SiC JFET Division

Is Now Part of

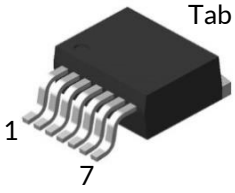
To learn more about onsemi™, please visit our website at
www.onsemi.com

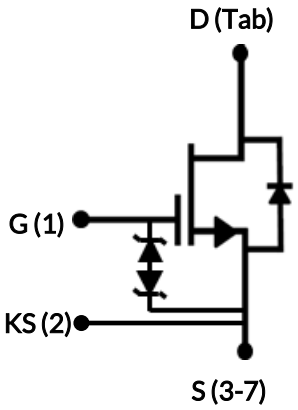
DATASHEET

UJ4C075060B7S

Silicon Carbide (SiC) Cascode JFET - EliteSiC, Power N-Channel, D2PAK-7L, 750 V, 58 mohm

Rev. C, January 2025





Part Number	Package	Marking
UJ4C075060B7S	D2PAK-7L	UJ4C075060B7S

RoHS COMPLIANT | Pb LEAD FREE | HF HALOGEN FREE

Description

The UJ4C075060B7S is a 750V, 58mΩ G4 SiC FET. It is based on a unique 'cascode' circuit configuration, in which a normally-on SiC JFET is co-packaged with a Si MOSFET to produce a normally-off SiC FET device. The device's standard gate-drive characteristics allows for a true "drop-in replacement" to Si IGBTs, Si FETs, SiC MOSFETs or Si superjunction devices. Available in the D^{2}PAK-7L package, this device exhibits ultra-low gate charge and exceptional reverse recovery characteristics, making it ideal for switching inductive loads and any application requiring standard gate drive.

Features

- On-resistance $R_{DS(on)}$: 58mΩ (typ)
- Operating temperature: 175°C (max)
- Excellent reverse recovery: Q_{rr} = 70nC
- Low body diode V_{FSD}: 1.31V
- Low gate charge: Q_G = 37.8nC
- Threshold voltage $V_{G(th)}$: 4.8V (typ) allowing 0 to 15V drive
- Low intrinsic capacitance
- ESD protected, HBM class 2
- D^{2}PAK-7L package for faster switching, clean gate waveforms
- AECQ Qualified

Typical applications

- EV charging
- PV inverters
- Switch mode power supplies
- Power factor correction modules
- Motor drives
- Induction heating

Maximum Ratings

Parameter	Symbol	Test Conditions	Value	Units
Drain-source voltage	V_{DS}		750	V
Gate-source voltage	V_{GS}	DC	-20 to +20	V
		AC (f > 1Hz)	-25 to +25	V
Continuous drain current [1]	I_D	T_C = 25°C	25.8	A
		T_C = 100°C	19	A
Pulsed drain current [2]	I_{DM}	T_C = 25°C	76	A
Single pulsed avalanche energy [3]	E_{AS}	L=15mH, I_{AS} =1.8A	24.3	mJ
SiC FET dv/dt ruggedness	dv/dt	$V_{DS} \leq 500V$	200	V/ns
Power dissipation	P_{tot}	T_C = 25°C	128	W
Maximum junction temperature	$T_{J,max}$		175	°C
Operating and storage temperature	T_J, T_{STG}		-55 to 175	°C
Reflow soldering temperature	T_{solder}	reflow MSL 1	245	°C

1. Limited by $T_{J,max}$
2. Pulse width t_p limited by $T_{J,max}$
3. Starting T_J = 25°C

Thermal Characteristics

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Thermal resistance, junction-to-case	$R_{\theta JC}$			0.9	1.17	°C/W

Electrical Characteristics (T_J = +25°C unless otherwise specified)

Typical Performance - Static

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Drain-source breakdown voltage	BV_{DS}	V_{GS}=0V, I_D=1mA	750			V
Total drain leakage current	I_{DSS}	V_{DS}=750V, V_{GS}=0V, T_J=25°C		0.7	40	µA
		V_{DS}=750V, V_{GS}=0V, T_J=175°C		15		
Total gate leakage current	I_{GSS}	V_{DS}=0V, T_J=25°C, V_{GS}=-20V / +20V		4.7	±20	µA
Drain-source on-resistance	$R_{DS(on)}$	V_{GS}=12V, I_D=20A, T_J=25°C		58	74	mΩ
		V_{GS}=12V, I_D=20A, T_J=125°C		106		
		V_{GS}=12V, I_D=20A, T_J=175°C		147		
Gate threshold voltage	$V_{G(th)}$	V_{DS}=5V, I_D=10mA	4	4.8	6	V
Gate resistance	R_G	f=1MHz, open drain		4.5		Ω

Typical Performance - Reverse Diode

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Diode continuous forward current [1]	I_S	T_C=25°C			25.8	A
Diode pulse current [2]	$I_{S,pulse}$	T_C=25°C			76	A
Forward voltage	V_{FSD}	V_{GS}=0V, I_F=10A, T_J=25°C		1.31	1.75	V
		V_{GS}=0V, I_F=10A, T_J=175°C		1.8		
Reverse recovery charge	Q_{rr}	V_R=400V, I_F=20A, V_{GS}=0V, R_{G_EXT}=20Ω di/dt=1200A/µs, T_J=25°C		70		nC
Reverse recovery time	t_{rr}			11		ns
Reverse recovery charge	Q_{rr}	V_R=400V, I_F=20A, V_{GS}=0V, R_{G_EXT}=20Ω di/dt=1200/µs, T_J=150°C		77		nC
Reverse recovery time	t_{rr}			13		ns

Typical Performance - Dynamic

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Input capacitance	C_{iss}	V_{DS}=400V, V_{GS}=0V f=100kHz		1420		pF
Output capacitance	C_{oss}			41		
Reverse transfer capacitance	C_{rss}			2.7		
Effective output capacitance, energy related	$C_{oss(er)}$	V_{DS}=0V to 400V, V_{GS}=0V		50		pF
Effective output capacitance, time related	$C_{oss(tr)}$	V_{DS}=0V to 400V, V_{GS}=0V		94		pF
C_{OSS} stored energy	E_{oss}	V_{DS}=400V, V_{GS}=0V		4		µJ
Total gate charge	Q_G	V_{DS}=400V, I_D=20A, V_{GS} = 0V to 15V		37.8		nC
Gate-drain charge	Q_{GD}			8		
Gate-source charge	Q_{GS}			11.8		
Turn-on delay time	$t_{d(on)}$	Note 4, V_{DS}=400V, I_D=20A, Gate Driver =0V to +15V, Turn-on $R_{G,EXT}$=1Ω, Turn-off $R_{G,EXT}$=20Ω Inductive Load, FWD: same device with V_{GS} = 0V, R_G = 20Ω, T_J=25°C		15		ns
Rise time	t_r			21		
Turn-off delay time	$t_{d(off)}$			75		
Fall time	t_f			11		
Turn-on energy	E_{ON}			132		µJ
Turn-off energy	E_{OFF}			29		
Total switching energy	E_{TOTAL}			161		
Turn-on delay time	$t_{d(on)}$	Note 4, V_{DS}=400V, I_D=20A, Gate Driver =0V to +15V, Turn-on $R_{G,EXT}$=1Ω, Turn-off $R_{G,EXT}$=20Ω Inductive Load, FWD: same device with V_{GS} = 0V, R_G = 20Ω, T_J=150°C		12		ns
Rise time	t_r			23		
Turn-off delay time	$t_{d(off)}$			83		
Fall time	t_f			12		
Turn-on energy	E_{ON}			148		µJ
Turn-off energy	E_{OFF}			37		
Total switching energy	E_{TOTAL}			185		

4. Measured with the half-bridge mode switching test circuit in Figure 23.

Typical Performance - Dynamic (continued)

Parameter	Symbol	Test Conditions	Value			Units
			Min	Typ	Max	
Turn-on delay time	$t_{d(on)}$	Notes 5 and 6, V_{DS}=400V, I_D=20A, Gate Driver =0V to +15V, Turn-on $R_{G,EXT}$ = 1Ω, Turn-off $R_{G,EXT}$=5Ω, inductive Load, FWD: same device with V_{GS} = 0V and R_G = 5Ω, RC snubber: R_S=10Ω and C_S=100pF, T_J=25°C		10		ns
Rise time	t_r			22		
Turn-off delay time	$t_{d(off)}$			32		
Fall time	t_f			8		
Turn-on energy including R_S energy	E_{ON}			96		µJ
Turn-off energy including R_S energy	E_{OFF}			36		
Total switching energy	E_{TOTAL}			132		
Snubber R_S energy during turn-on	E_{RS_ON}			0.7		
Snubber R_S energy during turn-off	E_{RS_OFF}			1		
Turn-on delay time	$t_{d(on)}$	Notes 5 and 6, V_{DS}=400V, I_D=20A, Gate Driver =0V to +15V, Turn-on $R_{G,EXT}$ = 1Ω, Turn-off $R_{G,EXT}$=5Ω, inductive Load, FWD: same device with V_{GS} = 0V and R_G = 5Ω, RC snubber: R_S=10Ω and C_S=100pF, T_J=150°C		14		ns
Rise time	t_r			23		
Turn-off delay time	$t_{d(off)}$			45		
Fall time	t_f			10		
Turn-on energy including R_S energy	E_{ON}			140		µJ
Turn-off energy including R_S energy	E_{OFF}			25		
Total switching energy	E_{TOTAL}			165		
Snubber R_S energy during turn-on	E_{RS_ON}			0.7		
Snubber R_S energy during turn-off	E_{RS_OFF}			1		

5. Measured with the chopper mode switching test circuit in Figure 24.

6. In this datasheet, all the switching energies (turn-on energy, turn-off energy and total energy) presented in the tables and Figures include the device RC snubber energy losses.

Typical Performance Diagrams

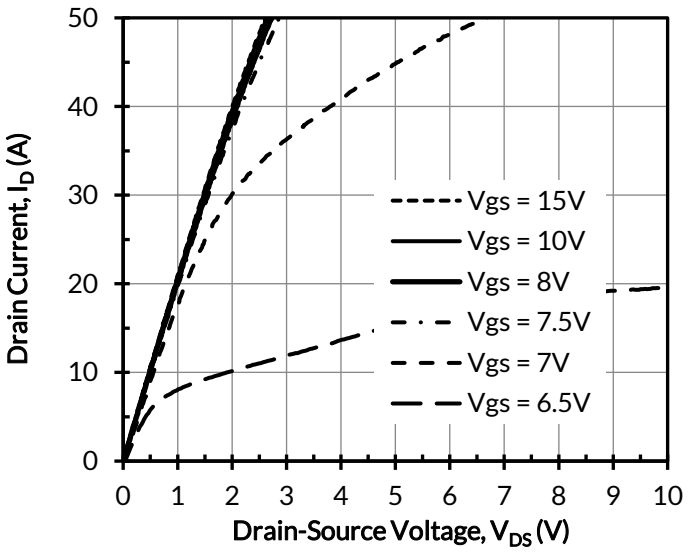


Figure 1. Typical output characteristics at T_J = - 55°C, tp < 250µs

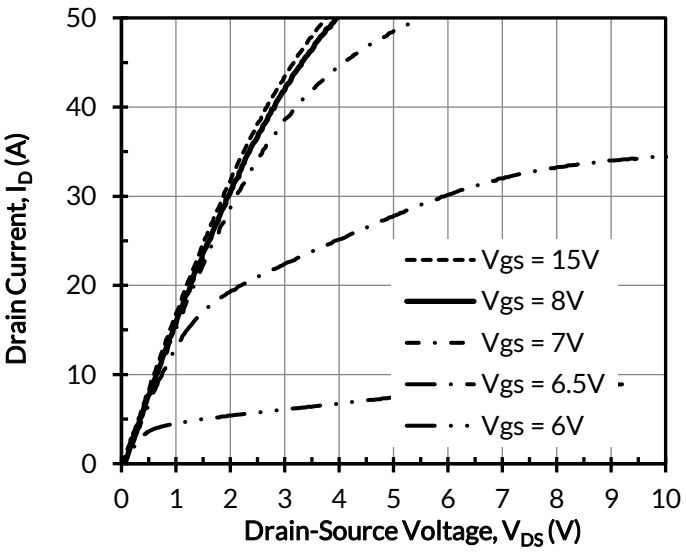


Figure 2. Typical output characteristics at T_J = 25°C, tp < 250µs

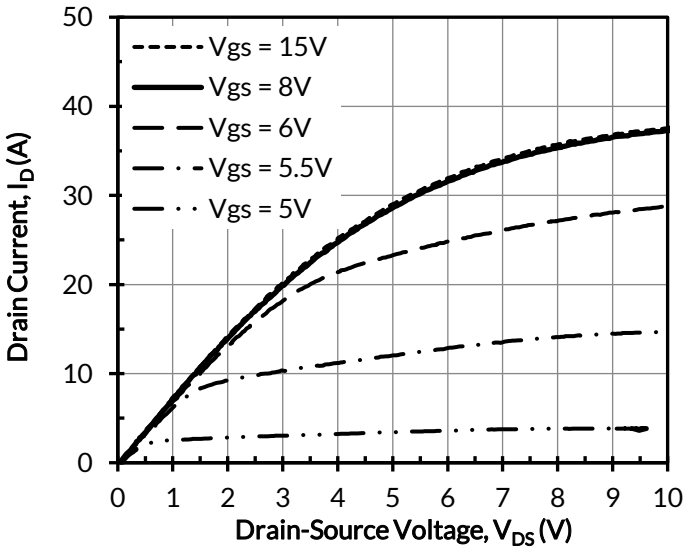


Figure 3. Typical output characteristics at T_J = 175°C, tp < 250µs

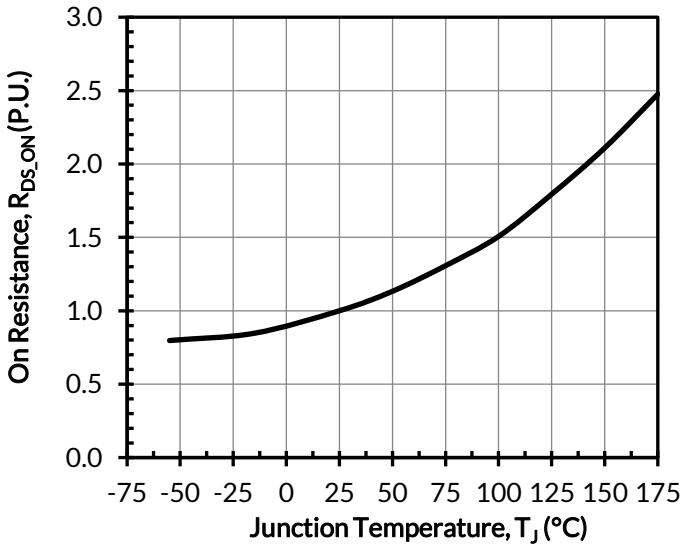


Figure 4. Normalized on-resistance vs. temperature at V_{GS} = 12V and I_D = 20A

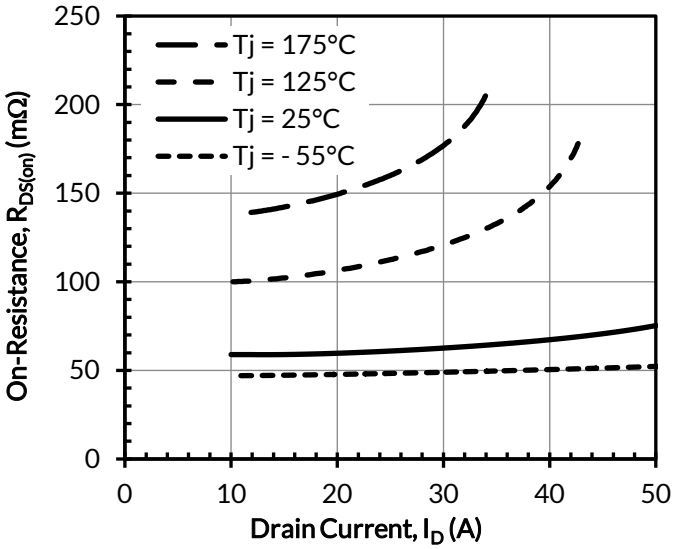


Figure 5. Typical drain-source on-resistances at V_{GS} = 12V

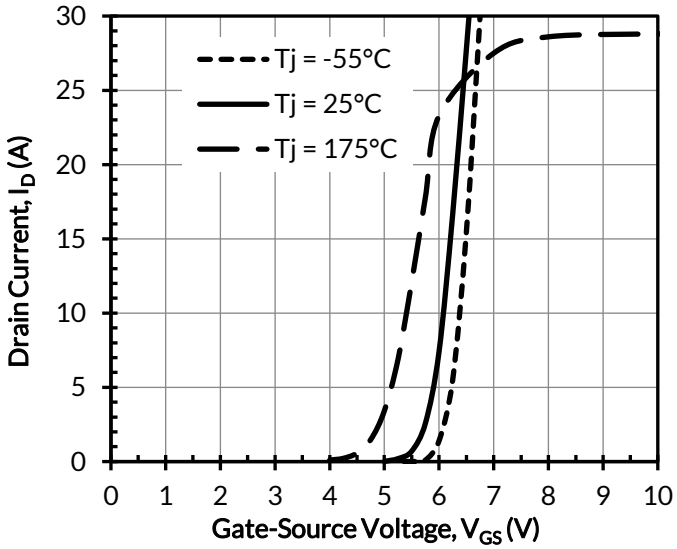


Figure 6. Typical transfer characteristics at V_{DS} = 5V

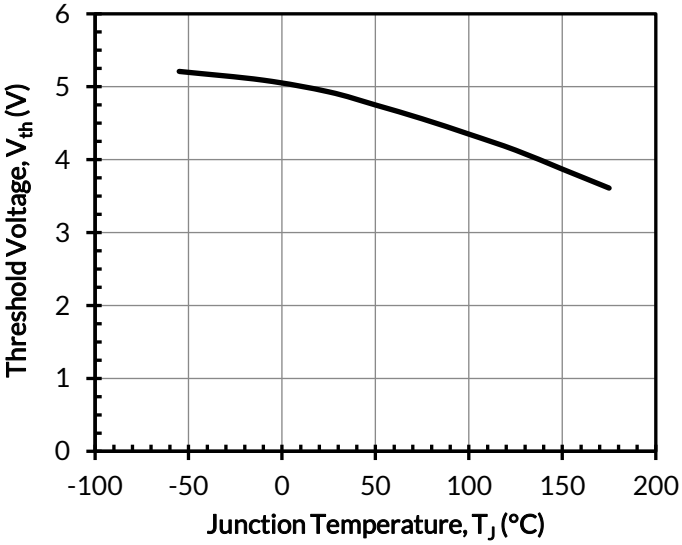


Figure 7. Threshold voltage vs. junction temperature at V_{DS} = 5V and I_D = 10mA

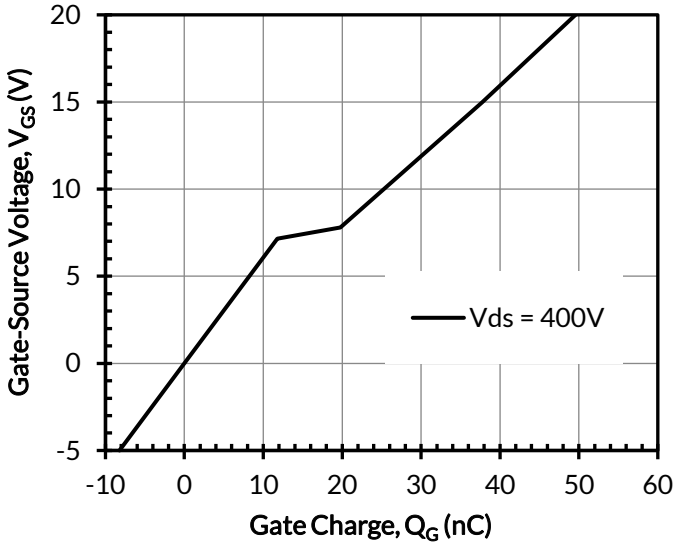


Figure 8. Typical gate charge at I_D = 20A

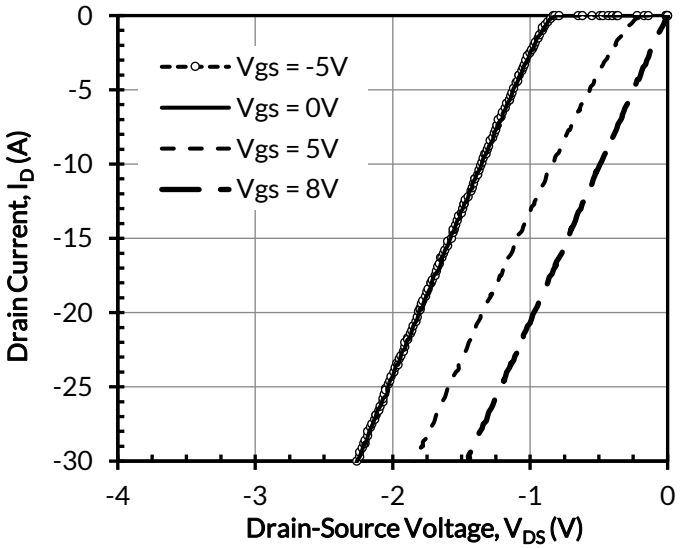


Figure 9. 3rd quadrant characteristics at T_J = -55°C

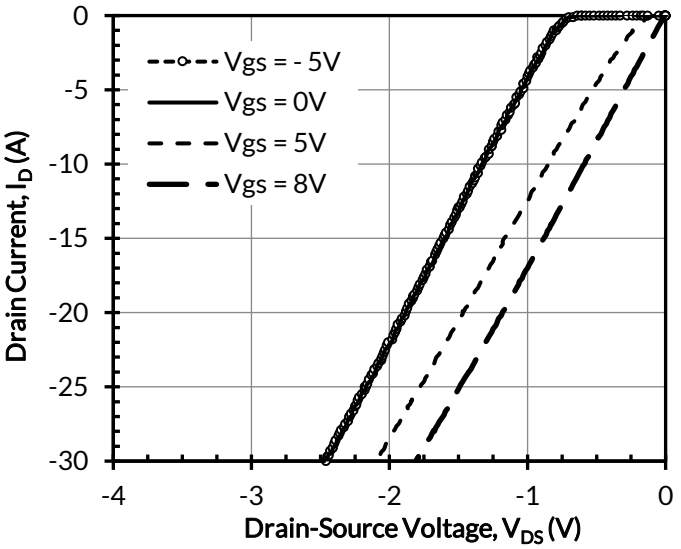


Figure 10. 3rd quadrant characteristics at T_J = 25°C

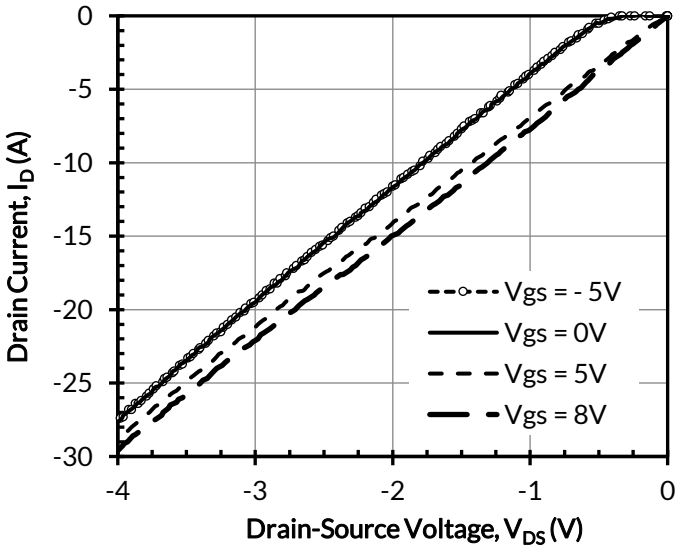


Figure 11. 3rd quadrant characteristics at T_J = 175°C

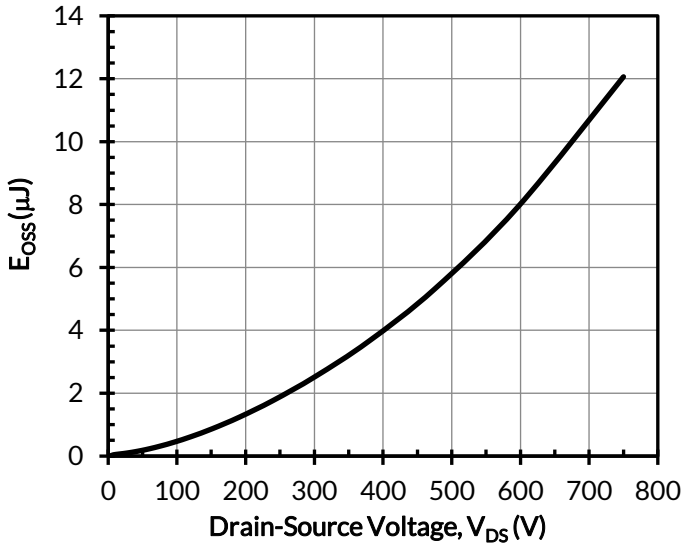


Figure 12. Typical stored energy in C_{OSS} at V_{GS} = 0V

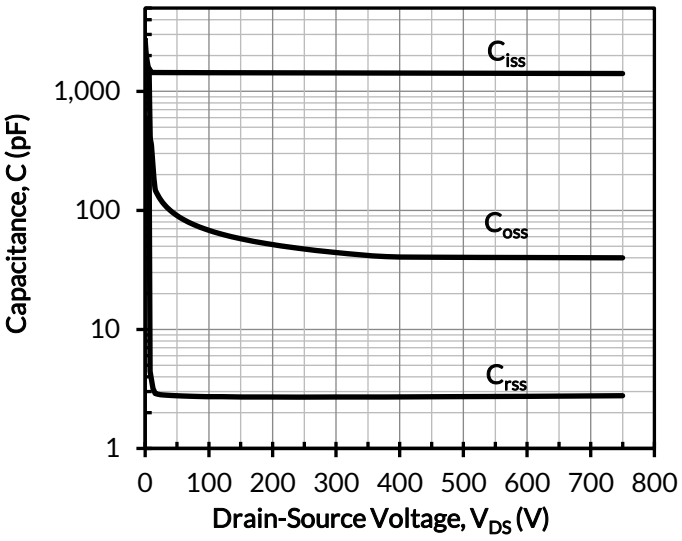


Figure 13. Typical capacitances at f = 100kHz and V_{GS} = 0V

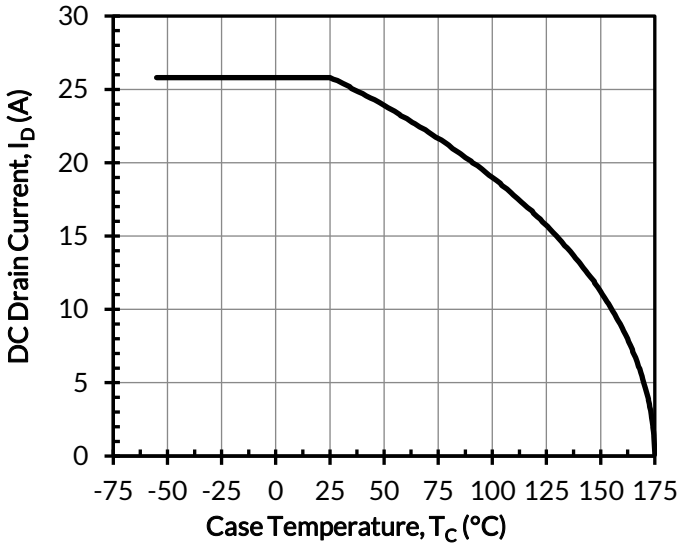


Figure 14. DC drain current derating

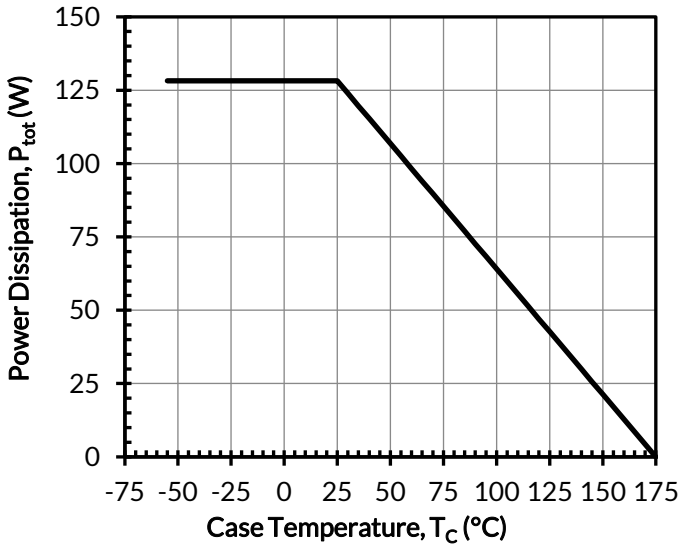


Figure 15. Total power dissipation

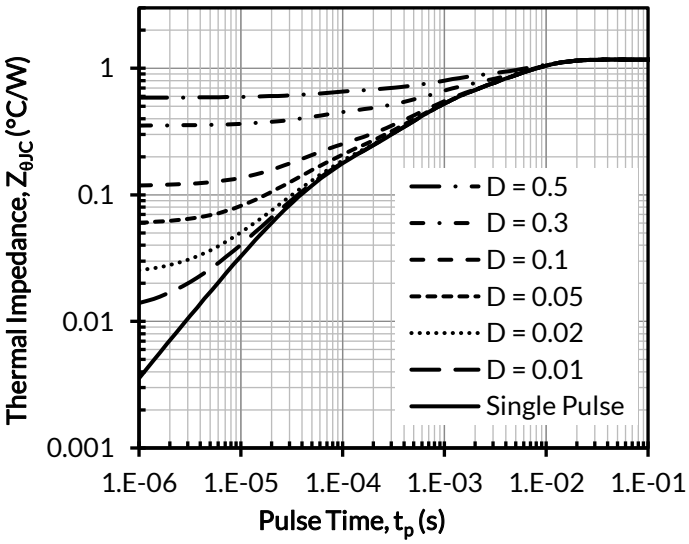


Figure 16. Maximum transient thermal impedance

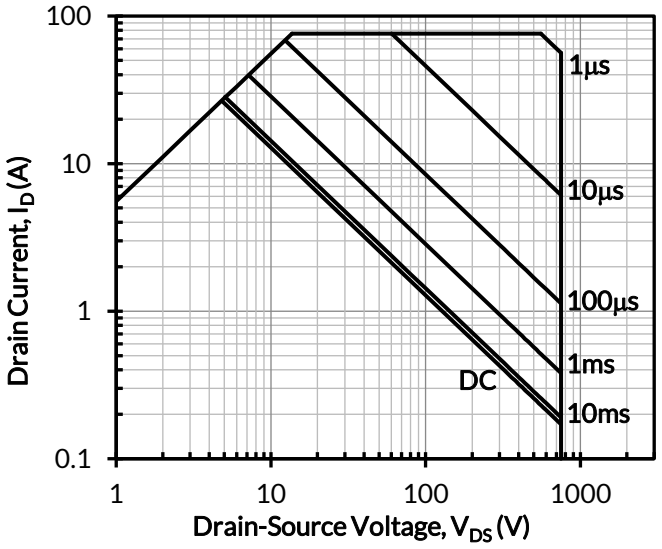


Figure 17. Safe operation area at T_C = 25°C, D = 0, Parameter t_p

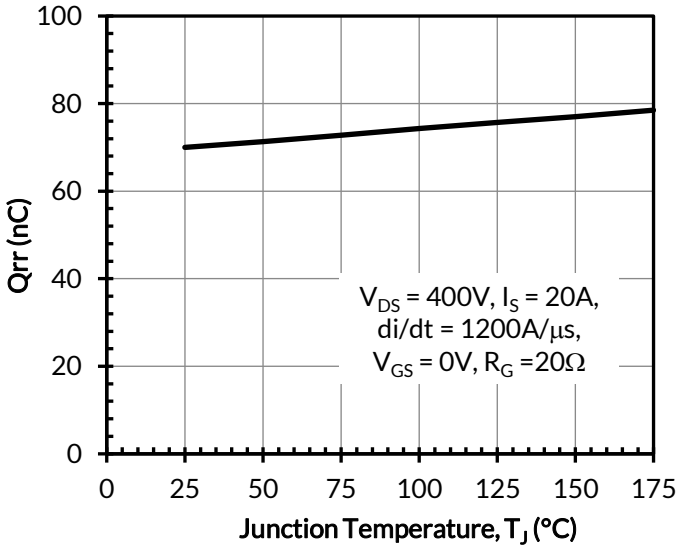


Figure 18. Reverse recovery charge Qrr vs. junction temperature

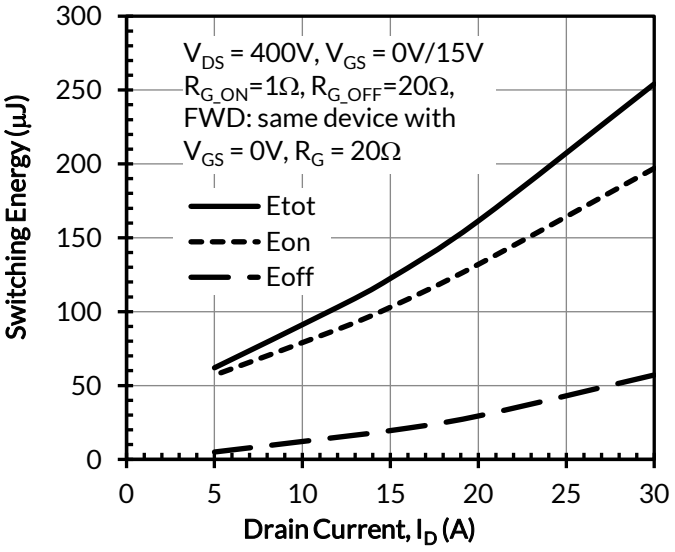


Figure 19. Clamped inductive switching energy vs. drain current at V_{DS} = 400V and T_J = 25°C

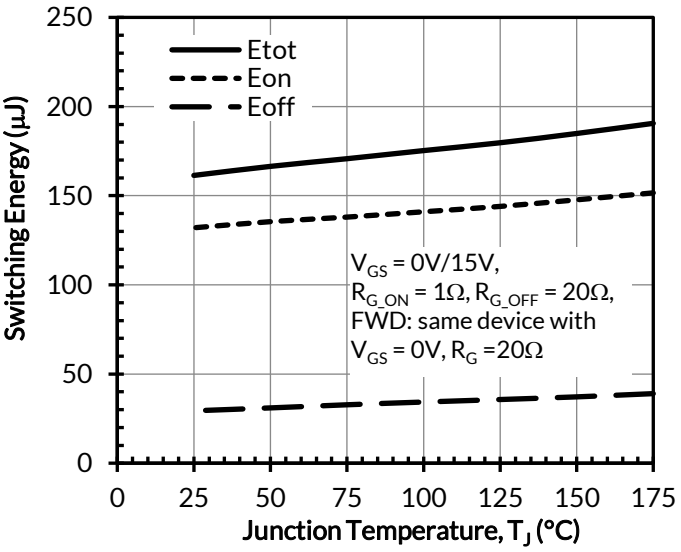


Figure 20. Clamped inductive switching energy vs. junction temperature at V_{DS} =400V and I_D = 20A

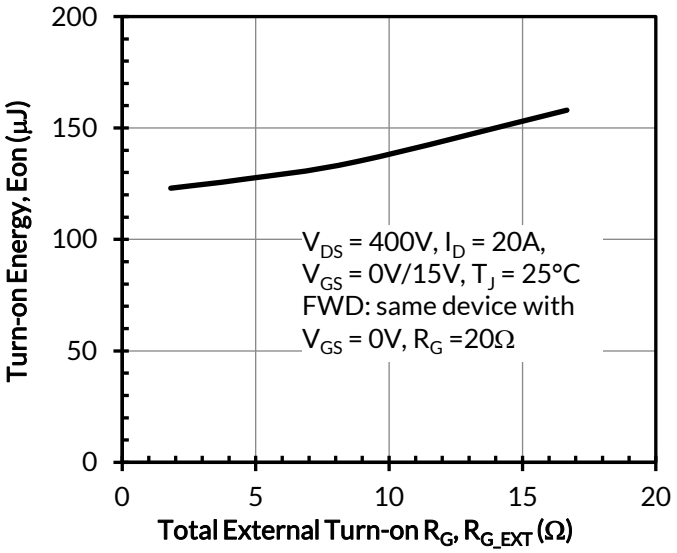


Figure 21. Clamped inductive switching turn-on energy vs. R_{G,EXT_ON}

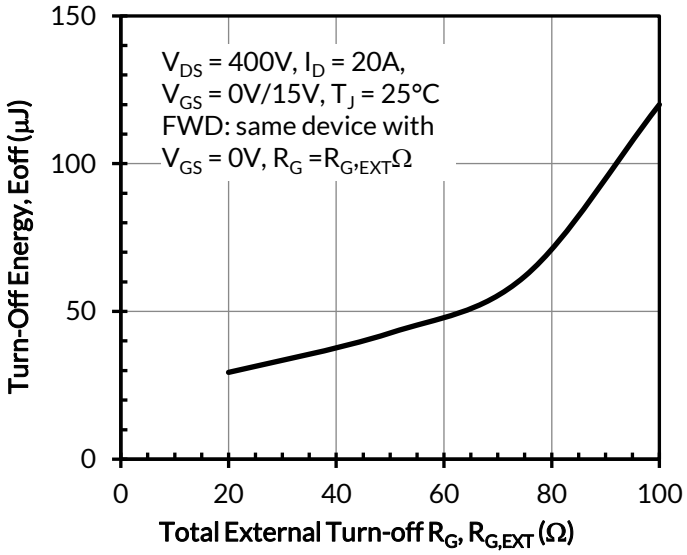


Figure 22. Clamped inductive switching turn-off energy vs. R_{G,EXT_OFF}

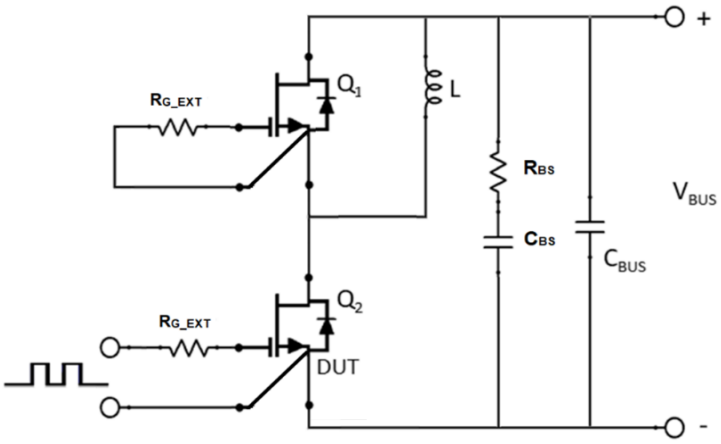


Figure 23. Schematic of the half-bridge mode switching test circuit. Note, a bus RC snubber (R_{BS} = 2.5Ω, C_{BS}=100nF) is used to reduce the power loop high

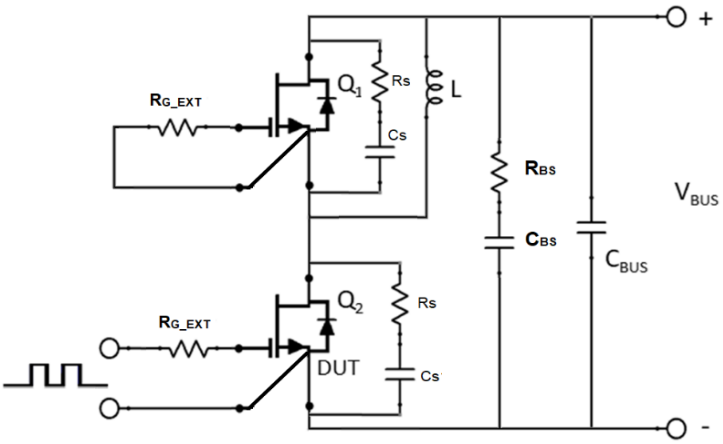


Figure 24. Schematic of the half-bridge mode switching test circuit with device RC snubbers (R_s =10Ω, C_s = 95pF) and a bus RC snubber (R_{BS} = 2.5Ω, C_{BS}=100nF).

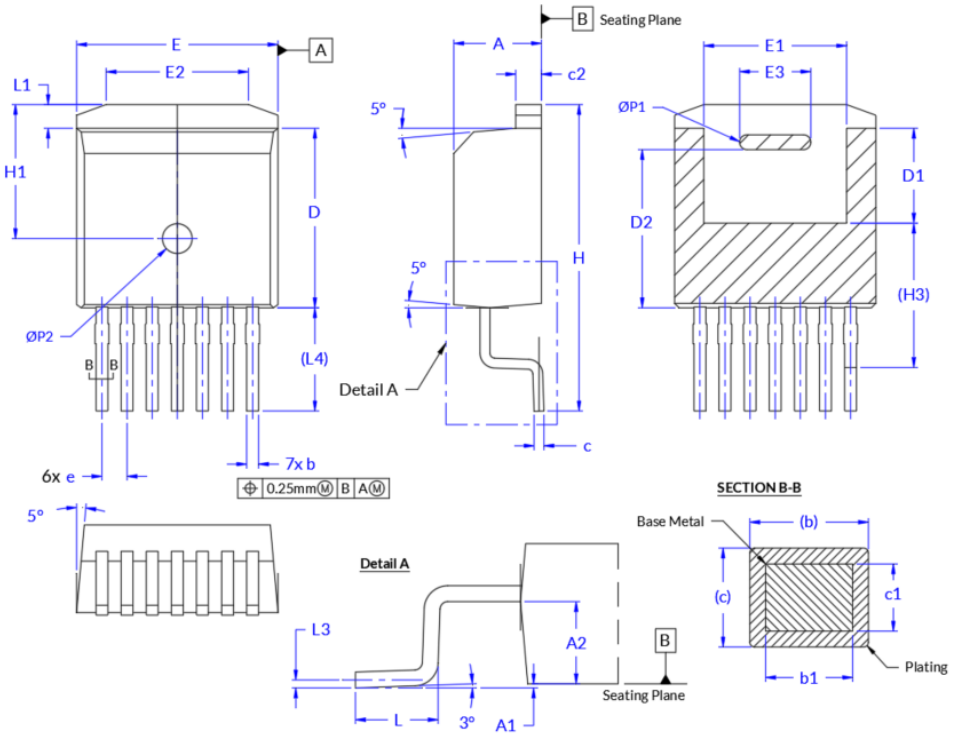
Applications Information

SiC FETs are enhancement-mode power switches formed by a high-voltage SiC depletion-mode JFET and a low-voltage silicon MOSFET connected in series. The silicon MOSFET serves as the control unit while the SiC JFET provides high voltage blocking in the off state. This combination of devices in a single package provides compatibility with standard gate drivers and offers superior performance in terms of low on-resistance ($R_{DS(on)}$), output capacitance (C_{oss}), gate charge (Q_G), and reverse recovery charge (Q_{rr}) leading to low conduction and switching losses. The SiC FETs also provide excellent reverse conduction capability eliminating the need for an external anti-parallel diode.
Like other high performance power switches, proper PCB layout design to minimize circuit parasitics is strongly recommended due to the high dv/dt and di/dt rates. An external gate resistor is recommended when the FET is working in the diode mode in order to achieve the optimum reverse recovery performance. For more information on SiC FET operation, see www.unitedsic.com.
A snubber circuit with a small $R_{(G)}$, or gate resistor, provides better EMI suppression with higher efficiency compared to using a high $R_{(G)}$ value. There is no extra gate delay time when using the snubber circuitry, and a small $R_{(G)}$ will better control both the turn-off $V_{(DS)}$ peak spike and ringing duration, while a high $R_{(G)}$ will damp the peak spike but result in a longer delay time. In addition, the total switching loss when using a snubber circuit is less than using high $R_{(G)}$, while greatly reducing $E_{(OFF)}$ from mid-to-full load range with only a small increase in $E_{(ON)}$. Efficiency will therefore improve with higher load current. For more information on how a snubber circuit will improve overall system performance, visit the UnitedSiC website at www.unitedsic.com

Important notice

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regard to such information itself or anything described by such information. THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, life-saving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

PACKAGE OUTLINE



SYM	7L-D2PAK			
	MM		INCH	
	Min	Max	Min	Max
A	4.30	4.56	.169	.180
A1	0.00	0.25	.000	.010
A2	2.45	2.75	.096	.108
b	0.50	0.70	.020	.028
b1	0.50	-	.020	-
c	0.40	0.60	.016	.024
c1	0.40	-	.016	-
c2	1.20	1.40	.047	.055
D	8.93	9.23	.352	.363
D1	4.65	4.95	.183	.195
D2	7.90	8.10	.311	.319
e	1.27 BSC		.050 BSC	
E	10.08	10.28	.397	.405
E1	6.82	7.62	.269	.300
E2	6.50	8.60	.256	.339
E3	3.50	3.70	.138	.146
H	15.00	16.00	.591	.630
H1	6.68	6.88	.263	.271
H3	7.3 REF.		.287 REF	
L	1.90	2.50	.075	.098
L1	0.98	1.42	.039	.056
L3	0.25 BSC		.0098 BSC	
L4	5.22 REF		.205 REF	
ØP1	0.65	0.85	.026	.033
ØP2	1.40	1.60	.055	.063

Notes:

1. GENERAL TOLERANCE: ±0.1 unless otherwise specified
2. CONTROLLING DIMENSION: **MILLIMETERS**
3. PACKAGE BODY SIDES EXCLUDE MOLD FLASH AND GATE BURRS.
4. DIMENSION L IS MEASURED IN GAUGE LINE.
5. CONVERTED INCH DIMENSIONS ARE NOT NECESSARILY EXACT.
6. DIMENSION c1 AND b1 APPLIES TO BASE METAL ONLY

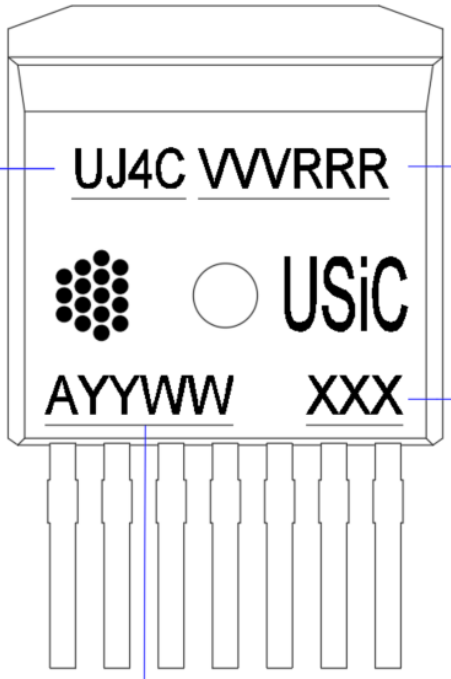
PART MARKING

G3, 650V / 1200V variant
UF3C: > 40 mOhm
UF3SC: ≤ 40 mOhm

G3, 1700V variant
UF3N: 400 mOhm

G4, 750V variant
UJ4C: ≥ 23 mOhm
UJ4SC: < 23 mOhm

G4, 1200V variant
UF4C: > 30 mOhm
UF4SC: ≤ 30 mOhm



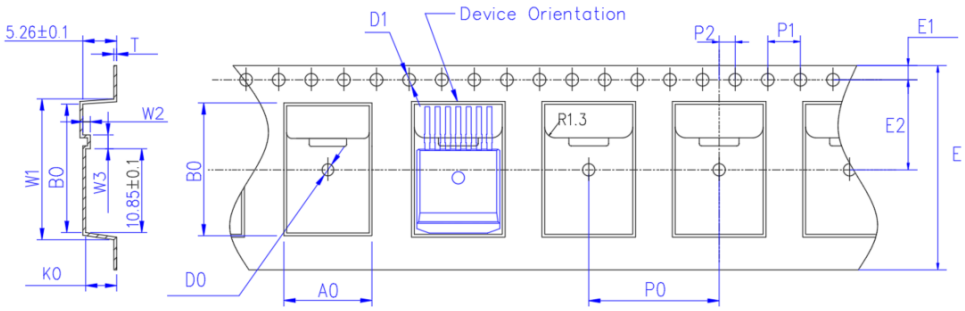
VVV : Voltage Rating
RRR : Resistance Rating

Lot Code

A: Assembly Site
YY: Year Code
WW: Week code

PACKING TYPE

Carrier Tape

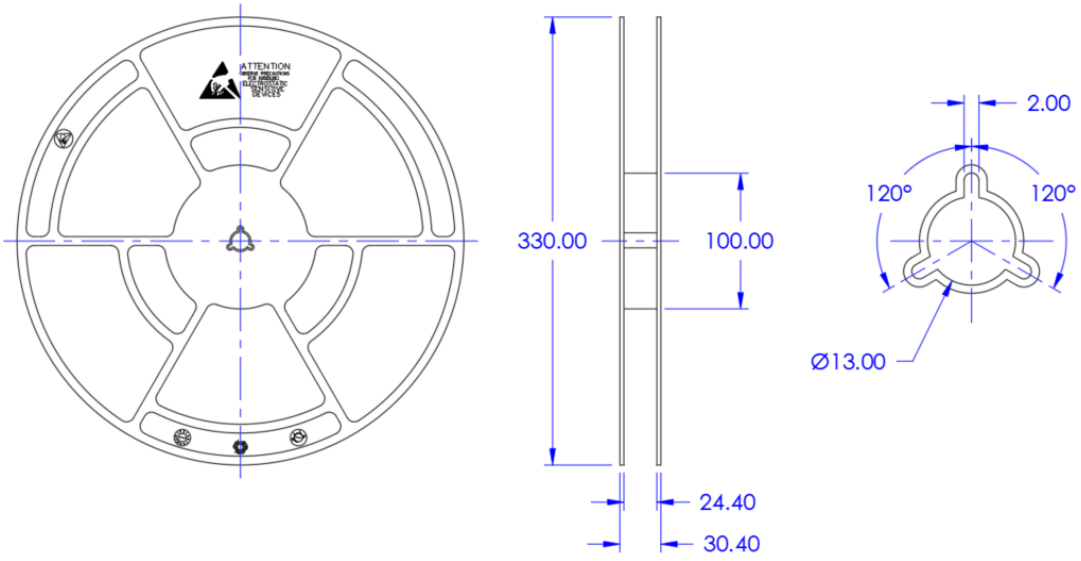


UNIT: MM

PACKAGE	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
D2PAK (24 mm)	10.80 ±0.10	16.30 ±0.10	4.70 ±0.10	1.50 ±0.10	1.50 $^{+0.1}_{-0}$	24.00 ±0.30	1.75 ±0.10	11.50 ±0.10	16.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.35 ±0.10

Exterior		size	
Spec 1	W1	16.9±0.1	
	W2	1.3±0.1	
	W3	1.0±0.1	
Spec 2	W1	17.2±0.1	ⓐ
	W2	1.8±0.1	ⓑ
	W3	0.85±0.1	ⓒ

Reel



All dimensions in millimeters
Anti-Static Tape and Rell (T&R)
Quantity per Reel: 800 units

DISCLAIMER

The information contained herein is believed to be reliable; however, Qorvo makes no warranties regarding the information contained herein and assumes no responsibility or liability whatsoever for the use of the information contained herein. All information contained herein is subject to change without notice. Customers should obtain and verify the latest relevant information before placing orders for Qorvo products. The information contained herein, or any use of such information does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other intellectual property rights, whether with regards to such information itself or anything described by such information. THIS INFORMATION DOES NOT CONSTITUTE A WARRANTY WITH RESPECT TO THE PRODUCTS DESCRIBED HEREIN, AND QORVO HEREBY DISCLAIMS ANY AND ALL WARRANTIES WITH RESPECT TO SUCH PRODUCTS WHETHER EXPRESS OR IMPLIED BY LAW, COURSE OF DEALING, COURSE OF PERFORMANCE, USAGE OF TRADE OR OTHERWISE, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Without limiting the generality of the foregoing, Qorvo products are not warranted or authorized for use as critical components in medical, lifesaving, or life-sustaining applications, or other applications where a failure would reasonably be expected to cause severe personal injury or death.

REVISION HISTORY

Revision	Create Date (mm/dd/yyyy)	Description of Change	Initiator of Change
C	11/06/2023	Updated to Qorvo template Updated Package outline drawing based latest drawing revision	Glenn Galang
D	05/21/2024	Added illustration of device orientation on carrier tape (page 3)	Glenn Galang

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales