



## Description

The HAOD538 uses advanced trench technology to provide excellent  $R_{DS(ON)}$ , low gate charge and operation with gate voltages as low as 4.5V. This device is suitable for use as a Battery protection or in other Switching application.



TO-252-2L

## General Features

$V_{DS} = 30V$   $I_D = 150A$

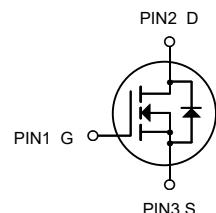
$R_{DS(ON)} < 2.9\text{ m}\Omega$  @  $V_{GS}=10V$

## Application

Battery protection

Load switch

Uninterruptible power supply



N-Channel MOSFET

## Package Marking and Ordering Information

Product ID	Pack	Brand	Qty(PCS)
HAOD538	TO-252-2L	HXY MOSFET	2500

## Absolute Maximum Ratings ( $T_c=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Rating	Units
$V_{DS}$	Drain-Source Voltage	30	V
$V_{GS}$	Gate-Source Voltage	$\pm 20$	V
$I_D @ T_c=25^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10V^1$	150	A
$I_D @ T_c=100^\circ\text{C}$	Continuous Drain Current, $V_{GS} @ 10V^1$	80	A
$I_{DM}$	Pulsed Drain Current <sup>2</sup>	450	A
EAS	Single Pulse Avalanche Energy <sup>3</sup>	580	mJ
$I_{AS}$	Avalanche Current	60	A
$P_D @ T_c=25^\circ\text{C}$	Total Power Dissipation <sup>4</sup>	87	W
$T_{STG}$	Storage Temperature Range	-55 to 150	$^\circ\text{C}$
$T_J$	Operating Junction Temperature Range	-55 to 150	$^\circ\text{C}$
$R_{\theta JA}$	Thermal Resistance Junction-Ambient 1	62	$^\circ\text{C}/\text{W}$
$R_{\theta JC}$	Thermal Resistance Junction-Case1	2.1	$^\circ\text{C}/\text{W}$



**Electrical characteristic (  $T_J = 25^\circ\text{C}$  unless otherwise specified )**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$\text{BV}_{\text{DSS}}$	Drain to source breakdown voltage	$V_{\text{GS}}=0\text{V}$ , $I_{\text{D}}=250\text{uA}$	30			V
$\Delta \text{BV}_{\text{DSS}} / \Delta T_J$	Breakdown voltage temperature coefficient	$I_{\text{D}}=250\text{uA}$ , referenced to $25^\circ\text{C}$		0.02		$\text{V}/^\circ\text{C}$
$I_{\text{DSS}}$	Drain to source leakage current	$V_{\text{DS}}=30\text{V}$ , $V_{\text{GS}}=0\text{V}$			1	$\text{uA}$
		$V_{\text{DS}}=24\text{V}$ , $T_J=125^\circ\text{C}$			50	$\text{uA}$
$I_{\text{GSS}}$	Gate to source leakage current, forward	$V_{\text{GS}}=20\text{V}$ , $V_{\text{DS}}=0\text{V}$			100	$\text{nA}$
	Gate to source leakage current, reverse	$V_{\text{GS}}=-20\text{V}$ , $V_{\text{DS}}=0\text{V}$			-100	$\text{nA}$
$V_{\text{GS(TH)}}$	Gate threshold voltage	$V_{\text{DS}}=V_{\text{GS}}$ , $I_{\text{D}}=250\text{uA}$	1.2		2.4	V
$R_{\text{DS(ON)}}$	Drain to source on state resistance	$V_{\text{GS}}=4.5\text{V}$ , $I_{\text{D}}=30\text{A}$ , $T_J=25^\circ\text{C}$		2.2	4.8	$\text{m}\Omega$
		$V_{\text{GS}}=10\text{V}$ , $I_{\text{D}}=30\text{A}$ , $T_J=25^\circ\text{C}$		1.5	2.9	$\text{m}\Omega$
		$V_{\text{GS}}=10\text{V}$ , $I_{\text{D}}=30\text{A}$ , $T_J=125^\circ\text{C}$		2.5		$\text{m}\Omega$
$G_{\text{fs}}$	Forward transconductance	$V_{\text{DS}}=5\text{V}$ , $I_{\text{D}}=30\text{A}$		73		S
$C_{\text{iss}}$	Input capacitance	$V_{\text{GS}}=0\text{V}$ , $V_{\text{DS}}=15\text{V}$ , $f=1\text{MHz}$		6272		pF
$C_{\text{oss}}$	Output capacitance			1022		
$C_{\text{rss}}$	Reverse transfer capacitance			718		
$t_{\text{d(on)}}$	Turn on delay time	$V_{\text{DS}}=15\text{V}$ , $I_{\text{D}}=30\text{A}$ , $R_{\text{G}}=4.7\Omega$ , $V_{\text{GS}}=10\text{V}$ (note 4,5)		20		ns
$t_r$	Rising time			58		
$t_{\text{d(off)}}$	Turn off delay time			158		
$t_f$	Fall time			77		
$Q_g$	Total gate charge	$V_{\text{DS}}=24\text{V}$ , $V_{\text{GS}}=10\text{V}$ , $I_{\text{D}}=30\text{A}$ , $I_{\text{G}}=5\text{mA}$ (note 4,5)		143		nC
$Q_{\text{gs}}$	Gate-source charge			17		
$Q_{\text{gd}}$	Gate-drain charge			43		
$R_{\text{g}}$	Gate resistance	$V_{\text{DS}}=0\text{V}$ , Scan F mode		4.2		$\Omega$
$I_s$	Continuous source current	Integral reverse p-n Junction diode in the MOSFET			110	A
$I_{\text{SM}}$	Pulsed source current				440	A
$V_{\text{SD}}$	Diode forward voltage drop.	$I_{\text{S}}=45\text{A}$ , $V_{\text{GS}}=0\text{V}$			1.4	V
$t_{\text{rr}}$	Reverse recovery time	$I_{\text{S}}=30\text{A}$ , $V_{\text{GS}}=0\text{V}$ , $dI_{\text{F}}/dt=100\text{A}/\text{us}$		26		ns
$Q_{\text{rr}}$	Reverse recovery charge			10		nC

※. Notes

1. Repetitive rating : pulse width limited by junction temperature.
2.  $L = 0.5\text{mH}$ ,  $I_{\text{AS}} = 48\text{A}$ ,  $V_{\text{DD}} = 30\text{V}$ ,  $R_{\text{G}} = 25\Omega$ , Starting  $T_J = 25^\circ\text{C}$
3.  $I_{\text{SD}} \leq 30\text{A}$ ,  $dI/dt = 100\text{A}/\text{us}$ ,  $V_{\text{DD}} \leq \text{BV}_{\text{DSS}}$ , Starting  $T_J = 25^\circ\text{C}$
4. Pulse Test : Pulse Width  $\leq 300\text{us}$ , duty cycle  $\leq 2\%$ .



## Typical Electrical and Thermal Characteristics

Fig. 1. On-state characteristics

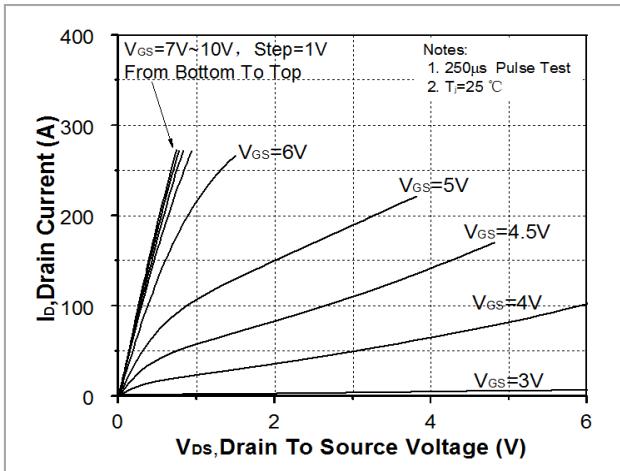


Fig. 2. Transfer Characteristics

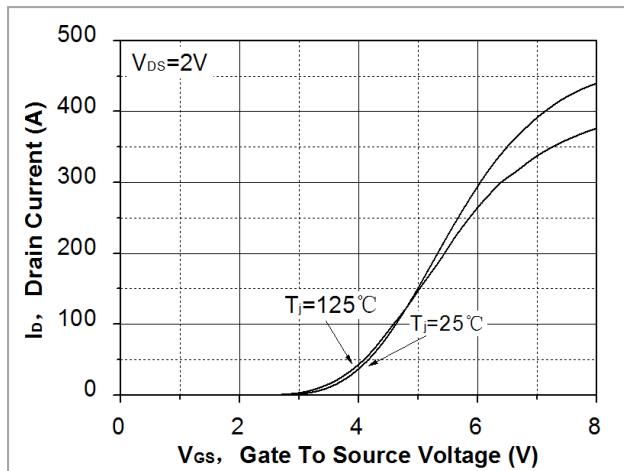


Fig. 3. On-resistance variation vs. drain current and gate voltage

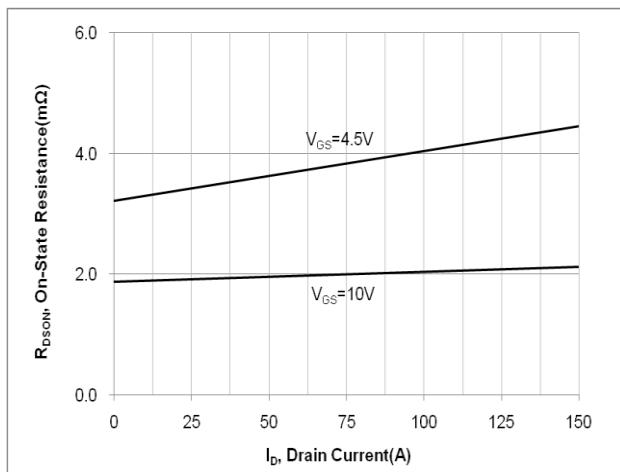


Fig. 4. On-state current vs. diode forward voltage

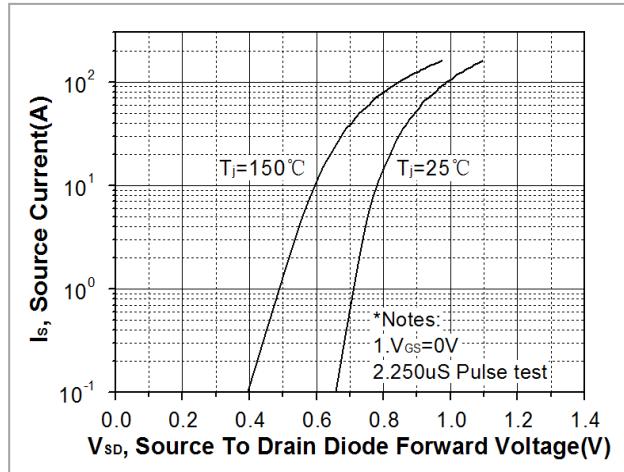


Fig 5. Breakdown voltage variation vs. junction temperature

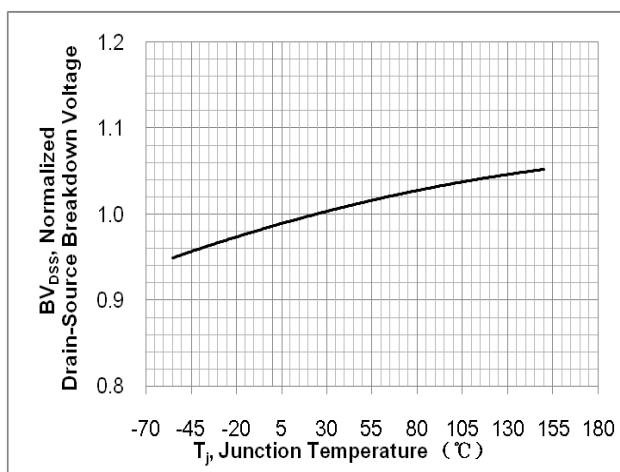


Fig. 6. On-resistance variation vs. junction temperature

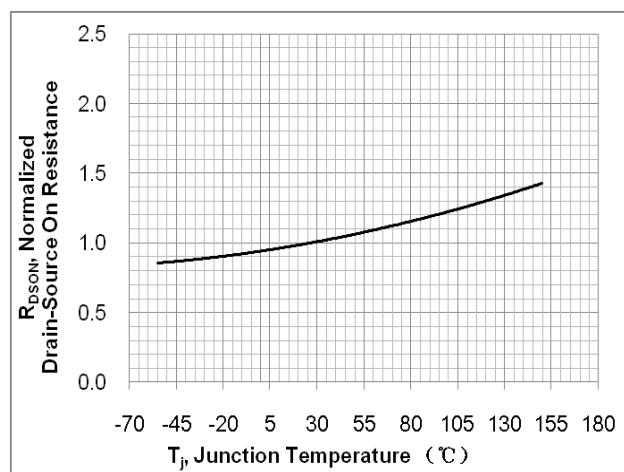




Fig. 7. Gate charge characteristics

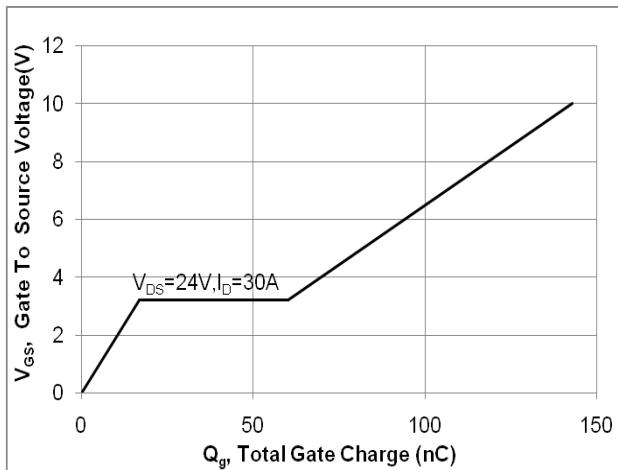


Fig. 8. Capacitance Characteristics

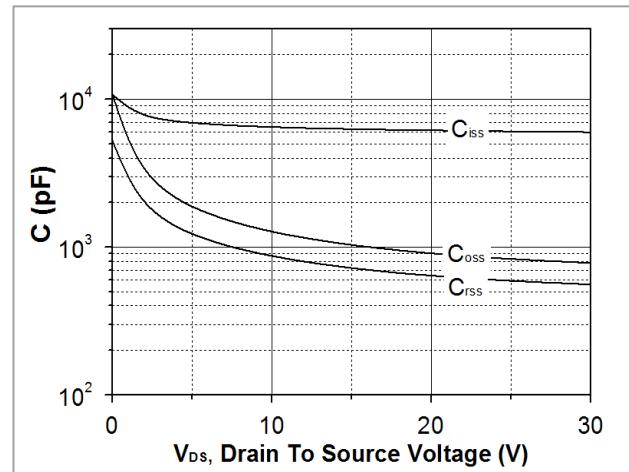


Fig. 9. Maximum safe operating area

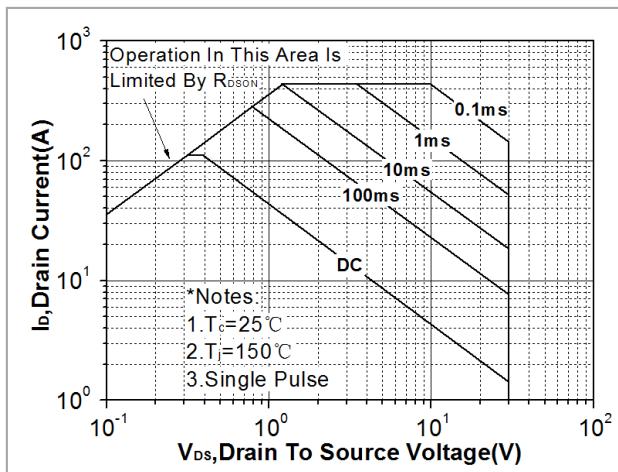


Fig. 10. Maximum drain current vs. case temperature

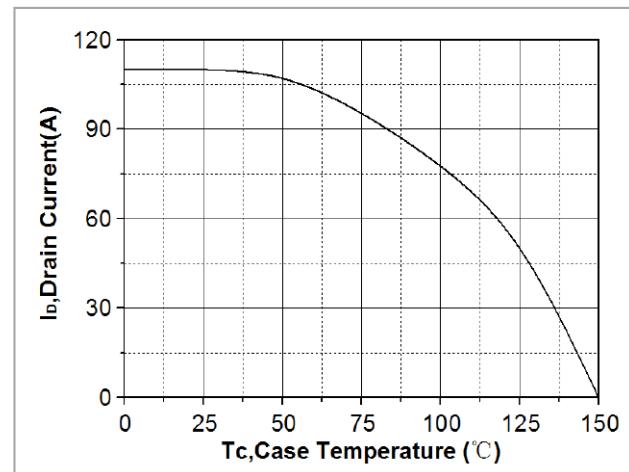
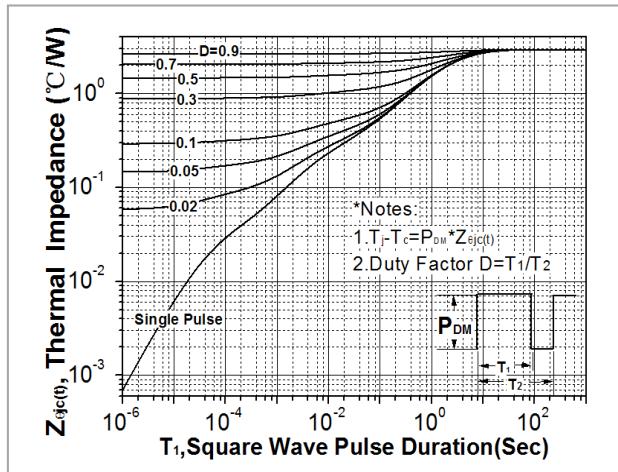


Fig. 11. Transient thermal response curve





## Test Circuit

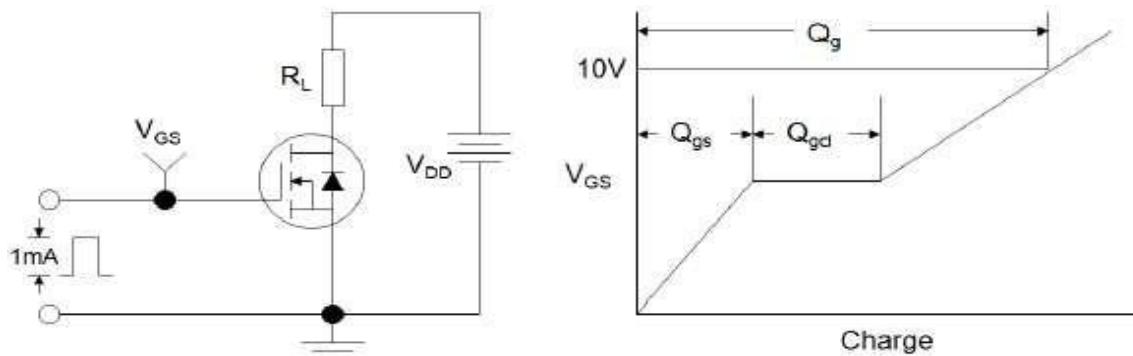


Figure1:Gate Charge Test Circuit & Waveform

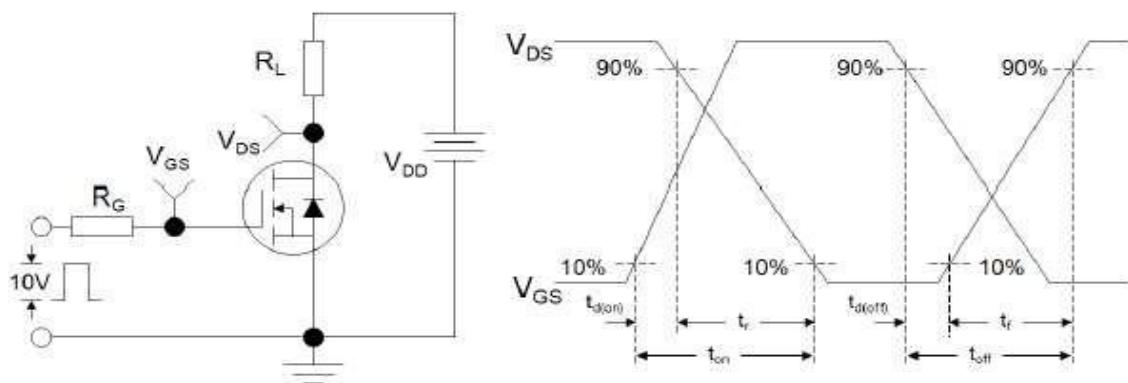


Figure 2: Resistive Switching Test Circuit & Waveforms

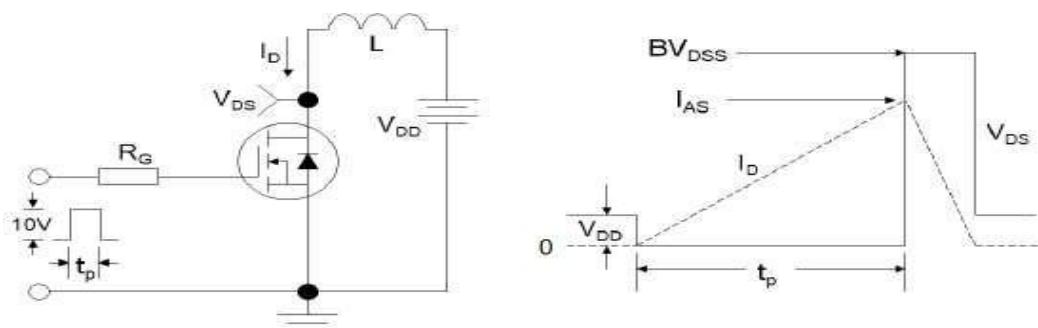
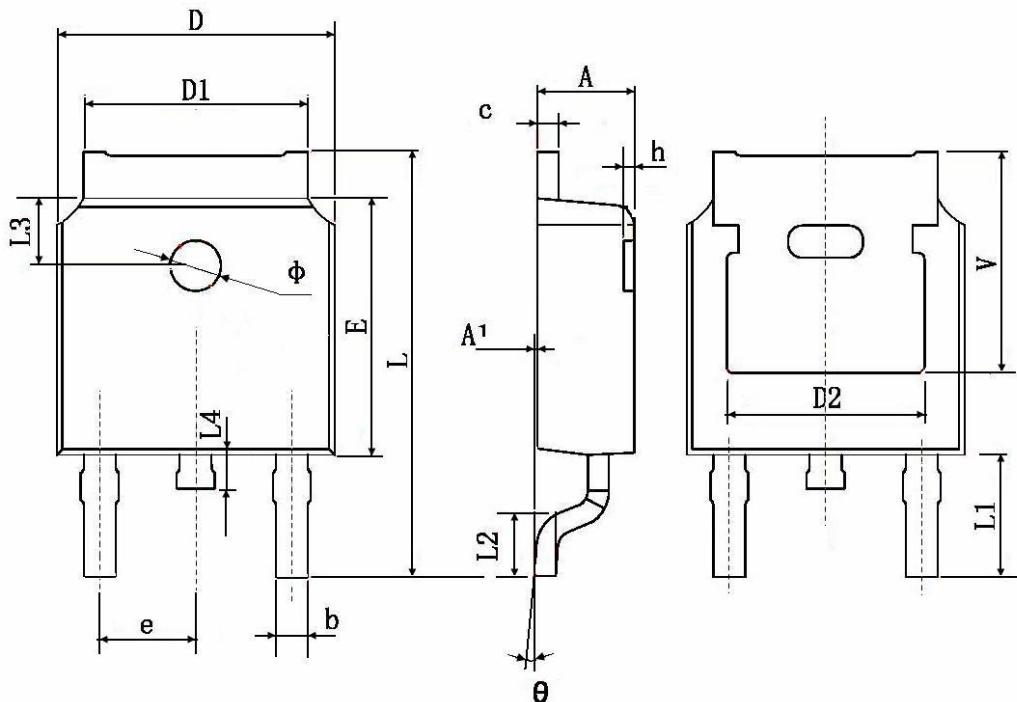


Figure 3:Unclamped Inductive Switching Test Circuit & Waveforms



## TO-252-2L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	2.200	2.400	0.087	0.094
A1	0.000	0.127	0.000	0.005
b	0.660	0.860	0.026	0.034
c	0.460	0.580	0.018	0.023
D	6.500	6.700	0.256	0.264
D1	5.100	5.460	0.201	0.215
D2	0.483 TYP.		0.190 TYP.	
E	6.000	6.200	0.236	0.244
e	2.186	2.386	0.086	0.094
L	9.800	10.400	0.386	0.409
L1	2.900 TYP.		0.114 TYP.	
L2	1.400	1.700	0.055	0.067
L3	1.600 TYP.		0.063 TYP.	
L4	0.600	1.000	0.024	0.039
phi	1.100	1.300	0.043	0.051
theta	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 TYP.		0.211 TYP.	



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