Measurements on PCS1900 Mobile Stations According to J-STD-007

Application Note 1EF22_0L

Subject to change

25 November 1996, Josef Wolf/Roland Minihold

Products:

FSE incl. Option FSE-B7

ROHDE&SCHWARZ

1 Introduction

The following application note describes the function and operation of user menus for FSE Spectrum Analyzers including option Vector Signal Analysis (FSE-B7). For measurements according to the PCS 1900 standard for Mobile Stations user menus are provided, which perform settings on FSE for the different measurements required in the standard. The menu and the accompanying setups are stored on a floppy disk.

For operation of the menus firmware version 1.40 or higher is required.

Option Vector Signal Analysis FSE-B7 has to be installed for the use of the application menu.

The floppy disk for the user menus contains the following directories:

Drive	Directory	Contents
A:\		Settings for FSE incl. limit lines

2 Installation

Operation from floppy disk

Insert the floppy disk into drive A: of the FSE.

Load the softkey menu according the following steps:

- **RECALL**: EDIT PATH: *A:*\
- SELECT ITEMS TO RECALL: ENABLE ALL ITEMS: ⇑
- DATA SET LIST: {*Select PCS_MAC in table*}: **ENTER**
- {*The filename PCS_MAC is entered into the input box*}: Press **ENTER**
- SELECT ITEMS TO RECALL: DEFAULT CONFIG

Operation from internal harddisk
(recommended, when Computer Function FSE-B15 has been installed)

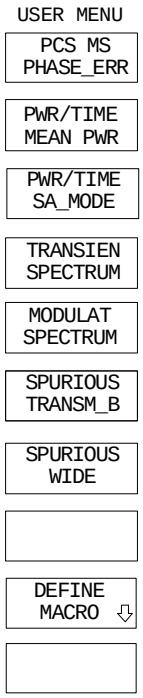
- Switch over to computer function [ALT + SysReq] on external keyboard.
- Copy the files for settings to c:\config\user directory: copy a:\ *.* c:\user\ config\

Load the softkey menu according the following steps:

- **RECALL**: EDIT PATH: *c:*\ *user* *config*\
- SELECT ITEMS TO RECALL: ENABLE ALL ITEMS: ⇑
- DATA SET LIST: {*Select PCS_MAC in table*}: **ENTER**
- {*The filename PCS_MAC is entered into the input box*}: Press **ENTER**
- SELECT ITEMS TO RECALL: DEFAULT CONFIG

Operation of the USER menu:

When pressing the USER key the following menu appears:



File for setting

PCS_PHAS

PCS_POW

PCS_PWTS

PCS_TSP

PCS_MOD

PCS_SPUN

PCS_SPUW

Each menu recalls settings for the specific measurement. When the menu is operated from floppy disk the settings are downloaded from the floppy disk in drive A. Therefore the floppy must remain in drive A: when the PCS user menu is used.

After recalling a test setting, all parameters for the measurement can be changed manually. Normally the center frequency and the level settings required will be different from the settings stored.

If settings different from the supplied values are needed, they can be updated by storing the changed settings on disk according to the following procedure:

- Recall the setting to be changed using the specific softkey in the user menu.
- Change parameters eg CENTER, REF LEVEL, MARKER, ...
  IMPORTANT:
- **SAVE**:*SELECT ITEMS TO SAVE:DISABLE ALL ITEMS:* ***ENTER***

Afterwards switch on *HW SETTINGS* and *LINES:*
HW SETTINGS: ***ENTER***
LINES: ***ENTER***

Macros may be destroyed if SELECT ITEMS TO SAVE is not set correctly.

- SAVE: {*the name for the specific file has been already entered in the input box*}: ENTER
- The new settings are stored on floppy in drive A or on internal harddisk depending on the path specified.

Warning: If changed settings are stored, the supplied default settings are lost and cannot be recovered. It is recommended to operate the FSE with a copy of the original disk.

3 Measurement of Phase Error

PCS MS
PHASE_ERR

With PCS MS the phase error versus time (PHASE_ERR) is displayed on screen A and for level adjustment the burst is displayed on screen B. The peak and rms phase error are output on screen A using the modulation marker.

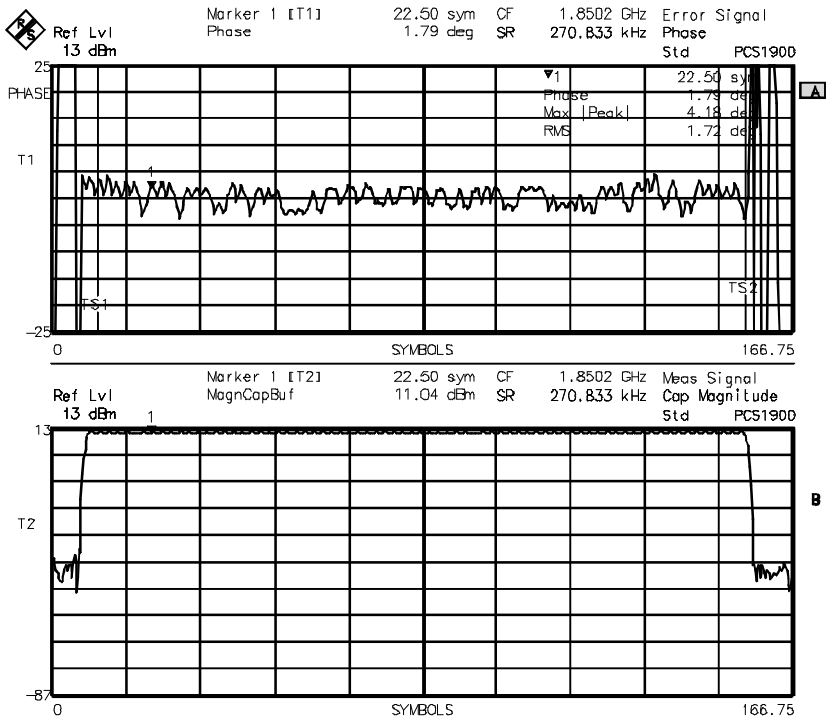


Fig 1 Display of PCS1900 phase error measurement

Following steps have to be carried out to perform the measurement:

- Set the center frequeny to the transmit channel
  [**CENTER**: {*xxxx.x*}: MHz]
- Adjust the level settings of the FSE so that the signal level is about 3 dB below reference level on screen B. [**REF LEVEL**: {*Input Ref Level = signal level + 3 dB*}: **dBm**]
  [**RANGE**: REF VALUE Y AXIS: *{ signal level*: **dBm**]
  If the signal level is too high, OVLD is output on the screen, if the signal level is too low, UNLD is displayed.
- For triggering, the midamble of the burst is used. The default setting for the midamble is PCS_BTS0. If the signal contains a different midamble, select the appropriate by [**TRIGGER**: SYNC SEQUENCE: {*select the appropriate midamble* (PCS_BTS0 to PCS_BTS7) *in table*}: **ENTER**]
  If the burst contains no midamble, switch off

synchronization to midamble
[**TRIGGER**: SYNC SEARCH OFF].

- When the reference level is set properly, screen B can be switched over to Symbol Table/Error Summary in order to get the numbered values of all modulation errors:
[**TRACE 2**: **MODE**: MEAS RESULT: SYMB TABLE/ERRORS]
To restrict the error calculation to the range of the active burst switch on Search Limit:
[**MARKER SEARCH**: SEARCH LIM ON]

4 Measurement of the Power / Time Template

The measurement of power versus time can be performed in analyzer mode (PWR/TIME SA_MODE) or in vector analyzer mode (PWR/TIME MEAN PWR).

In the analyzer mode the highest dynamic range is attained. In vector analyzer mode the FSE offers best time accuracy due to the synchronization to the midamble. With both modes, limit lines for mobile stations according to the standard are output on the screen.

4.1 Measurement in Vector Analyzer Mode/Mean Power measurement

PWR/TIME
MEAN PWR

The softkey PWR/TIME MEAN PWR recalls the settings for measurement of the mean power and of the burst timing. The FSE is switched to split-screen display. In screen A the the burst timing is shown with the limit lines according to the standard. In screen B the Symbol Table / Error Summary is output. In this way burst timing and modulation errors can be read out with a single measurement.

The mean power across the 147 useful bits can be read out by means of the Summary Marker MEAN which is displayed at the right side of screen A.

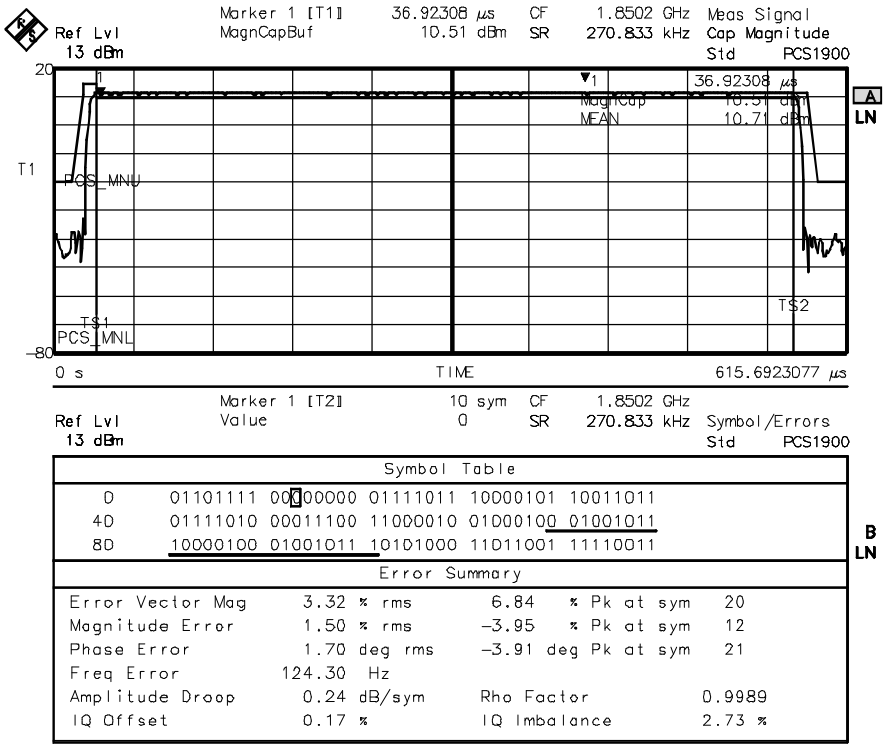


Fig 2 Display for power vs. time measurement and Mean Power in vector analyzer mode

Following steps have to be carried out to complete the settings for a specific signal:

- Set the center frequeny to the transmit channel
  [**CENTER**: {*xxxx.x*}: MHz]
- Adjust the level settings of the FSE so that signal level is about 3 dB below reference level.
  [**REF LEVEL**: {*Input Ref Level = signal level + 3 dB*}: dBm]
  If the signal level is too high, OVLD is output on screen, if the signal level is too low, UNLD is displayed.
- Adjust vertical scaling of the display
  [**RANGE**: REF VALUE Y AXIS: {*Ref Level - 3 dB*}: **ENTER**
- For triggering, the midamble of the burst is used. The default setting for the midamble is PCS_BTS0. If the signal contains a different midamble, select the appropiate by
  [**TRIGGER**: SYNC PATTERN: SELECT PATTERN: {*select the appropiate midamble* (PCS_BTS0 to PCS_BTS7) *in table*}: **ENTER**]
  If the burst contains no midamble, switch off synchronization to midamble:
  [**TRIGGER**: SYNC SEARCH OFF].

Note: If the message ´Sync not found` is output on the screen, the FSE centers the burst on the middle of the screen. The exact timing referred to the limit lines is lost in this case.

- Normally the ±1-dB tolerance on top of the limit lines does not fit to the burst level measured. The limit line can be shifted on level axis for this purpose.
  [**LIMITS**: Y OFFSET: {*Change the offset via the keypad in order to shift the limit lines; positve offset shifts the limit lines upwards, negative offset downwards*}: **ENTER]**
- Resolution of level axis can be increased by changing the Y per div value:
  [**RANGE**:Y PER DIV: {*xx*}: **dB**]

4.2 Measurement in Spectrum Analyzer Mode

In the analyzer mode the FSE attains the highest dynamic range for burst measurement. Therefore measurement can be carried out with 1-MHz resolution bandwidth. In this mode it is not possible to synchronize on data patterns within the signal. Triggering is performed via the video trigger according to the best fitting method.

PWR/TIME
SA_MODE

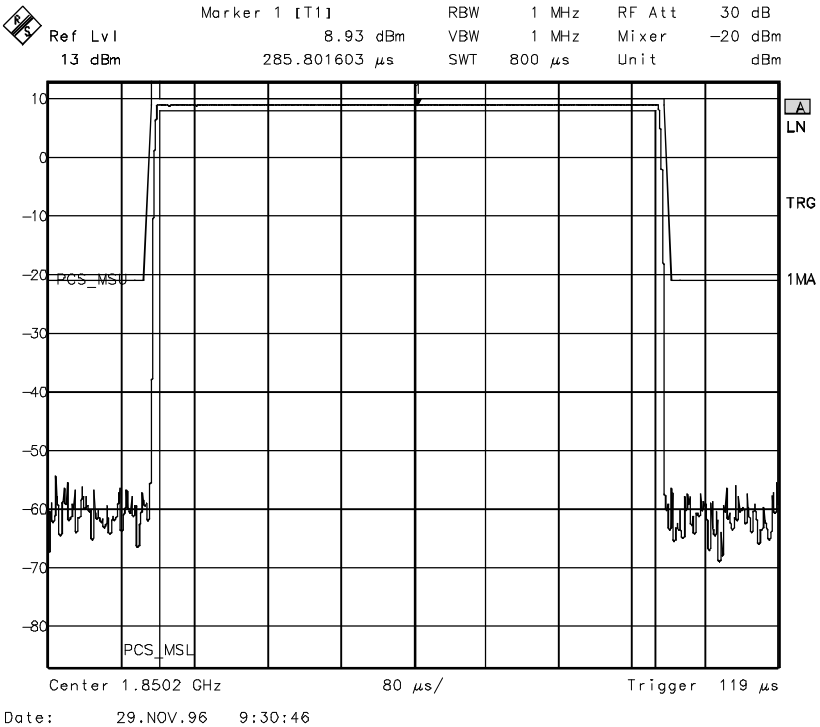


Fig. 3 Measurement of power time template in spectrum analyzer mode

Following steps have to be carried out to complete the settings for a specific signal:

- Set the center frequeny to the transmit channel
  [**TRACE1**: **CENTER**: {*xxxx.x*}: MHz]
- Set reference level to expected signal power + 3 dB
  [**TRACE1**: **REF**: {signal power + 3 dB}: **dB**]
- The settings recalled by the softkey PWR/TIME SA_MODE provide a raw triggering using the video trigger in connection with the pretrigger.
  To fit the trace measured to the limit mask first the level has to be set properly. Best procedure is to change the reference level, ie to shift the trace in the Y direction until it is in the middle of the ±1-dB limit on top of the mask.
  REF: {*Change Ref Lvl according to the mask via keypad*}: **dBm**
- To fit the limit line to the trace in the time axis the limit line has to be shifted:
  LIMITS:X OFFSET: {*Shift the limit line in the x axis using the tuning knob*}

Hint: If the trigger level causes time jitter of the burst, ie the rising ramp of the burst is not stable at the trigger level, change the trigger level.

5 Measurement of the Transient Spectrum

TRANSIEN SPECTRUM

With the softkey TRANSIEN SPECTRUM, settings for the transient spectrum test are activated. The transient spectrum is measured in analyzer mode using the bandwidth settings according to the standard. The limit in the standard is given as an absolute value (dBm). The supplied limit line is valid for all power control levels.

Center frequency and reference level have to be set according to the signal to be measured.

- Adjust center frequency: [**CENTER**: {input center frequency}: **MHz**].
- Set reference level: [**REF**: {input reference level = signal level + 3 dB}].

6 Measurement of Spectrum due to Modulation

MODULAT SPECTRUM

Spectrum due to modulation is measured using the gated sweep function. The FSE sweeps only from 50 % to 90 % of the burst. The midamble is excluded. Gating can be performed using an external gate derived from the device under test or by using the internal RF power trigger.

Note: With instruments delivered until June 96 trigger level for RF power trigger is about -4 dBm mixer level, ie always above the reference level. Instruments delivered from June 1996 have a trigger level of about -20 dBm mixer level, ie 10 dB below reference level, when -10 dBm mixer level is set. Older instrument can be modified.

With -20 dBm RF power trigger level, the use of the internel trigger is recommended as no additional means are needed to provide a trigger.

The default settings use the internal power gate. The gated sweep parameters are set correctly in this case.

When an external gate is used it has to be connected to the input TRIGGER/GATE at the rear panel of the FSE.

The settings for the gated sweep have to be adjusted according to the external gate available.

To set gate length and gate delay, zero span setting is recommended. The gate delay and the gate lengths are shown on display as vertical lines.

- Switch the span to zero: **[SPAN**: ZEROSPAN]
- Set the sample detector instead of the rms detector to overcome the minimum sweep time limit of 5 ms together with the rms detector:
  [**TRACE 1**: DETECTOR:SAMPLE]
- Set the parameters for gated sweep**:**
  [SWEEP: EXT GATE SETTINGS: GATE EXTERN: GATE LEVEL: { *input the gate level available*}: GATE MODE EDGE: GATE POL POS or NEG (depends on gate source available): GATE LENGTH: {214 µs}: GATE DELAY: {*tune the sweep time* (= time between the two vertical lines on screen) *to the 2nd*

half of a burst}: ⇑ (menu up): SPAN: LAST SPAN: **SWEEP**: EXT GATE ON]

- Switch on the RMS detector again. [**TRACE 1**: DETECTOR:RMS]

The limit line in the settings supplied is valid for all power control levels

Performing the measurement:

- Adjust center frequency: [**CENTER**: {*input center frequency*}: **MHz**].
- Set reference level: [**REF**: {*input reference level » signal level + 3 dB*}].
- To fit the limit line to the trace measured, limit line can be shifted in the Y direction by giving it an offset:
  LIMIT: Y OFFSET: {*shift limit line eg via tuning knob so that top of limit line is slightly above maximum level of trace displayed*}.

For measurement in the default setting, the rms detector is used. Spectrum analyzers which do not provide an rms detector, use the sample detector and average the trace to attain a stable test result. With the rms detector averaging is not necessary as each frequency point on the screen is the rms value of all samples represented by the point. When sweep time is increased, also the number of samples for rms calculation is increased. Generally, measurement is much faster than with the sample detector. The reason is that due to the limited number of pixels in the frequency axis with the sample detector most measurement values are discarded and only a few are displayed. Only the displayed ones are averaged.

The limited resolution of the rms detector at low levels (< -70 dB) can be overcome by averaging over different sweeps. But the number of averages needed is much lower as with the sample detector. Sliding average over 10 traces is sufficient (average sweep count = 0). The difference can be seen clearly when switching over to the sample detector
[**TRACE1**: DETECTOR: SAMPLE].

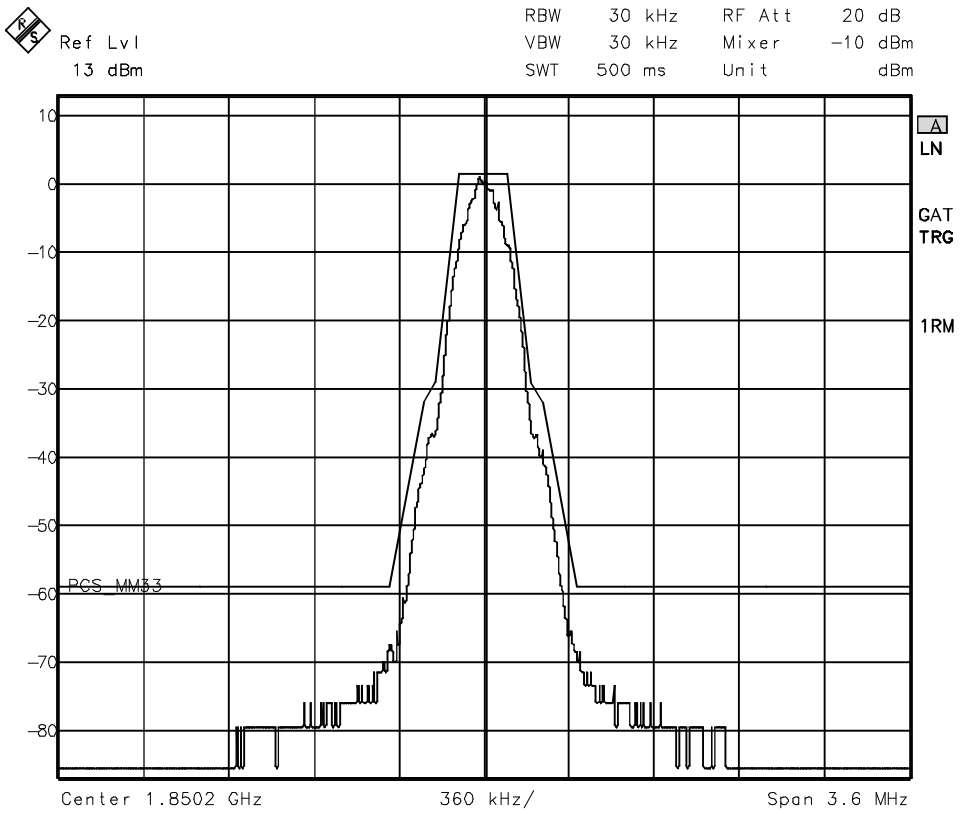


Fig 5 Spectrum due to modulation at fc ± 1.8 MHz measured with the rms detector

7 Measurement of Spurious in Transmit Band

SPURIOUS
TRANS_BD

Spurious in the transmit band have to be tested to the transmit band limits +2 MHz. Different bandwidth settings have to be used depending on the offset from carrier. From ±1.8 MHz to ±6 MHz from the carrier 30-kHz resolution bandwidth and 100-kHz video bandwidth are required according to J-STD-007. From ±6 MHz up to the band limits +2 MHz, 100-kHz resolution bandwidth and 300-kHz video bandwidth have to be used. The supplied settings use the bandwiths required from ±1.8 MHz to ±6 MHz (RBW = 30 kHz, VBW = 100 kHz).

Test procedure:

- Set reference level: [**REF**: {*input reference level » signal level + 3 dB*}].
- To fit the limit line to the transmit channel it has to be shifted in the frequency axis. In the supplied default setting it is centered in the middle of the display at 1880 MHz.
  According to the carrier to be tested an X offset has to be defined:
  LIMITS: X OFFSET: {*input appropiate X offset*}
  Example: Transmit channel 512 (=1850.2 MHz):
  Offset = 1850.2 MHz - 1880 MHz = -29.8 MHz
- The required bandwidths settings for carrier offset > 6 MHz are RBW = 100 kHz an VBW = 300 kHz.
  For measurement at carrier offsets >6 MHz set the required bandwidths:
  [**COUPLING**: RBW MANUAL: {*100*} **kHz**: VBW MANUAL: {*300*} **kHz**]

8 Measurement of Spurious in Complete Band

SPURIOUS
WIDE

Spurious have to be tested according to J-STD-007 from 100 kHz to 12.75 GHz. Different bandwidths have to be used in individual the frequency ranges as follows:

Frequency range	Resolution band-width	Video bandwidth
100 kHz to 50 MHz	10 kHz	30 kHz
50 to 500 MHz	100 kHz	300 kHz
500 to 1820 MHz	3 MHz	3 MHz
1820 to 1830 MHz	1 MHz	1 MHz
1830 to 1840 MHz	300 kHz	1 MHz
1840 to 1845 MHz	100 kHz	300 kHz
1845 to 1848 MHz	30 kHz	100 kHz
TX Band	___	—
1912 to 1915 MHz	30 kHz	100 kHz
1915 to 1920 MHz	100 kHz	300 kHz
1920 to 1930 MHz	300 kHz	1 MHz
1930 to 1990 MHz *)	1 MHz	3 MHz
1990 MHz to 12.75 GHz	3 MHz	3 MHz

*) Measurement in average mode

In default settings provided by the function SPURIOUS WIDE the FSE shows the complete frequency range (dependent on model of FSE). For the measurement, 1-MHz resolution bandwidth is used. To adopt the FSE to the different frequency bands following steps are required:

- Set start frequency and stop frequency according to the table above:
  [**START**: {*xxxx*] MHz: **STOP**: {*yyyy*} MHz].
- Set reference level: [**REF**: REF LEVEL: {*signal level + 3* dB}].
- Set RBW and VBW according to the table above: [**COUPLING**: RBW MANUAL: {*nn*} MHz : VBW MANUAL: {*mm*} MHz}]

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25 November 1996