

## N-Channel Super Junction Power MOSFET III

### 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.

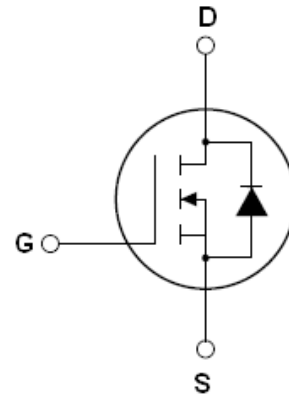
### Features

- 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

$V_{DS}$	650	V
$R_{DS(ON)TYP}$	110	m $\Omega$
$I_D$	28	A

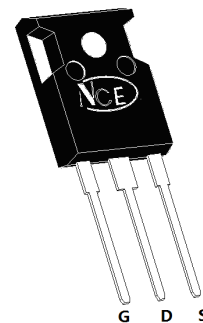


Schematic diagram

✧ Intrinsic fast-recovery body diode

### Package Marking And Ordering Information

Device	Device Package	Marking
NCE65TF130T	TO-247	NCE65TF130T



TO-247

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

Parameter	Symbol	Value	Unit
Drain-Source Voltage ( $V_{GS}=0V$ )	$V_{DS}$	650	V
Gate-Source Voltage ( $V_{DS}=0V$ ) AC ( $f>1$ Hz)	$V_{GS}$	$\pm 30$	V
Continuous Drain Current at $T_c=25^\circ\text{C}$	$I_{D(DC)}$	28	A
Continuous Drain Current at $T_c=100^\circ\text{C}$	$I_{D(DC)}$	18	A
Pulsed drain current (Note 1)	$I_{DM(pluse)}$	112	A
Maximum Power Dissipation( $T_c=25^\circ\text{C}$ )	$P_D$	260	W
Derate above $25^\circ\text{C}$		2.08	W/ $^\circ\text{C}$
Single pulse avalanche energy (Note 2)	$E_{AS}$	676	mJ
Avalanche current (Note 1)	$I_{AR}$	5.2	A
Repetitive Avalanche energy , $t_{AR}$ limited by $T_{jmax}$ (Note 1)	$E_{AR}$	3.2	mJ

Parameter	Symbol	Value	Unit
Drain Source voltage slope, $V_{DS} \leq 480V$ ,	dv/dt	50	V/ns
Reverse diode dv/dt, $V_{DS} \leq 480V, I_{SD} < I_D$	dv/dt	50	V/ns
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55...+150	°C

\* limited by maximum junction temperature

**Table 2. Thermal Characteristic**

Parameter	Symbol	Value	Unit
Thermal Resistance, Junction-to-Case (Maximum)	$R_{thJC}$	0.48	°C/W
Thermal Resistance, Junction-to-Ambient (Maximum)	$R_{thJA}$	62	°C/W

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

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>On/off states</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	650			V
Zero Gate Voltage Drain Current( $T_c=25^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			1	$\mu A$
Zero Gate Voltage Drain Current( $T_c=125^\circ C$ )	$I_{DSS}$	$V_{DS}=650V, V_{GS}=0V$			100	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$			$\pm 100$	nA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	3	3.5	4	V
Drain-Source On-State Resistance	$R_{DS(ON)}$	$V_{GS}=10V, I_D=14A$		110	140	m $\Omega$
<b>Dynamic Characteristics</b>						
Input Capacitance	$C_{iss}$	$V_{DS}=50V, V_{GS}=0V,$ $F=1.0MHz$		2070		pF
Output Capacitance	$C_{oss}$			120		pF
Reverse Transfer Capacitance	$C_{rss}$			0.5		pF
Total Gate Charge	$Q_g$	$V_{DS}=480V, I_D=28A,$ $V_{GS}=10V$		37.5		nC
Gate-Source Charge	$Q_{gs}$			13		nC
Gate-Drain Charge	$Q_{gd}$			11.5		nC
Intrinsic gate resistance	$R_G$	$f = 1 MHz$ open drain		10		$\Omega$
<b>Switching times</b>						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=380V, I_D=14A,$ $R_G=2.3\Omega, V_{GS}=10V$		14		nS
Turn-on Rise Time	$t_r$			12		nS
Turn-Off Delay Time	$t_{d(off)}$			65		nS
Turn-Off Fall Time	$t_f$			11		nS
<b>Source- Drain Diode Characteristics</b>						
Source-drain current(Body Diode)	$I_{SD}$	$T_c=25^\circ C$			28	A
Pulsed Source-drain current(Body Diode)	$I_{SDM}$				112	A
Forward On Voltage	$V_{SD}$	$T_J=25^\circ C, I_{SD}=28A, V_{GS}=0V$		0.9	1.2	V
Reverse Recovery Time	$t_{rr}$	$T_J=25^\circ C, I_F=14A, di/dt=100A/\mu s$		190		nS
Reverse Recovery Charge	$Q_{rr}$			2		$\mu C$
Peak Reverse Recovery Current	$I_{rrm}$			21		A

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

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

## TYPICAL ELECTRICAL AND THERMAL CHARACTERISTICS (curves)

Figure1. Safe operating area

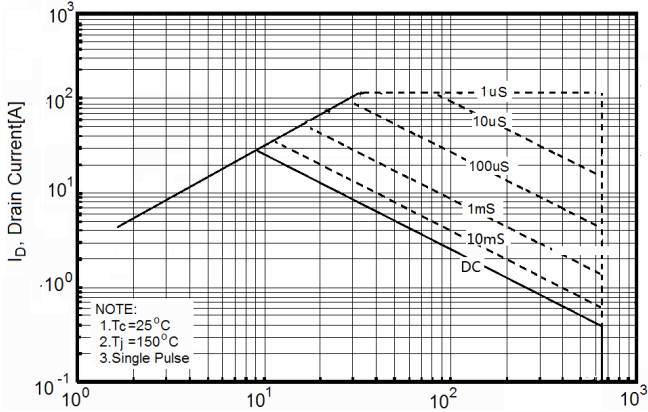


Figure2. Transient Thermal Impedance

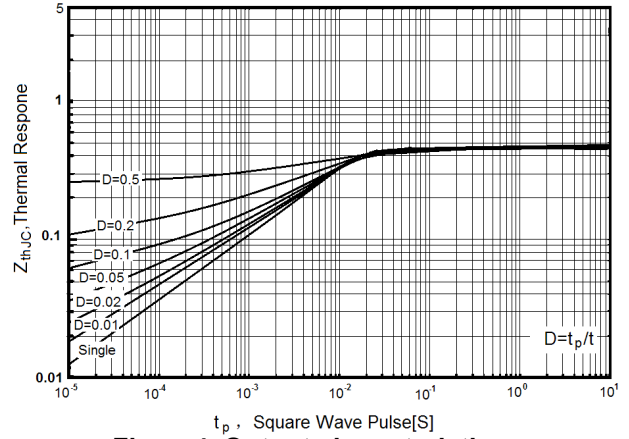


Figure3. Source-Drain Diode Forward Voltage

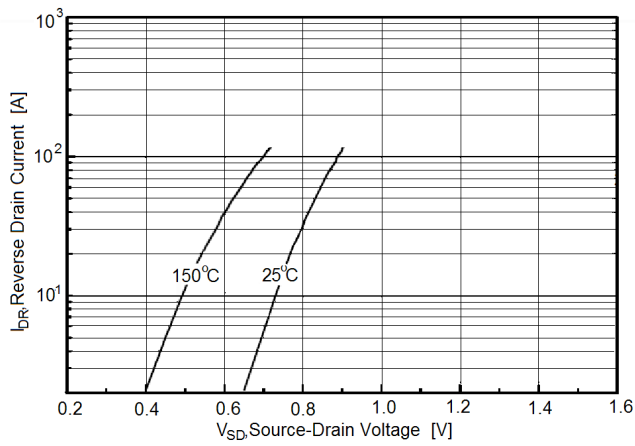


Figure4. Output characteristics

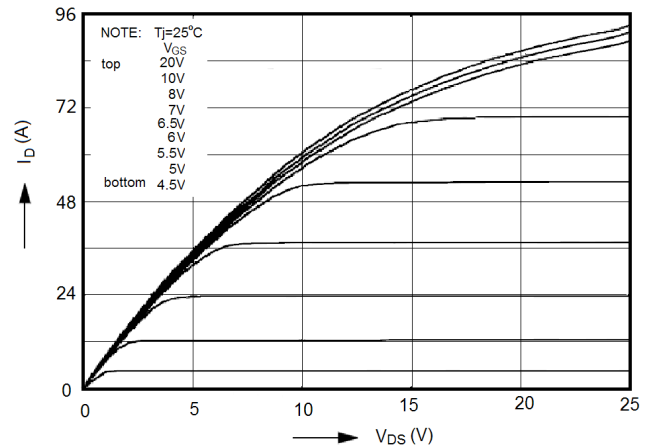


Figure5. Transfer characteristics

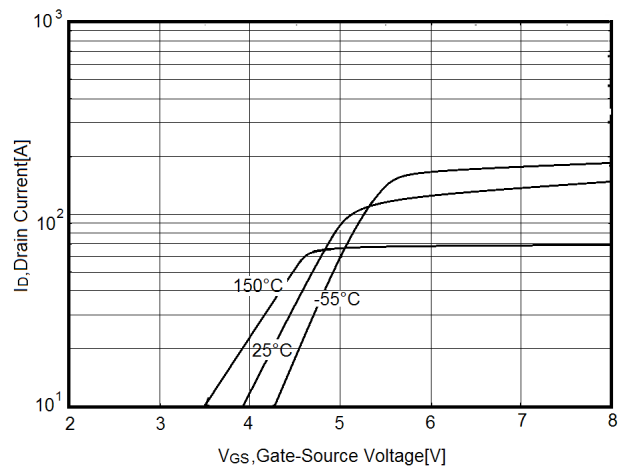
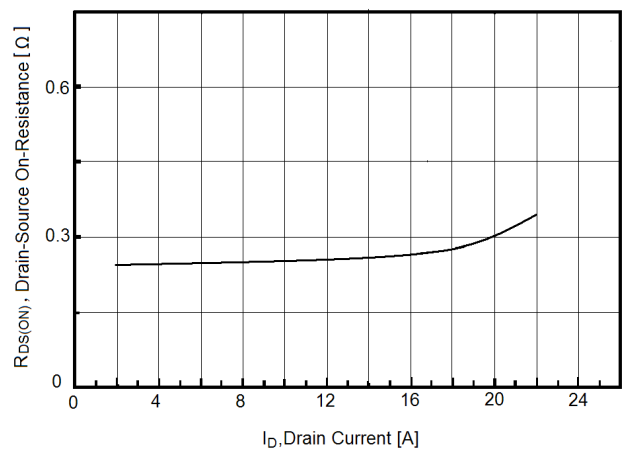
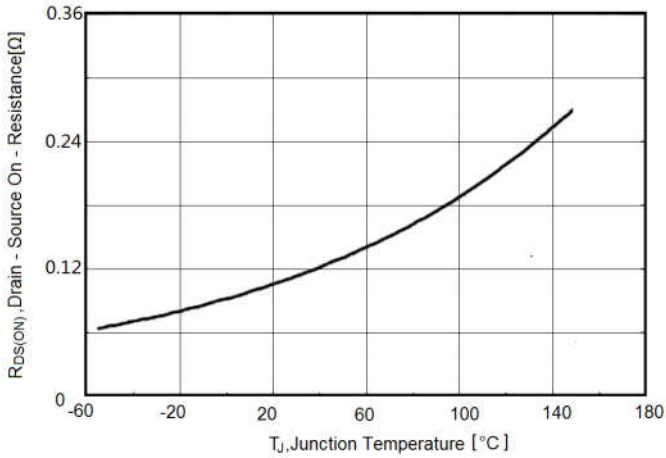


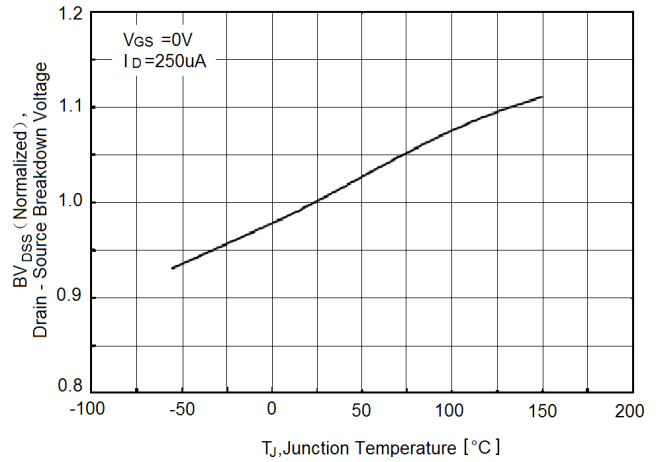
Figure6. Static drain-source on resistance



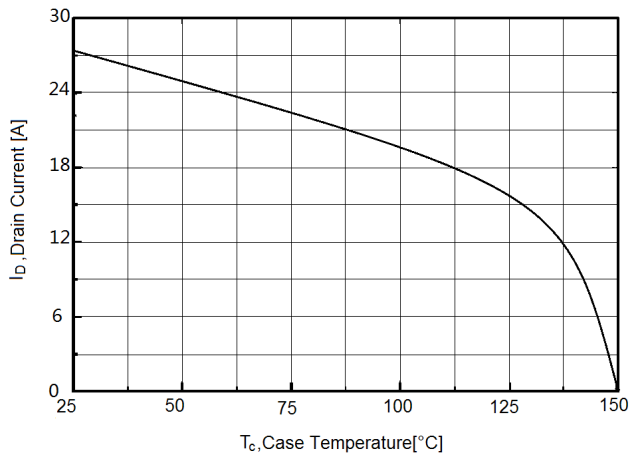
**Figure7.  $R_{DS(ON)}$  vs Junction Temperature**



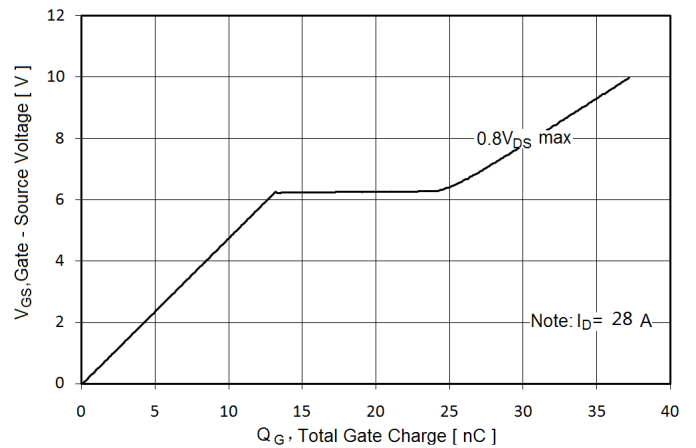
**Figure8.  $BV_{DSS}$  vs Junction Temperature**



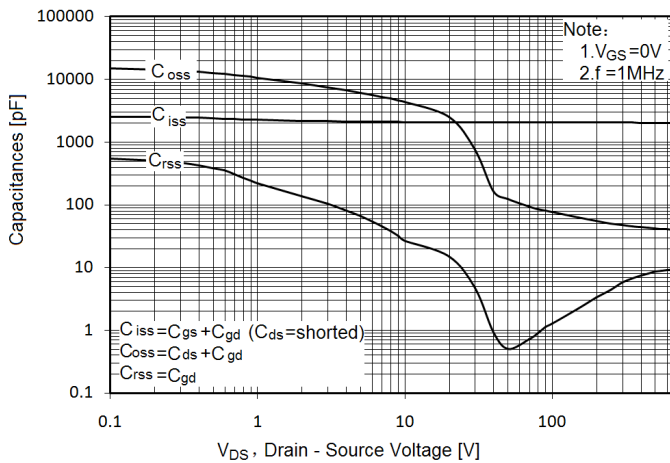
**Figure9. Maximum  $I_D$  vs Junction Temperature**



**Figure10. Gate charge waveforms**

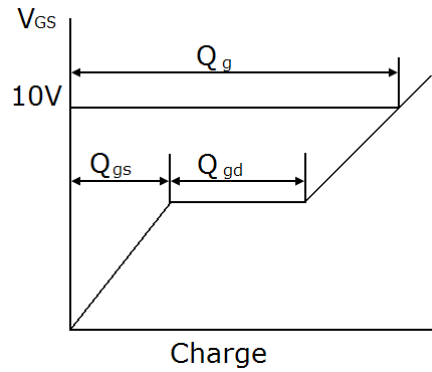
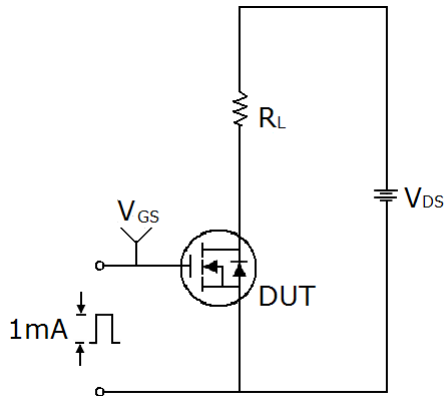


**Figure11. Capacitance**

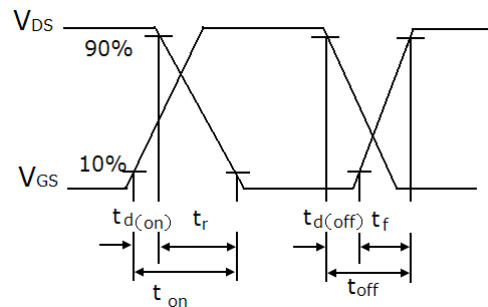
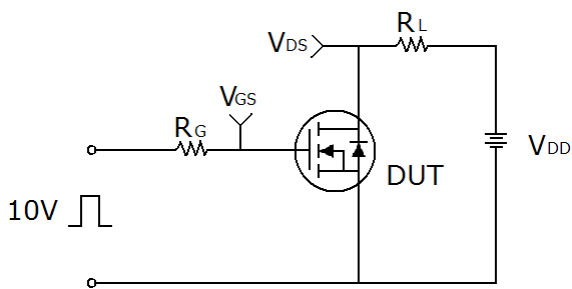


## Test circuit

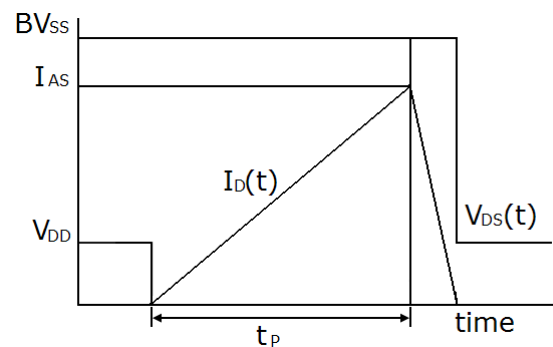
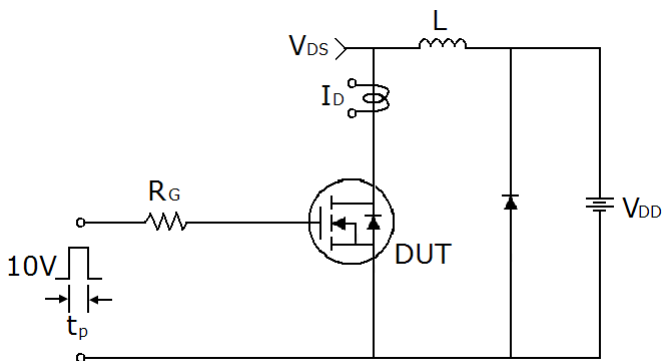
### 1) Gate charge test circuit & Waveform



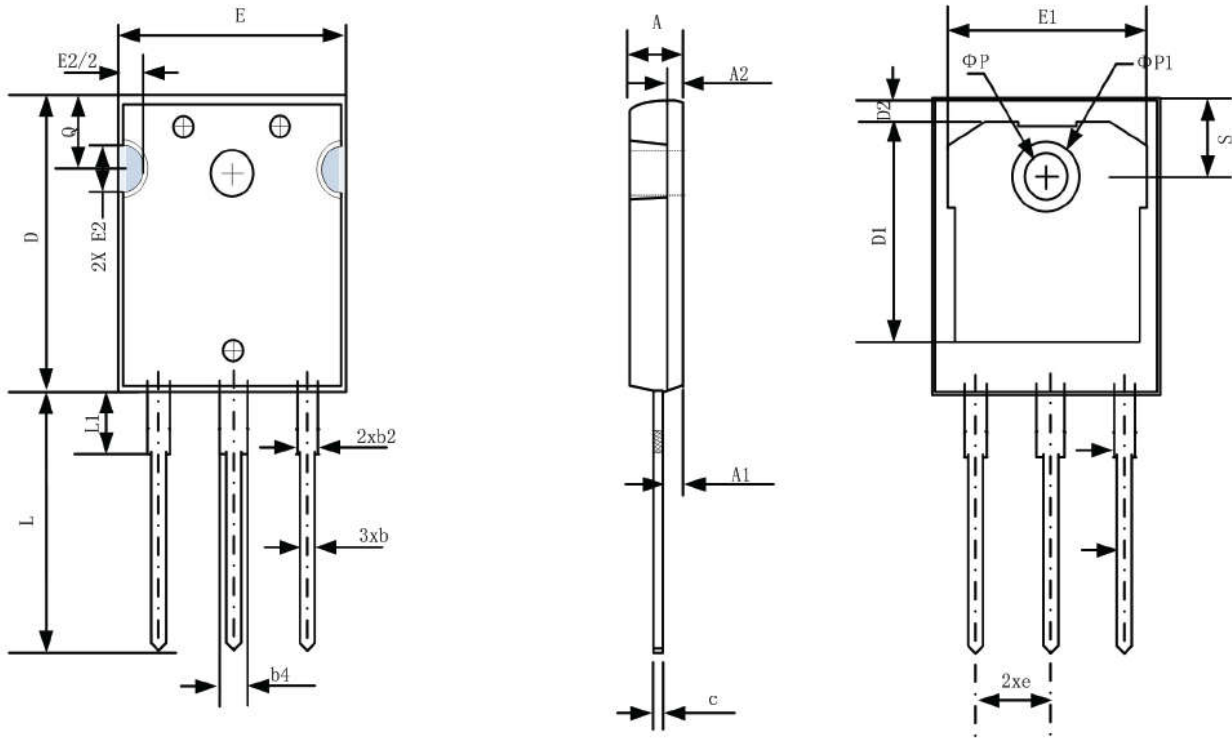
### 2) Switch Time Test Circuit:



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



## O-247-3L (GM) Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.83	5.21	0.190	0.205
A1	2.29	2.55	0.090	0.100
A2	1.50	2.49	0.059	0.098
b	1.12	1.33	0.044	0.052
b2	1.91	2.39	0.075	0.094
b4	2.87	3.22	0.113	0.127
c	0.55	0.69	0.022	0.027
D	20.80	21.10	0.819	0.831
D1	16.25	17.65	0.640	0.695
D2	0.51	1.35	0.020	0.053
E	15.75	16.13	0.620	0.635
E1	13.46	14.16	0.530	0.557
E2	4.32	5.49	0.170	0.216
e	5.44 BSC		0.214 BSC	
L	19.81	20.32	0.780	0.800
L1	4.10	4.40	0.161	0.173
ΦP	3.56	3.65	0.140	0.144
ΦP1	7.19 REF		0.283 REF	
Q	5.39	6.20	0.212	0.244
S	6.04	6.30	0.238	0.248

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