

600mA High PSRR, Low Noise LDO Regulator

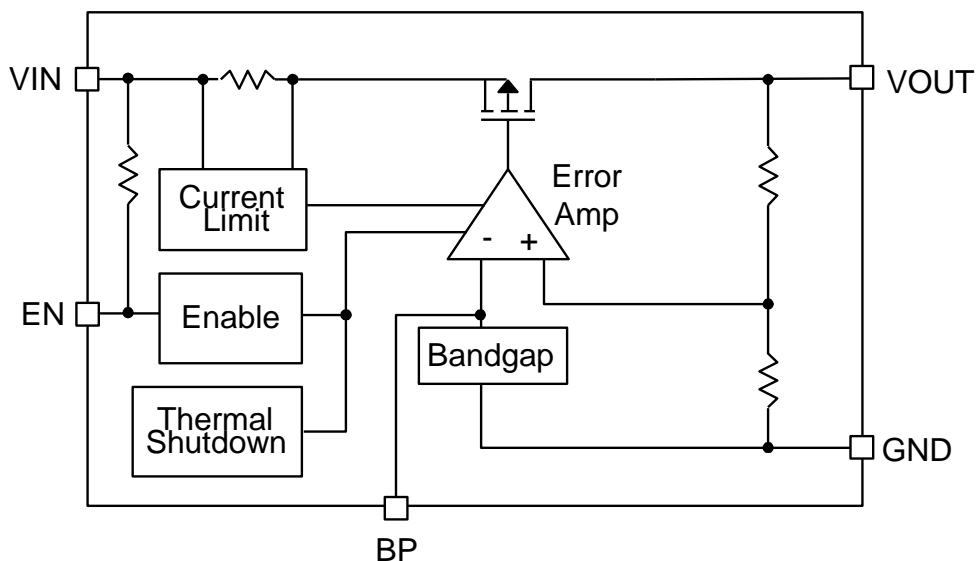
❖ GENERAL DESCRIPTION

The AX6608B is a low dropout, high PSRR, low noise linear regulator with very low quiescent. It can supply 600mA output current with low dropout voltage and very low output voltage. The Device includes pass element, error amplifier, band-gap, current-limit and thermal shutdown circuitry. The characteristics of low dropout voltage and less quiescent current make it good for some critical current application, for example, some battery powered devices. The typical quiescent current is approximately 30 μ A. In the shutdown mode, the maximum supply current is less than 1 μ A. Due to internal flexible design, result in extensively fixed output voltage versions is 1.0V/1.2V/1.5V/1.8V/2.5V/2.8V/3.0V/3.3V. Built-in current-limit and thermal-shutdown functions prevent any fault condition from IC damage.

❖ FEATURES

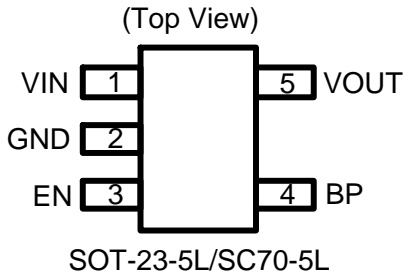
- Input voltage range : 2.8V~5.5V
- Guaranteed 600mA output current
- Low quiescent current is 30 μ A (typ.)
- Maximum supply current in shutdown mode <1 μ A
- Fixed Output voltage is 1.0V/1.2V/1.5V/1.8V/2.5V/2.8V/3.0V/3.3V.
- High PSRR=-60dB@1KHz
- Low-ESR Ceramic Capacitor for output stability
- Fast transient response
- Current limit and thermal shutdown protection
- Available in the 5-Pin Pb-Free SOT-23 and SC70 Packages

❖ BLOCK DIAGRAM



❖ **PIN ASSIGNMENT**

The packages of AX6608B are SOT-23-5L and SC70-5L; the pin assignment is given by:



Name	Description
VIN	Voltage input. The input capacitor in the range of 1uF to 10uF is sufficient.
GND	Ground
EN	Enable pin (Active High)
BP	Reference Noise Bypass (The Bypass capacitor $\geq 1nF$)
VOUT	Output Voltage, The AX6608B is stable with an output capacitor 1uF for greater.

❖ **ORDER/MARKING INFORMATION**

Order Information	
AX6608B- XX X X <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">Output voltage</div> <div style="border: 1px solid black; padding: 2px;">Package</div> <div style="border: 1px solid black; padding: 2px;">Packing</div> </div> <div style="display: flex; justify-content: space-around; margin-top: 5px;"> <div style="text-align: left;"> 10 : 1.0V 12 : 1.2V 15 : 1.5V 18 : 1.8V 25 : 2.5V 28 : 2.8V 30 : 3.0V 33 : 3.3V </div> <div style="text-align: left;"> A5 : SC70-5L B : SOT23-5L </div> <div style="text-align: left;"> Blank:Tube A : Taping </div> </div>	
Top Marking (SC70-5L)	Top Marking (SOT-23-5L)
CXXX → Date Code → Vout (refer below table) → Part number code	RTXXX → Date Code → Vout (refer below table) → Part number code

Appendix

Part Number	Identification Code	
	SOT23	SC70
AX6608B-1.0V	A	A
AX6608B-1.5V	C	C
AX6608B-1.8V	D	D
AX6608B-2.5V	F	F
AX6608B-2.8V	G	G
AX6608B-3.0V	H	H
AX6608B-3.3V	I	I

Date Code

1. Year : The under-line see the IC top marking
 XX : 2004, 2008, 2012...
XX : 2003, 2007, 2011...
XX : 2002, 2006, 2010...
XX : 2001, 2005, 2009...

2. Week : See the English word
 XX : "A~Z" showed on 1rd position --> week 1 ~ week 26,
 XX : "A~Z" showed on 2th position --> week 27 ~ week 52.

3. ID Code (internal) : See the number word
 XX : "1~9" showed on 1rd or 2rd position

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25 °C)

Characteristics	Symbol	Rating	Unit
V _{IN} Pin Voltage	V _{IN}	GND - 0.3 to GND + 6	V
Output Voltage	V _{OUT}	GND - 0.3 to V _{IN} + 0.3	V
Enable Voltage	V _{EN}	GND - 0.3 to GND + 6	V
Power Dissipation	PD	250	mW
Storage Temperature Range	T _{ST}	-40 to +150	°C
Operating Temperature Range	T _{OP}	-40 to +85	°C
Junction Temperature	T _J	-40 to +125	°C
Thermal Resistance from Junction to case	θ _{JC}	SOT23=180, SC70=230	°C/W
Thermal Resistance from Junction to ambient	θ _{JA}	SOT23=250, SC70=280	°C/W

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in²(Multi-layer). That need connect to V_{IN} pin.

❖ ELECTRICAL CHARACTERISTICS

(V_{IN}=V_{OUT}+1V or V_{IN}=2.8V whichever is greater, C_{IN}=C_{OUT}=1uF, T_A=25 °C, unless otherwise noted)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units	
Input Voltage	V _{IN}	(Note1)	2.8	-	5.5	V	
Output Voltage Accuracy	ΔV _{OUT}	I _{OUT} =1mA	-2	-	+2	%	
Quiescent Current	I _Q	I _{OUT} =0mA	-	30	60	μA	
Dropout Voltage (Note2)	V _{DROP}	I _{OUT} =600mA, 1.0V ≤ V _{OUT} ≤ 2.0V	-	1000	1600	mV	
		I _{OUT} =600mA, 2.0V < V _{OUT} ≤ 2.8V	-	350	600		
		I _{OUT} =600mA, 2.8V < V _{OUT} ≤ 3.3V	-	250	500		
Current Limit	I _{LIMIT}	R _{LOAD} =1Ω	600	650	-	mA	
Line Regulation	ΔV _{LINE}	I _{OUT} =1mA, V _{IN} =V _{OUT} +1.5V to 5V	-	1	5	mV	
Load Regulation (Note 3)	ΔV _{LOAD}	I _{OUT} =0m~600mA	-	50	100	mV	
Ripple Rejection	PSRR	C _{OUT} =1uF, I _{OUT} =1mA	F=1KHz	-	-60	-	dB
			F=10K	-	-40	-	

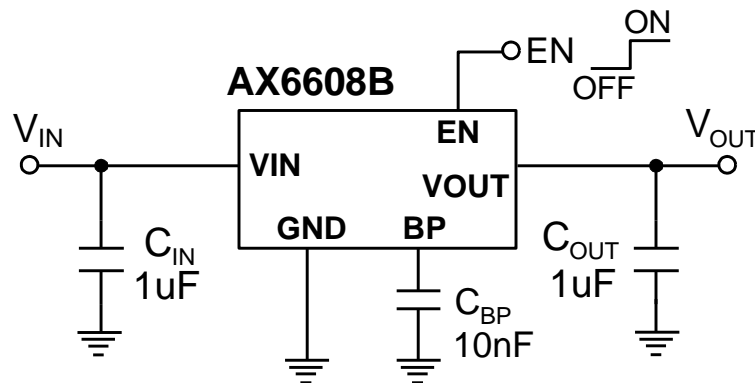
Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Enable Input Threshold	V_{ENH}	-	1.4	-	-	V
	V_{ENL}	-	-	-	0.4	
Enable Pin Current	I_{EH}	$V_{EN}=V_{IN}$	-	-	0.1	μA
Shutdown Current	I_{SD}	$V_{IN}=3.6V, V_{EN}=0V$	-	-	1	μA
Temperature Coefficient	TC	$I_{OUT}=1mA, V_{IN}=5V$	-	50	-	ppm/ $^{\circ}C$
Temperature Shutdown	TS	-	-	160	-	$^{\circ}C$
Temperature Shutdown Hysteresis	TSH	-	-	25	-	$^{\circ}C$

Note1. Minimum V_{IN} voltage is defined by output adds a dropout voltage.

Note2. The dropout voltage is defined as $V_{IN}-V_{OUT}$, which is measured when V_{OUT} drop about 100mV.

Note3. Regulation is measured at constant junction temperature by using pulsed testing with a low ON time.

❖ APPLICATION CIRCUIT



❖ FUNCTION DESCRIPTIONS

A minimum of 1uF capacitor must be connected from V_{OUT} to ground to insure stability. Typically a large storage capacitor is connected from V_{IN} to ground to ensure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be dropout voltage higher than V_{OUT} in order for the device to regulate properly.

❖ APPLICATION INFORMATION

Like any low-dropout regulator, the AX6608B requires input and output decoupling capacitors. The device is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance (see Capacitor Characteristics Section). Please note that linear regulators with a low dropout voltage have high internal loop gains which require care in guarding against oscillation caused by insufficient decoupling capacitance.

Capacitor Selection

Normally, use a 1 μ F capacitor on the input and a 1 μ F capacitor on the output of the AX6608B. Larger input capacitor values and lower ESR provide better supply-noise rejection and transient response. A large value output capacitor may be necessary if large, fast transients are anticipated and the device is located several inches from the power source. The capacitors is recommended to use 1 μ F X5R or X7R dielectric ceramic capacitors with 30m Ω to 50m Ω ESR range between device outputs to ground for transient stability.

Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain-to source on-resistance, $R_{DS(ON)}$, multiplied by the load current:

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

Current Limit and Thermal Shutdown Protection

In order to prevent overloading or thermal condition from damaging the device, AX6608B regulator has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

Thermal Considerations

The AX6608B series can deliver a current of up to 300mA over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$PD = (V_{IN} - V_{OUT}) I_{OUT}$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

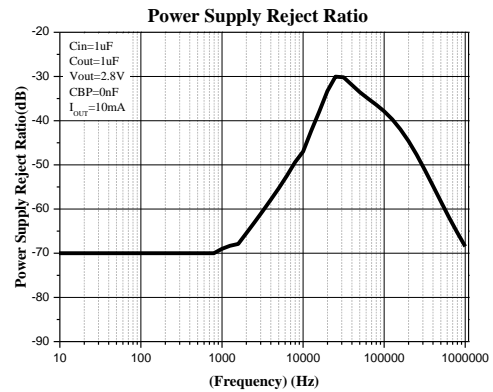
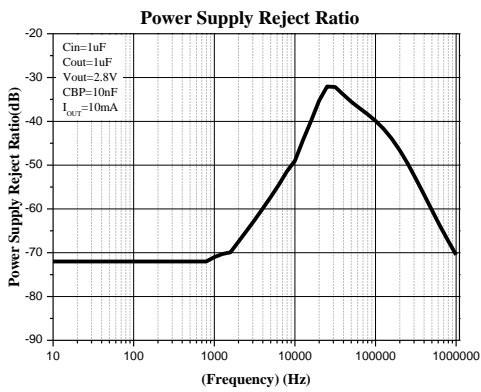
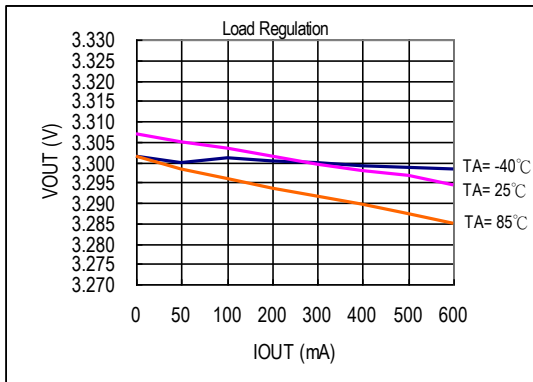
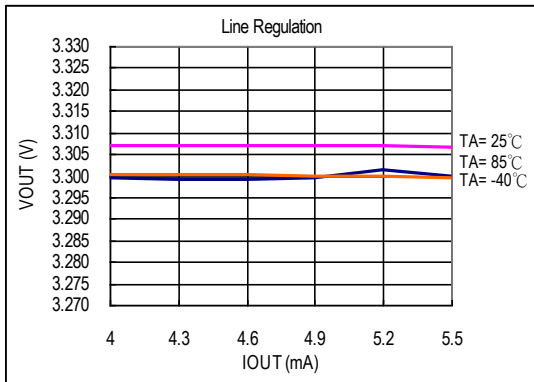
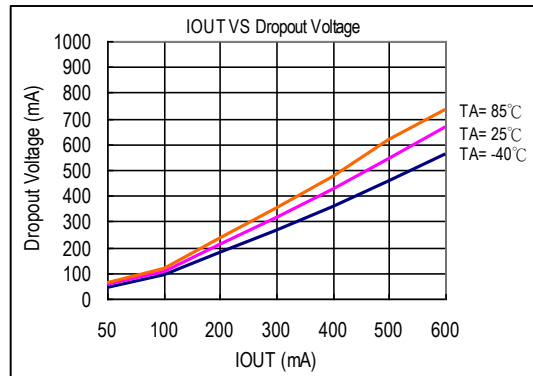
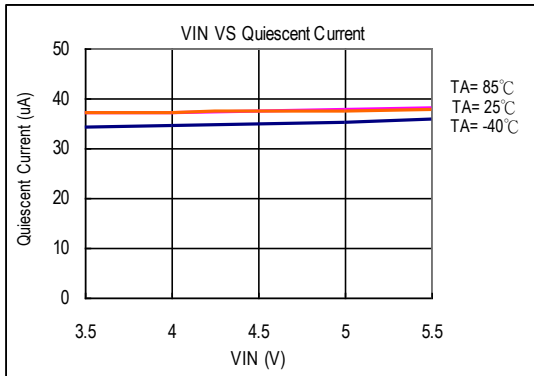
$$PD (MAX) = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where $T_{J(MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) for SOT-23-5 package at recommended minimum footprint is 250°C/W.

PCB Layout

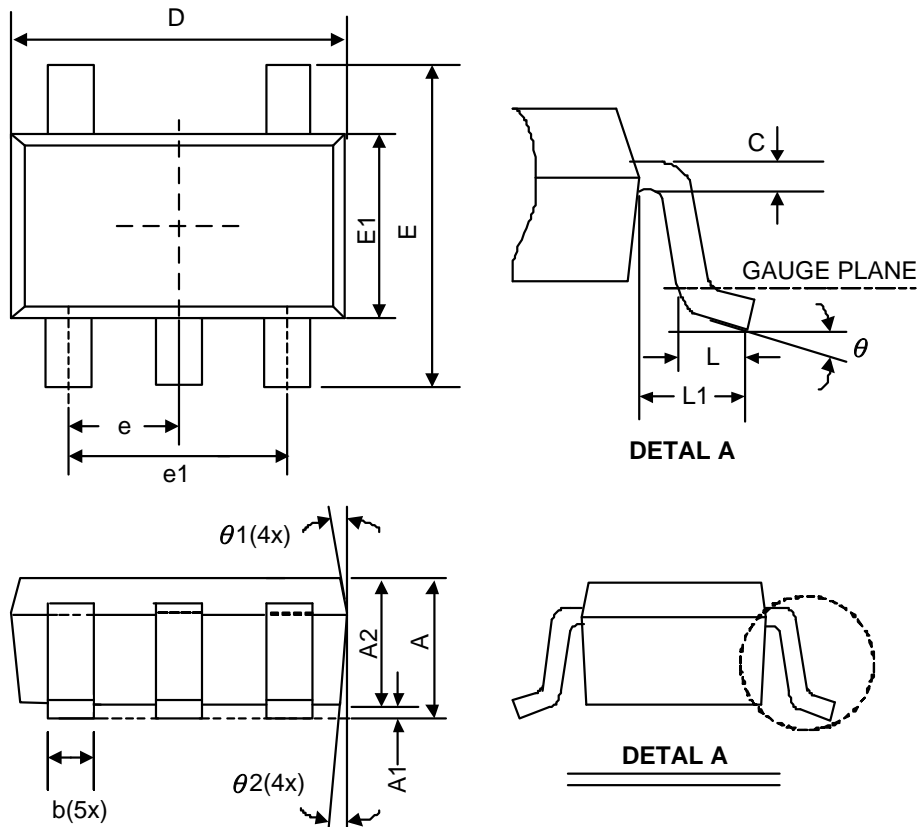
An input capacitance of $\cong 1\mu F$ is required between the AX6608B input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the V_{IN} pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire.

❖ TYPICAL CHARACTERISTICS



❖ PACKAGE OUTLINES

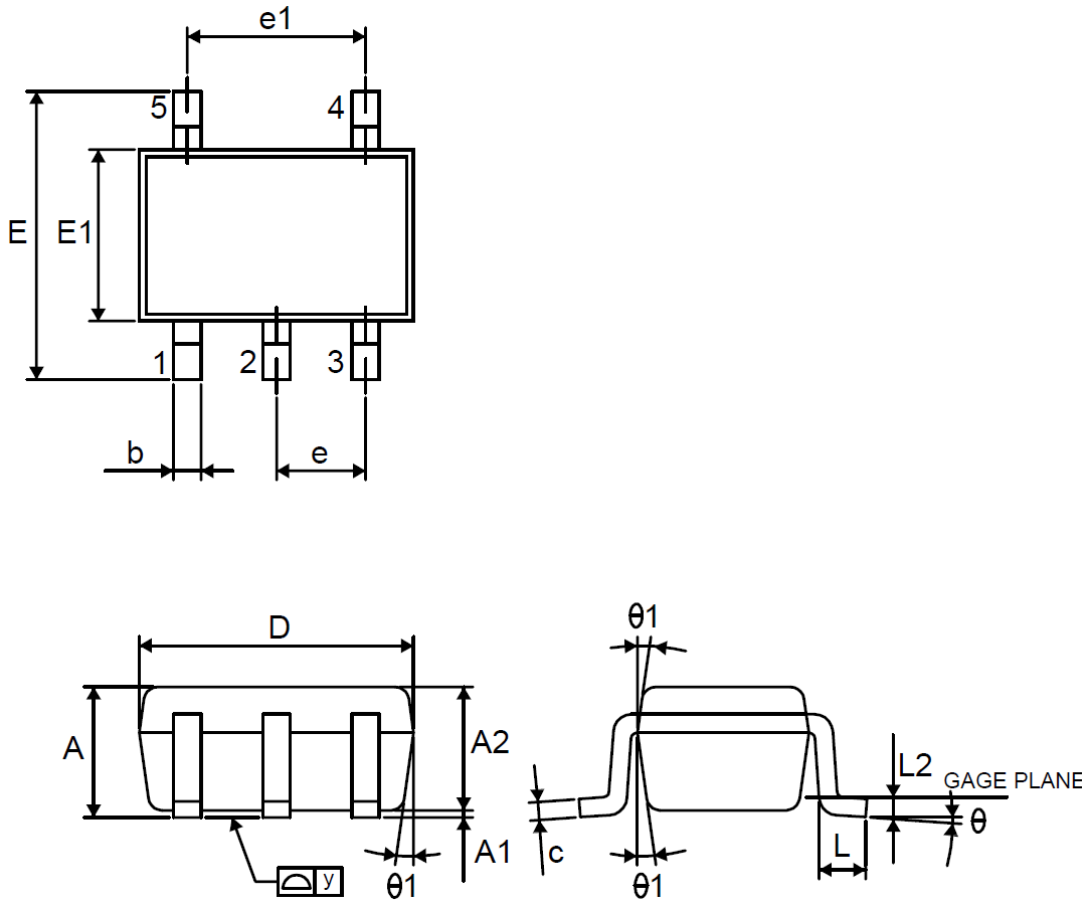
(1) SOT-23-5L



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.45	-	-	0.057
A1	0	0.08	0.15	0	0.003	0.006
A2	0.9	1.1	1.3	0.035	0.043	0.051
b	0.3	0.4	0.5	0.012	0.016	0.02
C	0.08	0.15	0.22	0.003	0.006	0.009
D	2.7	2.9	3.1	0.106	0.114	0.122
E1	1.4	1.6	1.8	0.055	0.063	0.071
E	2.6	2.8	3	0.102	0.11	0.118
L	0.3	0.45	0.6	0.012	0.018	0.024
L1	0.5	0.6	0.7	0.02	0.024	0.028
e1	1.9 BSC			0.075 BSC		
e	0.95 BSC			0.037 BSC		
θ	0°	4°	8°	0°	4°	8°
$\theta 1$	5°	10°	15°	5°	10°	15°
$\theta 2$	5°	10°	15°	5°	10°	15°

JEDEC outline: MO-178 AA

(2) SC70-5L



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.80	-	1.10	0.031	-	0.043
A1	0.00	-	0.10	0.000	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.15	-	0.30	0.006	-	0.012
C	0.08	-	0.22	0.003	-	0.009
D	1.80	2.00	2.20	0.071	0.079	0.087
E	1.95	2.10	2.25	0.077	0.083	0.089
E1	1.15	1.25	1.35	0.045	0.049	0.053
e	-	0.65	-	-	0.026	-
e1	-	1.30	-	-	0.051	-
L	0.26	0.36	0.46	0.010	0.014	0.018
L2	-	0.15	-	-	0.006	-
y	-	-	0.10	-	-	0.004
θ	0°	4°	8°	0°	4°	8°
$\theta 1$	4°	-	12°	4°	-	12°