



# LTC221/LTC222

## ABSOLUTE MAXIMUM RATINGS

(Note 1)

Voltages Referenced to  $V^-$

$V^+$ .....	44V
GND .....	25V
Digital Inputs, S, D (Note 2) .....	-2V to ( $V^+ + 2V$ ) or 20mA, Whichever Occurs First

Current

Any Input Except S or D .....	30mA
Continuous S or D .....	20mA
Peak S or D (Pulsed at 1 ms, 10% Duty Cycle Max) .....	70mA

ESD Susceptibility (Note 3) .....

Power Dissipation (Plastic) .....

Power Dissipation (Ceramic) .....

Operating Temperature Range

LTC221C/LTC222C .....

LTC221M/LTC222M (OBSOLETE).....

Storage Temperature Range .....

Lead Temperature (Soldering, 10 sec).....

## PACKAGE/ORDER INFORMATION

<p>N PACKAGE 16-LEAD PDIP <math>J_{MAX} = 110^{\circ}C</math>, <math>\theta_{JA} = 120^{\circ}C/W</math></p> <p>S PACKAGE 16-LEAD PLASTIC SO <math>J_{MAX} = 110^{\circ}C</math>, <math>\theta_{JA} = 130^{\circ}C/W</math></p> <p>J PACKAGE 16-LEAD CERDIP</p> <p><b>OBSOLETE PACKAGE</b> Consider the N or S Package for Alternate Source</p>	ORDER PART NUMBER
	LTC221CN LTC221CS LTC222CN LTC222CS
	LTC221MJ LTC221CJ LTC222MJ LTC222CJ

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

## LOGIC TABLE

INX	$\overline{WR}$	LTC221	LTC222
0	0	On	Off
1	0	Off	On
X	1	Maintain Previous State	Maintain Previous State

## DIGITAL AND DC ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over full operating temperature range, otherwise specifications are at  $T_A = 25^{\circ}C$ .  $V^+ = \pm 15V$ ,  $V^- = -15V$ , GND = 0V, unless noted.

PARAMETER	CONDITIONS	LTC221M/LTC222M			LTC221C/LTC222C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Analog Signal Range		●		$\pm 15$		$\pm 15$	V	
$R_{ON}$	$V_S = \pm 10V$ $I_D = 1mA$	$T_{MIN}$		90		90	$\Omega$	
		25°C		65	90	65	90	$\Omega$
		$T_{MAX}$			135		135	$\Omega$
Off Input Leakage $I_S$ (OFF)	$V_D = 14V$ , $V_S = \pm 14V$	●		0.01	$\pm 1$	0.01	$\pm 5$	nA
		●			$\pm 100$		$\pm 100$	nA
Off Output Leakage $I_D$ (OFF)	$V_{IN} = 2.4V$ , LTC221 $V_{IN} = 0.8V$ , LTC222	●		0.01	$\pm 1$	0.01	$\pm 5$	nA
		●			$\pm 100$		$\pm 100$	nA
On Channel Leakage $I_D$ (ON)	$V_D = V_S = \pm 14V$ , $V_{IN} = 2.4V$ , LTC222 $V_{IN} = 0.8V$ , LTC221	●		0.02	$\pm 1$	0.02	$\pm 5$	nA
		●			$\pm 200$		$\pm 200$	nA
Input High Voltage $V_{INH}$ , $V_{\overline{WRH}}$		●	2.4			2.4	V	
Input Low Voltage $V_{INL}$ , $V_{\overline{WRL}}$		●		0.8		0.8	V	
Input High or Low Current $I_{INH}$ , $I_{INL}$ , $I_{\overline{WRH}}$ , $I_{\overline{WRL}}$	$V_{IN} = 15V$ , 0V $V_{\overline{WR}} = 15V$ , 0V	●		$\pm 1$		$\pm 1$	$\mu A$	
$C_S$ (OFF)			5		5		pF	
$C_D$ (OFF)			12		12		pF	
$C_D$ , $C_S$ (ON)			30		30		pF	
$I^+$	All Channels On or Off $V_{IN} = V_{\overline{WR}} = 0V$ or 4.0V	●	16	40	16	40	$\mu A$	
		●		60		60	$\mu A$	

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## DIGITAL AND DC ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V^+ = \pm 15\text{V}$ ,  $V^- = -15\text{V}$ ,  $\text{GND} = 0\text{V}$ , unless noted.

PARAMETER	CONDITIONS	LTC221M/LTC222M			LTC221C/LTC222C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
$I^-$			0.1	5	0.1	5	$\mu\text{A}$	
		●		10		10		

## AC ELECTRICAL CHARACTERISTICS

$V^+ = 15\text{V}$ ,  $V^- = -15\text{V}$ ,  $\text{GND} = 0\text{V}$ , unless otherwise noted.

PARAMETER	CONDITIONS	LTC221M/LTC222M			LTC221C/LTC222C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{\text{ON}}$	$V_S = 2\text{V}$ , $R_L = 1\text{k}\Omega$ , $C_L = 35\text{pF}$		290	400	290	400	ns	
$t_{\text{OFF}}$			210	300	210	300		
$t_{\text{OPEN}}$		20	85		20	85	ns	
Off Isolation	$V_S = 2\text{Vp-p}$ , $R_L = 1\text{k}\Omega$ $f = 100\text{kHz}$		75		75		dB	
Crosstalk			90		90			
Charge Injection $O_{\text{INJ}}$	$R_{\text{GEN}} = 0\Omega$ , $C_L = 1000\text{pF}$ , $V_{\text{GEN}} = 0$		5	$\pm 25$	8	$\pm 25$	$\mu\text{C}$	
Total Harmonic Distortion THD	$V_S = 2\text{Vp-p}$ , $R_L = 10\text{k}\Omega$		0.01		0.01		%	
$t_{\text{ON}}, \overline{\text{WR}}$	$V_S = 2\text{V}$ , $R_L = 1\text{k}\Omega$ , $C_L = 35\text{pF}$		270	400	270	400	ns	
$t_{\text{OFF}}, \overline{\text{WR}}$			160	300	160	300		

## DIGITAL AND DC ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ .  $V^+ = 5\text{V}$ ,  $V^- = \text{GND} = 0\text{V}$ , unless noted.

PARAMETER	CONDITIONS	LTC221M/LTC222M			LTC221C/LTC222C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
Analog Signal Range		●	0	5	0	5	V	
$R_{\text{ON}}$	$V_S = 1.5\text{V}$ , $3\text{V}$ $I_D = 0.25\text{mA}$	$T_{\text{MIN}}$		450		520	$\Omega$	
		$25^\circ\text{C}$		280	450	280	520	$\Omega$
		$T_{\text{MAX}}$			650		650	$\Omega$
Off Input Leakage $I_S$ (OFF)	$V_D = 4\text{V}$ , $1\text{V}$ ; $V_S = 1\text{V}$ , $4\text{V}$ (Note 4)		0.01	$\pm 1$	0.01	$\pm 5$	nA	
		●		$\pm 100$		$\pm 100$	nA	
Off Output Leakage $I_D$ (OFF)			0.01	$\pm 1$	0.01	$\pm 5$	nA	
		●		$\pm 100$		$\pm 100$	nA	
On Channel Leakage $I_D$ (ON)	$V_D = V_S = 1\text{V}$ , $4\text{V}$ (Note 4)		0.01	$\pm 1$	0.01	$\pm 5$	nA	
		●		$\pm 200$		$\pm 200$	nA	
Input High Voltage $V_{\text{INH}}$ , $V_{\text{WRH}}$		●	2.4		2.4		V	
Input Low Voltage $V_{\text{INL}}$ , $V_{\text{WRL}}$		●		0.8		0.8	V	
Input High or Low Current $I_{\text{INH}}$ , $I_{\text{INL}}$ , $I_{\text{WRH}}$ , $I_{\text{WRL}}$	$V_{\text{IN}} = 5\text{V}$ , $0\text{V}$ $V_{\text{WR}} = 5\text{V}$ , $0\text{V}$	●		$\pm 1$		$\pm 1$	$\mu\text{A}$	
$C_S$ (OFF)			5		5		pF	
$C_D$ (OFF)			12		12		pF	
$C_D$ , $C_S$ (ON)			30		30		pF	
$I^+$	All Channels On or Off $V_{\text{IN}} = V_{\text{WR}} = 0\text{V}$ or $4.0\text{V}$		8	20	8	20	$\mu\text{A}$	
		●		30		30	$\mu\text{A}$	

## AC ELECTRICAL CHARACTERISTICS $V^+ = 5V, V^- = GND = 0V$ , unless otherwise noted.

PARAMETER	CONDITIONS	LTC221M/LTC222M			LTC221C/LTC222C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
$t_{ON}$	$V_S = 2V, R_L = 1k\Omega, C_L = 35pF$		450	600		450	600	ns
$t_{OFF}$			190	300		190	300	ns
$t_{OPEN}$		100	250		100	250		ns
Off Isolation	$V_S = 2V_{P-P}, R_L = 1k\Omega$		75			75		dB
Crosstalk	$f = 100kHz$		90			90		dB
Charge Injection $O_{INJ}$	$R_{GEN} = 0\Omega, C_L = 1000pF, V_{GEN} = 2.5V$		2			2		pC
Total Harmonic Distortion THD	$V_S = 2V_{P-P}, R_L = 10k\Omega$		0.01			0.01		%
$t_{ON, WR}$	$V_S = 2V, R_L = 1k\Omega, C_L = 35pF$		430	600		430	600	ns
$t_{OFF, WR}$			160	300		160	300	ns

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

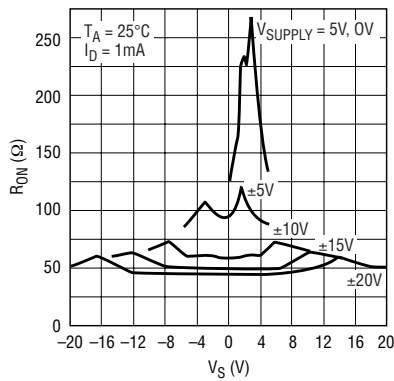
**Note 2:** Signals on S, D, or IN exceeding  $V^+$  or  $V^-$  will be clamped by internal diodes. Limit forward diode current to maximum current rating.

**Note 3:** In-circuit ESD on the switch pins (S or D) exceeds 4kV (see test circuit).

**Note 4:** Leakage current with a 5V supply is guaranteed by correlation with the  $\pm 15V$  leakage current.

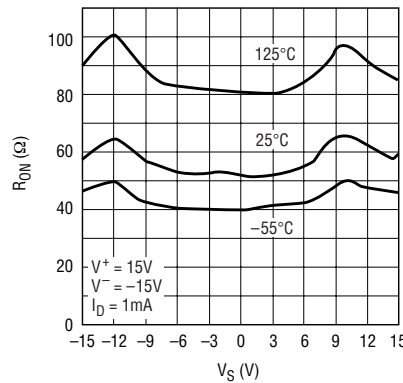
## TYPICAL PERFORMANCE CHARACTERISTICS

**$R_{ON}$  vs  $V_S$  Over Supply Voltage**



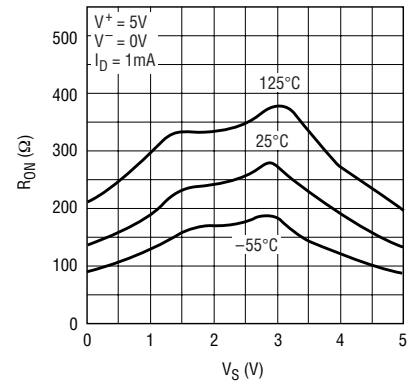
LTC221/222 • TPC01

**$R_{ON}$  vs  $V_S$  Over Temperature**



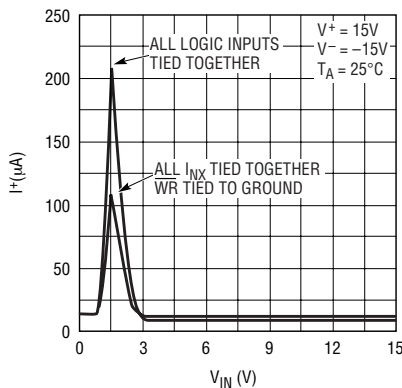
LTC221/222 • TPC02

**$R_{ON}$  vs  $V_S$  Over Temperature**



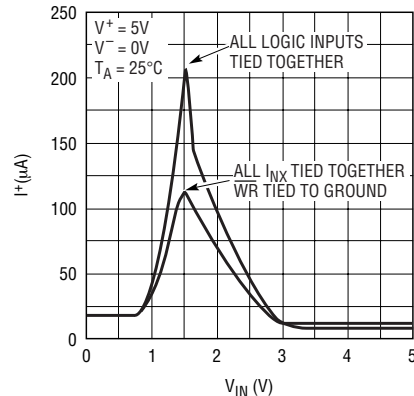
LTC221/222 • TPC03

**Positive Supply Current vs Logic Input Voltage**



LTC221/222 • TPC04

**Positive Supply Current vs Logic Input Voltage**



LTC221/222 • TPC05

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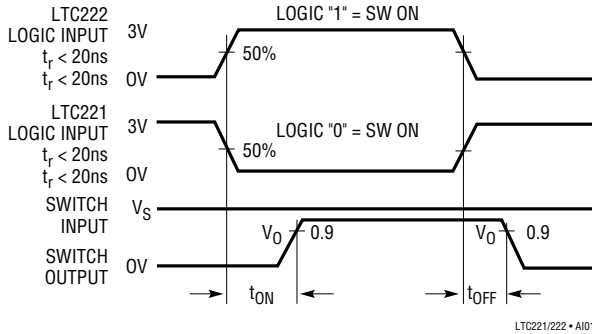
# APPLICATIONS INFORMATION

## Switching Time Test Circuit

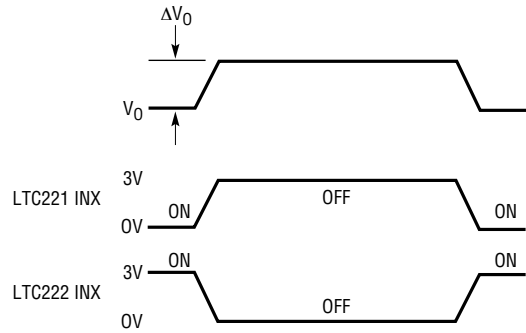
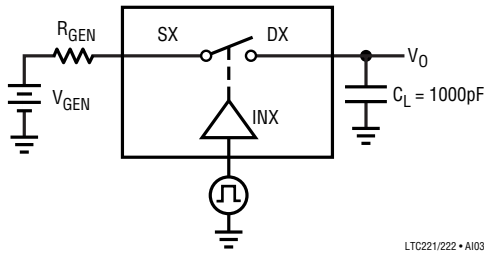
Switch output waveform shown for  $V_S = \text{constant}$  with logic input waveform as shown. Note that  $V_S$  may be (+) or (-) as per switching time test circuit.  $V_O$  is the steady

state output switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

### Switching Time Test Circuit



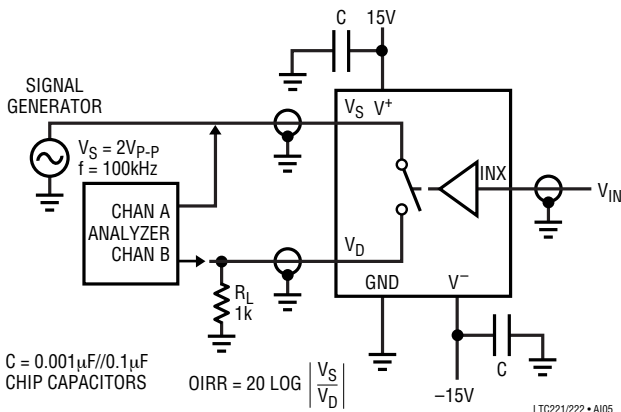
### Charge Injection Test Circuit



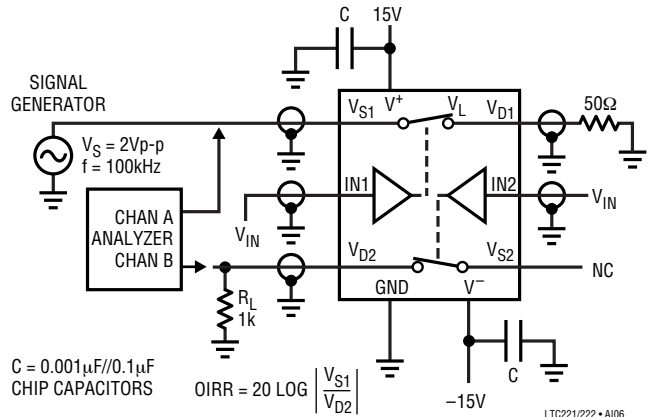
$\Delta V_O$  IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.  
 THE ERROR VOLTAGE IN COULOMBS IS  $\Delta Q = V_L \cdot \Delta V_O$

LTC221/222 • AI04

### OIRR-Off Isolation Test Circuit

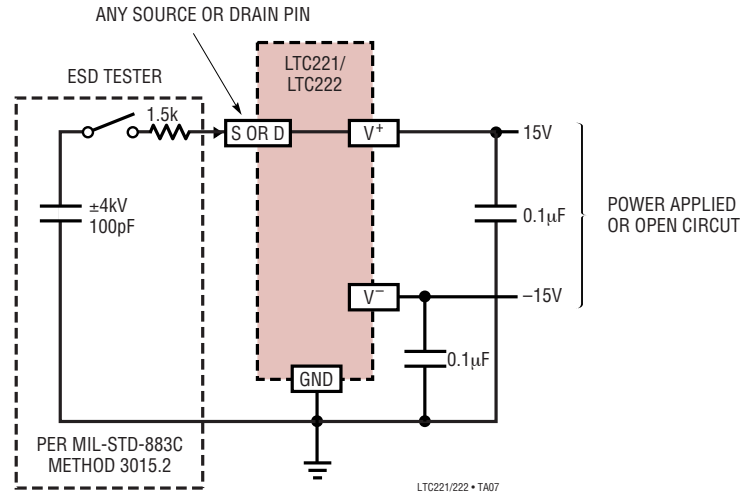


### CCRR-Channel to Channel Crosstalk Test Circuit

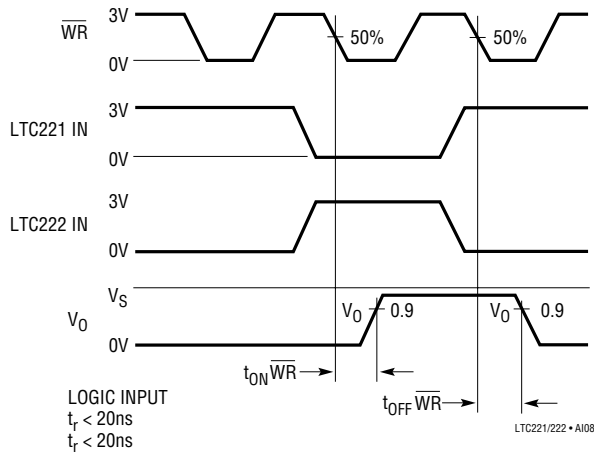


## APPLICATIONS INFORMATION

### In-Circuit ESD Test Circuit



### WR Switching Time Test Circuit



### WR Setup Conditions



### WR/Input Minimum Timing Requirements

PARAMETER	MIN LIMIT	UNITS
t <sub>WW</sub>	230	ns
t <sub>DW</sub>	180	ns
t <sub>WD</sub>	30	ns

# APPLICATIONS INFORMATION

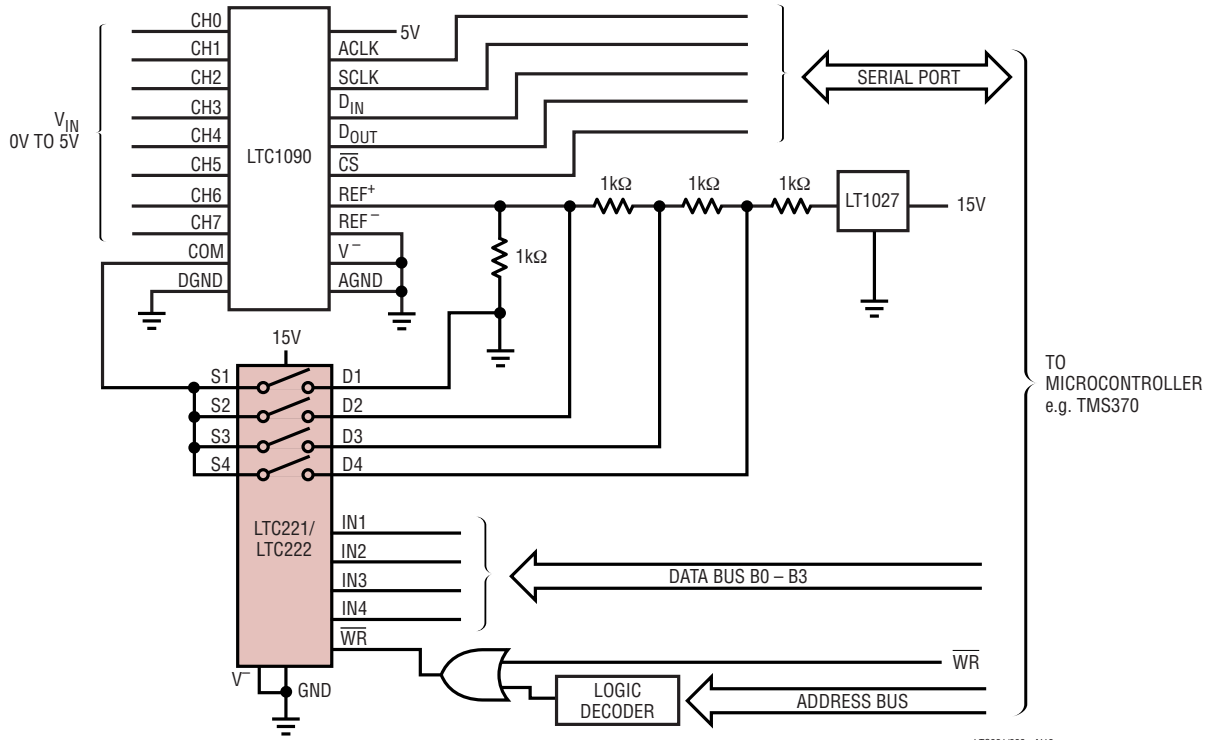
Auto Ranging an 8-Channel, 10-Bit A/D Converter



LTC221/222 • A111

## APPLICATIONS INFORMATION

### 8-Channel, 14-Bit A/D Converter

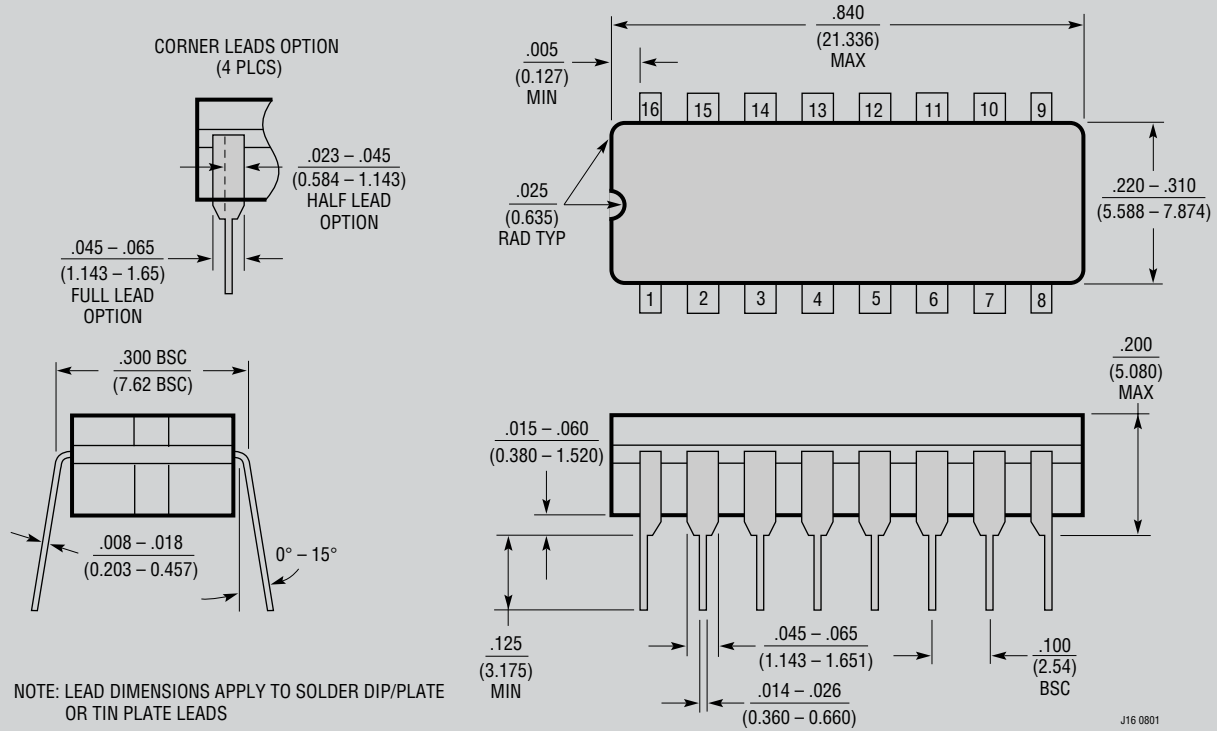


LTC221/222 • AI12



**PACKAGE DESCRIPTION**

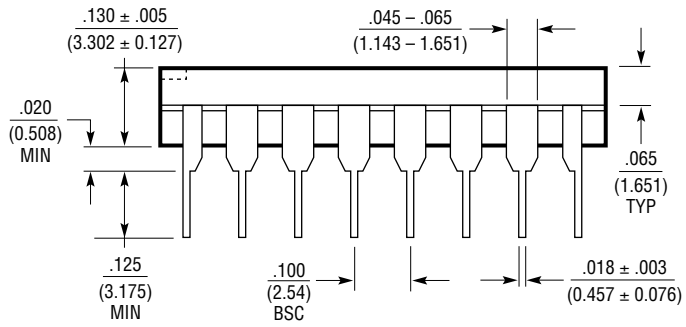
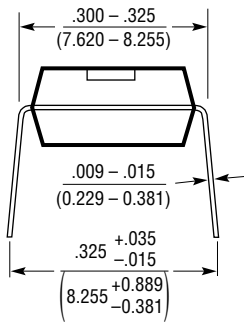
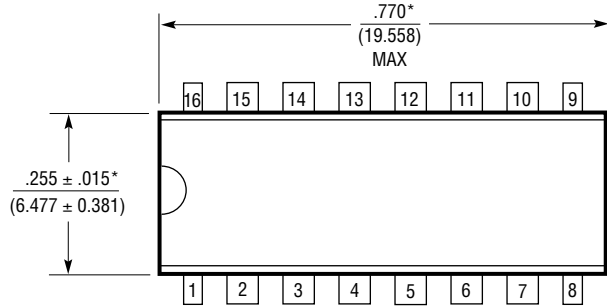
**J Package**  
**16-Lead CERDIP (Narrow .300 Inch, Hermetic)**  
 (Reference LTC DWG # 05-08-1110)



**OBSOLETE PACKAGE**

**PACKAGE DESCRIPTION**

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

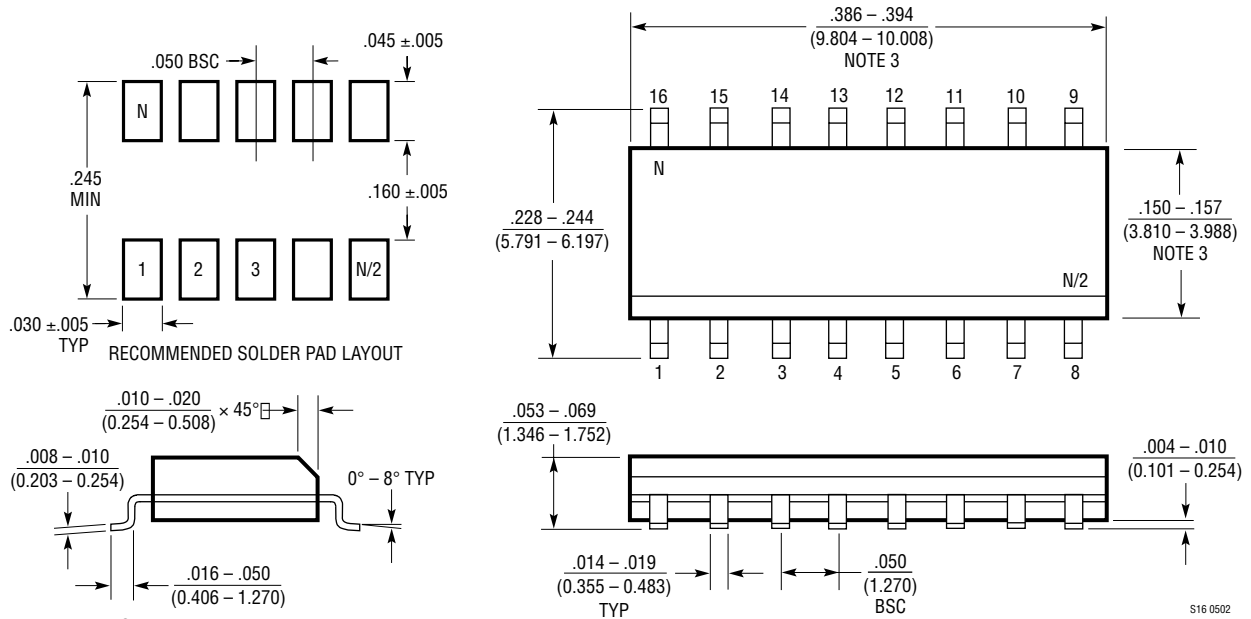


NOTE:  
 1. DIMENSIONS ARE  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$   
 \*THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
 MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .010 INCH (0.254mm)

N16 0502

# PACKAGE DESCRIPTION

## S Package 16-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  $.006''$  ( $0.15\text{mm}$ )

S16 0502

# LTC221/LTC222

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## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC201/LTC202/LTC203	Micropower, Low Charge Injection, Quad CMOS Analog Switches	DG201/DG202 Compatible
LTC1380/LTC1393	8-Channel/4-Channel Analog Multiplexer with SMBus Interface	3V to $\pm 15V$ , 8 Single Ended/4 Differential Inputs
LTC1390/LTC1391	8-Channel, Analog Multiplexer with Serial Interface	3V to $\pm 15V$ Operation