Dan Armstrong Orange Squeezer compressor - circuit description

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1. Introduction

There are several descriptions of the Orange Squeezer's circuit which can be found online. Some of them point out incorrect "facts" and others lack information for the circuit to be properly understood.

In the following article we will be describing the original Dan Armstrong Orange Squeezer design and its circuit specifics in detail.

Figure 1 - Dan Armstrong Orange Squeezer

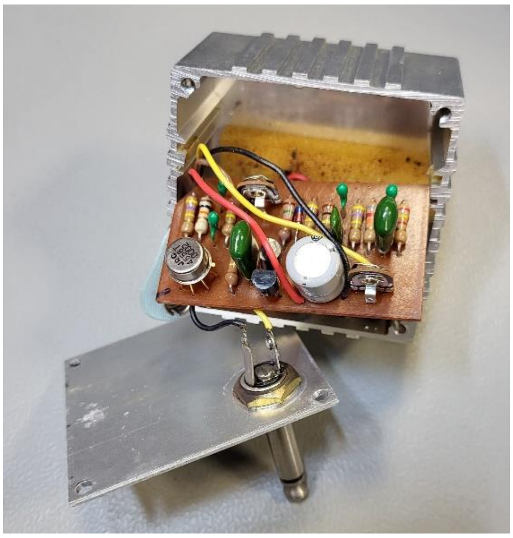

Figure 2 - Orange Squeezer electronics

2. Orange Squeezer circuit analysis

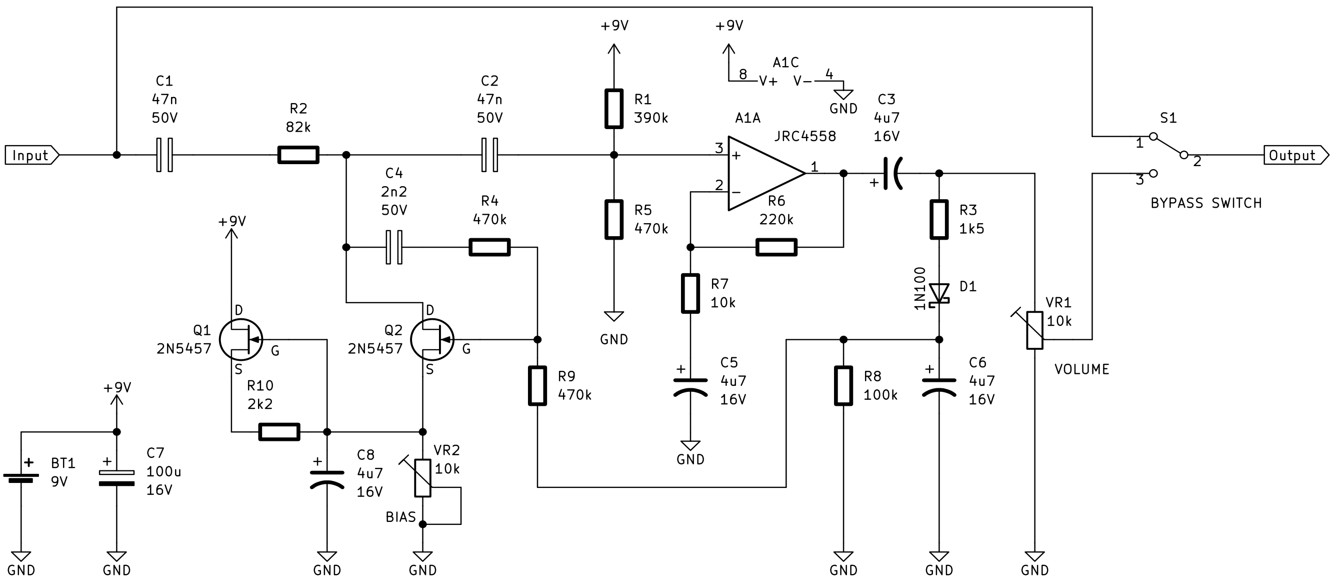

Figure 3 - Dan Armstrong Orange Squeezer

The Orange Squeezer is designed as a feedback FET compressor. The JFET Q2 acts as a voltage controlled resistor (active compression element) which makes a dynamic signal divider with the R2 resistor. The input signal is reduced in dependence to the Q2 gate control voltage which is generated by the feedback network. Dynamic resistance of the Q2 transistor has a range from a few hundred kΩ to a few kΩ controlled by the gate's control voltage and it is defined by the transistor's bias voltage.

The original transistor (2N5457) has a wide range of the Gate-Source cut-off voltage (-0.5 to -6V) and this type of parameter spread is usually the case with JFET transistors. To set the Q2 operating point (quiescent point), bias control is implemented using a simple current source (Q1, R10) and a biasing trimmer VR2. Transistor Q1 is not in the audio signal path and is not affecting the sonic character of the Orange Squeezer. It acts as a current source providing around 500 µA fed through the 10 kΩ trim pot to set the operating point of the Q2 transistor (bias).

Setting of the Original's biasing point and biasing trimmer is overly mystified and lots of discussions can be found online. From an engineering point of view, it can be physically set in the range of a few hundred millivolts around the transistor's cut-off voltage. In this adjustment range, the compression's character will change from a light compression through to limiting squashing. The bias point will also define the compression threshold. How it was originally set remains unknown to us. From an engineering perspective, in order to utilize the full active region of the JFET, it is best to place it where the impedance (Q2 channel resistance) has the largest dynamic range and well-balanced compression over the guitar signal's range. The playing experience and sound testing that we did confirm this to be the most musical setting.

The original design does not use an input buffer to act as a high impedance for the guitar's output signal, rather it acts as a variable input impedance, resulting as a dynamic EQ/attenuator combined with the guitar's high output impedance. This is one of the specific aspects of the original's design which gives the guitar's tone such a unique character when it's plugged directly into the guitar with passive pickups.

The feedback loop also acts as a make-up gain stage with a fixed value of 27dB, while providing the output signal and the signal for the half-wave rectifier that feeds the compression control signal integrator.
The control signal integrator is formed as a first order low pass filter by R3 (attack timing resistor) and C6 capacitor, loaded with the R8 resistor acting as a release timing constant in combination with C6. R3, C6 and R8, define the low pass filter with -3 dB point at 22Hz, giving it a considerable ripple at low frequencies, resulting in another sonic artefact which represents itself as a subtle, audible amplitude envelope modulation in the output signal.

The rectifying diode is not in the audio signal path, but it still influences the compression's character. It affects the compression's knee and threshold, and it's defined by the forward voltage. Originally, the germanium diode was used with forward voltage below 200 mV for currents below 1mA. Reverse diode current is also influencing the compressor's release time, resulting in faster release time as if we just calculated the R8-C6 time constant making it 470 mS. Both the forward diode voltage and the leakage current are temperature dependable, which means that they will significantly affect the compression threshold and release time in range from 0 – 50°C (32 – 122°F).

Due to the relatively high make-up gain (27dB) and moderate attack (~6 mS), the original circuit will clip fast input transients above 200 mV to the operational amplifier supply rails for a few milliseconds before the compression kicks in.
Another specific detail to keep in mind is that there is a negative voltage offset added to the output signal defined by the diode's forward voltage and rectified/integrated control voltage.
The bypass system is designed using the SPDT toggle switch and it will always "load" your guitar's signal with its input circuitry with a relatively low impedance. Although this relatively low dynamic impedance gives this compressor its special flavour and iconic status, it can be limiting in situations when the effect is bypassed. It

will affect top-end, high mid-frequencies and will result in the guitar's signal dropping slightly compared to true bypass. However, this can result in a pleasant feel and playing experience in combination with other pedals and/or guitar amplifiers.

3. Orange Squeezer technical data

Parameter	*Value*
Frequency response (-3 dB)	*40 Hz – 150 kHz*
Supply Voltage	*9 V*
Supply current	*6 mA*
Input impedance	*dynamic 200 kΩ – 80 kΩ (input signal dependence)*
Attack	*~6 mS*
Release	*~200 mS*
Output signal swing	*+3/-4.2 V*

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