CANADUINO® ES100 ADK V2 Tech Demo

Demo application user manual for CANADUINO® ES100 Application Development Kit V2

1. Overview

The ES100 ADK Tech Demo is a demonstration firmware for the Everset ES100 WWVB-BPSK radio time receiver. It combines:

- ES100 radio time receiver
- Arduino-compatible Atmega328P-PU MCU (16MHz)
- DS1307 real-time clock (RTC) with backup battery
- 20x4 character LCD
- Three push buttons

The ES100 periodically synchronizes time from the WWVB signal.
The DS1307 keeps local time running while the device is powered off.
The Atmega328 runs the Arduino demo program that controls the hardware.

This firmware is designed for software engineers, hobbyists and educational purposes. It does not provide a “wall clock” usability and might not be free from bugs. It stores important parameters in an EEPROM which avoids recompiling after changing of parameters.

This demonstration firmware requires multiple libraries, listed at the header of the Arduino code. The firmware is distributed together with the library **ES100_V2** and can be found under “Examples”.

2. Time concept

- The RTC stores local time, not UTC.
- The ES100 is configured with:
    - a timezone offset (hours)
    - optional automatic DST handling
- After a successful radio reception, the ES100 reports local time, which is written into the RTC.
- Between receptions, the RTC runs independently using its backup battery.
- Time zone changes in the settings will take effect after the next successful reception.

3. Buttons and basic operation

Buttons are active-low (pressed = LOW) and are externally accessible through a pin header.

Buttons

S1: Previous / Up | S2: Menu / Enter | S3: Next / Down

Button actions (normal screens)

- S1 short press: Previous screen
- S3 short press: Next screen
- S2 short press: Enter configuration menu
- S2 long press: Force immediate radio reception (manual sync)

Button actions (configuration screen)

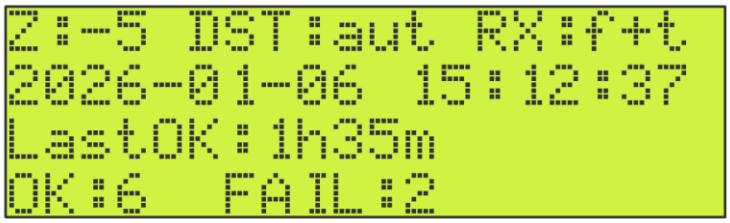
- S1 short press:
  - Navigation mode: previous setting
  - Edit mode: decrease value
- S3 short press:
  - Navigation mode: next setting
  - Edit mode: increase value
- S2 short press: Toggle between navigation and edit mode
- S2 long press:
  - Save changes (if modified) and exit
  - Exit without saving if unchanged

4. Screens

The display consists of five screens.
Use S1 and S3 to cycle through them.

4.1 Home / Clock screen

Purpose:
Show current local time from the RTC and overall synchronization status.



Typical layout:

- **Line 1**:
  Z:-5 DST:aut RX:f+t
  - Z: timezone offset in hours
  - DST:
    - aut = automatic DST (ES100 decides)
    - off = DST disabled
    - on = reserved for future manual DST mode
  - RX:
    - f = full reception only
    - f+t = full until first success, then tracking
    - t = tracking only
- **Line 2**:
  Current RTC date and time (YYYY-MM-DD HH:MM:SS)
- **Line 3**:
  Time since last successful radio synchronization
- **Line 4**:
  Counters for successful and failed receptions since power-up

4.2 RX (Receiver status) screen

Purpose:
Show current and recent receiver activity.

Typical fields:

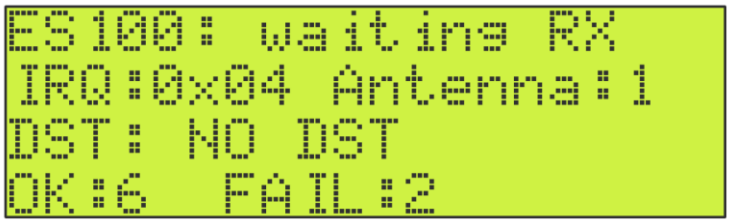
- RX state:
  - run = reception in progress

    - idle = no reception running
- Countdown until next scheduled reception
- Last IRQ status byte from ES100
- RXok flag (yes = last reception successful)
- Antenna used (1 or 2)
- Tracking mode:
    - Y = tracking
    - N = not tracking
- DST state (short form):
    - no = no DST
    - end = DST ends today
    - neg = DST begins today
    - on = DST currently active
- Time since last reception attempt

This screen is mainly for diagnostics and signal quality observation.

4.3 ES100 screen

Purpose:
Show information reported by the ES100 receiver itself.



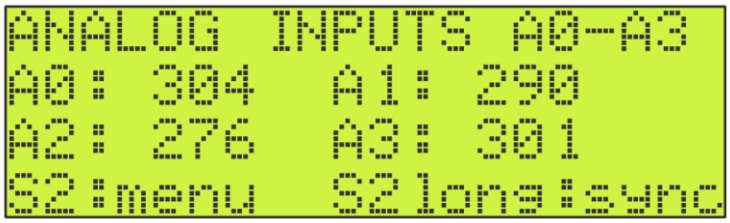
Behavior:

- Before the first successful reception:
    - Displays “waiting RX”
    - Shows last IRQ and antenna status
- After at least one successful reception:
    - ES100 date
    - ES100 time
    - Antenna used
    - Next DST change date and hour (if available)

Note:
The ES100 time shown here is a snapshot from the last successful reception.
The continuously running time is shown on the Home / Clock screen.

4.4 Analog input screen

Purpose:
Display raw ADC readings from analog pins A0–A3.

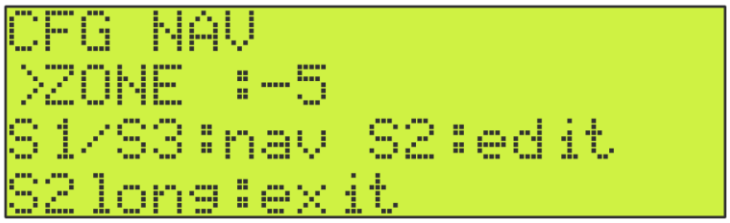


- Values range from 0 to 1023 (10-bit ADC)
- Intended for experimentation and testing external circuits

No scaling or interpretation is applied.

4.5 Configuration screen

Purpose:
Change system settings stored in EEPROM.



Settings persist across power cycles.

5. Configuration options

5.1 ZONE

Timezone offset in full hours. See NIST website for a coverage map.
Typical range: −12 to +14.

Example:

- Eastern Standard Time (UTC-5): −5

5.2 DST

Daylight Saving Time handling.

- aut: ES100 automatic DST handling
- off: DST disabled

DST rules are determined internally by the ES100.

5.3 ANT

Antenna selection policy.

- auto: ES100 selects antenna automatically
- ant1: force antenna 1
- ant2: force antenna 2
- alt: alternate antenna on failure

5.4 SYNC

Minutes between receptions after a successful sync.

Longer values reduce receiver activity.

5.5 RETRY

Minutes between reception attempts after a failure.

Shorter values help recover faster under weak signal conditions.

5.6 RX

Reception strategy.

- full: always perform full receptions
- full+track: full until first success, then tracking
- track: tracking only

Full reception is more robust. Tracking is faster once a stable signal is established.
For a better understanding refer to the ES100 PDF datasheet.

6. Reception behavior

- After power-up, multiple failed receptions are normal.
- Once a successful reception occurs:
    - Local time is written into the RTC
    - Counters are updated
- The firmware includes sanity checks to prevent invalid time values from overwriting the RTC.

7. RTC backup battery

The DS1307 requires a backup battery (CR1220) to retain time when powered off.

- If the battery is missing or depleted:
    - Time may be incorrect after power loss
    - The next successful radio reception will correct it

8. Forcing a manual sync

From any normal screen:

- Hold S2 to force an immediate reception attempt.

9. Serial output

Serial output is always available on the pin header (TX pin) at 9600 baud.

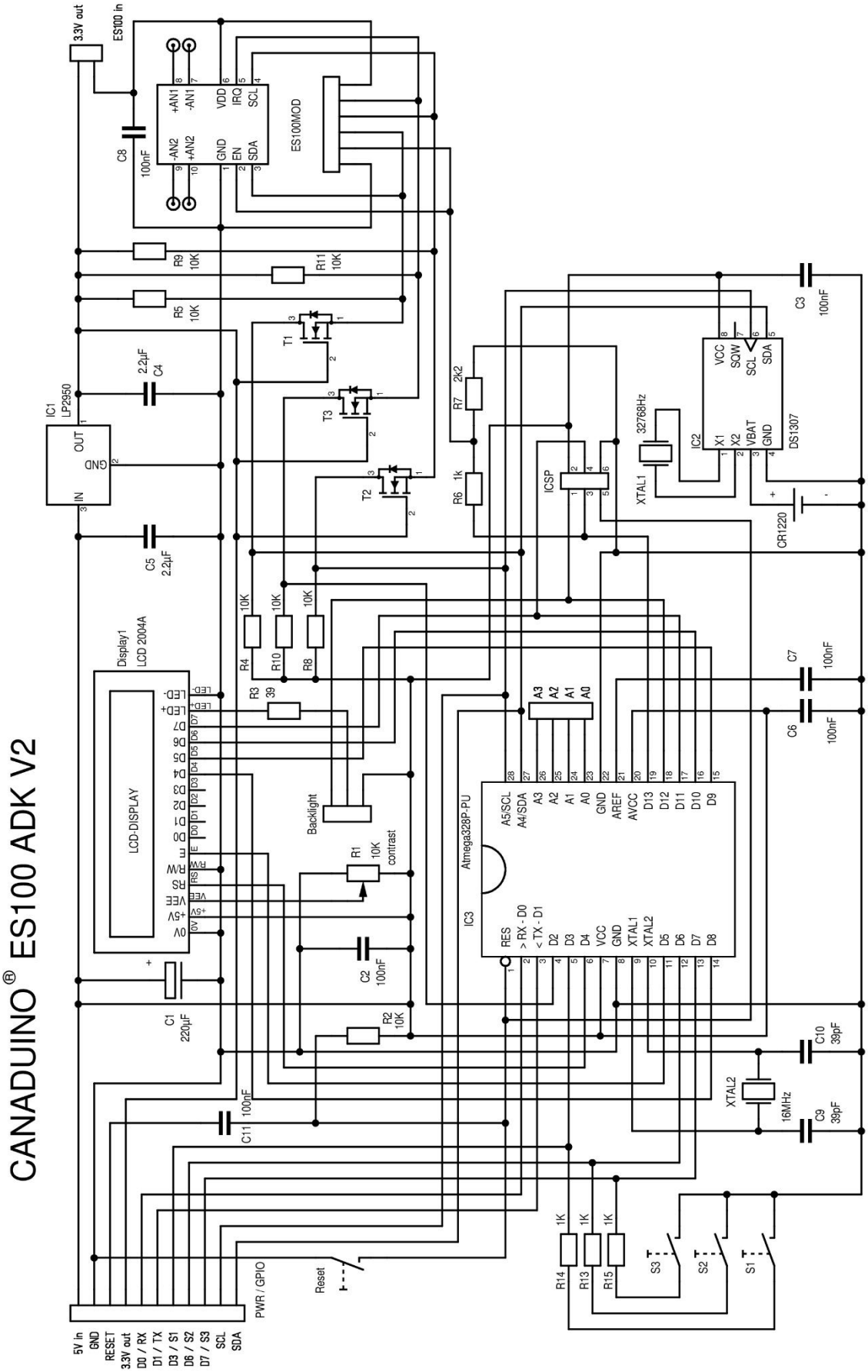
The firmware prints:

- Reception start (FULL or TRACK)
- IRQ and reception status
- RTC updates after successful reception
- Rejected time values (sanity check failures)

Serial output is useful for troubleshooting, development and applications without the display.

10. Practical notes

- Reception quality depends on location, building materials, and interference. You can find more information about it on NIST.com website or on Wikipedia.
- Best reception is usually near a window, away from switching power supplies and large metal objects.
- Analog inputs, if used, must remain within 0-5V safe voltage limits for the microcontroller.


CANADUINO® ES100 ADK V2
3.3V out
ES100 in
ES100MOD
C8 100nF
R9 10K
R11 10K
R5 10K
T1
T3
T2
IC1 LP2950
C4 2.2µF
C5 2.2µF
R7 2k2
R6 1k
ICSP
IC2 DS1307
32768Hz
XTAL1
CR1220
C3 100nF
C7 100nF
C6 100nF
Display1 LCD 2004A
LCD-DISPLAY
R4 10K
R10 10K
R8 10K
R3 39
Backlight
R1 10K contrast
C2 100nF
C1 220µF
R2 10K
IC3 Atmega328P-PU
C10 39pF
C9 39pF
XTAL2 16MHz
C11 100nF
R14 1K
R13 1K
R15 1K
S3
S2
S1
Reset
PWR / GPIO
5V in
GND
RESET
3.3V out
D0 / RX
D1 / TX
D3 / S1
D6 / S2
D7 / S3
SCL
SDA