IGBT - Field Stop, Trench

1200 V, 40 A

FGH40T120SMD, FGH40T120SMD-F155

Description

Using innovative field stop trench IGBT technology, ON Semiconductor's new series of field stop trench IGBTs offer the optimum performance for hard switching application such as solar inverter, UPS, welder and PFC applications.

Features

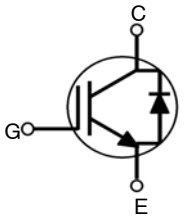
- FS Trench Technology, Positive Temperature Coefficient
- High Speed Switching
- Low Saturation Voltage: $V_{CE(sat)}$ = 1.8 V @ I_C = 40 A
- 100% of the Parts tested for I_{LM}(1)
- High Input Impedance
- These Devices are Pb−Free and are RoHS Compliant

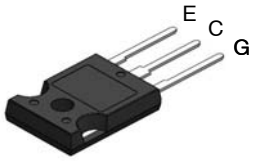
Applications

- Solar Inverter, Welder, UPS & PFC applications

ON Semiconductor®

www.onsemi.com

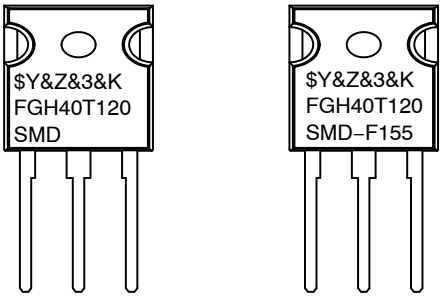




TO−247−3LD
CASE 340CK

TO−247−3LD
CASE 340CH

MARKING DIAGRAMS



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Numeric Date Code
&K	= Lot Code
FGH40T120SMD, FGH40T120SMD−F155	= Specific Device Code

ORDERING INFORMATION

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

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ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Description		Symbol	Ratings	Unit
Collector to Emitter Voltage		V_{CES}	1200	V
Gate to Emitter Voltage		V_{GES}	±25	V
Transient Gate to Emitter Voltage			±30	V
Collector Current	T_C = 25°C	I_C	80	A
Collector Current	T_C = 100°C		40	A
Clamped Inductive Load Current	T_C = 25°C	I_{LM} (Note 1)	160	A
Pulsed Collector Current		I_{CM} (Note 2)	160	A
Diode Continuous Forward Current	T_C = 25°C	I_F	80	A
Diode Continuous Forward Current	T_C = 100°C		40	A
Diode Maximum Forward Current		I_{FM}	240	A
Maximum Power Dissipation	T_C = 25°C	P_D	555	W
Maximum Power Dissipation	T_C = 100°C		277	W
Operating Junction Temperature		T_J	−55 to +175	°C
Storage Temperature Range		T_{stg}	−55 to +175	°C
Maximum Lead Temp. for soldering Purposes, 1/8” from case for 5 seconds		T_L	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.

1. Vcc = 600 V,V_{GE} = 15 V, I_C = 160 A, R_G = 10 W , Inductive Load
2. Limited by Tjmax

THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$(IGBT)	–	0.27	°C/W
Thermal Resistance, Junction to Case	$R_{\theta JC}$(Diode)	–	0.89	°C/W
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	–	40	°C/W

PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40T120SMD	FGH40T120SMD	TO−247−3 (PB−Free)	–	–	30
FGH40T120SMD	FGH40T120SMD−F155	TO−247−3 (Pb−Free)	–	–	30

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector to Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0 V, I_C = 250 μA	1200	–	–	V
Collector Cut−Off Current	I_{CES}	V_{CE} = V_{CES}, V_{GE} = 0 V	–	–	250	μA
G−E Leakage Current	I_{GES}	V_{GE} = V_{GES}, V_{CE} = 0 V	–	–	±400	nA
ON CHARACTERISTICs						
G−E Threshold Voltage	$V_{GE(th)}$	I_C = 40 mA, V_{CE} = V_{GE}	4.9	6.2	7.5	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C = 40 A, V_{GE} = 15 V, T_C = 25°C	–	1.8	2.4	V
		I_C = 40 A, V_{GE} = 15 V, T_C = 175°C	–	2.0	–	V

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

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
DYNAMIC CHARACTERISTICS						
Input Capacitance	C_{ies}	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	–	4300	–	pF
Output Capacitance	C_{oes}		–	180	–	pF
Reverse Transfer Capacitance	C_{res}		–	100	–	pF
SWITCHING CHARACTERISTICS						
Turn−On Delay Time	$t_{d(on)}$	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 25°C	–	40	–	ns
Rise Time	t_r		–	47	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	475	–	ns
Fall Time	t_f		–	10	–	ns
Turn−On Switching Loss	E_{on}		–	2.7	–	mJ
Turn−Off Switching Loss	E_{off}		–	1.1	–	mJ
Total Switching Loss	E_{ts}		–	3.8	–	mJ
Turn−On Delay Time	$t_{d(on)}$	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15 V, Inductive Load, T_C = 175°C	–	40	–	ns
Rise Time	tr		–	55	–	ns
Turn−Off Delay Time	$t_{d(off)}$		–	520	–	ns
Fall Time	t_f		–	50	–	ns
Turn−On Switching Loss	E_{on}		–	3.4	–	mJ
Turn−Off Switching Loss	E_{off}		–	2.5	–	mJ
Total Switching Loss	E_{ts}		–	5.9	–	mJ
Total Gate Charge	Q_g	V_{CE} = 600 V, I_C = 40 A, V_{GE} = 15 V	–	370	–	nC
Gate to Emitter Charge	Q_{ge}		–	23	–	nC
Gate to Collector Charge	Q_{gc}		–	210	–	nC

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

Parametr	Symbol	Test Conditions	Min	Typ	Max	Unit
Diode Forward Voltage	V_{FM}	I_F = 40 A, T_C = 25°C	–	3.8	4.8	V
		I_F = 40 A, T_C = 175°C	–	2.7	–	V
Diode Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, di_F/dt = 200 A/μs, T_C = 25°C	–	65	–	ns
Diode Peak Reverse Recovery Current	I_{rr}		–	7.2	–	A
Diode Reverse Recovery Charge	Q_{rr}		–	234	–	nC
Diode Reverse Recovery Time	t_{rr}	V_R = 600 V, I_F = 40 A, di_F/dt = 200 A/μs, T_C = 175°C	–	200	–	ns
Diode Peak Reverse Recovery Current	I_{rr}		–	18.0	–	A
Diode Reverse Recovery Charge	Q_{rr}		–	1800	–	nC

TYPICAL PERFORMANCE CHARACTERISTICS

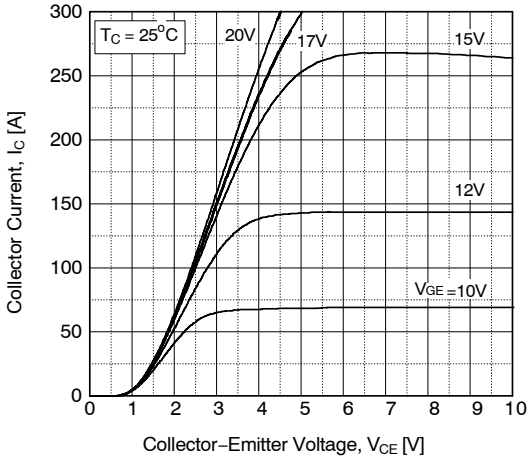


Figure 1. Typical Output Characteristics

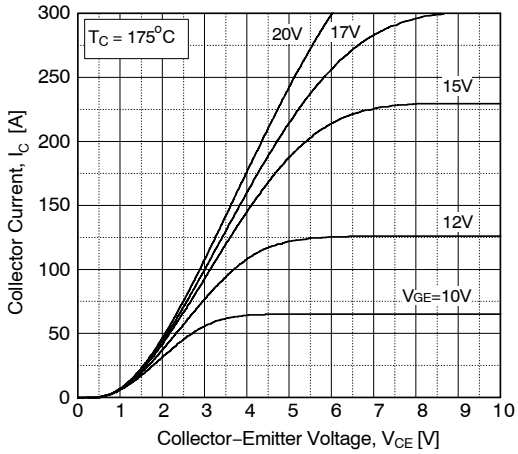


Figure 2. Typical Output Characteristics

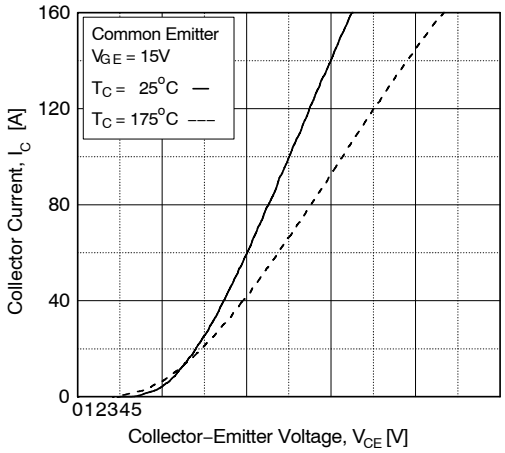


Figure 3. Typical Saturation Voltage Characteristics

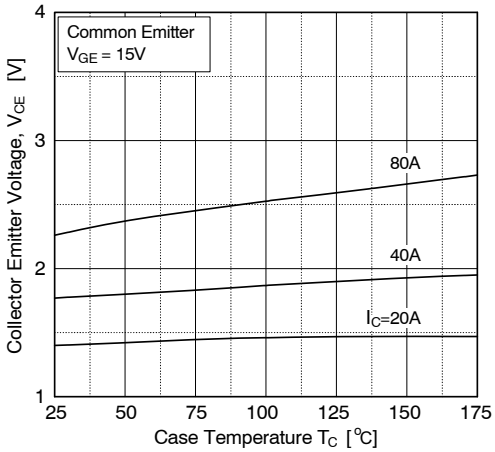


Figure 4. Saturation Voltage vs. Case Temperature at Variant Current Level

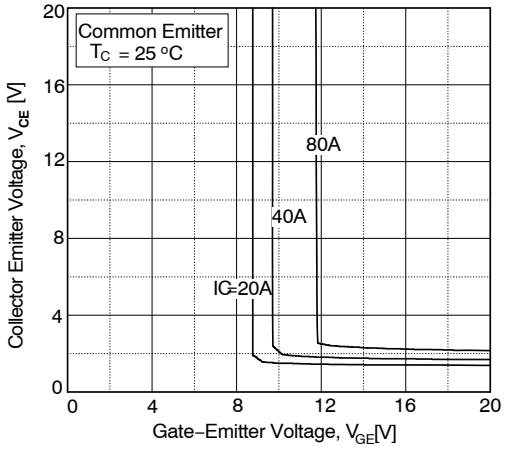


Figure 5. Saturation Voltage vs V_{GE}

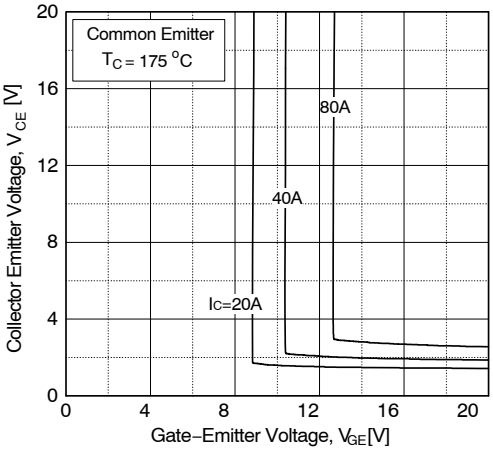


Figure 6. Saturation Voltage vs V_{GE}

TYPICAL PERFORMANCE CHARACTERISTICS

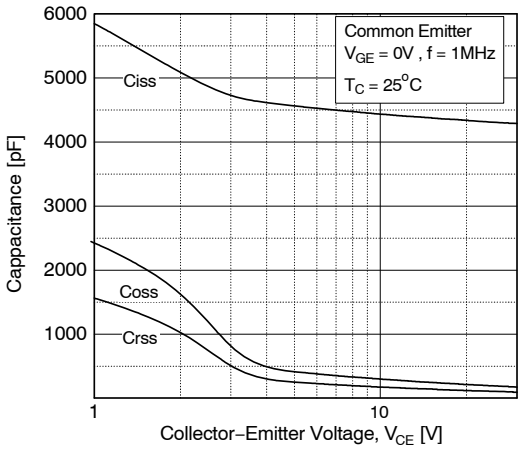


Figure 7. Capacitance Characteristics

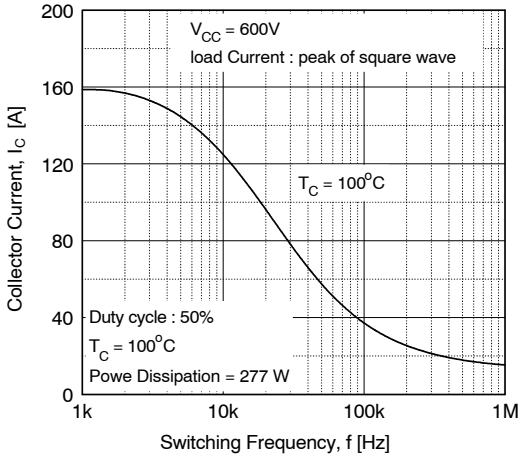


Figure 8. Load Current vs. Frequency

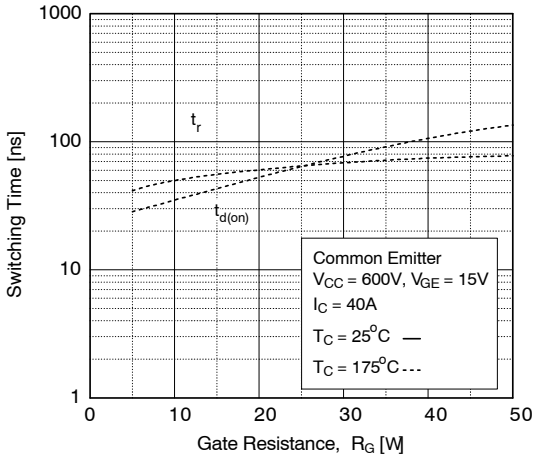


Figure 9. Turn−On Characteristics vs. Gate Resistance

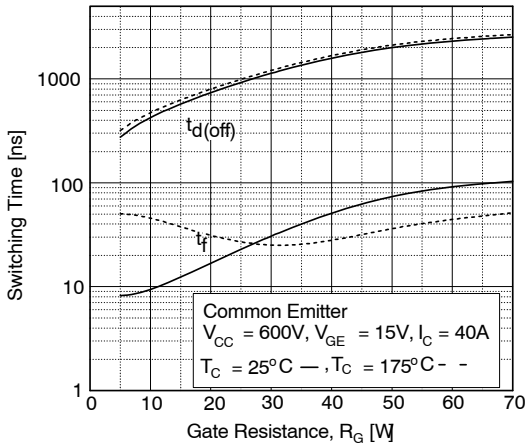


Figure 10. Turn−Off Characteristics vs. Collector Current

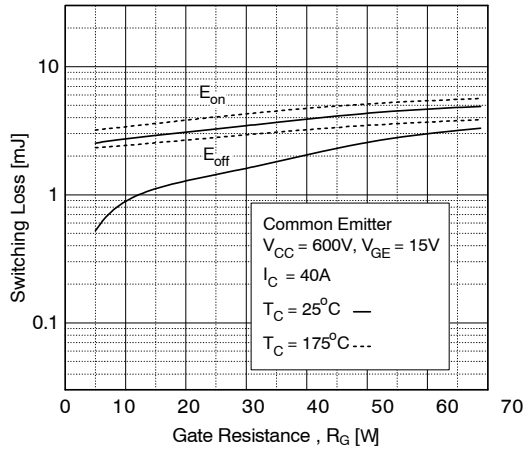


Figure 11. Switching Loss vs. Gate Resistance

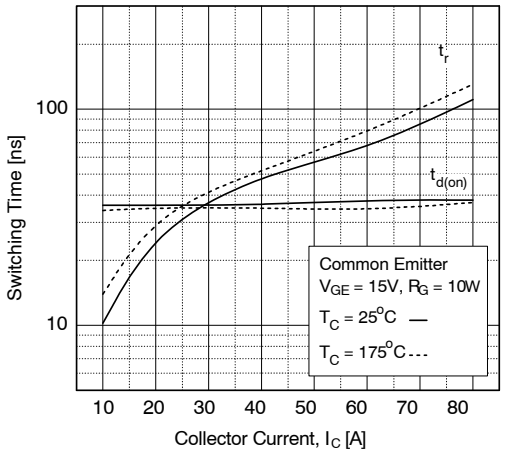


Figure 12. Turn−On Characteristics vs. Collector Current

TYPICAL PERFORMANCE CHARACTERISTICS

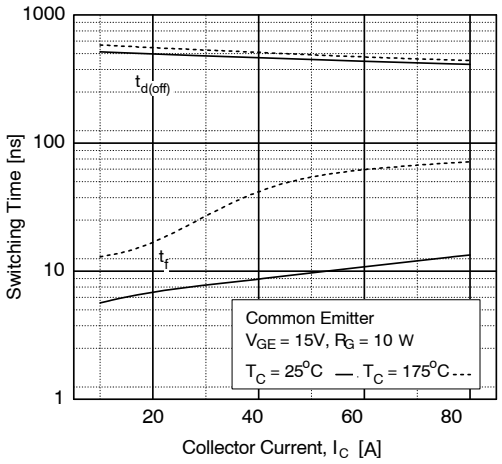


Figure 13. Turn−Off Characteristics vs. Collector Current

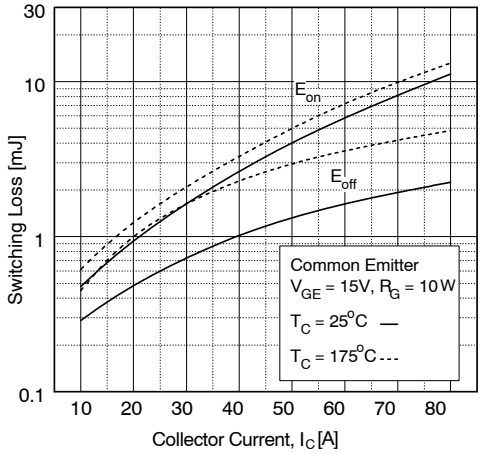


Figure 14. Switching Loss vs. Collector Current

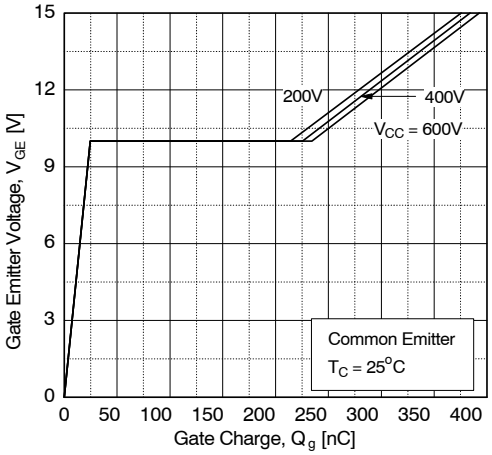


Figure 15. Gate Charge Characteristics

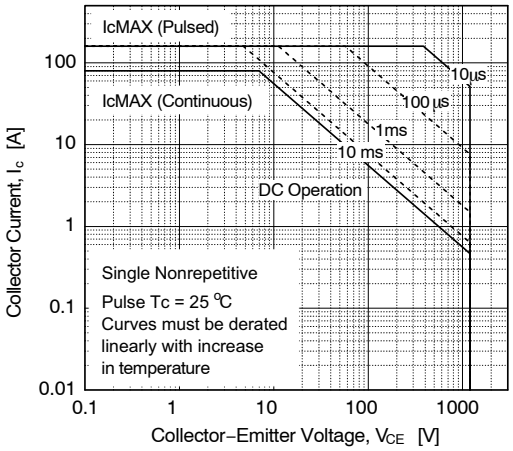


Figure 16. SOA Characteristics

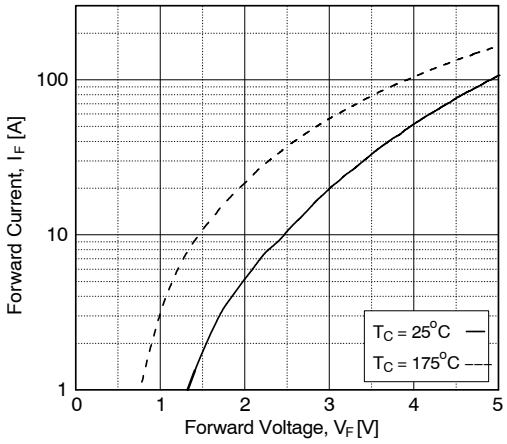


Figure 17. Forward Characteristics

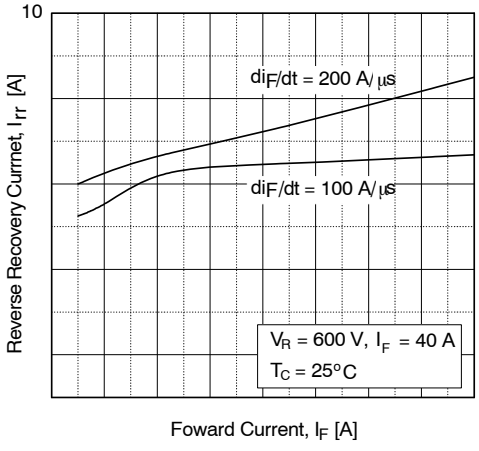


Figure 18. Reverse Recovery Current

TYPICAL PERFORMANCE CHARACTERISTICS

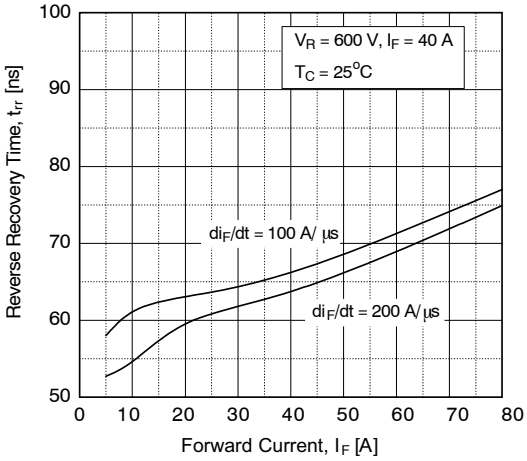


Figure 19. Reverse Recovery Time

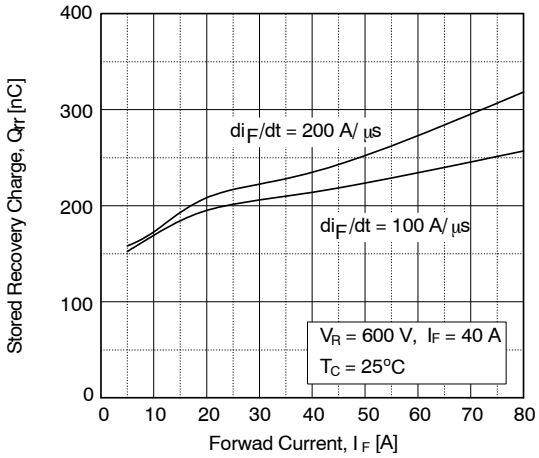


Figure 20. Stored Charge

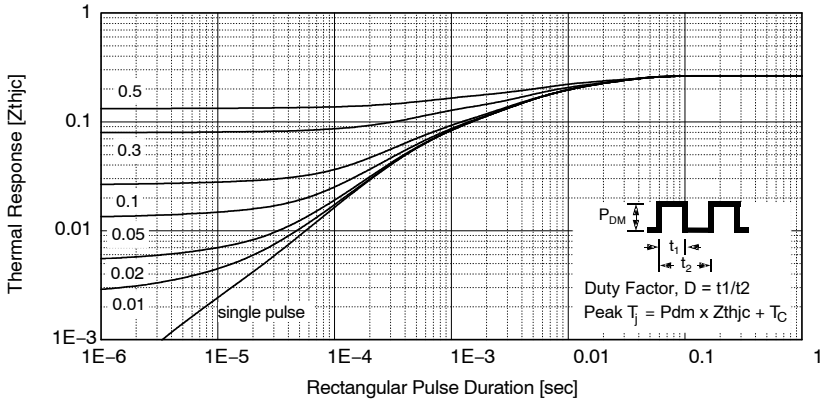


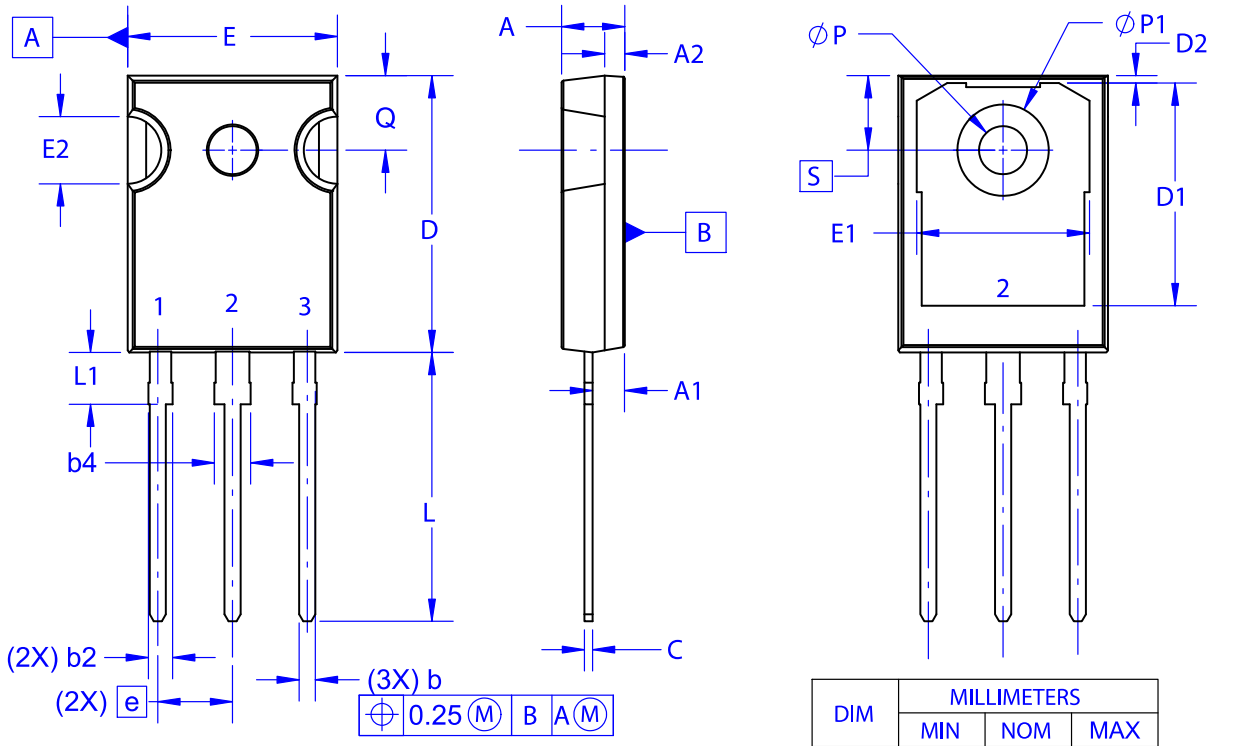
Figure 21. Transient Thermal Impedance of IGBT

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TO−247−3LD
CASE 340CH
ISSUE A

DATE 09 OCT 2019

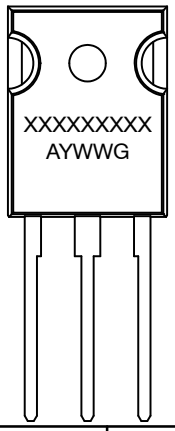


NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.29	2.475	2.66
A2	1.40	1.50	1.60
D	20.32	20.57	20.82
E	15.37	15.62	15.87
E2	4.96	5.08	5.20
e	~	5.56	~
L	19.75	20.00	20.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
Q	5.34	5.46	5.58
S	5.34	5.46	5.58
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D1	13.08	~	~
D2	0.51	0.93	1.35
E1	12.81	~	~
ØP1	6.61	6.73	6.85

GENERIC
MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
G = Pb−Free Package

*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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DESCRIPTION:	**TO−247−3LD**	**PAGE 1 OF 1**

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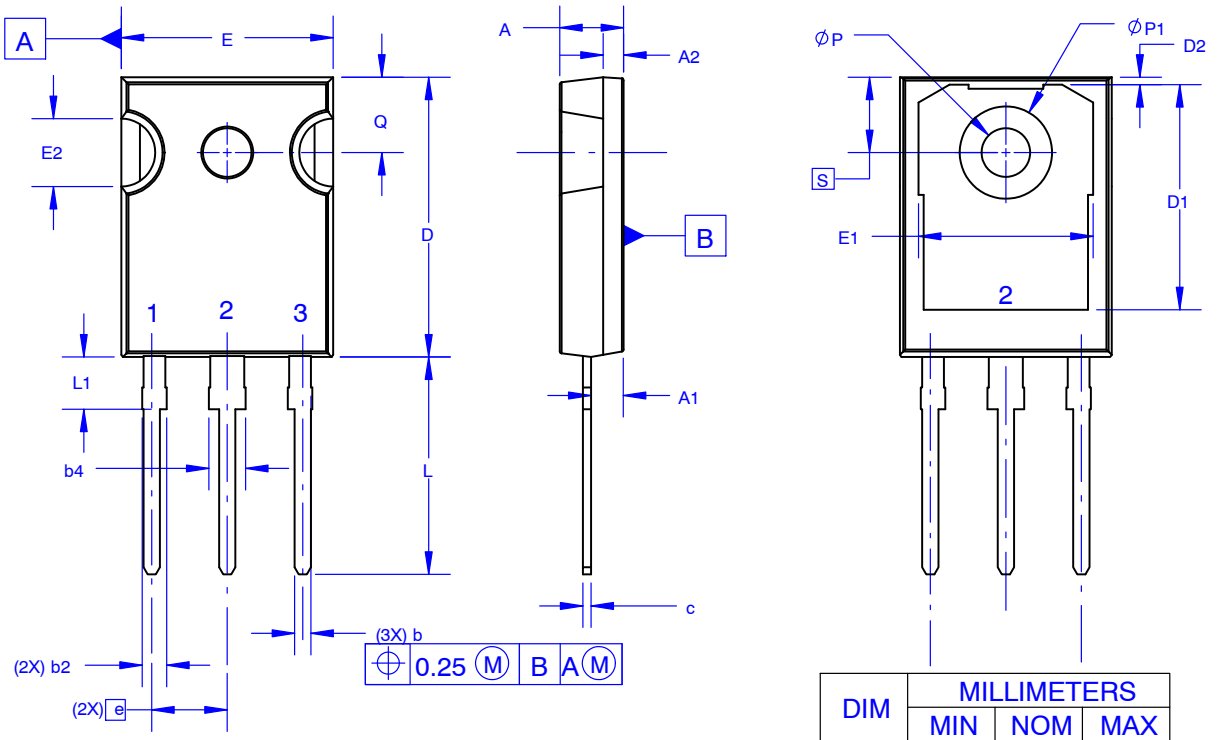
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

ON Semiconductor®

TO−247−3LD SHORT LEAD
CASE 340CK
ISSUE A

DATE 31 JAN 2019

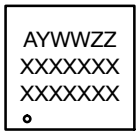


DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.58	4.70	4.82
A1	2.20	2.40	2.60
A2	1.40	1.50	1.60
b	1.17	1.26	1.35
b2	1.53	1.65	1.77
b4	2.42	2.54	2.66
c	0.51	0.61	0.71
D	20.32	20.57	20.82
D1	13.08	~	~
D2	0.51	0.93	1.35
E	15.37	15.62	15.87
E1	12.81	~	~
E2	4.96	5.08	5.20
e	~	5.56	~
L	15.75	16.00	16.25
L1	3.69	3.81	3.93
ØP	3.51	3.58	3.65
ØP1	6.60	6.80	7.00
Q	5.34	5.46	5.58
S	5.34	5.46	5.58

NOTES: UNLESS OTHERWISE SPECIFIED.

A. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DRAWING CONFORMS TO ASME Y14.5 - 2009.
D. DIMENSION A1 TO BE MEASURED IN THE REGION DEFINED BY L1.
E. LEAD FINISH IS UNCONTROLLED IN THE REGION DEFINED BY L1.

GENERIC
MARKING DIAGRAM*



XXXX = Specific Device Code
A = Assembly Location
Y = Year
WW = Work Week
ZZ = 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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