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## 13 Transmitter

### 13.1 Frequency error and phase error

#### 13.1.1 Definition and applicability

The frequency error is the difference in frequency, after adjustment for the effect of the modulation and phase error, between the RF transmission from the MS and either:

- the RF transmission from the BS, or
- the nominal frequency for the ARFCN used.

The phase error is the difference in phase, after adjustment for the effect of the frequency error, between the RF transmission from the MS and the theoretical transmission according to the intended modulation.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS.

#### 13.1.2 Conformance requirement

1. The MS carrier frequency shall be accurate to within 0,1 ppm, or accurate to within 0,1 ppm compared to signals received from the BS. For GSM 400 MS a value of 0.2 ppm shall be used in both cases.
  - 1.1 Under normal conditions; GSM 05.10, 6.1.
  - 1.2 Under vibration conditions; GSM 05.10, 6.1; GSM 05.05, annex D D.2.3.
  - 1.3 Under extreme conditions; GSM 05.10, 6.1; GSM 05.05, 4.4; GSM 05.05, annex D D.2.1, D.2.2.
2. The RMS phase error (difference between the phase error trajectory and its linear regression on the active part of the time slot) for each burst shall not be greater than 5 degrees.
  - 2.1 Under normal conditions; GSM 05.05, 4.6.
  - 2.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 2.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
3. The maximum peak deviation during the useful part of each burst shall not be greater than 20 degrees.
  - 3.1 Under normal conditions; GSM 05.05, 4.6.
  - 3.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 3.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.

#### 13.1.3 Test purpose

1. To verify that the MS carrier frequency error does not exceed 0,1 ppm (0.2 ppm for GSM 400):
  - 1.1 Under normal conditions.
  - 1.2 When the MS is being vibrated.
  - 1.3 Under extreme conditions.

NOTE: The transmit frequency accuracy of the SS is expected to be sufficient to ensure that the difference between 0,1 ppm (0.2 ppm for GSM 400) absolute and 0,1 ppm (0.2 ppm for GSM 400) compared to signals received from the BS would be small enough to be considered insignificant.

- 2 To verify that the RMS phase error on the useful part of the bursts transmitted by the MS does not exceed conformance requirement 2:
  - 2.1 Under normal conditions.
  - 2.2 When the MS is being vibrated.
  - 2.3 Under extreme conditions.
- 3 To verify that the maximum phase error on the useful part of the bursts transmitted by the MS does not exceed conformance requirement 3.
  - 3.1 Under normal conditions.
  - 3.2 When the MS is being vibrated.
  - 3.3 Under extreme conditions.

#### 13.1.4. Method of test

NOTE: In order to measure the accuracy of the frequency and phase error a sampled measurement of the transmitted phase trajectory is obtained. This is compared with the theoretically expected phase trajectory. The regression line of the difference between the expected trajectory and the measured trajectory is an indication of the frequency error (assumed constant through the burst), whilst the departure of the phase differences from this trajectory is a measure of the phase error. The peak phase error is the value furthest from the regression line and the RMS phase error is the root mean square average of the phase error of all samples.

##### 13.1.4.1 Initial conditions

A call is set up according to the Generic call setup procedure.

The SS commands the MS to hopping mode (table 6.1).

NOTE: It is not necessary to test in hopping mode but is done here as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to make sure bursts are taken from a few different channels.

The SS activates ciphering mode.

NOTE: Ciphering mode is active during this test to give a pseudo-random bit stream to the modulator.

The SS commands the MS to complete the traffic channel loop back without signalling of erased frames (see 36.2.1.1).

The SS generates Standard Test Signal C1 of annex 5.

##### 13.1.4.2 Procedure

- a) For one transmitted burst, the SS captures the signal as a series of phase samples over the period of the burst. These samples are evenly distributed over the duration of the burst with a minimum sampling rate of  $2/T$ , where  $T$  is the modulation symbol period. The received phase trajectory is then represented by this array of at least 294 samples.
- b) The SS then calculates, from the known bit pattern and the formal definition of the modulator contained in GSM 05.04, the expected phase trajectory.
- c) From a) and b) the phase trajectory error is calculated, and a linear regression line computed through this phase trajectory error. The slope of this regression line is the frequency error of the mobile transmitter relative to the simulator reference. The difference between the regression line and the individual sample points is the phase error of that point.
  - c.1) The sampled array of at least 294 phase measurements is represented by the vector:

$$\varnothing_m = \varnothing_m(0) \dots \varnothing_m(n)$$

where the number of samples in the array  $n+1 \geq 294$ .

- c.2) The calculated array, at the corresponding sampling instants, is represented by the vector:

$$\varnothing_c = \varnothing_c(0) \dots \varnothing_c(n).$$

- c.3) The error array is represented by the vector:

$$\varnothing_e = \{\varnothing_m(0) - \varnothing_c(0)\} \dots \dots \dots \{\varnothing_m(n) - \varnothing_c(n)\} = \varnothing_e(0) \dots \varnothing_e(n).$$

- c.4) The corresponding sample numbers form a vector  $t = t(0) \dots t(n)$ .

- c.5) By regression theory the slope of the samples with respect to  $t$  is  $k$  where:

$$k = \frac{\sum_{j=0}^{j=n} t(j) * \varnothing_e(j)}{\sum_{j=0}^{j=n} t(j)^2}$$

- c.6) The frequency error is given by  $k/(360 * \gamma)$ , where  $\gamma$  is the sampling interval in s and all phase samples are measured in degrees.

- c.7) The individual phase errors from the regression line are given by:

$$\varnothing_e(j) - k * t(j).$$

- c.8) The RMS value  $\varnothing_e$  of the phase errors is given by:

$$\varnothing_e(\text{RMS}) = \left[ \frac{\sum_{j=0}^{j=n} \{\varnothing_e(j) - k * t(j)\}^2}{n+1} \right]^{1/2}$$

- d) Steps a) to c) are repeated for 20 bursts, not necessarily contiguous.
- e) The SS instructs the MS to its maximum power control level, all other conditions remaining constant. Steps a) to d) are repeated.
- f) The SS instructs the MS to the minimum power control level, all other conditions remaining constant. Steps a) to d) are repeated.
- g) The MS is hard mounted on a vibration table and vibrated at the frequency/amplitudes specified in annex 1, TC4. During the vibration steps a) to f) are repeated.

NOTE: If the call is terminated when mounting the MS to the vibration table, it will be necessary to establish the initial conditions again before repeating steps a) to f).

- h) The MS is re-positioned on the vibration table in the two orthogonal planes to the plane used in step g). For each of the orthogonal planes step g) is repeated.

- i) Steps a) to f) are repeated under extreme test conditions (see annex 1, TC2.2).

NOTE: The series of samples taken to determine the phase trajectory could also be used, with different post-processing, to determine the transmitter burst characteristics of 13.3. Although described independently, it is valid to combine the tests of 13.1 and 13.3, giving both answers from single sets of captured data.

### 13.1.5 Test requirements

#### 13.1.5.1 Frequency error

For all measured bursts, the frequency error, derived in step c.6), shall be less than 0.1 ppm, except for GSM 400 MS where a value of 0.2 ppm shall be used.

#### 13.1.5.2 Phase error

For all measured bursts, the RMS phase error, derived in step c.8), shall not exceed 5 degrees.

For all measured bursts, each individual phase error, derived in step c.7), shall not exceed 20 degrees.

## 13.2 Frequency error under multipath and interference conditions

### 13.2.1 Definition and applicability

The frequency error under multipath and interference conditions is a measure of the ability of the MS to maintain frequency synchronization with the received signal under conditions of Doppler shift, multipath reception and interference.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS.

### 13.2.2 Conformance requirement

1. The MS carrier frequency error for each burst shall be accurate to within 0,1 ppm (0.2 ppm for GSM 400), or 0,1 ppm (0.2 ppm for GSM 400) compared to signals received from the BS for signal levels down to 3 dB below the reference sensitivity level.
  - 1.1 Under normal conditions; GSM 05.10, 6/6.1.
  - 1.2 Under extreme conditions; GSM 05.10, 6/6.1; GSM 05.05 annex D D.2.1, D.2.2.
2. The MS carrier frequency error for each burst shall be accurate to within 0,1 ppm (0.2 ppm for GSM 400), or 0,1 ppm (0.2 ppm for GSM 400) compared to signals received from the BS for 3 dB less carrier to interference ratio than the reference interference ratios (GSM 05.10, 6/6.1).

### 13.2.3 Test purpose

1. To verify that the MS carrier frequency error at reference sensitivity, under conditions of multipath and Doppler shift does not exceed 0,1 ppm (0.2 ppm for GSM 400) + the frequency error due to the Doppler shift of the received signal and the assessment error in the MS.
    - 1.1 Under normal conditions.
    - 1.2 Under extreme conditions.
- NOTE: Although the conformance requirement states that frequency synchronization should be maintained for input signals 3 dB below reference sensitivity. Due to the Radio Link Failure counter this test condition cannot be established. Hence all tests in this section are conducted at reference sensitivity level.
2. To verify that the MS carrier frequency error, under interference conditions and TUlow fading profile, does not exceed 0,1 ppm (0.2 ppm for GSM 400) + the frequency error due to the Doppler shift of the received signal and the assessment error in the MS.

NOTE: The test adds the effect of Doppler shift to the requirements as the conformance requirement refers to signals input to the MS receiver whereas the frequency reference for measurement will not take account of the Doppler shift.

### 13.2.4 Method of test

This test uses the same measurement process as test 13.1 for the MS operating under various RF conditions.

NOTE: The BA list sent on the BCCH and the SACCH will indicate at least six surrounding cells with at least one near to each band edge. It is not necessary to generate any of these BCCH but if they are provided none will be within 5 channels of the ARFCN used for the serving BCCH or TCH.

#### 13.2.4.1 Initial conditions

The MS is brought into the idle updated state on a serving cell with BCCH in the mid ARFCN range.

#### 13.2.4.2 Procedure

- a) The level of the serving cell BCCH is set to 10 dB above the reference sensitivity level( ) and the fading function set to RA. The SS waits 30 s for the MS to stabilize to these conditions. The SS is set up to capture the first burst transmitted by the MS during call establishment. A call is initiated by the SS on a channel in the mid ARFCN range as described for the generic call set up procedure but to a TCH at level 10 dB above the reference sensitivity level( ) and fading function set to RA.
- b) The SS calculates the frequency accuracy of the captured burst as described in test 13.1.
- c) The SS sets the serving cell BCCH and TCH to the reference sensitivity level( ) applicable to the type of MS, still with the fading function set to RA and then waits 30 s for the MS to stabilize to these conditions.
- d) The SS shall capture subsequent bursts from the traffic channel in the manner described in test 13.1.

NOTE: Due to the very low signal level at the MS receiver input the MS receiver is liable to error. The "looped back" bits are therefore also liable to error, and hence the SS does not know the expected bit sequence. The SS will have to demodulate the received signal to derive (error free) the transmitter burst bit pattern. Using this bit pattern the SS can calculate the expected phase trajectory according to the definition within GSM 05.04.

- e) The SS calculates the frequency accuracy of the captured burst as described in test 13.1.
- f) Steps d) and e) are repeated for 5 traffic channel bursts spaced over a period of not less than 20 s.
- g) The initial conditions are established again and steps a) to f) are repeated but with the fading function set to HT100 (HT200 for GSM 400).
- h) The initial conditions are established again and steps a) to f) are repeated but with the fading function set to TU50 (TU100 for GSM 400).
- i) The initial conditions are established again and steps a) and b) are repeated but with the following differences:
  - the levels of the BCCH and TCH are set to 18 dB above reference sensitivity level( ).
  - two further independent interfering signals are sent on the same nominal carrier frequency as the BCCH and TCH and at a level 10 dB below the level of the TCH and modulated with random data, including the midamble.
  - the fading function for all channels is set to TULow.
- j) The SS waits 100 s for the MS to stabilize to these conditions.
- k) Repeat steps d) to f), except that at step f) the measurement period must be extended to 200 s and the number of measurements increased to 20.
- l) The initial conditions are established again and steps a) to k) are repeated for ARFCN in the Low ARFCN range.
- m) The initial conditions are established again and steps a) to k) are repeated for ARFCN in the High ARFCN range.
- n) Repeat step h) under extreme test conditions (see annex 1, TC2.2).

### 13.2.5 Test requirements

The frequency error, with reference to the SS carrier frequency as measured in repeats of step e), for each measured burst shall be less than the values shown in tables 13-1a and 13-1b.

**Table 13-1a: Requirements for frequency error under multipath, Doppler shift and interference conditions**

GSM 900		DCS 1 800	
Propagation condition	Permitted frequency error	Propagation condition	Permitted frequency error
RA250	+/- 300 Hz	RA130	+/- 400 Hz
HT100	+/- 180 Hz	HT100	+/- 350 Hz
TU50	+/- 160 Hz	TU50	+/- 260 Hz
TU3	+/- 230 Hz	TU1,5	+/- 320 Hz

**Table 13-1b: Requirements for frequency error under multipath, Doppler shift and interference conditions**

GSM 450		GSM 480	
Propagation condition	Permitted frequency error	Propagation condition	Permitted frequency error
RA500	+/- 300 Hz	RA500	+/- 300 Hz
HT200	+/- 180 Hz	HT200	+/- 180 Hz
TU100	+/- 160 Hz	TU100	+/- 160 Hz
TU6	+/- 230 Hz	TU6	+/- 230 Hz

## 13.3 Transmitter output power and burst timing

### 13.3.1 Definition and applicability

The transmitter output power is the average value of the power delivered to an artificial antenna or radiated by the MS and its integral antenna, over the time that the useful information bits of one burst are transmitted.

The transmit burst timing is the envelope of the RF power transmitted with respect to time. The timings are referenced to the transition from bit 13 to bit 14 of the Training Sequence ("midamble") before differential decoding. The timing of the modulation is referenced to the timing of the received signal from the SS.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS.

### 13.3.2 Conformance requirement

1. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2 dB under normal conditions; GSM 05.05, 4.1.1, first table.
2. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2,5 dB under extreme conditions; GSM 05.05, 4.1.1, first table; GSM 05.05 annex D D.2.1, D.2.2.
3. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, second table (for GSM 400 and GSM 900) or third table (for DCS 1 800), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 1), with a tolerance of +/- 3, 4 or 5 dB under normal conditions; GSM 05.05, 4.1.1, second or third table.
4. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, second table (for GSM 400 and GSM 900) or third table (for DCS 1 800), from the lowest power control level up to the maximum

output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 2), with a tolerance of +/- 4, 5 or 6 dB under extreme conditions; GSM 05.05, 4.1.1, second or third table; GSM 05.05 annex D D.2.1, D.2.2.

5. The output power actually transmitted by the MS at consecutive power control levels shall form a monotonic sequence and the interval between power control levels shall be 2 +/- 1,5 dB; GSM 05.05, 4.1.1.
6. The transmitted power level relative to time for a normal burst shall be within the power/time template given in GSM 05.05, annex B top figure:
  - 6.1 Under normal conditions; GSM 05.05, 4.5.2..
  - 6.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.
7. When accessing a cell on the RACH and before receiving the first power command during a communication on a DCCH or TCH (after an IMMEDIATE ASSIGNMENT), all GSM and class 2 DCS 1 800 MS shall use the power control level defined by the MS\_TXPWR\_MAX\_CCH parameter broadcast on the BCCH of the cell, or if MS\_TXPWR\_MAX\_CCH corresponds to a power control level not supported by the MS as defined by its power class, the MS shall act as though the closest supported power control level had been broadcast. A Class 3 DCS 1 800 MS shall use the POWER\_OFFSET parameter.
8. The transmissions from the MS to the BS, measured at the MS antenna, shall be 468,75 - TA bit periods behind the transmissions received from the BS, where TA is the last timing advance received from the current serving BS. The tolerance on these timings shall be +/- 1 bit period:
  - 8.1 Under normal conditions; GSM 05.10, 6.4.
  - 8.2 Under extreme conditions; GSM 05.10, 6.4, GSM 05.05 annex D D.2.1, D.2.2.
9. The transmitted power level relative to time for a random access burst shall be within the power/time template given in GSM 05.05, annex B bottom figure:
  - 9.1 Under normal conditions; GSM 05.05, 4.5.2.
  - 9.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.
- 10 The MS shall use a TA value of 0 for the Random Access burst sent:
  - 10.1 Under normal conditions; GSM 05.10, 6.6.
  - 10.2 Under extreme conditions; GSM 05.10, 6.6, GSM 05.05 annex D D.2.1, D.2.2.

### 13.3.3 Test purpose

1. To verify that the maximum output power of the MS, under normal conditions, is within conformance requirement 1.
2. To verify that the maximum output power of the MS, under extreme conditions, is within conformance requirement 2.
3. To verify that all power control levels, relevant to the class of MS, are implemented in the MS and have output power levels, under normal conditions, within conformance requirement 3.
4. To verify that all power control levels have output power levels, under extreme conditions, within conformance requirement 4.
5. To verify that the step in the output power transmitted by the MS at consecutive power control levels is within conformance requirement 5 under normal conditions.
6. To verify that the output power relative to time, when sending a normal burst is within conformance requirement 6:
  - 6.1 Under normal conditions.

6.2 Under extreme conditions.

7. To verify that the MS uses the maximum power control level according to its power class if commanded to a power control level exceeding its power class.
8. To verify that, for normal bursts, the MS transmissions to the BS are timed within conformance requirement 8:
  - 8.1 Under normal conditions.
  - 8.2 Under extreme conditions.
9. To verify that the output power relative to time, when sending an access burst is within conformance requirement 9:
  - 9.1 Under normal conditions.
  - 9.2 Under extreme conditions.
10. To verify that, for an access burst, the MS transmission to the BS is timed within conformance requirement 10:
  - 10.1 Under normal conditions.
  - 10.2 Under extreme conditions.

#### 13.3.4 Methods of test

Two methods of test are described, separately for:

- 1) equipment fitted with a permanent antenna connector and for
- 2) equipment fitted with an integral antenna, and which cannot be connected to an external antenna except by the fitting of a temporary test connector as a test fixture.

NOTE: The behaviour of the MS in the system is determined to a high degree by the antenna, and this is the only transmitter test in this EN using the integral antenna. Further studies are ongoing on improved testing on the integral antenna, taking practical conditions of MS use into account.

##### 13.3.4.1 Method of test for equipment with a permanent antenna connector

###### 13.3.4.1.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

###### 13.3.4.1.2 Procedure

- a) Measurement of normal burst transmitter output power

The SS takes power measurement samples evenly distributed over the duration of one burst with a sampling rate of at least  $2/T$ , where  $T$  is the bit duration. The samples are identified in time with respect to the modulation on the burst. The SS identifies the centre of the useful 147 transmitted bits, i.e. the transition from bit 13 to bit 14 of the midamble, as the timing reference.

The transmitter output power is calculated as the average of the samples over the 147 useful bits. This is also used as the 0 dB reference for the power/time template.

- b) Measurement of normal burst timing delay

The burst timing delay is the difference in time between the timing reference identified in a) and the corresponding transition in the burst received by the MS immediately prior to the MS transmit burst sampled.

- c) Measurement of normal burst power/time relationship



The array of power samples measured in a) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in a).

- d) Steps a) to c) are repeated with the MS commanded to operate on each of the power control levels defined, even those not supported by the MS.
- e) The SS commands the MS to the maximum power control level supported by the MS and steps a) to c) are repeated for ARFCN in the Low and High ranges.
- f) Measurement of access burst transmitter output power

The SS causes the MS to generate an Access Burst on an ARFCN in the Mid ARFCN range, this could be either by a handover procedure or a new request for radio resource. In the case of a hand over procedure the Power Level indicated in the HANOVER COMMAND message is the maximum power control level supported by the MS. In the case of an Access Burst the MS shall use the Power Level indicated in the MS\_TXPWR\_MAX\_CCH parameter. If the power class of the MS is DCS 1 800 Class 3, the MS shall also use the POWER\_OFFSET parameter.

The SS takes power measurement samples evenly distributed over the duration of the access burst as described in a). However, in this case the SS identifies the centre of the useful bits of the burst by identifying the transition from the last bit of the synch sequence. The centre of the burst is then five data bits prior to this point and is used as the timing reference.

The transmitter output power is calculated as the average of the samples over the 87 useful bits of the burst. This is also used as the 0 dB reference for the power/time template.

- g) Measurement of access burst timing delay

The burst timing delay is the difference in time between the timing reference identified in f) and the MS received data on the common control channel.

- h) Measurement of access burst power/time relationship

The array of power samples measured in f) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in f).

- i) Depending on the method used in step f) to cause the MS to send an Access Burst, the SS sends either a HANOVER COMMAND with power control level set to 10 or it changes the System Information elements MS\_TXPWR\_MAX\_CCH and for DCS 1 800 the POWER\_OFFSET on the serving cell BCCH in order to limit the MS transmit power on the Access Burst to power control level 10 (+23 dBm for GSM 400 and GSM 900 or +10 dBm for DCS 1 800) and then steps f) to h) are repeated.
- j) Steps a) to i) are repeated under extreme test conditions (annex 1, TC2.2) except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

#### 13.3.4.2 Method of test for equipment with an integral antenna

NOTE: If the MS is equipped with a permanent connector, such that the antenna can be disconnected and the SS be connected directly, then the method of section 13.3.4.1 will be applied.

The tests in this section are performed on an unmodified test sample.

##### 13.3.4.2.1 Initial conditions

The MS is placed in the anechoic shielded chamber (annex 1, GC5) or on the outdoor test site, on an isolated support, in the position for normal use, at a distance of at least 3 metres from a test antenna, connected to the SS.

NOTE: The test method described has been written for measurement in an anechoic shielded chamber. If an outdoor test site is used then, in addition, it is necessary to raise/lower the test antenna through the specified height range to maximize the received power levels from both the test sample and the substitution antenna.

A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

#### 13.3.4.2.2 Procedure

- a) With the initial conditions set according to subclause 13.3.4.2.1 the test procedure in 13.3.4.1.2 is followed up to and including step i), except that in step a), when measurements are done at maximum power for ARFCN in the Low, Mid and High range, the measurement is made eight times with the MS rotated by  $n \cdot 45$  degrees for all values of  $n$  in the range 0 to 7.

The measurements taken are received transmitter output power measurements rather than transmitter output power measurements, the output power measurement values can be derived as follows.

- b) Assessment of test site loss for scaling of received output power measurements.

The MS is replaced by a half-wave dipole, resonating at the centre frequency of the transmit band, connected to an RF generator.

The frequency of the RF signal generator is set to the frequency of the ARFCN used for the 24 measurements in step a), the output power is adjusted to reproduce the received transmitter output power averages recorded in step a).

For each indication the power, delivered by the generator (in Watts) to the half-wave dipole, is recorded. These values are recorded in the form  $P_{nc}$ , where  $n$  = MS rotation and  $c$  = channel number.

For each channel number used compute:

$$P_{ac}(\text{Watts into dipole}) = \frac{1}{8} * \sum_{n=0}^{n=7} P_{nc}$$

from which:  $P_{ac}(\text{Tx dBm}) = 10 \log_{10}(P_{ac}) + 30 + 2,15$

The difference, for each of the three channels, between the actual transmitter output power averaged over the 8 measurement orientations and the received transmitter output power at orientation  $n = 0$  is used to scale the received measurement results to actual transmitter output powers for all measured power control levels and ARFCN, which can then be checked against the requirements.

- c) Temporary antenna connector calibration factors (transmit)

A modified test sample equipped with a temporary antenna connector is placed in a climatic test chamber and is linked to the SS by means of the temporary antenna connector.

Under normal test conditions, the power measurement and calculation parts of steps a) to i) of 13.3.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

NOTE: The values noted here are related to the output transmitter carrier power levels under normal test conditions, which are known after step b). Therefore frequency dependent calibration factors that account for the effects of the temporary antenna connector can be determined.

- d) Measurements at extreme test conditions.

NOTE: Basically the procedure for extreme conditions is:

- the power/time template is tested in the "normal" way,
- the radiated power is measured by measuring the difference with respect to the radiated power under normal test conditions.

Under extreme test conditions steps a) to i) of 13.3.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

The transmitter output power under extreme test conditions is calculated for each burst type, power control level and for every frequency used by adding the frequency dependent calibration factor, determined in c), to the values obtained at extreme conditions in this step.

### 13.3.5 Test requirements

- a) The transmitter output power, under every combination of normal and extreme test conditions, for normal bursts and access bursts, at each frequency and for each power control level applicable to the MS power class, shall be at the relevant level shown in table 13-2 or table 13-3 within the tolerances also shown in table 13-2 or table 13-3.

GSM 400 and GSM 900 only - begin

**Table 13-2: GSM 400 and GSM 900 transmitter output power for different power classes**

Power class				Power control level	Transmitter output power dBm	Tolerances	
2	3	4	5			normal	extreme
.	.	.	.	2	39	+/-2 dB	+/-2,5 dB
.	.	.	.	3	37	+/-3 dB*)	+/-4 dB*)
.	.	.	.	4	35	+/-3 dB	+/-4 dB
.	.	.	.	5	33	+/-3 dB*)	+/-4 dB*)
.	.	.	.	6	31	+/-3 dB	+/-4 dB
.	.	.	.	7	29	+/-3 dB*)	+/-4 dB*)
.	.	.	.	8	27	+/-3 dB	+/-4 dB
.	.	.	.	9	25	+/-3 dB	+/-4 dB
.	.	.	.	10	23	+/-3 dB	+/-4 dB
.	.	.	.	11	21	+/-3 dB	+/-4 dB
.	.	.	.	12	19	+/-3 dB	+/-4 dB
.	.	.	.	13	17	+/-3 dB	+/-4 dB
.	.	.	.	14	15	+/-3 dB	+/-4 dB
.	.	.	.	15	13	+/-3 dB	+/-4 dB
.	.	.	.	16	11	+/-5 dB	+/-6 dB
.	.	.	.	17	9	+/-5 dB	+/-6 dB
.	.	.	.	18	7	+/-5 dB	+/-6 dB
.	.	.	.	19	5	+/-5 dB	+/-6 dB

- \*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

GSM 400 and GSM 900 only - end

DCS 1 800 only - begin

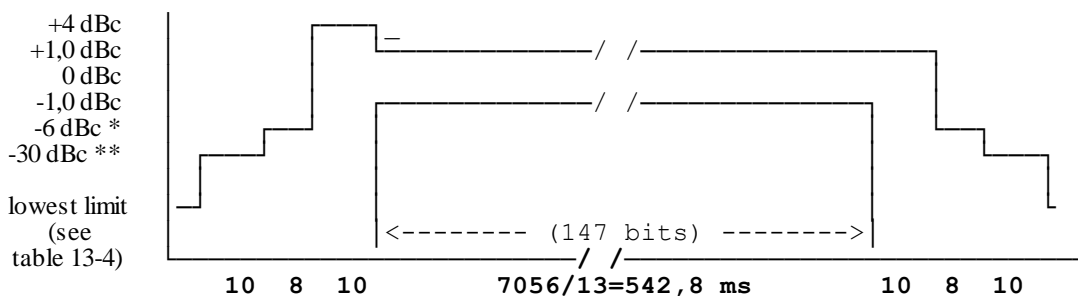
**Table 13-3: DCS 1 800 transmitter output power for different power classes**

Power class			Power control level	Transmitter output power	Tolerances	
1	2	3			normal	extreme
		.	29	36	+/-2,0 dB	+/-2,5 dB
		.	30	34	+/-3,0 dB	+/-4,0 dB
		.	31	32	+/-3,0 dB	+/-4,0 dB
.	.	.	0	30	+/-3,0 dB*)	+/-4 dB*)
.	.	.	1	28	+/-3 dB	+/-4 dB
.	.	.	2	26	+/-3 dB	+/-4 dB
.	.	.	3	24	+/-3 dB*)	+/-4 dB*)
.	.	.	4	22	+/-3 dB	+/-4 dB
.	.	.	5	20	+/-3 dB	+/-4 dB
.	.	.	6	18	+/-3 dB	+/-4 dB
.	.	.	7	16	+/-3 dB	+/-4 dB
.	.	.	8	14	+/-3 dB	+/-4 dB
.	.	.	9	12	+/-4 dB	+/-5 dB
.	.	.	10	10	+/-4 dB	+/-5 dB
.	.	.	11	8	+/-4 dB	+/-5 dB
.	.	.	12	6	+/-4 dB	+/-5 dB
.	.	.	13	4	+/-4 dB	+/-5 dB
.	.	.	14	2	+/-5 dB	+/-6 dB
.	.	.	15	0	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

DCS 1 800 only - end

- b) The difference between the transmitter output power at two adjacent power control levels, measured at the same frequency, shall not be less than 0,5 dB and not be more than 3,5 dB.
- c) The power/time relationship of the measured samples for normal bursts shall be within the limits of the power time template of figure 13-1 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.



**Figure 13-1: Power / time template for normal bursts**

\* For GSM400 and GSM900 MS: -4 dBc for power control level 16

-2 dBc for power control level 17

-1 dBc for power control levels 18 and 19

For DCS1800 MS: -4 dBc for power control level 11

-2 dBc for power control level 12

-1 dBc for power control levels 13, 14 and 15

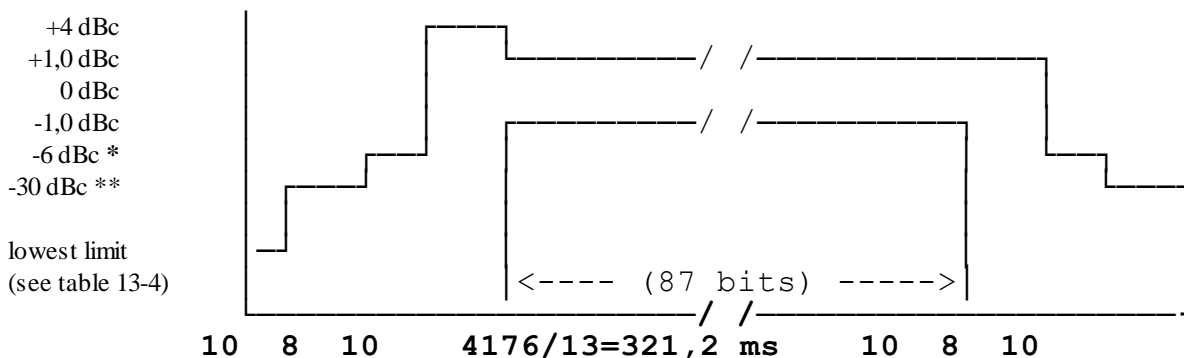
\*\* For GSM400 and GSM900 MS: -30 dBc or -17 dBm, whichever is the higher

For DCS1800 MS: -30 dBc or -20 dBm, whichever is the higher

**Table 13-4: Lowest measurement limit for power / time template**

	lowest limit
GSM400, GSM900	-59 dBc or -54 dBm whichever is the highest, except for the timeslot preceding the active slot, for which the allowed level is equal to -59 dBc or -36 dBm, whichever is the highest
DCS1800	-48 dBc or -48 dBm whichever is the highest

- d) All the power control levels, for the type and power class of the MS as stated by the manufacturer, shall be implemented in the MS.
- e) When the transmitter is commanded to a power control level outside of the capability corresponding to the type and power class of the MS as stated by the manufacturer, then the transmitter output power shall be within the tolerances for the closest power control level corresponding to the type and power class as stated by the manufacturer.
- f) The centre of the transmitted normal burst as defined by the transition of bits 13/14 of the midamble shall be 3 timeslot periods (1731 μs) +/- 1 bit period (+/- 3,69 μs) after the centre of the corresponding received burst.
- g) The power/time relationship of the measured samples for access bursts shall be within the limits of the power time template of figure 13-2 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.



**Figure 13-2: Power / time template for access burst**

\* For GSM400 and GSM900 MS: -4 dBc for power control level 16

-2 dBc for power control level 17

-1 dBc for power control levels 18 and 19

For DCS1800 MS: -4 dBc for power control level 11

-2 dBc for power control level 12

-1 dBc for power control levels 13, 14 and 15

\*\* For GSM400 and GSM900 MS: -30 dBc or -17 dBm, whichever is the higher

For DCS1800 MS: -30 dBc or -20 dBm, whichever is the higher

- h) The centre of the transmitted access burst shall be an integer number of timeslot periods less 30 bit periods relative to any CCCH midamble centre with a tolerance of +/- 1 bit period (+/- 3,69 μs).

## 13.4 Output RF spectrum

### 13.4.1 Definition and applicability

The output RF spectrum is the relationship between the frequency offset from the carrier and the power, measured in a specified bandwidth and time, produced by the MS due to the effects of modulation and power ramping.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS.

### 13.4.2 Conformance requirement

1. The level of the output RF spectrum due to modulation shall be no more than that given in GSM 05.05, 4.2.1, table a) for GSM 400 and GSM 900 or table b) for DCS 1 800, with the following lowest measurement limits:

- -36 dBm below 600 kHz offset from the carrier,
- -51 dBm for GSM 400 and GSM 900 or -56 dBm for DCS 1 800 from 600 kHz out to less than 1 800 kHz offset from the carrier,
- -46 dBm for GSM 400 and GSM 900 or -51 dBm for DCS 1 800 at and beyond 1 800 kHz offset from the carrier,

but with the following exceptions at up to -36 dBm:

- up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz in the combined range 600 kHz to 6000 kHz above and below the carrier,
- up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz at more than 6 000 kHz offset from the carrier.

1.1 Under normal conditions; GSM 05.05, 4.2.1.

1.2 Under extreme conditions; GSM 05.05, 4.2.1; GSM 05.05, annex D D.2.1, D.2.2.

2. The level of the output RF spectrum due to switching transients shall be no more than given in GSM 05.05, 4.2.2, table "a) Mobile Station:".

2.1 Under normal conditions; GSM 05.05, 4.2.2.

2.2 Under extreme conditions; GSM 05.05, 4.2.2; GSM 05.05 annex D D.2.1, D.2.2.

3. When allocated a channel, the power emitted by the MS, in the band 935 to 960 MHz shall be no more than -79 dBm, in the band 925 to 935 MHz shall be no more than -67 dBm and in the band 1 805 to 1 880 MHz shall be no more than -71 dBm except in five measurements in each of the bands 925 to 960 MHz and 1 805 to 1 880 MHz where exceptions at up to -36 dBm are permitted. For GSM 400 MS, in addition, the power emitted by MS, in the bands of 460.4 to 467.6 MHz and 488.8 to 496 MHz shall be no more than -67 dBm except in three measurements in each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where exceptions at up to -36 dBm are permitted.  
Under normal conditions; GSM 05.05, 4.3.3.

### 13.4.3 Test purpose

1. To verify that the output RF spectrum due to modulation does not exceed conformance requirement 1.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.
2. To verify that the output RF spectrum due to switching transients does not exceed conformance requirement 2 when a reasonable margin is allowed for the effect of spectrum due to modulation.
  - 2.1 Under normal conditions.
  - 2.2 Under extreme conditions.

3. To verify that the MS spurious emissions in the MS receive band do not exceed conformance requirement 3.

#### 13.4.4 Method of test

##### 13.4.4.1 Initial conditions

A call is set up according to the generic call set up procedure.

The SS commands the MS to hopping mode. The hopping pattern includes only three channels, namely one with an ARFCN in the Low ARFCN range, a second one with an ARFCN in the Mid ARFCN range and the third one with an ARFCN in the High ARFCN range.

NOTE 1: Although the measurement is made whilst the MS is in hopping mode, each measurement is on one single channel.

NOTE 2: This test is specified in hopping mode as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to handover the MS between the three channels tested at the appropriate time.

The SS commands the MS to complete the traffic channel loop back without signalling of erased frames (see 36.2.1.1). This is to set a defined random pattern for the transmitter.

The SS sends Standard Test Signal C1 (annex 5) to the MS at a level of 23 dB $\mu$ Vemf( ).

##### 13.4.4.2 Procedure

NOTE: When averaging is in use during frequency hopping mode, the averaging only includes bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement.

a) In steps b) to h) the FT is equal to the hop pattern ARFCN in the Mid ARFCN range.

b) The other settings of the spectrum analyser are set as follows:

- Zero frequency scan
- Resolution bandwidth: 30 kHz
- Video bandwidth: 30 kHz
- Video averaging: may be used, depending on the implementation of the test

The video signal of the spectrum analyser is "gated" such that the spectrum generated by at least 40 of the bits 87 to 132 of the burst is the only spectrum measured. This gating may be analogue or numerical, dependent upon the design of the spectrum analyser. Only measurements during transmitted bursts on the nominal carrier of the measurement are included. The spectrum analyser averages over the gated period and over 200 or 50 such bursts, using numerical and/or video averaging.

The MS is commanded to its maximum power control level.

c) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 50 bursts at all multiples of 30 kHz offset from FT to < 1 800 kHz.

d) The resolution and video bandwidth on the spectrum analyser are adjusted to 100 kHz and the measurements are made at the following frequencies:

on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the band 925 - 960 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.

In addition for GSM 400 MS:

at 200 kHz intervals over the band 460.4 to 467.6 MHz for each measurement over 50 bursts,

at 200 kHz intervals over the band 488.8 to 496 MHz for each measurement over 50 bursts.

- e) The MS is commanded to its minimum power control level. The spectrum analyser is set again as in b).
- f) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 200 bursts at the following frequencies:

FT

FT + 100 kHz                      FT - 100 kHz

FT + 200 kHz                      FT - 200 kHz

FT + 250 kHz                      FT - 250 kHz

FT + 200 kHz \* N              FT - 200 kHz \* N

where N = 2, 3, 4, 5, 6, 7, and 8

and FT = RF channel nominal centre frequency.

- g) The spectrum analyser settings are adjusted to:

- Zero frequency scan
- Resolution bandwidth:              30 kHz
- Video bandwidth:                      100 kHz
- Peak hold

The spectrum analyser gating of the signal is switched off.

The MS is commanded to its maximum power control level.

- h) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured at the following frequencies:

FT + 400 kHz                      FT - 400 kHz

FT + 600 kHz                      FT - 600 kHz

FT + 1,2 MHz                      FT - 1,2 MHz

FT + 1,8 MHz                      FT - 1,8 MHz

where FT = RF channel nominal centre frequency.

The duration of each measurement (at each frequency) will be such as to cover at least 10 burst transmissions at FT.

- i) Step h) is repeated for power control levels 7 and 11.
- j) Steps b), f), g) and h) are repeated with FT equal to the hop pattern ARFCN in the Low ARFCN range except that in step g) the MS is commanded to power control level 11 rather than maximum power.
- k) Steps b), f), g) and h) are repeated with FT equal to the hop pattern ARFCN in the High ARFCN range except that in step g) the MS is commanded to power control level 11 rather than maximum power.
- l) Steps a) b) f) g) and h) are repeated under extreme test conditions (annex 1, TC2.2). except that at step g) the MS is commanded to power control level 11.



13.4.5 Test requirements

For absolute measurements, performed on a temporary antenna connector, in the frequency band 450.4 to 457.6 MHz, 478.8 to 486 MHz, 880 to 915 MHz or 1710 to 1785 MHz, the temporary antenna connector coupling factor, determined according to 13.3.4.2.2 and annex 1 GC7, for the nearest relevant frequency, will be used.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 925 to 960 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 900 MS. For a GSM 400 or DCS 1 800 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 1805 to 1880 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for DCS 1 800 MS. For GSM 400 or GSM 900 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 460.4 to 467.6 MHz or 488.8 to 496 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 400 MS. For a GSM 900 or DCS 1800 MS 0 dB will be assumed.

The figures in the tables below, at the listed frequencies from the carrier (kHz), are the maximum level (dB) relative to a measurement in 30 kHz bandwidth on the carrier (reference GSM 05.05 section 4.2.1).

- a) For the modulation sidebands out to less than 1 800 kHz offset from the carrier frequency (FT) measured in step c), f), h), j), k) and l) the measured power level in dB relative to the power level measured at FT, for all types of MS, shall not exceed the limits derived from the values shown in table 13-5 for GSM 400 and GSM 900 or table 13-6 for DCS 1 800 according to the actual transmit power and frequency offset from FT. However any failures in the combined range 600 kHz to less than 1 800 kHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below.

**Table 13-5a: GSM 400 and GSM 900 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
39	+0,5	-30	-33	-60	-66
37	+0,5	-30	-33	-60	-64
35	+0,5	-30	-33	-60	-62
<= 33	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-51

**Table 13-6: DCS 1 800 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
<= 36	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-56

NOTE 1: For frequency offsets between 100 kHz and 600 kHz the requirement is derived by a linear interpolation between the points identified in the table with linear frequency and power in dB relative.

- b) For the modulation sidebands from 1 800 kHz offset from the carrier frequency (FT) and out to 2 MHz beyond the edge of the relevant transmit band, measured in step d), the measured power level in dB relative to the power level

measured at FT, shall not exceed the values shown in table 13-7 according to the actual transmit power, frequency offset from FT and system on which the MS is designed to operate. However any failures in the combined range 1 800 kHz to 6 MHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below, and any other failures may be counted towards the exceptions allowed in test requirements d) below.

**Table 13-7: Spectrum due to modulation from 1 800 kHz offset to the edge of the transmit band (wideband noise)**

power levels in dB relative to the measurement at FT						
GSM400 and GSM900				DCS1800		
Power level (dBm)	Frequency offset kHz			Power level (dBm)	Frequency offset kHz	
	1800 to < 3000	3000 to < 6000	>= 6000		1800 to < 6000	>= 6000
39	-69	-71	-77	36	-71	-79
37	-67	-69	-75	34	-69	-77
35	-65	-67	-73	32	-67	-75
<= 33	-63	-65	-71	30	-65	-73
				28	-63	-71
				26	-61	-69
				<= 24	-59	-67
The values above are subject to the minimum absolute levels (dBm) below.						
	-46	-46	-46		-51	-51

- c) Any failures (from a) and b) above) in the combined range 600 kHz to 6 MHz above and below the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, spurious emissions are allowed in up to three 200 kHz bands centred on an integer multiple of 200 kHz so long as no spurious emission exceeds -36 dBm. Any spurious emissions measured in a 30 kHz bandwidth which spans two 200 kHz bands can be counted towards either 200 kHz band, whichever minimizes the number of 200 kHz bands containing spurious exceptions.
- d) Any failures (from b) above) beyond 6 MHz offset from the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, up to twelve spurious emissions are allowed so long as no spurious emission exceeds -36 dBm.
- e) The MS spurious emissions in the bands 925 - 935 MHz, 935 - 960 MHz and 1 805 - 1 880 MHz, measured in step d), for all types of MS, shall not exceed the values shown in table 13-8 except in up to five measurements in the band 925 to 960 MHz and five measurements in the band 1 805 to 1 880 MHz where a level up to -36 dBm is permitted. For GSM 400 MS, in addition, the MS spurious emissions in the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz shall not exceed the value of -67 dBm, except in up to three measurements in each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where a level up to -36 dBm is permitted.

**Table 13-8: Spurious emissions in the MS receive bands**

Band (MHz)	Spurious emissions level (dBm)
925 to 935	-67
935 to 960	-79
1805 to 1880	-71

- f) For the power ramp sidebands of steps h) and i) the power levels must not exceed the values shown in table 13-9 for GSM 400 and GSM 900 or table 13-10 for DCS 1 800.

**Table 13-9: GSM Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
39 dBm	-13 dBm	-21 dBm	-21 dBm	-24 dBm
37 dBm	-15 dBm	-21 dBm	-21 dBm	-24 dBm
35 dBm	-17 dBm	-21 dBm	-21 dBm	-24 dBm
33 dBm	-19 dBm	-21 dBm	-21 dBm	-24 dBm
31 dBm	-21 dBm	-23 dBm	-23 dBm	-26 dBm
29 dBm	-23 dBm	-25 dBm	-25 dBm	-28 dBm
27 dBm	-23 dBm	-26 dBm	-27 dBm	-30 dBm
25 dBm	-23 dBm	-26 dBm	-29 dBm	-32 dBm
23 dBm	-23 dBm	-26 dBm	-31 dBm	-34 dBm
<= +21 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

**Table 13-10: DCS 1 800 Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
36 dBm	-16 dBm	-21 dBm	-21 dBm	-24 dBm
34 dBm	-18 dBm	-21 dBm	-21 dBm	-24 dBm
32 dBm	-20 dBm	-22 dBm	-22 dBm	-25 dBm
30 dBm	-22 dBm	-24 dBm	-24 dBm	-27 dBm
28 dBm	-23 dBm	-25 dBm	-26 dBm	-29 dBm
26 dBm	-23 dBm	-26 dBm	-28 dBm	-31 dBm
24 dBm	-23 dBm	-26 dBm	-30 dBm	-33 dBm
22 dBm	-23 dBm	-26 dBm	-31 dBm	-35 dBm
<= +20 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

NOTE 2: These figures are different from the requirements in GSM 05.05 because at higher power levels it is the modulation spectrum which is being measured using a peak hold measurement. This allowance is given in the table.

NOTE 3: The figures for table 13-9 and table 13-10 assume that, using the peak hold measurement, the lowest level measurable is 8 dB above the level of the modulation specification using the 30 kHz bandwidth gated average technique for 400 kHz offset from the carrier. At 600 and 1200 kHz offset the level is 6 dB above and at 1 800 kHz offset the level is 3 dB above. The figures for 1 800 kHz have assumed the 30 kHz bandwidth spectrum due to modulation specification at <1 800 kHz.

## 13.5 Intermodulation attenuation

### 13.5.1 Definition and applicability

The intermodulation attenuation is the ratio, in dB, of the power level of the wanted signal to the power level of the highest intermodulation component.

The requirements and this test apply to all types of DCS 1 800 MS.

### 13.5.2 Conformance requirement

The maximum level of any intermodulation product shall be no less than 50 dB below the level of the wanted signal when an interfering CW signal is applied, within the transmit band, at a frequency offset of 800 kHz and with a power level 40 dB below the power level of the wanted signal; GSM 05.05, 4.7.3.

### 13.5.3 Test purpose

To verify that the MS intermodulation attenuation is no less than conformance requirement 1.

### 13.5.4 Method of test

NOTE 1: When the measurements are performed precautions must be taken, so that non-linearities in the selective measuring device do not influence the results appreciably. Furthermore it should be ensured that intermodulation components which may be generated by non-linear elements in the test equipment (e.g. signal generator, circulators, selective measuring device) are sufficiently reduced. The RF transmit equipment under test and the test signal source should be physically separated in such a way that the measurement is not influenced by direct radiation.

NOTE 2: In the case of an MS which does not normally include an antenna connector, the coupling loss of the temporary antenna connector must be taken into account.

#### 13.5.4.1 Initial conditions

The antenna output of the MS is connected to the SS via a coupling device, presenting to the MS a load with an impedance of 50 ohms. The coupling device may consist of a circulator with one port connected by a coaxial cable to the output terminal of the MS, the second port correctly terminated with 50 ohms into a selective measuring device (e.g. a spectrum analyser) and the third port connected to the interfering test signal source via an isolator.

A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power.

#### 13.5.4.2 Procedure

- a) The interfering test signal will be unmodulated and the frequency will be 800 kHz above the transmit frequency of the MS under test. the power level is adjusted to give the equivalent of 40 dB below the transmit power level of the MS, if both the MS transmit power and the interfering test signal were measured with a correct termination but with the other signal absent.
- b) The frequency selective measuring device is set to measure peak hold in a bandwidth of 300 kHz. Any intermodulation components in the MS transmit band, are then measured.
- c) Steps a) and b) are repeated with the test signal at a frequency 800 kHz below the transmitted frequency.

### 13.5.5 Test requirements

The level of each intermodulation component, in the MS transmit band, shall be no less than 50 dB below the level of the transmit power of the wanted MS carrier.

## 13.6 Frequency error and phase error in HSCSD multislot configurations

### 13.6.1 Definition and applicability

The frequency error is the difference in frequency, after adjustment for the effect of the modulation and phase error, between the RF transmission from the MS and either:

- the RF transmission from the BS, or
- the nominal frequency for the ARFCN used.

The phase error is the difference in phase, after adjustment for the effect of the frequency error, between the RF transmission from the MS and the theoretical transmission according to the intended modulation.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS and any multiband MS which are capable of HSCSD multislot operation.

### 13.6.2 Conformance requirement

1. The MS carrier frequency shall be accurate to within 0,1 ppm, or accurate to within 0,1 ppm compared to signals received from the BS.
  - 1.1 Under normal conditions; GSM 05.10, 6.1.
  - 1.2 Under vibration conditions; GSM 05.10, 6.1; GSM 05.05, annex D D.2.3.
  - 1.3 Under extreme conditions; GSM 05.10, 6.1; GSM 05.05, 4.4; GSM 05.05, annex D D.2.1, D.2.2.
2. The RMS phase error (difference between the phase error trajectory and its linear regression on the active part of the time slot) for each burst shall not be greater than 5 degrees.
  - 2.1 Under normal conditions; GSM 05.05, 4.6.
  - 2.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 2.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
3. The maximum peak deviation during the useful part of each burst shall not be greater than 20 degrees.
  - 3.1 Under normal conditions; GSM 05.05, 4.6.
  - 3.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 3.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.

### 13.6.3 Test purpose

1. To verify that in a multislot configuration the MS carrier frequency error does not exceed 0,1 ppm:
  - 1.1 Under normal conditions.
  - 1.2 When the MS is being vibrated.
  - 1.3 Under extreme conditions.

NOTE: The transmit frequency accuracy of the SS is expected to be sufficient to ensure that the difference between 0,1 ppm absolute and 0,1 ppm compared to signals received from the BS would be small enough to be considered insignificant.

2. To verify that the RMS phase error on the useful part of the bursts transmitted by the MS in a multislot configuration does not exceed conformance requirement 2:
  - 2.1 Under normal conditions.
  - 2.2 When the MS is being vibrated.
  - 2.3 Under extreme conditions.
3. To verify that the maximum phase error on the useful part of the bursts transmitted by the MS in a multislot configuration does not exceed conformance requirement 3.
  - 3.1 Under normal conditions.
  - 3.2 When the MS is being vibrated.
  - 3.3 Under extreme conditions.

### 13.6.4 Method of test

NOTE: In order to measure the accuracy of the frequency and phase error a sampled measurement of the transmitted phase trajectory is obtained. This is compared with the theoretically expected phase trajectory. The regression line of the difference between the expected trajectory and the measured trajectory is an indication of the frequency error (assumed constant through the burst), whilst the departure of the phase differences from this trajectory is a measure of the phase error. The peak phase error is the value furthest from the regression line and the RMS phase error is the root mean square average of the phase error of all samples.

#### 13.6.4.1 Initial conditions

A call is set up according to the generic call setup procedure for multislot HSCSD.

The SS commands the MS to hopping mode (table 13.6.1).

NOTE: It is not necessary to test in hopping mode but is done here as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to make sure bursts are taken from a few different channels.

The SS activates ciphering mode.

NOTE: Ciphering mode is active during this test to give a pseudo-random bit stream to the modulator.

The SS sets the MS to operate in a multislot configuration with maximum number of transmitted time slots.

The SS commands the MS to complete the traffic channel multislot loop back including signalling of erased frames.

The SS generates Standard Test Signal CI of annex 5.

#### 13.6.4.2 Procedure

- a) For one transmitted burst on the last multislot subchannel, the SS captures the signal as a series of phase samples over the period of the burst. These samples are evenly distributed over the duration of the burst with a minimum sampling rate of  $2/T$ , where  $T$  is the modulation symbol period. The received phase trajectory is then represented by this array of at least 294 samples.
- b) The SS then calculates, from the known bit pattern and the formal definition of the modulator contained in GSM 05.04, the expected phase trajectory.
- c) From a) and b) the phase trajectory error is calculated, and a linear regression line computed through this phase trajectory error. The slope of this regression line is the frequency error of the mobile transmitter relative to the simulator reference. The difference between the regression line and the individual sample points is the phase error of that point.

- c.1) The sampled array of at least 294 phase measurements is represented by the vector:

$$\varnothing_m = \varnothing_m(0) \dots \varnothing_m(n)$$

where the number of samples in the array  $n+1 \geq 294$ .

- c.2) The calculated array, at the corresponding sampling instants, is represented by the vector:

$$\varnothing_c = \varnothing_c(0) \dots \varnothing_c(n).$$

- c.3) The error array is represented by the vector:

$$\varnothing_e = \{\varnothing_m(0) - \varnothing_c(0)\} \dots \dots \dots \{\varnothing_m(n) - \varnothing_c(n)\} = \varnothing_e(0) \dots \varnothing_e(n).$$

- c.4) The corresponding sample numbers form a vector  $t = t(0) \dots t(n)$ .

- c.5) By regression theory the slope of the samples with respect to  $t$  is  $k$  where:

$$k = \frac{\sum_{j=0}^{j=n} t(j) * \varnothing_e(j)}{\sum_{j=0}^{j=n} t(j)^2}$$

c.6) The frequency error is given by  $k/(360 * \gamma)$ , where  $\gamma$  is the sampling interval in s and all phase samples are measured in degrees.

c.7) The individual phase errors from the regression line are given by:

$$\varnothing_e(j) - k * t(j).$$

c.8) The RMS value  $\varnothing_e$  of the phase errors is given by:

$$\varnothing_e(\text{RMS}) = \left[ \frac{\sum_{j=0}^{j=n} \{\varnothing_e(j) - k * t(j)\}^2}{n + 1} \right]^{1/2}$$

- d) Steps a) to c) are repeated for 20 bursts, not necessarily contiguous.
- e) The SS instructs the MS to its maximum power control level on each multislot subchannel, all other conditions remaining constant. Steps a) to d) are repeated.
- f) The SS instructs the MS to the minimum power control level on each multislot subchannel, all other conditions remaining constant. Steps a) to d) are repeated.
- g) The MS is hard mounted on a vibration table and vibrated at the frequency/amplitudes specified in annex 1, TC4. During the vibration steps a) to f) are repeated.

NOTE: If the call is terminated when mounting the MS to the vibration table, it will be necessary to establish the initial conditions again before repeating steps a) to f).

- h) The MS is re-positioned on the vibration table in the two orthogonal planes to the plane used in step g). For each of the orthogonal planes step g) is repeated.
- i) Steps a) to f) are repeated under extreme test conditions (see annex 1, TC2.2).

NOTE: The series of samples taken to determine the phase trajectory could also be used, with different post-processing, to determine the transmitter burst characteristics of 'Transmitter output power and burst timing in multislot configuration'. Although described independently, it is valid to combine these two tests, giving both answers from single sets of captured data.

13.6.5 Test requirements

13.6.5.1 Frequency error

For all measured bursts, the frequency error, derived in step c.6), shall be less than 10E-7.

13.6.5.2 Phase error

For all measured bursts, the RMS phase error, derived in step c.8), shall not exceed 5 degrees.

For all measured bursts, each individual phase error, derived in step c.7), shall not exceed 20 degrees.

## 13.7 Transmitter output power and burst timing in HSCSD configurations

### 13.7.1 Definition and applicability

The transmitter output power is the average value of the power delivered to an artificial antenna or radiated by the MS and its integral antenna, over the time that the useful information bits of one burst are transmitted.

The transmit burst timing is the envelope of the RF power transmitted with respect to time. The timings are referenced to the transition from bit 13 to bit 14 of the Training Sequence ("midamble") before differential decoding. The timing of the modulation is referenced to the timing of the received signal from the SS.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS and multiband any MS which are capable of HSCSD multislot operation.

### 13.7.2 Conformance requirement

1. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2 dB under normal conditions; GSM 05.05, 4.1.1, first table.
2. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2,5 dB under extreme conditions; GSM 05.05, 4.1.1, first table; GSM 05.05 annex D D.2.1, D.2.2.
3. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM 400 and GSM 900) or fourth table (for DCS 1 800), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 1), with a tolerance of +/- 3, 4 or 5 dB under normal conditions; GSM 05.05, 4.1.1, third or fourth table.
4. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM 400 and GSM 900) or fourth table (for DCS 1 800), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 2), with a tolerance of +/- 4, 5 or 6 dB under extreme conditions; GSM 05.05, 4.1.1, third or fourth table; GSM 05.05 annex D D.2.1, D.2.2.
5. The output power actually transmitted by the MS at consecutive power control levels shall form a monotonic sequence and the interval between power control levels shall be 2 +/- 1,5 dB; GSM 05.05, 4.1.1.
6. The transmitted power level relative to time for a normal burst shall be within the power/time template given in GSM 05.05, annex B top figure. In multislot configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency, the template of annex B shall be respected at the beginning and the end of the series of consecutive bursts. The output power during the guard period between every two consecutive active timeslots shall not exceed the level allowed for the useful part of the first timeslot or the level allowed for the useful part of the second timeslot plus 3dB, whichever is the highest:
  - 6.1 Under normal conditions; GSM 05.05, 4.5.2..
  - 6.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.
7. In multislot configurations, bidirectional subchannels shall be individually power controlled; GSM 05.08, 4.2.
8. When accessing a cell on the RACH and before receiving the first power command during a communication on a DCCH or TCH (after an IMMEDIATE ASSIGNMENT), all GSM and class and class 2 DCS 1 800 MS shall use the power control level defined by the MS\_TXPWR\_MAX\_CCH parameter broadcast on the BCCH of the cell, or if MS\_TXPWR\_MAX\_CCH corresponds to a power control level not supported by the MS as defined by its power class, the MS shall act as though the closest supported power control level had been broadcast. A Class 3 DCS 1 800 MS shall use the POWER\_OFFSET parameter.



9. The transmissions from the MS to the BS, measured at the MS antenna, shall be 468,75 - TA bit periods behind the transmissions received from the BS, where TA is the last timing advance received from the current serving BS. The tolerance on these timings shall be +/- 1 bit period:
  - 9.1 Under normal conditions; GSM 05.10, 6.4.
  - 9.2 Under extreme conditions; GSM 05.10, 6.4, GSM 05.05 annex D D.2.1, D.2.2.
10. The transmitted power level relative to time for a random access burst shall be within the power/time template given in GSM 05.05, annex B bottom figure:
  - 10.1 Under normal conditions; GSM 05.05, 4.5.2.
  - 10.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.
- 11 The MS shall use a TA value of 0 for the Random Access burst sent:
  - 11.1 Under normal conditions; GSM 05.10, 6.6.
  - 11.2 Under extreme conditions; GSM 05.10, 6.6, GSM 05.05 annex D D.2.1, D.2.2.

### 13.7.3 Test purpose

1. To verify that the maximum output power of the MS in HSCSD multislot configuration, under normal conditions, is within conformance requirement 1.
2. To verify that the maximum output power of the MS in HSCSD multislot configuration, under extreme conditions, is within conformance requirement 2.
3. To verify that all power control levels, relevant to the class of MS, are implemented in the MS in HSCSD multislot configuration and have output power levels, under normal conditions, within conformance requirement 3.
4. To verify that all power control levels have output power levels, under extreme conditions, within conformance requirement 4.
5. To verify that the step in the output power transmitted by the MS in HSCSD multislot configuration at consecutive power control levels is within conformance requirement 5 under normal conditions.
6. To verify that the output power relative to time, when sending a normal burst is within conformance requirement 6 in HSCSD multislot configuration:
  - 6.1 Under normal conditions.
  - 6.2 Under extreme conditions.
7. To verify that the MS in HSCSD multislot configuration uses the maximum power control level according to its power class if commanded to a power control level exceeding its power class.
8. To verify that, for normal bursts, the MS transmissions to the BS are timed within conformance requirement 8 in HSCSD multislot configuration:
  - 8.1 Under normal conditions.
  - 8.2 Under extreme conditions.
9. To verify that the output power relative to time, when sending an access burst is within conformance requirement 9 in HSCSD multislot configuration:
  - 9.1 Under normal conditions.
  - 9.2 Under extreme conditions.
10. To verify that, for an access burst, the MS transmission to the BS is timed within conformance requirement 10 in HSCSD multislot configuration:

10.1 Under normal conditions.

10.2 Under extreme conditions.

11. To verify that, power is individually controlled on bidirectional HSCSD subchannels

#### 13.7.4 Methods of test

Two methods of test are described, separately for:

- 1) equipment fitted with a permanent antenna connector and for
- 2) equipment fitted with an integral antenna, and which cannot be connected to an external antenna except by the fitting of a temporary test connector as a test fixture.

NOTE: The behaviour of the MS in the system is determined to a high degree by the antenna, and this is the only transmitter test in this EN using the integral antenna. Further studies are ongoing on improved testing on the integral antenna, taking practical conditions of MS use into account.

##### 13.7.4.1 Method of test for equipment with a permanent antenna connector

###### 13.7.4.1.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure for HSCSD multislot configuration on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power and MS to operate in its highest number of uplink slots. MS TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

###### 13.7.4.1.2 Procedure

- a) Measurement of normal burst transmitter output power

The SS takes power measurement samples evenly distributed over the duration of one burst with a sampling rate of at least  $2/T$ , where  $T$  is the bit duration. The samples are identified in time with respect to the modulation on the burst. The SS identifies the centre of the useful 147 transmitted bits, i.e. the transition from bit 13 to bit 14 of the midamble, as the timing reference.

The transmitter output power is calculated as the average of the samples over the 147 useful bits. This is also used as the 0 dB reference for the power/time template.

- b) Measurement of normal burst timing delay

The burst timing delay is the difference in time between the timing reference identified in a) and the corresponding transition in the burst received by the MS immediately prior to the MS transmit burst sampled.

- c) Measurement of normal burst power/time relationship

The array of power samples measured in a) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in a).

- d) Steps a) to c) are repeated on each multislot subchannel with the MS commanded to operate on each of the power control levels defined, even those not supported by the MS.

- e) The SS commands the MS to the maximum power control level supported by the MS and steps a) to c) are repeated on each multislot subchannel for ARFCN in the Low and High ranges.

- f) The SS commands the MS to the maximum power control level in the first multislot subchannel allocated and to the minimum power control level in the second multislot subchannel allocated. Any further timeslots allocated are to be set to the maximum power control level. Steps a) to c) and corresponding measurements on each subchannel are repeated.

- g) Measurement of access burst transmitter output power

The SS causes the MS to generate an Access Burst on an ARFCN in the Mid ARFCN range, this could be either by a handover procedure or a new request for radio resource. In the case of a handover procedure the Power Level indicated in the HANDOVER COMMAND message is the maximum power control level supported by the MS. In the case of an Access Burst the MS shall use the Power Level indicated in the MS\_TXPWR\_MAX\_CCH parameter. If the power class of the MS is DCS 1 800 Class 3, the MS shall also use the POWER\_OFFSET parameter.

The SS takes power measurement samples evenly distributed over the duration of the access burst as described in a). However, in this case the SS identifies the centre of the useful bits of the burst by identifying the transition from the last bit of the synch sequence. The centre of the burst is then five data bits prior to this point and is used as the timing reference.

The transmitter output power is calculated as the average of the samples over the 87 useful bits of the burst. This is also used as the 0 dB reference for the power/time template.

h) Measurement of access burst timing delay

The burst timing delay is the difference in time between the timing reference identified in g) and the MS received data on the common control channel.

i) Measurement of access burst power/time relationship

The array of power samples measured in g) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in g).

j) Depending on the method used in step g) to cause the MS to send an Access Burst, the SS sends either a HANDOVER COMMAND with power control level set to 10 or it changes the System Information elements MS\_TXPWR\_MAX\_CCH and for DCS 1 800 the POWER\_OFFSET on the serving cell BCCH in order to limit the MS transmit power on the Access Burst to power control level 10 (+23 dBm for GSM 400 and GSM 900 or +10 dBm for DCS 1 800) and then steps g) to i) are repeated.

k) Steps a) to j) are repeated under extreme test conditions (annex 1, TC2.2) except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

#### 13.7.4.2 Method of test for equipment with an integral antenna

NOTE: If the MS is equipped with a permanent connector, such that the antenna can be disconnected and the SS be connected directly, then the method of section 13.7.4.1 will be applied.

The tests in this section are performed on an unmodified test sample.

##### 13.7.4.2.1 Initial conditions

The MS is placed in the anechoic shielded chamber (annex 1, GC5) or on the outdoor test site, on an isolated support, in the position for normal use, at a distance of at least 3 metres from a test antenna, connected to the SS.

NOTE: The test method described has been written for measurement in an anechoic shielded chamber. If an outdoor test site is used then, in addition, it is necessary to raise/lower the test antenna through the specified height range to maximize the received power levels from both the test sample and the substitution antenna.

A call is set up by the SS according to the generic call set up procedure on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power. MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

##### 13.7.4.2.2 Procedure

a) With the initial conditions set according to subclause 13.7.4.2.1 the test procedure in 13.7.4.1.2 is followed up to and including step j), except that in step a), when measurements are done at maximum power for ARFCN in the Low, Mid and High range, the measurement is made eight times with the MS rotated by  $n \cdot 45$  degrees for all values of  $n$  in the range 0 to 7.

The measurements taken are received transmitter output power measurements rather than transmitter output power measurements, the output power measurement values can be derived as follows.

- b) Assessment of test site loss for scaling of received output power measurements.

The MS is replaced by a half-wave dipole, resonating at the centre frequency of the transmit band, connected to an RF generator.

The frequency of the RF signal generator is set to the frequency of the ARFCN used for the 24 measurements in step a), the output power is adjusted to reproduce the received transmitter output power averages recorded in step a).

For each indication the power, delivered by the generator (in Watts) to the half-wave dipole, is recorded. These values are recorded in the form  $P_{nc}$ , where  $n$  = MS rotation and  $c$  = channel number.

For each channel number used compute:

$$P_{ac}(\text{Watts into dipole}) = \frac{1}{8} * \sum_{n=0}^{n=7} P_{nc}$$

from which:  $P_{ac}(\text{Tx dBm}) = 10\log_{10}(P_{ac}) + 30 + 2,15$

The difference, for each of the three channels, between the actual transmitter output power averaged over the 8 measurement orientations and the received transmitter output power at orientation  $n = 0$  is used to scale the received measurement results to actual transmitter output powers for all measured power control levels and ARFCN, which can then be checked against the requirements.

- c) Temporary antenna connector calibration factors (transmit)

A modified test sample equipped with a temporary antenna connector is placed in a climatic test chamber and is linked to the SS by means of the temporary antenna connector.

Under normal test conditions, the power measurement and calculation parts of steps a) to j) of 13.7.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

NOTE: The values noted here are related to the output transmitter carrier power levels under normal test conditions, which are known after step b). Therefore frequency dependent calibration factors that account for the effects of the temporary antenna connector can be determined.

- d) Measurements at extreme test conditions.

NOTE: Basically the procedure for extreme conditions is:

- the power/time template is tested in the "normal" way,
- the radiated power is measured by measuring the difference with respect to the radiated power under normal test conditions.

Under extreme test conditions steps a) to j) of 13.7.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

The transmitter output power under extreme test conditions is calculated for each burst type, power control level and for every frequency used by adding the frequency dependent calibration factor, determined in c), to the values obtained at extreme conditions in this step.

### 13.7.5 Test requirements

- a) The transmitter output power on each subchannel, under every combination of normal and extreme test conditions, for normal bursts and access bursts, at each frequency and for each power control level applicable to the MS power class, shall be at the relevant level shown in table 13.7-1 or table 13.7-2 within the tolerances also shown in table 13.7-1 or table 13.7-2.

GSM 400 and GSM 900 only - begin

**Table 13.7-1: GSM 400 and GSM 900 transmitter output power for different power classes**

Power class				Power control level	Transmitter output power	Tolerances	
2	3	4	5			dBm	normal
.	.	.	.	2	39	+/-2 dB	+/-2,5 dB
.	.	.	.	3	37	+/-3 dB*)	+/-4 dB*)
.	.	.	.	4	35	+/-3 dB	+/-4 dB
.	.	.	.	5	33	+/-3 dB*)	+/-4 dB*)
.	.	.	.	6	31	+/-3 dB	+/-4 dB
.	.	.	.	7	29	+/-3 dB*)	+/-4 dB*)
.	.	.	.	8	27	+/-3 dB	+/-4 dB
.	.	.	.	9	25	+/-3 dB	+/-4 dB
.	.	.	.	10	23	+/-3 dB	+/-4 dB
.	.	.	.	11	21	+/-3 dB	+/-4 dB
.	.	.	.	12	19	+/-3 dB	+/-4 dB
.	.	.	.	13	17	+/-3 dB	+/-4 dB
.	.	.	.	14	15	+/-3 dB	+/-4 dB
.	.	.	.	15	13	+/-3 dB	+/-4 dB
.	.	.	.	16	11	+/-5 dB	+/-6 dB
.	.	.	.	17	9	+/-5 dB	+/-6 dB
.	.	.	.	18	7	+/-5 dB	+/-6 dB
.	.	.	.	19	5	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

GSM 400 and GSM 900 only - end

DCS 1 800 only - begin

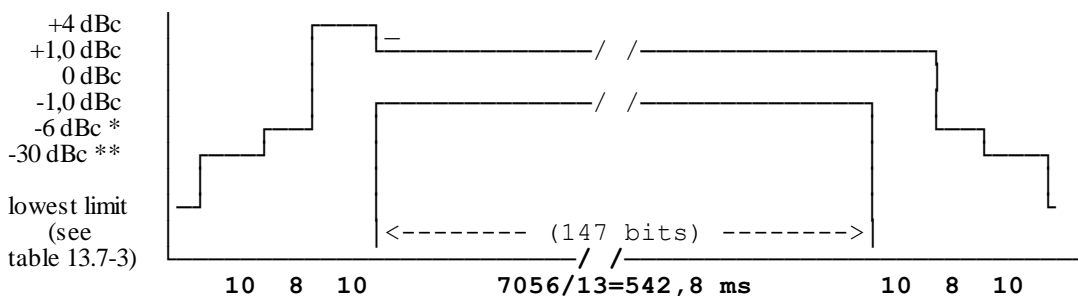
**Table 13.7-2: DCS 1 800 transmitter output power for different power classes**

Power class			Power control level	Transmitter output power	Tolerances	
1	2	3			normal	extreme
		.	29	36	+/-2,0 dB	+/-2,5 dB
		.	30	34	+/-3,0 dB	+/-4,0 dB
		.	31	32	+/-3,0 dB	+/-4,0 dB
.	.	.	0	30	+/-3,0 dB*)	+/-4 dB*)
.	.	.	1	28	+/-3 dB	+/-4 dB
.	.	.	2	26	+/-3 dB	+/-4 dB
.	.	.	3	24	+/-3 dB*)	+/-4 dB*)
.	.	.	4	22	+/-3 dB	+/-4 dB
.	.	.	5	20	+/-3 dB	+/-4 dB
.	.	.	6	18	+/-3 dB	+/-4 dB
.	.	.	7	16	+/-3 dB	+/-4 dB
.	.	.	8	14	+/-3 dB	+/-4 dB
.	.	.	9	12	+/-4 dB	+/-5 dB
.	.	.	10	10	+/-4 dB	+/-5 dB
.	.	.	11	8	+/-4 dB	+/-5 dB
.	.	.	12	6	+/-4 dB	+/-5 dB
.	.	.	13	4	+/-4 dB	+/-5 dB
.	.	.	14	2	+/-5 dB	+/-6 dB
.	.	.	15	0	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

DCS 1 800 only - end

- b) The difference between the transmitter output power at two adjacent power control levels, measured at the same frequency, shall not be less than 0,5 dB and not be more than 3,5 dB.
- c) The power/time relationship of the measured samples for normal bursts shall be within the limits of the power time template of figure 13.7-2 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.



**Figure 13.7-2: Power / time template for normal bursts**

\* For GSM400 and GSM900 MS: -4 dBc for power control level 16

-2 dBc for power control level 17

-1 dBc for power control levels 18 and 19

For DCS1800 MS: -4 dBc for power control level 11

-2 dBc for power control level 12

-1 dBc for power control levels 13, 14 and 15

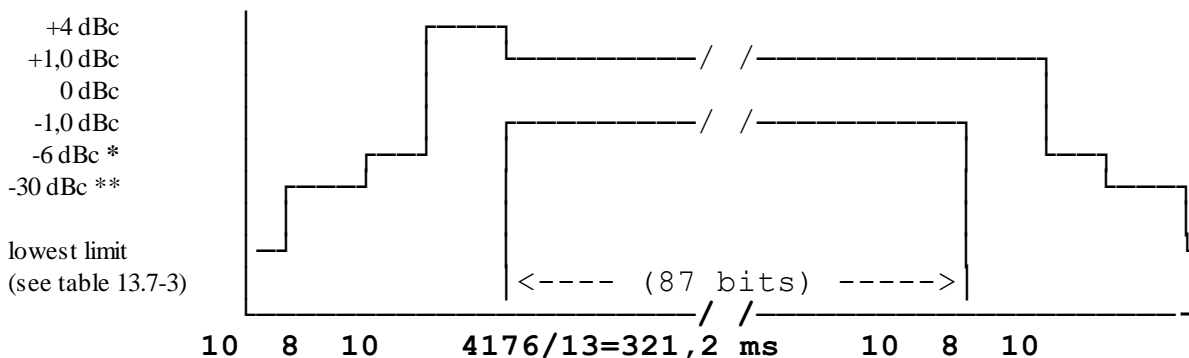
\*\* For GSM400 and GSM900 MS: -30 dBc or -17 dBm, whichever is the higher

For DCS1800 MS: -30 dBc or -20 dBm, whichever is the higher

**Table 13.7-3: Lowest measurement limit for power / time template**

	lowest limit
GSM400, GSM900	-59 dBc or -54 dBm whichever is the highest, except for the timeslot preceding the active slot, for which the allowed level is -59 dBc or -36 dBm, whichever is the highest
DCS1800	-48 dBc or -48 dBm whichever is the highest

- d) All the power control levels, for the type and power class of the MS as stated by the manufacturer, shall be implemented in the MS.
- e) When the transmitter is commanded to a power control level outside of the capability corresponding to the type and power class of the MS as stated by the manufacturer, then the transmitter output power shall be within the tolerances for the closest power control level corresponding to the type and power class as stated by the manufacturer.
- f) The centre of the transmitted normal burst as defined by the transition of bits 13/14 of the midamble shall be 3 timeslot periods (1731 μs) +/- 1 bit period (+/- 3,69 μs) after the centre of the corresponding received burst.
- g) The power/time relationship of the measured samples for access bursts shall be within the limits of the power time template of figure 13.7-3 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.



**Figure 13.7-3: Power / time template for access burst**

\* For GSM400 and GSM900 MS: -4 dBc for power control level 16

-2 dBc for power control level 17

-1 dBc for power control levels 18 and 19

For DCS1800 MS: -4 dBc for power control level 11

-2 dBc for power control level 12

-1 dBc for power control levels 13, 14 and 15

\*\* For GSM400 and GSM900 MS: -30 dBc or -17 dBm, whichever is the higher

For DCS1800 MS: -30 dBc or -20 dBm, whichever is the higher

- h) The centre of the transmitted access burst shall be an integer number of timeslot periods less 30 bit periods relative to any CCCH midamble centre with a tolerance of +/- 1 bit period (+/- 3,69 μs).

## 13.8 Output RF spectrum in HSCSD multislot configuration

### 13.8.1 Definition and applicability

The output RF spectrum is the relationship between the frequency offset from the carrier and the power, measured in a specified bandwidth and time, produced by the MS due to the effects of modulation and power ramping.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS and any multiband MS, which are capable of HSCSD multislot operation.

### 13.8.2 Conformance requirement

1. The level of the output RF spectrum due to modulation shall be no more than that given in GSM 05.05, 4.2.1, table a) for GSM 400 and GSM 900 or table b) for DCS 1 800, with the following lowest measurement limits:

- -36 dBm below 600 kHz offset from the carrier,
- -51 dBm for GSM 400 and GSM 900 or -56 dBm for DCS 1 800 from 600 kHz out to less than 1 800 kHz offset from the carrier,
- -46 dBm for GSM 400 and GSM 900 or -51 dBm for DCS 1 800 at and beyond 1 800 kHz offset from the carrier,

but with the following exceptions at up to -36 dBm:

- up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz in the combined range 600 kHz to 6000 kHz above and below the carrier,
- up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz at more than 6 000 kHz offset from the carrier.

1.1 Under normal conditions; GSM 05.05, 4.2.1.

1.2 Under extreme conditions; GSM 05.05, 4.2.1; GSM 05.05, annex D D.2.1, D.2.2.

2. The level of the output RF spectrum due to switching transients shall be no more than given in GSM 05.05, 4.2.2, table "a) Mobile Station:".

2.1 Under normal conditions; GSM 05.05, 4.2.2.

2.2 Under extreme conditions; GSM 05.05, 4.2.2; GSM 05.05 annex D D.2.1, D.2.2.

3. When allocated a channel, the power emitted by the MS, in the band 935 to 960 MHz shall be no more than -79 dBm, in the band 925 to 935 MHz shall be no more than -67 dBm and in the band 1 805 to 1 880 MHz shall be no more than -71 dBm except in five measurements in each of the bands 925 to 960 MHz and 1 805 to 1 880 MHz where exceptions at up to -36 dBm are permitted. For GSM 400 MS, in addition, the power emitted by MS, in the bands of 460.4 to 467.6 MHz and 488.8 to 496 MHz shall be no more than -67 dBm except in three measurements in each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where exceptions at up to -36 dBm are permitted. Under normal conditions; GSM 05.05, 4.3.3.

### 13.8.3 Test purpose

1. To verify that the output RF spectrum due to modulation does not exceed conformance requirement 1 in the multislot configurations.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.
2. To verify that the output RF spectrum due to switching transients does not exceed conformance requirement 2 in the multislot configurations when a reasonable margin is allowed for the effect of spectrum due to modulation.
  - 2.1 Under normal conditions.



2.2 Under extreme conditions.

3. To verify that the MS spurious emissions in the MS receive band do not exceed conformance requirement 3 in the multislot configurations.

#### 13.8.4 Method of test

##### 13.8.4.1 Initial conditions

A call is set up according to the generic call set up procedure for multislot HSCSD.

The SS commands the MS to hopping mode. The hopping pattern includes only three channels, namely one with an ARFCN in the Low ARFCN range, a second one with an ARFCN in the Mid ARFCN range and the third one with an ARFCN in the High ARFCN range.

NOTE 1: Although the measurement is made whilst the MS is in hopping mode, each measurement is on one single channel.

NOTE 2: This test is specified in hopping mode as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to handover the MS between the three channels tested at the appropriate time.

The SS sends Standard Test Signal C1 (annex 5) to the MS at a level of  $23 \text{ dB}\mu\text{Vemf}$  ( ).

The SS sets the MS to operate in a multislot configuration where is maximum number of transmitting timeslots. Maximum power level is set in all channels.

##### 13.8.4.2 Procedure

NOTE: When averaging is in use during frequency hopping mode, the averaging only includes bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement.

a) In steps b) to h) the FT is equal to the hop pattern ARFCN in the Mid ARFCN range.

b) The other settings of the spectrum analyser are set as follows:

- Zero frequency scan
- Resolution bandwidth: 30 kHz
- Video bandwidth: 30 kHz
- Video averaging: may be used, depending on the implementation of the test

The video signal of the spectrum analyser is "gated" such that the spectrum generated by at least 40 of the bits 87 to 132 of the burst in one of the active time slots is the only spectrum measured. This gating may be analogue or numerical, dependent upon the design of the spectrum analyser. Only measurements during transmitted bursts on the nominal carrier of the measurement are included. The spectrum analyser averages over the gated period and over 200 or 50 such bursts, using numerical and/or video averaging.

c) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 50 bursts at all multiples of 30 kHz offset from FT to  $< 1\ 800 \text{ kHz}$ .

d) The resolution and video bandwidth on the spectrum analyser are adjusted to 100 kHz and the measurements are made at the following frequencies:

on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the band 925 - 960 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.

in addition for GSM 400 MS:

at 200 kHz intervals over the band 460.4 to 467.6 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 488.8 to 496 MHz for each measurement over 50 bursts.

- e) The MS is commanded to its minimum power control level. The spectrum analyser is set again as in b).
- f) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 200 bursts at the following frequencies:

FT

FT + 100 kHz                      FT - 100 kHz

FT + 200 kHz                      FT - 200 kHz

FT + 250 kHz                      FT - 250 kHz

FT + 200 kHz \* N              FT - 200 kHz \* N

where N = 2, 3, 4, 5, 6, 7, and 8

and FT = RF channel nominal centre frequency.

- g) Steps a) to f) is repeated except that in step a) the spectrum analyzer is gated so that the burst of the next active time slot is measured.
- h) The spectrum analyser settings are adjusted to:
- Zero frequency scan
  - Resolution bandwidth:              30 kHz
  - Video bandwidth:                      100 kHz
  - Peak hold

The spectrum analyser gating of the signal is switched off.

The MS is commanded to its maximum power control level in every transmitted time slot.

- i) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured at the following frequencies:

FT + 400 kHz                      FT - 400 kHz

FT + 600 kHz                      FT - 600 kHz

FT + 1,2 MHz                      FT - 1,2 MHz

FT + 1,8 MHz                      FT - 1,8 MHz

where FT = RF channel nominal centre frequency.

The duration of each measurement (at each frequency) will be such as to cover at least 10 burst transmissions at FT.

- j) Step i) is repeated for power control levels 7 and 11.
- k) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the Low ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.
- l) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the High ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.

m) Steps a) b) f) h), and i) are repeated under extreme test conditions (annex 1, TC2.2). except that at step h) the MS is commanded to power control level 11.

13.8.5 Test requirements

For absolute measurements, performed on a temporary antenna connector, in the frequency band 450.4 to 457.6 MHz, 478.8 to 486 MHz, 880 to 915 MHz or 1710 to 1785 MHz, the temporary antenna connector coupling factor, determined according to 13.3.4.2.2 and annex 1 GC7, for the nearest relevant frequency, will be used.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 925 to 960 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 400 or GSM 900 MS. For a DCS 1 800 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 1805 to 1880 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for DCS 1 800 MS. For GSM 400 or GSM 900 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 460.4 to 467.6 MHz or 488.8 to 496 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 400 MS. For a GSM 900 or DCS 1800 MS 0 dB will be assumed.

The figures in the tables below, at the listed frequencies from the carrier (kHz), are the maximum level (dB) relative to a measurement in 30 kHz bandwidth on the carrier (reference GSM 05.05 section 4.2.1).

- a) For the modulation sidebands out to less than 1 800 kHz offset from the carrier frequency (FT) measured in step c), f), i), k), l) and m) the measured power level in dB relative to the power level measured at FT, for all types of MS, shall not exceed the limits derived from the values shown in table 1 for GSM 400 and GSM 900 or table 2 for DCS 1 800 according to the actual transmit power and frequency offset from FT. However any failures in the combined range 600 kHz to less than 1 800 kHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below.

**Table 1: GSM 400 and GSM 900 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
39	+0,5	-30	-33	-60	-66
37	+0,5	-30	-33	-60	-64
35	+0,5	-30	-33	-60	-62
<= 33	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-51

**Table 2: DCS 1 800 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
<= 36	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-56

NOTE 1: For frequency offsets between 100 kHz and 600 kHz the requirement is derived by a linear interpolation between the points identified in the table with linear frequency and power in dB relative.

- b) For the modulation sidebands from 1 800 kHz offset from the carrier frequency (FT) and out to 2 MHz beyond the edge of the relevant transmit band, measured in step d), the measured power level in dB relative to the power level measured at FT, shall not exceed the values shown in table 3 according to the actual transmit power, frequency offset from FT and system on which the MS is designed to operate. However any failures in the combined range 1 800 kHz to 6 MHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below, and any other failures may be counted towards the exceptions allowed in test requirements d) below.

**Table 3: Spectrum due to modulation from 1 800 kHz offset to the edge of the transmit band (wideband noise)**

power levels in dB relative to the measurement at FT						
GSM 400 and GSM900				DCS1800		
Power level (dBm)	Frequency offset kHz			Power level (dBm)	Frequency offset kHz	
	1800 to < 3000	3000 to < 6000	>= 6000		1800 to < 6000	>= 6000
39	-69	-71	-77	36	-71	-79
37	-67	-69	-75	34	-69	-77
35	-65	-67	-73	32	-67	-75
<= 33	-63	-65	-71	30	-65	-73
				28	-63	-71
				26	-61	-69
				<= 24	-59	-67
The values above are subject to the minimum absolute levels (dBm) below.						
	-46	-46	-46		-51	-51

- c) Any failures (from a) and b) above) in the combined range 600 kHz to 6 MHz above and below the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, spurious emissions are allowed in up to three 200 kHz bands centred on an integer multiple of 200 kHz so long as no spurious emission exceeds -36 dBm. Any spurious emissions measured in a 30 kHz bandwidth which spans two 200 kHz bands can be counted towards either 200 kHz band, whichever minimizes the number of 200 kHz bands containing spurious exceptions.
- d) Any failures (from b) above) beyond 6 MHz offset from the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, up to twelve spurious emissions are allowed so long as no spurious emission exceeds -36 dBm.
- e) The MS spurious emissions in the bands 925 - 935 MHz, 935 - 960 MHz and 1 805 - 1 880 MHz, measured in step d), for all types of MS, shall not exceed the values shown in table 4 except in up to five measurements in the band 925 to 960 MHz and five measurements in the band 1 805 to 1 880 MHz where a level up to -36 dBm is permitted. For GSM 400 MS, in addition, the MS spurious emissions in the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz shall not exceed the value of -67 dBm, except in up to three measurements in each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where a level up to -36 dBm is permitted.

**Table 4: Spurious emissions in the MS receive bands**

Band (MHz)	Spurious emissions level (dBm)
925 to 935	-67
935 to 960	-79
1805 to 1880	-71

- f) For the power ramp sidebands of steps h), i) and k) the power levels must not exceed the values shown in table 5 for GSM 400 and GSM 900 or table 6 for DCS 1 800.

**Table 5: GSM Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
39 dBm	-13 dBm	-21 dBm	-21 dBm	-24 dBm
37 dBm	-15 dBm	-21 dBm	-21 dBm	-24 dBm
35 dBm	-17 dBm	-21 dBm	-21 dBm	-24 dBm
33 dBm	-19 dBm	-21 dBm	-21 dBm	-24 dBm
31 dBm	-21 dBm	-23 dBm	-23 dBm	-26 dBm
29 dBm	-23 dBm	-25 dBm	-25 dBm	-28 dBm
27 dBm	-23 dBm	-26 dBm	-27 dBm	-30 dBm
25 dBm	-23 dBm	-26 dBm	-29 dBm	-32 dBm
23 dBm	-23 dBm	-26 dBm	-31 dBm	-34 dBm
<= +21 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

**Table 6: DCS 1 800 Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
36 dBm	-16 dBm	-21 dBm	-21 dBm	-24 dBm
34 dBm	-18 dBm	-21 dBm	-21 dBm	-24 dBm
32 dBm	-20 dBm	-22 dBm	-22 dBm	-25 dBm
30 dBm	-22 dBm	-24 dBm	-24 dBm	-27 dBm
28 dBm	-23 dBm	-25 dBm	-26 dBm	-29 dBm
26 dBm	-23 dBm	-26 dBm	-28 dBm	-31 dBm
24 dBm	-23 dBm	-26 dBm	-30 dBm	-33 dBm
22 dBm	-23 dBm	-26 dBm	-31 dBm	-35 dBm
<= +20 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

NOTE 2: These figures are different from the requirements in GSM 05.05 because at higher power levels it is the modulation spectrum which is being measured using a peak hold measurement. This allowance is given in the table.

NOTE 3: The figures for table 5 and table 6 assume that, using the peak hold measurement, the lowest level measurable is 8 dB above the level of the modulation specification using the 30 kHz bandwidth gated average technique for 400 kHz offset from the carrier. At 600 and 1200 kHz offset the level is 6 dB above and at 1 800 kHz offset the level is 3 dB above. The figures for 1 800 kHz have assumed the 30 kHz bandwidth spectrum due to modulation specification at <1 800 kHz.

## 13.9 Output RF spectrum for MS supporting the R-GSM band

### 13.9.1 Definition and applicability

The output RF spectrum is the relationship between the frequency offset from the carrier and the power, measured in a specified bandwidth and time, produced by the MS due to the effects of modulation and power ramping.

The requirements and this test apply to all types of R-GSM 900.

### 13.9.2 Conformance requirement

1. The level of the output RF spectrum due to modulation shall be no more than that given in GSM 05.05, 4.2.1, table a) for R-GSM 900 with the following lowest measurement limits:
  - -36 dBm below 600 kHz offset from the carrier,
  - -51 dBm for R-GSM 900 from 600 kHz out to less than 1 800 kHz offset from the carrier,

- -46 dBm for R-GSM 900 at and beyond 1 800 kHz offset from the carrier,

but with the following exceptions at up to -36 dBm:

- up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz in the combined range 600 kHz to 6000 kHz above and below the carrier,
- up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz at more than 6 000 kHz offset from the carrier.

1.1 Under normal conditions; GSM 05.05, 4.2.1.

1.2 Under extreme conditions; GSM 05.05, 4.2.1; GSM 05.05, annex D D.2.1, D.2.2.

2. The level of the output RF spectrum due to switching transients shall be no more than given in GSM 05.05, 4.2.2, table "a) Mobile Station:".

2.1 Under normal conditions; GSM 05.05, 4.2.2.

2.2 Under extreme conditions; GSM 05.05, 4.2.2; GSM 05.05 annex D D.2.1, D.2.2.

3. When allocated a channel, the power emitted by the MS, in the band 935 to 960 MHz shall be no more than -79 dBm, in the band 925 to 935 MHz shall be no more than -67 dBm, in the band 921 to 925 MHz shall be no more than -60 dBm and in the band 1 805 to 1 880 MHz shall be no more than -71 dBm except in five measurements in each of the bands 925 to 960 MHz and 1 805 to 1 880 MHz where exceptions at up to -36 dBm are permitted. Under normal conditions; GSM 05.05, 4.3.3.

### 13.9.3 Test purpose

1. To verify that the output RF spectrum due to modulation does not exceed conformance requirement 1.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.
2. To verify that the output RF spectrum due to switching transients does not exceed conformance requirement 2 when a reasonable margin is allowed for the effect of spectrum due to modulation.
  - 2.1 Under normal conditions.
  - 2.2 Under extreme conditions.
3. To verify that the MS spurious emissions in the MS receive band do not exceed conformance requirement 3.

### 13.9.4 Method of test

#### 13.9.4.1 Initial conditions

A call is set up according to the generic call set up procedure.

The SS commands the MS to hopping mode. The hopping pattern includes only three channels, namely one with an ARFCN in the Low R-GSM ARFCN range, a second one with an ARFCN in the Mid ARFCN range and the third one with an ARFCN in the High ARFCN range.

NOTE 1: Although the measurement is made whilst the MS is in hopping mode, each measurement is on one single channel.

NOTE 2: This test is specified in hopping mode as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to handover the MS between the three channels tested at the appropriate time.

The SS commands the MS to complete the traffic channel loop back without signalling of erased frames (see 36.2.1.1). This is to set a defined random pattern for the transmitter.

The SS sends Standard Test Signal C1 (annex 5) to the MS at a level of 23 dBμVemf( ).

13.9.4.2 Procedure

NOTE: When averaging is in use during frequency hopping mode, the averaging only includes bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement.

- a) In steps b) to h) the FT is equal to the hop pattern ARFCN in the Mid ARFCN range.
- b) The other settings of the spectrum analyser are set as follows:
  - Zero frequency scan
  - Resolution bandwidth: 30 kHz
  - Video bandwidth: 30 kHz
  - Video averaging: may be used, depending on the implementation of the test

The video signal of the spectrum analyser is "gated" such that the spectrum generated by at least 40 of the bits 87 to 132 of the burst is the only spectrum measured. This gating may be analogue or numerical, dependent upon the design of the spectrum analyser. Only measurements during transmitted bursts on the nominal carrier of the measurement are included. The spectrum analyser averages over the gated period and over 200 or 50 such bursts, using numerical and/or video averaging.

The MS is commanded to its maximum power control level.

- c) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 50 bursts at all multiples of 30 kHz offset from FT to < 1 800 kHz.
- d) The resolution and video bandwidth on the spectrum analyser are adjusted to 100 kHz and the measurements are made at the following frequencies:
  - on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.
  - at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.
  - at 200 kHz intervals over the band 921 - 960 MHz for each measurement over 50 bursts.
  - at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.
- e) The MS is commanded to its minimum power control level. The spectrum analyser is set again as in b).
- f) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 200 bursts at the following frequencies:

- FT
- FT + 100 kHz                      FT - 100 kHz
- FT + 200 kHz                    FT - 200 kHz
- FT + 250 kHz                    FT - 250 kHz
- FT + 200 kHz \* N              FT - 200 kHz \* N

where N = 2, 3, 4, 5, 6, 7, and 8  
and FT = RF channel nominal centre frequency.

- g) The spectrum analyser settings are adjusted to:
  - Zero frequency scan

- Resolution bandwidth: 30 kHz
- Video bandwidth: 100 kHz
- Peak hold

The spectrum analyser gating of the signal is switched off.

The MS is commanded to its maximum power control level.

- h) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured at the following frequencies:

FT + 400 kHz	FT - 400 kHz
FT + 600 kHz	FT - 600 kHz
FT + 1,2 MHz	FT - 1,2 MHz
FT + 1,8 MHz	FT - 1,8 MHz

where FT = RF channel nominal centre frequency.

The duration of each measurement (at each frequency) will be such as to cover at least 10 burst transmissions at FT.

- i) Step h) is repeated for power control levels 7 and 11.
- j) Steps b), f), g) and h) are repeated with FT equal to the hop pattern ARFCN in the Low R-GSM ARFCN range except that in step g) the MS is commanded to power control level 11 rather than maximum power.
- k) Steps b), f), g) and h) are repeated with FT equal to the hop pattern ARFCN in the High ARFCN range except that in step g) the MS is commanded to power control level 11 rather than maximum power.
- l) Steps a), b), f), g) and h) are repeated under extreme test conditions (annex 1, TC2.2). except that at step g) the MS is commanded to power control level 11.

### 13.9.5 Test requirements

For absolute measurements, performed on a temporary antenna connector, in the frequency band 876 to 915 MHz or 1710 to 1785 MHz, the temporary antenna connector coupling factor, determined according to 13.3.4.2.2 and annex 1 GC7, for the nearest relevant frequency, will be used.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 921 to 960 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 900 MS

For absolute measurements, performed on a temporary antenna connector, in the frequency band 1805 to 1880 MHz for R-GSM 900 MS 0 dB will be assumed.

The figures in the tables below, at the listed frequencies from the carrier (kHz), are the maximum level (dB) relative to a measurement in 30 kHz bandwidth on the carrier (reference GSM 05.05 section 4.2.1).

- a) For the modulation sidebands out to less than 1 800 kHz offset from the carrier frequency (FT) measured in step c), f), h), j), k) and l) the measured power level in dB relative to the power level measured at FT, for all types of MS, shall not exceed the limits derived from the values shown in table 13.9-1 for R-GSM 900 according to the actual transmit power and frequency offset from FT. However any failures in the combined range 600 kHz to less than 1 800 kHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below.



**Table 13.9-1a: R-GSM 900 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
39	+0,5	-30	-33	-60	-66
37	+0,5	-30	-33	-60	-64
35	+0,5	-30	-33	-60	-62
<= 33	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-51

NOTE 1: For frequency offsets between 100 kHz and 600 kHz the requirement is derived by a linear interpolation between the points identified in the table with linear frequency and power in dB relative.

- b) For the modulation sidebands from 1 800 kHz offset from the carrier frequency (FT) and out to 2 MHz beyond the edge of the relevant transmit band, measured in step d), the measured power level in dB relative to the power level measured at FT, shall not exceed the values shown in table 13.9-2 according to the actual transmit power, frequency offset from FT and system on which the MS is designed to operate. However any failures in the combined range 1 800 kHz to 6 MHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below, and any other failures may be counted towards the exceptions allowed in test requirements d) below.

**Table 13.9-2: Spectrum due to modulation from 1 800 kHz offset to the edge of the transmit band (wideband noise)**

Power levels in dB relative to the measurement at FT			
R-GSM900			
Power level	Frequency offset		
(dBm)	kHz		
	1800 to	3000 to	>= 6000
	< 3000	< 6000	
39	-69	-71	-77
37	-67	-69	-75
35	-65	-67	-73
<= 33	-63	-65	-71
The values above are subject to the minimum absolute levels (dBm) below			
	-46	-46	-46

- c) Any failures (from a) and b) above) in the combined range 600 kHz to 6 MHz above and below the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, spurious emissions are allowed in up to three 200 kHz bands centred on an integer multiple of 200 kHz so long as no spurious emission exceeds -36 dBm. Any spurious emissions measured in a 30 kHz bandwidth which spans two 200 kHz bands can be counted towards either 200 kHz band, whichever minimizes the number of 200 kHz bands containing spurious exceptions.
- d) Any failures (from b) above) beyond 6 MHz offset from the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, up to twelve spurious emissions are allowed so long as no spurious emission exceeds -36 dBm.
- e) The MS spurious emissions in the bands 921 – 925, 925 - 935 MHz, 935 - 960 MHz and 1 805 - 1 880 MHz, measured in step d), for all types of MS, shall not exceed the values shown in table 13.9-3 except in up to five measurements in the band 925 to 960 MHz and five measurements in the band 1 805 to 1 880 MHz where a level up to -36 dBm is permitted.

**Table 13.9-3: Spurious emissions in the R-GSM MS receive bands**

<b>Band (MHz)</b>	<b>Spurious emissions level (dBm)</b>
921 to 925	-60
925 to 935	-67
935 to 960	-79
1805 to 1880	-71

f) For the power ramp sidebands of steps h) and i) the power levels must not exceed the values shown in table 13.9-4 for GSM 900.

**Table 13.9-4: R-GSM Spectrum due to switching transients**

<b>Power level</b>	<b>Maximum level for various offsets from carrier frequency</b>			
	<b>400 kHz</b>	<b>600 kHz</b>	<b>1200 kHz</b>	<b>1800 kHz</b>
39 dBm	-13 dBm	-21 dBm	-21 dBm	-24 dBm
37 dBm	-15 dBm	-21 dBm	-21 dBm	-24 dBm
35 dBm	-17 dBm	-21 dBm	-21 dBm	-24 dBm
33 dBm	-19 dBm	-21 dBm	-21 dBm	-24 dBm
31 dBm	-21 dBm	-23 dBm	-23 dBm	-26 dBm
29 dBm	-23 dBm	-25 dBm	-25 dBm	-28 dBm
27 dBm	-23 dBm	-26 dBm	-27 dBm	-30 dBm
25 dBm	-23 dBm	-26 dBm	-29 dBm	-32 dBm
23 dBm	-23 dBm	-26 dBm	-31 dBm	-34 dBm
<= +21 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

NOTE 2: These figures are different from the requirements in GSM 05.05 because at higher power levels it is the modulation spectrum which is being measured using a peak hold measurement. This allowance is given in the table.

NOTE 3: The figures for table 13.9-4 assume that, using the peak hold measurement, the lowest level measurable is 8 dB above the level of the modulation specification using the 30 kHz bandwidth gated average technique for 400 kHz offset from the carrier. At 600 and 1200 kHz offset the level is 6 dB above and at 1 800 kHz offset the level is 3 dB above. The figures for 1 800 kHz have assumed the 30 kHz bandwidth spectrum due to modulation specification at <1 800 kHz.

13.10 *[Reserved for future GSM test]*

13.11 *[Reserved for future GSM test]*

13.12 *[Reserved for future GSM test]*

13.13 *[Reserved for future GSM test]*

13.14 *[Reserved for future GSM test]*

13.15 *[Reserved for future GSM test]*

## 13.16 GPRS transmitter tests

### 13.16.1 Frequency error and phase error in GPRS multislot configuration

#### 13.16.1.1 Definition and applicability

The frequency error is the difference in frequency, after adjustment for the effect of the modulation and phase error, between the RF transmission from the MS and either:

- the RF transmission from the BS, or
- the nominal frequency for the ARFCN used.

The phase error is the difference in phase, after adjustment for the effect of the frequency error, between the RF transmission from the MS and the theoretical transmission according to the intended modulation.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS which are capable of GPRS multislot operation.

#### 13.16.1.2 Conformance requirement

1. The MS carrier frequency shall be accurate to within 0,1 ppm compared to signals received from the BS.
  - 1.1 Under normal conditions; GSM 05.10, 6.1.
  - 1.2 Under vibration conditions; GSM 05.10, 6.1; GSM 05.05, annex D D.2.3.
  - 1.3 Under extreme conditions; GSM 05.10, 6.1; GSM 05.05, 4.4; GSM 05.05, annex D D.2.1, D.2.2.
2. The RMS phase error (difference between the phase error trajectory and its linear regression on the active part of the time slot) for each burst shall not be greater than 5 degrees.
  - 2.1 Under normal conditions; GSM 05.05, 4.6.
  - 2.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 2.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
3. The maximum peak deviation during the useful part of each burst shall not be greater than 20 degrees.
  - 3.1 Under normal conditions; GSM 05.05, 4.6.
  - 3.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.

3.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.

#### 13.16.1.3 Test purpose

1. To verify that in a multislot configuration the MS carrier frequency error does not exceed 0.1 ppm:
  - Under normal conditions
  - 1.2 When the MS is being vibrated
  - 1.3 Under extreme conditions
2. To verify that the RMS phase error on the useful parts of the bursts transmitted by the MS in a multislot configuration does not exceed conformance requirement 2:
  - 2.1 Under normal conditions
  - 2.2 When the MS is being vibrated
  - 2.3 Under extreme conditions
3. To verify that the maximum phase error on the useful parts of the bursts transmitted by the MS in a multislot configuration does not exceed conformance requirement 3:
  - 3.1 Under normal conditions
  - 3.2 When the MS is being vibrated
  - 3.3 Under extreme conditions

#### 13.16.1.4 Method of the test

NOTE: In order to measure the accuracy of the frequency and phase error a sampled measurement of the transmitted phase trajectory is obtained. This is compared with the theoretically expected phase trajectory. The regression line of the difference between the expected trajectory and the measured trajectory is an indication of the frequency error (assumed constant through the burst), whilst the departure of the phase differences from this trajectory is a measure of the phase error. The peak phase error is the value furthest from the regression line and the RMS phase error is the root mean square average of the phase error of all samples.

##### 13.16.1.4.1 Initial conditions

A call is set up according to the generic call setup procedure for multislot GPRS. The SS commands the MS to hopping mode (table 13.6.1, GSM 11.10).

NOTE: It is not necessary to test in hopping mode but is done here as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to make sure bursts are taken from a few different channels.

The SS activates ciphering mode.

NOTE: Ciphering mode is active during this test to give a pseudo-random bit stream to the modulator.

The SS sets the MS to operate in a multislot configuration with maximum number of transmitted time slots.

The SS commands the MS to complete the multislot PDTCH loop back, type (G), see 04.14, 5.2.1

The SS generates Standard Test Signal C1 of annex 5.

##### 13.16.1.4.2 Procedure

- a) For one transmitted burst on the last slot of the multislot configuration, the SS captures the signal as a series of phase samples over the period of the burst. These samples are evenly distributed over the duration of the burst

with a minimum sampling rate of  $2/T$ , where  $T$  is the modulation symbol period. The received phase trajectory is then represented by this array of at least 294 samples.

- b) The SS then calculates, from the known bit pattern and the formal definition of the modulator contained in GSM 05.04, the expected phase trajectory.
- c) From a) and b) the phase trajectory error is calculated, and a linear regression line computed through this phase trajectory error. The slope of this regression line is the frequency error of the mobile transmitter relative to the simulator reference. The difference between the regression line and the individual sample points is the phase error of that point.

c.1) The sampled array of at least 294 phase measurements is represented by the vector:

$$\varnothing_m = \varnothing_m(0) \dots \varnothing_m(n)$$

where the number of samples in the array  $n+1 \geq 294$ .

c.2) The calculated array, at the corresponding sampling instants, is represented by the vector:

$$\varnothing_c = \varnothing_c(0) \dots \varnothing_c(n).$$

c.3) The error array is represented by the vector:

$$\varnothing_e = \{\varnothing_m(0) - \varnothing_c(0)\} \dots \dots \dots \{\varnothing_m(n) - \varnothing_c(n)\} = \varnothing_e(0) \dots \varnothing_e(n).$$

c.4) The corresponding sample numbers form a vector  $t = t(0) \dots t(n)$ .

c.5) By regression theory the slope of the samples with respect to  $t$  is  $k$  where:

$$k = \frac{\sum_{j=0}^{j=n} t(j) * \varnothing_e(j)}{\sum_{j=0}^{j=n} t(j)^2}$$

c.6) The frequency error is given by  $k/(360 * g)$ , where  $g$  is the sampling interval in  $s$  and all phase samples are measured in degrees.

c.7) The individual phase errors from the regression line are given by:

$$\varnothing_e(j) - k * t(j).$$

c.8) The RMS value  $\varnothing_e$  of the phase errors is given by:

$$\varnothing_e(\text{RMS}) = \left[ \frac{\sum_{j=0}^{j=n} \{\varnothing_e(j) - k * t(j)\}^2}{n + 1} \right]^{1/2}$$

- d) Steps a) to c) are repeated for 20 bursts, not necessarily contiguous.
- e) The SS instructs the MS to its maximum power control level by setting the power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) for each timeslot to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2), all other conditions remaining constant. Steps a) to d) are repeated.
- f) The SS instructs the MS to the minimum power control level, all other conditions remaining constant. Steps a) to d) are repeated.
- g) The MS is hard mounted on a vibration table and vibrated at the frequency/amplitudes specified in an nex 1, TC4. During the vibration steps a) to f) are repeated.

NOTE: If the call is terminated when mounting the MS to the vibration table, it will be necessary to establish the initial conditions again before repeating steps a) to f).

- h) The MS is re-positioned on the vibration table in the two orthogonal planes to the plane used in step g). For each of the orthogonal planes step g) is repeated.
- i) Steps a) to f) are repeated under extreme test conditions (see annex 1, TC2.2).

#### 13.16.1.5.1 Frequency error

For all measured bursts, the frequency error, derived in step c.6), shall be less than  $10E-7$ .

#### 13.16.1.5.2 Phase error

For all measured bursts, the RMS phase error, derived in step c.8), shall not exceed 5 degrees.

For all measured bursts, each individual phase error, derived in step c.7), shall not exceed 20 degrees.

### 13.16.2 Transmitter output power in GPRS multislot configuration

#### 13.16.2.1 Definition and applicability

The transmitter output power is the average value of the power delivered to an artificial antenna or radiated by the MS and its integral antenna, over the time that the useful information bits of one burst are transmitted.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS and any multiband MS, which are capable of GPRS multislot operation.

#### 13.16.2.2 Conformance requirement

1. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of  $\pm 2$  dB under normal conditions; GSM 05.05, 4.1.1, first table.
2. The MS maximum output power shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of  $\pm 2,5$  dB under extreme conditions; GSM 05.05, 4.1.1, first table; GSM 05.05 annex D D.2.1, D.2.2.
3. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM 400 and GSM 900) or fourth table (for DCS 1 800), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 1), with a tolerance of  $\pm 3, 4$  or  $5$  dB under normal conditions; GSM 05.05, 4.1.1, third or fourth table.
4. The power control levels shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM 400 and GSM 900) or fourth table (for DCS 1 800), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 2), with a tolerance of  $\pm 4, 5$  or  $6$  dB under extreme conditions; GSM 05.05, 4.1.1, third or fourth table; GSM 05.05 annex D D.2.1, D.2.2.
5. The output power actually transmitted by the MS at consecutive power control levels shall form a monotonic sequence and the interval between power control levels shall be  $2 \pm 1,5$  dB; GSM 05.05, 4.1.1.
6. The transmitted power level relative to time for a normal burst shall be within the power/time template given in GSM 05.05, annex B top figure. In multislot configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency the template of annex B shall be respected during the useful part of each burst and at the beginning and the end of the series of consecutive bursts. The output power during the guard period between every two consecutive active timeslots shall not exceed the level allowed for the useful part of the first timeslot or the level allowed for the useful part of the second timeslot plus  $3$  dB, whichever is the highest.:
  - 6.1 Under normal conditions; GSM 05.05, 4.5.2..

6.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.

When accessing a cell on the PRACH or RACH and before receiving the first power control parameters during packet transfer on PDCH, all GSM and class 1 and class 2 DCS 1 800 MS shall use the power control level defined by the GPRS\_MS\_TXPWR\_MAX\_CCH parameter broadcast on the PBCCH or MS\_TXPWR\_MAX\_CCH parameter broadcast on the BCCH of the cell. When MS\_TXPWR\_MAX\_CCH is received on the BCCH, a class 3 DCS 1800 MS shall add to it the value POWER\_OFFSET broadcast on the BCCH. If MS\_TXPWR\_MAX\_CCH or the sum defined by: MS\_TXPWR\_MAX\_CCH plus POWER\_OFFSET corresponds to a power control level not supported by the MS as defined by its power class, the MS shall act as though the closest supported power control level had been broadcast.

8. The transmitted power level relative to time for a Random Access burst shall be within the power/time template given in GSM 05.05, annex B bottom figure:

9.1 Under normal conditions; GSM 05.05, 4.5.2.

9.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.

### 13.16.2.3 Test purpose

1. To verify that the maximum output power of the MS in GPRS multislot configuration, under normal conditions, is within conformance requirement 1.
2. To verify that the maximum output power of the MS in GPRS multislot configuration, under extreme conditions, is within conformance requirement 2.
3. To verify that all power control levels, relevant to the class of MS, are implemented in the MS in GPRS multislot configuration and have output power levels, under normal conditions, within conformance requirement 3.
4. To verify that all power control levels have output power levels, under extreme conditions, within conformance requirement 4.
5. To verify that the step in the output power transmitted by the MS in GPRS multislot configuration at consecutive power control levels is within conformance requirement 5 under normal conditions.
6. To verify that the output power relative to time, when sending a normal burst is within conformance requirement 6 in GPRS multislot configuration:
  - 6.1 Under normal conditions.
  - 6.2 Under extreme conditions.
7. To verify that the MS in GPRS multislot configuration uses the maximum power control level according to its power class if commanded to a power control level exceeding its power class.
8. To verify that the output power relative to time, when sending an access burst is within conformance requirement 8 in GPRS multislot configuration:
  - 9.1 Under normal conditions.
  - 9.2 Under extreme conditions.

### 13.16.2.4 Methods of test

Two methods of test are described, separately for:

- 1) equipment fitted with a permanent antenna connector and for
- 2) equipment fitted with an integral antenna, and which cannot be connected to an external antenna except by the fitting of a temporary test connector as a test fixture.

NOTE: The behaviour of the MS in the system is determined to a high degree by the antenna, and this is the only transmitter test in this ETS using the integral antenna. Further studies are ongoing on improved testing on the integral antenna, taking practical conditions of MS use into account.

### 13.16.2.4.1 Method of test for equipment with a permanent antenna connector

#### 13.16.2.4.1.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure for GPRS multislot configuration on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power and MS to operate in its highest number of uplink slots. The SS controls the power level by setting the concerned time slot's power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2) GPRS\_MS\_TXPWR\_MAX\_CCH / MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

#### 13.16.2.4.1.2 Procedure

##### a) Measurement of normal burst transmitter output power

The SS takes power measurement samples evenly distributed over the duration of one burst with a sampling rate of at least  $2/T$ , where  $T$  is the bit duration. The samples are identified in time with respect to the modulation on the burst. The SS identifies the centre of the useful 147 transmitted bits, i.e. the transition from bit 13 to bit 14 of the midamble, as the timing reference.

The transmitter output power is calculated as the average of the samples over the 147 useful bits. This is also used as the 0 dB reference for the power/time template.

##### b) Measurement of normal burst power/time relationship

The array of power samples measured in a) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in a).

c) Steps a) to b) are repeated on each timeslot within the multislot configuration with the MS commanded to operate on each of the power control levels defined, even those not supported by the MS.

d) The SS commands the MS to the maximum power control level supported by the MS and steps a) to b) are repeated on each timeslot within the multislot configuration for ARFCN in the Low and High ranges.

e) The SS commands the MS to the maximum power control level in the first timeslot allocated within the multislot configuration and to the minimum power control level in the second timeslot allocated. Any further timeslots allocated are to be set to the maximum power control level. Steps a) to b) and corresponding measurements on each timeslot within the multislot configuration are repeated.

##### f) Measurement of access burst transmitter output power

The SS causes the MS to generate an Access Burst on an ARFCN in the Mid ARFCN range, this could be either by a cell re-selection or a new request for radio resource. In the case of a cell re-selection procedure the Power Level indicated in the PSI3 message is the maximum power control level supported by the MS. In the case of an Access Burst the MS shall use the Power Level indicated in the GPRS\_MS\_TXPWR\_MAX\_CCH parameter. If the power class of the MS is DCS 1 800 Class 3 and the Power Level is indicated by the MS\_TXPWR\_MAX\_CCH parameter, the MS shall also use the POWER\_OFFSET parameter.

The SS takes power measurement samples evenly distributed over the duration of the access burst as described in a). However, in this case the SS identifies the centre of the useful bits of the burst by identifying the transition from the last bit of the synch sequence. The centre of the burst is then five data bits prior to this point and is used as the timing reference.

The transmitter output power is calculated as the average of the samples over the 87 useful bits of the burst. This is also used as the 0 dB reference for the power/time template.

##### g) Measurement of access burst power/time relationship

The array of power samples measured in f) are referenced in time to the centre of the useful transmitted bits and in power to the 0 dB reference, both identified in f).



- h) Depending on the method used in step f) to cause the MS to send an Access Burst, the SS sends either a PACKET CELL CHANGE ORDER along with power control level set to 10 in PSI3 parameter GPRS\_MS\_TXPWR\_MAX\_CCH or it changes the (Packet) System Information elements (GPRS\_)MS\_TXPWR\_MAX\_CCH and for DCS 1 800 the POWER\_OFFSET on the serving cell PBCCH/BCCH in order to limit the MS transmit power on the Access Burst to power control level 10 (+23 dBm for GSM 400 and GSM 900 or +10 dBm for DCS 1 800) and then steps f) to g) are repeated.
- i) Steps a) to h) are repeated under extreme test conditions (annex 1, TC2.2) except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

#### 13.16.2.4.2 Method of test for equipment with an integral antenna

NOTE: If the MS is equipped with a permanent connector, such that the antenna can be disconnected and the SS be connected directly, then the method of section 13.16.2.4.1 will be applied.

The tests in this section are performed on an unmodified test sample.

##### 13.16.2.4.2.1 Initial conditions

The MS is placed in the anechoic shielded chamber (annex 1, GC5) or on the outdoor test site, on an isolated support, in the position for normal use, at a distance of at least 3 metres from a test antenna, connected to the SS.

NOTE: The test method described has been written for measurement in an anechoic shielded chamber. If an outdoor test site is used then, in addition, it is necessary to raise/lower the test antenna through the specified height range to maximize the received power levels from both the test sample and the substitution antenna.

A call is set up by the SS according to the generic call set up procedure for GPRS multislot configuration on a channel with ARFCN in the Mid ARFCN range, power control level set to Max power and MS to operate in its highest number of uplink slots. The SS controls the power level by setting the concerned timeslot's power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2) GPRS\_MS\_TXPWR\_MAX\_CCH / MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

##### 13.16.2.4.2.2 Procedure

- a) With the initial conditions set according to subclause 13.16.2.4.2.1 the test procedure in 13.16.2.4.1.2 is followed up to and including step h), except that in step a), when measurements are done at maximum power for ARFCN in the Low, Mid and High range, the measurement is made eight times with the MS rotated by  $n \cdot 45$  degrees for all values of  $n$  in the range 0 to 7.

The measurements taken are received transmitter output power measurements rather than transmitter output power measurements, the output power measurement values can be derived as follows.

- b) Assessment of test site loss for scaling of received output power measurements.

The MS is replaced by a half-wave dipole, resonating at the centre frequency of the transmit band, connected to an RF generator.

The frequency of the RF signal generator is set to the frequency of the ARFCN used for the 24 measurements in step a), the output power is adjusted to reproduce the received transmitter output power averages recorded in step a).

For each indication the power, delivered by the generator (in Watts) to the half-wave dipole, is recorded. These values are recorded in the form  $P_{nc}$ , where  $n$  = MS rotation and  $c$  = channel number.

For each channel number used compute:

$$P_{ac}(\text{Watts into dipole}) = \frac{1}{8} * \sum_{n=0}^{n=7} P_{nc}$$

from which:  $P_{ac} \text{ (Tx dBm)} = 10 \log_{10}(P_{ac}) + 30 + 2,15$

The difference, for each of the three channels, between the actual transmitter output power averaged over the 8 measurement orientations and the received transmitter output power at orientation  $n = 0$  is used to scale the received measurement results to actual transmitter output powers for all measured power control levels and ARFCN, which can then be checked against the requirements.

c) Temporary antenna connector calibration factors (transmit)

A modified test sample equipped with a temporary antenna connector is placed in a climatic test chamber and is linked to the SS by means of the temporary antenna connector.

Under normal test conditions, the power measurement and calculation parts of steps a) to j) of 13.16.2.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

NOTE: The values noted here are related to the output transmitter carrier power levels under normal test conditions, which are known after step b). Therefore frequency dependent calibration factors that account for the effects of the temporary antenna connector can be determined.

d) Measurements at extreme test conditions.

NOTE: Basically the procedure for extreme conditions is:

- the power/time template is tested in the "normal" way,
- the radiated power is measured by measuring the difference with respect to the radiated power under normal test conditions.

Under extreme test conditions steps a) to h) of 13.16.2.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

The transmitter output power under extreme test conditions is calculated for each burst type, power control level and for every frequency used by adding the frequency dependent calibration factor, determined in c), to the values obtained at extreme conditions in this step.

### 13.16.2.5 Test requirements

- a) The transmitter output power, under every combination of normal and extreme test conditions, for normal bursts and access bursts, at each frequency and for each power control level applicable to the MS power class, shall be at the relevant level shown in table 13.16.2-1 or table 13.16.2-2 within the tolerances also shown in table 13.16.2-1 or table 13.16.2-2

GSM 400 and GSM 900 only - begin

**Table 13.16.2-1: GSM 400 and GSM 900 transmitter output power for different power classes**

Power class				Power control level	Transmitter output power	Tolerances	
2	3	4	5			normal	extreme
.	.	.	.	2	39	+/-2 dB	+/-2,5 dB
.	.	.	.	3	37	+/-3 dB*)	+/-4 dB*)
.	.	.	.	4	35	+/-3 dB	+/-4 dB
.	.	.	.	5	33	+/-3 dB*)	+/-4 dB*)
.	.	.	.	6	31	+/-3 dB	+/-4 dB
.	.	.	.	7	29	+/-3 dB*)	+/-4 dB*)
.	.	.	.	8	27	+/-3 dB	+/-4 dB
.	.	.	.	9	25	+/-3 dB	+/-4 dB
.	.	.	.	10	23	+/-3 dB	+/-4 dB
.	.	.	.	11	21	+/-3 dB	+/-4 dB
.	.	.	.	12	19	+/-3 dB	+/-4 dB
.	.	.	.	13	17	+/-3 dB	+/-4 dB
.	.	.	.	14	15	+/-3 dB	+/-4 dB
.	.	.	.	15	13	+/-3 dB	+/-4 dB
.	.	.	.	16	11	+/-5 dB	+/-6 dB
.	.	.	.	17	9	+/-5 dB	+/-6 dB
.	.	.	.	18	7	+/-5 dB	+/-6 dB
.	.	.	.	19	5	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

GSM 400 and GSM 900 only - end

DCS 1 800 only - begin

Table 13.16.2-2: DCS 1 800 transmitter output power for different power classes

Power class			Power control level	Transmitter output power	Tolerances	
1	2	3			dBm	normal
		.	29	36	+/-2,0 dB	+/-2,5 dB
		.	30	34	+/-3,0 dB	+/-4,0 dB
		.	31	32	+/-3,0 dB	+/-4,0 dB
.	.	.	0	30	+/-3,0 dB*)	+/-4 dB*)
.	.	.	1	28	+/-3 dB	+/-4 dB
.	.	.	2	26	+/-3 dB	+/-4 dB
.	.	.	3	24	+/-3 dB*)	+/-4 dB*)
.	.	.	4	22	+/-3 dB	+/-4 dB
.	.	.	5	20	+/-3 dB	+/-4 dB
.	.	.	6	18	+/-3 dB	+/-4 dB
.	.	.	7	16	+/-3 dB	+/-4 dB
.	.	.	8	14	+/-3 dB	+/-4 dB
.	.	.	9	12	+/-4 dB	+/-5 dB
.	.	.	10	10	+/-4 dB	+/-5 dB
.	.	.	11	8	+/-4 dB	+/-5 dB
.	.	.	12	6	+/-4 dB	+/-5 dB
.	.	.	13	4	+/-4 dB	+/-5 dB
.	.	.	14	2	+/-5 dB	+/-6 dB
.	.	.	15	0	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

DCS 1 800 only - end

- b) The difference between the transmitter output power at two adjacent power control levels, measured at the same frequency, shall not be less than 0,5 dB and not be more than 3,5 dB.
- c) The power/time relationship of the measured samples for normal bursts shall be within the limits of the power time template of figure 13-7-2 (GSM 11.10) at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.

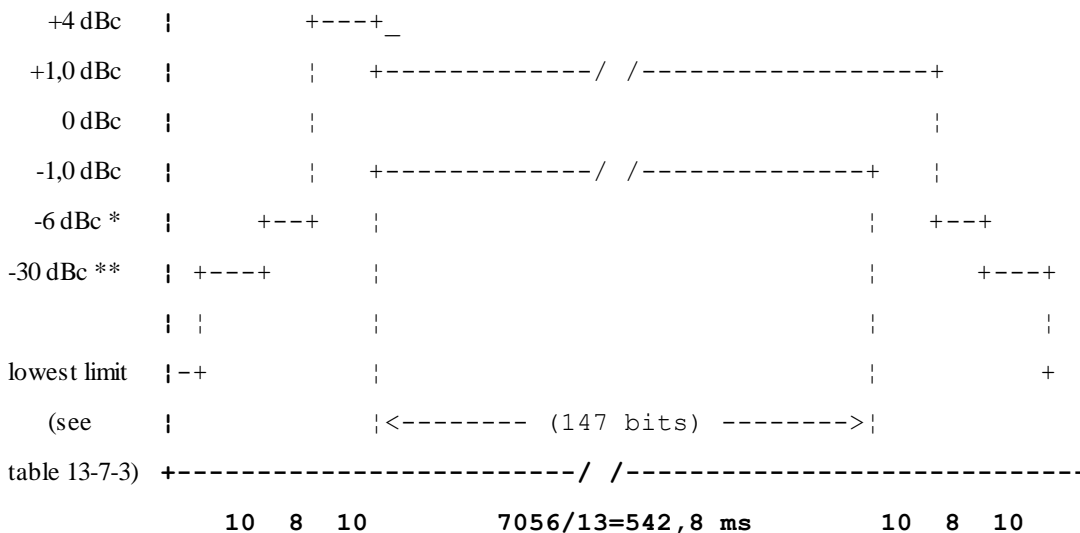


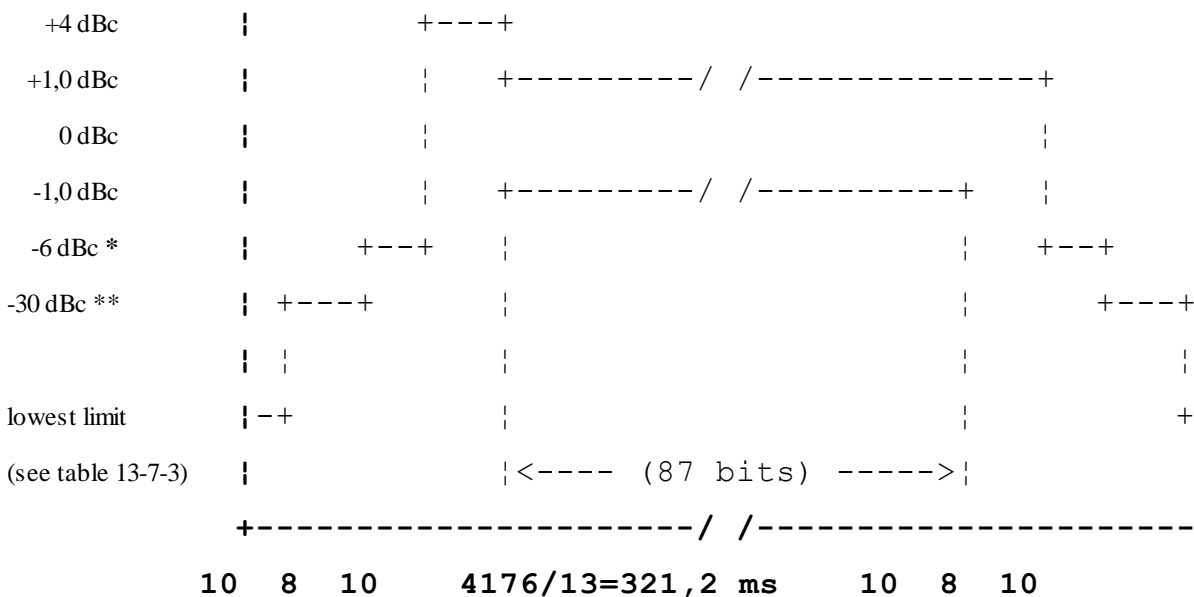
Figure 13.16.2-1: Power / time template for normal bursts

- \* For GSM400 and GSM900 MS:        -4 dBc for power control level 16  
    -2 dBc for power control level 17  
    -1 dBc for power control levels 18 and 19
- For DCS1800 MS:                    -4 dBc for power control level 11  
    -2 dBc for power control level 12  
    -1 dBc for power control levels 13, 14 and 15
- \*\* For GSM400 and GSM900 MS:        -30 dBc or -17 dBm, whichever is the higher
- For DCS1800 MS:                    -30 dBc or -20 dBm, whichever is the higher

**Table 13.16.2-3: Lowest measurement limit for power / time template**

	lowest limit
GSM400, GSM900	-59 dBc or -54 dBm whichever is the highest, except for the timeslot preceding the active slot, for which the allowed level is -59 dBc or -36 dBm, whichever is the highest
DCS1800	-48 dBc or -48 dBm whichever is the highest

- d) All the power control levels, for the type and power class of the MS as stated by the manufacturer, shall be implemented in the MS.
- e) When the transmitter is commanded to a power control level outside of the capability corresponding to the type and power class of the MS as stated by the manufacturer, then the transmitter output power shall be within the tolerances for the closest power control level corresponding to the type and power class as stated by the manufacturer.
- f) The power/time relationship of the measured samples for access bursts shall be within the limits of the power time template of figure 13-7-3 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.



**Figure 13.16.2-2: Power / time template for access burst**

- \* For GSM400 and GSM900 MS:
  - 4 dBc for power control level 16
  - 2 dBc for power control level 17
  - 1 dBc for power control levels 18 and 19
- For DCS1800 MS:
  - 4 dBc for power control level 11
  - 2 dBc for power control level 12
  - 1 dBc for power control levels 13, 14 and 15
- \*\* For GSM400 and GSM900 MS: -30 dBc or -17 dBm, whichever is the higher
- For DCS1800 MS: -30 dBc or -20 dBm, whichever is the higher

### 13.16.3 Output RF spectrum in GPRS multislots configuration

#### 13.16.3.1 Definition and applicability

The output RF spectrum is the relationship between the frequency offset from the carrier and the power, measured in a specified bandwidth and time, produced by the MS due to the effects of modulation and power ramping.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS and any multiband MS, which are capable of GPRS multislots operation.

#### 13.16.3.2 Conformance requirement

1. The level of the output RF spectrum due to modulation shall be no more than that given in GSM 05.05, 4.2.1, table a) for GSM 400 and GSM 900 or table b) for DCS 1 800, with the following lowest measurement limits:

- -36 dBm below 600 kHz offset from the carrier,
- -51 dBm for GSM 400 and GSM 900 or -56 dBm for DCS 1 800 from 600 kHz out to less than 1 800 kHz offset from the carrier,
- -46 dBm for GSM 400 and GSM 900 or -51 dBm for DCS 1 800 at and beyond 1 800 kHz offset from the carrier,

but with the following exceptions at up to -36 dBm:

- up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz in the combined range 600 kHz to 6000 kHz above and below the carrier,
- up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz at more than 6 000 kHz offset from the carrier.

1.1 Under normal conditions; GSM 05.05, 4.2.1.

1.2 Under extreme conditions; GSM 05.05, 4.2.1; GSM 05.05, annex D D.2.1, D.2.2.

2. The level of the output RF spectrum due to switching transients shall be no more than given in GSM 05.05, 4.2.2, table "a) Mobile Station".

2.1 Under normal conditions; GSM 05.05, 4.2.2.

2.2 Under extreme conditions; GSM 05.05, 4.2.2; GSM 05.05 annex D D.2.1, D.2.2.

3. When allocated a channel, the power emitted by the MS, in the band 935 to 960 MHz shall be no more than -79 dBm, in the band 925 to 935 MHz shall be no more than -67 dBm and in the band 1 805 to 1 880 MHz shall be no more than -71 dBm except in five measurements in each of the bands 925 to 960 MHz and 1 805 to 1 880 MHz where exceptions at up to -36 dBm are permitted. For GSM 400 MS, in addition, the power emitted by MS, in the bands of 460.4 to 467.6 MHz and 488.8 to 496 MHz shall be no more than -67 dBm except in three measurements in

each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where exceptions at up to  $-36$  dBm are permitted. Under normal conditions; GSM 05.05, 4.3.3.

### 13.16.3.3 Test purpose

1. To verify that the output RF spectrum due to modulation does not exceed conformance requirement 1 in the GPRS multislot configurations.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.
2. To verify that the output RF spectrum due to switching transients does not exceed conformance requirement 2 in the GPRS multislot configurations when a reasonable margin is allowed for the effect of spectrum due to modulation.
  - 2.1 Under normal conditions.
  - 2.2 Under extreme conditions.
3. To verify that the MS spurious emissions in the MS receive band do not exceed conformance requirement 3 in the GPRS multislot configurations.

### 13.16.3.4 Method of test

#### 13.16.3.4.1 Initial conditions

A call is set up according to the generic call set up procedure for multislot GPRS with the highest number of uplink slots.

The SS commands the MS to hopping mode. The hopping pattern includes only three channels, namely one with an ARFCN in the Low ARFCN range, a second one with an ARFCN in the Mid ARFCN range and the third one with an ARFCN in the High ARFCN range.

The SS commands the MS to complete the multislot loop back type G (see 04.14. 5.2). This is to set a defined random pattern for the transmitter.

The SS sends Standard Test Signal C1 (annex 5) to the MS at a level of  $23 \text{ dB}\mu\text{Vemf}$  ( ).

NOTE 1: Although the measurement is made whilst the MS is in hopping mode, each measurement is on one single channel.

NOTE 2: This test is specified in hopping mode as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to cell re-select the MS between the three channels tested at the appropriate time.

#### 13.16.3.4.2 Procedure

NOTE: When averaging is in use during frequency hopping mode, the averaging only includes bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement.

- a) In steps b) to h) the FT is equal to the hop pattern ARFCN in the Mid ARFCN range.
- b) The other settings of the spectrum analyser are set as follows:
  - Zero frequency scan
  - Resolution bandwidth: 30 kHz
  - Video bandwidth: 30 kHz
  - Video averaging: may be used, depending on the implementation of the test

The video signal of the spectrum analyser is "gated" such that the spectrum generated by at least 40 of the bits 87 to 132 of the burst in one of the active time slots is the only spectrum measured. This gating may be analogue or numerical, dependent upon the design of the spectrum analyser. Only measurements during transmitted bursts on the nominal carrier of the measurement are included. The spectrum analyser averages over the gated period and over 200 or 50 such bursts, using numerical and/or video averaging.

- c) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 50 bursts at all multiples of 30 kHz offset from FT to < 1 800 kHz.
- d) The resolution and video bandwidth on the spectrum analyser are adjusted to 100 kHz and the measurements are made at the following frequencies:

on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the band 925 - 960 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.

in addition for GSM 400 MS:

at 200 kHz intervals over the band 460.4 to 467.6 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 488.8 to 496 MHz for each measurement over 50 bursts.

- e) The MS is commanded to its minimum power control level. The spectrum analyser is set again as in b).
- f) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 200 bursts at the following frequencies:

FT

FT + 100 kHz                      FT - 100 kHz

FT + 200 kHz                      FT - 200 kHz

FT + 250 kHz                      FT - 250 kHz

FT + 200 kHz \* N              FT - 200 kHz \* N

where N = 2, 3, 4, 5, 6, 7, and 8

and FT = RF channel nominal centre frequency.

- g) Steps a) to f) is repeated except that in step a) the spectrum analyzer is gated so that the burst of the next active time slot is measured.

- h) The spectrum analyser settings are adjusted to:

- Zero frequency scan
- Resolution bandwidth:              30 kHz
- Video bandwidth:                      100 kHz
- Peak hold

The spectrum analyser gating of the signal is switched off.

The MS is commanded to its maximum power control level in every transmitted time slot.

- i) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured at the following frequencies:



FT + 400 kHz	FT - 400 kHz
FT + 600 kHz	FT - 600 kHz
FT + 1,2 MHz	FT - 1,2 MHz
FT + 1,8 MHz	FT - 1,8 MHz

where FT = RF channel nominal centre frequency.

The duration of each measurement (at each frequency) will be such as to cover at least 10 burst transmissions at FT.

- j) Step i) is repeated for power control levels 7 and 11.
- k) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the Low ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.
- l) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the High ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.
- m) Steps a) b) f) h), and i) are repeated under extreme test conditions (annex 1, TC2.2). except that at step h) the MS is commanded to power control level 11.

#### 13.16.3.5 Test requirements

For absolute measurements, performed on a temporary antenna connector, in the frequency band 450.4 to 457.6 MHz, 478.8 to 486 MHz, 880 to 915 MHz or 1710 to 1785 MHz, the temporary antenna connector coupling factor, determined according to 13.3.4.2.2 and annex 1 GC7, for the nearest relevant frequency, will be used.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 925 to 960 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 900 MS. For a GSM 400 or DCS 1 800 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 1805 to 1880 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for DCS 1 800 MS. For a GSM 400 or GSM 900 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 460.4 to 467.6 MHz or 488.8 to 496 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 400 MS. For a GSM 900 or DCS 1800 MS 0 dB will be assumed.

The figures in the tables below, at the listed frequencies from the carrier (kHz), are the maximum level (dB) relative to a measurement in 30 kHz bandwidth on the carrier (reference GSM 05.05 section 4.2.1).

- a) For the modulation sidebands out to less than 1 800 kHz offset from the carrier frequency (FT) measured in step c), f), i), k), l) and m) the measured power level in dB relative to the power level measured at FT, for all types of MS, shall not exceed the limits derived from the values shown in table 13.16.3-1 for GSM 400 and GSM 900 or table 13.16.3-2 for DCS 1 800 according to the actual transmit power and frequency offset from FT. However any failures in the combined range 600 kHz to less than 1 800 kHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below.

**Table 13.16.3-1: GSM 400 and GSM 900 Spectrum due to modulation out to less than 1 800 kHz offset**

power levels in dB relative to the measurement at FT					
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
39	+0,5	-30	-33	-60	-66
37	+0,5	-30	-33	-60	-64
35	+0,5	-30	-33	-60	-62
<= 33	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-51

**Table 13.16.3-2: DCS 1 800 Spectrum due to modulation out to less than 1 800 kHz offset**

power levels in dB relative to the measurement at FT					
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
<= 36	+0,5	-30	-33	-60	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-56

NOTE 1: For frequency offsets between 100 kHz and 600 kHz the requirement is derived by a linear interpolation between the points identified in the table with linear frequency and power in dB relative.

- b) For the modulation sidebands from 1 800 kHz offset from the carrier frequency (FT) and out to 2 MHz beyond the edge of the relevant transmit band, measured in step d), the measured power level in dB relative to the power level measured at FT, shall not exceed the values shown in table 13.16.3-3 according to the actual transmit power, frequency offset from FT and system on which the MS is designed to operate. However any failures in the combined range 1 800 kHz to 6 MHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below, and any other failures may be counted towards the exceptions allowed in test requirements d) below.

**Table 13.16.3-3: Spectrum due to modulation from 1 800 kHz offset to the edge of the transmit band (wideband noise)**

power levels in dB relative to the measurement at FT						
GSM 400 and GSM900				DCS1800		
Power level	Frequency offset kHz			Power level	Frequency offset kHz	
(dBm)	1800 to < 3000	3000 to < 6000	>= 6000	(dBm)	1800 to < 6000	>= 6000
39	-69	-71	-77	36	-71	-79
37	-67	-69	-75	34	-69	-77
35	-65	-67	-73	32	-67	-75
<= 33	-63	-65	-71	30	-65	-73
				28	-63	-71
				26	-61	-69
				<= 24	-59	-67
The values above are subject to the minimum absolute levels (dBm) below.						
	-46	-46	-46		-51	-51

- c) Any failures (from a) and b) above) in the combined range 600 kHz to 6 MHz above and below the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, spurious emissions are allowed in up to three 200 kHz bands centred on an integer multiple of 200 kHz so long as no spurious emission exceeds -36 dBm. Any spurious emissions measured in a 30 kHz bandwidth which spans two 200 kHz bands can be counted towards either 200 kHz band, whichever minimizes the number of 200 kHz bands containing spurious exceptions.
- d) Any failures (from b) above) beyond 6 MHz offset from the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, up to twelve spurious emissions are allowed so long as no spurious emission exceeds -36 dBm.
- e) The MS spurious emissions in the bands 925 - 935 MHz, 935 - 960 MHz and 1 805 - 1 880 MHz, measured in step d), for all types of MS, shall not exceed the values shown in table 13.16.3-4 except in up to five measurements in the band 925 to 960 MHz and five measurements in the band 1 805 to 1 880 MHz where a level up to -36 dBm is permitted. For GSM 400 MS, in addition, the MS spurious emissions in the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz shall not exceed the value of -67 dBm, except in up to three measurements in each of the bands 460.4 to 467.6 MHz and 488.8 to 496 MHz where a level up to -36 dBm is permitted.

**Table 13.16.3-4: Spurious emissions in the MS receive bands**

Band (MHz)	Spurious emissions level (dBm)
925 to 935	-67
935 to 960	-79
1805 to 1880	-71

- f) For the power ramp sidebands of steps h), i) and k) the power levels must not exceed the values shown in table 13.16.3-5 for GSM 400 and GSM 900 or table 13.16.3-6 for DCS 1 800.

**Table 13.16.3-5: GSM Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
39 dBm	-13 dBm	-21 dBm	-21 dBm	-24 dBm
37 dBm	-15 dBm	-21 dBm	-21 dBm	-24 dBm
35 dBm	-17 dBm	-21 dBm	-21 dBm	-24 dBm
33 dBm	-19 dBm	-21 dBm	-21 dBm	-24 dBm
31 dBm	-21 dBm	-23 dBm	-23 dBm	-26 dBm
29 dBm	-23 dBm	-25 dBm	-25 dBm	-28 dBm
27 dBm	-23 dBm	-26 dBm	-27 dBm	-30 dBm
25 dBm	-23 dBm	-26 dBm	-29 dBm	-32 dBm
23 dBm	-23 dBm	-26 dBm	-31 dBm	-34 dBm
<= +21 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

**Table 13.16.3-6: DCS 1 800 Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
36 dBm	-16 dBm	-21 dBm	-21 dBm	-24 dBm
34 dBm	-18 dBm	-21 dBm	-21 dBm	-24 dBm
32 dBm	-20 dBm	-22 dBm	-22 dBm	-25 dBm
30 dBm	-22 dBm	-24 dBm	-24 dBm	-27 dBm
28 dBm	-23 dBm	-25 dBm	-26 dBm	-29 dBm
26 dBm	-23 dBm	-26 dBm	-28 dBm	-31 dBm
24 dBm	-23 dBm	-26 dBm	-30 dBm	-33 dBm
22 dBm	-23 dBm	-26 dBm	-31 dBm	-35 dBm
<= +20 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

NOTE 2: These figures are different from the requirements in GSM 05.05 because at higher power levels it is the modulation spectrum which is being measured using a peak hold measurement. This allowance is given in the table.

NOTE 3: The figures for table 13.16.3-5 and table 13.16.3-6 assume that, using the peak hold measurement, the lowest level measurable is 8 dB above the level of the modulation specification using the 30 kHz bandwidth gated average technique for 400 kHz offset from the carrier. At 600 and 1200 kHz offset the level is 6 dB above and at 1 800 kHz offset the level is 3 dB above. The figures for 1 800 kHz have assumed the 30 kHz bandwidth spectrum due to modulation specification at <1 800 kHz.

## 13.17 EGPRS transmitter tests

### 13.17.1 Frequency error and Modulation accuracy in EGPRS Configuration

#### 13.17.1.1 Definition and applicability

The frequency error is the difference in frequency, after adjustment for the effect of the modulation accuracy between the RF transmission from the MS and either:

- the RF transmission from the BS, or
- the nominal frequency for the ARFCN used.

#### Modulation Accuracy

For GMSK, the modulation accuracy of the transmitted signal is described as the phase accuracy (phase error) of the GMSK modulated signal. The phase error for GMSK modulation is the difference in phase, after adjustment for the effect of the frequency error, between the RF transmission from the MS and the theoretical transmission according to the intended modulation.

For 8-PSK, the error vector between the vector representing the transmitted signal and the vector representing the error-free modulated signal defines modulation accuracy. The magnitude of the error vector is called Error Vector Magnitude (EVM). Origin suppression is defined to be the ratio of the carrier leakage to the modulated signal.

The requirements and this test apply to all types of GSM 400, GSM 900, DCS 1800, and PCS 1900

which are capable of EGPRS operation. For multiband MS, requirements and this test apply to all applicable bands.

#### 13.17.1.2 Conformance requirement

1. The carrier frequency under GMSK and 8PSK modulation shall be accurate to within 0,2ppm for GSM 400 and 0,1 ppm for all other bands compared to signals received from the BS.
  - 1.1 Under normal conditions; GSM 05.10, 6.1.
  - 1.2 Under vibration conditions; GSM 05.10, 6.1; GSM 05.05, annex D D.2.3.
  - 1.3 Under extreme conditions; GSM 05.10, 6.1; GSM 05.05, 4.4; GSM 05.05, annex D D.2.1, D.2.2.
2. The RMS phase error for GMSK modulated signal (difference between the phase error trajectory and its linear regression on the active part of the time slot) for each burst shall not be greater than 5 degrees.
  - 2.1 Under normal conditions; GSM 05.05, 4.6.
  - 2.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
  - 2.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
3. The maximum peak deviation for GMSK modulated signal during the useful part of each burst shall not be greater than 20 degrees.

- 3.1 Under normal conditions; GSM 05.05, 4.6.
- 3.2 Under vibration conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.3.
- 3.3 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
- 4. The RMS EVM over the useful part of any burst of the 8-PSK modulated signal shall not exceed:
  - 4.1 9.0% Under normal conditions; GSM 05.05, 4.6.
  - 4.2 10.0% Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
- 5. The peak EVM values of any burst of the 8PSK modulated signal shall be  $\leq 30\%$ 
  - 5.1 Under normal conditions; GSM 05.05, 4.6.
  - 5.2 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
- 6. The 95:th-percentile value of any burst of the 8-PSK modulated signal shall be  $\leq 15\%$ .
  - 6.1 Under normal conditions; GSM 05.05, 4.6.
  - 6.2 Under extreme conditions; GSM 05.05, 4.6; GSM 05.05, annex D D.2.1, D.2.2.
- 7. The Origin Offset for any 8PSK modulated signal shall be  $-30\text{dBc}$ .
  - 7.1 Under normal conditions; 05.05 4.6.
  - 7.2 Under extreme conditions; 05.05 4.6.2.2; GSM 05.05, annex D D.2.1, D.2.2.

#### 13.17.1.3 Test purpose

To verify that the carrier frequency error does not exceed conformance requirement 1:

- 1.1 Under normal conditions
- 1.2 When the MS is being vibrated
- 1.3 Under extreme conditions

To verify that the RMS phase error on the useful parts of the bursts transmitted by the MS does not exceed conformance requirement 2:

- 2.1 Under normal conditions
- 2.2 When the MS is being vibrated
- 2.3 Under extreme conditions

To verify that the maximum phase error on the useful parts of the bursts transmitted by the MS configuration does not exceed conformance requirement 3:

- 3.1 Under normal conditions
- 3.2 When the MS is being vibrated
- 3.3 Under extreme conditions

To verify that the RMS EVM over the useful part of the burst, excluding tail bits, transmitted by the MS does not exceed conformance requirement 4:

- 4.1 Under normal conditions
- 4.2 When the MS is being vibrated
- 4.3 Under extreme conditions

To verify that the peak EVM values over the useful part of the burst, excluding tail bits, transmitted by the MS does not exceed conformance requirement 5:

- 5.1 Under normal conditions
- 5.2 When the MS is being vibrated
- 5.3 Under extreme conditions

To verify that the 95:th percentile EVM over the useful part of any burst, excluding tail bits, does not exceed conformance requirement 6:

- 6.1 Under normal conditions
- 6.2 When the MS is being vibrated
- 6.3 Under extreme conditions

To verify that the origin suppression does not exceed conformance requirement 7:

- 7.1 Under normal conditions
- 7.2 When the MS is being vibrated
- 7.3 Under extreme conditions

#### 13.17.1.4 Method of the test

##### Initial conditions

A downlink TBF is set up according to the generic procedure in section 40. The SS orders the MS to transmit on the uplink in hopping mode. This is achieved using the EGPRS test mode by transmitting a EGPRS TEST\_CMD (see 04.14, section TBD).

**NOTE:** It is not necessary to test in hopping mode but is done here as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to make sure bursts are taken from a few different channels.

The SS controls the power level by setting the concerned timeslot's power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2) GPRS\_MS\_TXPWR\_MAX\_CCH / MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

For the GMSK and 8PSK procedures described below, the initial power value of each active timeslot shall be set to a mid-range power value.

#### 13.17.1.4.2 Test procedure

##### Procedure for GMSK Frequency error measurement and Phase error

- a) For one transmitted burst on the last slot of the multislot configuration, the SS captures the signal as a series of phase samples over the period of the burst. These samples are evenly distributed over the duration of the burst with a minimum sampling rate of  $2/T$ , where  $T$  is the modulation symbol period. The received phase trajectory is then represented by this array of at least 294 samples.
- b) The SS then calculates, from the known bit pattern and the formal definition of the modulator contained in GSM 05.04, the expected phase trajectory.
- c) From a) and b) the phase trajectory error is calculated, and a linear regression line computed through this phase trajectory error. The slope of this regression line is the frequency error of the mobile transmitter relative to the simulator reference. The difference between the regression line and the individual sample points is the phase error of that point.

c.1) The sampled array of at least 294 phase measurements is represented by the vector:

$$\varnothing_m = \varnothing_m(0) \dots \varnothing_m(n)$$

where the number of samples in the array  $n+1 \geq 294$ .

c.2) The calculated array, at the corresponding sampling instants, is represented by the vector:

$$\varnothing_c = \varnothing_c(0) \dots \varnothing_c(n).$$

c.3) The error array is represented by the vector:

$$\varnothing_e = \{\varnothing_m(0) - \varnothing_c(0)\} \dots \{\varnothing_m(n) - \varnothing_c(n)\} = \varnothing_e(0) \dots \varnothing_e(n).$$

c.4) The corresponding sample numbers form a vector  $t = t(0) \dots t(n)$ .

c.5) By regression theory the slope of the samples with respect to  $t$  is  $k$  where:

$$k = \frac{\sum_{j=0}^{j=n} t(j) * \varnothing_e(j)}{\sum_{j=0}^{j=n} t(j)^2}$$

c.6) The frequency error is given by  $k/(360 * g)$ , where  $g$  is the sampling interval in  $s$  and all phase samples are measured in degrees.

c.7) The individual phase errors from the regression line are given by:

$$\varnothing_e(j) - k * t(j).$$

c.8) The RMS value  $\varnothing_e$  of the phase errors is given by:

$$\varnothing_e(\text{RMS}) = \left[ \frac{\sum_{j=0}^{j=n} \{\varnothing_e(j) - k * t(j)\}^2}{n + 1} \right]^{1/2}$$

- d) Steps a) to c) are repeated for 20 bursts, not necessarily contiguous.
- e) The SS instructs the MS to its maximum power control level by setting the power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) for each timeslot to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2), all other conditions remaining constant. Steps a) to d) are repeated.
- f) The SS instructs the MS to the minimum power control level, all other conditions remaining constant. Steps a) to d) are repeated.
- g) The MS is hard mounted on a vibration table and vibrated at the frequency/amplitudes specified in annex 1, TC4. During the vibration steps a) to f) are repeated.

NOTE: If the call is terminated when mounting the MS to the vibration table, it will be necessary to establish the initial conditions again before repeating steps a) to f).

- h) The MS is re-positioned on the vibration table in the two orthogonal planes to the plane used in step g). For each of the orthogonal planes step g) is repeated.
- i) Steps a) to f) are repeated under extreme test conditions (see annex 1, TC2.2).

## Procedure for 8PSK Frequency error and modulation accuracy measurements

- j) For one transmitted burst on the last slot of the multislot configuration, the SS captures the transmitted signal by taking at least four samples per symbol. The transmitted signal is modeled by:

$$Y(t) = C1 \{R(t) + D(t) + C0\} W^t$$

R(t) is defined to be an ideal transmitter signal

D(t) is the residual complex error on signal R(t)

C0 is a constant origin offset representing carrier feedthrough

C1 is a complex constant representing the arbitrary phase and output power of the transmitter

$W = e^{\alpha + j 2\pi f}$  accounts for both a frequency offset of “ $2\pi f$ ” radians per second phase rotation and an amplitude change of “ $\alpha$ ” nepers per second

The symbol timing phase of Y(t) is aligned with R(t).

- k) The SS shall generate the ideal transmitter signal as a reference. The ideal transmitter signal can be constructed from a priori knowledge of the transmitted symbols or from the demodulated symbols of the transmitted burst. In the latter case, unknown symbols shall be detected with an error rate sufficiently small to ensure the accuracy of the measurement equipment (see Annex 5).

- 1.1) The transmitted signal Y(t) is compensated in amplitude, frequency and phase by multiplying with the factor:

$$W^{-t}/C1$$

The values for W and C1 are determined using an iterative procedure. W( $\alpha, f$ ), C1 and C0 are chosen to minimise the RMS value of EVM on a burst-by-burst basis.

- 1.2) After compensation, Y(t) is passed through the specified measurement filter (GSM 05.05, 4.6.2) to produce the signal

$$Z(k) = S(k) + E(k) + C0$$

where

S(k) is the ideal transmitter signal observed through the measurement filter

$k = \text{floor}(t/T_s)$ , where  $T_s = 1/270.833\text{kHz}$  corresponding to the symbol times

- 1.3) The error vector is defined to be:

$$E(k) = Z(k) - C0 - S(k)$$

It is measured and calculated for each instant k over the useful part of the burst excluding tail bits. The RMS vector error is defined as:

$$\text{RMS EVM} = \sqrt{\frac{\sum_{k \in K} |E(k)|^2}{\sum_{k \in K} |S(k)|^2}}$$

- 1.4) Steps 1.1) to 1.3) are repeated with successive approximations of W( $\alpha, f$ ), C1 and C0 until the minimum value of RMS EVM is found. The minimised value of RMS EVM and the final values for C1, C0 and f are noted. (f represents the frequency error of the burst).

- m) For each symbol in the useful part of the burst excluding tail bits, the SS shall calculate the error vector magnitude as:



$$\text{EVM}(k) = \sqrt{\frac{|E(k)|^2}{\sum_{k \in K} |S(k)|^2} \cdot N}$$

The peak value of symbol EVM in the useful part of the burst, excluding tail bits, is noted.

- n) The SS shall calculate the value for Origin Offset Suppression for the burst as:

$$\text{OOS (dB)} = -10 \log_{10} \left( \frac{|C_0|^2}{\frac{1}{N} \sum_{k \in K} |S(k)|^2} \right)$$

- o) Steps j) to n) are repeated for a total of 200 bursts.
- p) The peak values of symbol EVM noted in step m) are averaged for the 200 measured bursts.
- q) From the distribution of symbol EVM values calculated in step m) for the 200 measured bursts, the SS shall determine the 95:th percentile value.
- r) The SS instructs the MS to its maximum power control level by setting the power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) for each timeslot to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2), all other conditions remaining constant. Steps j) to q) are repeated.
- s) The SS instructs the MS to the minimum power control level, all other conditions remaining constant. Steps j) to q) are repeated.
- t) The MS is hard mounted on a vibration table and vibrated at the frequency/amplitudes specified in annex 1, TC4. During the vibration steps j) to q) are repeated.

NOTE: If the call is terminated when mounting the MS to the vibration table, it will be necessary to establish the initial conditions again before repeating steps a) to f).

- u) The MS is re-positioned on the vibration table in the two orthogonal planes to the plane used in step t). For each of the orthogonal planes step t) is repeated.
- v) Steps j) to q) are repeated under extreme test conditions (see annex 1, TC2.2).

#### 13.17.1.5 Test Requirements

1. For all measured bursts, the frequency error, derived in steps c.6) and l.4), shall be less than  $10E-7$ .
2. For all measured bursts, the RMS phase error, derived in step c.8), shall not exceed 5 degrees.
3. For all measured bursts, each individual phase error, derived in step c.7), shall not exceed 20 degrees.
4. For all measured bursts, the RMS EVM, derived in step l.3) shall not exceed 9.0% under normal conditions and 10.0% under extreme conditions.
5. The (averaged) value of peak EVM derived in step p) shall not exceed 30%.
6. The 95:th percentile value derived in step q) shall not exceed 15%.
7. For all measured bursts, the origin offset suppression derived in step n) shall not exceed 30dB.

## 13.17.2 Frequency error under multipath and interference conditions.

### 13.17.2.1 Definition and applicability

The frequency error under multipath and interference conditions is a measure of the ability of the MS to maintain frequency synchronization with the received signal under conditions of Doppler shift, multipath reception and interference.

The requirements and this test apply to all types of EGPRS GSM400, GSM 900 and DCS 1 800 MS, PCS1900.

### 13.17.2.2 Conformance requirement

1. The MS carrier frequency error for each burst shall be accurate to within 0,1 ppm for GSM 900, DCS 1800 and 0,2 ppm for GSM 400 compared to signals received from the BS for signal levels down to 3 dB below the reference sensitivity level.
  - 1.1 Under normal conditions; GSM 05.10, 6/6.1.
  - 1.2 Under extreme conditions; GSM 05.10, 6/6.1; GSM 05.05 annex D D.2.1, D.2.2.
2. The MS carrier frequency error for each burst shall be accurate to within 0,1 ppm, for GSM 900, DCS 1800 and PCS 1900 and 0,2 ppm for GSM 400 compared to signals received from the BS for 3 dB less carrier to interference ratio than the reference interference ratios; GSM 05.10, 6/6.1.

### 13.17.2.3 Test purpose

1. To verify that the MS carrier frequency error at reference sensitivity, under conditions of multipath and Doppler shift does not exceed 0,1 ppm for GSM900, DCS1800 and PCS 1900 and 0,2 ppm for GSM400 + the frequency error due to the Doppler shift of the received signal and the assessment error in the MS.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.

NOTE: Although the conformance requirement states that frequency synchronization should be maintained for input signals 3 dB below reference sensitivity. Due to the Radio Link Failure counter this test condition cannot be established. Hence all tests in this section are conducted at reference sensitivity level.

2. To verify that the MS carrier frequency error, under interference conditions and TUlow fading profile, does not exceed 0,1 ppm for GSM900, DCS1800 and PCS 1900 and 0,2 ppm for GSM400 + the frequency error due to the Doppler shift of the received signal and the assessment error in the MS.

NOTE: The test adds the effect of Doppler shift to the requirements as the conformance requirement refers to signals input to the MS receiver whereas the frequency reference for measurement will not take account of the Doppler shift.

### 13.17.2.4 Method of test

This test uses the same measurement process as test 13.17.1 for the MS operating under various RF conditions.

NOTE: The BA list sent on the BCCH will indicate at least six surrounding cells with at least one near to each band edge. It is not necessary to generate any of these BCCH but if they are provided none will be within 5 channels of the ARFCN used for the serving BCCH or PDTCH.

#### 13.17.2.4.1 Initial conditions

The MS is brought into the packet idle GPRS attached state on a serving cell with BCCH in the mid ARFCN range. The level of the serving cell BCCH is set to 10 dB above the reference sensitivity level( ) and the fading function set to RA. The SS waits 30 s for the MS to stabilize to these conditions.

## 13.17.2.4.2 Procedure

- a) The SS is set up to capture the first burst transmitted by the MS during the uplink TBF. The SS orders the MS to transmit on the uplink for the duration of the test. This is achieved using the EGPRS test mode by transmitting a EGPRS TEST\_CMD (see 04.14, section TBD). A downlink TBF is initiated by the SS on a channel in the mid ARFCN range. This downlink TBF is established according to the generic procedure in section 10 with the exceptions that the PDTCH level is set to 10 dB above the reference sensitivity level( ) and the fading function is set to RA. The TBF is maintained for the duration of the test.
- b) The SS calculates the frequency accuracy of the captured burst as described in test 13.1.
- c) The SS sets the serving cell BCCH and PDTCH to the reference sensitivity level( ) applicable to the type of MS, still with the fading function set to RA and then waits 30 s for the MS to stabilize to these conditions.
- d) The SS shall capture subsequent bursts from the traffic channel in the manner described in test 13.1.

NOTE: Due to the very low signal level at the MS receiver input the MS receiver is liable to error. The “looped back” bits are therefore also liable to error, and hence the SS does not know the expected bit sequence. The SS will have to demodulate the received signal to derive (error free) the transmitter burst bit pattern. Using this bit pattern the SS can calculate the expected phase trajectory according to the definition within GSM 05.04.

- e) The SS calculates the frequency accuracy of the captured burst as described in test 13.1.
- f) Steps d) and e) are repeated for 5 traffic channel bursts spaced over a period of not less than 20 s.
- g) Both downlink and uplink TBFs are terminated. The initial conditions are established again and steps a) to f) are repeated but with the fading function set to HT200 for GSM400 and HT100 for all other bands.
- h) The initial conditions are established again and steps a) to f) are repeated but with the fading function set to TU100 for GSM400 and TU50 for all other bands.
- i) The initial conditions are established again and steps a) and b) are repeated but with the following differences:
  - the levels of the BCCH and PDTCH are set to 18 dB above reference sensitivity level( ).
  - two further independent 8-PSK modulated interfering signals are sent on the same nominal carrier frequency as the BCCH and PDTCH and at a level 10 dB below the level of the PDTCH and modulated with random data, including the midamble.
  - the fading function for all channels is set to TUlow.
- j) The SS waits 100 s for the MS to stabilize to these conditions.
- k) Repeat steps d) to f), except that at step f) the measurement period must be extended to 200 s and the number of measurements increased to 20.
- l) The initial conditions are established again and steps a) to k) are repeated for ARFCN in the Low ARFCN range.
- m) The initial conditions are established again and steps a) to k) are repeated for ARFCN in the High ARFCN range.
- n) Repeat step h) under extreme test conditions (see annex 1, TC2.2).

## 13.17.2.5 Test requirements

The frequency error, with reference to the SS carrier frequency as measured in repeats of step e), for each measured burst shall be less than the values shown in table 13-17-1.

**Table 13-17-1: Requirements for frequency error under multipath, Doppler shift and interference conditions**

GSM 400		GSM 900		DCS 1 800 & PCS 1900	
Propagation condition	Permitted frequency error	Propagation condition	Permitted frequency error	Propagation condition	Permitted frequency error
RA500	+/- 300 Hz	RA250	+/- 300 Hz	RA130	+/- 400 Hz
HT200	+/- 180 Hz	HT100	+/- 180 Hz	HT100	+/- 350 Hz
TU100	+/- 160 Hz	TU50	+/- 160 Hz	TU50	+/- 260 Hz
TU6	+/- 230 Hz	TU3	+/- 230 Hz	TU1,5	+/- 320 Hz

### 13.17.3 EGPRS Transmitter output power

#### 13.17.3.1 Definition and applicability

The transmitter output power is the average value of the power delivered to an artificial antenna or radiated by the MS and its integral antenna, over the time that the useful information bits of one burst are transmitted.

The requirements and this test apply to all types of GSM 400, GSM 900 and DCS 1 800 MS, PCS1900 which are capable of EGPRS multislot operation. 8-PSK requirements are only applicable to EGPRS class B.

#### 13.17.3.2 Conformance requirement

1. The MS maximum output power for GMSK modulated signal shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2 dB under normal conditions; GSM 05.05, 4.1.1, first table.
2. The MS maximum output power for GMSK modulated signal shall be as defined in GSM 05.05, 4.1.1, first table, according to its power class, with a tolerance of +/- 2,5 dB under extreme conditions; GSM 05.05, 4.1.1, first table; GSM 05.05 annex D D.2.1, D.2.2.
3. The MS maximum output power for 8-PSK modulated signal shall be as defined in GSM 05.05, 4.1.1, second table, according to its power class, with a tolerances of +/-2; +/-3; +3/-4 dB defined under normal conditions in the GSM 05.05, 4.1.1, second table.
4. The MS maximum output power for 8-PSK modulated signal shall be as defined in GSM 05.05, 4.1.1, second table, according to its power class, with a tolerances of +/-2.5; +/-4; +4/-4.5 dB defined under extreme conditions in the GSM 05.05, 4.1.1, second table.
5. The power control levels for both GMSK and 8-PSK shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM400 & GSM 900), fourth table (for DCS 1 800) or fifth table (for PCS 1900), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 1), with a tolerance of +/-2; +/- 3, 4 or 5 dB under normal conditions; GSM 05.05, 4.1.1, third, fourth or fifth table.
6. The power control levels for both GMSK and 8-PSK shall have the nominal output power levels as defined in GSM 05.05, 4.1.1, third table (for GSM 400 & GSM 900), fourth table (for DCS 1 800) or fifth table (for PCS 1900), from the lowest power control level up to the maximum output power corresponding to the class of the MS (for tolerance on maximum output power see conformance requirements 2), with a tolerance of +/-2.5; +/- 4, 5 or 6 dB under extreme conditions; GSM 05.05, 4.1.1, third, fourth or fifth table; GSM 05.05 annex D D.2.1, D.2.2.
7. For both GMSK and 8-PSK, the output power actually transmitted by the MS at consecutive power control levels shall form a monotonic sequence and the interval between power control levels shall be 2 +/- 1,5 dB; GSM 05.05, 4.1.1.
8. The transmitted power level relative to time for a normal burst shall be within the power/time template given in GSM 05.05, annex B top figure for GMSK modulated signal. In multislot configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency, no requirements are specified to the power ramping in the guard times between the active slots, and the template of annex B shall respected at the beginning and the end of the series of consecutive bursts:

8.1 Under normal conditions; GSM 05.05, 4.5.2..

8.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.

9. The transmitted power level relative to time for a normal burst shall be within the power/time template given in GSM 05.05, annex B bottom figure for 8PSK modulated signal. In the case of Multislot Configurations where the bursts in two or more consecutive time slots are actually transmitted at the same frequency, the template of annex B shall be respected during the useful part of each burst and at the beginning and the end of the series of consecutive bursts. The output power during the guard period between every two consecutive active timeslots shall not exceed the level allowed for the useful part of the first timeslot, or the level allowed for the useful part of the second timeslot plus 3 dB, whichever is the highest.

9.1 Under normal conditions; GSM 05.05, 4.5.2.

9.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.

10. When accessing a cell on the PRACH or RACH (random access) and before receiving the first power control parameters during packet transfer on PDCH, the MS shall use the output power defined by P<sub>MAX</sub>. MS\_TXPWR\_MAX\_CCH is broadcast on the BCCH of the cell. A class 3 DCS1 800 MS shall add to it the value POWER OFFSET broadcast on the BCCH P<sub>MAX</sub> is the maximum allowed output power in the cell =GPRS\_MS\_TXPWR\_MAX\_CCH if PBCCH exists MS\_TXPWR\_MAX\_CCH otherwise. GSM05.08,10.2.1

11. The transmitted power level relative to time for a Random Access burst shall be within the power/time template given in GSM 05.05, annex B figure 3:

11.1 Under normal conditions; GSM 05.05, 4.5.2.

11.2 Under extreme conditions; GSM 05.05, 4.5.2, GSM 05.05 annex D D.2.1, D.2.2.

### 13.17.3.3 Test purpose

1. To verify that the maximum output power of the GMSK modulated signal of the MS in EGPRS multislot configuration, under normal conditions, is within conformance requirement 1.
2. To verify that the maximum output power of the GMSK modulated signal of the MS in EGPRS multislot configuration, under extreme conditions, is within conformance requirement 2.
3. To verify that the maximum output power of the 8-PSK modulated signal of the MS in EGPRS multislot configuration, under normal conditions, is within conformance requirement 3.
4. To verify that the maximum output power of the 8-PSK modulated signal of the MS in EGPRS multislot configuration, under extreme conditions, is within conformance requirement 4.
5. To verify that all power control levels, relevant to the class of MS, are implemented in the MS in EGPRS multislot configuration and have output power levels, under normal conditions, within conformance requirement 5.
6. To verify that all power control levels have output power levels, under extreme conditions, within conformance requirement 6.
7. To verify that the step in the output power transmitted by the MS in EGPRS multislot configuration at consecutive power control levels is within conformance requirement 7 under normal conditions.
8. To verify that the output power relative to time, when sending a normal burst of the GMSK modulated signal is within conformance requirement 8 in EGPRS multislot configuration:
  - 8.1 Under normal conditions.
  - 8.2 Under extreme conditions.
9. To verify that the output power relative to time, when sending a normal burst of the 8-PSK modulated signal is within conformance requirement 9 in EGPRS multislot configuration:
  - 9.1 Under normal conditions.

9.2 Under extreme conditions.

10. To verify that the MS in EGPRS is within conformance requirement 10., when accessing the cell on RACH or PRACH.
11. To verify that the output power relative to time, when sending an access burst is within conformance requirement 11 in EGPRS multislot configuration:
  - 11.1 Under normal conditions
  - 11.2 Under extreme conditions

#### 13.17.3.4 Methods of test

Two methods of test are described, separately for:

- 1) equipment fitted with a permanent antenna connector and for
- 2) equipment fitted with an integral antenna, and which cannot be connected to an external antenna except by the fitting of a temporary test connector as a test fixture.

NOTE: The behaviour of the MS in the system is determined to a high degree by the antenna, and this is the only transmitter test in this ETS using the integral antenna. Further studies are ongoing on improved testing on the integral antenna, taking practical conditions of MS use into account.

##### 13.17.3.4.1 Method of test for equipment with a permanent antenna connector

###### Initial conditions

A downlink TBF is set up according to the generic procedure in section 40. The SS orders the MS to transmit on the uplink on a mid range ARFCN, power control level set to Max power and MS to operate in its highest number of uplink slots. This is achieved using the EGPRS test mode by transmitting a EGPRS TEST\_CMD (see 04.14, section TBD)

The SS controls the power level by setting the concerned timeslot's power control parameter ALPHA ( $\alpha$ ) to 0 and GAMMA\_TN ( $\Gamma_{CH}$ ) to the desired power level in the Packet Uplink Assignment message (Closed Loop Control, see 05.08. Annex B.2) GPRS\_MS\_TXPWR\_MAX\_CCH / MS\_TXPWR\_MAX\_CCH is set to the maximum value supported by the Power Class of the Mobile under test. For DCS 1 800 mobile stations the POWER\_OFFSET parameter is set to 6 dB.

###### Test procedure

- a) Measurement of normal burst transmitter output power

For GMSK, average power is determined for each burst as follows:

The SS takes power measurement samples evenly distributed over the duration of one burst with a sampling rate of at least  $2/T$ , where  $T$  is the symbol duration. The samples are identified in time with respect to the modulation on the burst. The SS identifies the centre of the useful 147 transmitted symbols, i.e. the transition from symbol 13 to 14 of the midamble, as the timing reference.

The transmitter output power is calculated as the average of the samples over the 147 useful symbols. This is also used as the 0 dB reference for the power/time template.

For 8PSK, power may be determined by applying the technique described for GMSK above and then averaging over multiple bursts to achieve sufficient accuracy (see Annex 5). Alternatively, an estimation technique based on a single burst which can be demonstrated to yield the same result as the long term average may be used. The long term average or the estimate of long term average is used as the 0dB reference for the power/time template.

- b) Measurement of normal burst power/time relationship. The array of power samples measured in a) are referenced in time to the centre of the useful transmitted symbols and in power to the 0 dB reference, both identified in a).
- c) Steps a) to b) are repeated on each timeslot within the multislot configuration with the MS commanded to operate on each of the power control levels defined, even those not supported by the MS.

- d) The SS commands the MS to the maximum power control level supported by the MS and steps a) to b) are repeated on each timeslot within the multislot configuration for ARFCN in the Low and High ranges.
- e) The SS commands the MS to the maximum power control level in the first timeslot allocated within the multislot configuration and to the minimum power control level in the second timeslot allocated. Any further timeslots allocated are to be set to the maximum power control level. Steps a) to b) and corresponding measurements on each timeslot within the multislot configuration are repeated. This step is only applicable to MS which support more than one uplink time slot.
- f) Measurement of access burst transmitter output power

The SS causes the MS to generate an Access Burst on an ARFCN in the Mid ARFCN range, this could be either by a cell re-selection or a new request for radio resource. In the case of a cell re-selection procedure the Power Level indicated in the PSI3 message is the maximum power control level supported by the MS. The Power Level of the Access Burst shall be as indicated in the GPRS\_MS\_TXPWR\_MAX\_CCH parameter. If the power class of the MS is DCS 1 800 Class 3 and the Power Level is indicated by the MS\_TXPWR\_MAX\_CCH parameter, the MS shall also use the POWER\_OFFSET parameter.

The SS takes power measurement samples evenly distributed over the duration of the access burst as described in a). However, in this case the SS identifies the centre of the useful symbols of the burst by identifying the transition from the last bit of the synch sequence. The centre of the burst is then five data symbols prior to this point and is used as the timing reference.

The transmitter output power is calculated as the average of the samples over the 87 useful symbols of the burst. This is also used as the 0 dB reference for the power/time template.

- g) Measurement of access burst power/time relationship

The array of power samples measured in f) are referenced in time to the centre of the useful transmitted symbols and in power to the 0 dB reference, both identified in f).

- h) Depending on the method used in step f) to cause the MS to send an Access Burst, the SS sends either a PACKET CELL CHANGE ORDER along with power control level set to 10 in PSI3 parameter GPRS\_MS\_TXPWR\_MAX\_CCH or it changes the (Packet) System Information elements (GPRS\_)MS\_TXPWR\_MAX\_CCH and for DCS 1 800 the POWER\_OFFSET on the serving cell PBCCH/BCCH in order to limit the MS transmit power on the Access Burst to power control level 10 (+23 dBm for GSM 400 & GSM 900 or +10 dBm for DCS 1 800 & PCS 1900) and then steps f) to g) are repeated.
- i) Steps a) to h) are repeated under extreme test conditions (annex 1, TC2.2) except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

#### 13.17.3.4.2 Method of test for equipment with an integral antenna

NOTE: If the MS is equipped with a permanent connector, such that the antenna can be disconnected and the SS be connected directly, then the method of section 13.17.3.4.1 will be applied.

The tests in this section are performed on an unmodified test sample.

##### Initial conditions

The MS is placed in the anechoic shielded chamber (annex 1, GC5) or on the outdoor test site, on an isolated support, in the position for normal use, at a distance of at least 3 metres from a test antenna, connected to the SS.

NOTE: The test method described has been written for measurement in an anechoic shielded chamber. If an outdoor test site is used then, in addition, it is necessary to raise/lower the test antenna through the specified height range to maximize the received power levels from both the test sample and the substitution antenna.

The initial conditions for the MS are defined in 13.17.3.4.1.1

## Test procedure

- a) With the initial conditions set according to subclause 13.17.3.4.2.1 the test procedure in 13.17.3.4.1.2 is followed up to and including step h), except that in step a), when measurements are done at maximum power for ARFCN in the Low, Mid and High range, the measurement is made eight times with the MS rotated by  $n \cdot 45$  degrees for all values of  $n$  in the range 0 to 7.

The measurements taken are received transmitter output power measurements rather than transmitter output power measurements, the output power measurement values can be derived as follows.

- b) Assessment of test site loss for scaling of received output power measurements.

The MS is replaced by a half-wave dipole, resonating at the centre frequency of the transmit band, connected to an RF generator.

The frequency of the RF signal generator is set to the frequency of the ARFCN used for the 24 measurements in step a), the output power is adjusted to reproduce the received transmitter output power averages recorded in step a).

For each indication the power, delivered by the generator (in Watts) to the half-wave dipole, is recorded. These values are recorded in the form  $P_{nc}$ , where  $n$  = MS rotation and  $c$  = channel number.

For each channel number used compute:

$$P_{ac}(\text{Watts into dipole}) = \frac{1}{8} * \sum_{n=0}^{n=7} P_{nc}$$

from which:  $P_{ac} (\text{Tx dBm}) = 10 \log_{10}(P_{ac}) + 30 + 2,15$

The difference, for each of the three channels, between the actual transmitter output power averaged over the 8 measurement orientations and the received transmitter output power at orientation  $n = 0$  is used to scale the received measurement results to actual transmitter output powers for all measured power control levels and ARFCN, which can then be checked against the requirements.

- c) Temporary antenna connector calibration factors (transmit)

A modified test sample equipped with a temporary antenna connector is placed in a climatic test chamber and is linked to the SS by means of the temporary antenna connector.

Under normal test conditions, the power measurement and calculation parts of steps a) to j) of 13.17.3.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

NOTE: The values noted here are related to the output transmitter carrier power levels under normal test conditions, which are known after step b). Therefore frequency dependent calibration factors that account for the effects of the temporary antenna connector can be determined.

- d) Measurements at extreme test conditions.

NOTE: Basically the procedure for extreme conditions is:

- the power/time template is tested in the "normal" way,
- the radiated power is measured by measuring the difference with respect to the radiated power under normal test conditions.

Under extreme test conditions steps a) to h) of 13.17.3.4.1.2 are repeated except that the repeats at step d) are only performed for power control level 10 and the minimum power control level of the MS.

The transmitter output power under extreme test conditions is calculated for each burst type, power control level and for every frequency used by adding the frequency dependent calibration factor, determined in c), to the values obtained at extreme conditions in this step.



13.17.3.5 Test requirements

- a) The transmitter output power for the GMSK modulated signals, under every combination of normal and extreme test conditions, for normal bursts and access bursts, at each frequency and for each power control level applicable to the MS power class, shall be at the relevant level shown in table 13.17.3-1 or table 13.17.3-3 within the tolerances also shown in table 13.17.3-1 or table 13.17.3-3
- b) The transmitter output power for the 8-PSK modulated signals, under every combination of normal and extreme test conditions, for normal bursts and access bursts, at each frequency and for each power control level applicable to the MS power class, shall be at the relevant level shown in table 13.17.3-2 or table 13.17.3-4 within the tolerances also shown in table 13.17.3-2 or table 13.17.3-4

GSM 400 & GSM 900 beginning

**Table 13.17.3-1: GSM400 & GSM 900 transmitter output power for different power classes GMSK**

Power class				Power control level	Transmitter output power	Tolerances	
2	3	4	5			normal	extreme
.	.	.	.	2	39	+/-2 dB	+/-2,5 dB
.	.	.	.	3	37	+/-3 dB*)	+/-4 dB*)
.	.	.	.	4	35	+/-3 dB	+/-4 dB
.	.	.	.	5	33	+/-3 dB*)	+/-4 dB*)
.	.	.	.	6	31	+/-3 dB	+/-4 dB
.	.	.	.	7	29	+/-3 dB*)	+/-4 dB*)
.	.	.	.	8	27	+/-3 dB	+/-4 dB
.	.	.	.	9	25	+/-3 dB	+/-4 dB
.	.	.	.	10	23	+/-3 dB	+/-4 dB
.	.	.	.	11	21	+/-3 dB	+/-4 dB
.	.	.	.	12	19	+/-3 dB	+/-4 dB
.	.	.	.	13	17	+/-3 dB	+/-4 dB
.	.	.	.	14	15	+/-3 dB	+/-4 dB
.	.	.	.	15	13	+/-3 dB	+/-4 dB
.	.	.	.	16	11	+/-5 dB	+/-6 dB
.	.	.	.	17	9	+/-5 dB	+/-6 dB
.	.	.	.	18	7	+/-5 dB	+/-6 dB
.	.	.	.	19	5	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

**Table 13.17.3-2: GSM 400 & GSM 900 transmitter output power for different power classes  
8PSK Modulated Signals**

Power class			Power control level	Transmitter output power	Tolerances	
E1	E2	E3				
.			5	33	+/-2 dB	+/-2.5dB
			6	31	+/-3 dB	+/-4 dB
			7	29	+/-3 dB	+/-4 dB
	.		8	27	+/-3 dB	+/-4 dB
	.		9	25	+/-3 dB	+/-4 dB
	.	.	10	23	+/-3 dB	+/-4 dB
	.	.	11	21	+/-3 dB	+/-4 dB
	.	.	12	19	+/-3 dB	+/-4 dB
	.	.	13	17	+/-3 dB	+/-4 dB
	.	.	14	15	+/-3 dB	+/-4 dB
	.	.	15	13	+/-3 dB	+/-4 dB
	.	.	16	11	+/-5 dB	+/-6 dB
	.	.	17	9	+/-5 dB	+/-6 dB
	.	.	18	7	+/-5 dB	+/-6 dB
	.	.	19	5	+/-5 dB	+/-6 dB

GSM400 & GSM 900 - end

DCS 1 800 & PCS1900 - beginning

**Table 13.17.3-3: DCS 1 800 and PCS 1900 transmitter output power for different power classes  
GMSK Modulated signal**

Power class			Power control level	Transmitter output power	Tolerances	
1	2	3			normal	extreme
		.	29	36	+/-2,0 dB	+/-2,5 dB
		.	30	34	+/-3,0 dB	+/-4,0 dB
		.	31	32	+/-3,0 dB	+/-4,0 dB
		.	0	30	+/-3,0 dB*)	+/-4 dB*)
		.	1	28	+/-3 dB	+/-4 dB
		.	2	26	+/-3 dB	+/-4 dB
		.	3	24	+/-3 dB*)	+/-4 dB*)
		.	4	22	+/-3 dB	+/-4 dB
		.	5	20	+/-3 dB	+/-4 dB
		.	6	18	+/-3 dB	+/-4 dB
		.	7	16	+/-3 dB	+/-4 dB
		.	8	14	+/-3 dB	+/-4 dB
		.	9	12	+/-4 dB	+/-5 dB
		.	10	10	+/-4 dB	+/-5 dB
		.	11	8	+/-4 dB	+/-5 dB
		.	12	6	+/-4 dB	+/-5 dB
		.	13	4	+/-4 dB	+/-5 dB
		.	14	2	+/-5 dB	+/-6 dB
		.	15	0	+/-5 dB	+/-6 dB

\*) When the power control level corresponds to the power class of the MS, then the tolerances shall be 2,0 dB under normal test conditions and 2,5 dB under extreme test conditions.

**Table 13.17.3-4: DCS1800 and PCS1900 transmitter output power for different power classes  
8-PSK Modulated Signals**

Power class			Power control level	Transmitter output power	Tolerances	
E1	E2	E3			NORMAL	EXTREME
		.	0	30	+/-3 dB	+/-4dB
		.	1	28	+/-3 dB	+/-4 dB
		.	2	26	+/-3 dB	+/-4 dB
		.	3	24	+/-3 dB	+/-4 dB
		.	4	22	+/-3 dB	+/-4 dB
		.	5	20	+/-3 dB	+/-4 dB
		.	6	18	+/-3 dB	+/-4 dB
		.	7	16	+/-3 dB	+/-4 dB
		.	8	14	+/-4 dB	+/-4 dB
		.	9	12	+/-4 dB	+/-5 dB
		.	10	10	+/-4 dB	+/-5 dB
		.	11	8	+/-4 dB	+/-5 dB
		.	12	6	+/-4 dB	+/-5 dB
		.	13	4	+/-5 dB	+/-5 dB
		.	14	2	+/-5 dB	+/-6 dB

DCS 1 800 & PCS1900 - end

c) The difference between the transmitter output power at two adjacent power control levels, measured at the same frequency, shall not be less than 0,5 dB and not be more than 3,5 dB.

- d) The power/time relationship of the measured samples for normal bursts shall be within the limits of the power time template of figure 13.17.3-1 for GMSK and figure 13.17.3-2 for 8-PSK at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.

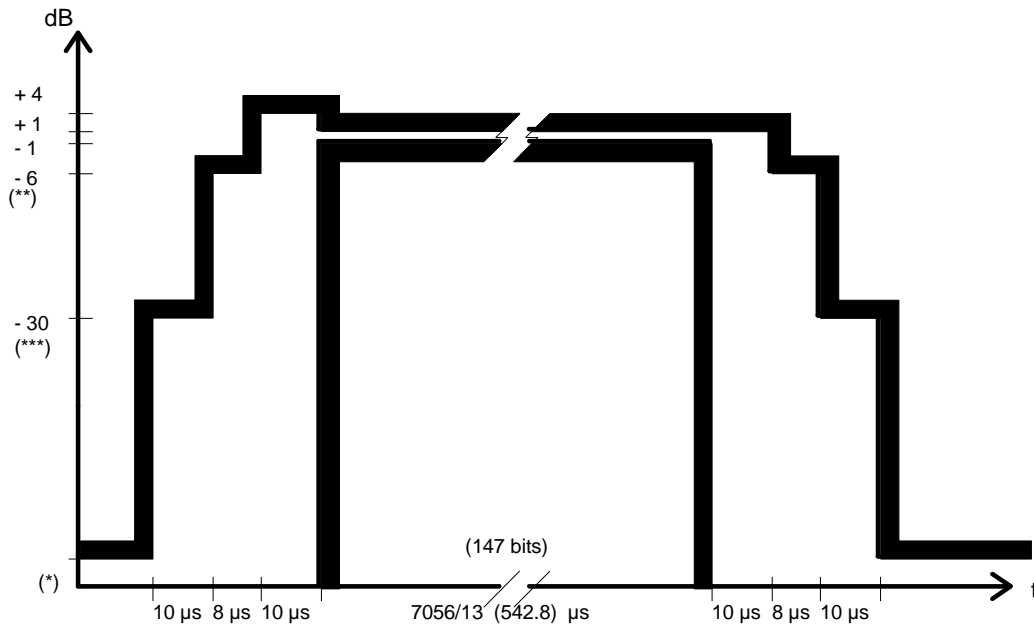


Figure 13.17.3-1: Power / time template for normal bursts (GMSK modulation)

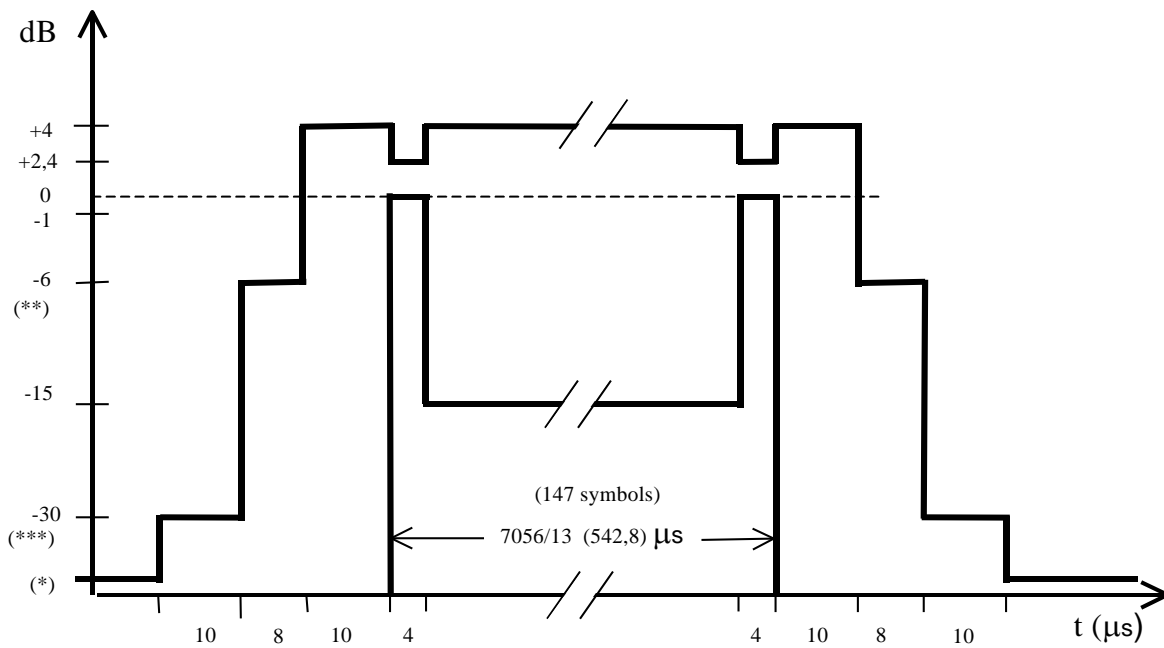


Figure 13.17.3-2: Time mask for normal duration bursts (NB) at 8-PSK modulation

- d) All the power control levels, for the type and power class of the MS as stated by the manufacturer, shall be implemented in the MS.
- f) When the transmitter is commanded to a power control level outside of the capability corresponding to the type and power class of the MS as stated by the manufacturer, then the transmitter output power shall be within the

tolerances for the closest power control level corresponding to the type and power class as stated by the manufacturer.

- g) The power/time relationship of the measured samples for access bursts shall be within the limits of the power time template of figure 13.17.3-3 at each frequency, under every combination of normal and extreme test conditions and at each power control level measured.

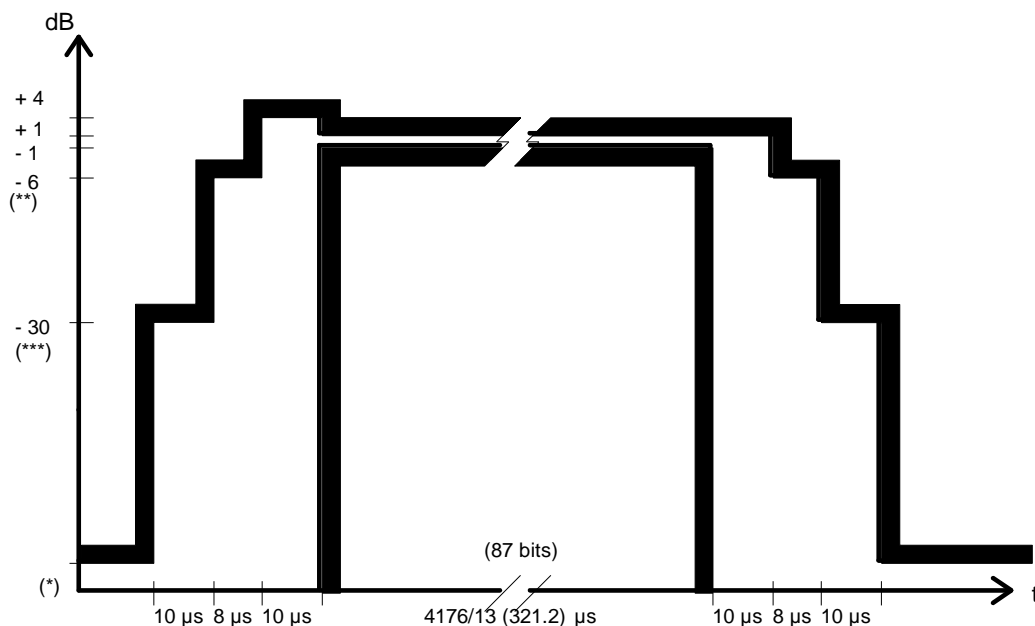


Figure 13.17.3-3: Power / time template for access burst

Table 13.17.3-3: Lowest measurement limit for power / time template

(*)	For GSM 400 and GSM 900 MS	:	59 dBc or -54 dBm whichever is the highest, except for the timeslot preceding the active slot, for which the allowed level is -59 dBc or -36 dBm, whichever is the highest
	For DCS 1 800 MS and PCS 1900 MS	:	-48 dBc or -48 dBm, whichever is the higher.
		:	no requirement below -30 dBc (see 4.5.1).
(**)	For GSM 400 and GSM 900 MS	:	-4 dBc for power control level 16; -2 dBc for power level 17;
	For DCS 1 800 MS	:	-1 dBc for power level controls levels 18 and 19. -4dBc for power control level 11, -2dBc for power level 12, -1dBc for power control levels 13,14 and 15
(***)	For GSM 400 and GSM 900 MS	:	-30 dBc or -17 dBm, whichever is the higher.
	For DCS 1 800 MS	:	-30dBc or -20dBm, whichever is the higher.

### 13.17.4 Output RF spectrum in EGPRS configuration

#### 13.17.4.1 Definition and applicability

The output RF spectrum is the relationship between the frequency offset from the carrier and the power, measured in a specified bandwidth and time, produced by the MS due to the effects of modulation and power ramping.

The requirements and this test apply to all types of GSM400, GSM 900, DCS 1 800 MS and PCS1900 and multiband GSM 900 / DCS 1800/ PCS1900 which are capable of EGPRS multislot operation.

#### 13.17.4.2 Conformance requirement

1. The level of the output RF spectrum due to GMSK and 8PSK modulations shall be no more than that given in GSM 05.05, 4.2.1, with the following lowest measurement limits:
  - 36 dBm below 600 kHz offset from the carrier,
  - 51 dBm for GSM 400 & GSM 900 or -56 dBm for DCS 1 800 and PCS1900 from 600 kHz out to less than 1 800 kHz offset from the carrier,
  - 46 dBm for GSM 400 & GSM 900 or -51 dBm for DCS 1 800 and PCS1900 at and beyond 1 800 kHz offset from the carrier,

but with the following exceptions at up to -36 dBm:

- up to three bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz in the combined range 600 kHz to 6000 kHz above and below the carrier,
- up to 12 bands of 200 kHz width centred on a frequency which is an integer multiple of 200 kHz at more than 6 000 kHz offset from the carrier.

1.1 Under normal conditions; GSM 05.05, 4.2.1.

1.2 Under extreme conditions; GSM 05.05, 4.2.1; GSM 05.05, annex D D.2.1, D.2.2.

2. The level of the output RF spectrum due to switching transients shall be no more than given in GSM 05.05, 4.2.2, table "a) Mobile Station:".

2.1 Under normal conditions; GSM 05.05, 4.2.2.

2.2 Under extreme conditions; GSM 05.05, 4.2.2; GSM 05.05 annex D D.2.1, D.2.2.

3. When allocated a channel, the power emitted by the GSM 400, GSM 900 & DCS 1800 MS, in the band 935 to 960 MHz shall be no more than -79 dBm, in the band 925 to 935 MHz shall be no more than -67 dBm and in the band 1 805 to 1 880 MHz shall be no more than -71 dBm, except in five measurements in each of the bands 925 to 960 MHz and 1 805 to 1 880 MHz, where exceptions at up to -36 dBm are permitted. For GSM 400 mobiles, in addition, a limit of -67 dBm shall apply in the frequency bands 460.4 – 467.6 MHz and 488.8 – 496 MHz.

The power emitted by the PCS 1900 shall not exceed -71 dBm in frequency band 1930-1990 MHz, Under normal conditions; GSM 05.05, 4.3.3.

#### 13.17.4.3 Test purpose

1. To verify that the output RF spectrum due to modulation does not exceed conformance requirement 1 in the EGPRS multislot configurations.
  - 1.1 Under normal conditions.
  - 1.2 Under extreme conditions.
2. To verify that the output RF spectrum due to switching transients does not exceed conformance requirement 2 in the EGPRS multislot configurations when a reasonable margin is allowed for the effect of spectrum due to modulation.
  - 2.1 Under normal conditions.
  - 2.2 Under extreme conditions.
3. To verify that the MS spurious emissions in the MS receive band do not exceed conformance requirement 3 in the EGPRS multislot configurations.

## 13.17.4.4 Method of test

## Initial conditions

The MS is ordered to transmit EGPRS RLC data blocks containing random data with the highest number of uplink slots. This is achieved using the EGPRS test mode by transmitting a EGPRS TEST\_CMD (see 04.14, section TBD)

The SS commands the MS to hopping mode. The hopping pattern includes only three channels, namely one with an ARFCN in the Low ARFCN range, a second one with an ARFCN in the Mid ARFCN range and the third one with an ARFCN in the High ARFCN range.

In the case that loop-back method of the EGPRS test mode is used, the SS sends the pseudo-random signal specified for the uplink only transmission method of EGPRS test mode in GSM 04.14. The SS shall use a level of  $23 \text{ dB}\mu\text{Vemf}$  ( ).

NOTE 1: Although the measurement is made whilst the MS is in hopping mode, each measurement is on one single channel.

NOTE 2: This test is specified in hopping mode as a simple means of making the MS change channel, it would be sufficient to test in non hopping mode and to cell re-select the MS between the three channels tested at the appropriate time.

## 13.17.4.4.2 Test procedure

This procedure shall apply to both GMSK and 8PSK modulations.

NOTE: When averaging is in use during frequency hopping mode, the averaging only includes bursts transmitted when the hopping carrier corresponds to the nominal carrier of the measurement.

a) In steps b) to h) the FT is equal to the hop pattern ARFCN in the Mid ARFCN range.

b) The other settings of the spectrum analyser are set as follows:

- Zero frequency scan
- Resolution bandwidth: 30 kHz
- Video bandwidth: 30 kHz
- Video averaging: may be used, depending on the implementation of the test

The video signal of the spectrum analyser is “gated” such that the spectrum generated by at least 40 of the symbols 87 to 132 of the burst in one of the active time slots is the only spectrum measured. This gating may be analogue or numerical, dependent upon the design of the spectrum analyser. Only measurements during transmitted bursts on the nominal carrier of the measurement are included. The spectrum analyser averages over the gated period and over 200 or 50 such bursts, using numerical and/or video averaging.

c) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 50 bursts at all multiples of 30 kHz offset from FT to  $< 1\ 800 \text{ kHz}$ .

d) The resolution and video bandwidth on the spectrum analyser are adjusted to 100 kHz and the measurements are made at the following frequencies:

on every ARFCN from 1 800 kHz offset from the carrier to the edge of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the 2 MHz either side of the relevant transmit band for each measurement over 50 bursts.

at 200 kHz intervals over the band 450-496 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 925 - 960 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 1805 - 1880 MHz for each measurement over 50 bursts.

at 200 kHz intervals over the band 1930 – 1990 MHz for each measurement over 50 bursts.

- e) The MS is commanded to its minimum power control level. The spectrum analyser is set again as in b).
- f) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured over 200 bursts at the following frequencies:

FT

FT + 100 kHz                      FT - 100 kHz

FT + 200 kHz                      FT - 200 kHz

FT + 250 kHz                      FT - 250 kHz

FT + 200 kHz \* N                  FT - 200 kHz \* N

where N = 2, 3, 4, 5, 6, 7, and 8

and FT = RF channel nominal centre frequency.

- g) Steps a) to f) is repeated except that in step a) the spectrum analyzer is gated so that the burst of the next active time slot is measured.
- h) The spectrum analyser settings are adjusted to:
- Zero frequency scan
  - Resolution bandwidth: 30 kHz
  - Video bandwidth: 100 kHz
  - Peak hold

The spectrum analyser gating of the signal is switched off.

The MS is commanded to its maximum power control level in every transmitted time slot.

- i) By tuning the spectrum analyser centre frequency to the measurement frequencies the power level is measured at the following frequencies:

FT + 400 kHz                      FT - 400 kHz

FT + 600 kHz                      FT - 600 kHz

FT + 1,2 MHz                      FT - 1,2 MHz

FT + 1,8 MHz                      FT - 1,8 MHz

where FT = RF channel nominal centre frequency.

The duration of each measurement (at each frequency) will be such as to cover at least 10 burst transmissions at FT.

- j) Step i) is repeated for power control levels 7 and 11.
- k) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the Low ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.
- l) Steps b), f), h) and i) are repeated with FT equal to the hop pattern ARFCN in the High ARFCN range except that in step h) the MS is commanded to power control level 11 rather than maximum power.
- m) Steps a) b) f) h), and i) are repeated under extreme test conditions (annex 1, TC2.2). except that at step h) the MS is commanded to power control level 11.



13.17.4.5 Test requirements

For absolute measurements, performed on a temporary antenna connector, in the frequency band 450-486 or 880 to 915 MHz or 1710 to 1785 MHz or 1850-1910, the temporary antenna connector coupling factor, determined according to 13.3.4.2.2 and annex 1 GC7, for the nearest relevant frequency, will be used.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 450-486 or 925 to 960 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for GSM 400 or GSM 900 MS respectively. For a DCS 1 800 MS & PCS 1900 MS 0 dB will be assumed.

For absolute measurements, performed on a temporary antenna connector, in the frequency band 1805 to 1880 MHz, the temporary antenna connector coupling factor, will be as determined according to annex 1 GC7 for DCS 1 800 MS. For GSM 400 MS & GSM 900 MS 0 dB will be assumed.

The figures in the tables below, at the listed frequencies from the carrier (kHz), are the maximum level (dB) relative to a measurement in 30 kHz bandwidth on the carrier (reference GSM 05.05 section 4.2.1).

- a) For the modulation sidebands out to less than 1 800 kHz offset from the carrier frequency (FT) measured in step c), f), i), k), l) and m) the measured power level in dB relative to the power level measured at FT, for all types of MS, shall not exceed the limits derived from the values shown in table 13.17.4-1 for GSM 400 & GSM 900 or table 13.17.4-2 for DCS 1 800 & PCS 1900 MS, according to the actual transmit power and frequency offset from FT. However any failures in the combined range 600 kHz to less than 1 800 kHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below.

**Table 13.17.4-1: GSM400 & GSM 900 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
39	+0,5	-30	-33	-60	-66
37	+0,5	-30	-33	-60	-64
35	+0,5	-30	-33	-60	-62
<= 33	+0,5	-30	-33	-60*	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-51

\*For equipment supporting 8PSK, the requirement for 8-PSK modulation is -54dB.

**Table 13.17.4-2: DCS 1 800/PCS 1900 Spectrum due to modulation out to less than 1 800 kHz offset**

	power levels in dB relative to the measurement at FT				
Power level	Frequency offset (kHz)				
(dBm)	0-100	200	250	400	600 to <1800
<= 36	+0,5	-30	-33	-60	-60
34	+0.5	-30	-33	-60	-60
32	+0.5	-30	-33	-60	-60
30	+0.5	-30	-33	-60*	-60
The values above are subject to the minimum absolute levels (dBm) below.					
	-36	-36	-36	-36	-56

\*For equipment supporting 8-PSK, the requirement for 8-PSK modulation is -54dB.

NOTE 1: For frequency offsets between 100 kHz and 600 kHz the requirement is derived by a linear interpolation between the points identified in the table with linear frequency and power in dB relative.

- b) For the modulation sidebands from 1 800 kHz offset from the carrier frequency (FT) and out to 2 MHz beyond the edge of the relevant transmit band, measured in step d), the measured power level in dB relative to the power level measured at FT, shall not exceed the values shown in table 13.17.4-3 according to the actual transmit power, frequency offset from FT and system on which the MS is designed to operate. However any failures in the combined range 1 800 kHz to 6 MHz above and below the carrier may be counted towards the exceptions allowed in test requirements c) below, and any other failures may be counted towards the exceptions allowed in test requirements d) below.

**Table 13.17.4-3: Spectrum due to modulation from 1 800 kHz offset to the edge of the transmit band (wideband noise)**

power levels in dB relative to the measurement at FT						
GSM400 & GSM900				DCS1800 & PCS 19004		
Power level (dBm)	Frequency offset kHz			Power level (dBm)	Frequency offset kHz	
	1800 to < 3000	3000 to < 6000	>= 6000		1800 to < 6000	>= 6000
39	-69	-71	-77	36	-71	-79
37	-67	-69	-75	34	-69	-77
35	-65	-67	-73	32	-67	-75
<b>&lt;= 33</b>	<b>-63</b>	<b>-65</b>	<b>-71</b>	30	-65	-73
				28	-63	-71
				26	-61	-69
				<= 24	-59	-67
The values above are subject to the minimum absolute levels (dBm) below.						
	-46	-46	-46		-51	-51

- c) Any failures (from a) and b) above) in the combined range 600 kHz to 6 MHz above and below the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, spurious emissions are allowed in up to three 200 kHz bands centred on an integer multiple of 200 kHz so long as no spurious emission exceeds -36 dBm. Any spurious emissions measured in a 30 kHz bandwidth which spans two 200 kHz bands can be counted towards either 200 kHz band, whichever minimizes the number of 200 kHz bands containing spurious exceptions.
- d) Any failures (from b) above) beyond 6 MHz offset from the carrier should be re-checked for allowed spurious emissions. For each of the three ARFCN used, up to twelve spurious emissions are allowed so long as no spurious emission exceeds -36 dBm.
- e) The MS spurious emissions in the bands 460.4 – 467.6 MHz, 488.8 – 496 MHz, 925 - 935 MHz, 935 - 960 MHz, 1 805 - 1 880 MHz and 1850-1910 MHz measured in step d), for all types of MS, shall not exceed the values shown in table 13.16.4-4 except in up to 3 measurements in the band 460.4-467.6 and 488.8-496MHz, in up to five measurements in the band 925 to 960 MHz and five measurements in the band 1 805 to 1 880 MHz where a level up to -36 dBm is permitted.

**Table 13.17.4-4: Spurious emissions in the MS receive bands**

Band (MHz)	Spurious emissions level (dBm)
460-496	-67 Applicable only for GSM 400 mobiles
925 to 935	-67
935 to 960	-79
1805 to 1880	-71
1850-1910	Comply with FCC rules for wideband PCS services (see GSM 05.05, 4.3)

f) For the power ramp sidebands of steps h), i) and k) the power levels must not exceed the values shown in table 13.17.4-5 for GSM 900 or table 13.17.4-6 for DCS 1 800.

**Table 13.17.4-5: GSM Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
39 dBm	-13 dBm	-21 dBm	-21 dBm	-24 dBm
37 dBm	-15 dBm	-21 dBm	-21 dBm	-24 dBm
35 dBm	-17 dBm	-21 dBm	-21 dBm	-24 dBm
33 dBm	-19 dBm	-21 dBm	-21 dBm	-24 dBm
31 dBm	-21 dBm	-23 dBm	-23 dBm	-26 dBm
29 dBm	-23 dBm	-25 dBm	-25 dBm	-28 dBm
27 dBm	-23 dBm	-26 dBm	-27 dBm	-30 dBm
25 dBm	-23 dBm	-26 dBm	-29 dBm	-32 dBm
23 dBm	-23 dBm	-26 dBm	-31 dBm	-34 dBm
<= +21 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

**Table 13.17.4-6: DCS 1 800/PCS1900 Spectrum due to switching transients**

Power level	Maximum level for various offsets from carrier frequency			
	400 kHz	600 kHz	1200 kHz	1800 kHz
36 dBm	-16 dBm	-21 dBm	-21 dBm	-24 dBm
34 dBm	-18 dBm	-21 dBm	-21 dBm	-24 dBm
32 dBm	-20 dBm	-22 dBm	-22 dBm	-25 dBm
30 dBm	-22 dBm	-24 dBm	-24 dBm	-27 dBm
28 dBm	-23 dBm	-25 dBm	-26 dBm	-29 dBm
26 dBm	-23 dBm	-26 dBm	-28 dBm	-31 dBm
24 dBm	-23 dBm	-26 dBm	-30 dBm	-33 dBm
22 dBm	-23 dBm	-26 dBm	-31 dBm	-35 dBm
<= +20 dBm	-23 dBm	-26 dBm	-32 dBm	-36 dBm

NOTE 2: These figures are different from the requirements in GSM 05.05 because at higher power levels it is the modulation spectrum which is being measured using a peak hold measurement. This allowance is given in the table.

NOTE 3: The figures for table 13.17.3-5 and table 13.17.3-6 assume that, using the peak hold measurement, the lowest level measurable is 8 dB above the level of the modulation specification using the 30 kHz bandwidth gated average technique for 400 kHz offset from the carrier. At 600 and 1200 kHz offset the level is 6 dB above and at 1 800 kHz offset the level is 3 dB above. The figures for 1 800 kHz have assumed the 30 kHz bandwidth spectrum due to modulation specification at <1 800 kHz.

## 13.17.5 Intermodulation attenuation

### 13.17.5.1 Definition and applicability

The intermodulation attenuation is the ratio, in dB, of the power level of the wanted signal to the power level of the highest intermodulation component.

The requirements and this test apply to all types of DCS 1 800 MS and PCS1900.

### 13.17.5.2 Conformance requirement

The maximum level of any intermodulation product shall be no less than 50 dB below the level of the wanted signal when an interfering CW signal is applied, within the transmit band, at a frequency offset of 800 kHz and with a power level 40 dB below the power level of the wanted signal; GSM 05.05, 4.7.3.

### 13.17.5.3 Test purpose

To verify that the MS intermodulation attenuation is no less than conformance requirement 1.

### 13.17.5.4 Method of test

NOTE 1: When the measurements are performed precautions must be taken, so that non-linearities in the selective measuring device do not influence the results appreciably. Furthermore it should be ensured that intermodulation components which may be generated by non-linear elements in the test equipment (e.g. signal generator, circulators, selective measuring device) are sufficiently reduced. The RF transmit equipment under test and the test signal source should be physically separated in such a way that the measurement is not influenced by direct radiation.

NOTE 2: In the case of an MS which does not normally include an antenna connector, the coupling loss of the temporary antenna connector must be taken into account.

#### 13.17.5.4.1 Initial conditions

The antenna output of the MS is connected to the SS via a coupling device, presenting to the MS a load with an impedance of 50 ohms. The coupling device may consist of a circulator with one port connected by a coaxial cable to the output terminal of the MS, the second port correctly terminated with 50 ohms into a selective measuring device (e.g. a spectrum analyser) and the third port connected to the interfering test signal source via an isolator.

The MS is ordered to transmit EGPRS RLC data blocks containing random data with the highest number of uplink slots. This is achieved using the EGPRS test mode by transmitting a EGPRS TEST\_CMD (see 04.14, section TBD) The ARFCN is set to a Mid range value and POWER control level is set to maximum.

#### 13.17.5.4.2 Procedure

This procedure shall apply to both GMSK and 8PSK modulations.

- a) The interfering test signal will be unmodulated and the frequency will be 800 kHz above the transmit frequency of the MS under test. the power level is adjusted to give the equivalent of 40 dB below the transmit power level of the MS, if both the MS transmit power and the interfering test signal were measured with a correct termination but with the other signal absent.
- b) The frequency selective measuring device is set to measure peak hold in a bandwidth of 300 kHz. Any intermodulation components in the MS transmit band, are then measured.
- c) Steps a) and b) are repeated with the test signal at a frequency 800 kHz below the transmitted frequency.

#### 13.17.5.5 Test requirements

The level of each intermodulation component, in the MS transmit band, shall be no less than 50 dB below the level of the transmit power of the wanted MS carrier.