Parrot (Voice Recorder) with ATtiny817 Hardware User's Guide

Introduction

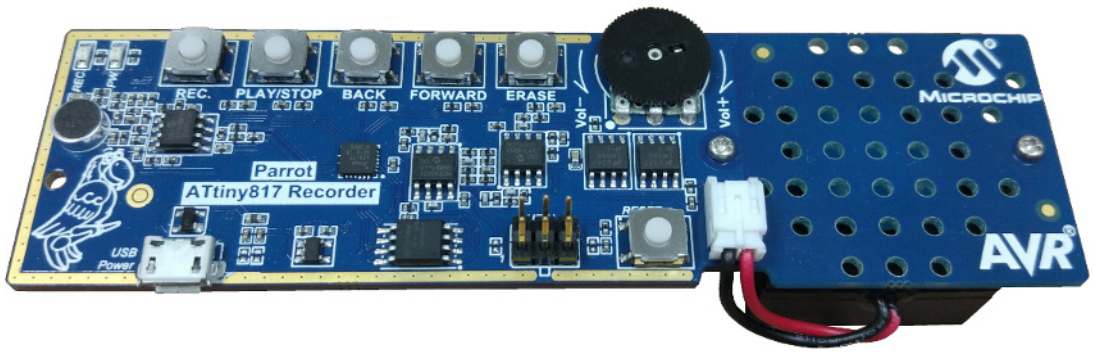
This user guide describes an audio demo board based on the ATtiny817, a high-performance tinyAVR® 8-bit microcontroller.

The Parrot field engagement board can be used as a voice recorder to record, play back, browse, and erase voice data. This application helps the user to quickly evaluate the ADC and DAC features of the microcontroller.

The firmware and accompanying application note (AVR42777) is available on Atmel START http://start.atmel.com/.

Features

- Voice Record and Playback
- Electret Microphone
- Volume Control
- 8Mb SPI Data Flash
- Single-Wire Programming via UPDI



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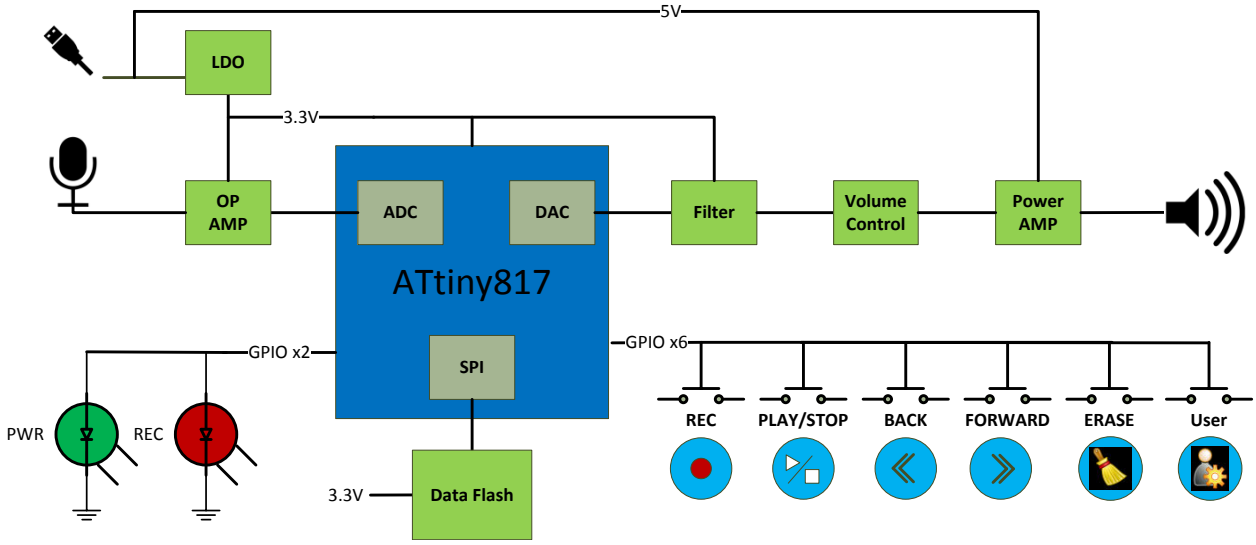


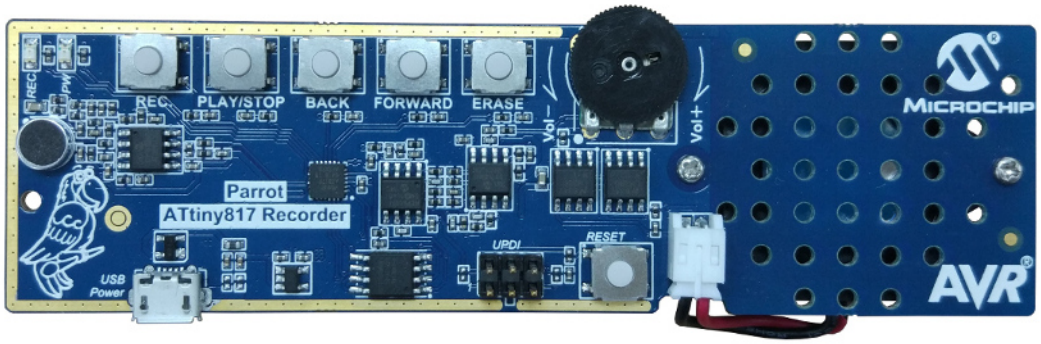
The Parrot field engagement board demonstrates the capabilities of the ATtiny817 with audio processing, using its ADC and DAC peripherals. It is possible to record, playback, erase, rewind, and fast forward by using the buttons.

As shown in the figure above, once the “REC” (record) button is pressed, the electret microphone starts to detect an analog sound signal. The sound signal will be processed in the front-end operation amplifier and a low-pass filter will be applied to the signal. The signal will then be digitized by the ADC of the ATtiny817 microcontroller. The converted sound data is stored in the external data Flash through the SPI interface. When the button is pressed again, this recording process is stopped.

Once the “PLAY/STOP” button is pressed, the sound data stored in the data Flash is read and converted to an analog signal through the DAC on the MCU. The analog signal is then sent through a low-pass filter before it is sent to the amplifier with the set volume. This allows the user to listen to the previously recorded sound. If the button is pressed again, the play process is stopped.

The board is supplied with +5V from the Micro-USB interface with ESD protection. The applied LDO can source out 150mA @ 3.3V system power.

Figure 1-1. Parrot Board



2. Hardware Details

2.1 Microphone

The device is a general low-cost electret microphone. See the table below for technical parameters.

It is highly recommended to keep the microphone at least 10cm away from the sound source to avoid peak clipping or distortion of the signal.

Table 2-1. Microphone Parameters

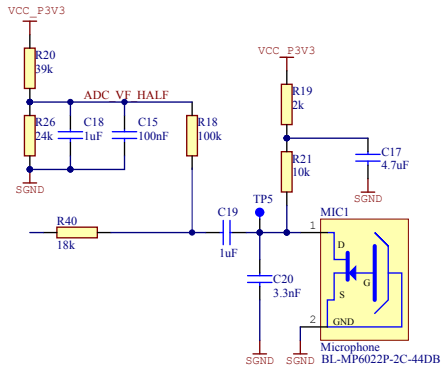
Parameters	Value
Manufacturer part number	BL-MP6022P-2C-44DB
Standard operation voltage (DC)	2V
Active current	<0.5mA
Sensitivity (1kHz, 0dB=1V/Pa)	-44dB ±3dB
S/N ratio	58dB
Impedance	< 2.2kΩ
Frequency (Hz)	20-16,000
Directivity	Omnidirectional

2.2 Filter for ADC

As shown in the figure below, the power for the microphone is VCC_P3V3, which is filtered by a low-pass filter to reduce noise from the power supply.

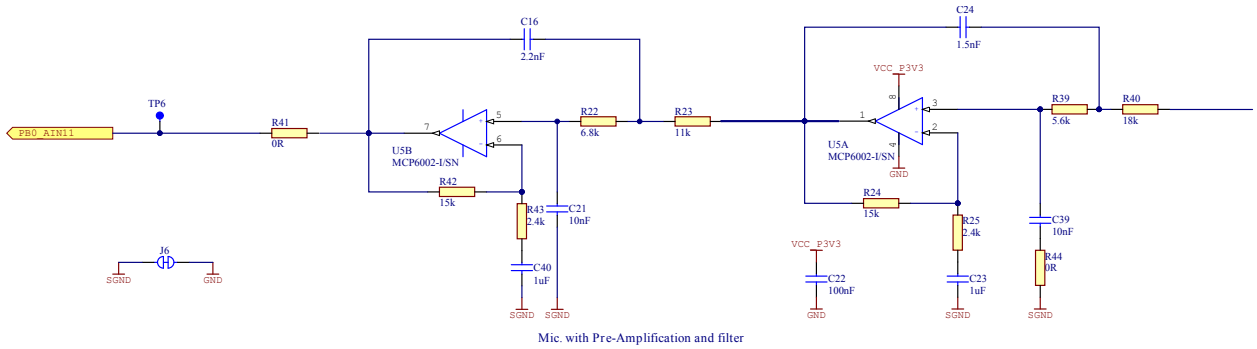
Typically, the original voice signal is quite weak, with measured amplitude around 10mV (less than 50mV). So the signal must be amplified and filtered accordingly. To make sure that the signal can be amplified without being distorted, a voltage offset is required.

Figure 2-1. Microphone Circuit



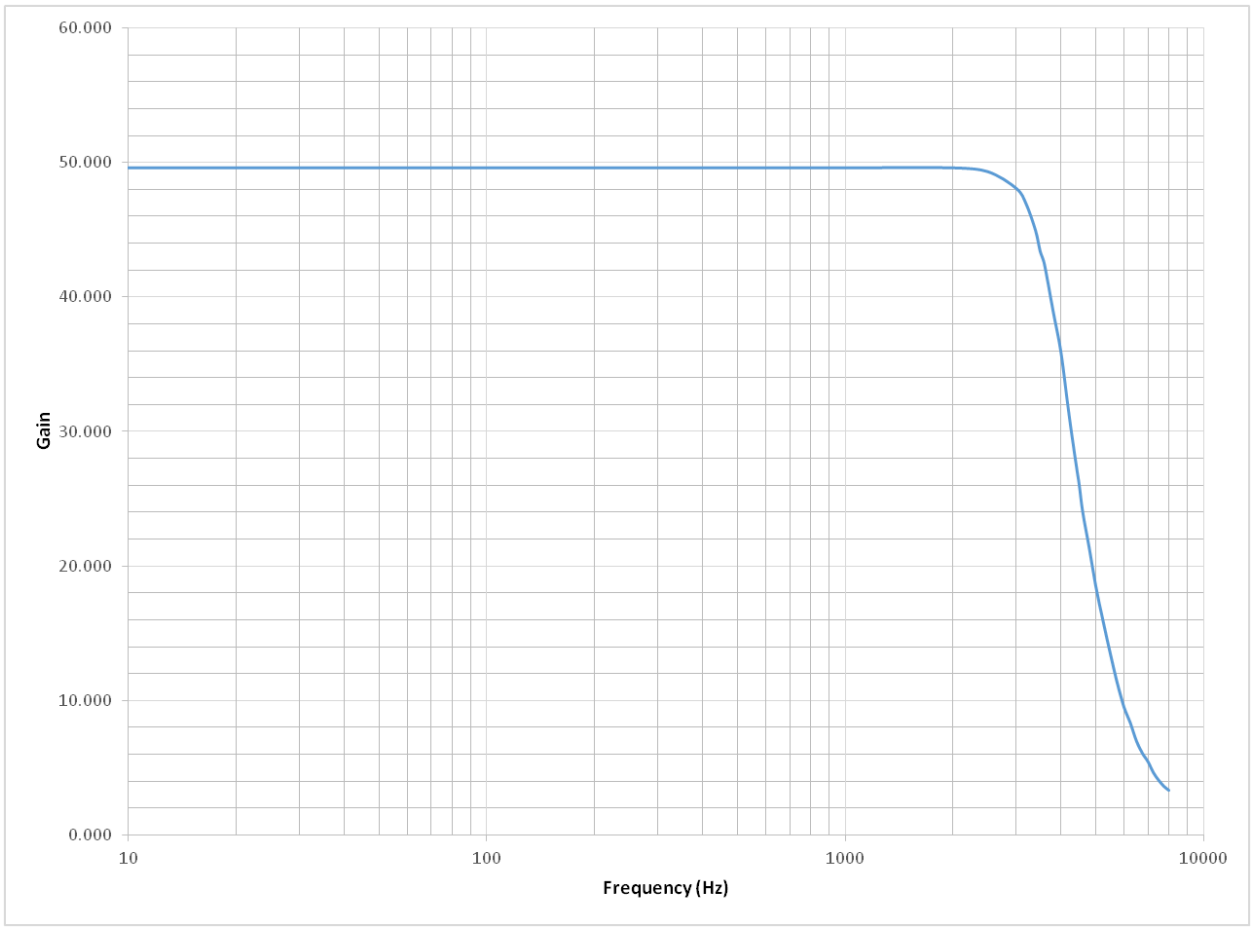
As shown in the figure below, the original signal is processed in a 4-order Sallen-Key Butterworth low-pass filter. The filter is designed to have a gain of 50 and a cut-off frequency of 4kHz. The amplified signal is connected to the MCU ADC input 11 (pin PB0_AIN11).

Figure 2-2. Amplifier and Filter Circuit



The real filter response vs. frequency curve based on measured data is shown in the figure below.

Figure 2-3. Gain vs. Frequency Curve for the Low-pass Filter of the MIC



2.3 Microcontroller

The ATtiny817 is a tinyAVR 8-bit microcontroller with up to 8KB Flash, 512 bytes of SRAM, and 128 bytes of EEPROM in a 14-, 20-, and 24-pin package.

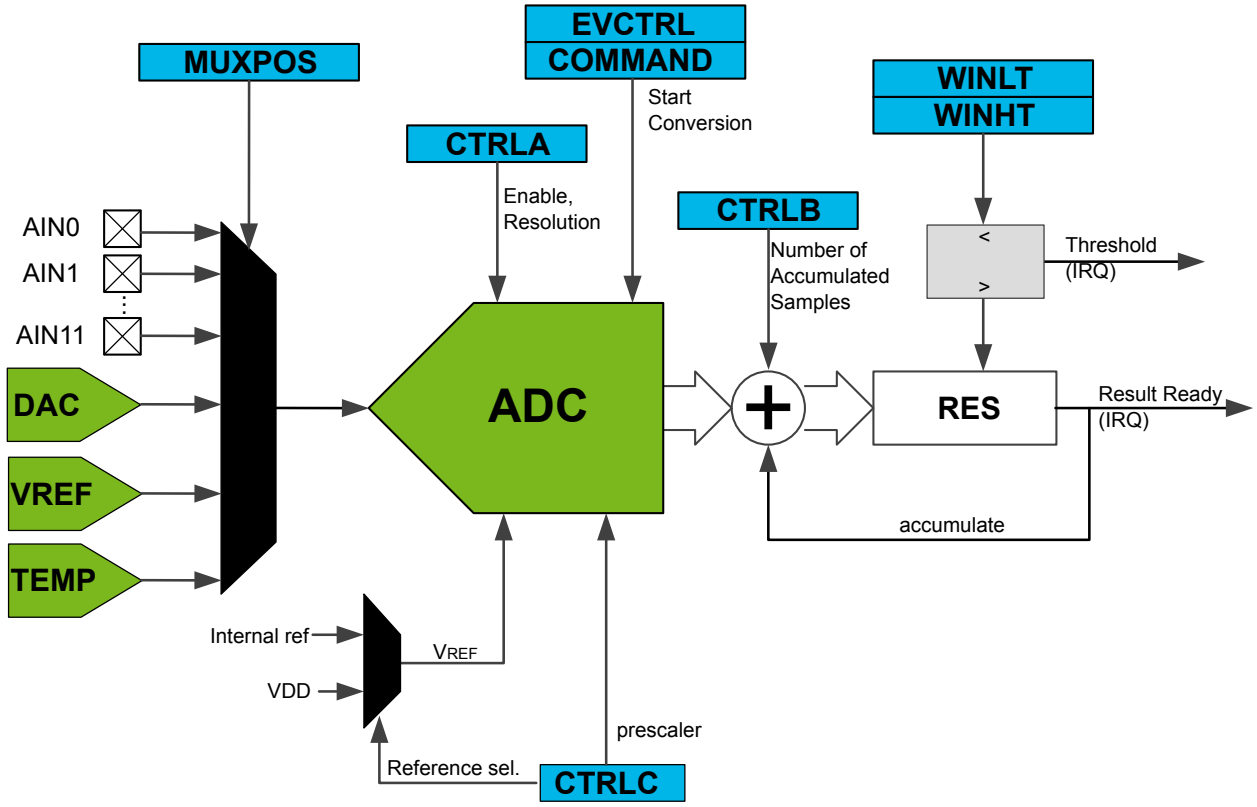
The microcontroller uses the latest technologies from Microchip Technology Inc. with a flexible and low-power architecture including Event System and SleepWalking, accurate analog features, and advanced peripherals.

2.3.1 ADC

The Analog-to-Digital Convert (ADC) peripheral features a 10-bit successive approximation ADC with capability of a sampling rate of up to 150ksps. The ADC is connected to a 12-channel Analog Multiplexer, which allows twelve single-ended voltage inputs. The single-ended voltage inputs refer to 0V (GND).

For more detail, refer to the latest data sheet of ATtiny817 available at http://www.microchip.com/wwwproducts/en/attiny817.

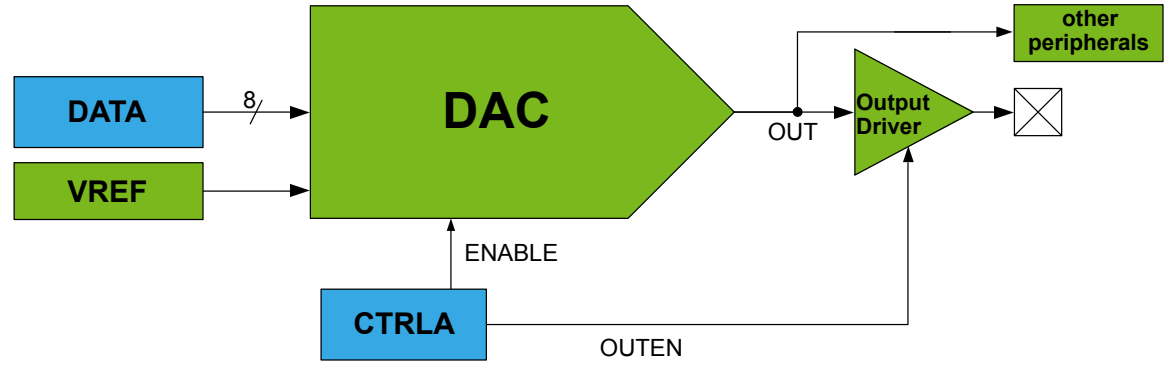
Figure 2-4. ATtiny817 ADC Block Diagram



2.3.2 DAC

The Digital-to-Analog Converter (DAC) converts a digital value to a voltage. ATtiny817 features an 8-bit Resistor String type DAC, capable of converting 350,000 samples per second (350ksps), with the internal Voltage Reference (VREF) as upper limit for conversion. The DAC has one continuous time output with high drive capabilities, which is able to drive a 5kΩ or 50pF load. The DAC has one analog output pin (DACOUT), namely the PA06, that must be configured before it can be used.

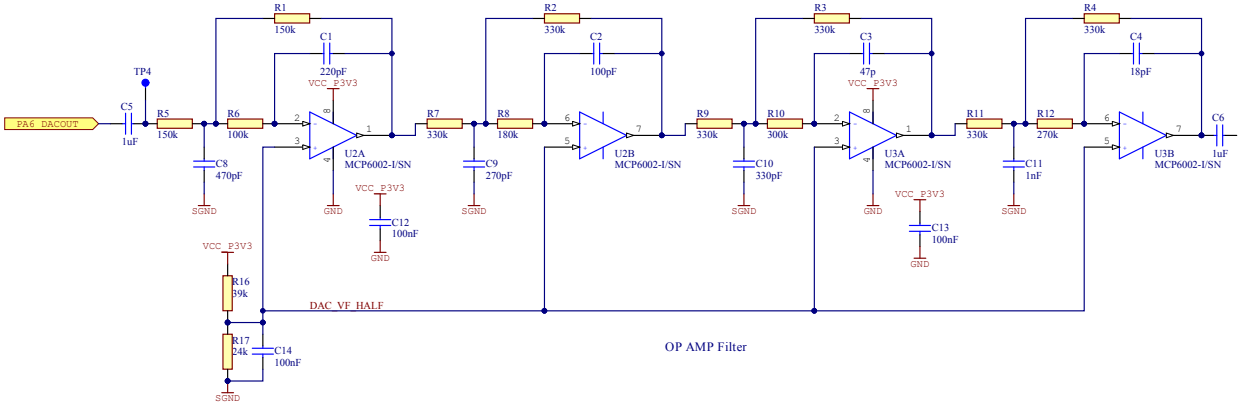
Figure 2-5. ATtiny817 DAC Block Diagram



2.4 Filter for DAC

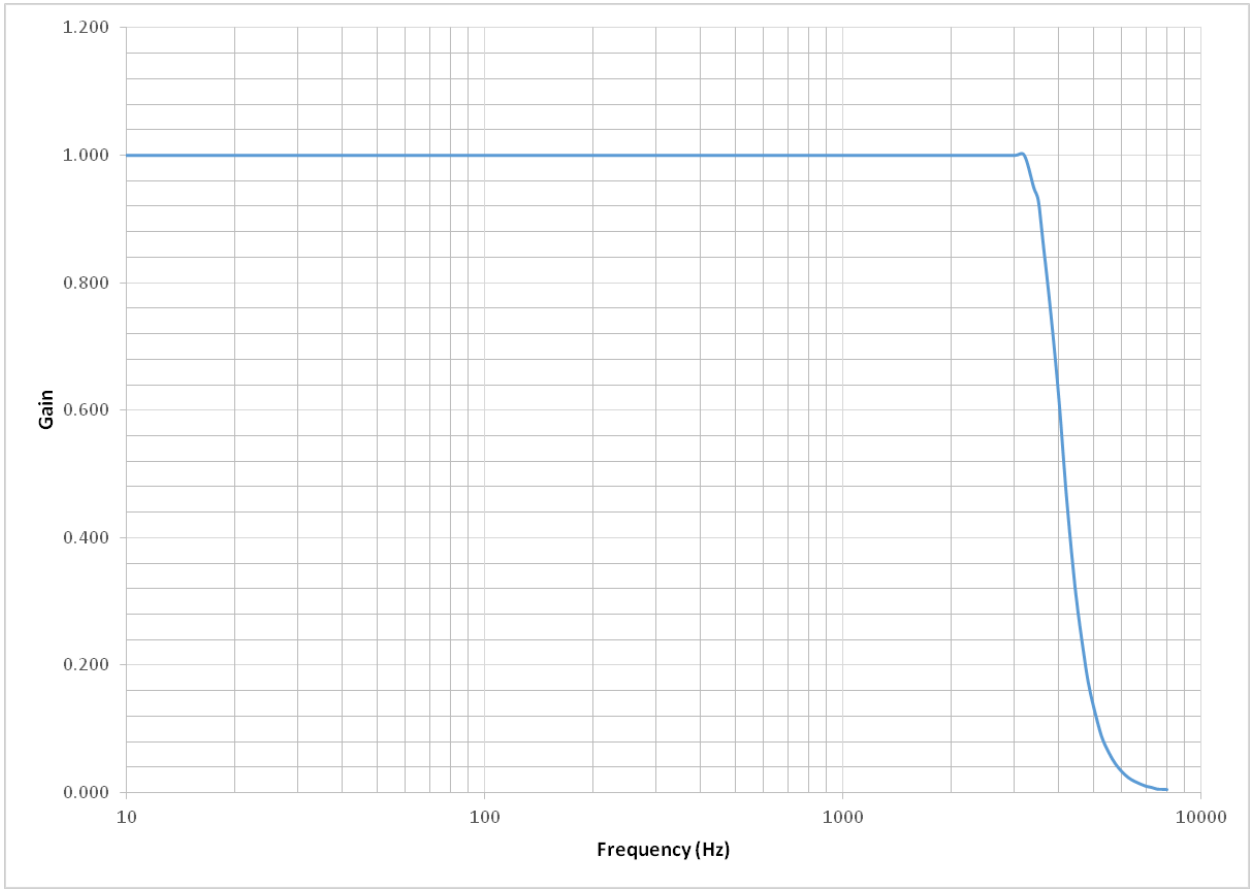
This filter is an 8-order Butterworth low-pass filter with 1V/V gain. The cut-off frequency is designed to be 4kHz with 0.5dB allowable pass band ripple.

Figure 2-6. 8-order Low-pass Chebyshev Filter



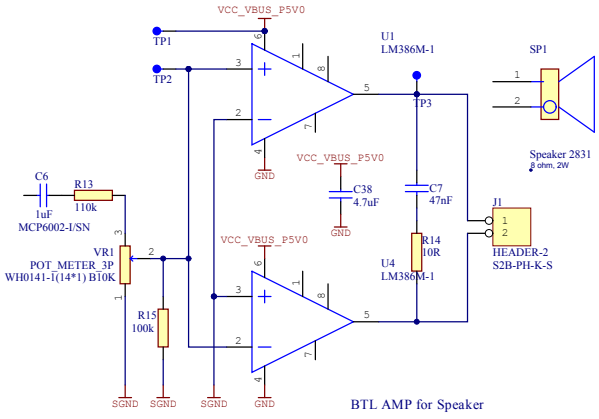
As shown in the figure below, the curve is based on measured data of the filter on the board.

Figure 2-7. Gain vs. Frequency Curve for the 8-order Low-pass Filter



2.5 Power Amplifier

Figure 2-8. Power Amplifier for the Speaker



As shown in the figure above, the LM386M-1 amplifier device is powered by USB +5V. The gain from the power amplifier circuit is fixed to 20 V/V. The input of this circuit is the analog output of the 8-order low power filter for the DAC.

In front of the power amplifier, one variable resistor (VR1) and a couple of relative resistors construct a simple circuit for the users to adjust the loudspeaker volume.

2.6 User Interfaces

2.6.1 Buttons

There are six functional buttons on the board:

- “REC” button, to start or stop the microphone recording
- “PLAY/STOP” button, to playback the recorded sound
- “BACK” button, to jump to previous sound data
- “FORWARD” button, to jump to forward sound data
- “ERASE” button, to erase sound data
- “USER” button, reserved for users

Figure 2-9. Buttons

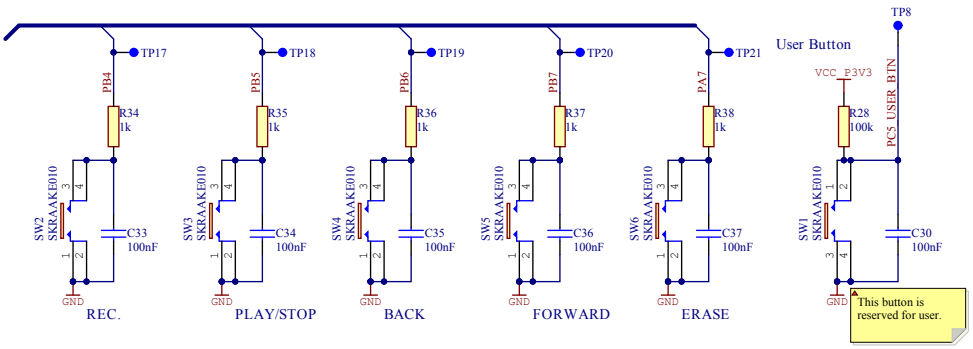


Table 2-2. Pin Map for the Buttons

Button Name	I/O Pin
REC	PB4
PLAY/STOP	PB5
BACK	PB6
FORWARD	PB7
ERASE	PA7
USER	PC5

2.6.2 LEDs

There are two LEDs on the board, as shown in the figure below. The firmware determines the use of the LEDs.

Figure 2-10. Status LEDs

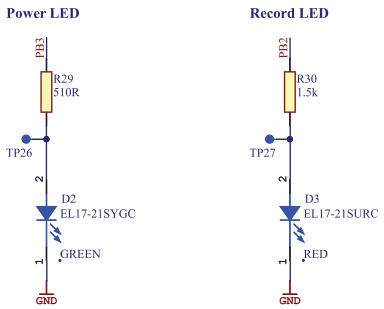


Table 2-3. Pin Map for the LEDs

Recommended LEDs name	ATtiny817 I/O pin	Color
Power LED	PB3	Green
Record LED	PB2	Red

2.7 External Data Flash

This data Flash from Microchip is an 8Mb SPI serial Flash. It supports single voltage read and write operations under 2.7-3.6V power supply.

Figure 2-11. External Data Flash

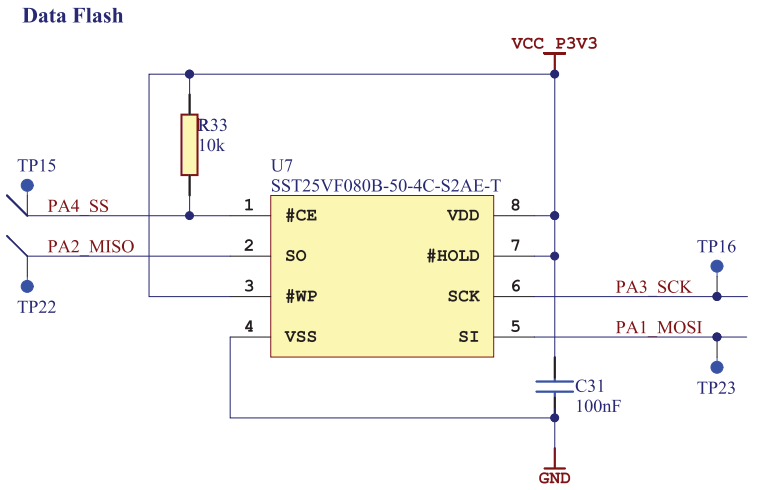


Table 2-4. Pinout for the SPI Interface

SPI Signal Name	MCU SPI Pin	Data Flash Pin
SCK	PA3	pin #6
SS	PA4	pin #1
MISO	PA2	pin #2
MOSI	PA1	pin #5

2.8 UPDI Programming Interface

The ATtiny817 supports UPDI (Unified Program and Debug Interface), which is a Microchip proprietary interface for external programming and on-chip debugging of a device.

Atmel-ICE supports the UPDI interface. The 2x3 connector for the interface is a 2.54mm pitch through-hole header.

Figure 2-12. UPDI Interface

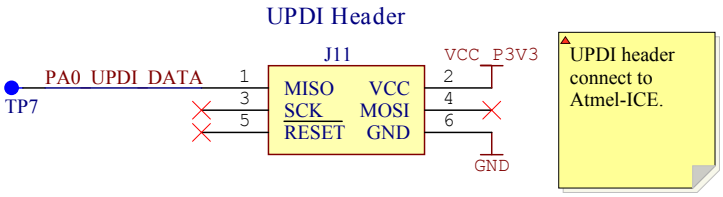


Table 2-5. Pin Map for ATtiny817 UPDI Interface

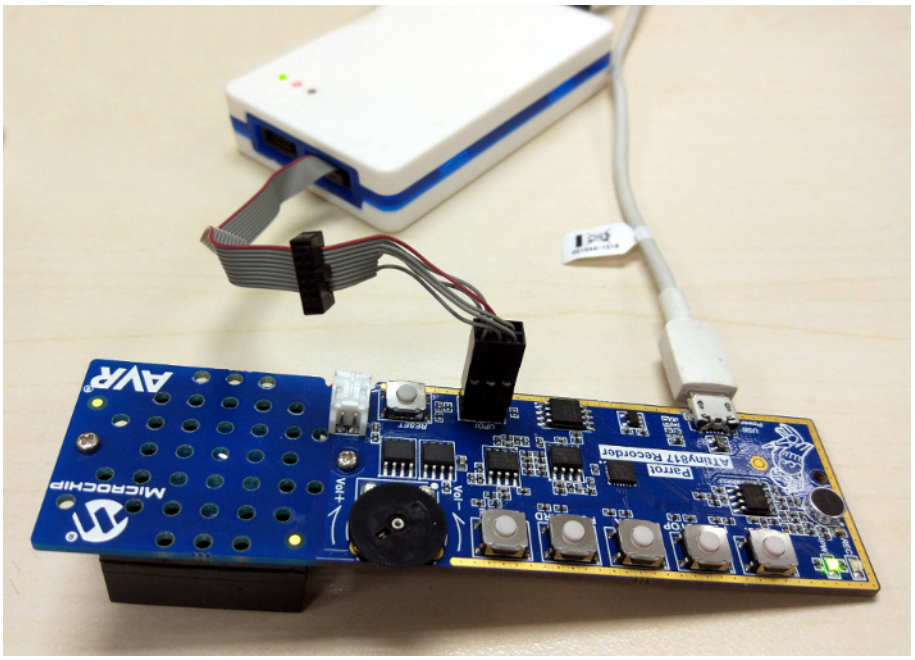
Signal Name	Pin Number in the Header	Pin Number in the MCU
PA0_UPDI_DATA	1	23
VCC	2	4
GND	6	3

3. Firmware Programming

3.1 Connection

The UPDI Interface is dedicated for the code debugging or reprogramming for the ATtiny817 device. Atmel-ICE supports this operation.

Figure 3-1. Connection for the Reprogramming



3.2 Firmware

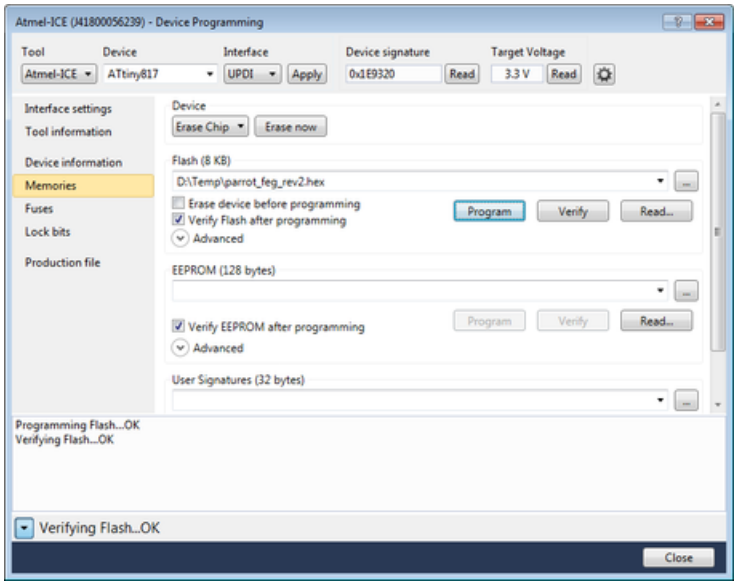
The latest firmware is available through **Atmel START:** http://start.atmel.com/

Search 'AVR42777 Parrot' in the Examples browser. The project user guide instructions outline how to download the .atzip package and import the project into Atmel Studio 7.0.

3.3 Programming

Atmel Studio can be used to program the device. Go to Tools → Device Programming → Memories.

Figure 3-2. Programming Interface in Atmel Studio



4. Revision History

Doc. Rev.	Date	Comments
A	07/2017	Initial document release.

5. Object of Declaration

EU Declaration of Conformity for Parrot Field Engagement Board

This declaration of conformity is issued by the manufacturer.

The development/evaluation tool is designed to be used for research and development in a laboratory environment. This development/evaluation tool is not a Finished Appliance, nor is it intended for incorporation into Finished Appliances that are made commercially available as single functional units to end users under EU EMC Directive 2004/108/EC and as supported by the European Commission's Guide for the EMC Directive 2004/108/EC (8th February 2010).

This development/evaluation tool complies with EU RoHS2 Directive 2011/65/EU.

This development/evaluation tool, when incorporating wireless and radio-telecom functionality, is in compliance with the essential requirement and other relevant provisions of the R&TTE Directive 1999/5/EC and the FCC rules as stated in the declaration of conformity provided in the module datasheet and the module product page available at www.microchip.com.

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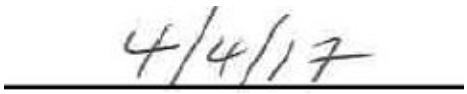
Signed for and on behalf of Microchip Technology Inc. at Chandler, Arizona, USA.

Rodger Richey
Director of Development Tools



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