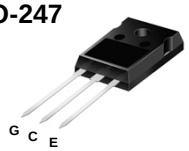
March 2015

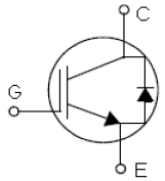
SemiHow
Know-How for Semiconductor

HGA40N120FV
1200V Field Stop Trench IGBT

V_{CES} = 1200 V
I_C = 40 A
$V_{CE(sat)\ typ}$ = 2.0 V

TO-247





FEATURES

- 1200V Field Stop Trench Technology
- Low Saturation Voltage
- High Switching Frequency
- Very Soft, Fast Recovery Anti-parallel diode

APPLICATION

- Welding Converters
- Uninterruptible Power Supply
- General Purpose Inverters

Absolute Maximum Ratings

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage	1200	V
I_C	Collector Current – Continuous (T_C = 25℃)	64	A
	Collector Current – Continuous (T_C = 100℃)	40	A
I_{CM}	Collector Current – Pulsed (Note 1)	160	A
I_F	Diode Forward Current – Continuous (T_C = 100℃)	20	A
I_{FM}	Diode Maximum Forward Current	60	A
V_{GES}	Gate-Emitter Voltage	±20	V
P_D	Power Dissipation – Continuous (T_C = 25℃)	400	W
	Power Dissipation – Continuous (T_C = 100℃)	160	W
T_J, T_{STG}	Operating and Storage Temperature Range	-55 to +150	℃
T_L	Maximum lead temperature for soldering purposes, 1/8" from case for 5 seconds	300	℃

Notes:
1. Pulse width limited by max junction temperature

Thermal Resistance Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$(IGBT)	Junction-to-Case	--	0.31	℃/W
$R_{\theta JC}$(Diode)	Junction-to-Case	--	1.11	
$R_{\theta JA}$	Junction-to-Ambient	--	40	

Electrical Characteristics of the IGBT T_C=25 °C unless otherwise specified

Symbol	Parameter	Test Conditions		Min	Typ	Max	Units
On Characteristics							
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	V_{CE} = V_{GE}, I_C = 1.5 mA		4.0	--	7.0	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	V_{GE} = 15 V, I_C = 40 A	T_C = 25℃	--	2.0	2.6	V
			T_C = 125℃	--	2.5	--	
Off Characteristics							
BV_{CES}	Collector-Emitter Breakdown Voltage	V_{GE} = 0 V, I_C = 250 uA		1200	--	--	V
I_{CES}	Zero Gate Voltage Collector Current	V_{CE} = 1200 V, V_{GE} = 0 V		--	--	1	mA
I_{GES}	Gate-Emitter Leakage Current	V_{GE} = ±20 V, V_{CE} = 0 V		--	--	±250	nA
Dynamic Characteristics							
C_{ies}	Input Capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1.0 MHz		--	9150	--	pF
C_{oes}	Output Capacitance			--	295	--	pF
C_{res}	Reverse Transfer Capacitance			--	76	--	pF
Switching Characteristics							
$t_{d(on)}$	Turn-On Time	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15V Inductive load, T_C = 25℃		--	50	--	ns
t_r	Turn-On Rise Time			--	65	--	ns
$t_{d(off)}$	Turn-Off Delay Time			--	295	--	ns
t_f	Turn-Off Fall Time			--	85	--	ns
E_{on}	Turn-On Switching Loss			--	2.3	--	mJ
E_{off}	Turn-Off Switching Loss			--	2.2	--	mJ
E_{ts}	Total Switching Loss			--	4.5		mJ
$t_{d(on)}$	Turn-On Time	V_{CC} = 600 V, I_C = 40 A, R_G = 10 Ω, V_{GE} = 15V Inductive load, T_C = 125℃		--	90	--	ns
t_r	Turn-On Rise Time			--	70	--	ns
$t_{d(off)}$	Turn-Off Delay Time			--	415	--	ns
t_f	Turn-Off Fall Time			--	165	--	ns
E_{on}	Turn-On Switching Loss			--	2.65	--	mJ
E_{off}	Turn-Off Switching Loss			--	3.2	--	mJ
E_{ts}	Total Switching Loss			--	5.85	--	mJ
Q_g	Total Gate Charge	V_{CC} = 600V, I_C = 40 A, V_{GE} = 15 V		--	225	--	nC
Q_{ge}	Gate-Emitter Charge			--	55	--	nC
Q_{gc}	Gate-Collector Charge			--	90	--	nC

Electrical Characteristics of the Diode

V_{FM}	Diode Forward Voltage	I_F = 40 A	T_C = 25℃	--	2.2	--	V
			T_C = 125℃	--	2.0	--	
t_{rr}	Diode Reverse Recovery Time	I_F = 40 A, di/dt = 200 A/μs	T_C = 25℃	--	200	300	ns
			T_C = 125℃	--	325	--	
I_{rr}	Diode Peak Reverse Recovery Current		T_C = 25℃	--	23	35	A
			T_C = 125℃	--	43	--	
Q_{rr}	Diode Reverse Recovery Charge		T_C = 25℃	--	2500	--	nC
			T_C = 125℃	--	7000	--	

IGBT Characteristics

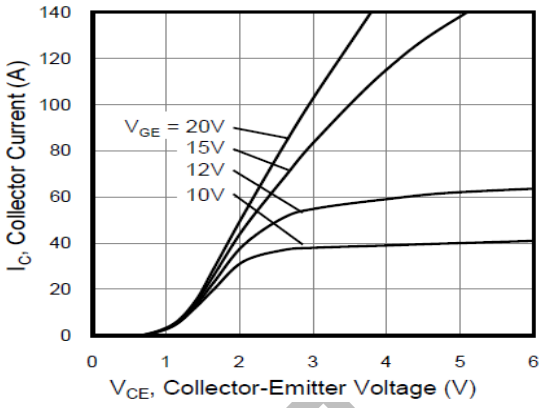


Figure 1. Typical Output Characteristics

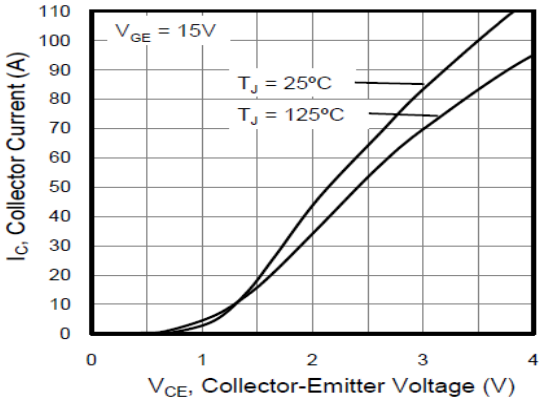


Figure 2. Typical Saturation Voltage Characteristics

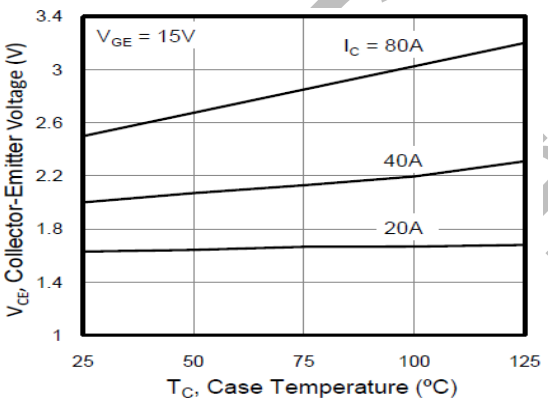


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

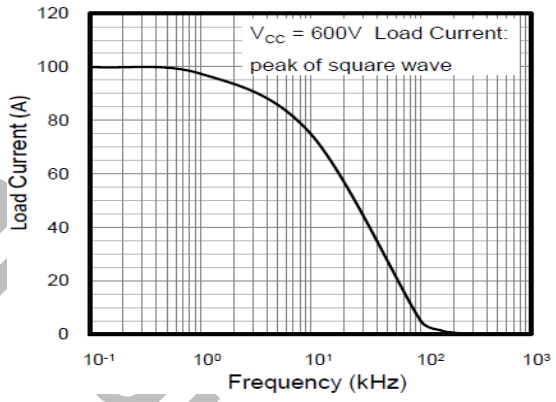


Figure 4. Load Current vs. Frequency

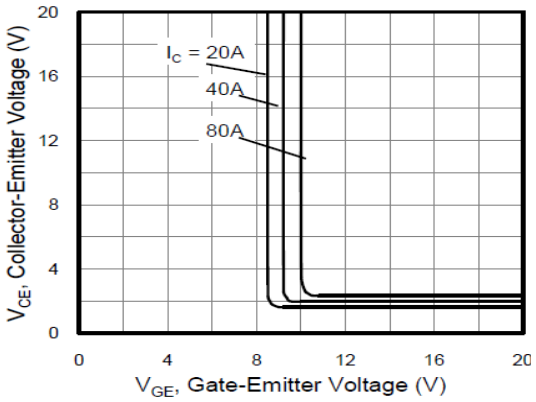


Figure 5. Saturation Voltage vs. V_{GE}

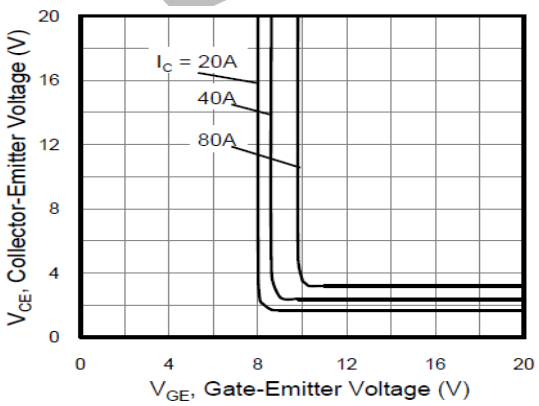


Figure 6. Saturation Voltage vs. V_{GE}

IGBT Characteristics

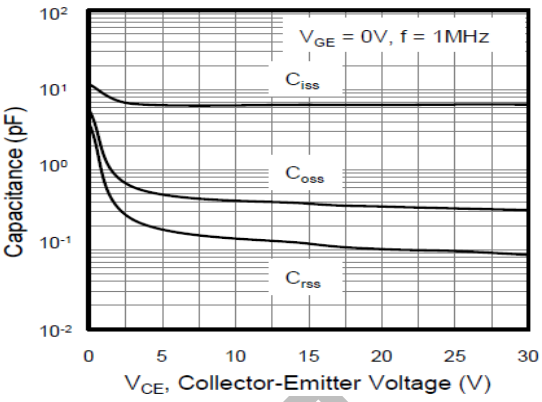


Figure 7. Capacitance Characteristics

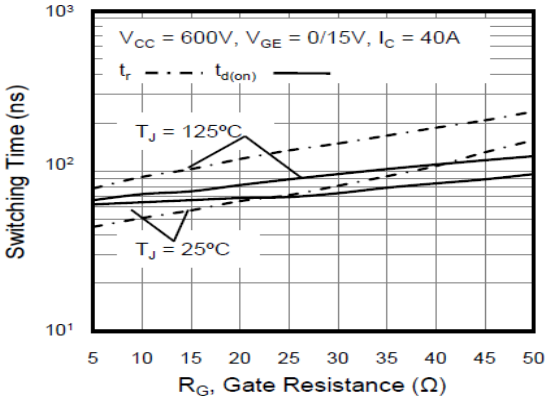


Figure 8. Turn-On Characteristics vs. Gate Resistance

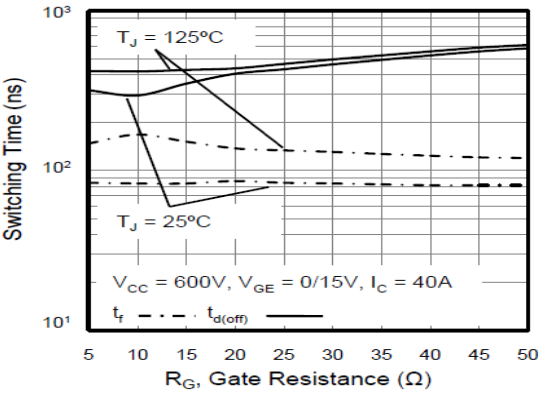


Figure 9. Turn-Off Characteristics vs. Gate Resistance

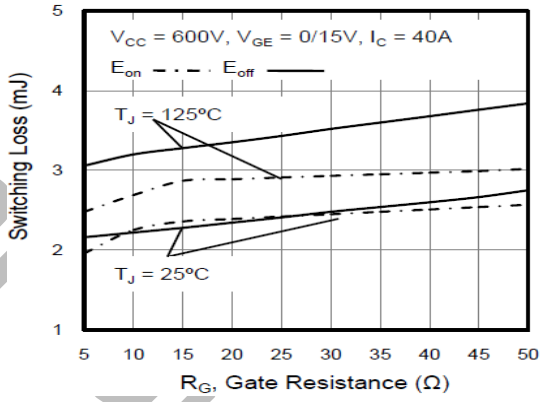


Figure 10. Switching Loss vs. Gate Resistance

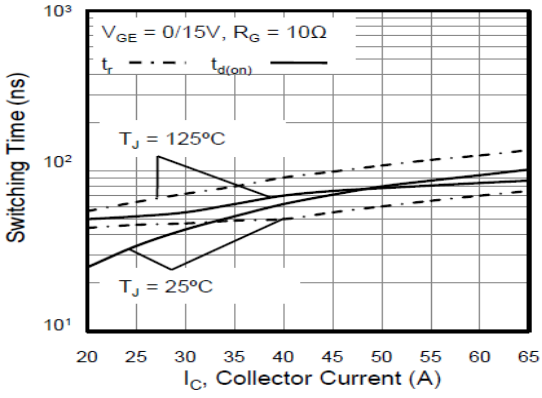


Figure 11. Turn-On Characteristics vs. Collector Current

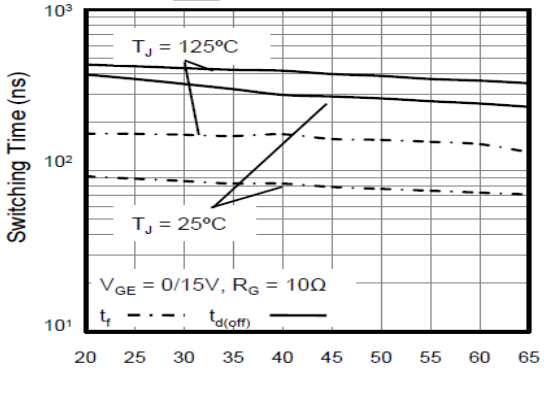


Figure 12. Turn-Off Characteristics vs. Collector Current

IGBT Characteristics

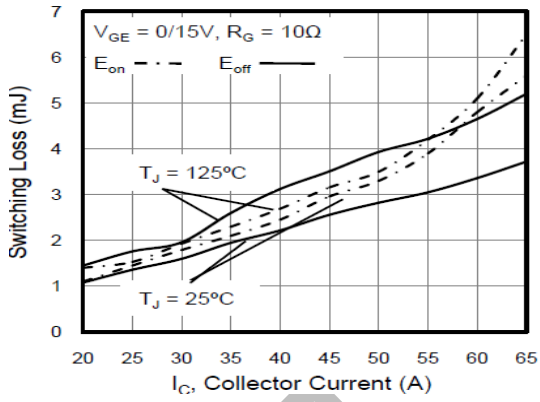


Figure 13. Switching Loss vs. Collector Current

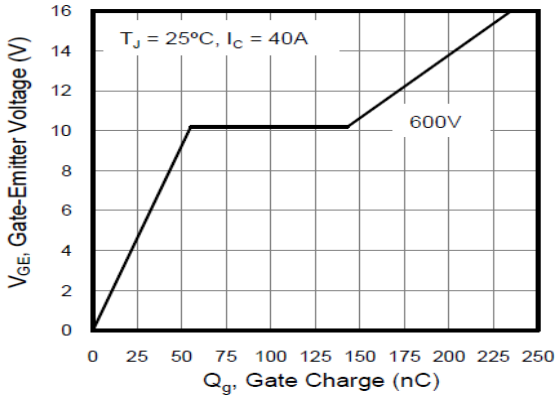


Figure 14. Gate Charge Characteristics

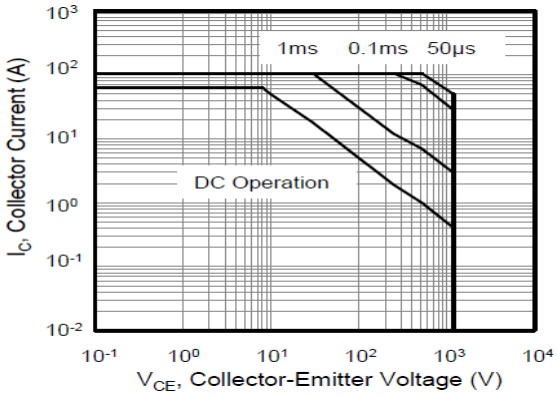


Figure 15. SOA Characteristics

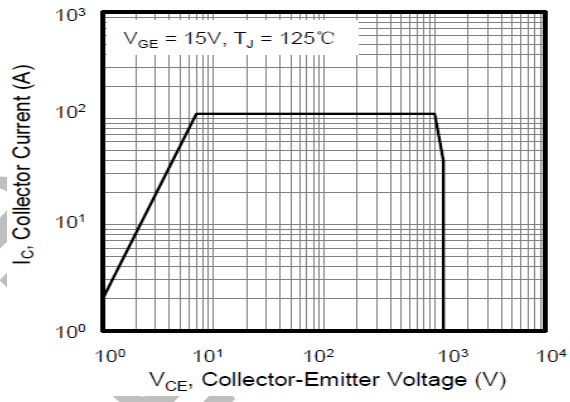


Figure 16. Turn-Off SOA

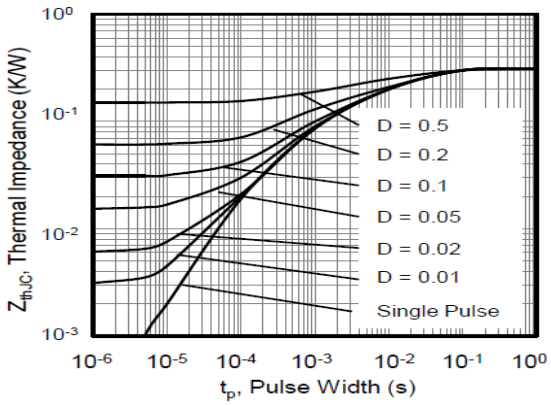


Figure 17. Transient Thermal Impedance of IGBT

Diode Characteristics

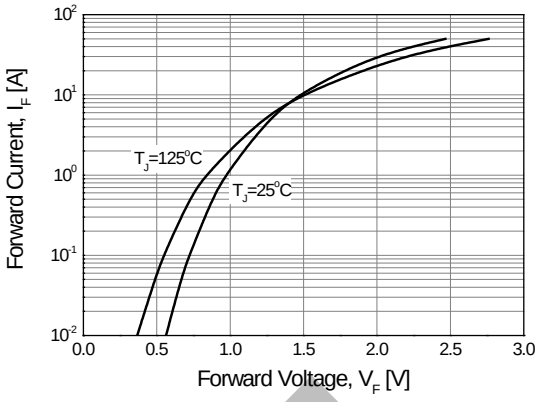


Figure 18. Forward Characteristics

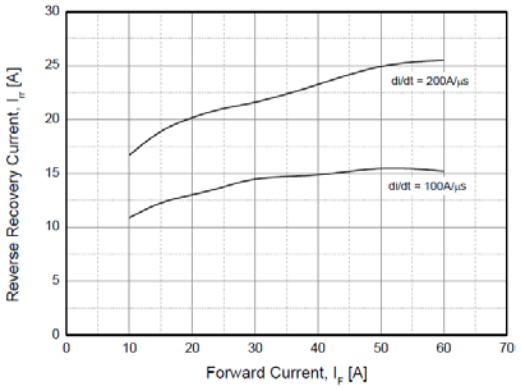


Figure 19. Reverse Recovery Current

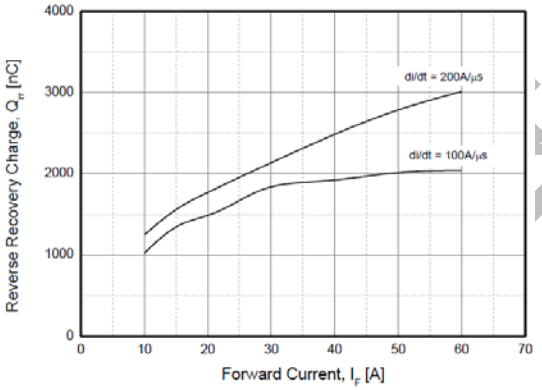


Figure 20. Stored Charge

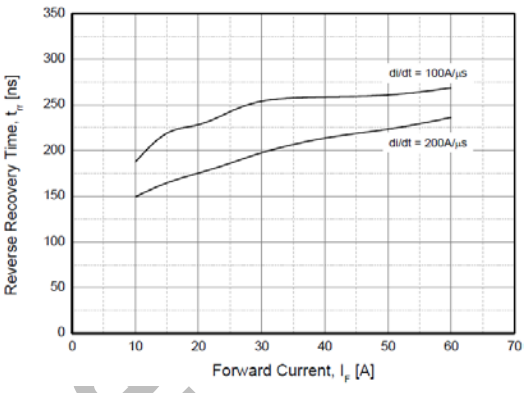


Figure 21. Reverse Recovery Time

Package Dimension

TO-247