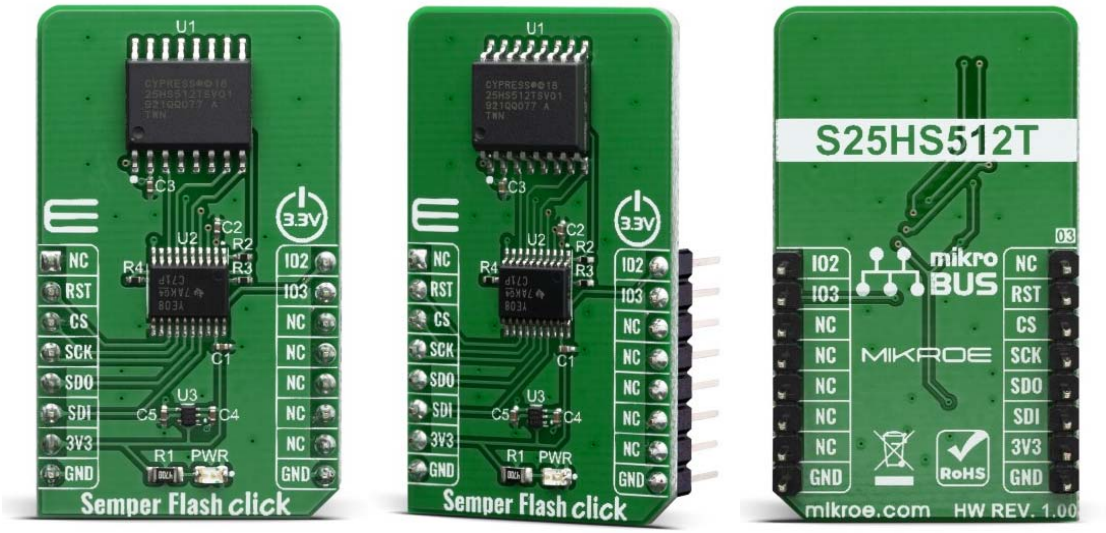


SEMPER FLASH CLICK

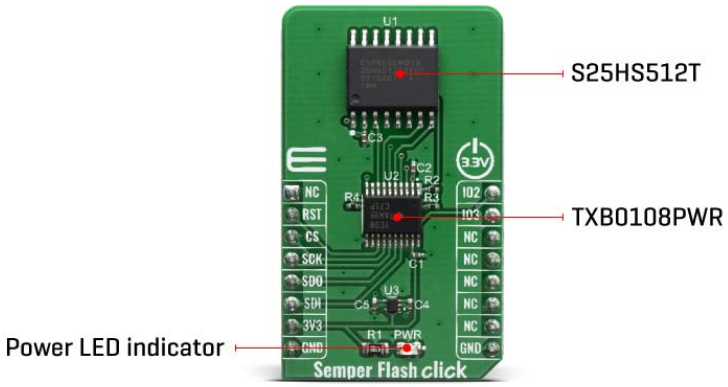
PID: MIKROE-3823
Weight: 18 g

The **Semper Flash Click** is a Click board™ which features the S25HS512T, a perfect solution for the mass storage option in various embedded applications. With fast performance being one of its key features, Semper Flash click can also be used for the code shadowing, execute-in-place (XIP), data logging and data storage. The Cypress Semper Flash with Quad SPI family of products are high-speed CMOS, MirrorBit NOR flash devices. Semper Flash is designed for Functional Safety with development according to ISO 26262 standard to achieve ASIL-B compliance and ASIL-D readiness. Built-in Error Correcting Code (ECC) corrects Single-bit Error and detects Double-bit Error (SECDED) on memory array data. The 512 Mbit SPI Flash memory module is one of the fastest and most reliable Flash modules on the market.

The Semper Flash 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?

The Semper Flash click is memory module based on the S25HS512T a 512 Mbit SPI Flash memory module, from Cypress. Featuring both normal and double data rates over the standard, Dual/Quad SPI interface, the improved reliability of the stored information by utilizing the hardware Error Correction Code (ECC) generation, One-Time Programmable (OTP) memory block of 1024 bytes, an advanced sector protection, AutoBoot, and much more, this Click board™ is a perfect solution for the mass storage option in various embedded applications. Due to its fast performance, Semper Flash click can also be used for the code shadowing, execute-in-place (XIP), data logging and data storage. An additional level translator IC allows Semper Flash click to be used with a wide range of MCUs.



The device control logic is subdivided into two parallel operating sections: the Host Interface Controller (HIC) and the Embedded Algorithm Controller (EAC). The HIC monitors signal levels on the device inputs and drives outputs as needed to complete read, program and write data transfers with the host system. The HIC delivers data from the currently entered address map on read transfers; places write transfer address and data information into the EAC command memory, and notifies the EAC of power transition, and write transfers. The EAC interrogates the command memory, after a program or write transfer, for legal command sequences and performs the related Embedded Algorithms.

Executing code directly from Flash memory is often called Execute-In-Place (XIP). By using XIP with Semper Flash devices at the higher clock rates with Quad or DDR Quad SPI transactions, the data transfer rate can match or exceed traditional parallel or asynchronous NOR flash memories while reducing signal count dramatically.

The advanced MirrorBit® technology allows storing of two data bits in each memory array transistor (memory cell), effectively doubling the capacity of a single storage cell this way. The Eclipse™ architecture is responsible for the greatly improved erase and programming performance, compared to other Flash modules of the previous generation. Due to a higher speed, an execute-in-place (XIP), as well as the data shadowing is possible with the Semper Flash click.

One of the key features of the S25HS512T is certainly the AutoBoot feature. It allows the module to automatically initiate the memory transfer from the predefined location (memory read operation) after the reset cycle. Considering a typical communication scenario, where READ command followed by the one or more address bytes need be used, AutoBoot allows the host MCU to pull down the #CS (Chip Select) pin and start receiving a data stream over the SPI interface for as long as the #CS pin is held LOW, without any wasted cycles. As soon as the #CS pin is released, the S25HS512T returns to a normal operation.

The Advanced Sector Protection (ASP) is a powerful protection model that incorporates a set of various software and hardware methods to enable or disable programming or erase operations within a sector or an entire memory. A specialized ASP OTP register offers a password protection mode or a persistent protection mode, allowing an increased flexibility of the protection. Using the OTP memory allows the protection mode to remain in place for the whole life-cycle of the device.

The SPI interface pins are routed to the mikroBUS™ so that the interfacing with the microcontroller unit (MCU) is easy and straightforward. Additional pins routed to the mikroBUS™ include the #WP/IO2 pin routed to the mikroBUS™ PWM pin and labeled as IO2, and #HOLD/IO3 pin routed to the mikroBUS™ INT pin and labeled as IO3. There is also the RESET pin, routed to the RST pin of the mikroBUS™, which performs a reset of the Flash module, initiating an AutoBoot sequence if enabled.

EnduraFlex Architecture provides system designers the ability to customize the NOR Flash endurance and retention for their specific application. The host defines partitions for high endurance or long retention, providing up to 1+ million cycles or 25 years of data retention.

Data Integrity Check transactions in Semper Flash perform a hardware accelerated Cyclic Redundancy Check (CRC) calculation over a user defined address range in the memory array. The SafeBoot feature allows Status Register polling to detect an embedded microcontroller initialization failure or configuration register corruption through error signatures.

SPECIFICATIONS

Type	FLASH
Applications	Mass storage option in multimedia devices, data drives, non-volatile data storage in embedded applications, secure storage, and similar applications that require reliable permanent storage of digital information.

On-board modules	S25HS512T, a 512 Mbit SPI Flash memory module, from Cypress
Key Features	High durability of 1+ million cycles, Advanced Sector Protection (ASP), secure OTP memory block, high transfer speed, SFDP mode for easy retrieval of IC-specific information, AutoBoot function for improved startup performance
Interface	QSPI,SPI
Input Voltage	3.3V

PINOUT DIAGRAM

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

Notes	Pin	mikroBUS				Pin	Notes
	NC	1	AN	PWM	16	**IO2**	Write Protect/IO2
Reset	RST	2	RST	INT	15	**IO3**	Hold/IO3
Chip Select	**CS**	3	CS	RX	14	NC	
SPI Clock	**SCK**	4	SCK	TX	13	NC	
SPI Data OUT/SO1	**SDO**	5	MISO	SCL	12	NC	
SPI Data IN/SO0	**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

SOFTWARE SUPPORT

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

Library Description
Library provides functions for using SPI module, changing pin states. Also it gives you function for controlling memory of device.

Key functions:

- `void semperflash_send_cmd ( uint8_t cmd )` - Function for sending one byte of data
- `void semperflash_transfer_data ( uint8_t *write_buf, uint8_t *read_buf, uint16_t buf_size )` - Function for transfering data via SPI module
- `void semperflash_write_data ( uint8_t *data_buf, uint16_t buf_size )` - Function for writing data via SPI module
- `void semperflash_write_config ( seperflash_cfg_t *cfg_data )` - Function for writing new config to device
- `uint8_t semperflash_read_memory ( uint32_t addr, uint8_t *data_buf, uint16_t buf_size )` - Function for reading memory from specific address
- `uint8_t semperflash_write_memory ( uint32_t addr, uint8_t *data_buf, uint16_t buf_size )` - Function for writing memory to specific address

Examples description
The application is composed of three sections :

- System Initialization - Initialization of SPI module and setting pins to output
- Application Initialization - Configure device reads manufacturer id and device id and writes device id
- Application Task - Erases memory of one address and then on one cycle writes one buffer and on the other writes other one

```
void application_task ( )
{
    memset( &read_buf_data[ 0 ], 0, 13 );
    semperflash_send_cmd( SEMPERFLASH_WRITE_ENABLE );
```

```
    semperflash_erase_memory( ADRESS_MEMORY );
    Delay_ms( 1000 );

    if ( COMPANY_FLAG == txt_flag )
    {
       semperflash_send_cmd( SEMPERFLASH_WRITE_ENABLE );
       status_data = semperflash_write_memory( ADRESS_MEMORY, &write_data_com[ 0 ], 7 );
       error_handler( status_data );
       status_data = semperflash_read_memory( ADRESS_MEMORY, &read_buf_data[ 0 ], 7 );
       error_handler( status_data );
       mikrobus_logWrite( read_buf_data, _LOG_LINE );
       txt_flag = CLICK_FLAG;
    }
    else if ( CLICK_FLAG == txt_flag )
    {
       semperflash_send_cmd( SEMPERFLASH_WRITE_ENABLE );
       status_data = semperflash_write_memory( ADRESS_MEMORY, &write_data_clk[ 0 ], 13 );
       error_handler( status_data );
       status_data = semperflash_read_memory( ADRESS_MEMORY, &read_buf_data[ 0 ], 13 );
       error_handler( status_data );
       mikrobus_logWrite( read_buf_data, _LOG_LINE );
       txt_flag = COMPANY_FLAG;
    }
    mikrobus_logWrite( "...................", _LOG_LINE );
    Delay_ms( 2000 );
}
```

Additional Functions :

- void error_handler (uint8_t stat) - Proceses return of the function and if it is error logs witch one it is

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

Other mikroE Libraries used in the example:

- SPI
- Conversions

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.