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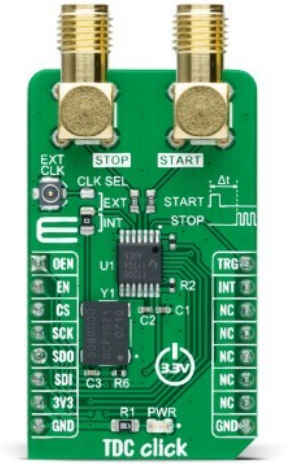
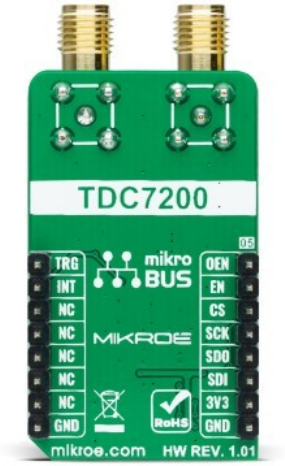
TDC Click





PID: MIKROE-4770

TDC Click is a compact add-on board that recognizes events and provides a digital representation of the time they occurred. This board features the TDC7200, a time-to-digital converter from Texas Instruments. The Time to Digital Converter (TDC) performs the function of a stopwatch and measures the elapsed time (time-of-flight or TOF) between a START pulse and up to five STOP pulses. The ability to measure from START to multiple STOPs gives users the flexibility to select which STOP pulse yields the best echo performance. This Click board™ is suitable for time-of-flight and flow meter applications where zero and low flow measurements require high accuracy.

TDC 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?

TDC Click as its foundation uses the TDC7200, a time-to-digital converter for time-of-flight (ToF) applications for LIDAR and ultrasonic from Texas Instruments. This stopwatch IC is used to measure the time between a single event known as time-of-flight (an edge on START signal) and multiple subsequent events (an edge on STOP signal), which are brought to the onboard SMA connectors marked as START and STOP. The user also can pair this Click board™ with some external board that contains the TDC1000 (ultrasonic analog front-end) and become a part of a complete ultrasonic sensing solution for measurements such as water, gas, and heat flow meter.

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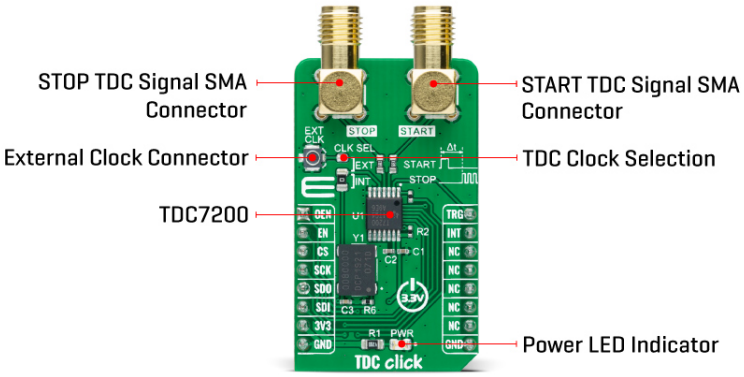

The TDC7200 has an internal self-calibrated time base which compensates for drift over time and temperature used to measure time with accuracy in the order of picoseconds. When placed in the Autonomous Multi-Cycle Averaging mode of operation, the TDC7200 can be optimized for low system power consumption. The host can go to sleep to save power, and the TDC can wake it up upon completion of the measurement sequence.

The TDC7200 also needs an external reference clock used to calibrate the internal time-base accurately. All digital circuits inside the device also use this reference clock; thus, the clock has to be available and stable at all times when the device is enabled. For this reason, there is the possibility of selecting an external clock connected to a miniature coaxial N.FL series connector or an internal one by an onboard 8MHz crystal that can be activated via an OEN pin routed on the AN pin of the mikroBUS™ socket. Selection can be performed by onboard SMD jumper labeled as CLK SEL to an appropriate position marked as EXT and INT.

The TDC7200 communicates with MCU using the standard SPI serial interface with a maximum frequency of 20MHz. In addition, it also uses several additional GPIO pins such as the EN pin routed on the RST pin of the mikroBUS™ socket used as a reset to all digital circuits in the TDC7200, TRG pin routed on the PWM pin of the mikroBUS™ socket as a start measurement trigger and INT pin which determine TDC measurement completion.

This Click board™ can be operated only with a 3.3V logic voltage level. The board must perform appropriate logic voltage level conversion before use with MCUs with different logic levels. However, the Click board™ comes equipped with a library containing functions and an example code that can be used, as a reference, for further development.

Specifications

Type	Clock generator
Applications	Can be used for time-of-flight and flow meter applications where zero and low flow measurements require high accuracy
On-board modules	TDC7200 - time-to-digital converter for time-of-flight (ToF) applications for LIDAR and ultrasonic from Texas Instruments
Key Features	Low power consumption, Autonomous Multi-Cycle Averaging mode, SPI interface for

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	configuration and register access, supports up to 5 STOP signals, internal self-calibrated time base which compensates for drift over time and temperature, and more
Interface	SPI
Feature	No ClickID
Compatibility	mikroBUS™
Click board size	M (42.9 x 25.4 mm)
Input Voltage	3.3V

Pinout diagram

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

Notes	Pin	mikroBUS				Pin	Notes
Onboard Crystal Enable	**OEN**	1	AN	PWM	16	**TRG**	Start Measurement Trigger
Enable	**EN**	2	RST	INT	15	**INT**	Interrupt
SPI Chip Select	**CS**	3	CS	RX	14	NC	
SPI Clock	**SCK**	4	SCK	TX	13	NC	
SPI Data OUT	**SDO**	5	MISO	SCL	12	NC	
SPI Data IN	**SDI**	6	MOSI	SDA	11	NC	
Power Supply	**3.3V**	7	3.3V	5V	10	NC	
Ground	**GND**	8	GND	GND	9	**GND**	Ground

Onboard settings and indicators

Label	Name	Default	Description
LD1	PWR	-	Power LED Indicator
JP1	CLK SEL	Left	TDC Clock Selection EXT/INT: Upper position EXT, Lower position INT

TDC Click electrical specifications

Description	Min	Typ	Max	Unit
Supply Voltage	-	3.3	-	V
Resolution	-	55	-	ps
External Clock	-	8	-	MHz
Operating Temperature Range	-40	+25	+85	°C

Software Support

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

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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 TDC Click driver.

Key functions:

- tdc_cfg_setup - Config Object Initialization function.
- tdc_init - Initialization function.
- tdc_default_cfg - Click Default Configuration function.

Examples description

This library contains an API for the TDC Click driver. This demo application shows the use of a TDC Click board™.

The demo application is composed of two sections :

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.Tdc

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 MikroElektronika compilers, or any other terminal application of your choice, can be used to read the message.

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

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Click boards™

Downloads

TDC click example on Libstock

TDC click 2D and 3D files

TDC7200 datasheet

TDC click schematic

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