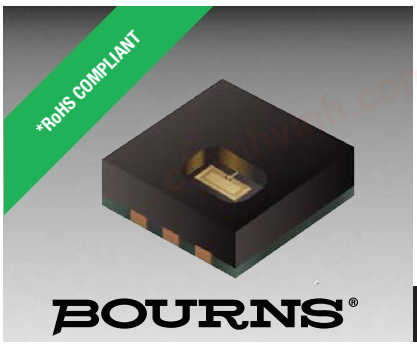
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Features

- Low voltage operation
- Low current consumption
- Fast response time
- I²C communication protocol
- Reliable capacitive technology
- Relative humidity accuracy of ±2 % (Typical)

Applications

Industrial:
- HVAC systems
- Process monitoring
- Climate monitoring, interior and exterior

**Medical Devices (low/medium risk):
- Diagnostic equipment
- Analysis equipment

BPS240 Series - 2 mm Humidity Sensor

Absolute Maximum Ratings

Supply Voltage (V_{cc}) ..... -0.3 to 7.0 V
Input Voltage (V_I)
  CE ..... -0.3 to V_{cc} + 0.3 V
  SCL/SDA ..... -0.3 to 7.0 V
Output Voltage (VO) ..... -0.3 to V_{cc} + 0.3 V
Hi-level Output Current (IOH)
  1 Terminal ..... -5 mA
  All Terminals Total ..... -20 mA
Low-level Output Current (IOL)
  1 Terminal ..... 5 mA
  All Terminals Total ..... 20 mA
Operating Temperature (T_a) ..... -40 °C to +105 °C
Storage Temperature (T_{stg}) ..... -50 °C to +125 °C

Additional Information

Click these links for more information:

PRODUCT | TECHNICAL LIBRARY | INVENTORY | SAMPLES | CONTACT

Recommended Operating Conditions

Power Supply Voltage (V_{cc}) ..... 1.62 to 5.5 VDC
Capacitance between V_{cc} and V_{ss} (C_p) ..... 0.1 µF typical
Pull Up Resistor Value on SDA[1] (R1) ..... 5 kΩ typical
Pull Up Resistor Value on SCL[1] (R2) ..... 5 kΩ typical

[1] Select the resistance value to meet AC characteristics.

Electrical Characteristics

Humidity Detection
  Measurement Range ..... 0 to 100 % RH
  Resolution (10-bit) ..... 0.1 % RH typical
  Humidity Accuracy - Typical (see Humidity Sensor Accuracy Graph for Maximum Rating)
    @ 25 °C (20 to 80 % RH) ..... ±2 % RH
    @ 5 °C to 45 °C (0 to 100 % RH) ..... ±4 % RH
  Hysteresis @ 5 °C to 45 °C (0 to 100 % RH) ..... ± 1 % RH typical
  Response Time
    Reach (τ 63 % @ 25 °C, wind velocity @ 1.0 m/s) ..... 1 second

Unless otherwise specified: V_{CC} = 1.62 to 5.5 V, V_{SS} = 0 V, T_a = -30 °C to 100 °C

Temperature Detection
  Measurement Range ..... -30 °C to +100 °C
  Resolution (11 bit)
    -30 °C to +100 °C ..... 0.1 °C
  Temperature Accuracy
    @ 5 °C to 60 °C ..... ± 0.3 °C
    @ -20 °C to 85 °C ..... ± 1.0 °C
  Reproducibility @ -30 °C to 100 °C ..... ± 0.1 °C
  Response Time
    Reach (τ 63 % (dependent on surrounding heat conduction NOTE 1) ..... 30 seconds

Unless otherwise specified: V_{CC} = 1.62 to 5.5 V, V_{SS} = 0 V, T_a = -30 °C to 100 °C
NOTE 1 Extended exposure to >90 % RH causes a shift of up to 3 % RH which is reversible after a period of 14 days.

Current Consumption

Sleep Current (CE=0, Sleep Mode) ..... 10 nA typical, 400 nA maximum
Average Operating Current ..... 4.8 µA typical, 10 µA maximum

Unless otherwise specified: V_{CC} = 1.62 to 5.5 V, V_{SS} = 0 V, T_a = 0 °C to 60 °C

* RoHS3 Directive 2015/863 Amendments of Annex II on March 31, 2015
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WARNING Cancer and Reproductive Harm
www.P65Warnings.ca.gov

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Input/Output Terminal Characteristics

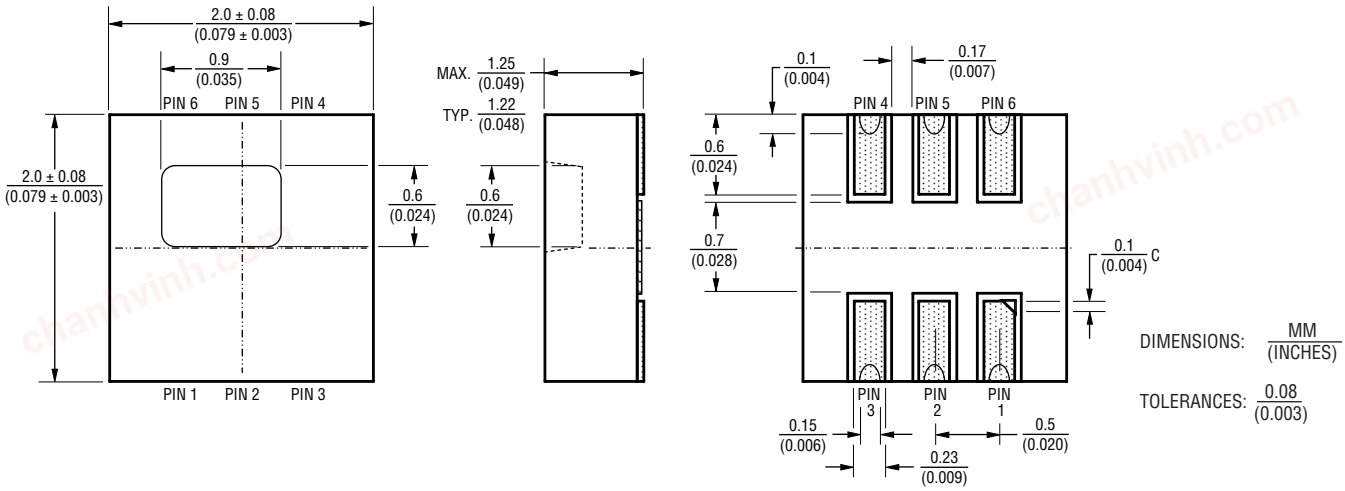
High Level Input Voltage 1 (VIH1) [Target Terminal: SCL, SDA] ..... 0.7 V_{CC} minimum, V_{CC} maximum
High Level Input Voltage 2 (VIH2) [Target Terminal: CE] ..... 0.8 V_{CC} minimum, V_{CC} maximum
Low Level Input Voltage 1 (VIL1) [Target Terminal: SCL, SDA] ..... V_{SS} minimum, 0.3 V_{CC} maximum
Low Level Input Voltage 2 (VIL2) [Target Terminal: CE] ..... V_{SS} minimum, 0.2 V_{CC} maximum
Low Level Output Current (IOL) [VOL = 0.1 V_{CC}, Target Terminal: SCL, SDA] ..... 0.5 mA minimum
Terminal Leak Current 1 (IL1) [Terminal voltage = V_{CC}, Target Terminal: SCL, SDA] ..... ± 1 µA
Terminal Leak Current 2 (IL2) [Terminal voltage = 0 V, Target Terminal: SCL, SDA, CE] ..... ± 1 µA
Input Pull-Down Resistance (RPD) [Terminal voltage = V_{CC}, Target Terminal: CE] ..... 60 kΩ minimum, 150 kΩ typical, 450 kΩ maximum

Unless otherwise specified: V_{CC} = 1.62 to 5.5 V, V_{SS} = 0 V, T_a = -30 °C to 100 °C

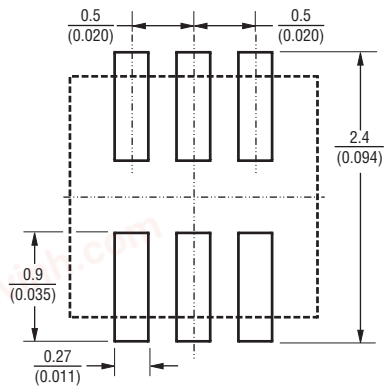
Product Characteristics

Moisture Sensitivity Level 1
ESD Classification (HBM) ..... 1 kV
Marking ..... B, Date Code
Standard Packaging ..... 2,000 pcs. per 7-inch reel
Weight ..... 10.45 milligrams

Product Dimensions



Recommended PCB Layout



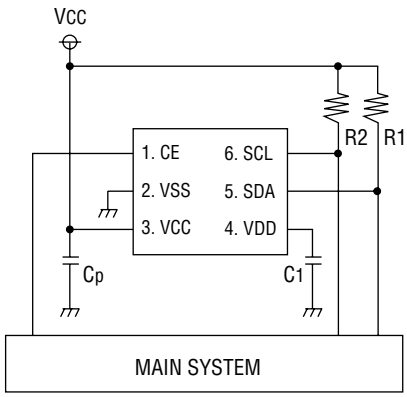
Terminal Assignment

No.	Terminal Name	Function
1	CE	Chip enable terminal
2	V_{SS}	Power supply terminal (-)
3	V_{CC}	Power supply terminal (+)
4	V_{DD}	Internal constant voltage output terminal
5	SDA	I^2C serial data
6	SCL	I^2C serial clock

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Basic Circuit Schematic



C_p ..... 0.1 μF
C1 ..... 0.47 μF
R1-R2 ..... 5k Ω

NOTE: R1 and R2 are reference values. Resistor values should be selected to meet the AC characteristics.

Operation Mode

Operation Mode	Terminal Setup	Operation State of Each Functional Block						
	CE	V_{pp}	Power Supply	Oscillation	Temp. Detection	Capacitance Detection	OTP Memory	I²C-Bus
Sleep *1	0	NC	Stop	Stop	Stop	Stop	Stop	Stop
Standby	1	NC	Operation	Operation	Stop	Stop	Read-out Possible	Operation

**1 In case of power control mode, there is no sleep operation.*
I²C slave address (SADR) is defined as "111 1111" (7Fh).

Control Register Map

Address	Bit	Bit Name	Function	Value	Read--Out	Write-In	R/W	Init.
00h	D7-1	-	Reserved	-			R	0
	D0	RESET	Reset	0	Normal Operation	None	R/W	0
				1	-	Reset Action		
01h	D7-6	MANMODE	Manual Detection Mode	00	Normal Operation Mode		R/W	0
	D5-3	HAVE[2:0]	Humidity Detection Value Avg. Mode	000	No Averaging Process			
				001	2 Times Average Mode			
				01x	4 Times Average Mode			
				1xx	8 Times Average Mode			
	D2	TAVE	Temperature Detection Value Avg. Mode	0	8 Times Average Mode		R/W	0
				1	16 Times Average Mode			

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Control Register Map (Continued)

Address	Bit	Bit Name	Function	Value	Read--Out	Write-In	R/W	Init.
01h	D1	-	Reserved	-			R	0
	D0	MAN	Manual Detection Mode	0	Standby State	Detection Operation Stop	R/W	0
				1	Under Detection Operation	Detection Operation Start		
03h	D7-1	-	Reserved	-			R	0
	D0	ERR	Manual Detection Error Flag	0	No Error	Nothing is Done	R/W	0
				1	Error Occurred	Error Flag Reset		
04h	D7-0	HC[7:0]	Humidity Detection Result *(After Correction Operation)*	000h-3FFh			R	X
05h	D7-2	-	Reserved	-			R	0
	D1-0	HC[9:8]	Humidity Detection Result *(After Correction Operation)*				R	X
06h	D7-0	TC[7:0]	Temperature Detection Result *(After Correction Operation)*	000h-7FFh			R	X
07h	D7-3	-	Reserved	-			R	0
	D2-0	TC[10:8]	Temperature Detection Result *(After Correction Operation)*				R	X
0Ah	D7-0	K[7:0]	Capacity Detection Result *(Before Correction Operation)*	000h-FFFFh			R	0

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Control Register Map (Continued)

Address	Bit	Bit Name	Function	Value	Read--Out	Write-In	R/W	Init.
0Bh	D7-0	K[15:8]	Capacity Detection Result *(Before Correction Operation)*				R	0
2Ch	D7-5	-	Reserved	-	-		R	0
	D4	SCR_ON_R	Standard Capacity Connection Control	0	Outside Capacity Cutting		R/W	0
				1	Outside Capacity Connection			
	D3-0	SCI_ ON_R[3:0]	Internal Capacity Connection Control	0h~Fh x 0.6 pF Example: At the time of 8 hours, access to internal capacity of 4.8 pF			R/W	X
03h	D7-1	-	Reserved	-			R	0
	D0	ERR	Manual Detection Error Flag	0	No Error	Nothing is Done	R/W	0
				1	Error Occurred	Error Flag Reset		

Transfer Function Formula

Humidity

$$RH = \frac{100}{2^{10}} \times RH_{IC} \qquad (0 \sim 100\ \%\ RH)$$

RH_{IC} : IC Humidity Output Data (10 bit)

Refer to Register Map:
RH_{IC} = Data of the addresses 04H and 05H (000h ~ 3FFh)
It changes into a decimal and is operation.

Temperature

$$T = [T_{IC} - (2^{10} - \frac{25}{0.1})] \times 0.1 \qquad (-30 \sim 100\ °C)$$

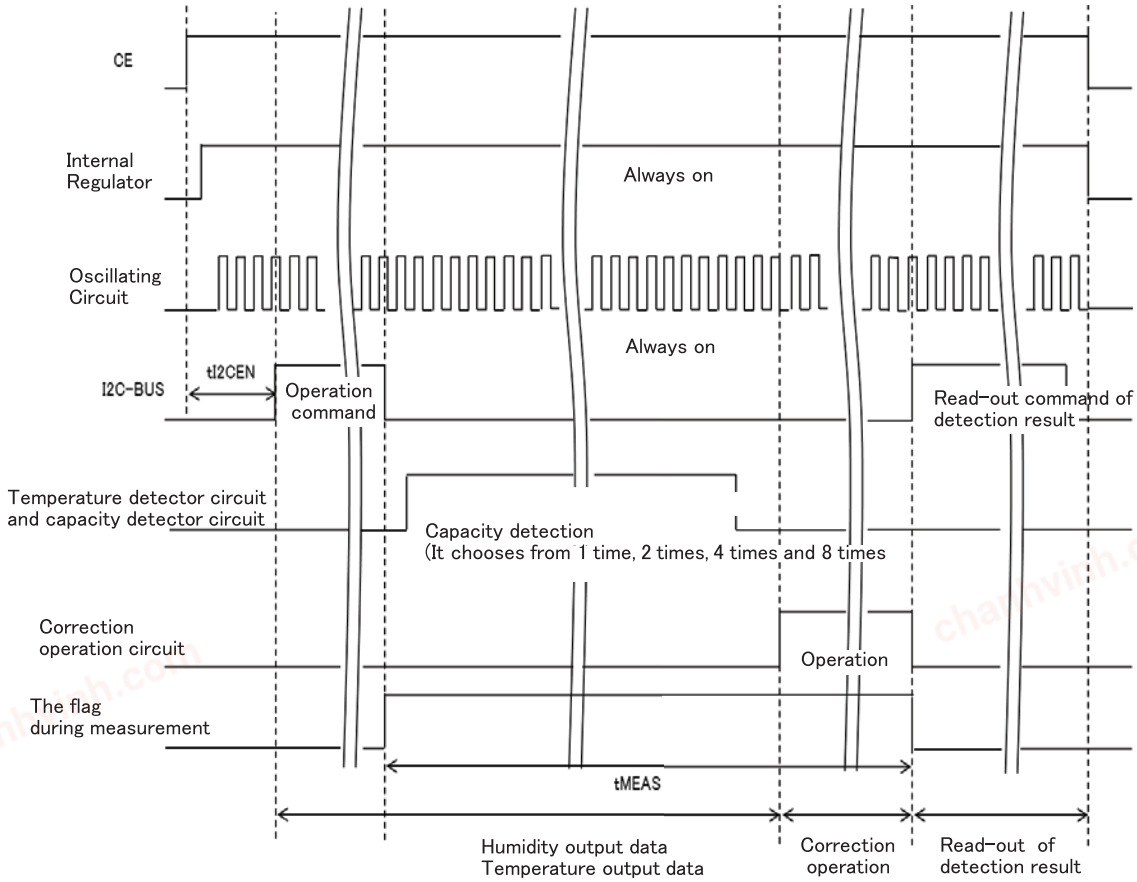
T_{IC} : IC Temperature Output Data (11 bit)

Refer to Register Map:
T_{IC} = Data of the addresses 06H and 07H (000h ~ 7FFh)
It changes into a decimal and is operation.

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Capacitance/Temperature Detection Sequence



How To Order

BPS240 - D 2P0 - S 10 E

Model Series
Humidity-Temperature Sensor

Output Type
D = Digital

Accuracy (% RH)
2P0 = ±2.0

Moisture Sensitivity
S = Standard

Resolution
10 = 10-bit

Packaging Designator
E = 2,000 pcs. per 7-inch Reel

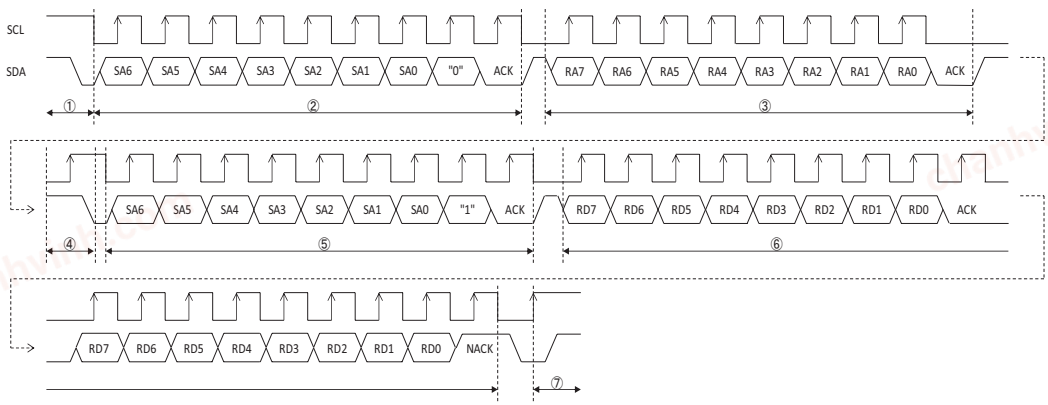
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Output Type Waveform and Data Read/Write Procedure

I²C-BUS Data Read-out Procedure

1. I²C master device releases START condition.
2. I²C master device transmits slave address and WRITE mode selection.
3. I²C master device transmits register address of this IC.
4. I²C master device releases repeated START condition. (Release method is same as START condition.)
5. I²C master device again transmits slave address and READ mode selection. (Read mode can be selected by transmitting "1" in 8th bit.)
6. I²C master device reads-out data from register address designated at (3).
   It is possible to read-out data while register address increments one, by reading-out multiple data continuously. However, during continuous read-out, please return ACK to this IC as a reply of master.
7. After the completion of all read-out, I²C master device releases STOP condition.



~ Continued ~

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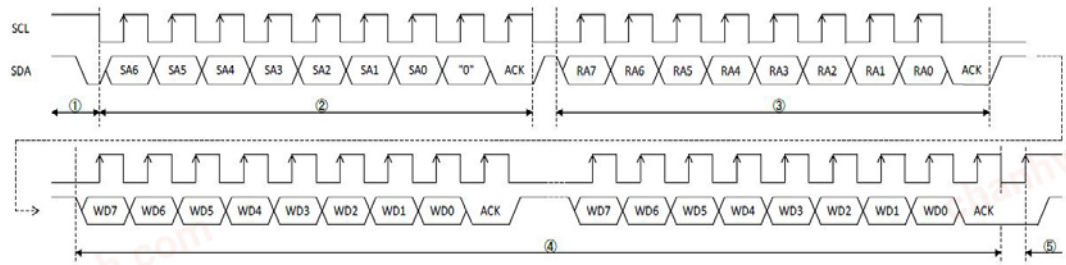
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Output Type Waveform and Data Read/Write Procedure (Continued)

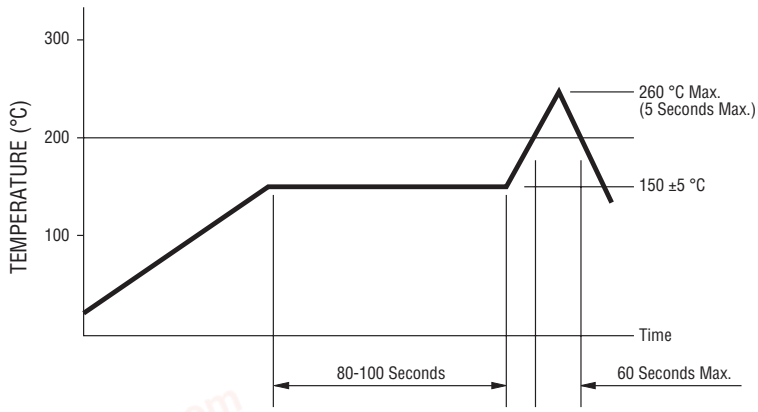
I²C-BUS Data Write-in Procedure

1. I²C master device releases START condition. (Start condition can be released by changing SDA from “H” to “L” while SCL is in “H” state.)
2. I²C master device transmits slave address and WRITE mode selection. (Write mode can be selected by transmitting “0” in 8th bit while 1~7th bits are slave address.)
3. I²C master device transmits register address of this IC.
4. I²C master device transmits write-in data.
5. It is possible to write-in data while register address increments one, by transmitting multiple write-in data continuously.

   After the completion of transmitting all write-in data, I²C master device releases stop condition. (Stop condition can be released by changing SDA from “L” to “H” while SCL is in “H” state.)



Solder Profile



Processing Method: Reflow soldering with infrared heat or forced air convection (only once).

Notes:

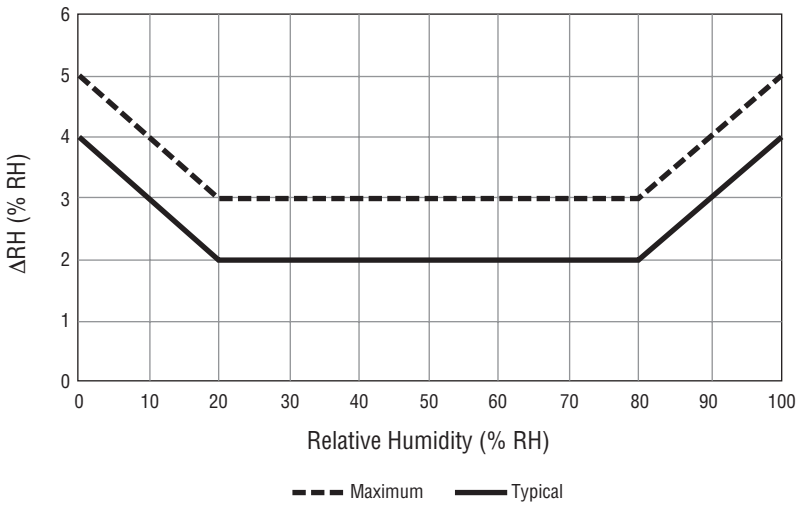
1. No clean solder paste is recommended.
2. Aqueous wash is not recommended.
3. Use of water soluble soldering flux should be avoided due to possible corrosion.
4. Multiple passes through the soldering process is not recommended.
5. Other SMD processes and profiles should be verified by the customer.

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Humidity Sensor Accuracy

Relative Humidity (% RH)	Maximum	Typical
0	5	4
10	4	3
20	3	2
30	3	2
40	3	2
50	3	2
60	3	2
70	3	2
80	3	2
90	4	3
100	5	4

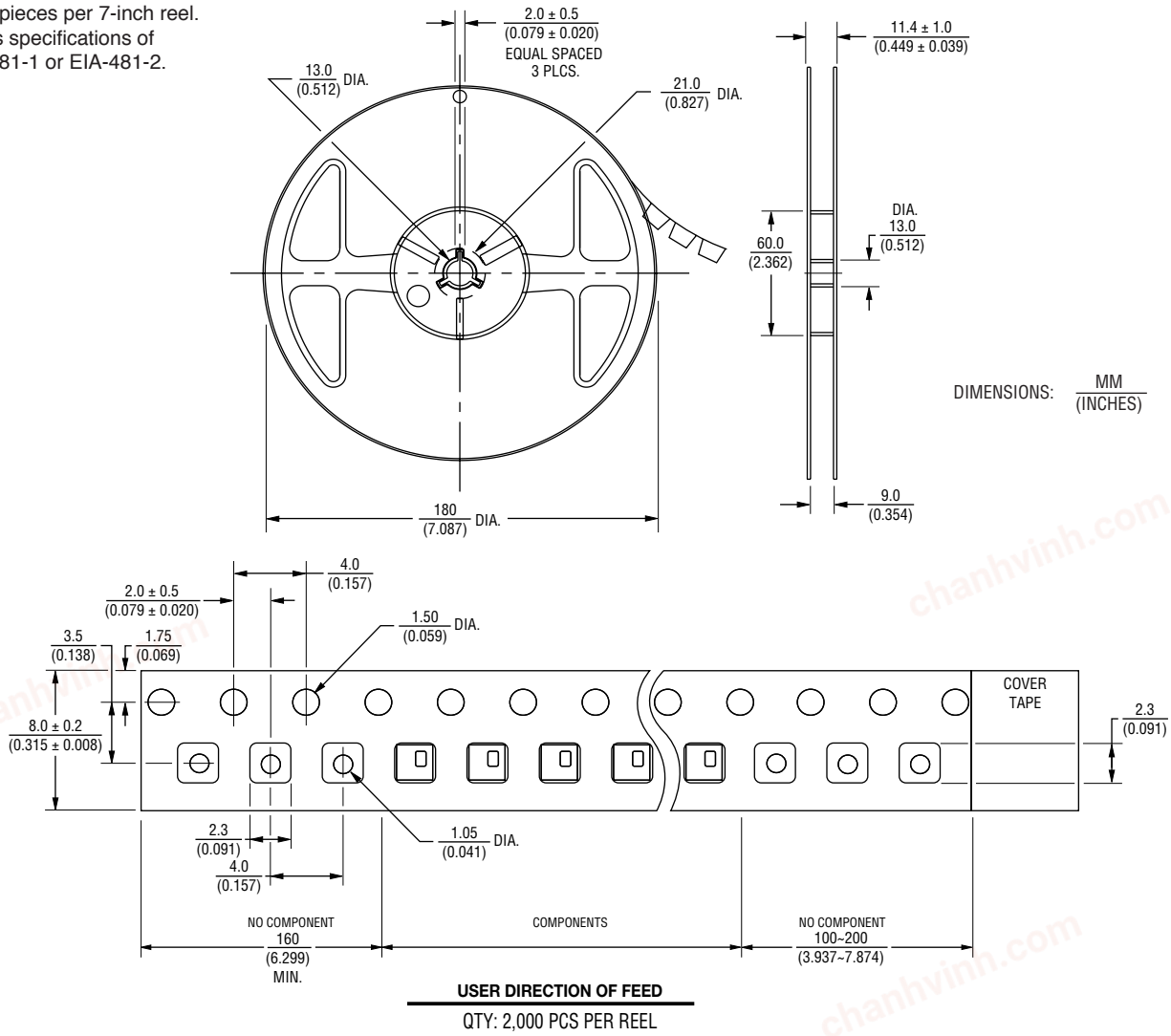


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Packaging Specification

2000 pieces per 7-inch reel.
Meets specifications of
EIA-481-1 or EIA-481-2.



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