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**Millimeter-wave source
with digital control and remote diagnostic
Model VCOM-05/197/50-DD
Serial No A-1110/07**



December 2011

Specifications

Frequency Range (controlled)	196.75...197.25 GHz
Output power (typ)	60 mW
Frequency step (max)	250kHz
Power level step (min)	1 mW
Spectrum line width at -20 dBc	200 kHz
Frequency stability	< 0.5 MHz over +10...+40 deg C temperature range
Frequency settling time	0.5 sec (max)
Absolute accuracy of set frequency	< 0.5 MHz
Max attenuation	40 dB
Control program Version	111117
Supply voltages of mm-wave oscillator block:	- 12VDC $\pm 10\%$, < 0,25A, +12VDC $\pm 10\%$ < 1.5A, +24VDC $\pm 10\%$ < 0.5A +24VDC $\pm 10\%$ < 0.5A (Heater) +5VDC $\pm 10\%$ < 0.8A
Output flange/ Waveguide	UG-387/U-M /WR05
Output frequency/power control interface /connector	RS-232, DB-9 male
Remote diagnostic protocol	Ethernet / SNMP v1
Ethernet port:	RG-45 socket
Operating temperature	+10° C°...+40° C°
Size, mm	423x130x85

Measured data of max output power vs. output frequency are presented in Fig.1

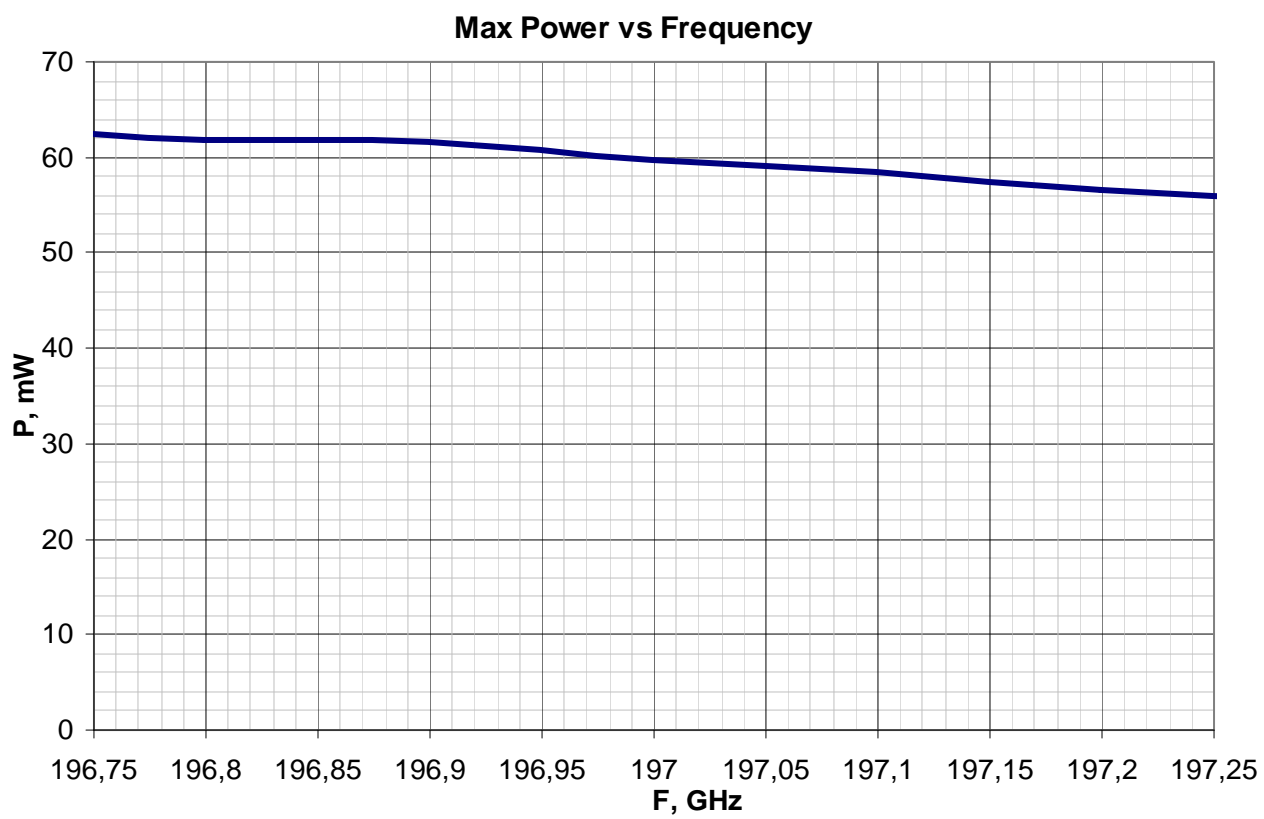


Fig.1 Max output power vs. output frequency

VCOM-05/197/50-DD

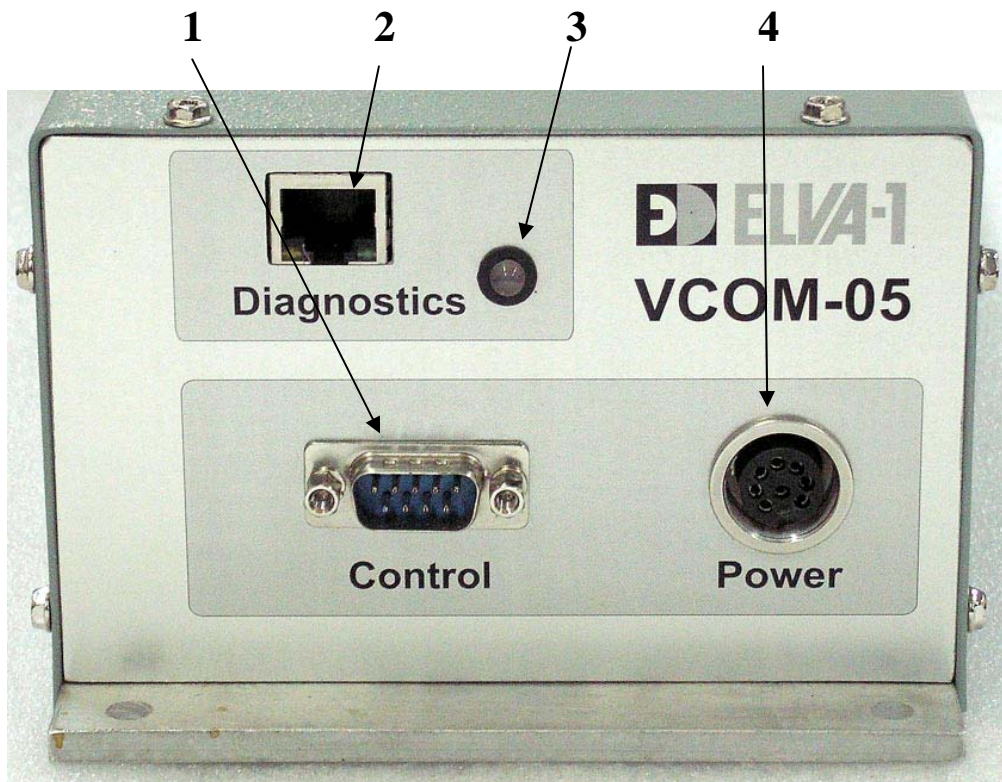


Fig.2 Front Panel of VCOM-05/197/50-DD

- 1 – DB-9 connector for output frequency/power level control
 - 2 – RJ-45 socket for remote diagnostic through Ethernet/SNMP v1
 - 3 – Indicator diode
 - 4 – Power supply connector
- Power supply connector is DB-9 male

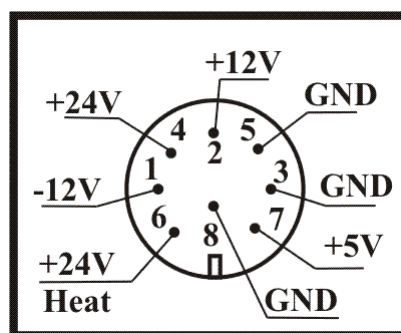


Fig.3 Pinout of the power supply cable connector of the VCOM source.



Fig.4 Millimeter wave output of **VCOM-05/197/50-DD** source

Order of switching the mm-wave source ON/OFF

Switching ON:

1. Put the Source on place
2. Connect output flange to waveguide input

Attention: Make sure that the waveguide flanges are properly connected. Large leakages of mm-wave power from waveguide channel are dangerous for human body.

3. Connect control cable to DB-9 connector. The cable connector must be DB-9 female.

Note: Use MODEM cable for connection of the source to RS-232 port of control computer. Wire pinout of MODEM cable is presented in fig.4. Only 3 wires numbered 2, 3 and 4 at DB-9 are used.

4. Connect power supply with the cable included.
5. Turn power supply on.
 - The source starts after all diagnostic tests have been passed. Initial state: there is no producing of mm-wave power, output attenuator is closed. Indicator diode on the front panel blinks **RED**.
 - **IMPORTANT!!! After switching power supply of the source ON (after OFF state), wait 5 minutes or more for warming the oscillator up and stabilizing reference frequency. Next the command @U27!on# can follow. Otherwise Indicator diode keeps blinking RED.**
 - To start producing of mm-wave power one has to send two commands to VCOM-05/197/50-DD source: @U27!on# and @PWR!xx# (see list of commands below).
 - It is possible to switch mm-wave power ON/OFF with turning +24V supply voltage ON/OFF from external power supply block or with command: @U27!on#

or @U27!off#. If the +24V voltage is switched OFF, the source does not produce mm-wave power. Indicator diode on the front panel blinks **RED**

Note: The VCOM-05/197/50-DD oscillator is fed with +24VDC voltage.

Format of command keeps symbols “27” which are used in different VCOM-XX models (for example VCOM-10/94 operates at 94 GHz).

- if one of the voltages is OFF, **ALARM** mode is ON. Indicator diode on the front panel blinks **RED**, the source does not produce mm-wave power
- If indicator diode on the front panel shines **GREEN**, all tests have been passed and the VCOM-05/197/50-DD source is producing mm-wave power.

6. Send commands through RS-232 for frequency and power level control.

Note:

It is possible to send the commands after +5V voltage is switched ON (other voltages can be switched OFF). The settings will be accepted by control board. The command will be performed after all supply voltages appear.

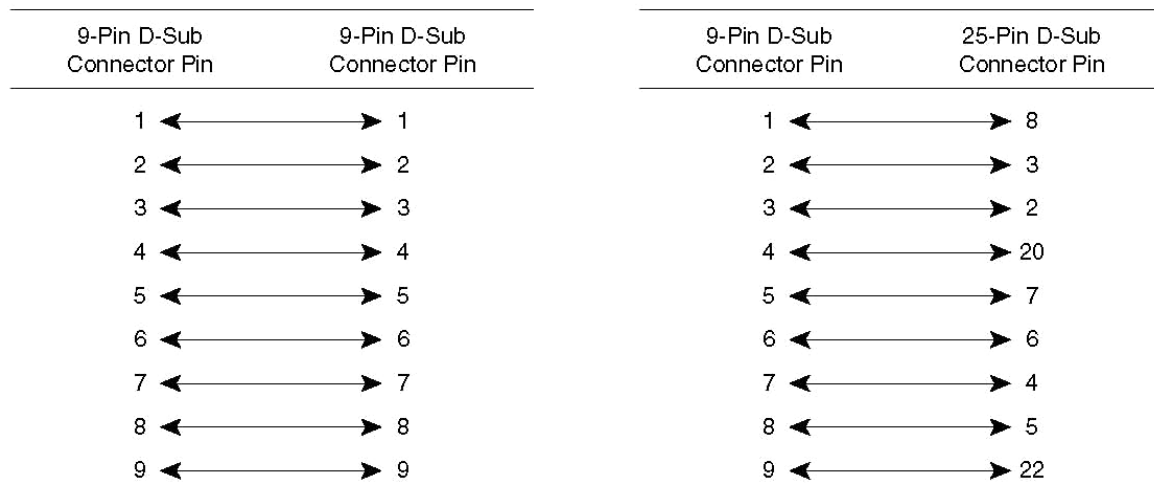


Fig.5 Schematic of Modem cable

The VCOM-05/197/50-DD source is equipped with 220-230/50Hz power supply. The power supply is connected with VCOM-05/197/50-DD source with power supply cable.



Fig.6 Outward view of the power supply

Additional information

1. Measurement of current frequency is doing approx 1 times per second.
2. Setting of new value of operating frequency is doing with a math algorithm. Frequency correction has been doing with sequence of frequency steps. One step takes approx 0.05 seconds. Max frequency settling time is 0.5 sec.

Note:

Frequency stabilization option can be switched off. Direct frequency control can be provided using DAC codes (read list of commands below)

3. The crystal oscillator used in frequency counter is not sensitive to magnet field. Exact value of measured current frequency does not depend on presence of magnet field with level < 0.01 T.
4. Long-time influence of strong magnet field on operation of the VCOM source has not been investigated. Can be requested if necessary.

Control Interface Definition

This document defines the messages that are to be used to control the millimetre wave source over an RS-232 link.

RS-232 Options:

Baud Rate 115200

Data bits 8

Parity none

Stop bits 1

9-pin female Modem cable for connecting PC with VCOM-05/197/50-DD

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1 Introduction

Software version is 111117

The interface is primarily designed to be machine (not human) friendly, so messages should use short mnemonics, obvious delimiters and avoid any unnecessary wordy descriptive text.

All messages use the same prefix ('@') and suffix ('#') character. These characters should not be used within the body of a message. The general format for all messages to be:

@[header][control][optional parameters]#

[header]	The header identifies the message and can be used for both queries and commands and the associated responses.
[control]	The control character is one of: ! a command ? a query; or : a response (also used to separate multiple parameters).
[optional parameters]	Any optional parameters are defined in section 2.

2 Interface Definition

2.1 Commands

The following table defines all of the commands in the interface, identified by the '!' control character.

Command	Example	Response	Notes
@FRQ!xxxxx.xx#	@FRQ!197100.00#	@FRQ:197100.00# @FRQ:naq#	Value in MHz “ack” indicates success; “naq” indicates invalid value.
@PWR!xxx#	@PWR!045# @PWR! 500 #	@PWR:45# @PWR:naq#	Value in mW “ack” indicates success; “naq” indicates invalid value.
@U27![text]#	@U27!on# @U27!off#	@U27:on# @U27:off#	Enable / disable the output stage to turn millimetre waves power on/off.
@HEA![text]#	@HEA!on# @HEA!off#	@HEA:on# @HEA:off#	Enable / disable the heater on the main oscillator.
@DAF![text]#	@DAF!on# @DAF!off#	@DAF:on# @DAF:off#	Enable / disable <i>Direct Frequency Control</i> mode.
@DAF![code]#	@DAF!37# @DAF!4077# @DAF!5012#	@DAF:37# @DAF:off# @DAF:naq#	Specifies the control code to be used, in the range {0..4095}. Response is “off” if disabled, “naq” for out-of-range.
@DAC![text]#	@DAC!on# @DAC!off#	@DAC:on# @DAC:off#	Enable / disable <i>Direct Power Control</i> mode.

Command	Example	Response	Notes
@DAC![code]#	@DAC!37# @DAC!4077# @DAC!5012#	@DAC:37# @DAC:off# @DAC:naq#	Specifies the control code to be used, in the range {0..4095}. Response is “off” if disabled, “naq” for out-of-range.
@[CMD][text]#	@U25!on#	@U25!:???#	(#1) Response to any unknown message with correct prefix/suffix. 4 first symbols from CMD

2.2 Queries

The following table defines the queries in the interface, identified by the ‘?’ control character.

Query	Response	Example	Notes
@FRQ?#	@FRQ:xxxxx.xx#	@FRQ:197000.00#	Value in MHz. requested frequency
@FRC?#	@FRC:xxxxx.xx#	@FRC:196999.87#	Value in MHz. Current frequency
@PWR?#	@PWR:xxx.x#	@PWR:57.6#	(#1) Value in mW, Requested power not measured
@PMA?#	@PMA:xxx.x#	@PMA:55.0#	Maximum power <i>at any frequency</i> Value in mW
@PMC?#	@PMC:xxx.x#	@PMC:57.0#	Maximum power (in mW) <i>at the current frequency</i> .
@HEA?#	@HEA:[text]#	@HEA:on# @HEA:off#	Status of the heater on the main oscillator.
@U27?# <u>read</u> <u>note</u> <u>below</u>	@U27:[code]:[text]#	@U27:23949:on# @U27:24012:off#	Query the current voltage (in mV) and on/off state.
@DAF?#	@DAF:[code]:[text]#	@DAF:3724:on# @DAF:241:off#	Query the control code for the current frequency.
@DAC?#	@DAC:[code]:[text]#	@DAC:129:on# @DAC:3742:off#	Query the control code for the current power.
@VER?#	@VER:xxxxxx#	@VER: 111117#	Version number
@S/N?#	@S/N:[text]#	@S/N:A-1110/07#	Serial number of the unit.

Note: The VCOM-05/197/50-DD oscillator is fed with +24VDC voltage.

Format of command keeps symbols “27” correspondingly which are used in different VCOM model at 94 GHz.

2.3 Alarms

The current alarm status can be queried using the following query. More detailed alarm status information is available using reserved commands (see section 2.5).

Query	Response	Examples	Notes
@ALA?#	@ALA:[state]#	@ALA:ok# @ALA:+27:temp#	See the next table for state strings.

Notes:

1. The response may contain more than one string, each identifying an alarm. Each string is separated by a `:` control character.

The following table defines all the valid alarm strings:

[state]	Description	Remedy
ok	All tests passed. Everything is OK	
+5	The +5v supply voltage is wrong.	Check the power supplies (turn them on).
-12	The -12v supply voltage is wrong.	Check the power supplies (turn them on).
+12	The +12v supply voltage is wrong.	Check the power supplies (turn them on).
+27	The +24v supply voltage is wrong.	Check the power supplies (turn them on).
Temp	At least one test point is over-temperature.	Try to cool the source.
Afc	Frequency control does not work	Reset the source
fail	The source can not work properly.	Detailed diagnostics is required or if @U27:off#.
off	@U27:off#	send @U27!on#

2.4 Supplemental

The following table defines supplementary queries in the interface that are not generally used by customer.

Query	Response	Example	Notes
@IMM?#	@IMM:[value]#	@IMM:11798#	Value in mV
@IMF?#	@IMF:[value]#	@IMF:16183#	Value in mV
@IMS?#	@IMS:[value]#	@IMS:14930#	Value in mV
@VCO?#	@VCO:[value]#	@VCO:9208#	Value in mV
@TS1?#	@TS1:[value]#	@TS1:24#	Value in degrees Celcius.
@TS2?#	@TS2:[value]#	@TS2:24#	Value in degrees Celcius.
@H27?#	@H24:[value]#	@H24:24096#	Value in mV
@U12?#	@U12:[value]#	@U12:11368#	Value in mV
@N12?#	@N12:[value]#	@N12:11263#	Value in mV
@U5S?#	@U5S:[value]#	@U5S:4947#	Value in mV

Note: The VCOM-05/197/50-DD oscillator is fed with +24VDC voltage.

Format of command keeps symbols “27” correspondingly which are used in different VCOM model at 94 GHz.

2.5 Reserved Messages

2.5.1 Queries

The following queries provide more detailed alarm status information.

Query	Response	Example	Notes
@ALM?#	@ALM:[A1][A2]#	@ALM:FE#	Current alarm status (hex)
@ALD?#	@ALD:[A1][A2]#	@ALD:175046#	Current alarm status (decimal)

2.5.2 Alarm flags

The following tables define the meaning of the two sets of flags [A1] and [A2] returned by the @ALM?# and @ALD?# queries. Each binary digit, shown as 'X', indicates the status of one parameter with the values 0 (OK) or 1 (failure).

Alarms: A1

7	6	5	4	3	2	1	0	Name	Description ('0' indicates OK)
						X		F	Frequency outside operating range
						X		TS1	Temperature of sensor 1 is outside limits
					X			TS2	Temperature of sensor 2 is outside limits
				X				TS3	Temperature of sensor 3 is outside limits
			X					+5v	+5v supply failed
		X						Imp M	Supply voltage at test point 1 is OK/ failed
	X							Imp F	Supply voltage at test point 2 is OK/ failed
X								Imp S	Supply voltage at test point 3 is OK/ failed

Alarms: A2

7	6	5	4	3	2	1	0	Value(Name)	Description ('0' indicates OK)
							X	-12 V (N12)	Failure of -12v supply.
							X	+12 V (U12)	Failure of +12v supply.
						X		+24 V (U27)	Failure of +24v supply.
				X				+24 V H (H27)	Failure of internal -24v supply.
			X					I -12 V (C12)	current in -12V circuit is wrong
		X						I +12 V (I12)	current in +12V circuit is wrong
	X							I +24 V (I27)	current in +24V circuit is wrong
X								I +24 VH (C27)	current of RF frequency multiplier is wrong

Example:

Everything is OK but +24V heater is OFF following @HEA!off# command. The +24v heater power supply is good but there is no current consumption in the heater circuits.

Alarm response is @ALD:000128#.

Segment	Decimal	Flags	Description
A1	000	00000000	No flags set.
A2	128	10000000	Current in heater +24V circuit is wrong or Heater is OFF.

3 Source Initialisation

This section defines requirements on the source during and just after power-on.

3.1 Requirements

The following table defines an initial sequence that allows the software to confirm the presence of a new-style source without applying the +24v power.

Command	U27!	FRQ!	FRC?	PWR!	PWR?	HEA!	Comments
Supply voltages +5/+12/-12 V off	n/a	n/a	n/a	n/a	n/a	n/a	No response from unit expected (!)
Supply voltages +5/+12/-12 V on	OFF	197.0	Lowest	0.0	0.0	OFF	Responds to all valid queries/commands.
Supply voltage +24 V on	OFF	197.0	197.0	0.0	0.0	OFF	Responds to all valid queries/commands.
<i>From now on, FRQ, PWR & HEA should maintain values set via commands, shown as (^)</i>							
@FRQ!nnnnn.nn#	OFF	nn.n	nn.n	0.0	0.0	OFF	<i>These commands are not required and can come in any order.</i>
@PWR!nnn#	OFF	(^)	(^)	n.n	0.0	OFF	
@HEA!on#	OFF	(^)	(^)	(^)	0.0	on	
@U27!on#	ON	(^)	(^)	(^)	n.n	(^)	Enables final stage output.
@U27!off#	OFF	(^)	(^)	(^)	0.0	(^)	Disables final stage output.
@U27!on#	ON	(^)	(^)	(^)	(^)	(^)	Enables final stage output.
...other commands...							
Supply voltage +24 V off	OFF	(^)	Lowest	(^)	0.0	(^)	Preserve FRQ, PWR & HEA
Supply voltage +24 V on	OFF	(^)	(^)	(^)	0.0	(^)	Preserve FRQ, PWR & HEA
@U27!on#	ON	(^)	(^)	(^)	(^)	(^)	Enables final stage output

In summary:

- start with U27 state OFF, power at zero and heater off
- accept & respond to queries/commands with supply voltage +24v OFF
- do not reset FRQ, PWR or HEA once set via command
- do reset U27:OFF state if supply voltage +24v goes OFF.

IF supply voltage +24 V off, @FRQ?# shows target frequency sent with the last @FRQ!XXXXX.XX# command. Default value is @FRQ:197000.00#

- IF supply voltage +24v off, @FRC?# shows current frequency which is below the lowest specified operating frequency 196.75 GHz

IMPORTANT!!!

After switching power supply of the source ON (after OFF state), wait 5 minutes or more for warming the oscillator up and stabilizing reference frequency.

Next the command @U27!on# can follow. Otherwise RED LED keeps blinking.

There is possibility to make diagnostic through RS-232 port and Ethernet/SNMP v1 protocol.

Note: Normally the diagnostics is doing at preventive testing or repair by staff of producer.

In case of failure or for test one can send a request for ALARM status of the source.

ATTENTION: Every time it is necessary to receive a reply from VCOM source that the command is completed.

If the reply has not been received the command has to be sent again.

The VCOM-05/197/50-DD source has a board for diagnostic and control through Ethernet using SNMP v1 protocol.

The source must be connected to local network or a network board of a separate computer with network cable with RJ-45 connector.

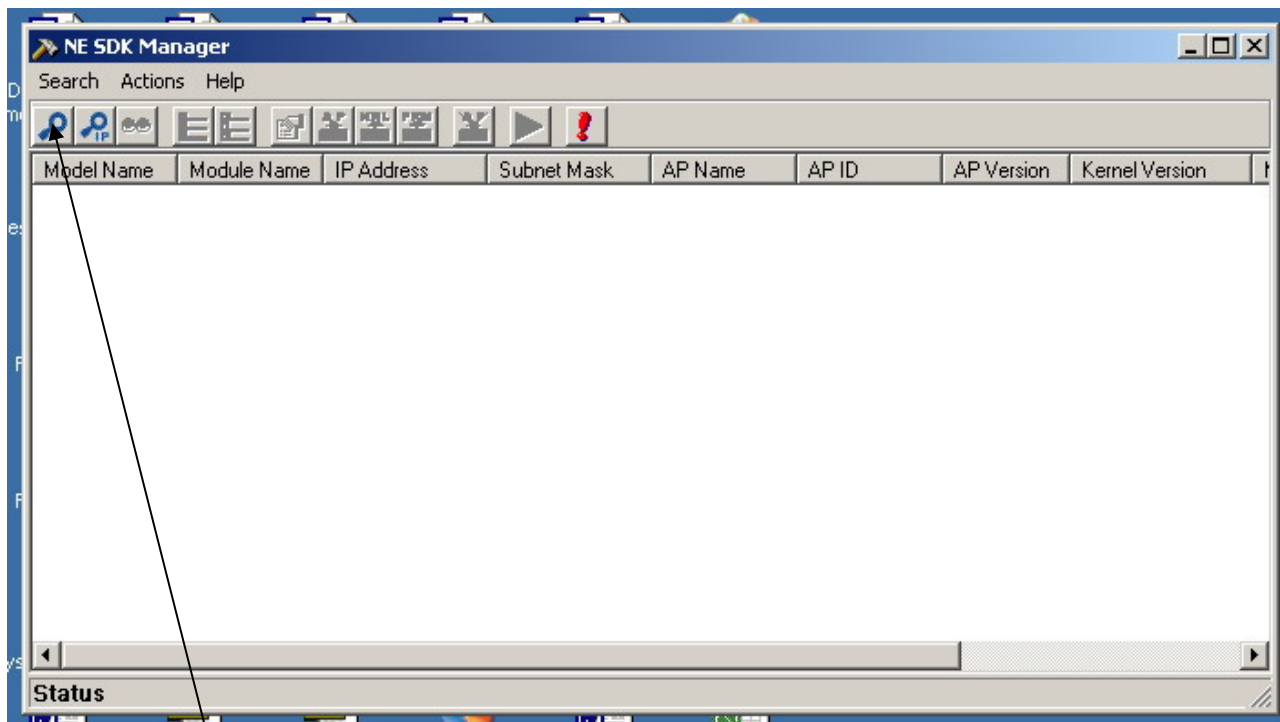
The source has a board Model NE-4110S of MOXA producing

<http://www.moxanet.com/product/NE-4110S.htm>

The board has got MAC address. IP address can be set static or DHCP (dynamic). Static IP address is set manually, DHCP address is set by local network server.

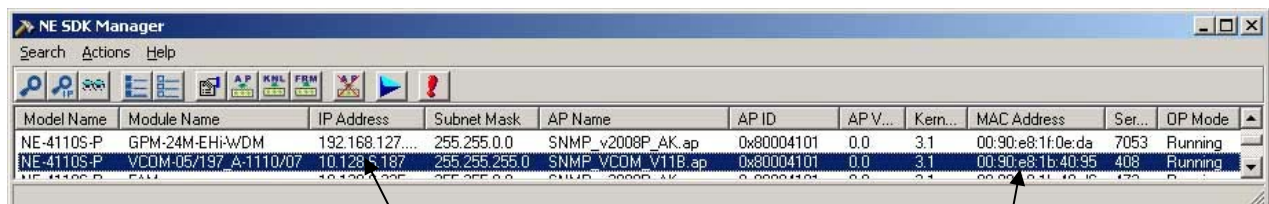
Run NE SDK Manager program:

Get the window:



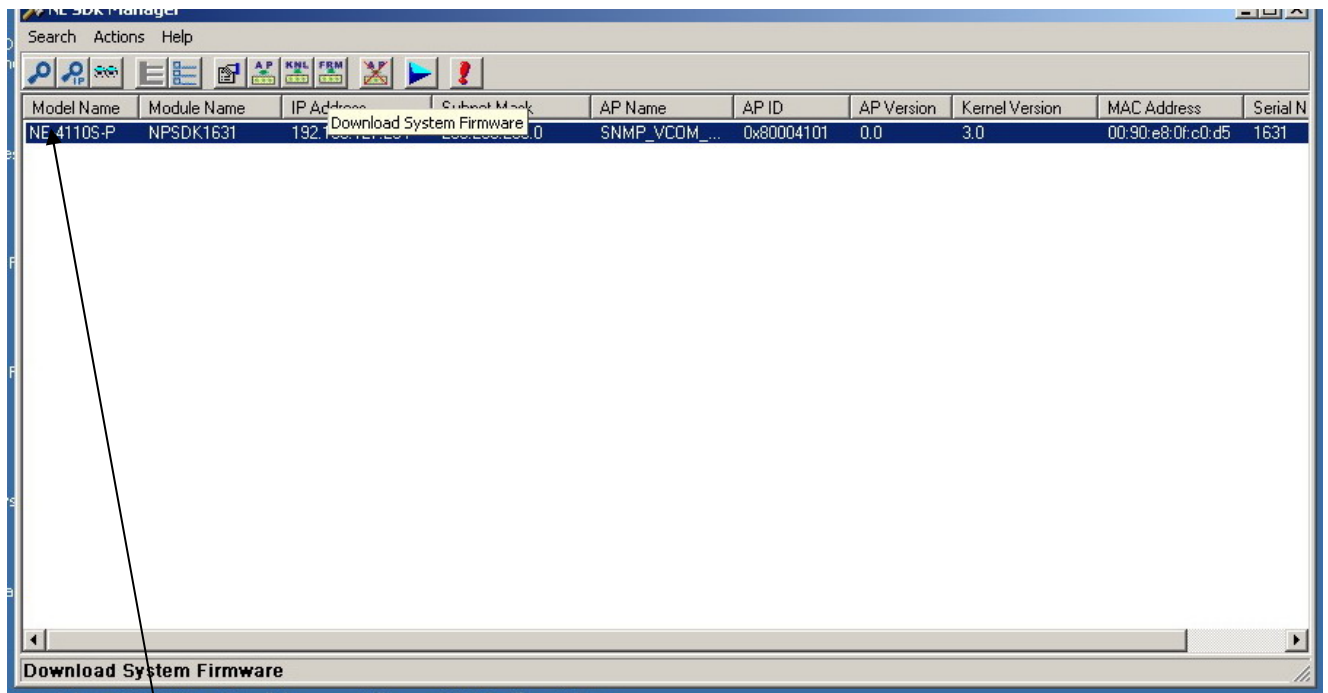
Click the button "IP".

You will find NE-4110S boards connected to local network:

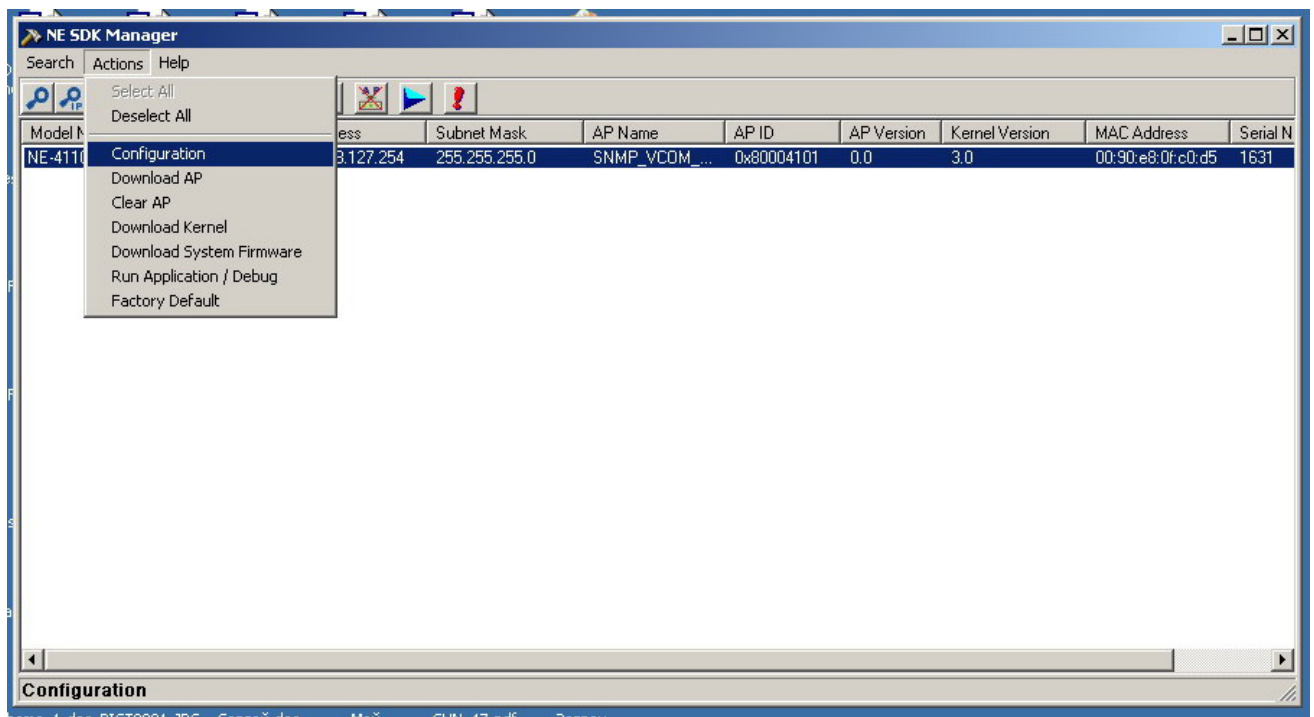


There are indicated IP address of the NE-4110S board and its MAC address in the window.

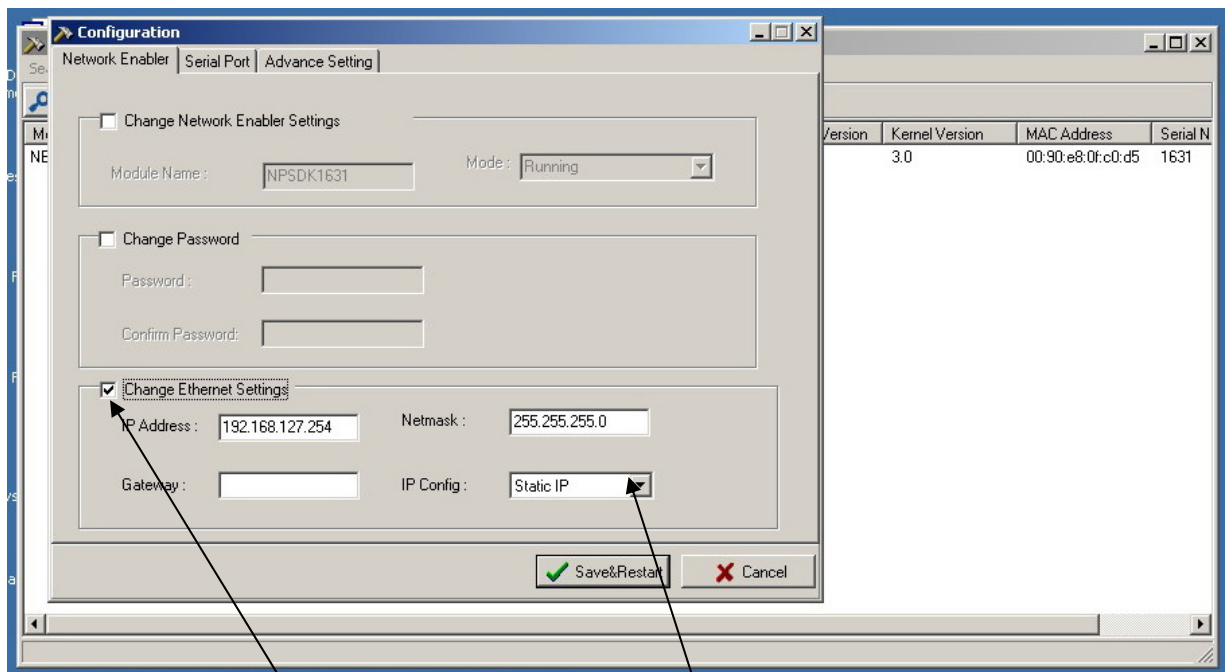
To change settings of the NE-4110S board



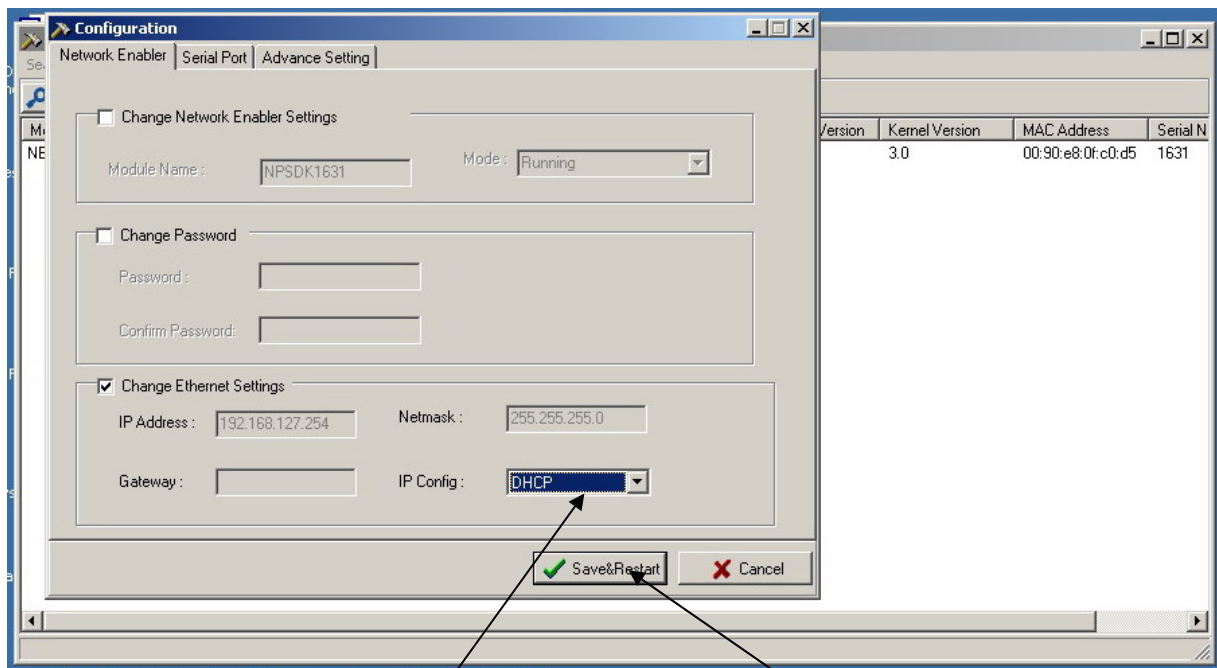
mark the NE-4110S board line (click on the line)



Click on "Action" next on "Configuration"



Tick “Change Ethernet Settings” (Static address is set)



Chose dynamic address DHCP if necessary and press “Save and Restart”

One can use static IP address if the NE-4110S board is connected through RJ-45 to a local computer.

The computer network board is to have also Static IP address.

The first 9 symbols of Static IP address of the computer and NE-4110S must be equal:

Example:

Computer static IP address is: ABC.DEF.GIH.xxx

NE-4110S static IP address is: ABC.DEF.GIH.yyy

Xxx, yyy can be within range: 0...253 and different for computer and NE-4110S board.

Note: do not use 254 for xxx or yyy

Cautions

1. Make sure the VCOM-05/197/50-DD source is protected from water drops falling on its housing. Failure of electronic circuits is possible if water penetrates inside the source.
2. Make sure there is a ventilation clearance between VCOM-05/197/50-DD housing and other surfaces (for example additional waterproof cover). This gap is necessary to prevent the source overheating and do not reduce lifetime of the source.
3. It's strongly recommended to place the VCOM-05/197/50-DD source directly on metal surface with good thermal contact to prevent overheating.
4. Make sure that output waveguide is not curved. To prevent this use screws or another tools to adjust VCOM-05/197/50-DD source position. One should select the source position (to make the waveguide straight) first and then fix the source on the mounting plate.
5. It is prohibited to hit, throw and drop VCOM-05/197/50-DD source. This can cause mechanical or electronics damage.
6. Do not keep waveguide output of the VCOM-05/197/50-DD source open. Metal particles penetrated inside the waveguide channel cause failure of source. This refers to all microwave devices especially to devices containing permanent magnets, e.g. circulators, isolators. Use special covers or an isolation (adhesive) tape or stickers to close any open waveguides.
7. Powerful microwave radiation is dangerous for any biological structures. Do not expose any body regions to microwave radiation; do not place them in front of an open waveguide when microwave source is working. Do not look into the open waveguide.