600V, 40A, Trench FS II Fast IGBT

General Description

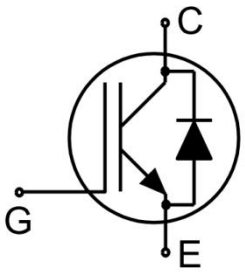
Using NCE's proprietary trench design and advanced FS (Field Stop) second generation technology, the 600V Trench FS II IGBT offers superior conduction and switching performances, and easy parallel operation;

Features

- Trench FSII Technology offering
- Very low $V_{CE\ (sat)}$
- High speed switching
- Positive temperature coefficient in $V_{CE\ (sat)}$
- Very tight parameter distribution
- High ruggedness, temperature stable behavior

Application

- Air Condition
- Inverters
- Motor drives



Schematic diagram

Package Marking and Ordering Information

Device	Device Package	Device Marking
NCE40TH60BT	TO-247	NCE40TH60BT

TO-247

Absolute Maximum Ratings (T_C=25°C unless otherwise noted)

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage	600	V
V_{GES}	Gate- Emitter Voltage	±30	V
I_C	Collector Current	80	A
	Collector Current @T_C = 100 °C	40	A
I_{Cpuls}	Pulsed Collector Current，t_p limited by T_{jmax}	120	A
-	turn off safe operating area，V_{CE}=600V, T_j=175°C	120	A
I_F	Diode Continuous Forward Current @T_C = 100 °C	30	A
I_{FM}	Diode Maximum Forward Current	90	A
P_D	Power Dissipation @ T_C = 25°C	288	W
	Power Dissipation @T_C = 100 °C	144	W
T_J,T_{stg}	Operating Junction and Storage Temperature Range	-55 to +175	°C
T_L	Maximum Temperature for Soldering	260	°C
t_{sc}	Short circuit withstand time V_{GE}=15V, V_{CC}≤400V, Allowed number of short circuits<1000Time between short circuits:≥1.0s,T_j≤150°C	5	us

Thermal Characteristic

Symbol	Parameter	Value	Units
$R_{\theta JC}$	Thermal Resistance, Junction to case for IGBT	0.52	°C/W
$R_{\theta JC}$	Thermal Resistance, Junction to case for Diode	2.12	°C/W
$R_{\theta JA}$	Thermal Resistance, Junction to Ambient	40	°C/W

Electrical Characteristics (T_C=25°C unless otherwise noted)

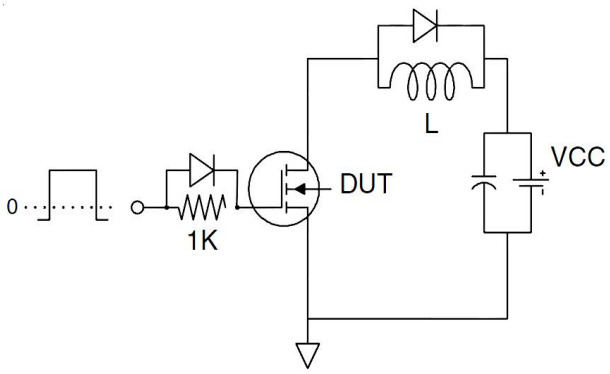
Symbol	Parameter	Test Conditions		Value			Units
				Min.	Typ.	Max.	
STATIC Characteristics							
$V_{(BR)CES}$	Collector-Emitter Breakdown Voltage	V_{GE}=0V,I_{CE}=1mA		600	--	--	V
I_{CES}	Collector-Emitter Leakage Current	V_{GE} =0V,V_{CE}=600V		--	--	40	uA
$I_{GES(F)}$	Gate to Emitter Forward Leakage	V_{GE}=+30V,V_{CE}=0V		--	--	200	nA
$I_{GES(R)}$	Gate to Emitter Reverse Leakage	V_{GE}=-30V,V_{CE} =0V		--	--	200	nA
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=40A	T_j=25°C	--	1.7	1.9	V
		V_{GE}=15V	T_j=175°C	--	1.9	--	V
$V_{GE(th)}$	Gate Threshold Voltage	I_C=1mA,V_{CE}=V_{GE}		4.0	5.0	6.0	V
Dynamic Characteristics							
C_{ies}	Input Capacitance	V_{CE}=25V,V_{GE}=0V, f=1MHz		--	4894	--	pF
C_{oes}	Output Capacitance			--	136	--	
C_{res}	Reverse Transfer Capacitance			--	94	--	
Q_g	Total Gate Charge	V_{CC}=480V, I_C=40A V_{GE}=15V		--	176	--	nC
Q_{ge}	Gate to Emitter Charge			--	38	--	
Q_{gc}	Gate to Collector Charge			--	73	--	
$I_{C(SC)}$	Short circuit collector current Max.1000 short circuits Time between short circuits: ≥1.0s	V_{GE}=15V,V_{CC}≤400V, t_{SC}≤5us,T_j≤150°C		--	240	--	A
Switching Characteristics							
$t_{d(ON)}$	Turn-on Delay Time	V_{CC}=400V,I_C=40A V_{GE}=0/15V, R_g=5Ω Inductive Load		--	19	--	ns
t_r	Rise Time			--	17	--	
$t_{d(OFF)}$	Turn-Off Delay Time			--	168	--	
t_f	Fall Time			--	16	--	
E_{on}	Turn-On Switching Loss			--	0.58	--	mJ
E_{off}	Turn-Off Switching Loss			--	0.48	--	
E_{ts}	Total Switching Loss			--	1.06	--	

Electrical Characteristics of the Diode (T_C= 25°C unless otherwise specified)

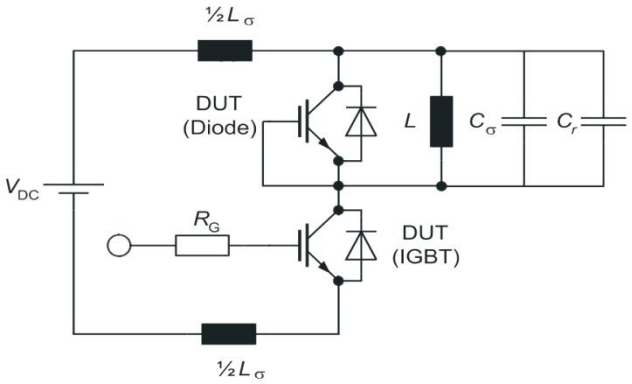
Symbol	Parameter	Test Conditions	Rating			Units
			Min.	Typ.	Max.	
V_{FM}	Diode Forward Voltage	I_F=30A	--	1.75	2.40	V
T_{rr}	Reverse Recovery Time	I_F=30A di/dt=200A/us	--	170	--	ns
I_{RRM}	Diode Peak Reverse Recovery Current		--	6.5	--	A
Q_{rr}	Reverse Recovery Charge		--	0.6	--	uC
Pulse width t_{tp}≤380μs,δ≤2%						

Test Circuit

1) Gate Charge Test Circuit

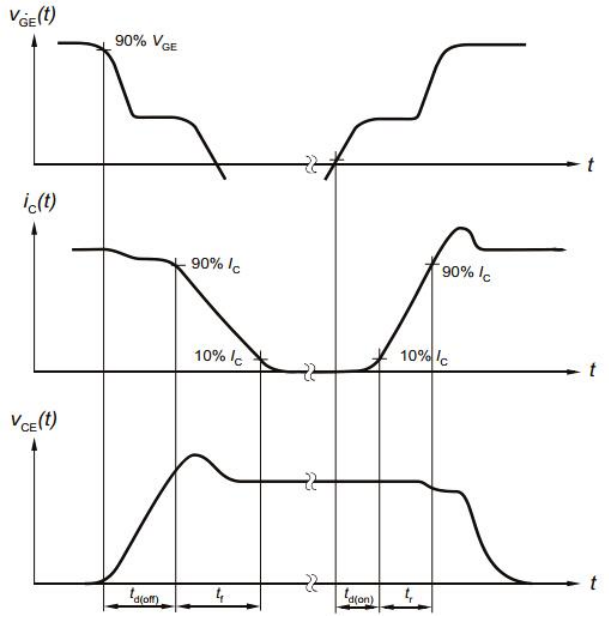


2) Switch Time Test Circuit

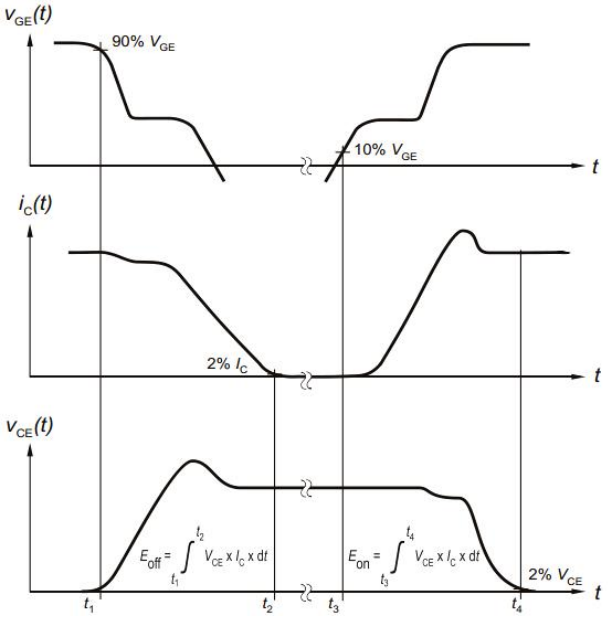


Switching characteristics

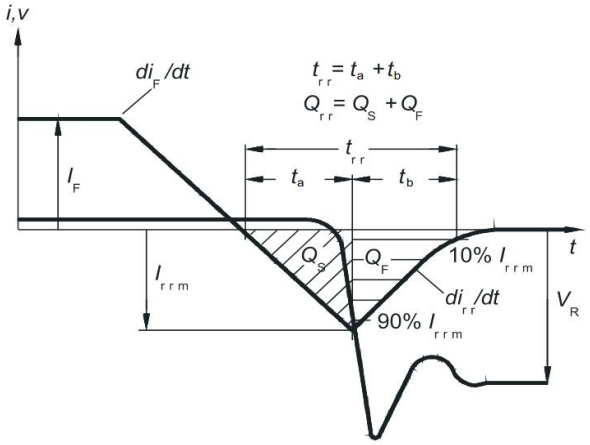
1) Definition of switching times



2) Definition of switching losses



3) Definition of diode switching characteristics



Typical Electrical and Thermal Characteristics

Figure 1 Output Characteristics

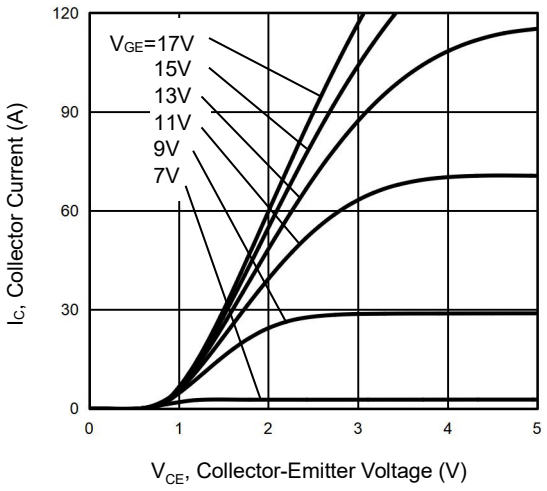


Figure 2 Transfer Characteristics

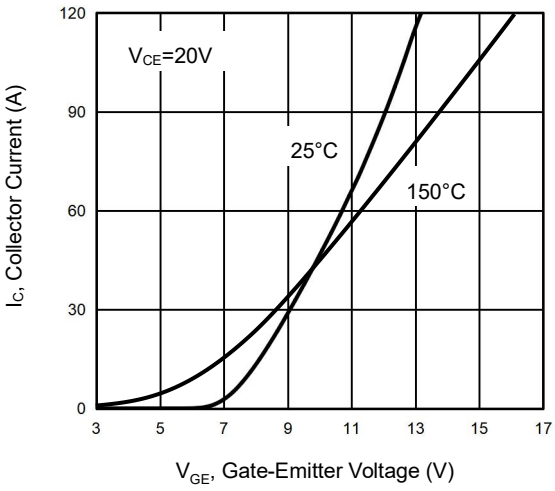


Figure 3 V_{CEsat} vs. Case Temperature

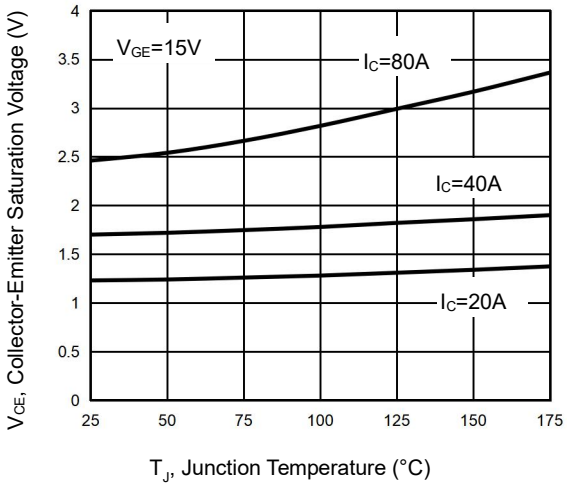


Figure 4 Saturation Voltage vs. V_{GE}

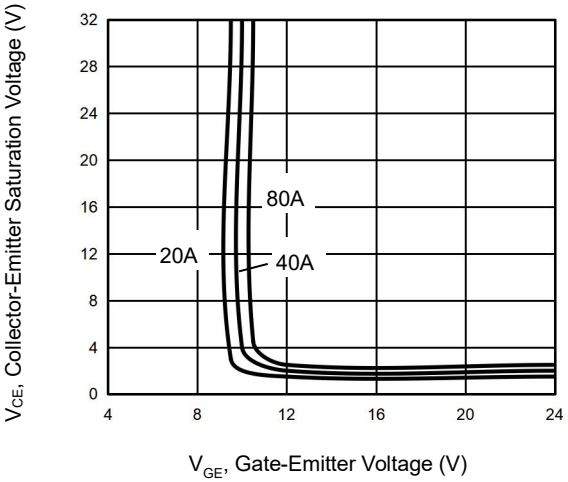


Figure 5 Capacitance Characteristics

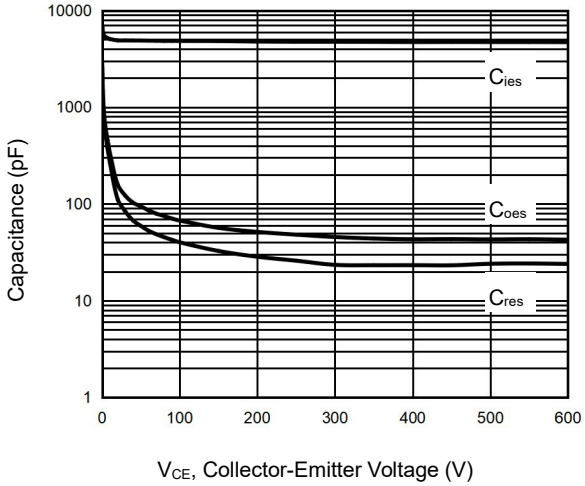
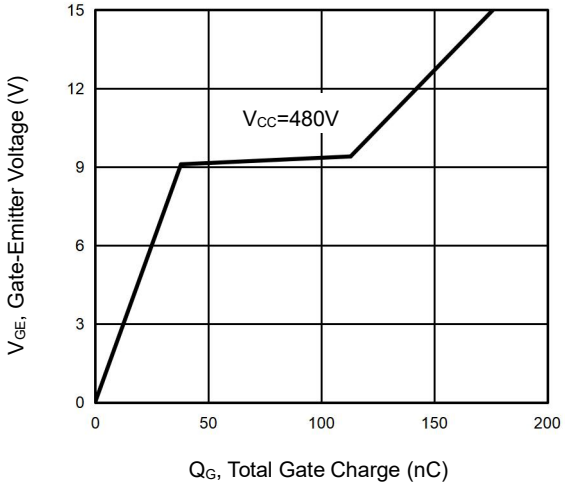


Figure 6 Gate charge waveform



Typical Electrical and Thermal Characteristics

Figure 7 Forward Characteristics

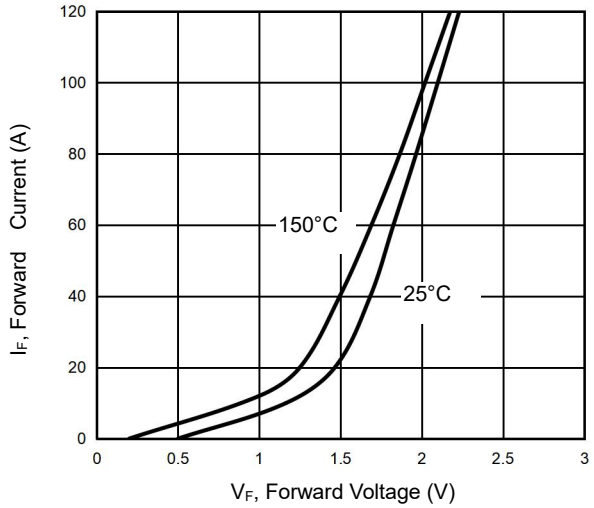


Figure 8 V_F vs. Temperature

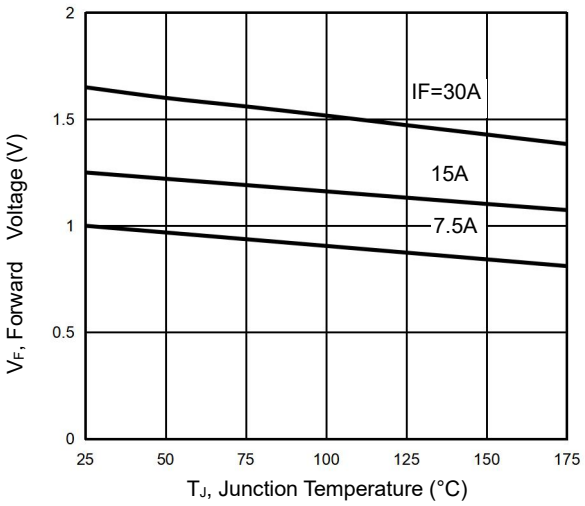


Figure 9 Typical Switching Times as a Function of Gate Resistor

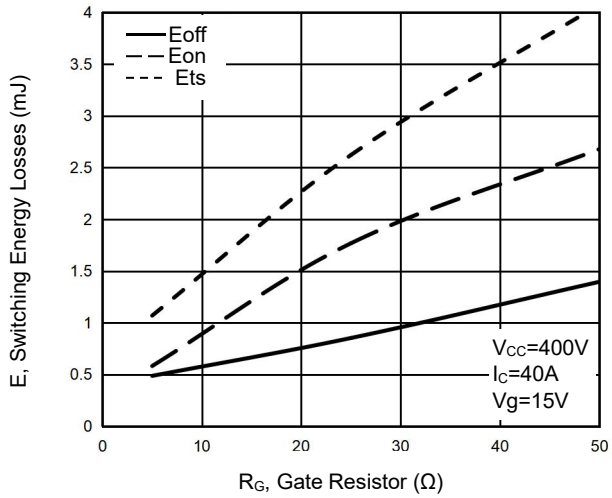


Figure 10 Typical Switching Times as a Function of Junction Temperature

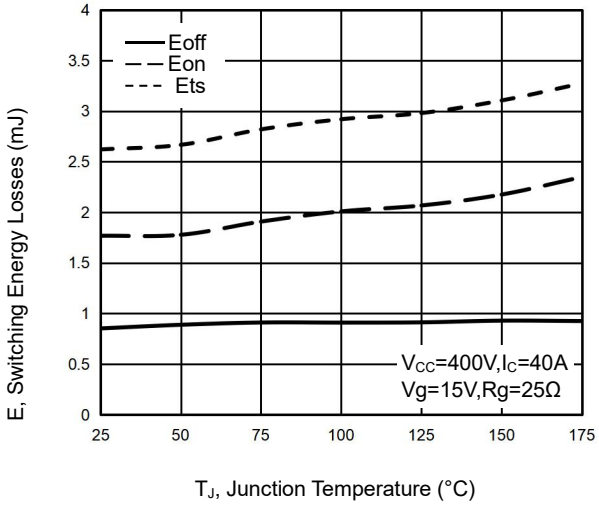


Figure 11 Gate-emitter Threshold Voltage as a Function of Junction Temperature

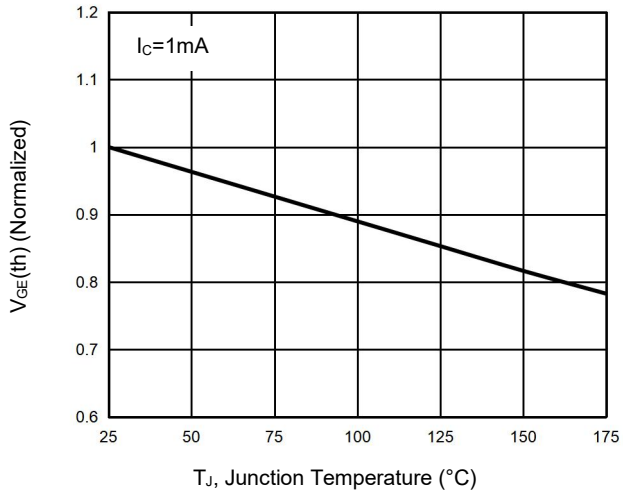
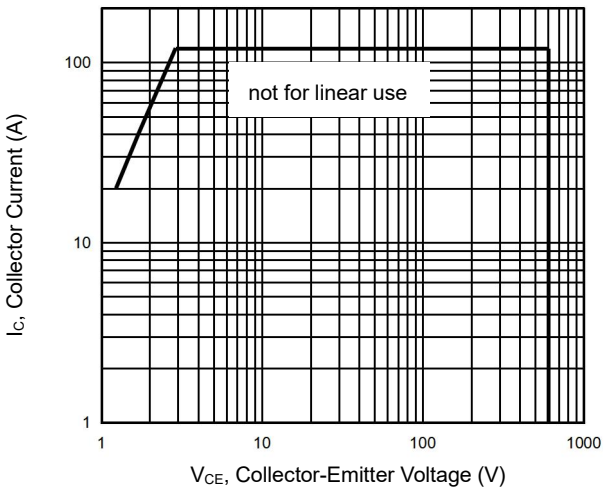
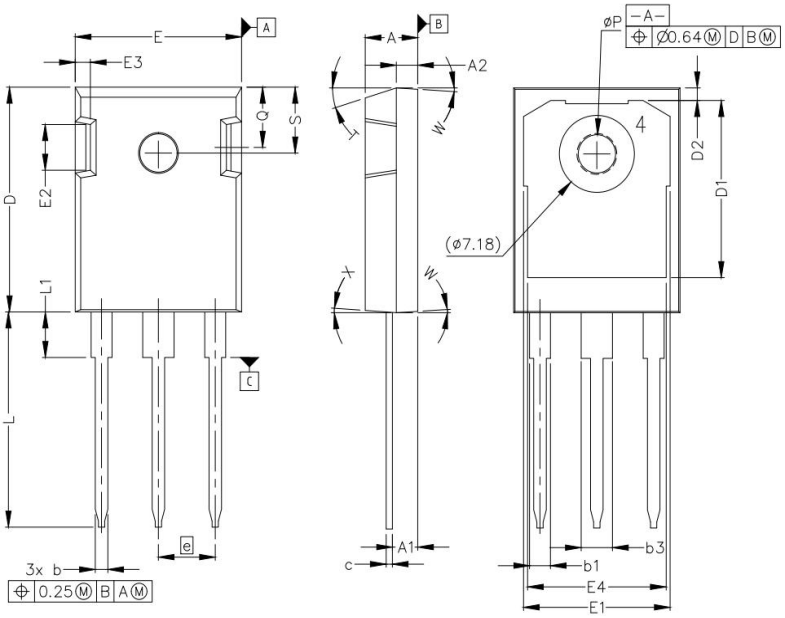


Figure 12 Forward Bias Safe Operating Area



TO-247-B Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.19	0.21
A1	2.29	2.54	0.09	0.10
A2	1.91	2.16	0.08	0.09
b	1.07	1.33	0.04	0.05
b1	1.91	2.41	0.08	0.10
b3	2.87	3.38	0.11	0.13
c	0.55	0.68	0.02	0.03
D	20.80	21.10	0.82	0.83
D1	16.25	17.65	0.64	0.70
D2	0.95	1.25	0.04	0.05
E	15.75	16.13	0.62	0.64
E1	13.10	14.15	0.52	0.56
E2	3.68	5.10	0.15	0.20
E3	1.00	1.90	0.04	0.08
E4	12.38	13.43	0.49	0.53
e	5.44 BSC		0.21 BSC	
L	19.81	20.32	0.78	0.80
L1	4.10	4.40	0.16	0.17
ØP	3.51	3.65	0.14	0.15
Q	5.49	6.00	0.22	0.24
S	6.04	6.30	0.24	0.25
T	17.5° REF			
W	3.5° REF			
X	4° REF			

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