100 VOLT 10 AMP RAD-HARD H-BRIDGE PWM MOTOR DRIVER/AMPLIFIER

4204RH

M.S.KENNEDY CORP.

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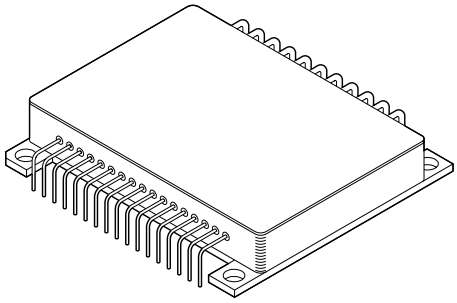
MIL-PRF-38534 CERTIFIED

FEATURES:

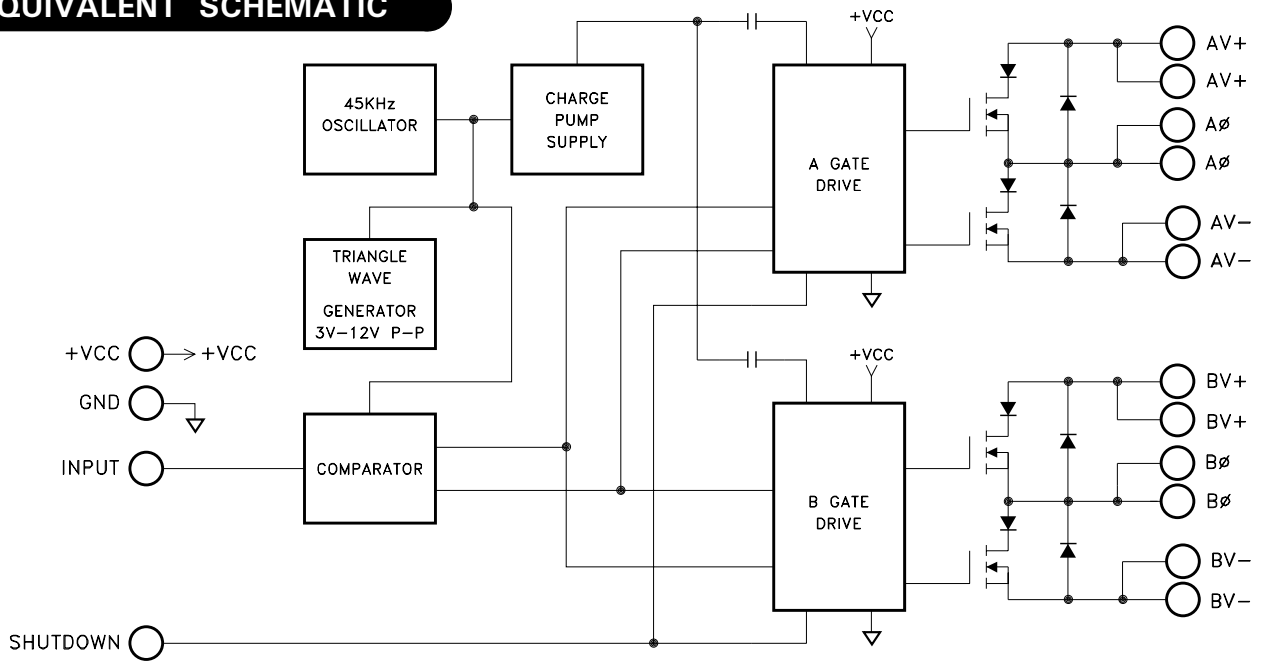
- 100 Volt, 10 Amp Capability
- Self-Contained Smart Lowside/Highside Drive Circuitry
- Internal PWM Generation, Shoot-through Protection
- Isolated Case Allows Direct Heatsinking
- Available Fully Screened To MIL-PRF-38534 Class K and Class H
- Total Dose Tested To 300K RAD
- Logic Level Shutdown Input
- Output Stage Includes Blocking Diodes



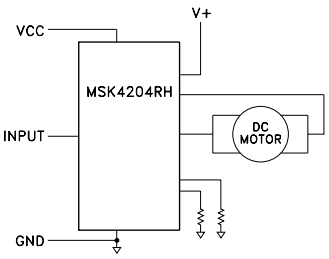
DESCRIPTION:

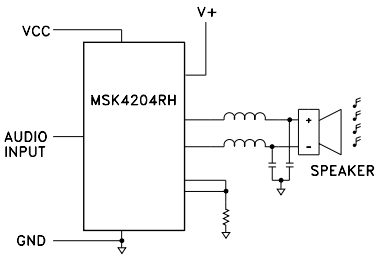
The MSK 4204RH is a radiation hardened complete H-Bridge microcircuit intended for use in DC brushed motor control applications or Class D switchmode amplification in space or other severe operating environments. The internal components have been selected to provide total dose up to 300K RAD for military and space applications. All of the drive/control circuitry for the lowside and highside switches are internal to the device. 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 MSK 4204RH is packaged in a space efficient isolated power package, available in three lead form configurations that can be directly connected to a heatsink.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS





PIN-OUT INFORMATION

1 TBD	8 TBD	15 TBD	22 TBD
2 TBD	9 TBD	16 TBD	23 TBD
3 TBD	10 TBD	17 TBD	24 TBD
4 TBD	11 TBD	18 TBD	25 TBD
5 TBD	12 TBD	19 TBD	26 TBD
6 TBD	13 TBD	20 TBD	27 TBD
7 TBD	14 TBD	21 TBD	28 TBD

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions ①	Subgroup Group A ④	MSK 4204RH ③ Min.	Typ.	Max.	Units
OUTPUT CHARACTERISTICS						
VDS(ON) Voltage (Diode plus MOSFET) ②	I_D = 10A	1	-	TBD	TBD	V
		2	-	TBD	TBD	V
		3	-	TBD	TBD	V
Instantaneous Forward Voltage ②	I_S = 10A	1	-	TBD	TBD	V
		2	-	TBD	TBD	V
		3	-	TBD	TBD	V
RDS (ON) each mosfet ② ⑥	ID = 10A TC = 25°C	-	-	0.06	0.1	Ω
Leakage Current, Each MOSFET ②	V+ = 100V	1	-	25	200	uA
		2	-	100	800	uA
		3	-	25	200	uA
PWM Frequency		4,5,6	40	45	50	KHz
Vcc SUPPLY CHARACTERISTICS						
Quiescent Current	V_{IN} = 7.5V	1,2,3	-	TBD	TBD	mA
OUTPUT DUTY CYCLE						
	V_{IN} = 7.5V Both Outputs Tested	4,5,6	40	50	60	%
	V_{IN} = 15V Output A = 100% Duty Cycle High, Output B = 0% Duty Cycle Low	7	-	Verify	-	P/F
	V_{IN} = OV Output A = 0% Duty Cycle Low, Output B = 100% Duty Cycle High	7	-	Verify	-	P/F
SWITCHING CHARACTERISTICS						
Rise-Time	R_L = 1K A to B	4	-	20	100	nS
Fall-Time	R_L = 1K A to B	4	-	20	100	nS
Dead-Time	R_L = 50Ω A upper to A lower	4	-	TBD	TBD	nS
	R_L = 50Ω B upper to B lower	4		TBD	TBD	nS
LOGIC CONTROL INPUTS						
Shutdown Input	Input Voltage LO	1,2,3	-	-	0.8	V
	Input Voltage HI	1,2,3	2.0	-	-	V
	Input Current (High or Low)	1,2,3	-	±100	±250	uA

NOTES:

① V_{CC} = 15V, V+ = 28V, R_{SENSE} A,B = Ground, Shutdown = OV unless otherwise specified.
② Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
③ Devices shall be 100% tested to subgroups 1,2,3,4, and 7. Subgroup 5 and 6 testing available upon request.
④ Subgroup 1,4,7 $T_A = T_C$ = +25°C
2,5 $T_A = T_C$ = +125°C
3,6 $T_A = T_C$ = -55°C
⑤ Industrial grade and "E" suffix devices shall be 100% tested at 25°C only.
⑥ The internal on resistance is for the die only. This should be used for thermal calculations only.
⑦ Consult factory for post radiation limits.

ABSOLUTE MAXIMUM RATINGS ①

V+	High Voltage Supply	100V
V_{CC}	Logic Supply	16.5V
I_{OUT}	Continuous Output Current	10A
I_{PK}	Peak Output Current	23A
V_{OUT}	Output Voltage Range	GND-5V min. to V+ max.
V_{IN}	Input Voltage	Vcc
V_L	Logic Input Voltage (Shutdown)	OV to V_{CC}

T_{ST}	Storage Temperature Range	-65°C to +150°C
T_{LD}	Lead Temperature Range (10 Seconds)	300°C
T_C	Case Operating Temperature	-55°C to +125°C
T_J	Junction Temperature	+175°C
θJc	Thermal Resistance (Output FETS @ 125°C)	3.5°C/W
	(Ouput Diodes @ 125°C)	TBD°C/W

NOTE:

① Continuous operation at or above absolute maximum ratings may adversly effect the device performance and/or life cycle.

APPLICATION NOTES

MSK 4204RH 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. Optimum operation occurs with V_{CC} set at 15V.

AV+, BV+ - Are the high voltage H-bridge supply pins. The MOSFETS obtain the drive current from these supply pins. The voltage 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 ensure removal of any drooping during switching, should be done as close to the pins on the hybrid as possible.

AØ - Are the output pins for one half of the bridge. Increasing the input voltage causes increasing duty cycles at this output.

BØ - Are the output pins for the other half of the bridge. Decreasing the input voltage causes increasing duty cycles at this output.

AV- - Are the connections 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 these pins is ±5 volts with respect to GND.

BV- - Are the connections 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 these pins is ±5 volts with respect to GND.

GND - Is the return connection for the input logic and Vcc.

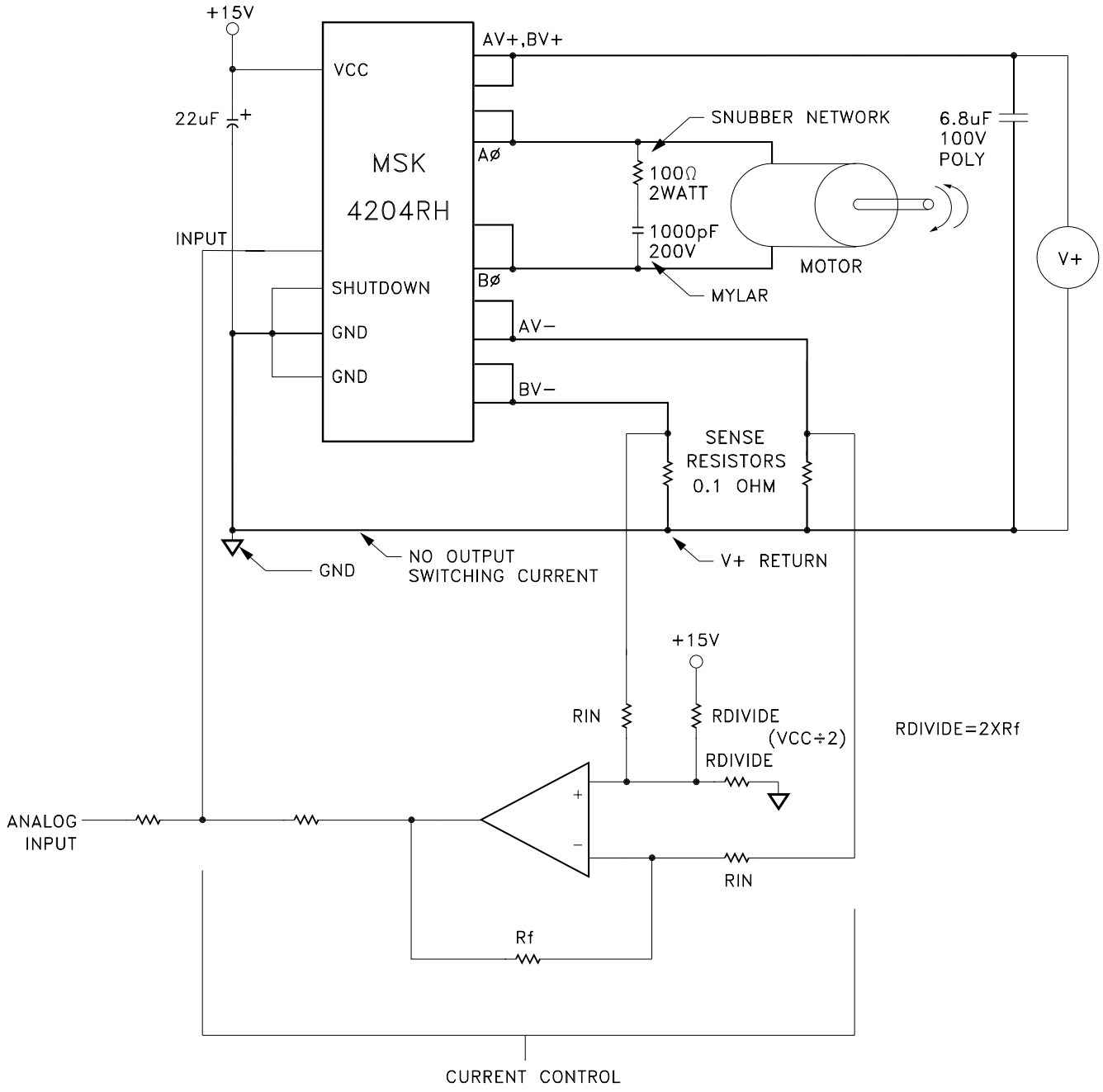
INPUT - Is an analog input for controlling the PWM pulse width of the bridge. A voltage higher than 7.5V will produce greater than 50% duty cycle pulses out of OUTPUT A. A voltage lower than 7.5V will produce greater than 50% duty cycle pulses out of OUTPUT B.

SHUTDOWN - Is the connection for disabling all 4 output switches. SHUTDOWN high overrides all other inputs. When taken low, everything functions normally. An internal pullup to Vcc will keep SHUTDOWN high if left unconnected. This pin should be grounded if not used.

RADIATION PERFORMANCE CURVES

TBD

TYPICAL SYSTEM OPERATION

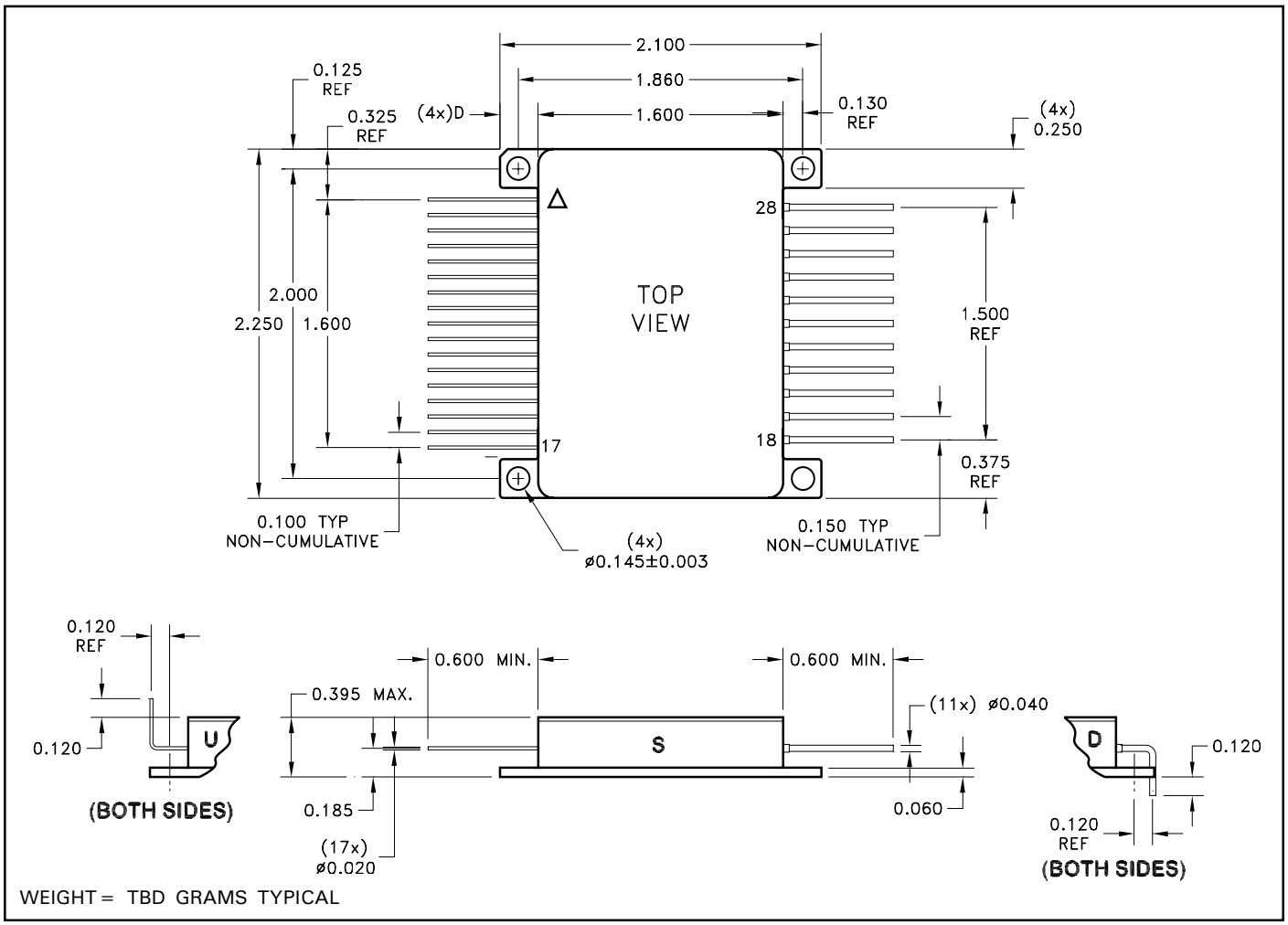


This is a diagram of a typical application of the MSK 4204RH. The design Vcc voltage is +15 volts and should have a good low ESR bypass capacitor such as a tantalum. The analog input can be an analog speed control voltage from a potentiometer, other analog circuitry or by microprocessor and a D/A converter. 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 hybrid 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 capacitor as close to hybrid 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 100V and negative spikes below -4V with respect to GROUND.

MECHANICAL SPECIFICATIONS



ESD Triangle indicates Pin 1.
ALL DIMENSIONS ARE ±0.01 INCHES UNLESS OTHERWISE LABELED

ORDERING INFORMATION

MSK4204 H RH U

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

RADIATION HARDENED

SCREENING
BLANK = INDUSTRIAL; E = EXTENDED RELIABILITY
H = MIL-PRF-38534 CLASS H; K = MIL-PRF-38534 CLASS K

GENERAL PART NUMBER

The above example is a Military grade class H hybrid with leads bent up.

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