

The making of the

# Tone Garage

## The aesthetics of sound design as revealed by pedal designers

### The VOX Tone Garage Series - crystalizing the wisdom of Japanese, American, and British engineers

The fruit of a collaborative project that enlisted VOX staff from around the world, we proudly announce the newly-completed Tone Garage stompbox series from VOX, the British musical instrument brand that has been supporting the music scene for many decades.

Each of the five pedals in this series is based on some extremely interesting analog technology. The series includes booster/overdrive/distortion units that generate distortion by driving a vacuum tube at high voltage, a delay that uses a BBD (Bucket Brigade Device) circuit to deliver a truly musical effect, and an octave fuzz that pays tribute to vintage sounds, yet also brings fresh new functionality. Here we unveil the full story of the Tone Garage series as told by the members of the VOX team within Korg Inc. who played central roles in developing and designing these pedals.

### The role of tubes in the three distortion-type pedals

British VOX staff were responsible for the conceptual planning and case design of the Tone Garage series, while the circuit design was done mainly by staff from Korg, who is the importer of VOX products in Japan. The painted graphics were designed by American staff, and the British staff cooperated in the adjustment and finalization of the tones. All in all, the completed product was the result of a cooperative development effort involving three countries. The concept of using vacuum tubes as the heart of the three distortion-type models (Flat 4 Boost, Straight 6 Drive, and V8 Distortion) was of the highest importance, since it carries on the brand image of VOX, who has produced numerous classic models of tube amplifiers since the 1960s. Actually, since a battery-driven 12AU7 tube was used in the Cooltron series of the 2000's, the challenge for VOX in designing the distortion pedals of the Tone Garage series was to drive a vacuum tube in a way that was as similar as possible to the preamp circuit of a guitar amp; in other words, to drive it at high voltage. The Flat 4 Boost, Straight 6 Drive, and V8 Distortion are all based on Hi-Volt technology consisting of a power supply provided by six AA batteries or a 9V adaptor which is internally boosted in voltage and used to apply 200V to the plate of a 12AX7 (ECC83) dual triode tube.

Here's how it's described by Mr. Yu Nishibori, who is involved with planning and development of VOX products within the Korg Inc. "As you know, VOX has produced classic models of tube amplifiers since the era of the Beatles. For many years, it has been our dream to reproduce the energetic sound of tube amps such as the AC30 within a package that's the size of a compact effect unit, and the Cooltron was an example of such an attempt. However to be honest, using the vacuum tube 'as an audio amp' was as much as the Cooltron series could manage; it wasn't able to make the component itself distort. The highest goal for the new Tone Garage series was to use the newly-developed Hi-Volt technology to obtain the distortion sound of the vacuum tube itself."

The engineer who played a central role in circuit design for the Tone Garage, Mr. Masahiro Lee, has this to say about Hi-Volt technology - "With the Tone Garage series, the first objective was to apply 100V or more voltage to the tube in order to get the actual vacuum tube distortion sound. Simply boosting voltage is not such a difficult technology; if you have a mind to, it's not impossible to get about 300V of voltage from a 9V battery. But doing that will drastically shorten the battery life. It was in order to balance sound with battery life that we arrived at our specifications of using six AA batteries to apply 200V of voltage to the 12AX7. As a result, the finished product is able to provide seven or eight hours of continuous operation on battery power." This is how we developed the Hi-Volt technology that is the foundation of the Flat 4 Boost, Straight 6 Drive, and V8 Distortion, but in order to build this technology into production models that might be used in a wide variety of conditions, we had to implement additional peripheral circuitry. First, all pedals in the Tone Garage series provide a standby switch that turns the power on/off in addition to the foot switch (true bypass type) that turns the effect circuit on/off. Mr. Lee explains that this was necessary in order to improve the electrical performance. "Most compact effect units turn the power on/off when a contact is made between the ring and ground of the input jack, and this is fine for circuits that handle low current and low voltage. However in circuits that handle high current and high voltage, such as the Tone Garage, just the contact resistance between the pins acting as a switch would significantly lower the overall electrical performance. That's why we provided an independent power on/off switch for these units." In addition, many other refinements were made in conjunction with the use of Hi-Volt technology, such as a switching circuit that controls the high current that rushes into the heater pin when the vacuum tube warms up, a "heater current slow start circuit" that protects both the tube and the adapter, a circuit board layout that eliminates the oscillation that tends to affect high-gain circuits, and the interior design of the case. Why did VOX insist on "making the vacuum tube distort" even at the cost of such extreme measures? When asked the question, "For an engineer, what is the great attraction of a vacuum tube as a component?" Mr. Lee responds as follows. "The great attraction of a vacuum tube as a component is that - in a good sense! - it has electrically poor performance [laughs]. Of course, a transistor could be used to amplify current and voltage in the same way as a vacuum tube, but a transistor's electrical response is just too ideal in some ways and when we use it to distort a guitar signal, the high range becomes jagged or the low end becomes boomy. That means that we have to put some type of filter before and after the transistor to adjust the tone, but in the case of a vacuum tube, we can make good-sounding distortion without using such filters. I think that when a vacuum tube is used to distort a guitar signal, it's the poorness of the electrical response that makes it produce sound that people find pleasant."



**The people of the VOX Japan team located at Korg Inc, which is the importer and distributor for VOX in Japan.**

**From the left: Mr. Yu Nishibori, Mr. Masahiro Lee, Mr. Masatoshi Tohyama, and Mr. Kenji Sakane**



**Mr. Phil Scaffe (left) and Mr. Dave Clarke (right), who are involved in product development at VOX in England, the home of the brand.**

### **For the analog delay, we insisted on the sound produced by BBD chips**

Next let's talk about the Tone Garage series' Analog Stomp unit, which VOX praises as "distilling the enjoyment of analog effect units." The red body of the Double Deca Delay sports a graphic of a London bus. Inside are an amazing three 3205 BBD ICs, which you can view through the clear cover (called a "canopy" by the developers) that lets you see the vacuum tube on the distortion-type pedals. The biggest feature is that you can switch the delay mode between SHORT, where a single BBD provides up to 300 msec of delay, and LONG, where all three BBD ICs are used to obtain a maximum delay of 900 msec. Additionally, there's a BOTH mode which multiplies the SHORT and LONG settings to utilize the feedback point of the delay signal, creating a complex reverberation and repeat effect that's like using reverb and delay at the same time. Here's how Mr. Lee explains the technical approach to this model. "The SHORT and LONG delay modes also differ in their tone. Using the high-cut filter that reduces the noise that occurs around the BBD, we've made fine adjustments to give the SHORT delay a bright tone and the LONG delay a dark tone. In BOTH modes, we determined the feedback point of the delay sound based on an algorithm used when creating reverb on a DSP. The difference between the SHORT and LONG tones should be easy to notice when you're hearing both of the sounds in BOTH mode."

### **A fuzz box that can produce three types of octave tones**

The last unit to introduce is the Trike Fuzz. It contains special diodes with characteristics that are similar to germanium types that are used to reproduce vintage sounds, but they also add new functionality that allows up to three types of octave sound to be generated. Regarding the development concept, Mr. Lee has this to say. "We are constantly researching circuits and parts, and in the course of our investigations we accumulate numerous discoveries such as 'you could use this part or circuit to create this sort of effect'. When it was decided that the Tone Garage body design would allow four knobs and one mini-switch, we reached into our collection of discoveries and decided to make an octave fuzz that would operate in three modes. We were aiming at the tone of an old fuzz unit named the "Octavia," but we also wanted to add unique functionality that did not exist on any other product." The unit generates bands corresponding to the +1, -1, and -2 octaves of the original sound, and uses what Mr. Lee calls "a somewhat antiquated design"; this has the consequence that, depending on the

guitar's pickup position, tracking is not always smooth, and noise can sometimes occur. Still, these idiosyncrasies contribute to the reproduction of that classic octave fuzz. More from Mr. Lee: "We had to make design decisions as to which part should stand out; for example, should we emphasize sustain, or should we emphasize the sense of compression on the attack? While we considered various possibilities, the British VOX people suggested that even if the octave sound was not always heard cleanly or if the sustain was not long, this might actually contribute to the atmosphere of the effect. In the end, that's the approach we took. We decided that maybe it was OK to have a somewhat violent-sounding effect. [Laughs]"



**Staff who develops VOX products in the USA: from the left, Bob McDonald, Eric Kirkland, and Rich Lasner**

### **Pedal Conference -- VOX EFFECTOR MEETING**

On July 17, a private showing of the Tone Garage series was held in Tokyo: the "VOX Effector Meeting." During the event, the largest share of time was allotted to a conference that allowed the VOX team within Korg Inc. to talk about the concept of the Tone Garage series, details of the technology, and inside stories about design and production. There were four attendees from VOX: Mr. Masatoshi Tohyama, the manager of the development section; Mr. Yu Nishibori, responsible for planning and development; Mr. Kenji Sakane, who was the team leader and also the designer of the pedal body; and Mr. Masahiro Lee, who was mainly responsible for the analog circuit design. Numerous questions were asked by the participants. The invited guests included some truly hard-core aficionados, such as professional guitarists and writers for effect-related products, who did not hesitate to interject pointed questions into the dialog between the VOX team and the moderator. It goes without saying that many of the topics were regarding tips for taking advantage of these new products. Of particular importance was a point of caution when using an AC adaptor to supply power to the Tone Garage series. "The models that contain a vacuum tube may draw nearly 500 mA of current when you turn on the standby switch. You won't have a problem if the 600 mA adaptor that we recommend (Korg KA181) is connected directly; however if a typical adaptor is used, it might not provide enough power, and if you've branched a single power supply to feed multiple pedals, you might have problems with other pedals in the chain," cautions Mr. Lee. Players who install Tone Garage units in their effect board should take thought as to how the power is going to be supplied. A more light-hearted caution was supplied by Mr. Tohyama: "The numbers '4', '6', and '8' on the distortion pedals do not indicate the number of amplification stages in the circuit; they are meant to suggest the number of cylinders in an automobile engine. [laughs]" Another mischievous note from Mr. Lee: "The Trike Fuzz can actually operate on a single 9V battery instead of six AA batteries. This design is due to the fact that we're using a case that's common to the entire series, but the result is that you actually get several hundred hours of continuous operation. [laughs]" After the approximately two-hour conference, the participants were given an opportunity to try out the Tone Garage series as they liked, and experience its potential first hand. As the attendees left the meeting, they were handed a VOX branded T-shirt and a 12AX7 vacuum tube printed with the VOX logo, concluding this warm-feeling event.

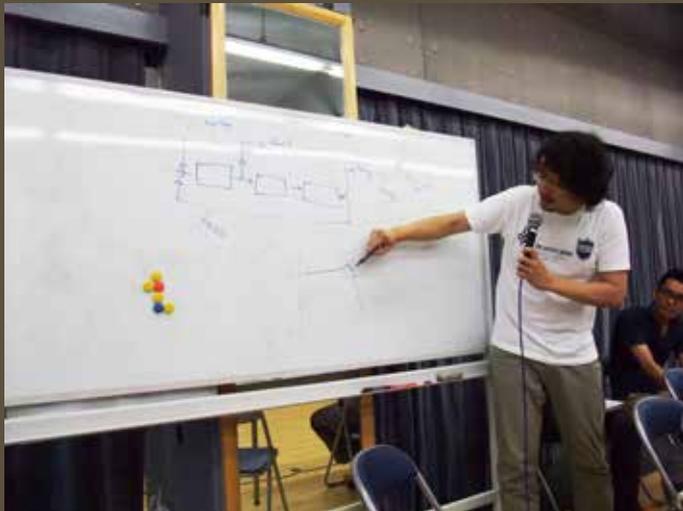
## Photos from the Pedal Conference



A scene from the conference, which saw energetic exchanges between the VOX development team and the various individuals who hold strong opinions about effect devices



The attendees lost no time trying out the effects



Mr. Lee explains how the delay operates



Participants were very interested in the product prototypes that were brought to the meeting

## VOX Tone Garage Series Straight 6 Drive

Examining the features of a drive pedal that takes full advantage of a vacuum tube

This is an overdrive where the distortion circuit is centered around a 12AX7 vacuum tube. The developers: "The case color (green) will probably remind you of a Tube Screamer [laughs], but this model was not developed to reproduce the sound and circuitry of a specific effect unit or amp. We were simply focused on creating a model that would have a certain quality of distortion and response that would make a lover of vacuum tube amps say, 'Yes! This is it!'" Just as the developers say, this unit gives you distortion with a musical character and an emotional appeal. It's a pedal that conveys the VOX philosophy of taking the vacuum tube not as a legacy device, but as the ideal contemporary component for realizing the tone that guitarists seek.



### Standby/ON

Power on/off switching is done by a "STANDBY/ON" switch; this measure was taken in order to avoid spoiling the electrical performance of the high-voltage circuitry.



### Battery

The six AA batteries are enclosed in a battery box. The overall case is compact, yet allocates the necessary space.



### Controls

A set of controls consisting of four knobs and one mini-switch is common to the entire series. On this unit, it controls the BRIGHT parameter.

### VOX 12AX7

Of the five units in the Tone Garage series, the three distortion-type units (Flat 4 Boost, Straight 6 Drive, and V8 Distortion) each use one vacuum tube in their amplification stage.

According to the developers, the amplification using the tube occurs at the final stage of the circuit, and its plate voltage is set to 200V as sometimes seen in amps and effect units that use the 12AX7 in the pre-amp section. Since the maximum plate voltage for a typical 12AX7 is approximately 250V, the setting of 200V was probably chosen by many manufacturers based on considerations such as getting the right vacuum tube sound, the power consumption, and the longevity of the components. Preceding the vacuum tube is a transistor-based circuit, but the distortion occurring in this section can essentially be ignored; the developers point out that "the core of the sound is created solely by the vacuum tube."



### Vacuum Tube

You can see the 12AX7 vacuum tube through the clear cover that the developers call "the canopy."



## VOX Flat 4 Boost

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With LOW and HIGH parameters, a MID BOOST switch, and its internal vacuum tube, this booster is capable of reproducing a wide variety of characters. While delivering the rich harmonics and the smooth and punchy mid-range that guitarists expect from a tube-equipped pedal, this is an easy-to-handle unit that avoids giving any impression of sonic excess.



## VOX V8 Distortion

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Tone/EQ controls for carefully selected frequency regions and a MID SHIFT switch allow this distortion unit to deliver nearly any genre of sound, from the hard rock of the 70s to the heavy metal of the 80s and even the modern metal of the 90s and 00s. Even with high settings of the GAIN control, your picking dynamics are clearly reflected in the output sound - one of the great things about a vacuum tube powered device.



## VOX Double Deca Delay

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This is a BBD analog delay that can be switched between three modes: SHORT with a maximum delay of 300 msec, LONG with a 900 msec maximum, and the BOTH mode, which combines the SHORT and LONG delay modes to generate complex delay and reverberation. While the delayed sounds exhibit that highly musical character of attenuation that is typical of an analog delay, this unit also achieves an excellent S/N ratio, creating a sound field that overflows with transparency.



## VOX Trike Fuzz

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This fuzz unit joins classic fuzz sounds with innovative functionality that generates tones at +1, -1, and -2 octave intervals relative to the original sound. It's a unit that gives you free control over a range of sounds including traditional octave fuzz sounds typified by the Octavia, sounds that are reminiscent of an analog synthesizer, and even aggressive sounds with nearly unpredictable harmonics and sub-harmonics.

