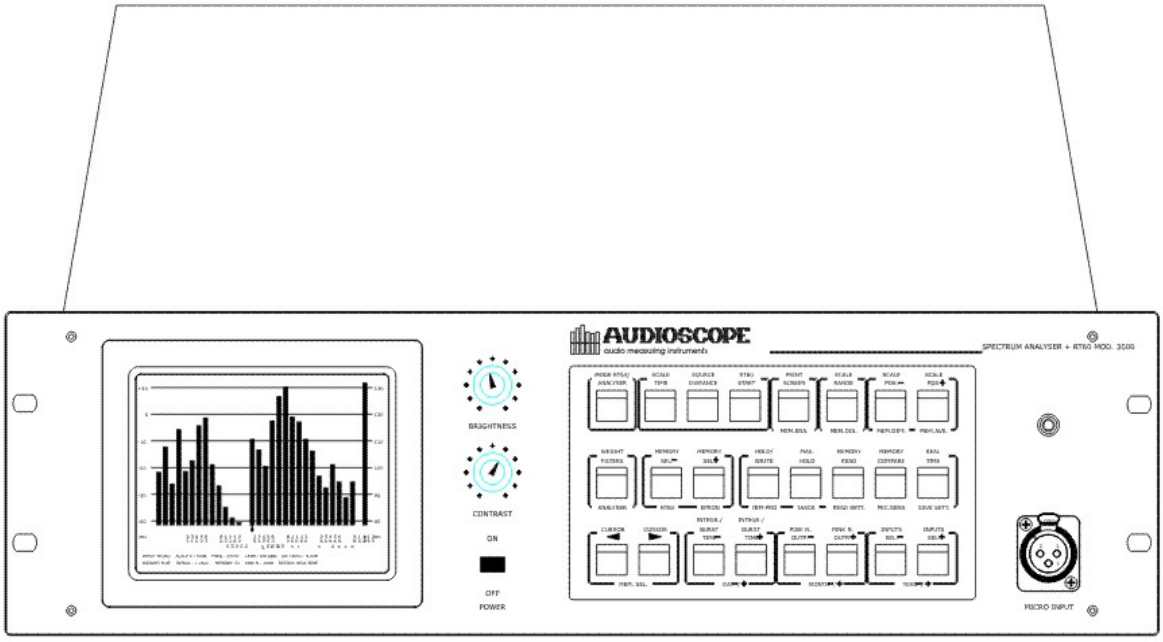
AUDIOSCOPE
audio measuring instruments

OPERATING INSTRUCTIONS

Before operating the unit, please read this manual thoroughly and retain it for future reference.

SPECTRUM ANALYZER + RT60

MODEL 3000



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AUDIOSCOPE Model 3000
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GETTING STARTED.

Be sure that the voltage selection switch placed on the rear of the unit is placed on the voltage position corresponding to your country.

Insert the power cable in the rear socket.

Power on the unit.

After about ten seconds, due to the display heating time, the instrument presents the image of the last environment left stored, with the same settings left stored.

Please, remember that the settings and parameters can be stored on the main choice menu that can be activated pressing the **<MODE RT60/ANALYZER>** key.

NOTE 1:

Avoid to Power-On the instrument immediately after a Power-Off. Wait ten seconds before to Power-On again. A Power-On immediately after a Power-Off can make appear on the screen an image not clear.

NOTE 2:

The unit is provided with a filter on the power supply input line, to avoid disturbs to be sent/received thru the power line.

Be sure to connect the power cable to an outlet provided with an efficient ground connection. This in order to ensure the maximum protection against electrical line disturbs, and for operation safety.

NOTE 3:

If the printer is connected to the 3000 unit, be sure to power-on first the 3000 unit, and then the printer. This to avoid making appear on the screen an image not clear.

NOTE 4:

The IASCA score computing function and the microphone sensitivity switch function for 130dB and 160dB SPL full scale are available only in the version for the Car Stereo use.
For the professional use, these two functions are disabled.

GENERAL DESCRIPTION.

The **AUDIOSCOPE Model 3000** is an audio measuring instrument, designed for measurement and control in Audio Professional environments, P.A., Radio, Television, Industry.

A 3U rackmount unit composes the instrument with a 5"1/2 high resolution, green phosphorus monitor housed into the cabinet.

The functions management is achieved with a keyboard held on the front panel of the unit.

The keyboard function is to select the environment, to select parameters and functions.

Connecting a printer is possible to print out the screen contents and measurement results, shown in a tabular format.

An RS232 interface is provided to connect the instrument to an external personal computer. From the P.C. is possible to program the instrument sending settings to execute a measuring process and receiving the results. Results can be stored on the P.C.'s Hard Disk for further statistics.

In addition, the same RS232 port can be used to automatically control an external equalization system, foreseen for the next future.

The instrument can perform the functions of:

1) Third of Octave Spectrum Analyser.
2) Reverberation Time Analyser (RT60).

AUDIOSCOPE Model 3000 - User Guide.
THIRD OF OCTAVE SPECTRUM ANALYSER.
TECHNICAL SPECIFICATIONS.

THIRD OF OCTAVE SPECTRUM ANALYSER.

The third of octave spectrum analyser have been designed for accurate measurements in Professional Audio environments, P.A., Radio, Television and Industry.

It can be used, for example, to test many parameters of an audio mixing console, of a multitrack tape recorder, or to test speakers or microphones during the manufacturing process.

TECHNICAL SPECIFICATIONS:

1/3 of octave bands: 30: ISO frequencies between 25Hz. and 20KHz.
Level Indicator: Wideband, for SPL measurements.
Filters: 30 four pole enhanced Chebyshev filters; widely conforming to IEC255, DIN 45651 and ANSI S1-11 1966 Class II.

INPUTS:

Microphone, Left Line (L), Right Line (R), Left Line + Right Line (L+R), Left Line - Right Line (L-R), Generator.

MICROPHONE: Selects the Microphone Input.
LEFT LINE (L): Selects the Left Line Input.
RIGHT LINE (R): Selects the Right Line Input.
LEFT + RIGHT LINE (L+R): Selects the sum between the Left and Right Line Inputs.
LEFT - RIGHT LINE (L-R): Selects the difference between the Left and Right Line Inputs.
GENERATOR: The generator output is used as input to monitor the generator output signal.

INPUTS SPECIFICATIONS:

MICROPHONE INPUT: Input impedance: 6k Ohm, electronically balanced.
Input sensitivity: 8 mV/PA. (***).
Acoustic pressure range measured:
130 to 45 dB SPL.
160 to 75 dB SPL.
The two ranges are selectable via the **<Mode RT60/Analyzer>** Menu key, and are valid for the microphone input only.
Input Connector: 3-pole XLR type.
Phantom power supply: +15V. For condenser microphones.
It can be switched off via the switch placed on the rear panel.

LINE INPUTS:

Input impedance: 20K Ohm, electronically balanced.
Input connector: 3 pole XLR type.
Max. Input Voltage: +20dBu.
L-R Line Input: CMRR: Better than -70dBu (20Hz - 20KHz.).

WEIGHTING FILTERS:

FLAT, 'A', Direct.
FLAT FILTER: four poles, analogue band pass filter.
Frequency response: 20Hz. - 22KHz. +/-.2dB. Roll-Off: 12dB/Octave.
"A" WEIGHT: Filter for acoustic measurements. Conforming to IEC 169/10.
DIRECT FILTER: No filter inserted, is an all pass.

AUDIOSCOPE Model 3000 - User Guide.
THIRD OF OCTAVE SPECTRUM ANALYSER.
TECHNICAL SPECIFICATIONS.

AUDIO OUTPUTS:
- GENERATOR: Pink noise generator output. Output Connector: 3-pole XLR type.

DIGITAL INPUT/OUTPUTS:
- PRINTER: Parallel type, printer output. For EPSON(*) or IBM Proprinter(**) printers. Connector type Sub-D 25 poles.
- RS232: Serial communication port to/from a personal computer. Connector type Sub-D 9 poles.

- VIDEO OUTPUT: For standard VGA colour monitors, 640x480 pixel resolution. Connector type Sub-D 15 pole high density.

SIGNAL GENERATOR:
- PINK-NOISE:
Frequency response: From 20Hz. to 20KHz. +/- .2dB.
Output Level: -10dBu max.
Output attenuator: from -10 to -45dBu in 5dBu steps.
Output impedance: 22 Ohm +/-5%, electronically balanced.

(*) EPSON is a registered Trademark of the EPSON Corporation.
(**) IBM is a registered Trademark of the IBM Corporation.
(***) It is the voltage (mV.) that applied to the microphone input make read about 94dB SPL on the Wideband indicator.

READING SCALES:
- 25dB, Logarithmic. Resolution better than 0,1dB.
- 50dB, Logarithmic. Resolution better than 0,2dB.

SCALE MEASURING UNITS:
- dBu. dB referred to .7745V. (0dBu = .7745V.).
- SPL. Sound Pressure Level. A signal of 8mV Eff. Applied to the microphone input make read about 94dB SPL on the Wideband indicator.

INTEGRATION TIME CONSTANTS:
ATTACK-DECAY TIMES: 1/8, 1/4, 1/2, 1, 2, 4, 6, 8s.

MEMORIES.
7 memories to store spectra levels.
7 memories to store RT60 levels.

STATUS:
It is the instrument status, depending on the functions executed.
Instrument status can be: Hold/Write, Max-Hold, Read, Compare, Real-Time, Running, Printing, Waiting, Send232, Recv232.

ENVIRONMENT INFORMATIONS:
The last two rows placed in the bottom of the screen are dedicated to show the parameter values.
Parameters that can appear are the followings:

1)- INPUT: Input selected.
2)- SCALE RANGE: Scale Range selected.
3)- FREQ: Frequency corresponding to the band selected by the cursor.
4)- LEVEL: SPL level of the band selected by the cursor.

5)- LEVEL: dBu level of the band selected by the cursor.
6)- WEIGHT: Weight filter selected.
7)- INTEGR: Integration time selected.
8)- MEMORY: Memory number selected.
9)- PINK N.: Pink Noise generator output level.
10)- STATUS: Instrument status.

REVERBERATION TIME ANALYSER (RT60).

The reverberation time analyser (RT60), have been realized to make acoustic measurements of acoustic rooms, concert halls, recording studios, cinema, theatre, etc.

All technical data relating to Inputs, Outputs and the generator are those described in the Spectrum Analyser environment.
Please, refer to the Spectrum Analyser specs, for more detailed information's.

The reverberation time Analyser (RT60) works sending in the room a Pink Noise burst signal and then measuring, via the measuring microphone, the level Vs. time of the reverberated signal related to the selected frequency.

The Pink-Noise burst is sent in the room via an external amplification system for the burst duration specified in the parameter 'Burst Time', and the decay levels measured during the time declared in the parameter 'Scale Time'. The decay levels are measured after that the time corresponding to the parameter 'distance' is passed.

The 'Distance' parameter is the distance (in Meters) between the sound source and the microphone.

This number is translated by the instrument in the equivalent time the sound needs to run from the speaker(s) and the measuring microphone, and the instrument will wait this time before to begin to measure the decay levels.
This to avoid measuring the 'Direct' sound, because our interest is to measure the 'Reflected' sound levels.

AUDIOSCOPE Model 3000 - User Guide.
Reverberation time Analyser (RT60).
Technical specifications.

ENVIRONMENT INFORMATIONS:

The last two rows in the bottom of the screen are dedicated to show the parameters set.
The parameters that appear are the followings:

1) - INPUT: Selected input.
2) - SCALE RANGE: Range scale selected (Always 50dB).
3) - FREQ: Frequency corresponding to the band selected by the cursor. Is the measurement frequency.
4) - DISTANCE: Distance in meters between the signal source and the measurement microphone.
5) - LEVEL: Level in dBu corresponding to the time selected by the cursor.
6) - FRMIS: Is the frequency the last measurement has been made.
7) - FRMEM: Is the frequency the recalled memory was made. When the measurement results are stored, the measurement frequency value is stored too. This is the frequency at which the recalled results were made.
8) - BURST T.: Pink Noise burst duration.
9) - MEMORY: Selected memory number.
10)- PINK N.: Pink Noise generator level.
11)- STATUS: Status of the instrument.

AUDIOSCOPE Model 3000 - User Guide.
SPECTRUM ANALYSER + RT60 Model 3000.
MECHANICAL AND ELECTRICAL CARACTERISTICS.

MECHANICAL AND ELECTRICAL CARACTERISTICS.:

POWER: Voltage: 117 V. from 100 to 125 V.
220 V. from 198 to 230 V.

FREQUENCY: 50/60Hz. Power consumption: About 120 W.

MECHANICS. DIMENSIONS:
Box only: m/m 440 x 126 x 320 (w,h,d).
Measured at max points: m/m 483 x 133 x 330 (w,h,d).

WEIGHT: About 10 Kg. (20Lbs.)

ENVIRONMENT SELECTION AND MAIN OPTIONS: <MODE RT60/ANALYSER> KEY.

Pressing this key will cause to make appear in the lower part of the screen some other selection parameter rows.
The parameter selections are:

- Date of the Day selection.
- Analyser or RT60 selection.
- EPSON(*) or IBM PROPRINTER(**) printer selection.
- Enable IASCA computing score.
- Microphone output level selection: 130/160dBSPL.
- Recall standard instrument settings.
- Store actual instrument Parameters/Settings.
- Average/Difference between memories.

DATE OF THE DAY SETTING.

Is possible to select the date of the day in terms of Day, Month, Year (GG:MM:AA) or Month, Day, Year (MM:DD:YY). The date will appear in the printout, right to the label "Date:".
The three date elements (Day, Month, Year) can be selected using the keys **<Integr. -/+>, <Pink N. -/+>, <Input -/+>**.

The Date of the day can be stored along with the instrument parameters and settings pressing the **<REAL TIME>** key.

ANALYZER/RT60 SELECTION.

To select the Spectrum analyser environment, just press the **<WEIGHT>** key, whilst to select the RT60 environment, just press the **<MEMORY ->** key.
The selection is evidenced by a light filled rectangle appearing at the left side of the selected option.
To exit this main menu, and to return to the selected environment, press the **<MODE RT60/ANALYSER>** key.

If the selected environment is the Spectrum Analyser, it is presented in 'Real Time' status, whilst if the selected environment is the RT60 analyser, it is presented in the 'Waiting' Status.

All parameters and settings of the recalled environment will be set and, in case of the RT60 environment, the last measuring results will be presented on the screen.

The Pink-Noise generator is always active in the Spectrum analyser, whilst in the RT60 environment, it is activated only during the measuring process and for the burst time duration.
In all other conditions it is not active.

EPSON/IBM PROPRINTER PRINTER SELECTION.

It is possible to choose between two printer types: EPSON(*) and IBM PROPRINTER(**). To select the EPSON printer, just press the **<MEMORY +>** key, whilst to select the IBM PROPRINTER printer, press the **<HOLD/WRITE>** key.

The selection is evidenced by a light filled rectangle at the left of the selected option.

IASCA SCORE COMPUTING.

The IASCA score option, valid only for the spectrum analyser, computes and prints an additional row with information's about how the response curve is 'regular'.
These informations give a numeric result or score in a range between 1.0 and 40.0, with a resolution of 0.1Pts.
The elements that produce this score are the following:

1) - Number of times a level difference greater than 3.0dBu between two adjacent bars have been found. In the printout, an asterisk will appear near to the difference levels found greater than 3.0dBu.
2) - Maximum level difference in dBu and tenths of dBu found between adjacent third of octave bands.
3) - **Penalty** computed adding the partial results #1 to the #2.
4) - The final score is obtained by the formula:
(40.0 - **Penalty**).
To enable the computing process and the printout of the IASCA score, just press the **<M. HOLD>** key.

MICROPHONE OUTPUT LEVEL SELECTION: 130/160dBSPL.

Is possible to select two different microphone types with different output voltages and then different capacity to measure acoustic pressure levels.

Pressing the **<Compare>** key, the Top of Scale of the instrument is changed from 130dBSPL to 160dBSPL.

The new scales are re-drawn when exit the main menu.

The extended 160dBSPL Top Scale will appear only if the Microphone input is selected. Selecting a different input, the Top Scale is set at 130dBSPL.

The numeric levels expressed in dBu and SPL will be automatically adequate to the new scale.

STANDARD SETTINGS RECALL.

To recall and set the instrument default settings.

Pressing the **<READ>** key, the default settings are read and set. The spectrum analyser environment is set and presented as default.

PARAMETER/SETTINGS STORAGE:

To store in the internal non-volatile memory (E2PROM) the instrument settings (Input selected, scale, last selected memory etc). After this settings storage, that is made pressing the <REAL TIME> key, the instrument is placed in 'real-time' or in 'waiting' status, depending on the selected environment.

At the next power-on, the instrument will be set in the same setting conditions found when the <REAL-TIME> key have been pressed.

DIFFERENCE AND AVERAGE BETWEEN MEMORIES.

It is possible to compute the average or the difference between any of the first six memories and to read the results stored into the memory #7.

The Difference/Average Menu shows the following informations:

<Cur.LR> <Print/Scale> <ScaleP>-/+> < 1> < 2> < 3> < 4> < 5> < 6>

The numbers inside the parentheses (E.G.< 1>) indicate the memory numbers.

The space at the left side of the number is reserved to the memory selection cursor and/or to the enabled memory indicator.

The <Cur.LR> keys are used to select the memory number on which the user wants to operate. The memory selected by the cursors is evidenced by a little light square placed in the lower part at the left side of the memory number.

The <Print/Scale-R> keys are used to enable/disable the selected memory.

The memory enabled is evidenced by a light square placed in the higher part at the left side of the memory number.

Is possible to select from one to six memories together.

The <Scale P. -> key computes the difference between the two selected memories and places the results in the memory #7.

If the contents of the two memories are identical, the result is a null histogram.

If only one memory has been selected, the result is the copy of the selected memory into the memory #7.

Please, remember that although is possible to compute the difference between more than two memories, the result has no meaning.

The <Scale P. +> key computes the average between the selected memory levels and places the results into the memory #7.

If only one memory has been selected, the result is the copy of the selected memory into the memory #7.

Note: The average and difference computing process is not related to the dynamic range to which informations have been stored.

Particular attention must be placed to take the measurements, store the results and make the average/difference using the same scale dynamic range (25dB or 50dB).

Particularly, the difference histogram between memories is presented normalized in the lower part of the screen.

SCALE-TIME.

Selects the Scale-Time for reverberation time (RT60) measurements. The scale time is composed of 32 values computed in the interval between zero and the full-scale value. The scale time appears instead the frequency labels.
The reverberation time measurement is then made in 32 equal time-steps.

For example, the 0.5Sec. 32 steps of 16mSec compose scale time. Each. The total measurement cycle is composed by 32 steps each one every 16mSec.

The total duration of the measurement cycle is then equal to the full-scale time value.

By the way a single key has been dedicated to this selection, the next scale will appear each time you press the key. Scale times have the following full-scale values (rounded):

0.5, 1, 2, 3, 4, 5, 6, 7 Seconds.

Values appear as computed multiple of 16mSec.
Small full-scale values are for small rooms and vice-versa. A room of 4 meters for 5 meters can have a reverberation time of about one second; depending on the absorption value; then a full-scale value of two seconds is proper.

(*) EPSON is a registered trademark of the EPSON Corporation.
(**) IBM is a registered trademark of the IBM Corporation.

DISTANCE (BETWEEN SOURCE AND MICROPHONE).

It is the distance, expressed in meters, between the sound source (Speaker(s)) and the measurement microphone.

This parameter is translated by the instrument in terms of time occurring to a sound to run along the declared distance, and will be used as waiting time before to acquire the reverberation curve level data.

This parameter represents the time of the 'Direct' sound, or the time the sounds needs to run along the source-microphone distance and must be subtracted to the measurement because our interest is represented by the 'Reverberated' sounds measurement.

By the way a single key have been dedicated for this selection, the numeric values change growing of 1 each time the key is pressed, until 20 (meters). Pressing the <SOURCE DISTANCE> key, the value will change from 1 to 20 in 1 meter step.

AUDIOSCOPE Modello 3000 - Guida all'uso.
MEASUREMENT START: <RT60 START> KEY.

RT60 MEASUREMENT START.

The reverberation time measurement is achieved by sending in the room a pink noise burst signal and then measuring -via the measuring microphone-, the level vs. time of the reverberated signal at the frequency selected via the horizontal cursors.

The measurement is then referred to the selected frequency.

By pressing the <START> key, the measurement cycle is made on the selected frequency and with the modality defined selecting the scale time, the burst duration, and the distance between the source and the microphone.

Before to proceed with the maesurement, is necessary to set the following parameters:

Adjust the pink-noise amplification level. Please, remember that in the RT60 environment, the generator is always OFF (MUTE) except when it is activated pressing the <START> key for the burst generation.

Do then some measurement tests to adjust the amplification level and the full-scale level reading, to read the begin of the decay curve about on the full scale limit. (<SP- SP+ keys).

Select the scale time foreseen depending on the room size.
Small full-scale values are for small rooms, and vice-versa.

A room of 4x5 meters dimension can have a reverberation time of about one second, depending on the absorption; a full scale of 2 Sec. can be proper.

Select the distance (in Meters) between the sound source (Speaker(s)) and the microphone.

Select the burst time duration. This depends on the room size we are measuring. The burst time duration must be so that the sound can run all room distances, and the presence of the sound in all room points is guaranteed.

In a room of 5mt. x 6mt. x 3mt., the 'perimeter' is about ~20mt.

A sound sent from one point of the room can run this perimeter in about 80mSec. A multiplying factor of four can ensure the room 'filling'. In a similar case, the 'Burst Time' can be set to 0.4Sec. Or more.

Select the frequency where the measurement must be made. Big rooms have a resonance frequency lower than small rooms. More bigger is the room more lower is the resonance, and then the measurements must begin from a lower frequency.

Press the <RT60 START> key to begin the measurement.

During the measurement process, a series of lines are drawn on the screen, corresponding to the levels reached during the measure at the different scale times.

At the end of the measure, a definitive filled histogram is drawn on the lines.

The generator is set to OFF (MUTE).

The measuring process cannot be interrupted.

The RT60 measurement can be done if the instrument is in the 'Compare' or 'Waiting' status only.

At the end of the measurement, the instrument is placed in 'Waiting' or 'Compare' status, for further commands.

To store the measurement results, is only necessary to select the number of the memory to be used and to press the <HOLD-WRITE> key.

The measuring results are then stored in the non-volatile internal memory; along with the informations of the frequency and the scale position and time the measurement have been made.

The frequency the measurement has been done will appear in the system informations as 'FRMIS'.

RESULTS PRINTOUT.

To print the image on the screen and the measurement data with a parallel dot printer. The printer type can be selected in the 'Mode RT60/Analyser' menu.

The printer cable must be connected to the 'Printer' connector placed on the rear panel.

All graphic informations will be printed along some rows to be filled with infos of the Customer and the measuring conditions.

Particularly, the date of the day set in the main menu is printed. To set the date, please refer to the paragraph 'Date of the day setting'; at page 10.

In addition, all the third-of-octave dBu and SPL levels will be printed in tabular format, with the differences in dBu between adjacent thirds.

In case of RT60, all time-step levels will be printed with the differences in dBu between the adjacent time-steps.

If the printer is not connected to the instrument, or is unable to print, the <PRINT SCREEN> key has no effect.

Is not possible to print if the instrument is in the 'Compare' status.

If the IASCA score computing and printing option have been requested, an additional row will appear at the end of the printout, showing all the elements of the score.

SCALE SELECT.

With the <SCALE SELECT> key, is possible to select two reading scales, to see the signals with different scale dynamics and resolution.
If the instrument is in Hold/Write, Max.Hold, Read or Compare status, these keys have no effect.

The available scales are as following:
25dB Logarithmic.
50dB Logarithmic.

In the lower dynamics scale, (25dB) the resolution is greater than .1dB.

The actual active scale value appears in the system information area.

The scale selection is possible only in the spectrum analyzer environment. In the RT60 environment it is fixed at 50dB dynamics.

The 50dB scale can be positioned in a dynamic range of from +10 to -75dBu in 5dB steps.

The level read in the information area in the lower part of the screen is that of the third of octave band (or the Wide Band indicator) selected via the cursor.

Measuring error: at -40dB respect the full-scale: +/- 1dB.
At -50dB respect the full scale: +/- 2dB.

SCALE POSITION -/+: (SCALE POS.- SCALE POS.+).

The purpose of these keys is to change the top of scale in 5dB steps. The scale values will automatically be changed according to the new position.

There are seven steps, so it is possible to see signals of -75dBu when the 50dB scale range is selected.

The <SCALE POS.+> key moves the scale in a higher position, this permitting to see low-level signals.

The <SCALE POS.-> key moves the scale in a lower position, this permitting to see high-level signals.

ABSOLUTE MODE.

The level readings are absolute. The instrument automatically adjusts the selected input gain so that the level read onto the scales is absolute, independently of the scale range and position selected.

For example, applying to the Left Line input a sine wave signal of 0,775V Eff., the instrument will read 0dBu, independently of the scale range and position selected.

To make measurements and to see the curves on a practical level on the screen, it is only necessary to select the scale with the necessary dynamic range and to 'position' it at the level useful to see the spectra or RT60 curves.

The scale values are automatically updated, indicating the absolute value (dBu and SPL) to be read.

WEIGHT FILTERS.

Three weight filters are available:

Flat, A, Direct.

The 'Flat' filter is to be used for frequency response measurements with the spectrum analyzer.
The band is limited to 20Hz. and 22KHz. so that values outside these limits do not affect the SPL measurements.

The 'A' weight filter can be used for frequency response measurements related to the human ear frequency and sensitivity.

The 'direct' selection means 'no filter inserted'. This can be used for wide range SPL measurements (5Hz. - 30KHz).
When the RT60 environment is active, the direct filter is automatically selected, to guarantee a level response without time delay, especially at the lower frequencies.

MEMORY SELECTION: (MEMORY SEL.- MEMORY SEL.+).

There are seven memories in the Spectrum Analyzer environment, and seven memories in the RT60 environment.
It is possible then to store up to seven spectra and up to seven RT60 measuring results.

Each memory is numbered from 1 to 7.

The selection of the memory where informations must be stored is made via the <MEMORY SEL-> and <MEMORY SEL.+> keys.

If the instrument is in status of Read or Compare, the previous/next memory will be presented.

When a spectrum or RT60 results are stored, some other informations are stored, like the scale range, scale position, time scale and frequency (RT60).
When a memory is read or compared with the real-time, the original conditions to which the memory have been stored are automatically recalled and set, to see the memory in the same conditions when have been stored.

If, E.G., at the moment of the store, the range scale was 25dB and the top of scale 0dB, and at the read/compare moment the scale range is 50dB and the top of scale +10dB, the 25dB range scale is set and the memory levels adjusted to the actual scale position of + 10dB.

HOLD AND STORE: (HOLD/WRITE).

The <HOLD WRITE> key holds the real-time and stores the current spectrum data into the selected memory number.
If the RT60 environment is active, the last measurement curve will be stored.

Before to store something, is then necessary to select the memory number where the data must be stored, avoiding to cancel previously stored informations.
The memory number selection is made via the <MEMORY SEL-> and <MEMORY SEL.+> keys.

There are seven memories for the Spectrum analyzer and seven memories for the RT60 environment. Memories are numbered from 1 to 7.

Informations are stored into the internal non-volatile memory (E2PROM) of the instrument. The memory contents are permanently stored also after the instrument power-off.
Informations stored into the memory are the spectra levels or the RT60 reverberation curve and the informations of scale range, scale position and scale time for the RT60.
When the memory is recalled, or compared with the real-time, the original store conditions will be set, to present the memory in the same conditions as stored.

Pressing the <HOLD WRITE> key, the status of 'Hold. Wr.' will be evidenced in the instrument information area.
The instrument will remain in this status until the <REAL-TIME> key is pressed. If the RT60 environment is active, the instrument will be placed in 'Waiting' status.

In the condition of 'Hold-Write' status is not possible to change the range of the scale, so the <SCALE RANGE> key has no effect.
On the contrary, is possible to change scale position, using the <SP-> and <SP+> keys.

In the 'Hold/Write' status, the cursor can be moved via the cursor keys. Is then possible to read the dBu or SPL value of the selected third of octave band.
If the RT60 environment is active, the reverberation level in dBu at the cursor scale time position is read.

MAX-HOLD: (MAXIMUM LEVEL REACHED).

The <MAX-HOLD> key first resets the real-time spectrum to the minimum level position and then presents the maximum band levels.

The image on the screen is updated when the level of everyone band is greater than the actual.
The levels presented are subject to the integration time selected.

The 'Max-Hold' levels cannot be stored.
Is not possible to change scale range when the 'Max-Hold' function is activated.

The 'Max-Hold' function works only in the Spectrum Analyzer environment.

MEMORY READ

Pressing the <READ> key, the memory contents associated with the selected memory number are presented on the screen.

In the 'Read' status is possible to see the other memories by pressing the <Memory-> or <Memory+> keys.

When spectra or RT60 measuring results have been stored, the informations of frequency, scale range, scale position and scale time have been stored.
To present stored curves in the same conditions they have been stored, the above parameters are set, so curves will be seen in the same conditions as stored.

If, E.G., the store was made with a scale range of 25dB and a top of scale of 0dB; and at the moment of read the scale range is 50dB and the top of scale +10dB, the original scale range is set and the memory levels adequate to the actual +10dB scale position.

In the RT60 environment, the measurement frequency is also stored. When the memory is read, the parameter 'FRMEM' will indicate the frequency the measurement was made.

In the 'Read' status the <ARROW> keys can be used to move the cursor along the third of octave frequencies or the scale time values. The level of the selected frequency or RT60 level is shown in dBu and SPL units with one decimal.

To return in the Real Time status, just press the <REAL-TIME> key.
Particularly, in the RT60 environment, at the return to the 'Waiting' status, is set the active scale time before the memory read was issued.

COMPARISON BETWEEN A MEMORY AND THE REAL-TIME (COMPARE).

Pressing the <COMPARE> key, the histogram bars are divided in two vertical halves.
The left half (more wide) shows the real-time level (or the RT60 level), whilst the right half (more narrow), show the selected memory level.
The two little bars appear on the instrument screen with different shade, whilst they appear with a different color on the external color monitor.

In this 'Compare' status, is possible to see the other stored curves pressing the <Memory-> and <Memory+> keys.

When spectra or RT60 measuring results have been stored, the informations of frequency, scale range, scale position and scale time have been stored.
To present stored curves in the same conditions they have been stored, the above parameters are set, so curves will be seen in the same conditions as stored.

In the RT60 environment, the measurement frequency is also stored. When the memory is read to be compared, the parameter 'FRMEM' will indicate the frequency the measurement was made.

In this 'Compare' status, the cursor arrows can select any Third-of-Octave band or RT60 measurement level.
The dBu and SPL values read are those of the real-time in case of Spectrum analyzer, or the measurement level in case of RT60.

To return to the 'Real-Time' status, or to the 'Waiting' status in the case of RT60, press the <REAL-TIME> key.

Particularly, in the RT60 environment, at the return to the 'Waiting' status, is set the active scale time before the memory read was issued.

RETURN TO THE REAL-TIME STATUS (REAL-TIME).

Pressing the <REAL TIME> key allows the return from a memory function to the 'Real-Time' status or to the 'Waiting' Status if the active environment is the RT60.

CURSOR POSITION (ARROWS).

The left and right arrows (< <- -> > keys) are dedicated to move the cursor along the bar positions.

The cursor is placed under the bars and looks like a vertical arrow. The arrow points a bar.

The cursor moves horizontally via the < <- -> > keys. The level of the band corresponding to the cursor position will be presented in the information area in the lower part of the screen, in the SPL and dBu-measuring units.

In the Spectrum analyzer environment, the cursor points a Third-of-Octave band or the Wideband (WB) indicator. Depending on the instrument status, the dBu and SPL values refer to:

- Hold-Write: The levels read are those of the 'Held' bars.
- Max-Hold: The levels read are those of the Real-Time bars.
- Read: The levels read are those of the memory read.
- Compare: The levels read are those of the Real-Time bars.
- Real-Time: The levels read are those of the Real-Time bars.

In the RT60 environment, the cursor has a double function. It points the bar corresponding to the scale time value (down the cursor), and the level of the bar shown in dBu units. In the same time it selects the Third-of-Octave band frequency where the measurement will be made.

The band level read depends on the instrument status:

- Hold-Write: Level read is referred to the last measurement.
- Read: Level read is referred to the memory recalled.
- Compare: The level read is referred to the last measurement.
- Waiting: The level read is referred to the last measurement.

In the same 'Waiting' status, the cursor arrows select the frequency where the measurement will be made.

The frequency value appears between the system informations, right to the 'FREQ.' parameter.

Remember that the last measurement frequency is indicated right to the 'FRMIS.' parameter.

INTEGRATION TIME AND BURST DURATION (INTEGR/BURST+/-).

These keys have a different function, depending on the active environment.

SPECTRUM ANALYSER:

In the Spectrum analyzer environment, these keys ere dedicated to select a different integration-time value of the Third-of-Octave band levels.

The integration is exponential type. A continuous integration process is performed on all Third-of-Octave bands and the Wide Band, and the result of this integration process shown on the screen.

RT60

In the RT60 environment, these keys are used to modify the pink-noise burst duration that means the time the generator is active.

This time must be set related to the size of the room we are measuring the RT60, and is proportional to this size.

The burst duration must be so that the sound can run along the distance of all walls and can 'fill' all the room points.

A room of 5mt. x 6mt. x 3mt., has a perimeter of about 20mt.

A sound emitted in one point of the room can run this perimeter in about 80mSec. A multiplying factor of four can guarantee a good room 'filling'. In a similar case, the Burst-Time time can be set to .4Sec. or greater.

GENERATOR OUTPUT LEVEL (PINK N. OUTPUT-/+).

These keys are dedicated to adjust the Pink-Noise generator output.

The output level is in 5dB steps.

The Pink-Noise generator output level is about 10Vpp. at -10dBu (Maximum level). It is recommended to use low output levels (-30 ~ -35dBu) to avoid the saturation of the amplifier or pre-amplifier input where the Pink-Noise signal is connected.

INPUTS SELECTOR (INPUTS SEL.-/+)

To select the input from which the measurement is made.

Inputs that can be selected are:

1 - OFF - No input selected.
2 - Micro - The Microphone input is selected.
3 - Line L - The Left Line source is selected.
4 - Line R - The Right Line source is selected.
5 - Line L+R - Selects the sum between the Left and Right line inputs.
6 - Line L-R - Selects the difference between the Left and the Right line inputs.
7 - Generator - Selects the generator source.

The 'Line L+R' input is the sum between the Left and the Right Line input signals.
Two sine wave signals of 0dBu level, applied to the Left and Right line inputs make read +6dBu on the Line L+R Input.

The 'Line L-R' input is the difference between the Left and Right Line input signals.
The difference between these signals is performed and the result presented as spectrum. If the signals applied on the Left and Right Line inputs are exactly in phase, the difference is a null spectrum. If they are out of phase, the spectrum show the frequencies the signals are out of phase, and the level or quantity of the frequencies out-of-phase.

Particular attention has been used in the difference circuitry; by regulating the CMRR at a typical value of -70dBu, and adequately compensating the high frequencies.

RS232 COMMUNICATION.

The Audioscope Model 3000 unit functions can be set thru the RS232 serial port, connected to an external personal computer.
The necessary software is available on request.

Via this software is possible to select the environment, set the measuring parameters and command the instrument to perform one or more measurements, read the results, print the report, and store results on the computer Hard Disk.

In other words, the P.C. works as a substitute of the 3000's keyboard with a screen page showing the parameters, commands and settings status. The enormous advantage is to perform measurements automatically and to store measuring results on the PC's Hard Disk.

Think, -E.G.- to the possibility to program the RT60 measurement on all frequency bands, to read the results of all the 30 measurements, to store them on the Hard-Disk and to present a 3D result image on the computer screen...

SPECTRUM ANALYSER -HOW TO USE IT IN A TYPICAL ROOM EQ.

A third of octave or parametric equalizer is necessary to modify the response curve of the room.

- Set to the minimum level the volume of the amplifier.
- Connect the Pink Noise Generator output of the Audioscope 3000 to a 'High Level' input of the amplifier or pre-amplifier. (Line, Tuner or Auxiliary input).
- Set the generator output level of the Audioscope 3000 to a level compatible with the amplifier or preamplifier input. Please, remember that the generator output level is about 10Vpp at -10dBu. It is recommended to use low output levels (-30 ~ -35dBu) to avoid the saturation of the amplifier or the preamplifier input. This can cause damage to the tweeters.
- Connect the microphone to the instrument micro input. The microphone must be positioned at the listening position.
- If the Spectrum analyzer is not already active, recall it via the <MODE ANALYSER/RT60> key. This key allows you to enter in the main menu where the Spectrum Analyzer or the RT60 environments can be selected.
- Select the Micro Input. <INPUT SEL-/+> keys.
- Select the scale range of 50dB dynamics (<SCALE RANGE> key).
- Select the Top-of-Scale 100dB SPL (<SP- SP+> keys).
- Select the Integration time 1s. (<INTEGR-/+> keys).
- Select the Flat Weight Filter (<WEIGHT> key).
- Set all amplifier/pre-amplifier/equalizer tone controls to 'Flat'.

In these conditions the instrument shows the spectrum of the environment noise and the Wideband noise level in dB SPL.

If the environment noise floor level is high or very low (Wideband level indicator out-of-scale or spectrum too low), you can change position of scale (<SP- SP+> keys) to read the spectrum at a practical level on the screen.

The purpose of this operation is to measure the noise floor level, and then determine which Pink-Noise level must be used for the measurements.

By the way we must measure a room frequency response possibly not affected by the room noise floor level, the Pink-Noise level sent in the room via the speaker(s) must be about 15dB greater than the noise floor.

- Select from the amplifier or the pre-amplifier the source input where the pink-noise signal has been connected. Adjust the amplifier volume to read on the instrument a noise level greater than about 15dB respect the noise floor (WideBand level). You are now hearing the Pink-Noise signal thru the speaker(s).

What you are seeing now on the Audioscope 3000 monitor is the spectrum or the frequency response of all the amplification set (amplifier and/or preamplifier, speakers, room).
You can store this spectrum as 'before the care', to compare it after you equalized the room.

Moving the amplifier or preamplifier tone controls or the equalizer faders, you can see how these controls act and how much the frequency response of the room is modified.
These variations can be more evident selecting the scale range of 25dB, being the screen resolution higher.

If the integration time is slow, you can select a lower integration time to obtain a more rapid image settling; after you can set a longer integration time.

If you want to hold the screen to better evaluate the response curve, just press the <HOLD WRITE> key. (Remember that this causes the selected memory number contents to be updated.)

Once established the frequency bands to correct, you can modify the equalizer controls and 'build' the desired response curve.

Anyway, consider that is very difficult to obtain a 'Flat' response curve. Differences of +/- 2dB are acceptable.

In addition is not useful to build a linear curve down 40Hz (unless a sub-woofer is present); this can solicit the woofer(s) more than the necessary, and produce distortion.

An optimal level with e.g. a woofer of 25Cm. diameter is -8dB at 32Hz; -4dB at 40Hz; -2dB at 50Hz; 0dB at 63Hz.

THEORY OF THE REVERBERATION TIME.

A sound originated in a room rebounds on the walls.
If, unreasonably, the walls do not absorb any sound, the sound level will increase as soon as other sounds are added. If the sound stops, the sound level does not stop because the sound continuously rebounces on the walls.

Into any real room the walls absorb the sound.
More is the absorption value, more rapidly the sound level decreases after the sound stops.
Some materials as carpets absorb very well the sound. A material as plaster or glass does not absorb sound.

In addition, the absorption value changes with the sound frequency, because the absorption value of the same material is different at different frequencies.
Big rooms, caused to the big walls surface, have a reverberation time greater than smaller rooms.

There are some instruments that read a reverberation value in seconds at some frequencies.
The Audioscope Model 3000 not only measures this reverberation time but also shows the decay levels of a sound in the selected scale time and for each one of the 30 frequencies.
The decay curve, presented as a histogram, gives detailed informations on how, how many and at what time the sound is absorbed or rebounces on the walls.

The **R**everberation **T**ime (starting from here we call it RT) is the time the sound takes after a burst to be reduced of 60dB respected the original level.

If the RT is longer at low frequencies, the room sounds hollow. If the RT is longer at the middle frequencies (200 to 500Hz) respect the other frequencies, the room will sound tubby.

If in a medium size room, the RT is constant with values around 1Sec. to the various frequencies, and the decay curves are regular (there are not big bumps or depressions) then the room is linear and can sound very well. Rooms with a RT of 1,5s represent the optimum situation.
Is a good rule that the RT at low frequencies can be a 30% higher than the other frequencies? This can be useful for the music in the churches where an organ sounds.

The quantity of sound, (Reverberation Time), how it changes at different frequencies and the outline of the decay curves at different frequencies, are the three elements that influence our perception about how a room sounds.

The Audioscope Model 3000 gives detailed informations of these three parameters, useful to ameliorate the acoustic of the room.

The Reverberation Time (RT60) function of the Audioscope Model 3000 instrument works sending in the room a Pink Noise burst and measuring -via the measuring microphone-, the level Vs. time of the reverberated signal.

The Pink Noise burst is sent in the room via an external amplification system that can be a single speaker. The speaker(s) are placed in the room.
If the room is provided with amplifiers and speakers, is only necessary to connect the Pink Noise output of the 3000 to the amplifier input.

- Set to the minimum level the amplifier volume control.

EXAMPLE OF USE OF THE RT60.

- Connect the 'Pink-noise' output of the 3000 to a High-Level input of the amplifier. (Line, Tuner, Aux. input).
- Set the generator output level of the Audioscope 3000 to a level compatible with the amplifier or preamplifier input. Please, remember that the generator output level is about 10Vpp at -10dBu. It is recommended to use low output levels (-30 ~ -35dBu) to avoid the saturation of the amplifier or the preamplifier input. This can cause damage to the tweeters.
- Connect the microphone to the instrument. The microphone can be positioned in the listening area.
- If the RT60 environment is not already active, select it thru the <MODE ANALYZER/RT60> key.
- Select the Micro Input <INPUT SEL-/+> keys.
- Set all Preamplifier and/or Equalizer tone controls on 'Flat'.
- Select the Pink-Noise burst time duration <INTEGR./BURST-/+> keys. This time must be set related to the room size where measurements must be made, and is proportional to the room size.

The burst time duration must be so that a sound emitted in one point of the room can run the distance of all walls, so that the presence of the sound in any point of the room is guaranteed.

In presence of a room of 5mt. x 6mt. x 3mt., the 'longer perimeter' is about 20 meters.
A sound emitted in one point of the room can run this perimeter length in about 80mSec. A multiplying factor of four can □ └ □ certainly guarantee a good room 'filling'. In a similar case, the Burst Time can be set at 0,4Sec. or more.

- Adjust the Pink-Noise amplification level. Please, remember that in the RT60 environment, the Pink-Noise generator is always in the OFF (MUTE) status, except when it is activated pressing the <START> key for the burst generation.

- Select the scale time of .5Sec full scale (<SCALE TIME> key), and do some measurements to adjust the speakers level and the measurement full scale level, to read the begin of the decay curve about at the full scale. (<SP-SP+> keys).

- Select the distance in meters between the speaker(s) and the measuring microphone (<DISTANCE> key).

- Select the scale time for the measurement. Small full-scale values (.5, 1Sec.) are for small rooms, and vice-versa. A room with dimensions of 4x5 meters can have a reverberation time of about one second, depending on the absorption; then a full-scale value of two seconds is proper.

- Select via the cursor keys the frequency you want to begin measurements. Bigger is the room, lower is the frequency to begin measurements.

- Press the <START> key to begin the measurement.

The instrument first activates the Pink Noise generator for the time corresponding to the Burst Time; at the end of the burst it will await the equivalent time occurring to the 'Direct Sounds' to reach the microphone position; after that it will read the 32 decay levels at the time interval indicated in the scale time.
At the end of each interval time, a short line is drawn on the screen at the measured level position.
At the end of the measurement, a complete histogram of 32 bars will be drawn on the screen.

If the decay curve falls down rapidly, this means that the measuring time is too much long. Select then a time scale with a lower full scale. Oppositely, if the decay curve continues to decay at the right limit of the graphic, is necessary to increase the time scale value.

Once a measurement have been made, it is possible to store data and result or to print graphics and tables.

If you want to make the same measurement at different microphone positions, is possible to store the curve, to activate the 'Compare' status, and to make the new measurement: the 3000 will show the two curves (the curve stored and the curve last made), this permitting to evaluate the differences.

MEASUREMENTS EVALUATION:

The variables that play in the quantity and quality of a sound reflecting in a listening room are so many that is not possible to give precise rules of evaluation. If you add to these premises the various compositions and nature of the rooms, is easy to realize that each situation is different of a similar one.

If the RT is congruent with the teorical values, and is the same at all frequencies and the curve outline is regular (there are not evident bumps or depressions), then the room is extraordinarily linear.
Is typical to find that the low frequencies (from 100Hz to 250Hz) are more reverberant of the high. Typically they are the 30% higher.
E.G. The RT60 at 2000 Hz = 1,00s; RT60 at 250 Hz = 1,30s
Readings like that indicate a correct room.

If otherwise one or more adjoining frequencies have a RT longer than the others, and/or show a decay outline not regular, we have a problem. At these frequencies the room reflects more than the other frequencies, reducing the sounds intelligibility.

The solutions to problems of bad reverberation of rooms are many. Once measurements have been made and discovered the frequencies to which the room reverberate and how much, is possible to use absorbent panels to reduce the quantity of the reflected sound.

This can help to deaden the room but not to solve the problem. It can be useful to use an acoustic trap on the unwanted frequencies (or it is possible to differently position furniture or other furnishings).

If, otherwise, we try to solve the problem with an octave or third-of-octave equalizer, we suppress a frequency portion too.

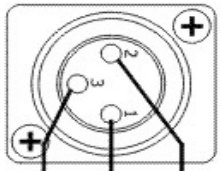
What really happens in the room at these frequencies is that the notes at these frequencies continue to be present longer than the notes that follow.
The care can be that to use a good notch filter, or a parametric equalizer able to build steep notch filters.

Inserting a steep notch filter of 1/12 or 1/24 of octave) to eliminate (-15 /-30 dB) the central frequency of the problem area, the quality of the sound can really ameliorate.

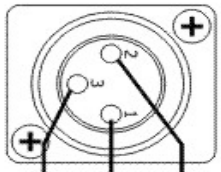
AUDIOSCOPE Model 3000 - User Guide.
I/O Connectors.

PIN CONFIGURATIONS:

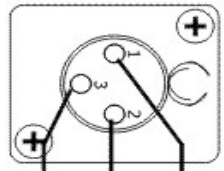
Micro Input Connector



Line Input Connector

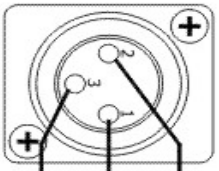


Generator out Connector

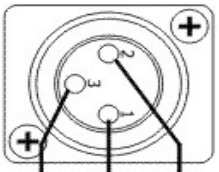


PIEDINATURA CONNETTORI:

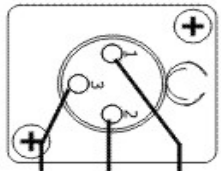
Connettore Ingressi Micro



Connettore Ingressi Linea



Connettore Uscita Generatore



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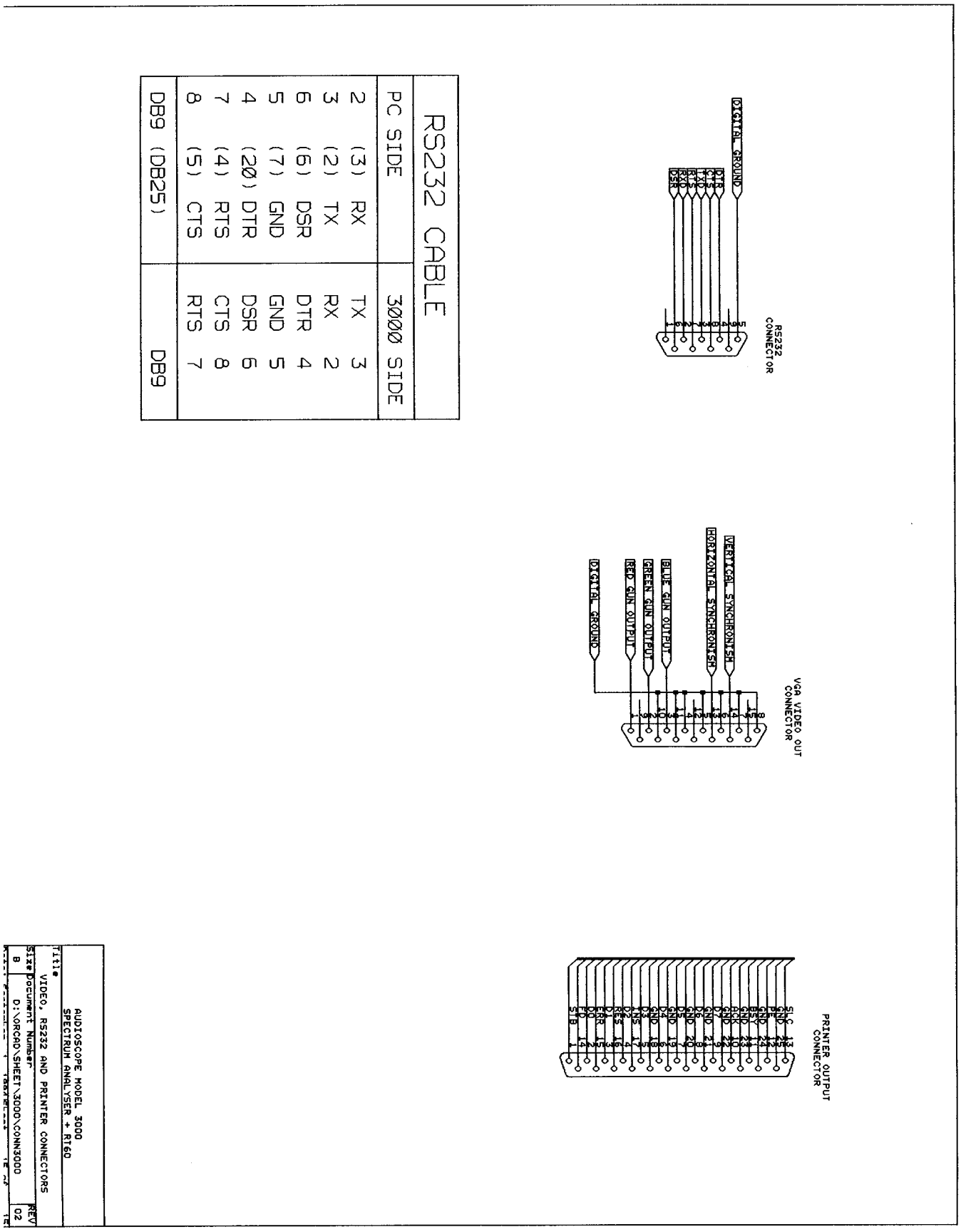
AUDIOSCOPE Model 3000 - User Guide.
RS232 Connections.



RS232 CABLE	
PC SIDE	3000 SIDE
2 (3) RX	TX 3
3 (2) TX	RX 2
6 (6) DSR	DTR 4
5 (7) GND	GND 5
4 (20) DTR	DSR 6
7 (4) RTS	CTS 8
8 (5) CTS	RTS 7
DB9 (DB25)	DB9