
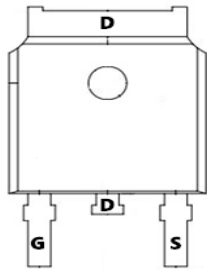


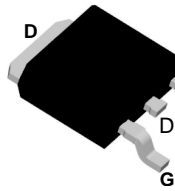
TMN4060D

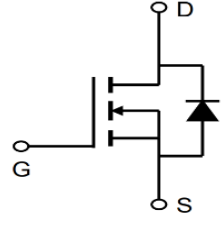
N-Channel Enhancement Mosfet

<p><b>General Description</b></p> <ul style="list-style-type: none"> <li>• Low <math>R_{DS(ON)}</math></li> <li>• RoHS and Halogen-Free Compliant</li> </ul> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>• Load switch</li> <li>• PWM</li> </ul>	<p><b>General Features</b></p> <p><math>V_{DS} = 40V</math> <math>I_D = 60A</math></p> <p><math>R_{DS(ON)} = 7.7m\Omega</math> (Typ.) @ <math>V_{GS} = 10V</math></p> <p>100% UIS Tested                  100% <math>R_g</math> Tested</p> 
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D:TO-252-3





Marking: 60N04

**Absolute Maximum Ratings ( $T_C = 25^\circ C$  unless otherwise noted)**

Symbol	Parameter	Rating	Unit	
<b>Common Ratings (<math>T_A = 25^\circ C</math> Unless Otherwise Noted)</b>				
$V_{DSS}$	Drain-Source Voltage	40	V	
$BV_{DS(Avalanche)}^*$	Drain-Source Avalanche Voltage (Maximum)	45		
$V_{GSS}$	Gate-Source Voltage	$\pm 20$		
$T_J$	Maximum Junction Temperature	175	$^\circ C$	
$T_{STG}$	Storage Temperature Range	-55 to 175	$^\circ C$	
$I_S$	Diode Continuous Forward Current	60	A	
$I_{DP}$	300 $\mu s$ Pulse Drain Current Tested	$T_C = 25^\circ C$	160	A
		$T_C = 100^\circ C$	90	
$I_D$	Continuous Drain Current	$T_C = 25^\circ C$	60	A
		$T_C = 100^\circ C$	48	
$P_D$	Maximum Power Dissipation	$T_C = 25^\circ C$	60	W
		$T_C = 100^\circ C$	30	
$R_{\theta JC}$	Thermal Resistance-Junction to Case	2.5	$^\circ C/W$	
$R_{\theta JA}$	Thermal Resistance-Junction to Ambient	50	$^\circ C/W$	
$E_{AS}^{**}$	Drain-Source Avalanche Energy	L=0.5mH	100	mJ

Notes : \* Avalanche single pulse test and avalanche period time  $t_{av} \leq 100 \mu s$ , duty < 1% .  
 \*\* Avalanche test condition:  $T_J = 25^\circ C$ , L=0.5mH,  $I_{AS} = 20A$ ,  $V_{DD} = 30V$ , and  $V_{GS} = 10V$ .  
 \*\*\* Current limited by bond wire.

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

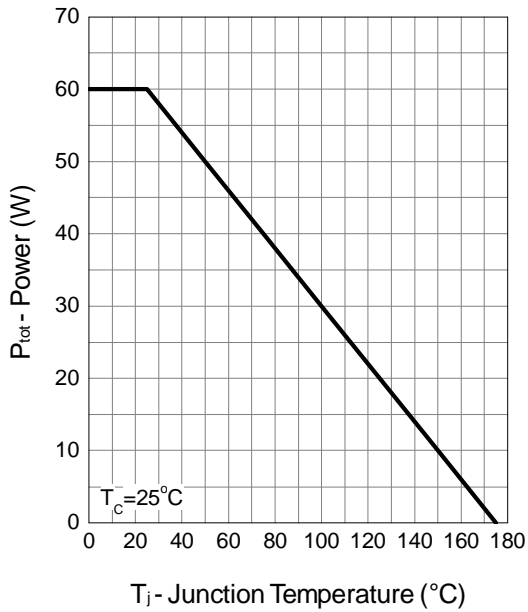
Symbol	Parameter	Test Conditions	XP4184			Unit
			Min.	Typ.	Max.	
<b>Static Characteristics</b>						
$BV_{DSS}$	Drain-Source Breakdown Voltage	$V_{GS}=0V, I_{DS}=250\mu A$	40	-	-	V
$I_{DSS}$	Zero Gate Voltage Drain Current	$V_{DS}=32V, V_{GS}=0V$	-	-	1	$\mu A$
		$T_J=85^{\circ}\text{C}$	-	-	30	
$V_{GS(th)}$	Gate Threshold Voltage	$V_{DS}=V_{GS}, I_{DS}=250\mu A$	1.0	1.5	2	V
$I_{GSS}$	Gate Leakage Current	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
$R_{DS(ON)}^a$	Drain-Source On-state Resistance	$V_{GS}=10V, I_{DS}=20A$	-	7.8	11	m $\Omega$
		$V_{GS}=4.5V, I_{DS}=10A$	-	10	18	
<b>Diode Characteristics</b>						
$V_{SD}^a$	Diode Forward Voltage	$I_{SD}=20A, V_{GS}=0V$	-	0.8	1.1	V
$t_{rr}$	Reverse Recovery Time	$I_{DS}=40A,$ $di_{SD}/dt=100A/\mu s$	-	28	-	ns
$Q_{rr}$	Reverse Recovery Charge		-	24	-	nC
<b>Dynamic Characteristics<sup>b</sup></b>						
$R_G$	Gate Resistance	$V_{GS}=0V, V_{DS}=0V, F=1\text{MHz}$	-	1.4	-	$\Omega$
$C_{iss}$	Input Capacitance	$V_{GS}=0V,$ $V_{DS}=20V,$ Frequency=1.0MHz	-	1460	-	pF
$C_{oss}$	Output Capacitance		-	180	-	
$C_{riss}$	Reverse Transfer Capacitance		-	146	-	
$t_{d(ON)}$	Turn-on Delay Time	$V_{DD}=20V, R_L=20\Omega,$ $I_{DS}=1A, V_{GEN}=10V,$ $R_G=6\Omega$	-	11	21	ns
$t_r$	Turn-on Rise Time		-	13	24	
$t_{d(OFF)}$	Turn-off Delay Time		-	37	67	
$t_f$	Turn-off Fall Time		-	11	21	
<b>Gate Charge Characteristics<sup>b</sup></b>						
$Q_g$	Total Gate Charge	$V_{DS}=20V, V_{GS}=10V,$ $I_{DS}=40A$	-	31.2	44	nC
$Q_{gs}$	Gate-Source Charge		-	3.8	-	
$Q_{gd}$	Gate-Drain Charge		-	9	-	

Note a : Pulse test ; pulse width $\leq 300\mu s$ , duty cycle $\leq 2\%$ .

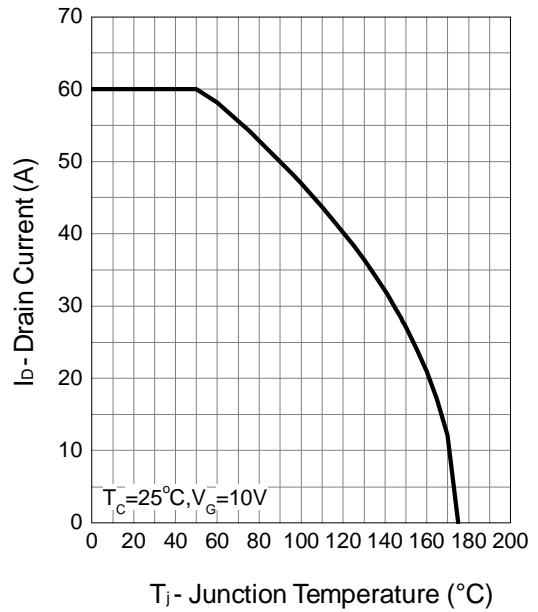
Note b : Guaranteed by design, not subject to production testing.

Typical Performance Characteristics

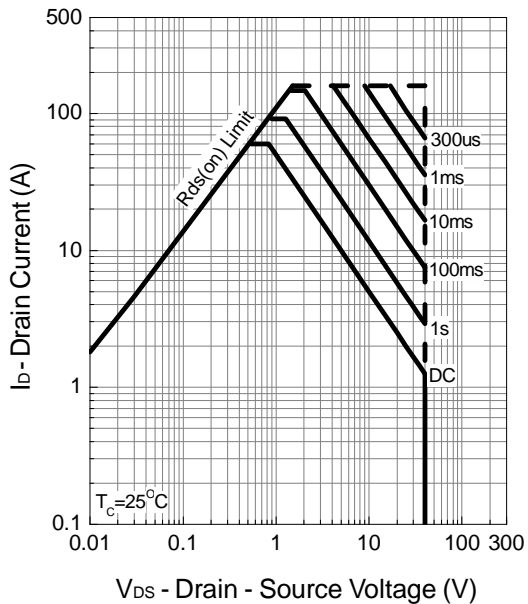
Power Dissipation



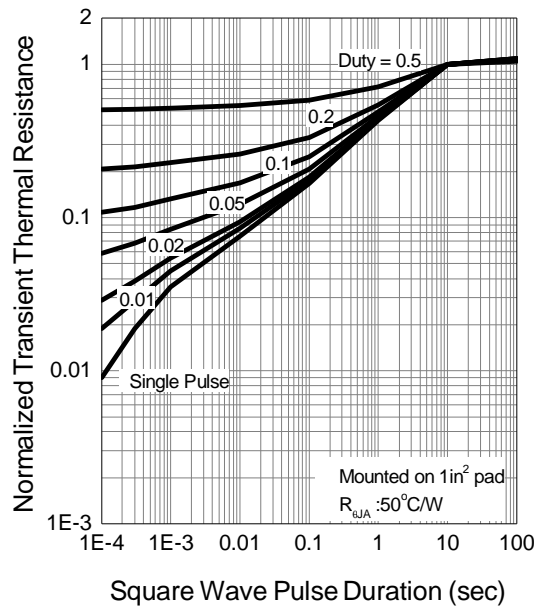
Drain Current



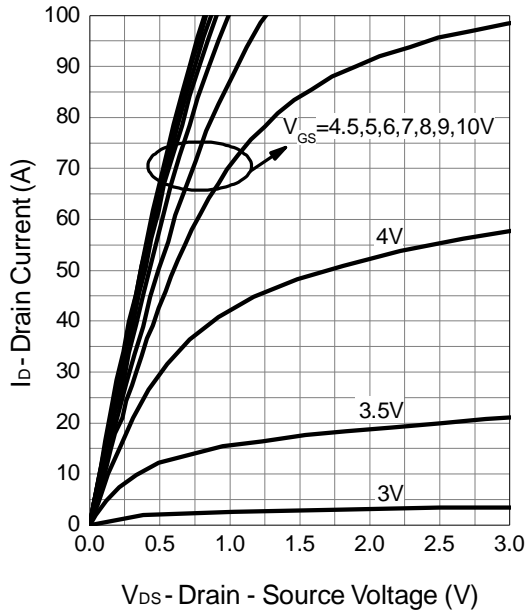
Safe Operation Area



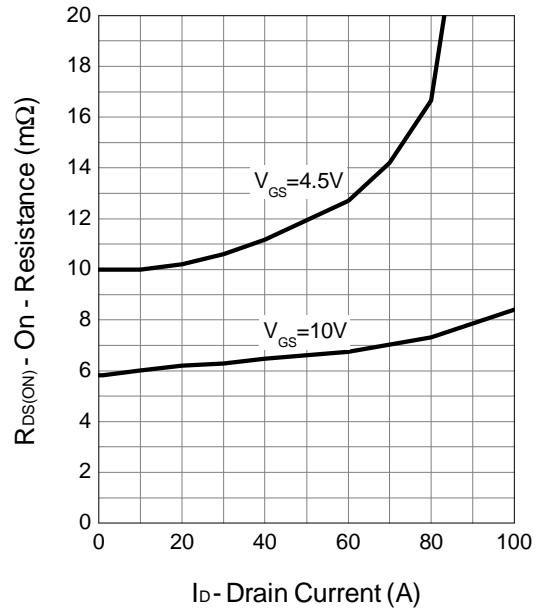
Thermal Transient Impedance



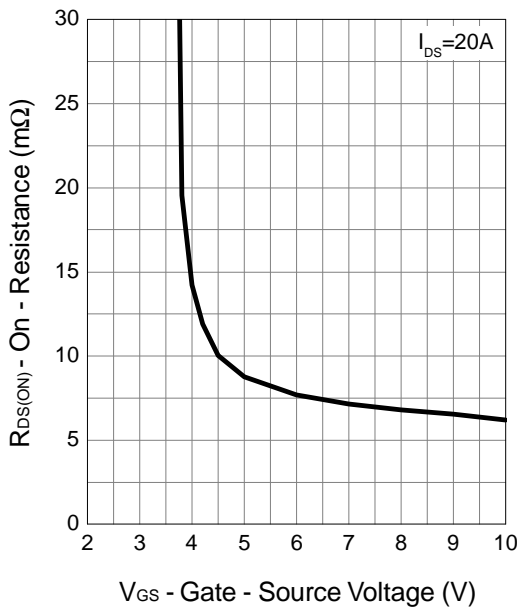
Output Characteristics



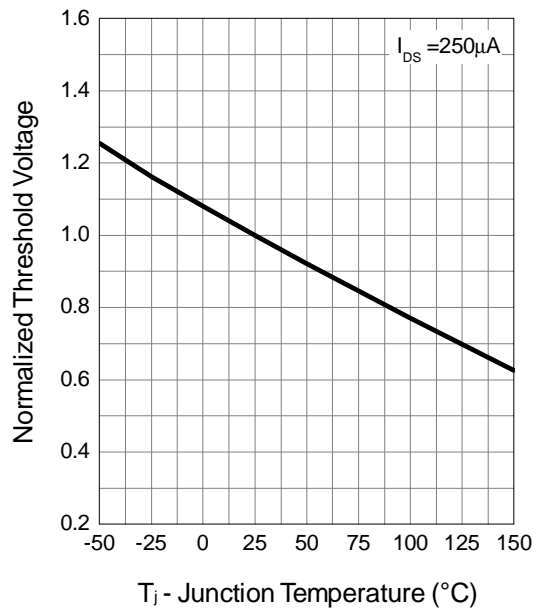
Drain-Source On Resistance



Gate-Source On Resistance

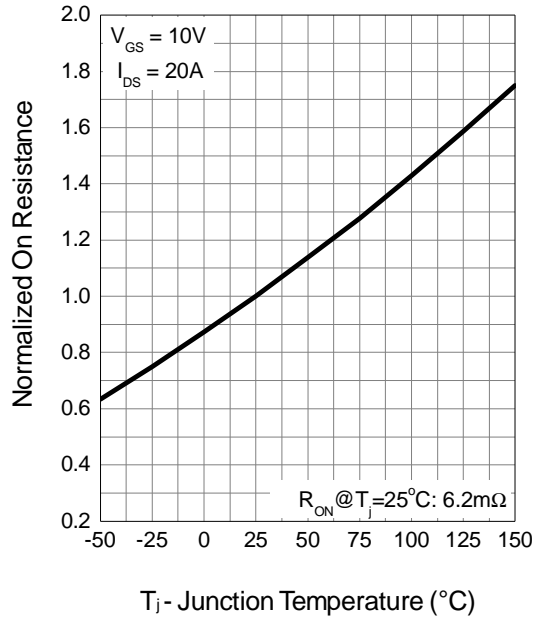


Gate Threshold Voltage

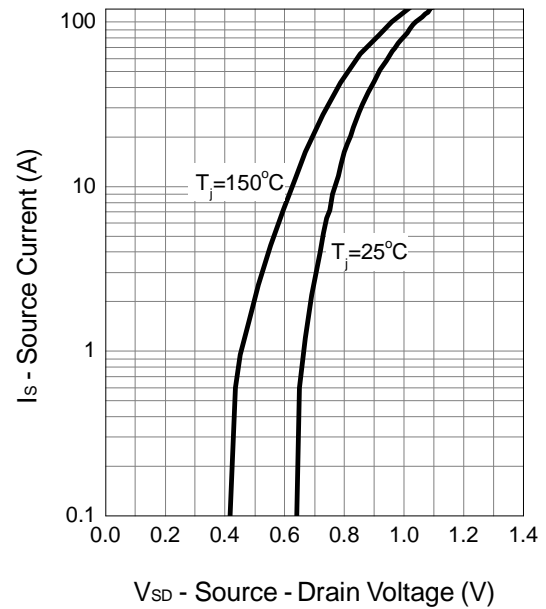




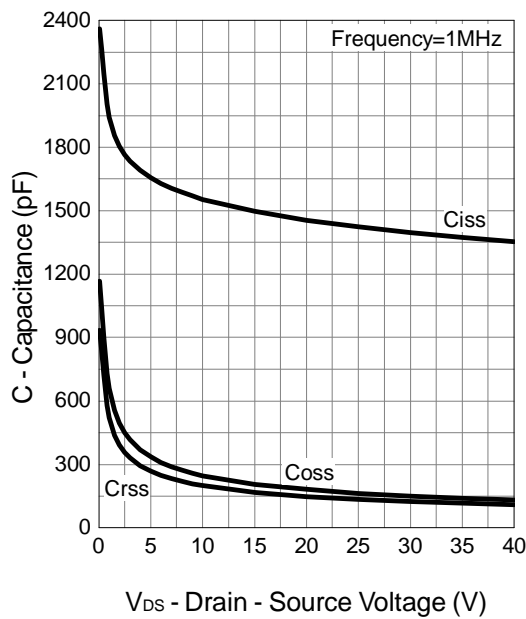
Drain-Source On Resistance



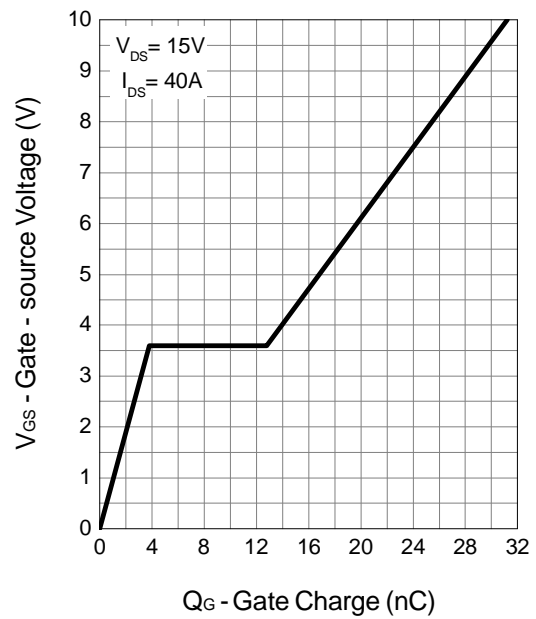
Source-Drain Diode Forward



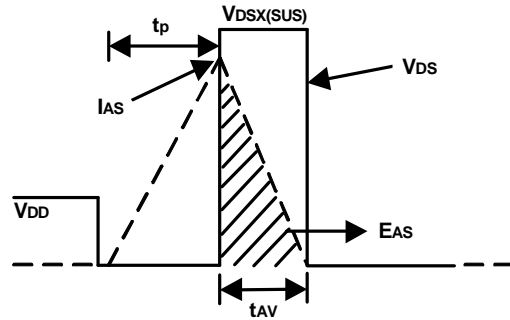
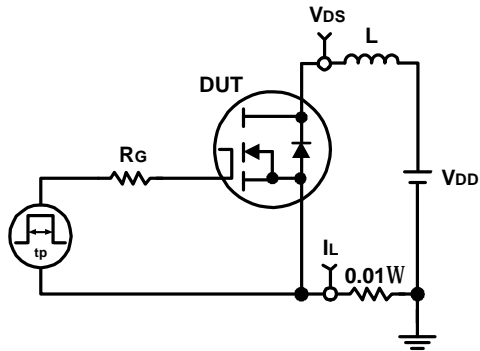
Capacitance



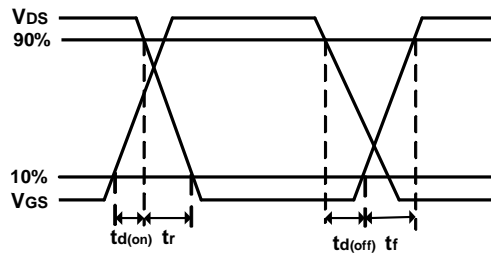
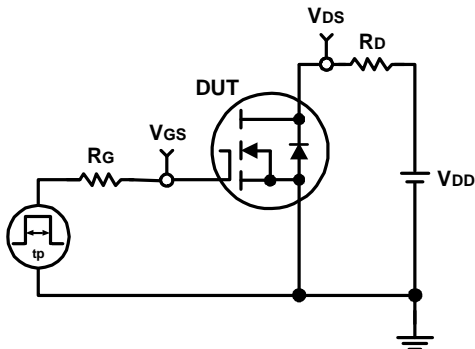
Gate Charge



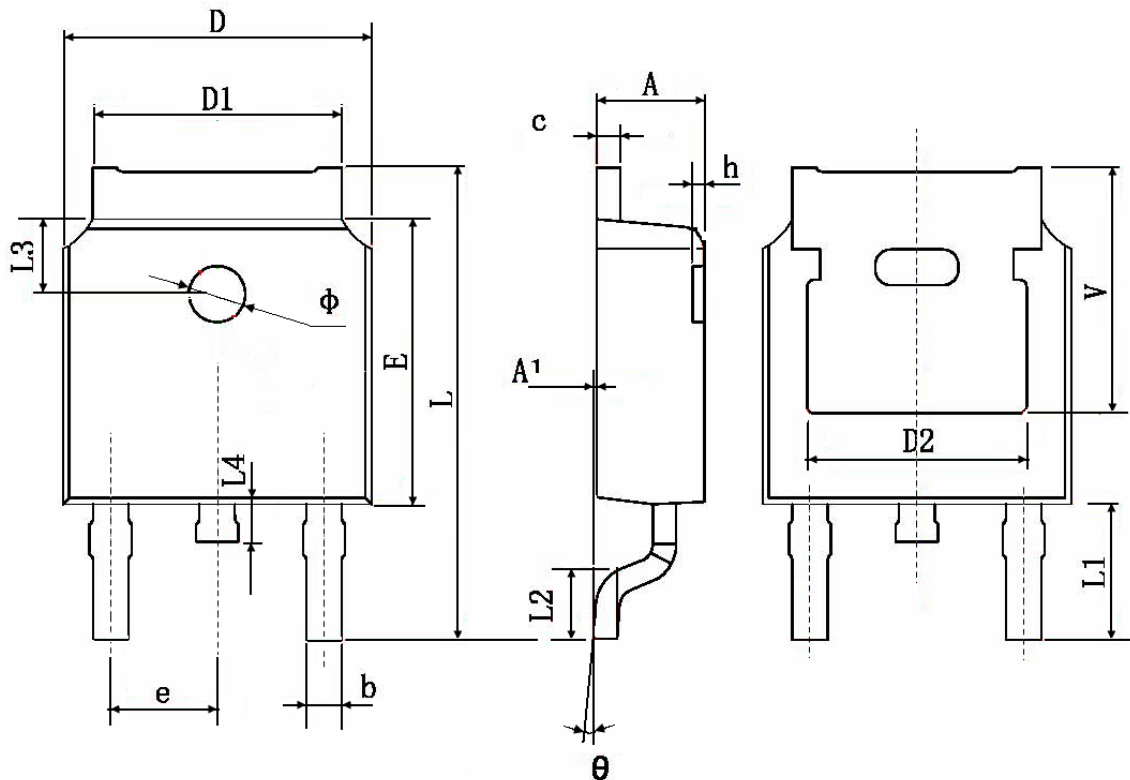
### Avalanche Test Circuit and Waveforms



### Switching Time Test Circuit and Waveforms



## Package Information: TO-252-3L



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	4.830 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
φ	1.100	1.300	0.043	0.051
θ	0°	8°	0°	8°
h	0.000	0.300	0.000	0.012
V	5.350 TYP.		0.211 TYP.	

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