OX 863B
150 MHz PORTABLE OSCILLOSCOPE

User's manual

906121665 - Ed. 1 - 09/00

CONTENTS

1. GENERAL INSTRUCTIONS

You have just purchased a 150 MHz portable two-channel oscilloscope; we congratulate you on your choice of this high quality product.

This apparatus complies with safety standard EN 61010-1, 1993, +A2 (1995), single insulation, dealing with electronic measurement instruments. Please read these instructions carefully and respect the usage precautions, in order to obtain the best use from it.
Failure to respect warnings and / or usage instructions may damage the apparatus and / or its components and may be dangerous to the user.

1.1 Safety precautions

1.1.1 Before use

- This instrument was designed for use indoors in an environment with a degree of pollution 2 at an elevation of less than 2000 m, a temperature between 0°C and 40°C, and a relative humidity of 80 % up to 31°C.

- It can be used for measurements on installations 150 V, CAT I, or, with the probes supplied with the instrument, on installations 400 V, CAT II. Its power supply is to be connected to the mains 300 V, CAT II.

- Definition of installation categories (see publication IEC 664-1):

CAT I : CAT I circuits are protected by devices limiting transient overvoltages to a low level.
Example: protected electronic circuits

CAT II : CAT II circuits are power supply circuits for domestic or digital devices that may include transient overvoltages with an average value.
Example: power supply for household appliances and portable tools.

CAT III : CAT III circuits are power supply circuits for power equipment that may include large transient overvoltages.
Example: power supply for industrial machines or equipment

CAT IV : CAT IV circuits may include very high transient overvoltages.
Example: energy arrivals

- Check that your electricity distribution network is within the range 94 to 264 V.

⚠ ***The replacement fuse must be identical to the original fuse. It is located inside the apparatus in a housing on the cathode ray tube support part.***

- Earth all metallic parts that are accessible to touch (including the working table).
- You are advised to use the accessories delivered with the instrument or proposed as options. Check that they are in perfect working condition before use.
- Plug the cable into a *socket fitted with an earth connection*.

1.1.2 During use

- Select vertical sensitivity and timebase ranges adapted to the measurement.

Never touch an unused terminal when the apparatus is connected to measurement circuits.

1.1.3 Symbols

***CAUTION* :** Refer to the instruction manual.
Incorrect use may result in damage to the device or its components.

***DANGER* :** High voltage, risk of electric shock.

Earth

1.1.4 Instructions

- ***Before opening the apparatus,*** always disconnect it from the mains power supply and measurement circuits, and make sure that you are not charged with static electricity which could damage internal components.
- Any repair, maintenance or adjustment of the oscilloscope when it is ***powered*** may only be done by qualified personnel, after reading the instructions in this manual.
- A ***"qualified person"*** is a person who is familiar with the installation, construction and use and the dangers present. He is authorized to switch the installation and equipment on and off in accordance with the safety rules.
- Take care not to obstruct ventilation holes when using the apparatus.

Some internal capacitors may retain a dangerous potential, even after the apparatus has been switched off.

1.2 Guarantee

This oscilloscope is guaranteed against any material defect or manufacturing vice in accordance with the general conditions of sale.

During the guarantee period (2 years), the apparatus may only be repaired by the manufacturer, and the manufacturer will be free to decide to repair or replace all or part of the apparatus. The guarantee conditions state that the manufacturer will pay for return transport.
The guarantee is not applicable in the following cases:

1. any improper use of the equipment or if it is used in association with incompatible equipment;
2. modification of the equipment without explicit authorization by the manufacturer’s technical departments;
3. work done by a person not approved by the manufacturer;
4. adaptation to a specific application not included in the definition of the equipment or by the operating instructions;
5. a shock, drop or flooding.

1.3 Maintenance and metrological verification

Return your instrument to your distributor for any work to be done within or outside the guarantee.

1.4 Servicing

Clean the instrument with a wet cloth and soap. Never use abrasive products or solvents.

2. DESCRIPTION

This instrument is a 150 MHz portable two-channel oscilloscope, designed to satisfy the most demanding users.

Performance

- 2 x 150 MHz channels
- Input range: 2 mV to 5 V/div.
- Triggering up to 180 MHz
- Dual resynchronized timebase
- AUTOSET
- Bandwidth limiting (BWL)
- 0 V reference display
- Remote control option
- TV line counting
- Cursor and information display on the screen

Reliability

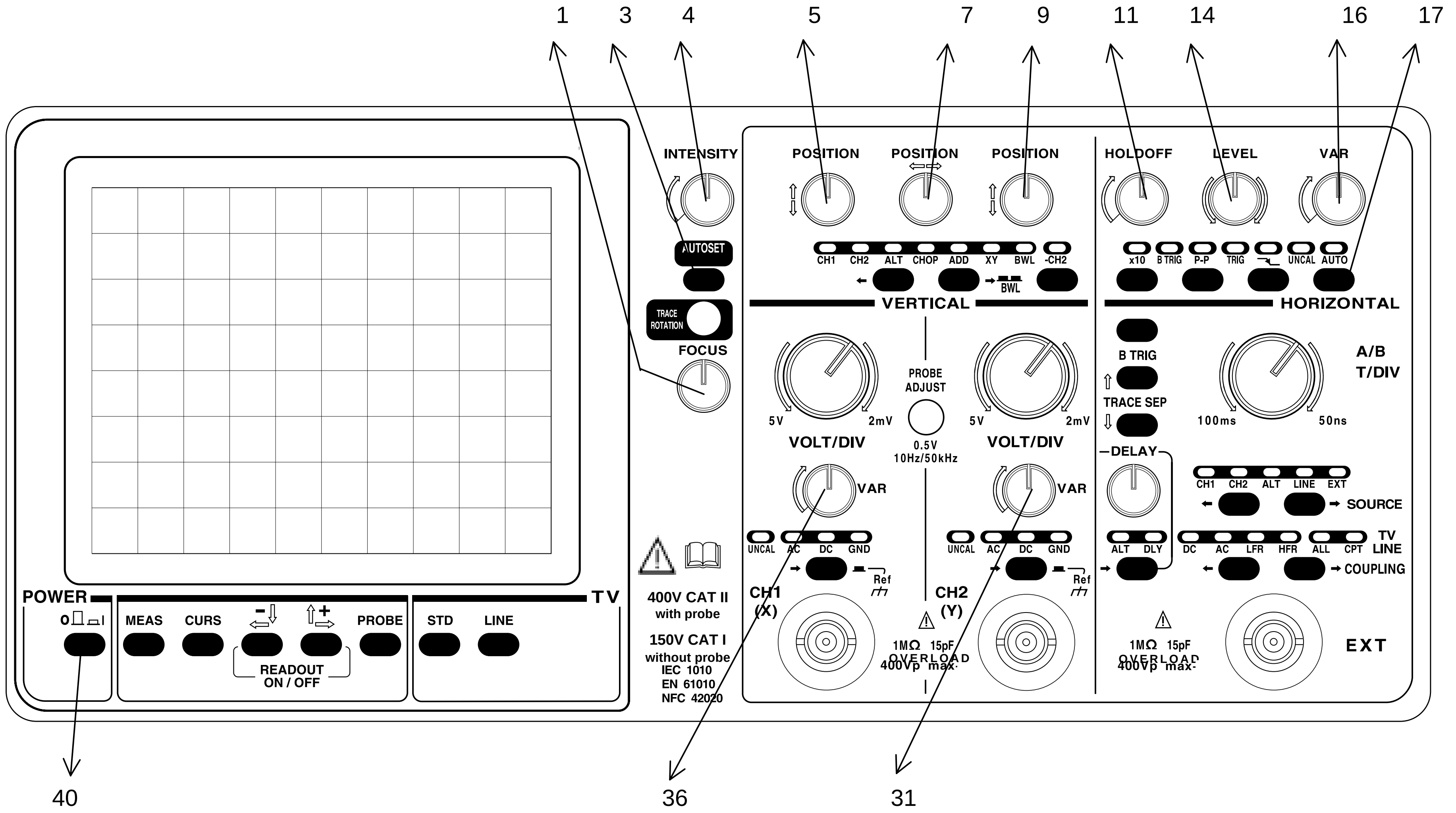
- Use of surface mount components and LSI circuits
- Full microprocessor-driven control
- Front panel separate from measurement circuits
- Internal switching by miniature relays and electronic switches

Serviceability

- Quick to open with full access to all components without removing the printed circuit

User interface

- Controls organized by function
- Functions implemented simply by pressing momentary action buttons
- Active functions indicated by leds
- Last configuration stored and recalled automatically on power up



1
3
4
5
7
9
11
14
16
17
INTENSITY
AUTOSET
TRACE ROTATION
FOCUS
POSITION
POSITION
POSITION
CH1 CH2 ALT CHOP ADD XY BWL -CH2
BWL
VERTICAL
HOLDOFF
LEVEL
VAR
x10 B TRIG P-P TRIG UNCAL AUTO
HORIZONTAL
B TRIG
TRACE SEP
A/B
T/DIV
100ms
50ns
5V
2mV
VOLT/DIV
PROBE
ADJUST
0.5V
10Hz/50kHz
5V
2mV
VOLT/DIV
VAR
VAR
DELAY
CH1 CH2 ALT LINE EXT
SOURCE
UNCAL AC DC GND
UNCAL AC DC GND
ALT DLY
DC AC LFR HFR ALL CPT
TV
LINE
COUPLING
Ref
Ref
CH1
(X)
CH2
(Y)
1MΩ 15pF
OVERLOAD
400Vp max
1MΩ 15pF
OVERLOAD
400Vp max
EXT
POWER
TV
MEAS
CURS
PROBE
STD
LINE
READOUT
ON / OFF
400V CAT II
with probe
150V CAT I
without probe
IEC 1010
EN 61010
NFC 42020
40
36
31

figure 1

3. COMMISSIONING

☝ ***Caution !*** ***Observe all the safety instructions set out in section 1.***

- Set the controls as shown below :

Potentiometer	Identifier	Position
INTENSITY	(4)	right end stop
POSITION	(5) (7) (9)	mid travel
HOLDOFF	(11)	left end stop
LEVEL	(14)	mid travel
VAR	(16) (31) (36)	left end stop
FOCUS	(1)	mid travel

- Press the POWER on/off key (40) : the last stored configuration is reinstated.
- Validate the key AUTO (17).
- Adjust the intensity (4) and focus (1) (figure 1).
- Apply the signal to be displayed to CH1 or CH2.
- Briefly press the AUTOSET key (3) (see § 4.1.).

☞ ***Note*** ***If the instrument does not work, respect a break of 5 sec. before switching it on again (the interval between 2 successive switching-on must be 5 sec. at least).***

4. FUNCTIONAL DESCRIPTION

4.1 Autoset

<u>Pressed briefly</u> : AUTOSET (key 3)
The autoset function automatically hunts for the following :

* channel
* level
* vertical sensitivity
* trigger edge
* horizontal deflection

The autoset function automatically sets the oscilloscope to the following configuration :

* PTP synchro
* BWL (off)
* AC coupling of the connected channel
* BDT A
* X 1
* DC coupling of the trigger source

The autoset function does not affect :

* POSITION (H and V)
* TRACE SEP
* VAR
* INTENSITY
* DELAY
* FOCUS

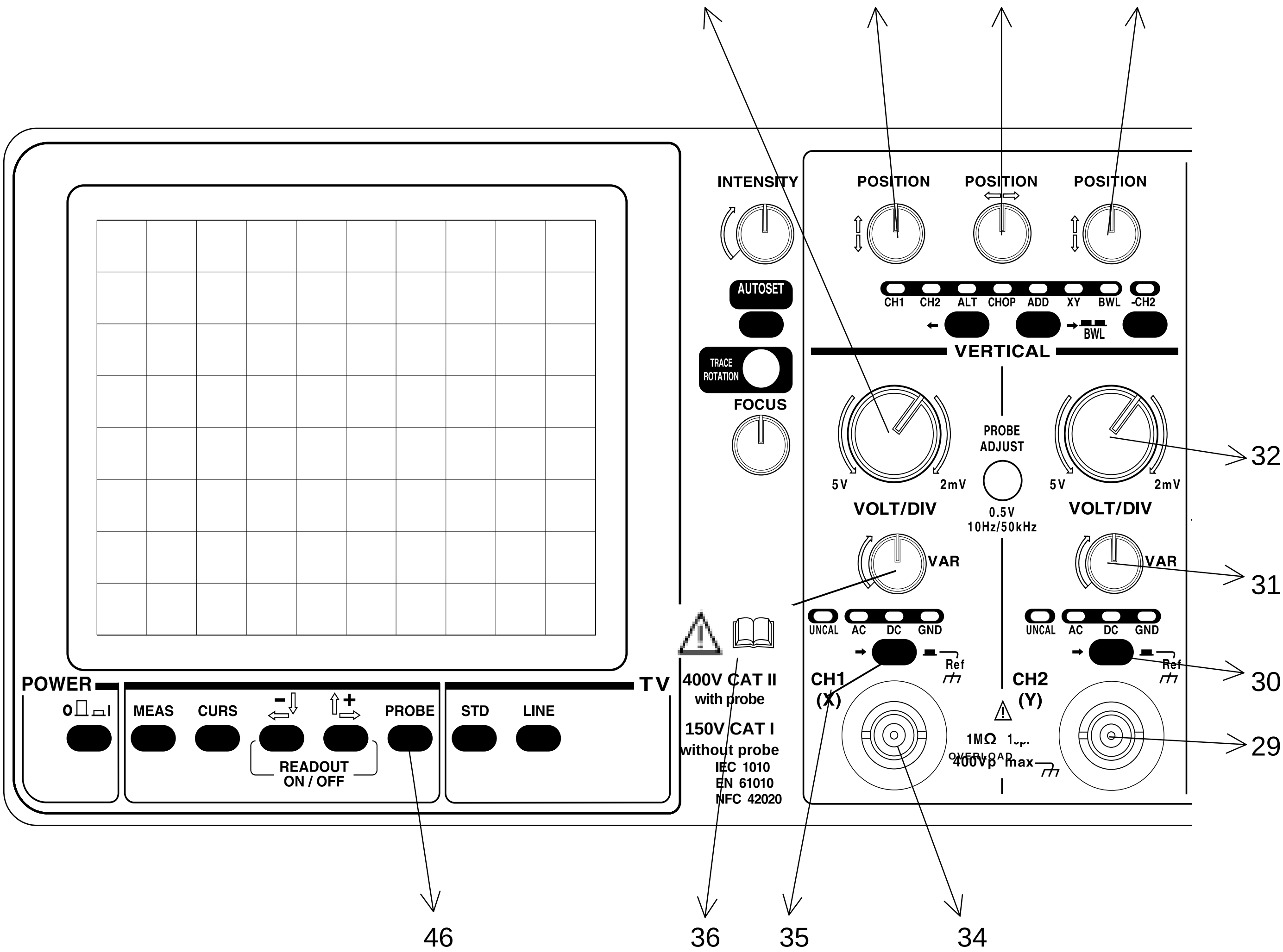

INTENSITY
POSITION
POSITION
POSITION
AUTOSET
TRACE ROTATION
FOCUS
CH1
CH2
ALT
CHOP
ADD
XY
BWL
-CH2
BWL
VERTICAL
5 V
2mV
VOLT/DIV
PROBE ADJUST
0.5V
10Hz/50kHz
5 V
2mV
VOLT/DIV
VAR
VAR
UNCAL
AC
DC
GND
UNCAL
AC
DC
GND
Ref
Ref
CH1
(X)
CH2
(Y)
400V CAT II
with probe
150V CAT I
without probe
IEC 1010
EN 61010
NFC 42020
POWER
MEAS
CURS
PROBE
READOUT
ON / OFF
STD
LINE
TV
32
31
30
29
46
36
35
34

figure 2

4.2 Vertical channels

(5 - 9) **POSITION** - Vertical alignment of traces.

(7) **POSITION** - Horizontal alignment of traces. This knob operates on CH1 and CH2 together.

(32 - 37) **VOLT/DIV** - Vertical sensitivity: 11 positions (2 mV to 5 V/div.).
- Active range displayed on the screen.

(31 - 36) **VAR** - Continuous vertical sensitivity adjustment.
When the knob is not locked in the left end stop position, the UNCAL LED is on and the corresponding symbol displays on the screen.

(30 - 35) **AC DC GND**

Pressed briefly : selects input coupling.

AC	Displays the AC component (DC component off).
DC	Displays the complete signal (0 to 100 MHz).
GND	Displays the channel's 0 V reference (without short-circuiting the input signal). Used to position the trace accurately on screen using POSITION controls (5 and 9).

Held down : Displays the 0 volt reference [35 (CH1) or 30 (CH2)].

(34 - 29) **CH1 and CH2** - BNC socket inputs for signals to be monitored.

(46) **PROBE** - x 1, x 10, x 100 probe factor.
This factor is taken into account in case of display of :

- ranges
- cursor measurements.

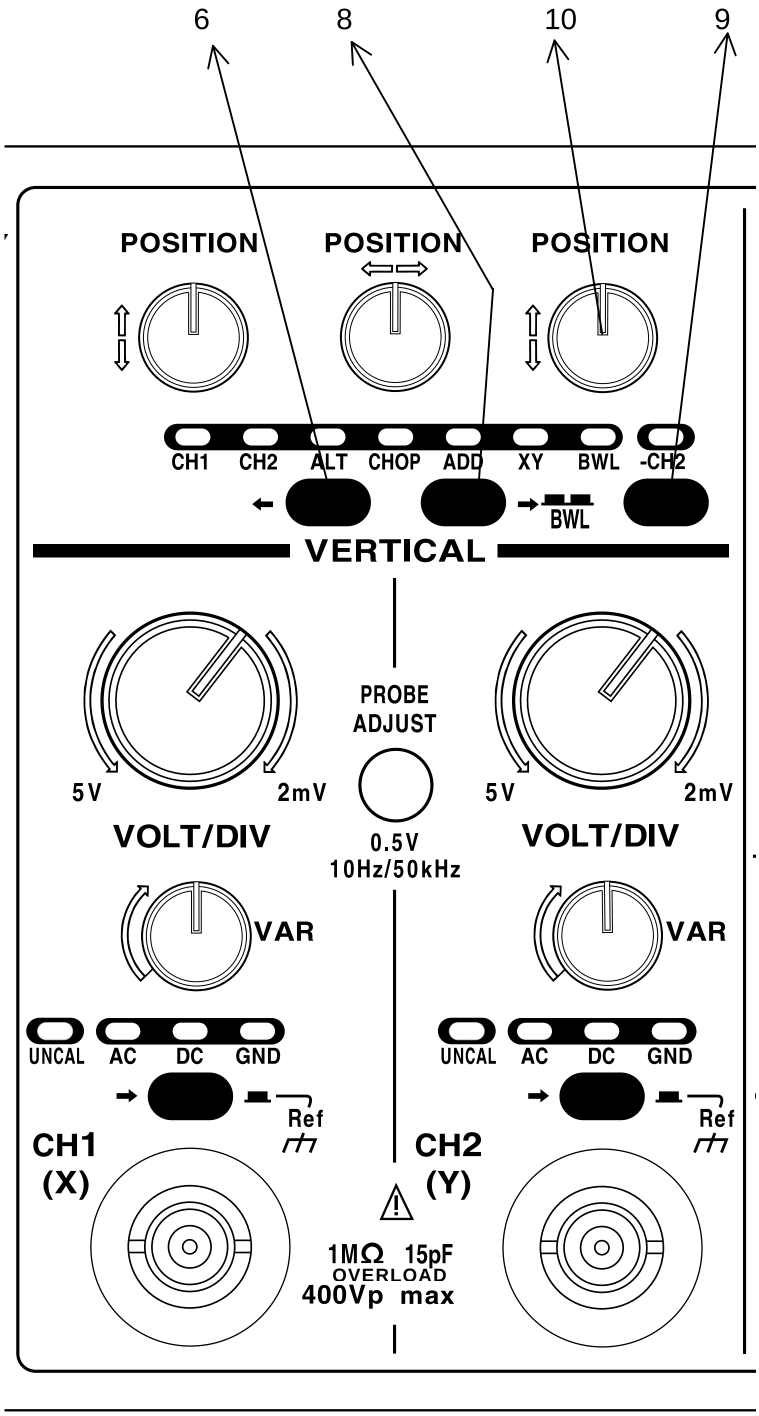

6
8
10
9
POSITION
POSITION
POSITION
CH1
CH2
ALT
CHOP
ADD
XY
BWL
-CH2
BWL
VERTICAL
5V
2mV
VOLT/DIV
PROBE
ADJUST
0.5V
10Hz/50kHz
5V
2mV
VOLT/DIV
VAR
VAR
UNCAL
AC
DC
GND
UNCAL
AC
DC
GND
Ref
Ref
CH1
(X)
CH2
(Y)
1MΩ 15pF
OVERLOAD
400Vp max

figure 3

4.3 Display modes

(6 - 8) **CH1 - CH2 - ALT - CHOP - ADD - XY - BWL**

Select by pressing → (8) or ← (6):

CH1 Displays CH1 only.

CH2 Displays CH2 only.

ALT Displays CH1 and CH2 (in alternate mode).

CHOP Displays CH1 and CH2 in chopped mode; during a single sweep, the channel switches from CH1 to CH2 at the chopping frequency (500 kHz).

ADD Displays CH1+CH2; the difference between CH1-CH2 is displayed if -CH2 mode is on.

XY Displays CH1 and CH2 in X-Y mode (X = CH1, Y = CH2).
The timebase is off and vertical alignment is adjusted by POSITION control (10).

BWL Bandwidth limited to 20 MHz for CH1 and CH2 simultaneously. At the same time press buttons 6 and 8.
Enables the reduction of the thickness of the trace when the masses are long or when the input junction is not normally shielded.

BWL function has a mechanism which launch it as soon as one of the 2 channels is on 2 mV/div.
If the necessary bandwidth is of 100 MHz, desactivate the BWL with (6) et (8).
Inhibited automatic device in AUTOSET.

(9) **-CH2** Inverts CH2.

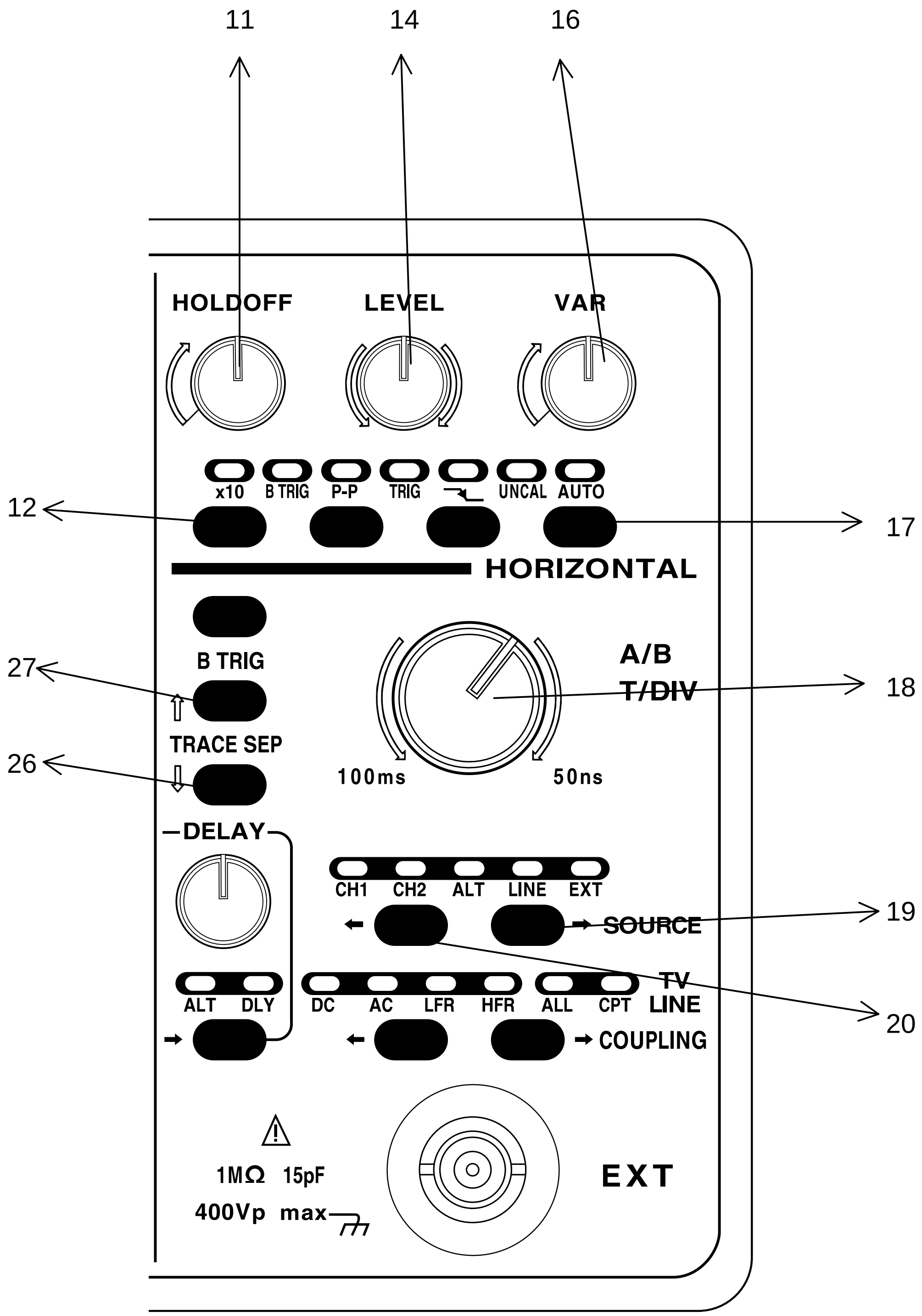

11
14
16
HOLDOFF
LEVEL
VAR
x10
B TRIG
P-P
TRIG
UNCAL
AUTO
12
17
HORIZONTAL
B TRIG
27
A/B
T/DIV
18
TRACE SEP
26
100ms
50ns
DELAY
CH1
CH2
ALT
LINE
EXT
SOURCE
19
TV
LINE
20
ALT
DLY
DC
AC
LFR
HFR
ALL
CPT
COUPLING
1MΩ 15pF
400Vp max
EXT

figure 4

4.4 Timebase

(18) **T/DIV. A/B** - Sweep speed :
20 positions (50 ns to 100 ms/div.) for the 1st timebase A.
20 positions (50 ns to 100 ms/div.) for the 2nd timebase B.
Timebase display on the screen.

(16) **VAR** - Continuous sweep speed adjustment for timebase A.
When the knob is not locked in the left end stop position, the UNCAL LED is on and the corresponding symbol displays on the screen.

(11) **HOLDOFF** - Continuous adjustment of the time between consecutive sweeps.
This control can be used to inhibit unwanted trigger events (multiple trigger conditions in one period of the signal under observation). In normal use, set the knob to the left end stop position.

(12) **x10** - Horizontal expansion (x 10).

(26 - 27) **TRACE SEP** - Separation between the A and B traces in ALT mode.
With this control, the TBB delayed trace can be positioned vertically in relation to the TBA main trace.

4.5 Triggering

(19 - 20) **SOURCE** - Select by pressing → (19) or ← (20) :
The same source synchronizes both timebases A and B.

CH1 Synchronized on channel CH1.

CH2 Synchronized on channel CH2.

ALT Trigger source defined by display mode:

Display mode	Trigger source
CH1	CH1
CH2	CH2
ALT	channel 1 synchronized with CH1
	channel 2 synchronized with CH2
CHOP	CH1
ADD	CH1
- CH2	CH2

LINE Synchronized on mains power supply frequency. Phase can be adjusted using the LEVEL control. The coupling control is disabled.

EXT Synchronized on external source.

(17) **AUTO** - Automatic timebase trigger
Traces visible even without trigger event.

(14) **LEVEL** - Trigger level adjustment
The TRIG LED is on when a trigger event is detected (timebase activated).

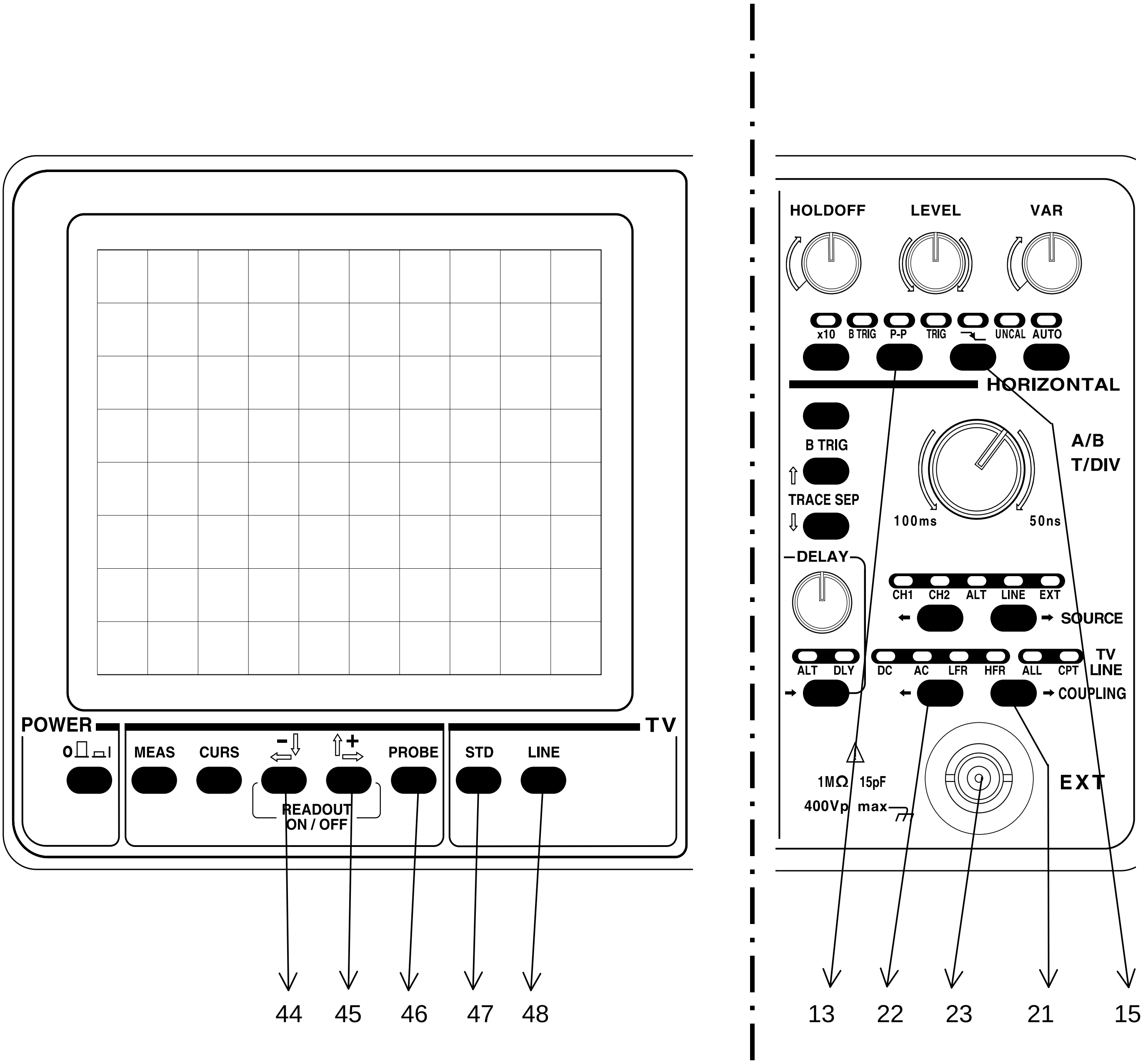

POWER
TV
MEAS
CURS
PROBE
STD
LINE
READOUT
ON / OFF
HOLDOFF
LEVEL
VAR
x10
B TRIG
P-P
TRIG
UNCAL
AUTO
HORIZONTAL
B TRIG
TRACE SEP
A/B
T/DIV
100ms
50ns
DELAY
CH1
CH2
ALT
LINE
EXT
SOURCE
ALT
DLY
DC
AC
LFR
HFR
ALL
CPT
TV
LINE
COUPLING
1MΩ 15pF
400Vp max
EXT
44
45
46
47
48
13
22
23
21
15

figure 5

(23) **EXT** - BNC socket for external sync signal input.
(See Specifications, Section 7)

(15) Trigger slope

led on : trigger on negative edge
led off : trigger on positive edge
Symbol displays on the screen (see Section 5.2.)

(13) **P - P -** Peak-to-peak trigger

The reference trigger level (accurately set using LEVEL) is automatically set between the low and high peaks of the signal, so ensuring triggering regardless of the amplitude or DC component of the source signal (80% of signal amplitude for f > 100 Hz).

(21 - 22) **COUPLING** - Trigger source coupling

Select by pressing → (21) or ← (22) :

DC DC coupling (See Specifications, Section 7)

AC AC coupling (See Specifications, Section 7)

LFR Rejects frequencies < 10 kHz from source signal (facilitates observation of signals with unwanted 50 Hz low frequency component, for example).

HFR Rejects frequencies > 10 kHz from source signal (facilitates observation of low frequency signals with high frequency noise).

ALL Trigger on video signal sync pulses of all lines

CPT Trigger on video signal sync pulses of a selected line

led off : ***TV signal with positive video modulation***

led on : ***TV signal with negative video modulation***

(47) **STD** - TV Standard 625, 525 or free standard

Select by pressing successively the key.
In free standard mode, the standard is selected by pressing the keys (44) and (45).
The standard is valuated from 525 to 1250 (included).

(48) **LINE** - TV line selection and memorization in TV trigger mode

Adjust the TV line with the keys (44) and (45).
A second press on LINE key (48) memorizes the TV line.

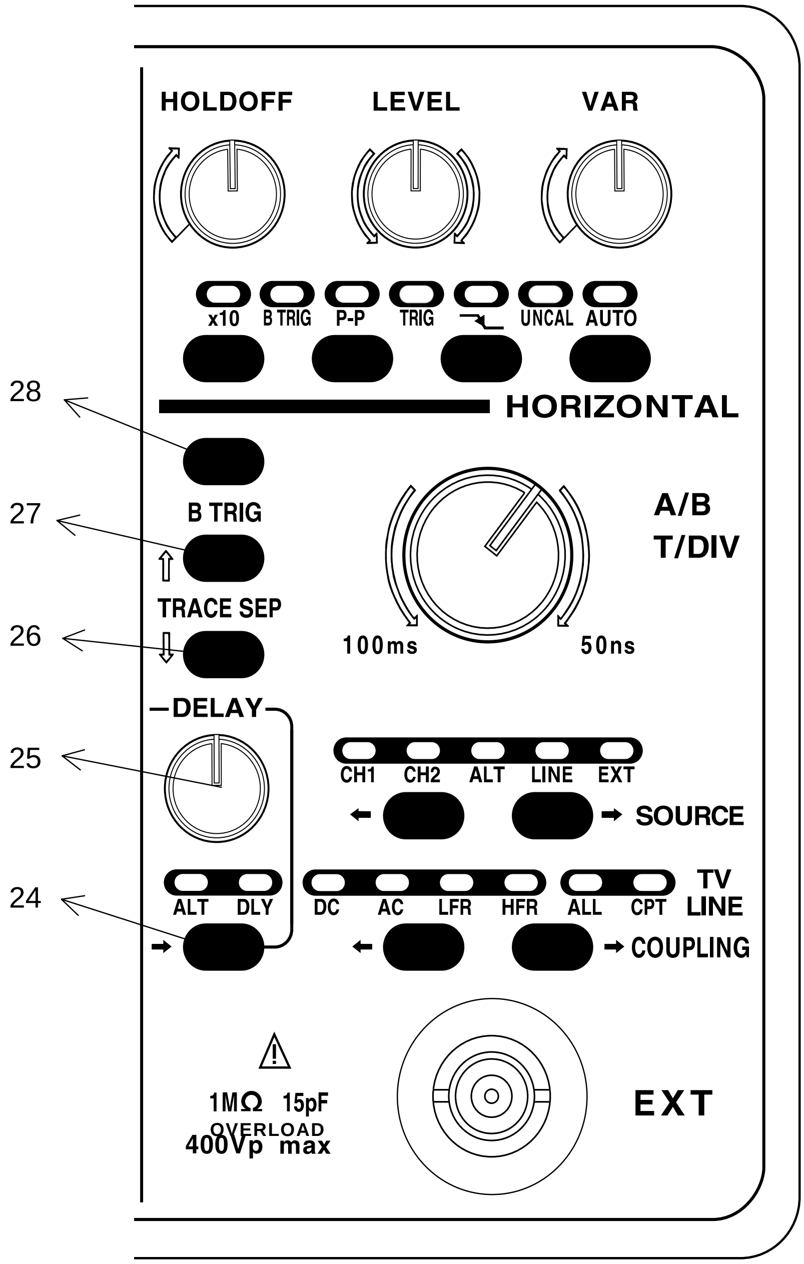

HOLDOFF
LEVEL
VAR
x10
B TRIG
P-P
TRIG
UNCAL
AUTO
28
HORIZONTAL
27
B TRIG
A/B
T/DIV
TRACE SEP
26
100ms
50ns
DELAY
25
CH1
CH2
ALT
LINE
EXT
SOURCE
24
ALT
DLY
DC
AC
LFR
HFR
ALL
CPT
TV
LINE
COUPLING
1MΩ 15pF
OVERLOAD
400Vp max
EXT

figure 6

4.6 Trigger delay - Timebase B

You can use this mode to examine (at high sweep speed) the details of a portion of a signal after the selected trigger event.

The DELAY control (25) provides continuous adjustment from at least 10 div.

(24 - 25) **DELAY** - Select by pressing ALT DLY → (24):

- Normal mode (ALT and DLY off):

  Sweep starts immediately (trigger event at extreme left of trace).

- Alternate mode (ALT on):

  Two traces are obtained for each Y channel: the first one represents the main sweep A with a dimmed area of duration B lagging by the DELAY value. The second trace is offset below the first.

  This has a duration corresponding to B and is offset using the TRACE SEP knobs (26) - (27). In ALT or CHOP mode, four traces are obtained:

1 : CH1 timebase A	2 : CH1 timebase B
3 : CH2 timebase A	4 : CH2 timebase B

  Sweep speeds
  The timebase A/B button is assigned :
  to the timebase A speed in normal mode (ALT and DLY off)
  and
  to timebase B in ALT or DLY mode.

  The timebase B sweep speed cannot be inferior to the A sweep speed.

☞ ***Note*** ***Before validating ALT or DLY mode, you must imperatively select the A sweep speed with the TIME BASE A/B button.***

Delay: To adjust the delay, use the ten-turn DELAY knob.

Alternate mode separation: From -1 to -5 div. Use both TRACE SEP keys located on the same vertical as the DELAY knob. The top key reduces separation and the bottom key increases it.

- Delay mode (DLY on). Only the timebase B sweep speed is displayed.

(28) **B.TRIG** - Resynchronizes timebase B. Active in ALT or DLY timebase B mode.

B.TRIG LED off
Starting the timebase B sweep needs going through the DELAY time. Mode « RUN AFTER DELAY ».

B.TRIG LED on
Starting the timebase B sweep needs going through the DELAY time and a TRIGGER event. Mode « TRIG AFTER DELAY ».

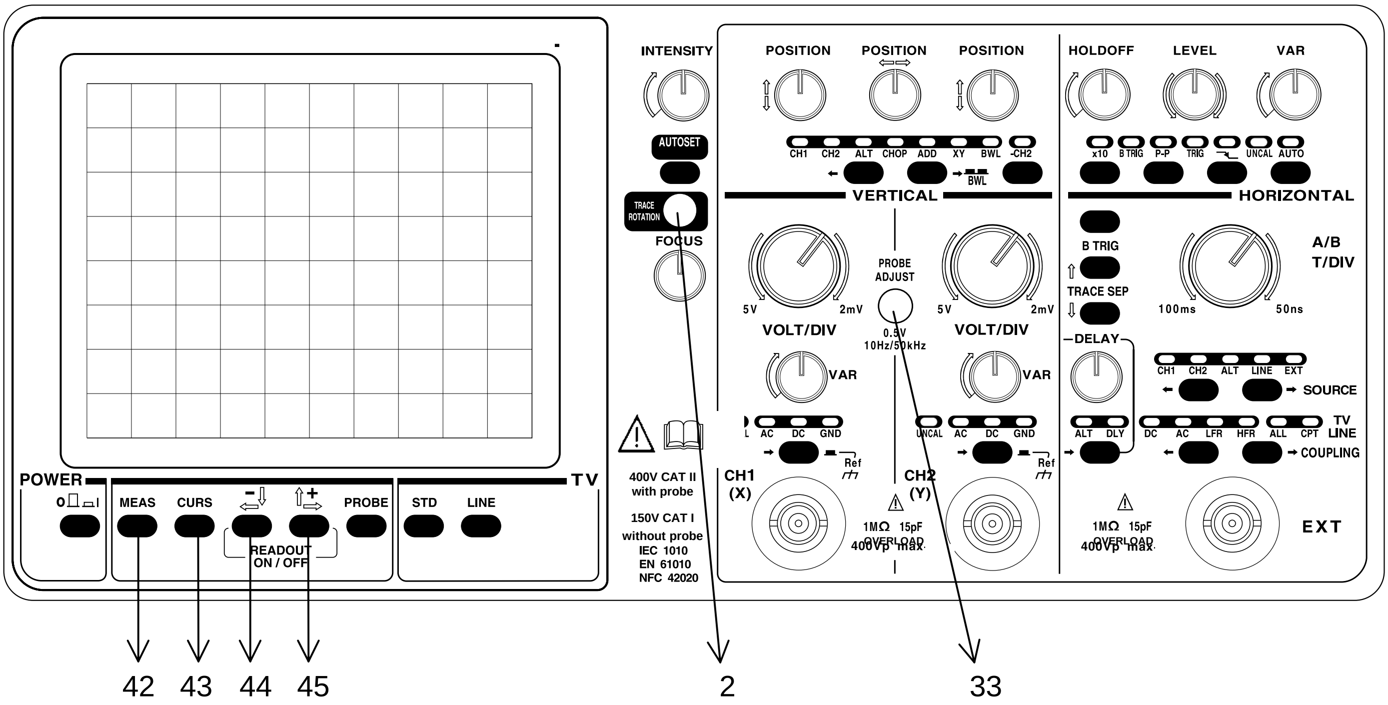


figure 7

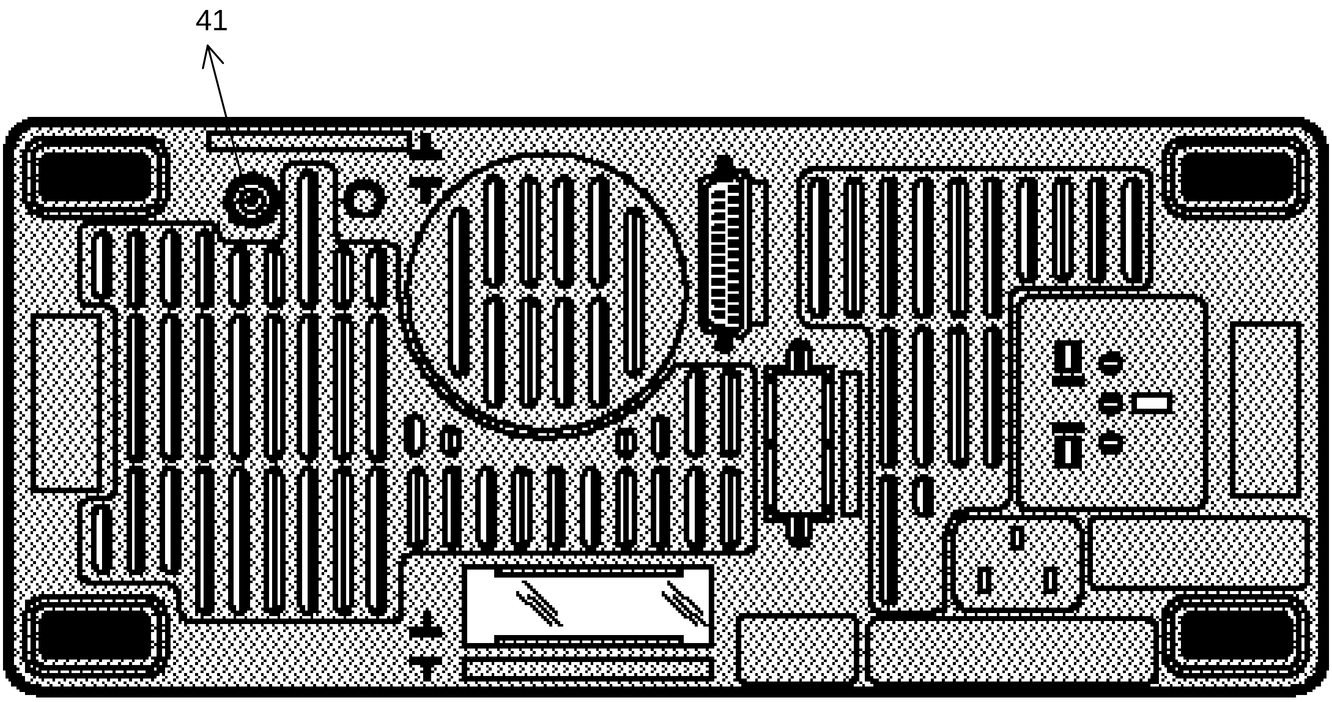


figure 8

4.7 Measurement

(42) **MEAS** - Measurement selection :

- Amplitude
- Period and frequency
- Phase network shifter

Select by pressing the key successively.

(43) **CURS** - Active cursor selection.

Select by pressing the key successively.
Active cursor shifting with keys (44) and (45).

4.8 Other functions

(33) **PROBE ADJUST** - Outputs a squarewave signal (0.5 V peak-to-peak).

This signal is used for measurement probe compensation or to check vertical amplifiers and the timebase (see section 5.1). The calibrator frequency is defined by the channel A sweep speed.

This frequency ranges from 10 Hz to 50 kHz so that each period makes five horizontal divisions from 20 ms/div. to 0.1 ms/div. The 1 kHz frequency corresponds to 0.2 ms/div.

This signal is used for LF and HF probe compensation. The reference plateau is the top level of the pulse.

(2) **TRACE ROTATE** - Adjusts parallel alignment of traces horizontally (this is done using a screwdriver).

(41) **Z MODULATION** - Inputs, via a BNC socket (41) on the rear panel (figure 8), a TTL signal to extinguish the spot (0 V level → trace on, 5 V level → trace off).

This input also allows the use of a timing reference signal (marker).

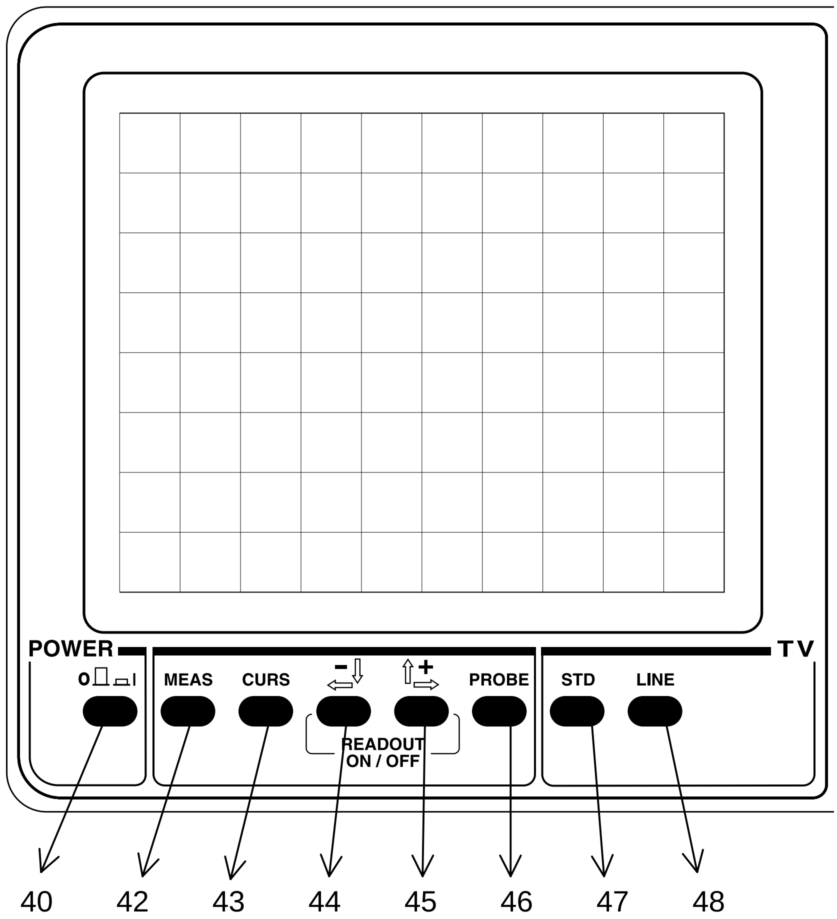

POWER
0
I
MEAS
CURS
-
+
PROBE
STD
LINE
TV
READOUT
ON / OFF
40
42
43
44
45
46
47
48

figure 9

5. DESCRIPTION OF THE INFORMATION DISPLAYED

5.1 Key selection

(42) **MEAS** - Cursor measurement selection :
- voltage
- time
- phase

To select, press successively the key. When in XY mode, selection can only be done between the horizontal or the vertical cursor.

(43) **CURS** - Selection of cursor to shift.
The symbol "X" applies to the active cursor.
To select, press successively the key
- With 2 cursors : the first one, the second one, or both can be active (tracking mode).
- With 3 cursors : the first one, the second one, the third one, or the three of them (tracking mode) can be active.

(44) [- ⇩ ⇦] This key will enable you :
- to shift the cursor to the left or to the bottom
- to scale down the TV line number
- to scale down the TV standard in free mode

The object to be modified or to be shifted is identified with the symbol "X".

(45) [⇧ + ⇨] This key will enable you :
- to shift the cursor to the right or to the top
- to scale up the TV line number
- to scale up the TV standard in free mode

The object to be modified or to be shifted is identified with the symbol "X".

(46) **PROBE** - Probe factor x 1, x 10, x 100.
The factor is taken into account to display
- the ranges
- the cursor measurements.

Factor change will be obtained by pressing successively the key. It will also works on the active channels.

Example ***In CHOP mode and in ALT mode : to assign simultaneously the same factor on the two channels, press once the PROBE key (46).***
To set CH1 with the probe factor x 10 and CH2 with the probe factor x 100, you must switch to vertical mode CH1, press once the PROBE key (46), switch to vertical mode CH2, press the key PROBE (46) twice and finally switch to vertical mode CHOP.

Note ***When coupling to TV CPT :***

(47) **STD** - TV standard adjustment : 525, 625, free (from 525 to 1250)
Selection by pressing successively the key in **free** mode, the symbol "X" will appear next to the number of lines of the selected standard. All you have to do is to use the keys (44) and (45) to adjust it.

(48) **LINE** - TV line selection and memorization in TV trigger mode
The symbol "X" will appear next to the line number. All you have to do is to press the keys (44) and (45) to make the selection.
When the "X" symbol is displayed, a second press on the LINE key (48) memorizes the TV line. The "X" symbol disappears. The TV line is then displayed at each launching of the instrument.

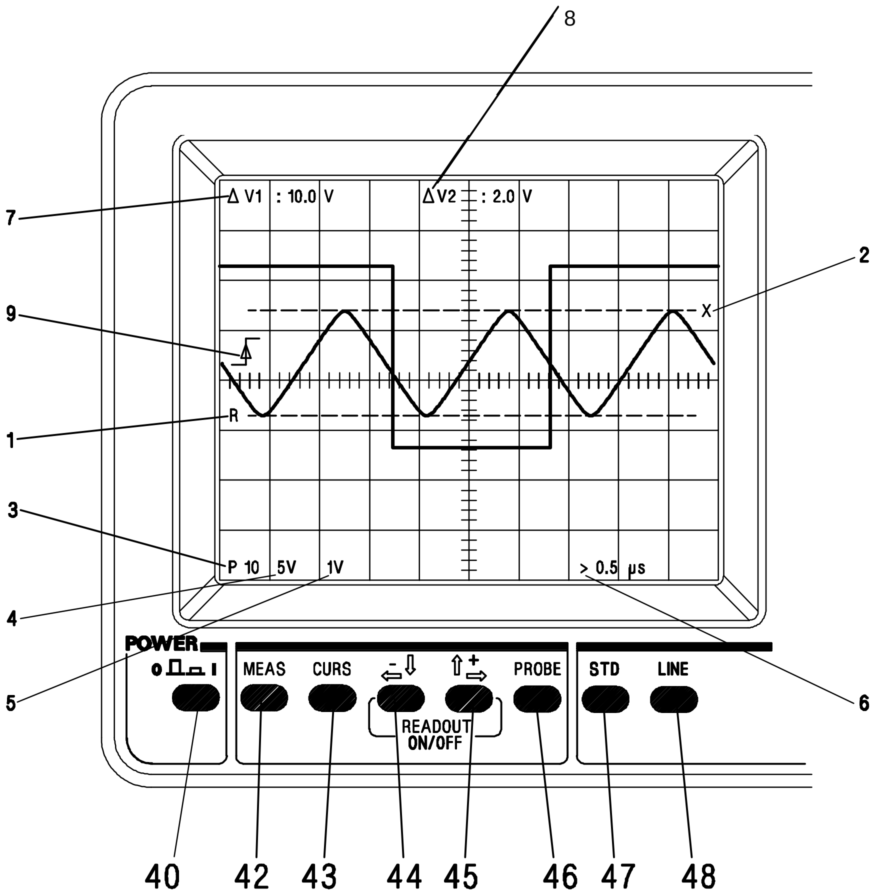


figure 10

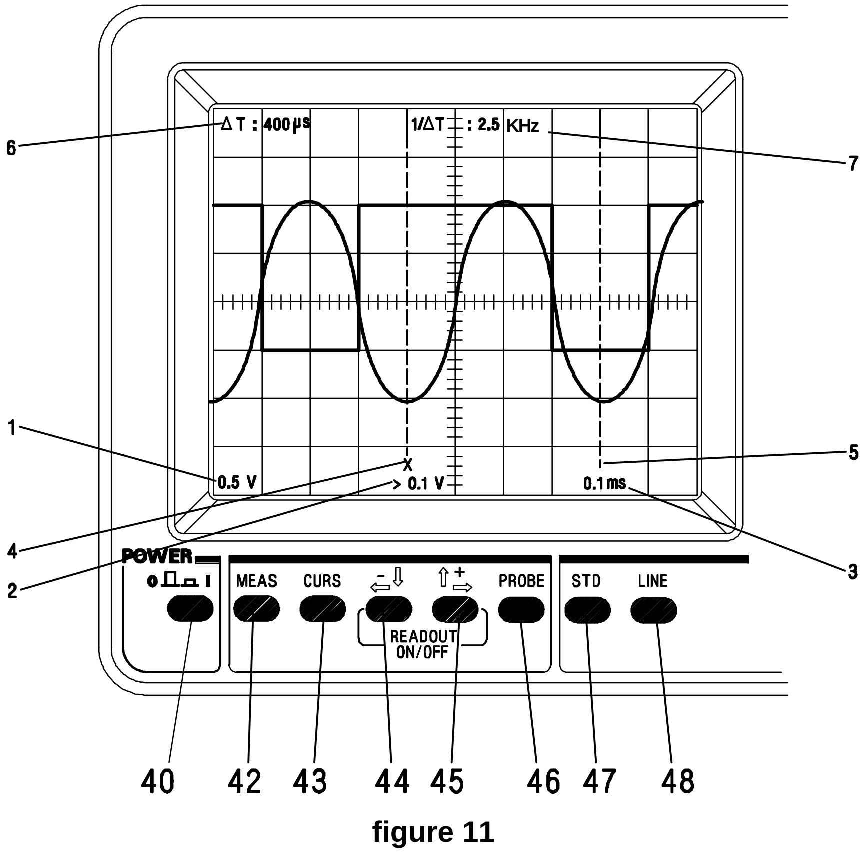


figure 11

5.2 Voltage measurement

Description of the example shown on the opposite page (figure 10) :

1 - Cursor of reference : R
The second cursor is :
- positioned above : the variation is positive,
- positioned below : the variation is negative.

2 - Active cursor : X
To select the active cursor use the key (43), to shift it use the keys (44) and (45)

3 - Probe factor x 10 is on channel CH1.

4 - Channel CH1 range : 5V / div.

If the probe factor is now x 1, the range will switch automatically to 0.5 V.

5 - Channel CH2 range : 1V / div.
Probe factor is x 1.

6 - Time base 0.5 µs/div.
The symbol ">" means that the time base is in decalibrated position.

7 - Measured variation between the cursors, from CH1 channel range.

8 - Measured variation between the cursors, from CH2 channel range.

9 - Edge trigger indicator

5.3 Time and frequency measurement

Description of the example shown on the opposite page (figure 11) :

1 - Channel CH1 range : 0.5 V/div.

2 - Channel CH2 range : 0.1 V/div., the symbol ">" indicates the channel UNCAL position.

3 - Time base : 0.1 ms.

4 - Active cursor "X".
To select the active cursor, use the key (43).

5 - Second cursor.

6 - Time variation between the two cursors.

7 - Hertz variation between the two cursors.
The cursor set, to enclose a period, will make measurement of the signal frequency possible.

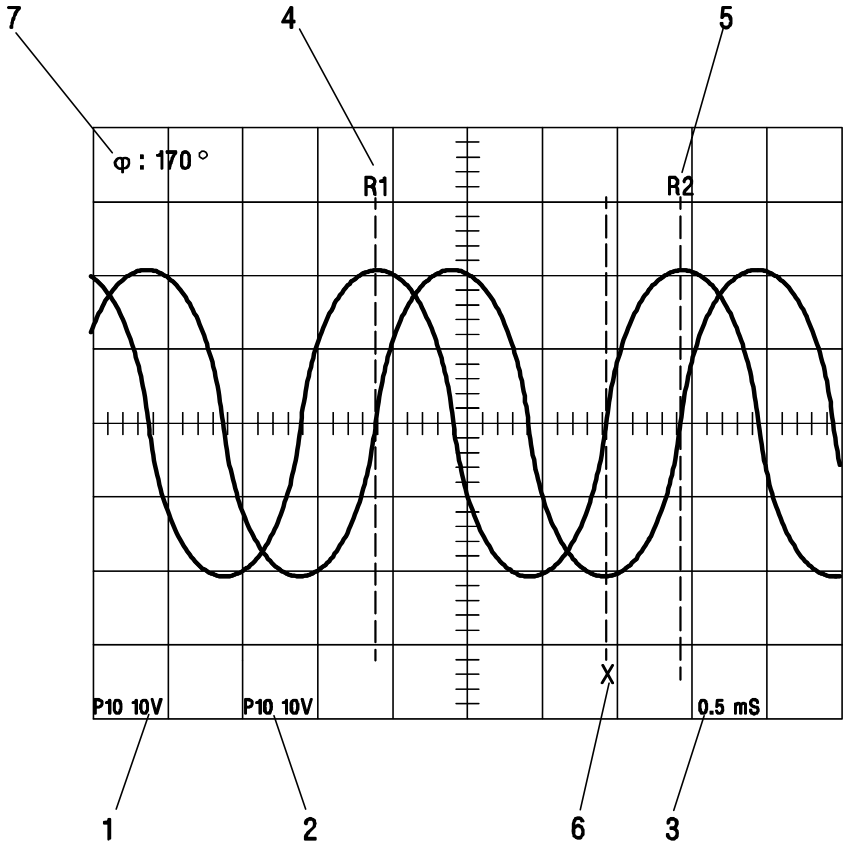


figure 12

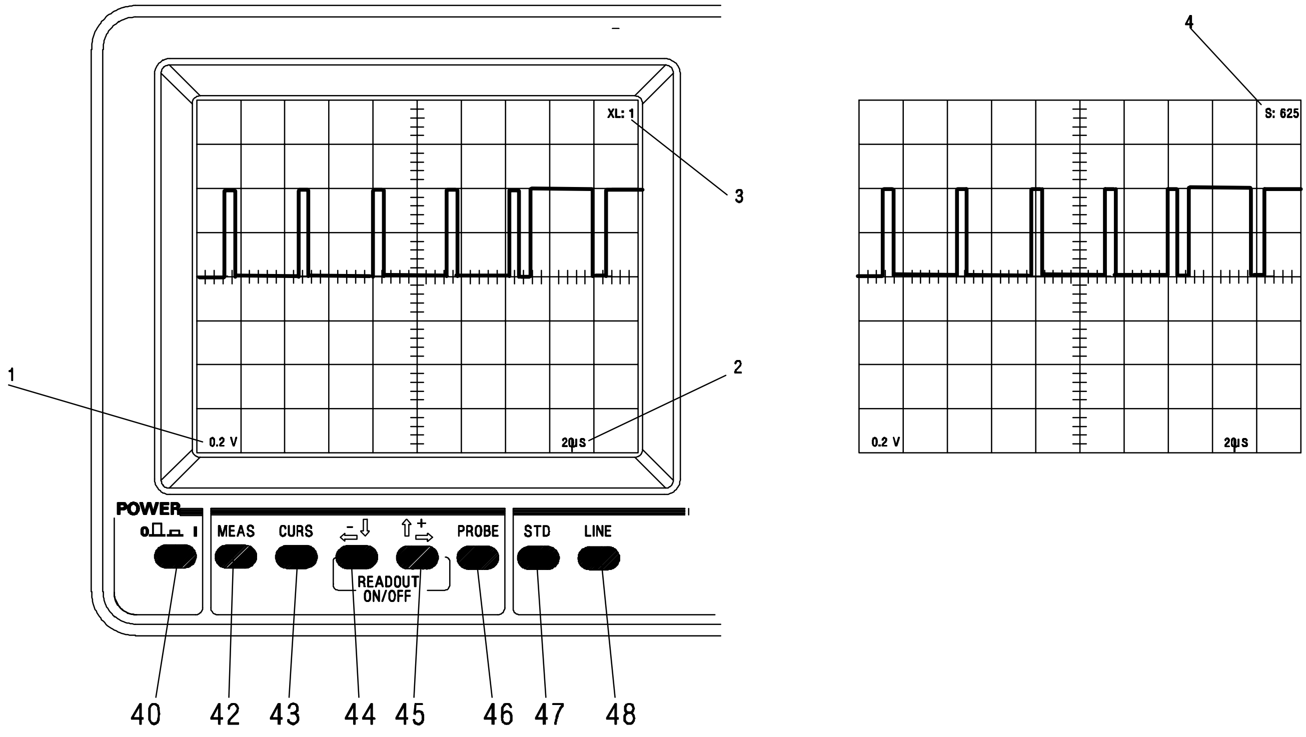


figure 13

5.4 Phase measurement

Description of the example shown on the opposite page (figure 12) :

1 - Channel CH1 range : 10 V/div. with probe factor x 10.

2 - Channel CH2 range : 10 V/div. with probe factor x 10.

3 - Time base 0.5 ms.

4 - Cursor of reference 1.

5 - Cursor of reference 2.

Cursors of reference 1 and 2 indicate the signal period, i. e. 360°.

6 - Phase measurement cursor.

In this example, the phase measurement cursor is the active cursor, since the symbol "X" is placed under this cursor.

7 - Result of the phase measurement.

5.5 TV Mode (coupling CPT)

Description of the example shown on the opposite page (figure 13) :

1 - Channel CH1 range : 0.2 V/div.

2 - Time base 20 µs/div.

3 - TV line : trigger line number.

Line 1, in this specific example.

4 - TV Standard

In this specific example, the standard is 625 lines.

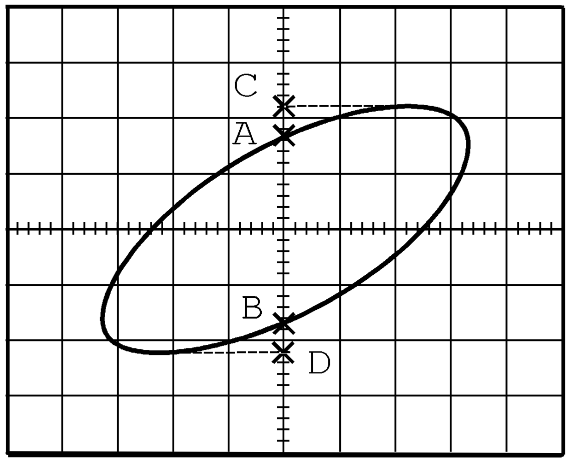


figure 14 : XY mode

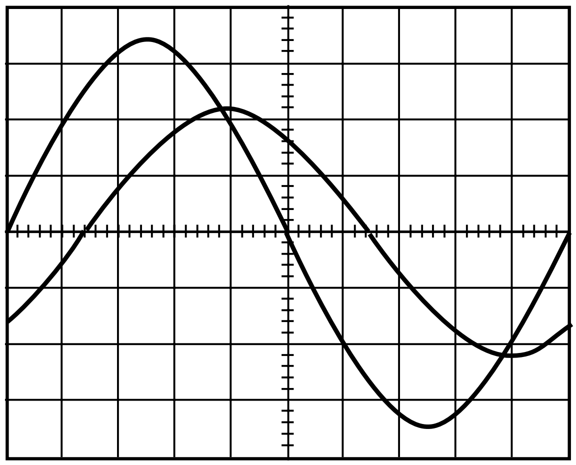


figure 15 : Dual-curve mode

6. APPLICATIONS

6.1 Viewing the calibration signal and adjusting probe compensation

- Connect the PROBE output (33) to the CH1 input (34) using a 1/1 or 1/10 measurement probe.

- Select the following functions :
  - . CH1 sensitivity (37) : 0.1 V/div.
  - . sweep speed (18) : 0.2 ms/div.
  - . trigger source (19) or (20) : CH1
  - . trigger mode (17) : **AUTO**

- If necessary, adjust vertical alignment using POSITION control (7) and stabilize the trace using LEVEL control (14).

- Adjust the probe LF compensation, so that the top plateau of the pulse is horizontal.

50 ns/div. sweep speed

- Adjust the probe HF compensation, so that the edge and start of the plateau are as rectangular as possible.

☞ ***Note*** ***To compensate, please refer to the operating manual of the probe.***

6.2 Measuring phase difference

6.2.1 In XY mode

- Select the XY display mode (6) or (8).
- Adjust vertical sensitivity (32) and (37) to obtain the image shown in figure 14.

Calculating phase difference φ sine φ = AB/CD = 3.5 div./5 div. = 0.7, so φ = 45°

6.2.2 In dual-curve mode

Use the cursors in φ mode.

(Refer to section 5.4. and figure 15).

6.3 B.W.L.

The launching of this mechanism improves the trace fineness in following cases :

- the full bandwidth is not necessary : B.F. or video signals
- the input junctions are not normally shielded : thickening of the trace (due to the hertzian spectrum collected at the input)
- the neutral point return is too long.

7. SPECIFICATIONS

Only the values assigned tolerances or limits are guaranteed values (after 30 minutes of heating-up). Values without tolerances are given for information only. The measurement errors must be considered in an environment of reference temperature (refer to Section 7.5).

7.1 Vertical deflection

CH1 - CH2	Specifications	Comments
Bandwidth -3 dB in BWL	5 mV to 5 V/div. BW > 150 MHz 2 mV/div. BW > 130 MHz ≈ 20 MHz	ref. 6 div. at 1 kHz
Rise time	5 mV at 5 V/div. tr < 2.3 ns	5 div. from 10 to 90 %
Vertical deflection factor (sensitivity)	Ranges: 2 mV/div. to 5 V/div. ± 3 %	11 positions 1-2-5 sequences
Variable vertical deflection factors	Multiplication of V/div. range by 1 to 2.5 (reducing displayed signal amplitude)	Calibrated position: control in left end stop position, led off. Uncalibrated position, led on.
Max. input voltage	Protection: ± 400 V (DC + AC peak at 1 kHz)	
Level limitation / frequency	DC at 3 MHz 400 Veff from 3 MHz to 150 MHz : -20 dB/decade	
Focused trace thickness	< 2 mm	
Chopping frequency (CHOP)	500 kHz approx.	
Input coupling	DC: 0 to 150 MHz AC: 10 Hz to 150 MHz GND: 0 V reference	
Input impedance	1 MΩ ± 1 % // 15 pF	
Squarewave signal response	Overshoot < 5 % Aberration at 10 mV/div. - on plateau < 1 mm - on edge < 2 mm	 1 kHz to 1 MHz 1 MHz (Rise time < 100 ps)
Crosstalk	42 dB typical (2 mV/div. : 36 db typ.)	until 150 MHz same sensitivity on CH1 and CH2, 4 div.
Display	CH1: CH1 only CH2: CH2 only ALT: CH1 then CH2 alternating CHOP: CH1 and CH2 chopped ADD: CH1 + CH2 or CH1 - CH2 XY: X = CH1 and Y = CH2	

7.2 Horizontal deflection (timebase)

CH1 - CH2	Specifications	Comments
Sweep speed	Ranges 50 ns to 100 ms/div. ± 3 %	20 positions 1-2-5 sequences
Variable factor (A only)	Modification of ms/div. range by 1 to 2.5 (signal horizontally contracted)	Calibrated position : control in left end stop position, led off.
		Uncalibrated position, led on.
x 10 expansion	Accuracy : ± 5 %	Gives 5 ns/div.
HOLDOFF	1 to 10, variable	
XY mode	X = CH1 DC coupling : 0 Hz to 4 MHz AC coupling : 10 Hz to 4 MHz	
	Y = CH2 DC coupling : 0 Hz to 150 MHz AC coupling : 10 Hz to 150 MHz	
	Phase difference < 1.5° at 100 kHz	

7.3 Trigger system

	Specifications		Comments
Source:	*Sensitivity in normal mode - Trigger from 0 to 180 MHz*		
CH1	0.6 div.	to 1 kHz	
or	1 div.	to 100 MHz	
CH2	2 div.	to 150 MHz	
ALT			Source according to display mode:
			CH1 trigger CH1
			CH2 trigger CH2
			ALT trigger CH1 then CH2
			CHOP trigger CH1
			ADD trigger CH1
			-CH2 trigger CH2
LINE			
EXT	100 mVrms	0 to 50 MHz	protection ± 400 V (DC + AC peak, f < 1 kHz)
	200 mVrms	50 to 150 MHz	
Filters (coupling)	*Bandwidth:*		
	AC DC LFR (rejection) HFR (rejection)	10 Hz to 150 MHz full bandwidth 10 kHz to 150 MHz DC to 10 kHz	
TV LINE	ALL :	synchronize video signal on all lines	Rising edge positive video Falling edge negative video
	CPT :	synchronize video signal on a selected line	Rising edge positive video Falling edge negative video
Horizontal mode	AUTO		Relaxed mode
	Normal		Triggered mode
Slope	Negative-going edge Positive-going edge		
Level	*Adjustment range:*		
	P-P: between signal minimum and maximum		
	Normal: ± 12 divisions		

7.4 Miscellaneous

Calibration signal

Shape	squarewave
Amplitude	-0.5 V ± 1% CAT I
Frequency	10 Hz to 50 kHz according to button (18)

Z modulation

Input	BNC socket on rear panel
Sensitivity	TTL level
Input resistance	10 kΩ
Bandwidth	20 MHz
Maximum voltage	± 50 V DC CAT I

7.5 General features

CRT

Type	rectangular with internal graticule, 13 cm diagonal
Graticule	eight vertical divisions with five sub-divisions ten horizontal divisions with five sub-divisions 1 division = 1 cm
Screen	average persistence phosphor GY
Trace	trace rotate adjustment focus adjustment intensity adjustment beam find feature

Total acceleration voltage 15,5 kV.

Power supply

Mains: automatic selection, 94 to 264 Vrms, 45 Hz to 440 Hz, CAT II
Removable mains power cord.
Cord winder with plug support on back of instrument.
Consumption:> 70 W

Safety

According to IEC 1010, class 1 (NFC 42020 ; VDE 0411) degree of pollution 2
Overvoltage category : inputs, CAT I, 150 V max. without probe
CAT II 400 V with the supplied probes
power supply, CAT II, 300 V max.

Environment

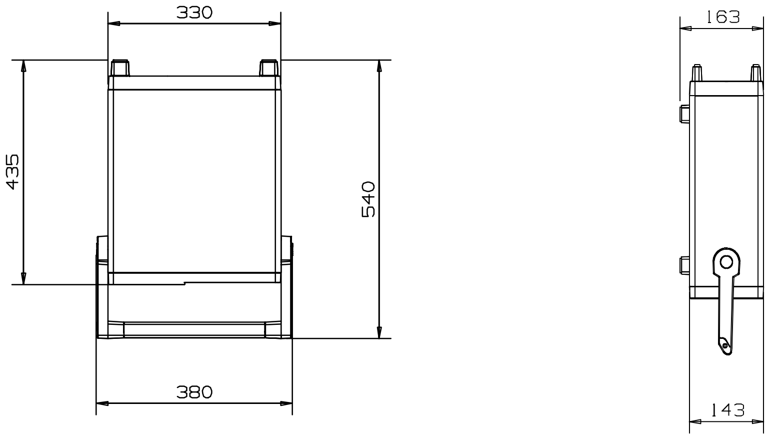
Indoor use
Altitude up to 2000 m

Reference temperature	+18°C	to +28°C
Range of use	+10°C	to +40°C
Operating temperature	0°C	to +40°C
Storage range	-20°C	to +70°C
Relative humidity	< 80 %	at +40°C

EMC
Emission according to EN 50081-1, 1992
Immunity according to EN 50082-1, 1997
Influence parameters :

<u>VERTICAL</u>	parasitic deflection < ± 2 div. under the effect of an 80 MHz to 1 GHz RF field or under directed RF interference of 150 MHz to 80 MHz
<u>TRIGGER</u>	triggering possible under the effect of rapid burst transients or electrostatic discharges

Mechanical features
Stackable, with handle which also doubles as stand.
Dimensions : see figure below
Weight : ≈ 5.5 kg



Packaging
Dimensions : 550 x 460 x 380 mm
Weight : ≈ 7 kg

8. ACCESSORIES AND OPTIONS

8.1 Accessories

Supplied with instrument

♦ Operating manual	
♦ Spare ceramic fuse T2.5 A / 5 x 20 / 250 V / located inside the instrument in a recess on the CRT mounting (Manufacturer: FERRAZ, B.P. 25, 69391 LYON Cedex)	AT 0090
♦ Mains power cord (AG 0439, UK only) (AG 0502, US only)	AG 0416
♦ 2 x 1/10 - 10 MΩ - 250 MHz stepdown passive probes	HX 0004

Supplied to order

♦ Male BNC/male plug lead 50 Ω	PA 2249C48
♦ Male BNC/male banana plug lead	HA 0844
♦ 1/100 - 100 MΩ - 200 MHz stepdown passive probe	HA 1317
♦ 15 MHz differential probe	MX 9000
♦ 50 Ω BNC Charge	PA 4119-50
♦ BNC T male/female	PA 3285
♦ 19" rack mounting set	RK 0008
♦ Remote programming kit	HA 1267

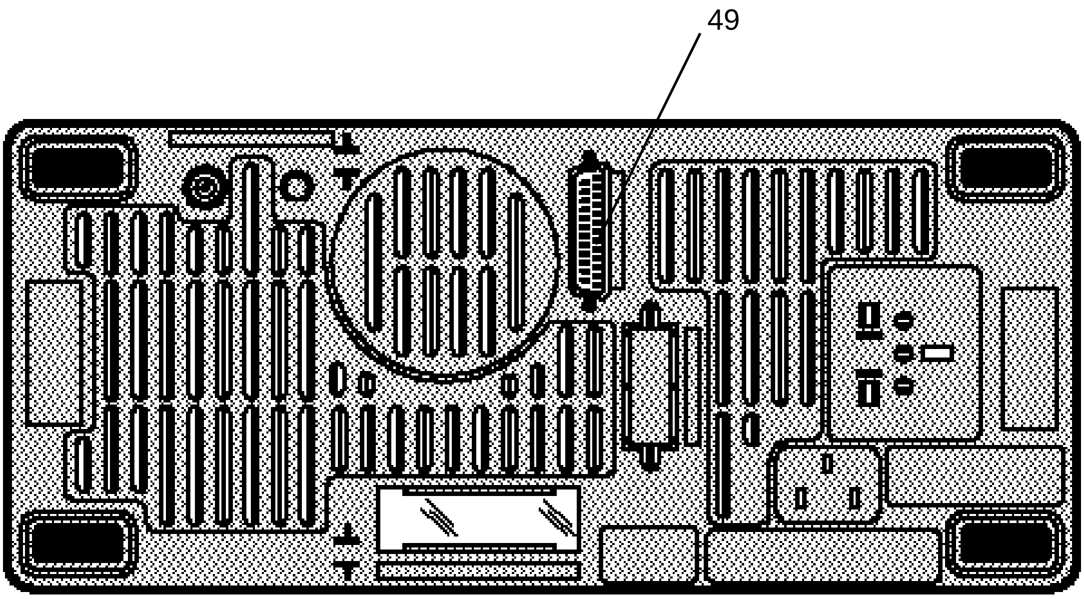


figure 16

Complete cale : 25 pins
(RTS protocol)

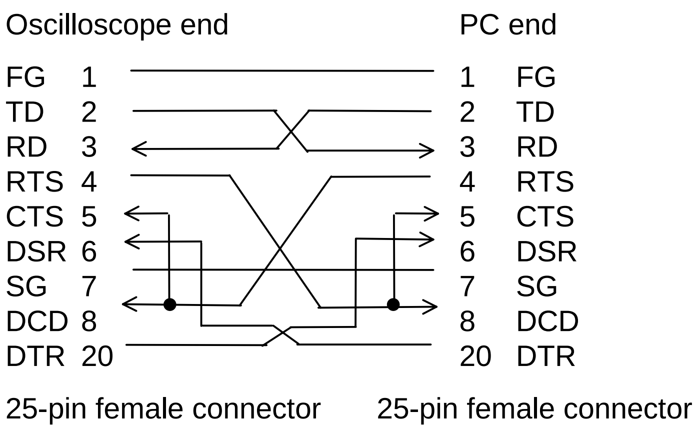


figure 17

Complete cale : 25/9 pins
(RTS protocol)

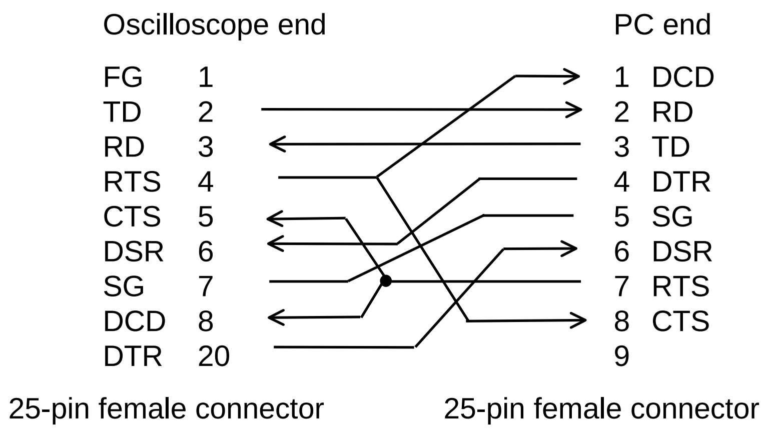


figure 18

9. PROGRAMMING

9.1 General description

This RS232 (49) standard serial link sets the communication between the oscilloscope and a PC or compatible computer, including :

- remote programming of the oscilloscope,
- reading the configuration of the oscilloscope.

9.2 Serial link characteristics

Oscilloscope connector :	25-pin cannon plug
cable :	five wires (two transmission wires, one ground wire, two control wires)
Protocol :	RTS
Data rate :	9600 bauds
Data format :	8 bits - no parity - 1 bit stop
Protection :	per EIA RS232C standard

9.3 PC / oscilloscope link wiring

The serial link cable from the oscilloscope to the PC or compatible microcomputer is a complete cable (figure 17) :

- a TXD wire for transmitted data,
- an RXD wire for received data,
- an SG wire for signal ground.

The serial connector at the oscilloscope end is a 25-pin cannon plug.
The pin-out of the connecting cable depends on the connector at the PC end. There are two possible types :

- 25-pin cannon plug (the most widely used),
- 9-pin plug (mainly on portables).

The link cable comprises two female connectors (25- or 9-pin). The wiring will depend on the connector on your computer (figure 18) :

☞ ***Note*** ***An RS232 cable measuring less than 15 metres is recommended.***

9.4 Command syntaxis

9.4.1 Oscilloscope configuration

All the oscilloscope functions(apart from potentiometer settings and the ON/OFF switch) can be programmed remotely from a PC or compatible computer. There are 15 programmable commands available.

Each command is divided into three characters:

<function> active function number,

<parameter> function parameter (depending on the current status of the oscilloscope),

<terminator> end of text character EOT.

Tables giving the syntax of all oscilloscope commands are in section 10.1 and following (codes expressed in decimal).

A «Decimal-Hexadecimal-ASCII» mapping table is given at the end of the manual. This table shows the 7 bit coded characters. The 8 bit coding is not standardized, and is therefore not given in this table.

✍ ***Example***

Configuration of the vertical ADD mode in Decimal, Hexadecimal and ASCII.

Used code	<Function>	<Parameter>	<Terminator>
in decimal	100	52	04
in hexadecimal	64	34	04
in ASCII	"d"	"4"	EOT

This configuration can be programmed (in hexadecimal) under QBASIC, as follows :

```
comm$=CHR$(&H64)+CHR$(&H34)+CHR$(&H04)
PRINT #1, comm$;
```

☞ ***Note*** ***- Vertical mode on "XY"***

When the vertical mode XY is configurated (handly or remotely), some functions are inhibited (following table). The leds are off and the keys corresponding to the functions are inoperative (the programming is not possible).

- Trigger source on "LINE"

When the trigger source "LINE" is configurated (handly or remotely), the function "Trigger filter" is inhibited. The led is off and the keys 21 and 22 are inoperative.

Functions	Key	XY mode	Synchro line
Time base	18	Inhibited	
x 10 Expansion	12	Inhibited	
Trigger source	19/20	Inhibited	
Automatic trigger	17	Inhibited	
Trigger coupling	21/22	Inhibited	Inhibited
Peak to Peak mode	13	Inhibited	
Trigger edge	15	Inhibited	
Trigger delay	24	Inhibited	
B-TRIG	28	Inhibited	
TRACE-SEP	26/27	Inhibited	

9.5 Reading the decalibration potentiometers status

After a command "Calibration Status", the oscilloscope sends a serial of 3 messages corresponding to the status of CH1 decalibrations (36), of CH2 (31) and of timebase A (16).

To get the decalibration status, send the command :
<0x78> <0x30> <0x04>

The answer is :

Function	<Function>	<Parameter>	<Terminator>
Decalibration CH1	<0x51>	<STATUS>	<0x04>
Decalibration CH2	<0x52>	<STATUS>	<0x04>
Decalibration BDT A	<0x53>	<STATUS>	<0x04>

with STATUS = 0x30 Potentiometer in calibrated position
0x31 Potentiometer in decalibrated position

9.6 Reading the oscilloscope configuration

You can query the internal configuration of the oscilloscope at any time from the computer, by sending the «Configuration request» commands.

Response to configuration request (<0x76> <0x30> <0x04>)

Functions	<Function>	<Parameter>	<Terminator>
Writing code of a configuration	119	48	04
Vertical sensitivity CH1	96	(acc. to oscilloscope status)	04
Input coupling CH1	106	(acc. to oscilloscope status)	04
Vertical sensitivity CH2	97	(acc. to oscilloscope status)	04
Input coupling CH2	108	(acc. to oscilloscope status)	04
CH2 invert	110	(acc. to oscilloscope status)	04
Bandwidth limit	111	(acc. to oscilloscope status)	04
Time base A	98	(acc. to oscilloscope status)	04
Time base B	99	(acc. to oscilloscope status)	04
Base resynchronisation B	102	(acc. to oscilloscope status)	04
x10 expansion	113	(acc. to oscilloscope status)	04
Automatic trigger	115	(acc. to oscilloscope status)	04
Trace separate	103	(acc. to oscilloscope status)	04
Trigger filter	105	(acc. to oscilloscope status)	04
Trigger source	104	(acc. to oscilloscope status)	04
Peak to Peak mode	112	(acc. to oscilloscope status)	04
Trigger edge	114	(acc. to oscilloscope status)	04
Trigger delay	101	(acc. to oscilloscope status)	04
Vertical mode	100	(acc. to oscilloscope status)	04

Response to display configuration request (<0x9E> <0x30> <0x04>)

Functions	<Function>	<Parameter>	<Terminator>
Remote mode	159	(acc. to oscilloscope status)	04
Read-out status	160	(acc. to oscilloscope status)	04
Probe CH1	161	(acc. to oscilloscope status)	04
Probe CH2	162	(acc. to oscilloscope status)	04
Measure	163	(acc. to oscilloscope status)	04
Cursor 1 position	165	(acc. to oscilloscope status)	04
Cursor 2 position	166	(acc. to oscilloscope status)	04
Cursor 3 position	167	(acc. to oscilloscope status)	04
TV standard unity	168	(acc. to oscilloscope status)	04
TV standard hundred	169	(acc. to oscilloscope status)	04
TV line unity	170	(acc. to oscilloscope status)	04
TV line hundred	171	(acc. to oscilloscope status)	04

When the oscilloscope identifies the "Configuration request" command, it returns 19 messages to the computer, showing the configuration of the oscilloscope.

In case of "Display configuration request", it returns 12 messages to the computer.

Message structure

Each message comprises three characters, using the format described previously for commands:

<function> active function number,

<parameter> function parameter (depending on the current status of the oscilloscope),

<terminator> end of text character EOT.

The parameter values depend on the current status of the oscilloscope. The parameter value also depends on the function (the values are given in the table of configuration commands).

☞ ***Note*** ***Configuration read messages have the same format as programming commands***.

Configuration read messages can be filed (for configuration backup purposes) so that the oscilloscope can subsequently be reconfigurated (restoring the configuration).

9.7 Remote programming software

A front panel driving software and its Labwindows drivers are available optionally under reference HA 1267.

10. SUMMARY TABLES

10.1 Configuration commands

VERTICAL MODE

Function	Selection	<function>	<parameter>	<terminator>
Display mode (vertical), keys 6-8				
	CH1	100	48	04
	CH2	100	49	04
	ALT	100	50	04
	CHOP	100	51	04
	ADD	100	52	04
	XY	100	53	04
CH1 Vertical sensitivity, switch 37				
	5 V	96	48	04
	2 V	96	49	04
	1 V	96	50	04
	0.5 V	96	51	04
	0.2 V	96	52	04
	0.1 V	96	53	04
	50 mV	96	54	04
	20 mV	96	55	04
	10 mV	96	56	04
	5 mV	96	57	04
	2 mV	96	58	04
CH2 Vertical sensitivity, switch 32				
	5 V	97	48	04
	2 V	97	49	04
	1 V	97	50	04
	0.5 V	97	51	04
	0.2 V	97	52	04
	0.1 V	97	53	04
	50 mV	97	54	04
	20 mV	97	55	04
	10 mV	97	56	04
	5 mV	97	57	04
	2 mV	97	58	04
CH1 input coupling, key 35	AC	106	48	04
	DC	106	49	04
	GND	106	50	04
CH2 input coupling, key 30	AC	108	48	04
	DC	108	49	04
	GND	108	50	04
CH2 invert, key 10	CH2 normal	110	48	04
	CH2 inverted	110	49	04
CH1 probe factor	x 1	161	48	04
	x 10	161	49	04
	x 100	161	50	04
CH2 probe factor	x 1	162	48	04
	x 10	162	49	04
	x 100	162	50	04

TIME BASE

Function	Selection	<function>		<parameter>	<terminator>
Sweep speed (s/div.), switch 18		TB A	TB B		
	100 ms/div.	98	99	48	04
	50 ms/div.	98	99	49	04
	20 ms/div.	98	99	50	04
	10 ms/div.	98	99	51	04
	5 ms/div.	98	99	52	04
	2 ms/div.	98	99	53	04
	1 ms/div.	98	99	54	04
	0.5 ms/div.	98	99	55	04
	0.2 ms/div.	98	99	56	04
	0.1 ms/div.	98	99	57	04
	50 µs/div.	98	99	58	04
	20 µs/div.	98	99	59	04
	10 µs/div.	98	99	60	04
	5 µs/div.	98	99	61	04
	2 µs/div.	98	99	62	04
	1 µs/div.	98	99	63	04
	0.5 µs/div.	98	99	64	04
	0.2 µs/div.	98	99	65	04
	0.1 µs/div.	98	99	66	04
	50 ns/div.	98	99	67	04
x 10 expansion, key 12					
	x 1	113		48	04
	x 10	113		49	04

TRIGGERING

Function	Selection	<function>	<parameter>	<terminator>
Trigger source, keys 19-20				
	CH1	104	48	04
	CH2	104	49	04
	ALT	104	50	04
	LINE	104	51	04
	EXT	104	52	04
Automatic trigger, key 17				
	normal	115	48	04
	automatic	115	49	04
Trigger coupling, keys 21-22				
	DC	105	48	04
	AC	105	49	04
	LFR	105	50	04
	HFR	105	51	04
	ALL	105	52	04
	CPT	105	53	04
Peak to Peak (P-P) mode, key 13				
	normal	112	48	04
	Peak to Peak	112	49	04
Trigger edge, key 15				
	rising	114	48	04
	falling	114	49	04
TV standard (*)				
	xx00 to xx99	168	48 to 147	04
	5xx to 12xx	169	53 to 60	04
TV line (**)				
	0xx to xx99	170	48 to 147	04
	0xx to 12xx	171	48 to 60	04

Caution (*) ***TV standard selection***

When switching from a line to another (unit, hundred), do not try to enter a transient value, i. e. less than 525 or more than 1250.

(**) ***TV line number selection***

When switching from a line to another (unit, hundred), do not try to enter a transient value, more than the TV standard.

Function	Selection	<function>	<parameter>	<terminator>
Trigger delay, key 24				
	normal	101	48	04
	ALT	101	49	04
	DLY	101	50	04
Time base B resynchronisation, key 28				
	Run after delay	102	48	04
	Trig after delay	102	49	04
Trace separate, key 26 & 27				
	value	103	48 ≤ par. ≤ 63	04

AUTOSET

Function	Selection	<function>	<parameter>	<terminator>
Autoset pressed briefly, key 3		117	48	04
Bandwidth limit, keys 6 & 8				
	normal	111	48	04
	Bandwidth limit	111	49	04

DISPLAY

Function	Selection	<function>	<parameter>	<terminator>
Display activation	OFF	160	48	04
	ON	160	49	04
Measurement	OFF	163	48	04
	voltage	163	49	04
	time	163	50	04
	phase	163	51	04
Selection				
tracking cursor		164	48	04
cursor 1		164	49	04
cursor 2		164	50	04
cursor 3		164	51	04
Position				
cursor 1 vertical		165	5 to 255	04
horizontal		165	48 to 248	04
cursor 2 vertical		166	5 to 255	04
horizontal		166	48 to 248	04
cursor 3		167	5 to 255	04

MISCELLANEOUS

Function	<function>	<parameter>	<terminator>
Front panel unlocking	116	48	04
Front panel locking	116	49	04

10.2 Configuration request

CONFIGURATION REQUEST

Function	<function>	<parameter>	<terminator>
Configuration request	118	48	04
Reading decalibrations	120	48	04
Display configuration request	158	48	04

10.3 ASCII Table

ASCII CODE

B7	0	0	0	0	1	1	1	1
B6	0	0	1	1	0	0	1	1
B5	0	1	0	1	0	1	0	1

B4	B3	B2	B1	Controle		Uppercase figure		Uppercase letter		Lowercase letter	
0	0	0	0	0 **NUL** 0	10 **DLE** 16	20 **SP** 32	30 **0** 48	40 **@** 64	50 **P** 80	60 **'** 96	70 **p** 112
0	0	0	1	1 **SOH** 1	11 **DC1** 17	21 **!** 33	31 **1** 49	41 **A** 65	51 **Q** 81	61 **a** 97	71 **q** 113
0	0	1	0	2 **STX** 2	12 **DC2** 18	22 **"** 34	32 **2** 50	42 **B** 66	52 **R** 82	62 **b** 98	72 **r** 114
0	0	1	1	3 **ETX** 3	13 **DC3** 19	23 **#** 35	33 **3** 51	43 **C** 67	53 **S** 83	63 **c** 99	73 **s** 115
0	1	0	0	4 **EOT** 4	14 **DC4** 20	24 **$** 36	34 **4** 52	44 **D** 68	54 **T** 84	64 **d** 100	74 **t** 116
0	1	0	1	5 **ENQ** 5	15 **NAK** 21	25 **%** 37	35 **5** 53	45 **E** 69	55 **U** 85	65 **e** 101	75 **u** 117
0	1	1	0	6 **ACK** 6	16 **SYN** 22	26 **&** 38	36 **6** 54	46 **F** 70	56 **V** 86	66 **f** 102	76 **v** 118
0	1	1	1	7 **BEL** 7	17 **ETB** 23	27 **'** 39	37 **7** 55	47 **G** 71	57 **W** 87	67 **g** 103	77 **w** 119
1	0	0	0	8 **BS** 8	18 **CAN** 24	28 **(** 40	38 **8** 56	48 **H** 72	58 **X** 88	68 **h** 104	78 **x** 120
1	0	0	1	9 **HT** 9	19 **EM** 25	29 **)** 41	39 **9** 57	49 **I** 73	59 **Y** 89	69 **i** 105	79 **y** 121
1	0	1	0	A **LF** 10	1A **SUB** 26	2A ***** 42	3A **:** 58	4A **J** 74	5A **Z** 90	6A **j** 106	7A **z** 122
1	0	1	1	B **VT** 11	1B **ESC** 27	2B **+** 43	3B **;** 59	4B **K** 75	5B **[** 91	6B **k** 107	7B **{** 123
1	1	0	0	C **FF** 12	1C **FS** 28	2C **,** 44	3C **<** 60	4C **L** 76	5C **** 92	6C **l** 108	7C **|** 124
1	1	0	1	D **CR** 13	1D **CS** 29	2D **-** 45	3D **=** 61	4D **M** 77	5D **]** 93	6D **m** 109	7D **}** 125
1	1	1	0	E **S0** 14	1E **RS** 30	2E **.** 46	3E **>** 62	4E **N** 78	5E **^** 94	6E **n** 110	7E **~** 126
1	1	1	1	F **S1** 15	1F **US** 31	2F **/** 47	3F **?** 63	4F **O** 79	5F **_** 95	6F **o** 111	7F **DEL** 127

Hexadecimal	**XY**
Decimal	