

## BUCK 7 click

PID: MIKROE-3094

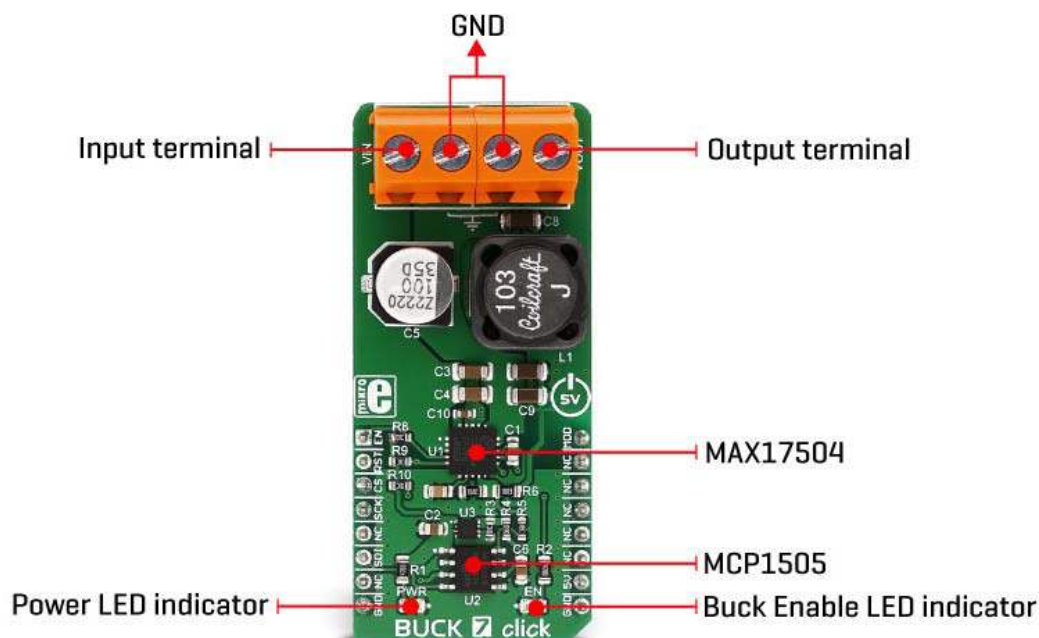
Weight: 35 g

**Buck 7 click** is a high-efficiency buck (step-down) DC-DC converter, which can provide digitally adjusted step-down voltage on its output while delivering up to 3.5A of current. Buck 7 click accepts a wide voltage range on its input - from 4.5V to 36V. The output voltage may be adjusted via the SPI interface, in the range from 0.9V to approximately 90% of the input voltage. This Click board™ utilizes the MAX17504, an integrated high efficiency, synchronous step-down DC-DC converter with internal compensation, from Maxim Integrated. In addition, to allow digital control of the output voltage, the MCP4921, a 12bit D/A converter with SPI Interface is used on the feedback loop.

This Click board™ is very useful for the development of applications that require programmed reduction of the input voltage, for various purposes. Features such as the low dissipation due to high efficiency, three different operating modes, overcurrent, undervoltage and thermal protection, output voltage monitoring pin, make this Click board™ very reliable power source for a range of applications, such as the distributed power supply regulation, wall transformer regulation, single board systems, general points of load, and similar applications.

## How does it work?

Buck 7 click is equipped with the MAX17504, a high efficiency, synchronous step-down DC-DC converter with internal compensation, from Maxim Integrated. This is an advanced integrated step-down converter, which requires a minimum number of external components, thanks to the internal feedback loop compensation. It utilizes a peak-current-mode control architecture, meaning that while the high side MOSFET is open and the current through the inductor ramps up, an overcurrent event will cause the MOSFET to close, preventing this current to become dangerously high. If there is a short circuit condition on the output, the device will reattempt to start after a timeout period, and if the condition is still present at the output, it will be turned off for another timeout period.



To allow adjustment of the output voltage via the SPI interface, the MCP4921, a 12bit D/A converter with SPI Interface made by Microchip, is used on the feedback loop. This DAC affects the current through the feedback loop forcing the PWM duty cycle of the internal generator, regulating the output voltage to a programmed value that way. As a result, by sending a digital value through the SPI interface to the MCP4921, it is possible to control the output voltage level in the range from 3.3V to 90% of the input voltage value.

While operating normally (PWM mode), the high and the low side MOSFETs are switched synchronously with the signal from the internal PWM generator, causing the current through the inductor to ramp up and down, regulating the output voltage that way. The lower pulse width (duty cycle) of the PWM signal, results in the lower voltage at the output.

Besides PWM mode, the device is also capable of operating in the PFM mode (Pulse Frequency Modulation). This mode allows even higher efficiency for light loads, as the low side MOSFET is completely unused. The high side MOSFET charges the inductor, letting the load drain it. During this period, the IC is in the hibernation state. This mode results in slightly more ripple at the output, with the added benefit of high efficiency for light loads. It is perfectly suited to power devices which are in the low power consumption mode (Sleep, Standby..)

The DCM mode is the compromise mode between the PWM and PFM modes. The low side MOSFET is still not used for light loads, but the PWM pulses are not skipped, and the IC constantly drives the high side MOSFET. This mode produces ripple at the output but it is slightly less efficient than the PFM mode for light loads.

Different modes are selected by the MODE pin. This pin is routed to the mikroBUS™ PWM pin (labeled as MOD), allowing the MCU to control the mode. When set to a HIGH level, the IC works in the DCM mode for light loads. When left floating, the PFM mode is selected. When it is set to the LOW logic level, the constant frequency PWM mode is set.

The #RES pin of the IC is routed to the mikroBUS™ RST pin. This pin signalizes problems with the output voltage. The pin is driven to a LOW logic level, when the output voltage drops under 92% of the nominal value, or during the thermal shutdown. It is an open drain output and it is otherwise pulled to a HIGH logic level (when not asserted)

To enable the buck converter IC, a HIGH logic level needs to be present at the EN pin of the IC, routed to the mikroBUS™ AN pin (labeled as EN). This allows the MCU to effectively control the Power ON function of the Click

board™. When the IC is enabled, the LED indicator labeled as EN will indicate that the IC is activated, and the step-down conversion is in progress. Soft-start circuit prevents high inrush currents by introducing a ramp-up of the output voltage, from 0V up to the nominal value.

## Specifications

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Type	Buck
Applications	A regulated power source for wide range of applications, such as the distributed power supply regulation, wall transformer regulation, single board systems, general points of load, and similar applications.
On-board modules	MAX17504, a high efficiency, synchronous step-down DC-DC converter with internal compensation, from Maxim Integrated; MCP4921, a 12bit D/A converter with SPI Interface, from Microchip; MCP1505, a buffered voltage reference, from Microchip.
Key Features	Low power dissipation due to high efficiency, three different operating modes, overcurrent, undervoltage and thermal protection, output voltage monitoring pin, output voltage set by the industry standard SPI interface.
Interface	SPI
Input Voltage	5V
Click board size	L (57.15 x 25.4 mm)

## Onboard jumpers and settings

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Label	Name	Default	Description
LD1	PWR	-	Power LED indicator
LD2	EN	-	Buck enable LED indicator
TB1	VIN	-	External power supply input connector
TB2	VOUT	-	Regulated voltage output connector

## Opto 2 click electrical specifications


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Description	Min	Typ	Max	Unit
Output voltage	3.3	-	30	V
Input voltage	5	-	35	V
Output current (continuous)	0	-	3.5	A

## Pinout diagram

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This table shows how the pinout on **Buck 7 click** corresponds to the pinout on the mikroBUS™ socket (the latter shown in the two middle columns).

Notes	Pin					Pin	Notes
Buck Enable	EN	1	AN	PWM	16	MOD	Mode Select

Voltage Monitor OUT	<b>RST</b>	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	
	NC	5	MISO	SCL	12	NC	
SPI Data IN	<b>SDI</b>	6	MOSI	SDA	11	NC	
	<b>3.3V</b>	7	3.3V	5V	10	<b>5V</b>	Power Supply
Ground	<b>GND</b>	8	GND	GND	9	<b>GND</b>	Ground

## Software support

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We provide a demo application for BUCK 7 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

The library initializes and defines the SPI bus driver. The library includes functions for enabling the IC, setting up the output voltage, as well as the functions for selecting the operating mode (PWM, PFM or DCM).

### Key functions :

`void buck7_setOutputVoltage(uint16_t voltage)` - Function for setting up the output voltage

`void buck7_enable()` - Function for chip enable

`void buck7_setMode(uint8_t mode)` - Function for the operating mode selection

## Example description

The application is composed of three sections:

- System Initialization - Initializes SPI module and set AN, CS and PWM pin as OUTPUT
- Application Initialization - Initializes Driver init, chip enable and mode selection
- Application Task - (code snippet) - Sets output voltage to 5V, 10V, 15V, 20V, 25V every 3 seconds. It is necessary to provide input voltage which is 2.7V above the programmed output voltage

```
void applicationTask()
{
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_5V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_10V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_15V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_20V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_25V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_20V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( _BUCK7_OUT_VOLTAGE_15V );
  Delay_ms( 3000 );
  buck7_setOutputVoltage( 0x0BB8 ); /* 10 V */
  Delay_ms( 3000 );
}
```

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

mikroE Libraries used in the example:

- SPI

### Additional notes and information

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

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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.

