

### P-Channel 40-V (D-S) MOSFET

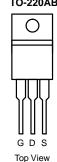
PRODUC	CT SUMMARY					
V <sub>DS</sub> (V)	r <sub>DS(on)</sub> (Ω)	I <sub>D</sub> (A) <sup>a</sup>	Q <sub>g</sub> (Typ.)			
- 40	0.0041 at V <sub>GS</sub> = - 10 V	- 110	185 nC			

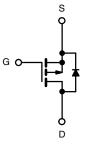
## TO-220AB Ο GΟ S Top View

### **FEATURES**

• TrenchFET<sup>®</sup> Power MOSFET







P-Channel MOSFET

Parameter	Symbol	Limit	Unit		
Drain-Source Voltage	V <sub>DS</sub>	- 40	V		
Gate-Source Voltage		V <sub>GS</sub>	± 20	v	
	T <sub>C</sub> = 25 °C		- 110 <sup>a</sup>		
Continuous Drain Current (T 175 °C)	T <sub>C</sub> = 70 °C		- 110 <sup>a</sup>		
Continuous Drain Current ( $T_J = 175 \ ^\circ C$ )	T <sub>A</sub> = 25 °C	I <sub>D</sub>	39 <sup>b, c</sup>		
	T <sub>A</sub> = 70 °C		33 <sup>b, c</sup>	A	
Pulsed Drain Current		I <sub>DM</sub>	240	A	
Continuous Courses Drain Diada Current	T <sub>C</sub> = 25 °C		110		
Continuous Source-Drain Diode Current	T <sub>A</sub> = 25 °C	I <sub>S</sub>	10 <sup>b, c</sup>		
Avalanche Current		I <sub>AS</sub>	75		
Single-Pulse Avalanche Energy	L = 0.1 mH	E <sub>AS</sub>	281	mJ	
	T <sub>C</sub> = 25 °C		375		
Maximum Dawar Dissinction	T <sub>C</sub> = 70 °C	PD	262	w	
Maximum Power Dissipation	T <sub>A</sub> = 25 °C	ГD	15 <sup>b, c</sup>	vv	
	T <sub>A</sub> = 70 °C		10.5 <sup>b, c</sup>		
Operating Junction and Storage Temperature Range		T <sub>J</sub> , T <sub>stg</sub>	- 55 to 175	°C	
Soldering Recommendations (Peak Temperature		260			

THERMAL RESISTANCE RATINGS						
Parameter		Symbol	Typical	Maximum	Unit	
Maximum Junction-to-Ambient <sup>b, d</sup>	t ≤ 10 s	R <sub>thJA</sub>	8	10	°C/W	
Maximum Junction-to-Case (Drain)	Steady State	R <sub>thJC</sub>	0.33	0.4	0/22	

Notes:

a. Package limited.b. Surface Mounted on 1" x 1" FR4 board.

d. Maximum under Steady State conditions is 40 °C/W.

$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	SPECIFICATIONS T <sub>J</sub> = 25 °C, u	nless other	wise noted					
$\begin{array}{ c c c c c } \hline Drain-Source Breakdown Voltage & V_{DS} & V_{GS} = 0 \ V, \ I_D = -250 \ \mu A & -40 & & & \\ \hline V_{DS} \ Temperature Coefficient & \Delta V_{DS}/T_J & & & I_D = -250 \ \mu A & -5.5 & & & \\ \hline V_{DS} \ Temperature Coefficient & \Delta V_{DS}/T_J & & & & I_D = -250 \ \mu A & -2 & -3 & -4 & \\ \hline Cate-Source Threshold Voltage & V_{GS}(h) & V_{DS} = V_{GS}, \ I_D = -250 \ \mu A & -2 & -3 & -4 & \\ \hline Cate-Source Leakage & I_{GSS} & V_{DS} = 0 \ V, \ V_{DS} = \pm 20 \ V & & & \pm 100 & \\ \hline V_{DS} = -40 \ V, \ V_{GS} = \pm 20 \ V & & & & \pm 100 & \\ \hline V_{DS} = -40 \ V, \ V_{GS} = \pm 0 \ V & V_{CS} = 0 \ V & V_{CS} = -10 \ V & V_{DS} = -40 \ V, \ V_{CS} = 0 \ V & V_{CS} = -10 \ V & -12 & & \\ \hline On-State Drain Current^a & I_{D(on)} & V_{DS} = 5 \ V, \ V_{GS} = -10 \ V & I_D = -20 \ A & 75 & & \\ \hline Drain-Source On-State Resistance^a \ r_{DS(on)} & V_{DS} = -25 \ V, \ V_{GS} = 0 \ V, \ I_D = -20 \ A & 75 & & \\ \hline Drain-Source On-State Resistance \ C_{ISS} & & \\ \hline Duptatic^b & & & \\ \hline Duptatic Capacitance \ C_{ISS} & & \\ \hline Total Gate Charge \ Q_{gd} & & \\ \hline Total Gate Charge \ Q_{gd} & & \\ \hline Cate-Source Charge \ Q_{gd} & & \\ \hline Cate-Source Charge \ Q_{gd} & & \\ \hline Cate-Source Charge \ Q_{gd} & & \\ \hline Turn-On Delay Time \ I_{d(on)} & \\ \hline Reserver Tankfer Capacitance \ R_g & f = 1 \ MHz \ M_DS = -10 \ V, \ I_D = -110 \ A & 48 & \\ \hline Cate-Darin Charge \ Q_{gd} & & \\ \hline Turn-On Delay Time \ I_{d(on)} & \\ \hline Rise Time \ I_{t} & \\ \hline U_{DD} = -20 \ V, \ R_{L} = 0.18 \ \Omega & \\ \hline D_{D} = -10 \ V, \ R_{g} = 1 \ MHz \ A.0 & \\ \hline U_{DD} = -20 \ V, \ R_{L} = 0.18 \ \Omega & \\ \hline D_{D} = -110 \ A, \ V_{DD} = -20 \ V, \ R_{g} = -10 \ V, \ R_{g} = 1 \ MHz \ A.0 & \\ \hline U_{DD} = -20 \ V, \ R_{g} = -10 \ V, \ R_{g} = 10 \ M & \\ \hline D_{D} = -110 \ A, \ V_{DD} = -20 \ V, \ R_{g} = -10 \ V, \ R_{g} = 1 \ M & \\ \hline D_{D} = -100 \ R_{g} \ S \ S \ S \ S \ S \ S \ S \ S \ S \ $	Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Unit	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Static							
$ \begin{array}{ c c c c c } \hline V_{GS(th)} \mbox{ trans} \mbox{ trans} \\ \hline V_{GS(th)} \mbox{ trans} \\ \hline V_{DS} = V_{GS}, \mbox{ trans} \\ \hline V_{DS} = V_{GS}, \mbox{ trans} \\ \hline V_{DS} = V_{GS}, \mbox{ trans} \\ \hline V_{DS} = V_{OS} \mbox{ trans} \\ \hline V_{DS} = V_{OV}, \mbox{ trans} \\ \hline Dynamic^b \\ \hline Dynamic^b \\ \hline Dynamic^b \\ \hline Dutput Capacitance \\ C_{16S} \\ \hline Output Capacitance \\ C_{16S} \\ \hline Output Capacitance \\ C_{16S} \\ \hline Output Capacitance \\ C_{16S} \\ \hline Cutat Gate Charge \\ Q_{gd} \\ \hline Gate Parise Transfer Capacitance \\ C_{16S} \\ \hline Cutat Gate Charge \\ Q_{gd} \\ \hline Gate Parise Transe \\ \hline Turn-On Delay Time \\ t_{d(onf)} \\ Rise Time \\ \hline t_r \\ Turn-Off Delay Time \\ t_{d(onf)} \\ Fall Time \\ \hline Trans \\ \hline Trans \\ \hline Trans \\ \hline Continuous Source-Drain Diode Current \\ \hline t_{S} \\ Trans \\ \hline Trans \\ \hline D_{2} = V_{OV}, \ V_{C} = V_{OV}, \ V_{C} = 1 \ V_{V}, \ V_{D} = 10 \ V_{V} \\ \hline Trans \\ \hline Tra$	Drain-Source Breakdown Voltage	$V_{DS}$	$V_{GS} = 0 V, I_D = -250 \mu A$	- 40			V	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	V <sub>DS</sub> Temperature Coefficient	$\Delta V_{DS}/T_{J}$	la – - 250 uA		- 40		mV/°C	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	V <sub>GS(th)</sub> Temperature Coefficient	$\Delta V_{GS(th)}/T_J$	η - 200 μλ		- 5.5		1110/ C	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Gate-Source Threshold Voltage	V <sub>GS(th)</sub>	$V_{DS} = V_{GS}, I_{D} = -250 \ \mu A$	- 2	- 3	- 4	V	
$ \begin{array}{ c c c c c } \hline \mbox{Prime} & \$	Gate-Source Leakage	I <sub>GSS</sub>	$V_{DS} = 0 V, V_{GS} = \pm 20 V$			± 100	nA	
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	Zara Cata Valtaga Drain Current	lass	$V_{DS} = -40 \text{ V}, \text{ V}_{GS} = 0 \text{ V}$			- 1	μA	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	zero Gate voltage Drain Current	DSS	$V_{DS}$ = - 40 V, $V_{GS}$ = 0 V, $T_{J}$ = 55 °C			- 10		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	On-State Drain Current <sup>a</sup>	I <sub>D(on)</sub>	$V_{DS} \ge 5$ V, $V_{GS} = -10$ V	- 120			А	
$ \begin{array}{ c c c c c c } \hline \textbf{Dynamic}^{b} & & & & & & & & & & & & & & & & & & &$	Drain-Source On-State Resistance <sup>a</sup>	r <sub>DS(on)</sub>	V <sub>GS</sub> = - 10 V, I <sub>D</sub> = - 20 A		0.0041		Ω	
$ \begin{array}{ c c c c c c c } \hline \text{Puput Capacitance} & C_{iss} & & & & & & & & & & & & & & & & & & $	Forward Transconductance <sup>a</sup>	9 <sub>fs</sub>	V <sub>DS</sub> = - 15 V, I <sub>D</sub> = - 20 A		75		S	
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Dynamic <sup>b</sup>							
$ \begin{array}{ c c c c c c c } \hline Reverse Transfer Capacitance & C_{rss} & & & & 1000 & & \\ \hline Total Gate Charge & Q_g & & & & & & & & & & & & \\ \hline Gate-Source Charge & Q_{gs} & Q_{gs} & & & & & & & & & & & & & \\ \hline Gate-Drain Charge & Q_{gd} & & & & & & & & & & & & & & & & \\ \hline Gate Resistance & R_g & f = 1 \ MHz & 4.0 & & & & & & & & & & & \\ \hline Gate Resistance & R_g & f = 1 \ MHz & 4.0 & & & & & & & & & \\ \hline Turn-On \ Delay Time & t_d(on) & & & & & & & & & & & & & & \\ \hline Rise Time & t_r & & V_{DD} = -20 \ V, \ R_L = 0.18 \ \Omega & & & & & & & & & & & & & \\ \hline Rise Time & t_r & V_{DD} = -20 \ V, \ R_L = 0.18 \ \Omega & & & & & & & & & & & & & & \\ \hline Turn-Off \ Delay Time & t_d(off) & & & & & & & & & & & & & & & & & \\ \hline Fall Time & t_r & & & & & & & & & & & & & & & & & & &$	nput Capacitance	C <sub>iss</sub>			11300		pF	
$ \begin{array}{ c c c c c } \hline Total Gate Charge & Q_g \\ \hline Gate-Source Charge & Q_{gs} \\ \hline Gate-Source Charge & Q_{gd} \\ \hline Gate-Drain Charge & Q_{gd} \\ \hline Gate Resistance & R_g \\ \hline Gate Resistance & R_g \\ \hline Turn-On Delay Time & t_{d(on)} \\ \hline Rise Time & t_r \\ \hline Turn-Off Delay Time & t_{d(off)} \\ \hline Fall Time & t_f \\ \hline Drain-Source Body Diode Characteristics \\ \hline Ortinuous Source-Drain Diode Current & I_S \\ \hline Continuous Source-Drain Diode Current & I_S \\ \hline Pulse Diode Forward Current^a & I_{SM} \\ \hline Body Diode Voltage & V_{SD} & I_S = -20 \text{ A} \\ \hline \end{array} $	Output Capacitance	C <sub>oss</sub>	$V_{DS}$ = - 25 V, $V_{GS}$ = 0 V, f = 1 MHz		1510			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Reverse Transfer Capacitance	C <sub>rss</sub>			1000			
$ \begin{array}{ c c c c c } \hline Gate-Drain Charge & Q_{gd} & & & & & & & & & & & & & & & & & & &$	Total Gate Charge	Qg			185	280	nC	
$ \begin{array}{ c c c c c } \hline Gate-Drain Charge & Q_{gd} & & & & & & & & & & & & & & & & & & &$	Gate-Source Charge	Q <sub>gs</sub>	$V_{DS} = -20 \text{ V}, V_{GS} = -10 \text{ V}, I_{D} = -110 \text{ A}$		48			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Gate-Drain Charge				42			
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Gate Resistance		f = 1 MHz		4.0		Ω	
$\begin{tabular}{ c c c c c c } \hline Turn-Off Delay Time & t_{d(off)} & I_D \cong -110 \text{ A}, V_{GEN} = -10 \text{ V}, \text{ R}_g = 1 \Omega & 110 & 165 \\ \hline Fall Time & t_f & 35 & 55 \\ \hline \end{tabular}$	Turn-On Delay Time	t <sub>d(on)</sub>			25	40		
Fall Time $t_f$ 35Drain-Source Body Diode CharacteristicsContinuous Source-Drain Diode Current $I_S$ $T_C = 25 \ ^{\circ}C$ - 110Pulse Diode Forward Current^a $I_{SM}$ - 240Body Diode Voltage $V_{SD}$ $I_S = -20 \ ^{\circ}A$ - 0.8- 1.5	Rise Time	t <sub>r</sub>	$V_{DD}$ = - 20 V, $R_L$ = 0.18 $\Omega$		290	440	- ns	
Fall Time $t_f$ 3555Drain-Source Body Diode CharacteristicsContinuous Source-Drain Diode Current $I_S$ $T_C = 25 \ ^{\circ}C$ $-110$ Pulse Diode Forward Current^a $I_{SM}$ $-240$ Body Diode Voltage $V_{SD}$ $I_S = -20 \ A$ $-0.8$ $-1.5$	Turn-Off Delay Time	t <sub>d(off)</sub>	$I_D \cong$ - 110 A, $V_{GEN}$ = - 10 V, $R_g$ = 1 $\Omega$		110	165		
Continuous Source-Drain Diode CurrentIs $T_C = 25 \ ^{\circ}C$ - 110Pulse Diode Forward Current <sup>a</sup> IsM- 240Body Diode Voltage $V_{SD}$ $I_S = -20 \ ^{\circ}A$ - 0.8	Fall Time				35	55		
Pulse Diode Forward Current <sup>a</sup> I <sub>SM</sub> - 240         Body Diode Voltage       V <sub>SD</sub> I <sub>S</sub> = - 20 A       - 0.8       - 1.5	Drain-Source Body Diode Characteristics							
Body Diode Voltage $V_{SD}$ $I_S = -20 \text{ A}$ $-0.8$ $-1.5$	Continuous Source-Drain Diode Current	ا <sub>S</sub>	T <sub>C</sub> = 25 °C			- 110	А	
	Pulse Diode Forward Current <sup>a</sup>	I <sub>SM</sub>				- 240	A	
Body Diode Reverse Recovery Time tr	3ody Diode Voltage	V <sub>SD</sub>	I <sub>S</sub> = - 20 A		- 0.8	- 1.5	V	
	Body Diode Reverse Recovery Time	t <sub>rr</sub>			70	105	ns	
Body Diode Reverse Recovery Charge $Q_{rr}$ $I_F = -20 \text{ A}, \text{ di/dt} = 100 \text{ A/µs}, T_I = 25 ^{\circ}\text{C}$ 130 200	3ody Diode Reverse Recovery Charge	Q <sub>rr</sub>	L = -20 A di/dt = 100 A/us T = 25 °C		130	200	nC	
Reverse Recovery Fall Time $t_a$ $I_F = -20$ A, $di/dt = 100$ A/µs, $I_J = 25$ C 37	Reverse Recovery Fall Time	t <sub>a</sub>	$F = -20 \text{ A}, \text{ u/ut} = 100 \text{ A/}\mu\text{s}, 1 123 \text{ C}$		37		ns	
Reverse Recovery Rise Time tb 33	Reverse Recovery Rise Time	t <sub>b</sub>			33			

Notes:

a. Pulse test; pulse width  $\leq$  300  $\mu s,$  duty cycle  $\leq$  2 %.

b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

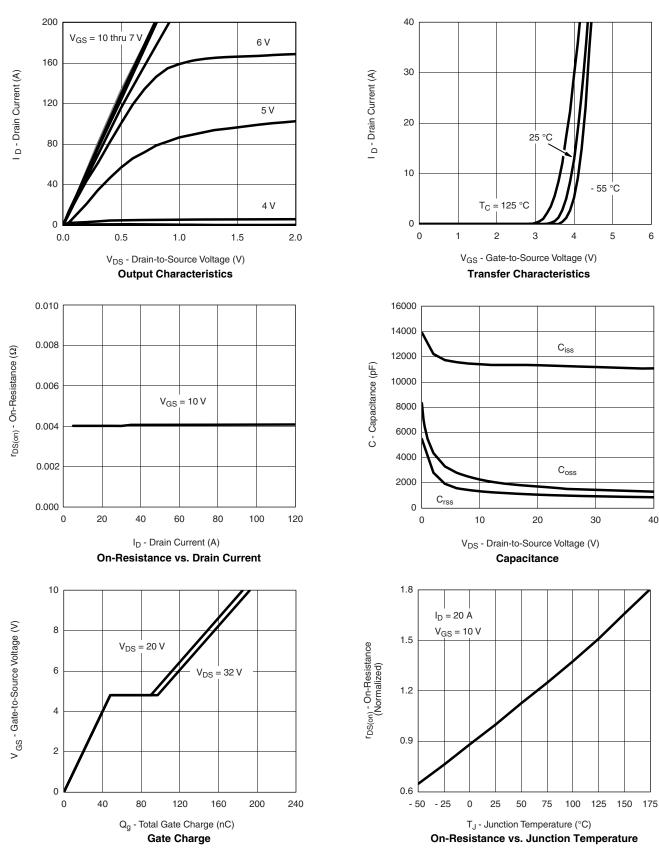
<u>VBsemi</u> Bsemi.com



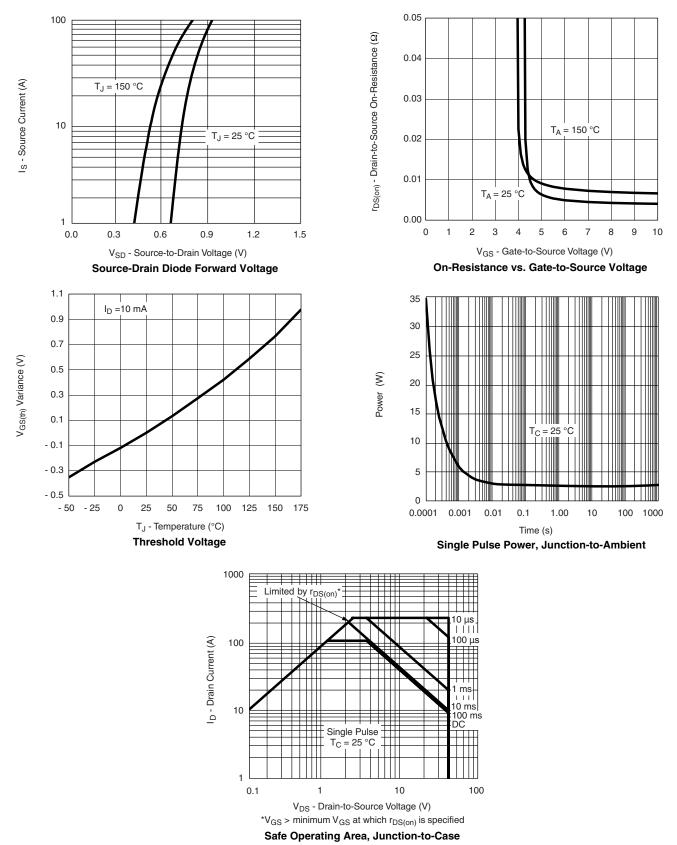
6

40

#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

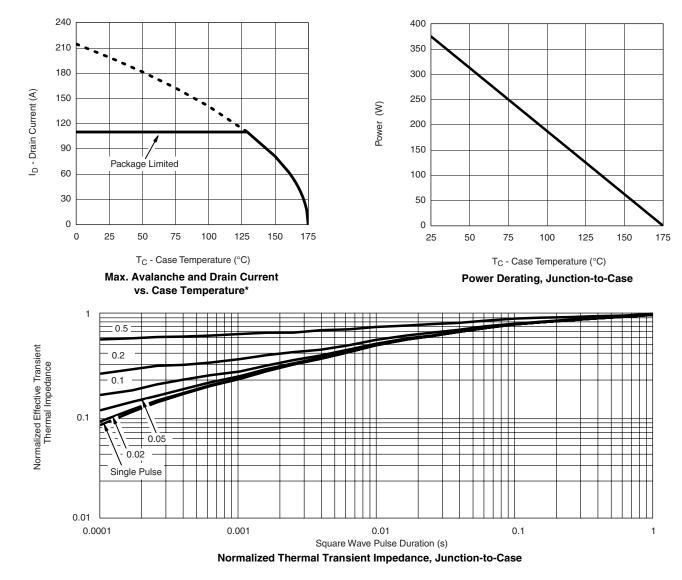






#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



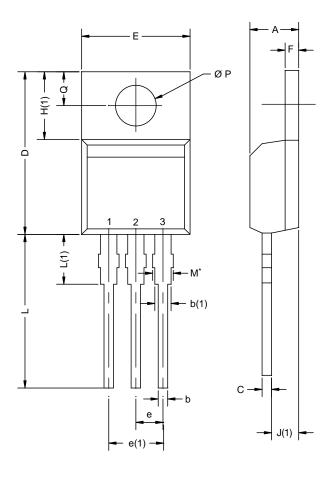


#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

\* The power dissipation  $P_D$  is based on  $T_{J(max)} = 175$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.



### **TO-220AB**



	MILLIN	IETERS	INCHES				
DIM.	MIN.	MAX.	MIN.	MAX.			
А	4.25	4.65	0.167	0.183			
b	0.69	1.01	0.027	0.040			
b(1)	1.20	1.73	0.047	0.068			
С	0.36	0.61	0.014	0.024			
D	14.85	15.49	0.585	0.610			
Е	10.04	10.51	0.395	0.414			
е	2.41	2.67	0.095	0.105			
e(1)	4.88	5.28	0.192	0.208			
F	1.14	1.40	0.045	0.055			
H(1)	6.09	6.48	0.240	0.255			
J(1)	2.41	2.92	0.095	0.115			
L	13.35	14.02	0.526	0.552			
L(1)	3.32	3.82	0.131	0.150			
ØΡ	3.54	3.94	0.139	0.155			
Q 2.60 3.00 0.102 0.118							
ECN: X12-0208-Rev. N, 08-Oct-12 DWG: 5471							

#### Notes

\* M = 1.32 mm to 1.62 mm (dimension including protrusion) Heatsink hole for HVM



# Disclaimer

All products due to improve reliability, function or design or for other reasons, product specifications and data are subject to change without notice.

Taiwan VBsemi Electronics Co., Ltd., branches, agents, employees, and all persons acting on its or their representatives (collectively, the "Taiwan VBsemi"), assumes no responsibility for any errors, inaccuracies or incomplete data contained in the table or any other any disclosure of any information related to the product.(www.VBsemi.com)

Taiwan VBsemi makes no guarantee, representation or warranty on the product for any particular purpose of any goods or continuous production. To the maximum extent permitted by applicable law on Taiwan VBsemi relinquished: (1) any application and all liability arising out of or use of any products; (2) any and all liability, including but not limited to special, consequential damages or incidental; (3) any and all implied warranties, including a particular purpose, non-infringement and merchantability guarantee.

Statement on certain types of applications are based on knowledge of the product is often used in a typical application of the general product VBsemi Taiwan demand that the Taiwan VBsemi of. Statement on whether the product is suitable for a particular application is non-binding. It is the customer's responsibility to verify specific product features in the products described in the specification is appropriate for use in a particular application. Parameter data sheets and technical specifications can be provided may vary depending on the application and performance over time. All operating parameters, including typical parameters must be made by customer's technical experts validated for each customer application. Product specifications do not expand or modify Taiwan VBsemi purchasing terms and conditions, including but not limited to warranty herein.

Unless expressly stated in writing, Taiwan VBsemi products are not intended for use in medical, life saving, or life sustaining applications or any other application. Wherein VBsemi product failure could lead to personal injury or death, use or sale of products used in Taiwan VBsemi such applications using client did not express their own risk. Contact your authorized Taiwan VBsemi people who are related to product design applications and other terms and conditions in writing.

The information provided in this document and the company's products without a license, express or implied, by estoppel or otherwise, to any intellectual property rights granted to the VBsemi act or document. Product names and trademarks referred to herein are trademarks of their respective representatives will be all.

### **Material Category Policy**

Taiwan VBsemi Electronics Co., Ltd., hereby certify that all of the products are determined to be oHS compliant and meets the definition of restrictions under Directive of the European Parliament 2011/65 / EU, 2011 Nian. 6. 8 Ri Yue restrict the use of certain hazardous substances in electrical and electronic equipment (EEE) - modification, unless otherwise specified as inconsistent.(www.VBsemi.com)

Please note that some documents may still refer to Taiwan VBsemi RoHS Directive 2002/95 / EC. We confirm that all products identified as consistent with the Directive 2002/95 / EC European Directive 2011/65 /.

Taiwan VBsemi Electronics Co., Ltd. hereby certify that all of its products comply identified as halogen-free halogen-free standards required by the JEDEC JS709A. Please note that some Taiwanese VBsemi documents still refer to the definition of IEC 61249-2-21, and we are sure that all products conform to confirm compliance with IEC 61249-2-21 standard level JS709A.

### **X-ON Electronics**

Largest Supplier of Electrical and Electronic Components

Click to view similar products for MOSFET category:

Click to view products by VBsemi Elec manufacturer:

Other Similar products are found below :

IRFD120 JANTX2N5237 BUK455-60A/B MIC4420CM-TR VN1206L NDP4060 SI4482DY IPS70R2K0CEAKMA1 SQD23N06-31L-GE3 TK16J60W,S1VQ(O 2SK2614(TE16L1,Q) DMN1017UCP3-7 DMN1053UCP4-7 SQJ469EP-T1-GE3 NTE2384 DMC2700UDMQ-7 DMN2080UCB4-7 DMN61D9UWQ-13 US6M2GTR DMN31D5UDJ-7 DMP22D4UFO-7B DMN1006UCA6-7 DMN16M9UCA6-7 STF5N65M6 IRF40H233XTMA1 STU5N65M6 DMN6022SSD-13 DMN13M9UCA6-7 DMTH10H4M6SPS-13 DMN2990UFB-7B IPB80P04P405ATMA2 2N7002W-G MCAC30N06Y-TP MCQ7328-TP BXP7N65D BXP4N65F AOL1454G WMJ80N60C4 BXP2N20L BXP2N65D BXT1150N10J BXT1700P06M TSM60NB380CP ROG RQ7L055BGTCR DMNH15H110SK3-13 SLF10N65ABV2 BSO203SP BSO211P IPA60R230P6 IPA60R460CE