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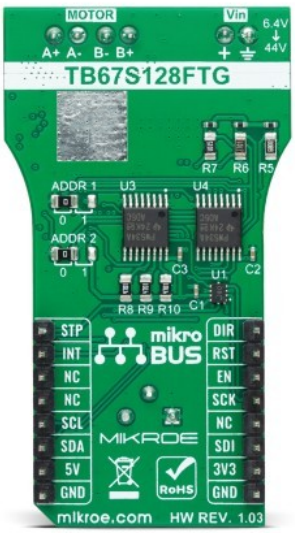
Stepper 10 Click



PID: MIKROE-4138

Stepper 10 Click is a compact add-on board that controls one stepper motor with a PWM constant current drive. This board features the TB67S128FTG, a two-phase bipolar stepping motor driver from Toshiba Semiconductor. It is fabricated using a BiCD process with an output rating of 50V/5A and a built-in decoder that can supply the motor with a voltage of up to 44V. Toshiba's innovative technology process results in low power consumption with low on-resistance (0.25Ω) on the integrated MOSFET output stage. The stepper motor can be driven in both directions from full step to 1/128 micro-steps. The motor driver possesses features like a high-efficiency motor control mechanism, advanced current detection system, active gain control, and multi-error detection functions. This Click board™ is a perfect solution for building various applications that require advanced stepper motor control with maximum precision and reliability.

Stepper 10 Click board™ 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?

Stepper 10 Click is based on the TB67S128FTG, a two-phase bipolar stepper motor driver from Toshiba Semiconductor, which features adjustable current limiting and micro-stepping down to 1/128 step operation. Fabricated using a leading-edge BiCD process with low power consumption and low output on-resistance, Toshiba's TB67S128FTG in a thermally enhanced small package helps improve efficiency and reduce the size of motor applications. This stepping motor driver incorporates a high-speed, high-precision control technology required for factory automation systems and office equipment and helps reduce the number of external

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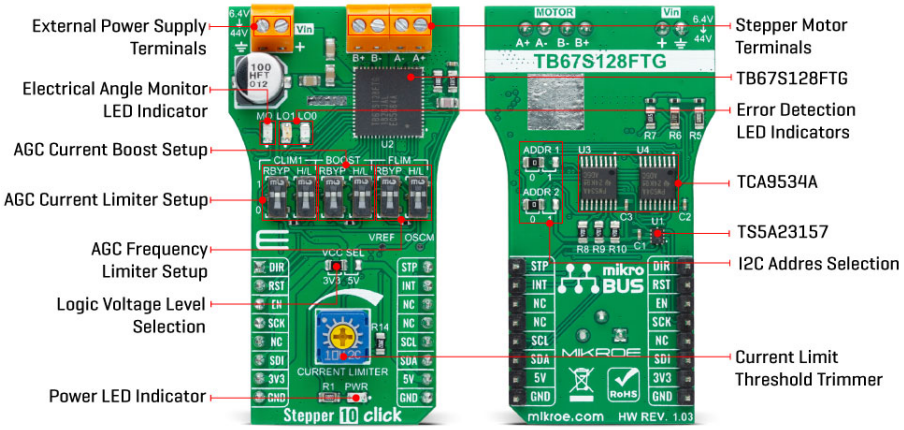
parts required, simplifying system design. The chip itself can dynamically select an optimal decay mode by monitoring the actual motor current and automatically reducing the driving current below the full amount when the motor is lightly loaded to minimize power consumption and heat generation. The driver has a wide operating voltage range of 6.4V to 44 V and can continuously deliver approximately 2.1 A per phase without a heat sink or forced air flow (up to 5 A peak). It features built-in protection against under-voltage, over-current, and over-temperature conditions.



There are two interface modes to select from: CLK mode for simple step and direction control and serial mode for controlling and setting the driver through a serial interface. Step resolution is configurable using MODE2, MODE1, and MODE0 by setting the appropriate pin level. Most pins are controlled using an IO expander via the I2C bus except DIR, STEP, ENABLE, and RESET, which are routed to mikroBUS™. Stepper 10 click has eight different step modes: full-step, half-step, 1/4-step, 1/8, 1/16, 1/32, 1/64, and 1/128. Besides that, four different decay modes are available using the MDT0 and MDT1 pins. The on-board trimmer potentiometer can be used to set the current limit to prevent damage to the motor.

Toshiba’s unique AGC feature stepping motor technology automatically optimizes the drive current in real-time according to the load torque. It helps reduce unnecessary current, drastically cut power consumption and heat generation. AGC is configured with six pins (AGC, CLIM0, CLIM1, FLIM, BOOST, and LTH). CLIM1, FLIM, and BOOST (BST) are four-state logic inputs that can be tied high to VCC, pulled high through a 100kΩ resistor, pulled low through a 100kΩ resistor, or tied low to GND. This is done by using the on-board switches, one for logic level and one to bypass the 100kΩ resistor by choice.

Stepper 10 Click has the function to detect several error states indicated by two LEDs: LO1 and LO0. If the overcurrent is detected, the LO0 will toggle, while the LO1 represents the motor load open indication. If both LEDs are toggled, then the thermal shutdown is detected. The errors are cleared by toggling standby mode or performing a power cycle to the driver. The LED designated as MO is toggled if the driver's electrical angle is equal to the initial value of 45°, which occurs immediately after reset or whenever the driver has stepped a full cycle.

Stepper 10 Click uses the two TCA9534APWR Low-Power IO Expanders that support the I2C interface protocol. To avoid conflicts on the bus, the slave addresses can be reconfigured by SMD jumpers labeled ADDR1 and ADDR2.

This Click board™ can operate with either 3.3V or 5V logic voltage levels selected via the VCC

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SEL jumper. This way, both 3.3V and 5V capable MCUs can use the communication lines properly. Also, this Click board™ comes equipped with a library containing easy-to-use functions and an example code that can be used as a reference for further development.

Specifications

Type	Stepper
Applications	Ideal for building various applications that require advanced stepper motor control, with maximum precision and reliability.
On-board modules	TB67S128FTG - two-phase bipolar stepper motor driver using a PWM chopper from Toshiba Semiconductor
Key Features	Full, half, quarter, 1/8, 1/16, 1/32, 1/64, 1/128 step operation, low on-resistance. MOSFET output stage, high-efficiency motor current control mechanism, built-in anti-stall architecture, built-in sense resistor less current control architecture, high voltage and current, multi error detect functions, and more
Interface	GPIO,I2C,SPI
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 Stepper 10 Click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin	mikroBUS				Pin	Notes
Direction Control	**DIR**	1	AN	PWM	16	**STP**	Step Clock Input
Reset	**RST**	2	RST	INT	15	**INT**	Interrupt
Motor Drive Enable	**EN**	3	CS	RX	14	NC	
SPI Clock	**SCK**	4	SCK	TX	13	NC	
	NC	5	MISO	SCL	12	**SCL**	I2C Clock
SPI Data IN	**SDI**	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	MO	-	Electrical angle LED Indicator
LD3-LD4	LO1-LO0	-	Error detection LED

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			Indicators
JP1-JP2	ADDR SEL	Left	I2C Address Selection 0/1: Left position 0, Right position 1
JP3	VCC SEL	Left	Logic Voltage Level Selection 3V3/5V: Left position 3V3, Right position 5V
VR1	Current Limiter	-	Current Limit Threshold Trimmer
SW1-SW3	R_BYPASS	Up	Switch bypassing 100kΩ resistor: Up - short, Down - open
SW4	CLIM1	Up	Bottom Current Limit CLIM1 Logic Level Selection: Up - VCC, Down - GND
SW5	BOOST	Up	Current BOOST Logic Level Selection: Up - VCC, Down - GND
SW6	FLIM	Up	Frequency Limit FLIM Logic Level Selection: Up - VCC, Down - GND

Stepper 10 Click electrical specifications

Description	Min	Typ	Max	Unit
Supply Voltage	3.3	-	5	V
External Power Supply	6.4	-	44	V
Output Current	-	-	5	A

Note 1: Usually, the maximum current value at the time should use 70% or less of the absolute maximum ratings for a standard on thermal rating. The maximum output current may be further limited given thermal considerations, depending on ambient temperature and board conditions.

Software Support

We provide a library for the Stepper 10 Click on our LibStock page, as well as a demo application (example), developed using MikroElektronika compilers. The demo can run on all the main MIKROE development boards.

Library Description

The library covers all the necessary functions that enables the usage of the Stepper 10 Click board™. It initializes and defines the I2C driver and drivers that allow full control of the device to the user.

Key functions:

- void stepper10_motor_start(void) - Start Movement
- void stepper10_process (void) - Stepper State Machine
- void stepper10_motor_stop (void) - Stop Movement

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Examples description

The application is composed of three sections :

- System Initialization - Initializes all GPIO pins found on Stepper 10 Click.
- Application Initialization - Initializes driver, stepper control, maximum and minimum speed, acceleration ratio and motor work mode.
- Application Task - Starting motor according to a predefined configuration.

The full application code, and ready to use projects can be found on our LibStock page.

Other MIKROE Libraries used in the example:

- UART library
- I2C library

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. The terminal available in all MIKROE compilers, or any other terminal application of your choice, can be used to read the message.

mikroSDK

This Click board™ is supported with mikroSDK - MIKROE 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

TB67S128FTG datasheet

TS5A23157 datasheet

Stepper 10 click 2D and 3D files v102

Stepper 10 click example on Libstock

Stepper 10 click schematic v102

Stepper 10 click 2D and 3D files v103

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Stepper 10 click Schematic v103