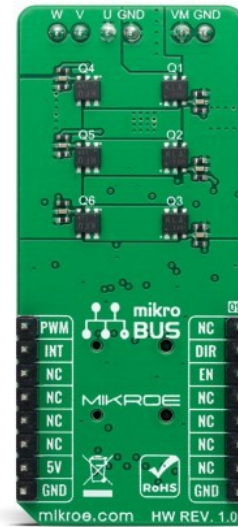




THE DATASHEET OF MIKROE-4885



Brushless 15 Click



PID: MIKROE-4885

Brushless 15 Click is a compact add-on board suitable for controlling BLDC motors with any MCU. This board features the TB9061AFNG, an automotive pre-driver that incorporates a sensorless controller for driving a 3-phase full-wave brushless DC motor from [Toshiba Semiconductor](#). The TB9061AFNG achieves 120° rectangular wave motor control by using an input signal line that measures the induced voltage of the motors and three-phase motor output without using Hall sensors, rated for an operating voltage range of 6 to 18V. Motor rotation can be controlled by either the DC or the PWM input signal. Besides, it features several diagnostic circuits and drive-control functions such as motor lock detection, step-out detection, over-current/over-temperature detection, and many more. This Click board™ can control motors without using heat-sensitive hole sensors, securing control of pumps in a hot environment providing optimum operating efficiency in automotive applications.

Brushless 15 Click is supported by a [mikroSDK](#) compliant library, which includes functions that simplify software development. This [Click board™](#) comes as a fully tested product, ready to be used on a system equipped with the [mikroBUS™](#) socket.

How does it work?

Brushless 15 Click as its foundation uses the TB9061AFNG, an automotive pre-driver that incorporates a sensorless controller for driving a 3-phase full-wave brushless DC motor from Toshiba Semiconductor. A 3-phase motor is driven by the PWM output signals, with the duty cycle determined by the PWM signal from mikroBUS. This input PWM signal is measured, calculated, and corrected in the logic circuit. The TB9061AFNG generates a 20kHz internal PWM signal according to its result. After that, the TB9061AFNG inputs internal PWM into the Sensorless Core Logic and outputs a sensorless driving signal for a 3-phase brushless motor.

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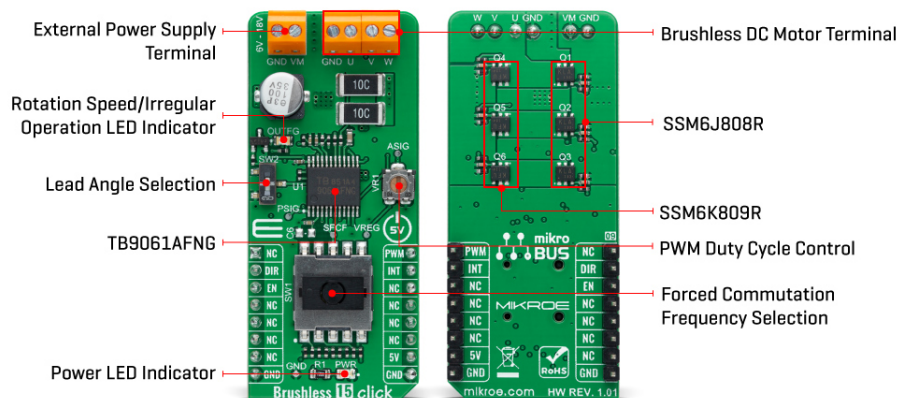
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In addition to the PWM signal, the internal PWM duty cycle can also be controlled using an analog voltage applied to the ASIG pin of the TB9061AFNG, set manually using an onboard trimmer labeled as VR1. Analog voltage from the VR1 controls the internal PWM duty cycle when the PWM pin is shorted to the ground. The user can also select a forced commutation frequency by choosing the input voltage via an onboard rotary switch labeled as SW1. Using an SW1, the TB9061AFNG receives the voltage at the SFCF (forced commutation frequency select) pin through the internal ADC and decides the forced commutation frequency from 9.375 up to 25.000rpm.

The user can also set a lead angle value at 7.5, 15, or 30° according to the setting of the SW2 switch. When SW2 is in a lower position, a lead angle is set to 7.5°, the upper position represents a lead angle of 15° set, and the middle position matches a lead angle of 30°. If 7.5 or 15° is selected, the lead angle is set to 0° during the forced commutation. When the normal commutation is started, it is changed automatically to the value specified by the SW2. If 30° is selected, the lead angle is set to 30° even during the forced commutation.

The TB9061AFNG features several diagnostic circuits and drive control functions, including over-current detection and a motor drive current limiter circuit, over-temperature (both internal and external), and over-voltage detection. Motor lock detection, step-out detection, and automatic return control circuits are also incorporated.

Alongside the PWM pin from the mikroBUS™ socket, used to drive a 3-phase motor, this Click board™ also has the Enable pin labeled as EN and routed to the CS pin of the mikroBUS™ socket to optimize power consumption used for power ON/OFF purposes (performs Start and Stop controls of the motor operation). The DIR pin, routed on the RST pin of the mikroBUS™ socket, is used to select the direction of motor rotation (clockwise/counterclockwise). Besides, it is possible to detect a rotation speed and irregular operations, such as motor lock-up, where the indication of such a condition is performed using the blue LED indicator labeled as OUTFG routed on the INT pin of the mikroBUS™ socket.

This Click board™ supports an external power supply for the motor, which can be connected to the input terminal labeled as VM and should be within the range of 6V to 18V, while the BLDC motor coils can be connected to the terminals labeled as U, V, and W.

This Click board™ can be operated only with a 5V logic voltage level. Therefore, the board must perform appropriate logic voltage level conversion before using MCUs with different logic levels. However, the Click board™ comes equipped with a library containing functions and an

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example code that can be used, as a reference, for further development.

Specifications

Type	Brushless
Applications	Can control motors without using heat-sensitive hole sensors, securing control of pumps in a hot environment providing optimum operating efficiency in automotive applications
On-board modules	TB9061AFNG - automotive pre-driver that incorporates a sensorless controller for driving a 3-phase full-wave brushless DC motor from Toshiba Semiconductor
Key Features	3-phase full-wave sensorless drive, compatible with both external PWM duty input and DC input control, lead angle control, rotation-speed and lock detection, protection features, and more.
Interface	GPIO,PWM
Feature	No ClickID
Compatibility	mikroBUS™
Click board size	L (57.15 x 25.4 mm)
Input Voltage	5V,External
Silicon Vendor	Toshiba Semi.

Pinout diagram

This table shows how the pinout on Brushless 15 Click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin					Pin	Notes
	NC	1	AN	PWM	16	PWM	PWM Signal
Forward/Reverse Direction	DIR	2	RST	INT	15	INT	Interrupt
Enable	EN	3	CS	RX	14	NC	
	NC	4	SCK	TX	13	NC	
	NC	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
	NC	7	3.3V	5V	10	5V	Power Supply
Ground	GND	8	GND	GND	9	GND	Ground

Onboard settings and indicators

Label	Name	Default	Description
LD1	PWR	-	Power LED Indicator

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LD2	OUTFG	-	Rotation Speed/Irregular Operation LED Indicator
SW1	SW1	-	Forced Commutation Frequency Selection 8-Position Switch (from 9.375 up to 25.000rpm)
SW2	SW2	-	Lead Angle Selection Switch
VR1	VR1	-	PWM Duty Cycle Control Trimmer

Brushless 15 Click electrical specifications

Description	Min	Typ	Max	Unit
Supply Voltage VCC	-	5	-	V
External Power Supply VM	6	-	18	V
Maximum Output Current	-	-	20	mA
Operating Temperature Range	-40	+25	+125	°C

Software Support

We provide a library for the Brushless 15 Click as well as a demo application (example), developed using MikroElektronika [compilers](#). The demo can run on all the main MikroElektronika [development boards](#).

Package can be downloaded/installed directly from NECTO Studio Package Manager(recommended way), downloaded from our [LibStock™](#) or found on [Mikroe github account](#).

Library Description

This library contains API for Brushless 15 Click driver.

Key functions

- `brushless15_set_duty_cycle` This function sets the PWM duty cycle in percentages (Range[0..1]).
- `brushless15_enable_device` This function enables the device by setting the EN pin to low logic state.
- `brushless15_switch_direction` This function switches the direction by toggling the DIR pin state.

Example Description

This example demonstrates the use of the Brushless 15 Click board™ by driving the motor in both directions at different speeds.

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The full application code, and ready to use projects can be installed directly from NECTO Studio Package Manager(recommended way), downloaded from our [LibStock™](#) or found on [Mikroe github account](#).

Other Mikroe Libraries used in the example:

- MikroSDK.Board
- MikroSDK.Log
- Click.Brushless15

Additional notes and informations

Depending on the development board you are using, you may need [USB UART click](#), [USB UART 2 Click](#) or [RS232 Click](#) to connect to your PC, for development systems with no UART to USB interface available on the board. UART terminal is available in all MikroElektronika [compilers](#).

mikroSDK

This Click board™ is supported with [mikroSDK](#) - MikroElektronika Software Development Kit. To ensure proper operation of mikroSDK compliant Click board™ demo applications, mikroSDK should be downloaded from the [LibStock](#) and installed for the compiler you are using.

For more information about mikroSDK, visit the [official page](#).

Resources

[mikroBUS™](#)

[mikroSDK](#)

[Click board™ Catalog](#)

[Click boards™](#)

Downloads

[Brushless 15 click 2D and 3D files](#)

[TB9061AFNG datasheet](#)

[SSM6J808R datasheet](#)

[Brushless 15 click schematic](#)

[Brushless 15 click example on Libstock](#)

[SSM6K809R datasheet](#)

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