

# IGBT - NPT

1200 V, 40 A

## FGH40N120AN

### Description

Employing NPT technology, ON Semiconductor's AN series of IGBTs provides low conduction and switching losses. The AN series offers an solution for application such as induction heating (IH), motor control, general purpose inverters and uninterruptible power supplies (UPS).

### Features

- High Speed Switching
- Low Saturation Voltage:  $V_{CE(sat)} = 2.6 \text{ V @ } I_C = 40 \text{ A}$
- High Input Impedance
- This Device is Pb-Free and is RoHS Compliant

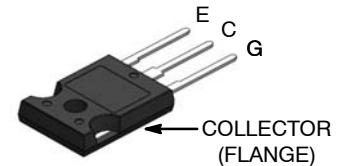
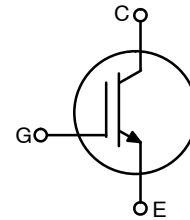
### Applications

- Induction Heating, UPC, AC & DC Motor Controls and General Purpose Inverters



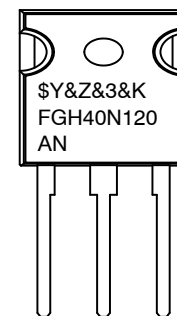
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TO-247-3LD  
CASE 340CK

### MARKING DIAGRAM



\$Y = ON Semiconductor Logo  
&Z = Assembly Plant Code  
&3 = Numeric Date Code  
&K = Lot Code  
FGH40N120AN = Specific Device Code

### ORDERING INFORMATION

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

# FGH40N120AN

## ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C unless otherwise noted)

Parameter	Symbol	FGH40N120AN	Unit	
Collector to Emitter Voltage	V <sub>CES</sub>	1200	V	
Gate to Emitter Voltage	V <sub>GES</sub>	±25	V	
Collector Current	I <sub>C</sub>	T <sub>C</sub> = 25°C	64	A
Collector Current		T <sub>C</sub> = 100°C	40	A
Pulsed Collector Current	I <sub>CM</sub> (Note 1)	160	A	
Maximum Power Dissipation	P <sub>D</sub>	T <sub>C</sub> = 25°C	417	W
Maximum Power Dissipation		T <sub>C</sub> = 100°C	167	W
Short Circuit Withstand Time, V <sub>CE</sub> = 600 V, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 125°C	SCWT	10	μs	
Operating Junction Temperature	T <sub>J</sub>	-55 to +150	°C	
Storage Temperature Range	T <sub>STG</sub>	-55 to +150	°C	
Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	T <sub>L</sub>	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. Pulse width limited by max. junction temperature.

## THERMAL CHARACTERISTICS

Parameter	Symbol	Typ	Max	Unit
Thermal Resistance, Junction to Case	R <sub>θJC</sub> (IGBT)	-	0.3	°C/W
Thermal Resistance, Junction to Ambient	R <sub>θJA</sub>	-	40	°C/W

## PACKAGE MARKING AND ORDERING INFORMATION

Device Marking	Device	Package	Reel Size	Tape Width	Quantity
FGH40N120AN	FGH40N120AN	TO-247	-	-	30

## ELECTRICAL CHARACTERISTICS OF THE IGBT (T<sub>C</sub> = 25°C unless otherwise noted)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
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### OFF CHARACTERISTICS

Collector to Emitter Breakdown Voltage	BV <sub>CES</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	1200	-	-	V
Temperature Coefficient of Breakdown Voltage	ΔBV <sub>CES</sub> /ΔT <sub>J</sub>	V <sub>GE</sub> = 0 V, I <sub>C</sub> = 1 mA	-	0.6	-	V/°C
Collector Cut-Off Current	I <sub>CES</sub>	V <sub>CE</sub> = V <sub>CES</sub> , V <sub>GE</sub> = 0 V	-	-	1	mA
G-E Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> = V <sub>GES</sub> , V <sub>CE</sub> = 0 V	-	-	±250	nA

### ON CHARACTERISTICS

G-E Threshold Voltage	V <sub>GE(th)</sub>	I <sub>C</sub> = 250 μA, V <sub>CE</sub> = V <sub>GE</sub>	3.5	5.5	7.5	V
Collector to Emitter Saturation Voltage	V <sub>CE(sat)</sub>	I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V	-	2.6	3.2	V
		I <sub>C</sub> = 40 A, V <sub>GE</sub> = 15 V, T <sub>C</sub> = 125°C	-	2.9	-	V
		I <sub>C</sub> = 64 A, V <sub>GE</sub> = 15 V	-	3.15	-	V

# FGH40N120AN

## ELECTRICAL CHARACTERISTICS OF THE IGBT ( $T_C = 25^\circ\text{C}$ unless otherwise noted) (continued)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	$C_{ies}$	$V_{CE} = 30\text{ V}, V_{GE} = 0\text{ V}, f = 1\text{ MHz}$	–	3200	–	pF
Output Capacitance	$C_{oes}$		–	370	–	pF
Reverse Transfer Capacitance	$C_{res}$		–	125	–	pF
<b>SWITCHING CHARACTERISTICS</b>						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 5\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 25^\circ\text{C}$	–	15	–	ns
Rise Time	$t_r$		–	20	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	110	–	ns
Fall Time	$t_f$		–	40	80	ns
Turn-On Switching Loss	$E_{on}$		–	2.3	3.45	mJ
Turn-Off Switching Loss	$E_{off}$		–	1.1	1.65	mJ
Total Switching Loss	$E_{ts}$		–	3.4	5.1	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 600\text{ V}, I_C = 40\text{ A},$ $R_G = 5\ \Omega, V_{GE} = 15\text{ V},$ Inductive Load, $T_C = 125^\circ\text{C}$	–	20	–	ns
Rise Time	$t_r$		–	25	–	ns
Turn-Off Delay Time	$t_{d(off)}$		–	120	–	ns
Fall Time	$t_f$		–	45	–	ns
Turn-On Switching Loss	$E_{on}$		–	2.5	–	mJ
Turn-Off Switching Loss	$E_{off}$		–	1.8	–	mJ
Total Switching Loss	$E_{ts}$		–	4.3	–	mJ
Total Gate Charge	$Q_g$	$V_{CE} = 600\text{ V}, I_C = 40\text{ A}, V_{GE} = 15\text{ V}$	–	220	–	nC
Gate to Emitter Charge	$Q_{ge}$		–	25	–	nC
Gate to Collector Charge	$Q_{gc}$		–	130	–	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.

TYPICAL PERFORMANCE CHARACTERISTICS

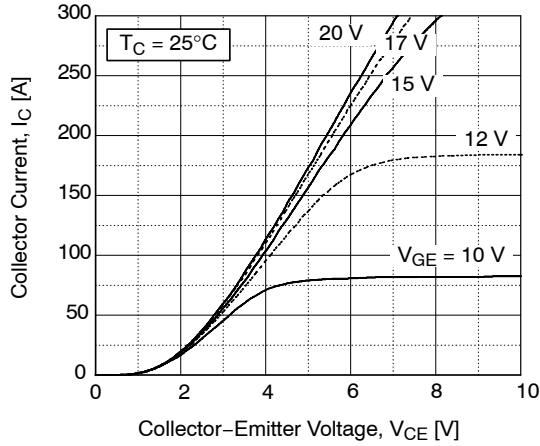


Figure 1. Typical Output Characteristics

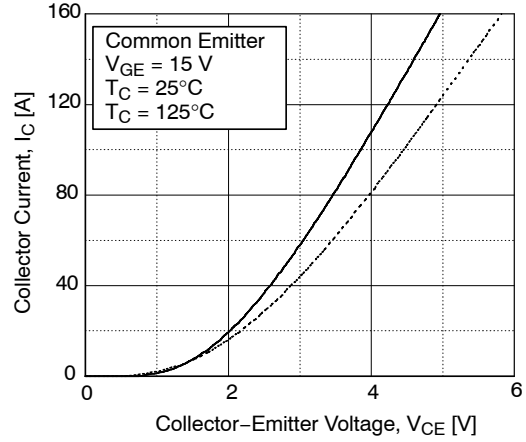


Figure 2. Typical Saturation Voltage Characteristics

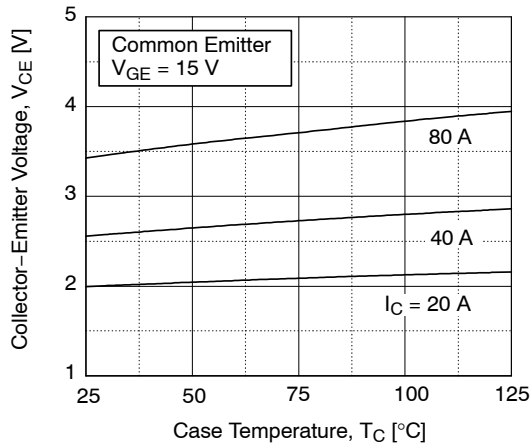


Figure 3. Saturation Voltage vs. Case Temperature at Variant Current Level

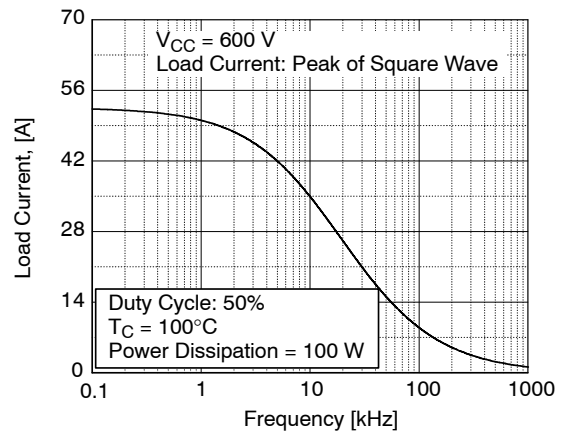


Figure 4. Load Current vs. Frequency

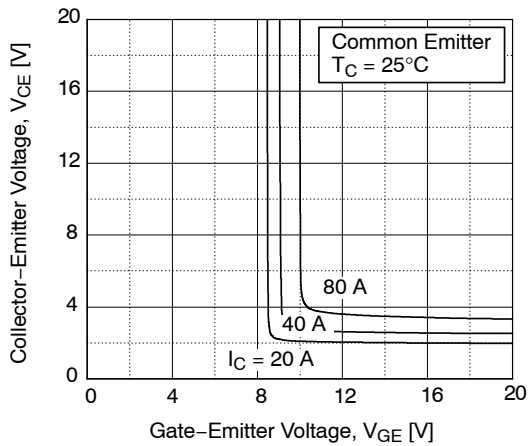


Figure 5. Saturation Voltage vs.  $V_{GE}$

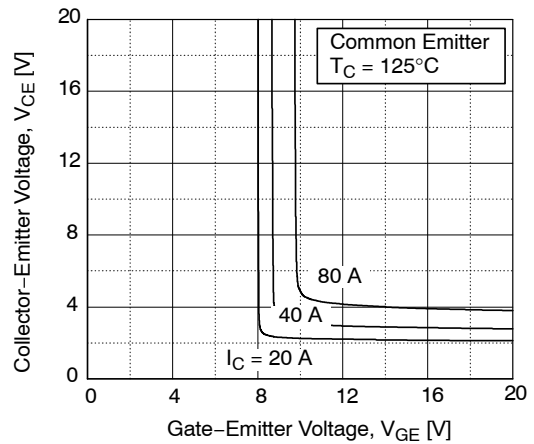


Figure 6. Saturation Voltage vs  $V_{GE}$

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

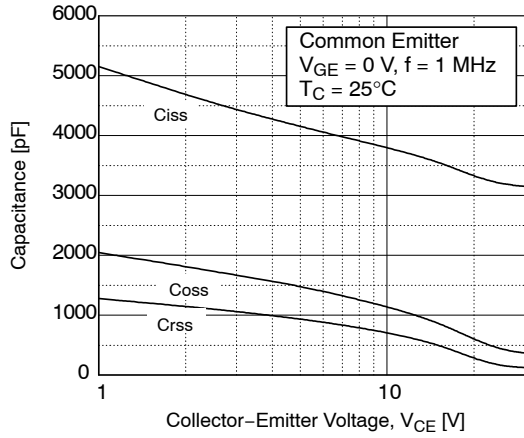


Figure 7. Capacitance Characteristics

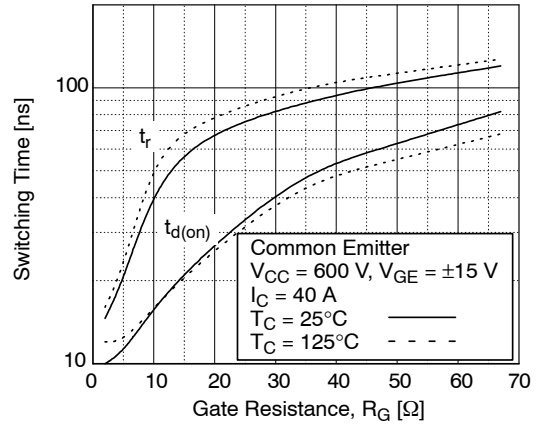


Figure 8. Turn-On Characteristic vs. Gate Resistance

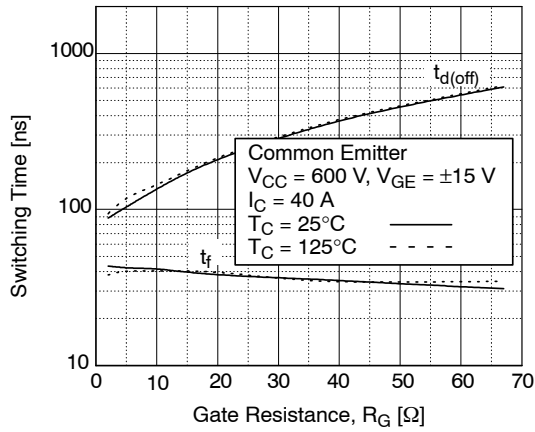


Figure 9. Turn-Off Characteristics vs. Gate Resistance

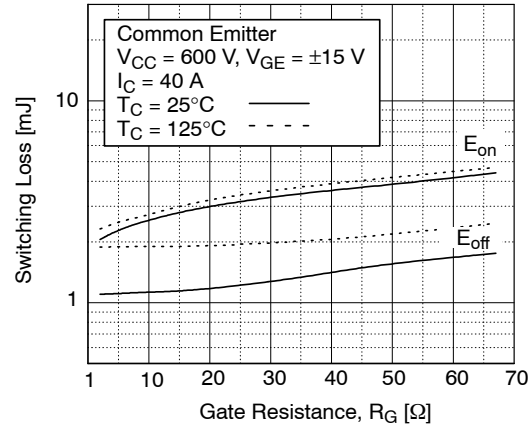


Figure 10. Switching Loss vs. Gate Resistance

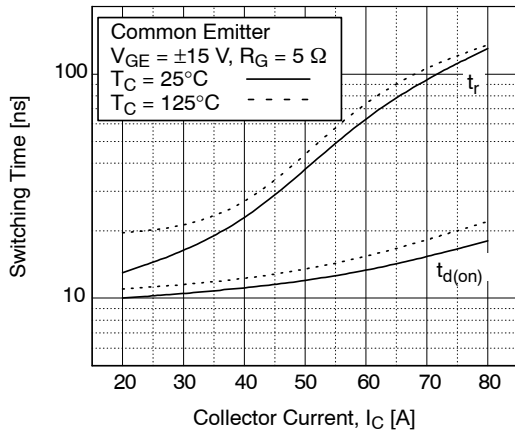


Figure 11. Turn-On Characteristics vs. Collector Current

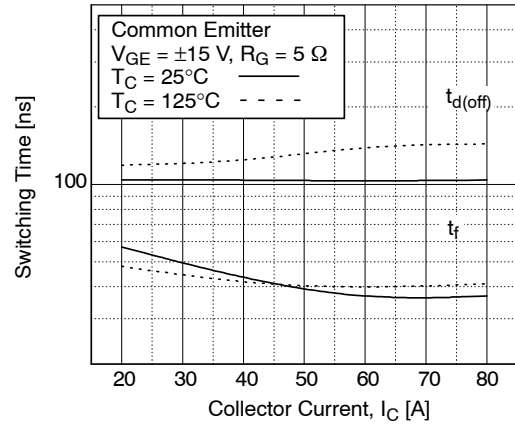
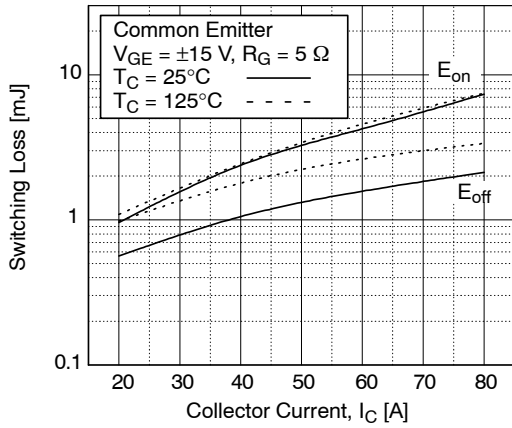


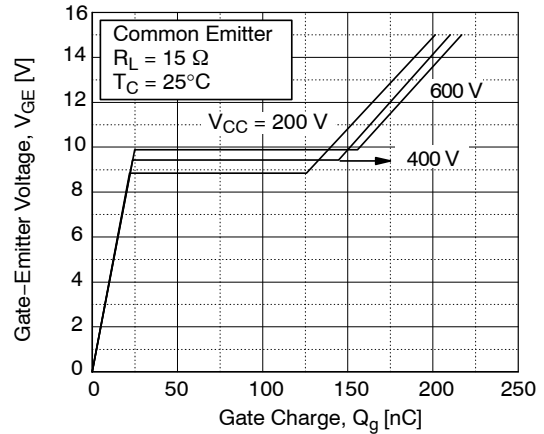
Figure 12. Turn-Off Characteristics vs. Collector Current

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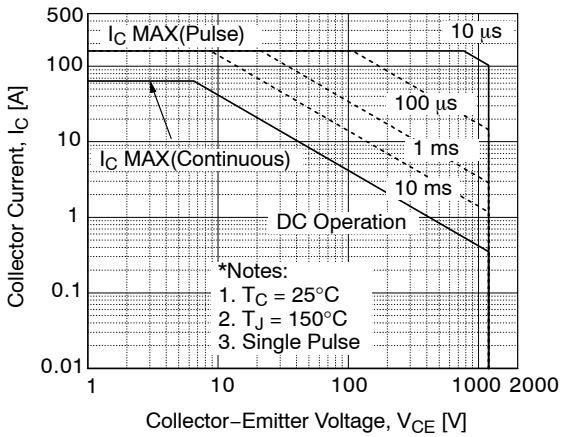
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)



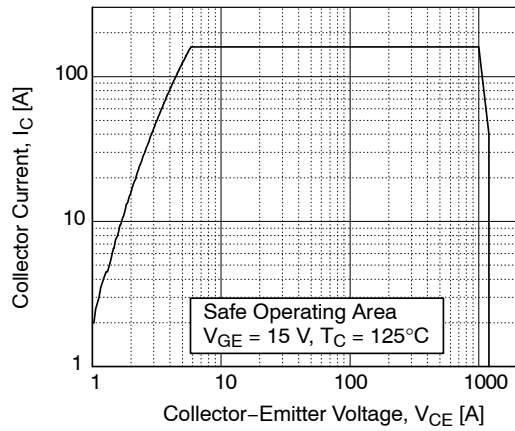
**Figure 13. Switching Loss vs. Collector Current**



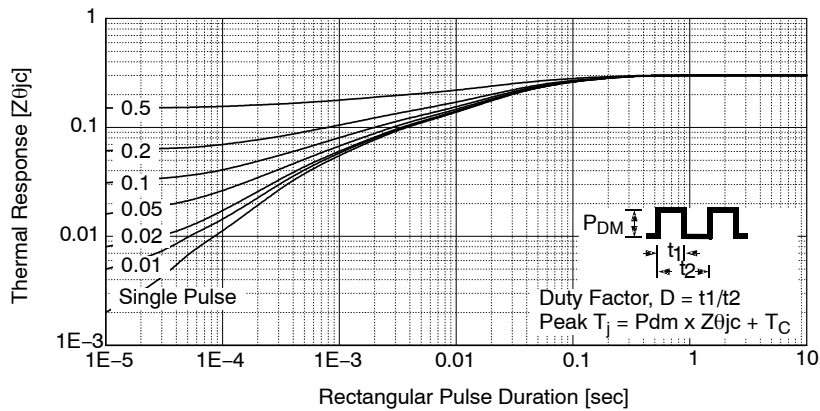
**Figure 14. Gate Charge Characteristics**



**Figure 15. SOA Characteristics**



**Figure 16. Turn-Off SOA**



**Figure 17. Transient Thermal Impedance of IGBT**



**TO-247-3LD SHORT LEAD**  
**CASE 340CK**  
**ISSUE A**

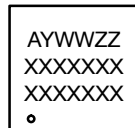
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NOTES: UNLESS OTHERWISE SPECIFIED.

- 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.

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

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