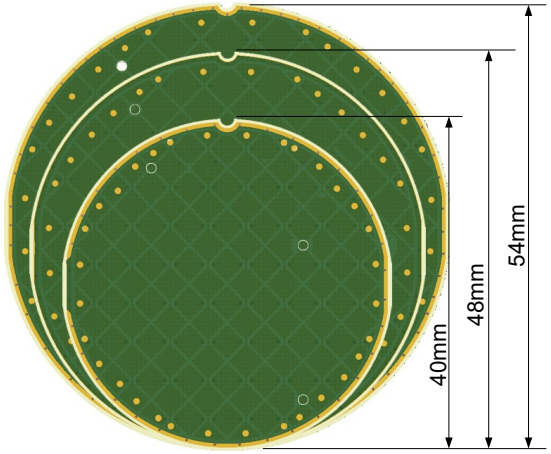
ProxSense® Trackpad Module Datasheet

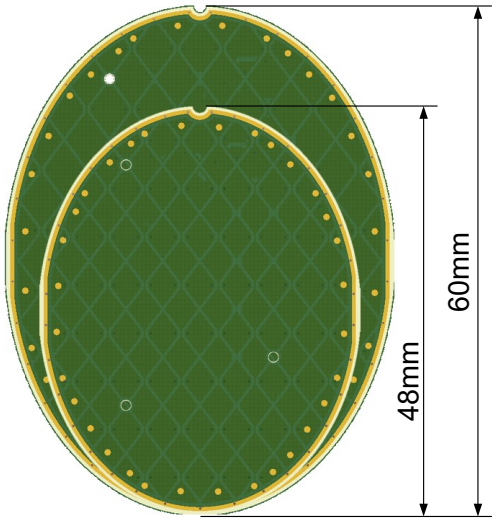
Capacitive Trackpads with Gesture Recognition for Headphones & Audio Equipment with Direct Connection to Bluetooth SoCs

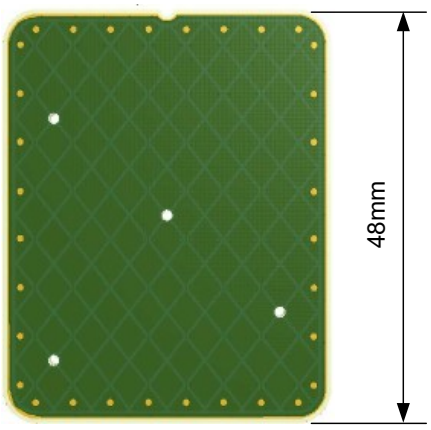
The ProxSense® series of capacitive trackpads offers best in class sensitivity, signal to noise ratio and power consumption. Automatic tuning for sense electrodes guarantees optimal operation over production and environmental change.

Main Features

- Trackpad with on chip XY coordinate calculation
- 1792 x 1792 resolution
- 170Hz scan rate for gesture recognition
- Adjustable Sensitivity
- Active high or low output
- Proximity wake up from low power
- Automatic drift compensation
- Gestures mapped to I/O pins for Audio Adjustment
    - Swipe Up
    - Swipe Down
    - Swipe Backwards
    - Swipe Forwards
    - Swipe Up & Hold
    - Swipe Down & Hold
    - Swipe Backwards & Hold
    - Swipe Forwards & Hold
    - Tap
    - Tap & Hold
- Low Power, suitable for battery applications
- Supply voltage: 1.65V to 3.6V
- <40µA active sensing Low Power mode
- Direct Interface to BlueTooth audio IC







Applications

- Bluetooth Headphones
- Bluetooth Speakers
- Mechanical Push Button Replacement
- Portable Electronics
- Wearable Electronics

Contents

Datasheet Revision History

Version	Description	Date
1.00	Preliminary Draft	May 2015
1.01	First Release	June 2015
1.02	Updated ordering Information for Value Line	August 2015
1.03	Update Illustrations	Sept 2015
1.04	Update TPR54 design	Nov 2015
1.05	Add TPR40-V	Nov 2016
1.06	Update output tables	Jan 2017
1.07	Output type correction	April 2017
1.08	Update available version in order info	May 2017

1 Hardware Description

All trackpad modules are available on RoHS2 and REACH compliant FR4 PCB material. The module PCBs are 1mm thick and have an OSP finish, with tinned pads for the user required solder points. The standard modules are not Halogen free. The trackpad sensing is done with IQS572, connected to an 8x8 diamond grid for 1792 pixel resolution in the X and Y directions. The modules are supplied with 3M double sided adhesive tape (PSA). Only certain modules include a connector, please consult Section 11.

Table 1.1 Summary of Trackpad Offerings

Module Name	Shape	Size
TPR40	Round	Ø40mm
TPR48	Round	Ø48mm
TPR54	Round	Ø54mm
TPE60	Ellipse	60mm x 46mm
TPE48	Ellipse	48mm x 38mm
TPS48	Rectangle	48mm x 38mm

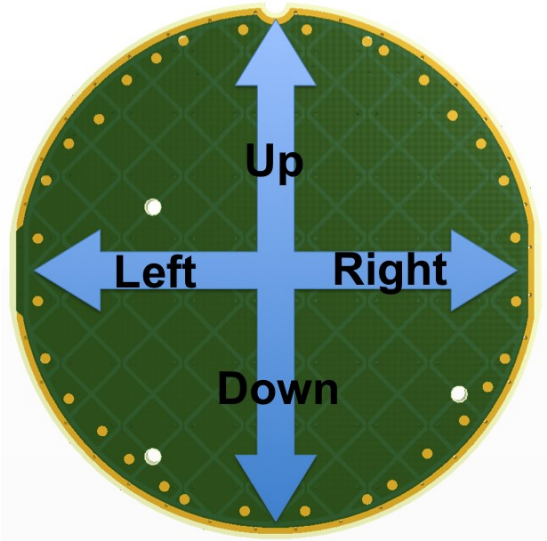
The TPR40 is also available in the **V**alue Line series. The value line uses the IQS525 in place of the IQS572, with maximum resolution of 1024 x 1024.

1.2 PCB Specification

- Material: 2-layer, FR4 PCB (non-HF material)
- Conductor: 35µm Copper (1oz. Cu)
- Finish: OSP (tinned)
- Size: Module Specific
- PCB Final Thickness = 1.0mm +/- 10%
- Outline: Precision DIE-CUT Profile

1.3 Module Orientation

All the modules have a cut in the PCB indicating the top of the module, which could also be used to align the module on the application overlay. This Notch can be seen in Figure 1.1



Tip: An overlay must be secured to the module with double sided adhesive tape without air gaps for performance evaluation.

Figure 1.1 Top Notch Illustrating Module Orientation.

1.4 Adhesive (PSA) Specification

All 6 modules offered are supplied with double sided adhesive applied on the trackpad for ease of integration. The adhesive is kept with the liner kept in place, with a pull tab for easy removal without tearing:

- Type: 3M 468 200MP
- Thickness = 0.13mm
- Liner = Polycoated Kraft Paper
- Liner w/ Pull-Tab (No glue on Pull-Tab)
- Adhesive sized to fit entire tracking area (module specific)

1.5 Total Thickness

The total thickness given in Figure 1.2 does not include the protective liner on the adhesive. The liner needs to be removed when the module is assembled into the application. The highest part (thickest part of the module) of the assembly is a 0603 capacitor – C2.

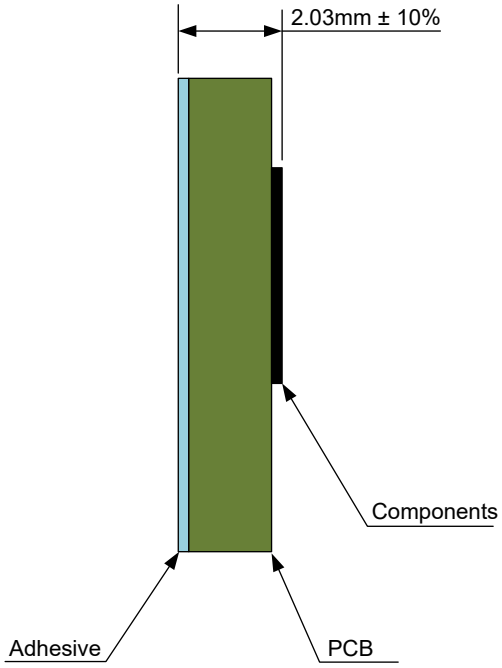


Figure 1.2 Maximum Module Thickness.

1.6 Compatible Overlay Thickness

The compatible overlay thicknesses are shown in Table 1.2 below. The modules have a solder link, S1, which can select one of two sensitivity settings tuned for different overlay thicknesses.

Table 1.2 Module Overlay Compatibility[1].

Solder link S1	Overlay Range
Open	1mm – 2mm
Closed	2mm – 3mm

For non-uniform overlays, the maximum curve in the overlay is limited to a 1mm height difference over the trackpad surface as shown in Figure 1.3.

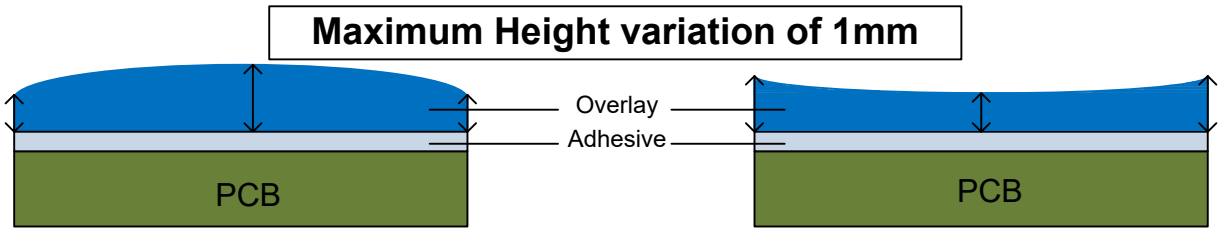


Figure 1.3 Maximum height variation in the overlay.

[1] Note: Pilot Built 1 (PB1) modules only support the 1-2mm setting. Contact Azoteq for updated FW.

1.7 Output Level

The active level of the output pins can be changed from active high (default) to active low. Connect a solder link on S2 to select active low. The active level is applicable to all 5 output pins.

Table 1.3 Module Output Pin Level.

Solder link S2	Output Level
Open	Active High
Closed	Active Low

1.8 Finger Sizes

The modules have the same number of rows and columns which results in different trackpad pitches. The smallest finger sizes for valid gestures on each module are shown in Table 1.4 below.

Table 1.4 Suggested Minimum Finger Sizes.

Module	Min Finger Diameter
TPR40	6.7 mm
TPR40-V	10.4mm
TPR48	8.0 mm
TPR54	9.0 mm
TPE60	9.0 mm
TPE48	7.2 mm
TPS48	7.2 mm

2 TPR40

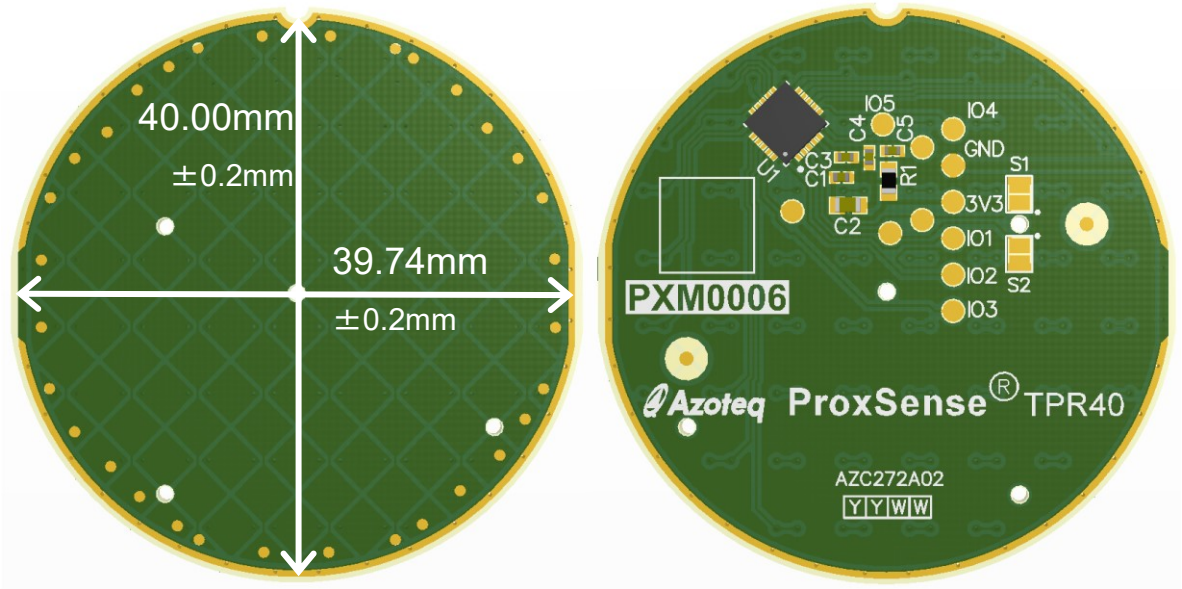


Figure 2.1 TPR40 – Front and Back View.

2.2 Outputs of TPR40

The pin mapping for the TPR40 gesture outputs are shown in below.

Table 2.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

3 TPR40-V

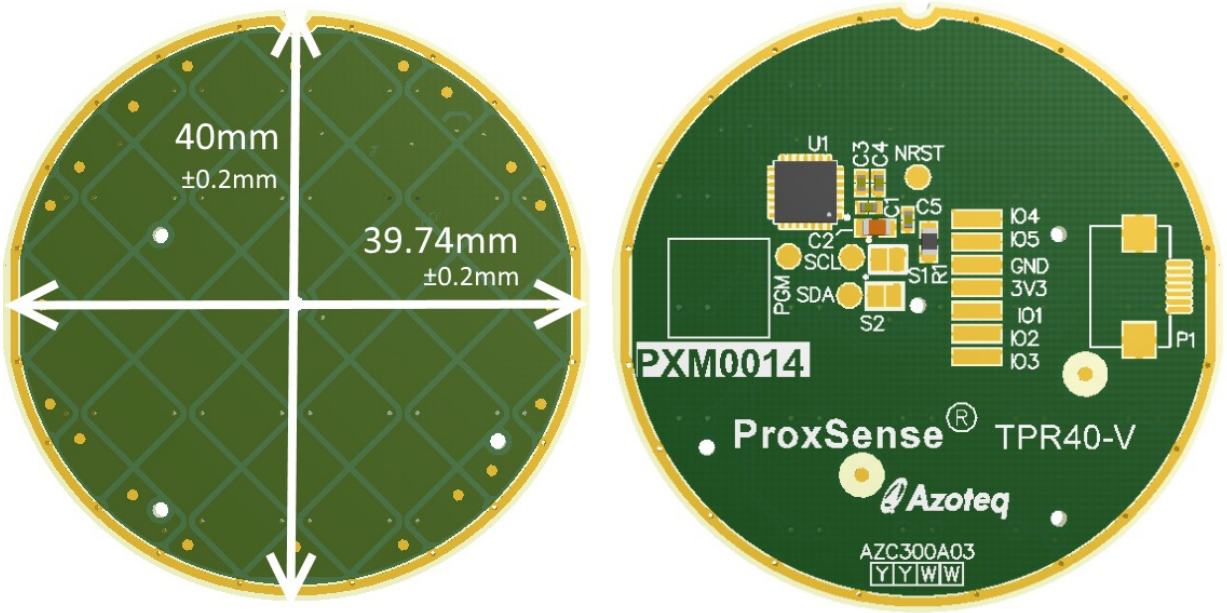


Figure 3.1 TPR40-V Front and Back View.

3.2 Outputs of TPR40-V

The pin mapping for the TPR40-V gesture outputs are shown in below.

Table 3.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_3	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_3	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_1	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_1	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

4 TPR48

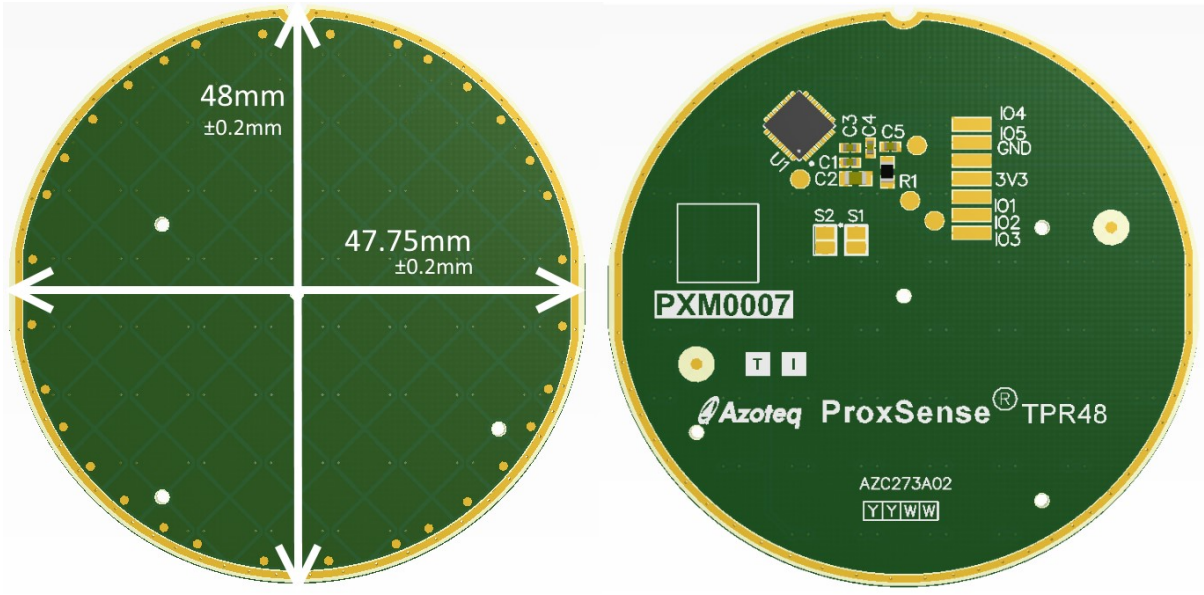


Figure 4.1 TPR48 – Front and Back View.

4.2 Outputs of TPR48

The pin mapping for the TR48 gesture outputs are shown in below.

Table 4.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

5 TPR54

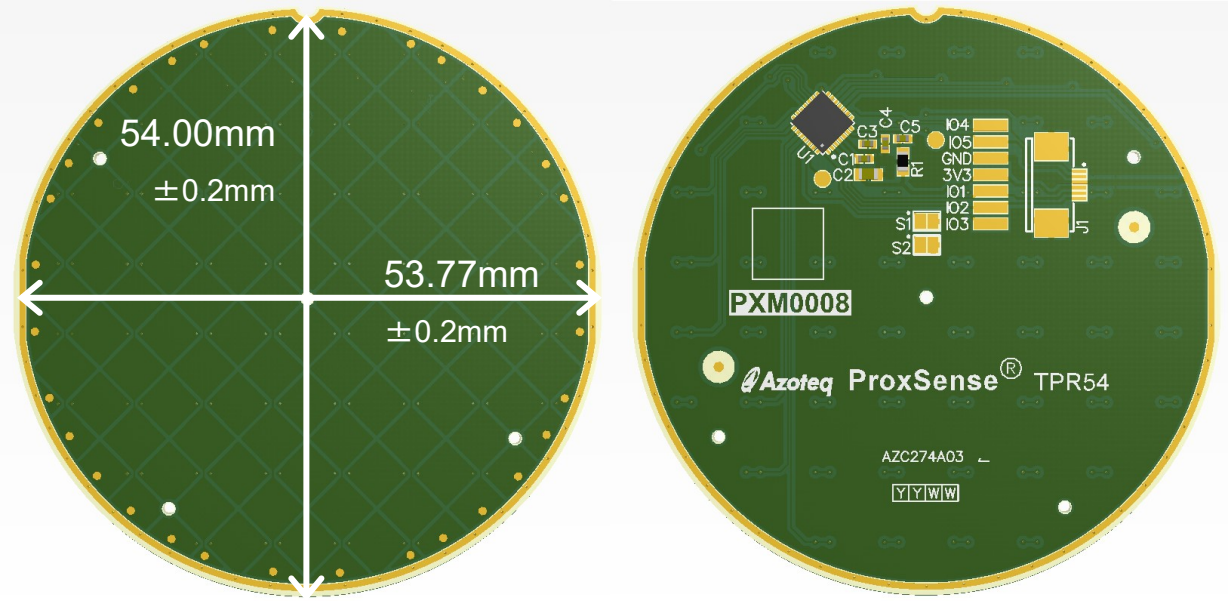


Figure 5.1 TPR54 – Front and Back View.

5.2 Outputs of TPR54

The pin mapping for the TPR54 gesture outputs are shown in below.

Table 5.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

Table 5.2 FPC connector pin out.

J1	Connection
1	NRST
2	RDY
3	GND
4	VDDHI
5	SCL
6	SDA

6 TPE48

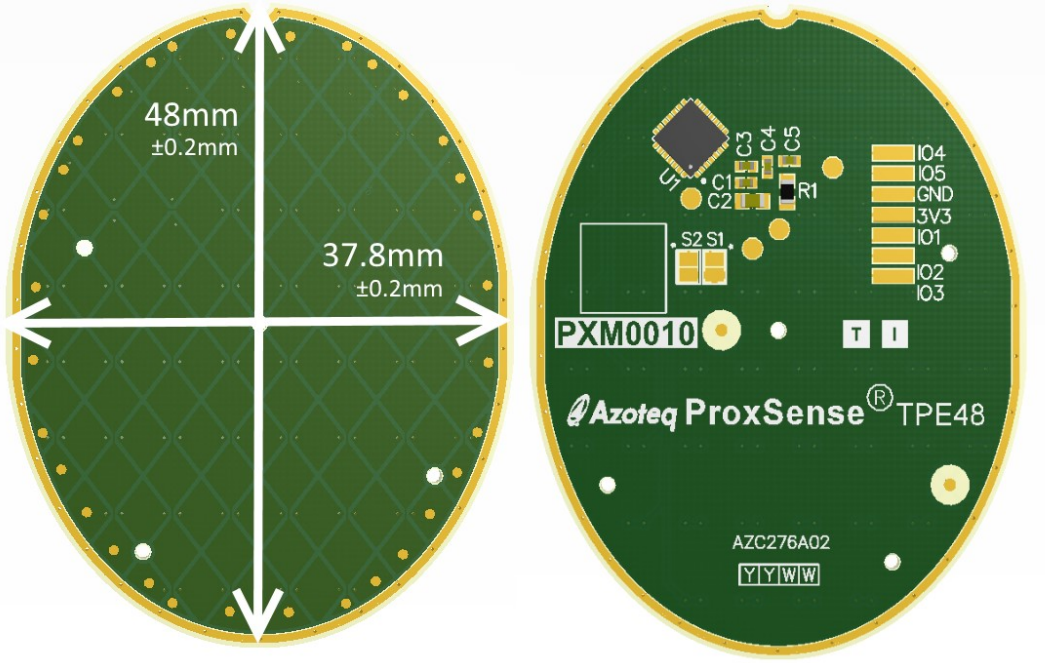


Figure 6.1 TPE48 – Front and Back View.

6.2 Outputs of TPE48

The pin mapping for the TPE48 gesture outputs are shown in below.

Table 6.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

7 TPE60

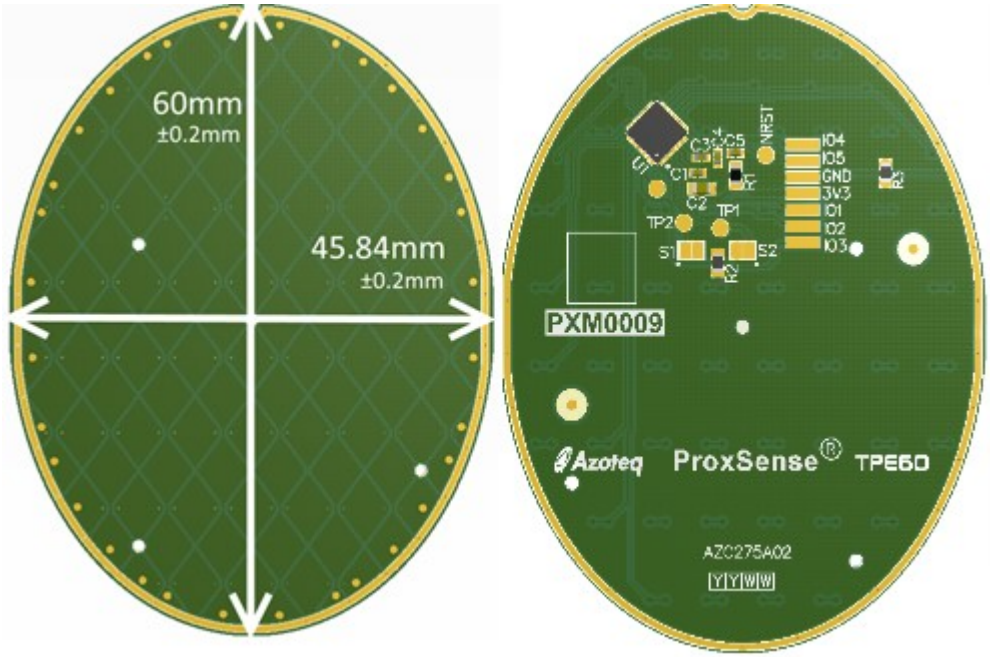


Figure 7.1 TPE60 – Front and Back View.

7.2 Outputs of TPE60

The pin mapping for the TPE60 gesture outputs are shown in below.

Table 7.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

8 TPS48

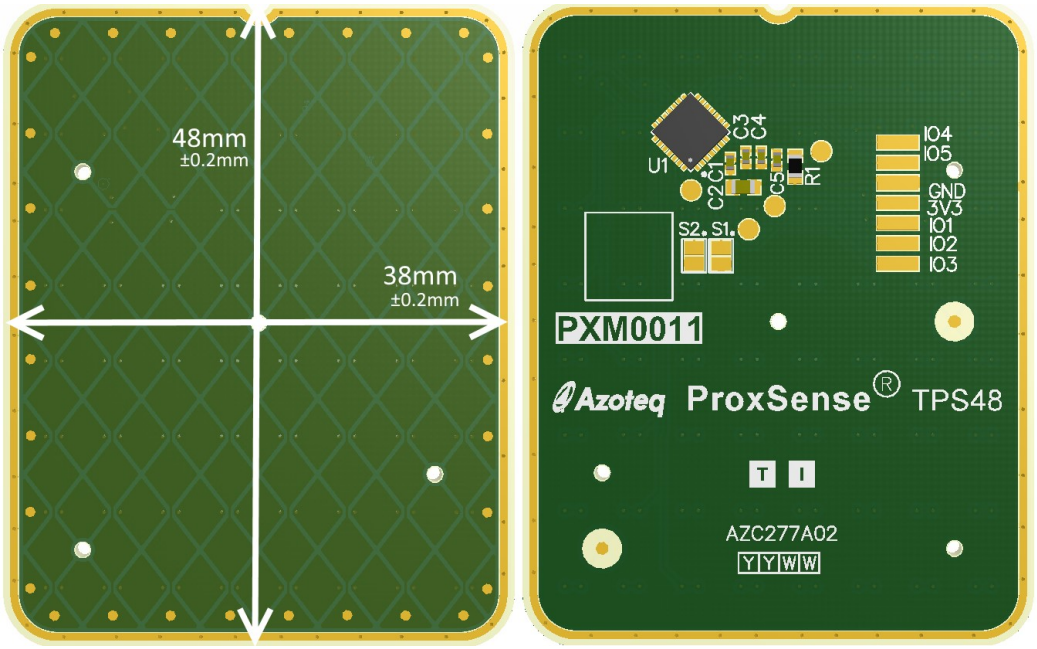


Figure 8.1 TPS48 – Front and Back View.

8.2 Outputs of TPS48

The pin mapping for the TPS48 gesture outputs are shown in below.

Table 8.1 Module Gesture Output Pin Mapping.

Gesture	Output Pin	Output Type	Typical Feature
Swipe Upward	I/O_1	Single Pulse	Volume Increase
Swipe Upward & Hold	I/O_1	Continuous Pulse	Continuous Volume Increase
Swipe Downward	I/O_3	Single Pulse	Volume Decrease
Swipe Downward & Hold	I/O_3	Continuous Pulse	Continuous Volume Decrease
Swipe Forward	I/O_5	Single Pulse	Skip / Next Track
Swipe Forward & Hold	I/O_5	Continuous Pulse	Fast Forward
Swipe Backward	I/O_4	Single Pulse	Skip / Previous Track
Swipe Backward & Hold	I/O_4	Continuous Pulse	Reverse/Rewind
Tap	I/O_2	Single Pulse	Play/Pause (Call Answer)
Tap & Hold	I/O_2	Continuous Pulse	Start/STOP

9 Gesture Implementation

9.1 Swipe Gestures

There are four swipe gestures that can be detected by the trackpad modules, as shown in Figure 9.1 below.

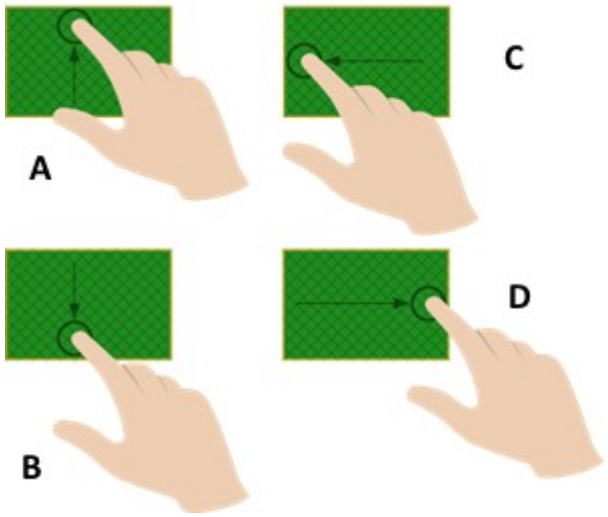


Figure 9.1 Illustrations off the 4 swipe gestures that can be detected by the trackpad modules.

Each time any of the swipe gestures are performed correctly (correct finger action within a 18ms to 1 second window), the corresponding I/O pin of the trackpad will output a single 200ms (100ms<Tpulse<300ms) pulse to the Bluetooth IC. The user has the option to select a high (default) or low (by adding a solder link on the module) pulse. The high level as indicated on the figure below will correspond to the input voltage supplied to the trackpad module.

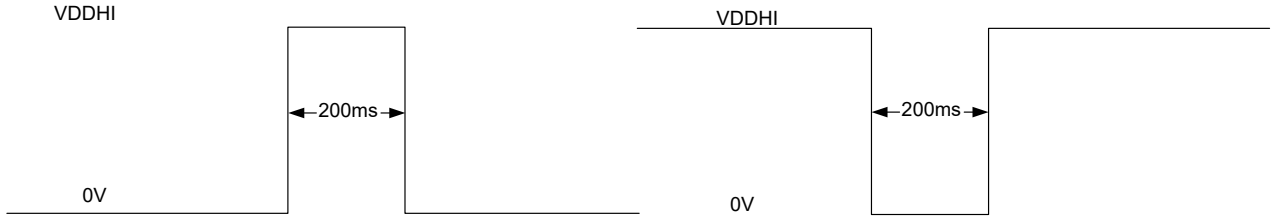


Figure 9.2 High output pulse shown on the left; Low output pulse shown on the right. Typical values only.

9.1.1 Swipe Upward (A)

A single finger action as shown in Figure 9.1 part A, place anywhere on the trackpad surface, and moved more than 14mm from the bottom to the top within 1s and then lifted off the trackpad will generate a 200ms (100ms<Tpulse<300ms) pulse on I/O_1. The swipe gesture is limited to finger movement < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage.

9.1.2 Swipe Downward (B)

A single finger action as shown in Figure 9.1 part B, place anywhere on the trackpad surface, and moved more than 14mm from the top to the bottom within 1s and then lifted off the trackpad will generate a 200ms (100ms<Tpulse<300ms) pulse on I/O_3. The swipe gesture is

limited to finger movement < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage.

9.1.3 Swipe Backward (C)

A single finger action as shown in Figure 9.1 part C, place anywhere on the trackpad surface, and moved more than 14mm from right to left within 1s and then lifted off the trackpad will generate a 200ms (100ms<Tpulse<300ms) pulse on I/O_4. The swipe gesture is limited to finger movement < +-45 degrees from the horizontal, and dependent on the finger not lifting off the trackpad during the finger movement stage.

9.1.4 Swipe Forward (D)

A single finger action as shown in Figure 9.1 part D, placed anywhere on the trackpad surface, and moved more than 14mm from left to right within 1s and then lifted off the trackpad will generate a 200ms (100ms<Tpulse<300ms) pulse on I/O_5. The swipe gesture is limited to finger movement < +-45 degrees from the horizontal, and dependent on the finger not lifting off the trackpad during the finger movement stage.

9.2 Tap Gesture

The trackpad modules can recognize a tap gesture, from a single finger, at any point on the trackpad surface. A valid tap gesture is recognized if a touch is made by moving less than 4mm on the overlay surface and release within 600ms but not faster than 18ms. When a valid tap is detected, the modules will output a 200ms (100ms<Tpulse<300ms) pulse on I/O_2 as shown in Figure 9.2.

Figure 9.3 Tap Gesture.

9.3 Tap and Hold Gesture

The trackpad modules can recognize a tap & hold gesture, from a single finger, at any point on the trackpad surface. A valid tap & hold gesture is recognized if a touch is made and the finger does not release the touch for more than 600ms without moving more than 4mm on the trackpad overlay surface.

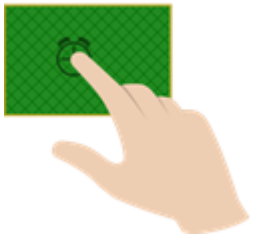


Figure 9.4 Tap& Hold Gesture.

When a valid tap & hold is detected, the modules will output a continuous pulse (continuous high level of the output, or low if solder link is made) on I/O_2 until the finger is lifted off the trackpad.

9.4 Swipe and Hold Gestures

There are four swipe & hold gestures that can be detected by the trackpad modules, as shown in Figure 9.5 below.

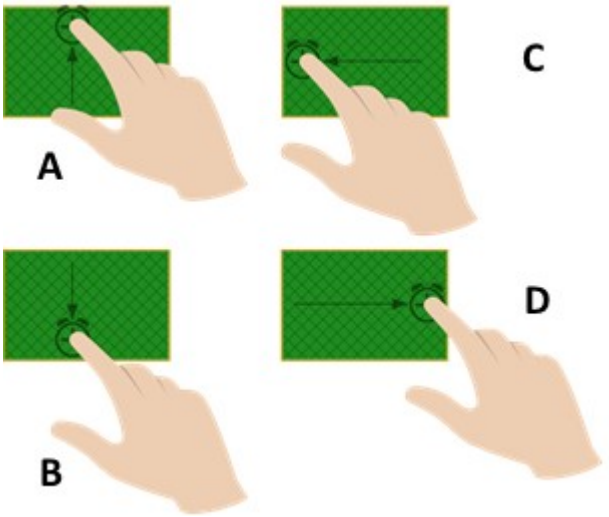


Figure 9.5 Illustrations off the 4 swipe & hold gestures that can be detected by the trackpad modules.

Each time any of the swipe & hold gestures are performed correctly, the corresponding I/O pin of the trackpad will output a continuous pulse (continuous high level of the output, or low if solder link is made) until the finger is lifted off the trackpad. The user has the option to select a high (default) or low (by adding a solder link on the module) pulse. The high level will correspond to the input voltage supplied to the trackpad module.

9.4.2 Swipe Upward & Hold (A)

A single finger action as shown in Figure 9.5 part A, placed anywhere on the trackpad surface, and moved more than 14mm from the bottom to the top within 1s and then kept stationary on the trackpad for 600ms or more will generate a continuous pulse on I/O_1. The swipe gesture is limited to < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage. The output pulse will stop once the finger is lifted off the trackpad.

9.4.3 Swipe Downward & Hold (B)

A single finger action as shown in Figure 9.5 part B, placed anywhere on the trackpad surface, and moved more than 14mm from the top to the bottom within 1s and then kept stationary on the trackpad for 600ms or more will generate a continuous pulse on I/O_3. The swipe gesture is limited to < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage. The output pulse will stop once the finger is lifted off the trackpad.

9.4.4 Swipe Backward & Hold (C)

A single finger action as shown in Figure 9.5 part C, placed anywhere on the trackpad surface, and moved more than 14mm from right to left within and then kept stationary on the trackpad

for 600ms or more will generate a continuous pulse on I/O_4. The swipe gesture is limited to < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage. The output pulse will stop once the finger is lifted off the trackpad.

9.4.5 Swipe Forward & Hold (D)

A single finger action as shown in Figure 9.5 part D, place anywhere on the trackpad surface, and moved more than 14mm from left to right within 1s and then kept stationary on the trackpad for 600ms or more will generate a continuous pulse on I/O_5. The swipe gesture is limited to < +-45 degrees from the vertical, and dependent on the finger not lifting off the trackpad during the finger movement stage. The output pulse will stop once the finger is lifted off the trackpad.

10 Specifications

10.1 Absolute Maximum Specifications

The following absolute maximum parameters are specified for the device:

Exceeding these maximum specifications may cause damage to the device.

- Operating temperature — 0°C to 40°C[1]
- Supply Voltage (VDDHI – GND) — 3.6V
- Minimum power-on slope — 100V/s
- ESD protection — ±2kV (Human body model)

10.2 Application Level Tests

According to the module design, with proper application system design implementation a 16kV IEC air discharge and 1Vp-p Conducted Immunity level should be possible to achieve.

10.3 Power Consumption

Table 10.1 Trackpad Module General Operating Conditions

DESCRIPTION	MIN	TYP	MAX	UNIT
Supply voltage	1.65	3.3V	3.6	V
Tracking Mode Current	-	4		mA
Low Power Current	-	35	TBD	µA

10.4 Output Pin Voltage

Table 10.2 Output Pin Characteristics

Symbol	Parameter Conditions	Conditions	Min.	Max.	Unit
V_{OL} (1)	Output low level voltage for an I/O pin	I_{IO} = +2mA, V_{DDHI} = 1.8V	-	0.45	V
		I_{IO} = +2mA, V_{DDHI} = 3.0V	-	0.45	
V_{OH} (2)	Output high level voltage for an I/O pin	I_{IO} = -1mA, V_{DDHI} = 1.8V	V_{DDHI} -0.45	-	
		I_{IO} = -1mA, V_{DDHI} = 3.0V	V_{DDHI} -0.45	-	

[1] Design parameter only.

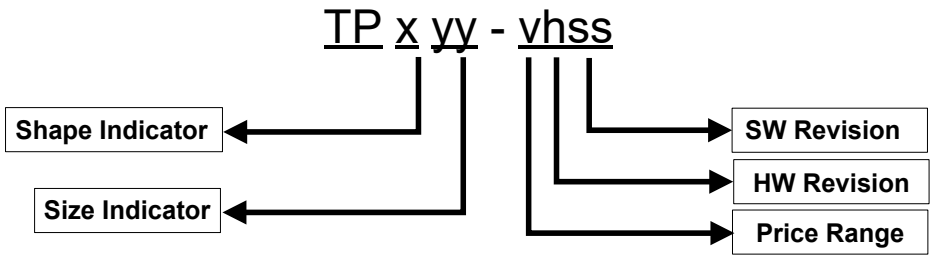
Table 10.3 Start-up and shut-down slope Characteristics

DESCRIPTION	Conditions	PARAMETER	MIN	MAX	UNIT
Power On Reset	V_{DDHI} Slope ≥ 100V/s @25°C	V_{POR}	1.44	1.65	V
Power Down Reset	V_{DDHI} Slope ≥ 100V/s @25°C	V_{PDR}	1.30	1.60	V

11 Ordering Information

Order quantities will be subject to MOQ of 5k pcs. Contact the official distributor for sample quantities. A list of the distributors can be found under the "Distributors" section of www.azoteq.com.

11.1 Ordering Description



Trackpad Module	TP	=	Trackpad
Shape Indicator (x)	R	=	Round
	E	=	Ellipsoid
	S	=	Square/Rectangular
Size Indicator (yy)	40	=	40mm
	48	=	48mm
	54	=	54mm
	60	=	60mm
Price Range (v)	V	=	Value Line (low cost)
	P	=	Performance Line (high performance)
Hardware Revision (h)	1	=	Test Points as Solder Pads
	2	=	Hotbar as Solder Pads
	3	=	Ziff Connector Placed
Software Revision (ss)	01	=	Standard Gestures Output on I/O's
	03	=	I2C (B000 FW version)

11.2 Standard Ordering Options Available

- TPR40-V201
- TPR40-P101
- TPR40-P103
- TPR48-P201
- TPR48-P203
- TPR54-P201
- TPR54-P203
- TPR54-P303
- TPE48-P201
- TPE48-P203
- TPE60-P201
- TPE60-P203
- TPS48-P201
- TPS48-P203

Note: For non-standard versions or version not listed above please contact Azoteq direct.

Appendix A. Contact Information

	USA	Asia	South Africa
Physical Address	6507 Jester Blvd Bldg 5, suite 510G Austin TX 78750 USA	Rm2125, Glittery City Shennan Rd Futian District Shenzhen, 518033 China	109 Main Street Paarl 7646 South Africa
Postal Address	6507 Jester Blvd Bldg 5, suite 510G Austin TX 78750 USA	Rm2125, Glittery City Shennan Rd Futian District Shenzhen, 518033 China	PO Box 3534 Paarl 7620 South Africa
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Please visit **www.azoteq.com** for a list of distributors and worldwide representation.