**TBMA** 



## Test Board for MagAlpha Sensors User Guide

### DESCRIPTION

The TBMA is a test board for the MagAlpha magnetic position sensor family. The TBMA allows users to run and test MagAlpha sensors quickly. TBMA boards come in two different formats: round (RD) and long (LT). In the RD format, the sensor is mounted in an end-of-shaft configuration. In the LT format, the sensor is mounted on the edge of the board and can be used in both side-shaft and end-of-shaft configurations.

TBMA test boards are compatible with the MACOM evaluation kit, offering seamless connection and operation of MagAlpha sensors, and allowing users to evaluate MagAlpha functionalities and performances with their own set-up.

The TBMA test board only includes the assembled board with the sensor and decoupling capacitors. It does not include connectors.

### FEATURES

- Round Board Format for End-of-Shaft Mounting
- Long Board Format for Side Shaft and Endof-Shaft Mounting
- Compatible with the MagAlpha Communication Interface Kit (EVKT-MACOM)

## APPLICATIONS

- Servo Drives
- Robotics
- Automotive
- BLDC Motor Commutation
- Encoders

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### **OVERVIEW**



Round (RD) Format



Long (LT) Format

Figure 1: TBMA Test Boards



### **Board Types**

Different board types are available, and each has a different schematic and layout design (see Table 1 on page 3). The board type to use is determined by the selected sensor part number.

Each board type is also available in two different formats: a round test board (RD), or a long test board (LT). The board part number specifies which format is used:

- TBMAXXX-Q-RD-XXX = Round test board
- TBMAXXX-Q-LT-XXX = Long test board

Both RD and LT board formats can be used for end-of-shaft configurations where the sensor is positioned at the end of the motor or knob shaft. For side-shaft configurations where the sensor is positioned perpendicularly to the motor or knob shaft, only the RD board format can be used.



Board Type	Board Part Number	MPS Chip Part Number
	TBMA100-Q-RD	144400
	TBMA100-Q-LT	MA100
	TBMA300-Q-RD	MA200
Deard type 1	TBMA300-Q-LT	MPS Chip Part Number           MA100           MA300           MA700           MA700           MA700           MA700           MA700           MA700           MA700           MA700           MA702           MA702           MA702           MA700           MA700           MA7010           MA700           MA800           MA704           MA732           MAQ430           MAQ470           MAQ473
Боаго туре т	TBMA700-Q-RD	MAZ00
	TBMA700-Q-LT	MA700
	TBMA750-Q-RD	MA750
	TBMA750-Q-LT	MA750
	TBMA102-Q-RD	MA102
	TBMA102-Q-LT	MATOZ
	TBMA302-Q-RD	MA202
	TBMA302-Q-LT	MASUZ
	TBMA310-Q-RD	MA310
	TBMA310-Q-LT	MAS TO
	TBMA702-Q-RD	MAZ02
	TBMA702-Q-LT	MA702
	TBMA710-Q-RD	MA710
	TBMA710-Q-LT	MATIO
	TBMA730-Q-RD	MA720
	TBMA730-Q-LT	MA730
	TBMA800-Q-RD	MA800
Board type 2	TBMA800-Q-LT	MA800
	TBMA820-Q-RD	MA820
	TBMA820-Q-LT	IVIA620
	TBMA850-Q-RD	MA850
	TBMA850-Q-LT	MA650
	TBMA704-Q-RD	MAZ04
	TBMA704-Q-LT	MA704
	TBMA330-Q-RD	MA330
	TBMA330-Q-LT	MA330
	TBMA732-Q-RD	MA722
	TBMA732-Q-LT	IMA732
	TBMAQ430-Q-RD	MAQ420
	TBMAQ430-Q-LT	
	TBMAQ470-Q-RD	MAQ470
	TBMAQ470-Q-LT	IVIAQ470
	TBMAQ473-Q-RD	MAQ 472
	TBMAQ473-Q-LT	IVIAQ473

#### Table 1: Board Type



Poord type 2	TBMA780-Q-RD	MAZOO
воаго туре з	TBMA780-Q-LT	MA780
Board type 4	TBMA782-Q-RD	MAZOO
	TBMA782-Q-LT	WIA7 62
Board type 5	TBMA734-Q-RD	NA794
	TBMA734-Q-LT	WA734

## **TBMA Contents**

Figure 2**Error! Reference source not found.** shows the TBMA test board contents, with each element described in the list below.



Figure 2: TBMA Contents

- 1. One TBMA board with MagAlpha mounted (RD or LT).
- 2. Decoupling capacitors.
- 3. Connector footprints (connectors not included).



### **BOARD TYPE 1**

#### **RD Format Overview**

Figure 3 shows an overview of the Type 1 round (RD) board.



Figure 3: RD Type 1 Board Overview

### LT Format Overview

Figure 4 shows an overview of the Type 1 long (LT) board.



Figure 4: LT Type 1 Board Overview



#### Schematic

Figure 5 shows a schematic for the Type 1 boards.



Figure 5: RD/LT Type 1 Schematic

#### **Bill of Materials**

Table 2 shows the Type 1 board bill of materials (BOM).

#### Table 2: Type 1 Board Bill of Materials

2C1, C4Ceramic capacitor, 10V, X6S, 04021μFMurataGRM155C81A1C2 (optional)Ceramic capacitor, 10V, X6S, 04021μFMurataGRM155C81A	1A105KA12D 1A105KA12D
C2 (optional)Ceramic capacitor, 10V, X6S, 04021μFMurataGRM155C81A	1A105KA12D
1 C3 Ceramic capacitor, 16V, (optional) X7R, 0402 100nF Murata GRM155R710	1C104KA88J
1 U1 MagAlpha magnetic position MAxxx MPS N/A	I/A
CN1, CN2 8-position receptacle connector. Wurth 6903672	'280876
2 (not 0.100" (2.54mm), surface-mount tin TE Connectivity 7-21785	)r 8711-8



#### **Assembly View**

Figure 6 shows the top-side assembly view of the Type 1 round board. Figure 7 shows the top-side assembly view of the Type 1 long board.





Figure 6: RD Type 1 Assembly View

Figure 7: LT Type 1 Assembly View



#### **Mechanical Drawing**

Figure 8 shows the top-side mechanical drawing of the Type 1 round board. Figure 9 shows the top-side mechanical drawing of the Type 1 long board.



mil = 0.001" = 0.0254mm



#### **Connector Pinout**

Figure 10 shows the Type 1 round board connector pinout. Figure 11 shows the Type 1 long board connector pinout.





#### Figure 10: RD Type 1 Connector Pinout

Figure 11: LT Type 1 Connector Pinout

Table 3 shows the Type 1 pin registers.

#### Table 3: Type 1 Board Connector Pin Registers

Pin	Name	Description
CN1.1	VDD	3.3V supply.
CN1.2	GND	Ground.
CN1.3	VFLASH	Flash power supply (3.9V only powered during flashing).
CN1.4	CS	Chip select (serial).
CN1.5	SCLK	Clock (serial).
CN1.6	MISO	Master in slave out (serial).
CN1.7	MOSI	Master out slave in (serial).
CN1.8	-	Leave unconnected.
CN2.1	U <sup>(1)</sup>	U output (optional motor commutation).
CN2.2	V <sup>(1)</sup>	V output (optional motor commutation).
CN2.3	W <sup>(1)</sup>	W output (optional motor commutation).
CN2.4	A <sup>(1)</sup>	A output (optional incremental encoder).
CN2.5	B <sup>(1)</sup>	B output (optional incremental encoder).
CN2.6	Z <sup>(1)</sup>	Z output (optional incremental encoder).
CN2.7	TEST	Test pin.
CN2.8	PWM <sup>(1)</sup>	Pulse-width modulation output (optional).

#### Note:

1) Availability of this option depends of the MagAlpha part number. Please refer directly to the part datasheet.



### **BOARD TYPE 2**

#### **RD Format Overview**

Figure 12 shows an overview of the Type 2 round (RD) board.



Figure 12: RD Type 2 Board Overview

### LT Format Overview

Figure 13 shows an overview of the Type 2 long (LT) board.







#### Schematic

Figure 14 shows a schematic for the Type 2 boards.





#### **Bill of Materials**

Table 4 shows the Type 2 board bill of materials (BOM).

Table 4	1: Tv	pe 2	Board	Bill	of	Materials
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Quantity	Designator	Description	Value	Manufacturer	Manufacturer P/N
1	C1	Ceramic capacitor, 10V, X6S, 0402	1µF	Murata	GRM155C81A105KA12D
1	C2 (not populated)	Ceramic capacitor, 16V, X7R, 0402	100nF	Murata	GRM155R71C104KA88J
1	U1	MagAlpha magnetic position sensor	MAxxx	MPS	N/A
2	CN1, CN2 (not populated)	8-position receptacle connector, 0.100" (2.54mm), surface-mount tin		Wurth or TE Connectivity	690367280876 or 7-2178711-8



#### **Assembly View**

Figure 15 shows the top-side assembly view of the Type 2 round board. Figure 16 shows the top-side assembly view of the Type 2 long board.





Figure 15: RD Type 2 Assembly View

Figure 16: LT Type 2 Assembly View



#### **Mechanical Drawing**

Figure 17 shows the top-side mechanical drawing of the Type 2 round board. Figure 18 shows the top-side mechanical drawing of the Type 2 long board.



Figure 18: LT Type 2 Mechanical Drawing, mil = 0.001" = 0.0254mm



#### **Connector Pinout**

Figure 19 shows the Type 2 round board connector pinout. Figure 20 shows the Type 2 long board connector pinout.





Figure 19: RD Type 2 Connector Pinout

Figure 20: LT Type 2 Connector Pinout

Table 5 shows the Type 2 pin registers.

#### Table 5: Type 2 Board Connector Pin Registers

Pin	Name	Description
CN1.1	VDD	3.3V supply.
CN1.2	GND	Ground.
CN1.3	-	-
CN1.4	CS	Chip select (serial).
CN1.5	SCLK	Clock (serial).
CN1.6	MISO	Master in slave out (serial).
CN1.7	MOSI	Master out slave in (serial).
CN1.8	TEST	Test pin.
CN2.1	IO6 <sup>(2)</sup>	Pin 15 (IO).
CN2.2	IO1 <sup>(2)</sup>	Pin 1 (IO).
CN2.3	IO5 <sup>(2)</sup>	Pin 9 (IO).
CN2.4	IO4 <sup>(2)</sup>	Pin 6 (IO).
CN2.5	IO2 <sup>(2)</sup>	Pin 2 (IO).
CN2.6	IO3 <sup>(2)</sup>	Pin 3 (IO).
CN2.7	MGL <sup>(3)</sup>	Magnetic level low (optional).
CN2.8	MGH <sup>(3)</sup>	Magnetic level high (optional).

#### Notes:

- 2) Refer to the MagAlpha part datasheet to know which features are available on these pins.
- 3) Availability of this option depends of the MagAlpha part number. Please refer directly to the part datasheet.



### **BOARD TYPE 3**

#### **RD Format Overview**

Figure 21 shows an overview of the Type 3 round (RD) board.



Figure 21: RD Type 3 Board Overview

### LT Format Overview

Figure 22 shows an overview of the Type 3 long (LT) board.







#### Schematic

Figure 23 shows a schematic for the Type 3 boards.





### **Bill of Materials**

Table 6 shows the Type 3 board bill of materials (BOM).

Table 6: T	vpe 3 Board	Bill of Materials
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Quantity	Designator	Description	Value	Manufacturer	Manufacturer PN
1	C1	Ceramic capacitor, 10V, X6S, 0402	1µF	Murata	GRM155C81A105KA12D
1	C2 (not populated)	Ceramic capacitor, 16V, X7R, 0402	100nF	Murata	GRM155R71C104KA88J
1	R1 (populated), R2 (not populated)	$0\Omega$ resistor, 0402	0Ω	Panasonic	ERJ-2GE0R00X
1	U1	MagAlpha magnetic position sensor	MA780	MPS	MA780GQ
2	CN1, CN2 (not populated)	8-position receptacle connector, 0.100" (2.54mm), surface-mount tin		Wurth or TE Connectivity	690367280876 or 7-2178711-8



#### **Assembly View**

Figure 24 shows the top-side assembly view of the Type 3 round board. Figure 25 shows the top-side assembly view of the Type 3 long board.





Figure 24: RD Type 3 Assembly View

Figure 25: LT Type 3 Assembly View



#### **Mechanical Drawing**

Figure 26 shows the top-side mechanical drawing of the Type 3 round board. Figure 27 shows the top-side mechanical drawing of the Type 3 long board.



Figure 27: LT Type 3 Mechanical Drawing, mil = 0.001" = 0.0254mm



#### **Connector Pinout**

Figure 28 shows the Type 3 round board connector pinout. Figure 29 shows the Type 3 long board connector pinout.





Figure 29: LT Type 3 Connector Pinout

Table 7 shows the Type 3 pin registers.

Figure 28: RD Type 3 Connector Pinout

#### Table 7: Type 3 Board Connector Pin Registers

Pin	Name	Description
CN1.1	VDD	3.3V supply.
CN1.2	GND	Ground.
CN1.3	VDDIO	1.8V to 3.3V supply for IOs.
CN1.4	CS	Chip select (serial).
CN1.5	SCLK	Clock (serial).
CN1.6	MISO	Master in slave out (serial).
CN1.7	MOSI	Master out slave in (serial).
CN1.8	TEST	Test pin.
CN2.1	EN	Enable (input). Switches the sensor to active mode.
CN2.2	ND	New data (output).
CN2.3	DV	Data valid (output).
CN2.4	ASC	Auto-power cycling mode (input).
CN2.5	ERR	Error flag (output).
CN2.6	NVM	Non-volatile memory (output).
CN2.7	MGL <sup>(4)</sup>	Magnetic level low (optional).
CN2.8	MGH <sup>(4)</sup>	Magnetic level high (optional).

#### Note:

4) Availability of this option depends of the MagAlpha part number. Please refer directly to the part datasheet.



### **BOARD TYPE 4**

### **RD Format Overview**

Figure 30 shows an overview of the Type 4 round (RD) board.



Figure 30: RD Type 4 Board Overview

### LT Format Overview

Figure 31 shows an overview of the Type 4 long (LT) board.







#### Schematic

Figure 32 shows a schematic for the Type 4 boards.





### **Bill of Materials**

Table 8 shows the Type 4 board bill of materials (BOM).

|--|

Quantity	Designator	Description	Value	Manufacturer	Manufacturer PN
1	C1	Ceramic capacitor, 10V, X6S, 0402	1µF	Murata	GRM155C81A105KA12D
1	C2 (not populated)	Ceramic capacitor, 16V, X7R, 0402	100nF	Murata	GRM155R71C104KA88J
1	R1 (populated), R2 (not populated)	$0\Omega$ resistor, 0402	0Ω	Panasonic	ERJ-2GE0R00X
1	U1	MagAlpha magnetic position sensor	MA782	MPS	MA782GGU
2	CN1, CN2 (not populated)	8-position receptacle connector, 0.100" (2.54mm), surface-mount tin		Wurth or TE Connectivity	690367280876 or 7-2178711-8



#### **Assembly View**

Figure 33 shows the top-side assembly view of the Type 4 round board. Figure 34 shows the top-side assembly view of the Type 4 long board.





Figure 33: RD Type 4 Assembly View

Figure 34: LT Type 4 Assembly View



90mil

#### **Mechanical Drawing**

Figure 35 shows the top-side mechanical drawing of the Type 4 round board. Figure 36 shows the top-side mechanical drawing of the Type 4 long board.



Figure 36: LT Type 4 Mechanical Drawing, mil = 0.001" = 0.0254mm



#### **Connector Pinout**

Figure 37 shows the Type 4 round board connector pinout. Figure 38 shows the Type 4 long board connector pinout.





Figure 38: LT Type 4 Connector Pinout

Table 9 shows the Type 4 board pin registers.

Figure 37: RD Type 4 Connector Pinout

 Table 9: Type 4 Board Connector Pin Registers

Pin	Name	Description
CN1.1	VDD	3.3V supply.
CN1.2	GND	Ground.
CN1.3	VDDIO	1.8V to 3.3V supply for IOs.
CN1.4	CS	Chip select (serial).
CN1.5	SCLK	Clock (serial).
CN1.6	MISO	Master in slave out (serial).
CN1.7	MOSI	Master out slave in (serial).
CN1.8	TEST	Test pin.
CN2.1	EN	Enable (input). Switches the sensor to active mode.
CN2.2	ND	New data (output).
CN2.3	DV	Data valid (output).
CN2.4	ASC	Auto-power cycling mode (input).
CN2.5	-	-
CN2.6	NVM	Non-volatile memory (output).
CN2.7	MGL <sup>(5)</sup>	Magnetic level low (optional).
CN2.8	-	-

#### Note:

5) Availability of this option depends of the MagAlpha part number. Refer directly to the related part's datasheet.



### **BOARD TYPE 5**

#### **RD Format Overview**

Figure 39 shows an overview of the Type 5 round board.



Figure 39: RD Type 5 Board Overview

### LT Format Overview

Figure 40 shows an overview of the Type 5 long board.







#### Schematic

Figure 41 shows a schematic for the Type 5 boards.



Figure 41: RD/LT Type 5 Schematic

### **Bill of Materials**

Table 10 shows the Type 5 board bill of materials (BOM).

Table TV. Type 5 Board Bill Of Materials
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Quantity	Designator	Description	Value	Manufacturer	Manufacturer PN
1	C1	Ceramic capacitor, 10V, X6S, 0402	1µF	Murata	GRM155C81A105KA12D
1	C2 (optional)	Ceramic capacitor, 16V, X7R, 0402	100nF	Murata	GRM155R71C104KA88J
3	R1, R2, R3	200Ω resistor, 0402	200Ω	Yageo	RC0402FR-07200RL
3	C3, C4, C5	Ceramic capacitor, 50V, C0G, 0402	10pF	Yageo	CC0402JRNPO9BN100
1	U1	MagAlpha magnetic position sensor	MA734	MPS	MA734
2	CN1, CN2	8-position receptacle connection 0.100" (2.54mm), surface-m	ctor, ount tin	Wurth or TE Connectivity	690367280876 or 7-2178711-8



#### **Assembly View**

Figure 42 shows the top-side assembly view of the Type 5 round board. Figure 43 shows the top-side assembly view of the Type 5 long board.



Figure 42: RD Type 5 Assembly View



Figure 43: LT Type 5 Assembly View



#### **Mechanical Drawing**

Figure 44 shows the top-side mechanical drawing of the Type 5 round board. Figure 45 shows the top-side mechanical drawing of the Type 5 long board.



mil = 0.001" = 0.0254mm



#### **Connector Pinout**

Figure 46 shows the Type 5 round board connector pinout. Figure 47 shows the Type 5 long board connector pinout.





Figure 46: RD Type 5 Connector Pinout

Figure 47: LT Type 5 Connector Pinout

Table 11 shows the Type 5 pin registers.

Tahlo <sup>2</sup>	11.	Type 5	Board	Connector	Pin	Rogistors
Iable		Type 5	Duaru	CONNECTOR	ГШ	registers

Pin	Name	Description
CN1.1	VDD	3.3V supply.
CN1.2	GND	Ground.
CN1.3	NC	Not connected.
CN1.4	CS	Chip select (serial).
CN1.5	SCLK	Clock (serial).
CN1.6	MISO	Master in, slave out (serial).
CN1.7	MOSI	Master out, slave in (serial).
CN1.8	TEST	Test pin.
CN2.1	NC	Not connected.
CN2.2	IRQ	Interrupt on angle change (output).
CN2.3	NC	Not connected.
CN2.4	NC	Not connected.
CN2.5	ERR	Error flag (output).
CN2.6	NVM	Non-volatile memory (output).
CN2.7	MGL	Magnetic level low (optional).
CN2.8	MGH	Magnetic level high (optional).



## MAGNET SUPPLIERS

A selection of magnets are available with the MPS MAG10 magnet product family. This family offers three different magnet geometries: cylinder, ring, and half-cylinder. Figure 48 shows the available magnet geometries. The MPS MAG10 magnet product family can be purchased directly from MPS.



#### Figure 48: MPS MAG10 Magnet Geometries

Visit our website learn more about our magnet portfolio:

https://www.monolithicpower.com/en/products/sensors/position-sensors/position-sensor-magnets.html

If the magnet required for your application is not listed on our website, consider the following nonexhaustive list of possible magnet suppliers (see Table 12). The magnetization direction must be chosen wisely given that most sold magnets are often axially magnetized, which is not a magnetization direction typically required in magnetic angle-sensing applications. Angle-sensing applications typically use diametrically magnetized magnets.

Company	Website	Address	Comments
Bomatec AG	www.bomatec.com	Hofstrasse 1, 8181 Höri, Switzerland	An MPS partner for many projects.
Maurer Magnetics AG	www.maurermagnetic.ch	Industriestrasse 8 8627 Grüningen, Switzerland	Maurer offers a selection of diametrically magnetized magnets in stock.
Arnold Technologies AG	www.arnoldmagnetics.com	Hübelacherstrasse 15 5242 Birr-Lupfig, Switzerland	
Dexter Magnetic Technologies	www.dextermag.com	1050 Morse Avenue, Elk Grove Village, IL 60007-5110 USA	
JPMF	www.jpmf.com.cn	8 LongWan Road, Jiangmen City, GuangDong Province, China	Magnet overmolding.
IMA	www.imamagnets.com	Avda. Cataluña 5, 08291 Ripollet, Barcelona, Spain	Magnet overmolding, magnetic tapes.

#### **Table 12: Magnet Suppliers**



## **Revision History**

Revision #	Revision Date	Description	Pages Updated
0.2	3/15/2017	Initial Release	-
1.0	9/17/2020	Added TBMAQ family into list of board types; expanded Magnet Suppliers section and modified list of magnet suppliers; grammar and formatting updates	All
1.1	9/22/2021	Added Type 5 Board (MA734)	4, 25–29

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