

Analogue indicator control system

This system serves to control analogue indicators.

There can be 2 versions: linear or logarithmic characteristic.

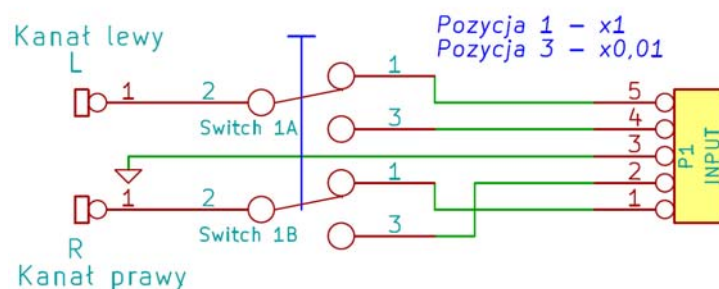
System descriptions (full version):

The system consists of:

- Input divider
- Input stage
- full-wave rectifier
- output amplifier with logarithmic system
- power supply

Operating description (left channel, indicator power amplifier)

The input signal should be supplied to connector P1-4 or P1-5. The input sensitivity of P1-5 is -20dB less. This allows to change system sensitivity depending to which input the signal is sent. It allows controlling the indicators when the volume is low. For example in amplifier 100W: At nominal 100W signal from amplifier output to input P1 -5 and indicators show 0dB. At low volume the indicators will not move because the range is about 42 db and the volume regulation range is over 70db. With the help of an external switch, the signal is supplied to P1-4 and indicated 0dB is achieved at 1W.



The resistors R3, R4, and RV1 make up the input divider. The potentiometer RV1 serves to calibrate the indicator. The DC component is filtered by the C1 capacitor, and the signal is supplied to the operational amplifier U1 – input stage. Next, the signal goes to the full-wave rectifier built by U3A and U3B. The rectified voltage loads the C3 capacitor and controls the next operational amplifier U4. The value of the capacitor and resistors R28 R29 determine reaction speed and return of the pointer.

Changing the capacity changes the pointer's reaction. The smaller the capacity, the more "aggressive" the pointer. The capacity should be in the range of 470nF-10uF. U4 is the output amplifier with regulated characteristic. Elements R31-33,37,41,43,45 i D7-9 make up the logarithmic system. The higher the signal, the more restricted the amplification and the flatter the characteristic. Not installing these elements causes that the system characteristic will be linear in the whole range.

The output signal through potentiometer RV7 and resistor R39 is supplied to output K1-1. K1-1 is connected to indicator.

POWER:

The system requires symmetrical power +/-15V. Depending on the equipment's voltage we configure an appropriate power supply.

Options:

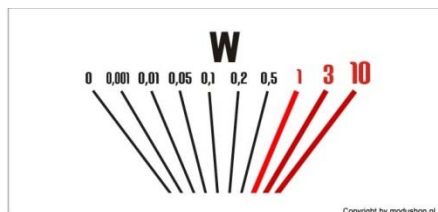
- ✓ - in equipment with +/-15V (power supply is unnecessary)
- ✓ - in equipment with +/- 17-25V (from power supply use only voltage stabilization module)
- ✓ - in equipment without the above – mentioned voltage . (install full power supply and power the system from 230V through transformer.)

VU meter – logarithmic or linear ?.

If we mount linear system with indicators having scale in dB for example Nissei (pictured below), indications will be in agreement with realistic signal level.



If we mount logarithmic system with indicators having scale in db, realistic value will be true only one point 0dB (after calibration process). In this case, it is necessary to make scale yourself and apply appropriate value of dB or W to the scale. As in the example below or use indicator with correct scale.



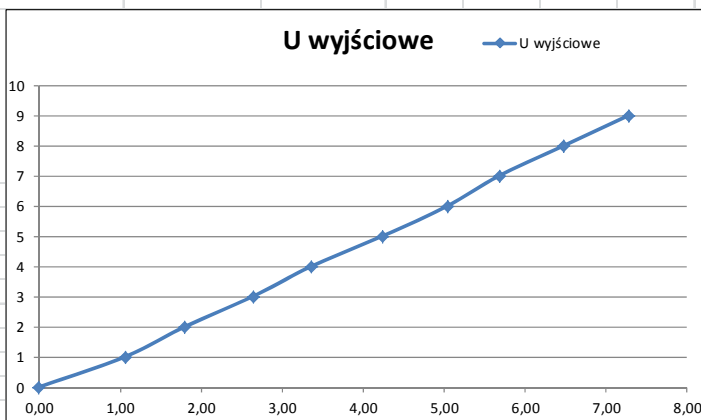
Independently – made scale



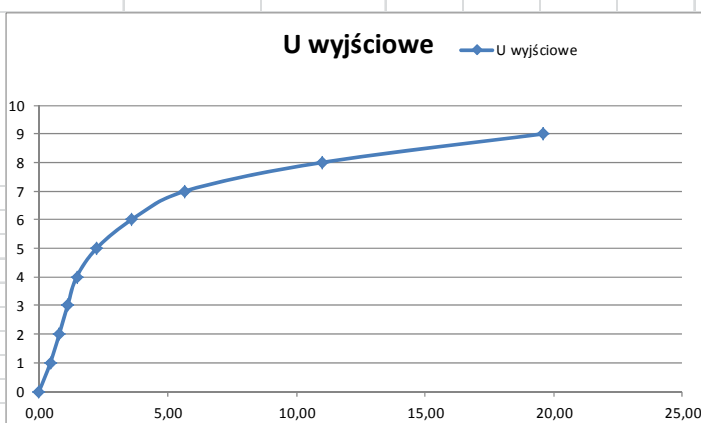
Scale from Nissei P-105 indicator

If the indicators or only to serve “artistically” and move with the rhythm of the music, logarithmic version is recommended. This version allows the pointer to move at lower volumes and is more resistant to signal overdrive.

wersja liniowa				
V _{pp} wejściowe	U wyjściowe	U realne (V) na 4 Ohm	P realna (W)	dB
0,00	0	0,000	0,00000	0,000
1,06	1	0,373	0,03483	-29,162
1,80	2	0,634	0,10043	-19,963
2,64	3	0,930	0,21603	-13,310
3,36	4	1,183	0,34993	-9,120
4,24	5	1,493	0,55723	-5,079
5,04	6	1,775	0,78734	-2,077
5,68	7	2,000	1,00000	0,000
6,48	8	2,282	1,30153	2,289
7,28	9	2,563	1,64273	4,311

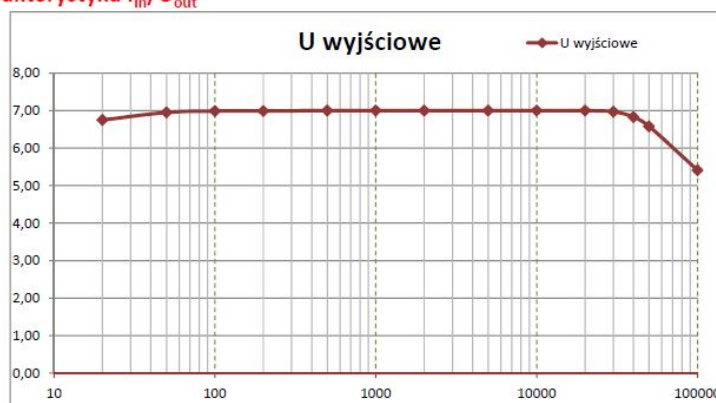


wersja logarytmiczna				
V _{pp} wejściowe	U wyjściowe	U realne (V) na 4 Ohm	P realna (W)	dB
0,00	0	0,000	0,00000	0,000
0,44	1	0,155	0,00600	-44,436
0,78	2	0,276	0,01905	-34,401
1,11	3	0,391	0,03819	-28,361
1,46	4	0,514	0,06607	-23,600
2,24	5	0,789	0,15552	-16,164
3,60	6	1,268	0,40171	-7,922
5,68	7	2,000	1,00000	0,000
11,00	8	3,873	3,75050	11,482
19,60	9	6,901	11,90736	21,516



f _{in} [Hz]	U wyjściowe	dB
20	6,75	-0,316
50	6,95	-0,062
100	6,99	-0,012
200	6,99	-0,012
500	7,00	0,000
1000	7,00	0,000
2000	7,00	0,000
5000	7,00	0,000
10000	7,00	0,000
20000	7,00	0,000
30000	6,97	-0,037
40000	6,83	-0,214
50000	6,58	-0,537
100000	5,41	-2,238

Charakterystyka f_{in}/U_{out}



Czułość układu - 0dB (U_{out} - 7V)

wersja logarytmiczna	U _{in} = 0,290V _{pp}
wersja liniowa	U _{in} = 0,580V _{pp}

Installation - power supply:

Before mounting [read about all options](#) and select the proper version for your equipment .

#1 – in equipment without symmetrical voltage +/- 17-25V nor +/- 15V

We mount all power supply elements and 3 jumpers connecting power supply part to main system. The system will be powered by 230V connected to P2. After mounting and connecting power to P2, check if K2 connector has +/-15 voltage.

Attention: voltage 230V is dangerous for your life and health. Mounting should be done with great care.

#2 – in equipment with symmetrical voltage +/- 17-25V

Don't mount connector P2, transformer ,rectifier D9 and capacitors C7 and C8. Mount stabilization unit – capacitors C5-C10, voltage regulators U6 and U7 and 3 jumpers connecting power supply part to main system. The system will be powered +/-17-25 voltage supplied to K3 connector. After mounting, connect to power ...

Attention: important polarization: K3-1 – [+] 17-25V; K3-2 – GND; K3-3 - [-] 17-25V

and check if K2 connector has +/-15 voltage.

#3 – in equipment with symmetrical voltage +/- 15V

Don't mount power supply. Break off PCB and supply voltage +/-15V to K2

Attention: important polarization: K2-1 – [+] 15V; K2-2 – GND; K2-3 – [-] 15V

If we mount **power supply in version #1 and #2**, connector K2, where there will be voltage +/- 15V, we can use other elements to power it for example VU meter backlight.

With voltage +/- 15V (30V) depending on VU meter model it is necessary to serially connect resistors to backlight. If backlight is made with LED, the current shouldn't exceed 20mA. The resistor should have about 1.5k 2W. Choose value to achieve satisfactory lightness.

Resistors aren't included !!!.

Installation – VU system

Start from jumper installation. Next install the remaining elements: resistors , capacitors, diodes, and other.

Attention: in linear version do not mount the following elements:

R31, R36	27k
R32, R35	47k
R33, R34	160k
R41, R42	13k
R45, R46	20k
R43, R44	47k
D7 – D12	1N4148

At the end solder connectors and sockets. Connect power and check voltage in the socket.

U3 - LM 324N - Pin 4 – (+15V); Pin 11 – (-15V)




U1, U2, U4, U5 - LM741P - Pin 7 – (+15V); Pin 4 – (-15V)

If the voltage is correct, disconnect power and mount chips. Your system is ready. You may begin calibration.

System calibration.

VU meter **output sygnal** – 0dB at nominal power.

To calibrate these things are essential :

-  - power amplifier on which VU meters will be used
-  - sinus generator 1kHz (sound card with proper program can be used)
-  - multimeter with TrueRMS or oscilloscope

Offset voltage liquidation:

Start calibration from establishing 0mV offset voltage in U1 and U4.

Ground INPUT's 1,2,4,5

- ✓ Voltmeter connect to TP1 and with RV3 set up 0mV
- ✓ Voltmeter connect to TP5 and with RV5 set up 0mV
- ✓ Check voltage TP1 again and make small corrections
- ✓ Voltmeter connect to TP2 and with RV4 set up 0 mV
- ✓ Voltmeter connect to TP6 and with RV6 set up 0 mV
- ✓ Check voltage TP2 again and make small corrections

The effect of this calibration should be **0mV in system outputs TP5 i TP6** without input signal.

Adjusting system parameters to your indicators

- ✓ **Absolutely disconnect the speakers from the amplifier**
- ✓ Amplifier with power off, set up volume to 0dB (total silence)
- ✓ Supply signal 1kHz to linear input amplifier AUX, CD or TUNER
- ✓ Set up RV1 and RV2 to about half value.
- ✓ Connect output from one channel (L or R) to INPUT2 and INPUT 4 – the same signal to both channels
- ✓ Voltmeter connect to TP5; range of voltmeter minimum 10V
- ✓ Turn on amplifier and increase volume **to get 9V in TP5**. If you don't get 9V in full volume, do additional calibration with RV1.
- ✓ Turn on amplifier and increase volume **to get 9V in TP6**. If you don't get 9V in full volume, do additional calibration with RV2.
- ✓ Connect indicators to the system. Remember the correct polarisation ([+] indicators to K1-1 i K1-3, [-] grounded indicators to K1-2.
- ✓ With RV7 and RV8 set up pointer to 100% deflection.
- ✓ Next set up RV1 and RV2 in the position which indicators show 0% - no signal.
- ✓ Set up amplifier volume to 0dB (total silence) and turn off.

The effect of this calibration is **to adjust indicators to the system** – 100% deflection in end of the range.

Calibration

The goal of calibration is to achieve 0dB deflection at nominal power. First calculate RMS voltage at nominal power with load (speakers). If the indicators are connected to out power amplifier, calculate formula value

$$U_{sk} = \sqrt[2]{P * R}$$

P – nominal power, R – nominal impedance of the speaker

For example amplifier with nominal power 100W and speakers with impedance of 4ohm.

In this case deflection 0db should be

$$U_{sk} = \sqrt[2]{100 * 4} = \sqrt[2]{400} = 20V.$$

Calibration is done without connecting the speakers !!!!.

- ✓ Leave potentiometers RV1 i RV2 previous position – potentiometer slide shorted to ground.
- ✓ Connect one amplifier output (L or R) to INPUT 1 i INPUT 5 – the same signal to both channels
- ✓ Supply signal 1kHz to linear input AUX, CD, TUNER
- ✓ Voltmeter (oscilloscope) connect to amplifier output. Turn on amplifier. Increase volume to until you get $U_{sk}=20V$ in output (*multimeter measurement at TrueRMS*) or $V_{pp}=U_{sk}*\sqrt{2} * 2 = 56,8V$ (*oscilloscope measurement*).
- ✓ With RV1 i RV2 set up pointer to 0db.

The effect of this calibration is **to achieve 0dB at nominal power.**

If the signal supplied to INPUT 2 i INPUT 4, full deflection is achieved at 1W power.

It is recommended to use switch x1 / x0,01 in amplifiers with the power over 10W if you would like the pointer to move at very low volume.

List of electronic components:

Electronic components	Value	Pcs.	Attentions
C1, C2	470nF	2	
C3, C4	1uF/25V	2	1uF in set, possible value 470nF-10uF
R13, R14	1k5	2	
R39, R40	3k9	2	
R1, R3, R6, R7, R26, R28, R29, R30	10k	8	
R19, R20	4k7	2	
R22, R23	22k	2	
R9, R12, R16, R17, R18, R21, R24, R25	30k	8	
R15, R27	43k	2	
R2, R8	47k	2	
R4, R5	82k	2	
R10, R11	100k	2	
R37, R38	150k	2	
R41, R42	13k	2	<i>Do not mount in linear version</i>
R45, R46	20k	2	<i>Do not mount in linear version</i>
R27, R36,	27k	4	<i>Do not mount in linear version</i>
R32, R35, R43, R44	47k	2	<i>Do not mount in linear version</i>
R33, R34	160k	2	<i>Do not mount in linear version</i>
D7-D12	1N4148	6	<i>Do not mount in linear version</i>
RV3, RV4, RV5, RV6	10k	4	
RV7, RV8	50k	2	
RV1, RV2	100k	2	
D3-D6	1N4148	4	
D1, D2	LED 3mm np. L934ID	2	
U3	LM324N	1	
Podstawka DIP14	ICVT-14P	1	
U1, U2, U3, U4	LM741P	4	
Podstawka DIP8	ICVT-8P	4	
K1, K2	MX-6410-03A	2	
K4	MX-6410-05A	1	
TP1 - TP6	1364P.61	6	
TR	TEZ 2.5/D/12-12	1	Transformer 2x12V
P2	DG301-5.0-2P11	1	
B1	RB1A	1	
C9, C10	100nF	2	
C6, C8	330nF	2	
C5, C7	100uF/35V	2	
C11, C12	220uF/35V	2	
U6	LM7815	1	Heater is not required
U7	LM7915	1	Heater is not required
K3	MX-6410-03A	1	

Recommended resistor with tolerance 1%.