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1. Safety

Please read this chapter carefully before using the instrument.

1.1 Introduction

The instrument described in this manual is designed to be used by properly trained personnel only. Adjustment, maintenance and repair of the exposed equipment must only be made by qualified personnel.

1.2 Safety Precautions

The battery pack includes a 500mAh rechargeable nickel-cadmium battery unit with output short-circuit protection. The output terminals of the battery pack are designed to reduce the risk of short-circuiting since this would reduce the lifetime and reliability of the battery pack.

The only maintenance required for the battery pack is to keep the battery charged and the contacts clean.

The battery pack may explode if disposed of by incineration. A nickel-cadmium battery may exhibit a reduced charge capacity, typically caused by repetitive partial discharge/recharge cycles. To avoid this reduction of charge capacity, please operate your instrument until the pack is fully discharged and then fully charge it.

1.3 Electrostatically Sensitive Devices

All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD). Careless handling during repair can reduce lifetime drastically. When repairing, make sure that you are connected to the same potential as the body of the instrument via a wrist wrap with resistance. Keep also components and tools at this potential.

ATTENTION

2. Introduction

2.1 General Information

The PM 5639/82 and PM 5639/83 Colour Alignment Generators are handhold battery operated generators. The generators provide all the signals needed for the daily calibration of colour monitors.

The generators may be used as stand-alone instruments or remote controlled, e.g. from the PM 5639 series colour analysers.

2.2 Versions and Types

The PM 5639/82 generators are the component generators and are configurable to RGB and Y, PB, PR. The generators come in both 625-line/50 Hz and 525-line/60 Hz versions.

The PM 5639/83 generators are the composite generators, and they are configurable to composite and Y/C.

The generators comes in both PAL (625-line/50Hz, fsc: 4.433618MHz) and M-NTSC (525-line/60Hz, fsc: 3.579545 MHz) versions.

2.3 Applications

The PM 5639/82 and PM 5639/83 Monitor Alignment Generators supply all the signals needed for the daily calibration and control of colour monitors.

The generators provide signals for the calibration of the following parameters:

- Purity
- Convergence
- Cut-off/Bias (low-level white balance and luminance)
- Contrast/Gain (high-level white balance and luminance)
- Chroma gain/Saturation/Hue
- High tension supply stability
- Videowall timing

3. Product Data

3.1 Safety Characteristics

This apparatus has been designed and tested in accordance with Safety Class II requirements or IEC publication 348 (Safety Requirements for Electronic Measuring Apparatus) and is safe as supplied. This manual contains information and warnings, which must be followed to ensure safe operation and to keep the apparatus safe for its operators.

3.2 Performance Characteristics

Properties expressed in numerical values with stated tolerances are guaranteed to tolerances. Specified non-tolerance numerical values indicate those which could be nominally expected to be the average of a range of identical instruments.

The design of the generator has been optimised with respect to tightest amplitude tolerances and low battery power consumption. The switching between signals is not time locked to the field. Hence, a small gleam on the monitor can be seen. Also a small change in the display may be observed during fine-tuning of the signal. Duration: 1/10 sec. These phenomena are not errors and have no influence on the monitor calibration.

3.3 Versions

PM 5639 G/82 Component, 625 RGB and Y, P_B, P_R
PM 5639 M/82 Component, 525 RGB and Y, P_B, P_R

PM 5639 G/83 Composite, PAL and Y/C
PM 5639 M/83 Composite, NTSC and Y/C

3.4 Test Signals

- PLUGE with vertical greyscale
- Window signal: 0% to 100% with ruler (5% intervals)
- Flat-field grey signal: 0% to 100% with ruler (5% intervals)
- Diagonal crosshatch: 16 x 16 lines
- Staircase: 5-step, 0% to 100%
- Needle pulse: white and black
- Flat-field red signal: 75% saturation

625-line generators only:
- Colour bar EBU + Grey, 2:1
- Crosshatch: 14 x 19 lines + dots + border castellations

525-line generator only:
- SMPTE Alignment Colour Bar Test Signal, in accordance with EG 1-1990
- Crosshatch: 14 x 17 lines + dots + border castellations

3.5 Video Levels, Nominal

3.5.1 Composite PAL and Y/C 625-Line Generator

100% Y (luminance):
700mV
Sync:
300mV
Subcarrier:
4.43361875 MHz, ±50Hz

3.5.2 Component RGB and Y, P_B, P_R 625-Line Generator

100% RGB:
700mV
100% Y (luminance):
700mV
100% P_B, P_R (B-Y, R-Y colour difference):
±350mV
Sync:
300mV

3.5.3 Composite M-NTSC and Y/C 525-Line Generator

100% Y (luminance):
714mV
Sync:
286mV
Setup:
53.6mV (7.5IRE)
Subcarrier:
3.579545 MHz, ±50 Hz

3.5.4 Component RGB and Y, P_B, P_R 525-Line Generator

100% RGB:
700mV
100% Y (luminance):
700mV
100% P_B, P_R (B-Y, R-Y colour difference):
±350 mV without setup on Y
± 323.8mV with setup on Y
Sync:
300mV
Setup:
52.5mV (can be disabled)

3.6 Video Outputs, Connection/ Accuracy

The connector on the generator is a 9 pole female sub-D type. Included with the generator is a special cable, which has four BNC connectors for the video signals. All video output levels are specified with 75Ω terminations at the end of the interface Sub-D to BNC cable.

Connector:
4 x BNC (from 9-pole sub-D connector)

3.6.1 Y, P_B, P_R Mode

Luminance level black and white signals:
±1% at 100% white
Luminance level colour and black and white signals:
±1.5% ±3mV at other levels, tracking with colour difference outputs better that 0.2%

Sync on Y (selectable):
±5%

3.6.2 RGB Mode

R, G and B output level:
Common mode:
±1% at 100% white
±1.5% ±3mV at other levels
Differential:
±0.2%
Sync on G (selectable):
±5%

3.6.3 Composite and Y/C Generators

Luminance level:
±1% at 100% white
±1.5% ±3mV at other levels

Chrominance to luminance amplitude error:
<2%, including burst
Chrominance phase error:
<2°
Sync on Y (selectable):
±5%

3.6.4 525-Line Generators Only

Selectable set-up:
Y, P_B, P_R mode:
52.5mV ±1.5% ±3mV
RGB mode:
52.5mV ±1.5% ±3mV with colour signals
Differential:
±0.2%

3.6.5 Synchronising Output

Sync out:
300mV or 286mV ±15% in 75Ω,
5V ±10% when open-ended
Output impedance:
~1.2 kΩ

3.6.6 Output Impedances

Composite (including sync):
75Ω ±2%
Luminance (including sync):
75Ω ±2%
Chrominance:
75Ω ±2%
Green (including sync), Blue, Red:
75Ω ±2%

Programming

3.7.1 User Programming

Presets
10 presets selectable from the keyboard and the remote connector.

Memory
Configuration and presets are stored in non-volatile memory. Backup battery neither included nor needed.

3.7.2 Factory Programming

A standard signal-set for monitor calibration is pre-programmed. The presets are programmed to match the printed text on the keys.
With the 625-line generators, the “window low" is 15% and the "window high” is 100%.

With the 525-line generators, the "window low" is 20% and the "window high" is 100%. Setup is enabled on the component output version of the 525-line generator.

The automatic power-down mode is enabled.

3.8 Remote Operation

Remote Control with PM 5639 Series Colour Analyser
The generator may be remotely controlled from the PM 5639/80 Display Unit. The 10 presets can in this case be recalled by recalling the 10 measuring setups of the display unit.

Advanced Remote Operation
The generator is completely remote controllable - signal and format selection - from an RS232C controller connected to the FCC-68/J11 remote connector.

3.9 Power

The generator is powered by a removable rechargeable battery package. The instrument may be operated when connected to the DC charger. The generators have an automatic standby mode - which is activated if 10 minutes have passed without a keystroke. Normal operation is enabled whenever a key is touched or activity on the remote is detected. The automatic power down mode can be deselected for continuous operation.

Charger consumption:
<7 VA
Operating time:
>6h (typically, on fully charged batteries)

Safety and EMC:

Safety:
In compliance with IEC 348 class II
Electromagnetic compatibility:
In compliance with EU requirements for EMC
Emission:
EN 55022 class B
Immunity:
EN 50082-1/1992, part 1

3.10 Environmental Conditions

Operating temperature:
+10 to +40°C (+50 to +104°F) (non-condensing)
Storage temperature:
-10 to +70°C (14 to 158°F)

3.11 Mechanical Data

3.11.1 Generator

Height : 34mm (1.3")
Width : 75mm (3.0”)
Length : 200mm (7.9”) (excluding connectors)
Weight : 350g (0.8lbs.) (including battery)

3.11.2 Battery Charger

Height : 86mm (3.4”)
Width : 50mm (2.0")
Length : 45mm (l.8”) (except mains connector)
Weight : 275g (0.6l lbs.)

4. Accessories

Qty	Description:	Ordering Number:
1	110V AC or 230V AC battery charger	
	European type	4008 105 90700
	American type	4008 105 90690
	British type	4008 105 90740
1	Rechargeable battery pack	4008 109 81770
1	Video interface cable sub-D to BNC (4 x BNC)	4008 105 03500
	Interface cable, FCC-68/J11 Connectors*)	4008 105 00120
1	Instruction manual	9499 493 09411

*) Cable for remote operation of the generator together with a PM 5639 Colour Analyser.

5. Installation Instructions

5.1 Initial Inspection

Please check the contents of the shipment immediately upon receipt. If the contents are incomplete or damaged, a claim should be filed with the carrier immediately, and should be notified in order to facilitate the repair or replacement of order.

Before inserting the charger into the main socket, make sure that it is the correct voltage. If it is not, please contact your local PTV representative.

WARNING: Any replacement of parts in the opened apparatus under voltage shall be avoided as far as possible and, if inevitable, shall be carried out only by a skilled person who is aware of the hazard involved.

5.2 Installing/Changing the Battery

To change the battery pack:
- Press and lift slightly with your thumb on the bottom of the battery pack and the battery pack can be lifted out.
- Insert a new battery pack.

The data memory in the generator is non-volatile, and it is possible to change the battery without loss of data. The non-volatile memory is made possible by Flash-PROM; there is no internal backup battery.

When you receive your monitor alignment generator (or a new battery pack), the battery is uncharged. Care should be taken to charge the battery completely the first time; this means charging for at least 14 hours.

6. Configuration

6.1 Automatic Operation

The generator may be configured to operate in an automatic mode together with the PM 5639/80 Display Unit of the PM 5639/00 CRT Colour Analyser or the PM 5639/10 Projector Colour Balance Meter.

When operated together with the PM 5639/80 Display Unit, the RECALL of the measuring setups in the display unit initialises a RECALL of the same numbered preset in the generator.

To use this feature, connect the cable from the colour analyser, which normally goes to the colour sensor directly to the connector labelled "SENSOR" (Colour Sensor) on the generator.

Connect the cable supplied with the generator to the connector labelled "CONTR." (Controller) on the generator and to the display unit.

Any recall of a measuring setup on the colour analyser will now recall the same numbered preset in the generator. In order to receive the full benefit of this feature, the generator should be programmed to give the correct video signal for each measuring setup in the colour analyser.

The generator will not enter the automatic power-down mode as long as signals are detected from the colour sensor.

6.2 Connectors

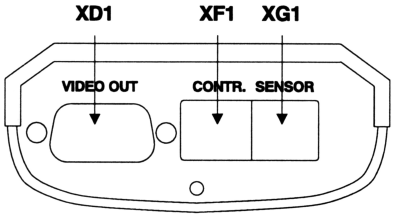

Fig. 6-1 Location of connectors

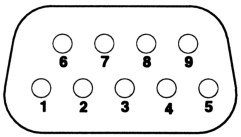

Fig. 6-2 Connector XD1, outer view

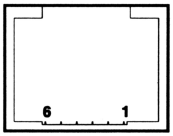

Fig. 6-3 Connectors XF1 and XG1, outer view

Connector XD1

Pin 1	G/Y/CVS out
Pin 2	B/U/Y out
Pin 3	R/V/C out
Pin4	Sync out
Pin 5	TXD Generator out
Pin 6	GND G/Y/CVS
Pin 7	GND B/U/Y
Pin 8	GND R/V/C
Pin 9	Loop through to XF1.3 (and XG1.4)

Connector XF1

Pin 1	GND
Pin 2	GND
Pin 3	TXD loop through to XG1.4
Pin 4	RXD loop through to XG1.3 + setup code listen
Pin 5	5V loop through to XG1.2
Pin 6	5V loop through to XG1.1

Connector XG1

Pin 1	5V loop through to XF1.6
Pin 2	5V loop through to XF1.5
Pin 3	TXD loop through to XF1.4
Pin 4	RXD loop through to XF1.3 + sensor data activity sensing for wake-up
Pin 5	GND
Pin 6	GND

CAUTION: When a display unit (PM 5639/80) is connected to one of the FCC-68/J11 connectors (XF1 or XG1) the other connector will have 5V DC potential between some of the pins originating from the power supply in the display unit. This is for powering a colour sensor, but can damage other type of equipment not suited for this system.

7. Operating Instructions

7.1 General Information

Power on/off
Power on/off is indicated by the power LED and the position of the slide main switch located at the bottom front of the generator.

The instrument also includes an automatic standby function. This function sets the instrument to power-down mode when 10 minutes has passed without any button being pressed and there has been no activity on the remote bus. When the instrument has entered the automatic power-off mode, normal operation is retained whenever activity on the remote line is detected or a button is pushed. The instrument restarts in the mode it was in when it went to power down. The power down facility may be disabled, by using the format function.

Local control
The instrument can be controlled completely from the keyboard. The local control can be used for the programming of presets for use in the remote control mode.

Remote control
Selection among presets #1 to #10 may be done from a connected PM 5639/80 display unit. The signals must be pre-programmed into the deferent registers of the instrument. If, for instance, preset #1 is selected on the colour analyser display unit, the generator selects the signal stored as preset #1.

Advanced remote use *(for more information please see paragraph 7.4)*
The complete range of signals and format changes may be controlled by use of a special software program.

7.2 Control Buttons

ON/OFF

The master on/off switch is located on the keyboard. In off position all power to the instrument is disconnected except for charging of the battery.

LO LEVEL

Toggles between the window signal and full-field white (or grey) signals with equal video level. A ruler is shown which indicates the video level for the first 10 seconds. The ruler can be turned on again by pressing **LO LEVEL** again.

If this button is pressed when another signal is active, the signal last in use is recalled - including the ruler.

HI LEVEL

Has the same function as the **LO LEVEL** button. Together the **LO LEVEL** and **HI LEVEL** buttons have a fast and very simple switch function between high and low level for monitor alignment.

▲

Selects between the various pattern options on the button selected.

When used with the window/full-field button, it runs through all the window or full-field levels. The white level is increased by 5% with every selection. The operation follows a circular repetition, meaning that when 100% has been reached the next selection is 0%. The ▲ button includes a repeat (scrolling) function when held down with either a window or a white field signal active.

When any of the other signals is active, this button toggles between the selections enabled by that button. There is no repeat function included in this situation.

▼

Same as ▲, except it goes in the opposite direction.

PLUGE

Selects the PLUGE and vertical staircase pattern.

C-BAR

Selects the colour bar pattern.

X-HTC

Toggles between standard crosshatch and diagonal crosshatch. When pressed the first time, it selects the crosshatch that was in use last.

STAIR

Selects the staircase pattern.

RED/NDL

Toggles between a full-field red and a needle pulse pattern. When pressed the first time, it recalls the pattern in use last.

STORE

Used to store signals on the 10 preset locations.

To store a preset:
Select the signal, then press **STORE** followed by one of the buttons numbered 1-10.

Once STORE has been pressed, the instrument expects a second button to be pressed within 5 seconds. The instrument returns to normal mode if no further selection is made before the 5 seconds are up.

RECALL

Used to recall the signal stored on one of the presets.

To recall a preset:
Press **RECALL** followed by one of the buttons numbered 1-10.

Once **RECALL** has been pressed, the instrument expects a second button to be pressed within 5 seconds. The

instrument returns to normal mode with the previous signal if no further selection is made before the 5 seconds are up.

FORMAT

Selects the format mode and puts the format display on the connected monitor. This mode is used to select among various primary format settings.

The format display consists of a frame with 6 or 8 fields; the number of fields depends upon the version of the generator. The fields indicate the status of the different settings in the generator. A brief description of the fields is written on the front of the generator.

A selected setting is indicated on the monitor by a highlighted field.

To change the format, find your selection and the number corresponding to that setting on the front of the generator.

Press **FORMAT** together with the button number of the setting you want to enable. The format changes when you release the buttons, and the changed format display is shown on the monitor.

If the **FORMAT** button and one of the numbered buttons are pressed simultaneously without the format display being enabled, the format changes immediately, and the signal is displayed in the new format.

Pressing the **FORMAT** button with the format display active ends the format mode and recalls the previous signal.

Format Selection Matrix for the PM 5639M/82

1	GBR	2	Y, P_B, P_R
3	Sync ON	4	Sync OFF
5	Pwr dwn ON	6	Pwr dwn OFF
7	Setup ON	8	Setup OFF

Format Selection for the PM 5639G/82

1	GBR	2	Y, P_B, P_R
3	Sync ON	4	Sync OFF
5	Pwr dwn ON	6	Pwr dwn OFF

Format Selection for the PM 5639G/83 and PM 5639M/83

1	Composite	2	Y/C
3	Sync ON	4	Sync OFF
5	Pwr dwn ON	6	Pwr dwn OFF

Description of the format settings

Format settings 1 and 2:
The generators are dual format generators. The component generators can be switched between the GBR and Y, PB, PR video signal formats. The composite generators can be switched between the Composite and Y/C video formats.

Format settings 3 and 4:
The composite sync on the video output may either be enabled or disabled. The separate sync output always carries a composite sync signal.

Format settings 5 and 6:
The automatic power-down function of the instrument may be enabled or disabled. The default setting is enabled. Power-down mode is activated when 10 minutes has passed without any button being pressed or any activity on the remote control lines. The instrument automatically leaves stand-by mode whenever any activity is detected.

Format settings 7 and 8:
Black setup on the video signal may be enabled or disabled on the PM 5639M/82 525-line component generator.

7.3 Video Signal Connections

The generators are supplied with a special video interface cable. This cable connects the 9-pin sub-D connector in the generator to four BNC connectors.

The PM 5639/83 supplies either Composite Video or Y/C (S-VHS) signals and can be switched back and forth between the two formats.

Connections for the PM 5639G/82 and PM 5639M/82:

BNC Connector:	Component RGB Format:	Component VUV Format:
Green Cable	Green Component (w/wo sync)	Luminance (w/wo sync)
Blue Cable	Blue Component	Colour Difference U (B-Y)
Red Cable	Red Component	Colour Difference V (R-Y)
Yellow/Black Cable	Composite Sync	Composite Sync

Connections for the PM 5639G/83 and PM 5639M/83:

BNC Connector:	Composite Format:	Y/C or S-VHS Format:
Green Cable	Composite Video (w/wo sync)	No Connection
Blue Cable	No Connection	Luminance Y (w/wo sync)
Red Cable	No Connection	Chroma C
Yellow/Black Cable	Composite Sync	Composite Sync

7.4 Remote Control

In the standard configuration the preset selection of the generator is controlled by a connected colour analyser, but a more general remote control from another source, such as a PC, is also possible.

The PM5639/82 and PM5639/83 Colour Alignment Generators can be controlled via an RS232 communication port, giving access to all the functions normally accessible by keyboard entry.

7.4.1 Hardware Connections for General Remote Control.

NOTE: General remote control excludes the possibility to simultaneously synchronise the generator to the set-up selection in the colour analyser.

To obtain general remote control of the generator from an RS232 port, such as a PC, the following steps should be performed (please see paragraph “6.2 Connectors” for a survey of connectors and their terminals):

- Make an RS232 connection between the FCC-68/J11 connector XF1 named “Contr.” and your external controller, e.g. a PC. A special cable is needed for this with a 6 pole FCC-68/J11 connector in one end and a suitable connector for your controller in the other end.

- In order to use commands which returns an answer, such as GVERS which returns the software-version, a connection is to be made in the “Video” connector XD1 between pin 5 and 9. This connector can be made in the cable part Sub-D. If only one-way remote commands to the generator are used the connection is not required.

Note: This connection must not be present when a colour analyser display unit and/or a sensor is connected to the generator.

7.4.2 Connection to a PC

PM 5639/82 and PM 5639/83 can be connected to a PC's RS232 data communication port by means of a special cable. For pins connection see table below.

PC end of cable Sub-D connector 9 poled, female		PM 5639/82/83 end of cable FCC-68/J11 connector 6 poled, male	
Pin no.:	**Signal:**	**Pin no.:**	**Signal:**
2	RXD (1)	3	TXD (1)
3	TXD	4	RXD
5	GND (0V)	1,2	GND (0V)

(1) This connection is only required when using the remote command GVERS which returns a message.

7.4.3 Data Protocol for the RS232 Communication

Baudrate: 4800
Databits: 8
Parity: none
Stop Bits: 2

Characters are ASCII coded.

All commands starts with the letter G and is followed by a maximum of 4 letters with an optional number. Letters are not case sensitive.

There are no separation between a command and an optional number.

Numbers are composed of digits (0-9).

Commands are ended and/or separated by one of the delimiters: <CR>, ";" (semicolon) or "," (comma).

Timing

When using the remote control several timing considerations must be taken into account, especially when issuing commands that redefines the selected pattern. Since the RS232 line contains no input buffer it is essential to insert a delay after having sent a command to the generator. This delay should be a minimum of 250ms except for the following commands:

GLEVL<n>: which configures the video level. No delay is necessary.

GKEY11 and **GKEY12**: which configures a recall-/store-function. No delay is necessary.

GVERS and **GSERV30**: which returns some information from the generator. After having received all bytes from the generator no delay is necessary.

7.4.4 Remote Commands

For general remote control of the generator the following ASCII-coded commands are available:

Command to recall a previously stored generator preset	**GS** <n>	n=1-10
Command that returns the software revision (note that this command requires the connection in the “VIDEO” connector XD1 mentioned above to be made).	**GVERS**	Returns 18 characters specifying the version of the software program, e.g. “940412 Ver 0.00a”.
Command to emulate the generator keyboard from the RS232-line.	**GKEY** <n>	n=1-20, where 1: LO LEVEL 2: HI LEVEL 3: PLUGE 4: C-BAR 5: X-HTC 6: STAIR 7: RED/NDL 8: UP 9: DOWN 10: FORMAT 11: RECALL 12: STORE 13: FORMAT+1 14: FORMAT+2 15: FORMAT+3 16: FORMAT+4 17: FORMAT+5 18: FORMAT+6 19: FORMAT+7 20: FORMAT+8

Command to select a specific pattern (2)	**GPATT**<n>	N= 0-21, where 0: LO LEVEL WINDOW 1: LO FULL FIELD 2: HI LEVEL WINDOW 3: HI FULL FIELD 4: PLUGE 5: (reserved) 6: COLOURBAR 7: (reserved) 8: CROSSHATCH 9: DIAGONAL CROSSHATCH 10: STAIR 11: (reserved) 12: RED 13: NEEDLE 14-21: (reserved)

Command to recall a previously stored generator preset (2)	**GS**<n>	n=1-10
Command that enables storing of a preset via button or remote control (2)	**GSERV10**	
Command that disables storing of preset via button or remote control (2)	**GSERV20**	

Command that requires five bytes indicating the state of the generator (note that this command requires the connection in the “Video” connector XD1 mentioned above to be made) (2)	**GSERV30**	Returns five bytes, see below for a detailed explanation of the bytes returned
Command to download the video level directly to the selected pattern (please note that this command only affects the video level if the pattern support this function) (2)		

Note: When issuing the command **GSERV30** five bytes are returned.

Byte 1: Pattern status. This byte returns the pattern currently selected. It corresponds to the pattern number as described for the command: **GPATT**<n>

Byte 2: Generator status:

- Bit 7: 0: Store function enabled.
  1: Store function disabled
- Bit 6: (reserved)
- Bit 5: (reserved)
- Bit 4: 0: Automatic shutdown disabled
  1: Automatic shutdown enabled
- Bit 3: 0: Setup OFF,
  (only selectable in PM5639/82)
  1: Seup ON,
  (only selectable in PM5639/82)
- Bit 2: 0: Sync ON
  1: Sync OFF
- Bit 1: 0: GBR-mode (component) or CVS-mode (composite)
  1: YUV-mode (component) or SVHS-mode (composite)
- Bit 0: 0: Ruler ON
  1: Ruler OFF

Byte 3 Content of the video level register for LO LEVEL

Byte 4: Content of the video level register for HI LEVEL

Byte 5: (reserved)

Application

8.1 General

The PM 5639/82 and PM 5639/83 Colour Alignment Generators are specifically designed to be used as signal sources when colour monitors are being calibrated. The monitors may be multi display systems or single systems based on projectors or CRT monitors.

Monitors are known to be the most unstable part in the production chain. Studies have shown that monitors should be adjusted every time they are turned on or, if kept switched on, after every 500 hours of operation. Only then can colour fidelity be guaranteed. The hand-held colour alignment generator supply all the signals needed for normal monitor calibration.

The quality of the electrical video signals is normally evaluated by means of waveform monitors and vector-scopes, whereas the only "tool" to judge a creative result is how the picture on the monitor looks. In order to be able to base decisions on such pictures, the different colour monitors in the studios must perform equally and according to standards.

The most important parameters to be controlled/calibrated are **PURITY, CONVERGENCE, COLOUR OF GREY, CONTRAST,** and **BRIGHTNESS**, for composite monitors also SATURATION and for the NTSC system, **HUE** as well.

Paragraph 8.1 describes these most basic adjustments, which can be used together with most monitors either CRT's or projectors.

Special videowall considerations are discussed in paragraph 8.2.

Special projector considerations are discussed in paragraph 8.3.

Other quality factors are discussed in paragraph 8.4.

8.1.1 Purity

Purity errors are indicated by different colour shadings in different parts of the screen. Typically, purity errors are most difficult to remove in the corners of the screens.

Purity is checked by using a RED full-field picture. The picture should not have any colour shading at any place. It may be necessary to accept a slight shading in the corners. Adjustment usually includes dismantling the monitor and adjusting the deflecting system, although some modern computer-controlled monitors may be controlled externally. Check the procedure in the monitor manual.

8.1.2 Geometry and Convergence

The appearance of pictures (shape) on the monitor must be correct in order to make an objective evaluation. The monitor should have an aspect ratio of 4:3 or 16:9, whichever is relevant. Straight lines should be displayed as straight lines and the three beams - red, green, and blue - generating the picture should register correctly in order to produce pictures without coloured edges. Geometry, linearity, and aspect ratio are adjusted using the crosshatch signal, turning on the green beam only and adjusting pin - cushion and scan linearity controls for visual alignment with a linearity overlay (ball-chart) over the CRT face.

Convergence is adjusted by means of the crosshatch signal with all three beams turned on. The three beams should be adjusted to “register”. When geometry has been adjusted with only the green beam turned on, any adjustment should be made using the controls for the red and blue beams only. In any case, the manufacturer's recommended adjustment procedures should be followed.

8.1.3 Brightness

Brightness is the level of lowest light (black) output from the screen. This level determines the darkest picture, which can be displayed. The optimal brightness setting depends much upon the ambient light level. A high ambient level requires a high setting of brightness and vice versa. When the brightness is adjusted to too high a level, the useful contrast range of the screen is reduced; if the brightness is adjusted to too low a level, the darkest parts of the picture will be lost.
Brightness is adjusted by means of the PLUGE signal. The PLUGE signal consists of two vertical bars on the left side of the picture. One bar is just below zero video and one bar just above zero video level. The adjustment of the brightness is correct when the bar just below zero cannot be seen and the bar just above zero can be seen.

8.1.4 Grey Scale Tracking

The colour of grey must track all the way from black to 100% white. If this is not the case, the dark part may look red and the highlight part green. The colour reference used for the white in broadcast studios is typically specified as D6500. Other references may be used for other applications.

CRT monitors are normally adjusted with window signals, since a full-field signal would be less representative of the normal average display situation, although fullfield is often used in videowall and projector systems.

To adjust the grey scale tracking, select a low-level window or full-field signal on the generator - SMPTE recommends a 20% and EBU recommends a 15% window signal. Use a colour analyser to control the colour of the grey field in the centre of the monitor. If the colour is not equivalent to the reference white, adjustments must be made. See the monitor manual for the adjustment procedure. Adjust the cut-off or black controls of the individual beams so that the colour equals the reference.

Select a high-level signal. A 100% or 100IRE window signal is nearly always used for CRT monitors. Projectors may use other levels (50% or 70%) for the high-level

adjustment; even full-field white is used in some applications. If in doubt, consult the manual. Now adjust the highlight gain controls on the monitor to equal the white reference. The contrast should also be adjusted to give a satisfactory result. SMPTE recommends 35ftL and EBU recommends 80Cd/m^2 for broadcast CRT monitors. The maximum display contrast range of the monitor will be checked later. Because of the interaction between adjustments it may in some cases be necessary to check and adjust the brightness and the grey scale setting a couple of times.

8.1.5 Saturation/Chroma Gain and Hue

Now that the black and white responses have been adjusted the colour saturation should be adjusted next. The amplitude of the colours is adjusted by means of the saturation or chroma gain control. This is only relevant on composite monitors. On NTSC monitors, the HUE must also be adjusted. Calibration is performed by means of special colourbar signals.

For composite PAL systems, a split-field colour bar signal is necessary (Fig. 8-1). This signal contains a 75% saturated colour bar in the upper 2/3 of the picture and a 75% grey signal in the lower 1/3 of the picture.

With only the blue beam switched on – “blue-only mode” - all the "blue” bars should be adjusted to the same intensity as the bottom “blue" part of the picture.

Fig. 8-1 EBU colourbar

With composite NTSC systems a SMPTE colourbar with reversed blue bars is necessary - (Fig. 8-2). This signal contains a 77% saturated colour bar in the upper 2/3 of the picture and below a narrow "chroma set" bar with some of the same colours in reverse order.

With only the blue beam switched on - "blue-only mode" all the "blue” bars in the upper part should be adjusted to the same intensity as the narrow blue part just below. Chroma gain is adjusted by matching the brightness of the left or right main blue bar with the narrow chroma set bar just below. Chroma phase is adjusted by matching the brightness of either centre main blue bar with the chroma set bar just below.

Fig. 8-2 SMPTE colourbar

8.2 Videowalls

8.2.1 General

Videowalls are systems where several individual monitors are used together in order to obtain a larger picture. Videowalls may be based on all types of monitors, but most frequently used are CRT direct-view monitors and projector cubes.

8.2.2 Videowall Timing

The signal feed to the individual displays of a videowall system is controlled by a special signal processor. The signal to each of the displays must be timed correctly. The timing can be checked by means of the diagonal crosshatch signal. When the timing is correct, the diagonal lines should appear straight.

If the lines appear stepped, then the timing between the individual displays is not optimal.

8.2.3 Videowall Grey Scale

The grey scale on each monitor in a videowall is in principle adjusted the same way as for a single unit, but very often a full-field white pattern is used instead of the window signal. When monitors are placed beside each other, the borderlands between the monitors are more important than the centres of the screens.

In cases where a highlight level is more important than having the highest quality picture, highlight adjustments should be performed at a video level of less than 100%: 50% and 700% are used instead. These adjustments result in a good display with average medium-level signals but with a high video output blooming and other artefacts will be visible.

8.3 Projector Monitor Calibrations

8.3.1 General

Projectors-can be divided in two main groups: front projectors and back (or retro) projectors.

Front projectors are typically used in single-set systems, but there are also applications where several front projectors are used to give very large pictures. The light output from a front projector screen is typically not very high: two projectors are some times stacked to get a higher light output. Each projector shows the same picture but together they produce more light.

Many back projectors are very often used together in videowall systems. These systems can have a very high light output.

Both front and back projectors use many different types of display screens. These screens are optimised for different uses.

When high intensity is the most important parameter, high-gain screens are used. High-gain screens typically produce a less ideal picture, but they can be used at higher ambient light levels than low-gain screens. These screens do not amplify the amount of light but direct the light to a narrower viewing angle. Screens with a gain of about 5 can have an optimal viewing angle of a few degrees. Screens of this type can be identified by the very great difference in luminance when viewed from different angles. Some screens even have varying colour reproduction when viewed from different angles.

When high picture quality is most important parameter, low-gain screens are used. With a low-gain screen, nearly no shift can be seen when it is viewed from different angles.

8.3.2 Back Projector Calibration

When back projectors are calibrated and used it is very important not to have any ambient light reaching the back of the screen. The light can be measured directly on the screen, for instance with a "PM 5639/00 Colour Analyser" but care should be taken when interpreting the absolute measuring results. If the screen exhibits any angle-dependent light transmission, the measuring result will be some kind of an average of this light output. With a high-gain screen the luminance measured may be off by several factors. The PM 5639/00 Colour Analyser can thus be used as a relative measuring device to perform grey scale calibration, and in videowall systems to parallel the monitors.

8.3.3 Front Projector Calibration

With this type of projectors, the light is reflected from a screen and not transmitted as with a back projector. When using the PM 5639/10 Projector Colour Balance Meter for projector calibration, the projector must first be adjusted to produce a satisfactory white display at one level. The projected white could be compared to a calibrated CRT monitor. Once this point has been established, the white balance should be stored in the PM 5639/l0. The colour analyser is mounted onto the lenses of the projector; it then measures the light and compares the balance with the stored white reference. This reference can then be used at other levels for the grey scale adjustment.

8.4 Simple Monitor Performance Checks

8.4.1 Visual Overall Check

The staircase may be used to visually check the overall performance of the monitor. The steps of the staircase should have the same neutral colour all the way from low to high. If this is not the case, the colour of grey is not correctly adjusted.

8.4.2 High-Tension Stability/Regulation

The capacity of the high-tension supply in the monitor can be checked in a very simple way. Select the needle pulse signal. The displayed needle pulse should be a straight line. If the line bends at some point, the contrast on the monitor has been adjusted to a point higher than the capacity of the high-tension power supply. The contrast should be reduced to obtain pictures without distortion.

The high-tension supply in some monitors is designed to go out of regulation at the point where the display tube reaches saturation. This will help prolong the life of the CRT rather than allowing it to burn out from excessive amounts of current.

8.4.3 Reflections and Ringing

Reflection and ringing in the video signal cable will be visible as additional faint vertical lines beside the needle pulse pattern. Ringing in the vertical lines is usually an indication of frequency peeking somewhere in the video amplifiers. Line width difference between the black and white portions may be caused by blooming or scan velocity modulation.

8.4.4 The Contrast Range of the Screen

The light output from the phosphors is limited in range. If the contrast is adjusted to a level higher than the linear range, blooming occurs on the screen. This can be checked by observing the vertical staircase in the PLUGE pattern. The steps in this staircase have the same width from bottom to top. If the phosphors on the screen are saturated and blooming is occurring, the top part will look wider than the other steps. Blooming also reduces screen resolution. The contrast should be reduced to a level where there is no blooming.

9. Service Instructions

9.1 Block Diagram Description

The heart of the instrument is a compact circuit board containing all vital functions such as:

- Signal pattern generation elements
- Microcontroller
- Sync generator
- RS232 interface
- Power supply

9.1.1 Pattern Generation

The following blocks are involved in the pattern generation:

- Field Programmable Gate Array
- Flash PROM, DAC's
- Lowpass filters
- Output buffers

The pattern generator is built into a Field Programmable Gate Array (FPGA), which fetches the individual pattern data from the Flash-PROM. Each pattern has its own "hardware" in the FPGA. The Flash-PROM contains the FPGA programming, the individual instrument calibrating data, the nominal video signals, the preset, and format information.

The FPGA directs the digital signal data to the fast Y/G, U/B, and V/R DAC's and controls (via the Trim DAC's) the reference inputs in order to perform individual signal level adjustments.

The signal from the DAC's is lowpass-filtered and buffered. Sync is added to the Y-buffer (switchable).

All the specified patterns in the component version are generated in either Y, P_B, P_R or RGB components.

The composite signal is generated in a modulator based on Y, P_B, P_R input plus subcarrier. The output is either Composite or SVHS (Y/C).

9.1.2 Microcontroller

The microcontroller contains an on-chip program ROM, and it controls the Flash-PROM, the FPGA, and the power. It also monitors the RS232 line and scans the keyboard.

9.1.3 Sync Generator

The sync generator generates all the necessary sync pulses. In composite versions it also generates the subcarrier.

9.1.4 RS232 Interface

An RS232 interface is used to look for preset number codes from the display unit and to activate the generator from standby mode in case of any RS232 communication. Besides the RS232 interface can be used for configuration or remote control by the user.

9.1.5 Power Supply

The power supply is a NiCd-pack followed by a regulated SMPS power supply to generate the +5V and the -5V. An external mains adapter can be used to charge the NiCd-pack and/or supply power to the generator. A charge control circuit controls the charging process. The analogue power supply is switched off by the microcontroller in power-down mode.

9.2 Adjustment

Caution: At the time of manufacturing, patterns and all the calibration information are downloaded through the RS232 interface to the flash PROM. Since each individual instrument is precisely calibrated with its own digital calibration constants.
If any components are changed the specifications **can not** be guaranteed without repeating the factory calibration.

9.3 Access to the circuit board

1. Remove the battery (200).

2. Remove the pointed screw (115) in the clip cover by using a 1.3mm Unbraco screwdriver (Allen key). Do not remove the clip itself.

3. Remove the two screws (110).

4. Carefully remove the back cover (113) starting in the connector end. Put the washers marked (111) somewhere you can find them again (they are easy to loose). Now you have access to the component side of the SMD circuit board.

5. To remove the complete SMD circuit board first remove the 3 screws (110), then lift up the circuit board slightly in the key board end, and pull it out in such a way that the connectors leave their holes in the cabinet.

To reassemble, follow the above steps in reverse order. Please be careful checking that the guide stub in the keyboard end finds the corresponding hole in the circuit board before mounting the screws (110).

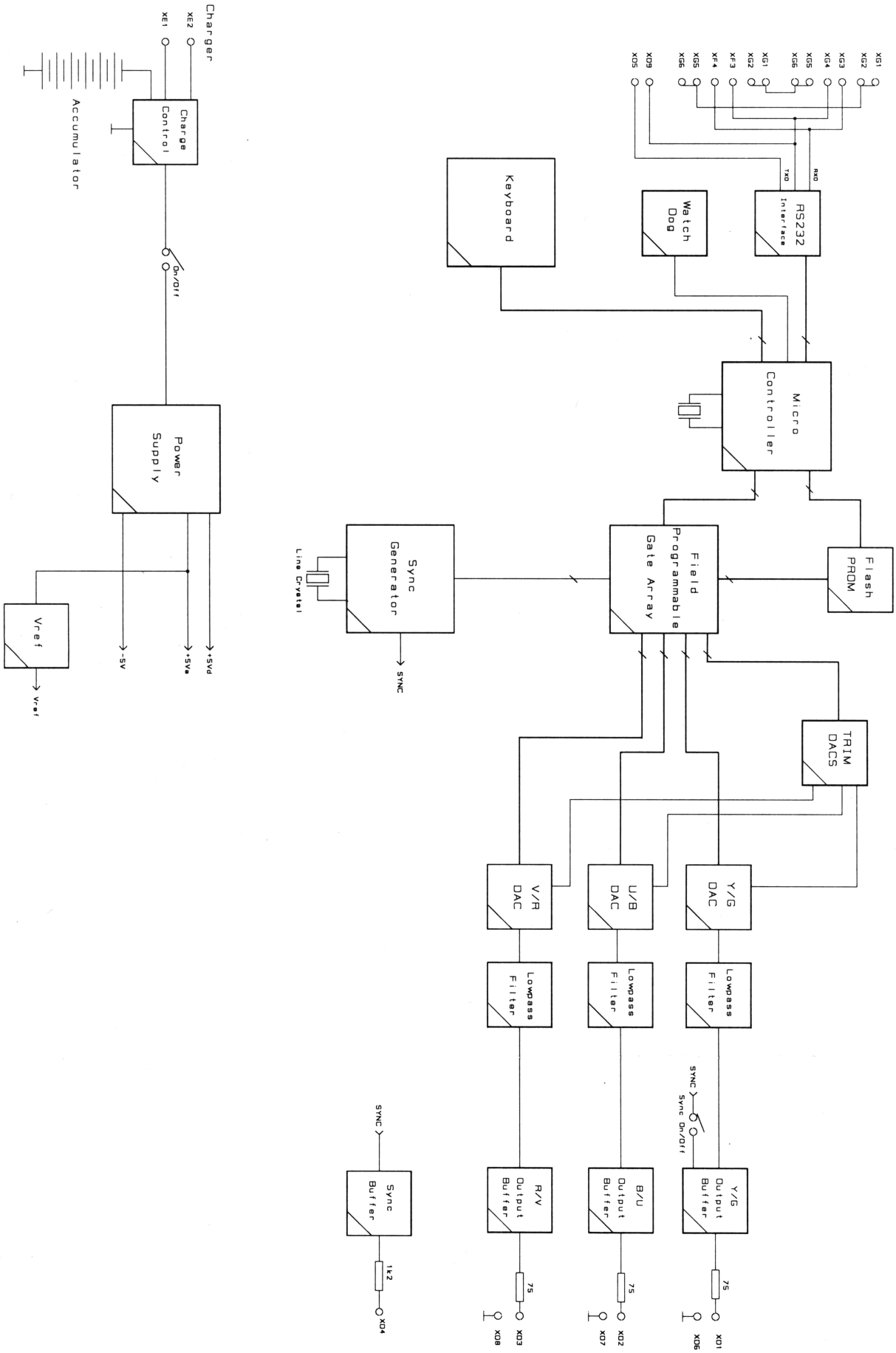

Fig. 9-1 Instrument block diagram - PM 5839/82

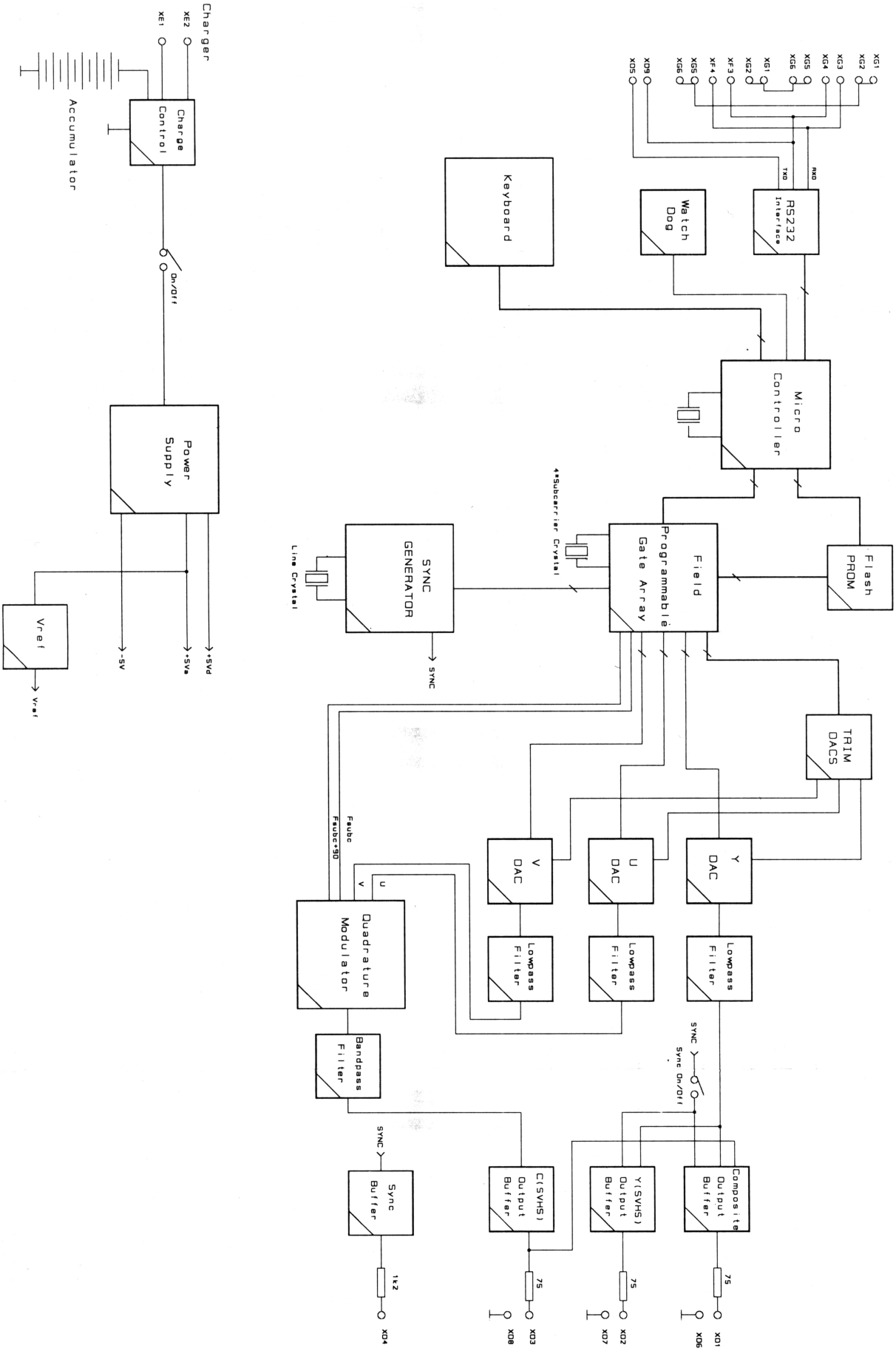

Fig. 9-2 Instrument block diagram - PM 5839/82

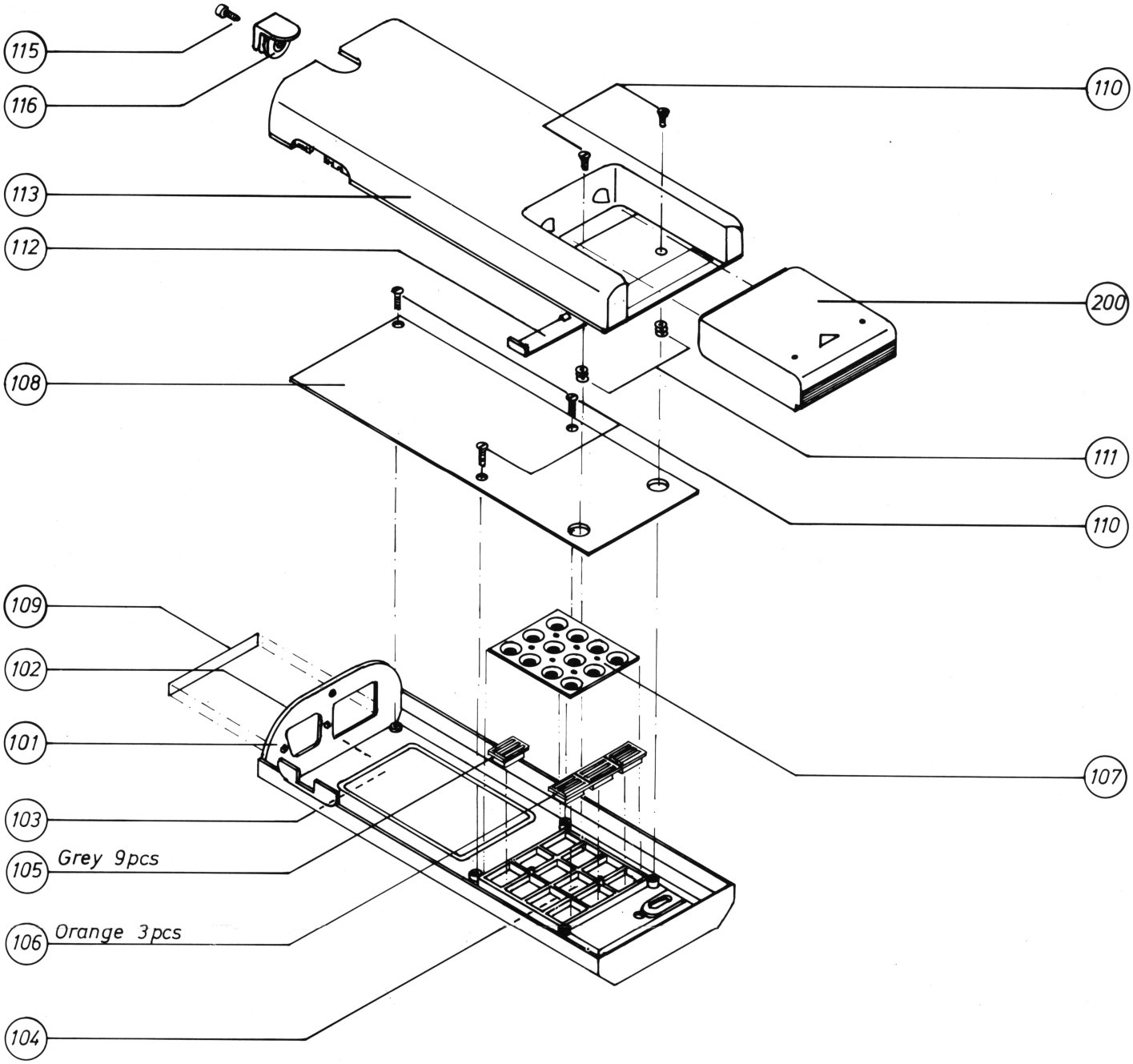

Fig. 9-2 Access to the circuit board

10. List of Parts

Item:	Description:	Ordering number:
101	FRONT PART	4008 108 04580
102	TEXT PLATE "PTV"	4008 127 02190
103	TEXT PLATE WINDOW	
	PM 5639/82 G	4008 127 03650
	PM 5639/82 M	4008 127 03600
	PM 5639/83	4008 127 03670
104	TEXT PLATE BUTTONS	4008 127 03610
105	PUSH BUTTON, GREY	4008 108 03930
106	PUSH BUITON, ORANGE	4008 108 03960
107	KEYBOARD RUBBER MATH	4008 104 50000
108	VIDEO GENERATOR UNIT	
	PM 5639/82 G	4008 109 81230
	PM 5639/82 M	4008 109 81240
	PM 5639/83 G	4008 109 81250
	PM 5639/83 M	4008 109 81260
109	TEXT LABEL CONNECTORS	4008 127 03700
110	SCREW (M2.5X6)	2522 178 31038

Item:	Description:	Ordering number:
111	WASHER	4008 108 04720
112	COVER	3508 101 52690
113	REAR PART	4008 108 04610
115	SCREW (M2.5X8)	4008 107 20860
116	LOCK	4008 108 04590
200	BATTERY	4008 109 81770
	LED 3mm GREEN TLG124	9335 593 70682
	SWITCH “ON/OFF”	4008 104 60080
	CONNECTORS	
	CONNECTOR - 9 POLE (XD1)	4008 103 66540
	CONNECTOR - 6 POLE (XF1/XG1)	2422 025 10137