

Dutchtronix Oscilloscope Clock 3.1

Item	PCB Designator	Description	Digi-Key Part Number	Mouser Part Number
		Bare 3" x 3" PCB (provide Gerber files and order bare PCB)		
1	PCB	Minimum Order quantities may apply.		
2	IC1	20MHz ATMEGA328P-PU 8BIT 32KB FLASH 28DIP	ATMEGA328P-PU-ND	556-ATMEGA328P-PU
3	IC2	AD7302BNZ DAC 8BIT V-OUT 20DIP	AD7302BNZ-ND	584-AD7302BNZ
4	IC3	8563 RTC CLK/CALENDAR I2C 8-PIN DIP		
5	IC5	HIN232ACPZ TTL to RS232C Level Converter/Driver	HIN232ACPZ-ND	968-HIN232ACPZ
6	Battery	Renata CR1225FV 48mAH Coin Cell 3V Lithium		614-CR1225FV-LF
7	Q1	CRYSTAL 20.0000MHz +/-10ppm 18pF	887-1248-ND	520-ECS200-18-4X-CKM
8	Q4	Citizen CFS-20632768HZFB CRYSTAL 32.7680kHz +/- 5ppm 12.5pF	300-8763-ND	695-CFS-20632768HZFB
9	D3, D4	BAT42 Schottky diode	497-2495-1-ND	511-BAT42
10	D5	1N4001 diode 50V 1A	1N4001GDICT-ND	621-1N4001G-T
11	R8	Amphenol PT10LV10-102A2020-S POT 1K OHM LINEAR	1993-1115-ND	531-PT10V-1K-S
12	S1, S2	TE Connectivity 1825910-6 SWITCH TACTILE SPST-NO 0.05A 24V	450-1650-ND	
13	S3	SWITCH SLIDE SPDT 200MA 30V	EG1903-ND	612-EG1218
14	D2	Green LED 10mcd at 7mA diffused 3mm round	732-5008-ND	710-151031VS06000
15	D1	Red LED 10mcd at 7mA diffused 3mm round	732-5006-ND	710-151031SS06000
16	IC4	5V 1A Regulator LM7805CT	296-47192-ND	926-LM7805CT/NOPB
17	Q3	2N3904 TRANS NPN 40V 0.2A TO-92	2N3904FS-ND	512-2N3904BU
18	C7, C8	Panasonic CAP ALUM 10uF 20% 16V RADIAL	P19513CT-ND	667-ECA-1CM100I
19	C6, C17	Rubycon CAP ALUM 100uF 20% 35V RADIAL	1189-1300-ND	232-35ZLH100MEFC63X1
20	C3, C4 C1, C2, C5, C12, C13, C14,	AVX CAP CER 22pF 100V NPO RADIAL	478-SR151A220GAA-ND	581-SR151A220GAA
21	C15, C16, C18	Kemet CAP CER 0.1uF 50V X7R RADIAL	399-9867-1-ND	80-C320C104J5R7301
22	R1, R2, R3, R4, R5	RES 10K ohm 1/4W 5% AXIAL	CF14JT10K0CT-ND	660-CF1/4CT26A103J
23	R6, R9	RES 390 ohm 1/4W 5% AXIAL (value is for LEDs specified)	CF14JT390RCT-ND	660-MF1/4LCT52R391J
24	R7, R14	RES 1K ohm 1/4W 5% AXIAL	CF14JT1K00CT-ND	660-MFS1/4LCT52R102J
25	R13	RES 4.7K ohm 1/4W 5% AXIAL	CF14JT4K70CT-ND	660-CFS1/4C472J
26	IC1 Socket	CONN IC DIP SOCKET 28POS TIN	ED90054-ND	575-11044328
27	IC2 Socket	CONN IC DIP SOCKET 20POS GOLD	ED90036-ND	575-11043320
28	IC3 Socket	CONN IC DIP SOCKET 8POS GOLD	ED90032-ND	575-11043308
29	IC4 Socket	CONN IC DIP SOCKET 16POS GOLD	ED3016-ND	575-110433161
30	X1	CONN D-SUB RCPT 9POS R/A SOLDER DB9 Connector	609-5188-ND	649-LD09S13A4GV00LF
31	J2, J3	Molex CONN BNC RCPT R/A 50 ohm PCB	WM5507-ND	538-73100-0223
32	J1	Kycon KLDX-0202-A CONN PWR JACK 2X5.5MM SOLDER	2092-KLDX-0202-A-ND	806-KLDX-0202-A
33	CH1, CH2	TERM TURRET SINGLE L=3.96MM	ED1069-ND	575-2506200440000
34	TXROUTE, GND	CONN HEADER VERT 3POS 2.54mm	732-5316-ND	710-61300311121
35	RS232	CONN HEADER VERT 3POS 2.54mm WITH LOCKING TAB	A19470-ND	571-6404563
36	Power	CONN HEADER VERT 2POS 2.54mm WITH LOCKING TAB	A1921-ND	571-6404562
37	1PPS	CONN HEADER VERT 2POS 2.54mm		
38	ISP	CONN HEADER VERT 10POS 2.54mm	2057-PH2-10-UA-ND	200-TSW10507GD
39	Header Shunt 1, 2, 3, 4	2-pin header shunt 0.1 inch center-to-center		855-M7582-05

Optional USB Connection Components (Note: If used, install these first. Do not attempt installation, unless you have experience installing SMT components.)

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40	IC6	IC USB FS SERIAL UART 28-SSOP	768-1306-ND	895-FT232RL-TUBE
41	X2	USB CONN RCPT TYPEB 4POS R/A	ED2983-ND	649-61729-1011BLF
42	L1	FERRITE BEAD 0805	240-2395-1-ND	875-HI0805R800R-10
43	C11	CAP TANT 10uF 10% 16V 1206	478-8235-1-ND	647-F931C106KAA
44	C10	CAP CER SMD 0805 .01uF 100V X7R	399-17617-1-ND	80-C0805C103K1R7210
45	C9	CAP CER 0.1uF 50V Y5V 0805	399-1177-1-ND	80-C0805C104Z5V

Optional GPS (Note: Requires programming through its TTL-level serial port to set up for the Dutchtronix Oscilloscope Clock)

. Backup battery + tab can be connected to the backup battery connection on the Dutchtronix Oscilloscope Clock PCBA to save programming.

Item	PCB Designator	Description	Digi-Key Part Number	Mouser Part Number
46	N/A	Adafruit 66 CH Ultimate GPS Module	1528-1153-ND	485-746

Additional Notes for the Adafruit Ultimate GPS:

Remove the 1PPS connector header on the Dutchtronix oscilloscope clock PCBA and connect the Ultimate GPS 1PPS output to the 1PPS input on the 1PPS connector pad. Commands must be entered into the Ultimate GPS, before connection of RX input and TX output, respectively, to the Dutchtronix TXROUTE and RXROUTE serial interface connections and the Dutchtronix oscilloscope clock must be set up to communicate with the GPS, before the physical connection is made. To preserve the settings for the Ultimate GPS, connect the backup battery connection (connect directly to the battery + pad on the PCB and GND pin) to the backup battery pads on the Dutchtronix clock PCBA. Connect the Ultimate GPS Vin pin to the +5V supply on the Dutchtronix clock PCBA. Set the Ultimate GPS to communicate at 4800 baud and to output \$GPRMC data only, once every 5 seconds. Set the Dutchtronix oscilloscope clock GPS setting and the baud to 4800 (should change to 4800 baud when the GPS setting is completed). Then connect the serial port of the ultimate GPS to the TXROUTE and RXROUTE pins on the Dutchtronix oscilloscope clock PCBA.

Ultimate GPS Command for 4800 baud:

```
$PMTK251,4800*14<CR><LF>
```

Ultimate GPS Command for 9600 baud (default):

```
$PMTK251,9600*17<CR><LF>
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Ultimate GPS Command for 19200 baud:

```
$PMTK251,19200*22<CR><LF>
```

Ultimate GPS Command to set the Ultimate GPS to output \$GPRMC data only, once every 5 seconds:

```
$PMTK314,0,5,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0*2D<CR><LF>
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ATMega328P Programmer				
Item	PCB Designator	Description	Digi-Key Part Number	Mouser Part Number
47	N/A	Olimex AVR-ISP-MK2; ATAVRISP2 COMPATIBLE PROGRAMMER	1188-1008-ND	909-AVR-ISP-MK2

Notes for the Olimex AVR-ISP-MK2: Use with the Atmel Studio development software available at:
<https://www.microchip.com/mplab/avr-support/atmel-studio-7>
 Set the programming tool type as AVRISP mkII and Device Type as ATmega328P. With the AVR-ISP-MK2 connected to the 10 pin header on the Dutchtronix Oscilloscope Clock PCBA, make sure the 5V supply is connected and on, before starting programming. When connecting to the 10 pin header, make sure Pin 1 is lined up properly. In Atmel Studio, right click on AVRISP mkII under Available Tools and select Device Programming. Set the Device Type to ATmega328P. Be aware that the AVR-ISP-MK2 will indicate a 3.3V connection to Atmel Studio regardless of the actual voltage level. Ignore this indication. Verify that the AVR-ISP-MK2 is communicating with the ATmega328P. When programming using the Dutchtronix Oscilloscope firmware with boot loader+clock software, set only the following fuses:

1. Ext Crystal Osc. Frequency 8.0- MHz, Start-up time PWRDWN/RESET: 16k CK/14 CK + 65mS
2. Boot reset vector Enabled (Boot Flash section size=512 words Boot start address=\$3E00; [BOOTSZ=10])
3. Preserve EEPROM memory through the Chip Erase cycle.
4. Serial program downloading (SPI) enabled.
5. Brown-out detection level at VCC=2.7V.
6. You should now have the following fuses settings check marked: SPIEN, EESAVE, BOOTZ0, BOOTRST, BODLEVEL1.
7. Make sure that the CKDIV8 fuse setting is unchecked and will not be set. You should have: Low 0xFF, High 0xD4, and Extended 0xFD. Apply the settings to program the fuses.
8. Next, specifically initialize (clear) all memory (EEPROM and FLASH). Then use only the Flash programming feature to load and program the boot loader+clock software. The FLASH and the EEPROM boot loader will both be programmed.
9. When programming has properly completed, the green LED on the Dutchtronix oscilloscope clock PCB should be blinking. Be sure that the 1PPS jumper was installed (or there is a 1PPS pulse coming from the GPS, if it was installed instead).

Item **Display Case**
Designator
 48 N/A

Description
 Acrylic Housing for Clock

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