Transient Measurements on GSM/PCN Synthesizers

Application Note 1EF08_1E

[replaces: 1EPAN08E (08.94)]
Subject to change

3 August 1994, 1ES3, R. Minihold

Products:

FMA, FMAB, FMB

ROHDE&SCHWARZ

Introduction

The GSM mobile phone system is the first civil radio network using purely digital transmission methods. In addition to the modulation mode GMSK (Gaussian Minimum Shift Keying) itself, both a time and a frequency multiplex method are used. This means for instance that the bits to be transmitted are distributed to several socalled *bursts* (time multiplex, **FIG. 1**). These bursts are then in turn transmitted at different frequencies in the f*requency hopping mode* (hopping mode, **FIG. 2**).

The dwell time at a frequency is 576.9 µs (156.25 bits of 3.69 µs each correspond to one slot).

In the GSM network the occupied frequency bands extend from 890 to 915 MHz and 935 to 960 MHz (transmitters of mobile and of base stations) .

In the future PCN or DCS 1800 network the transmission method is largely identical, with the following frequency bands however being occupied: 1710 to 1785 MHz and1805 to 1880 MHz (transmitters of mobile and of base stations).

Time and frequency multiplexing in RF radio link for GSM and PCN:

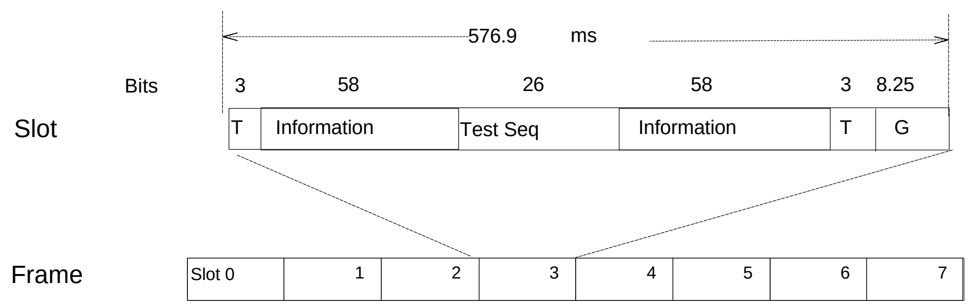

FIG. 1: Time slot and frame

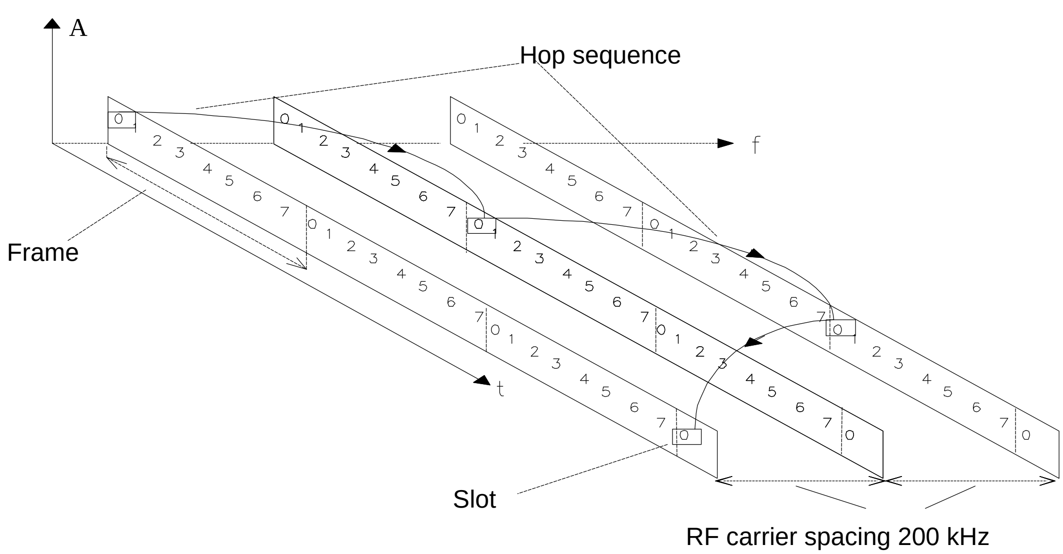

FIG. 2: Frequency hopping mode

Problem Definition

Due to the frequency hopping mode, the timing used in GSM/PCN networks and the low phase error required for correct data transmission, stringent requirements regarding the frequency transient response are placed on the synthesizers used in the base and mobile stations. For a frequency error of <100 Hz the transient response must be within approx. 100 µs to keep the residual phase error caused by the synthesizer sufficiently small.

Solution

The Modulation Analyzer FMA/FMB with its high-precision AM and FM demodulators featuring DC coupling capability is particularly suitable for an uncomplicated measurement of transient responses in conjunction with an oscilloscope. Both the FMA with its low residual FM in the **GSM band from 890 to 960 MHz** and the FMB, which in addition also covers the **PCN band from 1710 to 1880 MHz,** provide in conjunction with the fast transient response of the FM demodulator the characteristics required. Highest precision regarding the transient response is provided by the FMA/FMB's special function **"IF 300 kHz"** . (Prerequisite: firmware version 1.80 or higher).

With the "IF 300 kHz" setting, the FM demodulator exhibits a much lower DC error than in the normal setting mode "IF 1.5 MHz". The Modulation Analyzers FMA and FMB thus attain within 100 µs a frequency accuracy of better than 30 Hz.

For the measurement, only an oscilloscope (preferably a digital one) is additionally required. The DC-coupled (frequency-selective) AM demodulator supplies a voltage which is exactly proportional to the RF level and can be used as a trigger signal.

Test setup and FMA/FMAB settings:

Channel 1 of the oscilloscope is connected to the AF output, channel 2 either to the rear AM output of the FMA (level trigger) or (if available) to a trigger signal output of the DUT (see **FIG. 3**).

Settings on oscilloscope:
Time base 100 µs/divison,
Channel 1: Deflection 100 mV/division ,
Channel 2: Deflection approx. 200 mV/division

If a trigger signal (frequency switching signal) is available at the device under test (DUT), it can optionally be used as an external trigger for the oscilloscope.

Settings on FMA/FMB:

- Set the tune frequency to f_c of the DUT (in RF menu)
- Set the RF level to the level of the DUT (in RF menu)
- Select IF300 kHz (right-hand RF special menu)
- Select DC coupling for the AM output (in left-hand menu with AM demodulation mode)
- Select FM-DC demodulation mode and Fast Mute (in left-hand menu with FM demodulation mode)

  In the FastMute mode the additional processor control of the muting is disabled.

  The FM demodulator is ready for operation within a minimum of time.
- Set the FM range to 100 kHz deviation (in FM menu)
- Select Bessel lowpass filter 30 kHz (filter menu , special LP; optional Filter FMA-B1 required). The Bessel filter prevents overshoot of the FMA-AF circuit.

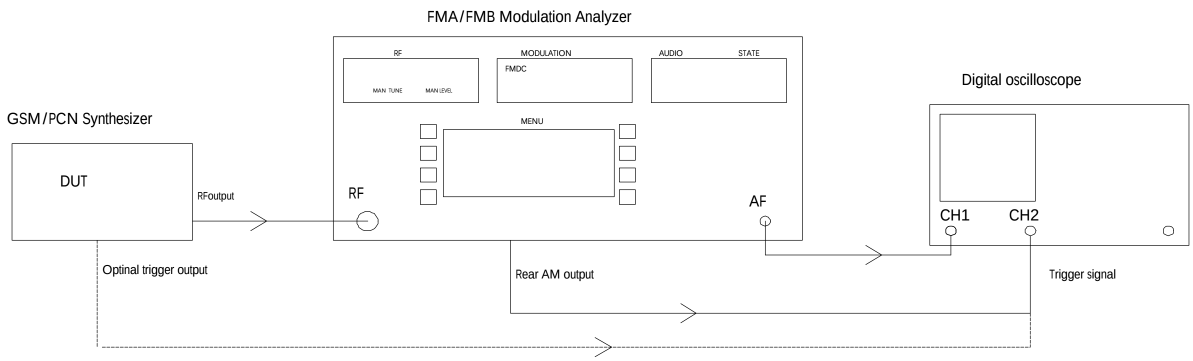

FIG. 3: Test setup for transient measurements

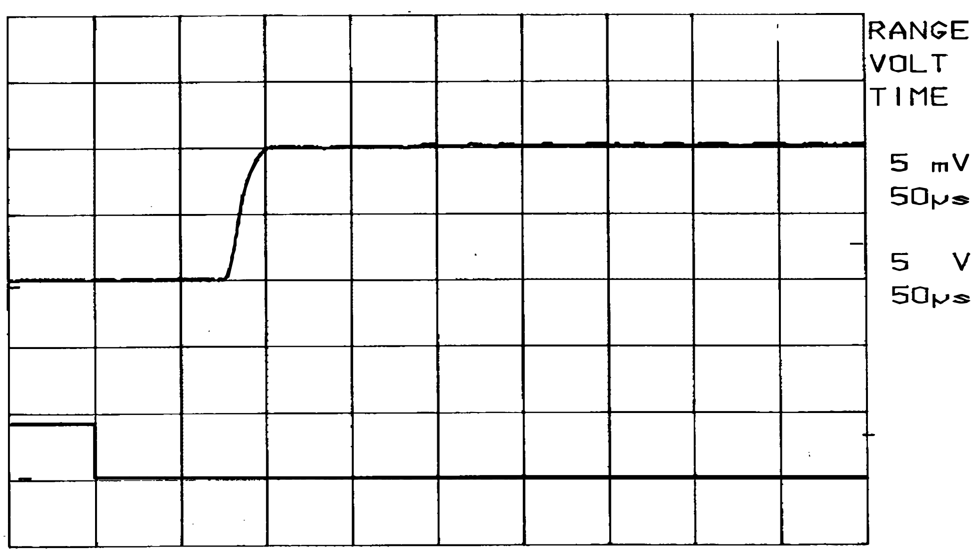

FIG. 4: Transient response of FMA/B FM demodulator

Upper curve: AF output of FMA/B
Scaling: vertical: 150 Hz/div, horizontal 50 µs/div

Starting from zero (no IF signal available), the FM demodulator reaches steady state without overshoot after approximately 100 µs. In spite of the high resolution of 150 Hz/div, the low residual FM of the FMA/B causes only minimum deflection. (This is of course also dependent of the spurious FM of the DUT!)

Lower curve: Trigger signal
(negative edge triggers frequency switchover)

ROHDE & SCHWARZ GmbH & Co. KG
Mühldorfstraße 15 , D-81671 München POB 801469 , D-81614 München
Tel +49-(0)4129-0 Fax +49-(0)89 4129-3567 Internet: http://www.rsd.de