

Power & Energy calibrators

M133 / M133i Single phase



Features

- Voltage **1 ... 280V**
- Current **8mA ... 30A**
- Frequency **DC, 15 ... 1000Hz**
- Phase **0 ... 360°**
- Power **0 ... 18kW**
- Energy function as standard
- Built in process multimeter

M133 only

- Harmonic distortion
(50 harmonic components)
- Interharmonic distortion
- Modulation and flicker
- Dip/Swell

Power & Energy calibrators

M133C / M133Ci Three phase



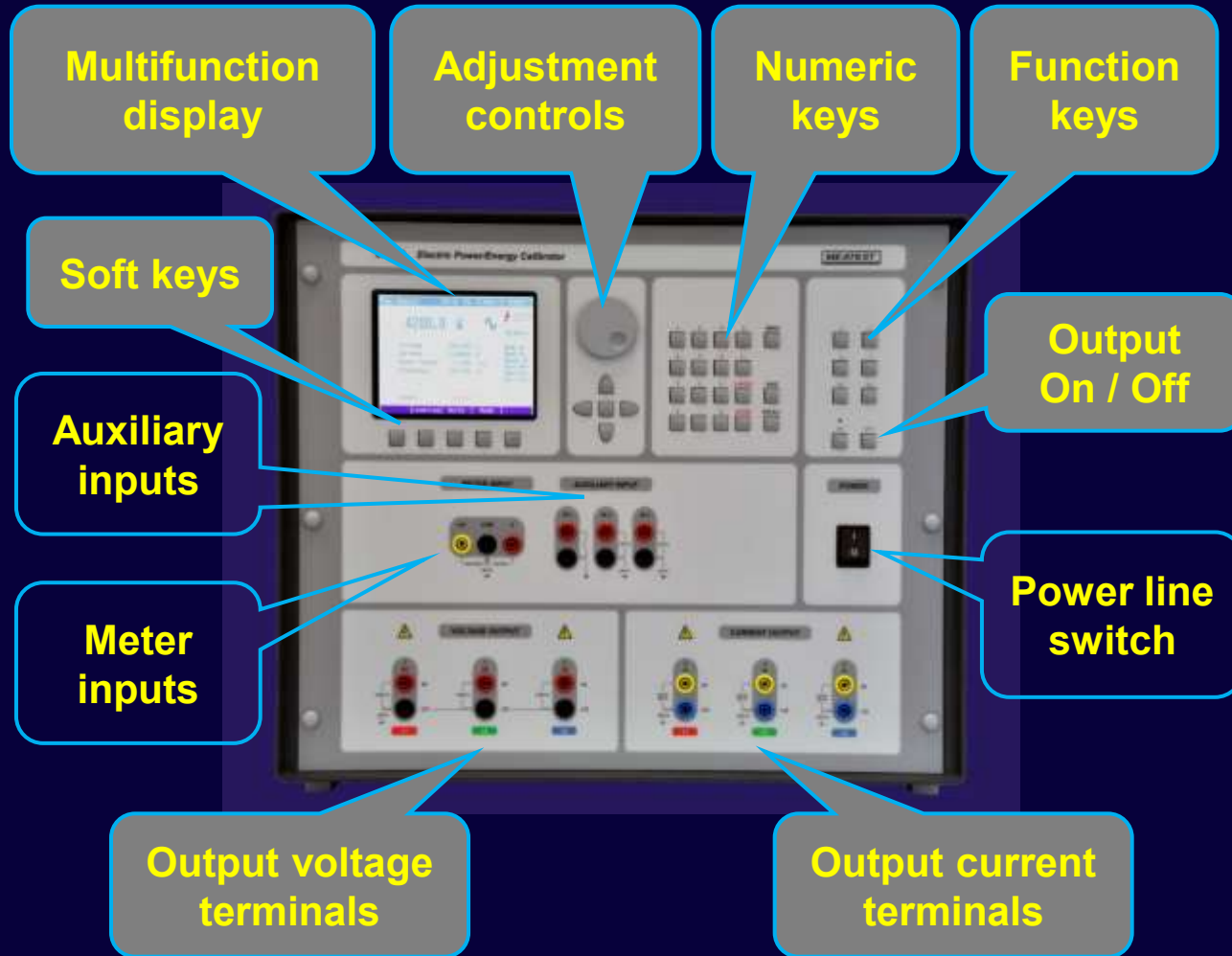
Features

- Voltage **1 ... 600Vac, 1 ... 280Vdc**
- Current **8mA ... 30A (90A single phase)**
- Frequency **DC, 15 ... 1000Hz**
- Phase **0 ... 360°**
- Power **0 ... 54kVA**
- Energy function as standard
- Built in process multimeter

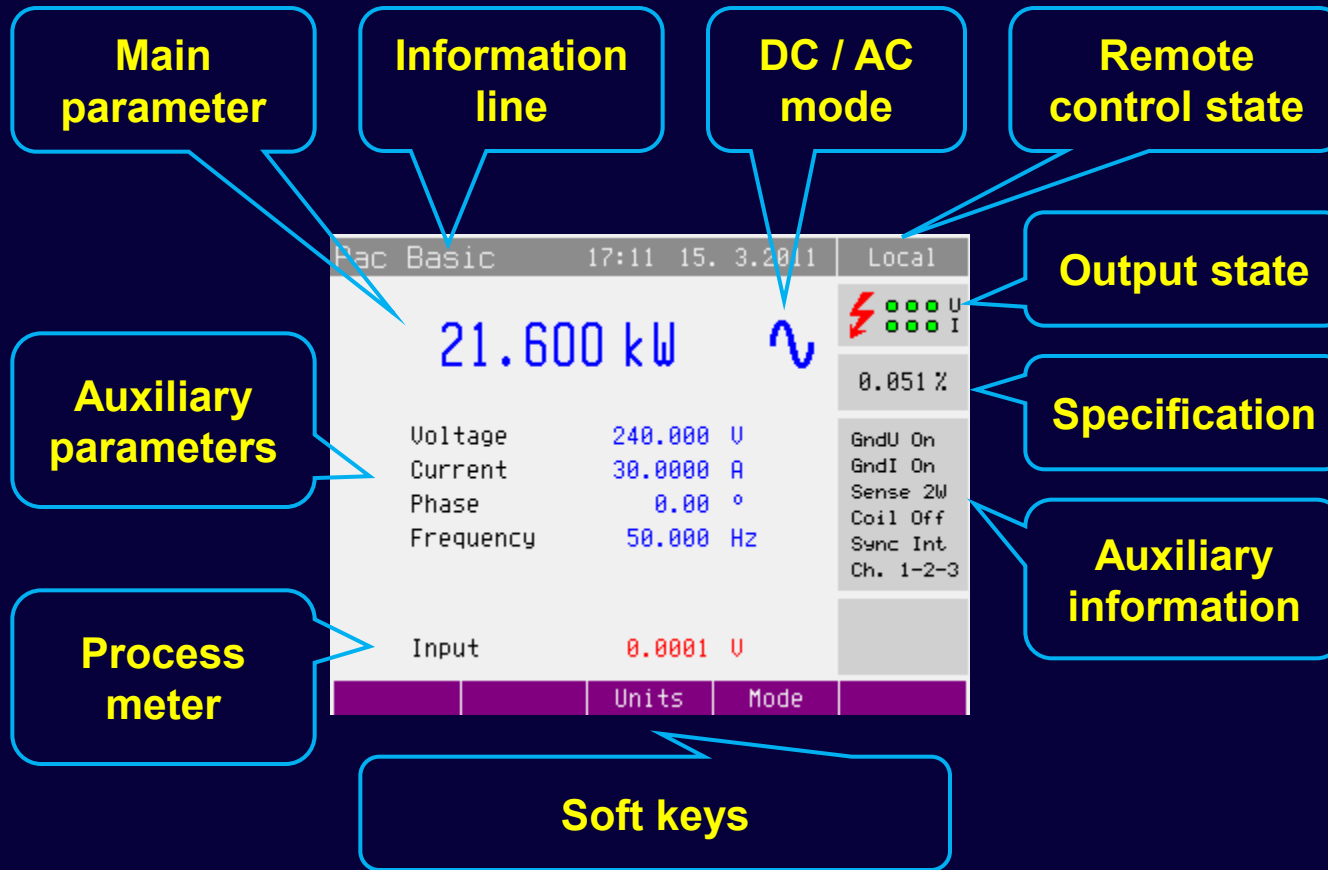
M133C only

- Harmonic distortion
(50 harmonic components)
- Interharmonic distortion
- Modulation and flicker
- Dip/Swell

M133C – Front panel



M133/M133C - Display



COLORS

RED
measured values

BLUE
editable parameters

BLACK
names, fixed parameters

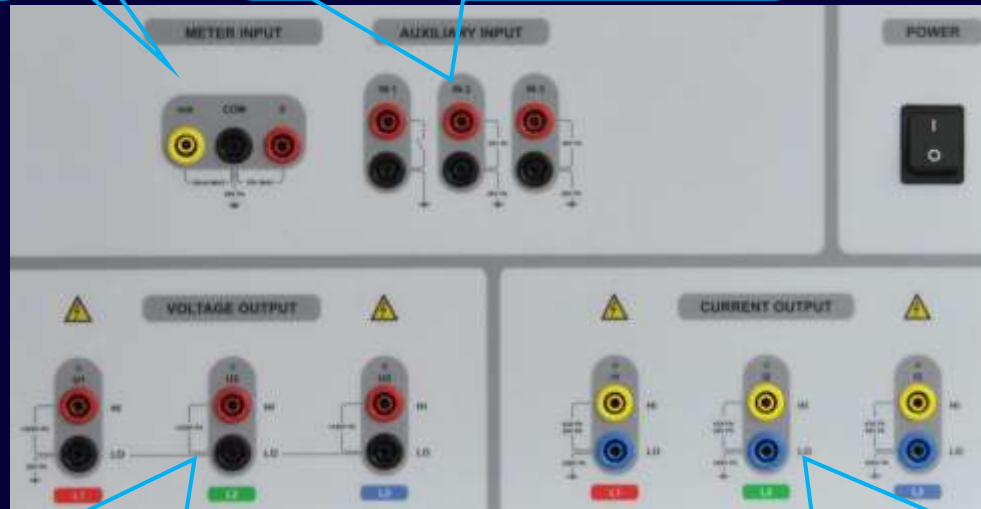
M133C - Terminals

Meter input

+/- 10V
+/- 20mA
0 ... 10kHz

Auxiliary input

Energy pulses counting
Dip / Swell triggering
External synchronization



Voltage outputs

L1, L2, L3 phases
Common Lo terminals
Floating up to 20Vpk

Current outputs

L1, L2, L3 phases
Independent Lo terminals
Floating up to 450Vpk

M133/M133C – Functions

Direct selection via Function keys

Function	Description
Power	One / three phase, AC/DC power generation Range 0.008 VA ... 18 kVA (each phase) Best accuracy 0.044%
Energy	One / three phase, AC/DC energy generation (counting) Best accuracy 0.044%
Voltage	One phase, AC/DC voltage generation Range 1 V ... 280 V (600 V in AC mode – M133C) Best accuracy 0.025%
Current	One phase, AC/DC current generation Range 8 mA ... 30 A (90A in high current mode – M133C) Best accuracy 0.035%

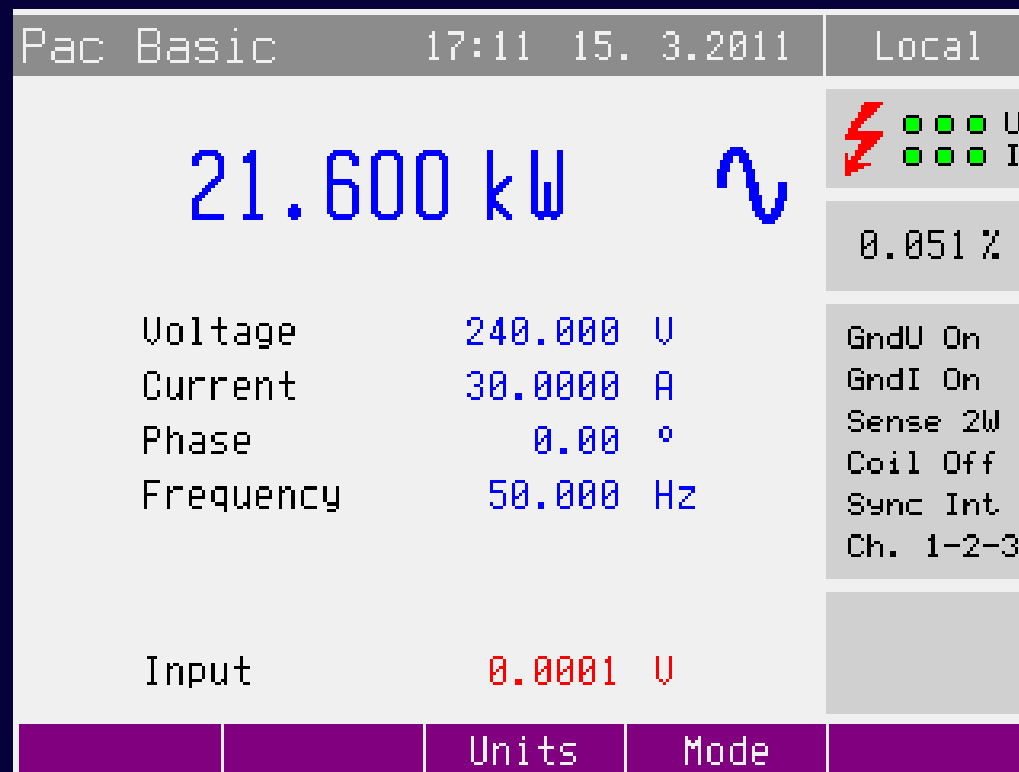
M133/M133C – Power function

Power modes – selection via „Mode“ soft key

	Mode	Description
M133i / M133Ci	Basic	Common setting for all phases (1-3).
	High current	All current outputs connected together. Output current up to 90A in one phase.
	Extended	Independent setting of amplitude and phase shift for each output (3x voltage, 3x current).
	Harmonic	Fundamental harmonic + 50 harmonic components generation. Modulation by square or harmonic signal.
	Interharmonic	Fundamental harmonic + one interharmonic component generation.
	Dip/Swell	Dips and Swells generation on the fundamental harmonic.

M133/M133C – Power function

Basic mode (AC and DC)



✓ Common setting for all selected phases.

✓ Easy setting of power value.

✓ Fixed phase shift between voltage channels (120°).

Basic mode – M133C application

Calibration of watt meters and multi meters

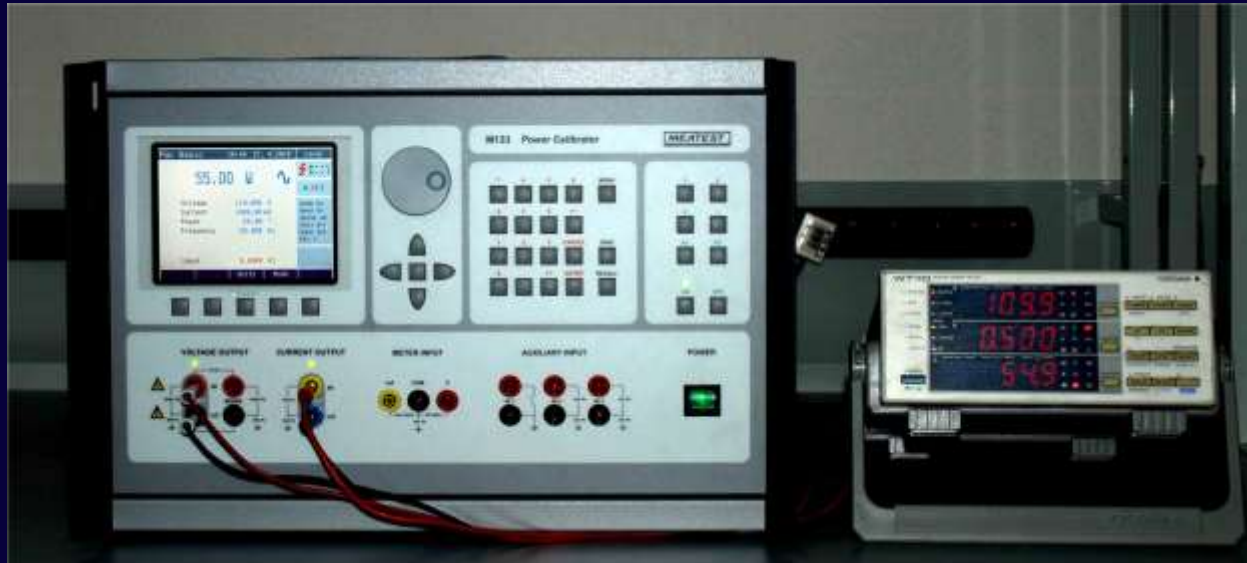


FUNCTIONS

power
voltage
current
phase
frequency

Basic mode – M133 application

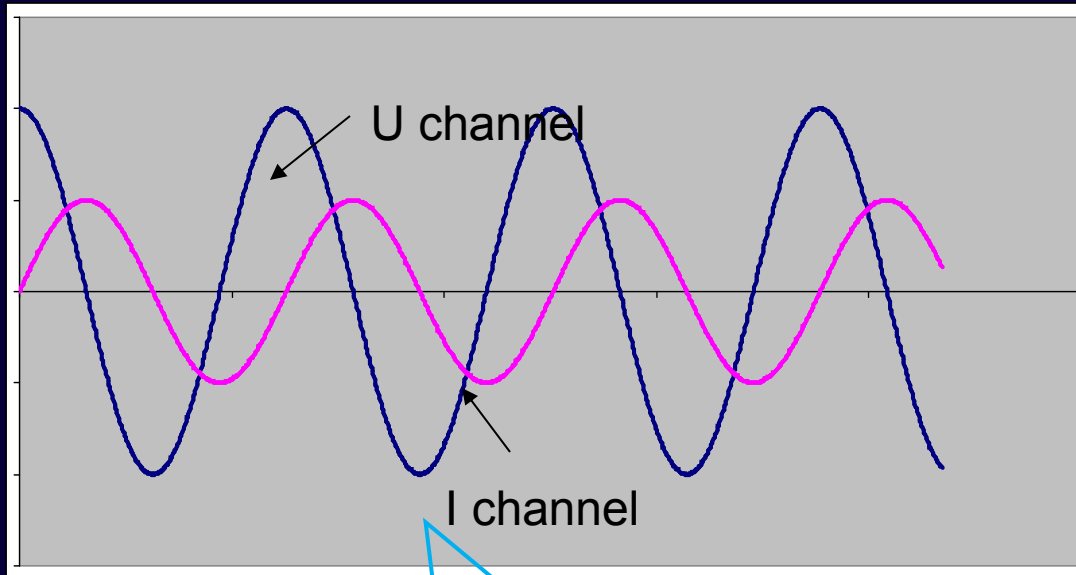
Calibration of watt meters and multi meters



FUNCTIONS

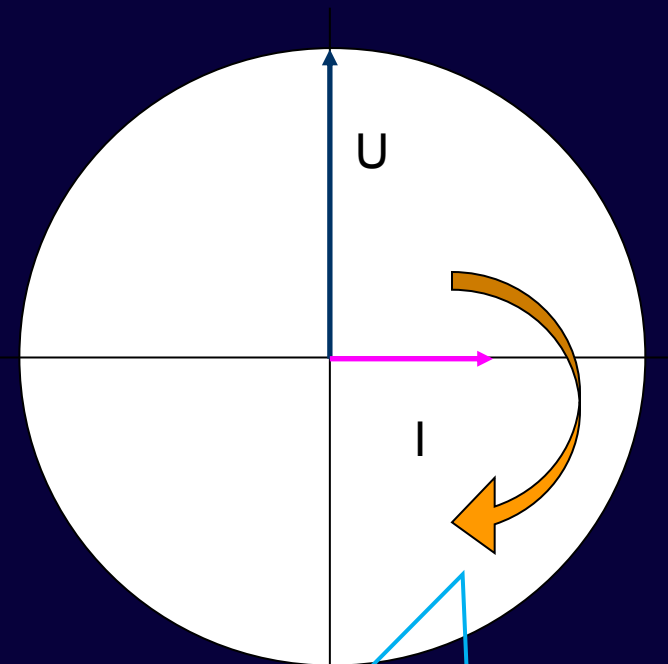
power
voltage
current
phase
frequency

Basic mode - signal vectors



Time diagram

Power Basic mode, single phase
Harmonic output signal



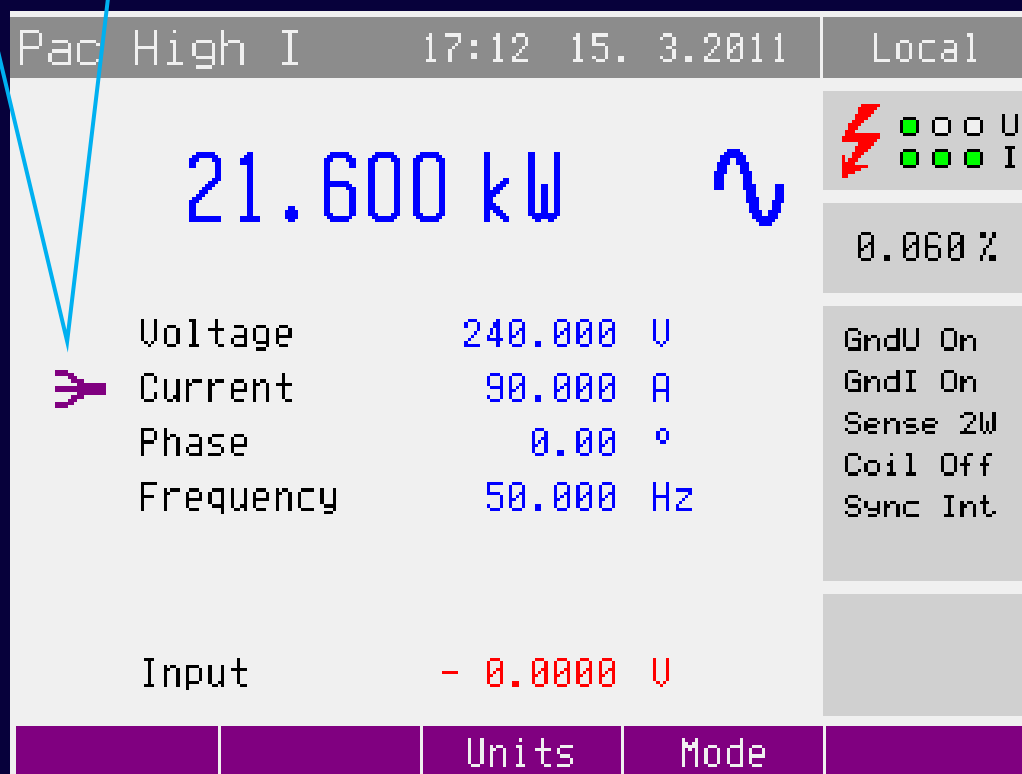
Phase diagram

Current vector can rotate 0...360°

M133/M133C – Power function

High current mode sign

High current mode (AC and DC)



- ✓ Only for three phase configuration
- ✓ Direct current in one phase up to 90A.
- ✓ Option 133-01 high current adapter required.

M133C – High current adapter

Up to 90A direct current in one-phase applications

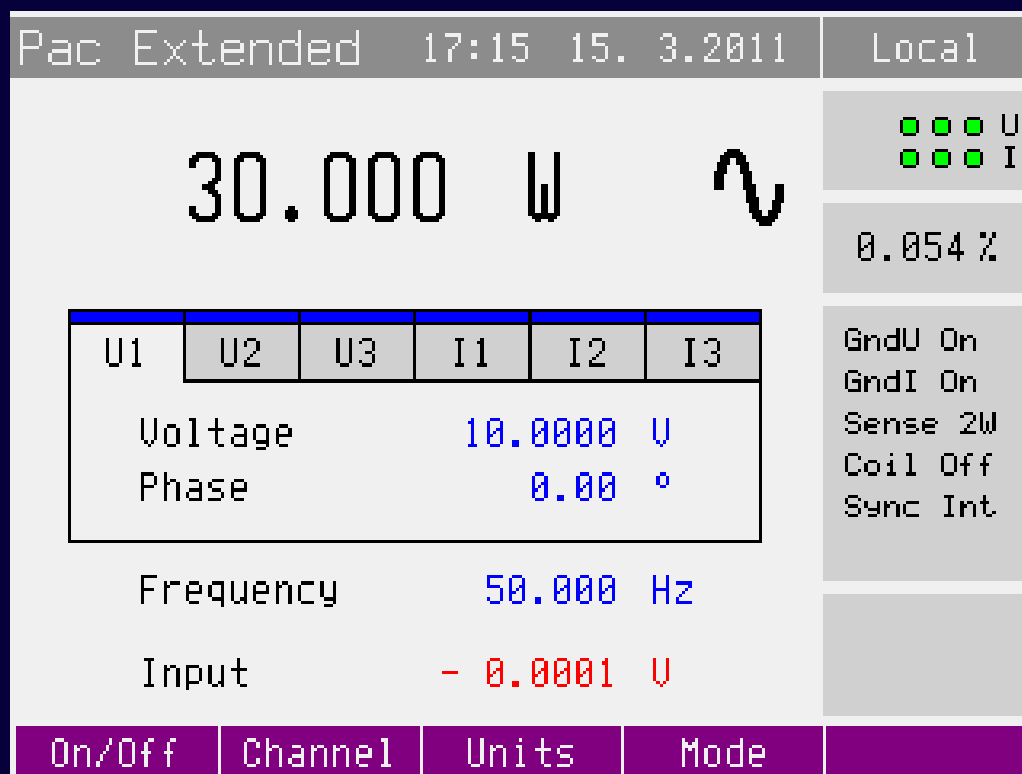


Option 133-01
High current
adapter

200A gold plated
output terminals

M133/M133C – Power function

Extended mode (AC and DC)



✓ Independent setting of amplitude and phase for all six channels.

✓ Individual channels can be switched ON / OFF.

✓ Testing of phase meters.

✓ Testing of watt meters with non standard input signals.

Extended mode - application

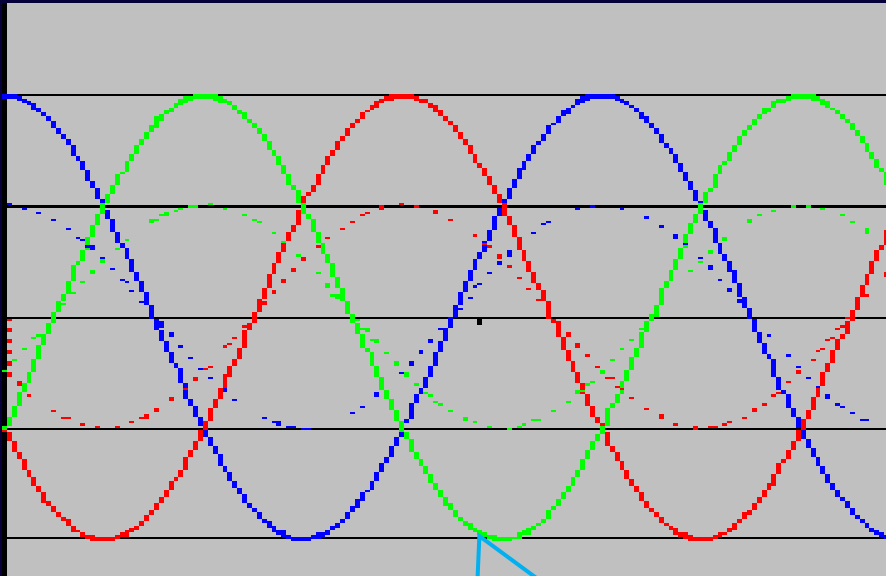
Calibration of different transducers



INPUT
power
voltage
current
phase
frequency

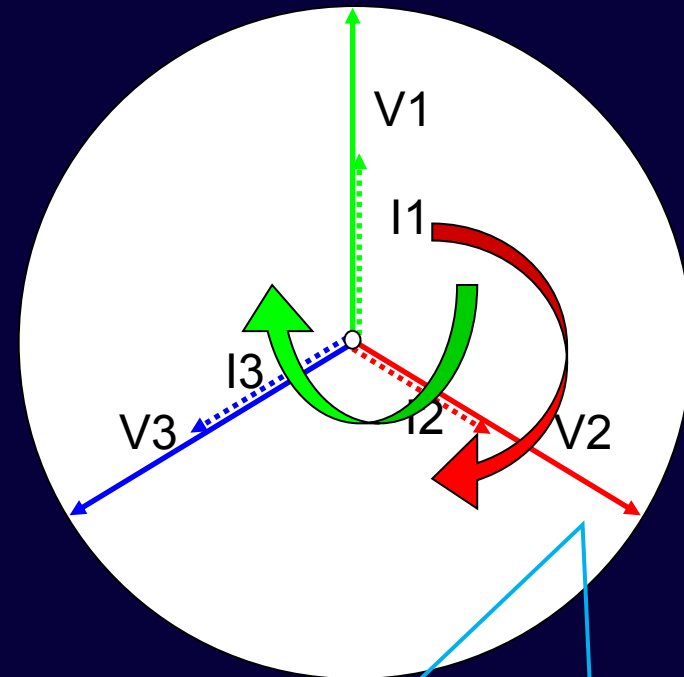
OUTPUT
+/- 10V
+/- 20mA
0...10 kHz

Extended mode - signal vectors



Time diagram

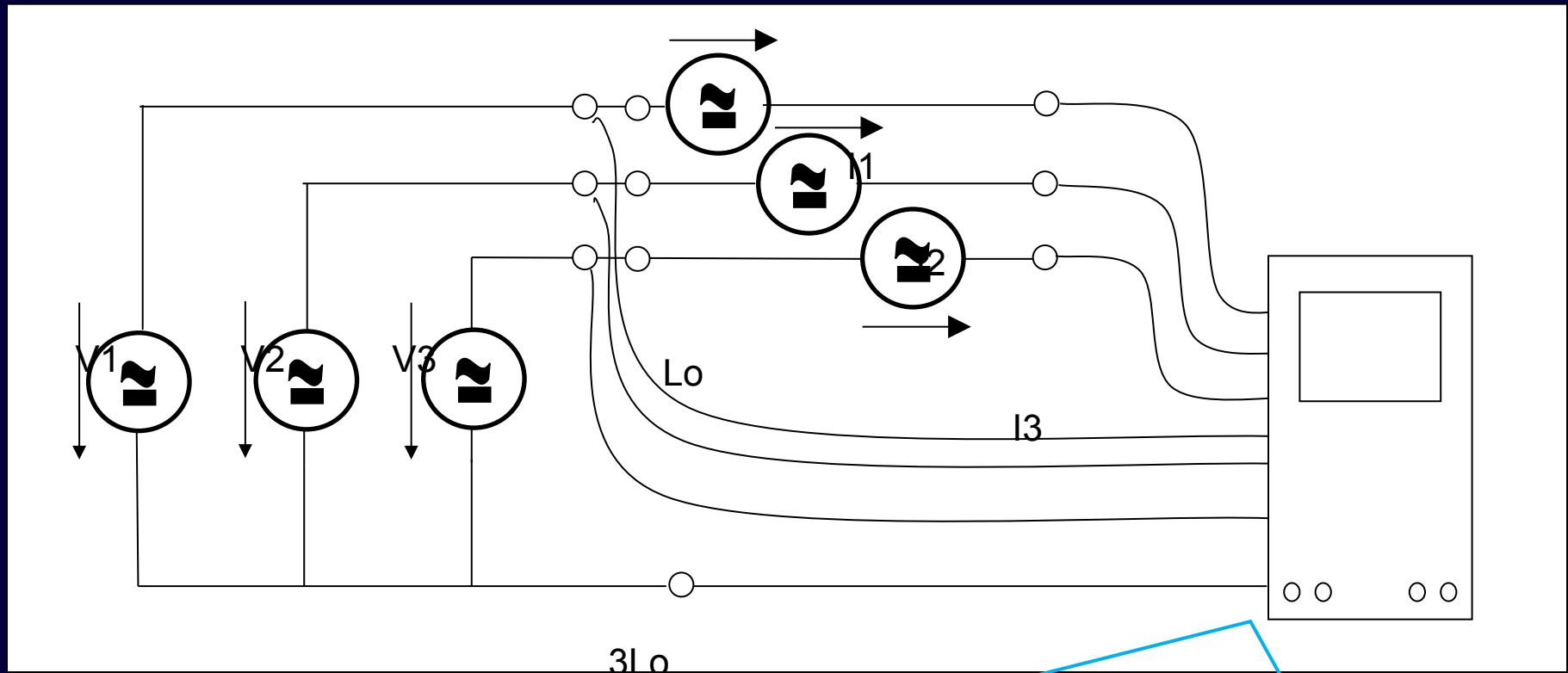
Power Extended mode, three phase
Harmonic output signal



Phase diagram

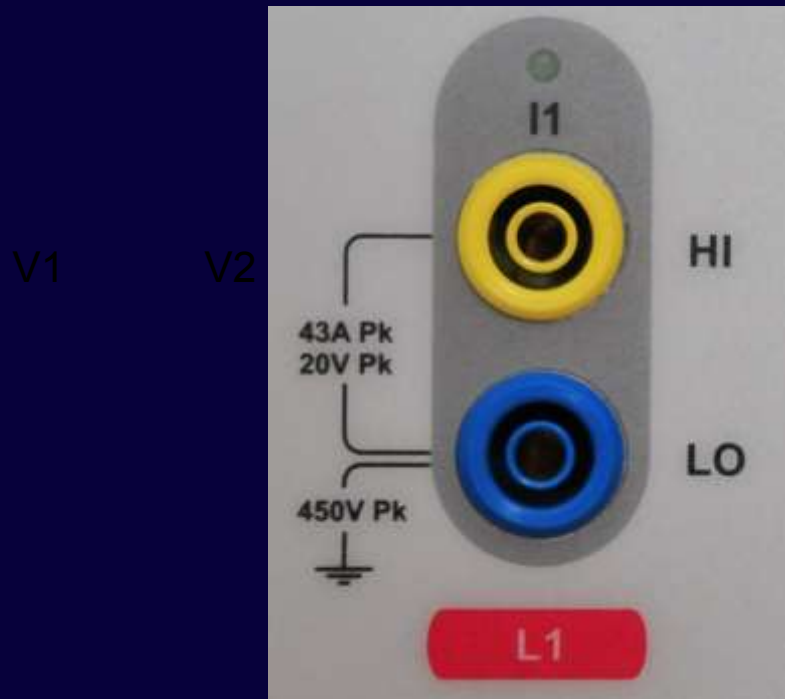
Current vectors can rotate 0...360°
Voltage vectors can rotate 0...360°

Floating current outputs (M133C only)



Meters with common voltage and current terminals need floating current outputs.

Floating current outputs (M133C only)

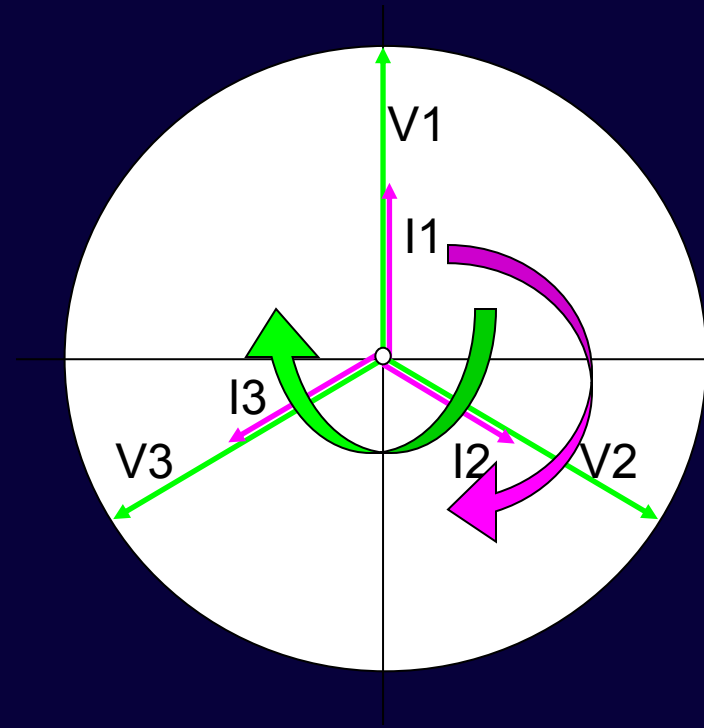


✓ M133C current terminals can float up to 450Vpk.

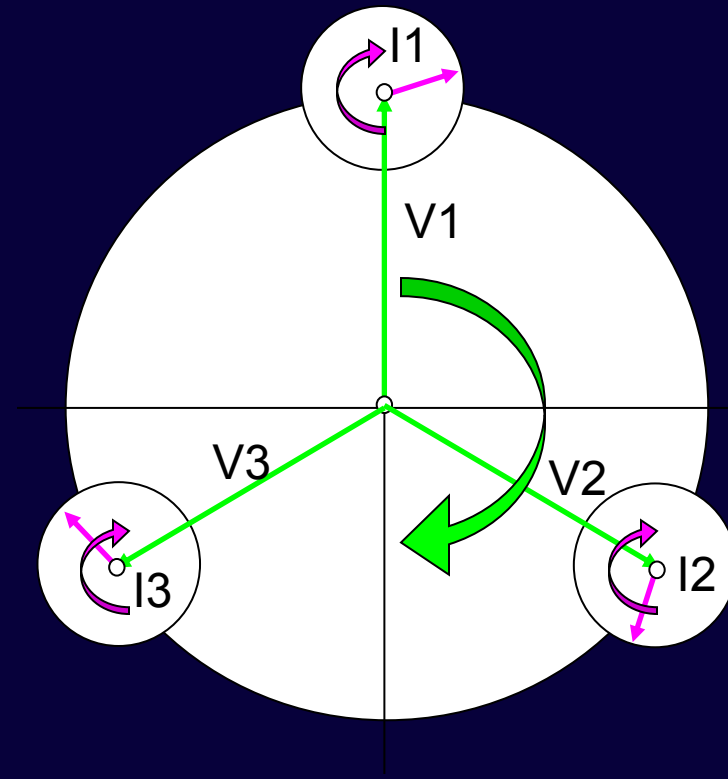
✓ Current terminals can be connected direct to the voltage terminals (HI output).

✓ For voltages above 280 V (RMS) are current terminals internally grounded.

Floating current outputs (M133C only)



Common current Lo system



Floating current system

M133/M133C – Power function

Harmonic mode (AC only)

P Harmonic		17:13 15. 3.2011		Local	
U1	U2	U3	I1	I2	I3
Voltage			10.0000		U
Phase			0.00		°
Harmonic		Amplitude			
3		10.000 %		●	
Modulation		RECT	30.000 %		
Duty Cycle		15%			
Frequency		50.000		Hz	
Modulation		20.000		Hz	
On/Off	Channel	Info	Mode		

Independent setting for each channel:

Fundamental harmonic

- amplitude

- phase

50 harmonic components

- amplitude

Modulation

- SIN or RECT

- duty cycle

Harmonic mode - application

Calibration of power quality meters

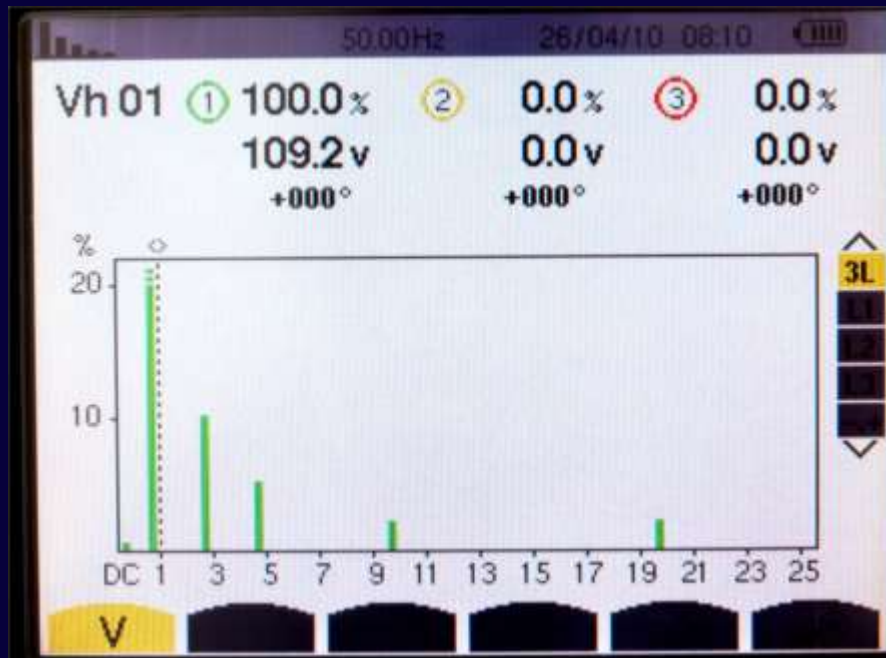


FUNCTIONS

power
voltage
current
phase
frequency
harmonic 1...50
interharmonic
modulation
flicker
dip/swell

Harmonic mode

Phase spectrum of harmonic signal (single phase)



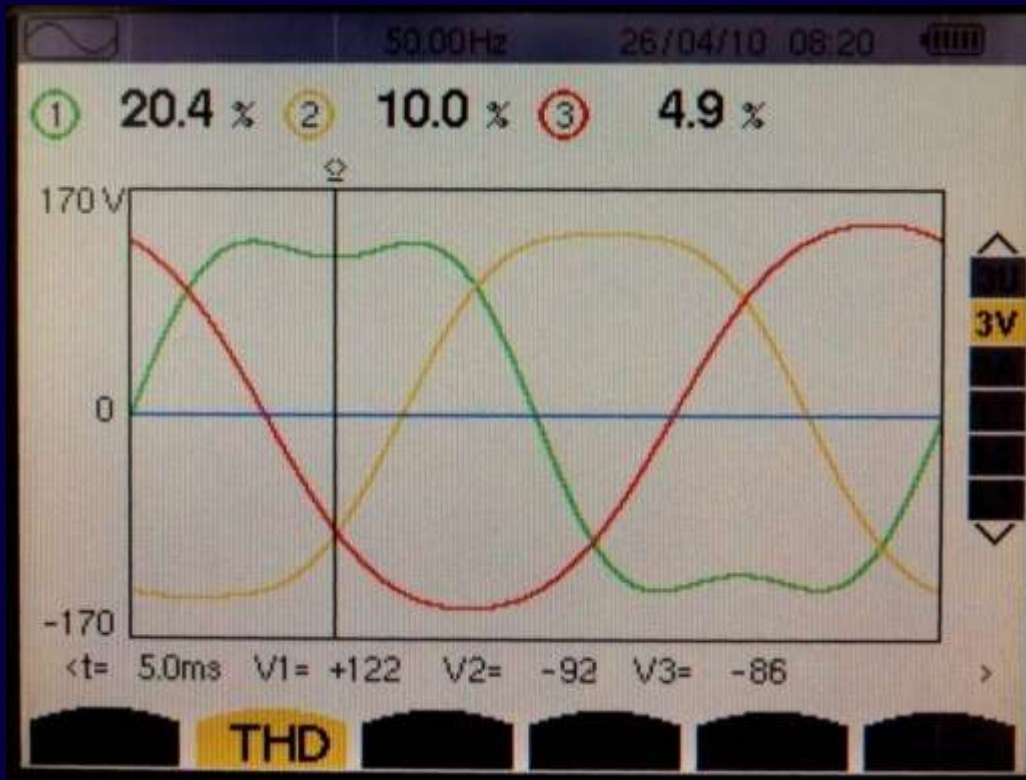
Setting:

One-phase output (L1)

1. Harmonic	110V (100%)
3. Harmonic	10 %
5. Harmonic	5 %
10. Harmonic	2 %
20. Harmonic	2 %

Harmonic mode

Signal with harmonic distortion (three phases)



Three – phase voltage output:

V1 phase

1H = 100 %

3H = 20 %

5H = 5 %

10H = 2 %

V2 phase

1H = 100 %

3H = 8 %

5H = 2 %

10H = 2 %

V3 phase

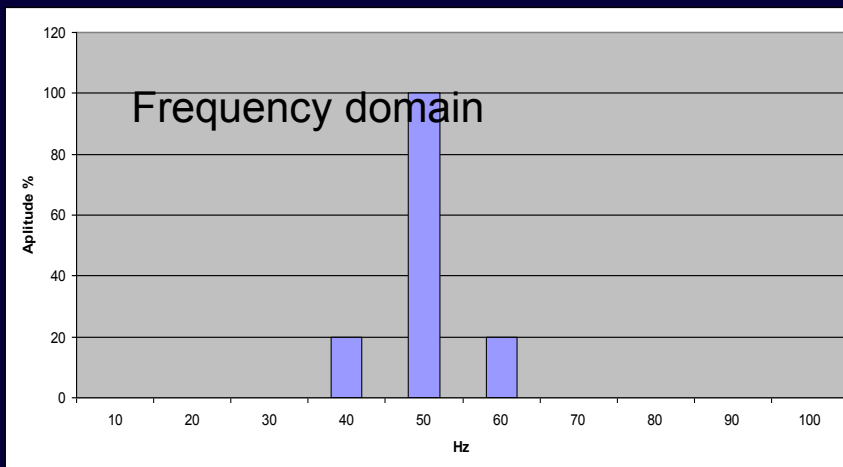
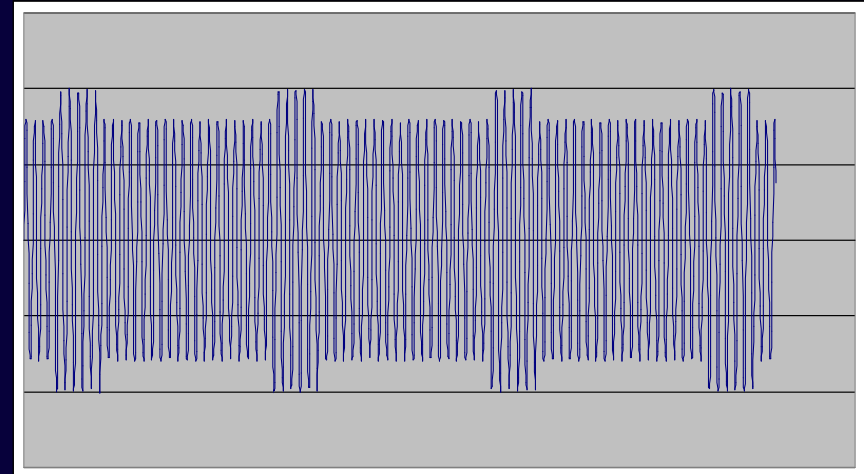
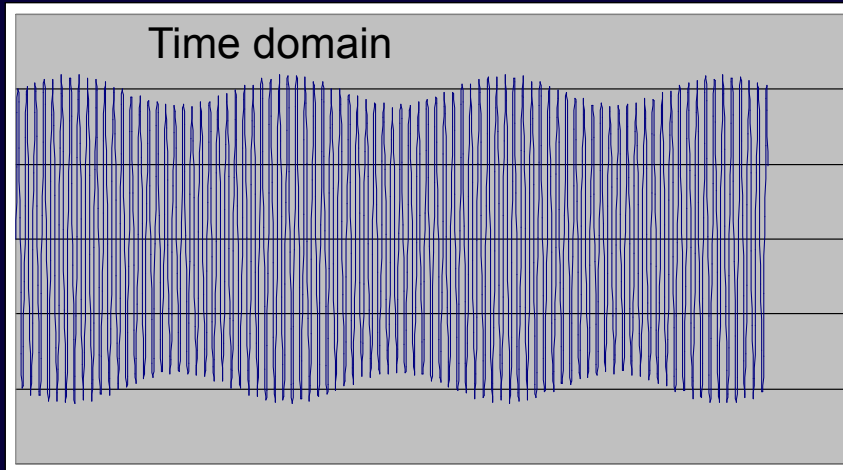
1H = 100 %

3H = 5 %

5H = 1 %

10H = 1 %

Harmonic mode - modulation



✓ **Modulation with sine or rectangular signal (floating harmonics or flicker).**

M133/M133C – Power function

Interharmonic mode (AC only)

P Iharmonic 17:43 11. 5.2008 Local

U1	U2	U3	I1	I2	I3
Voltage			100.000		V
Phase			0.00		°
Interharmonic			10.0000		V

Frequency 50.000 Hz
Interharmonic 70.000 Hz

⚡ O - - U
O - - I

GndU On
GndI On
Sense 2W
Coil Off
Sync Int.

On/Off Channel Info Mode

Independent setting for each channel:

Fundamental harmonic

- amplitude

- phase

Interharmonic component

- amplitude of one

interharmonic component

M133/M133C – Power function

Dip / Swell mode (AC only)

P Dip/Swell 16:32 1. 7.2010 Local

U1	U2	U3	I1	I2	I3
Voltage			100.000	U	
Phase			0.00	°	
Dip/Swell			10.0000	U	
Frequency			50.000	Hz	

1.0000 s t1 t2 t3 t4 t5
1.0000 s 1.0000 s 1.0000 s

On/Off Channel Trigger Mode

Local

⚡ O - - U
O - - I

GndU On
GndI On
Sense 4W
Coil Off
Sync Int.

Trigger
Repeat
Input IN2
Sync Off

Independent setting for each channel:

Fundamental harmonic

- amplitude

- phase

Dip or Swell

- amplitude of Dip (Swell)


M133/M133C – Energy function

Energy modes – selection via „Mode“ soft key

Mode	Description
Basic	Common setting for all phases (1-3).
High current	All current outputs connected together. Output current up to 90A in one phase.

M133/M133C – Energy function

Basic mode (AC and DC)

Eac Basic		10:31 20. 6.2011		Local
0.000 mWs				0 - - U 0 - - I
Deviation	- %	0.044 %		
Voltage	10.0000 U	GndU On		
Current	50.0000 A	GndI On		
Phase	0.00 °	Sense 2W		
Frequency	50.000 Hz	Coil x50		
Meter const.	1.000000 i/kWh	Sync Int		
Control input:		Ch. 1		
Frequency	- Hz			
Control		Units	Mode	



✓ Common setting for all selected phases.

✓ Fixed phase shift between voltage channels (120°).

M133/M133C – Energy function

High current mode sign

High current mode (AC and DC)

Eac High I		12:20	22. 9.2011	Service
25.300 Wh		~		 <input type="checkbox"/> U <input type="checkbox"/> I
1.0%				
	Voltage	230.000	V	GndU On
	Current	90.000	A	GndI On
	Phase	0.00	°	Sense 2W
	Frequency	50.000	Hz	Coil Off
	Meter const.	1.000000	i/kWh	Sync Int.
	Control input:			
	Time	4.4000	s	
Control		Units	Mode	

- ✓ Only for three phase configuration
- ✓ Direct current in one phase up to 90A.
- ✓ Option 133-01 high current adapter required.

Energy function - application

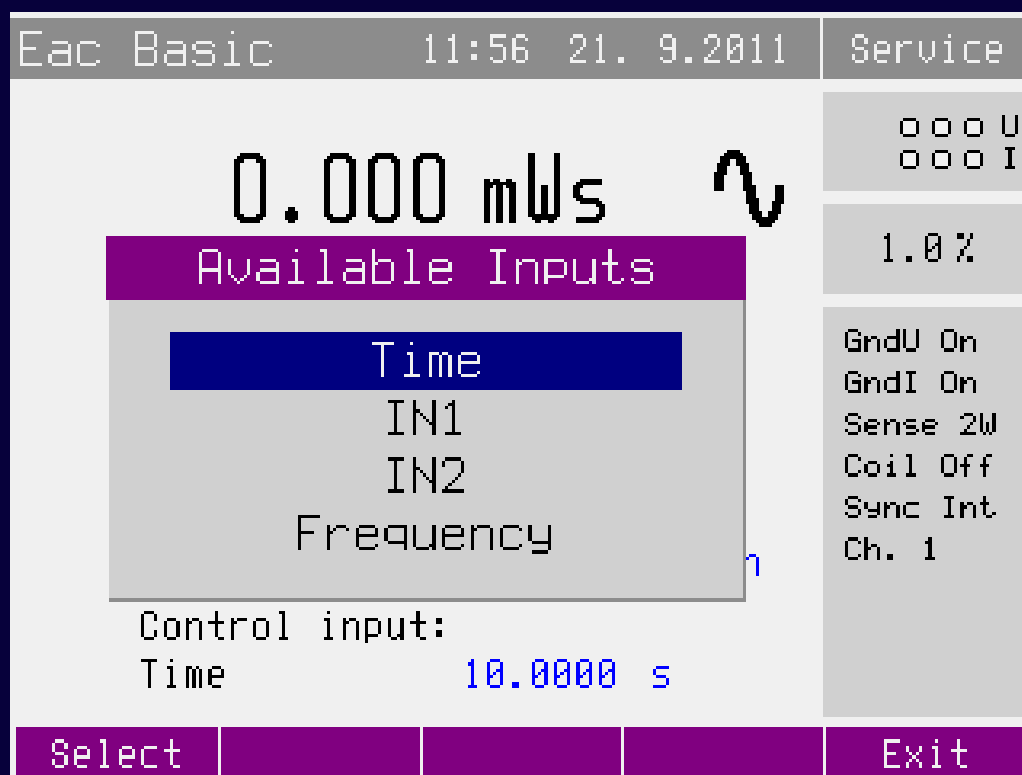
Calibration of electrometers



- ✓ **Calibrator can read pulses from tested electrometer and evaluate deviation of the electrometer.**

M133/M133C – Energy counting



Methods of energy counting (Control input)



- ✓ **Time**
Energy is delivered for defined time.
- ✓ **IN1, IN2**
Defined number of pulses on inputs IN1 (IN2) is counted.
- ✓ **Frequency**
Compares frequency generated by energy meter with standard frequency (calibrator).

M133/M133C – Energy counting

Timed Mode (Control input: Time)


Eac Basic		10:22 22. 9.2011		Service
11.500 kWh				 000 U 000 I
		0.18 %		
Voltage	230.000	U		GndU On
Current	1000.00	A		GndI On
Phase	0.00	°		Sense 2W
Frequency	50.000	Hz		Coil x50
Meter const.	1.000000	i/kWh		Sync Int
Control input:				Ch. 1-2-3
Time	60.000	s		
Control		Units	Mode	

✓ **Time**
Calibrator delivers energy for defined time period after pressing ON key. Then disconnects all outputs and displays counted energy.

Easy energy mode with lower accuracy.

M133/M133C – Energy counting

Counted Mode (Control input: IN1, IN2)

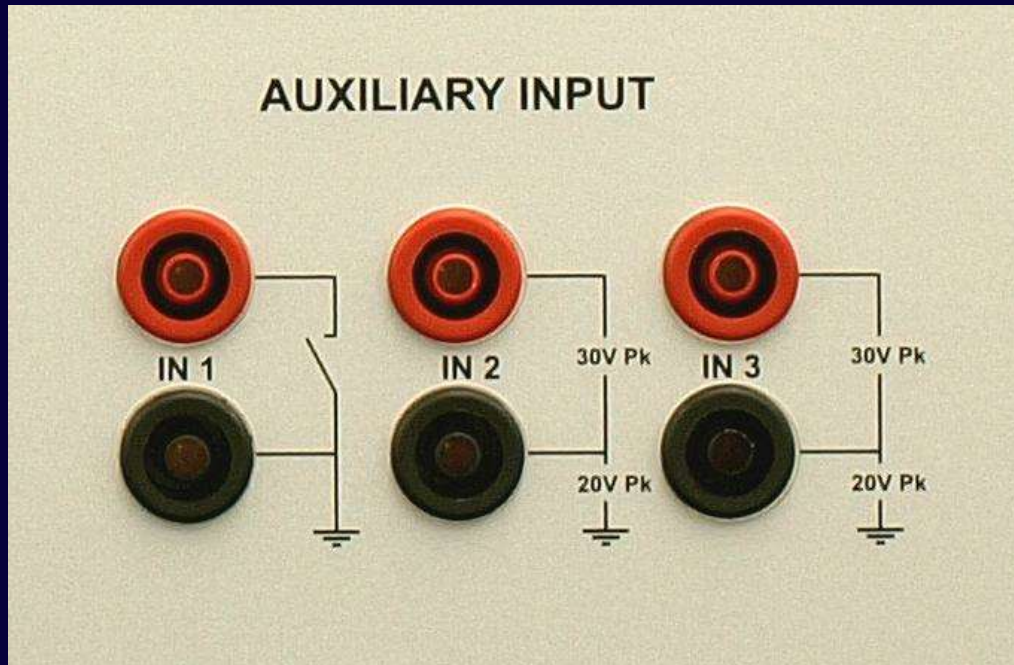
Eac Basic		10:53	22. 9.2011	Service
995.2 Wh		~		 000 U 000 I
Deviation	0.487 %	0.054 %		
Voltage	230.000 U	GndU On		
Current	500.000 A	GndI On		
Phase	0.00 °	Sense 2W		
Frequency	50.000 Hz	Coil x50		
Meter const.	100.0000 i/kWh	Sync Int.		
Control input:		Ch. 1-2-3		
IN2	0			
Control		Units	Mode	

✓ **IN1, IN2**
Calibrator starts counting energy after receiving third pulse (floating start) from the selected input. Then counts defined number of pulses, disconnects all outputs, displays counted energy and deviation of the meter.

Best accuracy and repeatability.

M133/M133C – Energy counting

Difference between inputs IN1 and IN2.



✓ IN1



For counting pulses from passive contacts (relay, open collector). IN1 is grounded to protective earth.

✓ IN2

For counting active (voltage) pulses. IN2 is floating up to 20Vpk.

M133/M133C – Energy counting

Free run Mode (Control input: Frequency)

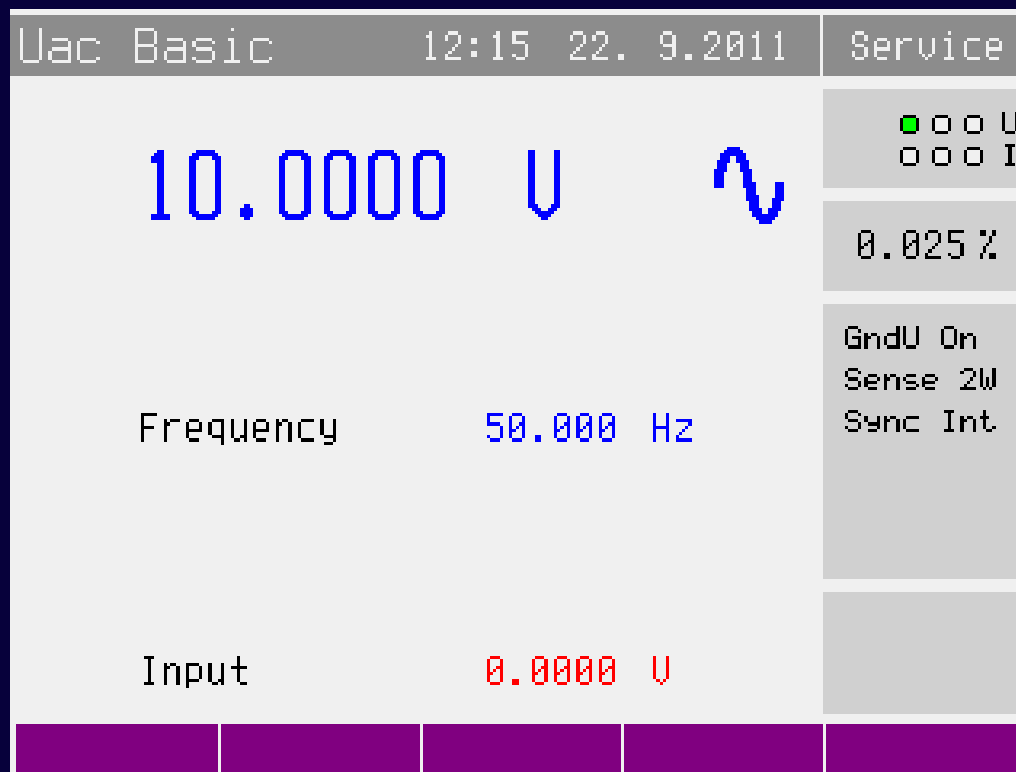
Eac Basic		11:05 22. 9.2011		Service		
10.743 kWh				 ●●● U ●●● I		
Deviation	- 0.107 %			0.054 %		
Voltage	230.000 U			GndU On		
Current	500.000 A			GndI On		
Phase	0.00 °			Sense 2W		
Frequency	50.000 Hz			Coil x50		
Meter const.	100.0000 i/kWh			Sync Int.		
Control input:				Ch. 1-2-3		
Frequency		9.573 Hz				
Control		Units	Mode			

✓ **Frequency**
Calibrator starts counting energy after pressing ON key.
Calibrator continuously measures frequency of pulses from measured meter and displays its deviation.

Fast method, suitable for manufactures for adjusting of meters.

M133/M133C – Voltage function

Basic mode (AC and DC)



- ✓ Generation of one phase voltage.
- ✓ Calibration of voltmeters.

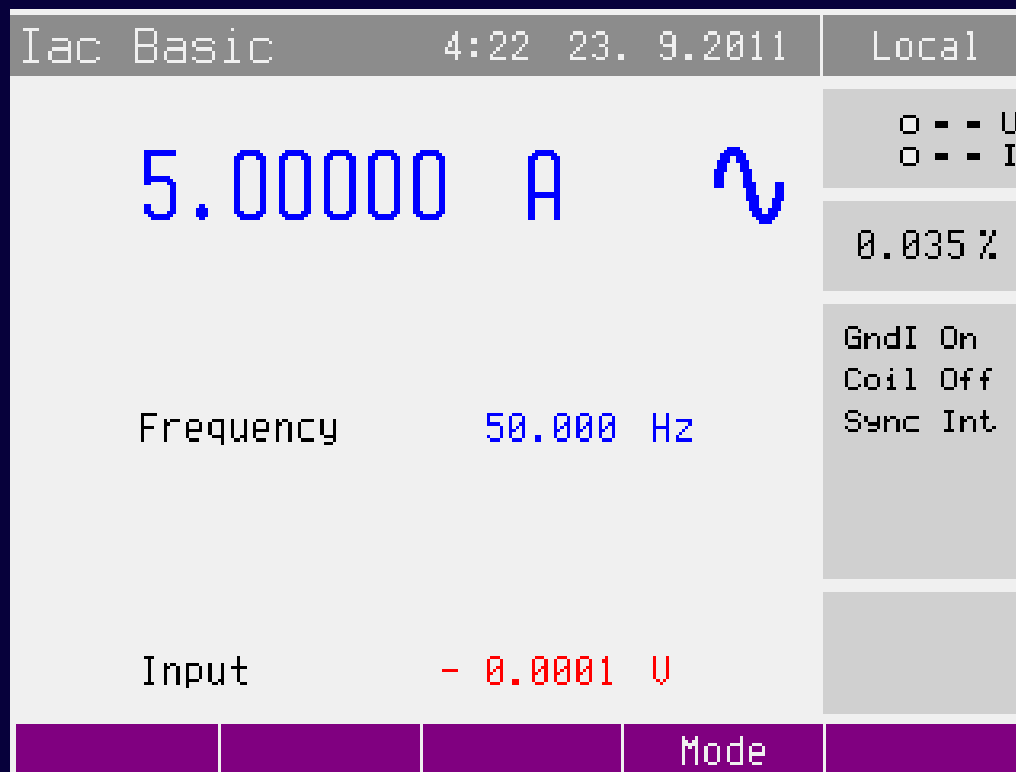
M133/M133C – Current function

Current modes – selection via „Mode“ soft key

Mode	Description
Basic	Common setting for all phases (1-3).
High current	All current outputs connected together. Output current up to 90A in one phase.

M133/M133C – Current function

Basic mode (AC and DC)

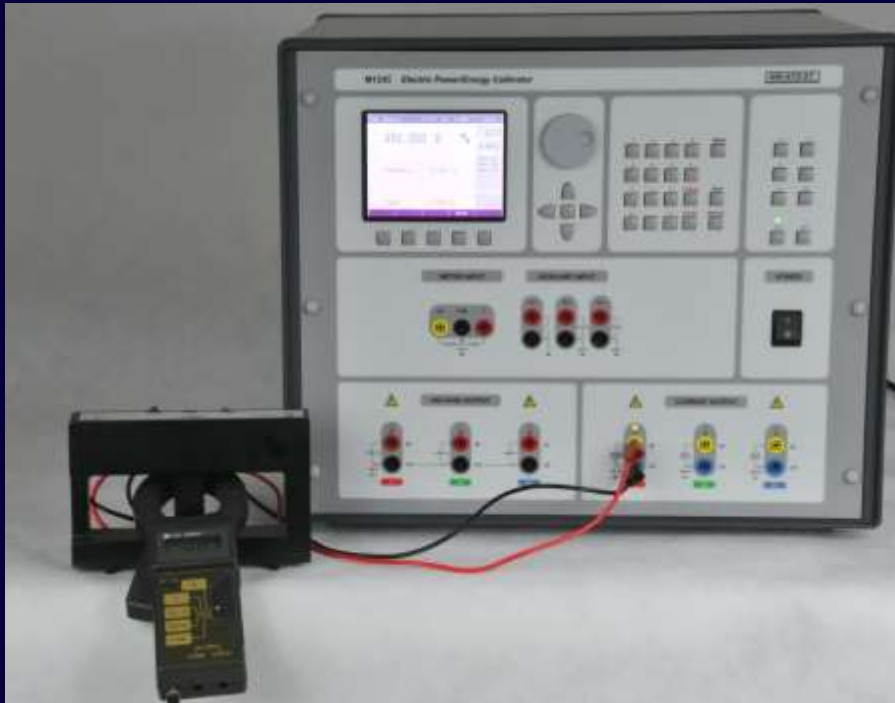


✓ Generation of one current.

✓ Calibration of current meters.

Current function – application

Calibration of clamp meters

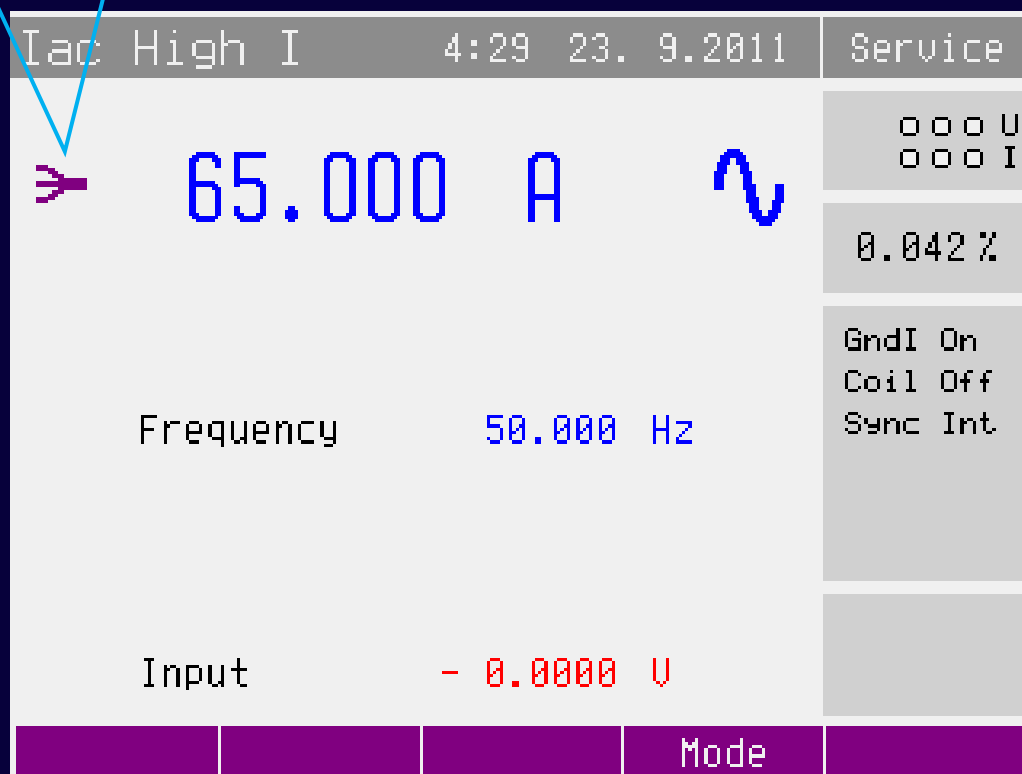


FUNCTIONS
current

M133/M133C – Current function

High current mode sign

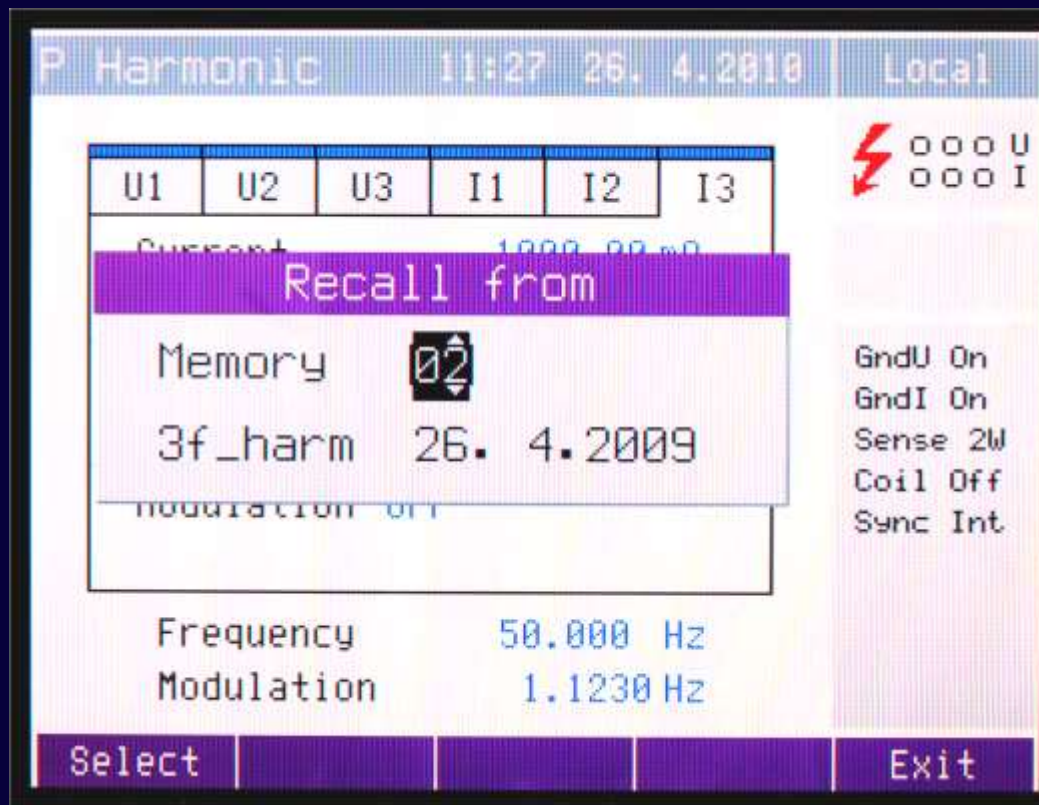
High current mode (AC and DC)



- ✓ Only for three phase configuration
- ✓ Direct current in one phase up to 90A.
- ✓ Option 133-01 high current adapter required.

M133/133C – Other features

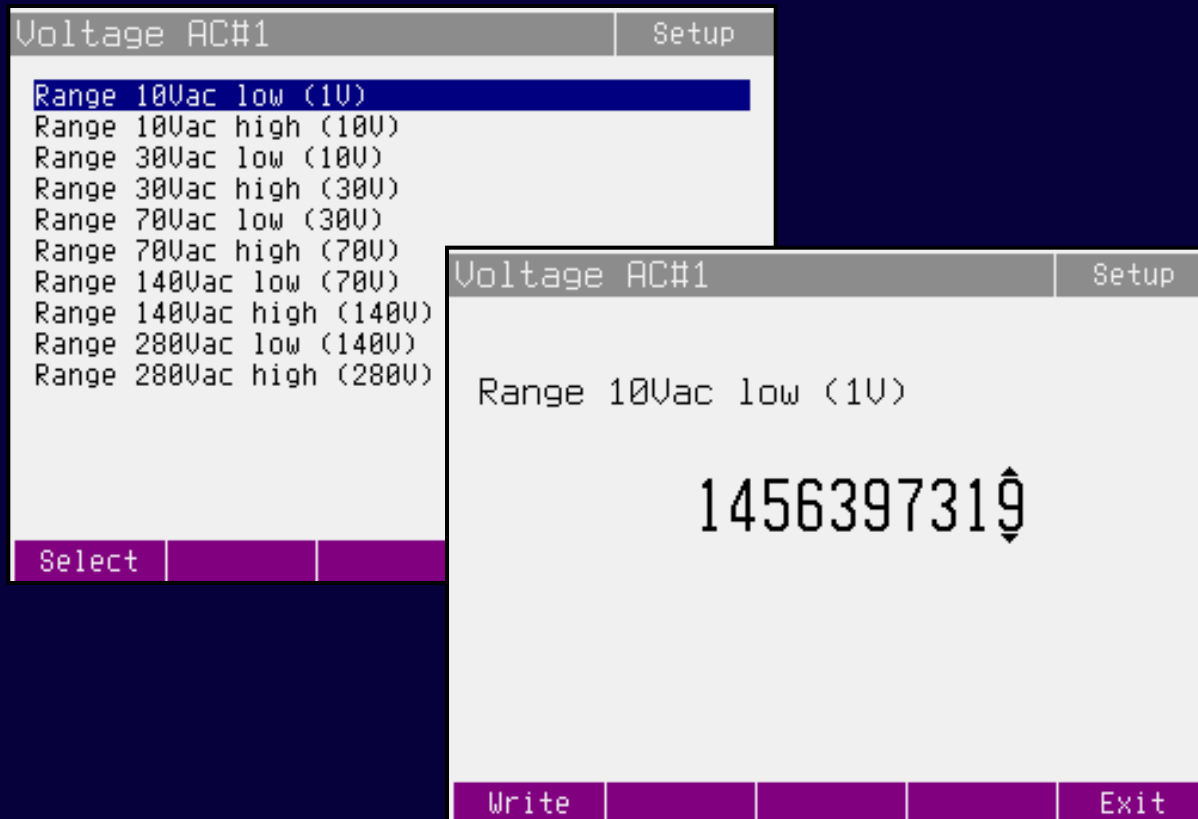
Saving current settings



- ✓ Actual instrument setting can be stored into internal memory.
- ✓ 100 memories.
- ✓ Each setting can be followed by the name.

M133/133C – Other features

Recalibration



✓ Access to calibration data protected with password.

✓ Simple system of calibration data saving.

M133/133C – Other features

Remote control



Standard interfaces

IEEE488

RS232

Ethernet

Optional USB interface

Interface converts RS232 to USB port



Optional

USB

M133/M133C - software

Programs available for M133 calibrators

Power

Specialized software for electric power transducers calibration. Easy to use.

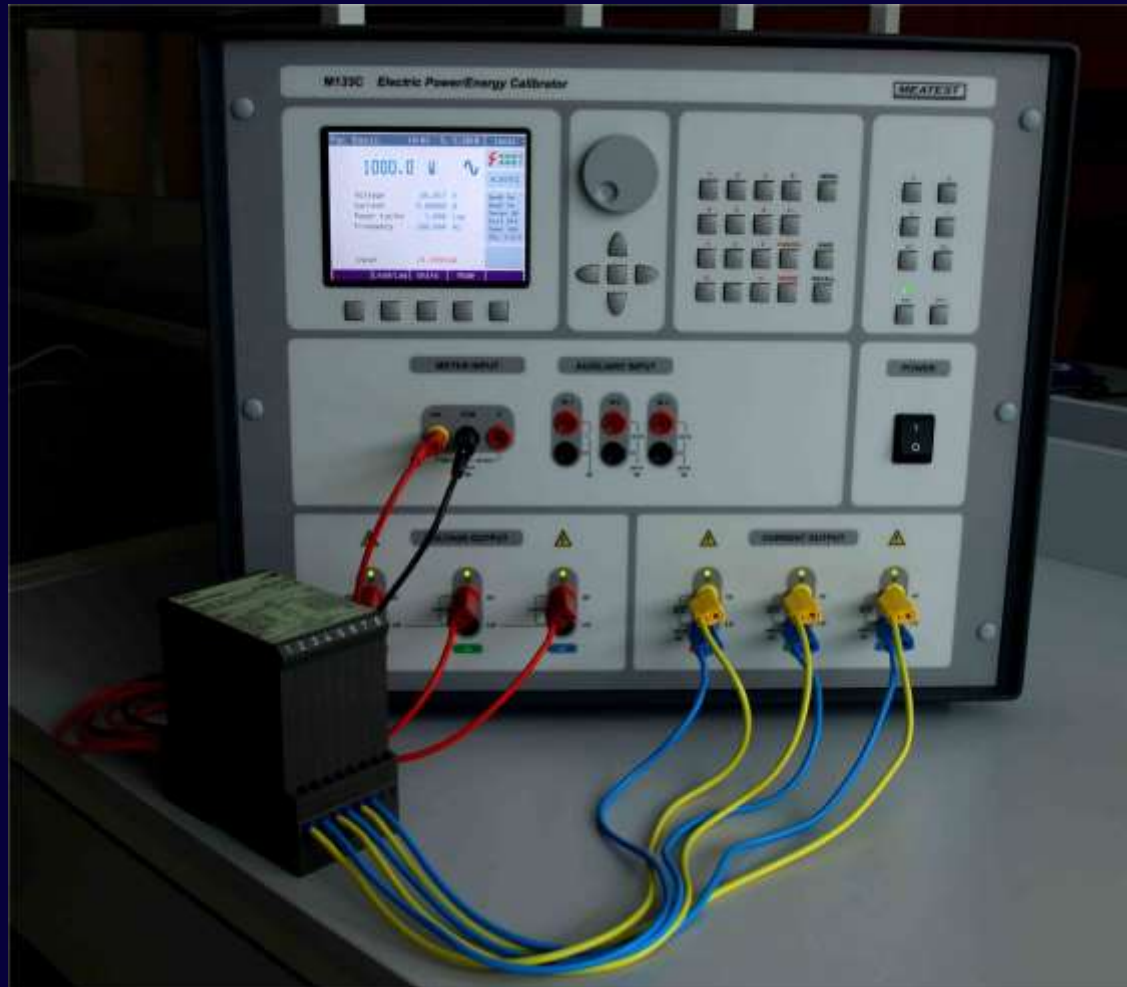
Caliber

Software for computer controlled calibration. Universal use.

Control Panel

Software for M133 easy setting. Freeware.

Power



Power

Features

Software for (power) transducers testing and calibration.

Full automatic calibration.

Deviation and uncertainty calculation.

Printing calibration certificate and labels for transducers.

Database of calibrated instruments and calibration certificates.

Easy to use.

Power

Requirements

Standard unit

Electrical power calibrator (M103, M133)

Computer

OS Windows 2000 or higher

RS232 , IEEE488 or USB interface

Power

Calibration procedure

The screenshot shows the 'Power 1.00' software interface. The title bar indicates the device being calibrated is 'rdr456'. The 'Connection scheme' section shows the following configuration:

- Source: M103
Channel: ABC
Voltage & Current
- Meter: M103
Current

The 'Readings' section is currently empty. Below this, a table displays the calibration conditions and their corresponding readings:

Conditions	Nominal [W]	Measured [W]	Deviat. [%]	%spe [%]	Allowed [%]	Uncert. [%]
3f power V=66V I=1A PF=1	200				2.5	0.074
3f power V=66V I=2A PF=1	400				1.25	0.105
3f power V=66V I=5A PF=1	1000				0.5	0.081
3f power V=66V I=1A PF=0.5	100				5	0.313

At the bottom of the window, the status bar shows 'Prot (c:\windows\plocha\power\data\prot) Record: 3/3' and 'Record Unlocked'.

Power

Calibration point - setup

The screenshot shows the 'Power 1.04' software interface. The main window displays a 'Connection scheme' for 'PQ502' with 'Source M103' and 'Meter M103'. A 'Setting' dialog box is open, showing the following configuration:

Conditions: 3f power V=66V I=1A PF=0.5LA

Channel	Voltage [V]	Current [A]	Phase [°]	Frequency [Hz]
Channel A	66.660	1.00000	60	50.00
Channel B	66.660	1.00000	60	
Channel C	66.660	1.00000	60	

Measurement Parameters:

Nominal value	Nominal transducer value	Tolerance [%]	Source uncertainty [%]
100	2 mA	5	0.313

The dialog box also includes 'OK' and 'Cancel' buttons. In the background, a table lists various calibration conditions, with the selected condition highlighted in green:

Conditions	Nominal value	Nominal transducer value	Tolerance [%]	Source uncertainty [%]
3f power V=66V I=2A PF=1	400			1.25
3f power V=66V I=5A PF=1	1000			0.5
3f power V=66V I=1A PF=0.5LA	100		5	0.313
3f power V=66V I=1A PF=0.5LE	100		5	0.313

Power

Typical application - transducers

Transducer's input:

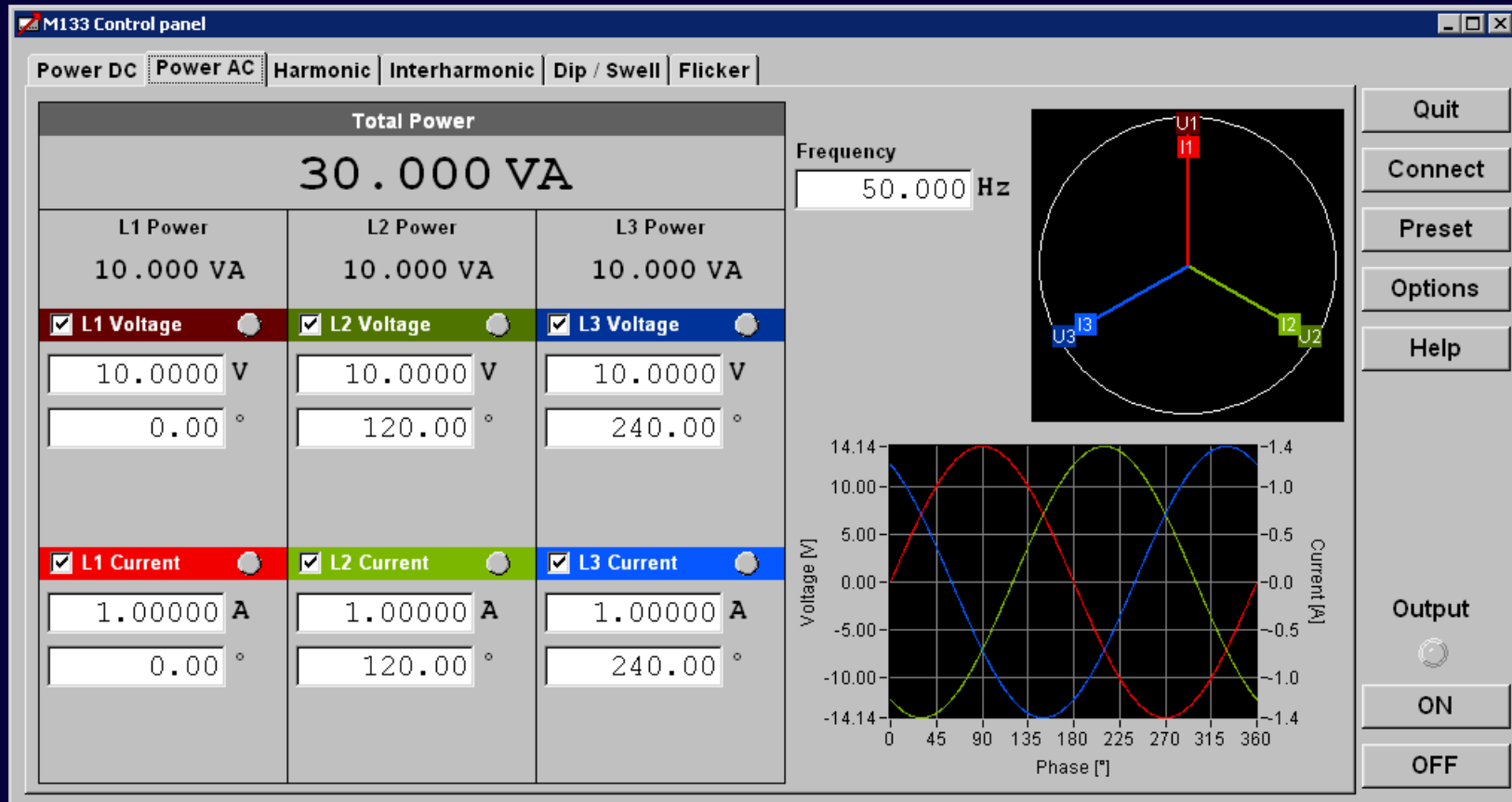
- Power [W, VA, VAr]
- Voltage
- Current
- Phase
- Frequency

Transducer's output:

- Voltage 0-10V
- Current 0(4)-20mA
- Frequency 0-15kHz

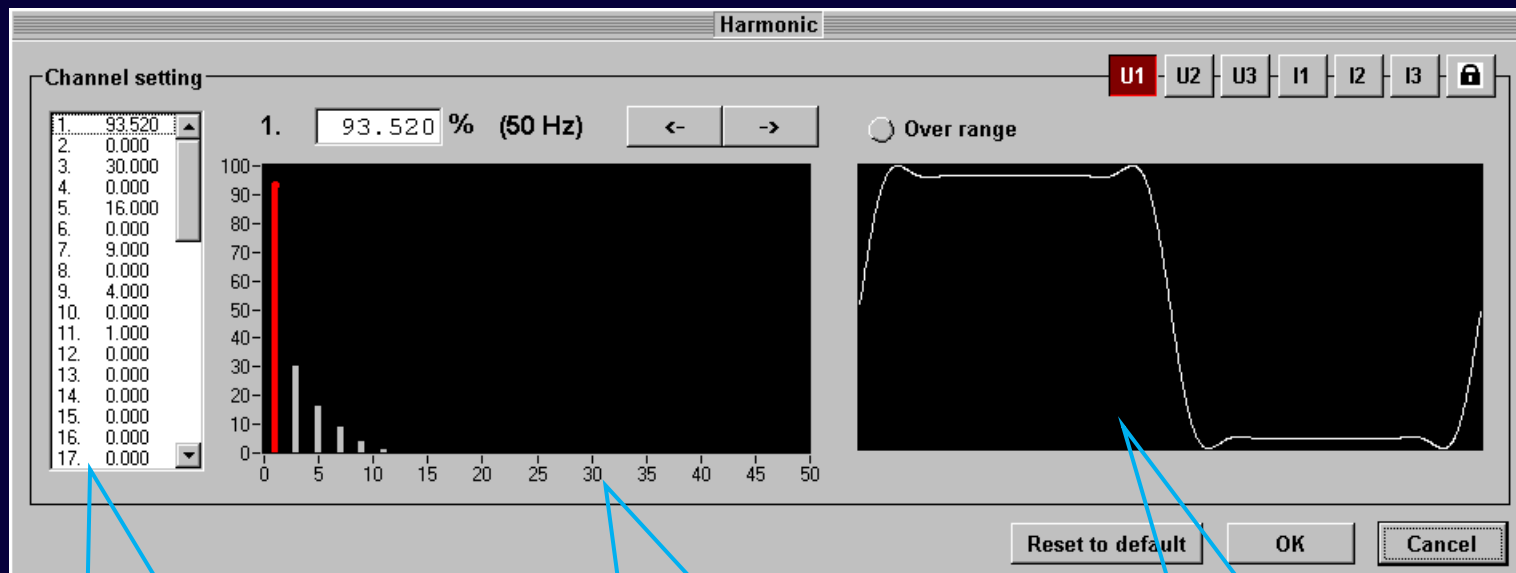
M133 – Control Panel

M133 easy setting (freeware)



M133 – Control Panel

Harmonic distortion setting



List of harmonic components

Harmonic components in frequency domain

Output signal shape