


Mikromedia 7 for STM32F7

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mikromedia 7 for STM32F7	
IC/Module	STM32F746ZG ^[1]
Interface	1x 26 pinout on board edges
Power supply	3.3V
Website	www.mikroe.com/mikromedia/7/stm32f7/ ^[2]
Schematic	PDF schematic ^[3]

mikromedia 7 for STM32F7 is a compact development system with lots of on-board peripherals which allow development of devices with multimedia contents. The central part of the system is a 32-bit ARM® Cortex™-M4 **STM32F746ZG** 144-pin microcontroller.

The mikromedia 7 for STM32F7 features integrated modules such as stereo MP3 codec, 7" TFT 800x480 touch screen display. The increased screen size is ideal for displaying larger amounts of data.

The board also contains an accelerometer, microSD card slot, buzzer, IR receiver, RGB LED diode, PIN photodiode, temperature sensor, 2.4GHz RF, WiFi, Ethernet and CAN transceivers, 8 Mbit flash memory, RTC battery, Li-Polimer battery charger, etc.

Additional components include MINI-B USB connector, power screw terminals, 2x5 JTAG connector, two 1x26 connection pads, ON/OFF switch and other. It comes with an onboard mikroProg™ for STM32 programmer and debugger, but can also be programmed with external programmers, such as ST-LINK programmer.

Power Supply

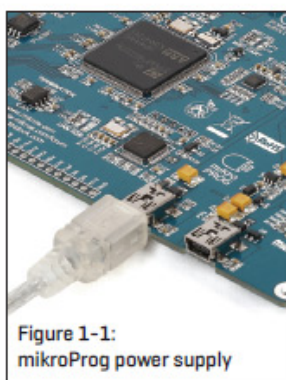


Figure 1-1:
mikroProg power supply

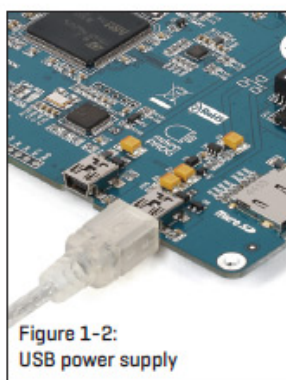


Figure 1-2:
USB power supply

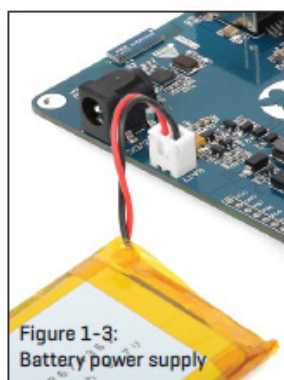


Figure 1-3:
Battery power supply

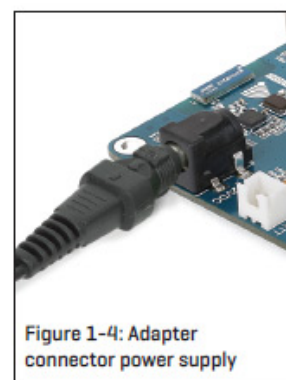
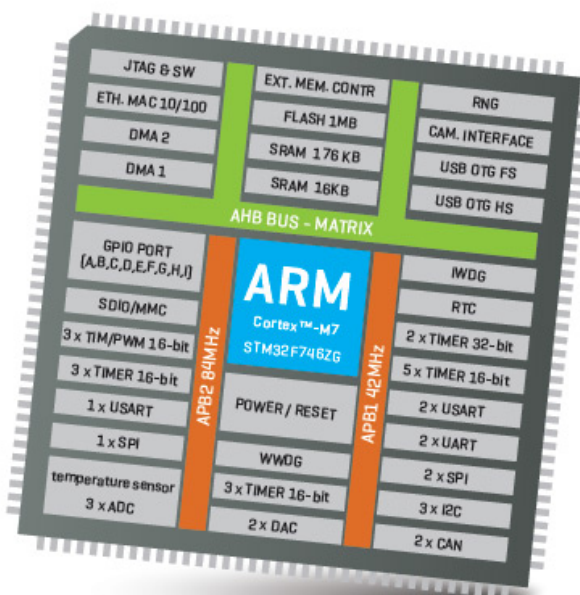


Figure 1-4: Adapter
connector power supply

The mikromedia 7 for STM32F7 board can be powered in four different ways: via two USB connectors using MINI-B USB cable provided with the board (CN4 or CN11), via battery connector using Li-Polymer battery (CN5) or via adapter connector using adapter power supply (CN3). After you plug in the appropriate power supply turn the power switch ON (SW1). The USB connection can provide up to 500mA of current which is more than enough for the operation of all on-board modules and the microcontroller as well. If you decide to use external power supply via screw terminals, voltage values must be within 5-12V DC range. Power LED ON (GREEN) indicates the presence of power supply. On-board battery charger circuit MCP73832 enables you to charge the battery over USB connection or via screw terminals. LED diode (RED) indicates when battery is charging. Charging current is ~250mA and charging voltage is 4.2V DC.

STM32F746ZG microcontroller

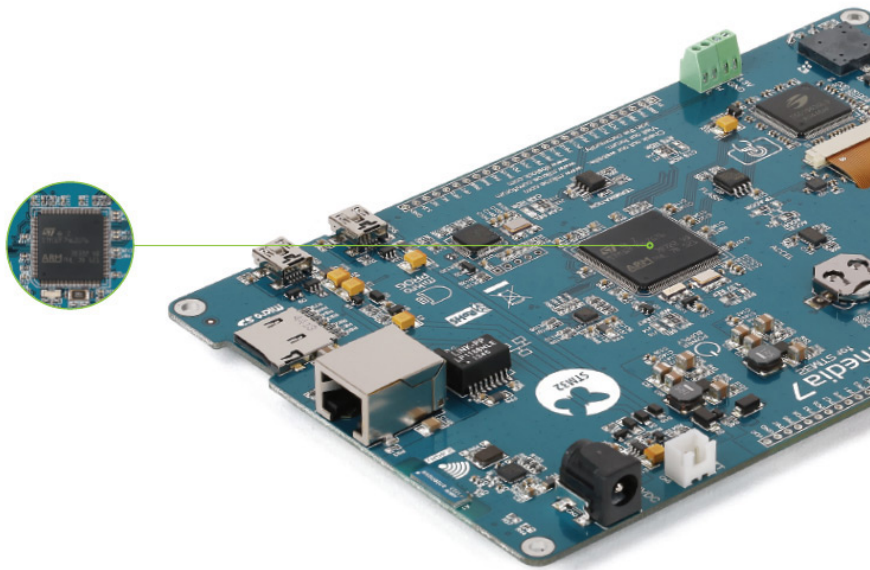


The mikromedia 7 for STM32F7 development board comes with the 144-pin ARM® Cortex™-M7 STM32F746ZG microcontroller. This high-performance 32-bit microcontroller with its integrated modules and in combination with other onboard modules is ideal for multimedia applications

Key microcontroller features

- Up to 462 DMIPS Operation (216 MHz);
- 1 MB of Flash memory;
- 320 + 64 KB of SRAM memory;
- up to 140 I/O pins;
- 16/32-bit timers
- 16MHz internal oscillator, 32kHz RTCC, PLL;
- 4xUART, 3xSPI, 3xI2C, 2xCAN, 3xADC, 3XADC etc.
- Ethernet, USB etc.

Programming the microcontroller



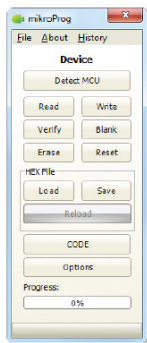
The microcontroller can be programmed in two ways:

1. Using onboard mikroProg™ for STM32 programmer
2. Using external programmers for STM32 (like ST-LINK)

Using mikroProg™ programmer

The microcontroller can be programmed with onboard mikroProg™ for STM programmer and mikroProg Suite™ for ARM® software. Connection with PC is established over an PROG USB connector. For proper insertion of the MINI-B USB cable. Signalization LED (LINK) is also provided on the opposite side of the PROG USB connector. It is also possible to program the microcontroller with external porogrammers, via 2x5 JTAG connector (CN1) with an appropriate adapter.

mikroProg Suite™ for ARM® software



mikroProg™ for STM32 programmer requires special programming software called mikroProg Suite™ for ARM®. This software is used for programming ALL of STM32 ARM® Cortex-M3™ and Cortex-M7™ microcontroller families. It features intuitive interface and SingleClick™ programming technology. Software installation is available on following link:

www.mikroe.com/downloads/get/1809/mikroprog_suite_for_arm.zip ^[4]

After downloading, extract the package and double click the executable setup file to start installation.

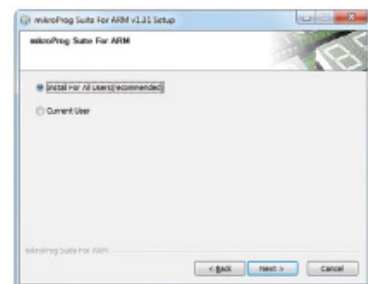
Software Installation wizard



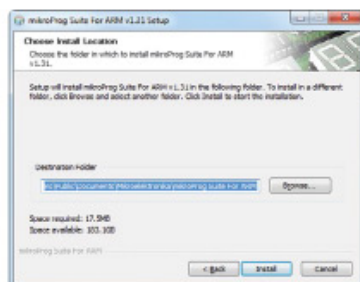
1. Start Installation



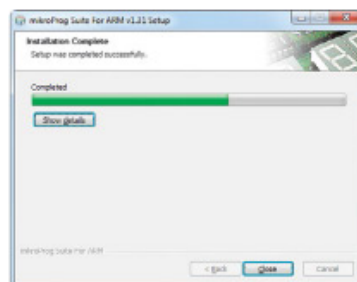
2. Accept EULA and continue



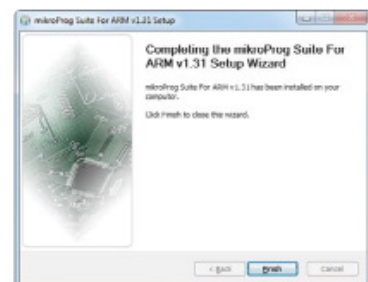
3. Install for all users



4. Choose destination folder



5. Installation in progress



6. Finish installation

The board is equipped with reset button, which is located on the front side of the board. If you want to reset the circuit, press the reset button. It will generate low voltage level on the microcontroller reset pin (input). A reset can also be externally provided through the pin 26 on the side headers.

RTC Battery and Rest Button

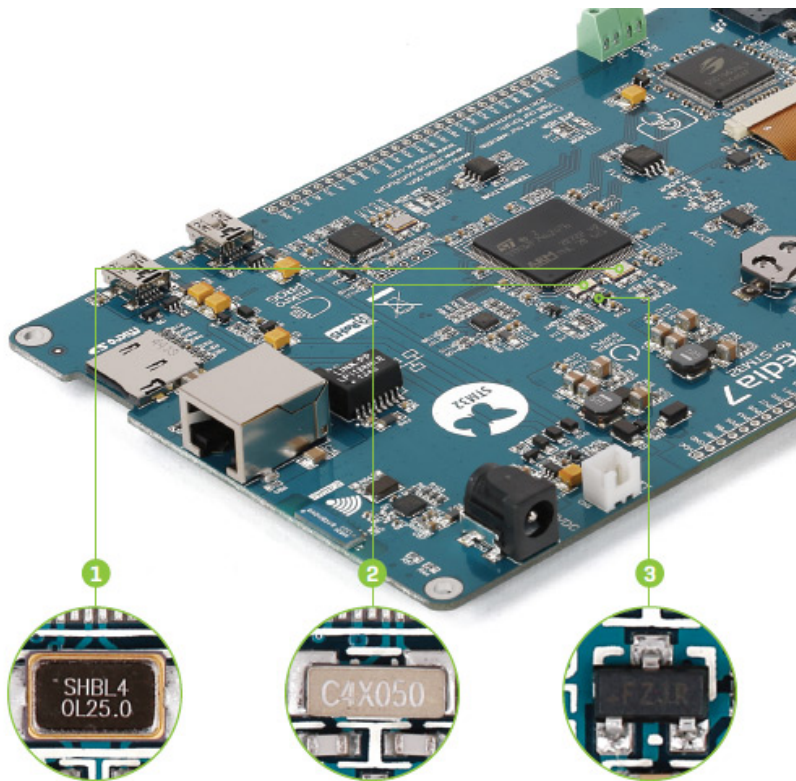
Reset Button

The board is equipped with reset button, which is located on the front side of the board. If you want to reset the circuit, press the reset button. It will generate low voltage level on the microcontroller reset pin (input). A reset can also be externally provided through the pin 26 on the side headers.

RTC Battery

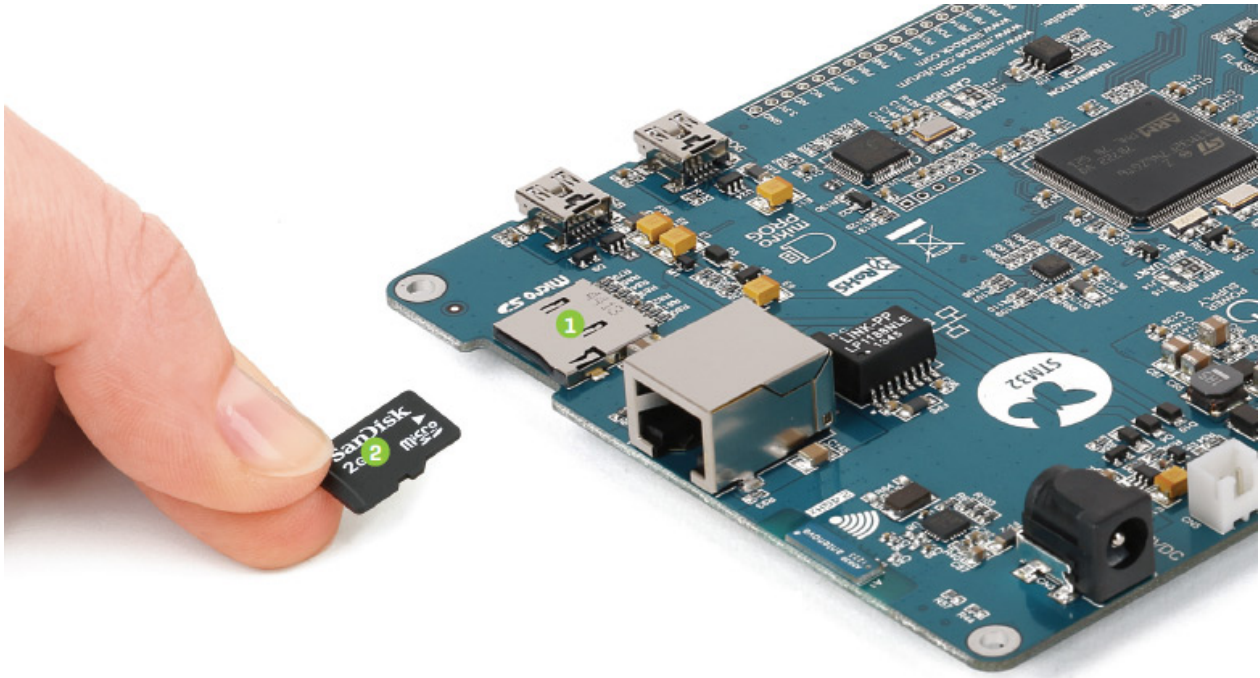
mikromedia 7 for STM32F7 features an RTC battery holder for microcontroller RTC module. Battery is used as alternate source of power, so the RTC module can continue to keep time while the primary source of power is off or currently unavailable. Three types of coin battery are supported: CR1216, CR1220 and CR1225.

Crystal oscillators and 2.048V reference



The board is equipped with 1 25MHz crystal oscillator (X5) circuit that provides external clock waveform to the microcontroller OSCO and OSCI pins. This base frequency is suitable for further clock multipliers and ideal for generation of necessary USB clock, which ensures proper operation of bootloader and your custom USB-based applications. The board also contains 2 32.768 kHz crystal oscillator (X4) which provides external clock for internal RTCC module. Microcontroller ADC requires an accurate source of reference voltage signal. That is why we provide the external 3 voltage reference to the microcontroller VREF pin which is 2.048V.

microSD Card Slot



Board contains 1 microSD card slot for using 2 microSD cards in your projects. It enables you to store large amounts of data externally, thus saving microcontroller memory. microSD cards use Serial Peripheral Interface (SPI) for communication with the microcontroller. Ferrite and capacitor are provided to compensate the voltage and current glitch that can occur when pushing-in and pushing-out microSD card into the socket. Proper insertion of the microSD card is shown in the image above.

This code snippet initializes the FAT32 library for usage with SD card:

```
void char Init_FAT() {
    char FAT_cnt = 0;
    if (MMC_Card_Detect == 0) {
        if (Fat_Initialized_Flag == 0) {
            while ((Fat32_Init() != 0) && (FAT_cnt < 5))
                Fat_cnt ++;
            if (FAT_cnt < 5) {
                SDIO_Init(_SDIO_CFG_POWER_SAVE_DISABLE |
                _SDIO_CFG_4_WIDE_BUS_MODE | _SDIO_CFG_CLOCK_BYPASS_DISABLE
                | _SDIO_CFG_CLOCK_RISING_EDGE |
                _SDIO_CFG_HW_FLOW_DISABLE, 1, &_GPIO_MODULE_SDIO_D0_D3);
                Fat_Initialized_Flag = 1;
            }
        }
        if (Ext_res_initialized == 0) {
            TFT_Set_Ext_Buffer(MyTFT_Get_Data);
            Ext_fhandle = FAT32_Open("Ext_reso.RES", 1);
            if (Ext_fhandle != 0xFF)
                Ext_res_initialized = 1;
        }
    }
}
```

```

return Ext_res_initialized;
}

```

Touch Screen



The development system features a 7" TFT 800x480 display covered with a resistive touch panel. Together they form a functional unit called a touch screen. It enables data to be entered and displayed at the same time. The TFT display is capable of showing graphics in 262K different colors.

For example here is how to program the SSD1963 display driver to trigger the Fade-in effect on the display:

```

void BLED_Fade_In() {
    int i;
    for (i = 1; i < 255; i++) {
        TFT_Set_DBC_SSD1963(i);
        Delay_ms(1);
    }
    TFT_Set_DBC_SSD1963(255);
}

```

This is the callibration routine for the touchscreen controller:

```

void Calibrate() {
    TFT_Fill_Screen(CL_BLACK);
    TFT_Set_Font(TFT_defaultFont, CL_WHITE, FO_HORIZONTAL);
    STMPE610_ClearInterruptFlagsAndFIFO();
    TFT_Set_Brush(1, CL_WHITE, 0, 0, 0, 0);
    TFT_Circle(0, 0, 3);
    STMPE610_CalibratePoint(STMPE610_FIRST_CORNER);
}

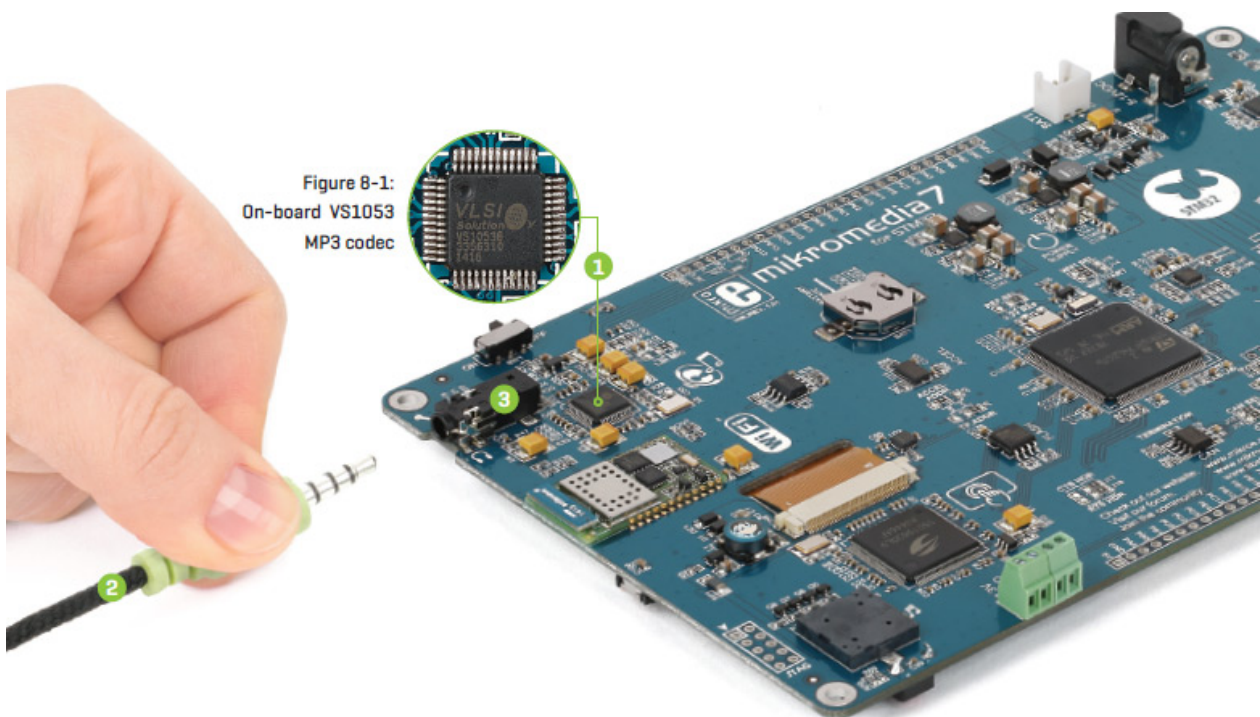
```

```

Delay_ms(500);
TFT_Set_Brush(1, CL_BLACK, 0, 0, 0, 0);
TFT_Circle(0, 0, 3);
STMPE610_ClearInterruptFlagsAndFIFO();
TFT_Set_Brush(1, CL_WHITE, 0, 0, 0, 0);
TFT_Circle(0, TFT_DISP_HEIGHT-1, 3);
STMPE610_CalibratePoint(STMPE610_SECOND_CORNER);
Delay_ms(500);
TFT_Set_Brush(1, CL_BLACK, 0, 0, 0, 0);
TFT_Circle(0, TFT_DISP_HEIGHT-1, 3);
STMPE610_ClearInterruptFlagsAndFIFO();
TFT_Set_Brush(1, CL_WHITE, 0, 0, 0, 0);
TFT_Circle(TFT_DISP_WIDTH-1, TFT_DISP_HEIGHT-1, 3);
STMPE610_CalibratePoint(STMPE610_THIRD_CORNER);
Delay_ms(500);
TFT_Set_Brush(1, CL_BLACK, 0, 0, 0, 0);
TFT_Circle(TFT_DISP_WIDTH-1, TFT_DISP_HEIGHT-1, 3);
STMPE610_ClearInterruptFlagsAndFIFO();
TFT_Set_Brush(1, CL_WHITE, 0, 0, 0, 0);
TFT_Circle(TFT_DISP_WIDTH-1, 0, 3);
STMPE610_CalibratePoint(STMPE610_FOURTH_CORNER);
TFT_Set_Brush(1, CL_BLACK, 0, 0, 0, 0);
TFT_Circle(TFT_DISP_WIDTH-1, 0, 3);
Delay_ms(500);
}

```

Audio Module

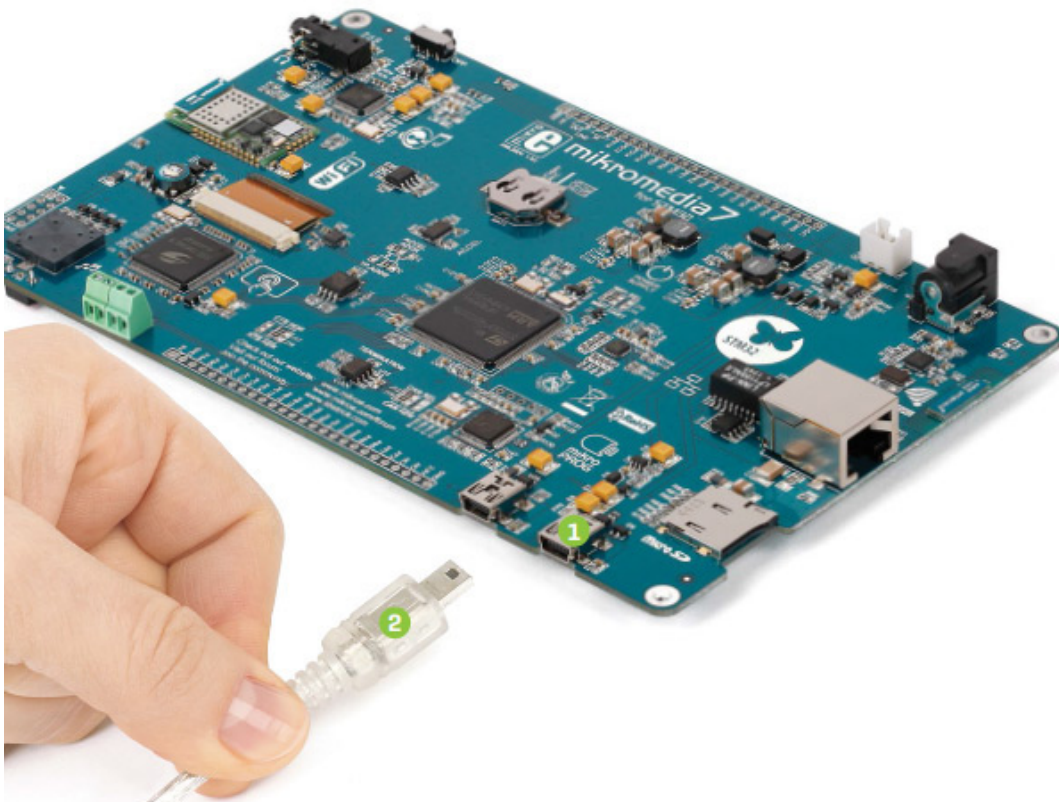


mikromedia 7 for STM32F7 features stereo audio codec 1 VS1053. This module enables audio reproduction and sound recording by using 2 stereo headphones with microphone connected to the system via a 3.5mm connector (CN2). All functions of this module are controlled by the microcontroller over Serial Peripheral Interface (SPI). IN and OUT channels are also provided on side headers (HDR2).

This is the function to start playing a chosen MP3 file from the SD card:

```
void MP3_play(char *Song_Name, char File_No) {  
    current_file = File_No;  
    Buffer_count = 0;  
    current_fhandle = FAT32_Open(Song_Name, FILE_READ);  
    FAT32_Size(Song_Name, &file_size);  
    Buffer_count = 0;  
    Total_Buffers = File_size / BUFFER_SIZE;  
    MP3_Reset_Time();  
    MP3_Check_Time();  
    MP3_Set_Volume(100 - level, 100 - level);  
    UpdateVolumeBar( level, 0);  
    MP3_Example_State = 2;  
}
```

USB DEVICE connection

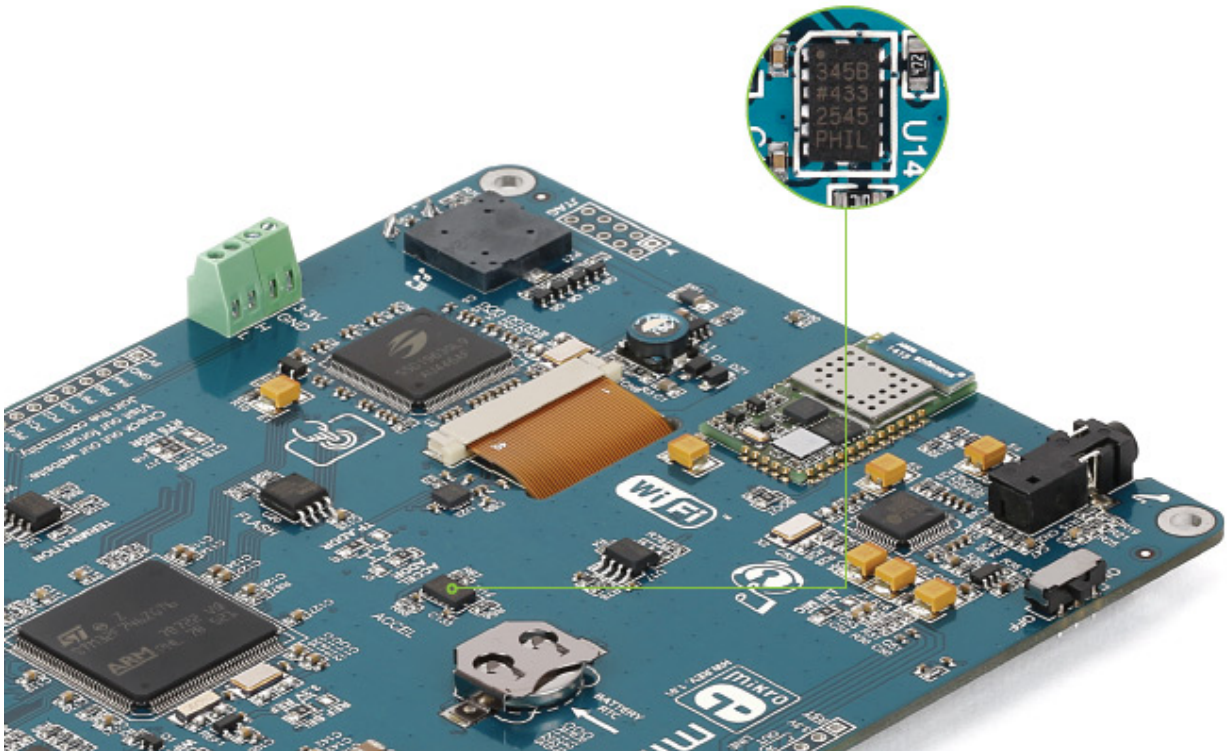


ARM® Cortex™-M7 STM32F746ZG microcontroller has integrated USB module, which enables you to implement USB communication functionality to your mikromedia board. Connection with target USB host is established over 1 MINI-B USB connector. For proper insertion of the 2 MINI-B USB see image above.

USB HOST connection

mikromedia 7 for STM32F7 can also be used as USB HOST which enables microcontroller to establish a connection with the target device (eg. USB keyboard, USB mouse, etc). The board provides necessary power supply to the target via TPS2041B IC. In order to enable the 1 USB HOST cable to be connected to the board, it is necessary to use the appropriate 2 MINI-B USB to USB type A adapter.

Accelerometer



Onboard ADXL345 accelerometer is used to measure acceleration in three axis: x, y and z. The accelerometer function is defined by the user in the program loaded into the microcontroller. Communication between the accelerometer and the microcontroller is performed via the I2C interface. There is an option to select the alternate accel address with jumper J3.

The following function reads 16 measurement samples from the accelerometer and returns the average value:

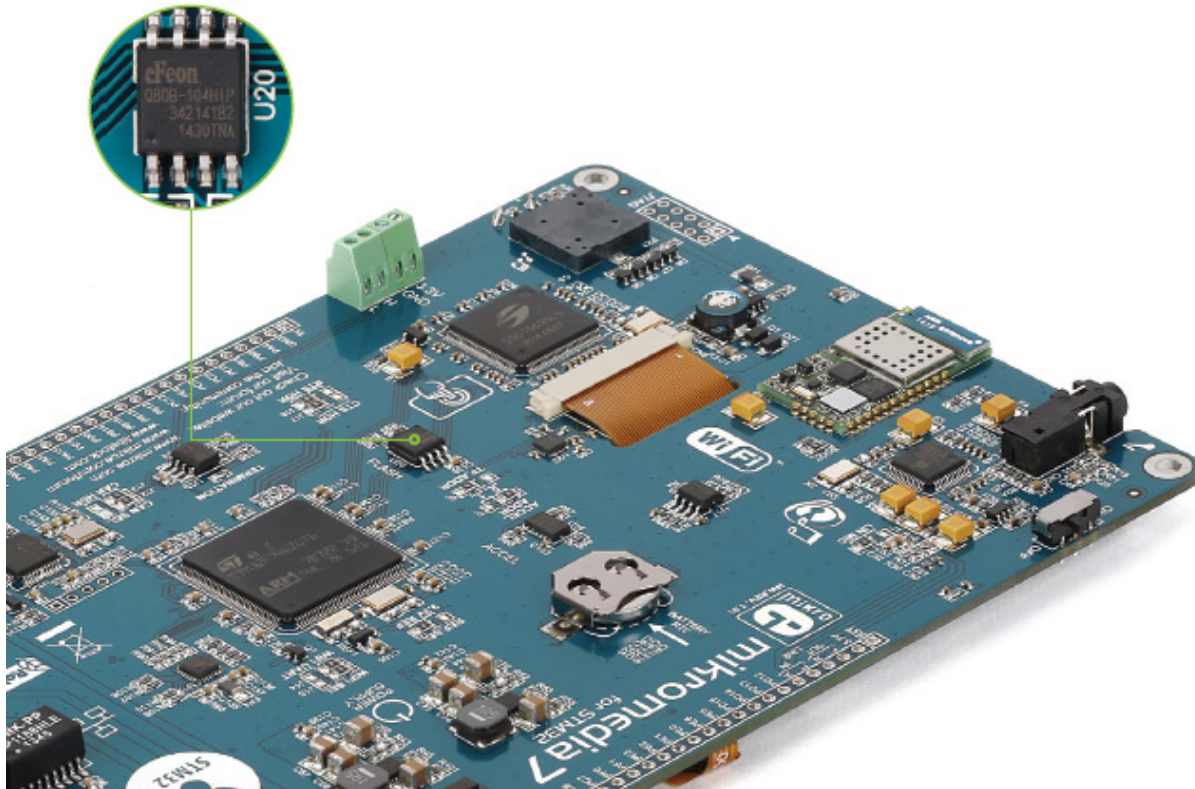
```
static void Accel_Average() {  
    int i, sx, sy, sz, xx, yy, zz;  
    // sum  
    sx = sy = sz = 0;  
    // average accelerometer reading over last 16 samples  
    for (i=0; i<16; i++) {  
        ADXL345_Read(&xx, &yy, &zz);  
        sx += xx;  
        sy += yy;  
        sz += zz;  
    }  
    // average  
    readings[0] = sx / 16;  
}
```

```

readings[1] = sy / 16;
readings[2] = sz / 16;
}

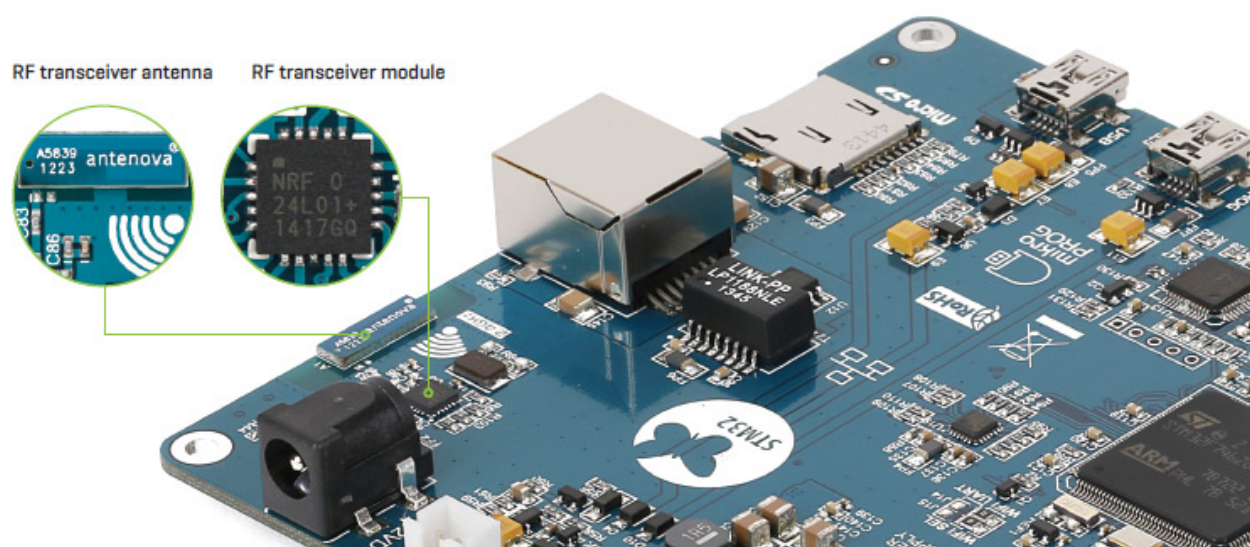
```

Flash Memory



Since multimedia applications are getting increasingly demanding, it is necessary to provide additional memory space to be used for storing more data. The flash memory module enables the microcontroller to use additional 8Mbit flash memory. It is connected to the microcontroller via the Serial Peripheral Interface (SPI).

RF Transceiver

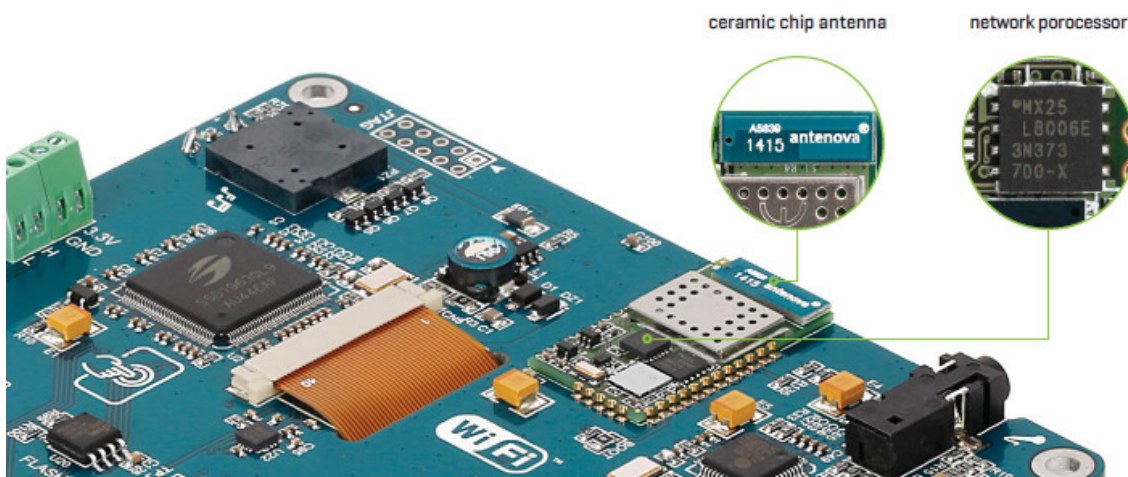


mikromedia 7 for STM32F7 board features RF transceiver chip with 2.4GHz chip antenna. It is suitable for wireless operation in the world wide ISM frequency band at 2.400 - 2.4835 GHz with air data rate up to 2Mbps. RF transceiver module is connected to the microcontroller via the Serial Peripheral Interface (SPI). This RF transceiver module is widely used for wireless PC peripherals, remote controllers, VoIP headsets, game controllers, sensors, home and commercial automation, active RFID, toys and many more.

This function sends a data packet using nRF24L01:

```
unsigned char nRF_Send_Packet()
{
    if ((ucCom_Mode == nRF_RX_MODE) || (ucIRQ_Source != nRF_IDLE))
        return 0;
    nRF_Write_TX_Pload(&TX_pload, nRF_TX_PLOAD_WIDTH);
    nRF_CE_Pin(nRF_CE_PULSE);
    ucTry_Ctr = 0;
    return 1;
}
```

Wi-Fi



mikromedia 7 for STM32F7 is equipped with SPWF01SA, a WiFi module with an integrated antenna from STMicroelectronics. The module packs a 2.4 GHz IEEE 802.11 b/g/n transceiver and its own STM32 ARM Cortex-M3 MCU that offloads the workload from the main microcontroller on the mikromedia. Full featured TCP/IP protocol stacks are also integrated. A BOOT jumper (zero ohm resistor) for updating the firmware on the WiFi module is located nearby, between the module itself and the WiFi silkscreen markings.

This function is used to connect to the WiFi access point and start the web server:

```
void startServer()
{
    Net_Wireless_SPWF01S_SetConfig(_NET_WIRELESS_SPWF01S_CFG_WAIT_TIME,
    socketWaitTime);
    scanForSSID(mySSID, scanBuf, BUFSIZE, &netType, &chNum, &sigStr,
    &capab, macAddr, &wpa, &wpa2, &wps, 10);
    netReady = 0;
    UpdateDescription("Connecting...");
    if ( ( wifiTest = Net_Wireless_SPWF01S_ConnectToAP(mySSID, myPass) )
    == _NET_WIRELESS_SPWF01S_OK )
```



```

{
    while (netReady == 0) {}
    UpdateDescription("Connected!");
    Net_Wireless_SPWF01S_MakeFile("index.html", html);
    Net_Wireless_SPWF01S_MakeFile("led_and_keyb.js", js);
    DrawScreen(&Screen1);
    TFT_Set_Font (ipLabel.FontName, 0x4229, FO_HORIZONTAL);
    TFT_Write_Text(ipLabel.Caption, ipLabel.Left, ipLabel.Top);
    Net_Wireless_SPWF01S_GetCurrentIP(ipAddr);
    strcat( strcpy(ipLabel.Caption, "Type in your browser: "),
ip2Str(ipAddr, ipStr) );
    TFT_Set_Font (ipLabel.FontName, ipLabel.Font_Color,
FO_HORIZONTAL);
    TFT_Write_Text(ipLabel.Caption, ipLabel.Left, ipLabel.Top);
}
}

```

Ethernet transceiver



Figure 15-1: Ethernet transceiver module (LAN8720A)

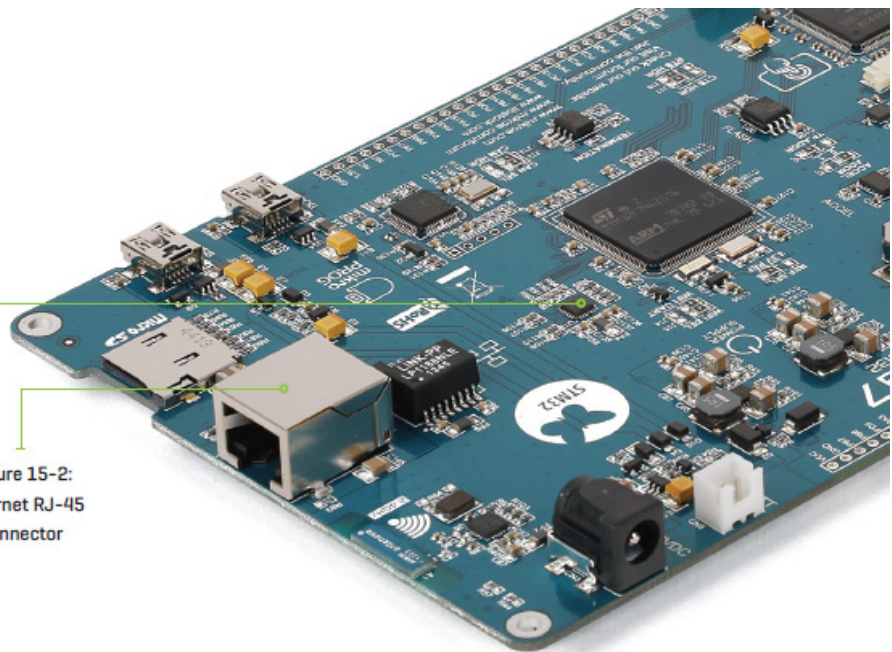


Figure 15-2: Ethernet RJ-45 connector

The development board features an Ethernet transceiver module LAN8720A. It is ideal for local area networking (LAN). If you want to establish connection with a computer, router or other devices, the development board also contains a standard RJ-45 connector. Communication over Ethernet is based on data packets called frames. Each frame contains source and destination addresses and error-checking data so that damaged data can be detected and retransmitted. Signalization LEDs (green and yellow) are on the opposite side of the board.

This function queries the DHCP server for an IP address:

```

static char Ethernet_DHCP() {
    char text[20], temp_text[7], i, result = SUCCESS;
    unsigned long timeout;
    if (ethDhcp_mark == NOT_SUCCESS) {
        Ethernet_Message("Obtaining IP ...");
    }
}

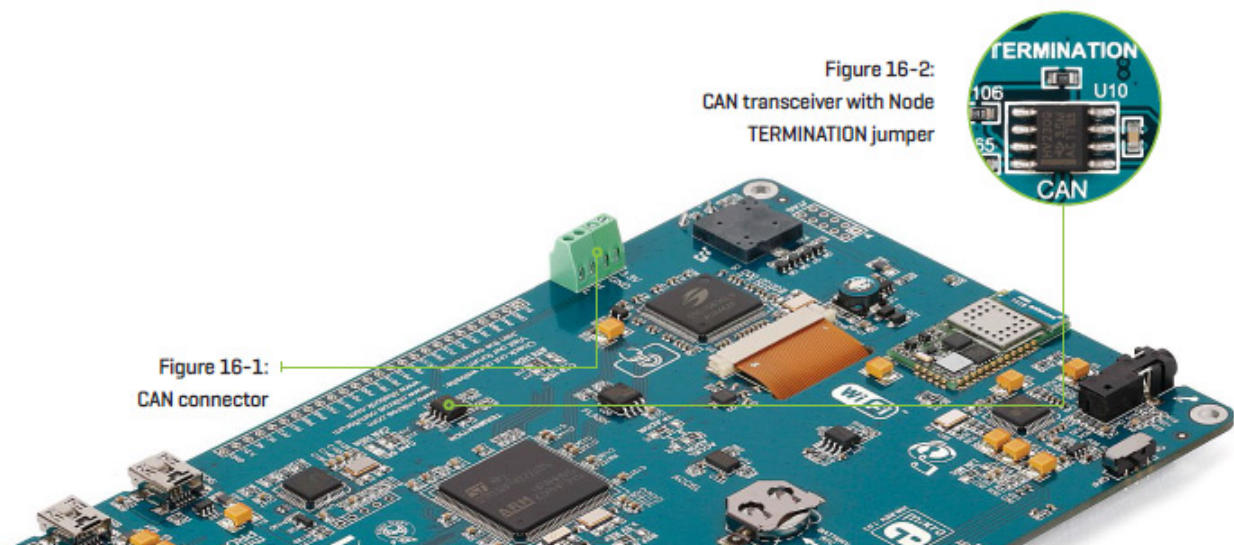
```

```

    timeout = 0;
    while((ethDhcp_mark == NOT_SUCCESS) && (timeout < 3)) {
        // init DHCP
        ethDhcp_mark = Net_Ethernet_Intern_initDHCP(5) ? SUCCESS :
NOT_SUCCESS;
        timeout++;
    }
    if (ethDhcp_mark == SUCCESS){
        // Get obtained IP
        memcpy(myIpAddress, Net_Ethernet_Intern_getIpAddress(), 4);
        text[0] = 0;
        for (i = 0; i < 4; i++){
            ByteToStr(myIpAddress[i], temp_text);
            strcat(text, temp_text);
            if(i != 3)
                strcat(text, ".");
        }
        // Display it on TFT
        Ethernet_Message(text);
    }
    else {
        Ethernet_Message("DHCP not respond");
        result = NOT_SUCCESS;
    }
    Delay_ms(2000);
}
Ethernet_Message("");
return result;
}

```

CAN communication



Controller Area Network (CAN or CAN bus) is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other within a vehicle without a host computer. CAN is a message-based protocol, designed specifically for automotive applications but now also used in other areas such as industrial automation and medical equipment. mikromedia 7 for STM32F7 is equipped with SN65HVD230 – a 3.3V CAN transceiver and a pair of screw terminals which provide microcontrollers with integrated CAN controller with the necessary physical interface for CAN communication. Make sure to correctly connect negative and positive differential communication lines before using this module.

Node termination jumper

If the board is the first and the last node of the CAN network, then TERMINATION jumper should be placed. If the board is a node in the middle, the jumper should be removed.

This short snippet shows the default initialization routine for the CAN module:

```
CAN_init() {
    CAN1InitializeAdvanced(1, 5, 4, 4, 1, Can_Init_Flags,
    &_GPIO_MODULE_CAN1_PD01);
    CAN1SetOperationMode(_CAN_OperatingMode_Initialization);
}
```

Buzzer

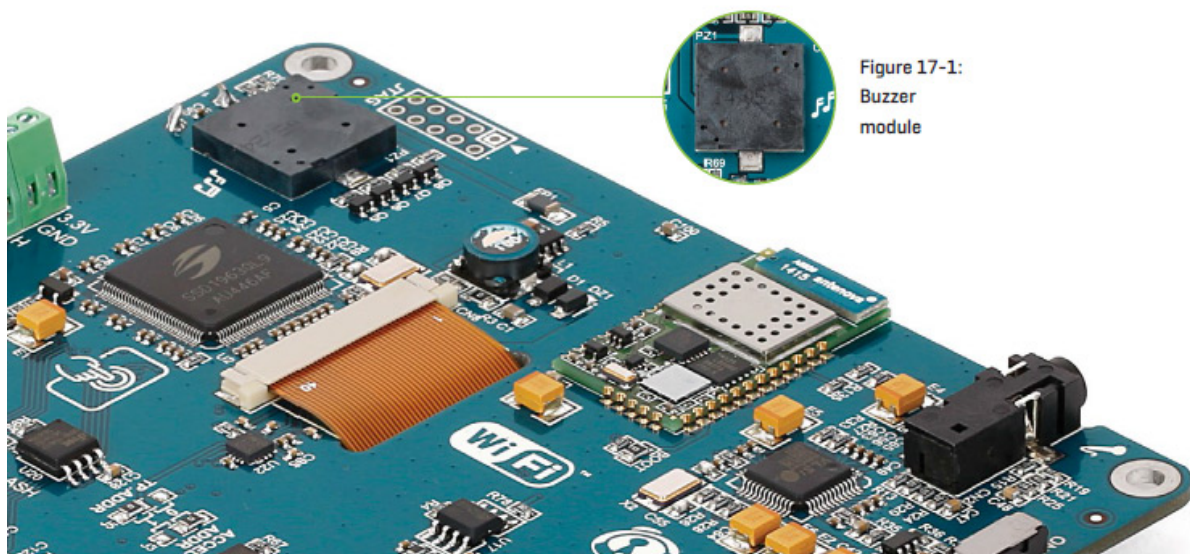


Figure 17-1:
Buzzer
module

The board is also equipped with a piezo buzzer. It is an electric component which can be used to create sound waves when provided with electrical signal. Microcontroller can create sound by generating a PWM signal. Frequency of the signal determines the pitch of the sound and duty cycle of the signal can be used to increase or decrease the volume.

This function plays a warning sound on the buzzer (three beeps of 100ms duration each, alternated with a 200ms delay):

```
void buzzer_warning( void ) {
    Sound_Play( 1000, 100 );
    Delay_ms( 200 );
    Sound_Play( 1000, 100 );
    Delay_ms( 200 );
    Sound_Play( 1000, 100 );
}
```

}

Other modules



The board also contains additional peripherals that can be very useful, such as 1 PIN photodiode, 2 IR receiver, 3 RGB led diode and 4 analog temperature sensor. PIN photodiode is a type of photo detector capable of converting light into the voltage with high sensitivity and speed of response. It is connected to the microcontroller analog pin. IR receiver is used for infrared remote control systems. The demodulated output signal obtained from IR module can be directly decoded by a microcontroller. Many of existing standard data formats are supported. RGB (Red, Green , Blue) diode is suitable for light indication in your design. Each of colour is driven separately by transistor. The analog temperature sensor converts temperature to analog voltage and it is directly connected to the microcontroller analog pin. Temperature measurement range of mikromedia 7 for STM32F7 board is from -20°C to 70°C.

This function reads the current temperature using MCU's 12 bit ADC module:

```
static void Get_Temperature() {
    unsigned long temp;
    float temp2;
    temp = ADC3_Get_Sample(6);
    temp = (unsigned long) (VREF * temp) / 4096;
    temp = temp - 500;
    Display_Temp(temp, 0);
    temp2 = (float) (temp) / 10 * 1.8 + 32;
    temp2 = temp2 * 10;
    Display_Temp((unsigned long)temp2, 1);
}
```

This function measures intensity of light using the MCU's 12 bit ADC module:

```
static unsigned int Get_Light_Intensity() {
    unsigned int Light_Intensity;
    char *ptr1, *ptr2;
    char text[7], temp;

    Light_Intensity = ADC3_Get_Sample(7);
```



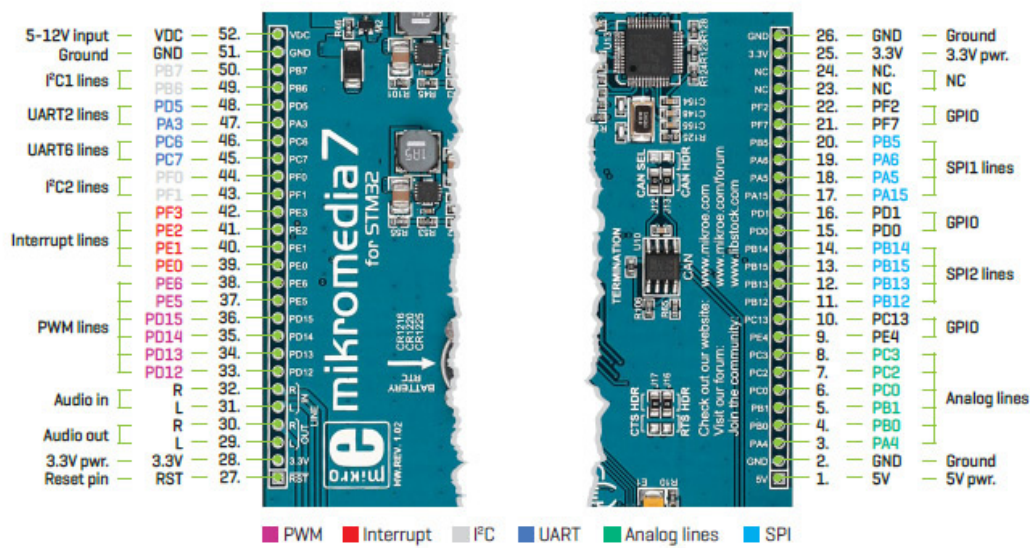
```
Light_Intensity = Light_Intensity / 4;
if (Light_Intensity >= 1000)
    Light_Intensity = 1000;
WordToStr(Light_Intensity, text);
ptr1 = text;
ptr2 = Diagram5_Label4_Caption;
while (*ptr1){
    if (*ptr1 != ' ')
        *ptr2++ = *ptr1;
    ptr1++;
}
ptr2--;
temp = *ptr2;
*ptr2++ = '.';
*ptr2++ = temp;
*ptr2++ = ' ';
*ptr2++ = '%';
*ptr2 = 0;
RedrawLabel(Diagram5_Box1.Color, &Diagram5_Label4, 240, 90);

return Light_Intensity;
}
```

This function displays color provided as an argument on RGB led:

```
static void Drive_RGB_Diode(TColors *colors){
    PWM_TIM2_Set_Duty((int)pwm_period2 / 64 * colors->Green,
    _PWM_NON_INVERTED, _PWM_CHANNEL2);
    PWM_TIM3_Set_Duty((int)pwm_period1 / 32 * colors->Blue,
    _PWM_NON_INVERTED, _PWM_CHANNEL1);
    SoftPWM_duty = colors->Red;
}
```

Pads



Many microcontroller pins are available for further connectivity via two 1x26 rows of connection pads on both sides of the board. They are designed to match with mikromedia 7 SHIELD for STM32F746ZG.

What's next?



You have now completed the journey through each and every feature of mikromedia 7 for STM32F4 board. You got to know its modules and organization. Now you are ready to start using your new board. We are suggesting several steps which are probably the best way to begin. Find useful projects and tutorials on the Libstock website (www.libstock.com ^[5]). Join our Forum (www.mikroe.com/forum ^[6]) and get help from a large ecosystem of users.

Compiler

You still don't have an appropriate compiler? Locate ARM® compiler that suits you best on our website: www.mikroe.com/arm/compilers ^[7] Choose between mikroC™, mikroBasic™ and mikroPascal™ and download a fully functional demo version, so you can start building your first applications.

Visual TFT

Once you have chosen your compiler, and since you already got the board, you are ready to start writing your first projects. Visual TFT software enables you to quickly create your GUI. It will automatically generate code compatible with MikroElektronika compilers. Visual TFT is rich with examples, which are an excellent starting point for your future projects. Download it from www.mikroe.com/visualtft ^[8]

Resources

- mikromedia 7 for STM32F7 landing page ^[9]
- mikroProg for STM32 drivers download ^[10]
- mikromedia for STM32F7 Libstock example ^[11]

References

- [1] <http://www.st.com/content/ccc/resource/technical/document/datasheet/96/ed/61/9b/e0/6c/45/0b/DM00166116.pdf/files/DM00166116.pdf/jcr:content/translations/en.DM00166116.pdf>
- [2] <http://www.mikroe.com/mikromedia/7/stm32f7>
- [3] http://cdn-docs.mikroe.com/images/a/a9/Mikromedia_7_stm32_schematic.pdf
- [4] http://www.mikroe.com/downloads/get/1809/mikroprog_suite_for_arm.zip
- [5] <http://www.libstock.com>
- [6] <http://www.mikroe.com/forum>
- [7] <http://www.mikroe.com/arm/compilers>
- [8] <http://www.mikroe.com/visualtft>
- [9] <http://www.mikroe.com/mikromedia/7/stm32f7/>
- [10] http://www.mikroe.com/downloads/get/2444/st_link_v2_usb_driver.zip
- [11] <http://libstock.mikroe.com/projects/view/1926/mikromedia-7-for-stm32f7>

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