

802.16™ Conformance

IEEE Standard for Conformance to IEEE 802.16

Part 3: Radio Conformance Tests (RCT) for 10–66 GHz WirelessMAN-SC™ Air Interface

IEEE Computer Society
and the
IEEE Microwave Theory and Techniques Society

Sponsored by the
LAN/MAN Standards Committee



IEEE Std 802.16/Conformance03™-2004

(Conformance to IEEE Std 802.16-2001
as amended by IEEE Std 802.16a™-2003
and IEEE Std 802.16c™-2002)

IEEE Standard for Conformance to IEEE 802.16

Part 3: Radio Conformance Tests (RCT) for 10–66 GHz WirelessMAN-SC™ Air Interface

Sponsors

**LAN/MAN Standards Committee
of the
IEEE Computer Society**

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IEEE Microwave Theory and Techniques Society



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Abstract: This standard represents the Radio Conformance Tests (RCT) specification for base stations and subscriber stations based upon the WirelessMAN-SC™ (10–66 GHz) air interface specified in IEEE 802.16.

Keywords: compliance, fixed broadband wireless access network, microwaves, millimeter waves, radio conformance test, WirelessMAN™ standards, wireless metropolitan area network

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Introduction

(This introduction is not a part of IEEE Std 802.16/Conformance03-2004, IEEE Standard for Conformance to IEEE Standard 802.16— Part 3: Radio Conformance Tests (RCT) for 10–66 GHz WirelessMAN-SC™ Air Interface.)

This is the third of a set of standards specifying test methods for demonstrating conformance to IEEE Standard 802.16. It represents the Radio Conformance Tests (RCT) for conformance specification of base stations and subscriber stations based upon the WirelessMAN-SC (10–66 GHz) air interface specified in IEEE Standard 802.16. The work was developed within the IEEE 802.16 Working Group beginning in March 2003.

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CONTENTS

1.	Overview.....	1
	1.1 Scope.....	1
	1.2 Purpose.....	1
2.	References.....	2
3.	Definitions and Abbreviations	2
	3.1 Definitions	2
	3.2 Abbreviations.....	2
4.	Measurement System.....	3
	4.1 General Requirements.....	3
	4.2 Test Conditions	4
	4.2.1 Test Under Normal Environmental Conditions	4
	4.2.2 Testing Under Extreme Environmental Conditions.....	4
5.	Required Tests	5
6.	Test Procedures.....	6
	6.1 Tests for the Subscriber Station	7
	6.1.1 RS Outer Code $t = 10 / \text{BCC} - \text{Frame Control TP/SS/PHYDL/FC/CA000}$	7
	6.1.1.1 Test Setup	7
	6.1.1.2 Test Procedure	7
	6.1.2 RS Outer Code Other Bursts TP/SS/PHYDL/RS/CA000-001	8
	6.1.2.1 Test Setup	8
	6.1.2.2 Test Procedure	8
	6.1.3 Fixed Codeword Operation TP/SS/PHYDL/FCO/CA000	9
	6.1.3.1 Test Setup	9
	6.1.3.2 Test Procedure	9
	6.1.4 Shortened Last Codeword Operation TP/SS/PHYDL/SC/CA000	10
	6.1.4.1 Test Setup	10
	6.1.4.2 Test Procedure	10
	6.1.5 Burst Preamble TP/SS/PHYDL/BP/CA000	11
	6.1.5.1 Test Setup	11
	6.1.5.2 Test Procedure	11
	6.1.6 Modulation TP/SS/PHYDL/M/CA000-002	12
	6.1.6.1 Test Setup	12
	6.1.6.2 Test Procedure	12
	6.1.7 RS Outer Code - Information Block Length TP/SS/PHYDL/IBL/CA000.....	12
	6.1.7.1 Test Setup	12
	6.1.7.2 Test Procedure	13
	6.1.8 Randomization with Programmable seed TP/SS/PHYUL/RPS/CA000.....	13
	6.1.8.1 Test Setup	13
	6.1.8.2 Test Procedure	14
	6.1.9 RS Outer Coder - Initial Ranging TP/SS/PHYUL/IR/CA000.....	15
	6.1.9.1 Test Setup	15
	6.1.9.2 Test Procedure	15
	6.1.10 RS Outer Code Other Bursts TP/SS/PHYUL/RS/CA000	16
	6.1.10.1 Test Setup	16

6.1.10.2	Test Procedure	16
6.1.11	Fixed Codeword Operation TP/SS/PHYUL/FCO/CA000	17
6.1.11.1	Test Setup	17
6.1.11.2	Test Procedure	17
6.1.12	Shortened Last Codeword Operation TP/SS/PHYUL/SC/CA000	18
6.1.12.1	Test Setup	18
6.1.12.2	Test Procedure	18
6.1.13	BCC Inner Code TP/SS/PHYUL/BCC/CA000	19
6.1.13.1	Test Setup	19
6.1.13.2	Test Procedure	19
6.1.14	Burst Preamble TP/SS/PHYUL/BP/CA000	20
6.1.14.1	Test Setup	20
6.1.14.2	Test Procedure	20
6.1.15	Modulation TP/SS/PHYUL/M/CA000-002	21
6.1.15.1	Test Setup	21
6.1.15.2	Test Procedure	21
6.1.16	RS Outer Code - Information Block Length TP/SS/PHYUL/IBL/CA000.....	22
6.1.16.1	Test Setup	22
6.1.16.2	Test Procedure	22
6.1.17	Tx Dynamic Range TP/SS/PHYMP/TDR/CA000	23
6.1.17.1	Test Setup	23
6.1.17.2	Test Procedure	23
6.1.18	Rx Dynamic Range TP/SS/PHYMP/RDR/CA000.....	24
6.1.18.1	Test Setup	24
6.1.18.2	Test Procedure	24
6.1.19	Tx Power Level at Maximum Power Level Setting TP/SS/PHYMP/TXP/CA000.....	25
6.1.19.1	Test Setup	25
6.1.19.2	Test Procedure	25
6.1.20	Tx Power Level Adjustment Step Accuracy TP/SS/PHYMP/ASA/CA000-004	26
6.1.20.1	Test Setup	26
6.1.20.2	Test Procedure	26
6.1.21	Symbol Timing Accuracy TP/SS/PHYMP/STA/CA000-001	27
6.1.21.1	Test Setup	27
6.1.21.2	Test Procedure	27
6.1.22	Tx Burst Timing TP/SS/PHYMP/BT/CA000.....	28
6.1.22.1	Test Setup	28
6.1.22.2	Test Procedure	28
6.1.23	Carrier Frequency TP/SS/PHYMP/CF/CA000	29
6.1.23.1	Test Setup	29
6.1.23.2	Test Procedure	29
6.1.24	Spectral Mask TP/SS/PHYMP/SM/CA000.....	30
6.1.24.1	Test Setup	30
6.1.24.2	Test Procedure	30
6.1.25	Ramp Up / Down Time TP/SS/PHYMP/RUD/CA000	31
6.1.25.1	Test Setup	31
6.1.25.2	Test Procedure	31
6.1.26	Output Noise Power Spectral Density When Tx is not Transmitting TP/SS/PHYMP/ON/CA000.....	32
6.1.26.1	Test Setup	32
6.1.26.2	Test Procedure	32
6.1.27	Modulation Accuracy TP/SS/PHYMP/MA/CA000-004.....	33
6.1.27.1	Test Setup	33
6.1.27.2	Test Procedure	33
6.1.28	BER Performance Threshold TP/SS/PHYMP/BER/CA000-006.....	34

6.1.28.1	Test Setup	34
6.1.28.2	Test Procedure	34
6.1.29	Transition Time From Tx to Rx and From Rx to Tx TP/SS/PHYMP/TT/CA000-001 .	35
6.1.29.1	Test Setup	35
6.1.29.2	Test Procedure	35
6.1.30	1st Adjacent Channel Interference TP/SS/PHYMP/1AC/CA000-011	36
6.1.30.1	Test Setup	36
6.1.30.2	Test Procedure	36
6.1.31	2nd Adjacent Channel Interference TP/SS/PHYMP/2AC/CA000-011	37
6.1.31.1	Test Setup	37
6.1.31.2	Test Procedure	38
6.1.32	Tx Power Level Absolute Accuracy TP/SS/PHYMP/PAA/CA000	39
6.1.32.1	Test Setup	39
6.1.32.2	Test Procedure	39
6.2	Tests for the Base Station	40
6.2.1	RS Outer Code $t = 10$ / BCC - Frame Control TP/BS/PHYDL/FC/CA000	40
6.2.1.1	Test Setup	40
6.2.1.2	Test Procedure	40
6.2.2	RS Outer Code Other Bursts TP/BS/PHYDL/RS/CA000	41
6.2.2.1	Test Setup	41
6.2.2.2	Test Procedure	41
6.2.3	Fixed Codeword Operation TP/BS/PHYDL/FCO/CA000	42
6.2.3.1	Test Setup	42
6.2.3.2	Test Procedure	42
6.2.4	Shortened Last Codeword Operation TP/BS/PHYDL/SC/CA000	43
6.2.4.1	Test Setup	43
6.2.4.2	Test Procedure	43
6.2.5	Burst Preamble TP/BS/PHYDL/BP/CA000	44
6.2.5.1	Test Setup	44
6.2.5.2	Test Procedure	44
6.2.6	Modulation TP/BS/PHYDL/M/CA000-002	45
6.2.6.1	Test Setup	45
6.2.6.2	Test Procedure	45
6.2.7	RS Outer Code - Information Block Length TP/BS/PHYDL/IBL/CA000	46
6.2.7.1	Test Setup	46
6.2.7.2	Test Procedure	46
6.2.8	Randomization with Programmable Seed TP/BS/PHYUL/RPS/CA000	47
6.2.8.1	Test Setup	47
6.2.8.2	Test Procedure	47
6.2.9	RS Outer Code - Initial ranging TP/BS/PHYUL/IR/CA000	48
6.2.9.1	Test Setup	48
6.2.9.2	Test Procedure	48
6.2.10	RS Outer Code Other Bursts TP/BS/PHYUL/RS/CA000-001	49
6.2.10.1	Test Setup	49
6.2.10.2	Test Procedure	49
6.2.11	Fixed Codeword Operation TP/BS/PHYUL/FCO/CA000	50
6.2.11.1	Test Setup	50
6.2.11.2	Test Procedure	50
6.2.12	Shortened Last Codeword Operation TP/BS/PHYUL/SC/CA000	51
6.2.12.1	Test Setup	51
6.2.12.2	Test Procedure	51
6.2.13	BCC Inner Code TP/BS/PHYUL/BCC/CA000	52
6.2.13.1	Test Setup	52
6.2.13.2	Test Procedure	52

6.2.14	Burst Preamble TP/BS/PHYUL/BP/CA000	53
6.2.14.1	Test Setup	53
6.2.14.2	Test Procedure	53
6.2.15	Modulation TP/BS/PHYUL/M/CA000-002	54
6.2.15.1	Test Setup	54
6.2.15.2	Test Procedure	54
6.2.16	RS Outer Code - Information Block Length TP/BS/PHYUL/IBL/CA000	55
6.2.16.1	Test Setup	55
6.2.16.2	Test Procedure	55
6.2.17	Symbol Timing Accuracy TP/BS/PHYMP/STA/CA000	56
6.2.17.1	Test Setup	56
6.2.17.2	Test Procedure	56
6.2.18	Carrier Frequency TP/BS/PHYMP/CF/CA000	57
6.2.18.1	Test Setup	57
6.2.18.2	Test Procedure	57
6.2.19	Spectral Mask TP/BS/PHYMP/SMCA000	58
6.2.19.1	Test Setup	58
6.2.19.2	Test Procedure	58
6.2.20	Spurious TP/BS/PHY/MP/SP/CA000	59
6.2.20.1	Test Setup	59
6.2.20.2	Test Procedure	59
6.2.21	Tx RMS Power Level TP/BS/PHYMP/TXP/CA000-002	60
6.2.21.1	Test Setup	60
6.2.21.2	Test Procedure	60
6.2.22	Ramp Up / Down Time TP/BS/PHYMP/RUD/CA000	61
6.2.22.1	Test Setup	61
6.2.22.2	Test Procedure	61
6.2.23	Modulation Accuracy TP/BS/PHYMP/MA/CA000-004	62
6.2.23.1	Test Setup	62
6.2.23.2	Test Procedure	62
6.2.24	Rx Dynamic Range TP/BS/PHYMP/RDR/CA000	63
6.2.24.1	Test Setup	63
6.2.24.2	Test Procedure	63
6.2.25	BER Performance Threshold TP/BS/PHYMP/BER/CA000-005	64
6.2.25.1	Test Setup	64
6.2.25.2	Test Procedure	64
6.2.26	1st Adjacent Channel Interference TP/BS/PHYMP/1AC/CA000-011	65
6.2.26.1	Test Setup	65
6.2.26.2	Test Procedure	65
6.2.27	2nd Adjacent Channel Interference TP/BS/PHYMP/2AC/CA000-011	66
6.2.27.1	Test Setup	66
6.2.27.2	Test Procedure	67
Annex A (informative) Recommendation for the Test Laboratories		68
A.1	Antenna Input Connectors	68
A.1.1	Test Equipment	68
A.2	General Test Platform	68
A.2.1	Forcing PHY Mode Changes	68
A.2.2	Duty Cycle for Power Measurements	69
A.2.3	Frequency Range	69
A.2.4	Bit Error Rate (BER) Versus Packet Error Rate (PER)	69
A.2.5	Microwave Measurement Techniques	70
A.3	Carrier Frequencies	71

LIST OF FIGURES

Figure 1—PHY Layer Conceptual Block Diagram.....	3
Figure 2—General Block Diagram.....	3
Figure 3—Test Setup for RS Outer Code $t = 10$ / BCC - Frame Control.....	7
Figure 4—Test Setup for RS Outer Code Other Bursts.....	8
Figure 5—Test Setup for Fixed Codeword Operation.....	9
Figure 6—Test Setup for Shortened Codeword Operation.....	10
Figure 7—Test Setup for Burst Preamble.....	11
Figure 8—Test Setup for Modulation.....	12
Figure 9—Test Setup for RS Outer Code - Information Block Length.....	13
Figure 10—Test Setup for Randomization With Programmable Seed.....	14
Figure 11—Test Setup for RS Outer Code - Initial Ranging.....	15
Figure 12—Test Setup for RS Outer Code Other Bursts.....	16
Figure 13—Test Setup for Fixed Codeword Operation.....	17
Figure 14—Test Setup for Shortened Codeword Operation.....	18
Figure 15—Test Setup for BCC Inner Code Operation.....	19
Figure 16—Test Setup for Burst Preamble.....	20
Figure 17—Test Setup for the Modulation Schemes.....	21
Figure 18—Test Setup for RS Outer Code - Information Block Length.....	22
Figure 19—Test setup for Tx Dynamic Range.....	23
Figure 20—Test Setup for Rx Dynamic Range.....	24
Figure 21—Test Setup for Tx Power at Maximum Power Level Setting.....	25
Figure 22—Test setup for Tx Power Level Step Adjustment Step Accuracy.....	26
Figure 23—Test Setup for Symbol Timing Accuracy.....	27
Figure 24—Test Setup for Tx Burst Timing.....	28
Figure 25—Test Setup for Carrier Frequency.....	29
Figure 26—Test Setup for Spectral Mask.....	30
Figure 27—Test Setup for Ramp Up / Down Time.....	31
Figure 28—Test Setup for Output Noise Power Spectral Density.....	32
Figure 29—Test Setup for Modulation Accuracy.....	33
Figure 30—Test Setup for BER Performance Threshold.....	34
Figure 31—Test Setup for Transition time from Tx to Rx and from Rx to Tx.....	35
Figure 32—Test Setup for 1st Adjacent Channel Interference.....	36
Figure 33—Test Setup for 2nd Adjacent Channel Interference.....	37
Figure 34—Test setup for Tx Power Level Absolute Accuracy.....	39
Figure 35—Test Setup for RS Outer Code $t = 10$ / BCC - Frame Control.....	40
Figure 36—Test Setup for RS Outer Code Other Bursts.....	41
Figure 37—Test Setup for Fixed Codeword Operation.....	42
Figure 38—Test Setup for Shortened Codeword Operation.....	43
Figure 39—Test Setup for Burst Preamble.....	44
Figure 40—Test Setup for Modulation.....	45
Figure 41—Test Setup for RS Outer Code - Information Block Length.....	46
Figure 42—Test Setup for Randomization with Programmable Seed.....	47
Figure 43—Test Setup for RS Outer Code - Initial Ranging.....	48
Figure 44—Test Setup for RS Outer Code Other Bursts.....	49
Figure 45—Test Setup for Fixed Codeword Operation.....	50
Figure 46—Test Setup for Shortened Codeword Operation.....	51
Figure 47—Test Setup for BCC Inner Code Operation.....	52
Figure 48—Test Setup for Burst Preamble.....	53
Figure 49—Test Setup for the Modulation Schemes.....	54
Figure 50—Test Setup for RS Outer Code - Information Block Length.....	55
Figure 51—Test Setup for Symbol Timing Accuracy.....	56
Figure 52—Test Setup for Carrier Frequency.....	57

Figure 53—Test Setup for Spectral Mask	58
Figure 54—Test Setup for Spurious Frequencies	59
Figure 55—Test Setup for Tx RMS Power level	60
Figure 56—Test Setup for Ramp Up / Down Time.....	61
Figure 57—Test Setup for Modulation Accuracy	62
Figure 58—Test Setup for Rx Dynamic Range	63
Figure 59—Test Setup for BER Performance Threshold	64
Figure 60—Test Setup for 1st Adjacent Channel Interference.....	65
Figure 61—Test Setup for 2nd Adjacent Channel Interference	66

LIST OF TABLES

Table 1—Required Tests	5
Table 2—Spectrum Analyzer Settings	30
Table 3—EVM Requirements	33
Table 4—BER Performance Threshold Sensitivity Values.....	34
Table 5—1st Adjacent Channel Interference BER10-3.....	37
Table 6—1st Adjacent Channel Interference BER=10-6.....	37
Table 7—2nd Adjacent Channel Interference BER10-3.....	38
Table 8—2nd Adjacent Channel Interference BER=10-6	38
Table 9—Spectrum Analyzer Settings	58
Table 10—Spectrum Analyzer Settings	59
Table 11—EVM Requirements	62
Table 12—BER Performance Threshold Sensitivity Values.....	64
Table 13—1st Adjacent Channel Interference BER10-3.....	66
Table 14—1st Adjacent Channel Interference BER=10-6.....	66
Table 15—2nd Adjacent Channel Interference BER10-3.....	67
Table 16—2nd Adjacent Channel Interference BER=10-6	67
Table A.1—Recommended Antenna Wave Guide Connectors.....	68
Table A.2—Carrier Frequencies	71

IEEE Standard for Conformance to IEEE 802.16™

Part 3: Radio Conformance Tests (RCT) for 10–66 GHz WirelessMAN-SC™ Air Interface

1. Overview

To evaluate conformance of a particular implementation of a radio interface, it is necessary to have a common radio testing document with common radio test procedures, as outlined in the Test Suite Structure and Test Purposes (TSS&TP) document. The Radio Conformance Tests (RCT) specification document serves this purpose.

This document specifies the radio aspects of the test procedures and the test conditions needed to ensure conformance to the WirelessMAN-SC™ air interface in IEEE Std 802.16 and to support interoperability between equipment developed by different manufacturers. It specifies tests of the baseband and radio frequency (RF) signal processing functionalities in the transmitter and the receiver. The specification covers basic RF aspects, including the radio frequency channel plans and those other parameters necessary for radio regulatory coexistence purposes. The tests primarily relate to physical layer specifications, but the test procedures require some basic functionalities from the medium access control layer.

The tests correspond to the requirements in IEEE Std 802.16™/Conformance02-2003. The requirements are given in conjunction with the tests.

In order to perform these tests, some dedicated test equipment and testing capabilities are required by test laboratories. Requirements for test laboratories are provided in Annex A.

1.1 Scope

This standard represents the RCT specification for base stations (BS) and subscriber stations (SS) based upon the WirelessMAN-SC™ (10–66 GHz) air interface specified in IEEE 802.16.¹

1.2 Purpose

These RCT specifications form the basis of conformance and interoperability testing at the radio interface.

¹When IEEE 802.16 is referenced this generally includes the base document and any existing amendments and corrigenda.

2. References

The following documents contain provisions that, through reference in this text, constitute provisions of the present document. References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific. For a specific reference, subsequent revisions do not apply.

IEEE Std 802.16-2001, IEEE Standard for Local and Metropolitan Area Networks—Part 16: Air Interface for Fixed Wireless Access Systems.²

IEEE Std 802.16aTM-2003, IEEE Standard for Local and Metropolitan Area Networks—Part 16: Air Interface for Fixed Broadband Wireless Access Systems—Amendment 2: Medium Access Control Modifications and Additional Physical Layer Specifications for 2–11 GHz.

IEEE Std 802.16cTM-2002, IEEE Standard for Local and Metropolitan Area Networks—Part 16: Air Interface for Broadband Fixed Wireless Access Systems—Amendment 1: Detailed System Profiles for 10–66 GHz.

IEEE Std 802.16TM/Conformance01-2003, IEEE Standard for Conformance to IEEE Std 802.16TM—Part 1: Protocol Implementation Conformance Statement (PICS) Proforma for 10–66 GHz WirelessMANTM-SC Air Interface.

IEEE Std 802.16/Conformance02-2003, IEEE Standard for Conformance to IEEE Std 802.16TM—Part 2: Test Suite Structure and Test Purposes for 10–66 GHz WirelessMANTM-SC Air Interface.³

ISO/IEC 9646-1:1994, Information technology — Open Systems Interconnection — Conformance testing methodology and framework —Part 1: General concepts.

ISO/IEC 9646-6:1995, Information technology — Open Systems Interconnection — Conformance testing methodology and framework - Part 6: Protocol profile test specification.

ISO/IEC 9646-7:1995, Information technology — Open Systems Interconnection — Conformance testing methodology and framework – Part 7: Implementation conformance statements.

3. Definitions and Abbreviations

3.1 Definitions

This document uses terms defined in IEEE Std 802.16-2001, as amended by IEEE Std 802.16a-2003 and IEEE Std 802.16c-2002.

3.2 Abbreviations

This document uses terms defined in IEEE Std 802.16-2001, as amended by IEEE Std 802.16a-2003 and IEEE Std 802.16c-2002.

²IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org>).

³ISO/IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iso.ch/>). ISO/IEC publications are also available in the United States from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>). Electronic copies are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

4. Measurement System

The general block diagram of the downlink and uplink system is illustrated in Figure 1.

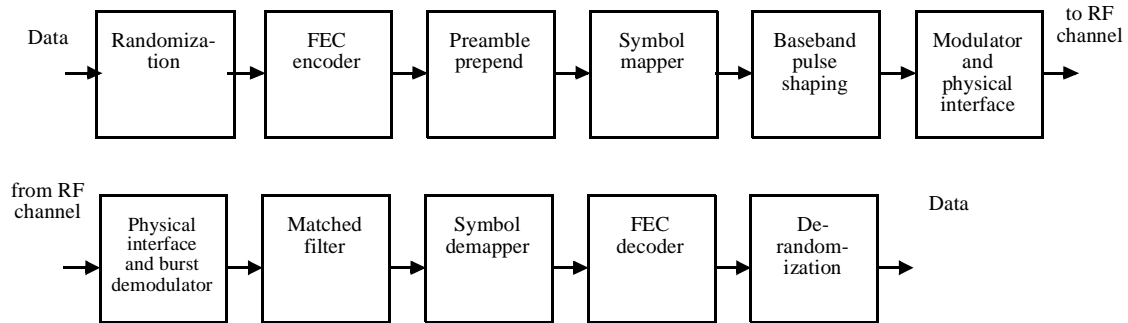


Figure 1—PHY Layer Conceptual Block Diagram

4.1 General Requirements

The general block diagram, naming the test interfaces, is given in Figure 2. The block diagram describes the main system components and interfaces only conceptually, without specifying the implementation. The manufacturer shall, during testing, occasionally make the signals in the listed interfaces available for measurements. In the figure, the following abbreviations are used:

- A: antenna interface
- M: MAC interface
- SC: symbol clock interface

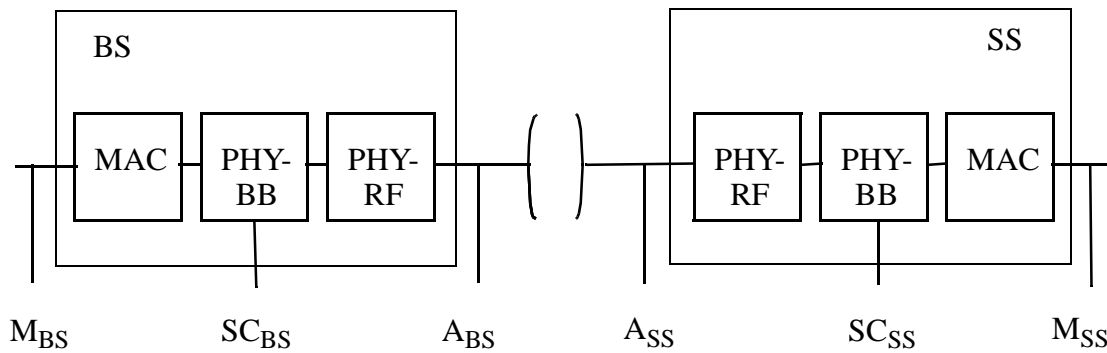


Figure 2—General Block Diagram

4.2 Test Conditions

4.2.1 Test Under Normal Environmental Conditions

All conformance tests shall be carried out in normal environmental conditions. The result of the measurements under normal environmental conditions shall be taken to be reference performance. The reference performance will be used in comparison with representative measurements made at the climatic limits. It is recognized that all requirements given in the standard are relevant for all combinations of temperature and humidity of the chosen climatic class. However, some tests may be carried out only in environmental reference conditions for reasons of practicality and convenience

The normal environmental conditions are the combinations of temperature, and humidity falling within the limits specified below. Tests shall be performed in environmental conditions falling within these bounds.

Temperature: +15 °C to +30 °C

Relative humidity: 45% to 75%

All tests shall also be performed at three different carrier frequencies in the declared frequency bands corresponding to Bottom, Middle, and Top frequencies.

4.2.2 Testing Under Extreme Environmental Conditions

In addition, some conformance tests shall be carried out for temperature variation only; mechanical, chemical and biological environmental stresses are outside the scope of the present document.

The Implementation Under Test (IUT) shall be tested under extreme conditions of $-30\text{ °C} - +40\text{ °C}$ according to the declarations of the manufacturer.⁴

NOTE—Before testing at temperature extremes a period of stabilization is required.⁵

⁴+40 °C is a recommendation and not an upper limit which may be higher depending upon customer or legal requirements.

⁵Notes in text, tables, and figures are given for information only, and do not contain requirements needed to implement the standard.

5. Required Tests

The required tests are listed in Table 1.

Table 1—Required Tests

	Mandatory	Optional
Parameters for the SS		
Downlink		
Reed-Solomon (RS) outer code $t = 10$ / block conventional code (BCC) - frame control	M	
RS outer code other bursts	M	
Fixed codeword operation	M	
Shortened last codeword operation	M	
Burst preamble	M	
Modulation	M	
RS outer code - information block length	M	
Uplink		
Randomization with programmable seed	M	
RS outer coder - initial ranging	M	
RS outer code other bursts	M	
Fixed codeword operation	M	
Shortened last codeword operation	M	
BCC inner code	M	
Burst preamble	M	
Modulation	M	
RS outer code - information block length	M	
Minimum performance		
Tx dynamic range	M	
Rx dynamic range	M	
Tx RMS power level at maximum power level setting	M	
Tx power level adjustment step accuracy	M	
Symbol timing accuracy	M	
Tx burst timing	M	
Carrier frequency	M	
Spectral mask	M	
Ramp up / down time	M	
Output noise power spectral density when Tx is not transmitting	M	
Modulation accuracy	M	
Bit Error Rate (BER) performance threshold	M	
Transition time from Tx to Rx and from Rx to Tx	M	
1st adjacent channel interference	M	
2nd adjacent channel interference	M	
Tx power level absolute accuracy		
Parameters for the BS		

Table 1—Required Tests (continued)

Downlink		
RS outer code $t = 10$ / BCC - frame control	M	
RS outer code other bursts	M	
Fixed codeword operation	M	
Shortened last codeword operation	M	
Burst preamble	M	
Modulation	M	
RS outer code - information block length	M	
Uplink		
Randomization with programmable seed	M	
RS outer coder - initial ranging	M	
RS outer code other bursts	M	
Fixed codeword operation	M	
Shortened last codeword operation	M	
BCC inner code	M	
Burst preamble	M	
Modulation	M	
RS outer code - information block length	M	
Minimum performance		
Symbol timing accuracy	M	
Carrier frequency	M	
Spectral mask	M	
Spurious	M	
Tx RMS power level	M	
Ramp up / down time	M	
Modulation accuracy	M	
Rx dynamic range	M	
BER performance threshold	M	
1st adjacent channel interference	M	
2nd adjacent channel interference	M	

6. Test Procedures

Some test procedures assume that the counterpart for the IUT, denoted “Test BS”, “Test SS” or “Tester”, has some additional features not mandated by the 802.16 standard. These features are solely there to aid the test procedures. Typical tester functions are: capability to eject gating signals for the measurement instruments, special software for requesting a special behavior of the IUT. The tester also has significantly better and known output signal quality than the IUT.

6.1 Tests for the Subscriber Station

6.1.1 RS Outer Code $t = 10$ / BCC - Frame Control TP/SS/PHYDL/FC/CA000

6.1.1.1 Test Setup

Figure 3 shows the test setup for testing the RS outer code $t = 10$ / BCC - frame control.

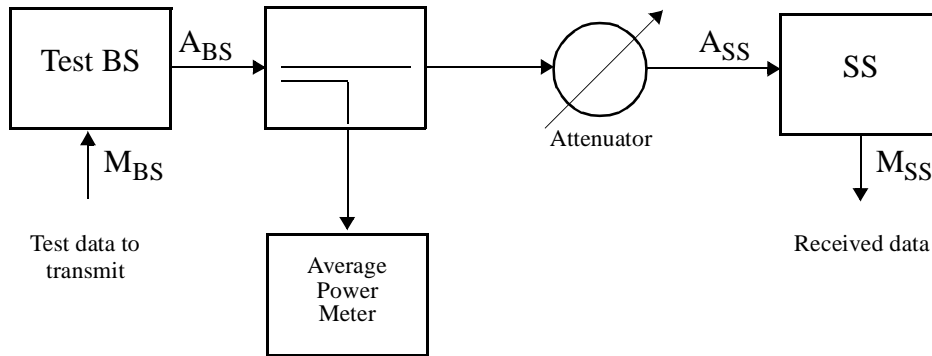


Figure 3—Test Setup for RS Outer Code $t = 10$ / BCC - Frame Control

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.1.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS is setup to send data consisting of frames filled with quadrature phase-shift keying (QPSK) modulated data and coded with block convolutional code (BCC) + Reed- Solomon (RS) $t = 4$. The number of information bytes in a RS block shall be 128. The packet error rate (PER) is monitored at the receiver. In this test we are on purpose using $t = 4$ (instead of 10) in order to avoid extremely small PERs. This will make the test perform faster. The required PER is adjusted accordingly.

The attenuator is adjusted until the received power is $-98 + 10\log(B)$ dBm, where B is the symbol rate in MBaud.

The PER is measured at the SS and shall be less than 5×10^{-4} . This test procedure, using the forward error correction (FEC), is in conformance with the bit error rate (BER) requirement of uncoded QPSK in the base specification [1]. The fact that the packets are received correctly proves that the decoding of the frame control portion, BCC + RS $t = 4$, works correctly. This is used to infer that the same coding with $t = 10$ works correctly as well. The measured PER is another proof that the BCC decoding works satisfactorily.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	YES	YES	4	128

6.1.2 RS Outer Code Other Bursts TP/SS/PHYDL/RS/CA000-001

6.1.2.1 Test Setup

Figure 4 shows the test setup for testing the RS outer code other bursts.

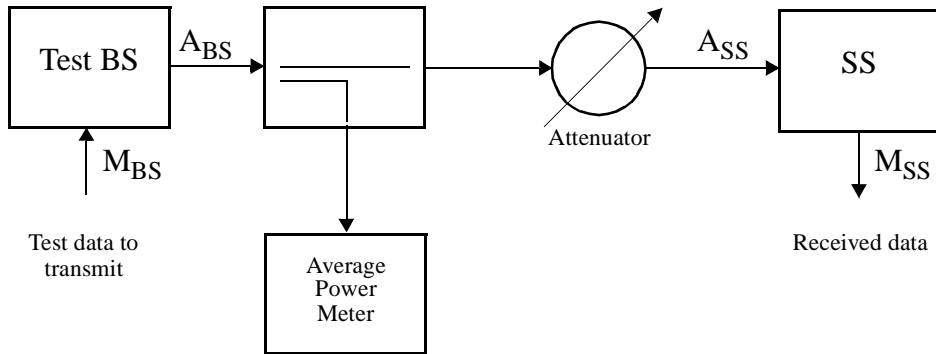


Figure 4—Test Setup for RS Outer Code Other Bursts

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.2.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS transmits the bursts with QPSK modulation, no BCC coding, RS coding with $t = 0, 4, 8,$ and $12,$ and information bytes = 128.

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal. The data received at the SS is checked for correctness.

The Test BS inserts alternatively 0, 4, 8, or 12 erroneous bytes in the codeword corresponding to $t = 0, 4, 8,$ and $12.$ The SS shall receive the data correctly.

The Test BS inserts alternatively 1, 5, 9, or 13 erroneous bytes in the codeword corresponding to $t = 0, 4, 8,$ and $12.$ The SS shall not be able to receive the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	0, 4, 8, 12	128

6.1.3 Fixed Codeword Operation TP/SS/PHYDL/FCO/CA000

6.1.3.1 Test Setup

Figure 5 shows the test setup for testing the RS fixed codeword operation.

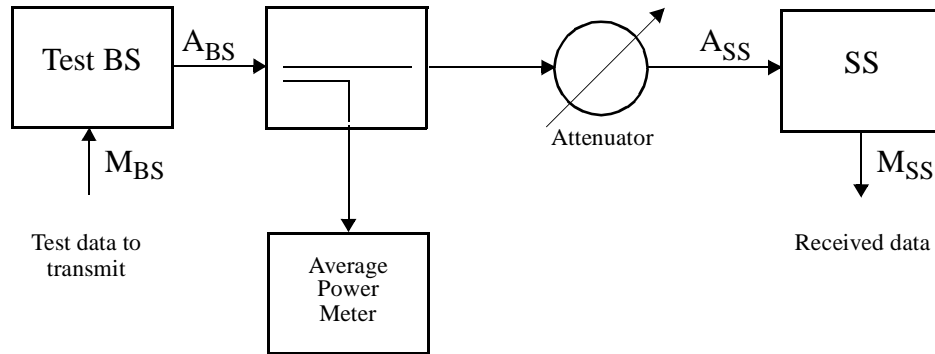


Figure 5—Test Setup for Fixed Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.3.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS transmits the bursts with RS using fixed codeword option, QPSK modulation, no BCC coding, RS coding with $t = 8$ and information bytes = 128.

The downlink frame is filled with bursts of test data. The number of bytes in the downlink frame must not be a multiple of 128. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	128

6.1.4 Shortened Last Codeword Operation TP/SS/PHYDL/SC/CA000

6.1.4.1 Test Setup

Figure 6 shows the test setup for testing the RS shortened codeword operation.

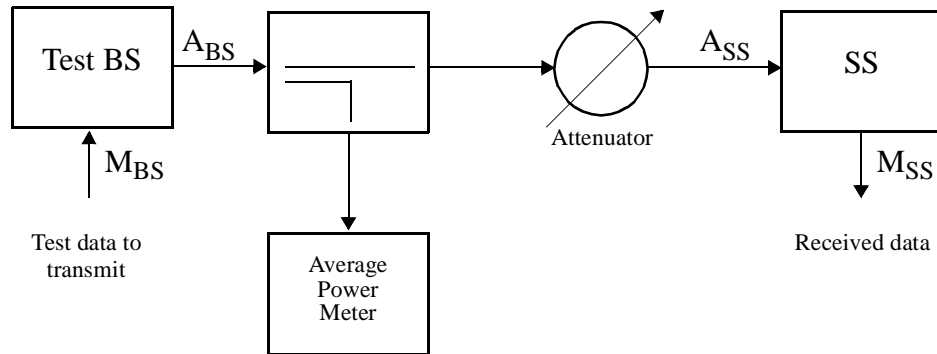


Figure 6—Test Setup for Shortened Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.4.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS transmits the bursts with RS using Shortened codeword option, QPSK modulation, no BCC coding, RS coding with $t = 8$ and information bytes = 128.

The downlink frame is filled with bursts of test data. The number of bytes in the downlink frame must not be a multiple of 128. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	128

6.1.5 Burst Preamble TP/SS/PHYDL/BP/CA000

6.1.5.1 Test Setup

Figure 7 shows the test setup for testing the burst preamble.

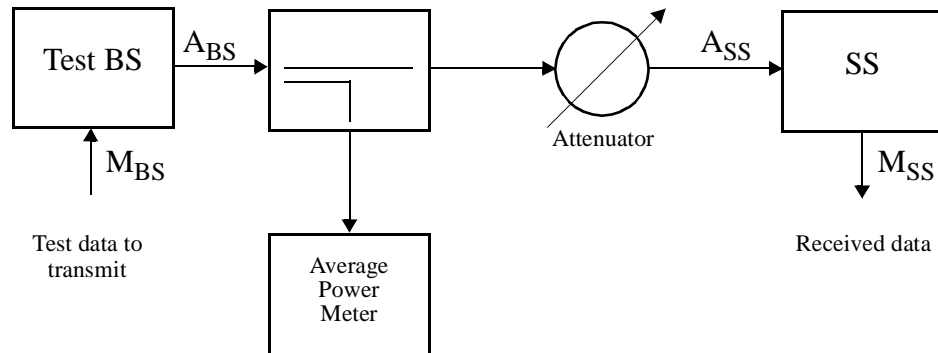


Figure 7—Test Setup for Burst Preamble

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.5.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS is setup to transmit data in the time division multiple access (TDMA) portion of the frame.

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS receives the data correctly.

The fact that the SS receives the data correctly proves that the SS is able to synchronize to burst preambles, which are in the beginning of each TDMA burst.

6.1.6 Modulation TP/SS/PHYDL/M/CA000-002

6.1.6.1 Test Setup

Figure 8 shows the test setup for testing the modulation.

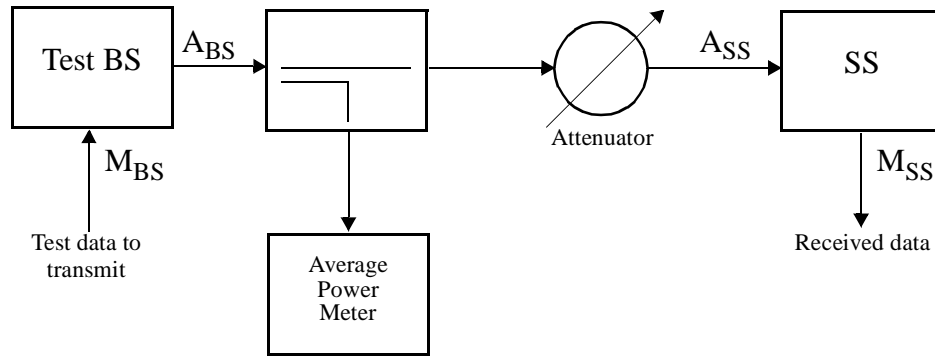


Figure 8—Test Setup for Modulation

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.6.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS is setup to transmit data in the time division multiplex (TDM) and TDMA portions of the frame (for H-FDD subscriber stations) with all modulation schemes supported by the SS present in each frame. The FEC shall be chosen from any of the mandatory modes

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS receives the data correctly.

6.1.7 RS Outer Code - Information Block Length TP/SS/PHYDL/IBL/CA000

6.1.7.1 Test Setup

Figure 9 shows the test setup for testing the RS outer code - Information Block Length.

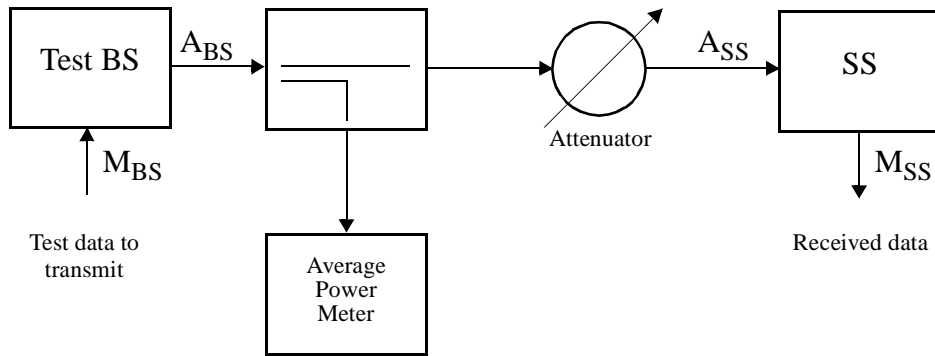


Figure 9—Test Setup for RS Outer Code - Information Block Length

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.7.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. QPSK modulation, no BCC coding, RS coding with Information Block Length = 6, 128, 239 and t = 8 are used.

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS shall receive the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	6, 128, 239

6.1.8 Randomization with Programmable seed TP/SS/PHYUL/RPS/CA000

6.1.8.1 Test Setup

Figure 10 shows the test setup for randomization with programmable seed.

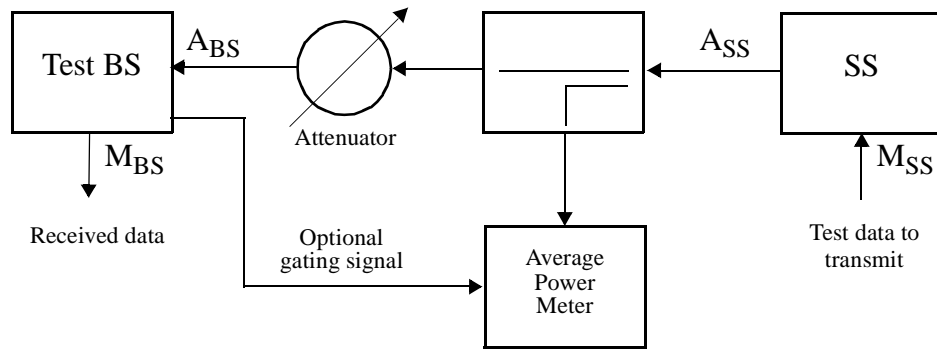


Figure 10—Test Setup for Randomization With Programmable Seed

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.8.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with different seed values for the randomization.

Data is transmitted in the uplink.

The Test BS shall receive the data correctly.

6.1.9 RS Outer Coder - Initial Ranging TP/SS/PHYUL/IR/CA000

6.1.9.1 Test Setup

Figure 11 shows the test setup for testing the RS outer code - Initial Ranging.

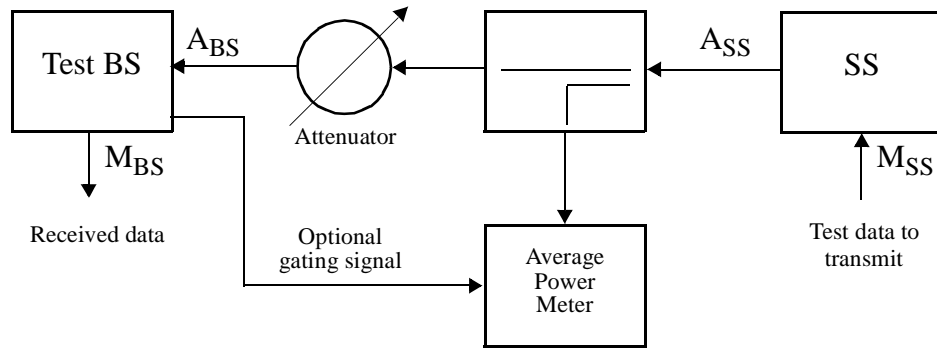


Figure 11—Test Setup for RS Outer Code - Initial Ranging

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.9.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS.

The Test BS commands the SS to use burst profiles with RS parameter $t = 10$ for initial ranging.

The SS sends a RNG-REQ message in the initial ranging opportunity. The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	YES	YES	10	128

6.1.10 RS Outer Code Other Bursts TP/SS/PHYUL/RS/CA000

6.1.10.1 Test Setup

Figure 12 shows the test setup for testing the RS outer code other bursts.

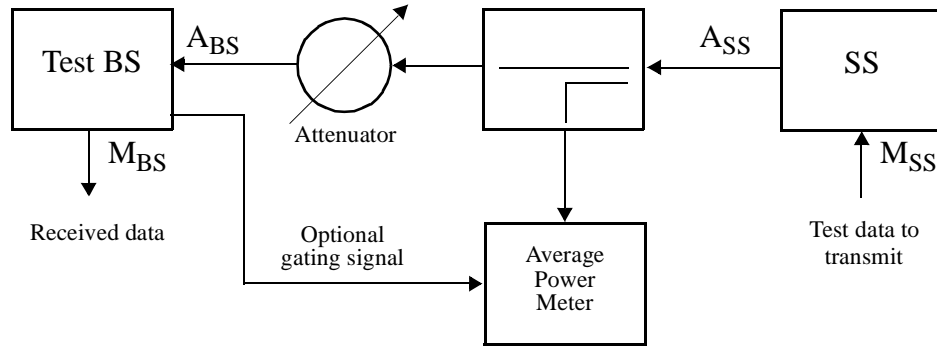


Figure 12—Test Setup for RS Outer Code Other Bursts

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.10.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with the RS parameter $t = 0, 4, 8, \text{ or } 12$, and information bytes 128 are used.

Data is transmitted in the uplink

The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	0, 4, 8, 12	128

6.1.11 Fixed Codeword Operation TP/SS/PHYUL/FCO/CA000

6.1.11.1 Test Setup

Figure 13 shows the test setup for testing the RS fixed codeword operation.

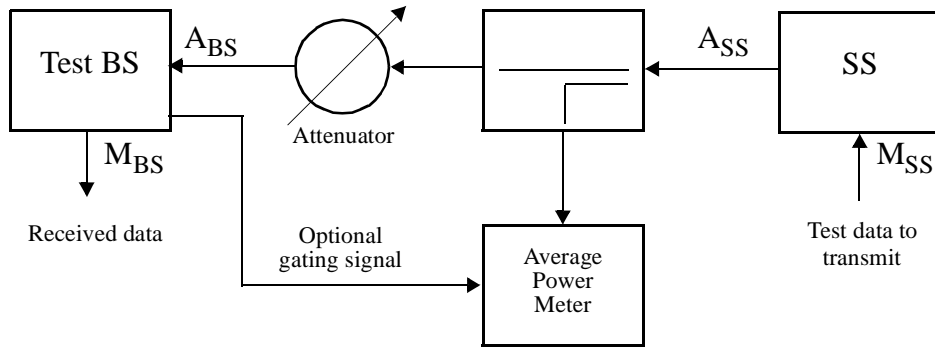


Figure 13—Test Setup for Fixed Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.11.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with RS fixed codeword option, QPSK modulation, no BCC coding, RS coding with $t = 8$, and information bytes = 128 in all uplink bursts. The number of bytes in the downlink frame must not be a multiple of 128.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	128

6.1.12 Shortened Last Codeword Operation TP/SS/PHYUL/SC/CA000

6.1.12.1 Test Setup

Figure 14 shows the test setup for testing the RS shortened codeword operation.

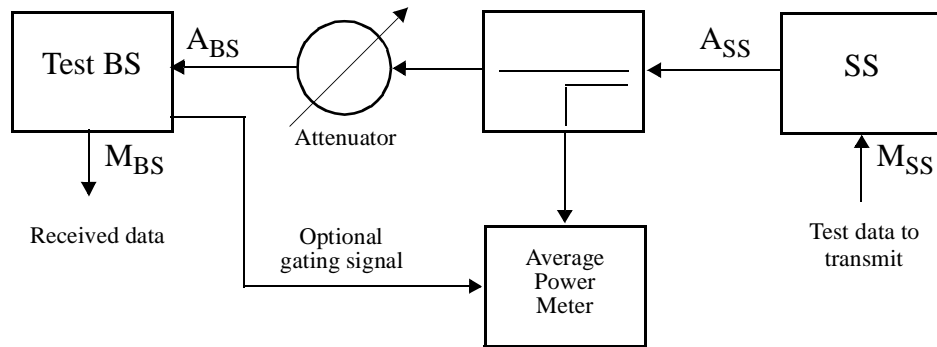


Figure 14—Test Setup for Shortened Codeword Operation

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.12.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with RS shortened codeword, QPSK modulation, no BCC coding, RS coding with $t = 8$, and information bytes = 128 in all uplink bursts. The number of bytes in the downlink frame must be not be a multiple of 128.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	128

6.1.13 BCC Inner Code TP/SS/PHYUL/BCC/CA000

6.1.13.1 Test Setup

Figure 15 shows the test setup for testing the BCC inner code operation.

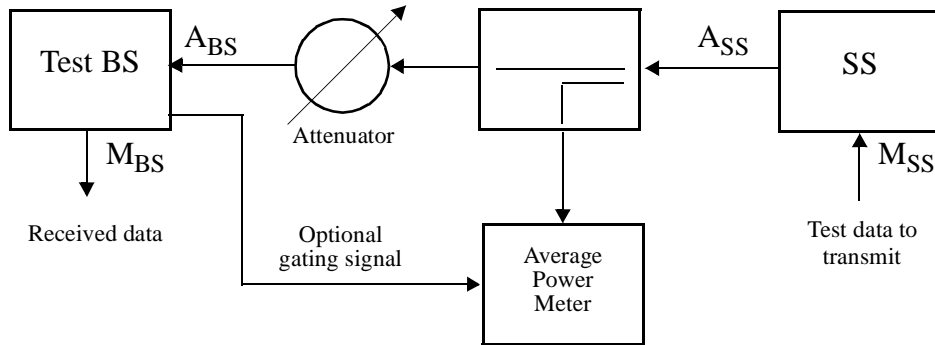


Figure 15—Test Setup for BCC Inner Code Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.13.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with BCC inner code in all uplink bursts.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	YES	YES	8	128

6.1.14 Burst Preamble TP/SS/PHYUL/BP/CA000

6.1.14.1 Test Setup

Figure 16 shows the test setup for testing the burst preamble.

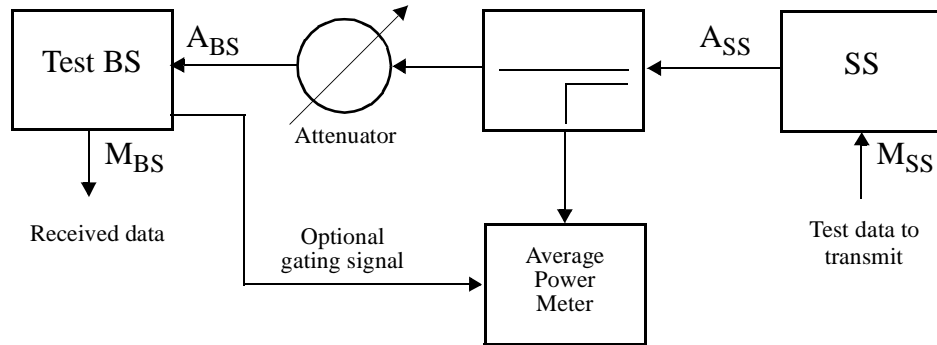


Figure 16—Test Setup for Burst Preamble

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.14.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with different preamble lengths in the uplink bursts.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

6.1.15 Modulation TP/SS/PHYUL/M/CA000-002

6.1.15.1 Test Setup

Figure 17 shows the test setup for testing the modulation schemes.

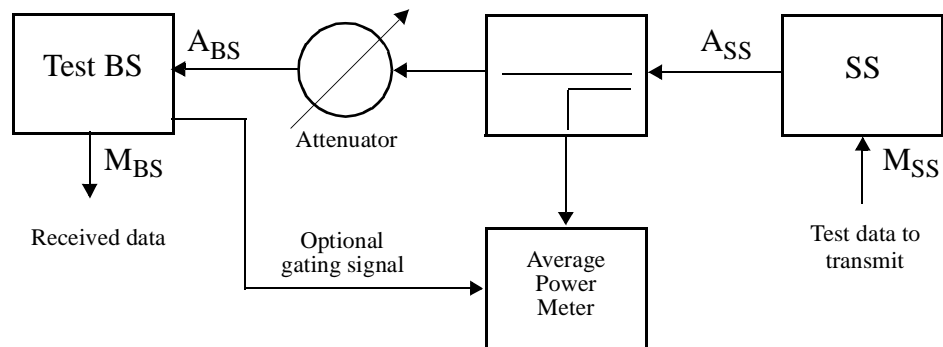


Figure 17—Test Setup for the Modulation Schemes

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.15.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with a different modulation scheme supported by the SS used in the uplink burst in each frame. The test should last enough frames to cover all modulations supported by the SS. The FEC and other parameters for the PHY mode should be chosen from the set of mandatory parameters.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

6.1.16 RS Outer Code - Information Block Length TP/SS/PHYUL/IBL/CA000

6.1.16.1 Test Setup

Figure 18 shows the test setup for testing the RS outer code - Information Block Length.

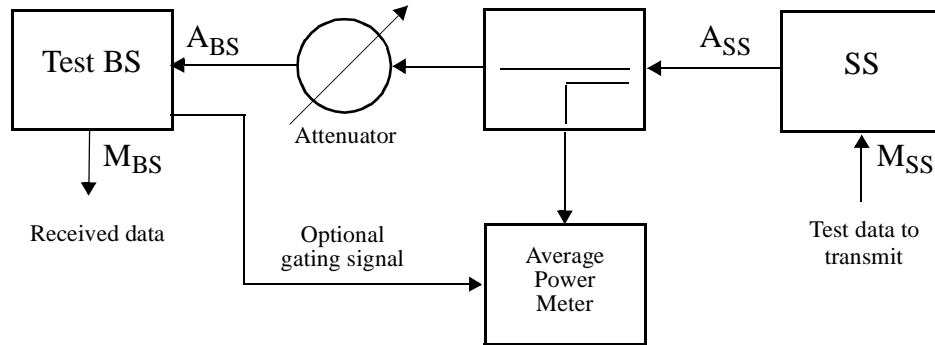


Figure 18—Test Setup for RS Outer Code - Information Block Length

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.16.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use burst profiles with the RS parameter Information block length = 6, 128, and 239. RS parameter $t = 8$.

Data is transmitted in the uplink.

The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block Length
	QPSK	NO	YES	8	6, 128, 239

6.1.17 Tx Dynamic Range TP/SS/PHYMP/TDR/CA000

6.1.17.1 Test Setup

Figure 19 shows the test setup for testing the Tx Dynamic Range

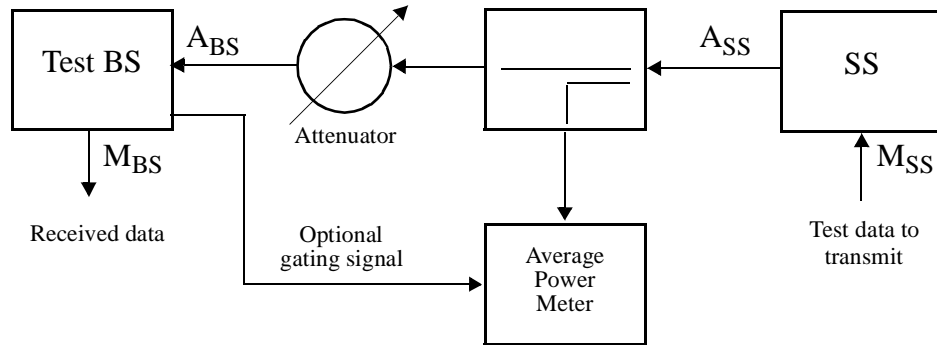


Figure 19—Test setup for Tx Dynamic Range

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.17.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use QPSK modulation, block convolutional code and Reed-Solomon parameter $t = 8$. The number of information bytes in a RS block shall be 128 and the burst length shall be constant. Data is transmitted in the uplink.

The attenuator is slowly adjusted to its lowest value and as a consequence the SS shall decrease its transmit power until the minimum operable value is achieved. The transmitted power is measured and recorded. The attenuator is then slowly increased until the SS reaches its maximum operable value. The transmitted power is measured and recorded.

The difference between the two power values is the Tx dynamic range and shall be ≥ 40 dB.

6.1.18 Rx Dynamic Range TP/SS/PHYMP/RDR/CA000

6.1.18.1 Test Setup

Figure 20 shows the test setup for testing the Rx Dynamic Range

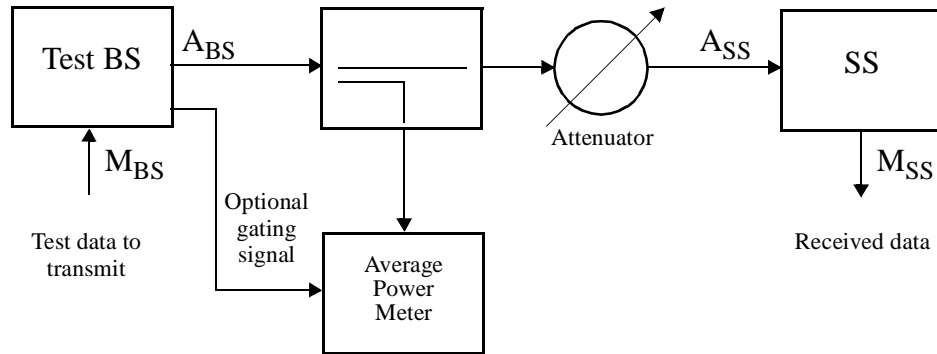


Figure 20—Test Setup for Rx Dynamic Range

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.18.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use the most robust burst profile. Data is transmitted in the downlink.

The attenuator is slowly adjusted to its lowest operable value. The power of the received signal is measured and recorded. The attenuator is then slowly increased until the maximum operable value is reached. The power is measured and recorded.

The difference between the two power values is the Rx dynamic range and shall be ≥ 40 dB.

6.1.19 Tx Power Level at Maximum Power Level Setting TP/SS/PHYMP/TXP/CA000

6.1.19.1 Test Setup

Figure 19 shows the test setup for testing the Tx Power level at maximum power level setting

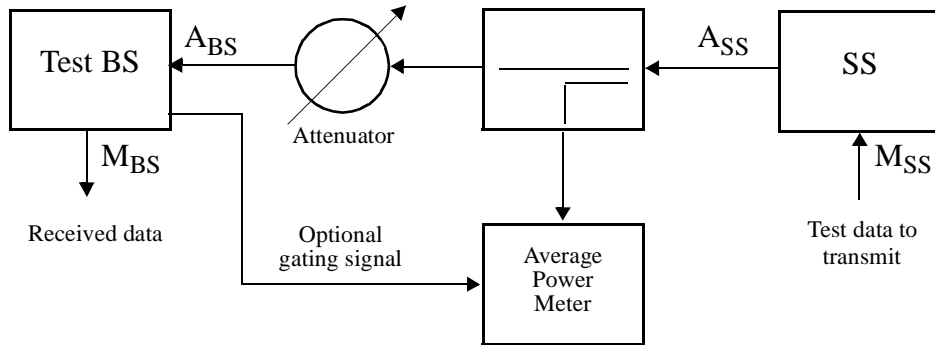


Figure 21—Test Setup for Tx Power at Maximum Power Level Setting

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.19.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use the most robust burst profile. Data is transmitted in the uplink.

The attenuator is slowly adjusted towards its highest value until the SS increases its transmit power to its maximum. The Test BS shall receive the data correctly. The power is measured

The power shall be ≥ 15 dBm.

6.1.20 Tx Power Level Adjustment Step Accuracy TP/SS/PHYMP/ASA/CA000-004

6.1.20.1 Test Setup

Figure 22 shows the test setup for testing the Tx Power level adjustment step accuracy.

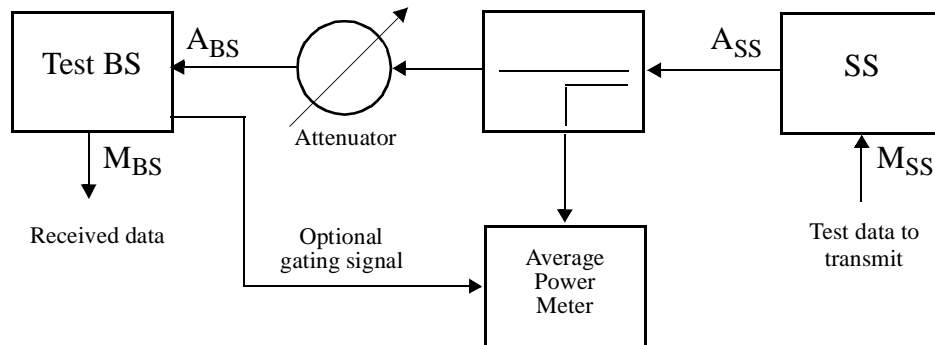


Figure 22—Test setup for Tx Power Level Step Adjustment Step Accuracy

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.20.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use the most robust burst profile at the bottom, medium and top values of the transmit power range. Data is transmitted in the uplink. The transmit power is measured

The Test BS commands the SS to adjust its transmit power level with the step sizes $\pm [0.5 - 2.0]$ dB, $\pm [2 - 5]$ dB, and $> \pm 5$ dB.

The measured change in power shall be monotonically positive (negative), ± 2 dB of the requested change, ± 5 dB of the requested change.

6.1.21 Symbol Timing Accuracy TP/SS/PHYMP/STA/CA000-001

6.1.21.1 Test Setup

Figure 23 shows the test setup for testing the symbol timing accuracy.

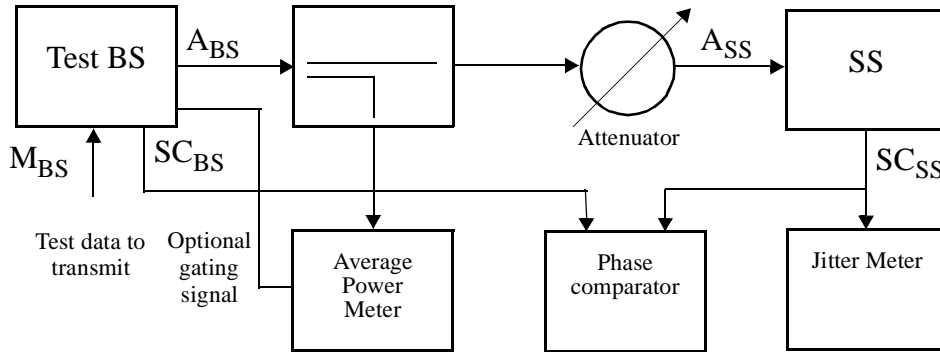


Figure 23—Test Setup for Symbol Timing Accuracy

- Instruments needed:
- Directional coupler
 - Average power meter
 - Attenuator
 - Jitter meter
 - Phase comparator

6.1.21.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS but no data is transmitted in the downlink so the downlink consists only of the control portion. The signal is adjusted until the received power is $-98 + 10\log(B)$ dBm, where B is the symbol rate in MBaud, in order to correspond to a worst case signal.

The jitter of the SS symbol clock is measured. Peak-to-peak jitter during a 2 sec measurement period must be less than 2%.

The symbol clock of the Test BS and SS are connected to a phase comparator. The SS shall be locked to the Test BS symbol clock as indicated by a constant phase error.

6.1.22 Tx Burst Timing TP/SS/PHYMP/BT/CA000

6.1.22.1 Test Setup

Figure 24 shows the test setup for testing the Tx Burst timing.

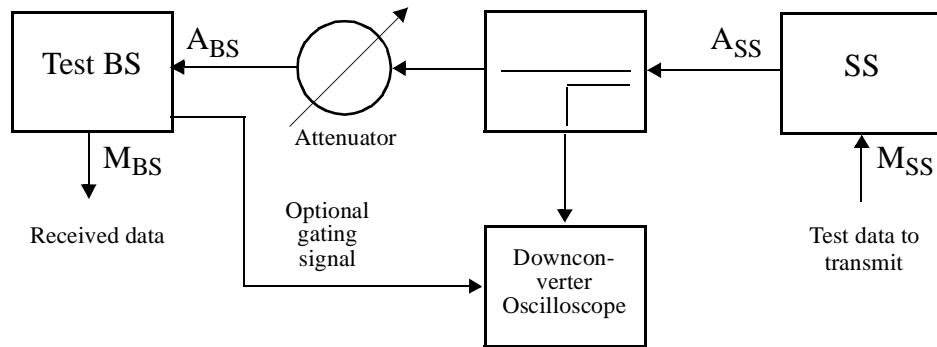


Figure 24—Test Setup for Tx Burst Timing

Instruments needed:

- Directional coupler
- Attenuator
- Downconverter
- Oscilloscope

6.1.22.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. Data is transmitted in the uplink with QPSK modulation.

The Test BS defines the burst at different positions with 0.25 symbol time resolution by using unsolicited RNG-RSP messages.

The actual position of the burst is compared with the gating signal provided by the Test BS. The difference shall be less than 0.125 symbol time.

6.1.23 Carrier Frequency TP/SS/PHYMP/CF/CA000

6.1.23.1 Test Setup

Figure 25 shows the test setup for testing the carrier frequency.

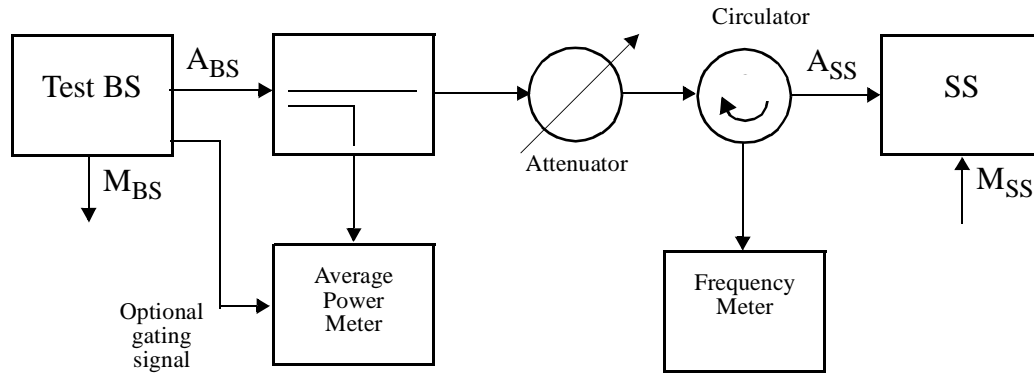


Figure 25—Test Setup for Carrier Frequency

- Instruments needed:
- Directional coupler
 - Average power meter
 - Circulator
 - Attenuator
 - Frequency meter

6.1.23.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

The SS is set in the CW test mode. The Test BS transmits a downlink signal containing only the control portion. The signal is adjusted until the received power is $-98 + 10\log(B)$ dBm, where B is the symbol rate in MBaud, in order to correspond to a worst case signal. The SS is then commanded to transmit in the uplink (UL) using the CW test mode.

The Test BS generates frequencies which are multiples of 250 KHz in frequency range declared by the SS manufacturer

The SS is able to lock to the frequencies generated by the Test BS. For time division duplex (TDD) the frequencies for the Test BS and SS shall be equal and for frequency division duplex (FDD) they shall be separated by the duplex distance declared by the manufacturer.

If the SS does not support a CW test mode, the test shall be conducted by commanding the SS to use randomizer seed = 0, no FEC, and bursts containing a constant QPSK symbol. The payload of the UL packets will then be modulated to CW. The test BS knows when this happens and shall emit a proper gating signal to the test instrument.

6.1.24 Spectral Mask TP/SS/PHYMP/SM/CA000

6.1.24.1 Test Setup

Figure 26 shows the test setup for testing the spectral mask.

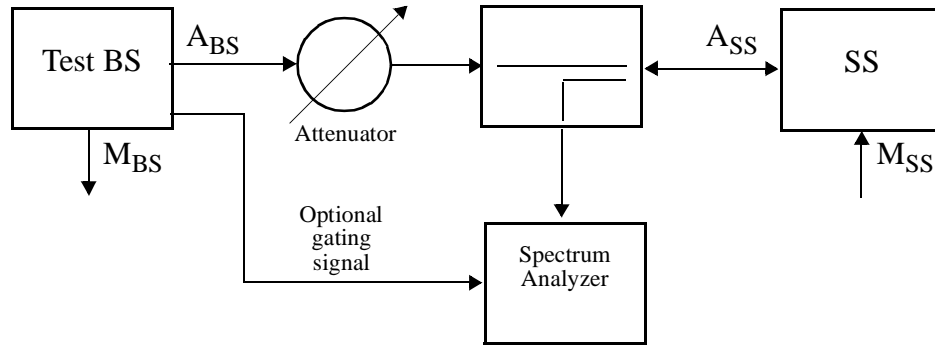


Figure 26—Test Setup for Spectral Mask

Instruments needed: Circulator
 Attenuator
 Spectrum Analyzer

6.1.24.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use the most robust burst profile. Data is transmitted in the uplink.

The spectrum is measured with a spectrum analyzer. The spectrum shall not exceed the mask given by the local regulator.

The settings of the spectrum analyzer shall be according to table 2. B is the channel width in MHz

Table 2—Spectrum Analyzer Settings

Parameter	SS
Center frequency	Actual
Span	5 x B MHz
Scan time	Auto
Resolution bandwidth	300 KHz
Video bandwidth	100 KHz

6.1.25 Ramp Up / Down Time TP/SS/PHYMP/RUD/CA000

6.1.25.1 Test Setup

Figure 27 shows the test setup for testing the ramp up / down time.

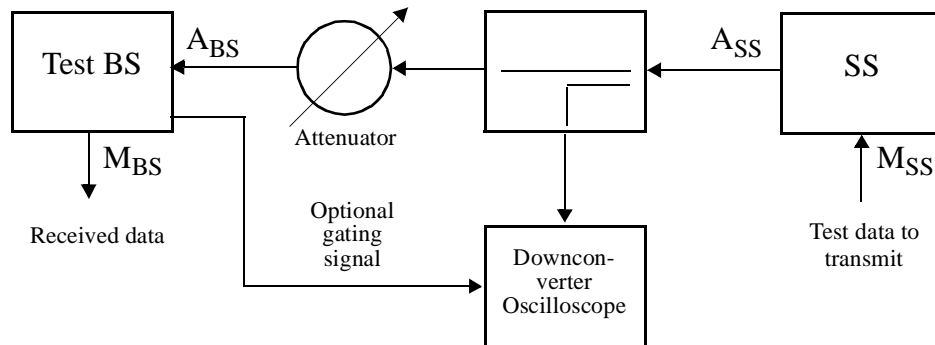


Figure 27—Test Setup for Ramp Up / Down Time

Instruments needed:

- Directional coupler
- Attenuator
- Downconverter
- Oscilloscope

6.1.25.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. Data is transmitted in the uplink with QPSK modulation.

The ramp up/ ramp down times are measured and shall be ≤ 24 symbols.

6.1.26 Output Noise Power Spectral Density When Tx is not Transmitting TP/SS/PHYMP/ON/CA00

6.1.26.1 Test Setup

Figure 28 shows the test setup for testing the output noise power spectral density.

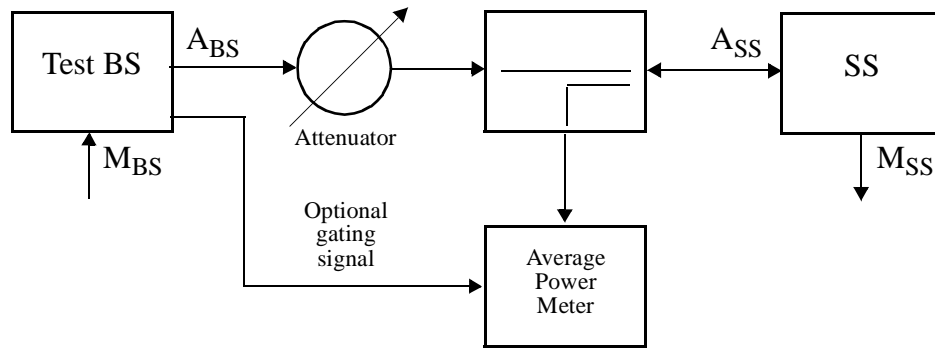


Figure 28—Test Setup for Output Noise Power Spectral Density

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.1.26.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS allocates a small amount of data in each uplink frame. The actual measurement is made during the period when the SS is not transmitting.

The output noise power emitted from the SS when not transmitting shall be ≤ -80 dBm/Mhz

6.1.27 Modulation Accuracy TP/SS/PHYMP/MA/CA000-004

6.1.27.1 Test Setup

Figure 28 shows the test setup for testing the modulation accuracy.

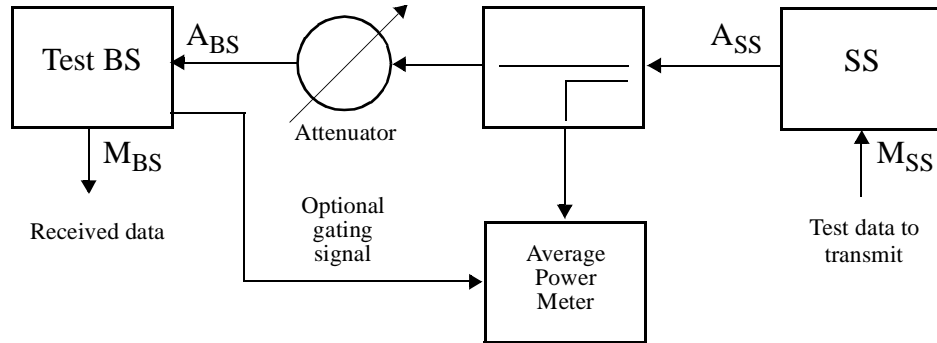


Figure 29—Test Setup for Modulation Accuracy

- Instruments needed:
- Directional coupler
 - Attenuator
 - Average power meter

6.1.27.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

The system is setup for a BER test for the Test BS. The sensitivity value P for the Test BS for $BER=10^{-3}$ is measured using a high quality transmitter as the signal source with a known implementation margin K.

The sensitivity value M for the Test BS for $BER=10^{-3}$ is measured using the SS as the signal source. The expression $M - P + K$ shall be less than or equal to the values in column 2 in table 3. The corresponding error vector magnitude (EVM) figures are shown in columns 3 and 4.

Table 3—EVM Requirements

	Tx implementation margin	EVM no equalizer	EVM equalizer
QPSK	0.5 dB	12%	10%
16-QAM	1.0 dB	6%	3%
64-QAM	1.5 dB		1.5%

6.1.28 BER Performance Threshold TP/SS/PHYMP/BER/CA000-006

6.1.28.1 Test Setup

Figure 30 shows the test setup for testing the BER performance threshold.

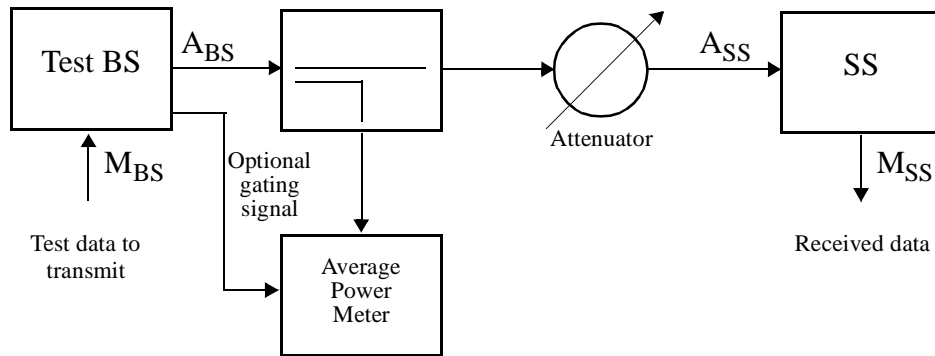


Figure 30—Test Setup for BER Performance Threshold

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.28.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS transmits the bursts with all supported modulation schemes and no FEC. The cyclic redundancy check (CRC) is disabled.

The BER is computed from the data packets accepted by the SS. The attenuator is adjusted until BER = 10^{-3} and then 10^{-6} . The input power is measured and shall be according to table 4. B is the symbol rate in MBaud.

Table 4—BER Performance Threshold Sensitivity Values

	BER 10^{-3}	BER 10^{-6}
QPSK	$-94 + 10\log(B)$ dBm	$-90 + 10\log(B)$ dBm
16-QAM	$-87 + 10\log(B)$ dBm	$-83 + 10\log(B)$ dBm
64-QAM	$-79 + 10\log(B)$ dBm	$-74 + 10\log(B)$ dBm

6.1.29 Transition Time From Tx to Rx and From Rx to Tx TP/SS/PHYMP/TT/CA000-001

6.1.29.1 Test Setup

Figure 31 shows the test setup for testing the Transition time from Tx to Rx and from Rx to Tx.

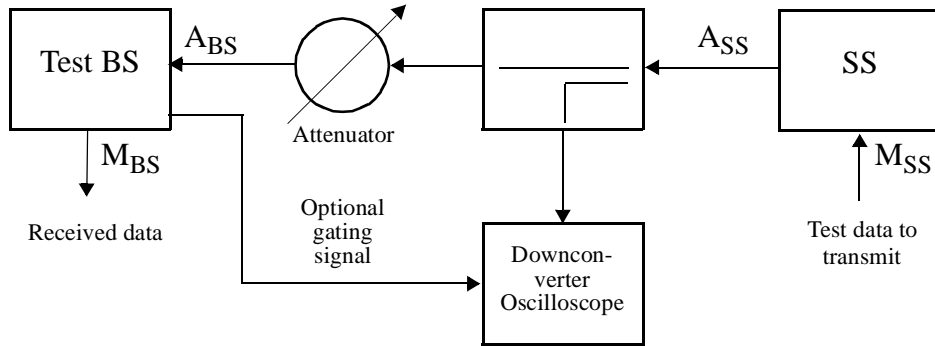


Figure 31—Test Setup for Transition time from Tx to Rx and from Rx to Tx

- Instruments needed:
- Directional coupler
 - Attenuator
 - Downconverter
 - Oscilloscope

6.1.29.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

The SS ranges and registers with the test BS. The test BS keeps track of the round trip delay (RTD) for the link to the SS by accumulating the Tx Timing Advance adjustments given in RNG-RSP messages. A connection is setup between the Test BS and the SS. The attenuator is adjusted for an optimal signal quality. The Test BS provides downlink and uplink maps with a transition time between the end of an uplink burst and the start of a downlink burst of 2 μ s for TDD and 20 μ s for H-FDD and with transition times between the end of a downlink burst and start of an uplink burst of 2 μ s for TDD and 20 μ s for H-FDD plus RTD. Uplink and downlink data is generated.

The SS successfully transmits uplink data and receives downlink data.

6.1.30 1st Adjacent Channel Interference TP/SS/PHYMP/1AC/CA000-011

6.1.30.1 Test Setup

Figure 32 shows the test setup for testing the 1st adjacent channel interference.

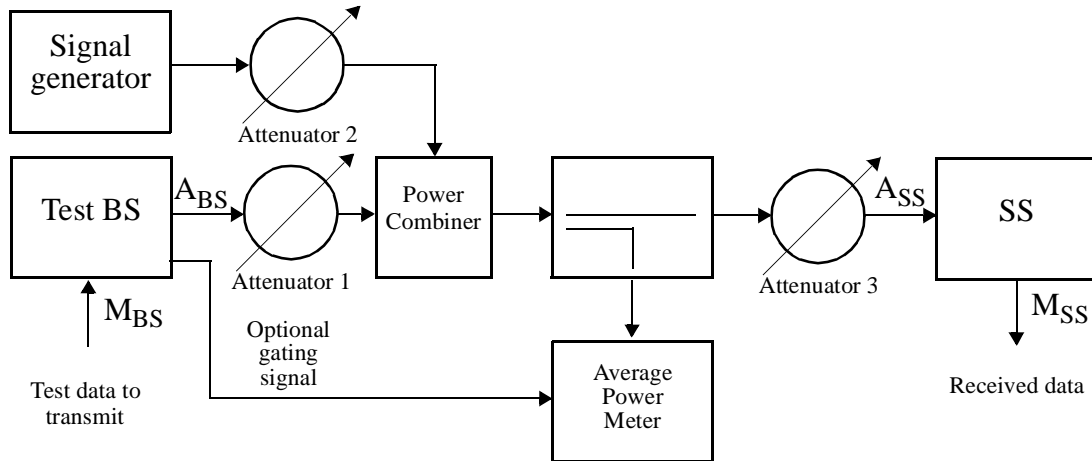


Figure 32—Test Setup for 1st Adjacent Channel Interference

Instruments needed:

- Directional coupler
- Attenuators
- Average power meter
- Power combiner

6.1.30.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuators are calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account. Attenuators 1 and 2 are used to adjust the ratio between the useful and interfering signals. Attenuator 3 is used for adjusting the absolute signal level at the receiver and can be held at a constant value of 10 dB. The signal generator transmits a similar signal as the useful signal on the first adjacent channel.

A connection is setup between the Test BS and the SS. Attenuator 2 is set to its maximum value and the signal generator is switched off. Downlink QPSK data is generated and attenuator 1 is adjusted for $BER = 10^{-3}$ (10^{-6}). The signal power is increased by 3 (1) dB and the power is measured.

The signal generator is switched on and attenuator 2 is decreased until $BER = 10^{-3}$ (10^{-6}) is achieved. The Test BS is turned off and the power of the interfering signal is measured.

The procedure is repeated for the other modulation schemes, 1 dB degradation and $BER = 10^{-6}$. The C/I values shall be according to Tables 5 and Table 6.

Table 5—1st Adjacent Channel Interference BER 10^{-3}

	1 dB degradation	3 dB degradation
QPSK	-5 dB	-9 dB
16-QAM	+2 dB	-2 dB
64-QAM	+9 dB	+5 dB

Table 6—1st Adjacent Channel Interference BER= 10^{-6}

	1 dB degradation	3 dB degradation
QPSK	-1 dB	-5 dB
16-QAM	+6 dB	+2 dB
64-QAM	+13 dB	+9 dB

6.1.31 2nd Adjacent Channel Interference TP/SS/PHYMP/2AC/CA000-011

6.1.31.1 Test Setup

Figure 33 shows the test setup for testing the 2nd adjacent channel interference.

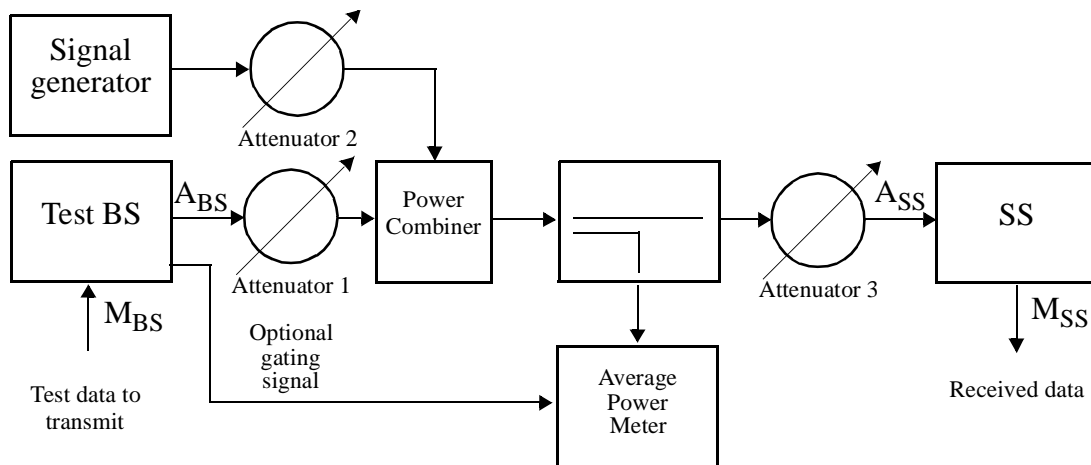


Figure 33—Test Setup for 2nd Adjacent Channel Interference

- Instruments needed:
- Directional coupler
 - Attenuators
 - Average power meter
 - Power combiner

6.1.31.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuators are calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account. Attenuators 1 and 2 are used to adjust the ratio between the useful and interfering signals. Attenuator 3 is used for adjusting the absolute signal level at the receiver and can be held at a constant value of 10 dB. The signal generator transmits a similar signal as the useful signal on the second adjacent channel.

A connection is setup between the Test BS and the SS. Attenuator 2 is set to its maximum value and the signal generator is switched off. Downlink QPSK data is generated and attenuator 1 is adjusted for BER = 10^{-3} (10^{-6}). The signal power is increased by 3 (1) dB and the power is measured.

The signal generator is switched on and attenuator 2 is decreased until BER = 10^{-3} (10^{-6}) is achieved. The Test BS is turned off and the power of the interfering signal is measured.

The procedure is repeated for the other modulation schemes, 1 dB degradation and BER = 10^{-6} . The C/I values shall be according to tables 7 and 8.

Table 7—2nd Adjacent Channel Interference BER 10^{-3}

	1 dB degradation	3 dB degradation
QPSK	-30 dB	-34 dB
16-QAM	-22 dB	-27 dB
64-QAM	-16 dB	-20 dB

Table 8—2nd Adjacent Channel Interference BER= 10^{-6}

	1 dB degradation	3 dB degradation
QPSK	-26 dB	-30 dB
16-QAM	-20 dB	-23 dB
64-QAM	-12 dB	-16 dB

6.1.32 Tx Power Level Absolute Accuracy TP/SS/PHYMP/PAA/CA000

6.1.32.1 Test Setup

Figure 34 shows the test setup for testing the Tx Power level absolute accuracy.

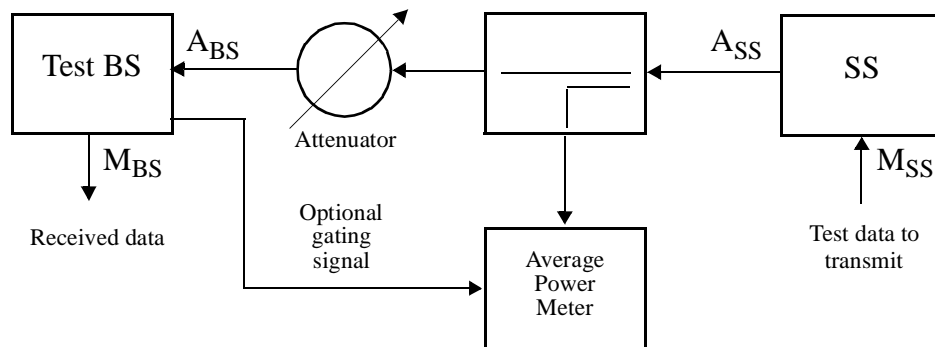


Figure 34—Test setup for Tx Power Level Absolute Accuracy

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.1.32.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the SS. The Test BS commands the SS to use the most robust burst profile at the bottom, medium and top values of the transmit power range. Data is transmitted in the uplink. The transmit power is measured.

The Test BS commands the SS to adjust its transmit power level to an absolute level in the current power range. The Test BS shall receive the data correctly.

The accuracy of the power level shall be ± 6 dB.

6.2 Tests for the Base Station

6.2.1 RS Outer Code $t = 10$ / BCC - Frame Control TP/BS/PHYDL/FC/CA000

6.2.1.1 Test Setup

Figure 35 shows the test setup for testing the RS outer code $t = 10$ / BCC - frame control.

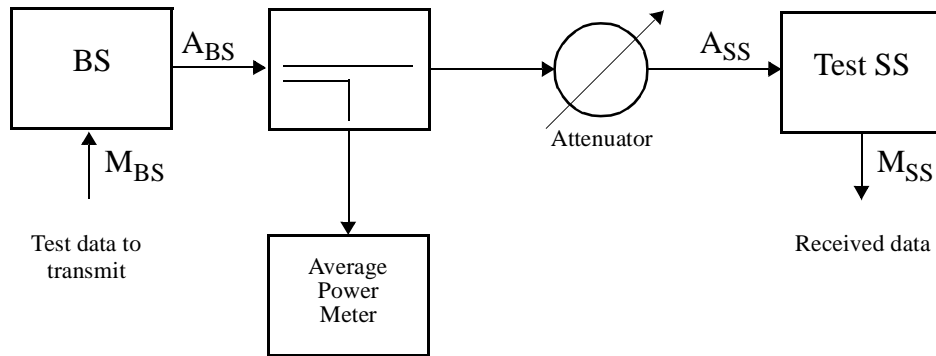


Figure 35—Test Setup for RS Outer Code $t = 10$ / BCC - Frame Control

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.1.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

The BS is operable. No connections are set up. The Test SS tries to register.

The Test SS is able to register to the BS.

6.2.2 RS Outer Code Other Bursts TP/BS/PHYDL/RS/CA000

6.2.2.1 Test Setup

Figure 36 shows the test setup for testing the RS outer code other bursts.

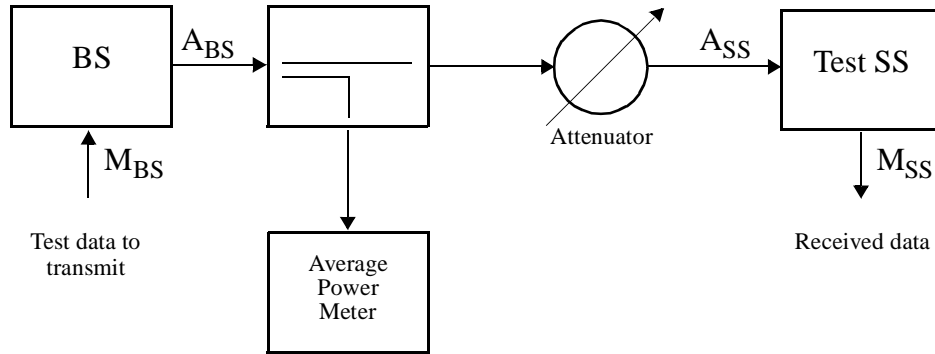


Figure 36—Test Setup for RS Outer Code Other Bursts

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.2.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS requests the BS to use bursts profiles with RS parameter $t = 0, 4, 8$ and 12 . Data is transmitted in the downlink.

The SS shall receive the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	0, 4, 8, 12	128

6.2.3 Fixed Codeword Operation TP/BS/PHYDL/FCO/CA000

6.2.3.1 Test Setup

Figure 37 shows the test setup for testing the RS fixed codeword operation.

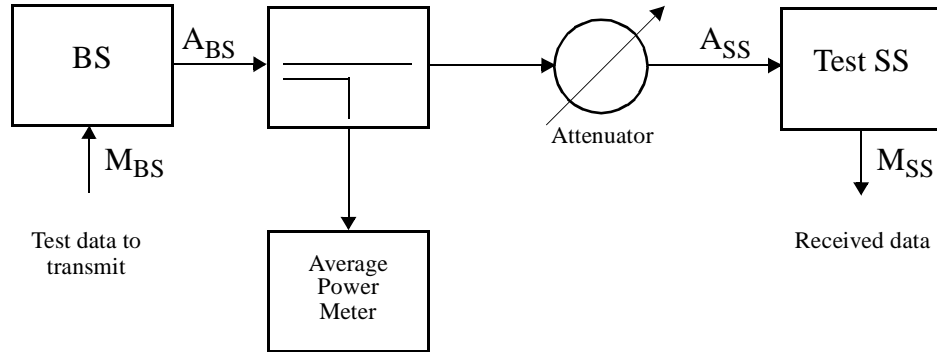


Figure 37—Test Setup for Fixed Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.3.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS requests the BS to use burst profiles with fixed codeword operation.

Data is transmitted in the downlink.

The SS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	128

6.2.4 Shortened Last Codeword Operation TP/BS/PHYDL/SC/CA000

6.2.4.1 Test Setup

Figure 38 shows the test setup for testing the RS shortened codeword operation.

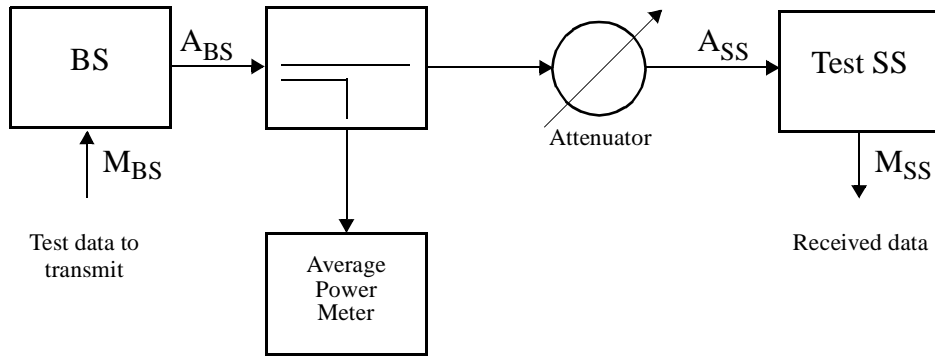


Figure 38—Test Setup for Shortened Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.4.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS requests the BS to use burst profiles with shortened codeword operation.

Data is transmitted in the downlink.

The SS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	128

6.2.5 Burst Preamble TP/BS/PHYDL/BP/CA000

6.2.5.1 Test Setup

Figure 39 shows the test setup for testing the burst preamble.

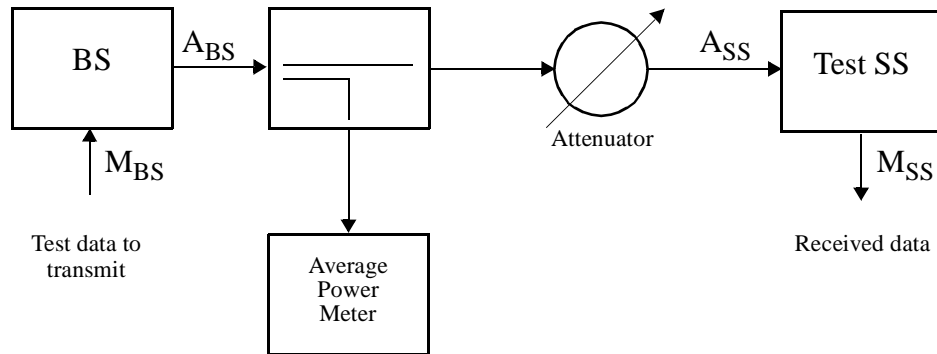


Figure 39—Test Setup for Burst Preamble

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.5.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the Test BS and the half-duplex Test SS.

Data is transmitted in the TDMA portion of the downlink

The SS receives the data correctly.

6.2.6 Modulation TP/BS/PHYDL/M/CA000-002

6.2.6.1 Test Setup

Figure 40 shows the test setup for testing the modulation.

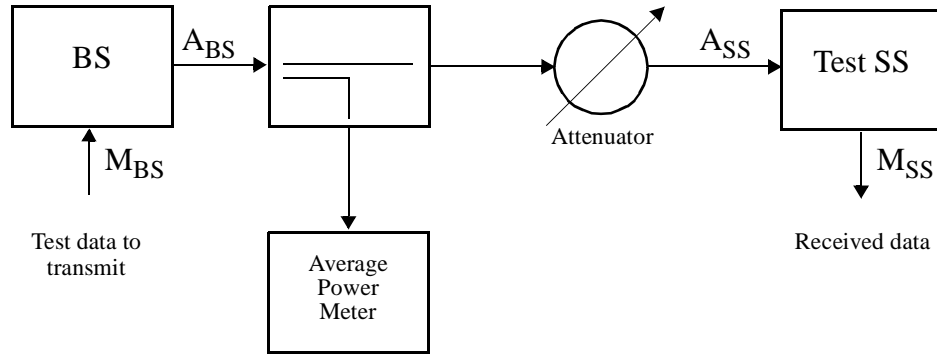


Figure 40—Test Setup for Modulation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.6.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS requests the BS to use burst profiles with different modulation schemes supported by the BS.

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS receives the data correctly.

6.2.7 RS Outer Code - Information Block Length TP/BS/PHYDL/IBL/CA000

6.2.7.1 Test Setup

Figure 41 shows the test setup for testing the RS outer code - Information Block Length.

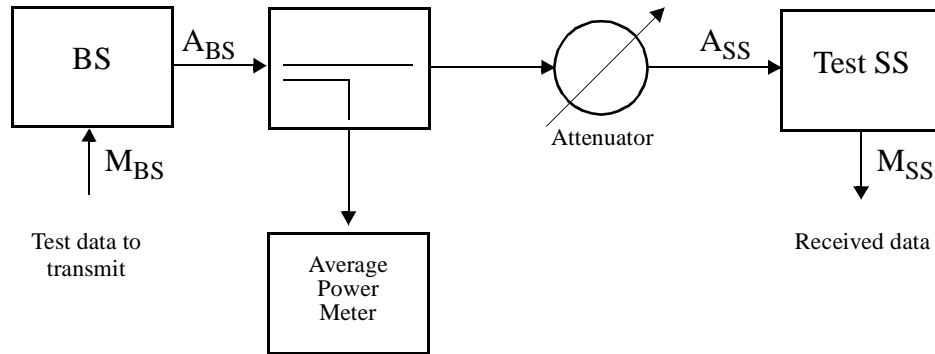


Figure 41—Test Setup for RS Outer Code - Information Block Length

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.7.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. QPSK modulation, no BCC coding, RS coding with information block length = 6, 128, 239, and $t = 8$ are used.

The downlink frame is filled with bursts of test data. The received power is adjusted until the S/N is approximately 10 dB above the actual threshold to ensure the quality of the signal.

The SS shall receive the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	6, 128, 239

6.2.8 Randomization with Programmable Seed TP/BS/PHYUL/RPS/CA000

6.2.8.1 Test Setup

Figure 42 shows the test setup for randomization with programmable seed.

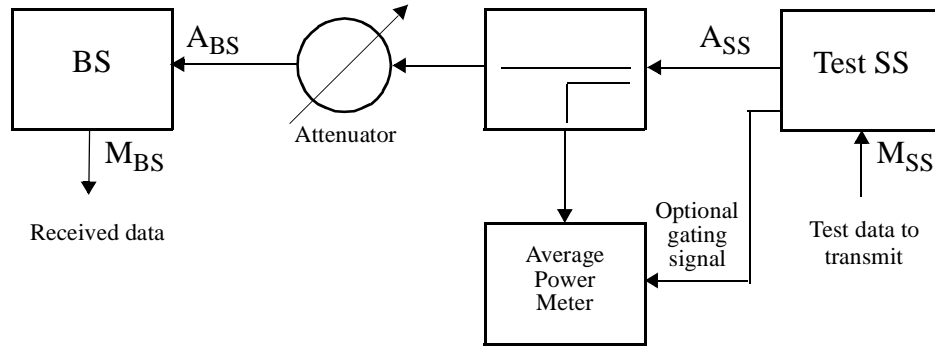


Figure 42—Test Setup for Randomization with Programmable Seed

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.8.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. Various UL burst profiles are defined different only in their seed values. The test network management (NMS) requests the BS to use burst profiles with different seed values for the randomization.

Data is transmitted in the uplink.

The BS receives the data correctly.

6.2.9 RS Outer Code - Initial ranging TP/BS/PHYUL/IR/CA000

6.2.9.1 Test Setup

Figure 43 shows the test setup for testing the RS outer code - initial ranging.

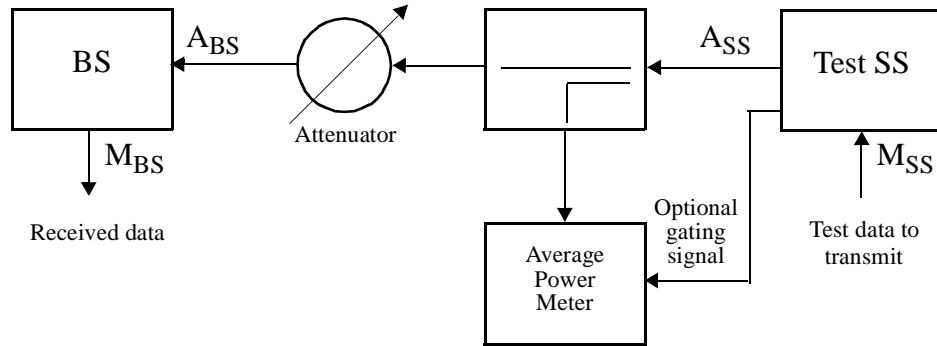


Figure 43—Test Setup for RS Outer Code - Initial Ranging

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.9.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS.

The test NMS requests the BS to use burst profiles with RS parameter $t = 10$.

Data is transmitted in the uplink. The Test BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	10	128

6.2.10 RS Outer Code Other Bursts TP/BS/PHYUL/RS/CA000-001

6.2.10.1 Test Setup

Figure 44 shows the test setup for testing the RS outer code other bursts.

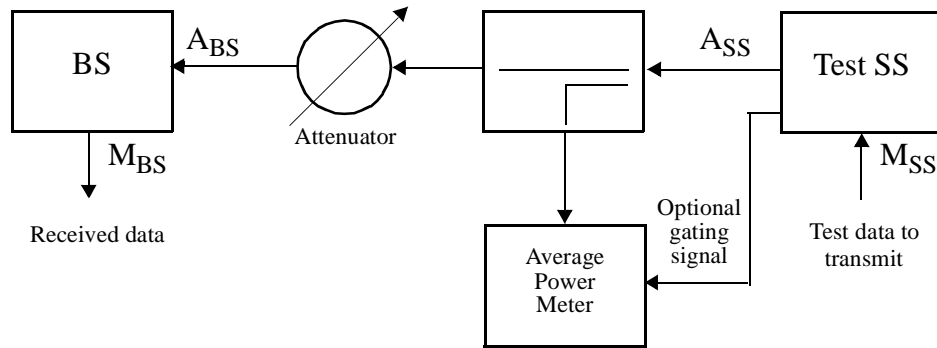


Figure 44—Test Setup for RS Outer Code Other Bursts

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.10.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with the RS parameter $t = 0, 4, 8, \text{ or } 12$, and information bytes 128 are used.

The uplink frame is filled with bursts of test data. The data received at the BS is checked for correctness.

The Test SS inserts alternatively 0, 4, 8, or 12 erroneous bytes in the codeword corresponding to $t = 0, 4, 8, \text{ and } 12$. The BS shall receive the data correctly.

The Test SS inserts alternatively 1, 5, 9, or 13 erroneous bytes in the codeword corresponding to $t = 0, 4, 8, \text{ and } 12$. The BS shall not be able to receive the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	0, 4, 8, 12	128

6.2.11 Fixed Codeword Operation TP/BS/PHYUL/FCO/CA000

6.2.11.1 Test Setup

Figure 45 shows the test setup for testing the RS fixed codeword operation.

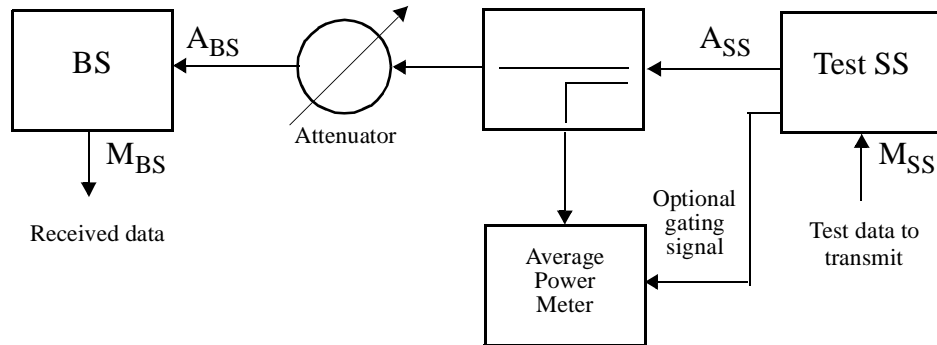


Figure 45—Test Setup for Fixed Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.11.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with RS fixed codeword option, QPSK modulation, no BCC coding, RS coding with $t = 8$ and information bytes = 128.

The uplink frame is filled with bursts of test data. The number of bytes in the uplink frame must be not be a multiple of 128.

The BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	128

6.2.12 Shortened Last Codeword Operation TP/BS/PHYUL/SC/CA000

6.2.12.1 Test Setup

Figure 46 shows the test setup for testing the RS shortened codeword operation.

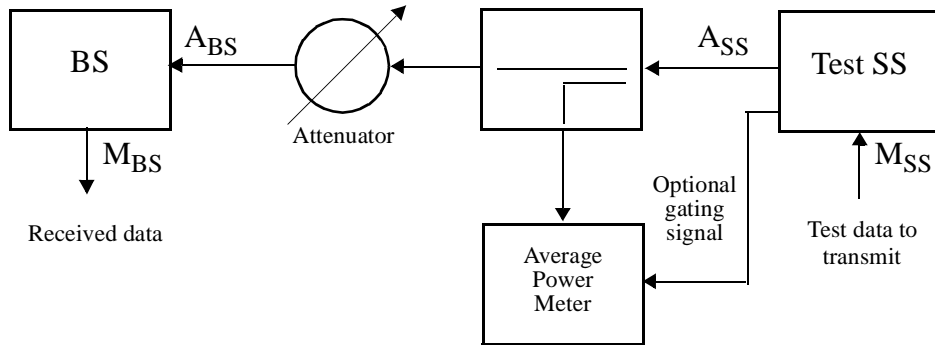


Figure 46—Test Setup for Shortened Codeword Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.12.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with RS shortened codeword option, QPSK modulation, no BCC coding, RS coding with $t = 8$ and information bytes = 128.

The uplink frame is filled with bursts of test data. The number of bytes in the uplink frame must be not be a multiple of 128.

The BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	128

6.2.13 BCC Inner Code TP/BS/PHYUL/BCC/CA000

6.2.13.1 Test Setup

Figure 47 shows the test setup for testing the BCC inner code operation.

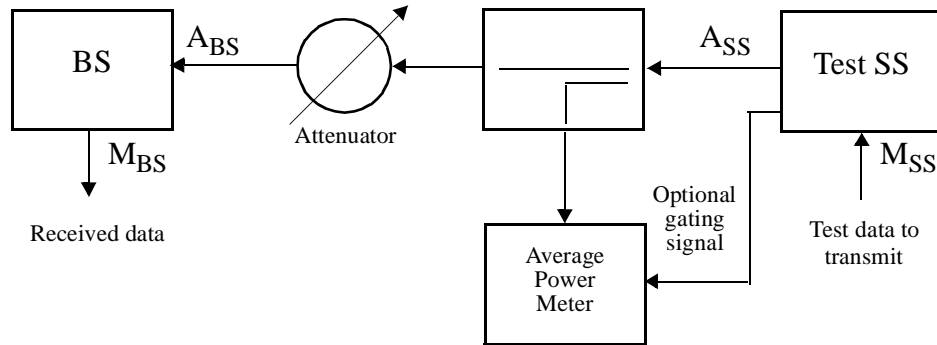


Figure 47—Test Setup for BCC Inner Code Operation

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.13.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use a burst profile with BCC inner code.

Data is transmitted in the uplink.

The BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	YES	YES	8	128

6.2.14 Burst Preamble TP/BS/PHYUL/BP/CA000

6.2.14.1 Test Setup

Figure 48 shows the test setup for testing the burst preamble.

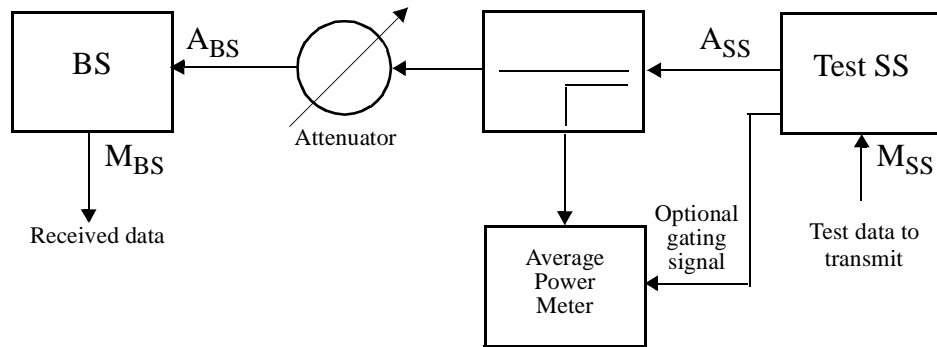


Figure 48—Test Setup for Burst Preamble

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.14.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with different preamble lengths.

Data is transmitted in the uplink.

The BS receives the data correctly.

6.2.15 Modulation TP/BS/PHYUL/M/CA000-002

6.2.15.1 Test Setup

Figure 49 shows the test setup for testing the modulation schemes.

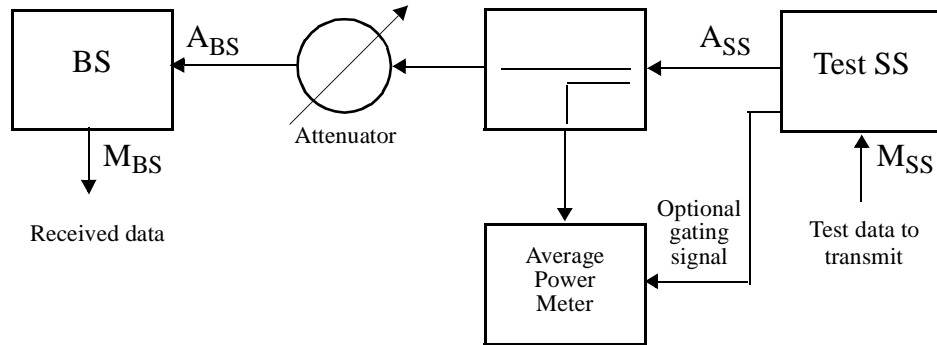


Figure 49—Test Setup for the Modulation Schemes

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.15.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with the different modulation schemes supported by the SS.

Data is transmitted in the uplink.

The BS receives the data correctly.

6.2.16 RS Outer Code - Information Block Length TP/BS/PHYUL/IBL/CA000

6.2.16.1 Test Setup

Figure 50 shows the test setup for testing the RS outer code - Information Block Length.

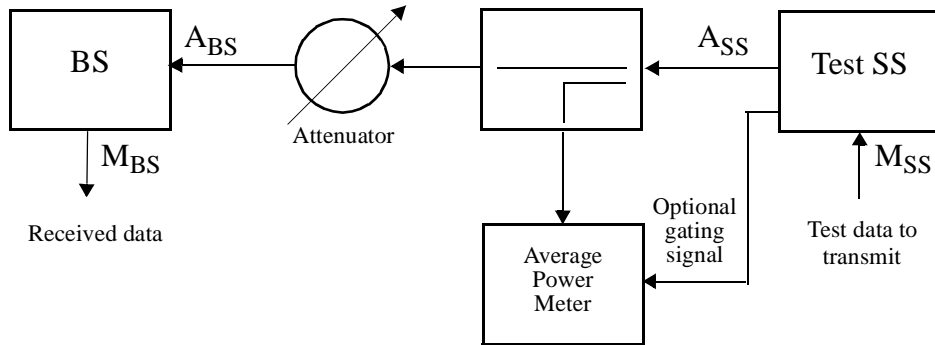


Figure 50—Test Setup for RS Outer Code - Information Block Length

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.16.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power and the the losses, the effect of the coupler and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS requests the BS to use burst profiles with the RS parameter Information block length = 6, 128, and 239. RS parameter t = 8.

Data is transmitted in the uplink.

The BS receives the data correctly.

Parameter	Modulation	BCC	RS	t	Block length
	QPSK	NO	YES	8	6, 128, 239

6.2.18 Carrier Frequency TP/BS/PHYMP/CF/CA000

6.2.18.1 Test Setup

Figure 52 shows the test setup for testing the carrier frequency.

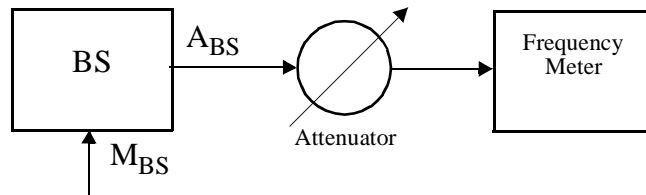


Figure 52—Test Setup for Carrier Frequency

Instruments needed: Attenuator
 Frequency meter

6.2.18.2 Test Procedure

The BS is set in the CW test mode. The attenuator is adjusted for an optimal reception level

The BS is requested to generate frequencies which are multiples of 250 KHz in frequency range declared by the manufacturer

The accuracy shall be better than ± 10 ppm.

6.2.19 Spectral Mask TP/BS/PHYMP/SMCA000

6.2.19.1 Test Setup

Figure 53 shows the test setup for testing the spectral mask.

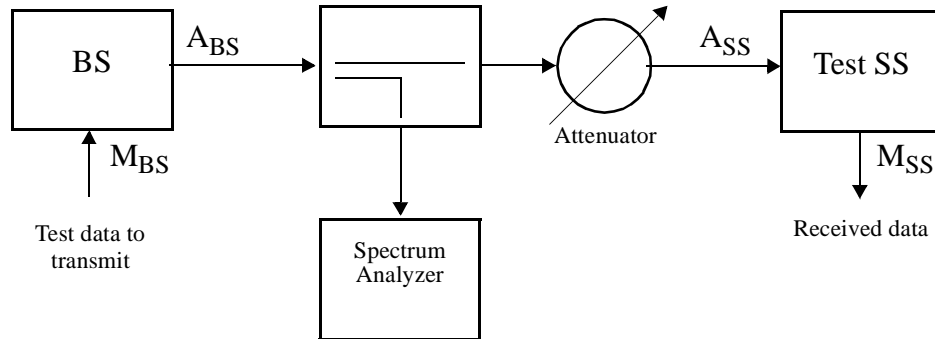


Figure 53—Test Setup for Spectral Mask

Instruments needed: Attenuator
 Spectrum Analyzer

6.2.19.2 Test Procedure

A connection is setup between the BS and the Test SS. The downlink frame is filled with QPSK modulated data.

The spectrum is measured with a spectrum analyzer. The spectrum shall not exceed the mask given by the local regulator.

The settings of the spectrum analyzer shall be according to Table 9. B is the channel width in MHz.

Table 9—Spectrum Analyzer Settings

Parameter	SS
Center frequency	Actual
Span	5 * B MHz
Scan time	Auto
Resolution bandwidth	300 KHz
Video bandwidth	100 KHz

6.2.20 Spurious TP/BS/PHY/MP/SP/CA000

6.2.20.1 Test Setup

Figure 54 shows the test setup for testing the spurious frequencies.

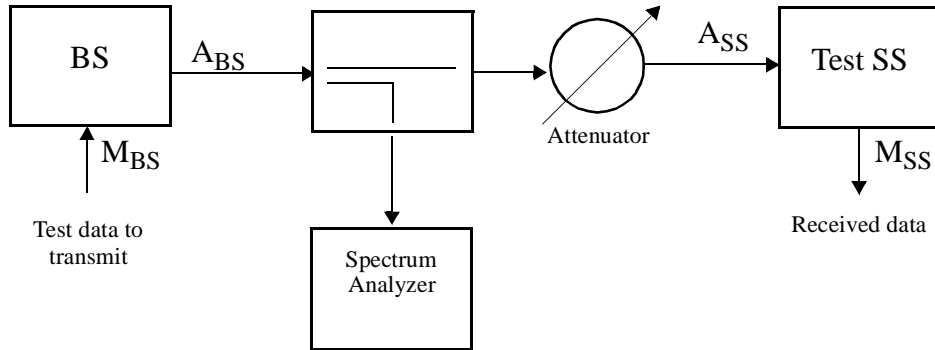


Figure 54—Test Setup for Spurious Frequencies

Instruments needed: Attenuator
 Spectrum Analyzer

6.2.20.2 Test Procedure

A connection is setup between the BS and the Test SS. The downlink frame is filled with QPSK modulated data.

The spectrum is measured with a spectrum analyzer. The spurious frequencies shall not exceed the values given by the local regulator.

The settings of the spectrum analyzer shall be according to table 10. B is the channel width in MHz.

Table 10—Spectrum Analyzer Settings

Parameter	SS
Center frequency	Actual
Span	5 * B MHz
Scan time	Auto
Resolution bandwidth	Determined by local regulator
Video bandwidth	Determined by local regulator

6.2.21 Tx RMS Power Level TP/BS/PHYMP/TXP/CA000-002

6.2.21.1 Test Setup

Figure 55 shows the test setup for testing the Tx RMS Power level

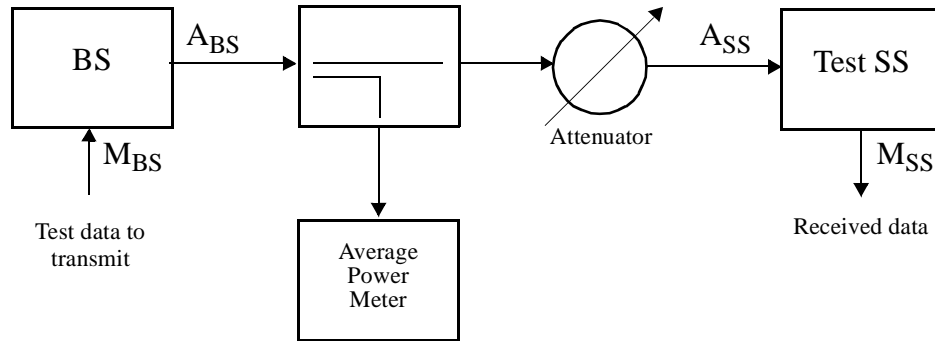


Figure 55—Test Setup for Tx RMS Power level

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.21.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS requests the BS to use the most robust burst profile. The downlink is filled with data.

The power is measured.

The power shall be = declared value ± 2 dB.

6.2.22 Ramp Up / Down Time TP/BS/PHYMP/RUD/CA000

6.2.22.1 Test Setup

Figure 56 shows the test setup for testing the ramp up / down time.

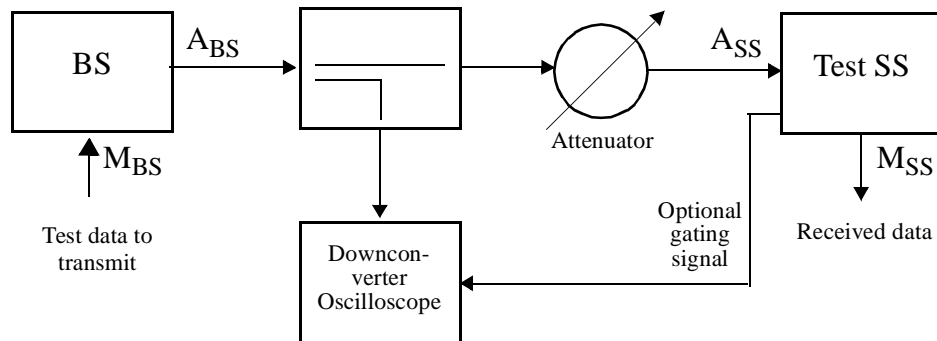


Figure 56—Test Setup for Ramp Up / Down Time

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.22.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. Multiple bursts are transmitted in the downlink with QPSK modulation.

The ramp and ramp down time for the bursts shall be ≤ 24 symbols.

6.2.23 Modulation Accuracy TP/BS/PHYMP/MA/CA000-004

6.2.23.1 Test Setup

Figure 57 shows the test setup for testing the modulation accuracy.

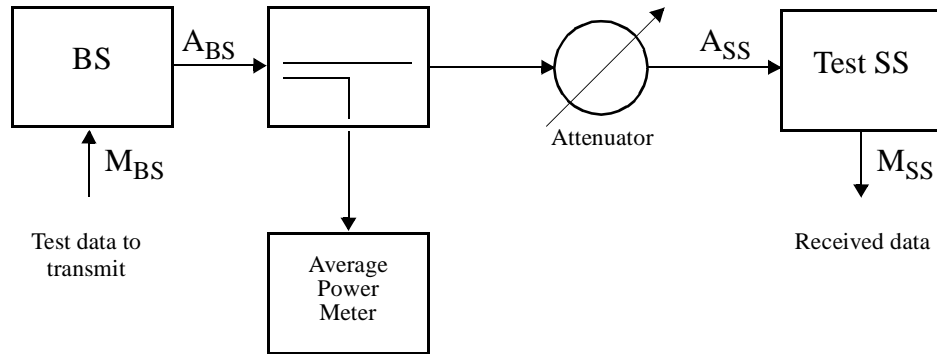


Figure 57—Test Setup for Modulation Accuracy

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.23.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

The sensitivity value P for the Test SS for $BER=10^{-3}$ is measured using a high quality transmitter as the signal source.

The sensitivity value M for the Test SS for $BER=10^{-3}$ is measured using the BS as the signal source. The difference $M - P$ shall be less than or equal to the values in column 2 in table 11

Table 11—EVM Requirements

	Tx implementation margin	EVM no equalizer	EVM equalizer
QPSK	0.5 dB	12%	10%
16-QAM	1.0 dB	6%	3%
64-QAM	1.5 dB		1.5%

6.2.24 Rx Dynamic Range TP/BS/PHYMP/RDR/CA000

6.2.24.1 Test Setup

Figure 58 shows the test setup for testing the Rx Dynamic Range

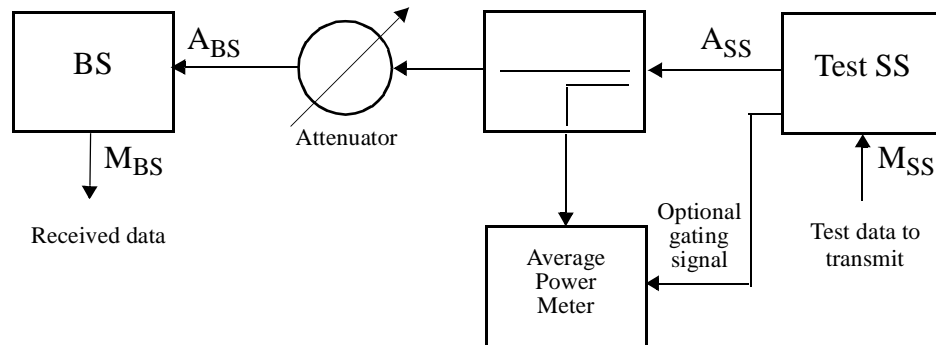


Figure 58—Test Setup for Rx Dynamic Range

Instruments needed:

- Directional coupler
- Attenuator
- Average power meter

6.2.24.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The test NMS request the BS to use the most robust burst profile. Data is transmitted in the uplink.

The attenuator is adjusted until the minimum operable value is reached. The power of the received signal is measured and recorded. The attenuator is then increased until the maximum operable value is reached. The power is measured and recorded.

The difference between the two power values is the Rx dynamic range and shall be $\geq 27\text{dB}$.

6.2.25 BER Performance Threshold TP/BS/PHYMP/BER/CA000-005

6.2.25.1 Test Setup

Figure 59 shows the test setup for testing the BER performance threshold.

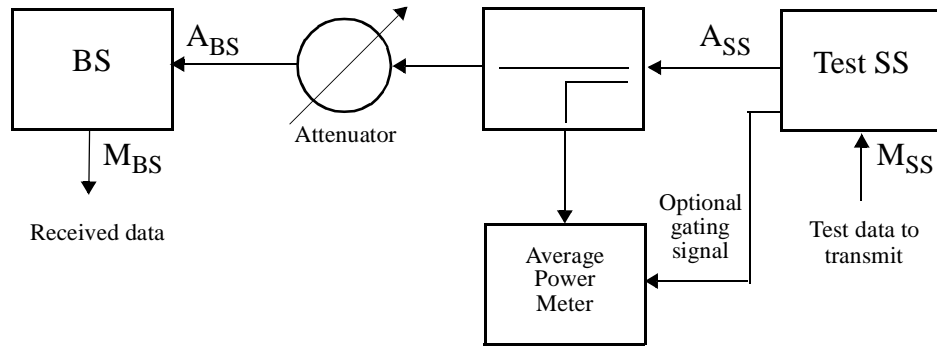


Figure 59—Test Setup for BER Performance Threshold

Instruments needed: Directional coupler
 Attenuator
 Average power meter

6.2.25.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuator is calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account.

A connection is setup between the BS and the Test SS. The Test SS transmits the bursts with all supported modulation schemes and no FEC. CRC is disabled

The BER is computed from the data packets accepted by the BS. The attenuator is adjusted until $BER = 10^{-3}$ and then 10^{-6} . The input power is measured and shall be according to table 12. B is the symbol rate in MBaud.

Table 12—BER Performance Threshold Sensitivity Values

	BER 10^{-3}	BER 10^{-6}
QPSK	$-94 + 10\log(B)$ dBm	$-90 + 10\log(B)$ dBm
16-QAM	$-87 + 10\log(B)$ dBm	$-83 + 10\log(B)$ dBm
64-QAM	$-79 + 10\log(B)$ dBm	$-74 + 10\log(B)$ dBm

6.2.26 1st Adjacent Channel Interference TP/BS/PHYMP/1AC/CA000-011

6.2.26.1 Test Setup

Figure 60 shows the test setup for testing the 1st adjacent channel interference.

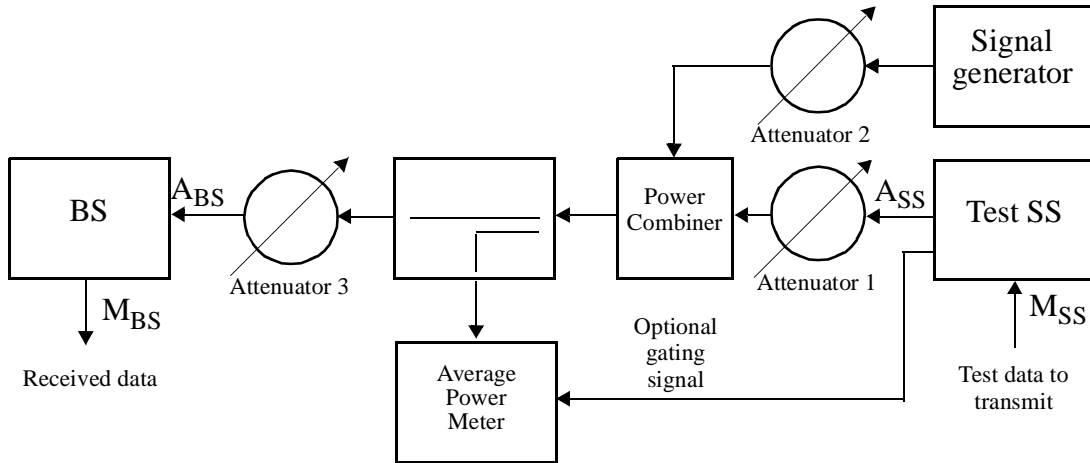


Figure 60—Test Setup for 1st Adjacent Channel Interference

- Instruments needed:
- Directional coupler
 - Attenuators
 - Average power meter
 - Power combiner
 - Signal generator

6.2.26.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuators are calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account. Attenuators 1 and 2 are used to adjust the ratio between the useful and interfering signals. Attenuator 3 is used for adjusting the absolute signal level at the receiver and can be held at a constant value of 10 dB. The signal generator transmits a similar signal as the useful signal on the first adjacent channel.

A connection is setup between the BS and the Test SS. Attenuator 2 is set to its maximum value and the signal generator is switched off. The uplink frame is filled with QPSK modulated data and attenuator 1 is adjusted for BER = 10⁻³ (10⁻⁶). The signal power is increased by 3 (1) dB and the power is measured.

The signal generator is switched on and attenuator 2 is decreased until BER = 10⁻³ (10⁻⁶) is achieved. The Test BS is turned off and the power of the interfering signal is measured.

The procedure is repeated for the other modulation schemes, 1 dB degradation and BER = 10⁻⁶. The C/I values shall be according to Table 13 and Table 14.

Table 13—1st Adjacent Channel Interference BER 10^{-3}

	1 dB degradation	3 dB degradation
QPSK	-5 dB	-9 dB
16-QAM	+2 dB	-2 dB
64-QAM	+9 dB	+5 dB

Table 14—1st Adjacent Channel Interference BER= 10^{-6}

	1 dB degradation	3 dB degradation
QPSK	-1 dB	-5 dB
16-QAM	+6 dB	+2 dB
64-QAM	+13 dB	+9 dB

6.2.27 2nd Adjacent Channel Interference TP/BS/PHYMP/2AC/CA000-011

6.2.27.1 Test Setup

Figure 61 shows the test setup for testing the 2nd adjacent channel interference.

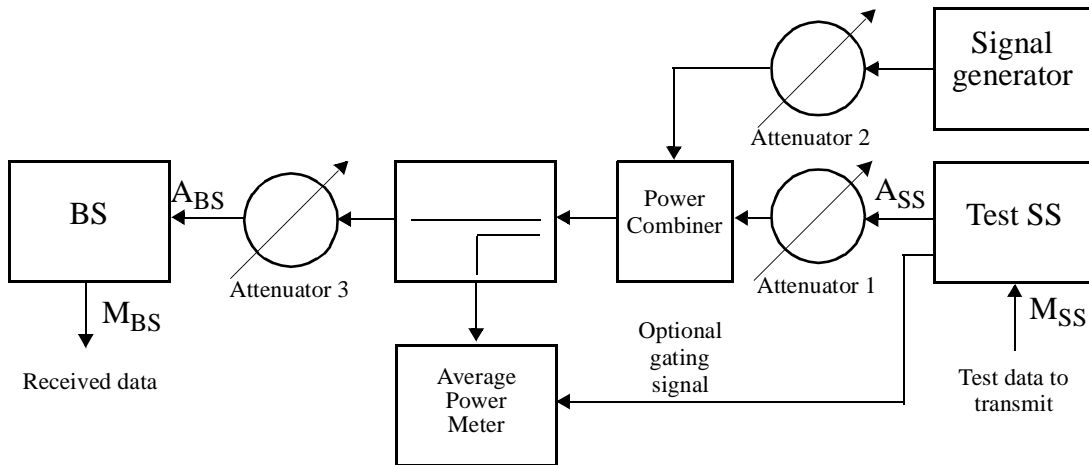


Figure 61—Test Setup for 2nd Adjacent Channel Interference

- Instruments needed:
- Directional coupler
 - Attenuators
 - Average power meter
 - Power combiner
 - Signal generator

6.2.27.2 Test Procedure

The losses for the coupler and the connecting waveguides are measured and the attenuators are calibrated. When measuring the power, the effect of the coupler, the losses and the duty cycle shall be taken into account. Attenuators 1 and 2 are used to adjust the ratio between the useful and interfering signals. Attenuator 3 is used for adjusting the absolute signal level at the receiver and can be held at a constant value of 10 dB. The signal generator transmits a similar signal as the useful signal on the second adjacent channel.

A connection is setup between the BS and the Test SS. Attenuator 2 is set to its maximum value and the signal generator is switched off. The uplink frame is filled with QPSK modulated data and attenuator 1 is adjusted for BER = 10^{-3} (10^{-6}). The signal power is increased by 3 (1) dB and the power is measured.

The signal generator is switched on and attenuator 2 is decreased until BER = 10^{-3} (10^{-6}) is achieved. The Test BS is turned off and the power of the interfering signal is measured.

The procedure is repeated for the other modulation schemes, 1 dB degradation and BER = 10^{-6} . The C/I values shall be according to tables 15 and 16.

Table 15—2nd Adjacent Channel Interference BER 10^{-3}

	1 dB degradation	3 dB degradation
QPSK	–30 dB	–34 dB
16-QAM	–22 dB	–27 dB
64-QAM	–16 dB	–20 dB

Table 16—2nd Adjacent Channel Interference BER= 10^{-6}

	1 dB degradation	3 dB degradation
QPSK	–26 dB	–30 dB
16-QAM	–20 dB	–23 dB
64-QAM	–12 dB	–16 dB

Annex A

(informative)

Recommendations for the Test Laboratories

A.1 Antenna Input Connectors

When flanges are provided at the input port of the antenna they should be in accordance with IEC 60154-2.⁶ Table A.1 list some IEC and EIA connector types for different frequency bands.

Table A.1—Recommended Antenna Wave Guide Connectors

EIA	IEC	frequency GHz
WR75	R120	10.0–15.0
WR62	R140	12.4–18.0
WR51	R180	15.0–22.0
WR42	R220	18.0–26.5
WR34	R260	22.0–33.0
WR28	R320	26.5– 40.0
WR22	R400	33.0–50.0
WR19	R500	40.0–60.0

A.1.1 Test Equipment

The following equipment is needed for the tests and shall be provided by the test laboratory:

- Terminal for system configuration (parameter setting) and control
- RF-Adapter
- Spectrum Analyzer
- Variable RF-Attenuator
- Power meter
- Oscilloscope
- Printer, Plotter

A.2 General Test Platform

A.2.1 Forcing PHY Mode Changes

⁶IEC publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<http://www.iso.ch/>). IEC publications are also available in the United States from Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112, USA (<http://global.ihs.com/>). Electronic copies are available in the United States from the American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

Forcing an IUT to change PHY modes requires knowledge of how the PHY mode changes are stimulated in the real world. First, the set of PHY modes for a test must be set up in the base station so the DCD and UCD messages are properly generated. For a test base station, this may be via some test user interface. For a real base station this would typically be via network management (NMS) or element management (EMS), but the specific mechanism is outside the scope of the IEEE 802.16. So, the test laboratory needs to collect information on how to specify these from the BS vendor. Typically, this type of information, along with all other “how does your device work?” type information is collected via a PIXIT statement. The questions in the PIXIT may be impacted by the actual test set-up and will at least initially be specific to individual test laboratories.

Assuming the PHY modes are set up and the DCD and UCD messages are being sent properly, the next question is how to force an IUT to change to a specific PHY mode. If the SS is the IUT, the UL PHY mode can be changed by simply using a different UIUC in the UL map entry allocating bandwidth to the SS. To force a DL PHY mode change when the SS is the IUT there are a couple of options depending upon what is being tested. First, if the signal quality is sufficient, the test BS can simply send an unsolicited RNG-RSP. The SS should respond favorably. This method tests the physical ability to change, but does not test the measurement capabilities necessary to implement a change. The second method of forcing the SS IUT to change DL PHY mode is to vary the attenuation of the airlink (in particular the DL) to ensure the signal crosses the threshold specified in the DCD message. This will test not only the change of mode, but the measurement capability of the SS.

When the BS is the IUT, the situation is almost exactly reversed. DL PHY mode changes are as simple as the test SS issuing a DBPC-REQ message. To force a BS IUT to change the UL PHY mode, the thresholds must be known and the signal attenuation must be adjusted to cause a threshold crossing.

A.2.2 Duty Cycle for Power Measurements

In particular for TDD airlinks, the link may not be full with continuous signal from the source for which a power measurement is being performed. The base station has quite a bit of control over the duty cycle. A test BS, for instance can fill the downlink with data destined for a fictitious SS. Since the SS must fill its allocated bandwidth with at least fill data, the BS, through the UL-MAP, can control the duration and timing of bursts from the SS, and therefore the duty cycle.

If the BS is the IUT, the problem is a bit more difficult. In the DL it can be forced on the average by sending a constant rate of data. The same mechanism can be used on the UL as well, but if UGS services are not available, it may be less consistent due to request/grant cycles.

A.2.3 Frequency Range

It is conceivable that the test laboratory may not have a test BS or test SS that can operate over the full 10–66 GHz band. Since some tests must be conducted at RF, the test setup may need to include up conversion or down conversion of the signal to and from the IUT.

A.2.4 Bit Error Rate (BER) Versus Packet Error Rate (PER)

There are basically two kinds of tests for the ITU in this specification: qualitative tests and functional tests.

Qualitative tests, like the BER- and ACI-tests, measure the BER or PER in order to assess the quality of the ITU. The base standard requires some minimum value for the performance of the IUT and the test tries to ensure that the capability of the IUT exceeds that requirement.

Functional tests, on the other hand, make sure that a function is implemented in the IUT and that the IUT responds to the control signals commanding this feature. In this case the quality of the IUT is not measured, as it will be measured in other tests, but it is simply required that the receiver “receives data correctly” when a high quality signal is transmitted. Therefore it is said in many tests that the S/N is adjusted to be approximately 10 dB above the actual threshold to ensure the quality of the signal.

For an ideal receiver the BER would be extremely low with a 10 dB margin. In reality we cannot, however, demand more than what is required in the standard which is $BER=10^{-6}$ ([1] section 8.2.9). So for uncoded transmission “receives data correctly” means that the background $BER \leq 10^{-6}$.

Some tests use the FEC capabilities in the IUT. Because these tests make use of RS code, which is a block code, it is natural both to measure and require a PER rather than a BER performance value. For functional tests, using FEC, “receives data correctly” means that $PER \sim 0$.

One simple way to measure the BER for uncoded operation could be to measure the PER and using the relationship

$$PER = 1.0 - (1 - BER)^n$$

to calculate the BER, where n is the number of bits in the packet. This relationship is valid for uncoded operation on an AWGN channel. For the small BER we can approximate by:

$$BER \sim PER/n$$

The PER can be measured simply by enabling the CRC in the MAC layer and count the accepted packets.

Another, faster, way to measure the BER under similar conditions could be to disable the CRC and compare the contents of the payloads of accepted packets. The number of erroneous bits divided with the total number of payload bits gives the BER. This method is based on the assumption that packets with errors in the header are detected by the MAC and that the BER for the payload is the same for both accepted and rejected packets.

For RS-coded operations the IUT usually discards packets declared erroneous by the FEC. The PER can be computed from the number of packets received by the MAC to the number of packets actually transmitted. The number of received packets can be reported by the IUT or be determined by the contents of the received data.

A.2.5 Microwave Measurement Techniques

For each test in this document there is a recommended test setup showing one possible way of conducting the test. The test instruments and micro wave equipment needed varies from test to test but typically includes:

Test BS	when testing the SS
Test SS	when testing the BS
Directional coupler	to sample the signal
Attenuator	to simulated a link length
Average power meter	to measure the transmitted power, usually through the coupler
Frequency meter	for carrier and symbol clock frequencies

- Oscilloscope for timing measurements
- Power combiner for certain tests like adjacent channel interference

miscellaneous mw equipment like circulators, waveguides, splitters etc.

In each test description, one possible test setup is shown as an example of how the test could be performed. Alternative ways of doing the test are allowed and depend naturally on the test lab, and its procedures, and the instruments used in the lab.

As an example, in the setup figures, the attenuator is placed after the coupler. The attenuator could also be placed before the coupler. The difference is that when the attenuator is placed after the coupler we get a strong signal to measure. The measurement time is short but the coupler and attenuator must be accurately calibrated.

When the attenuator is placed before the coupler we get a weak signal to measure and the integration time is long. On the other hand we do not have to calibrate the attenuator. The coupler must, however, be equally well calibrated in either case.

Sometimes a measurement could be done equally well with either a coupler or an circulator. It is up to the test lab to pass final judgement on how the test is performed.

A.3 Carrier Frequencies

The WirelessMAN-SC air interface is targeted for operation in the 10–66 GHz frequency range. The frequency bands identified for fixed wireless access (FWA) service are shown in table A.2.

Table A.2—Carrier Frequencies

Frequency (GHz)	Range
42	40.500 – 43.500
38	38.600 – 40.000
32	31.800 – 33.400
31	31.000 – 31.800
31	31.000 – 31.300
31	29.100 – 31.225
28	27.500 – 29.500
26	24.500 – 25.500

The manufacturer shall declare the frequency bands in which the equipment is compliant.