



PFC Device Corporation

## PSM20N65CTF

### 20A 650V Single N-Channel Power MOSFET

#### Major ratings and characteristics

Characteristics	Values	Units
$V_{DS}@T_J \text{ max}$	650	V
$R_{DS(ON)}, V_{GS}=10V$	0.19	$\Omega$
$I_D$	20	A

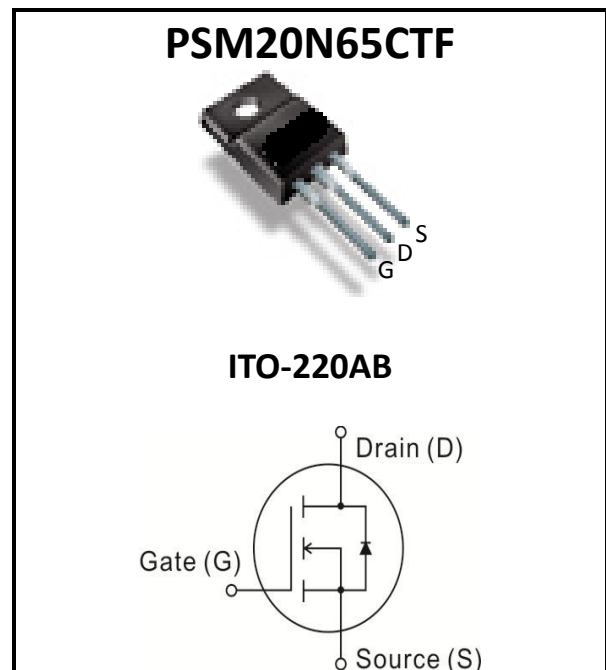
#### General Description

PFC MLSJ (Multi-Layer Super Junction) MOSFET technology is the ideal choice for the PFC and PWM application. PFC device provides practical advantages of higher pressure-resistance, lower on-resistance to achieve the ideal balance between the switching speed and on-resistance.

#### Typical Applications

PFC stages, hard switching PWM stages and resonant switching stages for PC, Adapter, LCD & PDP TV, Lighting, Server, Telecom and UPS.

*Please note: For MOSFET paralleling the use of ferrite beads on the gate or separate totem poles is generally recommended.*



#### Features

- Advanced High Voltage Technology
- Low On-Resistance
- Low Gate Threshold Voltage
- Low Input Capacitance
- Extreme dv/dt rated
- Lead Free Finish, RoHS Compliant

## 1. Characteristics

### Maximum Ratings Characteristics

(  $T_A = 25^\circ\text{C}$  unless otherwise specified )

Symbol	Parameter	Rating	Units
$V_{DSS}$	Drain-Source Voltage	650	V
$I_D$	Drain Current – Continuous ( $T_C=25^\circ\text{C}$ )	20	A
	Drain Current – Continuous ( $T_C=100^\circ\text{C}$ )	13	A
$I_{D\text{ pulsed}}$	Pulsed Drain Current tp limited by $T_J$ max (Note 1)	60	A
$E_{AS}$	Single Pulse Avalanche Energy (Noted 2)	300	mJ
$E_{AR}$	Avalanche Energy, repetitive $t_{AR}$ limited by $T_{jmax}$ (Note 3) $I_D=20\text{A}$ , $V_{DD}=50\text{V}$	1	mJ
$I_{AR}$	Avalanche Current, repetitive $t_{AR}$ limited by $T_{jmax}$	20	A
$V_{GS}$	Gate-Source Voltage Static	$\pm 20$	V
$V_{GS}$	Gate-Source Voltage AC ( $f>1\text{Hz}$ )	$\pm 30$	V
$P_{tot}$	Power Dissipation	34.5	W
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating Junction Temperature Range	-55 to 150	$^\circ\text{C}$
dv/dt	Peak Diode Recovery dv/dt (Note 4)	15	V/nS
dv/dt	MOSFET dvdt ruggedness, $V_{DS}=480\text{V}$	50	V/nS

### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Unit
$R_{\theta JA}$	Thermal Resistance Junction to ambient	---	80	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance Junction to case (Drain)	---	3.6	$^\circ\text{C/W}$



## Electrical Characteristics ( $T_J = 25^\circ\text{C}$ unless otherwise specified )

### Off Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_D=250\mu A$	650	---	---	V
$I_{DSS}$	Drain-Source Leakage Current	$V_{DS}=600V, V_{GS}=0V, T_J=25^\circ\text{C}$	---	0.05	1	$\mu A$
		$V_{DS}=600V, V_{GS}=0V, T_J=150^\circ\text{C}$	---	---	100	$\mu A$
$I_{GSS}$	Gate-Source Leakage Current	$V_{GS}=\pm 30V, V_{DS}=0V$	---	---	$\pm 100$	nA

### On Characteristics

$R_{DS(ON)}$	Static Drain-Source On-Resistance	$V_{GS}=10V, I_D=13A, T_J=25^\circ\text{C}$	---	0.165	0.190	$\Omega$
		$V_{GS}=10V, I_D=13A, T_J=150^\circ\text{C}$	---	0.45	---	$\Omega$
$V_{GS(th)}$	Gate-Source Threshold Voltage	$V_{GS}=V_{DS}, I_D=1000\mu A$	2.8	3.2	3.9	V
$R_G$	Gate input resistance	f=1MHz, open Drain	---	0.54	---	$\Omega$

### Dynamic and switching Characteristics

$Q_{gs}$	Gate-Source Charge	$V_{DD}=480V, I_D=20A,$ $V_{GS}=0$ to 10V	---	13	---	nC
$Q_{gd}$	Gate-Drain Charge		---	33	---	
$Q_g$	Gate charge total		---	75	110	
$V_{(plateau)}$	Gate plateau voltage		---	5.9	---	V
$g_{fs}$	Transeconductance	$V_{DS} \geq 2 \cdot I_D \cdot R_{DS(on)max}, I_D=13A$	---	20.5	---	S
$T_{d(on)}$	Turn-On Delay Time	$V_{DD}=380V, V_{GS}=0/13V, I_D=20A,$ $R_g=3.6\Omega, T_J=25^\circ\text{C}$	---	8	---	nS
$T_r$	Rise Time		---	34	---	
$T_{d(off)}$	Turn-Off Delay Time		---	42	---	
$T_f$	Fall Time		---	58	---	
$C_{iss}$	Input Capacitance	$V_{GS}=0V, V_{DS}=100V$ f=1 MHz	---	2400	---	pF
$C_{oss}$	Output Capacitance		---	81	---	
$C_{rss}$	Reverse Transfer Capacitance		---	32	---	

### Drain-Source Diode Characteristics and Maximum ratings

$V_{SD}$	Inverse diode forward voltage	$I_S = 20A, V_{GS} = 0V$	---	0.91	1.2	V
$t_{rr}$	Reverse Recovery Time	$V_R=480V, I_F=I_S,$ $di_F/dt=100A/\mu S$	---	491	800	nS
$Q_{rr}$	Reverse Recovery Charge		---	10	---	$\mu C$
$I_{rrm}$	Peak reverse recovery current		---	42	---	A

Note :

1. Repetitive Rating: Pulsed width limited by maximum junction temperature.
2.  $V_{DD}=50V, I_D=10A$ , Starting  $T_J=25^\circ\text{C}$ .
3. Repetitive avalanche cause additional power lose that can be calculated as  $P_{AV}=E_{AR} \cdot f$ .
4.  $I_{SD} \leq I_D, di/dt \leq 400A/\mu s, T_J < T_{J,max}$



2. Characteristics Curves

Ratings and Characteristics Curves

( $T_A = 25^{\circ}\text{C}$  unless otherwise specified)

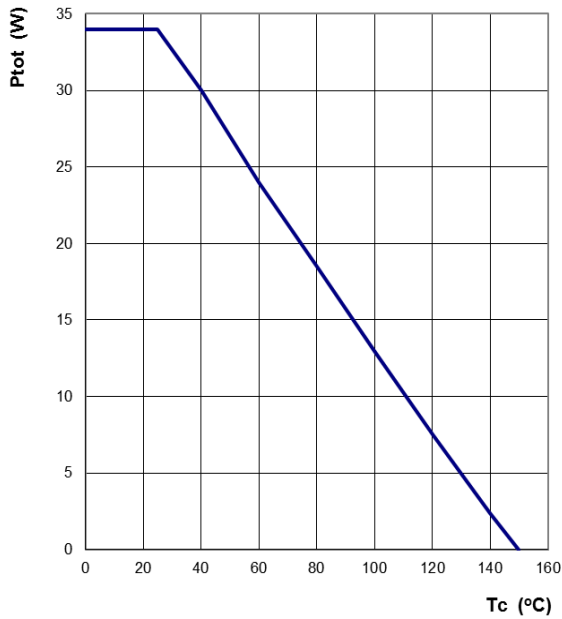


Figure 1: Power Dissipation  
 $P_{tot} = f(T_c)$

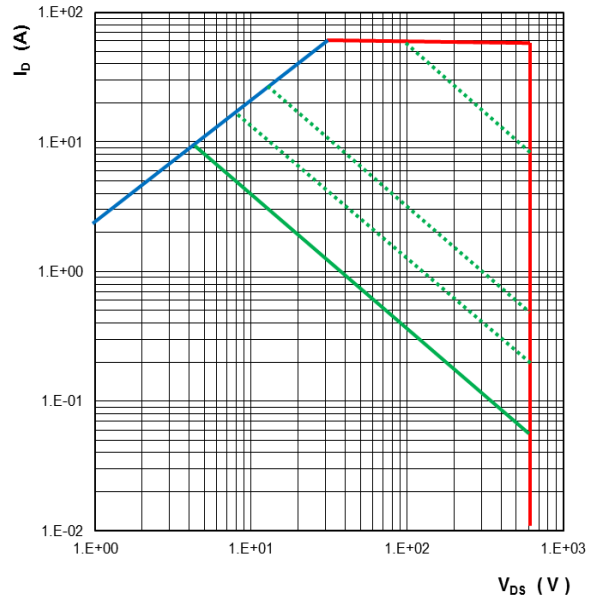


Figure 2: Safe operating area  
 $I_D = f(V_{DS})$   
parameter :  $D = 0, T_c = 25^{\circ}\text{C}$

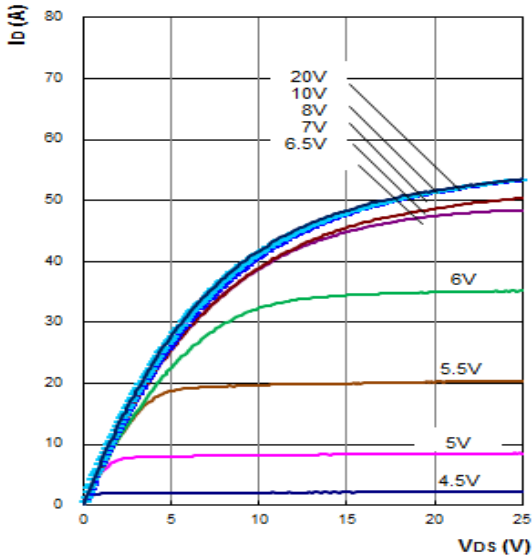


Figure 3: Typ. Output Characteristics  
 $I_D = f(V_{DS}) ; T_J = 25^{\circ}\text{C}$   
parameter :  $t_p = 100\mu\text{s}, V_{GS}$

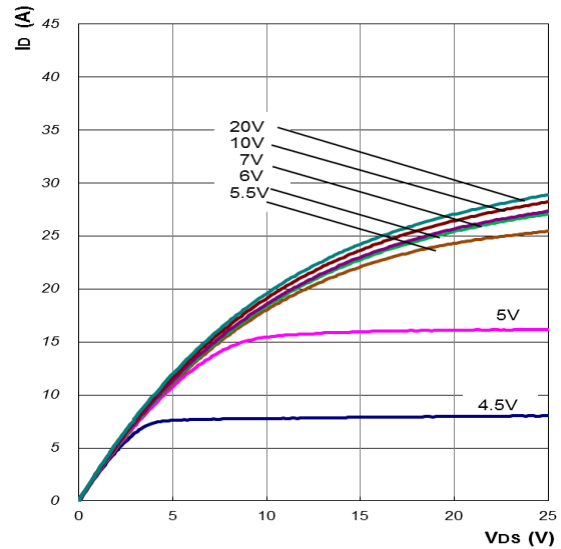


Figure 4: Typ. Output Characteristics  
 $I_D = f(V_{DS}) ; T_J = 150^{\circ}\text{C}$   
parameter :  $t_p = 100\mu\text{s}, V_{GS}$



Ratings and Characteristics Curves

( $T_A = 25^\circ\text{C}$  unless otherwise specified)

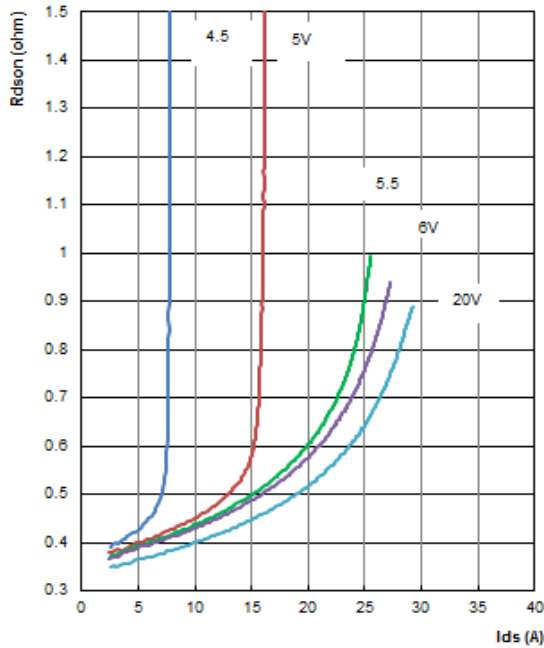


Figure 5: Typ. Drain Source On-Resistance  
 $R_{DS(on)} = f(I_D)$   
 parameter :  $t_p = 100\mu\text{s}$ ,  $T_J = 150^\circ\text{C}$ ,  $V_{GS}$

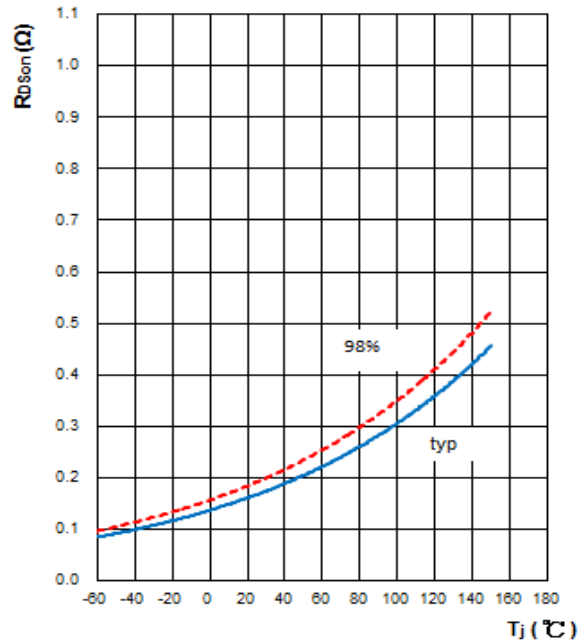


Figure 6: Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_J)$   
 parameter :  $I_D = 13\text{A}$ ,  $V_{GS} = 10\text{V}$

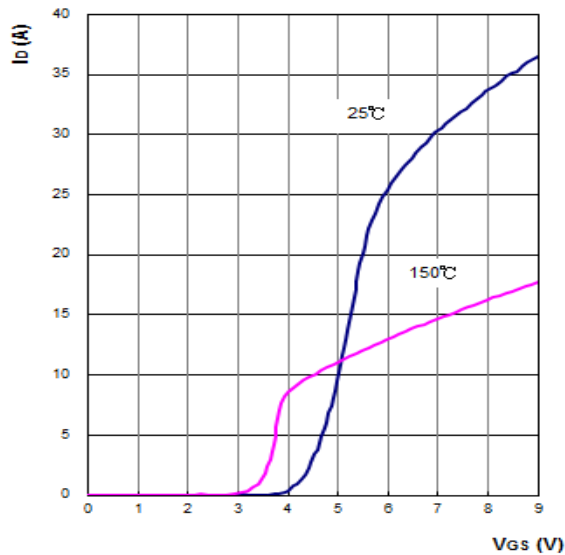


Figure 7: Typ. Transfer Characteristics  
 $I_D = f(V_{GS})$ ;  $V_{DS} \geq 2 \times I_D \times R_{DS(on)} \text{ max}$   
 parameter :  $t_p = 100 \mu\text{s}$

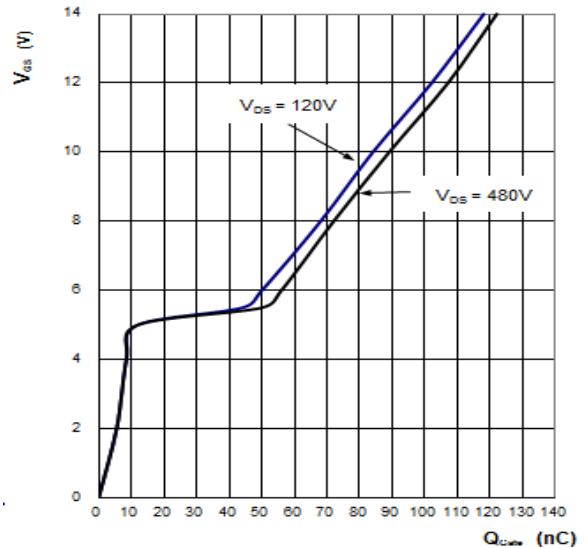


Figure 8: Typ. Gate Charge  
 $V_{GS} = f(Q_{GATE})$   
 parameter :  $I_D = 20\text{A}$  pulsed



Ratings and Characteristics Curves

(  $T_A = 25^\circ\text{C}$  unless otherwise specified )

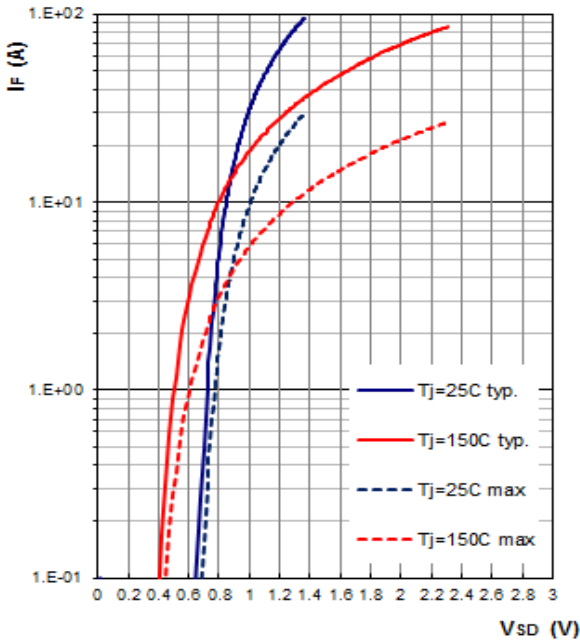


Figure 9: Forward characteristics of body diode  
 $I_F = f(V_{DS})$   
 parameter :  $T_J, t_p=100\mu\text{s}$

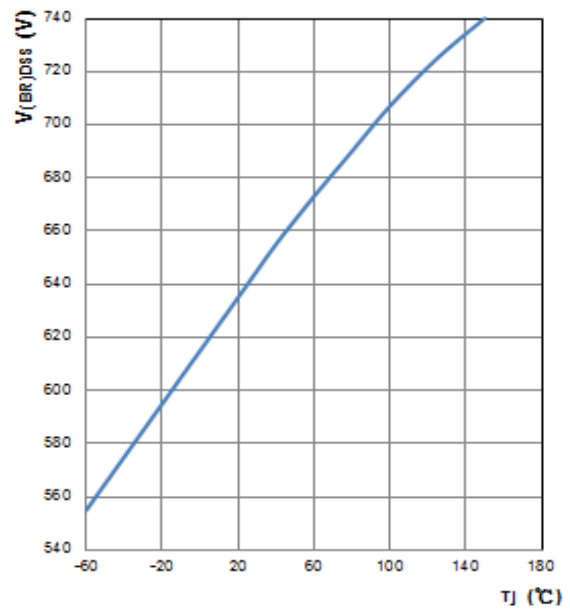


Figure 10: Drain-source breakdown voltage  
 $V_{(BR)DSS} = f(T_J)$

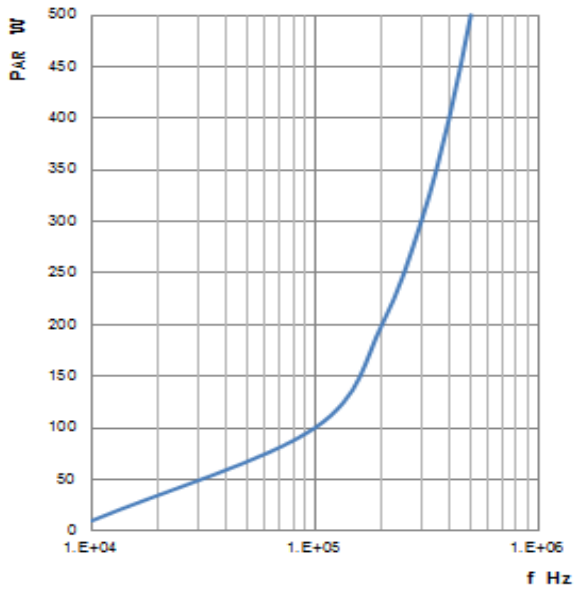


Figure 11: Avalanche power losses  
 $P_{AR} = f(f)$   
 parameter :  $E_{AR}=1\text{mJ}$

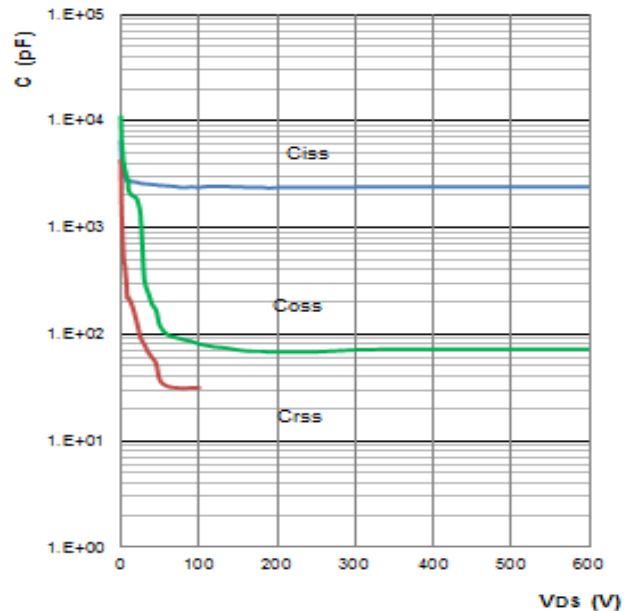
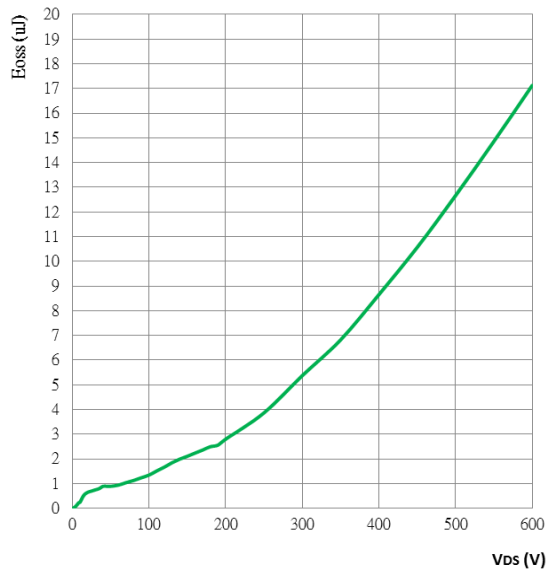


Figure 12: Typ. Capacitances  
 $C = f(V_{DS})$   
 parameter :  $V_{GS}=0\text{V}, f=1\text{MHz}$





**Figure 13: Typ.  $C_{oss}$  stored energy**  
 $E_{oss}=f(V_{DS})$



3. Test Circuits and Waveforms

Test Circuits and Waveforms

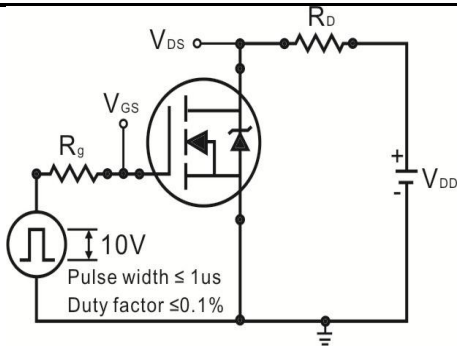


Figure 1: Switching times test circuit

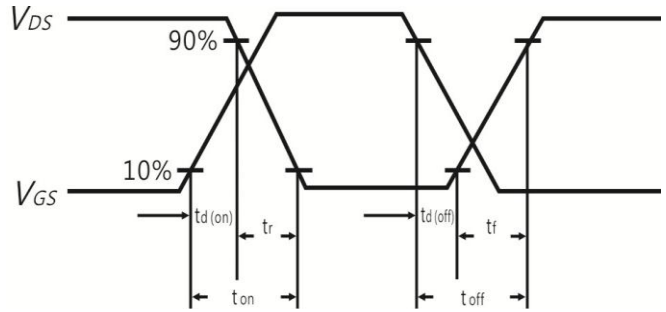


Figure 2: Switching time waveform

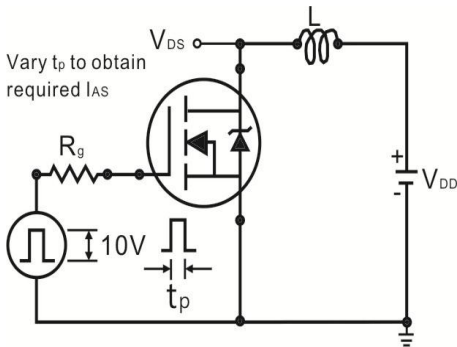


Figure 3: Unclamped test circuit

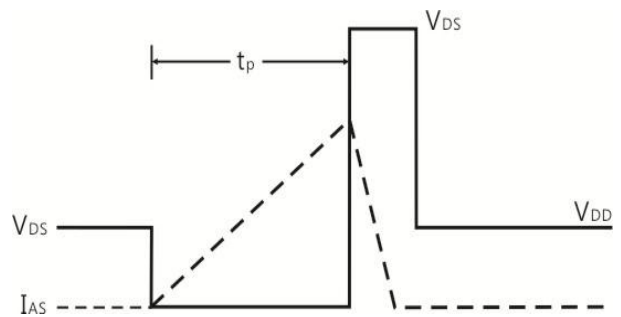


Figure 4: Unclamped test waveform

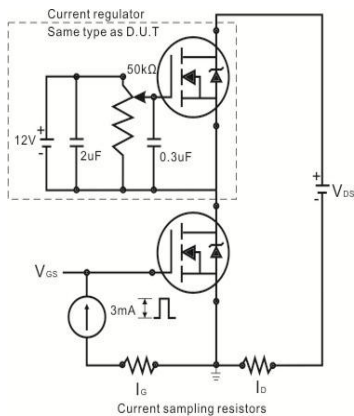


Figure 5: Gate charge test circuit

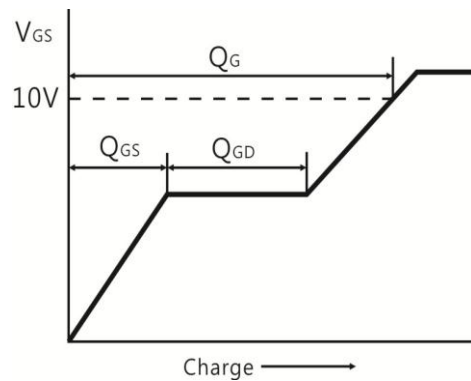


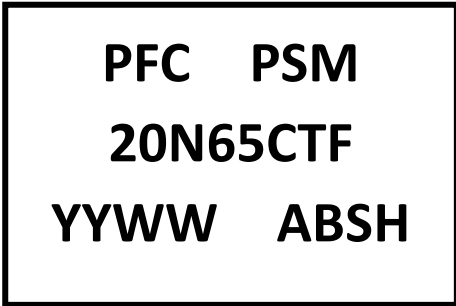
Figure 6: Basic gate charge waveform





4. Marking information

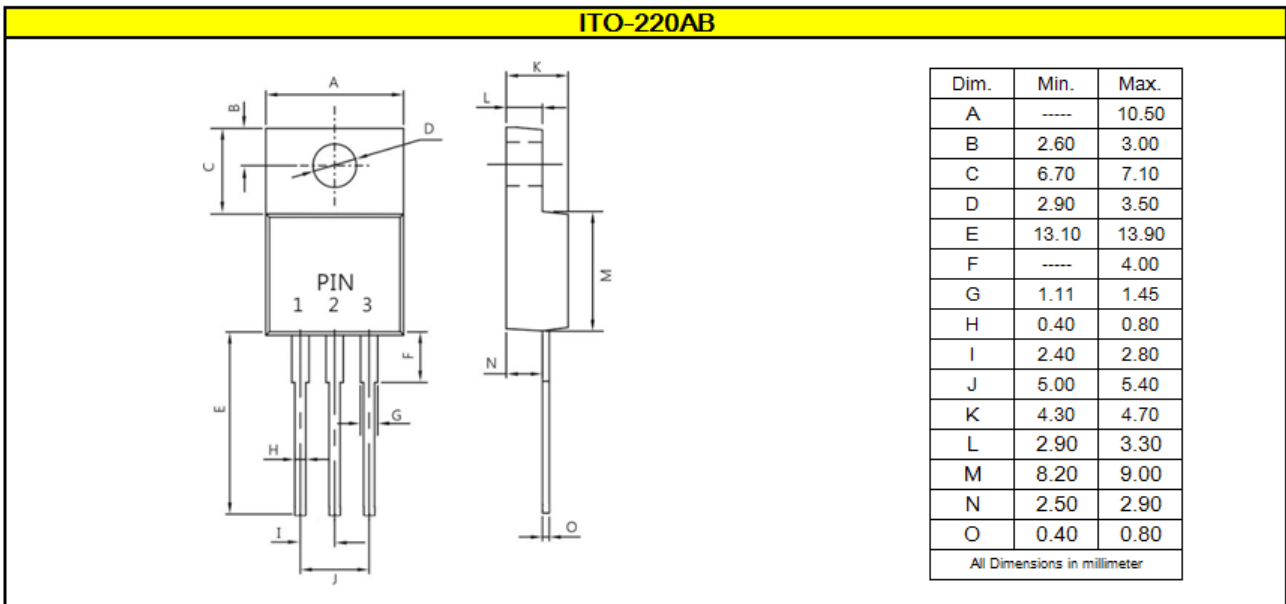
Top Marking Rule



PSM20N65CTF = Product Type Marking Code  
 YY = Last two digits of year  
 WW = Week code  
 ABS = Assembly code  
 H = Halogen Free (N/A = common molding compound)

5. Package information

Package Outline Dimensions millimeters



**6. Ordering information**

Part Number	Package	Delivery mode
PSM20N65CTF	ITO-220AB	50 pieces / tube

Note: For Halogen Free molding compound, add "H" suffix to part number above.

Mechanical

- Case: ITO-220AB
- Molder Plastic: UL Flammability Classification Rating 94V-0
- Device Weight : 0.06 ounces (1.74grams)
- Mounting Torque : 10 in-lbs maximum.

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