

650V 23mΩ SiC MOSFET

Features:

- High blocking voltage with low $R_{DS(on)}$
- High frequency operation with low capacitance
- Simple to drive with -4V/+18V gate
- Robust body diode with low Q_{rr}
- 100% avalanche tested

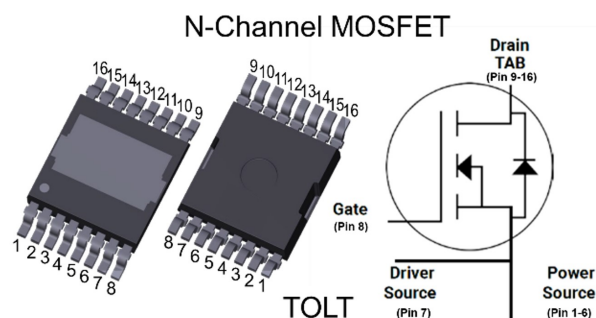
Benefits

- Superior robustness and system reliability
- Higher system efficiency
- Easier paralleling without thermal runaway
- Capable of high temperature application
- Faster and more efficient switching

Applications:

- Server power
- EV/HEV charging station
- Energy storage and battery charging
- High performance DC-DC converters
- On-board charge
- Battery management system

Circuit Diagram



Key Performance and Package Parameters

Type	V_{DS}	$R_{DS(ON)}$	$I_D@25^{\circ}C$	$I_D@100^{\circ}C$	Marking	Package
PP023S065TNC	650V	23mΩ	102A	72A	PP023S065TNC	TOLT

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

Parameter	Symbols	Conditions	Value	Unit
Drain - source voltage	$V_{DS(max)}$	$V_{GS}=0V, I_D=100\mu A$	650	V
Gate - source voltage	$V_{GS(max)}$	AC ($f>1Hz$, duty cycle $<1\%$, pulse width $<200ns$)	-9 / +23	V
Gate – source voltage	$V_{GS(op)}$	Recommend operation	-4 / +18	V
Continuous drain current (limited by $T_{J,max}$)	I_D	$V_{GS}=15V, T_C=25^{\circ}C$ $V_{GS}=15V, T_C=100^{\circ}C$	102 72	A
Pulsed drain current	$I_{D(pulse)}$	$T_C=25^{\circ}C$	215	A
Total power dissipation	P_D	$T_C=25^{\circ}C$	326	W
Operating junction temperature	T_J		-55 to 175	$^{\circ}C$
Storage temperature	T_{STG}		-55 to 175	$^{\circ}C$
Soldering temperature	T_L		260	$^{\circ}C$
Avalanche capability, single pulse*	I_{AV}	$V_{DD}=100V, V_{GS}=10V, L=2mH$	35	A
Avalanche capability, single pulse**	E_{AV}	$V_{DD}=100V, V_{GS}=10V, L=2mH$	1225	mJ

*100% tested in 60% rating

**100% tested in 36% rating

Electrical Characteristics at Tc= 25°C (unless otherwise specified)

Parameter	Symbols	Conditions	Value			Unit
			Min	Typ	Max	
Drain-source breakdown voltage	$V_{(BR)DSS}$	$V_{GS}=0V, I_D=100\mu A$	650	-	-	V
Gate threshold voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=10mA$	2.6	3.0	4.2	V
		$V_{DS}=V_{GS}, I_D=10mA, T_J=150^\circ C$	-	2.3	-	V
		$V_{DS}=V_{GS}, I_D=10mA, T_J=175^\circ C$	-	2.2	-	V
Zero gate voltage drain current	I_{DSS}	$V_{DS}=650V, V_{GS}=0V$	0	0.5	60	μA
		$V_{DS}=650V, V_{GS}=0V, T_J=175^\circ C$	0	5	200	μA
Gate-source leakage current	I_{GSS}	$V_{GS}=18V, V_{DS}=0V$	0	5	100	nA
Gate-source leakage current	I_{GSS}	$V_{GS}=-4V, V_{DS}=0V$	-100	-5	0	nA
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS}=18V, I_D=30A$	-	23	29	$m\Omega$
		$V_{GS}=18V, I_D=30A, T_J=175^\circ C$	-	28	-	$m\Omega$
Transconductance	g_{fs}	$V_{DS}=20V, I_D=30A$	-	24	-	S
		$V_{DS}=20V, I_D=30A, T_J=175^\circ C$	-	22	-	S
Input capacitance	C_{iss}	$V_{DS}=400V, V_{GS}=0V$ $f=1MHz, V_{AC}=25mV$	-	2420	-	pF
Output capacitance	C_{oss}		-	189	-	pF
Reverse transfer capacitance	C_{rss}		-	8	-	pF
Coss stored energy	E_{oss}		-	18	-	μJ
Turn-on switching energy	E_{ON}	$V_{DS}=400V, V_{GS}=-4V/18V$	-	28	-	μJ
Turn-off switching energy	E_{OFF}	$I_D=30A, R_{G(ext)}=2\Omega, L=200\mu H$	-	27	-	μJ
Turn-on delay time	$t_{d(on)}$	$V_{DS}=400V, V_{GS}=-4V/18V$ $I_D=30A, R_{G(ext)}=2\Omega, L=200\mu H$	-	13	-	ns
Rise time	t_r		-	12	-	ns
Turn-off delaytime	$t_{d(off)}$		-	27	-	ns
Fall time	t_f		-	5	-	ns
Total gate charge	Q_g	$V_{DS}=400V, V_{GS}=-4V/18V$ $I_D=30A$	-	113	-	nC
Gate-source charge	Q_{gs}		-	32	-	nC
Gate-drain charge	Q_{gd}		-	46	-	nC
Internal gate input resistance	$R_{g(int)}$	$f=1MHz, I_D=0A$	-	1.2	-	Ω

***Turn-off with -4V gate bias is highly recommended

Reverse Diode Characteristics at Tc= 25°C (unless otherwise specified)

Parameter	Symbols	Conditions	Value			Unit
			Min	Typ	Max	
Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_{SD}=20A, T_J=25^\circ C$	-	3.2	-	V
Diode Forward Voltage	V_{SD}	$V_{GS}=0V, I_{SD}=20A, T_J=175^\circ C$	-	2.9	-	V
Continuous diode forward current	I_S	$V_{GS}=-4V, T_J=25^\circ C$	-	60	-	A
Reverse recovery time	t_{rr}	$V_{GS}=-4V, I_{SD}=30A, V_R=400V,$ $R_{G(ext)}=20\Omega, L=200\mu H$ $diff/dt=1420A/us$	-	20	-	ns
Reverse recovery charge	Q_{rr}		-	238	-	nC
Peak reverse recovery current	I_{rrm}		-	20	-	A

Thermal Characteristics

Parameter	Symbols	Conditions	Value			Unit
			Min	Typ	Max	
Thermal resistance	$R_{th(j-c)}$	Junction to case	-	0.46	0.55	$^\circ C/W$

Typical Characteristics

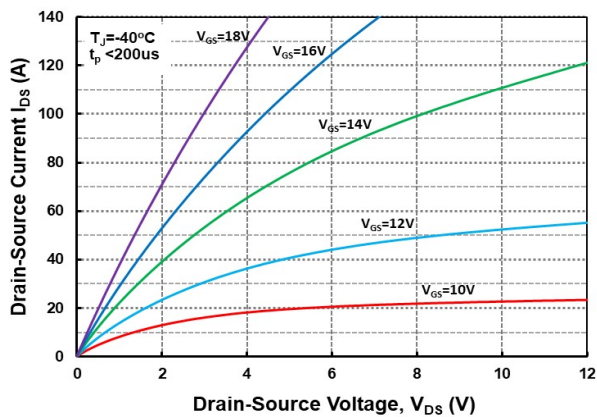


Figure 1: Output Characteristics, $T_J = -40^\circ\text{C}$

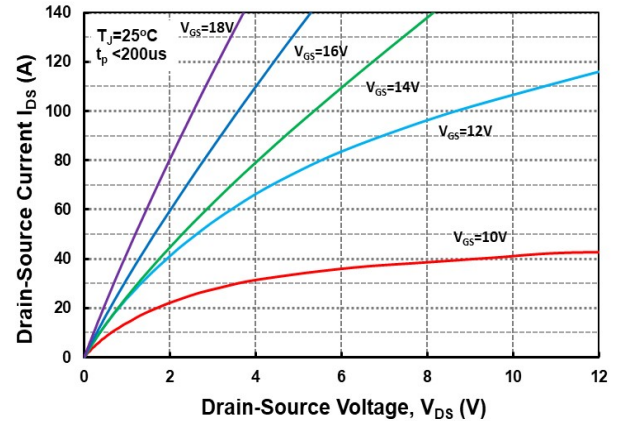


Figure 2: Output Characteristics, $T_J = 25^\circ\text{C}$

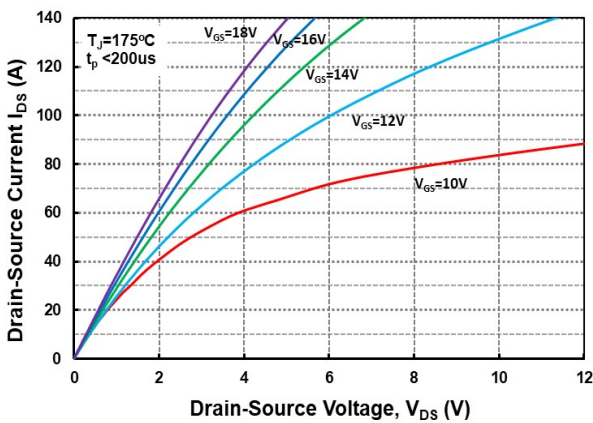


Figure 3: Output Characteristics, $T_J = 175^\circ\text{C}$

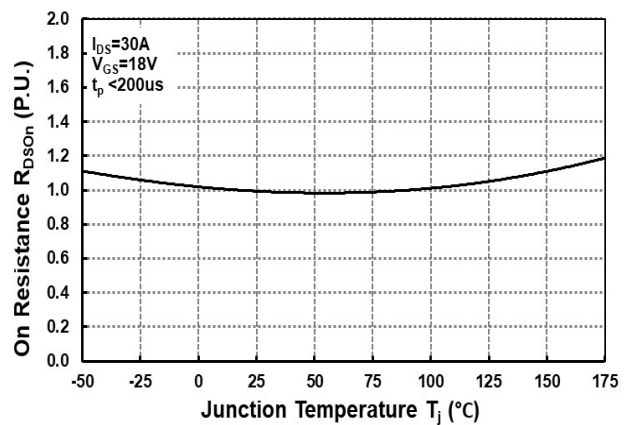


Figure 4: Normalized On-Resistance vs. Temperature

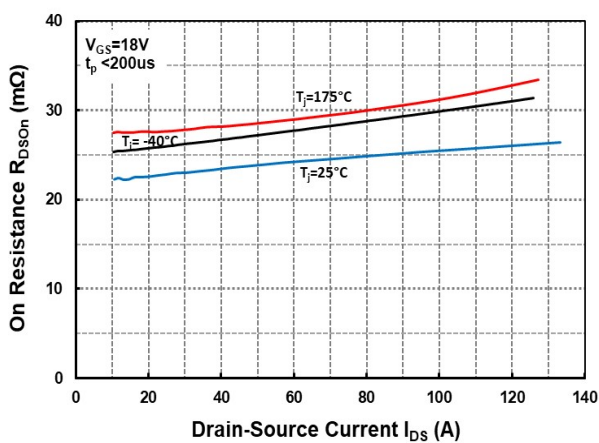


Figure 5: On-Resistance vs. Drain Current for Various Temperatures

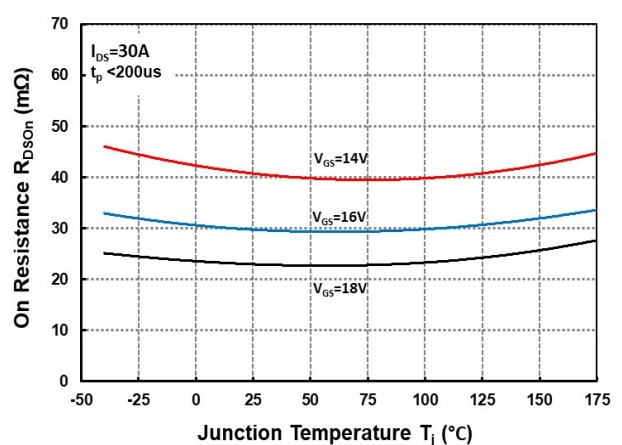


Figure 6: On-Resistance vs. Temperature for Various Gate Voltage

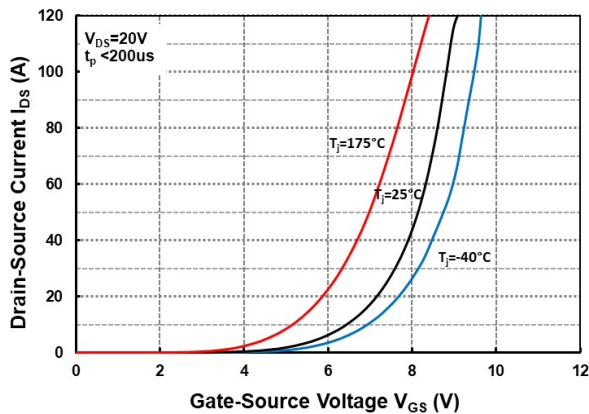


Figure 7: Transfer Characteristic for Various Junction Temperatures

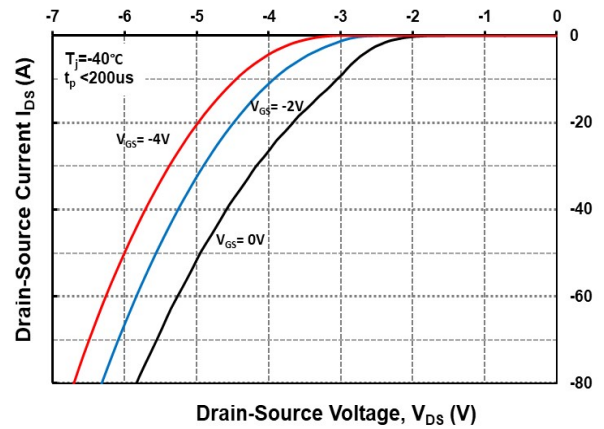


Figure 8: Body Diode Characteristics @ -40°C

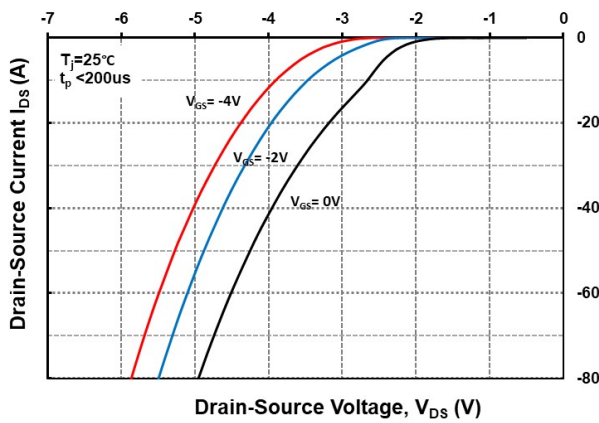


Figure 9: Body Diode Characteristics @ 25°C

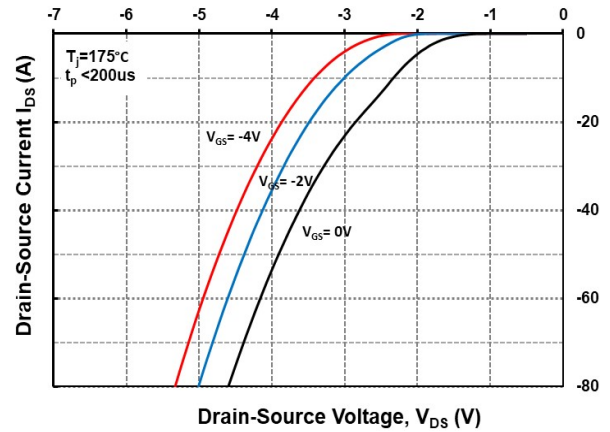


Figure 10: Body Diode Characteristics @ 175°C

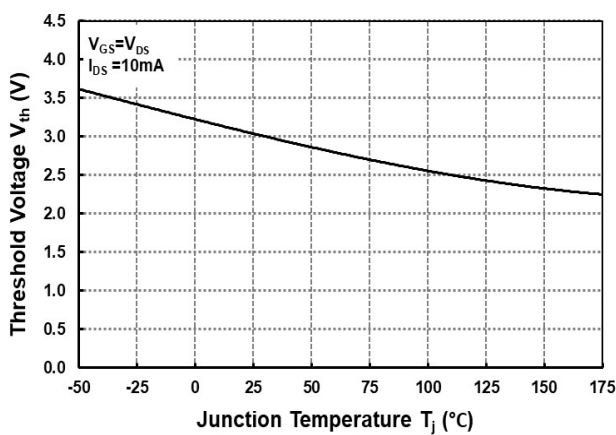


Figure 11: Threshold Voltage vs. Temperature

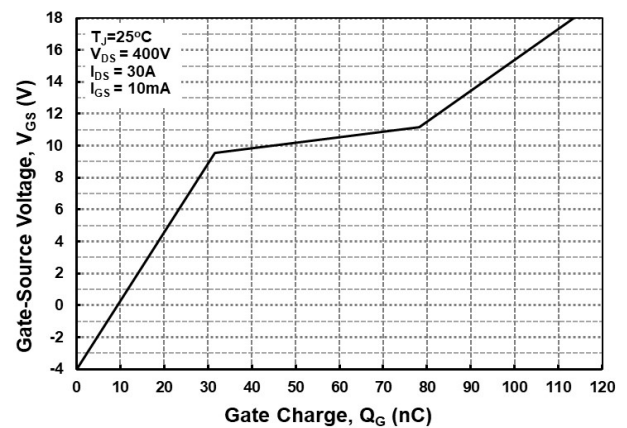


Figure 12: Gate Charge Characteristics

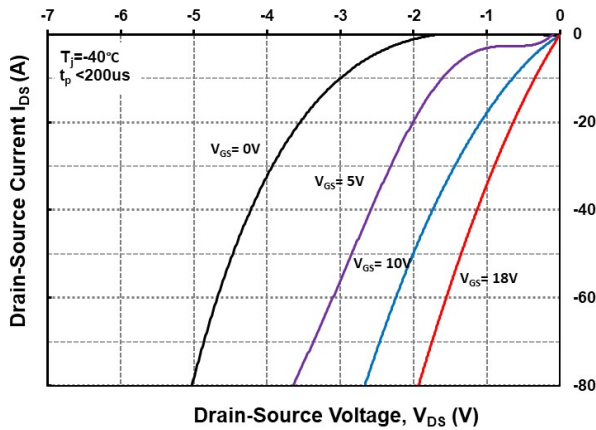


Figure 13: 3rd Quadrant Characteristics @ -40°C

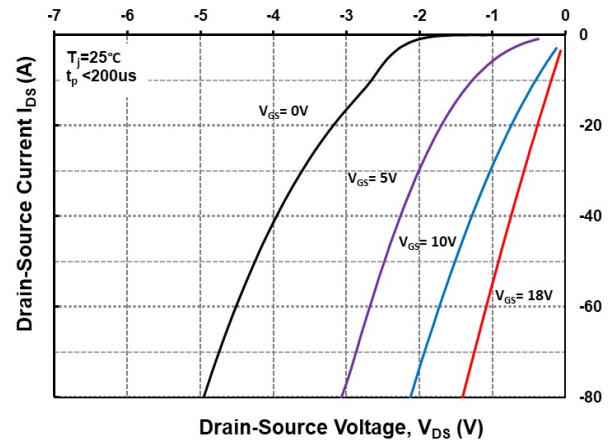


Figure 14: 3rd Quadrant Characteristics @ 25°C

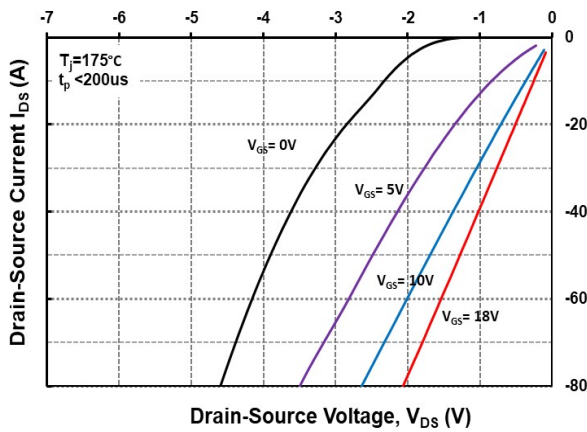


Figure 15: 3rd Quadrant Characteristics @ 175°C

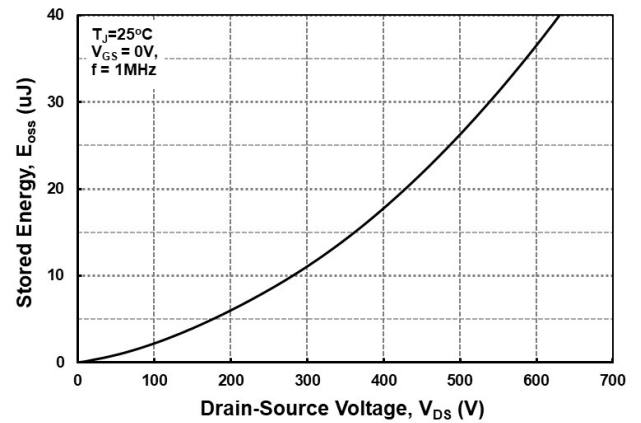


Figure 16: Output Capacitor Stored Energy

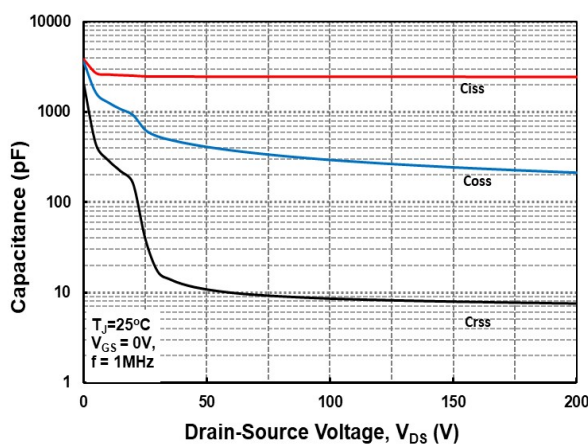


Figure 17: Capacitances vs. Drain-Source Voltage (0-200V)

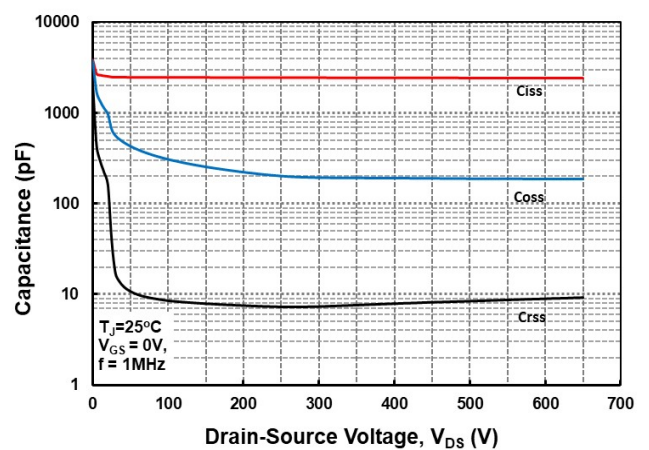


Figure 18: Capacitances vs. Drain-Source Voltage (0-650V)

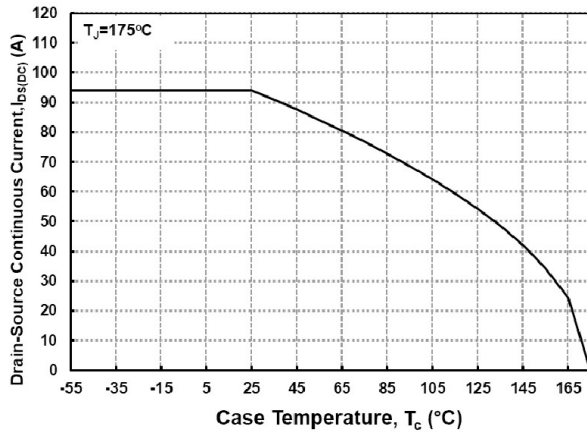


Figure 19: Continuous Drain Current Derating vs. Case Temperature

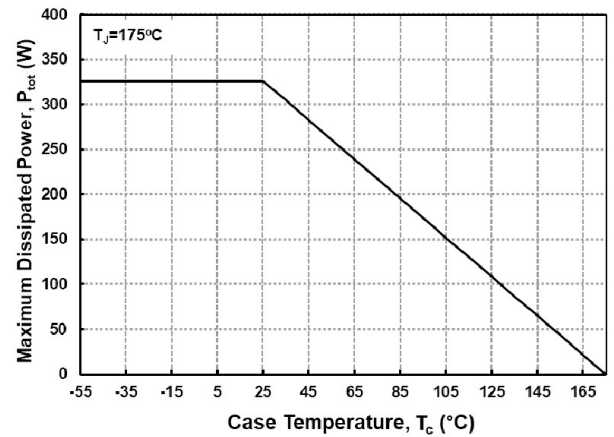


Figure 20: Maximum Power Dissipation Derating vs. Case Temperature

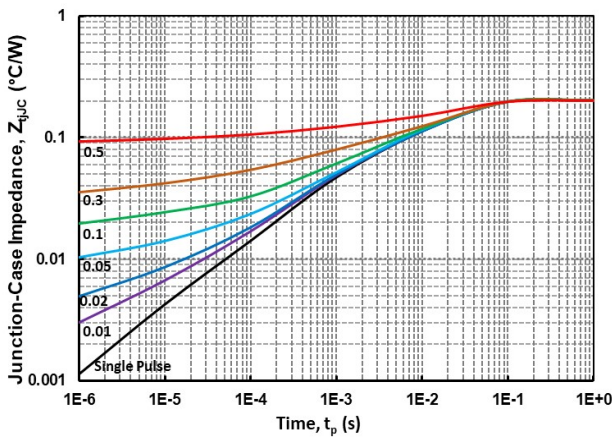


Figure 21: Transient Thermal Impedance (Junction - Case)

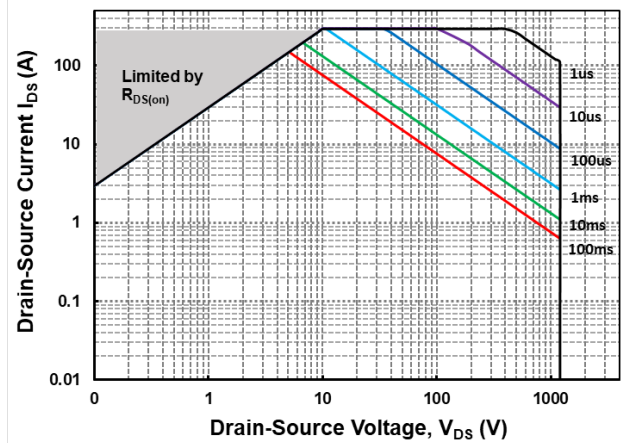


Figure 22: Safe Operating Area

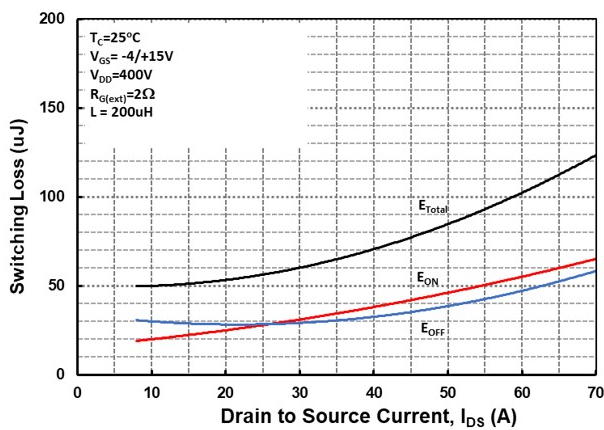


Figure 23: Clamped inductive Switching Energy vs Drain Current (V_{DD}= 400V)

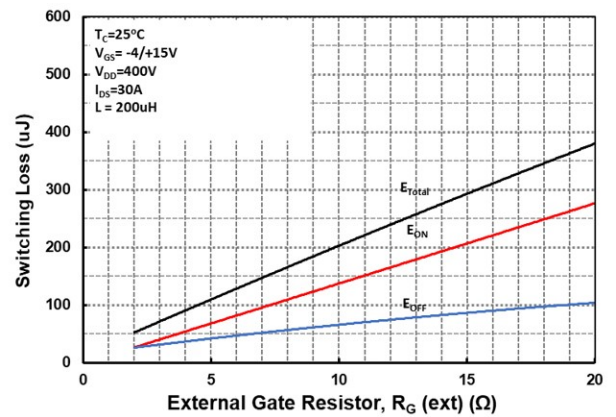


Figure 24: Clamped inductive Switching Energy vs External Gate Resistor R_{G(ext)}

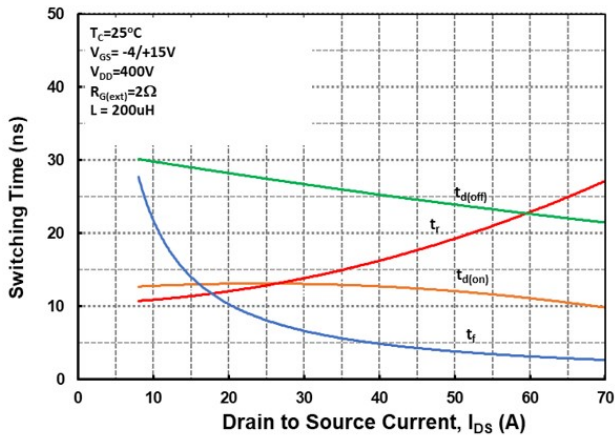


Figure 25: Switching Times vs Drain Current($V_{DD}=400\text{V}$)

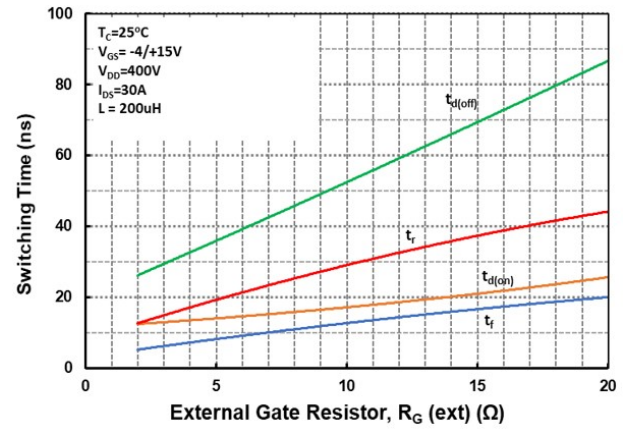
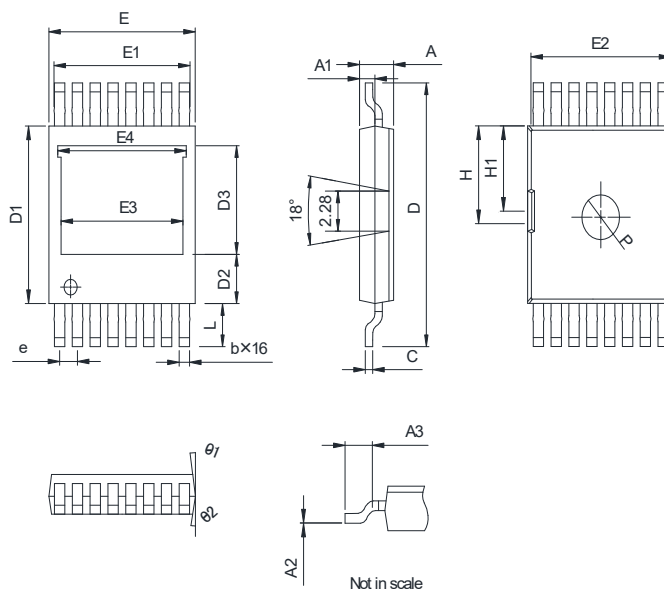


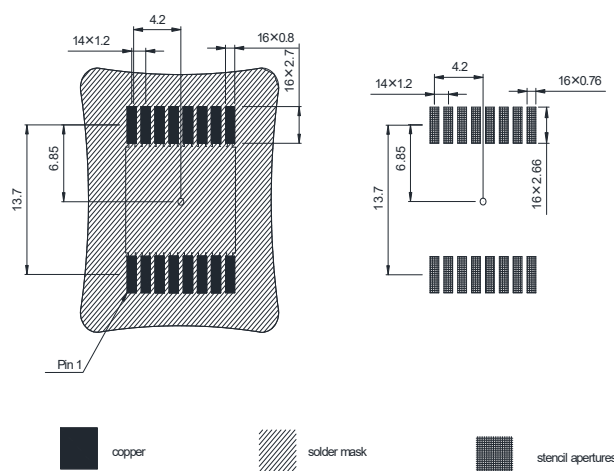
Figure 26: Switching Times vs External Gate Resistor $R_{G(ext)}$

Package Dimensions

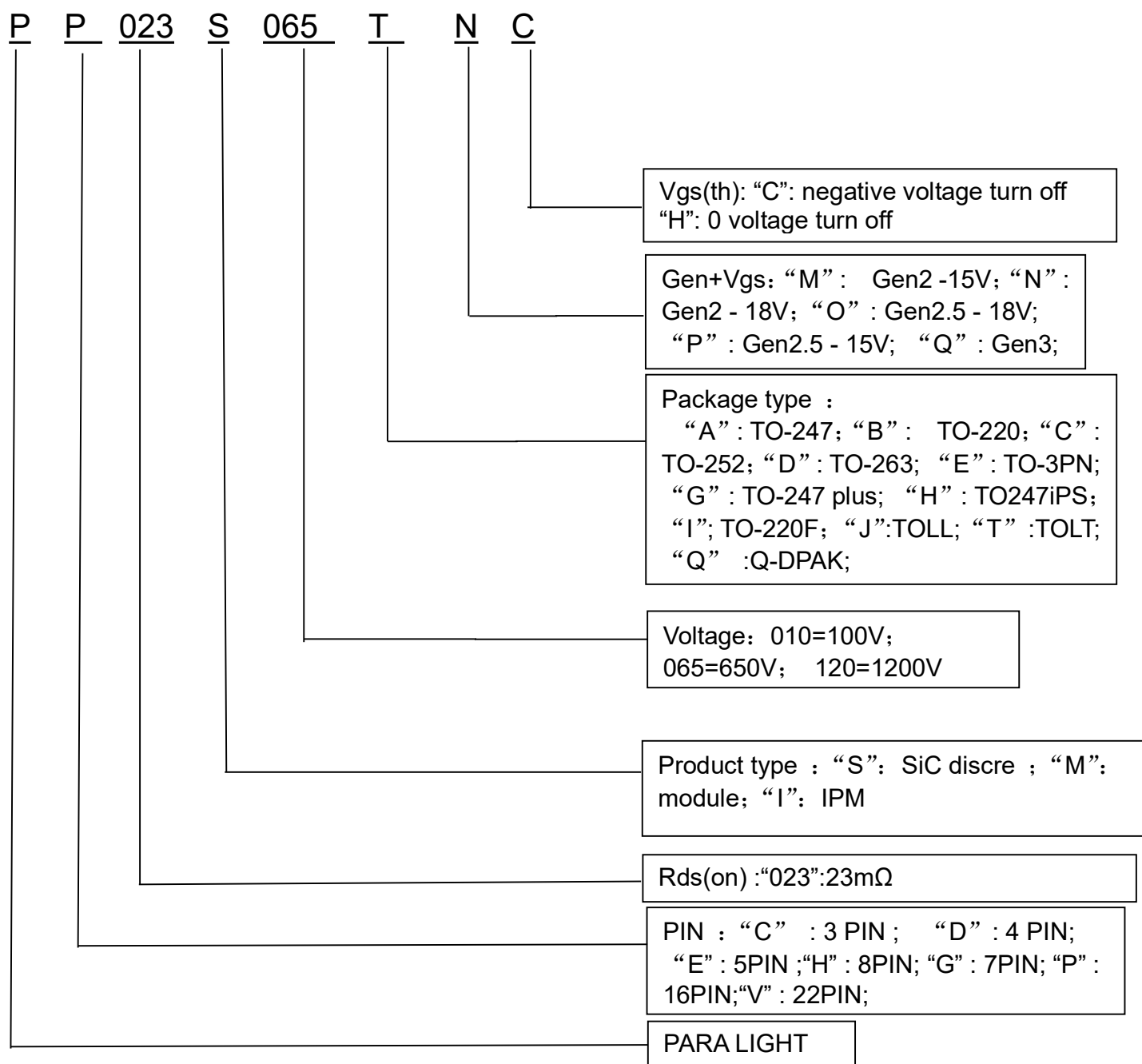


Common dimensions(mm)							
Symbol	Min	Typ	Max	Symbol	Min	Typ	Max
A	2.25	2.30	2.35	E1	9.46REF		
A1	1.00	1.04	1.08	E2	9.25REF		
A2	0.01	0.08	0.16	E3	8.25REF		
A3	1.50REF			E4	8.70REF		
b	0.68	0.70	0.74	e	1.18	1.20	1.22
c	0.45	0.50	0.55	H	5.00	5.20	5.40
D	14.80	15.00	15.20	H1	4.40	4.60	4.80
D1	10.00	10.10	10.30	L	2.40	2.45	2.50
D2	2.60	2.80	3.00	P	2.80	3.00	3.20
D3	5.77REF			Θ1	7°	-	9°
E	9.70	9.90	10.10	Θ2	7°	-	9°

Recommended Solder Pad Layout



PART NO. SYSTEM :



Revision history

Document revision history

Date	Version	Changes
2025.10.31	A / 0	First release.
2025.12.22	A / 1	Version Upgrade.