

# Field Stop Trench IGBT with Soft Fast Recovery Diode

# 100 A, 650 V

# AFGY100T65SPD

AFGY100T65SPD which is AEC Q101 qualified offers very low conduction and switch losses for a high efficiency operation in various applications, rugged transient reliability and low EMI.

Meanwhile, this part also offers an advantage of outstanding parallel operation performance with balance current sharing.

#### **Features**

- AEC-Q101 Qualified
- Very Low Saturation Voltage:  $V_{CE(Sat)} = 1.6 \text{ V (Typ.)}$  @  $I_C = 100 \text{ A}$
- Maximum Junction Temperature:  $T_J = 175^{\circ}C$
- Positive Temperature Co-efficient for Easy Parallel Operating
- Tight Parameter Distribution
- High Input Impedance
- 100% of the Parts are Tested for I<sub>LM</sub>
- Short Circuit Ruggedness
- Co-packed with Soft Fast Recovery Diode

#### **Typical Applications**

- Traction Inverter for HEV/EV
- Auxiliary DC/AC Converters
- Motor Drives
- Other Power-Train Applications Requiring High Power Switch

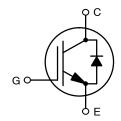
#### **MAXIMUM RATINGS**

Rating	Symbol	Value	Unit
Collector-to-Emitter Voltage	V <sub>CES</sub>	650	V
Gate-to-Emitter Voltage Transient Gate-to-Emitter Voltage	$V_{GES}$	±20 ±30	٧
Collector Current (Note 1) @ T <sub>C</sub> = 25°C @ T <sub>C</sub> = 100°C	I <sub>C</sub>	120 100	Α
Pulsed Collector Current	$I_{LM}$	300	Α
Pulsed Collector Current	I <sub>CM</sub>	300	Α
Diode Forward Current (Note 1) @ $T_C = 25^{\circ}C$ @ $T_C = 100^{\circ}C$	I <sub>F</sub>	120 100	Α
Maximum Power Dissipation @ $T_C = 25^{\circ}C$ @ $T_C = 100^{\circ}C$	P <sub>D</sub>	660 330	W
Short Circuit Withstand Time @ T <sub>C</sub> = 25°C	SCWT	6	μs
Voltage Transient Ruggedness (Note 2)	dV/dt	10	V/ns
Operating Junction / Storage Temperature Range	T <sub>J</sub> , T <sub>STG</sub>	-55 to +175	°C
Maximum Lead Temp. for Soldering Purposes, 1/8" from case for 5 seconds	TL	265	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

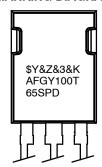
- 1. Value limit by bond wire
- 2.  $V_{CC} = 400 \text{ V}$ ,  $V_{GE} = 15 \text{ V}$ ,  $I_{C} = 300 \text{ A}$ , Inductive Load

100 A, 650 V, V<sub>CESat</sub> = 1.6 V





#### MARKING DIAGRAM



\$Y = onsemi Logo &Z = Assembly Plant Code &3 = Date Code (Year & Week) &K = Lot Traceability Code AFGY100T65SPD = Specific Device Code

#### **ORDERING INFORMATION**

Device	Package	Shipping
AFGY100T65SPD	TO-247-3LD	30 Units / Tube

#### THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction-to-case, for IGBT	$R_{ heta JC}$	0.23	°C/W
Thermal resistance junction-to-case, for Diode	$R_{ heta JC}$	0.40	
Thermal resistance junction-to-ambient	$R_{ heta JA}$	40	

### **ELECTRICAL CHARACTERISTICS** (T<sub>.1</sub> = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit
OFF CHARACTERISTICS	•		•	•	•	
Collector-emitter breakdown voltage, gate-emitter short-circuited	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	BV <sub>CES</sub>	650	_	_	V
Temperature Coefficient of Breakdown Voltage	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	$\frac{\Delta BV_{CES}}{\Delta T_{J}}$	-	0.6	-	V/°C
Collector-emitter cut-off current, gate-emitter short-circuited	V <sub>GE</sub> = 0 V, V <sub>CE</sub> = 650 V	I <sub>CES</sub>	-	-	40	μΑ
Gate leakage current, collector- emitter short-circuited	V <sub>GE</sub> = 20 V, V <sub>CE</sub> = 0 V	I <sub>GES</sub>	_	_	±250	nA
ON CHARACTERISTICS						
Gate-emitter threshold voltage	$V_{GE} = V_{CE}$ , $I_C = 100 \text{ mA}$	V <sub>GE(th)</sub>	4.3	5.3	6.3	V
Collector-emitter saturation voltage	V <sub>GE</sub> = 15 V, I <sub>C</sub> = 100 A V <sub>GE</sub> = 15 V, I <sub>C</sub> = 100 A, T <sub>J</sub> = 175°C	V <sub>CE(sat)</sub>	- -	1.6 2.15	2.05 -	V
DYNAMIC CHARACTERISTICS				•	•	<u></u>
Input capacitance	V <sub>CE</sub> = 30 V,	C <sub>ies</sub>	_	4220	-	pF
Output capacitance	V <sub>GE</sub> = 0 V, f = 1 MHz	C <sub>oes</sub>	-	302	-	
Reverse transfer capacitance		C <sub>res</sub>	-	38	-	
Internal Gate Resistance	f = 1 MHz	$R_{G}$	-	3	-	Ω
Gate charge total	V <sub>CE</sub> = 400 V,	Qg	-	109	164	nC
Gate-to-emitter charge	I <sub>C</sub> = 100 A, V <sub>GE</sub> = 15 V	Q <sub>ge</sub>	-	34	-	
Gate-to-collector charge		$Q_{gc}$	-	36	-	
SWITCHING CHARACTERISTICS, IND	DUCTIVE LOAD					
Turn-on delay time	T <sub>J</sub> = 25°C,	t <sub>d(on)</sub>	-	36	-	ns
Rise time	$V_{CC} = 400 \text{ V},$ $I_{C} = 100 \text{ A},$	t <sub>r</sub>	-	92	-	
Turn-off delay time	$R_G$ = 5.0 Ω, $V_{GE}$ = 15 V,	t <sub>d(off)</sub>	-	78	-	
Fall time	Inductive Load	t <sub>f</sub>	-	106	-	
Turn-on switching loss	]	E <sub>on</sub>	-	5.1	-	mJ
Turn-off switching loss	]	E <sub>off</sub>	-	2.7	-	
Total switching loss		E <sub>ts</sub>	-	7.8	-	
Turn-on delay time	T <sub>J</sub> = 175°C,	t <sub>d(on)</sub>	-	32	-	ns
Rise time	$V_{CC} = 400 \text{ V},$ $I_{C} = 100 \text{ A},$	t <sub>r</sub>	-	96	-	
Turn-off delay time	$R_G$ = 5.0 Ω, $V_{GE}$ = 15 V,	t <sub>d(off)</sub>	-	84	-	
Fall time	Inductive Load	t <sub>f</sub>	-	156	-	
Turn-on switching loss	]	E <sub>on</sub>	-	7.9	-	mJ
Turn-off switching loss		E <sub>off</sub>	-	4.0	-	1
Total switching loss	]	E <sub>ts</sub>	-	11.9	-	

# **ELECTRICAL CHARACTERISTICS** (T<sub>J</sub> = 25°C unless otherwise noted) (Continued)

Parameter	Test Conditions	Symbol	Min	Тур	Max	Unit
DIODE CHARACTERISTIC			•	•	•	
Diode Forward Voltage	I <sub>F</sub> = 100 A, T <sub>J</sub> = 25°C	$V_{FM}$	_	1.3	1.6	V
	I <sub>F</sub> = 100 A, T <sub>J</sub> = 175°C		_	1.25	-	
Reverse Recovery Energy $ I_F = 100 \text{ A, } dI_F/dt = 1000 \text{ A/$\mu$s}, \\ V_{CE} = 400 \text{ V, } T_J = 25^{\circ}\text{C} $	E <sub>rec</sub>	-	383	-	μJ	
	$I_F = 100 \text{ A}, dI_F/dt = 1000 \text{ A}/\mu\text{s}, \ V_{CE} = 400 \text{ V}, T_J = 175^{\circ}\text{C}$		-	1668	-	
Diode Reverse Recovery Time	$I_F$ = 100 A, $dI_F/dt$ = 1000 A/µs, $V_{CE}$ = 400 V, $T_J$ = 25°C	T <sub>rr</sub>	-	105	-	ns
	$I_F = 100 \text{ A}, dI_F/dt = 1000 \text{ A}/\mu\text{s}, \ V_{CE} = 400 \text{ V}, T_J = 175^{\circ}\text{C}$		-	208	-	
Diode Reverse Recovery Charge	$I_F$ = 100 A, $dI_F/dt$ = 1000 A/ $\mu$ s, $V_{CE}$ = 400 V, $T_J$ = 25°C	Q <sub>rr</sub>	=	2090	-	nC
	$I_F = 100 \text{ A}, dI_F/dt = 1000 \text{ A}/\mu\text{s}, \ V_{CE} = 400 \text{ V}, T_J = 175^{\circ}\text{C}$		-	6974	-	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

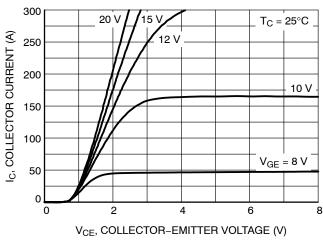


Figure 1. Typical Output Characteristics

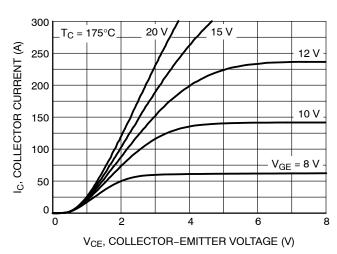


Figure 2. Typical Output Characteristics

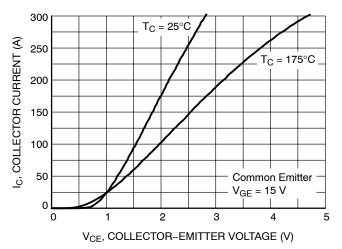


Figure 3. Typical Saturation Voltage

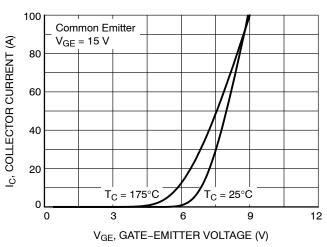


Figure 4. Transfer Characteristics

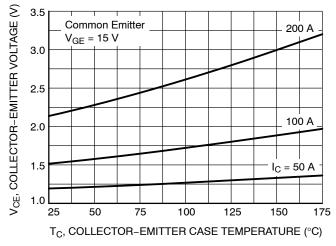


Figure 5. Saturation Voltage vs. Case Temperature

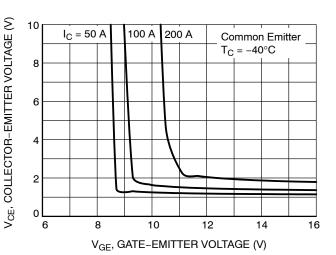
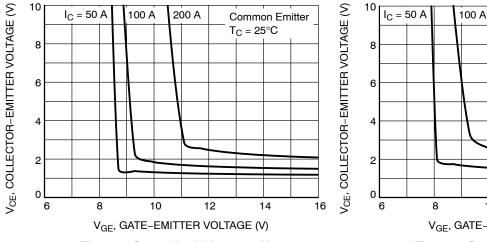


Figure 6. Saturation Voltage vs. V<sub>GE</sub>

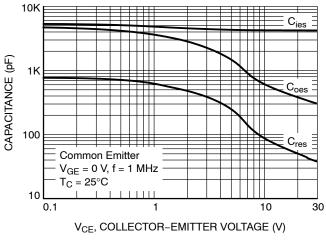


8 200 A Common Emitter T<sub>C</sub> = 175°C

8 200 A 200

Figure 7. Saturation Voltage vs. V<sub>CE</sub>

Figure 8. Saturation Voltage vs. V<sub>CE</sub>



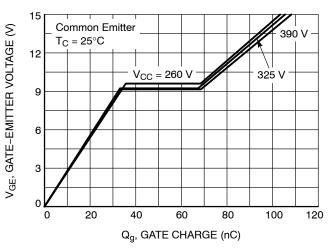
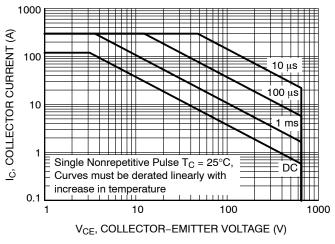


Figure 9. Capacitance Characteristics

Figure 10. Gate Charge Characteristics



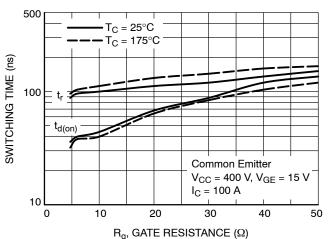


Figure 11. SOA Characteristics

Figure 12. Turn-On Characteristics vs. Gate Resistance

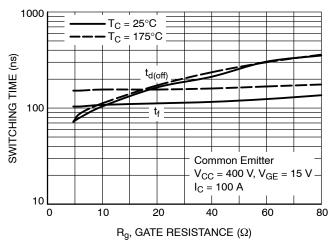


Figure 13. Turn-Off Characteristics vs. Gate Resistance

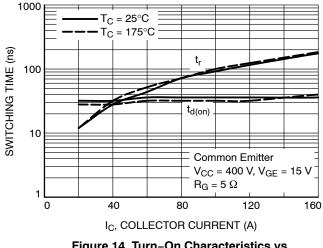


Figure 14. Turn-On Characteristics vs.
Collector Current

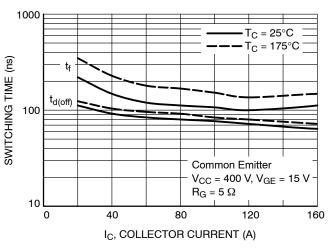


Figure 15. Turn-Off Characteristics vs.
Collector Current

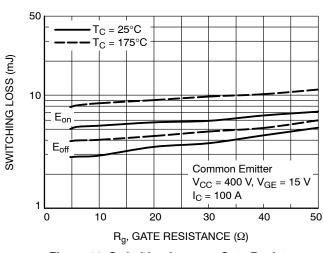


Figure 16. Switching Loss vs. Gate Resistance

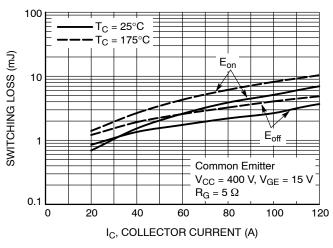


Figure 17. Switching Loss vs. Collector Current

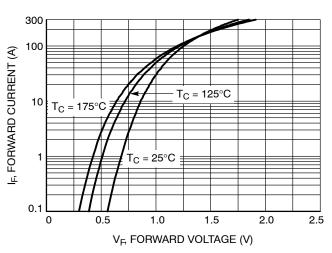


Figure 18. Forward Characteristics

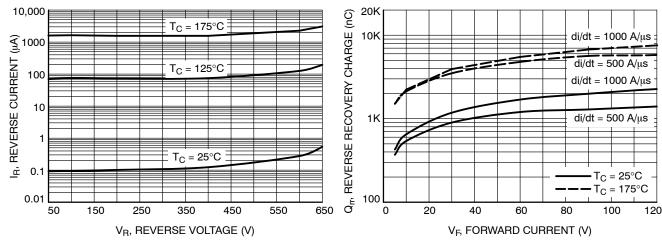


Figure 19. Reverse Current

Figure 20. Stored Charge

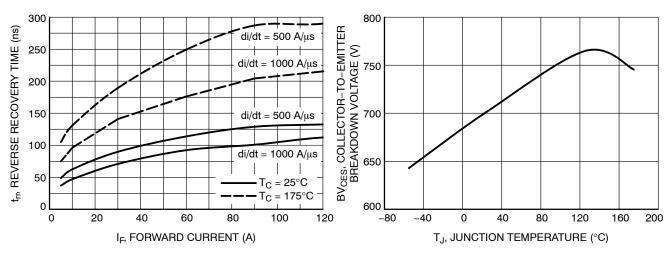


Figure 21. Reverse Recovery Time

Figure 22. Collector-to-Emitter Breakdown Voltage vs. Junction Temperature

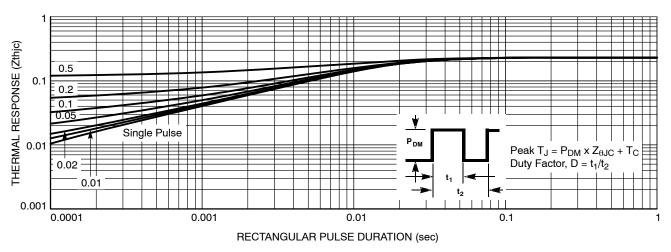


Figure 23. Transient Thermal Impedance of IGBT

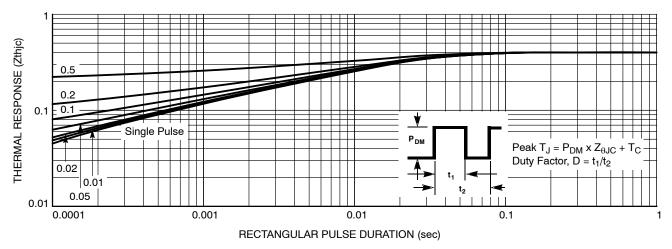
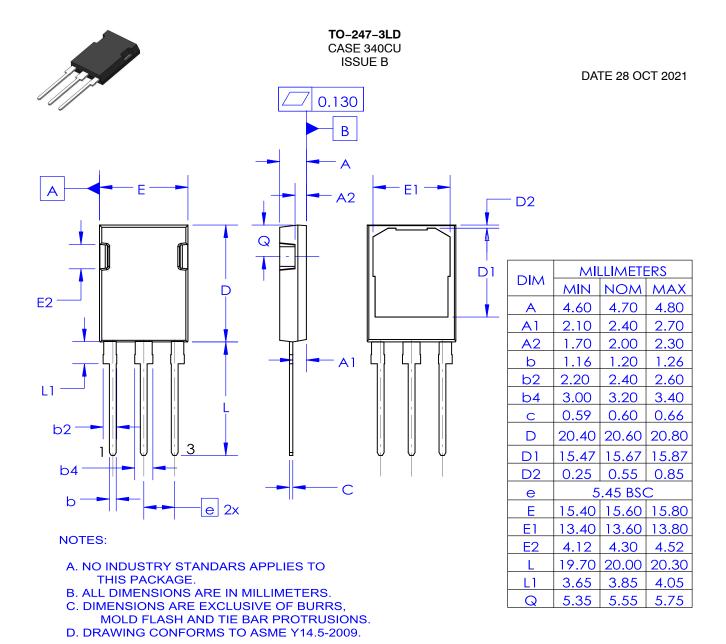


Figure 24. Transient Thermal Impedance of Diode





# GENERIC MARKING DIAGRAM\*



XXXX = Specific Device Code

A = Assembly Site Code Y = Year

WW = Work WeekZZ = Assembly Lot Code

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "•", may or may not be present. Some products may not follow the Generic Marking.

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