

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

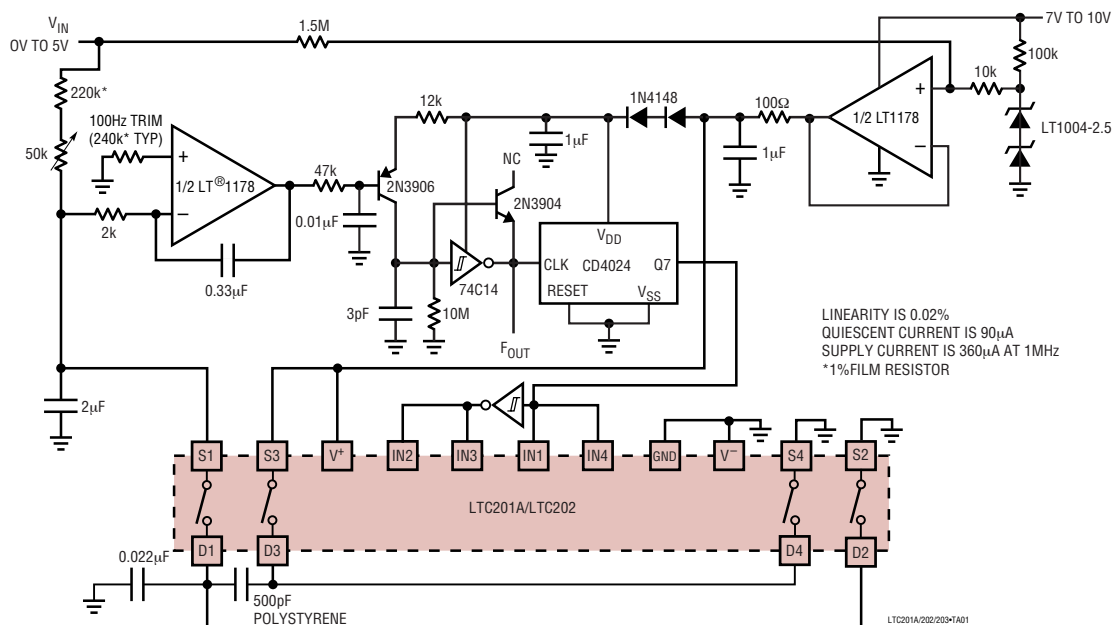
The LTC®201A, LTC202, and LTC203 are micropower, quad CMOS analog switches which typically dissipate only 250µW from ±15V supplies and 40µW from a single 5V supply. The switches have 65Ω typical on resistance and a very high off resistance. A break-before-make characteristic, inherent in these switches, 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 $T_{JMAX} = 110^\circ\text{C}$, $\theta_{JA} = 120\text{C/W}$ S PACKAGE 16-LEAD PLASTIC SO $T_{JMAX} = 110^\circ\text{C}$, $\theta_{JA} = 130\text{C/W}$ J PACKAGE 16-LEAD CERDIP $T_{JMAX} = 150^\circ\text{C}$, $\theta_{JA} = 100\text{C/W}$	ORDER PART NUMBER
	LTC201ACN LTC201ACS LTC202CN LTC202CS LTC203CN LTC203CS
	ORDER PART NUMBER
	LTC201AMJ LTC201ACJ LTC202MJ LTC202CJ LTC203MJ LTC203CJ

OBSOLETE PACKAGE

Consider the N16 or SO-16 Package for Alternate Source

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

201a23fb

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)	$V_D = 4\text{V}$, 1V ; $V_S = 1\text{V}$, 4V (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		●			± 100			± 100	nA
Off Output Leakage I_D (OFF)	$V_D = 4\text{V}$, 1V ; $V_S = 1\text{V}$, 4V (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		●			± 100			± 100	nA
On Channel Leakage I_D (ON)	$V_D = V_S = 1\text{V}$, 4V (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}	$V_{IN} = 5\text{V}$, 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			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		%

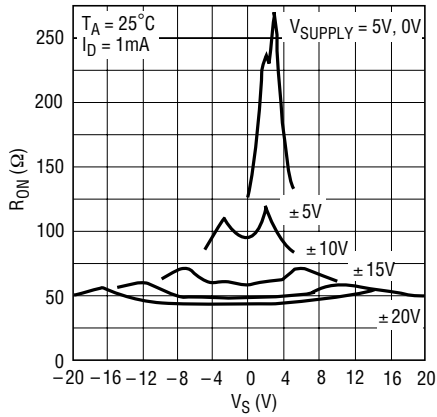
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

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.

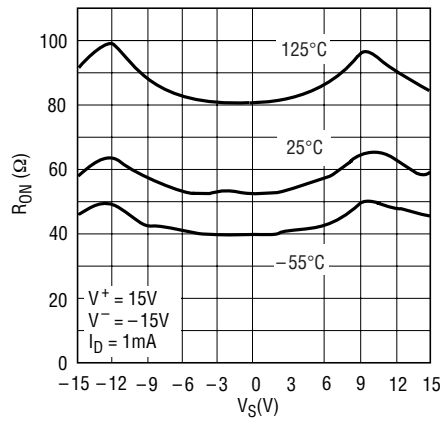
Note 3: In-circuit ESD on the switch pins (S or D) exceeds 4kV (see test circuit).

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

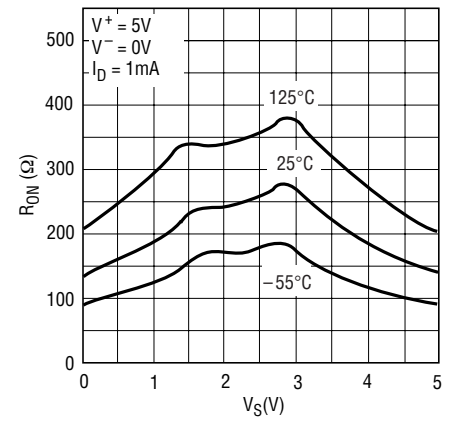
TYPICAL PERFORMANCE CHARACTERISTICS

 R_{ON} vs V_S Over Supply Voltage

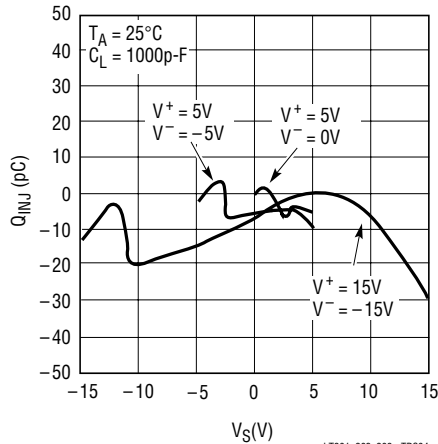
LT201_202_203 • TPC01

 R_{ON} vs V_S Over Temperature

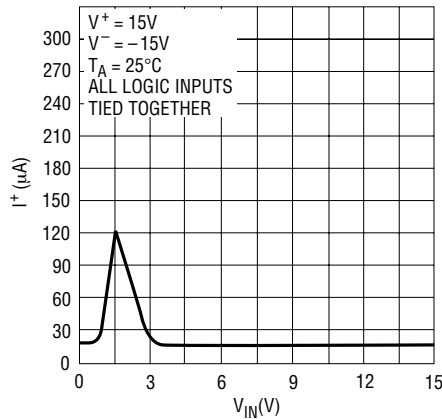
LT201_202_203 • TPC02

 R_{ON} vs V_S Over Temperature

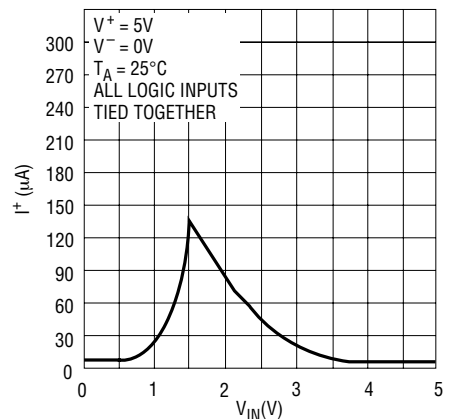
LT201_202_203 • TPC03

 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

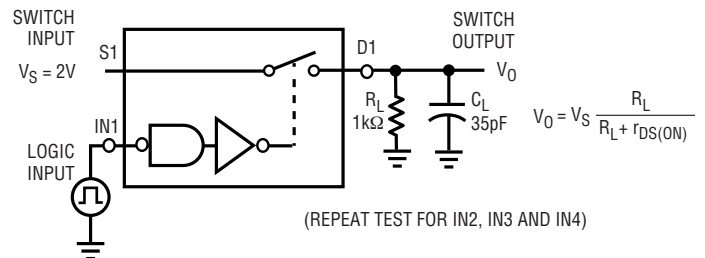
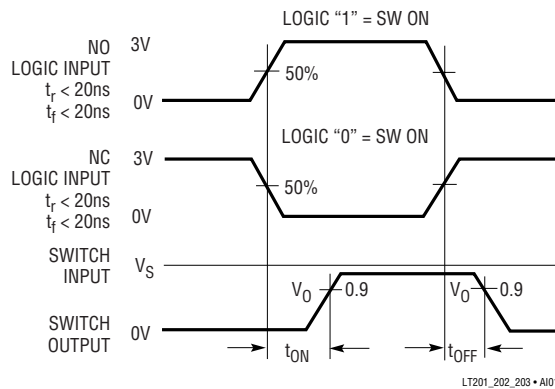
APPLICATIONS INFORMATION

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

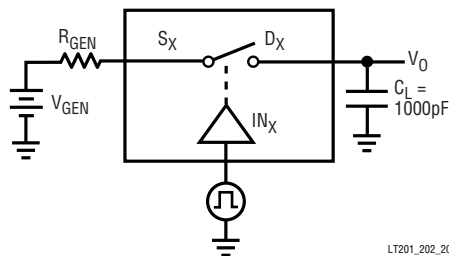
output switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

Switching Time Test Circuit

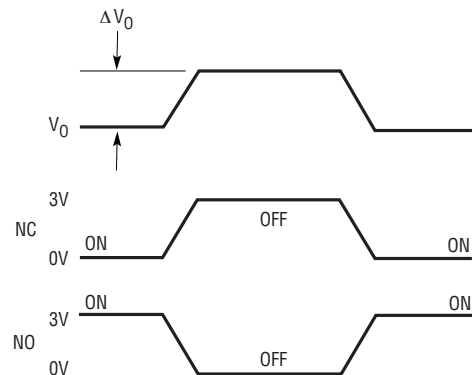


LT201_202_203 • A102

Charge Injection Test Circuit



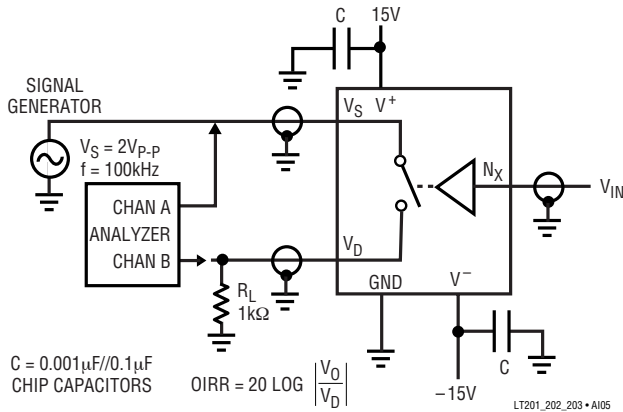
LT201_202_203 • A103



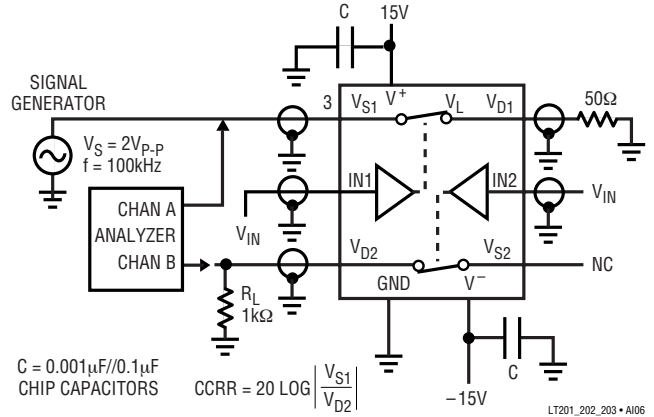
ΔV_O IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.
THE ERROR VOLTAGE IN COULOMBS IS $\Delta Q = C_L \cdot \Delta V_O$

LT201_202_203 • A104

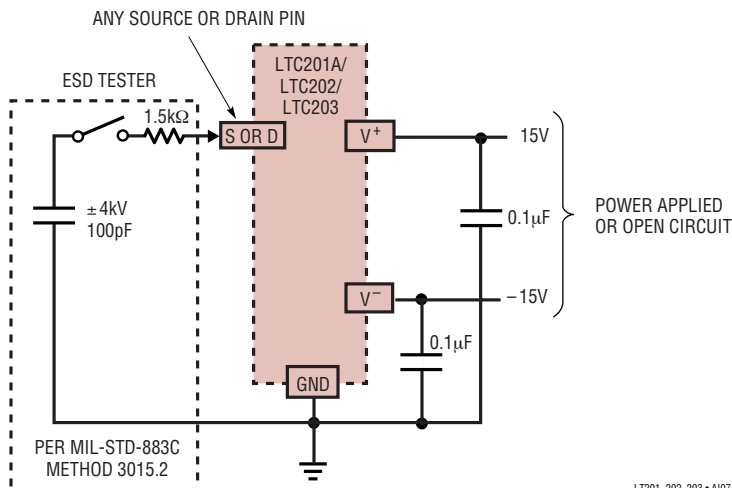
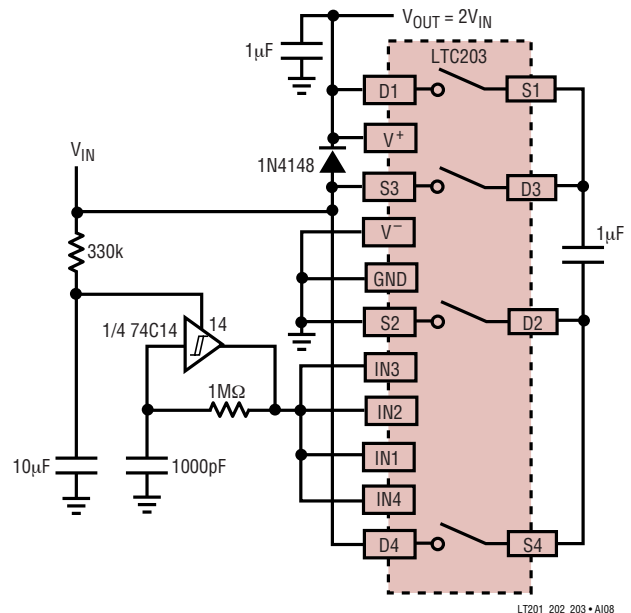
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit


V_{IN}	
3V	NC
0V	NO

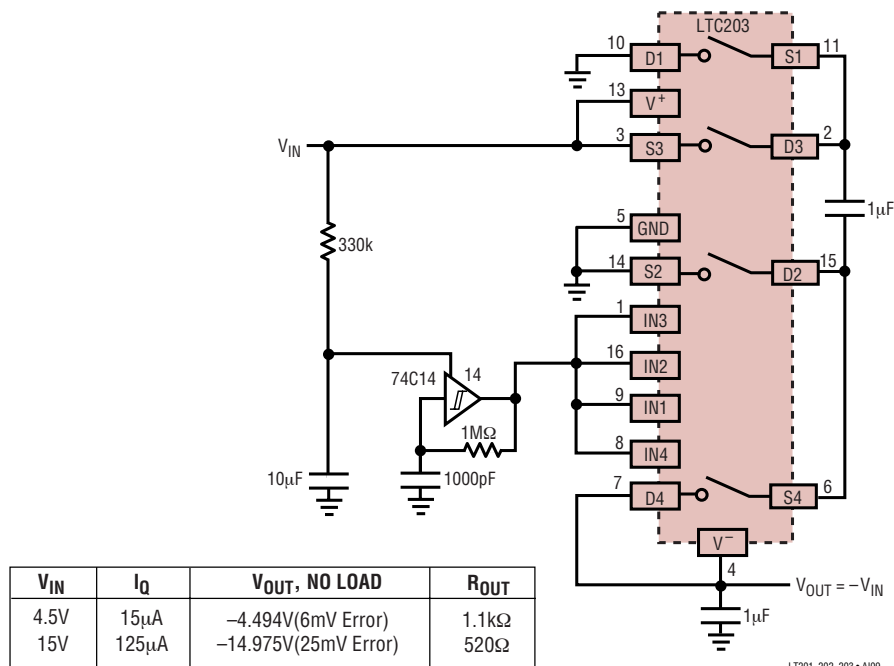
CCRR-Channel to Channel Crosstalk Test Circuit


V_{IN}	
3V	NC
0V	NO

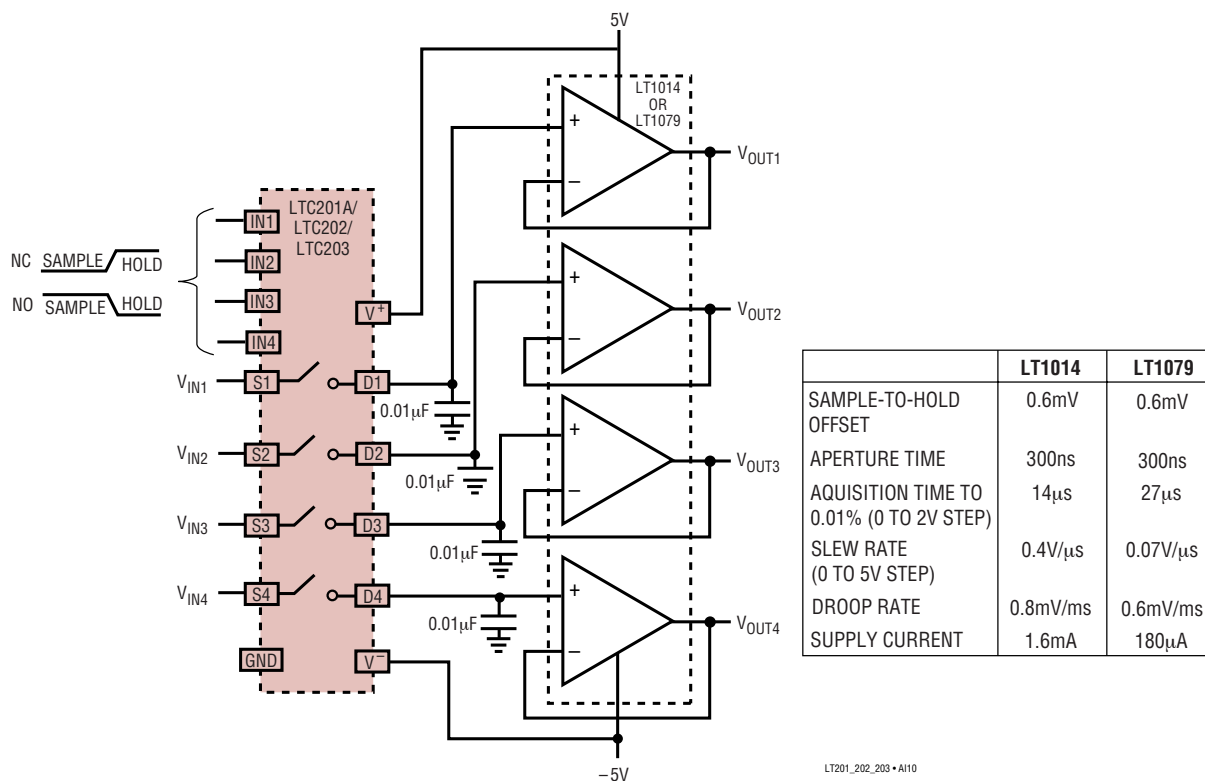
In-Circuit ESD Test Circuit

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


V_{IN}	I_Q	$V_{OUT}, \text{ NO LOAD}$	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

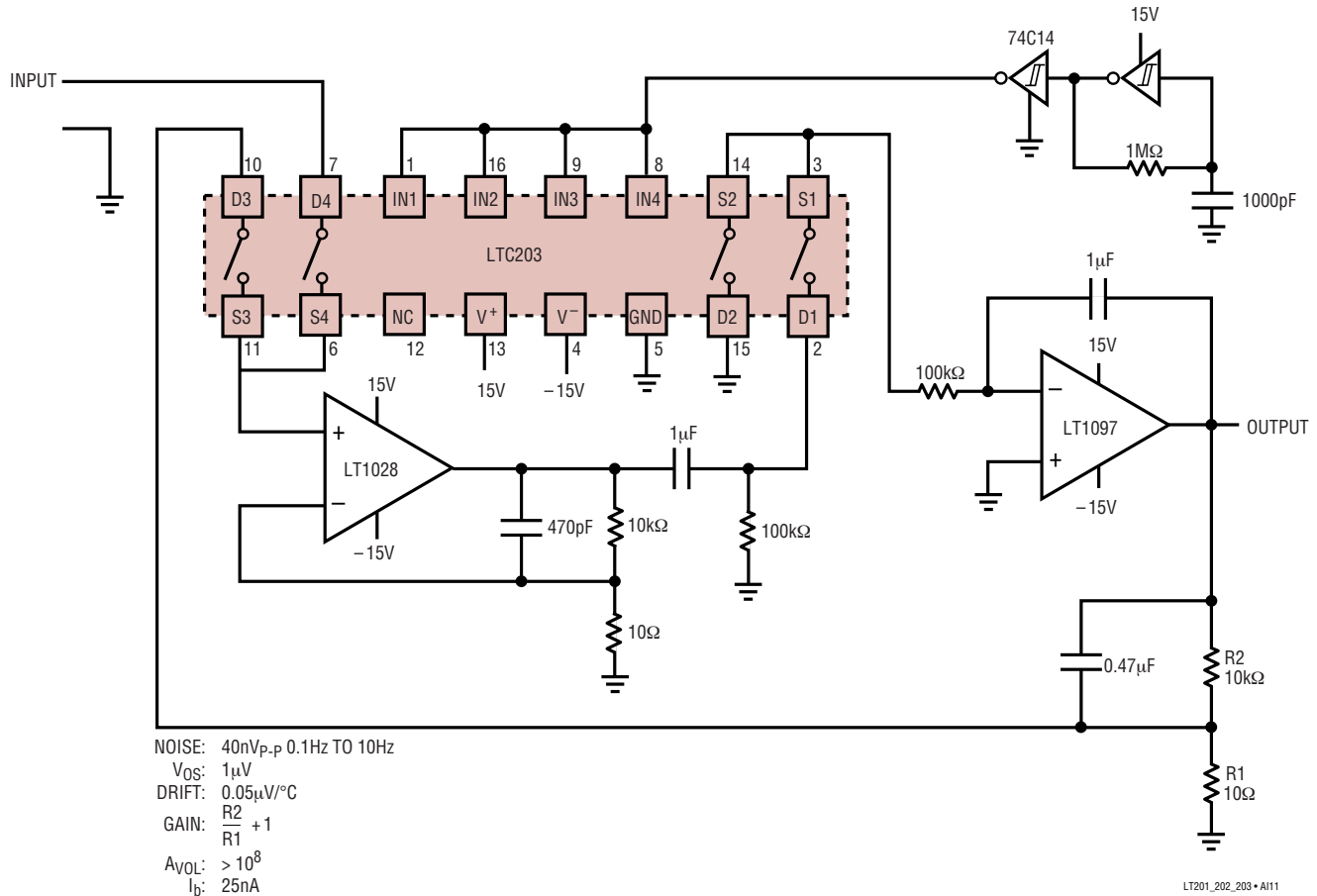


Quad 12-Bit Sample-and-Hold

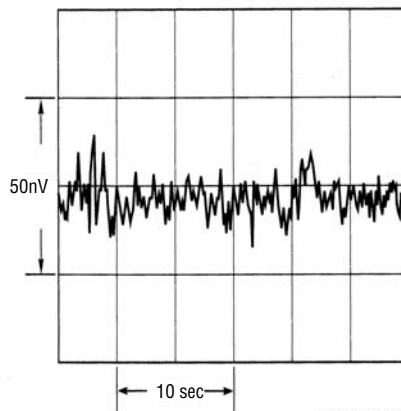


APPLICATIONS INFORMATION

Ultra Low Noise, Low Drift Chopper Amplifier



Noise in a 0.1 to 10Hz Bandwidth



The circuit diagram illustrates a precision 100kHz sine wave generator. The core component is the LTC203, a precision sine wave generator, which is configured with its input pins (IN1, IN2, IN3, IN4) connected to a 15V supply and its output pins (S1, S2, S3, S4) connected to a 15V supply. The LTC203 is also connected to a 0.01μF capacitor and a 0.1μF capacitor. The output of the LTC203 is connected to a 74C04 hex inverters, which are configured to produce a 0kHz to 10kHz output. The circuit is powered by a 15V supply and a -15V supply. The input signal is connected to the LT1056 op-amp, which is configured as a voltage follower. The output of the LT1056 is connected to the LT1012 op-amp, which is configured as a voltage follower. The output of the LT1012 is connected to the LT1011 op-amp, which is configured as a voltage follower. The output of the LT1011 is connected to a 2N2369 transistor, which is configured as a common emitter amplifier. The output of the transistor is connected to a 1N4148 diode, which is configured as a rectifier. The circuit is also connected to a 36.5kΩ resistor, a 10kΩ resistor, a 3.6kΩ resistor, a 3.3kΩ resistor, a 100pF capacitor, a 10kΩ resistor, and a 0.33μF capacitor.

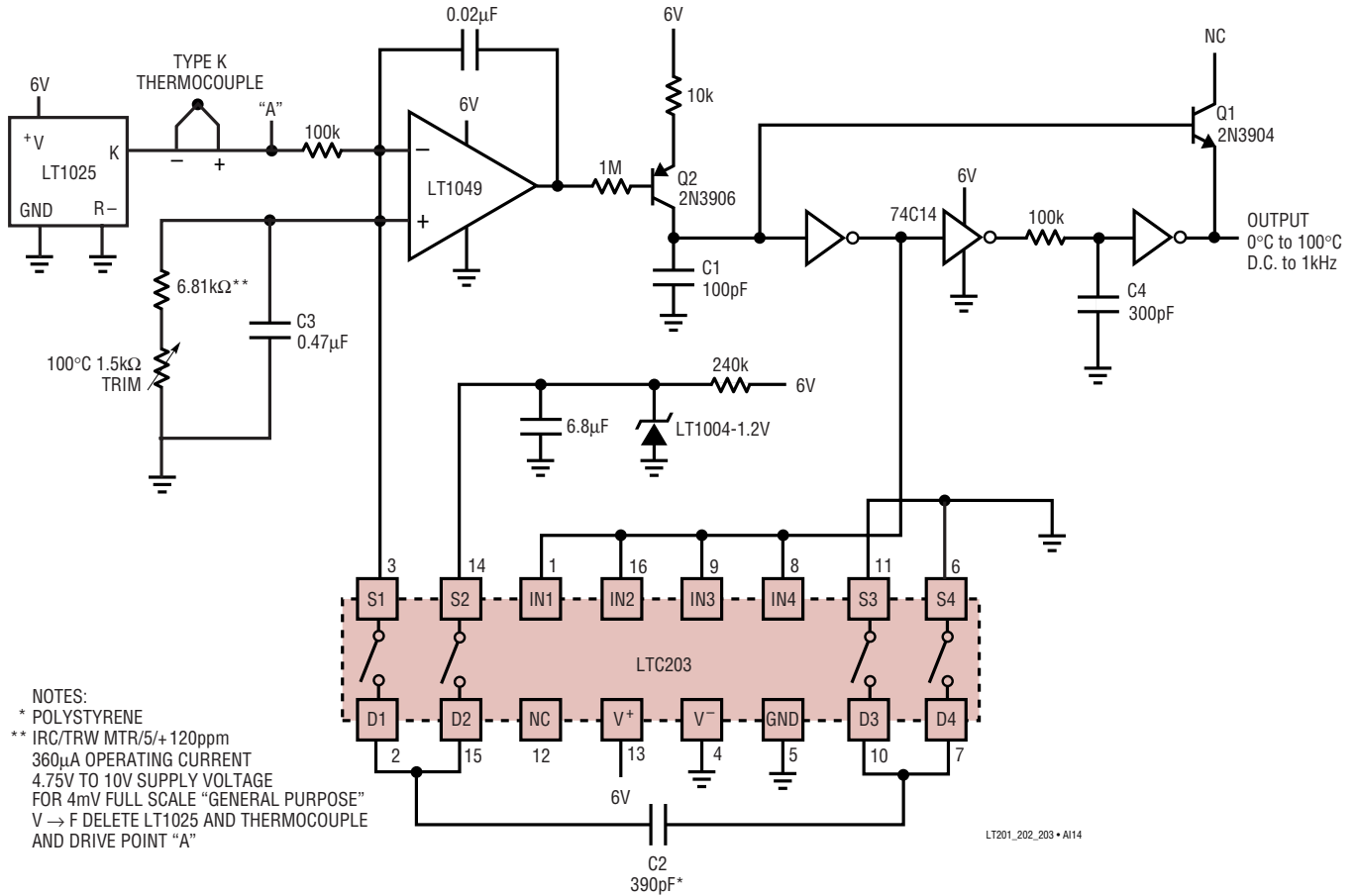
* POLYSTYRENE
50ppm/°C DRIFT
0.04% LINEARITY

** TRW/IRC MTR/5/+120

LT201_202_203 • AI13

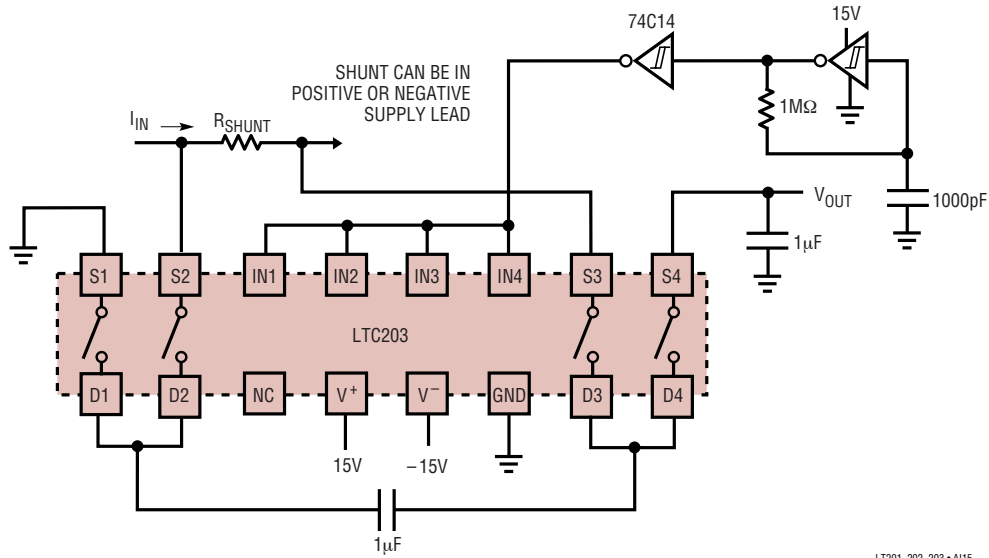
APPLICATIONS INFORMATION

Micropower Thermocouple Temperature to Frequency Converter

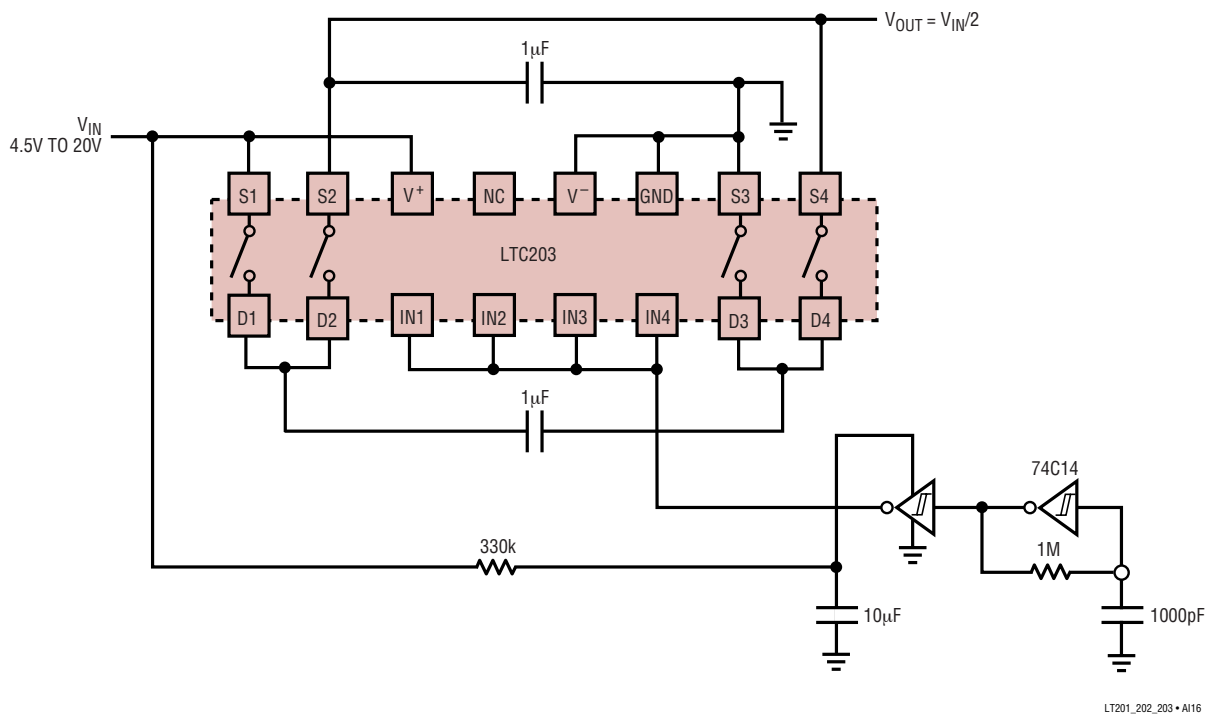


APPLICATIONS INFORMATION

Precision Current Sensing in Supply Rails

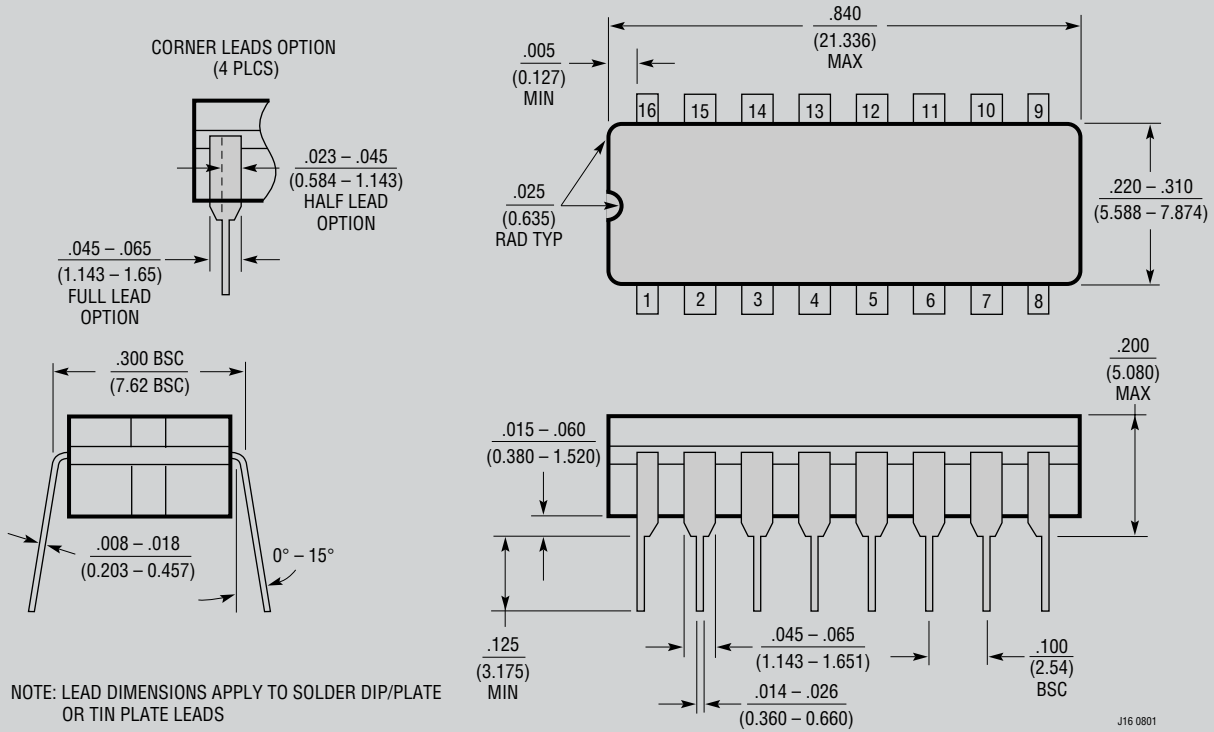


Precision Voltage Divide by 2 Circuit



PACKAGE DESCRIPTION

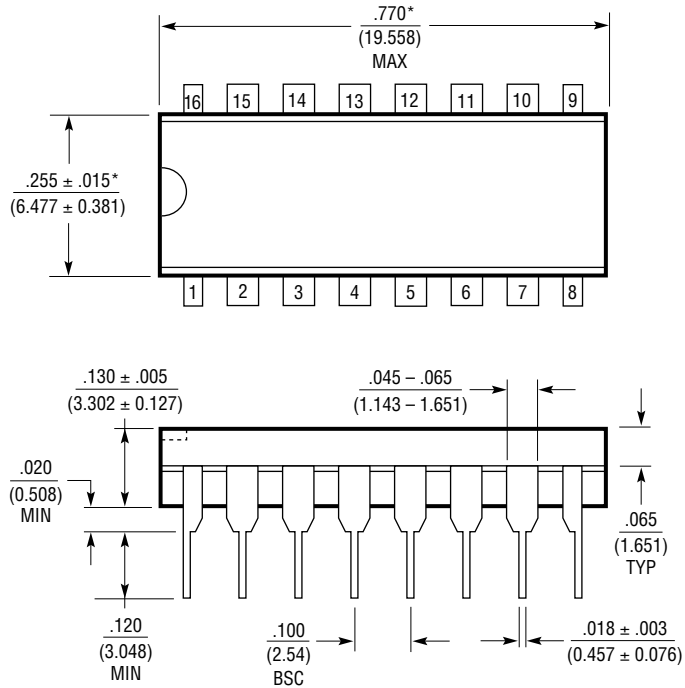
J Package
16-Lead CERDIP (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



OBSOLETE PACKAGE

PACKAGE DESCRIPTION

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



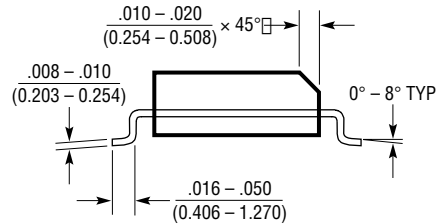
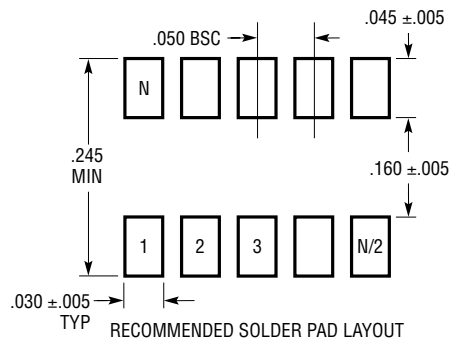
NOTE:
1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

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

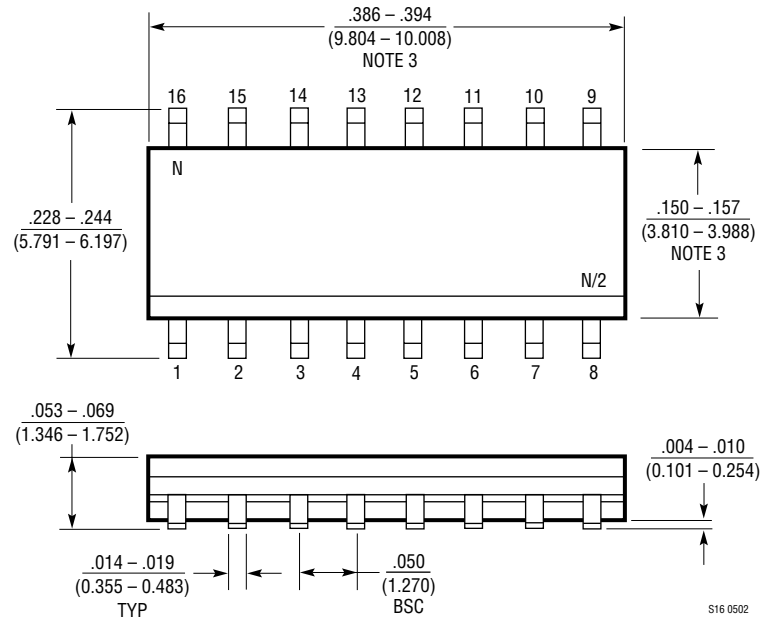
N16 1002

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" (0.15mm)



S16 0502

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