MIL-PRF-38534 AND 38535 CERTIFIED FACILITY

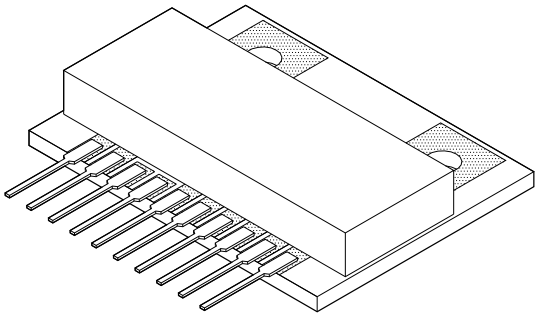
M.S.KENNEDY CORP.

75 VOLT 6 AMP MOSFET H-BRIDGE PWM MOTOR DRIVER/AMPLIFIER

4223

FEATURES:

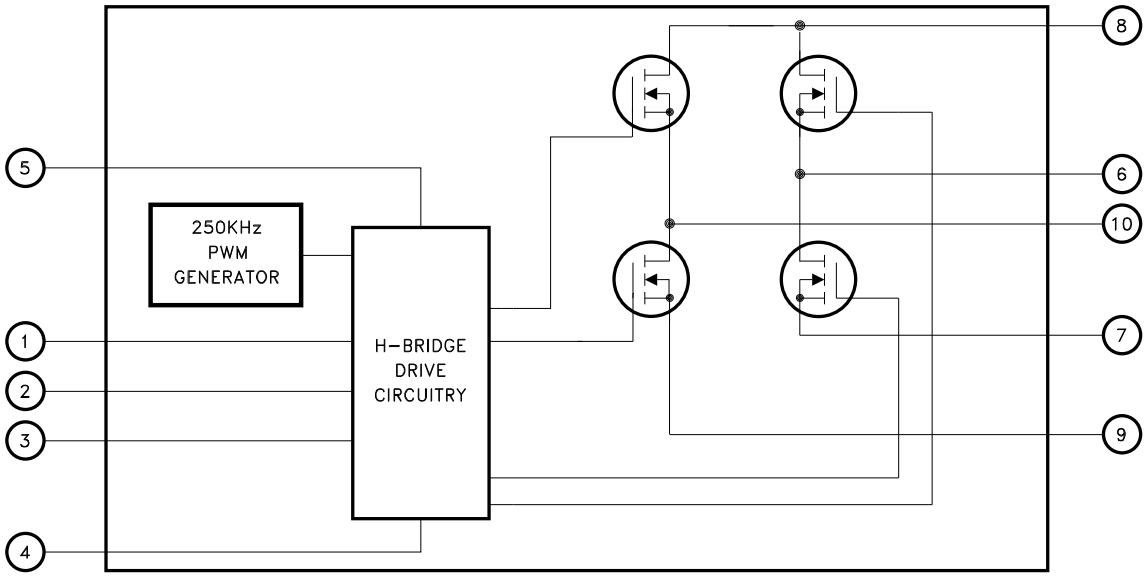
- Low Cost Complete H-Bridge
- 6 Amp Capability, 75 Volt Maximum Rating
- Self-contained Smart Lowside/Highside Drive Circuitry
- Internal PWM Generation, Shoot-through Protection
- Isolated Case Allows Direct Heatsinking
- Logic Level Disable Input
- Logic Level High Side Enable Input for Special Modulation or Function
- Available With Leads Bent Up, Down or Straight



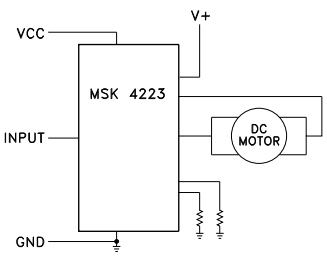
DESCRIPTION:

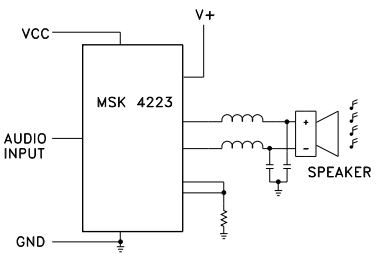
The MSK4223 is a complete H-Bridge circuit to be used for DC brushed motor control or Class D switchmode amplification. All of the drive/control circuitry for the lowside and highside switches are internal to the circuit. The PWM circuitry is internal as well, leaving the user to only provide an analog signal for the motor speed/direction, or audio signal for switchmode audio amplification. The MSK4223 is constructed on a space efficient ceramic substrate that can be directly connected to a heatsink.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS





PIN-OUT INFORMATION

1	HEN
2	DISABLE
3	INPUT
4	GROUND
5	VCC
6	OUTPUT A
7	RSENSE A
8	V+
9	RSENSE B
10	OUTPUT B

ABSOLUTE MAXIMUM RATINGS ③

V+	High Voltage Supply ④ 75V	T_{ST}	Storage Temperature Range ⑤ . -65°C to +150°C
VCC	Logic Supply 16V	T_{LD}	Lead Temperature Range
I_{OUT}	Continuous Output Current 6A		(10 Seconds Lead Only) . . . . . 200°C
I_{PK}	Peak Output Current 9A	T_C	Case Operating Temperature
V_{OUT}	Output Voltage Range . .GND-2V min. To V+ max.		MSK4223 . . . . . -40°C to +125°C
θ_{JC}	Thermal Resistance . . . . . .4.6°C/W (Output Switches)	T_J	Junction Temperature . . . . . +150°C

ELECTRICAL SPECIFICATIONS

All Ratings: Tc = +25°C Unless Otherwise Specified

Parameter	Test Conditions ②	MSK4223 Min.	MSK4223 Typ.	MSK4223 Max.	Units
OUTPUT CHARACTERISTICS					
VDS(ON) Voltage ①	Each MOSFET I_D = 6A	-	0.75	1.5	V
Instantaneous Forward Voltage ①	Each MOSFET I_S = 6A Intrinsic Diode	-	1.1	1.8	V
Reverse Recovery Time ①	Intrinsic Diode	-	-	260	nS
Leakage Current ①	Each MOSFET V+ = 70V	-	1.0	25	uA
PWM Frequency		225	250	275	KHz
VCC SUPPLY CHARACTERISTICS					
Quiescent Bias Current	Analog Input = 6V_{DC} $R_L = \infty$	-	46	60	mA
VCC Voltage Range ①		9	12	16	V
INPUT SIGNAL CHARACTERISTICS					
Analog Input Voltage	Output A,B = 50% Duty Cycle	5.5	6	6.5	V
Analog Input Voltage	Output A = 100% Duty Cycle High	2.5	3	3.5	V
Analog Input Voltage	Output B = 100% Duty Cycle High	8.5	9	9.5	V
LOGIC CONTROL INPUTS ①					
Disable Input	Input Voltage LO	-	-	0.8	V
	Input Voltage HI	2.7	-	-	V
	Input Current (DISABLE = 0V)	-	-	-135	uA
HEN Input	Input Voltage LO	-	-	0.8	V
	Input Voltage HI	2.7	-	-	V
	Input Current (HEN = 0V)	-	-	-270	uA
SWITCHING CHARACTERISTICS ①	$R_L = 100\Omega$				
Rise-Time	V+ = 75V	-	56	84	nS
Fall-Time	V+ = 75V	-	33	50	nS
Dead-Time		-	100	-	nS

NOTES:

① Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
② VCC = +12V, V+ = 28V, R_L = 1K A_{OUT} to B_{OUT}, unless otherwise specified.
③ Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.
④ When applying power to the device, apply the low voltage followed by the high voltage or alternatively, apply both at the same time. Do not apply high voltage without low voltage present.
⑤ Internal solder reflow temperature is 180°C, do not exceed.

APPLICATION NOTES

MSK4223 PIN DESCRIPTIONS

VCC - Is the low voltage supply for powering internal logic and drivers for the lowside and highside MOSFETS. The supplies for the highside drivers are derived from this voltage.

V+ - Is the higher voltage H-bridge supply. The MOSFETS obtain the drive current from this supply pin. The voltage on this pin is limited by the drive IC. The MOSFETS are rated at 100 volts. Proper by-passing to

GND with sufficient capacitance to suppress any voltage transients, and to ensure removing any drooping during switching, should be done as close to the pins of the module as possible.

OUTPUT A - Is the output pin for one half of the bridge. Decreasing the input voltage causes increasing duty cycles at this output.

OUTPUT B - Is the output pin for the other half of the bridge. Increasing the input voltage causes increasing duty cycles at this output.

RSENSE A - Is the connection for the bottom of the A half bridge. This can have a sense resistor connection to the V+ return ground for current limit sensing, or can be connected directly to ground. The maximum voltage on this pin is ±2 volts with respect to GND.

RSENSE B - Is the connection for the bottom of the B half bridge. This can have a sense resistor connection to the V+ return ground for current limit sensing, or can be connected directly to ground. The maximum voltage on this pin is ±2 volts with respect to GND.

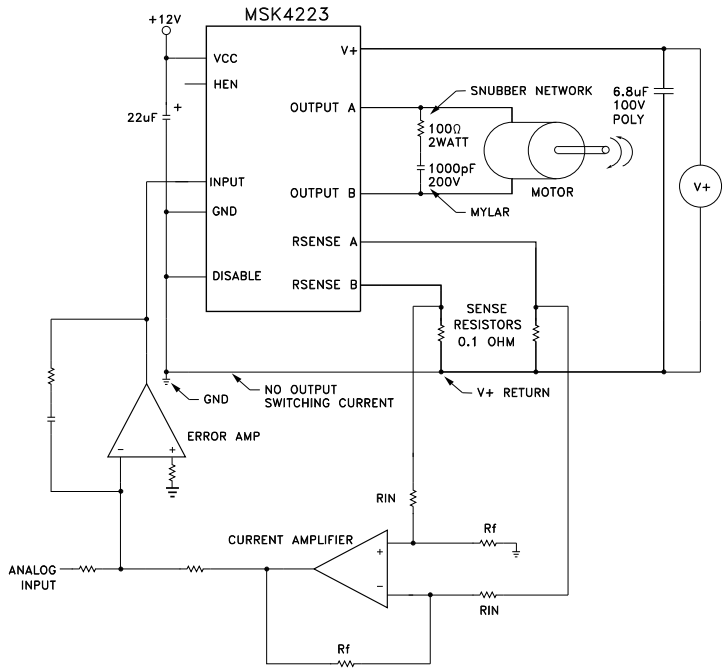
GND - Is the return connection for the input logic and VCC

INPUT - Is an analog input for controlling the PWM pulse width of the bridge. A voltage lower than VCC/2 will produce greater than 50% duty cycle pulses out of OUTPUT A. A voltage higher than VCC/2 will produce greater than 50% duty cycle pulses out of OUTPUT B.

DISABLE - Is the connection for disabling all 4 output switches. DISABLE high overrides all other inputs. When taken low, everything functions normally. An internal pullup to VCC will keep DISABLE high if left unconnected.

HEN - Is the connection for enabling the high side output switches. When taken low, HEN overrides other inputs and the high side switches remain off. When HEN is high everything functions normally. An internal pullup to VCC will keep HEN high if left unconnected.

TYPICAL SYSTEM OPERATION



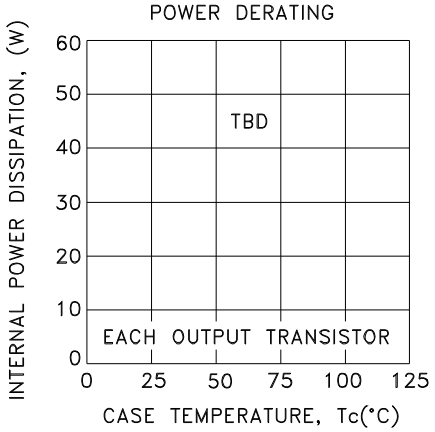
This is a diagram of a typical application of the MSK4223. The design VCC voltage is +12 volts and should have a good low ESR bypass capacitor such as a tantalum electrolytic. The analog input can be an analog speed control voltage from a potentiometer, other analog circuitry or by microprocessor and a D/A converter. This analog input gets pulled by the current control circuitry in the proper direction to reduce the current flow in the bridge if it gets too high. The gain of the current control amplifier will have to be set to obtain the proper amount of current limiting required by the system.

Current sensing is done in this case by a 0.1 ohm sense resistor to sense current from both legs of the bridge separately. It is important to make the high current traces as big as possible to keep inductance down. The storage capacitor connected to the V+ and the module should be large enough to provide the high energy pulse without the voltage sagging too far. A low ESR ceramic capacitor or large polypropylene capacitor will be required. Mount the capacitor as close to the module as possible. The connection between GND and the V+ return should not be carrying any motor current. The sense resistor signal is common mode filtered as necessary to feed the limiting circuitry for the microprocessor. This application will allow full four quadrant torque control for a closed loop servo system.

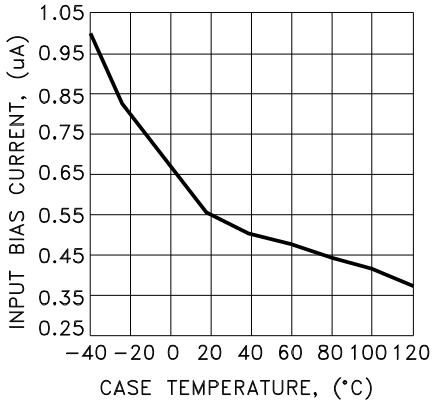
A snubber network is usually required, due to the inductance in the power loop. It is important to design the snubber network to suppress any positive spikes above 75V and negative spikes below -2V with respect to ground.

TYPICAL PERFORMANCE CURVES

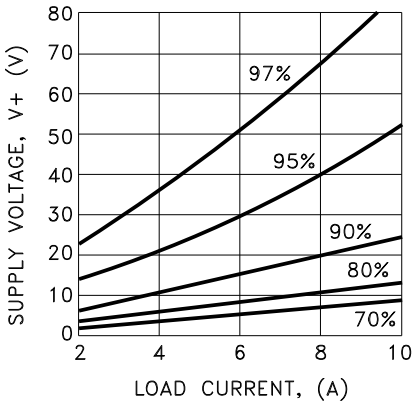
POWER DERATING



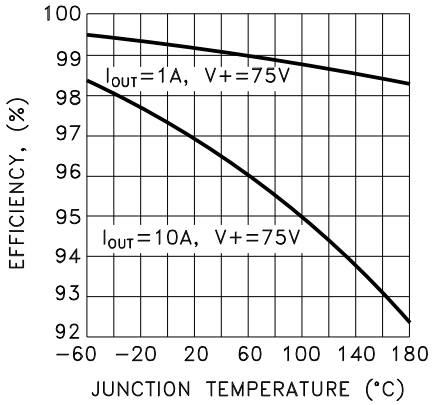
INPUT CURRENT vs TEMP.



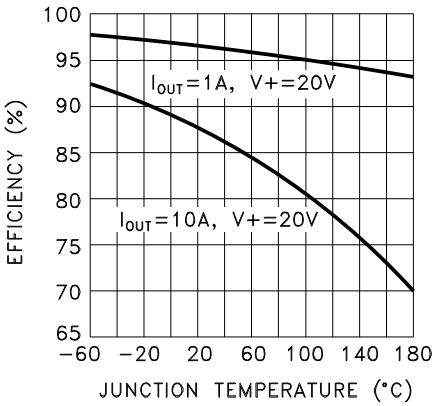
EFFICIENCY CONTOURS



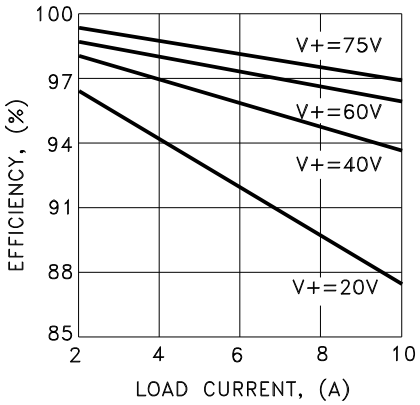
EFFICIENCY vs TEMP @ 75V



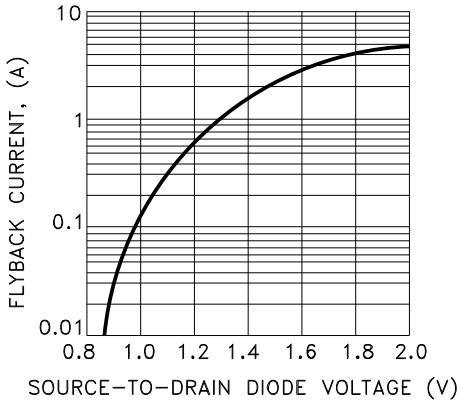
EFFICIENCY vs TEMP @ 20V



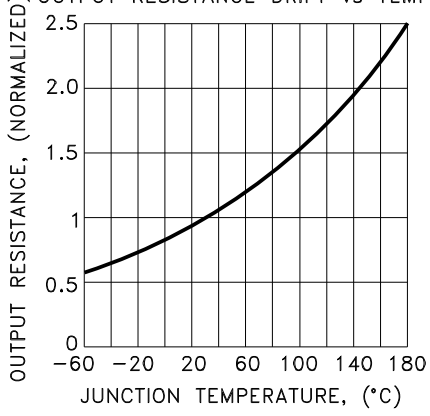
EFFICIENCY vs LOAD CURRENT



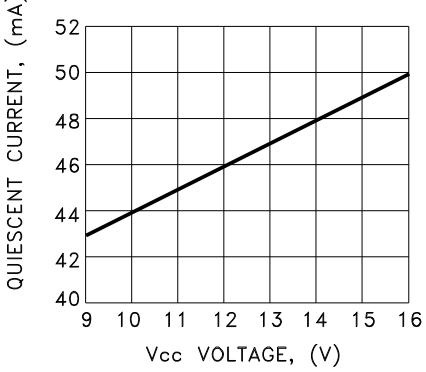
H−BRIDGE FLYBACK DIODES



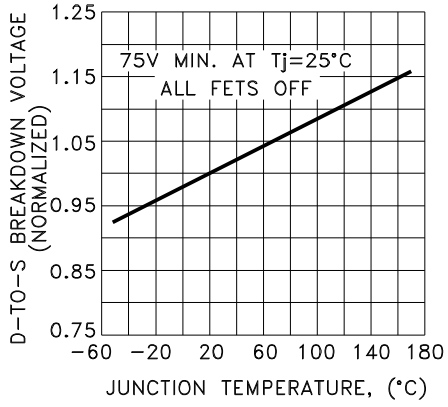
OUTPUT RESISTANCE DRIFT vs TEMP.



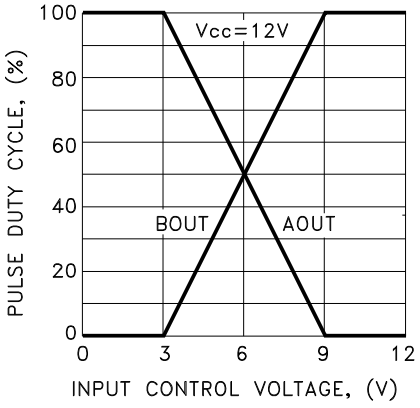
QUIESCENT CURRENT vs VOTLAGE



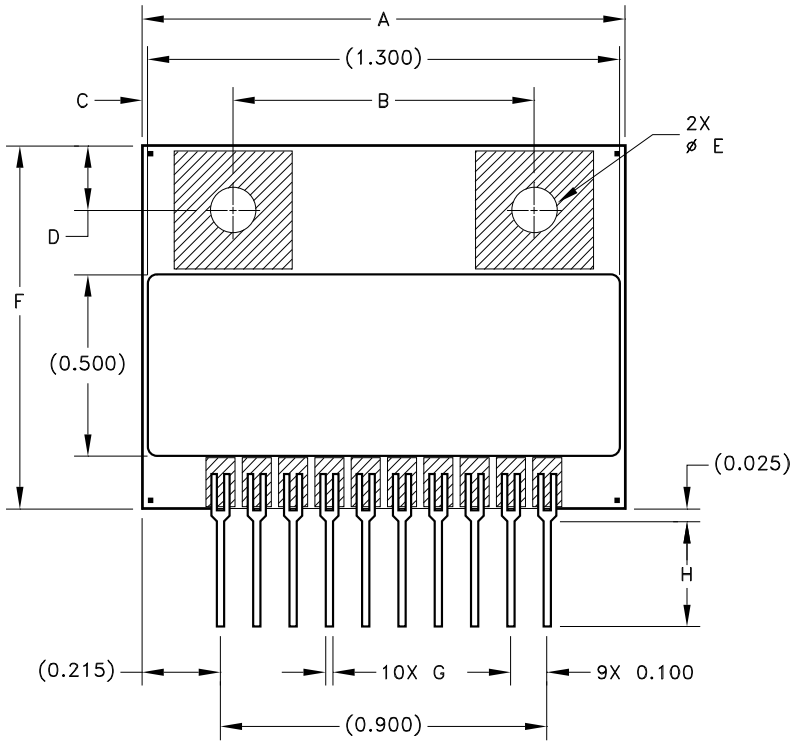
H−BRIDGE BREAKDOWN VOLTAGE vs TEMP.

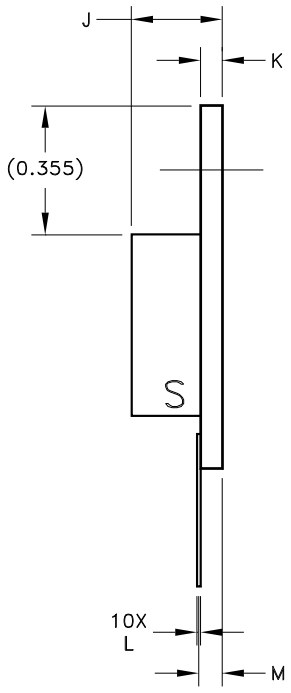


PULSE DUTY CYCLE vs INPUT

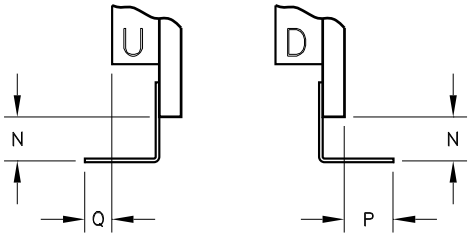


MECHANICAL SPECIFICATIONS





REF	MIN	MAX
A	1.320	1.340
B	0.825	0.835
C	0.245	0.255
D	0.1725	0.1825
E	0.120	0.130
F	0.990	1.010
G	0.015	0.025
H	0.275	———
J	———	0.260
K	0.057	0.063
L	0.008	0.012
M	0.058	0.072
N	0.115	0.135
P	0.175	———
Q	0.075	———



WEIGHT = 7.9 GRAMS TYPICAL
TORQUE SPECIFICATION 3-5 IN./LBS.
TEFLON SCREWS OR WASHERS ARE RECOMMENDED.

ALL DIMENSIONS ARE SPECIFIED IN INCHES

ORDERING INFORMATION

MSK4223 U

LEAD CONFIGURATIONS
S = STRAIGHT; U = BENT UP; D = BENT DOWN

GENERAL PART NUMBER

REVISION HISTORY

REV	STATUS	DATE	DESCRIPTION
J	Released	10/14	Format update, add internal note and clarify mechanical specifications.

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