

### FEATURES:

- RAD-PAK® technology radiation-hardened against natural space radiation
- Total dose hardness:
  - > 50 Krad (Si), depending upon space mission
- Excellent Single Event Effects:
  - $SEL_{TH}$ : > 110 MeV/mg/cm<sup>2</sup>
  - $SEU_{TH}$ : > 110 MeV/mg/cm<sup>2</sup>
- Package: 28-pin RAD-PAK® flat pack
- Guaranteed on-resistance matching between channels: < 5Ω max
- Low on-resistance < 100Ω max
- Guaranteed flat on-resistance over specified signal range: 7Ω max
- Guaranteed Charge Injection: < 10 pC
- $I_{NO(OFF)}$  Leakage < 2.5 nA at +85°C
- $I_{COM(OFF)}$  Leakage < 20 nA at +85°C
- ESD Protection > 2000V
- Single-supply operation (+4.5V to +30V)
- Bipolar-supply operation (±4.5V to ±20V)
- Low power consumption, < 1.25 mW
- Rail-to-rail signal handling
- TTL/CMOS-logic compatible

### DESCRIPTION:

Maxwell Technologies' 306 high-performance, high-precision, monolithic, CMOS analog multiplexer features a greater than 50 krad (Si) total dose tolerance, depending upon space mission. The patented radiation-hardened RAD-PAK® technology incorporates radiation shielding in the microcircuit package. Using Maxwell's radiation hardened RAD-PAK packaging technology, this single-ended 1-of-16 device offers very low (less than 100Ω) on-resistance which is matched to within 5Ω between channels and remains flat over the specified analog signal range. The 306 also offers low leakage over temperature and fast switching speeds. The 306 operates with a single +4.5V to +30V supply, or bipolar ±4.5V to ±20V supplies, while retaining TTL/CMOS- logic input compatibility and fast switching.

Maxwell Technologies' patented Rad-Pak packaging technology incorporates radiation shielding in the microcircuit package. It eliminates the need for box shielding while providing the required radiation shielding for a lifetime in orbit or a space mission. In a GEO orbit, Rad-Pak provides greater than 50 krad (Si) total radiation dose tolerance, dependent upon space mission. This product is available with packaging and screening up to Class S.

TABLE 1. PINOUT DESCRIPTION

PIN	SYMBOL	DESCRIPTION
1	V+	Positive Supply Voltage Input
2, 3, 13	NC	No Internal Connections
4-11	NO16-NO9	Analog Inputs-bidirectional
12	GND	Ground
14-17	A3-A0	Address Inputs
18	EN	Enable Inputs
19-26	NO1-NO8	Analog Inputs-bidirectional
27	V-	Negative Supply Voltage Input
28	COM	Output-bidirectional

TABLE 2. 306 ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Units
Voltage Referenced to V- V+ GND	$V_{CC}$	-0.3 -0.3	44 25	V
Digital Inputs, NO, COM <sup>1</sup>		V- -2	V+ +2	V
Continuous Current any terminal <sup>2</sup>			30	mA
Peak Current, NO or COM (pulsed at 1ms, 10% duty cycle max)			100	mA
Thermal Impedance	$\Theta_{JC}$	--	3.62	°C/W
Operating Temperature Range:	$T_A$	-55	+125	°C
Storage Temperature Range:	$T_S$	-65	+150	°C

1. Signals on NO, COM, A0, A1, A2, A3, or EN exceeding V+ or V- are clamped by internal diodes. Limit forward current to maximum current ratings.
2. Or 30mA (whichever occurs first)

TABLE 3. DELTA LIMITS

PARAMETER	VARIATION
I+	±10% of specified value in table 5
I-	±10% of specified value in table 5

TABLE 4. 306 ELECTRICAL CHARACTERISTICS — SINGLE SUPPLY

(V+ = +12V, V- = 0V, GND = 0V, V<sub>AH</sub> = +2.4V, V<sub>AL</sub> = +0.8V, T<sub>A</sub> = -55 TO +125°C, UNLESS OTHERWISE SPECIFIED.)

PARAMETER	SYMBOL	TEST CONDITIONS	SUBGROUPS	MIN <sup>1</sup>	TYP <sup>1</sup>	MAX <sup>1</sup>	UNITS	
SWITCH								
Analog Signal Range <sup>2</sup>	V <sub>NO</sub> V <sub>COM</sub>		1, 2, 3	0	--	12	V	
On-Resistance	R <sub>ON</sub>	I <sub>NO</sub> = -1.0mA V <sub>COM</sub> = 3V or 10V	T <sub>A</sub> = +25°C	1	--	120	175	Ω
DYNAMIC <sup>2</sup>								
Transition Time	t <sub>TRANS</sub>	V <sub>NO1</sub> = 8V V <sub>NO8</sub> = 0V V <sub>IN</sub> = 2.4V Figure 9	T <sub>A</sub> = +25°C	9	--	130	450	nA
Enable Turn-ON Time	t <sub>ON(EN)</sub>	V <sub>INH</sub> = 2.4V V <sub>INL</sub> = 0V V <sub>NO1</sub> = 5V Figure 11	T <sub>A</sub> = +25°C	9	--	--	600	ns
Enable Turn-OFF Time	t <sub>OFF(EN)</sub>	V <sub>INH</sub> = 2.4V V <sub>INL</sub> = 0V V <sub>NO1</sub> = 5V Figure 11	T <sub>A</sub> = +25°C	9	--	--	300	ns
Charge Injection	Q	CL = 1.0nF VNO = 0V VS = 0V	T <sub>A</sub> = +25°C	9	--	--	10	pC

1. The Algebraic convention where the most negative value is a minimum and the most positive value a maximum is used in this data sheet.
2. Guaranteed by design.

TABLE 5. 306 ELECTRICAL CHARACTERISTICS - DUAL SUPPLIES

(V+ = +15V, V- = -15V, GND = 0V, V<sub>AH</sub> = +2.4V, V<sub>AL</sub> = +0.8V, T<sub>A</sub> = -55 TO +125°C, UNLESS OTHERWISE SPECIFIED.)

PARAMETER	SYMBOL	TEST CONDITIONS	SUBGROUPS	MIN	TYP	MAX	UNITS	
<b>SWITCH</b>								
Analog Signal Range <sup>1</sup>	V <sub>NO</sub> V <sub>COM</sub>		1, 2, 3	-15	--	15	V	
On-Resistance	R <sub>ON</sub>	I <sub>NO</sub> = -1.0 mA V <sub>COM</sub> = ±10V	T <sub>A</sub> = +25°C	1	--	60	100	Ω
			T <sub>A</sub> = -55 TO +125°C	2, 3			125	
On-Resistance Matching Between Channels <sup>2, 3</sup>	ΔR <sub>ON</sub>	I <sub>NO</sub> = -1.0 mA V <sub>COM</sub> = ±10V	T <sub>A</sub> = +25°C	1	--	1.5	5	Ω
			T <sub>A</sub> = -55 TO +125°C	2, 3			8	
On-Resistance Flatness <sup>2</sup>	R <sub>FLAT</sub>	I <sub>NO</sub> = -1.0 mA V <sub>COM</sub> = +5V or 0V	T <sub>A</sub> = +25°C	1	--	1.8	7	Ω
			T <sub>A</sub> = -55 TO +125°C	2, 3			10	
NO-Off Leakage Current <sup>4</sup>	I <sub>NO(OFF)</sub>	V <sub>COM</sub> = ±10 V <sub>NO</sub> = ±10V V <sub>EN</sub> = 0V	T <sub>A</sub> = -55 TO +125°C	9, 10, 11	-5.0	--	5.0	nA
COM-Off Leakage Current <sup>4</sup>	I <sub>COM(OFF)</sub>	V <sub>COM</sub> = ±10 V <sub>NO</sub> = ±10V V <sub>EN</sub> = 0V	T <sub>A</sub> = -55 TO +125°C	9, 10, 11	-40	--	40	nA
COM-On Leakage Current <sup>4</sup>	I <sub>COM(ON)</sub>	V <sub>COM</sub> = ±10 V <sub>NO</sub> = ±10V sequence each switch on	T <sub>A</sub> = -55 TO +125°C	9, 10, 11	-50	--	50	nA
<b>INPUT</b>								
Input Current with Input Voltage High	I <sub>AH</sub>	V <sub>A</sub> = 2.4V or 15V		1, 2, 3	-1.0	--	1.0	μA
Input Current with Input Voltage Low	I <sub>AL</sub>	V <sub>EN</sub> = 0V or 2.4V, V <sub>A</sub> = 0V		1, 2, 3	-1.0	--	1.0	μA
<b>SUPPLY</b>								
Power-Supply Range				1, 2, 3	±4.5	--	±20	V
Positive Supply Current	I <sub>+</sub>	V <sub>EN</sub> = V <sub>A</sub> = 0V or 4.5V	T <sub>A</sub> = +25°C	1	--	16	30	μA
			T <sub>A</sub> = -55 TO +125°	2, 3			75	
		V <sub>EN</sub> = 2.4V, V <sub>A(ALL)</sub> = 0V or 2.4	T <sub>A</sub> = +25°C	1		0.075	0.5	mA
			T <sub>A</sub> = -55 TO +125°C	12, 3			1	
Negative Supply Current	I <sub>-</sub>	V <sub>EN</sub> = 2.4V, V <sub>A</sub> = 0V or 2.4V	T <sub>A</sub> = +25°C	1	-1	--	1	μA
			T <sub>A</sub> = -55 TO +125°C	2, 3			-10	
<b>DYNAMIC</b>								
Transition Time	t <sub>TRANS</sub>	Figure 10	T <sub>A</sub> = +25°C	9	--	110	300	ns
			T <sub>A</sub> = -55 TO +125°C	10, 11			400	
Break-Before-Make Interval	t <sub>OPEN</sub>	Figure 12	T <sub>A</sub> = +25°C	9	10	40		ns

PARAMETER	SYMBOL	TEST CONDITIONS	SUBGROUPS	MIN	TYP	MAX	UNITS	
Enable Turn-On Time	$t_{ON(EN)}$	Figure 11	$T_A = +25^\circ\text{C}$	9	--	130	ns	
			$T_A = -55 \text{ TO } +125^\circ\text{C}$	10, 11		400		
Enable Turn-Off Time	$t_{OFF(EN)}$	Figure 11	$T_A = +25^\circ\text{C}$	9	--	55	ns	
			$T_A = -55 \text{ TO } +125^\circ\text{C}$	10, 11		300		
Charge Injection <sup>1</sup>	Q	$C_L = 1.0 \text{ nF}$ , $V_{NO} = 0\text{V}$ , $R_S = 0\Omega$ , Figure 13	$T_A = +25^\circ\text{C}$	9	--	2	10	pC
Off Isolation <sup>5</sup>	$V_{ISO}$	$V_{EN} = 0\text{V}$ , $R_L = 1 \text{ k}\Omega$ , $f = 100 \text{ kHz}$ , Figure 14	$T_A = +25^\circ\text{C}$	9	--	-69	--	dB
Crosstalk Between Channels	$V_{CT}$	$V_{EN} = 2.4\text{V}$ , $f = 100 \text{ kHz}$ , $V_{GEN} = 1\text{V p-p}$ , $R_L = 1 \text{ k}\Omega$ , Figure 15	$T_A = +25^\circ\text{C}$	9	--	-92	--	dB
Logic Input Capacitance	$C_{IN}$	$f = 1 \text{ MHz}$	$T_A = +25^\circ\text{C}$	9	--	8	--	pF
NO-Off Capacitance	$C_{NO(OFF)}$	$f = 1 \text{ MHz}$ $V_{EN} = V_{NO} = 0\text{V}$ Figure 16	$T_A = +25^\circ\text{C}$	9	--	8	--	pF
COM-Off Capacitance	$C_{COM(OFF)}$	$f = 1 \text{ MHz}$ $V_{EN} = 2.4\text{V}$ Figure 16	$T_A = +25^\circ\text{C}$	9	--	130	--	pF
COM-On Capacitance	$C_{COM(ON)}$	$f = 1 \text{ MHz}$ $V_{EN} = 0.8\text{V}$ Figure 16	$T_A = +25^\circ\text{C}$	9	--	140	--	pF

1. Guaranteed by design.
2. Characterized and not 100% tested.
3.  $\Delta RON = RON_{(MAX)} - RON_{(MIN)}$ . On-resistance match between channels and flatness are guaranteed only with specified voltages. Flatness is defined as the difference between the maximum and minimum value of on-resistance as measured at the extremes of the specified analog signal range.
4. Leakage parameters are 100% tested at the maximum rated hot temperature and guaranteed by correlation at  $+25^\circ\text{C}$ .
5. Off isolation =  $20\log V_{COM}/V_{NO}$ , where  $V_{COM}$  = output and  $V_{NO}$  = input to off switch.

FIGURE 1. ON-RESISTANCE VS.  $V_{COM}$  (DUAL SUPPLIES)

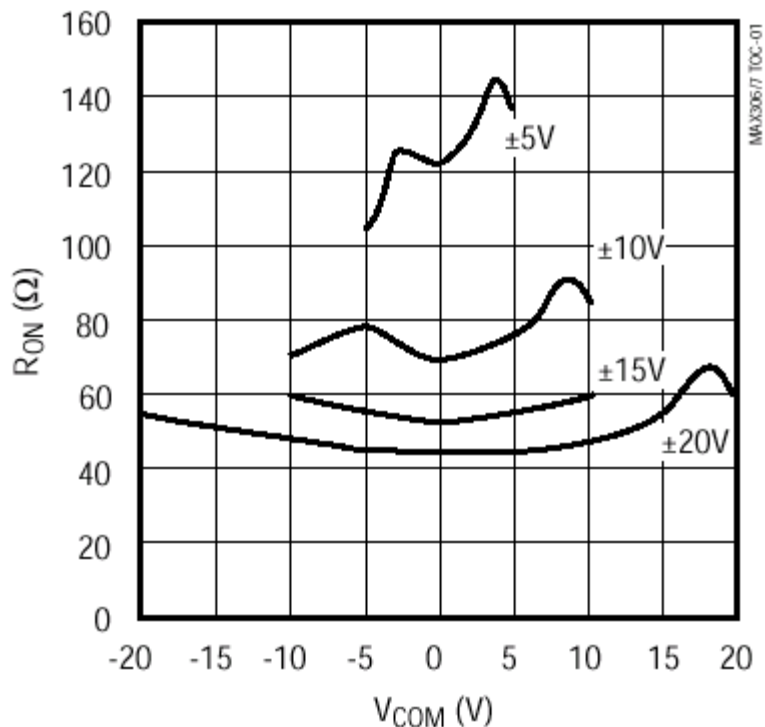


FIGURE 2. ON-RESISTANCE VS.  $V_{COM}$  AND TEMPERATURE (DUAL SUPPLIES)

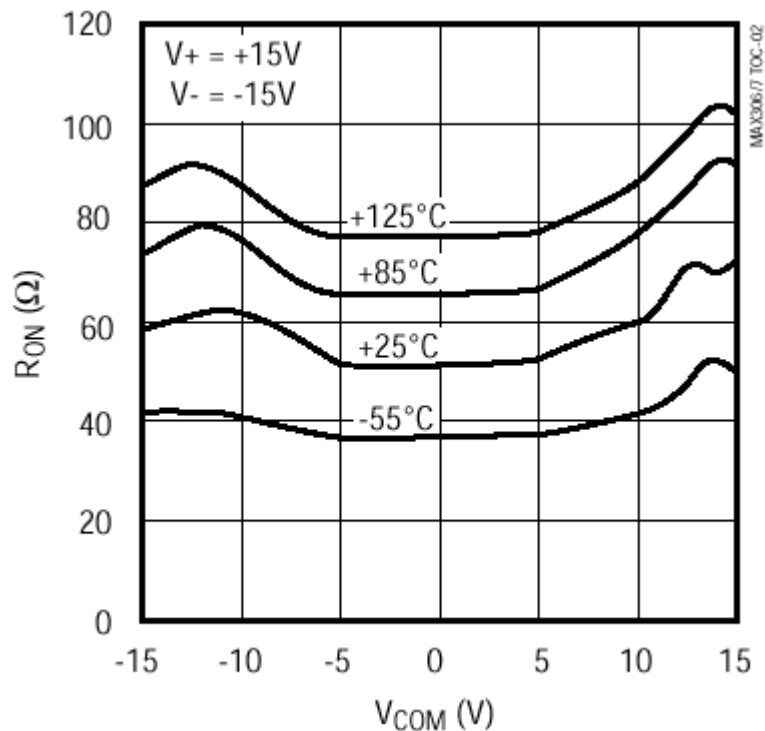


FIGURE 3. ON-RESISTANCE VS.  $V_{COM}$  (SINGLE SUPPLY)

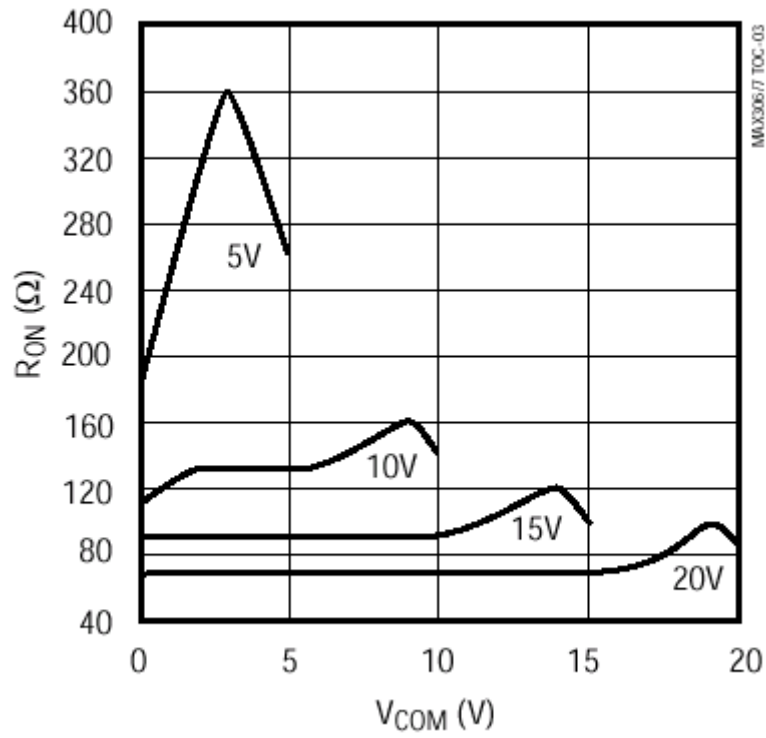


FIGURE 4. ON-RESISTANCE VS.  $V_{COM}$  AND TEMPERATURE (SINGLE SUPPLY)

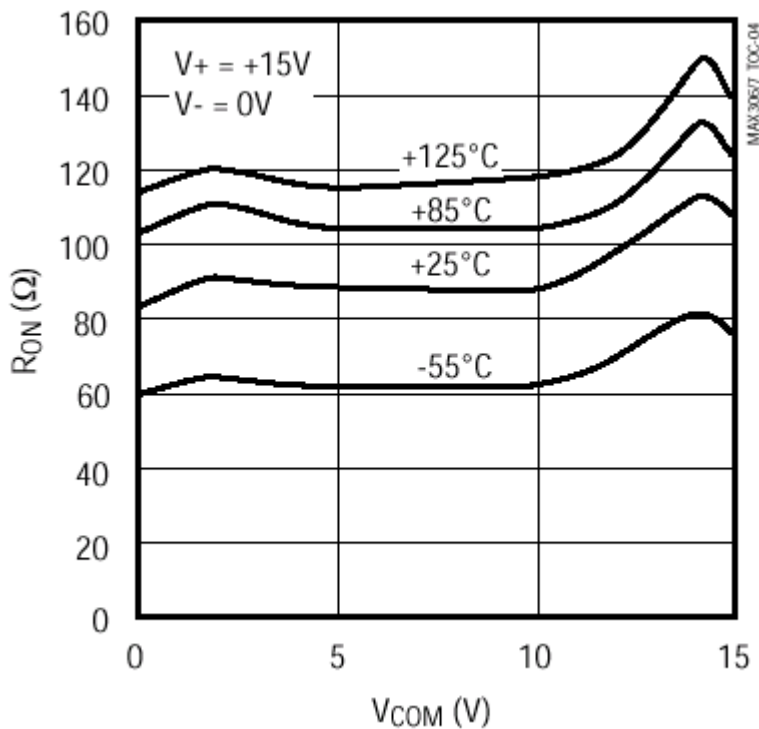


FIGURE 5. OFF LEAKAGE VS. TEMPERATURE

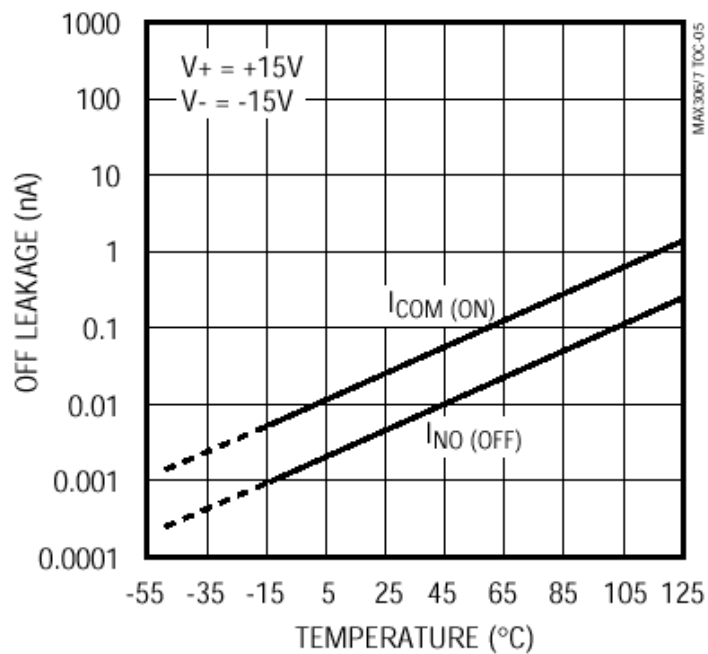


FIGURE 6. ON LEAKAGE VS. TEMPERATURE

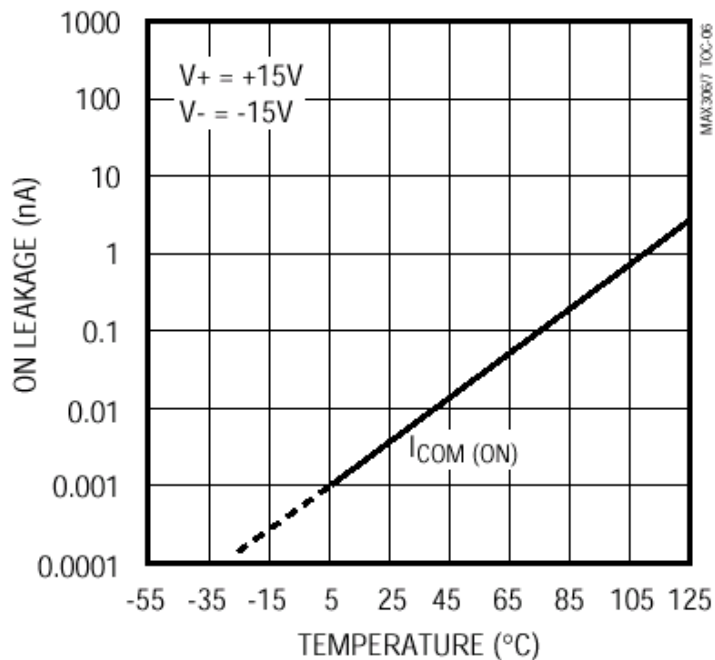


FIGURE 7. CHARGE INJECTION VS.  $V_{COM}$

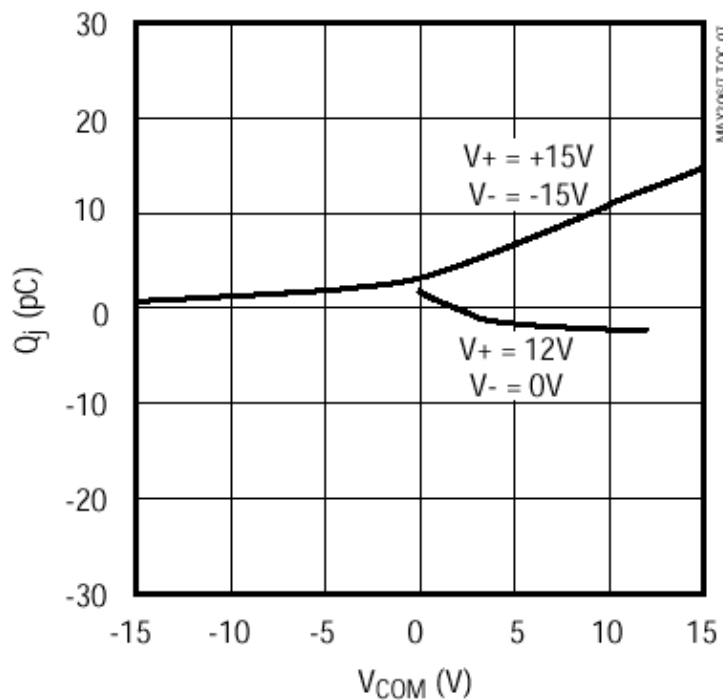


FIGURE 8. SUPPLY CURRENT VS. TEMPERATURE

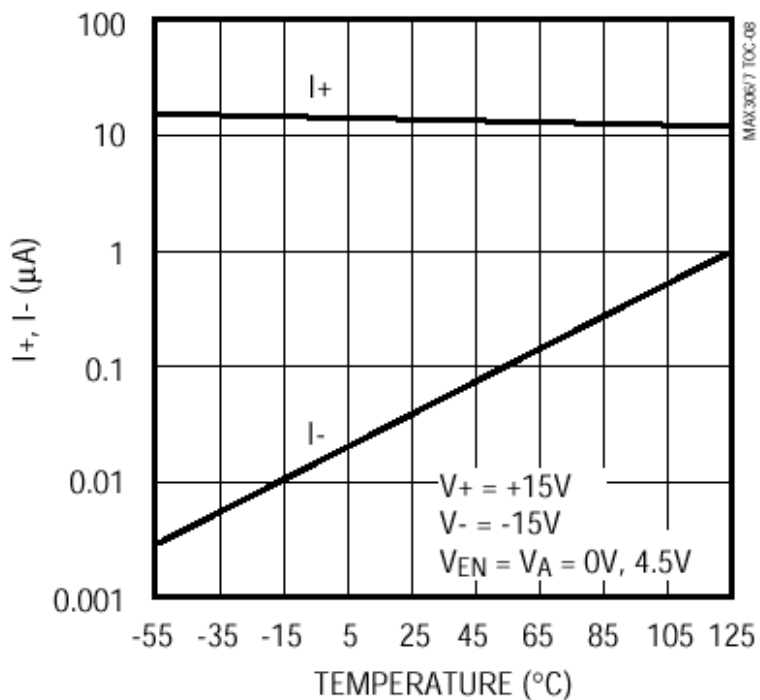


FIGURE 9. OVERVOLTAGE PROTECTION USING EXTERNAL BLOCKING DIODES

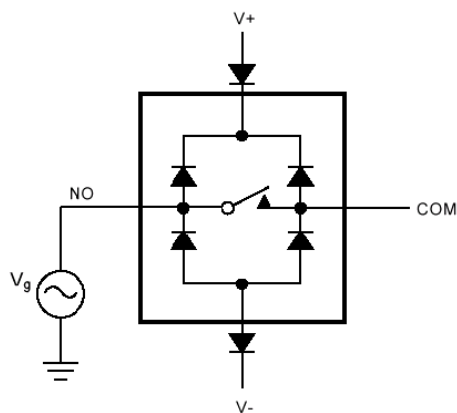


FIGURE 10. TRANSITION TIME

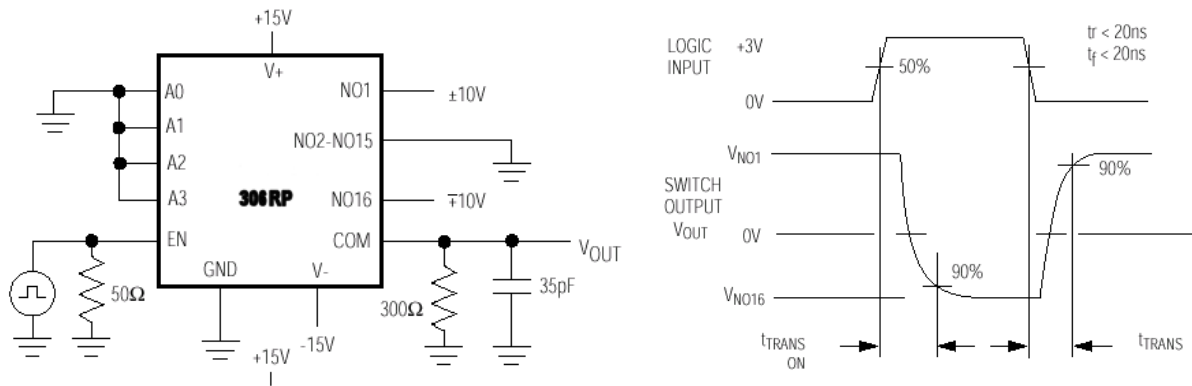


FIGURE 11. ENABLE SWITCHING TIME

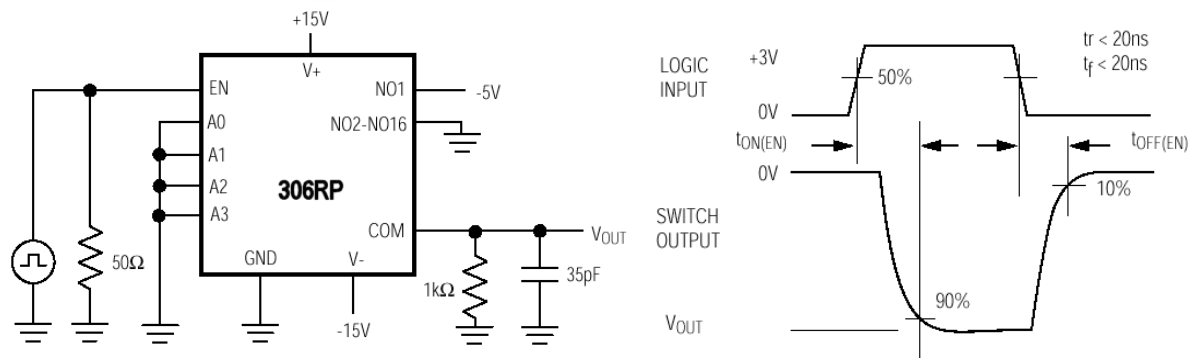


FIGURE 12. BREAK-BEFORE-MAKE INTERVAL

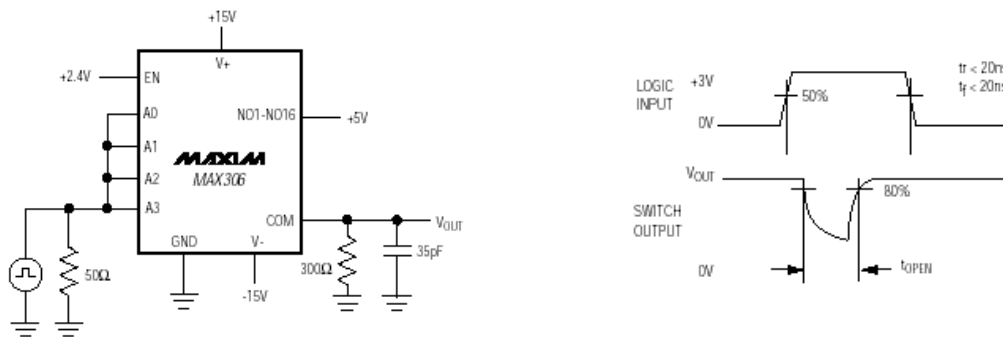


FIGURE 13. CHARGE INJECTION

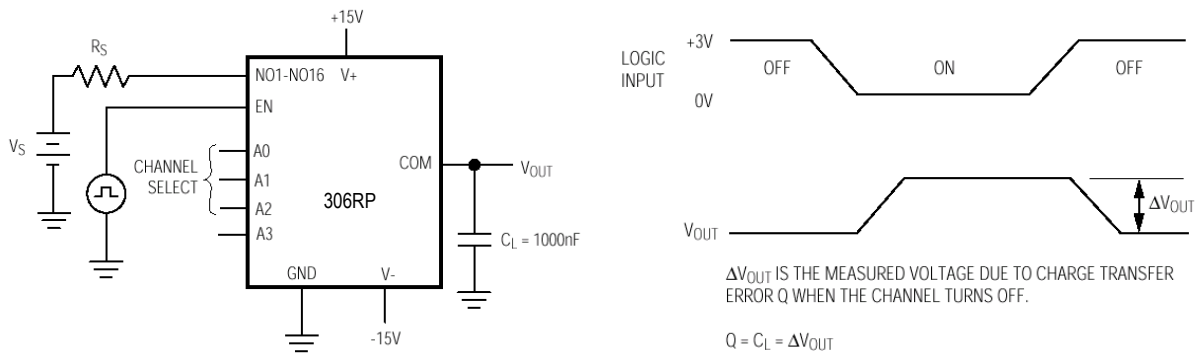


FIGURE 14. OFF ISOLATION

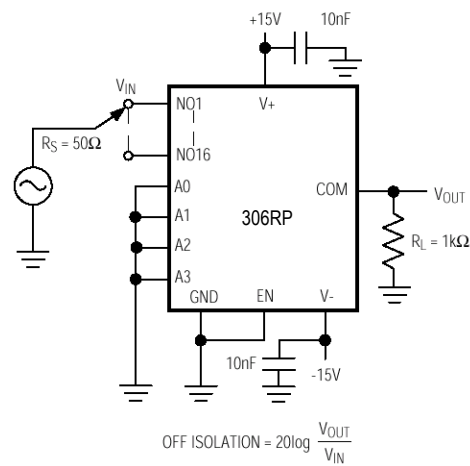


FIGURE 15. CROSSTALK

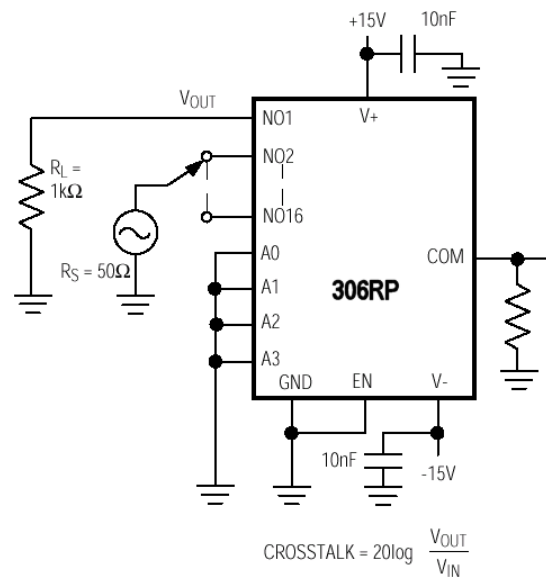


FIGURE 16. NO/COM CAPACITANCE

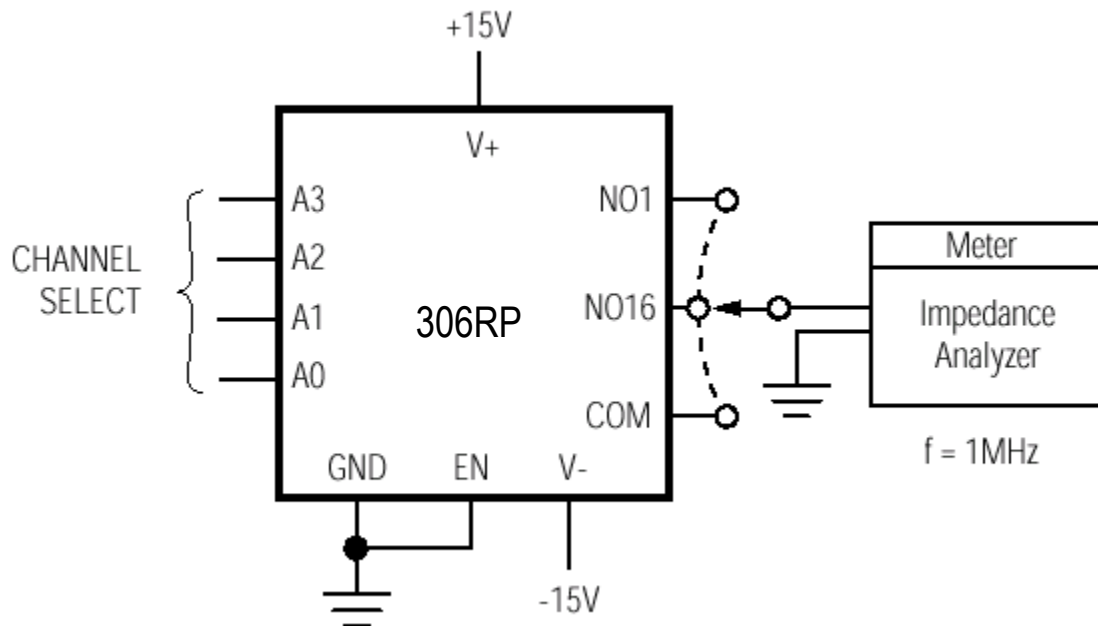
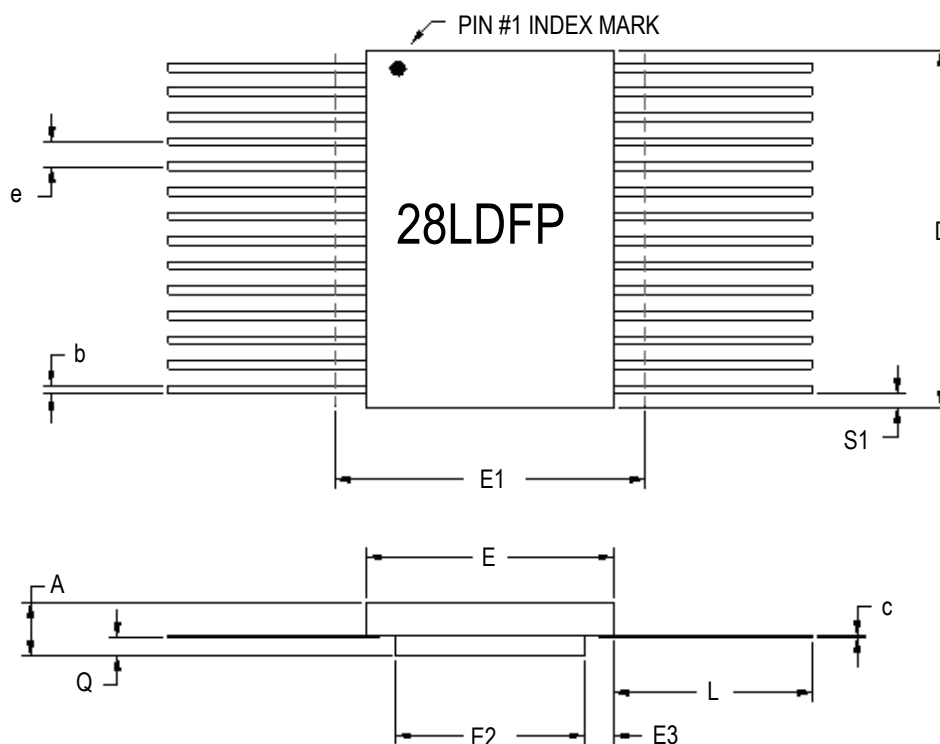


FIGURE 17. PACKAGE OUTLINE DIAGRAM



## 28-PIN RAD-PAK® FLAT PACKAGE

SYMBOL	DIMENSIONS		
	MIN	NOM	MAX
A	.190	.207	.224
b	.015	.017	.022
c	.004	.005	.009
D	--	.720	.740
E	.380	.410	.420
E1	--	--	.440
E2	.180	.250	--
E3	.030	.080	--
e	.050 BSC		
L	.360	.370	.380
Q	.062	.073	.081
S1	.000	.027	--
N	28		

F28-02  
All dimensions in inches

**Important Notice:**

These data sheets are created using the chip manufacturers published specifications. Maxwell Technologies verifies functionality by testing key parameters either by 100% testing, sample testing or characterization.

The specifications presented within these data sheets represent the latest and most accurate information available to date. However, these specifications are subject to change without notice and Maxwell Technologies assumes no responsibility for the use of this information.

Maxwell Technologies' products are not authorized for use as critical components in life support devices or systems without express written approval from Maxwell Technologies.

Any claim against Maxwell Technologies must be made within 90 days from the date of shipment from Maxwell Technologies. Maxwell Technologies' liability shall be limited to replacement of defective parts.

## Product Ordering Options

