

ANSI
C16.39-1972

IEEE
Std 184-1969
(Revision of 49 IRE 16 S1)

An American National Standard

IEEE Test Procedure for

FREQUENCY-MODULATED

MOBILE COMMUNICATIONS

RECEIVERS

Approved July 11, 1972 by the American National Standards Institute

ANSI C16.39-1972 — IEEE Std 184-1969



PUBLISHED BY

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, Inc.

345 EAST 47 STREET, NEW YORK, N. Y. 10017



Documents

Document Sharing Hub

Authorized licensed use limited to: Tsinghua University. Downloaded on February 25, 2026 at 01:21:51 UTC from IEEE Xplore. Restrictions apply.

Full document details: IEEE 184-1969

CONTENTS

	<i>Page</i>
1. Scope	3
1.1. Presentation of Data.....	3
1.2. Subsystems.....	3
1.3. Limitations.....	3
1.4. Supplementary Testing.....	3
2. Definitions	3
2.1. General.....	3
2.2. Standard Reference Terms.....	3
2.3. Performance Characteristics.....	4
3. Test Conditions, Apparatus, and Assembly	4
3.1. Test Conditions.....	4
3.2. Test Apparatus.....	4
3.3. Apparatus Assembly.....	5
4. Test Procedures and Presentation of Data	6
4.1. Desired Signal Performance.....	6
4.2. Interference Rejection Characteristics.....	10
4.3. Spurious Response Attenuation.....	13
4.4. Undesired Radiation and Conducted Radio-Frequency Power.....	15



ACKNOWLEDGMENT

The Institute wishes to acknowledge its indebtedness to those who have so freely given of their time and knowledge, and have conducted experimental work on which many of the IEEE publications are based.

The material for this publication was prepared by the Methods of Testing Subcommittee of the Mobile Communication Systems Committee of the IEEE Vehicular Technology Group. Members of the Subcommittee, during all or a part of the period of its preparation, were

J. R. Neubauer, *Chairman*

N. Alexander, *Consulting Member*

K. Backman, *Liaison with IEEE Electromagnetic Compatibility Committee*

W. G. Chaney, *Liaison with IEEE Electromagnetic Compatibility Committee*

J. Germain, *Liaison with EIA Receiver Committee*

R. G. Nyberg

H. W. Nylund

N. H. Shepherd, *Liaison with CCIR Receiver Committee*

W. A. Shipman

© Copyright 1969 by The Institute of Electrical and Electronics Engineers, Inc.

IEEE Test Procedure for FREQUENCY-MODULATED MOBILE COMMUNICATIONS RECEIVERS

1. SCOPE

This Test Procedure covers definition of terms, controlled test conditions, test apparatus, test methods, and data presentation, which form the basis for establishing performance criteria of mobile communication receivers designed to receive frequency-modulated waves in the frequency range from 25 to 1000 megahertz. Specific limits are not included; however, reference values that are not limited by the state of the art are provided. Test conditions, apparatus, and methods are based on known instrumentation and measuring techniques and are not restricted to any special apparatus other than necessary terminal simulators. Presentation of data has been standardized to the three forms of tabular, graphical, and empirical equations.

1.1 Presentation of Data. The three forms of presentation of data have been selected to provide the maximum uniformity in comparing receiver performance, and the minimum data required for predicting interference by either manual or computer methods. The tabular and graphic forms are the most accurate methods of presentation of data and primarily suited for interference predictions by manual methods. The empirical equations, although less accurate, are best suited for computer programming.

1.2 Subsystems. In those cases where receivers are equipped with special function subsystems, such as coded squelch or impulse noise blankers, said systems shall be disabled. This Test Procedure does not provide for testing of receivers which include subsystems that cannot be disabled or bypassed.

1.3 Limitations. This Test Procedure will be limited to measurements of single-channel voice-modulated receivers independent of its application to any specific communication system. Methods of testing or specific apparatus for use in testing of "Personal" portable type receivers employing integral antennas and audio output devices are not included.

1.4 Supplementary Testing. Special function subsystems, which may require supplementary test methods, are not covered by this Test Procedure.

2. DEFINITION OF TERMS

2.1 General. Definition of terms will be limited to those expressions that are unique to mobile communications system performance. Terms used in standard texts, related industry Standards, or recognized by common usage will not be defined, except where the application within the

context of this Test Procedure requires specific limitation. Under these conditions the definition will be included within the applicable paragraph of the Test Procedure.

2.1.1 IRE Dictionary. Whenever the IRE Dictionary terms fully satisfy the application, they are not defined in this Test Procedure. Any modification or extension of these terms, which is required for a specific use, will appear within the applicable paragraph of the Test Procedure.

2.2 Standard Reference Terms

2.2.1 Rated System Deviation. The specified maximum permissible carrier frequency deviation. Nominal values for mobile communications systems are ± 15 kilohertz or ± 5 kilohertz.

2.2.2 Standard Test Modulation. Sixty percent of the rated system deviation at a frequency of 1 kilohertz.

2.2.3 SINAD. An acronym for "signal plus noise plus distortion to noise plus distortion ratio" expressed in decibels where the "signal plus noise plus distortion" is the audio power recovered from a modulated radio-frequency carrier, and the "noise plus distortion" is the residual audio power that is present after the audio signal is removed. This ratio is a measure of audio output signal quality, for a given receiver audio power output level.

2.2.4 Reference Audio Power Output. The manufacturers rated audio-frequency power available at the output of a properly terminated receiver, when responding to a standard test modulated radio-frequency input signal at a -80 dBW level.

2.2.5 Reference Sensitivity. The level of a radio-frequency signal with standard test modulation which provides a 12-decibel SINAD with at least 50 percent reference audio power output.

2.2.6 Squelch. A circuit function that acts to suppress the audio output of a receiver when noise power that exceeds a predetermined level is present.

2.2.7 Reference Audio Noise Power Output. The average audio noise power present at the output of an unsquelched receiver having no radio-frequency signal input in which the audio gain has been adjusted for the reference audio power output.

2.2.8 Reference Threshold Squelch Adjustment. The minimum adjustment position of the squelch control required to reduce the reference audio noise power output by at least 40 decibels.

2.3 Performance Characteristics

2.3.1 Squelch Sensitivity. The minimum radio-frequency signal input level, with standard test modulation required to increase the audio power output from the reference threshold squelch adjustment condition to within 6 decibels of the reference audio power output.

2.3.2 Squelch Selectivity. The characteristic that permits the receiver to remain squelched when a radio-frequency signal not on the receiver's tuned frequency is present at the input.

2.3.3 Squelch Clamping. The characteristic of the receiver, when receiving a normal signal, in which the squelch circuit under certain conditions of modulation will cause suppression of the audio output.

2.3.4 Two-Signal Selectivity. The characteristic that determines the extent to which the receiver is capable of differentiating between the desired signal and disturbances of signals at other frequencies. It is expressed as the amplitude ratio of the modulated desired signal and the unmodulated disturbing signal when the reference sensitivity SINAD of the desired signal is degraded 6 decibels.

2.3.5 Modulation Acceptance Bandwidth. The selectivity characteristic of a receiver that limits the maximum permissible modulation deviation of the radio-frequency input signal that a receiver can accept, without degradation of the 12-decibel SINAD, when the radio-frequency input signal is 6 decibels greater than the reference sensitivity level.

2.3.6 Spurious Response. Any receiver response that occurs because of frequency conversions other than the desired frequency translations in the receiver.

2.3.7 Intermodulation Spurious Response. The response resulting from the mixing of two or more undesired frequencies in the nonlinear elements of the receiver in which a resultant frequency is generated that falls within the receiver passband.

2.3.8 Audio Power Output. The measure of the audio-frequency energy dissipated in a specified output load.

2.3.9 Audio-Frequency Response. The measure of the relative departure of all audio-frequency signal levels within a specified bandwidth, from a specified reference frequency signal power level.

2.3.10 Incidental Radiation or Conducted Power. Radio-frequency energy generated or amplified by the receiver, which is detectable outside the receiver.

2.3.10.1 Undesired Conducted Power—Radio-frequency power that is present at the antenna, power terminals, or any other interfacing terminals.

2.3.10.2 Undesired Radiated Power—Radio-frequency power radiated from the receiver that can be measured outside a specified area.

3. TEST CONDITIONS, APPARATUS, AND ASSEMBLY

Test conditions, apparatus, and assembly of apparatus should be controlled. Uniformity of environment and apparatus are essential to producing correlative data. The following requirements provide reasonable limits to measurement accuracy and illustrate minimum test equipment configurations to support the method of measurement recommended.

3.1 Test Conditions

3.1.1 Temperature, Humidity, Environment, and Primary Power Supply. In order to reproduce and verify the data resulting from the tests included in this Test Procedure, the temperature and humidity shall be specified in the data presentation. The primary supply voltage shall be the nominal primary voltage applied to the input of the power cables normally supplied with the receiver. The voltage shall be recorded for data presentation.

The test shall be conducted with minimum modification of the receiver itself and its associated equipment. Where removal of connectors, modules, walls, or shields are required for certain tests, these should be removed for these tests only. To prevent pickup of extraneous radiation during measurements, certain tests may be performed in a suitable shielded enclosure.

3.2 Test Apparatus

3.2.1 Signal Generators

3.2.1.1 Radio-Frequency Signal Generators—Frequency-modulated radio-frequency generators are recommended for use as the input signal source when testing frequency-modulation radio receivers, though some of the tests may be performed with an amplitude-modulation generator when modulation is not required. The generators shall cover at least the carrier frequency ranges of 25–1000 megahertz. They should also cover additional frequency ranges of interest as required for spurious response tests. The signal generators shall include a calibrated output control, the output of which is an unbalanced 50-ohm radio-frequency coaxial type connector. It should simulate the impedance of a transmission line connected to a properly matched antenna indicating the available power at the 50-ohm coaxial terminal. (See "Available Power" in IEEE Standard Definitions of Terms for Audio, No. 151.)

The generators shall be capable of being frequency modulated from 60–5000 hertz and at deviations from 10–200 percent of the rated system deviation of the receiver being tested. A deviation indicator covering the required range shall be provided. The incidental frequency and amplitude modulation of the output voltage shall be negligible in comparison with the effects under observation.

The signal generator shall be adequately shielded and filtered to limit any radio-frequency energy leakage, both

radiated and conducted, to a level 6 decibels less than the lowest test signal level to be used.

The minimum acceptable frequency stability shall enable the test signal to remain within 5 percent of the rated system deviation over the period of any one measurement.

3.2.1.2 Audio-Signal Generator—An audio-signal generator capable of providing modulation inputs to the radio-frequency signal generator from 60–5000 hertz is required, if the radio-frequency signal generator does not provide it as a built-in capability.

3.2.2 Voltage-Measuring Equipment

3.2.2.1 Direct-Current and Alternating-Current Meters Voltmeters used to measure test power input voltages shall have a direct voltage accuracy of ± 1.0 percent and a root-mean-square alternating voltage accuracy of ± 1 percent for a full-scale reading.

3.2.3 Noise and Distortion Meter. The noise and distortion meter shall be of the type that integrates the total noise and distortion while balancing or filtering out the fundamental frequency of the audio test signal. Normally the distortion meter is equipped with a continuously variable null frequency network; however, for the purpose of this Test Procedure there is a minimum requirement for a null network for 1000 hertz. The noise and distortion meter shall in addition have the capabilities of measuring audio output voltage, which will be used to measure audio power, quieting, and frequency response. The output indicator shall have volume-unit characteristics as defined by IEEE Standard No. 152.

3.2.4 Radio-Frequency Field-Strength Meter. A frequency-selective voltmeter or calibrated receiver that can tune over the full range of radiated or conducted frequencies of interest is required.

The equipment cabinet should include good radio-frequency shielding techniques and the power lines should be adequately filtered. Radiation and susceptibility levels should be controlled over the frequency range of interest below the sensitivity threshold of the equipment under test.

3.2.5 Impulse Generator. The calibrated impulse generator, when applied to a 50-ohm resistive load, shall provide an output that is flat within ± 1.0 decibel from 25–1000 megahertz. The peak voltage available in any selected bandwidth shall be at least 70 decibels above 1 microvolt per megahertz.

The impulse generator shall be capable of calibration within ± 2 decibels of indicated output. A pulse repetition frequency of 60 pulses per second shall be available.

3.2.6 Test Adapters

3.2.6.1 Input Coupling Devices—Interaction between mutually coupled generators as well as the reactive components of the receiver input and generator output shall be minimized by the use of coaxial 50-ohm couplers or resistive pads. Directional couplers may be required when making intermodulation measurements to isolate signal-generator intermodulation products.

3.2.6.2 Output Load Termination—All receiver measurements shall be made with the audio output terminated in a load that matches its specified impedance.

3.2.6.3 Line Stabilization Network—Conducted radio-frequency power measurements on lines other than the antenna connection shall be made through a stabilization network in each line. For measurements up to 25 megahertz the network shall be equivalent to but not necessarily identical to the configuration illustrated in Figure 1.

3.2.6.4 Frequency Weighting or Filter Networks—If desired, measuring instrument response may be modified by frequency weighting or filter networks. The electrical characteristics should be included in the test record.

3.2.7 Test Apparatus Record. A record of the make, model, and serial number of all test apparatus shall be included in the presentation of data.

3.3 Apparatus Assembly. Typical apparatus assemblies are illustrated in this Section. They are assembled from apparatus specified in paragraph 3.2 and are for use in Section 4.

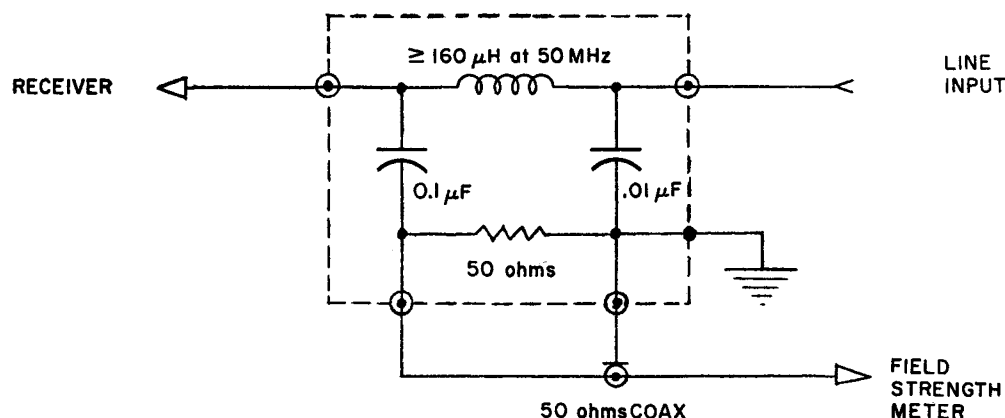


Fig. 1.