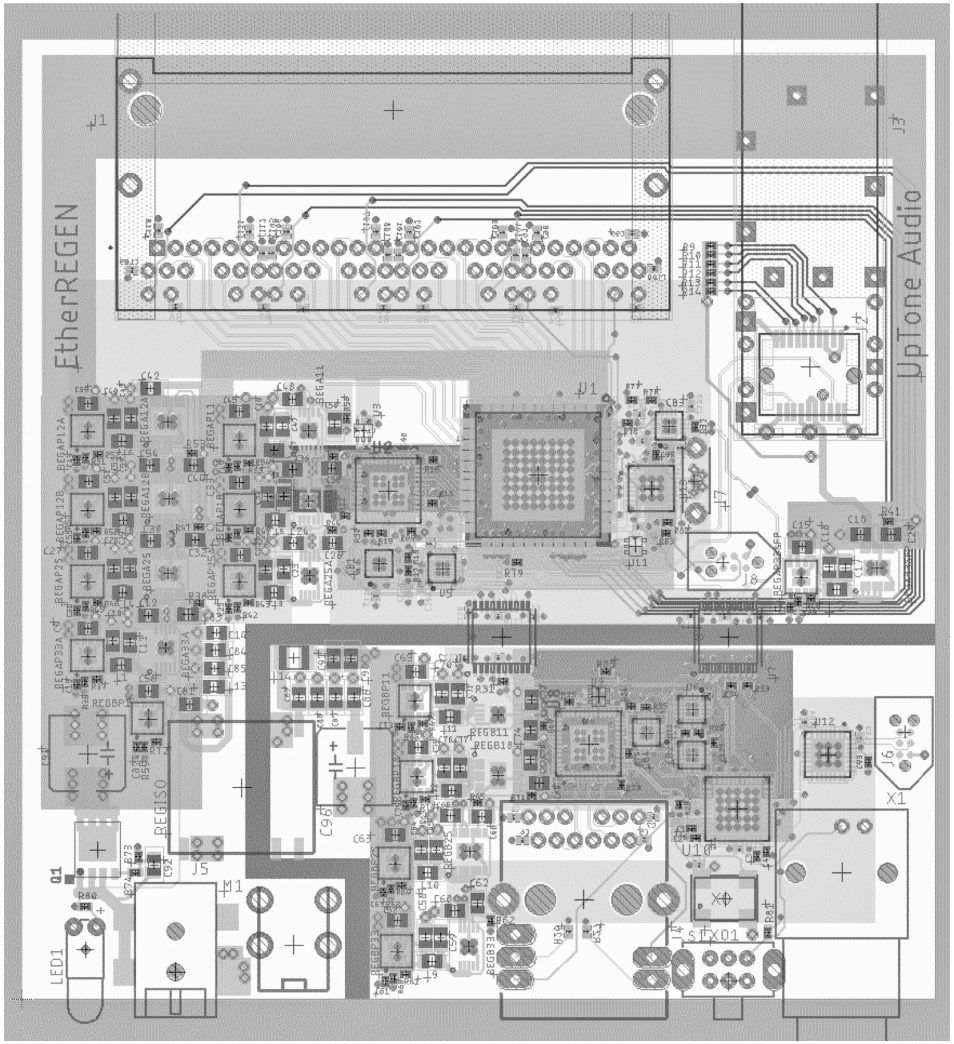
UpTone Audio

EtherREGEN



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User Guide

Thank you for purchasing an UpTone Audio EtherREGEN!

Introduction and Design

This revolutionary and sophisticated Ethernet switch is capable of producing surprisingly audible sonic improvements in fine music systems. **The goals and architecture of the EtherREGEN are completely different than any other Ethernet switch on the planet.**

Other "audiophile" Ethernet switches typically apply clock and power supply modifications to cheap off-the-shelf switches, or simply add passive filter parts to standard magnetics and augment with a separate fancy clock board. **EtherREGEN is an all-new from the ground-up design, built on a costly 6-layer circuit board. Its components and topology are unmatched by any other Ethernet switch.**

The heart of what makes our switch so unique is use of ACTIVE, HIGH-SPEED, LOW-JITTER DIFFERENTIAL DIGITAL ISOLATOR chips in conjunction with ULTRA-LOW JITTER DIFFERENTIAL RE-CLOCKING FLIP-FLOPS. No other Ethernet switch on the market does this. Implementing this architecture correctly is difficult and costly!

Going from port-to-port on the 'A' side of EtherREGEN is already better than most any other switch, but crossing our **A**ctive **D**ifferential **I**solation **M**oat ("**ADIM**™")—to its 'B' side—brings an unmatched level of Ethernet performance for audio. The dark-grey line in the lower third of the circuit board image on this Guide's cover is the EtherREGEN's "moat," across which sit the differential digital isolators.

The design methods and innovative ADIM™ of the EtherREGEN results in dual, isolated clock/data/power domains, blockage of all external leakage currents, a significant reduction in upstream phase-noise fingerprint, and maximal signal integrity.

During manufacturing, each unit has been carefully tested to assure reliable performance. Your EtherREGEN is covered by a 3-year warranty. Do contact us if you ever have difficulty or need advice or service.

Please read this entire instruction booklet to learn important information about installation and operation of the EtherREGEN.

Technical Highlights

- EtherREGEN has two isolated data/power/clock domains. Each isolated domain is re-clocked using 10GHz-capable ultra-low-jitter (less than 0.8 picoseconds) differential flip-flops.
- The clocking system runs from an advanced, programmable, jitter-attenuating clock synthesizer with four differential outputs. It is referenced to an ultra-low-jitter/phase-noise Crystek CCHD-575 oscillator. Importantly, the clock distribution system (for the switch chip, the special Ethernet format conversion chips, and the high-speed flip-flops) is run differentially throughout. Special conversion buffers are positioned just millimeters from chips that require single-ended clocks.
- Even the magnetics of the four Gigabit 'A'-side ports are special. We chose an RJ45 module that utilizes 12 transformer cores in each port (most Ethernet ports have 2~6 cores), and ground their center-taps through capacitors in a way that blocks port-to-port AC leakage currents.
- To support its performance, the power networks of the EtherREGEN are as sophisticated and costly as the rest of the design. We use 12 of the world's lowest-noise, lowest-impedance integrated voltage regulators—the famous Linear Technology LT3045 and LT3042. Supporting both the voltage regulators and the data chips are 195 low-inductance, X7R and X5R capacitors sized and selected by their derating curves.
- The EtherREGEN incorporates two newly introduced Ethernet transceiver chips—one on each side of the ADIM™. These advanced chips were very new at the time of design; UpTone was among the first OEM manufacturers in the world to engineer a product using them.
- The main processor is an advanced, flexible, and fully managed switch processor—with integrated high quality PHYs and support for all current IEEE network protocols.
- If required, the start-up programming and extensive register settings of the EtherREGEN's processor can be updated by the end-user via a microUSB port located on its circuit board. Downloading a small file from UpTone and copying it to the virtual drive that appears upon attachment of a microUSB cable will easily accomplish this.

Installation and Use

Suggested Connections:

On the EtherREGEN's 'A'-side, there are four Gigabit copper Ethernet ports, plus an SFP cage for a Gigabit LC optical module. **A typical user will attach a single Ethernet cable from their main network router or switch to any of these 'A'-side ports—as illustrated on the opposite page.** This leaves open three additional RJ45 copper ports (and the SFP cage) on the 'A' side. The choice to connect any server, NAS (network attached storage), or other devices to these ports—or to leave that equipment attached to your main upstream switch/router—is mostly a matter of convenience and effects on sonic performance are likely to be small.

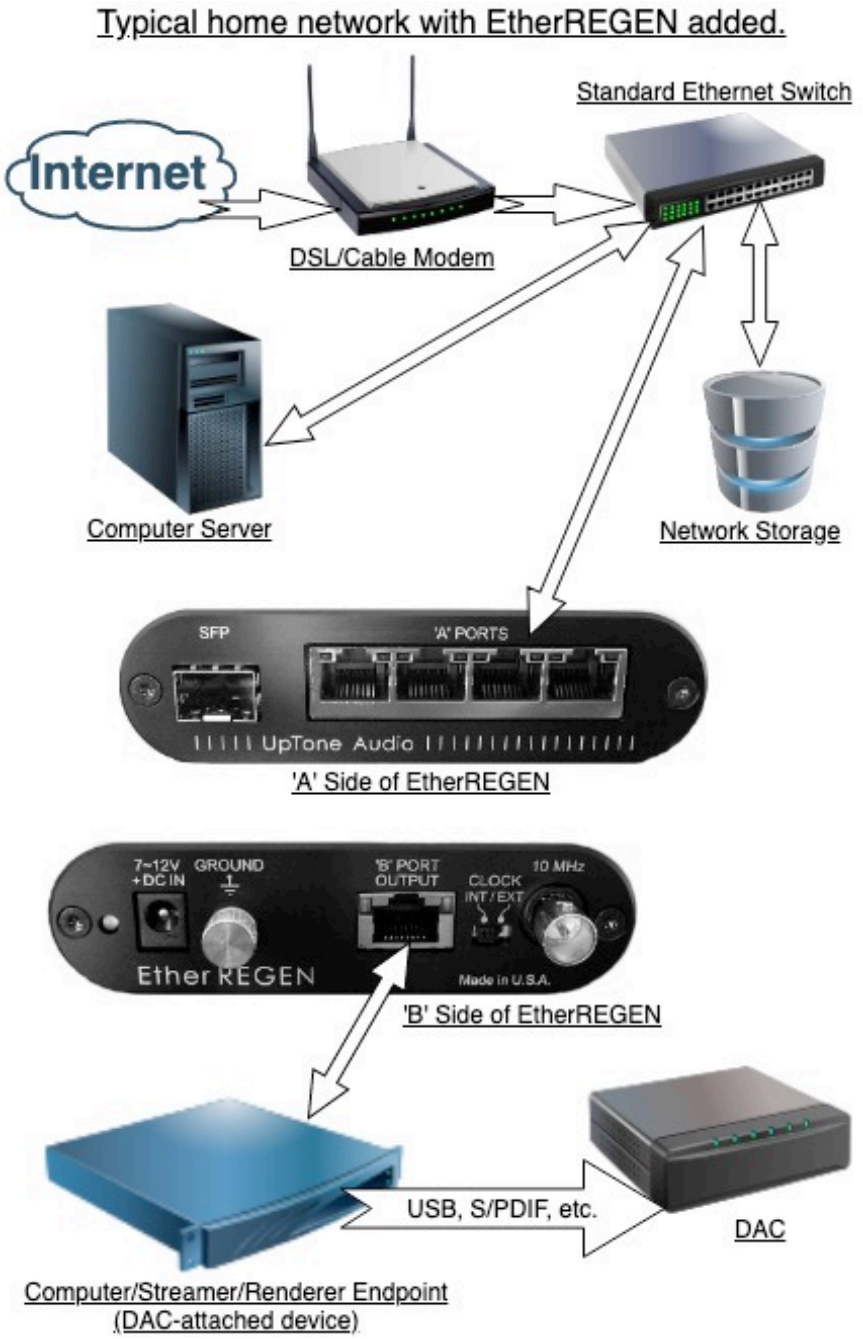
Across the ADIM™, at the other end of the EtherREGEN, is a single 100Mbps copper Ethernet port. This is the 'B'-side port. Attach the computer/streamer/renderer endpoint that is directly connected to your DAC* to the 'B'-side Ethernet port with a copper Ethernet cable. (*DACs that have an Ethernet input can be directly connected to the 'B'-side port).

So why does this arrangement matter?

There are two types of sound-degrading influences the EtherREGEN is designed to radically decrease: Leakage—both high-impedance and low-impedance—and clock phase-noise. The clock phase-noise travels on the Ethernet signal itself and on power- and ground-planes. [Every signal edge coming out of any digital device carries the jitter/phase-noise of the clock used to "clock out" that edge; this shows up on the ground-plane and affects the threshold of chips' clock inputs. This is an oversimplification of a complex subject; we may publish to our web site a "white paper" and measurements to demonstrate this.]

The circuitry across the ADIM™ (moat) is designed to eliminate the signal-borne phase-noise from one side to the other. EtherREGEN is mostly symmetrical—there is no "dirty side" or "clean side." **While it works identically in both directions, it is best to have the DAC-attached Ethernet endpoint device (computer/streamer/etc.) alone on one side—typically the 'B' side.**

The circuitry between ports on the 'A' side decreases phase-noise effects to some degree, but not nearly as much as crossing the 'A'>'B' moat.
It is the differential isolators used in conjunction with the differential flip-flops that delivers the performance of the EtherREGEN. The differential isolators prevent the data-borne clock signature from getting onto the ground-plane of the PCB, while the differential flip-flops prevent the signature from getting into the flip-flop's own internal ground network. It takes the *combination* of these to achieve the performance of the EtherREGEN.



Locating the EtherREGEN:

During use, it is normal for the case of the EtherREGEN to become somewhat hot. 48~52C (118~126F), depending on room air temperature is to be expected. Do not be concerned about the heat. Even when hot, all parts are operating at less than half their thermal ratings. The case is the heat-sink. Please locate the EtherREGEN on a shelf where air can flow under and around it. If the heat of the case bothers you, standing it on edge will permit more airflow and will lower the case temperature by a few degrees. **Do not stack other devices under or on top of the EtherREGEN.**

Powering the EtherREGEN:

All EtherREGEN units are shipped with a fully certified, world-voltage compatible (100~240VAC), 7.5 volt / 4.8 amp AC>DC adapter. The included detachable 45cm IEC C14 AC mains cord has a USA wall plug. Connect any properly grounded local cord if you reside in a country where a different style of wall plug is used.

If you choose to power the EtherREGEN with an AC>DC supply other than the one we include, then it must be a **regulated** power unit in the range of 7~12 volts +DC. The amperage requirement of the EtherREGEN varies based on the input voltage. The guidelines for input voltages within its range are: 7V/1.4A, 9V/1.0A, or 12V/0.8A. The size of the DC input barrel-jack is a standard 5.5mm x 2.1mm (center-positive).
You may wonder why the AC>DC adapter supplied with the EtherREGEN is rated at a high 4.8A. It is because UpTone uses the same adapter for our popular UltraCap LPS-1.2 linear power supply, and because this unit is customized for us with its output 0-volt/-VE ('ground') common to AC mains ground. [For more on this topic refer to the section of this guide regarding the EtherREGEN's Ground terminal screw.]

Use of a fancy linear power supply (such as our matching UltraCap LPS-1.2) is NOT required to get outstanding performance from the EtherREGEN. While high-quality power supplies make a nice difference most everywhere else in a music system, we personally are not hearing very much change with power supplies and the EtherREGEN (certainly owing to its great isolation and internal power networks). Yet others do report some benefit, so you are of course welcome to experiment within the +DC 7~12V range. [Note: The original UltraCap LPS-1, with top setting of 7V, does not have enough current for the EtherREGEN. The UltraCap LPS-1.2, with its 9V and 12V settings can easily power an EtherREGEN.]

Start-up:

Network connections can be made before or after attaching the DC power cable to the EtherREGEN. However, **the position of the CLOCK INT/EXT switch must be correctly set BEFORE applying power to the EtherREGEN.**
Your EtherREGEN should have been delivered with the CLOCK INT/EXT switch in the 'INT' position—to use its excellent on-board oscillator as reference. Leave the switch in that position unless you plan to use a special 10MHz external reference clock (see details on the last page of this User Guide).

If you apply power but your network devices do not connect, **check to be sure the CLOCK INT/EXT switch is in the 'INT' position.** If you move the CLOCK slide switch, then you will need to remove and reapply power in order for the clock circuits of the EtherREGEN to be properly programmed.

The EtherREGEN separately programs vital functions on both sides of its isolation moat each time you apply proper DC voltage to its power jack. Complete start up is faster than most other full Ethernet switches. It will be fully programmed and running in less than 10 seconds, and within 20 seconds all active port attachments will have negotiated and established a network link. This assumes you have connected an Ethernet cable having a path back to whatever router or modem is assigning IP addresses to devices on your local area network.

EtherREGEN LEDs:

The green LED at left of the EtherREGEN's DC input jack indicates that the switch is receiving power. There are two small LED indicators above each of the unit's RJ45 Ethernet ports. The meaning of the colors and activity with cable connections are different for the four Gigabit-capable 'A'-side ports than for the lone 100Mbps 'B'-side port, as follows:

'A' Side
Flashing yellow = Gigabit link with network activity
Flashing green = 100Mbps link with network activity
Solid LED (yellow or green) = Link established but no network activity

'B' Side (100Mbps only)
Solid or Flashing green = Network activity
Solid yellow = Network link established (should stay on all the time when a 'B'-side connection is made)

Regarding Ethernet cables:

We are frequently asked for guidance regarding Ethernet cables to use with the EtherREGEN. This can be a controversial subject—by what means can an Ethernet cable affect the sound?—and absent objective evidence of variations, we will decline to recommend purchase of any fancy or expensive Ethernet cabling. Still, ultimate audio is a pursuit with many variables not yet fully understood. Not long ago few would believe an Ethernet switch could make a sonic impact—so we are open-minded about experimentation with network cables.

However, there are some very real physical differences between certain Ethernet cables which can affect fine audio systems. Specifically, the shielding of Ethernet cables and if the wire shield on the cable is electrically connected to metal-shelled RJ45 plugs at both ends. For this explanation we will refer to such cables as "shield-tied."

It is desirable to avoid connection of multiple shield-tied cables into the RJ45 ports on the 'A'-side of the EtherREGEN. This has nothing at all to do with data or signal quality. In fact, this recommendation is not even specific to the EtherREGEN. **Ethernet cables having metal RJ45 shells and end-to-end connected shield wires will unite the grounds and zero-volt power domains of the equipment they are attached to. This provides a path for potentially detrimental AC leakage loops to form.** If all you are attaching with such cables (on the 'A' side) are computer, NAS, and the feed from your main switch or modem/router, the leakage loops formed between that gear will likely be fairly benign. But if one of those components is somehow also connected to your audio/video system, you may introduce undesirable leakage currents.

Keep in mind that the above is exclusively with regards to 'A'-side EtherREGEN connections (or with standard switches). **The 'B' side of the EtherREGEN is neither susceptible, nor can it become part of, ANY leakage loops.** The 'B' side circuitry and port exist on their own entirely isolated power and ground domain. [Only the External clock BNC ground is common to the 'B'-side ground-plane.] **So if you have a fancy metal-shell shield-tied Ethernet cable, go ahead and use it on the 'B' side port for connection your DAC-attached streamer/renderer endpoint.** This is the connection that matters most when using an EtherREGEN anyway: If you are going to hear a difference with an Ethernet cable, it will more likely be with the 'B'-side cable. This is also a good one to keep short.

Use of the EtherREGEN's Ground terminal screw:

We have measured high-source-impedance leakage on Ethernet cables coming from various other common network gear and computers. Leakage is common-mode AC current traveling over DC connections. It is pernicious stuff—passing easily along both analog and digital connections in our audio systems—and it is desirable to shunt it away. We address leakage in the design of the EtherREGEN in several ways, including our use of RJ45 magnetics having 12 tiny transformer cores per port. And their center-taps are wired to ground and to the Ethernet switch chip through capacitors to maximally block port-to-port leakage. **This works best if the EtherREGEN is grounded—either through the power supply or via the ground screw.**

The DC output 0-volt/-VE ('ground'/shell) of the UpTone-branded AC>DC power supply included with the EtherREGEN is common to AC mains ground**. When our supply is used to power the EtherREGEN it is NOT necessary to use the Ground screw.** [Do not assume that 3rd party linear power supplies are like this—some are and some are not. Some multi-rail supplies have separate diode bridges and transformer secondaries and thus each output ground is "floated." This is easy to test with a continuity/multimeter (be sure power is disconnected.)]

If you power the EtherREGEN with a "floating" supply—one whose 0-volt/-VE ('ground'/shell) is not common to AC mains ground—then ideally the Ground screw of the EtherREGEN should be used. You can do so by running an insulated wire safely to some AC mains ground or to the chassis of a known-grounded component in your audio system. [By the way, our UltraCap LPS-1.2 is a completely "floated" and isolated supply, so if using it with EtherREGEN the ground screw should be used.]

Please keep in mind that all of the above regarding grounding concerns only the blocking of leakage from one RJ45 jack on the 'A' side to another RJ45 jack also on the 'A' side. **Regardless of grounding, zero AC leakage from upstream Ethernet devices ever gets past the full active digital isolation and reclocking ADIM™—to the EtherREGEN's 'B'-side port.**

Regarding use of multi-output or shared power supplies:
The DC voltage input connection powers all the regulators on the 'A' side of the EtherREGEN's isolation moat. A special isolating regulator transfers voltage across the moat to the 'B' side. **Avoid powering both the EtherREGEN and your 'B'-side endpoint from the same AC>DC supply**—unless you are certain the PS outputs used do not share a common 0-volt/-VE ('ground'/shell). If they do you will be defeating the EtherREGEN's sophisticated isolation.

Use of the SFP cage with fiber-optic modules:
Use of optical into—or out of—EtherREGEN is not required to obtain best performance. **The whole point of all the isolation and re-clocking techniques we are using (in dual domains) is to make most all of the upstream stuff not matter.** Other than the complete galvanic isolation that optical offers going into the EtherREGEN (which we duplicate going across the moat), there is likely no advantage to running optical into it.
If you happen to have a router with an optical port and have already run many feet of optical cable to your music system rack, then sure, use the optical port of the EtherREGEN. But don't go out of your way to run fiber-optic if you do not already have it.

For the few people who have an endpoint with optical input (the excellent Sonore opticalRendu comes to mind), one can "turn around" the EtherREGEN and feed that DAC-connected endpoint from the optical cage, while connecting the lone 'B'-side port to the network. Thus 'B' >'A'. The EtherREGEN's SFP cage is on the 'A' side of its active differential isolation moat. Since it is preferred that your audio endpoint (DAC-attached streamer/renderer) be alone on one side of the moat, users who connect an optical endpoint should avoid connecting any other devices to the other 'A'-side ports (the four RJ45 copper ports).

Only Gigabit LC-optical or copper interface modules are compatible with the SFP cage of the EtherREGEN. They can be SX multi-mode, LX multi-mode, or LX single-mode, as long as they are Gigabit and match what is used at the other end of the optical cable.
The modules at each end can be from different manufacturers as long as their type and mode specifications match. While some manufacturer's switches work only with special "branded" SFP modules, that is just an ID code stored in the module. The EtherREGEN ignores this code so any Gigabit SFP module can be used regardless of manufacturer code.

Extreme usage with an external reference clock:
The Crystek CCHD-575 oscillator used in the EtherREGEN is one of the lowest phase-noise production crystal oscillators (XO) available. [Sorry, but the $50~$100 OCXOs we see tossed into stock switches do not outperform the Crystek at low-offsets where it counts; Manufacturers have to spend $500 and up to obtain OCXO clocks with significantly lower phase-noise than the Crystek we use.]

Yet some audiophiles have discovered benefits using expensive ultra-low-jitter/low-phase-noise 10MHz reference clocks with their DACs or USB streamers and conditioners. A clock synthesizer (to generate the various frequencies) is always required for a device to accept an external reference clock. Since we already utilize a very advanced one to produce the 4 clock lines in the EtherREGEN, it was easy for us to include provision for connection of an external 10MHz clock.
The BNC jack and termination resistor of the EtherREGEN are for a 75ohm clock line. (Unless you special-ordered your unit with 50 Ohm BNC and termination resistor—in which case your unit has a small '50 Ohm' label affixed.)

If you are going to attach an external 10MHz reference clock to the EtherREGEN, then you must move the small switch labeled "CLOCK INT/EXT" to the 'EXT' position. **In order for the EtherREGEN to correctly program its clock synthesizer chip to use either the Internal (Crystek XO) or External clock as reference, the CLOCK INT/EXT switch must be set BEFORE DC power is applied.** Programming will not occur if the CLOCK switch is moved after DC power is applied.

The sequence to utilize an external reference clock with the EtherREGEN is:

1) Remove DC power from the EtherREGEN.
2) Set the CLOCK INT/EXT switch to the EXT position.
3) Connect a BNC clock cable from a 10MHz reference clock.
4) Power on the reference clock.
5) Apply DC power to the EtherREGEN.

We hope the EtherREGEN enhances your music system.