1.6mΩ, 40V, N-Channel Power MOSFET SRT04N016LS

General Description

The Sanrise SRT04N016LS is a low voltage power MOSFET, fabricated using advanced split gate trench technology. The resulting device has extremely low on resistance, low gate charge and fast switching time, making it especially suitable for applications which require superior power density and synchronous rectification.

The SRT04N016LS break down voltage is 40V and it has a high rugged avalanche characteristics. The SRT04N016LS is available in PDFN5*6 and TO-252 and TO-220C and TO-263-2 packages.

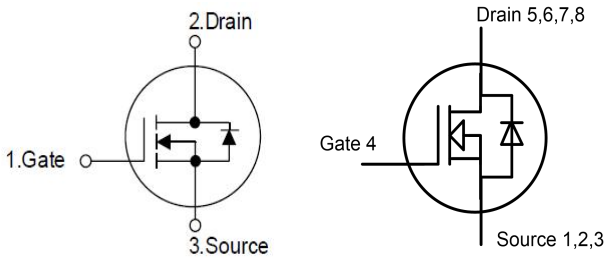
Features

- Ultra Low
  $R_{DS(ON)\_TYP}$ = 1.15mΩ,PDFN5*6 @V_{GS} = 10V.
  $R_{DS(ON)\_TYP}$ = 2.0mΩ,TO-252 @V_{GS} = 10V.
  $R_{DS(ON)\_TYP}$ = 1.8mΩ,TO-220C @V_{GS} = 10V.
  $R_{DS(ON)\_TYP}$ = 1.7mΩ,TO-263-2 @V_{GS} = 10V.
- Ultra Low Gate Charge, Qg=85nC typ.
- Fast switching capability
- Robust design with better EAS performance
- EMI Improved
- Non-automotive Qualified

Application

- Server/Telecom
- High Power Supply
- E-Tools
- BMS
- Motor Driver

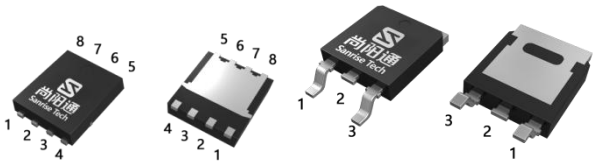
Symbol



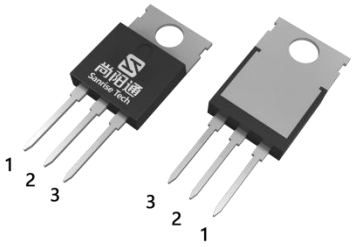
TO-252,TO-220C,TO-263-2 PDFN5*6

Figure 1 Symbol of SRT04N016LS

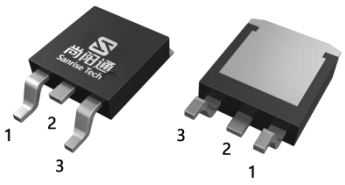
Package Type



PDFN5*6 TO-252



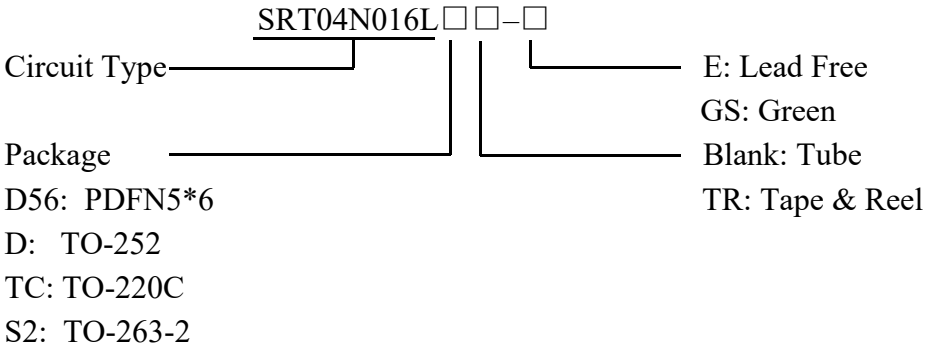
TO-220C



TO-263-2

Figure 2 Package Type of SRT04N016LS

Ordering Information



Package	Part Number	Marking ID	Packing Type
PDFN5*6	SRT04N016LD56TR-GS	SRT04N016LD56GS	Tape & Reel
TO-252	SRT04N016LDTR-GS	SRT04N016LDGS	Tape & Reel
TO-220C	SRT04N016LTC-GS	SRT04N016LTCGS	Tube
TO-263-2	SRT04N016LS2TR-GS	SRT04N016LS2GS	Tape & Reel

Absolute Maximum Ratings

Parameter		Symbol	Rating		Unit
Drain-Source Voltage		V_{DSS}	40		V
Gate-Source Voltage		V_{GSS}	±20		V
Continuous Drain Current,Silicon	T_C=25ºC	I_D	PDFN5*6	173	A
			TO-252	141	
			TO-220C	186	
			TO-263-2	186	
	T_C=100ºC		PDFN5*6	109	
			TO-252	89.5	
			TO-220C	118	
			TO-263-2	118	
Pulsed Drain Current (Note 2)		I_{DM}	PDFN5*6	692	A
			TO-252	564	
			TO-220C	744	
			TO-263-2	744	
Avalanche Energy, Single Pulse (Note 3)		E_{AS}	81		mJ
Avalanche Destructive Energy, Single Pulse (Note 4)		E_{AS_Limit}	756		mJ
Avalanche Energy, Repetitive (Note 2)		E_{AR}	0.2		mJ
Avalanche Current, Repetitive (Note 2)		I_{AR}	50.0		A
Continuous Diode Forward Current		I_S	100		A
Diode Pulse Current		$I_{S.PULSE}$	692		A
Max Power Dissipation		P_D	104		W
Operating Junction Temperature		T_J	150		ºC
Storage Temperature		T_{STG}	-55 to 150		ºC
Lead Temperature (Soldering, 10 sec)		T_{LEAD}	260		ºC

Note:

1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating: Pulse width limited by maximum junction temperature
3. I_{AS}= 18A, V_{DD}= 20V, R_G= 25Ω, Starting T_J= 25°C
4. I_{AS_Limit}= 55A, V_{DD}= 20V, R_G= 25Ω, Starting T_J= 25°C

Thermal Resistance

Parameter		Symbol	Min	Typ	Max	Unit
Thermal Resistance，Junction-to-Case	PDFN5*6	R_{thJC}			1.2	ºC/W
Thermal Resistance，Junction-to-Ambient	PDFN5*6	R_{thJA}			50	
Thermal Resistance，Junction-to-Case	TO-252	R_{thJC}			1.2	ºC/W
Thermal Resistance，Junction-to-Ambient	TO-252	R_{thJA}			60	
Thermal Resistance，Junction-to-Case	TO-220C	R_{thJC}			0.8	ºC/W
Thermal Resistance，Junction-to-Ambient	TO-220C	R_{thJA}			60	
Thermal Resistance，Junction-to-Case	TO-263-2	R_{thJC}			0.8	ºC/W
Thermal Resistance，Junction-to-Ambient	TO-263-2	R_{thJA}			60	

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Electrical Characteristics

T_J = 25℃, unless otherwise specified.

Parameter		Symbol	Test Conditions	Min	Typ	Max	Unit
Statistic Characteristics							
Drain-Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D=250uA	40			V
Zero Gate Voltage Drain Current		I_{DSS}	V_{DS}=40V, V_{GS}=0V			1	uA
Gate-Body Leakage Current	Forward	I_{GSSF}	V_{GS}=20V, V_{DS}=0V			200	nA
	Reverse	I_{GSSR}	V_{GS}=-20V, V_{DS}=0V			-200	
Gate Threshold Voltage		$V_{GS(TH)}$	V_{DS}=V_{GS}, I_D=0.25mA	1.2	1.8	2.4	V
Static Drain-Source On-Resistance	PDFN5*6	$R_{DS(ON)}$	V_{GS}=10V, I_D=50A		1.15	1.6	mΩ
			V_{GS}=4.5V, I_D=50A		2.0	3.05	
	TO-252		V_{GS}=10V, I_D=50A		2.0	2.5	
			V_{GS}=4.5V, I_D=50A		2.6	3.5	
	TO-220C		V_{GS}=10V, I_D=50A		1.8	2.2	
			V_{GS}=4.5V, I_D=50A		2.3	3.5	
	TO-263		V_{GS}=10V, I_D=50A		1.7	2.2	
			V_{GS}=4.5V, I_D=50A		2.2	3.5	
Gate Resistance		R_G	f=1MHz, Open Drain		1.3		Ω
Dynamic Characteristics							
Input Capacitance		C_{ISS}	V_{DS}=20V, V_{GS}=0V, f=1MHz		5.8		nF
Output Capacitance		C_{OSS}			1.6		nF
Reverse Transfer Capacitance		C_{RSS}			98		pF
Effective output capacitance, energy related NOTE5		$C_{O(er)}$	V_{GS}=0V, V_{DS}=0…32V		2.4		nF
Effective output capacitance, time related NOTE6		$C_{O(tr)}$			3.0		
Turn-on Delay Time		$t_{d(on)}$	V_{DD}=20V, I_D=50A R_G=1.6Ω, V_{GS}=10V		18		ns
Rise Time		t_r			55		
Turn-off Delay Time		$t_{d(off)}$			60		
Fall Time		t_f			12		
Gate Charge Characteristics							
Gate to Source Charge		Q_{gs}	V_{DD}=20V, I_D=50A V_{GS}=0 to 10V		12.5		nC
Gate to Drain Charge		Q_{gd}			9.5		
Gate Charge Total		Q_g			85		
Gate Plateau Voltage		$V_{plateau}$			2.3		V
Gate Charge Total, sync FET		Q_g	V_{DD}=0.1V, V_{GS}=0 to 10V		79		nC
Reverse Diode Characteristics							
Drain-Source Diode Forward Voltage		V_{SD}	V_{GS}=0V, I_{SD}=50A		0.84	1.0	V
Reverse Recovery Time		t_{rr}	V_R=20V, I_F=50A dI$_F$/dt=100A/us		60		ns
Reverse Recovery Charge		Q_{rr}			120		nC
Peak Reverse Recovery Current		I_{rrm}			4.0		A

Note:

5. $C_{O(er)}$ is a fixed capacitance that gives the same stored energy as C_{OSS} while V_{DS} is rising from 0 to 32V
6. $C_{O(tr)}$ is a fixed capacitance that gives the same charging time as C_{OSS} while V_{DS} is rising from 0 to 32V

Typical Performance Characteristics

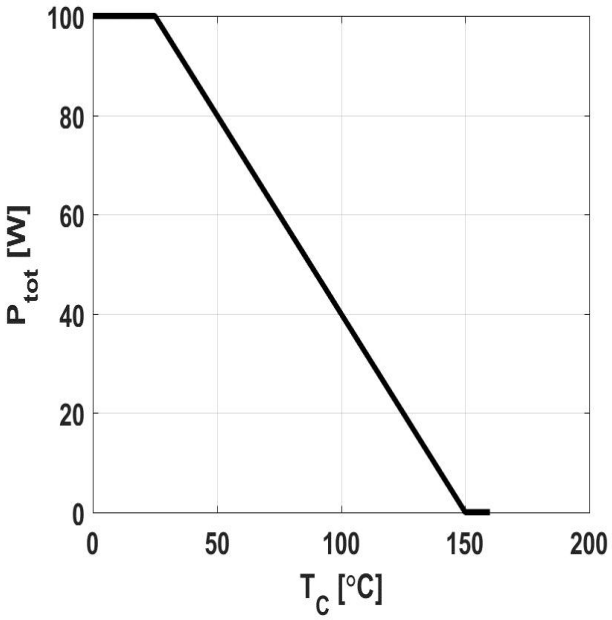
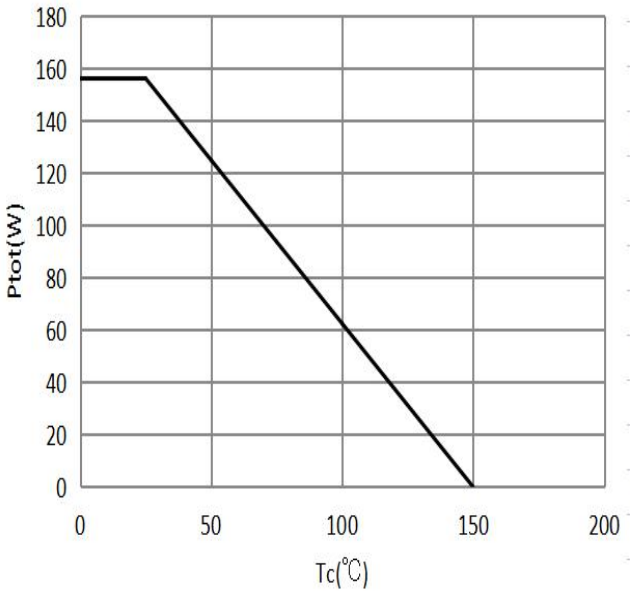
Figure 3A: Power Dissipation (PDFN5*6&TO-252)	Figure 3B: Power Dissipation (TO-220C&TO-263-2)
	
$P_{tot}=f(T_c)$	$P_{tot}=f(T_c)$

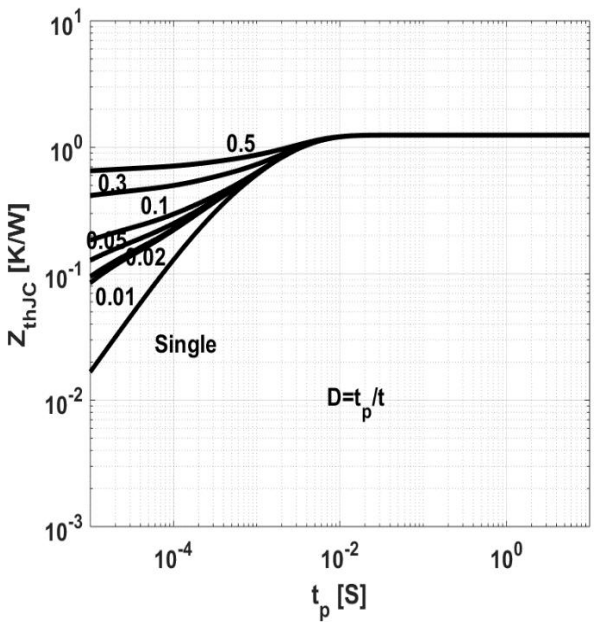
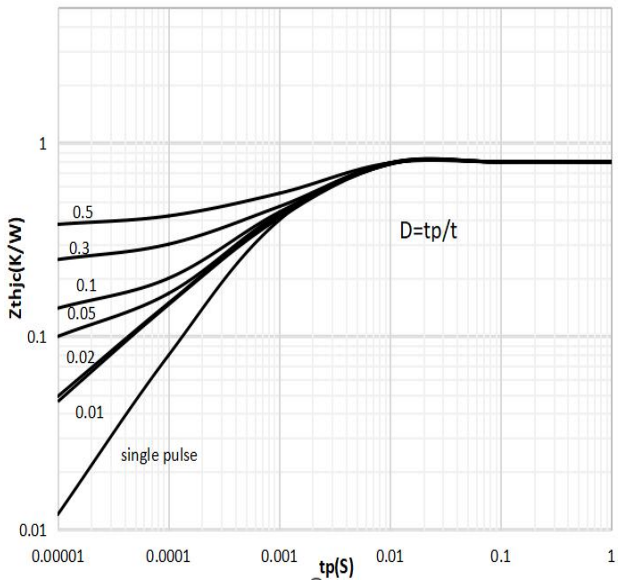
Figure 4A: Max. Transient Thermal Impedance (PDFN5*6&TO-252)	Figure 4B: Max. Transient Thermal Impedance (TO-220C&TO-263-2)
	
$Z_{(thJC)}=f(t_p)$;parameter:$D=t_p/T$	$Z_{(thJC)}=f(t_p)$;parameter:$D=t_p/T$

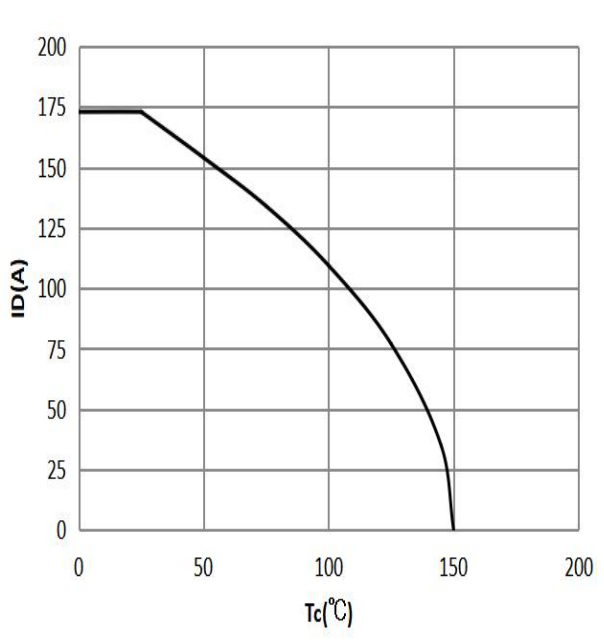
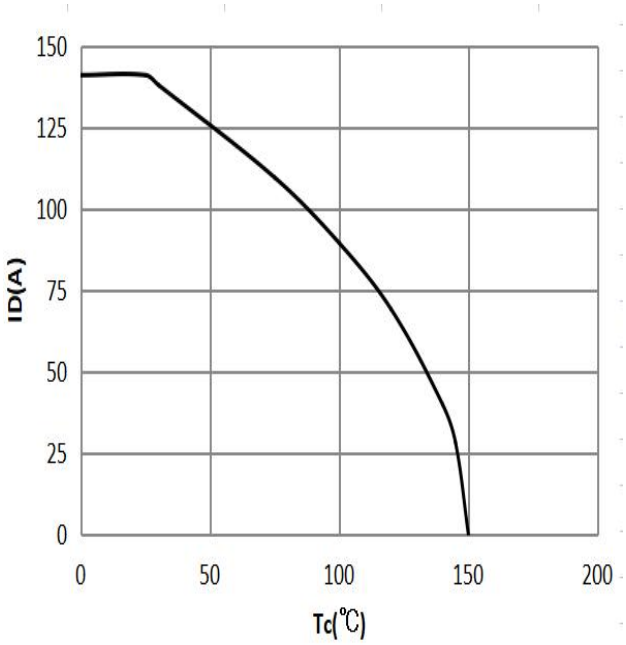
Figure5A: Drain Current(PDFN5*6)	Figure5B: Drain Current(TO-252)
	
I_D=f(T_C);V_{GS}≥10V	I_D=f(T_C);V_{GS}≥10V

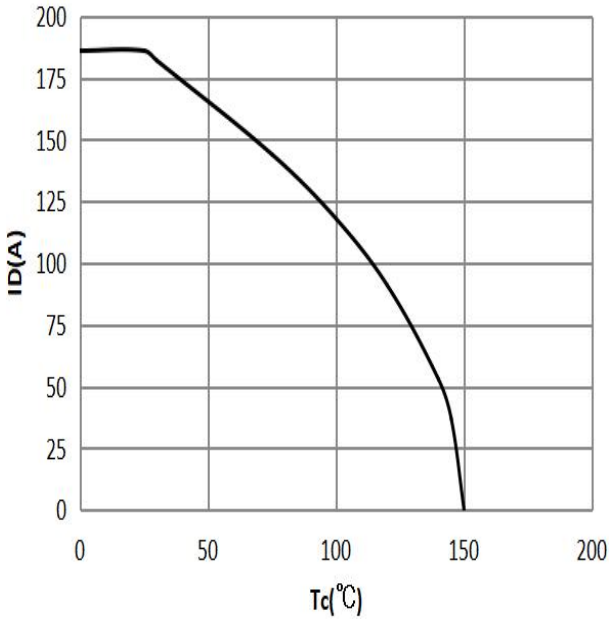
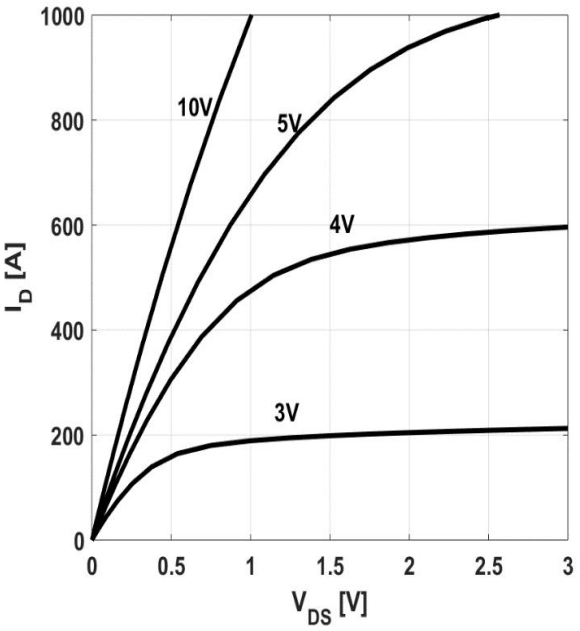
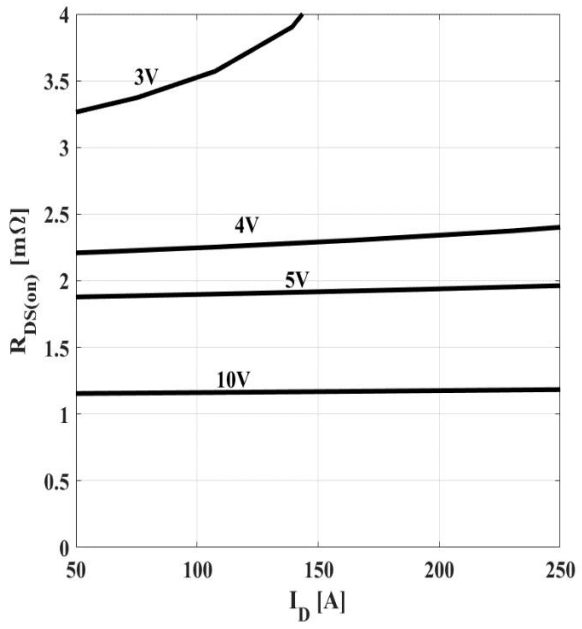
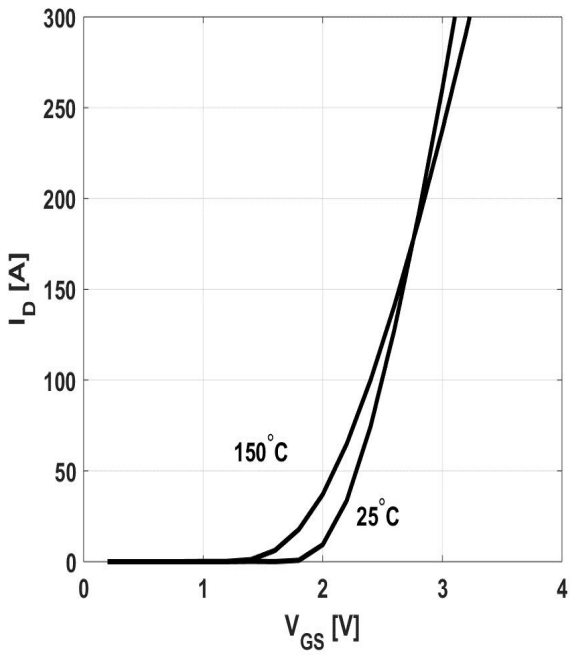
Figure5C: Drain Current(TO-220C&TO-263-2)	Figure6: Typ. Output Characteristics
	
I_D=f(T_C);V_{GS}≥10V	I_D=f(V_{DS});Tj=25ºC; parameter:V_{GS}

Figure7: Typ. Drain-Source On-State Resistance (PDFN5*6)



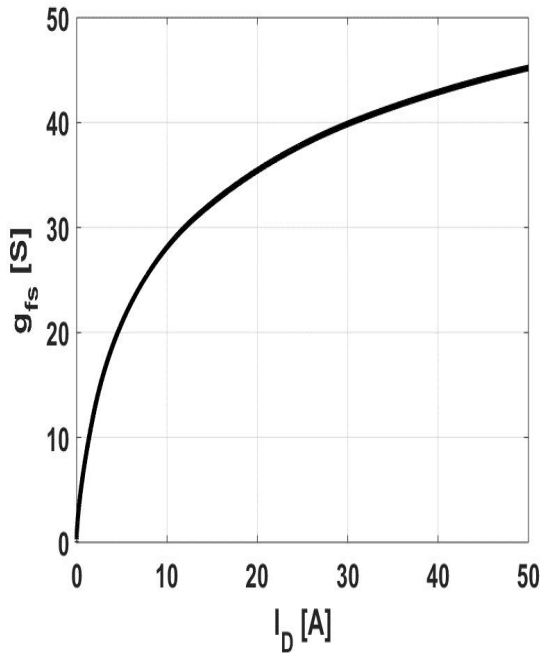
$R_{DS(ON)}$=f(I_D);T_j=25ºC; parameter:V_{GS}

Figure8: Typ. Transfer Characteristics



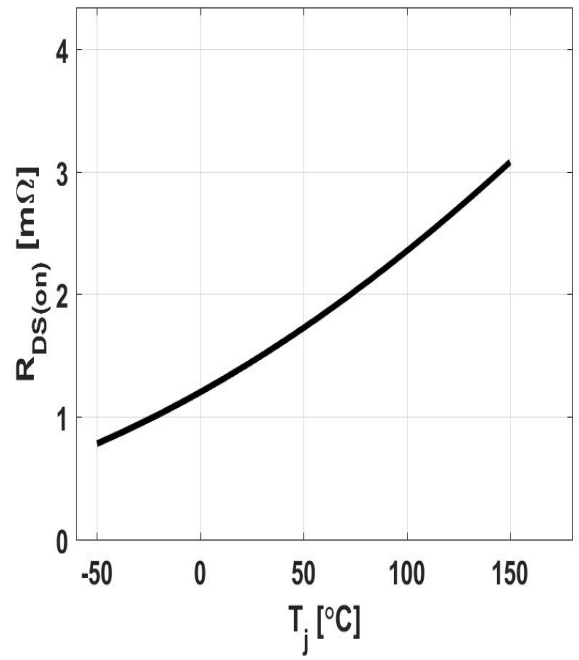
I_D=f(V_{GS}); |V_{DS}|>2|I_D|$R_{DS(on)max}$; parameter: T_j

Figure9: Typ. Forward Transconductance



g_{fs}=f(I_D); T_j=25°C

Figure10A: Typ. Drain-Source On-State Resistance(PDFN5*6)



$R_{DS(ON)}$=f(T_j);I_D=50A;V_{GS}=10V

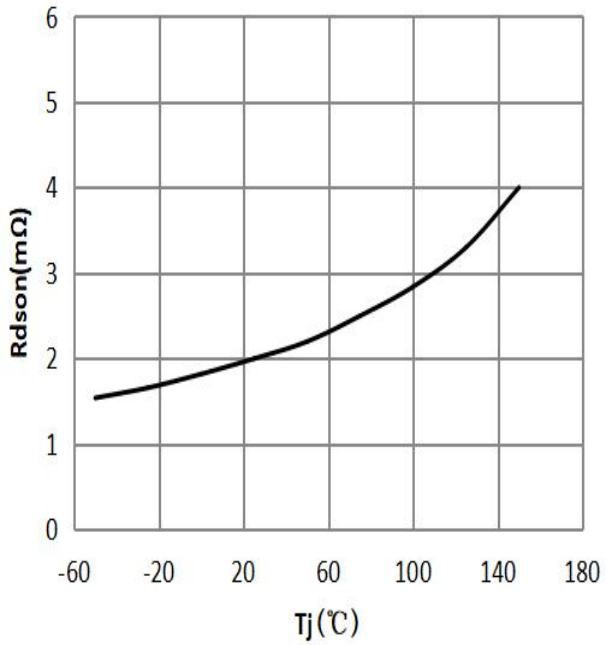
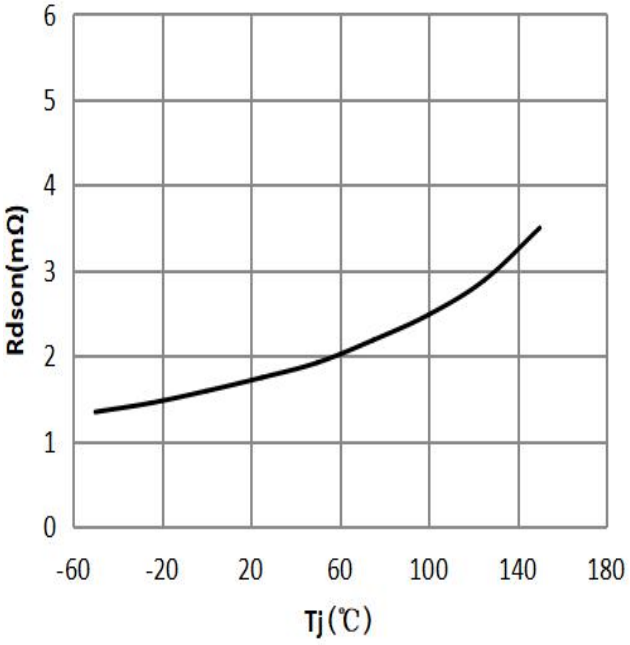
Figure10B: Typ. Drain-Source On-State Resistance(TO-252)	Figure10C: Typ. Drain-Source On-State Resistance (TO-220C&TO-263-2)
	
$R_{DS(ON)}$=f(T_j);I_D=50A;V_{GS}=10V	$R_{DS(ON)}$=f(T_j);I_D=50A;V_{GS}=10V

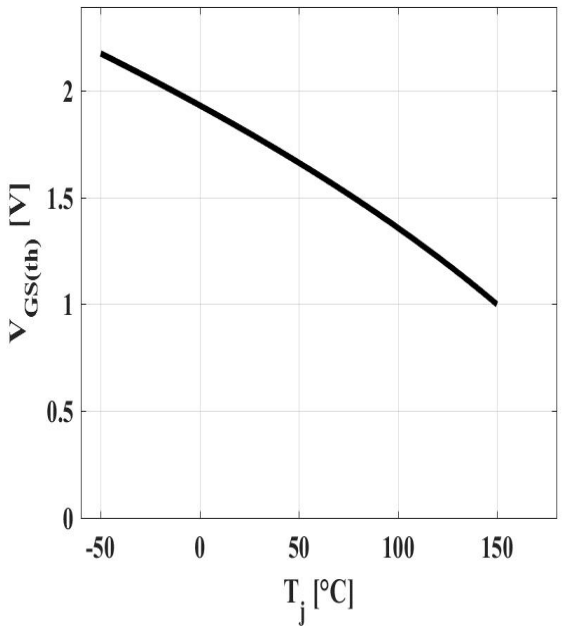
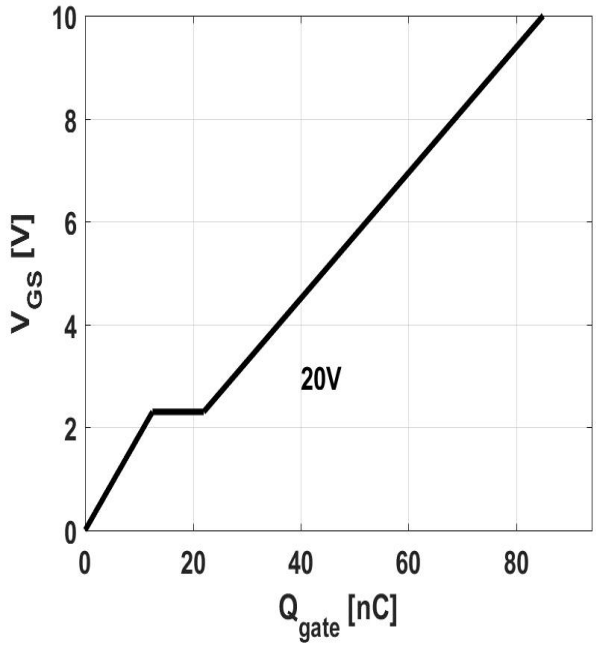
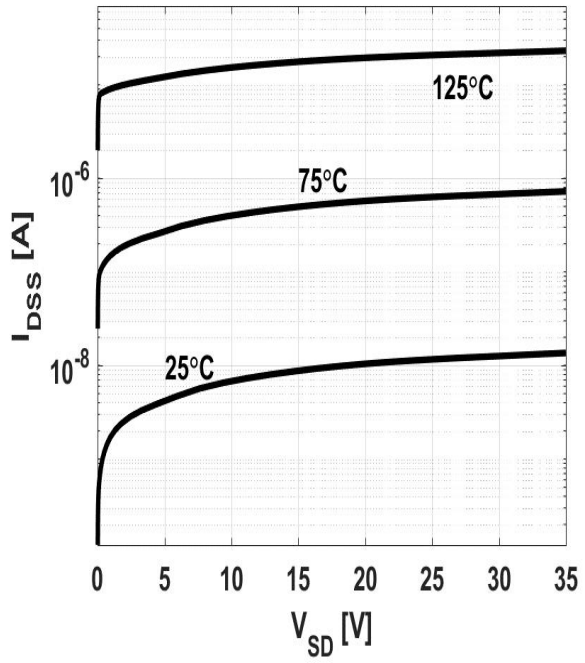
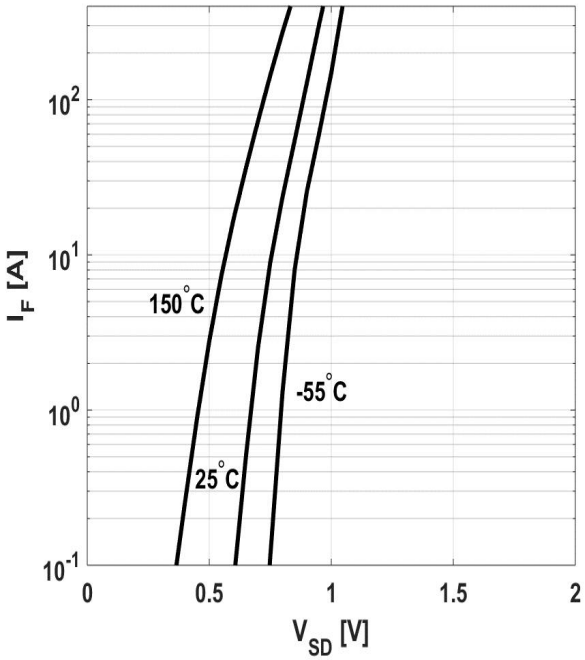
Figure11: Typ.Gate Threshold Voltage	Figure 12: Typ. Gate Charge
	
$V_{GS(th)}$=f(T_j); V_{GS}=V_{DS}; I_{DS}=250μA	V_{GS}= f(Q_{gate}), I_D=50A pulsed

Figure 13: Drain-Source Leakage Current



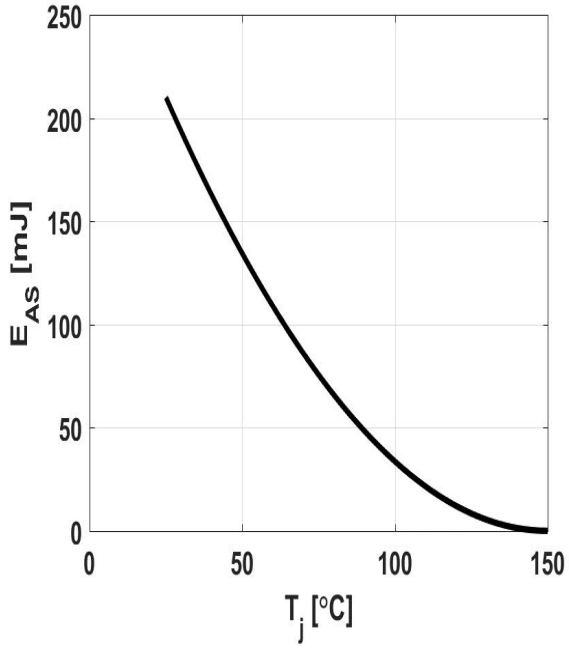
$I_{DSS}=f(V_{DS})$; $V_{GS}=0V$; parameter: T_j

Figure 14: Forward Characteristics of Reverse Diode



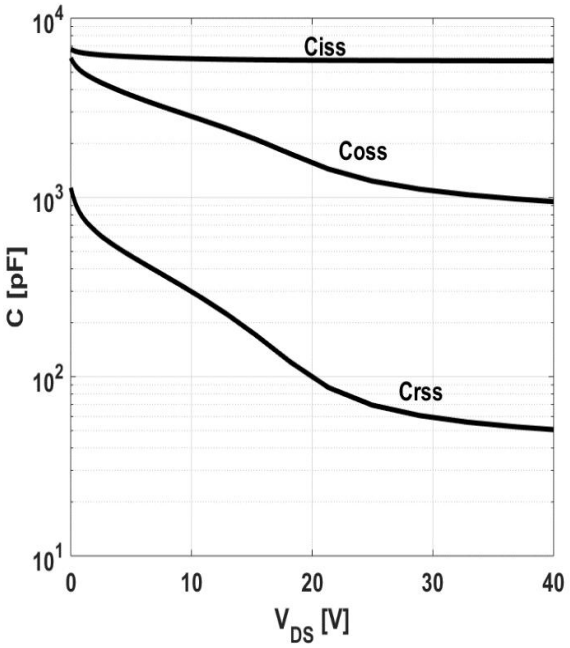
$I_F=f(V_{SD})$; parameter: T_j

Figure 15: Avalanche Energy



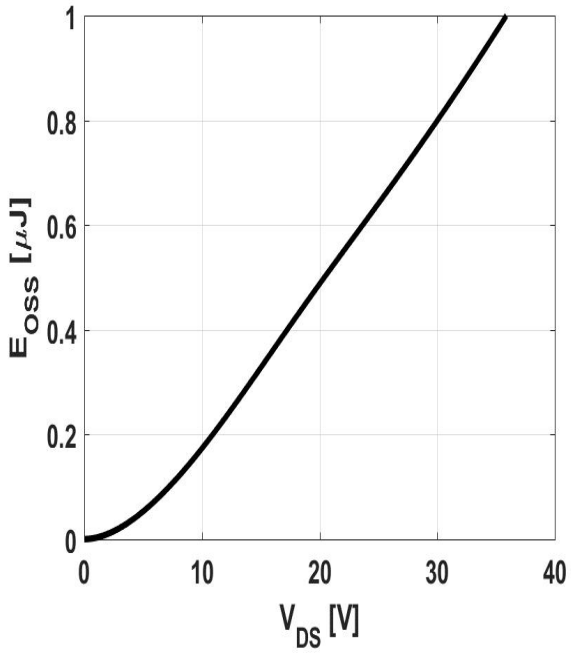
$E_{AS}=f(T_j)$;$I_D=50.0A$; $V_{DD}=20V$

Figure 16: Typ. Capacitances



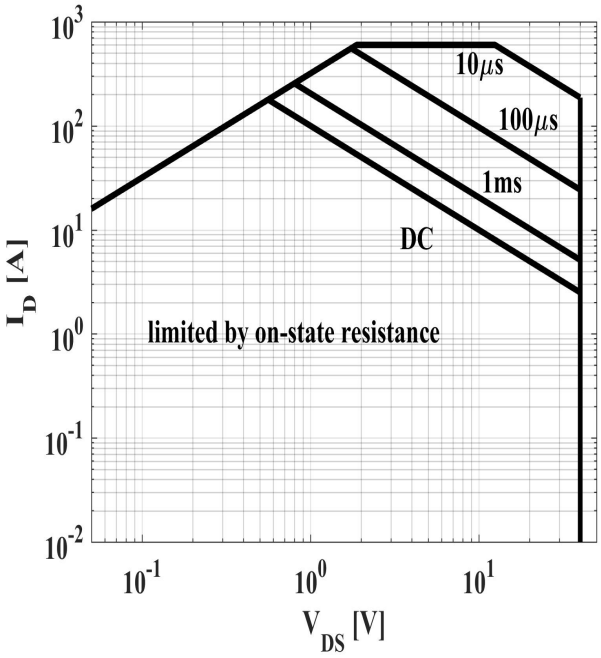
$C=f(V_{DS})$; $V_{GS}=0$; f=1MHz

Figure 17: C_{OSS} Stored Energy



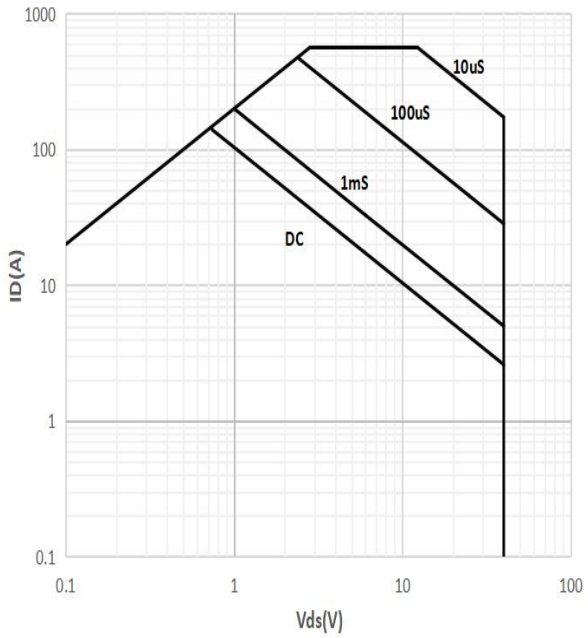
$E_{OSS}=f(V_{DS})$

Figure 18A: Safe Operating Area(PDFN5*6)



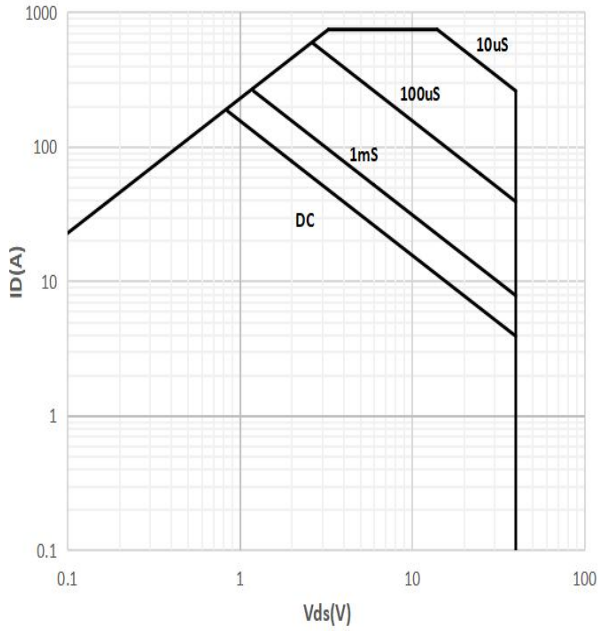
$I_D = f(V_{DS})$; T_c= 25ºC; V_{GS}>7V; parameter t_p

Figure 18B: Safe Operating Area (TO-252)



$I_D = f(V_{DS})$; T_c= 25ºC; V_{GS}>7V; parameter t_p

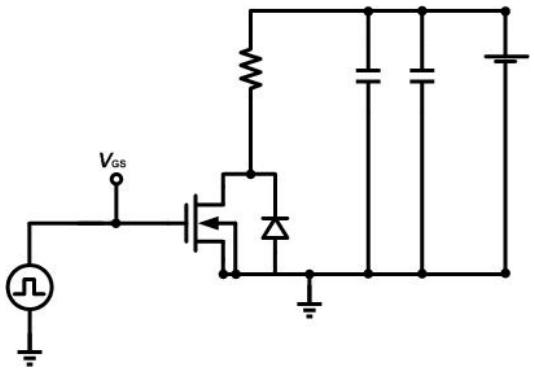
Figure 18C: Safe Operating Area (TO-220C&TO-263-2)

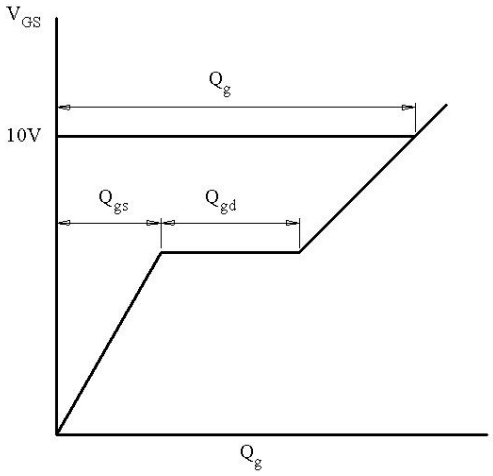


$I_D = f(V_{DS})$; T_c= 25ºC; V_{GS}>7V; parameter t_p

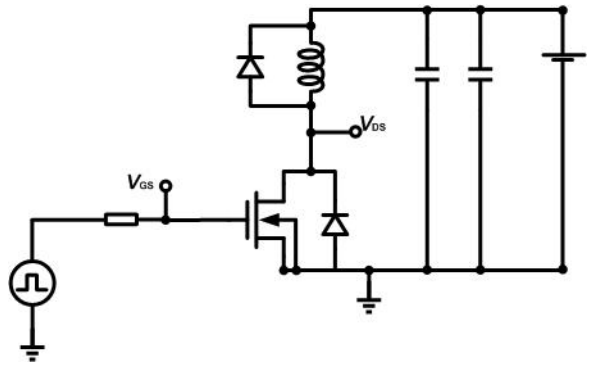
Test Circuits

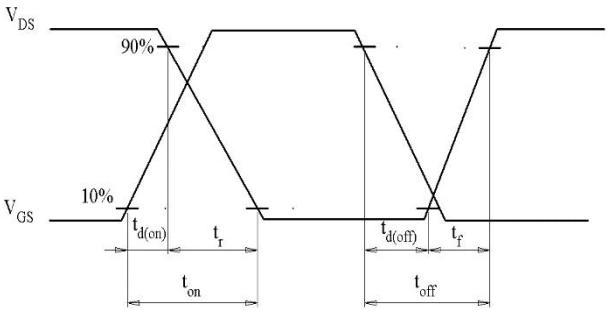
1. Gate Charge Test Circuit & Waveform



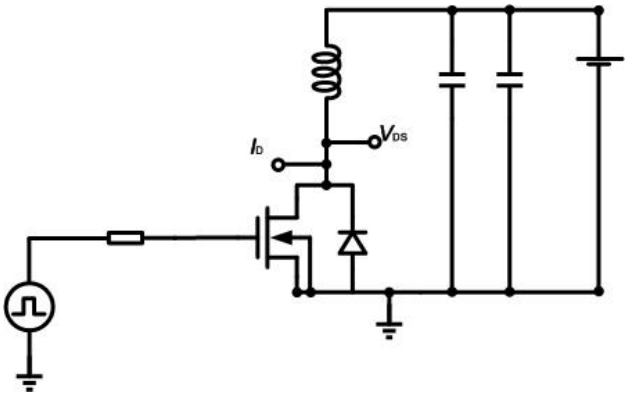


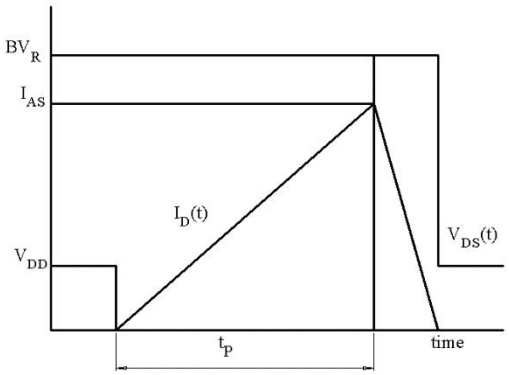
2. Switch Time Test Circuit



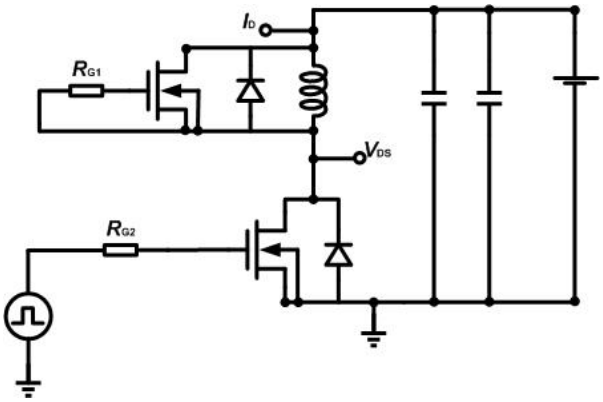


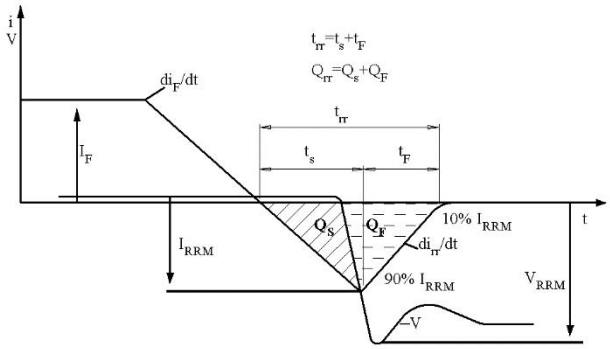
3. Unclamped Inductive Switching Test Circuit & Waveforms





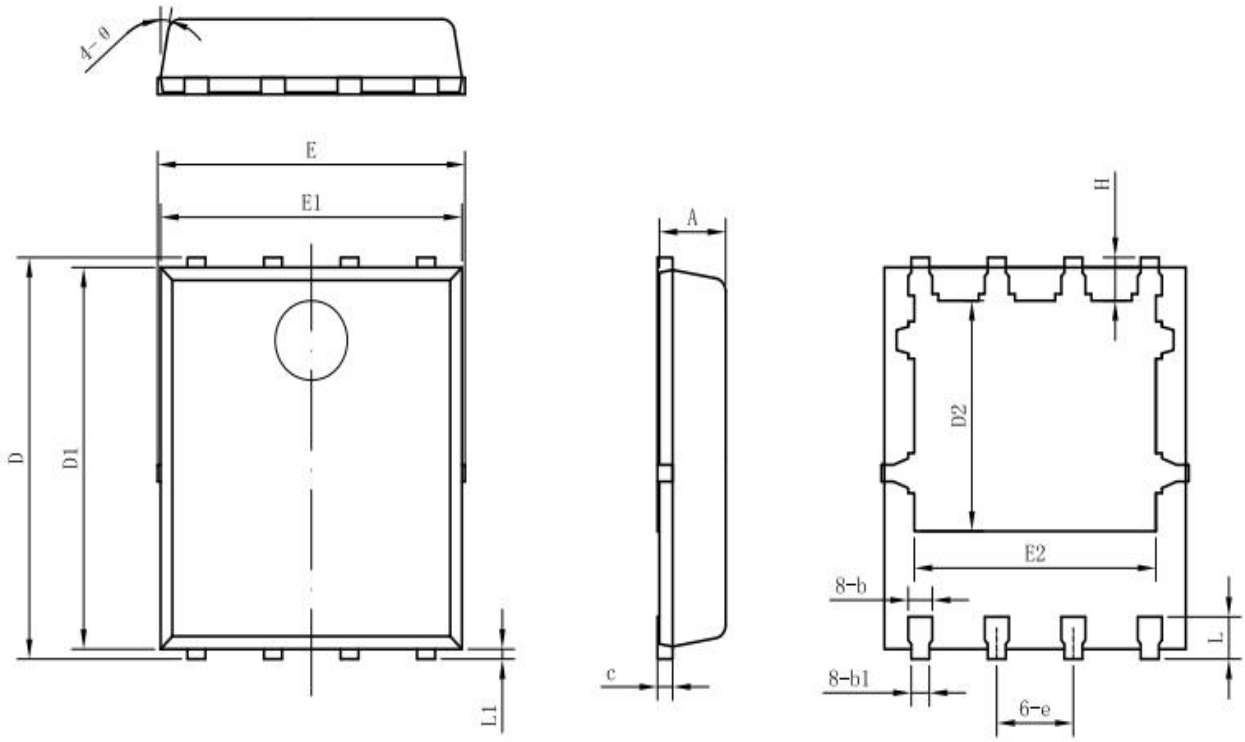
4. Test Circuit and Waveform for Diode Characteristics





Mechanical Dimensions

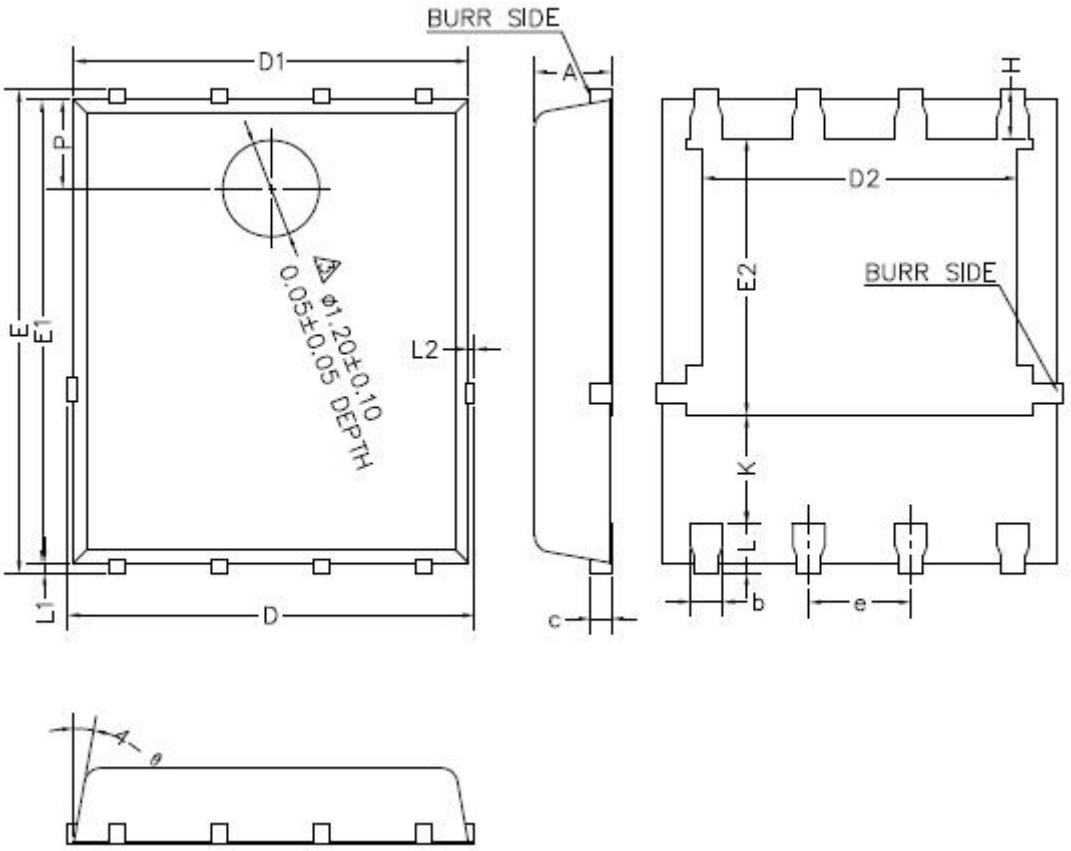
PDFN5*6-8 (Package1) **Unit: mm**



Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	0.90		1.20	E1	4.90	5.00	5.10
b	0.30	0.40	0.50	E2	-	4.01	-
b1	0.20	0.30	0.40	e	-	1.27BSC	-
c	0.20	0.25	0.35	H	0.50	0.65	0.75
D	5.90	6.05	6.20	L	0.51	0.635	0.75
D1	5.65	5.75	5.85	L1	-	0.15	-
D2	-	3.475	-	θ	-	10°	-
E	-	-	5.20				

Mechanical Dimensions

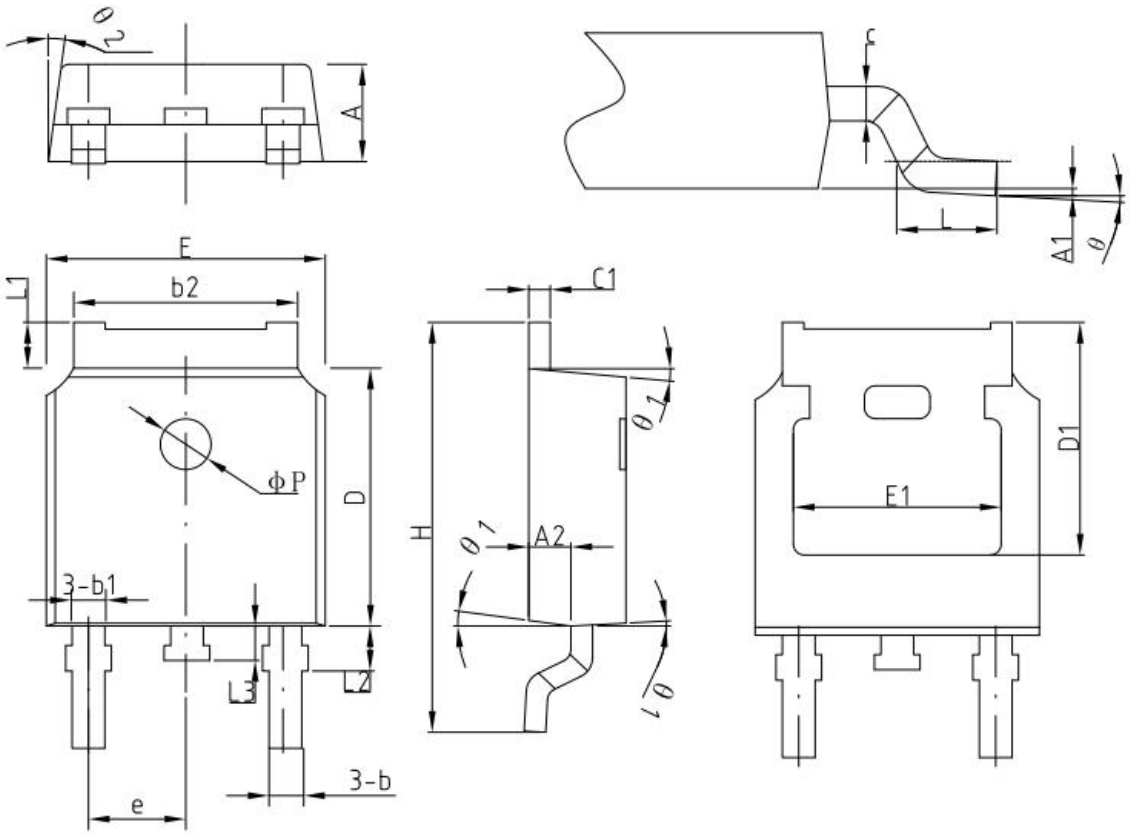
PDFN5*6-8 (Package2) **Unit: mm**



Symbol	Dimensions(mm)		
	Min.	Typ.	Max.
A	0.90		1.20
b	0.35	0.40	0.45
c	0.21	0.25	0.34
D			5.10
D1	4,80	4.90	5.00
D2	3.91	4.01	4.11
e	1.17	1.27	1.37
E	5.90	6.00	6.10
E1	5.70	5.75	5.80
E2	3.34	3.44	3.54
H	0.51	0.61	0.71
K	1.10		
L	0.51	0.61	0.71
L1	0.06	0.13	0.20
L2			0.10
P	1.00	1.10	1.20
θ	8°	10°	12°

Mechanical Dimensions

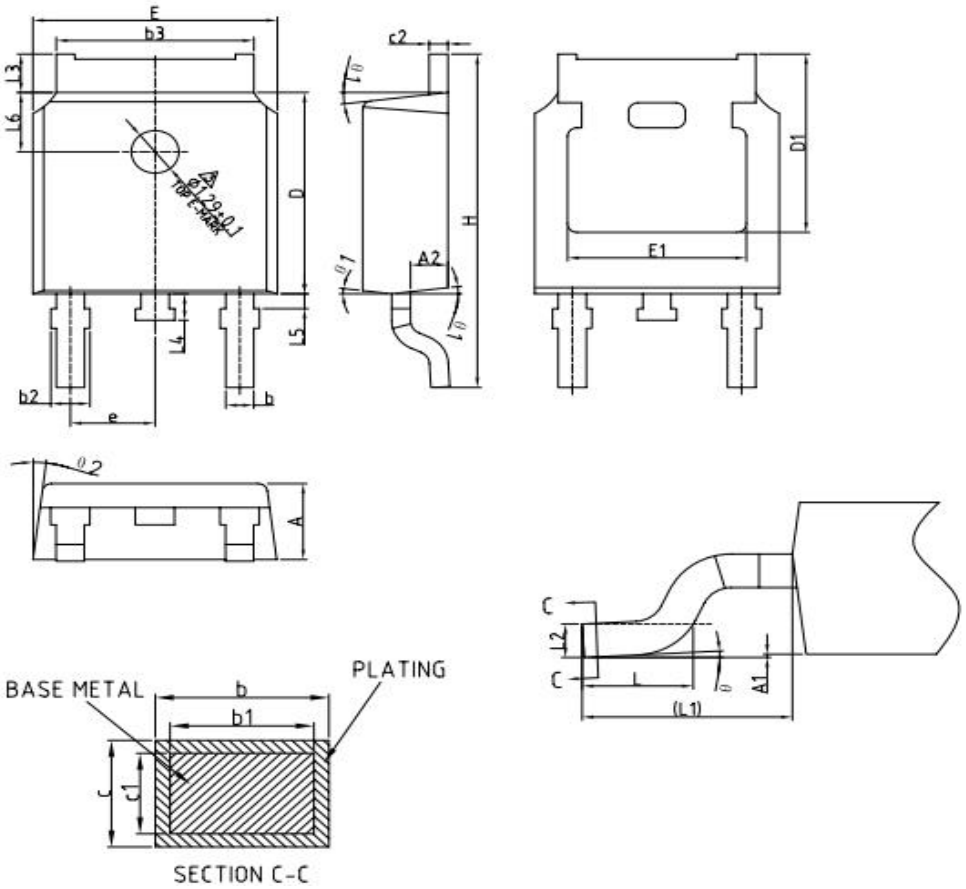
TO-252 (Package1) **Unit: mm**



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	2.20	2.30	2.38	E1	-	4.83	-
A1	0	-	0.127	e	-	2.86BSC	-
A2	0.90	1.01	1.10	H	9.70	10.10	10.40
b	0.635	0.76	0.86	L	1.40	1.50	1.70
b1	-	0.76	-	L1	0.90	-	1.25
b2	5.20	5.33	5.46	L2	-	1.00	-
c	0.47	0.50	0.60	L3	-	0.80	-
c1	0.47	0.50	0.60	ΦP	-	1.20	-
D	6.00	6.10	6.20	Θ	0°	-	8°
D1	-	5.30	-	Θ1	5°	7°	9°
E	6.50	6.60	6.70	Θ2	5°	7°	9°

Mechanical Dimensions

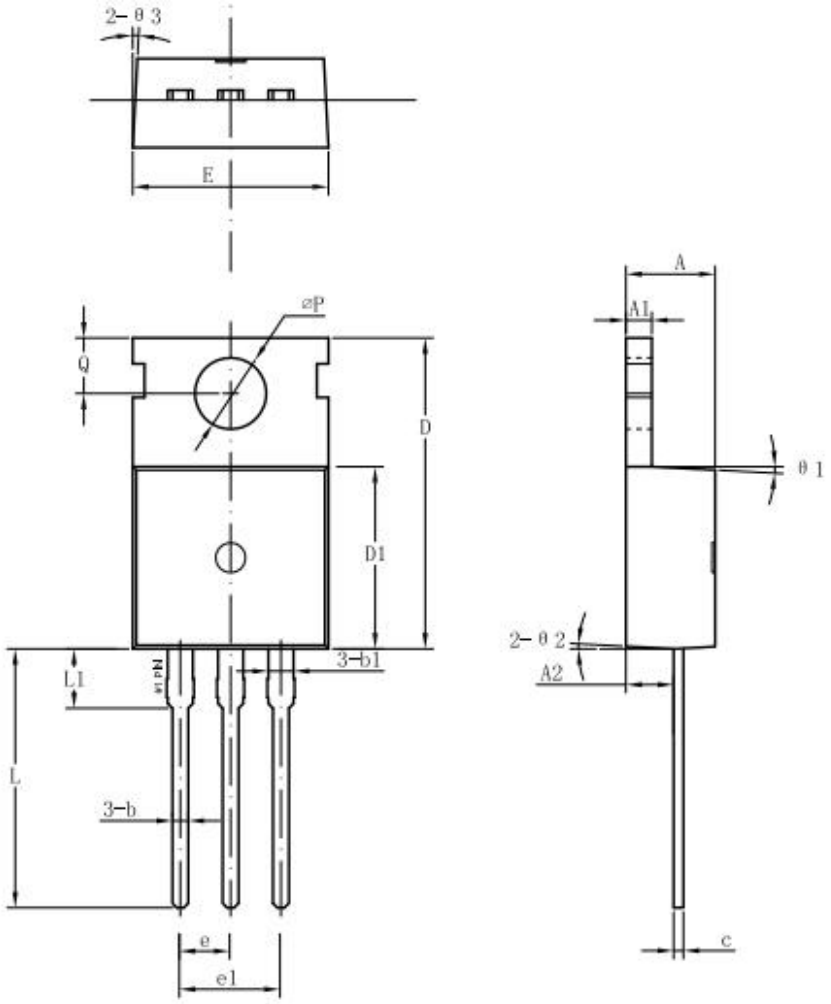
TO-252 (Package2) **Unit: mm**



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	2.20	2.30	2.38	E1	4.70	-	-
A1	0	-	0.10	e	2.186	2.286	2.386
A2	0.90	1.01	1.10	H	9.80	10.10	10.40
b	0.72	-	0.85	L	1.40	1.50	1.70
b1	0.71	0.76	0.81	L1	-	2.90REF	-
b2	0.72	-	0.90	L2	-	0.51BSC	-
b3	5.13	5.33	5.46	L3	0.90	-	1.25
c	0.47	-	0.60	L4	0.60	0.80	1.00
c1	0.46	0.51	0.56	L5	0.15	-	0.75
c2	0.47	-	0.60	L6	-	1.80REF	-
D	6.00	6.10	6.20	Θ	0°	-	8°
D1	5.25	-	-	Θ1	5°	7°	9°
E	6.50	6.60	6.70	Θ2	5°	7°	9°

Mechanical Dimensions

TO-220C(Package1) **Unit: mm**

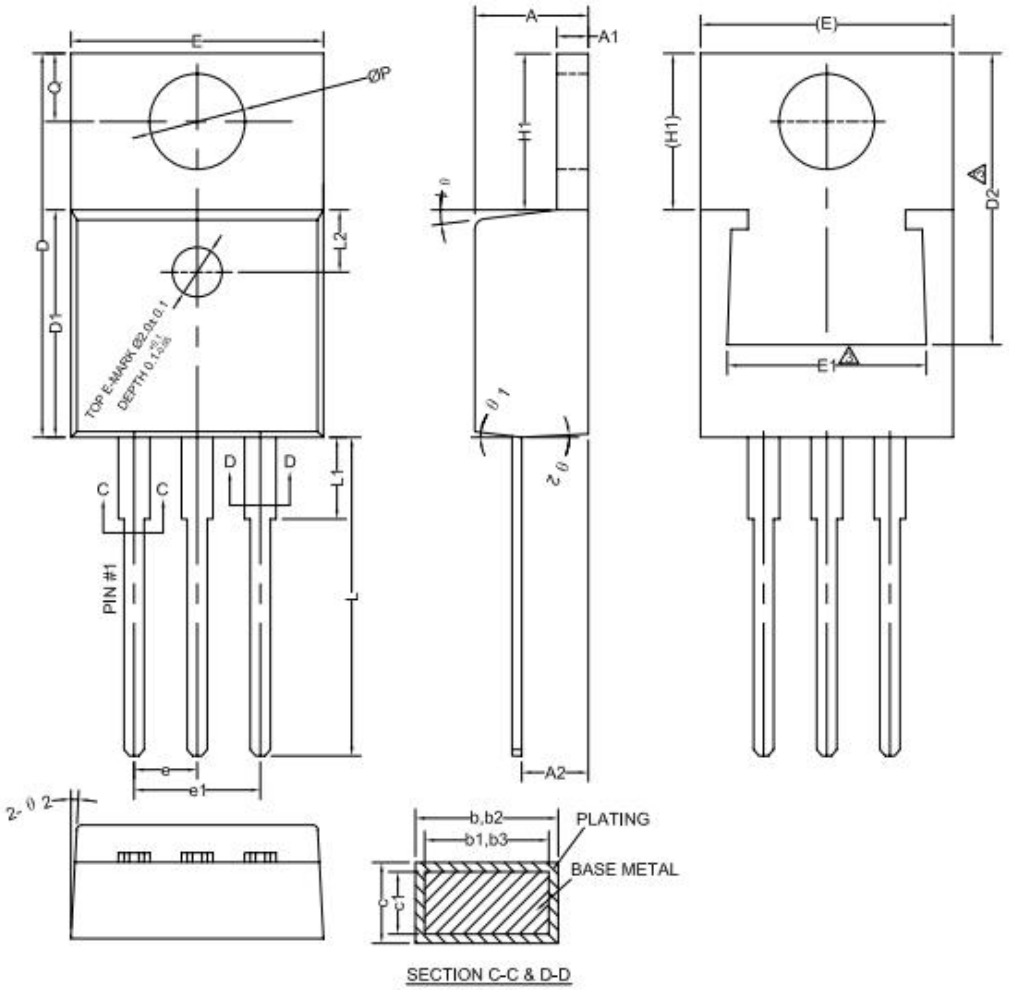


Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.30	4.50	4.70	e	-	2.54	-
A1	1.25	1.30	1.40	e1	-	5.08	-
A2	2.20	2.40	2.60	L	12.60	13.08	13.60
b	0.70	0.80	0.95	L1	-	3.00	-
b1	-	1.27	-	ΦP	3.50	3.60	3.80
c	0.40	0.50	0.65	Q	2.60	2.80	3.00
D	15.20	15.70	16.20	Θ1	-	3°	-
D1	9.00	9.20	9.40	Θ2	-	3°	-
E	9.70	10.00	10.10	Θ3	-	3°	-

1.6mΩ, 40V, N-Channel Power MOSFET SRT04N016LS

Mechanical Dimensions

TO-220C(Package2) **Unit: mm**



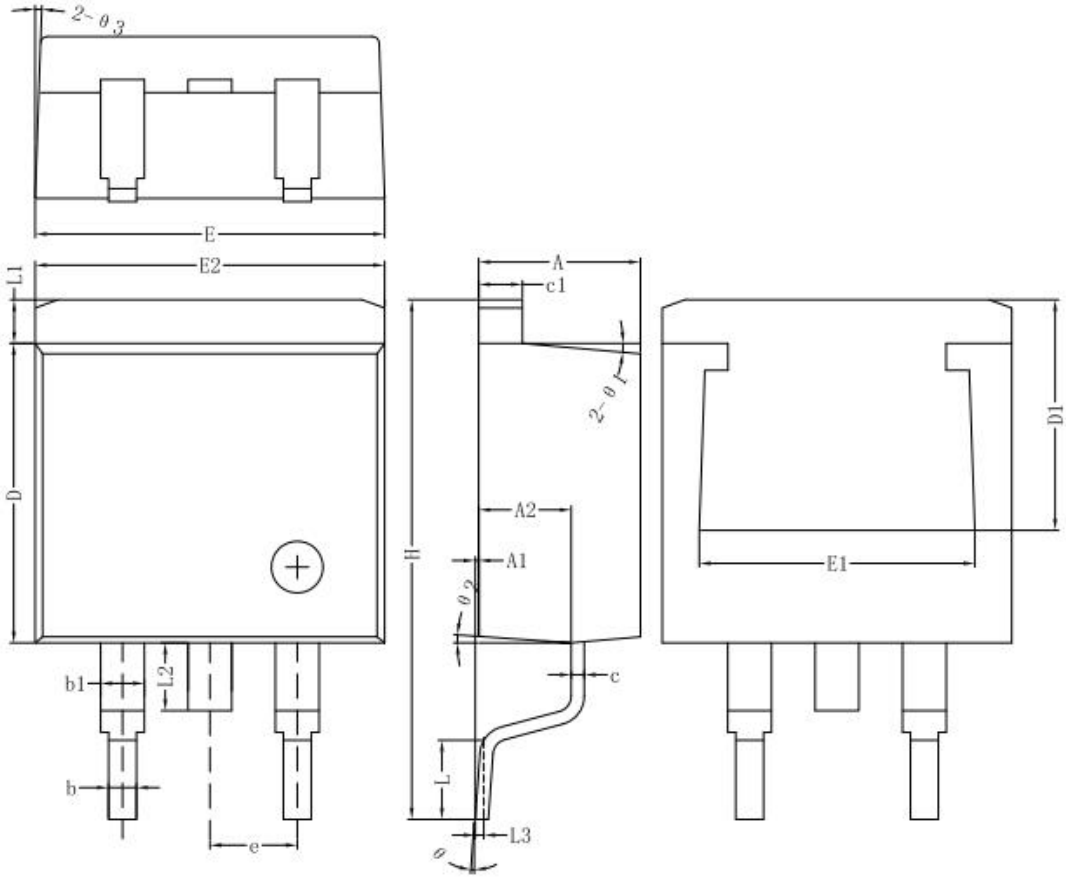
Symbol	Dimensions(mm)			Symbol	Dimensions(mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.40	4.57	4.70	E	9.96	10.16	10.36
A1	1.22	-	1.32	E1	6.86	-	8.89
A2	2.59	2.69	2.79	e	2.44	2.54	2.64
b	0.77	-	0.90	e1	4.98	5.08	5.18
b1	0.76	0.81	0.86	H1	6.10	6.30	6.50
b2	1.23	-	1.36	L	12.70	-	13.12
b3	1.22	1.27	1.32	L1	-	-	3.90
c	0.34	-	0.47	L2	-	2.50REF	-
c1	0.33	0.38	0.43	ΦP	3.80	3.84	3.88
D	15.15	15.45	15.75	Q	2.60	-	2.90
D1	9.05	9.15	9.25	θ1	5°	7°	9°
D2	11.40	-	12.88	θ2	1°	3°	5°

1.6mΩ, 40V, N-Channel Power MOSFET SRT04N016LS

Mechanical Dimensions (Continued)

TO-263-2(Package1)

Unit: mm

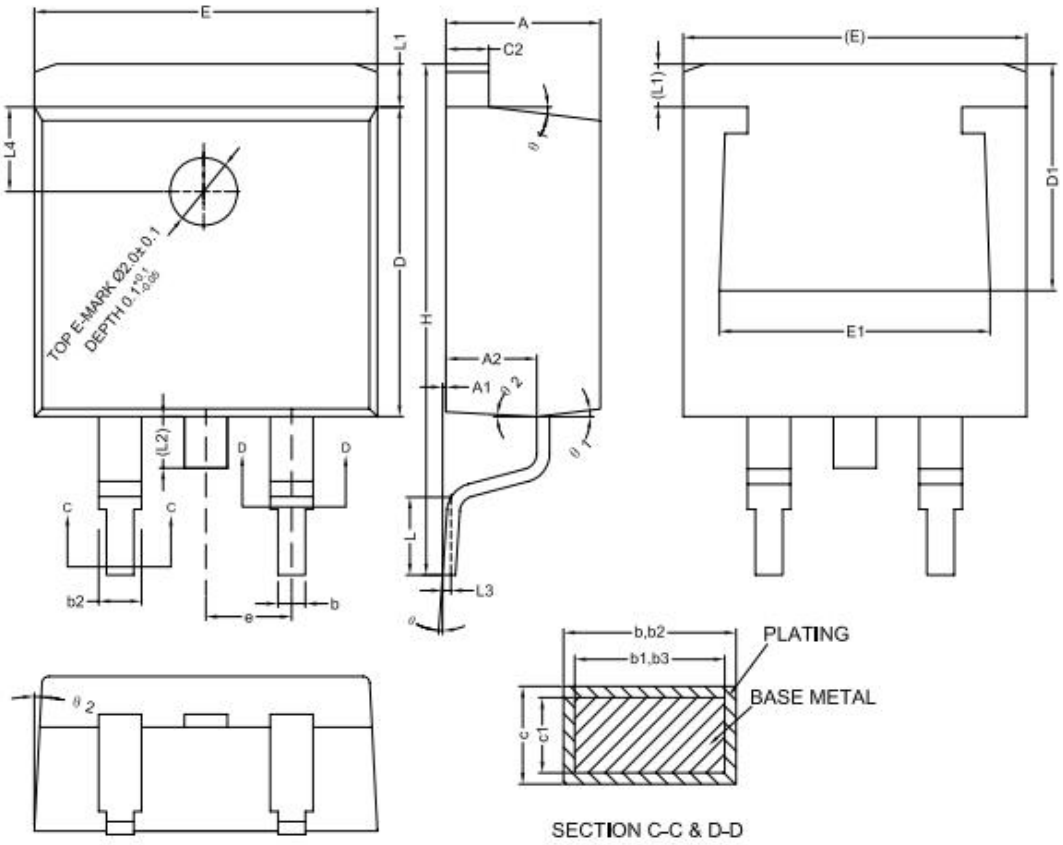


Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.55	4.70	4.85	E2	9.98	10.08	10.18
A1	0.00	0.10	0.25	e	-	2.54	-
A2	2.59	2.69	2.89	H	14.70	15.10	15.50
b	0.71	0.81	0.96	L	2.00	2.30	2.70
b1	-	1.27	-	L1	1.17	1.27	1.40
c	0.36	0.38	0.61	L2	-	-	2.20
c1	1.17	1.27	1.37	L3	-	0.25BSC	-
D	8.55	8.70	8.85	Θ	0°	-	8°
D1	-	7.20	-	Θ1	-	5°	-
E	10.01	10.16	10.31	Θ2	-	4°	-
E1	-	7.8	-	Θ3	-	4°	-

Mechanical Dimensions (Continued)

TO-263-2(Package2)

Unit: mm



Symbol	Dimensions (mm)			Symbol	Dimensions (mm)		
	Min.	Typ.	Max.		Min.	Typ.	Max.
A	4.40	4.57	4.70	E	10.06	10.16	10.26
A1	0.00	0.10	0.25	E1	7.80	-	8.20
A2	2.59	2.69	2.79	e	-	2.54BSC	-
b	0.77	-	0.90	H	14.70	15.10	15.50
b1	0.76	0.81	0.86	L	2.00	2.30	2.60
b2	1.23	-	1.36	L1	1.17	1.27	1.40
b3	1.22	1.27	1.32	L2	-	-	1.75
c	0.34	-	0.47	L3	-	0.25BSC	-
c1	0.33	0.38	0.43	L4	-	2.00REF	-
c2	1.22	-	1.32	Θ	0°	-	8°
D	9.05	9.15	9.25	Θ1	5°	7°	9°
D1	6.60	-	-	Θ2	1°	3°	5°

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