Reset

5V in
GND
RESET
3.3V out
D0 / RX / S1
D1 / TX
D3 / IRQ / S2
D6 / S3
D7
SCL
SDA

A0
A1
A2
A3

3.3V out
ES100 in

-ANT2

+ANT2

+ANT1

-ANT1

GND
EN
SDA
SCL
IRQ
3.3V

ES100MOD

100nF
C8

Antennas

Backlight

D12 / MISO
Backlight in
5V

Contrast

ICSP

5V
MOSI
GND

MISO
SCK
RES

R1
10K

LCD

100nF
C2

D1
1N5817

IC1
LP2950-33

2.2µF
C5

2.2µF
C4

10K
R2

39
R3

10K
R4

10K
R5

1k
R6

2k2
R7

10K
R8

10K
R9

10K
R10

10K
R11

1K
R14

T1
2N7000

T2
2N7000

T3
2N7000

S1

C1
220µF/10V

IC2
DS1307

C3
100nF

CR1220

XTAL1
32768Hz 12.5pF

C7
100nF

IC3   Atmega328P-PU

C6
100nF

16MHz 20pF
XTAL2

C9
39pF

C10
39pF

1K
R13

1K
R15

S2

S3

Author: Volker Förster		Page: 1/1
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File: ES100MOD ADK V1	Status: released to public	

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Everset ES100 Application Development Kit (Arduino software compatible)

Everset ES100 is a fully self-contained phase modulation time code receiver that receives and decodes the 60 kHz time signal from the National Institute of Standards and Technology's WWVB transmitter located in Fort Collins, Colorado, USA.

Everset ES100 ADK features:
- ✓ Easy to assemble DIY Soldering Kit
- ✓ PCB, mechanical and electronic parts
- ✓ Arduino compatible ATmega328 MCU
- ✓ 4 x 20 Character LCD with backlight
- ✓ Socket for ES100-MOD Carrier Board
- ✓ ES100-MOD direct solder location
- ✓ 2 x 60kHz Antennas with Holder
- ✓ ICSP Header for Programming
- ✓ 4 User-defined analog inputs (0-5V)
- ✓ 5 user-defined GPIO (5V level)
- ✓ 3 user-defined pushbuttons
- ✓ I2C Bus for external sensors etc.
- ✓ RTC with a backup battery
- ✓ Power supply: 5V, max. 100mA
- ✓ Included: ES100-MOD Module
- ✓ Included: ES100-MOD Carrier Board

This ADK is offered as a DIY Kit. It requires only basic soldering skills of through-hole parts and works without any programming as "Atomic Clock" with the raw time and date information shown on the Display. It comes with a battery-backed Real-Time-Clock and a 4 x 20 alpha-numeric LCD.

With this kit, we want to enable Professionals and Hobbyists to easily develop any kind of Clock Applications using Arduino IDE.

INTRODUCTION

Everset ES100 Development Kit is a Do-It-Yourself kit based on easy to solder through-hole components. The circuit board shows the names of all connections and electronic parts to avoid assembling mistakes.

The included Microcontroller Atmel Atmega328P-PU is the same as used on the common Arduino UNO R3 development board, and it is already loaded with an application that shows the time, the date, DST status and information about the last reception on the included 4-line LCD.

We added 3 user-definable push buttons to support the Development of typical Clock applications, requiring buttons for example to enter settings, adjust display contrast, set alarm time or whatever the development requires.

All unused digital and analog pins of the Atmega328P-PU are available for user-defined functions on a standard pin header. There are 4 analog inputs A0-A3 available, which can be used as GPIO as well (software-defined function) and 5 digital GPIO. An ICSP header with the typical pinout as found on Arduino development boards is also available.

The display contrast can be manually adjusted using the onboard trim potentiometer.

We include a transflective LCD with backlight. The LCD backlight can be controlled by a GPIO pin (D12, MISO) for example to adjust the brightness using PWM. It can also be permanently turned OFF (disconnected) or ON (connected to 5V rail) using the jumper named "Backlight".

Our Application Development Kit requires a 5V DC power supply (4.2-5.5V) with a minimum current of 100mA for stable function and activated backlight. A clean power supply (e.g. battery) is highly recommended to avoid interferences caused by ripple and noise.

The demonstration program, which is pre-installed on the MCU, is available for download from our website. Its functions are well documented within the Arduino code. Also available for download are the required ES100 library and the library for the RTC chip.

ASSEMBLING

Assembling this kit requires basic electronic soldering skills, a soldering iron, solder wire, an electronic shear (flush) cutter. Basic knowledge of analog and digital electronics is recommended for commissioning and troubleshooting. To support your work and to make some steps easier to understand, please see the pictures on UNIVERSAL-SOLDER.ca website.

The following order is recommended for flawless and easy assembling:

1. Start with the lowest profile parts, which are the resistors. Proceed with the 2 crystals and the diode, then with the IC sockets (make sure the notch lines up with the silkscreen) and angle connectors, followed by the ceramic multilayer capacitors. Finally install the 3 transistors and the 3.3V voltage regulator before you solder the electrolytic capacitor and the connectors for ICSP (2x3 male), LCD (1x16 female) and ES100-MOD Carrier Board (1x6 female) in place. The pushbuttons can be assembled any time when most other parts have been soldered already. They are quite low profile, but their leads snap into the holes and they will not fall off even without anything supporting them during soldering.

2. Now prepare the Display and solder a 1x16 male header strip to the LCD as shown in the picture.

3. In the next step please mount the spacers: Install an 8mm stud underneath the corner positions **A**, **B** and **H**. Use 3 machine screws M3 with a built-in washer. Install an 8mm stud underneath position **F** using an 11+6mm stud on top. Install 3 studs 11+6mm on the top side on positions **D** to **G** using a nut on the bottom side. The stud on position **C** is only required if you want to use the Carrier Board. Install an 11+6mm stud on top using washer, lock washer and a nut on the bottom side.

4. If you want to use an ES100-MOD directly soldered to the ADK mainboard, you need to solder the antenna wires to the antenna connections on the PCB. In this case, feed the antenna wires through the holes in the bottom part of the antenna holder. Turn the antenna rods in a position that gives you enough wire length to comfortably solder the wires to the PCB. Please insert the 2 antennas into the bottom part of the antenna holder bracket. It should be a snug fit. Add the top part and push both parts tight together. Use 2 wood screws on position **I** and **J** to mount the holder to the circuit board.
If you want to use the ES100-MOD together with the Carrier Board, you will connect the antenna wires to the screw terminals. Therefore, keep the antenna wires loose and do not feed them through the holes. Turn the antenna rods that way that the wires are on top.

5. The ES100-MOD is a little tricky but not impossible to solder to the mainboard or the Carrier Board. If you don't want to use the Carrier Board it is recommended to finish everything else first and power up the board and make sure the display shows the time (not set yet) instead of nothing or just some black blocks (don't forget to adjust the contrast). If you are going to use the Carrier Board, assemble the ES100-MOD first, and the connectors and terminals afterward.

6. To solder the ES100-MOD to either the Carrier Board or directly to the ADK mainboard, it is recommended to first add a small drop of solder to one of the pads on the ADK mainboard or the Carrier Board. Add some flux to all the 10 solder pads. Now align the ES100-MOD module, press it down gently, and re-heat the one solder drop you just placed. After the ES100-MOD module is perfectly aligned with the 10 solder pads, solder another pin on the opposing side of the module, and then the remaining 8.

That is it – congratulation. Supply 5V to the 5V and GND pin on the angled connector and measure the current. If there are no shorts or other mistakes on your board, the current should be less than 10mA. Disconnect power. Now install the 2 ICs in the sockets. Make sure the notch lines up with pin 1 on the IC. Measure the current again (not more than 20mA). If everything looks good, install the display, and affix it with 4 machine screws M3. Adjust the contrast on the trim potentiometer.

The last remaining machine screw is to hold the Carrier Board in place.

Please see the schematic for details about the function, and the ports assignment.

PROGRAMMING

Since the Microcontroller is an Arduino-enabled Atmega328P-PU, it can be programmed just like any other "Arduino Controller":

1. By installing the chip on a compatible Arduino UNO R3 module (EAN 4260474030279)
2. By using an ICSP Programmer like USBtinyISP (EAN 4260474030743)
3. By using a USB-UART serial interface connection (e.g. EAN 4260474030385)
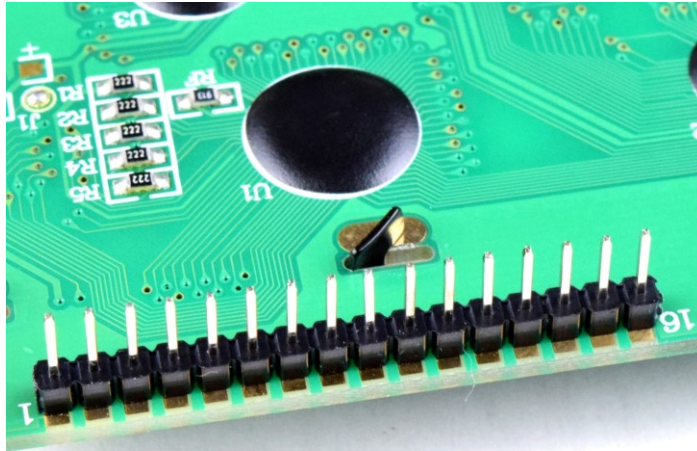
ORDER INFORMATION

ES100 ADK: EAN 4260474035229
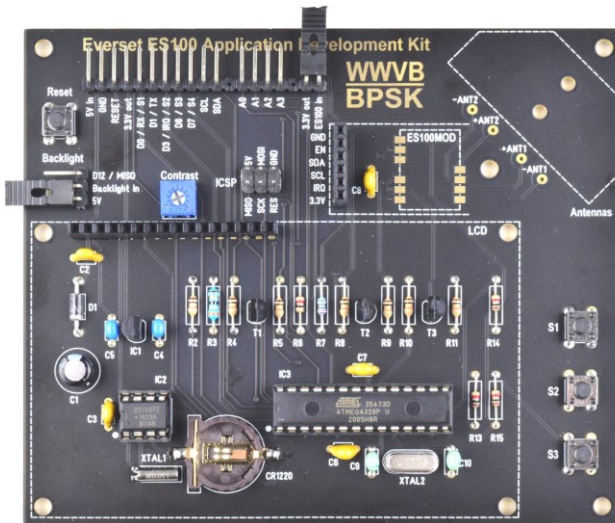ES100-MOD: EAN 4260474035205
Carrier Board: EAN 4260474035212
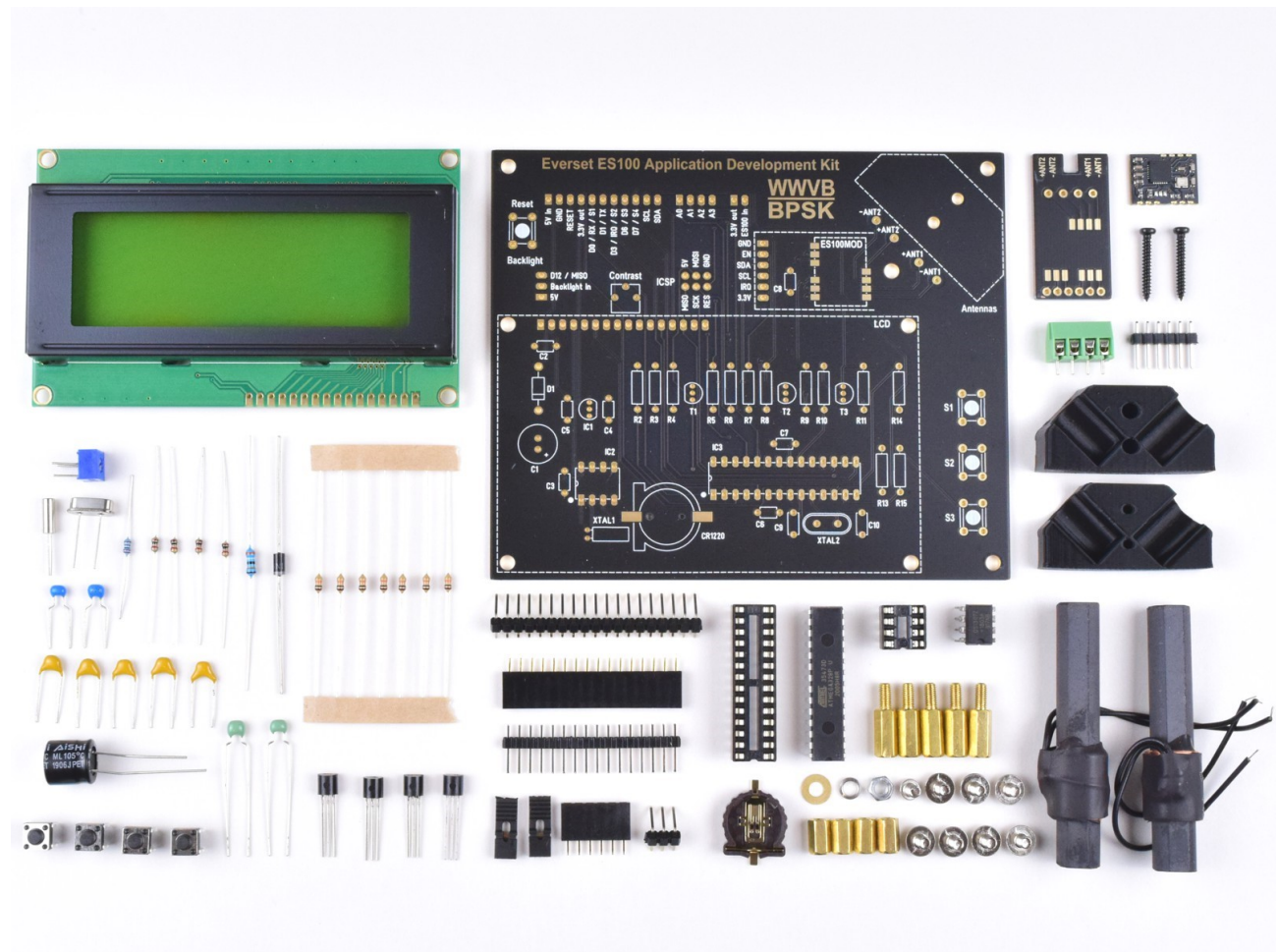
DIY Kit and included parts for reference only. Please see parts list on the last page.
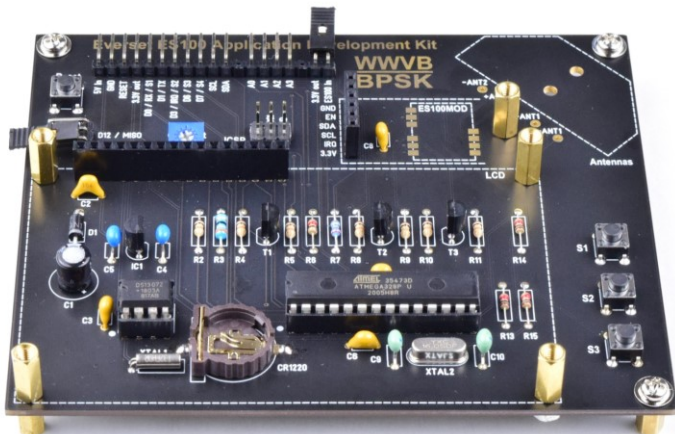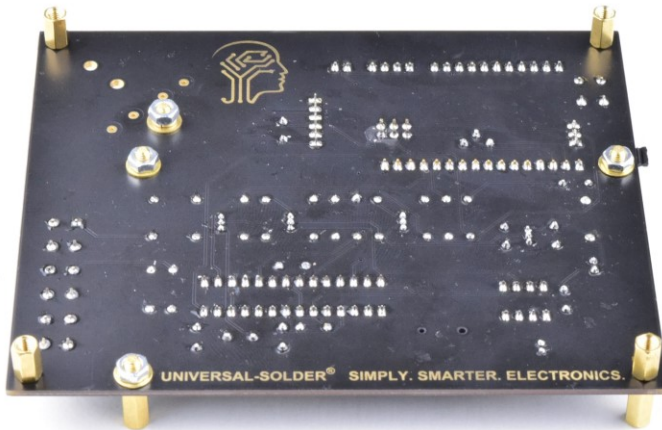
How to install 1x16 male header strip on the backside of the display module.
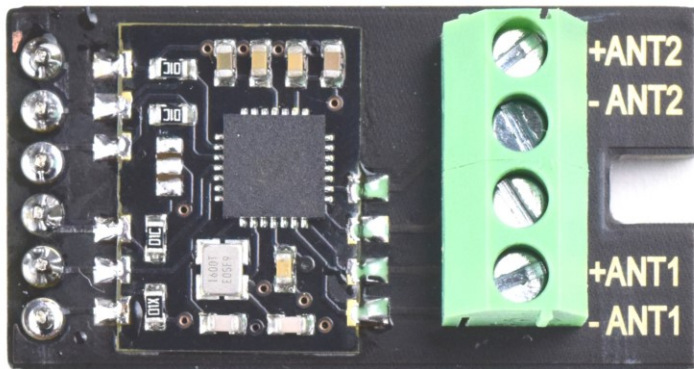

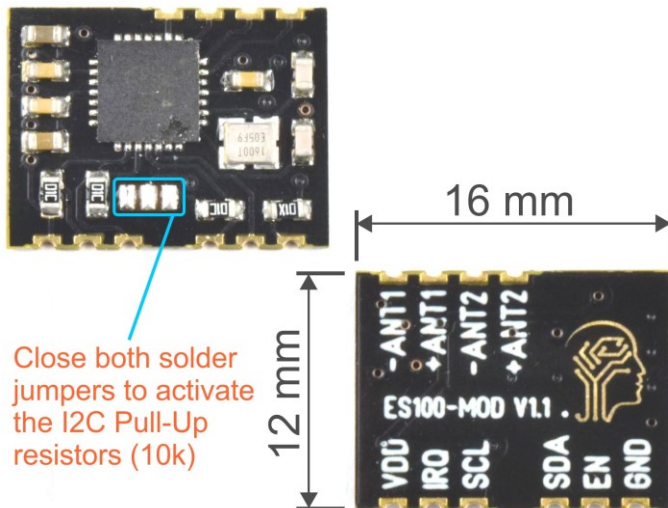All electronic parts are assembled.

Studs installed on the top side.

Studs installed on the bottom side.

Carrier Board complete with connectors and ESP100-MOD.
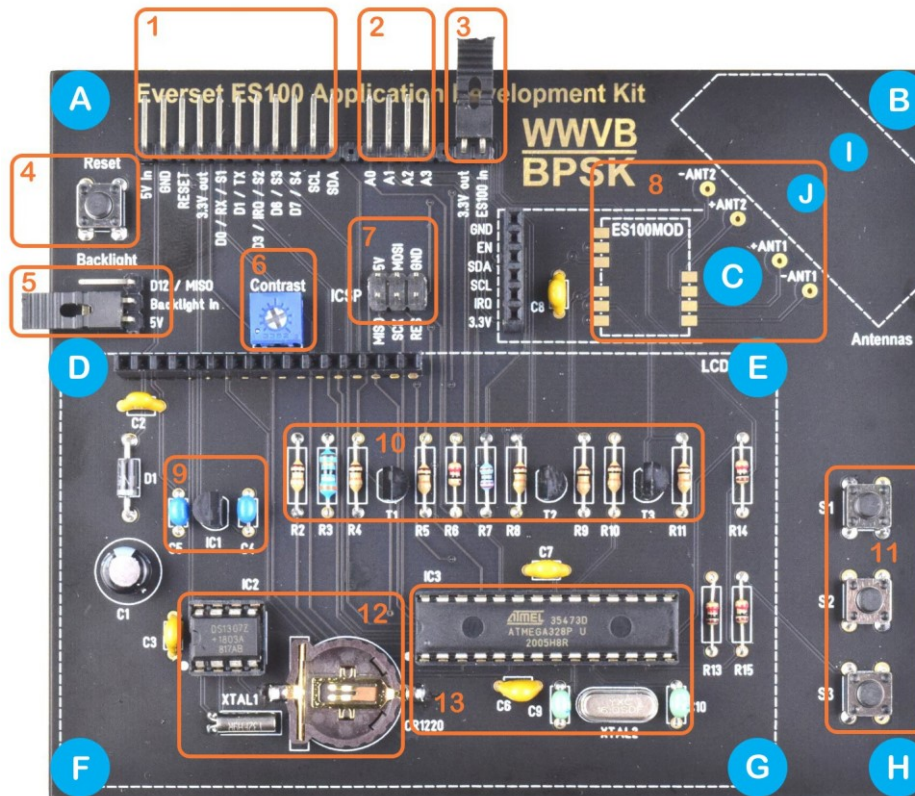

16 mm

12 mm

Close both solder jumpers to activate the I2C Pull-Up resistors (10k)

Important:
Pull-Up resistors are already available on the Development Board PCB. No need to activate them on the ES100-MOD module as well.

Please see ES100-MOD datasheet.

1 – Power Supply, serial Communication, GPIO *   2 – Analog Inputs

3 – Power Supply for ES100-MOD On/Off   4 – MCU Reset Button

5 – Display Backlight Mode Selector   6 – Display Contrast Potentiometer

7 – ICSP Programming Header   8 – Direct Connection for ES100-MOD

9 – Voltage Regulator 3.3V for ES100-MOD   10 – Logic Level Converter 5V <-> 3.3V

11 – User-Defined Push Buttons **   12 – Real-Time-Clock with Backup Battery

13 – MCU with Arduino Bootloader

* The signal "S4" is irrelevant since a button S4 was only available on an earlier prototype.

** Ports used for push buttons:
S1 – GPIO D3 (pin 5)
S2 – GPIO D6 (pin 12)
S3 – GPIO D7 (pin 13)

To use these buttons, the internal pull-up resistor must be activated for each port. Pressing the button pulls the corresponding port to LOW level.

Packaging list CANADUINO ES100 Development Kit

Quantity	Name	Value
1	CR1220	CR1220 socket Harwin S8411-45R
1	CR1220	Lithium button cell
1	C1	220µF - 2.5mm
5	C2, C3, C6, C7, C8	100nF - 5mm
2	C4, C5	2.2µF - 5mm
2	C9, C10	39pF - 5mm
1	D1	1N5817 - DO41
1	Display1	LCD 2004A Green
1	Header	1x16 Female Header
1	Header	1x40 male Header
1	Header	1x40 male Header - 90 deg.
1	Header	1x6 Female Header
1	Header	2x3 Male Header
2	Jumper	Jumper cap
1	IC1	LP2950-33 - TO92
1	IC2	DS1307 DIP8
1	IC2	Socket DIP8
1	IC3	Atmega328P-PU
1	IC3	Socket DIP28
1	R1	10kOhm trim potentiometer
7	R2, R4, R5, R8, R9, R10, R11	10kOhm
1	R3	39Ohm
4	R6, R13, R14, R15	1kOhm
1	R7	2.2kOhm
4	S1, S2, S3, Reset	Tactile button 6x6mm
3	T1, T2, T3	2N7000 - TO92
1	XTAL1	Crystal 32768kHz / 12.5pF
1	XTAL2	Crystal 16MHz / 20pF
3	Screw 5mm (wide)	M3
5	Screw 5mm (narrow)	M3
4	spacer 8mm	M3
5	spacer 11+6mm	M3
4	Nut	M3
1	Washer	M3
1	Spring washer	M3
1	Antenna Holder	Printed PLA
2	Wood Screw	2.5mm
1	PCB Devkit	Circuit Board
1	PCB Carrier Board	Circuit Board
1	Screw Terminal 4P - 3.5mm	Antenna Connector
1	ES100-MOD	WWVB-BPSK Receiver Module
2	Antenna	60kHz fine-tuned loopstick antenna, 60x10mm