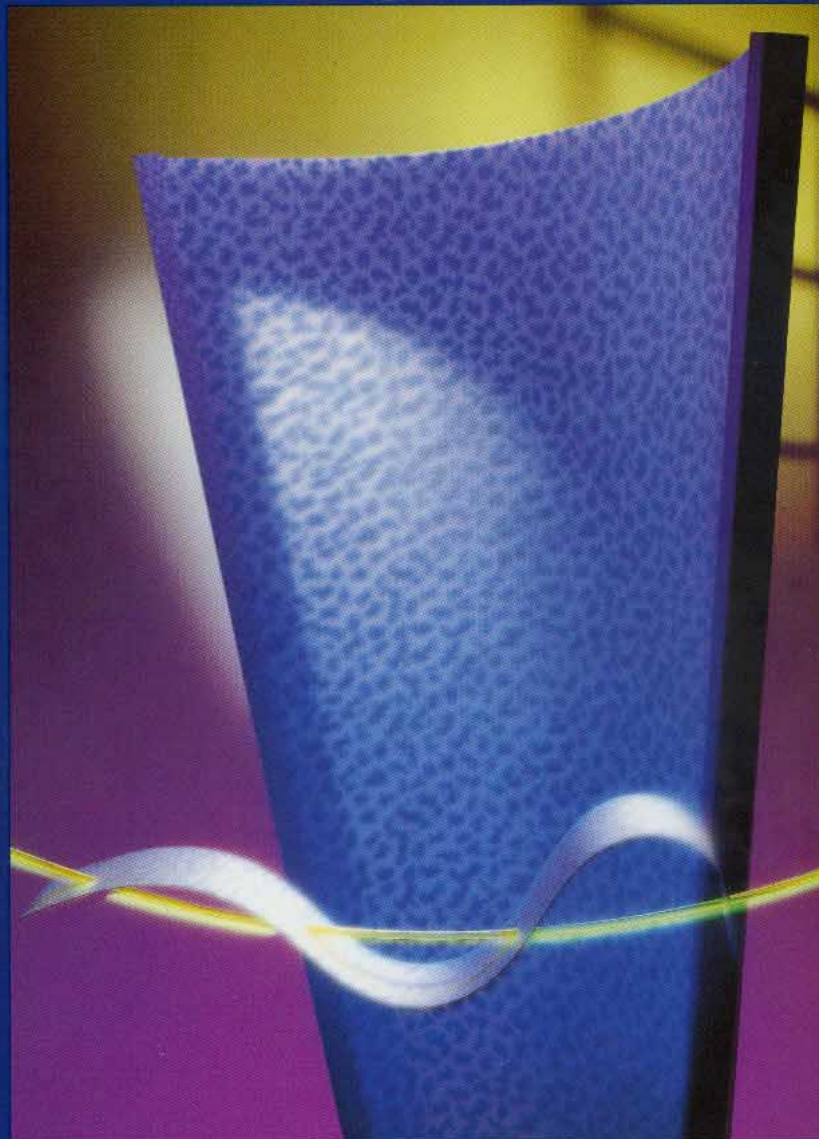




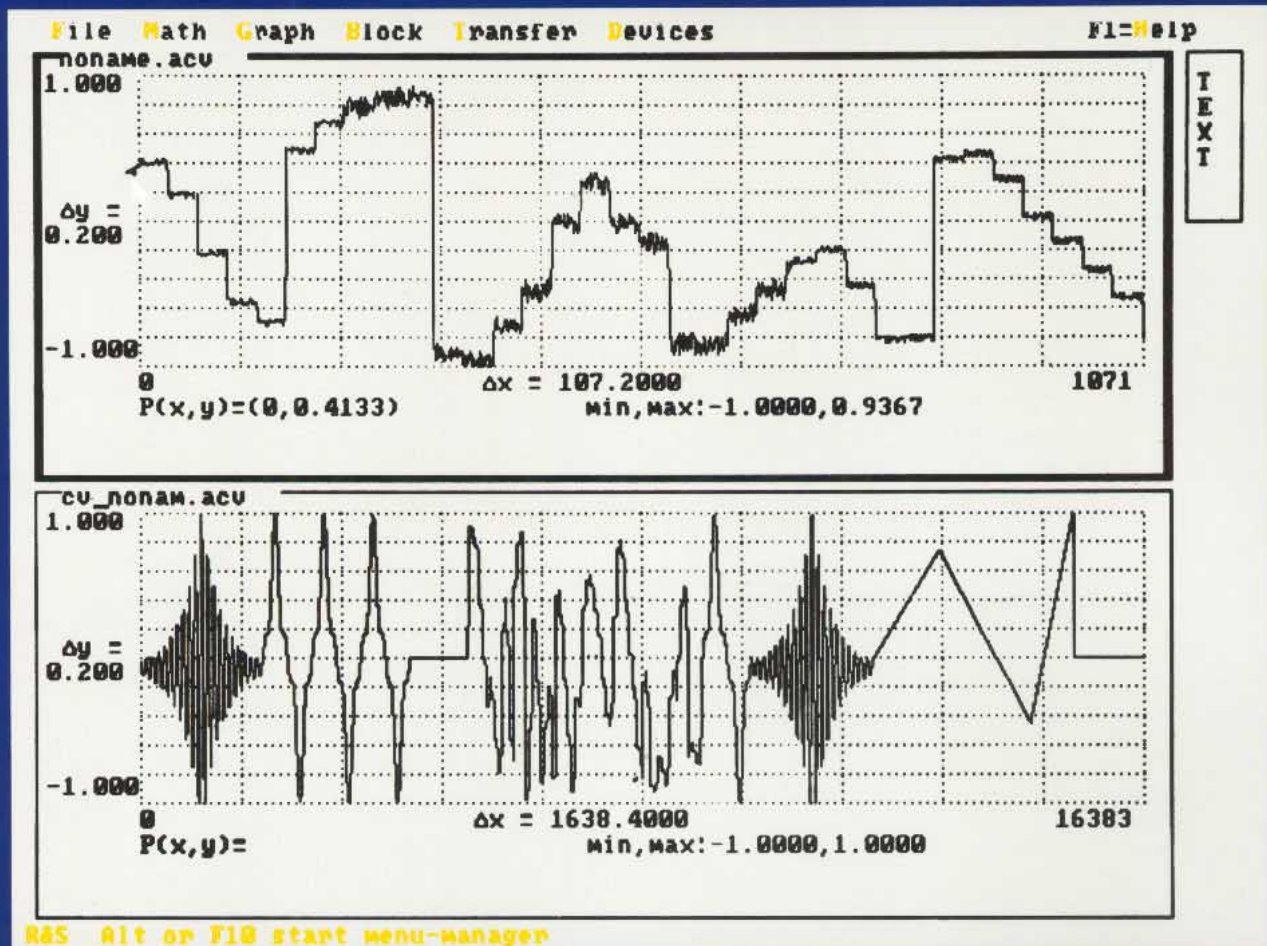
**ROHDE & SCHWARZ**

# **Arbitrary Waveform Designer AWD-K1**

- Programming of AMS, ADS and AFGU Generators
- Waveform design by means of mathematical formulas
- Line segments
- Freehand design
- Transfer of real signals
- Modular waveform design



Application software for generating arbitrary waveforms



The Arbitrary Waveform Designer AWD-K1 is a DOS program for designing waveforms for the R&S Generators AMS, ADS and AFGU.

User-defined signals (ARbitrary waveforms) are gaining importance in view of the increasing complexity and fast innovation in all fields of electronics. Used at an early design phase of electronic systems, they enable system emulation and optimization. High additional costs caused by subsequent design changes can thus be avoided.

In the past, arbitrary signals could only be generated with the aid of special generators involving high expenditure in terms of time and costs. Today, easily programmable, universal function generators are available to perform this task.

The Arbitrary Waveform Generators AMS and ADS as well as the Function/ARB Generator AFGU are three powerful instruments from R&S featuring many auxiliary functions required for waveform synthesis.

Users working with frequently varying, complex waveforms, however, will certainly appreciate the convenience of the Software AWD-K1, all the more since this program allows the generator capabilities to be fully utilized. AWD-K1 provides all relevant design methods:

- Entry of formulas
- Freehand design using the mouse
- Drawing of line segments
- Loading of signals from digital storage oscilloscopes
- Combining existing waveforms or parts thereof
- Compression or expansion of waveforms in X and Y directions
- Addition, subtraction and multiplication of two waveforms
- Superimposed noise with adjustable amplitude
- Any combination of these methods

The waveform thus designed can be stored as a file or directly transferred to the generator via the IEC/IEEE bus.

## Generation of a stereo multiplex signal

$x:0:2*\pi*(1-1/12500):12500;$  !definition range and  
!resolution along the X axis

!parameters:

$N = 40;$  !signal deviation in kHz

$P = 6.72;$  !pilot deviation in kHz

$L = 1.0;$  !left-channel frequency in kHz

$R = 0;$  !right-channel frequency in kHz

$PH = 0;$  !pilot phase in degrees

!auxiliary functions:

$A = n/(N+P);$

$B = P/(N+P);$

$M = 0.5*\text{SIN}(L*x)+0.5*\text{SIN}(R*x);$

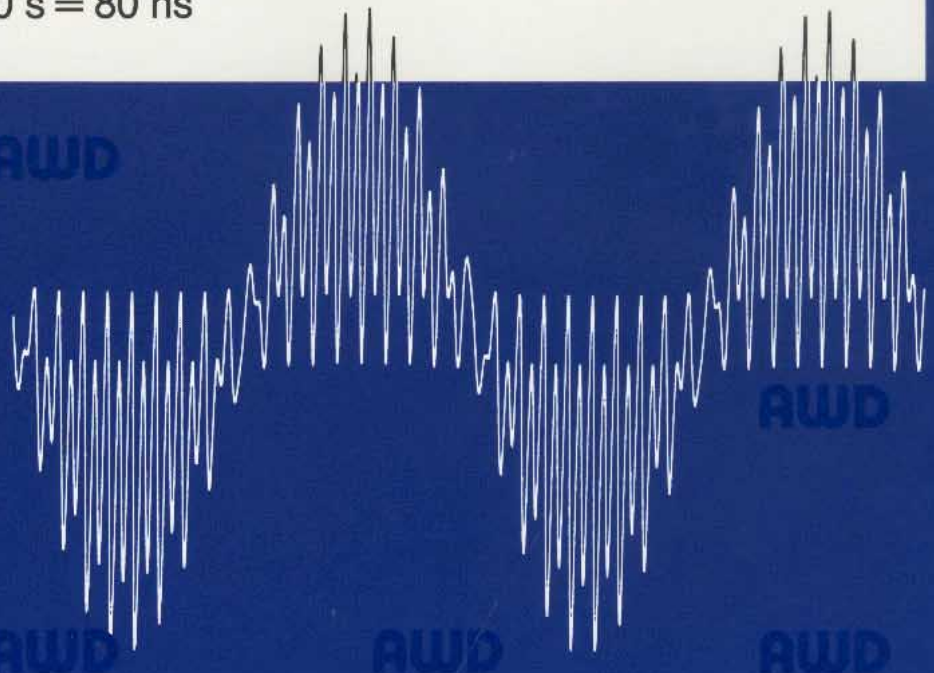
$S = 0.5*\text{SIN}(L*x)-0.5*\text{SIN}(R*x);$

!stereo multiplex signal:

$y = A*(M+S*\text{SIN}(38*x))+B*\text{SIN}(19*x+PH);$

!setting on AMS/ADS:

!dt = 1/1000/12500 s = 80 ns



## Specifications

### System features

User interface	automatic adaptation to the graphics mode used, easy-to-operate menu, context-sensitive help system, interactive dialog boxes, DOS access, selectable colour palettes
Data type	real
<b>Mathematical interpreter system</b>	
Arithmetic operations	addition, subtraction, multiplication, division, raising to a power
Mathematical functions	sine, cosine, tangent, arc tangent, exponential function, natural logarithm, decadic logarithm, hyperbolic sine, hyperbolic cosine, hyperbolic tangent, square-root function, absolute value, unit step, square function, sign function, random function, truncate function
Notation	algebraic
Evaluation	depending on the value and definition range of function; entry of these ranges within formula possible, use of constant expressions
Normalization	automatic amplitude matching (autoranging) selectable
Formula editor	text input, insert/overwrite mode, extensive erase functions (wastebasket), convenient cursor control, automatic line feed
<b>Graphics</b>	
Display	linear with automatic scaling
Coordinate system	automatic decadic setting
Display mode	X axis: time Y axis: voltage
Resolution	freely selectable zoom over the complete range of a waveform; scrolling in X direction
Graphics windows	two graphics windows for simultaneous processing of two waveforms
<b>Graphics editor</b>	
Basic functions	addition of a constant offset, change of waveform resolution, superposition of noise of variable amplitude
Distortion	expansion or compression of a waveform in X and Y direction
Generation of line segments	graphical determination of origin and end point of a straight line, line fixing
Freehand design	using mouse or keyboard
Block commands	marking, shifting, copying, insertion of a block
Extended block commands	erasure of a block, ie storage in a buffer (wastebasket), reinsertion into the waveform as often as desired
Data exchange	
Combination of waveforms	insertion, copying, extraction of complete curves, insertion of a block from the other graphics window
Linkage of waveforms	addition, subtraction and multiplication of curves
Linking of blocks and waveform sections	1:1 ratio, continuously joined on the left
Taking into account of generator	choice between ADS/AMS and AFGU
automatic	upon program start and change of IEC/IEEE-bus address
manual	by selection in the menu
<b>Transfer interface</b>	
Setting functions	IEC/IEEE-bus address of generator
Communication with generator	transmission and reception of arbitrary waveforms or - with AFGU - of sections thereof
Interaction with any kind of storage oscilloscope	transfer of real signals, defined interface, driver library

### File management, documentation

Files, I/O	convenient loading and storage of waveforms and formulas; storage of waveforms in binary floating-point format; loading of waveforms in ASCII format or binary floating-point format; formulas plus additional information stored as ASCII text
Documentation	output of waveforms and formulas on all common printers

### Hardware

<b>Controller</b>	controller family PSA or AT compatible with the industry standard (controller with 80386 CPU and minimum clock of 20 MHz recommended)
Operating system	MS-DOS 3.0 upwards
Main memory	conventional RAM of 420 Kbytes minimum; recommended: 1-Mbyte extended memory with XMS driver (versions from 2.0 upwards supported) plus RAM disk
Monitor and monitor adapter	Hercules graphics card and monochrome screen, Enhanced Graphics Adapter (EGA) with monochrome or colour screen, Video Graphics Adapter (VGA) and monochrome or colour screen
Drives	hard disk drive with an available storage capacity of at least 2 Mbytes, 5 $\frac{1}{4}$ floppy disk drive for high-density disks
IEC-bus card (IEEE 488)	R&S IEC-bus card (included in PSA), IEEE-488 Instrumentation Interface PCIIA from National Instruments or 100% compatibles
IEC/IEEE-bus driver	R&S IEC-bus Driver PS-K2, National Instruments GPIB-PC software
Mouse	R&S PS-B11, serial Microsoft mouse or compatibles
Numeric coprocessor	R&S PS-B10, Intel 80x87 or compatibles
Printer	all common graphics or laser printers: Acer, Alps, Anadex, Apple, Brother, C. Itoh, Canon, Centronics, Citizen, DEC, Epson, Fujitsu, Hewlett Packard, IBM, Kyocera, Mannesmann, NEC, Nissho, Okidata, Panasonic, Printronix, Ricoh, Rohde & Schwarz, Seikosha, Star, Texas Instruments, Tandy, Tektronix, Toshiba

### Generator

Function Generator AFGU 377.5000.02	resolution of X axis: 4096 pixels resolution of Y axis: 1024 pixels step width: 100 ns to 327 s
Arbitrary Waveform Generator AMS 1013.0000.02 and Dual Arbitrary Waveform Generator ADS 1012.4002.02	resolution of X axis: 16384 pixels resolution of Y axis: 4000 pixels, normalized step width: 30 ns to 2.5/5 ms

All generators feature an arbitrary sweep facility.

<b>Storage oscilloscope</b>	Digital Storage Oscilloscope BOS, Philips PM 3350 A, PM 3365 A, PM 3355, PM 3375, Tektronix 2440, 2230, LeCroy 9400A, 9410, 9420, 9424, 9430, 9450, Hewlett Packard 54200A, 54200D, other drivers on request
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### Ordering information

<b>Order designation</b>	► Arbitrary Waveform Designer AWD-K1 1026.4500.03
Material supplied	2 disks of 1.2 Mbytes each, manual

## Operation

AWD-K1 uses the SAA standard, ie operation is guided by pull-down menus which may branch into dialog boxes. All commands are also directly accessible via key combinations. A context-sensitive help system provides explanations for each menu item.

Two graphics windows are active simultaneously. Since waveform parts can easily be exchanged between the two windows, one of them can be used as a buffer or "raw data base" for the other. Formulas are entered via a separate text window which can be opened at any time at the right-hand top of the screen by means of an icon.

## Formula interpreter

The interpreter generates from an algebraic formula the appropriate waveform within the defined range and places it left-adjusted in the upper graphics window. All relevant basic functions are supported. To shorten long formulas, it is possible to define constants, constant expressions and auxiliary functions for use in the notation. The generated waveform can then be manipulated with the graphics editor as desired.

## Graphics editor

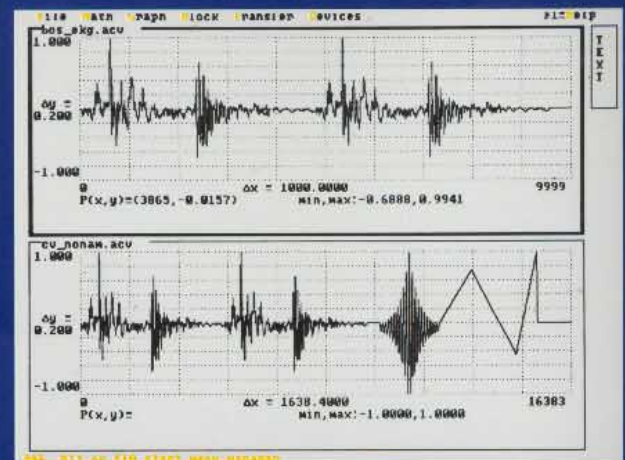
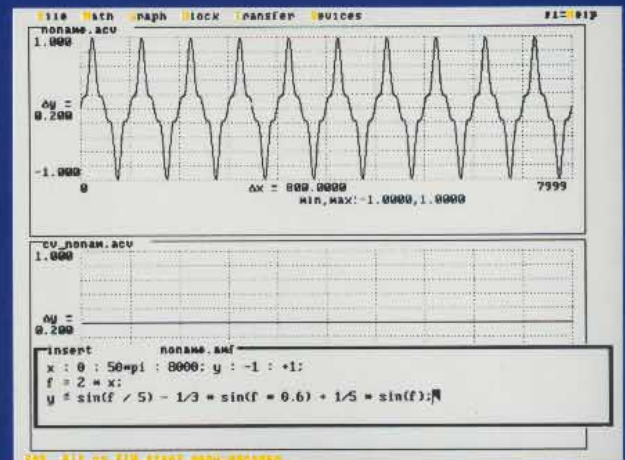
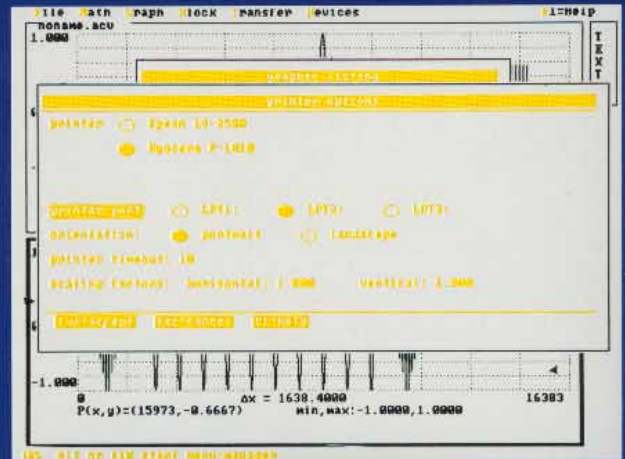
The graphics editor provides the commands for cutting, copying, inserting, distorting, superimposing, combining and erasing waveforms and waveform sections. In addition, it supports freehand design with the mouse and drawing of line segments. Zoom function and horizontal scroll ensure that the desired waveform section is displayed suitably and thus edited with optimal resolution.

## Transfer interface

AWD-K1 is able to read and display the memory contents of a large number of commercial digital oscilloscopes. Real waveforms can thus be transferred for test purposes either in unchanged form or edited at any frequency desired.

## File management

The file manager handles formula and graphics files. Each text and graphics window can be stored under a separate file name and also printed out as a hardcopy; AWD-K1 supports all commercial types of printers.



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