

## BUCK 13 CLICK

PID: MIKROE-3651 Weight: 22 g

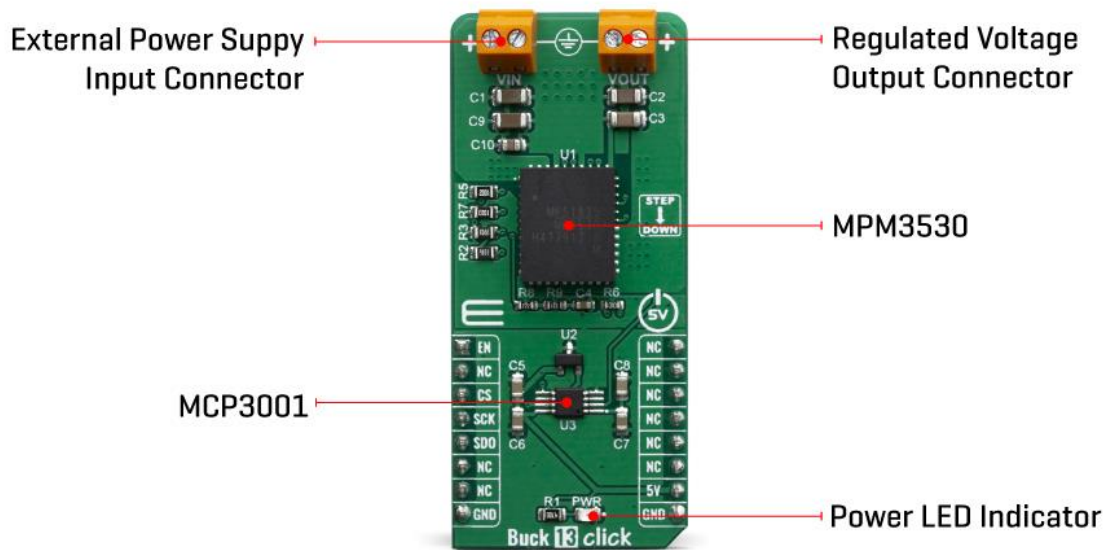
**Buck 13 Click** is a high-efficiency step-down converter which provides a highly regulated output voltage derived from the connected power source, rated from 4.5V to 5.5V. The regulated output voltage is 3.3V, the most common choice for various embedded applications. Buck 13 click is based around an integrated DC-DC converter, labeled as MPM3530. Due to its high efficiency, MPM3530 allows the Click board™ to easily deliver up to 3A of current. The MPM3530 is very reliable, offering over-current and over-voltage protection, as well as a thermal shutdown.

Buck 13 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.

Equipped with a number of different protection features such as the overload protection, thermal protection, soft startup, this step-down converter offers a very secure and convenient way of reducing the input voltage from a VIN terminal. It provides a clean, low noise and reliable power source. It can be used for different types of power supplies, regulation of the wall transformers output, single board applications powered by high voltage, and for any application that requires clean and efficient step-down voltage conversion.

## HOW DOES IT WORK?

The step down DC-DC regulator used on this click board™ is the MPM3530, a 55V 3A ultra-low profile DC-to-DC power module by Monolithic Power Systems (MPS). This IC is a valley current mode controlled power module, meaning that it has a faster response than the traditional peak current mode control, thus better response to transients. This IC requires a minimal number of external components, which makes the whole device pretty robust and easy to work with.



The output voltage is determined by the feedback voltage on the FB pin. Therefore, Buck 13 click is equipped with a fixed voltage divider calculated to ensure stable, the most frequently used, 3.3V output. The MPM3530 operates at very high switching frequency of 520 kHz, which allows a good compromise between the efficiency and the size of the device with no external coil needed and minimal number of other external components.

Click board™ uses the MCP3001, a 10-bit A/D converter (ADC) which uses the SPI interface, from Microchip. It allows monitoring the output voltage over the SPI interface. This ADC is powered from the +5V mikroBUS™ power rail. The same voltage is used to

supply the MCP1541 voltage reference, as well. That way, the stable 4.096V reference voltage is obtained in order to ensure precise measurement of the output voltage. The Click board™ itself requires an external power supply to be connected at the input terminal, labeled as VIN. The VOUT terminal provides the connected load with the regulated 3.3V voltage.

The over-current protection is based on cycle-by-cycle limiting of the inductor current. If the output voltage starts to drop during the current limiting interval, causing the FB voltage to drop under 50% of the internal reference, the device enters the hiccup mode, shutting down the output. After a fixed period, the device will try to re-enable the output. If the short-circuit condition still exists, it will shut down the output again, repeating the whole process, until the short-circuit condition disappears. The hiccup mode greatly reduces the short-circuit current, protecting the device when the output is shorted to ground.

Thanks to its ability to work with the high duty cycle of the internal switching PWM signal, the MPM3530 requires the input voltage to be only about 0.7V above the output voltage, in order to maintain the regulation. However, if the input voltage drops under 3.5V, the device will not be able to operate properly. Therefore, the under-voltage protection shuts down the device, as a protection measure. The under-voltage protection is disabled once the input voltage exceeds 3.9V. This small hysteresis of 0.4V prevents erratic behavior in border-cases.

As mentioned before, the voltage of the power supply at the input terminal should stay within the range between 4V and 55V. However, the voltage at the input is desirable to be approximately 5.7V to 6V at least, in order to provide a good regulation at the output.


## SPECIFICATIONS

<b>Type</b>	Buck
<b>Applications</b>	A perfect choice for step-down applications for embedded electronic devices, servers, routers, data storage devices, low power ICs, etc
<b>On-board modules</b>	MPM3530, 3A ultra-low profile DC-to-DC power module by Monolithic Power Systems (MPS) MCP3001, a 10-bit A/D converter (ADC) which uses the SPI interface, from Microchip.
<b>Key Features</b>	Buck 13 click features a wide range of input voltages, pin configurable working parameters, internal soft start, thermal

	shutdown, hiccup mode short-circuit protection and high switching efficiency
<b>Interface</b>	GPIO
<b>Click board size</b>	L (57.15 x 25.4 mm)
<b>Input Voltage</b>	5V

## PINOUT DIAGRAM

This table shows how the pinout on Buck 13 click corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin					Pin	Notes
Enable Input	<b>EN</b>	1	AN	PWM	16	NC	
	NC	2	RST	INT	15	NC	
Chip Select	<b>CS</b>	3	CS	RX	14	NC	
SPI Clock	<b>SCK</b>	4	SCK	TX	13	NC	
SPI Data Out	<b>SDO</b>	5	MISO	SCL	12	NC	
	NC	6	MOSI	SDA	11	NC	
	NC	7	3.3V	5V	10	<b>5V</b>	Power supply
Ground	<b>GND</b>	8	GND	GND	9	<b>GND</b>	Ground

## ONBOARD SETTINGS AND INDICATORS

Label	Name	Default	Description
LD1	PWR	-	Power LED Indicator
TB1	VIN-EXT	-	Screw terminal for connecting an external voltage source
TB2	VOUT	-	Screw terminal for connecting the load

## BUCK 13 CLICK ELECTRICAL SPECIFICATIONS

Description	Min	Typ	Max	Unit
Input voltage range	4.5	5	55	V
Output voltage range	-	3.3	-	V
Output current	0	-	3	A

## SOFTWARE SUPPORT

We provide a library for the Buck 13 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

This library performs a control of the Buck 13 click board, which is used to convert the input DC voltage, in the range from 6.5V to 50V, to output DC voltage of 3.3V, with maximal current of 3A. Library uses SPI serial interface to allow the ADC output reading from the Buck 13. For more details check documentation.

## Key functions:

- `void buck13_spiDriverInit( T_BUCK13_P gpioObj, T_BUCK13_P spiObj )` - This function initializes SPI serial interface.
- `void buck13_enable( T_BUCK13_STATE pwr_state )` - This function allows user to perform a control of the Buck 13 output.
- `uint16_t buck13_getVoltage( void )` - This function returns the output voltage value calculated to millivolts.

## Examples description

The application is composed of three sections :

- System Initialization - Initializes peripherals and pins.
- Application Initialization - Initializes SPI serial interface and turns OFF the Buck 13 output as default state. Also writes possible commands to the uart terminal.
- Application Task - (code snippet) - Checks the command entered by user and executes the operation determined by selected command. If entered command was invalid sends a report to the uart terminal. Also the report will be sent to the uart terminal after each entered command and executed operation. Note: Input voltage range is from 6.5V to 50V Output voltage is about 3.3V Current limit is 3A.

```
void applicationTask()
{
    rx_dat = UART_Rdy_Ptr();

    if (rx_dat != 0)
    {
        rx_dat = UART_Rd_Ptr();

        switch (rx_dat)
        {
            case 'e' :
            {
                if (out_state == _BUCK13_DISABLE)
                {
                    buck13_enable( _BUCK13_ENABLE );
                    out_state = _BUCK13_ENABLE;
                    mikrobus_logWrite( "*** Buck 13 output is enabled now.", _LOG_LINE );
                }
            }
            else
```

```
        {
            mikrobus_logWrite( "*** Buck 13 output is already enabled.", _LOG_LINE );
        }
    break;
}
case 'd' :
{
    if (out_state == _BUCK13_ENABLE)
    {
        buck13_enable( _BUCK13_DISABLE );
        out_state = _BUCK13_DISABLE;
        mikrobus_logWrite( "*** Buck 13 output is disabled now.", _LOG_LINE );
    }
    else
    {
        mikrobus_logWrite( "*** Buck 13 output is already disabled.", _LOG_LINE );
    }
}
break;
}
case 'v' :
{
    out_voltage = buck13_getVoltage();

    WordToStr( out_voltage, text );
    Ltrim( text );
    mikrobus_logWrite( "*** VOUT = ", _LOG_TEXT );
    mikrobus_logWrite( text, _LOG_TEXT );
    mikrobus_logWrite( " mV.", _LOG_LINE );
}
break;
}
case 'c' :
{
    writeCmd();
}
break;
}
default :
{
```

```
        mikrobus_logWrite( "***** Invalid command. *****", _LOG_LINE );
        writeCmd();
        break;
    }
}
}
```

#### Additional Functions :

- writeCmd - Writes possible commands for the user to the uart terminal.

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

Other mikroE Libraries used in the example:

- Conversions
- C\_String
- SPI
- UART

#### 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™ Standard specification

LibStock: mikroSDK

Click board catalog

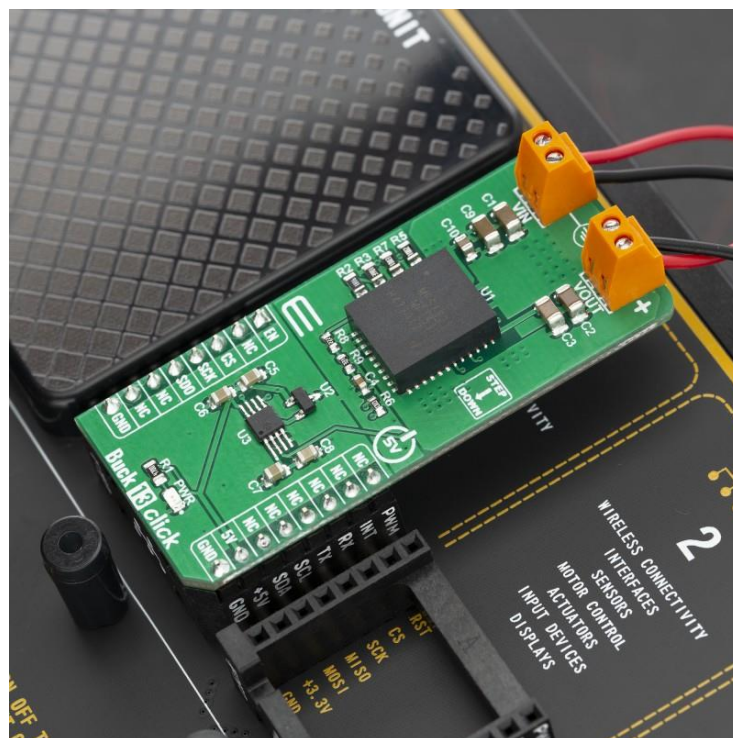
## DOWNLOAD

Buck 13 click example on Libstock

Buck 13 click 2D and 3D files

MPM3530 datasheet

Buck 13 click schematic



<https://www.mikroe.com/buck-13-click/7-29-19>