

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

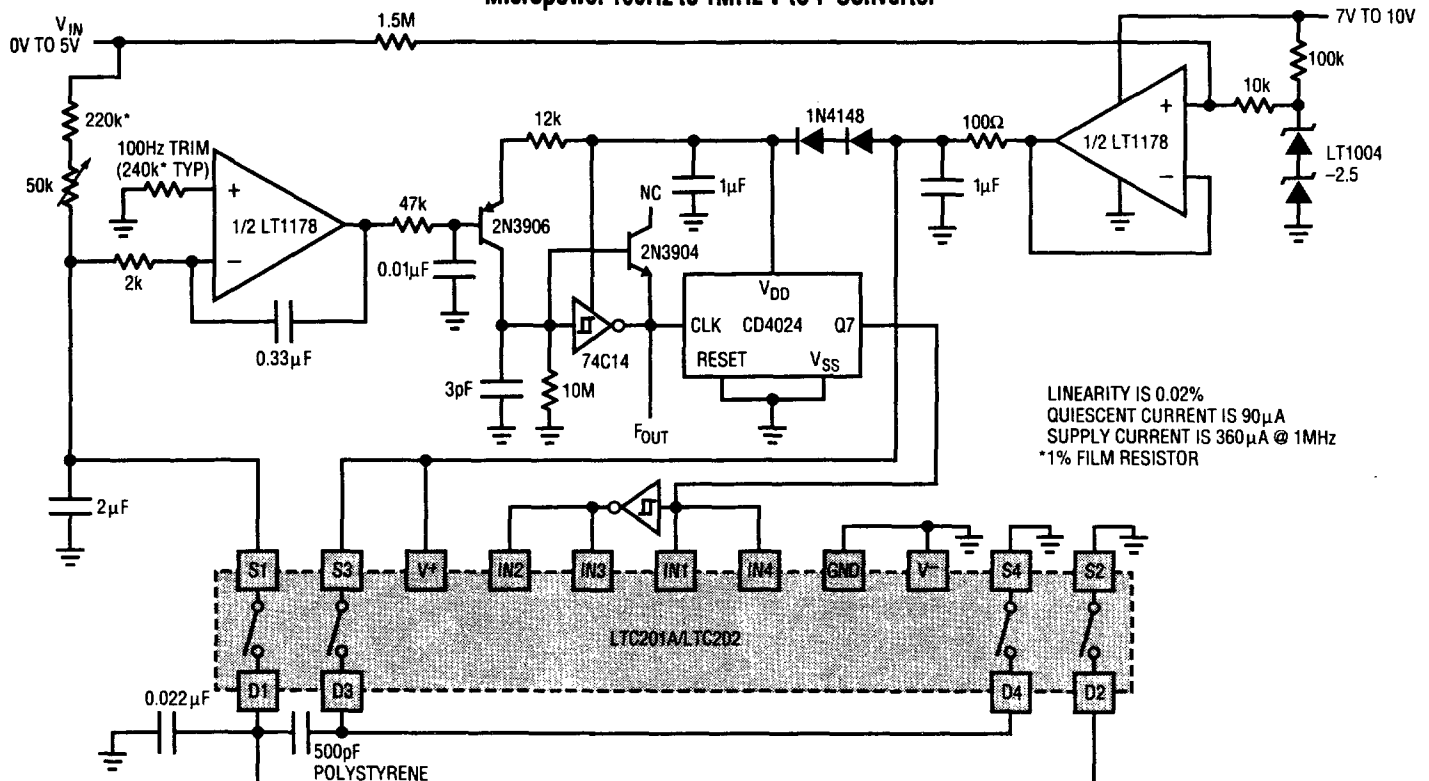
- Supply Current $I^+ = 40\mu A, I^- = 5\mu A$ Max.
- Charge Injection ($\pm 15V$ Supplies) $\pm 25pC$ Max.
(Single 5V Supply) $2pC$ Typ.
- R_{ON} 65Ω Typ.
- Signal Range $\pm 15V$

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

| | |
|--|--|
| <p>TOP VIEW</p> <p>J PACKAGE 16-LEAD CERAMIC DIP N PACKAGE 16-LEAD PLASTIC DIP SO PACKAGE 16-LEAD PLASTIC SOIC</p> | ORDER PART NUMBER |
| | <p>LTC201AMJ LTC201ACJ LTC201ACN LTC201ACS LTC202MJ LTC202CJ LTC202CN LTC202CS LTC203MJ LTC203CJ LTC203CN LTC203CS</p> |

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 = ±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 = ±14V, V _S = ∓14V Switch Off | | 0.01 | ±1 | 0.01 | ±5 | nA | |
| | | • | | ±100 | | ±100 | | |
| Off Output Leakage I _D (OFF) | V _D = ±14V, V _S = ∓14V Switch Off | | 0.01 | ±1 | 0.01 | ±5 | nA | |
| | | • | | ±100 | | ±100 | | |
| On Channel Leakage I _D (ON) | V _D = V _S = ±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 = 1kΩ, 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 = 1kΩ, f = 100kHz | | 75 | | 75 | | 75 | dB |
| Crosstalk | | | 90 | | 90 | | 90 | |
| Charge Injection Q _{INJ} | R _S = 0Ω, C _L = 1000pF, V _S = 0V | | 5 | | ±25 | 8 | ±25 | pC |
| Total Harmonic Distortion THD | V _S = 2Vp-p, R _L = 10kΩ | | 0.01 | | 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°C | | 280 | | 450 | 280 | | 525 |
| | | T _{MAX} | | | | 650 | | | 650 |
| ΔR _{ON} vs V _S | | | 20 | | 20 | | 20 | % | |
| ΔR _{ON} vs Temperature | | | 0.5 | | 0.5 | | 0.5 | %/°C | |
| R _{ON} Match | V _S = 2.5V, I _{DS} = 0.25mA | | 5 | | 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 _O (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 _O (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 | | 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 (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 | | 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 = 1kΩ, 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 = 1kΩ, f = 100kHz | | 75 | | | 75 | | dB |
| Crosstalk | | | 90 | | | 90 | | |
| Charge Injection Q _{INJ} | R _S = 0Ω, C _L = 1000pF, V _S = 2.5V | | 2 | | | 2 | | pC |
| Total Harmonic Distortion THD | V _S = 2Vp-p, R _L = 10kΩ | | 0.01 | | | 0.01 | | % |

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

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

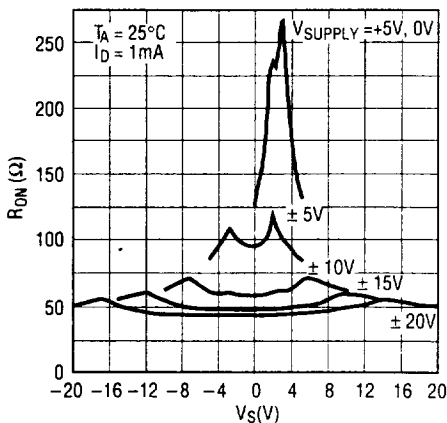
Note 2: Signals on S, D, or IN exceeding V⁺ or V⁻ will be clamped by internal diodes. Limit forward diode current to maximum current rating.

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

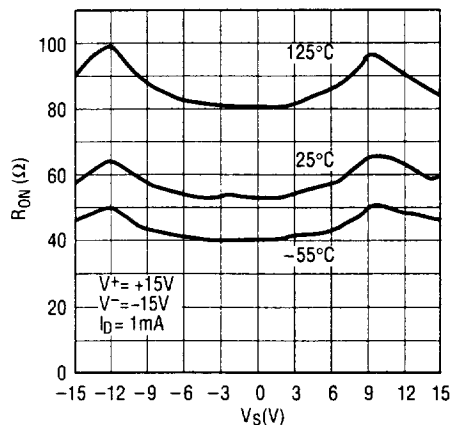
Note 4: Leakage current with a single 5V supply is guaranteed by correlation with the ±15V leakage current.

TYPICAL PERFORMANCE CHARACTERISTICS

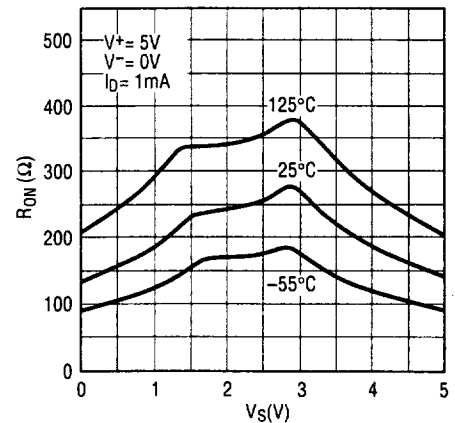
R_{ON} vs V_S Over Supply Voltage



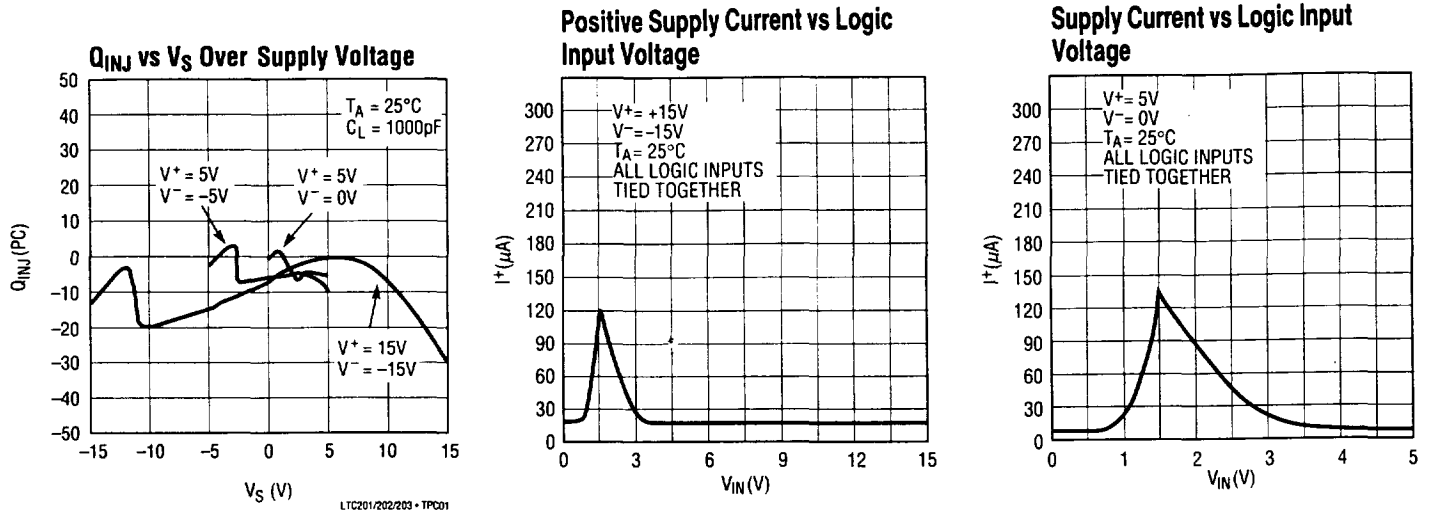
R_{ON} vs V_S Over Temperature



R_{ON} vs V_S Over Temperature



TYPICAL PERFORMANCE CHARACTERISTICS



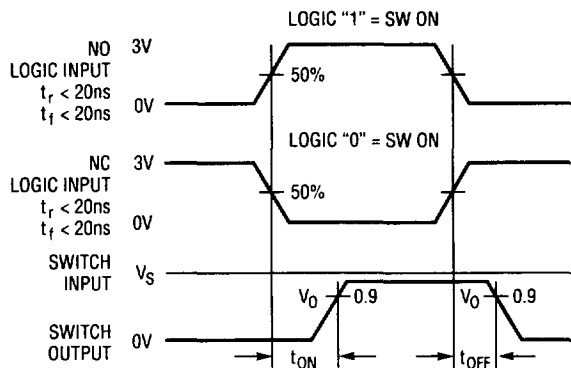
APPLICATIONS INFORMATION

Switching Time Test Circuit

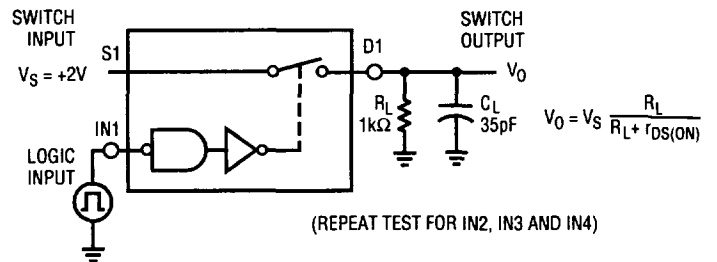
Switch output waveform shown for V_S = constant with logic input waveform as shown. Note that V_S may be + or - as per switching time test circuit. V_O is the steady state

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

Switching Time Test Circuit

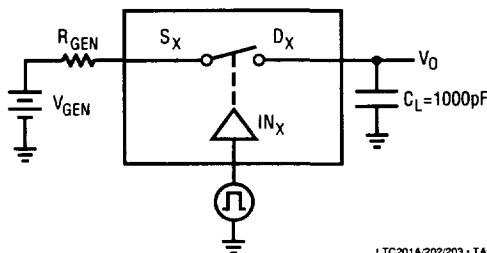


LTC201A/202/203 - TA02

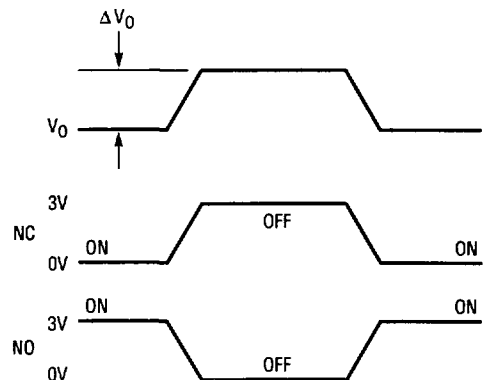


LTC201A/202/203 - TA03

Charge Injection Test Circuit



LTC201A/202/203 - TA04

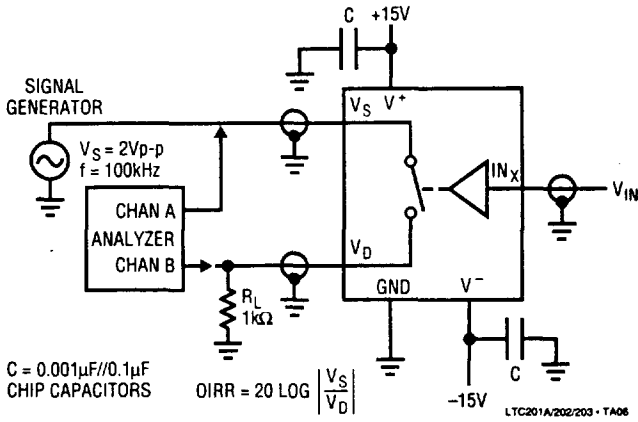


ΔV_O IS THE MEASURED VOLTAGE ERROR DUE TO CHARGE INJECTION.
 THE ERROR VOLTAGE IN COULOMBS IS ΔQ = C_L × ΔV_O.

LTC201A/202/203 - TA05

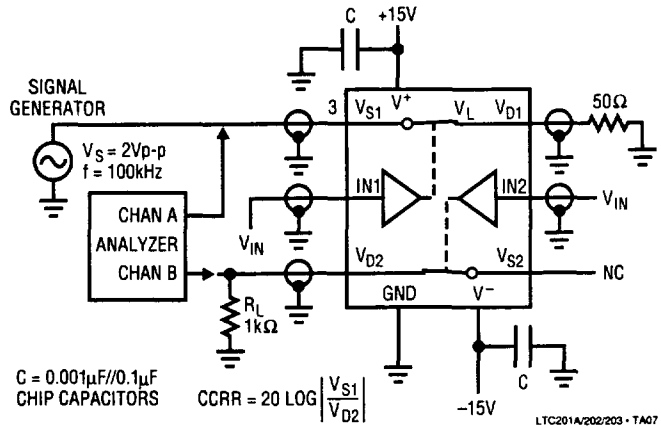
APPLICATIONS INFORMATION

OIRR-Off Isolation Test Circuit



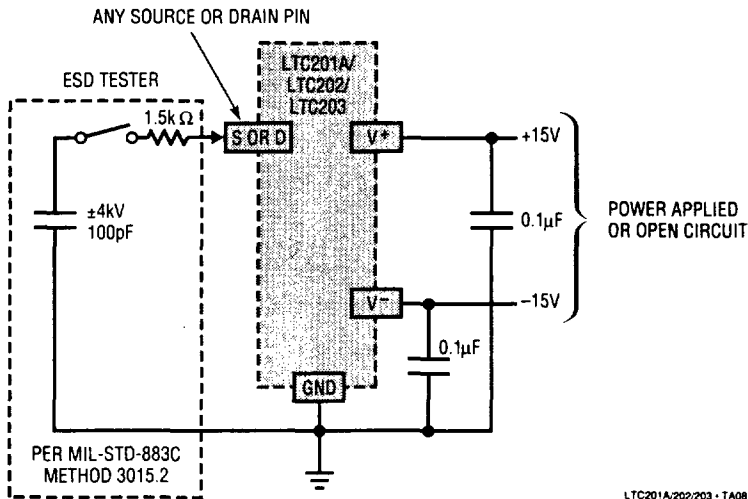
| V_{IN} | |
|----------|----|
| 3V | NC |
| 0V | NO |

CCRR-Channel to Channel Crosstalk Test Circuit

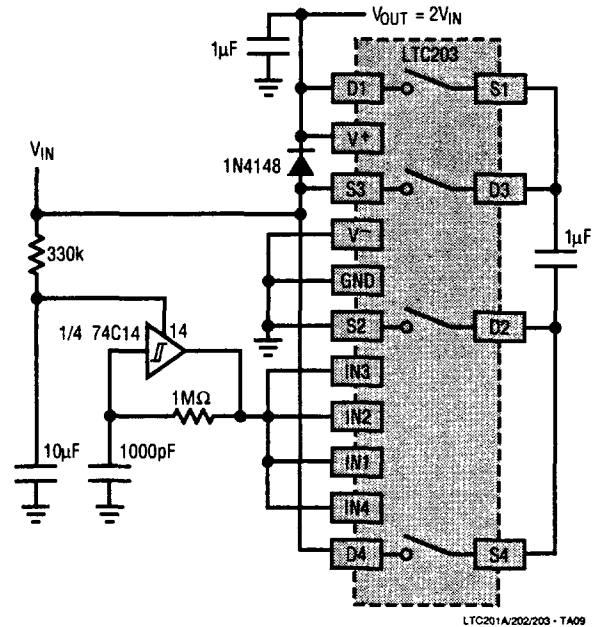


| V_{IN} | |
|----------|----|
| 3V | NC |
| 0V | NO |

In-Circuit ESD Test Circuit



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

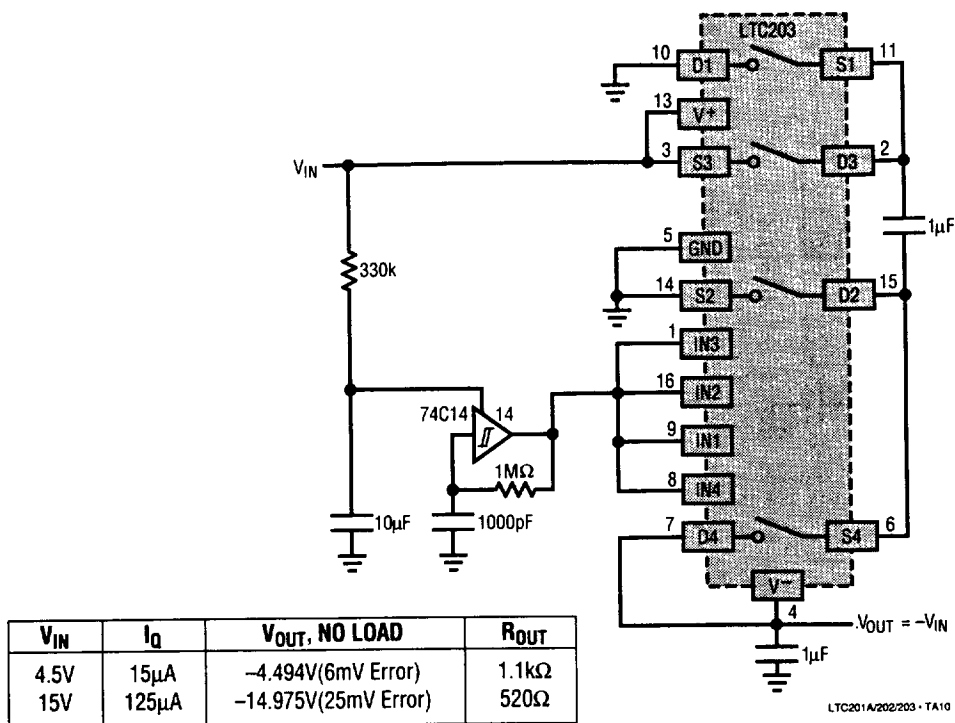


| V_{IN} | I_Q | $V_{OUT, NO \text{ LOAD}}$ | R_{OUT} |
|----------|-------|----------------------------|-----------|
| 4.5V | 20μA | 8.988V(12mV Error) | 1.2k |
| 15V | 130μA | 29.96V(40mV Error) | 600Ω |

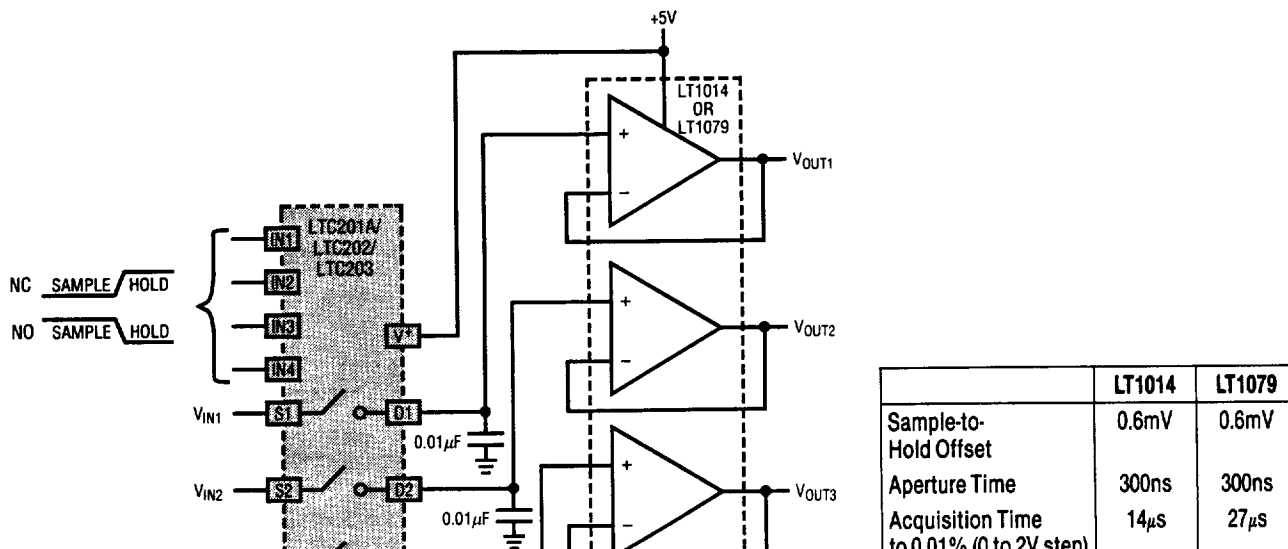
LTC201A/LTC202/LTC203

APPLICATIONS INFORMATION

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

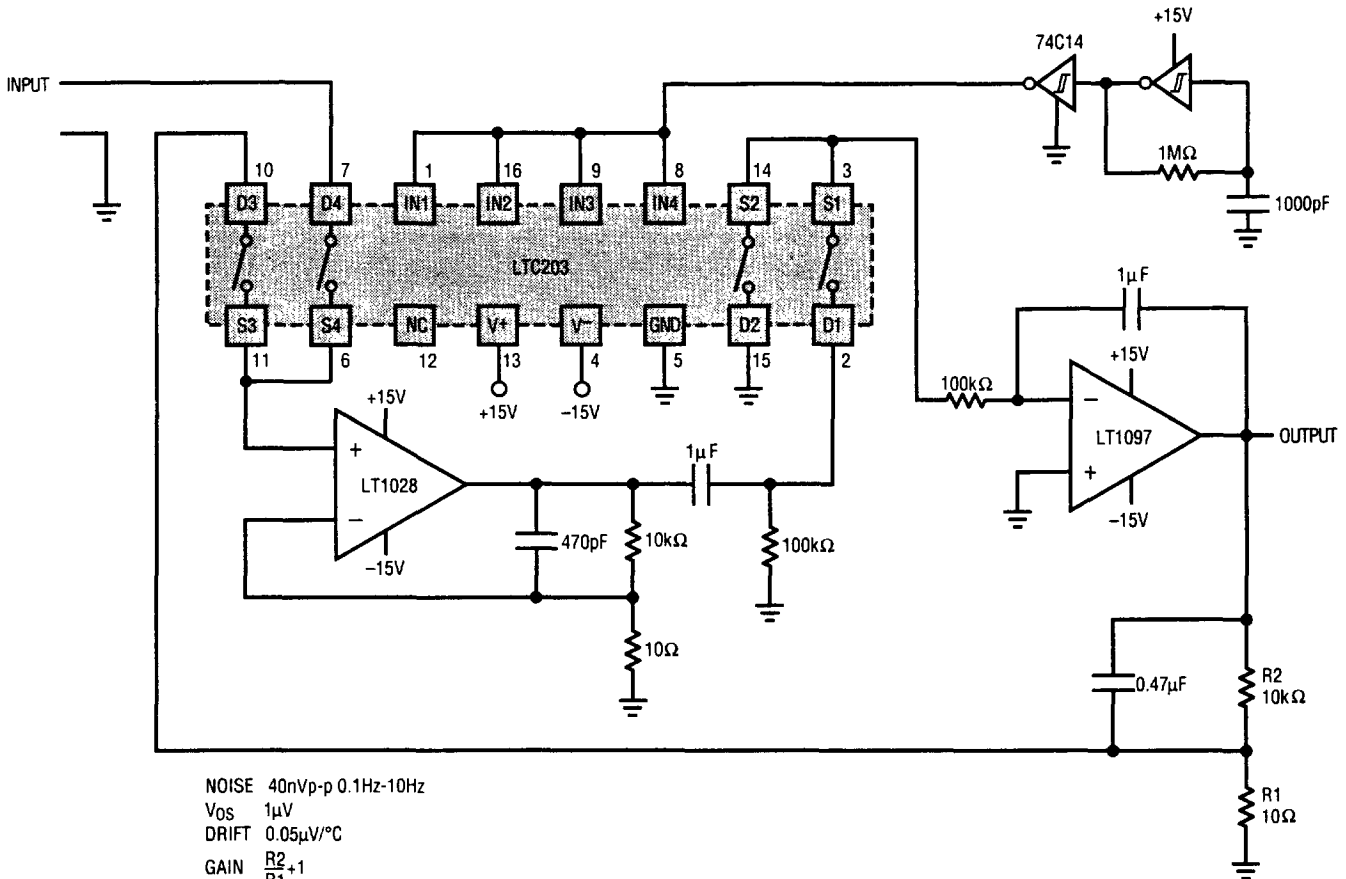


Quad 12-Bit Sample and Hold



APPLICATIONS INFORMATION

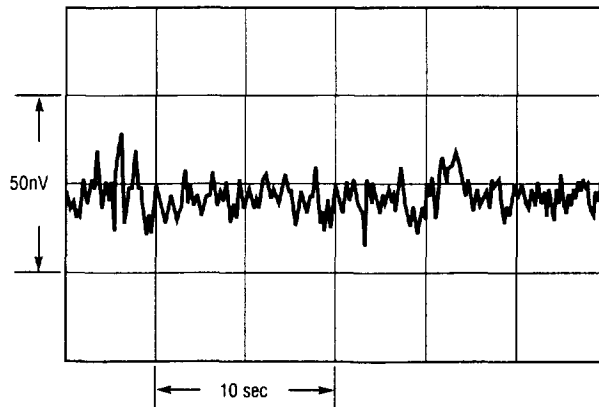
Ultra Low Noise, Low Drift Chopper Amplifier



NOISE 40nVp-p 0.1Hz-10Hz
 Vos 1μV
 DRIFT 0.05μV/°C
 GAIN $\frac{R2}{R1} + 1$
 AVOL $>10^8$
 Ib 25nA

LTC201A/202/203 • TA11

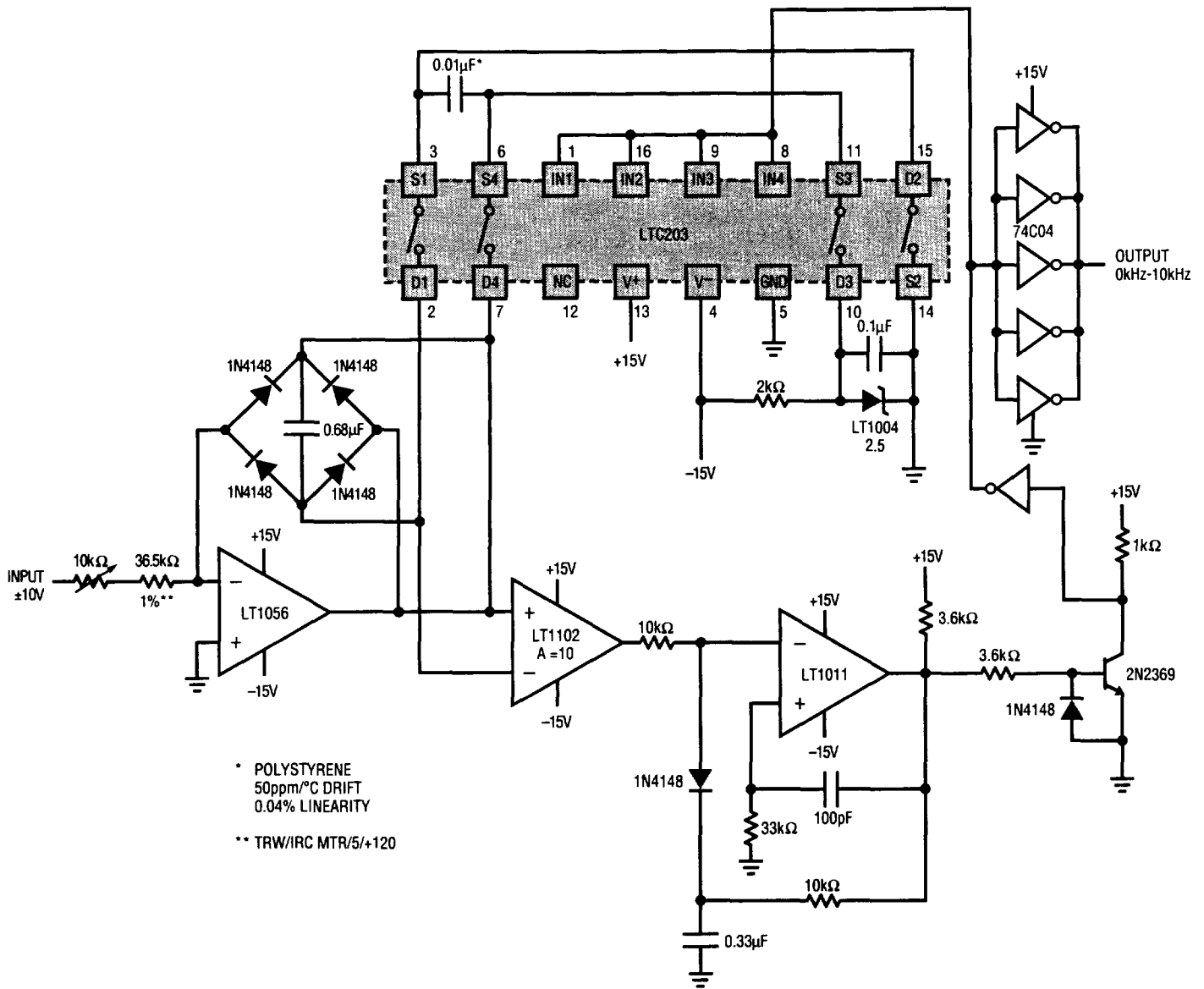
Noise in a 0.1-10Hz Bandwidth



LTC201A/202/203 • TA16

APPLICATIONS INFORMATION

Bipolar (AC) Input V → F Converter

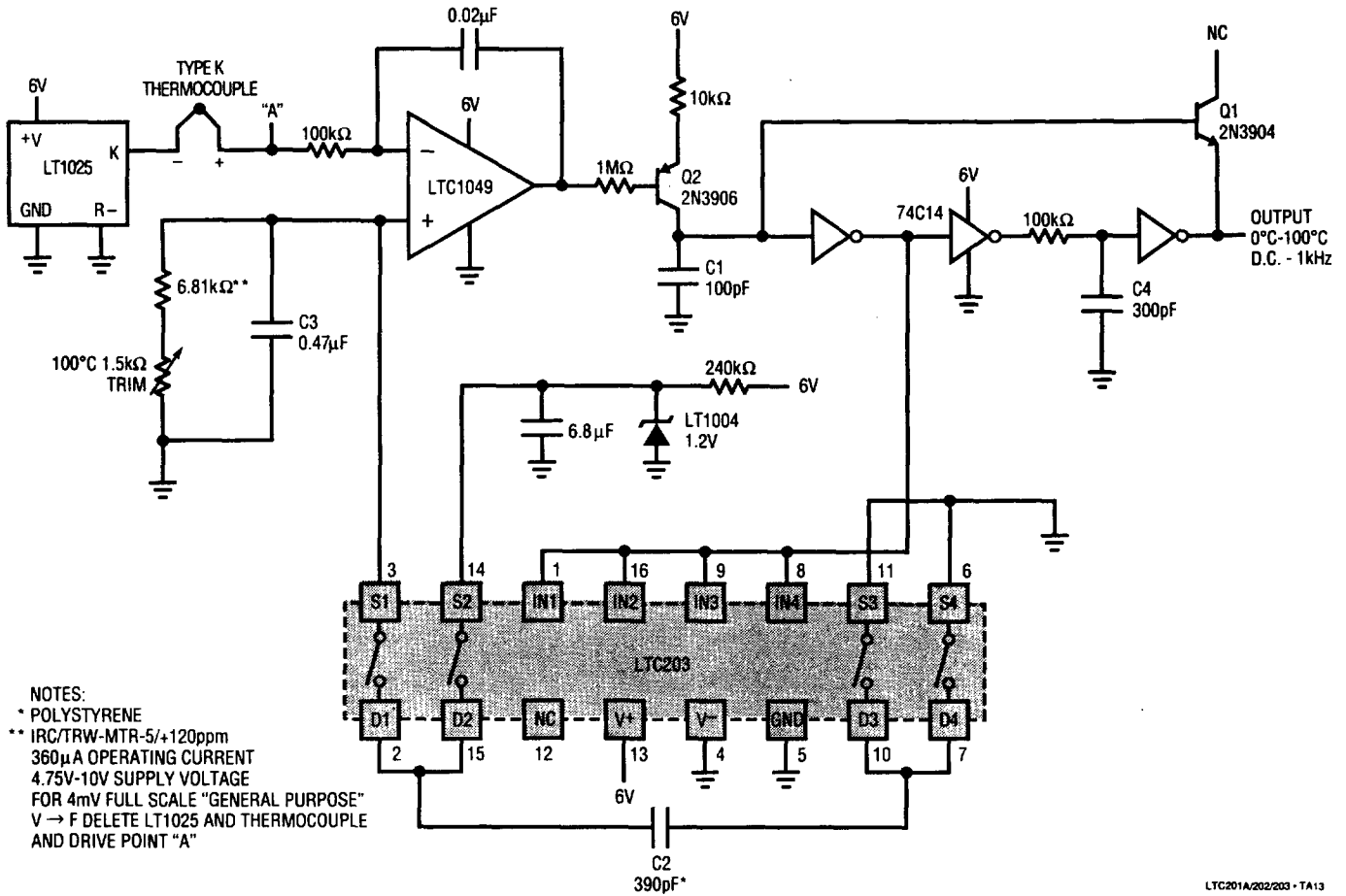


* POLYSTYRENE
50ppm/°C DRIFT
0.04% LINEARITY

** TRW/IRC MTR/5/+120

APPLICATIONS INFORMATION

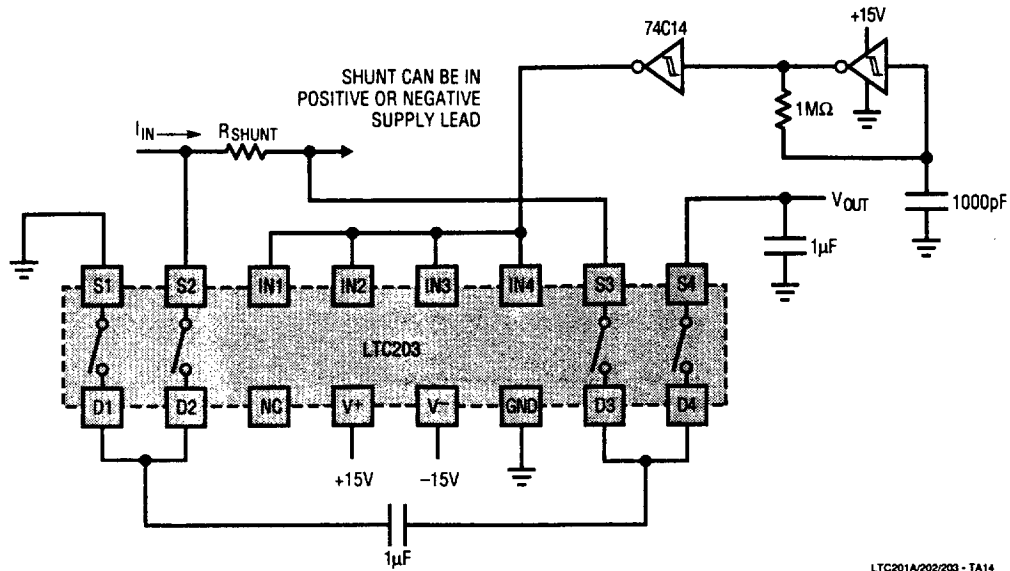
Micropower Thermocouple Temperature to Frequency Converter



LTC201A/202/203 - TA13

APPLICATIONS INFORMATION

Precision Current Sensing in Supply Rails



Precision Voltage Divide by 2 Circuit

