

## N-Channel Enhancement Mode Power MOSFET

### Description

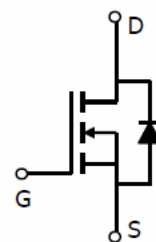
The HM60N05 uses advanced trench technology and design to provide excellent  $R_{DS(ON)}$  with low gate charge. It can be used in a wide variety of applications.

### General Features

- $V_{DS} = 50V, I_D = 60A$   
 $R_{DS(ON)} < 7.6m\Omega @ V_{GS}=10V$  (Typ:5.7m $\Omega$ )  
 $R_{DS(ON)} < 8.0m\Omega @ V_{GS}=4.5V$  (Typ:6.3m $\Omega$ )
- High density cell design for ultra low Rdson
- Fully characterized avalanche voltage and current
- Low gate to drain charge to reduce switching losses

### Application

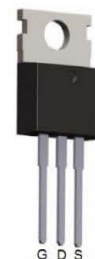
- Power switching application
- Load switch



Schematic diagram



Marking and pin assignment



TO-220-3L top view

### Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity
HM60N05	HM60N05	TO-220-3L	Ø330mm	12mm	2500 units

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

Parameter	Symbol	Limit	Unit
Drain-Source Voltage	$V_{DS}$	50	V
Gate-Source Voltage	$V_{GS}$	$\pm 20$	V
Drain Current-Continuous	$I_D$	60	A
Drain Current-Continuous( $T_C=100^\circ\text{C}$ )	$I_D(100^\circ\text{C})$	42	A
Pulsed Drain Current	$I_{DM}$	180	A
Maximum Power Dissipation	$P_D$	3	W
Operating Junction and Storage Temperature Range	$T_J, T_{STG}$	-55 To 150	$^\circ\text{C}$

### Thermal Characteristic

Thermal Resistance, Junction-to-Ambient <sup>(Note 2)</sup>	$R_{\theta JA}$	42	$^\circ\text{C/W}$
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**Electrical Characteristics (TC=25°C unless otherwise noted)**

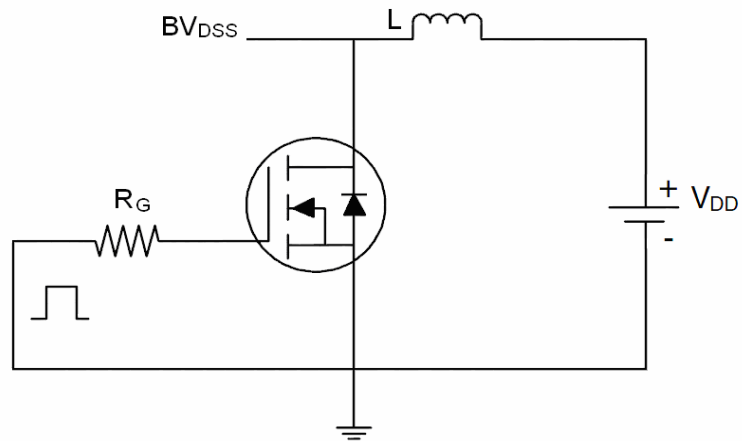
Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Off Characteristics</b>						
Drain-Source Breakdown Voltage	$BV_{DSS}$	$V_{GS}=0V, I_D=250\mu A$	50		-	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=50V, V_{GS}=0V$	-	-	1	$\mu A$
Gate-Body Leakage Current	$I_{GSS}$	$V_{GS}=\pm 20V, V_{DS}=0V$	-	-	$\pm 100$	nA
<b>On Characteristics</b> (Note 3)						
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=V_{GS}, I_D=250\mu A$	0.9	1.2	1.8	V
Drain-Source On-State Resistance	$R_{DS(on)}$	$V_{GS}=10V, I_D=60A$	-	5.7	7.6	m $\Omega$
		$V_{GS}=4.5V, I_D=6A$	-	6.3	8.0	m $\Omega$
Forward Transconductance	$g_{FS}$	$V_{DS}=5V, I_D=60A$	40	-	-	S
<b>Dynamic Characteristics</b> (Note 4)						
Input Capacitance	$C_{iss}$	$V_{DS}=30V, V_{GS}=0V,$ $F=1.0MHz$	-	4100	-	PF
Output Capacitance	$C_{oss}$		-	298	-	PF
Reverse Transfer Capacitance	$C_{rss}$		-	229	-	PF
<b>Switching Characteristics</b> (Note 4)						
Turn-on Delay Time	$t_{d(on)}$	$V_{DD}=30V, R_L=1\Omega$ $V_{GS}=10V, R_{GEN}=3\Omega$	-	8.5	-	nS
Turn-on Rise Time	$t_r$		-	7	-	nS
Turn-Off Delay Time	$t_{d(off)}$		-	40	-	nS
Turn-Off Fall Time	$t_f$		-	15	-	nS
Total Gate Charge	$Q_g$	$V_{DS}=30V, I_D=60A,$ $V_{GS}=10V$	-	93	-	nC
Gate-Source Charge	$Q_{gs}$		-	9.7	-	nC
Gate-Drain Charge	$Q_{gd}$		-	20	-	nC
<b>Drain-Source Diode Characteristics</b>						
Diode Forward Voltage	$V_{SD}$	$V_{GS}=0V, I_S=60A$	-	-	1.2	V
Diode Forward Current	$I_S$		-	-	60	A
Reverse Recovery Time	$t_{rr}$	$T_J = 25^\circ C, I_F=60A$ $di/dt = 100A/\mu s$ (Note 3)	-	32	-	nS
Reverse Recovery Charge	$Q_{rr}$		-	45	-	nC

**Notes:**

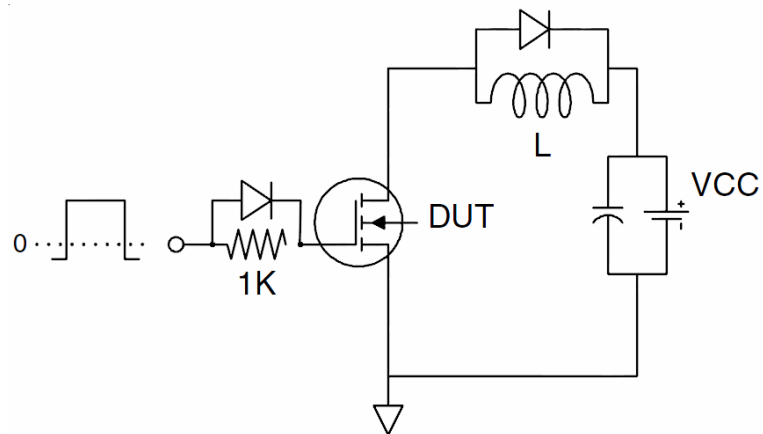
1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to production

Test Circuit

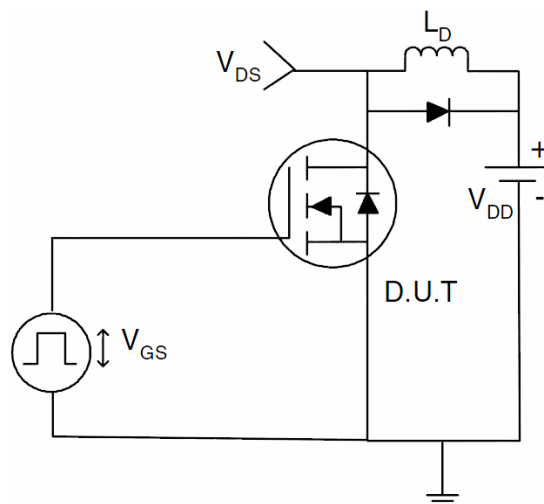
1)  $E_{AS}$  test Circuit



2) Gate charge test Circuit



3) Switch Time Test Circuit



Typical Electrical and Thermal Characteristics (Curves)

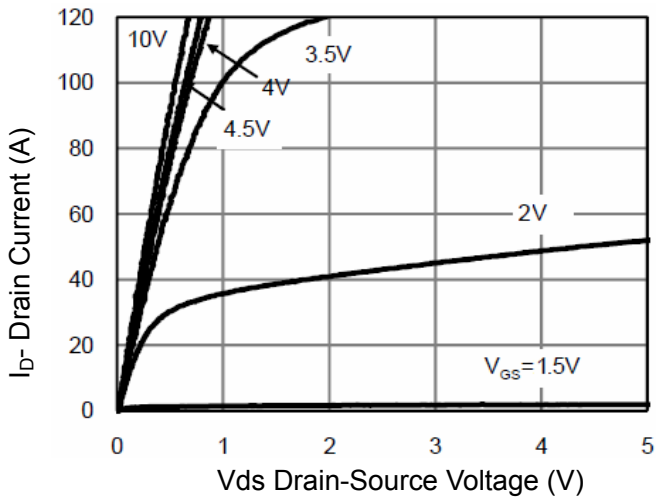


Figure 1 Output Characteristics

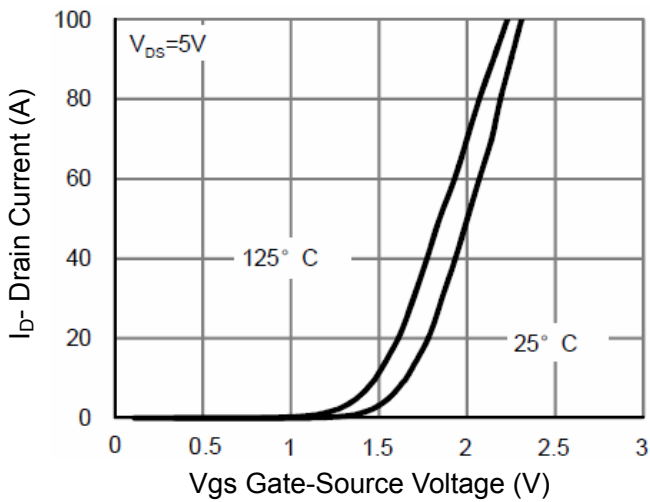


Figure 2 Transfer Characteristics

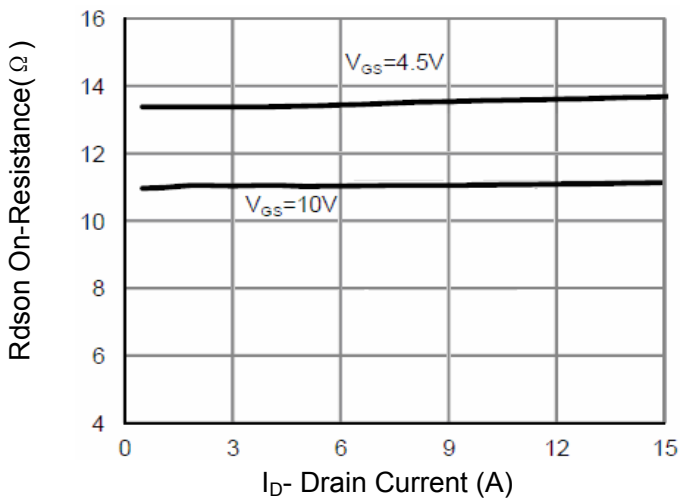


Figure 3  $R_{DS(on)}$ - Drain Current

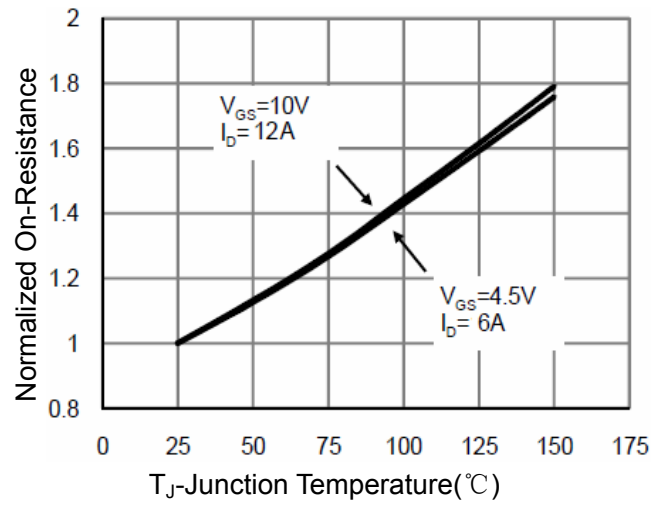


Figure 4  $R_{DS(on)}$ -Junction Temperature

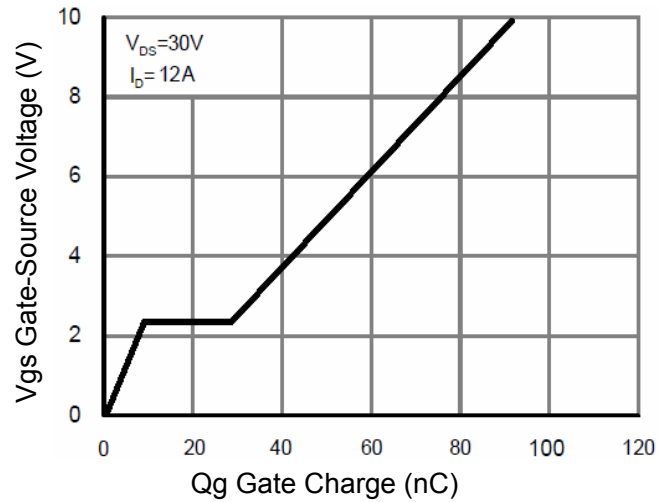


Figure 5 Gate Charge

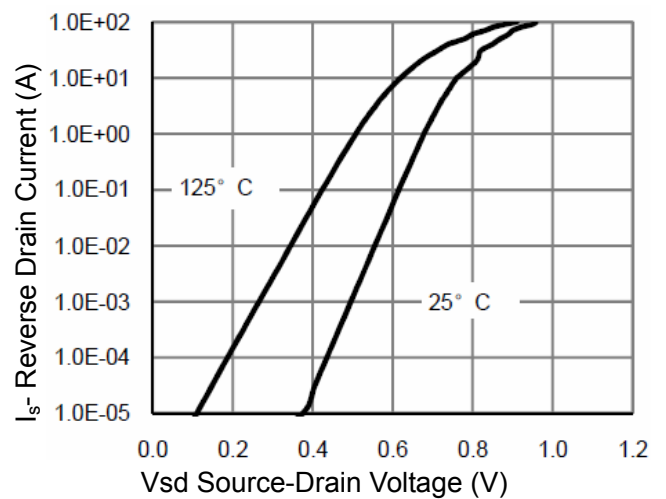


Figure 6 Source- Drain Diode Forward

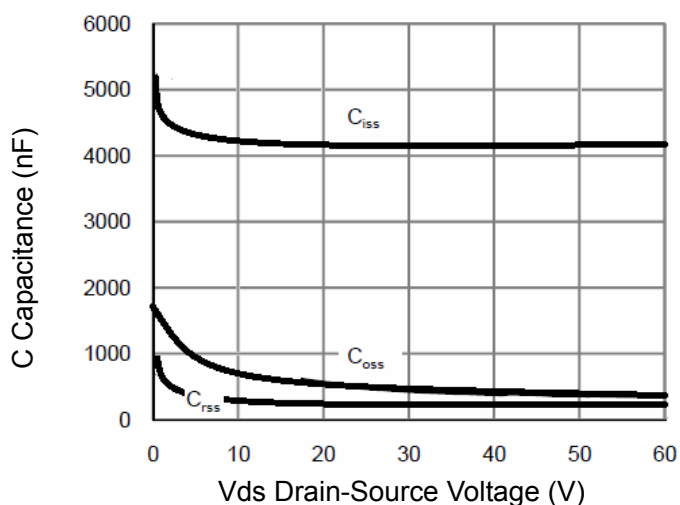


Figure 7 Capacitance vs Vds

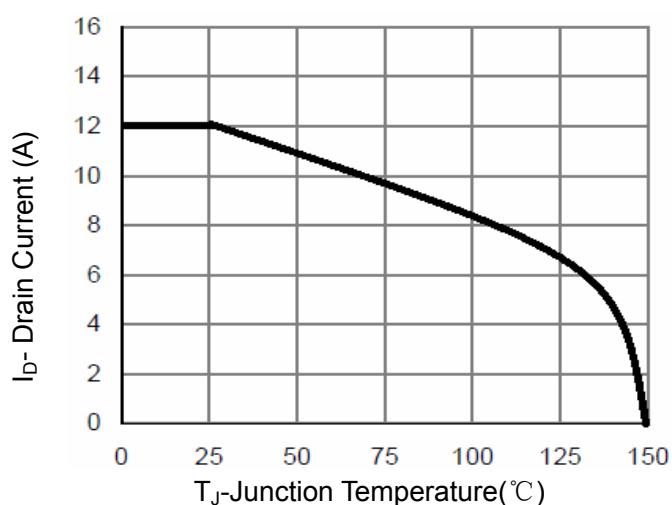


Figure 9 Current De-rating

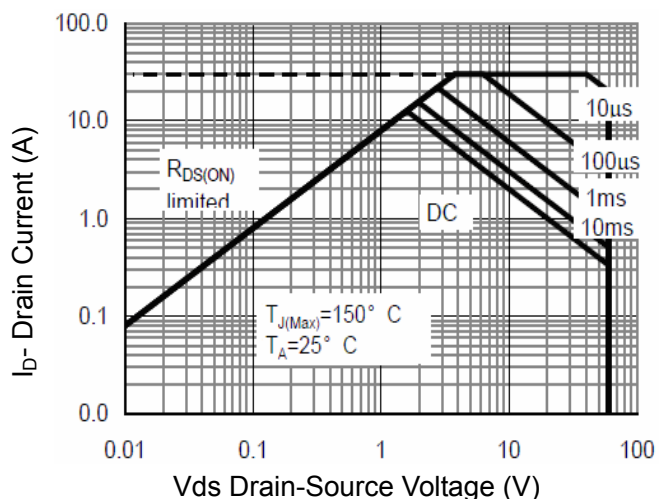


Figure 8 Safe Operation Area

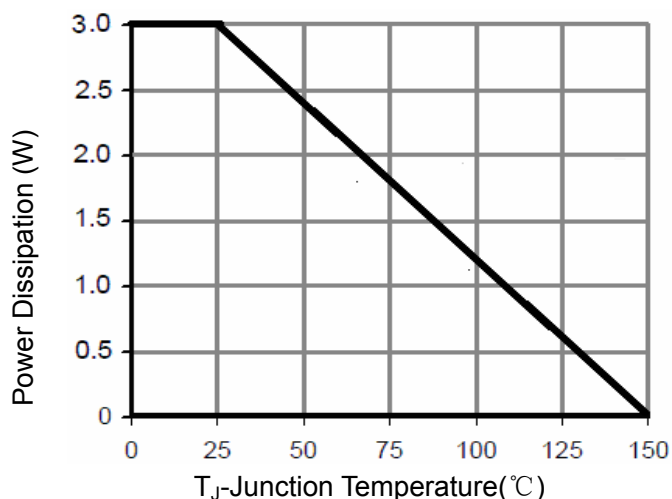


Figure 10 Power De-rating

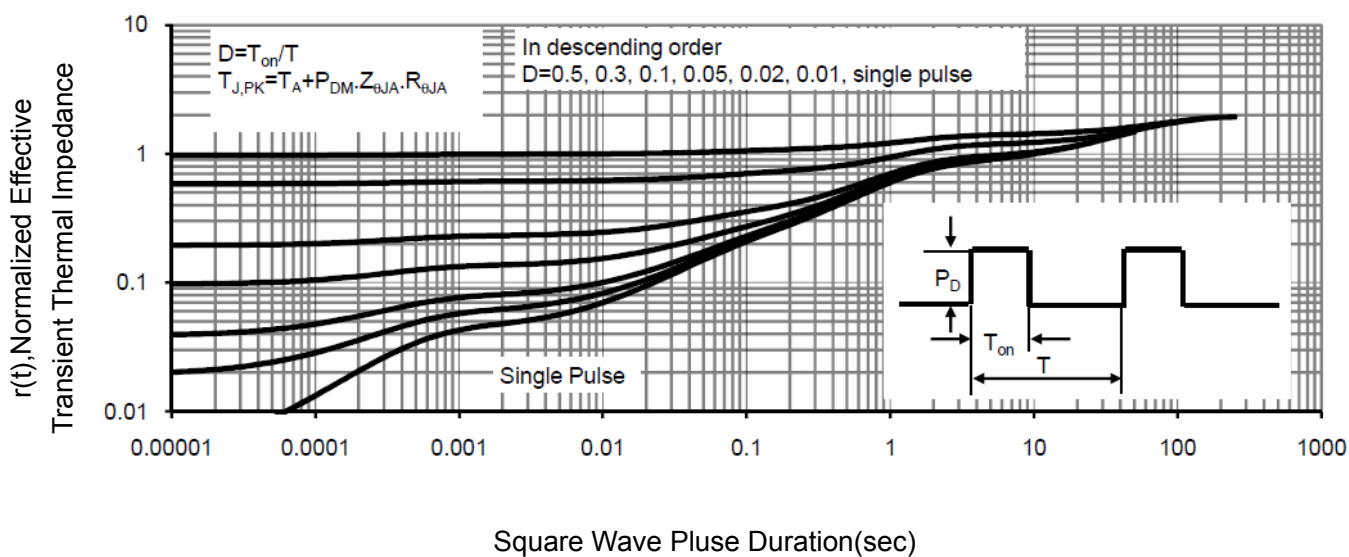
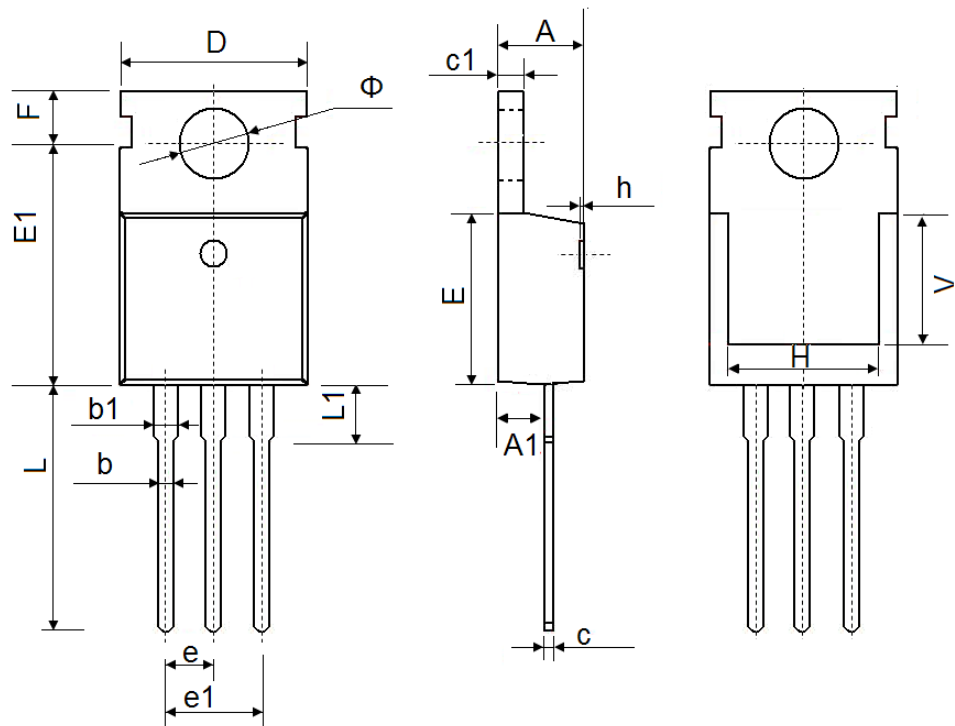


Figure 11 Normalized Maximum Transient Thermal Impedance

TO-220-3L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	2.250	2.550	0.089	0.100
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.330	0.650	0.013	0.026
c1	1.200	1.400	0.047	0.055
D	9.910	10.250	0.390	0.404
E	8.9500	9.750	0.352	0.384
E1	12.650	12.950	0.498	0.510
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
F	2.650	2.950	0.104	0.116
H	7.900	8.100	0.311	0.319
h	0.000	0.300	0.000	0.012
L	12.900	13.400	0.508	0.528
L1	2.850	3.250	0.112	0.128
V	7.500 REF.		0.295 REF.	
$\Phi$	3.400	3.800	0.134	0.150