Field Stop Trench IGBT With Soft Fast Recovery Diode and V_{CESAT}, V_{TH} Binning 650 V, 160 A

AFGY160T65SPD-B4

Features

- AEC-Q101 Qualified and PPAP Capable
- Very Low Saturation Voltage: $V_{CE(sat)} = 1.6 \text{ V (Typ.)} @ I_C = 160 \text{ A}$
- Maximum Junction Temperature: $T_J = 175^{\circ}C$
- Positive Temperature Co-Efficient
- Tight Parameter Distribution
- High Input Impedance
- 100% of the Parts are Dynamically Tested
- Short Circuit Ruggedness > 6 μs @ 25°C
- Copacked with Soft, Fast Recovery Extremefast Diode
- This Device is Pb–Free, Halogen Free/BFR Free and are RoHS Compliant

Benefits

- Very Low Conduction and Switching Losses for a High Efficiency Operation in Various Applications
- Rugged Transient Reliability
- Outstanding Parallel Operation Performance with Balance Current Sharing
- Low EMI

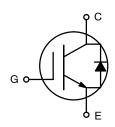
Applications

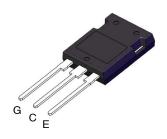
- Traction Inverter for HEV/EV
- Auxiliary DC/AC Converter
- Motor Drives
- Other Power-Train Applications Requiring High Power Switch



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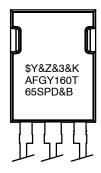
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TO-247-3LD CASE 340CU

MARKING DIAGRAM



\$Y = ON Semiconductor Logo &Z = Assembly Plant Code &3 = Date Code (Year & Week) &K = Lot Traceability Code AFGY160T65SPD = Specific Device Code &B = BIN Designator

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Ratings	Unit
V _{CES}	Collector to Emitter Voltage	650	V
V_{GES}	Gate to Emitter Voltage	±20	V
	Transient Gate to Emitter Voltage	±30	V
I _C	Collector Current @ T _C = 25°C (Note 1)	240	Α
	Collector Current @ T _C = 100°C	220	А
I _{Nominal}	Nominal Current	160	Α
I _{CM}	Pulsed Collector Current	480	Α
I _{FM}	Diode Forward Current @ T _C = 25°C (Note 1)	240	Α
	Diode Forward Current @ T _C = 100°C	188	Α
P_{D}	Maximum Power Dissipation @ T _C = 25°C	882	W
	Maximum Power Dissipation @ T _C = 100°C	441	W
SCWT	Short Circuit Withstand Time @ T _C = 25°C	6	μs
ΔV/Δt	Voltage Transient Ruggedness (Note 2)	10	V/ns
TJ	Operating Junction Temperature	-55 to +175	°C
T _{stg}	Storage Temperature Range	-55 to +175	°C
TL	Maximum Lead Temp. for soldering Purposes, 1/8" from case for 5 seconds	300	°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.

THERMAL CHARACTERISTICS

Symbol	Parameter	Тур.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction to Case	-	0.17	°C/W
R ₀ JC (Diode)	Thermal Resistance, Junction to Case	-	0.32	°C/W
$R_{ heta JA}$	Thermal Resistance, Junction to Ambient	-	40	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Bin Designator	Packing Type	Qty per Tube/Reel*
AFGY160T65SPDA	AFGY160T65SPD-B4	Α	Tube	30
AFGY160T65SPDB	AFGY160T65SPD-B4	В	Tube	30
AFGY160T65SPDC	AFGY160T65SPD-B4	С	Tube	30
AFGY160T65SPDD	AFGY160T65SPD-B4	D	Tube	30

^{*}Generally all tubes in one box will belong to the same bin. In rare and unusual cases there may be tubes from more than one bin inside one box. Such mixing would not be considered a quality excursion.

The primary container quantity (MPQ) for these binning products is 30 units and therefore partial box shipment can be expected.

^{1.} Limited to bondwire.

^{2.} V_{CC} = 400 V, V_{GE} = 15 V, I_{CE} = 480 A, Inductive load.

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Тур.	Max.	Unit
OFF CHARAC	CTERISTICS			•		
BV _{CES}	Collector to Emitter Breakdown Voltage	$V_{GE} = 0 \text{ V}, I_{C} = 1 \text{ mA}$	650	-	-	V
$\Delta BV_{CES} / \Delta T_{J}$	Temperature Coefficient of Breakdown Voltage	V _{GE} = 0 V, I _C = 1 mA	-	0.6	-	V/°C
I _{CES}	Collector Cut-Off Current	V _{CE} = V _{CES} , V _{GE} = 0 V	-	-	40	μΑ
I _{GES}	G-E Leakage Current	V _{GE} = V _{GES} , V _{CE} = 0 V	-	-	±250	nA
ON CHARAC	TERISTICS					
V _{GE(th)A}	G-E Threshold (Bin A)	Ic = 160 mA; V _{CE} = V _{GE}	5.15	5.5	6.3	V
V _{CE(sat)A}	Collector to Emitter Saturation Voltage (Bin A)	Ic = 160 A; V _{GE} = 15 V	1.5	1.6	1.67	V
V _{GE(th)B}	G-E Threshold (Bin B)	Ic = 160 mA; V _{CE} = V _{GE}	5.15	5.5	6.3	V
V _{CE(sat)B}	Collector to Emitter Saturation Voltage (Bin B)	Ic = 160 A; V _{GE} = 15 V	1.57	1.64	2.05	V
V _{GE(th)C}	G-E Threshold (Bin C)	Ic = 160 mA; V _{CE} = V _{GE}	4.3	5.3	5.65	V
V _{CE(sat)C}	Collector to Emitter Saturation Voltage (Bin C)	Ic = 160 A; V _{GE} = 15 V	1.5	1.6	1.67	V
V _{GE(th)D}	G-E Threshold (Bin D)	Ic = 160 mA; V _{CE} = V _{GE}	4.3	5.3	5.65	V
V _{CE(sat)D}	Collector to Emitter Saturation Voltage (Bin D)	Ic = 160 A; V _{GE} = 15 V	1.57	1.64	2.05	V
V _{GE(th)}	G-E Threshold	Ic = 160 mA; V _{CE} = V _{GE}	4.3	5.3	6.3	V
V _{CE(sat)}	Collector to Emitter Saturation Voltage	Ic = 160 A; V _{GE} = 15 V	-	1.6	2.05	V
		Ic = 160 A; V _{GE} = 15 V; T _J = 175°C	-	2.15	-	V
DYNAMIC CH	IARACTERISTICS			•		
C _{ies}	Input Capacitance	V _{CE} = 30 V, V _{GE} = 0 V,	-	6710	-	pF
C _{oes}	Output Capacitance	f = 1 MHz	-	450	-	pF
C _{res}	Reverse Transfer Capacitance		-	55	-	pF
R_{G}	Internal Gate Resistance	f = 1 MHz	-	3	-	Ω
SWITCHING (CHARACTERISTICS			•		
T _{d(on)}	Turn-On Delay Time	$V_{CC} = 400 \text{ V}, I_{C} = 160 \text{ A},$	-	53	-	ns
T _r	Rise Time	$R_G = 5 \Omega$, $V_{GE} = 15 V$, Inductive Load, $T_J = 25^{\circ}C$	-	197	-	ns
T _{d(off)}	Turn-Off Delay Time		-	98	-	ns
T _f	Fall Time]	_	141	-	ns
E _{on}	Turn-On Switching Loss	1	_	12.4	-	mJ
E _{off}	Turn-Off Switching Loss	1	_	5.7	-	mJ
E _{ts}	Total Switching Loss	1	_	18.1	-	mJ
T _{d(on)}	Turn-On Delay Time	V _{CC} = 400 V, I _C = 160 A,	_	52	-	ns
T _r	Rise Time	$R_G = 5 \Omega$, $V_{GE} = 15 V$, Inductive Load, $T_J = 175^{\circ}C$	_	236	_	ns
T _{d(off)}	Turn-Off Delay Time	inductive Load, 1j = 175 G	_	104	-	ns
T _f	Fall Time		_	204	-	ns
E _{on}	Turn-On Switching Loss	-	_	21	-	mJ
E _{off}	Turn-Off Switching Loss	-	_	8.5	-	mJ
E _{ts}	Total Switching Loss	†	_	29.5	_	mJ

ELECTRICAL CHARACTERISTICS OF THE IGBT (T_J = 25°C unless otherwise noted) (continued)

Symbol	Parameter Test Condition		Min.	Тур.	Max.	Unit
SWITCHING C	SWITCHING CHARACTERISTICS					
Qg	Total Gate Charge	V _{CE} = 400 V, I _C = 160 A, V _{GF} = 15 V	-	163	245	nC
Q _{ge}	Gate to Emitter Charge	v _{GE} = 15 v	-	50	-	nC
Q _{gc}	Gate to Collector Charge		-	49	_	nC

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.

ELECTRICAL CHARACTERISTICS OF THE DIODE (T_J = 25°C unless otherwise noted)

Symbol	Parameter	Test Conditions		Min.	Тур.	Max.	Unit
V _{FM}	Diode Forward Voltage	I _F = 160 A	T _J = 25°C	-	1.4	1.7	V
			T _J = 175°C	-	1.35	-	
E _{rec}	Reverse Recovery Energy	V _{CE} = 400 V, I _F = 160 A,	T _J = 25°C	_	598	-	μJ
		$\Delta I_F/\Delta t = 1000 A/\mu s$	T _J = 175°C	-	4000	-	
T _{rr}	Diode Reverse Recovery		T _J = 25°C	-	132	-	ns
	Time		T _J = 175°C	-	245	-	
Q _{rr}			T _J = 25°C	-	3.3	-	μС
	Charge		T _J = 175°C	-	12.5	-	

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.

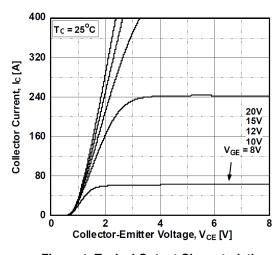


Figure 1. Typical Output Characteristics

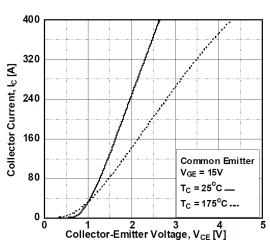


Figure 3. Typical Saturation Voltage Characteristics

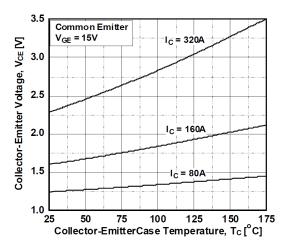


Figure 5. Saturation Voltage vs. Case Temperature at Variant Current Level

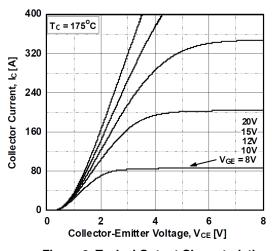


Figure 2. Typical Output Characteristics

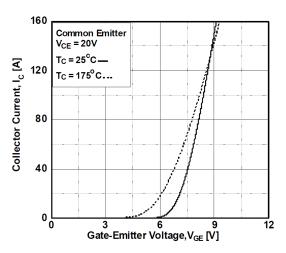


Figure 4. Transfer Characteristics

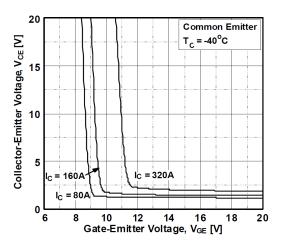


Figure 6. Saturation Voltage vs. V_{GE}

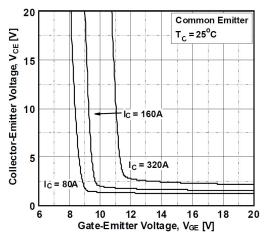


Figure 7. Saturation Voltage vs. V_{GE}

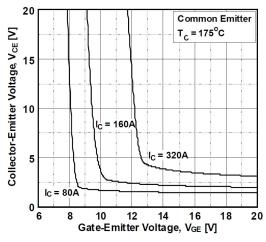


Figure 8. Saturation Voltage vs. V_{GE}

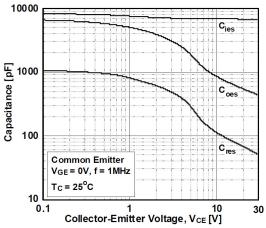


Figure 9. Capacitance Characteristics

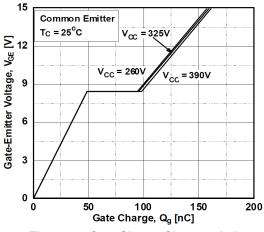


Figure 10. Gate Charge Characteristics

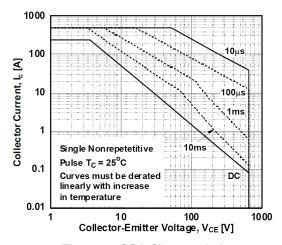


Figure 11. SOA Characteristics

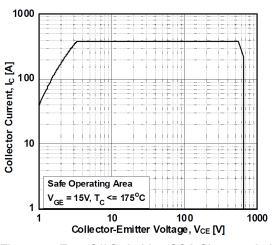


Figure 12. Turn Off Switching SOA Characteristics

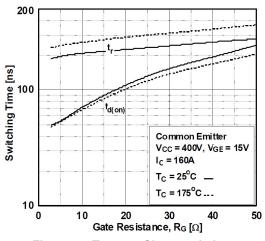


Figure 13. Turn-on Characteristics vs.

Gate Resistance

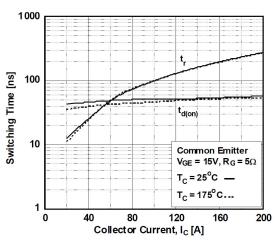


Figure 15. Turn-on Characteristics vs. Collector Current

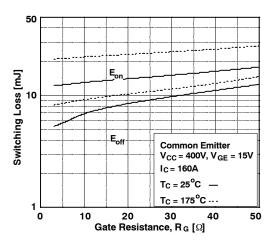


Figure 17. Switching Loss vs. Gate Resistance

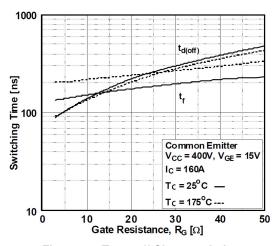


Figure 14. Turn-off Characteristics vs.

Gate Resistance

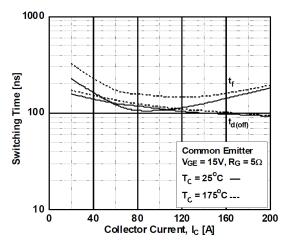


Figure 16. Turn-off Characteristics vs. Collector Current

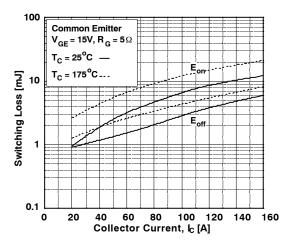


Figure 18. Switching Loss vs. Collector Current

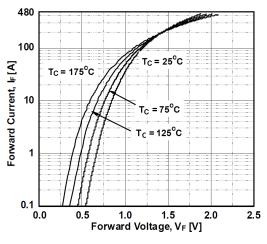


Figure 19. Forward Characteristics

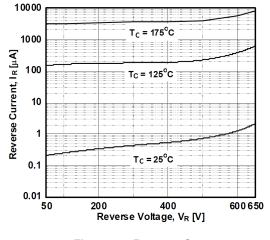


Figure 20. Reverse Current

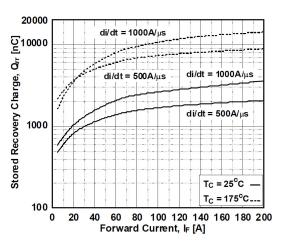


Figure 21. Stored Charge

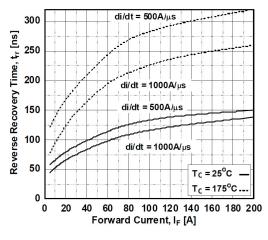


Figure 22. Reverse Recovery Time

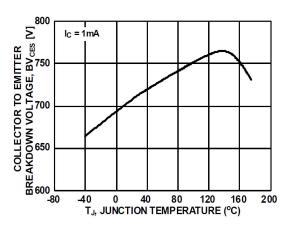


Figure 23. Collector to Emitter Breakdown Voltage vs. Junction Temperature

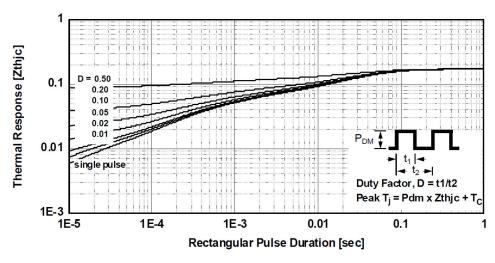


Figure 24. Transient Thermal Impedance of IGBT

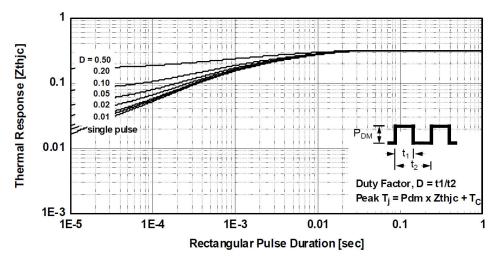
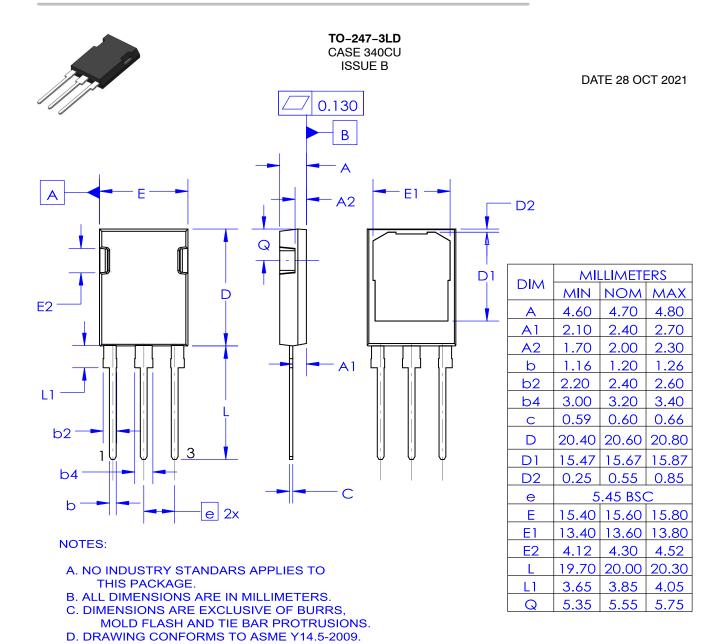


Figure 25. Transient Thermal Impedance of Diode



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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