

650V N-Channel SiC Silicon Carbide Power MOSFET

MAIN CHARACTERISTICS

I_D	20A
V_{DS}	650V
$R_{DS(on)-typ}$ (@ $V_{GS}=18V$ $T_C=25^{\circ}C$)	$<245m\Omega$ (Typ:184m Ω)

FEATURES

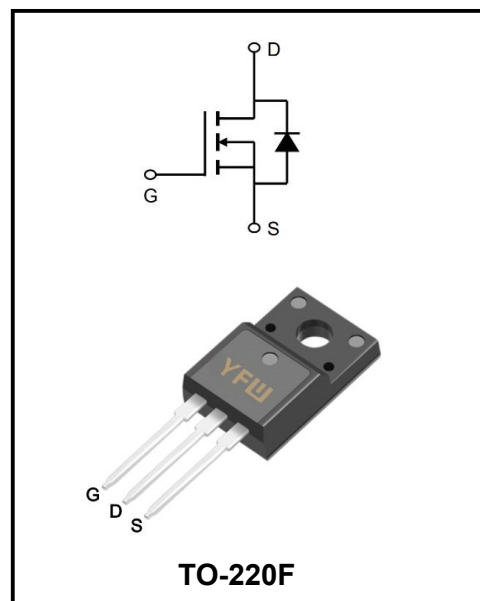
- ♦ High blocking voltage with low on-resistance
- ♦ Temperature-Independent switching behavior
- ♦ High operating junction temperature capability

APPLICATIONS

- ♦ Solar Inverters
- ♦ Switch Mode Power Supplies
- ♦ UPS
- ♦ High Voltage DC/DC Converters

MECHANICAL DATA

- ♦ Case: TO-220F/AF
- ♦ Mounting Position: Any
- ♦ Molded Plastic: UL Flammability Classification Rating 94V-0
- ♦ Lead free in compliance with EU RoHS 2011/65/EU directive
- ♦ Solder bath temperature 275°C maximum, 10s per JESD 22-B106



Maximum Ratings at $T_C=25^{\circ}C$ unless otherwise specified

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	650	V
Gate-Source Voltage	V_{GS}	-8/+22	V
Recommended Operation Value	V_{GSop}	-4/+18	V
Continue Drain Current	I_D	20	A
Pulsed Drain Current (Note1)	I_{DM}	80	A
Power Dissipation	P_D	120	W
Operating Temperature Range	T_J	-55 to +175	$^{\circ}C$
Storage Temperature Range	T_{STG}	-55 to +175	$^{\circ}C$
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.43	$^{\circ}C/W$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	60	$^{\circ}C/W$

Note1: Pulse test: 300 μs pulse width, 2 % duty cycle

Electrical Characteristics at Tc=25°C unless otherwise specified

Parameter	Test Condition	Symbol	Min	Typ	Max	Unit
Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	BV_{DSS}	650	-	-	V
Drain-Source Leakage Current	$V_{DS} = 650\text{ V}, V_{GS} = 0\text{ V}$	I_{DSS}	-	-	10	μA
Gate Leakage Current	$V_{GS} = +18\text{ V}, V_{DS} = 0\text{ V}$	I_{GSS}	-	-	100	nA
	$V_{GS} = -4\text{ V}, V_{DS} = 0\text{ V}$		-	-	-100	nA
Gate-Source Threshold Voltage	$V_{DS} = V_{GS}, I_D = 1\text{ mA}$	$V_{GS(th)}$	1.8	2.8	4.3	V
Drain-Source On-State Resistance	$V_{GS} = 18\text{ V}, I_D = 3\text{ A}$	$R_{DS(on)}$	-	184	245	m Ω
	$V_{GS} = 18\text{ V}, I_D = 3\text{ A}, T_J = 175^\circ\text{C}$		-	220	-	
Input Capacitance	$V_{GS} = 0\text{ V}, V_{DS} = 400\text{ V}, f = 1\text{ MHz}$	C_{iss}	-	375	-	pF
Output Capacitance		C_{oss}	-	40	-	pF
Reverse Transfer Capacitance		C_{rss}	-	5.3	-	pF
Coss Stored Energy		E_{oss}	-	4	-	pF
Total Gate Charge(Note2)	$I_D = 5\text{ A}, V_{DD} = 400\text{ V}$	Q_G	-	23	-	nC
Gate to Source Charge(Note2)		Q_{GS}	-	4.3	-	nC
Gate to Drain Charge(Note2)		Q_{GD}	-	12	-	nC
Gate plateau voltage		V_{pl}	-	8.3	-	V
Turn-on Delay Time(Note2)	$V_{DS} = 400\text{ V}, I_D = 5\text{ A}, V_{GS} = -3/+18\text{ V}, R_G = 2.5\text{ }\Omega, L = 200\mu\text{H}$	$td(on)$	-	5	-	ns
Rise Time(Note2)		tr	-	15.7	-	ns
Turn-Off Delay Time(Note2)		$td(off)$	-	11	-	ns
Fall Time(Note2)		tf	-	34	-	ns
Turn-on Switching Energy	$V_{DS} = 400\text{ V}, I_D = 5\text{ A}, V_{GS} = -3/+18\text{ V}, R_G = 2.5\text{ }\Omega, L = 200\mu\text{H}$	E_{on}	-	50	-	μJ
Turn-off Switching Energy		E_{off}	-	8	-	μJ
Maximun Body-Diode Continuous Current		I_S	-	-	20	A
Maximun Body-Diode Pulsed Current(Note2)		I_{SM}	-	-	80	A
Drain-Source Diode Forward Voltage	$V_{GS} = -4\text{ V}, I_{SD} = 3\text{ A}$	V_{SD}	-	3.5	-	V
Reverse Recovery Time(Note2)	$I_{SD} = 5\text{ A}, V_R = 400\text{ V}, dI/dt = 1000\text{ A}/\mu\text{s}$	trr	-	9.3	-	ns
Reverse Recovery Charge(Note2)		Q_{rr}	-	31	-	nC
Peak Reverse Recovery Current		I_{rrm}	-	6.1	-	A

Note2:Pulse test: 300 μs pulse width, 2 % duty cycle

RATINGS AND CHARACTERISTIC CURVES

Fig.1 Forward Output Characteristics at $T_j=25^\circ\text{C}$

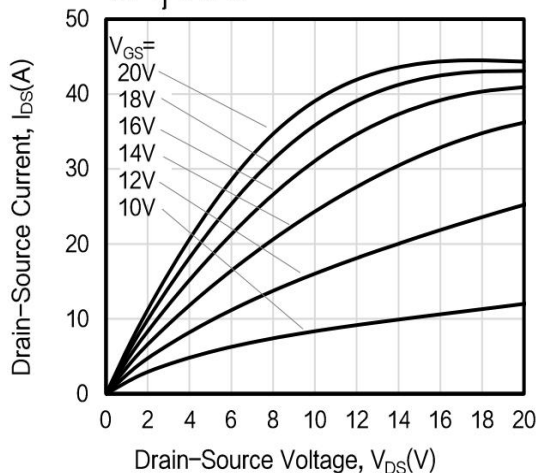


Fig.2 Forward Output Characteristics at $T_j=175^\circ\text{C}$

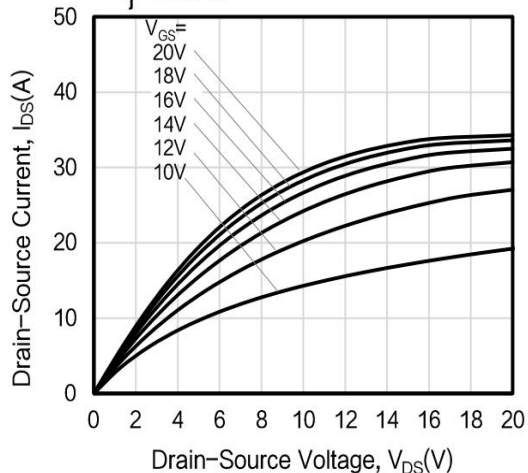


Fig.3 On-Resistance vs. Drain Current for Various T_j

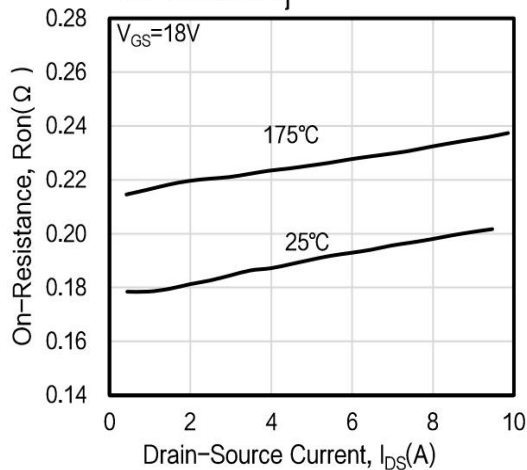


Fig.4 Transfer Characteristics for Various T_j

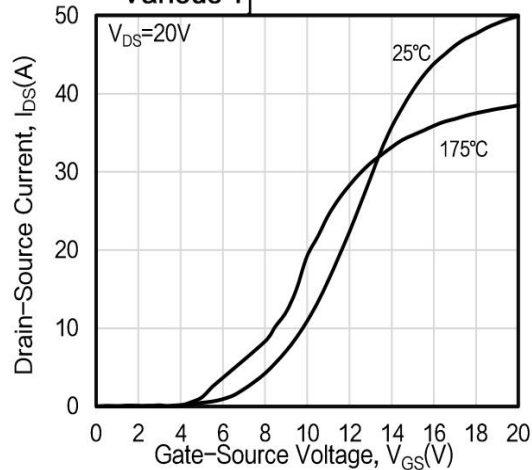


Fig.5 On-Resistance vs. Gate Voltage for Various T_j

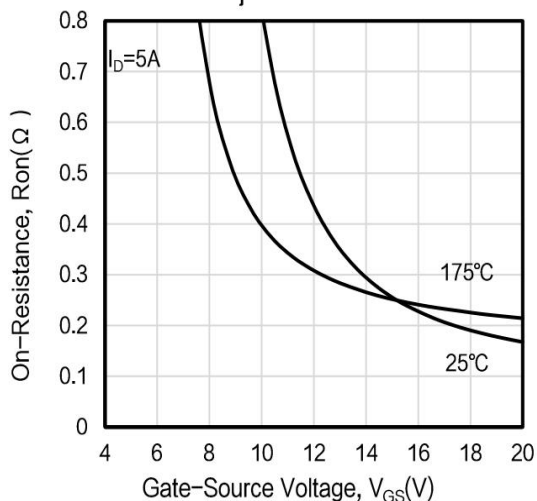
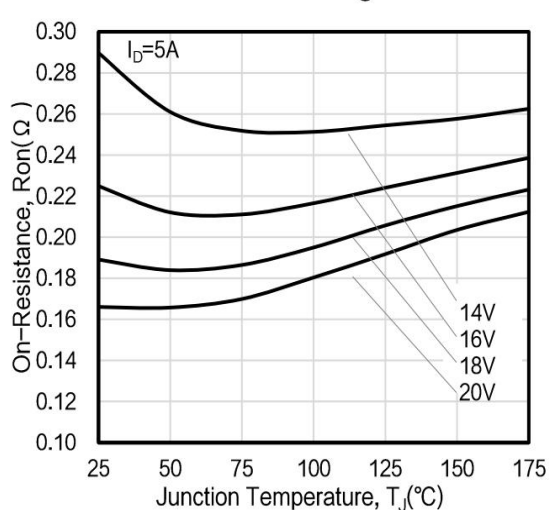


Fig.6 On-Resistance vs. Temperature for Various Gate Voltage



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Fig.7 Normalized On-Resistance vs. Temperature

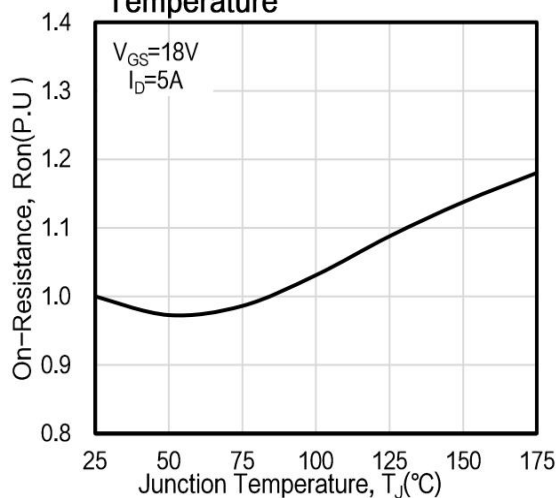


Fig.8 Body Diode Characteristics at $T_J=25^{\circ}C$

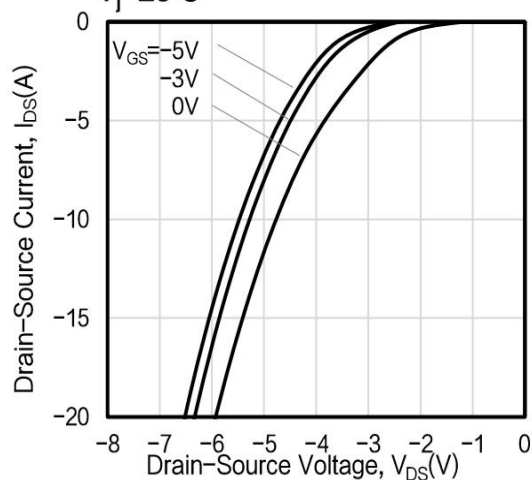


Fig.9 Body Diode Characteristics at $T_J=175^{\circ}C$

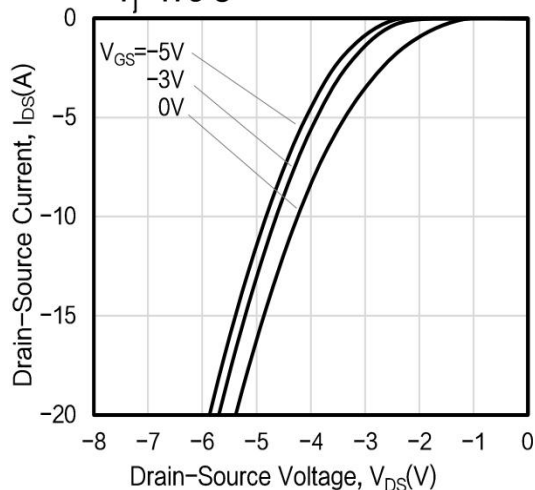


Fig.10 Capacitances vs. Drain to Source Voltage(0 – 200V)

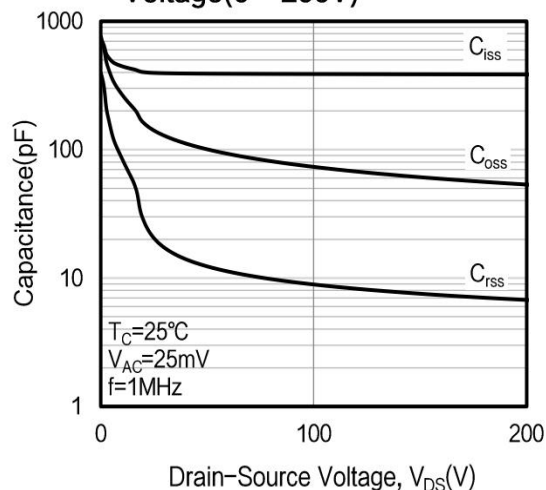


Fig.11 Capacitances vs. Drain to Source Voltage(0 – 400V)

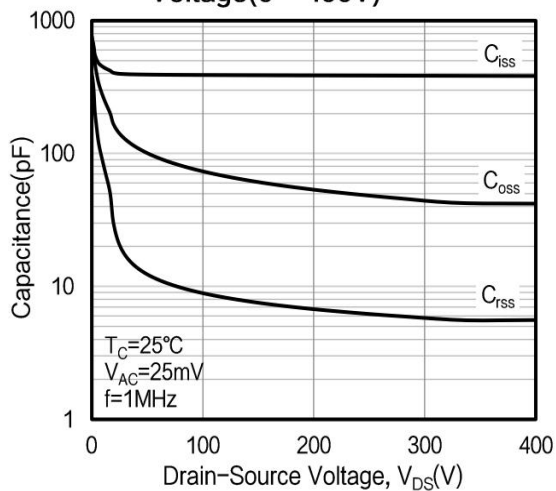
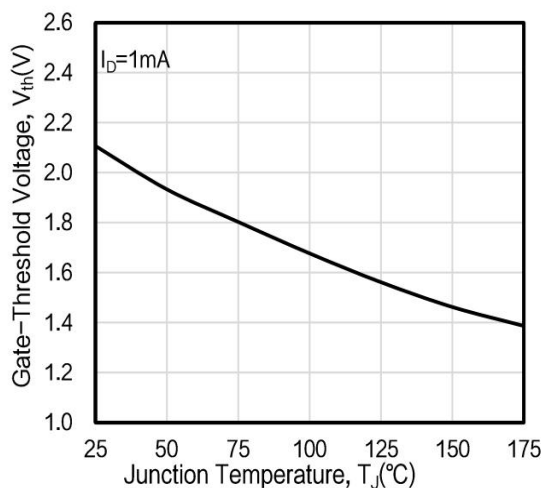


Fig.12 Threshold Voltage vs. Temperature



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Fig. 13 Gate Charge Characteristics

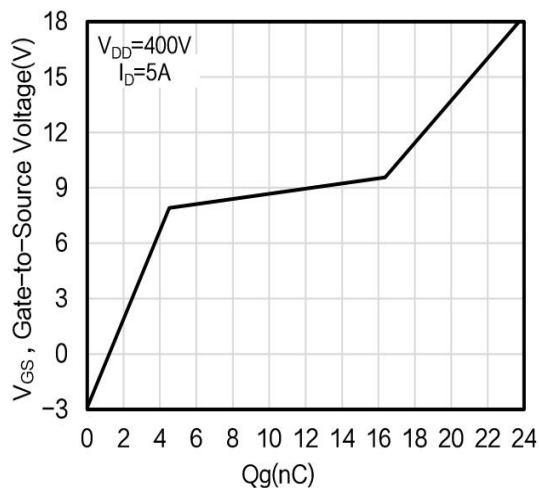


Fig.14 Maximum Power Dissipation Derating vs. Case Temperature

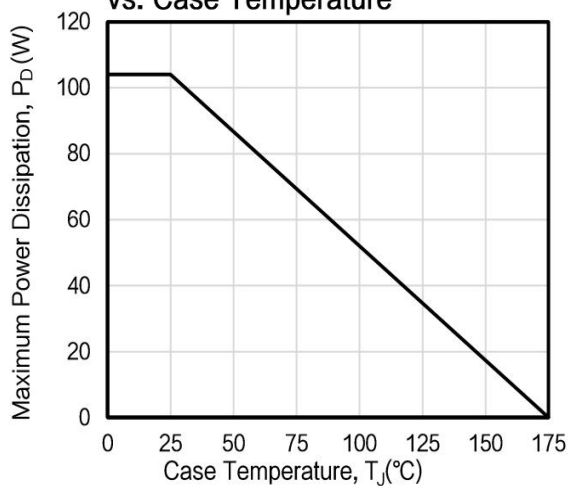


Fig. 15 Drain Current Derating vs. Case Temperature

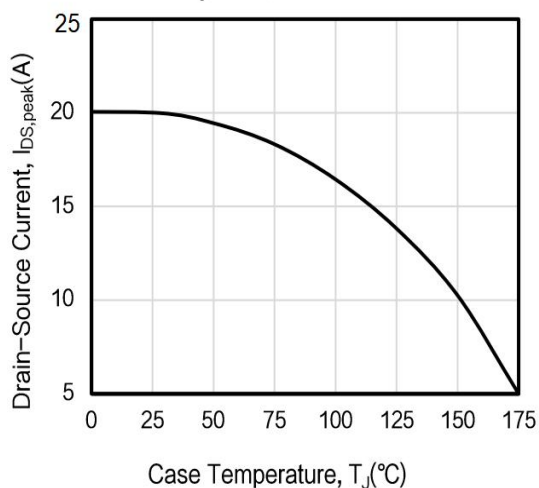


Fig. 16 Transient Junction to Case Thermal Impedance

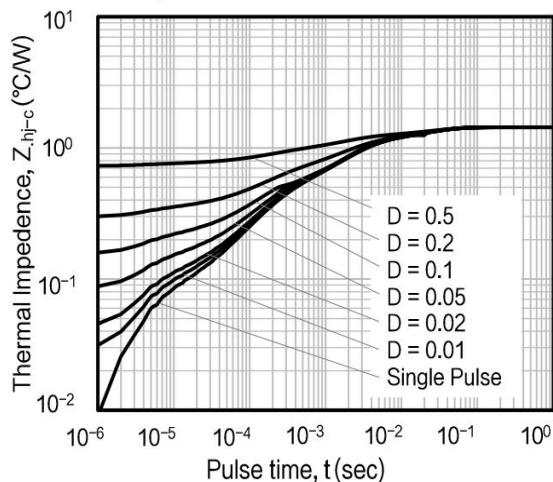


Fig. 17 Safe Operating Area

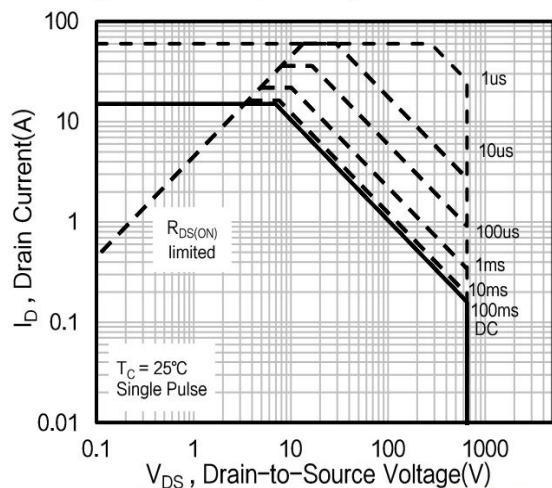
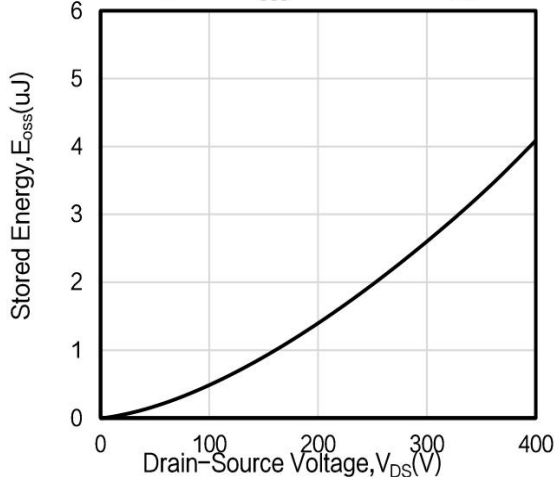
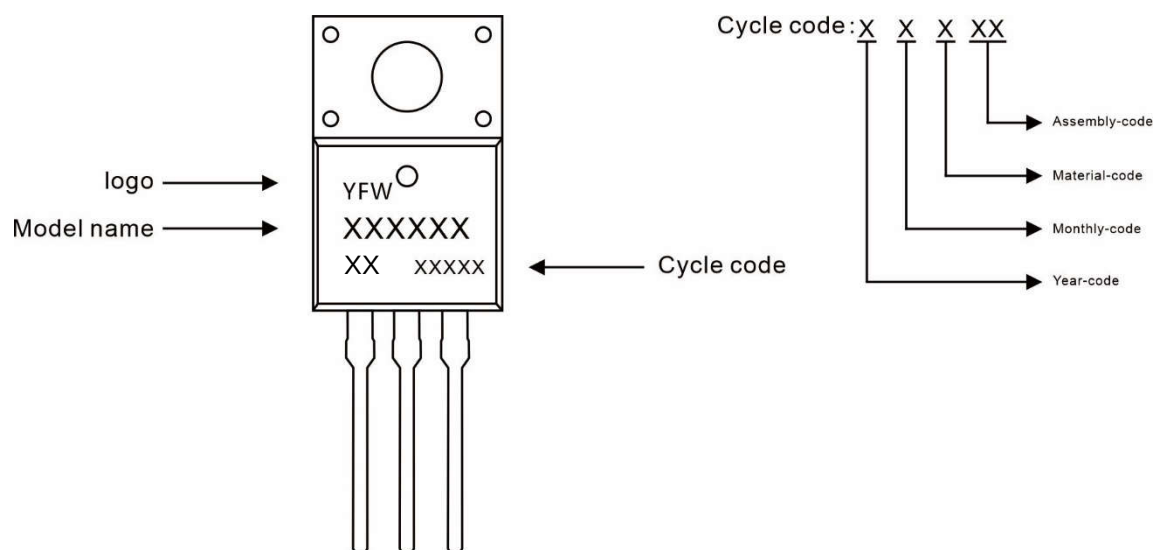


Fig. 18 C_oss Stored Energy



Marking Diagram



Ordering information

Model name	Package	Unit Weight	Base Quantity	Packing Quantity
YFWM319065AFG3	TO-220F	0.06oz(1.74g)	50pcs/tube	1000PCS/Box 5000PCS/Carton

Package Dimensions

TO-220F

Symbol	Millimeter		Inches	
	Min.	Max.	Min.	Max.
A	4.50	4.90	0.177	0.193
A1	2.34	2.74	0.092	0.108
A2	2.66	2.86	0.105	0.113
b	0.75	0.85	0.030	0.033
b1	1.24	1.44	0.049	0.057
c	0.40	0.60	0.016	0.024
D	10.00	10.32	0.394	0.406
E	15.75	16.05	0.620	0.632
e	2.44	2.64	0.096	0.104
e1	4.88	5.28	0.192	0.208
F	3.10	3.5	0.122	0.138
L	13.50	13.90	0.531	0.547
L1	2.90	3.30	0.114	0.130
Φ	3.10	3.30	0.122	0.130

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