltage 5.0 V ±1%
- Output Current Capability Up to 100 mA
- Very Low Dropout Voltage Less Than 0.4 V
- Reset Circuit Sensing The Output Voltage
- Programmable Reset Pulse Delay With External Capacitor
- Voltage Sense Comparator
- Thermal Shutdown and Short Circuit Protections

MULTIFUNCTION VERY LOW DROPOUT VOLTAGE REGULATOR

SILICON MONOLITHIC INTEGRATED CIRCUIT

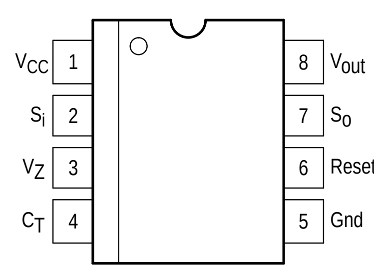


N SUFFIX
PLASTIC PACKAGE
CASE 626



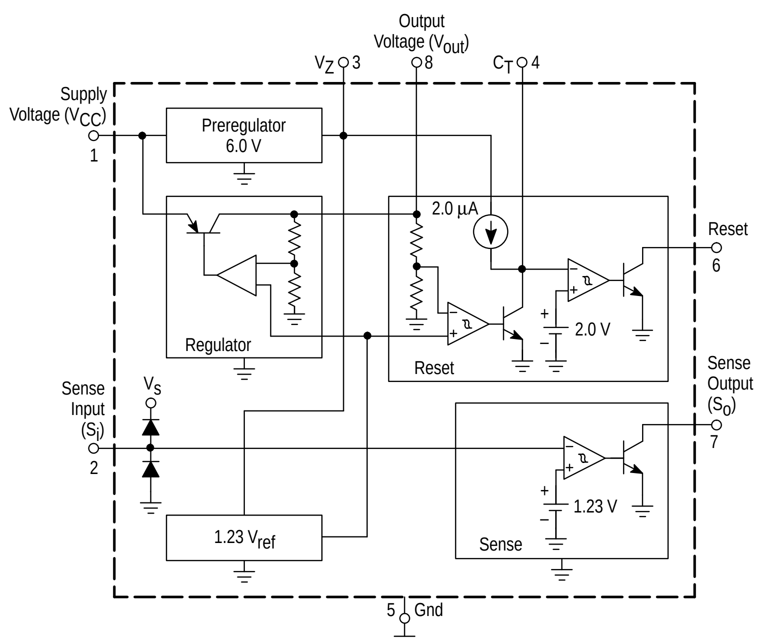
D SUFFIX
PLASTIC PACKAGE
CASE 751

PIN CONNECTIONS



(Top View)

Representative Block Diagram



ORDERING INFORMATION

Device	Operating Temperature Range	Package
L4949N	T_J = –40° to +125°C	DIP–8
L4949D		SO–8

This document contains information on a new product. Specifications and information herein are subject to change without notice.

ABSOLUTE MAXIMUM RATINGS (Absolute Maximum Ratings indicate limits beyond which damage to the device may occur.)

Rating	Symbol	Value	Unit
DC Operating Supply Voltage	V_{CC}	28	V
Transient Supply Voltage (t < 1.0 s)	$V_{CC\ TR}$	40	V
Output Current	I_{out}	Internally Limited	–
Output Voltage	V_{out}	20	V
Sense Input Current	I_{SI}	±1.0	mA
Sense Input Voltage	V_{SI}	V_{CC}	–
Output Voltages Reset Output Sense Output	 V_{Reset} V_{SO}	 20 20	V
Output Currents Reset Output Sense Output	 I_{Reset} I_{SO}	 5.0 5.0	mA
Preregulator Output Voltage	V_Z	7.0	V
Preregulator Output Current	I_Z	5.0	mA
ESD Protection at any pin Human Body Model Machine Model	 – –	 2000 400	V
Thermal Resistance, Junction–to–Air P Suffix, DIP–8 Plastic Package, Case 626 D Suffix, SO–8 Plastic Package, Case 751	$R_{\theta JA}$	 100 200	°C/W
Maximim Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{stg}	–65 to +150	°C

NOTE: ESD data available upon request.

ELECTRICAL CHARACTERISTICS (V_{CC} = 14 V, –40°C < T_J < 125°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit
Output Voltage (T_J = 25°C, I_{out} = 1.0 mA)	V_{out}	4.95	5.0	5.05	V
Output Voltage (6.0 V < V_{CC} < 28 V, 1.0 mA < I_{out} < 50 mA)	V_{out}	4.9	5.0	5.1	V
Output Voltage (V_{CC} = 35 V, t < 1.0 s, 1.0 mA < I_{out} < 50 mA)	V_{out}	4.9	5.0	5.1	V
Dropout Voltage I_{out} = 10 mA I_{out} = 50 mA I_{out} = 100 mA	V_{drop}	 – – –	 0.1 0.2 0.3	 0.25 0.40 0.50	V
Input to Output Voltage Difference in Undervoltage Condition (V_{CC} = 4.0 V, I_{out} = 35 mA)	V_{IO}	–	0.2	0.4	V
Line Regulation (6.0 V < V_{CC} < 28 V, I_{out} = 1.0 mA)	Reg_{line}	–	1.0	20	mV
Load Regulation (1.0 mA < I_{out} < 100 mA)	Reg_{load}	–	8.0	30	mV
Current Limit V_{out} = 4.5 V V_{out} = 0 V	I_{Lim}	 105 –	 200 100	 400 –	mA
Quiescent Current (I_{out} = 0.3 mA, T_J < 100°C)	I_{QSE}	–	150	260	µA
Quiescent Current (I_{out} = 100 mA)	I_Q	–	–	5.0	mA

ELECTRICAL CHARACTERISTICS (continued) (V_{CC} = 14 V, –40°C < T_J < 125°C, unless otherwise specified.)

Characteristic	Symbol	Min	Typ	Max	Unit
RESET					
Reset Threshold Voltage	V_{Resth}	–	V_{out} – 0.5	–	V
Reset Threshold Hysteresis @ T_J = 25°C @ T_J = –40 to +125°C	$V_{Resth,hys}$	 50 50	 100 –	 200 300	mV
Reset Pulse Delay (C_T = 100 nF, t_R ≥ 100 µs)	t_{ResD}	55	100	180	ms
Reset Reaction Time (C_T = 100 nF)	t_{ResR}	–	5.0	30	µs
Reset Output Low Voltage (R_{Reset} = 10 kΩ to V_{out}, V_{CC} ≥ 3.0 V)	V_{ResL}	–	–	0.4	V
Reset Output High Leakage Current (V_{Reset} = 5.0 V)	I_{ResH}	–	–	1.0	µA
Delay Comparator Threshold	V_{CTth}	–	2.0	–	V
Delay Comparator Threshold Hysteresis	$V_{CTth, hys}$	–	100	–	mV
SENSE					
Sense Low Threshold (V_{SI} Decreasing = 1.5 V to 1.0 V)	V_{SOth}	1.16	1.23	1.35	V
Sense Threshold Hysteresis	$V_{SOth,hys}$	20	100	200	mV
Sense Output Low Voltage (V_{SI} ≤ 1.16 V, V_{CC} ≥ 3.0 V, R_{SO} = 10 kΩ to V_{out})	V_{SOL}	–	–	0.4	V
Sense Output Leakage (V_{SO} = 5.0 V, V_{SI} ≥ 1.5 V)	I_{SOH}	–	–	1.0	µA
Sense Input Current	I_{SI}	–1.0	0.1	1.0	µA
PREREGULATOR					
Preregulator Output Voltage (I_Z = 10 µA)	V_Z	–	6.3	–	V

PIN FUNCTION DESCRIPTION

Pin	Symbol	Description
1	V_{CC}	Supply Voltage
2	S_i	Input of Sense Comparator
3	V_Z	Output of Preregulator
4	C_T	Reset Delay Capacitor
5	Gnd	Ground
6	Reset	Output of Reset Comparator
7	S_O	Output of Sense Comparator
8	V_{out}	Main Regulator Output

TYPICAL CHARACTERIZATION CURVES

Figure 1. Output Voltage versus Junction Temperature

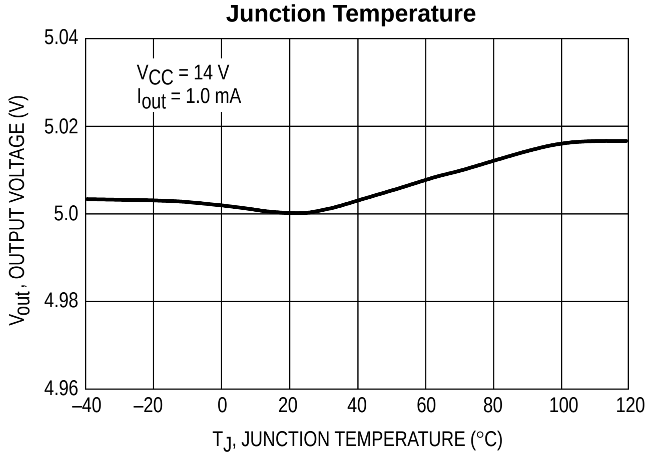
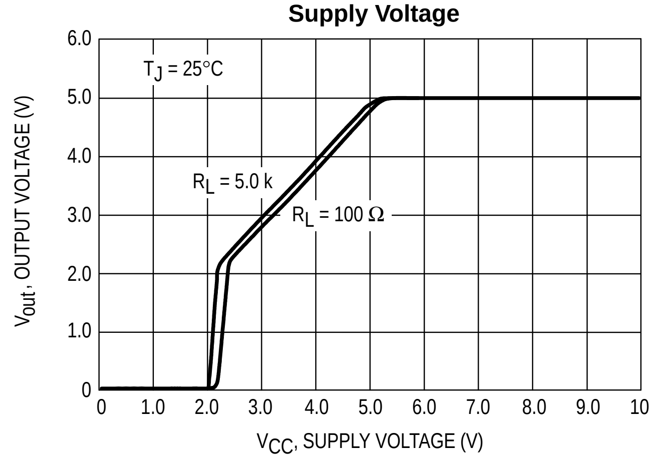


Figure 2. Output Voltage versus Supply Voltage



TYPICAL CHARACTERIZATION CURVES (continued)

Figure 3. Dropout Voltage versus Output Current

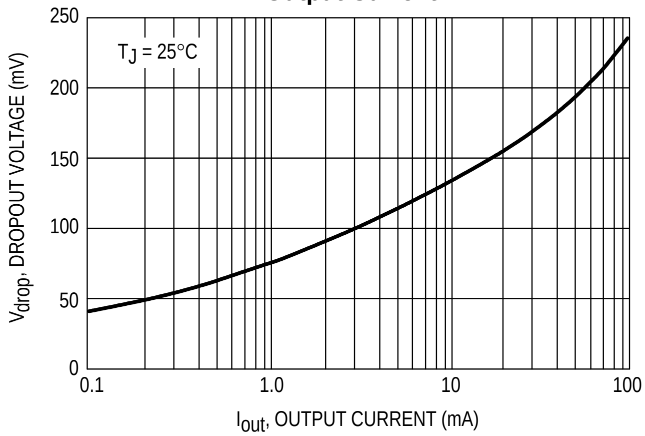


Figure 4. Dropout Voltage versus Junction Temperature

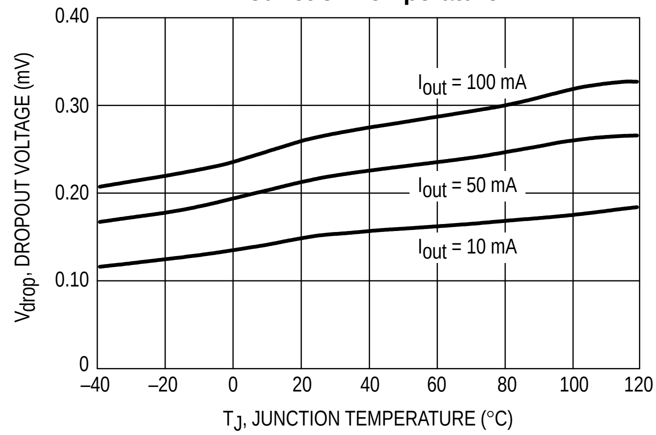


Figure 5. Quiescent Current versus Output Current

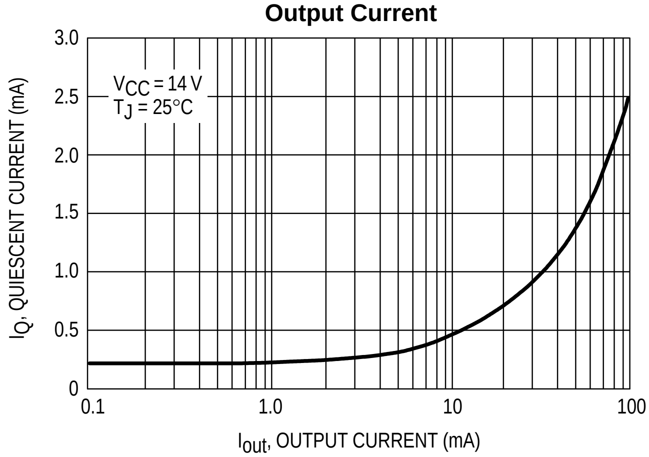


Figure 6. Quiescent Current versus Supply Voltage

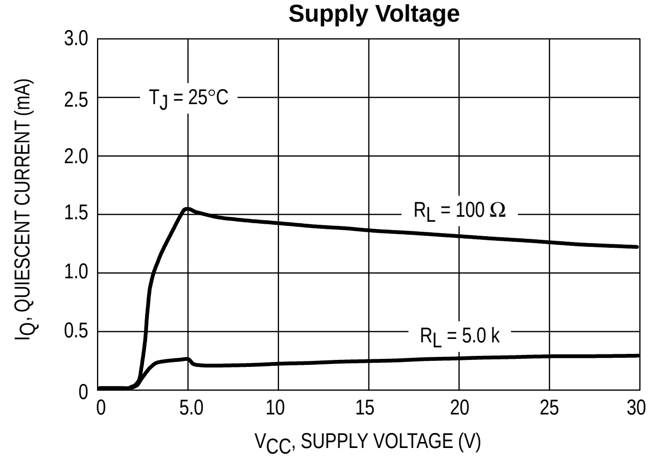


Figure 7. Reset Output versus Regulator Output Voltage

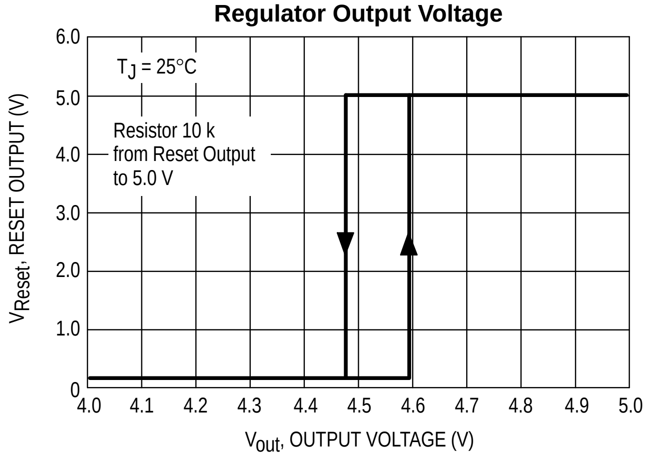
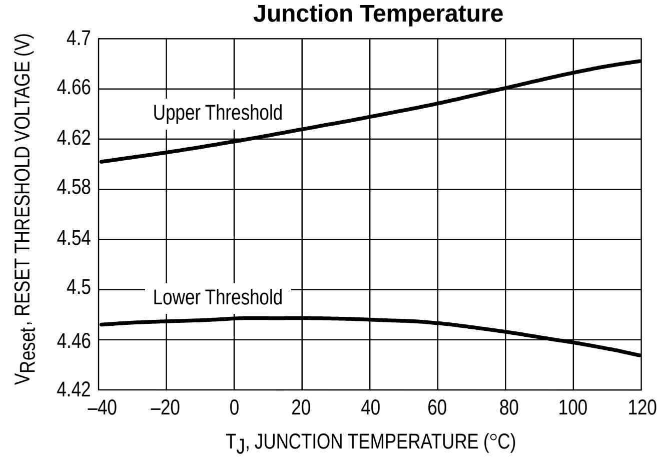


Figure 8. Reset Thresholds versus Junction Temperature



TYPICAL CHARACTERIZATION CURVES (continued)

Figure 9. Sense Output versus Sense Input Voltage

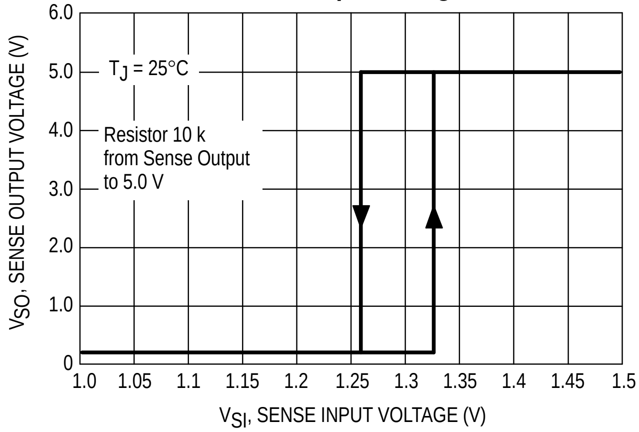
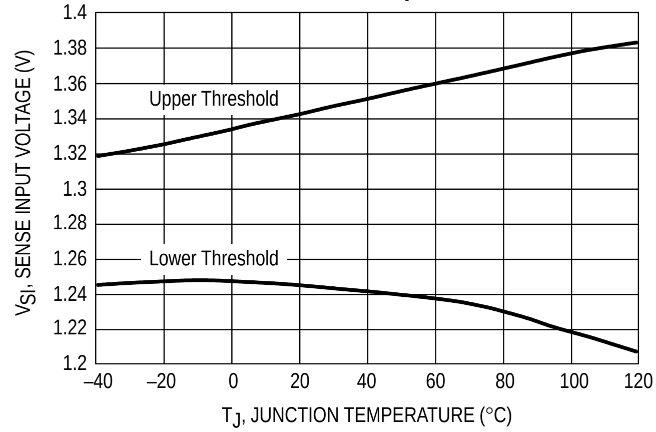


Figure 10. Sense Thresholds versus Junction Temperature

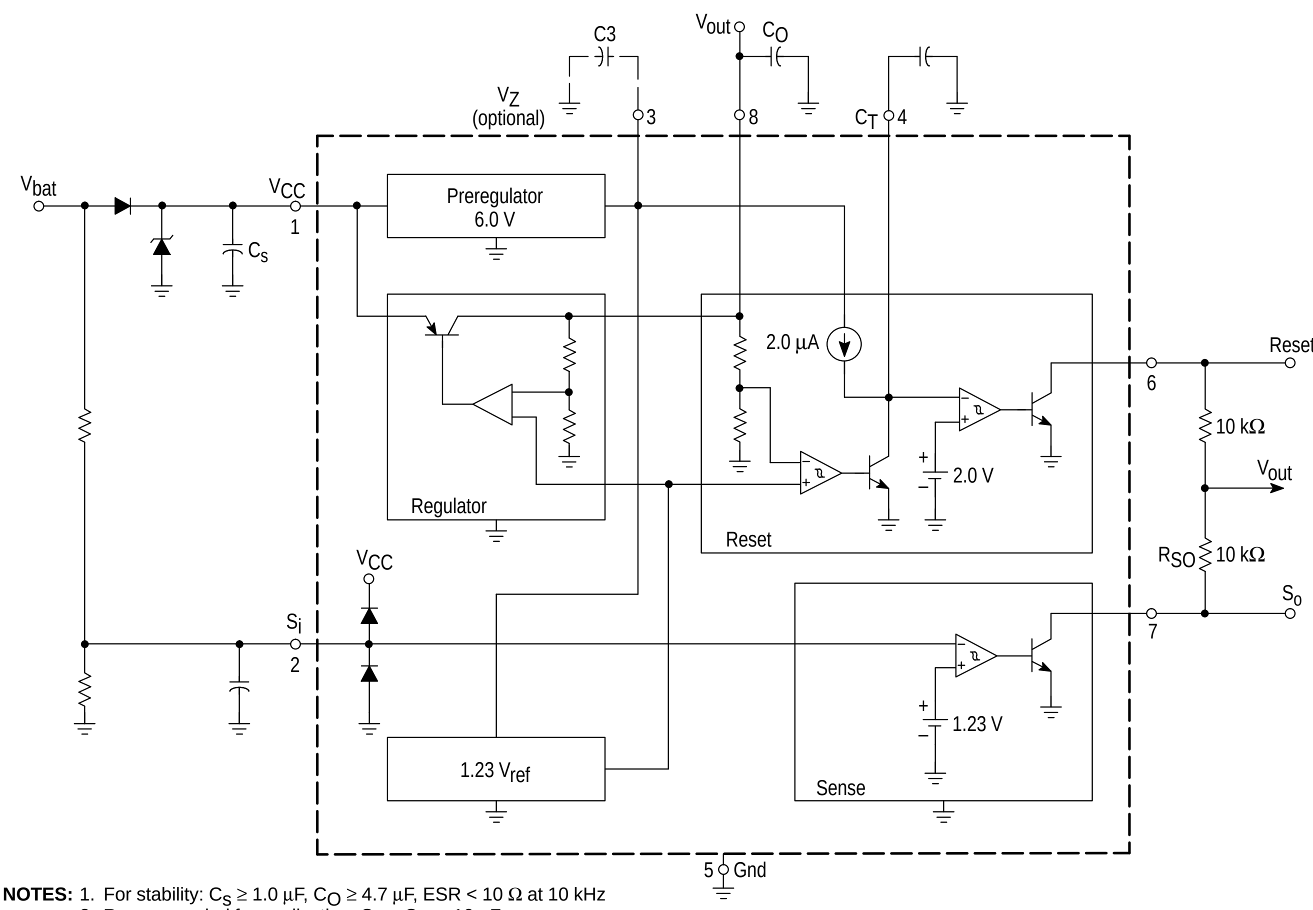


APPLICATION INFORMATION

Supply Voltage Transient

High supply voltage transients can cause a reset output signal perturbation. For supply voltages greater than 8.0 V the circuit shows a high immunity of the reset output against supply transients of more than 100 V/µs. For supply voltages less than 8.0 V supply transients of more than 0.4 V/µs can cause a reset signal perturbation. To improve the transient behavior for supply voltages less than 8.0 V a capacitor at Pin 3 can be used. A capacitor at Pin 3 (C3 ≤ 1.0 µF) reduces also the output noise.

Figure 11. Application Schematic



NOTES: 1. For stability: C_S ≥ 1.0 µF, C_O ≥ 4.7 µF, ESR < 10 Ω at 10 kHz
2. Recommended for application: C_S = C_O = 10 µF

OPERATING DESCRIPTION

The L4949 is a monolithic integrated low dropout voltage regulator. Several outstanding features and auxiliary functions are implemented to meet the requirements of supplying microprocessor systems in automotive applications. Nevertheless, it is suitable also in other applications where the present functions are required. The modular approach of this device allows the use of other features and functions independently when required.

Voltage Regulator

The voltage regulator uses an isolated Collector Vertical PNP transistor as a regulating element. With this structure, very low dropout voltage at currents up to 100 mA is obtained. The dropout operation of the standby regulator is maintained down to 3.0 V input supply voltage. The output voltage is regulated up to the transient input supply voltage of 35 V. With this feature no functional interruption due to overvoltage pulses is generated.

The typical curve showing the standby output voltage as a function of the input supply voltage is shown in Figure 13.

The current consumption of the device (quiescent current) is less than 200 µA.

To reduce the quiescent current peak in the undervoltage region and to improve the transient response in this region, the dropout voltage is controlled. The quiescent current as a function of the supply input voltage is shown in Figure 14.

Short Circuit Protection:

The maximum output current is internally limited. In case of short circuit, the output current is foldback current limited as described in Figure 12.

Figure 12. Foldback Characteristic of V_{out}

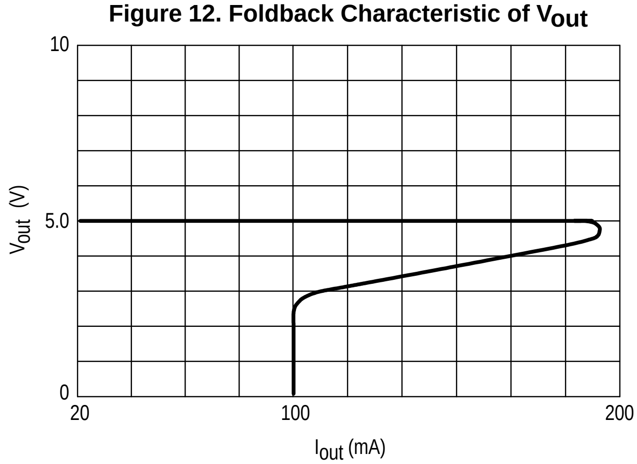


Figure 13. Output Voltage versus Supply Voltage

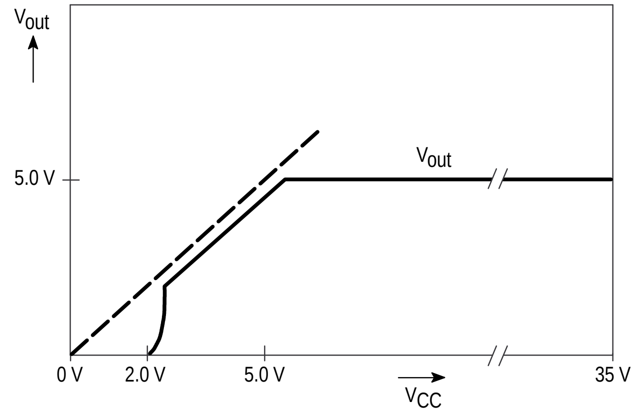
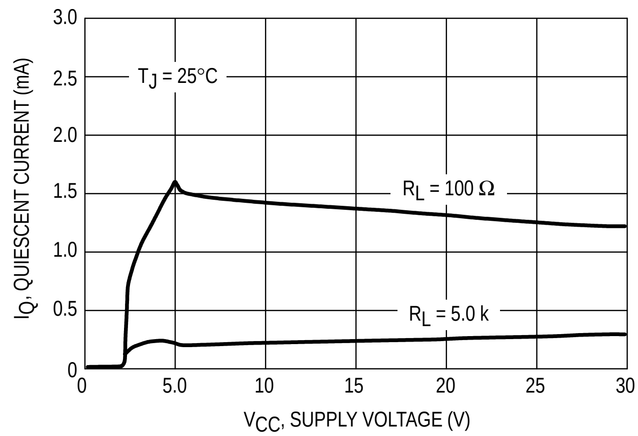


Figure 14. Quiescent Current versus Supply Voltage



Preregulator

To improve the transient immunity a preregulator stabilizes the internal supply voltage to 6.0 V. This internal voltage is present at Pin 3 (V_Z). This voltage should not be used as an output because the output capability is very small (≤ 100 µA).

This output may be used as an option when better transient behavior for supply voltages less than 8.0 V is required. In this case a capacitor (100 nF – 1.0 µF) must be connected between Pin 3 and Gnd. If this feature is not used Pin 3 must be left open.

Reset Circuit

The block circuit diagram of the reset circuit is shown in Figure 15.

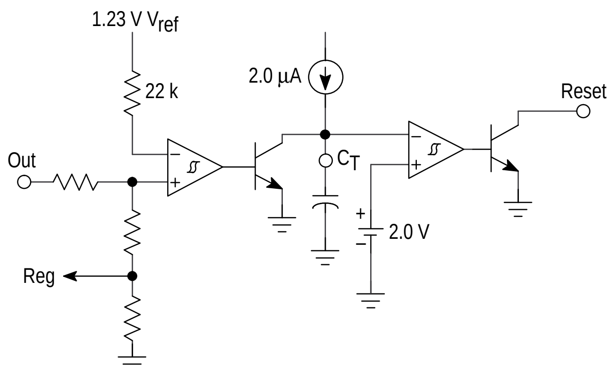
The reset circuit supervises the output voltage. The reset thereshold of 4.5 V is defined with the internal reference voltage and standby output drivider.

The reset pulse delay time t_{RD}, is defined with the charge time of an external capacitor C_T:

$$t_{RD} = \frac{C_T \times 2.0\ V}{2.0\ \mu A}$$

The reaction time of the reset circuit originates from the discharge time limitation of the reset capacitor C_T and is proportional to the value of C_T. The reaction time of the reset circuit increases the noise immunity.

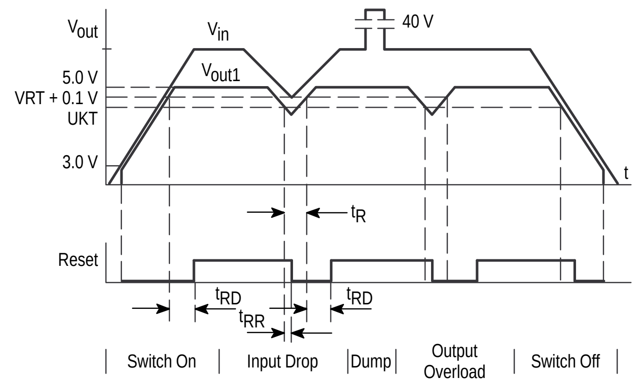
Figure 15. Reset Circuit



Standby output voltage drops below the reset threshold only a bit longer than the reaction time results in a shorter reset delay time.

The nominal reset delay time will be generated for standby output voltage drops longer than approximately 50 µs. The typical reset output waveforms are shown in Figure 16.

Figure 16. Typical Reset Output Waveforms



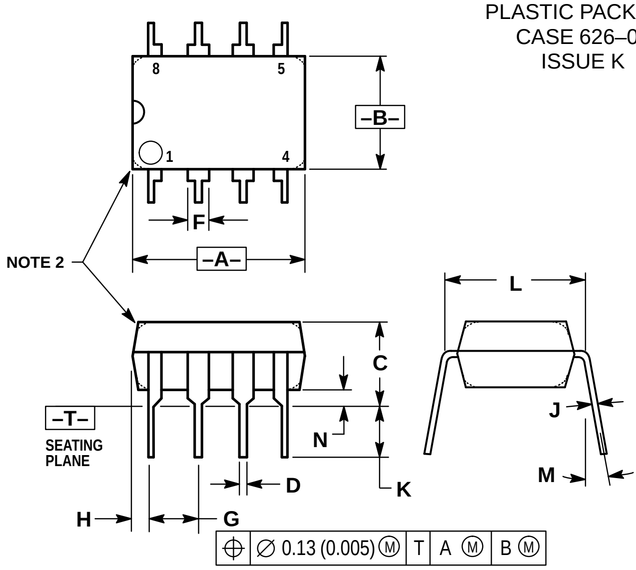
Sense Comparator

The sense comparator compares an input signal with an internal voltage reference of typical 1.23 V. The use of an external voltage divider makes this comparator very flexible in the application.

It can be used to supervise the input voltage either before or after the protection diode and to give additional information to the microprocessor like low voltage warnings.

OUTLINE DIMENSIONS

N SUFFIX
PLASTIC PACKAGE
CASE 626–05
ISSUE K

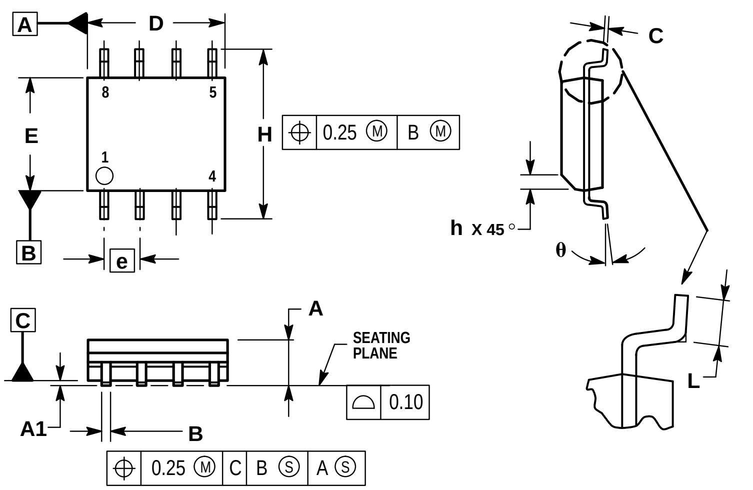


NOTES:
1. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
2. PACKAGE CONTOUR OPTIONAL (ROUND OR SQUARE CORNERS).
3. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.40	10.16	0.370	0.400
B	6.10	6.60	0.240	0.260
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.020
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	0.76	1.27	0.030	0.050
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	—	10°	—	10°
N	0.76	1.01	0.030	0.040

STYLE 1:
PIN 1. AC IN
2. DC + IN
3. DC – IN
4. AC IN
5. GROUND
6. OUTPUT
7. AUXILIARY
8. V_{CC}

D SUFFIX
PLASTIC PACKAGE
CASE 751–05
ISSUE S



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. DIMENSIONS ARE IN MILLIMETERS.
3. DIMENSION D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE MOLD PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 TOTAL IN EXCESS OF THE B DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS	
DIM	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.35	0.49
C	0.18	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.25
θ	0°	7°

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