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PowerTest
Special Modules

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1. Energy Meter

This module is designed to check the functionality and accuracy of energy meter.

Following type of 1-phase or 3-phase energy meters can be checked.

- Active power meter
- Reactive power meter
- Apparent power meter

NR	Name	Item	Sel	
1	Energy Meter	Errorcurve 20%load	X	○
2		Errorcurve 40%load	X	○
3		Errorcurve 50%load	X	○
4		Errorcurve 60%load	X	○
5		Errorcurve 70%load	X	○
6		Errorcurve 80%load	X	○
7		Errorcurve 100%load	X	○

Parameters | Assessment | Wiring

Name: Add

Phase: Remove

Current: In A

Voltage: Vn V

Power Angle: Power Factor: Load:

Stab. time:

Pulses: Est. time:

Waveform: Harmonic: %

E%

Energy meter error curve

No.	Results
4	
5	
6	

Note: to check some type energy meters the **optional scanning head** is required to turn the LED flash on energy meter into electrical pulse which can be sensed by the test set. Please contact the manufacture for more details regarding the scanning head

Set group parameters

Click button to enter into group parameter page. Group test parameter page along with default settings is shown below

Name	Value	Variable
Meter type	P	MeterType
Select	Pulse/kVARh(kWh,k	PulseType
Constant	50000.000	Constant
CT ratio	1.000	Kct
PT ratio	1.000	Kpt

Meter type

- P** Active power meter
- Q** Reactive power meter
- S** Apparent power meter

Select

Pulse/kVARh(kWh,kVAh)

Select pulse unit as pulse per kVARh((kWh, kVAh)

VARh(Wh,VAh)/Pulse

Select pulse unit as kVARh((kWh, kVAh) per pulse

Constant

Defines the number of pulse for 1 KVARh(kWh, kVAh) if we select **Pulse/kVARh(kWh,kVAh)**

Defines the KVARh(kWh, kVAh) value for each pulse if we select **kVARh(kWh,kVAh)/Pulse**

Example

- Select to test kWh meter
- Seect **Pulse/kVARh(kWh,kVAh)**
- Set **Constant** as 100: indicate that each 100 pulses represents 1 kWh

- Set **Pulses** in test parameters page as 6: indicate that we are going to sense only 6 pulses for the whole test process. The total kWh measured for the whole test process should be $6/100=0.06\text{kWh}$

PT ratio

Ratio for voltage in case

CT ratio

Ratio for Current

Set test parameters

Name

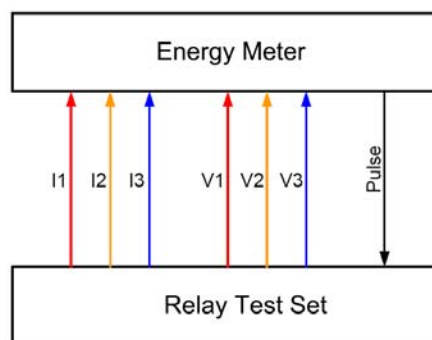
Edit here the name for the current test point

Phase

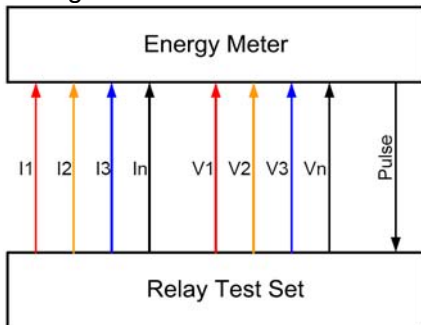
Indicate the wiring type for the energy meter.

LABC for 3-phase 3-wire meter and 3-phase 4-wiring meter

Wiring for 3P-3W meter

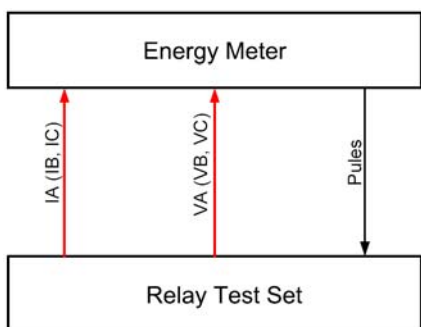


Wiring for 3P-3W meter



LA, LB,LC for single phase meter

Wiring for single phase meter



Note: Pulse output from energy meter or scanning head must be connected to binary input 1

Current

Percent of rate current

Voltage

Percent of rate voltage

Power angle, Power Factor, Load

Set angle or power factor which will be influenced by the selection of **Load**

Stab. time

Stabilization time required for energy meter to enter into stable working condition

Pulses

Pulses numbers to be sensed for testing.

Est. time

Time required for the test and this time is calculated based on the **Pulses** number setting and the voltage and current settings.

Waveform

We can select to add harmonic to the voltage or current output.

Sinus

no harmonic in the output

Sinus+Current Harmonic

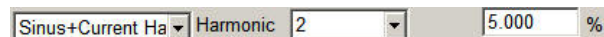
add harmonic to current output

Sinus+Current Harmonic

add harmonic to current output

The harmonic number and percentage can also be set

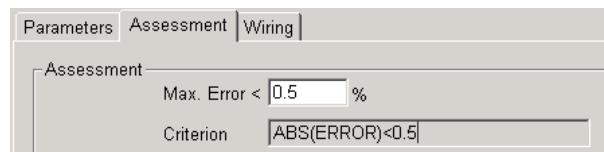
Example



In this example we have set to add 5% of 2nd harmonic to the current to be supplied to the energy meter.

Set assessment criterion

Click **Assessment** to enter into criterion setting page



We can set the value based on the accuracy of the meter under test

2. High Burden Relay

This module is used to test high burden relay along with *optional Phpc-01 Current Booster*.

Connected to the main test set the Phpc-01 Current Booster will provide one channel current source and will be controlled by this module.

Necessary voltage sources can also be provided to make relay in proper working condition.

The screenshot displays the 'HighImp' software interface. At the top left is a table with columns: NR, Name, Item, and Sel. Below this is a 'Parameters' section with various input fields for current (I), voltage (Va, Vb, Vc), and frequency. A 'Phasor Diagram' is shown on the right, a circular plot with axes labeled +90, 0, -90, and +/-180. Below the diagram is a table with columns: Name, Module, Angle, and Frequency. At the bottom right is a 'Results' table with columns: No. and Results.

NR	Name	Item	Sel
1	HighImp	(U.)	▼

Parameters | Binary | Wiring | Enter Results

I: 0.000A, 0.00deg, Current Start: 0.000A, Ratio: 2, Factor: 1.0000
 Current End: 10.000A
 Va: 0.000V, 0.00deg, Step: 0.100A, 4, 1.0000
 Vb: 0.000V, 0.00deg, Time: 1.000S, 6, 1.0000
 Vc: 0.000V, 0.00deg, Frequency: 50.000Hz, 8, 1.0000
 10, 1.0000

Transformer Ratio: 2 4 6 8 10
 Out1 Out2
 Out3 Out4
 Trip time: 0.0000s

Setting Para Binary

Name	Module	Angle	Frequency
Va	0.000V	0.0deg	50.000Hz
Vb	0.000V	0.0deg	50.000Hz
Vc	0.000V	0.0deg	50.000Hz
I	0.000A	0.0deg	50.000Hz

No.	Results
1	

refer to *optional Phpc-01 Current Booster* user manual

3. Power Swing Simulation

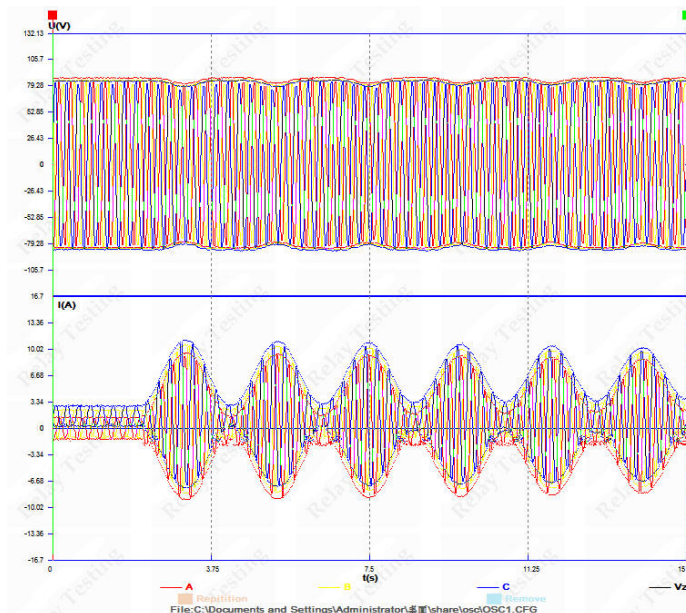
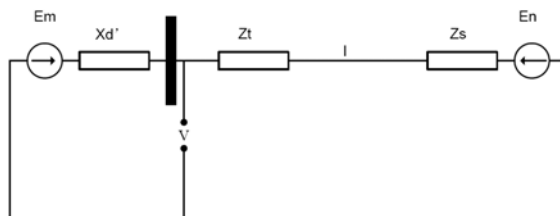
General

This module is used to simulate the power swing. This can be a tool for relay test engineer to observe the relay behavior during dynamic power swing process.

Principle of power swing

Important feature of power swing is as follow.

- phase angle between Generator and Load will swing
- The voltage and current will also have swing



Simulation principle

The typical system model used for simulating the power swing is as follows



For such a system the swing frequency is determined by swing cycle T .

We can easily simulate the power swing by defining the following settings:

Power angle	angle between the Generator and Load
Swing cycle	the time used to complete one cycle of swing
Swing numbers	how many swing cycles we want to simulate
Em/En	the direction of power swing

Internally the swing voltage and current will be calculated by taking account of the above parameters and other parameters in our power swing module.

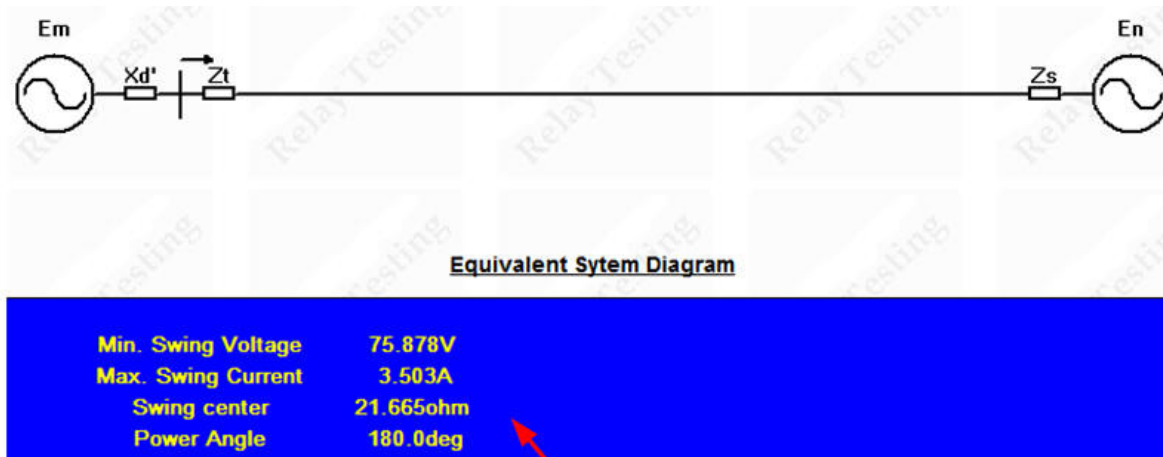
Power swing parameters

Switch the view button to display swing model and parameters



Click this button to view the system

Then the follow window will pop up.



Here we an see power swing parameters

The power swing center is calculated by taking account of system settings set in group parameters.

The position of power swing center can be changed by changing the system settings

Set group parameters



Click here to set system settings

Group parameters setting page will appear

Name	Value	Variable
Tprefault	5.000S	PreFaultTime
CT Polarity	Line	CTPOINT
Zs	25.000Ohm	Zs
Phi(Zs)	90.000Deg	Phis
Zt	15.000Ohm	Zt
Phi(Zt)	78.000Deg	Phit
Xd'	1.000Ohm	Xd



- Tprefault** prefault time (will be used when simulating the power swing with fault)
- CT Side** select the installation position of CT (Line or Busbar)
- |Zs|** Equivalent system impedance for En
- Phi(Zs)** Impedance angle of Zs
- |Zt|** Line impedance
- Phi(Zt)** Impedance angle of Zt
- Xd'** Equivalent system impedance for Em

Set test parameters

Parameters	Results	Wiring
Name	0-200DegSwing	
Pow. Angle Start	0	Deg
Pow. Angle End	200	Deg
Swing Cycle	2	S
Swing Number	5	
Em / En	1.25	
Trip Contact	A	
Acc. Signal Contact	C	
Dec. Signal Contact	D	
	<input type="checkbox"/> Fault	
	Fault type	A-E
	Zf	1.000Ohm
	If	5.000A
	Fault Time	0.500S
	Reference Frequency	50.000Hz
	Swing Mode	
	<input type="checkbox"/> from-to-from	
	<input checked="" type="radio"/> Increase speed	
	<input type="radio"/> Decrease speed	

Pow Angle Start start power angle

Pow Angle End end power angel (will be activated when 'from-to-from'is selected in 'Swing Mode')

Swing Cycle time used to complete on cycle of power swing (normally set range: 2-5s)

Swing Number number of power swing cycle to simulate

|Em|/|En| the ratio of Em/En

Swing mode selection

Swing Mode
<input type="checkbox"/> from-to-from
<input checked="" type="radio"/> Increase speed
<input type="radio"/> Decrease speed

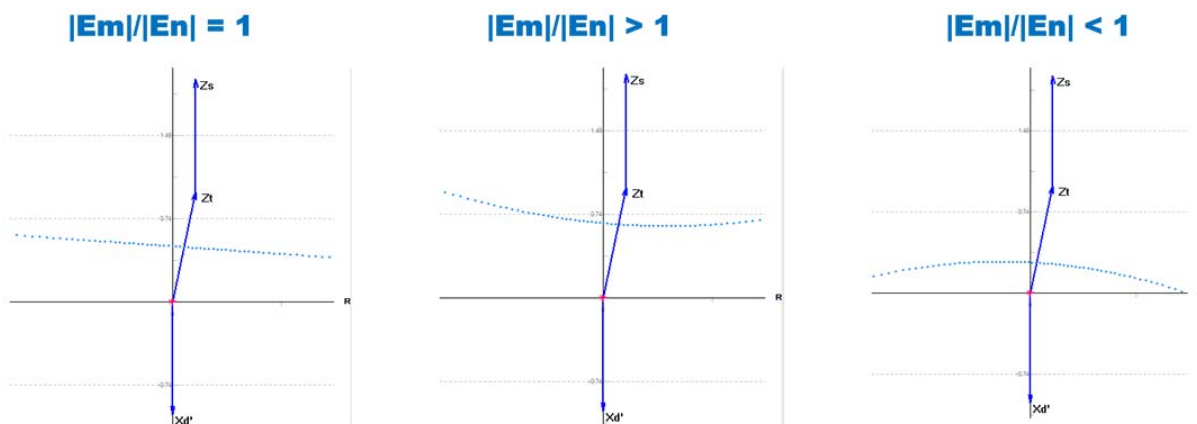
from-to-from swing angle will change from angle start to angle end and then from angle end to angle start

increase speed swing angle will change from angle start to angle end

decrease speed swing angle will change from angle end to angle start

Set power swing center

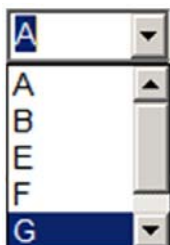
The ratio of E_m/E_n will influence the position of power swing center



Set binary input

Trip Contact assign the binary input for sensing the tripping signal from the relay

Available binary inputs are A,B, E, F,G,H



Other settings

- Acc. Signal Contact** incoming **Acceleration** signal from relay
- Dec. Signal Contact** incoming **Deceleration** signal from relay

The above two parameters are mostly used when testing **out-of-step relay**

- Fault type** fault type
- |Zf|** fault impedance
- Fault time Reference** this indicates when the fault will occur after power swing stars
- Frequency** this is the reference frequency set in **System Configuration**

Power swing example

In this example we have made the following settings

Name	Value	Variable
Tprefault	5.000S	PreFaultTime
CT Side	Line	CTPOINT
Zs	2.000Ohm	Zs
Phi(Zs)	90.000Deg	Phis
Zt	2.000Ohm	Zt
Phi(Zt)	78.000Deg	Phit
Xd'	0.500Ohm	Xd

Parameters Results Wiring

Name: 0-200DegSwing

Pow. Angle Start: 0 Deg

Pow. Angle End: 360 Deg

Swing Cycle: 3 S

Swing Number: 5

|Em| / |En|: 1.55

Trip Contact: A

Acc. Signal Contact: C

Dec. Signal Contact: D

Fault

Fault type: A-E

|Zf|: 1.000Ohm

If: 5.000A

Fault Time Reference: 0.500S

Frequency: 50.000Hz

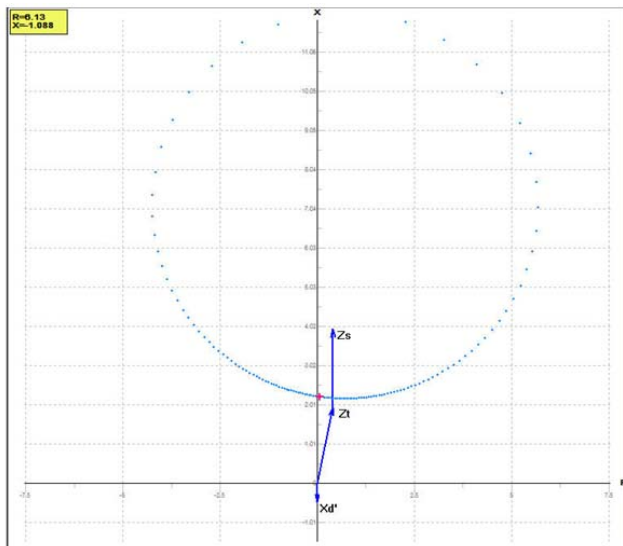
Swing Mode

from-to-from

Increase speed

Decrease speed

Add Remove



4. Transducer

This module is used to check the accuracy of transducer

NR	Name	Item	Sel
1	Transducer	100W	✓

Parameters

Name: 100W Add

Vnom(L-N): 63.500V Angle: 84.98 Class: 5.000% Add Sweep...

Current: 6.000A Frequency: 50.000Hz Stabilizing time: 5.000S Delete

Delete All

Transducer settings

Type: Active power Single phase Three phase CT And PT Ratio

Input Range: Output Range: Prim.: 10.000 A

Min: -1000.000W -4.000mA Output: mA Sec.: 0.010 A

Max: 1000.000W 4.000mA Input Value: 100.000W Prim.: 10.000 kV

Sec.: 0.010 V

Primary Side

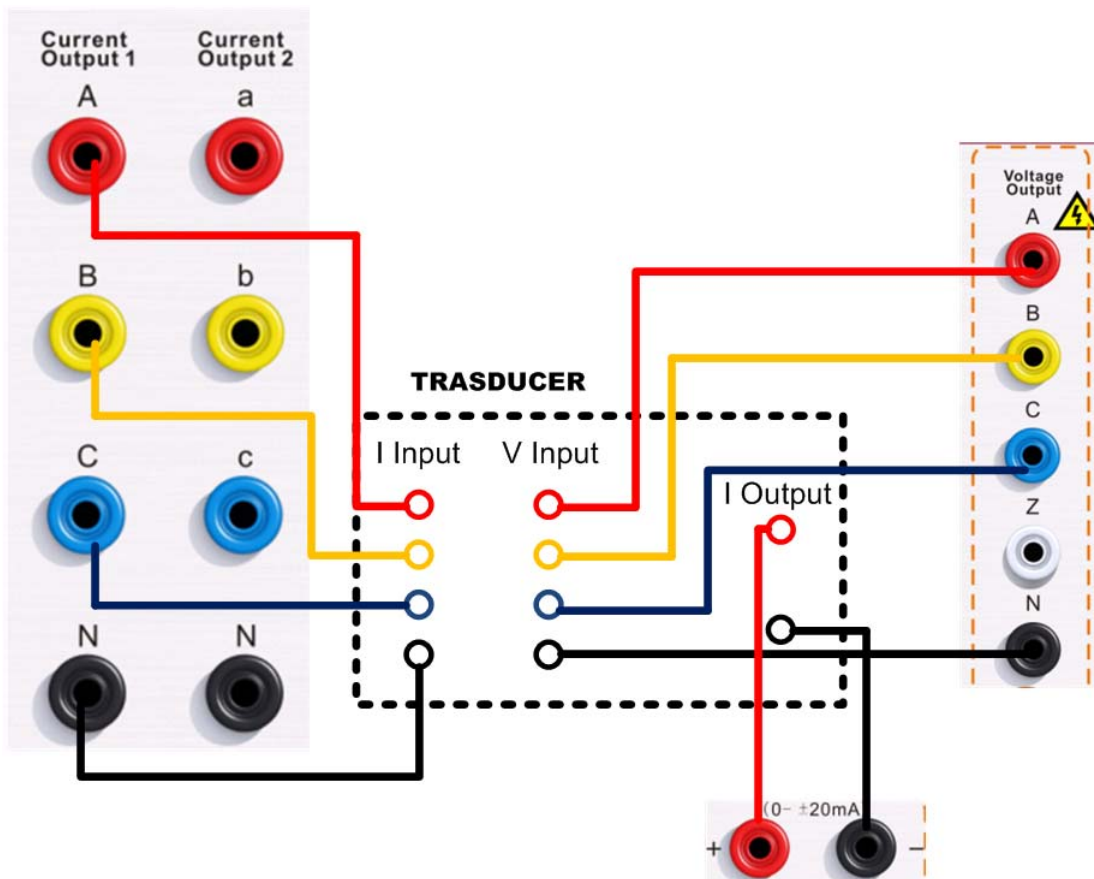
No.	Results
1	

Example: test procedure for one typical transducer

Transducer parameters

Transducer type	Var
Transducer connection	3 phase, 4 wires
Transducer range	0-350MVar
Transducer output type and range	Current, 0-4mA
Rate voltage:	110V
PT ratio	400KV/110V
Rate current	1A
CT ratio	1000A/1A

Test connection



Set test parameters

Parameters

Name: 0MVar

Vnom(L-N): 63.500V Angle: 0.00 Class: 1.000% Add

Current: 1.000A Frequency: 50.000Hz Stabilizing time: 5.000S Add Sweep...

Delete

Delete All

Transducer settings

Type: Reactive power Single phase Three phase

Input Range Output Range

Min: 0.000MVar 0.000mA Output: mA

Max: 350.000MVar 4.000mA Input Value: 0.000MVar

Primary Side

CT And PT Ratio

Prim.: 1000.000 A

Sec.: 1.000 A

Prim.: 400.000 kV

Sec.: 110.000 V

Vnom(L-N) 63.500V	nominal L-N voltage of transducer input									
Current 1.000A	output current to be injected into transducer									
Angle 0.00	angle between output voltage and current based on power									
Input Value 0.000MVar	power to be provided to the transducer									
<input type="radio"/> Single phase <input checked="" type="radio"/> Three phase	select 3 phase (based on the type of transducer)									
Type Reactive power	Select Reactive power test (based on our test requirement)									
<table border="1"> <tr> <td></td> <td>Input Range</td> <td>Output Range</td> </tr> <tr> <td>Min</td> <td>0.000MVar</td> <td>0.000mA</td> </tr> <tr> <td>Max</td> <td>350.000MVar</td> <td>4.000mA</td> </tr> </table>		Input Range	Output Range	Min	0.000MVar	0.000mA	Max	350.000MVar	4.000mA	the measuring and output range of transducer
	Input Range	Output Range								
Min	0.000MVar	0.000mA								
Max	350.000MVar	4.000mA								
Output mA	the output type of transducer									

<input checked="" type="checkbox"/> Primary Side CT And PT Ratio Prim. 1000.000 A Sec. 1.000 A Prim. 400.000 kV Sec. 110.000 V	Set the primary side rating in case transducer input reflects the primary side value
Class 1.000%	The accuracy class of transducer and this setting will be used as the assessment criterion
Stabilizing time 5.000S	The average measuring values during this time will be used to reflect the actual accuracy of the transducer under test

Add test point

Click **Add** to add one point each time

NR	Name	Item	Sel	
1	Transducer	0MVar	X	○
2		0MVar	✓	●

New test point.

Click **Quick Add** to add more test points each time

- Start** Start value of the test points.
- Stop** Stop value of the test points.
- Step** Step value.

Confirm the setting and we see new test points added in the test list

NR	Name	Item	Sel	
1	Transducer	0MVar	X	○
2		50.000MVar	✓	●
3		100.000MVar	✓	●
4		150.000MVar	✓	●
5		200.000MVar	✓	●
6		250.000MVar	✓	●
7		300.000MVar	✓	●
8		350MVar	✓	●