MIL-PRF-38534 CERTIFIED

RAD HARD VOLTAGE COMPARATOR

120RH

M.S.KENNEDY CORP.

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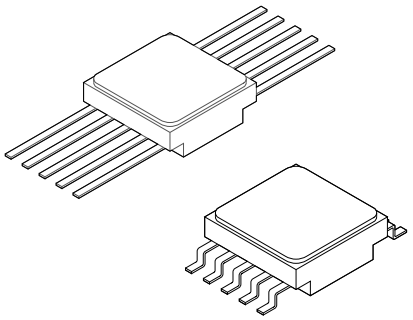
FEATURES:

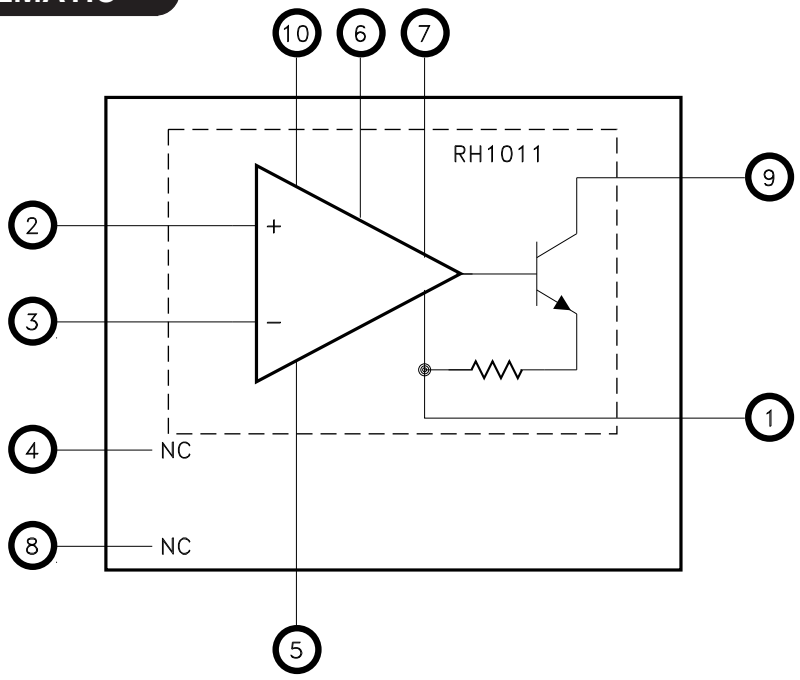
- Manufactured using LINEAR TECHNOLOGY Space Qualified RH1011 Die
- MIL-PRF-38535 Class V Processing & Screening
- Total Dose Tested to 450 Krads(Si) (Method 1019.7 Condition A)
- 50mA Output Current Source or Sink
- ±30V Differantial Input Voltage
- Single 5V Operation
- Guaranteed Input Parameter Specifications
- Available in Straight or Gull Wing Lead Form
- Contact MSK for MIL-PRF-38535 Qualification Status



DESCRIPTION:

The MSK 120RH is a radiation hardened general purpose comparator with a wide input supply range of a single 3V to ±18V. The floating output transistor with 50mA source/sink capability, can drive loads referenced to either ground, negative supply or positive supply. This comparator offers guaranteed input characteristics including offset voltage drift over the full temperature range. The MSK 120RH is packaged in a space saving surface mount ceramic package with straight or gull wing lead form.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Peak Detector/Window Detector
- Voltage to Frequency Converter
- Solenoid/Relay Driver
- Motor Speed Control

PIN-OUT INFORMATION

1	GND	10	V+
2	+INPUT	9	OUTPUT
3	-INPUT	8	NC
4	NC	7	BALANCE/STROBE
5	V-	6	BALANCE

ABSOLUTE MAXIMUM RATINGS ⑥

$\pm V_{CC}$ Supply Voltage 36V
Output to Negative Supply Voltage 35V
Ground to Negative Supply Voltage 30V
Differential Input Voltage . . . . . ±35V
Input Voltage . . . . . Equal to Supplies
Voltage at Strobe Pin (Pin 7 to 10) 5V
I_{OUT} Output Current 50mA
T_C Case Operating Temperature Range
MSK 120VRH . . . . . -55°C to +125°C
MSK 120RH . . . . . -40 °C to + 85 °C
Output Short-Circuit Duration . . . . . 10 Sec
T_{ST} Storage Temperature Range . . . -65 °C to +150 °C
T_{LD} Lead Temperature Range
(10 Seconds) . . . . . 300°C
T_J Junction Temperature . . . . . 150°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①	Group A Subgroup	MSK 120VRH Min.	MSK 120VRH Typ.	MSK 120VRH Max.	MSK 120RH Min.	MSK 120RH Typ.	MSK 120RH Max.	Units
Input Offset Voltage	V_{OUT} = 0V $I_{OUT\ SINK}$ = 1.5mA VGND = -15V	1	-1.5	±0.4	1.5	-1.5	±0.4	1.5	mV
		2,3	-3.0	-	3.0	-	-	-	mV
	Post Radiation	1	-2.5	-	2.5	-2.5	-	2.5	mV
Input Offset Current	V_{OUT} < 0.25V $I_{OUT\ SINK}$ = 1.5mA	1	-4	±0.3	4	-4	±0.3	4	nA
		2,3	-20	-	20	-	-	-	nA
	Post Radiation	1	-2.0	-	20	-20	-	20	nA
Input Bias Current	V_{OUT} < 0.25V $I_{OUT\ SINK}$ = 1.5mA	1	-50	17	50	-50	17	50	nA
		2,3	-80	-	80	-	-	-	nA
	Post Radiation	1	-200	-	200	-200	-	200	nA
Input Offset Voltage Drift ②	$T_{MIN} \leq T \leq T_{MAX}$	2,3	-	-	25	-	-	-	uV/°C
Large Signal Voltage Gain ②	-10V ≤ V_{OUT} ≤ 14.5V R_l = 1kΩ	4	200	-	-	200	-	-	V/mV
	Post Radiation	4	100	-	-	100	-	-	V/mV
Common Mode Rejection Ratio ②		1	90	-	-	90	-	-	dB
Input Voltage Range ②	±V = ±15V	1	-14.5	-	13.0	-14.5	-	13.0	V
		2,3	-14.5	-	13.0	-	-	-	V
	+V = 5V -V = 0V	1	0.5	-	3.0	0.5	-	3.0	V
		2,3	0.5	-	3.0	-	-	-	V
Response Time	V_{PU} = 5V ±100mV STEP INPUT	1	-	130	250	-	130	250	nS
Output Saturation Voltage	-IN = 5mV I_{SINK} = 8mA	1	-	0.26	0.4	-	0.26	0.4	V
		2,3	-	-	0.5	-	-	-	V
	-IN = 5mV I_{SINK} = 50mA	1	-	0.71	1.5	-	0.71	1.5	V
		2,3	-	-	1.5	-	-	-	V
Output Leakage Current	+IN = 5mV VGND = -15V V_{OUT} = 20V	1	-	0.3	10	-	0.3	10	nA
		2,3	-	-	500	-	-	-	nA
	V_{PU} = 20V Post Radiation	1	-	-	100	-	-	100	nA
Positive Supply Current		1	-	2.5	4	-	2.5	4	mA
Negative Supply Current		1	-	1.7	2.5	-	1.7	2.5	mA
Strobe Current	Minimum to Strobe Vout	1	-	204	500	-	204	500	uA
Input Capacitance ②		-	-	6	-	-	6	-	pF
Thermal Resistance ②	Junction to Case @125°C	-	-	54.5	65.6	-	54.5	65.6	°C/W

NOTES:

① Unless otherwise specified, ±V = ±15V, VGND = 0V.
② Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
③ Industrial grade devices shall be tested to subgroups 1 and 4 unless otherwise specified.
④ Military grade devices (V Suffix) shall be 100% tested to subgroups 1,2,3 and 4.
⑤ Subgroup 1,4 TA = TC = +25°C
Subgroup 2 TA = TC = +125°C
Subgroup 3 TA = TC = -55°C
⑥ Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.
⑦ Pre and Post irradiation limits at 25°C, up to 100Krads(Si) TID, are identical unless otherwise specified.

APPLICATION NOTES

OFFSET BALANCING

The input offset voltage of the MSK 120RH can be brought to absolute zero or adjusted to compensate for system errors. A 3KΩ resistor and 20KΩ potentiometer is typically sufficient to compensate for internal current imbalances, see Figure 1. The potentiometer value may vary depending on the amount of the offset change the comparator and/or system requires.

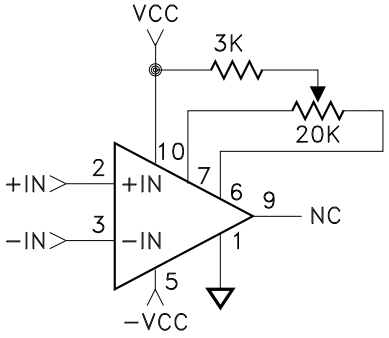


FIGURE 1

DRIVING POSITIVE OR NEGATIVE SUPPLY REFERENCED LOADS

The MSK 120RH's floating output transistor allows the load to be referenced to either a positive or negative supply. The floating output stage has the flexability to interface to multiple logic families and loads. The output transistor has the added benefit of no current flowing through it when the output pin is pulled up with a positive referenced supply configuration or the GND pin is pulled down with a negative referenced supply configuration. Figure 2 shows a typical load connected to the output pin referenced to VPU, with the GND pin either connected to V- or ground. A separate supplied voltage applied to Vpu can be greater than +Vcc as long as the output to negative supply absolute maximum rating is not exceeded.

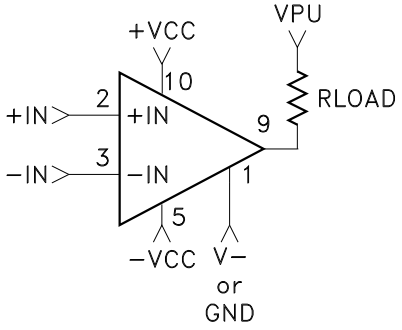


FIGURE 2

Figure 3 shows a load referenced to a negative supply or ground where the output is taken from the MSK 120RH GND pin (output transistor emitter). For this configuration, the GND pin voltage is approximately 2V less than VPU when conducting current. Since the output at the emitter has reverse phasing with respect to the collector output, the + INPUT (pin 2) and - INPUT pin (pin 3) must reverse their input designations as shown.

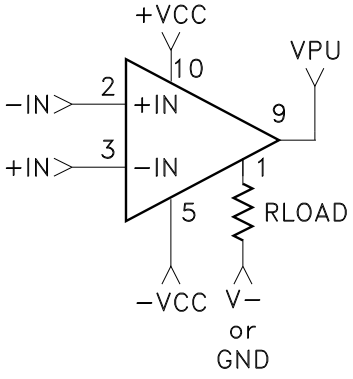


FIGURE 3

STROBING THE OUTPUT

The output transistor of the MSK 120RH can be forced off causing the output pin voltage to go to the pull up supply voltage of the load. As shown in Figure 4, a low current voltage source connected to the base of a 2N2222 is all that is rquired. When turned on the transistor will pull current out of the Balance/Strobe pin. The Balance/Strobe pin must not be pulled directly to ground, but current limited to between 3mA and 5mA. The voltage on the Balance/Strobe pin is approximately 2V less than +Vcc at 3mA. The Balance/Strobe pin current can be reduced to 500uA, but the strobe delay will be increased from approximately 60nS to 300nS.

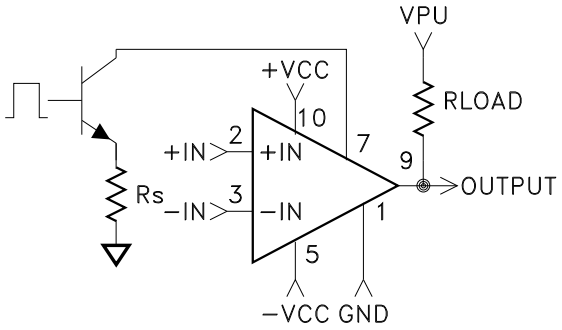


FIGURE 4

HYSTERISIS

The strobe and balance pins of the MSK 120RH can simplify adding hysterisis. The input referred offset with respect to balance pin current is approximately 0.5mV/1μA. A 15MΩ resistor connected between pin 6 and pin 9 will provide approximately 0.5mV of hysterisis, see Figure 5. The 0.003μF capacitor between +VCC and pin 7 provides a small amount of AC hysterisis. Both of the balance pins (6 and 7) shift approximately 4mV during output transitions. The capacitor allows a small amount of current to flow in and out of pin 7 momentarily shifting the input offset creating the AC hysterisis. The circuit in Figure 5 combines AC and DC hysterisis without feeding signals back to the input pins.

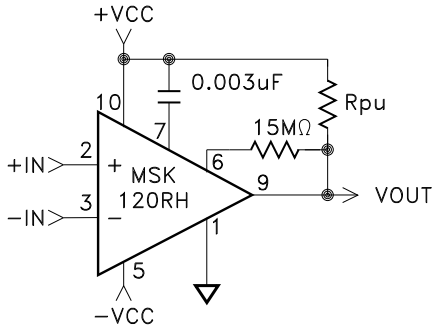


FIGURE 5

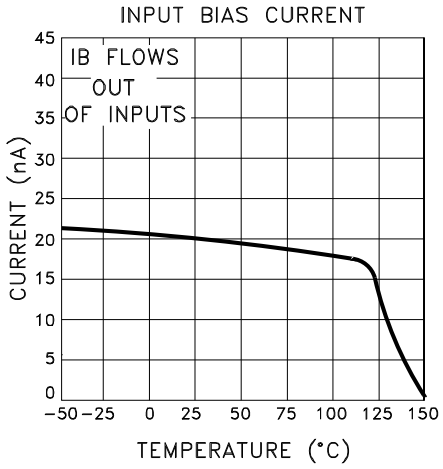
TOTAL DOSE RADIATION TEST PERFORMANCE

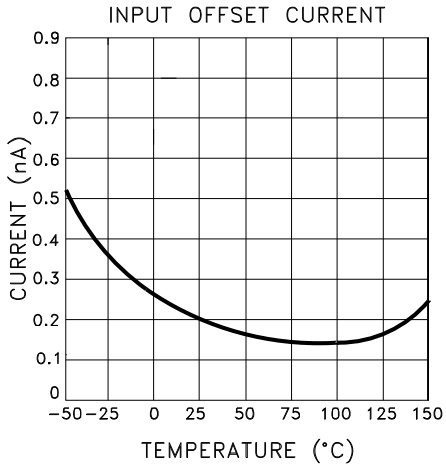
Radiation performance curves for TID testing have been generated for all radiation testing performed by MS Kennedy. These curves show performance trends throughout the TID test process and can be located in the MSK 120RH radiation test report. The complete radiation test report is available in the RAD HARD PRODUCTS section on the MSK website.

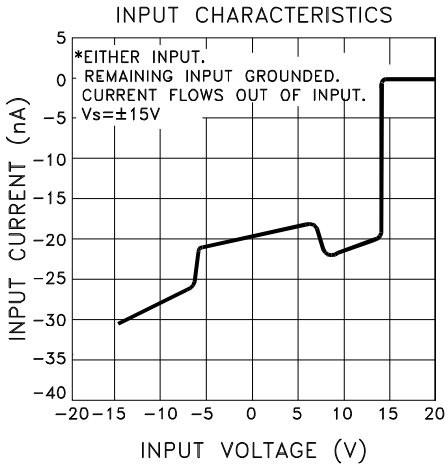
ADDITIONAL APPLICATION INFORMATION

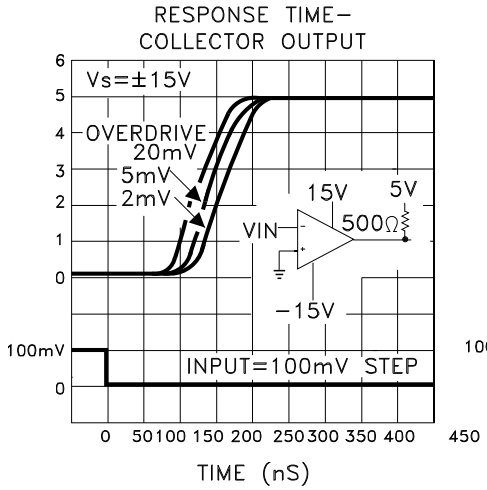
For additional applications information, please reference Linear Technology Corporation's® LT1011 and RH1011 data sheets.

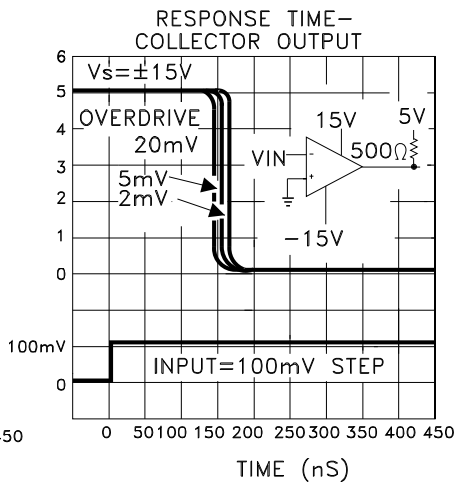
TYPICAL PERFORMANCE CURVES

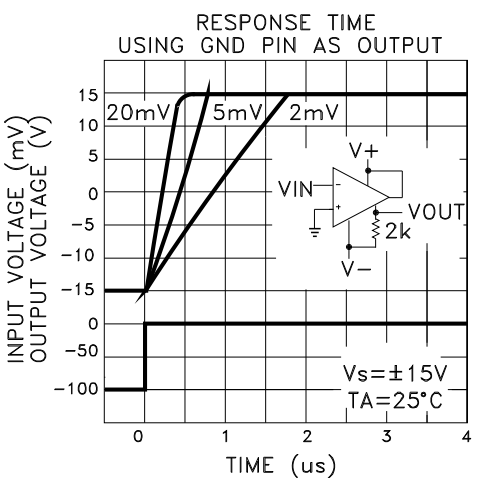


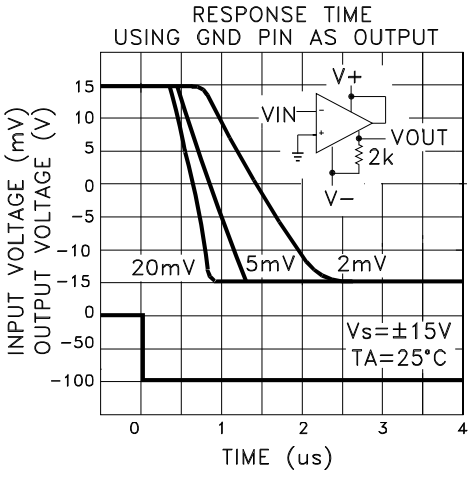


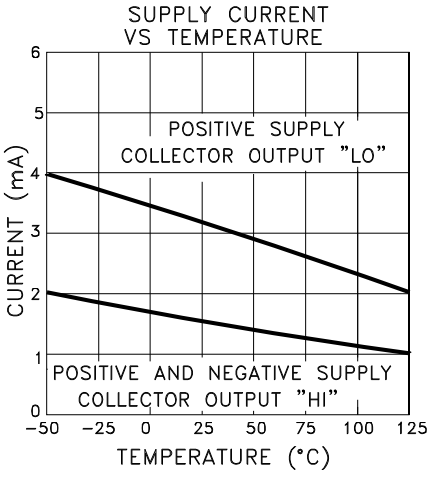


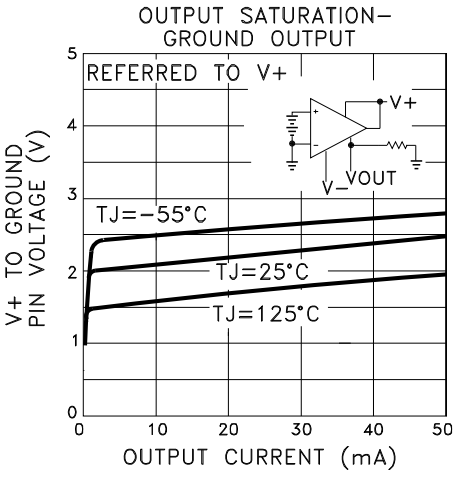




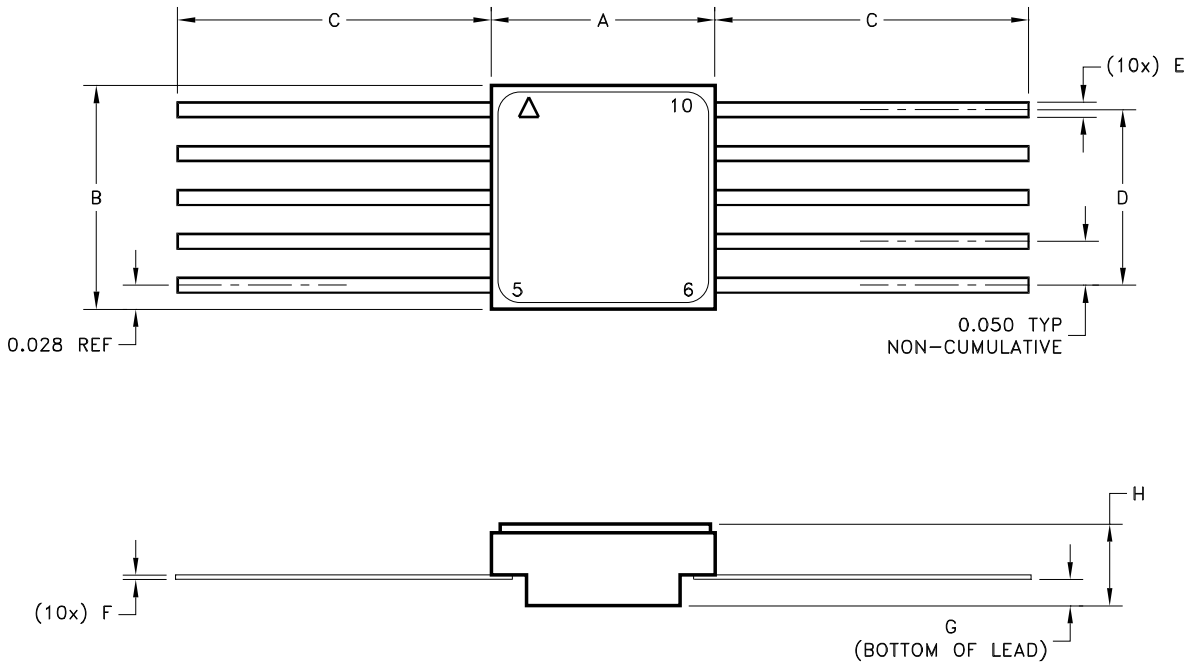








MECHANICAL SPECIFICATIONS



REF	MIN	MAX	REF	MIN	MAX
A	0.245	0.265	E	0.015	0.019
B	0.245	0.265	F	0.004	0.006
C	0.250	———	G	0.026	———
D	0.195	0.205	H	———	0.105

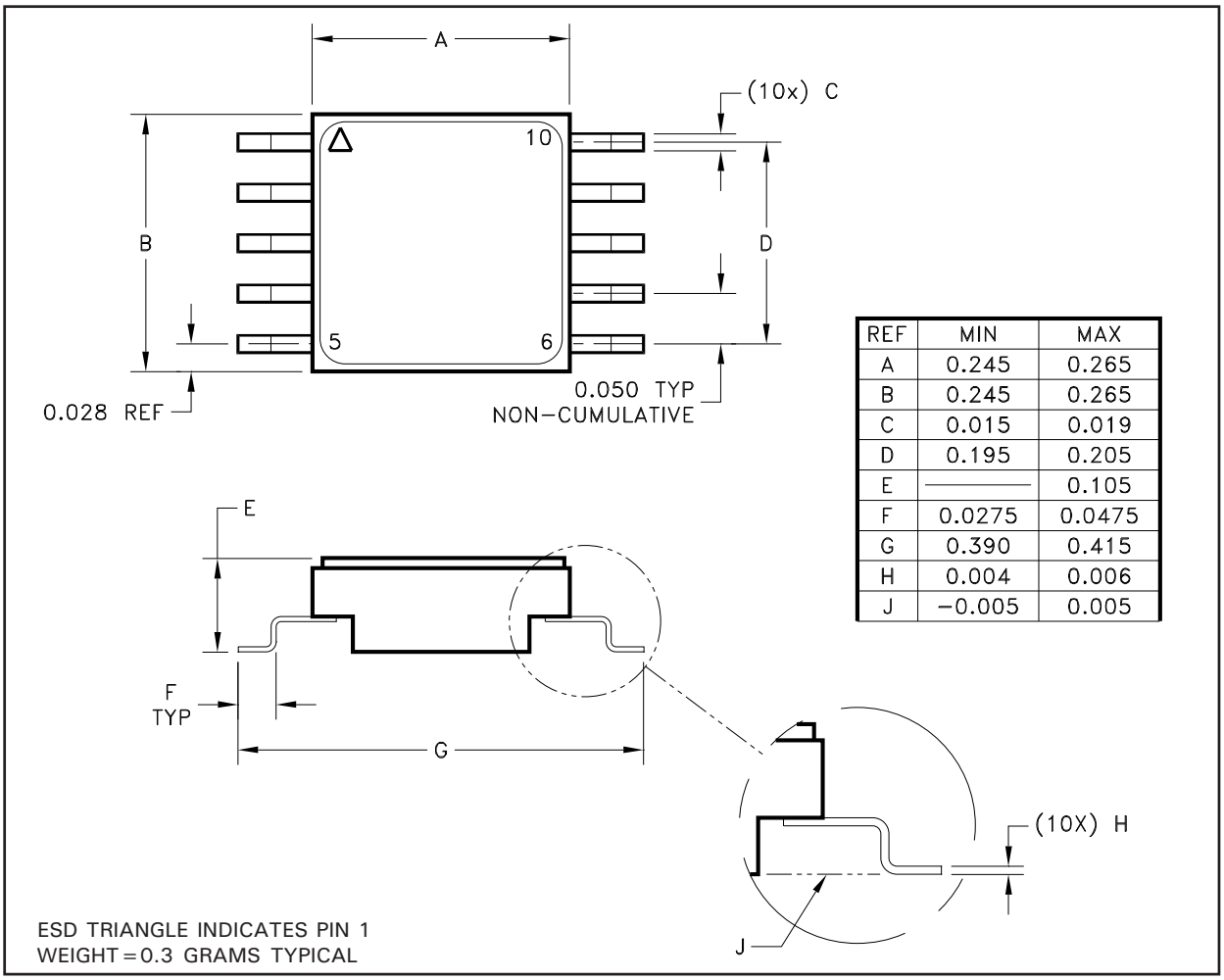
ESD TRIANGLE INDICATES PIN 1
WEIGHT = 0.3 GRAMS TYPICAL

ORDERING INFORMATION

MSK120 V RH

LEAD CONFIGURATIONS
BLANK = STRAIGHT
RADIATION HARDENED
SCREENING
BLANK = INDUSTRIAL
V = MIL-PRF-38535 CLASS V
GENERAL PART NUMBER

The above example is a Class V comparator with straight leads.



REF	MIN	MAX
A	0.245	0.265
B	0.245	0.265
C	0.015	0.019
D	0.195	0.205
E	———	0.105
F	0.0275	0.0475
G	0.390	0.415
H	0.004	0.006
J	−0.005	0.005

ORDERING INFORMATION

MSK120 V RH G

LEAD CONFIGURATIONS
G = GULL WING
RADIATION HARDENED
SCREENING
BLANK = INDUSTRIAL
V = MIL-PRF-38535 CLASS V
GENERAL PART NUMBER

The above example is a Class V comparator with gull wing lead form.

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