THREE PHASE BRIDGE MOSFET POWER MODULE 3001

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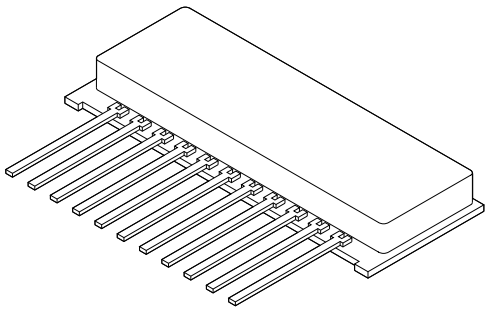


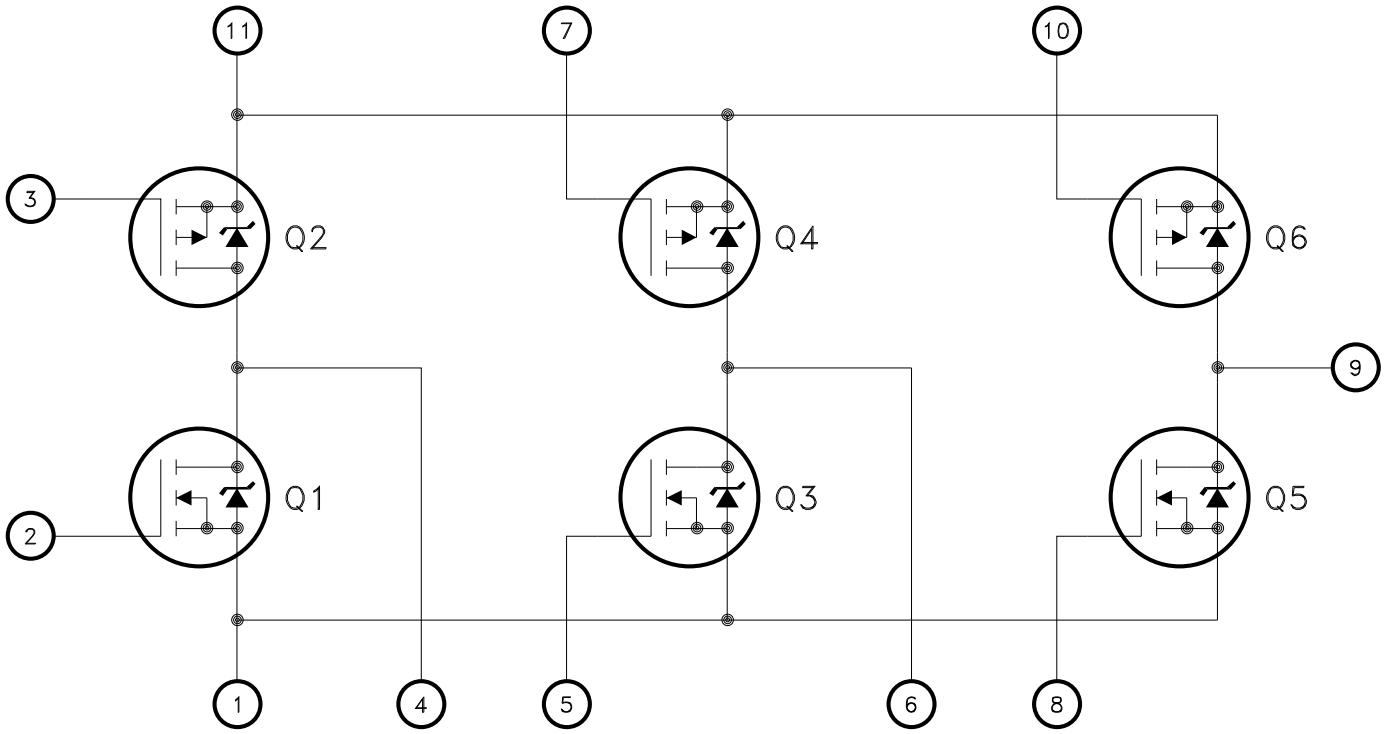
FEATURES:

- Pin Compatible with IRFT001
- P and N Channel MOSFETs for Ease of Drive
- Isolated Package for Direct Heat Sinking, Excellent Thermal Conductivity
- Avalanche Rated Devices
- Interfaces Directly with Most Brushless Motor Drive IC's
- 100 Volt, 5 Amp Full Three Phase Bridge at 25°C

DESCRIPTION:

The MSK 3001 is a three phase bridge power circuit packaged in a space efficient isolated ceramic tab power SIP package. Consisting of P-Channel MOSFETs for the top transistors and N-Channel MOSFETs for the bottom transistors, the MSK 3001 will interface directly with most brushless motor drive IC's without special gate driving requirements. The MSK 3001 uses M.S.Kennedy's proven power hybrid technology to bring a cost effective high performance circuit for use in today's sophisticated servo motor and disk drive systems. The MSK 3001 is a replacement for the IRFT001 with only minor differences in mechanical and electrical specifications.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Three Phase Brushless DC Motor Servo Control
- Disk Drive Spindle Control
- Fin Actuator Control
- Az-El Antenna Control

PIN-OUT INFORMATION

1	Source 1,3,5	11	Source 2,4,6
2	Gate 1	10	Gate 6
3	Gate 2	9	Drain 5,6
4	Drain 1,2	8	Gate 5
5	Gate 3	7	Gate 4
6	Drain 3,4		

ABSOLUTE MAXIMUM RATINGS

V_{DSS} Drain to Source Voltage . . . . 100V MAX
V_{DGDR} Drain to Gate Voltage (R_{GS} = 1MΩ) . . . . . 100V MAX
V_{GS} Gate to Source Voltage (Continuous) . . . . . ±20V MAX
I_D Continuous Current . . . . . 5.6A MAX
I_{DM} Pulsed Current . . . . . 22A MAX
R_{TH-JC} Thermal Resistance (Junction to Case) . . . . . 6°C/W

Single Pulse Avalanche Energy
(Q1,Q3,Q5) 91mJ
(Q2,Q4,Q6) 210mJ
T_J Junction Temperature . . . . . +175°C MAX
T_{ST} Storage Temperature . . . . . -55°C to +150°C
T_C Case Operating Temperature Range -55°C to +125°C
T_{LD} Lead Temperature Range (10 Seconds Lead Only) . . . . . 200°C MAX

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ④	MSK3001 Min.	MSK3001 Typ.	MSK3001 Max.	Units
Drain-Source Breakdown Voltage	V_{GS} = 0 I_D = 0.25mA (All Transistors)	100	-	-	V
Drain-Source Leakage Current	V_{DS} = 100V V_{GS} = 0V (Q1,Q3,Q5)	-	-	25	µA
	V_{DS} = -100V V_{GS} = 0V (Q2,Q4,Q6)	-	-	-100	µA
Gate-Source Leakage Current	V_{GS} = ±20V V_{DS} = 0 (All Transistors)	-	-	±100	nA
Gate-Source Threshold Voltage	V_{DS} = V_{GS} I_D = 250µA (Q1,Q3,Q5)	2.0	-	4.0	V
	V_{DS} = V_{GS} I_D = 250µA (Q2,Q4,Q6)	-2.0	-	-4.0	V
Drain-Source On Resistance ②	V_{GS} = 10V I_D = 5.6A (Q1,Q3,Q5)	-	0.18	0.30	Ω
	V_{GS} = -10V I_D = -3.4A (Q2,Q4,Q6)	-	0.37	0.75	Ω
Drain-Source On Resistance ③	V_{GS} = 10V I_D = 5.6A (Q1,Q3,Q5)	-	-	0.21	Ω
	V_{GS} = 10V I_D = -3.4A (Q2,Q4,Q6)	-	-	0.60	Ω
Forward Transconductance ①	V_{DS} = 25V I_D = 5.7A (Q1,Q3,Q5)	2.7	-	-	S
	V_{DS} = -50V I_D = -3.4A (Q2,Q4,Q6)	1.5	-	-	S
N-Channel (Q1,Q3,Q5)					
Total Gate Charge ①	I_D = 5.7A	-	-	25	nC
Gate-Source Charge ①	V_{DS} = 80V	-	-	4.8	nC
Gate-Drain Charge ①	V_{GS} = 10V	-	-	11	nC
Turn-On Delay Time ①	V_{DD} = 50V	-	4.5	-	nS
Rise Time ①	I_D = 5.7A	-	23	-	nS
Turn-Off Delay Time ①	R_G = 22Ω	-	32	-	nS
Fall Time ①	R_D = 8.6Ω	-	23	-	nS
Input Capacitance ①	V_{GS} = 0V	-	330	-	pF
Output Capacitance ①	V_{DS} = 25V	-	92	-	pF
Reverse Transfer Capacitance ①	f = 1MHz	-	54	-	pF
P-CHANNEL (Q2,Q4,Q6)					
Total Gate Charge ①	I_D = -6.8A	-	-	18	nC
Gate-Source Charge ①	V_{DS} = -80V	-	-	3.0	nC
Gate-Drain Charge ①	V_{GS} = -10V	-	-	9.0	nC
Turn-On Delay Time ①	V_{DD} = -50V	-	9.6	-	nS
Rise Time ①	I_D = -6.8A	-	29	-	nS
Turn-Off Delay Time ①	R_G = 18Ω	-	21	-	nS
Fall Time ①	R_D = 7.1Ω	-	25	-	nS
Input Capacitance ①	V_{GS} = 0V	-	390	-	pF
Output Capacitance ①	V_{DS} = -25V	-	170	-	pF
Reverse Transfer Capacitance ①	f = 1MHz	-	45	-	pF
BODY DIODE					
Forward On Voltage ①	I_S = 5.5A V_{GS} = 0V (Q1,Q3,Q5)	-	1.3	-	V
	I_S = -5.6A V_{GS} = 0V (Q2,Q4,Q6)	-	-1.6	-	V
Reverse Recovery Time ①	I_S = 5.7A di/dt = 100A/µS (Q1,Q3,Q5)	-	99	150	nS
	I_S = -6.8A di/dt = 100A/µS (Q2,Q4,Q6)	-	100	200	nS
Reverse Recovery Charge ①	I_S = 5.7A di/dt = 100A/µS (Q1,Q3,Q5)	-	0.39	0.58	µC
	I_S = -6.8A di/dt = 100A/µS (Q2,Q4,Q6)	-	0.33	0.66	µC

NOTES:

① This parameter is guaranteed by design but need not be tested. Typical parameters are representative of actual device performance but are for reference only.
② Resistance as seen at package pins.
③ Resistance for die only; use for thermal calculations.
④ T_A = 25°C unless otherwise specified.

APPLICATION NOTES

N-CHANNEL GATES (Q1,Q3,Q5)

For driving the N-Channel gates, it is important to keep in mind that it is essentially like driving a capacitance to a sufficient voltage to get the channel fully on. Driving the gates to +15 volts with respect to their sources assures that the transistors are on. This will keep the dissipation down to a minimum level [$R_{DS(ON)}$ specified in the data sheet]. How quickly the gate gets turned ON and OFF will determine the dissipation of the transistor while it is transitioning from OFF to ON, and vice-versa. Turning the gate ON and OFF too slow will cause excessive dissipation, while turning it ON and OFF too fast will cause excessive switching noise in the system. It is important to have as low a driving impedance as practical for the size of the transistor. Many motor drive IC's have sufficient gate drive capability for the MSK 3001. If not, paralleled CMOS standard gates will usually be sufficient. A series resistor in the gate circuit slows it down, but also suppresses any ringing caused by stray inductances in the MOSFET circuit. The selection of the resistor is determined by how fast the MOSFET wants to be switched. See Figure 1 for circuit details.

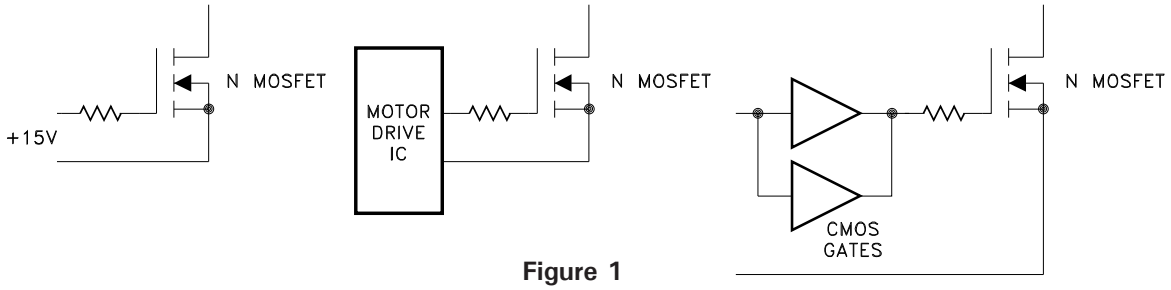


Figure 1

P-CHANNEL GATES (Q2,Q4,Q6)

Most everything applies to driving the P-Channel gates as the N-Channel gates. The only difference is that the P-Channel gate to source voltage needs to be negative. Most motor drive IC's are set up with an open collector or drain output for directly interfacing with the P-channel gates. If not, an external common emitter switching transistor configuration (see Figure 2) will turn the P-Channel MOSFET on. All the other rules of MOSFET gate drive apply here. For high supply voltages, additional circuitry must be used to protect the P-Channel gate from excessive voltages.

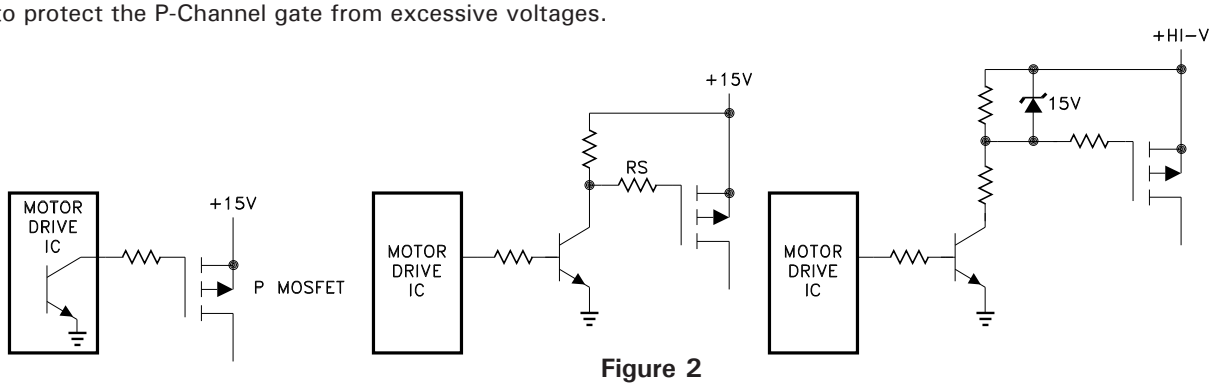


Figure 2

BRIDGE DRIVE CONSIDERATIONS

It is important that the logic used to turn ON and OFF the various transistors allow sufficient "dead time" between a high side transistor and its low side transistor to make sure that at no time are they both ON. When they are, this is called "shoot-through", and it places a momentary short across the power supply. This overly stresses the transistors and causes excessive noise as well. See Figure 3.

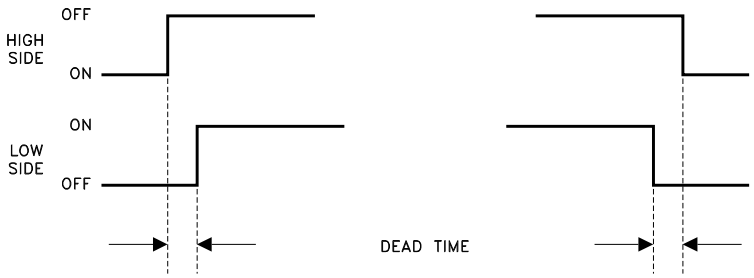


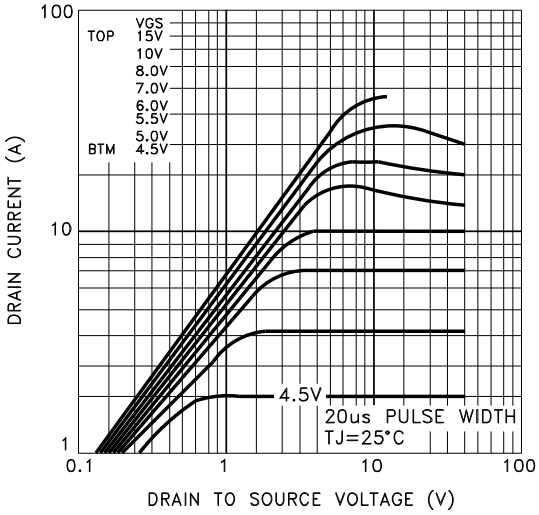
Figure 3

This deadtime should allow for the turn on and turn off time of the transistors, especially when slowing them down with gate resistors. This situation will be present when switching motor direction, or when sophisticated timing schemes are used for servo systems such as locked antiphase PWM'ing for high bandwidth operation.

TYPICAL PERFORMANCE CURVES

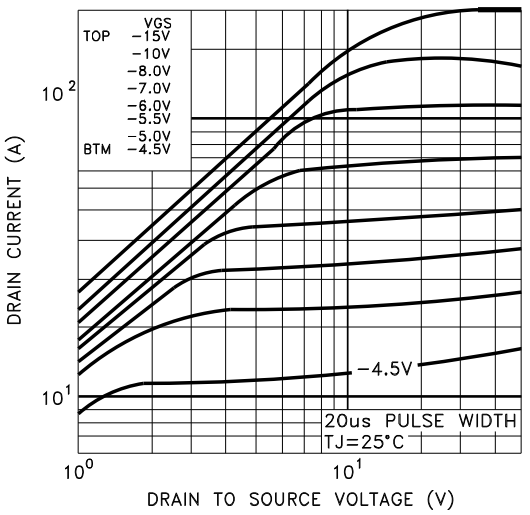
N-CHANNEL DEVICES (Q1,Q3,Q5)

DRAIN CURRENT vs DRAIN TO SOURCE VOLTAGE

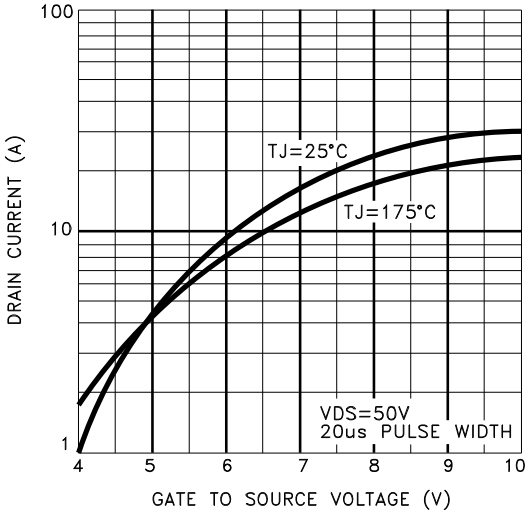


P-CHANNEL DEVICES (Q2,Q4,Q6)

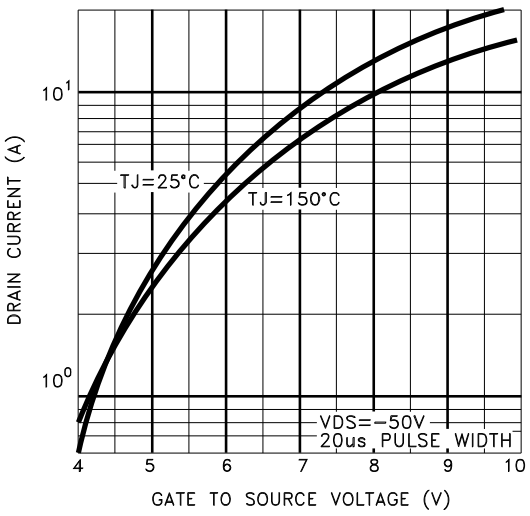
DRAIN CURRENT vs DRAIN TO SOURCE VOLTAGE



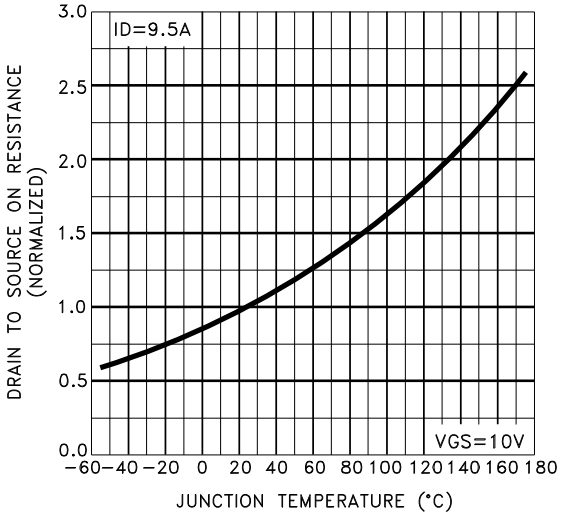
DRAIN CURRENT vs GATE TO SOURCE VOLTAGE



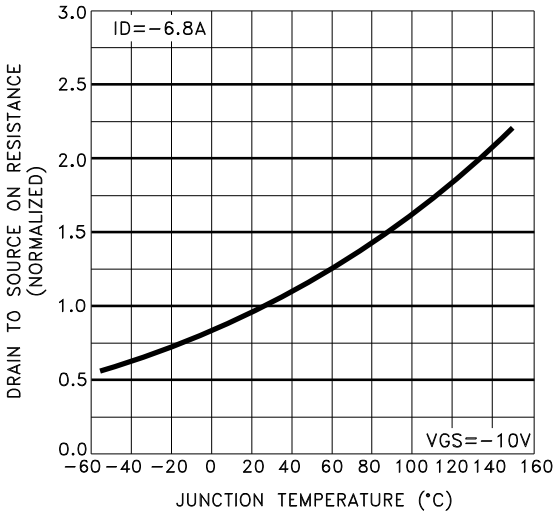
DRAIN CURRENT vs GATE TO SOURCE VOLTAGE



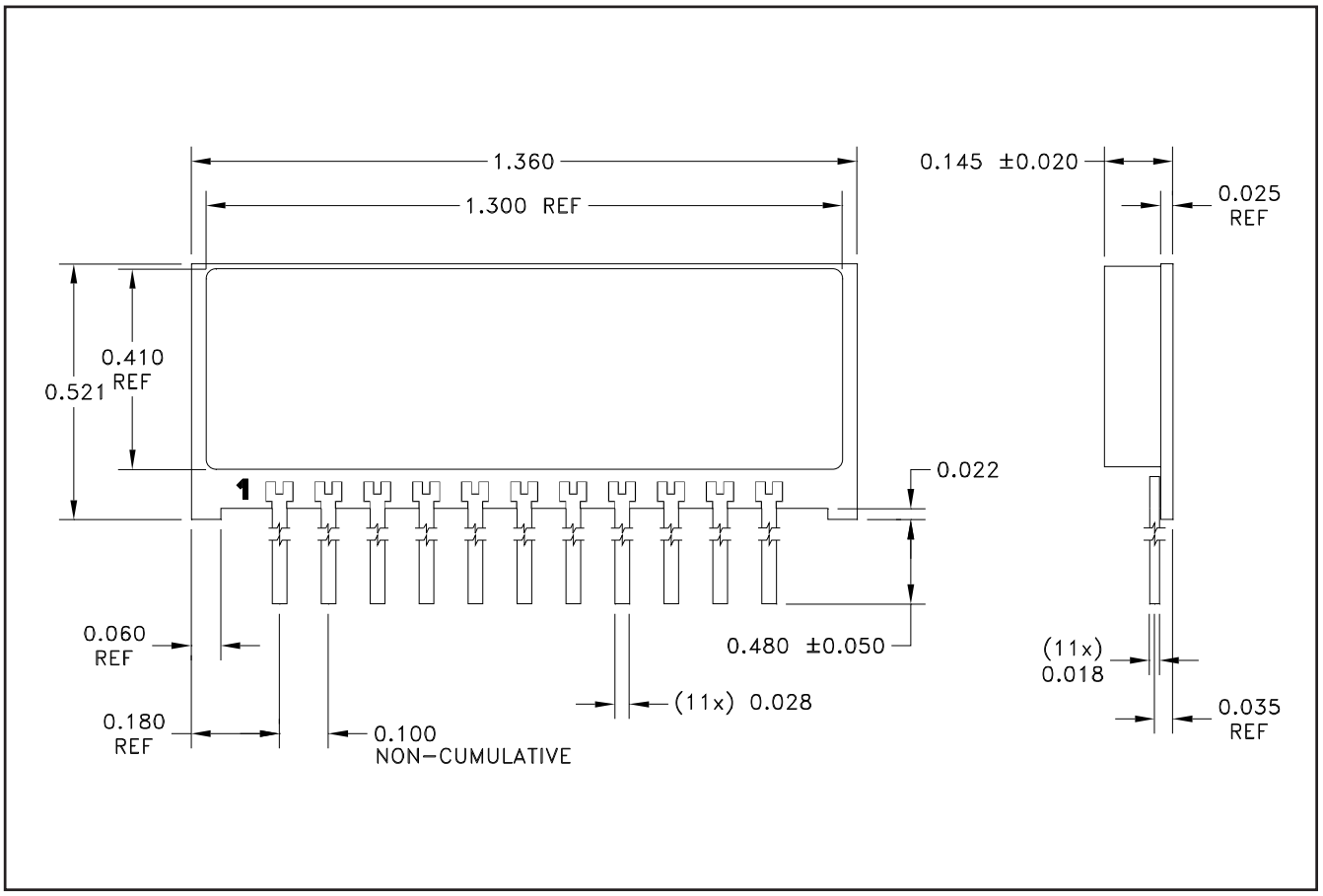
DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMP.



DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMP.



MECHANICAL SPECIFICATIONS



ALL DIMENSIONS ARE ±0.010 INCHES UNLESS OTHERWISE LABELED.

ORDERING INFORMATION

PART NUMBER	SCREENING LEVEL
MSK 3001	Industrial

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