

LPS1001 Datasheet

Programmable Current Limit Switch IC

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Preliminary



The world is driven by analog

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GENERAL DESCRIPTION

The LPS1001 IC is programmable current limit Switch IC for power management. This switch IC limits the current to prevent damage due to excessive load. Switch fabricated with an advanced submicron CMOS process that provides low power dissipation, low on resistance, and low leakage currents. This switch IC can adjust current limit level from 50mA to 400mA. They also got a thermal shutdown function will automatically turn off the channel temperature exceeds 160°C. The off-leakage current is only 90nA at room temperature.

FEATURE

3.3V logic-compatible input ($V_{IH}=1.0V$, $V_{IL}=0.4V$)
Single supply operation: 5V
Analog signal frequency: DC-to-10KHz
Low on-resistance: **0.1Ω** (@typ)
Wide range analog input from 0.8V to 4.7V
Current on analog input: 50mA to 400mA
Thermal shutdown temperature: 160°C
Single-channel switch control
Switching control using CMOS interface command
Reverse Current Block
16-pin FC-BGA package

APPLICATIONS

Power distribution system
Industrial equipment
Memory test

FUNCTIONAL BLOCK DIAGRAM

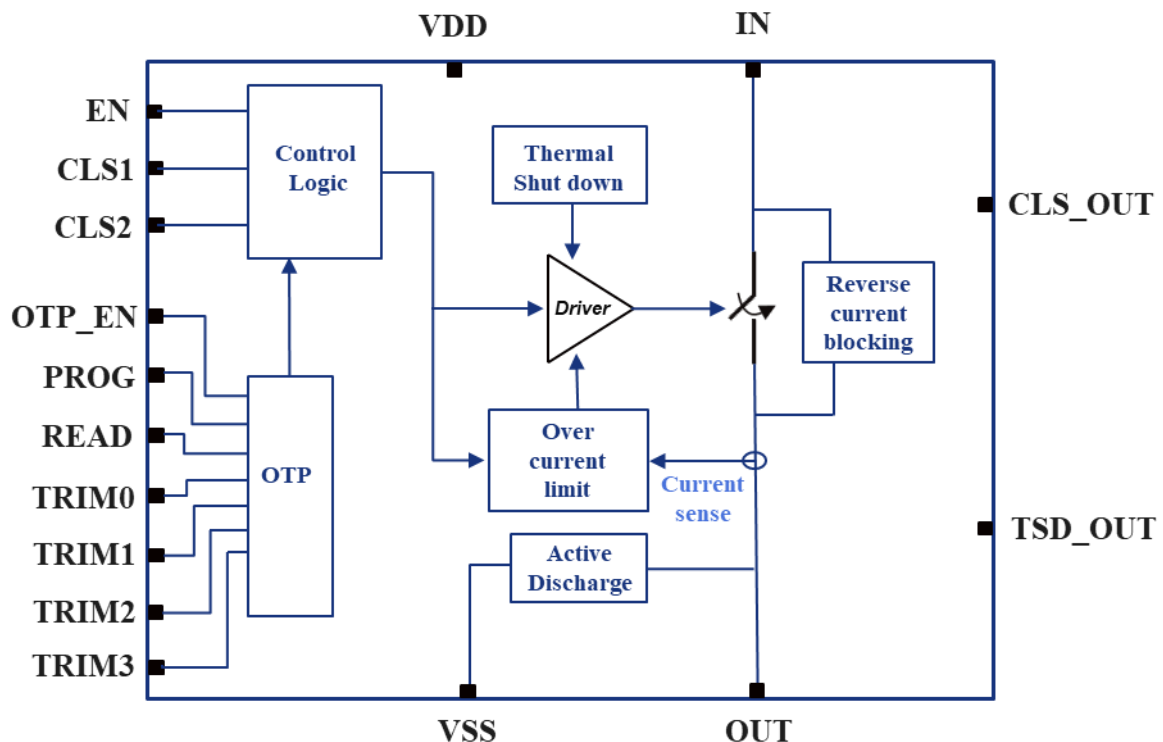


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PIN MAPPING TABLE

	1	2	3	4	
A	EN	PROG	OTP_EN	READ	A
B	CLS1	TRIM[0]	TRIM[2]	VSS	B
C	CLS2	TRIM[1]	TRIM[3]	VDD	C
D	IN	TSD_OUT	CLS_OUT	OUT	D
	1	2	3	4	

PIN DESCRIPTIONS

PIN NAME	I/O	Descriptions
CLS1	I	Over current limit level select 1
CLS2	I	Over current limit level select 2
READ	I	OTP read enable
PROG	I	OTP write enable
OTP_EN	I	OTP enable
EN	I	Switch enable (ON)
TRIM[3:0]	I	Over current limit level trimming
TSD_OUT	O	Thermal shutdown flag
CLS_OUT	O	Over current limit flag
IN	I	Analog switch input
OUT	O	Analog switch output
VDD	PWR	Analog power (OTP power)
VSS	GND	Analog ground

I: input
PWR: power

O: output
GND: ground

ABSOLUTE MAXIMUM RATINGS

(All Voltages Referenced to GND, Unless Otherwise Noted.)

VDD (for Analog Switch).....	-0.3V to +6V	Operating temperature range	-40°C to +125°C
Voltage at any pin	-0.3V to +6V	Storage temperature range	-55°C to +125°C
Continuous current into any terminal	450mA	Junction temperature.....	+160°C
Peak current into analog switch I/O.....	600mA	ESD protection on all pins (HBM, MM).....	≥ TBD
(current pulse with 1ms and 10% duty cycle)			

Notice: Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only and functional operation of the device at those or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

VDD=5.0V, VSS=0V, and TA = +25°C, unless otherwise noted.

PARAMETER		SYMBOL	CONDITION	VALUE			UNIT
				MIN	TYP	MAX	
POWER SUPPLIES							
Analog Supply Voltage		VDD		4.5	5	5.5	V
Analog Ground Voltage		VSS			0		V
ANALOG SWITCH							
Input Signal Range		V _{AIN}	VSS=0V,	0.8		4.5	V
Channel On Current		I _{ON_CL}	VDD=5V, V _{AIN} =3.3V	50		400	mA
Switch On-resistance		R _{ON}	I _{CH_ON} =10mA, V _{AIN} =3.3V		0.02	0.5	Ω
Leakage Current	Source Off Leakage Current	I _{S_OFF}	VDD=5V, V _{AIN} =0V, V _{AO} UT=0V		1	50	nA
	Channel ON Leakage Current	I _{CH_ON}	VDD=5V, V _{AIN} =3.3V, V _{AO} UT=3.3V		16	50	nA
	Channel OFF Leakage Current	I _{CH_OFF}	VDD=5V, V _{AIN} =3.3V, V _{AO} UT=0V		13	50	nA
Thermal Shutdown Temperature		T _{ST}	Guaranteed by design. Cannot be guaranteed by testing.		+160		°C
Thermal Shutdown Hysteresis		T _{SH}			20		°C
Reverse Blocking Current		I _{RC}	VDD=5V, V _{AIN} =0V, V _{AO} UT=3.3V, V _{AO} UT=4.5V		-56	-300	uA

ELECTRICAL CHARACTERISTICS (Continued)

VDD=5.0V, VSS=0V, and TA = +25°C, unless otherwise noted.

PARAMETER		SYMBOL	CONDITION	VALUE			UNIT
				MIN	TYP	MAX	
Current Limit Reaction Time		t _{CLRT}	V _{AIN} =4.5V, CL=1μF		32	50	μs
Current Limit Flag Time		t _{CLFT}	V _{AIN} =4.5V, CL=1μF		282	350	μs
Switching Time	Turn ON Time	t _{ON}	V _{AIN} =4.5V, R _L =500Ω, CL=0.1μF		30	50	μs
	Turn OFF Time	t _{OFF}	V _{AIN} =4.5V, R _L =500Ω, CL=0.1μF		0.7	3	μs
Capacitance	Input Off-Capacitance	C _{AIN_OFF}	Guaranteed by design. Cannot be guaranteed by testing			500	pF
	Output Off-Capacitance	C _{AOUT_OFF}				500	pF
	Output On-Capacitance	C _{AOUT_ON}				1000	pF
Output Discharge Resistance		R _{DS}			100		Ω
DIGITAL I/O							
Logic Input Voltage	Input High	V _{IH}		0.9			V
	Input Low	V _{IL}				0.4	V
Logic Input Current	Input High	I _{IH}		-1		1	μA
	Input Low	I _{IL}		-1		1	μA
POWER CONSUMPTION							
Analog Operating Current (VDD)	Static (OFF)	I _{VDD_ST_OFF}	VDD=5V, VSS= 0V, Switch OFF		0.13	0.2	mA
	Static (ON)	I _{VDD_ST_ON}	VDD=5V, VSS= 0V, Switch ON		0.18	0.4	mA
	Dynamic	I _{VDD_DYN}	VDD=5V, VSS= 0V, f _{SW} =10KHz,		0.22	0.5	mA

TIMING CHARACTERISTICS

VDD=5.0V, VSS=0V, and TA = +25°C, unless otherwise noted.

PARAMETER	SYMBOL	CONDITION	VALUE			UNIT
			MIN	TYP	MAX	
POWER AND RESET SEQUENCE						
POR Set Time	t _P		900			us
POR Read Set Time	t _{RST}		1			us
OTP Read Time	t _{ORD}		1			us

Power up and Operating Sequence

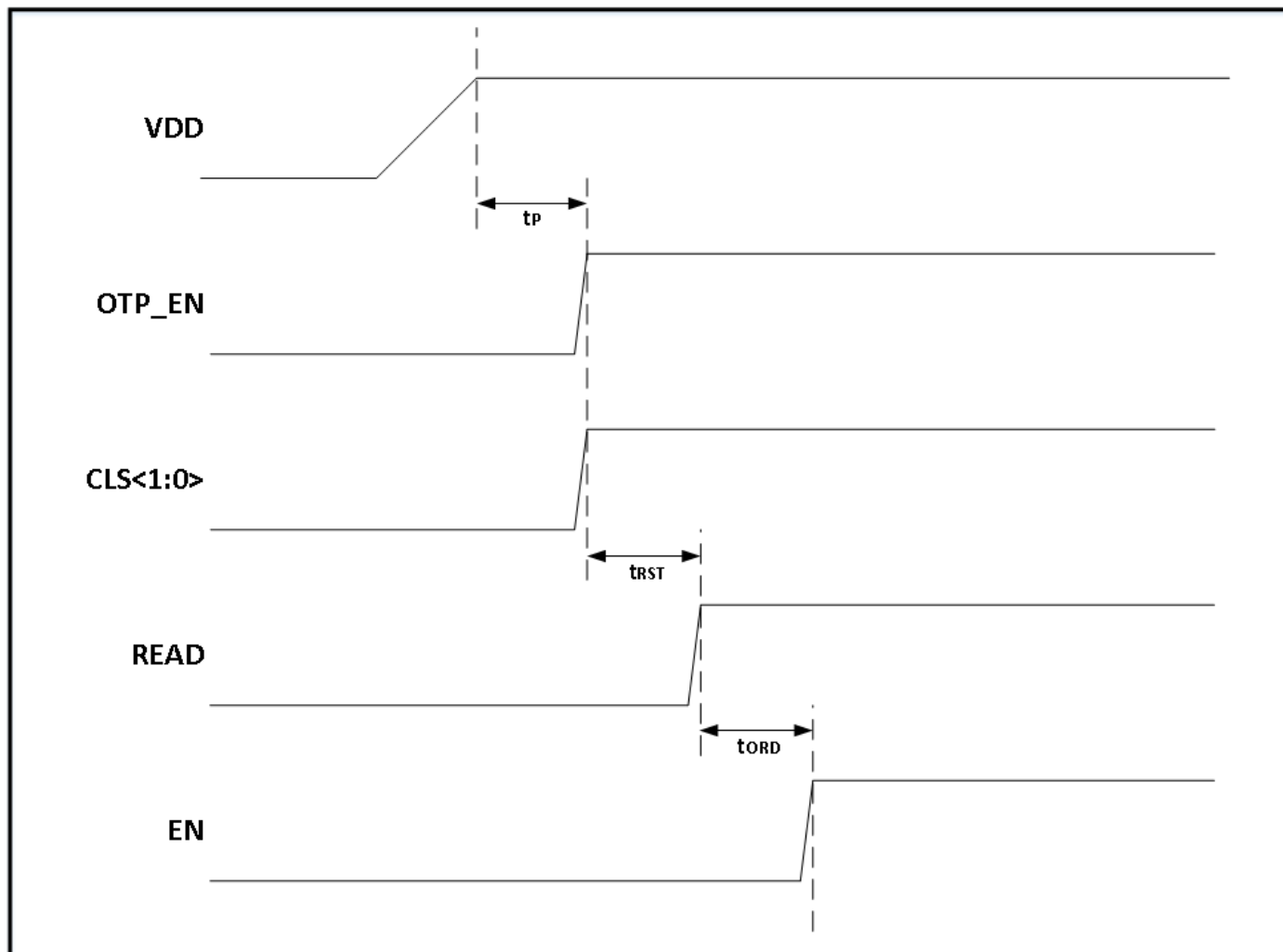


Figure 1. Operating Timing Diagram.

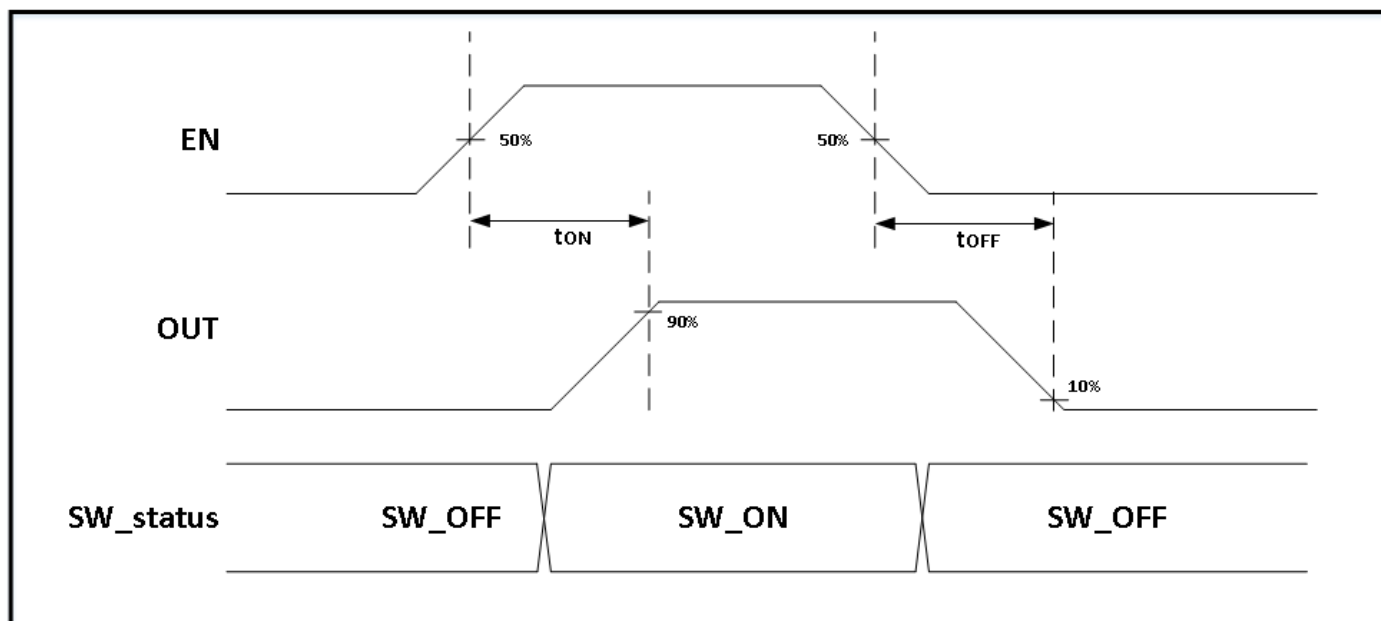
SW On/Off Timing Diagram

Figure 2. SW ON/OFF Timing Diagram.

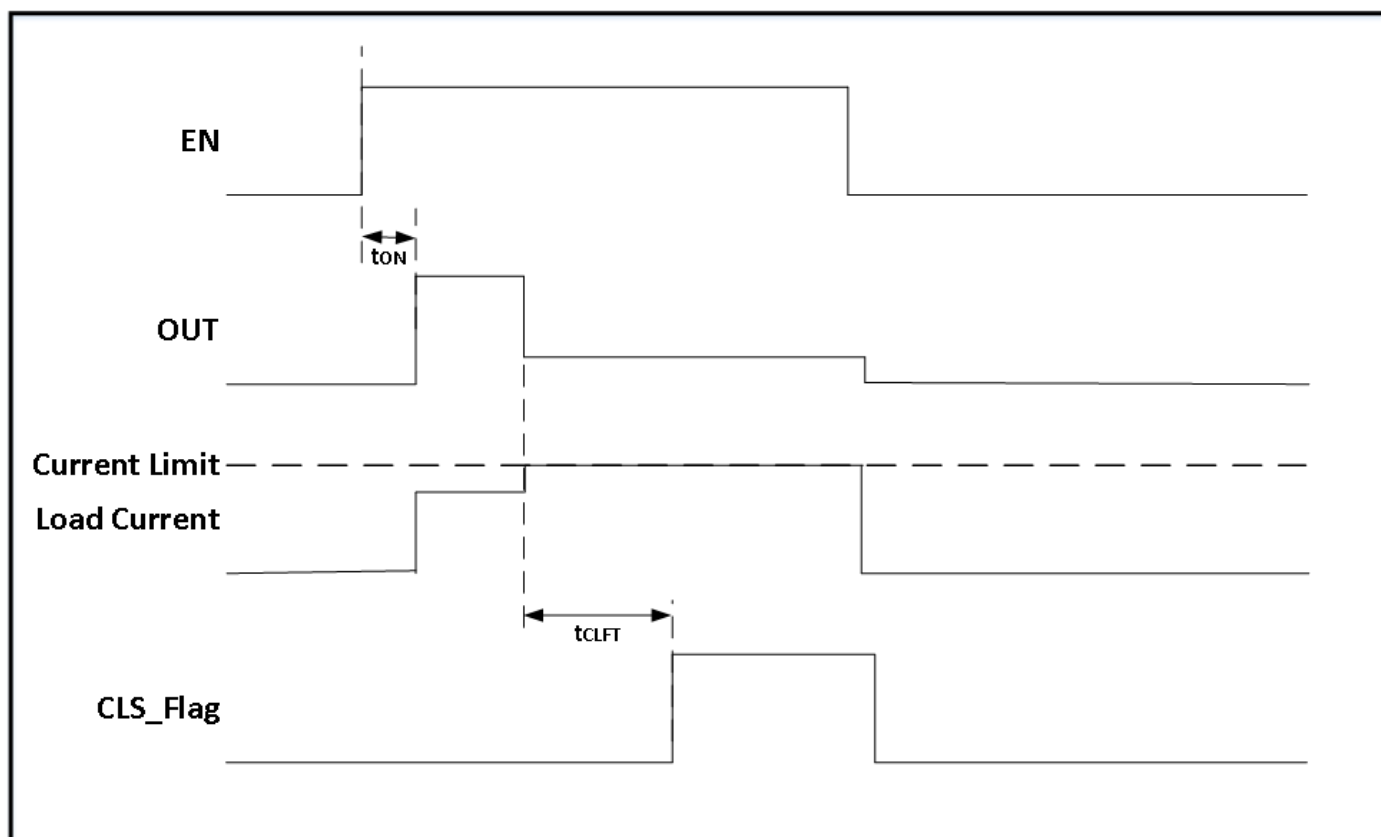
Current Limit Operating and CLS flag Timing Diagram

Figure 3. Current Limit Operating and CLS flag Timing Diagram.

TEST RESULTS

TBD

On-resistance vs. V_{in}

TBD

On-resistance(room temp) vs. V_{in}

TBD

Current limit vs. V_{in}

Figure 4. Test Results.

FUNCTIONAL DESCRIPTION

Protection from Excessive Current

- Current Limiting and Flag

LPS1001 supports Current Limiting to protect itself from excessive high current. If current more than the threshold flows through a switch, the switch is automatically raises turn-on resistance by internal protection circuit. The threshold is loaded from value of external PIN (CLS2, CLS1 pins). Table 1 shows supported threshold values for current limiting function.

Table 1. Current Limit Level according to setting value

	CLS2	CLS1	Current Limit Level
Switch on, Vin=3.3V, @25°C	0	0	50mA
	0	1	100mA
	1	0	200mA
	1	1	400mA

The current limit is continuous type and is automatically released when the load current decreases.

Once the switch operates current limit status, the current limit flag is outputted from CLS_OUT pin. (Active High)
In order to initialize current limit flag, switch IC has to reset. (input LOW to HIGH at EN pin)

- Thermal Shutdown and Flag

LPS1001 supports thermal shutdown to protect itself from excessive high current. If the temperature of a switch goes above the threshold (+160°C, typ.), the switch is automatically DISCONNECTED by internal thermal shutdown circuit. The threshold is set from internal Thermal Shutdown Circuit. Thermal Shutdown is the secondary protection scheme for the case that Current Limiting does not work for some reasons even though excessive high current flows. The switch turns on again after the device temperature drops by approximately 20°C (typ.).

Once the switch is disconnected by Thermal Shutdown, Thermal Shutdown flag is outputted from TSD_OUT pin and the switch does not work until the temperature goes below the threshold.

PACKAGE INFORMATION

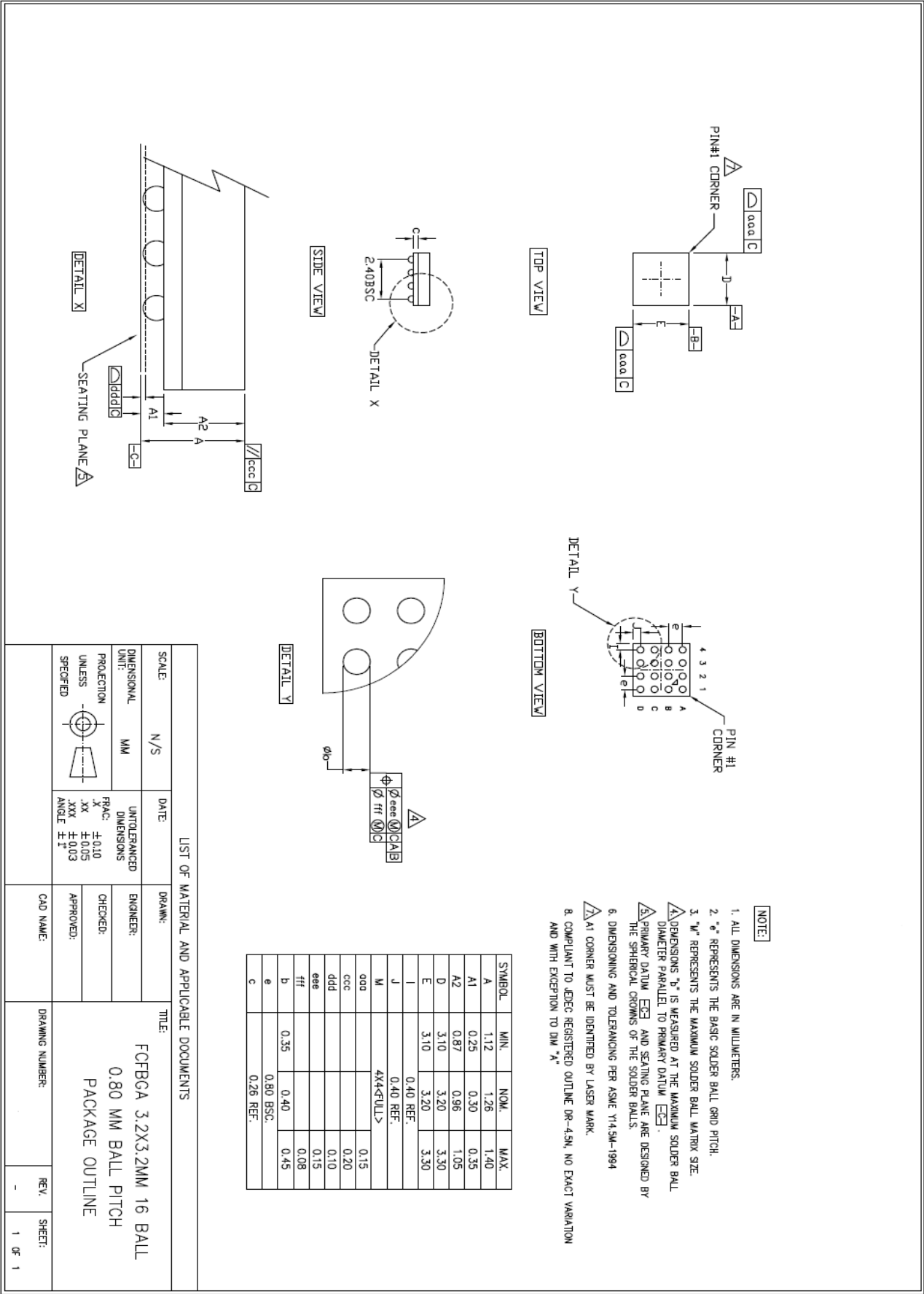


Figure 5. Package Information.

APPLICATION EXAMPLE

REVISION HISTORY

Revision	Date	Description
0.0	2019-07	Initial draft

DOCUMENT INFORMATION

File name: LPS1001 Datasheet
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