



M.S.KENNEDY CORP.

**20 AMP, 200 VOLT MOSFET
SMART POWER 3-PHASE
MOTOR DRIVE HYBRID**

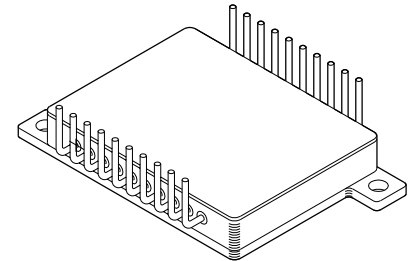
4322

4707 Dey Road Liverpool, N.Y. 13088

(315) 701-6751

FEATURES:

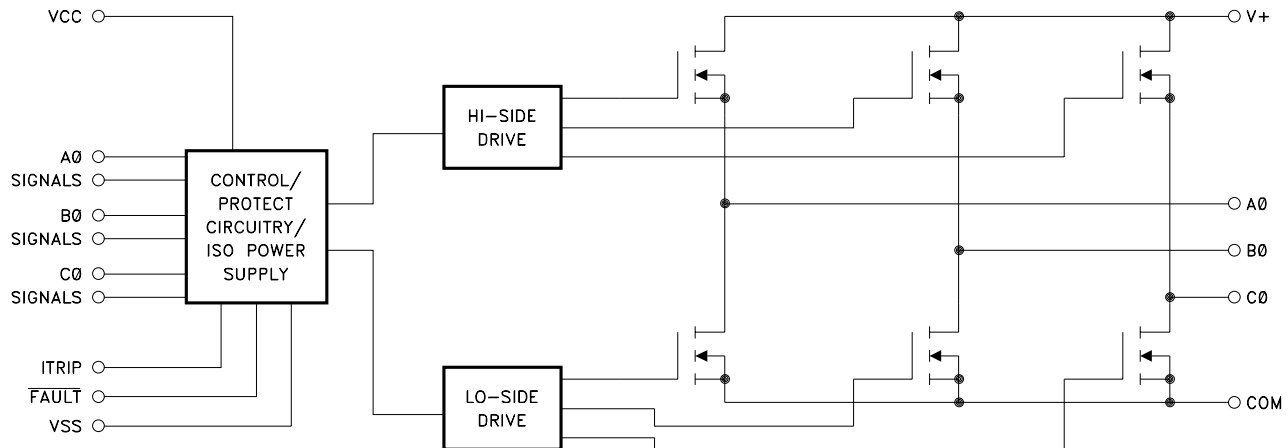
- 200V, 20 Amp Capability
- Ultra Low Thermal Resistance - Junction to Case - 0.6° C/W (Each MOSFET)
- Self-Contained, Smart Lowside/Highside Drive Circuitry
- Under-Voltage Lockout, Internal 2µS Deadtime
- Capable of Switching Frequencies to 25KHz
- Isolated Case Allows Direct Heat Sinking
- Case Bolt-down Design Allows Superior Heat Dissipation
- Contact MSK for MIL-PRF-38534 Qualification Status



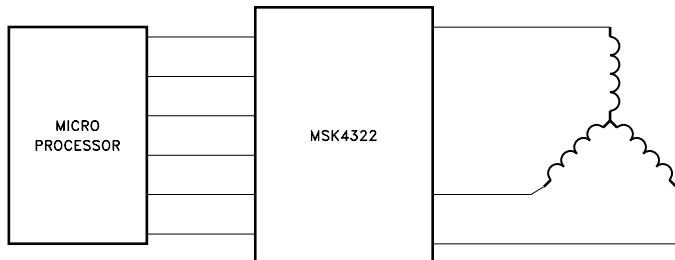
DESCRIPTION:

The MSK 4322 is a 20 Amp, 3 Phase Bridge Smart Power Motor Drive Hybrid with a 200 volt rating on the output switches. The output switches are power MOSFETs with intrinsic fast-recovery diodes for the free-wheeling currents of motor drives. This new smart power motor drive hybrid is compatible with 5V CMOS or TTL logic levels. The internal circuitry prevents simultaneous turn-on of the in-line half bridge transistors with a built-in 2µS deadtime to prevent shoot-through. Undervoltage lockout shuts down the bridge when the supply voltage gets to a point of incomplete turn-on of the output switches. The internal high-side boot strap power supply derived from the +15 volt supply completely eliminates the need for 3 floating independent power supplies for the high-side drive. Current sense circuitry is provided to sense current from an external resistor to shut down the bridge for overcurrent.

EQUIVALENT SCHEMATIC



TYPICAL APPLICATIONS



**3 PHASE SIX STEP DC BRUSHLESS MOTOR DRIVE
OR 3 PHASE SINUSOIDAL INDUCTION MOTOR DRIVE**

PIN-OUT INFORMATION

1	VCC	20	N/C
2	AØHIN	19	AØ
3	BØHIN	18	V+
4	CØHIN	17	N/C
5	AØLIN	16	N/C
6	FAULT	15	BØ
7	CØLIN	14	N/C
8	BØLIN	13	N/C
9	VSS	12	CØ
10	ITRIP	11	COM

ABSOLUTE MAXIMUM RATINGS ^⑥

V+	High Voltage Supply ^⑦	200V	TsT	Storage Temperature Range	-65° to +150° C
VCC	Logic Supply	18V	TLD	Lead Temperature Range (10 Seconds)	300° C
IOUT	Continuous Output Current	20A	TC	Case Operating Temperature	MSK 4322 -40° C to +85° C MSK 4322H/E -55° C to +125° C
IPK	Peak Output Current	44A	TJ	Junction Temperature	+150° C
θJC	Thermal Resistance (Output Switches) (Junction to Case @ 125° C)	0.6° C/W			

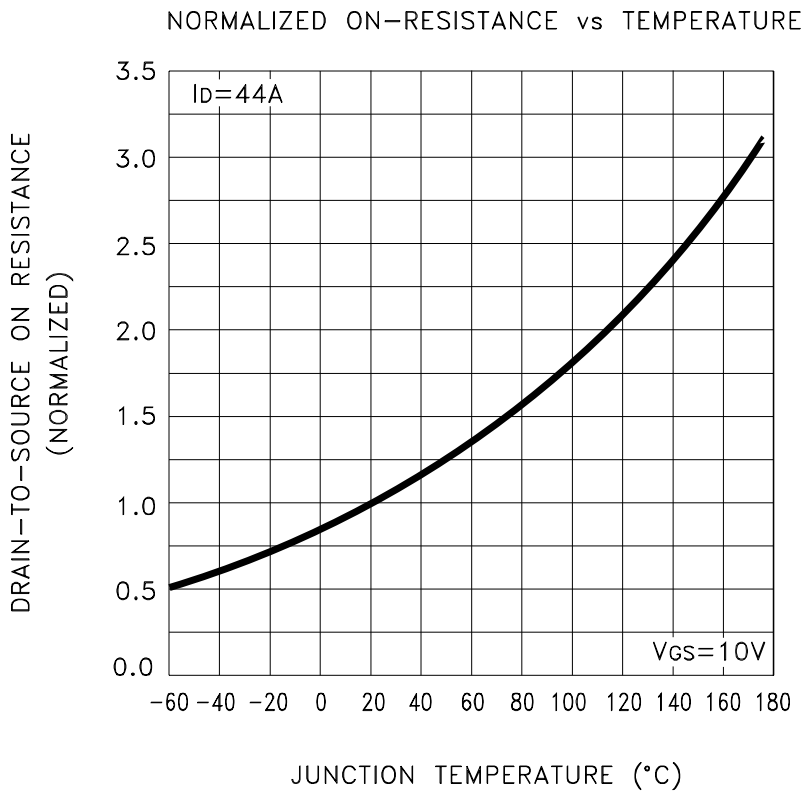
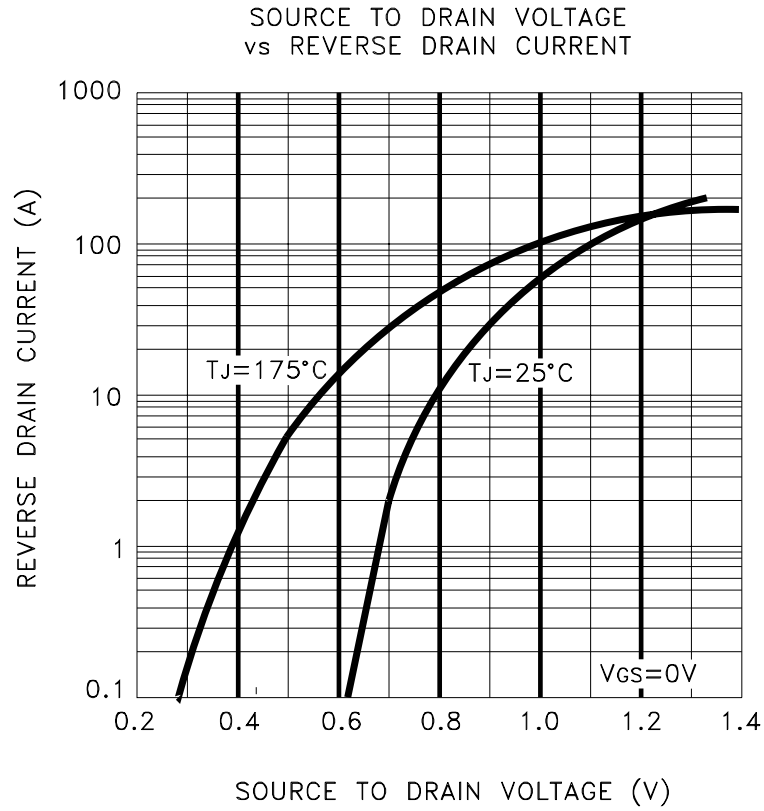
ELECTRICAL SPECIFICATIONS

Parameters	Test Conditions	GROUP A SUBGROUP ⑤	MSK 4322H/E ③			MSK 4322 ②			UNITS
			Min.	Typ.	Max.	Min.	Typ.	Max.	
OUTPUT CHARACTERISTICS									
V _{DS(ON)} (Each Transistor)	I _D = 20A	1	-	1.2	1.4	-	1.2	1.5	V
		2	-	2.3	3.5	-	-	-	V
		3	-	0.7	1.0	-	-	-	V
Instantaneous Forward Voltage (Intrinsic Diode)	I _S = 20A	1	-	1.0	1.4	-	1.0	1.5	V
		2	-	0.9	1.4	-	-	-	V
		3	-	1.2	1.5	-	-	-	V
Reverse Recovery Time ①		-	-	-	330	-	-	330	nS
Leakage Current	V ₊ = 200V	1	-	3	250	-	3	250	μA
	V ₊ = 160V	2	-	-	250	-	-	-	μA
BIAS SUPPLY CHARACTERISTICS									
Quiescent Bias Current	VCC = 15V (non-switching)	1	-	3	6	-	3	6	mA
		2	-	4.5	8	-	-	-	mA
		3	-	3	6	-	-	-	mA
INPUT SIGNAL CHARACTERISTICS									
Positive Trigger Threshold Voltage	VCC = 15V	-	2.2	-	-	2.2	-	-	V
Negative Trigger Threshold Voltage	VCC = 15V	-	-	-	0.8	-	-	0.8	V
I. Trip Threshold Voltage	VCC = 15V	1,2,3	400	500	600	400	500	600	mV
SWITCHING CHARACTERISTICS ①									
Upper Drive: V ₊ = 100V, VCC = 15V, I _D = 20A									
Turn-On Propagation Delay		-	-	0.98	1.5	-	0.98	1.5	μS
Turn-Off Propagation Delay		-	-	2.4	3.5	-	2.4	3.5	μS
Turn-On		-	-	330	375	-	330	375	nS
Turn-Off		-	-	440	475	-	440	475	nS
Lower Drive: V ₊ = 100V, VCC = 15V, I _D = 20A									
Turn-On Propagation Delay		-	-	0.9	1.5	-	0.9	1.5	μS
Turn-Off Propagation Delay		-	-	2.0	3.5	-	2.0	3.5	μS
Turn-On		-	-	140	175	-	140	175	nS
Turn-Off		-	-	215	250	-	215	250	nS
Dead Time ①		-	-	2	-	-	2	-	μS
Minimum Pulse Width ①		-	-	300	-	-	300	-	nS

NOTES:

- ① Guaranteed by design but not tested. Typical parameters are representative of actual device performance but are for reference only.
- ② Industrial grade and "E" suffix devices shall be tested to subgroups 1 and 4 unless otherwise specified.
- ③ Military grade devices ("H" suffix) shall be 100% tested to subgroups 1, 2, 3 and 4.
- ④ Subgroups 5 and 6 testing available upon request.
- ⑤ Subgroup
1, 4 TA = TC = +25° C
2, 5 TA = TC = +125° C
3, 6 TA = TC = -55° C
- ⑥ Continuous operation at or above absolute maximum ratings may adversely effect the device performance and/or life cycle.
- ⑦ 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.

TYPICAL PERFORMANCE CURVES



APPLICATION NOTES

MSK 4322 PIN DESCRIPTION

VCC - Is the low voltage supply for all the internal logic and drivers. A 0.1 μF ceramic capacitor in parallel with a 10 μF tantalum capacitor is recommended bypassing for the VCC-VSS pins.

VSS - Is the low voltage supply return pin and the input logic return reference. All logic input and logic output is referenced to this pin. This pin can vary $\pm 5\text{V}$ from the COM power return pin without affecting any of the logic functions.

AØHIN, BØHIN, CØHIN - Are low active logic inputs for signalling the corresponding phase high-side switch to turn on. The input levels are 5V **CMOS** or **TTL** compatible.

AØLIN, BØLIN, CØLIN - Are low active inputs for signalling the corresponding phase low-side switch to turn on. The input levels are 5V **CMOS** or **TTL** compatible.

FAULT - Is an open drain logic output pin that gets enabled any time the **VCC** level goes below the cutoff point, or an overcurrent condition occurs. Bringing **VCC** back to normal levels will reset **FAULT**. Removing the overcurrent condition and allowing the low-side logic inputs to remain high(off) for 10 μS will restore operation.

ITRIP - Is an analog input pin for sensing current flowing from the **COM** pin through a sense resistor to the high power ground. A 0.5 volt level at this pin with respect to **VSS** will signal an overcurrent condition, enable the **FAULT** pin and shut down all output switching. Bringing the voltage below this point (100 mV hysteresis) will remove the **FAULT** output and leaving the low-side logic inputs simultaneously high (de-activated) for 10 μS will restore normal operation.

V+ - Is the high voltage positive rail for the bridge. Proper bypassing to **VSS** 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.

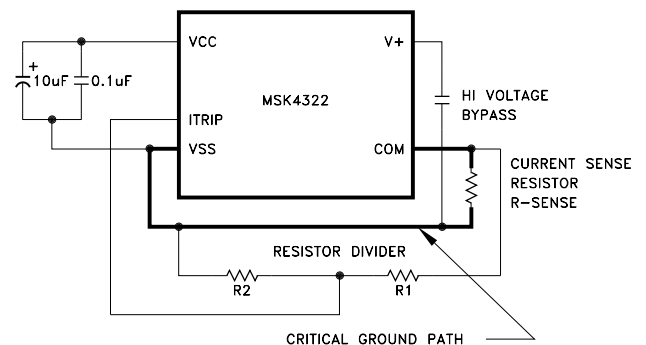
COM - Is the return side of the bridge. A sense resistor can be connected between this point and **VSS**, which is the high voltage negative rail. **COM** can float above and below the **VSS** pin up to 5 volts and proper operation will be maintained. Precautions should be taken so as to not allow this voltage to get over ± 5 volts under any conditions.

AØ, BØ, CØ - Are the pins connecting the 3 phase bridge switch outputs.

PROTECTION

- All logic inputs use a 300nS filter. A pulse width below this will get ignored.
- **VCC** voltage below the cutoff level of 8.65 volts will reset all switch outputs off and ignore subsequent logic inputs until **VCC** is restored.
- Undervoltage lockout of the internal drivers for the high-side switches also occurs at 8.65 volts, but will not flag with the **FAULT** output. This may occur if the high-side output gets switched without switching the low-side. The internal boot strap power supply for the high-side switch will sag too low for adequate switching. The boot strap supply depends on PWMing of the low-side switches for proper operation.
- Switching a low-side logic input while the corresponding phase high-side logic input is activated will turn off both switches. The opposite condition is also true. This is cross-conduction lockout and will occur any time low and high-side inputs for a phase are activated at the same time.
- A 2 μS deadtime is automatically inserted between high and low-side output switching to allow complete turn-off of each switch so no overlap will occur.
- An overcurrent condition detected by the **ITRIP** pin will shut down all output switches until the overcurrent condition is removed and all three low-side logic inputs are held high for 10 μS , then normal operation will resume.
- **ITRIP** has a 100nS leading edge blanking time after switching to ignore any switching current transients.

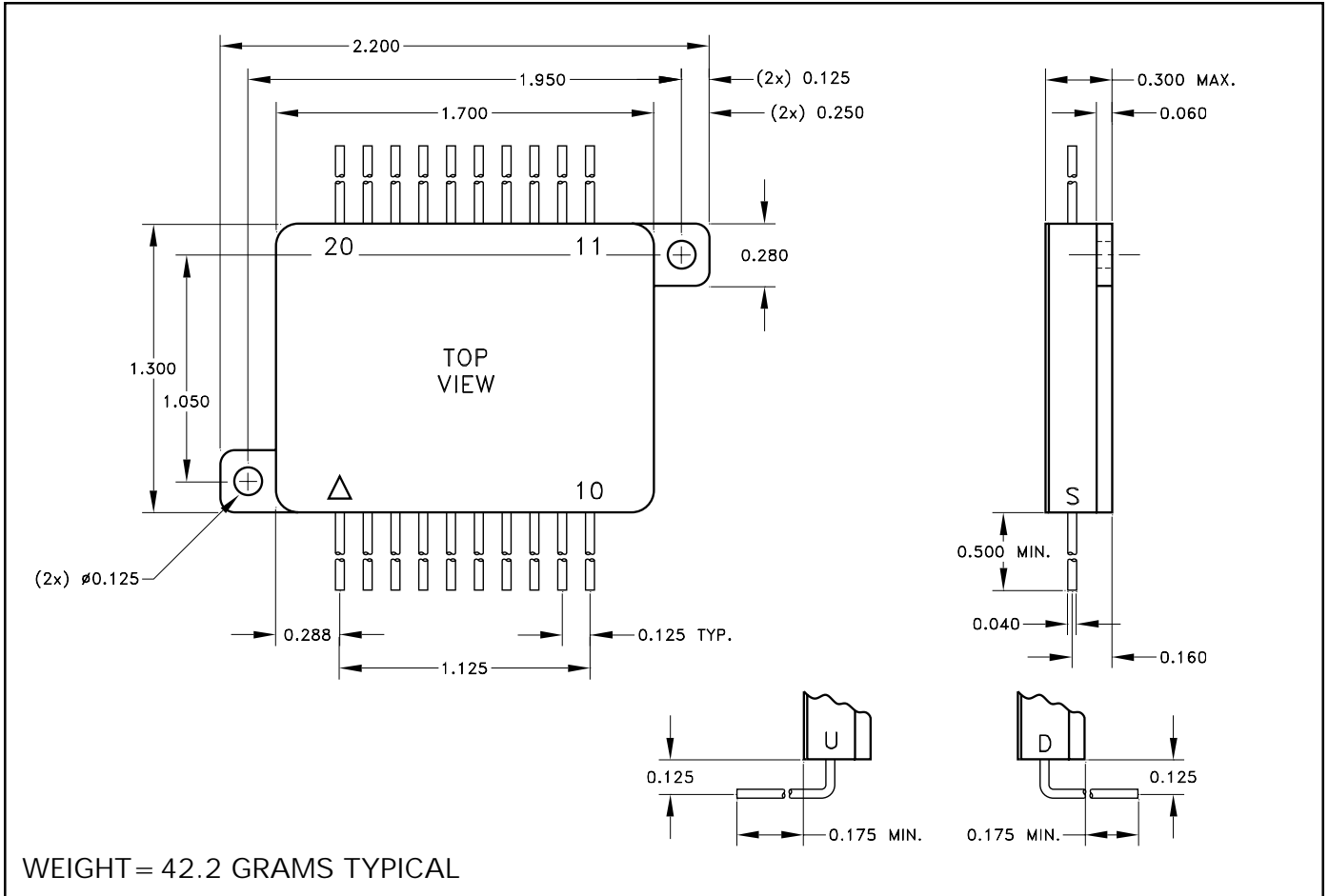
TYPICAL OPERATION



EXAMPLE:
 FOR 20 AMP LIMIT:
 R-SENSE = 0.050 OHMS
 R-SENSE VOLT = 1 VOLT
 R1 = 51.5 OHMS
 R2 = 48.5 OHMS

FIGURE 1. GROUNDING, BYPASSING, CURRENT SENSE

MECHANICAL SPECIFICATIONS



All dimensions are ± 0.01 inches unless otherwise specified.

ESD Triangle Indicates Pin 1

ORDERING INFORMATION

MSK4322 H U

LEAD CONFIGURATIONS

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

SCREENING

BLANK = INDUSTRIAL; E = EXTENDED RELIABILITY;

H = MIL-PRF-38534

GENERAL PART NUMBER

M.S. Kennedy Corp.
 4707 Dey Road, Liverpool, New York 13088
 Phone (315) 701-6751
 FAX (315) 701-6752
www.mskennedy.com

The information contained herein is believed to be accurate at the time of printing. MSK reserves the right to make changes to its products or specifications without notice, however and assumes no liability for the use of its products.

Please visit our website for the most recent revision of this datasheet.

Contact MSK for MIL-PRF-38534 qualification status.