Microsemi
POWER PRODUCTS GROUP

Thunderbolt HS™

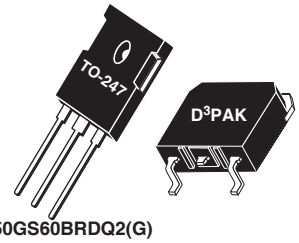
APT50GS60BRDQ2(G)
APT50GS60SRDQ2(G)

600V, 50A, $V_{CE(ON)}$ = 2.8V Typical

Thunderbolt® High Speed NPT IGBT with Anti-Parallel 'DQ' Diode

The Thunderbolt HS™ series is based on thin wafer non-punch through (NPT) technology similar to the Thunderbolt® series, but trades higher $V_{CE(ON)}$ for significantly lower turn-on energy E_{off}. The low switching losses enable operation at switching frequencies over 100kHz, approaching power MOSFET performance but lower cost.

An extremely tight parameter distribution combined with a positive $V_{CE(ON)}$ temperature coefficient make it easy to parallel Thunderbolts HS™ IGBT's. Controlled slew rates result in very good noise and oscillation immunity and low EMI. The short circuit duration rating of 10µs make these IGBT's suitable for motor drive and inverter applications. Reliability is further enhanced by avalanche energy ruggedness. Combi versions are packaged with a high speed, soft recovery DQ series diode.



APT50GS60BRDQ2(G)
APT50GS60SRDQ2(G)

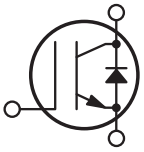
Features

- **Fast Switching with low EMI**
- **Very Low E_{OFF} for Maximum Efficiency**
- **Short circuit rated**
- **Low Gate Charge**
- **Tight parameter distribution**
- **Easy paralleling**
- **RoHS Compliant**

Typical Applications

- **ZVS Phase Shifted and other Full Bridge**
- **Half Bridge**
- **High Power PFC Boost**
- **Welding**
- **Induction heating**
- **High Frequency SMPS**

Single die IGBT with separate DQ diode die



Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
I_{C1}	Continuous Collector Current T_C = @ 25°C		93	A
I_{C1}	Continuous Collector Current T_C = @ 100°C		50	
I_{CM}	Pulsed Collector Current ①		195	
V_{GE}	Gate-Emitter Voltage		±30V	V
SSOA	Switching Safe Operating Area		195	
E_{AS}	Single Pulse Avalanche Energy②		280	mJ
t_{SC}	Short Circut Withstand Time③		10	µs
I_F	Diode Continuous Forward Current	T_C = 25°C	90	A
		T_C = 100°C	55	
I_{FRM}	Diode Max. Repetitive Forward Current		195	

Thermal and Mechanical Characteristics

Symbol	Parameter		Min	Typ	Max	Unit
P_D	Total Power Dissipation T_C = @ 25°C		-	-	415	W
$R_{\theta JC}$	Junction to Case Thermal Resistance	IGBT	-	-	0.30	°C/W
		Diode			0.67	
$R_{\theta CS}$	Case to Sink Thermal Resistance, Flat Greased Surface		-	0.11	-	
T_J, T_{STG}	Operating and Storage Junction Temperature Range		-55	-	150	°C
T_L	Soldering Temperature for 10 Seconds (1.6mm from case)		-	-	300	
W_T	Package Weight		-	0.22	-	oz
			-	5.9	-	g
Torque	Mounting Torque (TO-247), 6-32 M3 Screw		-	-	10	in·lbf
			-	-	1.1	N·m

CAUTION: These Devices are Sensitive to Electrostatic Discharge. Proper Handling Procedures Should be Followed.

Static Characteristics $T_J = 25°C$ unless otherwise specified **APT50GS60B_SRDQ2(G)**

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
$V_{BR(CES)}$	Collector-Emitter Breakdown Voltage	V_{GE} = 0V, I_C = 250µA		600	-	-	V
$\Delta V_{BR(CES)}/\Delta T_J$	Breakdown Voltage Temperature Coeff	Reference to 25°C, I_C = 250µA		-	0.60	-	V/°C
$V_{CE(ON)}$	Collector-Emitter On Voltage④	V_{GE} = 15V, I_C = 50A	T_J = 25°C	-	2.8	3.15	V
			T_J = 125°C	-	3.25	-	
V_{EC}	Diode Forward Voltage④	I_C = 50A	T_J = 25°C	-	2.15	-	
			T_J = 125°C	-	1.8	-	
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}$, I_C = 1mA		3	4	5	
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage Temp Coeff			-	6.7	-	mV/°C
I_{CES}	Zero Gate Voltage Collector Current	V_{CE} = 600V, V_{GE} = 0V	T_J = 25°C	-	-	50	µA
			T_J = 125°C	-	-	TBD	
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = ±20V		-	-	±100	nA

Dynamic Characteristics $T_J = 25°C$ unless otherwise specified

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
g_{fs}	Forward Transconductance	V_{CE} = 50V, I_C = 50A	-	31	-	S
C_{ies}	Input Capacitance	V_{GE} = 0V, V_{CE} = 25V f = 1MHz	-	2635	-	pF
C_{oes}	Output Capacitance		-	240	-	
C_{res}	Reverse Transfer Capacitance		-	145	-	
$C_{o(cr)}$	Reverse Transfer Capacitance Charge Related ⑤	V_{GE} = 0V, V_{CE} = 0 to 400V	-	115	-	
$C_{o(er)}$	Reverse Transfer Capacitance Current Related ⑥			85		
Q_g	Total Gate Charge	V_{GE} = 0 to 15V, I_C = 50A, V_{CE} = 300V	-	235	-	nC
Q_{ge}	Gate-Emitter Charge		-	18	-	
G_{gc}	Gate-Collector Charge		-	100	-	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching IGBT and Diode: T_J = 25°C, V_{CC} = 400V, I_C = 50A, R_G = 4.7Ω⑦, V_{GG} = 15V	-	16	-	ns
t_r	Rise Time		-	33	-	
$t_{d(off)}$	Turn-Off Delay Time		-	225	-	
t_f	Fall Time		-	37	-	
E_{on1}	Turn-On Switching Energy ⑧		-	TBD	-	mJ
E_{on2}	Turn-On Switching Energy ⑨		-	1.2	-	
E_{off}	Turn-Off Switching Energy ⑩		-	0.755	-	
$t_{d(on)}$	Turn-On Delay Time	Inductive Switching IGBT and Diode: T_J = 125°C, V_{CC} = 400V, I_C = 50A, R_G = 4.7Ω⑦, V_{GG} = 15V	-	33	-	ns
t_r	Rise Time		-	33	-	
$t_{d(off)}$	Turn-Off Delay Time		-	250	-	
t_f	Fall Time		-	23	-	
E_{on1}	Turn-On Switching Energy ⑧		-	TBD	-	mJ
E_{on2}	Turn-On Switching Energy ⑨		-	1.7	-	
E_{off}	Turn-Off Switching Energy ⑩		-	0.950	-	
t_{rr}	Diode Reverse Recovery Time	I_F = 50A, V_R = 400V, di_F/dt = 200A/µs	-	25	-	ns
Q_{rr}	Diode Reverse Recovery Charge		-	35	-	nC
I_{rrm}	Peak Reverse Recovery Current		-	3	-	A