JHH40N120FA2

Product Preview

1200V/40A FIELD-STOP TRENCH IGBT WITH DIODE

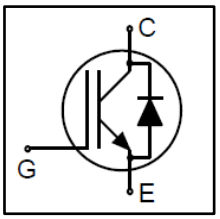
Features

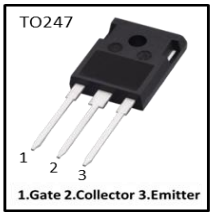
- Low $V_{CE(sat)}$
- Fast Switching
- High Ruggedness
- Short-Circuit Rated

Product Summary	
V_{CES}	1200V
I_C	40A (1)
$V_{CE(sat),typ}$	1.75V (T_J = 25°C)
Package	TO-247

Applications

- Inverters
- Frequency Converters
- Industrial Motor Drives
- Uninterrupted Power Supply





Ordering Information

Part Number	Marking	Package	Packaging
JHH40N120FA2	HH40N120FA2	TO-247	Tube

Absolute Maximum Ratings

Parameter	Symbol	Limit	Unit
Collector-to-Emitter Voltage	V_{CES}	1200	V
Gate-to-Emitter Voltage	V_{GES}	±20	
DC Collector Current (T_c = 25°C, T_J = 175°C)	I_C	65	A
DC Collector Current (T_c = 100°C, T_J = 175°C)		43	
Pulsed Collector Current (pulse width limited by maximum T_J)	I_{CM}	160	
Diode Forward Current (T_c = 25°C, T_J = 175°C)	I_F	65	
Diode Forward Current (T_c = 100°C, T_J = 175°C)		43	
Diode Pulsed Current (pulse width limited by maximum T_J)	I_{FM}	160	
Short Circuit Withstand Time (V_{GE} = 15V, V_{CC} ≤ 600V, T_{J_start} ≤ 175°C)	t_{SC}	10	µs
Turn-off Safe Operating Area (V_{CE} ≤ 1200V, T_J ≤ 175°C)	-	160	A
Maximum Power Dissipation (T_c = 25°C, T_J = 175°C)	$P_{D(max)}$	300	W
Operating Junction Temperature	T_J	-40 to +175	°C
Storage Temperature	T_{stg}	-55 to +150	
Maximum Lead Temperature for Soldering (1/8" from case for 5 seconds)	T_{sld}	260	

Static Electrical Characteristics (2)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Collector-to-Emitter Breakdown Voltage	BV_{CES}	V_{GE} = 0V, I_C = 250μA	1200	-	-	V
Collector-to-Emitter Leakage Current	I_{CES}	V_{CE} = 1200V, V_{GE} = 0V	-	-	10	μA
		V_{CE} = 1200V, V_{GE} = 0V, T_J =150°C	-	-	5	mA
		V_{CE} = 1200V, V_{GE} = 0V, T_J =175°C	-	-	20	mA
Gate-to-Emitter Leakage Current	I_{GES}	V_{CE} = 0V, V_{GE} = ±20V	-	-	100	nA
Gate Threshold Voltage	$V_{GE(th)}$	V_{CE} = V_{GE} , I_C = 1.5mA	5.5	6.5	7.5	V
Collector-to-Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE} = 15V, I_C = 40A	-	1.75	2.1	
		V_{GE} = 15V, I_C = 40A, T_J =150°C	-	2.3	-	
		V_{GE} = 15V, I_C = 40A, T_J =175°C	-	2.45	-	
Diode Forward Voltage	V_F	V_{GE} = 0V, I_F = 40A	-	2.15	2.6	
		V_{GE} = 0V, I_F = 40A T_J =150°C	-	2.35	-	
		V_{GE} = 0V, I_F = 40A T_J =175°C	-	2.25	-	

Thermal Characteristics

Parameter	Symbol	Min	Typ	Max	Unit
Junction-to-Ambient Thermal Resistance	$R_{\theta JA}$	-	-	40	°C/W
Junction-to-Case Thermal Resistance, IGBT	$R_{\theta JC}$	-	-	0.5	
Junction-to-Case Thermal Resistance, Diode		-	-	0.6	

Dynamic Electrical Characteristics (2)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Total Gate Charge	Q_g	V_{CC} = 600V, V_{GE} = 15V, I_C = 40A	-	148	-	nC
Input Capacitance	C_{iss}	V_{CE}= 25V, V_{GE} = 0V, f = 1MHz	-	3460	-	pF
Output Capacitance	C_{oss}		-	154	-	
Reverse Transfer Capacitance	C_{rss}		-	41	-	

Switching Characteristics, Inductive Load (2), (3)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Turn-on Delay time	$t_{d(ON)}$	V_{CC} = 600V, V_{GE} = 0/15V, R_G = 10Ω, I_C = 40A, L_{load} = 0.82mH, Energy losses include "tail" and diode reverse recovery.	-	45	-	ns
Rise Time	t_r		-	58	-	
Turn-off Delay time	$t_{d(OFF)}$		-	165	-	
Fall Time	t_f		-	110	-	
Turn-On Switching Loss	E_{on}		-	2.9	-	mJ
Turn-Off Switching Loss	E_{off}		-	1.8	-	
IGBT Total Switching Loss	E_{ts}		-	4.7	-	
Diode Reverse-Recovery Time	t_{rr}	V_R = 600V, I_F = 40A, dI_F/dt = 672A/μs	-	195	-	ns
Diode Reverse-Recovery Charge	Q_{rr}		-	1500	-	nC
Diode Peak Reverse-Recovery Current	I_{rrm}		-	18	-	A
Turn-on Delay time	$t_{d(ON)}$	V_{CC} = 600V, V_{GE} = 0/15V, R_G = 10Ω, I_C = 40A, L_{load} = 0.82mH, T_J = 175°C Energy losses include "tail" and diode reverse recovery.	-	42	-	ns
Rise Time	t_r		-	60	-	
Turn-off Delay time	$t_{d(OFF)}$		-	210	-	
Fall Time	t_f		-	153	-	
Turn-On Switching Loss	E_{on}		-	4.3	-	mJ
Turn-Off Switching Loss	E_{off}		-	2.4	-	
IGBT Total Switching Loss	E_{ts}		-	6.7	-	
Diode Reverse-Recovery Time	t_{rr}	V_R = 600V, I_F = 40A, dI_F/dt = 520 A/μs, T_J = 175°C	-	360	-	ns
Diode Reverse-Recovery Charge	Q_{rr}		-	3400	-	nC
Diode Peak Reverse-Recovery Current	I_{rrm}		-	23	-	A
Short Circuit Collector Current (T_J = 25°C)	$I_{C(SC)}$	V_{GE} = 15V, V_{CC} ≤ 600V, t_{SC} ≤ 10μs	-	160	-	A

(1) DC collector current, T_c = 100°C, T_J = 175°C.

(2) T_J = 25°C unless otherwise specified

(3) t_r: from 10% of Ic to 90% of Ic; t_f: from 90% of Ic to 10% of Ic;

E_{on}: from 10% of V_{GE} to 10% of V_{CE}; E_{off}: from 90% of V_{GE} to 10% of Ic.

Typical Electrical Characteristics

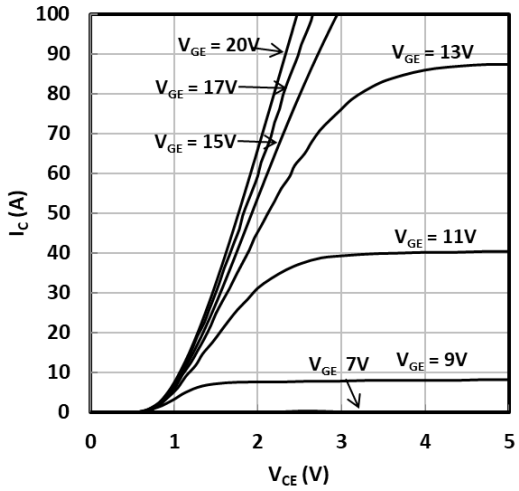


Fig. 1 Typical output characteristics

(T_J = 25 °C, t_p = 250 µs)

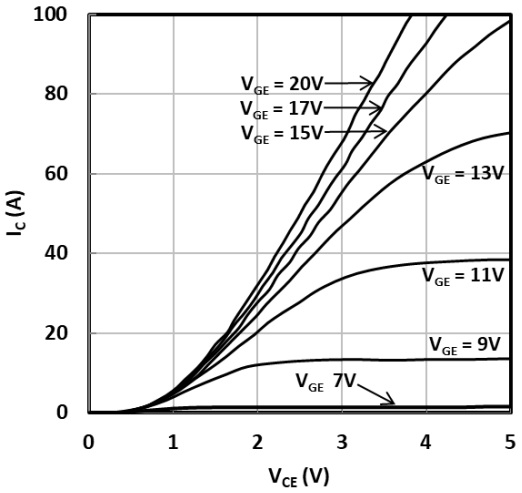


Fig. 2 Typical output characteristics

(T_J = 175 °C, t_p = 250 µs)

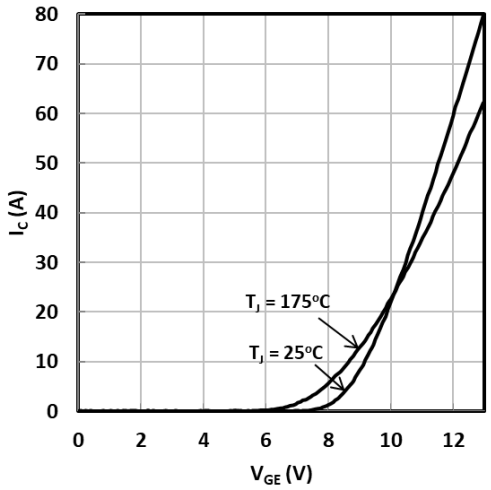


Fig. 3 Typical transfer characteristics

(V_{CE} = 20 V, t_p = 250 µs)

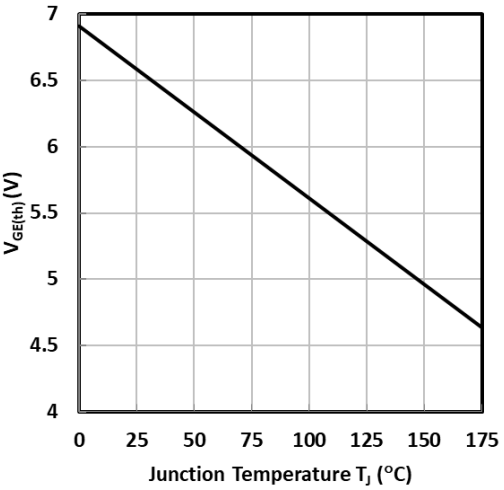


Fig. 4 Typical gate threshold voltage as a function of junction temperature

(V_{CE} = V_{GE} , I_C = 1.5mA)

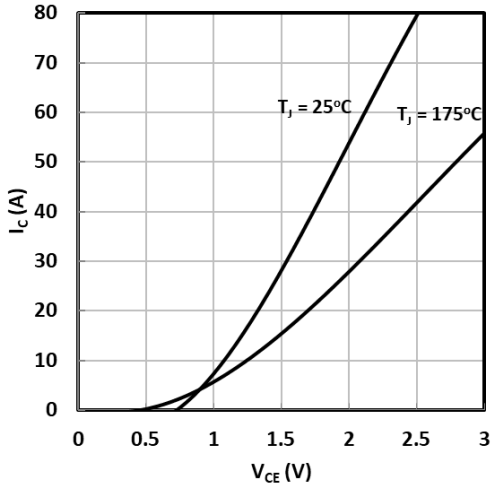


Fig. 5 Typical saturation voltage characteristics

(V_{GE} = 15 V, t_p = 250 µs)

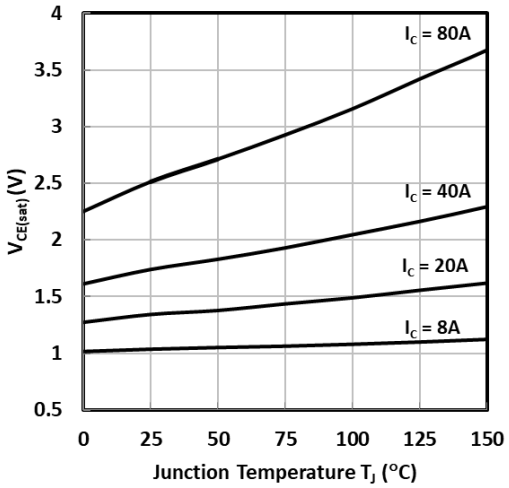


Fig. 6 Typical saturation voltage as a function of junction temperature

(V_{GE} = 15 V, t_p = 250 µs)

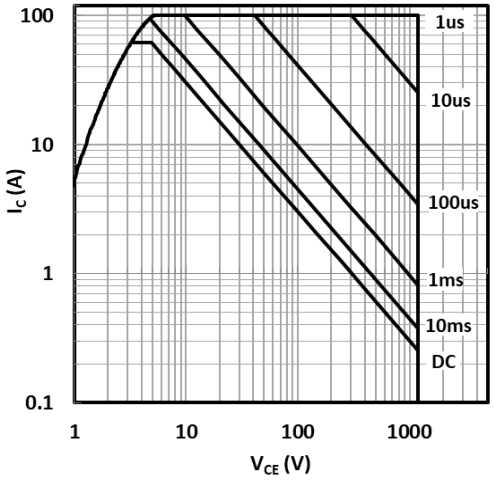


Fig. 7 Safe operating area

($D = 0$, T_C = 25 °C, V_{GE} = 15 V, $T_J \leq$ 175 °C)

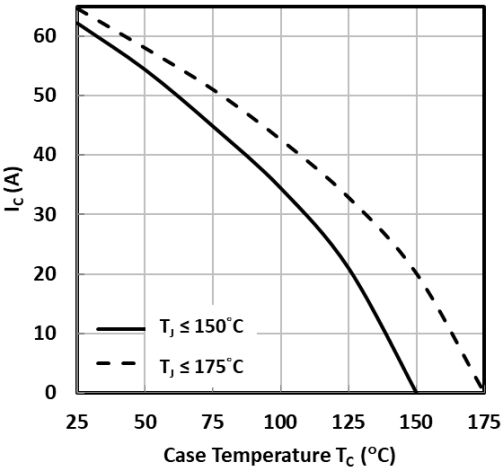


Fig. 8 Maximum DC collector current as a function of case temperature

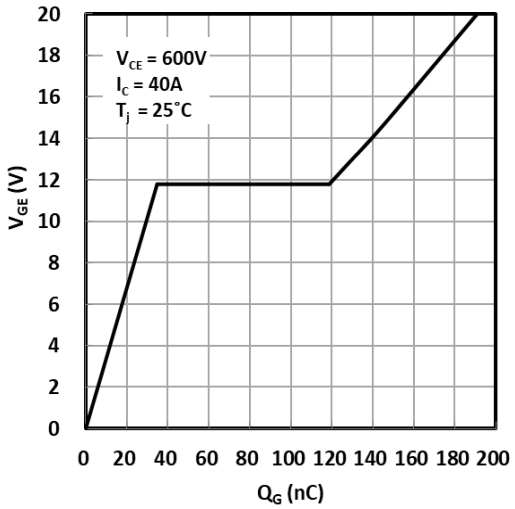


Fig. 9 Typical gate charge characteristics

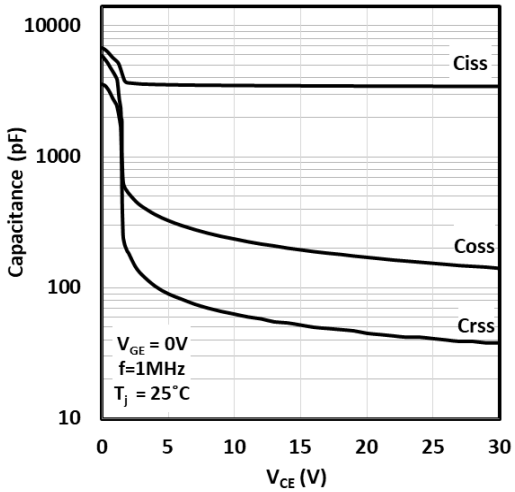


Fig. 10 Typical capacitance as a function of collector-to-emitter voltage

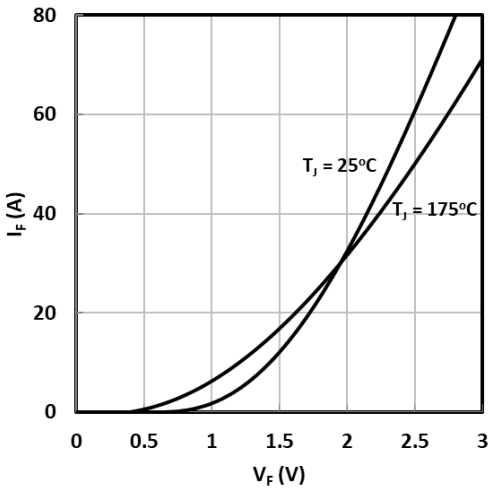


Fig. 11 Typical diode forward current as a function of forward voltage

(V_{GE} = 0 V, t_p = 250 µs)

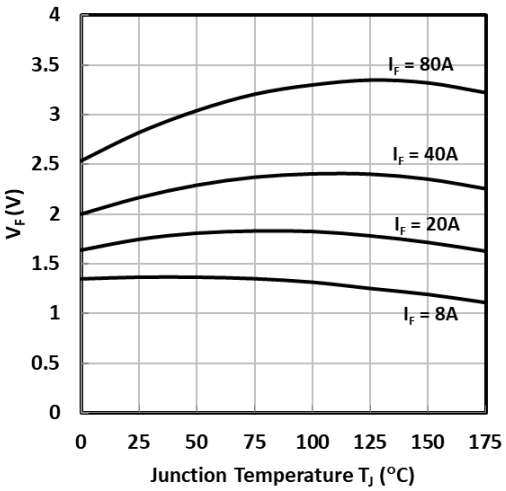


Fig. 12 Typical diode forward voltage as a function of junction temperature

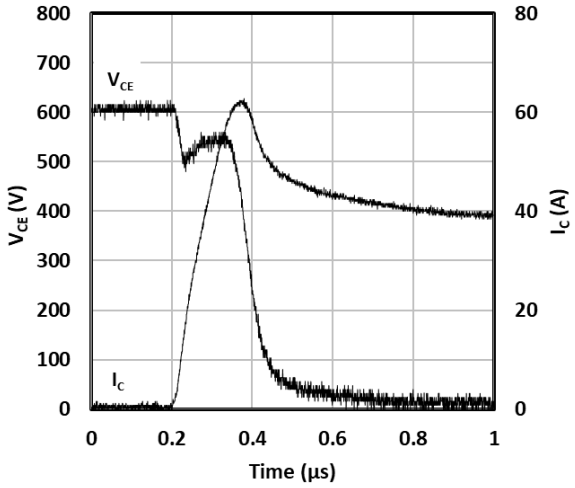


Fig. 13 Typical turn on behavior

(V_{GE} = 0/15V, R_G = 10Ω, T_J = 175°C)

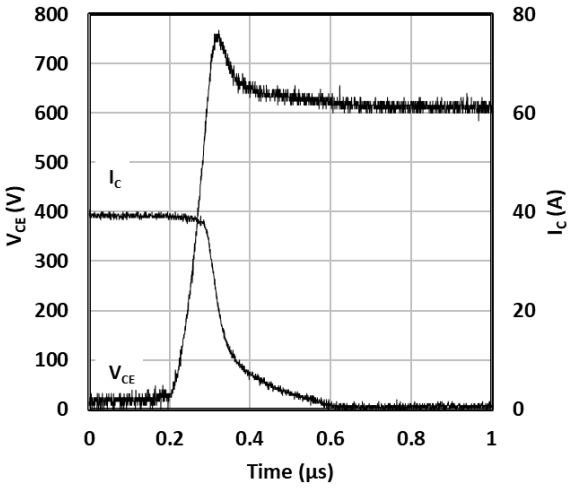


Fig. 14 Typical turn off behavior

(V_{GE} = 0/15V, R_G = 10Ω, T_J = 175°C)

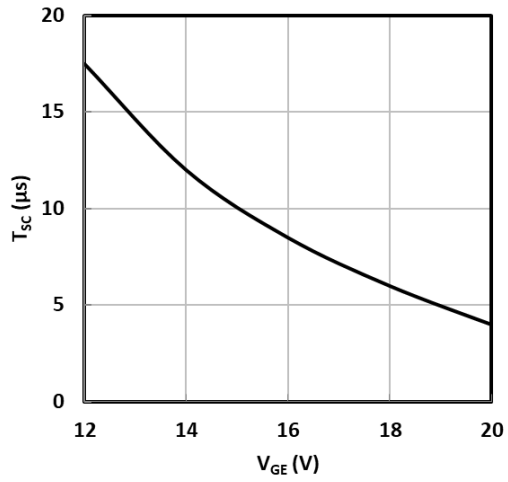


Fig. 15 Typical short circuit withstand time as a function of gate-emitter voltage

(V_{CE} = 600V, Start at T_J = 175 °C)

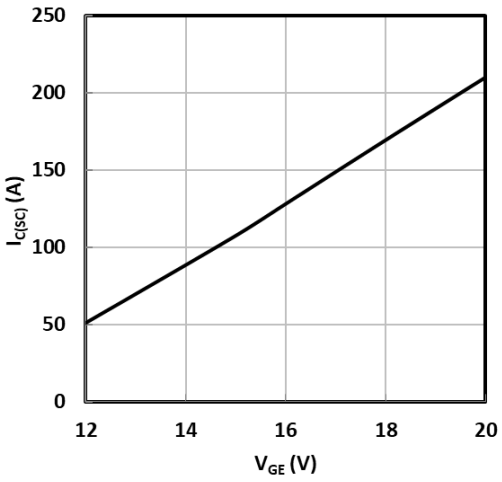
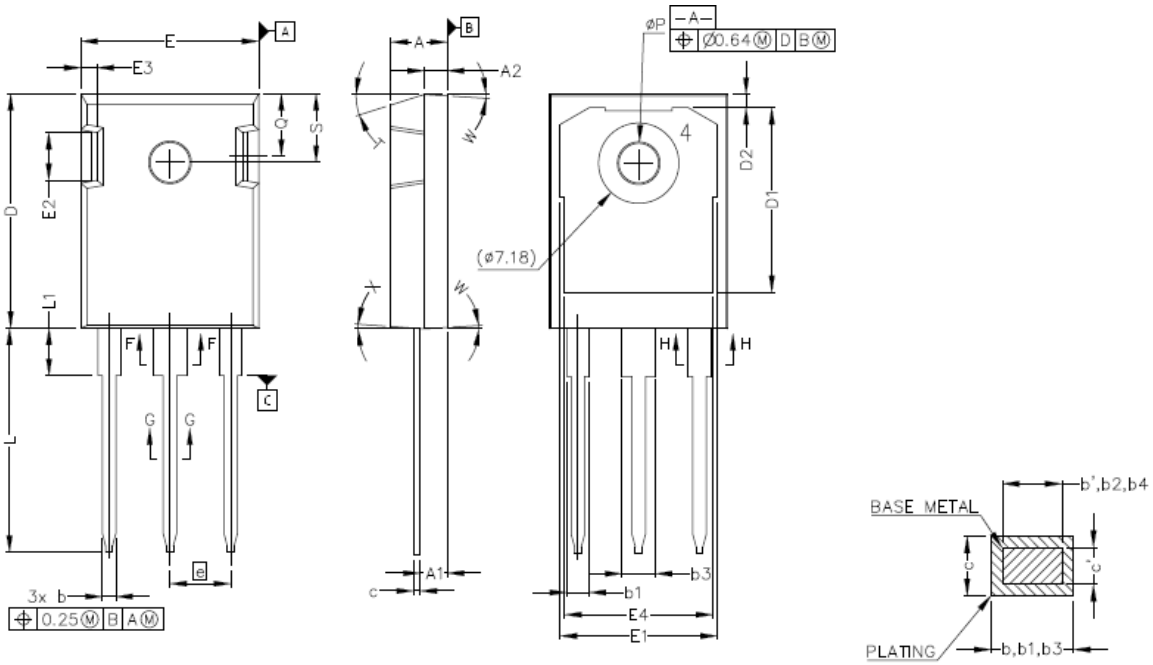


Fig. 16 Typical short circuit collector current as a function of gate-emitter voltage

($V_{CE} \leq$ 600V, Start at T_J = 175 °C)

Package Drawing



SYM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.83	5.21	.190	.205
A1	2.29	2.54	.090	.100
A2	1.91	2.16	.075	.085
b'	1.07	1.28	.042	.050
b	1.07	1.33	.042	.052
b1	1.91	2.41	.075	.095
b2	1.91	2.16	.075	.085
b3	2.87	3.38	.113	.133
b4	2.87	3.13	.113	.123
c'	0.55	0.65	.022	.026
c	0.55	0.68	.022	.027
D	20.80	21.10	.819	.831
D1	16.25	17.65	.640	.695
D2	0.95	1.25	.037	.049
E	15.75	16.13	.620	.635
E1	13.10	14.15	.516	.557
E2	3.68	5.10	.145	.201
E3	1.00	1.90	.039	.075
E4	12.38	13.43	.487	.529
e	5.44 BSC		.214 BSC	
N	3		3	
L	19.81	20.32	.780	.800
L1	4.10	4.40	.161	.173
ØP	3.51	3.65	.138	.144
Q	5.49	6.00	.216	.236
S	6.04	6.30	.238	.248
T	17.5° REF.			
W	3.5° REF.			
X	4° REF.			

TO-247

Revision history of JHH40N120FA2 Specification

Version	Change Items	Effective Date
1.00	Initial Release	22-Jun-20
1.01	Thermal and switching characteristic updates.	30-Jul-20

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