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August 2016

FCB110N65F — N-Channel SuperFET<sup>®</sup> II FRFET<sup>®</sup> MOSFET



## N-Channel SuperFET<sup>®</sup> II FRFET<sup>®</sup> MOSFET

650 V, 35 A, 110 m $\Omega$ 

#### Features

- 700 V @T<sub>J</sub> = 150°C
- Typ. R<sub>DS(on)</sub> = 96 mΩ (Typ.)
- Ultra Low Gate Charge (Typ. Q<sub>g</sub> = 98 nC)
- Low Effective Output Capacitance (Typ. C<sub>oss(eff.)</sub> = 464 pF)
- 100% Avalanche Tested
- RoHS Compliant

#### Applications

- Telecom/Server Power Supplies 
   Solar Inverters
- Computing Power Supplies
   FPD TV Power/Lighting



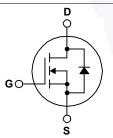
## Description

SuperFET<sup>®</sup> II MOSFET is Fairchild Semiconductor's brand-new high voltage super-junction (SJ) MOSFET family that is utilizing charge balance technology for outstanding low on-resistance and lower gate charge performance.

SuperFET<sup>®</sup> II FRFET<sup>®</sup> MOSFET combines a faster and more rugged intrinsic body diode performance with fast switching,

aimed at achieving better reliability and efficiency especially in resonant switching applications.

SuperFET<sup>®</sup> II FRFET<sup>®</sup> is very suitable for the switching power applications such as server/telecom power, Solar inverter, FPD TV power, computing power, lighting and industrial power applications.



#### Absolute Maximum Ratings T<sub>C</sub> = 25<sup>o</sup>C unless otherwise noted.

Symbol	Parameter			FCB110N65F	Unit
V <sub>DSS</sub>	Drain to Source Voltage			650	V
V		- DC		±20	V
V <sub>GSS</sub>	Gate to Source Voltage	- AC		±30	v
	Ducin Current	35			
I <sub>D</sub>	Drain Current	- Continuous (T <sub>C</sub> = 100 <sup>o</sup> C)		24	A
I <sub>DM</sub>	Drain Current	- Pulsed	(Note 1)	105	А
E <sub>AS</sub>	Single Pulsed Avalanche Ene	rgy	(Note 2)	809	mJ
I <sub>AR</sub>	Avalanche Current (Note 1)			8	А
E <sub>AR</sub>	Repetitive Avalanche Energy		(Note 1)	3.57	mJ
dv/dt	MOSFET dv/dt		(Note 3)	100	V/no
	Peak Diode Recovery dv/dt			50	V/ns
D	Dewer Dissingtion	$(T_{\rm C} = 25^{\rm o}{\rm C})$		357	W
P <sub>D</sub>	Power Dissipation	- Derate Above 25°C		2.86	W/ <sup>o</sup> C
T <sub>J</sub> , T <sub>STG</sub>	Operating and Storage Tempe	erature Range		-55 to +150	°C
Τ <sub>L</sub>	Maximum Lead Temperature for Soldering, 1/8" from Case for 5 Seconds			300	°C

### **Thermal Characteristics**

Symbol	Parameter	FCB110N65F	Unit
$R_{\thetaJC}$	Thermal Resistance, Junction to Case	0.35	
D	Thermal Resistance, Junction to Ambient (Mimimum Pad of 2-oz copper), Max.	62.5	°C/W
$R_{ heta JA}$	Thermal Resistance, Junction to Ambient (1 in <sup>2</sup> Pad of 2-oz copper), Max.	40	

1

Electrical Characteristics $T_C = 25^\circ$ C unless otherwise noted.         Symbol       Parameter       Test Conditions       Min.       Typ.       Max.       U         Off Characteristics         BV <sub>DSS</sub> Drain to Source Breakdown Voltage $\frac{I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 25^\circ \text{C}}{10} - \frac{650}{700} - \frac{1}{7}$ $V_{Coefficient       V_{DS} = 650 \text{ V}, V_{CS} = 0 \text{ V}$ $ 10$ $ABV_{DSS}/AT_J$ Breakdown Voltage Temperature $I_D = 10 \text{ mA}, Referenced to 25^\circ \text{C} 0.72  V_{VC} Coefficient       V_{DS} = 650 \text{ V}, V_{CS} = 0 \text{ V}  10 V_{DS} = 520 \text{ V}, V_{CS} = 0 \text{ V}  10 V_{DS} = 520 \text{ V}, V_{CS} = 0 \text{ V}  100 \text{ F}         On Characteristics         VGS = V_{DS}, I_D = 3.5 \text{ mA}       3  5         Norward Transconductance       V_{OS} = 100 \text{ V}, V_{GS} = 0 \text{ V}  36800 \text{ 4895} fr         Output Capacitance       V_{OS} = 100 \text{ V}, V_{CS} = 0 \text{ V}  36800 \text{ 4895} fr         Output Capacitance       V_{OS} = 0 \text{ V} fa \text{ 1MHz} - $	Electrical Characteristics $T_c = 25^{\circ}C$ unless otherwise noted.         Symbol       Parameter       Test Conditions       Min.       Typ.       Max.       Ur         Off Characteristics         BV <sub>DSS</sub> Drain to Source Breakdown Voltage $I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 25^{\circ}C$ $650$ -       -       V/V         ABV <sub>DSS</sub> /AT, J       Breakdown Voltage Temperature $I_D = 10 \text{ mA}, Referenced to 25^{\circ}C 0.72       -       V/C         Lpss       Zero Gate Voltage Drain Current       VDS = 650 V, VGS = 0 V, T_J = 125^{\circ}C       -       110       -       140         Lgss       Gate to Body Leakage Current       VGS = 20 V, VGS = 0 V, T_S = 125^{\circ}C       -       1100       n/V         On Characteristics       VGS = 10 V, I_D = 17.5 A       -       30       -       55         Dynamic Characteristics       VDS = 100 V, VGS = 0 V, T_S = 0.4 + 0.4844       -       0.65       -       pf         Cqss       Input Capacitance       VDS = 300 V, VGS = 0 V, T = 10.145       -       30       -       55         Dynamic Characteristics       -       -       3680       4895       pf       -       655       -       pf$	Part Num	ber	Top Mark	Package	Packing Method	Reel Size	Тар	e Width	Таре	Width
SymbolParameterTest ConditionsMin.Typ.Max.UDff CharacteristicsBV <sub>DSS</sub> Drain to Source Breakdown Voltage $\frac{1}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 25^{\circ}\text{C}}{10} = 100^{\circ}\text{ C}$ $650$ $ -$ NBV <sub>DSS</sub> / AT,Breakdown Voltage Temperature $1_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 150^{\circ}\text{C}$ $700$ $ -$ NDSSZero Gate Voltage Drain Current $V_{DS} = 650 \text{ V}, V_{CS} = 0 \text{ V}$ $  100$ NDSSZero Gate Voltage Drain Current $V_{DS} = 520 \text{ V}, V_{CS} = 0 \text{ V}$ $  1100$ $-$ NGSSGate Threshold VoltageVGS = 10 V, I_D = 17.5 \text{ A} $ 960$ $  3100$ $-$ POR CharacteristicsVGS(m)Gate Threshold VoltageVGS = 10 V, I_D = 17.5 \text{ A} $ 960$ $  3680$ $4895$ $pf$ Porpamic CharacteristicsCrassOutput CapacitanceV_{OS} = 100 V, V_{OS} = 0 V, I_D = 17.5 \text{ A} $ 3680$ $4895$ $pf$ CrassOutput CapacitanceV_{OS} = 380 V, V_{OS} = 0 V, I_D = 110142 $ 3680$ $4895$ $pf$ CrassOutput CapacitanceV_{OS} = 380 V, V_{OS} = 0 V, I_D = 17.5 \text{ A} $ 98$ $145$ $pf$ CrassGate to Drain Miller CharageV_{OS} = 380 V, I_D = 17.5 \text{ A} $ 311$ $72$ $100$ CrassGate to Drain Miller CharageV_{OS} = 10 V, R_S = 4.7 \Omega $ 31$ $72$ $100$ <tr< th=""><th>SymbolParameterTest ConditionsMin.Typ.Max.UrDff CharacteristicsBV<sub>DSS</sub>Drain to Source Breakdown Voltage<math>\frac{10}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_y = 25^{\circ}\text{C}}{100}</math><math>650</math>VABV<sub>DSS</sub> / ATyBreakdown Voltage Temperature Coefficient<math>\frac{10}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_y = 150^{\circ}\text{C}}{700}</math>VAbvSecond State Voltage Drain Current<math>\frac{V_{OS} = 650 \text{ V}, V_{OS} = 0 \text{ V}}{V_{DS} = 520 \text{ V}, V_{OS} = 0 \text{ V}}</math>10MossZero Gate Voltage Drain Current<math>\frac{V_{OS} = 650 \text{ V}, V_{OS} = 0 \text{ V}</math>±100n/Conditionation StaticGate Threshold VoltageVGS = V_{DS}, I_p = 3.5 \text{ mA}3-5VVGS(m)Gate Threshold VoltageVGS = 10 V, I_p = 17.5 A-96110mBysicForward TransconductanceV_{DS} = 100 V, V_{OS} = 0 \text{ V}-300-SSynamic CharacteristicsV10048495pfCaseInput CapacitanceV_{DS} = 100 V, V_{OS} = 0 \text{ V}-0.65-pfCaseOutput CapacitanceV_{DS} = 380 V, V_{GS} = 0 \text{ V}-48495pfCaseOutput CapacitanceV_DS = 380 V, V_{GS} = 0 \text{ V}-4844-0.65-CaseOutput CapacitanceV_DS = 380 V, V_GS = 0 \text{ V}-4844-0.65-pfCaseOutput CapacitanceV_DS = 380 V, V_GS = 0 V, = 110H1z</th><th>FCB110N</th><th>65F</th><th>FCB110N65F</th><th>D<sup>2</sup>-PAK</th><th>Tape and Reel</th><th>330 mm</th><th>24</th><th>4 mm</th><th>800</th><th>units</th></tr<>	SymbolParameterTest ConditionsMin.Typ.Max.UrDff CharacteristicsBV <sub>DSS</sub> Drain to Source Breakdown Voltage $\frac{10}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_y = 25^{\circ}\text{C}}{100}$ $650$ VABV <sub>DSS</sub> / ATyBreakdown Voltage Temperature Coefficient $\frac{10}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_y = 150^{\circ}\text{C}}{700}$ VAbvSecond State Voltage Drain Current $\frac{V_{OS} = 650 \text{ V}, V_{OS} = 0 \text{ V}}{V_{DS} = 520 \text{ V}, V_{OS} = 0 \text{ V}}$ 10MossZero Gate Voltage Drain Current $\frac{V_{OS} = 650 \text{ V}, V_{OS} = 0 \text{ V}$ ±100n/Conditionation StaticGate Threshold VoltageVGS = V_{DS}, I_p = 3.5 \text{ mA}3-5VVGS(m)Gate Threshold VoltageVGS = 10 V, I_p = 17.5 A-96110mBysicForward TransconductanceV_{DS} = 100 V, V_{OS} = 0 \text{ V}-300-SSynamic CharacteristicsV10048495pfCaseInput CapacitanceV_{DS} = 100 V, V_{OS} = 0 \text{ V}-0.65-pfCaseOutput CapacitanceV_{DS} = 380 V, V_{GS} = 0 \text{ V}-48495pfCaseOutput CapacitanceV_DS = 380 V, V_{GS} = 0 \text{ V}-4844-0.65-CaseOutput CapacitanceV_DS = 380 V, V_GS = 0 \text{ V}-4844-0.65-pfCaseOutput CapacitanceV_DS = 380 V, V_GS = 0 V, = 110H1z	FCB110N	65F	FCB110N65F	D <sup>2</sup> -PAK	Tape and Reel	330 mm	24	4 mm	800	units
Dr f CharacteristicsBV <sub>DSS</sub> Drain to Source Breakdown Voltage $\frac{I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 150^\circ\text{C}}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 150^\circ\text{C}}{700} = \frac{10}{10} = 10 \text{ mA}, V_{GS} = 0 \text{ V}, T_J = 150^\circ\text{C}}{700} = 10 = 10  by set of the transmission of transmissing transmission of transmission of $	Dr Control Contro	Electrical	Chara	acteristics T <sub>c</sub> =	25°C unless of	otherwise noted.					
		Symbol		Parameter		Test Conditi	ons	Min.	Тур.	Max.	Uni
		Off Charact	eristics	6							
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$\begin{array}{ c c c c c c c c c c c c c c c c c c c$	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	BVDSS	Drain to	Source Breakdown v	oltage	I <sub>D</sub> = 10 mA, V <sub>GS</sub> = 0 V	T <sub>J</sub> = 150°C	700	-	-	V
Ibps         Lero Gate Voltage Drain Current $V_{DS} = 520 V, V_{CS} = 0 V, T_{C} = 125^{\circ}C$ 110         1           Idgs         Gate to Body Leakage Current $V_{GS} = 420 V, V_{DS} = 0 V$ -         - $\pm 100$ r           Dn Characteristics         VGS(m)         Gate Threshold Voltage $V_{GS} = V_{DS}, I_D = 3.5 \text{ mA}$ 3         -         5         0           Static Drain to Source On Resistance $V_{GS} = 10 V, V_{DS} = 17.5 A$ -         96         110         n           grs         Forward Transconductance $V_{DS} = 20 V, V_{DS} = 0 V, -         -         30         -         0           Optamic Characteristics          -         3680         4895         f         f         f         110         145         f         f         110         145         f         f         f         110         145         f         f         f         f         f         f         f         110         145         f         $		$\Delta BV_{DSS} / \Delta T_{J}$			ure	I <sub>D</sub> = 10 mA, Reference	d to 25°C	-	0.72	-	V/ºC
Non-         Nos         520 V, Nos         0 V, I_C = 123°C         10         -         1         100         -         1         100         -         1         100         -         1         100         -         1         100         -         1         100         -         1         100         -         1         100         1         100         1         100         1         100         1         100         1         100         1         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100	VDS         5.20 V, VGS         0.1 C = 125°C         -         110         -         -         ±100         nv           Case         Gate to Body Leakage Current         VGS = ±20 V, VGS = 0 V         -         -         ±100         nv           On Characteristics         VGS = ±20 V, VGS = 0 V         -         -         ±100         nv           Static Drain to Source On Resistance         VGS = 10 V, VGS = 0 V, ID = 17.5 A         -         96         110         mm           Gras         Forward Transconductance         VDS = 20 V, ID = 17.5 A         -         30         -         S           Dynamic Characteristics          -         100 V, VGS = 0 V, IC = 101 V, VGS = 0 V, IC = 101 V, ID = 110 T, ID         145 pr         110         145 pr           Cass         Output Capacitance         VDS = 380 V, VGS = 0 V, IC = 101 Hz         -         0.65 -         pf           Cass         Output Capacitance         VDS = 380 V, VGS = 0 V, IC = 101 Hz         -         0.7         -         0.7           Gate to Drain Viller'Characteristics         -         20 -         nd         -         0.7         -         0.7           Gate to Source Gate Charge         VGS = 10 V         -         31         72         n <td>l</td> <td colspan="2">Zoro Cato Voltago Drain Current</td> <td>ont</td> <td><math>V_{DS}</math> = 650 V, <math>V_{GS}</math> = 0 V</td> <td>V</td> <td>-</td> <td>-</td> <td>10</td> <td></td>	l	Zoro Cato Voltago Drain Current		ont	$V_{DS}$ = 650 V, $V_{GS}$ = 0 V	V	-	-	10	
On Characteristics         VGS(th)       Gate Threshold Voltage       VGS = VDS, ID = 3.5 mA       3       -       5       5         RSS(m)       Static Drain to Source On Resistance       VGS = 10 V, ID = 17.5 A       -       96       110       n         9FS       Forward Transconductance       VDS = 20 V, ID = 17.5 A       -       30       -       5         Optimic Characteristics         Ciss       Input Capacitance       -       -       3680       4895       pf         Coss       Output Capacitance       -       -       3680       4895       pf         Coss       Output Capacitance       VDS = 100 V, VGS = 0 V, f = 1 MHz       -       0.65       -       pf         Coss       Output Capacitance       VDS = 380 V, VGS = 0 V, f = 1 MHz       -       0.65       -       pf         Qast       Gate to Durbut Capacitance       VDS = 380 V, ID = 17.5 A,       -       98       145       r         Qagd       Gate to Drain "Miller" Charge       VGS = 10 V       -       20       -       r         Switching Characteristics       -       0.7       -       21       52       -       12       12       12	On Characteristics         VGS(th)       Gate Threshold Voltage       VGS = VDS. ID = 3.5 mA       3       -       5       V         RDS(an)       Static Drain to Source On Resistance       VGS = 10 V, ID = 17.5 A       -       96       110       mm         9FS       Forward Transconductance       VDS = 20 V, ID = 17.5 A       -       300       -       SS         Optimic Characteristics         Criss       Input Capacitance       VDS = 100 V, VGS = 0 V,       -       3680       4895       pf         Criss       Neverse Transfer Capacitance       VDS = 380 V, VGS = 0 V,       -       110       145       pf         Criss       Reverse Transfer Capacitance       VDS = 380 V, VGS = 0 V,       -       10.65       -       pf         Coss       Output Capacitance       VDS = 380 V, VGS = 0 V       -       464       -       pf         Qagtor)       Total Gate Charge at 10V       VDS = 380 V, ID = 17.5 A,       -       98       145       nd         Qagd       Gate to Source Gate Charge       VGS = 10 V       -       43       -       nd         Qagd       Gate to Source Setscharce       f = 1 MHz       -       0.7       -       0D <td>DSS</td> <td>2610 08</td> <td>te voltage Drain Curr</td> <td>ent</td> <td></td> <td></td> <td>-</td> <td>110</td> <td>-</td> <td>μΛ</td>	DSS	2610 08	te voltage Drain Curr	ent			-	110	-	μΛ
		I <sub>GSS</sub>	Gate to	Body Leakage Currer	nt	$V_{GS}$ = ±20 V, $V_{DS}$ = 0 V		-	-	±100	nA
		On Charact	eristics	6							
						$V_{GS} = V_{DS}$ , $I_{D} = 3.5 \text{ m}$	A	3	-	5	V
grsForward Transconductance $V_{DS}^{c} = 20 V$ , $I_{D} = 17.5 A$ -30-OpparationOpparationClassInput Capacitance $V_{DS} = 100 V$ , $V_{GS} = 0 V$ , $f = 1 MHz$ -36804895pClassInput Capacitance $V_{DS} = 100 V$ , $V_{GS} = 0 V$ , $f = 1 MHz$ -36804895pCrssReverse Transfer Capacitance $V_{DS} = 380 V$ , $V_{GS} = 0 V$ , $f = 1 MHz$ -65-pCoss eff.Effective Output Capacitance $V_{DS} = 380 V$ , $V_{GS} = 0 V$ -464-p $Q_{gt(ot)}$ Total Gate Charge at 10V $V_{DS} = 380 V$ , $V_{GS} = 10 V$ -20 $Q_{gd}$ Gate to Source Gate Charge $V_{CS} = 10 V$ 0.7137210 $Q_{gd}$ Gate to Drain "Miller" Charge $V_{CS} = 10 V$ $V_{CS} = 10 V$ -0.7-137210 $Q_{gd}$ Gate to Drain "Miller" Charge $V_{CS} = 10 V$ $V_{CS} = 10 V$ -0.7-1317210Switching Characteristics $t_{d(off)}$ Turn-On Delay Time $V_{CS} = 10 V$ , $R_g = 4.7 \Omega$ -317210 $V_{SD}$ Maximum Continuous Drain to Source Diode Forward Current35 $t_{f}$ Maximum Continuous Drain to Source Diode Forward Current1.4 $V_{SD}$ Drain to Source Diode Forward Vultage $V_{GS} = 0 V$ , $I_{SD} = 1$	Production         Forward Transconductance $V_{DS}^{c} = 20 V, I_{D} = 17.5 A$ -         30         -         S0           Opynamic Characteristics         Class         Input Capacitance $V_{DS} = 100 V, V_{GS} = 0 V, f = 1 MHz$ -         3680         4895         pf           Class         Output Capacitance $f = 1 MHz$ -         0.65         -         pf           Class         Output Capacitance $V_{DS} = 380 V, V_{GS} = 0 V, f = 1 MHz$ -         0.65         -         pf           Coss         Output Capacitance $V_{DS} = 380 V, V_{GS} = 0 V, f = 1 MHz$ -         0.65         -         pf           Coss         Output Capacitance $V_{DS} = 380 V, V_{GS} = 0 V$ -         464         -         pf           Qagtoti         Total Gate Charge at 10V $V_{DS} = 380 V, I_D = 17.5 A, V_{GS} = 0 V$ -         484         -         0.7         -         GG           Gade to Drain "Miller" Charge $V_{CS} = 10 V, R_g = 4.7 \Omega$ -         31         72         n $V_{dof}$ Turn-Of Delay Time $V_{CS} = 10 V, R_g = 4.7 \Omega$ -         31         72         n $V_{dof}$ Turn-Off Delay Time				sistance			-	96	-	mΩ
Dynamic CharacteristicsOpenation of the second state of the second	Dynamic Characteristics       VDS       VDS       VDS       0       <					00		-			S
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $		haracto	rictics		50 5					
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CrissReverse Transfer CapacitanceI = T MH2-0.65-ICossOutput Capacitance $V_{DS} = 380 V, V_{GS} = 0 V, f = 1 MH2$ -65-fCoss eff.Effective Output Capacitance $V_{DS} = 0 V to 400 V, V_{GS} = 0 V$ -464-fQg(ot)Total Gate Charge at 10V $V_{DS} = 380 V, I_D = 17.5 A,$ -98145rQgsGate to Source Gate Charge $V_{GS} = 10 V$ -464-rQgdGate to Drain "Miller" Charge $V_{CS} = 10 V$ -433-rESREquivalent Series Resistancef = 1 MHz-0.7-4Switching Characteristicstransfer Capacitance $V_{DS} = 380 V, I_D = 17.5 A,$ -3172r $V_{CS} = 10 V$ $V_{CS} = 10 V, R_g = 4.7 \Omega$ -3172r(Note 4)-5.721rtransfor CapacitanceV_DD = 380 V, I_D = 17.5 A,-2152r(Note 4)-5.721rTurn-On Rise TimeV_DD = 380 V, I_D = 17.5 A,-2152r(Note 4)-5.721rOther CharacteristicsIsMaximum Continuous Drain to Source Diode Forward Current35IsMaximum Pulsed Drain to Source Diode Forward Current	CrissReverse Transfer CapacitanceI = 1 MH2-0.65-pfCossOutput Capacitance $V_{DS} = 380 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$ -65-pfCoss eff.Effective Output Capacitance $V_{DS} = 0 \text{ V}$ to 400 V, $V_{GS} = 0 \text{ V}$ -464-pfQg(ot)Total Gate Charge at 10V $V_{DS} = 380 \text{ V}, I_D = 17.5 \text{ A},$ -98145nfQgdGate to Source Gate Charge $V_{GS} = 10 \text{ V}$ -464-pfQgdGate to Drain "Miller" Charge $V_{GS} = 10 \text{ V}$ -433-nfESREquivalent Series Resistancef = 1 MHz-0.7-0.65Switching Characteristicstd(on)Turn-On Delay TimetrTurn-Off Delay Time-3172nt_d(off)Turn-Off Fall TimeVDD = 380 V, ID = 17.5 A,-2152nt_d(off)Turn-Off Fall TimeVDD = 380 V, ID = 17.5 A,35At_gMaximum Continuous Drain to Source Diode Forward Current35At_rReverse Recovery TimeVGS = 0 V, ISD = 17.5 A,1.4VVSDDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A,1.4VVgSDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A,1.4VVgSDrain to Source Diode Forward VoltageVGS						V,	_			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccc} \hline \label{eq:coss} & Output Capacitance & V_{DS} = 380 \ V, \ V_{GS} = 0 \ V, \ f = 1 \ MHz & - & 65 & - & \rhof \\ \hline \ C_{oss} \ eff. & Effective Output Capacitance & V_{DS} = 0 \ V \ o 400 \ V, \ V_{GS} = 0 \ V & - & 464 & - & \rhof \\ \hline \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$				<u> </u>	f = 1 MHz	_	_		-	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{cccc} C_{\text{OSS}} \text{ eff.} & \text{Effective Output Capacitance} & V_{\text{DS}} = 0 \ V \ to 400 \ V, V_{\text{GS}} = 0 \ V & - & 464 & - & \text{pf} \\ \hline Q_{q(tot)} & \text{Total Gate Charge at 10V} & V_{\text{DS}} = 380 \ V, I_{\text{D}} = 17.5 \ \text{A}, & - & 98 & 145 & \text{nd} \\ \hline Q_{\text{gs}} & \text{Gate to Source Gate Charge} & V_{\text{GS}} = 10 \ V & (\text{Note 4}) & - & 433 & - & \text{nd} \\ \hline Q_{\text{gd}} & \text{Gate to Drain "Miller" Charge} & f = 1 \ \text{MHz} & - & 0.7 & - & 0.7 \\ \hline \text{SR} & \text{Equivalent Series Resistance} & f = 1 \ \text{MHz} & - & 0.7 & - & 0.7 \\ \hline \text{Switching Characteristics} & & & & & & & & & & & & & & & & & & &$				-	$V_{PQ} = 380 \text{ V} \text{ V}_{QQ} = 0^{10}$	V f = 1 MHz			-	pF
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $									-	pF
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Qgs QgsGate to Source Gate Charge Qgd $V_{GS} = 10 V$ $ 20$ $ ncd$ $Q_{gd}$ Gate to Drain "Miller" Charge(Note 4) $ 43$ $ ncd$ ESREquivalent Series Resistance $f = 1 MHz$ $ 0.7$ $ 0.7$ Switching Characteristicstrun-On Delay Time tr $t_{q(off)}$ Turn-On Rise Time $V_{DD} = 380 V, I_D = 17.5 A, V_GS = 10 V, R_g = 4.7 \Omega$ $ 31$ $72$ $ncd$ $t_{d(off)}$ Turn-Off Delay Time $V_{GS} = 10 V, R_g = 4.7 \Omega$ $ 89$ $188$ $ncd$ $t_{f}$ Turn-Off Fall Time $V_{GS} = 0 V, R_g = 4.7 \Omega$ $ 5.7$ $21$ $ncd$ Drain-Source Diode CharacteristicsIs $I_S$ Maximum Continuous Drain to Source Diode Forward Current $  1.4$ $V$ $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 V, I_{SD} = 17.5 A$ $  1.4$ $V$ $V_{Tr}$ Reverse Recovery Time $V_{GS} = 0 V, I_{SD} = 17.5 A$ $  1.4$ $V$ $Q_{rr}$ Reverse Recovery Charge $d _F/dt = 100 A/\mu s$ $ 0.67$ $ \mu t$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature. $2. I_{AS} = 8 A, R_G = 25 \Omega, starting T_J = 25^{\circ}C.3. I_{SD} \leq 17.5 A, di/dt < 200 A/\mu s, V_{DD} < 380 V, starting T_J = 25^{\circ}C.$							-		145	nC
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{c c c c c c c c c c c c c c c c c c c $			-			, , , , , , , , , , , , , , , , , , ,	-	20	-	nC
ESREquivalent Series Resistancef = 1 MHz-0.7Switching Characteristics $t_{d(on)}$ Turn-On Delay Time $V_{DD} = 380 V, I_D = 17.5 A, V_{GS} = 10 V, R_g = 4.7 \Omega$ -21521 $t_{d(off)}$ Turn-Off Delay Time $V_{GS} = 10 V, R_g = 4.7 \Omega$ -891881 $t_{f}$ Turn-Off Fall Time $V_{OD} = 380 V, I_D = 17.5 A, V_{GS} = 10 V, R_g = 4.7 \Omega$ -891881Drain-Source Diode Characteristics $I_S$ Maximum Continuous Drain to Source Diode Forward Current351 $I_S$ Maximum Pulsed Drain to Source Diode Forward Current100100 $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 V, I_{SD} = 17.5 A$ 1.4 $t_{rr}$ Reverse Recovery Time $V_{GS} = 0 V, I_{SD} = 17.5 A,1.33-1Q_{rr}Reverse Recovery ChargedI_F/dt = 100 A/\mu S-0.67-\muNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. I_{AS} = 8 A, R_G = 25 \Omega, starting T_J = 25^{\circ}C.$	$\begin{array}{c c c c c c c c c c c c c c c c c c c $						(Note 4)	-	43	-	nC
Turn-On Delay Time tr trVDD = 380 V, ID = 17.5 A, VDD = 380 V, Rg = 4.7 $\Omega$ -317211-215211-89188-10V, Rg = 4.7 $\Omega$ -89188-10V, Rg = 4.7 $\Omega$ -5.72110Drain-Source Diode CharacteristicsIsometria Maximum Continuous Drain to Source Diode Forward Current35IsMaximum Pulsed Drain to Source Diode Forward Current100VSDDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A1.4trrReverse Recovery TimeVGS = 0 V, ISD = 17.5 A,-133-11QrrReverse Recovery ChargedIF/dt = 100 A/µs-0.67-µNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 A, R_G = 25 \Omega, starting T_J = 25^{\circ}C1.4$	Turn-On Delay Time trVDD = 380 V, ID = 17.5 A, VGS = 10 V, Rg = 4.7 $\Omega$ -3172nmtd(off)Turn-Off Delay Time tqVDD = 380 V, Rg = 4.7 $\Omega$ -2152nmtd(off)Turn-Off Delay Time tq-89188nmtqTurn-Off Fall TimeNote 4)-5.721nmOrain-Source Diode CharacteristicsIsMaximum Continuous Drain to Source Diode Forward Current35AIsMaximum Pulsed Drain to Source Diode Forward Current100AVSDDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A1.4VtrrReverse Recovery TimeVGS = 0 V, ISD = 17.5 A, dIF/dt = 100 A/µs-0.67- $\mu$ CNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. IAS = 8 A, Rg = 25 Q, starting TJ = 25°C.3.S0 V, starting TJ = 25°C.					f = 1 MHz		-	0.7	-	Ω
Turn-On Delay Time tr trVDD = 380 V, ID = 17.5 A, VDD = 380 V, Rg = 4.7 $\Omega$ -317211-215211-89188-10V, Rg = 4.7 $\Omega$ -89188-10V, Rg = 4.7 $\Omega$ -5.72110Drain-Source Diode CharacteristicsIsometria Maximum Continuous Drain to Source Diode Forward Current35IsMaximum Pulsed Drain to Source Diode Forward Current100VSDDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A1.4trrReverse Recovery TimeVGS = 0 V, ISD = 17.5 A,-133-11QrrReverse Recovery ChargedIF/dt = 100 A/µs-0.67-µNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 A, R_G = 25 \Omega, starting T_J = 25^{\circ}C1.4$	Turn-On Delay Time trVDD = 380 V, ID = 17.5 A, VGS = 10 V, Rg = 4.7 $\Omega$ -3172nmtd(off)Turn-Off Delay Time tqVDD = 380 V, Rg = 4.7 $\Omega$ -2152nmtd(off)Turn-Off Delay Time tq-89188nmtqTurn-Off Fall TimeNote 4)-5.721nmOrain-Source Diode CharacteristicsIsMaximum Continuous Drain to Source Diode Forward Current35AIsMaximum Pulsed Drain to Source Diode Forward Current100AVSDDrain to Source Diode Forward VoltageVGS = 0 V, ISD = 17.5 A1.4VtrrReverse Recovery TimeVGS = 0 V, ISD = 17.5 A, dIF/dt = 100 A/µs-0.67- $\mu$ CNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. IAS = 8 A, Rg = 25 Q, starting TJ = 25°C.3.S0 V, starting TJ = 25°C.	Switching (	haract	oristics					I	1	
O(III)Turn-On Rise Time $V_{DD} = 380 \text{ V}, I_D = 17.5 \text{ A}, V_{GS} = 10 \text{ V}, R_g = 4.7 \Omega$ -21521 $t_{d(off)}$ Turn-Off Delay Time $V_{GS} = 10 \text{ V}, R_g = 4.7 \Omega$ -891881 $t_f$ Turn-Off Fall Time(Note 4)-5.7211Drain-Source Diode Characteristics $I_S$ Maximum Continuous Drain to Source Diode Forward Current35 $I_{SM}$ Maximum Pulsed Drain to Source Diode Forward Current100 $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},1.4t_{rr}Reverse Recovery TimeV_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},1.33-1Q_{rr}Reverse Recovery ChargedI_F/dt = 100 \text{ A}/\mu \text{s}-0.67-\muNotes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. I_{AS} = 8 \text{ A}, R_G = 25 \Omega, starting T_J = 25^\circ \text{ C}.$	O(III)Turn-On Rise Time $V_{DD} = 380 \text{ V}, I_D = 17.5 \text{ A}, V_{GS} = 10 \text{ V}, R_g = 4.7 \Omega$ -2152n: $t_{d(off)}$ Turn-Off Delay Time89188n: $t_f$ Turn-Off Fall Time <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td>31</td> <td>72</td> <td>ns</td>							-	31	72	ns
Image: display fill below fill bel	Turn-Off Delay Time $V_{GS} = 10 \text{ V}, \text{ R}_{g} = 4.7 \Omega$ -89188number of the second sec	t.				V <sub>DD</sub> = 380 V, I <sub>D</sub> = 17.5	Α,				ns
Turn-Off Fall Time       (Note 4)       -       5.7       21       1         Drain-Source Diode Characteristics         Is       Maximum Continuous Drain to Source Diode Forward Current       -       -       35       1         Is       Maximum Pulsed Drain to Source Diode Forward Current       -       -       100       100         VsD       Drain to Source Diode Forward Voltage       V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 17.5 A       -       -       1.4       1.4         trr       Reverse Recovery Time       V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 17.5 A,       -       0.67       -       µ         Notes:       1.8       8A, R <sub>G</sub> = 25 Ω, starting T <sub>J</sub> = 25°C.       25.0       25.0       25.0       25.0	Turn-Off Fall Time(Note 4)-5.721nDrain-Source Diode Characteristics $I_S$ Maximum Continuous Drain to Source Diode Forward Current35A $I_{SM}$ Maximum Pulsed Drain to Source Diode Forward Current100A $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ 1.4V $t_{rr}$ Reverse Recovery Time $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ ,-133-ns $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 A/\mu s$ -0.67- $\mu d$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 A$ , $R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .	ta(off)									ns
Drain-Source Diode Characteristics         Is       Maximum Continuous Drain to Source Diode Forward Current       -       -       35         ISM       Maximum Pulsed Drain to Source Diode Forward Current       -       -       100         VSD       Drain to Source Diode Forward Voltage       VGS = 0 V, ISD = 17.5 A       -       -       1.4         trr       Reverse Recovery Time       VGS = 0 V, ISD = 17.5 A,       -       133       -       IN         Notes:       1.       Repetitive rating: pulse width limited by maximum junction temperature.       2.       I_AS = 8 A, R_G = 25 \Omega, starting T_J = 25°C.       Image: Color	Drain-Source Diode Characteristics $I_S$ Maximum Continuous Drain to Source Diode Forward Current       -       -       35       A $I_{SM}$ Maximum Pulsed Drain to Source Diode Forward Current       -       -       100       A $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ -       -       1.4       V $t_{rr}$ Reverse Recovery Time $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ ,       -       133       -       ns $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 A/\mu s$ -       0.67       - $\mu c$ Notes:       .       .       .       .       .       .       .       .         1. Repetitive rating: pulse width limited by maximum junction temperature.       .       .       .       .       .       .       .         1. $S_{1S} = 8 A$ , $R_G = 25 \Omega$ , starting $T_J = 25^\circ C$ .       .       .       .       .       .       .	+				(Note 4)		7.			ns
Is       Maximum Continuous Drain to Source Diode Forward Current       -       -       35         IsM       Maximum Pulsed Drain to Source Diode Forward Current       -       -       100         V <sub>SD</sub> Drain to Source Diode Forward Voltage       V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 17.5 A       -       -       1.4         t <sub>rr</sub> Reverse Recovery Time       V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 17.5 A,       -       133       -       1.4         Q <sub>rr</sub> Reverse Recovery Charge       U <sub>IF</sub> /dt = 100 A/µs       -       0.67       -       µ         Notes:       1.8 = 8 A, R <sub>G</sub> = 25 Ω, starting T <sub>J</sub> = 25°C.       -       -       -       -       1.4	Is       Maximum Continuous Drain to Source Diode Forward Current       -       -       35       A         IsM       Maximum Pulsed Drain to Source Diode Forward Current       -       -       100       A         VSD       Drain to Source Diode Forward Voltage       VGS = 0 V, ISD = 17.5 A       -       -       1.4       V         trr       Reverse Recovery Time       VGS = 0 V, ISD = 17.5 A,       -       -       1.33       -       ns         Qrr       Reverse Recovery Charge       dIF/dt = 100 A/µs       -       0.67       -       µ0         Notes:       -       1.8 = 8 A, RG = 25 Ω, starting TJ = 25°C.       -       -       0.67       -       µ0			a Diede Characteristics							
Solution       Maximum Pulsed Drain to Source Diode Forward Current       -       100 $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ -       -       1.4 $t_{rr}$ Reverse Recovery Time $V_{GS} = 0 V$ , $I_{SD} = 17.5 A$ ,       -       133       -       1 $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 A/\mu s$ -       0.67       - $\mu$ Notes:       I. Repetitive rating: pulse width limited by maximum junction temperature.       2. $I_{AS} = 8 A$ , $R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .       - </td <td>JoMaximum Pulsed Drain to Source Diode Forward Current100A<math>V_{SD}</math>Drain to Source Diode Forward Voltage<math>V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A}</math>1.4V<math>t_{rr}</math>Reverse Recovery Time<math>V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},</math>-133-ns<math>Q_{rr}</math>Reverse Recovery Charge<math>dI_F/dt = 100 \text{ A/}\mu\text{s}</math>-0.67-<math>\mu</math>Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. <math>I_{AS} = 8 \text{ A}, R_G = 25 \Omega</math>, starting <math>T_J = 25^{\circ}</math>C.8. <math>I_{SD} \le 17.5 \text{ A}, di/dt \le 200 \text{ A/}\mu\text{s}, V_{DD} \le 380 \text{ V}, starting <math>T_J = 25^{\circ}</math>C.</math></td> <td></td> <td></td> <td></td> <td></td> <td>Eanword Current</td> <td></td> <td></td> <td></td> <td>25</td> <td>Δ</td>	JoMaximum Pulsed Drain to Source Diode Forward Current100A $V_{SD}$ Drain to Source Diode Forward Voltage $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A}$ 1.4V $t_{rr}$ Reverse Recovery Time $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},$ -133-ns $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 \text{ A/}\mu\text{s}$ -0.67- $\mu$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}$ C.8. $I_{SD} \le 17.5 \text{ A}, di/dt \le 200 \text{ A/}\mu\text{s}, V_{DD} \le 380 \text{ V}, starting T_J = 25^{\circ}C.$					Eanword Current				25	Δ
Similar       Drain to Source Diode Forward Voltage $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A}$ -       1.4 $V_{Tr}$ Reverse Recovery Time $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},$ -       133       -       1 $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 \text{ A}/\mu \text{ s}$ -       0.67       -       1         Notes:       I. Repetitive rating: pulse width limited by maximum junction temperature.       2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .       -       -       -       -       -       -	OW VSDDrain to Source Diode Forward Voltage $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A}$ -1.4V $V_{rr}$ Reverse Recovery Time $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},$ -133-ns $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 \text{ A/}\mu\text{s}$ -0.67- $\mu$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .8. $I_{SD} \le 17.5 \text{ A}, di/dt \le 200 \text{ A/}\mu\text{s}, V_{DD} \le 380 \text{ V}, starting T_J = 25^{\circ}C.$								-		
trrReverse Recovery Time $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},$ -133-IQrrReverse Recovery Charge $dI_F/dt = 100 \text{ A}/\mu \text{ s}$ -0.67- $\mu$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .	$t_{rr}$ Reverse Recovery Time $V_{GS} = 0 \text{ V}, I_{SD} = 17.5 \text{ A},$ -133-ns $Q_{rr}$ Reverse Recovery Charge $dI_F/dt = 100 \text{ A/}\mu\text{s}$ -0.67- $\mu(r)$ Notes:1. Repetitive rating: pulse width limited by maximum junction temperature.2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}\text{C}$ .3. $I_{SD} \le 17.5 \text{ A}, di/dt \le 200 \text{ A/}\mu\text{s}, V_{DD} \le 380 \text{ V}, starting T_J = 25^{\circ}\text{C}.$						1				V
Image: Note of the second	Image: Note:       Image: Note:       Image: Note:       Image: Note:         1. Repetitive rating: pulse width limited by maximum junction temperature.       2. $I_{AS} = 8 A, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .       3. $I_{SD} \le 17.5 A$ , di/dt $\le 200 A/\mu s$ , $V_{DD} \le 380 V$ , starting $T_J = 25^{\circ}C$ .				a voltage						
Notes: I. Repetitive rating: pulse width limited by maximum junction temperature. 2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ .	Notes: I. Repetitive rating: pulse width limited by maximum junction temperature. 2. $I_{AS} = 8 \text{ A}, R_G = 25 \Omega$ , starting $T_J = 25^{\circ}C$ . 3. $I_{SD} \le 17.5 \text{ A}$ , di/dt $\le 200 \text{ A/}\mu\text{s}, V_{DD} \le 380 \text{ V}$ , starting $T_J = 25^{\circ}C$ .			,		00 02	٦,				μC
	$B_{\rm L}$ Is $D_{\rm SD} \leq 17.5$ A, di/dt $\leq 200$ A/µs, V <sub>DD</sub> $\leq 380$ V, starting T <sub>J</sub> = 25°C.	Notes: . Repetitive rating:	pulse width	limited by maximum junction	temperature.					(F	2
		, 10			5°C.						
4. Essentially independent of operating temperature typical characteristics.											

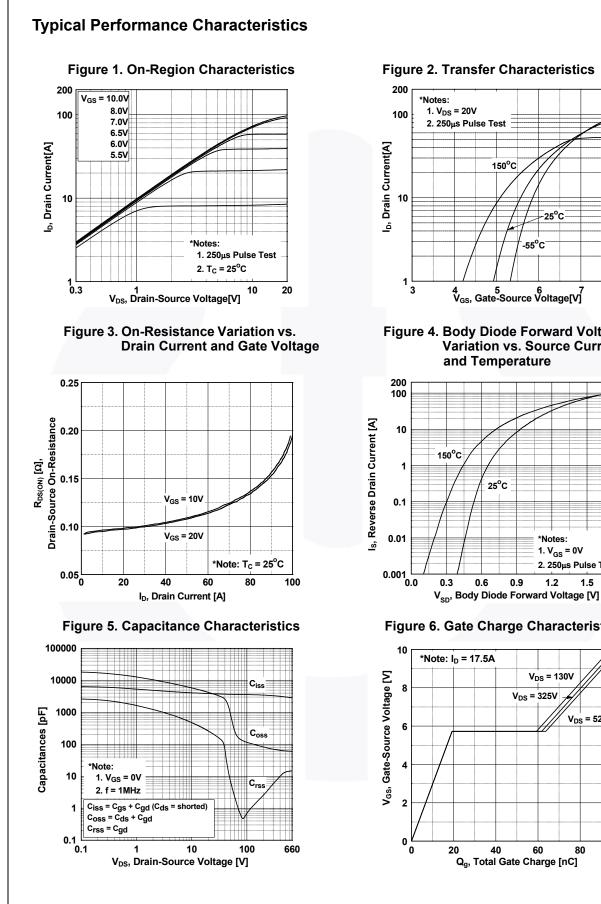
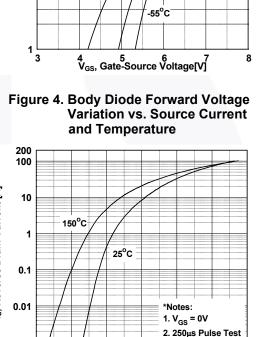
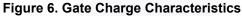


Figure 2. Transfer Characteristics

150°C

25°C





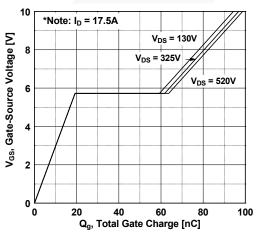
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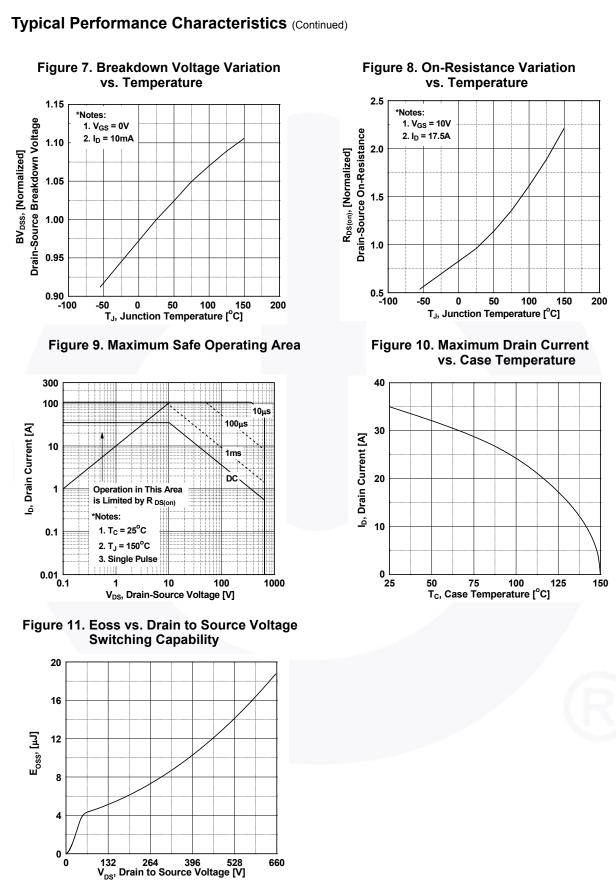
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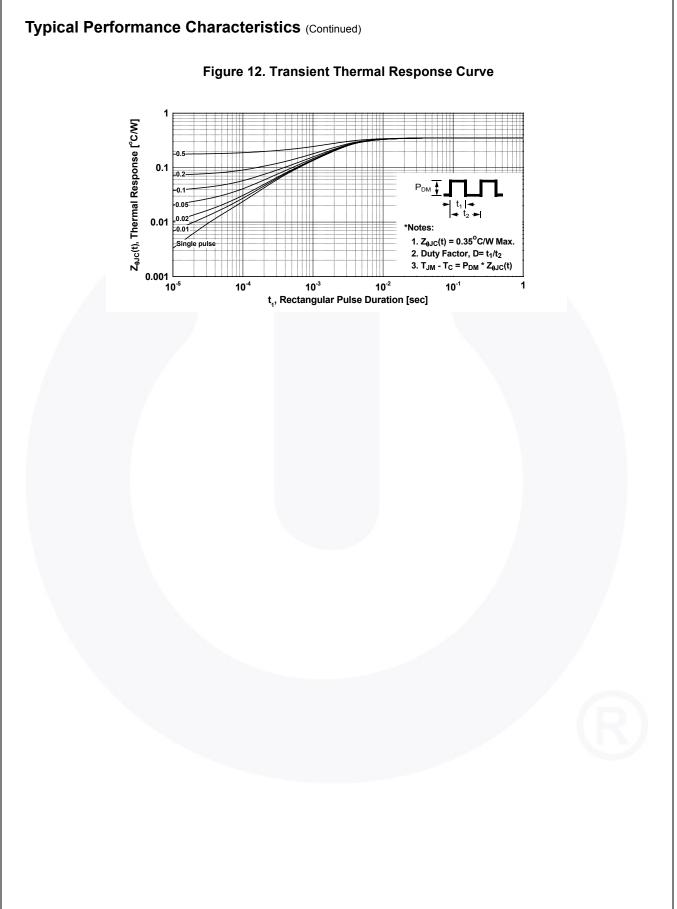
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1.5

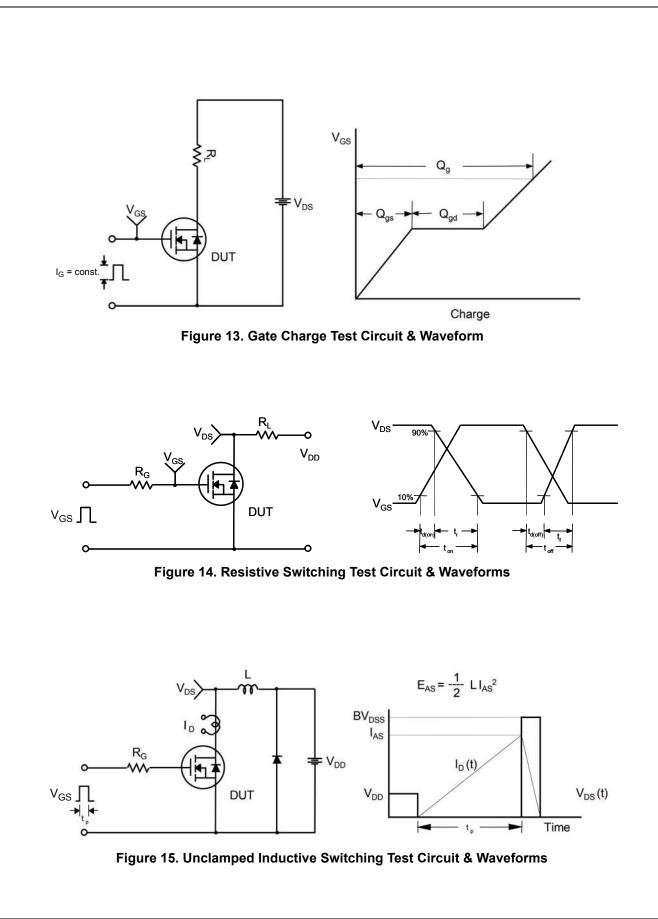
1.8



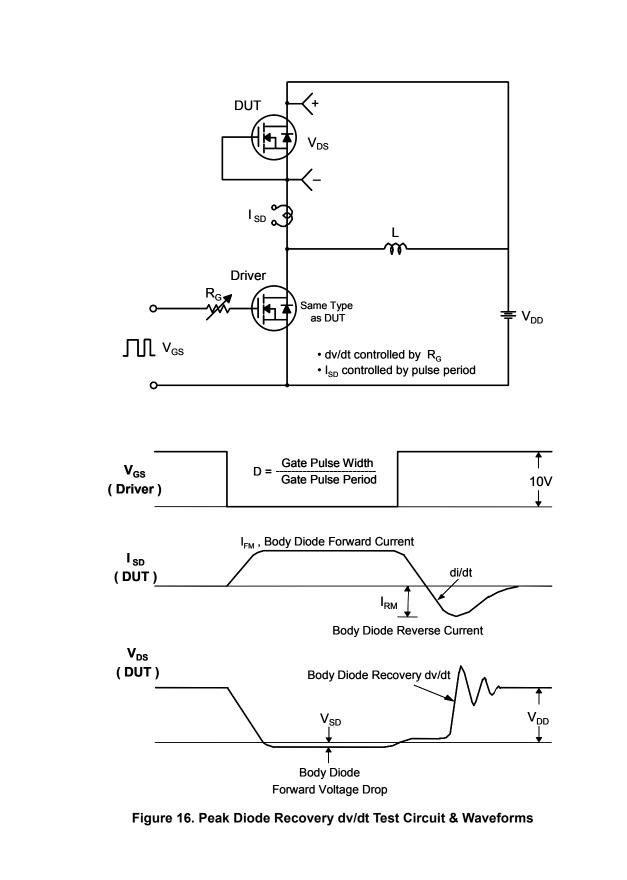




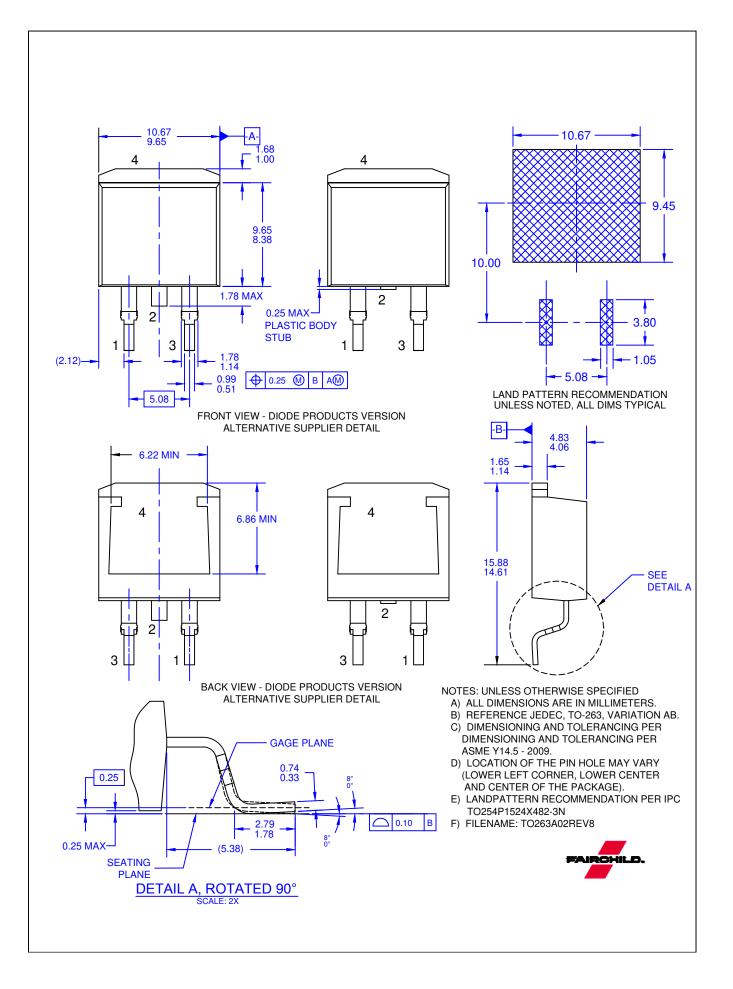
FCB110N65F — N-Channel SuperFET<sup>®</sup> II FRFET<sup>®</sup> MOSFET



FCB110N65F — N-Channel SuperFET<sup>®</sup> II FRFET<sup>®</sup> MOSFET



7



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