



MCP1601

Evaluation Board

User's Guide

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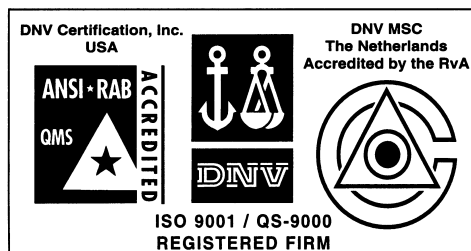
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General Information

INTRODUCTION AND HIGHLIGHTS

This section contains general information that will be useful to know before using the MCP1601 Evaluation Board.

This section covers the following topics:

- About this Guide
- Recommended Reading
- The Microchip Internet Web Site
- Customer Support

ABOUT THIS GUIDE

Document Layout

This document describes how to use the MCP1601 Evaluation Board.

The User's Guide layout is as follows:

- **Chapter 1: MCP1601 Evaluation Board** - For user's evaluating the MCP1601 device, this section describes how to use the various features of the board.

Appendices

- **Appendix A: Schematic and Board Layout** – shows the schematic and Printed Circuit Board (PCB) layout diagrams for the MCP1601 Evaluation Board.
 - Appendix A.1 gives some overview and highlight information.
 - Appendix A.2 contains the Evaluation Board Schematic
 - Appendix A.3 shows the Silk Screen Layer of the PCB.
 - Appendix A.4 shows the Silk Screen and Top Metal Layer of the PCB.
 - Appendix A.5 shows the Silk Screen and Bottom Metal layer of the PCB.
- **Appendix B: Bill of Materials** – Table B-1 shows the Bill of Materials (BOM) for the PCB.
- **Worldwide Sales and Service** – gives the address, telephone and fax number for Microchip Technology Inc. sales and service locations throughout the world.

Recommended Reading

For more information regarding the MCP1601 device, the following is recommended reading:

MCP1601 Data Sheet (DS21762)

This data sheet provides detailed information regarding the MCP1601 500 mA Synchronous BUCK Regulator. The data sheet is available for download from our World Wide Web Site (www.microchip.com) or from the Technical Library CD-ROM (DS00161).

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Chapter 1. MCP1601 Evaluation Board

1.1 INTRODUCTION

The MCP1601 Evaluation Board is designed to demonstrate the use of the MCP1601 Synchronous BUCK Regulator in a step down, inductor-based DC/DC converter application. It also describes the capability of the MCP1601 Evaluation Board and how to select the desired Synchronous Converter operating mode and program the output voltage.

The Evaluation Board Schematic is shown is Figure 1-1.

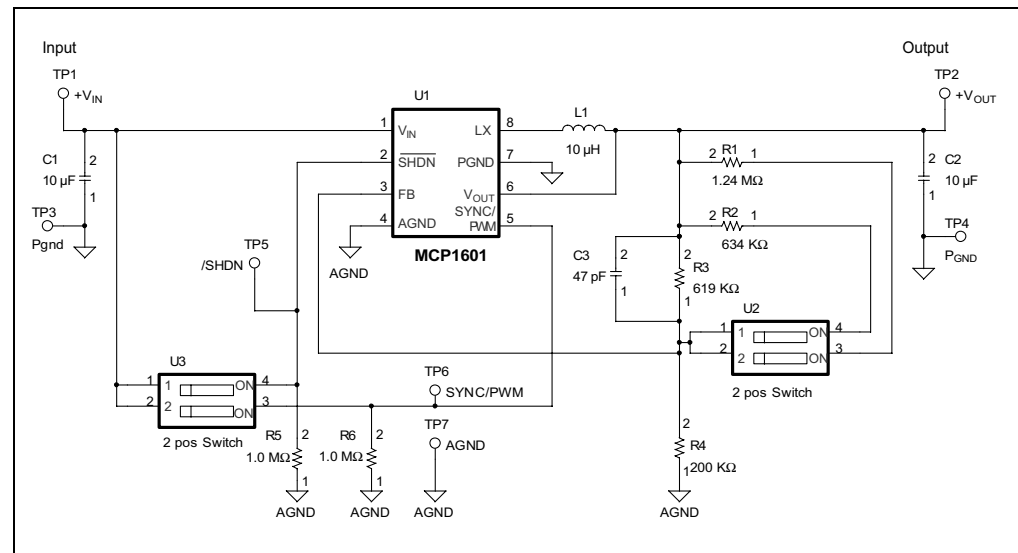


FIGURE 1-1: MCP1601 Evaluation Board Schematic.

1.2 DETAILED DESCRIPTION

The MCP1601 is a 500 mA Synchronous BUCK Regulator. Both the high-side BUCK P-Channel and the low-side N-Channel switches are integrated within the device. The integrated synchronous switch makes the MCP1601 very efficient, even when converting unregulated input voltages to low voltage fixed outputs. This evaluation board is designed for a wide range of output voltages and currents. For specific applications, smaller inductors, shielded inductors, tantalum capacitors and different output voltage settings can improve the total DC/DC converter performance and cost.

The MCP1601 device can operate in three different modes of operation to optimize the efficiency of the voltage conversion. The three operating modes are:

- Automatic switching from PFM Mode to PWM mode and back
- Synchronization to external Oscillator
- Fixed Frequency Forced PWM Mode

The MCP1601 output voltage is adjustable and is set by two external divider resistors. A two-position switch is used on the MCP1601 Evaluation Board to change the resistance of the external divider and adjust the output voltage to four different settings. These output voltage settings are: 1.8V, 2.05V, 2.45V and 3.28V.

1.2.1 Applying Power to the Board

Two surface mount test points are used to apply power to the MCP1601 Evaluation Board. For proper operation, the input voltage range is $2.7V < +V_{IN} < +5.5V$ for all operating conditions. The MCP1601 has an internal Under-Voltage Lockout (UVLO) which will prevent the board from operating when the input voltage is below the specified 2.7V minimum.

1. Connect the positive side of the external power supply (+) to the $+V_{IN}$ test point.
2. Connect the negative side (GND) of the external power supply to the P_{GND} test point which is located directly below the $+V_{IN}$ test point.

1.2.2 Connecting a Load to the Board

To connect an external load to the board, the $+V_{OUT}$ and P_{GND} test points are used.

- Connect the positive side of the load to the $+V_{OUT}$ pin and the negative or ground side of the load to the P_{GND} test point located directly under the $+V_{OUT}$ test point. The MCP1601 output is rated for 500 mA (maximum) continuous current. The output is protected against over current and short circuit conditions.

1.2.3 Enabling the MCP1601 - Using Switch U_3 , Position 1

Switch U_3 , position 1 is used to determine the $\overline{SHDN}$ mode for the MCP1601 device. With switch U_3 , position 1 pushed to the right, the $\overline{SHDN}$ pin is pulled up and the output of the MCP1601 device is enabled. When switch U_3 , position 1 is to the left, the MCP1601 device is in a low quiescent current $\overline{SHDN}$ mode and the output is disabled.

1.2.4 Selecting the Operating Mode - Using Switch U3, Position 2

The multi-function SYNC/PWM pin on the MCP1601 is used to set the operating mode of the device. The three operating modes are:

- Automatic switching from PFM Mode to PWM mode and back
- Synchronization to external Oscillator
- Fixed Frequency Forced PWM Mode

To select automatic PFM/PWM mode:

- Slide switch U₃, position 2 to the left or off position. While operating in this mode, the MCP1601 device will automatically select the most efficient operating mode by approximating the load current internally.

To synchronize the MCP1601 switching frequency to an external oscillator:

- Slide switch U₃, position 2 to the left. Connect the external oscillator to the SYNC/PWM test point located directly below switch U₃ and the A_{GND} test point. See the MCP1601 datasheet (DS21762) for external clock specifications. When synchronizing to an external oscillator, the MCP1601 will operate in the fixed frequency mode at the same frequency as the external oscillator.

To select fixed frequency mode that operates off of the 750 kHz internal oscillator:

- Slide switch U₃, position 2 to the right or “on” position. This will tie the SYNC/PWM pin high and force PWM operation from the internal oscillator, making the MCP1601 device independent of external load conditions.

1.2.5 Selecting the MCP1601 output voltage

Switch U₂ is used to select the output voltage. Refer to Table 1-1 to choose one of the pre-selected output voltages.

TABLE 1-1: SWITCH SETTINGS FOR PRE-SELECTED OUTPUT VOLTAGES

U2, Position 1	U2, Position 2	V _{OUT}
OFF	OFF	3.28V
OFF	ON	2.45V
ON	OFF	2.05V
ON	ON	1.8

The output voltage for the MCP1601 device is determined by using the following formula.

EQUATION

$$V_{OUT} = V_{REF} \left(1 + \frac{R_2}{R_4} \right)$$

Where: V_{REF} = 0.8V Typical

R₄ = 200 kΩ for the Evaluation board

R₂ is set by the parallel combination of R₁, R₂ and R₃.

1.3 TEST POINTS

1.3.1 /SHDN

The /SHDN or shutdown test point can be used to monitor the level of the shutdown pin or as an input to the shutdown pin of the MCP1601 device. With switch U₃, position 1 in the “off” position, a 1 MΩ resistor will pull the pin low.

1.3.2 SYNC/PWM

The SYNC/PWM pin can be used to monitor the level of the SYNC/PWM pin or as an input to the MCP1601 device. With switch U₃, position 2 in the “off” position, a 1 MΩ resistor will pull the pin low.

To synchronize to an external oscillator:

- With switch U₃, position 2 in the off position, connect the external oscillator to the SYNC/PWM test point.

1.3.3 A_{GND}

The analog ground or A_{GND} can be used as a quiet ground connection. When using the external oscillator synchronization function, connect the return or ground of the external oscillator to the A_{GND} test point.

Appendix A. Schematic and Board Layouts

A.1 INTRODUCTION

This appendix contains the schematic and board layout diagrams for the MCP1601 Evaluation Board.

A.1.1 Highlights

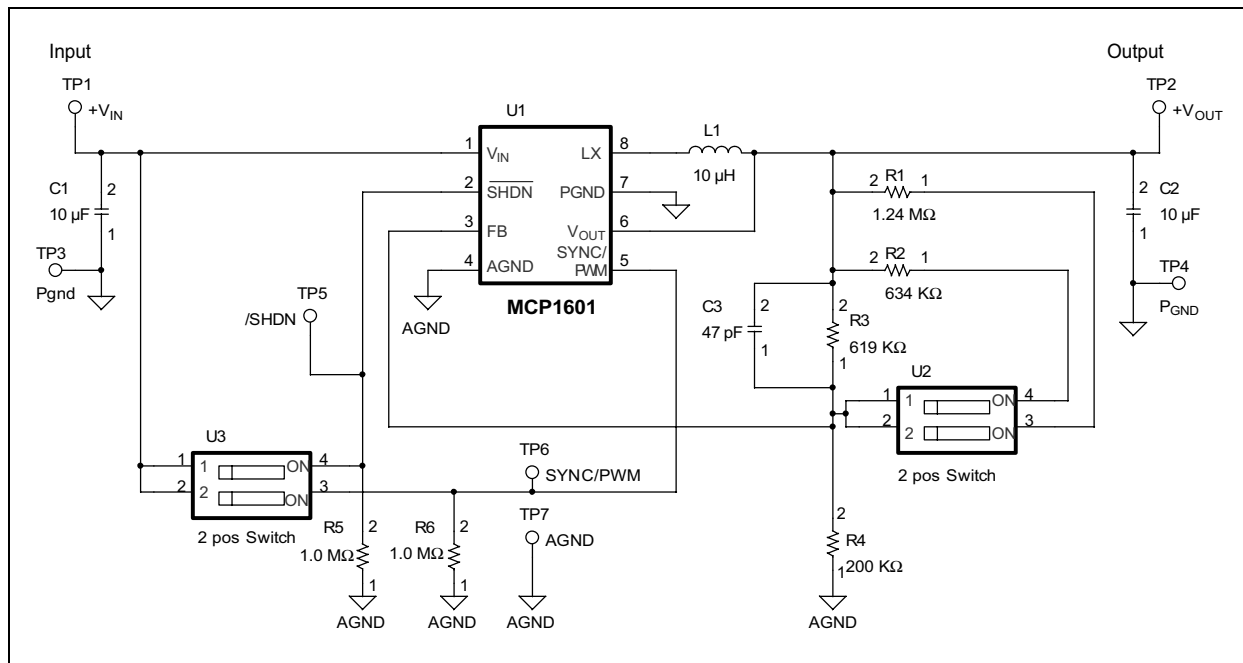
The MCP1601 Evaluation Board is constructed using one (1) silk screen layer and two (2) 1 oz. metal wiring layers. The bottom metal wiring layer is a single ground plane which is routed to partition the P_{GND} high current return pin from the small signal A_{GND} return pin on the MCP1601 device.

Diagrams included in this appendix:

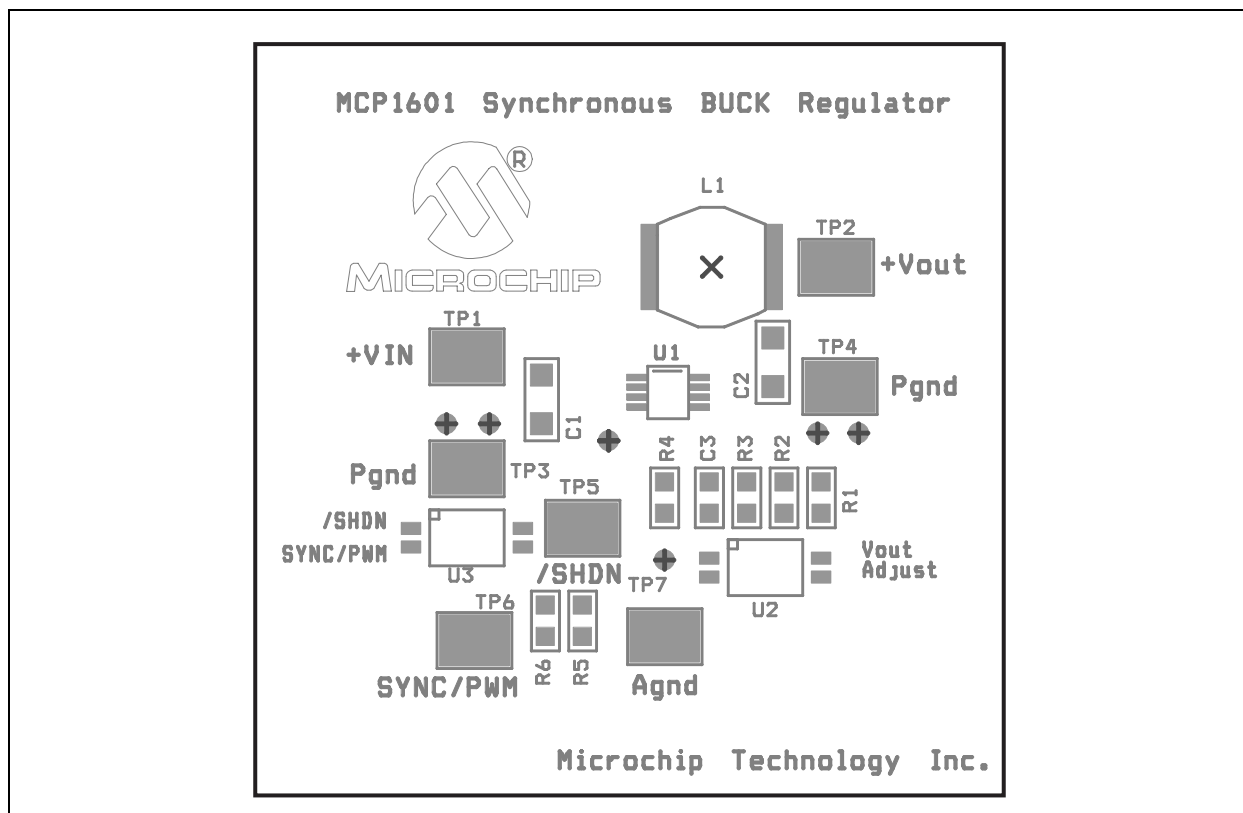
- Evaluation Board Schematic
- Evaluation Board - Top Silk Screen Layer
- Evaluation Board - Top Metal Layer
- Evaluation Board - Bottom Metal Layer

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A.2 EVALUATION BOARD SCHEMATIC



A.3 EVALUATION BOARD - SILK SCREEN LAYER



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Appendix B. Bill Of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Reference Designator	Qty	Description	Manufacturer	Manufacturer Part Number
R ₁	1	Resistor 1.24 M Ω 1/8W 1% 0805 SMD	Yageo [®]	9C08052A1224FKHFT
R ₂	1	Resistor 634 k Ω 1/10W 1% 0805 SMD	Panasonic [®] - ECG	ERJ-6ENF6343V
R ₃	1	Resistor 619 k Ω 1/10W 1% 0805 SMD	Panasonic [®] - ECG	ERJ-6ENF6193V
R ₄	1	Resistor 200 k Ω 1/10W 1% 0805 SMD	Panasonic [®] - ECG	ERJ-6ENF200V
R ₅ , R ₆	2	Resistor 1.00 M Ω 1/10W 1% 0805 SMD	Panasonic [®] - ECG	ERJ-6ENF1004V
C ₁ , C ₂	2	Capacitor 10 μ F, 6.3V Ceramic X5R 1206 SMD	Kemet [®]	C1206C106K9PACT
C ₃	1	Capacitor 47 pF, 50V Ceramic 0805 SMD	Panasonic [®] - ECG	ECJ-2VC1H470J
L ₁	1	10 μ H Coilcraft Wafer Inductor	Coilcraft [®]	LPO2506IB-103
U ₁	1	Microchip Synchronous BUCK Regulator	Microchip Technology Inc.	MCP1601
U ₂ , U ₃	2	DIP Switches, 2-Position, SPST	C&K [®]	TDA02H0SK1
TP ₁ - TP ₇	7	Test Points	Keystone [®]	5016
	4	Bumpers - Protective Products	3M [®]	SJ5003-0



WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office

2355 West Chandler Blvd.
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Technical Support: 480-792-7627
Web Address: <http://www.microchip.com>

Rocky Mountain

2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7966 Fax: 480-792-4338

Atlanta

3780 Mansell Road, Suite 130
Alpharetta, GA 30022
Tel: 770-640-0034 Fax: 770-640-0307

Boston

2 Lan Drive, Suite 120
Westford, MA 01886
Tel: 978-692-3848 Fax: 978-692-3821

Chicago

333 Pierce Road, Suite 180
Itasca, IL 60143
Tel: 630-285-0071 Fax: 630-285-0075

Dallas

4570 Westgrove Drive, Suite 160
Addison, TX 75001
Tel: 972-818-7423 Fax: 972-818-2924

Detroit

Tri-Atria Office Building
32255 Northwestern Highway, Suite 190
Farmington Hills, MI 48334
Tel: 248-538-2250 Fax: 248-538-2260

Kokomo

2767 S. Albright Road
Kokomo, Indiana 46902
Tel: 765-864-8360 Fax: 765-864-8387

Los Angeles

18201 Von Karman, Suite 1090
Irvine, CA 92612
Tel: 949-263-1888 Fax: 949-263-1338

San Jose

Microchip Technology Inc.
2107 North First Street, Suite 590
San Jose, CA 95131
Tel: 408-436-7950 Fax: 408-436-7955

Toronto

6285 Northam Drive, Suite 108
Mississauga, Ontario L4V 1X5, Canada
Tel: 905-673-0699 Fax: 905-673-6509

ASIA/PACIFIC

Australia

Microchip Technology Australia Pty Ltd
Suite 22, 41 Rawson Street
Epping 2121, NSW
Australia
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

China - Beijing

Microchip Technology Consulting (Shanghai)
Co., Ltd., Beijing Liaison Office
Unit 915
Bei Hai Wan Tai Bldg.
No. 6 Chaoyangmen Beidajie
Beijing, 100027, No. China
Tel: 86-10-85282100 Fax: 86-10-85282104

China - Chengdu

Microchip Technology Consulting (Shanghai)
Co., Ltd., Chengdu Liaison Office
Rm. 2401-2402, 24th Floor,
Ming Xing Financial Tower
No. 88 TIDU Street
Chengdu 610016, China
Tel: 86-28-86766200 Fax: 86-28-86766599

China - Fuzhou

Microchip Technology Consulting (Shanghai)
Co., Ltd., Fuzhou Liaison Office
Unit 28F, World Trade Plaza
No. 71 Wusi Road
Fuzhou 350001, China
Tel: 86-591-7503506 Fax: 86-591-7503521

China - Hong Kong SAR

Microchip Technology Hongkong Ltd.
Unit 901-6, Tower 2, Metroplaza
223 Hing Fong Road
Kwai Fong, N.T., Hong Kong
Tel: 852-2401-1200 Fax: 852-2401-3431

China - Shanghai

Microchip Technology Consulting (Shanghai)
Co., Ltd.
Room 701, Bldg. B
Far East International Plaza
No. 317 Xian Xia Road
Shanghai, 200051
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

China - Shenzhen

Microchip Technology Consulting (Shanghai)
Co., Ltd., Shenzhen Liaison Office
Rm. 1812, 18/F, Building A, United Plaza
No. 5022 Binhe Road, Futian District
Shenzhen 518033, China
Tel: 86-755-82901380 Fax: 86-755-82966626

China - Qingdao

Rm. B503, Fullhope Plaza,
No. 12 Hong Kong Central Rd.
Qingdao 266071, China
Tel: 86-532-5027355 Fax: 86-532-5027205

India

Microchip Technology Inc.
India Liaison Office
Divyasree Chambers
1 Floor, Wing A (A3/A4)
No. 11, O'Shaughnessey Road
Bangalore, 560 025, India
Tel: 91-80-2290061 Fax: 91-80-2290062

Japan

Microchip Technology Japan K.K.
Benex S-1 6F
3-18-20, Shinyokohama
Kohoku-Ku, Yokohama-shi
Kanagawa, 222-0033, Japan
Tel: 81-45-471-6166 Fax: 81-45-471-6122

Korea

Microchip Technology Korea
168-1, Youngbo Bldg. 3 Floor
Samsung-Dong, Kangnam-Ku
Seoul, Korea 135-882
Tel: 82-2-554-7200 Fax: 82-2-558-5934

Singapore

Microchip Technology Singapore Pte Ltd.
200 Middle Road
#07-02 Prime Centre
Singapore, 188980
Tel: 65-6334-8870 Fax: 65-6334-8850

Taiwan

Microchip Technology (Barbados) Inc.,
Taiwan Branch
11F-3, No. 207
Tung Hua North Road
Taipei, 105, Taiwan
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

EUROPE

Austria

Microchip Technology Austria GmbH
Durisolstrasse 2
A-4600 Wels
Austria
Tel: 43-7242-2244-399
Fax: 43-7242-2244-393

Denmark

Microchip Technology Nordic ApS
Regus Business Centre
Lautrup høj 1-3
Ballerup DK-2750 Denmark
Tel: 45 4420 9895 Fax: 45 4420 9910

France

Microchip Technology SARL
Parc d'Activite du Moulin de Massy
43 Rue du Saule Trapu
Batiment A - 1er Etage
91300 Massy, France
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

Germany

Microchip Technology GmbH
Steinheilstrasse 10
D-85737 Ismaning, Germany
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

Italy

Microchip Technology SRL
Centro Direzionale Colleoni
Palazzo Taurus 1 V. Le Colleoni 1
20041 Agrate Brianza
Milan, Italy
Tel: 39-039-65791-1 Fax: 39-039-6899883

United Kingdom

Microchip Ltd.
505 Eskdale Road
Winnersh Triangle
Wokingham
Berkshire, England RG41 5TU
Tel: 44 118 921 5869 Fax: 44-118 921-5820

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