

■ Features

- Very low dropout voltage
- Low current consumption: Typ. 30 μ A, Max. 35 μ A
- High accuracy output voltage: +/-1.5%
- Guaranteed 600mA output
- Thermal shutdown
- Current limiting
- Factory pre-set output voltages
- Short circuit current fold-back
- Low temperature coefficient
- 3-pin SOT89 and SOT223 **Pb-Free** packages

■ Applications

- Battery-powered Devices
- Personal Communication Devices
- Home Electric / Electronic Appliances
- PC Peripherals

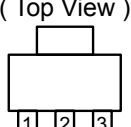
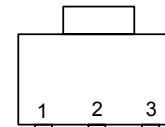
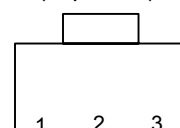
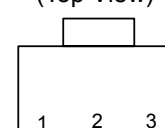
■ General Description

The AP160 family is a positive voltage linear regulator developed utilizing CMOS technology featured low quiescent current (30 μ A typ.), low dropout voltage, and high output voltage accuracy. Built-in low on-resistance transistor provides low dropout voltage and large output current. A 2.2 μ F or greater can be used as an output capacitor.

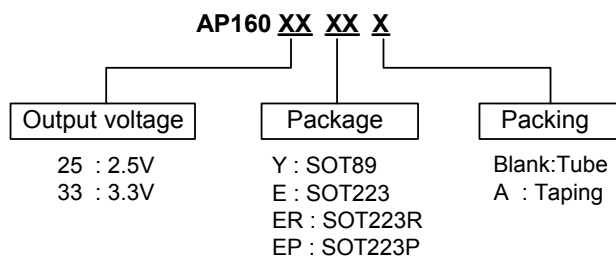
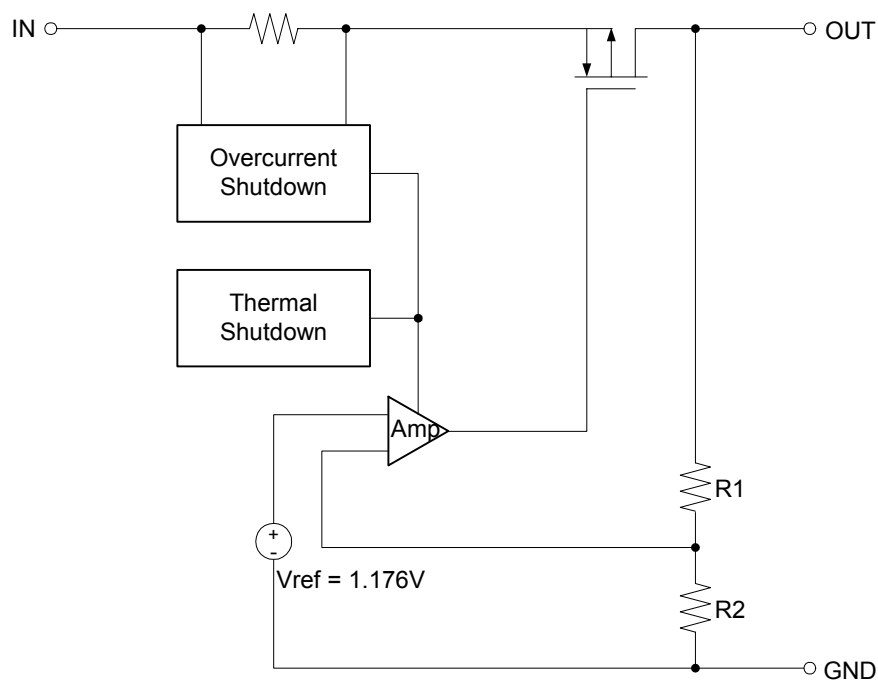
The SOT-89 and SOT-223 packages are attractive for "Pocket" and "Hand Held" applications.

These robust devices are designed to prevent device failure under the worst operation condition with both Thermal Shutdown and Current Fold-back.

■ Pin Assignments and Pin Descriptions

Package		No.	Name	Package		No.	Name
Type	Code			Type	Code		
(Top View)  (SOT89)	Y	1	GND	(Top View)  (SOT223R)	ER	1	GND
		2	V _{IN}			2	V _{OUT}
		3	V _{OUT}			3	V _{IN}
(Top View)  (SOT223)	E	1	V _{IN}	(Top View)  (SOT223P)	EP	1	V _{OUT}
		2	GND			2	GND
		3	V _{OUT}			3	V _{IN}

Description		
V _{IN} : Power Input	V _{OUT} : Output Voltage	GND: Ground

■ Ordering Information

■ Block Diagram

■ Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	+7	V
I_{OUT}	Output Current	1	A
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

Parameter	Package	Max.	Unit
Thermal Resistance (θ_{jc})	SOT89	100	$^{\circ}\text{C}/\text{W}$
	SOT223/R/P	50	
Thermal Resistance (θ_{ja})	SOT89	180	$^{\circ}\text{C}/\text{W}$
	SOT223/R/P	100	
Internal Power Dissipation (P_D) ($T=100^{\circ}\text{C}$, No Heatsink)	SOT89	400	mW
	SOT223	900	
	SOT223R	800	
	SOT223P	800	
Maximum Junction Temperature		150	$^{\circ}\text{C}$
Maximum Lead Temperature (10 Sec)		300	$^{\circ}\text{C}$

Caution: Stress above the listed absolute rating may cause permanent damage to the device.

■ Electrical Characteristics

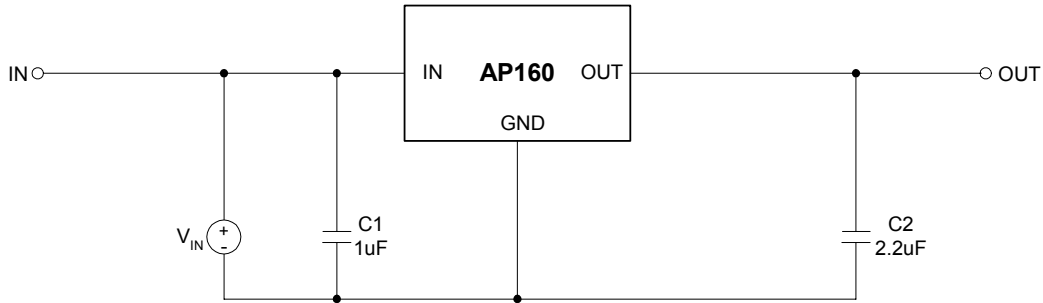
($T_A=+25^{\circ}\text{C}$; $V_{IN}=V_{IN(MIN)}$ unless otherwise noted)

Sym.	Parameter	Test Conditions	Min.	Typ.	Max.	Unit	
V_{IN}	Input Voltage		Note 1	-	7	V	
V_{OUT}	Output Voltage Accuracy	$I_O=1\text{mA}$	-1.5	-	1.5	%	
$V_{DROPOUT}$	Dropout Voltage	$I_O=600\text{mA}$, $V_{OUT}=V_{O(NOM)}-1.5\%$,	$1.5\text{V}<V_{O(NOM)}\leq 2.0\text{V}$	-	-	1000	mV
			$2.0\text{V}<V_{O(NOM)}\leq 2.8\text{V}$	-	-	800	
			$2.8\text{V}<V_{O(NOM)}<3.8\text{V}$	-	-	600	
I_O	Output Current	$V_{OUT} > 1.2\text{V}$	600	-	-	mA	
I_{LIM}	Current Limit	$V_{OUT} > 1.2\text{V}$, $V_{IN}=V_{IN(MIN)}$	600	1000	-	mA	
I_{SC}	Short Circuit Current	$V_{OUT} < 0.8\text{V}$	-	250	-	mA	
I_Q	Quiescent Current	$I_O=0\text{mA}$	-	30	50	μA	
I_{GND}	Ground Pin Current	$I_O=1\text{mA}$ to 600mA	-	30	50	μA	
REG_{LINE}	Line Regulation	$I_{OUT}=5\text{mA}$, $V_{IN}=V_{OUT}+1$ to $V_{OUT}+2$	$V_{OUT} \leq 2.0\text{V}$	-	-	0.15	%
			$V_{OUT} > 2.0\text{V}$	-	0.02	0.1	
REG_{LOAD}	Load Regulation	$I_O=1\text{mA}$ to 600mA	-	0.2	1	%	
OTS	Over Temperature Shutdown		-	150	-	$^{\circ}\text{C}$	
OTH	Over Temperature Hysteresis		-	30	-	$^{\circ}\text{C}$	
TC	V_{OUT} Temperature Coefficient		-	30	-	ppm/ $^{\circ}\text{C}$	
PSRR	Power Supply Rejection	$I_O=100\text{mA}$, $C_O=2.2\mu\text{F}$ ceramic	f=1kHz	-	50	-	dB
			f=10kHz	-	20	-	
			f=100kHz	-	15	-	
eN	Output Voltage Noise	f=10Hz to 100kHz $I_O=10\text{mA}$, $C_{V_{BG}}=0\mu\text{F}$	$C_O=2.2\mu\text{F}$	-	30	-	Vrms
			$C_O=100\mu\text{F}$	-	20	-	

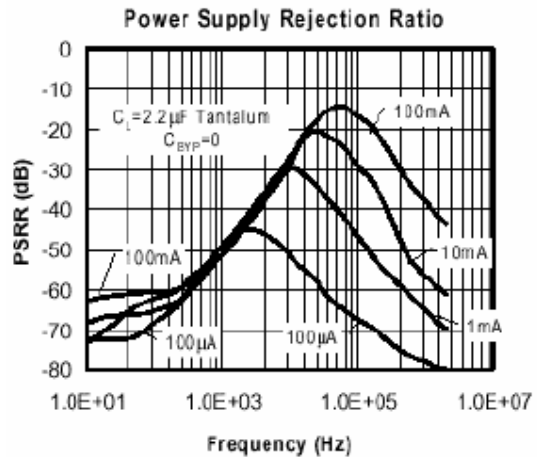
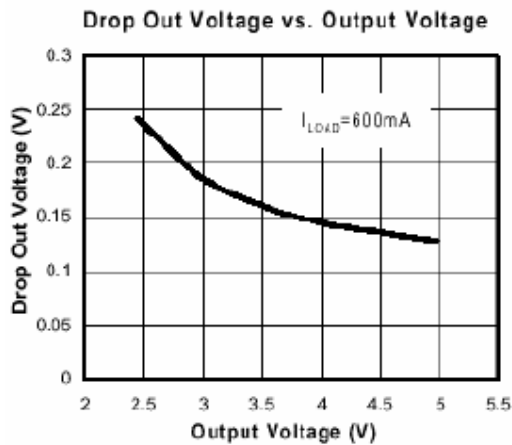
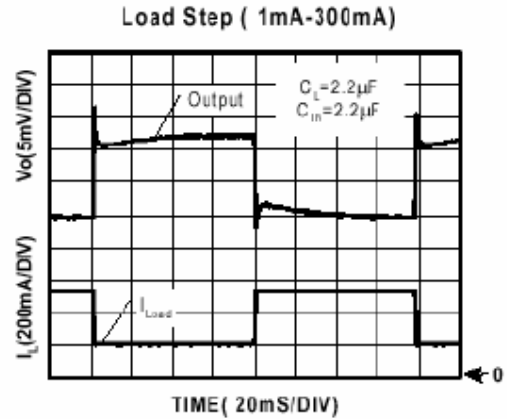
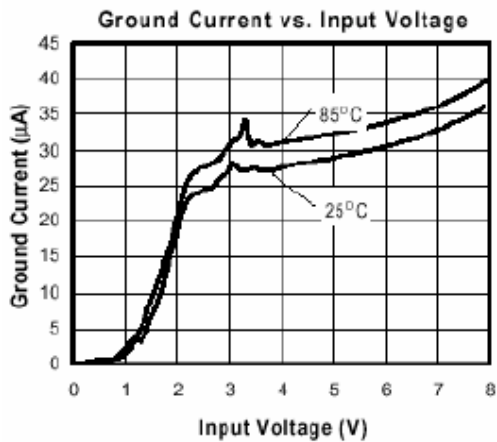
Note 1: $V_{IN(MIN)}=V_{OUT}+V_{DROPOUT}$

Note 2: As V_{IN} is larger than $V_{IN(MIN)}$, the Current Limit and output short current Spec value will increase.

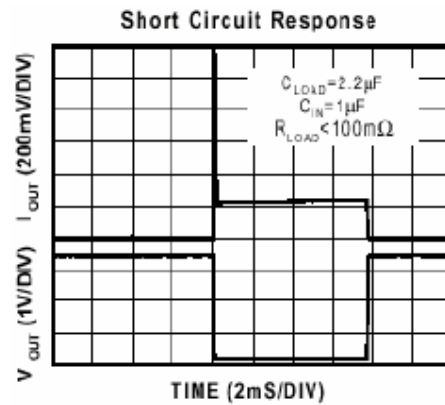
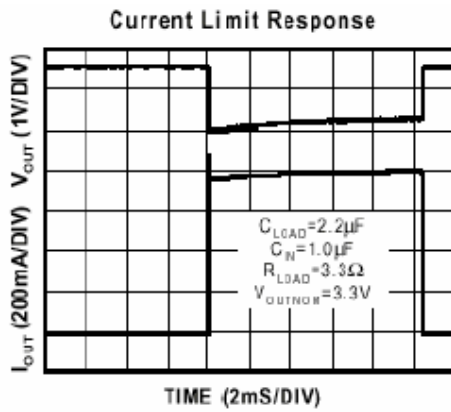
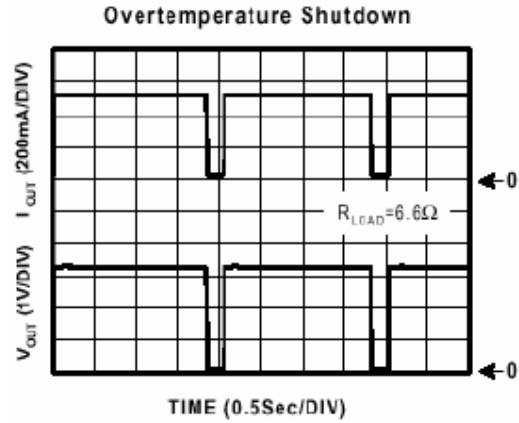
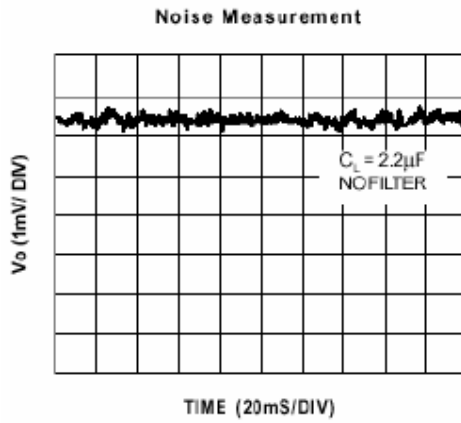
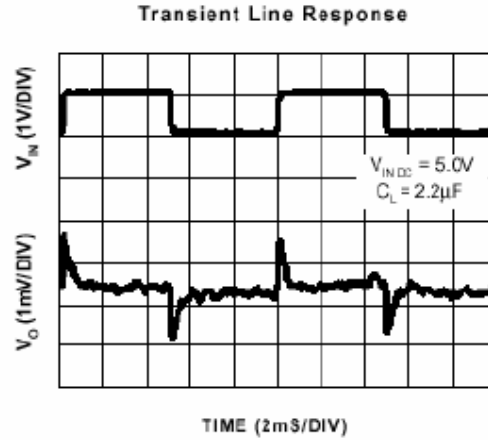
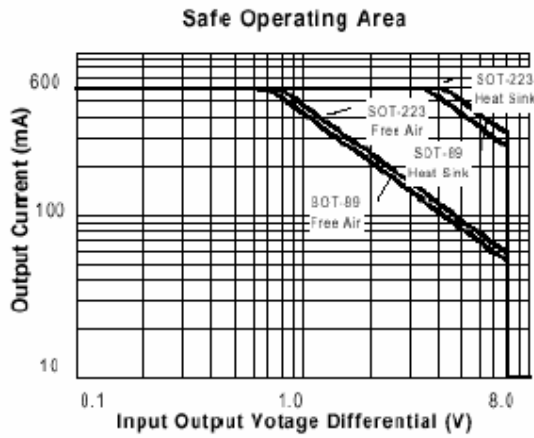
■ Typical Application Circuit



■ Typical Characteristics



■ Typical Characteristics (Continued)





■ Detailed Description

The AP160 family of CMOS regulators contain a PMOS pass transistor, voltage reference, error amplifier, over-current protection, thermal shutdown, and short circuit protection.

The P-channel pass transistor receives data from the error amplifier, over-current shutdown, short output 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 150°C, or the current exceeds

600mA. During thermal shutdown, the output voltage remains low. Normal operation is restored when the junction temperature drops below 120°C.

The AP160 switches from voltage mode to current mode when the load exceeds the rated output current. This prevents over-stress. The AP160 also incorporates current fold-back to reduce power dissipation when the output is short-circuited. This feature becomes active when the output drops below 0.8V, and reduces the current flow by 65%. Full current is restored when the voltage exceeds 0.8V.

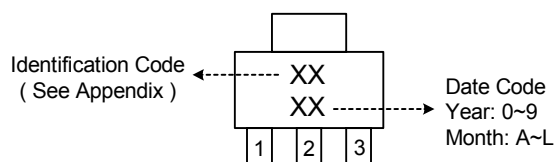
■ External Capacitor

The AP160 is stable with an output capacitor to ground of 2.2μF or greater. It can keep stable even with higher or poor 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

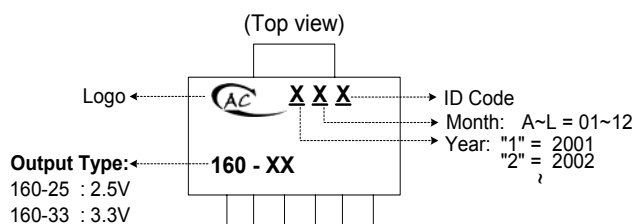
(1) SOT89



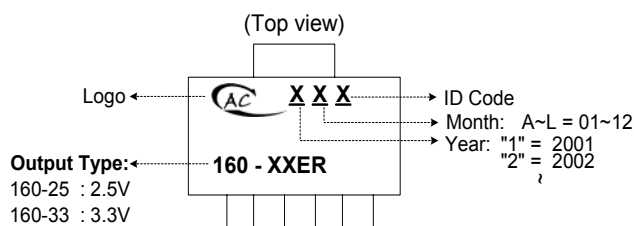
Appendix

Part Number	Identification code
AP160-25Y	QK
AP160-33Y	QS

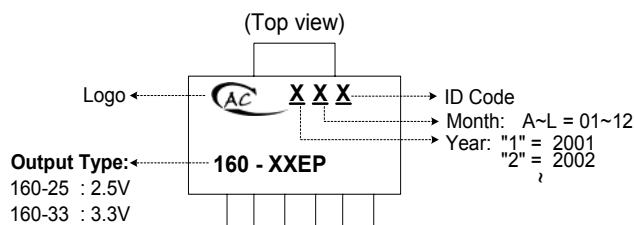
(2) SOT223

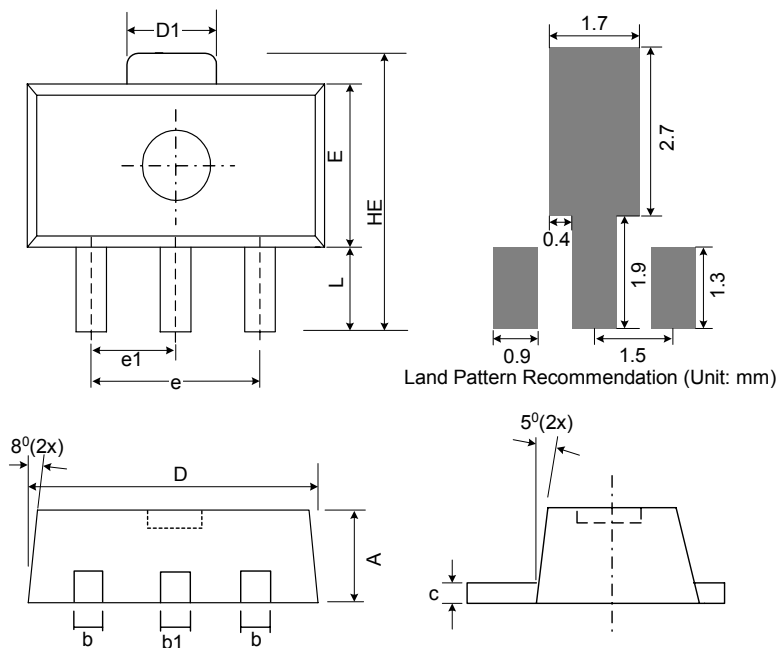


(3) SOT223R

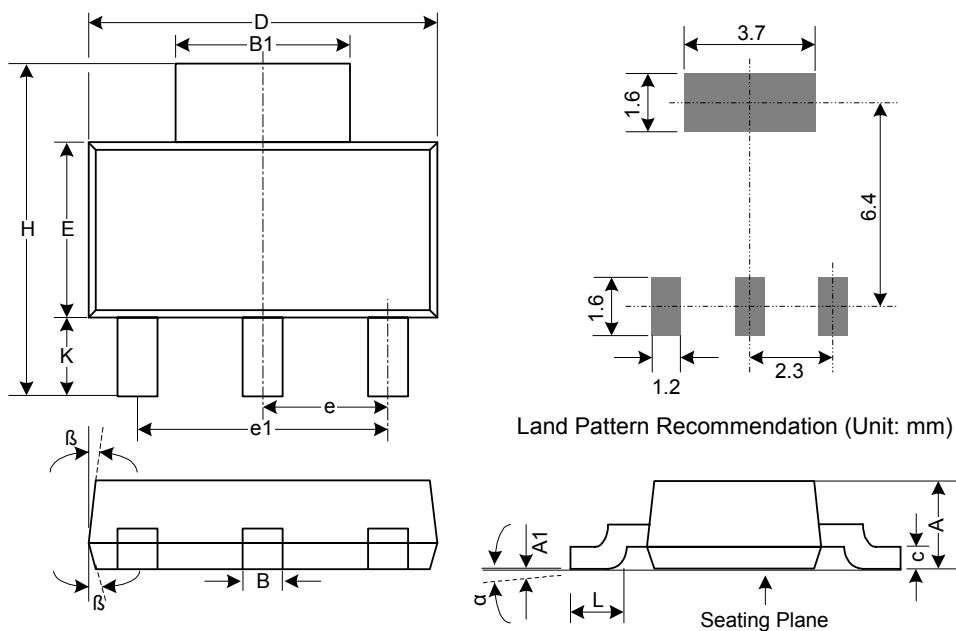


(4) SOT223P



■ Package Information
(1)SOT-89


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.40	1.50	1.60	0.055	0.059	0.063
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.043	0.051
C	0.35	0.39	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
e	2.90	3.00	3.10	0.114	0.118	0.122
e1	1.45	1.50	1.55	0.057	0.059	0.061
E	2.35	2.48	2.60	0.093	0.098	0.102
HE	3.94	-	4.25	0.155	-	0.167
L	0.80	-	1.20	0.031	-	0.047

■ Package Information (Continued)
(2) SOT-223


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.50	1.65	1.80	0.059	0.065	0.071
A1	0.02	0.05	0.08	0.001	0.002	0.003
B	0.60	0.70	0.80	0.024	0.028	0.031
B1	2.80	-	3.40	0.110	-	0.134
c	0.28	0.30	0.32	0.011	0.012	0.013
D	6.30	6.50	6.70	0.248	0.256	0.264
E	3.30	3.50	3.70	0.130	0.138	0.146
e	2.3 Basic			0.091 Basic		
e1	4.6 Basic			0.181 Basic		
H	6.70	7.00	7.30	0.264	0.276	0.287
L	0.91	1.00	1.10	0.036	0.039	0.043
K	1.50	1.75	2.00	0.059	0.069	0.079
α	0°	5°	10°	0°	5°	10°
β	-	13°	-	-	13°	-