

SOT-23, 44V, Over-the-Top, Micropower, Precision Rail-to-Rail Comparator

FEATURES

- Operates from 2.7V to 44V
- **Over-The-Top®**: Input Common Mode Range Extends 44V Above V^- , Independent of V^+
- Micropower: 35 μ A I_Q
- Offset Voltage: 1.5mV Max
- Valid Output with Either Input 5V Below V^-
- Rail-to-Rail Output Swing
- Output Can Drive Loads Above V^+
- Internal Pull-Up Current
- -40°C to 125°C Operating Temperature Range
- Low Profile (1mm) SOT-23 (ThinSOT™) Package

APPLICATIONS

- Power Supply Monitors
- Relay/Lamp Driver
- Oscillators
- Peak Detector
- Level Shifting

DESCRIPTION

The LT®1716 comparator operates on any total power supply voltage between 2.7V and 44V drawing 35 μ A of quiescent current. The LT1716 has a unique input stage that can be taken 44V above V^- , independent of V^+ supply. (Built-in resistors protect the inputs for faults below the negative supply of up to 5V.) The inputs can withstand 44V both differential and common mode.

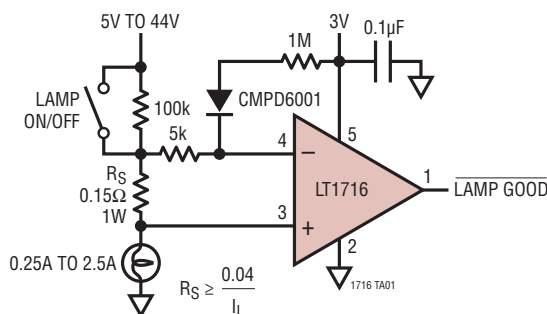
The output stage includes a class “B” pull-up current source, eliminating the need for an external resistive pull-up and saving power. Output voltage swings to within 35mV of the negative supply and 55mV of the positive supply, which makes the comparator a good choice for low voltage single supply operation. The output stage is also designed to drive loads connected to a higher supply than the LT1716 supply, the same as an open collector output stage.

The LT1716 is available in a SOT-23 5-lead package.

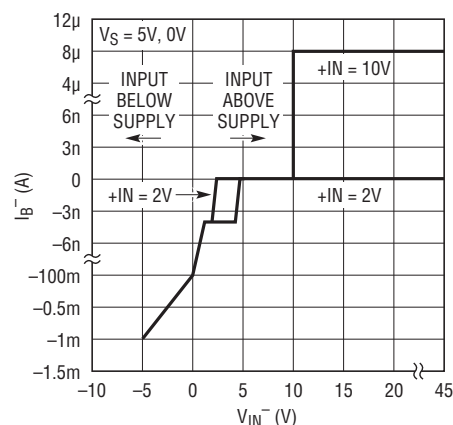
LT, LT, LTC, LTM, Over-The-Top, Linear Technology and the Linear logo are registered trademarks of Linear Technology Corporation. ThinSOT is a trademark of Linear Technology Corporation. All other trademarks are the property of their respective owners.

TYPICAL APPLICATION

Lamp Monitor



Input Bias Current vs Input Bias Voltage



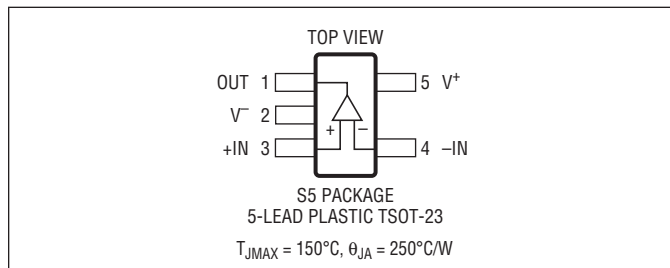
1716 TA02

ABSOLUTE MAXIMUM RATINGS

(Note 1)

Supply Voltage (V^+ to V^-)	44V
Differential Input Voltage	44V
Input Voltage	44V, -5V
Output Short-Circuit Duration (Note 2)	Indefinite
Operating Temperature Range (Note 3)	
LT1716C/LT1716I	-40°C to 85°C
LT1716H	-40°C to 125°C
Specified Temperature Range (Note 4)	
LT1716C/LT1716I	-40°C to 85°C
LT1716H	-40°C to 125°C
Maximum Junction Temperature	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 sec)	300°C

PIN CONFIGURATION



ORDER INFORMATION

LEAD FREE FINISH	TAPE AND REEL	PART MARKING*	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE
LT1716CS5#PBF	LT1716CS5#TRPBF	LTYP	5-Lead Plastic TSOT-23	-40°C to 85°C
LT1716IS5#PBF	LT1716IS5#TRPBF	LTYP	5-Lead Plastic TSOT-23	-40°C to 85°C
LT1716HS5#PBF	LT1716HS5#TRPBF	LTYP	5-Lead Plastic TSOT-23	-40°C to 125°C

Consult LTC Marketing for parts specified with wider operating temperature ranges. *The temperature grade is identified by a label on the shipping container. Consult LTC Marketing for information on non-standard lead based finish parts.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandreel/>

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range of $-40^\circ\text{C} \leq T_A \leq 85^\circ\text{C}$, otherwise specifications are at $T_A = 25^\circ\text{C}$. Single supply operation $V^+ = 5\text{V}$, $V^- = 0\text{V}$; $V_{CM} = V^+/2$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS	LTC1716C/LT1716I			UNITS
			MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	$0.5\text{V} < V_{CM} < (V_{CC} - 1\text{V})$		300	1600	μV
		$0^\circ\text{C} < T_A < 70^\circ\text{C}$			2100	μV
		$-40^\circ\text{C} < T_A < 85^\circ\text{C}$			2500	μV
	Input Offset Voltage Drift (Note 5)	$0^\circ\text{C} < T_A < 70^\circ\text{C}$		2		$\mu\text{V}/^\circ\text{C}$
		$-40^\circ\text{C} < T_A < 85^\circ\text{C}$		2		$\mu\text{V}/^\circ\text{C}$
I_{OS}	Input Offset Current	$V_{CM} = V^+/2$		3	15	nA
		$V_{CM} = 0\text{V}$			1.3	μA
		$V_{CM} = 44\text{V}$			0.9	μA
I_B	Input Bias Current	$V_{CM} = V^+/2$		20	50	nA
				35	75	nA
		$V^+ = 0\text{V}$, $V_{CM} = 44\text{V}$		2		nA
		$V_{CM} = 0\text{V}$		3	13	μA
		$V_{CM} = 44\text{V}$		6	9	μA
		$V_{CM} = -5\text{V}$		1	1.4	mA
	Input Voltage Range (Note 7)		0.5		44	V
CMRR	Common Mode Rejection Ratio	$0.5\text{V} \leq V_{CM} < (V^+ - 1\text{V})$	89	110		dB
		$0.5\text{V} \leq V_{CM} < 44\text{V}$ (Note 6)	81	110		dB

1716fa

ELECTRICAL CHARACTERISTICS The ● denotes the specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. Single supply operation $V^+ = 5\text{V}$, $V^- = 0\text{V}$; $V_{\text{CM}} = V^+/2$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LTC1716C/LT1716I			UNITS
				MIN	TYP	MAX	
PSRR	Power Supply Rejection Ratio	$V^- = 0\text{V}$, $V_{\text{CM}} = 1.5\text{V}$; $2.7\text{V} < V^+ < 36\text{V}$	●	95	110		dB
	Minimum Operating Supply Voltage		●		2.4	2.7	V
A_{VOL}	Large-Signal Voltage Gain	$R_L = 1\text{k}$; $1\text{V} < V_{\text{OUT}} < 4\text{V}$	●	200 100	500		V/mV V/mV
I_S	Supply Current	$V^+ = 3\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		35	50 65	μA μA
		$V^+ = 5\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		35	55 75	μA μA
		$V^+ = 12\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		40	60 85	μA μA
			●				
I_{SC}^-	Output Sink Current (Note 2)	$V_{\text{OVERDRIVE}} > 30\text{mV}$	●	10	20		mA
I_{SC}^+	Output Source Current	$V_{\text{OVERDRIVE}} = 5\text{mV}$, $V_{\text{OUT}} = 1\text{V}$	●	60	85		μA
V_{OL}	Output Voltage Swing Low (Referred to V^-)	$I_{\text{SINK}} = 0\text{mA}$, $V_{\text{OVERDRIVE}} = -10\text{mV}$	●		20	35	mV
		$I_{\text{SINK}} = 0.1\text{mA}$	●		75	110	mV
		$I_{\text{SINK}} = 1\text{mA}$	●		200	300	mV
		$I_{\text{SINK}} = 5\text{mA}$	●		550	900	mV
V_{OH}	Output Voltage Swing High (Referred to V^+)	$I_{\text{SOURCE}} = 0\mu\text{A}$, $V_{\text{OVERDRIVE}} = 10\text{mV}$	●		30	55	mV
		$I_{\text{SOURCE}} = 10\mu\text{A}$	●		130	185	mV
	Leakage Current	$V_{\text{OUT}} = 40\text{V}$, $V_{\text{OVERDRIVE}} > 100\text{mV}$	●		0.5	2	μA
	Propagation Delay	$V_{\text{OVERDRIVE}} > 100\text{mV}$, $R_{\text{LOAD}} = 10\text{k}$			3	5.5	μs

The ● denotes the specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. Split supply operation $V_S = \pm 15\text{V}$, $V_{\text{CM}} = 0\text{V}$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1716C/LT1716I			UNITS
				MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	$-14.5\text{V} < V_{\text{CM}} < 14\text{V}$	●		300	1500	μV
		$0^{\circ}\text{C} < T_A < 70^{\circ}\text{C}$	●			2000	μV
		$-40^{\circ}\text{C} < T_A < 85^{\circ}\text{C}$	●			2400	μV
	Input Offset Voltage Drift (Note 5)	$0^{\circ}\text{C} < T_A < 70^{\circ}\text{C}$	●		2		$\mu\text{V}/^{\circ}\text{C}$
		$-40^{\circ}\text{C} < T_A < 85^{\circ}\text{C}$	●		2		$\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current	$V_{\text{CM}} = 0\text{V}$	●		3	15	nA
		$V_{\text{CM}} = 29\text{V}$	●			0.9	μA
		$V_{\text{CM}} = -15\text{V}$	●			1.3	μA
I_B	Input Bias Current	$V_{\text{CM}} = 0\text{V}$	●		30 50	60 100	nA nA
		$V_{\text{CM}} = 29\text{V}$	●		6	9	μA
		$V_{\text{CM}} = -15\text{V}$	●		3	13	μA
		$V_{\text{CM}} = -20\text{V}$	●		1	1.4	mA
	Input Voltage Range (Note 7)		●	-14.5		14	V
CMRR	Common Mode Rejection Ratio	$-14.5\text{V} < V_{\text{CM}} < 14\text{V}$	●	92	110		dB
		$-14.5\text{V} < V_{\text{CM}} < 29\text{V}$ (Note 6)	●	81	98		dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 1.35\text{V}$ to $\pm 22\text{V}$	●	90	110		dB
	Minimum Operating Supply Voltage		●		2.4	2.7	V
A_{VOL}	Large-Signal Voltage Gain	$R_L = 6\text{k}$; $-14\text{V} < V_{\text{OUT}} < 14\text{V}$	●	500 400	1000		V/mV V/mV
I_S	Supply Current	$V_S = \pm 15\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		40	95	μA
I_{SC}^-	Output Sink Current (Note 2)	$V_{\text{OVERDRIVE}} > 30\text{mV}$	●	10	20		mA
I_{SC}^+	Output Source Current	$V_{\text{OVERDRIVE}} = 5\text{mV}$, $V_{\text{OUT}} = -14\text{V}$	●	70	105		μA

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} \leq T_A \leq 85^{\circ}\text{C}$, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. Split supply operation $V_S = \pm 15\text{V}$, $V_{CM} = 0\text{V}$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1716C/LT1716I			UNITS
				MIN	TYP	MAX	
V_{OL}	Output Voltage Swing Low (Referred to V^-)	$I_{SINK} = 0\text{mA}$, $V_{OVERDRIVE} = -10\text{mV}$	●		20	35	mV
		$I_{SINK} = 0.1\text{mA}$	●		75	110	mV
		$I_{SINK} = 1\text{mA}$	●		200	300	mV
		$I_{SINK} = 5\text{mA}$	●		550	900	mV
V_{OH}	Output Voltage Swing High (Referred to V^+)	$I_{SOURCE} = 0\mu\text{A}$, $V_{OVERDRIVE} = 10\text{mV}$	●		45	75	mV
		$I_{SOURCE} = 10\mu\text{A}$	●		140	210	mV
	Leakage Current	$V_{OUT} = 25\text{V}$, $V_{OVERDRIVE} > 100\text{mV}$	●		0.6	2	μA
	Propagation Delay	$V_{OVERDRIVE} > 100\text{mV}$, $R_{LOAD} = 10\text{k}$			5.5	9	μs

The ● denotes the specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} < T_A < 125^{\circ}\text{C}$, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. Single supply operation $V^+ = 5\text{V}$, $V^- = 0\text{V}$; $V_{CM} = V_{CC}/2$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1716H			UNITS
				MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	$0.5\text{V} < V_{CM} < (V_{CC} - 1\text{V})$	●		300	1600 2900	μV μV
	Input Offset Voltage Drift (Note 5)		●		2		$\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current	$V_{CM} = V^+/2$	●		3	220	nA
		$V_{CM} = 0\text{V}$	●			1.3	μA
		$V_{CM} = 44\text{V}$	●			0.9	μA
I_B	Input Bias Current	$V_{CM} = V^+/2$	●		20	50 900	nA nA
		$V^+ = 0\text{V}$, $V_{CM} = 44\text{V}$	●		2		nA
		$V_{CM} = 0\text{V}$	●		3	25	μA
		$V_{CM} = 44\text{V}$	●		6	14	μA
		$V_{CM} = -5\text{V}$	●		1	1.4	mA
	Input Voltage Range (Note 7)			0.5		44	V
CMRR	Common Mode Rejection Ratio	$0.5\text{V} < V_{CM} < (V^+ - 1\text{V})$	●	75	110		dB
		$0.5\text{V} < V_{CM} < 44\text{V}$ (Note 6)	●	72	110		dB
PSRR	Power Supply Rejection Ratio	$V^- = 0\text{V}$, $V_{CM} = 1.5\text{V}$, $2.7\text{V} < V^+ < 36\text{V}$	●	85	110		dB
	Minimum Operating Supply Voltage		●		2.4	2.7	V
A_{VOL}	Large-Signal Voltage Gain	$R_L = 1\text{k}$, $1\text{V} < V_{OUT} < 4\text{V}$	●	200	500		V/mV
		$R_L = 6\text{k}$	●	20			V/mV
I_S	Supply Current per Amplifier	$V^+ = 3\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		35	50 70	μA μA
		$V^+ = 5\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		35	55 75	μA μA
		$V^+ = 12\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$	●		40	60 85	μA μA
			●				
I_{SC}^-	Output Sink Current (Note 2)	$V_{OVERDRIVE} > 30\text{mV}$	●	5	10		mA
I_{SC}^+	Output Source Current	$V_{OVERDRIVE} = 5\text{mV}$, $V_{OUT} = 1\text{V}$	●	60	110		μA
V_{OL}	Output Voltage Swing Low (Referred to V^-)	$I_{SINK} = 0\text{mA}$, $V_{OVERDRIVE} = -10\text{mV}$	●		20	60	mV
		$I_{SINK} = 0.1\text{mA}$	●		75	170	mV
		$I_{SINK} = 1\text{mA}$	●		200	480	mV
		$I_{SINK} = 5\text{mA}$	●		550	1200	mV
V_{OH}	Output Voltage Swing High (Referred to V^+)	$I_{SOURCE} = 0\mu\text{A}$, $V_{OVERDRIVE} = -10\text{mV}$	●		50	110	mV
		$I_{SOURCE} = 10\mu\text{A}$	●		130	220	mV
	Leakage Current	$V_{OUT} = 40\text{V}$, $V_{OVERDRIVE} > 100\text{mV}$	●		1.7	5	μA
	Propagation Delay	$V_{OVERDRIVE} > 100\text{mV}$, $R_{LOAD} = 10\text{k}$			6	9	μs

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range of $-40^{\circ}\text{C} < T_A < 125^{\circ}\text{C}$, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. Split supply operation $V_S = \pm 15\text{V}$, $V_{CM} = 0\text{V}$ unless otherwise noted. (Note 4)

SYMBOL	PARAMETER	CONDITIONS		LT1716H			UNITS
				MIN	TYP	MAX	
V_{OS}	Input Offset Voltage	$-14.5\text{V} < V_{CM} < 14\text{V}$	●		300	1500 2900	μV μV
	Input Offset Voltage Drift (Note 5)		●		2		$\mu\text{V}/^{\circ}\text{C}$
I_{OS}	Input Offset Current	$V_{CM} = 0\text{V}$ $V_{CM} = 29\text{V}$ $V_{CM} = -15\text{V}$	● ● ●		3	280 0.9 1.3	nA μA μA
I_B	Input Bias Current	$V_{CM} = 0\text{V}$	●		30 50	60 1400	nA nA
		$V_{CM} = 29\text{V}$ $V_{CM} = -15\text{V}$ $V_{CM} = -20\text{V}$	● ● ●		6 3 1	20 30 1.4	μA μA mA
	Input Voltage Range (Note 7)		●	-14.5		14	V
CMRR	Common Mode Rejection Ratio	$-14.5\text{V} < V_{CM} < 14\text{V}$ $-14.5\text{V} < V_{CM} < 29\text{V}$ (Note 6)	● ●	85 70	110 93		dB dB
PSRR	Power Supply Rejection Ratio	$V_S = \pm 1.35\text{V}$ to $\pm 22\text{V}$	●	80	110		dB
	Minimum Operating Supply Voltage		●		2.4	2.7	V
A_{VOL}	Large-Signal Voltage Gain	$R_L = 6\text{k}; -14\text{V} < V_{OUT} < 14\text{V}$ $R_L = 6\text{k}; -13\text{V} < V_{OUT} < 13\text{V}$	●	500 50	1000		V/mV V/mV
I_S	Supply Current	$V_S = \pm 15\text{V}$, $R_L = \text{Open}$, $V_O = \text{High}$			40	95	μA
I_{SC}^-	Output Sink Current (Note 2)	$V_{OVERDRIVE} > 30\text{mV}$	●	5	10		mA
I_{SC}^+	Output Source Current	$V_{OVERDRIVE} = 5\text{mV}$, $V_{OUT} = -14\text{V}$	●	70	155		μA
V_{OL}	Output Voltage Swing Low (Referred to V^-)	$I_{SINK} = 0\text{mA}$, $V_{OVERDRIVE} = -10\text{mV}$ $I_{SINK} = 0.1\text{mA}$ $I_{SINK} = 1\text{mA}$ $I_{SINK} = 5\text{mA}$	● ● ● ●		20 75 200 550	70 170 480 1200	mV mV mV mV
V_{OH}	Output Voltage Swing High (Referred to V^+)	$I_{SOURCE} = 0\mu\text{A}$, $V_{OVERDRIVE} = 10\text{mV}$ $I_{SOURCE} = 10\mu\text{A}$	● ●		45 140	120 250	mV mV
	Leakage Current	$V_{OUT} = 25\text{V}$, $V_{OVERDRIVE} > 100\text{mV}$	●		1.5	5	μA
	Propagation Delay	$V_{OVERDRIVE} > 100\text{mV}$, $R_{LOAD} = 10\text{k}$			5.5	10	μs

Note 1: Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

Note 2: A heat sink may be required to keep the junction temperature below absolute maximum.

Note 3: The LT1716C/LT1716I are guaranteed functional over the operating temperature range of -40°C to 85°C . The LT1716H is guaranteed functional over the operating temperature range of -40°C to 125°C .

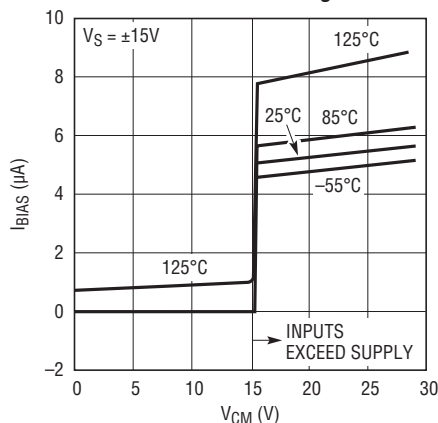
Note 4: The LT1716C is guaranteed to meet specified performance from 0°C to 70°C . The LT1716C is designed, characterized and expected to meet performance from -40°C to 85° but is not tested or QA sampled at the temperatures. The LT1716I is guaranteed to meet specified performance from -40°C to 85°C . The LT1716H is guaranteed to meet specified performance from -40°C to 125°C .

Note 5: This parameter is not 100% tested.

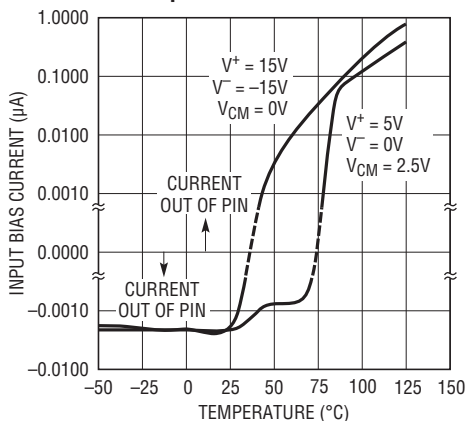
Note 6: Typical input offset voltage of $500\mu\text{V}$ at $V_{CM} = 44\text{V}$ above V^- and a maximum input offset voltage of 4mV at $V_{CM} = 44\text{V}$ above V^- .

Note 7: If one input is within this input range, the other input can go 5V below V^- and the output will be valid.

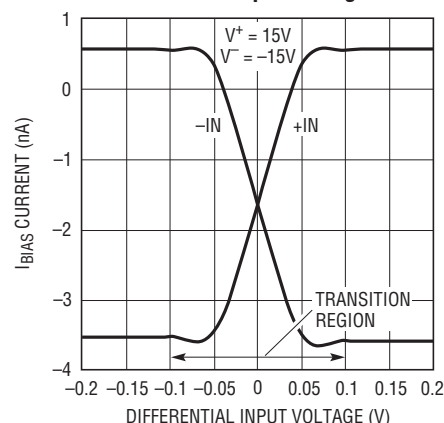
TYPICAL PERFORMANCE CHARACTERISTICS

Input Bias Current
vs Common Mode Voltage

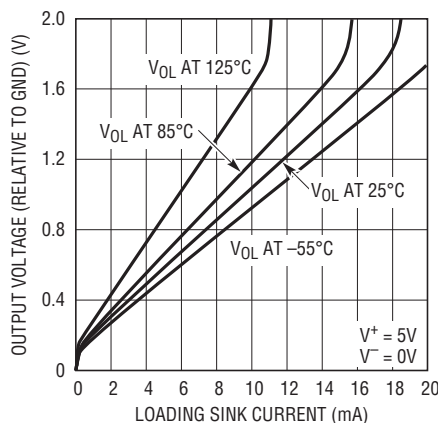
1716 G01

Input Bias Current
vs Temperature

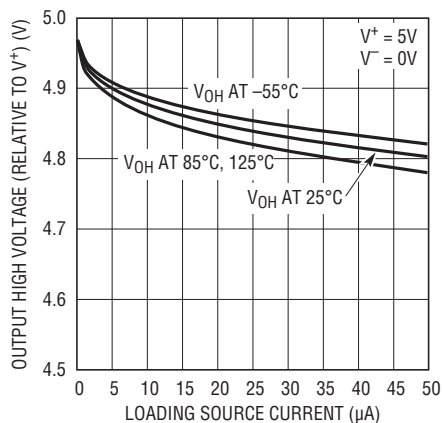
1716 G02

Input Bias Current
vs Differential Input Voltage

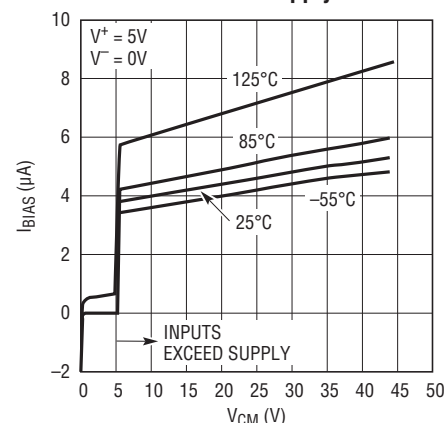
1716 G03

Output Low Voltage
vs Sink Current

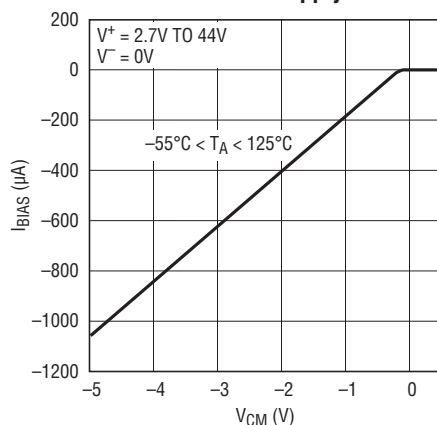
1716 G04

Output High Voltage
vs Source Current

1716 G05

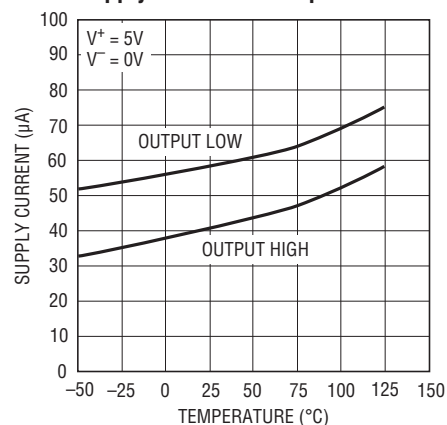
Input Bias Current with Inputs
Driven Above the Supply

1716 G06

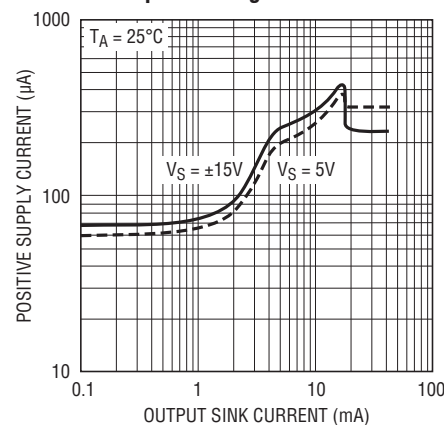
Input Bias Current with Inputs
Driven Below the Supply

1716 G07

Supply Current vs Temperature



1716 G08

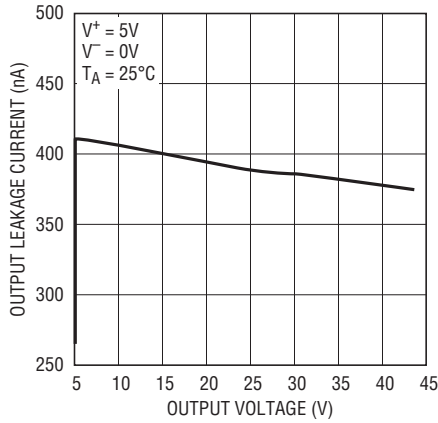
Positive Supply Current
vs Output Sinking Current

1716 G09

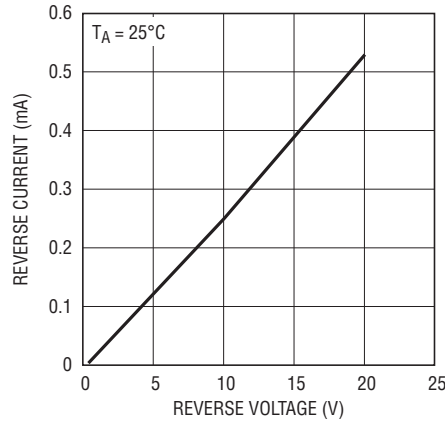
1716fa

TYPICAL PERFORMANCE CHARACTERISTICS

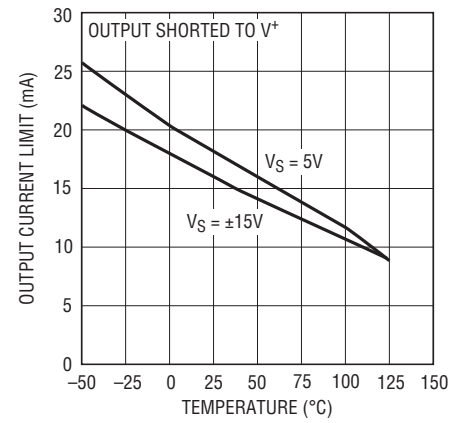
Output Leakage Current vs Output Voltage



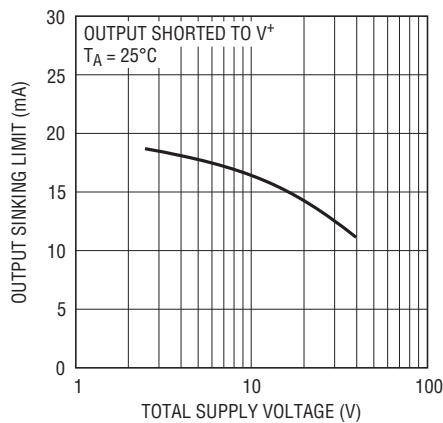
Reverse Supply Current



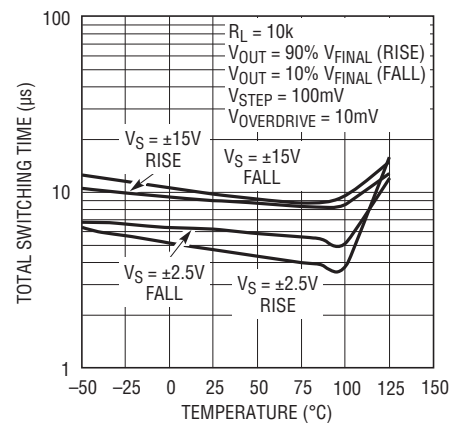
Output Sinking Current Limit vs Temperature



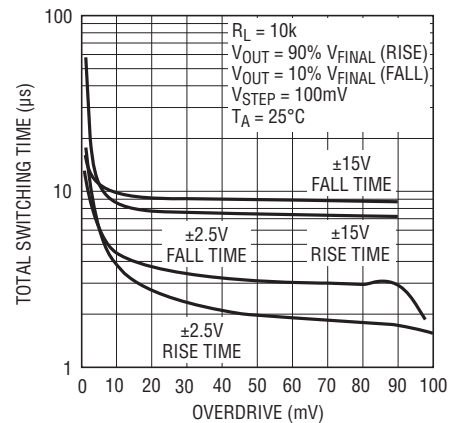
Output Sinking Current vs Total Supply Voltage



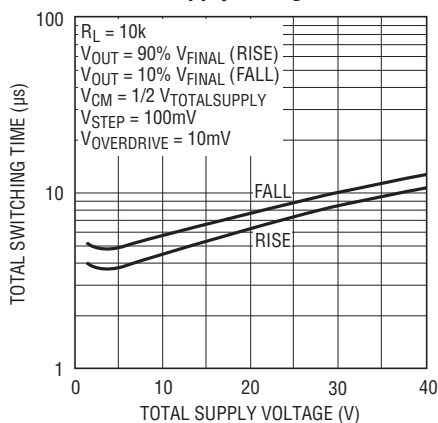
Total Switching Time vs Temperature



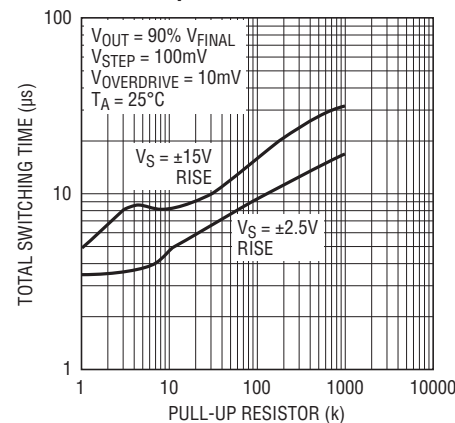
Total Switching Time vs Overdrive



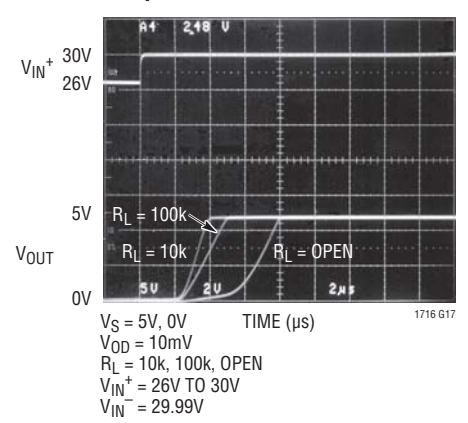
Total Switching Time vs Total Supply Voltage



Total Switching Time vs Pull-Up Resistor

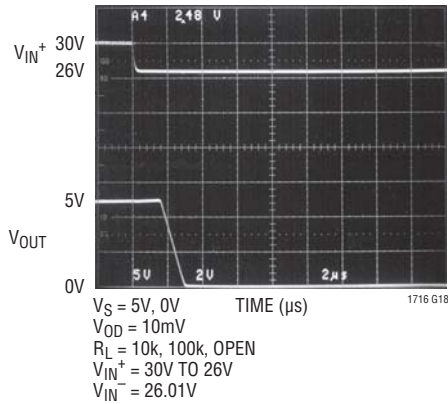


Response Time

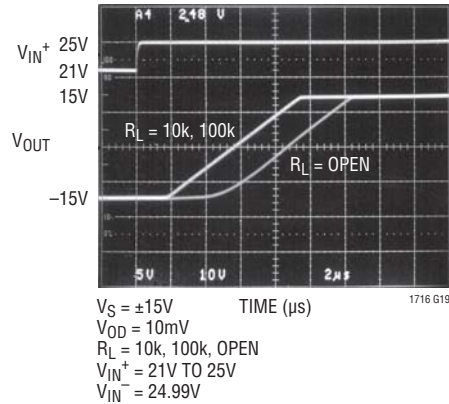


TYPICAL PERFORMANCE CHARACTERISTICS

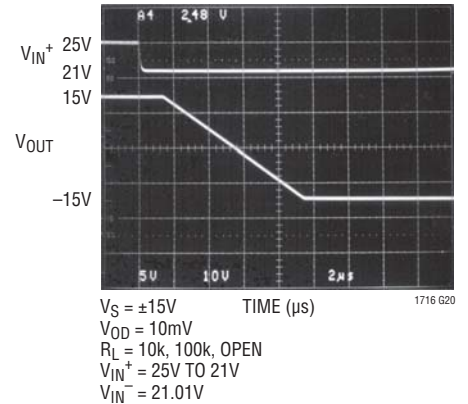
Response Time



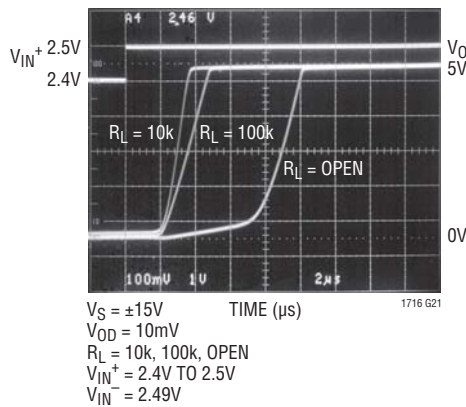
Response Time



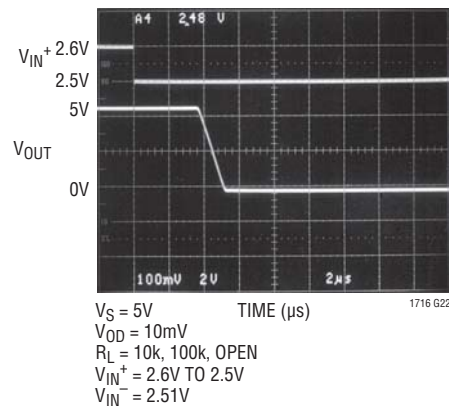
Response Time



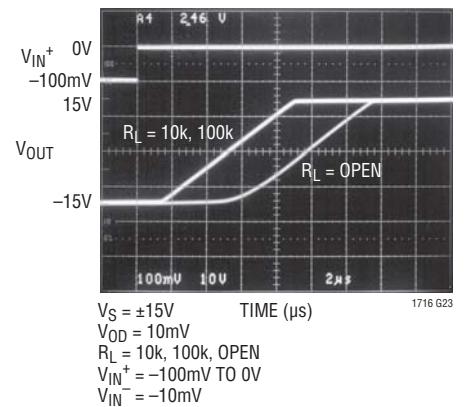
Response Time



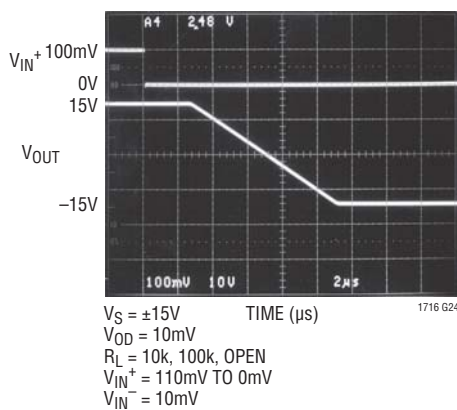
Response Time



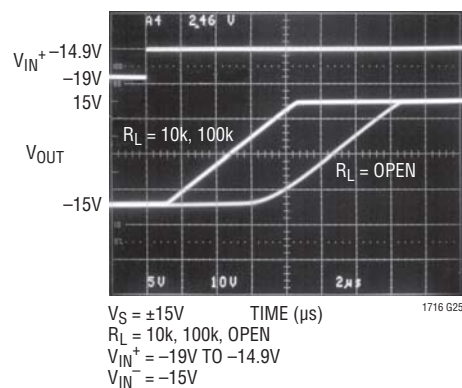
Response Time



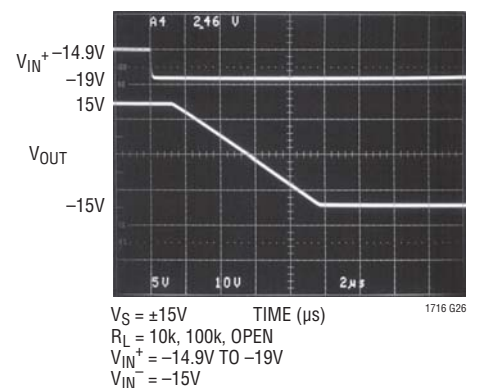
Response Time



Below V_S^- Fault (Rising)



Below V_S^- Fault (Falling)



APPLICATIONS INFORMATION

The LT1716 comparator features low power operation with exceptional input precision with rail-to-rail input and output swing. The comparator operates flawlessly even when the inputs are pulled over the positive rail or below the negative rail.

Supply Voltage

The LT1716 operates from 2.7V to 44V. The comparator can be shut down by removing V^+ . In this condition, the input bias current is typically less than 3nA, even if the inputs are 44V above the negative supply. The LT1716 is protected against reverse battery voltages of up to 20V. The reverse battery current is resistive as shown in the Reverse Supply Current graph.

Inputs

The comparator inputs can swing from 0.5V above to 44V above V^- . If one input is within this range, the other input can be forced up to 5V below V^- without phase reversal occurring at the output.

The LT1716 has three stages—NPN, PNP and common base (see Simplified Schematic)—resulting in three distinct operating regions and two transition regions as shown in the Input Bias Current vs Common Mode typical performance curve.

For input voltages about 0.8V or more below V^+ , the PNP input stage is active and the input bias current is typically -4nA . The PNP differential input stage will have bias current that flows out of the device. With a differential input voltage of even just 100mV or so, there will be zero bias current into the higher of the two inputs, while the current flowing out of the lower input will be twice the measured bias current.

When the input voltage is about 0.5V or less from V^+ , the NPN state is operating and the input bias current is typically 10nA. Increases in temperature will cause the voltage at which operation switches from the PNP stage to the NPN stage to move towards V^+ . The input offset voltage of the NPN stage is untrimmed and is typically 500 μV .

A Schottky diode in the collector of each NPN transistor of the NPN input stage allows the LT1716 to operate with either or both of its inputs above V^+ . At about 0.3V above V^+ , the NPN transistor is fully saturated and the input bias current is typically 4 μA at room temperature. The input offset voltage is typically 500 μV when operating above V^+ . The LT1716 will operate with its input 44V above V^- , regardless of V^+ .

The transition to the negative common mode input stage occurs at 0.3V above V^- . Above this trip point the PNP stage is active. When the inputs are 0.3V below V^- , the common base input stage is active in addition to the PNP stage. The input bias current out of each input becomes $V_{IN}/5\text{k}\Omega$. The LT1716 is designed to operate when either input falls below the negative supply. Internal resistors protect the inputs for faults below the negative supply of up to 5V without phase reversal. The built-in 5k resistor limits the current at each input to 1mA at 5V below the negative supply. External matched input resistors can be added for increased voltage fault operation below the negative supply but the maximum input current should be kept under 1mA.

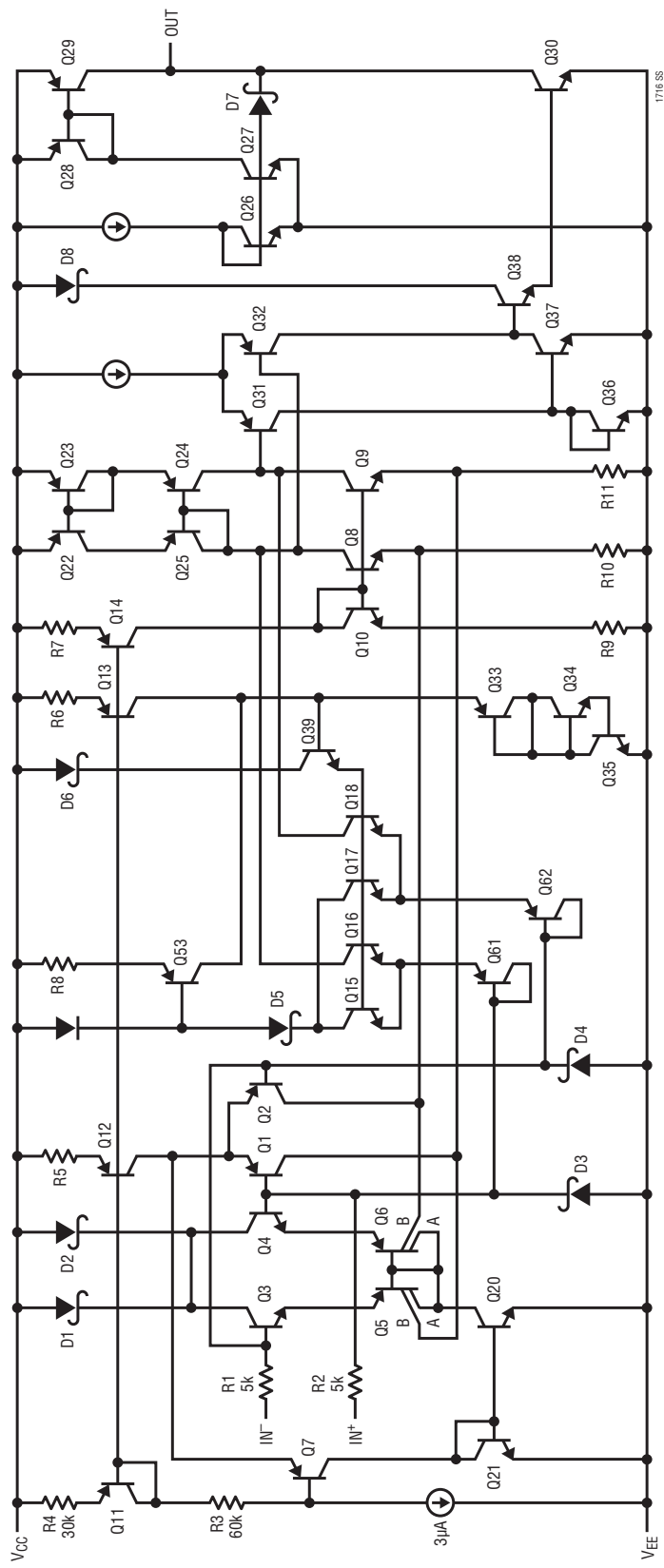
Input Protection

The inverting and noninverting input pins of the LT1716 have on-chip protection. ESD protection is provided to prevent damage during handling. The input transistors have voltage clamping and limiting resistors to protect against excursions as much as 5V below V^- . There are no clamping diodes between the inputs and the maximum differential input voltage is 44V.

Output

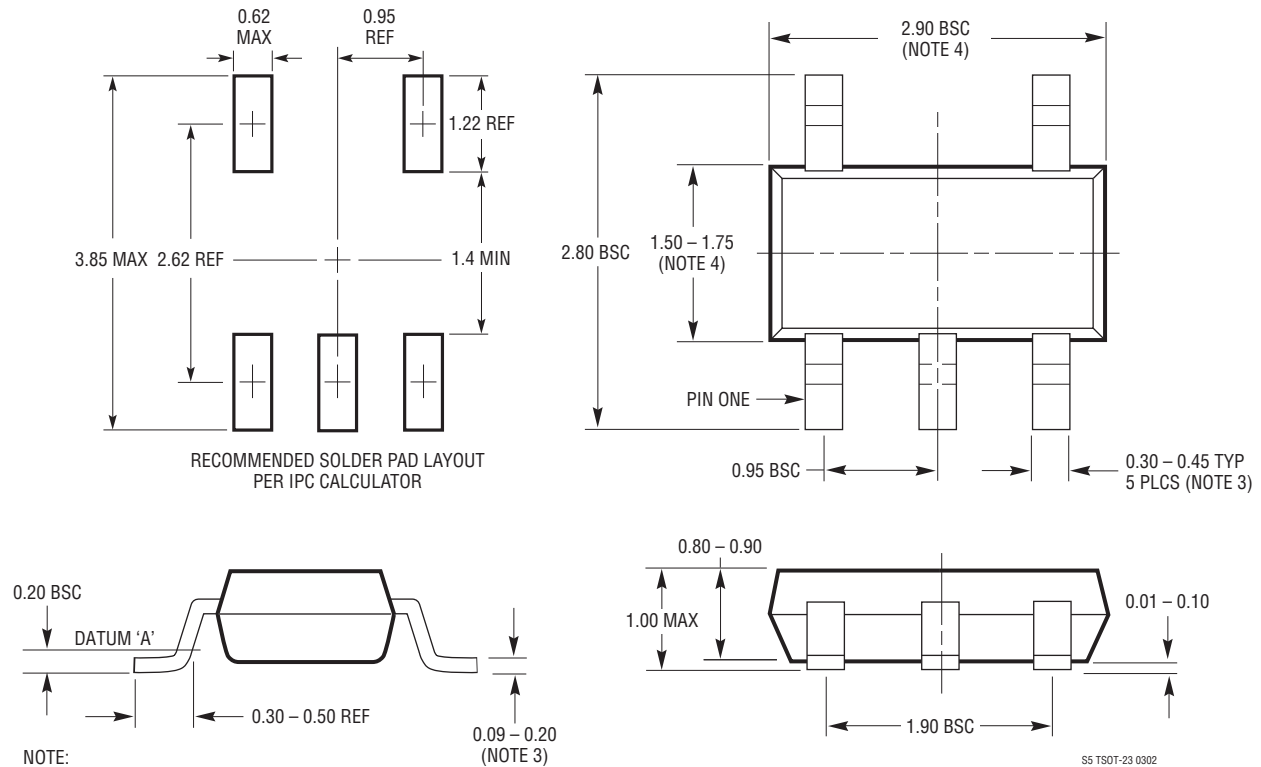
The output stage of the LT1716 can drive loads connected to a supply more positive than the device, the same as comparators with open collector output stages. The output of the LT1716 can be pulled up to 44V above V^- , regardless of V^+ .

SIMPLIFIED SCHEMATIC



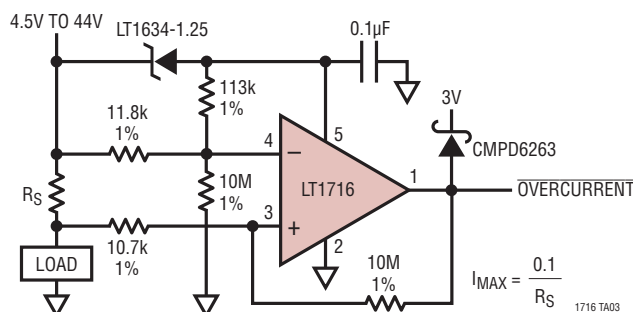
PACKAGE DESCRIPTION

S5 Package 5-Lead Plastic TSOT-23 (Reference LTC DWG # 05-08-1635)

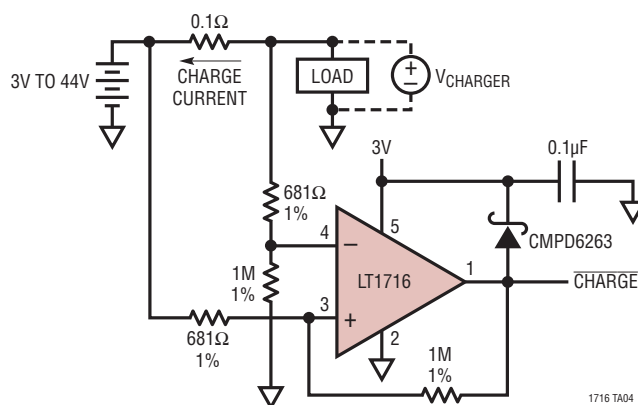


TYPICAL APPLICATIONS

Overcurrent Flag



Charge/Discharge Indicator



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC1442	Dual Micropower Comparator and 1% Reference	1.182V ±1% Reference, ±10mV _{MAX} Input Offset
LTC1540	Nanopower Comparator and 1% Reference	1.182V ±1% Reference, ±10mV _{MAX} Input Offset
LT1634	Micropower Precision Shunt Reference	0.05%, 10μA, 10ppm/°C Max Drift, 1.25V, 2.5V, 4.096V, 5V, MSOP, SO-8, TO-92 Packages
LTC1921	Dual -48V Telecom Supply Monitor	Monitors Two Supplies and Fuses
LTC1998	Micropower Li-Ion Battery Monitor	1% Trip Point Adjustable from 2.5V to 3.25V