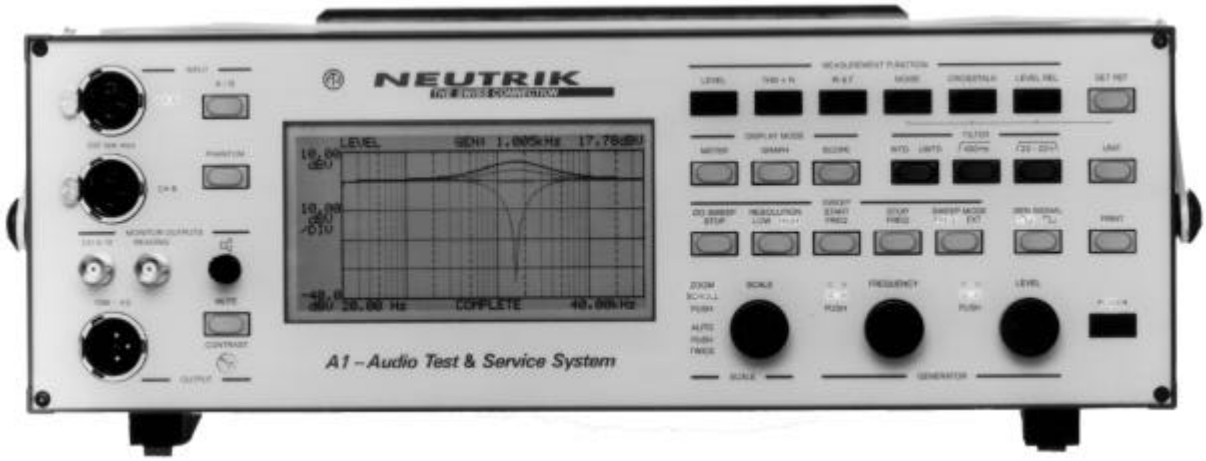
User Manual

A1

Audio Test & Service System



Version 2.0e

NEUTRIK CORTEX INSTRUMENTS
AUDIO ANALYZERS+PSYCHOACOUSTICS

Mar. 98 / V2.0 / PhS, MBe
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INTERNATIONAL WARRANTY

Limited Warranty

NEUTRIK guarantees the A1 Audio Test & Service System and its components against defects in material or workmanship for a period of one year from the date of original purchase for use, and agrees to repair or to replace any defective unit, at no cost for either parts or labor.

Important

This warranty does not cover damage resulting from accident, misuse or abuse, lack of reasonable care, the affixing of any attachment not provided with the product, loss of parts, or connecting the product to any but the specified receptacles. This warranty is void unless service or repairs are performed by an authorized service center.

No responsibility is taken for any special, incidental, or consequential damages.

Take, or ship prepaid, your NEUTRIK A1 Audio Test and Service System to your nearest authorized service center. Be sure to include your sales invoice as proof of purchase date. All transit damages that may eventually occur are not covered by this warranty.

Note

No other warranty, written or oral, is authorized by NEUTRIK.
Except as otherwise stated in this warranty NEUTRIK makes no representation or warranty of any kind, expressed or implied in law or in fact, including, without limitation, merchasing or fitting for any particular purpose and assumes no liability, either in tort, strict liability, contract or warranty for products.

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This instrument has been designed according to IEC Publication 348, class I, "Safety requirements for Electronic Measuring Apparatus". The owner's manual contains information for safe operation which should be followed by the user.

CE DECLARATION OF CONFORMITY

We, the manufacturer

NEUTRIK AG
Im Alten Riet 34
FL-9494 Schaan

hereby declare that this product was designed and manufactured in accordance with the basic security- and health-requirements of EC-rules

73/23, 89/336, 89/392, 91/368, 92/31, 93/44 and 93/68.

This declaration becomes void in case of any changes on the machine without written authorization by us.

Product name	Analog Audio Measurement System
Type	A1
Year of construction	1991
Applied harmonized standards, in particular	- IEC 65, IEC 68-2-31, IEC 348 - EN50081-1, EN50082-1, EN50140, EN 61010-1

Date / signature of manufacturer Schaan, 28. 02. 1995

Position of signatory Product manager test instruments

CE

Samples of this instrument have been tested and found to conform with the statutory protective requirements. Instruments of this type thus meet all requirements to be given the CE mark.

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INTRODUCTION

Important User Information

The A1 complies with Part 15 of the FCC rules. Operation is subject to the following two conditions

- This device may not cause harmful interference.
- This device must accept any interference received, including interference that may cause undesired operation.

This device produces RF energy and is intended for use only in a commercial environment. If the unit is used in a residual setting, then the user is responsible for correcting any interference which may result. Any user modification can void the authority granted by the FCC to operate the equipment.

How to Use this Manual

This Users Manual has been designed with you, the operator in mind to serve as a complete reference document for using the A1 as a solution to your measurement needs. Maintenance procedures such as installation are placed at the beginning of the manual while not often required tasks such as re calibration are given at the end of the manual.
Familiarize yourself with the A1 by looking through this manual. The best way to feel at ease with the instrument is to sit down with this manual and the A1 and follow the chapters "Installation" and "Using the A1". It won't take long to become familiar with the instrument and its many features.

Brief Overview on the A1

The NEUTRIK A1 is a flexible, powerful, accurate and easy-to-use audio measurement system. It measures

- Level (absolute) in µV, mV, V, dBV and dBu or dBm
- Level relative in *1, % and dBr
- Total harmonic distortion & noise (THD+N) in % and dB
- Wow and Flutter in %
- Noise (absolute) in µVq, mVq, Vq and dBq
- Noise relative in *1, % and dBr
- Crosstalk (absolute) in µV, mV, V, dBV and dBu or dBm
- Crosstalk (relative) in *1, % and dBr
- Frequency in Hz
- Phase in the range of ±180° degree (*available with installed AO2 option only*)

Results are shown on a large, backlit graphics LC-display. Individual measurement results are displayed in digits, while sweeps are shown graphically.

Another, very powerful diagnostic aid of the A1 is the SCOPE mode, that displays the waveform of the input signal on the LCD just like on a conventional oscilloscope. In the THD+N function, the original input signal *and* the distortion residual are shown as two traces. In other functions, the measured signal is shown as a single trace.

The contents of the display can be printed out at any time to an ordinary dot-matrix printer to provide hardcopies e.g. of frequency responses or signal waveforms.

All measurements - except noise - are made after true RMS conversion of the input signal. Noise is quasi-peak measured according to CCIR 468-3. Both a 400 Hz high-pass and a 22Hz-22kHz band-pass filter are available as a standard.

The two inputs of the A1 are DC-isolated to ±100V, and equipped with both a standard input impedances of 100kΩ and a Phantom power supply.
A small, built-in loudspeaker allows acoustical monitoring of the input signal.

The internal oscillator may generate sine or square signals from 20Hz to 40kHz, and is able to sweep in coarse or fine steps. Its 0Ω output impedance makes it suitable for feeding even loudspeakers directly.

Sweep ability is available for Level, THD+N, Noise, Crosstalk, Phase and Relative Level functions. Sweeps can be controlled from the built-in generator or from external sources (e.g. test tapes, test CDs, or remote A1s at other locations).

INSTALLATION

Before being switched On, the A1 has to be connected to an appropriate AC mains supply and to a printer if desired.

Inventory

Your new A1 comes along in a box together with some accessories. Please check its contents to be sure that you have received

1 A1 Audio Test & Service System.
1 Front panel protection cover.
1 Power cable with the chassis connector attached to the cable.
2 19" rack mount wings.
1 This user manual.

Please keep both the box and front panel protection cover in case that it ever becomes necessary to ship the A1.

Options & Accessories

The subsequent table lists all optionally available items for the A1. Please contact your local representative for further details.

Code	Article
AO1	RS232 interface with software package AS03. Allows remote control of A1 and enhances the functions of the instruments. A very easy-to-learn programming language (AMSL) allows to build up sequences and PASS/FAIL tests.
AO2	Phase board for 2-channel level and phase measurements. Allows phase sweeps. Phase range ±180°
AO3	Selectable input impedance. Replaces standard Phantom power by selectable 150Ω, 600Ω and 100kΩ input impedances for one channel.
AO4	A-weighting filter according to IEC651.
AO5	User definable filter. Allows wiring of up to 4 opAmps and passive components to configure special filter characteristics.
AO6	-100dBu generator to extend the output range from -77dBu to -97.7dBu. Improves THD+N measurements at low levels.
AO9	Trigger output to provide a trigger signal at a BNC connector, indicating zero transition of the output sine signal.
AA10	Soft carrying bag for protection of the A1 with pouch for cables and connectors. Allows in-bag operation of the instrument.
AA13	Spare parts kit, containing the most commonly used spare parts to cover the average lifetime requirements for 3 A1 units. More than 235 parts.

Power Connection

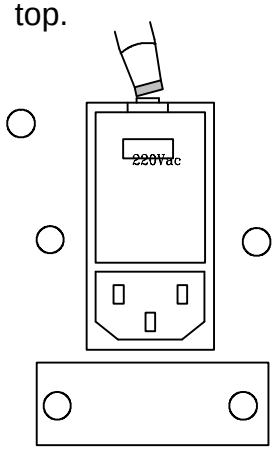
The mains power cable has an unconnected end with three colored leads. These correspond to

Brown	=	Live
Blue	=	Ground
Green/Yellow	=	Earth

Attach a mains plug to the cable that fits the receptacles of your country.

NOTE	**Before connecting power to the A1 make sure that the power source matches the power requirements, as marked on the connector/fuse holder assembly on the chassis rear. If the instrument is incompatible with the available power source, go through the following paragraph to adjust the power requirements.**

The A1 can operate from 100VAC, 120VAC, 220VAC and 240VAC. To re-configure the mains power voltage, remove the mains cable and open the flap of the connector/fuse holder assembly by pressing a small screwdriver into the slot on the top.



Take out the drum and insert it in the new position. The label pointing towards the operator indicates the selected mains power voltage.

At the same time, a fuse with the proper current rating must be installed. For 100 / 120 VAC, a 2A fuse has to be used, while for 220 / 240VAC, a 1A fuse is required.

After installing the proper fuse and setting the desired line voltage close the flap and insert the power cable.

The A1 is designed with a protective ground (earth) connection through the ground wire in the power cord. This connection is essential for safe operation.

HINT	**There are four more 1AT fuses inside the A1 for safety reasons. They are accessible by opening the top and bottom cover of the unit. Disconnect from mains power before opening the unit.**

Printer Connection

The printer connector is on the back panel of the A1. It is a 25-pin female D-type connector - the same as in IBM compatible PCs. For the settings of the various printer drivers, please refer to chapter ***Printouts***.

INPUT & MONITOR CONNECTORS

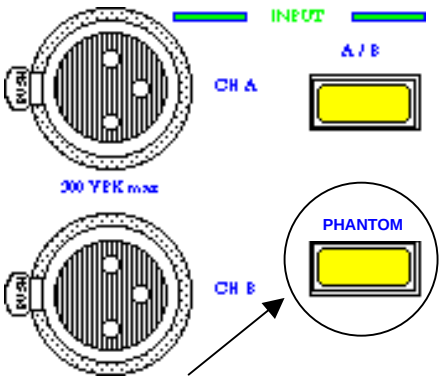
The A1 is a 2-channel system by means of having 2 switchable input channels A & B. This allows the alternating measurement of 2 independent signals without the need to change cables. The selected (active) channel is displayed by an illuminated LED behind the CH A / CH B labels.
With installed phase option (AO2), it becomes possible to measure the phase shift between both input signals, or the level of both input channels in parallel.

Input Wiring of Phantom Supply

Normally, both input channels are fully balanced at an impedance of 100kΩ / 50pF. Alternatively, the built-in +15V Phantom power supply via 1kΩ can be activated. This allows e.g. the use of capacitor type microphones & preamplifiers as the NEUTRIK 3382 measuring microphone.

Selectable Input Impedances

NEUTRIK offers an option for the A1 to have 2 additional input impedances insatalled instead of the Phantom power supply. In this case, the <PHANTOM> key swops through the 3 available impedances 100kΩ, 600Ω and 150Ω. The actual choice is displayed in the bottom line of the METER display.



The Phantom power may be switched On and Off by pressing the <PHANTOM> key on the right hand side of the CH B input connector.
A red LED will light up as soon as the Phantom power is active.

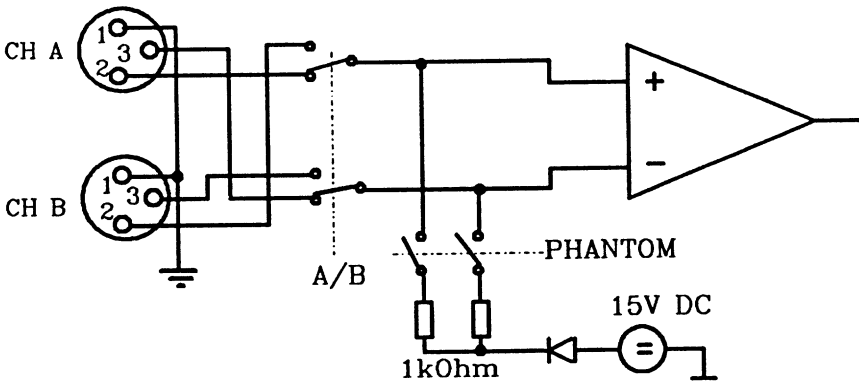


Fig 1 Input Circuitry & Phantom Power

Balanced Signals

The device under test (DUT) is connected between pin 2 (IN +) and pin 3 (IN -). The shield may be connected to pin 1.

Keep in mind not to ground the shield on both ends of the cable.

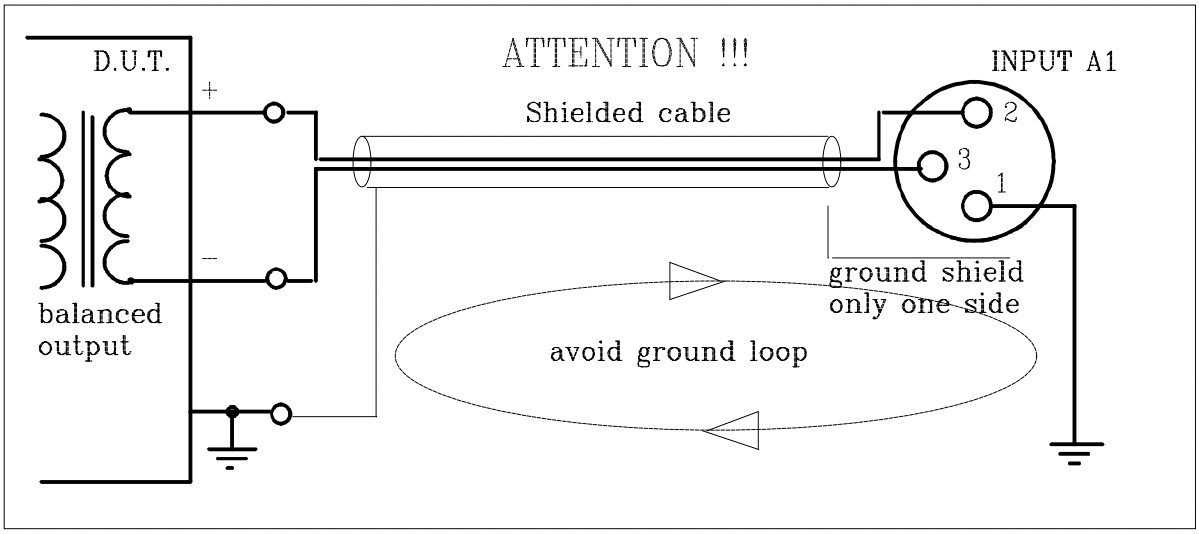


Fig 2 Balanced Connection to the A1

Unbalanced Signals

The device under test (DUT) is connected between pin 2 (Signal +) and pin 3 (GND). Do not connect pin 1 and pin 3 together as long as you are not absolutely sure that the GND output of the DUT is galvanically isolated from earth. If in doubt leave pin 1 of the A1 unconnected to avoid earth loops.

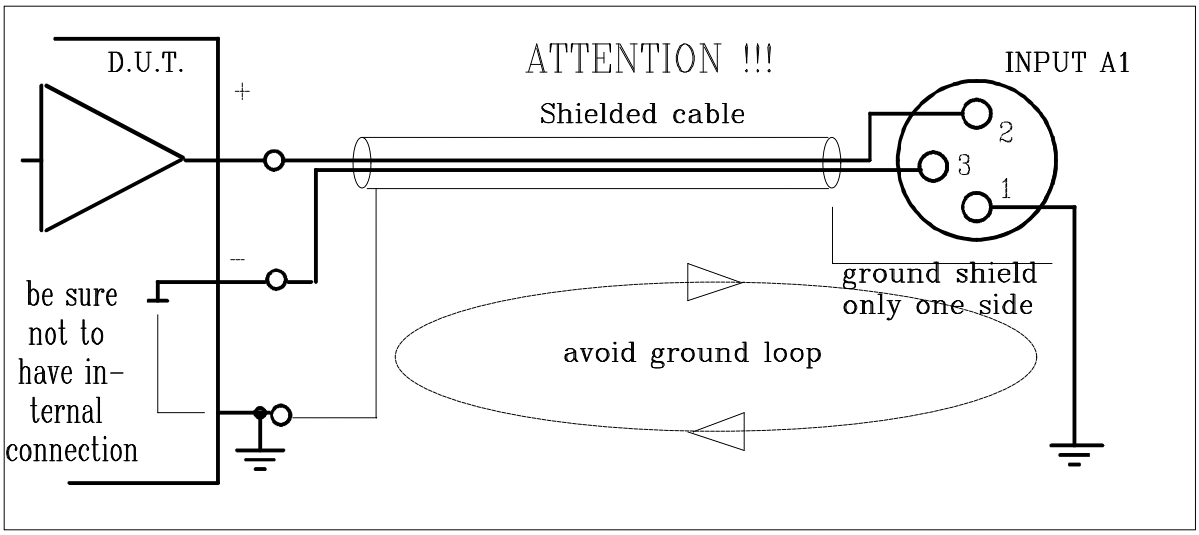


Fig 3 Unbalanced Connection To The A1

Monitor Outputs

The "CH A/B" monitor output (BNC connector) provides the unbalanced signal of the active input connector just after the first internal preamplifier/attenuator stage.

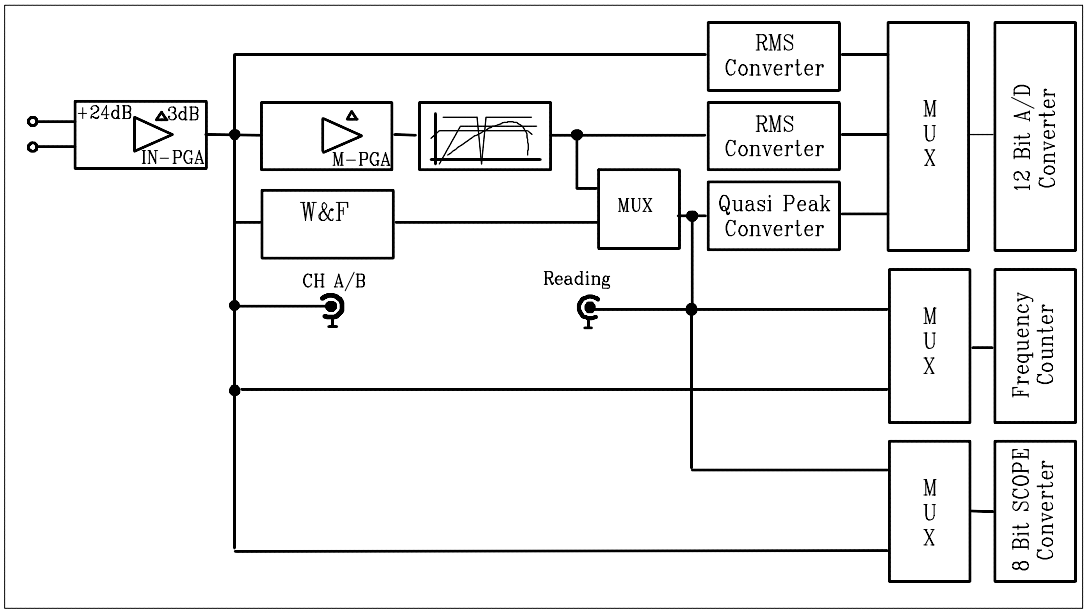


Fig 4 Block Diagram Input Stage

The READING monitor output (BNC connector) permanently provides the input signal after its amplification and filtering, but before the measuring circuit. Depending on the selected measurement function, the READING signal may be almost the same as the CH A/B monitor signal (e.g. in LEVEL mode), or differ clearly from it (as soon as a filter stage is involved as e.g. in THD + N mode).

The READING signal is also used for the internal loudspeaker. Its volume can be adjusted by the poti marked with the loudspeaker sign.

Both CH A/B and RREADING monitor signals may help to qualify a measurement. However, since these two outputs are not calibrated, they shall not be used as measurement outputs.

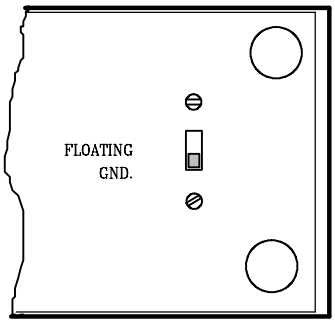
THE GENERATOR

The A1 has a built-in high quality audio generator to stimulate the device under test with different signals.

The features of the generator are

- Sine, Square and W&F Test signal
- *Output voltage* 200µV-10V (-71.7dBu to +22.2dBu)
- *Frequency range* 40Hz-15kHz
- *Output impedance* < 0.2###, 150###, 600### (switchable)
- *Output power* 10W into 4Ω (low output impedance)
- *THD + N* < -86dB (-92dB typ.)
- Fast setting through softwheels
- Mute function for generator output
- Sweepable

The output amplifier is built as a bootstrap amplifier with a virtual ground. Depending on the measurement application, this reference potential can be connected to GND (earth) or can be kept floating.



The switch to choose the option is located on the back panel of the A1.

FLOAT ties the amplifiers to zero potential floating.

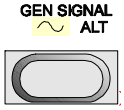
In GND position, the zero potential of the amplifier and the chassis ground are connected.

Setting The Generator

Press the <METER> key to have the best overview on the generator settings and activate the LEVEL function.

NOTE	**The generator settings can be changed in any display mode and measurement function.**

The METER display shows the generator settings and the level value of the measured input signal. In the absence of an input signal, the reading will be unstable.

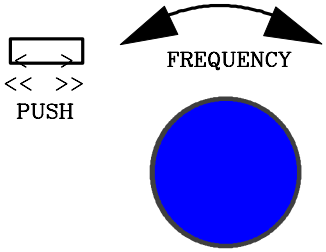


The <GEN SIGNAL> key will have either the sine or the square wave symbol illuminated by a LED. If you want the other setting, push the button once.

In SQUARE mode, the duty cycle of the output signal is 50% by default. However, for applications where the polarity changes of a signal shall be investigated, it is necessary to have a duty cycle different from 50%. For this purpose, the A1 can be set to 40/60% duty cycle. Please contact your local NEUTRIK representative for further details.

Generator Frequency

The generator frequency is adjusted through the <FREQUENCY> softwheel. Turn it counter-clockwise to reduce the output frequency, or clockwise to increase the frequency. The limits of 20Hz and 40kHz cannot be exceeded.



The frequency does not change continuously - as e.g. with a poti-controlled analog generator - but in a series of discrete steps. Pushing the softwheel toggles the step size between *coarse* (« ») and *fine* (< >). The selected mode is indicated by a LED behind the two signs.

- In the *coarse* mode, a quick turn causes the generator to jump to the next frequency of following list

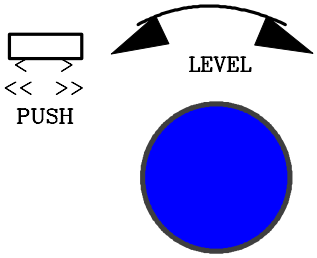
  20Hz ↔ 100Hz ↔ 1kHz ↔ 10kHz ↔ 40kHz

  while a slow turn increases / decreases the frequency by 12.25%

- In the *fine* mode, a quick turn causes the generator to jump in 3rd-octave steps, while a slow turn increases / decreases the frequency by 0.5%.

Generator Level

The generator level is controlled through the <LEVEL> softwheel.



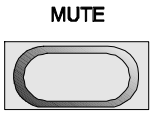
Slow turns of the softwheel result in level steps of ±2dB (coarse mode) or ±0.05dB (fine mode).

The absolute limits of +22.2dBu / -73.9dBu cannot be exceeded.

- In the *coarse* mode, a quick turn causes the generator to jump by ±20dB in logarithmic units (dBu or dBV), and by decades (factor 10) in the linear (V) unit. Slow turns change the output level in ±2dB steps or by 25.9% respectively.

- In the *fine* mode, quick turns result in jumps of ±2dB or a factor of 2 / 2.5, while slow turns let the generator jump in increments of ±0.04dB / 0.5% respectively.

Channel Muting



The <MUTE> button right of the output connector allows to switch Off the output signal. This feature is very helpful to switch Off the generator signal without disconnecting the cable.

When muted, the output line is galvanically disconnected from the generator, but still terminated with the selected output impedance (either 0###, 150###, or 600###) to produce the lowest possible output level.

Generator Overload

Should it ever happen, that due to a short circuit the power output amplifier will become overheated, the generator will mute automatically . The red MUTE indicator will be illuminated in such cases and an error message appears on the display.

GENERATOR MUTED Wait 1 minute

Please check for the cause of the overload before unmuting the generator.

DISPLAY MODES

There exist three different display modes which can be selected by the DISPLAY MODE buttons of the keyboard. The default display after power up depends on the selection stored in the nonvolatile memory of the system (refer to section ***Frontpanel Setup*** for further details).

METER Mode

The display provides all the necessary generator and analyzer information for the selected measurement. Additionally, the display shows some helpful information about the generator status on its top line and, on the bottom line, the level and frequency of the input signal.

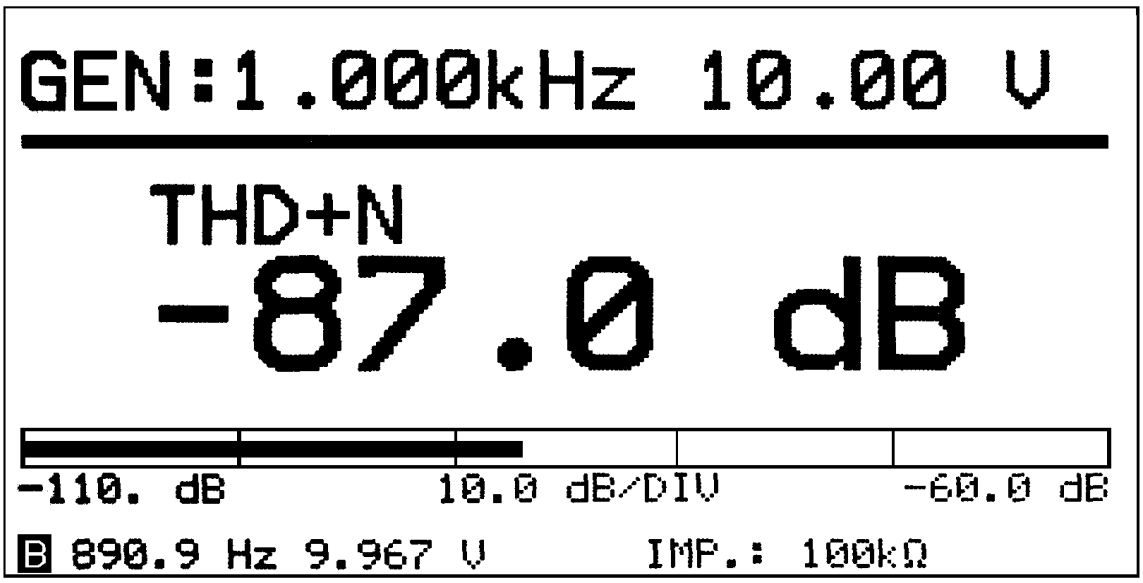


Fig 5 Example of a METER Display

The Generator Settings

On top of the METER display, the output voltage and frequency of the generator are displayed permanently. The unit of the frequency (Hz) cannot be influenced by the operator. The unit of the output voltage level can be changed only by pressing the <UNIT> button in the LEVEL measurement function (refer to ***Unit Selection***).
The setting of the generator is described in chapter ***Setting The Generator***.

The Measurement Results

The results of the actual measurement function are displayed in large figures numerically and below as a bargraph in analog form.

The bottom line of the METER display provides additional information about the active input channel, its input level, frequency and the selected input impedance.

Unit Selection

The unit, in which the measurement result shall be expressed, can be selected by pressing the <UNIT> button on the right hand side of the front panel. Each keypress steps to the next available unit. If there are no alternative units (e.g. in measurement function W&F), pressing the <UNIT> button has no effect.

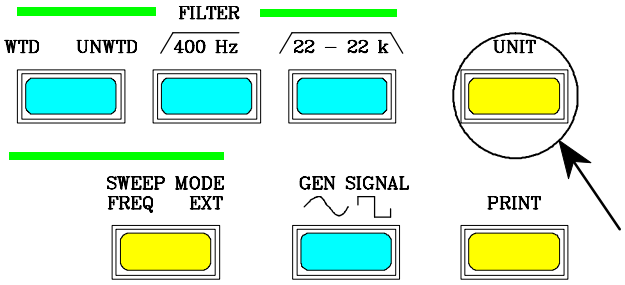


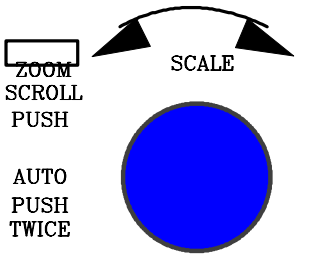
Fig 6 Location of the <UNIT> Button

Analog Bargraph

The analog bargraph displays the actual measurement result in an analog way. This display may be very helpful to watch trends and tendencies of a signal (e.g. when doing adjustments to minimize or maximize a signal).
The scaling of the bargraph is automatic in the AUTO mode, but it can also be adjusted manually by swopping into the ZOOM and SCROLL mode (see below).

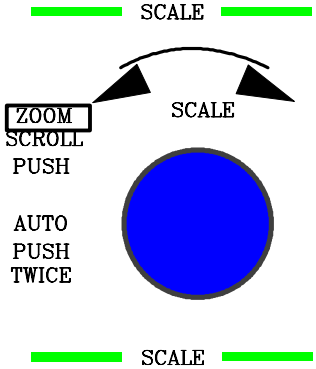
Change the Bargraph Sensitivity

The leftmost wheel, labeled <SCALE> gives you the possibility to set the bargraph to your needs. If SCALE mode is set to AUTO, a single push on the <SCALE> softwheel swops it into the ZOOM mode. Each further push to the <SCALE> softwheel toggles between ZOOM and SCROLL.



In the ZOOM mode, every step of the <SCALE> softwheel increases / decreases the sensitivity of the bargraph. The selected sensitivity is displayed in the middle below the bargraph.

The used units are the same as in the digital display and can be changed with the <UNIT> button (see above).



In the SCROLL mode, every step of the <SCALE> softwheel scrolls the scale of the bargraph one division (selected with ZOOM) upwards or downwards. The actually selected range is displayed below the left and the right end of the bargraph.

To set the SCALE mode back to AUTO mode, push the <SCALE> softwheel twice quickly (double click). The selected function is always indicated by a LED behind the respective label.

Please notice that the contents of the METER display can be printed by pressing the <PRINT> button. The printout contains all relevant information to document the measurement result.

```
---------------------------|---------------------|-------------------------
Input:  2.007 V / 3.152kHz | Filter:             | N.REL   8.192dBr
Output: 2.007 V / 3.152kHz |  Unweighted         |        Ref. = 774.5mV
---------------------------|---------------------|-------------------------
```

Fig 7 Printout Example of the METER Display

The INPUT Display

The bottom line of the METER display comprises the active channel and the input frequency & voltage, measured just behind the first internal preamplifier/attenuator stage of the A1. Additionally, the selected input impedance is indicated.
The INPUT display is very helpful for two reasons. First, it permanently displays the measured input signal frequency & level, regardless of the actual measurement function. Second, it provides additional information about the unfiltered input signal and may thereby help you to interpret your measurement results more thoroughly.

If the input signal is too small or too noisy to be measured accurately, "INP LOW" is displayed.

GRAPH Mode

The A1 can do more than just to measure and display single results. A built-in curve tracer allows to measure and display sweeps over a certain frequency range or time period.
To enter the GRAPH mode, press the <GRAPH> button. The GRAPH display will automatically plot the last trace, supposed that it has been recorded under the actual measurement function.

The different sweep setups may be selected through the <RESOLUTION>, <START FREQ> and <STOP FREQ> keys. To start a new or stop a running sweep, press the <DO SWEEP> key. Please refer to chapter ***Sweeps*** for further details.

Please notice that it is also possible to display several recorded sweep curve on the same graph. To do this, the GRAPH mode must not be left, the SCALE mode has to be set to ZOOM or SCROLL and the <SCALE> softwheel must not be touched.

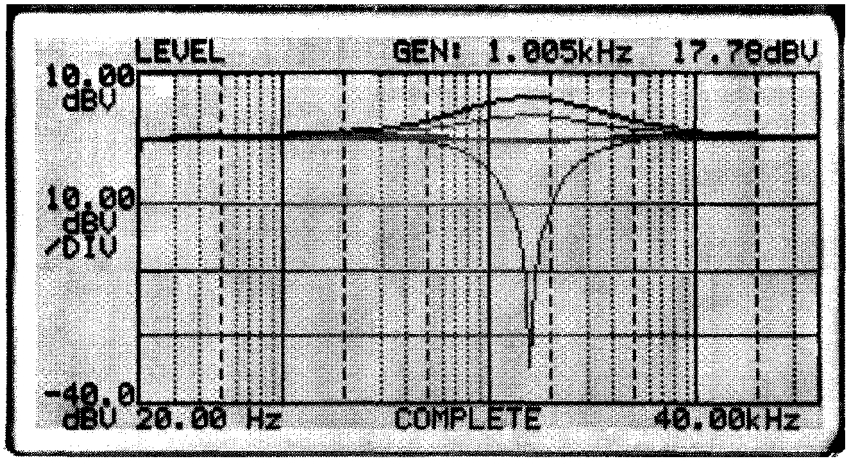


Fig 8 Example of a GRAPH Display

The actual measurement function is displayed on the top line of the GRAPH display, together with the running generator frequency and the selected output level.
The bottom line shows the start & stop frequencies of the X-axis. The displayed "LOG" indicates, that the frequency axis has a logarithmic scaling.

The unit of the Y-axis (i.e. measurement function) may be changed through the <UNIT> button. Each keypress steps to the next available unit.

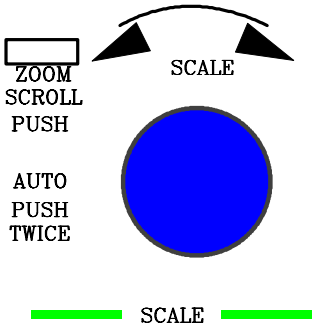
Cursor Function in Graph

When turning the <FREQUENCY> softwheel after having recorded a sweep curve, a crosshair becomes visible in the graph. The X-position of this cursor follows the generator frequency, displayed on the bottom line, together with the corresponding Y-result. You may change the frequency steps between *fine* and *coarse* as explained in chapter ***Generator Frequency***.

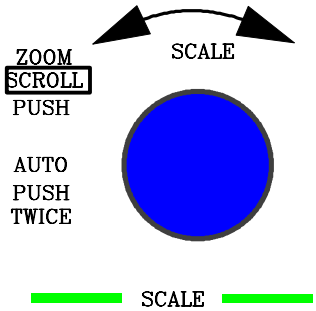
The cursor disappears as soon as the upper or lower end of the frequency axis is reached and it reappears as soon as the generator frequency is within the displayed frequency range of the graph. The cursor will not be printed out.

Y-Scaling

The leftmost wheel labeled with SCALE gives you the possibility to set the Y axis in GRAPH mode to your needs. If SCALE is in AUTO mode then the A1 calculates the appropriate scale itself. To leave the AUTO mode, push the SCALE wheel once. Each further push to the SCALE wheel toggles between ZOOM and SCROLL.



In the ZOOM mode, every incremental turn of the <SCALE> softwheel increases / decreases the sensitivity (units per division) of the Y-axis.
The selected sensitivity is displayed in the middle of the Y-axis.



In the SCROLL mode, every incremental turn of the <SCALE> softwheel scrolls the contents of the graphics one division (selected with ZOOM) upwards / downwards. The borders of the actually selected range are displayed at the bottom and top of the Y-axis.

Each change of the SCROLL or ZOOM settings automatically redraws the complete trace in the new scale.
Nevertheless, the values of the main trace are not modified, so no information is lost upon changes of the scaling.

To set the SCALE mode back to AUTO, push the <SCALE> softwheel twice quickly (double click). As soon as the A1 has returned to the AUTO mode, an automatic zoom & scroll is performed.

The GRAPH display can be printed out by pressing the <PRINT> key.

X-Scaling

The span of the frequency axis may be changed before or after having recorded a sweep curve. In both cases, the lower und upper boundary may be selected by setting the generator to the respective frequency and pushing the <START FREQ> or <STOP FREQ> button respectively.
If a curve has been already recorded, it is redrawn automatically. Please note that the curve is not measured again - it is just redrawn in the new frequency range. Refer to chapter ***Sweeps*** for more information.

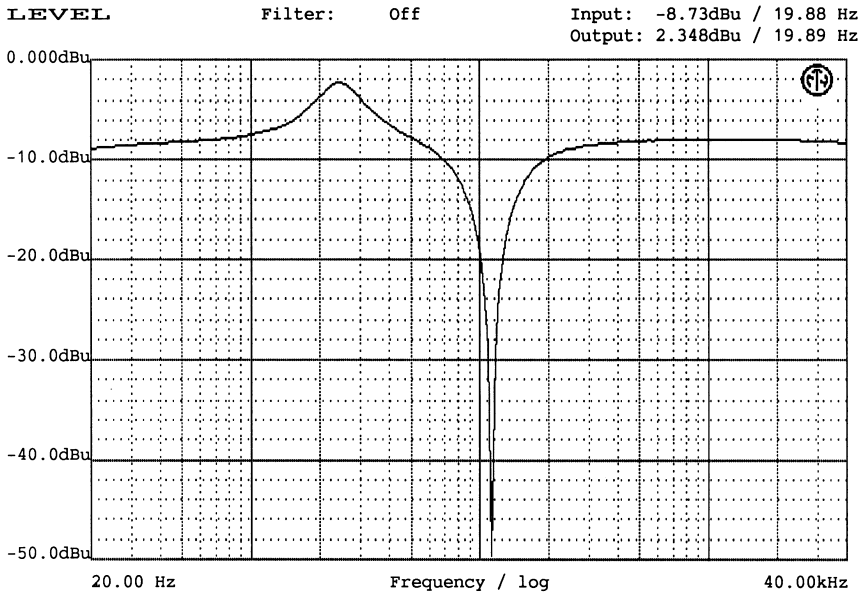
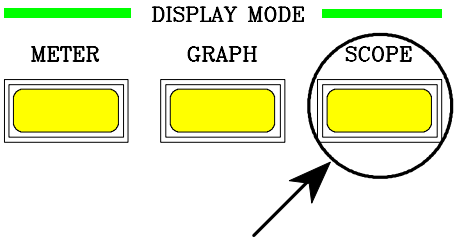


Fig 9 Example of a Printed GRAPH Display

SCOPE Mode

The SCOPE display mode is one of the most powerful features of the A1. Apart from making an input signal audible through the built-in monitor loudspeaker, the SCOPE mode allows you to make the waveform of the signal visible as well.



To enter the SCOPE mode, simply push the <SCOPE> key.
Consequently, the waveform of the actual input signal will appear on the display.

In the THD+N measurement function, two traces are displayed in parallel. The bigger one is the complete signal before the fundamental is removed, while the smaller one is the distortion residual. Both displayed traces are synchronized, so that the waveform is stable and can be inspected. However, please be aware that the filter, which removes the fundamental, also causes a phase shift between the harmonic frequency and the distortion residual. This effect is most powerful at the second harmonic.
In the PHASE measurement function, the SCOPE display shows both traces of channel A & B. In all other measurement functions than THD+N and PHASE, only the input signal before the RMS rectifier will be displayed.

The X- and Y-scales of the SCOPE screen are set automatically. There is no possibility to change them.
The measurement function as well as the generator frequency & level are displayed on the top line of the screen.

The data for the oscilloscope function is captured at the rate implied by the display. Equivalent time sampling is not used. Therefore, displays remain genuine even with non-repetitive waveforms.

To analyze changing signals, the display can be frozen by a second push to the <SCOPE> button. The additional label STORED indicates this state. A further push to the <SCOPE> button leaves this state.

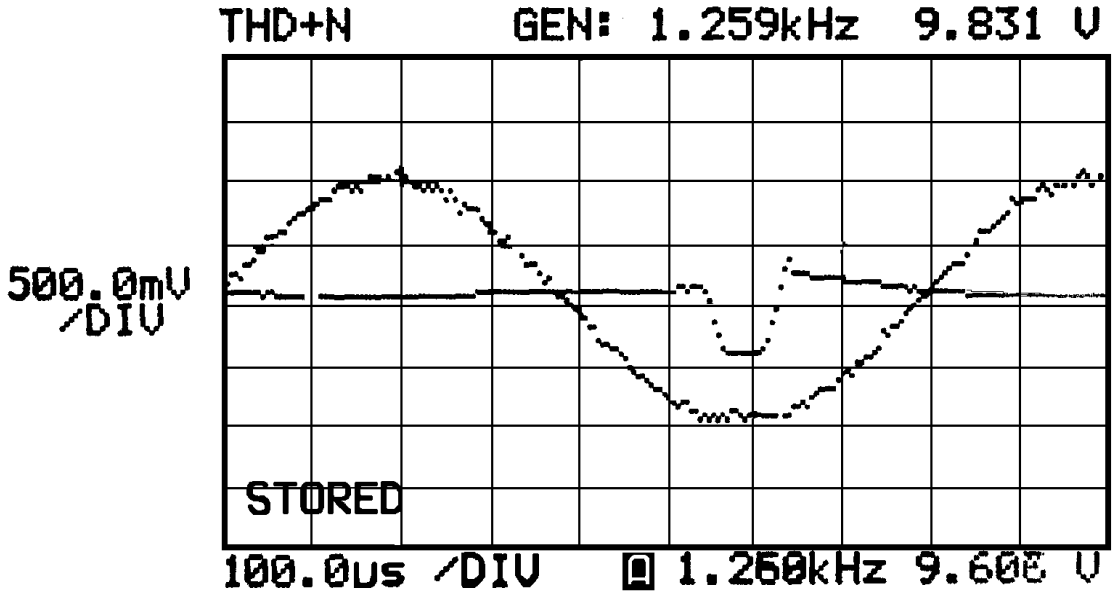


Fig 10 Example of a Stored SCOPE Trace

Like all other display modes, the SCOPE screen can be dumped to a connected printer by pressing the <PRINT> key. In the two-trace mode (THD+N), only the distortion residual is printed out.
During the print-out, the display frozen to speed-up the process. Nevertheless, the operator can stop this state by a double-press to the <SCOPE> button to watch the trace even during printing, but with the effect of a slower print-out. See chapter ***Printouts*** for details about the printer settings.

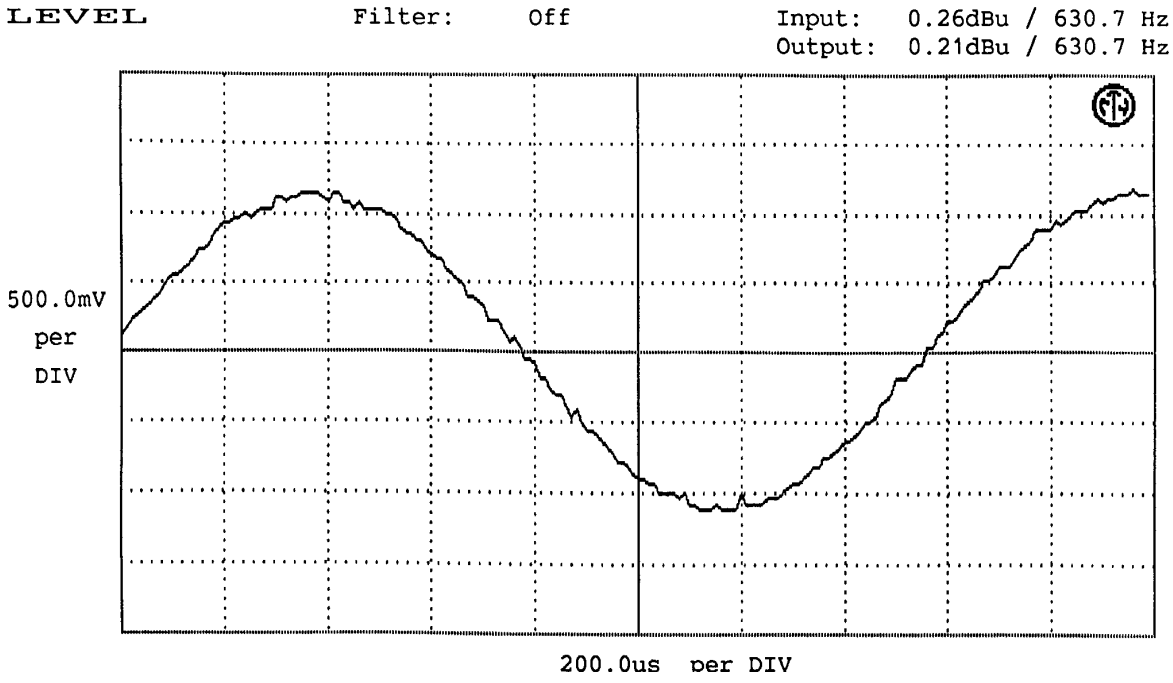


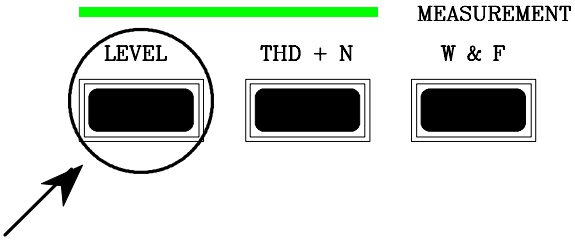
Fig 11 Printout Example of a SCOPE Screen

THE ANALYZER

LEVEL Function

The LEVEL function allows you to execute absolute level measurements. Relative level measurements are described in chapter ***LEVEL REL Function***.

To learn more about swept level measurements (frequency responses), read this chapter and then chapter ***Sweeps***.

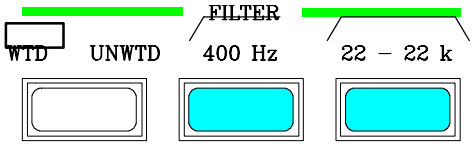


Press the <LEVEL> and the <METER> button. The display will then show the generator frequency & level in the top line, and the measured level of the active signal in large letters.

Press the <UNIT> button to select the unit in which the measured level shall be expressed. The unit will swop through dBu, dBV, and V / mV / µV (depending on the input level), for both the generator level display and measurement result.

Filters

The A1 has two standard filters available for level measurements. The 400Hz highpass filter and the 22Hz-22kHz Audio bandpass filter. The Audio bandpass is built by a 3rd order lowpass-filter at 22.4 Hz and a 3rd order highpass filter at 22.4 kHz. The 400 Hz highpass filter has also 3rd order and therefore an edge steepness of 60dB/decade.
Either one or both standard filters may be activated. Just push the related button, and the corresponding LED will light up. Be aware that the full measurement bandwidth of the A1 without activated filter is limited to 130kHz.



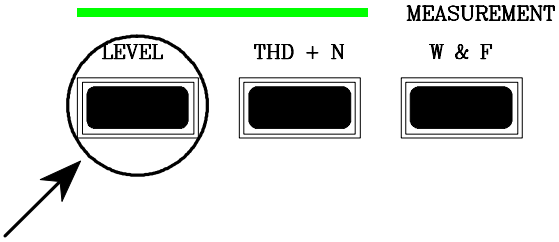
The A1 is prepared to handle one additional weighting filter for LEVEL measurements. If this option is installed, the button <WTD UWTD> may be pressed to loop the filter into the measurement path.

Keep in mind that the optional filter may be activated exclusively only, i.e. that it will switch Off the bandpass / highpass filter automatically.

LEVEL REL Function

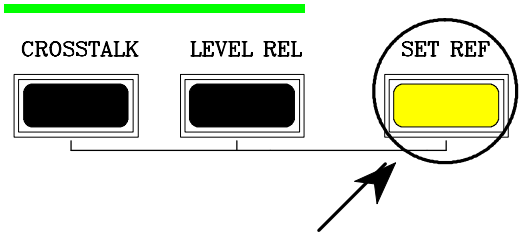
The LEVEL RELATIVE function is an extension of the Level function, allowing to set the 0 dB reference to any input level.

As described above for the LEVEL function, ensure that no sweep is running, and set the display mode to METER.



Press the <LEVEL> button. On the display, below "L.REL" the measured relative level will be shown.
Please notice, that both the generator & input level will continue to be measured in absolute terms.

The <UNIT> button cycles through dBr (dB relative), %, and *1.



Every level relative measurement is made against a reference level. To set this level, apply the desired reference level to the active input and press the <SET REF> button. Consequently, depending on the selected unit, the display will show 0.00 dBr, 1.000 *1 or 100.0%.

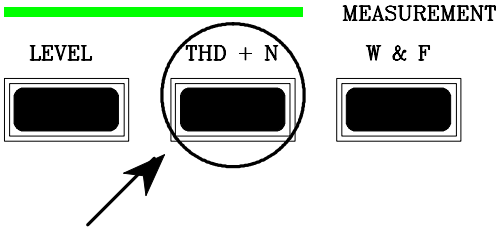
To measure e.g. the channel balance of stereo equipment, apply its output signals to the two inputs of the A1. Make the input of the reference signal (usually left) to the active channel and push the <SET REF> button. Then make the other input to the active channel and read out directly the channel balance.

Positive level relative results, expressed in dBr, show that the currently measured level voltage is above the reference level, while the inverse applies for negative results.

THD+N Function

The A1 measures THD+N by inserting a notch filter into the signal path. This notch filter is automatically tuned to the frequency of the main component (i.e. the fundamental frequency) of the incoming signal. The fundamental frequency is removed, leaving everything else, i.e. harmonic distortion and noise, to be measured. The measured value is referred to the level of the incoming signal to give a result in % or dB.

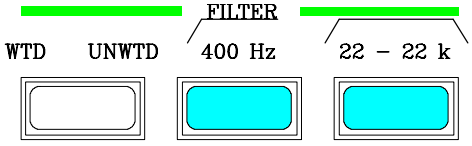
The A1 is able to measure THD+N of fundamentals up to 40kHz. However, for most systems, measuring THD+N above 9kHz is pointless.



Make sure that no sweep is running, set the display mode to METER and press the <THD + N> button.
The display will show the measured THD+N result in large letters, except that the input signal is too small, so that "INP LOW" will appear.

Filters

The 400Hz highpass filter can be very useful in the THD + N function in order to remove mains hum and its harmonics from the result. However, don't measure THD+N of fundamentals below about 250Hz with this filter in, since in this case the second harmonic would be attenuated, causing inaccuracy of the measurement result.
The bandwidth of THD+N measurements with an A1 is 130kHz (no filter active).

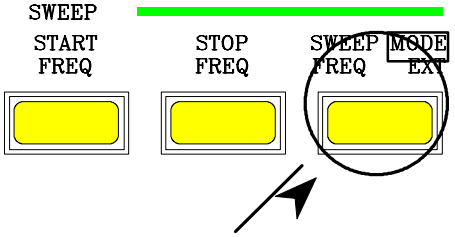


Apply the signal to be measured. Select the required filter(s) - we recommend use of the 22-22k filter for fundamentals up to 6 kHz.

External Synchronization

Normally, the notchfilter of the A1 is tuned to the internal generator frequency. This speeds up the tuning and allows faster measurements, especially when the device under test (DUT) is driven by the generator of the A1.

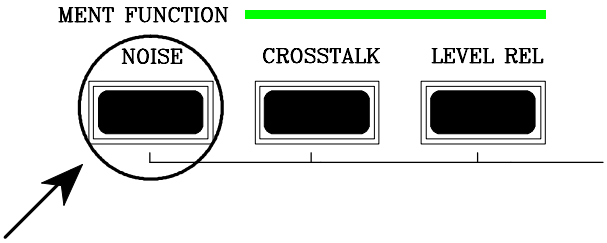
However, sometimes it is necessary to tune the notchfilter of the A1 to the dominant frequency (fundamental) of an externally generated signal.



To measure the THD+N of an external signal, or if you want to have the notchfilter be tuned to the dominant input frequency, simply set the <SWEEP MODE> button to EXT.
In position FREQ, the notchfilter is tuned to the internal A1 generator frequency.

NOISE Function

The NOISE function of the A1 measures noise according to CCIR Recommendation 468-3 and 468-2, in either absolute or relative terms. The signal path in the NOISE function may include either the Audio-bandpass filter or the internal noise weighting filter. The rectifier measures always quasi-peak.



Apply the signal to be measured to the active input. Make sure that no sweep is running, and set the display mode to METER. Press the <NOISE> button once and watch the display.
Press the <UNIT> button to select the desired unit dBq or Vq / mVq / µVq.

The Quasi-Peak measured NOISE measurement result can be read in large digits and in analog form in the center of the display, while the input signal level in true RMS is displayed on the bottom line.
Please notice, that if you are applying a random noise signal, the input frequency reading will not be stable.

Noise Weighting Filter

The NOISE measurements can be done either unweighted under the Audio Bandpass or weighted according to CCIR 468-3. Note that the weighting filter has its maximum gain at 6.3kHz.

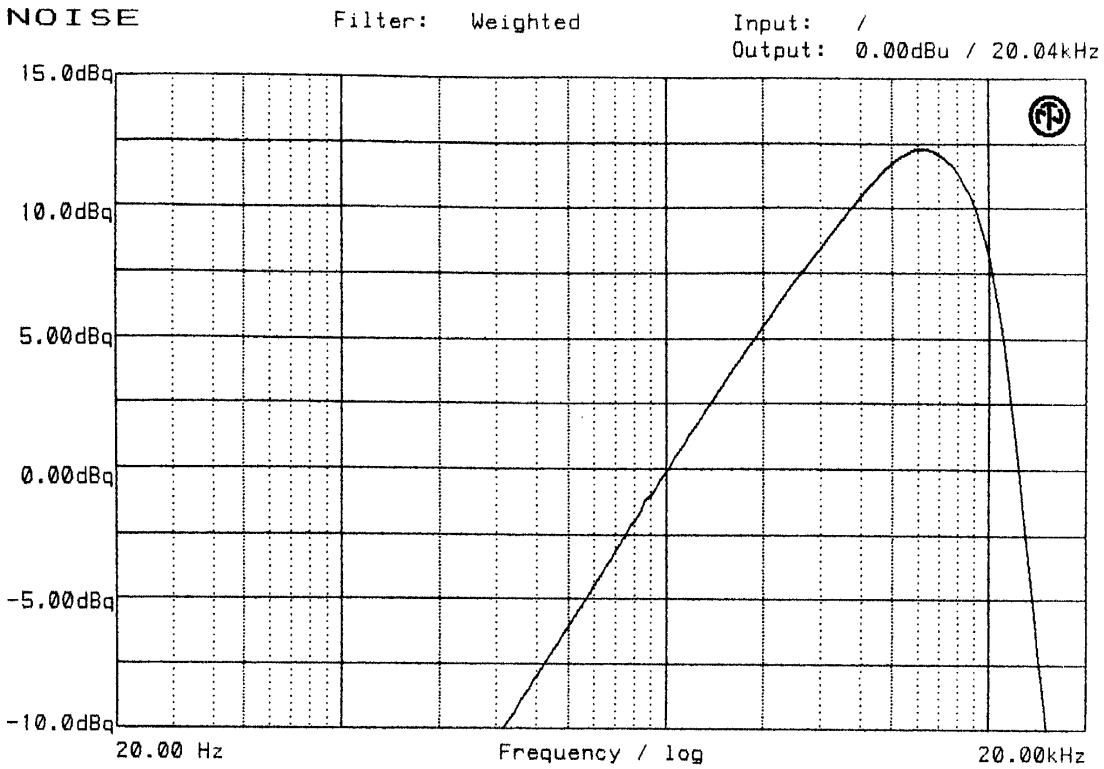
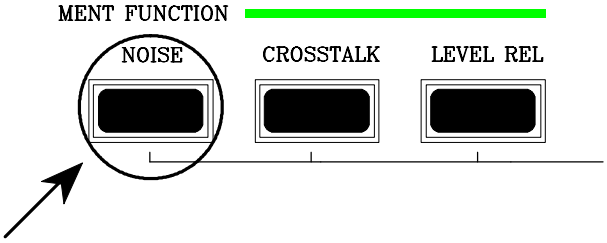


Fig 12 CCIR 468-3 Filter Characteristics

NOISE REL Function

Pressing the <NOISE> button again, toggles between absolute and relative NOISE measurements, denoted by NOISE and N.REL messages in the display.



Apply the reference signal to the active input, with the A1 in the NOISE REL function, and press the <SET REF> button.

Now apply the noise signal to be measured by reconnecting or switching the active channel. Use the <UNIT> button to select the unit dBr, *1 pr %.

NOTE	**When setting a signal as the reference in the function NOISE REL, in the weighted mode it is also filtered by CCIR 468 filter and therefore, the gain is only at 1kHz equal with / without the filter.**

CROSSTALK Function

The CROSSTALK function of the A1 inserts a bandpass filter into the measurement path. If the "live" and "dead" signals are applied to the A1 simultaneously, it is very easy to make direct measurements of crosstalk as a ratio (Crosstalk Relative). Crosstalk can also be measured in absolute terms.

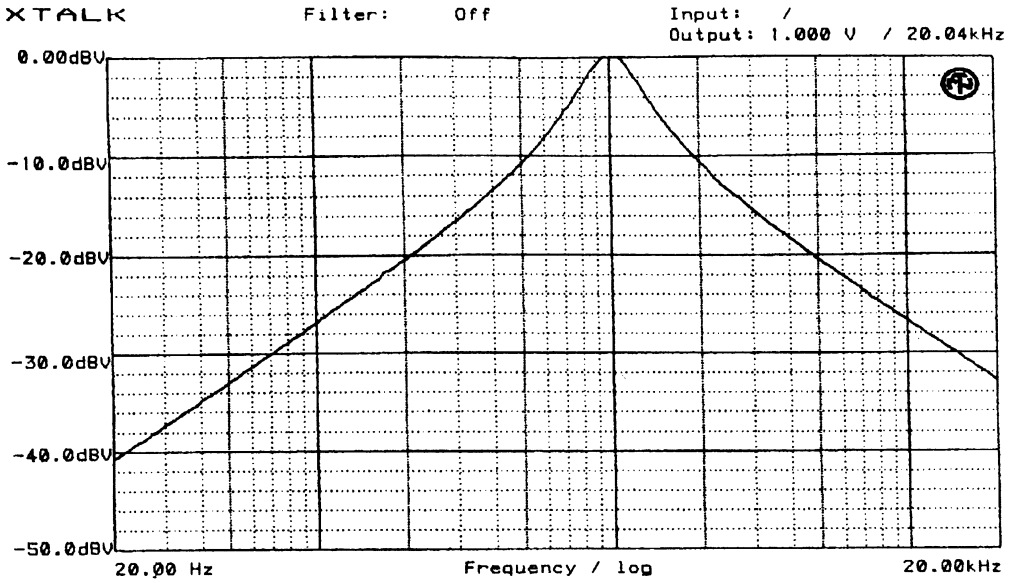
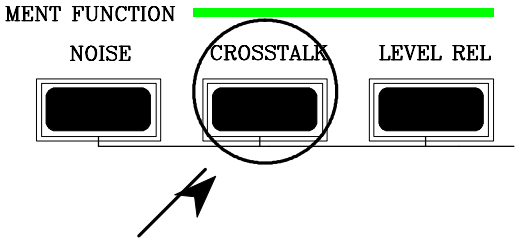


Fig 13 CROSSTALK Bandpass Filter Characteristics

Crosstalk (Absolute)

Apply the signals to be measured to the input connectors and make the appropriate input the active channel. Make sure that no sweep is running, and set the display mode to METER.



Press the <CROSSTALK> button once, so that the display shows XTALK and the measurement result in large figures.
The unit may be selected from dBu, dBV and V / mV / µV by successively pressing the UNIT button.

Crosstalk (Relative)

Apply the input from the "live" channel of the device under test (DUT) and select the Crosstalk Relative (X.REL) function by pressing the <CROSSTALK> key.

Push the <SET REF> button to store the input signal as reference.

Select the input from the "dead" channel of the DUT. Depending on the selected unit, the display will show the crosstalk expressed in dBr, % or *1, as a ratio to the actual reference level.

WOW & FLUTTER Function

The Wow and Flutter function (W & F) measures wow and flutter, either weighted or unweighted, according to various international standards, from either a 3.15kHz or a 3kHz signal. The standard and center frequency are selected by DIL switches on the back panel of the A1.

Although several standards exist, they fall into two groups. Within each group, the standards are functionally identical. One group consists of IEC 386, DIN 45507, BS 4847 and CCIR 409. They measure quasi-peak.
The other group consists of NAB and JIS C 5551, that measure with a VU-like response. Both groups use the same weighting curve.

The IEC group normally measures from 3.15kHz, while the NAB group measures from 3kHz. However, in the A1 measurements may be made to either standard from either frequency, there is no need to buy two different test tapes.

Setting the W&F Standards

All the common standards described above can be selected by DIP switches on the rear panel of the unit.

Switches 0 and 1 are designated for standard settings. The settings become active only when the A1 is switched OFF and ON again.

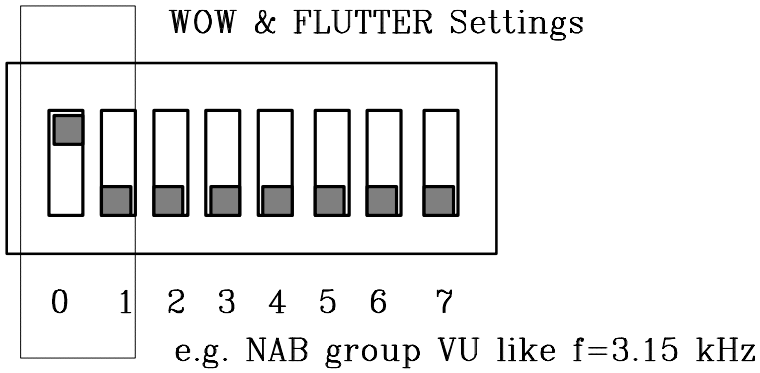
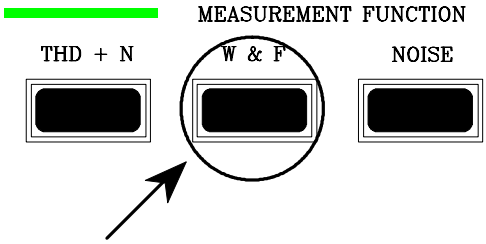


Fig 14 DIP Switch Settings for WOW & FLUTTER Measurements

SW0	*SW1*	*Measurement Selection*	
0	0	IEC group quasi-peak	f = 3.15 kHz
0	1	IEC group quasi-peak	f = 3.00 kHz
1	0	NAB group VU-like	f = 3.15 kHz
1	1	NAB group VU-like	f = 3.00 kHz

Wow & Flutter Measurements (Replay Only)

Connect the replay output of the recorder under test to the input of the A1. Load a standard wow & flutter test tape. Be sure that the settings of the frequency corresponds to the test tape. The generator frequency may be used to check the selected frequency.



Press the <W & F> key and select the display mode METER.
One of the LEDs of the <WTD UWTD> button will be lit, indicating whether the measurement is done weighted or unweighted. Change the setting if necessary.

Start the tape in the replay mode. The display will show the WOW & FLUTTER measurement in big digits and the drift measurement on the bottom line, both expressed in %. The wow & flutter result will also be shown as a bargraph. If the input level is too low, the message "INP LOW" appears on the display.

The A1 does not strictly measure drift, but rather speed error. Drift is the difference in speed between the beginning and the end of a tape or disc. Therefore, to measure drift, you will need to take two measurements, one near the beginning and one near the end, and subtract one from the other. Be careful if one is positive and the other negative!

Wow & Flutter Measurements (Record to Replay)

The procedure is basically the same as before, except following requirements.

1. Connect the generator output of the A1 to the record input of the recorder
2. Load a blank tape
3. Start the machine in record mode
4. After a suitable length of recording (usually at least 30 seconds), rewind the tape and restart in the replay mode.

Don't measure wow & flutter whilst actually performing the recording, because wow & flutter at some frequencies will be canceled out, and the measurement will be lower than the truth. The Frequencies, that are canceled, are those where the delay from record head to replay head is an exact multiple of the time period (duration of one cycle) of the wow frequency. The effect is that of a comb filter. For the same reason, to get a more reliable result, rewind and repeat the measurements several times, and average the results. Only one recording is necessary.

Wow & Flutter Analysis

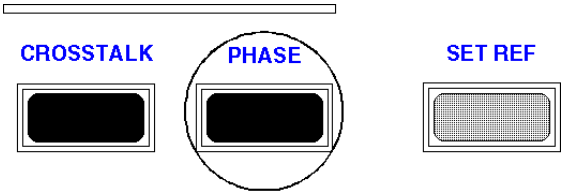
By pressing the <SCOPE> button, the waveform of the wow & flutter signal will be displayed on the screen. Regular periodic wow & flutter can be identified from this waveform. From the frequency, the offending rotating components can be deduced (capstan, pinch wheel, idlers, intermediate wheels etc.)

The scope will select its timebase for displaying the demodulated signal in a way, that the most influencing part can be determined easily by calculating the rotation frequency and from the diameter of the wheel.

PHASE Function

NOTE	**The PHASE measurement function of the A1 is available with installed AO2 option only.**

The function PHASE measures the phase of the active channel against the inactive channel (reference channel). The phase correlation of the two channels is displayed in the full range of ±180° degrees.



Make sure that no sweep is running, and set the display mode to METER. Press the <PHASE> button to display the phase result.

A positive measurement result (e.g. +30°) with active channel B means that the signal of channel B passed the zero volts line before channel A did.

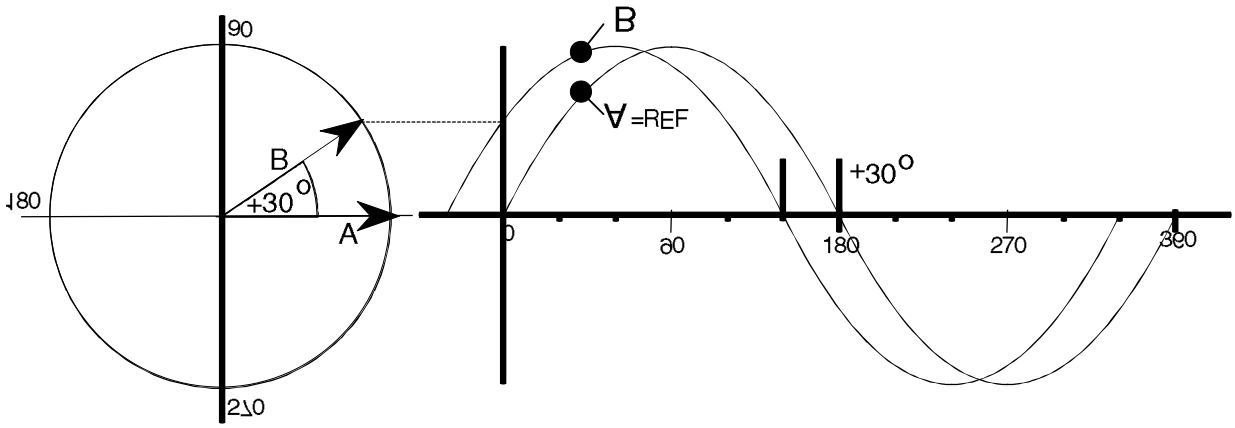


Fig 15 Example of Phase Shift

Pressing the <UNIT> button has no effect in the function PHASE, due to degrees being the only available unit.

The bottom line shows simultaneously frequency and input level of both channels. This is possible due to the additional full equipped measurement channel on the phase board.

If one of the levels is too low, or the level difference between the two channels is too high (>18dB) to measure the phase correlation, the message INP LOW is displayed instead of a result.

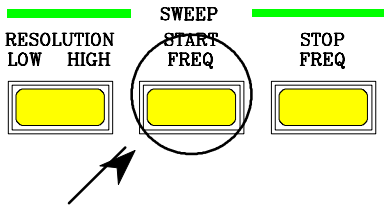
SWEEPS

The A1 has a built-in frequency sweep ability. Sweeps can be driven from internal or external sources. The internal generator can be swept with 30 or 200 steps between the chosen start and stop frequencies.

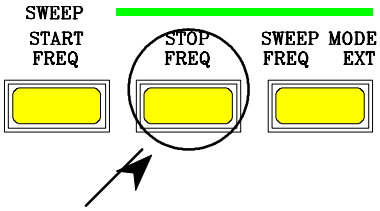
NOTE	**A sweep with 30 steps corresponds to a 3rd-octave analysis, supposed that the start and stop frequencies are 3 decades apart (e.g. 20Hz - 20kHz).** **Frequency ranges different from 3 decades will not result in 3rd-octave steps.**

Frequency Response Sweeps

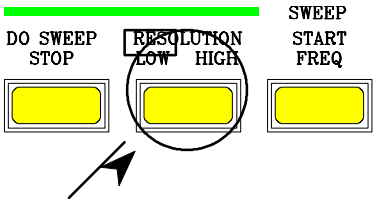
To record the frequency response - the most common kind of sweep - of a DUT, set the A1 to the LEVEL function and the display mode to GRAPH.
Use the <LEVEL> softwheel to set the required output level (displayed on the top line of the screen) and proceed as follows.



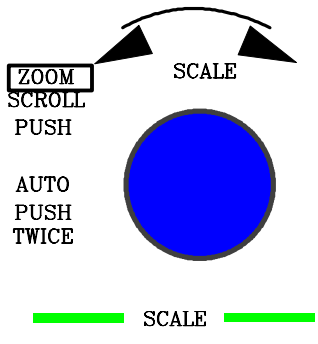
Use the <FREQUENCY> softwheel to adjust the generator frequency to the value, where the sweep shall start.
Push the <START FREQ> button to store this frequency as the starting point.



Use again the <FREQUENCY> softwheel to set the stop frequency of the sweep.
Push the <STOP FREQ> button to store this frequency.

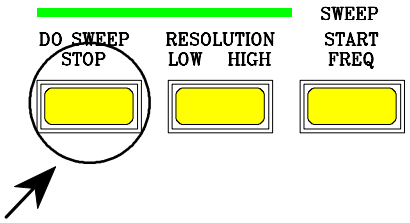


Press the <RESOLUTION> button if necessary to toggle between low resolution (30 steps) and high resolution (200 steps).



If necessary, push the <SCALE> softwheel twice quickly (double-click) to enter the AUTO scaling mode.

Connect the output and input(s) of the A1 to the device under test (DUT). Adjust any controls on the DUT as necessary.



As soon as you are ready, press the <DO SWEEP> button to start the sweep.

Pressing this button during a running sweep will stop the process immediately.

After having pressed the <DO SWEEP> key, the A1 will perform a sweep and draw a graph. After completion of the sweep the graph will be rescaled automatically, supposed that the autoscale mode is active.

During the sweep recording process, the message RUNNING appears at the bottom of the screen. At the end, it will be replaced by the message COMPLETE.

Pressing the <DO SWEEP / STOP> button again will either stop the currently running sweep, or start a new one if none is currently running.

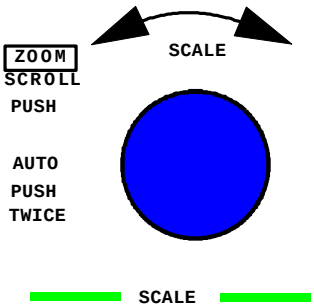
The A1 also allows to record several sweeps in a sequence and display them in parallel on the screen. However, the requirements for this mode are, that

- the SCALE mode is not set to AUTO
- the <SCALE> softwheel is not touched
- the GRAPH mode is not left and
- the measurement function is not changed.

Consequently, every new sweep recording lets the previously recorded curves remain on the screen, displayed in grey, while the actual / last recorded curve will be drawn in black.

Y-Scaling & Units

The <UNIT> button allows to change the unit of the actual measurement function, plotted on the Y-axis. The way to change the unit is exactly the same as in the METER display mode.



The scaling of the Y-axis may be changed by pushing the <SCALE> knob.

In the ZOOM mode, the increment of the Y-axis may be selected.

In the SCROLL mode, the entire range of the Y-axis may be scrolled up or down by one current Y-increment.

To return to AUTO scaling mode, press the SCALE knob twice quickly (double-click). If you leave too much time between the two pushes, the A1 will toggle between ZOOM and SCROLL mode only.

Sweeps in Other Functions

Apart from LEVEL sweeps, the A1 can also perform sweeps of the measurement functions LEVEL REL, THD+N, NOISE, CROSSTALK and PHASE - supposed that the Phase option is installed. WOW & FLUTTER sweeps are not possible. The procedure is basically the same as described before, but with the appropriate measurement function selected.

In Relative measurement functions (LEVEL REL, NOISE REL etc.) it is only possible to use one fixed level as a reference. In other terms, the stored level will act as reference level for the whole sweep.

Cursor

If the <FREQUENCY> softwheel is turned after a sweep curve has been recorded, a crosshair becomes visible in the graph at the generator frequency. On the bottom line of the screen, the interpolated measurement result at this selected frequency is displayed.

The cursor disappears as soon as the upper or lower end of the frequency axis is reached and it is brought back as soon as the generator frequency is within the displayed window again.

The cursor will not be printed out.

X-Rescaling

If a sweep has already been recorded, but the frequency scale doesn't satisfy, the displayed frequency range can be changed easily by re-setting the start- & stop-frequency.

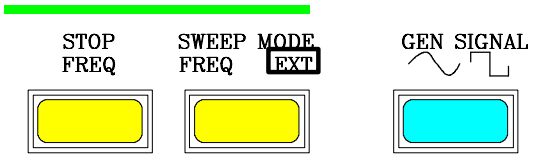
Adjust the generator frequency to the desires value and press the <START FREQ> / <STOP FREQ> key, depending on which border of the scale you want to change. After having set the parameter, the curve is redrawn automatically.

Please note that the curve is not measured again - it is just redrawn in the new range. The part of the curve outside the displayed graph is not lost, it is just not visible. It is therefore always possible to return to the original frequency span.

External Sweeps

External sweeps allow to control the A1 by externally generated frequency steps, instead of using the internal sweep settings.

This mode is of special importance when performing sweeps of pre-recorded test tapes or discs.



Set the sweep mode to EXT by pressing the <SWEEP MODE> button. Each press of this button toggles between FREQ (internal frequency sweep) and EXT (external sweep).

Preparing an External Sweep

1. Set the A1 to GRAPH mode and select the measurement function you have to measure (LEVEL, LEVEL REL, THD+N, NOISE, CROSSTALK or PHASE)
2. Set the A1 to sweep mode <EXT> by pressing the <SWEEP MODE> key.
3. Choose the start- & stop-frequency exactly the same way as for an internally controlled sweep.
4. Connect the Device Under Test (DUT) / external source to the input of the A1. Check for the correct settings of the external generator.
5. Go to the GRAPH mode and start the sweep of your external generator. The A1 is set into the recording mode by pressing the <DO SWEEP> button.

   Alternatively, there is another method to initiate an external sweep. If the first frequency of the incoming sweep signal is 1kHz, followed by a lower frequency, this frequency drop is interpreted by the A1 as the START command. From then on, the external frequency has to rise with every step, since the next frequency drop will be interpreted as STOP command (see ***Fig 16***).

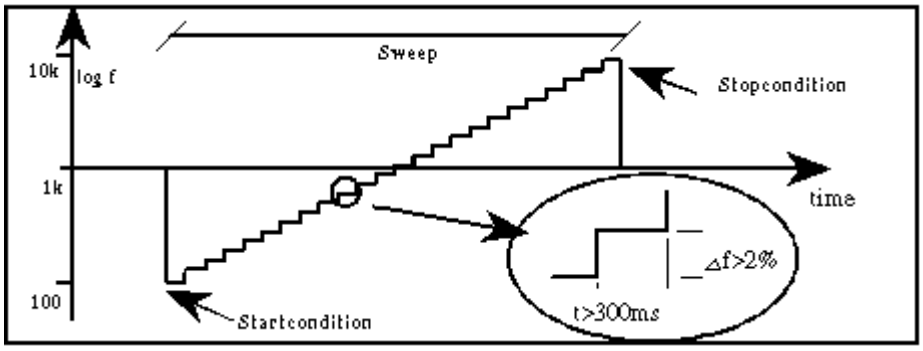


Fig 16 Auto START/STOP Condition in EXT SWEEP Mode

Basically, only stepped frequency sweeps can be performed. However, if the frequency steps are not too high, even continuous sweeps are handled correctly.

Such a continuous level sweep from 20Hz - 20kHz will last for ~20s.

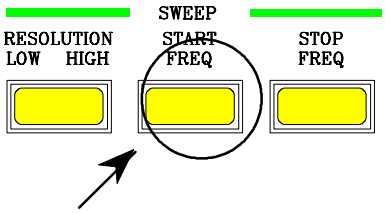
Tape Sweeps

Additionally to the external sweep mode, the A1 also offers the facility to generate a time controlled sweep signal to be recorded on a tape. This pre-defined signal resembles strongly the one shown in ***Fig 16***, with fixed time- & frequency-stepwidths.

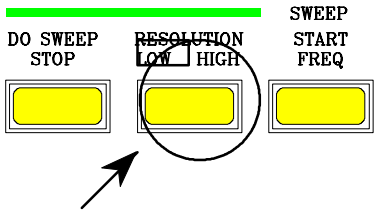
The tape swep feature is not only very helpful to produce test tapes by yourself, but also allows to record sweeps of DUTs with long lasting transients.

To record a tape sweep onto a tape, proceed as follows.

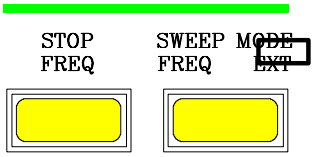
1. Choose the start- & stop-frequency in the GRAPH mode to define the limits of the tape sweep.
2. Set the generator to 1kHz at the desired output level.



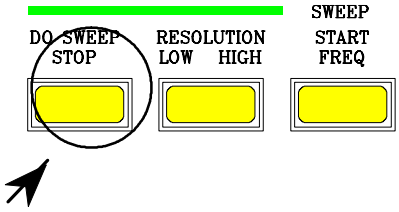
3. Choose the required resolution to record the sweep (30 steps in LOW and 200 steps in HIGH mode). The time step is fixed to 3 seconds.



4. Set the SWEEP MODE to EXT
5. Disconnect the active input of the A1 and connect the tape recorder to the A1 output.



6. Switch the tape machine to 'Recording'. The 1kHz tone shall be recorded for a few seconds.
7. Press the <DO SWEEP> button twice quickly (double click) to start the tape sweep.
8. A message appears on the bottom line of the graph to inform about the status of the tape sweep.



Alternatively, if the tape sweep mode shall be used to perform a sweep of a DUT with long lasting transients, the same procedure applies with following exceptions.

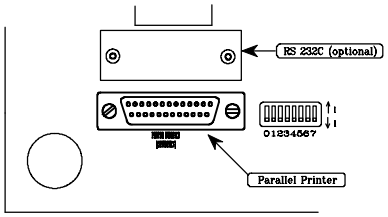
Step 2. Set the generator to the start frequency instead of 1kHz.

Step 5. Link your DUT between the A1 output and input instead of connecting a tape recorder.

Step 6. This step may be omitted.

PRINTOUTS

The actual screen contents of the A1 display may be printed out to a dot matrix printer at any time by pushing the <PRINT> button. The printer graphics protocol must be either compatible with the Epson FX-80, a HP Thinkjet, or an IBM Proprinter.



The Centronics printer connector is located on the rear panel of the A1. It is a 25-piny D-type, connected in the same way as in PC-compatible computers.

Printer Driver Selection

Most printers offer an emulation of one of the drivers implemented in the A1. However, you should check carefully the manual of your printer to see which settings should be used.

The DIP switches 5 and 6 of the A1 are designated to select the printer protocol.

SW5	SW6	Printer Driver
0	0	HP Thinkjet
0	1	EPSON LQ 1000 (24 Dot Matrix)
1	0	EPSON FX80 (9 Dot Matrix)
1	1	IBM Proprinter XL

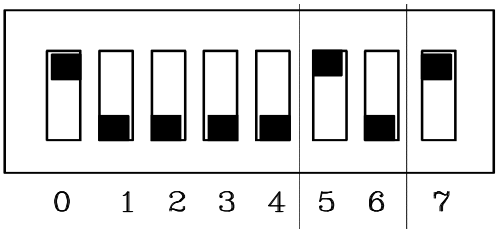
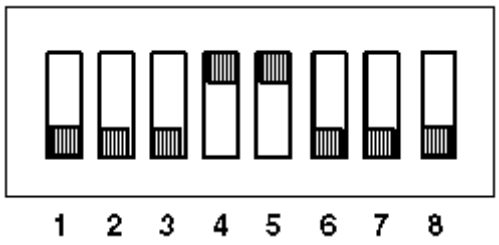


Fig 17 Switches for Printer Setting

Examples of Printer Settings

The following two examples show the recommended settings for different printers.

HP Thinkjet



Epson FX80, IBM Proprinter XL

- DIP-switch settings according to ***Fig 17***.
- Printer setup as listed below

Page Length	8"
Automatic form feed	OFF (inactive)
Automatic line feed	OFF (inactive)
Automatic CR	OFF (inactive)
Print quality	selectable
Graphics density	120 dpi
Text density	12 cpi

Printer Errors

If the print function is initiated, but an error occurs during the printing process, the A1 displays the error message

Printer-ERROR or no printer connected

Possible reasons for this message could be

- Printer not connected
- Printer is switched OFF
- Printer is OFF line
- No paper in the printer

In this status, any keypress returns the A1 to normal operation.

FRONTPANEL SETUP

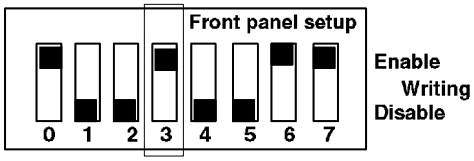
The A1 offers a setup function that allows the operator to configure the various settings on the frontpanel according to the individual demands. This means, that after saving these settings, the A1 will start-up always in that setup.

The parameter stored in the setup are

- Oscillator waveform, frequency & level, level unit
- Muted output channel
- Measurement function and selected level
- Selected input channel
- Activated filter(s)
- Display mode (METER, GRAPH or SCOPE)
- Sweep Mode with Start- & Stop-frequency, resolution

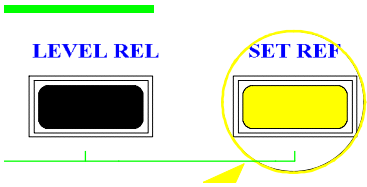
To permanently store the setup in the memory of the A1, follow the procedure below.

1. Switch On the A1 and adjust all the settings to your needs.
2. Disable the write protection by setting DIP-SW 3 to ↑ 1. This allows to write the settings into the permanent memory.



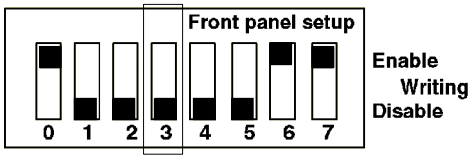
3. Press <SET REF> button to write the information into the memory. Do not alter anything at the front panel during the writing procedure.

   The A1 displays following warning message during this procedure.



Writing data to EEPROM. Do not switch off now.

4. To protect the stored information against overwriting, set the DIP-SW 3 back to ↓ 0.



APPENDIX

DIP Switch Settings

This chapter describes all DIP switch settings, configuring the various functions of the A1. The settings are described in more detail in the corresponding chapters.

W&F Selection

SW0	SW1	Measurement selection	
0	0	IEC group quasi-peak	f = 3,15 kHz
0	1	IEC group quasi-peak	f = 3,00 kHz
1	0	NAB group VU-like	f = 3,15 kHz
1	1	NAB group VU-like	f = 3,00 kHz

Front Panel Setup

SW3	Function	Effect	Operation
0	Disable writing to EEPROM	Write protect	Normal A1 operation
1	Enable writing to EEPROM	Write enable	Store setup

Printer Settings

SW5	SW6	Printer Driver	
0	0	HP Thinkjet	
0	1	EPSON LQ 1000	24 Dot Matrix Printer
1	0	EPSON FX80	9 Dot Matrix Printer
1	1	IBM Proprinter XL	

Overview

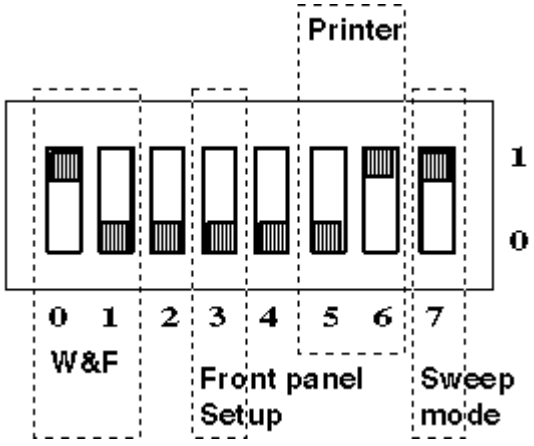


Fig 18 DIP Switch Overview

Switches 2, 4 and 7 are not used

Centronics Interface

The Centronics 8bit parallel interface is equipped with a female 25pin Sub-D connector that is fully compatible to PC computers. Use a standard Printer cable to connect the printer to the A1.

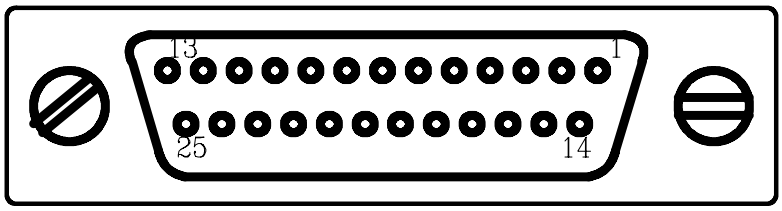


Fig 19 Centronics Connector on A1

Pin Assignment

Pin	Signal Name
1	STROBE
2	DATA 0
3	DATA 1
4	DATA 2
5	DATA 3
6	DATA 4
7	DATA 5
8	DATA 6
9	DATA 7
10	ACK
11	BUSY
12	Paper End
13	SELECT

Pin	Signal Name
14	AUTO XT
15	ERROR
16	INIT
17	SELECT IN
18	GND
19	GND
20	GND
21	GND
22	GND
23	GND
24	GND
25	GND

Timing Diagram

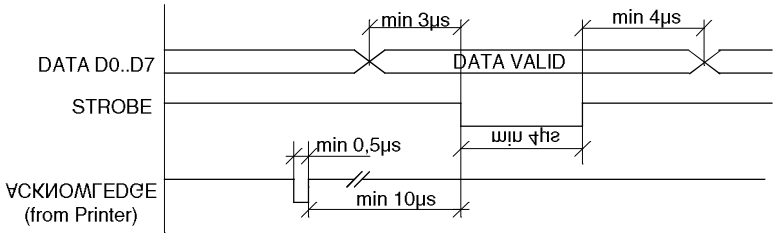


Fig 20 Centronics Timing

RS232 Interface

The RS232 interface is a fully PC compatible serial interface using the 9pin Sub-D connector. The A1 acts as the DCE unit and therefore has the lines already twisted, so that the cable to the PC is a straight-through connected 9pin cable.
The communication parameter are fixed to 7 data bits, 1 stop bit, even parity.

Pin Assignment

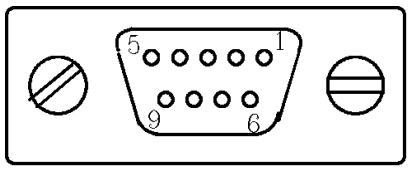


Fig 21 RS232 Connector

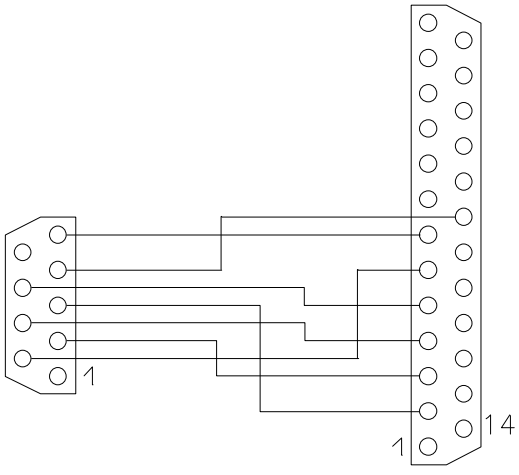
Pin	Name	Type	Description
1	+5V	Output	+5V from A1
2	TXD	Output	Send DATA
3	RXD	Input	Receive DATA
4	DTR	Input	Data terminal ready?
5	RSGND	I/O	DATA GND
6	DSR	Output	Data set ready! (+5V)
7	CTS	Input	Clear To Send
8	RTS	Output	Request To Send
9	--	--	NC

Cables

MD9 female to MD9 female

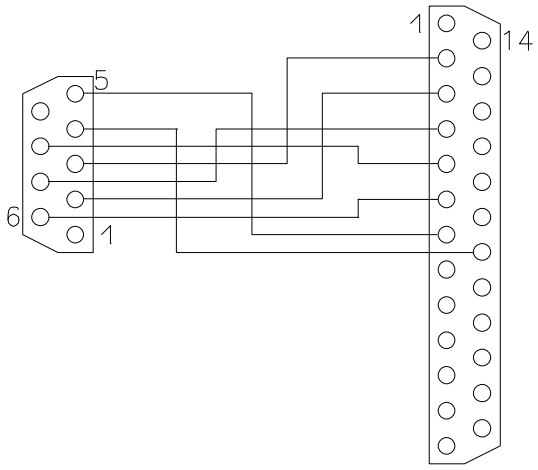
female female

MD9 female to MD25 female



female female

MD9 Female to MD25 Male



female male

TECHNICAL SPECIFICATIONS

Generator

Signals	Sine, square, W&F test signal
Frequency range	20Hz to 40kHz
Output voltage range	200µV to 10V (-71.7dBu to +22.2dBu)
Output impedance	< 0.2Ω
Output power	10W into 4Ω
Frequency response	± 0.1dB from 20Hz to 40kHz (without load)
THD+N	*Max*: < 0.005% (-86dB) or 25µV *Typ*: < 0.0025% (-92dB)
Square signal	Rise & fall time < 5µs
Overshot	< 0.5% (no load)

Sweep Function

Frequency resolution	*a) Low*: 30 steps (3rd octave steps from 20Hz to 20kHz) *b) High*: 200 steps
Start/Stop frequency	Selectable between 20Hz to 40kHz
Sweep modes	*a) Internal*: controlled by A1 generator *b) External*: Automatic synchronization to an external signal source (e.g. test tape)
Y-Scaling	Automatically optimized or manually selected

Analyzer

Inputs	Two selectable fully symmetric inputs
Input impedance	100kΩ @ 50pF or +15V Phantom power via 1kΩ
Max. input voltage	300VAC peak, $200V_{RMS}$ (240VAC @ f<500Hz)
CMRR	> 80dB

LEVEL Function

Range	10µV to 200V (-120dBV to +46dBV)
Noise	< 1.5µV (22Hz to 22kHz bandwidth)
Accuracy	± 0.1dB @ 1kHz
Rectifier	True RMS
3 dB bandwidth	2Hz to 130kHz

CROSSTALK and LEVEL SELECTIVE Function

Frequency range	20Hz to 40kHz
Accuracy	± 0.3dB
Filter	Autotracking two-pole bandpass filter Q=5
Rectifier	True RMS

NOISE Function

Residual noise	*a) Weighted*: -104dBqs (weighted) *b) Unweighted*: -108dBqs (unweighted)
Filters	*a) Weighted*: CCIR 468 weighting filter *b) Unweighted*: DIN Audio-BP filter 22Hz to 22.4kHz
Rectifier	Quasipeak acc. CCIR 468

THD + N Function

Range	20Hz to 40kHz
Display range	0.001% to 100 % (-100 dB to 0 dB)
Input voltage range	10mV to 200V
Residual THD	*Max*: -86 dB (0.005%) (V_{In} > 0dBV, 130kHz BW) *Typ*: -92 dB (0.0025%)
3 dB bandwidth	2Hz to130kHz
Rectifier	True RMS

WOW & FLUTTER Function and DRIFT

Input voltage range	100mV to 200V
Displayed range	0.05% to 10%
Meas. frequency	3.00kHz or 3.15kHz (selected with DIP switches)
Accuracy	3%
Weighting filter	Acc. IEC 386, DIN 45 507, CCIR 409, BS 4047, NAB, JIB C5551 (selected with DIP switches)

Drift Measurement

Display	Continuous
Frequency range	± 15% of selected measurement frequency
Accuracy	20ppm (± 0,002%)

PHASE Function (Option)

Range	±180° degree
Display	Numerical and bargraph
Input voltage range	*Min*: >10mV (-40dBV) *Typ*: >4mV (-48dBV)
Frequency range	20Hz to 40kHz
Resolution	0.1°
Accuracy	1°
Max. Level difference	<18 dB
Level display 2 channel	continuous

Frequency Measurement

Display	Continuous
Frequency range	16Hz to 200 kHz
Accuracy	± 0.05%
Resolution	0.1% of displayed frequency

SCOPE function

Display Range	Fully automatic
Time Base	Fully automatic 10µs/Div. to 20ms/Div.

Filters

400Hz HP	60dB / decade; -3dB at 400Hz ± 10%
22.4Hz to 22.4kHz BP	60dB / decade; -3dB at 22.4Hz and 22.4kHz (± 10%)
Crosstalk filter	40 dB / decade; Q = 5

Display

Graphic 256*128 dot backlit LCD module

Display Modes

Measurement display	15mm high characters and 100mm wide bargraph
Graphics	Curves (Sweeps)
Oscilloscope	Input signal vs. time

Interfaces

Printer Interface	Centronics interface (25pin Sub-D female connector) for printouts of sweeps, scope graphics and single measurement results.
Serial Interface	RS232C for remote control and data transfer with a PC

General Data

Size	274*396*132mm
Weight	approx. 7.5 kg

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