



PFC Device Corporation

PSM20N65CT

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	Ω
I_D	20	A

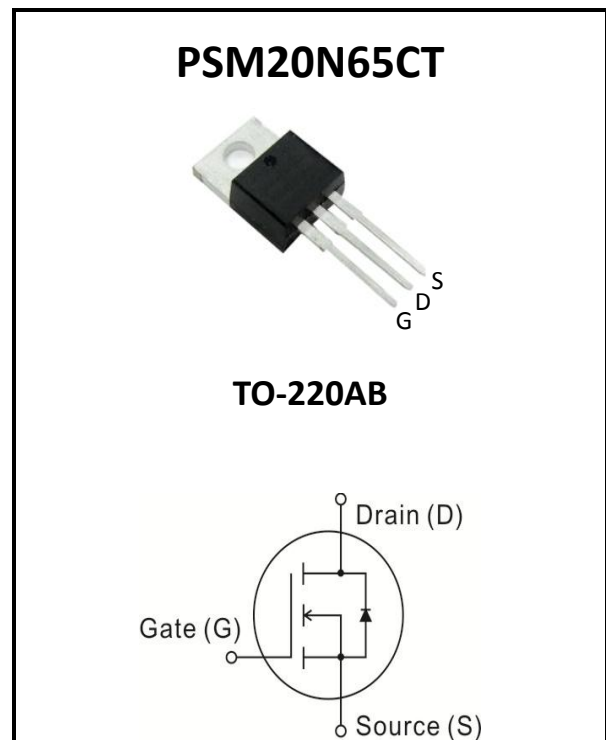
General Description

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_{imax} (Note 3) $I_D=20\text{A}$, $V_{DD}=50\text{V}$	1	mJ
I_{AR}	Avalanche Current, repetitive t_{AR} limited by T_{imax}	20	A
V_{GS}	Gate-Source Voltage Static	± 20	V
V_{GS}	Gate-Source Voltage AC ($f>1\text{Hz}$)	± 30	V
P_{tot}	Power Dissipation	204	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	---	62	$^\circ\text{C/W}$
$R_{\theta JC}$	Thermal Resistance Junction to case (Drain)	---	0.61	$^\circ\text{C/W}$



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	μA
		$V_{DS}=600V, V_{GS}=0V, T_J=150^\circ\text{C}$	---	---	100	μA
I_{GSS}	Gate-Source Leakage Current	$V_{GS}=\pm 30V, V_{DS}=0V$	---	---	± 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	Ω
		$V_{GS}=10V, I_D=13A, T_J=150^\circ\text{C}$	---	0.45	---	Ω
$V_{GS(th)}$	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	---	Ω

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	$V_{DS} \geq 2 * I_D * R_{DS(on)max}, I_D=13A$	---	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	---	μC
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 $P_{AV}=E_{AR} * f$.
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)

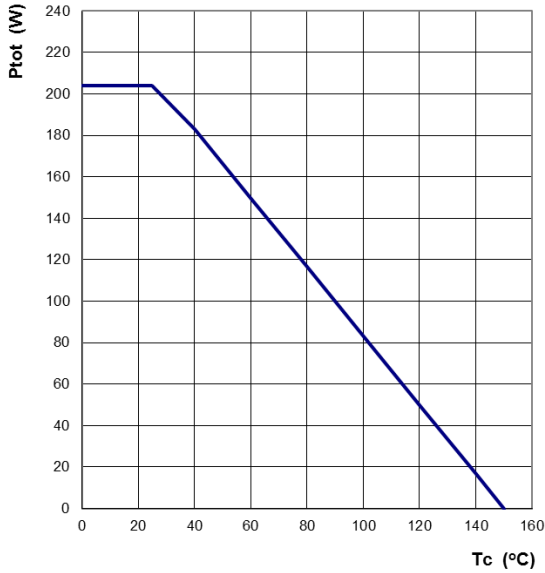


Figure 1: Power Dissipation
 $P_{tot} = f(T_c)$

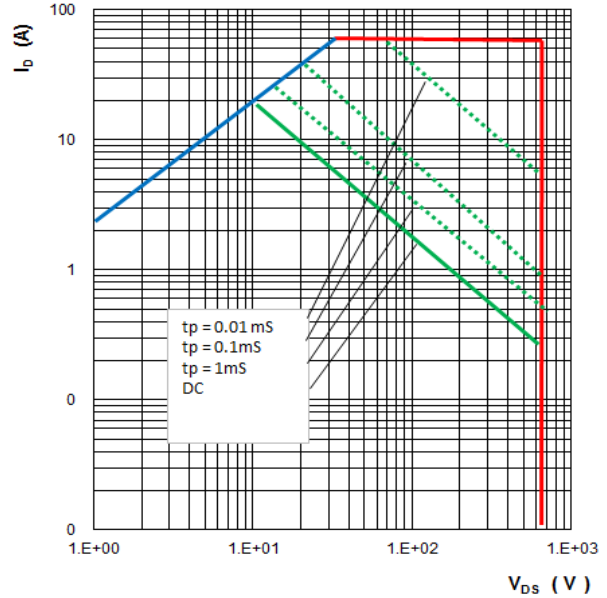


Figure 2: Safe operating area
 $I_D = f(V_{DS})$
parameter : $D = 0, T_c = 25^\circ\text{C}$

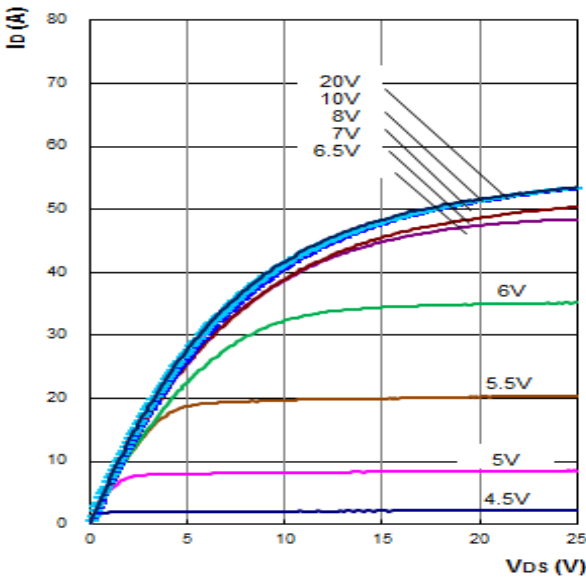


Figure 3: Typ. Output Characteristics
 $I_D = f(V_{DS}) ; T_J = 25^\circ\text{C}$
parameter : $t_p = 100\mu\text{s}, V_{GS}$

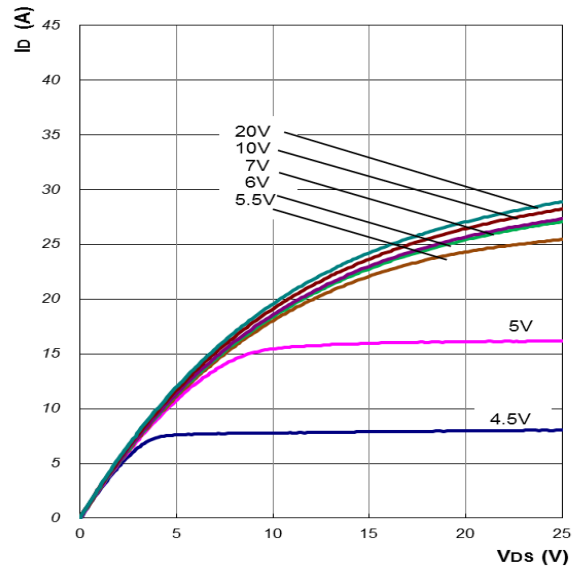


Figure 4: Typ. Output Characteristics
 $I_D = f(V_{DS}) ; T_J = 150^\circ\text{C}$
parameter : $t_p = 100\mu\text{s}, V_{GS}$



Ratings and Characteristics Curves

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

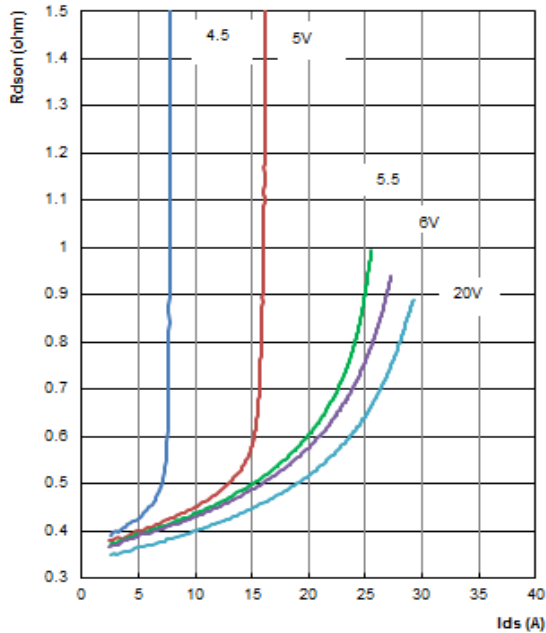


Figure 5: Typ. Drain Source On-Resistance
 $R_{DS(on)} = f(I_D)$
 parameter : $t_p = 100\mu\text{s}$, $T_J = 150^\circ\text{C}$, V_{GS}

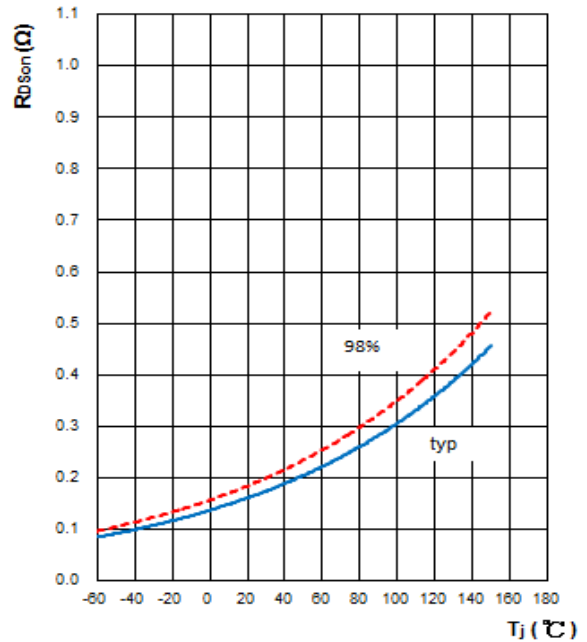


Figure 6: Drain-Source On-state Resistance
 $R_{DS(on)} = f(T_J)$
 parameter : $I_D = 13\text{A}$, $V_{GS} = 10\text{V}$

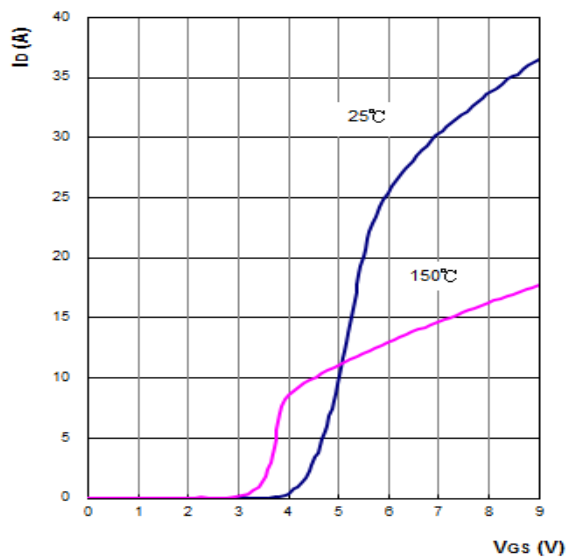


Figure 7: Typ. Transfer Characteristics
 $I_D = f(V_{GS})$; $V_{DS} \geq 2 \times I_D \times R_{DS(on)} \text{ max}$
 parameter : $t_p = 100\mu\text{s}$

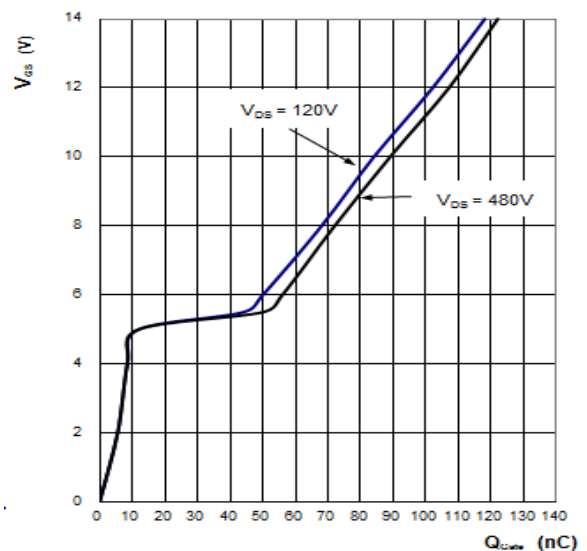


Figure 8: Typ. Gate Charge
 $V_{GS} = f(Q_{GATE})$
 parameter : $I_D = 20\text{A}$ pulsed



Ratings and Characteristics Curves

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

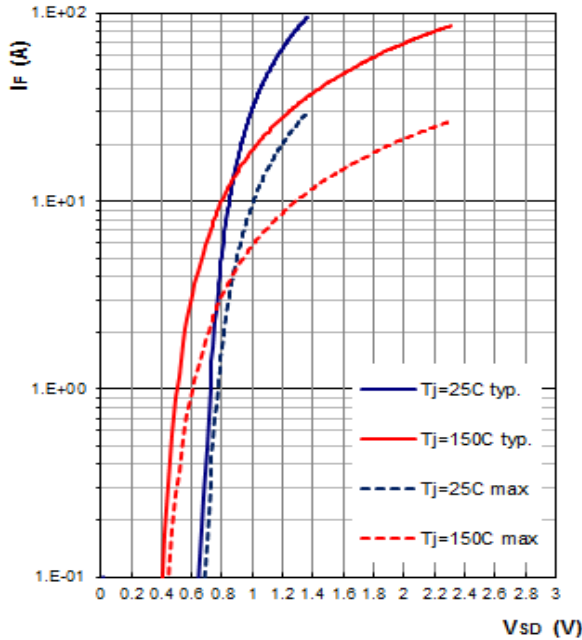


Figure 9: Forward characteristics of body diode
 $I_F = f(V_{SD})$
 parameter : $T_J, t_p=100\mu\text{s}$

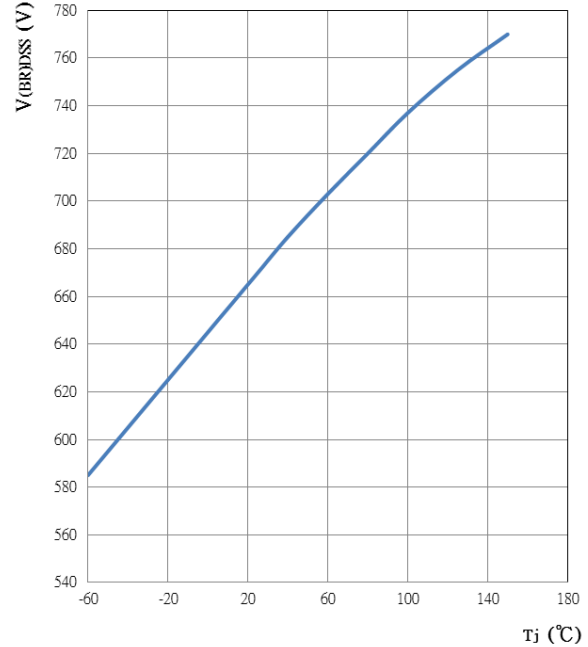


Figure 10: Drain-source breakdown voltage
 $V_{(BR)DSS} = f(T_J)$

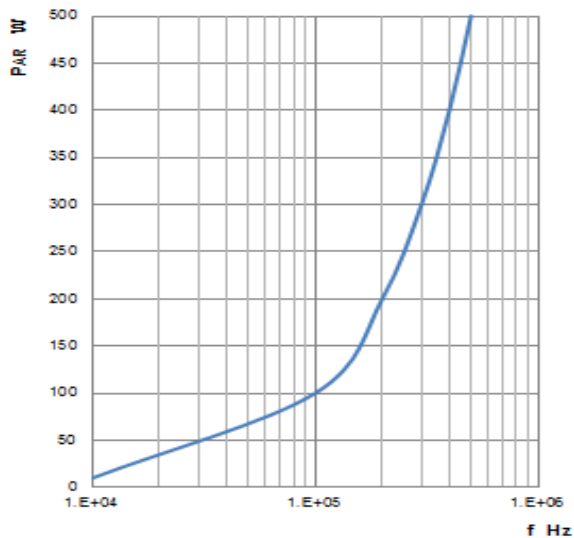


Figure 11: Avalanche power losses
 $P_{AR} = f(f)$
 parameter : $E_{AR}=1\text{mJ}$

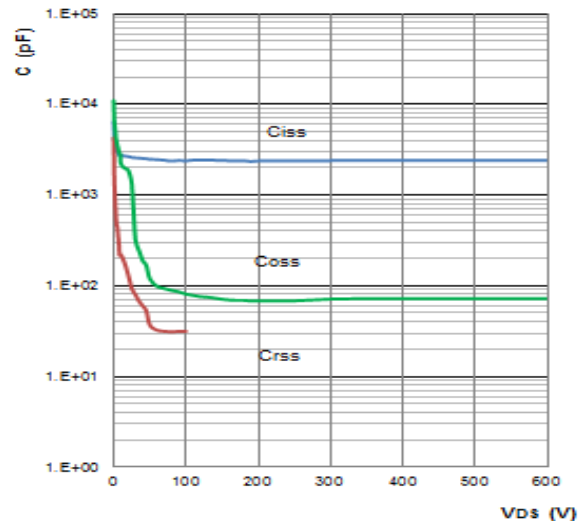


Figure 12: Typ. Capacitances
 $C = f(V_{DS})$
 parameter : $V_{GS}=0\text{V}, f=1\text{MHz}$



Ratings and Characteristics Curves

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

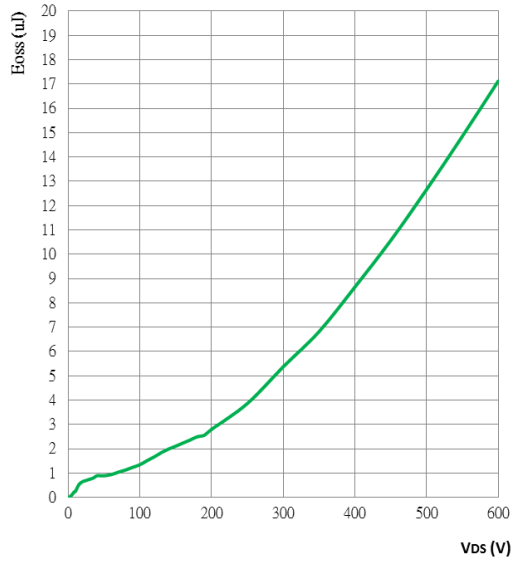


Figure 13: Typ. C_{oss} stored energy
 $E_{oss}=f(V_{DS})$



3. Test Circuits and Waveforms

Test Circuits and Waveforms

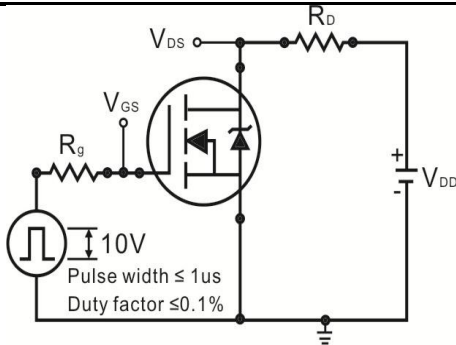


Figure 1: Switching times test circuit

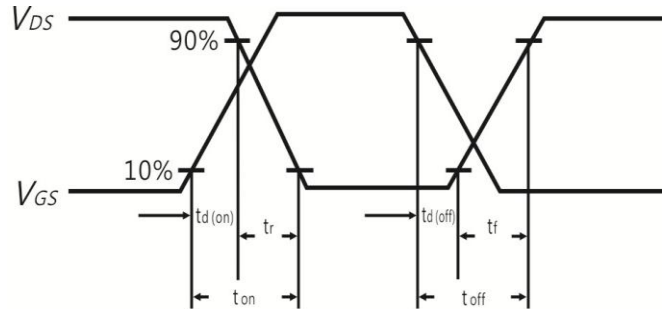


Figure 2: Switching time waveform

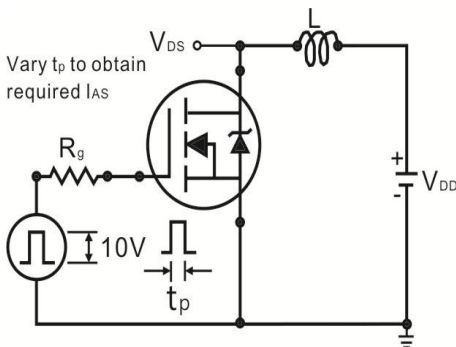


Figure 3: Unclamped test circuit

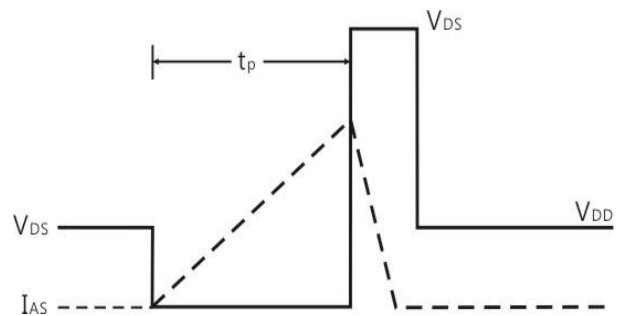


Figure 4: Unclamped test waveform

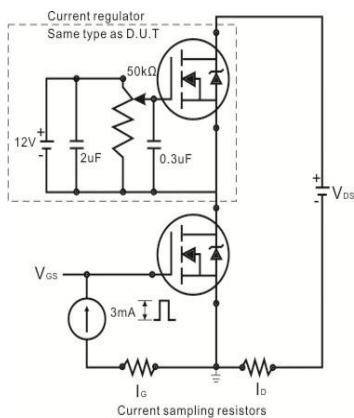


Figure 5: Gate charge test circuit

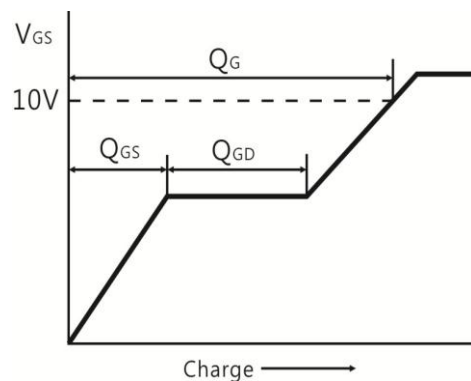
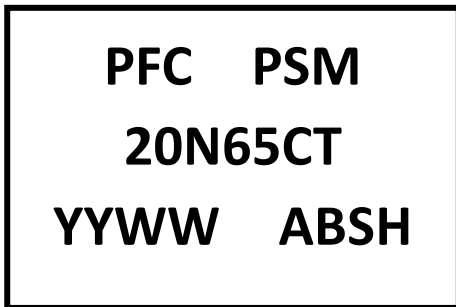


Figure 6: Basic gate charge waveform



4. Marking information

Top Marking Rule



PSM20N65CT = 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

TO-220AB

Dim.	Min.	Max.
A	-----	10.50
B	2.50	3.50
C	3.50	4.10
D	13.10	13.90
E	1.15	1.49
F	-----	6.35
G	0.65	0.95
H	2.29	2.79
I	4.80	5.30
J	4.40	4.80
K	1.14	1.40
L	5.84	6.86
M	8.50	9.60
N	2.03	2.92
O	0.30	0.64

All Dimensions in millimeter



6. Ordering information

Part Number	Package	Delivery mode
PSM20N65CT	TO-220AB	50 pieces / tube

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

Mechanical

- Molder Plastic: UL Flammability Classification Rating 94V-0
- Device Weight : 0.07 ounces (1.96grams) – TO-220AB
- Mounting Torque : Recommended 10 in-lbs maximum

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