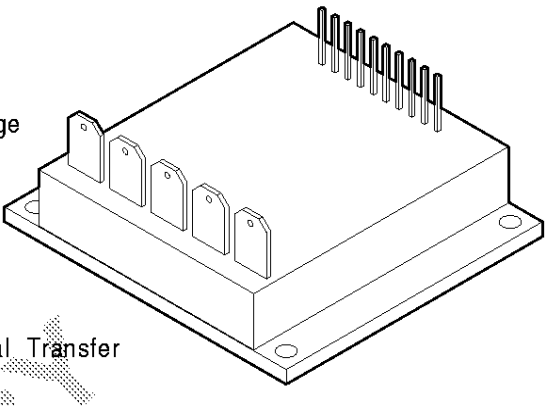
MSK 4401

M.S.KENNEDY CORP.

29 AMP, 80V, 3 PHASE MOSFET BRIDGE WITH INTELLIGENT INTEGRATED GATE DRIVE

8170 Thompson Road Cicero, N.Y. 13039 (315) 699-9201



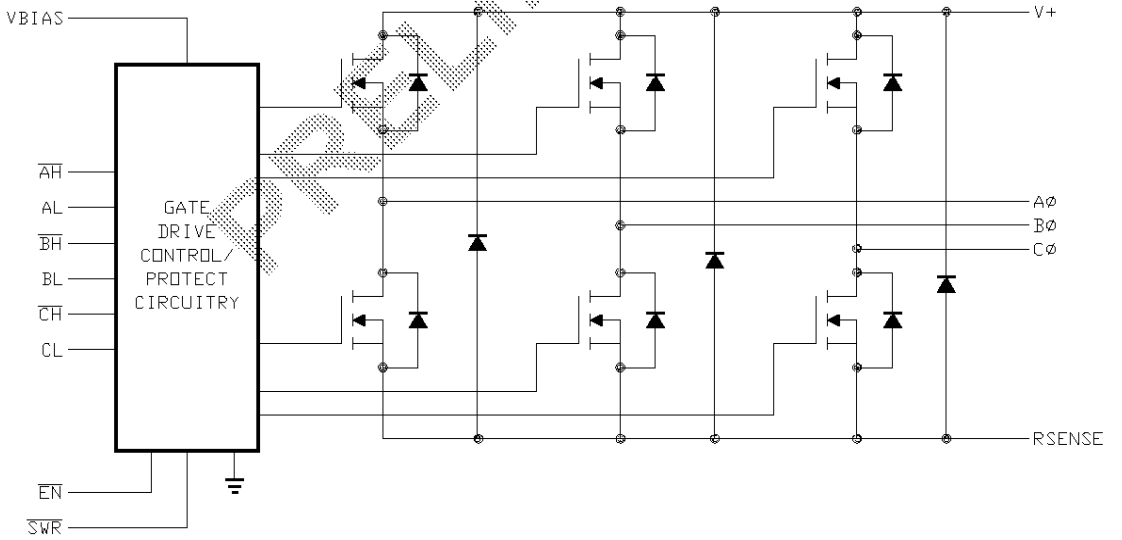
FEATURES:

- 80 Volt Motor Supply Voltage
- 29 Amp Output Switch Capability, All N-Channel MOSFET Output Bridge
- 100% Duty Cycle High Side Conduction Capable
- Suitable for PWM Applications from DC to 100KHz
- Shoot-Through/Cross Conduction Protection
- Undervoltage Lockout Protection
- Programmable Dead-Time Control
- Low Active Enable for Bridge Shutdown Control
- Isolated Base Plate Design for High Voltage Isolation Plus Good Thermal Transfer

DESCRIPTION:

The MSK 4401 is a 3 phase MOSFET bridge plus drivers in a convenient isolated baseplate package. The module is capable of 29 amps of output current and 80 volts of DC bus voltage. It has a full line of protection features, including undervoltage lockout protection of the bias voltage, cross conduction control and a user programmable dead-time control for shoot-through elimination. In addition, the bridge may shut down by using the $\overline{\text{ENABLE}}$ control. The MSK 4401 provides good thermal conductivity for the MOSFETs due to isolated plate design that allows direct heat sinking of the device without insulators.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS

- 3 Phase Brushless DC
  - Servo Control
  - Fin Actuator Control
  - Gimbal Control
- 3 Phase AC
  - Induction Motor Control
  - HVAC Blower Control

PIN-OUT INFORMATION

1 CØ	15 $\overline{CH}$
2 AØ	14 CL
3 V +	13 $\overline{EN}$
4 BØ	12 $\overline{SWR}$
5 Rsense	11 GND
	10 $\overline{AH}$
	9 AL
	8 $\overline{BL}$
	7 $\overline{BH}$
	6 Vbias

ABSOLUTE MAXIMUM RATINGS

$V+$	High Voltage Supply	θ_{JC}	Thermal Resistance 0.8°C/W
V_{BIAS}	Bias Supply 16V	T_{ST}	Storage Temperature Range -25°C to +150°C
V_{IND}	Logic Input Voltages -0.3V to V_{BIAS} +0.3V	T_{LD}	Lead Temperature Range (10 Seconds) +300°C
I_{OUT}	Continuous Output Current 29A	T_C	Case Operating Temperature -25°C to +125°C
I_{PK}	Peak Output Current 41A	T_J	Junction Temperature +150°C

ELECTRICAL SPECIFICATIONS

Parameter	Test Conditions	MSK 4401 Min.	MSK 4401 Typ.	MSK 4401 Max.	Units
CONTROL SECTION					
V_{BIAS} Quiescent Current	All Inputs Off	5	6	7	mAmp
V_{BIAS} Operating Current	f=20KHz, 50% Duty Cycle	9	11	13	mAmp
Undervoltage Threshold (Falling)		5.75	6.6	7.5	Volts
Undervoltage Threshold (Rising)		6.2	7.1	8.0	Volts
Low Level Input Voltage		-	-	0.8	Volts
High Level Input Voltage		2.7	-	-	Volts
Low Level Input Current	V_{IN}=0V	60	100	135	µAmp
High Level Input Current	V_{IN}=5V	-1	-	+1	µAmp
OUTPUT BRIDGE					
Drain-Source Breakdown Voltage	I_D=100µA, All Inputs Off	60	-	-	V
Drain-Source Leakage Current	V_{DS}=60V	-	-	10	µAmp
Drain-Source On Resistance	I_D=29A	-	-	0.055	Ω
SWITCHING CHARACTERISTICS					
Turn-On Delay Time	V+=29V, R_L=1Ω, I_D=29A	-	500	-	nSec
Rise Time		-	15	-	nSec
Turn-Off Delay Time		-	500	-	nSec
Fall Time		-	20	-	nSec
Enable Turn-On Prop Delay (Lower)		-	100	-	µSec
Enable Turn-Off Prop Delay (Lower)		-	100	-	µSec
Enable Turn-On Prop Delay (Upper)	$\overline{SWR}$ Resistor=∞	-	2	-	µSec
Enable Turn-Off Prop Delay (Upper)	$\overline{SWR}$ Resistor=∞	-	2	-	µSec
Dead Time	$\overline{SWR}$=Open	6.0	7.0	8.0	µSec
Dead Time	$\overline{SWR}$=12K	0.3	0.5	0.7	µSec
SOURCE-DRAIN DIODE CHARACTERISTICS					
Forward Voltage	I_{SD}=29A	-	2.5	-	Volts
Reverse Recovery Time	I_{SD}=10A, di/dt=100A/µS	-	220	330	nSec

APPLICATION NOTES

MSK 4210 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 on the hybrid as possible.

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

OUTPUT B - Is the output pin for the other half of the bridge. Decreasing 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 higher than Vcc/2 will produce greater than 50% duty cycle pulses out of OUTPUT A. A voltage lower 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 MSK 4210. 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 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.

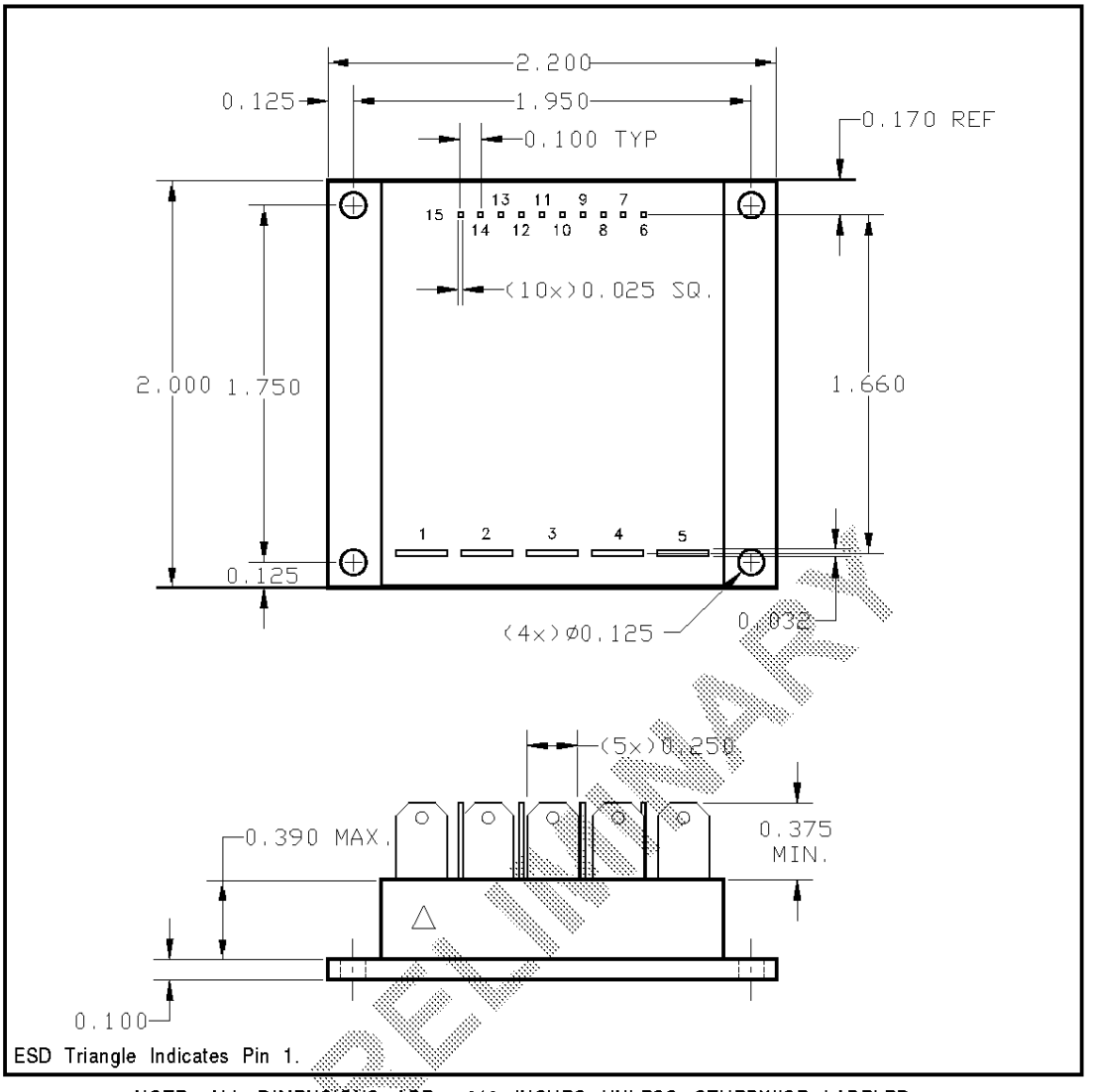
A snubber network is usually required, due to the inductance in the power loop. It is important to design the snubber network to suppress any positive spikes above 80V and negative spikes below -2V with respect to ground.

TYPICAL PERFORMANCE CURVES

NOTES:

① Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
② Vcc=+12V unless otherwise specified.

MECHANICAL SPECIFICATIONS



NOTE: ALL DIMENSIONS ARE ±.010 INCHES UNLESS OTHERWISE LABELED.

ORDERING INFORMATION

Part Number	Screening Level
MSK4401	Industrial

M.S. Kennedy Corp.
8170 Thompson Rd., Cicero, New York 13039-9393
Tel. (315) 699-9201
FAX (315) 699-8023