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AUTOMATIC BROADCAST EQUIPMENT TEST SYSTEM

B.V. Horn and T.J. Nel

South African Broadcasting Corporation , Republic of South Africa

INTRODUCTION

The expansion program the SABC initiated when the decision was taken in 1979 to introduce the TV2 and TV3 television networks, together with the routine equipment replacement program, placed a heavy burden on the engineering staff and facilities which control the acceptance testing of broadcast equipment and systems. The problem was compounded by the shortage of engineering staff and in order to maintain the Corporation's technical standards, an autotest system for both audio and video measurements was developed to enable the large volume of testing to be done.

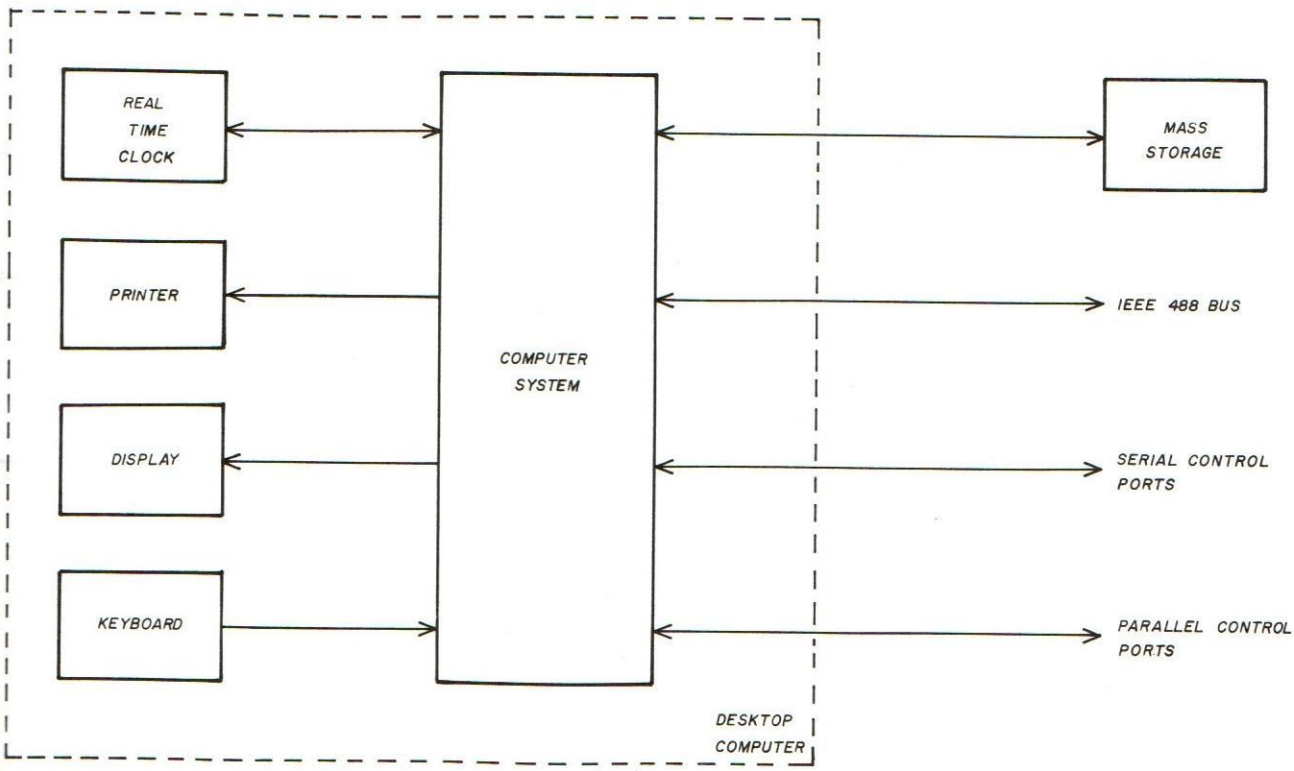
The heart of the autotest system is a powerful desk-top computer which controls both the audio and video sub-systems.

COMPUTER SYSTEM

The desktop computer system is an intergral unit which consists of the computer hardware, keyboard, display with full graphics capabilities, real time clock and printer. The computer system controls the audio and video test systems via the IEEE 488 control bus and the serial control port. The unit under test can be controlled by either the serial or parallel ports.

Mass storage is provided by either magnetic disc or tape drives and is used for program and test result storage. The mass storage devices are connected to the computer system via the IEEE 488 bus.

The desktop computer has a memory capacity of 64K bytes of RAM with a ROM based BASIC language operating system. The internal real time clock is used for program timing and report date and time identification.



COMPUTER SYSTEM

The graphics facilities allow the test results to be presented as bar graph or XY plots. The printer which has full graphics capability is used for hard copy outputs of test results.

PROGRAMMING

The system is programmed using an extended BASIC high level language which has been structured to provide simple control of devices attached to the I/O busses.

The measurement procedures have been structured as individual audio or video measurement sub-routines. These sub-routines have been encoded and fully documented and are used by the system programmer as building blocks for a structured program. The sub-routines are encoded to ensure that standard measurement procedures are adhered to and not modified by the system programmer.

The test results obtained are analysed and evaluated in the program, and output to the printer and mass storage device in the desired format. Results that exceed programmed limits are flagged on the hard copy output for easy identification.

The computer has user programmable keys which enable interaction with the system operator to be implemented at a low level, enabling unskilled operators to be used.

AUDIO TEST SYSTEM

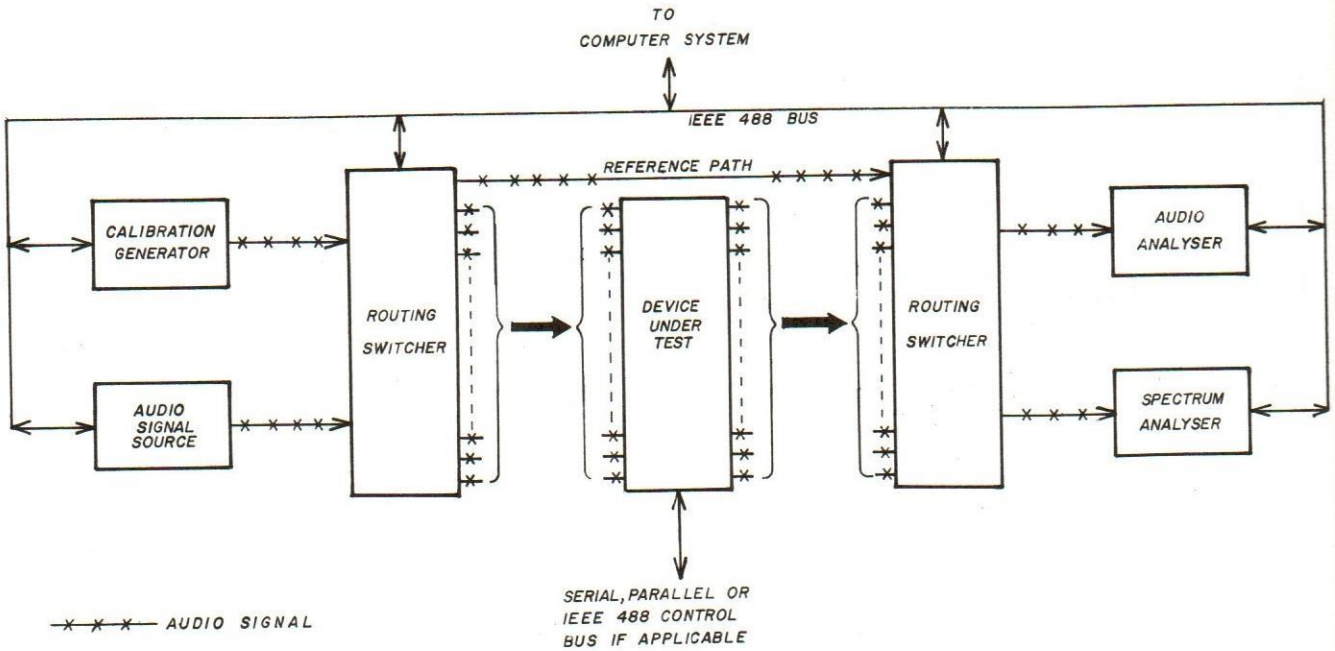
The system comprises signal generators and measuring instruments which are connected to the device under test by routing switches.

A synthesised level generator is used as the calibration generator, whose function is to provide test signals to ensure that the system is operating correctly and at the specified signal levels.

The audio signal generator provides the test signals required for the various audio measurements.

The signal from either the calibration generator or the audio signal generator is routed via a routing switcher to the device under test and on from the device under test via a second routing switcher to the measuring devices. A reference path is connected in parallel with the device under test for system calibration and reference measurements.

The measuring devices consist of two instruments, an audio analyser and a spectrum analyser.



AUDIO TEST SYSTEM

These instruments enable the following audio parameters to be measured :

a) INSERTION GAIN

b) FREQUENCY RESPONSE

c) SIGNAL TO NOISE RATIO

d) CROSSTALK

e) DISTORTION

f) WOW AND FLUTTER

g) FREQUENCY

h) DC LEVEL

The instruments and routing switchers are all operated under program control.

The device under test may be controlled by utilizing the parallel, serial or IEEE 488 ports or bus.

VIDEO TEST SYSTEM

The video test signal generator used is a standard multiple output device.

The test signal routing to and from the device under test is based on the same principal as the audio test system.

The video measurement system analyses the signal received, produces the test result requested and sends it to the computer system.

The video parameters which can be measured are :

a) INSERTION GAIN

b) FREQUENCY RESPONSE

c) LINE TIME NON-LINEARITY

d) CHROMINANCE/LUMINANCE CROSSTALK

e) DIFFERENTIAL PHASE

f) DIFFERENTIAL GAIN

g) 2T PULSE TO BAR RATIO

h) 2T PULSE RESPONSE

i) 2T BAR RESPONSE

j) 50 Hz SQUARE WAVE RESPONSE

k) CHROMINANCE/LUMINANCE GAIN INEQUALITY

l) CHROMINANCE/LUMINANCE DELAY INEQUALITY

m) SIGNAL TO NOISE RATIO

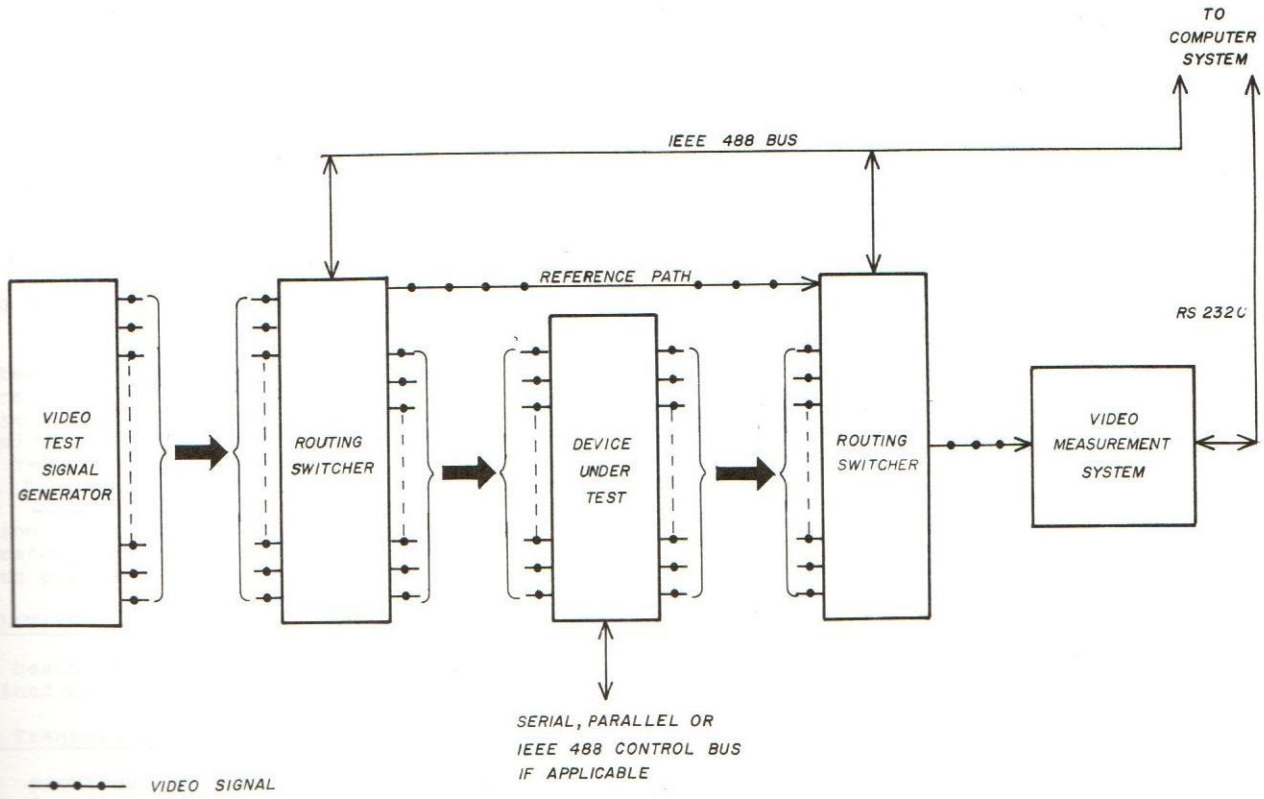
n) MOIRE

o) CROSSTALK

p) PULSE TIMING

The routing switchers are controlled on the IEEE 488 bus and the data exchange between computer system and the video measurement system is done via a RS232C format serial port.

The device under test, as with the audio system, may be controlled by utilizing the parallel, serial or IEEE 488 ports or bus.



VIDEO TEST SYSTEM

VIDEO MEASUREMENT SYSTEM

The video measurements are made using a digital video measurement system. This system samples, digitises and stores the video signal under test. This data is then processed and the desired video parameter result calculated.

The system as purchased comes with a PAL application program which is designed for automatic monitoring of PAL video signals and is based on insertion test signal analysis. The application program is not used in the video test system, instead software has been written to meet the measurement requirements using standard full field video test signals.

The system being software based allows for the development of measurement routines not easily implemented with existing measuring equipment. The only limitation of the system is the inability of its operating system to directly support mass storage devices. Therefore the program and test results are transferred to the computer system for final processing and storage.

FUTURE APPLICATIONS

The test system has been expanded by the addition of a 100 MHz oscilloscope, a 5½ digit digital multimeter and a 100 MHz frequency counter, all of which are under program control via the IEEE 488 bus. These instruments have been added to enable the system to be used for first line maintenance. The program will enable a technician to test and align if determined necessary, a unit of equipment or system without reference being made to the manufacturers maintenance manuals. The program initialises the instruments for each test required and prompts the operator when probes are required to be attached to the unit under test, or when adjustments are necessary.

This process will be applied to all items of broadcast equipment, enabling faster equipment alignment to a single standard.

SUMMARY

The autotest and maintenance system allows for rapid, accurate and repeatable measurements to be obtained on both audio and video equipment and systems for both evaluation and maintenance purposes.

The effectiveness of the system can be judged by evaluation tests made on a 50 input 20 output routing switcher where approximately 25 000 measurements are made in 10 hours, with no operator intervention required.

An important consideration in the development of the system was the fact that all units of equipment were standard production items.

The SABC has had two of the systems in operation for the past 20 months. These systems have enabled an increase in productivity and complete system tests to be done on multipath equipment which would otherwise have been tested by taking a number of representative sample paths.