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1. GENERAL DESCRIPTION

1.1. INTRODUCTION

DG5400 is a digital test pattern generator, which simultaneously provide signals in digital format - D1 serial - according to the standard ITU-R BT.601, SMPTE 270 Mbit/s, and analog PAL video signal, according to the standard ITU-R BT.470 norm. This PAL output can be used as an external sync to the digital serial signal. DG5400 has been designed to achieve the following functions:

- To generate standard test signals in order to carry out several adjustments in video systems.
- To enable all KROMA monitors the accomplishment of AUTO SET-UP function.

The DG5400, due to their reduced dimensions, weight and other features, could be possible to power it by battery, so, it is total portable with a function autonomy of approximately 1,5 hours.

1.2. OPERATION

The DG5400 operation is extremely simple, enough with power on the equipment, the switch is located at the rear back of the equipment, in order to view automatically on the screen a 100% colour bars pattern. This is the first pattern that the DG5400 has stored in memory. To change it, press repeatedly the keys ∧ and ∨ located in the front of the equipment. Also, on a LCD display a mnemonic of the name and a numbers associated with the particular pattern could be seen. Figures 1.1 and 1.2 show the appearance of the front and the rear of equipment, respectively.

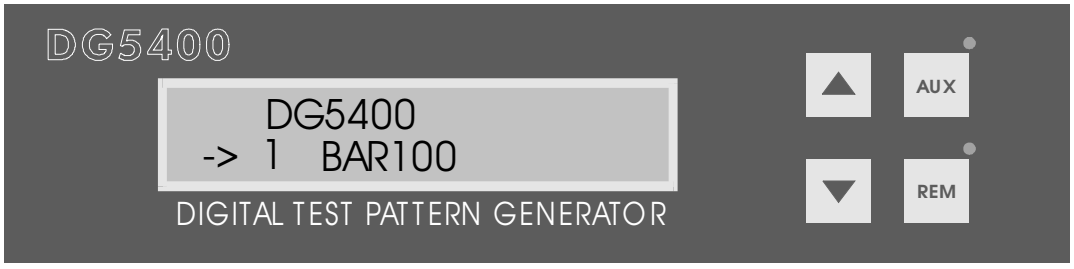


FIGURE 1.1 The Generator Front Part Appearance

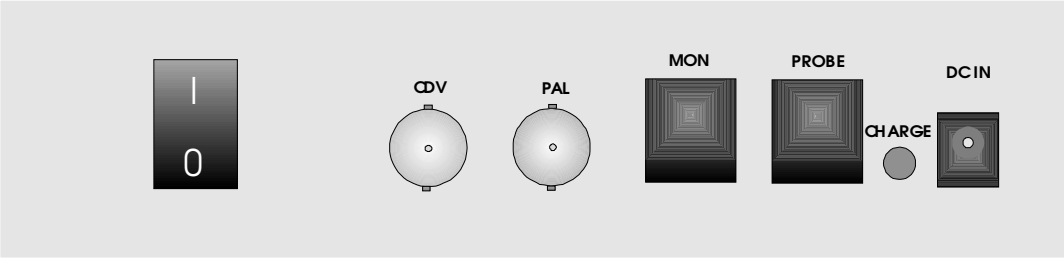


FIGURE 1.2 The Generator Rear Part Appearance

1.3. PATTERNS

From factory, the equipment is provided with a set of signals of the standard test, this set is composed of approximately 30 signals, which undertake different purposes in the adjustments that permits adjustment of linearity, frequency response, levels and gaps between luminance and chrominance, etc., nevertheless, this list can be modified on the user request with patterns of their own creation (those will be programmed at the factory).
The equipment is arranged of permanent memories where the different test signals are stored, being addressed by a logic control according to the selected pattern.

1.4. CONSTRUCTION

The equipment is build on a plastic material box, light with reduced dimensions, inside is inserted the electronic circuit board and a pack of batteries. It is used as support for the display and keyboard of front operations, it enables the internal treatment of screen in order to avoid electromagnetic radiations and interferences to the exterior. There are two BNC connectors at the rear panel, designed to offer the corresponding signal of video in the two previously described formats: digital serial D1 and PAL. There are also two telephone connectors with 6 pins in order to enable the AUTO SET-UP to KROMA monitors. In one of the connectors a probe is connected, which directly measures levels of luminance by placing it on the monitor tube, the other connector is available to connect the monitor microprocessor with the DG5400 in order to exchange the information and orders/instructions. Also, there are a main switch and a LED that it is lighting when the batteries are in load state, switching off at the end of the process.

2. TECHNICAL SPECIFICATIONS

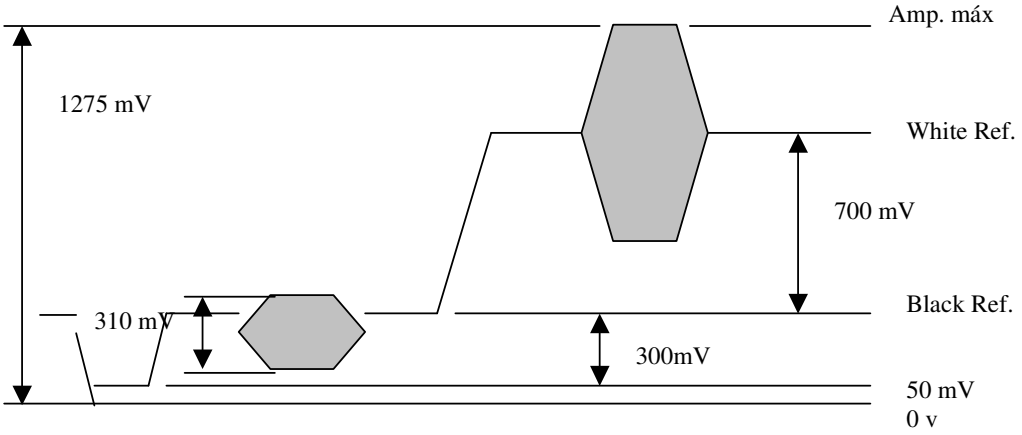
Output format: - ITU R BT 601 Digital
- ITU R BT 407 Pal

Operation mode: 625/50 System
Note: 525/60 and NTSC-M output format (as an option)

Signal generator: internal digital generation process at 10 bits.

Patterns: See section 5 from this manual.

Outputs: - D1 digital serial: Output through the BNC connector.
ECL balanced.
270 Mbit/s
- Composite PAL: Output through the BNC connector.
Filtered antialiasing.
Video levels.
- Level DC: 350 mV
- Amp. sync: 50-350 mV
- Amp. burst: 310 mV pp
- White Ref.: 1050 mV
- Black Ref.: 350 mV
- Amp. Max: 1275 mV



Oscillator: TCXO Type
Frequency: 27 Mhz
Stability: <1 ppm (in the worse case)
Ageing: 2ppm years

Jitter: 1ns pp

K Factor: K-2T: 0,3% KF
K-PB: 0,1% KF
PB Ratio: 100,5%
HAD: 195 ns
Note: Measurements with one pulse CCIR-2T 5.0% pattern VITS 17

Chrominance AM-PM: AM Noise: -27 dB rms
PM Noise: -1,9 dB rms
Note: Measurements with one signal of bars 100 / 0 / 100 / 0 pattern BAR100

Multiburst: 0 - 5MHz: - 1,13 dB

Power Supply: Input Tension Range: 200-240 V
Input Frequency Range: 50-60 Hz
Output Tension: 15V / 2 A

Return Losses: Output D1: -18 dB to 270 MHz
Output PAL: -36 dB to 10MHz

Mechanic characteristics: Length: 205 mm
Width: 175 mm
Height: 50 mm
Weight (including batteries): 850 grs.

Autonomy: Approx. 1,5 hours

Recharge time: Approx. 2 hours

3. ELECTRIC DESCRIPTION

Figure 3.1 shows a blocks diagram, which enables to observe different operational components that form the equipment. This Figure distinguishes:

- Power Supply
- Digital generation logic of patterns
- Microprocessor Circuit
- User interface (display and keyboard)
- Encoder PAL Circuit
- Serialize and driver of line for digital signal D1
- Battery charger Circuit
- Output signal Connectors and communication

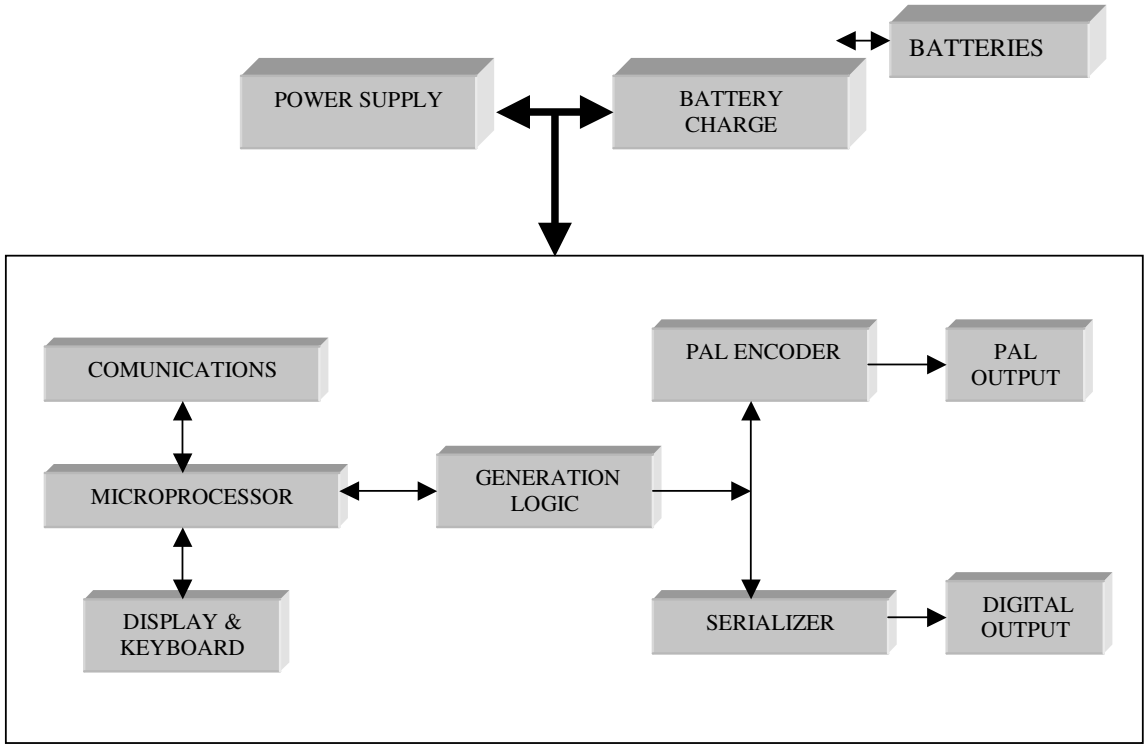


Figure 3.1 DG5400 Block of Diagram

3.1. FUNCTION THEORY

The equipment has a number of memories in which several configured patterns are stored. A Digital core is responsible to obtain the information from those memories, as well as to generate codified words of synchronization that conforms a digital signal D1, subsequently, this information (at 10 bits format), is passed to a parallel-serial circuit and it is deliveried in the corresponding connector, simultaneously this signal is offered to a PAL encoder, which offers the analog signal from an amplifier circuit in the connector. By pressing a key located in the front allow the microprocessor to select another pattern, doing the desired change. The sequence of necessary operations can take the DG5400 to collaborate in the KROMA monitors AUTO SET-UP functions, by putting the corresponding probe and connecting it to the monitor through the adapted way.

3.1.1. Power supply

The equipment is powered by an external power supply, which connects the mains and offers a DC voltage output of 15V/ 1.2A. It has a JACK connector, located at the DG5400 rear panel. Internally, there are 2 DC/DC converters, they are in charge of transforming the input tension in +5V and -5V, it is necessary, in order to power the equipment different circuits.

3.1.2. Logic of patterns generation

The heart of the equipment is formed by two memories, where the several lines that make up each of the patterns are stored. It also consists of a logic circuit which is programmed to be in charge of the memories mentioned above, and sequence generation of necessary codes for the signals formation. The system works with enough bus width in order to permit the generation of the patterns with a resolution of 10 bits.

3.1.3. Microprocessor Circuit

A microprocessor based on the xx51 architecture is responsible to generate the control signals toward the logic of pattern generation, for its selection, it also controls the LCD display and the operation keyboard. This microprocessor, also, carries out the protocols of communication with the optical probe and the monitor in order to carry out the AUTO SET-UP functions. In the AUTO SET-UP mode, it automatically selects necessary patterns and introduces the corresponding data to the values obtained from the optical probe, which are arranged in the tube of the monitor for chromaticity measurements.

3.1.4. User interface

It consists of, (as we have mentioned previously), a keyboard and a LCD display in the front part of the equipment. Through the keyboard it is possible to select availability between the different patterns and select the communication channel with the probe for signal levels measurement. On the display a mnemonic and a number of corresponding order to the selected pattern are represented, when either AUTO SET-UP mode or the selection of probe is entered, the corresponding values of measurements related to that probe in magnitude function detected from Red, Green and Blue, in resolution of 3 integers and 3 decimals.

3.1.5. Encoder PAL Circuit

It consists of a Digital-Analog converter circuit, that accepts on its input digital signal in parallel format, through the standard CCIR-656 and delivers to its output Pal signal according to the ITU-R BT.470 norm, this signal is amplified and adjusted to the necessary levels by an amplifier circuit and an antialiasing filter. The signal constructed becomes available in the corresponding BNC connector.

3.1.6. Serializer and driver of line for digital signal

The signal that constitutes different patterns, is built in parallel format with 10 bits word, it is necessary, therefore, to convert this signal to serial format and to carry out a conversion to ECL levels, required for the transmission, accoding to the standard SMPTE 270Mb/ s. In order to get an output impedance appropriate to this type of transmission and to attack properly the line one that is used a driver of especific line.

3.1.7. Battery Charger Circuit

The equipment is provided with the necessary elements in order to carry out the recharge of the batteries with which it could be powered. This circuit consists of a charger controller for Ni-Cd batteries and the associated circuits. The charger circuit is responsible to power the equipment from mains with the included supplier, in case of not needing to load the batteries it becomes disconnected in just a few minutes.

3.1.8. Connectors of output signal and communication

In DG5400 rear panel there are two BNC connectors, where the generated signal is obtained, in PAL or DIGITAL format. Also, it is provided with two telephone connectors appointed to the connection of the optical probe and communication with the monitor, respectively. On that rear panel there are also the main mains switch, a led indicator of battery charge and a JACK connector for power.

4. EQUIPMENT DETAILED DESCRIPTION. TESTS AND ADJUSTMENTS

4.1. EQUIPMENT DETAILED DESCRIPTION

Note: With reference to the constituent elements of the equipment in this section, it could come to the electronic schemes, in the corresponding section, in order to locate them.

4.1.1. Power Supply

The DG5400 constituent electronic needs voltage of +5V and - 5V in order to operate properly. These voltages are obtained through DC-DC converters, constructed from the U3 and U6 integrated circuits. These converters are powered, through the mains, with the incorporated adapter or through the batteries. The tensions provided by these two elements are superior to the ones required by the circuit, because it includes these two elements in order to carry out this transformation. A detailed description of the utilised circuit could be found in the electric schemes in the corresponding section of this manual.

4.1.2. Patterns Generation Logic

The patterns that are capable of generating the equipment are stored in the form of lines in the memories U12 and U13, these utilised memories are FLASH technology because they can be reprogrammed if necessary, one of the memories stores the data corresponding to the words of luminance, the other memory stores the codes associated with the chrominance signals. These memories are addressed by means of programmable logic circuit U14, which makes up the true heart of the system. This circuit receives, from the microprocessor, a code corresponding to a determined pattern and is responsible for addressing the memories in order to get the corresponding information of the signal to create, it inserts in the frame the corresponding codes to the reference of temporisation and synchronization required by the digital signal and delivers such frame, as the serializer in order to transmit a digital signal serial, as the digital-analog converter in order to conform the PAL signal.

This circuit, also, generates line pulses reference and field reference toward the necessary microprocessor for certain functions achievement.

4.1.3. Microprocessor Circuit

It is responsible to manage the user applications through the keyboard in order to act on the pattern logic generation. It delivers the appropriate code of the selected pattern allowing the correct addressing of the logic generation. The management program contains the necessary protocols for the correct communication with the optical probe and with the monitor for the AUTO SET-UP functions achievement, in this mode it is selected

automatically the necessary patterns for the adjustments and a serial of measurements are obtained on the tube of the monitor through the probe, those values are used for the DAC's calibration that act on the levels of different signals in the monitor, carrying out this function periodically on the KROMA monitors it is succeeded in maintaining them with some levels of signal, which exist within the specifications.

4.1.4. User controls

As it has been mentioned previously, it consists of a keyboard of four elements which allows to select between the different functions of the equipment. There are two keys of pattern selection with which it is possible to modify the pattern which is displayed at that particular time, there are also another two keys of auxiliary functions for optical probe selection, it allows to carry out measurements of signal level in the tube of the monitor and the other key activates the functions of the remote control. It also has a 20x2 characters LCD display with backlight for a correct visibility even though in conditions of low luminosity, on the display is presented some information with relation to the function developing every single moment. In pattern generator mode it is presented an associated number as well as mnemonic, which describe the selected pattern, when the AUTO SET-UP functions are executing or the optical probe is selected, on the screen appears information concerning the values of signal measurements with the mentioned before probe for each one of the three colours; red, green and blue. Figure 4.1 shows the information of the display when the measurements with the optical probe are carried out. The first group of values corresponds to the values of red, the second to green and the last one to blue. Figure 4.2 shows the information corresponding to the AUTO SET-UP mode. It shows the presentation of the selected pattern name and the measurement delivered by the probe.

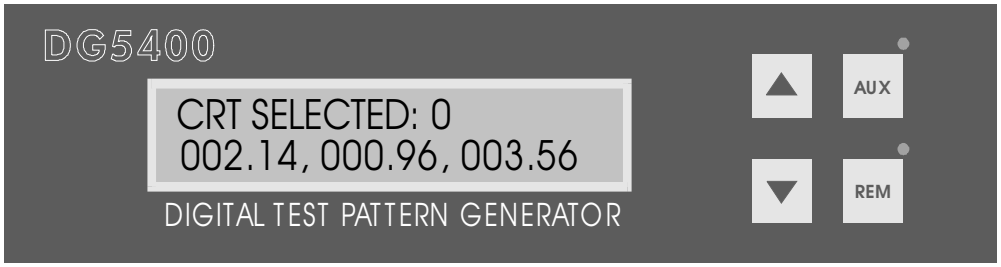


Figure 4.1 The Equipment Front Part Appearance in measurement mode

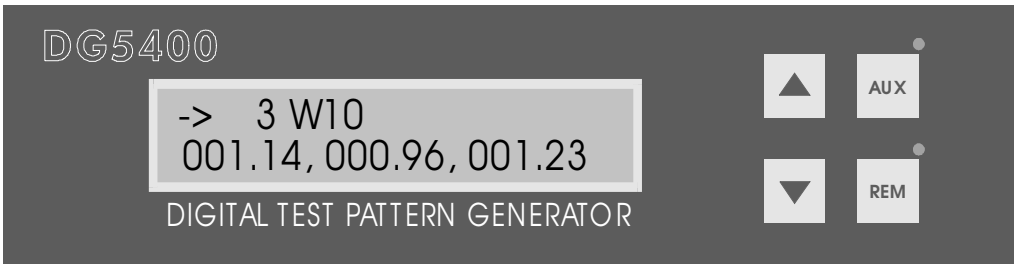


Figure 4.2 The Equipment Front Part Appearance in AUTO SET-UP mode

4.1.5. Encoder PAL Circuit

It consists of an integrated circuit, with the appropriated external elements, which receives the digital video frame generated by the core and converts the PAL analog signal in band base corresponding to the standard ITU-R BT.470. This signal passes through the low-pass filter in order to eliminate components of high frequency and, therefore, eliminate the aliasing phenomenon, afterwards, amplify the signal in levels with the appropriate object and adapt in impedances in order to attack a load of 75 Ω. Circuit is supplied by a reference voltage of high pressure and low temperature coefficient and a clock signal of 27MHz necessary in order to achieve the conversion efficiently. As being the signal oversample to the double of its frequency of Nyquist, and due to the analog filter inclusion, obtains an output signal free of spectral components of high frequency.

4.1.6. Serializer and driver of line for the digital signal

Since the digital generation signal takes parallel form at 10 bits, it is necessary to have a mechanism that carries out the pertinent conversion to necessary serial format in order to carry out the transmission through coaxial line. It consists of a circuit that receives the parallel data at 10 bits and a clock signal at 27MHz and through an internal PLL, it converts the signal to serial format with a speed of 270Mb/s with the ECL levels required for this type of transmissions, the signal so generated passes through a driver of line that adapts signal in levels and necessary impedance in order to attack the 75 Ω lines.

4.1.7. Circuit of the battery charger

DG5400 has the possibility of being powered from two different modes, it can be done through the external incorporated power supply or directly from the mains 220V/ 50Hz, connecting it to the jack located at the rear part of the equipment or through the NiCd batteries that come included in the interior of the equipment. In order to recharge this batteries they must be connect to the external supply and a charge controller, which determines if it is necessary to recharge them, and in affirmative case all the necessary circuits are started in order to carry out the function and the batteries are recharged to their nominal capacity, while this process is being executed it is indicated through the led located at the DG5400 rear part, if the recharge is not necessary the led goes off in a few minutes and the controller cuts the supply of power towards the batteries restraining its pass transistor.
Figure 4.3 shows the Jack of power and the indicating LED of charge.

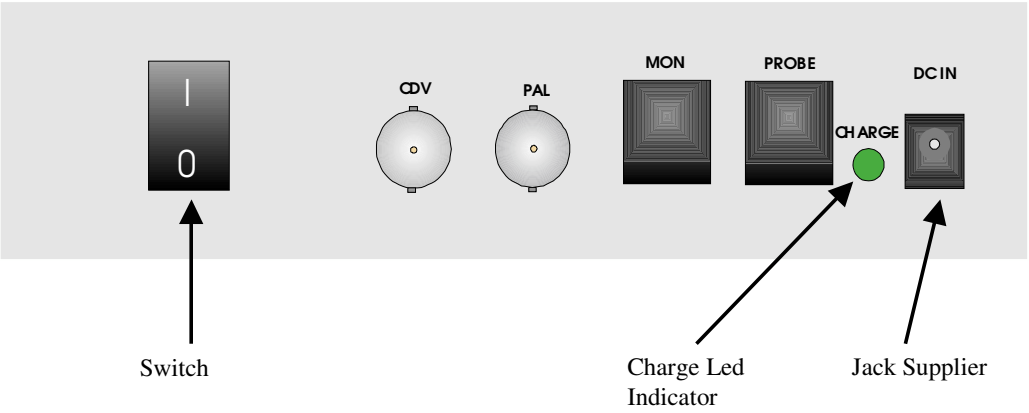


Figure 4.3 Disposition of charge indicator led and jack supplier

4.1.8. Output Connectors and communication

All the DG5400 necessary connectors are located at the rear panel, so, there are a load of batteries indicating LED and the jack connector in order to power the equipment externally. Also it has a main switch in order to connect or to disconnect the power. There are two telephone connectors with 6 pins destined to stablish the necessary communications with the monitor and the optical probe to achieve the AUTOSETUP functions, or only with the probe in case of choosing this way of operation. Also, there are another two BNC connectors in order to connect both coaxial cables where the signals will be available, as in serial digital format, as analog PAL All the connectors are easily identifiable by means of the silk-screen printing located at thre rear panel.

Figure 4.4 shows the output signal connectors and the communications ones

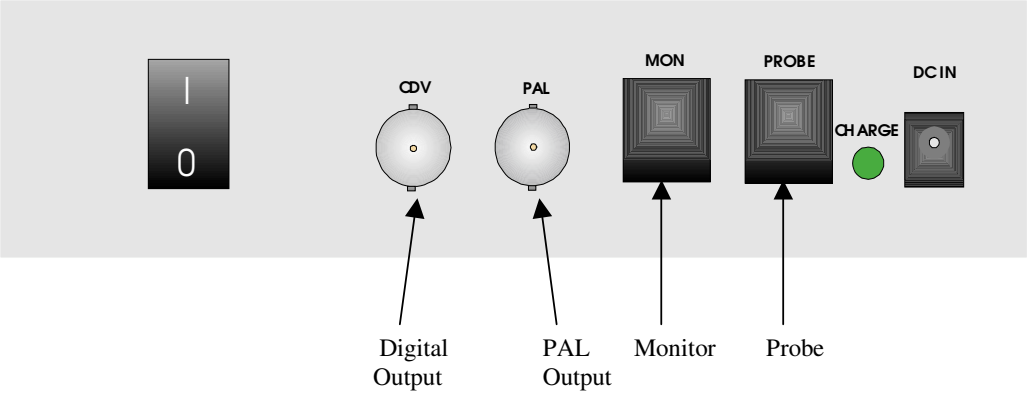


Figure 4.4 Disposition of the signal connectors and communications

4.2. TESTS AND ADJUSTMENTS

4.2.1. Material necessary for the equipment adjustment and test

The following equipment is necessary in order to carry out the procedure of test and adjustment of the DG5400.

- 1 oscilloscope of 2 channels and 400MHz (Tektronix 2465B or similar)
- Colour Monitor with Digital serial and PAL video inputs (KROMA BM3000/4400/ 5000/5300/5400)
- VHF frequency meter, which basic time more accurate than 5 [ppm]
- Equipment of video measurement (Tektronix VM700 or similar)
- Visualizer of wave digital serial form with capacity of analysis of the data (TektronixWFM601M or similar)
- Different laboratory tools (trimmer, coaxials cables, etc.)
- PC in order to connect a serial port (RS-232) for discharge and reprogrammation of the DG5400 flash memories.

4.2.2. Procedure of setting in progress and adjustment.

1. Screw the printed circuit board to the base of the box and assemble the front and the rear panel of the equipment plugging in all the necessary connectors, as well as the battery.

2. Load the configuration program in the logic and send the programming files of the memories through the PC serial port, first selecting the speed of transmission of 19200 bauds.

3. Once the two programs have been launched, turn off the equipment and load the program of execution in the logic.

4. Place a jumper in J14.

5. Connect the VHF frequency meter in TP (it is near U16) and act on R85 until a frequency of 27.0000 Mhz is obtained.

6. Remove the jumper in J14.

7. Connect a coaxial cable in J9 and connect it to the WFM601M input and check that the output signal does not contain any errors in the data format and that the indicator of alarm is off.

8. Connect a probe of oscilloscope in the TP placed/located next to J8 and select the 100% colour bars on the keyboard.

9. Measure on the screen of the oscilloscope and act on R68 until the level of signal reaches 1.4 Vpp.

10. Connect a coaxial cable in J8 toward an input of the VM700 and check that the signal is viewed free of errors and check that it stays in specifications.

11. Finally it is possible to act on R8 in order to adjust the brightness of the texts represented on the LCD display.

12. Proceed by connecting the optical probe and the monitor in the connectors provided for that purpose and the AUTO SET-UP function of the monitor will be carried out in order to verify that all the communications are achieved correctly.

5. PATTERNS DESCRIPTION

In this section the different included patterns are described, indicating their position in the DG5400, as well as any possible utility and notes if necessary.

1- BAR100

100% Standard colour bars
Applications: Measurement of delay between channels, as well as their relative amplitude.
Adjustment the monitor matrixed.
Notes: CCIR 100/ 0/ 100/ 0 standard colour bars

2- W100

White window centred with 100% of luminance value (700mV).
Applications: Adjustment of white level on the monitor.
Notes: Used by the KROMA monitors for AUTO SET-UP of luminance.

3- W10

White window centred with 10% of luminance (70mV).
Applications: Adjustment of white level on the monitor.
Notes: Used by the KROMA monitors for AUTO SET-UP of luminance.

4- W15

White window centred with 15% of luminance (105mV).
Applications: Adjustment of white level on the monitor.

5- W50

White window centred with 50% of luminance (350 [mV]).
Applications: Adjustment of white level on the monitor.

6- WHT50

Flat field formed by 50% luminance level (350mV).
Applications: Adjustment of white level on the monitor.

7- WHT100

Flat field formed by 100% luminance level (700mV).
Applications: Adjustment of white level on the monitor.
Notes: Used by the KROMA monitors for AUTO SET-UP of chrominance.

8- WHT15

Flat field formed by 15% luminance level (105mV).
Applications: Adjustment of white level on the monitor.

9- BAR75

Standard colour bars with 100% of luminance and 75% of amplitude in chrominance.
Applications: Measurement of delay between channels, as well as its relative amplitude.
Alignment of the monitor.
Notes: EBU 100/ 0/ 75/ 0 standard colour bars.

10- CRHT_1

Formed by a grid of 12 x 9 squares.
Applications: Focus of the monitor, adjustment of parameters of centring and convergence.

11- CRHTD_1

Formed by a grid of 12 x 9 squares with points in the centre of each square.
Applications: Focus of the monitor, adjustment of parameters of centring and convergence.

12- CRHT_2

Formed by a grid of 18 x 13 squares.
Applications: Focus of the monitor, adjustment of parameters of centring and convergence.

13- CRHTD_ 2

Formed by a grid of 18 x 13 squares with points in the centre of each square.
Applications: Focus of monitor, adjustment of parameters of centring and convergence.

14- STAIR10

Stairway of luminance with 10 steps of different levels.
Applications: Adjustment of such parameters of monitor as brightness and contrast.
Notes: The stairway is formed by 10 steps ascendant from 0 to 700mV.

15- SINX/ X

Formed by a line with 5MHz sinx/ x with 125mV of pedestal, until half of the line; and 5MHz sinx/x inverted with 575mV of pedestal.
Applications: Measurements of frequency response.
Detection of gain distortion
Measurements of relation between signal-noise.

16- RAMP100

Formed by an ascendant ramp for each one of the channels.
Applications: Measurements of linearity.
Verification of dynamic range of the DAC's
Notes: They are reached the maximal and minimal values in the digital video signal for the channels of luminance and chrominance according to the recommendation 601 of the CCIR.
The introduced colours are illegal.

17- VRAMP

Formed by 3 ramps in luminance and 2 for chrominance, separated for values to black level.
Applications: Measurements of linearity.

18- YRAMP

Formed by a ramp of luminance from 0 to 700mV, in all visible area.
Applications: Measurements of linearity.

19- MBURST

Formed by 8 packages in frequency of luminance from 500KHz to 5,8MHz, and 7 packages in frequency of chrominance from 250KHz to 2,5MHz.
Applications: frequency response.
Measurements of amplitude distortion
Notes: This pattern is only available in format D1, not presenting any DG5400 signal in the PAL output when this pattern is selected.

20- BURSTP

Formed by 6 packages of frequency only in the channel of luminance. Frequency values from the left to the right are: 500KHz, 1MHz, 2MHz 3MHz, 4MHz and 5MHz.
Applications: Measurements of frequency response.
Measurements of distortion of amplitude

21- VITS17

Formed by a stairway in luminance, pulse and bar with a pulse 2T in modulated chrominance.
Applications: The realisation of measuring of pulse response and frequency as much automatic as manuals.
Notes: Defined for the CCIR.
Pulse 2T in modulated chrominance.

22- VITS330

Formed by pulse and bar, in addition to the stairway modulated in chrominance.
Applications: Achievement of reply measurement to the pulse response and linearity as much manuals as automatic.
Notes: Defined for the CCIR.
The stairway is modulated in chrominance.

23- BOWTIE

The pattern consist of a sin function in luminance of 500KHz and by a sin of 502KHz in chrominance, besides of the marks zone compound of eleven pulses 2T in luminance.
Applications: Measurements of delay between channels of luminance and chrominance.
Measurements of amplitude difference between the channels of luminance and chrominance.
Notes: This pattern is only available in format D1, not presenting any DG5400 signal in the PAL output when this pattern is selected.

24- RRBARS

Consist of a number of 100% colour bars occupying the two superior thirds of the screen and a red reference in the inferior third.
Applications: Measurement of noise.
Measurement of purity and matrixed
Measurement of delay between channels, as well as their relative amplitude.

25- YRBARS

Consist of CCIR 100/ 0/ 100/ 0 bars in the superior half of the screen and the same bars, only in luminance, in the inferior part.
Applications: Measurement of delay between channels, as well as their relative amplitude.
Test of linearity of amplifiers, contrast and brightness of the monitor.

26- WRBARS

The pattern is formed by some100% colour bars in the two superior thirds of the screen and a white reference in the inferior third.
Applications: Measurement of noise.
Measurement of purity and matrixed of the monitor
Measurement of delay between channels as well as their relative amplitude.

27-, 28-, 29- SAT_1, SAT_2, SAT_3

These three patterns are formed by different combinations of blue and white in different configurations (vertical with progressive transition, horizontal and to fringes).
Applications: They are used for adjustment of saturation level of the monitor.
Note: Adjustment of saturation can be achieved on the KROMA monitors, when a composite video input is selected.

30- BLACKB

Formed by a flat field corresponding to a black level.
Applications: Reference of synchronism.

31- NET

Formed by a flat field in red colour.
Applications: Measurements of noise and purity and matrixed of the monitor.

32-. .53- RESERVE

These positions for patterns are reserved for future extensions, presenting it, in each case, the ASETUPC pattern corresponding to the position 54.

54- ASETUPC

Formed by a blue flat field with 100% colour of saturation.
Applications: Measurement and adjustment of the saturation level of the monitor(only with composite video input selected).
Note: Used by KROMA monitors in order to carry out the AUTOSETUP in chrominance.

55- BOUNCE

This pattern consist of an alternative flat field with 100% luminance level and 50% luminance level.