22 Transmit power control timing and confirmation

22.1 Transmit power control timing and confirmation, single slot

22.1.1 Definition and applicability

The RF power level to be employed by the MS is indicated by means of the 5 bit TXPWR field sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block.

When a power change is signalled the MS must change its power control level to the new level at a certain rate of change.

The MS shall confirm the power level that it is currently employing by setting the MS_TXPWR_CONF field in the uplink SACCH L1 header.

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

22.1.2 Conformance requirement

1. The RF power control level to be employed by the MS is indicated by means of the power control information sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block; GSM 05.08, 4.2.

2. The MS shall confirm the power level that it is currently employing in the uplink SACCH L1 header. The indicated value shall be the power control level actually used by the MS for the last burst of the previous SACCH period; GSM 05.08, 4.2.

3. Upon receipt of a command on the SACCH to change its RF power level, the MS shall change to the new level at a rate of one nominal 2 dB power control step every 60 ms; GSM 05.08, 4.7.

4. The change (in conformance requirement 3) shall commence at the first TDMA frame belonging to the next reporting period; GSM 05.08, 4.7.

5. In case of channel change the commanded power level shall be applied on the new channel immediately; GSM 05.08, 4.7.

22.1.3 Test purpose

1. To verify that the MS will set its transmitter output power in accordance with conformance requirement 1.

2. To verify that the MS will confirm the power level it is currently employing according to conformance requirement 2.

3. To verify that the MS, upon receipt of a command from the SACCH to change its RF power level, will change according to conformance requirement 3.

4. To verify that the MS will commence the change of power level at least by the sixth TDMA frame belonging to the next reporting period.

5. To verify that in case of new channel assignment the commanded power level is applied on the new channel according to conformance requirement 5.

22.1.4 Method of test

NOTE: The method of measuring the MS transmitter output power is given in section 13.3.

22.1.4.1 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 (ref. table 3.3), power control level set to maximum power.

22.1.4.2 Procedure

a) The SS signals minimum power control level to the MS in the SACCH.

b) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

c) The SS now sets TXPWR in the SACCH to the maximum peak power appropriate to the class of the MS.

d) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

e) The SS now sets the SACCH TXPWR to 8.

f) After 3 s the SS sets the SACCH TXPWR to 9.

g) The SS measures the MS transmitter output power on TDMA frame 6.

h) The SS sets the SACCH TXPWR to 8.

i) The SS measures the MS transmitter output power on TDMA frame 6.

j) The channel assignment is changed and the demanded power within the channel assignment is set to the minimum power control level of the MS.

k) When the MS has changed channel its output power is measured on the first burst on the new channel.

22.1.5 Test requirements

NOTE: Refer to tables 13-2 , 13-3 and 13-4 for relationship between the power class, power control level, transmitter output power and the relevant tolerances .

a) In steps b) and d), the transmitter output power shall change by one power step towards the new level signalled for each measured burst until the MS is operating at the closest supported power control level and from then on, all transmissions shall be at that level.

b) In steps b) and d), the value of the MS_TXPWR_CONF field in the uplink SACCH L1 header shall correspond to the actual power control level used for the last transmitted burst of the previous SACCH multiframe. The first one shall indicate the initial transmitted power control level, the subsequent ones shall change by 8 each time until the final power control level has been reached in which case that value shall be indicated.

c) In steps g) and i) the transmitter output power of TDMA frame 6 shall correspond to the new commanded power control level.

d) In step k) the MS output power, measured on the new channel shall correspond to the power control level in the channel assignment.

22.2 Transmit power control timing and confirmation in HSCSD multislot configurations

22.2.1 Definition and applicability

The RF power level to be employed by the MS is indicated by means of the 5 bit TXPWR field sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block.

When a power change is signalled the MS must change its power control level to the new level at a certain rate of change.

The MS shall confirm the power level that it is currently employing by setting the MS_TXPWR_CONF field in the uplink SACCH L1 header.

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.

22.2.2 Conformance requirement

1. The RF power control level to be employed by the MS is indicated by means of the power control information sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block; GSM 05.08, 4.2.

2. The MS shall confirm the power level that it is currently employing in the uplink SACCH L1 header. The indicated value shall be the power control level actually used by the MS for the last burst of the previous SACCH period; GSM 05.08, 4.2.

3. Upon receipt of a command on the SACCH to change its RF power level, the MS shall change to the new level at a rate of one nominal 2 dB power control step every 60 ms; GSM 05.08, 4.7.

4. The change (in conformance requirement 3) shall commence at the first TDMA frame belonging to the next reporting period; GSM 05.08, 4.7.

5. In case of channel change the commanded power level shall be applied on the new channel immediately; GSM 05.08, 4.7.

22.2.3 Test purpose

1. To verify that the MS will set its transmitter output power in accordance with conformance requirement 1.

2. To verify that the MS will confirm the power level it is currently employing according to conformance requirement 2.

3. To verify that the MS, upon receipt of a command from the SACCH to change its RF power level, will change according to conformance requirement 3.

4. To verify that the MS will commence the change of power level at least by the sixth TDMA frame belonging to the next reporting period.

5. To verify that in case of new channel assignment the commanded power level is applied on the new channel according to conformance requirement 5.

22.2.4 Method of test

NOTE: The method of measuring the MS transmitter output power is given in section 13.3.

22.2.4.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure for multislot configuration on a channel with ARFCN in the Mid ARFCN range (ref. table 3.3), power control level set to maximum power.

The SS commands the MS to operate in multislot configuration where it has highest possible number of Tx slots.

22.2.4.2 Procedure

a) The SS signals minimum power control level to the MS in the SACCH for one of the subchannels.

b) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

c) The SS now sets TXPWR in the SACCH to the maximum peak power appropriate to the class of the MS.

d) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

e) The SS now sets the SACCH TXPWR to 8.

f) After 3 s the SS sets the SACCH TXPWR to 9.

g) The SS measures the MS transmitter output power on TDMA frame 6.

h) The SS sets the SACCH TXPWR to 8.

i) The SS measures the MS transmitter output power on TDMA frame 6.

j) The channel assignment is changed and the demanded power within the channel assignment is set to the minimum power control level of the MS.

k) When the MS has changed channel its output power is measured on the first burst on the new channel.

l) Steps a) to k) are repeated on the next subchannel untill each is is tested.

22.2.5 Test requirements

NOTE: Refer to tables 13-2, 13-3 and 13-4 for relationship between the power class, power control level, transmitter output power and the relevant tolerances.

a) In steps b) and d), the transmitter output power shall change by one power step towards the new level signalled for each measured burst until the MS is operating at the closest supported power control level and from then on, all transmissions shall be at that level.

b) In steps b) and d), the value of the MS_TXPWR_CONF field in the uplink SACCH L1 header shall correspond to the actual power control level used for the last transmitted burst of the previous SACCH multiframe. The first one shall indicate the initial transmitted power control level, the subsequent ones shall change by 8 each time until the final power control level has been reached in which case that value shall be indicated.

c) In steps g) and i) the transmitter output power of TDMA frame 6 shall correspond to the new commanded power control level.

d) In step k) the MS output power, measured on the new channel shall correspond to the power control level in the channel assignment.

22.3 GPRS Uplink Power Control – Use of α and Γ_{CH} parameters

22.3.1 Definition and applicability

Power control is important for spectrum efficiency as well as for power consumption in a cellular system. Power control for a packet oriented connection is more complicated than for a circuit switched connection, since there is no continuos two-way connection.

The RF output power, P_{CH} , to be employed by the MS on each individual uplink PDCH shall be:

$$P_{CH} = \min(\Gamma_0 - \Gamma_{CH} - \alpha * (C + 48), PMAX),$$

Where

Γ_{CH} is an MS and channel specific power control parameter, sent to the MS in an RLC control message (see GSM 04.60).

Γ_0 = 39 dBm for GSM 400 and GSM900
= 36 dBm for DCS1800

α is a system parameter, broadcast on PBCCH or optionally sent to MS in an RLC control message (see GSM 04.08 and 04.60).

C is the normalised received signal level at the MS as defined in GSM 05.08, 10.2.3.1.

PMAX is the maximum allowed output power in the cell =
GPRS_MS_TXPWR_MAX_CCH if PBCCH exists
MS_TXPWR_MAX_CCH otherwise

All power values are expressed in dBm. (Note that the constants Γ_0 and 48 are included only for optimising the coding of Γ_{CH} and C-value).

This is a flexible tool that can be used for different power control algorithms.

A pure open loop is achieved by setting $\alpha = 1$ and keeping Γ_{CH} constant. With this method the output power is based on the received signal level assuming the same path loss in uplink and downlink. This is useful in the beginning of a packet transmission.

A pure closed loop is achieved by setting $\alpha = 0$. With this method the output power is commanded by the network based on received signal level measurements made in the BTS in a similar way as for a circuit switched connection.

This test applies to all GSM 400, GSM900 and DCS1800 which support GPRS.

22.3.2 Conformance requirement

The MS shall use the same output power on all four bursts within one radio block. GSM 05.08, 10.2.1.

If a calculated output power is not supported by the MS, the MS shall use the supported output power which is closest to the calculated output power. GSM 05.08, 10.2.1.

When the MS receives new Γ_{CH} or α values, the MS shall use the new value to update P_{CH} 2 radio blocks after the end of the frame containing the last timeslot of the message block containing the new value. GSM 05.08, 10.2.1.

The transmitted power shall be a monotonic function of the calculated output power and any change of 2 dB in the calculated value shall correspond to a change of of 2 ± 1.5 dB in the transmitted value. The MS may round the calculated output power to the nearest nominal output power value. GSM 05.08, 10.2.1.

22.3.3. Test purpose

To verify the MS uses that the same output power on all four bursts of a radio block under normal conditions.

To verify that the highest power supported by the MS is used if the calculated power is greater.

To verify that the MS applies new Γ_{CH} or α values 2 radio blocks after the end of the frame containing the last timeslot of the message block containing the new value.

To verify that any change of 2dB in the calculated power corresponds to a change of 2 ± 1.5 dB in the transmitted value under normal conditions.

NOTE: For changes in calculated power which are less than the tolerances specified for absolute power accuracy in a MS, the transmitted power as a function of calculated power cannot be tested for monotonicity. Monotonicity between power control steps is implicitly tested in section 13.16.

22.3.4 Method of test

22.3.4.1 Initial conditions

The SS establishes a BCCH and a PBCCH on the same carrier in the mid ARFCN range. GPRS_MS_TXPWR_MAX_CCH is set to the maximum level (39dBm for GSM and 36dBm for DCS). The Γ_{CH} value is set such that (Γ_0 - Γ_{CH}) equals the maximum power control level supported by the Power Class of the MS under test. The α value is set to 0.

The SS establishes a downlink TBF on the same ARFCN as the BCCH and PBCCH. The MS shall transmit on the uplink. This is achieved using the GPRS test mode by transmitting a GPRS_TEST_MODE_CMD (see GSM 04.14, section5.4). The downlink power level is adjusted until a stable C-value of –52dBm is reported by the MS in the channel quality report (see GSM 05.08, 10.2.3).

22.3.4.2 Procedure

a) The SS shall trigger a transmitter output power measurement on each of the four bursts of any radio block.

   The method of power measurement is described in section 13.16.

b) The SS shall modify the Γ_{CH} value such that (Γ_0 - Γ_{CH}) equals the minimum power control level supported by the MS under test (5dBm for GSM 400 and GSM900 and 0dBm for DCS1800). If the transmission of the RLC control message containing the new Γ_{CH} value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

c) The SS shall modify the Γ_{CH} value such that (Γ_0 - Γ_{CH}) equals the maximum power control level supported by the power class of the MS under test. If the transmission of the RLC control message containing the new Γ_{CH} value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

d) The SS shall modify the Γ_{CH} value such that (Γ_0 - Γ_{CH}) equals the value 4dB below the maximum power control level supported by the power class of the MS under test. The α value is set to 1.

e) The SS shall decrement the α value with a step size of 0.1 until α equals 0. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

f) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step e). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

NOTE

If the power values measured for the four bursts of the radio block with α equal to 1.0 are:

$P_{m0}, P_{m1}, P_{m2}, P_{m3}$

And, the power values measured for the four bursts of the radio block with α equal to 0.5 are:

$P_{n0}, P_{n1}, P_{n2}, P_{n3}$

Then,

$P_{m(max)} = MAX(P_{m0}, P_{m1}, P_{m2}, P_{m3})$

$P_{m(min)} = MIN(P_{m0}, P_{m1}, P_{m2}, P_{m3})$

$P_{n(max)} = MAX(P_{n0}, P_{n1}, P_{n2}, P_{n3})$

$P_{n(min)} = MIN(P_{n0}, P_{n1}, P_{n2}, P_{n3})$

The maximum and minimum step sizes are:

$STEP(MAX) = P_{m(max)} - P_{n(min)}$

$STEP(MIN) = P_{m(min)} - P_{n(max)}$

g) The SS shall modify the Γ_{CH} value such that (Γ_0 - Γ_{CH}) equals the midrange power control level supported by the MS under test. The α value is set to 0.

h) The SS shall increment the α value with a step size of 0.1 until α equals 1. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

i) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step h). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

j) The SS shall modify the Γ_{CH} value such that (Γ_0 - Γ_{CH}) equals the minimum power control level supported by the MS under test (5dBm for GSM 400 and GSM900 and 0dBm for DCS1800). The α value is set to 0.

k) The SS shall increment the α value with a step size of 0.1 until α equals 1. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

l) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step k). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

22.3.5 Test requirements

1. The power of all four bursts within the radio block measured in step a) and c) shall be with in the accuracies specified for the power class of the mobile under test, as indicated in the following table:

Power class	GSM 400 & GSM 900 Nominal Maximum output power	DCS 1 800 Nominal Maximum output power	Tolerance (dB) for normal conditions
1	- - - - - -	1 W (30 dBm)	±2
2	8 W (39 dBm)	0.25 W (24 dBm)	±2
3	5 W (37 dBm)	4 W (36 dBm)	±2
4	2 W (33 dBm)		±2
5	0.8 W (29 dBm)		±2

2. The power of all four bursts within the radio block measured in step b) shall be 5dBm for a GSM 400 or GSM900 MS and 0dBm for a DCS1800 MS with an accuracy of ± 5dB in both cases.

3. In steps f), i) and l), the maximum change in transmitted power between each identified pair of α values shall be 3.5dB.

4. In steps f), i) and l), the minimum change in transmitted power between each identified pair of α values shall be 0.5dB.

22.4 GPRS Uplink Power Control – Independence of TS Power Control

22.4.1 Definition and applicability

This test applies to all GSM 400, GSM900 and DCS1800 MS which support multislot GPRS on the uplink.

22.4.2 Conformance requirement

For a GPRS multislot MS supporting 2 or more uplink PDCHs, power control shall be employed by the MS on each individual uplink PDCH. GSM 05.08, 10.2.1.

22.4.3 Test purpose

To verify that for a GPRS multislot MS supporting 2 or more uplink PDCHs, power control shall be employed by the MS on each individual uplink PDCH.

22.4.4 Method of test

22.4.4.1 Initial conditions

The MS shall transmit on the uplink with the maximum number of TS for the multislot class of the MS.. This is achieved using the GPRS test mode by first establishing a downlink TBF and transmitting a GPRS_TESST_MODE_CMD (see GSM 04.14, section 5,4). Each TS is transmitting on its maximum power. The α-value is set to 0.

22.4.4.2. Procedure

The SS shall modify the Γ_{CH} value of one TS such that (Γ_0 - Γ_{CH}) equals the minimum power control level supported by the MS under test (5dBm for GSM 400 and GSM900 and 0dBm for DCS1800).

a) The SS shall trigger a transmitter output power measurement on each of the four bursts of any radio block of the TS under test.

b) The SS shall trigger a transmittter output power measurement on each of the four bursts of any radio block of the other active TS.

c) The SS shall modify the Γ_{CH} value for the TS under test such that (Γ_0 - Γ_{CH}) equals the maximum power control level supported by the MS under test.

d) Steps a) to d) shall be repeated for each TS of the multislot configuration.

22.4.5. Test requirements

1. The power of all four bursts within the radio block measured in step b) shall be 5dBm for a GSM 400 or GSM900 MS and 0dBm for a DCS1800 MS with an accuracy of ± 5dB in both cases.

2. For all TS, the power of all four bursts within the radio block measured in step c) shall be within the accuracies specified for the power class of the mobile under test, as indicated in the following table:

Power class	GSM 400 & GSM 900 Nominal Maximum output power	DCS 1 800 Nominal Maximum output power	Tolerance (dB) for normal conditions
1	- - - - - -	1 W (30 dBm)	±2
2	8 W (39 dBm)	0.25 W (24 dBm)	±2
3	5 W (37 dBm)	4 W (36 dBm)	±2
4	2 W (33 dBm)		±2
5	0.8 W (29 dBm)		±2

22.5 [Reserved for future GPRS test]

22.6 Normal transmit power control timing and confirmation in ECSD

22.6.1 Definition and applicability

The RF power level to be employed by the MS is indicated by means of the 5 bit TXPWR field sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block.

When a power change is signalled the MS must change its power control level to the new level at a certain rate of change.

The MS shall confirm the power level that it is currently employing by setting the MS_TXPWR_CONF field in the uplink SACCH L1 header.

The requirements and this test apply to all types of GSM 400, GSM 900, DCS1800and and PCS 1900 MS and multiband GSM 400 / GSM 900 / DCS 1800 / PCS1900 MS which are capable of ECSD operation.

22.6.2 Test conformance

1. The RF power control level to be employed by the MS is indicated by means of the power control information sent in the layer 1 header of each downlink SACCH message block and may be sent in a dedicated signalling block; GSM 05.08, 4.2.

2. The MS shall confirm the power level that it is currently employing in the uplink SACCH L1 header. The indicated value shall be the power control level actually used by the MS for the last burst of the previous SACCH period; GSM 05.08, 4.2.

3. Upon receipt of a command on the SACCH to change its RF power level, the MS shall change to the new level at a rate of one nominal 2 dB power control step every 60 ms; GSM 05.08, 4.7.

4. The change (in conformance requirement 3) shall commence at the first TDMA frame belonging to the next reporting period; GSM 05.08, 4.7.

5. In case of channel change the commanded power level shall be applied on the new channel immediately; GSM 05.08, 4.7.

22.6.3 Test purpose

1. To verify that the MS will set its transmitter output power in accordance with conformance requirement 1.

2. To verify that the MS will confirm the power level it is currently employing according to conformance requirement 2.

3. To verify that the MS, upon receipt of a command from the SACCH to change its RF power level, will change according to conformance requirement 3.

4. To verify that the MS will commence the change of power level at least by the sixth TDMA frame belonging to the next reporting period.

5. To verify that in case of new channel assignment the commanded power level is applied on the new channel according to conformance requirement 5.

22.6.4 Test method

NOTE: The method of measuring the MS transmitter output power is given in section 13.3. For 8PSK modulation, a measurement method for estimating the long term average power from a single burst shall be employed. See section 13.17.3.

22.6.4.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure for multislot configuration on a channel with ARFCN in the Mid ARFCN range (ref. table 3.3), power control level set to maximum power.

The SS commands the MS to operate in multislot configuration where it has highest possible number of Tx slots.

22.6.4.2 Procedure

If the MS supports both GMSK and 8PSK modulation on the uplink, the test is repeated with each modulation format.

a) The SS signals minimum power control level to the MS in the SACCH for one of the subchannels.

b) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

c) The SS now sets TXPWR in the SACCH to the maximum peak power appropriate to the class of the MS.

d) The SS measures the MS transmitter output power on TDMA frames 6, 19, 32 and every subsequent 13th TDMA frame to TDMA frame 214. The SS also monitors the MS_TXPWR_CONF field in the uplink SACCH L1 header for the four SACCH multiframes after the SS signals the power change.

e) The SS now sets the SACCH TXPWR to 8.

f) After 3 s the SS sets the SACCH TXPWR to 9.

g) The SS measures the MS transmitter output power on TDMA frame 6.

h) The SS sets the SACCH TXPWR to 8.

i) The SS measures the MS transmitter output power on TDMA frame 6.

j) The channel assignment is changed and the demanded power within the channel assignment is set to the minimum power control level of the MS.

k) When the MS has changed channel its output power is measured on the first burst on the new channel.

l) Steps a) to k) are repeated on the next subchannel until each is tested.

22.6.5 Test requirement

NOTE: Refer to tables 13.17.3-1, 13.17.3-2, 13.17.3-3 and 13.17.3-4 for relationship between the power class, power control level, transmitter output power and the relevant tolerances.

a) In steps b) and d), the transmitter output power shall change by one power step towards the new level signalled for each measured burst until the MS is operating at the closest supported power control level and from then on, all transmissions shall be at that level.

b) In steps b) and d), the value of the MS_TXPWR_CONF field in the uplink SACCH L1 header shall correspond to the actual power control level used for the last transmitted burst of the previous SACCH multiframe. The first one shall indicate the initial transmitted power control level, the subsequent ones shall change by 8 each time until the final power control level has been reached in which case that value shall be indicated.

c) In steps g) and i) the transmitter output power of TDMA frame 6 shall correspond to the new commanded power control level.

d) In step k) the MS output power, measured on the new channel shall correspond to the power control level in the channel assignment.

22.7 ECSD Fast Power Control (FPC) timing and interworking with normal power control

22.7.1 Definition and applicability

Using the SACCH L1 header, normal uplink power control modifies the MS transmit power at a maximum rate of one power control level change per SACCH period (480ms). Under Fast Power Control the output power of an MS, in E-TCH mode, is updated each fast power reporting period. There are 24 fast power reporting periods in a 104 frame SACCH period.

The requirements and this test apply to all types of GSM 400, GSM 900, DCS1800 and PCS 1900 MS and multiband GSM 400 / GSM 900 / DCS 1800 / PCS1900 MS which are capable of class B ECSD operation.

22.7.2 Test conformance

1. In the E-TCH mode, the MS shall, if so indicated by the BSS in the SACCH L1 header or Assignment command, use FPC (fast power control); GSM 05.08, 4.2

2. Switching between the normal power control mechanism and FPC shall be done if FPC is enabled or disabled via signalling in the SACCH L1 header. The respective power control mechanism to be used shall then be active as from the first TDMA frame belonging to the next reporting period; GSM 05.08, 4.7

3. The initial power control level to be used by the MS immediately after switching between normal and fast power control mechanisms shall, in both cases, be the level last commanded by the normal power control mechanism; GSM 05.08, 4.7

4. The fast power control mechanism shall use the differential power control mechanism defined in the table of GSM 05.08, 4.3

5. The MS shall employ the most recently commanded fast power control level on each uplink E-TCH channel; GSM 05.08, 4.2

6. If a power control command is received but the requested output power is not supported by the MS, the MS shall use the supported output power which is closest to the requested output power; GSM 05.08, 4.3

7. If FPC is in use, the MS shall report, in the SACCH L1 header, the power control level used at the end of the normal power control reporting period; GSM 05.08, 4.2

8. In case of a multislot configuration, each bi-directional channel shall be power controlled individually by the corresponding SACCH or fast inband signalling link, whichever is applicable; GSM 05.08, 4.2

22.7.3 Test purpose

1. To verify that the MS switches between normal power control and fast power control mechanisms in accordance with conformance requirements 1 and 2.

2. To verify that the initial power control level used by the MS after switching between normal and fast power control mechanisms is in accordance with conformance requirement 3.

3. To verify that power level changes using the fast power control are implemented by the MS in accordance with conformance requirements 4 and 5.

4. To verify that power control commands requesting levels not supported by the MS are treated in accordance with conformance requirement 6.

5. To verify that the power reported by the MS at the end of the normal power control reporting period is in accordance with conformance requirement 7.

6. To verify that in a multislot configuration the MS implements fast power control independently on each bi-directional E-TCH in accordance with conformance requirement 8.

22.7.4 Test method

22.7.4.1 Initial conditions

A call is set up by the SS according to the generic call set up procedure for multislot configuration on a channel with ARFCN in the Mid ARFCN range (ref. table 3.3).

The SS commands the MS to operate in multislot configuration where it has the highest possible number of bi-directional E-TCHs. Using normal power control, the level of each TX slot is set to maximum power.

22.7.4.2 Procedure

For the purpose of this test the SS shall randomly select one bi-directional E-TCH to exercise. All other E-TCHs shall maintain the state defined under the initial conditions. In this procedure these other E-TCHs are referred to as the active but unselected channels.

a) Using the normal power control mechanism, the SS shall command the MS to transmit at power level 15 in the case of GSM400 and GSM900 or power level 8 in the case of DCS1800 and PCS1900 on the selected E-TCH. After 1s, a power measurement shall be made on each TX slot of the multislot configuration.

NOTE: The method of measuring the MS transmitter output power is given in section 13.3. For 8PSK modulation, a measurement method for estimating the long term average power from a single burst shall be employed. See section 13.17.3.

b) The SS shall command the MS to switch between the normal power control and the fast power control mechanism by means of the SACCH L1 header (see GSM 04.04). Each power control mechanism shall be maintained for a single SACCH period. This cycle shall be repeated until all power measurements specified in steps c) to h) have been completed.

During the SACCH periods when normal power control is active, the SS shall command the MS to maintain the power levels set in step a). During the SACCH period when Fast Power Control is active, the SS shall command the MS to follow the schedule of fast power control detailed in the table below.

FPC Reporting Period Number	Fast Power Control Command	Nominal Output Power during FPC Reporting period GSM400 & GSM900	Nominal Output Power during FPC Reporting Period DCS1800 & PCS1900	Pn
0	2 Step Decrease	13dBm	14dBm	P0
1	2 Step Decrease	11dBm	12dBm	
2	2 Step Decrease	9dBm	10dBm	
3	2 Step Decrease	7dBm	8dBm	
4	2 Step Decrease	5dBm	6dBm	
5	2 Step Decrease	5dBm	4dBm	
6	2 Step Decrease	5dBm	2dBm	
7	2 Step Decrease	5dBm	0dBm	
8	4 Step Increase	5dBm	0dBm	P34
9	4 Step Increase	9dBm	4dBm	
10	4 Step Increase	13dBm	8dBm	
11	4 Step Increase	17dBm	12dBm	
12	4 Step Increase	21dBm	16dBm	
13	4 Step Increase	Max(25dBm,Pmax)	20dBm	
14	4 Step Increase	Max(29dBm,Pmax)	Max(24dBm,Pmax)	
15	4 Step Increase	Max(33dBm,Pmax)	Max(28dBm,Pmax)	
16	2 Step Decrease	Pmax	Pmax	P69
17	1 Step Increase	Pmax – 4dB	Pmax – 4dB	P73
18	2 Step Decrease	Pmax – 2dB	Pmax – 2dB	P78
19	3 Step Increase	Pmax – 6dB	Pmax – 6dB	P82
20	2 Step Decrease	Pmax	Pmax	P86
21	2 Step Decrease	Pmax – 4dB	Pmax – 4dB	P91
22	4 Step Increase	Pmax – 8dB	Pmax – 8dB	P95
23	No Change	Pmax	Pmax	P99

Pmax is the maximum power for the mobile class.

Pn values refer to the power measured in the nth frame of the SACCH period.

a) The SS shall make power measurements on each active, but unselected timeslot of the multislot configuration during frames 0 and 103 of the SACCH period when normal power control is active.

b) The SS shall make power measurements on each active, but unselected timeslot of the multislot configuration during frames 0, 34, 69, 73, 78, 82, 86, 91, 95 and 99 of the SACCH period when fast power control is active.

c) The SS shall make power measurements of the selected timeslots during frames 0 and 103 of the SACCH period when normal power control is active.

d) The SS shall make power measurements on the selected timeslot during frames 0, 34, 69, 73, 78, 82, 86, 91, 95 and 99 of the SACCH period when fast power control is active. These power measurements shall be referred to as P0, P34, P69, P73, P78, P82, P86, P91, P95 and P99 respectively.

e) The SS shall note the MS TX power reported by the MS for the selected timeslot in the SACCH reporting period following the change from fast power control to normal power control.

f) The SS shall note the MS TX power reported by the MS for the selected timeslot in the SACCH reporting period following the change from normal power control to fast power control.

22.7.5 Test requirement

a) The powers measured for the unselected timeslots in steps a), c) and d) shall conform with the Pmax specification for the MS power class given in the following table.

Power class	GSM400 & GSM900 Nominal Maximum output power (MS TX Level)	GSM400 & GSM900 Tolerance (dB) for normal conditions	DCS 1 800 Nominal Maximum output power	PCS 1900 Nominal Maximum Output Power (MS TX Level)	DCS1800 & PCS1900 Tolerance (dB) for normal conditions
E1	33 dBm (5)	±2	30dBm	30dBm (0)	±2
E2	27dBm (8)	±3	26dBm	26dBm (2)	-4/+3
E3	23dBm (10)	±3	22dBm	22dBm (4)	±3

b) The power measured for the selected timeslot in steps a) and e) shall be 13dBm in the case of GSM 400 and GSM900, and 14dBm in the case of DCS1800 and PCS1900. In all cases the tolerance shall be +/-3dB.

c) The powers measured in step f) shall conform with the power specifications in the following table.

Pn	GSM400/GSM900	DCS1800/PCS1900	Tolerance
P0	13dBm	14dBm	+/-3dB
P34	5dBm	0dBm	+/-5dB
P69	Pmax	Pmax	+/-2dB
P73	Pmax – 4dB	Pmax – 4dB	+/-3dB
P78	Pmax – 2dB	Pmax – 2dB	+/-3dB
P82	Pmax – 6dB	Pmax – 6dB	+/-3dB
P86	Pmax	Pmax	+/-2dB
P91	Pmax – 4dB	Pmax – 4dB	+/-3dB
P95	Pmax – 8dB	Pmax – 8dB	+/-3dB
P99	Pmax	Pmax	+/-2dB

See table in test requirement a) for Pmax value for MS power class.

a) The power level reported by the MS in step g) shall be MS TX level corresponding to Pmax for the MS power class. See the table in test requirement a).

b) The power level reported by the MS in step h) shall be MS TX Level 15 in the case of GSM400 and GSM900 and MS TX Level 8 in the case of DSC1800 and PCS1900.

22.8 EGPRS Uplink Power Control – Use of α and Γ_{CH} parameters

22.8.1 Definition and applicability

Power control is important for spectrum efficiency as well as for power consumption in a cellular system. Power control for a packet oriented connection is more complicated than for a circuit switched connection, since there is no continuos two-way connection.

The RF output power, P_{CH} , to be employed by the MS on each individual uplink PDCH shall be:

$$P_{CH} = \min(\Gamma_0 - \Gamma_{CH} - \alpha * (C + 48), PMAX),$$

Where

Γ_{CH} is an MS and channel specific power control parameter, sent to the MS in an RLC control message (see GSM 04.60).

Γ_0 = 39 dBm for GSM400 and GSM900

= 36 dBm for DCS1800 and PCS1900

α	is a system parameter, broadcast on PBCCH or optionally sent to MS in an RLC control message (see GSM 04.08 and 04.60).
C	is the normalised received signal level at the MS as defined in GSM 05.08, 10.2.3.1.
PMAX	is the maximum allowed output power in the cell = GPRS_MS_TXPWR_MAX_CCH if PBCCH exists MS_TXPWR_MAX_CCH otherwise

All power values are expressed in dBm. (Note that the constants Γ_0 and 48 are included only for optimising the coding of Γ_{CH} and C-value).

This is a flexible tool that can be used for different power control algorithms.

A pure open loop is achieved by setting $\alpha = 1$ and keeping Γ_{CH} constant. With this method the output power is based on the received signal level assuming the same path loss in uplink and downlink. This is useful in the beginning of a packet transmission.

A pure closed loop is achieved by setting $\alpha = 0$. With this method the output power is commanded by the network based on received signal level measurements made in the BTS in a similar way as for a circuit switched connection.

This test applies to all GSM400, GSM900, DCS1800 and PCS1900 and all multiband MS which support EGPRS.

22.8.2 Conformance requirement

1. The MS shall use the same output power on all four bursts within one radio block. GSM 05.08, 10.2.1.
2. If a calculated output power is not supported by the MS, the MS shall use the supported output power which is closest to the calculated output power. GSM 05.08, 10.2.1.
3. When the MS receives new Γ_{CH} or α values, the MS shall use the new value to update P_{CH} 2 radio blocks after the end of the frame containing the last timeslot of the message block containing the new value. GSM 05.08, 10.2.1.
4. The transmitted power shall be a monotonic function of the calculated output power and any change of 2 dB in the calculated value shall correspond to a change of of 2 ± 1.5 dB in the transmitted value. The MS may round the calculated output power to the nearest nominal output power value. GSM 05.08, 10.2.1.

22.8.3 Test purpose

1. To verify the MS uses that the same output power on all four bursts of a radio block under normal conditions.
2. To verify that the highest power supported by the MS is used if the calculated power is greater.
3. To verify that the MS applies new Γ_{CH} or α values 2 radio blocks after the end of the frame containing the last timeslot of the message block containing the new value.
4. To verify that any change of 2dB in the calculated power corresponds to a change of 2 ± 1.5 dB in the transmitted value under normal conditions.

NOTE: For changes in calculated power which are less than the tolerances specified for absolute power accuracy in a MS, the transmitted power as a function of calculated power cannot be tested for monotonicity. Monotonicity between power control steps is implicitly tested in section 13.16.

22.8.4 Test method

22.8.4.1 Initial conditions

The SS establishes a BCCH and a PBCCH on the same carrier in the mid ARFCN range. GPRS_MS_TXPWR_MAX_CCH is set to the maximum level (39dBm for GSM400 and GSM900 and 36dBm for DCS1800 and PCS1900). The Γ_{CH} value is set

such that ($\Gamma_0 - \Gamma_{CH}$) equals the maximum power control level supported by the Power Class of the MS under test. The α value is set to 0.

The SS establishes a downlink TBF on the same ARFCN as the BCCH and PBCCH. The SS orders the MS to transmit on the uplink. This is achieved using the EGPRS test mode by transmitting a EGPRS_TEST_MODE_CMD (see GSM 04.14, section TBD).

The downlink power level is adjusted until a stable C-value of –52dBm is reported by the MS in the channel quality report (see GSM 05.08, 10.2.3).

22.8.4.2 Procedure

If the MS supports both GMSK and 8PSK modulation on the uplink, the test is repeated with each modulation format.

a) The SS shall trigger a transmitter output power measurement on each of the four bursts of any radio block.

b) The method of power measurement is described in section 13.17.3.

c) NOTE: For 8PSK modulation, a measurement method for estimating the long term average power from a single burst shall be employed. See section 13.17.3.

d) The SS shall modify the Γ_{CH} value such that ($\Gamma_0 - \Gamma_{CH}$) equals the minimum power control level supported by the MS under test (5dBm for GSM400 and GSM900 and 0dBm for DCS1800 and PCS1900). If the transmission of the RLC control message containing the new Γ_{CH} value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

e) The SS shall modify the Γ_{CH} value such that ($\Gamma_0 - \Gamma_{CH}$) equals the maximum power control level supported by the power class of the MS under test. If the transmission of the RLC control message containing the new Γ_{CH} value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

f) The SS shall modify the Γ_{CH} value such that ($\Gamma_0 - \Gamma_{CH}$) equals the value 4dB below the maximum power control level supported by the power class of the MS under test. The α value is set to 1.

g) The SS shall decrement the α value with a step size of 0.1 until α equals 0. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

h) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step e). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

NOTE:

If the power values measured for the four bursts of the radio block with α equal to 1.0 are:

$P_{m0}, P_{m1}, P_{m2}, P_{m3}$

And, the power values measured for the four bursts of the radio block with α equal to 0.5 are:

$P_{n0}, P_{n1}, P_{n2}, P_{n3}$

Then,

$P_{m(max)} = MAX(P_{m0}, P_{m1}, P_{m2}, P_{m3})$

$P_{m(min)} = MIN(P_{m0}, P_{m1}, P_{m2}, P_{m3})$

$P_{n(max)} = MAX(P_{n0}, P_{n1}, P_{n2}, P_{n3})$

$P_{n(min)} = MIN(P_{n0}, P_{n1}, P_{n2}, P_{n3})$

The maximum and minimum step sizes are:

$STEP(MAX) = P_{m(max)} - P_{n(min)}$

$STEP(MIN) = P_{m(min)} - P_{n(max)}$

g) The SS shall modify the Γ_{CH} value such that ($\Gamma_0 - \Gamma_{CH}$) equals the midrange power control level supported by the MS under test. The α value is set to 0.

h) The SS shall increment the α value with a step size of 0.1 until α equals 1. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

i) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step h). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

j) The SS shall modify the Γ_{CH} value such that ($\Gamma_0 - \Gamma_{CH}$) equals the minimum power control level supported by the MS under test (5dBm for GSM400 and GSM900 and 0dBm for DCS1800 and PCS1900). The α value is set to 0.

k) The SS shall increment the α value with a step size of 0.1 until α equals 1. For each step change in α value, if the transmission of the RLC control message containing the new α value is completed in radio block N, the SS shall trigger a transmitter output power measurement on each of the four bursts of radio block N+3.

l) For each value of α, the SS shall note the maximum and minimum power values measured from the four bursts of the radio block in step k). The SS shall then calculate the maximum and minimum changes in output power measured for the following pairs of α values: 1.0 and 0.5; 0.9 and 0.4; 0.8 and 0.3; 0.7 and 0.2; 0.6 and 0.1; 0.5 and 0. The maximum change is calculated by subtracting the minimum power measured from the smaller value of α from the maximum power measured for the larger value of α. The minimum step change is calculated by subtracting the maximum power measured from the smaller value of α from the minimum power measured for the larger value of α.

22.8.5 Test requirement

1. The power of all four bursts within the radio block measured in step a) and c) shall be within the accuracies specified for the power class of the mobile under test, as indicated in the following table:

Power class	GSM400 & GSM 900 Nominal Maximum output power	GSM400 & GSM 900 Tolerance (dB) for normal conditions	DCS 1 800 Nominal Maximum output power	PCS 1900 Nominal Maximum Output power	DCS1800 & PCS1900 Tolerance (dB) for normal conditions
1	- - - - - -		30 dBm	30dBm	±2
2	39 dBm		24 dBm	24dBm	±2
3	37 dBm		36 dBm	33dBm	±2
4	33 dBm				±2
5	29 dBm				±2
E1	33 dBm	±2	30dBm	30dBm	±2
E2	27dBm	±3	26dBm	26dBm	-4/+3
E3	23dBm	±3	22dBm	22dBm	±3

2. The power of all four bursts within the radio block measured in step b) shall be 5dBm for a GSM400 and GSM900 MS and 0dBm for a DCS1800 or PCS1900 MS with an accuracy of ± 5dB in all cases.

3. In steps f), i) and l), the maximum change in transmitted power between each identified pair of α values shall be 3.5dB.

4. In steps f), i) and l), the minimum change in transmitted power between each identified pair of α values shall be 0.5dB.

22.9 EGPRS Uplink Power Control – Independence of TS Power Control

22.9.1 Definition and applicability

This test applies to all GSM400, GSM900, DCS1800 and PCS1900 MS and all multiband MS which support multislot EGPRS.

22.9.2 Test conformance

For an EGPRS multislot MS supporting 2 or more uplink PDCHs, power control shall be employed by the MS on each individual uplink PDCH. GSM 05.08, 10.2.1.

22.9.3 Test purpose

To verify that EGPRS power control is applied to each PDCH in a multislot configuration independently.

22.9.4 Test method

22.9.4.1 Initial conditions

The SS establishes a downlink TBF. The SS orders the MS to transmit on the maximum number of timeslots for the multislot class of the MS on the uplink. This is achieved using the EGPRS test mode by transmitting a EGPRS_TEST_MODE_CMD (see GSM 04.14, section TBD).

Each timeslot is transmitting on its maximum power. The α-value is set to 0.

22.9.4.2 Procedure

If the MS supports both GMSK and 8PSK modulation on the uplink, the test is repeated with each modulation format.

a) The SS shall modify the Γ_{CH} value of one timeslot such that (Γ_0 - Γ_{CH}) equals the minimum power control level supported by the MS under test (5dBm for GSM400 and GSM900 and 0dBm for DCS1800 and PCS1900).

b) The SS shall make a transmitter output power measurement on each of the four bursts of any radio block of the timeslot under test.

NOTE: For 8PSK modulation, a measurement method for estimating the long term average power from a single burst shall be employed. See section 13.17.3.

c) The SS shall make a transmittter output power measurement on each of the four bursts of any radio block of the other active timeslots.

d) The SS shall modify the Γ_{CH} value for the timeslot under test such that (Γ_0 - Γ_{CH}) equals the maximum power control level supported by the MS under test.

e) Steps a) to d) shall be repeated for each timeslot of the multislot configuration.

22.9.5 Test requirement

1. The power of all four bursts within the radio block measured in step b) shall be 5dBm for a GSM400 and GSM900 MS and 0dBm for a DCS1800 or PCS1900 MS with an accuracy of $\pm$ 5dB in all cases.

2. For all TS, the power of all four bursts within the radio block measured in step c) shall be within the accuracies specified for the power class of the mobile under test, as indicated in the following table:

Power class	GSM400 & GSM 900 Nominal Maximum output power	GSM400 & GSM 900 Tolerance (dB) for normal conditions	DCS 1 800 Nominal Maximum output power	PCS 1900 Nominal Maximum Output power	DCS1800 & PCS1900 Tolerance (dB) for normal conditions
1	- - - - - -		30 dBm	30dBm	±2
2	39 dBm		24 dBm	24dBm	±2
3	37 dBm		36 dBm	33dBm	±2
4	33 dBm				±2
5	29 dBm				±2
E1	33 dBm	±2	30dBm	30dBm	±2
E2	27dBm	±3	26dBm	26dBm	-4/+3
E3	23dBm	±3	22dBm	22dBm	±3

22.10 [Reserved for future EGPRS test]

23 Single frequency reference

23.1 Definition and applicability

The MS is required to use one single frequency reference for both RF generation/reception and baseband signals. A test method to verify this is not available.

The requirement applies to all types of GSM 400, GSM 900and DCS 1 800 MS.

23.2 Conformance requirement

The MS shall use the same frequency source for both RF frequency generation and clocking the timebase; GSM 05.10, 6.1.

23.3 Test purpose

There is no test specified.

24 Tests of the layer 1 signalling functions

Testing of Layer 1 signalling functions is included in the tests in sections 15, 16, 17, 18, 19, 20, 21, 22, 23. Other Layer 1 functions are tested in sections 12, 13 and 14. Some testing of Layer 1 functions is integrated with Layer 3 signalling testing (26).