
# Operation Manual

# TSW300TIM

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# Summary

# 1 - Introduction

The TSW300TIM is a portable equipment, easy to use, employed to map and analyze the many parameters of a telephone line. The goal is not only to qualify this line for voice traffic, but also for the many data communication applications, such as RDSI, HDSL and ADSL. It has many operation modes, described below:

- Sinusoidal generator with digitally selected level and frequency.
- Level and frequency meter, in narrow band or in wide band.
- Noise meter, with many filters such as: Psophometric, C-Message, D, E, F, G, G.SHDSL.
- SNR (signal-to-noise ratio) Meter
- Crosstalk Meter.
- Three level impulse noise Meter.
- Longitudinal Balance Meter.

## *1.1 - General Characteristics*

- High resolution graphic display
- Rechargeable batteries with external power supply
- Display monitoring of the available battery charge
- Real-time clock
- Software update through PC, with e-mail versions available
- ABS-injected plastic cabinet, with modern and ergonomic design

## *1.2 - TSW300TIM Specification*

### 1.2.1 - Signal Generator

a) Transmitter frequency:
   - Range: 100 Hz to 2MHz
   - Resolution:
     - 1Hz from 100 Hz to 999 Hz
     - 10 Hz from 1kHz to 9.99 kHz
     - 100 Hz from 10kHz to 2MHz
   - Precision: 0.01%

b) Transmitter level:
   - Range:
     - -50 dBm to +10dBm @ 600 ohms
     - -40 dBm to +16dBm @ 100, 135 e 150 ohms
   - Resolution: 0.1 dBm

- Unit: dBm, Vrms and Vpp

c) Additional transmitter functions
   - Programmable output impedance: 100, 135, 150 ohms or 600 ohms, balanced
   - Frequency resolution
   - Level resolution
   - Manual or automatic sweep mode, where the following parameters are programmable:
     - Initial Frequency
     - Final Frequency
     - Step Frequency
     - Step duration

## 1.2.2 - Level and frequency meter

a) Receiver frequency:
   - Range:
     - 100 Hz to 999 Hz,
     - 1.00kHz to 9.99kHz,
     - 10.0 kHz to 2000.0kHz
   - Resolution: 1 Hz, 10 Hz and 100 Hz, respectively
   - Precision: 0.03%

b) Receiver Level:
   - Range:
     - -70 dBm to +16 dBm @ 600 ohms (low frequency)
     - -65 dBm to+22 dBm @ 100, 135 and 150 ohms (low frequency )
     - -60 dBm to +15 dBm @ 600 ohms (wide band)
     - -55 dBm to +20 dBm @ 100, 135 and 150 ohms (wide band)
   - Resolution: 0.1 dBm

c) Additional receiver functions:
   - Programmable input impedance: 100, 135, 150 and 600 ohms, termination or bridge (parallel).

## 1.2.3 - Noise Meter

- Noise range:
  - -80 dBm to+10 dBm @ 600 ohms.
  - -65 dBm to +10 dBm @ 100, 135 and 150 ohms .
- Resolution: 0.1 dBm.
- Input impedances: 100, 135, 150 and 600 ohms and bridge (high impedance).
- Filters: LP 20kHz, LP 50 kHz, LP 245 kHz, LP 500 kHz, LP 1.1 MHz, C-Message, D, E, F, G, G.SHDSL, Psophometric.

## 1.2.4 - Signal-to-noise ratio meter (S/N)

- Transmitter: 100 to 1500000 Hz
- Noise range: -80 dBm to +10 dBm
- Resolution: 1 dB
- Filters: D, E, F, G, G.SHDSL e Psophometric.
- Input impedances: 100, 135, 150 and 600 ohms

### 1.2.5 - Crosstalk Meter

- Frequency range: 100 Hz to 8 kHz, programmable
- Frequency resolution: 1 Hz
- Bandwidth: 40 dB attenuation for ± 10% of the frequencies tuned within the range from 100 Hz to 2 kHz and ± 5% of the frequencies tuned within the range from 2 kHz to 8 kHz.
- Level: -80 dBm to +10 dBm
- Level resolution: 1 dB
- Attenuation reference: level selected at the transmitter.

### 1.2.6 - Three-level impulse noise meter

- Threshold range:-60 dBm to +8 dBm @ 600 ohms
- Threshold separation: three levels (lower, medium and upper) programmable from 1 to 5 dB in 1 dB steps
- Counters: 0 to 99999
- Timer: 1 to 99 minutes, or continuous
- Timer resolution: 1 second
- Measurement interval: 10 ms to 130 ms programmable in 5 ms steps
- Input impedances: 100, 135, 150 and 600 ohms and bridge (high impedance)
- Filters: D, E, F, G, G.SHDSL, Psophometric

### 1.2.7 - Longitudinal balance meter (optional)

- Transmitter: fixed at 0.774 Vrms (equivalent to 0 dBm using a 600 ohms impedance)
- Output impedances: 100, 135, 150 and 600 ohms
- Input impedances: 100, 135, 150 and 600 ohms and bridge (high impedance)
- Filters: E, F, G.SHDSL, G, 2 MHz
- Receiver: from 0 to +99 dBm

### 1.2.8 - Frequency Response Meter (optional)

- Test type: local (single end) or end-to-end
- Horizontal scale: 10 kHz, 50 kHz, 100 kHz, 500 kHz, 1 MHz, 1.5 MHz, 2 Mhz and

G.SHDSL (from 20 kHz to 800 kHz with 10 kHz steps)

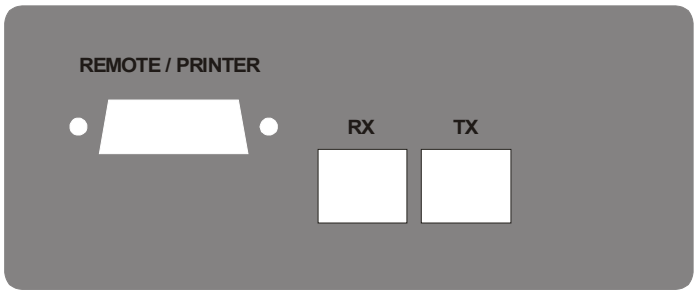
- Output impedances: 100, 135, 150 and 600 ohms
- Input impedances: 100, 135, 150 and 600 ohms and bridge (high impedance)
- Filters: E, F, G.SHDSL, G, 2 MHz

# 2 - Physical Characteristics

The TSW300TIM is a portable equipment that can be operated by a keyboard and has a liquid crystal display sporting 16 lines, each with 32 characters. It is powered by a set of internal batteries that must be charged using the appropriate charger, provided with the equipment. In the following sections, each of the equipment parts will be specified.

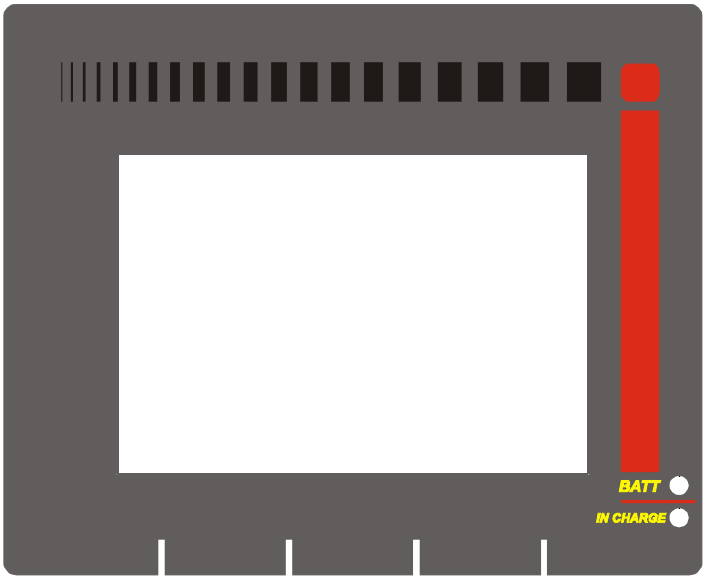
## *2.1 - External Connections*

- Battery charger: at the side of the equipment, there is a connector to plug in the provided battery charger.
- Remote/printer: a connector for serial communication with a printer or PC, located at the back panel.
- TX: a connector for the transmitter cable, which is connected to the line.
- RX: a connector for the receiver cable, which is connected to the line.



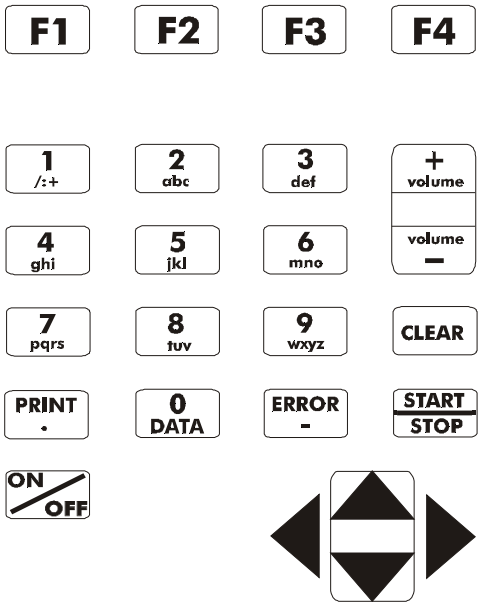

## *2.2 - Leds*

- BATT: blinks when the battery has insufficient charge to operate the equipment.
- IN CHARGE: on when the battery charger is connected. Turns red when the battery is being charged and green if it is already fully charged.




## 2.3 - Keyboard

The TSW300TIM keyboard has a variety of keys so as to ease its operation:




- ON/OFF: turns the equipment on and off.
- F1, F2, F3, F4: These keys have functions that depend on the screen that is being displayed. The function of each key is specified in a label appearing right over each one.
- ←, ↑, → e ↓: Used to move the cursors through the screen and to change the option pointed to by the cursor. By pressing simultaneously the ← and → the backlight is turned on or off.

- Volume+, volume-: Used respectively to increase or decrease the loudspeaker volume.
- START/STOP: starts or ends the impulsive noise test.
- PRINT: Sends to the printer the data stored in memory or from the last test. This option is not enabled in this equipment.
- DATA(0): According to the screen where it is pressed, enters the editing mode or then works as the numeric key 0 (zero).
- CLEAR: clears editing or activates/deactivates the QUIET function. When pressed from any screen that is not an editing screen, this key mutes the equipment transmitter.
- ERROR (-): operates as the alphanumeric key "-" (minus sign)
- Alphanumeric keys: used for editing. When editing numbers, they have the value of the number shown. When editing text, the first pressing gives the first letter shown. When pressed for a second time, they give the second letter shown. A third pressing gives the third letter shown. A fourth pressing gives the number of the key.

## *2.4 - Battery*

The TSW300TIM is fed by NiMH batteries capable of maintaining the equipment working for 5 hours (average), according to the use and to the remaining charge. The complete battery charge is achieved in approximately 6 hours. Due to the NiMH battery characteristics, to achieve the best performance, it is recommended that, once charged, the battery is used up to its minimum limit before recharging again. This procedure will allow the battery to recharge up fully and ensures the battery life as specified by its maker. It is also important to remember that even with the device off the battery suffers discharge and it is recommended to recharge it at least once a month. Keeping the battery totally discharged lowers the life-time specified.

When the internal batteries of the TSW300TIM need recharge, the equipment must be connected to the Switching Power Supply SPS-12A (input: 90 to 240 VAC / 60 Hz) by means of the battery charger input connector, at the equipment side. When the switching power supply is connected to the electric power source, a LED will go on meaning that the power supply is ready for charge.

During the battery charge, the user can know it is already fully charged or not by means of the "IN CHARGE" LED in the TSW300TIM front panel. While this LED remains red, the battery is being charged. If the LED turns green, the battery has reached its maximum limit. The TSW300TIM then keeps being charged by the charger so that after disconnection or energy failure, the batteries will have maximum charge.

If the battery is not charged up to its maximum limit, the TSW300TIM operating time will be reduced.

To avoid that the power line interferences alter test results, it is wise to avoid plugging or unplugging the battery charger from the TSW300TIM when a test is running.

The TSW300TIM has a battery manager that informs the percent of the charge remaining (see section 3). When the battery reaches its minimum level, the led marked BATT, next to the display, will blink during 20 (twenty) seconds and the beep will be turned on. After this time the equipment turns itself off. If the battery level is normal, this LED remains off.

**Note: the TSW300TIM should be charged only with the power supply provided**

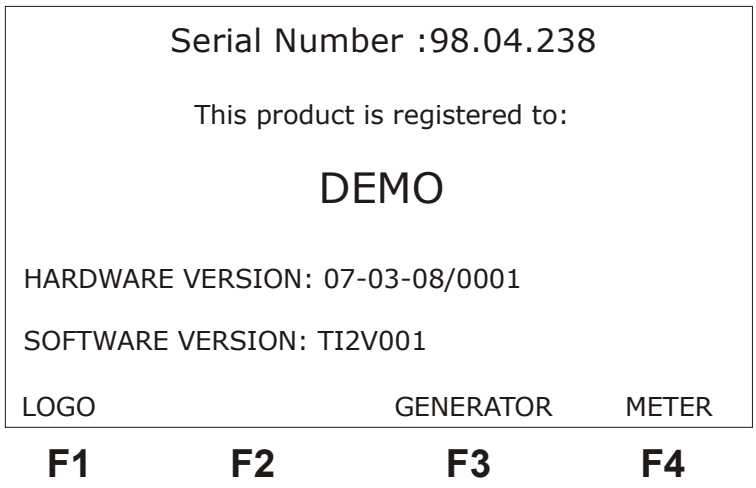
**alongside the equipment; otherwise, the maker cannot be held responsible for any damage to the equipment and to battery performance and life.**

# 3 - TSW300TIM Operation

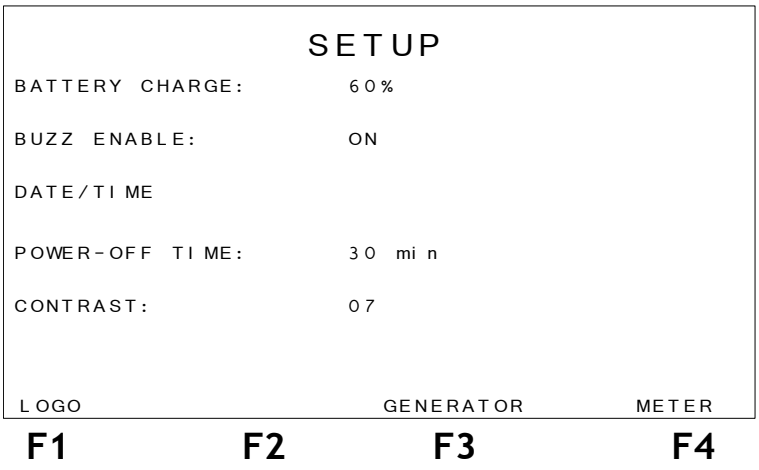
The TSW300TIM operation is very simple. When the equipment is turned on for the first time, with charged batteries, the logo screen is shown (see figures below). After the first time, if the equipment battery has not been discharged, the screen displayed is the last one displayed when the equipment was turned off.


From the logo screen three operations can be performed:

- Check the equipment register screen by pressing the F1 (REGIST) key.




- Access the configuration screen, where general parameters and some utilities can be found, from the F2 (SETUP) key.



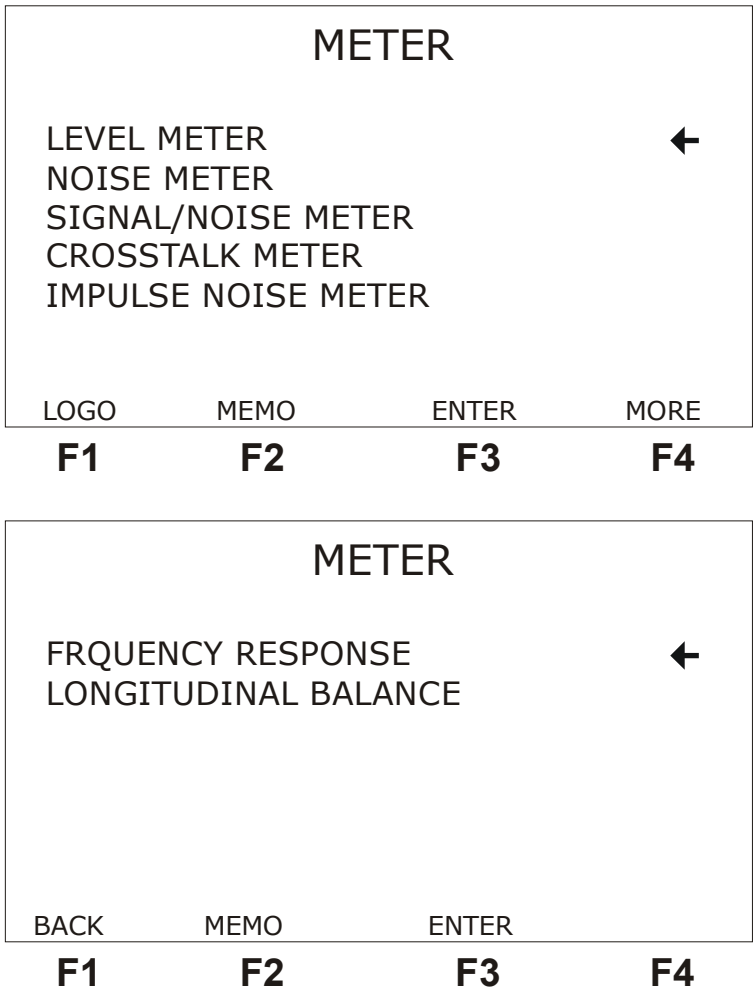

In this screen it is possible to turn on or off the beep by changing the BUZZ ENABLE parameter to ON or OFF respectively. The user can also select the time that the equipment waits to turn itself off in the POWER-OFF TIME parameter as 05, 10, 20 or 30 minutes. Another functionality of the SETUP screen is to alter the display contrast. The equipment date can be edited and the battery charge percentage is also informed.

- Choose the equipment operating mode as generator, by pressing the F3 (GENERATOR) key, or meter, by pressing the F4 (METER) key. This choice is further detailed in the following sections.

## *3.1 - Choosing the operating mode*

The TSW300TIM has many operating modes. Basically it can operate as level generator (GENERATOR) and METER (of level, noise, signal-to-noise ratio, crosstalk, impulsive noise, longitudinal balance) or both.

When choosing the GENERATOR, the generator screen will be exhibited. It is further detailed on the following section. When choosing the meter, the first of the two menu screens below will be displayed:



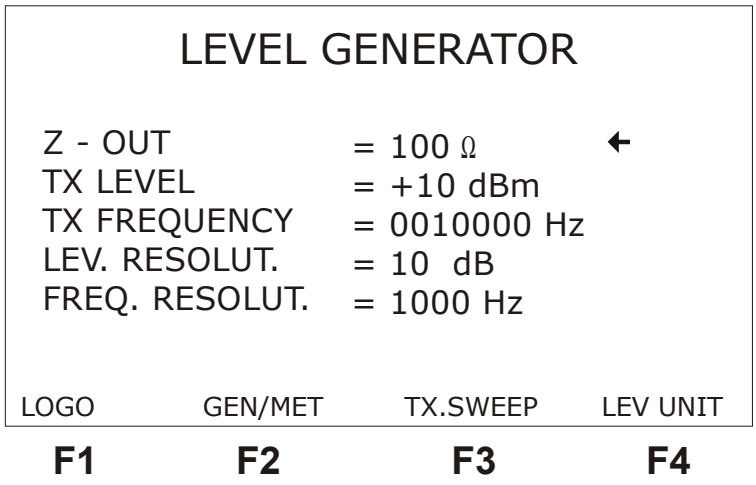

From these screens, it is possible to choose one of the modes for configuring and operating the equipment. To toggle between the screens, use the F4 (MORE) and F1 (BACK) keys.

Watch the arrow-shaped cursor at the right side of the screen. With this cursor, the equipment meter operating mode is selected. To move the cursor, use the keys ↑ and ↓ . When the cursor points to the selected mode, press F3 (ENTER). The screen for the chosen mode will be presented.

From the first meter screen, it is also possible to go back to the logo screen using the F1 (LOGO) key. Both screens allow accessing the equipment memory, by pressing F2 (MEMO). See on section 3.10 how to manage and check memory.

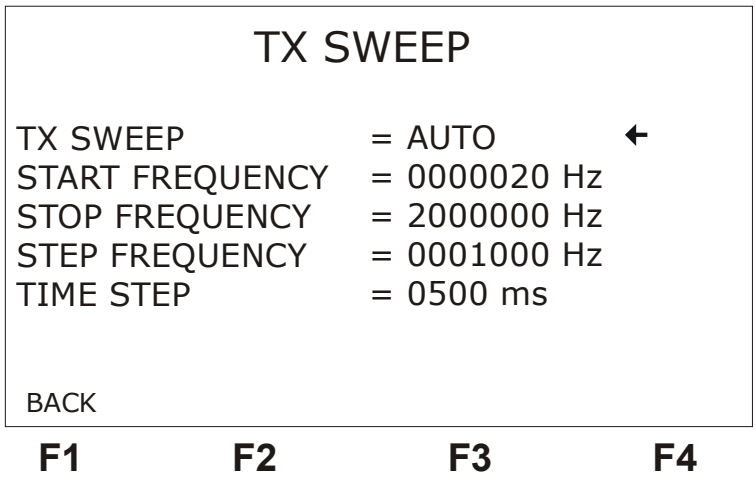
## *3.2 - The level generator*

When choosing the option GENERATOR (F3), the following screen will be shown:

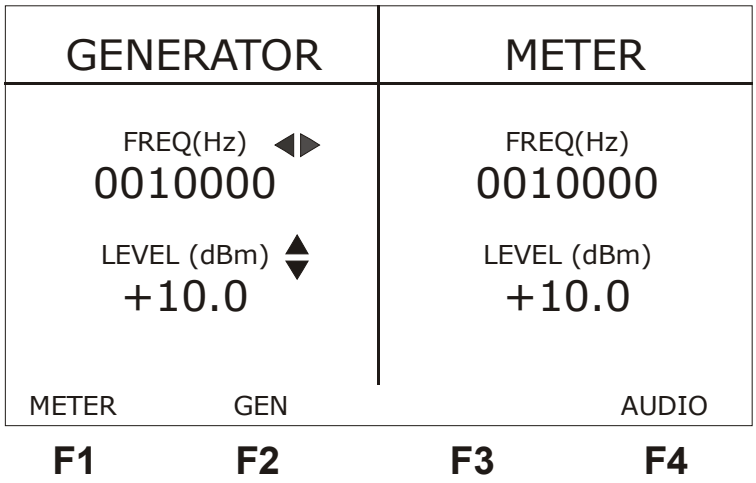



Using the ↑ and ↓ keys, it is possible to select which of the generation parameters will be changed. Some can be altered using the ← and → keys or, by editing, and some by these two ways.

It is possible to go back to the logo screen by pressing F1 (LOGO) or to visualize the next generator configuration screen - sweep parameters - by pressing F3 (TX.SWEEP). The F4 (LEV UNIT) key has the function of changing the level measurement unit among one of these options: dBm, Vrms (rms volts) and Vpp (peak-to-peak volts).




There is also the possibility of, in a single screen, have the information for generator level and frequency and the level meter. To do this, press F2 (GEN/MET).




Using the ↑ and ↓ keys the generated signal level value is modified, and with the ← and → keys the generated signal frequency value is changed. From this screen it is possible to access the generator configurator, pressing F2 (GEN). To access the meter, press F1 (METER). To turn on or off the receive audio,

use the F4 (AUDIO) key.

A description of each of the generator configuration parameters follows:

- Z-OUT: generator output impedance. It is a balanced impedance that can have one of the following levels: 100, 135, 150 or 600 ohms.
- TX LEVEL: Level of the signal to be generated. The user can choose from -50 dBm to +10 dBm, if the impedance is 600 ohms, or from -40 dBm to +16 dBm, for the other cases. Using the ← and → keys, the value is varied in steps defined by the LEV.RESOLUT parameter. To edit the value, place the cursor selecting this option and press the DATA key. Key in the value and press F4 (ENTER).
- TX FREQUENCY: Frequency of the signal to be generated by the equipment, it must be in the range 50 to 2,000,000 Hz and the choice is made by editing or using the ← and → keys. To edit place the cursor appropriately and press the DATA key. Key in the desired value and press F4 (ENTER).
- LEV.RESOLUT: defines the step of variation of the TX LEVEL parameter, when the ← and → keys are used to change it. It can vary from 0.1 dB, 0.5 dB, 1 dB and 5 dB.
- FREQ RESOLUTION: Editing this value it is possible to change the frequency variation step, from 1 to 100,000 Hz, when the ← and → keys are used to change the value of the TX FREQUENCY option.
- TX SWEEP: This functions performs a systematic sweep of the signal frequency. It is possible to disable (OFF) this capability, have it to operate manually (MANUAL) or automatically (AUTO). For the manual option, the F3 (SWEEP) key must be used for the frequency increment to occur. This screen is shown in the GEN/METER screen and in the TX SWEEP screen.
- START FREQUENCY: This option is displayed only in the TX SWEEP screen. It is the starting frequency of the TX Sweep. It can have values from 50 to 100,000 Hz.
- STOP FREQUENCY: It is the frequency in which the sweep is ended. Its range goes from the starting frequency up to 2 MHz. This option appears on the screen only if the sweep is enabled.
- STEP FREQUENCY: It is the value of the frequency increment performed at each

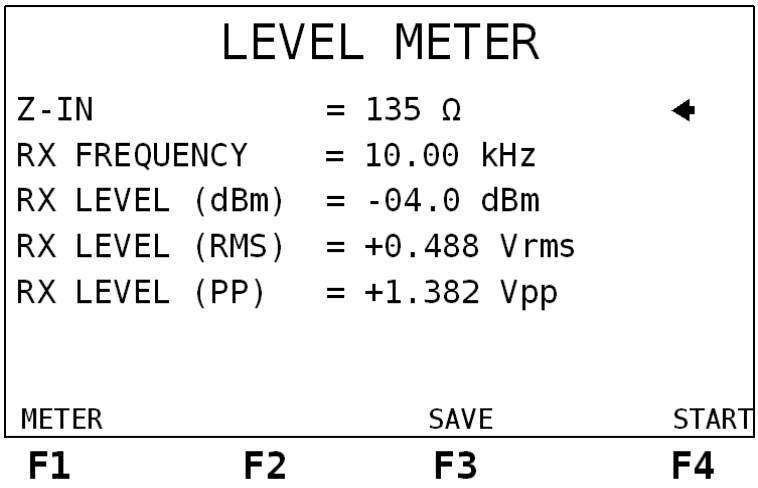
step, ranging from 20 to 100,000 Hz. This option appears on the screen only if the sweep is enabled.

- TIME STEP: Appears on the screen if the sweep is set as automatic. It is the time between each frequency change, ranging from 500 to 5000 ms.

The QUIET function can be activated from most of the TSW300TIM screens. It cannot be activated from the menu screens and from some modules that use the transmitter with preset values. When pressing the CLEAR key, the equipment transmitter is silenced and the QUIET word is written right over the function key menu. To leave the QUIET function, press the CLEAR key again or edit the transmission level in the first generator screen.

## *3.3 - The Level Meter*

When choosing the LEVEL METER option in the equipment menu, the following screen will be shown, containing information about the measurement of the received signal:




From this screen, the user can go back to the meter menu using the F1 (METER) key. To check the joint meter and generator screen, press F2 (GEN/MET) (see section 3.2 for more details on this screen). Turn on or off the audio by pressing the F4 (AUDIO) key. The F3 (SAVE) key is used to save the test in the LAST memory. When pressing it, the "CLEAR LAST MEMORY?" message is displayed. Choosing F2 (NO), the test is saved without erasing the other tests present in memory. If F3 (YES) is chosen, the test is saved, cleaning the rest of the memory. Section 3.10 details the equipment memory use.

Two configuration parameters can be changed using the ↑ and ↓ keys to place the cursor and the ← and → keys to change the selected option:

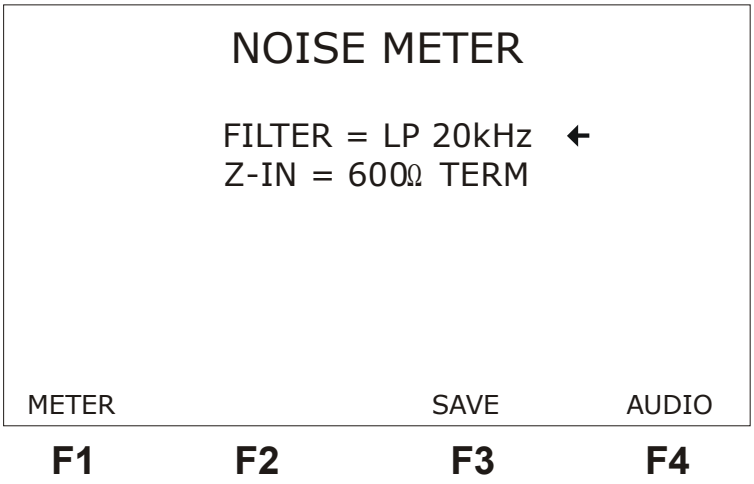
- Z-IN: meter input impedance. For a balanced impedance (BAL), it can have the following values: 100, 135, 150, 600 ohms. It can be TERM or BRIDGE. The option TERM must be used when the TSW300TIM is the only equipment at the end of the line. An appropriate impedance must be chosen so there is a correct impedance match. If there is another equipment connected to the line and with matched impedance, the TSW300TIM must be placed in parallel (or BRIDGE), so that the

measurements are performed without altering the impedance matching.

The other parameters displayed are the meter results. The level is shown in three units of measure: dBm, Vrms, Vpp.

## *3.4 - The Noise Meter*

When the chosen menu option is NOISE METER, the following screen will be shown:




This screen presents two configuration parameters and the results of measuring the noise in dBm. The user can choose the input impedance (Z-IN) and the type of filter to be used, placing the cursor by means of the ↑ and ↓ keys on the appropriate line. To choose the impedance, see section 3.3. To select the desired filter, use the ← and → keys. The TSW300TIM allows using the following filters:

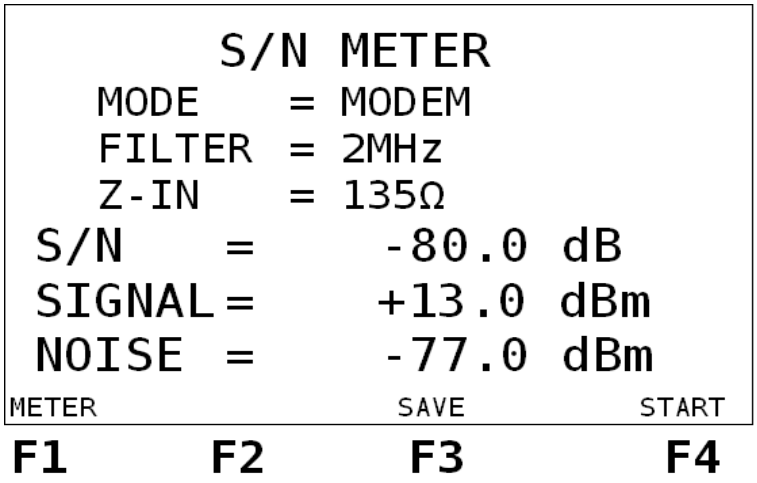
- Low-pass filters:
  - LP 20 KHz: allows frequencies from 0 to 20 kHz (audio)
  - LP 50 KHz: allows frequencies from 0 to 50 kHz (voice + RDSI)
  - LP 245 KHz: allows frequencies from 0 to 245 kHz (voice + HDSL)
  - LP 550 KHz: allows frequencies from 0 to 550 kHz (voice + G.SHDSL)
  - LP 1.1 MHz: allows frequencies from 0 to 1.1 MHz (voice + ADSL)
- Band-pass filters:
  - D Filter, allows frequencies from 300 to 3400 Hz (voice)
  - E Filter, allows frequencies from 1 to 50 kHz (RDSI)
  - F Filter, allows frequencies from 4.9 to 245 kHz (HDSL)
  - G.SHDSL Filter, allows frequencies from 10 to 550 kHz (SHDSL)
  - G Filter, allows frequencies from 20 kHz to 1.1 MHz (ADSL)
  - Psophometric Filter, allows frequencies from 500 to 2000 Hz (voice)
  - C-Message Filter, allows frequencies from 700 to 3000 Hz (voice)

To get back to the meter menu, the user has only to press the F1 (METER) key. The F3 (SAVE) key is used to save the test in the LAST memory. When pressing it, the “CLEAR LAST

MEMORY?" message is exhibited. Choosing F2 (NO), the test is saved without erasing the other tests present in that memory. Choosing F3 (YES) saves the test erasing the rest of this memory. Section 3.10 details the equipment memory use.

## *3.5 - The Signal/Noise Meter*

The TSW300TIM presents a signal-to-noise ratio meter. The following screen will be displayed when the SIGNAL/NOISE METER option is selected in the equipment menu.




In this module it is possible to run tests that show the rate between the signal power and the line noise. Three configuration options are shown for the MODE parameter: TX, RX and MODEM.

The TX and RX modes are related to each other by a synchronism protocol. In the TX mode, the TSW300TIM sends signals with sync frequencies, signal (with user-selected level and frequency) and noise.

In the RX mode, the equipment measures the signal and the noise sent by other TSW300TIM configured as TX and displays the received values. The time elapsed to complete the signal and noise measuring cycle is 16 seconds.

The MODEM mode is prepared to measure signal and noise sent by the POWER 2048 SHDSL Brazilian Parks modem in its pulsed transmission mode. The time elapsed to complete a signal and noise measurement cycle is 20 seconds.

In the RX and MODEM modes, it is possible to choose the filter and the input impedance (Z-IN) to be used. To do this, place the cursor appropriately and use the ← and → keys. The following filter options are offered:

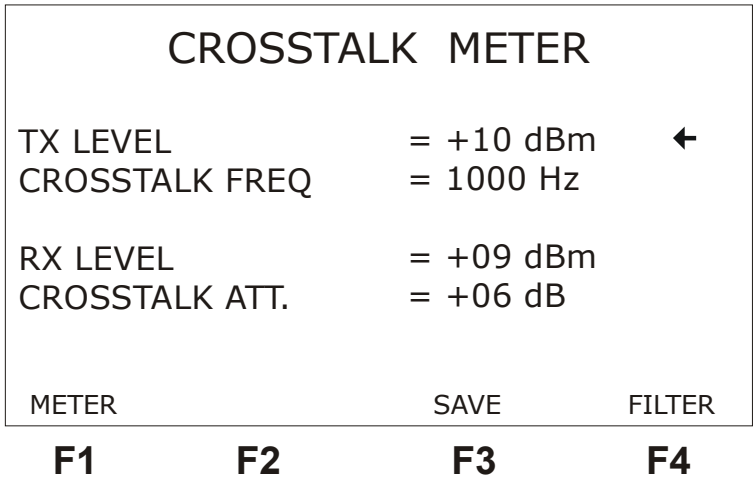
- D Filter
- E Filter
- F Filter
- G Filter
- G.SHDSL Filter
- Psophometric Filter

The signal-to-noise ratio and the signal level are presented, as the noise level.

To go back to the meter menu, press the F1 (METER) key. The F3 (SAVE) key is used to save the test in the LAST memory. When pressing it, the “CLEAR LAST MEMORY?” message is exhibited. Choosing F2 (NO), the test is saved without erasing the other tests present in that memory. Choosing F3 (YES) saves the test erasing the rest of this memory. Section 3.10 details the equipment memory use.

## *3.6 - The Crosstalk Meter*

To measure the influence of a physical wire pair over another, the TSW300TIM presents a Crosstalk meter. In this test, it is possible to generate a signal in a certain wire pair and measure the level received in another pair, evaluating if there is interference or not of one in the other. If the measured level (RX LEVEL) is close to the transmitted level (TX LEVEL), there is influence; otherwise, there isn't. Look at the screen below.




To edit the level and the frequency of the signal to be sent, place the cursor pointing to the value to be changed, use the ← and → keys and press DATA. Within the editing mode, key in the desired value and press F4 (ENTER). The level varies from -50 to +10 dBm and the frequency from 100 to 8000 Hz.

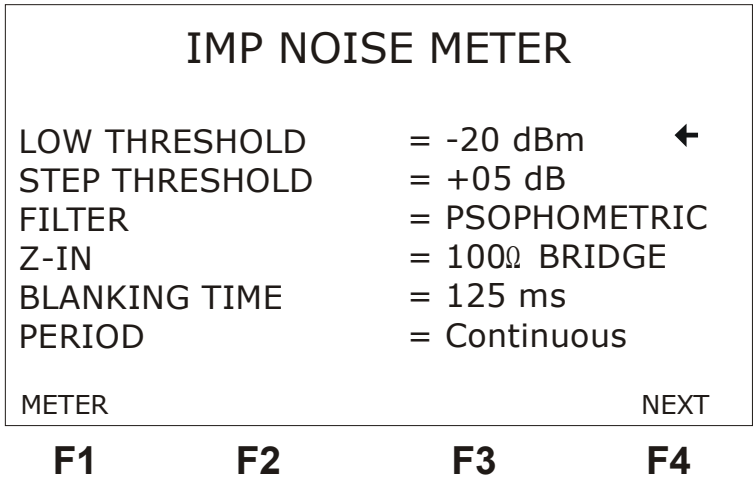
After editing the desired frequency value for the signal to be generated, press F4 (FILTER) to activate the receive filter that selects this frequency. While this key is not pressed, the results are not valid, for the filter is selecting the previous frequency.

To go back to the menu, press F1 (METER). The F3 (SAVE) key is used to save the test in the memory named LAST. When it is pressed, the message “CLEAR LAST MEMORY?” is displayed. When F2 (NO) is pressed, the test is saved without erasing the previous ones stored in memory. If F3 (YES) is pressed, the test is saved, clearing the rest of the memory. Section 3.10 details the equipment memory use.

## *3.7 - The Impulse Level Meter*

The impulse level is acquired by comparing the received noise level with three thresholds (LOW, MID, HIGH), user pre-selectable. Once it is seen that this level surpasses one of these thresholds, the corresponding counter is incremented. The acquisition also uses time windows where only one impulse is considered within each window.

When the IMPULSE NOISE METER option is selected, the following screen is displayed:

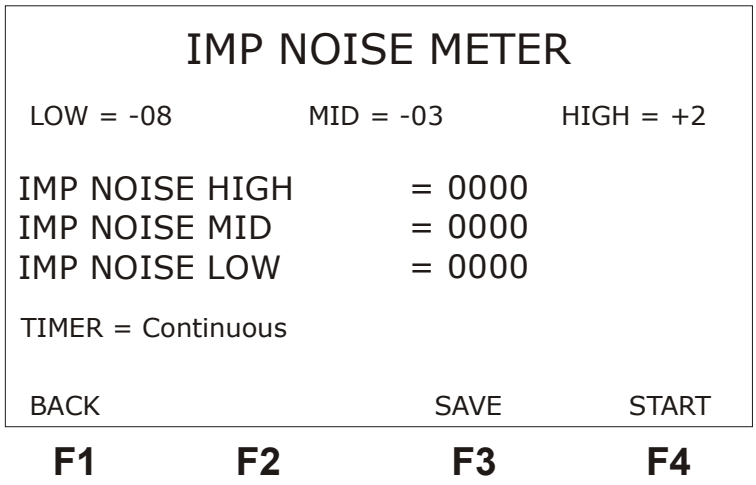



To go back to the menu, press F1 (METER).

At this screen, it is possible to choose the measurement parameters. They can be changed by using the ← and → keys when the cursor points to the desired option. Below follows the description of each parameter:

- LOW THRESHOLD: It is the lowest noise measurement level. Its lowest value is -60 dBm and its maximum depends on the next parameter: it can get up to 8 dBm when the Step Threshold is minimum.
- STEP THRESHOLD: It is the level difference for each threshold. This difference can vary from 1 to 5 dB.
- Z-IN: This option chooses which input impedance will be used by the meter.
- FILTER: Chooses which is the filter used for metering. It can be: psophometric, D, E, F, G, SHDSL, G or 2 MHz.
- BLANKING TIME: Chooses the size of the time window where the impulse will be measured. Its value can vary from 10 to 130 ms.
- PERIOD: Allows the user to choose if the test will be continuous or timer-controlled. The timer duration, in minutes, is from 01 to 99. In case the continuous test is chosen, the test time is measured and shown when the test results are printed.

After configuring these parameters, press F4 (NEXT) to display the next screen of the impulse noise meter, with the test results.

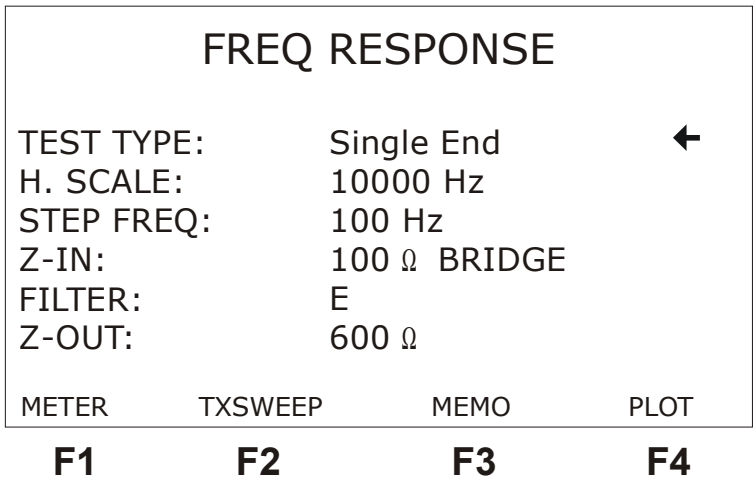



To start the test, press START or F4. Besides the selected thresholds, this screen presents the impulse counters for each level and the remaining test time.

The F3 (SAVE) key is used to save the test in the memory named LAST. When it is pressed, the message “CLEAR LAST MEMORY?” is displayed. When F2 (NO) is pressed, the test is saved without erasing the previous ones stored in memory. If F3 (YES) is pressed, the test is saved, clearing the rest of the memory. Section 3.10 details the equipment memory use.

## *3.8 - Frequency Response*

When the chosen option is FREQUENCY RESPONSE, the following screen is displayed:



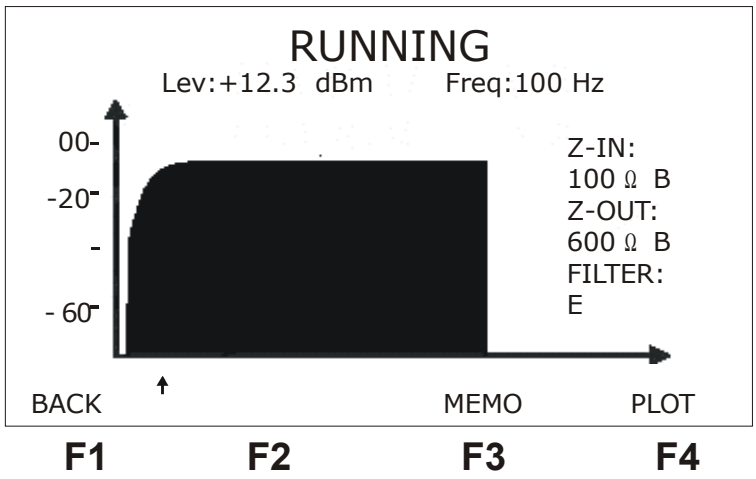

The following options are available in the configuring screen of the frequency response test:

- TEST TYPE: This options defines if the equipment will transmit and receive at the same time (Single End), if it will act as receiver (End to End Rx) or if it will only transmit (End to End Tx).
- H. SCALE (Horizontal scale): Defines the maximum frequency up to which the test will be taken.

- STEP FREQ: Defines which is the value of the frequency increment performed by the transmitter at each new iteration.
- Z-IN: Defines the receive input impedance .
- FILTER: Defines the filter used by the receiver.
- Z-OUT: Defines the transmitter output impedance.

Notes: it is interesting to note that the H.SCALE and STEP FREQ options are inter-dependent. Changing one of them affects the other. The Z-OUT option is relevant for the Single End and End to End Rx tests. The Z-IN parameter is important for the Single End and End to End Tx tests.

To start the test, press F4 (PLOT). When the chosen test is End to End Tx, the screen displays the frequency that is being transmitted at that moment. If the chosen test is End to End Rx or Single End, a screen similar to the one shown below is displayed on the next figure:




The F4 (PLOT) key allows the test to be run again. The ← and → keys move the cursor to check, in the upper part of the screen, the frequency and level values for each of the graph positions. With the ↑ and ↓ keys, the cursor is moved in 15-step positions.

When pressing the F3 (MEMO) key, the memory screen is displayed. In this screen, the graph can be stored in any of the 9 available memory positions. The date and time of the running of the test are stored too. A description of the memory operation is seen on Section 3.10 of this manual.

## *3.9 - The Longitudinal Balance Meter*

### 3.9.1 - Introdution

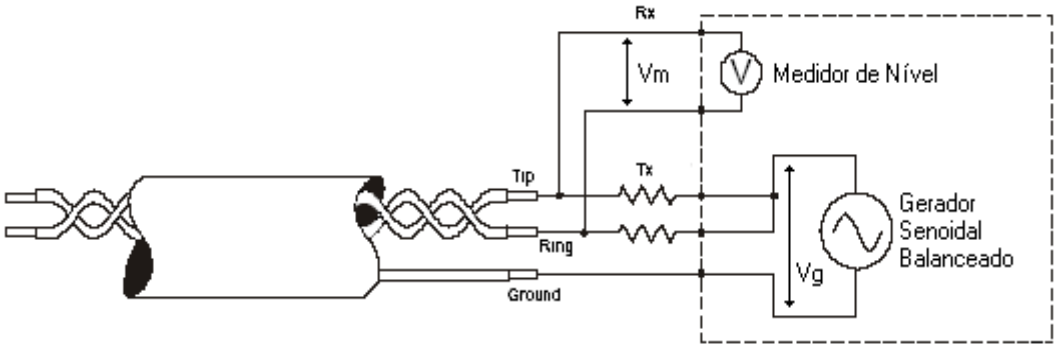
The purpose of the longitudinal balance test is to make sure the twisted pair is properly balanced. ITU-T Recommendation O.9 defines the measurement of the longitudinal balance as being the relation between the transmitted level Vg (measured between the twisted pair and the ground) and the measured level Vm (obtained between the twisted pair wires: Tip and Ring). The

longitudinal balance measure is normally expressed in dB according to the following expression:

$$BL = 20*\log(Vg/Vm)$$

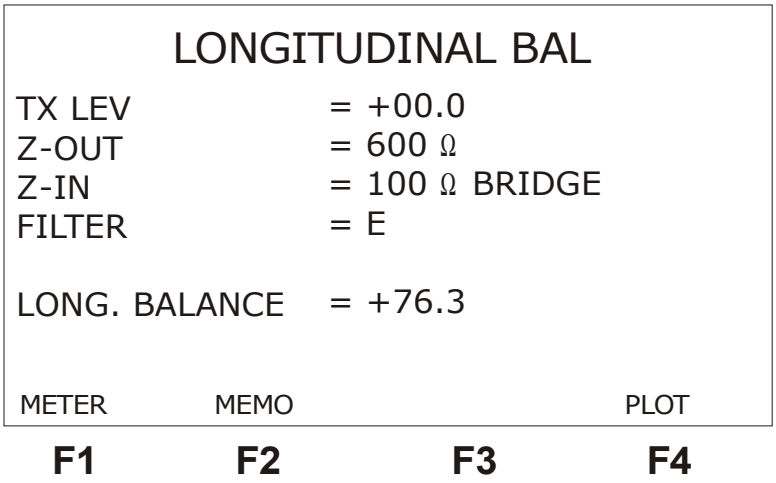
The higher the value of the longitudinal balance, the better balanced will be the twisted pair under test. The following figure illustrates how the longitudinal balance measurement should be done for a telephony cable.

For the TX cable, the three ends must be used: TIP, RING and GND (ground). For RX, only two ends need to be used: TIP and RING.




## 3.9.2 - Longitudinal Balance Test

When choosing the option LONGITUDINAL BALANCE at the METER screen, the following screen is displayed:




To go back to the menu, press F1 (METER).

To plot the longitudinal balance measure in a graph, press F4 (PLOT).

In this screen, it is possible to see the TX level, set to 0.774 Vrms. This value can not be changed. The TX and RX impedances are also displayed. It is possible to change their values to 100, 135, 150 and 600 ohms for TX and 100, 135, 150 and 600 ohms, TERM or BRIDGE for RX. The filters allowed for this test are E, F, G.SHDSL, G and 2MHz.

In this same screen, the measured value of the longitudinal balance is displayed. This

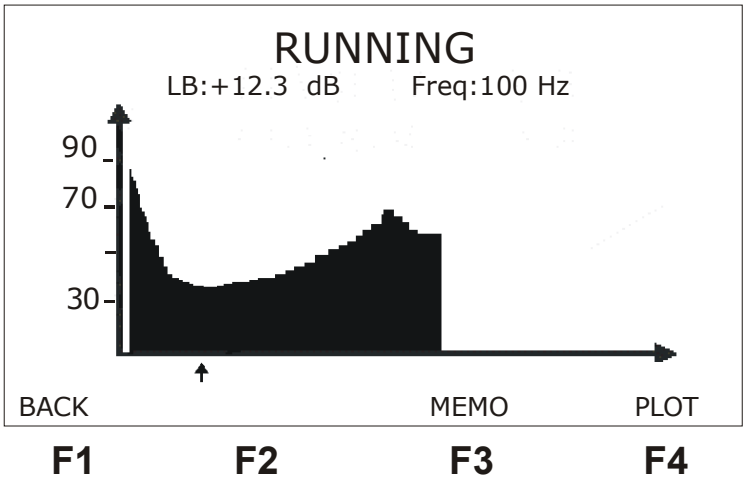
measure is done for a single frequency only, which depends on the chosen filter. The used frequency is the filter reference frequency, normally placed in the center of the filter bandpass. The reference frequencies used are:

- E filter ==> Ref. Freq. = 10 kHz
- F filter ==> Ref. Freq. = 35 kHz
- G.SHDSL filter ==> Ref. Freq. = 100 kHz
- G filter ==> Ref. Freq. = 300 kHz
- 2 MHz filter ==> Ref. Freq. = 900 kHz

If it is necessary to perform the longitudinal balance measure in a range of frequencies, it suffices to press F4 (PLOT). Immediately, the TSW300TIM starts a sweeping procedure in its transmitter. The frequency range of the transmitter depends on the filter selected by the user. The sweep ranges for each filter are:

- E filter ==> range from 100 Hz to 50 kHz in 500Hz steps
- F filter ==>range from 100 Hz to 250 kHz in 2500Hz steps
- G.SHDSL filter ==>range from 100 Hz to 550 kHz in 5 kHz steps
- G filter ==>range from 100 Hz to 1.1 MHz in 10 kHz steps
- 2 MHz filter ==>range from 100 Hz to 2 MHz in 20 kHz steps

The longitudinal balance measurements that correspond to each of the frequencies of the chosen frequency range are plotted in a frequency response graph. The screen with the longitudinal balance graph screen is displayed below.



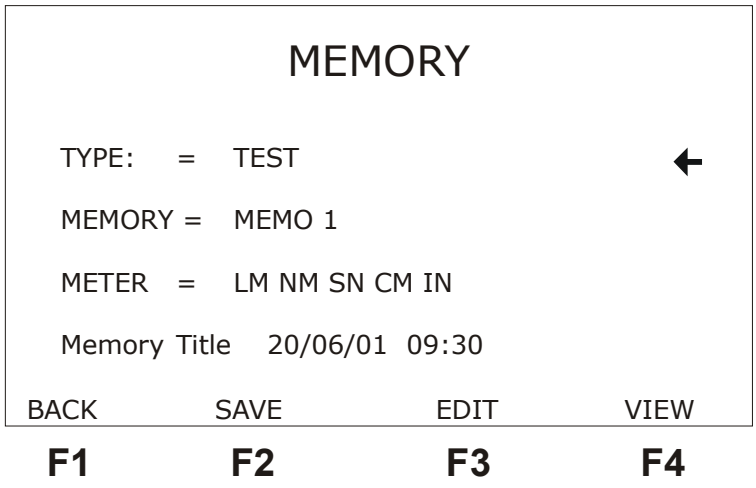

By pressing the F1 (STOP) key, the frequency sweep is interrupted. It can be restarted by pressing the F4 (PLOT) key. When the test is stopped, the user can navigate over the graph, using the cursor. Press the ← and → keys and check on the upper part of the screen the level and frequency values for each of the graph positions. With the ↑ and ↓ keys, the cursor moves 15 steps at a time.

By pressing the F3 (MEMO) key, the user gets to the memory screen. In this screen, the graph can be memorized in any of the 9 available memory positions. Date and time of the running of the test are automatically stamped. A description of the equipment memory operation is in

Section 3.10 of this manual.

## *3.10 - Memory Access*

The equipment memory is accessible from the meter menu screens or from the longitudinal balance meter and frequency response screens.




The TSW300TIM memory has 9 (nine) positions to store the graphs obtained in the longitudinal balance and frequency response and 9 (nine) other positions to store the information coming from the other meter tests. For the graphs, the last performed test is stored in position 0 (Last). For the other tests, it is necessary to save the results from each one independently, by pressing the F3 key at the screen for each mode.

The screen above presents two user-modifiable parameters used to select the memory type where data will be saved or visualized:

- TYPE: Selects if the data type comes from graphs (HISTOGRAM) or from the other meter tests (TEST).
- MEMORY: Selects LAST or the memories MEMO 1 to MEMO 9.

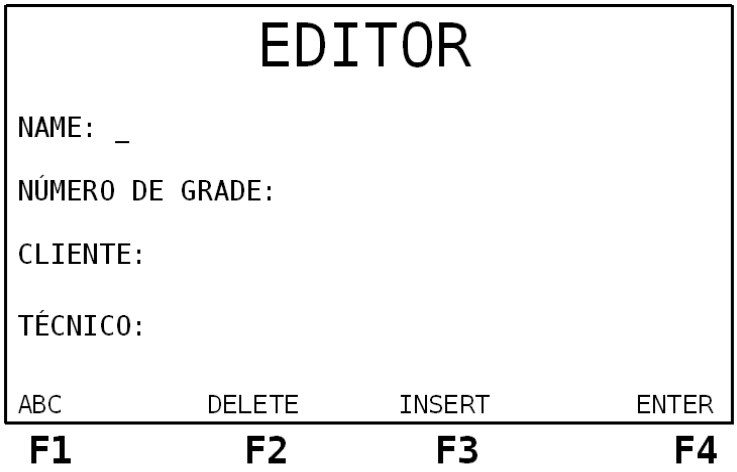
The METER parameter displays the content of the selected memory. For the histograms, it could be FREQ RESPONSE or LONGITUDINAL BAL. For the other meter tests, the following acronyms appear, meaning that the corresponding tests were stored in memory:

- LM: Level Meter
- NM: Noise Meter
- SN: Signal / Noise Meter
- CM: Crosstalk Meter
- IN: Impulsive Noise Meter

To visualize a test already stored in memory, press F4 (VIEW). If there is data in memory, the test results will be displayed, in screens similar to the test screen itself. Otherwise, the EMPTY MEMORY message will be displayed. To go back to where the memory was accessed, press F1

(BACK).

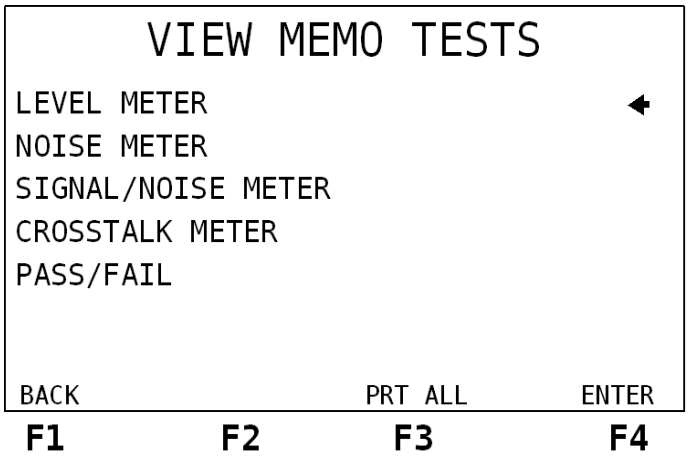
The CLEAR key erases the selected memory position. To save the last performed test in memory, select one of the memories and press F2 (SAVE). Each saved test allows editing a corresponding title: press the F3 (EDIT) key. The following screen will be displayed, where it is possible to edit the title corresponding to that memory.




In this screen, use the alphanumeric keys pressing the needed number of times for the desired letter to appear on the display. The F1 (abc/ABC/123) allows choosing among UPPER, lower caps or numbers. The F2 key deletes the character pointed to by the cursor.

The F3 key allows inserting a character to the right of the cursor position without erasing what was previously entered. The maximum number of characters for the title is 12 (twelve). When done editing, press F4 (ENTER) to return to the memory screen.

In order to view the stored data, in the memory screen push the key F4 (VIEW option), that will show the following screen. When pressing F3 (PRT ALL option) the viewed information, as well as the equipment part number, will be printed.



# 4 - TSW300TIM Applications

Some of the applications of the TSW300TIM are listed next, showing where the equipment must be connected and how the test must be performed.

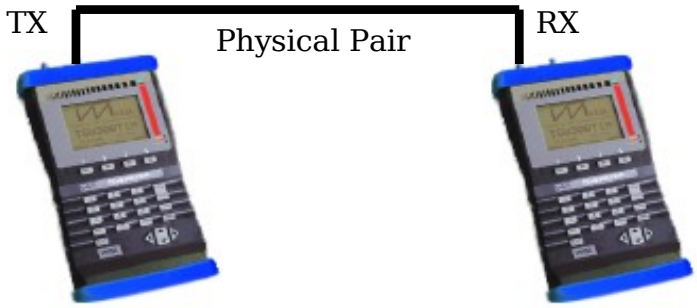
## *4.1 - Attenuation Measurement*

One of the most important applications of the TSW300TIM is to measure the signal attenuation on a telephone line. Too much attenuated signals will compromise the operation of data communication equipment. The line transmission properties are basically a function of the line attenuation, for the attenuation reduces the transmitted signal power. Line attenuation varies with the signal frequency, being directly proportional to the frequency and to the line length, that is: the higher the frequency, the bigger the attenuation and the longer the line, the bigger the attenuation. The measurements can be done over the full transmission frequency range, which will depend upon the type of service to be employed (HDSL, ADSL, etc.)

The best situation is to operate with a pair of equipments, placing each one at each end of the line under test. If there are not two TSW300TIMs available, the test can also be performed with one equipment only, as long as a loop is made on the opposite end of the line. The only drawback is that, in this case, the signal will be doubly attenuated, that is, on both ways, making it more susceptible to noise and external interference.

Some attenuation thresholds must be defined to approve the line under test. These thresholds are empirical values and only after some initial trial and error runs and after gaining knowledge of the area where the lines are located the user will set trustworthy criteria to condemn or approve a line for a certain job, considering the attenuation measurements.

Below follows a schematic diagram of how the attenuation test must be done using the TSW300TIM:




## *4.2 - Noise Measurement*

The term wideband noise describes the noise affecting a certain system throughout the whole transmission frequency range. This kind of noise is caused by adjacent wire pairs that carry digital information.

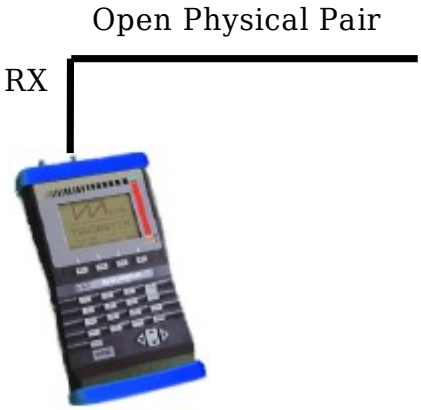
This test is normally done with the line left open, that is, at one end of the line, the TSW300TIM is connected configured in such a way so as to measure noise. The other end of the

line is left open.

The appropriate filter choice is crucial for the test. The filter must be chosen according to the application for which the line will be used. For example, consider a voice-only line. It should be measured with filters that only allow voice frequency range signals to pass through (from 300 Hz to 3400 Hz), like the psophometric, the D or the C-message filters. Similarly, for an ADSL line, it must be measured employing filters that allow signals up to 1.1 MHz to pass through. For this case, the most appropriate filters would be the G or 1.1 MHz LP filters. To sum it all up, before proceeding to perform the noise meter test, it is important that the user has a clear notion of the function of the line so he or she can select the proper filters, the best matches for the desired frequency range.

The measured values must be the lowest possible, to evidence a noiseless line. Below follows a diagram showing how the noise measuring test should be run:

| Relative deviation ($\delta = 100*\Delta/X_{med}$) - Level measure @ 600 omhs | | | | | |
|---|---|---|---|---|---|
| **Reference Level** | **100Hz – 100KHz** | **100KHz – 200KHz** | **200KHz - 300KHz** | **300KHz – 600KHz** | **600KHz – 700KHz** |
| **0dBm** | *100,0%* | *100,0%* | *100,0%* | *100,0%* | *100,0%* |
| **-25dBm** | *0,4%* | *0,4%* | *0,4%* | *1,2%* | *2,0%* |
| **-50dBm** | *0,4%* | *0,4%* | *1,0%* | *1,0%* | *1,0%* |
| **Reference Level** | **700KHz – 800KHz** | **800KHz – 900KHz** | **900KHz – 1.3MHz** | **1.3MHz – 1.7MHz** | **1.7MHz – 1.8MHz** |
| **0dBm** | *100,0%* | *100,0%* | *100,0%* | *100,0%* | *100,0%* |
| **-25dBm** | *2,0%* | *3,8%* | *3,8%* | *5,7%* | *5,7%* |
| **-50dBm** | *2,0%* | *2,0%* | *2,9%* | *3,8%* | *4,4%* |
| **Reference Level** | **1.8MHz – 1.9MHz** | **1.9MHz – 2MHz** | | | |
| **0dBm** | *100,0%* | *100,0%* | | | |
| **-25dBm** | *6,4%* | *6,4%* | | | |
| **-50dBm** | *4,4%* | *4,4%* | | | |




# 5 - Software Update

To update the equipment's software, insert or remove modules, look for UPW Operation Manual.

# 6 - Accuracy Table

| 100 ohms | Frequency | 100Hz - 500Hz | 500Hz - 100kHz | 100kHz - 500KHz | 500kHz - 1MHz | 1MHz - 1.5MHz | 1.5MHz - 2MHz |
|---|---|---|---|---|---|---|---|
| | 16dBm | 0,5 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |
| | 0dBm | 0,5 | 0,1 | 0,2 | 0,2 | 0,2 | 0,2 |
| | -20dBm | 0,3 | 0,3 | 0,3 | 0,8 | 1,2 | |
| | -40dBm | 0,6 | 0,3 | 0,9 | 1,3 | 2 | |
| 135 ohms | Frequency | 100Hz - 500Hz | 500Hz - 100kHz | 100kHz - 500KHz | 500kHz - 1MHz | 1MHz - 1.5MHz | 1.5MHz - 2MHz |
| | 16dBm | 0,4 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |
| | 0dBm | 0,4 | 0,1 | 0,3 | 0,3 | 0,3 | 0,3 |
| | -20dBm | 0,5 | 0,1 | 0,4 | 0,9 | 1,3 | 1,8 |
| | -40dBm | 0,7 | 0,3 | 0,9 | 1,4 | 2 | |
| 150 ohms | Frequency | 100Hz - 500Hz | 500Hz - 100kHz | 100kHz - 500KHz | 500kHz - 1MHz | 1MHz - 1.5MHz | 1.5MHz - 2MHz |
| | 16dBm | 0,3 | 0,2 | 0,2 | 0,2 | 0,2 | 0,2 |
| | 0dBm | 0,2 | 0,1 | 0,3 | 0,3 | 0,3 | 0,4 |
| | -20dBm | 0,5 | 0,1 | 0,5 | 1 | 1,4 | 1,9 |
| | -40dBm | 0,8 | 0,3 | 1 | 1,4 | 2,1 | |
| 600 ohms | Frequency | 100Hz - 500Hz | 500Hz - 100kHz | 100kHz - 500KHz | 500kHz - 1MHz | 1MHz - 1.5MHz | 1.5MHz - 2MHz |
| | 10dBm | 0,2 | 0,1 | 0,1 | 0,1 | 0,1 | 0,1 |
| | 0dBm | 0,4 | 0,1 | 0,4 | 0,5 | 0,5 | 0,5 |
| | -25dBm | 0,6 | 0,1 | 0,6 | 1 | 1,5 | 1,9 |
| | -50dBm | 0,6 | 0,1 | 1,5 | 1,8 | 2,7 | |