

FEATURES

- Micropower Operation
- Single 5V or $\pm 15\text{V}$ Supply Operation
- Low Charge Injection
- Low R_{ON}
- Low Leakage
- Guaranteed Break Before Make
- Latch Resistant Design
- TTL/CMOS Compatible
- Improved Second Source for DG201A/DG202

KEY SPECIFICATIONS

- | | |
|------------------------|--------------------------------------|
| ■ Supply Current | $I^+ = 40\mu A$, $I^- = 5\mu A$ Max |
| ■ Charge Injection | |
| ±15V Supplies | ±25pC Max |
| Single 5V Supply | 2pC Typ |
| ■ R_{ON} | 65Ω Typ |
| ■ Signal Range | ±15V |

DESCRIPTION

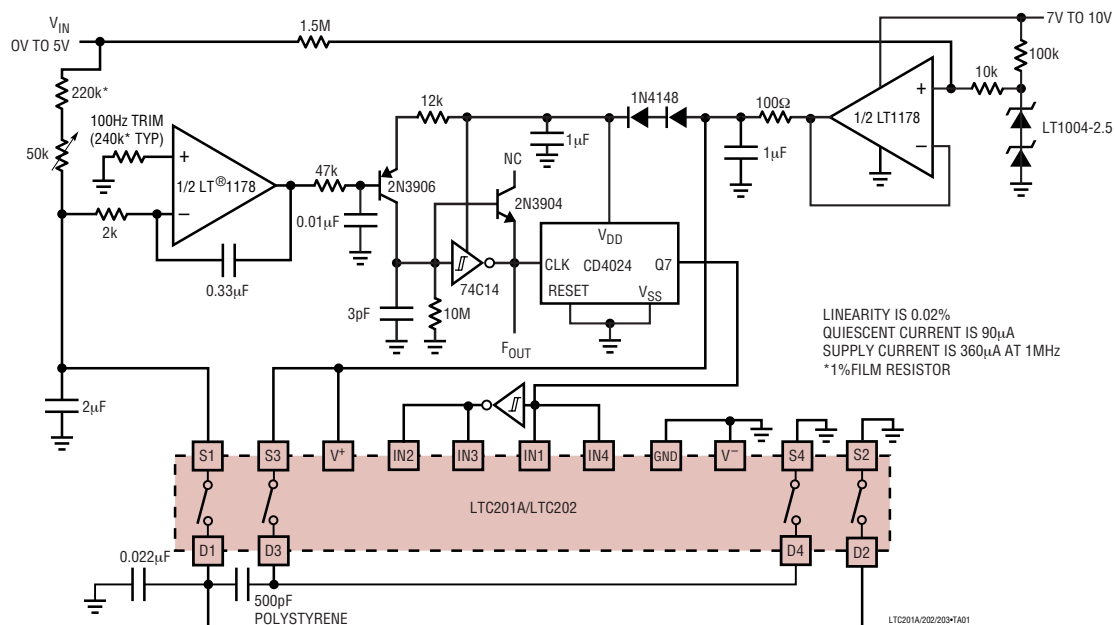
The LTC®201A, LTC202, and LTC203 are micropower, quad CMOS analog switches which typically dissipate only 250µW from ±15V supplies and 40µW from a single 5V supply. The switches have 65Ω typical on resistance and a very high off resistance. A break-before-make characteristic, inherent in these switches, prevents the shorting of two channels. With a supply voltage of ±15V, the signal range is ±15V. These switches have special charge compensation circuitry which greatly reduces charge injection to a maximum of ±25pC (±15V supplies).

The LTC201A, LTC202, and LTC203 are designed for applications such as programmable gain amplifiers, analog multiplexers, sample-and-hold circuits, precision charge switching and remote switching. These three devices are differentiated by the type of switch action, as shown in the logic table.

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TYPICAL APPLICATION

Micropower 100Hz to 1MHz V-to-F Converter



LTC201A/LTC202/LTC203

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 1ms, 10% Duty Cycle Max)	70mA

ESD Susceptibility (Note 3) 4kV

Power Dissipation (Plastic) 500mW

Power Dissipation (Ceramic) 900mW

Operating Temperature Range

LTC201AC/LTC202C/LTC203C 0°C to 70°C

LTC201AM/LTC202M/LTC203M -55°C to 125°C

Storage Temperature Range -65°C to 150°C

Lead Temperature (Soldering, 10 sec) 300°C

LOGIC TABLE

IN_X	LTC201A IN1 TO IN4	LTC202 IN1 TO IN4	LTC203 IN1, IN4 IN2, IN3	
0	ON	OFF	OFF	ON
1	OFF	ON	ON	OFF

PACKAGE/ORDER INFORMATION

TOP VIEW N PACKAGE 16-LEAD PDIP $T_{JMAX} = 110^\circ\text{C}, \theta_{JA} = 120^\circ\text{C/W}$ S PACKAGE 16-LEAD PLASTIC SO $T_{JMAX} = 110^\circ\text{C}, \theta_{JA} = 130^\circ\text{C/W}$ J PACKAGE 16-LEAD CERDIP $T_{JMAX} = 150^\circ\text{C}, \theta_{JA} = 100^\circ\text{C/W}$	ORDER PART NUMBER
	LTC201ACN LTC201ACS LTC202CN LTC202CS LTC203CN LTC203CS
OBSELETE PACKAGE Consider the N16 or SO-16 Package for Alternate Source	ORDER PART NUMBER
	LTC201AMJ LTC201ACJ LTC202MJ LTC202CJ LTC203MJ LTC203CJ

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

DIGITAL AND DC ELECTRICAL CHARACTERISTICS

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

PARAMETER	CONDITIONS			LTC201AM/LTC202M/ LTC203M			LTC201AC/LTC202C/ LTC203C			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
Analog Signal Range			●			±15			±15	V
R_{ON}	$V_S = \pm 10V$ $I_D = 1mA$	T_{MIN}				110			125	Ω
		25°C			65	110		65	125	Ω
		T_{MAX}				160			160	Ω
ΔR_{ON} vs V_S					20			20		%
ΔR_{ON} vs Temperature					0.5			0.5		%/°C
R_{ON} Match	$V_S = 0V, I_{DS} = 1mA$				5			5		%
Off Input Leakage I_S (OFF)	$V_D = \pm 14V, V_S = \pm 14V$ Switch Off		●		0.01	±1 ±100		0.01	±5 ±100	nA nA

DIGITAL AND DC ELECTRICAL CHARACTERISTICS

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

PARAMETER	CONDITIONS		LTC201AM/LTC202M/ LTC203M			LTC201AC/LTC202C/ LTC203C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Off Output Leakage I_D (OFF)	$V_D = \pm 14\text{V}$, $V_S = \pm 14\text{V}$ Switch Off	●		0.01	± 1 ± 100		0.01	± 5 ± 100	nA nA
On Channel Leakage I_D (ON)	$V_D = V_S = \pm 14\text{V}$ Switch On			0.02	± 1		0.02	± 5	nA
		●			± 200			± 200	nA
Input High Voltage V_{INH}		●	2.4			2.4			V
Input Low Voltage V_{INL}		●			0.8			0.8	V
Input High or Low Current I_{INH} and I_{INL}	$V_{IN} = 15\text{V}$, 0V	●			± 1			± 1	μA
C_S (OFF)				5			5		pF
C_D (OFF)				12			12		pF
C_D , C_S (ON)				30			30		pF
I^+	All Logic Inputs Tied Together $V_{IN} = 0\text{V}$ or 4.0V		16		40	16		40	μA
		●			60			60	μA
I^-				0.1	5		0.1	5	μA
		●			10			10	μA

AC ELECTRICAL CHARACTERISTICS

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

PARAMETER	CONDITIONS		LTC201AM/LTC202M/ LTC203M			LTC201AC/LTC202C/ LTC203C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
t_{ON}	$V_S = 2\text{V}$, $R_L = 1\text{k}\Omega$, $C_L = 35\text{pF}$			290	400		290	400	ns
t_{OFF}				210	300		210	300	ns
t_{OPEN}			20	85		20	85		ns
Off Isolation	$V_S = 2V_{P-P}$, $R_L = 1\text{k}\Omega$, $f = 100\text{kHz}$			75			75		dB
Crosstalk				90			90		dB
Charge Injection O_{INJ}	$R_S = 0\Omega$, $C_L = 1000\text{pF}$, $V_S = 0\text{V}$			5	± 25		8	± 25	pC
Total Harmonic Distortion THD	$V_S = 2V_{P-P}$, $R_L = 10\text{k}\Omega$			0.01			0.01		%

LTC201A/LTC202/LTC203

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 otherwise noted.

PARAMETER	CONDITIONS		LTC201AM/LTC202M/ LTC203M			LTC201AC/LTC202C/ LTC203C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
Analog Signal Range		●	0		5	0		5	V
R_{ON}	$V_S = \pm 1.5\text{V}, +3\text{V}$ $I_D = 0.25\text{mA}$	T_{MIN}			450			520	Ω
		25°C		280	450		280	525	Ω
		T_{MAX}			650			650	Ω
ΔR_{ON} vs V_S				20			20		%
ΔR_{ON} vs Temperature				0.5			0.5		%/ $^\circ\text{C}$
ΔR_{ON} Match	$V_S = 2.5\text{V}$, $I_{DS} = 0.25\text{mA}$			5			5		%
Off Input Leakage I_S (OFF)	$V_D = 4\text{V}, 1\text{V}$; $V_S = 1\text{V}, 4\text{V}$ (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		●			± 100			± 100	nA
Off Output Leakage I_D (OFF)	$V_D = 4\text{V}, 1\text{V}$; $V_S = 1\text{V}, 4\text{V}$ (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		●			± 100			± 100	nA
On Channel Leakage I_D (ON)	$V_D = V_S = 1\text{V}, 4\text{V}$ (Note 4) Switch On			0.01	± 1		0.01	± 5	nA
		●			± 200			± 200	nA
Input High Voltage V_{INH}		●	2.4			2.4			V
Input Low Voltage V_{INL}		●			0.8			0.8	V
Input High or Low Current I_{INH} and I_{INL}	$V_{IN} = 5\text{V}, 0\text{V}$	●			± 1			± 1	μA
C_S (OFF)				5			5		pF
C_D (OFF)				12			12		pF
C_D, C_S (ON)				30			30		pF
I^+	All Logic Inputs Tied Together $V_{IN} = 0\text{V}$ OR 4.0V			8	20		8	20	μA
		●			30			30	μA

AC ELECTRICAL CHARACTERISTICS

$V^+ = 5\text{V}$, $V^- = \text{GND} = 0\text{V}$ unless otherwise noted.

PARAMETER	CONDITIONS	LTC201AM/LTC202M/ LTC203M			LTC201AC/LTC202C/ LTC203C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
t_{ON}	$V_S = 2\text{V}$, $R_L = 1\text{k}\Omega$, $C_L = 35\text{pF}$		450	600		450	600	ns
t_{OFF}			190	300		190	300	ns
t_{OPEN}		100	250		100	250		ns
Off Isolation	$V_S = 2V_{P-P}$, $R_L = 1\text{k}\Omega$, $f = 100\text{Hz}$		75			75		dB
Crosstalk			90			90		dB
Charge Injection Q_{INJ}	$R_S = 0\Omega$, $C_L = 1000\text{pF}$, $V_S = 2.5\text{V}$		2			2		pC
Total Harmonic Distortion THD	$V_S = 2V_{P-P}$, $R_L = 10\text{k}\Omega$		0.01			0.01		%

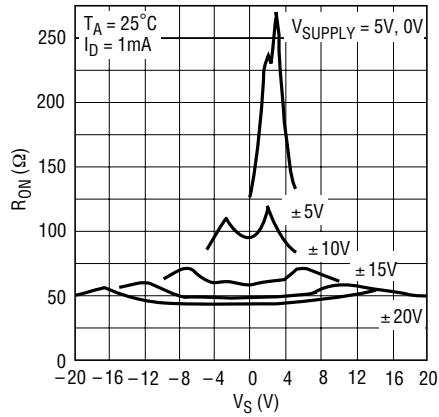
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

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.

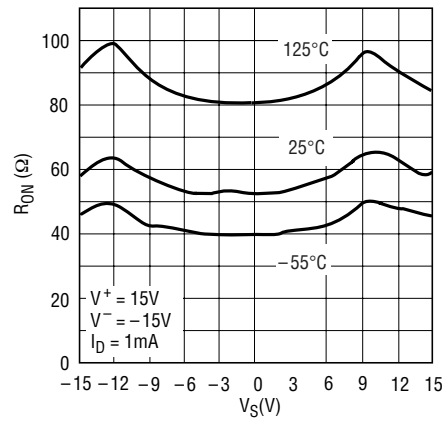
Note 3: In-circuit ESD on the switch pins (S or D) exceeds 4kV (see test circuit).

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

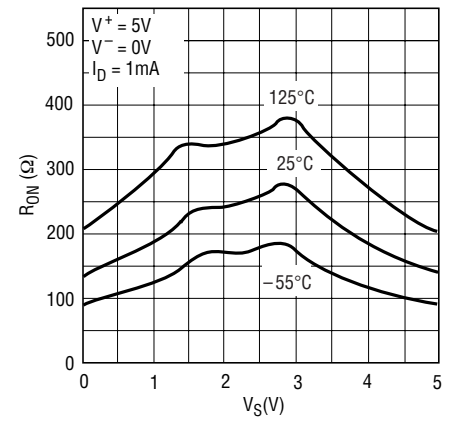
TYPICAL PERFORMANCE CHARACTERISTICS

 R_{ON} vs V_S Over Supply Voltage

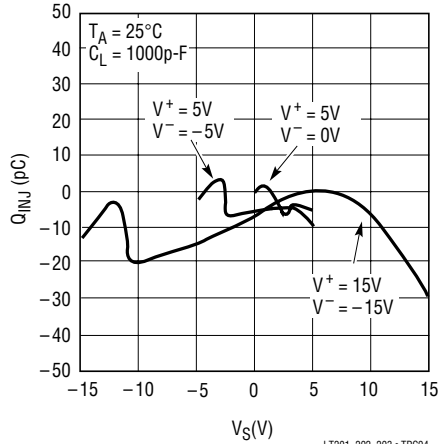
LT201_202_203 • TPC01

 R_{ON} vs V_S Over Temperature

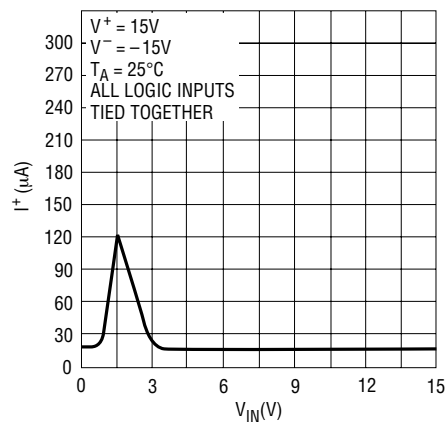
LT201_202_203 • TPC02

 R_{ON} vs V_S Over Temperature

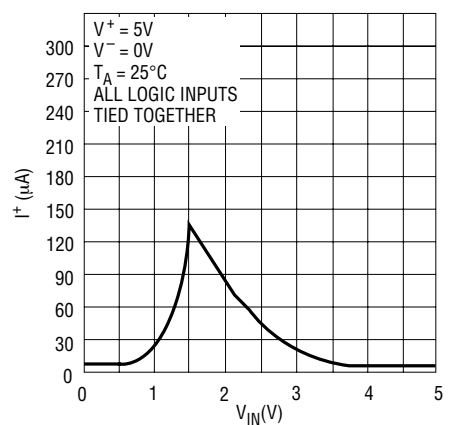
LT201_202_203 • TPC03

 Q_{INJ} vs V_S Over Supply Voltage

LT201_202_203 • TPC04

Positive Supply Current vs Logic Input Voltage

LT201_202_203 • TPC05

Supply Current vs Logic Input Voltage

LT201_202_203 • TPC06

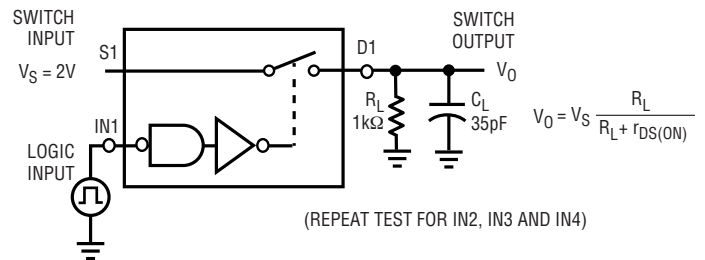
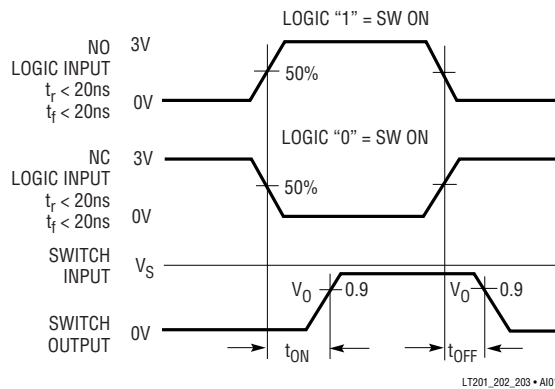
APPLICATIONS INFORMATION

Switching Time Test Circuit

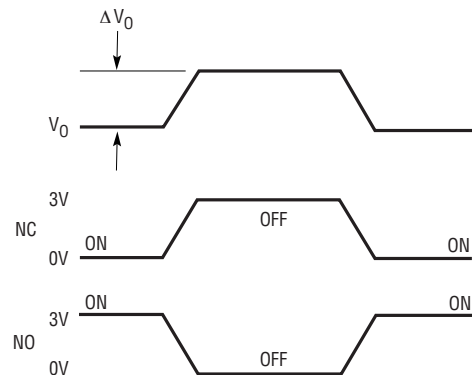
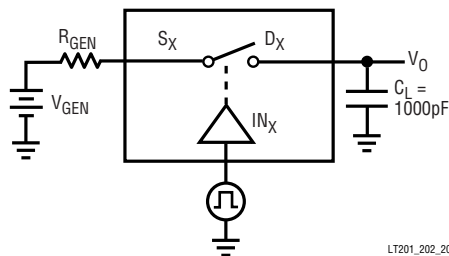
Switch output waveform shown for $V_S = \text{constant}$ with logic input waveform as shown. Note that V_S may be + or – as per switching time test circuit. V_O is the steady state

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

Switching Time Test Circuit



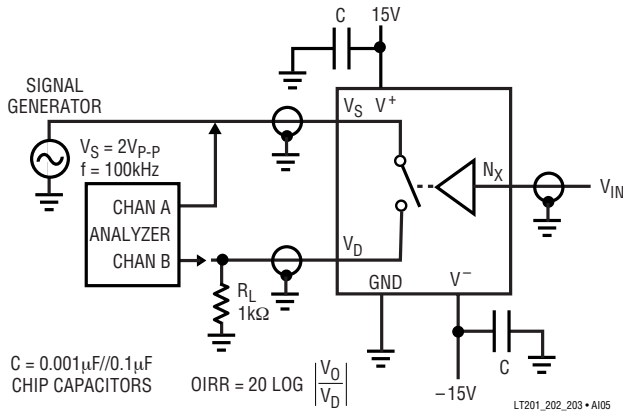
Charge Injection Test Circuit



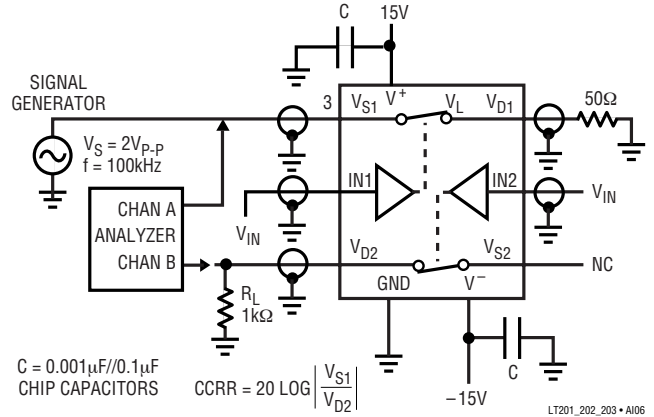
ΔV_O IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.
THE ERROR VOLTAGE IN COULOMBS IS $\Delta Q = C_L \cdot \Delta V_O$

LT201_202_203 • A104

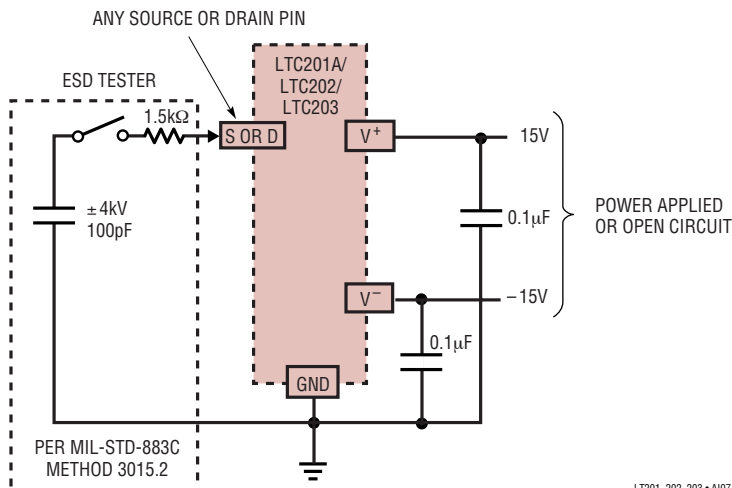
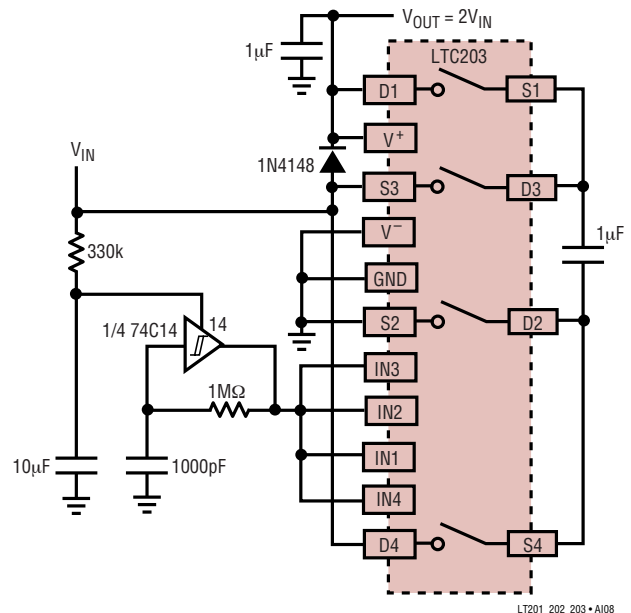
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit


V_{IN}	
3V	NC
0V	NO

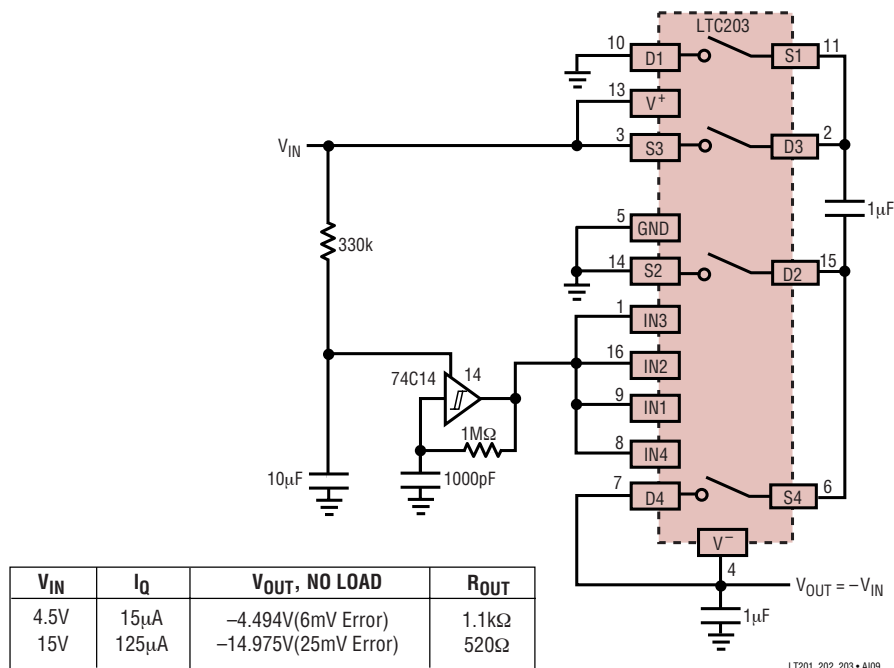
CCRR-Channel to Channel Crosstalk Test Circuit


V_{IN}	
3V	NC
0V	NO

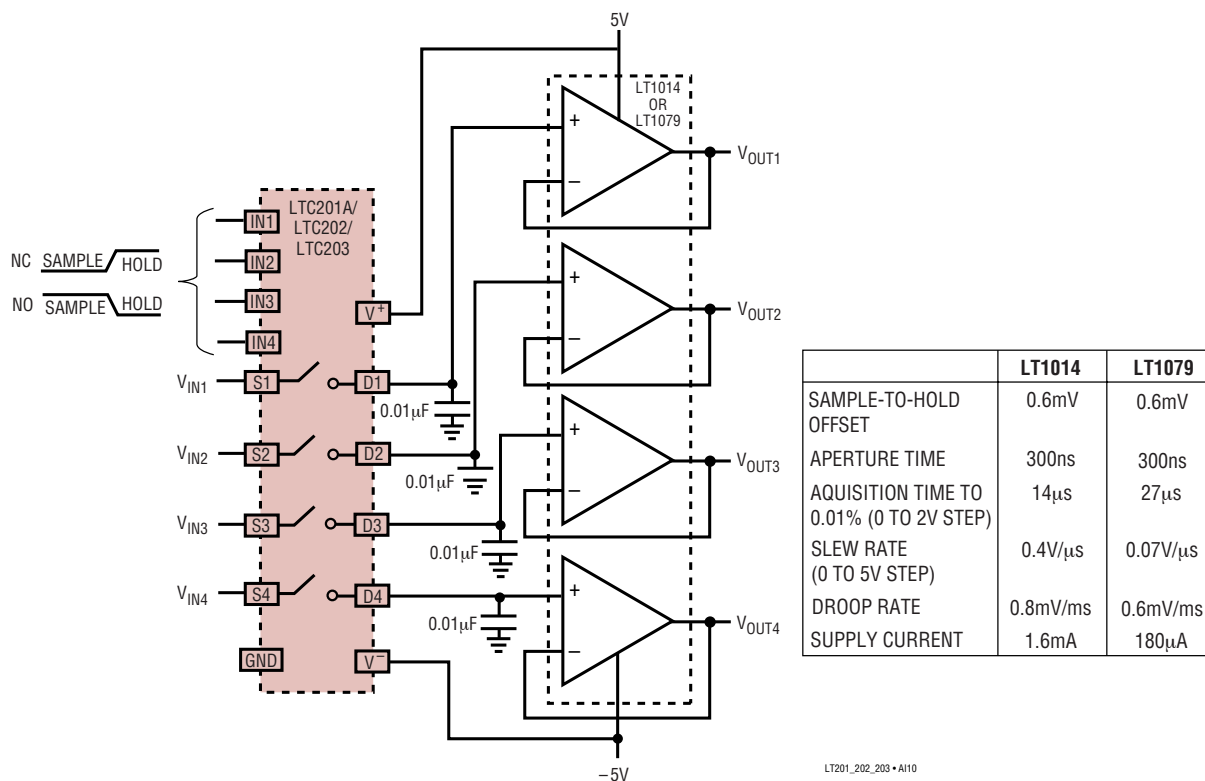
In-Circuit ESD Test Circuit

**Micropower, 4.5V to 15V Input,
Voltage Doubler Using the LTC203**


V_{IN}	I_Q	V_{OUT} , NO LOAD	R_{OUT}
4.5V	20μA	8.988V(12mV Error)	1.2k
15V	130μA	29.96V(40mV Error)	600Ω

Micropower, $\pm 4.5\text{V}$ to $\pm 15\text{V}$, Voltage Inverter Using the LTC203



Quad 12-Bit Sample-and-Hold



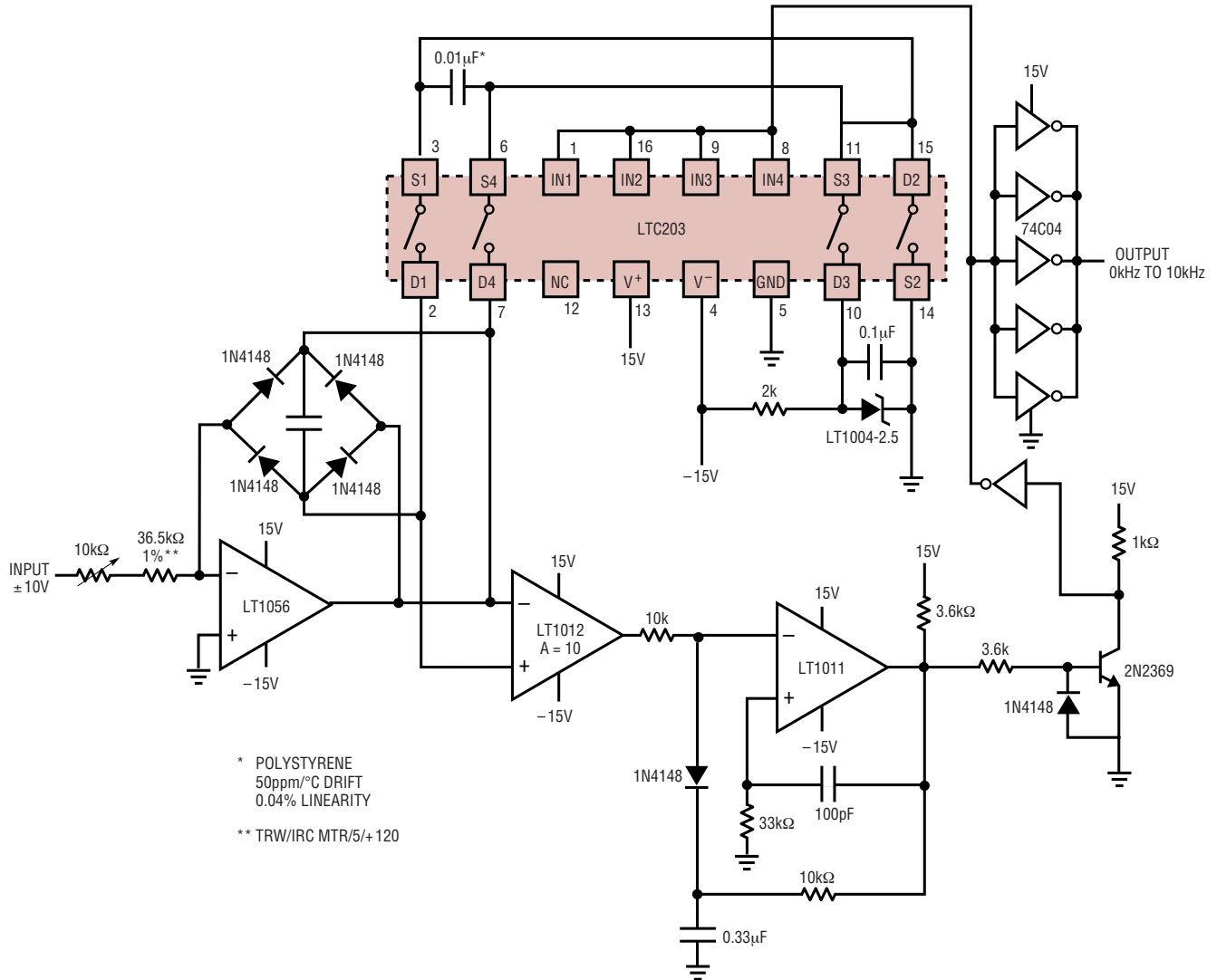
NOISE: 40nV_{p-p} 0.1Hz TO 10Hz
 V_{OS} : 1μV
 DRIFT: 0.05μV/°C
 GAIN: $\frac{R_2}{R_1} + 1$

A graph showing a noisy signal. The vertical axis has a scale bar indicating 50nV. The horizontal axis has a scale bar indicating 10 sec. The signal is a high-frequency, low-amplitude noise centered around a horizontal line.

LTC201A/202/203 • AI12

APPLICATIONS INFORMATION

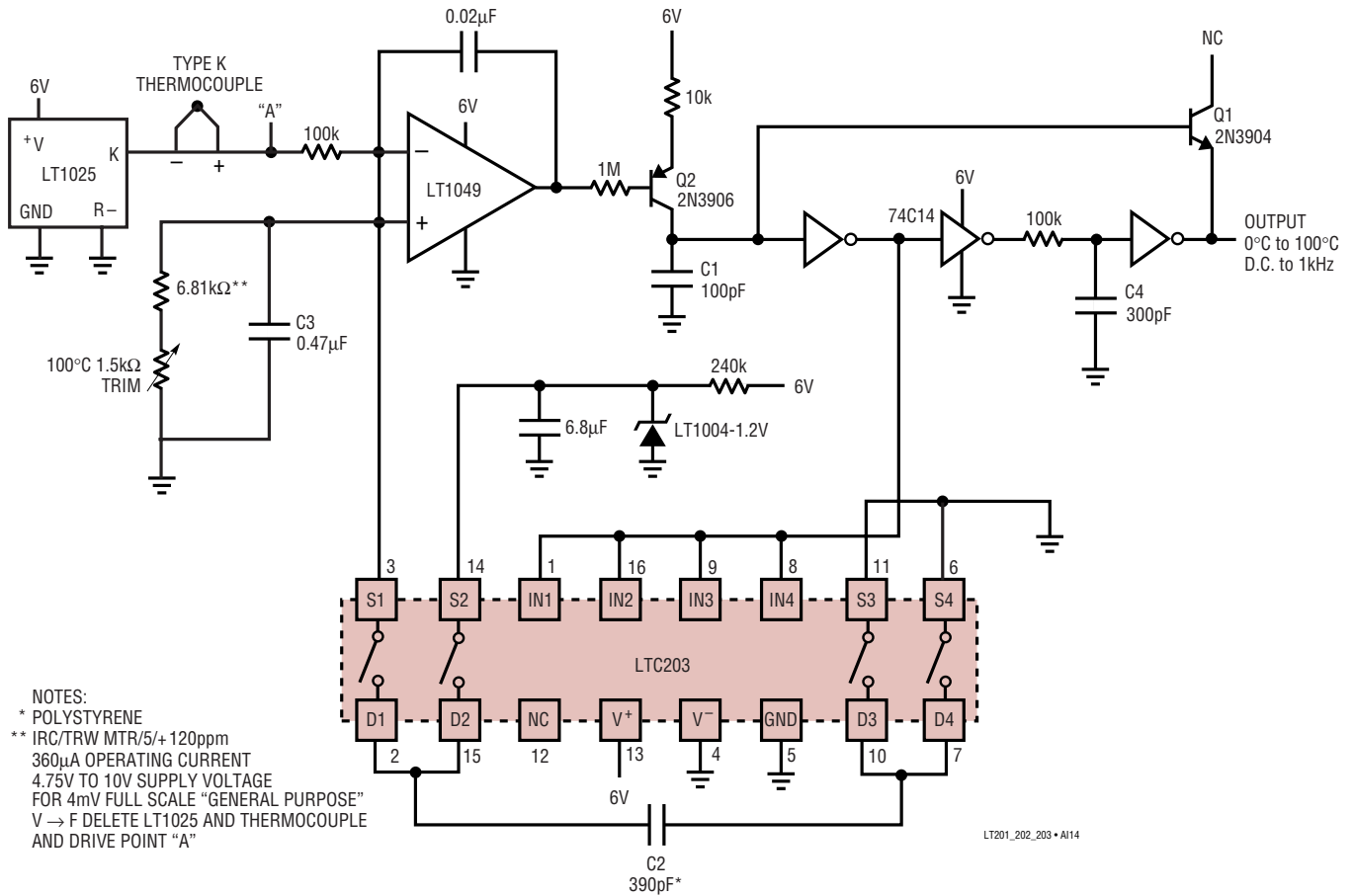
Bipolar (AC) Input V/F Converter



LT201_202_203 • A113

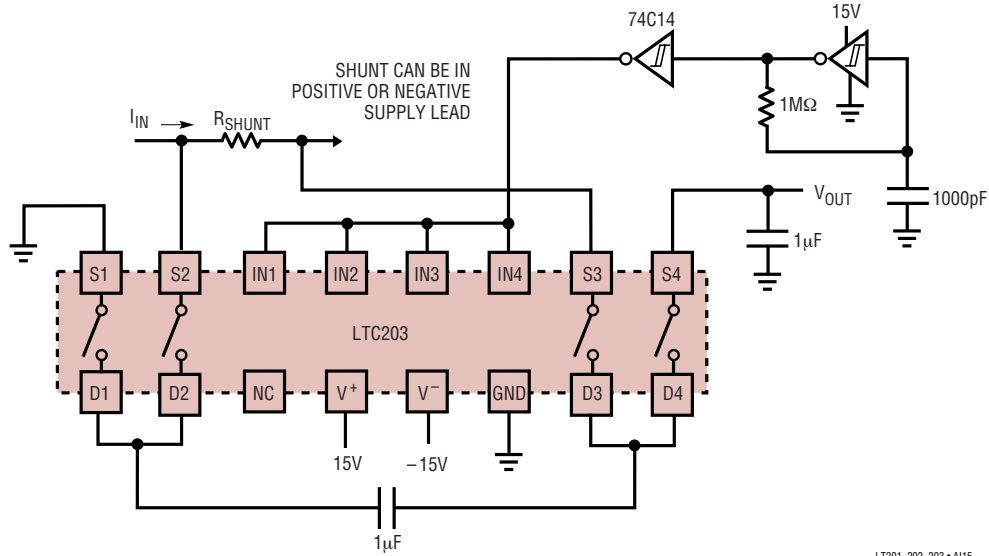
APPLICATIONS INFORMATION

Micropower Thermocouple Temperature to Frequency Converter

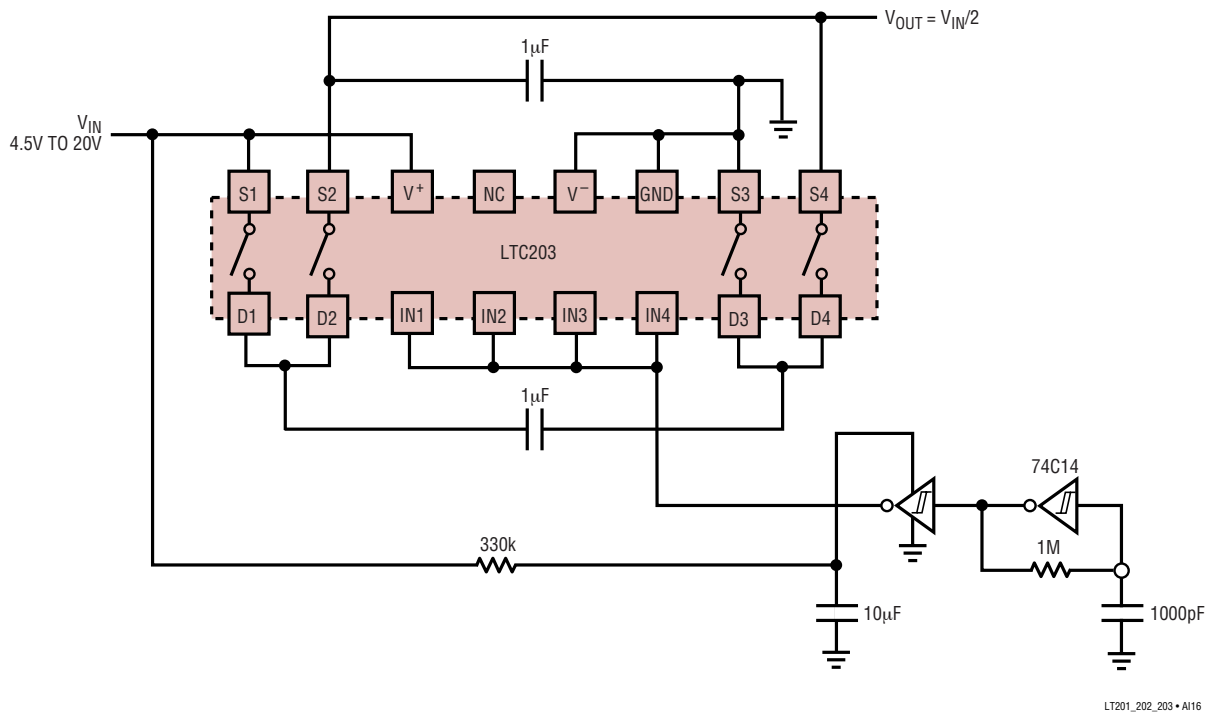


APPLICATIONS INFORMATION

Precision Current Sensing in Supply Rails

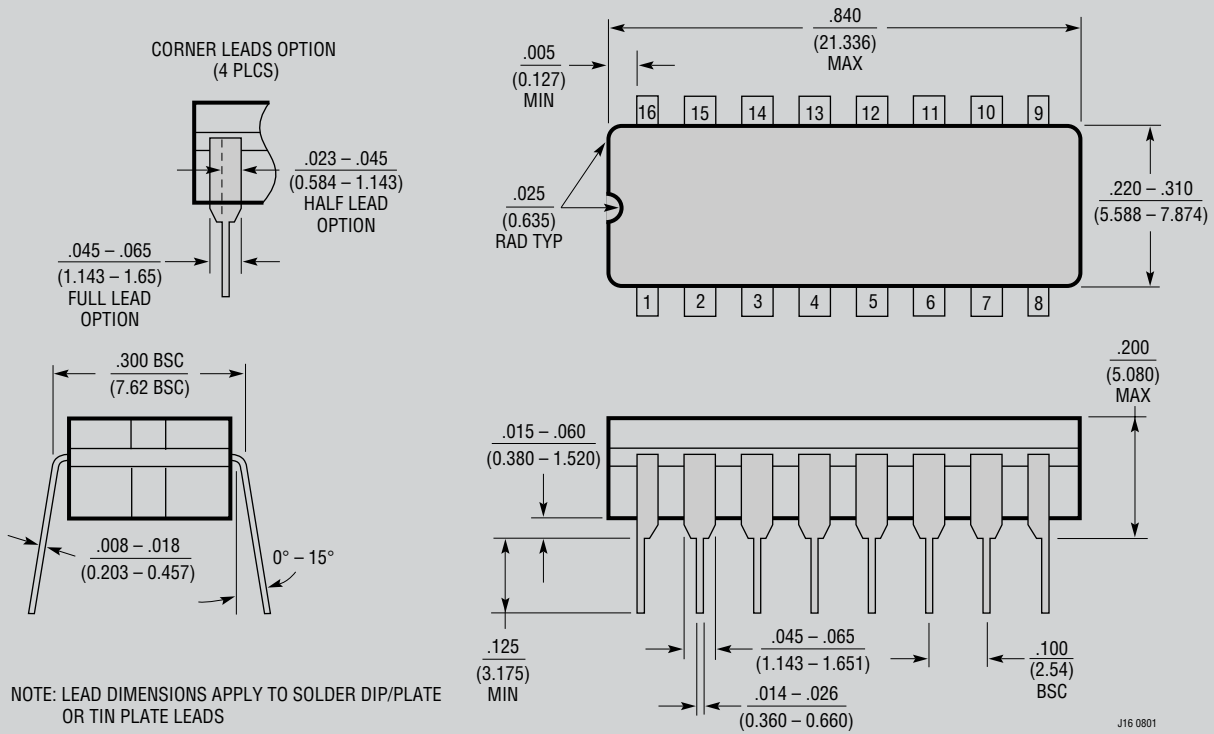


Precision Voltage Divide by 2 Circuit



PACKAGE DESCRIPTION

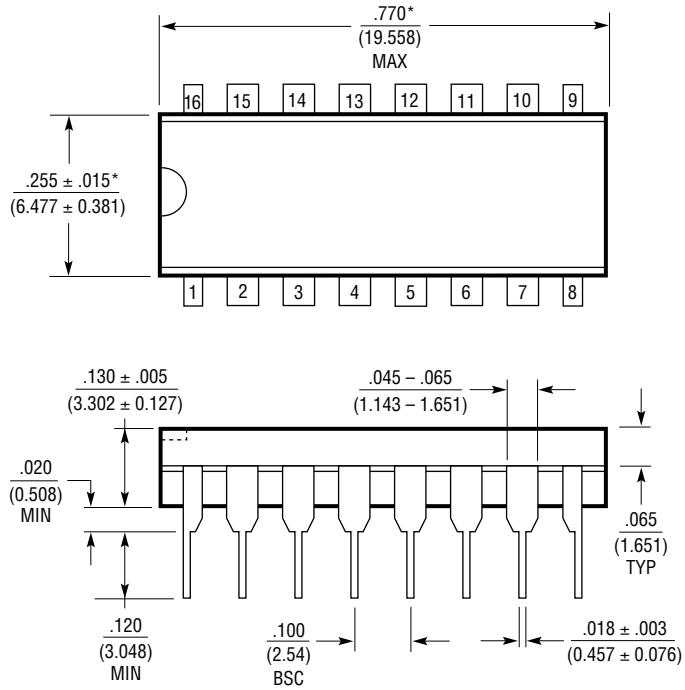
J Package
16-Lead CERDIP (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



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 1002

LTC201A/LTC202/LTC203

RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC221/LTC222	Micropower, Low Charge Injection, Quad CMOS Analog Switches	Parallel Controlled with Data Latches
LTC1380/LTC1393	8-Channel/4-Channel Differential Analog Multiplexer with SMBus Interface	3V to $\pm 15V$, $R_{ON} = 35\Omega$ Single-Ended/ 70Ω Differential
LTC1390/LTC1391	8-Channel, Analog Multiplexer with Serial Interface	3V to $\pm 15V$, $R_{ON} = 45\Omega$, Low Charge Injection
LT1675/LT1675-1	250MHz, Triple and Single RGB Multiplexer	100MHz Pixel Switching, 1100V/ μs Slew Rate