



# LT1017/LT1018

## Micropower Dual Comparator

### FEATURES

- Maximum Offset Voltage: 1mV
- Maximum Bias Current: 15nA
- Typical Output Drive: 70mA
- Operates from 1.1V to 40V
- Internal Pull-Up Current
- Output Can Drive Loads Above V+
- 30µA Supply Current (LT1017)
- 110µA Supply Current (LT1018)

### APPLICATIONS

- Power Supply Monitors
- Relay Driving
- Oscillators

### DESCRIPTION

The LT<sup>®</sup>1017/LT1018 are general purpose micropower comparators. The LT1017 is optimized for lowest operating power while the LT1018 operates at higher power and higher speed. Both devices can operate from a single 1.1V cell up to 40V. The output stage includes a class “B” pull-up current source, eliminating the need for an external resistive pull-up and saving power. The output stage is also designed to allow driving loads connected to a supply more positive than the device, as can comparators with open-collector output stages.

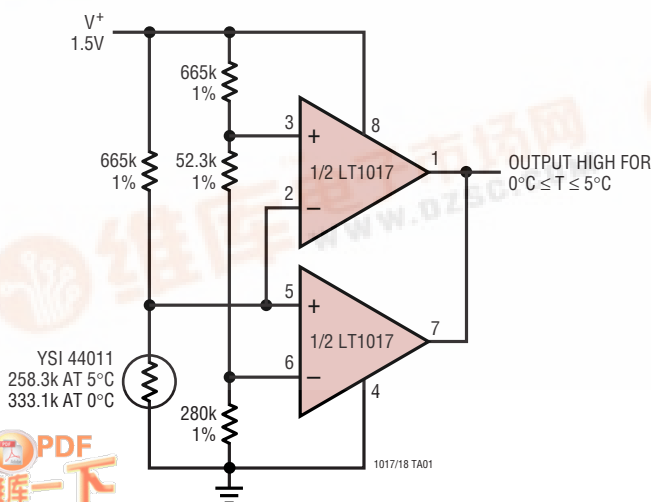
Input specifications are also excellent. On-chip trimming minimizes offset voltage, while high gain and common mode rejection ratio keep other input referred errors low. Common mode voltage range includes ground. Special circuitry prevents false output states even if the input is overdriven.

The LT1017/LT1018 are pin compatible with older dual comparators such as 393 type devices.

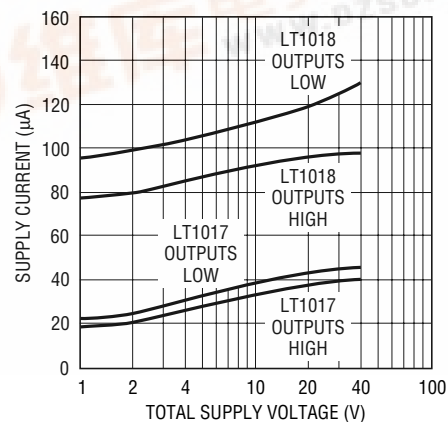
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### TYPICAL APPLICATION

1.5V Powered Refrigerator Alarm



Supply Current

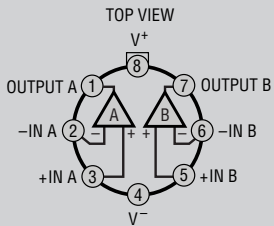
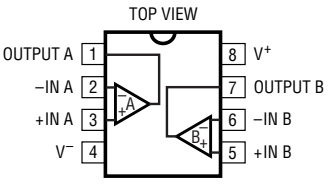
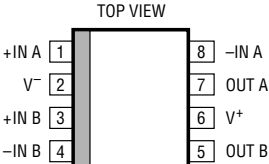
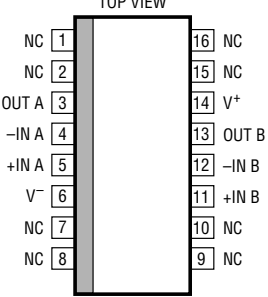


# LT1017/LT1018

## ABSOLUTE MAXIMUM RATINGS (Note 1)

|                                  |                |  |                |
|----------------------------------|----------------|--|----------------|
| Supply Voltage .....             | 40V            | Operating Temperature Range                |                |
| Differential Input Voltage ..... | 40V            | LT1017M/LT1018M .....                      | -55°C to 125°C |
| Input Voltage .....              | -0.3V to 40V   | LT1017C/LT1018C .....                      | 0°C to 70°C    |
| Short-Circuit Duration .....     | Indefinite     | LT1017I .....                              | -40°C to 85°C  |
| Storage Temperature Range .....  | -65°C to 150°C | Lead Temperature (Soldering, 10 sec) ..... | 300°C          |

## PACKAGE/ORDER INFORMATION

|   |   |   |   |
|---|---|---|---|
|  <p>H PACKAGE<br/>8-LEAD TO-5 METAL CAN<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 150^{\circ}\text{C/W}</math>, <math>\theta_{JC} = 45^{\circ}\text{C/W}</math></p> <p><b>OBsolete PACKAGE</b><br/>Consider the 8-Lead Plastic Dip Package for Alternate Source</p> | <p>ORDER PART NUMBER</p> <p>LT1017MH<br/>LT1017CH<br/>LT1018MH<br/>LT1018CH</p>   |  <p>N8 PACKAGE<br/>8-LEAD PDIP<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 130^{\circ}\text{C/W}</math></p>          | <p>ORDER PART NUMBER</p> <p>LT1017CN8<br/>LT1017IN8<br/>LT1018CN8</p> |
|  <p>S8 PACKAGE<br/>8-LEAD PLASTIC SO<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 190^{\circ}\text{C/W}</math></p>   | <p>ORDER PART NUMBER</p> <p>LT1017CS8<br/>LT1017IS8<br/>LT1018CS8</p> <p>S8 PART MARKING</p> <p>1017<br/>1017I<br/>1018</p> |  <p>SW PACKAGE<br/>16-LEAD PLASTIC SO<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 130^{\circ}\text{C/W}</math></p> | <p>ORDER PART NUMBER</p> <p>LT1017CSW<br/>LT1018CSW</p>               |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

## ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the operating temperature range of -55°C to 85°C for M grade parts, -40°C to 85°C for I grade parts and 0°C to 70°C for C grade parts.

| PARAMETER                   | CONDITIONS   |       | LT1017 |     |     | LT1018 |     |     | UNITS |
|-----------------------------|--|-------|--------|-----|-----|--------|-----|-----|-------|
|                             |  |       | MIN    | TYP | MAX | MIN    | TYP | MAX |       |
| Offset Voltage (Note 2)     | $\pm 0.75\text{V} \leq V_S \leq \pm 20\text{V}$                      | 25°C  |        | 0.4 | 1   |        | 0.4 | 1   | mV    |
|                             |  | ●     |        | 0.5 | 1.4 |        | 0.5 | 1.4 | mV    |
|                             |  | 125°C |        |     | 5   |        | 0.7 | 1.5 | mV    |
| Bias Current                | $\pm 0.75\text{V} \leq V_S \leq \pm 20\text{V}$                      | 25°C  |        | 5   | 15  |        | 15  | 75  | nA    |
|                             |  | ●     |        | 7   | 25  |        | 18  | 100 | nA    |
|                             |  | 125°C |        | 10  | 60  |        |     | 110 | nA    |
| Offset Current              | $\pm 0.75\text{V} \leq V_S \leq \pm 20\text{V}$                      | 25°C  |        | 0.4 | 2   |        | 1   | 8   | nA    |
|                             |  | ●     |        | 0.5 | 3   |        | 1.6 | 12  | nA    |
|                             |  | 125°C |        |     | 20  |        |     | 20  | nA    |
| Common Mode Rejection Ratio | $V_S = \pm 20\text{V}$ , $-20\text{V} \leq V_{CM} \leq 19.1\text{V}$ | 25°C  | 105    | 115 |     | 105    | 115 |     | dB    |
|                             |  | ●     | 100    | 115 |     | 100    | 115 |     | dB    |
|                             |  | 125°C | 82     | 100 |     | 95     | 110 |     | dB    |

**ELECTRICAL CHARACTERISTICS** The ● denotes specifications which apply over the operating temperature range of -55°C to 85°C for M grade parts, -40°C to 85°C for I grade parts and 0°C to 70°C for C grade parts.

| PARAMETER   | CONDITIONS  |  | LT1017 |     |      | LT1018 |     |     | UNITS |    |
|---|---|--|--------|-----|------|--------|-----|-----|-------|----|
|   |   |  | MIN    | TYP | MAX  | MIN    | TYP | MAX |       |    |
| Power Supply Rejection Ratio                                    | $\pm 0.75V \leq V_S \leq \pm 20V$   | 25°C                                       | 96     | 110 |      | 96     | 110 |     | dB    |    |
|   |   | ●  | 95     | 105 |      | 95     | 105 |     | dB    |    |
|   |   | 125°C                                      | 82     |     |      | 86     | 100 |     | dB    |    |
| Gain  | No Load, $V_{OUT} = \pm 19.9V$ (Note 3)   | 25°C                                       | 110    | 115 |      | 110    | 125 |     | dB    |    |
|   |   | ●  | 105    | 115 |      | 105    | 120 |     | dB    |    |
|   |   | 125°C                                      | 100    |     |      | 100    |     |     | dB    |    |
|   | $R_L = 4k, V_{OUT} = \pm 19V$   | 25°C                                       | 100    | 110 |      | 100    | 110 |     | dB    |    |
| ●   |   | 94   |        |     | 94   |        |     | dB  |       |    |
| Output Sink Current   | $V^+ = 4.5V, V^- = 0V$<br>Overdrive > 30mV  | 25°C                                       | 30     | 65  |      | 35     | 70  |     | mA    |    |
|   |   | ●  | 25     | 50  |      | 25     | 50  |     | mA    |    |
|   |   | 125°C                                      | 10     | 20  |      | 10     | 30  |     | mA    |    |
| Output Source Current   | $V^+ = 40V, V^- = 0V$<br>$V_{IN} = 5mV, V_{OUT} = 0.4V$                                     | 25°C                                       | 30     | 75  |      | 75     | 250 |     | μA    |    |
|   |   | ●  | 25     | 70  |      | 50     | 220 |     | μA    |    |
|   |   | 125°C                                      | 25     | 75  |      | 50     | 200 |     | μA    |    |
|   | $V^+ = 1.2V, V^- = 0V$<br>$V_{IN} = 5mV, V_{OUT} = 0.4V$                                    | 25°C                                       | 25     | 35  |      | 70     | 140 |     | μA    |    |
|   |   | ●  | 15     | 20  |      | 45     | 120 |     | μA    |    |
|   |   | 125°C                                      | 25     | 40  |      | 40     | 110 |     | μA    |    |
| Negative Output Saturation                                      | $I_{OUT} = 0mA$<br>$= 0.1mA$<br>$= 1mA$<br>$= 10mA$<br>$= 30mA$                             | $V^+ = 4.5V, V^- = 0V$<br>$V_{IN} = -10mV$ | 25°C   |     | 5    | 20     |     | 5   | 15    | mV |
|   |   |  | 25°C   |     | 35   | 60     |     | 35  | 60    | mV |
|   |   |  | 25°C   |     | 60   | 120    |     | 60  | 120   | mV |
|   |   |  | 25°C   |     | 120  | 200    |     | 120 | 250   | mV |
|   |   |  | 25°C   |     | 350  | 600    |     | 350 | 700   | mV |
|   |   |  | 25°C   |     |      |        |     |     |       |    |
|   | $I_{OUT} = 0mA$<br>$= 0.1mA$<br>$= 1mA$<br>$= 10mA$<br>$= 30mA$                             | $V^+ = 4.5V, V^- = 0V$<br>$V_{IN} = -10mV$ | ●      |     | 5    | 20     |     | 8   | 20    | mV |
|   |   |  | ●      |     | 40   | 75     |     | 35  | 70    | mV |
|   |   |  | ●      |     | 75   | 150    |     | 70  | 150   | mV |
|   |   |  | ●      |     | 150  | 300    |     | 150 | 300   | mV |
|   |   |  | ●      |     | 600  | 900    |     | 500 | 900   | mV |
|   |   |  | ●      |     |      |        |     |     |       |    |
| $I_{OUT} = 0mA$<br>$= 0.1mA$<br>$= 1mA$<br>$= 10mA$<br>$= 30mA$ | $V^+ = 4.5V, V^- = 0V$<br>$V_{IN} = -10mV$  | 125°C                                      |        | 25  | 50   |        | 10  | 40  | mV    |    |
|   |   | 125°C                                      |        | 60  | 100  |        | 60  | 100 | mV    |    |
|   |   | 125°C                                      |        | 100 | 200  |        | 110 | 200 | mV    |    |
|   |   | 125°C                                      |        | 300 | 600  |        | 300 | 400 | mV    |    |
|   |   | 125°C                                      |        |     |      |        | 900 |     |       | mV |
|   |   | 125°C                                      |        |     |      |        |     |     |       | mV |
| Positive Output Saturation                                      | $I_{OUT} = 0\mu A$<br>$= 10\mu A$<br>$= 0\mu A$<br>$= 10\mu A$<br>$= 0\mu A$<br>$= 10\mu A$ | 25°C                                       |        | 40  | 80   |        | 35  | 80  | mV    |    |
|   |   |  | 25°C   |     | 175  | 250    |     | 175 | 250   | mV |
|   |   |  | ●      |     | 45   | 90     |     | 45  | 90    | mV |
|   |   |  | ●      |     | 190  | 300    |     | 190 | 300   | mV |
|   |   |  | 125°C  |     | 50   | 100    |     | 50  | 100   | mV |
|   |   |  | 125°C  |     |      | 300    |     |     | 300   | mV |
| Leakage Current   | $V_S = 5V, V_{OUT} = 40V$<br>$V_{IN} \geq 100mV$  | 25°C                                       |        | 0.5 | 3    |        | 1   | 8   | μA    |    |
|   |   | ●  |        | 0.6 | 3    |        | 1.8 | 10  | μA    |    |
|   |   | 125°C                                      |        |     | 5    |        |     | 15  | μA    |    |
| Supply Current  | $V_S = 5V$  | 25°C                                       |        | 30  | 60   |        | 110 | 250 | μA    |    |
|   |   | ●  |        | 40  | 80   |        | 110 | 250 | μA    |    |
|   |   | 125°C                                      |        |     | 80   |        |     | 300 | μA    |    |
|   | $V_S = 40V$   | 25°C                                       |        | 40  | 90   |        | 130 | 250 | μA    |    |
|   |   | ●  |        | 55  | 100  |        | 140 | 270 | μA    |    |
|   |   | 125°C                                      |        |     | 100  |        |     | 300 | μA    |    |
| Minimum Operating Voltage                                       | $I_{OUT} = 1mA$   | 25°C                                       |        |     | 1.15 |        | 1.2 |     | V     |    |
|   |   | ●  |        |     | 1.15 |        | 1.2 |     | V     |    |
|   |   | 125°C                                      |        |     | 1.15 |        | 1.2 |     | V     |    |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of the device may be impaired.

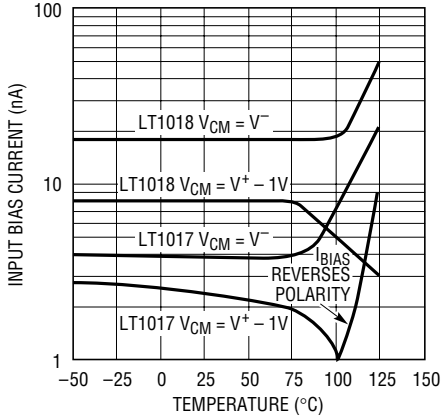
**Note 2:** Offset voltage is guaranteed over a common mode voltage range of  $V^- \leq V_{IN} \leq (V^+ - 0.9V)$ .

**Note 3:** No load gain is guaranteed but not tested (LT1017 only).

# LT1017/LT1018

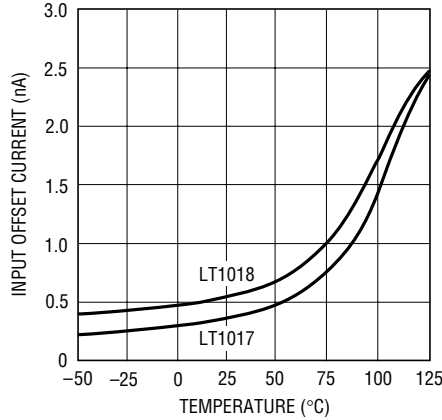
## TYPICAL PERFORMANCE CHARACTERISTICS

**Input Bias Current**



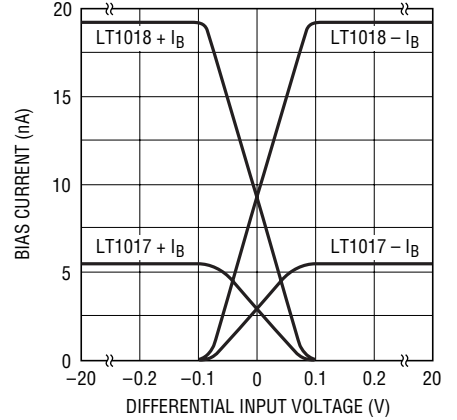
1017/18 G01

**Input Offset Current**



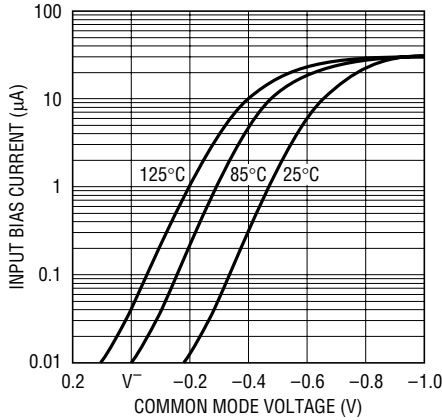
1017/18 G02

**Bias Current vs Differential Input**



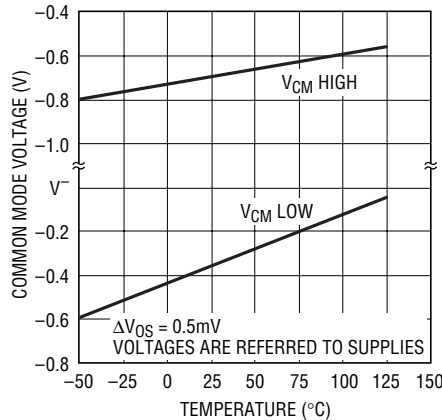
1017/18 G03

**Input Bias Current with Inputs Driven Below the Supply**



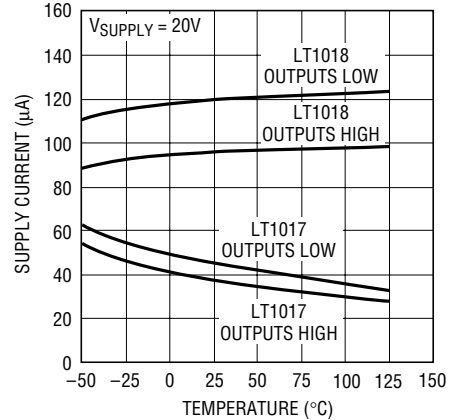
1017/18 G04

**Common Mode Limits**



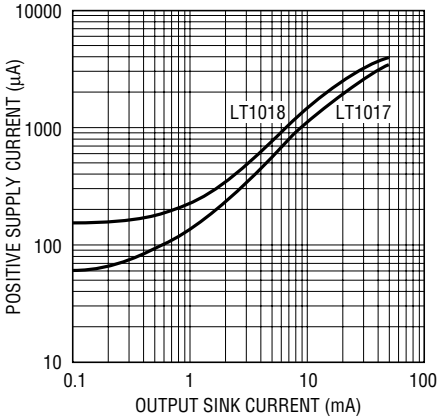
1017/18 G05

**Supply Current**



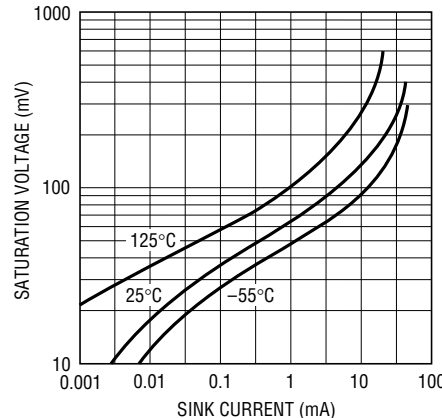
1017/18 G06

**Positive Supply Current**



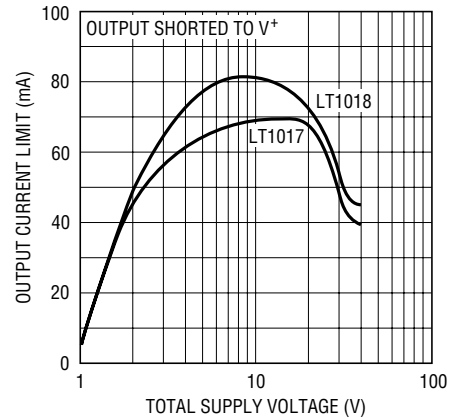
1017/18 G07

**NPN Output Saturation Voltage**



1017/18 G08

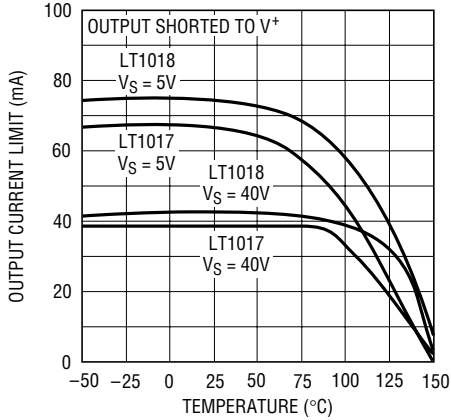
**Output Sinking Current Limit**



1017/18 G09

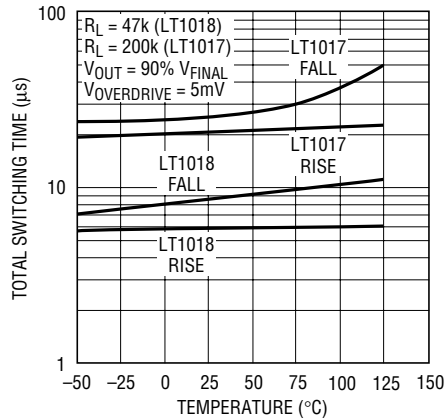
# TYPICAL PERFORMANCE CHARACTERISTICS

**Output Sinking Current Limit**



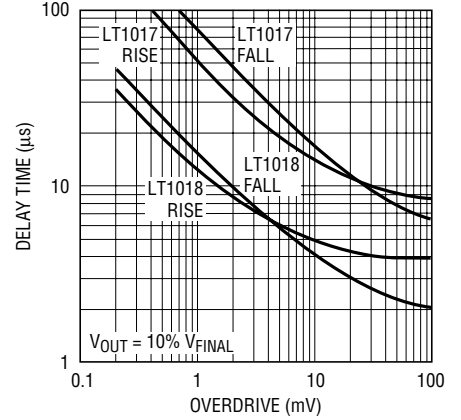
1017/18 G10

**Total Switching Time**



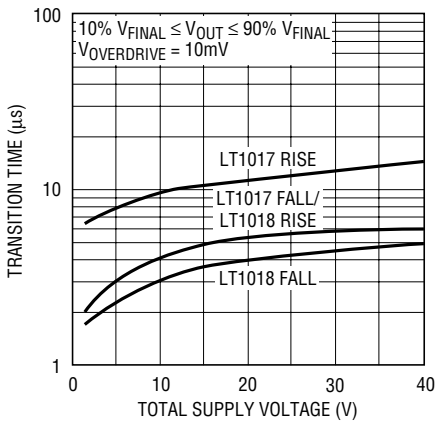
1017/18 G11

**Output Delay**



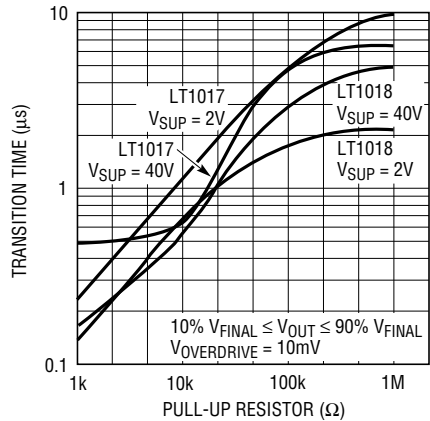
1017/18 G12

**Transition Time**



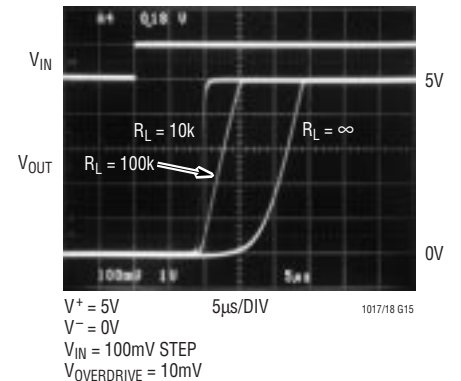
1017/18 G13

**Positive Transition Time**



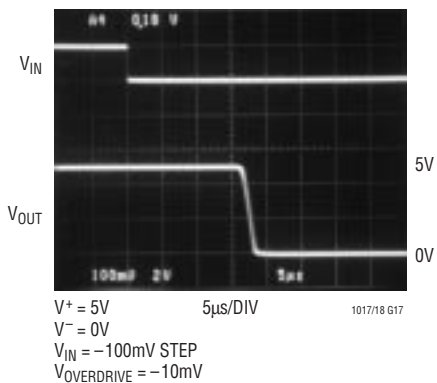
1017/18 G14

**LT1017 Response Time**



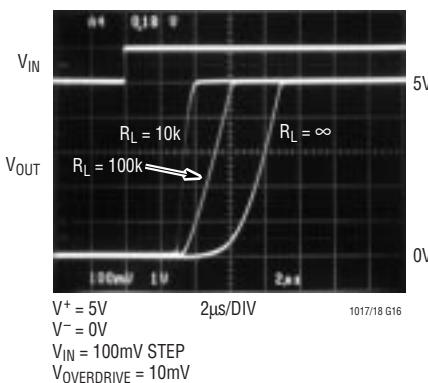
1017/18 G15

**LT1017 Response Time**



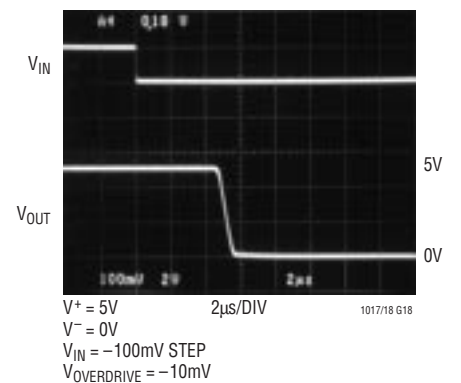
1017/18 G17

**LT1018 Response Time**



1017/18 G16

**LT1018 Response Time**

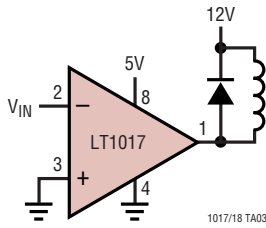


1017/18 G18

# LT1017/LT1018

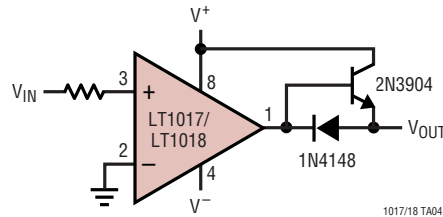
## TYPICAL APPLICATIONS

Driving Relays



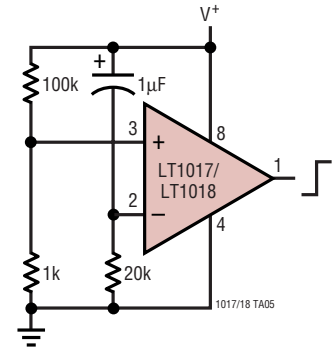
1017/18 TA03

Increasing Positive Output Current



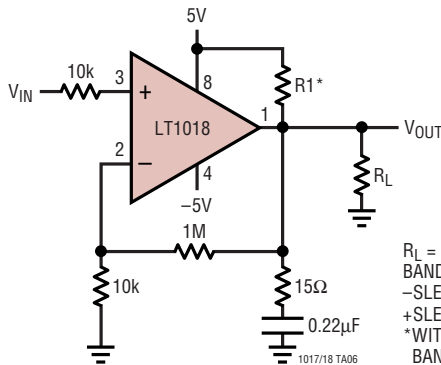
1017/18 TA04

Delay On Power Up



1017/18 TA05

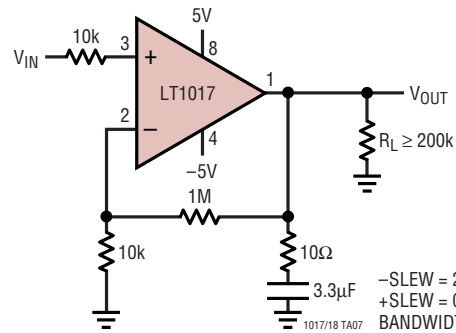
LT1018 Op Amp,  $A_V = 100$



$R_L = 100k$   
 BANDWIDTH = 30Hz  
 -SLEW = 320V/ms  
 +SLEW = 0.93V/ms  
 \*WITH  $R_1 = 1k$   
 BANDWIDTH  $\cong 200Hz$

1017/18 TA06

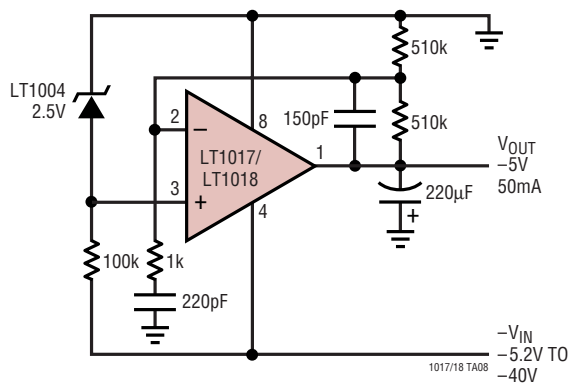
LT1017 Op Amp,  $A_V = 100$



-SLEW = 23.5V/ms  
 +SLEW = 0.017V/ms  
 BANDWIDTH = 0.3Hz AT  $R_L = 220k$

1017/18 TA07

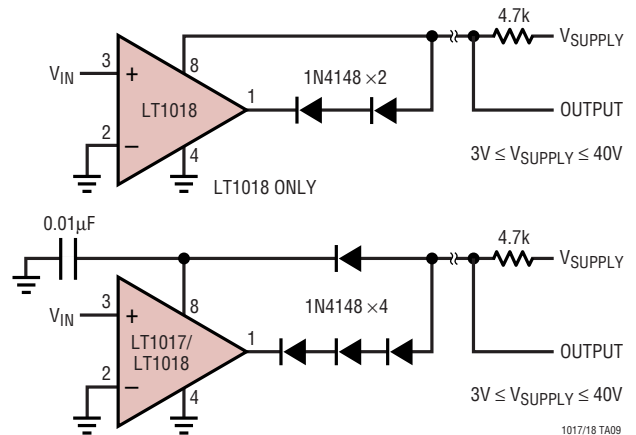
Negative Voltage Regulator



-VIN  
 -5.2V TO  
 -40V

1017/18 TA08

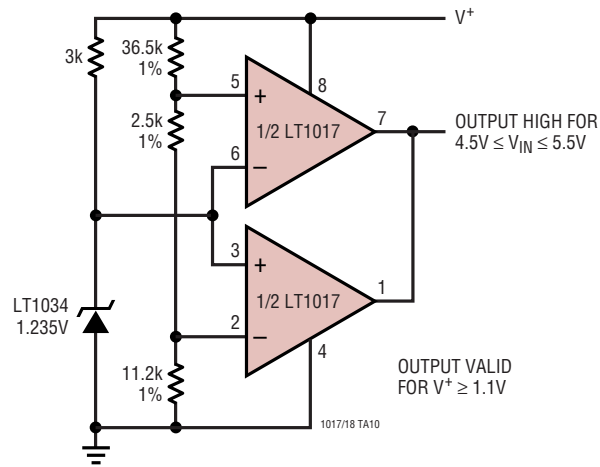
2-Wire Comparator



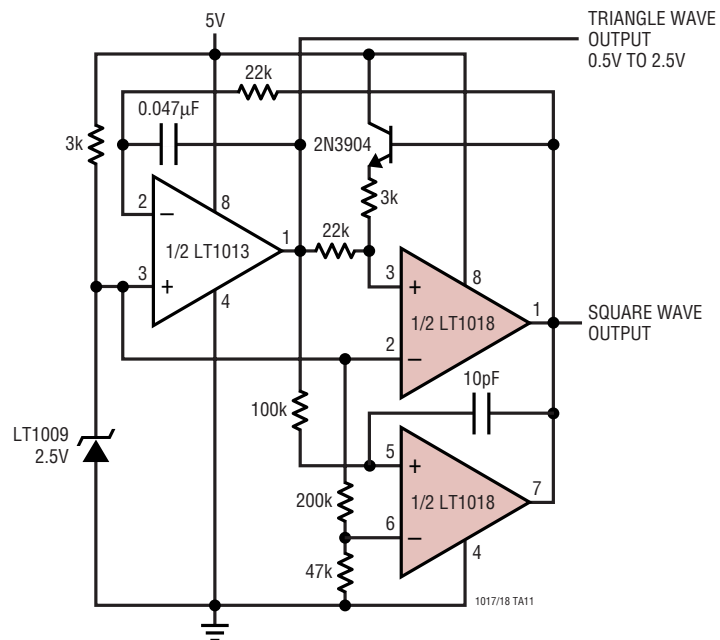
1017/18 TA09

# TYPICAL APPLICATIONS

### 5V Power Supply Monitor

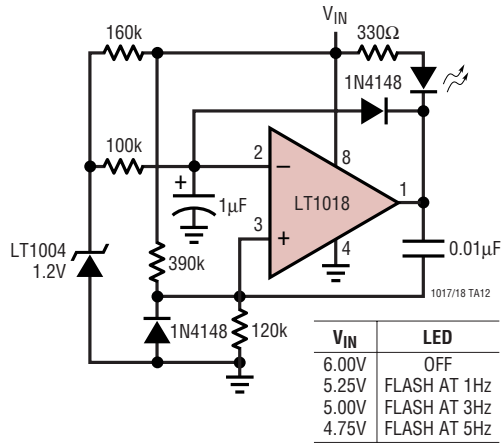


### Precise Tri-Wave Generator

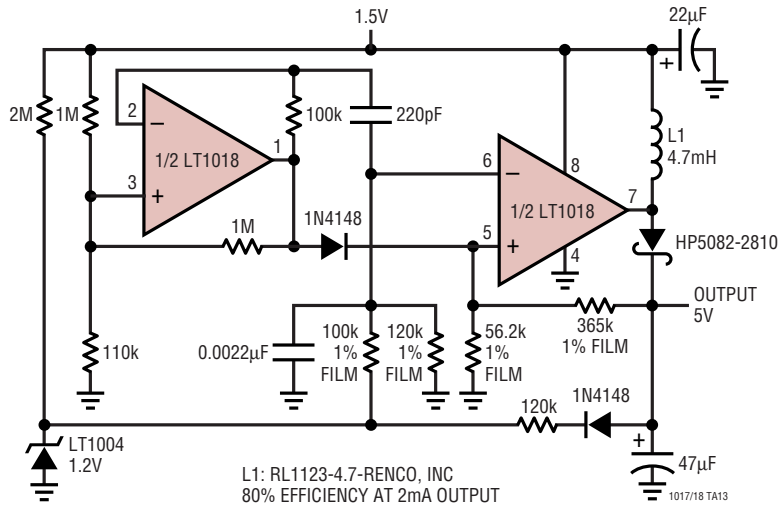


## TYPICAL APPLICATIONS

### Power Supply Monitor



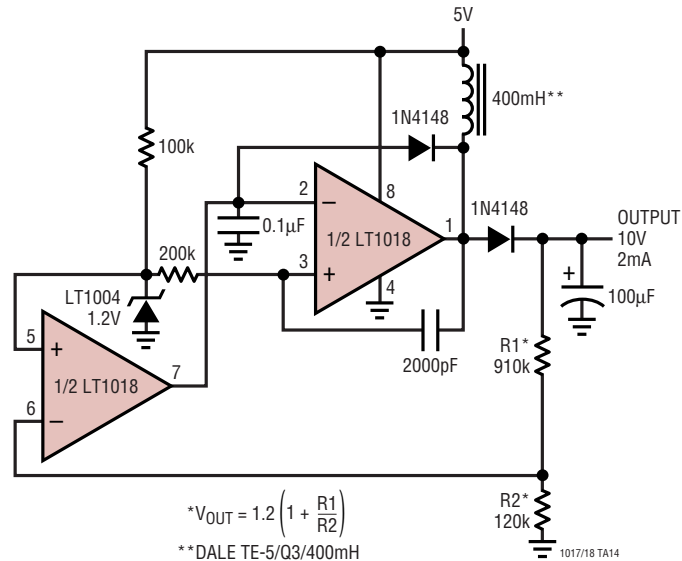
### 1.5V Input Flyback Regulator



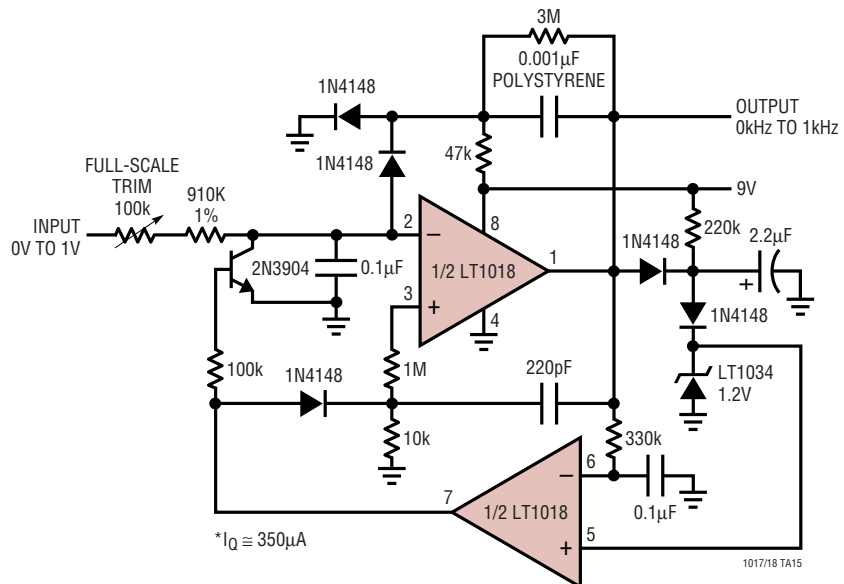


# TYPICAL APPLICATIONS

### Regulated Step-Up Converter

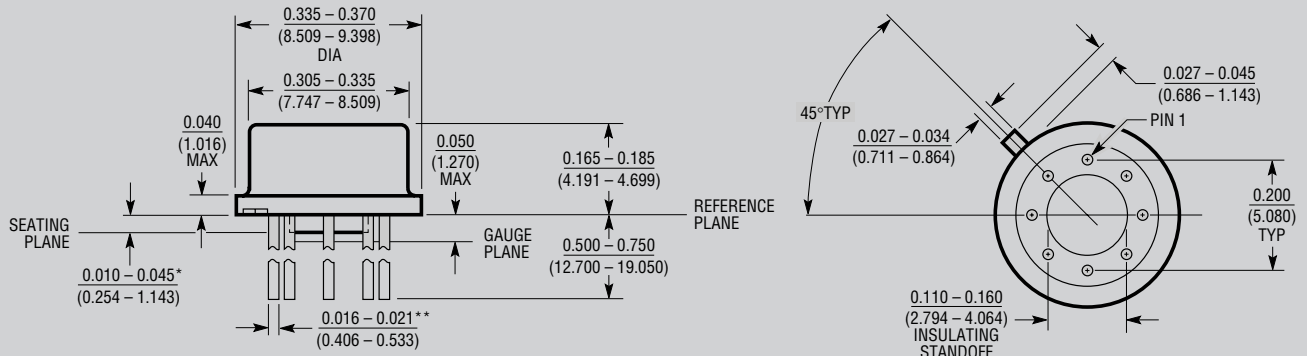


### Low Power\* V-to-F Converter



**PACKAGE DESCRIPTION**

**H Package**  
**8-Lead TO-5 Metal Can (.200 Inch PCD)**  
 (Reference LTC DWG # 05-08-1320)

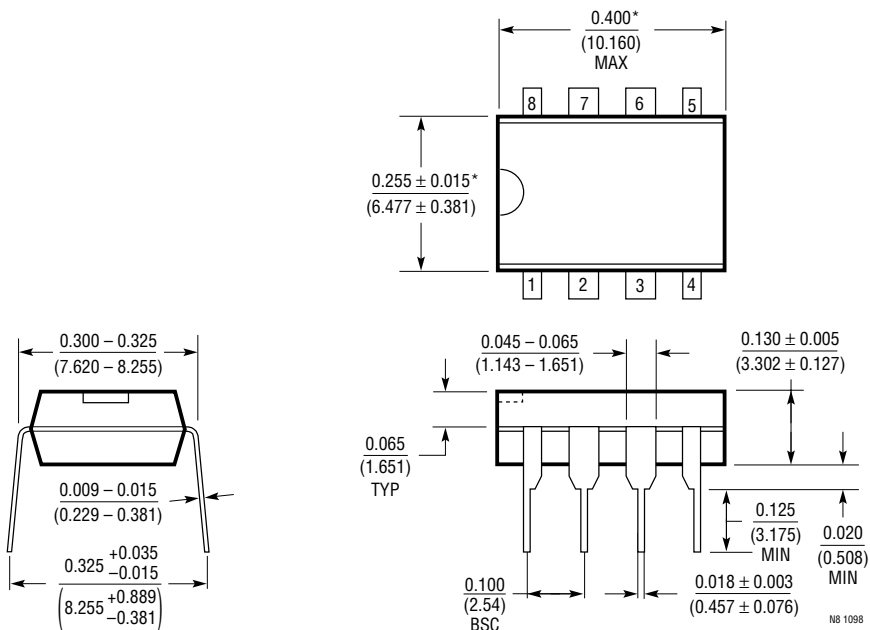


\* LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND 0.045" BELOW THE REFERENCE PLANE  
 \*\* FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS  $\frac{0.016 - 0.024}{(0.406 - 0.610)}$

**OBsolete PACKAGE**

H8(TO-5) 0.200 PCD 1197

**N8 Package**  
**8-Lead PDIP (Narrow .300 Inch)**  
 (Reference LTC DWG # 05-08-1510)

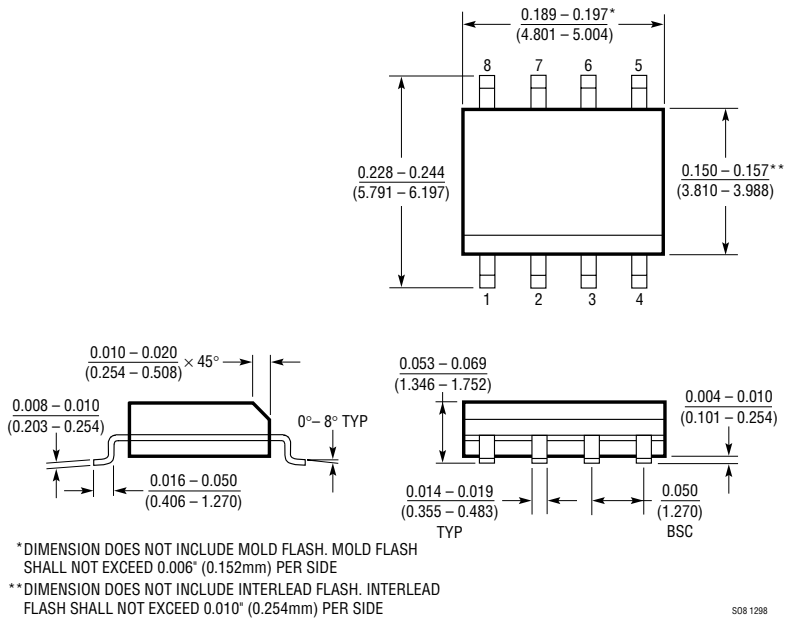


\* THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.010 INCH (0.254mm)

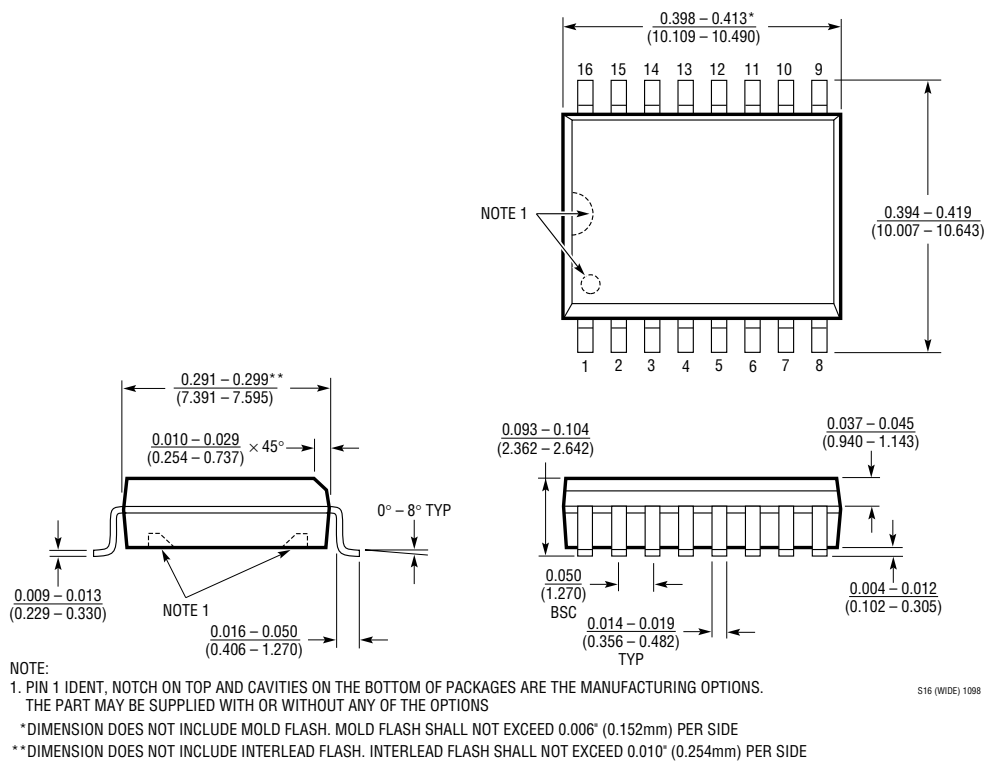
N8 1098

# PACKAGE DESCRIPTION

## S8 Package 8-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610)



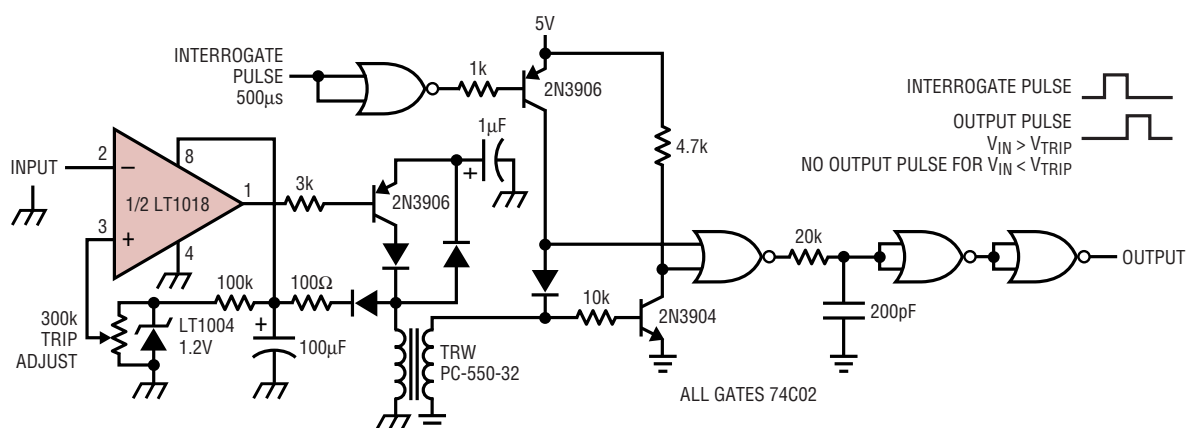
## SW Package 16-Lead Plastic Small Outline (Wide .300 Inch) (Reference LTC DWG # 05-08-1620)



# LT1017/LT1018

## TYPICAL APPLICATION

Fully Isolated Limit Comparator



## RELATED PARTS

| PART NUMBER    | DESCRIPTION                                       | COMMENTS   |
|----------------|---|--|
| LT1011/LT1011A | Voltage Comparators                               | Improved LT111A, 0.5mV $V_{OS(MAX)}$ , 25nA $I_{B(MAX)}$ , 3nA $I_{OS(MAX)}$ , 250ns $t_{PD(MAX)}$ |
| LT1020         | Micropower Regulator and Comparator               | 40μA $I_{SUPPLY}$ , 125mA $I_{OUT}$ , 2.5V Reference Voltage                                       |
| LTC1040        | Dual Micropower Comparator                        | 1.5μW (1Sample/Second), 0.5mV $V_{OS(MAX)}$ , Rail-to-Rail Input                                   |
| LT1120/LT1120A | Micropower Regulator with Comparator and Shutdown | 20μA $I_{SUPPLY}$ , 125mA $I_{OUT}$ , 2.5V Reference Voltage                                       |
| LT319A         | Dual Comparators                                  | 0.5mV $V_{OS(MAX)}$ , 25mA $I_{OUT}$ , 80ns $t_{PD}$   |
| LT1671         | Single Supply Ground Sensing Comparator           | 450μA $I_{SUPPLY}$ , 60ns $t_{PD}$ , 0.8mV $V_{OS}$  |
| LT1716         | Micropower, 44V, SOT-23 Ground Sensing Comparator | Input Common Mode Range Extends from -5V to 44V from Negative Supply                               |