



# PCMQ040R120D7Q

## 1,200V 63A 40mΩ Silicon Carbide MOSFET

### Features

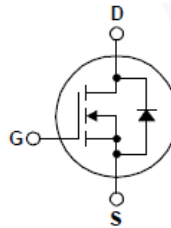
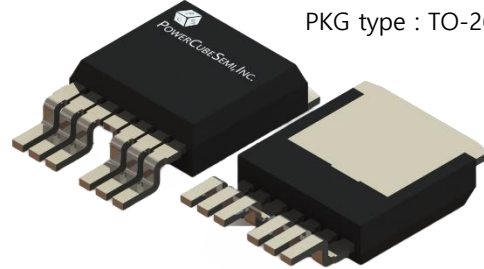
- High-Speed Switching
- Reliable Body Diode
- All parts tested to greater than 1,400V
- Avalanche tested to 400mJ
- Driver Source Pin for Gate Driving
- Higher System Efficiency
- Lower Switching Loss
- AEC-Q101 Qualified

### Applications

- Switch Mode Power Supplies, UPS
- Solar Inverters
- High Voltage DC/DC Converters
- EV Charging stations
- Motor Drives
- Induction Heating and Welding

### Package Outline

PKG type : TO-263 7L



### Pin Description

Pin	Description	Simplified Outline
1	Gate (G)	
2, 3	Source (S)	
4	Drain (D)	
5, 6, 7	Source (S)	

## Electrical Characteristics

### Absolute Maximum Ratings

$T_j = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Value	Units
$V_{DSS}$	Drain-Source Voltage	1200	V
$I_D$	Drain Current - Continuous ( $T_j = 25^\circ\text{C}$ ) - Continuous ( $T_j = 100^\circ\text{C}$ )	63	A
		47	A
$I_{DM}$	Drain Current - Pulsed	160	A
$V_{GSS\ Max}$	Gate-Source Voltage	-10 / +25	V
$V_{GSS}$	Gate-Source Voltage (Recommended operational)	-5 / +20	V
$P_D$	Power Dissipation ( $T_j = 25^\circ\text{C}$ )	322	W
$T_J, T_{STG}$	Operating and Storage Temperature Range	-55 to +175	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Value			Units
		Min	Typ	Max	
$R_{\theta JC}$	Thermal Resistance, Junction-to-Case	-	0.38	0.47	$^\circ\text{C}/\text{W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient	-	-	40.0	

### Static Electrical Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS} = 0\text{ V}, I_D = 1\text{ mA}$	1200	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}$	-	0.1	1.0	$\mu\text{A}$
		$V_{DS} = 1200\text{ V}, V_{GS} = 0\text{ V}, T_J = 175^\circ\text{C}$	-	1	-	
$I_{GSS (+)}$	Gate-Source Leakage Current	$V_{GS} = 20\text{ V}, V_{DS} = 0\text{ V}$	-	-	$\pm 100$	nA
$I_{GSS (-)}$		$V_{GS} = -5\text{ V}, V_{DS} = 0\text{ V}$	-	-		
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS} = V_{GS}, I_D = 10\text{ mA}$	2	3.5	4	V
		$V_{DS} = V_{GS}, I_D = 15\text{ mA}$	2	3.6	4	
$R_{DS(on)}$	Drain-Source On-Resistance	$V_{GS} = 20\text{ V}, I_D = 40\text{ A}$	-	40	52	m $\Omega$
		$V_{GS} = 20\text{ V}, I_D = 20\text{ A}$	-	38	50	
$R_G$	Gate Resistance	$f = 1\text{ MHz}, V_{AC} = 25\text{ mV}$	-	2.5	-	$\Omega$

## Electrical Characteristics

### Dynamic Characteristics

$T_j = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$C_{iss}$	Input Capacitance	$V_{DS} = 1,000\text{ V}, V_{GS} = 0\text{ V},$ $f = 200\text{ kHz}$	-	3200	-	pF
$C_{oss}$	Output Capacitance		-	135	-	
$C_{rss}$	Reverse Transfer Capacitance		-	9	-	

### Switching Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$t_{d(on)}$	Turn-On Delay Time	$V_{DD} = 800\text{V}, V_{GS} = -5/20\text{V},$ $I_D = 40\text{A}, L = 273\mu\text{H},$ $R_G = 2.5\Omega$	-	14	-	ns
$t_r$	Turn-On Rise Time		-	5	-	
$t_{d(off)}$	Turn-Off Delay Time		-	23	-	
$t_f$	Turn-Off Fall Time		-	14	-	
$E_{on}$	Turn-On Switching loss	$V_{DD} = 800\text{V}, V_{GS} = -5/20\text{V}$ $I_D = 40\text{A}, L = 273\mu\text{H},$ $R_G = 2.5\Omega$	-	339	-	uJ
$E_{off}$	Turn-Off Switching loss		-	70	-	
$Q_g$	Total Gate Charge	$V_{DS} = 800\text{V}, I_D = 20\text{A},$ $V_{GS} = -5/20\text{V}$	-	118	-	nC
$Q_{gs}$	Gate-Source Charge		-	51	-	
$Q_{gd}$	Gate-Drain Charge		-	10	-	

### Body Diode Characteristics

Symbol	Parameter	Test Conditions	Min	Typ	Max	Units
$I_S$	Maximum Continuous Diode Forward Current	$V_{GS} = -5\text{ V}, T_j = 25^\circ\text{C}$	-	-	74	A
$I_{SM}$	Maximum Pulsed Diode Forward Current		-	-	160	A
$V_{SD}$	Diode Forward Voltage	$V_{GS} = -5\text{ V}, I_S = 20\text{ A}$	-	3.9	-	V
$t_{rr}$	Reverse Recovery Time	$V_R = 800\text{V}, V_{GS} = -5\text{V},$ $I_S = 40\text{A}, di/dt = 9.6\text{A/ns}$	-	11	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	316	-	nC
$I_{rr}$	Reverse Recovery Current		-	46	-	A

# Typical Characteristics

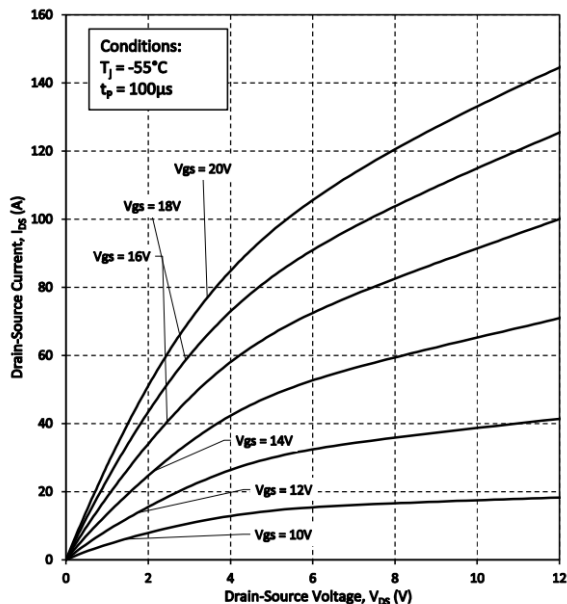


Figure 1. Output Characteristics at  $T_j = -55^\circ\text{C}$

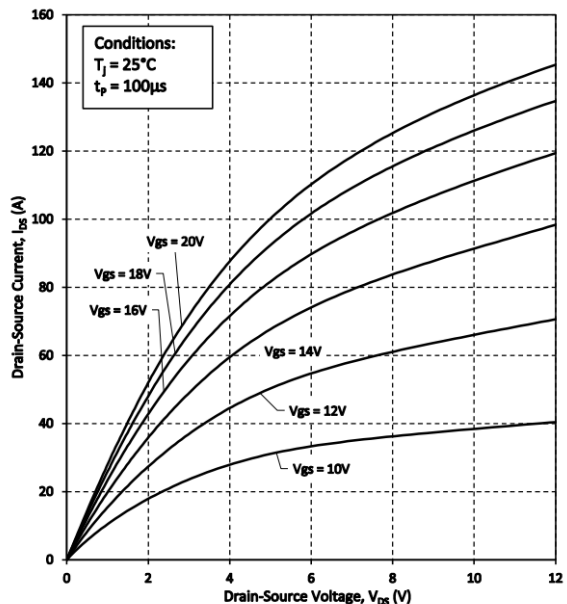


Figure 2. Output Characteristics at  $T_j = 25^\circ\text{C}$

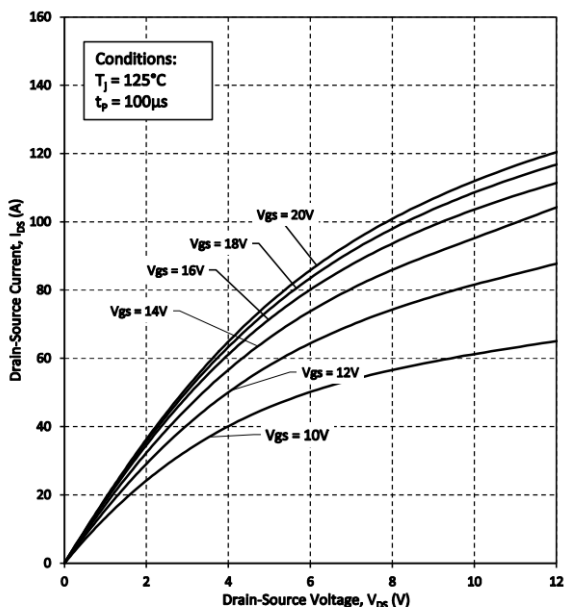


Figure 3. Output Characteristics at  $T_j = 125^\circ\text{C}$

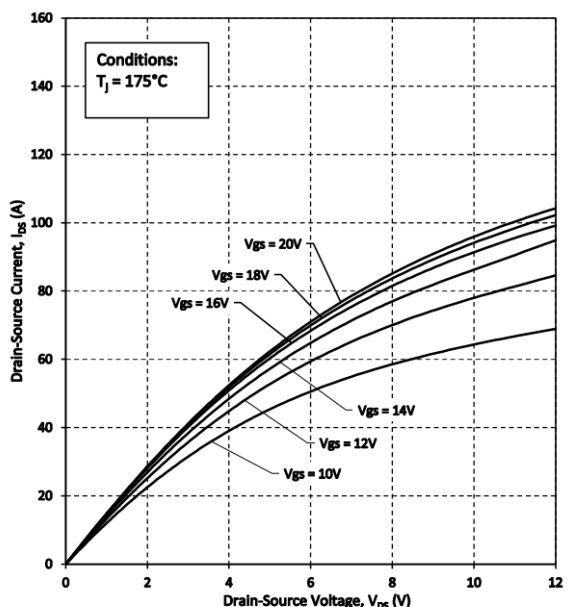


Figure 4. Output Characteristics at  $T_j = 175^\circ\text{C}$

# Typical Characteristics

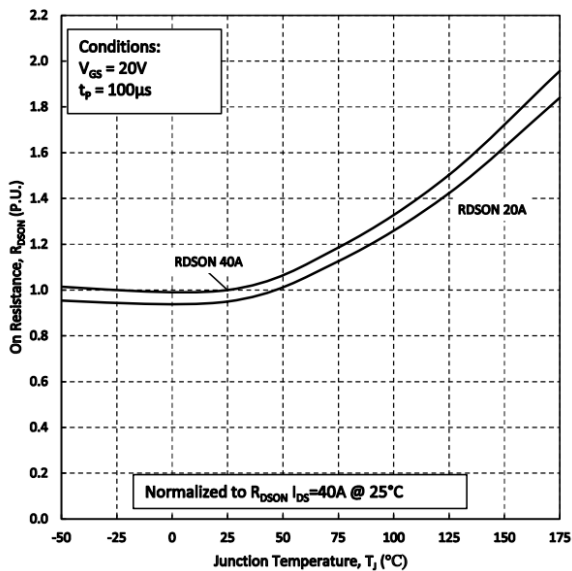


Figure 5. Normalized On-Resistance vs. Temperature

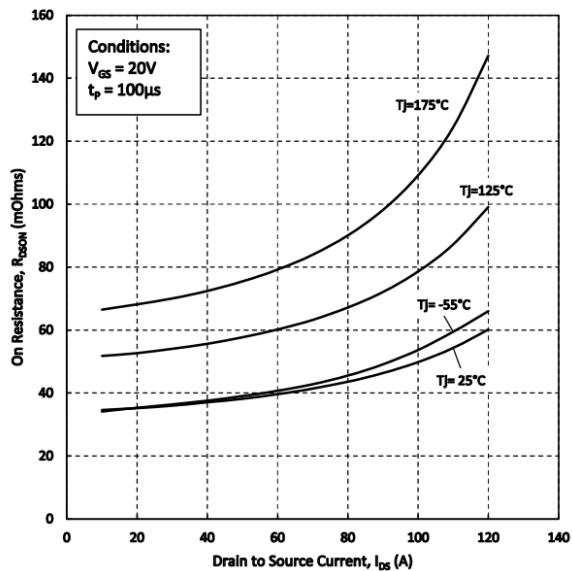


Figure 6. On-Resistance vs. Drain Current for Various Temperature

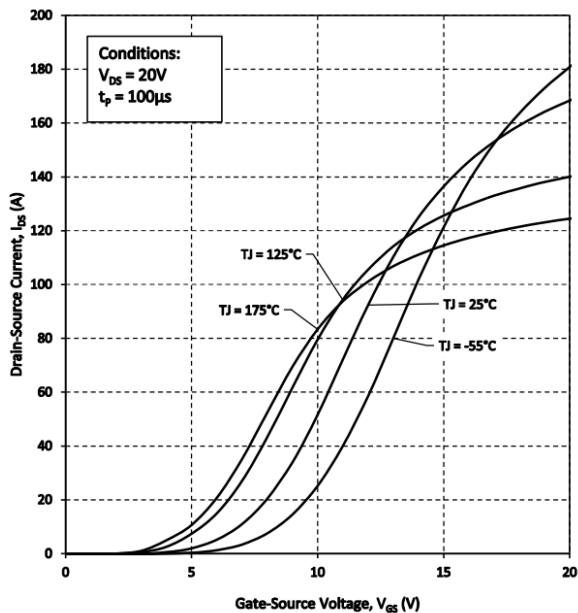


Figure 7. Transfer Characteristics for Various Junction Temperature

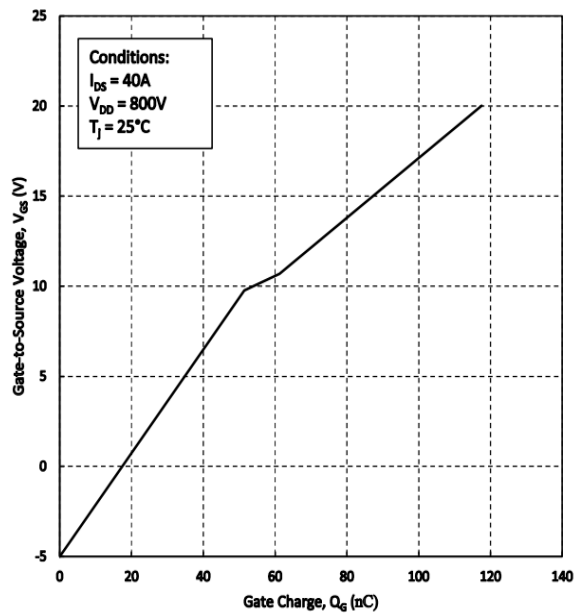


Figure 8. Gate Charge Characteristics

# Typical Characteristics

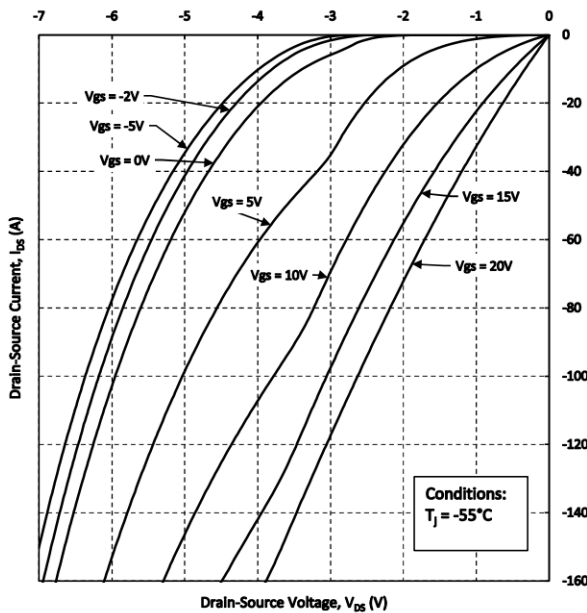


Figure 9. Body Diode Characteristics at  $T_j = -55^\circ\text{C}$

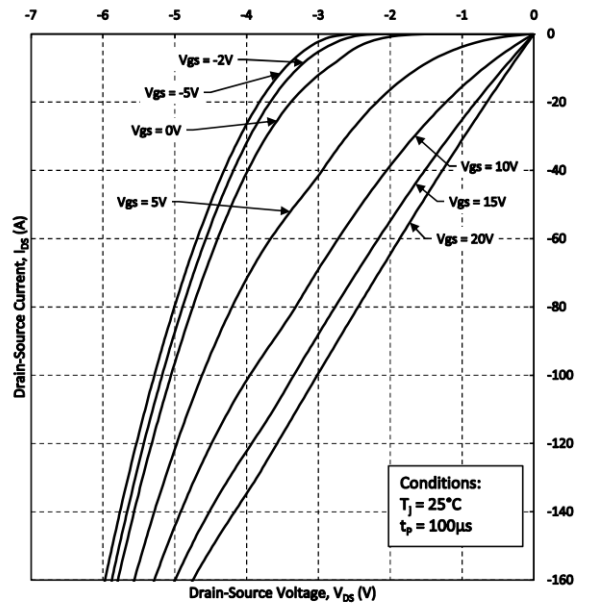


Figure 10. Body Diode Characteristics at  $T_j = 25^\circ\text{C}$

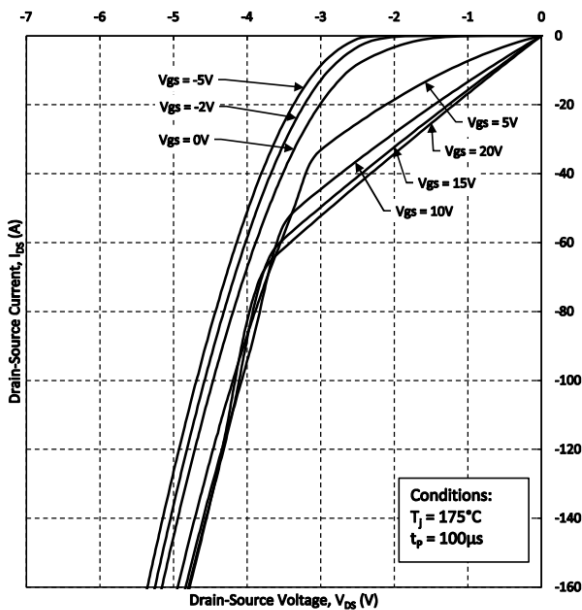


Figure 11. Body Diode Characteristics at  $T_j = 175^\circ\text{C}$

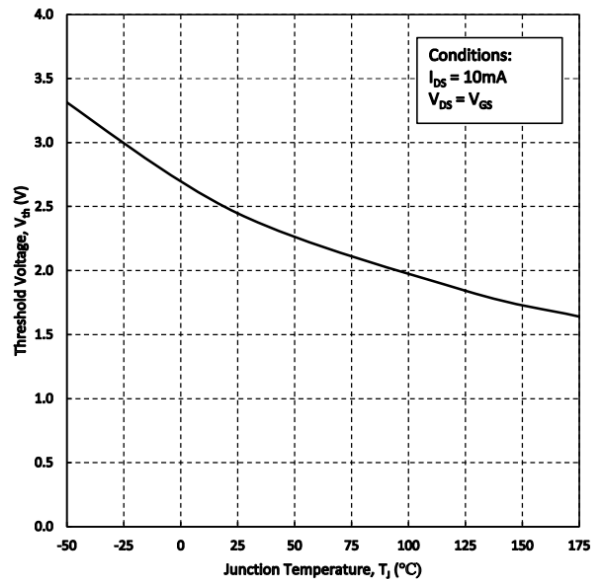


Figure 12. Output Capacitor Stored Energy

# Typical Characteristics

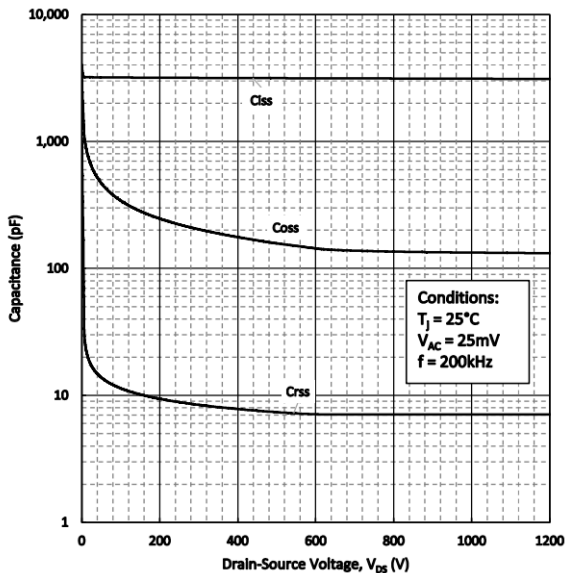


Figure 13. Capacitance vs Drain-Source Voltage

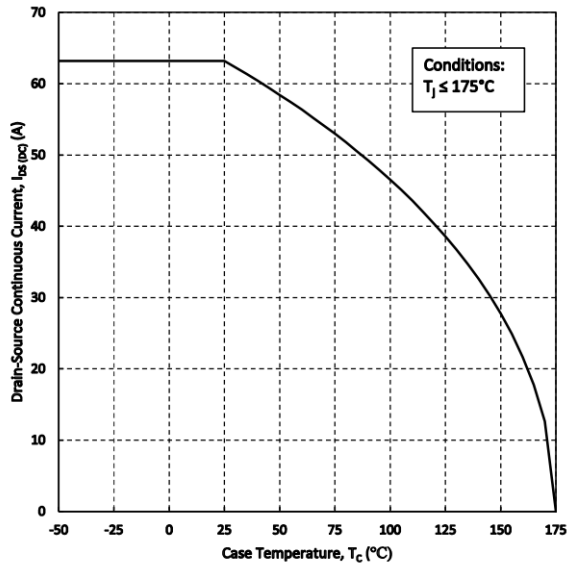


Figure 14. Continuous Drain Current Derating vs. Case Temperature

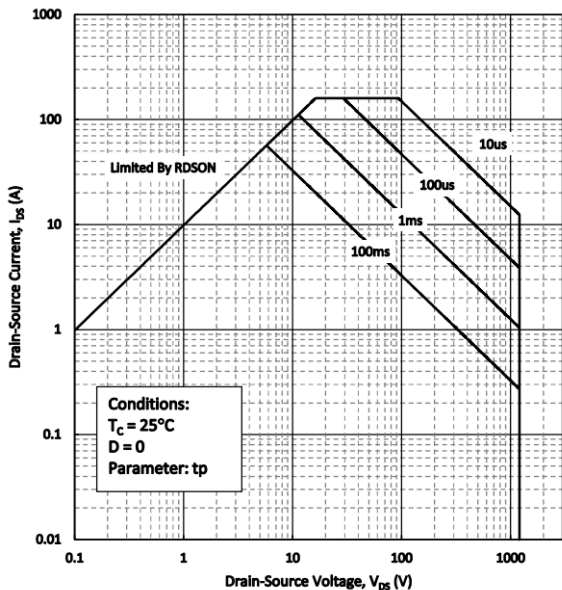


Figure 15. Safe Operating Area

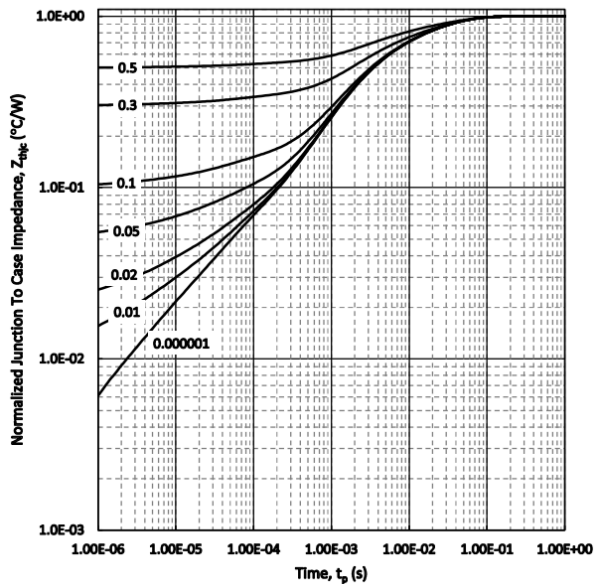


Figure 16. Transient Thermal Impedance (Junction to Case)

# Typical Characteristics

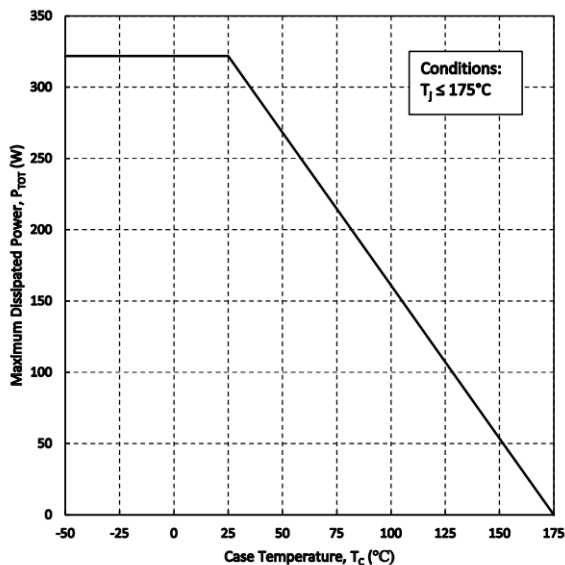


Figure 17. Maximum Power Dissipation Derating vs Case Temperature

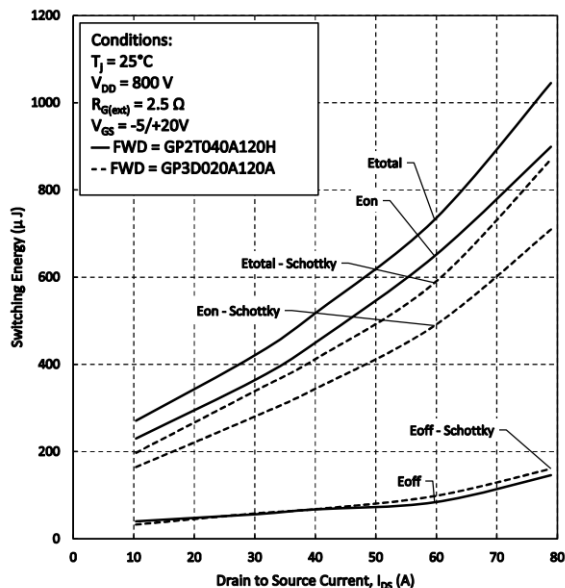


Figure 18. Clamped Inductive Switching Energy vs. Drain Current

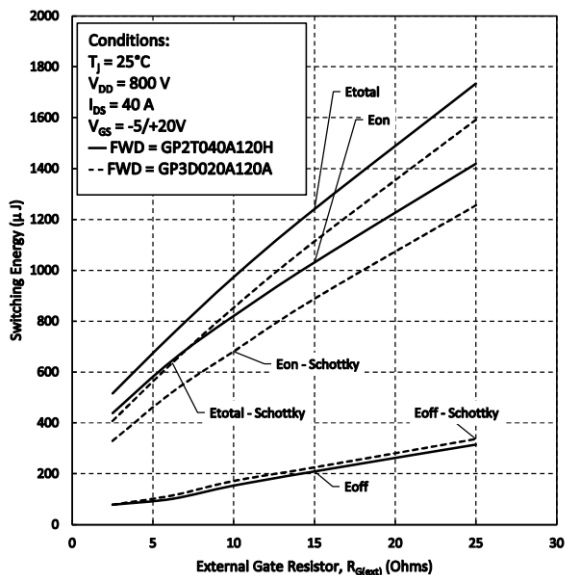


Figure 19. Clamped Inductive Switching Energy vs.  $R_G$

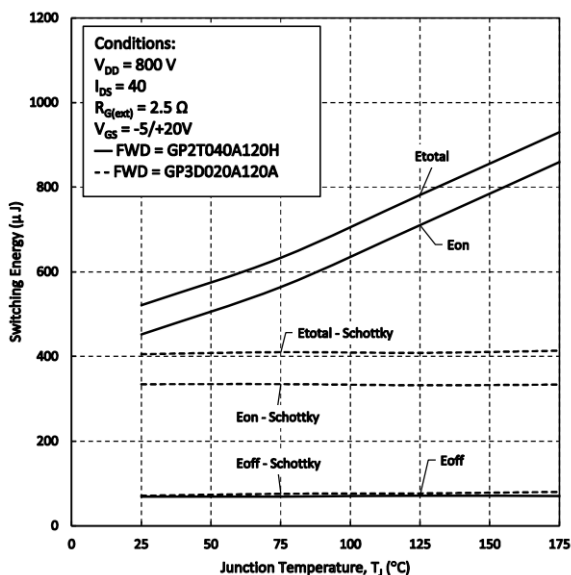
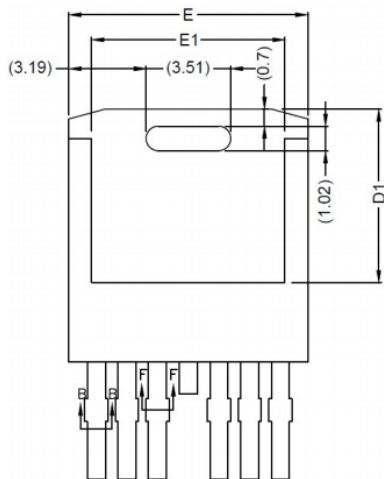
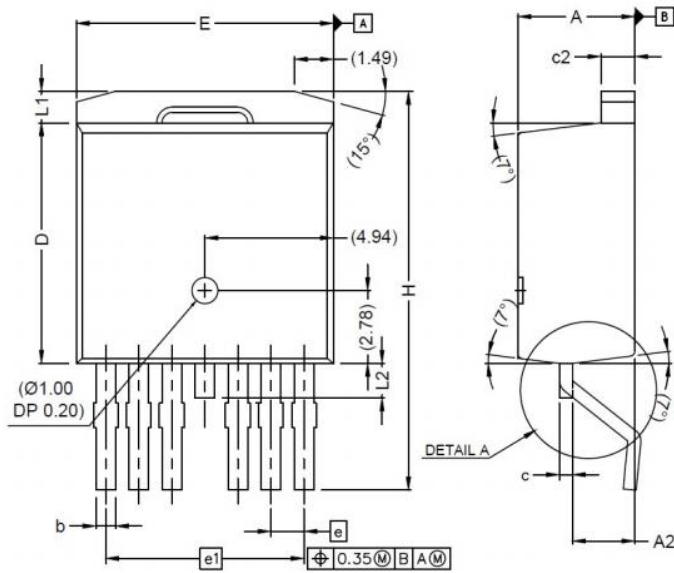


Figure 20. Clamped Inductive Switching Energy vs. Temperature



# Package Outline

Unit : mm



SYMBOL	DIMENSION	
	MIN	MAX
A	4.30	4.70
A1	-	0.25
A2	2.20	2.60
b	0.65	0.85
b1	0.65	0.80
b2	0.80	1.00
b3	0.80	0.95
c	0.45	0.60
c1	0.45	0.55
c2	1.25	1.40
D	9.00	9.40
D1	6.86	7.42
E	9.68	10.08
E1	7.70	8.30
e	1.27 BSC	
e1	7.62 BSC	
L	1.78	2.79
L1	-	1.60
L2	-	1.78
L3	0.25 BSD	
H	14.61	15.88

