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

Application Note 1EF24_0L

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 user menus are provided, which perform settings on FSE for Base Station testing 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: SELECT ALL ITEMS: ⇑
- DATA SET LIST: {*Select PCS_MAC in table*}: **ENTER**
- {*The filename PCS_MAC is entered into the input box*}: Press **ENTER**
- DATA SET LIST: {*Select PCS_MAC1 in table*}: **ENTER**
- {*The filename PCS_MAC1 is entered into the input box*}: Press **ENTER**
- DATA SET LIST: {*Select PCS_MAC2 in table*}: **ENTER**
- {*The filename PCS_MAC2 is entered into the input box*}: Press **ENTER**

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

- Switch over to computer function [ALT + SysReq] on external keyboard.
- Create PCS1900 directory under C.\user\config directory: *md PCS_BTS*
- Copy files to c:\user\config\PCS_BTS directory: *copy a:*.* c:\user\ config\PCS_BTS*

Load the softkey menu according the following steps:

- **RECALL**: EDIT PATH: *c:\ user \config\PCS_BTS* **ENTER**
- 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**
- DATA SET LIST: {*Select PCS_MAC1 in table*}: **ENTER**
- {*The filename PCS_MAC1 is entered into the input box*}: Press **ENTER**
- DATA SET LIST: {*Select PCS_MAC2 in table*}: **ENTER**
- {*The filename PCS_MAC2 is entered into the input box*}: Press **ENTER**

Operation of the USER menu:

When pressing the USER key the following menu appears:

USER MENU	File for setting
PCS BTS PHAS_ERR	*PCS_*PHAS
PWR/TIME MEAN PWR	*PCS_*POW
PWR/TIME SA MODE	*PCS_*PWTS
TRANSIEN SPECTRUM	*PCS_*TSP
MODULAT SPECTRUM	*PCS_*MOD
SPURIOUS TRANSM_BD	*PCS_*SPUN
SPURIOUS WIDE	*PCS_*SPUW
DEFINE MACRO ⇩	

Each menu recalls settings for the specific measrement. 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**

- **SAVE**: {*the name for the specific file has already been 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.

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

3   Measurement of Phase Error

<div style="border:1px solid #000; background:#ffff00; display:inline-block">PCS BTS PHAS_ERR</div>

With *PCS BTS PHAS_ERR* the phase error versus time 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.
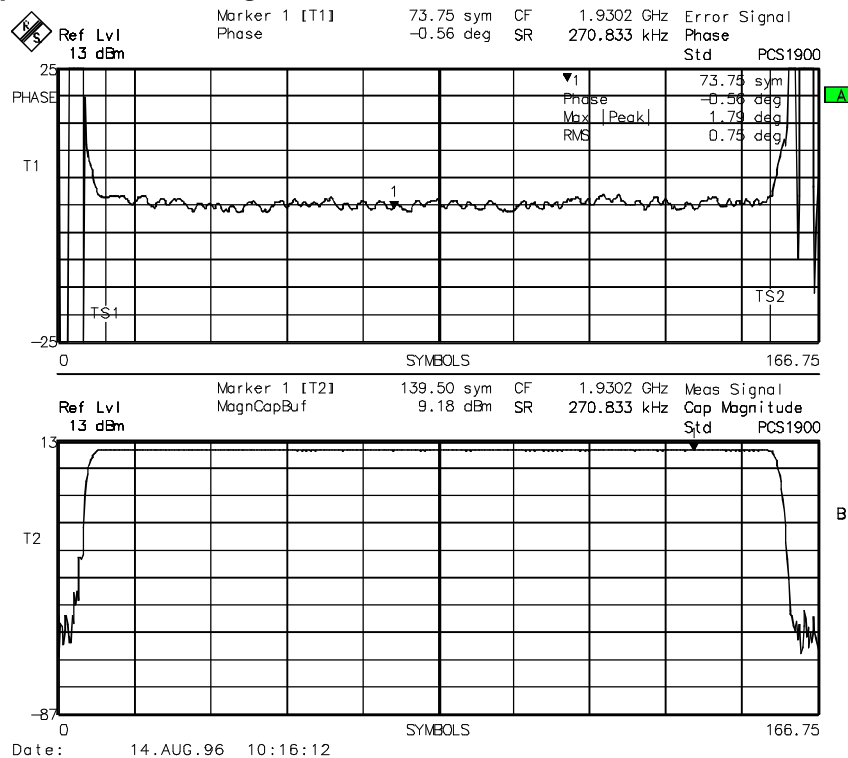

Fig 1 Display of *PCS* phase error measurement

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

- Set the center frequency to the transmit channel
   [**CENTER**: {*xxx.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]
   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 appropiate by [**TRIGGER**: SYNC SEQUENCE: {*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].

- 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].
The limits for error calculation in screen B have to be set by switching on the limit search function in the marker menu: [**MARKER SEARCH**: SEARCH LIM ON].

4 Measurement of the Power / Time Template and the Mean Power

The measurement of power versus time can be performed in analyzer mode (PWR/TIME) 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 base stations according to the standard are output on the screen.

4.1 Measurement in Vector Analyzer Mode

```
PWR/TIME
MEAN PWR
```

The softkey PWR/TIME MEAN PWR recalls the settings for measurement of the burst timing and power measurement. The FSE is switched to split screen display. In screen A 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.
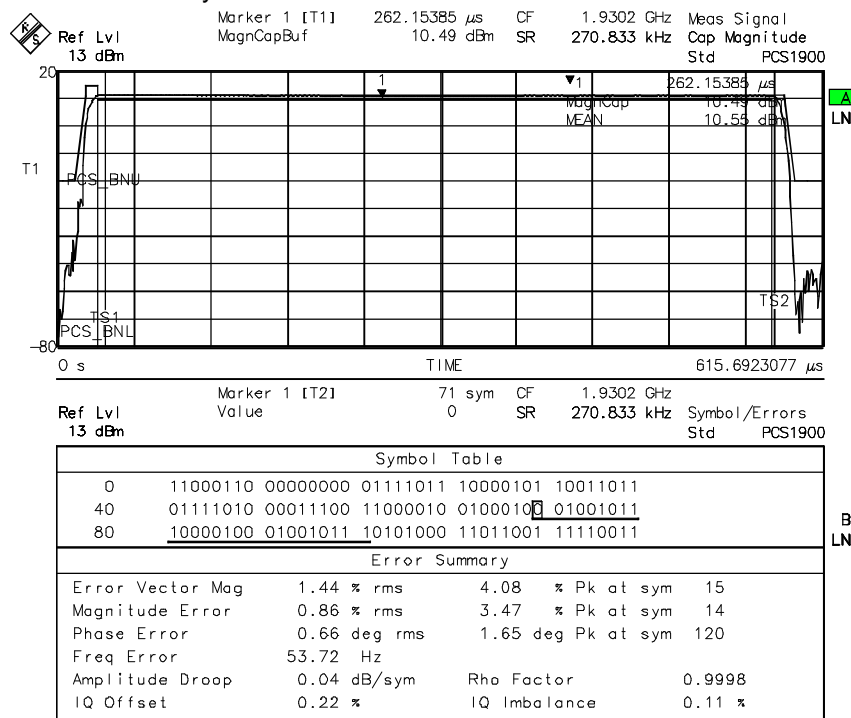
Fig 2   Display for power vs. time measurement in vector analyzer mode

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

- Set the center frequeny to the transmit channel
[**CENTER**: {*xxx.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 the signal level is too high, OVLD is

output on the screen, if 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 synchronisation 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; positive 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**]

- To check the rising slope of the burst simply change with [**MODE**:MEAS

RESULT:
RESULT LENGTH: 20 SYMBOLS:**ENTER**]

- To check the falling slope of the burst additionally set:
  [**TRIGGER**:SYNC OFFSET: -76 SYMBOLS:
  ENTER]
  [**LIMITS**:x-OFFSET:-238 µ**s**]

4.2 Measurement in Spectrum Analyzer Mode

In the analyzer mode the FSE attains the highest dynamic range for burst measurement (>85 dB). Therefore measurement can be carried out with 1-MHz resolution bandwidth. But it is not able to synchronize on data patterns within the signal. Triggering is performed via the video trigger according to the best fitting method.
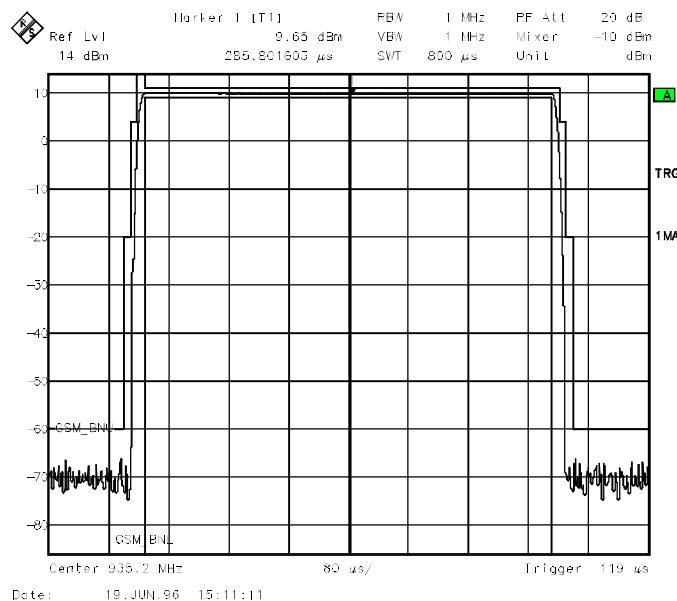
PWR/TIME

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**: {*xxx.x*}: MHz]

- Set reference level to expected signal power + 6 dB
  [**TRACE1**: **REF**: {signal power + 6 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, it may be appropiate to 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 in relative values (dB) referred to the maximum BTS peak power or as an absolute power level of -36 dBm which ever is higher. The supplied limit lines is valid for all power levels.

Performing the measurement:

- Adjust center frequency: [**CENTER**: {input center frequency}: **MHz**].

- Set reference level: [**REF**: {input reference level = signal level + 3 dB}].

  The shown spectrum should be slightly below the center of the limit line.
  Make a fine adjustment of the reference level with the knob.

- To achieve maximum noise performance it may be necessary (dependant on signal level) to overdrive the FSE by 10 db:
  [**REF**: {input reference level = old reference level - 10 dB}]

Shift Limit Line by 10 dB:
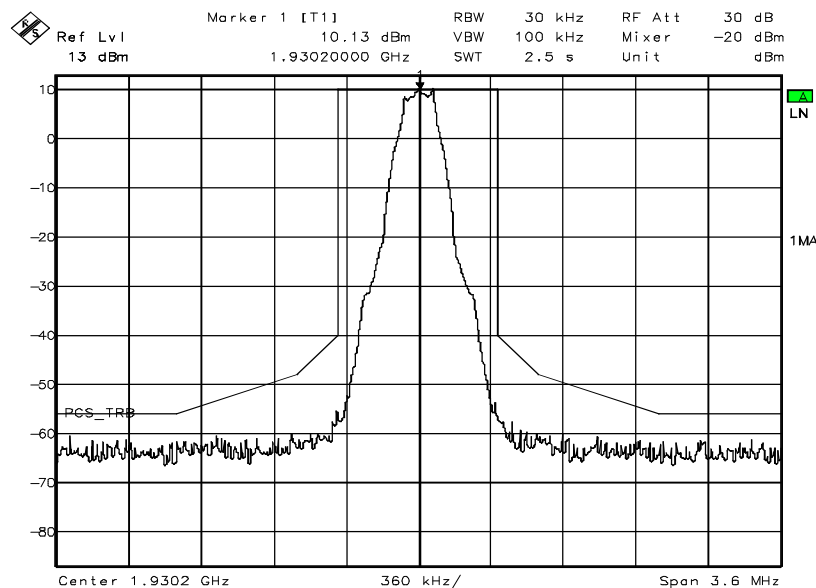[**LIMITS**:**Y_OFFSET** {old Y-OFFSET + 10 dB) dB}]

Fig 4   Display for spectrum due to transients measurement

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 provide 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 internal 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]

- Attention: With the preset RMS-Detector Sweep Time in Zero Span is limited to min. 5 ms. Set Max PK Detector when adjusting the Gate Settings: **[TRACE 1**: DETECTOR:MAX PK]

- 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 RMS Detector again: **[TRACE 1**: DETECTOR:RMS]

The limit line in the settings supplied is valid for 39 dBm output power. If the spectrum at a different power level has to be tested, the limit line can be exchanged.

- Select the appropiate limit line: [**LIMITS**: {*select the appropiate limit line from limit line table using the cursor*}: **ENTER**]. The limit line switched on is marked with √ .
  Switch off the default limit line PCS_MB39:
  [{*select the limit line PCS_MB39*}: **ENTER**]

Following limit lines are supplied for modulation spectrum:

Name	Output power level
PCS_MB43	≥43 dBm
PCS_MB41	41 dBm
PCS_MB39	39 dBm
PCS_MB37	37 dBm
PCS_MB35	35 dBm
PCS_MB33	≤33 dBm

Note: The limits are relative to the power measured with RBW 30 kHz.

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, the 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*}.

```
         Marker 1 [T1]              RBW    30 kHz    RF Att    20 dB
Ref Lvl                 -75.47 dBm  VBW    30 kHz    Mixer    -10 dBm
13 dBm           1.92840000 GHz     SWT   500 ms     Unit         dBm
```



```
Center 1.9302 GHz         360 kHz/          Span 3.6 MHz
Date:    14.AUG.96  12:22:26
```
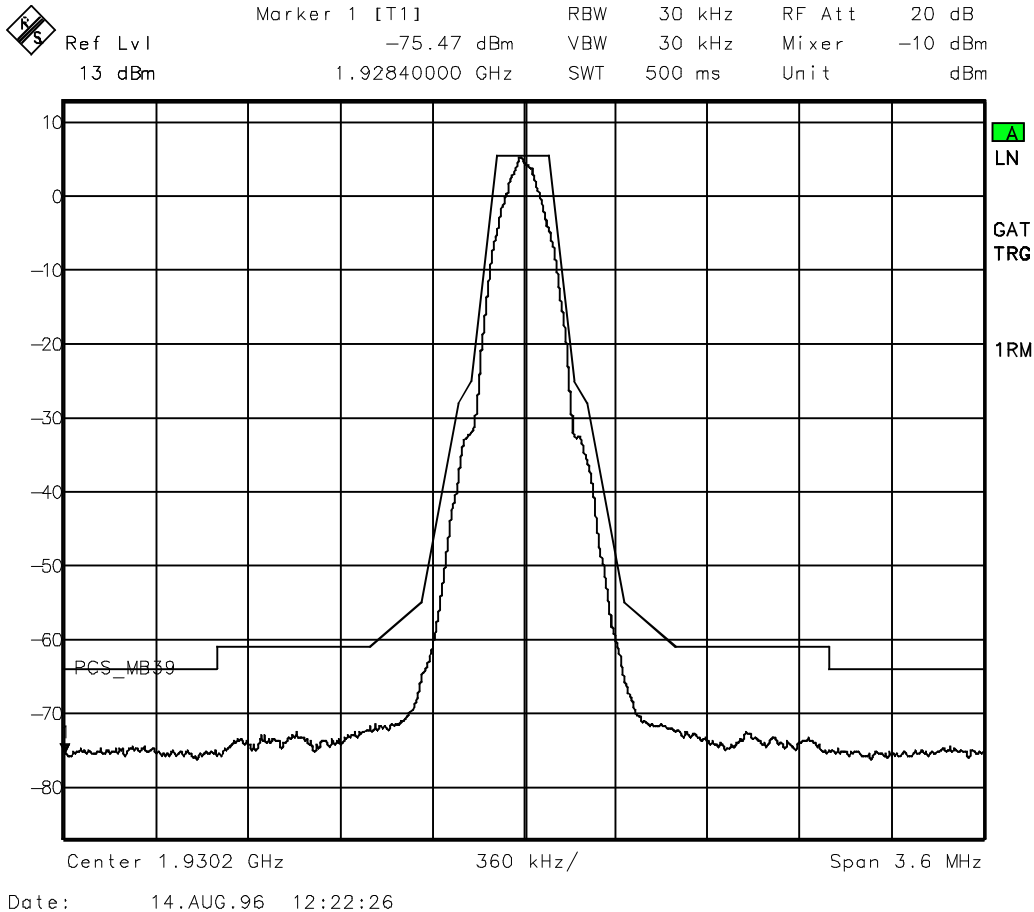
Fig 5   Spectrum due to modulation measured with the rms detector

For measurement in the default setting, the rms detector is used. For 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].

7 Measurement of Spurious in Transmit Band

```
SPURIOUS
TRANS_BD
```

Spurious in the transmit band 1930 - 1990 MHz have to be tested. Different bandwidth settings have to be used depending on the offset from the carrier.

The following settings of resolution bandwidth (RBW) and video bandwidth (VBW) dependent on carrier offset are required:

Carrier offset:	RBW	VBW
>1.8 MHz to 6 MHz:	30 kHz	100 kHz
>6 MHz up to the band limits:	100 kHz	300 kHz

The supplied settings use the bandwidths required for carrier offsets > 6 MHz (RBW = 100 kHz, VBW = 300 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 frequency axis. In the supplied default setting it is centered at channel No. 1 at 1930.2 MHz with the appropiate offset of -29.8 MHz.(= 1930.2 - center frequency: 1960 MHz)
  According to the channel to be tested a different X Offset has to be defined:
  LIMITS: X OFFSET: {*input appropiate X Offset*}
  Example: Transmit channel 810
  (1930.2 + 0.2 *(810-512)= 1989.8 MHz):
  Offset = 1989.8 MHz - center frequency: 1960 MHz = 29.8 MHz.

Set required bandwidth for carrier offset >1.8 MHz - 6 MHz:
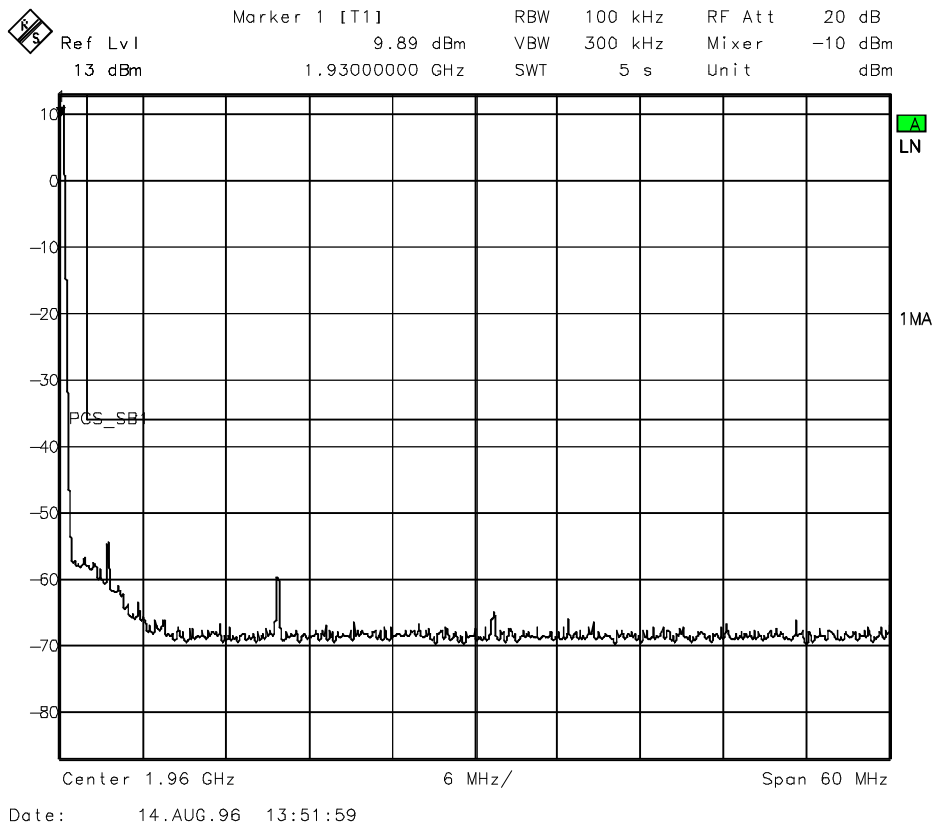[**COUPLING**: RBW MANUAL: {3*0*} **kHz**: VBW MANUAL: {1*00*} **kHz**]

Fig 6   Spurious in transmit band

8 Measurement of Spurious in Complete Band

`SPURIOUS WIDE`

Spurious have to be tested according to PCS1900
J-STD-007 from 100 kHz to 12.75 GHz. Different bandwidths have to be used in individual frequency ranges as follows:

Frequency range	RBW	VBW
100 kHz to 50 MHz	10 kHz	30 kHz
50 MHz to 500 MHz	100 kHz	300 kHz
500 MHz to 1850 MHz	3 MHz	3 MHz
1850 MHz to 1910 MHz*)	100 kHz	100 kHz
1910 to 1920 MHz	300 kHz	1 MHz
1920 MHz to 1925 MHz	100 kHz	300 kHz
1925 MHz to 1928 MHz	30 kHz	100 kHz
TX Band	__	—
1992 MHz to 1995 MHz	30 kHz	100 kHz
1995 MHz to 2000 MHz	100 kHz	300 kHz
2000 MHz to 2010 MHz	300 kHz	1 MHz
2010 MHz to 2020 MHz	1 MHz	3 MHz
2020 MHz to 12.75 GHz	3 MHz	3 MHz

*)For RX band separate setting necessary

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

- Set start frequency and stop frequency according to the table above:
  [**START**: {*xxx*} MHz: **STOP**: {*yyy*} 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}]

The limit line in the settings supplied is valid for Normal BTS. For Micro BTS separate limit lines are valid dependant on power class of the Micro BTS. The limit line can be exchanged.

- Select the appropiate limit line:
  [**LIMITS**: {*select the appropiate limit line from limit line table using the cursor*}: **ENTER**]. The limit line switched on is marked with √ .
  Switch off the default limit line PCS_SBNO: [{*select the limit line PCS_SBNO*}: **ENTER**]

Following limit lines are supplied for Spurious Wide measurement:

Name	BTS Type
PCS_SBNO	Normal BTS
PCS_SBM1	Micro BTS M1
PCS_SBM2	Micro BTS M2
PCS_SBM3	Micro BTS M3

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