# OctoClock CDA-2990

## Contents

The OctoClock CDA-2990 is an affordable solution for high-accuracy time and frequency reference distribution. The OctoClock accepts 10 MHz and PPS signals from an external source, and distributed each signal 8 ways. The OctoClock is a useful accessory for users that would like to build multi-channel systems that are synchronized to a common timing source.

The OctoClock-G CDA-2990 provides the same functionality as the OctoClock CDA-2990, but includes a GPSDO that can be used to produce internal 10 MHz and PPS signals, as well as a front-panel switch to select between internal and external sources for the signals. Note that *both* signals must come from the same chosen source: either *both* are generated internally from the GPSDO, or *both* are provided from the external inputs.

**Note:** Both of the CDA-2990 devices are functionally identical to the previous generation OctoClock, which contained an Ettus Research logo.

- 8-Way Time and Frequency Distribution (1 PPS and 10 MHz)
- Convenient Solution for Multi-Channel Synchronization
- Use with MIMO Capable N-Series Devices for Coherent System
- External 10 MHz/1 PPS Source Required
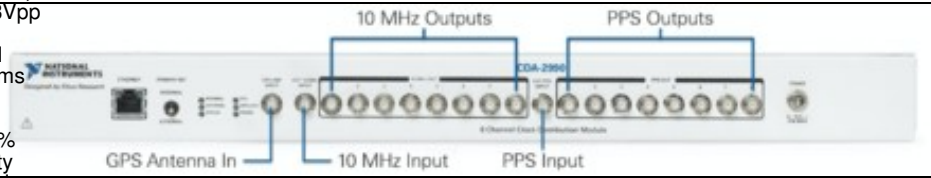- 19" Rackmount ? 1U

| | |
|---|---|
| 10 MHz output | square wave with close to 50% duty cycle; 1.25 Vpp at 50 ohms, 3.3Vpp at 1M ohms |
| 1 PPS output | 20% duty cycle square wave with amplitude 5 V |



10 MHz input: 0-20 dBm

1 PPS input: 2.5-5 V

4 x 17.187x 1.75 inches

2.6 lbs

- File:cu ettus octoclock cca.pdf
- File:cu ettus-octoclock.pdf

- Motherboard

- Enclosure

- 0-40 °C

- 10% to 90% non-condensing

All RF Ports are matched to 50 Ohm with -10dB or better return loss generally. Detailed test is pending.

The Ethernet port on the OctoClock and OctoClock-G allows the device to be connected to the network. When connected, the `uhd_find_devices` utility can find any OctoClock devices on the network, and the device's firmware may be updated over Ethernet using the `octoclock_burn_eeprom` utility. In addition, with the OctoClock-G, NMEA strings may be obtained from the internal GPSDO via the UHD API. Note that there is no host CPU in the OctoClock, so it is not possible to SSH into the device.

OctoClock Schematics

| Part Number | Description | Schematic ID (Page) |
|---|---|---|
| ENC28J60?DIG | Ethernet Controller | U103 (1) |
| ATmega128 | Microcontroller | U102 (1) |
| LC_XO Spec Sheet Manual | Jackson Labs LC_XO (OCXO) | U206 (2) |
| SN74AUP1T57 | VOLTAGE-LEVEL TRANSLATOR | U204, U203 (2) |
| CDCE18005?PWR | Output Clock Programmable Buffer | U205 (2) |
| 74HC4020 | Binary Ripple Counter | U207 (2) |
| LMZ12001 | Power Module | U101 (1) |

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- Media:OctoClock CoV.pdf

The OctoClock's firmware is divided into two image files: octoclock_bootloader.hex and octoclock_r4_fw.hex. All pre-built image files can be found here, in version-specific ZIP files. Download the version corresponding to the version of UHD that you're running. You must use at least version 3.9.2.

- Full instructions on updating the OctoClock's firmware is located here
- Source of the firmware for the OctoClock is located here

OctoClock Spec Sheet

FPGA Resources

UHD Stable Binaries

UHD Source Code on Github

- **What are the OctoClock and OctoClock-G?**

The OctoClock is a USRP-compatible accessory that allows you to easily synchronize up to 8 USRP radios. Multiple OctoClock devices can be combined for synchronization of larger numbers of USRP radios.

The OctoClock-G is an OctoClock with added GPSDO module.

In this FAQ we will use "OctoClock" to refer to either unless there is a specific need to use either name.

- **When would I used the OctoClock?**

The OctoClock is useful for synchronizing multiple USRP devices for high channel count systems.

The following applications can benefit from OctoClock clock distribution:

- Direction Finding
- Beamforming
- Adaptive Beamforming
- Multiple-In-Multiple-Out (MIMO) Prototyping
- Geolocation Systems that Use Time-Difference-of-Arrival (TDOA)
- Multi-Channel, Multi-Static, and Passive RADAR
- Multi-Band GPS Record and Playback
- Multi-Band Cellular Monitoring

Essentially, anything that requires synchronization or the distribution of timing information would benefit from the use of the OctoClock.

- **How does the OctoClock work?**

The OctoClock accepts 10 MHz and PPS signals from an external source. Active circuits are used to amplify and split the signals 8-ways. Matched-length traces minimize phase differences between all 10 MHz and 1 PPS outputs

The OctoClock-G includes an internal GPSDO (GPS Disciplined Oscillator) which provides an internal source for 10 MHz and PPS from an OCXO high precision oscillator. Add a GPS antenna (optional) with a clear view of the sky for GPS Disciplining of the OCXO that futher enhances frequency accuracy of the OCXO and global time synchronization.

- **Does the OctoClock-G provide power for using an active GPS antenna?**

Yes. The OctoClock-G's GPSDO module is the Labs LC_XO, which can provide 5 V at up to 50 mA to the external active GPS antenna. The non-G OctoClock does not have this GPSDO module, and thus cannot use a GPS antenna if attached, nor provide power to one if attached.

- **Where can I find user manuals for the OctoClock and USRP?**

Synchronization and MIMO Capability with USRP Devices

UHD Manual: Multiple USRP configurations

- **What USRP model is recommended for MIMO systems?**

The USRP N200 + N210, N310, N320 + N321, X300 / X310 are recommended for building high channel count and MIMO systems. These models provide external PPS and 10 MHz reference inputs. The USRP N200 and N210 support the USRP MIMO cable.

The USRP B100, B200, B210, E100, E110, and E310 can be synchronized with 10 MHz/PPS but are not phase coherent MIMO capable devices. The USRP1 cannot be synchronized with 10 MHz/PPS.

### • How does the automatic switchover functionality work?

When using the OctoClock-G, the Internal/External switch on the front panel allows the user to choose between the internal GPSDO and external source 10 MHz/PPS source. If the selected source is unavailable, the device will automatically switch over to the backup frequency source. When switchover is active the corresponding LED indicator will illuminate.

If neither source is present, the internal, external and status LEDs will not be illuminated and the user will not received valid 10 MHz/PPS outputs.

### • What do the LEDs status indicators mean?

The following list describes the behavior when each of the 6 LED status indicators is illuminated:

- Internal - internal GPSDO is selected and present.
- External - external source is selected and present
- Status - Either the internal GPSDO or external source is selected. If neither source is present this LED will turn off (no signals are output).
- PPS - selected PPS pulse high.
- GPS Locked - GPS is receiving signals and has valid time/position lock.
- Power - Power is applied.

### • What are the input and output specifications?

- 10 MHz Input ? 0-10 dBm
- 10 MHz Outputs - ~1.4 Vpp Square Wave, Impedance 50 ohm nominal
- 1 PPS Input - Logic-level pulse, 2.5 V - 5 V
- 1 PPS Outputs - Logic-level pulse, 2.5 V - 5 V

### • What is the input voltage rating?

The OctoClock can be powered at any voltage between 6 and 15 Vdc.

### • Are the design files open source?

As with all of our products, the driver code is free & open source, and can be found in our UHD repository. The schematics are also available.