

## 300mA Low-Noise CMOS LDO

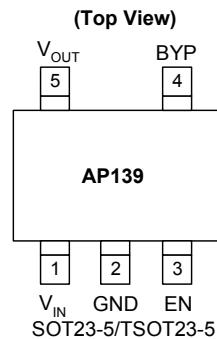
### ■ Features

- Very low dropout voltage
- Low current consumption: Typ.45 $\mu$ A, Max. 60 $\mu$ A
- Output voltage: 1.5V,1.8V,2.0V, 2.5V, 2.8V, 3.0V, 3.3V, and 3.5V
- Guaranteed 300mA output
- Input range up to 7.0V
- Thermal shutdown
- Current limiting
- Stability with low ESR capacitors
- Low temperature coefficient
- **Pb-free** package: SOT23-5L,TSOT23-5L

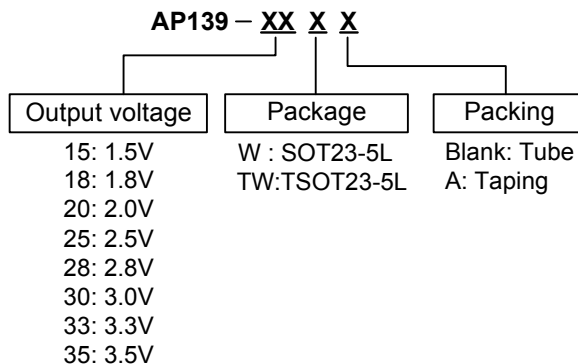
### ■ Applications

- Battery-powered devices
- Personal communication devices
- Home electric/electronic appliances
- PC peripherals

### ■ Pin Assignments



### ■ Ordering Information



### ■ General Descriptions

The AP139 is a positive voltage linear regulator utilizing CMOS technology. The features that include low quiescent current (45 $\mu$ A typ.), low dropout voltage, and high output voltage accuracy, make it ideal for battery applications. EN input connected to CMOS has low bias current. The space-saving SOT23-5L and TSOT23-5L package is attractive for “Pocket” and “Hand Held” applications.

This rugged device has both thermal shutdown, and current limit protections to prevent device failure under the “Worst” operating conditions.

In a low noise, regulated supply application, a 10nF capacitor is necessary to be placed in between Bypass and Ground.

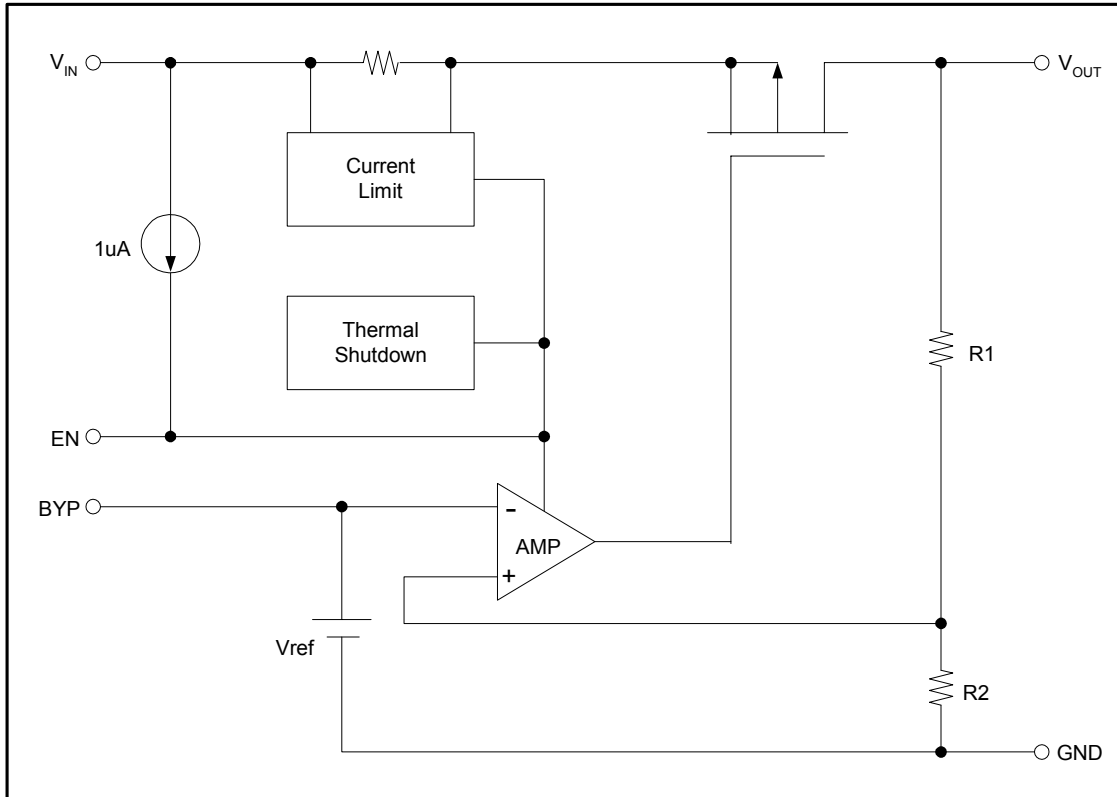
The AP139 is stable with a low ESR output capacitor of 1.0 $\mu$ F or greater.

### ■ Pin Descriptions

Pin Name	Pin No.	Function
V <sub>IN</sub>	1	Power Supply
GND	2	Ground
EN	3	Enable Pin
BYP	4	Bypass Signal Pin
V <sub>OUT</sub>	5	Output

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### ■ Block Diagram



### ■ Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
$V_{IN}$	Input Voltage	+7	V
$I_{OUT}$	Output Current	$P_D / (V_{IN} - V_O)$	mA
$V_{OUT}$	Output Voltage	GND - 0.3 to $V_{IN} + 0.3$	V
	ESD Classification	B	
$T_A$	Ambient Temperature Range	-40 to +85	°C
$T_J$	Junction Temperature Range	-40 to +125	°C

### ■ Thermal Information

Symbol	Parameter		Maximum	Unit
$\theta_{jc}$	Thermal Resistance	SOT23-5L	160	°C/W
$P_D$	Internal Power Dissipation ( $\Delta T = 100$ °C)	SOT23-5L	250	mW
$T_J$	Maximum Junction Temperature		150	°C
$T_{Lead}$	Maximum Lead Temperature (10 sec)		300	°C

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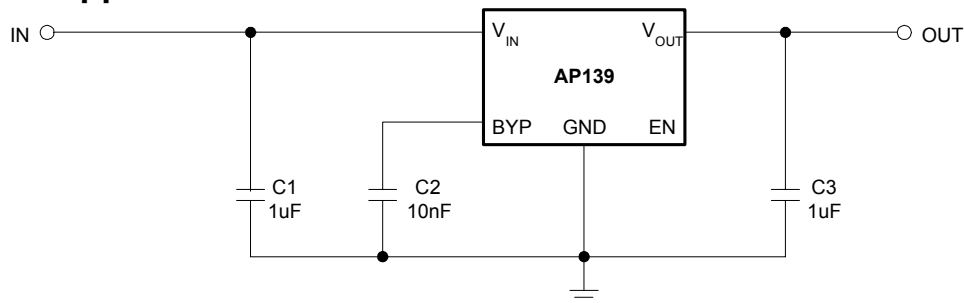
### ■ Electrical Characteristics

( $T_A=+25^{\circ}\text{C}$ , unless otherwise noted.)

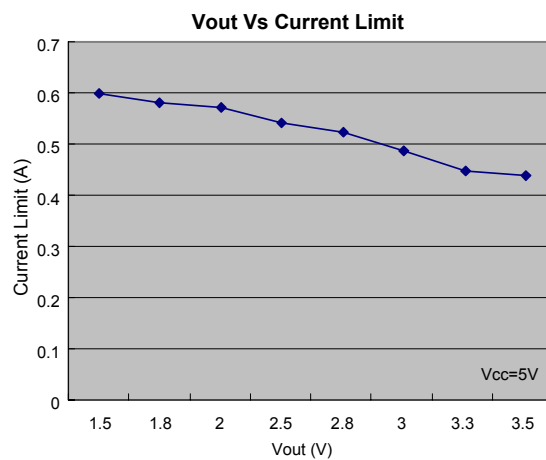
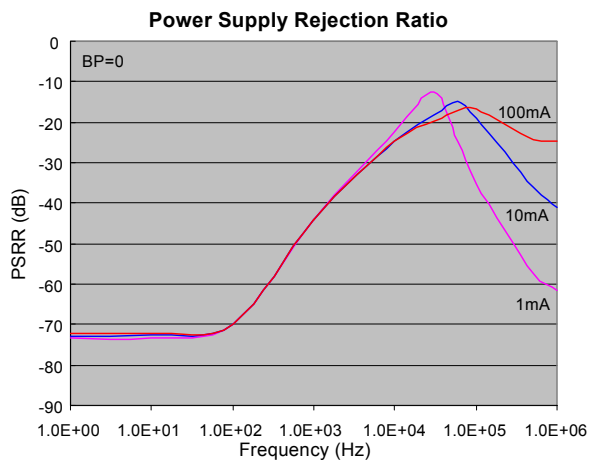
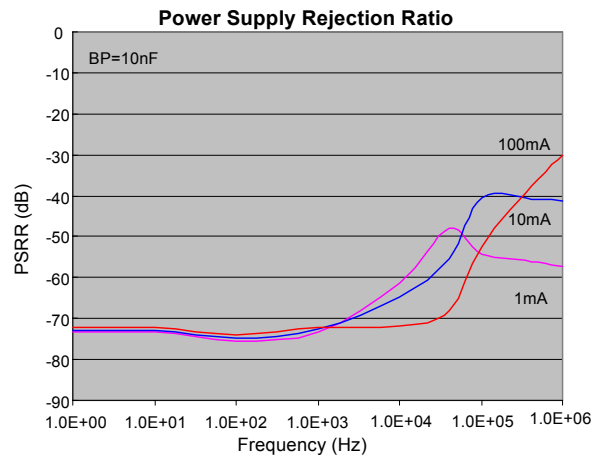
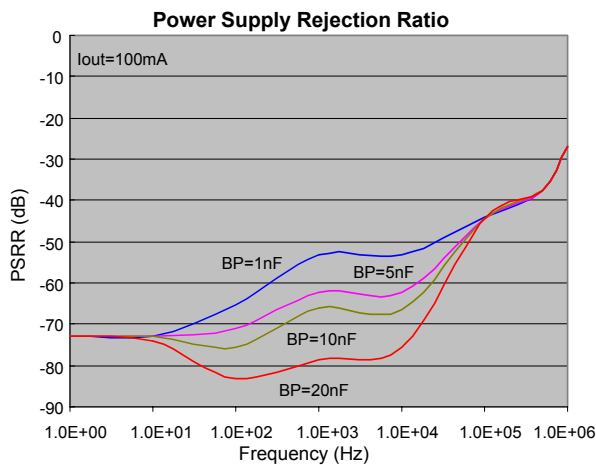
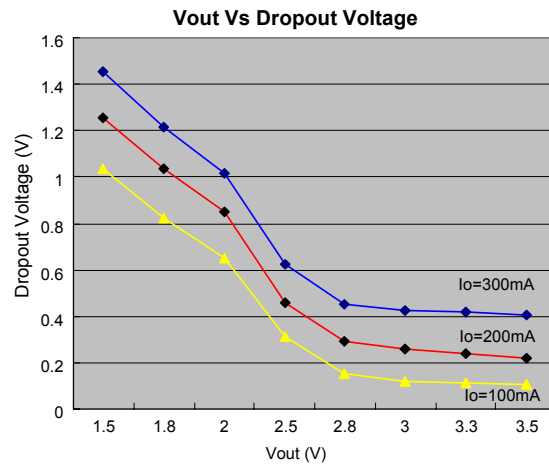
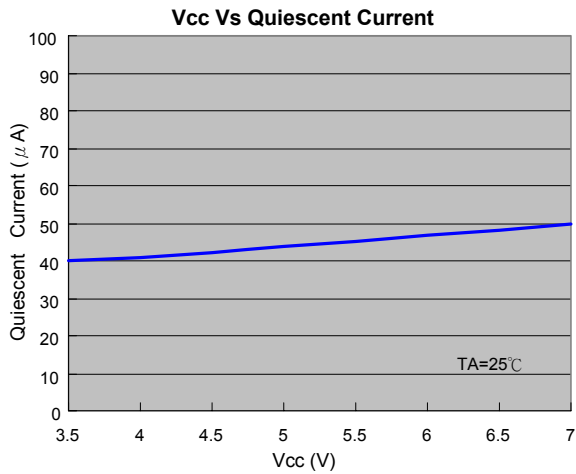
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
$V_{IN}$	Input Voltage		Note 1	-	7	V	
$I_Q$	Quiescent Current	$I_O=0\text{mA}$	-	45	60	$\mu\text{A}$	
$I_{STB}$	Standby Current	$V_{IN}=5.0\text{V}$ , $V_{OUT}=0\text{V}$ , $V_{EN} < V_{EL}$	-	2.0	3.0	$\mu\text{A}$	
$V_{OUT}$	Output Voltage Accuracy	$I_O=1\text{mA}$ , $V_{IN}=5\text{V}$	-2	-	2	%	
	$V_{OUT}$ Temperature Coefficient		-	50	-	ppm/ $^{\circ}\text{C}$	
$V_{DROPOUT}$	Dropout Voltage	$I_O=1\text{mA to }300\text{mA}$ , $V_{OUT}=V_{O(NOM)}-1.5\%$	$V_O=1.5\text{V}$	-	-	1.5	V
			$V_O=1.8\text{V}$	-	-	1.2	
			$V_O=2\text{V}$	-	-	1	
			$V_O=2.5\text{V}$	-	-	0.6	
			$V_O \geq 2.8\text{V}$	-	-	0.45	
$I_{OUT}$	Output Current		300	-	-	mA	
$I_{LIMIT}$	Current Limit	$V_{OUT} > 1.05\text{V}$	300	450	-	mA	
$I_{short}$	Short Circuit Current	$V_{CC}=5\text{V}$ , $V_{out} < 1.05\text{V}$	-	150	300	mA	
$\Delta V_{LINE}$	Line Regulation	$I_{OUT}=5\text{mA}$ , $V_{IN}=5\sim 7\text{V}$	-	0.1	0.3	%	
$\Delta V_{LOAD}$	Load Regulation	$I_O=1\text{mA to }300\text{mA}$ , $V_{IN}=5\text{V}$	-	0.3	1	%	
PSRR	Power Supply Rejection	$I_O=100\text{mA}$ , $C_O=2.2\mu\text{F ceramic}$	$f=1\text{KHz}$	-	60	-	dB
			$f=10\text{KHz}$	-	50	-	
			$f=100\text{KHz}$	-	40	-	
PSRR	Power Supply Rejection	$I_O=100\text{mA}$ , $C_O=2.2\mu\text{F ceramic}$ , $C_{BYP}=20\text{nF}$	$f=1\text{KHz}$	-	75	-	dB
			$f=10\text{KHz}$	-	55	-	
			$f=100\text{KHz}$	-	30	-	
$V_{EH}$	EN Input Threshold	Output ON	1.7	-	-	V	
$V_{EL}$		Output OFF	-	-	0.8	V	
$I_{EN}$	Enable Pin Current		-	-	<0.1	$\mu\text{A}$	
OTS	Over Temperature Shutdown		-	130	-	$^{\circ}\text{C}$	
OTH	Over Temperature Hysteresis		-	20	-	$^{\circ}\text{C}$	

Note 1 :  $V_{IN(MIN)}=V_{OUT}+V_{DROPOUT}$

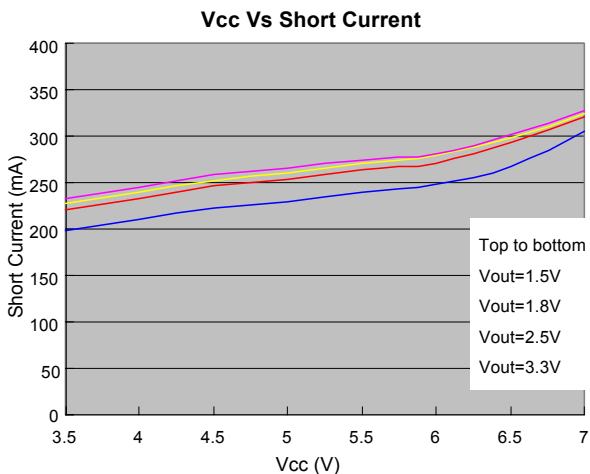
### ■ Typical Application



### ■ Typical Performance Characteristics



### ■ Typical Performance Characteristics (Continued)



### ■ Function Description

The AP139 of CMOS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, thermal shutdown.

The P-channel pass transistor receives data from the error amplifier, over-current protection, and thermal protection circuits. During normal operation, the error amplifier compares the output voltage to a precision reference. Over-current and thermal shutdown circuits become active when the junction temperature exceeds 130°C, or the current exceeds 300mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 110°C.

The AP139 switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over-stress.

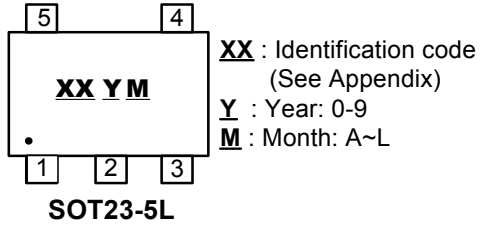
#### **Enable**

The enable pin normally floats high. When actively, pulled low, the PMOS pass transistor shut off, and all internal circuits are powered down. In this state, the quiescent current is less than 2μA. This pin behaves much like an electronic switch.

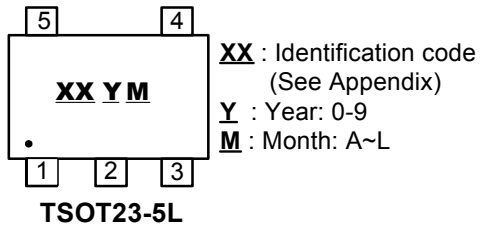
#### **External Capacitor**

The AP139 is stable with a low ESR output capacitor to ground of 1.0μF or greater. It can keep stable even with higher ESR capacitors. A second capacitor is recommended between the input and ground to stabilize VIN. The input capacitor should be larger than 0.1μF to have a beneficial effect. All capacitors should be placed in close proximity to the pins. A “quiet” ground termination is desirable.

### ■ Marking Information



**XX** : Identification code  
(See Appendix)  
**Y** : Year: 0-9  
**M** : Month: A~L



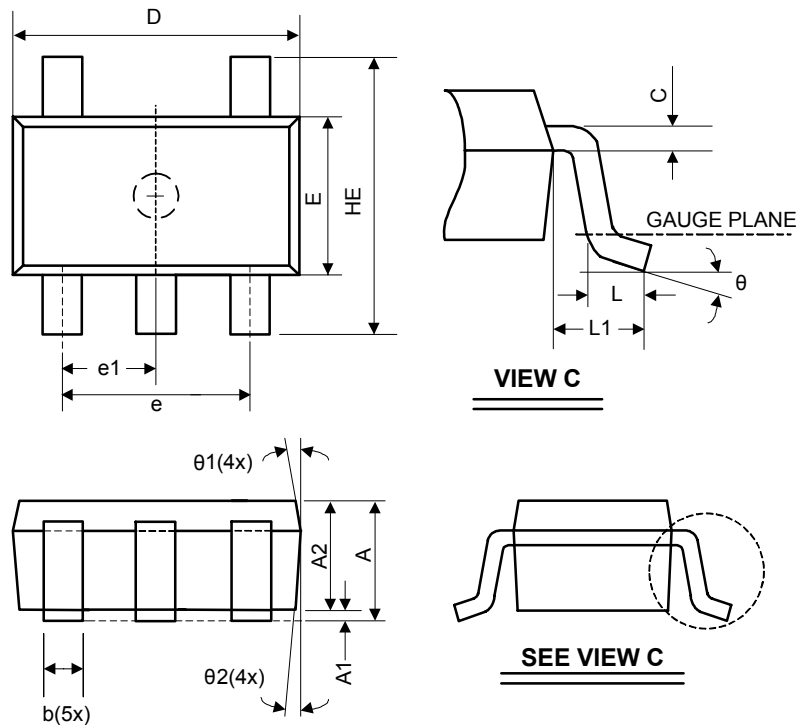
**XX** : Identification code  
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### Appendix

Identification Code	Output version
N0	AP139-1.5V
N1	AP139-1.8V
N2	AP139-2.0V
N3	AP139-2.5V
N4	AP139-2.8V
N5	AP139-3.0V
N6	AP139-3.3V
N7	AP139-3.5V

### ■ Package Information

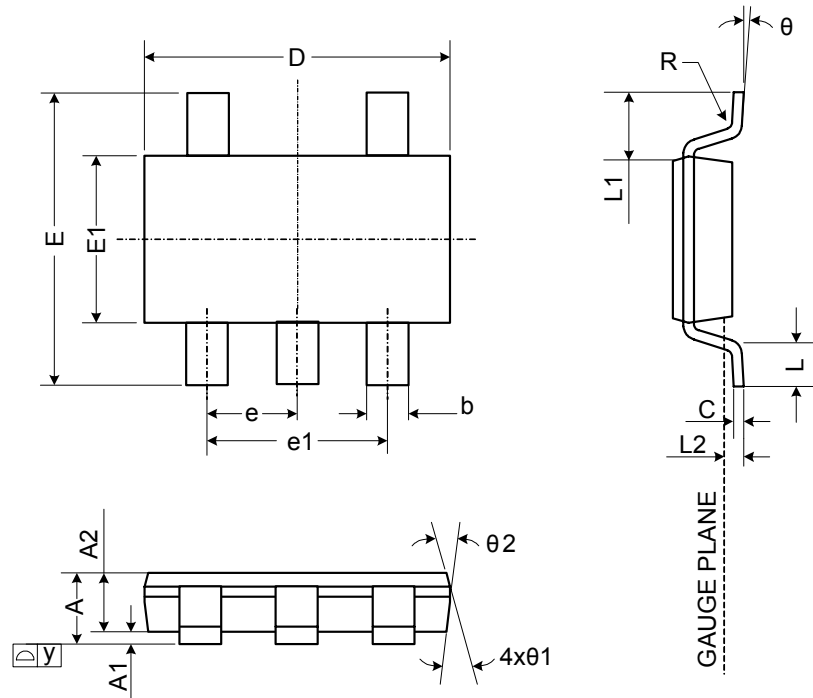
(1)Package Type: SOT23-5L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.05	-	1.35	0.041	-	0.053
A1	0.05	-	0.15	0.002	-	0.006
A2	1.00	1.10	1.20	0.039	0.043	0.047
b	0.25	-	0.50	0.010	-	0.020
C	0.08	-	0.20	0.003	-	0.008
D	2.70	2.90	3.00	0.106	0.114	0.118
E	1.50	1.60	1.70	0.059	0.063	0.067
HE	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	-	0.60	0.012	-	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e	1.80	1.90	2.00	0.071	0.075	0.079
e1	0.85	0.95	1.05	0.033	0.037	0.041
theta	0°	5°	10°	0°	5°	10°
theta1	3°	5°	7°	3°	5°	7°
theta2	6°	8°	10°	6°	8°	10°

### ■ Package Information (Continued)

(2) Package Type: TSOT23-5L



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.75	-	0.90	0.030	-	0.035
A1	0.00	-	0.10	0.000	-	0.004
A2	0.70	0.75	0.80	0.028	0.030	0.031
b	0.35	-	0.51	0.014	-	0.020
C	0.10	-	0.25	0.004	-	0.010
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037		
e1	1.90 BSC.			0.075		
L	0.37	-	-	0.015	-	-
L1	0.60 REF.			0.024		
L2	0.25 BSC.			0.010		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0°	-	8°	0°	-	8°
θ1	7° NOM.			7° NOM.		
θ2	5° NOM.			5° NOM.		