application note

How does the “Phase” of a mobile effect its testing strategy

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INTRODUCTION

Introduction

During the evolution of GSM mobile there have been 2 phases of implementation Phase 1 and Phase 2. The phase of the mobile defines the RF capability of the mobile and hence the way it is tested. The phase of the mobile its transmitted to the network or test equipment as part of the class mark.

The class mark is the information that is passed from the mobile during the registration. This is used by the network (or test equipment) to identify the capability of the mobile. The rest of this article explains the differences in RF performance and features between the phases of mobiles. The following provides the details of this information covering the frequency allocations, power classes of mobiles, power levels.

Frequency Allocations

Phase 1

Phase 1 was the initial phase of mobile and supported P-GSM, GSM 1800 (often known as DSC) and GSM 1900 (often known as PCS). The following outlines the frequency plans for each of the bands

GSM Band	Channel Number Range	Mobile transmit and in MHz Basestation Receive Frequency in MHz	Mobile Receive and Basestation ransmit Frequency in MHz
P-GSM 900 (Primary Band)	1 to 124	890 + 0.2 x channel number	Mobile Tx + 45 MHz
GSM 1800 (DCS)	512 to 885	1710.2+0.2 x (channel number -512)	Mobile Tx + 95
GSM 1900 (PCS)	512 to 810	1850.2+0.2 x (channel number -512)	Mobile Tx + 80

Phase 1 frequency Allocation

Phase 2

Phase 2 added the capability for additional channels in the GSM 900 band, known as E-GSM.

GSM Band	Channel Number Range	Mobile transmit and in MHz Basestation Receive Frequency in MHz	Mobile Receive and Basestation ransmit Frequency in MHz
E- GSM (Extended Band)	0 to 124	890 + 0.2 x channel number	Mobile Tx + 45 MHz
	975 to 1023	890 + 0.2 x channel number-1024)	Mobile Tx + 45 MHz

Additionak Phase 2 - Frequency Allocation

Power Class

The power class of the mobile defines the maximum output power level for the mobile in each of the GSM bands are shown below :-

GSM 900

Power Class	Maximum Power Level	Maximum Output Power
1	----	----
2	PL2	39 dBm, 8 W
3	PL3	37 dBm, 5 W
4	PL4	33 dBm, 2 W
5	PL5	29 dBm, 800 mW

GSM 900 Power Classes

GSM 1800

Power Class	Maximum Power Level	Maximum Output Power
1	PL0	30 dBm, 1 W
2	PL3	24 dBm, 250 mW
3	PL29	36 dBm, 4 W

GSM 1800 Power Classes

GSM 1900

Power Class	Maximum Power Level	Maximum Output Power
1	PL0	30 dBm, 1 W
2	PL3	24 dBm, 250 mW
3	PL30	33 dBm, 2 W

GSM 1900 Power Classes

Power Levels

The base station controls the mobile output power level by sending a power level (as a number) which the mobile then transmits. This is used to ensure that the optimum power level is received by the base station and maximises the battery life. The following are the power levels for each of the GSM bands and the standard test specification for each of the power levels.

GSM 900

Power Level	Nominal Output power	Normal Specification	
2	39 dBm	± 2	
3	37 dBm	± 3	
4	35 dBm	± 3	
5	33 dBm	± 3	
6	31 dBm	± 3	
7	29 dBm	± 3	
8	27 dBm	± 3	
9	25 dBm	± 3	
10	23 dBm	± 3	
11	21 dBm	± 3	
12	19 dBm	± 3	
13	17 dBm	± 3	
14	15 dBm	± 3	
15	13 dBm	± 3	
16	11 dBm	± 5	Phase 2 only
17	9 dBm	± 5	Phase 2 only
18	7 dBm	± 5	Phase 2 only
19	5 dBm	± 5	Phase 2 only

GSM 900 Power Levels

GSM 1800

Power Level	Nominal Output power	Normal Specification	
29	36 dBm	± 2	Phase 2 Only
30	34 dBm	± 3	Phase 2 Only
31	32 dBm	± 3	Phase 2 Only
0	30 dBm	± 3	
1	28 dBm	± 2	
2	26 dBm	± 3	
3	24 dBm	± 3	
4	22 dBm	± 3	
5	20 dBm	± 3	
6	18 dBm	± 3	
7	16 dBm	± 3	
8	14 dBm	± 3	
9	12 dBm	± 4	
10	10 dBm	± 4	
11	8 dBm	± 4	
12	6 dBm	± 4	
13	4 dBm	± 4	
14	2 dBm	± 5	Phase 2 Only
15	0 dBm	± 5	Phase 2 Only

GSM 1800 Power Levels

GSM 1900

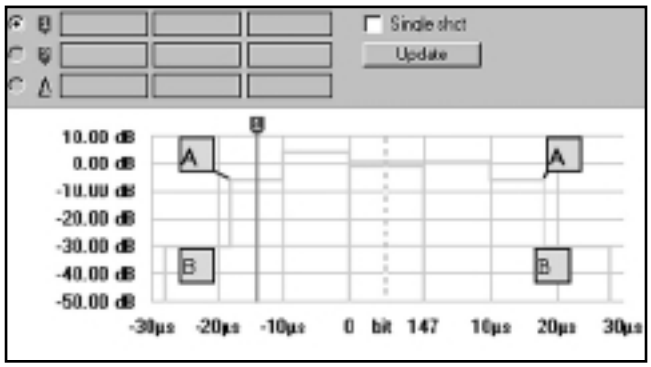
Power Level	Nominal Output power	Normal Specification
30	33 dBm	±2 dB
31	32 dBm	±2 dB
0	30 dBm	±3 dB
1	28 dBm	±3 dB
2	26 dBm	±3 dB
3	24 dBm	±3 dB
4	22 dBm	±3 dB
5	20 dBm	±3 dB
6	18 dBm	±3 dB
7	16 dBm	±3 dB
8	14 dBm	±3 dB
9	12 dBm	±4 dB
10	10 dBm	±4 dB
11	8 dBm	±4 dB
12	6 dBm	±4 dB
13	4 dBm	±4 dB
14	2 dBm	±5 dB
15	0 dBm	±5 dB

GSM 1900 Power Levels

Burst Power Profile

The power profile test ensures that the GSM burst lies within a predefine power / time template. The power profile is not static with changes in power level. The following shows how the major points of the power profile changes for low power levels

GSM 900



Power burst profile definition for low power levels

Power burst profile definition for low power levels

Point A is defined as :--

- 6 dBc for Power Levels 15 and higher
- -4 dBc for Power Level 16;
- -2 dBc for power level 17;
- -1 dBc for power level controls levels 18 and 19

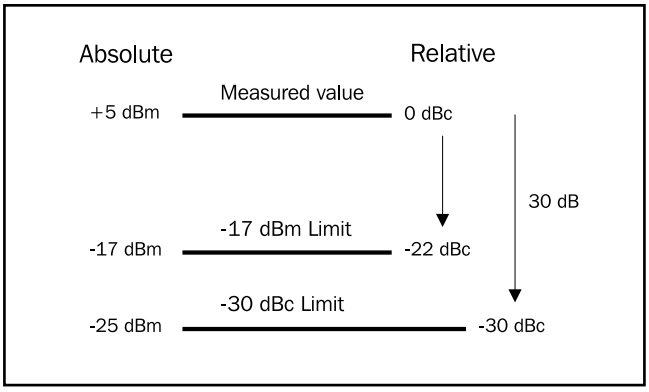
Point B is defined as :-

-30 dBc (dB with respect to the carrier) or -17 dBm (an absolute value in dB with respect to 1 mW), whichever is the higher.

The impact of this is that the lower limit of the mask can change dependent upon the actual power measured . The following are 2 examples :

Example 1

A mobile is set to PL19 (5 dBm) and has no error, the absolute measured power will be +5 dBm hence the -30 dBc power level equivalent to an absolute power -25 dBm (+5 - 30), and the absolute value of -17 dBm would be equivalent to -22 dBc (+5 - 17). Therefore the as -22 dBc is greater than -30 dBc the absolute

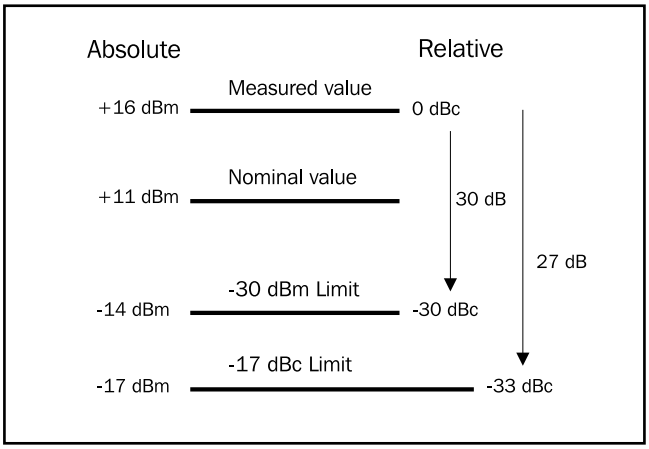


Example of power burst calculation for power level 19

Power Level 19 with No error then the -17 dBm limit is used

Example 2

If the mobile is set to PL 16 (i.e. +11 dBm) and has a error of + 5 dB (ie transmitting +16 dBm), then the -30 dBc value would be equivalent to -14 dBm, and the -17 dBm value would be equivalent to -33 dBc. Therefore the -30 dBc limit will be used.

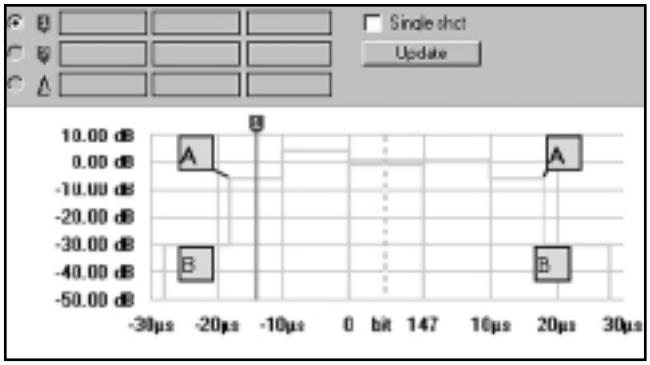


Example of power burst calculation for power level 16

Power Level 16 with a +5 dB error then the -30 dBc limit is used

GSM 1800/ 1900

The Power time template for GSM 1800 and 1900



The Power time template for GSM 1800 and 1900

The specification for GSM 1800 and 1900

Point A is defined as :-
-4 dBc for power level 11,
-2 dBc for power level 12,
-1 dBc for power levels 13,14 and 15

Point B is defined as
-30 dBc or -20 dBm, whichever is the higher.

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