

## 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  $V^+$
- 30 $\mu$ A Supply Current (LT1017)  
110 $\mu$ A Supply Current (LT1018)
- Available in 8-Lead PDIP, 8-Lead Plastic SO, and 16-Lead Plastic SO Packages

## APPLICATIONS

- Power Supply Monitors
- Relay Driving
- Oscillators

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## DESCRIPTION

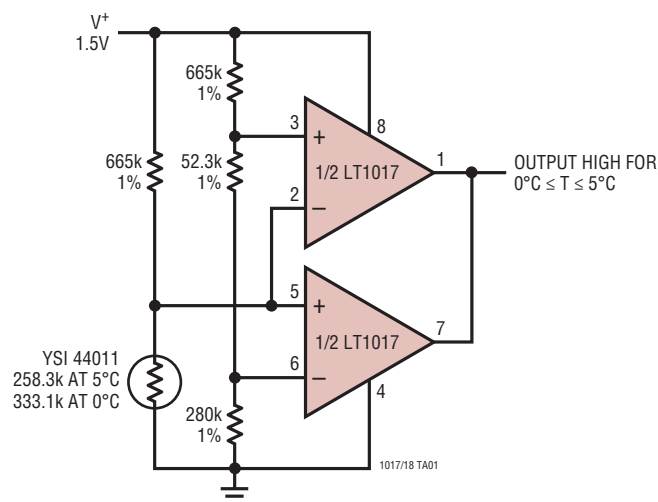
The LT<sup>®</sup>1017/LT1018 are general purpose micropower comparators. The LT1017 is optimized for lowest operating power while the LT1018 operates at higher power and higher speed. Both devices can operate from a single 1.1V cell up to 40V. The output stage includes a class "B" pull-up current source, 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.

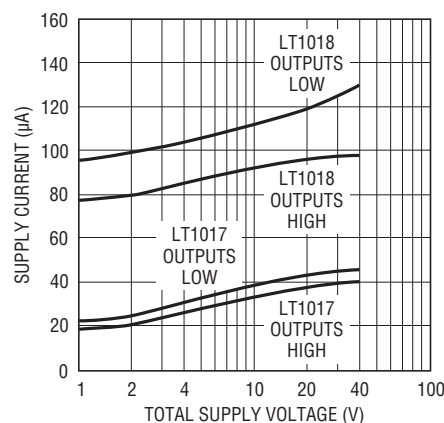
The LT1017/LT1018 are pin compatible with older dual comparators such as 393 type devices.

## TYPICAL APPLICATION

**1.5V Powered Refrigerator Alarm**



**Supply Current**



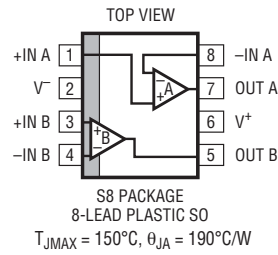
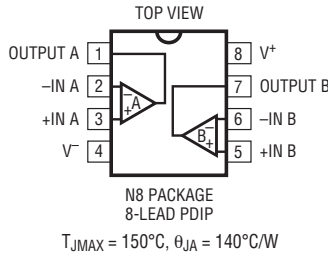
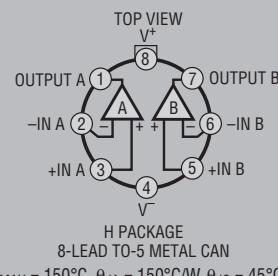
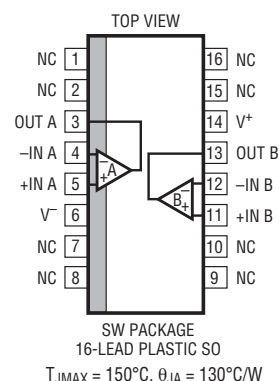
# LT1017/LT1018

## ABSOLUTE MAXIMUM RATINGS (Note 1)

Supply Voltage ..... 40V  
 Differential Input Voltage ..... 40V  
 Input Voltage ..... -0.3V to 40V  
 Short-Circuit Duration ..... Indefinite  
 Storage Temperature Range ..... -65°C to 150°C

Operating Temperature Range  
 LT1017M/LT1018M ..... -55°C to 125°C  
 LT1017C/LT1018C ..... 0°C to 70°C  
 LT1017I/LT1018I ..... -40°C to 85°C  
 Lead Temperature (Soldering, 10 sec) ..... 300°C

## PACKAGE/ORDER INFORMATION

|  <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>N8 PACKAGE<br/>8-LEAD PDIP<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 140^{\circ}\text{C/W}</math></p>           |              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| ORDER PART NUMBER                                                                                                                                                                                                                                                                                                                                                              | S8 PART MARKING                | ORDER PART NUMBER                                                                                                                                                                                                                | PART MARKING |
| LT1017CS8<br>LT1017IS8<br>LT1018CS8<br>LT1018IS8                                                                                                                                                                                                                                                                                                                               | 1017<br>1017I<br>1018<br>1018I | LT1017CN8<br>LT1017IN8<br>LT1018CN8                                                                                                                                                                                              |              |
|  <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><br/><b>OBSOLETE PACKAGE</b><br/>Consider the 8-Lead Plastic Dip Package For Alternate Source</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> |              |
| ORDER PART NUMBER                                                                                                                                                                                                                                                                                                                                                              | PART MARKING                   | ORDER PART NUMBER                                                                                                                                                                                                                | PART MARKING |
| LT1017MH<br>LT1017CH<br>LT1018MH<br>LT1018CH                                                                                                                                                                                                                                                                                                                                   |                                | LT1017CSW<br>LT1018CSW                                                                                                                                                                                                           |              |

**Order Options** Tape and Reel: Add #TR  
 Lead Free: Add #PBF Lead Free Tape and Reel: Add #TRPBF  
 Lead Free Part Marking: <http://www.linear.com/leadfree/>

\*The temperature grade is identified by a label on the shipping container. Consult LTC Marketing for parts specified with wider operating temperature ranges.

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# **ELECTRICAL CHARACTERISTICS**

The ● denotes the specifications which apply over the full 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<br>(Note 2)   | $\pm 0.75V \leq V_S \leq \pm 20V$                                  | 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                 | $\pm 0.75V \leq V_S \leq \pm 20V$                                  | 25°C                                       |        | 5   | 15  |        | 15  | 75  | nA    |
|                              |                                                                    | ●                                          |        | 7   | 25  |        | 18  | 100 | nA    |
|                              |                                                                    | 125°C                                      |        | 10  | 60  |        |     | 110 | nA    |
| Offset Current               | $\pm 0.75V \leq V_S \leq \pm 20V$                                  | 25°C                                       |        | 0.4 | 2   |        | 1   | 8   | nA    |
|                              |                                                                    | ●                                          |        | 0.5 | 3   |        | 1.6 | 12  | nA    |
|                              |                                                                    | 125°C                                      |        |     | 20  |        |     | 20  | nA    |
| Common Mode Rejection Ratio  | $V_S = \pm 20V, -20V \leq V_{CM} \leq 19.1V$                       | 25°C                                       | 105    | 115 |     | 105    | 115 |     | dB    |
|                              |                                                                    | ●                                          | 100    | 115 |     | 100    | 115 |     | dB    |
|                              |                                                                    | 125°C                                      | 82     | 100 |     | 95     | 110 |     | dB    |
| 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    |
|                              |                                                                    |                                            |        |     |     |        |     |     |       |
|                              | $I_{OUT} = 0mA$<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  |       |
|                              |                                                                    |                                            |        |     |     |        |     |     |       |
| Positive Output Saturation   | $I_{OUT} = 0\mu A$<br>= 10μA<br>= 0μA<br>= 10μA<br>= 0μA<br>= 10μA | 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  |       |
|                              |                                                                    | 125°C                                      |        |     |     |        |     |     |       |
|                              |                                                                    | 125°C                                      |        |     |     |        |     |     |       |

## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range of  $-55^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  for M grade parts,  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$  for I grade parts and  $0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$  for C grade parts.

| PARAMETER                 | CONDITIONS                                                               |                            | LT1017 |     |      | LT1018 |     |     | UNITS         |
|---------------------------|--------------------------------------------------------------------------|----------------------------|--------|-----|------|--------|-----|-----|---------------|
|                           |                                                                          |                            | MIN    | TYP | MAX  | MIN    | TYP | MAX |               |
| Leakage Current           | $V_S = 5\text{V}$ , $V_{OUT} = 40\text{V}$<br>$V_{IN} \geq 100\text{mV}$ | $25^{\circ}\text{C}$       |        | 0.5 | 3    |        | 1   | 8   | $\mu\text{A}$ |
|                           |                                                                          | ●<br>$125^{\circ}\text{C}$ |        | 0.6 | 3    |        | 1.8 | 10  | $\mu\text{A}$ |
|                           |                                                                          |                            |        |     | 5    |        |     | 15  | $\mu\text{A}$ |
| Supply Current            | $V_S = 5\text{V}$                                                        | $25^{\circ}\text{C}$       |        | 30  | 60   |        | 110 | 250 | $\mu\text{A}$ |
|                           |                                                                          | ●<br>$125^{\circ}\text{C}$ |        | 40  | 80   |        | 110 | 250 | $\mu\text{A}$ |
|                           |                                                                          |                            |        |     | 80   |        |     | 300 | $\mu\text{A}$ |
|                           | $V_S = 40\text{V}$                                                       | $25^{\circ}\text{C}$       |        | 40  | 90   |        | 130 | 250 | $\mu\text{A}$ |
|                           |                                                                          | ●<br>$125^{\circ}\text{C}$ |        | 55  | 100  |        | 140 | 270 | $\mu\text{A}$ |
|                           |                                                                          |                            |        |     | 100  |        |     | 300 | $\mu\text{A}$ |
| Minimum Operating Voltage | $I_{OUT} = 1\text{mA}$                                                   | $25^{\circ}\text{C}$       |        |     | 1.15 |        |     | 1.2 | V             |
|                           |                                                                          | ●<br>$125^{\circ}\text{C}$ |        |     | 1.15 |        |     | 1.2 | V             |
|                           |                                                                          |                            |        |     | 1.15 |        |     | 1.2 | V             |

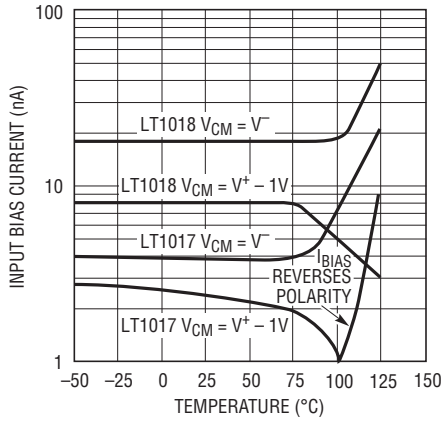
**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

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

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

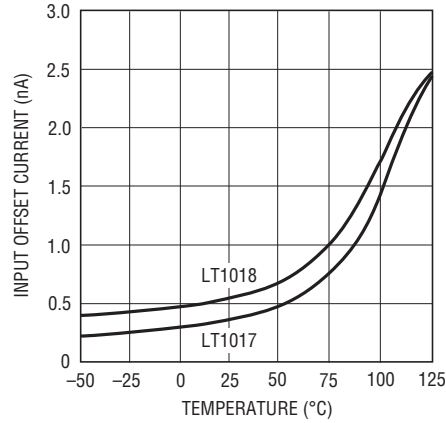
# TYPICAL PERFORMANCE CHARACTERISTICS

Input Bias Current



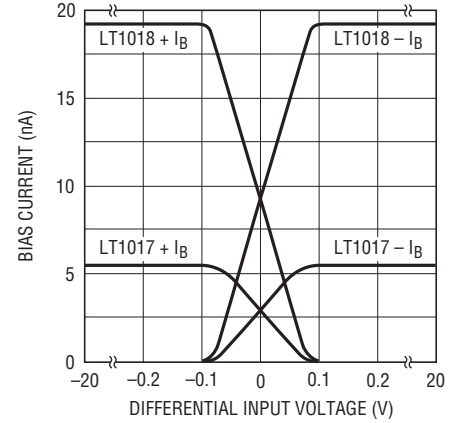
1017/18 G01

Input Offset Current



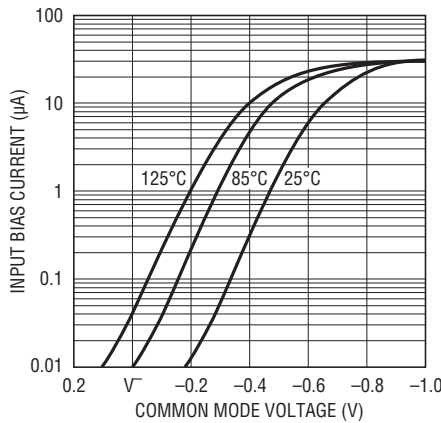
1017/18 G02

Bias Current vs Differential Input



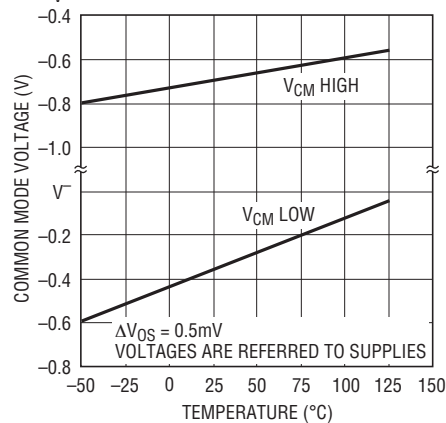
1017/18 G03

Input Bias Current with Inputs Driven Below the Supply



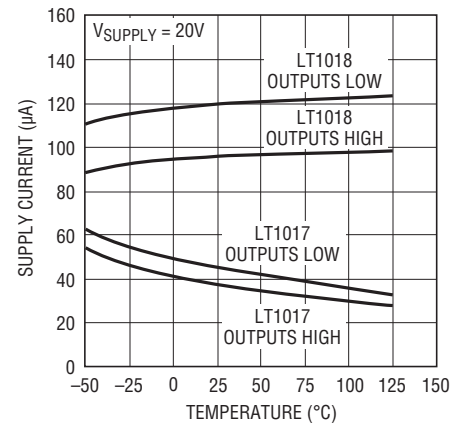
1017/18 G04

Common Mode Limits



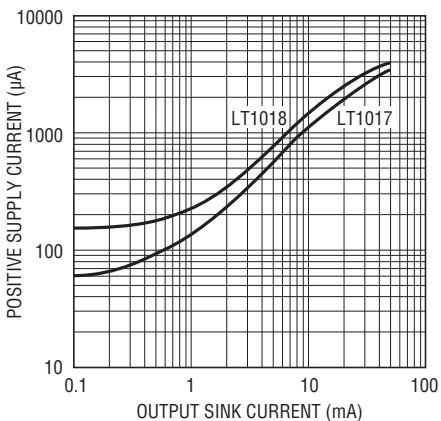
1017/18 G05

Supply Current



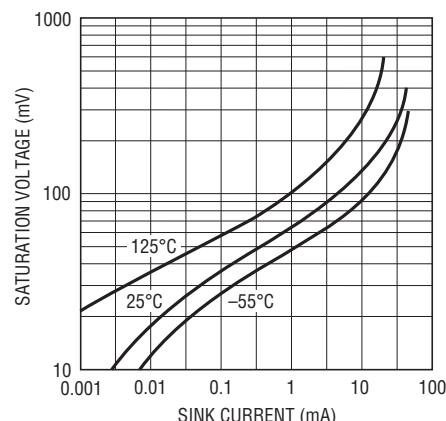
1017/18 G06

Positive Supply Current



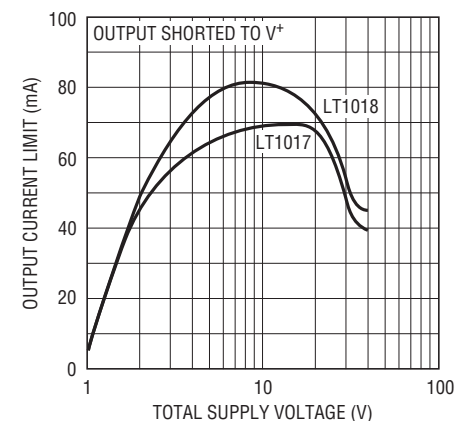
1017/18 G07

NPN Output Saturation Voltage



1017/18 G08

Output Sinking Current Limit

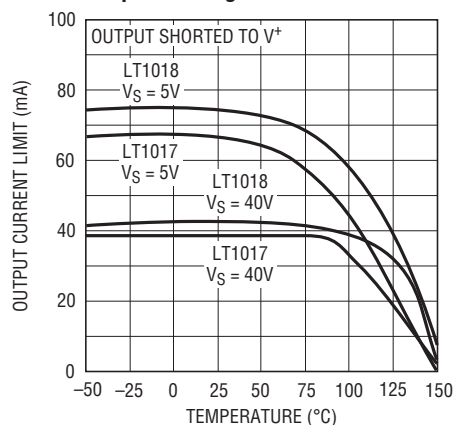


1017/18 G09

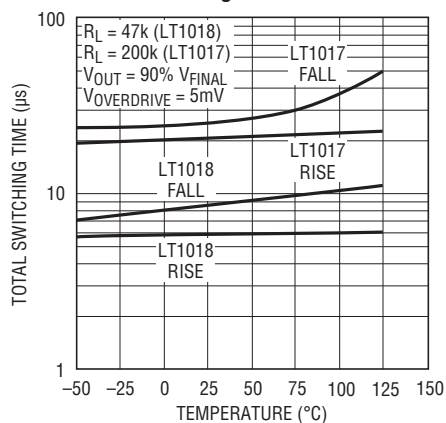
# LT1017/LT1018

## TYPICAL PERFORMANCE CHARACTERISTICS

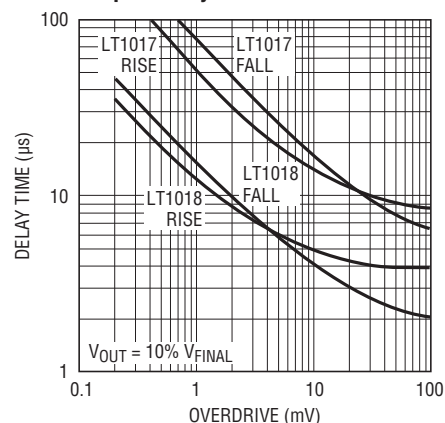
**Output Sinking Current Limit**



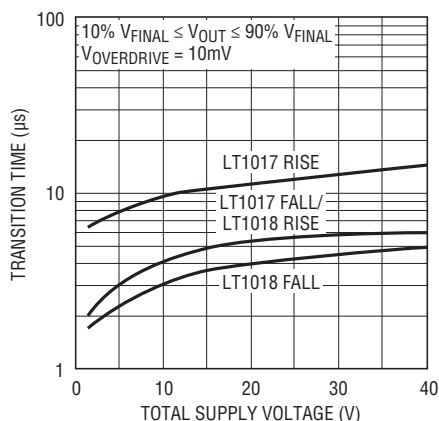
**Total Switching Time**



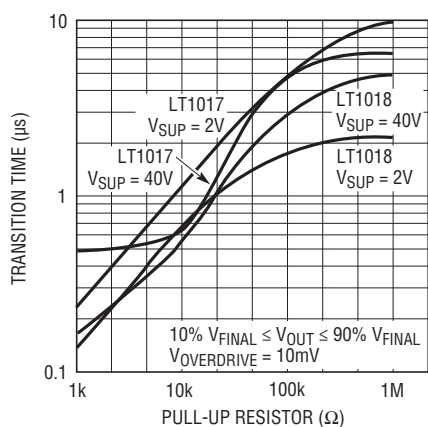
**Output Delay**



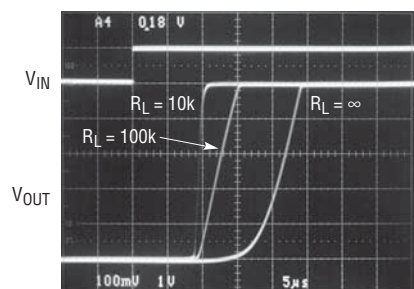
**Transition Time**



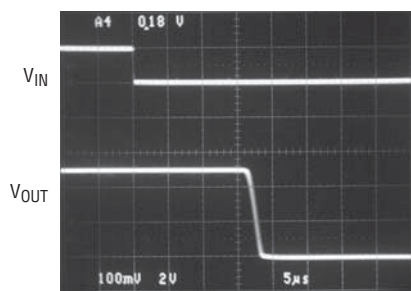
**Positive Transition Time**



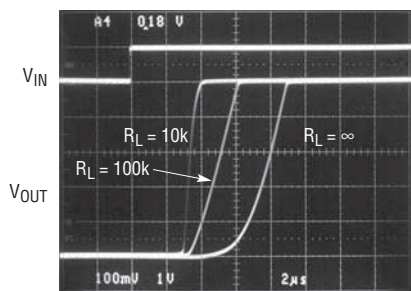
**LT1017 Response Time**



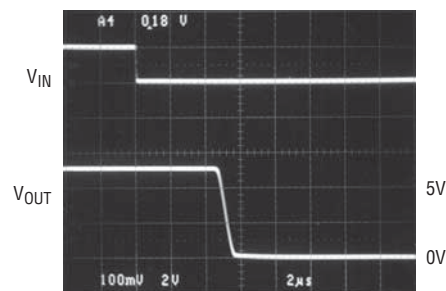
**LT1017 Response Time**



**LT1018 Response Time**

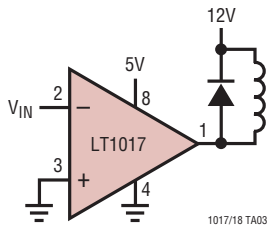


**LT1018 Response Time**

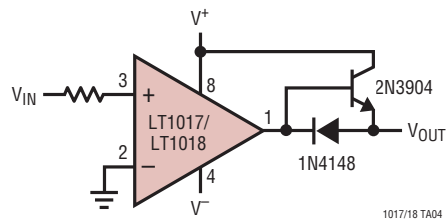


## TYPICAL APPLICATIONS

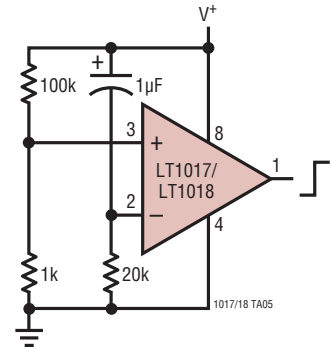
Driving Relays



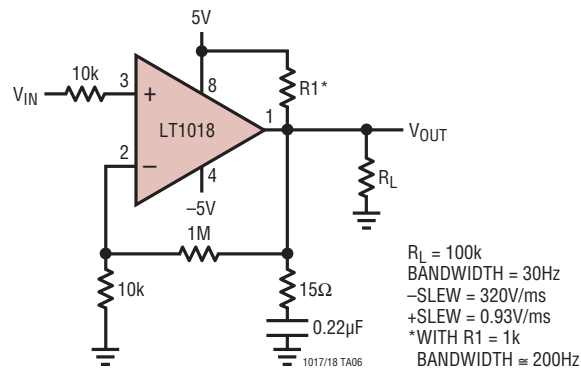
Increasing Positive Output Current



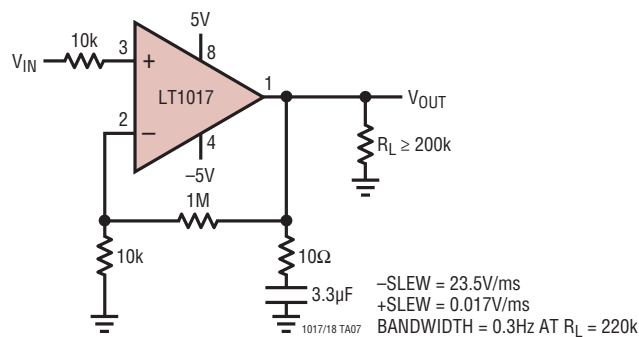
Delay On Power Up



LT1018 Op Amp,  $A_V = 100$

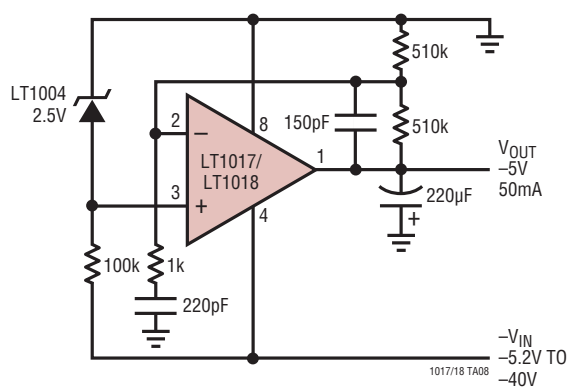


LT1017 Op Amp,  $A_V = 100$

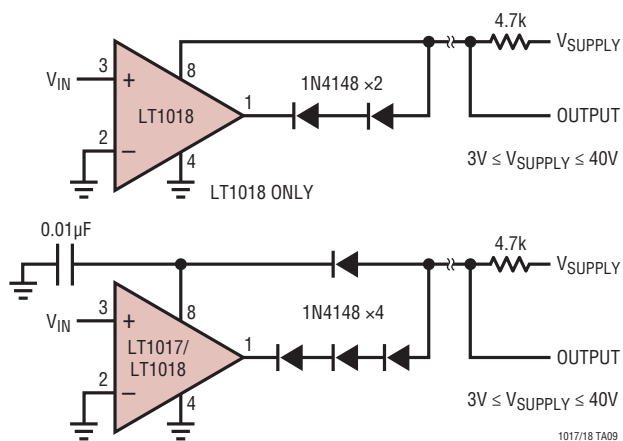


## TYPICAL APPLICATIONS

### Negative Voltage Regulator



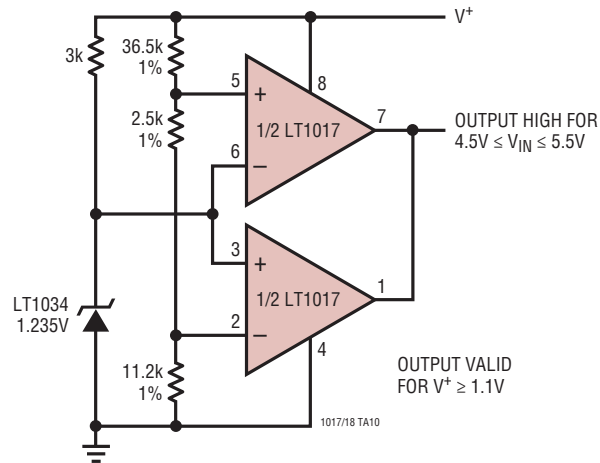
### 2-Wire Comparator



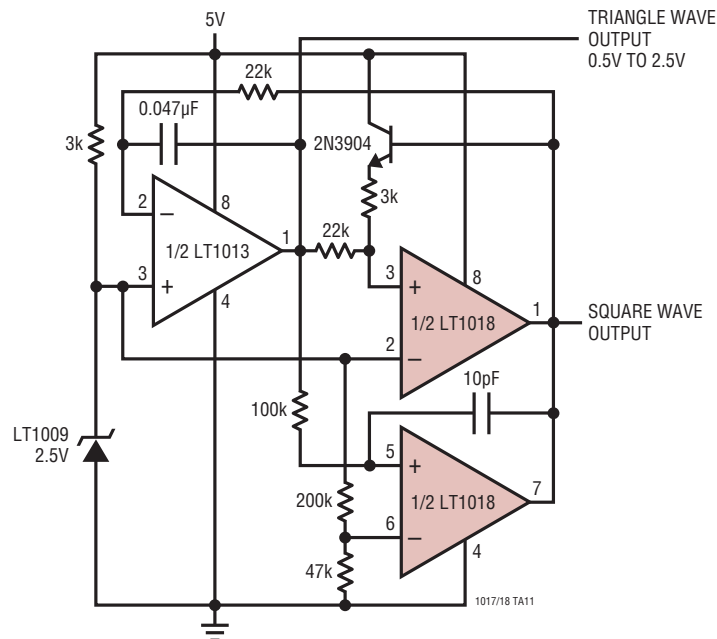


## TYPICAL APPLICATIONS

5V Power Supply Monitor



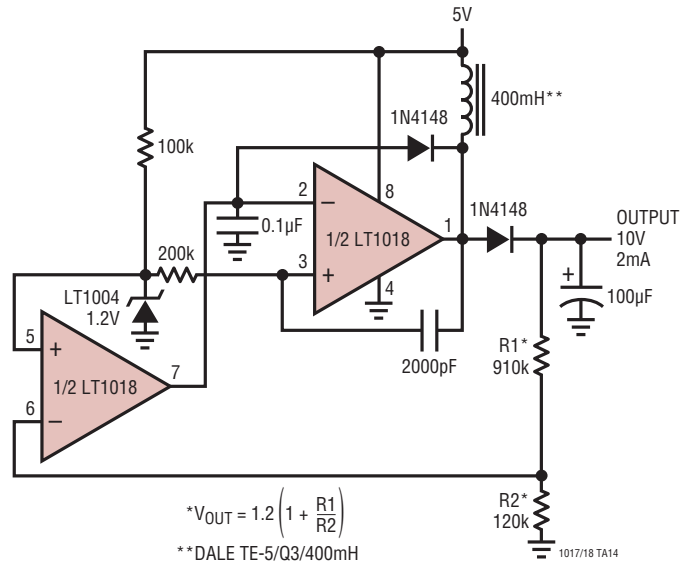
Precise Tri-Wave Generator



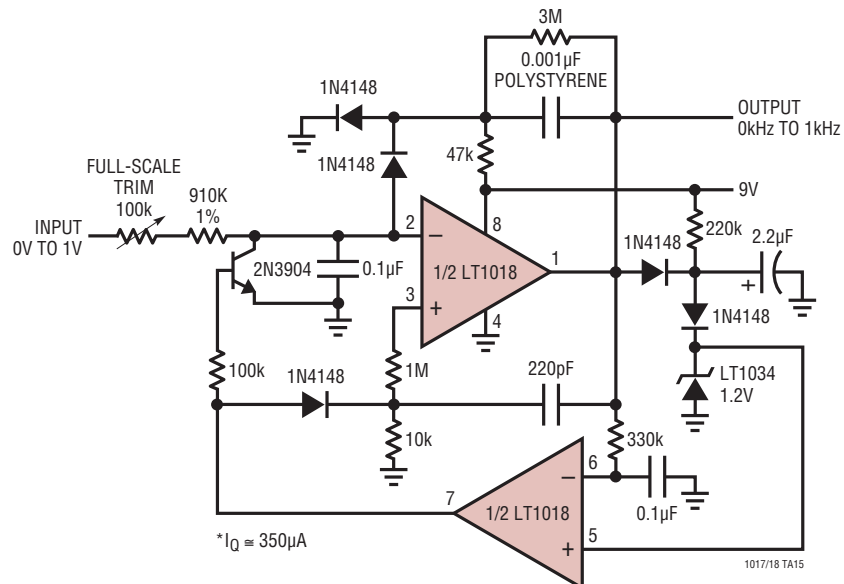
| $V_{IN}$ | LED          |
|----------|--------------|
| 6.00V    | OFF          |
| 5.25V    | FLASH AT 1Hz |
| 5.00V    | FLASH AT 3Hz |
| 4.75V    | FLASH AT 5Hz |

# TYPICAL APPLICATIONS

## Regulated Step-Up Converter

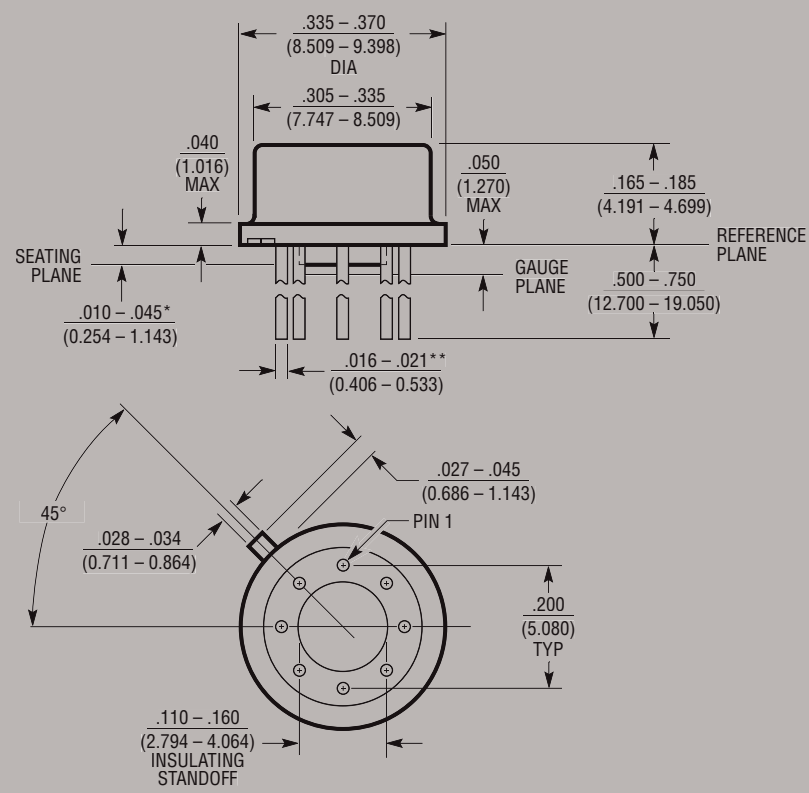


## Low Power\* V-to-F Converter



PACKAGE DESCRIPTION

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

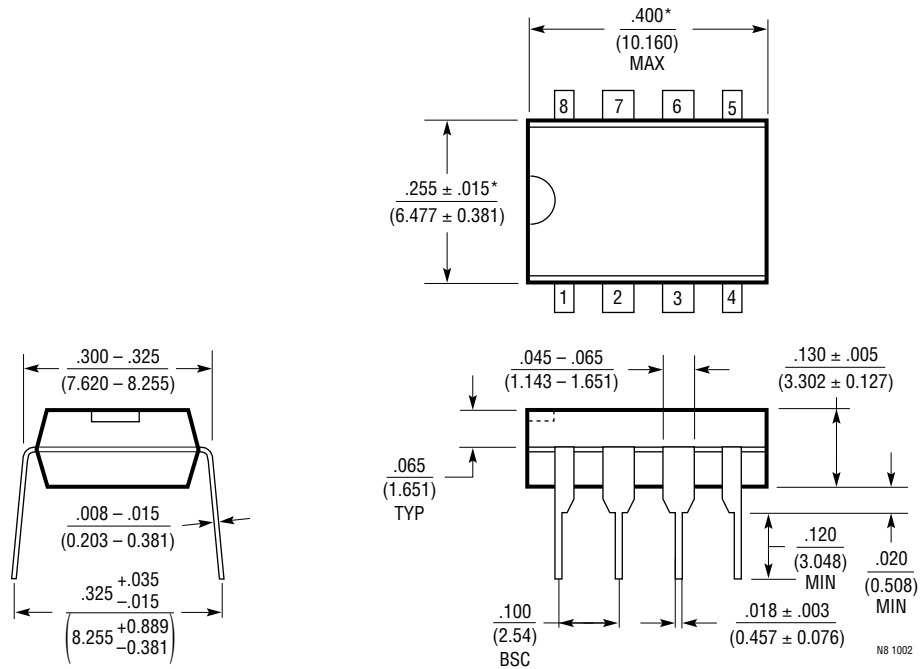


\*LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND THE SEATING PLANE  
\*\*FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS  $.016 - .024$  (0.406 - 0.610) H8(TO-5) 0.200 PCD 0204

OBSOLETE PACKAGE

## PACKAGE DESCRIPTION

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

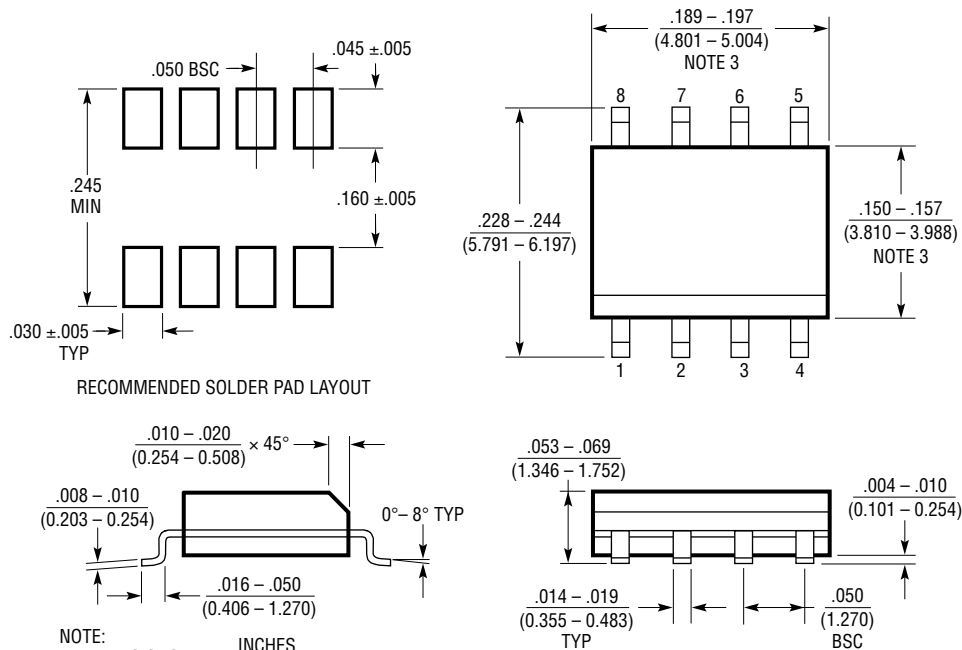


NOTE:  
 1. DIMENSIONS ARE  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

\*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

## PACKAGE DESCRIPTION

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

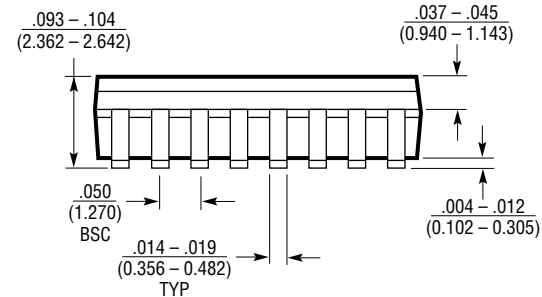
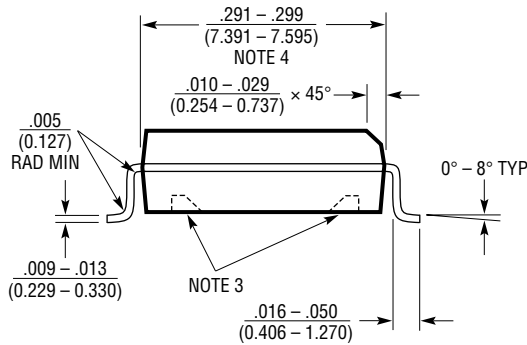
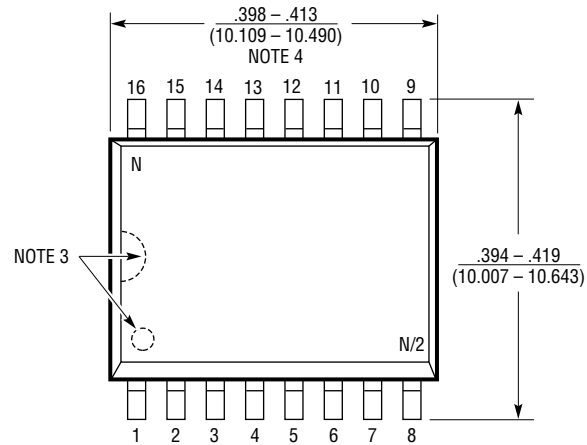
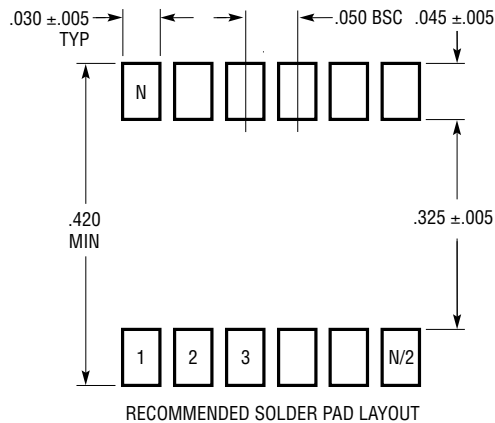


- NOTE:
1. DIMENSIONS IN  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$
  2. DRAWING NOT TO SCALE
  3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED  $.006"$  ( $0.15\text{mm}$ )

S08 0303

# PACKAGE DESCRIPTION

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



- NOTE:
1. DIMENSIONS IN  $\frac{\text{INCHES}}{\text{(MILLIMETERS)}}$
  2. DRAWING NOT TO SCALE
  3. PIN 1 IDENT, NOTCH ON TOP AND CAVITIES ON THE BOTTOM OF PACKAGES ARE THE MANUFACTURING OPTIONS. THE PART MAY BE SUPPLIED WITH OR WITHOUT ANY OF THE OPTIONS
  4. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)

S16 (WIDE) 0502

