



CENTRUM ODBORNÉHO VZDELÁVANIA
PRE AUTOMATIZÁCIU,
ELEKTROTECHNIKU
A INFORMAČNÉ TECHNOLOGIE



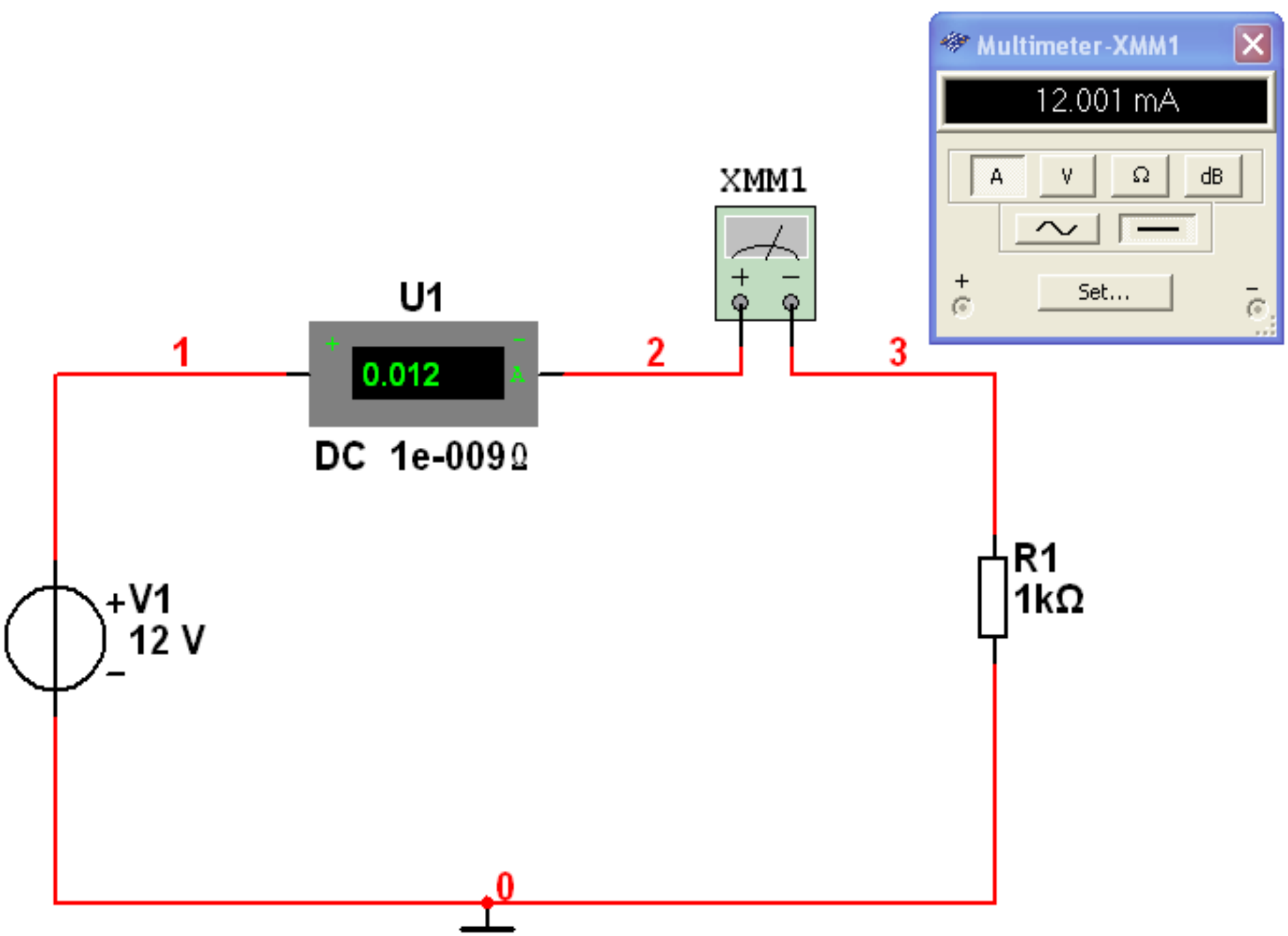
15. Metódy merania

**(prúdu, napätia, odporu, frekvencie, fázového posunu)
pomocou simulačného programu Multisim**

Ing. Milan Schvarzbacher

Meranie jednosmerného prúdu

- zapojenie A-metra v obvode do série,
- A-meter s prepnutým ovládacím prvkom na meranie jednosmerného prúdu,
- nastavenie potrebného rozsahu (ak je potrebné).



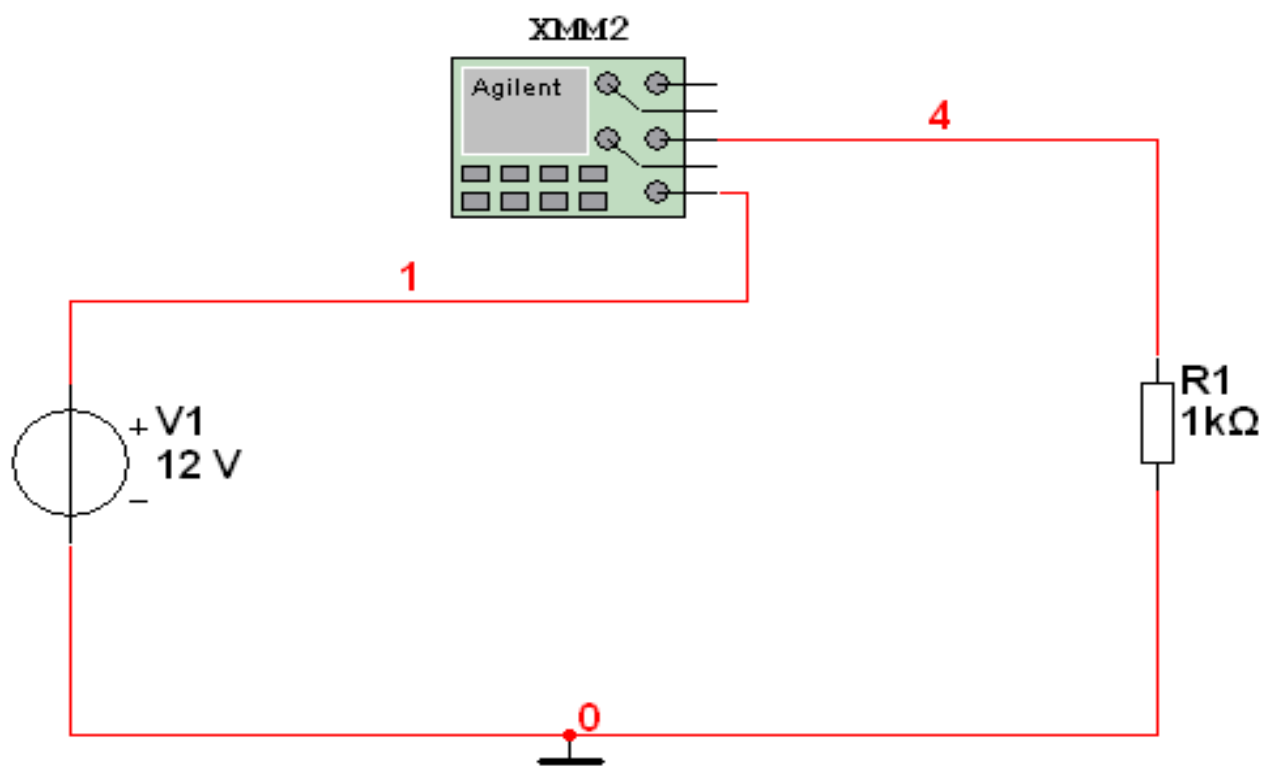
Multimeter-XMM1

12.001 mA

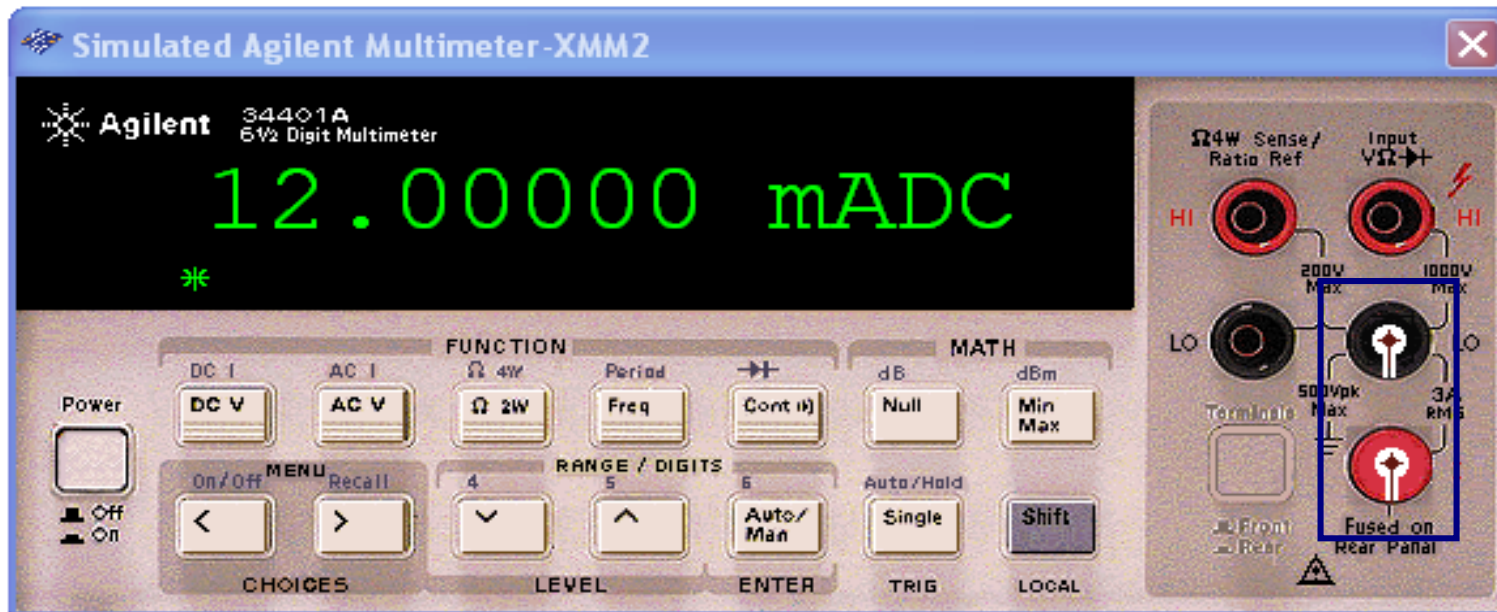
A V Ω dB

~ -

+ Set... -

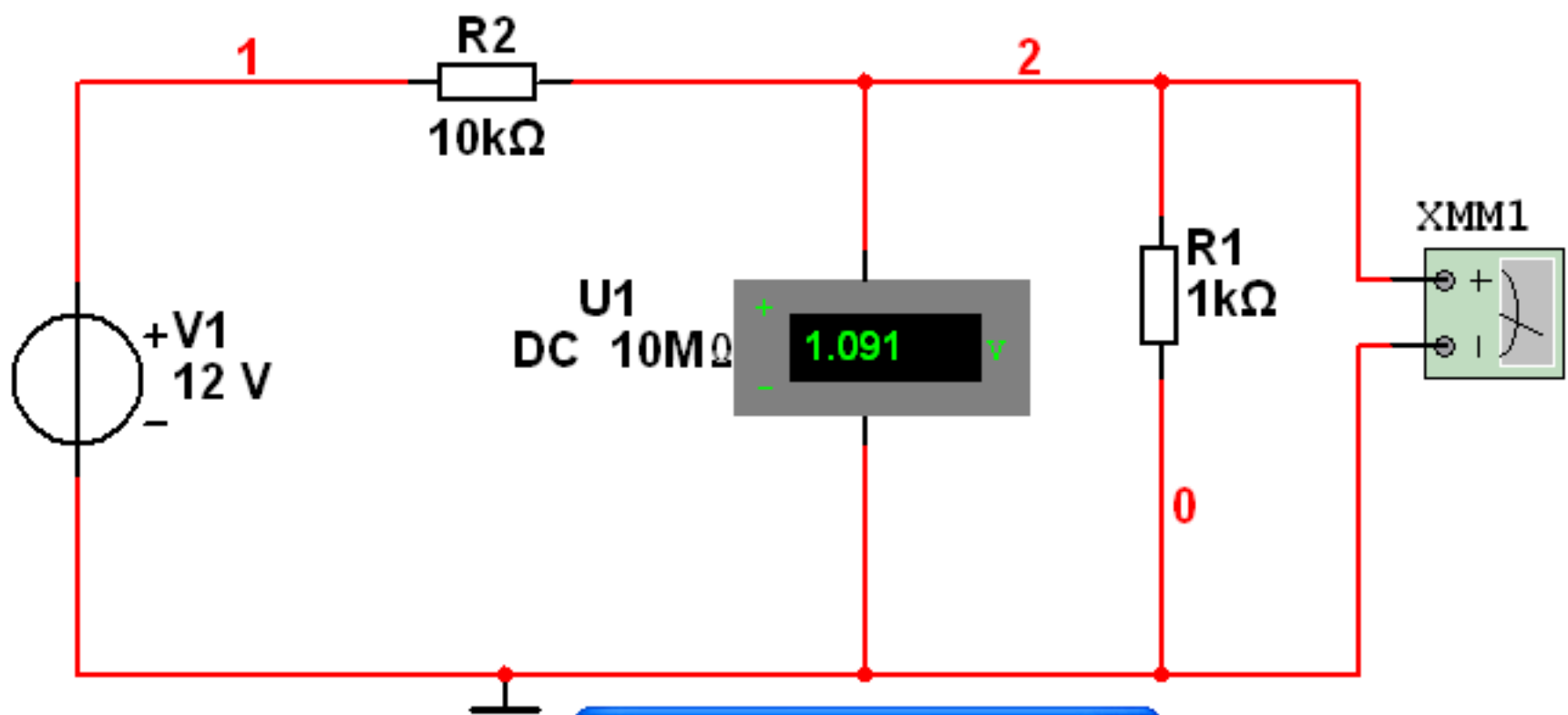


• Shift + DC V



Meranie jednosmerného napätia

- zapojenie V-metra v obvode paralelne,
- V-meter s prepnutým ovládacím prvkom na meranie jednosmerného napätia,
- nastavenie potrebného rozsahu (ak je potrebné).



Multimeter-XMM1

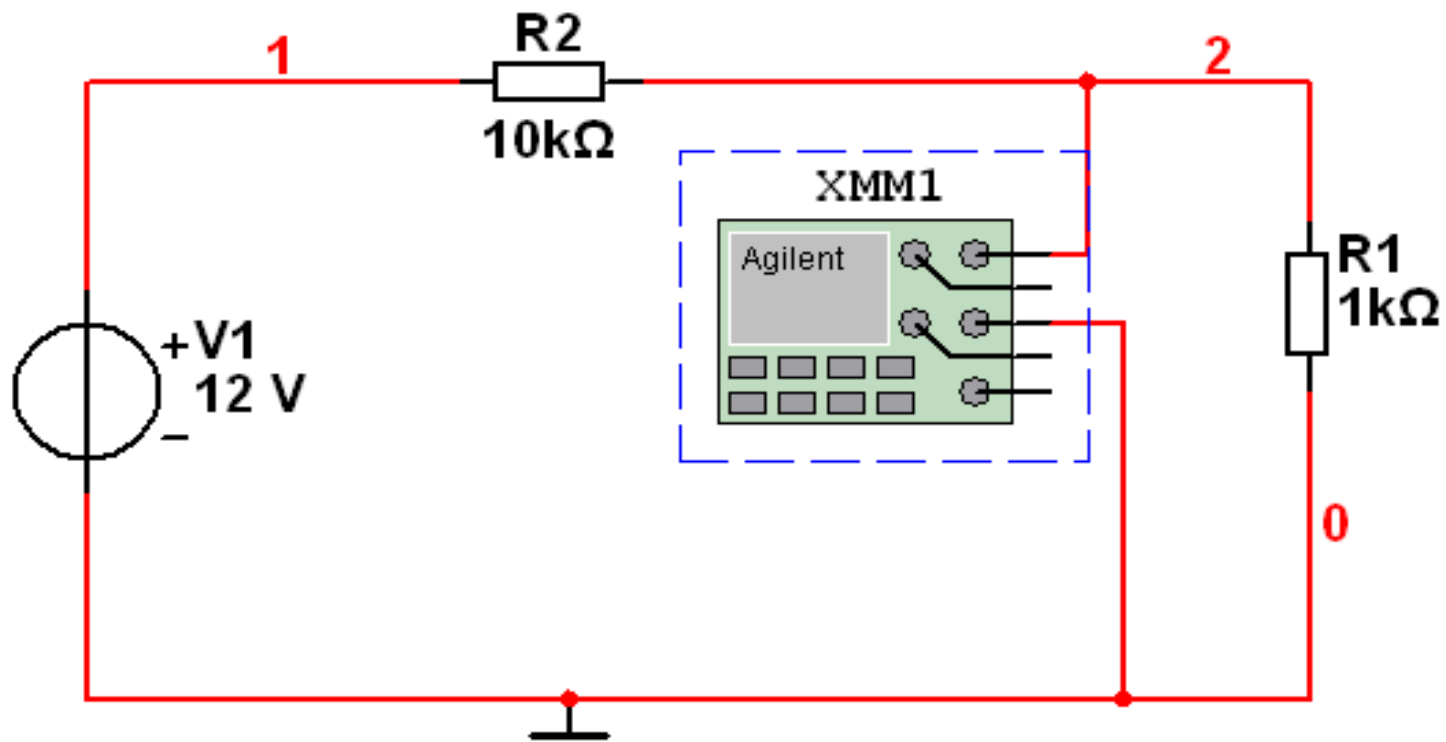
1.091 V

A V Ω dB

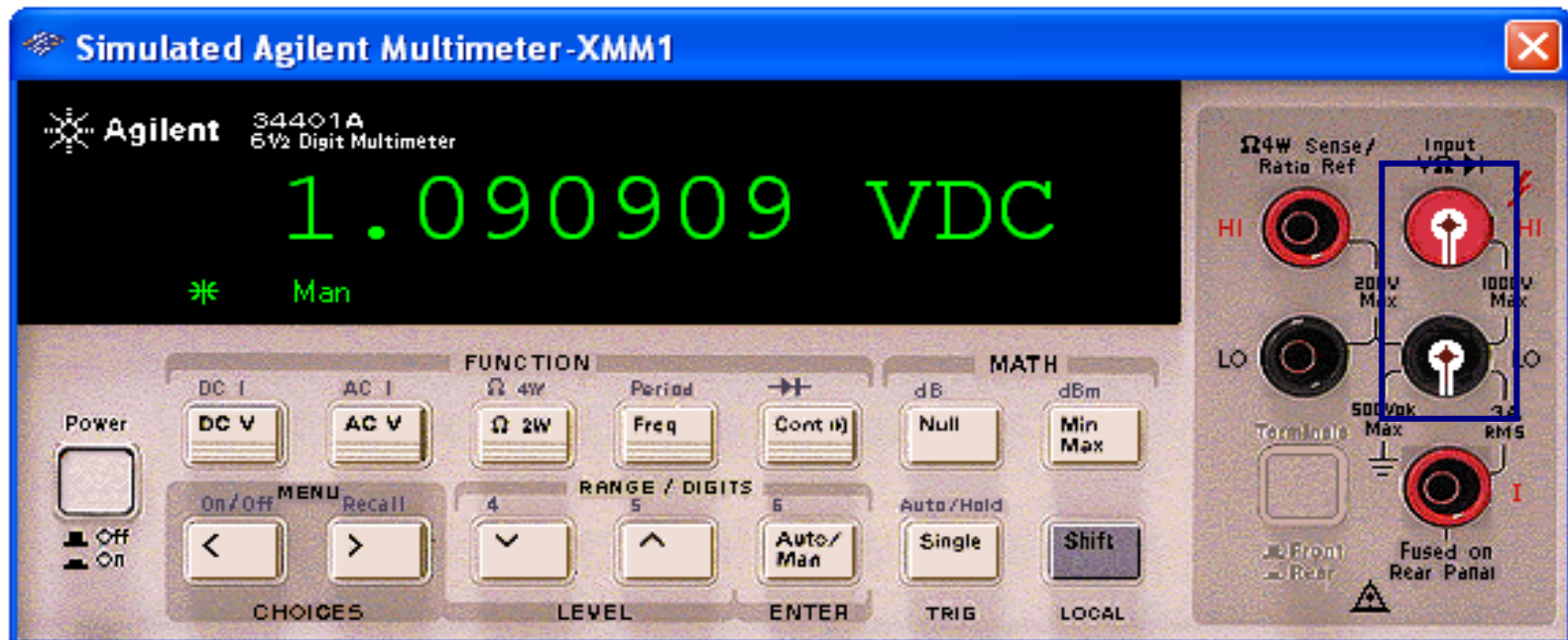
~ -

Set...

+ -

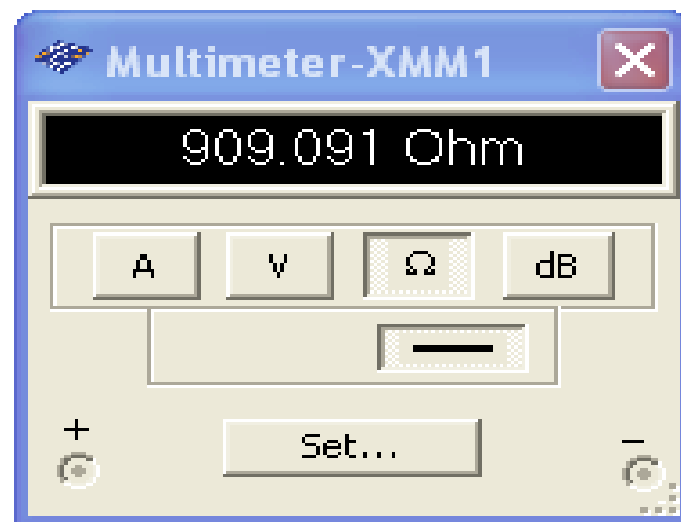
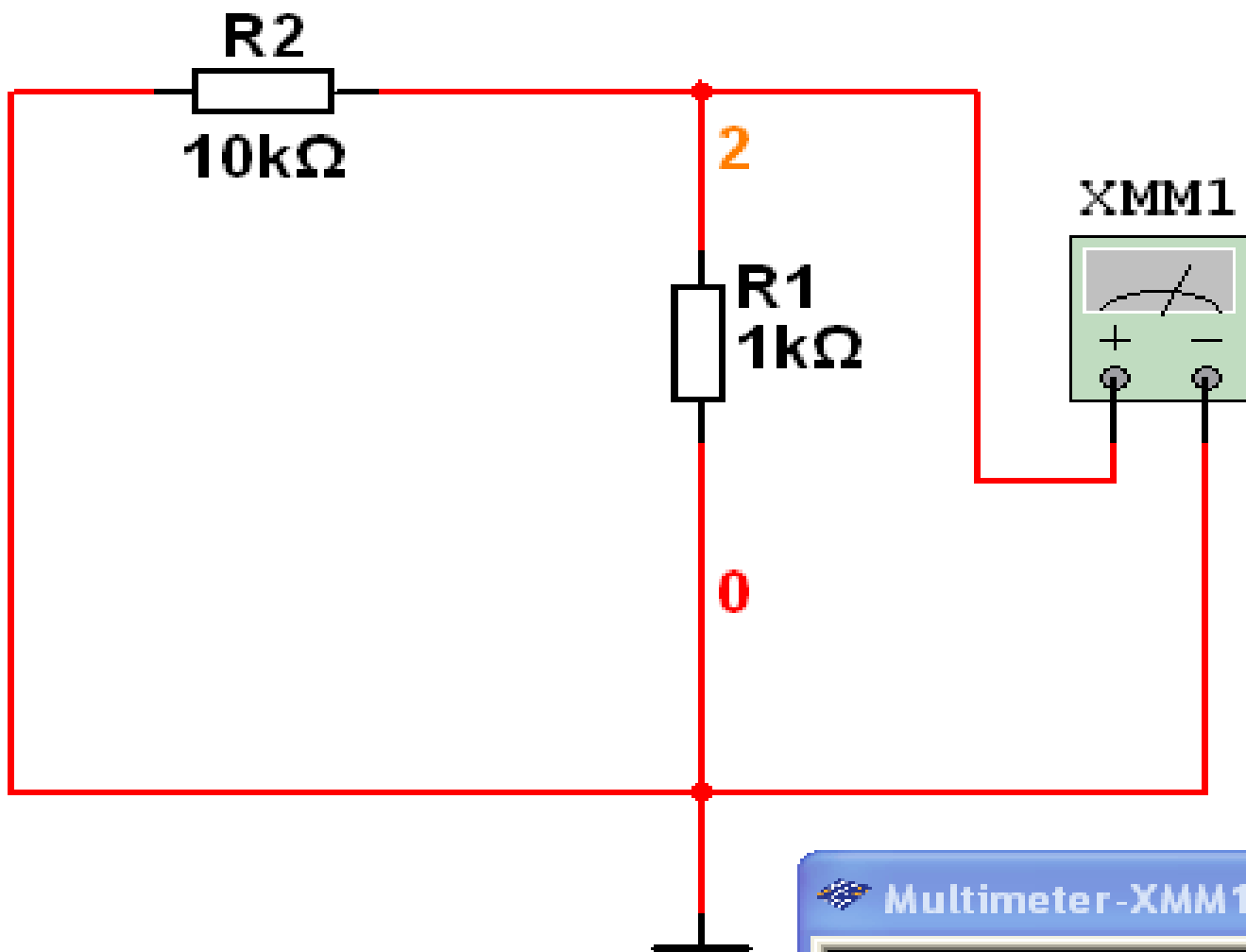


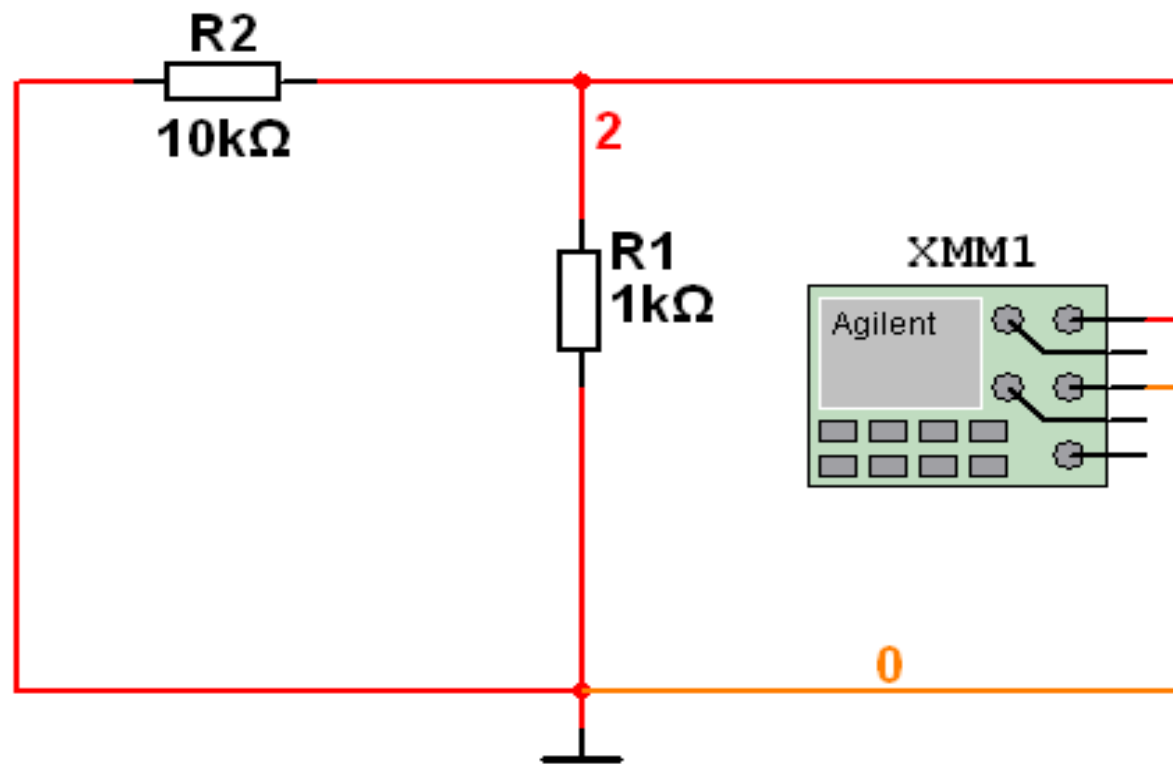
• DC V



Meranie odporu

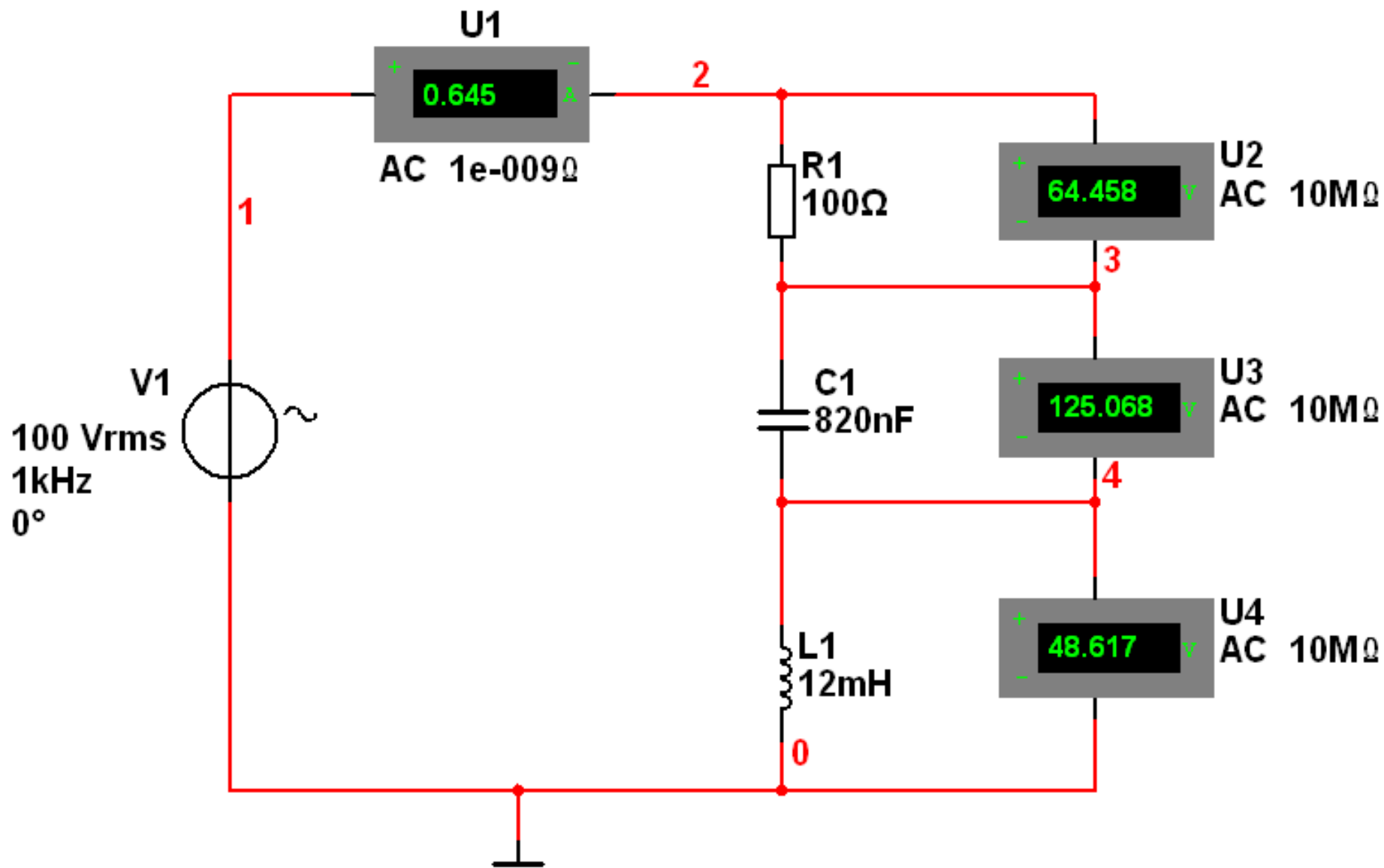
- zapojenie Ω -metra v obvode paralelne,
- Ω -meter s prepnutým ovládacím prvkom na meranie odporu,
- nastavenie potrebného rozsahu (ak je potrebné).

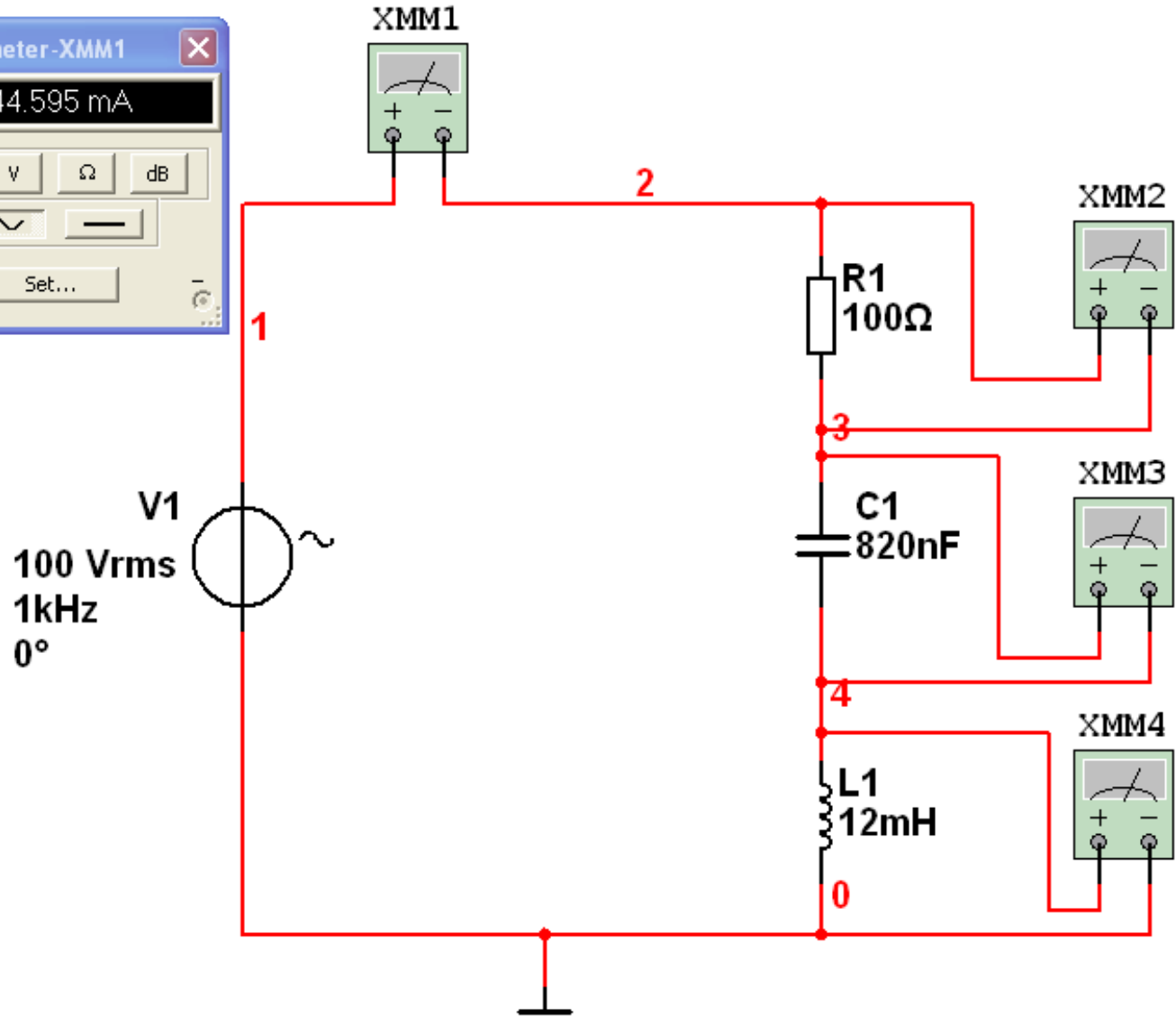
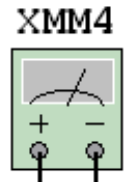
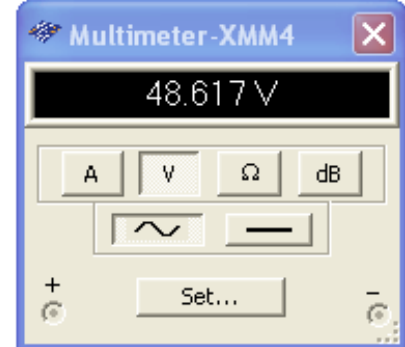
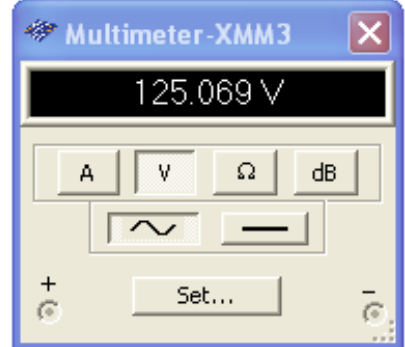
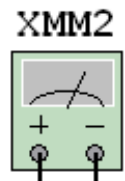
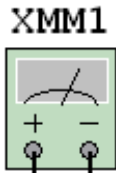




Meranie striedavého prúdu a napätia

- zapojenie A-metra v obvode do série,
- zapojenie V-metra v obvode paralelne,
- A- meter a V-meter s prepnutým ovládacím prvkom na meranie striedavých veličín,
- nastavenie potrebného rozsahu (ak je potrebné).





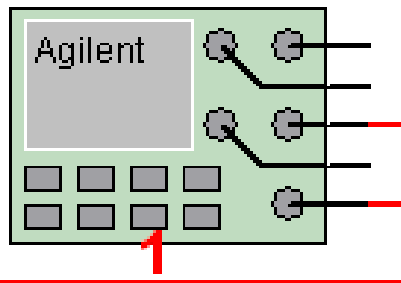
V1
100 Vrms
1kHz
0°

R1
100Ω

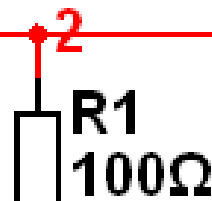
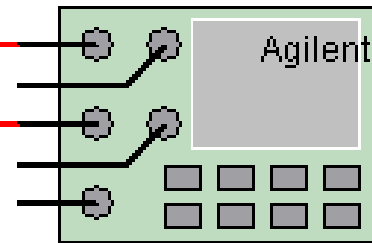
C1
820nF

L1
12mH

XMM1



XMM2



XMM3



Simulated Agilent Multimeter - XMM1

Agilent 34401A 6 1/2 Digit Multimeter

0.644596 AAC

FUNCTION: AC V, Ω 2W, Freq, Cont (H)

Input: HI, LO

Simulated Agilent Multimeter - XMM2

Agilent 34401A 6 1/2 Digit Multimeter

064.4595 VAC

FUNCTION: AC V, Ω 2W, Freq, Cont (H)

Input: HI, LO

Simulated Agilent Multimeter - XMM4

Agilent 34401A 6 1/2 Digit Multimeter

048.6173 VAC

FUNCTION: AC V, Ω 2W, Freq, Cont (H)

Input: HI, LO

Simulated Agilent Multimeter - XMM3

Agilent 34401A 6 1/2 Digit Multimeter

125.0693 VAC

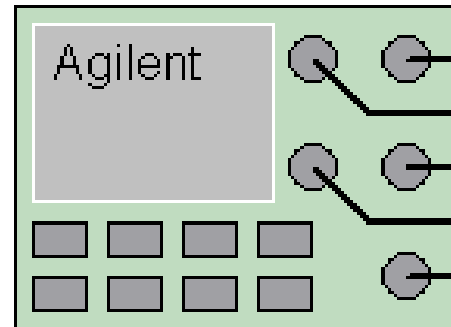
FUNCTION: AC V, Ω 2W, Freq, Cont (H)

Input: HI, LO

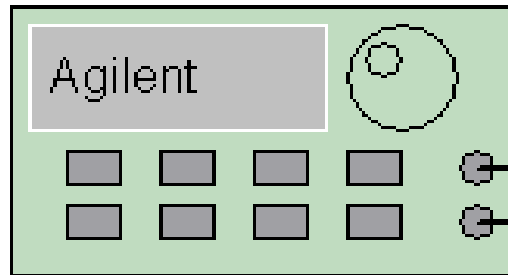
Meranie frekvencie

- pomocou čítača frekvencie,
- pomocou osciloskopu,
 - priamo (digitálne osciloskopy – funkcia MEASURE),
 - nepriamo (s obrazovky osciloskopu).

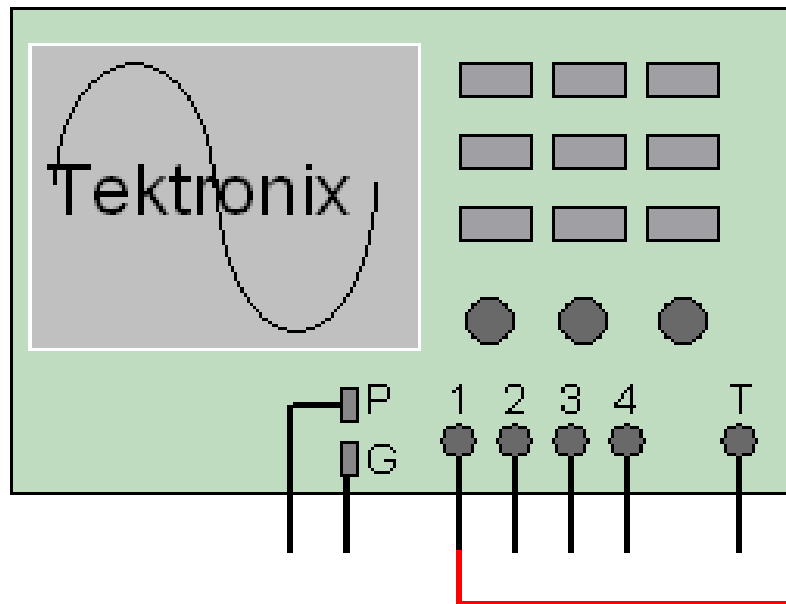
XMM1



XFG1



XSC1

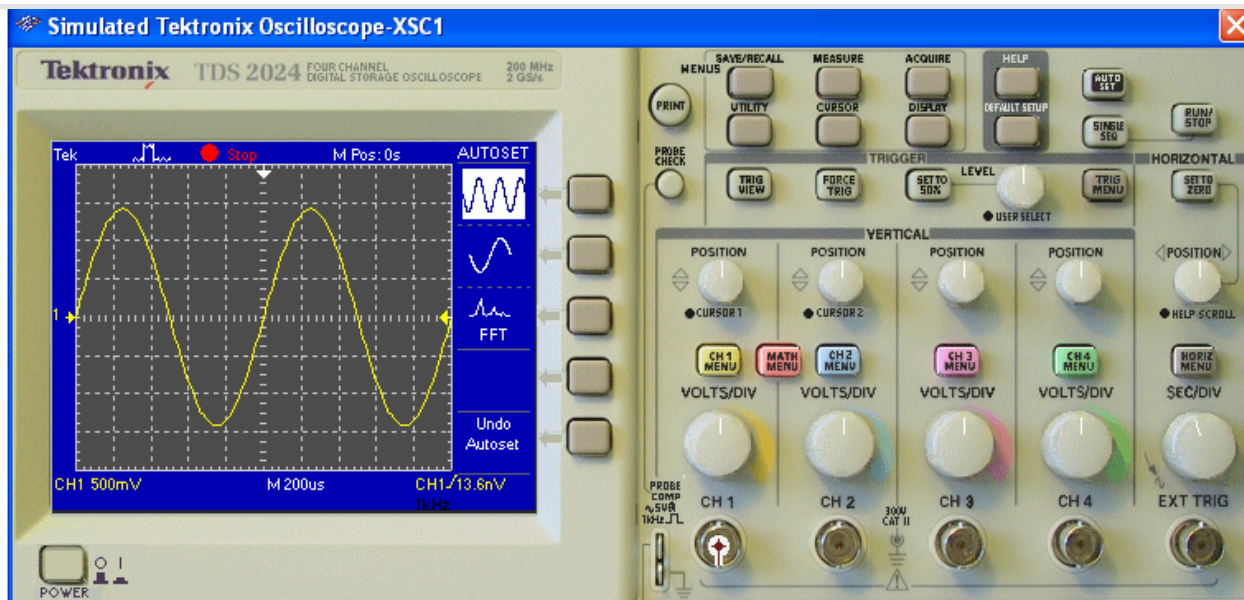


1

0

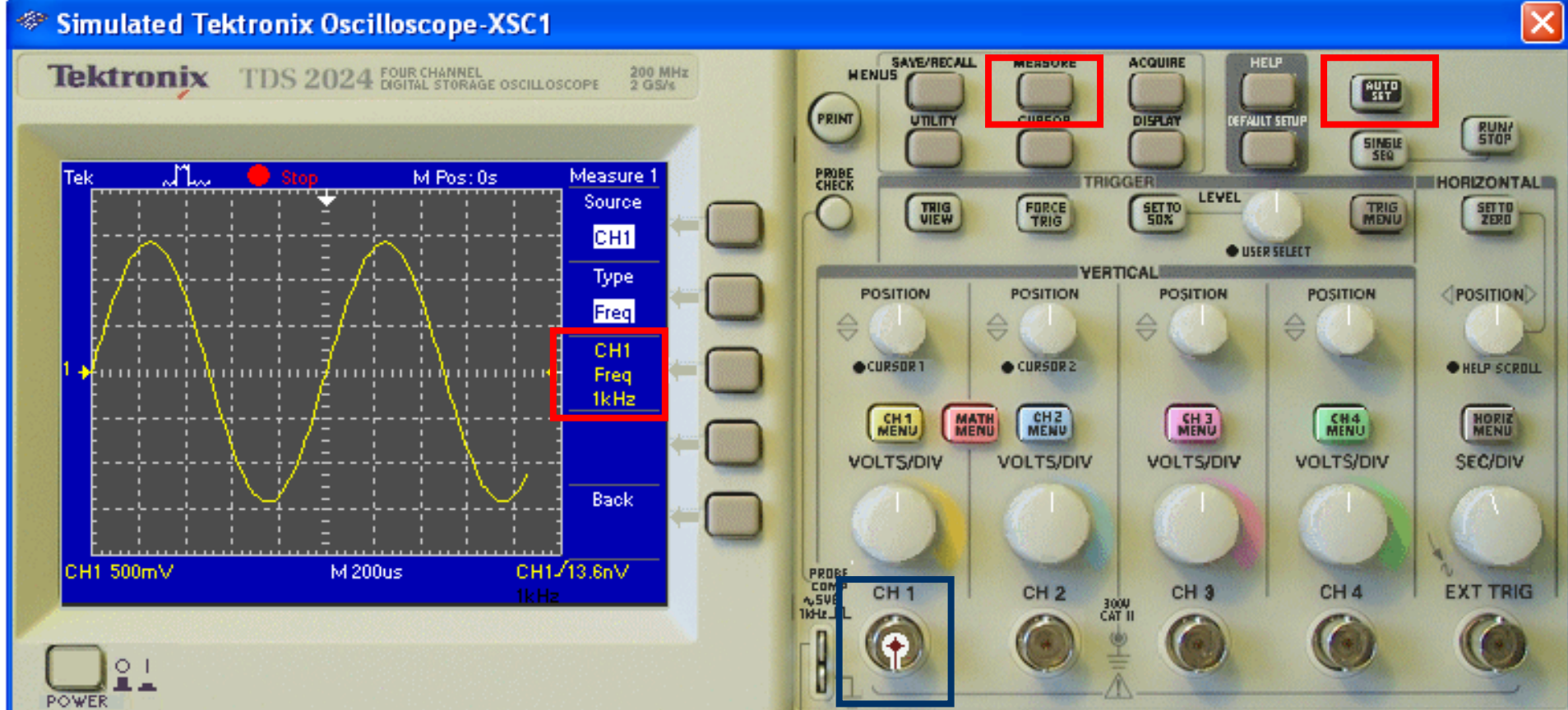


Meranie frekvencie pomocou čítača

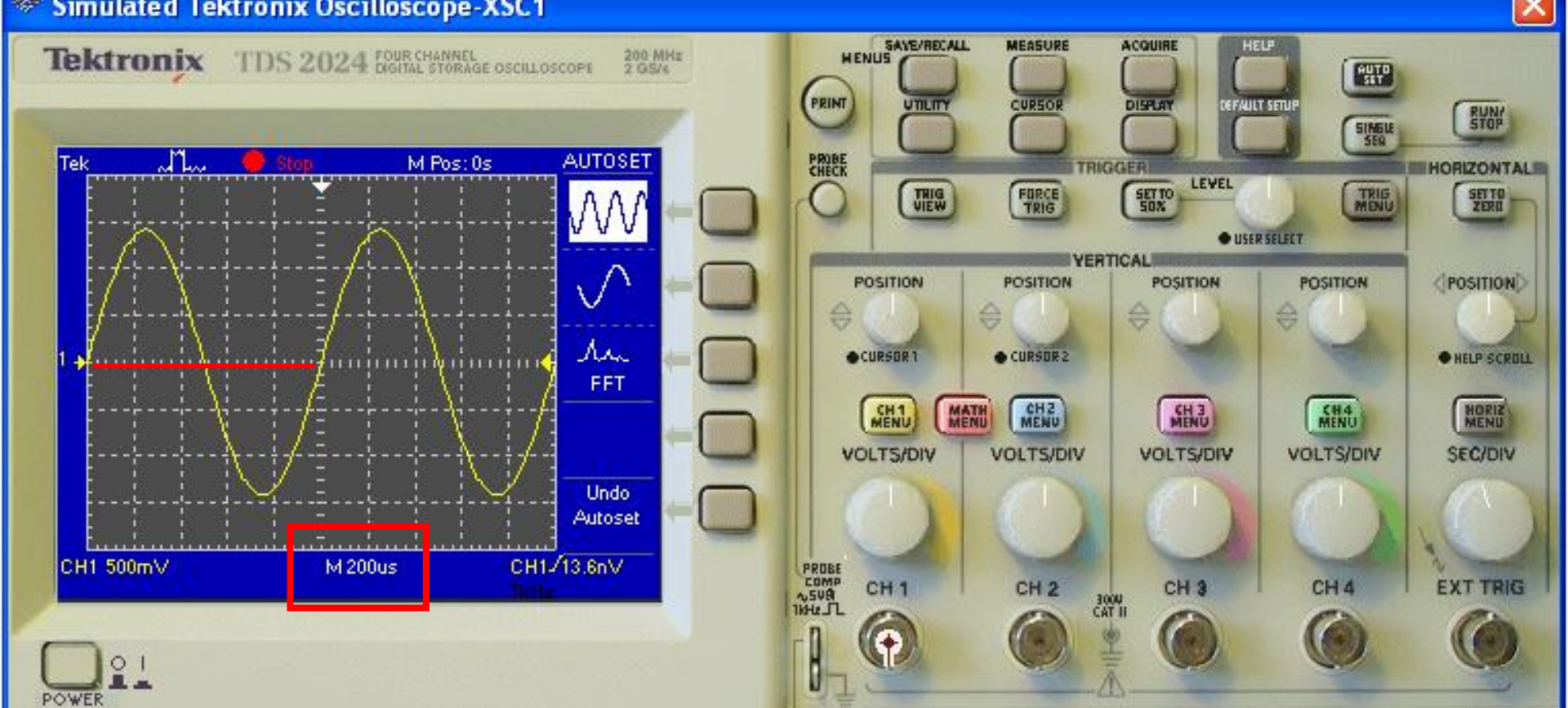




- pripojenie signálu z generátora,
- zapnutie meracieho prístroja,
- meranie frekvencie.



- pripojenie signálu kanál CH 1,
- AUTO SET,
- MEASURE,
- odčítanie frekvencie.

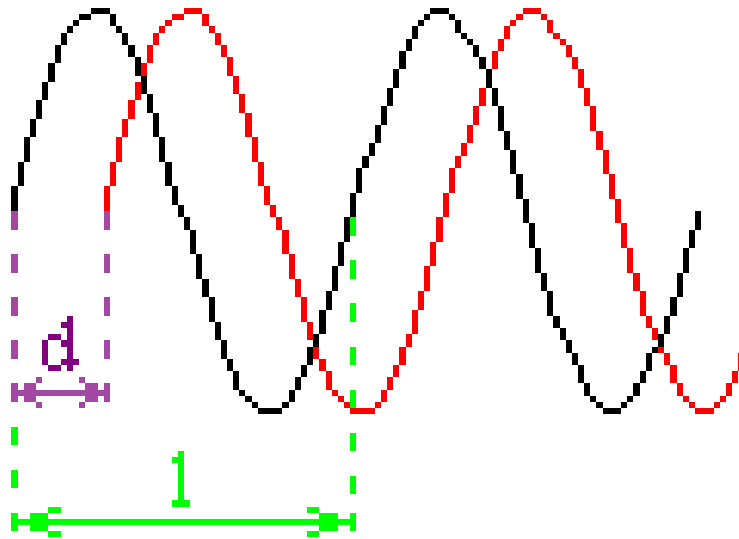


- odčítanie rozsahu časovej základne – $r_T = 200\mu s$
- odčítanie počtu dielikov v smere osi X
($T = 5$ dielikov),

- výpočet frekvencie $f_{\text{max}} = \frac{1}{T \cdot r_T} \left[\text{Hz, diel, } \frac{s}{\text{diel}} \right]$

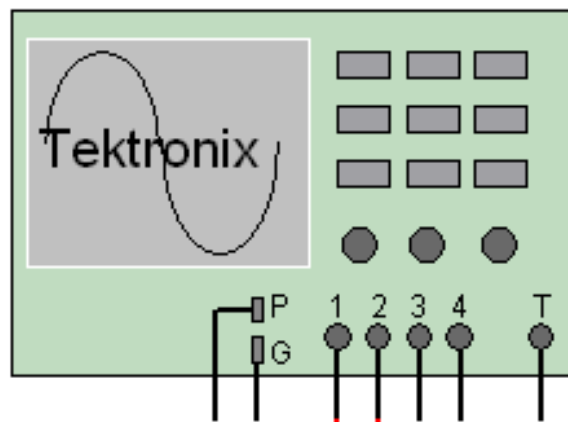
Meranie fázového posunu

- pomocou dvojkanálového osciloskopu (z dvoch signálov),

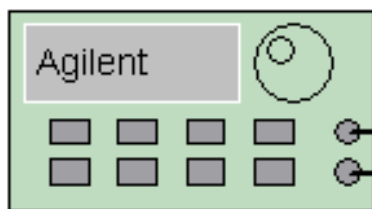


$$\varphi_a = \frac{d}{l} \cdot 360^\circ \quad [^\circ, \text{dielik}]$$

XSC1



XFG1



1

R1

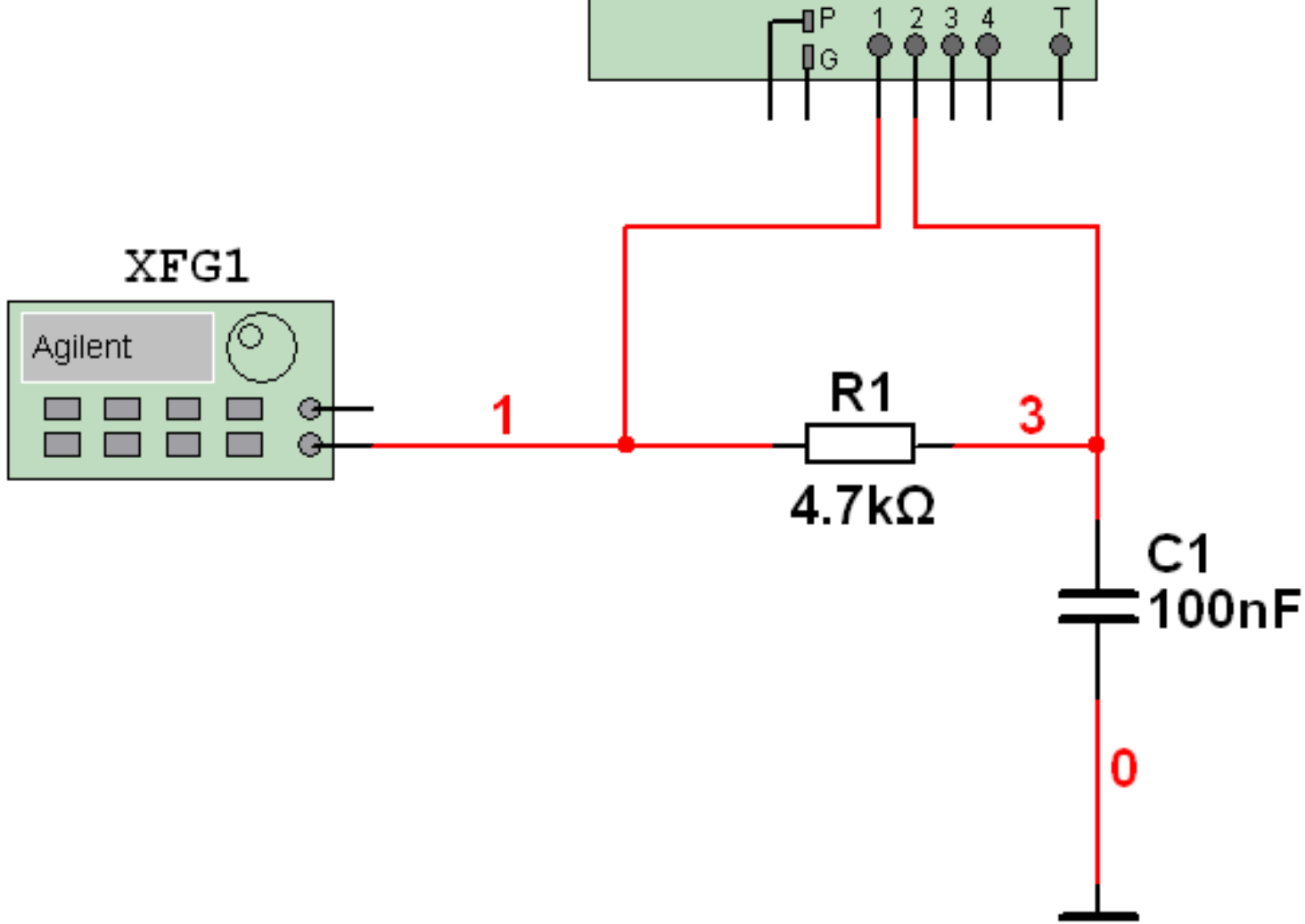
4.7kΩ

3

C1

100nF

0



Simulated Tektronix Oscilloscope-XSC1



Tektronix TDS 2024 FOUR CHANNEL DIGITAL STORAGE OSCILLOSCOPE 200 MHz 2 GS/s

VERTICAL

CH 1	CH 2	CH 3	CH 4	EXT TRIG
POSITION	POSITION	POSITION	POSITION	POSITION
CURSOR 1	CURSOR 2			HELP SCROLL
CH 1 MENU	MATH MENU	CH 2 MENU	CH 3 MENU	CH 4 MENU
VOLTS/DIV	VOLTS/DIV	VOLTS/DIV	VOLTS/DIV	SEC/DIV
CH 1	CH 2	CH 3	CH 4	EXT TRIG

TRIGGER: TRIG VIEW, FORCE TRIG, SET TO 50%, LEVEL, TRIG MENU, RUN/STOP, SINGLE SEQ, AUTO SET, HELP, DEFAULT SETUP, SAVE/RECALL, MEASURE, ACQUIRE, MENU, UTILITY, CURSOR, DISPLAY, PRINT, PROBE CHECK, TRIGGER, HORIZONTAL, SET TO ZERO

Simulated Agilent Function Generator-XFG1



Agilent 33120A 15 MHz Function / Arbitrary WaveForm Generator

1.0000000 kHz ~

FUNCTION/MODULATION

AM	FM	FSK	Burst	Sweep	Arb List
1	2	3	4	5	±
AM/FM	Level	% Duty	Internal	Store	Cancel
6	7	8	9	0	Enter Number
MODIFY	TRIG	STATE	LOCAL		

Power: Off/On

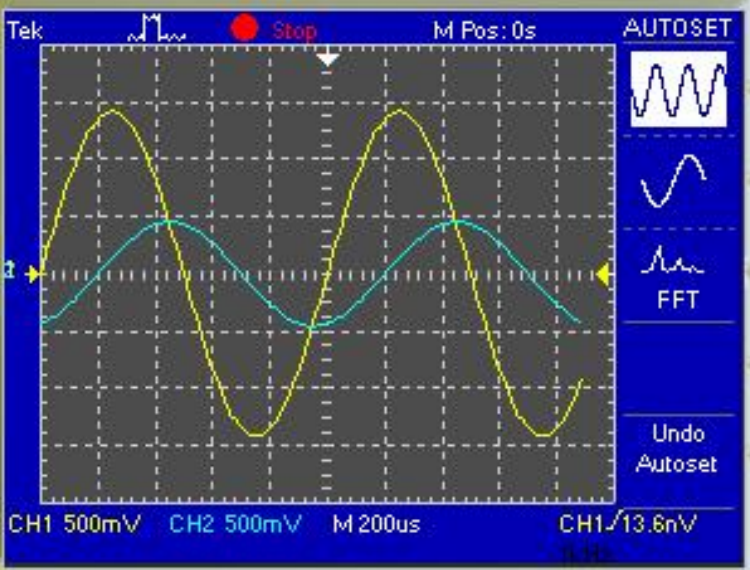
OUTPUT: 42V Max, 50Ω

SYNC: MHz, kHz, Hz, dBm, Back Space Recall Menu

Buttons: MENU On/Off, Enter, Shift, LOCAL

Simulated Tektronix Oscilloscope-XSC1

Tektronix TDS 2024 FOUR CHANNEL DIGITAL STORAGE OSCILLOSCOPE 200 MHz 3 GS/s



POWER

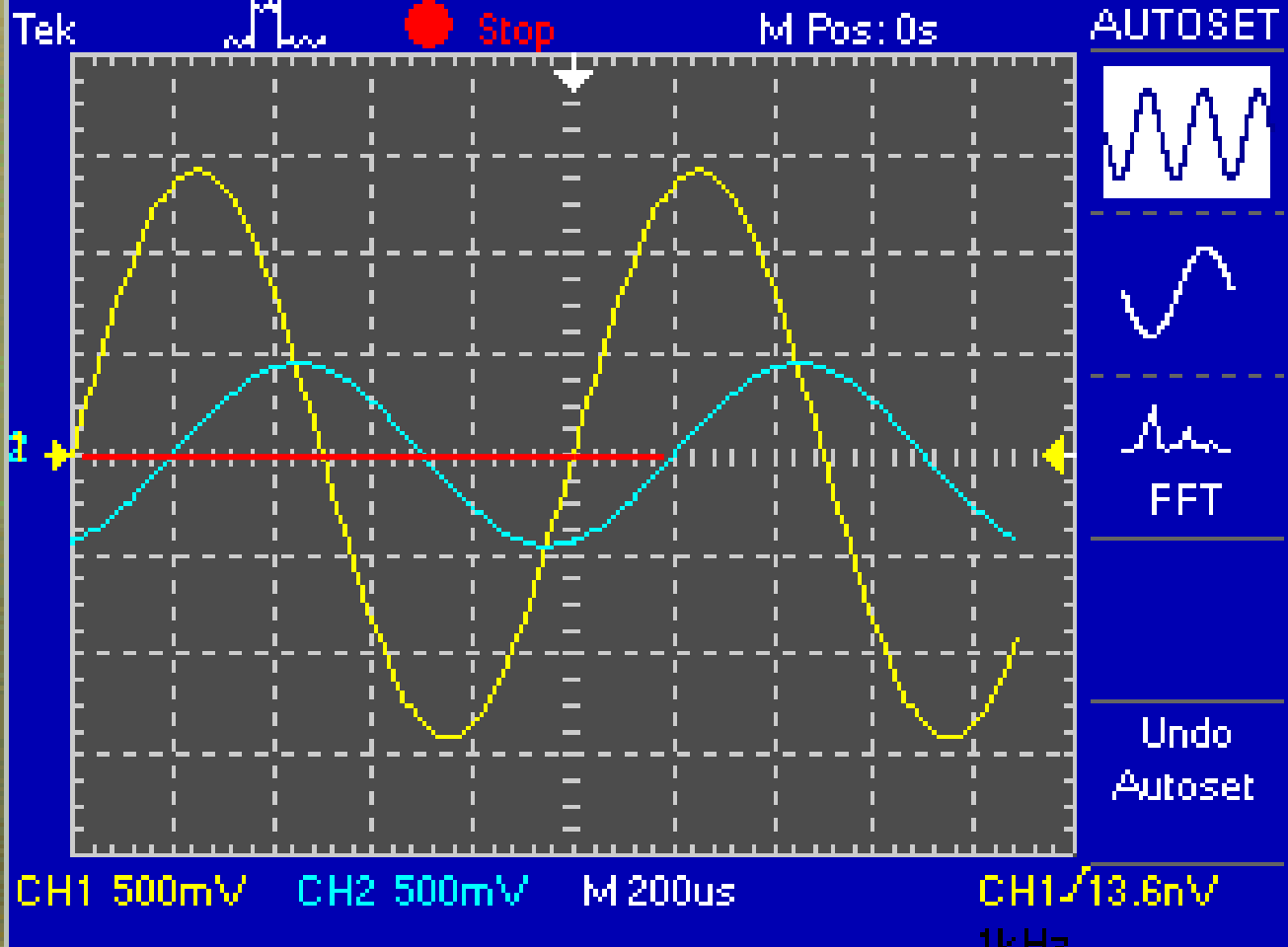
MENUS SAVE/RECALL MEASURE ACQUIRE HELP
PRINT UTILITY CURSOR DISPLAY DEFAULT SETUP
AUTO SET RUN/STOP
UTILITY CURSOR DISPLAY DEFAULT SETUP SINGLE SEQ

TRIGGER TRIG VIEW FORCE TRIG SET TO 50% LEVEL TRIG MENU SET TO ZERO
USER SELECT

VERTICAL

POSITION	POSITION	POSITION	POSITION	POSITION
CURSOR 1	CURSOR 2			HELP SCROLL
CH 1 MENU	MATH MENU	CH 2 MENU	CH 3 MENU	CH 4 MENU
VOLTS/DIV	VOLTS/DIV	VOLTS/DIV	VOLTS/DIV	SEC/DIV
CH 1	CH 2	CH 3	CH 4	EXT TRIG

PROBE COMP 5V 10MHz FL 300W CAT II



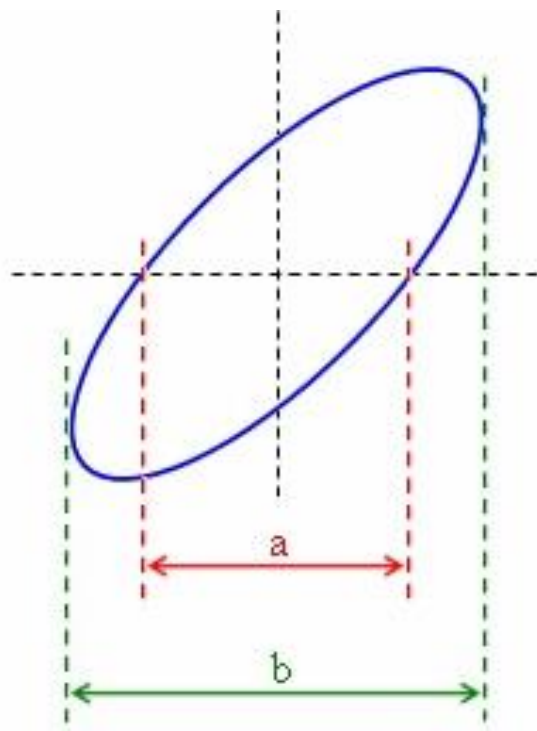
$$\varphi_d = \frac{d}{l} \cdot 360^\circ \quad [^\circ, \text{dielik}]$$

d = 1 dielik
l = 5 dielikov

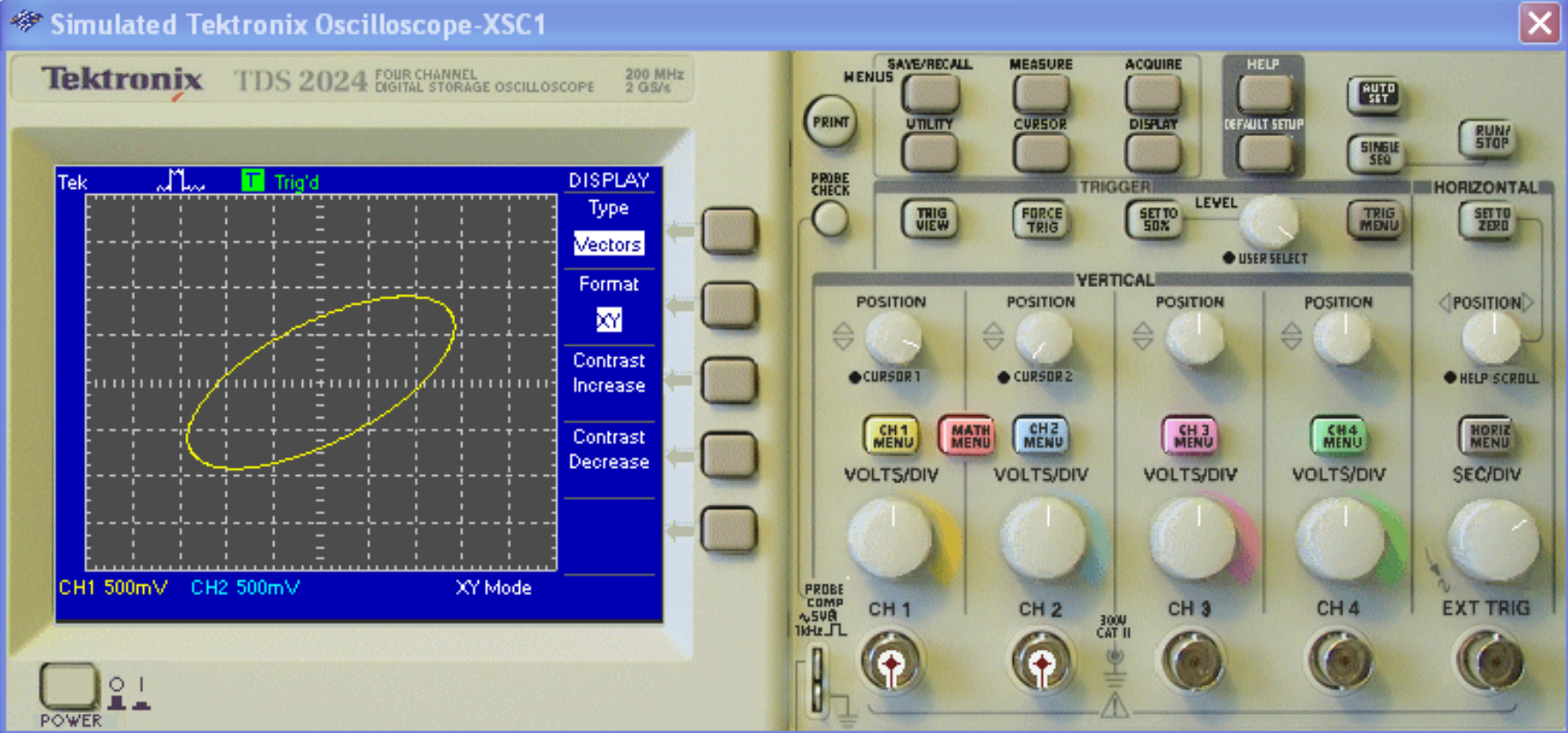
$$\varphi = 72^\circ$$

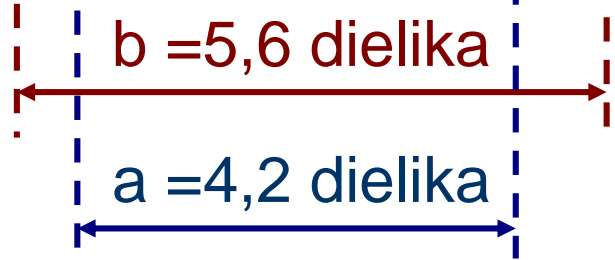
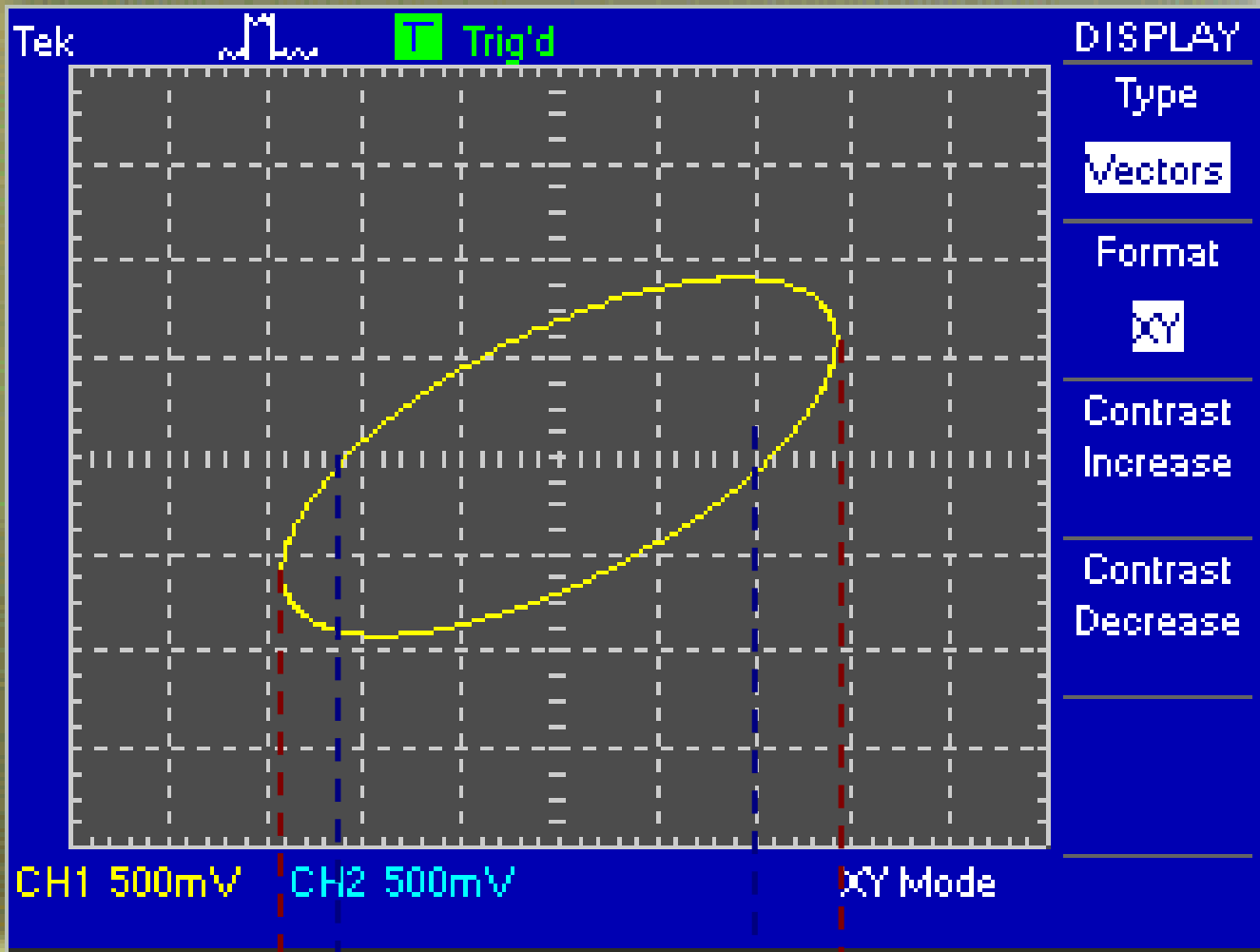
Meranie fázového posunu

- pomocou dvojkanálového osciloskopu (v režime XY),



$$\varphi_{\delta} = \arcsin \frac{a}{b} \quad [^{\circ}, \text{dielik}]$$



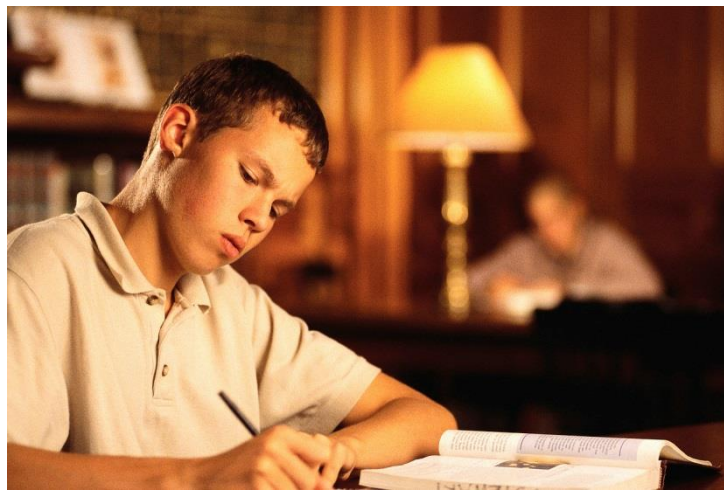


$$\varphi_{\delta} = \arcsin \frac{a}{b} \quad [^{\circ}, \text{dielik}]$$



Domáce zadanie

- napísať poznámky z preberanej problematiky



Ďakujem za pozornosť

