



Features

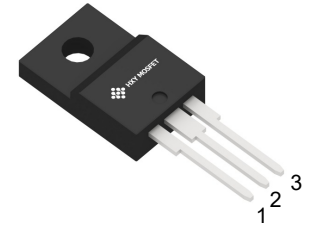
- High Speed Switching with Low Capacitances
- High Blocking Voltage with Low $R_{DS(on)}$
- Easy to parallel
- Simple to drive
- RoHS Compliant

Benefits

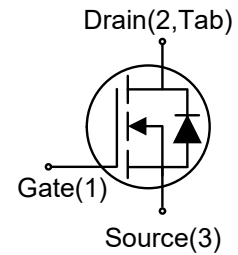
- Increased Power Density
- Faster Operating Frequency
- Reduction of Heat Sink Requirements
- Higher Efficiency
- Reduced EMI

Applications

- Power Factor Correction Modules
- Switch Mode Power Supplies
- DC-AC Inverters
- High Voltage DC/DC Converters



TO-220F



Ordering Part Number	Package	Brand
HCS65R320S-FM	TO-220F	HXY MOSFET

Maximum Ratings ($T_c = 25^\circ\text{C}$ unless otherwise specified)

Symbol	Parameter	Value	Unit	Test Conditions
V_{DSmax}	Drain - Source Voltage	650	V	$V_{GS} = 0\text{ V}$, $I_D = 100\text{ }\mu\text{A}$
V_{GSmax}	Gate - Source Voltage (dynamic)	-5/+26	V	AC ($f > 1\text{ Hz}$)
V_{GSop}	Gate - Source Voltage (static)	0/+18	V	Static
I_D	Continuous Drain Current	15	A	$T_C = 25^\circ\text{C}$
		12		$T_C = 100^\circ\text{C}$
I_{DM}	Pulsed Drain Current	39	A	Pulse width t_p limited by T_{Jmax}
P_D	Power Dissipation	52	W	$T_C = 25^\circ\text{C}$
		25		$T_C = 100^\circ\text{C}$
T_J, T_{stg}	Operating Junction and Storage Temperature	-55 to +175	$^\circ\text{C}$	



Electrical Characteristics ($T_C = 25^\circ\text{C}$ unless other wise specified)

Static Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	$I_D=1\text{ mA}, V_{GS}=0\text{V}$	650			V
I_{DSS}	Zero Gate Voltage Drain Current	$V_{DS}=850\text{V}, V_{GS}=0\text{V}$		1	15	μA
I_{GSS}	Gate-Source Leakage Current	$V_{DS}=0\text{V}, V_{GS}=18\text{V}$			50	$\text{m}\Omega$
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_D=1\text{mA}$ $T_J=25^\circ\text{C}$ $T_J=175^\circ\text{C}$		3.5 2.8	4	V
$R_{DS(on)}$	Drain-Source On-State Resistance	$V_{GS}=18\text{V}, I_D=4.5\text{A}$ $T_J=25^\circ\text{C}$ $T_J=175^\circ\text{C}$		180 205	220	$\text{m}\Omega$
	Drain-Source On-State Resistance	$V_{GS}=15\text{V}, I_D=4.5\text{A}$ $T_J=25^\circ\text{C}$ $T_J=175^\circ\text{C}$		260 295	300	nA
C_{iss}	Input Capacitance	$V_{DS}=400\text{V}, f=1\text{MHz},$ $V_{GS}=0\text{V}$		180		pF
C_{oss}	Output Capacitance			20		pF
C_{rss}	Reverse Transfer Capacitance			0.9		pF
Q_g	Total Gate Charge	$V_{DS}=400\text{V}, I_D=5\text{A},$ $R_G = 10\ \Omega$ $V_{GS} = 0/15\text{V}$		11.2		nC
Q_{gs}	Gate to Source Charge			2.3		nC
Q_{gd}	Gate to Drain Charge			1.1		nC
$t_{d(on)}$	Turn-On Delay Time	$V_{DD}=400\text{V}, I_D=5\text{ A},$ $V_{GS}=-5/18\text{ V},$ $R_G=10\ \Omega ,$		5		ns
t_r	Rise Time			17		ns
$t_{d(off)}$	Turn-Off Delay Time			8		ns
t_f	Fall Time			10		ns
E_{on}	Turn-On Energy			25		μJ
E_{off}	Turn-Off Energy			10		μJ



Reverse Diode Characteristics

Symbol	Parameter	Test conditions	Value			Unit
			Min.	Typ.	Max.	
V_{SD}	Diode Forward Voltage	$V_{GS}=-4V$, $I_{SD}=2.5A$ $T_j=25^{\circ}C$ $T_j=175^{\circ}C$		4.0 3.6		V
I_S	Continuous Diode Forward Current	$T_c=25^{\circ}C$ $T_c=100^{\circ}C$		15 12		A
t_{rr}	Reverse Recovery Time	$I_{SD}=-5A$ $V_{GS}=-5V$, $I_{SD}=4.5A$, $V_R=400V$, $di/dt=1000A/\mu s$		50		ns
Q_{rr}	Reverse Recovery Charge			38		nC
I_{rrm}	Peak Reverse Recovery Current			2.4		A

Thermal Characteristics

Symbol	Parameter	Value			Unit
		Min.	Typ.	Max.	
$R_{th(j-c)}$	Thermal Resistance from Junction to Case		2.88		$^{\circ}C/W$
$R_{th(j-a)}$	Thermal Resistance from Junction to Ambient		40		$^{\circ}C/W$



Typical Performance

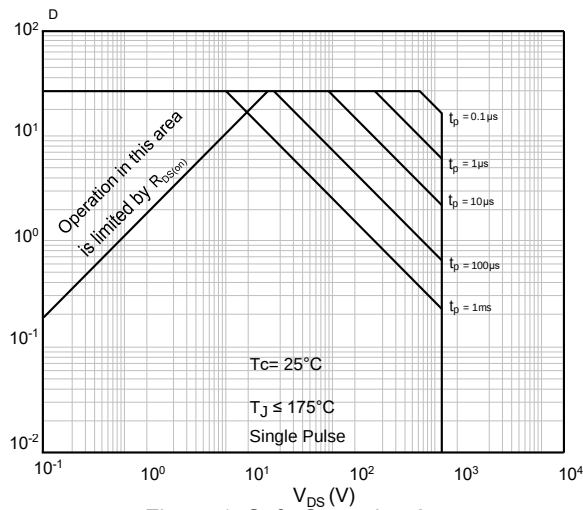


Figure 1. Safe Operating Area

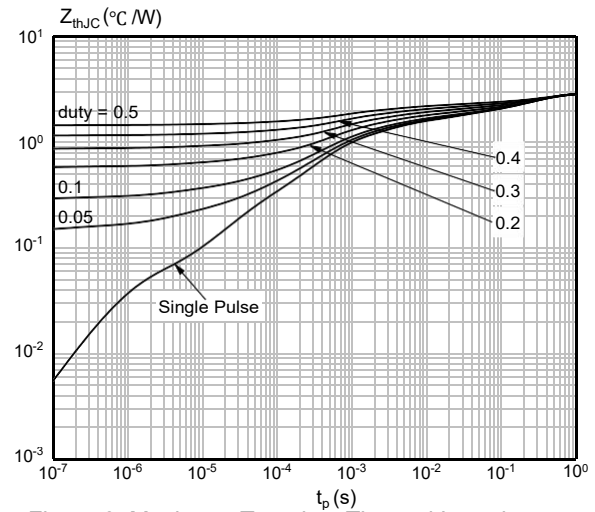


Figure 2. Maximum Transient Thermal Impedance

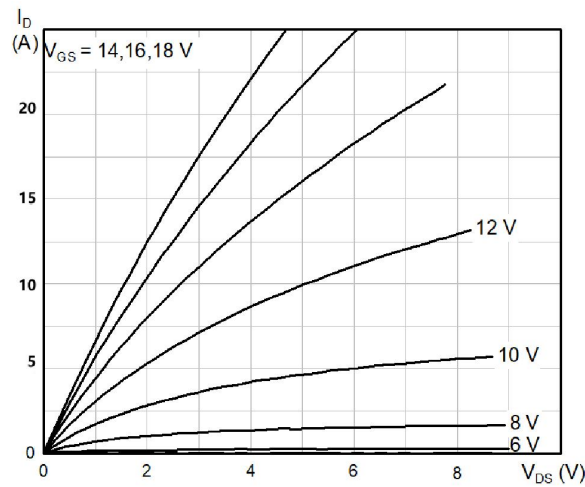


Figure 3. Typical Output Characteristics, $T_J = 25^\circ\text{C}$

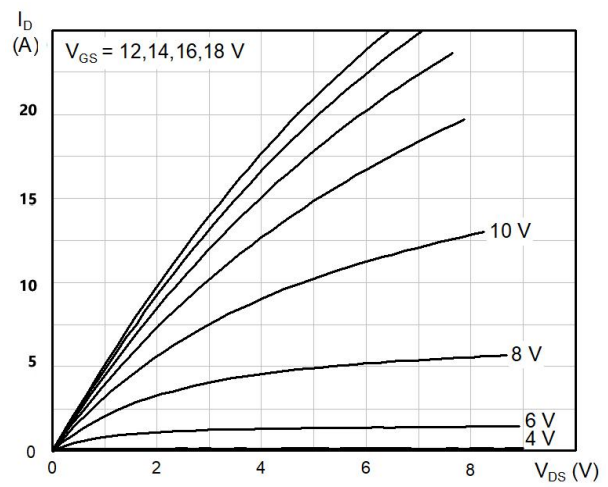


Figure 4. Typical Output Characteristics, $T_J = 175^\circ\text{C}$

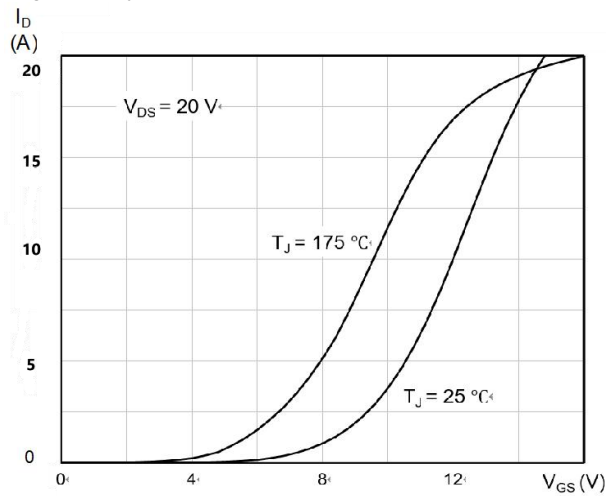


Figure 5. Typical Transfer Characteristics

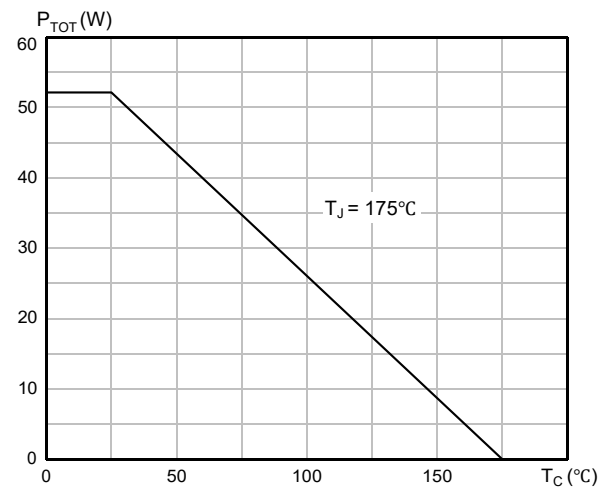
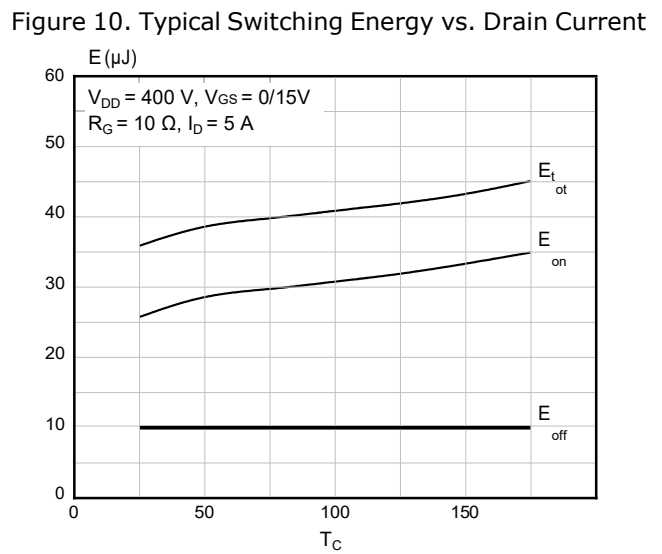
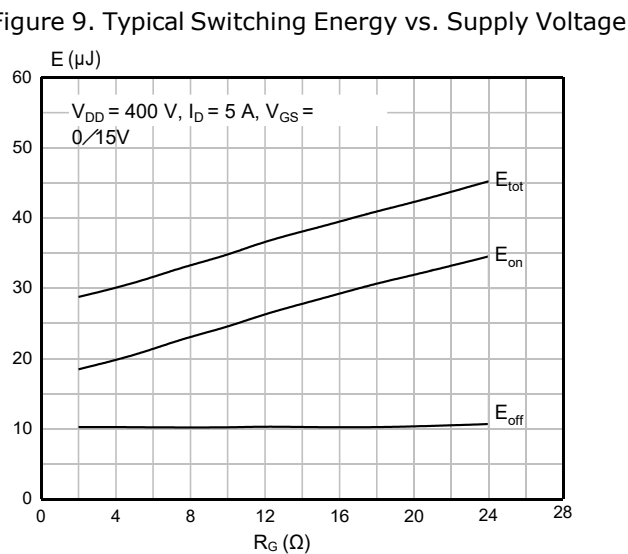
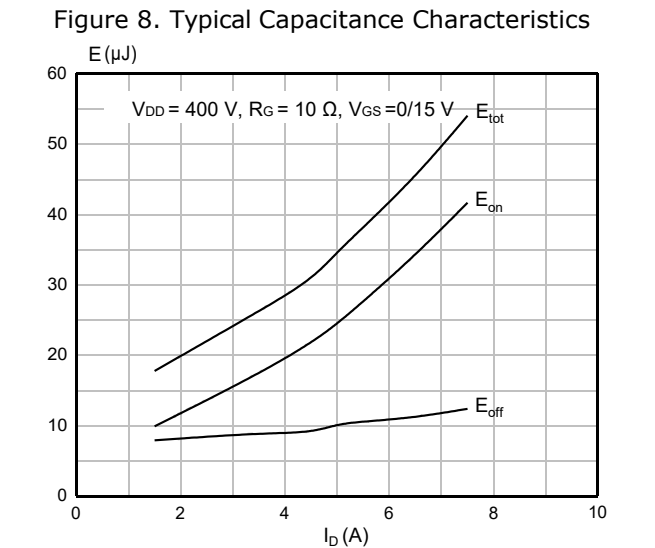
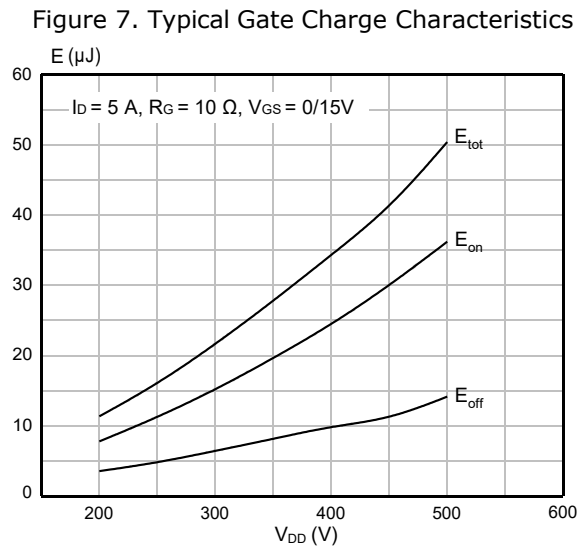
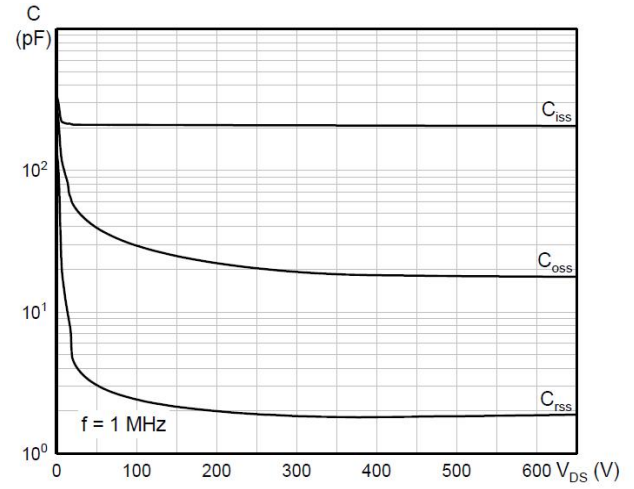
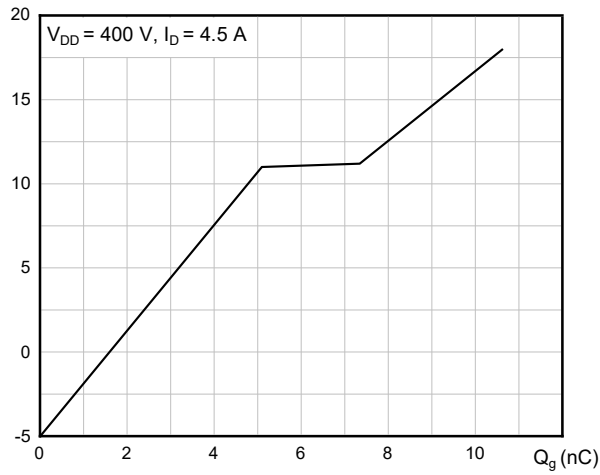


Figure 6. Total Power Dissipation



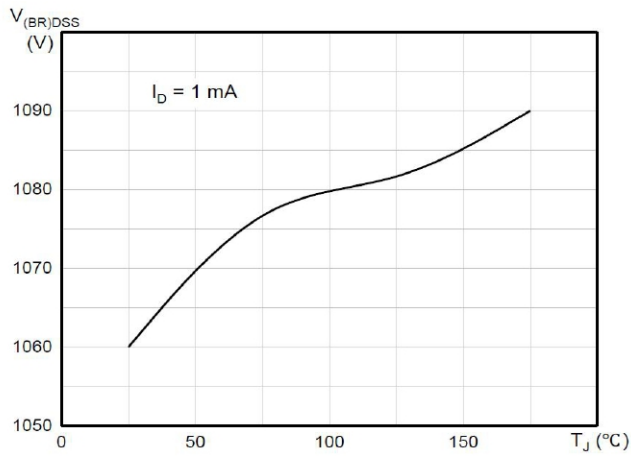


Figure 13. Breakdown Voltage vs. Temperature

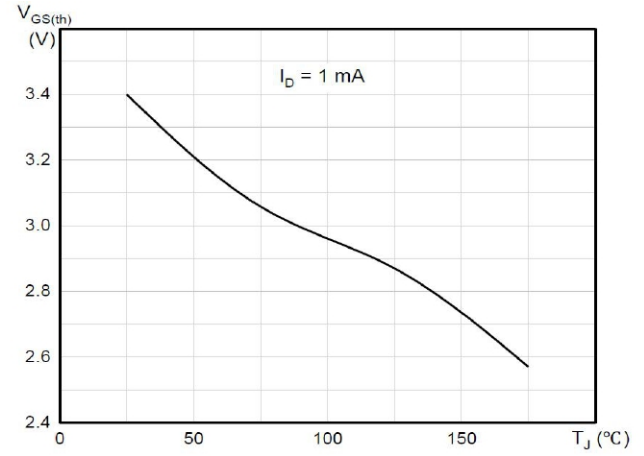


Figure 14. Gate Threshold vs. Temperature

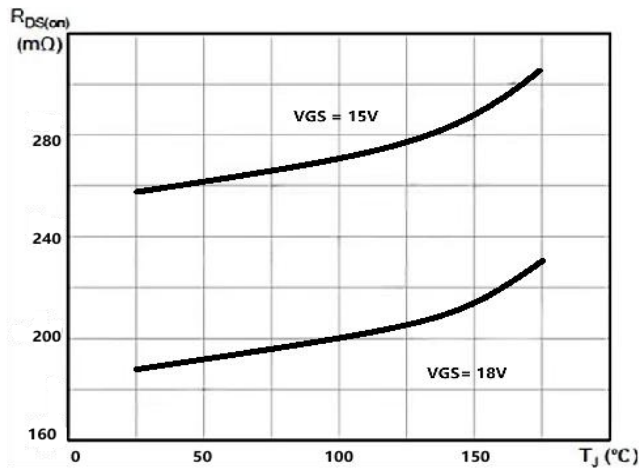


Figure 15. On-Resistance vs. Temperature

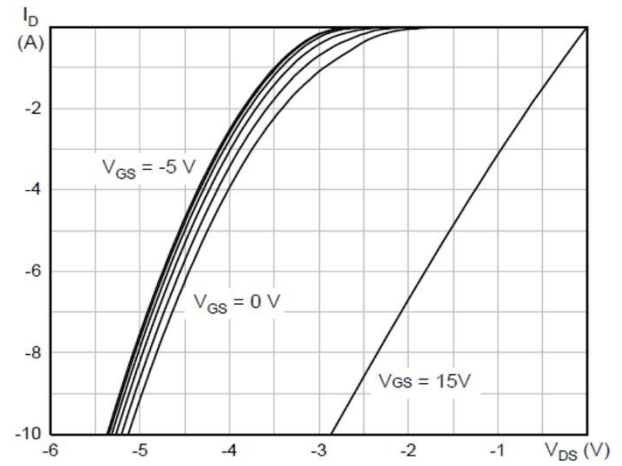


Figure 16. Body Diode Characteristics, $T_J = 25^\circ \text{C}$

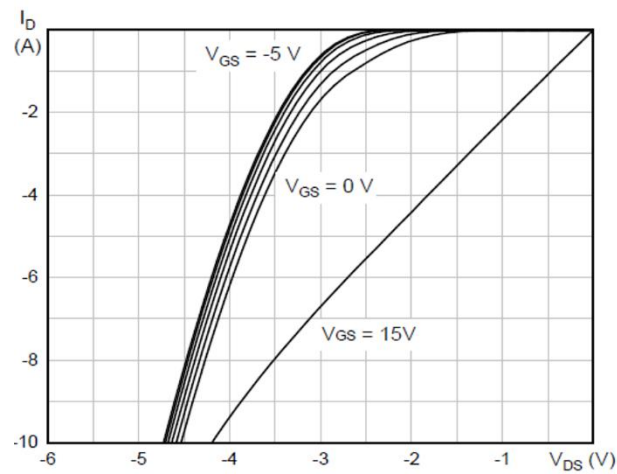
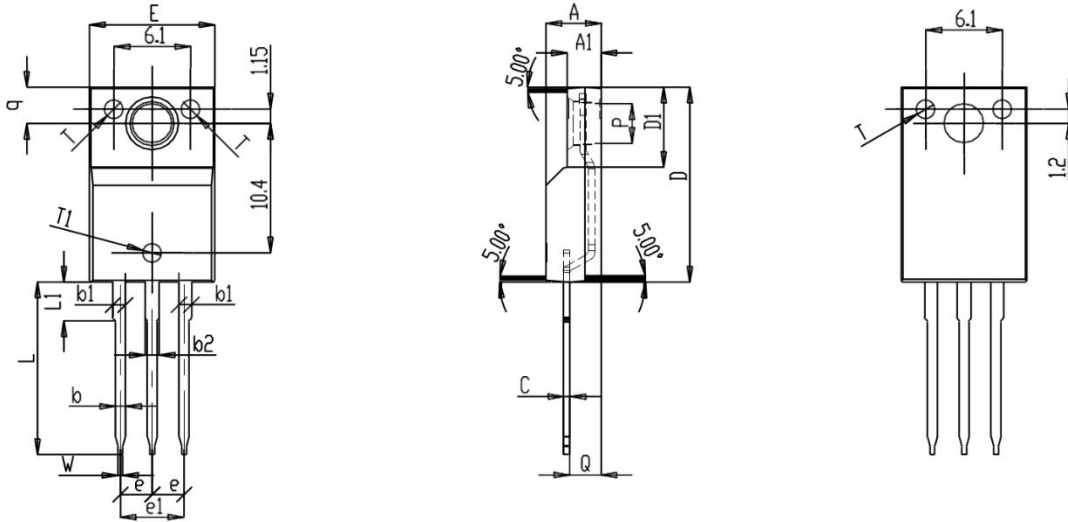


Figure 17. Body Diode Characteristics, $T_J = 175^\circ \text{C}$



Package Dimensions

Package TO-220F



SYMBOL	MILLIMETERS			NOTES	SYMBOL	MILLIMETERS			NOTES
	Normal	MIN.	MAX.			Normal	MIN.	MAX.	
A	4.4	4.2	4.6		e1	5.08	5	5.12	
A1	2.7	2.5	2.9		L	13.90	13.5	14.4	
b	0.8	0.7	0.9		L1	3.12	2.8	3.3	
b1	1.07	0.9	1.3		P	3.14	3.00	3.20	
b2	1.17	1	1.4		Q	2.44	2.3	2.6	
C	0.5	0.4	0.6		q	2.87	2.6	3	
D	15.63	15.4	15.8		W	0.37	0.3	0.5	
D1	6.22	6	6.4		T	1.52	1.3	1.7	
E	10.06	9.7	10.3		T1	1.20	1.1	1.3	
e	2.54	2.5	2.58						



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