

## 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

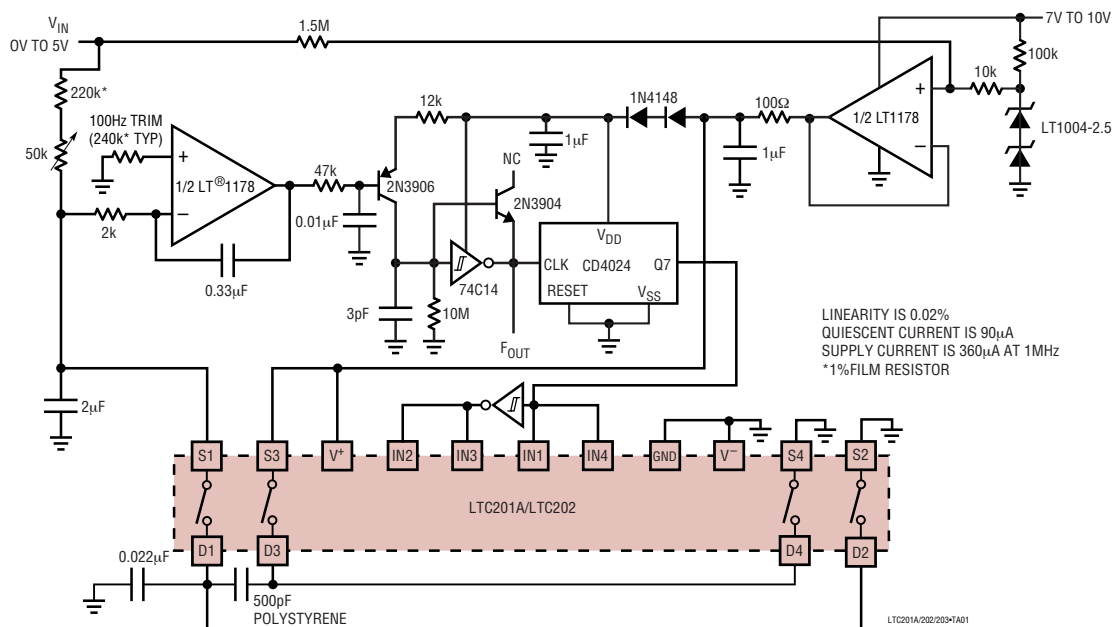
The LTC<sup>®</sup>201A, LTC202, and LTC203 are micropower, quad CMOS analog switches which typically dissipate only 250μW from ±15V supplies and 40μW from a single 5V supply. The switches have 65Ω typical on resistance and a very high off resistance. A break-before-make characteristic, inherent in these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

LT, LTC and LT are registered trademarks of Linear Technology Corporation.

## 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 .....

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

## 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

<p>TOP VIEW</p> <p>N PACKAGE 16-LEAD PDIP <math>T_{JMAX} = 110^\circ\text{C}</math>, <math>\theta_{JA} = 120\text{C/W}</math></p> <p>S PACKAGE 16-LEAD PLASTIC SO <math>T_{JMAX} = 110^\circ\text{C}</math>, <math>\theta_{JA} = 130\text{C/W}</math></p> <p>J PACKAGE 16-LEAD CERDIP <math>T_{JMAX} = 150^\circ\text{C}</math>, <math>\theta_{JA} = 100\text{C/W}</math></p>	ORDER PART NUMBER
	<p>LTC201ACN</p> <p>LTC201ACS</p> <p>LTC202CN</p> <p>LTC202CS</p> <p>LTC203CN</p> <p>LTC203CS</p>
	ORDER PART NUMBER
	<p>LTC201AMJ</p> <p>LTC201ACJ</p> <p>LTC202MJ</p> <p>LTC202CJ</p> <p>LTC203MJ</p> <p>LTC203CJ</p>

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

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	$\Omega$
		25°C		65	110		65	125	$\Omega$
		$T_{MAX}$			160			160	$\Omega$
$\Delta R_{ON}$ vs $V_S$				20			20		%
$\Delta R_{ON}$ 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

## 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	$\pm 1$ $\pm 100$		0.01	$\pm 5$ $\pm 100$	nA nA
On Channel Leakage $I_D$ (ON)	$V_D = V_S = \pm 14\text{V}$ Switch On			0.02	$\pm 1$		0.02	$\pm 5$	nA
		●			$\pm 200$			$\pm 200$	nA
Input High Voltage $V_{\text{INH}}$		●	2.4			2.4			V
Input Low Voltage $V_{\text{INL}}$		●			0.8			0.8	V
Input High or Low Current $I_{\text{INH}}$ and $I_{\text{INL}}$	$V_{\text{IN}} = 15\text{V}$ , $0\text{V}$	●			$\pm 1$			$\pm 1$	$\mu\text{A}$
$C_S$ (OFF)				5			5		pF
$C_D$ (OFF)				12			12		pF
$C_D$ , $C_S$ (ON)				30			30		pF
$I^+$	All Logic Inputs Tied Together		16		40		16	40	$\mu\text{A}$
	$V_{\text{IN}} = 0\text{V}$ or $4.0\text{V}$	●			60			60	$\mu\text{A}$
$I^-$				0.1	5		0.1	5	$\mu\text{A}$
		●			10			10	$\mu\text{A}$

## 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	
$t_{\text{ON}}$	$V_S = 2\text{V}$ , $R_L = 1\text{k}\Omega$ , $C_L = 35\text{pF}$			290	400		290	400	ns
$t_{\text{OFF}}$				210	300		210	300	ns
$t_{\text{OPEN}}$			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 $O_{\text{INJ}}$	$R_S = 0\Omega$ , $C_L = 1000\text{pF}$ , $V_S = 0\text{V}$			5	$\pm 25$		8	$\pm 25$	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	$\Omega$	
		$25^\circ\text{C}$		280	450	280	525	$\Omega$	
		$T_{MAX}$			650		650	$\Omega$	
$\Delta R_{ON}$ vs $V_S$				20		20	%		
$\Delta R_{ON}$ vs Temperature				0.5		0.5	$\%/^\circ\text{C}$		
$\Delta R_{ON}$ 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	$\pm 1$	0.01	$\pm 5$	nA	
		●			$\pm 100$		$\pm 100$	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	$\pm 1$	0.01	+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) Switch On			0.01	$\pm 1$	0.01	$\pm 5$	nA	
		●			$\pm 200$		$\pm 200$	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 $I_{INL}$	$V_{IN} = 5\text{V}, 0\text{V}$		●		$\pm 1$		$\pm 1$	$\mu\text{A}$	
$C_S$ (OFF)				5		5	pF		
$C_D$ (OFF)				12		12	pF		
$C_D, C_S$ (ON)				30		30	pF		
$I^+$	All Logic Inputs Tied Together $V_{IN} = 0\text{V}$ OR $4.0\text{V}$			8	20	8	20	$\mu\text{A}$	
		●			30		30	$\mu\text{A}$	

## 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.

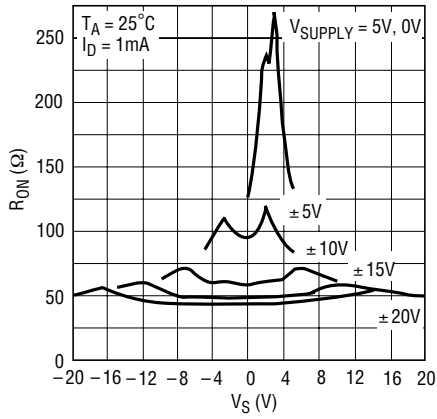
**Note 2:** Signals on S, D, or IN exceeding  $V^+$  or  $V^-$  will be clamped by internal diodes. Limit forward diode current to maximum current rating.

**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.

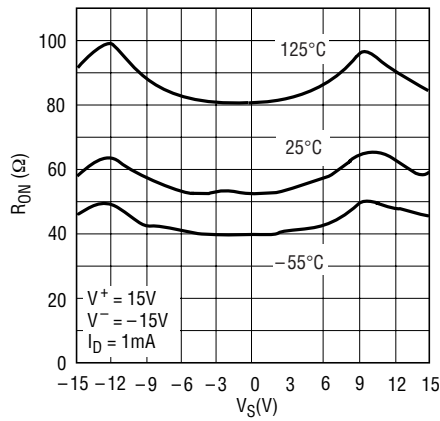
# TYPICAL PERFORMANCE CHARACTERISTICS

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



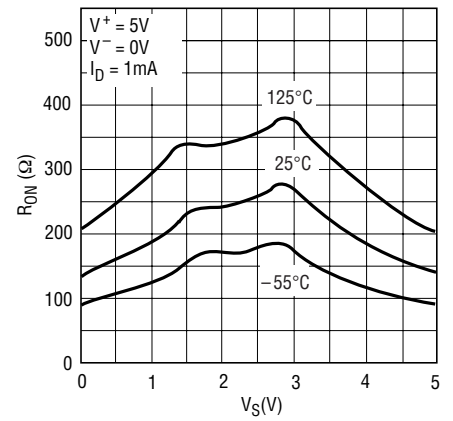
LT201\_202\_203 • TPC01

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



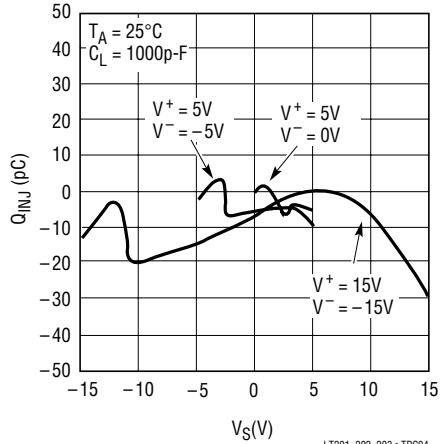
LT201\_202\_203 • TPC02

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



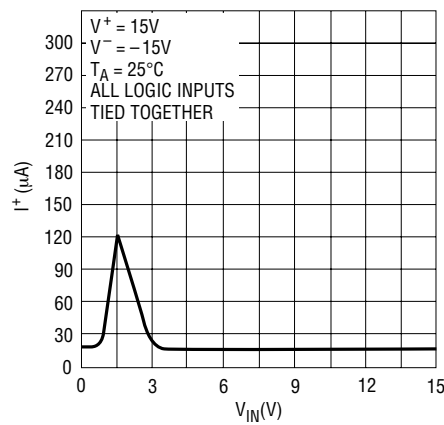
LT201\_202\_203 • TPC03

**$Q_{INJ}$  vs  $V_S$  Over Supply Voltage**



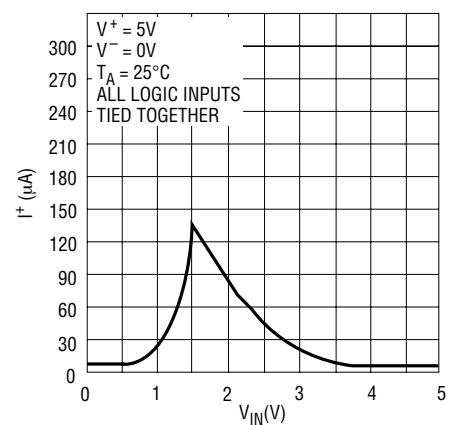
LT201\_202\_203 • TPC04

**Positive Supply Current vs Logic Input Voltage**



LT201\_202\_203 • TPC05

**Supply Current vs Logic Input Voltage**



LT201\_202\_203 • TPC06

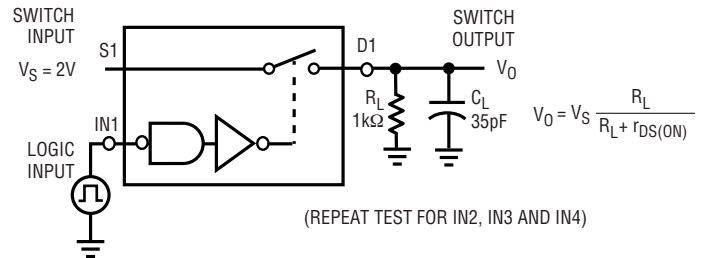
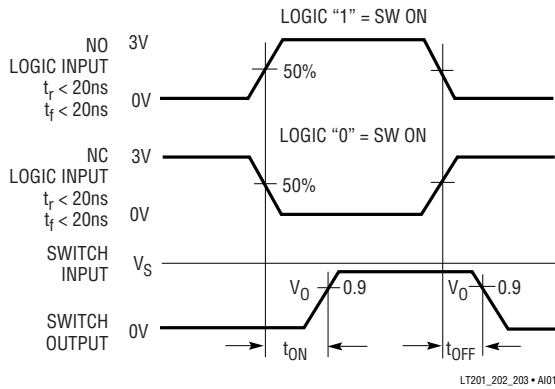
## APPLICATIONS INFORMATION

### Switching Time Test Circuit

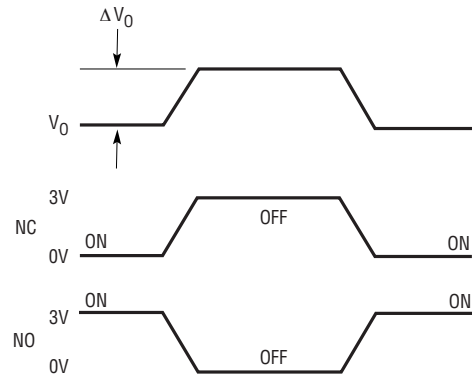
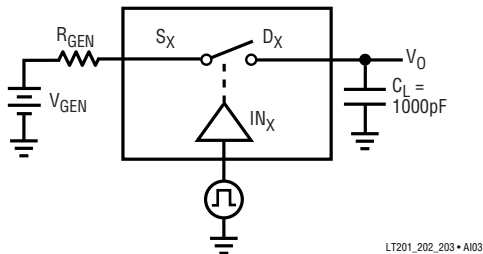
Switch output waveform shown for  $V_S = \text{constant}$  with logic input waveform as shown. Note that  $V_S$  may be + or – as per switching time test circuit.  $V_O$  is the steady state

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

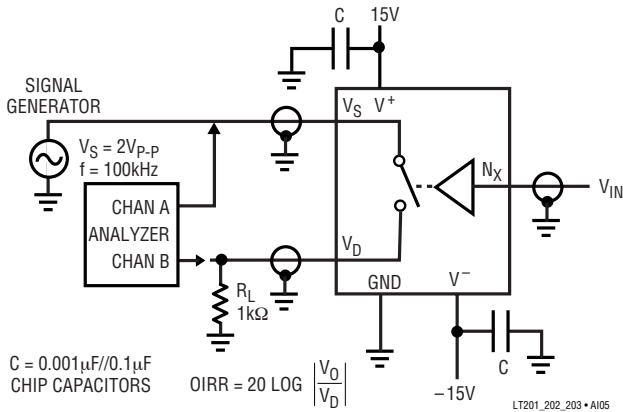


$\Delta V_O$  IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.  
THE ERROR VOLTAGE IN COULOMBS IS  $\Delta Q = C_L \cdot \Delta V_O$

LT201\_202\_203 • A104

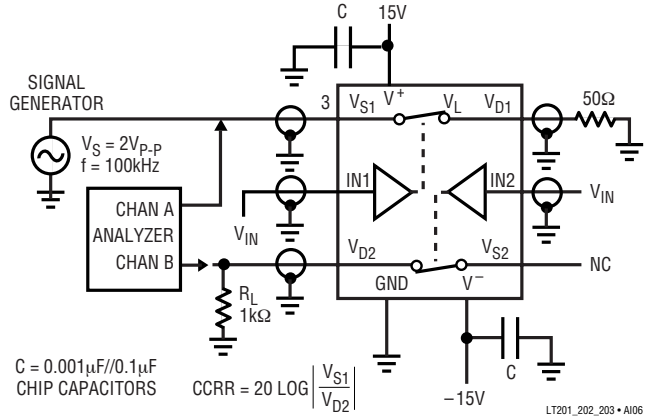
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit



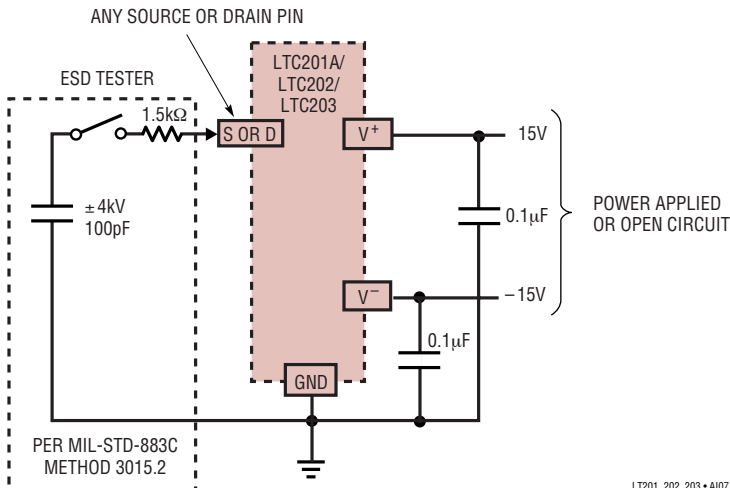
$V_{IN}$	
3V	NC
0V	NO

CCRR-Channel to Channel Crosstalk Test Circuit

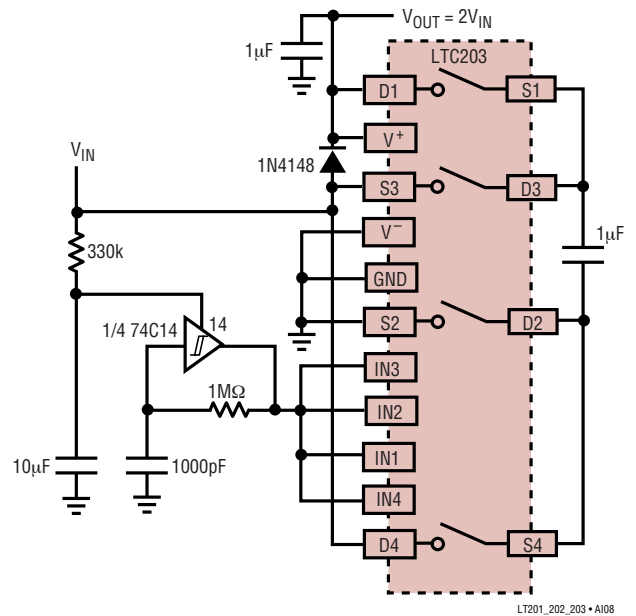


$V_{IN}$	
3V	NC
0V	NO

In-Circuit ESD Test Circuit



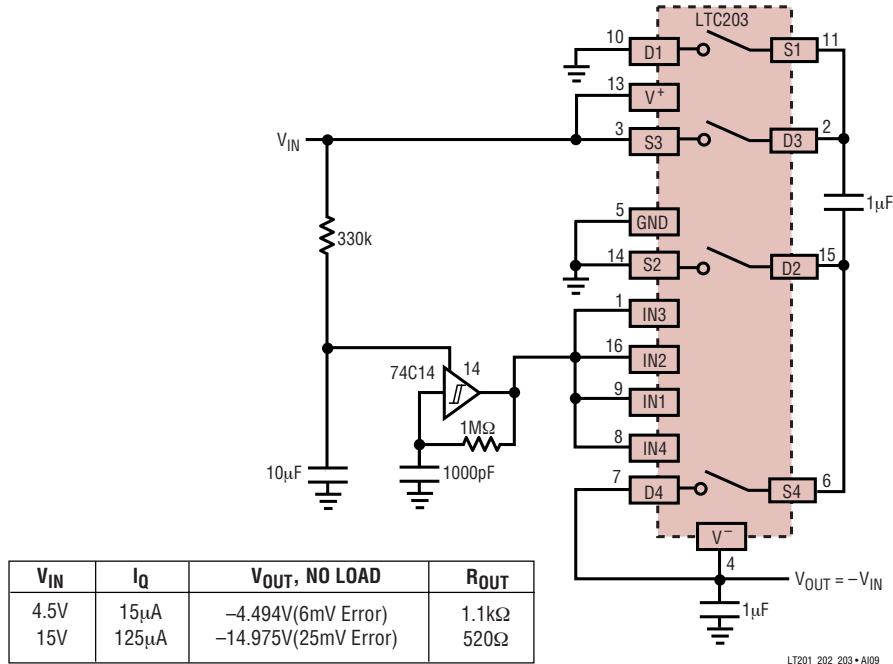
Micropower, 4.5V to 15V Input, Voltage Doubler Using the LTC203



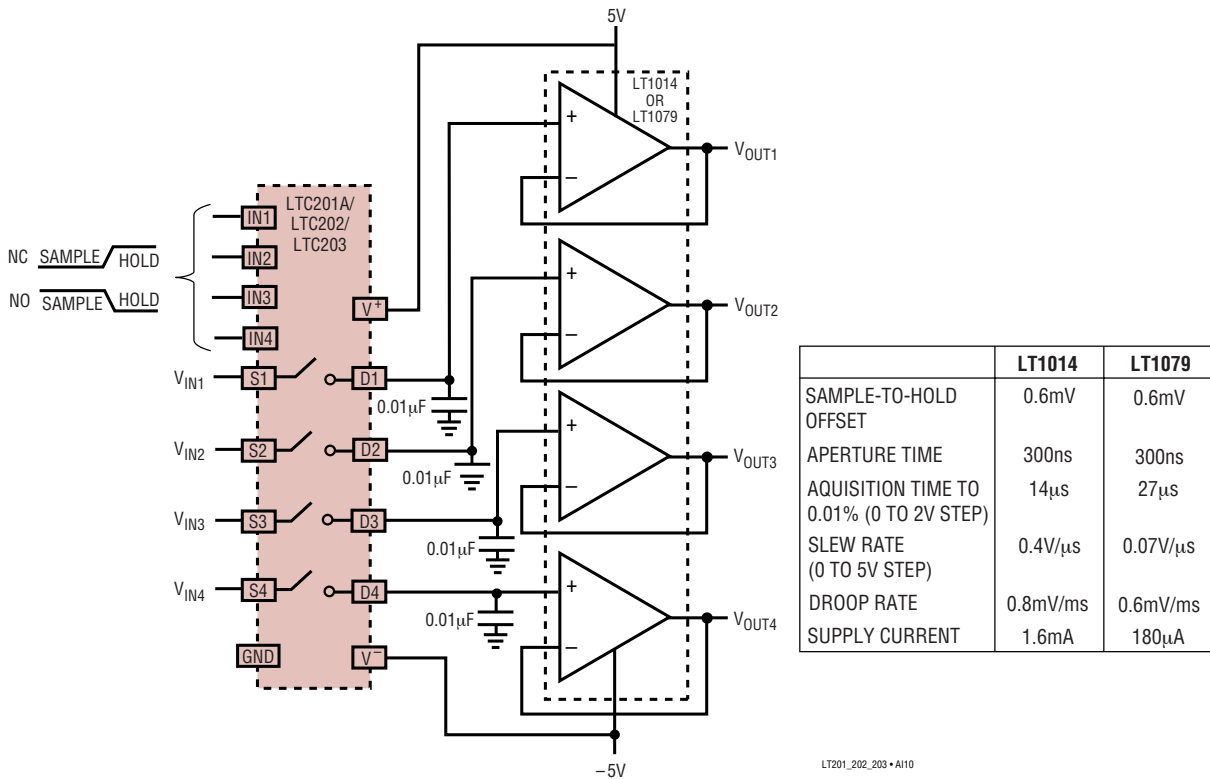
$V_{IN}$	$I_Q$	$V_{OUT}, \text{ NO LOAD}$	$R_{OUT}$
4.5V	20μA	8.988V(12mV Error)	1.2k
15V	130μA	29.96V(40mV Error)	600Ω

## APPLICATIONS INFORMATION

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



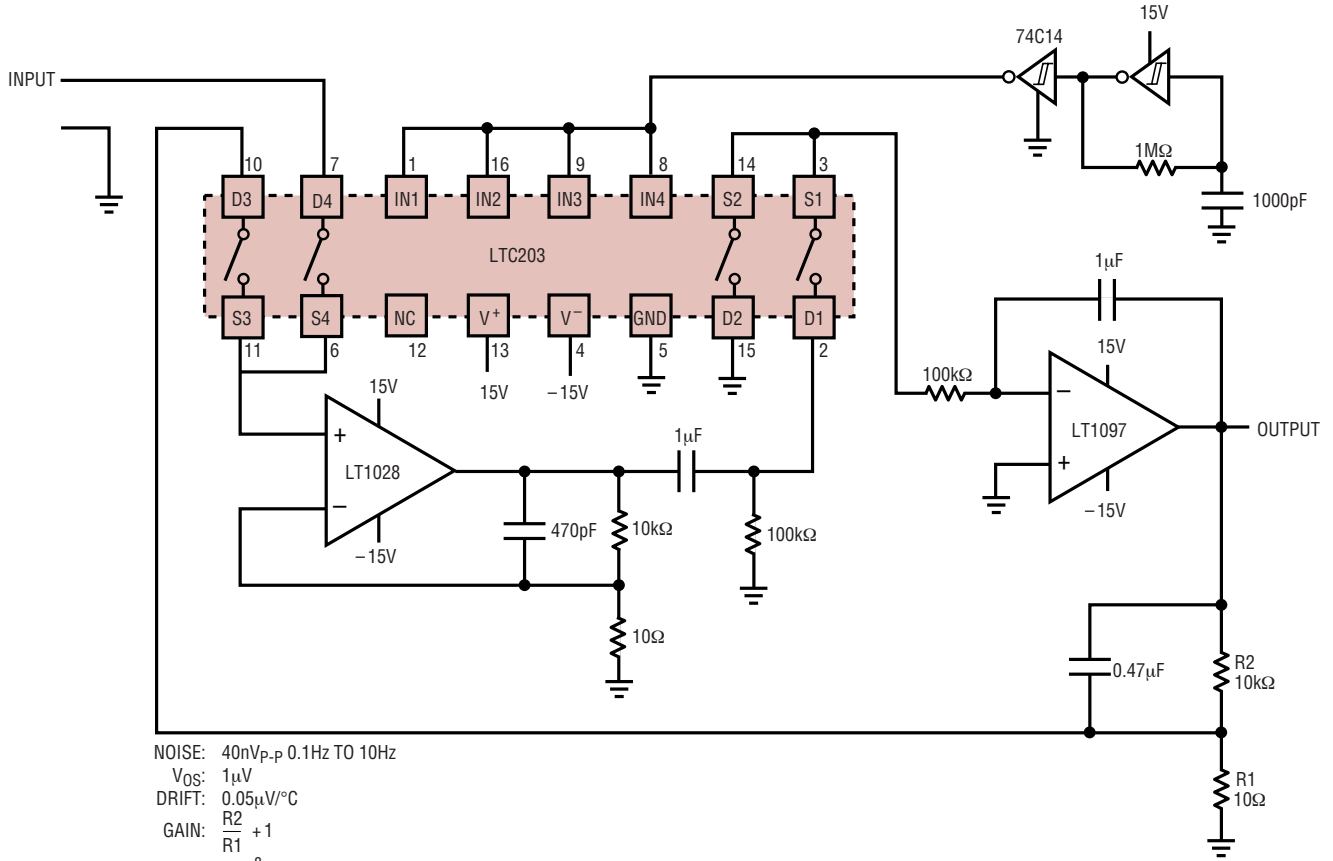
Quad 12-Bit Sample-and-Hold





APPLICATIONS INFORMATION

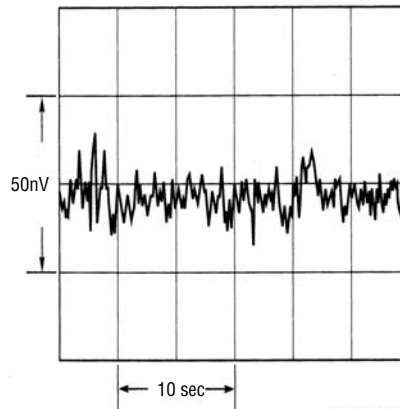
Ultra Low Noise, Low Drift Chopper Amplifier



NOISE: 40nV<sub>p-p</sub> 0.1Hz TO 10Hz  
 V<sub>OS</sub>: 1μV  
 DRIFT: 0.05μV/°C  
 GAIN:  $\frac{R2}{R1} + 1$   
 A<sub>VOL</sub>: > 10<sup>8</sup>  
 I<sub>b</sub>: 25nA

LT201\_202\_203 • AI11

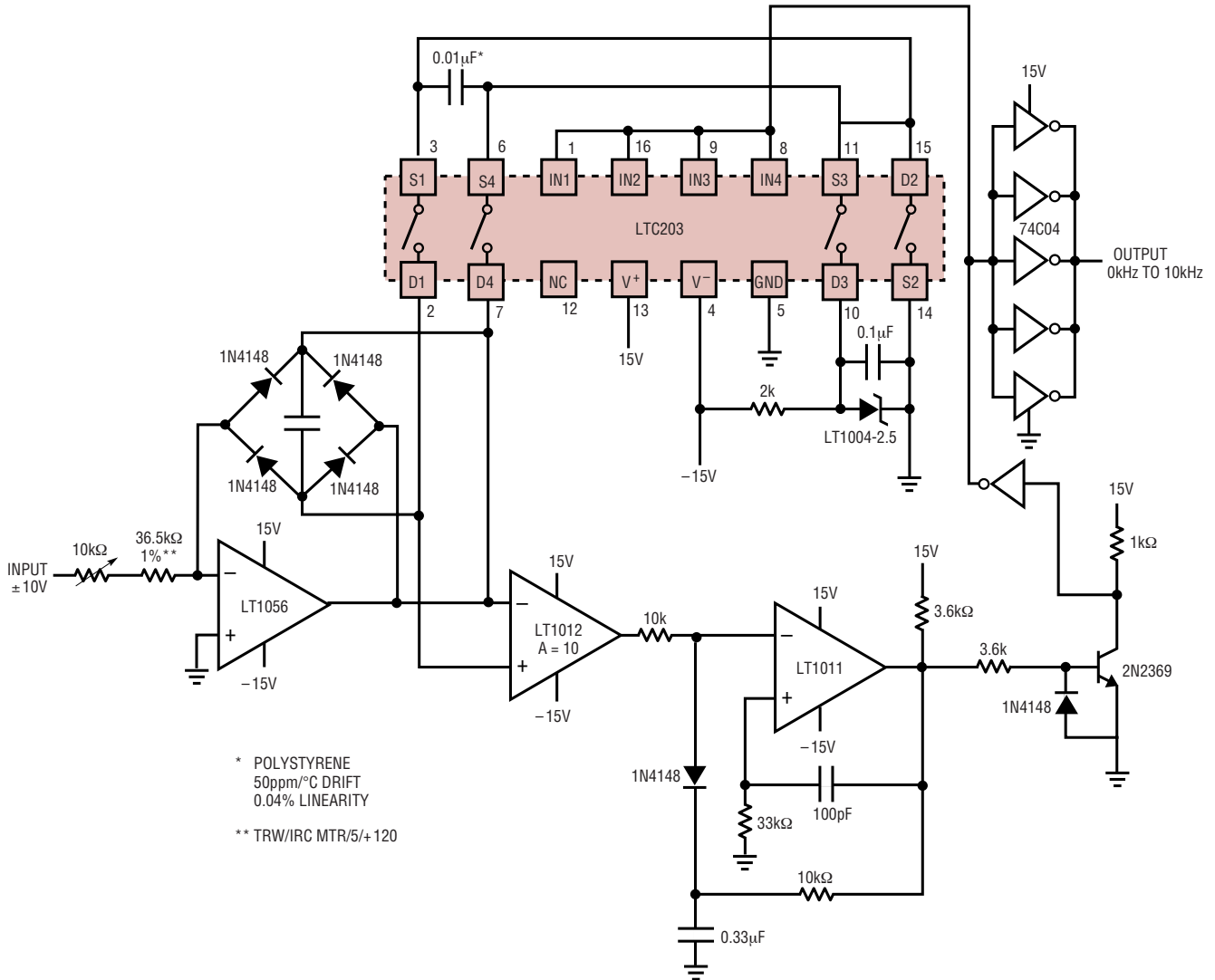
Noise in a 0.1 to 10Hz Bandwidth



LTC201A/202/203 • AI12

## APPLICATIONS INFORMATION

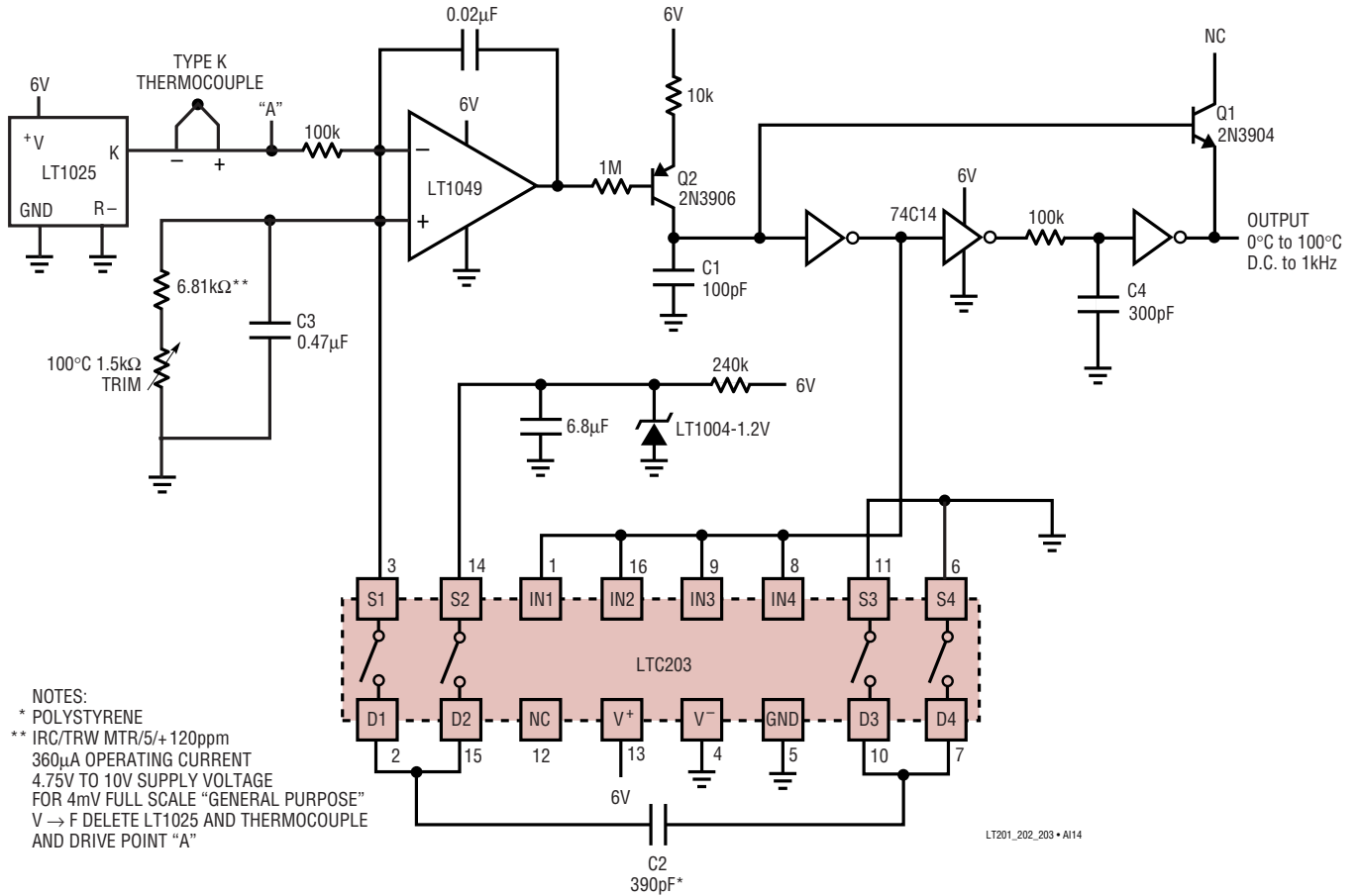
### Bipolar (AC) Input V/F Converter



LT201\_202\_203 • A113

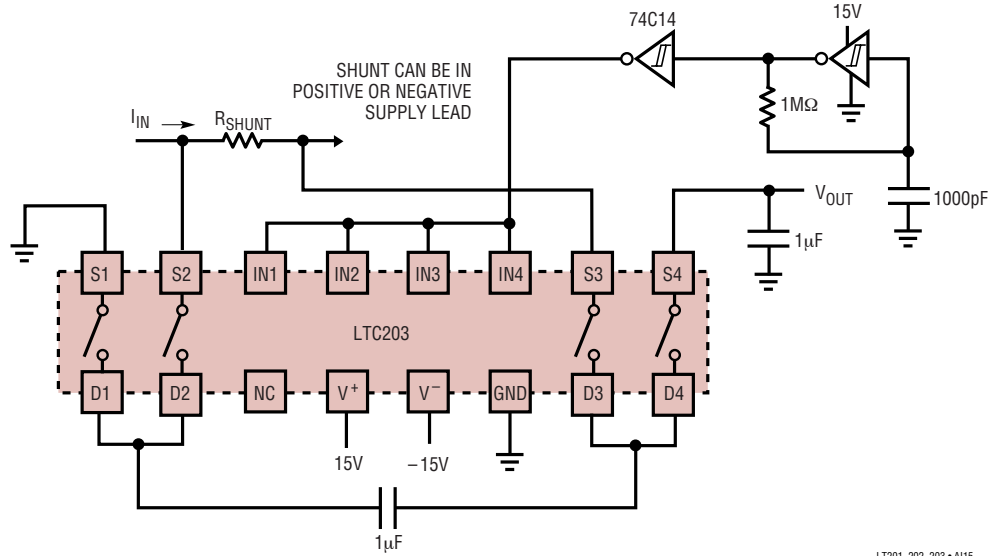
APPLICATIONS INFORMATION

Micropower Thermocouple Temperature to Frequency Converter

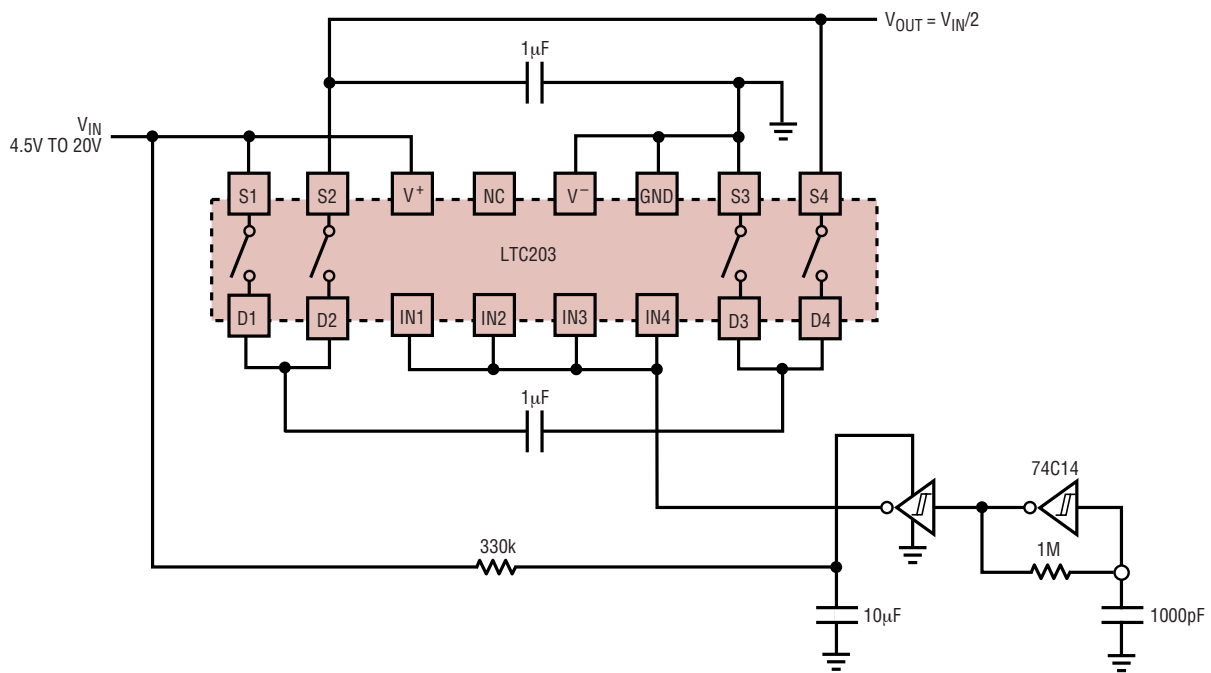


## APPLICATIONS INFORMATION

### Precision Current Sensing in Supply Rails

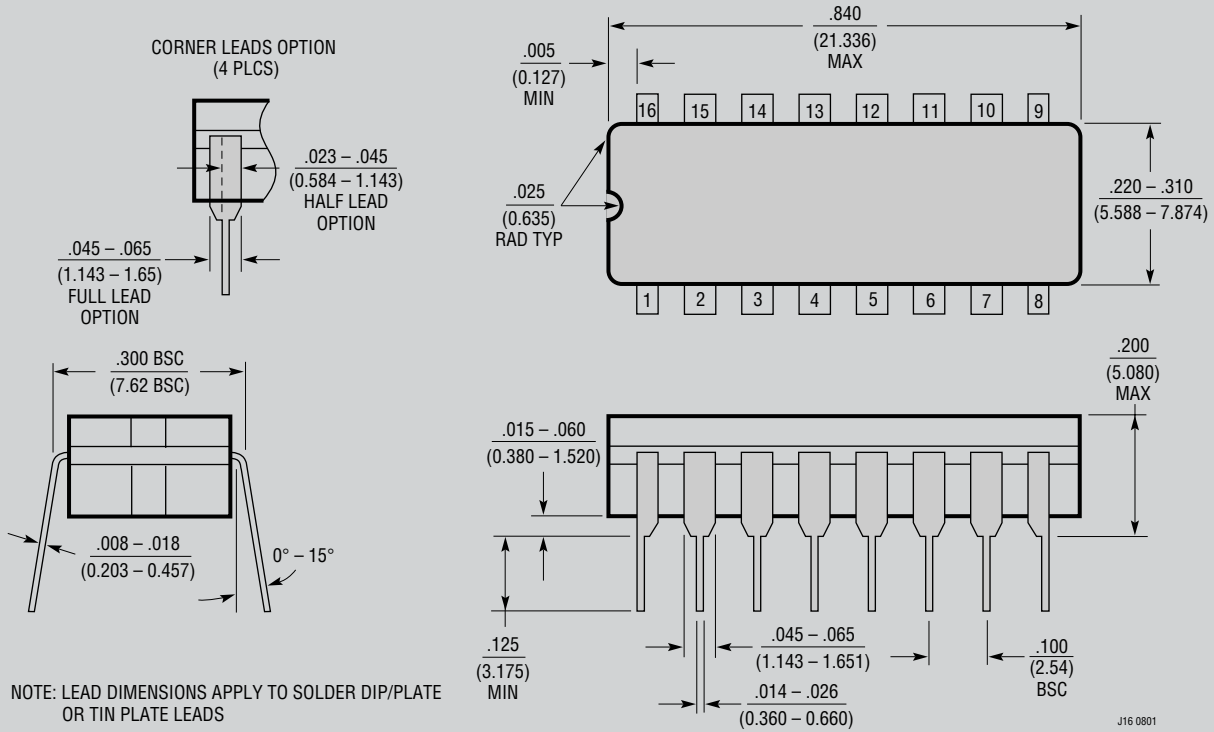


### Precision Voltage Divide by 2 Circuit



**PACKAGE DESCRIPTION**

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



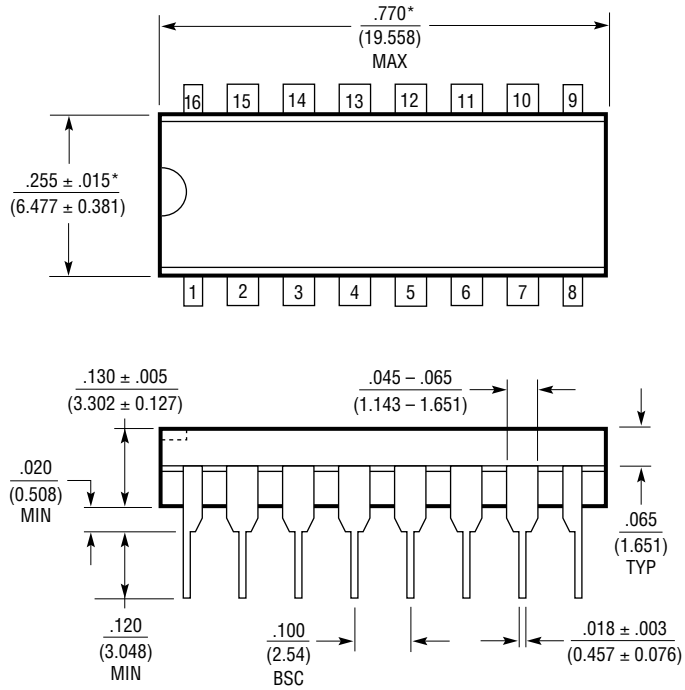
NOTE: LEAD DIMENSIONS APPLY TO SOLDER DIP/PLATE OR TIN PLATE LEADS

J16 0801

**OBSOLETE PACKAGE**

**PACKAGE DESCRIPTION**

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



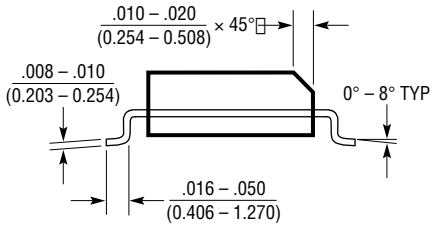
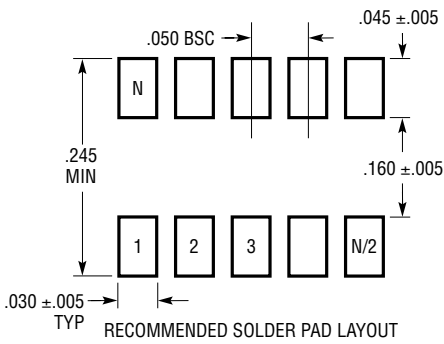
NOTE:  
 1. DIMENSIONS ARE  $\frac{\text{INCHES}}{\text{MILLIMETERS}}$

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

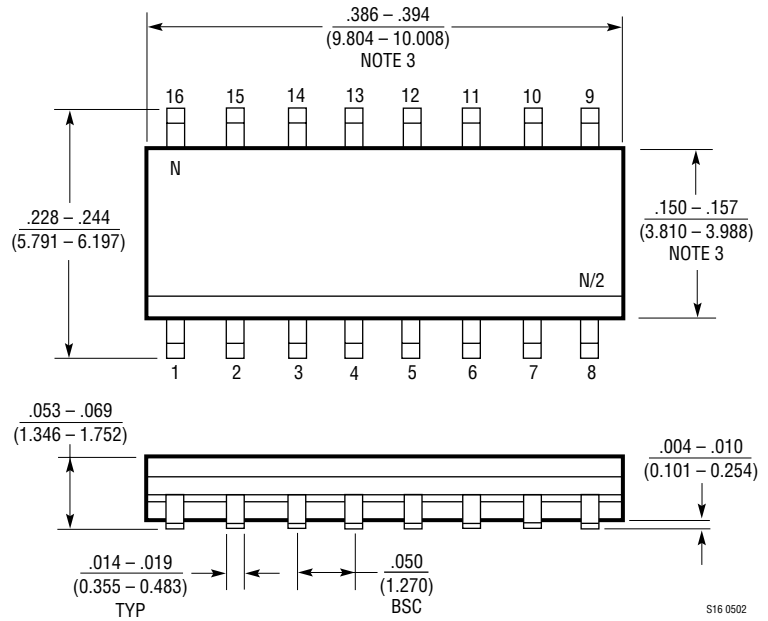
N16 1002

**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/70 $\Omega$ 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/ $\mu s$ Slew Rate





Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



#### Как с нами связаться

**Телефон:** 8 (812) 309 58 32 (многоканальный)

**Факс:** 8 (812) 320-02-42

**Электронная почта:** [org@eplast1.ru](mailto:org@eplast1.ru)

**Адрес:** 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.