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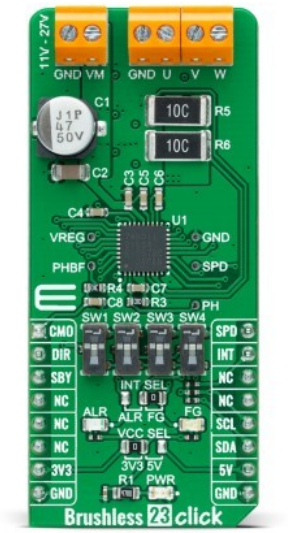
Brushless 23 Click



PID: MIKROE-5100

Brushless 23 Click is a compact add-on board suitable for controlling BLDC motors with any microcontroller. This board features the TC78B011FTG, a three-phase sine-wave PWM pre-driver realized with six external MOSFETs to drive sensorless brushless motors from Toshiba Semiconductor. Some of the main features are a built-in closed-loop speed control function with internal non-volatile memory (NVM) for speed profile setting and the ability to set other features such as rotation direction selection, brake, Standby mode, and others. It also has a wide operating voltage range of 11V to 27V with an output current capacity of 5A and several built-in error detection circuits. This Click board™ provides optimum operational efficiency in applications such as high-velocity server fans, blowers, and pumps.

Brushless 23 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 23 Click is based on the TC78B011FTG, a three-phase sine-wave PWM pre-driver capable of driving Delta or Wye configured motors from Toshiba Semiconductor. Motor rotation is controlled without Hall sensors by detecting the rotational position from the induced voltage. The TC78B011FTG has a built-in closed-loop speed control function, which regulates and maintains the motor rotational speed under dynamic power fluctuations and load variations. This function has an internal non-volatile memory (NVM) for speed profile setting. The TC78B011FTG also has protection features such as thermal shutdown, under-voltage, over-current protection, lock detection, and more.

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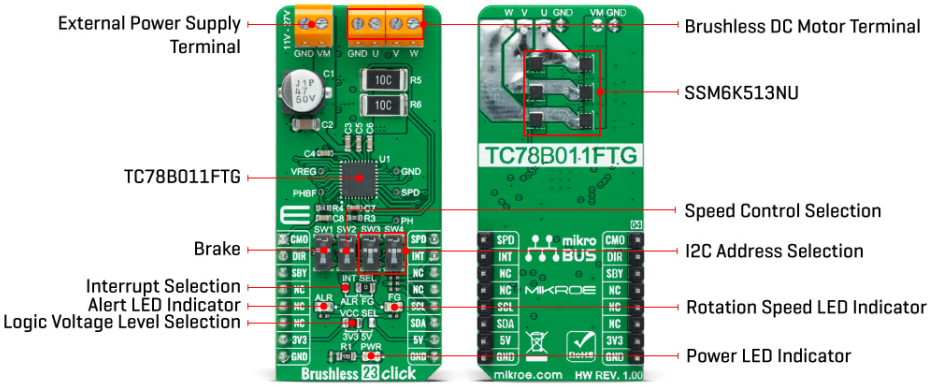

The TC78B011FTG possesses a speed control command that can control the motor's start, stop, and rotation speed. This signal type is determined by the position of an onboard SW2 switch and register setting, allowing the selection among PWM, analog voltage signal, and standard I2C 2-Wire interface to read data and configure settings with a maximum frequency of 400kHz. The TC78B011FTG also allows choosing its I2C slave address by positioning SMD switches labeled as SW3 and SW4 to an appropriate position. In the case of PWM signal or analog voltage signal, the TC78B011FTG is controlled through the mikroBUS™ PWM signal marked as SPD.

This Click board™ has several operational modes: Standby, Idle, Brake, and Error Mode. Standby mode is available to reduce the power consumption, controlled by the SBY pin routed to the CS pin of the mikroBUS™ socket, together with register settings. After Power-on, with the SBY pin disabled, the TC78B011FTG reads parameters from NVM and stores them in the registers. After that, IC goes to the Brake sequence and then moves to Idle mode. The brake function is controllable by a register setting or an onboard SW1 switch. The TC78B011FTG starts the motor by Start-Up sequence with the speed control command set. When an abnormal condition is detected, IC moves to Error mode and automatically restarts after restart time. In Error mode with Stop as a speed control command, the TC78B011FTG will move to Idle mode.

Alongside I2C communication, several signals connected to the mikroBUS™ socket pins are also used to forward the information to the MCU. The DIR pin, routed on the RST pin of the mikroBUS™ socket, is used to select the direction of motor rotation (clockwise/counterclockwise), while the CMO pin, routed on the AN pin of the mikroBUS™ socket, serves as the motor’s output current monitoring. Also, the TC78B011FTG provides selectable interrupts chosen via the INT SEL jumper routed on the INT pin of the mikroBUS™ socket by positioning the SMD jumper to an appropriate position marked as ALR od FG. The default position of this jumper is the FG position which serves as a rotation speed indicator, while the ALR position represents an abnormality detection feature. Both features have visual indicators; a red LED marked as ALR, and a blue LED labeled as FG.

Brushless 23 Click is realized using six N-channel MOSFETs, the SSM6K513NU also from Toshiba Semiconductor, two for each of the three phases. Using these FETs, capable of handling 15A, allows low power dissipation when driving 5A BLDC before hitting the output current limit threshold, used to restrain the current flowing to the motor. It also 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 11V to 27V, while the BLDC motor coils can be connected to the terminals labeled as U, V, and W.

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This Click board™ can operate with both 3.3V and 5V logic voltage levels selected via the VCC SEL jumper. This way, it is allowed for both 3.3V and 5V capable MCUs to use the communication lines properly. However, the Click board™ comes equipped with a library that contains easy-to-use functions and an example code that can be used, as a reference, for further development.

Specifications

Type	Brushless
Applications	Can be used for high-velocity server fans, blowers, and pumps
On-board modules	TC78B011FTG - three-phase sine-wave PWM pre-driver for sensorless brushless motors from Toshiba Semiconductor
Key Features	Sensorless PWM drive, capable to drive Delta or Wye configured motors, low power consumption, built-in closed loop speed control with adjustable speed curve, motor speed control by analog voltage, PWM duty cycle, or I2C, integrated error detection circuits, and more
Interface	Analog,GPIO,I2C,PWM
ClickID	No
Compatibility	mikroBUS™
Click board size	L (57.15 x 25.4 mm)
Input Voltage	3.3V or 5V,External

Pinout diagram

This table shows how the pinout on Brushless 23 Click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin	mikroBUS				Pin	Notes
Current Monitor	**CMO**	1	AN	PWM	16	**SPD**	Speed Control
Rotation Direction	**DIR**	2	RST	INT	15	**INT**	Interrupt
Standby	**SBY**	3	CS	RX	14	NC	
	NC	4	SCK	TX	13	NC	
	NC	5	MISO	SCL	12	**SCL**	I2C Clock
	NC	6	MOSI	SDA	11	**SDA**	I2C Data
Power Supply	**3.3V**	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
LD2	ALR	-	Alert LED Indicator
LD3	FG	-	Rotation Speed LED

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			Indicator
JP1	VCC SEL	Left	Logic Level Voltage Selection 3V3/5V: Left position 3V3, Right position 5V
JP2	INT SEL	Right	Interrupt Selection ALR/FG: Left position ALR, Right position FG
SW1	SW1	Upper	Brake Switch: Upper position 0, Lower position 1
SW2	SW2	Upper	Speed Control Selection Switch: Upper position 0, Lower position 1
SW3-SW4	SW3-SW4	Upper	I2C Address Selection Switch: Upper position 0, Lower position 1
TP1	GND	-	Ground Testpoint
TP2	PHBF	-	Current Monitor Testpoint
TP3	PH	-	Peak Hold Setting Testpoint
TP4	SPD	-	Speed Control Command Testpoint
TP5	VREG	-	Voltage Reference Testpoint

Brushless 23 Click electrical specifications

Description	Min	Typ	Max	Unit
Supply Voltage VCC	3.3	-	5	V
External Supply Voltage VM	11	-	27	V
Output Current	-	-	5	A
PWM Frequency	1	-	100	kHz
Operating Temperature Range	-40	+25	+105	°C

Software Support

We provide a library for the Brushless 23 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 23 Click driver.

Key functions

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- brushless23_pwm_set_duty_cycle This function sets the PWM duty cycle in percentages (Range[0..1]).
- brushless23_switch_direction This function switches the direction by toggling the DIR pin state.
- brushless23_get_motor_speed This function reads the motor speed in Hz.

Example Description

This example demonstrates the use of the Brushless 23 Click board™ by driving the motor in both directions at different speeds.

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.Brushless23

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 23 click example on Libstock

Brushless 23 click 2D and 3D files

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SSM6K513NU datasheet

TC78B011FTG datasheet

Brushless 23 click schematic