

FEATURES

- Micropower Operation
- Single 5V or ±15V 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

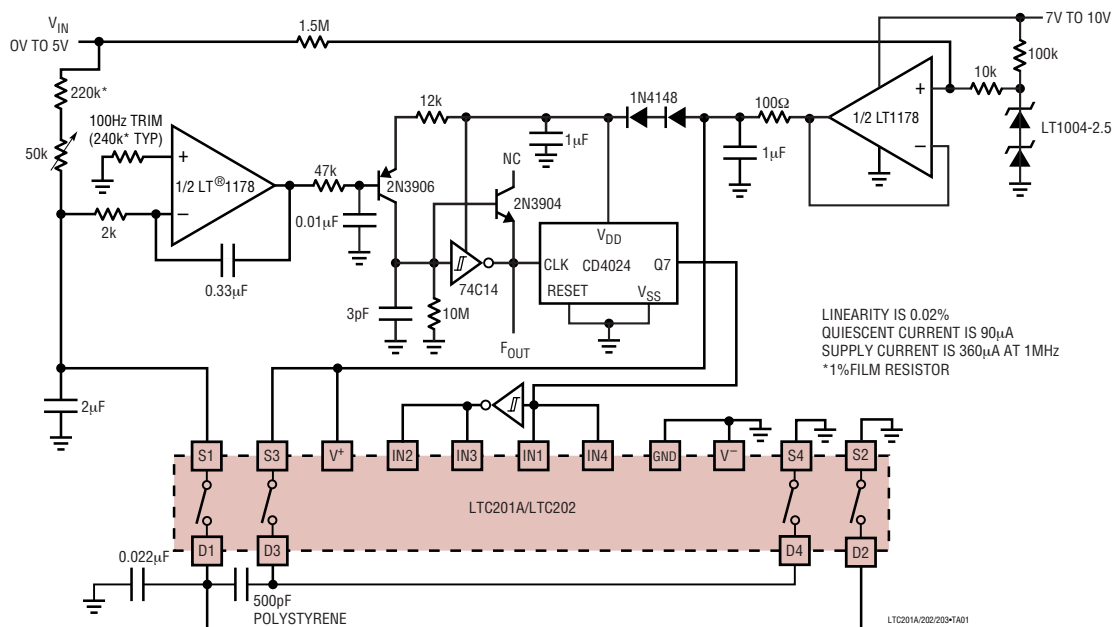
The LTC[®]201A, LTC202, and LTC203 are micropower, quad CMOS analog switches which typically dissipate only 250μW from ±15V supplies and 40μW from a single 5V supply. The switches have 65Ω typical on resistance and a very high off resistance. A break-before-make characteristic, inherent in these switches, 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	LTC202	LTC203	
	IN1 TO IN4	IN1 TO IN4	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

OBSELETE 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 $T_A = 25^\circ\text{C}$. $V^+ = 15\text{V}$, $V^- = -15\text{V}$, $\text{GND} = 0\text{V}$.

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

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}	$V_{\text{IN}} = 15\text{V}$, 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		16		40		16	40	μA
	$V_{\text{IN}} = 0\text{V}$ or 4.0V	●			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	$V_S = 2V_{\text{p-p}}$, $R_L = 1\text{k}\Omega$, $f = 100\text{kHz}$			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	$V_S = 2V_{\text{p-p}}$, $R_L = 10\text{k}\Omega$			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.

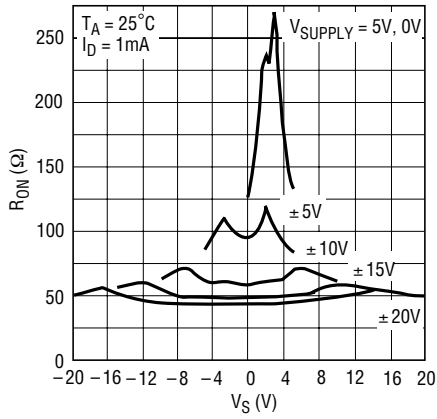
Note 2: Signals on S, D, or IN exceeding V^+ or V^- will be clamped by internal diodes. Limit forward diode current to maximum current rating.

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.

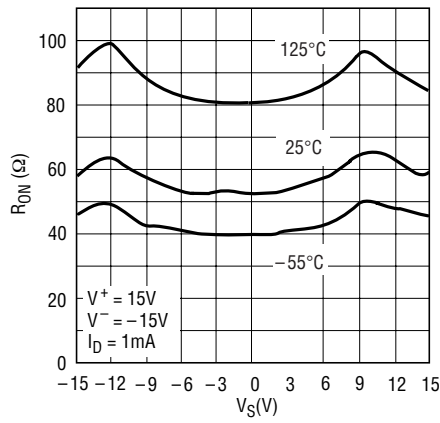
TYPICAL PERFORMANCE CHARACTERISTICS

R_{ON} vs V_S Over Supply Voltage



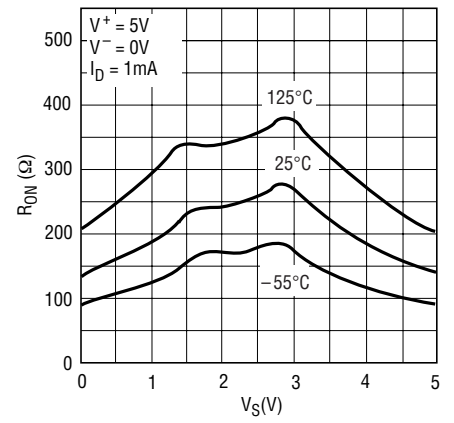
LT201_202_203 • TPC01

R_{ON} vs V_S Over Temperature



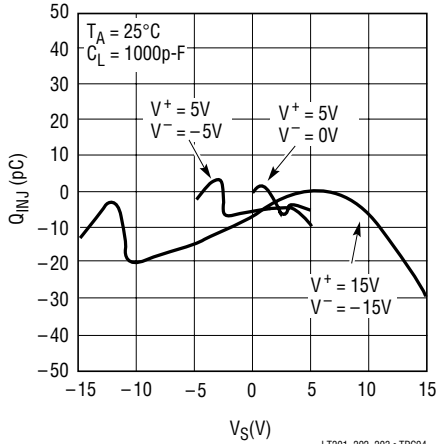
LT201_202_203 • TPC02

R_{ON} vs V_S Over Temperature



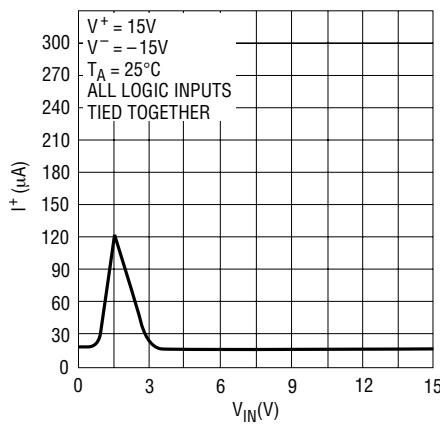
LT201_202_203 • TPC03

Q_{INJ} vs V_S Over Supply Voltage



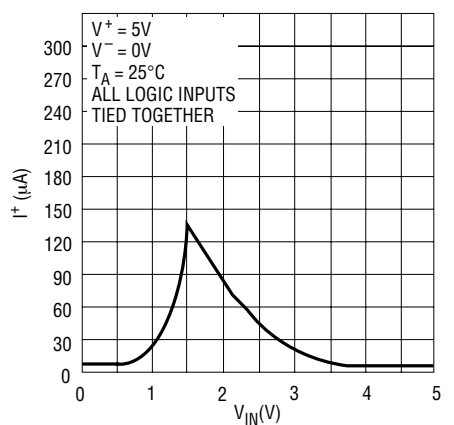
LT201_202_203 • TPC04

Positive Supply Current vs Logic Input Voltage



LT201_202_203 • TPC05

Supply Current vs Logic Input Voltage



LT201_202_203 • TPC06

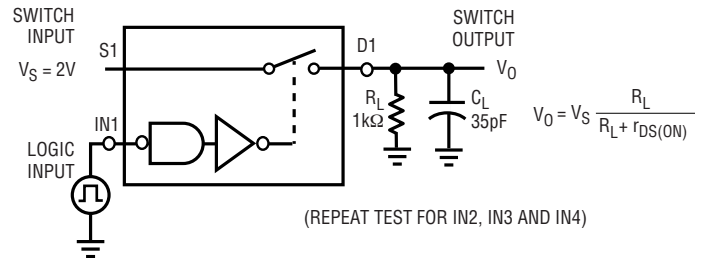
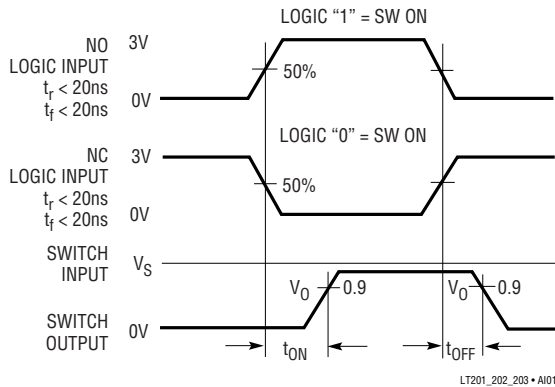
APPLICATIONS INFORMATION

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

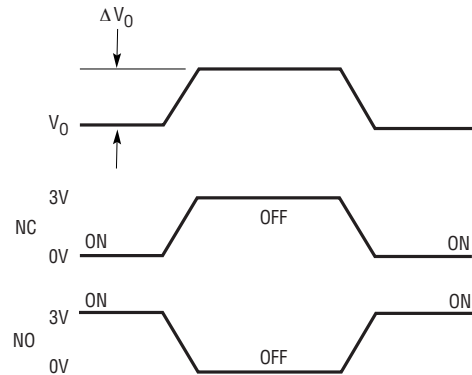
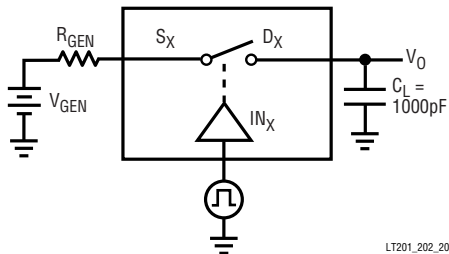
output switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

Switching Time Test Circuit



LT201_202_203 • A102

Charge Injection Test Circuit

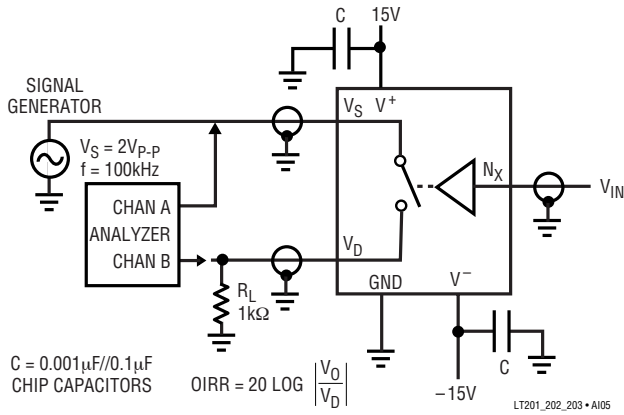


ΔV_O IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.
THE ERROR VOLTAGE IN COULOMBS IS $\Delta Q = C_L \cdot \Delta V_O$

LT201_202_203 • A104

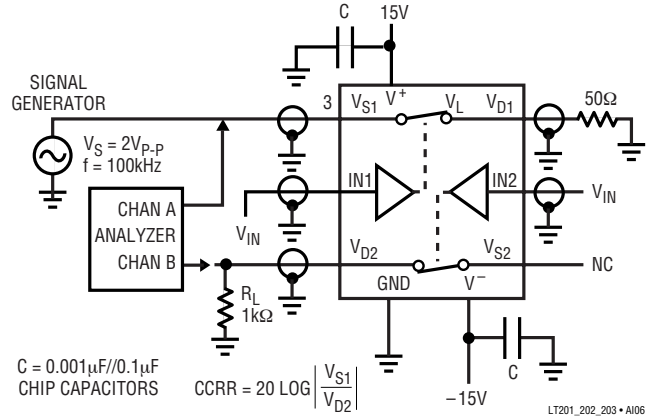
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit



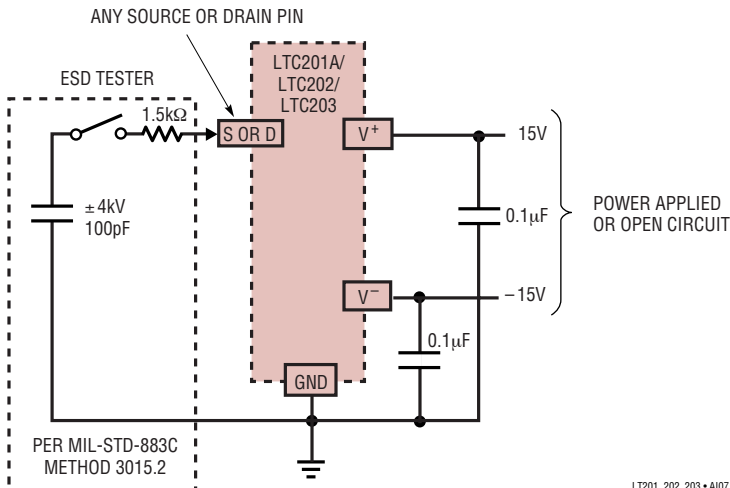
V_{IN}	
3V	NC
0V	NO

CCRR-Channel to Channel Crosstalk Test Circuit

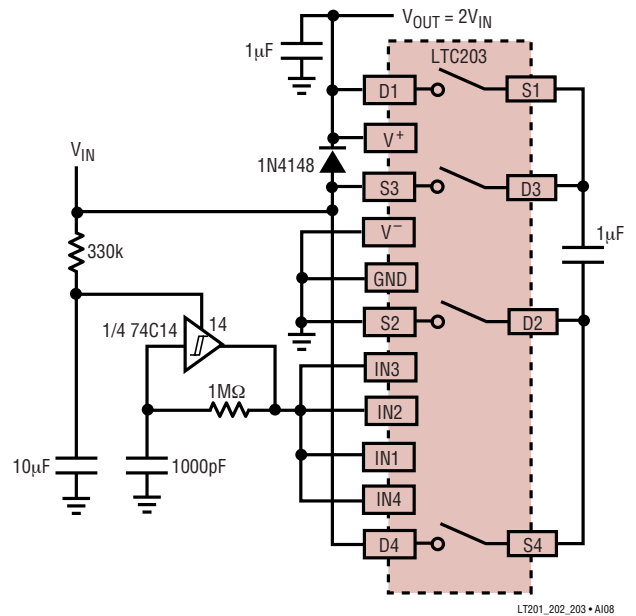


V_{IN}	
3V	NC
0V	NO

In-Circuit ESD Test Circuit



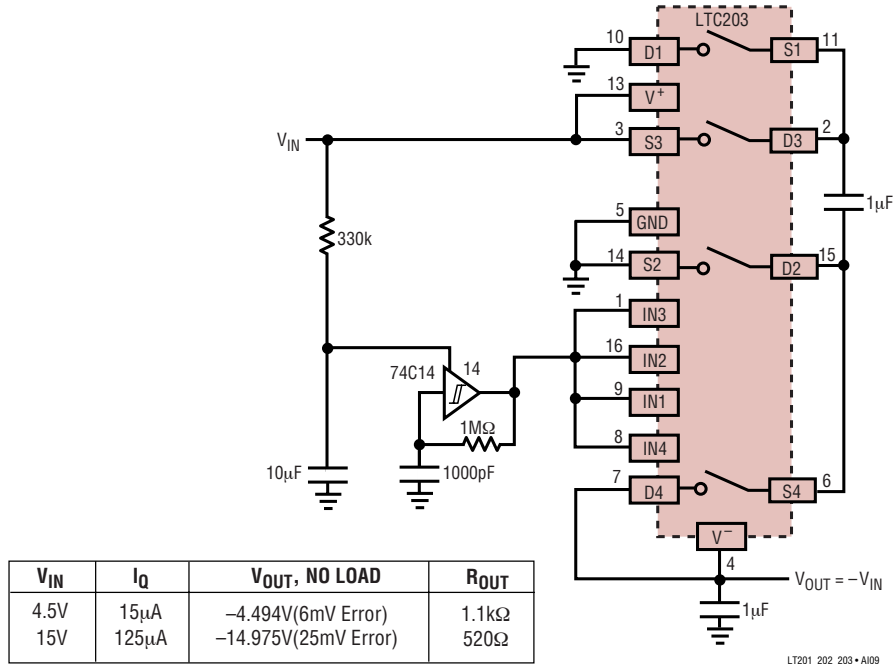
**Micropower, 4.5V to 15V Input,
Voltage Doubler Using the LTC203**



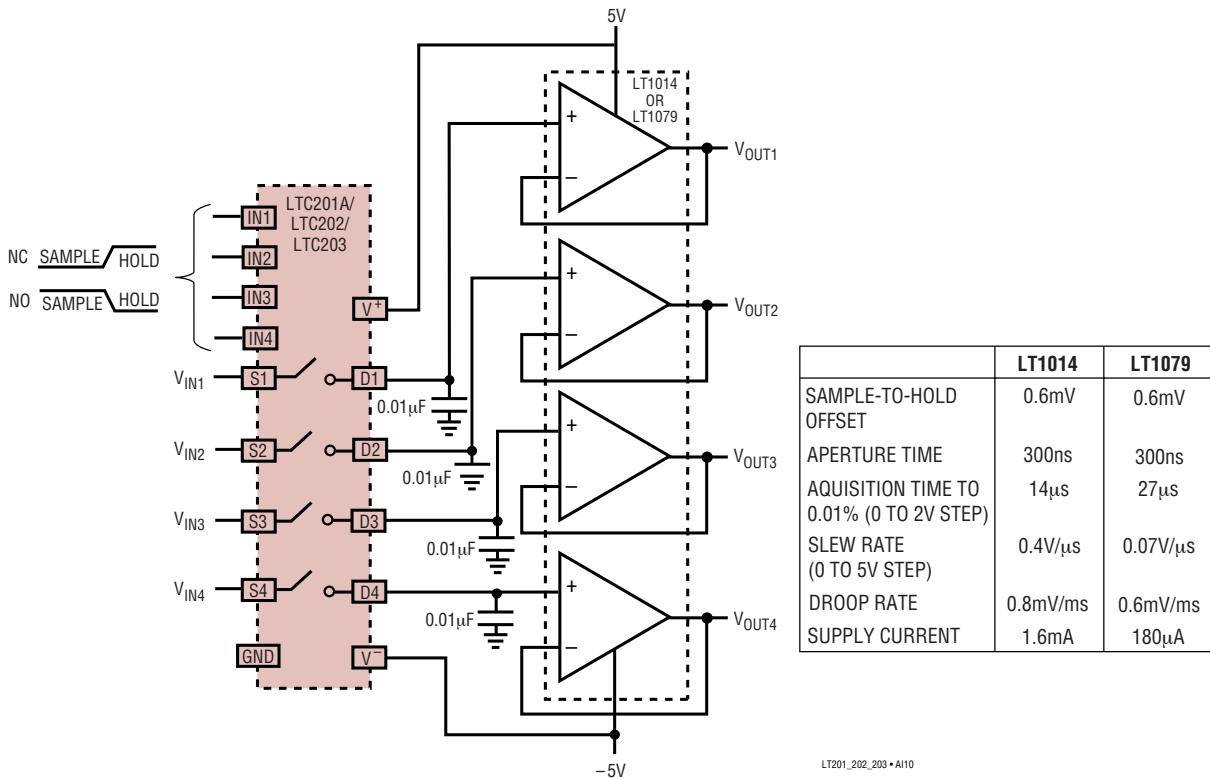
V_{IN}	I_Q	$V_{OUT}, \text{ NO LOAD}$	R_{OUT}
4.5V	20μA	8.988V(12mV Error)	1.2k
15V	130μA	29.96V(40mV Error)	600Ω

APPLICATIONS INFORMATION

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

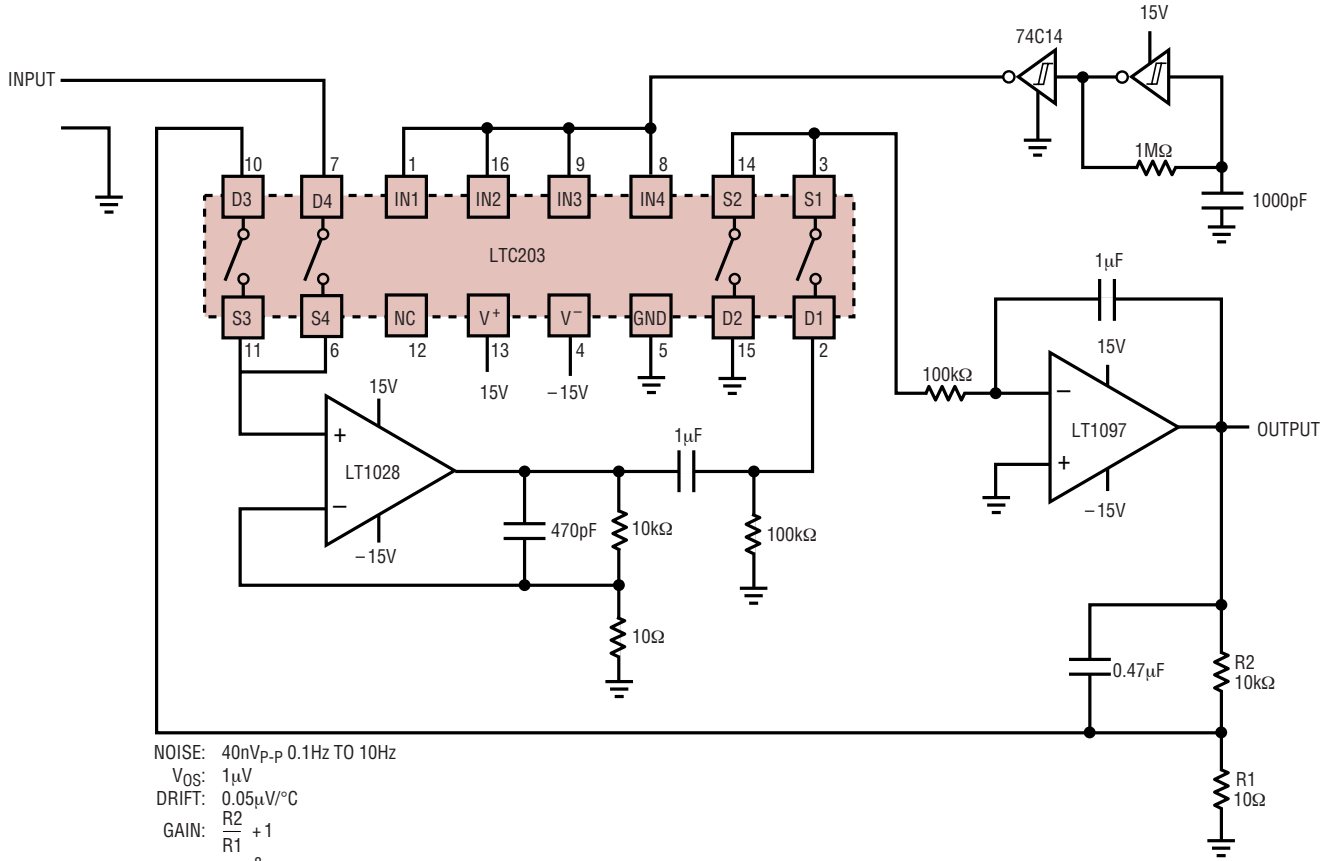


Quad 12-Bit Sample-and-Hold



APPLICATIONS INFORMATION

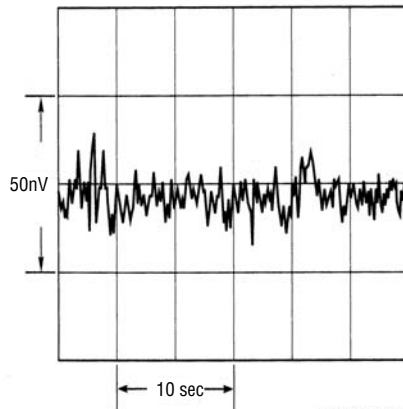
Ultra Low Noise, Low Drift Chopper Amplifier



NOISE: 40nV_{p-p} 0.1Hz TO 10Hz
 V_{OS}: 1μV
 DRIFT: 0.05μV/°C
 GAIN: $\frac{R2}{R1} + 1$
 A_{VOL}: > 10⁸
 I_b: 25nA

LT201_202_203 • AI11

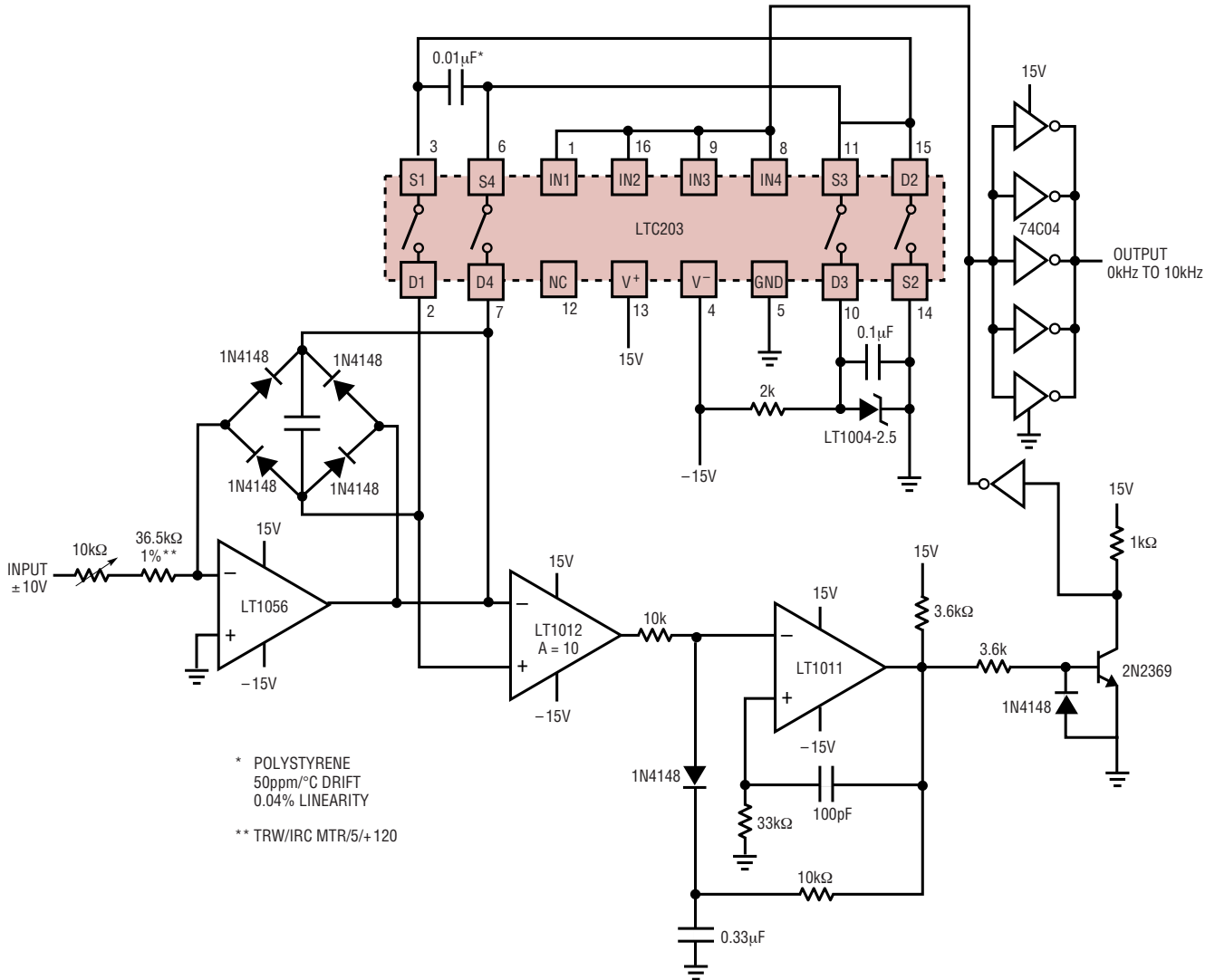
Noise in a 0.1 to 10Hz Bandwidth



LTC201A/202/203 • AI12

APPLICATIONS INFORMATION

Bipolar (AC) Input V/F Converter



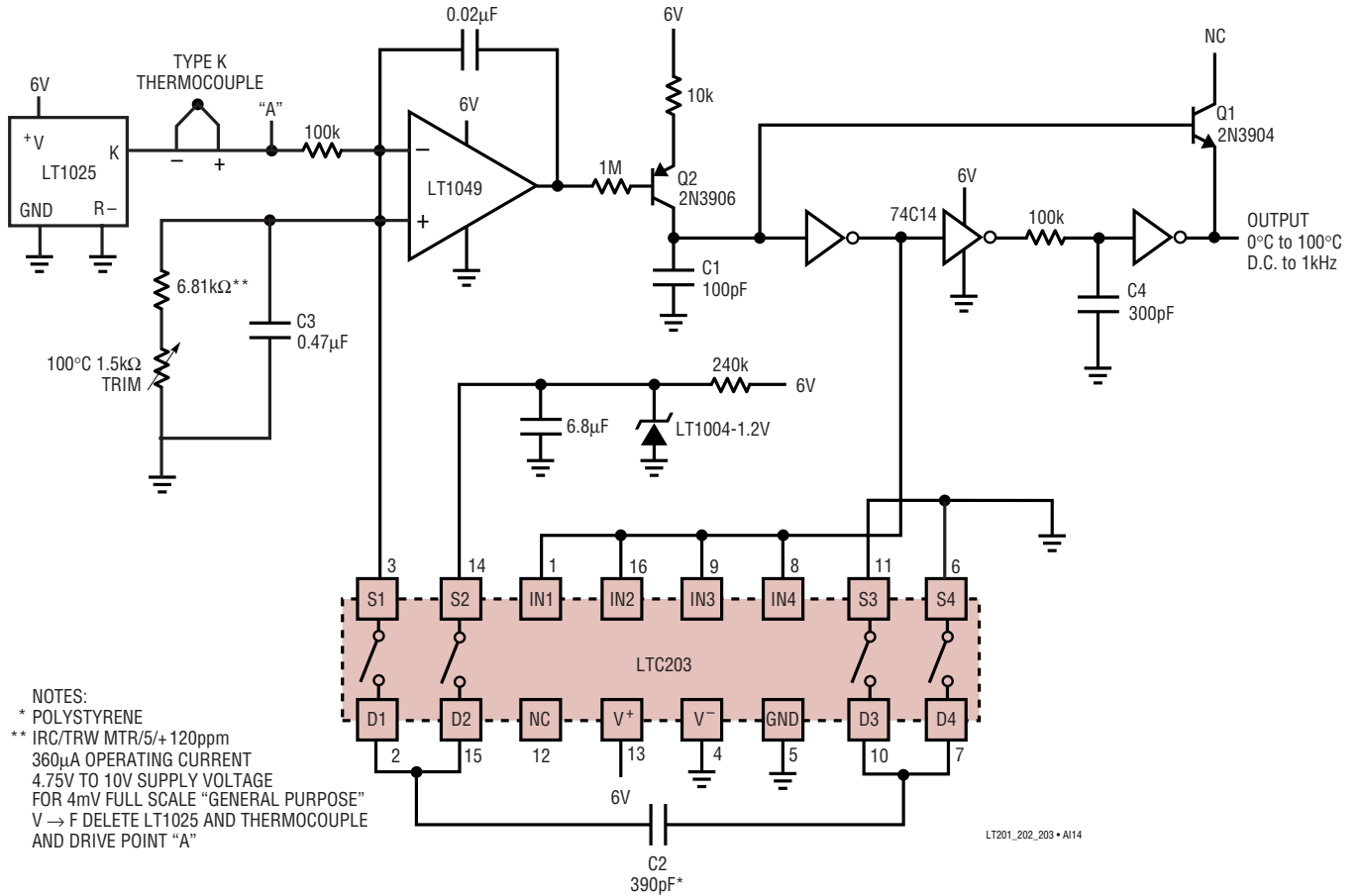
* POLYSTYRENE
50ppm/°C DRIFT
0.04% LINEARITY

** TRW/IRC MTR/5/+120

LT201_202_203 • A113

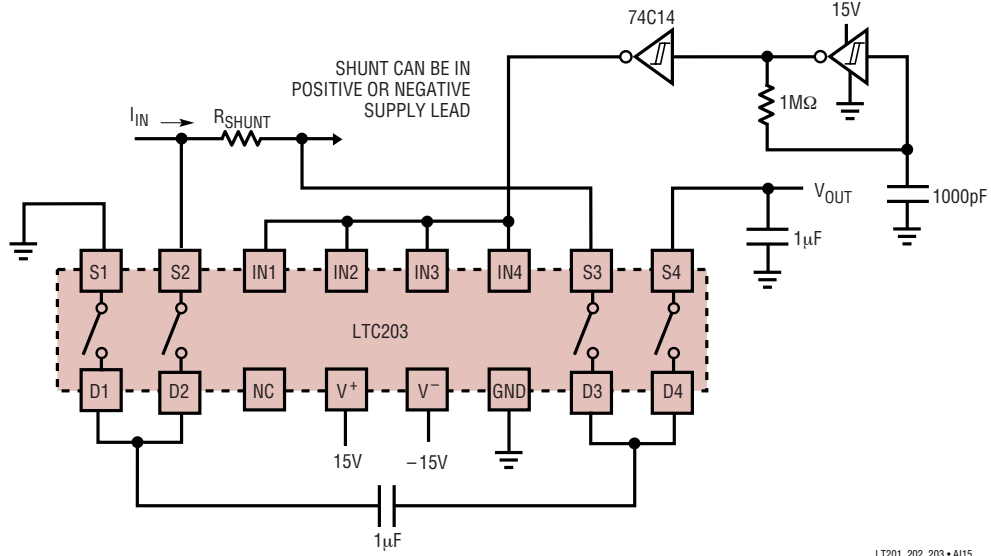
APPLICATIONS INFORMATION

Micropower Thermocouple Temperature to Frequency Converter

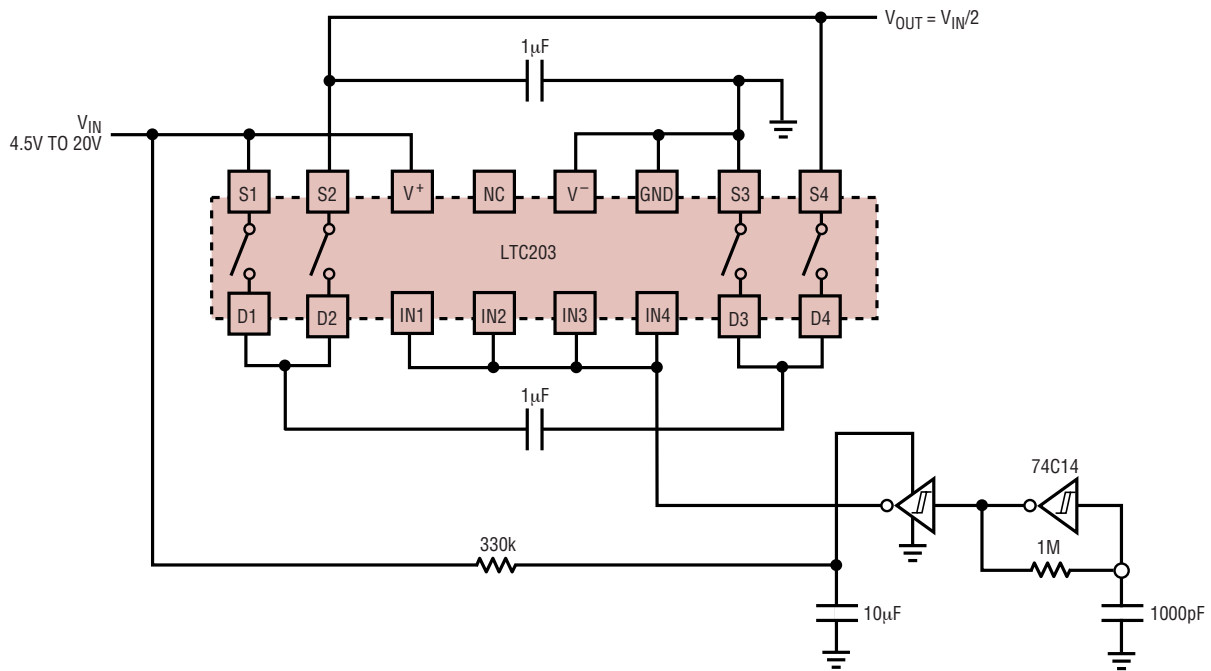


APPLICATIONS INFORMATION

Precision Current Sensing in Supply Rails

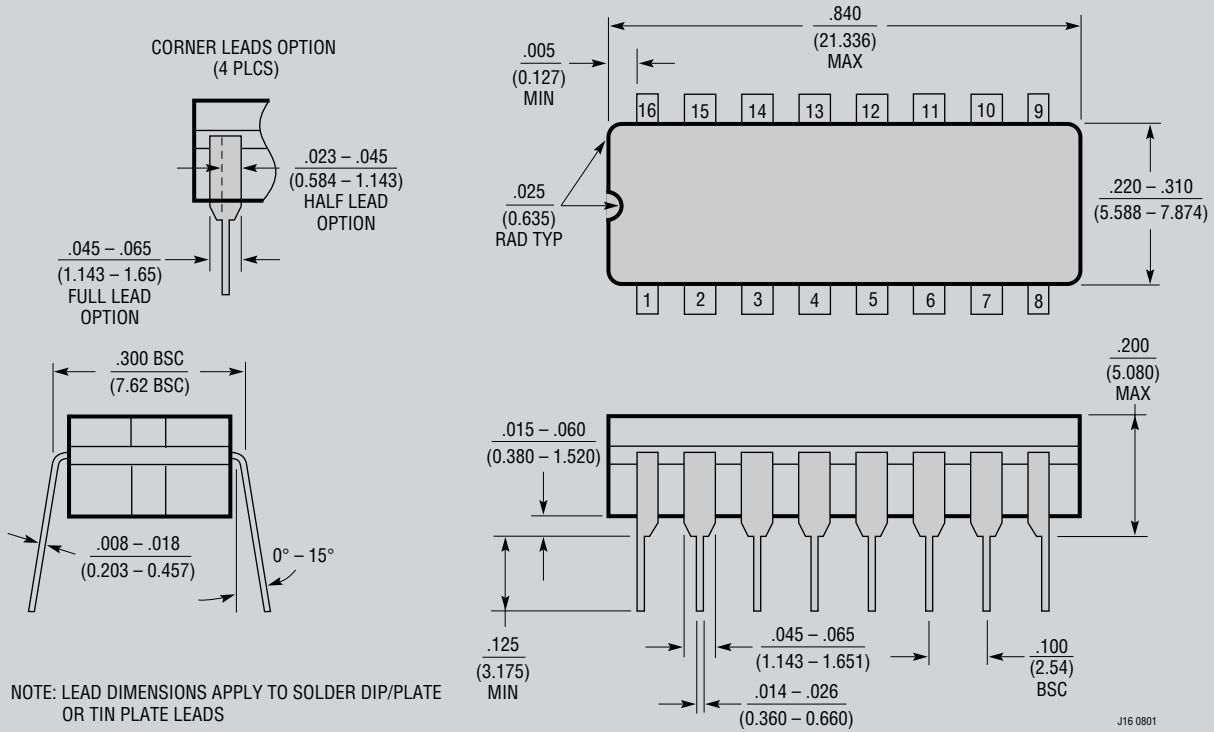


Precision Voltage Divide by 2 Circuit



PACKAGE DESCRIPTION

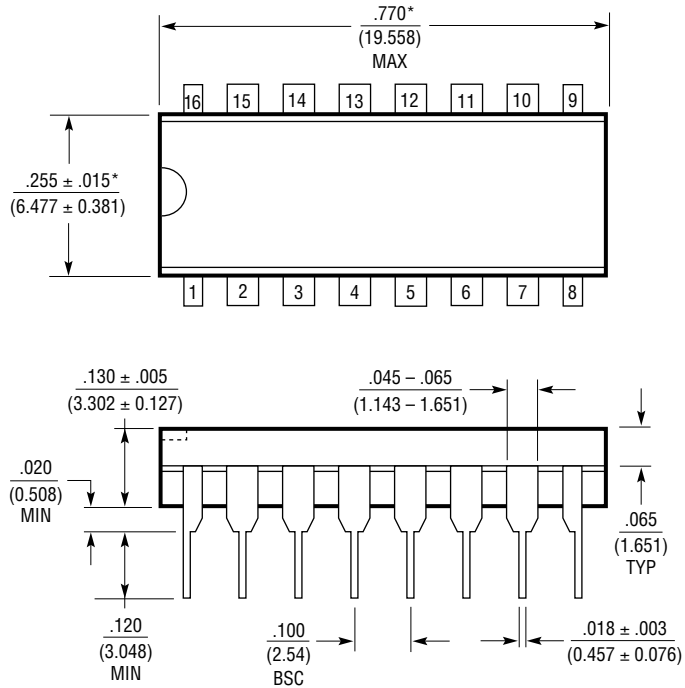
J Package
16-Lead CERDIP (Narrow .300 Inch, Hermetic)
 (Reference LTC DWG # 05-08-1110)



OBSOLETE PACKAGE

PACKAGE DESCRIPTION

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



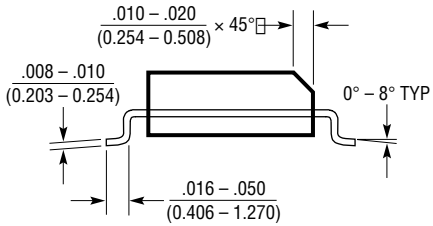
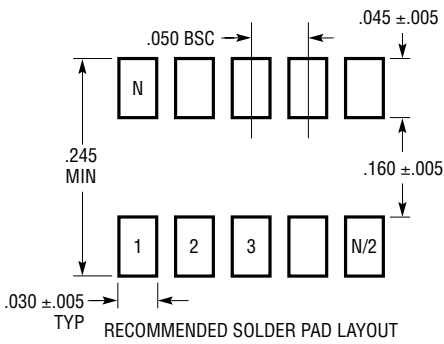
NOTE:
 1. DIMENSIONS ARE $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

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

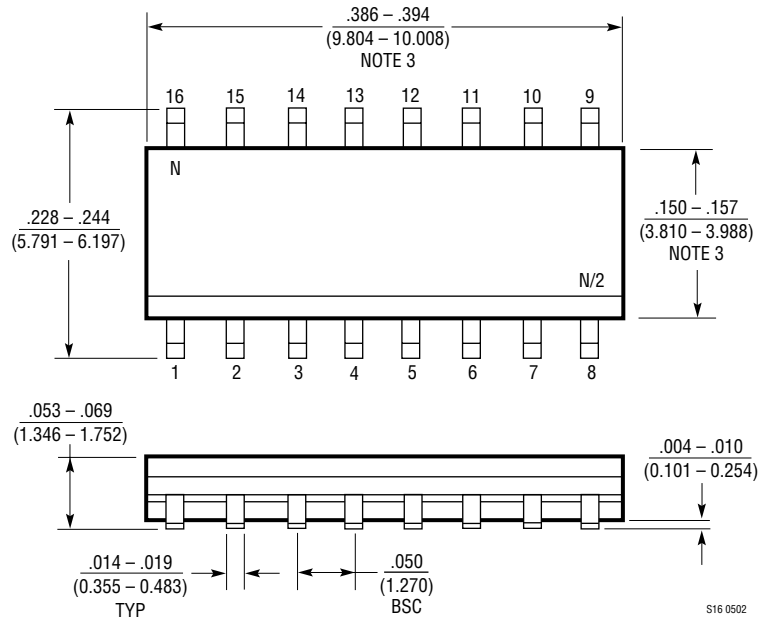
N16 1002

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)



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/70 Ω 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