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June 2015

FPF2C8P2NL07A

F2, 3-phase, 3-level NPC module with Press-fit / NTC

General Description

Fairchild's new inverter modules provide low conduction and switching loss as well. And Press-Fit technology provides simple and reliable mounting. These modules are optimized for the applications such as solar inverter and UPS where a high efficiency and robust design is needed.

Electrical Features

- · High Efficiency
- · Low Conduction and Switching Losses
- · Field Stop IGBT for Inner and Outer Switch
- STEALTHTM Diode for Path Diode
- · Built-in NTC for Temperature Monitoring

Mechanical Features

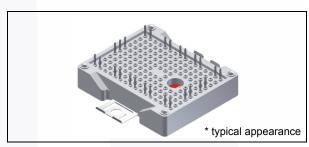
- · Compact Size: F2 Package
- · Press-fit Contact Technology
- Al₂O₃ Substrate with Low Thermal Resistance

Applications

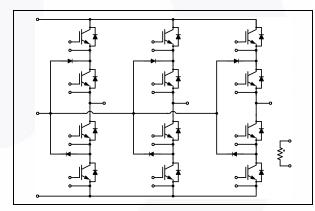
- Solar Inverter
- UPS

Related Materials

 AN-4167: Mounting Guideline for F1 / F2 Modules with Press-Fit Pins



Package Code: F2



Internal Circuit Diagram

Package Marking and Ordering Information

Device	Device Marking	Package	Packing Type	Quantity / Tray
FPF2C8P2NL07A	FPF2C8P2NL07A	F2	Tray	14

Absolute Maximum Ratings $T_C = 25^{\circ}C$ unless otherwise noted.

Symbol	Description		Rating	Units
Outer IGBT	(Q1, Q4, Q5, Q8, Q9, Q12)	<u>'</u>		
V _{CES}	Collector-Emitter Voltage		650	V
V _{GES}	Gate-Emitter Voltage		± 20	V
I _C	Continuous Collector Current	@ T _C = 80 °C, T _{Jmax} = 175 °C	30	А
I _{CM}	Pulsed Collector Current	limited by T _{Jmax}	60	Α
P_{D}	Maximum Power Dissipation	@ T _C = 25 °C	135	W
T _J	Operating Junction Temperature		- 40 to + 150	°C
Inner IGBT	(Q2, Q3, Q6, Q7, Q10, Q11)			
V _{CES}	Collector-Emitter Voltage		650	V
V _{GES}	Gate-Emitter Voltage		± 20	V
I _C	Continuous Collector Current	@ T _C = 80 °C, T _{Jmax} = 175 °C	50	А
I _{CM}	Pulsed Collector Current	limited by T _{Jmax}	100	Α
P _D	Maximum Power Dissipation	@ T _C = 25 °C	174	W
T _J	Operating Junction Temperature		- 40 to + 150	°C
Outer - Inne	er IGBT Series Connection			
SCWT	Short Circuit Withstand Time	V_{DC} = 300 V, V_{GE} = 15 V T_{C} = 25 °C	4	μS
Diode				
V_{RRM}	Peak Repetitive Reverse Voltage		650	V
l _F	Continuous Forward Current	@ T _C = 80 °C, T _{Jmax} = 175 °C	15	А
I _{FM}	Maximum Forward Current		30	Α
P_{D}	Maximum Power Dissipation	@ T _C = 25 °C	100	W
T _J	Operating Junction Temperature		- 40 to + 150	°C
Module				
T _{STG}	Storage Temperature		- 40 to + 125	°C
V _{ISO}	Isolation Voltage	@ AC 1 min.	2500	V
IsoMaterial	Internal Isolation Material		Al ₂ O ₃	
T _{MOUNT}	Mounting Torque		2.0 to 5.0	Nm
Creepage	Terminal to Heat Sink		11.5	mm
	Terminal to Terminal		6.3	mm
Clearance	Terminal to Heat Sink		10.0	mm
	Terminal to Terminal		5.0	mm

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Electrical Characteristics $T_C = 25$ °C unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Units
Outer IGE	ВТ			!		
Off Charac	teristics					
BV _{CES}	Collector-Emitter Breakdown Voltage	V _{GF} = 0 V, I _C = 1 mA	650	_	_	V
I _{CES}	Collector Cut-off Current	$V_{CE} = V_{CES}$, $V_{GE} = 0$ V	-	-	250	μА
I _{GES}	Gate-Emitter Leakage Current	$V_{GE} = V_{GES}$, $V_{CE} = 0$ V	-	_	2	μА
On Charac	3	-GE -GES, -GE				
V _{GE(th)}	Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}$, $I_C = 30 \text{ mA}$	4.5	5.6	6.7	V
V _{CE(sat)}	Collector-Emitter Saturation Voltage	I _C = 30 A, V _{GE} = 15 V	-	1.55	2.2	V
OL(Sat)		I _C = 30 A, V _{GE} = 15 V @T _C = 125 °C	-	1.75	-	V
		I _C = 60 A, V _{GF} = 15 V	-	2.13	-	V
Switching	Characteristics	C 23 7 GE				
t _{d(on)}	Turn-On Delay Time	V _{CC} = 300 V	-	33	_	ns
t _r	Rise Time	I _C = 30 A		43	-	ns
t _{d(off)}	Turn-Off Delay Time	$V_{GE} = \pm 15 \text{ V}$	_	197	-	ns
t _f	Fall Time	$R_G = 20 \Omega$ Inductive Load	-	17	\ -	ns
E _{ON}	Turn-On Switching Loss per Pulse	T _C = 25 °C	-	0.68	_	mJ
E _{OFF}	Turn-Off Switching Loss per Pulse		_	0.38	_	mJ
t _{d(on)}	Turn-On Delay Time	V _{CC} = 300 V	_	29	_	ns
t _r	Rise Time	$I_C = 30 \text{ A}$		50	_	ns
t _{d(off)}	Turn-Off Delay Time	$V_{GE} = \pm 15 \text{ V}$		205	_	ns
t _f	Fall Time	$R_G = 20 \Omega$ Inductive Load	_	25	_	ns
E _{ON}	Turn-On Switching Loss per Pulse	T _C = 125 °C	_	0.86		mJ
E _{OFF}	Turn-Off Switching Loss per Pulse	1.6 .20 0	_	0.52	_	mJ
Q _g	Total Gate Charge	$V_{CC} = 300 \text{ V}, I_{C} = 30 \text{ A}, V_{GE} = \pm 15 \text{ V}$		0.32	_	μС
$R_{\theta JC}$	Thermal Resistance of Junction to Case	per Chip		0.20	1.11	°C/W
Inner IGB	Т					
Off Charac	teristics					
BV _{CES}	Collector-Emitter Breakdown Voltage	V _{GE} = 0 V, I _C = 1 mA	650	-	_	V
I _{CES}	Collector Cut-off Current	$V_{CE} = V_{CES}$, $V_{GE} = 0$ V	- /	-	250	μА
I _{GES}	Gate-Emitter Leakage Current	V _{GE} = V _{GES} , V _{CE} = 0 V	-	-	2	μ A
On Charac		GE GEO, GE		1		
V _{GE(th)}	Gate-Emitter Threshold Voltage	$V_{GE} = V_{CE}$, $I_C = 50 \text{ mA}$	4.5	5.6	6.7	
V _{CE(sat)}	Collector-Emitter Saturation Voltage				6.7	V
CL(Sat)		$I_{C} = 50 \text{ A. } V_{CE} = 15 \text{ V}$	-		_	V
	Concetor-Emitter Catalation Voltage	I _C = 50 A, V _{GE} = 15 V I _C = 50 A, V _{GE} = 15 V @T _C = 125 °C	-	1.65	2.3	•
	Collector-Emitter Catalation Voltage	I _C = 50 A, V _{GE} = 15 V @T _C = 125 °C	-	1.65	2.3	V
Switching	J		-	1.65 1.95	2.3	V
	Characteristics Turn-On Delay Time	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V } @T_C = 125 \text{ °C}$ $I_C = 100 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CC} = 300 \text{ V}$	- - -	1.65 1.95	2.3	V
t _{d(on)}	Characteristics	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V} @T_C = 125 \text{ °C}$ $I_C = 100 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CC} = 300 \text{ V}$ $I_C = 50 \text{ A}$	-	1.65 1.95 2.49	2.3	V V
t _{d(on)}	Characteristics Turn-On Delay Time Rise Time	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V } @T_C = 125 \text{ °C}$ $I_C = 100 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CC} = 300 \text{ V}$ $I_C = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$	-	1.65 1.95 2.49 41 65	2.3	V V V
$t_{d(on)}$ t_{r} $t_{d(off)}$	Characteristics Turn-On Delay Time	$I_{C} = 50 \text{ A}, V_{GE} = 15 \text{ V } @T_{C} = 125 \text{ °C}$ $I_{C} = 100 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CC} = 300 \text{ V}$ $I_{C} = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$ $R_{G} = 15 \Omega$	-	1.65 1.95 2.49	2.3	V V V
$t_{d(on)}$ t_r $t_{d(off)}$ t_f	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time	$I_C = 50 \text{ A}, V_{GE} = 15 \text{ V } @T_C = 125 \text{ °C}$ $I_C = 100 \text{ A}, V_{GE} = 15 \text{ V}$ $V_{CC} = 300 \text{ V}$ $I_C = 50 \text{ A}$ $V_{GE} = \pm 15 \text{ V}$		1.65 1.95 2.49 41 65 233	2.3 - -	V V V Ns ns ns
$\begin{array}{c} t_{d(on)} \\ t_r \\ t_{d(off)} \\ t_f \\ E_{ON} \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse	$\begin{split} &I_{C} = 50 \text{ A, V}_{GE} = 15 \text{ V } @T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, V}_{GE} = 15 \text{ V} \\ &V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive Load \end{split}$		1.65 1.95 2.49 41 65 233 18	2.3 - - -	V V V ns ns ns ns mJ
$\begin{array}{c} t_{d(on)} \\ t_r \\ \\ t_{d(off)} \\ \\ t_f \\ \\ E_{ON} \\ \\ E_{OFF} \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time	$\begin{split} &I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \end{split}$ $&V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ &T_{C} = 25 \text{ °C} \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87	2.3 - - -	V V V Ns ns ns ns ns
$\begin{array}{c} t_{d(on)} \\ t_r \\ t_{d(off)} \\ t_f \\ E_{ON} \\ E_{OFF} \\ t_{d(on)} \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time	$\begin{split} &I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \end{split}$ $&V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ &T_{C} = 25 \text{ °C} \end{split}$ $&V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77	2.3 - - -	V V V V ns ns ns ns mJ mJ
$\begin{array}{c} t_{d(on)} \\ t_r \\ \end{array}$ $\begin{array}{c} t_{d(off)} \\ t_f \\ \end{array}$ $\begin{array}{c} E_{ON} \\ E_{OFF} \\ \end{array}$ $\begin{array}{c} t_{d(on)} \\ t_r \\ \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time Rise Time	$\begin{split} &I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \end{split}$ $&V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ &T_{C} = 25 \text{ °C} \end{split}$ $&V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77 39 76	2.3 - - - - - -	V V V V Ns ns ns ns mJ mJ ns ns ns
$\begin{array}{c} t_{d(on)} \\ t_r \\ t_{d(off)} \\ \end{array}$ $\begin{array}{c} t_{d(off)} \\ t_f \\ \end{array}$ $\begin{array}{c} E_{ON} \\ \end{array}$ $\begin{array}{c} E_{OFF} \\ t_{d(on)} \\ t_r \\ \end{array}$ $\begin{array}{c} t_{d(off)} \\ \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time Rise Time Turn-Off Delay Time	$\begin{split} & I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ & I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \\ & V_{CC} = 300 \text{ V} \\ & I_{C} = 50 \text{ A} \\ & V_{GE} = \pm 15 \text{ V} \\ & R_{G} = 15 \Omega \\ & \text{Inductive Load} \\ & T_{C} = 25 \text{ °C} \\ & V_{CC} = 300 \text{ V} \\ & I_{C} = 50 \text{ A} \\ & V_{GE} = \pm 15 \text{ V} \\ & R_{G} = 15 \Omega \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77 39 76 243	2.3 - - - - - - - - -	V V V V Ns ns ns ns mJ mJ ns ns ns ns
$\begin{array}{c} t_{d(on)} \\ t_r \\ t_{d(off)} \\ t_f \\ E_{ON} \\ E_{OFF} \\ t_{d(on)} \\ t_r \\ \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time	$\begin{split} &I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \\ &V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ &T_{C} = 25 \text{ °C} \\ &V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77 39 76 243 20	2.3 - - - - - - - - -	V V V V N N N N N N N N N N N N N N N N
td(on) tr td(off) tr EON EOFF td(on) tr td(off) tr EON EOFF	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-Off Switching Loss per Pulse	$\begin{split} & I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ & I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \\ & V_{CC} = 300 \text{ V} \\ & I_{C} = 50 \text{ A} \\ & V_{GE} = \pm 15 \text{ V} \\ & R_{G} = 15 \Omega \\ & \text{Inductive Load} \\ & T_{C} = 25 \text{ °C} \\ & V_{CC} = 300 \text{ V} \\ & I_{C} = 50 \text{ A} \\ & V_{GE} = \pm 15 \text{ V} \\ & R_{G} = 15 \Omega \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77 39 76 243 20 0.99	2.3 	V V V V N N N N N N N N N N N N N N N N
$\begin{array}{c} t_{d(on)} \\ t_r \\ t_{d(off)} \\ t_f \\ E_{ON} \\ E_{OFF} \\ t_{d(on)} \\ t_r \\ \end{array}$	Characteristics Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time Turn-On Switching Loss per Pulse Turn-Off Switching Loss per Pulse Turn-On Delay Time Rise Time Turn-Off Delay Time Fall Time	$\begin{split} &I_{C} = 50 \text{ A, } V_{GE} = 15 \text{ V } \textcircled{0} T_{C} = 125 \text{ °C} \\ &I_{C} = 100 \text{ A, } V_{GE} = 15 \text{ V} \\ &V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ &T_{C} = 25 \text{ °C} \\ &V_{CC} = 300 \text{ V} \\ &I_{C} = 50 \text{ A} \\ &V_{GE} = \pm 15 \text{ V} \\ &R_{G} = 15 \Omega \\ &Inductive \text{ Load} \\ \end{split}$		1.65 1.95 2.49 41 65 233 18 0.87 0.77 39 76 243 20	2.3 - - - - - - - - -	V V V V N N N N N N N N N N N N N N N N

Electrical Characteristics $T_C = 25$ °C unless otherwise noted.

Symbol	Parameter	Conditions	Min.	Тур.	Max.	Units
Diode			"		•	
V_{FM}	Diode Forward Voltage	I _F = 15 A	-	2.55	3.4	V
		I _F = 15 A @T _C = 125 °C	-	1.78	-	V
I _R	Reverse Leakage Current	V _R = 650 V	-	-	250	μА
t _{rr}	Reverse Recovery Time	V _R = 300 V, I _F = 15 A	-	23	-	ns
I _{rr}	Reverse Recovery Current	$di_F / dt = 700 \text{ A/us}$	-	9.9	-	Α
Q _{rr}	Reverse Recovery Charge	$T_C = 25 ^{\circ}C$	-	113	-	nC
t _{rr}	Reverse Recovery Time	V _R = 300 V, I _F = 15 A	-	49	-	ns
I _{rr}	Reverse Recovery Current	$di_F / dt = 700 \text{ A/us}$	-	15.2	-	Α
Q _{rr}	Reverse Recovery Charge	$T_C = 125 ^{\circ}C$	-	366	-	nC
$R_{\theta JC}$	Thermal Resistance of Junction to Case	per Chip	-	-	1.44	°C/W
NTC_ The	ermistor					
R _{NTC}	Rated Resistance	T _C = 25 °C	-	5.0	-	kΩ
Tolerance		T _C = 100 °C	-	493	-	Ω
	Tolerance	T _C = 25 °C	- 5	-	+ 5	%
P _D	Power Dissipation	T _C = 25 °C	-	-	20	mW
B _{Value}	B-Constant	B _{25/50}	-	3375	-	K
		B _{25/100}	-	3436	-	K

Typical Performance Characteristic

Fig 1. Typical Output Characteristics

- Outer IGBT

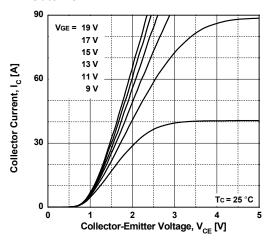


Fig 2. Typical Output Characteristics

- Outer IGBT

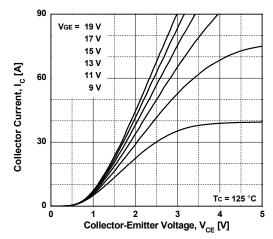


Fig 3. Typical Saturation Voltage Characteristics

- Outer IGBT

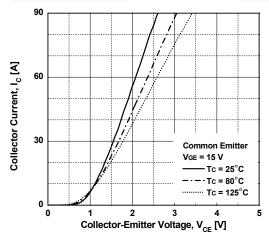


Fig 4. Switching Loss vs. Collector Current

- Outer IGBT

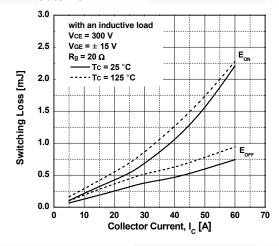


Fig 5. Switching Loss vs. Gate Resistance

- Outer IGBT

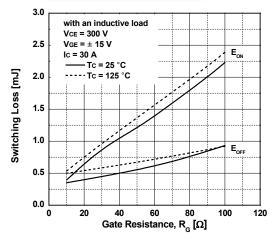
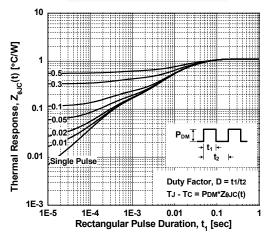


Fig 6. Transient Thermal Impedance

- Outer IGBT



Typical Performance Characteristic

Fig 7. Typical Output Characteristics

- Inner IGBT

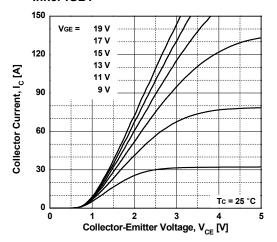


Fig 8. Typical Output Characteristics

- Inner IGBT

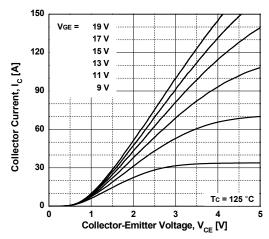


Fig 9. Typical Saturation Voltage Characteristics

- Inner IGBT

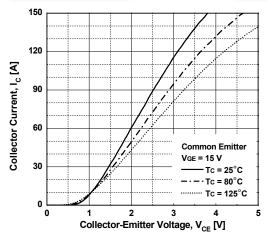


Fig 10. Switching Loss vs. Collector Current

- Inner IGBT

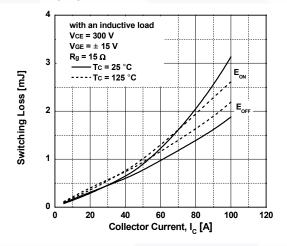


Fig 11. Switching Loss vs. Gate Resistance
- Inner IGBT

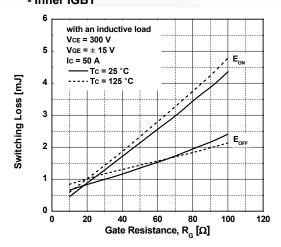
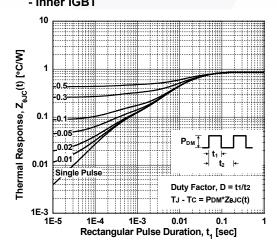


Fig 12. Transient Thermal Impedance
- Inner IGBT



Typical Performance Characteristic

Fig 13. Reverse Bias Safe Operating Area (RBSOA)

- Outer IGBT

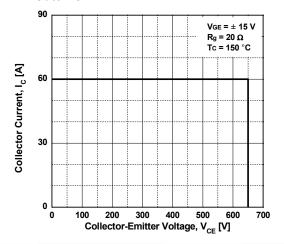


Fig 14. Reverse Bias Safe Operating Area (RBSOA)

- Inner IGBT

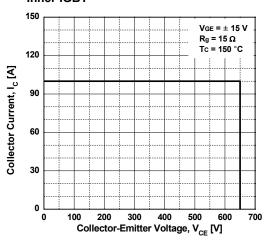


Fig 15. Typical Forward Voltage Drop

- Diode

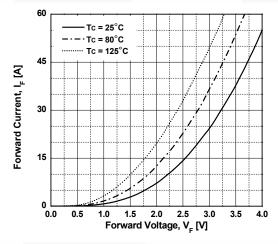


Fig 16. Reverse Recovery Energy vs. Forward Current

- Diode

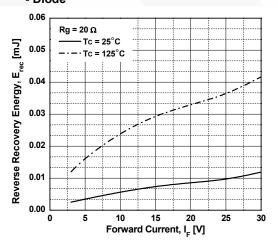
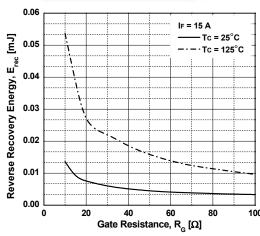
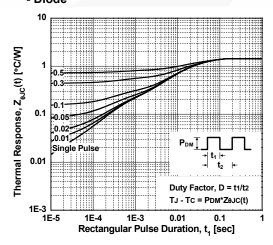


Fig 17. Reverse Recovery Energy vs. Gate Resistance Fig 18. Transient Thermal Impedance

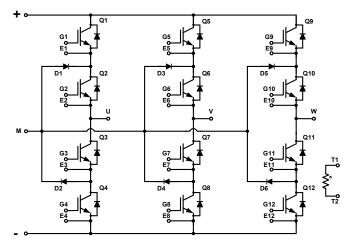
- Diode



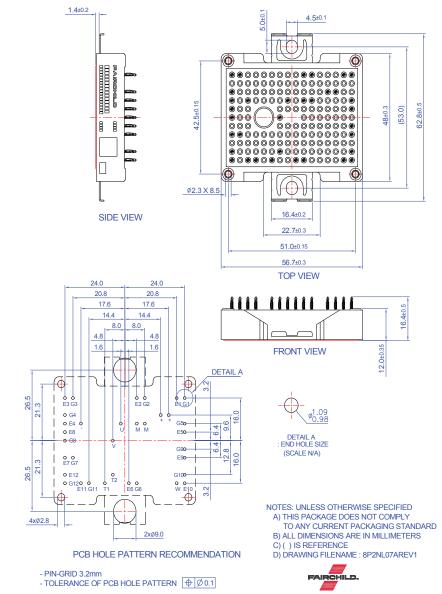
- Diode



Internal Circuit Diagram



Package Outlines [mm]







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