

650V 50A CoolFAST™ 7 Technology IGBT

Part No.: HMG50N65FT

Package: TO-247-3L

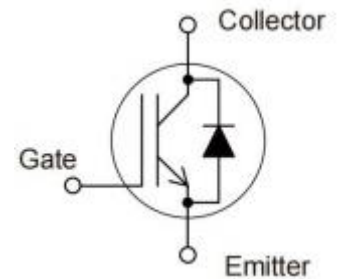
Features:

- Low Switching Power Loss
- Low Switching Surge and Noise
- Advanced Field Stop Technology
- Low EMI
- Maximum Junction Temperature 175°C
- Qualified According to JEDEC For Target Applications
- Pb-free Lead Plating, Halogen-free Mold Compound, RoHS Compliant



Applications:

- Industrial UPS
- Welding Machine
- Solar Converters
- Energy Storage
- EV Charger



Key Performance and Package Parameters

Type	Vce	Ic	VCEsat, Tvj=25°C	Tvjmax	Marking	Package
HMG50N65FT	650V	50A	1.55V	175°C	HMG50N65FT	TO-247-3L

Maximum Ratings and Characteristics

Absolute Maximum Ratings at Tvj= 25°C (unless otherwise specified)

Items	Symbols	Value	Units
Collector-emitter voltage	V _{CEs}	650	V
Gate-emitter voltage	V _{GES}	±20	V
Transient gate-emitter voltage (t _p ≤ 10μs, D < 0.010)		±30	V
DC collector current, limited by T _{vjmax} T _C = 25°C T _C = 100°C	I _C	90 50	A
Pulsed collector current, t _p limited by T _{vjmax}	I _{CP}	200	A
Diode forward current, limited by T _{vjmax} T _C = 25°C T _C = 100°C	I _F	110 50	A
Diode Pulsed collector current, t _p limited by T _{vjmax}	I _{FP}	200	A
Short circuit withstand time, V _{GE} = 15V, V _{CE} ≤ 400V	T _{SC}	5	μs
IGBT max. power dissipation	P _{D_IGBT}	365	W
FWD max. power dissipation	P _{D_FWD}	300	W
Operating junction temperature	T _{vj}	-40 ~ +175	°C
Storage temperature	T _{stg}	-55 ~ +175	°C

Electrical Characteristics at $T_{vj} = 25^{\circ}\text{C}$ (unless otherwise specified)

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
Collector-emitter breakdown voltage	$V_{(BR)CES}$	$V_{GE} = 0\text{V}$, $I_C = 0.25\text{mA}$	650	-	-	V
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650\text{V}$, $V_{GE} = 0\text{V}$	-	-	200	μA
Gate-emitter leakage current	I_{GES}	$V_{CE} = 0\text{V}$, $V_{GE} = \pm 20\text{V}$	-	-	± 200	nA
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}$, $I_C = 250\mu\text{A}$	5.0	5.8	6.6	V
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{V}$, $I_C = 50\text{A}$	-	1.55	2.25	V
		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	2.0	-	
Input capacitance	C_{ies}	$V_{CE} = 25\text{V}$, $V_{GE} = 0\text{V}$ $f = 1\text{MHz}$	-	5805	-	pF
Output capacitance	C_{oes}		-	164	-	pF
Reverse transfer capacitance	C_{res}		-	57	-	pF
Gate charge	Q_G	$V_{CC} = 520\text{V}$, $I_C = 50\text{A}$, $V_{GE} = 15\text{V}$	-	223	-	nC
Forward voltage drop	V_F	$I_F = 50\text{A}$	-	1.55	3.0	V
		$T_{vj} = 25^{\circ}\text{C}$ $T_{vj} = 175^{\circ}\text{C}$	-	1.3	-	

Switching Characteristics at $T_{vj} = 25^{\circ}\text{C}$

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400V$ $I_C = 50A$ $V_{GE} = 15V$ $R_G = 10\Omega$ Inductive load	-	42	-	ns
Rise time	t_r		-	77	-	ns
Turn-off delay time	$t_{d(off)}$		-	153	-	ns
Fall time	t_f		-	31	-	ns
Turn-on energy	E_{on}		-	1.9	-	mJ
Turn-off energy	E_{off}		-	0.5	-	mJ
Total switching energy	E_{ts}		-	2.4	-	mJ
Diode Characteristics						
Diode reverse recovery time	t_{rr}	$V_{CC} = 400V$	-	106	-	ns
Diode reverse recovery charge	Q_{rr}	$I_F = 50A$	-	0.8	-	μC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt = 500A/\mu s$	-	11.2	-	A

Switching Characteristics at $T_{vj} = 175^{\circ}\text{C}$

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC} = 400V$ $I_C = 50A$ $V_{GE} = 15V$ $R_G = 10\Omega$ Inductive load	-	36	-	ns
Rise time	t_r		-	73	-	ns
Turn-off delay time	$t_{d(off)}$		-	176	-	ns
Fall time	t_f		-	41	-	ns
Turn-on energy	E_{on}		-	1.9	-	mJ
Turn-off energy	E_{off}		-	0.8	-	mJ
Total switching energy	E_{ts}		-	2.7	-	mJ
Diode Characteristics						
Diode reverse recovery time	t_{rr}	$V_{CC} = 400V$	-	199	-	ns
Diode reverse recovery charge	Q_{rr}	$I_F = 50A$	-	3.7	-	μC
Diode peak reverse recovery current	I_{rrm}	$di_F/dt = 500A/\mu s$	-	30	-	A

Thermal Resistance

Items	Symbols	Characteristics			Unit
		Min	Typ	Max	
Thermal resistance, junction-ambient	$R_{\theta JA}$	-	-	50	°C /W
Thermal resistance, IGBT junction to case	$R_{\theta JC}$	-	0.41	0.5	
Thermal resistance, diodes junction to case	$R_{\theta JC}$	-	0.5	0.65	

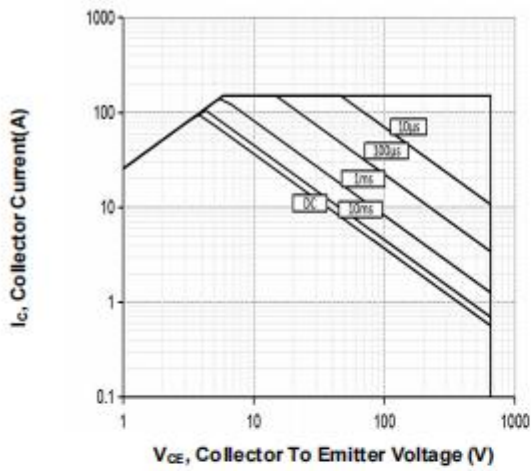


Figure 1. Forward bias safe operating area
($D=0$, $T_C=25^\circ\text{C}$, $T_J \leq 175^\circ\text{C}$; $V_{GE}=15\text{V}$)

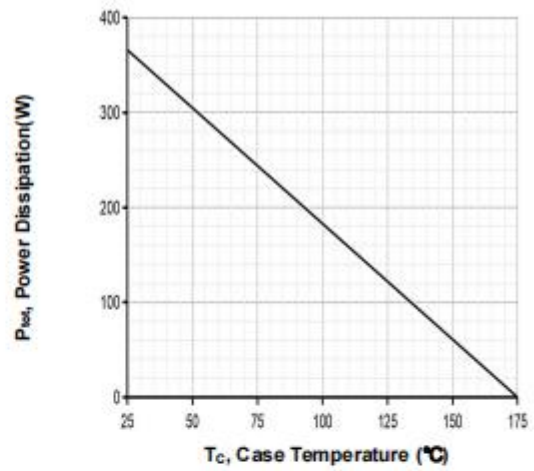


Figure 2. Power dissipation vs. case temperature
($T_J \leq 175^\circ\text{C}$)

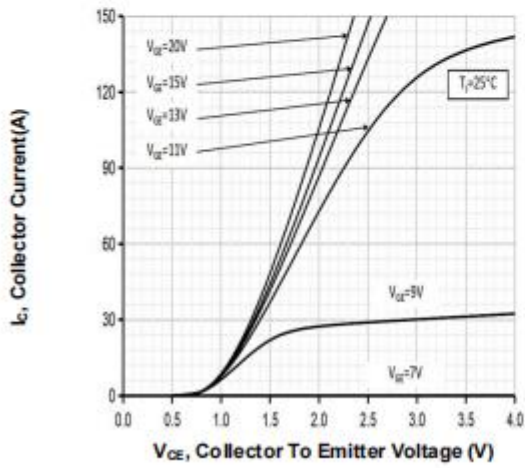


Figure 3. Typical output characteristic
($T_J=25^\circ\text{C}$)

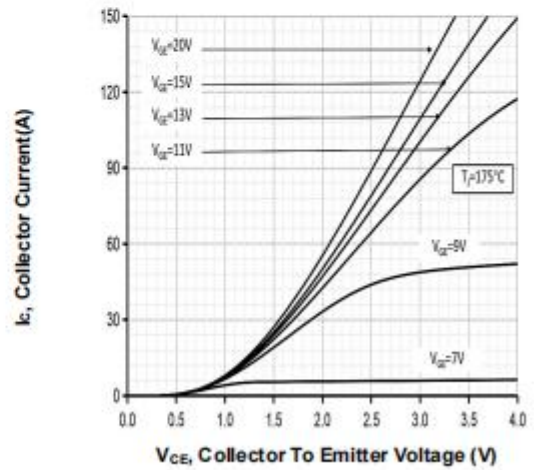


Figure 4. Typical output characteristic
($T_J=175^\circ\text{C}$)

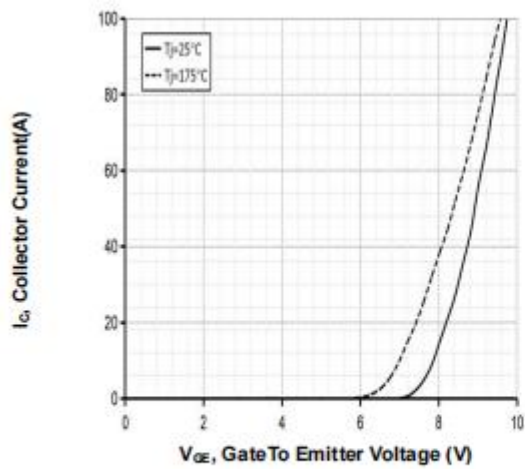


Figure 5. Typical transfer characteristic
($V_{CE}=20\text{V}$)

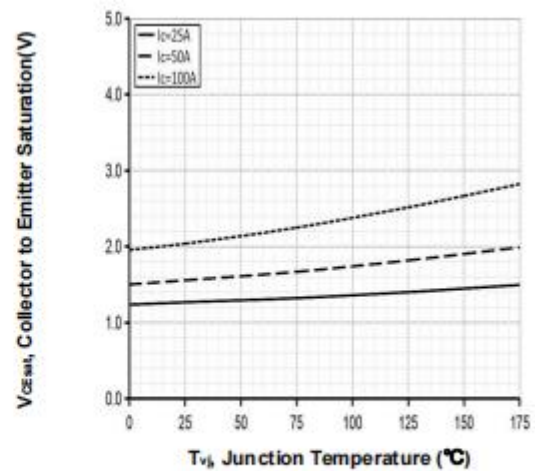


Figure 6. Typical collector-emitter saturation voltage vs. T_J ($V_{GE}=20\text{V}$)

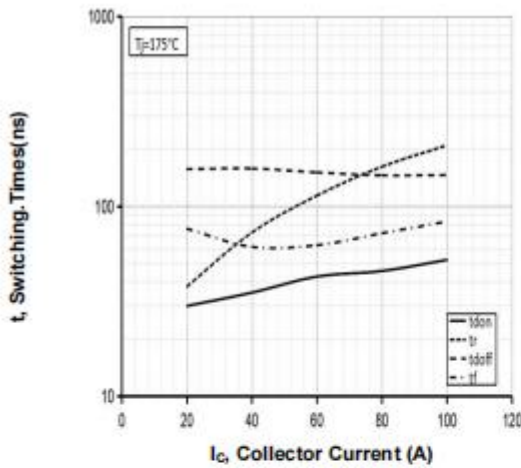


Figure 7. Typical switching times vs. collector current (Ind. load, $T_j = 175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $R_G = 10\Omega$)

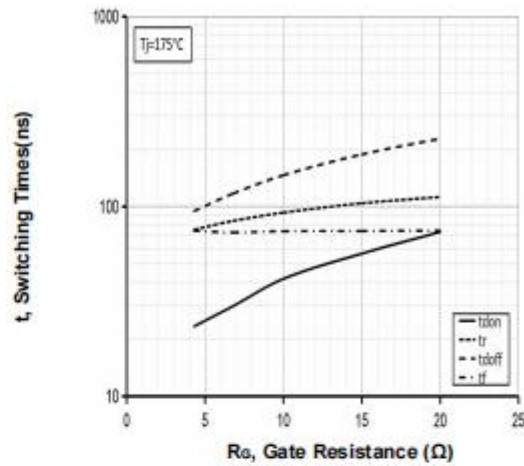


Figure 8. Typical switching times vs. gate resistor (Ind. Load, $T_j = 175^\circ\text{C}$, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $I_C = 50\text{A}$)

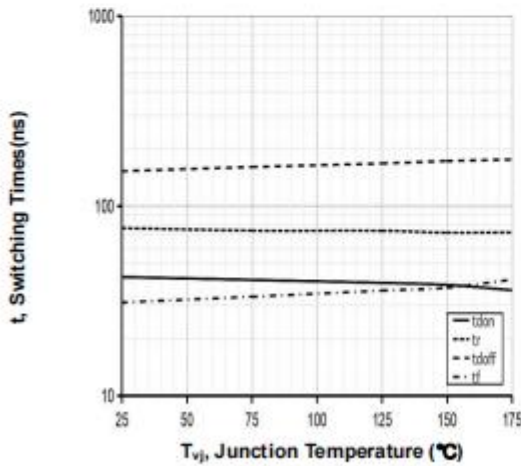


Figure 9. Typical switching times vs. T_j (Ind. Load, $V_{CE} = 400\text{V}$, $V_{GE} = 15/0\text{V}$, $I_C = 50\text{A}$, $R_G = 10\Omega$)

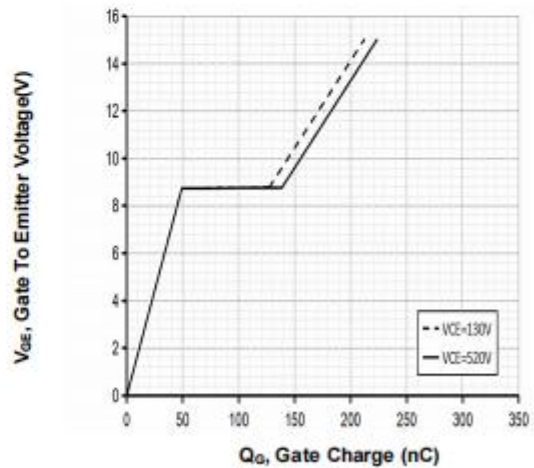


Figure 10. Typical gate charge ($I_C = 50\text{A}$)

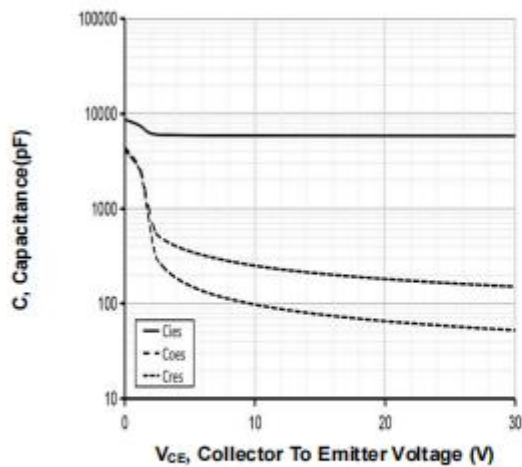


Figure 11. Typical capacitance vs. collector-emitter voltage ($V_{GE} = 0\text{V}$, $f = 1\text{MHz}$)

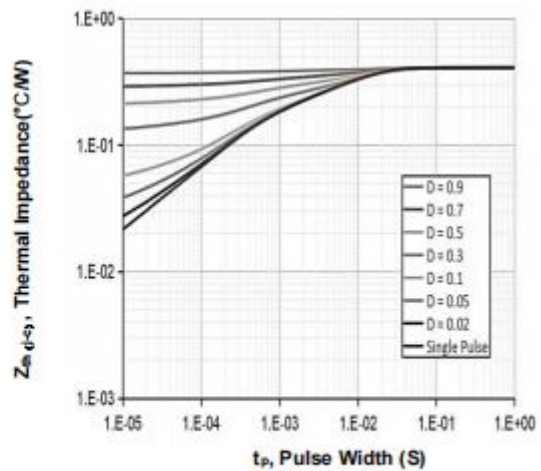


Figure 12. IGBT transient thermal impedance ($D = t_p/T$)

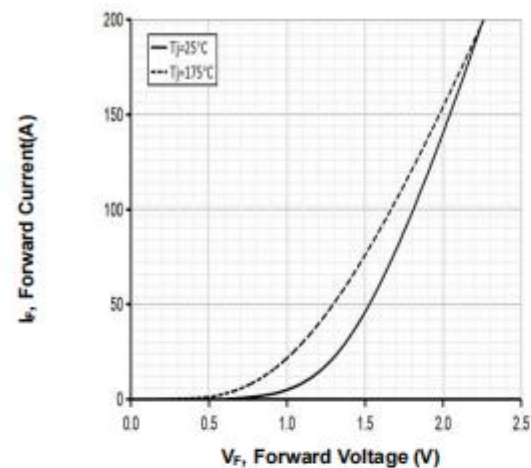


Figure 13. Typical diode forward current vs. forward voltage

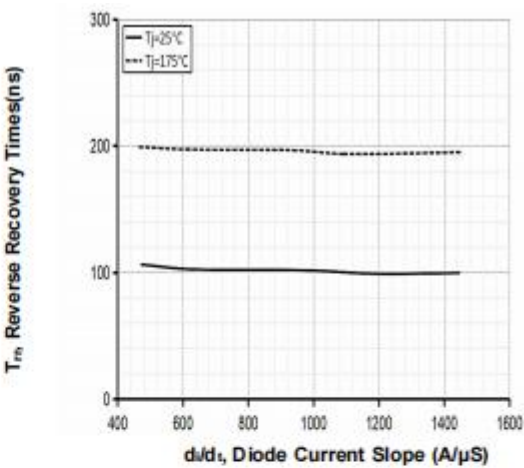


Figure 14. Typical reverse recovery time vs. diode current slope ($V_R = 400V$)

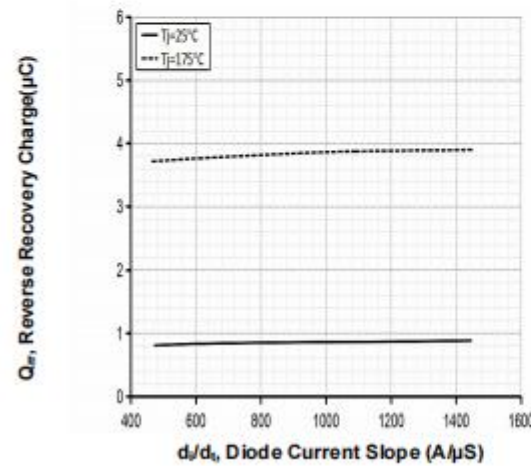


Figure 15. Typical reverse recovery charge vs. diode current slope ($V_R = 400V$)

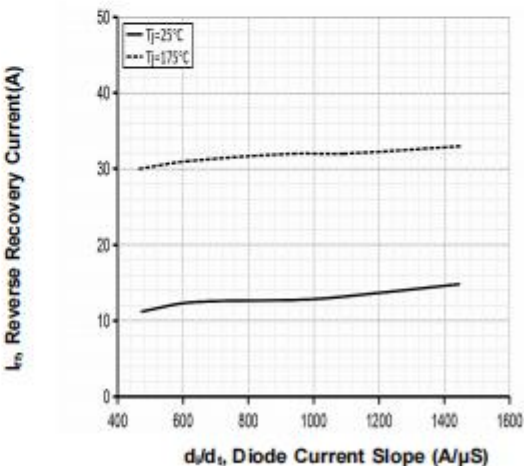
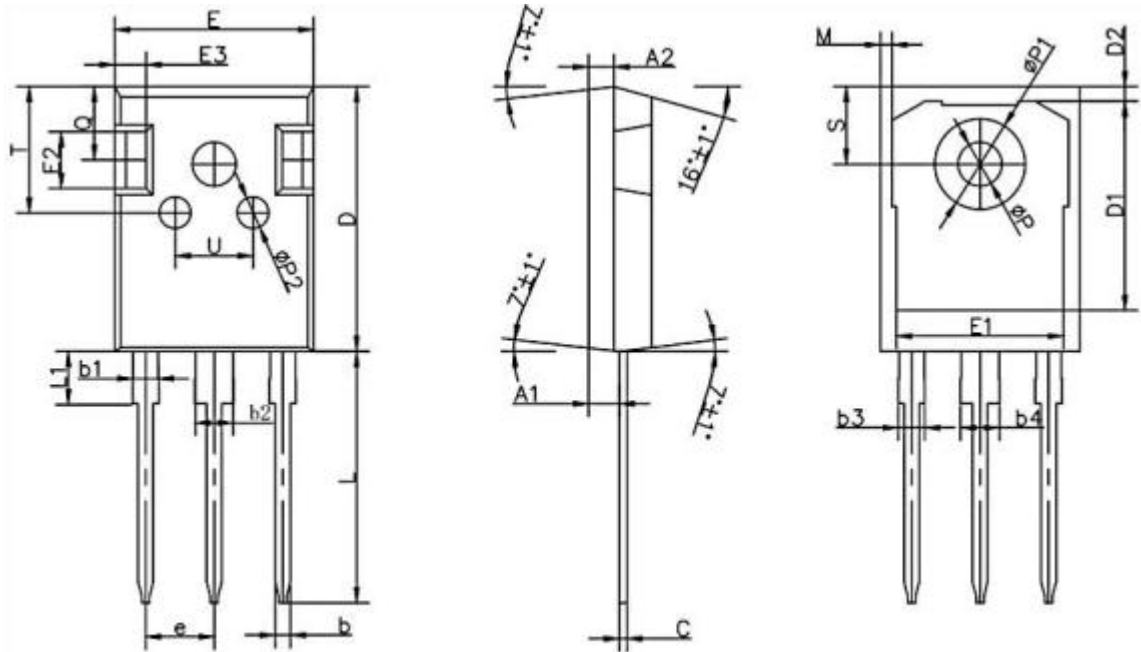


Figure 16. Typical reverse recovery current vs. diode current slope ($V_R = 400V$)

TO-247-3L Package Outline



TO247-3L			
DIM.	MIN.	NOM.	MAX.
A	4.90	5.00	5.10
A1	2.25	2.36	2.51
A2	1.90	2.00	2.10
b	1.16	1.20	1.26
b1	1.96	2.00	2.06
b2	2.96	3.00	3.06
b3	-	-	2.25
b4	-	-	3.25
c	0.59	0.60	0.66
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
E	15.70	15.80	15.90
E1	13.10	13.26	13.50
E2	4.40	4.50	4.60
E3	2.40	2.50	2.60
e	5.436BSC		
L	19.80	19.90	20.10
L1	-	-	4.30
M	0.35	0.89	0.95
P	3.40	3.50	3.60
P1	7.00	7.20	7.40
P2	2.40	2.50	2.60
Q	5.60	5.80	6.00
S	6.05	6.15	6.25
T	9.80	10.00	10.20
U	6.00	6.20	6.40
All dimensions in millimeters			