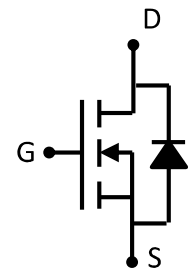


Feature

- 650V,20A
 $R_{DS(ON)} < 190m\ \Omega @ V_{GS}=10V$
- Low FOM $R_{DS(ON)} \times Q_G$
- Better EMI
- 100% UIS and Isolation tested
- RoHs compliant
- Halogen-free



Schematic diagram

Application

- Switch Mode Power Supply (SMPS)
- Uninterruptible Power Supply (UPS)
- Power Factor Correction (PFC)
- Charge



TO-220F

Package Marking and Ordering Information

Device Marking	Device	Device Package	Reel Size	Tape width	Quantity (PCS)
65R190FM	APC65R190FM	TO-220F	-	-	1000

ABSOLUTE MAXIMUM RATINGS ($T_a=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	650	V
Gate-Source Voltage	V_{GSS}	± 30	V
Continuous Drain Current ($T_a=25^\circ\text{C}$) ⁽¹⁾	I_D	20	A
Continuous Drain Current ($T_a=100^\circ\text{C}$) ⁽¹⁾		13	A
Pulsed Drain Current ^{(1) (2)}	I_{DM}	60	A
Single Pulsed Avalanche Energy ⁽³⁾	E_{AS}	390	mJ
Power Dissipation	P_D	26.8	W
Mosfet dV/dT ruggedness	dV/dT	50	V/ns
Reverse diode dV/dT		24	V/ns
Thermal Resistance from Junction to Ambient ⁽⁴⁾	$R_{\theta JA}$	50.6	$^\circ\text{C}/\text{W}$
Junction Temperature	T_J	150	$^\circ\text{C}$
Storage Temperature	T_{STG}	-55~ +150	$^\circ\text{C}$

MOSFET ELECTRICAL CHARACTERISTICS(T_a=25°C unless otherwise noted)

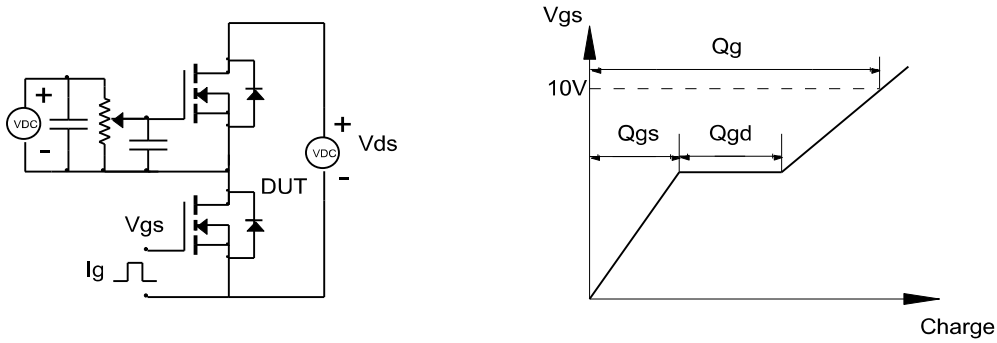
Parameter	Symbol	Test Condition	Min	Type	Max	Unit
Static Characteristics						
Drain-source breakdown voltage	V _{(BR)DSS}	V _{GS} = 0V, I _D =250uA	650	-	-	V
Zero gate voltage drain current	I _{DSS}	V _{DS} =650V, V _{GS} = 0V, T _J =25°C	-	-	1	uA
		V _{DS} =100V, V _{GS} = 0V, T _J =150°C	-	100	-	
Gate-body leakage current	I _{GSS}	V _{GS} =±30V, V _{DS} = 0V	-	-	±100	nA
Gate threshold voltage	V _{GS(th)}	V _{DS} =V _{GS} , I _D =250uA	2.6	3.3	4.0	V
Drain-source on-resistance	R _{DS(on)}	V _{GS} =10V, I _D =10A	-	145	190	mΩ
Forward Transconductance	g _{FS}	V _{DS} =10V, I _D =10A	-	9	-	S
Gate Resistance	R _G	f=1.0MHZ open drain	-	20	-	Ω
Dynamic characteristics						
Input Capacitance	C _{iSS}	V _{DS} =100V, V _{GS} =0V, f =100KHz	-	1670	-	pF
Output Capacitance	C _{oSS}		-	83.1	-	
Reverse Transfer Capacitance	C _{rSS}		-	0.8	-	
Switching characteristics						
Turn-on delay time	t _{d(on)}	V _{DS} =520V, I _D =20A, R _G =25Ω, V _{GS} =10V	-	49.8	-	ns
Turn-on rise time	t _r		-	61.4	-	
Turn-off delay time	t _{d(off)}		-	195.8	-	
Turn-off fall time	t _f		-	55.8	-	
Total Gate Charge	Q _g	V _{DS} =520V, I _D =10A, V _{GS} =10V	-	44	-	nC
Gate-Source Charge	Q _{gs}		-	9	-	
Gate-Drain Charge	Q _{gd}		-	18	-	
Source-Drain Diode characteristics						
Diode Forward voltage	V _{SD}	V _{GS} =0V, I _S =10A	-	-	1.3	V
Maximum Continuous Body-Diode Forward Current	I _S		-	-	8	A
Maximum Pulsed Body-Diode Forward Current ⁽⁵⁾	I _{SM}		-	-	32	A
Peak Reverse Recovery Current	I _{rrm}	V _R =400v, I _F =40A, di _F /dt=100A/us	-	36	-	A
Reverse Recovery Time	Q _{rr}		-	6.2	-	uC
Reverse Recovery Charge	T _{rr}		-	350	-	ns

Notes:

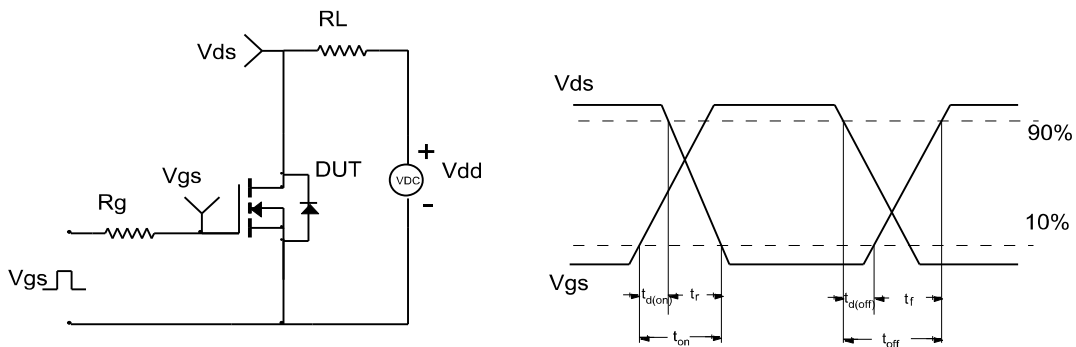
1. The max drain current rating limited by package and maximum junction temperature
2. Repetitive Rating: pulse width limited by maximum junction temperature
3. EAS Condition: T_J=25°C, V_{DD}=150V, R_G=25 Ω, L=10.8mH, I_{AS}=8.5A
4. Mount on minimum PCB layout
5. Pulse Test: Pulse width ≤ 300us, Duty ≤ 2%
6. Essentially independent of operating temperature

Test Circuit and Waveform

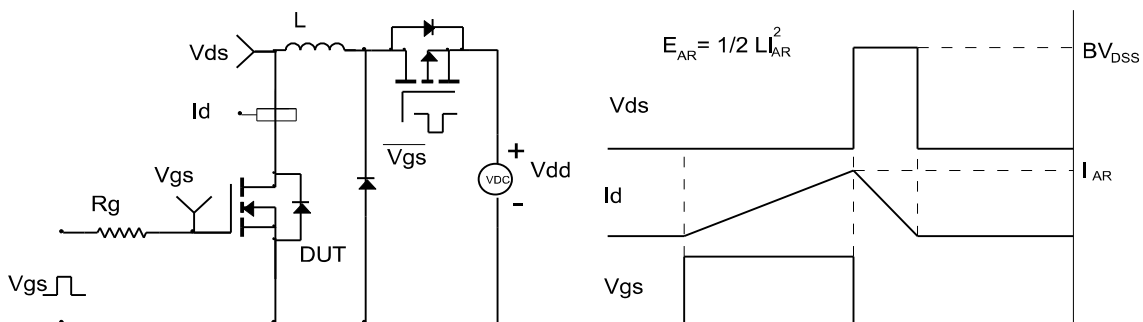
Gate Charge Test Circuit & Waveform



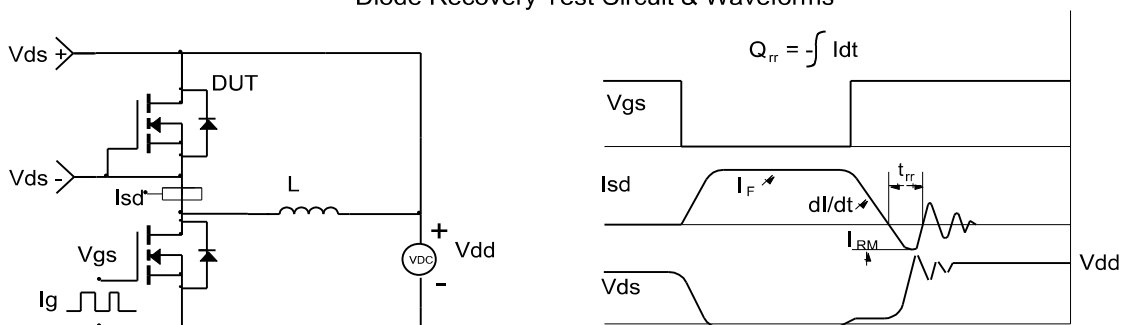
Resistive Switching Test Circuit & Waveforms



Unclamped Inductive Switching (UIS) Test Circuit & Waveforms



Diode Recovery Test Circuit & Waveforms



Electrical Characteristics Diagrams

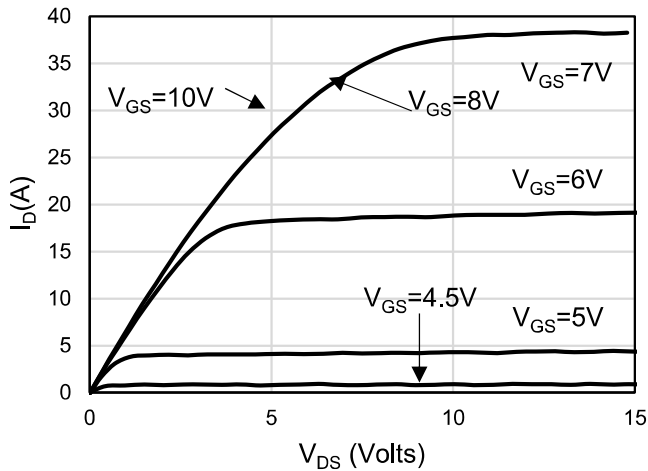


Figure 1: On-Region Characteristics

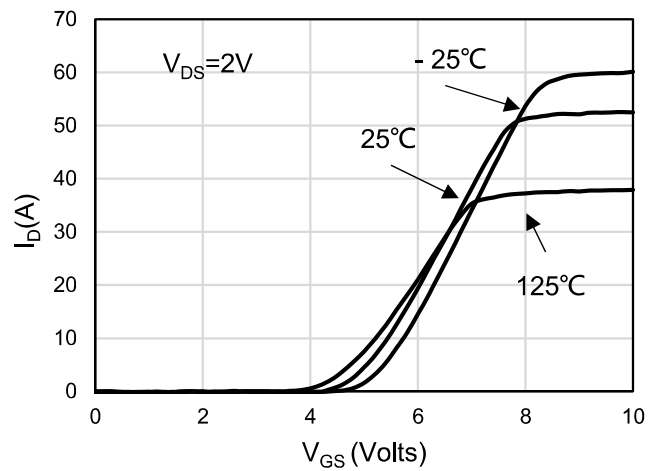


Figure 2: Transfer Characteristics

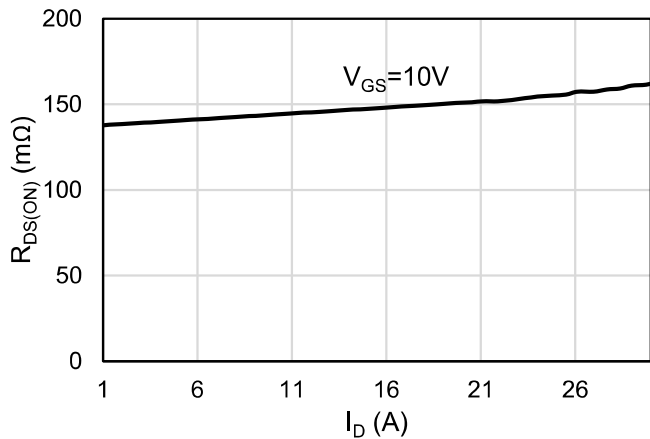


Figure 3: On-Resistance vs. Drain Current and Gate Voltage

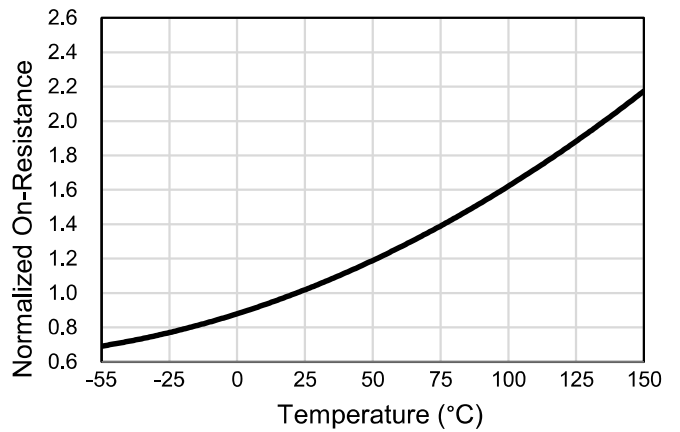


Figure 4: On-Resistance vs. Junction Temperature

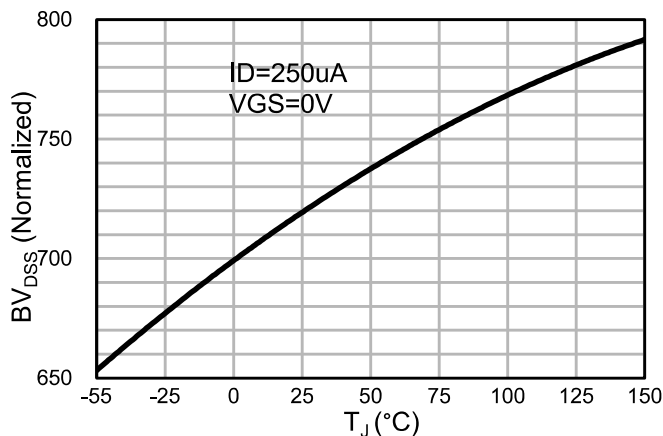


Figure 5: Break Down vs. Junction Temperature

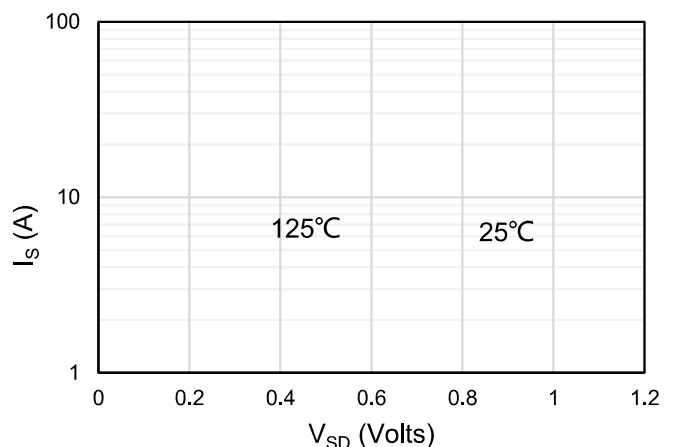


Figure 6: Body-Diode Characteristics

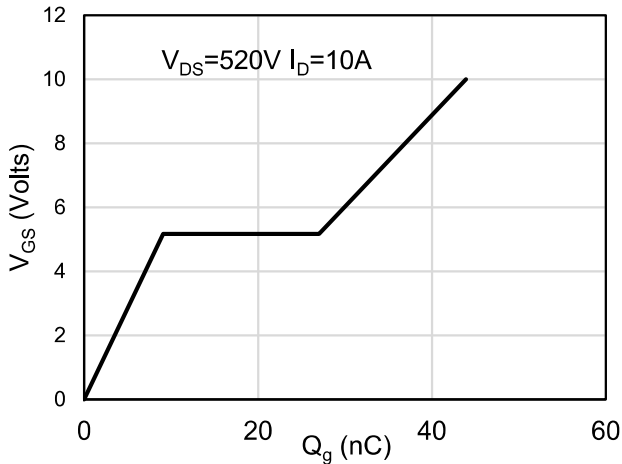


Figure 7: Gate-Charge Characteristics

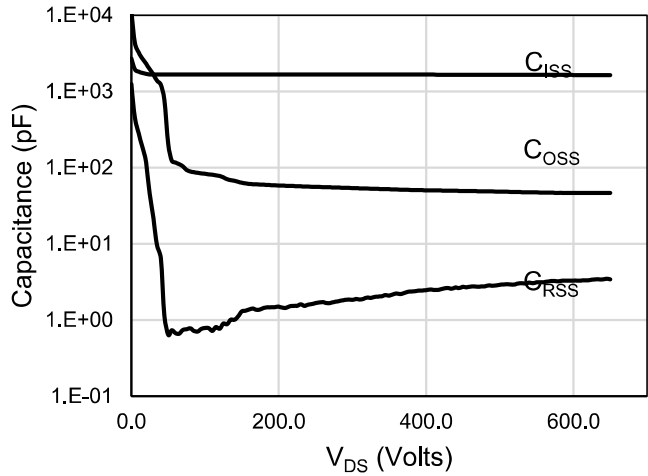


Figure 8: Capacitance Characteristics

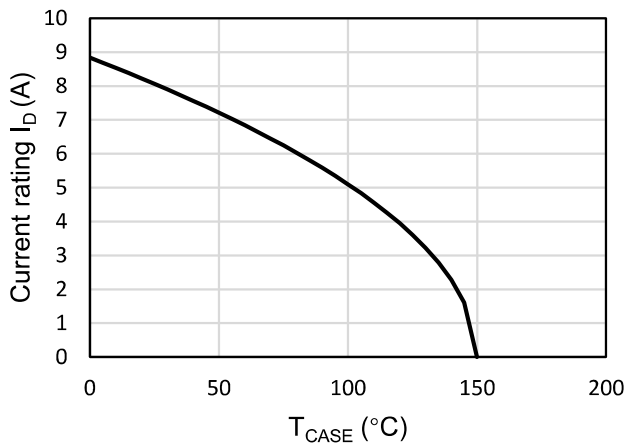


Figure 9: Current De-rating

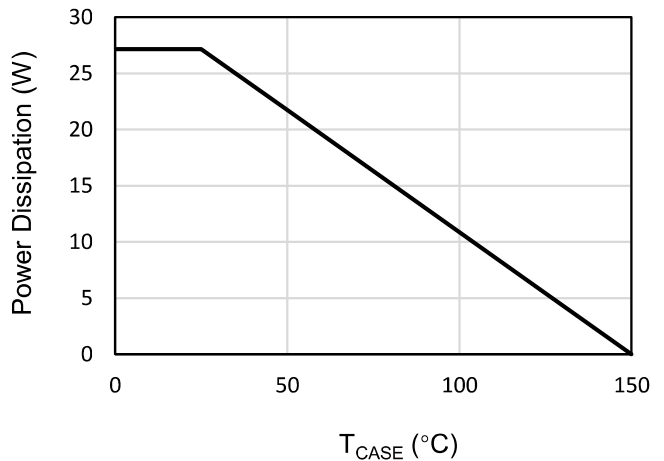


Figure 10: Power De-rating

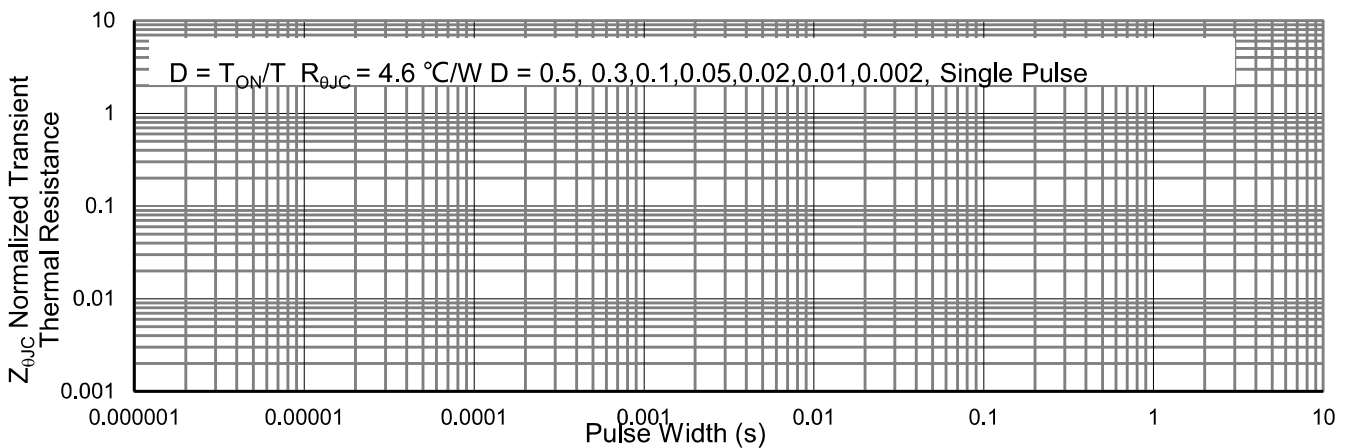
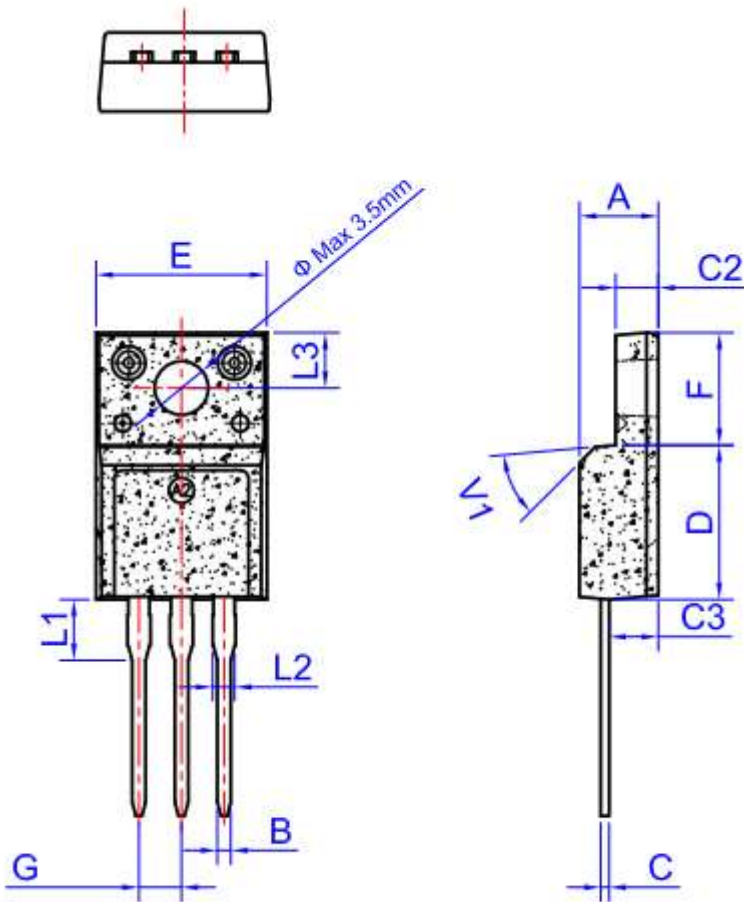


Figure 11: Normalized Maximum Transient Thermal Impedance

Package Outlines



Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	4.50		4.90	0.177		0.193
B	0.74	0.80	0.83	0.029	0.031	0.033
C	0.47		0.65	0.019		0.026
C2	2.45		2.75	0.096		0.108
C3	2.60		3.00	0.102		0.118
D	8.80		9.30	0.346		0.366
E	9.80		10.4	0.386		0.410
F	6.40		6.80	0.252		0.268
G		2.54			0.1	
H	28.0		29.8	1.102		1.173
L1		3.63			0.143	
L2	1.14		1.70	0.045		0.067
L3		3.30			0.130	
V1		45°			45°	