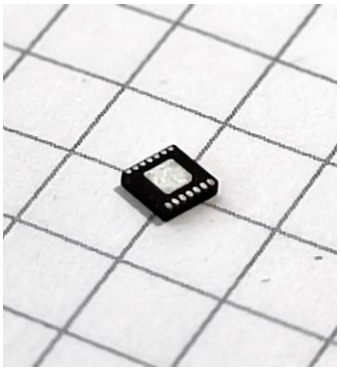
SSP-SIC515

IC for Inductive Proximity Switches with Short Protection



PRODUCTS FEATURES

- Wide supply voltage: 4~40V
- Low current consumption < 0.7 mA
- Integrated output stage current >70mA
- High noise immunity
- High switching frequencies up to 5 kHz
- Suitable for two wire AC proximity switches
- Temperature response of the IC compensates that of the coil
- Short circuit and overload protection of output stages and external componets
- Temperature range -40~+125°C

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1.Electrical characteristics

Recommended working conditions

Parameter	Symbol	Min	Max	Unit	Test Conditions
Voltage	V_{CC}	4	40	V	Normal work
Voltage	V_{CC}	3.1	4.5	V	$V_{CC}=V_{REF}$, Low voltage work
Range of working temperature	T_A	-40	125	C	

Limit parameter

Parameter	Symbol	Min	Max	Unit	Test Conditions
Voltage	Vcc	-0.3	50	V	
Output pin voltage	$V_{Q1;}V_{Q3}$	-1	45	V	$V_{Q2;}V_{Q4}\leq V_{CC}$
Output tube voltage (B-pin open)	$V_{Q2;}V_{Q4}$	-1	$_{V}$CC	V	$V_{Q1;}V_{Q2;}V_{Q4<}V_{Q3}$
Output tube voltage (B-pin connection)	$V_{Q2;}V_{Q4}$	-1	$_{V}$B	V	$V_{Q1;}V_{Q2;}V_{Q4<}V_{Q3}$
Output tube output current	$I_{Q1;}$ I_{Q3}	0	70	mA	No short circuit protection
Output tube output current	$-I_{Q2;}$ $-I_{Q4}$	0	70	mA	No short circuit protection
V_T pin voltage	V_T	-0.3	14	V	
$_{V}$REF pin current	$-I_{VREF}$	0	100	μA	
SC pin voltage	V_{SC}	0	$_{V}$CC	V	
$_{R}$Di pin pull current	$-I_{RDi}$	0	2	mA	
$_{R}$Hys pin sink current	I_{RHy}	0	2	mA	
B pin voltage	V_B	-0.3	$_{V}$CC	V	
Junction temperature	T_J	-40	150	℃	
Storage temperature	T_S	-55	160	℃	

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Electrical parameters

Typical test conditions: VCC = 4~40V, TA = 25°C, unless otherwise stated

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Power section						
Static supply current	Three-wire system	I_{CC}		0.55	0.70	mA
Three-wire system						
Minimum starting voltage	Output start action	V_{TON1}		3.64	4	V
Shutdown voltage	Output to no action	V_{TOFF1}	3.0	3.6		V
Hysteresis	V_{TON1}-V_{TOFF1}	ΔV_{Hy1}		0.04		V
Oscillator section (LC, R_{Di})						
Oscillating frequency		f_{OSC}			3	MHz
Oscillation amplitude		A_{OSC}		0.8		V_{PP}
Modulator and threshold switch section (C_I, R_{Hy})						
C_I Pin threshold		V_{CI}		2		V
C_I Pin hysteresis		V_{HyCI}		0.8		V
C_I pin sink current		I_{CI}		7		μA
C_I pin pull current		$-I_{CI}$		6		μA
On-off level frequency	C_I < 50 pF, L=70μH	f_S		5		kHz
Reference voltage (V_{REF})						
Reference voltage	I_{VREF} = 0~100μA	V_{REF}	2.65	3.0	3.10	
Two-wire regulator (V_T)						
Minimum starting voltage		V_{TON2}	6.7	8.0	9.3	V
Shutdown voltage		V_{TOFF2}	5.0	6.0	7.0	V
Hysteresis	V_{TON2}-V_{TOFF2}	ΔV_{Hy2}	1.6	2.0	2.4	V
Switch delay and short circuit protection delay (C_D)						
Turn-on delay		t_{DON}	0.49	0.65	0.82	ms/nF
Shutdown delay		t_{VA}	17.0	25	34.0	μs/nF
Short circuit protection delay		t_{SC}	1.70	2.5	3.40	μs/nF
Output stage (Q1, Q2, Q3, Q4)						
Output voltage difference	I_Q=5mA, V_{Q1}-V_{Q2}, V_{Q3}-V_{Q4}	V_{QR}		0.10	0.14	V
Output voltage difference	I_Q=70mA, V_{Q1}-V_{Q2}, V_{Q3}-V_{Q4}	V_{QR}		0.5	0.99	V
Output current during short circuit protection		I_{QSC}		300	500	mA

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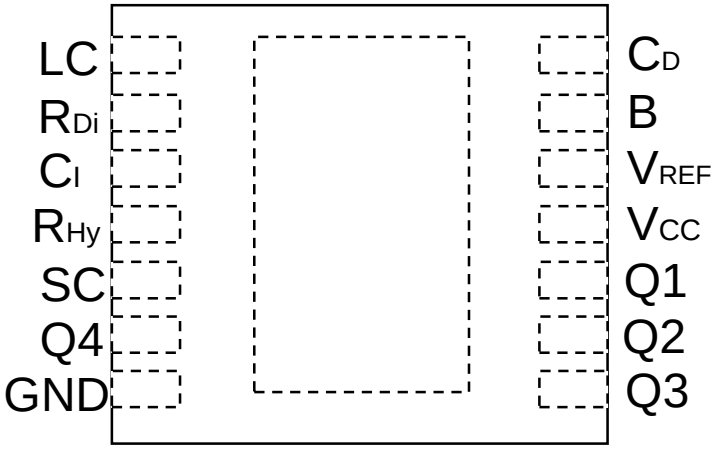
Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Short circuit detection (SC)						
Trigger voltage when short-circuiting the power supply Vcc		V_{SCS}	0.255	0.3	0.345	V
Trigger current when short circuit to power supply VCC		I_{SCS}			30	μA
Trigger voltage when shorted to ground GND		V_{SCO}	0.255	0.3	0.345	V
Trigger current when shorted to ground GND		$-I_{SCO}$			6	μA

2.Pin configurations



Pin	Symbol	Function	Description
1	LC	Oscillator	An external inductor and capacitor are connected between LC and GND to form a resonant circuit
2	R_{Di}	Distance	R_{Di} external resistor that sets the current and detection distance in the oscillator.
3	C_I	Integrating capacitance	An external 1nF capacitor is usually connected between C_I and GND to reduce interference.
4	R_{Hy}	Hysteresis	An external resistor between R_{Hy} and GND is used to set the detected window hysteresis.
5	SC	Short-circuit detector	Short-circuit sampling of the output stage of the circuit (can be for Vcc or GND).
6	GND	Output	Emitter of second output transistor (open circuit)
7	Q4	Ground	
8	Q3	Output	Collector of second output transistor (open circuit)
9	Q2	Output	Emitter of first output transistor (open circuit)

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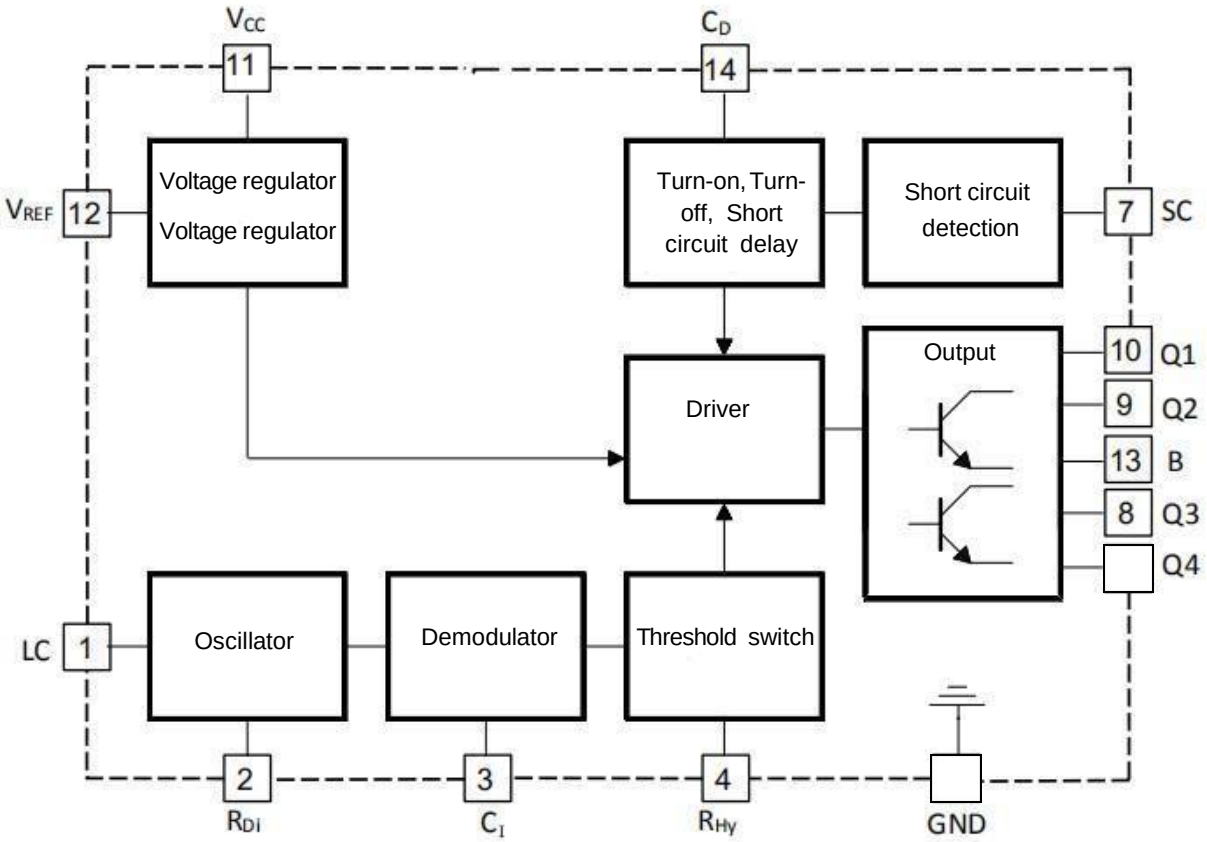
Pin	Symbol	Function	Description
10	Q1	Output	Collector of first output transistor (open circuit)
11	V_{CC}	Supply voltage	
12	V_{REF}	Internal reference voltage	Internal stable reference voltage, approximately 3.0V.When V_{REF} and V_{CC} are connected together, the operating voltage range of the circuit can be reduced to 3.1~4.5V
13	B	Base Output Transistors	Used to limit the base voltage of the internal output stage transistors
14	C_D	Turn-On Delay Short-circuit delay	An external capacitor between C_D and GND is used to set the action delay time

3.Functional block diagram



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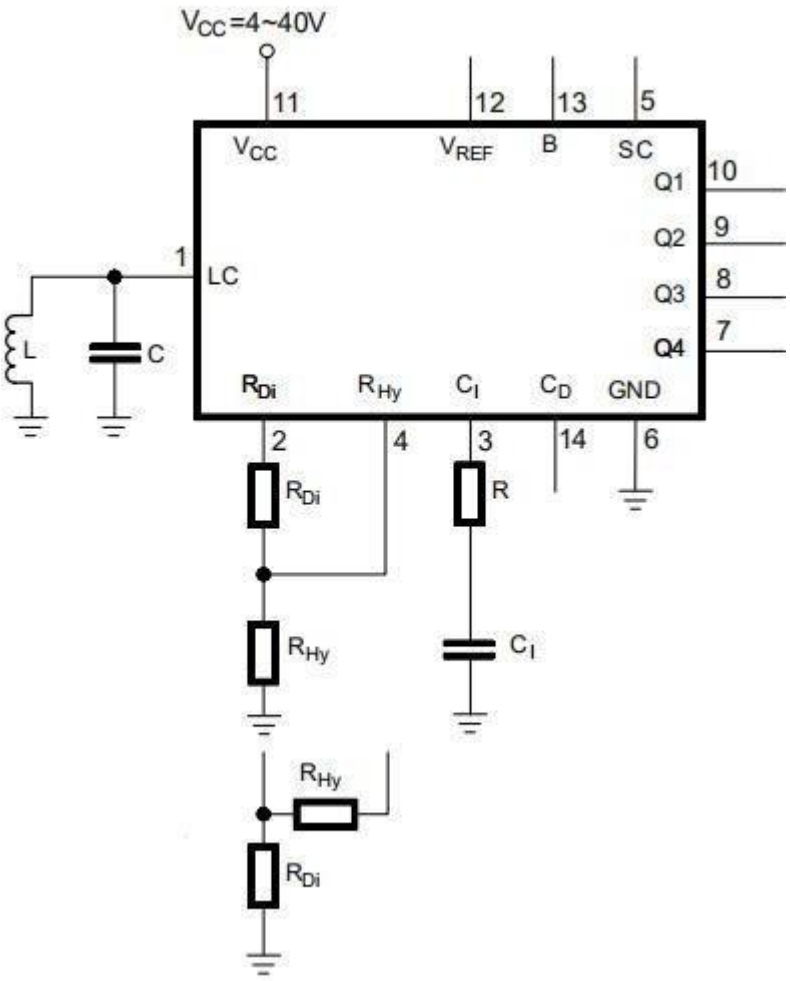
4.Application circuit

The input circuit uses four pins of LC, R_{Di}, R_{Hy} and C_I



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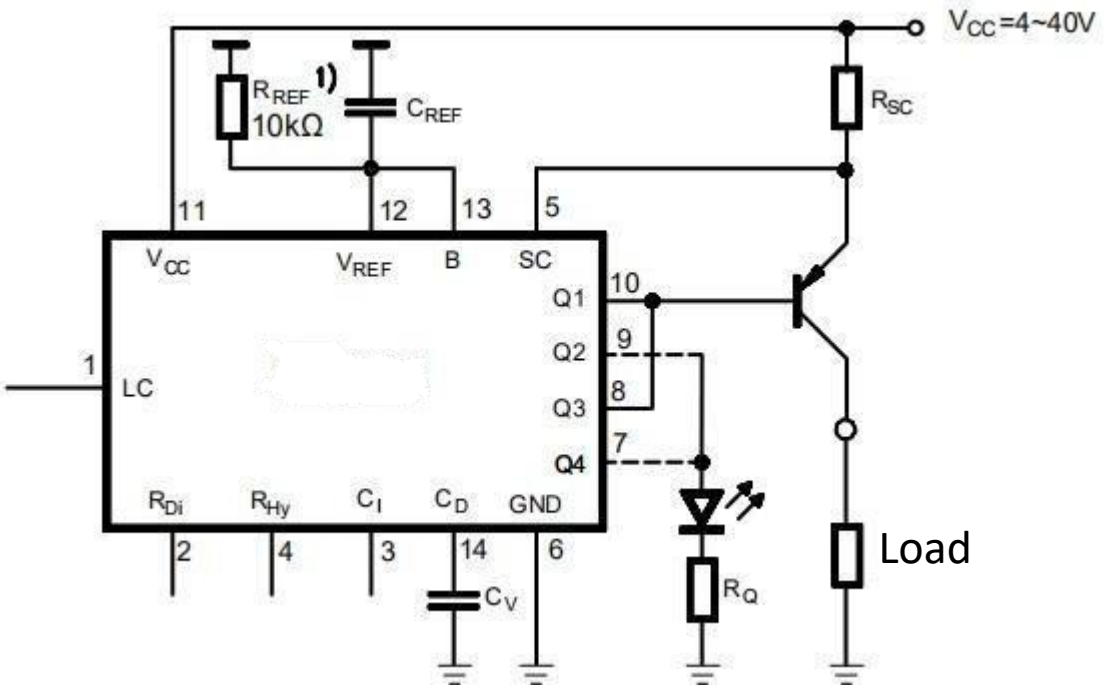
The output circuit uses eight pins of V_{REF}, B, Q1, Q2, Q3, Q4, and C_D
External PNP structure output with short circuit protection and LED indication. Generally, the short circuit protection is calculated by using the following equation:

$$R_{sc} = \frac{-0.3V}{max.load\ current}$$

During the current sampling period, the current in the chip is limited to a maximum of 250mA.



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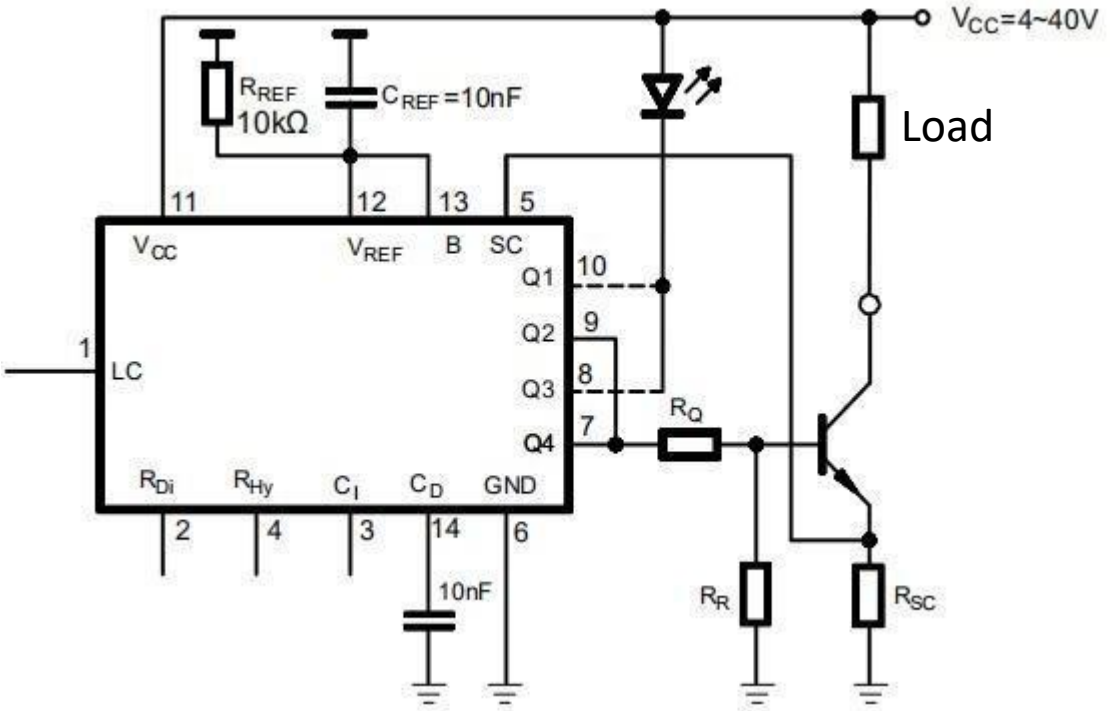
The output circuit uses eight pins of V_{REF}, B, Q1, Q2, Q3, Q4, and C_D



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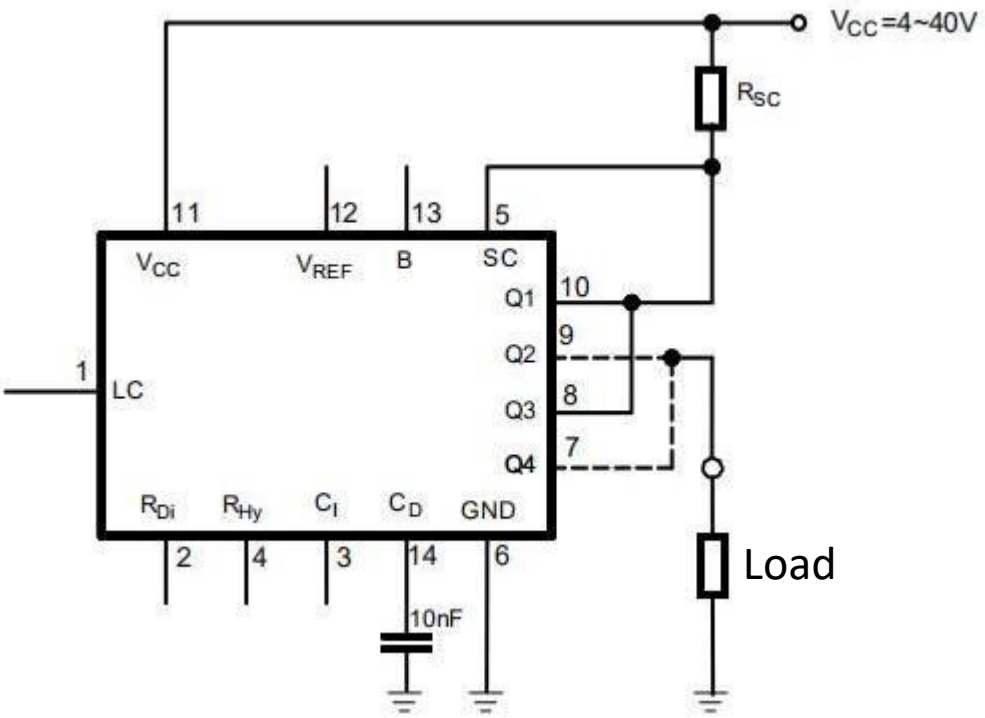
The output circuit uses six pins of SC, Q1, Q2, Q3, Q4, and C_D
Direct internal NPN output structure with short circuit protection and LED indication.
Generally, the short circuit protection is calculated by using the following equation:

$$R_{sc} = \frac{-0.3V}{max.load\ current}$$

During the current sampling period, the current in the chip is limited to a maximum of 250mA.



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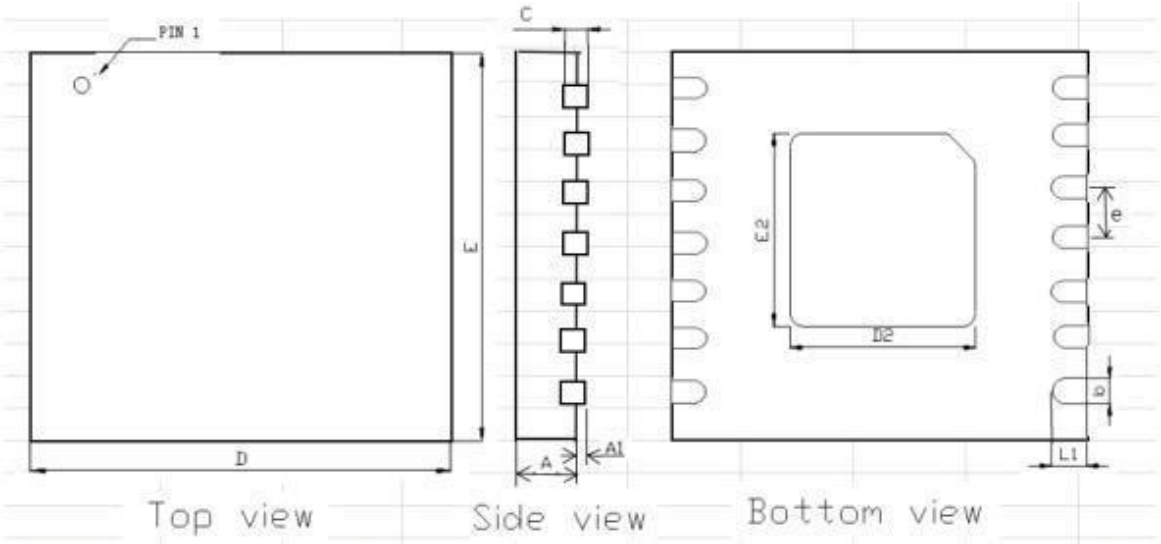
5.Package information

DFN-14L



Symbol	Millimeters			Inches		
	Min	Nom	Max	Min	Nom	Max
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	<0.05			<0.002		
b	0.21	0.23	0.25	0.008	0.009	0.010
C	0.20			0.008		
D	2.90	3.00	3.10	0.116	0.120	0.124
D2	1.55	1.60	1.65	0.062	0.064	0.066
E	2.90	3.00	3.10	0.116	0.120	0.124
E2	1.55	1.60	1.65	0.062	0.064	0.066
e	0.40 BSC			0.016		
L1	0.25	0.30	0.35	0.010	0.012	0.014

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