# AVR652: ATtiny43U Demonstration Kit

8-bit AVR® Microcontrollers

Application Note

## Features

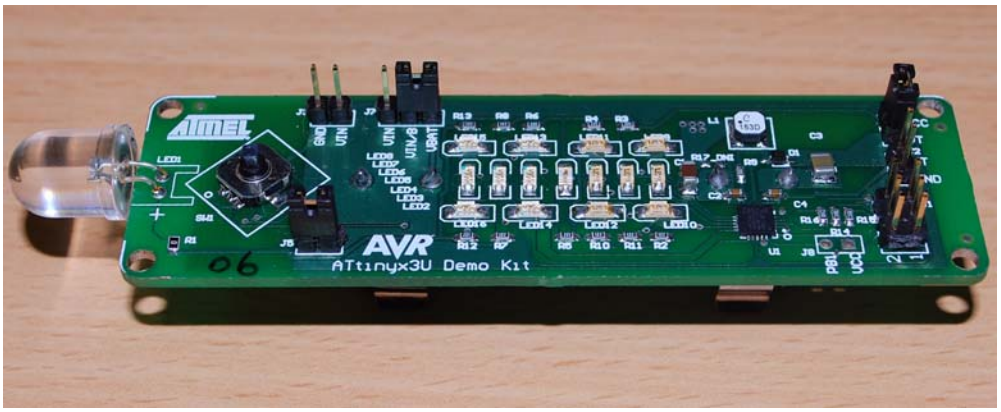
- **ATtiny43u With Integrated Boost Regulator**
- **Powered By Battery Or External Power Supply**
- **High Brightness LED**
- **Joystick For User Input**
- **ISP Interface For Programming**

## 1 Introduction

AVR®652 is a Hardware platform to demonstrate the capabilities of ATtiny43U device, also providing support for programming and debug via ISP and debugWIRE.

This document provides a description of both the Hardware and Software of AVR652

**Figure 1-1.** ATtiny43U Demonstration Kit

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# 2 Features Overview

The schematics and layout files (gerber format) are available in separate files distributed with this application note. The bill of material is found last in this document.

**Figure 2-1**. ATtiny43U Demo board Top

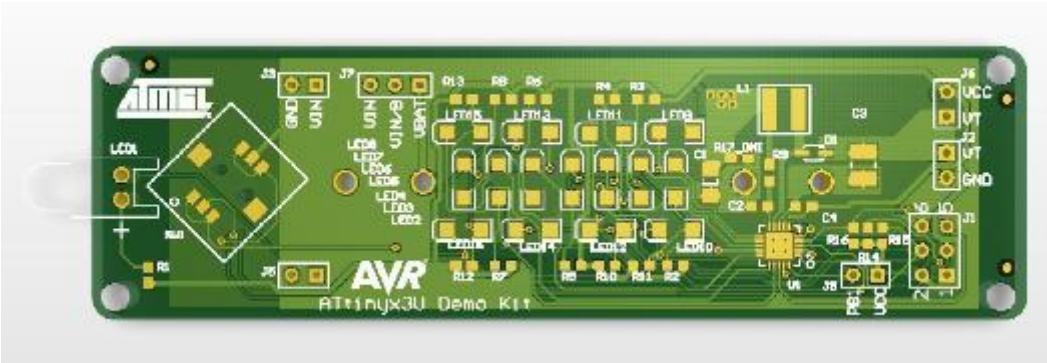
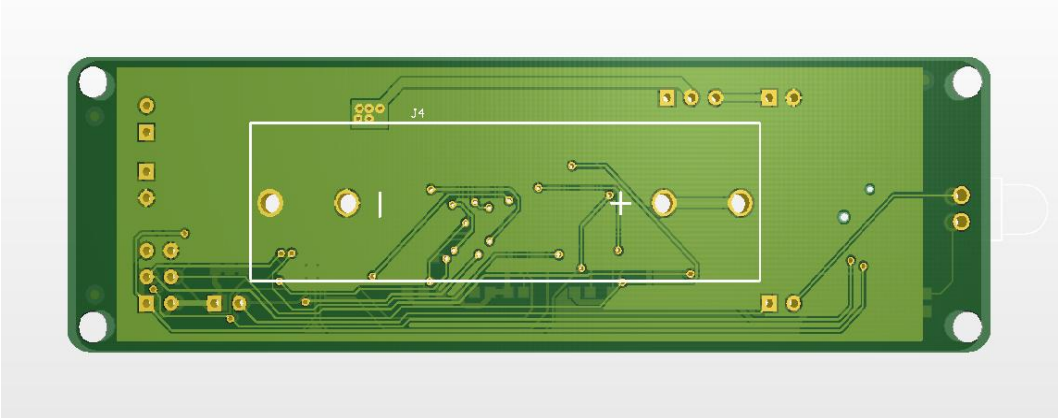



**Figure 2-2**. ATtiny43U Demo board Bottom



# 3 Hardware Description

## 3.1 AVR Microcontroller

ATtiny43U has an integrated (3.0V) Boost Regulator making it suitable for single AA-Battery operated applications. The controller has 4K Flash, 64 Bytes EEPROM & 128/256 Bytes of Internal SRAM.

## 3.2 Integrated Boost Regulator

A boost regulator converts a low DC voltage (as low as 0.9V) to a higher regulated (3.0V) DC voltage. The integrated boost regulator of ATtiny43U provides the

microcontroller (and its peripherals) with a fixed supply of 3.0V, even if the input supply from AA-battery or an external power supply drops as low as 0.9V.

The ATtiny23U/43U boost regulator is a switching type, step-up regulator that uses an external inductor, a diode and some bypass capacitors. The boost converter is self-sufficient, completely independent and does not need any control from the MCU. The converter starts automatically as soon as there is sufficient voltage at the VBAT pin.

The microcontroller will start as soon as the regulated output of the boost converter rises above power-on and brown-out reset levels (if enabled). After the MCU is released from reset and has started running the application software can then measure the battery voltage and decide if there is sufficient voltage to continue operation. Without the boost converter connected the microcontroller can be powered directly from an external source also.

## 3.3 Joystick

A four way Joystick is used with the opposite switches shorted and hence providing 3 switches effectively for the users to select the mode of operation and control functions in each mode. The Joystick is connected to PB2, PB4 and PB6 of ATtiny43U.

The Center switch used for selection of Mode and the other two switches for control of selected mode functionality.

**Figure 3-1.** Joystick

## 3.4 Power Supply

AVR652 can be powered either by an AA size battery or an external power supply. The jumper J7 is used to configure the power supply to the device.

For using a battery J7 has to be connected between VIN/B and VBAT.

While using an external Power supply, the jumper J7 has to be connected between VIN and VIN/B.

And external power supply must be connected to J3 (VIN & GND).

The power supply range can be from 0.7V to 1.8V. From that voltage the Boost Converter of ATtiny43U provides the microcontroller (and its peripherals) a fixed supply of 3V. The start voltage of the Boost Converter is approximately 1.2V.

### 3.4.1 Battery Supply*

Hardware setup for battery operation is:

1. Mount jumper J7 on VBAT and VIN/B
2. Mount jumper J6 on VCC and VT
3. Mount AA Battery (1.5V) in the Battery Holder

**Figure 3-2.** Battery connected. J7 jumper mounted

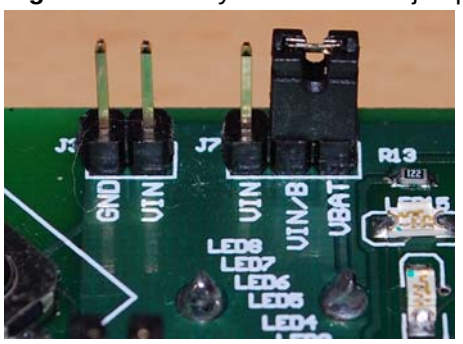
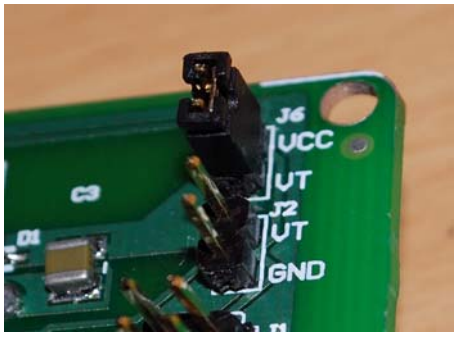



**Figure 3-3.** Battery connected. J6 jumper mounted




* Package does not contain AA size Battery

### 3.4.2 External Supply with Boost Regulator ON

There is also a provision to provide external variable supply to VBAT to test the Boost Regulator operation.

**Figure 3-4.** Variable Supply to VIN pin

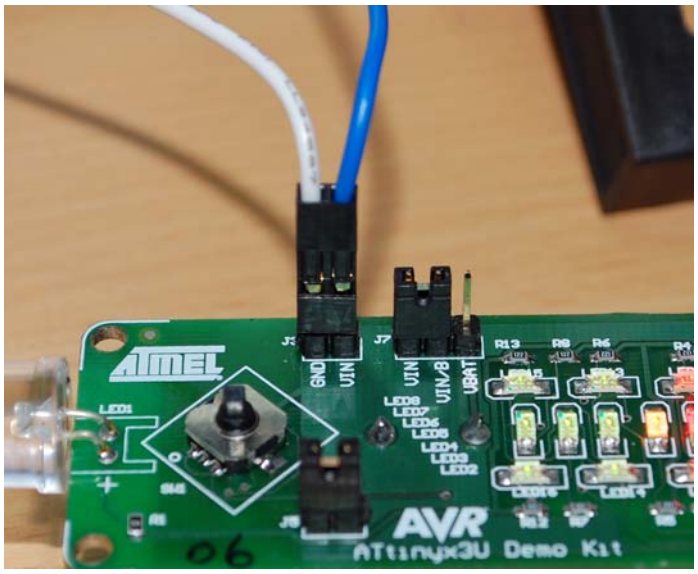
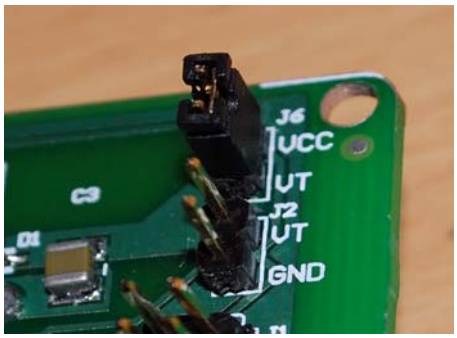


**Figure 3-5.** J6 jumper mounted




Hardware setup for variable supply to VBAT input is:

1. Mount jumper J7 on VIN and VIN/B. Battery connected will be isolated from the circuit.
2. Mount jumper J6 on VCC and VT.
3. Use a 2-wire cable on J3 to provide the external variable supply to VBAT.
4. Vary the supply voltage from 1.8V to 0.7V demonstrating the capability of ATtiny43U to operate at very low voltage levels.

Note: At 0.7V VIN voltage the loading capability of the VCC is below 15mA.

### 3.4.3 External Supply with Boost Regulator OFF

Without the boost converter connected the microcontroller can be powered directly from an external source. The external source can be 1.8 – 5.5V

Hardware setup for external supply is:

1. Mount jumper  J7 on VIN and VIN/B
2. Mount jumper J6 on VCC and VT
3. Mount jumper J3 on VIN and GND
4. Use a 2-wire cable on J2 to provide the external variable supply

**Figure 3-6**. External Supply to J2

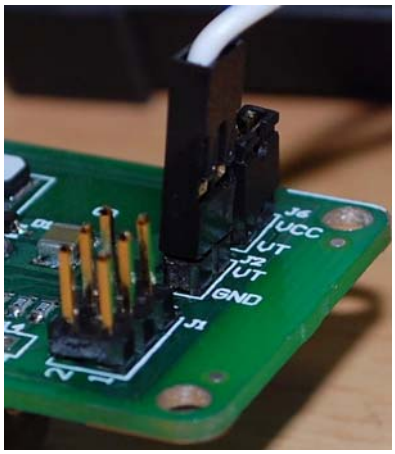
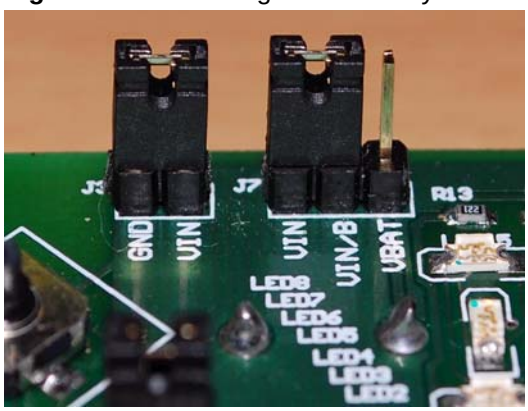


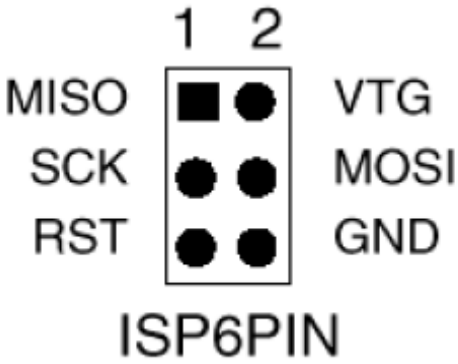
**Figure 3-7.** Boost Regulator OFF by mounting J3 and J7




## 3.5 Programming Interface

The device can be further programmed via ISP and J1 serves as a programming interface for AVR652. The device can be programmed using any standard ISP programmer for AVR Devices.

**Figure 3-8**. ISP Connector




## 3.6 Debug Interface

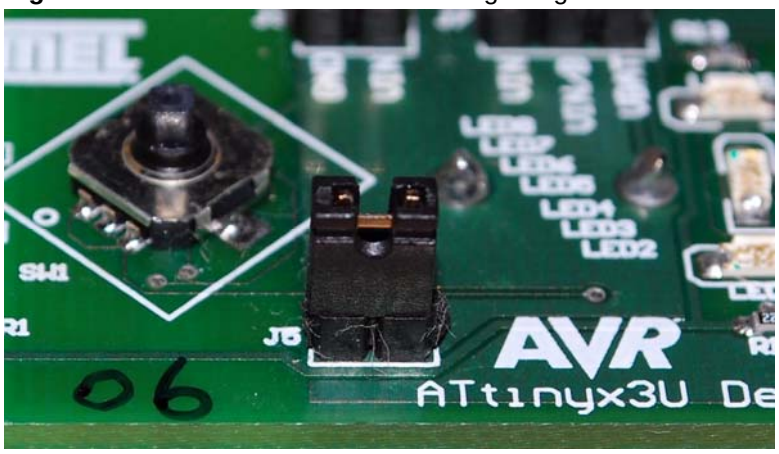
The ISP connector available in AVR652 can be used for debugging ATtiny43U via debugWIRE.

## 3.7 Outputs

### 3.7.1 High Brightness LED

The High Brightness white LED, LED1, is used to demonstrate the high current driving capability of the high sinking I/O pins. The LED1 is connected to one of these pins, PB1. Jumper J5 is present in series to this LED providing an option to disconnect it from pin PB1 and to measure the current of the High Bright LED with ammeter. Mount J5 for normal operation.

**Figure 3-9.** J5 header to measure the High Bright LED current




There is also an option to connect Auxiliary Load to PB1 in sinking configuration. The load has to be connected to J8 and un-mount jumper J5.

### 3.7.2 LEDs

There are 15 more LEDs available in AVR652 to demonstrate various functionality of the application software loaded.

### 3.7.3 Boost Converter with External Load

The loading capability of the Boost Converter can be tested with external load. Typically up to 30mA and even 60mA can be achieved from the pin VT with above 1.0V and 1.2V of VBAT voltages, respectively.

- Set Demo Kit to Torch mode
- Disconnect J5 for maximum external loading capability
- Connect external load between VT and GND on J2

Note: If overloaded, the Converter VT voltage drops below 2.7V. Disconnect the external load and apply 1.2V of VBAT voltage to start the ATtiny43U again.

Note: No external loads are allowed when the Boost Converter in starting its operation.

# 4 Software Description

The AVR652 Software is available as a separate downloadable file from www.atmel.com

## 4.1 Modes of Operation:

- Idle Mode
- Torch mode
- Battery Gauge mode
- Dice mode
- LED Chaser
- Twinkle mode

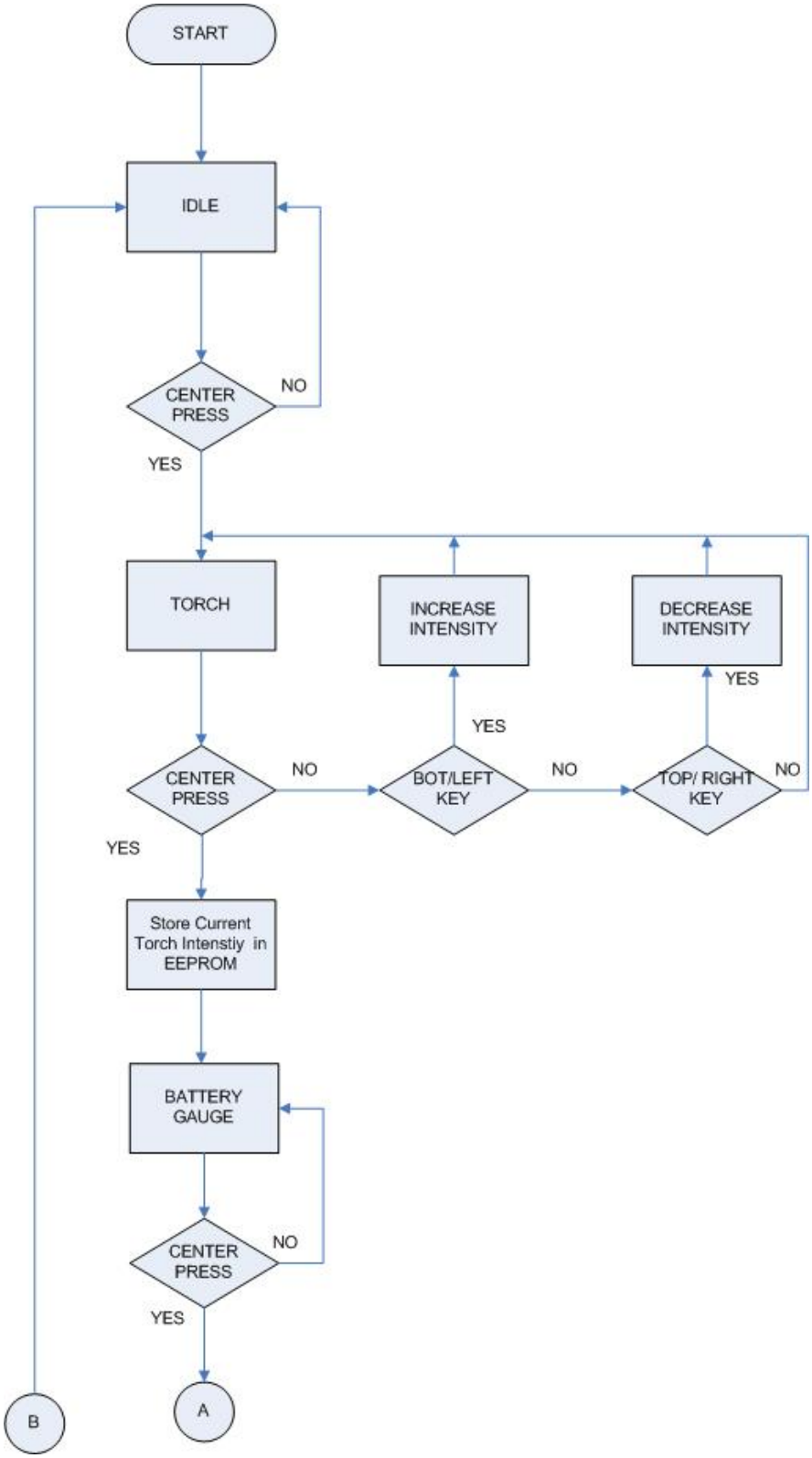
## 4.2 User Settings:

User Settings for Intensity (PWM values) of LEDs are stored in EEPROM along with the speed settings for LED Chaser and Intensity level of High Brightness LED while switching to the next mode. These settings are used as initial levels in the corresponding modes while entering.

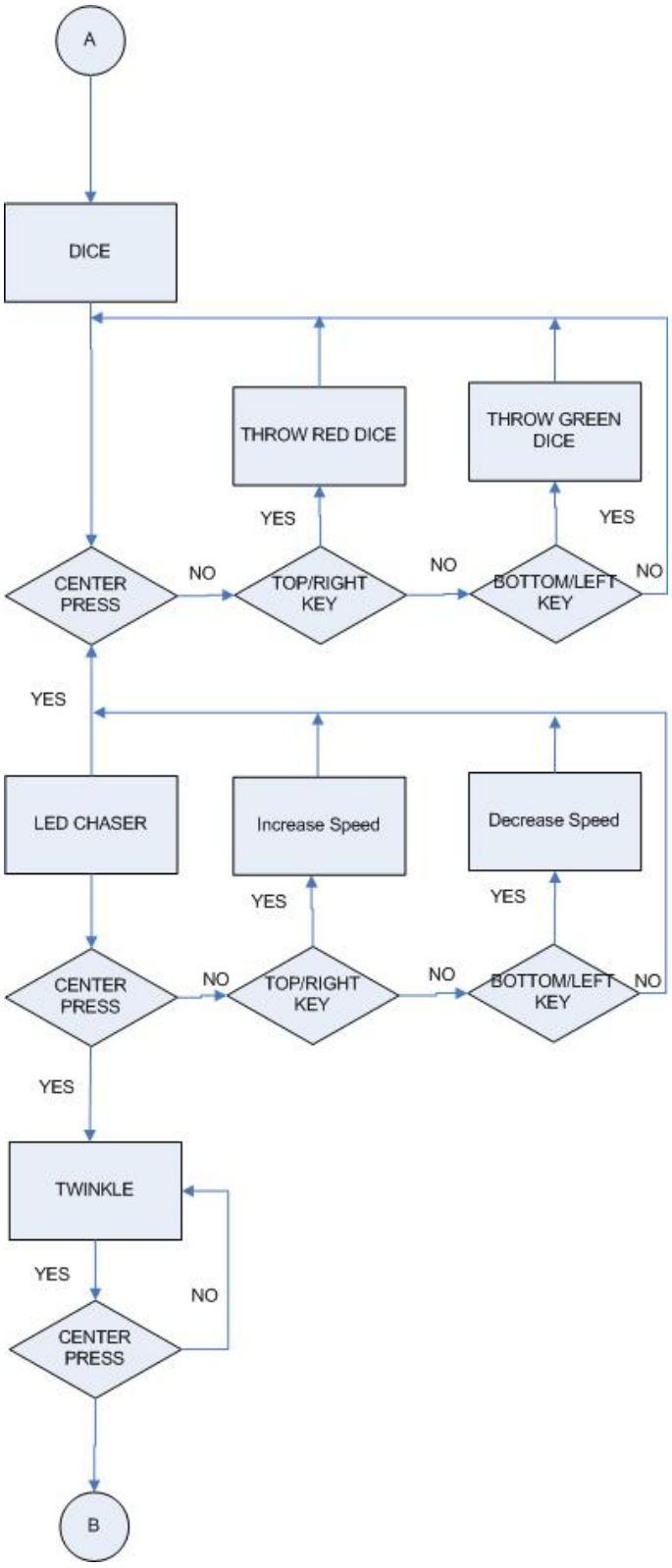
## 4.3 Demonstration of modes:

1. Connect the kit in the Battery mode as explained in Section 3.4.1 Battery Supply
2. Once powered all the LEDS will flash once during initialization and the kit enters the **IDLE** mode.
3. Press the joystick Center Key and the device enters the **TORCH** mode.
4. In the Torch mode the High Bright LED will be ON with the last stored intensity level. Press the joystick Left/Down to increase the intensity. Press the joystick Right/Up to decrease the intensity.
5. Press the joystick Center Key and the device enters the **BATTERY GAUGE** mode.
6. In the Battery Gauge mode the LED status shows the charge on the battery. If the Green, Yellow and Red LEDs are ON it means that the Battery is healthy. Reduction of Battery charge switches off LEDs from left to right, i.e., green to red. Only RED LEDs lit means that the Battery is to be recharged or replaced. This mode can be demonstrated by using an external power supply instead of Battery as explained in Section 3.4.2 External Supply with Boost Regulator ON
7. Press the joystick Center Key and the device enters the **DICE** mode.
8. In the Dice mode, default value ‘5’ is shown on the Red and Green LEDs. Press the joystick Left/Down to change the Red Dice. Press the joystick Right/Up to change the Green Dice.
9. Press the joystick Center Key and the device enters the **LED CHASER** mode.
10. In the LED chaser mode the LEDs will move back and forth with fading pattern.
11. Press the joystick Center Key and the device enters the **Twinkle** mode.
12. In the Twinkle mode LEDs will be randomly lit.
13. Steps 3 to 13 can be repeated with External Supply (as explained in Section 3.4.3) instead of Battery or with External Supply (as explained in Sections 3.4.1 & 3.4.2) with the Boost Regulator disabled.

## 5 Software Flow Chart



**Software Flow Chart Continued**.



# 6 Schematics and Bill of Materials

The schematics can be downloaded from www.atmel.com as separate PDF file.

**Table 6-1. Bill Of Material for AVR652**

| SL NO | Description | Vendor Part Number | Vendor name | Designator | Quantity |
|---|---|---|---|---|---|
| 1 | CAP CER 4U7F 10% 50V 1206 X5R | | | C1 | 1 |
| 2 | CAP CER 22UF 10% 50V 1210 X5R | | | C3 | 1 |
| 3 | CAP CER 0U1F 10% 50V 0603 | | | C2, C4 | 2 |
| 4 | DIO SCHOTTKY SOD323 | BAT20JFILM | ST Microelectronics | D1 | 1 |
| 5 | CON HDR 6PIN (2x3) BERG STICK 2.54mm | 7731310106LF | FCI | J1 | 1 |
| 6 | CON HDR 2PIN (1x2) BERG STICK 2.54mm | 7731110102LF | FCI | J3, J5, J6,J2 | 3 |
| 7 | CON HDR 3PIN (1x3) BERG STICK 2.54mm | 7731110103LF | FCI | J7 | 2 |
| 8 | CON AA BATT HOLDER | 92 | Kingstone® Electronics | J4 | 2 |
| 9 | IND 15UH 0.86A | LPS4018-153MLB | Coilcraft® | L1 | 1 |
| 10 | LED SMD RED 1206 | 15-21SURC/S530-A2/TR8 | Everlight | LED2, LED3, LED4, LED9, LED10, LED11, LED12, | 7 |
| 11 | LED SMD GREEN 1206 | 15-21SYGC/S530-E2/TR8 | Everlight | LED6, LED7,LED8, LED13, LED14, LED15, LED16 | 7 |
| 12 | LED SMD YELLOW 1206 | 15-21UYC/S530-A2/TR8 | Everlight | LED5 | 1 |
| 13 | High Bright LED White TH 3mm (VF=3V, IF=20mA) | | | LED1 | 1 |
| 14 | RES SIN 0R .0625W 0603 | | | R1 | 1 |
| 15 | RES SIN 220R .0625W 0603 | | | R2, R3, R4, R5, R6, R7, R8, R10, R11, R12, R13, | 11 |
| 16 | RES SIN 680R .0625W 0603 | | | R9 | 1 |
| 17 | RES SIN 10K .0625W 0603 | | | R14, R15, R16 | 3 |
| 18 | 4 way joystick with press function | SKRHABE010 | ALPS® | SW1 | 1 |
| 19 | MCU ATtiny43U | ATtiny43U-MU | Atmel® | U1 | 1 |
| 20 | PCB | | | | 1 |

# 7 Certification and Compliance

This design Hardware and Software together complies CE/FCC Standards.

# 8 EVALUATION BOARD/KIT IMPORTANT NOTICE

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