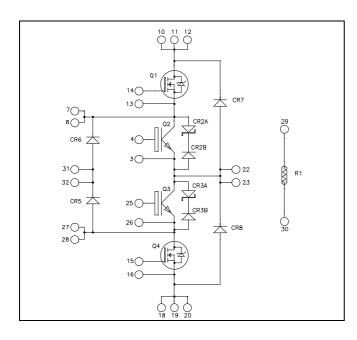
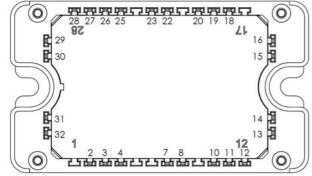


Three level inverter Power Module





All multiple inputs and outputs must be shorted together Example: 10/11/12 ; 7/8 ...

APTCV60TLM99T3G

Trench & Field Stop IGBT3 Q2, Q3: $V_{CES} = 600V$; $I_C = 30A$ @ Tc = 80°C

Super junction MOSFET Q1, Q4: $V_{DSS} = 600V$; $I_D = 17A$ @ Tc = 80°C

Application

- Solar converter
- Uninterruptible Power Supplies

Features

- Q2, Q3 Trench + Field Stop IGBT3
- Low voltage drop
- Low tail current
- Switching frequency up to 20 kHz
- Low leakage current
- RBSOA and SCSOA rated
- Q1, Q4 Super junction MOSFET
 - Ultra low R_{DSon}
 - Low Miller capacitance
- Ultra low gate charge
- Avalanche energy rated
- Very rugged
- Kelvin emitter for easy drive
- Very low stray inductance
- High level of integration
- Internal thermistor for temperature monitoring

Benefits

- Stable temperature behavior
- Very rugged
- Direct mounting to heatsink (isolated package)
- Low junction to case thermal resistance
- Low profile
- RoHS Compliant

All ratings (a) $T_j = 25^{\circ}C$ unless otherwise specified

WA CAUTION: These Devices are sensitive to Electrostatic Discharge. Proper Handling Procedures Should Be Followed.



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Q1 & Q4 Absolute maximum ratings (per Super junction MOSFET)

Symbol	Parameter	,	Max ratings	Unit
V _{DSS}	Drain - Source Voltage		600	V
т	Continuous Drain Current	$T_c = 25^{\circ}C$	22	
I _D	Continuous Drain Current	$T_c = 80^{\circ}C$	17	А
I _{DM}	Pulsed Drain current		75	
V _{GS}	Gate - Source Voltage		±20	V
R _{DSon}	Drain - Source ON Resistance		99	mΩ
PD	Power Dissipation	$T_c = 25^{\circ}C$	110	W
I _{AR}	Avalanche current (repetitive and non repetitive)		11	А
E _{AR}	Repetitive Avalanche Energy		1.2	in I
E _{AS}	Single Pulse Avalanche Energy		800	mJ

Q1 & Q4 Electrical Characteristics (per Super junction MOSFET)

Symbol	Characteristic	Test Conditions	Min	Тур	Max	Unit
I _{DSS}	Zero Gate Voltage Drain Current	$V_{GS} = 0V$; $V_{DS} = 600V$			50	μΑ
R _{DS(on)}	Drain – Source on Resistance	$V_{GS} = 10V, I_D = 18A$			99	mΩ
V _{GS(th)}	Gate Threshold Voltage	$V_{GS} = V_{DS}, I_D = 1.2 \text{ mA}$	2.5	3	3.5	V
I _{GSS}	Gate – Source Leakage Current	$V_{GS} = \pm 20 V, V_{DS} = 0V$			100	nA

Q1 & Q4 Dynamic Characteristics (per Super junction MOSFET)

Symbol	Characteristic	Test Conditions	Min	Тур	Max	Unit
C _{iss}	Input Capacitance	$V_{GS} = 0V$; $V_{DS} = 100V$		2800		pF
Coss	Output Capacitance	f = 1MHz		130		рг
Q_{g}	Total gate Charge	$V_{GS} = 10V$		14		
Q_{gs}	Gate – Source Charge	$V_{Bus} = 400 V$		20		nC
Q_{gd}	Gate – Drain Charge	$I_D = 18A$		60		
T _{d(on)}	Turn-on Delay Time	$V_{GS} = 10V$		10		
T_r	Rise Time	$V_{Bus} = 400 V$		5		
T _{d(off)}	Turn-off Delay Time	$I_D = 18A$ R _G = 3.3Ω		60		ns
$T_{\rm f}$	Fall Time			5		
R_{thJC}	Junction to Case Thermal Resistance				1.15	°C/W

Q2 & Q3 Absolute maximum ratings (per IGBT)

Symbol	Parameter		Max ratings	Unit
V _{CES}	Collector - Emitter Voltage		600	V
т	Continuous Collector Current	$T_C = 25^{\circ}C$	50	
I _C	Continuous Conector Current	$T_C = 80^{\circ}C$	30	А
I _{CM}	Pulsed Collector Current	$T_C = 25^{\circ}C$	60	
V_{GE}	Gate – Emitter Voltage		± 20	V
PD	Power Dissipation	$T_C = 25^{\circ}C$	90	W
RBSOA	Reverse Bias Safe Operating Area	$T_J = 150^{\circ}C$	60A @ 550V	



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Q2 & Q3 Electrical Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Тур	Max	Unit	
I _{CES}	Zero Gate Voltage Collector Current	$V_{GE} = 0V, V_{CE} =$			250	μA	
V	Collector Emitter Saturation Voltage	$V_{GE} = 15V$	$T_j = 25^{\circ}C$		1.5	1.9	V
V _{CE(sat)}	Conector Emitter Saturation Voltage	$I_C = 30A$	$T_j = 150^{\circ}C$		1.7		v
V _{GE(th)}	Gate Threshold Voltage	$V_{GE} = V_{CE}, \ I_C = 400 \mu A$		5.0	5.8	6.5	V
I _{GES}	Gate – Emitter Leakage Current	$V_{GE} = 20V, V_{CE}$	= 0V			300	nA

Q2 & Q3 Dynamic Characteristics (per IGBT)

Symbol	Characteristic	Test Conditions	Min	Тур	Max	Unit
Cies	Input Capacitance	$V_{GE} = 0V$		1600		
Coes	Output Capacitance	$V_{CE} = 25V$		110		pF
Cres	Reverse Transfer Capacitance	f = 1 MHz		50		
Q_{G}	Gate charge	$\begin{array}{c} V_{GE} = \pm 15 V, \ I_C = 30 A \\ V_{CE} = 300 V \end{array}$		0.3		μC
T _{d(on)}	Turn-on Delay Time	Inductive Switching (25°C)		110		
Tr	Rise Time	$V_{GE} = \pm 15V$		45		
T _{d(off)}	Turn-off Delay Time	$V_{Bus} = 300V$ $I_{C} = 30A$		200		ns
T _f	Fall Time	$R_G = 10\Omega$		40		
T _{d(on)}	Turn-on Delay Time	Inductive Switching (150°C)		120		
Tr	Rise Time	$V_{GE} = \pm 15V$ $V_{Bus} = 300V$		50		ns
T _{d(off)}	Turn-off Delay Time	$I_C = 30A$		250		115
$T_{\rm f}$	Fall Time	$R_G = 10\Omega$		60		
Eon	Turn-on Switching Energy	$V_{GE} = \pm 15V \qquad T_j = 25^{\circ}C$		0.16		mJ
Lon		$V_{Bus} = 300V$ $T_j = 150^{\circ}C$		0.3		1115
E _{off}	Turn-off Switching Energy	$I_C = 30A$ $T_j = 25^{\circ}C$		0.7		mJ
		$R_G = 10\Omega \qquad \qquad T_j = 150^{\circ}C$		1.05		
Isc	Short Circuit data			150		А
R_{thJC}	Junction to Case Thermal Resistance				1.6	°C/W

CR2 & CR3 diode ratings and characteristics (per device)

Symbol	Characteristic	Test Conditions	Min	Тур	Max	Unit
V_{F}	Diode + tranzorb Forward Voltage	$I_F = 10A$		10		V
R _{thJC}	Junction to Case Thermal Resistance				8	°C/W



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CR5 & CR6 diode ratings and characteristics (per diode)

Symbol	Characteristic	Test Conditions		Min	Тур	Max	Unit
V _{RRM}	Peak Repetitive Reverse Voltage					600	V
I _{RM}	Reverse Leakage Current	$V_R=600V$				25	μΑ
I _F	DC Forward Current		$Tc = 80^{\circ}C$		30		Α
		$I_F = 30A$			1.8	2.2	
$V_{\rm F}$	Diode Forward Voltage	$I_F = 60A$ $I_F = 30A$			2.2		v
			$T_j = 125^{\circ}C$		1.5		v
+	Reverse Recovery Time		$T_j = 25^{\circ}C$		25		100
t _{rr}	Reverse Recovery Time	$I_{\rm F} = 30 {\rm A}$	$T_j = 125^{\circ}C$		160		ns
0	Reverse Recovery Charge	$V_R = 400V$ di/dt = 200A/µs	$T_j = 25^{\circ}C$		35		nC
Qrr	Reverse Recovery Charge		$T_j = 125^{\circ}C$		480		ne
Err	Reverse Recovery Energy	$I_F = 30A$ $V_R = 400V$ $di/dt = 1000A/\mu s$	$T_j = 125^{\circ}C$		0.6		mJ
R_{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

CR7 & CR8 diode ratings and characteristics (per diode)

Symbol	Characteristic	haracteristic Test Conditions		Min	Тур	Max	Unit
V _{RRM}	Peak Repetitive Reverse Voltage					1200	V
I _{RM}	Reverse Leakage Current	V _R =1200V				100	μΑ
I _F	DC Forward Current		$Tc = 80^{\circ}C$		30		Α
		$I_F = 30A$			2.6	3.1	
$V_{\rm F}$	Diode Forward Voltage	$I_F = 60A$ $I_F = 30A$			3.2		V
			$T_{j} = 125^{\circ}C$		1.8		v
+	Payarsa Pagayary Tima		$T_j = 25^{\circ}C$		300		n 0
t _{rr}	Reverse Recovery Time	$I_F = 30A$	$T_j = 125^{\circ}C$		380		ns
Q _{rr}	Reverse Recovery Charge	$V_R = 800V$ di/dt = 200A/µs	$T_j = 25^{\circ}C$		360		nC
Qrr	Reverse Recovery Charge		$T_j = 125^{\circ}C$		1700		пс
Err	Reverse Recovery Energy	$I_F = 30A$ $V_R = 800V$ $di/dt = 1000A/\mu s$	$T_j = 125^{\circ}C$		1.6		mJ
R _{thJC}	Junction to Case Thermal Resistance					1.2	°C/W

Temperature sensor NTC (see application note APT0406 on www.microsemi.com for more information).

Symbol	Characteristic		Min	Тур	Max	Unit
R ₂₅	Resistance @ 25°C			50		kΩ
$\Delta R_{25}/R_{25}$				5		%
B _{25/85}	$T_{25} = 298.15 \text{ K}$			3952		K
$\Delta B/B$		$T_C=100^{\circ}C$		4		%

$$= \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$
 T: Thermis
R_T: Thermi

stor temperature

$$R_{T} = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]} = \frac{1}{1}$$

istor value at T



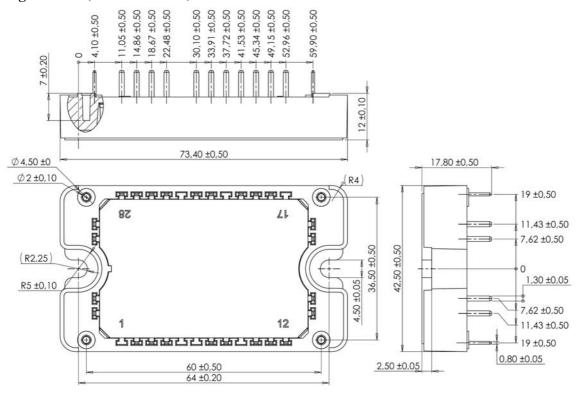
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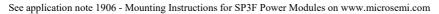
Thermal and package characteristics

Symbol	Characteristic			Min	Max	Unit
VISOL	RMS Isolation Voltage, any terminal to case	IS Isolation Voltage, any terminal to case t =1 min, 50/60Hz				V
TJ	Operating junction temperature range			-40	175*	
T _{JOP}	Recommended junction temperature under s	witching condit	ions	-40	T _J max -25	°C
T _{STG}	Storage Temperature Range			-40	125	C
T _C	Operating Case Temperature			-40	125	
Torque	Mounting torque	To heatsink	M4	2	3	N.m
Wt	Package Weight				110	g

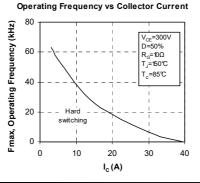
* Tjmax = 150°C for Q1 & Q4

Package outline (dimensions in mm)

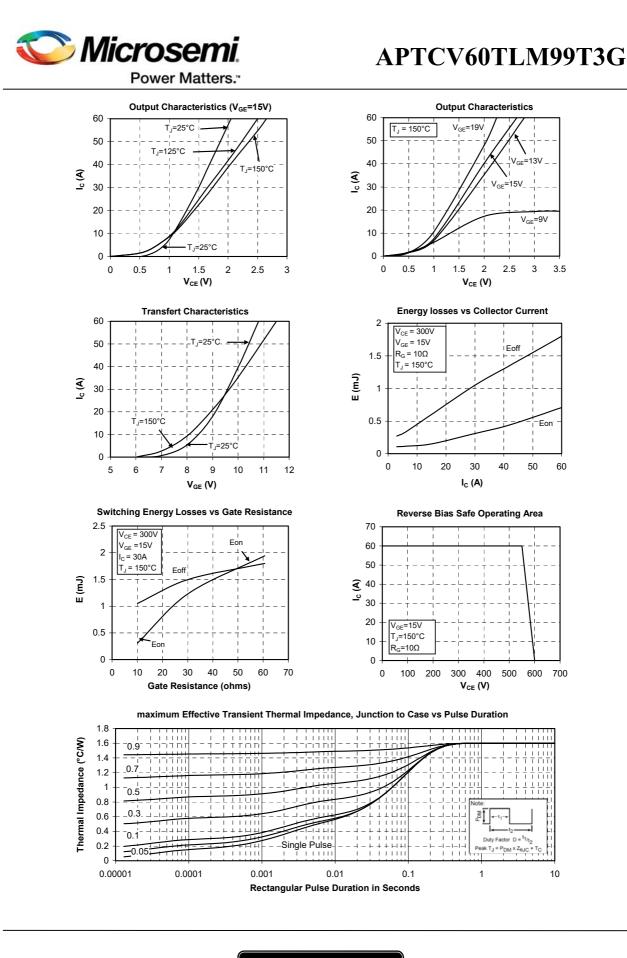




Q2 & Q3 Typical performance curve

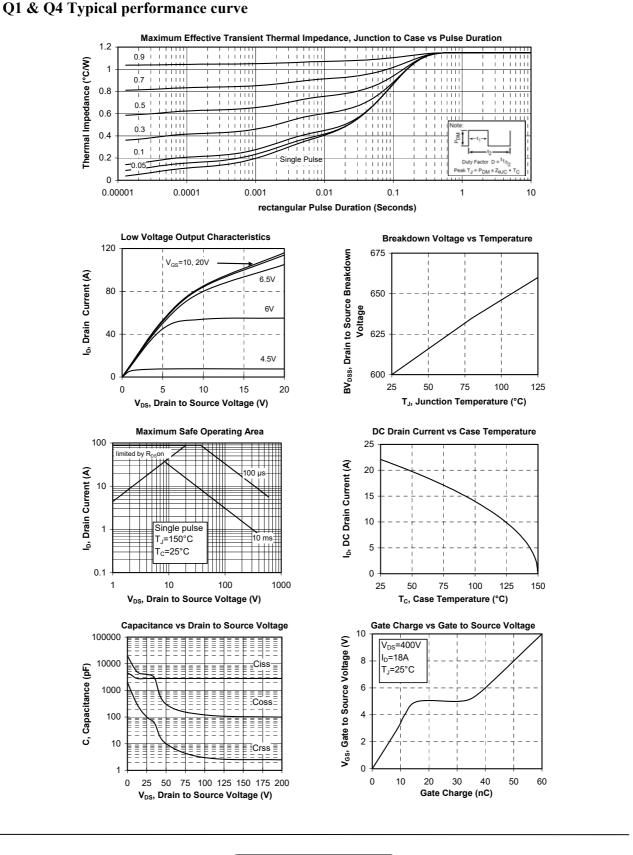


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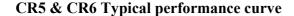


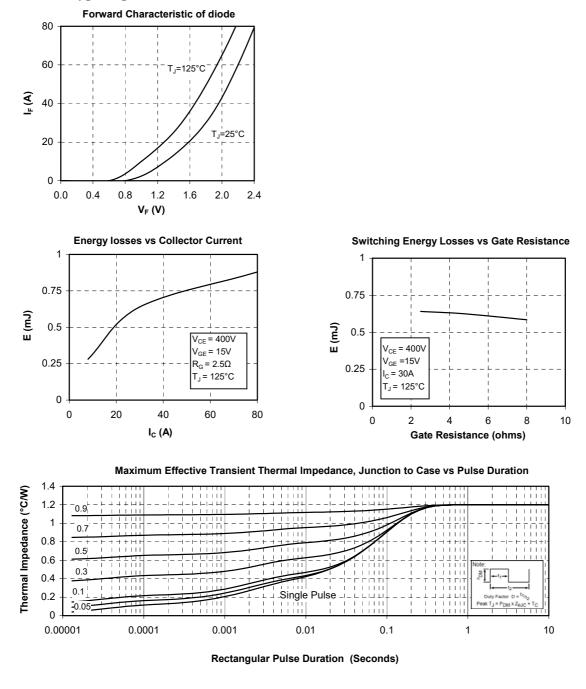




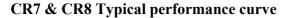
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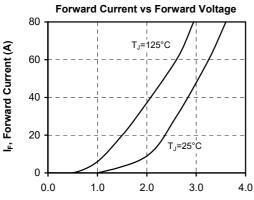




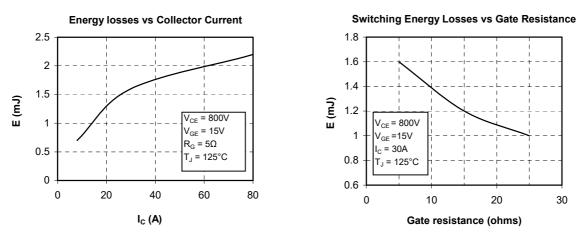


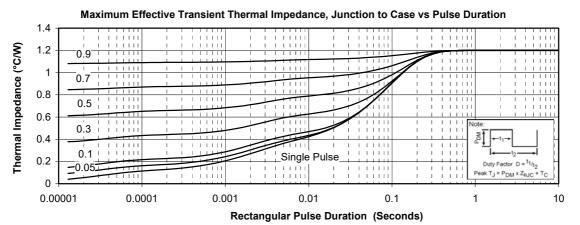






V_F, Anode to Cathode Voltage (V)







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