ADJUSTABLE PRECISION SHUNT REGULATOR

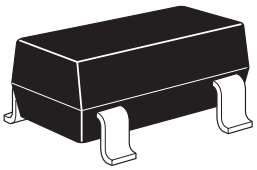
SUMMARY

DESCRIPTION

The ZR431L is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 25mA. The output voltage may be set to any chosen voltage between 1.24 and 10 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

The ZR431L is particularly used in the feedback control loop of switch mode power supplies. In this application the device 1.24 volt reference enables the generation of low voltage supplies, typically 3.3. volts or 3 volts.



SOT23

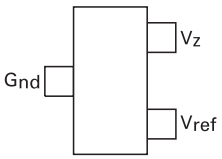
FEATURES

- 2.5% and 1% tolerance
- Max. temperature coefficient 50 ppm/°C
- Temperature compensated for operation over the full temperature range
- 100μA to 25mA current sink capability
- Surface mount SOT23 package
- TO92 package

TO92

APPLICATIONS

- Switch mode power supplies
- Shunt regulator
- Series regulator
- Voltage monitor
- Over voltage / under voltage protection

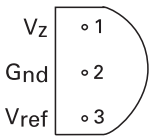


SOT23

Top View

ORDERING INFORMATION

DEVICE	PACK	TOL %	REEL SIZE	QUANTITY PER REEL	PART MARK
ZR431LF01TA	SOT23	1	7”	3000	43M
ZR431LF02TA	SOT23	2.5	7”	3000	43L
ZR431LC01STOB	TO92	1		1500	ZR431L01
ZR431LC02STOB	TO92	2.5		1500	ZR431L02
ZR431LC01L	TO92	1	LOOSE		ZR431L01
ZR431LC02L	TO92	2.5	LOOSE		ZR431L02



TO92

Underside View

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ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	LIMIT	UNIT
Cathode Voltage	V_Z	10	V
Cathode Current		50	mA
Operating Temperature	T_{OMP}	-40 to 85	°C
Storage Temperature	T_{STG}	-55 to 125	°C

RECOMMENDED OPERATING CONDITIONS

PARAMETER	MIN.	MAX.
Cathode Voltage	V_{REF}	10V
Cathode Current	100μA	25mA

POWER DISSIPATION (at T_{amb} = 25°C unless otherwise stated)

PACKAGE	VALUE	UNIT
SOT23	330	mW
TO92	600	mW

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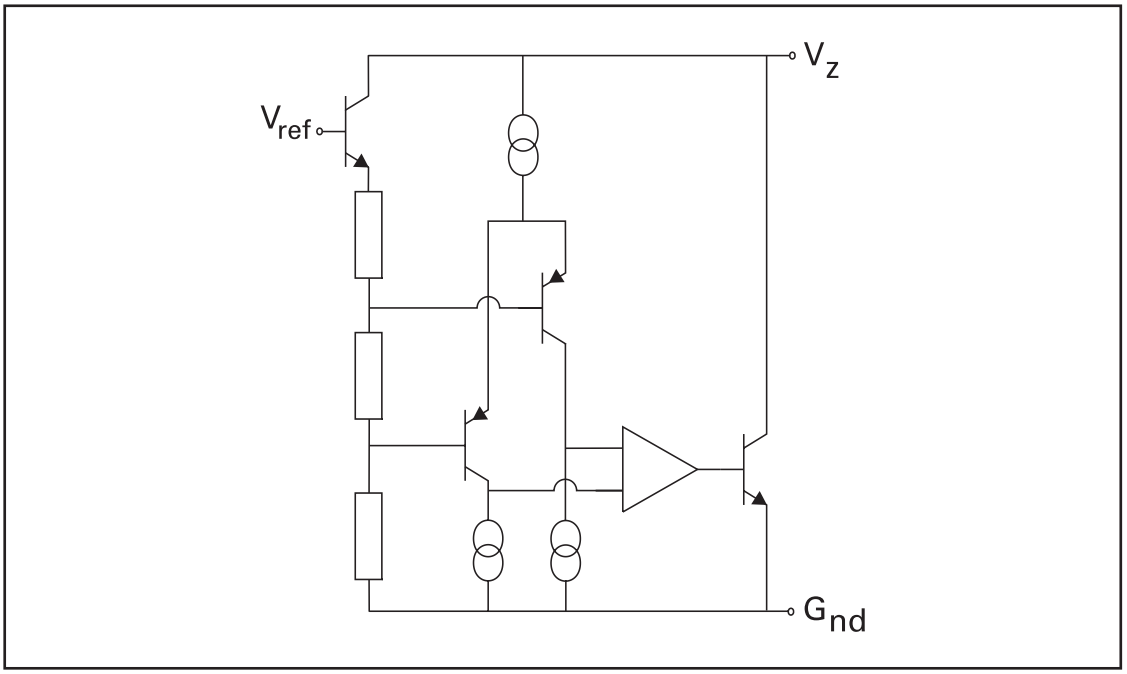
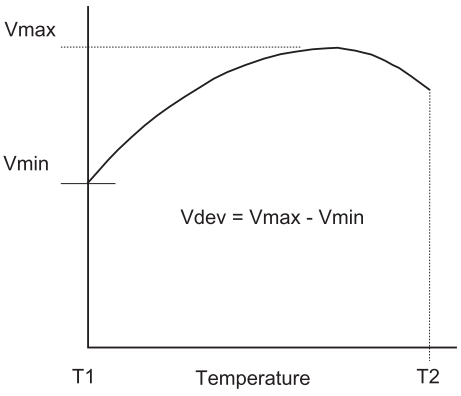
BLOCK DIAGRAM





Deviation of reference input voltage, V_{dev}, is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage, V_{ref} is defined as:

$$V_{ref}(ppm\ /\ C) = \frac{V_{dev} x 1000000}{V_{ref}(T1 - T2)}$$

The dynamic output impedance, R_Z, is defined as:

$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, R1 and R2, (fig 2), the dynamic output impedance of the overall circuit, R', is defined as:

$$R' = R_Z(1 + \frac{R1}{R2})$$

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ELECTRICAL CHARACTERISTICS (at T_{amb} = 25°C unless otherwise stated)

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT	CONDITIONS
Reference Voltage 2.5% 1.0%	V_{ref} Vref	1.209 1.228	1.24 1.24	1.271 1.252	V V	I_L = 10mA (Fig1), $V_Z = V_{ref}$
Deviation of Reference Input Voltage over Temperature	V_{dev}		4.0	8.0	mV	I_L = 10mA, $V_Z = V_{ref}$ T_a = full range (Fig 1)
Ratio of the change in Reference Voltage to the change in Cathode Voltage	$\frac{\Delta V_{ref}}{\Delta V_Z}$		0.5	2.0	mV/V	V_Z from V_{ref} to 10V I_Z = 10mA (Fig2)
Reference Input Current	I_{ref}	0.02	0.11	0.4	µA	R1 = 10k, R2 = O/C, I_L = 10mA (fig2)
Deviation of Reference Input Current over Temperature	ΔI_{ref}		0.02	0.2	µA	R1 = 10k, R2 = O/C, I_L = 10mA T_a = full range (Fig2)
Minimum Cathode Current for Regulation	I_{Zmin}		30	100	µA	
Off-state Current	I_{Zoff}		10	30	µA	V_Z = 10V, V_{ref} = 0V (Fig3)
Dynamic Output Impedance	R_Z		0.25	2	Ω	$V_Z = V_{ref}$(Fig1), f = 0Hz, I_L = 10mA

DC TEST CIRCUITS

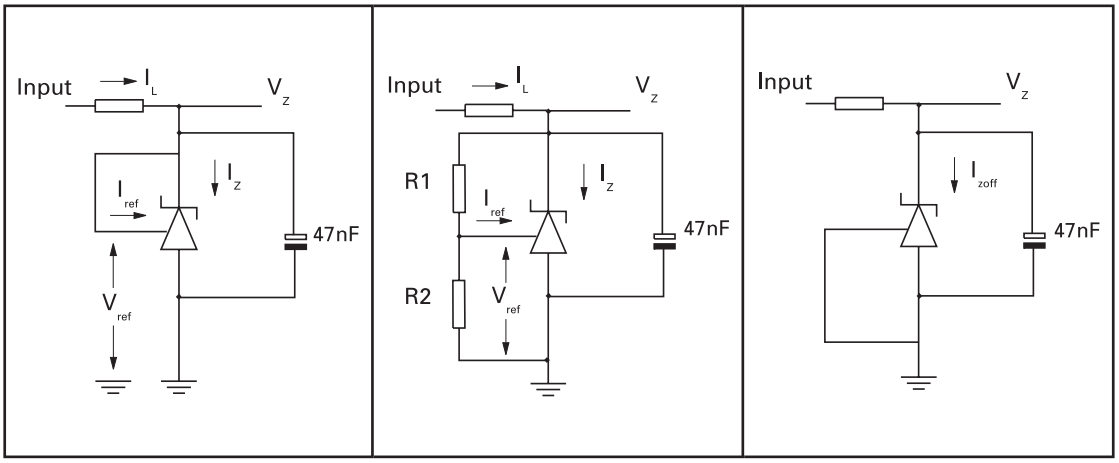

Fig 1 - Test Circuit for $V_Z = V_{ref}$

Fig 2 - Test Circuit for $V_Z > V_{ref}$

Fig 3 - Test Circuit for Off State current

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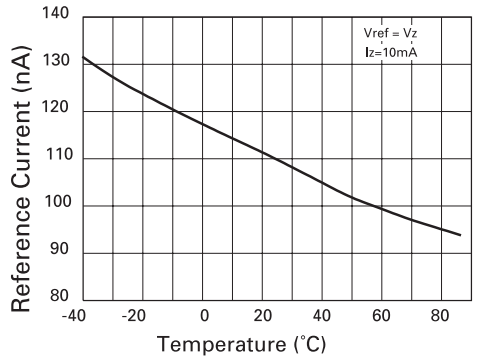
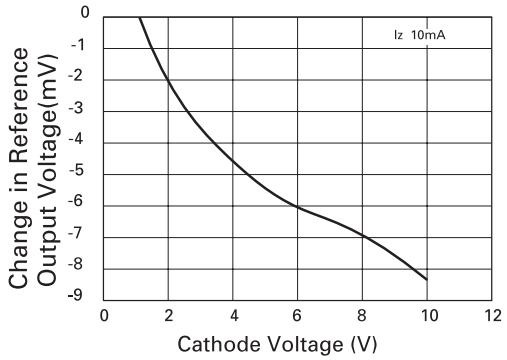
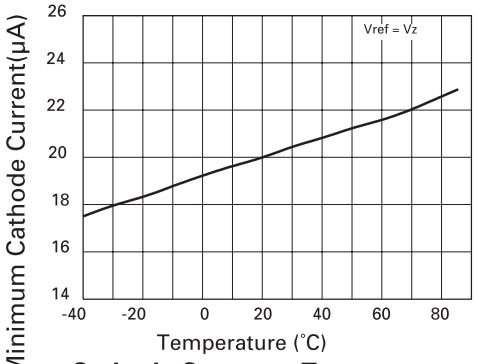
TYPICAL CHARACTERISTICS



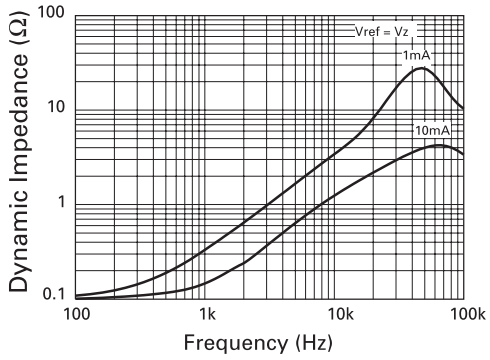
Reference Current v Temperature



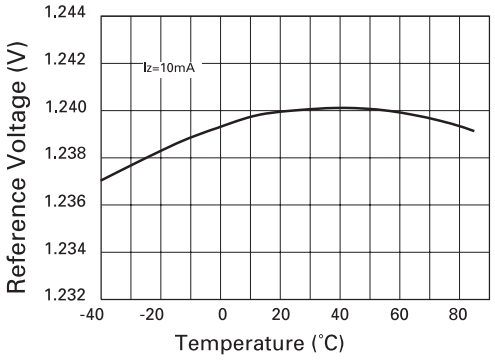
Change in V_{ref} v Cathode Voltage



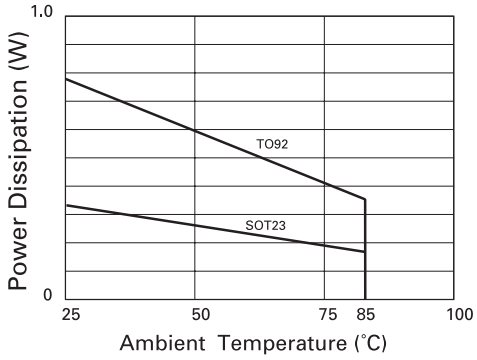
Cathode Current v Temperature



Dynamic Impedance v Frequency



Reference Voltage v Temperature



Power Dissipation Derating

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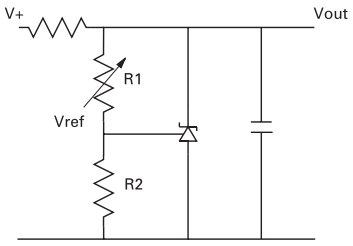
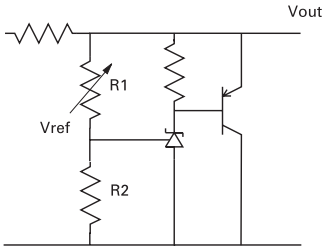
APPLICATIONS CIRCUITS



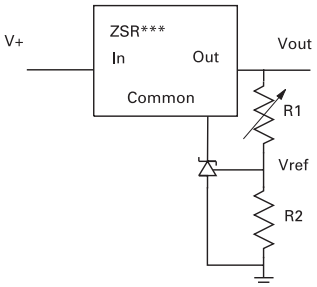
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

SHUNT REGULATOR



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

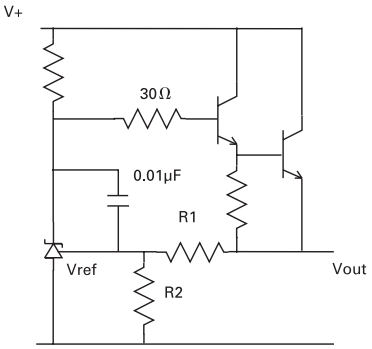
HIGHER CURRENT SHUNT REGULATOR



$$V_{out_{MIN}} = V_{ref} + V_{reg}$$

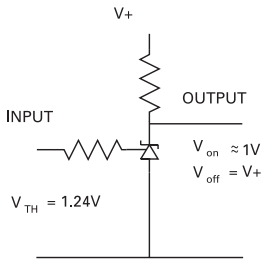
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

OUTPUT CONTROL OF A
THREE TERMINAL FIXED REGULATOR

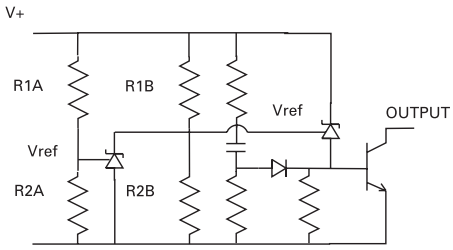


$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR
WITH TEMPERATURE
COMPENSATED THRESHOLD



$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) V_{ref}$$

$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) V_{ref}$$

OVER VOLTAGE / UNDER VOLTAGE
PROTECTION CIRCUIT

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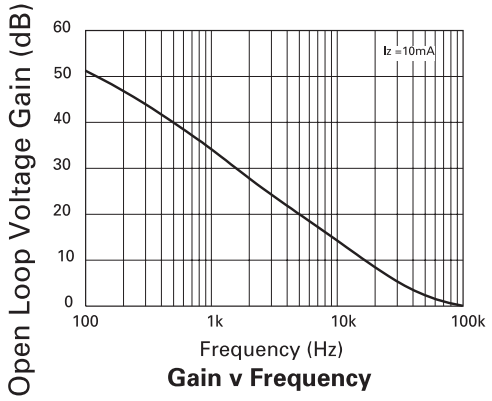
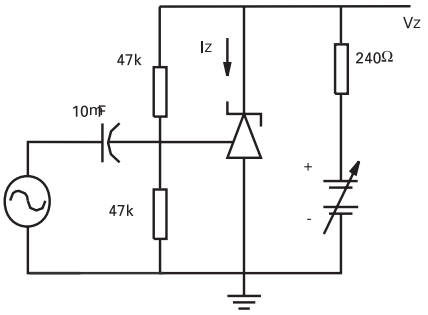
TYPICAL CHARACTERISTICS

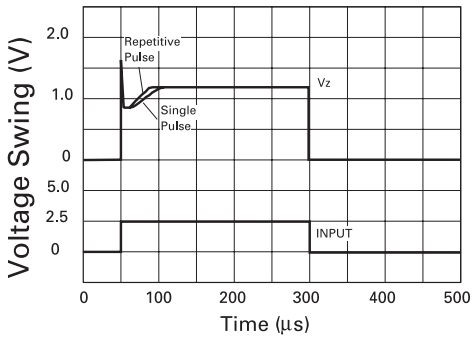


Gain v Frequency

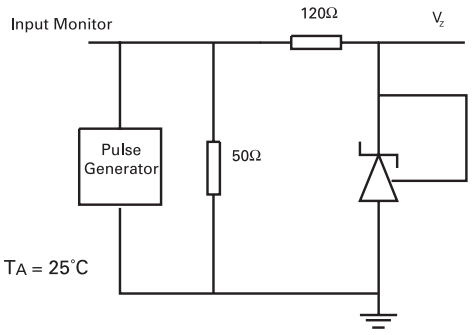


IZ = 10mA, TA = 25°C

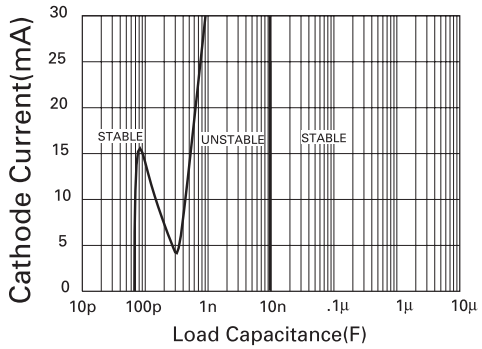
Test Circuit for Open Loop Voltage Gain



Pulse Response

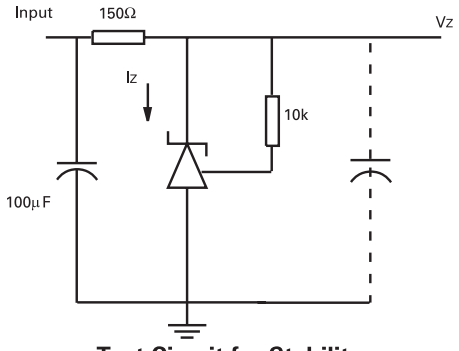


Test Circuit for Pulse Response



Stability Boundary Conditions

Vref < VZ < 10, IZ = 10mA, TA = 25°C



Test Circuit for Stability Boundary Conditions

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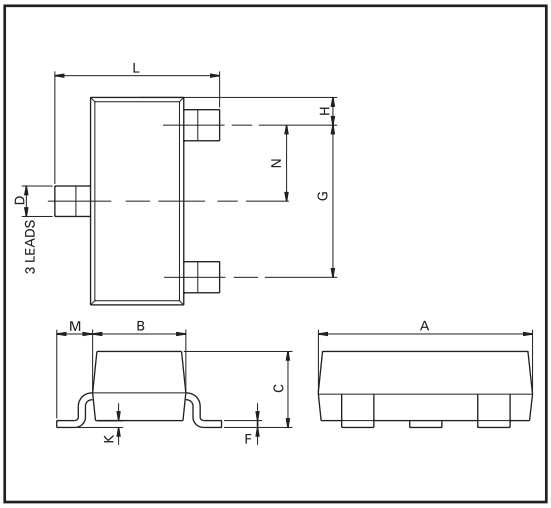
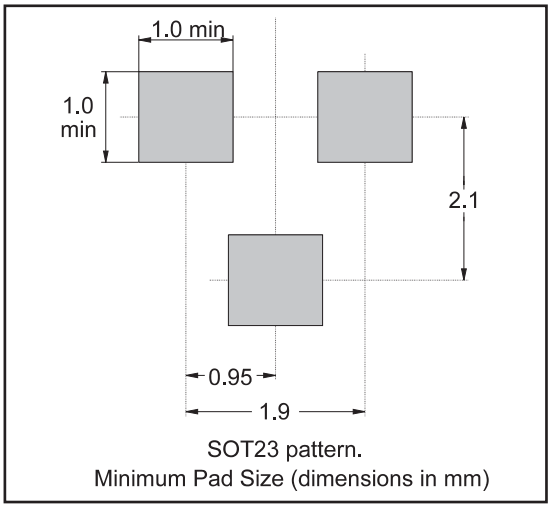
SOT23 PACKAGE OUTLINE AND PAD LAYOUT DETAILS

PACKAGE OUTLINE



PAD LAYOUT



Controlling dimensions are in millimetres. Approximate conversions are given in inches

PACKAGE DIMENSIONS

DIM	Millimetres		Inches		DIM	Millimetres		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	2.67	3.05	0.105	0.120	G	NOM 1.9		NOM 0.037	
B	1.20	1.40	0.047	0.055	K	0.01	0.10	0.0004	0.004
C	–	1.10	–	0.043	L	2.10	2.50	0.083	0.0985
D	0.37	0.53	0.0145	0.021	N	NOM 0.95		NOM 0.037	
F	0.085	0.15	0.0033	0.0059					

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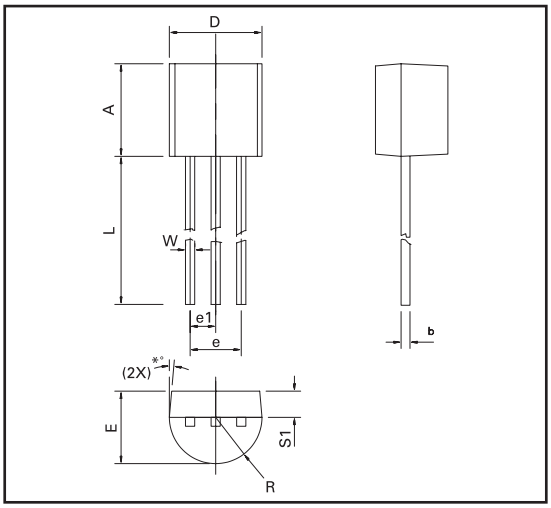
TO92 PACKAGE OUTLINE DETAILS

PACKAGE OUTLINE



Controlling dimensions are in millimetres. Approximate conversions are given in inches

PACKAGE DIMENSIONS

DIM	Millimetres		Inches		DIM	Millimetres		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	4.32	4.95	0.170	0.195	R	2.16	2.41	0.085	0.095
b	0.36	0.51	0.014	0.020	S1	1.14	1.52	0.045	0.060
E	3.30	3.94	0.130	0.155	W	0.41	0.56	0.016	0.022
e	2.41	2.67	0.095	0.105	D	4.45	4.95	0.175	0.195
e1	1.14	1.40	0.045	0.055	*°	4°	6°	4°	6°
L	12.70	15.49	0.500	0.610					

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