

## N-Channel Super Junction Power MOSFET IV

### General Description

The series of devices use advanced trench gate super junction technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. This super junction MOSFET fits the industry's AC-DC SMPS requirements for PFC, AC/DC power conversion, and industrial power applications.

### Features

- Optimized body diode reverse recovery performance
- Low on-resistance and low conduction losses
- Small package
- Ultra Low Gate Charge cause lower driving requirements
- 100% Avalanche Tested
- ROHS compliant

### Application

- Power factor correction (PFC)
- Switched mode power supplies(SMPS)
- Uninterruptible Power Supply (UPS)
- LLC Half-bridge

$V_{DS\ min@T_{jmax}}$	650	V
$R_{DS(ON)TYP}$	180	mΩ
$I_D$	18	A
$Q_g$	22.8	nC



Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE60NF200D	TO-263	NCE60NF200D



TO-263-2L

Table 1. Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ )

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	600	V
Gate-Source Voltage ( $V_{DS}=0V$ ) AC ( $f>1\text{ Hz}$ )	$V_{GS}$	$\pm 30$	V
Gate-Source Voltage ( $V_{DS}=0V$ ) DC	$V_{GS}$	$\pm 20$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	18	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	12.6	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	54	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	150	W
Derate above $25^\circ\text{C}$		1.0	W/ $^\circ\text{C}$
Avalanche current (Note 1)	$I_{AS}$	3.5	A
Drain Source voltage slope, $V_{DS} \leq 480\text{ V}$ ,	$dv/dt$	50	V/ns
Reverse diode $dv/dt$ , $V_{DS} \leq 480\text{ V}, I_{SD} < I_D$	$dv/dt$	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	$-55...+175$	$^\circ\text{C}$

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	1.0	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	$^{\circ}\text{C}/\text{W}$

**Table 3. Electrical Characteristics (TA=25°C unless otherwise noted)**

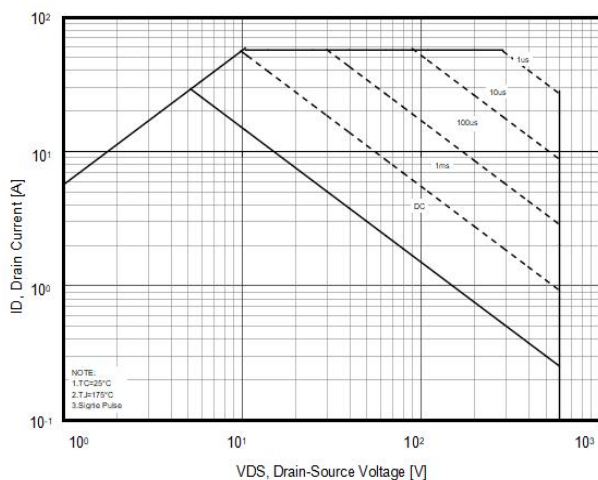
Parameter	Symbol	Condition	Min	Typ	Max	Unit
On/off states						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> =0V I <sub>D</sub> =250μA	600			V
Zero Gate Voltage Drain Current(Tc=25℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			10	μA
Zero Gate Voltage Drain Current(Tc=125℃)	I <sub>DSS</sub>	V <sub>DS</sub> =600V, V <sub>GS</sub> =0V			300	μA
Gate-Body Leakage Current	I <sub>GSS</sub>	V <sub>GS</sub> =±20V, V <sub>DS</sub> =0V			±200	nA
Gate Threshold Voltage	V <sub>GS(th)</sub>	V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA	3.5	4.2	5.0	V
Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> =10V, I <sub>D</sub> =9A		180	200	mΩ
Dynamic Characteristics						
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =0V, F=1.0MHz		1157		pF
Output Capacitance	C <sub>oss</sub>			60		pF
Reverse Transfer Capacitance	C <sub>rss</sub>			1.5		pF
Total Gate Charge	Q <sub>g</sub>	V <sub>DS</sub> =400V, I <sub>D</sub> =9A, V <sub>GS</sub> =10V		22.8		nC
Gate-Source Charge	Q <sub>gs</sub>			9.1		nC
Gate-Drain Charge	Q <sub>gd</sub>			6		nC
Gate plateau voltage	V <sub>gp</sub>			6.5		V
Intrinsic gate resistance	R <sub>G</sub>	f = 1 MHz open drain		20		Ω
Switching times						
Turn-on Delay Time	t <sub>d(on)</sub>	V <sub>DD</sub> =380V, I <sub>D</sub> =9A, R <sub>G</sub> =1.7Ω, V <sub>GS</sub> =10V		25		nS
Turn-on Rise Time	t <sub>r</sub>			16		nS
Turn-Off Delay Time	t <sub>d(off)</sub>			75		nS
Turn-Off Fall Time	t <sub>f</sub>			9		nS
Source- Drain Diode Characteristics						
Source-drain current(Body Diode)	I <sub>SD</sub>	T <sub>C</sub> =25℃			18	A
Pulsed Source-drain current(Body Diode)	I <sub>SDM</sub>				54	A
Forward On Voltage	V <sub>SD</sub>	T <sub>j</sub> =25℃, I <sub>SD</sub> =18A, V <sub>GS</sub> =0V		1.0	1.2	V
Reverse Recovery Time	t <sub>rr</sub>	T <sub>j</sub> =25℃, I <sub>F</sub> =9A, di/dt=100A/μs		90		nS
Reverse Recovery Charge	Q <sub>rr</sub>			0.32		uC
Peak Reverse Recovery Current	I <sub>rrm</sub>			7		A

Notes 1.Repetitive Rating: Pulse width limited by maximum junction temperature

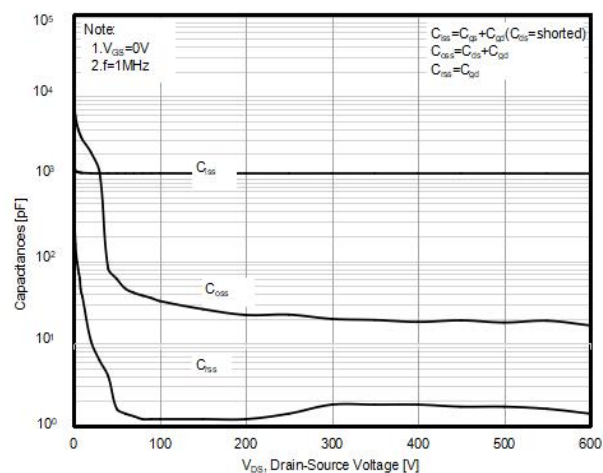
2.  $T_j=25^{\circ}\text{C}, V_{DD}=50V, V_G=10V, R_G=25\Omega$

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

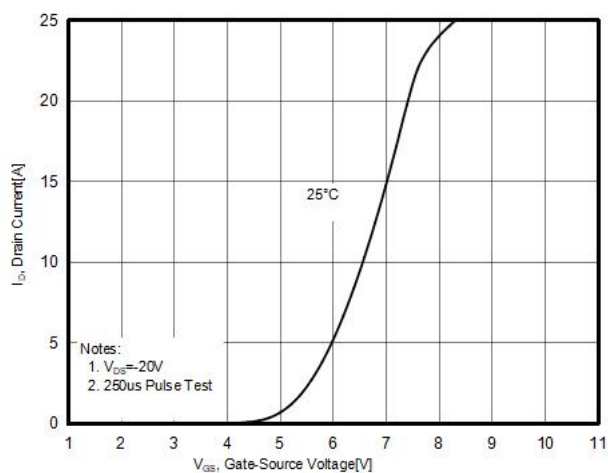
**Figure1. Safe operating area**



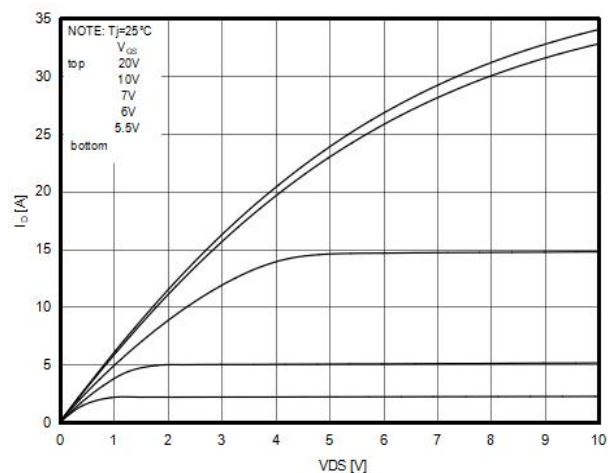
**Figure2. Capacitance**



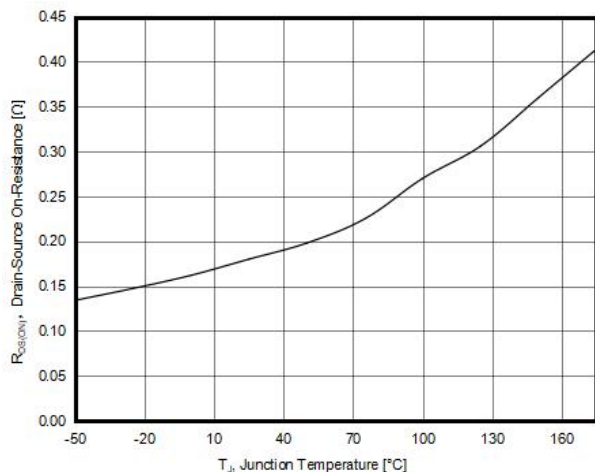
**Figure3. Transfer characteristics**



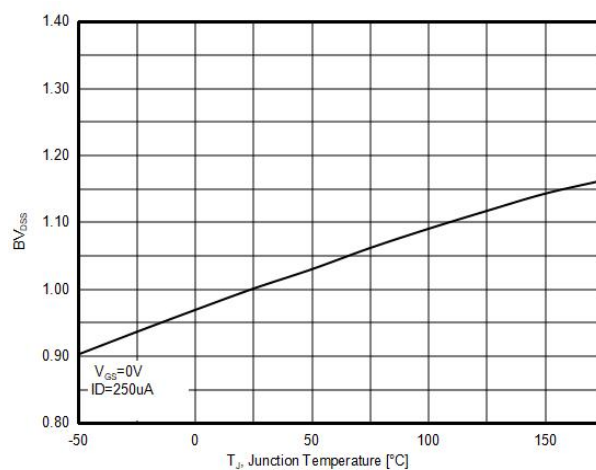
**Figure4. Output characteristics**



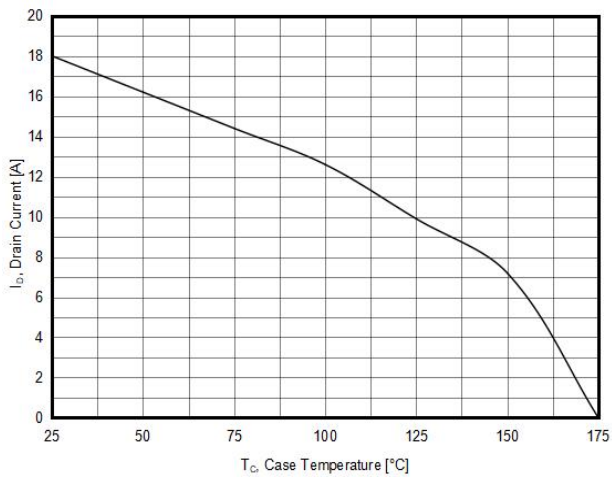
**Figure5.  $R_{DS(ON)}$  vs Junction Temperature**



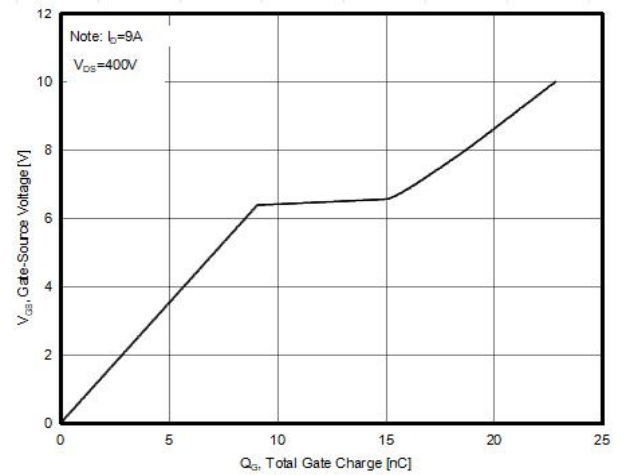
**Figure6.  $BV_{DSS}$  vs Junction Temperature**



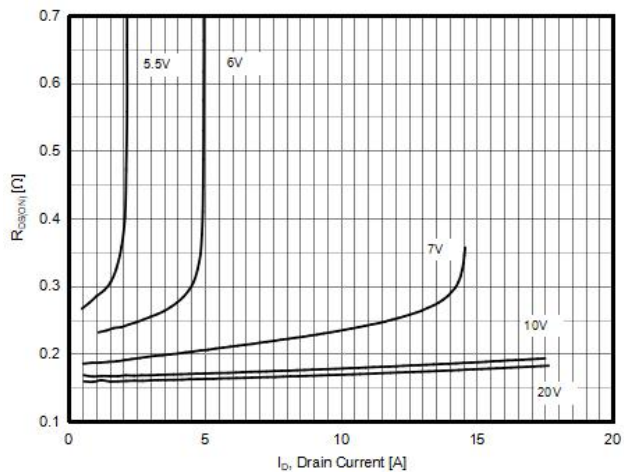
**Figure7. Maximum  $I_D$  vs Junction Temperature**



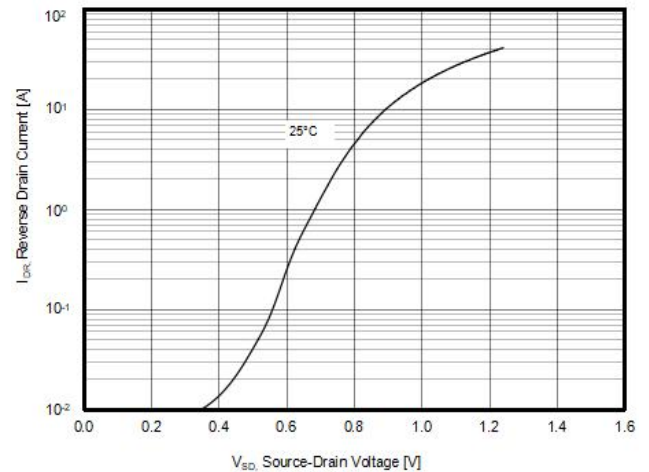
**Figure8. Gate charge waveforms**



**Figure9. Static drain-source on resistance**



**Figure10. Source-Drain Diode Forward Voltage**

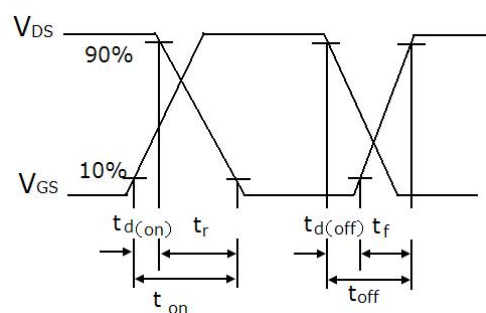
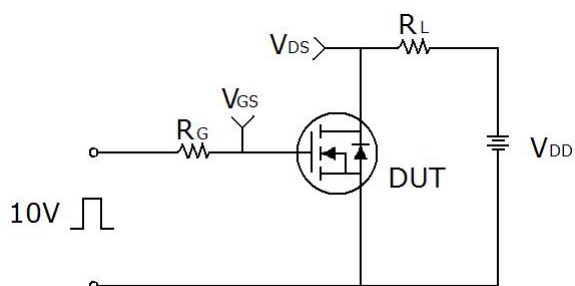


## Test circuit

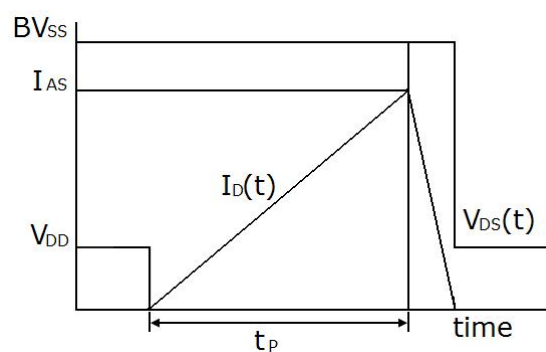
### 1) Gate charge test circuit & Waveform



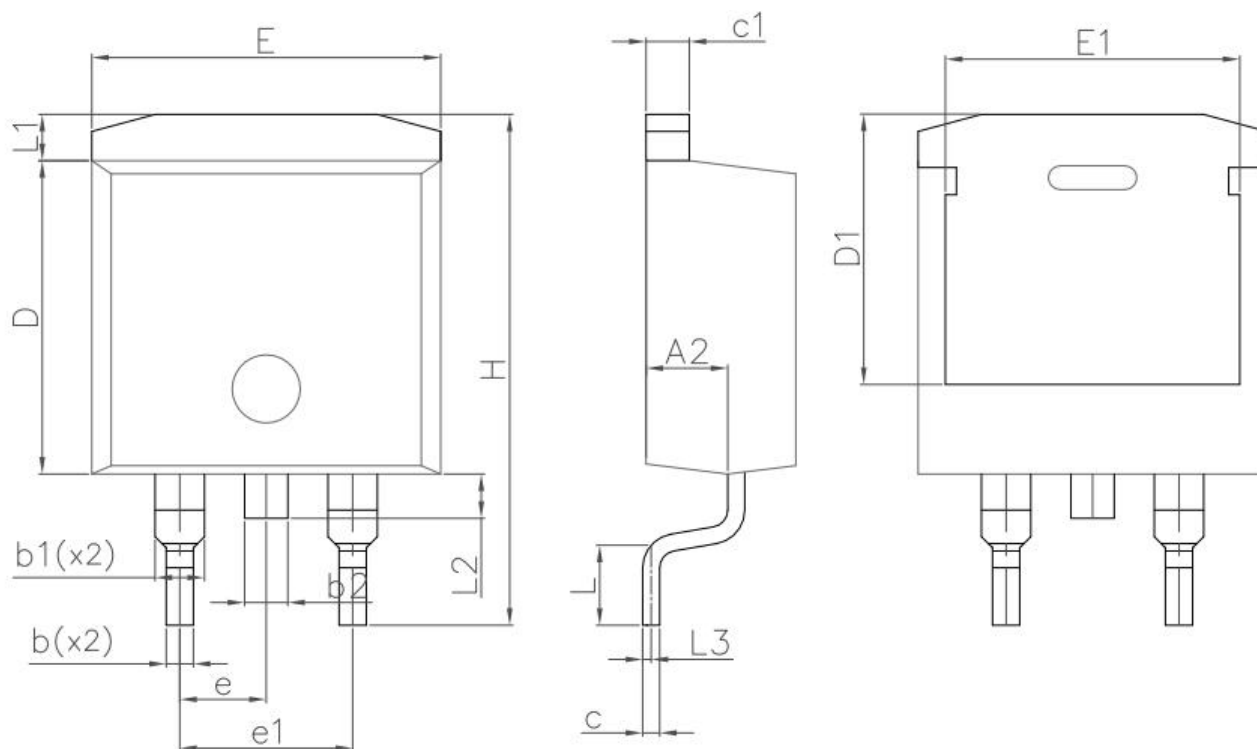
### 2) Switch Time Test Circuit:



### 3) Unclamped Inductive Switching Test Circuit & Waveforms

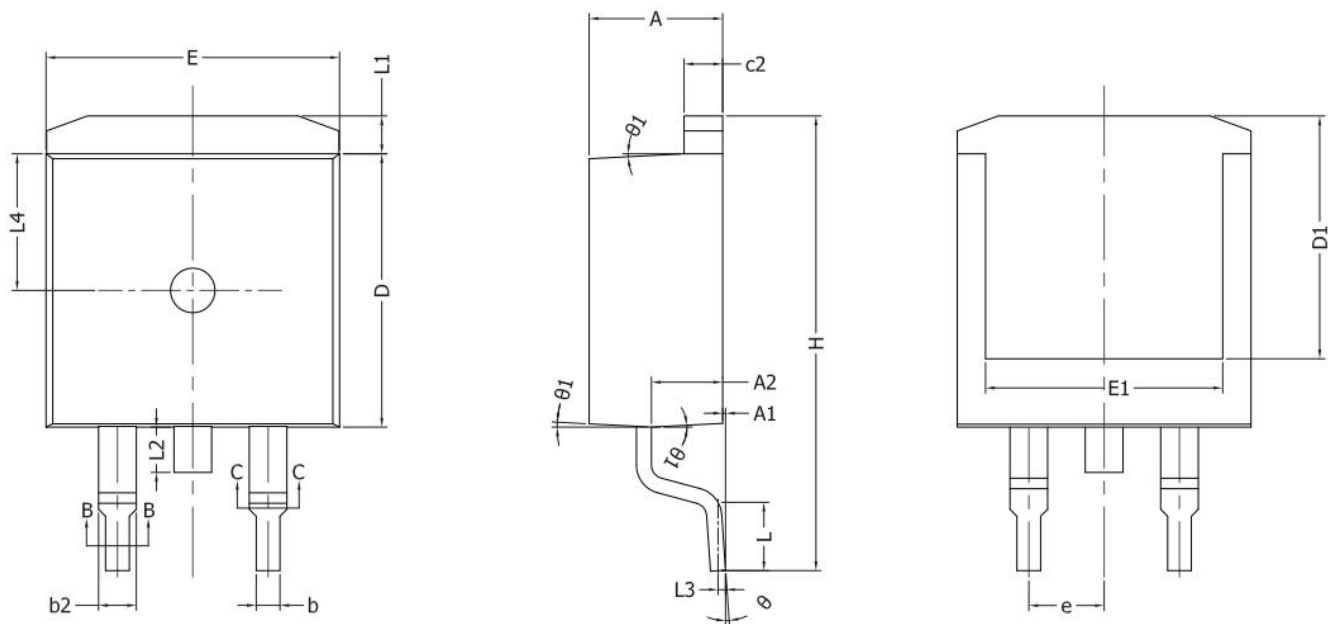


## TO-263-2L-E Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A2	4.20	4.60	0.165	0.181
b	0.70	0.90	0.028	0.035
b1	1.20	1.75	0.047	0.069
b2	1.17	1.37	0.046	0.054
c	0.40	0.60	0.016	0.024
c1	1.15	1.40	0.045	0.055
D	9.10	9.30	0.358	0.366
D1	7.63	8.23	0.300	0.324
E	10.05	10.45	0.396	0.411
E1	8.35	8.95	0.329	0.352
e	2.54BSC		0.100BSC	
e1	5.08BSC		0.200BSC	
H	14.61	15.88	0.575	0.625
L	1.78	2.79	0.070	0.110
L1	1.36REF		0.054REF	
L2	1.30REF		0.051REF	

## TO-263-2L-P Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.40	4.60	0.173	0.181
A1	0.00	0.25	0.000	0.010
A2	2.20	2.60	0.087	0.102
b	0.76	0.89	0.030	0.035
b1	0.75	0.85	0.030	0.033
b2	1.23	1.37	0.048	0.054
b3	1.22	1.32	0.048	0.052
c	0.47	0.60	0.019	0.024
c1	0.46	0.56	0.018	0.022
c2	1.25	1.35	0.049	0.053
D	9.10	9.30	0.358	0.366
D1	8.00		0.315	
E	9.80	10.00	0.386	0.394
E1	7.80		0.307	
e	2.54BSC		0.100BSC	
H	14.90	15.70	0.587	0.618
L	2.00	2.60	0.079	0.102
L1	1.17	1.40	0.046	0.055
L2		1.75		0.069
L3	0.25BSC		0.101BSC	
L4	4.60REF		0.181REF	

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