

# N-Channel 650V (D-S) Super Junction Power MOSFET

## PRODUCT SUMMARY

$V_{DS}$ (V) at $T_J$ max.	650	
$R_{DS(on)}$ typ. ( $\Omega$ ) at 25 °C	$V_{GS} = 10$ V	0.160

## FEATURES

- Low figure-of-merit (FOM)  $R_{on} \times Q_g$
- Low input capacitance ( $C_{iss}$ )
- Reduced switching and conduction losses
- Ultra low gate charge ( $Q_g$ )
- Avalanche energy rated (UIS)

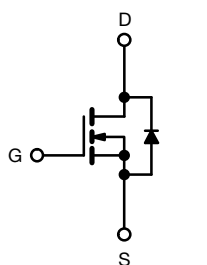


**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

TO-252



Top View



N-Channel MOSFET

## APPLICATIONS

- Server and telecom power supplies
- Switch mode power supplies (SMPS)
- Power factor correction power supplies (PFC)
- Lighting
  - High-intensity discharge (HID)
  - Fluorescent ballast lighting
- Industrial
  - Welding
  - Induction heating
  - Motor drives
  - Battery chargers
  - Renewable energy
  - Solar (PV inverters)

## ABSOLUTE MAXIMUM RATINGS ( $T_C = 25$ °C, unless otherwise noted)

PARAMETER			SYMBOL	LIMIT	UNIT
Drain-source voltage			V <sub>DS</sub>	650	V
Gate-source voltage			V <sub>GS</sub>	± 30	
Continuous drain current (T <sub>J</sub> = 150 °C)	V <sub>GS</sub> at 10 V	T <sub>C</sub> = 25 °C	I <sub>D</sub>	20	A
		T <sub>C</sub> = 100 °C		12	
Pulsed drain current <sup>a</sup>			I <sub>DM</sub>	60	
Linear derating factor				1.7	W/°C
Single pulse avalanche energy <sup>b</sup>			E <sub>AS</sub>	380	mJ
Maximum power dissipation			P <sub>D</sub>	180	W
Operating junction and storage temperature range			T <sub>J</sub> , T <sub>stg</sub>	-55 to +150	°C
Drain-source voltage slope	T <sub>J</sub> = 125 °C		dV/dt	50	V/ns
Reverse diode dV/dt <sup>d</sup>		5.1			
Soldering recommendations (peak temperature) <sup>c</sup>	For 10 s			260	°C


### Notes

- Repetitive rating; pulse width limited by maximum junction temperature
- $V_{DD} = 100$  V, starting  $T_J = 25$  °C,  $L = 30$  mH,  $R_g = 25$   $\Omega$ ,  $I_{AS} = 1.0$  A
- 1.6 mm from case
- $I_{SD} \leq I_D$ ,  $dI/dt = 100$  A/ $\mu$ s, starting  $T_J = 25$  °C

**THERMAL RESISTANCE RATINGS**

PARAMETER	SYMBOL	TYP.	MAX.	UNIT
Maximum junction-to-ambient	$R_{thJA}$	-	62	°C/W
Maximum junction-to-case (drain)	$R_{thJC}$	-	0.85	

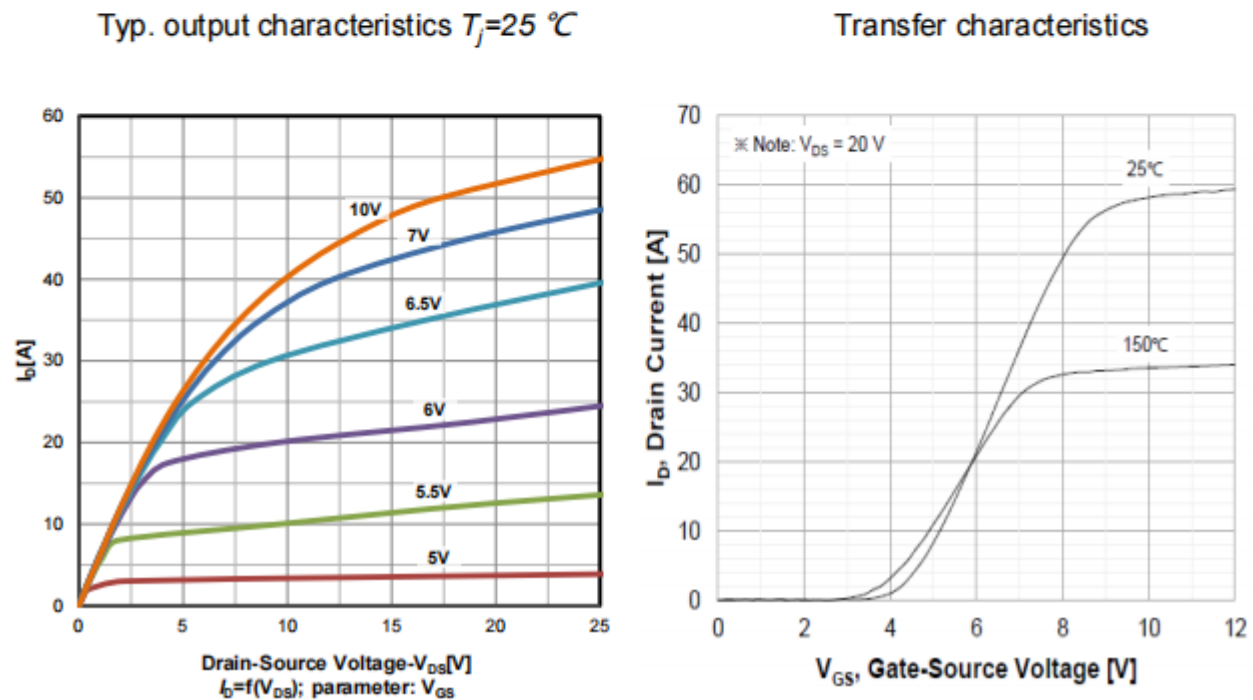
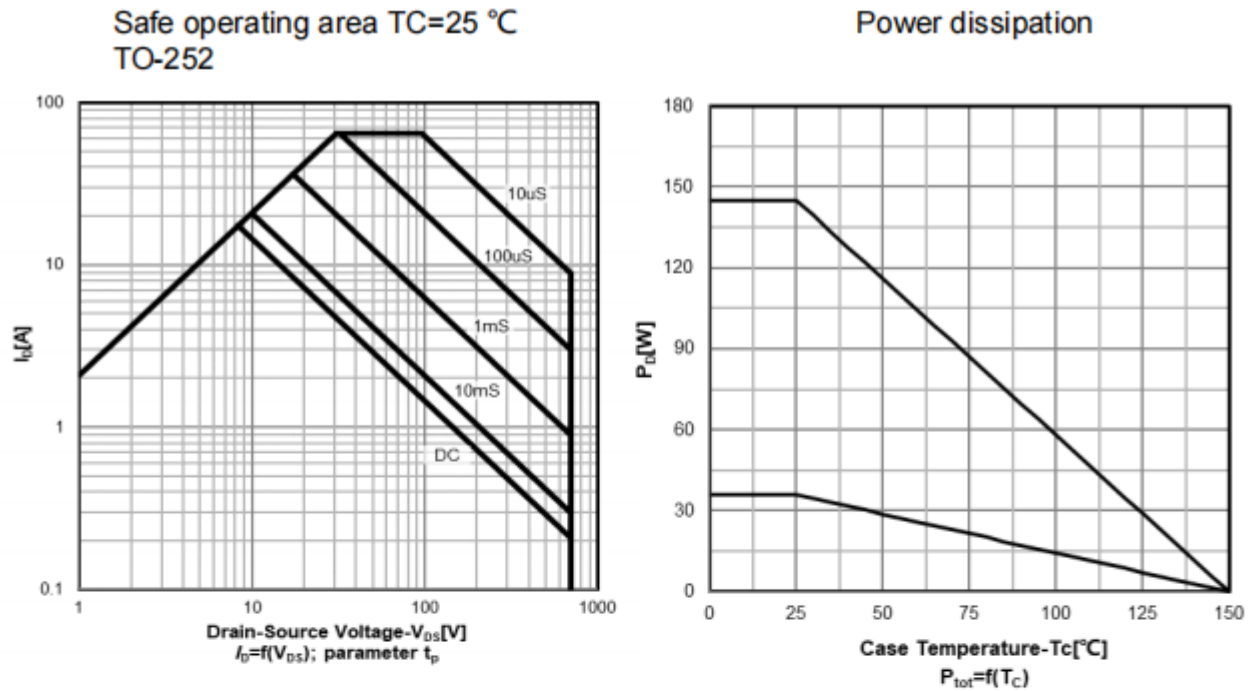
**SPECIFICATIONS** ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN.	TYP.	MAX.	UNIT
Static							
Drain-source breakdown voltage	$V_{DS}$	$V_{GS} = 0\text{ V}$ , $I_D = 250\text{ }\mu\text{A}$		650	-	-	V
$V_{DS}$ temperature coefficient	$\Delta V_{DS}/T_J$	Reference to $25\text{ }^\circ\text{C}$ , $I_D = 1\text{ mA}$		-	1.08	-	$V/^\circ\text{C}$
Gate-source threshold Voltage (N)	$V_{GS(th)}$	$V_{DS} = V_{GS}$ , $I_D = 250\text{ }\mu\text{A}$		2.0	-	4.0	V
Gate-source leakage	$I_{GSS}$	$V_{GS} = \pm 20\text{ V}$		-	-	$\pm 100$	nA
		$V_{GS} = \pm 30\text{ V}$		-	-	$\pm 1$	$\mu\text{A}$
Zero gate voltage drain current	$I_{DSS}$	$V_{DS} = 650\text{ V}$ , $V_{GS} = 0\text{ V}$		-	-	1	$\mu\text{A}$
		$V_{DS} = 520\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 125\text{ }^\circ\text{C}$		-	-	10	
Drain-source on-state resistance	$R_{DS(on)}$	$V_{GS} = 10\text{ V}$	$I_D = 6.5\text{ A}$	-	0.160	-	$\Omega$
Forward transconductance	$g_{fs}$	$V_{DS} = 30\text{ V}$ , $I_D = 12\text{ A}$		-	8.7	-	S
Dynamic							
Input capacitance	$C_{iss}$	$V_{GS} = 0\text{ V}$ , $V_{DS} = 100\text{ V}$ , $f = 1\text{ MHz}$		-	2800	-	pF
Output capacitance	$C_{oss}$			-	51	-	
Reverse transfer capacitance	$C_{rss}$			-	12	-	
Effective output capacitance, energy related <sup>a</sup>	$C_{o(er)}$	$V_{DS} = 0\text{ V to } 480\text{ V}$ , $V_{GS} = 0\text{ V}$		-	52	-	
Effective output capacitance, time related <sup>b</sup>	$C_{o(tr)}$			-	205	-	
Total gate charge	$Q_g$	$V_{GS} = 10\text{ V}$	$I_D = 12\text{ A}$ , $V_{DS} = 480\text{ V}$	-	25	-	nC
Gate-source charge	$Q_{gs}$			-	8	-	
Gate-drain charge	$Q_{gd}$			-	10	-	
Turn-on delay time	$t_{d(on)}$	$V_{DD} = 480\text{ V}$ , $I_D = 12\text{ A}$ , $V_{GS} = 10\text{ V}$ , $R_g = 9.1\text{ }\Omega$		-	12	24	ns
Rise time	$t_r$			-	14	23	
Turn-off delay time	$t_{d(off)}$			-	61	110	
Fall time	$t_f$			-	16	-	
Gate input resistance	$R_g$	$f = 1\text{ MHz}$ , open drain		0.3	0.7	1.4	$\Omega$
Drain-Source Body Diode Characteristics							
Continuous source-drain diode current	$I_S$	MOSFET symbol showing the integral reverse p - n junction diode 		-	-	20	A
Pulsed diode forward current	$I_{SM}$			-	-	60	
Diode forward voltage	$V_{SD}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_S = 12\text{ A}$ , $V_{GS} = 0\text{ V}$		-	-	1.2	V
Reverse recovery time	$t_{rr}$	$T_J = 25\text{ }^\circ\text{C}$ , $I_F = I_S = 12\text{ A}$ , $dI/dt = 100\text{ A}/\mu\text{s}$ , $V_R = 25\text{ V}$		-	70	140	ns
Reverse recovery charge	$Q_{rr}$			-	6.4	12.8	$\mu\text{C}$
Reverse recovery current	$I_{RRM}$			-	27	-	A

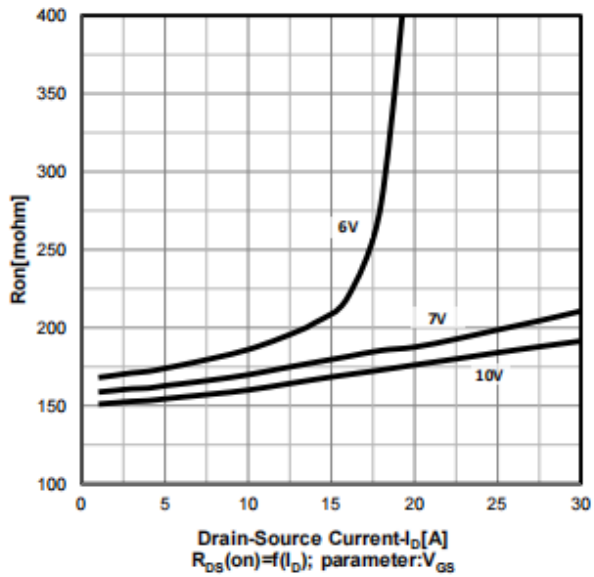
**Notes**

- a.  $C_{oss(er)}$  is a fixed capacitance that gives the same energy as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$   
 b.  $C_{oss(tr)}$  is a fixed capacitance that gives the same charging time as  $C_{oss}$  while  $V_{DS}$  is rising from 0 % to 80 %  $V_{DSS}$

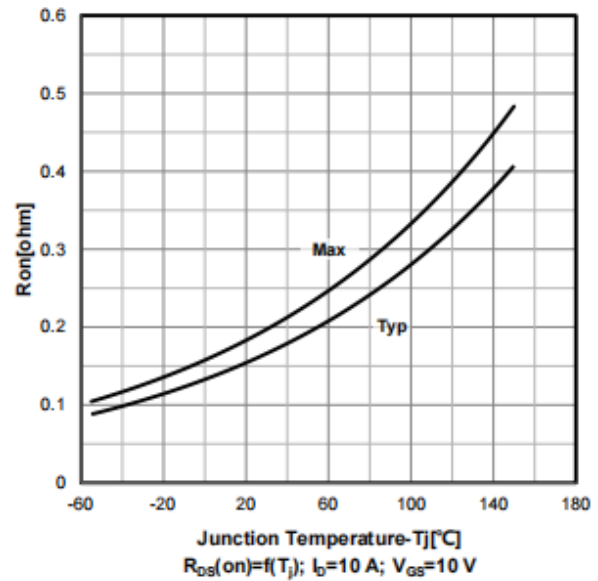
**TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



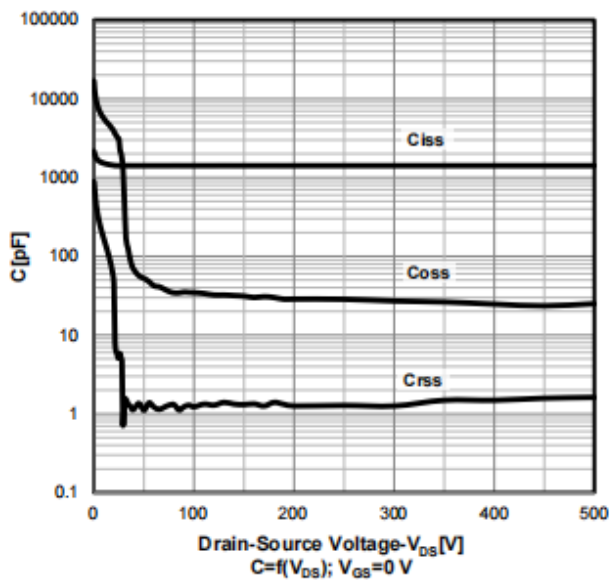
Typ. drain-source on-state resistance



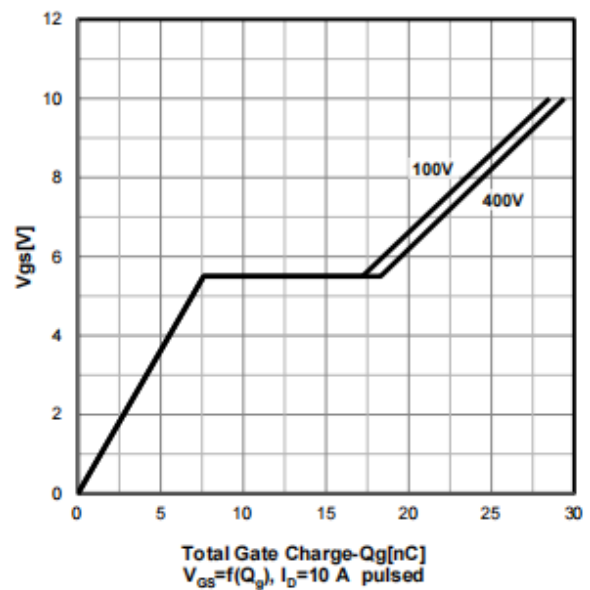
On-resistance vs temperature



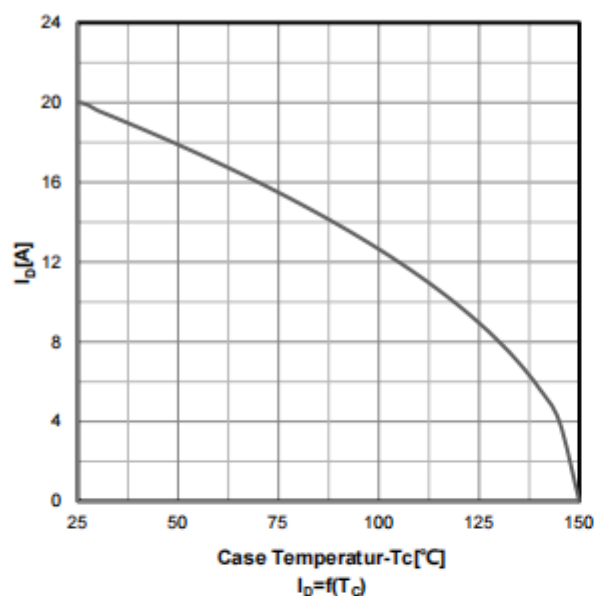
Typ. capacitances



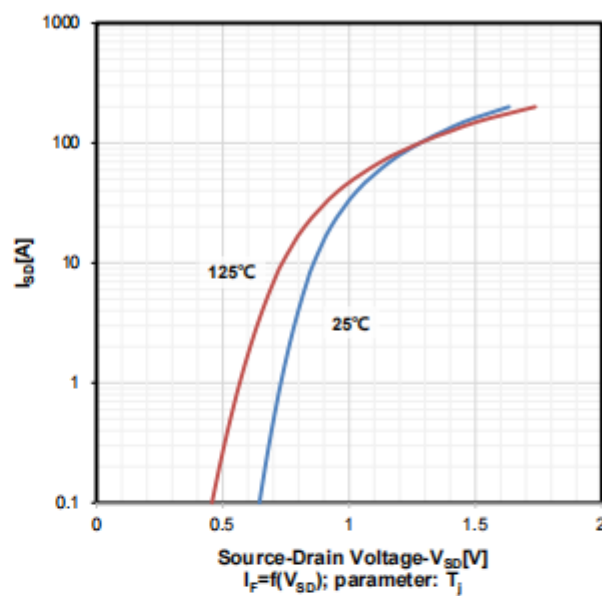
Typ. gate charge characteristics



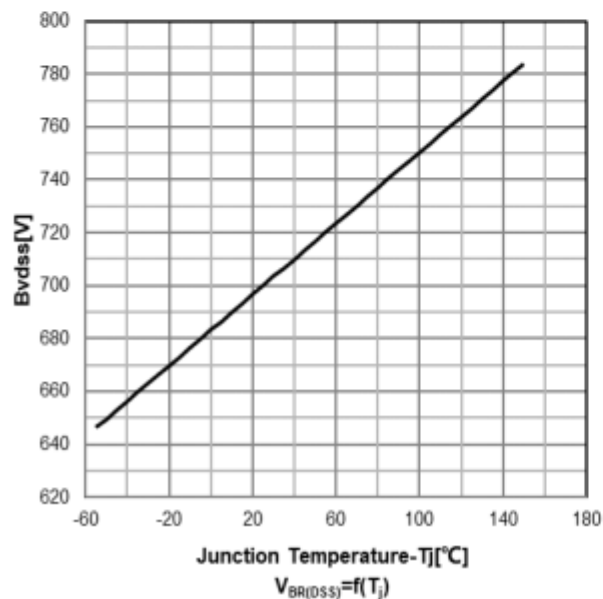
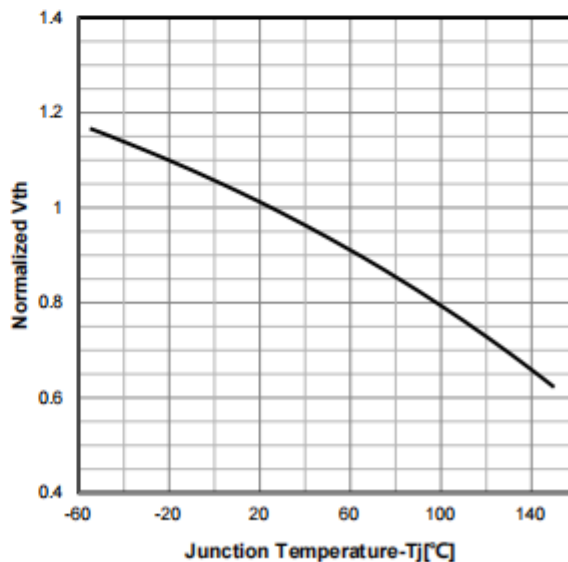
Drain current vs temperature



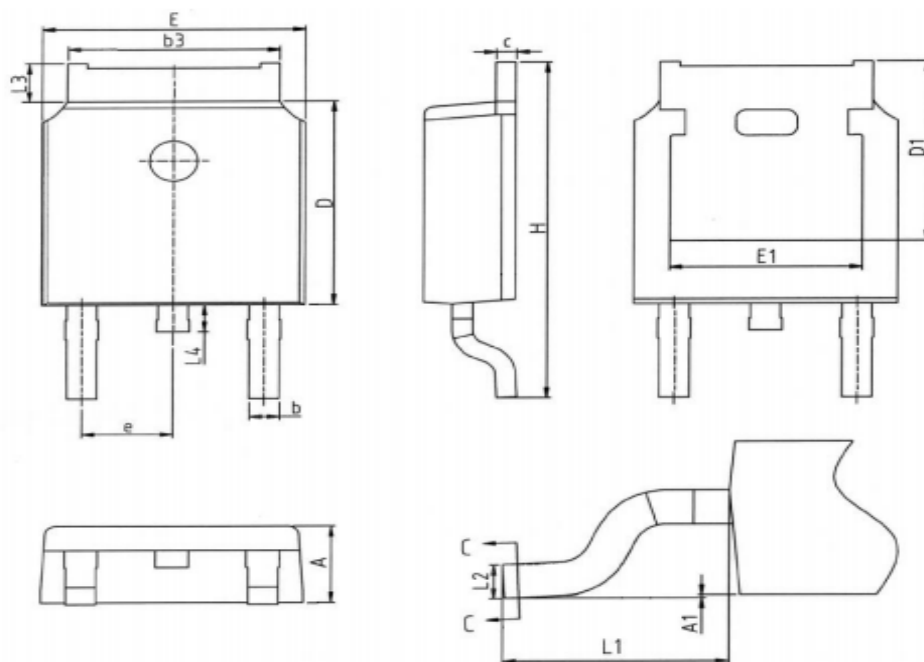
Forward characteristics of reverse diode



Drain-source breakdown voltage

Normalized  $V_{GS(th)}$  characteristics

Package Outline : TO 252



COMMON DIMENSIONS

SYMBOL	UNIT(mm)		
	MIN	NOM	MAX
A	2.20	2.30	2.40
A1	0.00	-	0.127
b	0.66	0.78	0.90
b3	5.16	5.31	5.46
c	0.43	0.53	0.63
D	5.98	6.10	6.22
D1	5.30REF		
E	6.40	6.60	6.75
E1	4.63	-	-
e	2.286BSC		
H	9.40	10.10	10.50
L1	2.90REF		
L2	0.51BSC		
L3	0.88	1.08	1.28
L4	0.50	0.80	1.00

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