

FEATURES

- Micropower Operation
- Single 5V or $\pm 15V$ 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 ($\pm 15V$ Supplies) $\pm 25pC$ Max.
(Single 5V Supply) $2pC$ Typ.
- R_{ON} 65Ω Typ.
- Signal Range $\pm 15V$

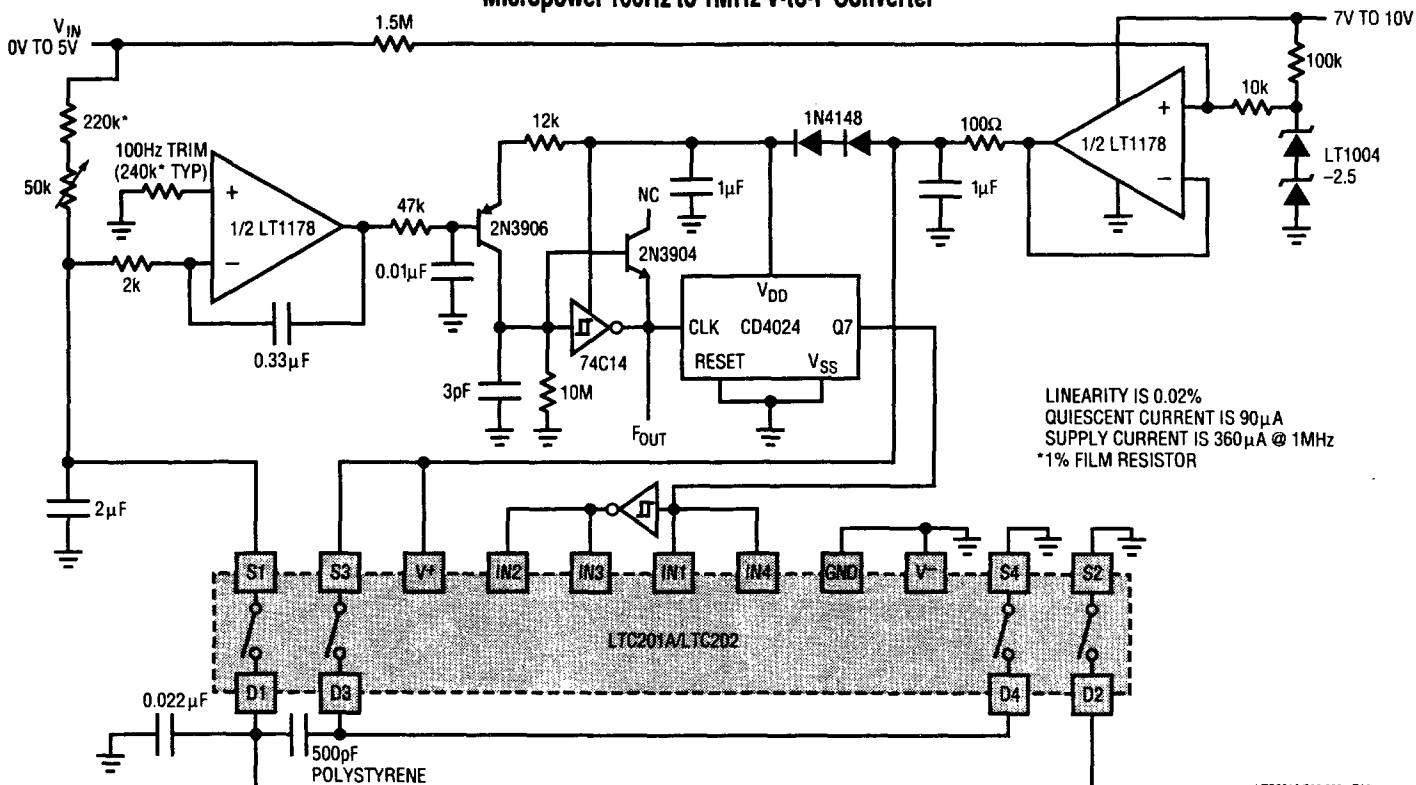
DESCRIPTION

The LTC201A, LTC202, and LTC203 are micropower, quad CMOS analog switches which typically dissipate only $250\mu W$ from $\pm 15V$ supplies and $40\mu W$ 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 $\pm 15V$, the signal range is $\pm 15V$. These switches have special charge compensation circuitry which greatly reduces charge injection to a maximum of $\pm 25pC$ ($\pm 15V$ 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.

TYPICAL APPLICATION

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



LTC201A/202/203 - TA01

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

Peaks 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

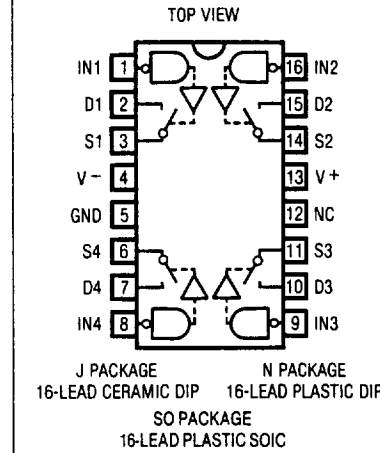
LTC201AM/LTC202M/LTC203M -55°C to 125°C

Storage Temperature Range -65°C to 150°C

Lead Temperature (Soldering, 10 sec.) 300°C

PACKAGE/ORDER INFORMATION

TOP VIEW	ORDER PART NUMBER	
	LTC201AMJ LTC201ACJ LTC201ACN LTC201ACS LTC202MJ LTC202CJ LTC202CN LTC202CS LTC203MJ LTC203CJ LTC203CN LTC203CS	

**LOGIC TABLE**

IN_x	LTC201A	LTC202	LTC203	
	IN1-IN4	IN1-IN4	IN1, IN4	IN2, IN3
0	ON	OFF	OFF	ON
1	OFF	ON	ON	OFF

DIGITAL AND DC ELECTRICAL CHARACTERISTICS $V^+ = +15V$, $V^- = -15V$, GND = 0V unless otherwise noted.

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	
		T_{MAX}			160			160	
ΔR_{ON} vs V_S				20			20		%
ΔR_{ON} vs Temperature				0.5			0.5		%/°C
R_{ON} Match	$V_S = 0V$, $I_{DS} = 1mA$			5			5		%
Off Input Leakage I_S (OFF)	$V_D = \pm 14V$, $V_S = \mp 14V$ Switch Off	•		0.01	±1		0.01	±5	nA
		•			±100			±100	
Off Output Leakage I_D (OFF)	$V_D = \pm 14V$, $V_S = \mp 14V$ Switch Off	•		0.01	±1		0.01	±5	nA
		•			±100			±100	
On Channel Leakage I_D (ON)	$V_D = V_S = \pm 14V$ Switch On	•		0.02	±1		0.02	±5	nA
		•			±200			±200	
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}	$V_{IN} = 15V$, 0V	•		±1			±1		μA

LTC201A/LTC202/LTC203

DIGITAL AND DC ELECTRICAL CHARACTERISTICS

$V^+ = +15V$, $V^- = -15V$, $GND = 0V$ unless otherwise noted.

PARAMETER	CONDITIONS		LTC201AM/LTC202M/LTC203M			LTC201AC/LTC202C/LTC203C			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
$C_S(OFF)$				5			5		pF
$C_D(OFF)$				12			12		pF
$C_D, C_S(ON)$				30			30		pF
I^+	All Logic Inputs Tied Together $V_{IN} = 0V$ or $4.0V$		16		40	16		40	μA
		•			60			60	
I^-				0.1	5		0.1	5	
		•			10			10	

AC ELECTRICAL CHARACTERISTICS $V^+ = +15V$, $V^- = -15V$, $GND = 0V$ unless otherwise noted.

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

DIGITAL AND DC ELECTRICAL CHARACTERISTICS

$V^+ = +5V$, $V^- = GND = 0V$ 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}	$V_S = +1.5V, +3V$ $I_D = 0.25mA$	T_{MIN}			450			520	Ω
		$25^\circ C$		280	450		280	525	
		T_{MAX}			650			650	
ΔR_{ON} vs V_S				20			20		%
ΔR_{ON} vs Temperature				0.5			0.5		%/ $^\circ C$
R_{ON} Match	$V_S = 2.5V$, $I_{DS} = 0.25mA$			5			5		%
Off Input Leakage $I_S(OFF)$	$V_D = 4V, 1V$; $V_S = 1V, 4V$ (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		•			± 100			± 100	
Off Output Leakage $I_D(OFF)$	$V_D = 4V, 1V$; $V_S = 1V, 4V$ (Note 4) Switch Off			0.01	± 1		0.01	± 5	nA
		•			± 100			± 100	
On Channel Leakage $I_D(ON)$	$V_D = V_S = 1V, 4V$ (Note 4) Switch On			0.01	± 1		0.01	± 5	nA
		•			± 200			± 200	
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}	$V_{IN} = 5V, 0V$	•			± 1			± 1	μA

DIGITAL AND DC ELECTRICAL CHARACTERISTICS

$V^+ = +5V$, $V^- = GND = 0V$ unless otherwise noted.

PARAMETER	CONDITIONS	LTC201AM/LTC202M/LTC203M			LTC201AC/LTC202C/LTC203C			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	
$C_S(\text{OFF})$			5			5		pF
$C_D(\text{OFF})$			12			12		pF
$C_D, C_S(\text{ON})$			30			30		pF
I^+	All Logic Inputs Tied Together $V_{IN} = 0V$ or $4.0V$		8	20		8	20	μA
		●		30			30	

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

PARAMETER	CONDITIONS	LTC201AM/LTC202M/LTC203M			LTC201AC/LTC202C/LTC203C			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	
T_{OPEN}	-	100	250		100	250		ns
Off Isolation	$V_S = 2Vp-p$, $R_L = 1k\Omega$, $f = 100kHz$		75			75		dB
Crosstalk			90			90		
Charge Injection Q_{INJ}	$R_S = 0\Omega$, $C_L = 1000pF$, $V_S = 2.5V$		2			2		pC
Total Harmonic Distortion THD	$V_S = 2Vp-p$, $R_L = 10k\Omega$		0.01			0.01		%

The ● denotes the specifications which apply over full operating temperature range. All other limits and typicals $T_A = 25^\circ C$.

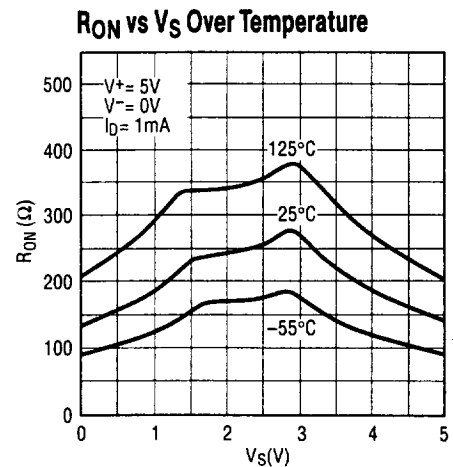
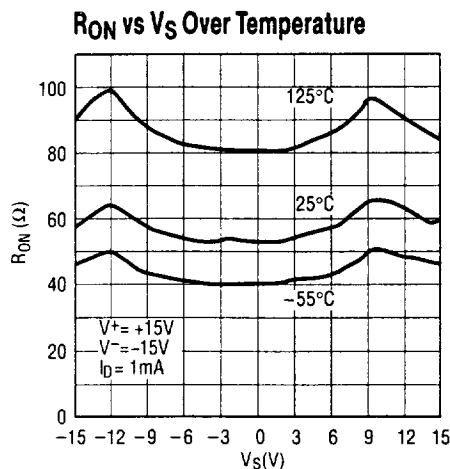
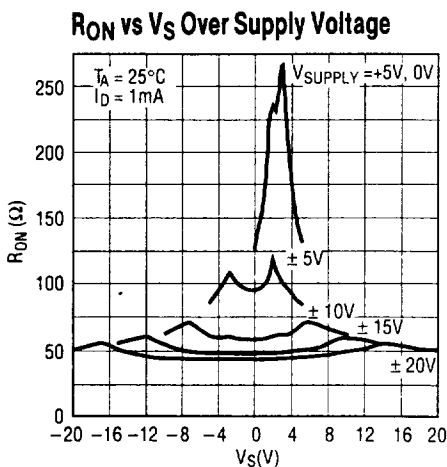
Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

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.

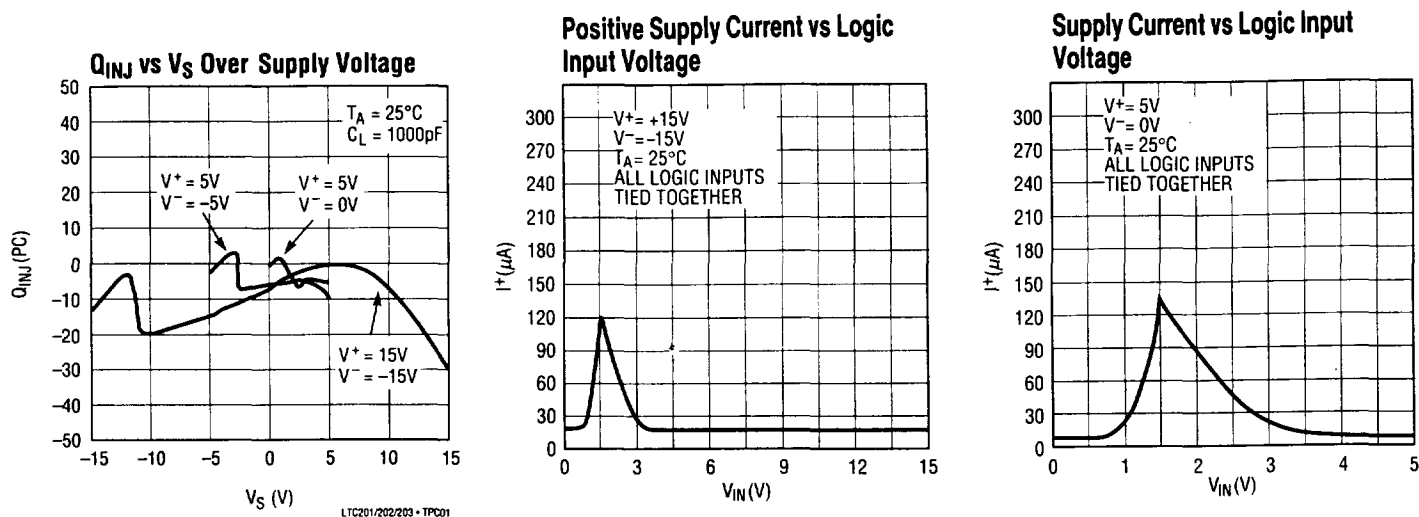
Note 3: In-circuit ESD on the switch pins (S or D) exceeds 4kV (see test circuit).

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

TYPICAL PERFORMANCE CHARACTERISTICS



TYPICAL PERFORMANCE CHARACTERISTICS



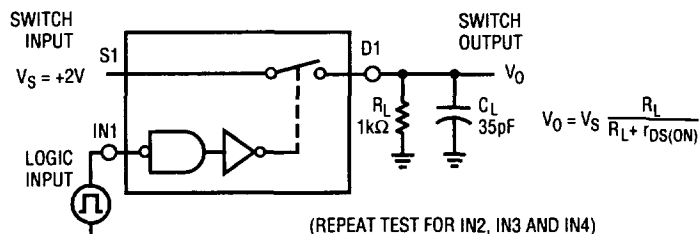
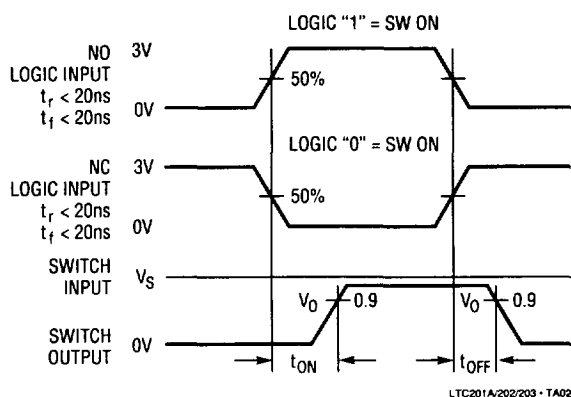
APPLICATIONS INFORMATION

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

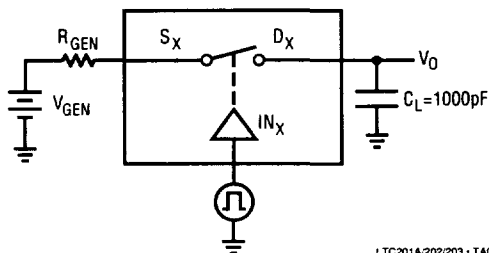
output switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

Switching Time Test Circuit

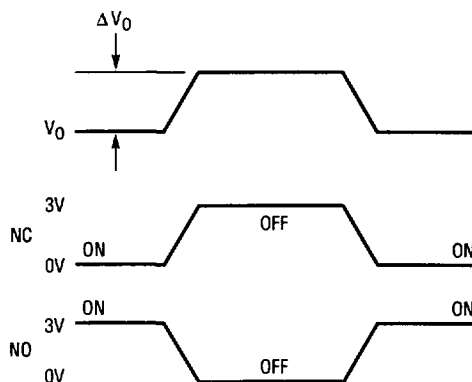


LTC201A/202/203 - TA03

Charge Injection Test Circuit



LTC201A/202/203 - TA04

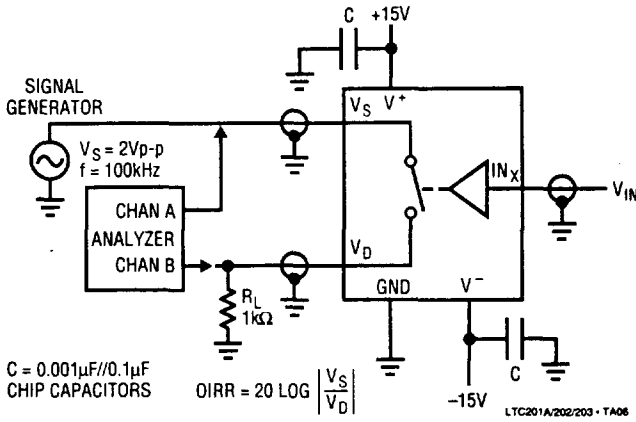


ΔV_O IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION. THE ERROR VOLTAGE IN COULOMBS IS $\Delta Q = C_L \times \Delta V_O$.

LTC201A/202/203 - TA05

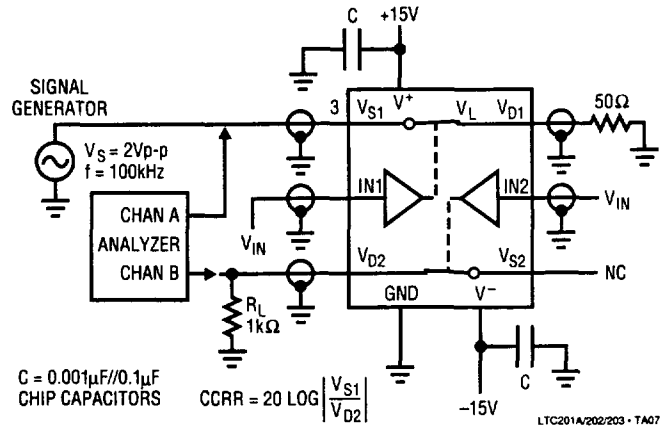
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit



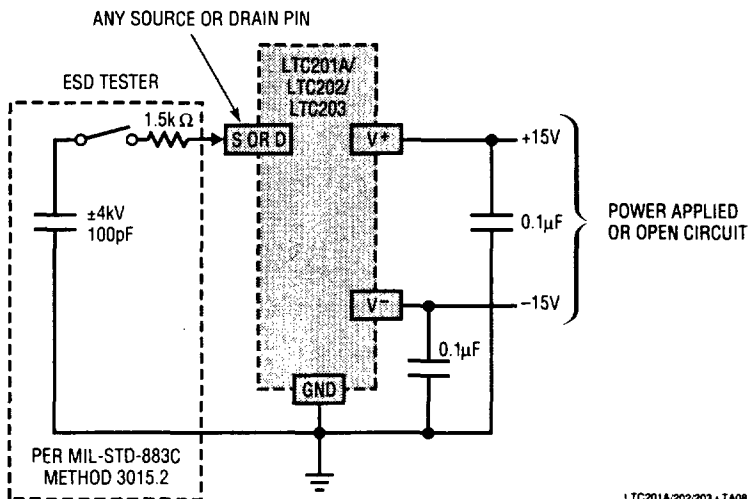
V_{IN}	
3V	NC
0V	NO

CCRR-Channel to Channel Crosstalk Test Circuit

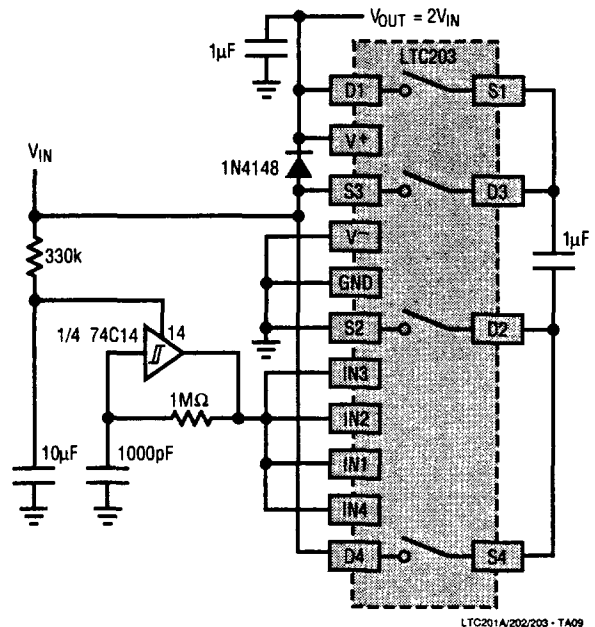


V_{IN}	
3V	NC
0V	NO

In-Circuit ESD Test Circuit



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

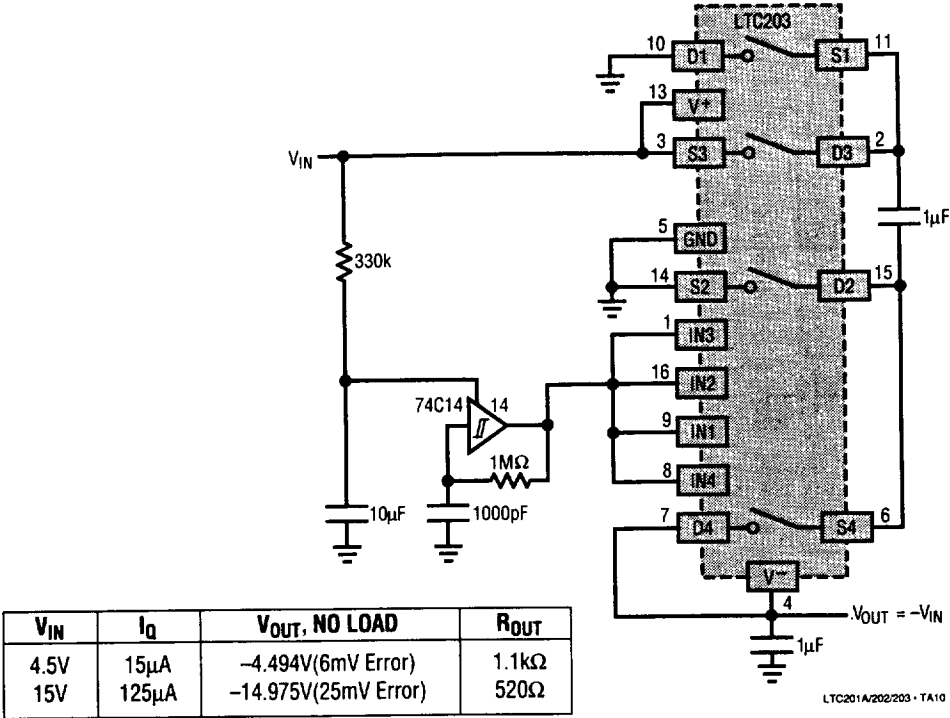


V_{IN}	I_Q	$V_{OUT, \text{ NO LOAD}}$	R_{OUT}
4.5V	20μA	8.988V(12mV Error)	1.2k
15V	130μA	29.96V(40mV Error)	600Ω

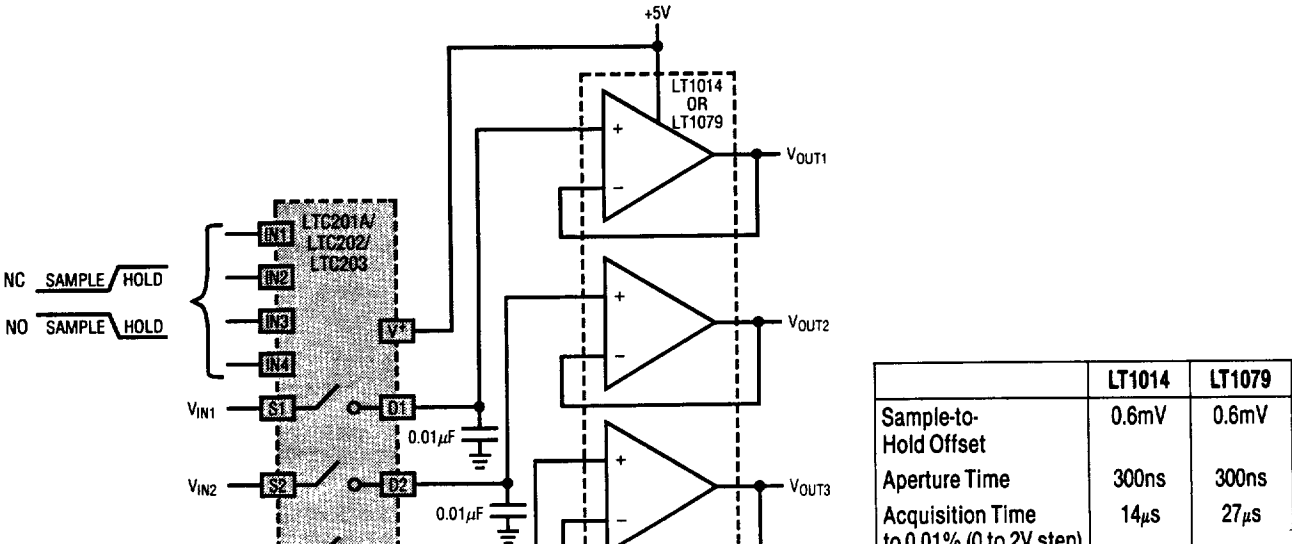
LTC201A/LTC202/LTC203

APPLICATIONS INFORMATION

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



Quad 12-Bit Sample and Hold

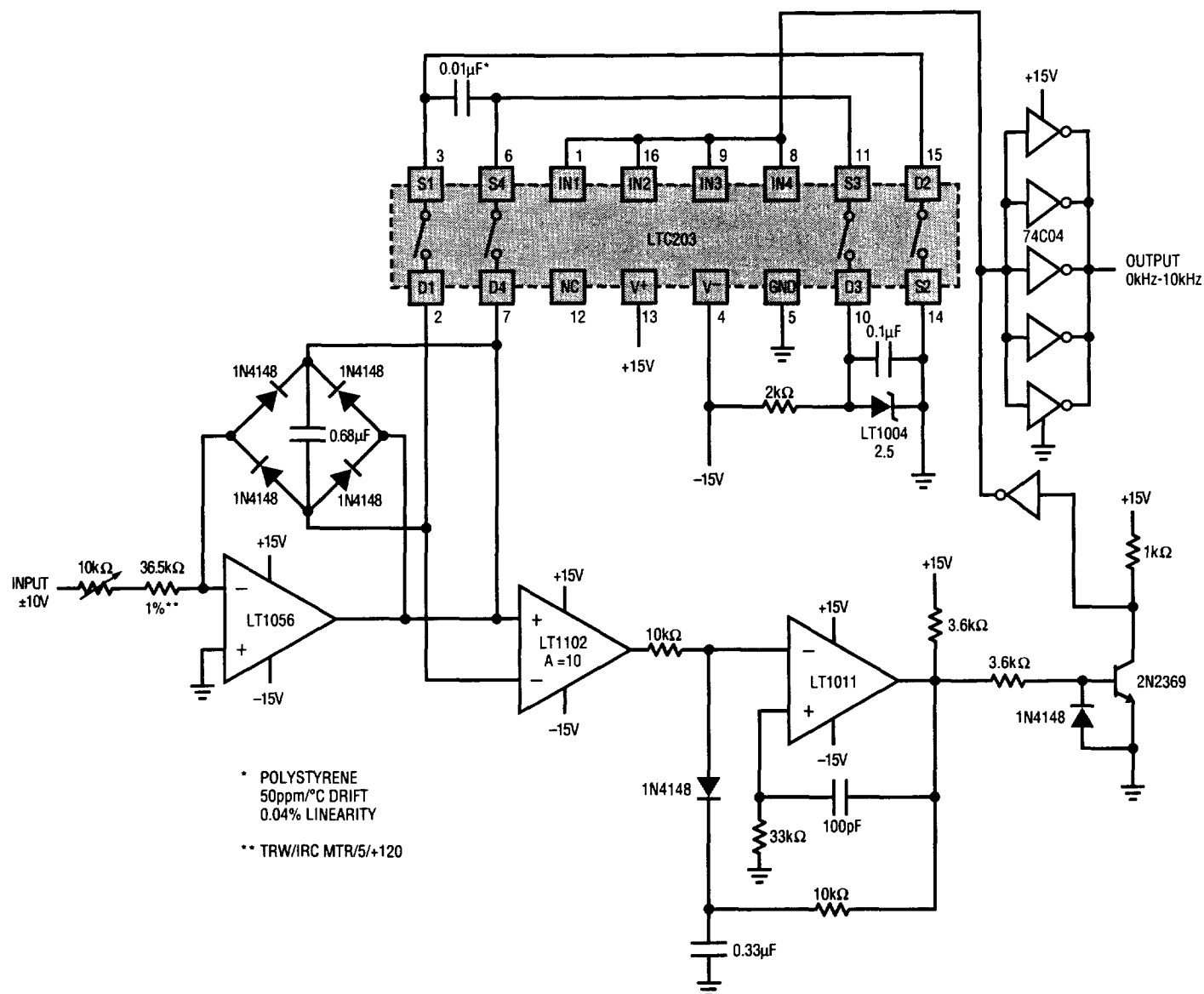


NOISE 40nVp-p 0.1Hz-10Hz
 V_{OS} 1μV
 DRIFT 0.05μV/°C
 GAIN $\frac{R_2}{R_1} + 1$
 A_{VOL} $>10^8$
 I_b 25nA

LTC201A/202/203 • TA11

APPLICATIONS INFORMATION

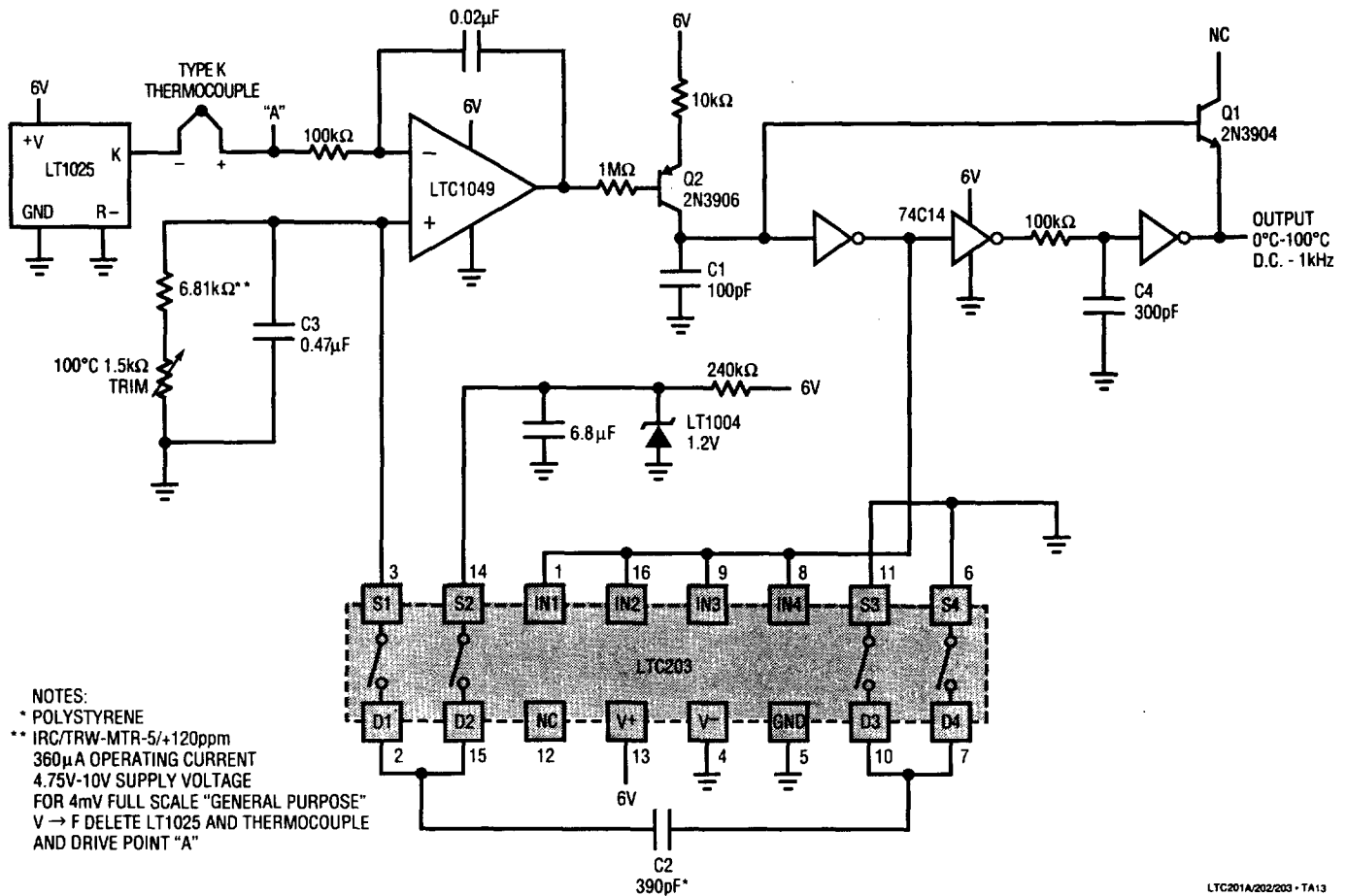
Bipolar (AC) Input $V \rightarrow F$ Converter



LTC201A/202/203 • TA12

APPLICATIONS INFORMATION

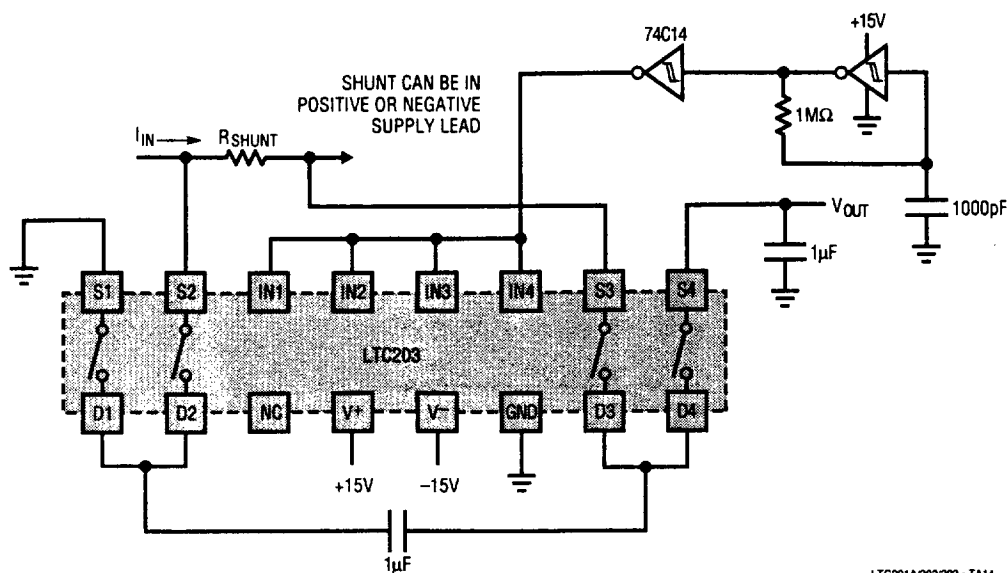
Micropower Thermocouple Temperature to Frequency Converter



LTC201A/202/203 - TA13

APPLICATIONS INFORMATION

Precision Current Sensing in Supply Rails



Precision Voltage Divide by 2 Circuit

