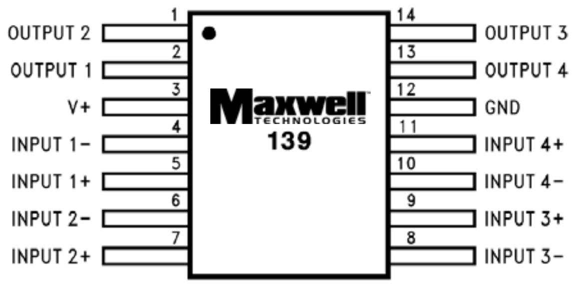
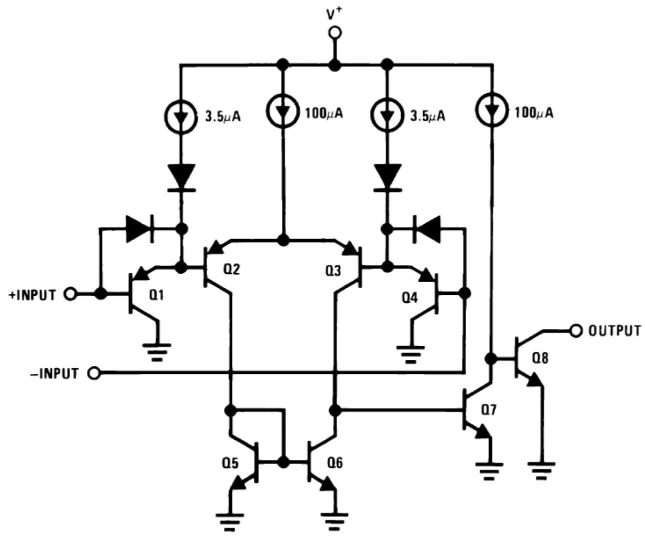
Quad Comparators, Low Offset Voltage





Logic Diagram

Features:

- Rad-Pak® technology-hardened against natural space radiation
- Total dose hardness:
  - >100 krad (Si), depending upon orbit and space mission
- Single Event Effects:
  - SEL > 59.8 MeV/mg/cm^2
- Package:
- - 14 pin Rad-Pak® flat package
- Wide supply voltage range
  - 2 VDC to 36 VDC or ±1 VDC to ±18 VDC
- Very low supply current drain:
  - (0.8 mA) - independent of supply voltage
- Low input biasing current: 25 nA
- Differential input voltage range equal to the power supply voltage
- Low output saturation voltage: 250 mV at 4 mA
- Power drain suitable for battery operation
- Allows sensing near GND
- Eliminates need for dual supplies
- Output voltage compatible with TTL, DTL, ECL, MOS and CMOS logic systems
- Low input offset current and offset voltage:
  - +5 nA, +3 mV

Description:

Maxwell Technologies 139 consisting of four independent precision voltage comparators, features a greater than 100 krad (Si) total dose tolerance, depending upon space mission. Using Maxwell Technologies radiation- hardened Rad-Pak® packaging technology, the 139 has an offset voltage specification as low as 2 mV max for all four comparators. The 139 was also designed specifically to operate from a single power supply over a wide range of voltages. Operation from split power supplies is possible and the low power supply current drain is independent of the magnitude of the power supply voltage. These comparators also have a unique characteristic in that the input common-mode voltage range includes ground, even though operated from a single power supply voltage.

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 space mission. In a GEO orbit, RAD-PAK provides greater than 100 krad (Si) radiation dose tolerance. This product is available with screening up to Class S.

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Table 1. Pinout Description

Pin	Symbol	Description
2, 1, 14, 13	OUTPUT1 - 4	Output Signal
4, 6, 8, 10	INPUT1- – 4	Negative Input Signal
5, 7, 9, 11	INPUT+ – 4	Positive Input Signal
3	V+	Positive Voltage
12	GND	Ground

Table 2. 139 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage (V+ - V-)	V+ - V-	36 V_{DC} or ±18 V_{DC}		V
Differential Input Voltage[1]		--	36	V
Input Voltage		-0.3	+36	V
Open Short-Circuit to Ground[2]		Continuous		
Input Current (V_{IN} < $-0.3V_{DC}$)		--	50	mA
Power Dissipation	P_D	--	1	W
Storage Temperature Range	T_S	-65	150	˚C
Operating Temperature Range	T_A	-55	125	˚C
ESD Tolerance [3]		--	600	V

1. Positive excursions of input voltage may exceed the power supply level. As long as the other voltage remains within the common-mode range, the comparator will provide a proper output state. The low output voltage state must not be less than -0.3 V_{DC} (or 0.3 V_{DC} below the magnitude of the negative power supply, if used) (at 25°C).
2. Short Circuits from the output to V+ can cause excessive heating and eventual destruction. When considering short circuits to ground, the maximum output current is ~20mA independent of the magnitude of V+.
3. 1.5 kΩ in series with 100 pF.

Table 3. Delta Limits

Parameter	Variation
I_{CC}	±10% of specified value in Table 5

Table 4. 139 Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V+ - V-	36 V_{DC} or ±18 V_{DC}		V

Table 5. 139 Electrical Characteristics

(V+ = 5V, T_A = -55 to 125°C, unless otherwise specified)

Parameter	Symbol	Test Conditions		Min	Typ	Max	Unit
Input Offset Voltage	V_{IO}	[1]	+25°C	--	2	5	mV_{DC}
			-55 to 125°C	--	--	9	
Input Bias Current	I_{IB}	$I_{IN}(+)$ or $I_{IN}(-)$ with Output in Linear Range,[2], V_{CM} = 0V	+25°C	--	25	100	nA_{DC}
			-55 to 125°C	--	--	300	
Input Offset Current	I_{IO}	$I_{IN}(+) - I_{IN}(-)$, V_{CM} = 0V	+25°C	--	3	25	nA_{DC}
			-55 to 125°C	--	--	100	
Input Common Mode Voltage Range	V_{CM}	V+ = 30 V_{DC}[3]	+25°C	0		V+ -1.5	V_{DC}
			-55 to 125°C	0	--	V+ -2.0	
Supply Current	I_{CC}	$R_L=\infty$ on all comparators, V+ = 30V	+25°C	--	0.8	2.0	mA_{DC}
			-55 to 125°C	--	--	3.0	
Voltage Gain	A_V	$R_L \geq 15k\Omega$, V+=15V_{DC}; V_O = 1V_{DC} to 11 V_{DC} (To support large V_O swing)	+25°C	50	200	--	V/mV
Large Signal Response Time	t_r	V_{IN} = TTL Logic Swing, V_{REF} = 1.4V, V_{RL} = 5V_{DC}, R_l = 5.1kΩ[2]	+25°C	--	300	--	ns
Response Time	t_{Rtil}	V_{RL} = 5V_{DC}, R_L = 5.1kΩ[4]	+25°C	--	1.3	--	µs
Output Sink Current	I_{SINK}	$V_{IN}(-)$ = 1V_{DC}, $V_{IN}(+)$ = 0, $V_O \leq 1.5V_{DC}$	+25°C	6.0	16	--	mA_{DC}
Saturation Voltage	V_{SAT}	$V_{IN}(-) \geq 1V$, $V_{IN}(+)$ = 0, $I_{SINK} \leq 4$ mA	+25°C	--	250	400	mV_{DC}
			-55 to 125°C	--	--	700	
Output Leakage Current	I_{CEX}	$V_{IN}(+)$ = 1V_{DC}, $V_{IN}(-)$ = 0, V_O = 5V_{DC} $V_{IN}(-)$ = 0	+25°C	--	0.1	--	nA_{DC}
			-55 to 125°C	--	--	1.0	μA_{DC}
Differential Input Voltage	V_{diff}	Keep all $V_{IN's}$ > 0 V_{DC} (or V- if used)[5]	-55 to 125°C	--	--	36	V_{DC}

1. At output switch point, V_O=1.4V, RS=0Ω with V+ from 5V_{DC} to 30 V_{DC}; and over the full input common-mode range (0V_{DC} to V+-1.5V_{DC}).
2. The direction of the input current is out of the IC due to the PNP input stage. This current essentially constant, independent of the state of the output so no loading change exists on the reference or input lines.
3. The input common-mode voltage or either input voltage signal should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is V+-1.5V at 25°C, but either or both inputs can go to +30V without damage, independent of the magnitude of V+.
4. The response time specified is for a 100mV input step with 5 mV overdrive. For larger overdrive signals 300 ns can be obtained.
5. Positive excursions of input voltage may exceed the power level as long as the other voltage remains within the common mode range, the comparator will provide a proper output state. The low input voltage state must not be less than -0.3 V_{DC} (or 0.3V_{DC} below the magnitude of the negative power supply, if used) (at 25°C).

FIGURE 1. SUPPLY CURRENT

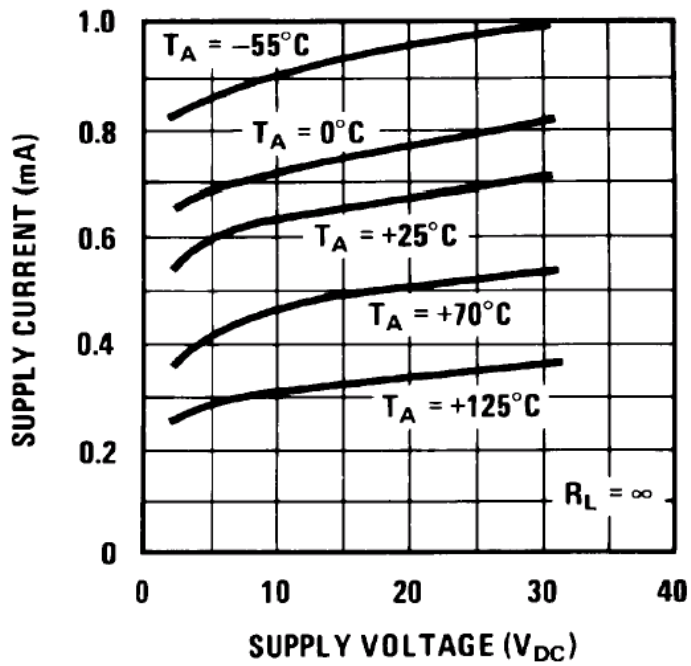


FIGURE 2. INPUT CURRENT

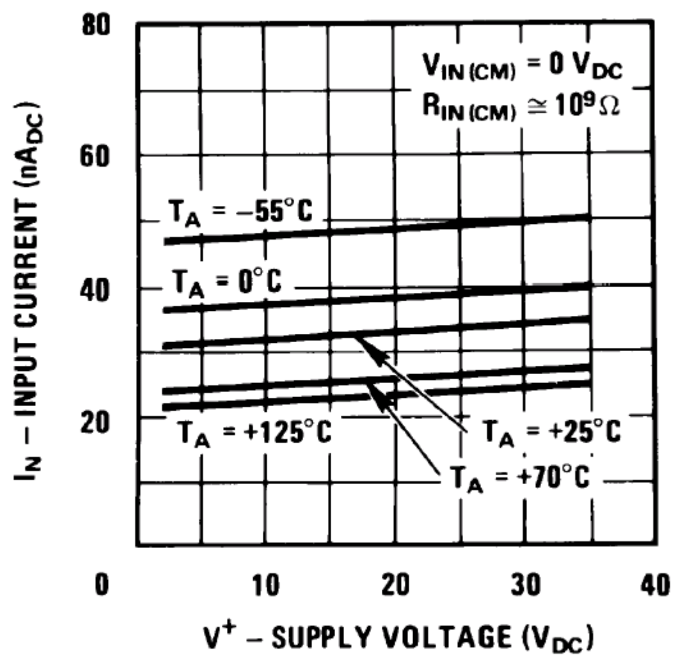


FIGURE 3. OUTPUT SATURATION VOLTAGE

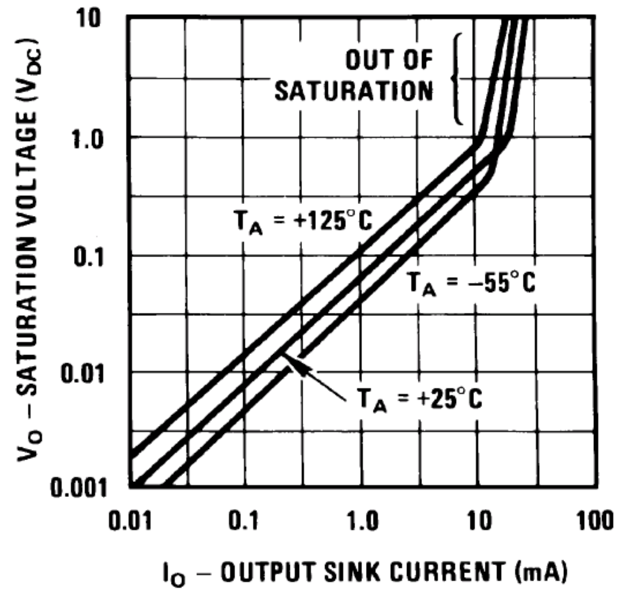


FIGURE 4. RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES – NEGATIVE TRANSITION

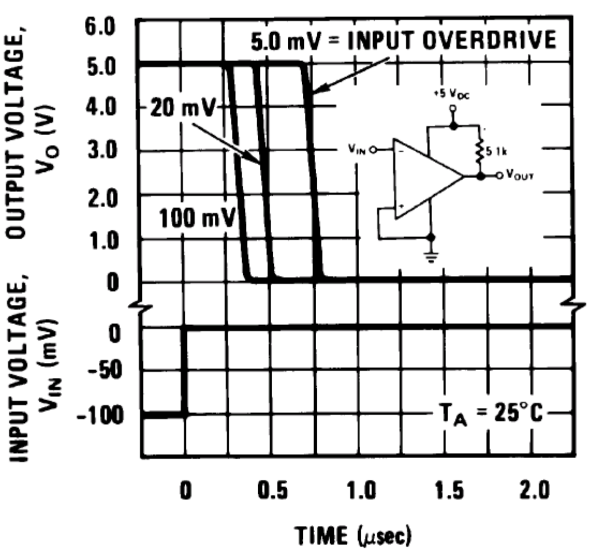
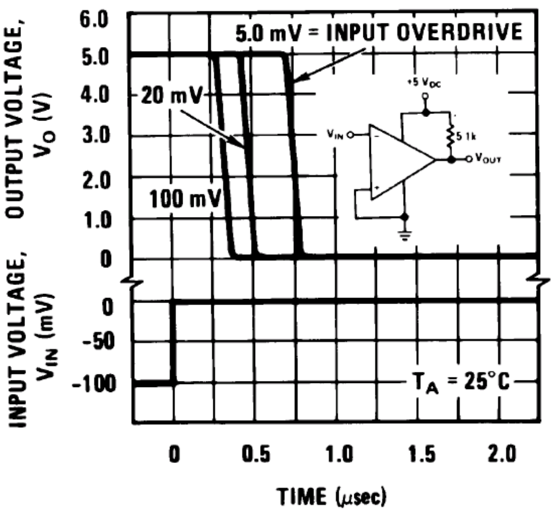
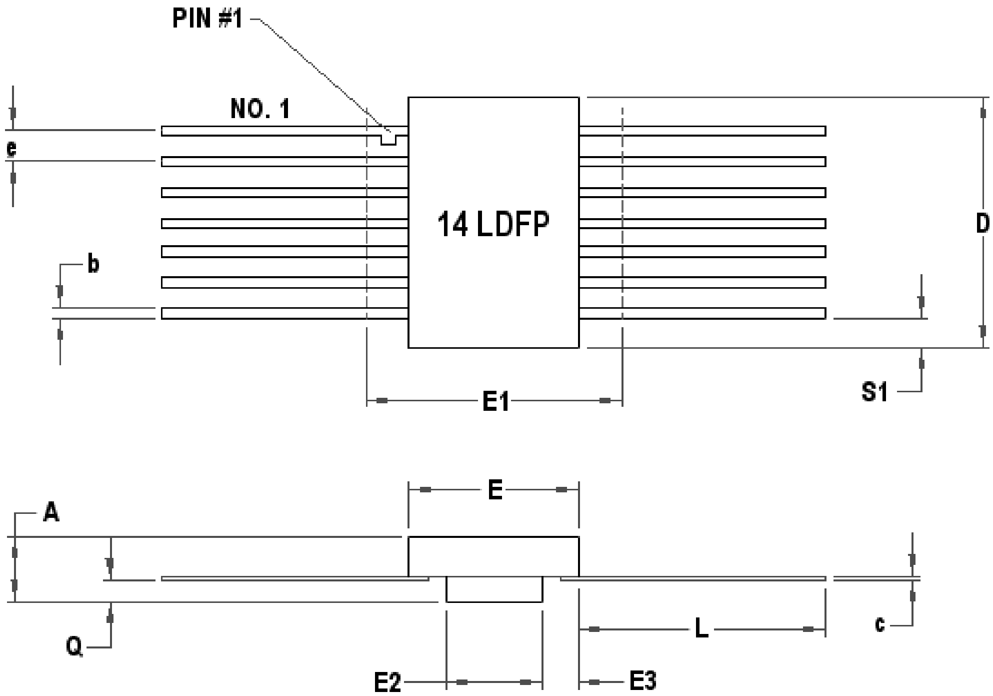


FIGURE 5. RESPONSE TIME FOR VARIOUS INPUT OVERDRIVES – POSITIVE TRANSITION





14 PIN RAD-PAK® FLAT PACKAGE

SYMBOL	DIMENSION		
	MIN	NOM	MAX
A	0.140	0.157	0.170
b	0.015	0.017	0.020
c	0.004	0.005	0.009
D	--	0.380	0.390
E	0.250	0.255	0.260
E1	--	--	0.290
E2	0.125	0.130	--
E3	0.030	0.062	--
e	0.050 BSC		
L	0.270	0.325	0.370
Q	0.026	0.030	0.035
S1	0.005	--	--
N	14		

Note: All dimensions in inches.
F14-05

Important Notice:

These data sheets are created using the chip manufacturer's 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.

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Product Ordering Options

Model Number

139 RP F X

Code	Feature	Option Details
X	Screening Flow	Monolithic S = Maxwell Class S B = Maxwell Class B E = Engineering (testing @ +25°C) I = Industrial (testing @ -55°C, +25°C, +125°C)
F	Package	F = Flat Pack
RP	Radiation Feature	RP = RAD-PAK® package
139	Base Product Nomenclature	Quad Comparators, Low Offset Voltage