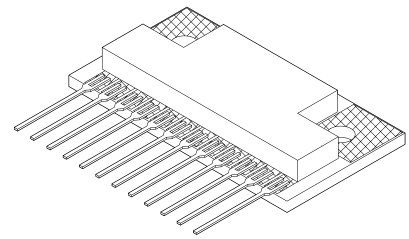
M.S.KENNEDY CORP.

H-BRIDGE MOSFET POWER MODULE 3004



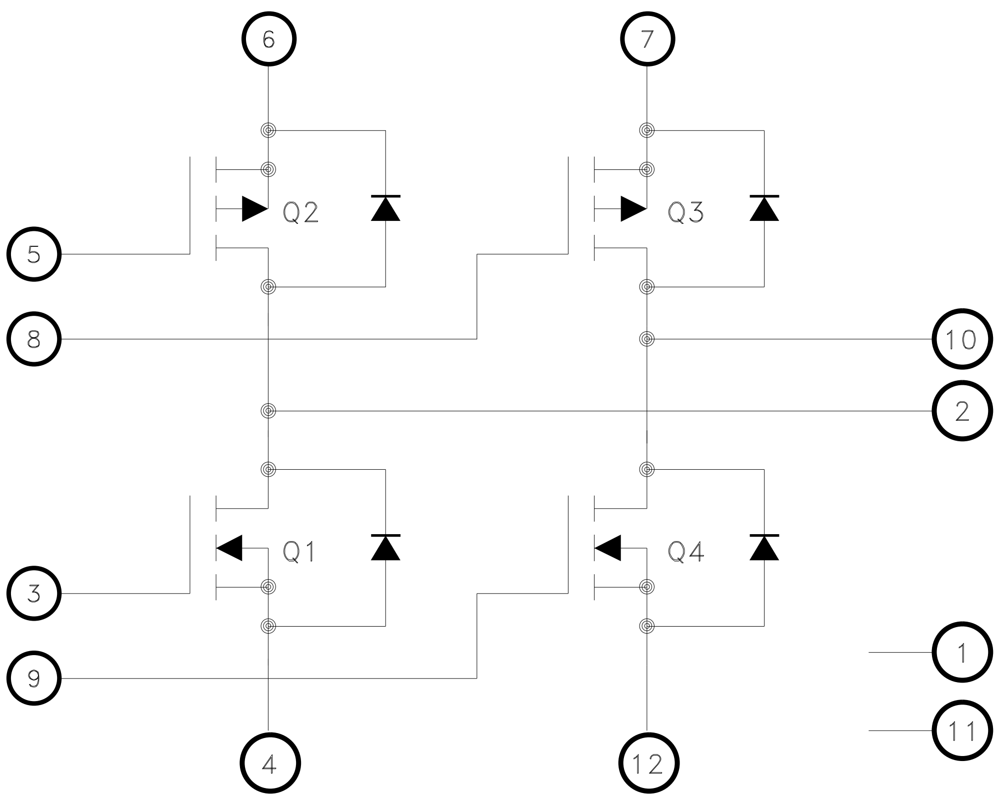
FEATURES:

- Pin Compatible with MPM3004
- P and N Channel MOSFETs for Ease of Drive
- Isolated Package for Direct Heat Sinking, Excellent Thermal Conductivity
- Avalanche Rated Devices
- 55 Volt, 10 Amp Full H-Bridge

DESCRIPTION:

The MSK3004 is an H-bridge power circuit packaged in a space efficient isolated ceramic tab power SIP package. The MSK3004 consists of P-Channel MOSFETs for the top transistors and N-Channel MOSFETs for the bottom transistors. The MSK3004 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 MSK3004 is a replacement for the MPM3004 with only minor differences in mechanical specifications.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- Stepper Motor Servo Control
- Disk Drive Head Control
- X-Y Table Control
- Az-El Antenna Control

PIN-OUT INFORMATION

1	N/C	12	Source 4
2	Drain 1,2	11	N/C
3	Gate 1	10	Drain 3,4
4	Source 1	9	Gate 4
5	Gate 2	8	Gate 3
6	Source 2	7	Source 3

ABSOLUTE MAXIMUM RATINGS

V_{DSS} Drain to Source Voltage . . . . 55V MAX
V_{DGDR} Drain to Gate Voltage (RGS = 1MΩ) . . . . 55V MAX
V_{GS} Gate to Source Voltage (Continuous) . . . . ±20V MAX
I_D Continuous Current . . . . 10A MAX
I_{DM} Pulsed Current . . . . 25A MAX
Single Pulse Avalanche Energy
(Q1,Q4) 71mJ
(Q2,Q3) 96mJ

T_J JunctionTemperature . . . . +175°C MAX
T_{ST} Storage Temperature ⑤ . . . . . . -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
R_{TH-JC} Thermal Resistance (Junction to Case)
P-Channel @ 25°C . . . . 9.7°C/W
P-Channel @ 125°C . . . . 14.5°C/W
N-Channel @ 25°C . . . . 9.7°C/W
N-Channel @ 125°C . . . . 14.5°C/W

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ④	MSK3004 Min.	Typ.	Max.	Units
Drain-Source Breakdown Voltage	VGS = 0 ID = 0.25mA (All Transistors)	55	-	-	V
Drain-Source Leakage Current	VDS = 55V VGS = 0V (Q1,Q4)	-	-	25	μA
	VDS = -55V VGS = 0V (Q2,Q3)	-	-	-25	μA
Gate-Source Leakage Current	VGS = ±20V VDS = 0 (All Transistors)	-	-	±100	nA
Gate-Source Threshold Voltage	VDS = VGS ID = 250μA (Q1,Q4)	2.0	-	4.5	V
	VDS = VGS ID = 250μA (Q2,Q3)	-2.0	-	-4.5	V
Drain-Source On Resistance ②	VGS = 10V ID = 10A (Q1,Q4)	-	-	0.15	Ω
	VGS = -10V ID = -7.2A (Q2,Q3)	-	-	0.28	Ω
Drain-Source On Resistance ③	VGS = 10V ID = 10A (Q1,Q4)	-	-	0.07	Ω
	VGS = 10V ID = -7.2A (Q2,Q3)	-	-	0.175	Ω
Forward Transconductance ①	VDS = 25V ID = 10A (Q1,Q4)	4.5	-	-	S
	VDS = -25V ID = -7.2A (Q2,Q3)	2.5	-	-	S
N-Channel (Q1,Q4)					
Total Gate Charge ①	ID = 10A	-	-	20	nC
Gate-Source Charge ①	VDS = 44V	-	-	5.3	nC
Gate-Drain Charge ①	VGS = 10V	-	-	7.6	nC
Turn-On Delay Time ①	VDD = 28V	-	4.9	-	nS
Rise Time ①	ID = 10A	-	34	-	nS
Turn-Off Delay Time ①	RG = 24Ω	-	19	-	nS
Fall Time ①	RD = 2.6Ω	-	27	-	nS
Input Capacitance ①	VGS = 0V	-	370	-	pF
Output Capacitance ①	VDS = 25V	-	140	-	pF
Reverse Transfer Capacitance ①	f = 1MHz	-	65	-	pF
P-CHANNEL (Q2,Q3)					
Total Gate Charge ①	ID = -7.2A	-	-	19	nC
Gate-Source Charge ①	VDS = -44V	-	-	5.1	nC
Gate-Drain Charge ①	VGS = -10V	-	-	10	nC
Turn-On Delay Time ①	VDD = -28V	-	13	-	nS
Rise Time ①	ID = -7.2A	-	55	-	nS
Turn-Off Delay Time ①	RG = 24Ω	-	23	-	nS
Fall Time ①	RD = 3.7Ω	-	37	-	nS
Input Capacitance ①	VGS = 0V	-	350	-	pF
Output Capacitance ①	VDS = -25V	-	170	-	pF
Reverse Transfer Capacitance ①	f = 1MHz	-	92	-	pF
BODY DIODE					
Forward On Voltage ①	IS = 10A VGS = 0V (Q1,Q4)	-	1.3	-	V
	IS = -7.2A VGS = 0V (Q2,Q3)	-	-1.6	-	V
Reverse Recovery Time ①	IS = 10A di/dt = 100A/μS (Q1,Q4)	-	56	83	nS
	IS = -7.2A di/dt = 100A/μS (Q2,Q3)	-	47	71	nS
Reverse Recovery Charge ①	IS = 10A di/dt = 100A/μS (Q1,Q4)	-	0.12	0.18	μC
	IS = -7.2A di/dt = 100A/μS (Q2,Q3)	-	0.084	0.13	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.
⑤ Internal solder reflow temperature is 180°C, do not exceed.

APPLICATION NOTES

N-CHANNEL GATES (Q1,Q4)

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 MSK3004. 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.

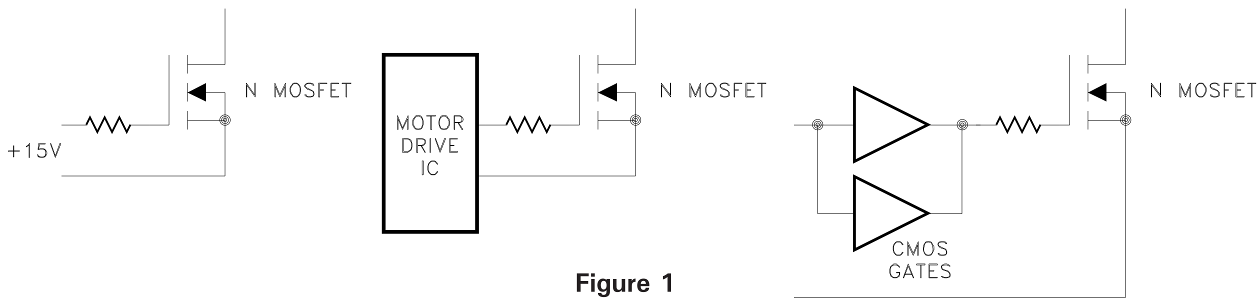


Figure 1

P-CHANNEL GATES (Q2,Q3)

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.

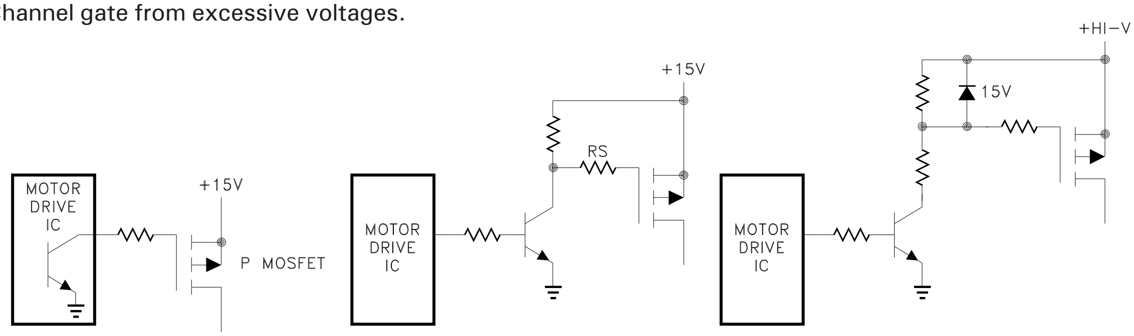


Figure 2

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

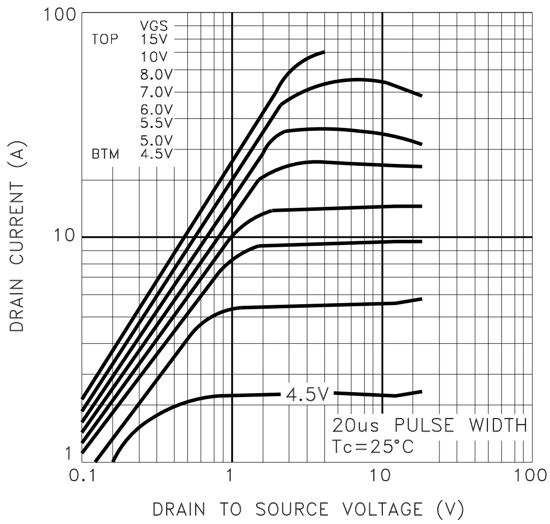
This deadtime should allow for the turn on and turn off time of the transistors, especially when slowing them down with gate resistors. This situation will be present when switching motor direction, or when sophisticated timing schemes are used for servo systems such as locked antiphase PWM'ing for high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

TYPICAL PERFORMANCE CURVES

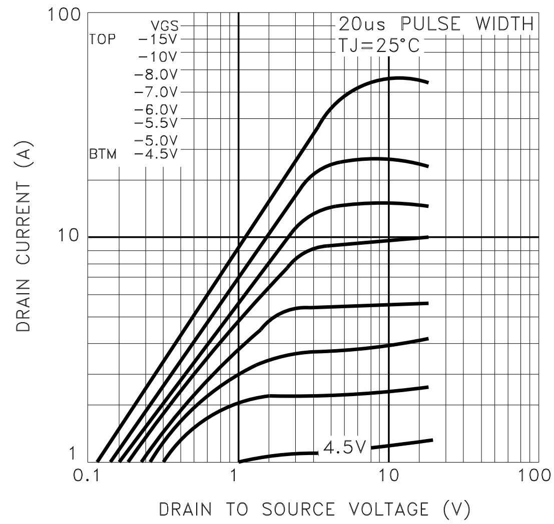
N-CHANNEL DEVICES (Q1,Q4)

P-CHANNEL DEVICES (Q2,Q3)

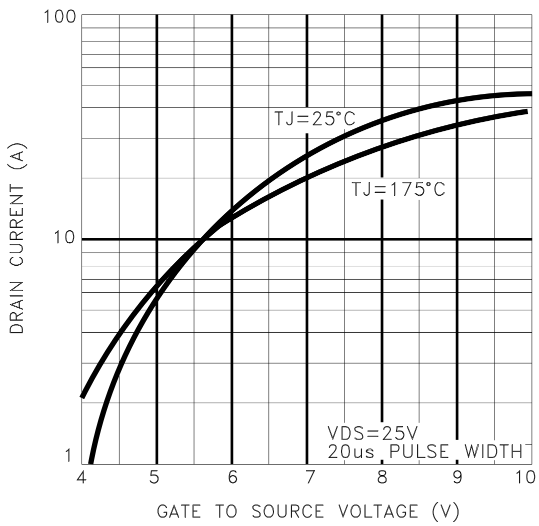
DRAIN CURRENT vs DRAIN TO SOURCE VOLTAGE



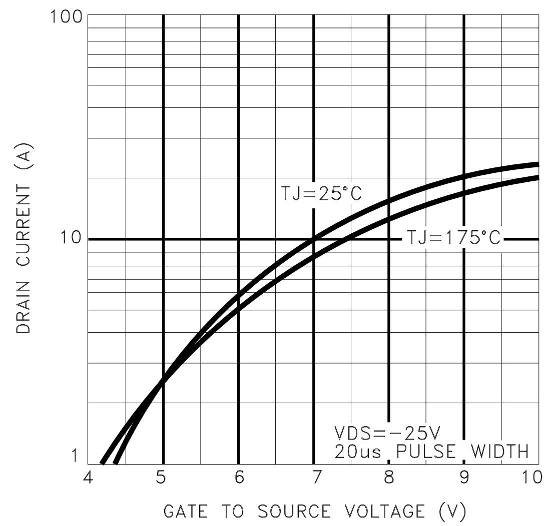
DRAIN CURRENT vs DRAIN TO SOURCE VOLTAGE



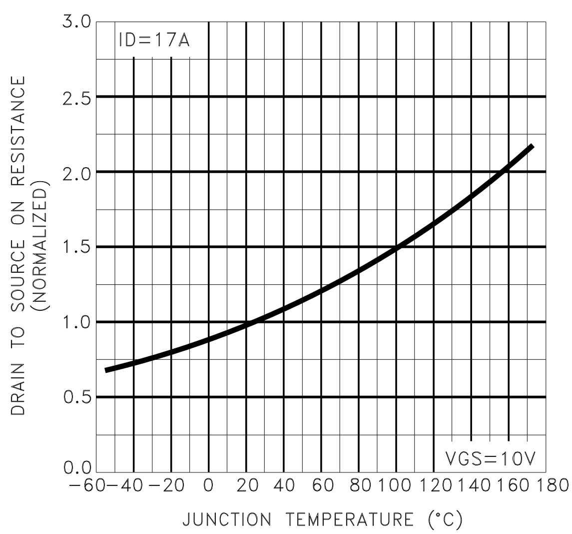
DRAIN CURRENT vs GATE TO SOURCE VOLTAGE



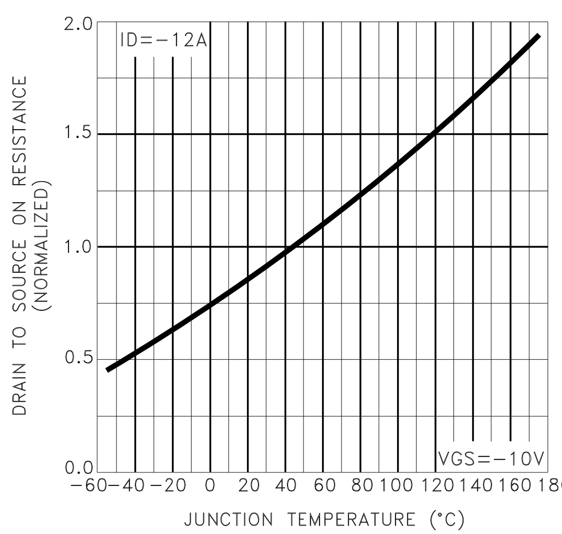
DRAIN CURRENT vs GATE TO SOURCE VOLTAGE



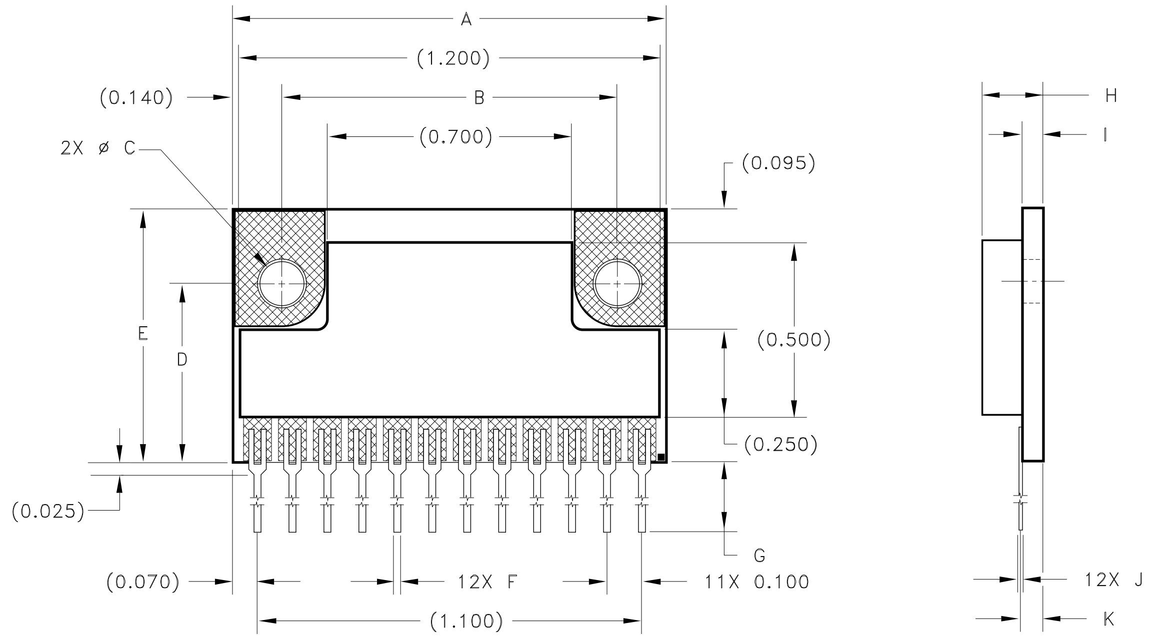
DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMP.



DRAIN TO SOURCE ON RESISTANCE vs JUNCTION TEMP.



MECHANICAL SPECIFICATIONS



REF	MIN	MAX
A	1.230	1.250
B	0.950	0.970
C	0.121	0.131
D	0.507	0.517
E	0.715	0.735
F	0.017	0.023
G	0.250	———
H	———	0.205
I	0.055	0.065
J	0.008	0.012
K	0.058	0.072

WEIGHT = 3.4 GRAMS TYPICAL
TORQUE SPECIFICATION 3 TO 5 IN/LBS.
TEFLON SCREWS OR WASHERS ARE RECOMMENDED.

ALL DIMENSIONS ARE SPECIFIED IN INCHES

ORDERING INFORMATION

PART NUMBER	SCREENING LEVEL
MSK3004	Industrial

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
J	Released	11/14	Format update, add internal note and clarify mechanical specifications.

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