

# FET Compressor

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The proposed compressor designed to compress the dynamic range of the signal electric guitars with passive and active electronics. The compressor can be successfully used for signal processing bass guitar.

In the design of the compressor the authors relied on the most simple circuitry, ensuring optimal for the guitar signal specifications. The device requires no configuration and proper installation starts immediately: Modes of DC are set automatically.

Technical characteristics

Table 1

Power, <b>in:</b>	7 ... 9
Current consumption, <b>mA:</b>	<6
The maximum input <b>signal, dv.ampl.</b> ( $U_{num} = 9V$ ):	7 ***
Noise given to the input <b>mV:</b>	2
Operating threshold ( <i>Threshold</i> ), <b>mV:</b>	5 ... 30
Compression ratio ( <i>Ratio</i> ):	1:1.5 1:6 ...
Settling Time ( <i>Attack</i> ), <b>ms:</b>	1 ... 40
Recovery time ( <i>Release</i> ), <b>sec:</b>	0.7 ... 3

\*\*\* When using T1 cutoff 4 ... 5 V

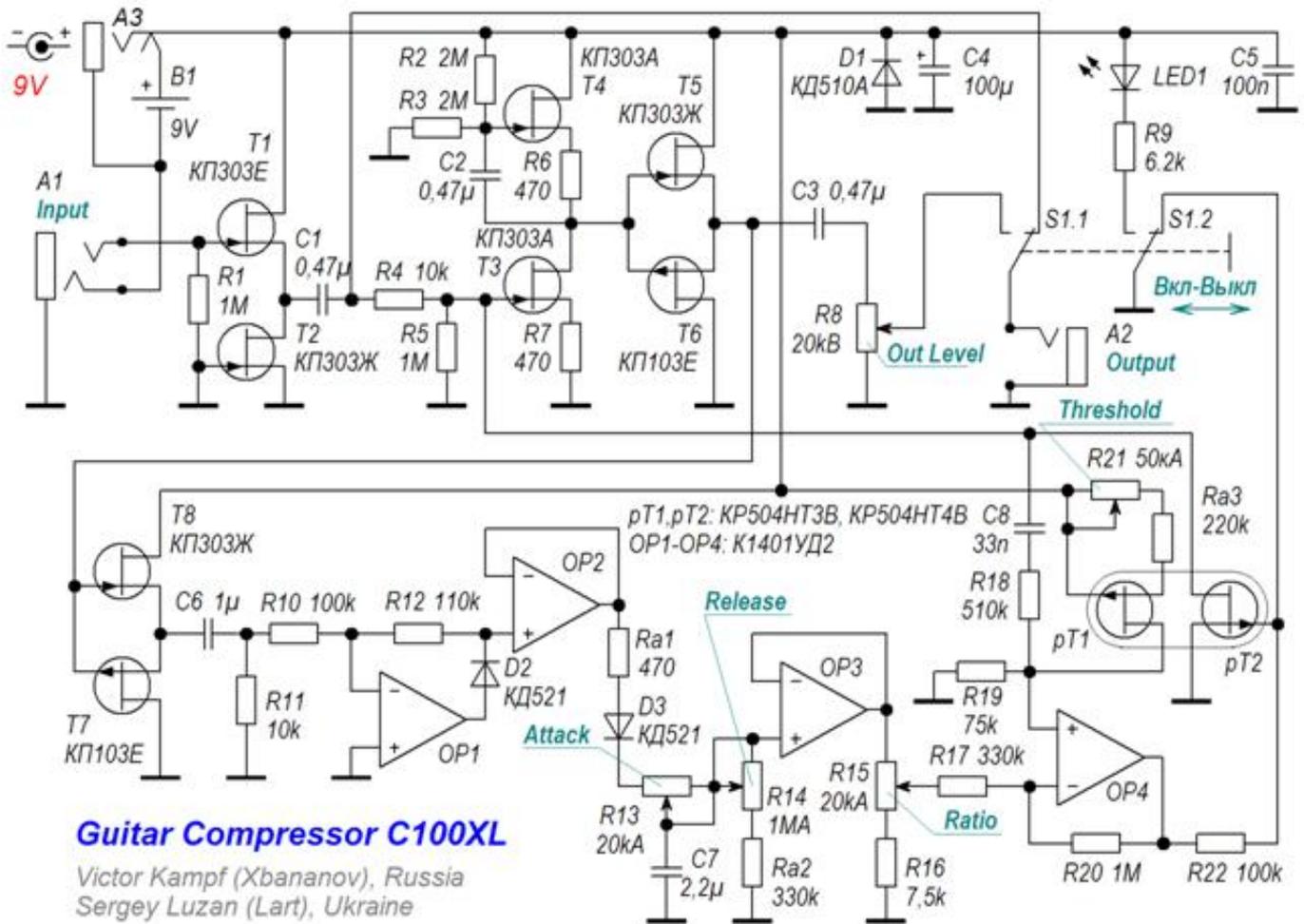


Fig.1. Schematic diagram of the compressor

### Amplification channel audio

Channel gain is based on field-effect transistors, because, according to the authors, these devices are among the most suitable semiconductors for signal processing guitar. In this scheme was based on the principle of the shortest circuit of the signal.

The input signal is fed directly to the converter resistance of T1, T2. Bias voltage of the cascade is generated automatically as T1 - a transistor with a high voltage cut-off (4-5B). The current through T1 is determined by simple current source to "malootsechnom" T2 is the initial current flow T2. Use as a current source load T1 significantly reducing distortion at the output of the repeater at work on relatively low-resistance load  $R_4 + R_{RNA}$ . P T2 at high signal levels.

The main amplifier - selected m-stage (T3, T4), to the greatest extent, in their opinion, meets the requirements of a smooth transition from linear mode to limit that provides the low noise, large gain, high linearity and harmonious distribution of the harmonic spectrum. To improve the linearity of the cascade in the origins Fri put small local environmental protection current.

Next, push-pull signal is fed to the repeater, made on the T5 and T6 and eliminates the effect of the load compressor to work m-stage. Repeater practically does not introduce additional distortion even when the signal at the output of m-stage with a double amplitude close to the supply voltage.

### Regulator

As a regulatory element is selected p-channel TP in the assembly KR504NT4V (KR504NT3V)-mode voltage controlled resistance. The choice of p-channel FET caused, first of all, the ability to control this type of transistor, a positive voltage to the gate. In this case the source of the regulatory FET connects directly to a shared bus, which eliminates any effect on the sound of chains that form in such cases, the necessary capacity on source when using n-channel controllers. The second p-channel TP in the assembly is used to generate the initial bias on the gate regulating FET

### ***The control channel***

Management is implemented at the OS K1401UD2 quadruple (analogue - a common foreign Shelter LM 324), capable of working in a range of output voltages from 0 to U<sub>Pit-1</sub>, 5V.

At the entrance to the control channel is added another follower, complementary FET T7 and T8, designed to eliminate the effect of rectifying the output of the cascade compressor.

OP1 collected on full-wave rectifier, which allows to obtain the output signal of both OP1 rectified half-waves with an amplitude equal to the amplitude of the signal at the output of the compressor. The signal is then fed to the repeater ER2, loaded with standard smoothing circuit "attack" - the "restoration»  $(R_{a1} + D_3 + R_{13}) + (R_{14} + R_{a2}) // C_7$ .

ER3 excludes the impact of the following stages to work smoothing circuit. To ensure the most appropriate ratio of compression, the output of the repeater ER3 level control signal can be reduced by an adjustable divider R<sub>15</sub> R<sub>16</sub>.

Cascade on ER4 is a block correction is supplying the gate p T2 signal on half of the runoff FET (reception can significantly reduce the distortion knob). Correction voltage is generated as follows: Stock p signal T2 is divided into a chain of R<sub>18</sub> R<sub>19</sub> and about 1 / 8 of this signal is fed to the non-inverting input of ER4. Given the fact that the non-inverting input of the KU<sub>OU4</sub> = 4, the output signal ER4 formed with a level of about half the signal level at the drain p T2. The proposed method of forming the correction voltage, in contrast to the commonly used simple resistor divider, completely eliminates the possibility of penetration of the control signal in the processed signal.

ER4 also performs the function of the initial formation of the gate voltage regulated DC, as in the absence of a signal to the compressor inlet and at least signals the threshold (Threshold) knob p T2 should be closed. Initial voltage is generated as follows: p is a source of T1 self-bias current. Since the total resistance of resistors R<sub>21</sub> and R<sub>a3</sub>, p T1 circuit source is sufficiently large, this resistor creates a voltage drop that is close to the cutoff voltage of a matched pair of transistors T1 and p T2 p. At the current R<sub>19</sub> of the current source generates a voltage drop equal to:

$$U_{R19} = \frac{U_{R21 + Ra3} \cdot R19}{R21 + Ra3}$$

When the selected R<sub>19</sub> denominations, R<sub>a3</sub>, and R<sub>21</sub> is a voltage of just over a quarter cut-off voltage of transistors assembly (p T1 and p T2). Further increases this tension ER4 4-fold, forming a gate voltage of T2, p, a slightly larger voltage to cutoff. Excess capacity at the gate with respect to p T2 cut-off voltage is adjusted by potentiometer R<sub>21</sub> (Threshold). As a result, the emerging field of "dead" or in other words, the compressor threshold beginning of compression.

### **ALTERNATIVE COMPRESSOR**

Can be implemented with the compressor almost the same parameters on another circuit.

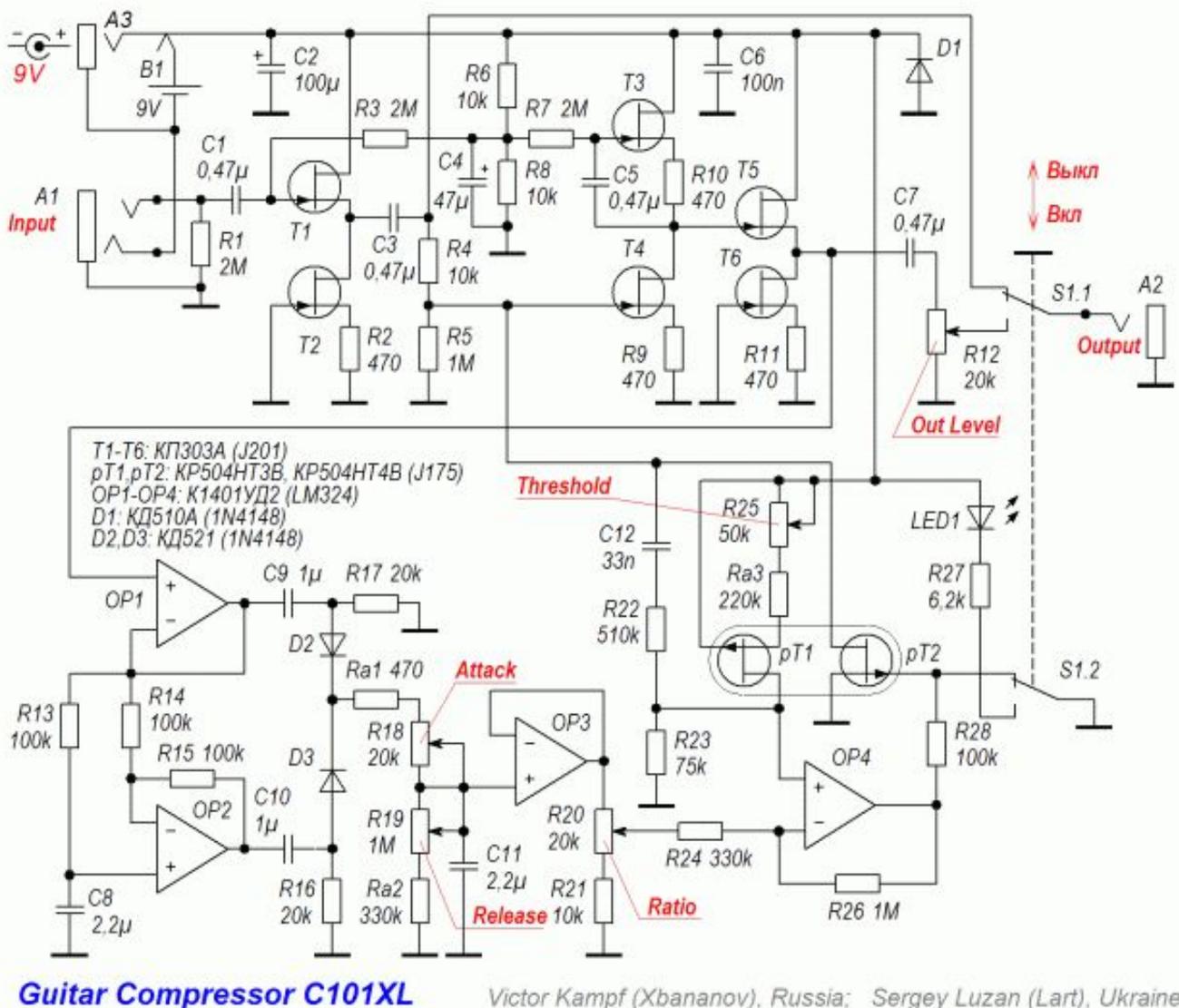


Figure 2. The scheme of the compressor for the same type of field effect transistors (focused on foreign element basis).

Channel signal amplification built entirely on Fri the same type (suitable, for example, well-known J 201 without any choice). In the control channel repeater input is excluded and the other used a rectifier, which does not require isolation of the input. True, this has led to a few more passive components in the control channel.

The adjustment range of compression, in contrast to the previous scheme, is somewhat limited from below the ratio 1:2 (the inability of the repeater and the inverter at OP1 and OP2 to strengthen the upper half-wave of more U Pit-1, 5V signal compression at high levels). The rest of the scheme is similar to the previous one.

### PARTS AND ANALOGUES

The undoubted convenience for those who are fortunate enough to live on the post-Soviet space, is that the compressor is designed for so-called "national" element base.

By repeating the scheme of the radioactive element in the foreign main problem arises only in the choice of p-channel PF with cut-off voltage in the region of 3-5V. The situation is complicated by the fact that a backward foreign industry has not yet mastered the production of affordable analog assemblies KR504NT J

In this particular design it is possible to eliminate the use of the assembly procedure of a setting device, since p T1 generates all the necessary initial tension for a "twin» p T2.

As p T1 and p T2 in the compressor can be used by other assemblies K504 series. The most suitable assembly with index K504NT3V, 4B. Using K504NT3B and 4B due to the lower cutoff of these assemblies will lead to some increase in distortion. You can use also builds K504NT1V, 2B. In this case, to provide the required range compression, you may need to increase the resistance of R 4 to 22 33kOm, which will increase noise device. It should also be borne in mind that the pinout of HT1, 2 and HT 3 and 4 do not match, so the use of HT 1 and 2 will need to adjust the circuit board.

Little information about the use of discrete p-channel instead of assembling Fri KR504NT3 (4). As p T2 is desirable to use p-channel cut-off Friday from 3-5V. The efficiency of the compressor and stored for use as pT 2, the cutoff value is somewhat beyond these limits (up to 2V to 6V down and up), but in this case, increase the minimum level of harmonics and voltage. As p T1 can be any p-channel PF with a cutoff of 1.5 to 5V.

From the available abroad p - JFET satisfy the requirements listed above J 271, 2N5461, 2N5462, J175, J174, 2N5115. From domestic discrete Fri quite possible to use KP103L, F, G.

By repeating the scheme based on discrete PF with different parameters need only specify nominal Ra 3 (for both schemes). The method is as follows: setting knob Threshold to the maximum resistance, the selection of Ra 3 must be installed on the gate voltage of 2 pT its cut-off, which, of course, you first need to measure, using this way:

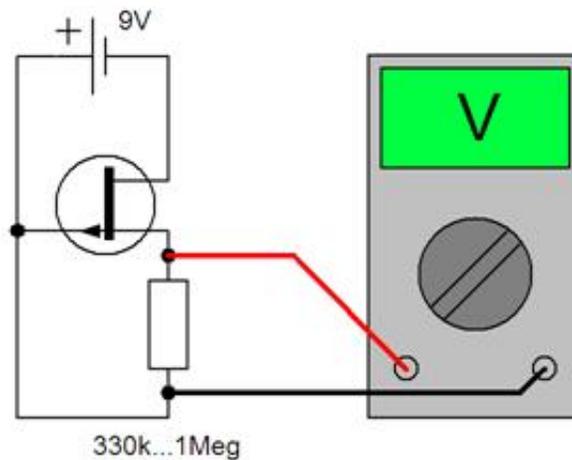


Fig.8. OTS scheme for measuring the U p-channel Fri

Possible replacement semiconductors Table 2

KP303E	2 N 5458 2 N 5459 ( $V_{GS(OFF)} = 4 \dots 5 \text{ V}$ )
KP303A, F	J 201
KP103E	2 N 5020
KD521	1 N 4148
K1401UD2	LM 324
KR504NT3 (4)	J 271, 2 N 5461 2 N 5462, J 175, J 174, 2 N 5115

## CONSTRUCTION

Mindful of the fact that "it is better to see once than hear a hundred times," the authors chose not to abuse the verbal descriptions, limiting only summary tables with a list of used parts, and the rest - have focused on the visualization of the instructions. See, sort it out.

Option compressor according to the scheme in Figure 1

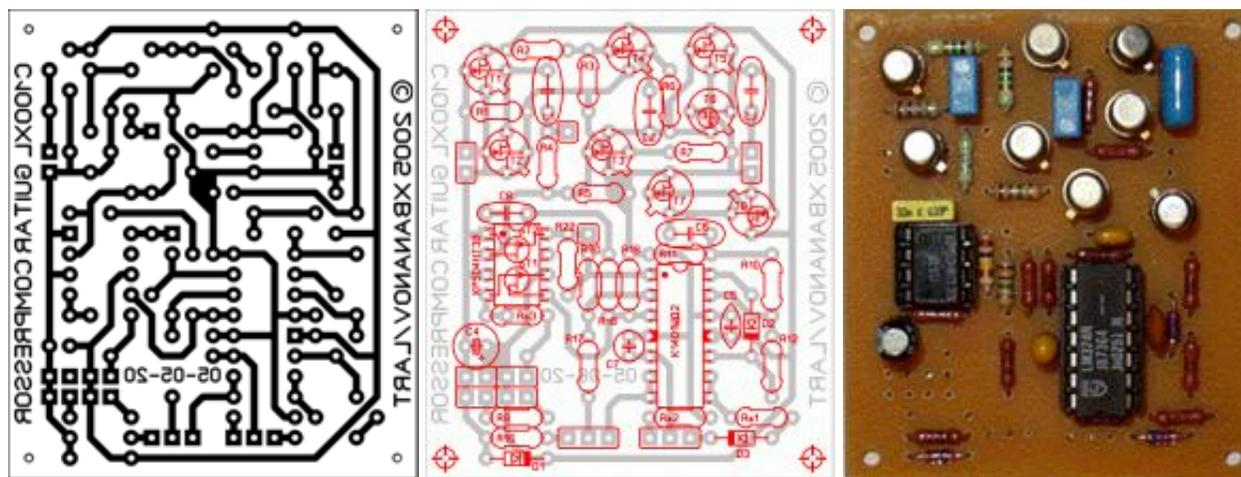


Figure 3. The printed circuit board, a view from the installation details (scale 1:1 size 51h59mm)

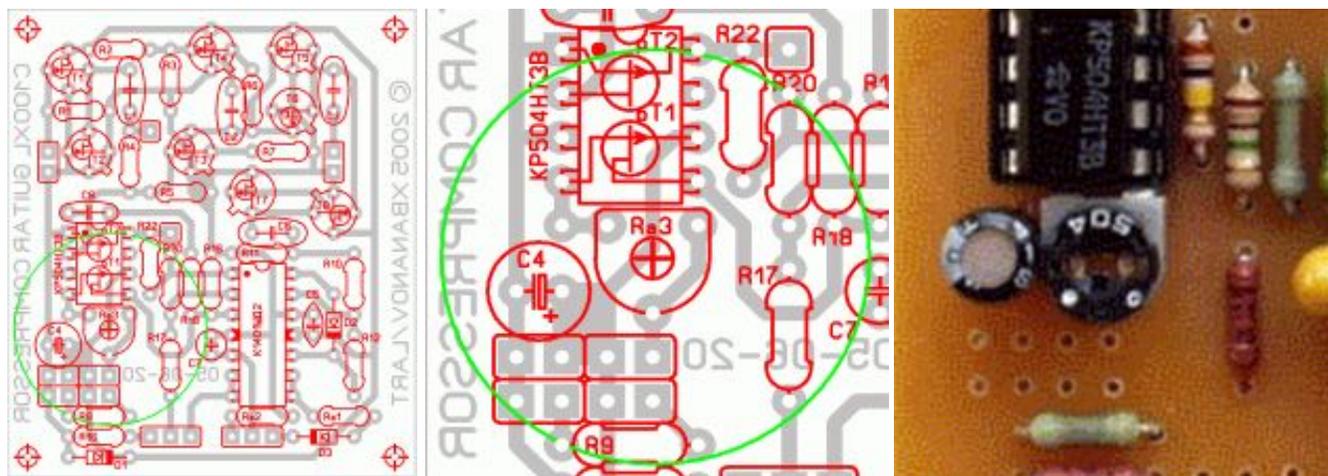


Figure 4. Option to install the board trimmer for the cases of forced use in the scheme of discrete p-channel instead of Fri KR504NT

Table 3 List of parts

Type	Compliance with the scheme	Quant.	Name, nominal	Notes
To install the board				
Field-effect transistor	T1	A	KP303E	$U_{TS} U > 3B$
Field-effect transistor	T2, T5, T8	3	KP303ZH	min $I_{D. START}$ and $U_{UTS}$
Field-effect transistor	T4, T3	2	KP303A	
Field-effect transistor	T7, T6	2	KP103E	min $I_{D. START}$
Fri assembly	p T1, p T 2	A	KR504NT3V, KR504NT4V	$U_{UTS} > 3$
Shelter	OP1 ... OP4	A	K1401UD2, DIP -14	
Diode	D2, D3	2	KD521	
Zener diode	D1	A	KD510A	
Resistor	R1, R5, R20	3	1M	5%, 0.125 Tues
Resistor	R6, R7, R a 1	3	470	-
Resistor	R2, R3	2	2M	-
Resistor	R11, R4, R9	3	10k	-
Resistor				

Resistor	R19, R22	2	100k	=
Resistor	R16	A	7,5 k	-
Resistor	R17, R a 2	2	330k	-
Resistor	R19	A	75k	-
Resistor	R18	A	510k	-
Resistor	R a 3	A	220k	-
Capacitor	C2, C3, C1	3	0,47 $\mu$ , polyester	
Capacitor	C6	A	1 $\mu$ , tantalum	
Capacitor	C7	A	2,2 $\mu$ , tantalum	
Capacitor	C4	A	100 $\mu$ , electrolyte	
Capacitor	C5	A	100n, ceramics	
Capacitor	C8	A	33n, polyester	
External to the board				
Nest	A1	A	6.3 mm stereo	
Nest	A2	A	6.3 mm mono	
Nest	A3	A	With the breaker	
Potentiometer	R 8 (Out Level)	A	10 ... 50k, exponential	
Potentiometer	R1 3 (Attack)	A	20k, a linear	
Potentiometer	4 R1 (Release)	A	1M, linear	
Potentiometer	R 15 (Ratio)	A	20k, a linear	
Potentiometer	R2 1 (Threshold)	A	50k, a linear	
Switch	S1.1, S1.2	A	P2K, PBS24-202	
LED	LED1	A	3-mm high-brightness	

# Компрессор C100XL

ВИД СО СТОРОНЫ УСТАНОВКИ ДЕТАЛЕЙ

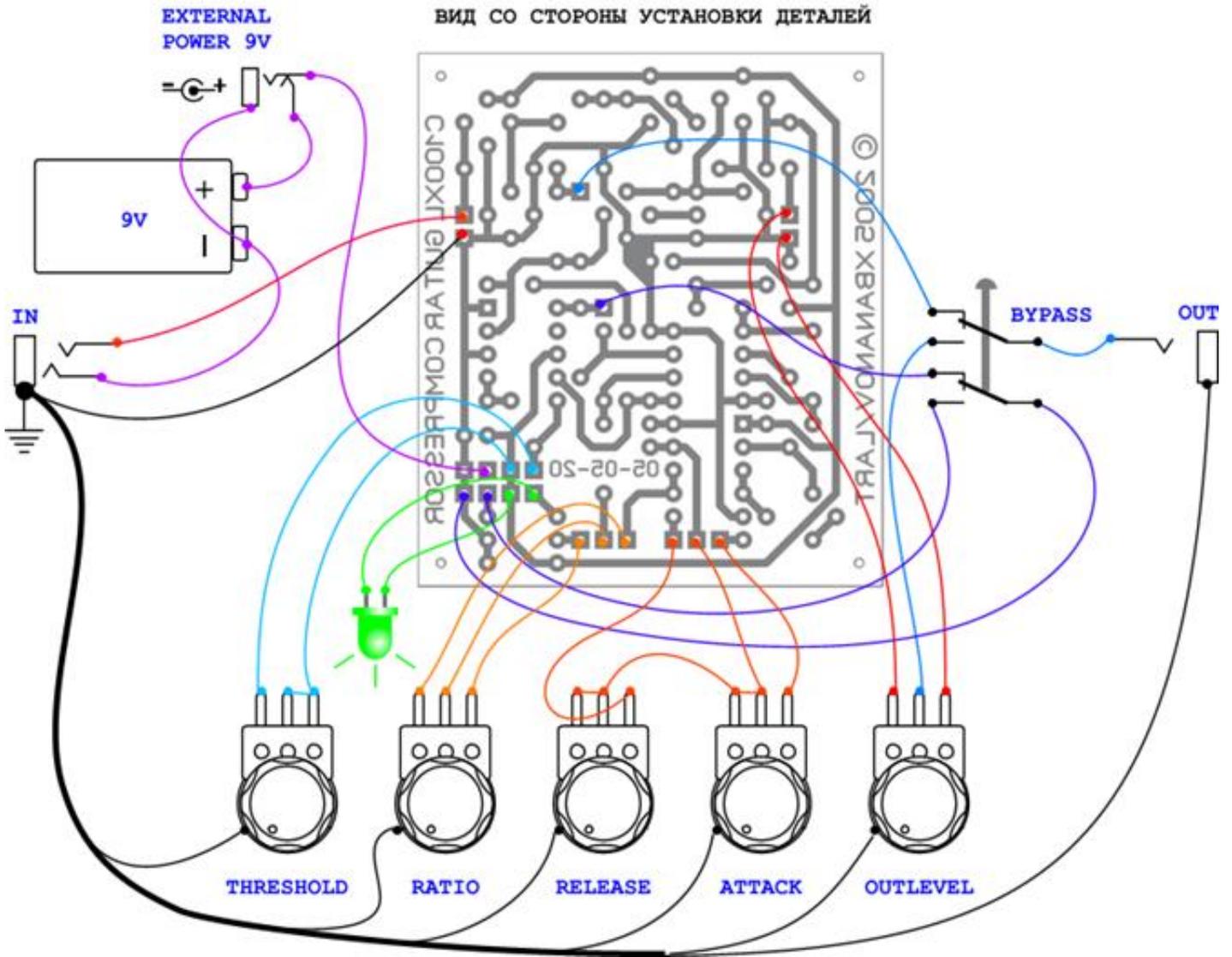


Figure 5. Wiring diagram of external components to the board

*Option compressor according to the scheme in Figure 2*

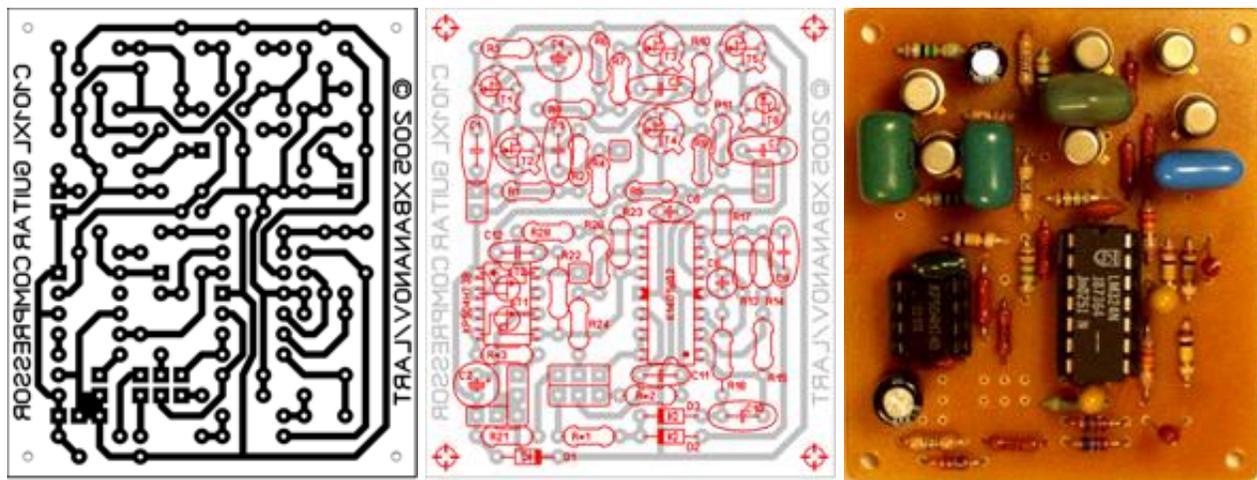


Fig 6. The printed circuit board, a view from the installation details (scale 1:1 size 51h59mm)

Table 4 List of parts

Type	Compliance with the scheme	Quant.	Name, nominal	Notes
<b>To install the board</b>				
Field-effect transistor	T1 ... T6	6	KP303A	J201, 2N5457
Fri assembly	p T1, p T2	A	KR504NT3V, KR504NT4V	J175
Zener diode	D1	A	KD510A	1N4148
Diode	D2, D3	2	KD521	1N4148
Shelter	OP1 ... OP4	A	K1401UD2, DIP-14	LM324
Resistor	R1, R3, R7	3	2M	5%, 0.125 Tues
Resistor	R2, R9, R10, R11, R a 1	5	470	-
Resistor	R4, R6, R8, R21	4	10k	-
Resistor	R5, R26	2	1M	-
Resistor	R16, R17	2	20k	-
Resistor	R13, R14, R15, R28	4	100k	-
Resistor	R22	A	510k	-
Resistor	R23	A	75k	-
Resistor	R24, R a 2	2	330k	-
Resistor	R a 3	A	220k	-
Capacitor	C1, C3, C5, C7	4	0,47 $\mu$ , polyester	
Capacitor	C8, C11	2	2,2 $\mu$ , tantalum	
Capacitor	C9, C10	2	1 $\mu$ , tantalum	
Capacitor	C4	A	47 $\mu$ , electrolyte	
Capacitor	C2	A	100 $\mu$ , electrolyte	
Capacitor	C6	A	100n, ceramics	
Capacitor	C12	A	33n, polyester	
<b>External to the board</b>				
Nest	A1	A	6.3 mm stereo	
Nest	A2	A	6.3 mm mono	
Nest	A3	A	With the breaker	
Potentiometer	R12 (Out Level)	A	10 ... 50k, exponential	
Potentiometer	R18 (Attack)	A	20k, a linear	
Potentiometer	R19 (Release)	A	1M, linear	
Potentiometer	R20 (Ratio)	A	20k, a linear	
Potentiometer	R25 (Threshold)	A	50k, a linear	
Switch	S1.1, S1.2	A	P2K, PBS24-202	
LED	LED1	A	3-mm high-brightness	
Resistor	R27	A	6,2 k	5%, 0.125 Tues

## Компрессор C101XL

ВИД СО СТОРОНЫ УСТАНОВКИ ДЕТАЛЕЙ

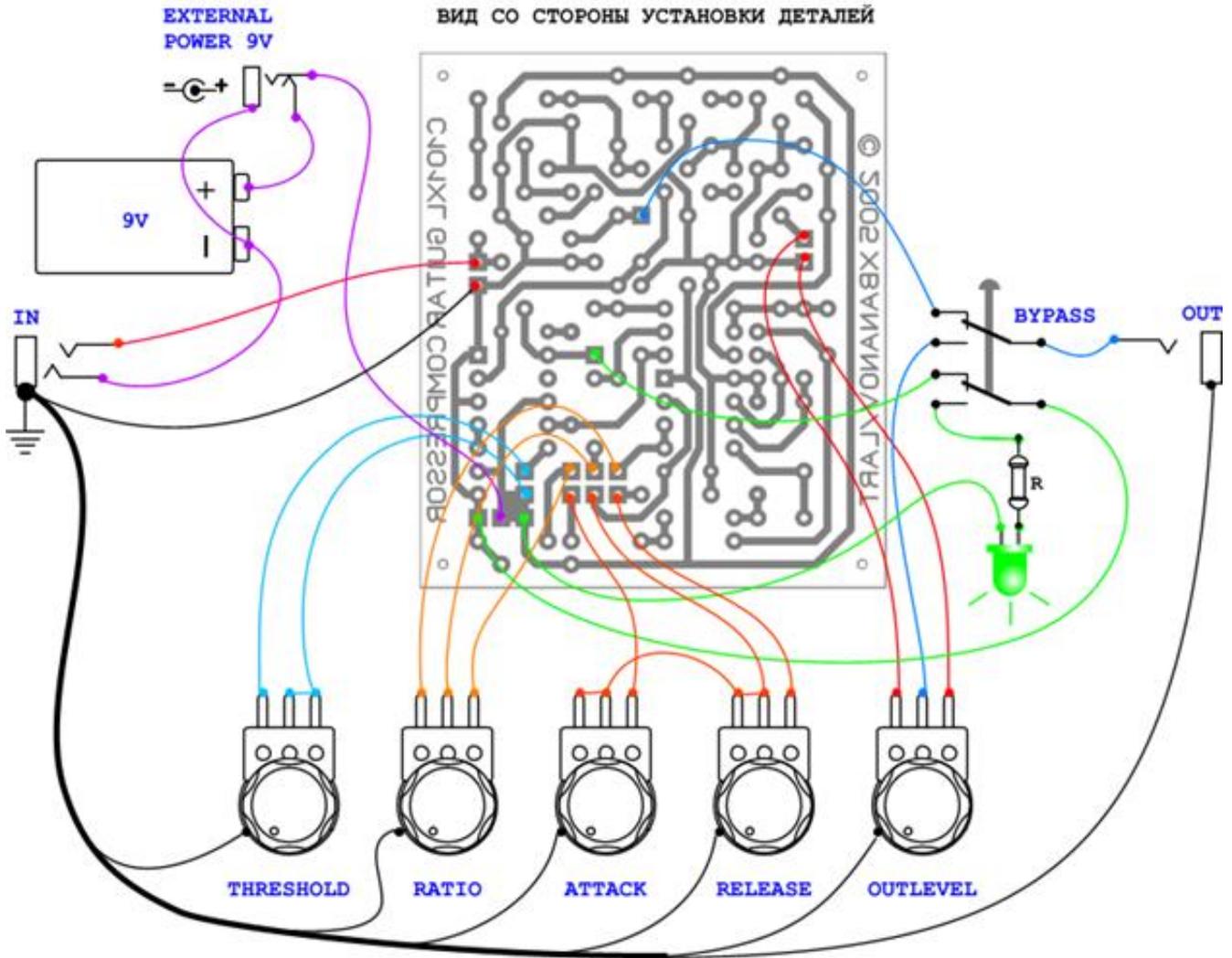


Fig.7. Wiring diagram of external components to the board

### WARNING!

When used in place of its analog K1401UD2 LM 324 must be borne in mind that "+" and "-" Power of the op amp are the exact opposite, so the LM 324 must be installed by launching a 180°. In the figure the location of parts on the PCB and in the files for Sprint Layout (for both versions of the compressor) shows the orientation of the housing 14 for DIP K1401UD2, the photos are willing to pay - LM 324 (as it happens)

### MODIFICATION

Often need the full set of adjustments to the compressor does not. In this case it is possible to simply replace the corresponding resistive circuit resistor with resistance from the table below:

ADJUSTMENT	RECOMMENDED ACTION
	Instead of the potentiometer Release solder jumper, the recommended resistance Ra2 for guitar -

Release	470kOm ... 1M, for bass guitar - 1 .. 1.5 megohms
Threshold	Instead of the potentiometer Threshold solder jumper, the recommended resistance Ra3 = 240kOm
Attack	Instead of the potentiometer Attack solder jumper, the recommended resistance Ra1 = 1 ... 10K. Recommend leaving the lights
Ratio	Cleaning is not recommended in any case, the most useful control
Out Level	You can use the potentiometers rated at 10 ... 50kOm, preferably with an exponential characteristic

At the authors' opinion, the most useful adjustment **Ratio** and **Attack** (and, naturally, **Out Level**), so if you limit the number of regulators recommend three to choose on these adjustments. In the construction of the compressor with four adjustable parameters in addition to the above we advise to add control threshold compression **Threshold**.

Here are some tips to optimize the compressor.

*For the circuit in Figure 1*

- ü The transistor T1 to pick up on the minimum noise factor and the maximum value of the cut-off voltage. You can use deliberately low-noise voltage cutoff KP303G/KP307G with more than 3V.
- ü In the case of an assembly instead of discrete KR504NT KP103G, L, M must choose a transistor mounted as p T2, the maximum possible voltage cut-off within 3 ... 5V. Go beyond these limits is not recommended.
- ü A copy of all consumes a bit less than 6 mA. To reduce the consumption of transistors T2, T6 and T7 to pick up the minimum initial current flow. For the same purpose LED indicator for effect it is desirable to choose a series of high-brightness, for a decent level of luminescence which is enough power in the 100 ... 200 mA. It is theoretically possible to reduce consumption to 4.5 mA.

*For the circuit in Figure 2*

Almost makes sense to only choice T2 and T6 on the minimum value of the initial drain current to reduce power consumption. A copy of all consumes about 3.5 mA.

## RESULTS

Compressors made by the scheme presented, showed almost identical characteristics. At the very least, use your own ears as a recording device any noticeable difference in the compressor to detect not allowed.

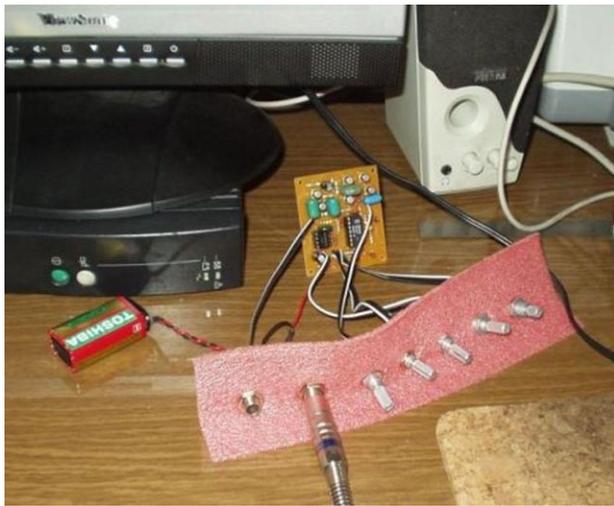
In practice, the author's thesis is fully confirmed by the lack of necessary adjustment of units: properly mounted in a known-good parts of the marking on the chart, the unit starts to work immediately after assembly. For the sake of purity of the experiment was carried out not even a preliminary selection of parts.

Consumption of both options is approximately the same device (variant of the scheme in Figure 1 a little more "greedy"), during *continuous* operation of the new standard 9V battery will be at least 60 hours *in the worst case*. The size of the PCB will not be a limiting factor when mounting the device virtually any available housing.

*Good luck in repeating structures.*

[Here](#) you can take PCB layout files in the formats Sprint Layout (Zip-file ~ 60 k)

Then - a few unpretentious musical phrases using the compressor (the chain of records: Chinese telecaster - Compressor C 101 XL (All controls in the middle position, unless otherwise indicated) - Line in an integrated sound card



PC - Adobe Audition, only the normalization, no other treatment)

*Attention extension "abc" to rename the "mp3"*

[Example 1](#) (neck pickup, high-tidy, Ratio and Threshold at maximum, ~ 260 k)

[Example 2](#) (neck + bridge pickups, ~ 2 3 0 k)

[Example 3](#) (neck pickup, ~ 290 k)

After listening to the examples can be seen on the device resistance to interference from a photograph the prototype compressor being recorded (next to the monitor, UPS, and columns), no screening - the situation, as you see, is not very favorable, but it is moderately fonit, and J is for singles

The author can talk on the forums:

<http://www.guitar.ru/board/11/> and <http://forum.gtlab.net/> (xbananov and Iart)

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Back to Home Page: <http://www.sugardas.lt/~igoramps>

[Here](#) is a Page with "Tube smilies"! Have fun! 🗨️