Capacitive Fingerprint IC

LC1550_52L

Datasheet

IC No:	LC1550_52L
Document Version:	V1.0
Release Date:	2016/09/26

Revision History

Version	Revisions	Date	Modified by
1.0	1. Update toV1.0.	2016-09-26	

Index

Features

- ✧ 112x88 pixel sensing array;
- ✧ 5.6x4.4(mm) active sensing area;
- ✧ 508 dpi spatial resolution;
- ✧ 256 gray scale levels;
- ✧ Up to 8MHz 4-wire SPI interface;
- ✧ 1.8V single power supply;
- ✧ 1.8V/3.3V compatible I/O;
- ✧ 4mA current consumption during image capture mode;
- ✧ 3uA current consumption during deep sleep mode;
- ✧ Insensitive to environmental variations and touch variations;
- ✧ Support finger wake-up function with ultra-low current consumption;
- ✧ Auto calibration;
- ✧ Payment function.

1. Description

LC1550_52L is a low power CMOS capacitive fingerprint sensor chip. It is a touch fingerprint sensor which offers high quality fingerprint image with 256 grey scale levels via durable scratch resistant coating. With ultra-low current consumption finger touch wake-up function, LC1550_52L is specially designed for mobile market of android platform, such as smart phone, tablet.

2. Typical Applications

- Smart phone, PDA, tablet
- Notebook, PC
- Security product
- Encryption equipment

3. Functional Description

3.1 Block Diagram

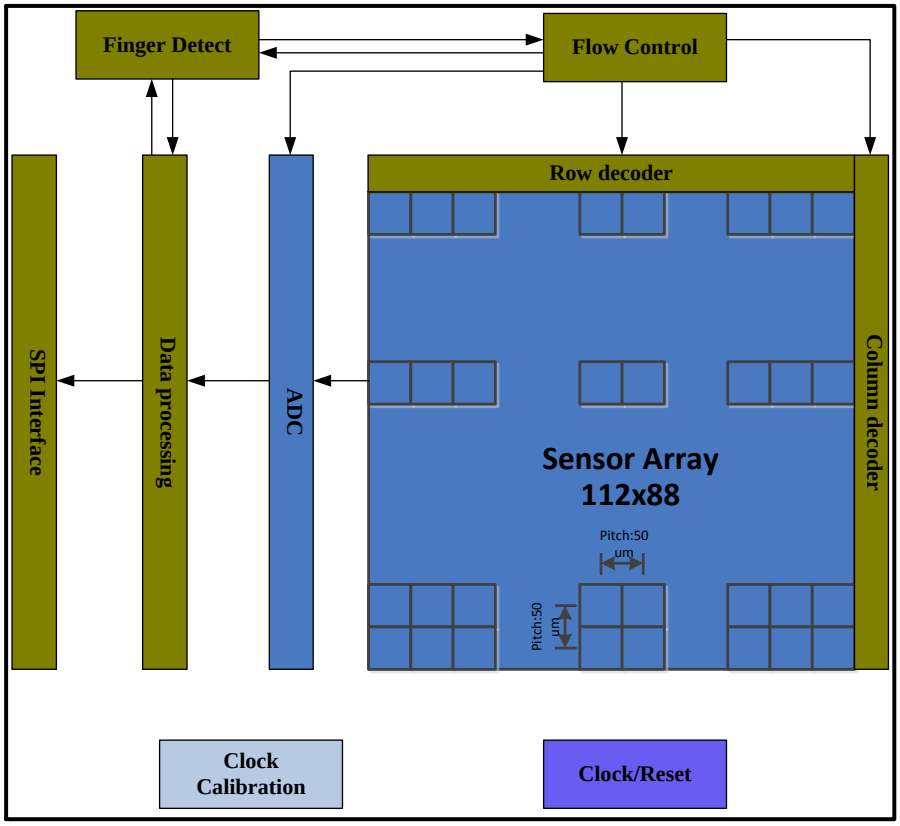


Fig.1 Function block diagram for LC1550_52L

LC1550_52L can be divided into the following function blocks:

- Sensor Array

  The sensor array senses the capacitance and converts to electric signal;

- ADC

  Analog to Digital Converter (ADC) converts the voltage signals to digital codes;

- Row/Column decoder, Flow Control

  Control the working modes of LC1550_52L; also select the sensing area with different working modes;

- Data Processing

  The ADC output data will be processed in digital domain and arranged as 256 grey scale level data format;

- SPI Interface

  LC1550_52L communicates with Host via 4-wire SPI interface;

- Finger Detect

  LC1550_52L can execute the finger detect operation and finger wake-up function with ultra-low power consumption.

3.2 Communication interface

LC1550_52L communicates with Host as slave device with 4-wire SPI interface (SPI_CLK, SPI_MISO, SPI_MOSI and SPI_CS_N).

The sensor chip LC1550_52L must be configured by writing to the setup registers before initiating a sensor command. When accessing a multi-byte register, byte 'N' is transmitted first and byte 0 last. Configuration should not be changed during the execution of any command sequence. A typical command sequence is shown in Fig.2.

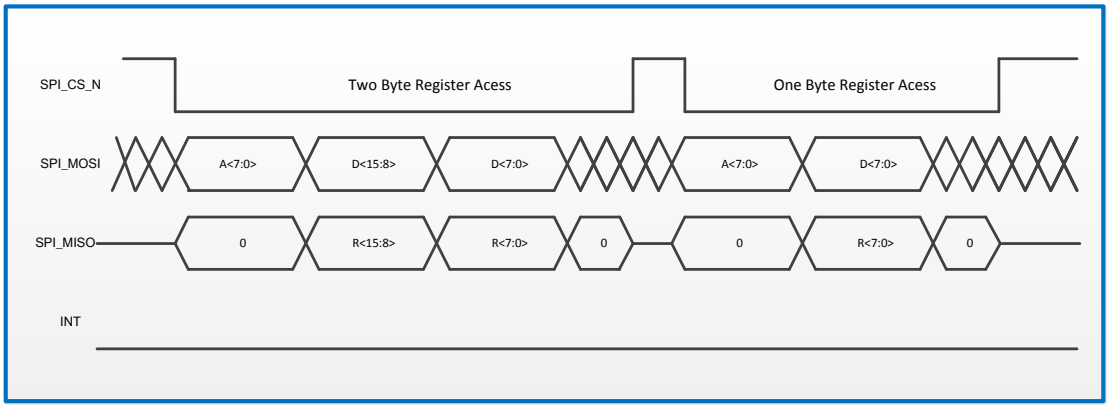


Fig.2 SPI sequence for writing to a setup register

3.3 Operating Modes

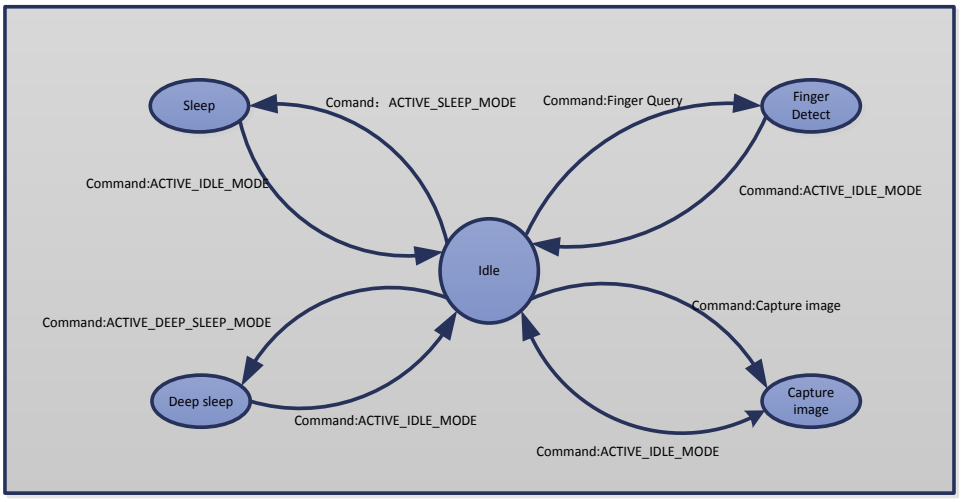


Fig.3 Operating Modes

3.3.1 Image Capture

LC1550_52L will enter Image Capture when Host sending Capture Image command by SPI interface.

When LC1550_52L receiving the Capture Image command, the sensor array begins to sense the fingerprint image. If the captured image data is ready to be read, an interrupt signal (pin INT) is set up.

The captured sensing area is not limited to 112x88 pixels, both the column and row numbers can be set by Host.

3.3.2 Sleep Mode

Sleep Mode is designed for improving system power efficiency, especially for mobile applications. In Sleep Mode, sensor is kept in a low power mode, and is periodically waked-up to perform reduced finger detect.

3.3.3 Deep Sleep Mode

Host controls the LC1550_52L to enter Deep Sleep Mode to further reduce the power consumptions. Different with Sleep Mode, LC1550_52L will not execute the reduced finger detect at Deep Sleep Mode. The sensor chip will not respond the finger touch action and only can go back to Idle State by SPI command.

3.3.4 Finger Detect Mode

LC1550_52L can execute finger detect operation if receiving the related command. If a finger is placed on the sensor, reduced size sub-area sets will be captured to detect, without doing a full image capture. It decreases capture response time and improves performance. Up to 12 sub-areas of 8x8 pixels are supported, the number and the positions of the sub-areas are configurable by setting registers.

If a finger is presented on the sensor, captured pixel values are collected by sub-areas and compared to the adjustable threshold value which is set in the register. A status register indicates which of the twelve sub-areas have surpassed the threshold value when the sensor is covered by a finger. If the finger down is detected, the interrupt signal will be set and the sensor chip return to Idle State.

The finger detect can be execute periodically. The execution period can be adjusted by setting registers.

3.4 Reset

RST_N must be connected to Host. Host should drive RST_N to zero for at least 50us to initialize the sensor chip. Host can further configure the sensor chip when interrupt is set. An external off-chip capacitor between RST_N and ground will be needed, if RST_N is floating, as fig.4 shown.

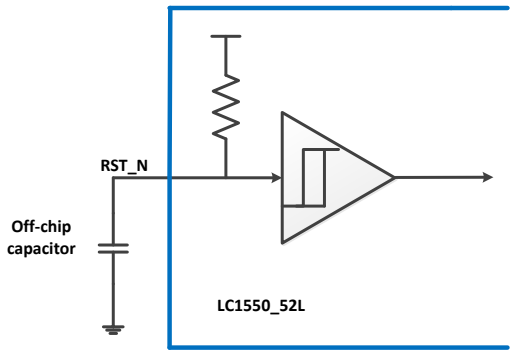


Fig.4 Power on Reset Circuit

3.5 Clock

LC1550_52L has two on-chip clock generators. One is used to generate system clock, which is 7.5MHz by default; the other is low speed clock signal as timer in sleep mode.

LC1550_52L supports clock calibration which can calibrate the above two clock signal frequencies by SPI clock signal.

4. DC and AC Electrical Characteristics

4.1 Recommended Operating Conditions

Parameters	Descriptions	Min.	Typ.	Max.	Unit
VDD	Supply voltage	1.62	1.8	1.98	V
T_A	Operating temperature	-40	25	85	℃
Ts	Storage temperature	-45		125	℃
VDDIO	I/O power supply	1.62	1.8	1.98	V
		3.0	3.3	3.6	V

4.2 DC Electrical Characteristics

(VDDA=VDDD=1.8V, Ta=25℃)

Parameters	Descriptions	Condition	Min.	Typ.	Max.	Unit
I_{DD}	Supply Current	Idle Mode		0.3		mA
		Image Capture		4		mA
		Sleep Mode@20Hz		12		uA
		Sleep Mode@30Hz		15		uA
		Sleep Mode@60Hz		30		uA
		Deep Sleep Mode		3		uA
CMOS DC Specifications						
V_{IH}	High level input voltage	-	0.7VDDIO	-	VDDIO	V
V_{IL}	Low level input voltage	-	VSS	-	0.3VDDIO	V
V_{OH}	High level output voltage	-	0.8VDDIO	-	VDDIO	V
V_{OL}	Low level output voltage	-	VSS	-	0.2VDDIO	V
I_{IN}	Input leakage current	-	-	-	±10	μA

4.3 AC characteristics

4-wire SPI characteristics

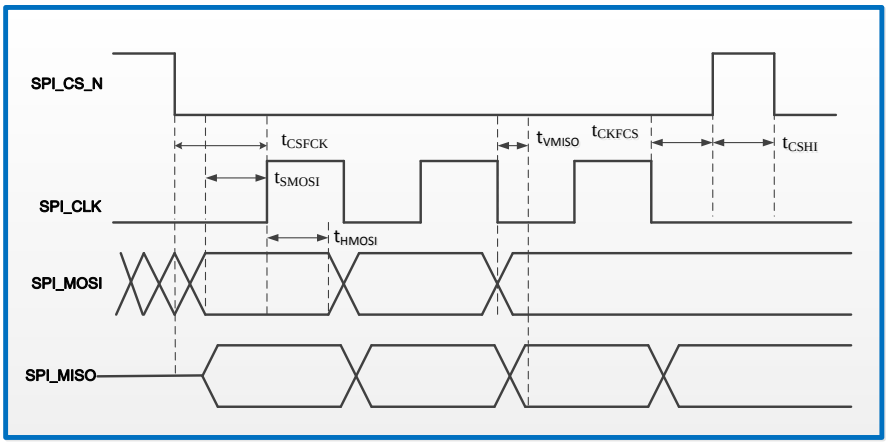


Fig.5 SPI Timing

Parameters	Descriptions	Min.	Max.	Unit	Notes
t_{VMISO}	SPI_MISO valid data time	3.8	20	ns	
t_{SMOSI}	SPI_MOSI setup time	20		ns	
t_{HMOSI}	SPI_MOSI hold time	20		ns	
t_{CSFCK}	Time for SPI_CS_N low to SPI_CLK high	30		ns	
t_{CKFCS}	Time for SPI_CLK low to SPI_CS_N high	30		ns	
t_{CSHI}	Minimum duration time of SPI_CS_N high	31.25		ns	
$f_{SPI,CLK}$	SPI_CLK Frequency	1	8	MHz	

5. Application Circuit Diagram

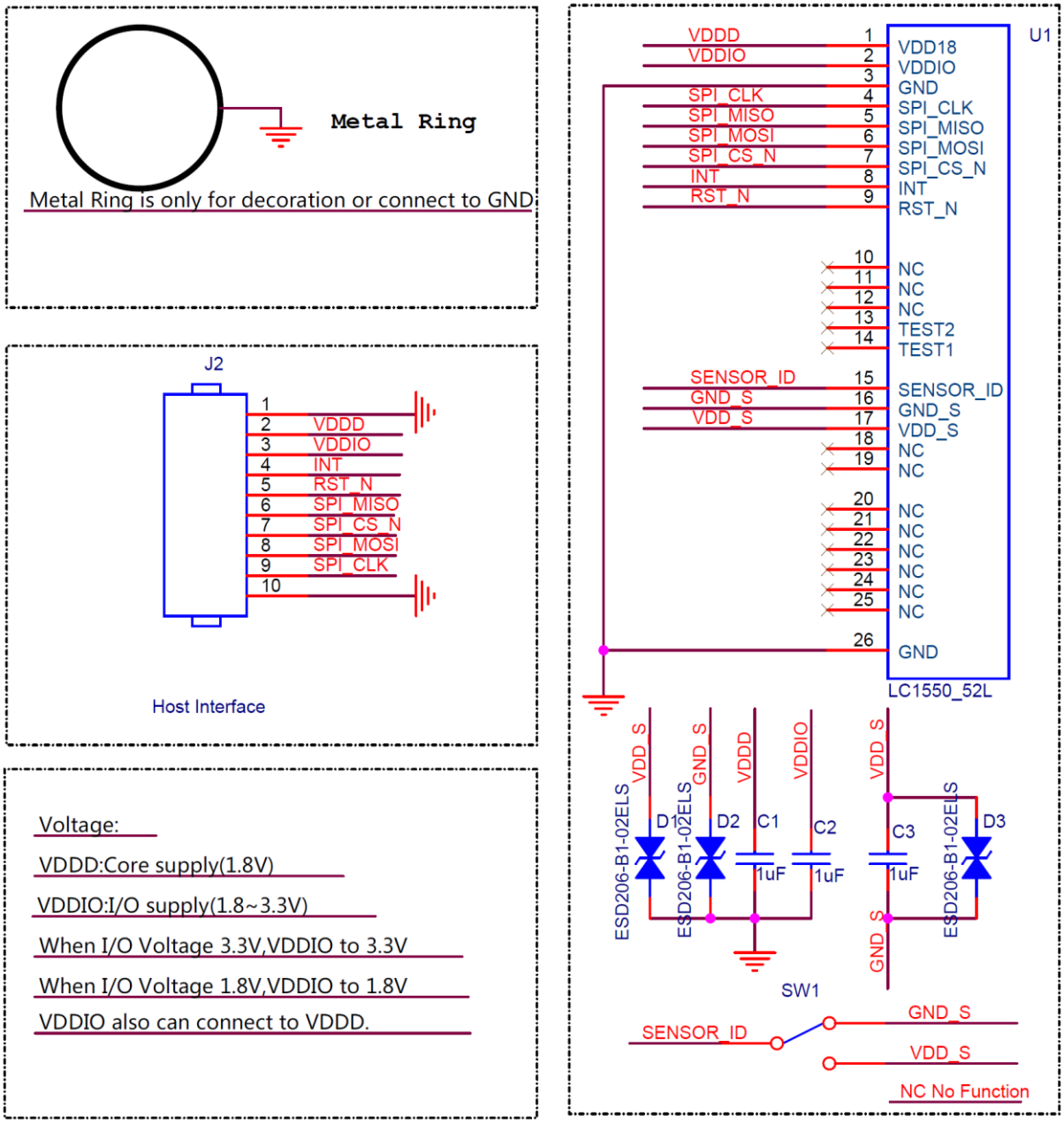


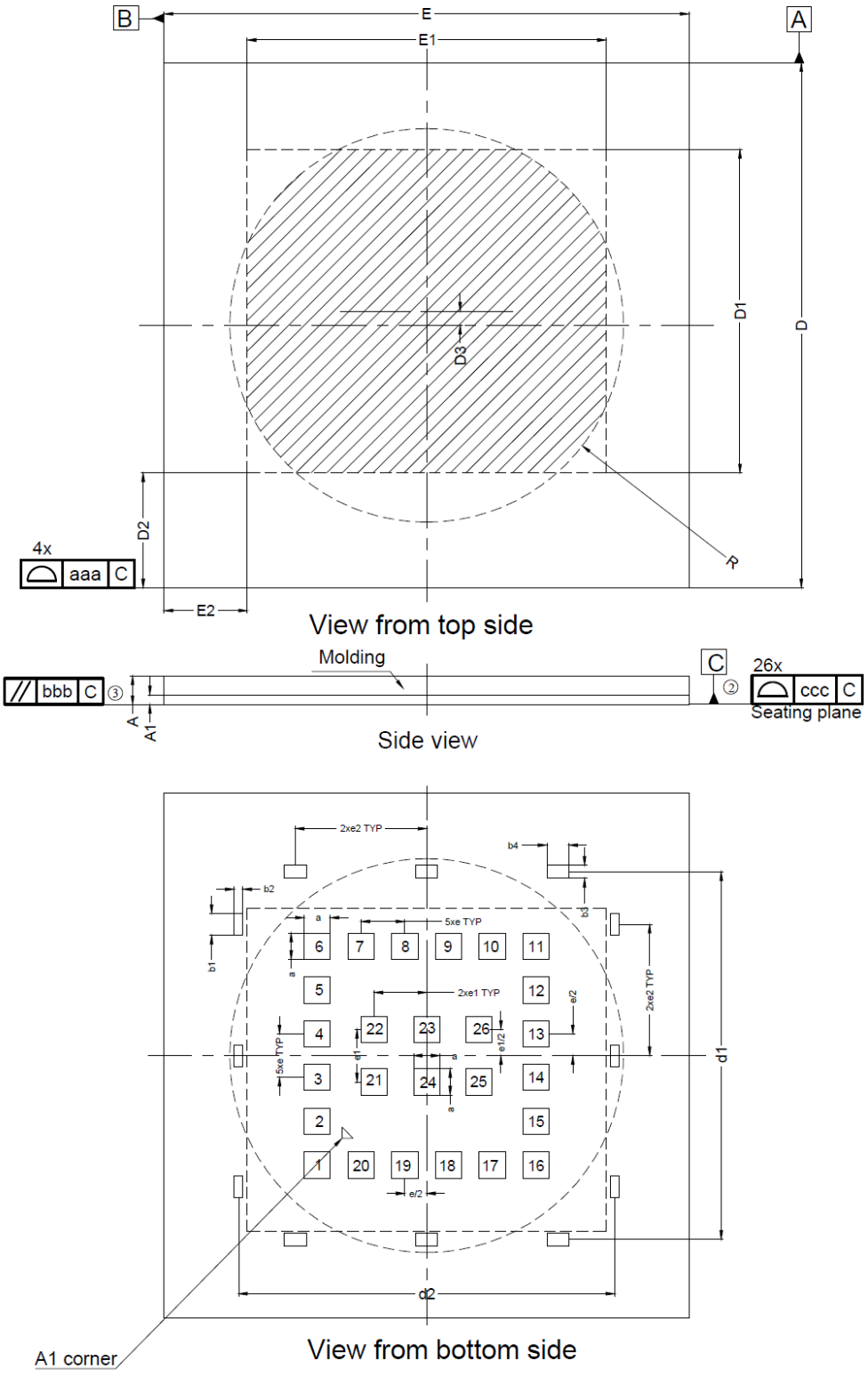
Fig.6 Application Circuit Diagram

6. Pin Descriptions

Pin	Name	Type	Description
1	VDD18	Power	1.8V Power supply
2	VDDIO	Power	I/O power supply
3	GND	Ground	Ground
4	SPI_CLK	D,I	SPI clock
5	SPI_MISO	D,O	SPI Data out
6	SPI_MOSI	D,I	SPI Data in
7	SPI_CS_N	D,I	SPI chip select
8	INT	D,O	Interrupt request
9	RST_N	D,I	System reset
10	NC	NC	NC
11	NC	NC	NC
12	NC	NC	NC
13	TEST2	A,O	Test output;
14	TEST1	A,O	Test output;
15	SENSOR_ID	D, I	Digital input pin of Sensor ID
16	GND_S	Ground	Sensor Ground
17	VDD_S	Power	1.8V Sensor Power supply
18	NC		NC
19	NC		NC
20	NC		NC
21	NC		NC
22	NC		NC
23	NC		NC
24	NC		NC
25	NC		NC
26	GND	Ground	Ground

7. Package Outline

LGA-26 (12x12mm)



DIMENSIONAL REFERENCES Units:mm

SYMBOL	DIMENSIONAL REQMTS			SYMBOL	Tolerance of Form &Position
	MIN	NOM	MAX	aaa	0.10
A	0.60	0.65	0.70	bbb	0.10
A1	0.19	0.22	0.25	ccc	0.10
D	11.90	12.00	12.10		
D1	--	7.400	--		
D2	--	2.625	--		
D3	--	0.325	--		
R	--	4.500	--		
E	11.90	12.00	12.10		
E1	--	8.200	--		
E2	--	1.900	--		
a	0.55	0.60	0.65		
b1	0.45	0.50	0.55		
b2	0.15	0.20	0.25		
b3	0.25	0.30	0.35		
b4	0.45	0.50	0.55		
e	1.00REF				
e1	1.20REF				
e2	3.00REF				
d1	8.40REF				
d2	8.60REF				

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