TC Electronic PolyTune

Mike Rivers
November 2010

I don't usually write about guitar accessories (this review is a first for me) but I was intrigued by the PolyTune, introduced at the January 2010 NAMM show where it generated quite a bit of buzz and was picked as Best in Show "Gotta Stock It" by Music Inc. magazine. It's a player's tool, but it's also a studio tool, so I got my hands on one and put it through its paces.

What it is, and Isn't

The TC Electronic PolyTune is an electronic guitar and bass tuner in stomp box format, We've got tuners by the dozen, each one having its fans and detractors, but what's unique about the PolyTune is the six string display which gives it its name. Strum across the open strings of a guitar and red LEDs appear above or below the green arc to instantly show the strings which need touching up. You can tune while in the polyphonic display mode, or, when plucking an individual string, the PolyTune automatically switches to a fully chromatic single-note display mode typical of conventional tuners.

What might be a deal-breaker, so you might as well know right now, is that the PolyTune's polyphonic mode works only with standard guitar or bass tuning (though it'll handle a 5- or 6-string bass). You can shift the tuning reference (A=440 Hz) up or down by 5 Hz, and pitch the whole shebang down (but not up) as low as five frets in half-step increments, but the notes must be, or be relative to EADGBE. If you play in open tunings, it's just another guitar tuner, though a very good one. It's fast, stable and accurate, all important characteristics. There's no built-in microphone, so using it with an acoustic guitar requires some juggling.

TC's technology behind detecting the pitch of six strings simultaneously is pretty hush-hush, but there's obviously some DSP filtering and analysis involved to detect the difference between a single string and multiple strings, and to quickly identify each string in the open chord and detect its pitch. TC recommends that using the neck pickup and strumming with a thumb rather than a pick (which yields the minimum harmonic content) provides the best accuracy, which in turn suggests that it prefers to work with the fundamental frequency of each string. It appears to responds a little slower and perhaps requires more DSP horsepower to sort through the higher overtones.

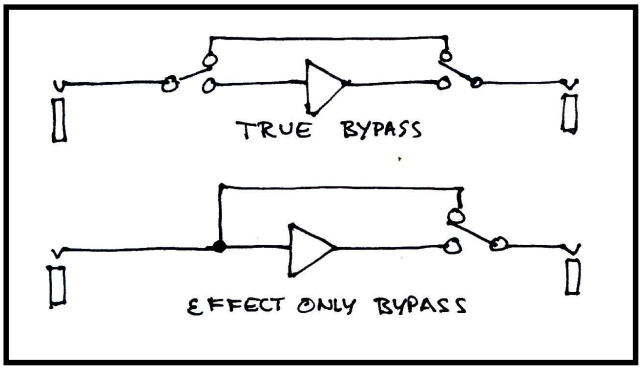
Essential Characteristics

Physically, the PolyTune is built into a sturdy 2½ x 4¾ inch cast aluminum box, with a 1¾ x 2 inch LED matrix display. Velcro strips with adhesive backing are included to secure the box to a pedal board that uses this mounting system. It's a little slippery if placed on a smooth floor with the Velcro attached; without the Velcro, it rests on four soft rubber-like bumpers in the corners of the case which do a reasonable job of keeping it from wandering off. The input jack is on the right side, with the output/thru jack on the left. Being a system engineer, I tend to think of input to output signal flow from left to right, but this is layout is apparently conventional for floor mounted effect pedals. It seems to make for a more trip-resistant cable layout for a right-handed guitarist, so I won't quibble.

Power is from a standard 9V battery, easily accessible by loosening a single large captive screw in the rear cover, slotted so any (US) coin from a penny to a quarter makes a fine screwdriver. There are also power in and thru jacks that use a common wall wart coaxial connector (5.5 mm OD x 2.1 mm ID, Size M) with the center pin negative for daisy-chaining with other similarly powered pedals to a common power supply. If you lose external power, the PolyTune automatically switches to the battery (assuming it's good), though no current is drawn from the battery when operating on external power. The manual warns not to attempt to power another pedal from the power output jack when running on batteries, but in fact you simply can't do it. No voltage is present at the power output jack unless it comes from the power input jack. The low battery indicator reminds you that it's time for a change when the terminal voltage under load gets down to about 7.5 volts, and the tuner dies completely at around 5.5 volts. Specified (and confirmed) current drain is 45 mA. Given that a standard 9V alkaline battery has about a 500 milliampere-hour capacity, from the discharge curves on the Energizer™ web site, it looks like it might want to be replaced after 8-10 hours of operation. Given that you'll probably have it off most of the time, a battery is likely to last for several gigs, but not for several months.

As is common with most effect pedals, the instrument input jack serves as the primary power switch, so it doesn't draw current from the battery when the guitar is unplugged. The stomp button, in addition to muting the output (so you won't tune in public) also controls power – the display is blank and no power is drawn when you're not tuning. A group of four LEDs in the display matrix serves as a pilot light, indicating that the unit is powered, switched to the tuning mode, and awaiting a signal from the plugged-in instrument.

TC's promotional material makes a big deal about "True Bypass," so it's worth understanding just what this means. Any small signal electronic device presents a load impedance to its input source. An instrument pickup, due to its characteristically high source impedance, is particularly susceptible to loading, which in turn can affect the tone of the instrument.



With true bypass, when the device is switched off, the input jack is completely disconnected from the processing circuitry and connected directly to the output jack. Some effect pedals, when switched off, simply bypass the effect, but the input jack (and hence the pickup) remains connected to the processor, loading the pickup even when off.

Why doesn't everyone do true bypassing? Well, for one thing, it requires a two-pole switch rather than a single pole switch, which costs more money. Additionally, there's a third set of switch contacts which, to conserve power, turn off power to the device when it's not being used. I've read a few comments on forums about true bypassing, some complaining that the stomp switch is subject to wear and failure, resulting a noisy output, or worse, no output, when switching the effect in or out. TC mitigates this in the PolyTune by using the big stomp button to control a sealed relay that does the switching rather than passing the low level, high impedance instrument signal through the mechanical switch itself. It's a more costly approach than using a thirty cent push-button switch, but it's quieter and more reliable. I measured less than 0.2 Ω from input to output with the PolyTune bypassed, a resistance easily attributable to connector contact resistance. Good job!

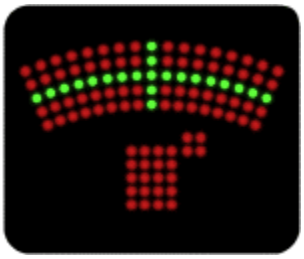
Not that it matters, since you can't hear the instrument while you're tuning (unless your setup feeds the PolyTune from something other than the pickup), but the input impedance that the pickup sees with the PolyTune active is greater than 500k Ω. Personally, I find tuning my guitar completely visually and not being able to hear what I'm doing to be a little odd, but then I'm primarily an acoustic guitarist, and I'm not accustomed to having the sound of my instrument disappear at the press of a button. I suppose you get used to it.

Accuracy is claimed to be ±0.5 cent and that may actually be true. I tried to confirm this, but the display resolution isn't quite up to supporting the claimed accuracy. At 440 Hz, I had to move ±0.3 Hz, a bit more than 1 cent, before the needle moved one step off center. Hence you can be nearly 1 cent off and still have an in-tune indication. Absolute accuracy is important if you were using the tuner to verify or adjust the intonation of an instrument, however there are better tools for this. It's resolution certainly supports good enough tuning accuracy for rock'n'roll.

One input characteristic that's important, since it determines how "hot" your guitar signal needs to be in order to get a stable display on the tuner, is the dynamic range. When testing with a sine wave from a generator, the PolyTune gives a

stable indication with an input level as low as –80 dBu (around 0.2 mV peak-to-peak). It takes a long time for even a gentle strum on my single-coil pickup guitar to decay that far. On the upper end, it gives an accurate and stable reading with an input level as high as +18 dBu, which suggests that if you like what your guitar sounds like when going through a favorite rack-mount processor with line level output, you can connect the PolyTune to the processor's output. This is a dynamic range on par with the best mic preamps.

The Display – A Closer Look

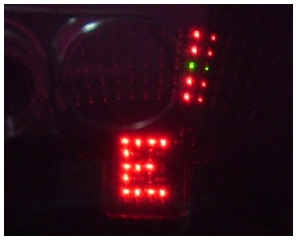


To get a sense of what you'll see, let's look at the whole LED matrix with all of the LEDs illuminated. The green arc is the "in tune" line when in the polyphonic mode. The vertical array of green LEDs is the needle pointer in the mono mode when you're perfectly in tune. The small group of four red LEDs is the # (sharp) indicator. It doesn't display flats when tuning, only when adjusting it for a lower overall pitch. The 4 x 5 matrix at the bottom displays the note name and serves as the "pilot light."

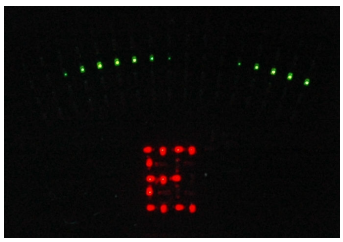
An ambient light sensor dims the display in the dark and runs it at full brightness in bright light. This is kind of difficult to see in action, but I was able to verify its operation by turning out the lights and shining a flashlight directly on the sensor, however, to be sure it was actually working, I cheated and watched a meter connected in series with the battery, which confirmed a variation of couple of milliamperes between light and dark. On one of the rare days here when we have bright sunlight during November, I took it out to the back porch and could read the display just fine as long as glare wasn't a problem. I don't anticipate that anyone with reasonably normal vision would have trouble reading the PolyTune display from eyeball-to-floor distance.

Here's the polyphonic display with a mono display of each of the three out-of-tune strings below. As you can see from the LED matrix, the poly display has two steps above and below the correct pitch. Note that the A string, being pretty sharp, is at the second "off pitch" step. This is sharp enough to be interpreted as being A# and a little flat

.



When a string is much further off pitch than a half-step, the green LED in the “on pitch” arc will either blink or disappear.



An alternative to the needle display in the mono chromatic mode called the “stream” mode. This is a set of moving arc segments that stands still when the string is on pitch. It gives the impression of tuning to a strobe tuner. I preferred stream mode to the needle mode, finding it easier to zero in on correct pitch. In either of the mono/chromatic display modes, the PolyTune implements what TC calls a “tuner magnet” which slows down the needle or the pseudo strobe as you get close to pitch. I found this to be very effective in stream mode, making it feel very much like tuning to a strobe. It seemed to me to be less effective (actually less apparent) in the needle mode.

When the battery is getting weak, a reminder will flash across the screen, then the display will return to business at hand.

When first powered up, a sequence of displays reminds you of how it is configured – the reference (A=440) pitch, whether it’s set up for guitar or bass, needle or stream mode, and, for a dropped pitch tuning, the note to which the 1st and 6th strings are tuned (E down through B).

In The Trenches

So how well does the PolyTune work in practice? I’ll have to admit that when I first started working it, I was skeptical, and actually a little disappointed. It took some getting used to, as well as some encouragement from enthusiastic users, before I really caught on to its value and how to use it effectively. Electric guitar isn’t really my instrument, but I have a few oddballs here. For testing the PolyTune, I mostly used a Casio MIDI guitar, a Strat-shaped Ibanez-built instrument with one double coil and two single coil pickups. I found that all pickups, either singly or in combinations worked equally well.

When first becoming acquainted with the PolyTune, I’d strum across all the strings and just gape in amazement at the polyphonic display. By the time I actually started to adjust the tuning, the guitar signal faded down below threshold and the display blanked. I discovered two methods for tuning that worked about equally well for me. One method (illustrated in a demo video on the TC web site) is to repeatedly strum the strings and tune while watching the poly display. The other method is to take a quick glance at the poly display, see which strings are

out of tune, and then tune those strings individually while watching the mono chromatic display.

You can get a pretty good education in guitar mechanics from this gadget. When tuning in the polyphonic mode, you can see the effect that tuning one string has on the other strings. This is most noticeable on a guitar that has a vibrato tailpiece, but, for what it's worth (a whammy bar rarely returns all the strings to where it found them), you can get it perfectly in tune with a couple of passes tweaking and re-tweaking strings. I often obsserved a discrepancy between the two tuning modes – I'd put a string right on pitch using the mono display, then when strumming across all of the strings in the poly mode, finding a string or two out of tune again. One explanation was that I was holding the guitar differently when strumming than when playing an individual string, and the tuning discrepancy was a result of the difference in the amount of bending of the neck.

When I tried comparing a polyphonic tune-up with tuning one string at a time with the guitar placed on a stand rather than held in playing position, the concurrence was a little better sometimes, but not always. The display is very consistent in the mono mode – setting a test generator to 440 Hz consistently showed a perfectly tuned A. The only method I could come up with for generating a test signal for the polyphonic mode was to record a strum after getting the guitar in perfect tune (as indicated on the display), loop it, then play it back into the PolyTune. This demonstrated the tuner to be consistent with every pass through the loop, so whatever it's telling me, it really believes it, and that's a good thing.

While I wouldn't dare to ask for *less* resolution, I think it's possible to get too fiddly with this tuner. Given time to become accustomed to how much information you can get at a glance, you'll most likely come up with your own best way of working with it. If you're doing a fast paced show with very little time between songs, a quick strum across all the strings will show you what needs the most attention and you can do a quick fix before starting the next song. In the studio, you can take as much time as is necessary. Being perfectly in tune really makes a difference.

My collection of electric instruments is pretty esoteric (no P-basses here), so I used an Ampeg fretless bass guitar to check the PolyTune in bass mode. This bass has a piezoelectric pickup and uses standard acoustic bass strings. All I needed to do was to change the setup from guitar to bass, plug it in, and the tuner worked very well.

Speaking of setup, two recessed buttons on the back edge of the case select the display mode and reference pitch. Normally you'll be watching the display while operating these buttons, so their

labels, “display (-)” and “tuning (+)” are on the front panel above the LED screen. Pressing the Display button sequences through the Guitar/Needle, Guitar/Stream, Bass/Needle and Bass/Stream displays. Pressing the Tuning button cycles the note for the 6th and 1st string from E down to C in half steps. Pressing both buttons together engages the reference pitch mode. From here, pressing the (+) or (-) button adjusts the pitch in 1 Hz steps from 435 to 445 Hz. The settings are stored in non-volatile memory so the tuner comes up in the mode in which it was last used. If you’re inclined to shift off standard pitch, it’s a good idea to pay attention to the startup display to be sure that it’ll get you tuned up where you want to be.

Acoustic Guitars

This is my primary instrument. Even though the PolyTune doesn’t have a built-in microphone, I had hopes that I would be able to use it on stage by feeding it a direct output from the PA mixer, or in the studio with a feed from the console or mic preamp. My initial experiments were disappointing. It seemed that no matter which preamp and mic I used and how the mic was positioned (including a tie tack mic clipped to the sound hole that I use occasionally when playing a dance with a large group of musicians), the poly display, if it came up at all, didn’t remain stable long enough to tune. The mono display was only a little better, but still inadequate. Bummer.

None of my acoustic guitars are equipped with built-in pickups (I never found one that really sounds like the guitar), but I took the PolyTune along to a festival where I was running sound and I knew that just about all the guitars on my stage would have pickups. I wanted to give the tuner a fair shake with what’s become a more typical performing acoustic guitarist’s stage setup, and it indeed worked quite well with all of the guitars present that weekend. This was a contemporary Celtic music festival, so we had acoustic guitars that weren’t simply going direct into the PA system, but also run through chorus pedals and such. One player was particularly impressed with the PolyTune because of the true bypass feature. He had other tuners that he no longer used in-line because he didn’t like what they did to his guitar sound. But I digress.

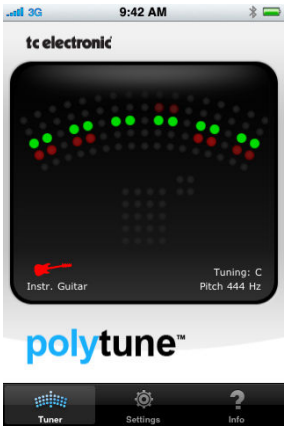
When I finally got down to writing this review after playing with the PolyTune on and off for several months, I decided to go back to my acoustic guitars and mics so I could at least offer up a more detailed explanation of what was, or was not happening. I started off with an AKG C567 tie tack mic clipped to the sound hole a Martin 000-28, used a Mackie Satellite as a preamp simply because it was handy on the bench, and darn if I didn’t get a good, solid display this time around. The display wasn’t quite as quick in coming up as with the electric guitar, perhaps because it was having a more difficult time sorting out pitch due to the difference in harmonic structure between the electric and acoustic instruments. Still, within a bit more than one second, I had a polyphonic display that remained stable long enough to touch up a few strings. Individual notes in the mono display

displayed equally well. I have no idea what was different this time around that would make the performance so dramatically different from on my first try. Perhaps it sensed that I was about to write up its lackluster acoustic performance in a published review and it got scared into behaving. I hate it when I have irreproducible results, but I can't argue with success.

While I can usually find a mixer output to feed the PolyTune when on stage, I wasn't keen on having to bring along a power supply and preamp for the condenser mic when just jamming with friends, so I tried some dynamic mics. First up was a Shure SM57 with an in-line step-up transformer to provide a little level boost and a ¼" phone plug to mate with the PolyTune's input jack. It worked fine, but it turned out that the transformer wasn't really necessary, thanks to the huge dynamic range of the PolyTune input. A simple XLR-TS cable or adapter worked with any dynamic mic I tried. I hereby retract any comments I may have made about it not doing well with acoustic guitars.

Just for kicks, I tried a mic on a banjo into the PolyTune. While, as I expected, the poly mode didn't give me much useful information (banjos, other than banjo-guitars, aren't tuned like a guitar) the mono/chromatic mode worked fine, even with some pretty odd tunings. That was a pleasant surprise.

Hold The Phone!



In addition to the stomp box format tuner, there's a PolyTune app for the iPhone, iPod Touch, and iPad. I didn't review this version since I don't have an iGadget, but reports from the field have been quite favorable, and it's only ten bucks. It uses the same display and the same technology as the hardware box, which is interesting in that TC was able to use the same DSP base code (clearly it's not exactly the same code) in both in the iPhone and the DSP chip used in the stomp box. The i* version takes advantage of the phone's built-in microphone which makes it more friendly for tuning acoustic guitars, but you'll need an adapter such as the AmpliTube iRig from IK Multimedia if you choose to plug in an electric guitar.

In Summary

A couple of things that I haven't mentioned yet, so here's my last chance. The manual is a single, large sheet in six languages with illustrations of the various displays. It's worth a read since not everything about the PolyTune is obvious. Even though the English isn't perfect, it's easy to understand. Then there's the

mysterious USB connector on the top edge of the case. It's presently there only for factory testing, but perhaps one day it will have some user applications.

You can look at the PolyTune as breakthrough technology, or you might see it as a clever and sometimes useful parlor trick. But if you can keep your show or recording session moving along more smoothly by shaving a few seconds off re-tuning, or if you just love nifty gadgets, one might be in your future.

What's in TC's future? While it's a useful product today, my gut tells me that it's also a proof-of-concept, and that there may be more exciting applications for the polyphonic pitch detection technology coming from TC, a company that has a warm spot in its corporate heart for the guitarist and stage performer. Perhaps if the PolyTune takes off, we'll see a more programmable version, or perhaps one that automatically recognizes alternate tunings. Stay tuned.

Pros
Rugged, accurate, fast-responding, good readability, power pass-through, full (true) bypass when disengaged.

Cons
Polyphonic mode only works for conventional guitars or basses in standard tuning (no 12-string, 7 string, or lap steel guitars, nor slack key, dropped-d, nor DADGAD), requires an external microphone or line level signal for tuning acoustic guitars.

Just under $100 from most musical instrument dealers

Further info from TC Electronic:
http://www.tcelectronic.com/polytune
http://itunes.apple.com/app/polytune/id364009203?mt=8