September, 2012

SJ-FET

SSP20N60S / SSF20N60S
600V N-Channel MOSFET

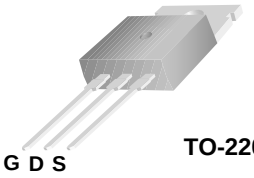
Description

SJ-FET is new generation of high voltage MOSFET family that is utilizing an advanced charge balance mechanism for outstanding low on-resistance and lower gate charge performance.

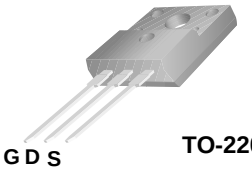
This advanced technology has been tailored to minimize conduction loss, provide superior switching performance, and withstand extreme dv/dt rate and higher avalanche energy. SJ-FET is suitable for various AC/DC power conversion in switching mode operation for higher efficiency.

Features

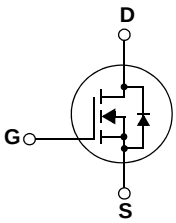
- 650V @T_J = 150°C
- Typ. $R_{DS(on)}$ = 0.16 Ω
- Ultra Low Gate Charge (typ. Q_g = 70nC)
- 100% avalanche tested



TO-220



TO-220F



Absolute Maximum Ratings

Symbol	Parameter	SSP20N60S	SSF20N60S	Unit
V_{DSS}	Drain-Source Voltage	600		V
I_D	Drain Current - Continuous (T_C = 25°C) - Continuous (T_C = 100°C)	20 12	20* 12*	A A
I_{DM}	Drain Current - Pulsed (Note 1)	60	60*	A
V_{GSS}	Gate-Source voltage	± 30		V
E_{AS}	Single Pulsed Avalanche Energy (Note 2)	600		mJ
I_{AR}	Avalanche Current (Note 1)	20		A
E_{AR}	Repetitive Avalanche Energy (Note 1)	20.5		mJ
dv/dt	Peak Diode Recovery dv/dt (Note 3)	4.5		V/ns
P_D	Power Dissipation (T_C = 25°C) - Derate above 25°C	205 1.67	35 0.3	W W/°C
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150		°C
T_L	Maximum Lead Temperature for Soldering Purpose, 1/8" from Case for 5 Seconds	300		°C

* Drain current limited by maximum junction temperature.

Thermal Characteristics

Symbol	Parameter	SSP20N60S	SSF20N60S	Unit
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	0.6	3.6	°C/W
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink Typ.	0.5	--	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	62	62	°C/W

Electrical Characteristics TC = 25℃ unless otherwise noted

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Off Characteristics						
BVDSS	Drain-Source Breakdown Voltage	VGS = 0V, ID = 250μA, TJ = 25℃	600	--	--	V
		VGS = 0V, ID = 250μA, TJ = 150℃	--	650	--	V
ΔBVDSS / ΔTJ	Breakdown Voltage Temperature Coefficient	ID = 250μA, Referenced to 25℃	--	0.6	--	V/℃
IDSS	Zero Gate Voltage Drain Current	VDS = 600V, VGS = 0V VDS = 480V, TC = 125℃	--	--	1 10	μA μA
IGSSF	Gate-Body Leakage Current, Forward	VGS = 30V, VDS = 0V	--	--	100	nA
IGSSR	Gate-Body Leakage Current, Reverse	VGS = -30V, VDS = 0V	--	--	-100	nA
On Characteristics						
VGS(th)	Gate Threshold Voltage	VDS = VGS, ID = 250μA	2.5	--	4.5	V
RDS(on)	Static Drain-Source On-Resistance	VGS = 10V, ID = 5A	--	0.16	0.19	Ω
gFS	Forward Transconductance	VDS = 40V, ID = 5A (Note 4)	--	16	--	S
Dynamic Characteristics						
Ciss	Input Capacitance	VDS = 25V, VGS = 0V, f = 1.0MHz	--	1440	--	pF
Coss	Output Capacitance		--	300	--	pF
Crss	Reverse Transfer Capacitance		--	10	--	pF
Switching Characteristics						
td(on)	Turn-On Delay Time	VDD = 400V, ID = 5A RG = 20Ω(Note 4, 5)	--	25	--	ns
tr	Turn-On Rise Time		--	55	--	ns
td(off)	Turn-Off Delay Time		--	70	--	ns
tf	Turn-Off Fall Time		--	40	--	ns
Qg	Total Gate Charge	VDS = 480V, ID = 10A VGS = 10V (Note 4, 5)	--	70	90	nC
Qgs	Gate-Source Charge		--	7.8	--	nC
Qgd	Gate-Drain Charge		--	9	--	nC
Drain-Source Diode Characteristics and Maximum Ratings						
IS	Maximum Continuous Drain-Source Diode Forward Current		--	--	20	A
ISM	Maximum Pulsed Drain-Source Diode Forward Current		--	--	60	A
VSD	Drain-Source Diode Forward Voltage	VGS = 0V, IF = 10A	--	1	1.5	V
trr	Reverse Recovery Time	VR = 400V, IF = 10A di_F/dt =100A/μs (Note 4)	--	475	--	ns
Qrr	Reverse Recovery Charge		--	5.8	--	μC
Irrm	Peak reverse recovery Current		--	35	--	A

NOTES:

1. Repetitive Rating: Pulse width limited by maximum junction temperature
2. L=10.5mH, I_{AS}=10A, VDD=150V, Starting TJ=25 ℃
3. I_{SD}≤ID, di/dt ≤ 200A/us, V_{DD} ≤ BV_{DSS}, Starting TJ = 25 ℃
4. Pulse Test: Pulse width ≤ 300us, Duty Cycle ≤ 2%
5. Essentially Independent of Operating Temperature Typical Characteristics

Typical Performance Characteristics

Figure 1. On-Region Characteristics

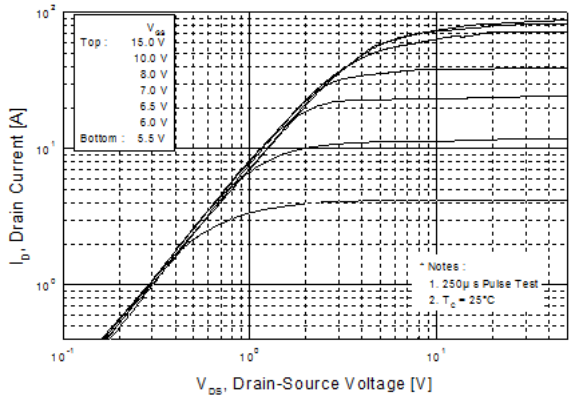


Figure 2. Transfer Characteristics

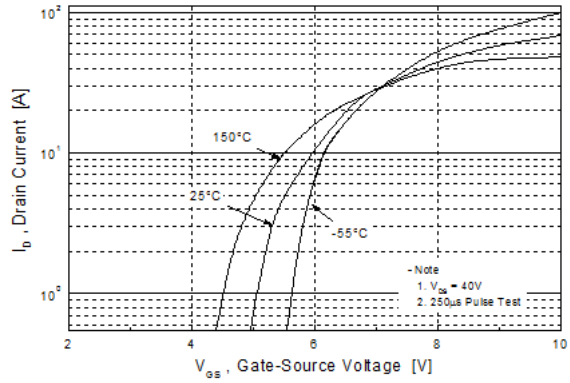


Figure 3. On-Resistance Variation vs. Drain Current and Gate Voltage

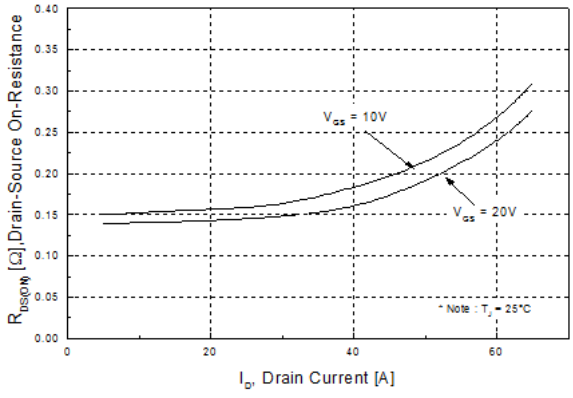


Figure 4. Body Diode Forward Voltage Variation vs. Source Current and Temperatue

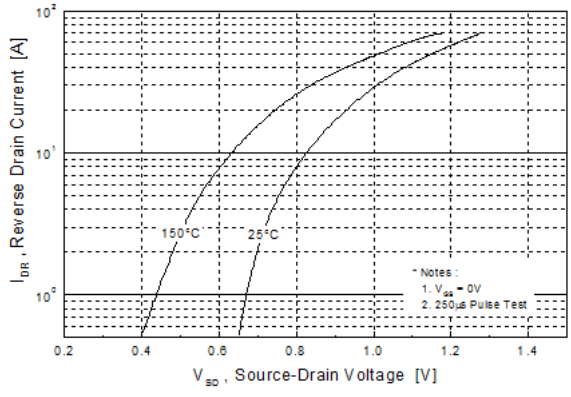


Figure 5. Capacitance Characteristics

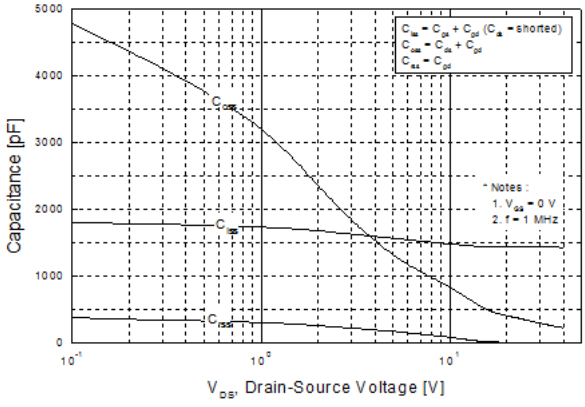
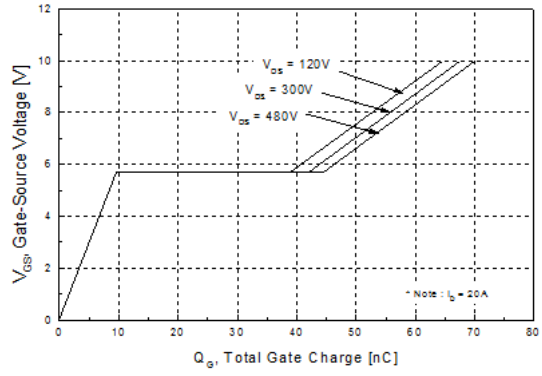


Figure 6. Gate Charge Characteristics



Typical Performance Characteristics (Continued)

Figure 7. Breakdown Voltage Variation vs. Temperature

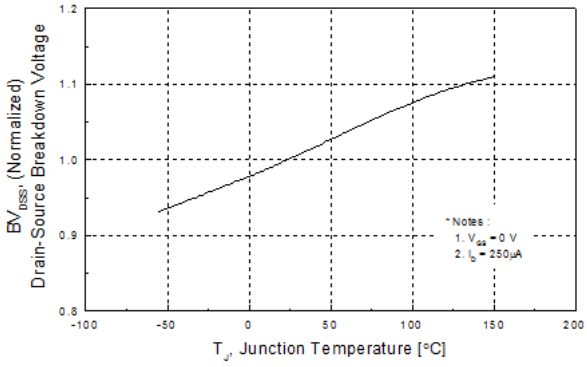


Figure 8. On-Resistance Variation vs. Temperature

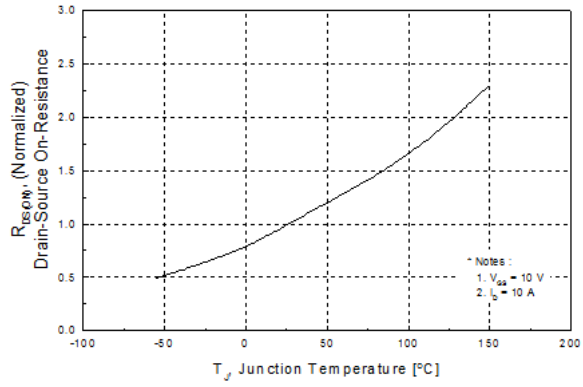


Figure 9-1. Safe Operating Area of SSP20N60S

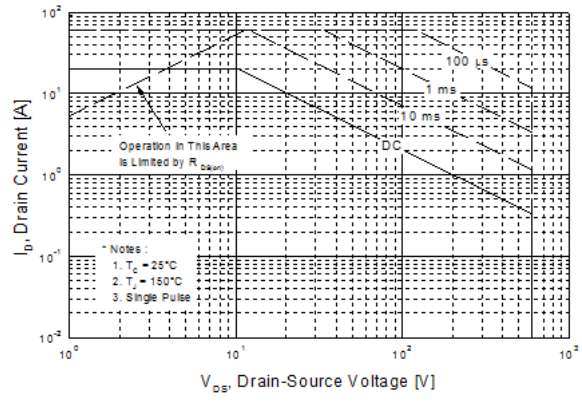


Figure 9-2. Safe Operating Area of SSF20N60S

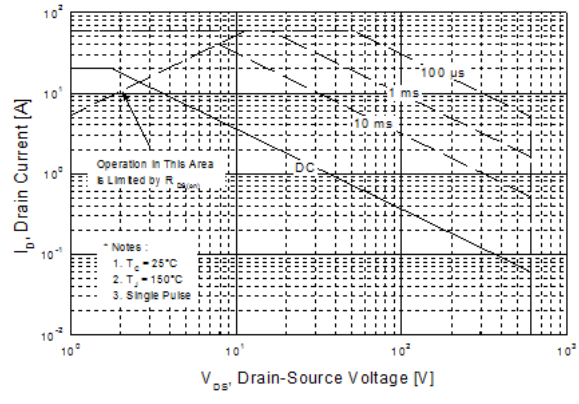
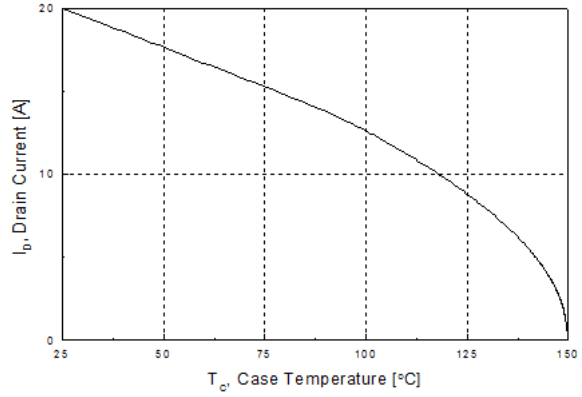


Figure 10. Maximum Drain Current vs. Case Temperature



Typical Performance Characteristics (Continued)

Figure 10-1. Transient Thermal Response Curve of SSP20N60S

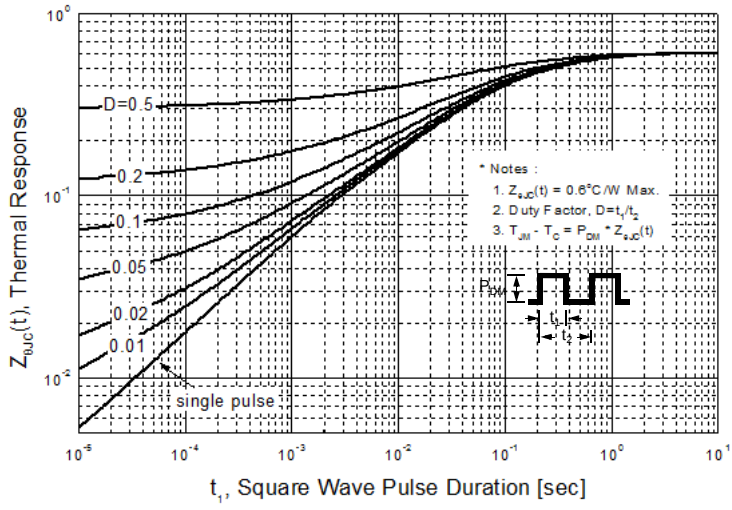
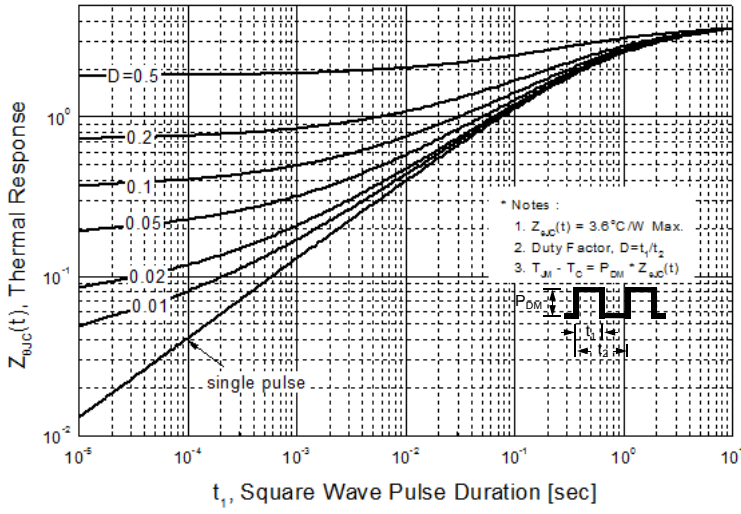
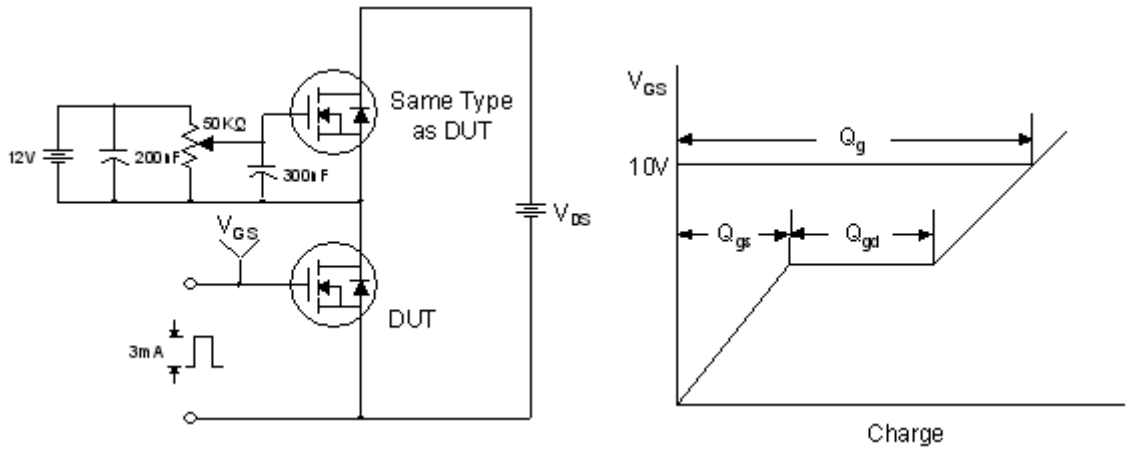


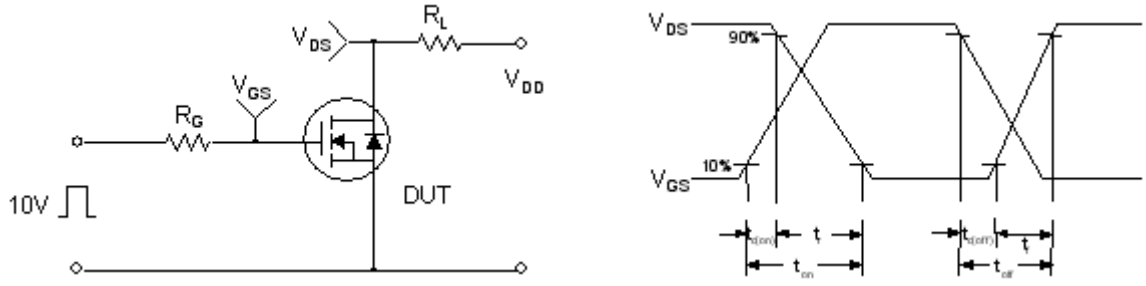
Figure 10-2. Transient Thermal Response Curve of SSF20N60S



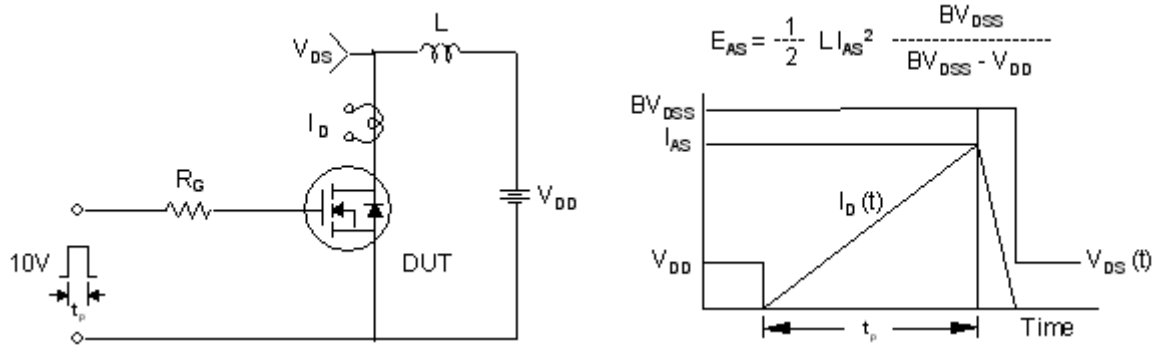
Gate Charge Test Circuit & Waveform



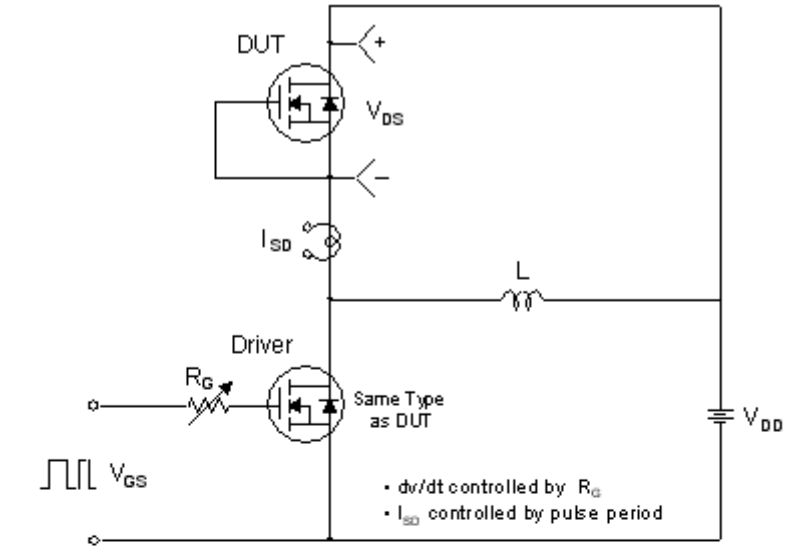
Resistive Switching Test Circuit & Waveforms

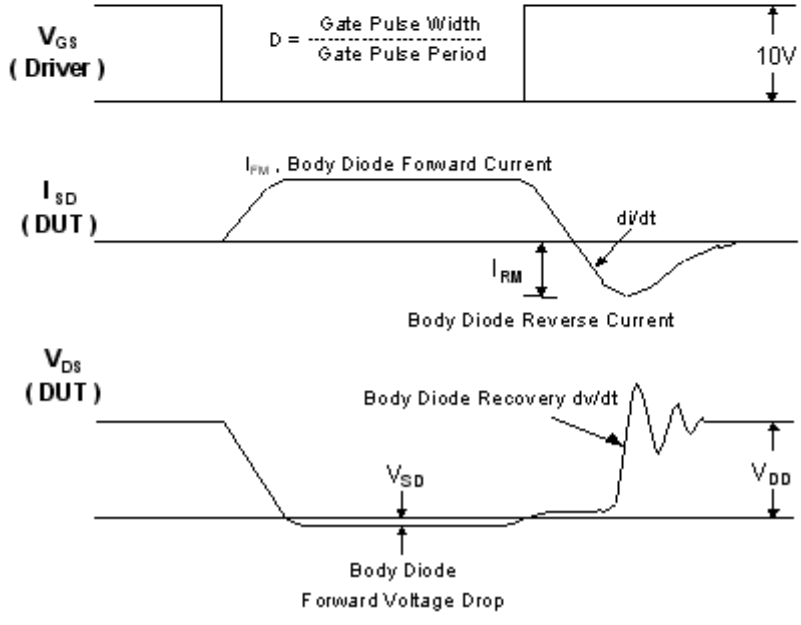


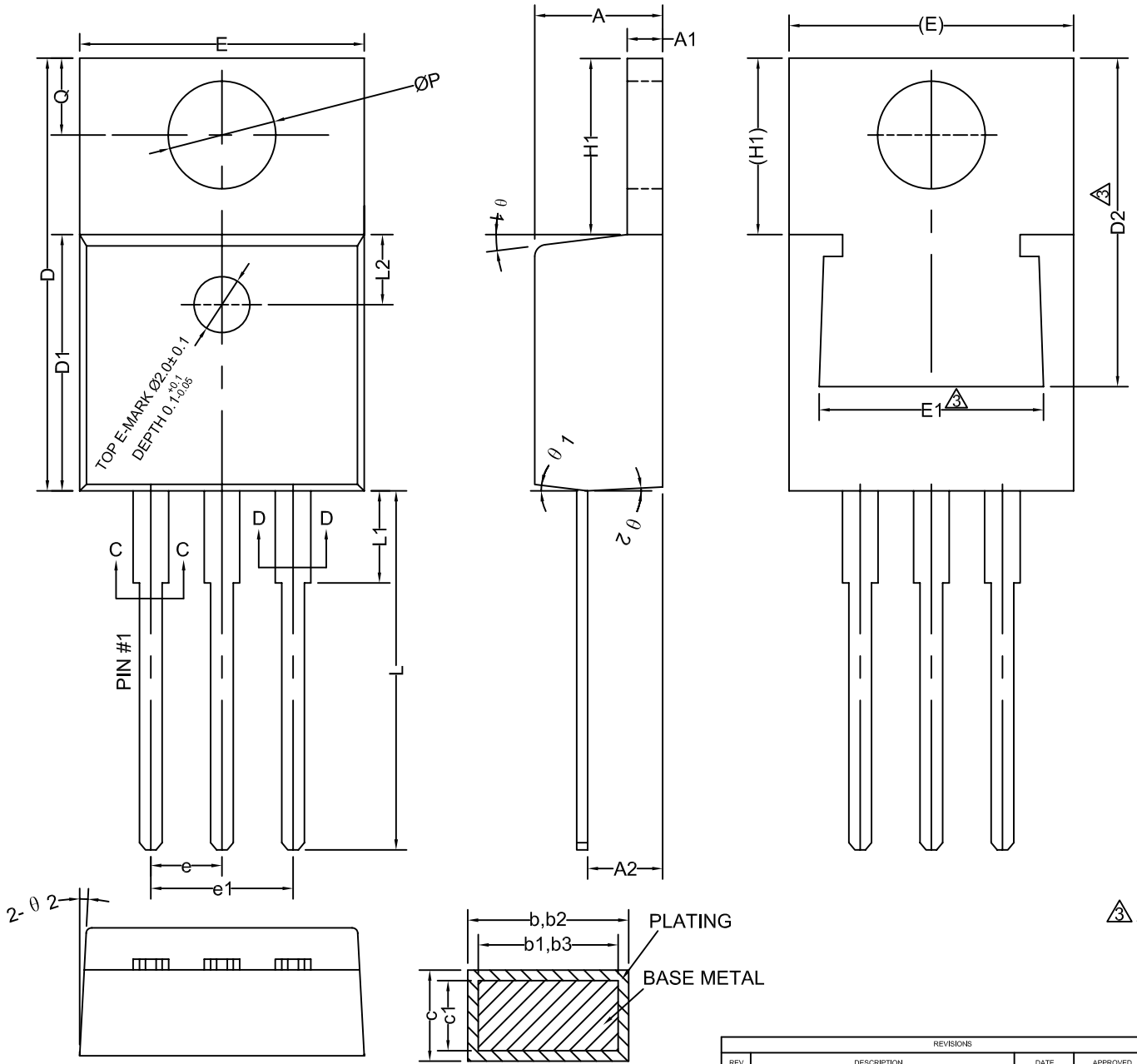
Unclamped Inductive Switching Test Circuit & Waveforms



Peak Diode Recovery dv/dt Test Circuit & Waveforms







SECTION C-C & D-D

COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

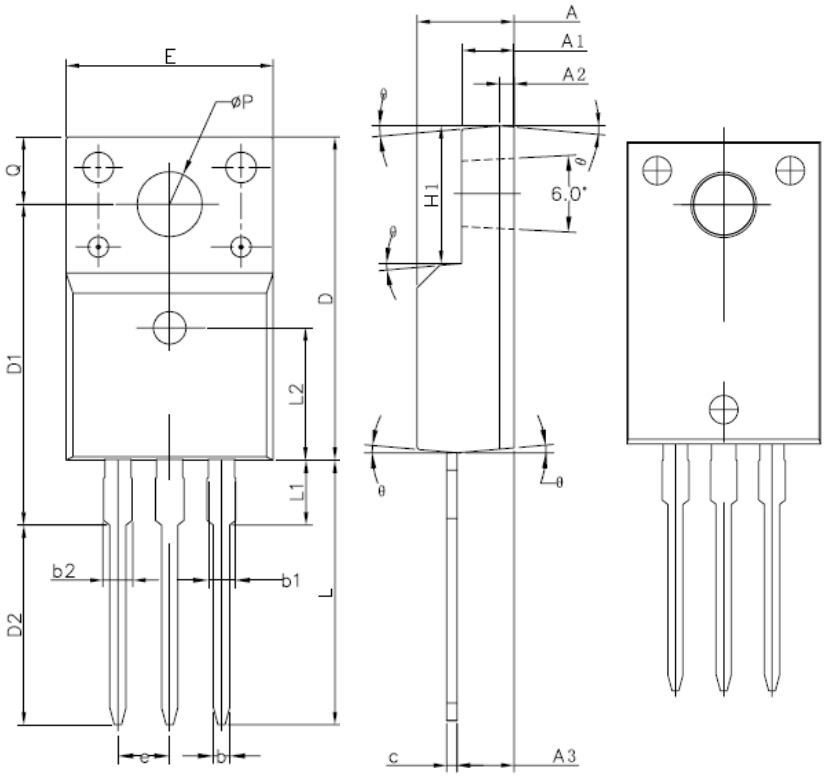
SYMBOL	MIN	NOM	MAX
A	4.40	4.57	4.70
A1	1.22	-	1.32
A2	2.59	2.69	2.79
b	0.77	-	0.90
b1	0.76	0.81	0.86
b2	1.23	-	1.36
b3	1.22	1.27	1.32
c	0.34	-	0.47
c1	0.33	0.38	0.43
D	15.15	15.45	15.75
D1	9.05	9.15	9.25
3 D2	11.40	-	12.88
E	9.96	10.16	10.36
3 E1	6.86	-	8.89
3 e	2.44	2.54	2.64
3 e1	4.98	5.08	5.18
H1	6.10	6.30	6.50
2 L	12.70	-	13.12
L1	-	-	3.90
L2	2.50REF		
ØP	3.80	3.84	3.88
Q	2.60	-	2.90
θ 1	5°	7°	9°
θ 2	1°	3°	5°

NOTES:
1. ALL DIMENSIONS REFER TO JEDEC STANDARD TO-220 AB DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.
3 2.'D2' AND 'E1' ARE VARIABLES DEPENDING ON DIE PAD SIZES.

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
3	Revise the dimension sizes and notes.	07.06.21	
2	Revise the dimension size.	07.01.15	

DRN.:
CHK.:
APPD.:
APPD.:

TITLE: CP2E-3
SIZE:
DWG NO.:
REV. 3
SHEET: 1/1



COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.34	2.54	2.74
A2		0.70 REF	
A3	2.56	2.76	2.96
b	0.70	–	0.90
b1	1.18	–	1.38
b2	–	–	1.47
c	0.45	0.50	0.60
D	15.67	15.87	16.07
D1	15.55	15.75	15.95
D2	9.60	9.80	10.0
E	9.96	10.16	10.36
e		2.54BSC	
H1	6.48	6.68	6.88
L	12.68	12.98	
L1	–	–	3.50
L2		6.50REF	
øP	3.08	3.18	3.28
Q	3.20	–	3.40
θ	3°	5°	7°