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Radio Equipment and Systems
Radiotelex equipment operating in the maritime MF/HF service
Technical characteristics and methods of measurement

ETSI

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Foreword

This European Telecommunications Standard (ETS) has been produced by the Radio Equipment and Systems (RES) Technical Committee of the European Telecommunications Standards Institute (ETSI) and has undergone the ETSI standards approvals procedure.

The standard sets out the minimum requirements for the use of radiotelex equipment aboard ships, operating in the maritime mobile MF/HF radio service. Equipment must be capable of transmitting on one or more of the frequency bands assigned to the service (415 kHz to 526.5 kHz, 1605 kHz to 4.0 MHz, or 1605 kHz to 28MHz).

The standard incorporates the requirements of International Maritime Organisation (IMO) Assembly Resolutions A 569(14) and A 613(15), CCIR Recommendations 490, 491-1 and 625 and CCITT Recommendation F.130. It includes the performance standards for Narrow-Band Direct Printing (NBDP) equipment operating in the Global Maritime Distress and Safety System (GMDSS). Where the equipment is provided with a digital input panel, it must comply where practicable with CCITT Recommendation E.161/Q.11.

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1 Scope

This standard states the minimum requirements for radiotelex equipment[1)] for use on board ships. These requirements include the relevant provisions of the Radio Regulations and the performance standards for shipborne MF/HF radio installations for Narrow Band Direct Printing (NBDP) equipment operating in the Global Maritime Distress and Safety System (GMDSS), and of the performance standards Res. A 569(14) and Res. A 613(15) as adopted by the International Maritime Organization (IMO).

Annex VI of CEPT Recommendation T/R 34-01, CCIR Recommendation 625, 490, 491-1 and CCITT Recommendation F 130 are regarded as a constituent part of this standard.

Maritime radiotelex equipment shall use the error-detecting and correcting system used for direct-printing telegraphy in the maritime mobile service as described in CCIR Recommendation 625.

The equipment shall be able to operate in the Forward Error Correcting (FEC) and Automatic Repetition reQuest (ARQ) modes in accordance with CCIR Recommendation 625.

Maritime radiotelex equipment may consist of integrated equipment or of a combination of a maritime mobile transmitter/receiver and external NBDP equipment. Where such a combination is used the requirements for integrated equipment shall apply to that combination.

If the equipment, or parts of it, is designed in such a manner that it can also be used for other categories of maritime radio communication (e.g. radiotelephony), the relevant parts of the equipment shall furthermore fulfil the requirements of the relevant standards applicable for the service(s) in question.

2 General requirements

2.1 Construction

In all respects the mechanical and electrical design and construction and also the finish of the equipment shall conform with good engineering practice, and the equipment shall be suitable for use on board ships at sea.

The number of operational controls, their design and manner of function, location, arrangement and size should provide for simple, quick and effective operation. The controls should be arranged in a manner as to minimize the chance of inadvertent operation.

Their number should be the minimum necessary for satisfactory operation.

All operational controls should permit normal adjustments to be easily performed and should be easy to identify from the position at which the equipment is normally operated. Controls not required for normal operation should not be readily accessible.

The equipment should be so designed that the main units can be replaced readily, without elaborate recalibration or readjustment.

All controls, indicators, and terminals, shall be clearly labelled. A label showing the type designation under which the equipment is submitted for type testing, shall be fitted to the equipment so as to be clearly visible in the normal operating position.

The serial number shall be permanently marked on each unit of the equipment or on a name plate permanently fastened to that unit.

If the equipment consists of more than one unit, each unit shall have a clear identity.

Details of the power supply from which the equipment is intended to operate, shall also be clearly indicated.

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1) For the purposes of this standard, radiotelex equipment is defined as direct-printing telegraph equipment employing automatic identification and error correction in the maritime mobile MF/HF radio service.

Equipment intended to be installed on the bridge shall be provided with adequate illumination to enable identification of controls and facilitate reading of indicators at all times. Means shall be provided for dimming to extinct the output of any equipment light source.

The design of the equipment shall be such that misuse of the controls shall not cause damage to the equipment or injury to personnel.

If an equipment is connected to one or more other equipments, the performance of each shall be maintained.

Where a digital input panel with the digits "0" to "9" is provided, the digits shall, where practicable, be arranged to conform with CCITT Recommendation E 161/Q.11.

For the purpose of maintenance, components shall be easily identifiable either by markings within the equipment, or with the aid of the technical description.

For type-testing purposes, a comprehensive technical description shall be provided with the equipment.

Where external terminals can be used to operate the radiotelex equipment, the equipment shall be provided with at least a standard interface in conformity with CCITT Recommendation V.10 or Recommendation V.28 and/or be capable to operate a teleprinter in a 60 V/30 mA loop.

Where more than one keyboard/printer combination can be used, one shall have priority over the others.

At each operating position, an indication shall be available to indicate that another operating position is in use.

Incoming calls shall have priority over the local use of the teleprinter and/or display unit.

Associated teleprinters or display units shall display 69 characters per line.

The self-identification data of the radiotelex equipment shall be in conformity with CCIR Recommendation 625 and shall be permanently stored in the equipment. It shall not be possible for the user to change this data.

2.2 Controls and indicators

Visual indicators shall be available to indicate that:

- the supply voltage is connected (ON)
- the terminal is ready for operation (STAND BY)
- a call is detected (CALLED)
- the transmitter has been inhibited from operation when a continuous B (SPACE) or Y (MARK) signal is generated.
- that the transmitter is delivering RF output power to the antenna. Failure of the indicating circuit shall not interrupt the antenna circuit.

For integrated equipment, indication shall be given for failure to activate the associated transmitter.

An equipment on/off switch shall be provided.

2.3 Operational precautions

All adjustments and control-settings necessary to use the equipment in distress related traffic shall be readily accessible.

The ship's identity and information inherent to the radiotelex process shall be stored in non-volatile memory devices (i.e. not backed-up by primary or secondary power sources).

The information in volatile memory devices shall be protected against interruptions in the power supply of up to at least 10 hours duration.

If primary or secondary batteries are used to protect information stored in memory devices, it shall be stated on the equipment or on a label attached to the equipment when the batteries have to be replaced.

Transmission shall be inhibited under all conditions until the frequency has stabilized within the required limits.

2.4 Operational and maintenance instructions

Adequately detailed operation and maintenance instructions shall be provided with the equipment.

If the equipment is so constructed, that fault diagnosis and repair is practicable down to component level, the instructions shall include full circuit diagrams, component layouts and components parts lists.

If the equipment contains modules in which fault diagnosis and repair down to component level is not practicable, the instructions shall contain sufficient information to enable localization and replacement of the defective module. With regard to other modules and components in the equipment, the instructions shall contain the information mentioned in the previous paragraph.

2.5 Safety precautions

Provision shall be made to protect the equipment from the effects of excessive current or voltage and from excessive rise of temperature in any part of the equipment due to failure of the cooling system, if any.

Provision shall be made to protect the equipment from damage if the power supply is subject to transient voltage changes and from damage due to the accidental reversal of the polarity of the power supply.

Means shall be provided to earth exposed metallic parts of the equipment, but this shall not cause any terminal of the source of electrical energy to be earthed.

All parts and wiring, in which the direct or alternating voltage or both (other than radio frequency voltages) combine to give a peak voltage greater than 50 volts, shall be protected against accidental access and shall be isolated automatically from all sources of electrical energy when the protective covers are removed. Alternatively, the equipment shall be so constructed that access to such voltages may only be gained after having used a tool for this purpose, like a spanner or a screwdriver, and warning labels shall be prominently displayed both within the equipment and on protective covers.

2.6 Warming-up period

The equipment shall be operational and shall meet the requirements of this specification within one minute of being switched on, except as provided in the next paragraph.

If the equipment includes parts which require to be heated in order to operate correctly, for example crystal ovens, then a warming-up period of 30 minutes from the moment of application of power to those parts shall be allowed, after which the requirements of this specification shall be met.

Where the above paragraph is applicable, the power supplies to the heating circuits shall be so aranged so that they can remain operative when other supplies to the equipment or within the equipment are switched off. If a special switch for these circuits is provided on the equipment, the function of the switch shall be clearly indicated and the operating instructions shall state that the circuit should normally be left connected to the supply source. A visual indication that power is connected to such circuits shall be provided on the front panel.

2.7 Operational facilities

The following operational facilities shall be available:

a) Activation of calling towards the corresponding radiotelex station (CALL).

b) Reversion of transmission direction (OVER).

c) Facilities to compose and verify messages to be transmitted. It shall be possible to compose and verify messages of at least 4000 characters before transmission.

d) A printing facility shall be provided.

For scanning systems the following facilities shall also be available:

e) Selection of frequencies to be scanned.

f) Printout or display of selected scanned frequencies.

All functions mentioned above shall be controllable from a keyboard.

3 Test conditions

3.1 General

The type approval tests shall be carried out under normal test conditions and, where stated, also under extreme test conditions.

3.2 Test power supply source

During type approval tests the equipment shall be supplied from a test power source capable of producing normal and extreme test voltages as specified in subclauses 3.3.2 and 3.5.2.

For the purpose of tests, the voltage of the power supply shall be measured at the input terminals of the equipment.

If the equipment is provided with a permanently connected power cable, the test voltage shall be that measured at the point of connection of the power cable to the equipment.

During tests, the power supply voltages shall be maintained within a tolerance of $\pm$3% relative to the voltage at the beginning of each test.

3.3 Normal test conditions

3.3.1 Normal temperature and humidity

The normal temperature and humidity conditions for tests shall be any convenient combination of temperature and humidity within the following ranges:

Temperature	+15°C to +35°C
Relative humidity	20 % to 75 %.

NOTE: When it is impracticable to carry out the test under the conditions stated above, a note to this effect, stating the actual temperature and relative humidity during the tests, shall be added to the test report.

3.3.2 Normal test power source

3.3.2.1 Mains voltage and mains frequency

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of this specification, the nominal voltage shall be the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of the test power supply corresponding to the mains shall be 50 Hz $\pm$1 Hz.

3.3.2.2 Secondary battery power sources

When the equipment is intended for operation from a secondary battery power supply, the normal test voltage shall be the nominal voltage of the battery (e.g. 12 volts, 24 volts etc.).

3.4 Extreme test conditions

3.4.1 Temperatures when testing under extreme conditions

When testing under extreme conditions, the measurements shall be carried out at 0°C and +40°C for equipment below deck, and -25°C and +55°C for equipment above deck, according to the procedure described in subclause 3.5.

3.5 Procedures of tests at extreme temperatures

3.5.1 Before measurements

Before making measurements the equipment shall have reached thermal balance in the test chamber. The equipment shall be switched off during the temperature stabilizing period, except as provided in the last paragraph of subclause 2.6. The sequence of measurements shall be chosen, and the humidity content in the test chamber shall be controlled so that excessive condensation does not occur.

3.5.2 Extreme values of test power sources

3.5.2.1 Mains voltage and mains frequency

The extreme test voltages for equipment to be connected to a mains supply shall be the nominal mains voltage $\pm$10%.

The frequency of the test power supply corresponding to the mains shall be 50 Hz $\pm$1 Hz.

3.5.2.2 Secondary battery power sources

When the equipment is intended for operation from a secondary battery power supply, the extreme test voltage shall be 1.3 and 0.9 times the nominal voltage of the battery (e.g. 12 volts, 24 volts etc.).

3.6 Environmental tests

Environmental tests shall be carried out before tests of the same equipment in respect of the other requirements of this specification are performed. Where electrical tests are required, these shall be done with normal test voltage.

For receiving/decoding equipment, the term performance check shall be taken to mean test with the RF test signal 1 with a level of 20 dBuV applied to the input of the receiver. In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS), and the occurrence of incorrect information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 SEQUENCE. The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12% in any period of not less than 5 minutes.

For transmitting/coding equipment, the term performance check shall be taken to mean a check of the transmitter RF output power. The output power shall be within the limits stated in subclause 4.3.3 of this specification. The following tests shall be made under environmental conditions as detailed in the specification for "Environmental Testing of Maritime Radio Equipment":[1)])

- Vibration, para 4
- Dryheat cycle, para 5.2
- Damp heat cycle, para 6
- Low temperature cycle, para 7.2

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1) At present still contained in Annex VI to CEPT Recommendation T/R 34-01

- Low temperature cycle, para 7.2
- Corrosion tests, para 10.1 and 10.2
- During vibration test para 5.8 for integrated equipment, para 8.10 for RF-transmitters and para 9.5 for RF-receivers apply.

3.7 Standard test signals

During the type approval tests, the standard test signals with the following format shall be used:

3.7.1 Standard test signal 1

Consisting of the following information, signals shall be sent in the order as stated:

- ABCDEFGHIJKLMNOPQRSTUVWXYZ1234567890-?().,'=/+
- ABCDEFGHIJKLMNOPQRSTUVX
- Carriage Return, Line feed
- ABC etc.

(69 printed characters per line)

3.7.2 Standard test signal 2

Consisting of a continuously emitted signal in the "Y" (MARK) or "B" (SPACE) condition, where Y is the lower frequency and B the higher frequency.

3.7.3 Standard test signal 3

Consisting of the 'no information' signal (combination 32) in accordance with CCIR Recommendation 625 table 1. If difficulties arise with the generation of this signal it may be replaced by a continuous transmitted character 'R' signal (combination 18).

3.7.4 Standard test signal 4

Consisting of a sinusoidal signal with a frequency of 1700 Hz keyed in amplitude with a square-wave signal with a duty-cycle of 50%, resulting in a modulated signal with an on and off time of 210 msec (simulating an ARQ information block).

The stability of the amplitude of the test signal shall be within $\pm$0.5 dB.

3.7.5 Standard test signal 5

Consisting of a sinusoidal signal with a frequency of 1700 Hz.

3.7.6 Standard test signal 6

Consisting of an FSK signal having a centre frequency of 1700 Hz with a deviation of $\pm$85 Hz and modulated with a square-wave signal with a frequency of 50 Hz (simulating an FEC signal).

Phase coherent switching between MARK and SPACE is preferable. The frequency spectrum of the test signal shall comply with figure 2.

3.7.7 Standard test signal 7

Consisting of frequencies of respectively 1615 Hz and 1785 Hz $\pm$0.1 Hz (simulating the B and Y signal).

The test signal shall be of sufficient length for the measurement to be performed or it should be possible to repeat it without interruption as long as necessary to perform the measurements.

3.7.8 Modulation rate

The modulation rate of the standard test signals 1 and 3 shall be 100 baud.

3.8 Application of test signals for integrated equipment and separate transmitters/receivers

3.8.1 Receiver

Sources of test signals for application to the receiver input shall be connected through a network such that the impedance presented to the receiver's input is equal to that of the artificial antennas specified in subclause 3.9.2. This requirement shall be met irrespective of whether one, two, or more test signals are applied to the receiver simultaneously. In case of multiple test signals, steps shall be taken to prevent any undesirable effects due to interaction between the signals in the generator or other sources.

The test signals are radio frequency signals FSK modulated with a frequency shift of 170 Hz where "MARK" and "SPACE" are symmetrical disposed about the nominal frequency of the test signal.

The nominal frequency shall be equal to an assigned RF frequency for radiotelex operation. The accuracy of the two fundamental RF frequencies (spectral components) thus produced shall be better than $\pm$1 Hz.

The levels of test input signals shall be expressed in terms of the e.m.f. which would exist at the output terminals of the source, including the associated network referred to in subclause 3.8.1.

3.9 Artificial antennas

3.9.1 Transmitter

For the purpose of type testing, the transmitter shall meet the requirements of the specification when connected to the artificial antennas listed below. This shall in no way imply that the transmitter shall only work with antennas having these characteristics.

[1] 415 - 526.5 kHz

The artificial antenna shall consist of a non-reactive resistor of 3 ohms and a capacitor of 400 pF connected in series.

[2] 1605 - 4000 kHz

The artificial antenna shall consist of a non-reactive resistor of 10 ohms and a capacitor of 250 pF connected in series.

[3] 4 - 28MHz

The artificial antenna shall consist of a non-reactive resistor of 50 ohms.

3.9.2 Receivers

For the purpose of type testing, the receiver shall meet the requirements of this specification when connected as described below. This shall in no way imply that the receiver should operate satisfactorily only with antennas having these characteristics.

The test signal shall be derived from a resistive source of 50 ohms except as permitted in the following paragraph.

At the request of the manufacturer and with the approval of the testing authority, an artificial antenna consisting of a 10 ohms resistor in series with a 250 pF capacitor may be used for frequencies below 4 MHz.

3.10 Connection of test signals for radiotelex modems

3.10.1 NBDP encoder

The equipment shall be connected to a load which associated with possible measuring instruments shall present an impedance towards the equipment of 600 ohms resistive.

3.10.2 NBDP decoder

The test signals shall be applied through a matching network arranged so that the impedance towards the equipment is equal to a resistive impedance of 600 ohms irrespective of the number of signals applied simultaneously. The level of the test signal shall be defined as in the final paragraph of subclause 3.8.1.

The test signals are audio frequency signals, FSK modulated with a frequency shift of 170 Hz where "MARK" and "SPACE" are symmetrically disposed about the centre frequency of the test signal. The centre frequency of the test signal shall be 1700 Hz. The accuracy of the two fundamental AF frequencies (spectral components) thus produced shall be better than $\pm$0.1 Hz.

3.10.3 Encoder/decoder states

Where discrete level inputs are employed in encoders/decoders under test, the "B" state in the test signal shall correspond to the logic "zero" and the "Y" state to the logic "one" of CCITT Recommendations V.10 and V.24, or Recommendations V.28 and V.24.4.

4 Integrated equipment - transmitting part: technical and operational requirements

4.1 General

4.1.1 Modulation rate

The modulation rate on the radiolink is 100 baud.

The equipment's clock controlling the modulation-rate shall have an accuracy of 30 ppm. or better (see also subclause 10.2).

4.2 Frequencies and classes of emission (IMO COM.30/WP 4)

The transmitter shall be capable of transmitting on all assigned radiotelex frequencies allocated to the maritime mobile service in one or more of the following frequency bands:

- 415 kHz to 526.5 kHz.
- 1605 kHz to 4.0 MHz.
- 1605 kHz to 28 Mhz.

Where applicable the following frequencies shall be readily accessible to the operator: 2174.5 kHz, 4177.5 kHz, 6268 kHz, 8376.5 kHz, 12520 kHz and 16695 kHz.

Radiotelex frequencies are designated in terms of the assigned frequency (centre of the F1B spectrum). When radiotelex signals are transmitted using a transmitter in the J2B mode, the frequency of the suppressed carrier needs to be adjusted so as to have the radiotelex signal transmitted on the assigned frequency. The assigned transmitting frequency shall be clearly identifiable on the control panel of the equipment.

The transmitter shall use the class of emission F1B (frequency modulation with digital information, without a sub-carrier for automatic reception) or J2B (single side band with digital information, with the use of a modulating sub carrier, with the carrier suppressed to at least 40 dB below peak envelope power).

When switching to the assigned frequencies (centre of the F1B spectrum) for radiotelex as specified in the second paragraph above, the class of emission F1B or J2B shall be automatically selected.

Independent selection of the transmitter's and receiver's frequency shall be possible.

It shall be possible to change the transmitter from operation on any frequency to operation on any other frequency as quickly as possible, but in any event within a period not exceeding 15 seconds.

For transmitters operating in the frequency band 415 - 526.5 kHz, this period shall not exceed 25 seconds.

The frequency shift shall be 170 Hz. The higher of the emitted frequencies shall correspond to the "B" (SPACE) signal, and the lower of the emitted frequencies shall correspond to the "Y" (MARK) signal.

The equipment shall be provided with a device to inhibit the transmission automatically within a period of 1 minute, when a continuous "B" or "Y" signal is being generated.

For type approval tests and maintenance purposes, the equipment shall have facilities not accessible to the operator to:

- disengage the device of the previous paragraph.
- generate a continuous "B" or "Y" signal.

4.3 RF output power

4.3.1 Definition

The RF output power is the mean power delivered by the transmitter to the artificial antenna, measured during the period in which a specific test signal is supplied to the input of the transmitter.

4.3.2 Method of measurement

The equipment shall transmit, in the FEC mode of operation, the standard test signal 2 of subclause 3.7.2.

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

4.3.3 Limits

In the frequency band 415 to 526.5 kHz, the RF output power shall be at least 60 W.

In the frequency band 1.6 to 4 MHz, the RF output power shall be at least 60 W and shall not exceed 400 W.

In the frequency band 4 to 28 MHz, the RF output power shall be at least 60 W and shall not exceed 1500 W.

4.4 RF output power stability

4.4.1 Definition

The RF output power stability is a function of the variation in the RF output power of the transmitter within a specified period of time in which the information block or control signal is transmitted.

4.4.2 Method of measurement

In the ARQ mode of operation, the equipment shall be set up as information sending station (ISS) using standard test signal 3. The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1. The RF output power shall be measured at the output of the transmitter within the duration of one information block.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

4.4.3 Limits

The variation of the RF output power during an information block shall be within $\pm$2 dB relative to the mean power level of that information block.

4.5 Residual RF noise power at the receiver input

4.5.1 Definition

The residual RF noise power of the transmitter at the input of the receiver is defined as the RF power level, using the ARQ mode of operation during the period of time that no information block or control signal (CS1, CS2, etc.) is transmitted, measured at the frequency to which the radiotelex station's receiver is tuned.

4.5.2 Method of measurement

The equipment shall be set up in the ARQ mode of operation and shall transmit test signal 3 of subclause 3.7.3 or a control signal. The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

Measurement of the residual RF noise output power at the associated receiving frequency shall be made with the transmitter tuned to the assigned frequencies listed in the second paragraph of subclause 4.2 and tuned to representative frequencies throughout the frequency bands listed in the second paragraph of subclause 4.2. These frequencies shall be noted in the test report.

The measuring bandwidth shall lie between 300 Hz and 500 Hz. Any auxiliary switched attenuator, antenna relay, or duplex filter that normally forms a part of the ship's radiotelex installation may be used in connection with this measurement.

The residual RF noise output power may alternatively be measured at the transmitter output directly, provided the limits of subclause 4.5.3 are satisfied. Details of the installation configuration shall be noted in the test report.

Where a pre-key time facility is used (subclause 6.5) to activate the transmitter in advance of the transmission of the information block or control signal, the same requirements for the residual RF noise output power applies to the transmitter for the period of time where the pre-key time exceeds the local equipment delay time (subclause 10.4).

4.5.3 Limits

The RF power of the transmitter supplied to the receiver input at the frequency to which the receiver is tuned shall not exceed a level -150 dB relative to the RF output as measured in subclause 4.3 or ^ ^93 dBm, whichever is the higher power level, not later than 12 msec. after the last bit of the information block or control signal has ended and until 12 msec. before the start of the transmission of the next information block or control signal.

4.6 Antenna tuning

The transmitter and the antenna connected thereto shall be capable of being properly tuned on all the frequencies throughout the frequency bands for which the equipment is intended to operate.

If tuning is performed automatically, the tuning time shall not exceed the period stated in subclause 4.2, seventh paragraph.

4.7 Protection of transmitters

When delivering maximum output power in the FEC mode of operation, the transmitter shall not be damaged by the antenna output terminal being short-circuited or open-circuited in each case for a period of at least 5 minutes.

4.7.1 Limit

At the end of this period the transmitter shall be able to operate normally for all available modes without further attention.

4.8 Continuous operation

4.8.1 Definition

Continuous operation of the transmitter is operation without interruption at maximum RF output power during the period of time considered necessary for traffic handling.

4.8.2 Method of measurement

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1 and adjusted to produce maximum RF output power. For a period of 15 minutes the equipment shall transmit continuously in the FEC mode of operation. The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

4.8.3 Limits

Continuous operation shall be possible when the transmitter is adjusted at its maximum power.

The variation in the mean value of the output power shall not exceed 3 dB, provided that the limits of subclause 4.3.3 are not exceeded.

4.9 Unwanted emissions

4.9.1 Definition

Unwanted emissions consist of spurious emissions and out-of-band emissions. Spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, frequency conversion products, but exclude out-of-band emissions.

Out-of-band emissions are emissions on a frequency or frequencies immediately outside the necessary bandwidth which result from the modulation process, but exclusive of spurious emissions.

4.9.2 Method of measurement

Unwanted emissions shall be measured at the output terminals of the transmitter. The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

The equipment shall be set up as an information receiving station in the ARQ mode of operation. The measurement shall be carried out in the frequency range 9 kHz - 2 GHz.

4.9.3 Limits

Unwanted emissions shall lie below the curve of figure 1.0 dB refers to the mean power within the necessary bandwidth.

4.10 Residual frequency modulation

4.10.1 Definition

The residual frequency modulation of the transmitter is defined as the ratio in dB of the demodulated RF signal when test signal 2 is transmitted to the demodulated RF signal during the transmission of test signal 3.

4.10.2 Method of measurement

The equipment shall be set up in the FEC mode of operation transmitting test signal 3 and 2 consecutively. The output of the transmitter shall be fed to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low-pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

The ratio of the two RMS output levels from the demodulator shall be determined.

DC voltages originated by frequency offset or by test signal 2 shall be suppressed by an AC coupling device so that they do not influence the results of the measurements.

4.10.3 Limit

The residual frequency modulation ratio shall be at least -26 dB.

4.11 Frequency error

4.11.1 Definition

The frequency error of the transmitter is the difference between the measured frequency and its nominal value.

4.11.2 Method of measurement

The standard test signal 2 shall be applied to the transmitter. The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1. The transmitter shall be set to a radio frequency assigned for radiotelex operation in at least the highest frequency band for which the equipment has been designed.

The output power shall be reduced by 3 dB relative to the maximum output power as obtained in subclause 4.3. The measurement shall be performed for both the continuous "B" and "Y" state by switching at regular time intervals between the two states.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

The frequency of the output signal shall be registered.

The temperature range of subclause 3.4.1 shall be achieved by varying the temperature linearly with time from the lower to the upper extreme condition and vice versa within a total cycle period of 16 hours.

4.11.3 Limits

The measured frequency shall at any time for the "B" state be within +10 Hz relative to the assigned frequency +85 Hz and for the "Y" state within +10 Hz relative to the assigned frequency -85 Hz.

4.12 Rise time

4.12.1 Definition

The rise time is the time between:

a) the start of an information block and the moment when the output power of the transmitter has reached a value of -2 dB relative to the mean power in that information block.

b) the start of a control signal and the moment when the output power of the transmitter has reached a value of -2 dB relative to the mean power in that control signal.

The start of an information block or control signal is defined as the moment when the first bit of the first character is initiated.

4.12.2 Method of measurement

In the ARQ mode of operation the equipment shall be subsequently set up as:

a) an information sending station (ISS) using standard test signal 3.

b) an information receiving station (IRS).

The rise time shall be measured at the output of the transmitter.

4.12.3 Limits

The rise time shall be less than 2 msec.

4.13 Fall time

4.13.1 Definition

The fall time is defined as:

a) the time between the end of an information block and the moment when the RF output power of the transmitter has reached a value of 20 dB below the RF output power as measured in subclause 4.3.

b) the time between the end of a control signal and the moment when the RF output power of the transmitter has reached a value as specified in a).

The end of an information block or control signal is defined as the moment when the last bit of the last character has ended.

4.13.2 Method of measurement

In the ARQ mode of operation the equipment shall be subsequently set up as:

a) an information sending station (ISS) using standard test signal 3.

b) an information receiving station (IRS).

The fall time shall be measured at the output of the transmitter.

4.13.3 Limit

The fall time shall be less than 2 ms.

5 Integrated equipment - receiving part: technical and operational requirements

5.1 Frequencies and classes of emission

The receiver shall be capable of receiving on all assigned radiotelex frequencies allocated to the maritime mobile service in one or more of the following frequency bands:

- 415 kHz to 526.5 kHz.
- 1605 kHz to 4.0 MHz.
- 1605 kHz to 28 Mhz.

Where applicable, the following frequencies shall be readily accessible to the operator: 2174.5 kHz, 4177.5 kHz, 6268 kHz, 8376.5 kHz, 12520 kHz and 16695 kHz.

Radiotelex frequencies are designated in terms of the assigned frequency (centre of the F1B spectrum). The selected receiver frequency shall be clearly identifiable on the control unit of the equipment.

The receiver shall be capable of receiving signals with the class of emission F1B or J2B.

Where more than one class of emission can be selected, each class of emission shall be directly accessible to the operator.

Independent selection of the transmitter's and receiver's frequency shall be possible.

The receiver shall be capable of being tuned from any frequency to any other frequency as quickly as possible and in any event within a period not exceeding 15 seconds.

5.2 Calling sensitivity

5.2.1 Definition

The calling sensitivity of the receiver is a defined RF input signal level at which a specified number of repetitions of information blocks is not exceeded.

5.2.2 Method of measurement

An RF test signal with a level of 0 dBuV comprising of test signal 1 shall be applied to the receiver as specified in subclause 3.9.2.

The nominal frequency of the RF test signal shall be equal to an assigned radiotelex frequency. The receiver shall be set to that frequency.

The measurements shall also be carried out at a frequency of $\pm$20 Hz relative to an assigned frequency without change to the receiver setting.

In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS), and the occurrence of incorrect received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

The measurements shall be carried out under normal test conditions and under extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

5.2.3 Limits

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.3 Adjacent channel selectivity

5.3.1 Definition

The adjacent channel selectivity is defined as the ability of the equipment to discriminate between a wanted signal and unwanted signals in channels adjacent to the wanted signal.

5.3.2 Method of measurement

Two RF test signals shall be applied to the input of the receiver as specified in subclause 3.8.

The wanted signal shall be test signal 1 with a level of 20 dBuV.

The unwanted signal shall be a frequency modulated RF signal with a level of 60 dBuV.

The modulation of the unwanted signal shall have the following characteristics:

A square-wave audio-frequency of 51 Hz filtered by a first order low-pass filter with a cut-off frequency of 160 Hz shall be used to modulate an RF generator resulting in FSK modulation with a shift of 170 Hz.

In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS), and the relative occurrence of incorrectly received informations blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2.

The measurements shall be carried out with the nominal frequency of the unwanted signal at the higher adjacent channel (f_{nom} +500 Hz) as well as at the lower adjacent channel (f_{nom} -500 Hz). However, the unwanted signals shall be supplied to one adjacent channel at a time.

The measurement shall be carried out at RF frequencies equal to assigned frequencies and at RF frequencies ±10 Hz relative to the RF frequencies. Measurements shall be performed under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

5.3.3 Limits

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.4 Automatic gain control (AGC) or limiter response

5.4.1 Definition

The AGC or limiter response is the ability of the receiver to cope with changes in the RF input signal level.

5.4.2 Method of measurement

In the ARQ mode of operation the equipment shall be set up as an Information Receiving Station (IRS) and occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signal CS1/CS2 sequence.

An RF test signal modulated with test signal 1 shall be applied to the receiver input.

The RF generator shall be connected to the receiver via a switched attenuator.

The trigger signal for the switched attenuator may be derived from the ARQ test generator or the transmitter's RF signal.

The RF test signal shall be varied in amplitude in the following periodical sequence:

- Five information blocks with a level of 80 dBuV.
- The following five information blocks with a level of 56 to 57 dBuV.
- The following five information blocks with a level of 33 to 34 dBuV.
- The next five information blocks with a level of 10 dBuV.
- The following information blocks with a level of 45 dBuV.

This sequence shall be continuously repeated starting again with the information blocks with a level of 80 dBuV etc.

In order to simulate the presence of an RF signal at the input of the receiver, generated by the station's own transmitter, the control signals of the ARQ unit under test shall be used to key the output of an RF generator tuned to the same RF frequency as the station's transmitter is tuned to.

The output of the RF generator shall be adjusted to a level of 120 dBuV.

Any additional switched antenna relay or an attenuator that normally forms a part of the ship's radio installation may be used in connection with this test.

5.4.3 Limit

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.5 Interference rejection and blocking immunity

5.5.1 Definition

The interference rejection and blocking immunity is the ability of the equipment to discriminate between a wanted signal and an unwanted signal with a frequency outside the pass-band of the equipment.

5.5.2 Method of measurement

In the ARQ mode of operation, the equipment shall be set up as an Information Receiving Station (IRS), and the occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signal CS1/CS2 sequence.

In the FEC mode of operation, the equipment shall be set up as an IRS and the occurrence of incorrect characters shall be registered by measuring the number of printed error characters within a given period of time.

Two RF test signals shall be applied to the receiver as specified in subclause 3.9.2.

The wanted test signal shall have a level of 20 dBuV and shall be modulated with testsignal 1.

The unwanted signal shall be unmodulated

For the frequencies +1 kHz to +3 kHz and -1 kHz to -3 kHz, the level of the unwanted signal shall be 60 dBuV.

For the frequencies in the range from 100 kHz to 2 GHz with the exception of the frequency band $\pm$3 kHz from the nominal frequency of the receiver, the level of the unwanted signal shall be 90 dBuV.

5.5.3 Limits

ARQ mode of operation

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

FEC mode of operation

The number of printed combination No. 31 or error characters, measured in any period of 5 minutes, shall not exceed 86 characters.

5.6 Co-channel rejection

5.6.1 Definition

The co-channel rejection is the ability of the equipment to receive a wanted signal in the presence of an unwanted signal, both signals being on the wanted channel of the equipment.

5.6.2 Method of measurement

The equipment shall be set up in the ARQ mode of operation. Two signals are applied to the receiver as specified in subclause 3.9.2.

The wanted signal shall be an RF signal with a level of 20 dBuV and modulated with standard test signal 1.

A square-wave audio-frequency signal of 51 Hz filtered by a first order low-pass filter with a cut-off frequency of 160 Hz shall be used to modulate an RF generator resulting in FSK modulation with a shift of 170 Hz. This signal is the unwanted signal and shall have a level of 14 dBuV.

The frequency of the unwanted signal shall differ by approximately 10 Hz from the frequency of the wanted signal.

The occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

5.6.3 Limits

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.7 Intermodulation immunity

5.7.1 Definition

Intermodulation immunity is the ability of the equipment to receive a wanted signal in the presence of two unwanted signals outside the pass-band of the receiver.

5.7.2 Method of measurement

The equipment shall be set up in the ARQ mode of operation as Information Receiving Station (IRS). Three signals shall be applied to the receiver as specified in subclause 3.9.2.

An RF test signal with a level of 20 dBuV comprising of test signal 1 shall be used as the wanted signal.

The two unwanted signals are both unmodulated and shall have a level of 85 dBuV. One of the signals shall have a frequency difference from the nominal frequency of the wanted signal of approximately 30 kHz.

The other signal shall have a frequency difference of approximately 60 kHz and shall be adjusted in frequency to have maximum effect.

The occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

5.7.3 Limits

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.8 Errors due to vibration

5.8.1 Definition

Errors due to vibration is defined as the ability of the equipment to operate correctly when a specific amount of mechanical vibration is applied to the equipment.

5.8.2 Method of measurement

An RF signal comprising of test signal 1 shall be applied to the receiver as specified in para 3.9.2.

The frequency of the RF test signal shall be at an assigned frequency.

The equipment complete with chassis covers and shock absorbers (if supplied) shall be clamped in its normal operating position to a vibration table. The receiver shall then be switched on and after the warming-up period permitted under subclause 2.6, an RF test signal with a level of 20 dBuV shall be applied to its input.

The table shall be vibrated as described in the environmental test specification (Annex VI to CEPT Recommendation T/R 34-01).

In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS), and the occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

5.8.3 Limits

The relative number of deviations from the alternating control signals CS1 and CS2 shall not exceed 12%. The measurements shall be carried out in a period of not less than 5 minutes.

5.9 Protection of input circuits

The receiver shall not suffer damage when an unmodulated signal, with a level of 30 volts r.m.s. is applied to its input as specified in subclause 3.8.1 for a period of 15 minutes, at any frequency in the range from 100 kHz to 28 MHz.

The receiver shall operate normally without further attention when the test signal is removed.

In order to provide protection against damage due to static voltages which may appear at the antenna connection of the receiver, there shall be a DC path from the antenna terminal to chassis not exceeding 100k ohms.

6 Radiotelex modems - modulating part: technical and operational requirements

6.1 General

The modulation rate of the output signal is 100 baud. The equipment's clock controlling the modulation-rate shall have an accuracy of 30 ppm. or better.

The equipment shall be provided with a facility to inhibit the transmission of an associated transmitter automatically within a period of 1 minute, when a continuous "B" or "Y" signal is being generated.

For type approval tests and maintenance purposes, the equipment shall have internal facilities, not accessible to the operator, to:

- disengage the inhibition device referred to in the preceding paragraph
- generate a continuous "B" (SPACE) OR "Y" (MARK) signal

6.2 Output signals

The equipment shall be provided with at least one of the following outputs:

a) Binary digital output for use in combination with F1B transmitters.

b) An audio output.

6.3 Binary digital output

Where a binary digital output is provided, it shall comply with CCITT Recommendations V.10 and V.24 or Recommendations V.28 and V.24.

6.4 Audio output

6.4.1 General

Where an audio output is provided, it shall be free of earth and its r.m.s. output voltage level measured over a non-reactive 600 ohm load shall be internally adjustable from 0.24 to 2.44 Volts.

The total output level of the two tones shall not vary by more than 0.5 dB during the transmission of an information block or control signal and each tone shall be within 0.5 dB relative to the other.

The audio output shall have a frequency shift of 170 Hz and a centre frequency of 1700 Hz. The lower frequency 1615 Hz indicates a "Y" (MARK) signal and the higher frequency 1785 Hz indicates a "B" (SPACE) signal.

Phase coherent switching between "MARK" and "SPACE" is preferable in order to limit the bandwidth and character distortion.

6.4.2 Frequency error

6.4.2.1 Definition

The frequency error is the difference between the measured frequency and its nominal value.

6.4.2.2 Method of measurement

The frequencies corresponding to B state and Y state shall be measured on the output terminals. The measurements shall be carried out under normal test conditions and under extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

6.4.2.3 Limit

The frequency error following after the warming-up period of subclause 2.6 shall at any time be within 0.5 Hz.

6.4.3 Spurious signals on the output terminals

6.4.3.1 Definition

Spurious signals are signals on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding information. Spurious signals include harmonic components, parasitic signals, intermodulation products, but exclude out-of-band signals.

6.4.3.2 Method of measurement

The output terminals of the equipment shall be connected to a non-reactive load of 600 ohms. The equipment shall be set up to generate information blocks. The level of the spurious signals at the output terminals shall be measured.

6.4.3.3 Limit

Irrespective of the power output setting of paragraph 1 of subclause 6.4.1 the spurious signal components shall not exceed the level as indicated in figure 2.0 dB refers to the r.m.s. output level of the modulated signal.

6.4.4 Residual frequency modulation

6.4.4.1 Definition

The residual frequency modulation level is the ratio in dB between the noise power during the emission of a continuous "B" or "Y" signal (test signal 2) and the output power while emitting test signal 3.

6.4.4.2 Method of measurement

The equipment shall be set up in the FEC mode of operation emitting test signal 3 and 2 sequencially. The output shall be fed to a linear FM demodulator. The output of the demodulator shall be limited in bandwidth by a low-pass filter with a cut-off frequency of 1 kHz and a slope of 24 dB/octave. The ratio of the two r.m.s. output levels from the demodulator shall be determined.

DC voltages originated by frequency offset or by test signal 2 shall be suppressed by an AC coupling device so that they do not influence the results of the measurements.

6.4.4.3 Limit

The residual frequency modulation ratio shall be -36 dB or less.

6.4.5 Rise time (character form)

6.4.5.1 Definition

The rise time is the time between:

a) the start of an information block and the moment when the output voltage of the encoder has reached a value of -2 dB relative to the r.m.s. voltage in that information block.

b) the start of a control signal and the momemt when the output voltage of the encoder has reached a value of -2 dB relative to the r.m.s. voltage in that control signal.

The start of an information block or control signal is defined as the moment when the first bit of the first character is initiated.

6.4.5.2 Method of measurement

In the ARQ mode of operation, the equipment shall be set up as:

a) an information sending station (ISS) using standard test signal 3.

b) an information receiving station (IRS)

The rise time shall be measured at the output of the encoder.

6.4.5.3 Limits

The rise time shall be less than 1.6 msec.

6.4.6 Fall time

6.4.6.1 Definition

The fall time is defined as:

a) the time between the end of an information block and the moment when the output voltage of the encoder has reached a value of -20 dB relative to the r.m.s. voltage in that information block.

b) the time between the end of a control signal and the moment when the output voltage of the encoder has reached a value of -20 dB relative to the r.m.s. voltage in that control signal.

The end of an information block or control signal is defined as the moment when the last bit of the last character has ended.

6.4.6.2 Method of measurement

In the ARQ mode of operation, the equipment shall be set up as:

a) an information sending station (ISS) using standard test signal 3.

b) an information receiving station (IRS).

6.4.6.3 Limit

The fall time shall be less than 1.6 msec.

6.5 Activation of an associated transmitter

A device to key an associated transmitter in advance of the first bit to the transmitted shall be available. This device may be combined with the device to activate and de-activate an associated receiver (subclause 7.4).

The time between the activation of the transmitter and the start of the first bit shall be internally adjustable either continuously or in steps of not more than 1.5 msec. from 0 msec. up to a minimum of 100 msec.

7 Radiotelex modems - demodulating part: technical and operational requirements

7.1 Input signal

The equipment shall be provided with at least the following input:

An audio input capable to accept signals with a frequency shift of 170 Hz and a centre frequency of 1700 Hz. The lower frequency 1615 Hz indicates a "Y" (MARK) signal and the higher frequency 1785 Hz indicates a "B" (SPACE) signal.

7.1.1 Input level

The audio input shall be free of earth and be able to accept at least a level of 0.775 volt +10 dB without manual adjustments. The input impedance shall be non-reactive with a value of approx. 600 ohms.

7.2 Calling sensitivity

7.2.1 Definition

The calling sensitivity of the decoder is a defined input signal at which a specified number of repetitions of information blocks is not exceeded.

7.2.2 Method of measurement

A test signal with an r.m.s. voltage level of 0.24 Volt consisting of test signal 1 shall be applied to the receiver as specified in subclause 3.10.2.

The frequency of the test signal shall be at 1700 Hz.

The measurements shall also be carried out at a frequency $\pm$20 Hz relative to 1700 Hz.

In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS), and the occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

The measurements shall be carried out under normal test conditions and under extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

7.2.3 Limits

In any period of 5 minutes not more than one repetition of an information block is permitted.

7.3 Dynamic range

7.3.1 Definition

The dynamic range of the equipment is the range from the minimum to the maximum level of the input signal at which a specified number of repetitions of information blocks is not exceeded.

7.3.2 Method of measurement

In the ARQ mode of operation, the equipment shall be set up as Information Receiving Station (IRS). Test signal 1 shall be applied to the decoder as specified in subclause 3.10.2.

The level of the test signal shall be varied over the range 0.775 Volt $\pm$10 dB with an approximately sinusoidal cycle of 0.5 to 1 Hz.

The occurrence of incorrectly received information blocks shall be registered by counting the number of deviations from the alternating control signals CS1/CS2 sequence.

7.3.3 Limits

In any period of 5 minutes not more than one repetition of an information block is permitted.

7.4 Activation or deactivation of an associated receiver

A device to mute an associated receiver shall be available.

This device may be combined with the device to activate an associated transmitter (subclause 6.5). The time between the finish of the last bit of the associated transmitter and the re-activation of the receiver may be internally adjustable and shall not exceed 12 msec.

8 RF transmitters for use in combination with radiotelex modems: technical and operational requirements

8.1 Frequencies and classes of emission

The transmitter shall be capable of transmitting on all assigned radiotelex frequencies allocated to the maritime mobile service in one or more of the following frequency bands:

- 415 kHz to 526.5 kHz.
- 1605 kHz to 4.0 MHz
- 1605 kHz to 28 Mhz.

Where applicable the following frequencies shall be readily accessible to the operator: 2174.5 kHz, 4177.5 kHz, 6268 kHz, 8376.5 kHz, 12520 kHz and 16695 kHz.

Radiotelex frequencies are designated in terms of the assigned frequency (centre of the F1B spectrum). When radiotelex signals are generated in the J2B mode, the frequency of the suppressed carrier needs to be adjusted so as to have the Radiotelex signal transmitted on the assigned frequency. The assigned transmitting frequency shall be clearly identifiable on the control panel of the equipment.

The transmitter shall use the class of emission F1B (frequency modulation with digital information, without a sub-carrier for automatic reception) or J2B (single side band with digital information, with the use of a modulating sub-carrier, with the carrier suppressed to at least 40 dB below peak envelope power).

When switching to the assigned frequencies (centre of the F1B spectrum) for radiotelex as specified in the second paragraph above, the class of emission F1B or J2B shall be automatically selected.

It shall be possible to change the transmitter from operation on any frequency to another frequency as quickly as possible, but in any event within a period not exceeding 15 seconds. For transmitters operating in the frequency band 415 - 526.5 kHz, this period shall not exceed 25 seconds.

For F1B transmitters, the frequency shift shall be 170 Hz. The higher of the emitted frequencies shall correspond to the "B" (SPACE) signal, and the lower of the emitted frequencies shall correspond to the "Y" (MARK) signal.

The "B" element shall be binary number zero and the "Y" element number 1. For J2B the audio input frequency of 1785 Hz shall correspond to the higher of the emitted frequencies, the "B" (SPACE) and an input of 1615 Hz shall correspond to the lower emitted frequencies, the "Y" (MARK).

It shall be possible to key the transmitter from a radiotelex modem.

8.2 RF output power

8.2.1 Definition

The RF output power is the mean power delivered by the transmitter to the artificial antenna, measured during the period in which a specific test signal is supplied to the input of the transmitter.

8.2.2 Method of measurement

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

Test signal 5 shall be used to modulate the transmitter. The input level shall be increased until the RF output power has reached its maximum value.

This value shall be taken as the RF output power.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

8.2.3 Limits

In the frequency band 415 to 526.5 kHz, the RF output power shall be at least 60 W.

In the frequency band 1.6 to 4 MHz, the RF output power shall be at least 60 W and shall not exceed 400 W.

In the frequency band 4 to 28 MHz, the RF output power shall be at least 60 W and shall not exceed 1500 W.

8.3 RF output power stability

8.3.1 Definition

The RF output power stability is a function of the variation in the RF output power of the transmitter within a specified period of time.

8.3.2 Method of measurement

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

The RF output power stability shall be measured during excitation of the transmitter with test signal 4.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

8.3.3 Limits

The variation of the RF output power during one block of the test signal shall be within $\pm$2 dB relative to the mean power level of that block.

8.4 Residual RF noise output power

8.4.1 Definition

The residual RF noise output power of the transmitter is defined as the RF output power level with the transmitter not keyed, measured at the associated radiotelex receiving frequencies.

8.4.2 Method of measurement

Measurement of the residual RF noise output power on the associated receiving frequency shall be made with the transmitter tuned to the assigned frequencies listed in the second paragraph of subclause 4.2, and

tuned to representative frequencies throughout the frequency bands listed in the second paragraph of subclause 4.2. These frequencies shall be recorded in the test report.

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1.

The transmitter shall be driven with test signal 5 to maximum RF output power as measured in subclause 8.2.

The transmitter shall then be switched off using the key input intended to be operated from an ARQ unit.

A switched attenuator or antenna relay that forms a standard part of the ship's radiotelex installation may be used in connection with this measurement.

The same requirements for the residual RF noise output power applies to the transmitter for the period where the pre-key time exceeds the local equipment delay time (subclause 10.4).

8.4.3 Limits

The RF output power supplied to the artificial antenna shall, within 12 msec. after the transmitter has been switched off by means of the keying signal, decrease to a level below -150 dB relative to the RF output as measured in para 8.2 or -93 dBm, whichever is the higher power level.

8.5 Antenna tuning

The transmitter and the antenna connected thereto shall be capable of being properly tuned on all the frequencies throughout the frequency bands for which the equipment is intended to operate.

If tuning is performed automatically, the tuning time shall not exceed the period as stated in subclause 8.1, sixth paragraph.

8.6 Protection of transmitters

When delivering maximum output power using test signal 5, the transmitter shall not be damaged when the antenna output terminal is short-circuited or open-circuited in each case for a period of at least 5 minutes.

8.6.1 Limits

At the end of this period the transmitter shall be able to operate normally for all available modes without further attention.

8.7 Continuous operation

8.7.1 Definition

Continuous operation of the transmitter is operation without interruption at maximum RF output power during the period of time considered necessary for traffic handling.

8.7.2 Method of measurement

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1 and driven to its maximum RF output power using test signal 5. For a period of 15 minutes the equipment shall transmit continuously.

The measurements shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

8.7.3 Limits

The variation in the mean value of the output power shall not exceed 3 dB. The limits of para 8.2 shall not be exceeded.

8.8 Unwanted emissions

8.8.1 Definition

Unwanted emissions consist of spurious emissions and out-of-band emissions.

Spurious emissions are emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products, frequency conversion products, but exclude out-of-band emissions.

Out-of-band emissions are emissions on a frequency or frequencies immediately outside the necessary bandwidth which result form the modulation process, but exclude spurious emissions.

8.8.2 Method of measurement

Unwanted emissions shall be measured at the output terminals of the transmitter.

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1 and adjusted to produce maximum RF output power.

The transmitter shall be modulated with test signal 6. The measurement shall be carried out in the frequency range 9 kHz - 2 GHz.

8.8.3 Limits

Unwanted emissions shall lie below the curve of fig.1. 0 dB refers to the mean power within the necessary bandwidth.

8.9 Residual frequency modulation

8.9.1 Definition

The residual frequency modulation of the transmitter is defined as the ratio in dB of the demodulated signal when test signal 5 and test signal 6 is transmitted successively to the demodulated RF signal.

8.9.2 Method of measurement

The transmitter shall be connected to the artificial antenna as specified in subclause 3.9.1 and adjusted to produce maximum RF output power.

The equipment shall be modulated with test signal 5 and test signal 6 successively and the ratio of the r.m.s. output level of a linear FM demodulator, connected to the output terminals of the transmitter via a suitable attenuator, shall be measured. The output of the demodulator shall be limited in bandwidth by a low-pass filter with a cut-off frequency of 1 kHz and a slope of 12 dB/octave.

8.9.3 Limit

The residual frequency modulation ratio shall be at least -26 dB.

8.10 Frequency modulation due to vibration

8.10.1 Definition

The frequency modulation due to vibration is the deviation of the output frequency which may occur when the complete equipment is vibrated over a specific range of frequencies and amplitudes.

8.10.2 Method of measurement

The transmitter complete with chassis covers and shock absorbers (if supplied), shall be clamped in its normal operating position to a vibration table.

The transmitter shall be connected to the artificial antenna as described in subclause 3.9.1.

The transmitter shall be switched on and test signal 5 shall be applied to its input.

The RF output power shall be adjusted to -10 dB relative to the power as measured in subclause 8.2.

The table shall be vibrated as described in the environmental test specification (Annex VI to CEPT Recommendation T/R 34-01).

Any frequency deviation of the output signal occurring during this test shall be measured using a suitable discriminator. While performing this test, care should be taken to avoid measurement errors due to frequency drift.

8.10.3 Limits

The frequency deviation shall not exceed +5 Hz.

8.11 Frequency error

8.11.1 Definition

The frequency error of the transmitter is the difference between the measured frequency and its nominal value.

8.11.2 Method of measurement

The transmitter shall be set to a radio frequency assigned for radiotelex operation in at least the highest frequency band for which the equipment has been designed.

The transmitter shall be connected to the artificial antenna as described in subclause 3.9.1.

Test signal 7 shall be applied to its input.

The output power shall be reduced by 3 dB relative to the maximum output power as obtained in subclause 4.3. The measurement shall be performed for both the "B" and "Y" state by switching at regular time intervals between the two states. The measurement shall be carried out under normal and extreme test conditions (subclauses 3.4.1 and 3.5.2 applied simultaneously).

The frequency of the output signal shall be registered.

The temperature range of subclause 3.4.1 shall be achieved by varying the temperature linearly with time from the lower to the upper extreme condition and vice versa within a total cycle period of 16 hours.

8.11.3 Limits

The measured frequency shall at any time for the "B" state be within $\pm$10 Hz relative to the assigned frequency +85 Hz and for the "Y" state within $\pm$10 Hz relative to the assigned frequency -85 Hz.

8.12 Rise time

8.12.1 Definition

The rise time is the time between:

the start of an information block and the moment when the output power of the transmitter has reached a value of -2 dB relative to the mean power in that information block.

The start of an information block or control signal is defined as the moment when the first bit of the character is initiated.

8.12.2 Method of measurement

The transmitter shall be connected to the artificial antenna as described in subclause 3.9.1. Test signal 4 shall be used to drive the transmitter to its maximum output power.

The rise time shall be measured at the output of the transmitter.

8.12.3 Limits

The rise time shall be less than 2 msec.

8.13 Fall time

8.13.1 Definition

The fall time is defined as:

the time between the end of an information block and the moment when the RF output power of the transmitter has reached a value of 20 dB below the RF output power as measured in subclause 8.2.

The end of an information block or control signal is defined as the moment when the last bit of the last character has ended.

8.13.2 Method of measurement

The transmitter shall be connected to the artificial antenna as described in subclause 3.9.1. Test signal 4 shall be used to drive the transmitter to its maximum output power.

The fall time shall be measured at the output of the transmitter.

8.13.3 Limit

The fall time shall be less than 2 ms.

8.14 Input signals

The transmitter shall be provided with at least one of the following inputs:

a) A binary input where the "B" (SPACE) element shall be a binary zero and the "Y" (MARK) element a binary 1.

b) An audio input suitable for a frequency shift of 170 Hz and a centre frequency of 1700 Hz. The lower frequency 1615 Hz indicates a "Y" (MARK) signal and the higher frequency of 1785 Hz indicates a "B" (SPACE) signal.

8.15 Input level

Where a binary input is provided, it shall comply with CCITT Recommendation V.10 and V.24 or Recommendations V.28 and V.24.

Where an audio input is provided, it shall be free of earth and suitable to receive an r.m.s. input of 0 dBm measured into 600 ohm.

9 RF receivers for use in combination with radiotelex modems: technical and operational requirements

9.1 General

The receiver's design shall allow for the reception of F1B signals with a frequency-shift of 170 Hz and a modulation rate of 100 bauds.

9.2 Frequencies and classes of emission

The receiver shall be capable of receiving on all assigned radiotelex frequencies allocated to thearitime mobile service in one or more of the following frequency bands:

- 415 kHz to 526.5 kHz
- 1605 kHz to 4.0 MHz
- 1605 kHz to 28 Mhz.

Where applicable the following frequencies shall be readily accessible to the operator: 2174.5 kHz, 4177.5 kHz, 6828 kHz, 8376.5 kHz, 12520 kHz and 16695 kHz.

Radiotelex frequencies are designated in terms of the assigned frequency (centre of the F1B spectrum). The selected receiver frequency shall be clearly identifiable on the control unit of the equipment.

The receiver shall be capable of receiving signals with classes of emission F1B and J2B.

Where more than one class of emission can be selected, each class of emission shall be directly accessible to the operator.

The receiver shall be capable of being tuned from any frequency to any other frequency as quickly as possible and in any event within a period not exceeding 15 seconds.

9.3 Method of tuning

The receiver shall provide for tuning to the assigned radiotelex frequencies within the specified frequency ranges by one of the following methods:

- continuous tuning
- incremental tuning by means of synthesizer with steps not greater than 100 Hz.

9.4 Frequency conversion

In order to preserve the polarity of "MARK" and "SPACE", an initial change of the frequency of the input signal at the receiver and the change of frequency of the signal at the output terminals shall be the same.

To facilitate the use of existing NBDP equipment with a nominal input frequency of 1500 Hz, provisions may be available to change the output frequency to 1500 Hz.

9.5 Frequency modulation due to vibration

9.5.1 Definition

The frequency modulation due to vibration is the deviation of output frequency which may occur when the complete equipment is vibrated over a specified range of frequencies and amplitudes.

9.5.2 Method of measurement

The receiver complete with chassis covers and shock absorbers (if supplied) shall be clamped in its normal operating position to a vibration table. The receiver shall then be switched on and after the warming-up period permitted under subclause 2.6, an unmodulated RF test signal shall be applied to its input at a level of +20 dBuV.

The receiver shall be adjusted to deliver standard output power at 1700 Hz (see subclause 9.10). The table shall be vibrated as described in the environmental test specification (Annex VI to CEPT Recommendation T/R 34-01).

Any frequency deviation of the output signal occuring during this test shall be measured using a suitable discriminator. While performing this test, care shall be taken to avoid measurement errors due to frequency drift.

9.5.3 Limits

The frequency peak deviation shall not exceed ±5 Hz.

9.6 Maximum usable sensitivity

9.6.1 Definition

The maximum usable sensitivity is the minimum level (e.m.f) of an RF input signal with specified modulation which will produce at the receiver output a defined value of signal plus noise plus distortion to noise plus distortion and at the same time an output power level of not less than the minimum required output power (subclause 9.10.3).

9.6.2 Methods of measurements

Tests shall be carried out for each frequency band for which the receiver is designed.

The test input signal to the receiver shall be unmodulated and tuned to an assigned frequency in each available frequency band.

For each test the input of the test signal shall be adjusted until the S+N+D/N+D ratio at the receiver's output is 20 dB. The measured input level is the maximum usable sensitivity.

9.6.3 Specified limits

With a test signal source of 50 ohms and a S+N+D/N+D ratio of 20 dB, the maximum usable sensitivity shall be better than the following values.

The maximum level of the input signal shall be +5 dBuV for frequencies above 4 MHz and +10 dBuV for frequencies below 4 MHz.

When at the request of the manufacturer and with the approval of the testing authority, a test signal source consisting of 10 ohms resistor in series with a 250 pF capacitor may be used in the frequency range 1605 - 4000 kHz, the following specified limits apply for the maximum usable sensitivity.

The maximum level of the input signal shall be +20 dBuV at a S+N+D/N+D ratio of 20 dB.

9.7 Adjacent channel selectivity

9.7.1 Definition

Adjacent channel selectivity is defined as the ability of the receiver to discriminate between the wanted signal (to which the receiver is tuned) and unwanted signals (having frequencies generally outside the pass-band), the wanted and unwanted signals acting simultaneously. The adjacent channel selectivity is defined for the purpose of this specification as the ratio of the levels at the receiver input of a specified unwanted signal to a specified wanted signal which results in a reduction of the S+N+D/N or S+N+D/N+D ratio from 20 dB to 14 dB.

9.7.2 Method of measurement

The wanted signal shall be unmodulated and adjusted in frequency and level to produce an output signal with a frequency of 1700 Hz and with a S+N+D/N+D of 20 dB.

The unwanted signal shall also be unmodulated and have a frequency equal to the wanted frequency +500 Hz or the wanted frequency -500 Hz and adjusted in level such that the S+N+D/N or S+N+D/N+D ratio has been reduced from 20 dB to 14 dB.

9.7.3 Limits

The ratio of the level of the unwanted signal to the level of the wanted signal shall be 40 dB or more.

9.8 Two-signal tests of selectivity

9.8.1 Blocking

Blocking is a change (reduction) in the wanted output power of a receiver due to an unwanted signal on another frequency.

9.8.2 Method of measurement

The measurement shall be made by means of the simultaneous application of two test signals to the input of the receiver. One of the test signals is the wanted signal to which the receiver is tuned, and the other is the unwanted signal.

The measurement shall be carried out with an input level of the wanted signal of +60 dBuV (e.m.f.) and shall be repeated with the wanted signal at a level equal to the maximum usable sensitivity of the receiver.

The wanted test input signal to the receiver shall be unmodulated and tuned to the assigned frequency.

The unwanted signal shall have a frequency of $\pm$20 kHz relative to that of the wanted signal and shall be unmodulated. Its input level shall be adjusted until it causes a change of 3 dB in the output level of the wanted signal. When the specified condition is reached, the input level of the unwanted signal shall be taken as the blocking level.

When performing the above measurements, precautions have to be taken that the distortion components in the output signal do not influence the results noticeably.

9.8.3 Limits

With the wanted signal +60 dBuV (e.m.f.) the level of the unwanted signal shall not be less than +100 dBuV (e.m.f.).

With the wanted signal at a level equal to the maximum usable sensitivity, the level of the unwanted signal shall be at least +65 dB above the maximum usable sensitivity level.

9.8.4 Cross-modulation

Cross-modulation is the transfer of modulation from an unwanted, amplitude-modulated signal on another frequency to the wanted signal.

9.8.5 Method of measurement

The measurement shall be made by means of the simultaneous application of two signals to the input of the receiver. One of the test signals is the wanted signal to which the receiver is tuned and the other is the unwanted signal.

The wanted test input signal to the receiver shall be the normal test signal specified in subclause 4.2, paragraph 3 with a level of +60 dBuV e.m.f. The receiver shall give an output voltage of 0.775 V $\pm$3 dB (see subclause 9.10).

The amplitude modulation of the wanted signal shall then be switched off. The unwanted signal shall have a frequency of +20 kHz relative to that of the wanted signal.

The unwanted signal shall be modulated to a depth of 30% at 400 Hz.

The input level of the unwanted signal shall be increased until the total unwanted power in the receiver output due to cross-modulation is 30 dB below standard output power. The input of the unwanted signal at which this condition is obtained shall be taken as the cross-modulation level (level modulation transfer -30 dB).

When performing the above measurements, precautions have to be taken that the distortion components in the output signal do not influence the results noticeably.

9.8.6 Limits

The level of the unwanted signal shall not be less than +94 dBuV e.m.f.

9.8.7 Reciprocal mixing

Reciprocal mixing is the transfer from the noise sidebands of the receiver's local oscillator(s) to a wanted signal due to the presence of a wanted and/or unwanted signal.

9.8.8 Methods of measurements

The measurement shall be made by means of the simultaneous application of two test signals to the input of the receiver. One of the test signals is the wanted signal to which the receiver is tuned and the other is the unwanted signal, both signals unmodulated.

The wanted test input signal to the receiver shall be tuned to the assigned frequency and have a level of +60 dBuV e.m.f.

The output frequency due to the wanted signal shall be 1700 Hz and pass a low-pass filter with a cut-off frequency of not less than 2200 Hz and an attenuation of 14 dB at 3400 Hz.

The unwanted signal shall have a frequency separation of $\pm$20 kHz or more relative to that of the wanted signal.

The input level of the unwanted signal shall be adjusted until it causes a reduction of the S+N+D/N+D ratio down to 30 dB. When specified condition is reached, the input level of the unwanted signal, shall be taken as the reciprocal mixing level.

Care should be taken that the noise sidebands of the generators representing the wanted but especially the unwanted signal do not influence the measurements noticeably.

9.8.9 Limits

For reciprocal mixing the level of the unwanted signal shall not be less than +100 dBuV e.m.f.

9.9 Intermodulation

9.9.1 Definition

Intermodulation is a process by which signals are produced from two or more (generally unwanted) signals simultaneously present in a non-linear circuit.

9.9.2 Method of measurement

An unmodulated input signal on an assigned frequency shall be applied to the receiver input at a level of +30 dBuV.

The output voltage shall be noted for reference as given in subclause 9.10. This output voltage shall be taken as the reference output voltage.

The wanted signal shall then be removed and two equal in level unmodulated signals shall be simultaneously applied to the input of the receiver. One of the signals shall have a frequency difference from the nominal frequency of the wanted signal of approximately 30 kHz.

The other signal shall have a frequency difference of approximately 60 kHz and shall be adjusted in frequency to have maximum effect.

When choosing the frequencies used for this measurement, care should be taken to avoid frequencies at which spurious responses occur. The input levels of the two interfering signals shall remain equal and shall be adjusted until the output power of the receiver due to the interfering signals is equal to the reference output power.

If the output/input characteristic is not suitable for determining these input levels precisely, it should be ensured that the AGC settings are the same as with the wanted signal, for example by using the AGC voltage as the reference.

9.9.3 Limits

The level of each of the two interfering signals which result in standard output shall not be less than +90 dBuV e.m.f.

9.10 Receiver's line output

9.10.1 Definition

The receiver's line output voltage is defined as a fixed AF r.m.s. voltage available at the line output terminals of the receiver.

9.10.2 Method of measurement

The measurement shall be carried out with an input level of the wanted signal of +60 dBuV e.m.f. and shall be repeated with the wanted signal at a level equal to the maximum usable sensitivity of the receiver.

The wanted test input signal to the receiver shall be unmodulated and tuned to an assigned frequency.

The output voltage shall be measured across a non-reactive resistor of 600 ohm.

9.10.3 Limits

The audio frequency output voltage shall have a level of 0.775 Volts $\pm$3 dB.

The output terminal shall be free from earth.

9.11 AGC characteristics (attack and decay times)

9.11.1 Definitions

AGC Attack time: the time from the instant at which the input signal level is suddenly increased by a specified amount, until the instant at which the level of the output signal reaches and remains within $\pm$2 dB of the subsequent steady-state value.

AGC decay time: the time from the instant when the input signal is suddenly decreased by a specified amount until the instant at which the output signal reaches and remains within $\pm$2 dB of the subsequent steady-state value.

9.11.2 Method of measurement

A test signal unmodulated and tuned to an assigned frequency shall be applied to the input of the receiver via an attenuator capable of being switched in a single step of 30 dB. The resulting audio output shall be displayed by means of an oscilloscope.

The input level (in e.m.f.) shall be adjusted to produce an output S+N+D/N or S+N+D/N+D ratio of 20 dB, and the output level adjusted to 10 dB below the standard audio frequency output power. The attenuator shall then be switched so that the input signal increases in level by 30 dB. The attack time shall be measured.

The attenuator shall then be switched so that the input signal returns in a single step to its original level. The recovery time shall be measured.

9.11.3 Limits

The attack time shall not exceed 2 ms.

The decay time rate shall be in the range of 100-200 msec.

The overshoot in the output signal due to an increase of the input signal by a step of 70 dB shall not exceed 3 dB relative to the steady state output signal.

9.12 Protection of input circuits

The receiver shall not suffer damage when an unmodulated signal with a level of 30 volts r.m.s. is applied to its input as specified in para 3.8.1 for a period of 15 minutes, at any frequency in the range from 100 kHz to 28 MHz.

The receiver shall operate normally without further attention when the test signal is removed.

In order to provide protection against damage due to static voltages which may appear at the antenna connection of the receiver, there shall be a DC path from the antenna terminal to chassis not exceeding 100

k ohms.

9.13 Tuning error and tuning drift

9.13.1 Definitions

Tuning error is the amount by which the frequency indicated on the receiver differs from the carrier frequency of an input signal to which the receiver is intended to be tuned.

Tuning drift is the amount by which the tuning changes over a period of time, in the absence of adjustment to the receiver.

9.13.2 Method of measurement of tuning error

An unmodulated test signal tuned to an assigned frequency and with a level of 60 dBuV shall be applied to the input of the receiver, the frequency accuracy of the test signal being $\pm$1 Hz.

The output frequency shall then be measured at suitable intervals of time. The measurements shall be performed under normal test conditions and extreme test conditions (paras 3.4.1 and 3.5.2 applied simultaneously).

9.13.3 Limits for tuning error

The combined effects of tuning error and tuning drift shall not cause a frequency error of the receiver's output signal exceeding 10 Hz at all times.

9.14 Spurious response rejection

9.14.1 Definition

Spurious response rejection is the ability of the receiver to discriminate between a wanted signal and unwanted signals with frequencies outside the pass-band of the receiver.

Spurious responses occur on such frequencies as image frequency, intermediate frequency, and other.

9.14.2 Method of measurement

The receiver shall be set in the mode used for radiotelex operation. Two signals are applied to the receiver simultaneously as specified in subclause 3.8.

The wanted signal shall be an unmodulated RF signal tuned to an assigned frequency for radiotelex operation.

The level of the wanted signal shall be 20 dBuV at the nominal frequency of the receiver.

The unwanted signal shall be unmodulated and varied in frequency to search for spurious responses between 100 kHz and 2 GHz excluding the frequency band $\pm$1 kHz around the nominal frequency of the receiver.

The level shall be adjusted to reduce the S+N+D/N+D ratio to 14 dB.

9.14.3 Limits

The level of the unwanted signal producing spurious responses causing a reduction in S+N+D/N+D ratio to 14 dB, shall exceed +60 dBuV in the neighbouring band -3 kHz to -1 kHz and +1 kHz to +3 kHz relative to the nominal frequency, and shall exceed +76 dBuV outside the above-mentioned neighbouring bands.

9.15 Operation of the receiver during ARQ operation

9.15.1 Definition

Operation of the receiver during ARQ operation is the ability of the receiver to retain its sensitivity when an RF signal, representing the radiotelex station's transmitter, is periodically present at the receiver's input.

9.15.2 Method of measurement

In order to simulate the presence of an RF signal at the input of the receiver generated by the radiotelex station's own transmitter during ARQ mode of operation, an RF signal with a level of 120 dBuV shall be connected to the receiver's input.

The connection of this signal shall be periodical with a connection time of approx. 210 msec. with a total cycle time of approx. 450 msec.

In addition to the signal above, the wanted RF signal with a level of 10 dBuV and in correspondence with the tuning frequency of the receiver shall permanently be connected to the receiver's input.

At the 1700 Hz output terminal of the receiver, the signal shall be adjusted to 0.775 V $\pm$10 dB peak voltage.

The r.m.s. value of the output signal shall then be measured by disconnecting the RF signal representing the transmitter permanently. The effect of this signal on the rms. value of the wanted signal shall be measured.

A keying signal connecting and disconnecting the 120 dBuV RF signal shall be used to activate and deactivate the receiver.

Any additional antenna relay or an attenuator that normally forms a part of the ship's radio installation may be used in connection with this test.

9.15.3 Limits

The r.m.s. output value of the 1700 Hz signal shall not vary by more than $\pm$3 dB when the 120 dBuV RF signal is periodically connected or permanently disconnected.

10 Station requirements

10.1 General

When the radiotelex station has been set up to the required working frequency or frequencies, the transmitter shall be activated automatically when the receiver registers that a selective call number has been received corresponding to the identity number of the equipment.

In the ARQ mode of operation, the station which establishes a circuit is the master station and sends the "call signal" until it receives an appropriate control signal. However, if the circuit has not been established after 128 cycles (128 x 450 msec.), the station shall change its condition to "stand-by" and shall wait for a duration of at least 128 cycles before it sends the "call signal" again.

10.2 Maintenance of phasing

10.2.1 Definition

The maintenance of phasing is defined as the ability of the Information Receiving Station (IRS) to maintain synchronization with the Information Sending Station (ISS), when the incoming signal is suppresed for a specified period of time.

10.2.2 Method of measurement

The equipment shall be set up as Information Receiving Station (IRS) in the ARQ-mode of operation.

An RF signal with a level of 20 dBuV and modulated with test signal 1, shall be applied to the receiver through a matching network as specified in para 3.9.

The test signal applied to the receiver shall be suppressed so that precisely 31 repetitions occur and then be reestablished.

10.2.3 Limits

The information receiving station shall start to print the information of the test signal as soon as the connection is reestablished and no character from the order of the test signal shall be missing.

10.3 Time-to-answer a call

10.3.1 Definition

The time-to-answer a call is the time between the reception of a selective call number in the equipment, and the beginning of emission of correct signals.

10.3.2 Method of measurement

The equipment shall be tuned to the correct frequency and set up as a station ready for operation (STAND-BY).

An RF test signal with a level of 20 dBuV shall be applied to the receiver as specified in subclause 3.9.

The test signal shall comprise of call-blocks containing the identity number of the equipment.

The time-to-answer a call shall be measured as the time the selective call signal is applied to the receiver until the transmitter starts to emit the correct control signals, indicating that the equipments identity has been correctly decoded.

10.3.3 Limits

The time-to-answer a call shall not exceed 4.1 seconds.

10.4 Station delay time

10.4.1 Definition

In the ARQ mode of operation, the station delay time is the time between:

a) the end of an information block on the receiver's antenna input and the start of a related control signal on the transmitter's antenna output.

b) the end of a control signal on the receiver's antenna input and the start of an information block on the transmitter's antenna output.

The end and start of an information block, respectively a control signal, refer to the moment the level of the RF signal has reached a value corresponding to -2 dB relative to the mean level.

10.4.2 Method of measurement

The equipment shall be set up as an:

a) Information Receiving Station (IRS)

b) Information Sending Station (ISS).

An RF test signal with a level of 20 dBuV consisting of standard test signal 3 shall be applied to the receiver through the matching network specified in subclause 3.9.

10.4.3 Limits

The station delay time shall not be more than 12 msec.

10.5 Scanning receivers

Where scanning receivers are used, the following requirements are to be met.

10.5.1 Channel dwell-time

10.5.1.1 Definition

The channel dwell-time is the time that the receiver monitors each channel effectively.

10.5.1.2 Method of measurement

The equipment shall be set up as station ready for operation (STAND-BY).

Two RF test signals with a level of 20 dBuV shall be applied to the receiver as specified in para 3.8.

One of the RF signals, with a nominal frequency corresponding to a desired radiotelex channel, shall consist of standard test signal 2.

The other RF signal shall have a frequency corresponding to the assigned frequency of an arbitrarily chosen radiotelex channel and shall be unmodulated.

The receiver shall be arranged to scan between the two radiotelex channels, and the channel dwell-time shall be measured at the output of the receiver.

10.5.1.3 Limits

The dwell-time per channel shall be at least 2.7 seconds but not more than 4.5 seconds. The dwell-time per channel shall in no event be shorter than the measured time to answer a call (subclause 10.3).

10.5.2 Time for channel shift

10.5.2.1 Definition

The time for channel shift is the time between the moment the receiver ceases the monitoring of a channel until the moment the receiver is ready for operation on another channel.

10.5.2.2 Method of measurement

The equipment shall be set up as a station ready for operation (STAND-BY). The two RF signals with a level of 20 dBuV shall be applied to the receiver as specified in subclause 3.8.

One of the RF signals, with a nominal frequency corresponding to a desired radiotelex channel shall consist of standard test signal 2.

The other RF signal shall have a frequency corresponding to the assigned frequency of an arbitrarily chosen radiotelex channel and shall be unmodulated. The receiver shall be arranged to scan between the two radiotelex channels. The time for channel shift shall be measured at the output of the receiver.

10.5.2.3 Limits

The time for channel shift shall not exceed 10% of the channel dwell-time.

10.6 Station requirements

The relevant station requirements of this annex shall also be met when the NBDP equipment is operated in combination with:

- a separate transmitter complying with chapter 8 of this annex and the relevant requirements of annex 1 of the CEPT Recommendation T/R 34-01 and/or

- a separate receiver complying with chapter 9 of this annex and with the relevant requirements of annex 1 and annex 7 of the CEPT Recommendation T/R 34-01.

11 Interference

11.1 General

All reasonable and practicable steps should be taken to ensure electromagnetic compatibility between the equipment concerned and other radio communication and navigational equipment carried on board in compliance with the relevant requirements of Chapter IV and Chapter V of the 1974 SOLAS Convention as amended.

11.2 Conducted spurious emission into the mains

11.2.1 Conditions of measurement

The interconnection cable between the equipment under test and the artificial mains network shall be screened and not exceed 0.6 m in length.

The antenna connection of the equipment under test, if any, shall be terminated with a non-radiating artificial antenna.

For equipment intended to operate on frequencies above 30 MHz, the equipment may be measured with the antenna connected.

For transmitters intended to operate in the frequency bands up to 30 MHz, this measurement only applies in the operational but not-keyed condition.

11.2.2 Method of measurement

Conducted spurious emissions shall be measured in the frequency range of 9 kHz to 30 MHz as described in CISPR publication 16, section 1 - measuring receiver and section 2 subclauses 8.1 to 8.3 - artificial mains network (50 ohm).

11.2.3 Specified limits

The level of any conducted spurious signal shall not exceed the values given in figure 3.

12 Operational procedures

12.1 Objective

The objective of the test is to verify that the procedures used by the radiotelex equipment under test conform fully with the relevant CCIR Recommendations.

12.1.1 Method of testing

The mobile radiotelex equipment under test is connected to a reference laboratory equipment which has been checked as fully conforming to the CCIR Recommendations 625, 490 and 491-1. The following operations shall be performed:

- Calling
- Connection
- Identification
- The exchange of messages both ways
- The end of communication.

12.1.2 Results

All operations shall be performed without incident. Any incident shall be reported.

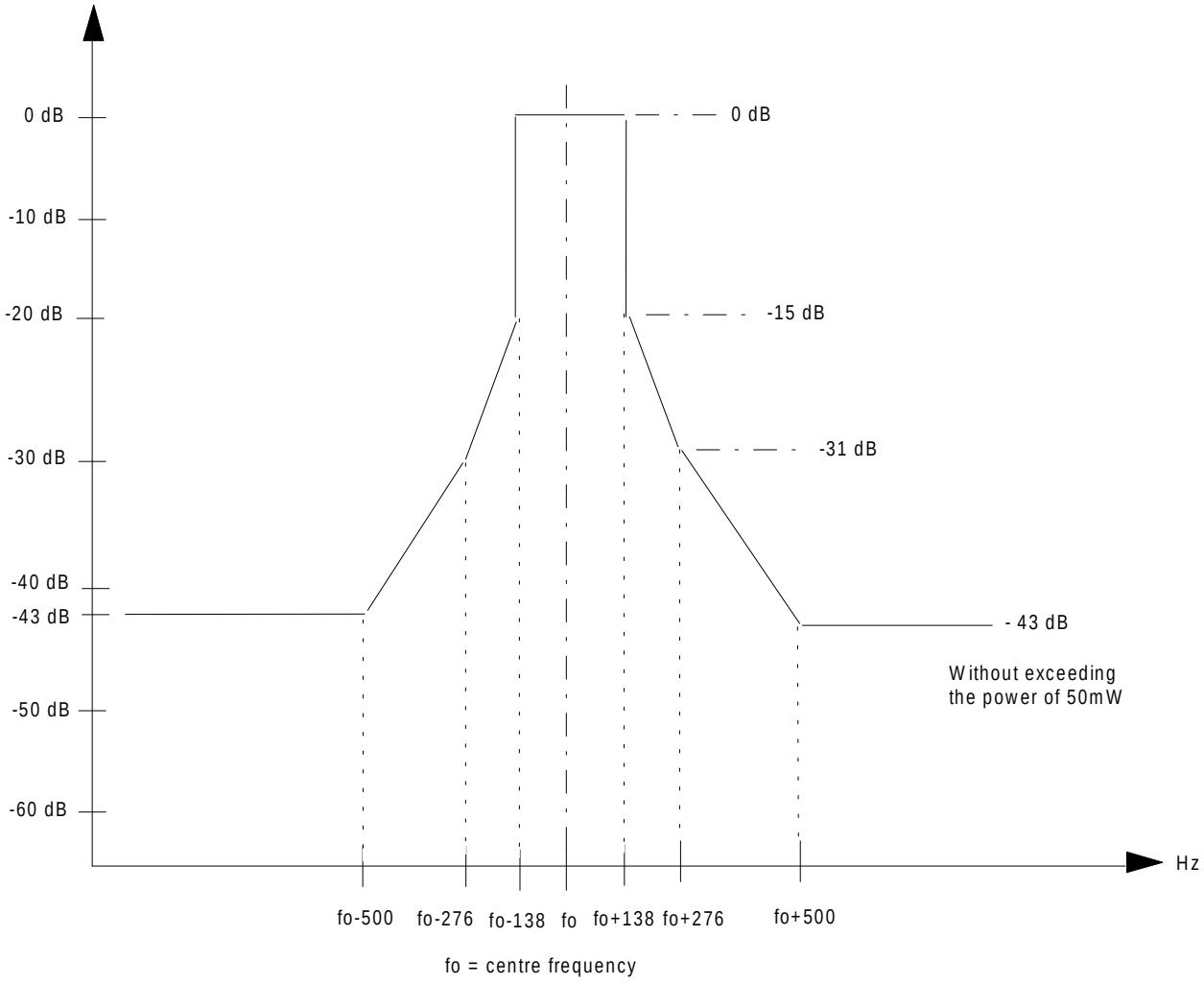


Figure 1: Limits for unwanted emissions from radiotelex transmitters

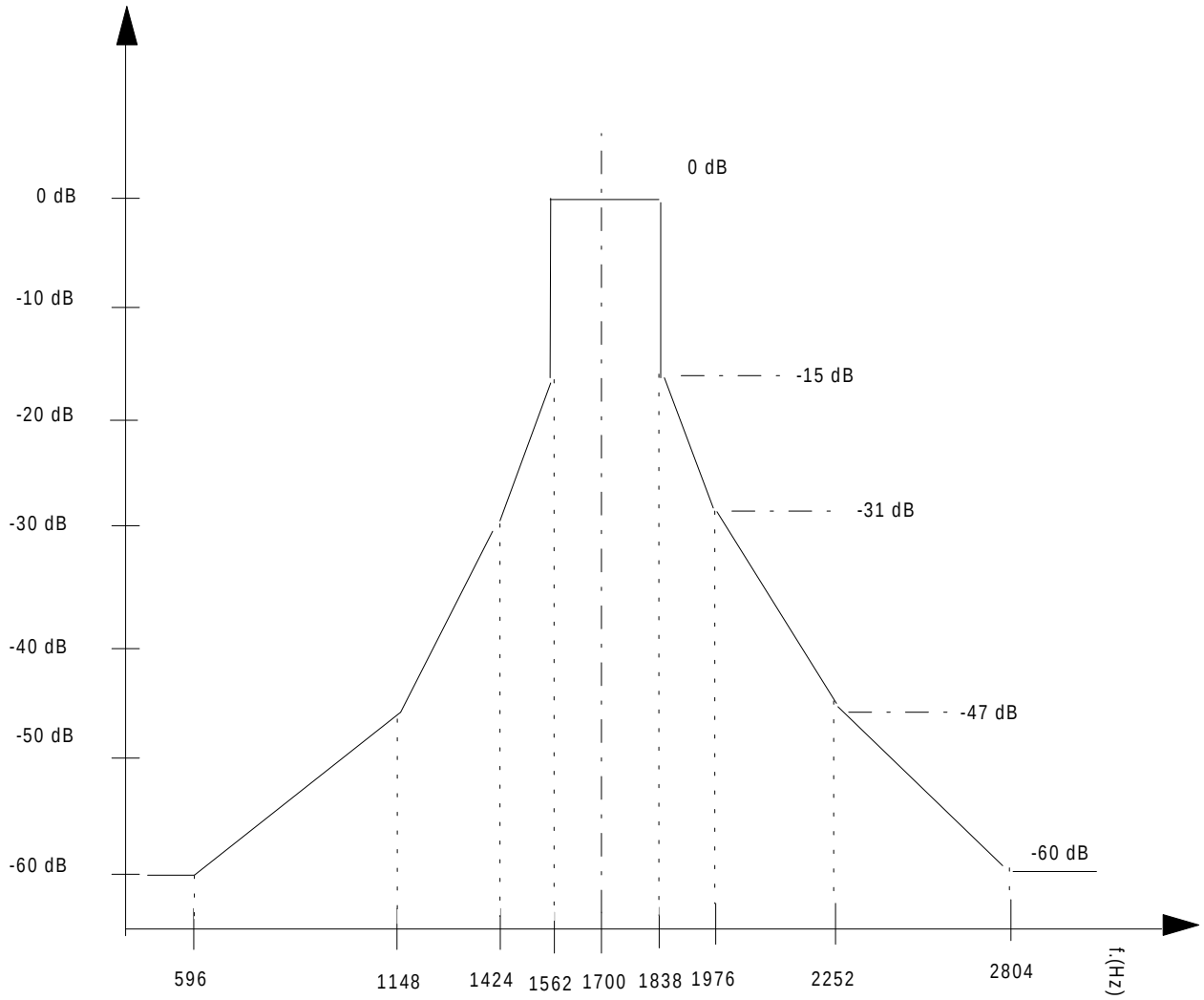
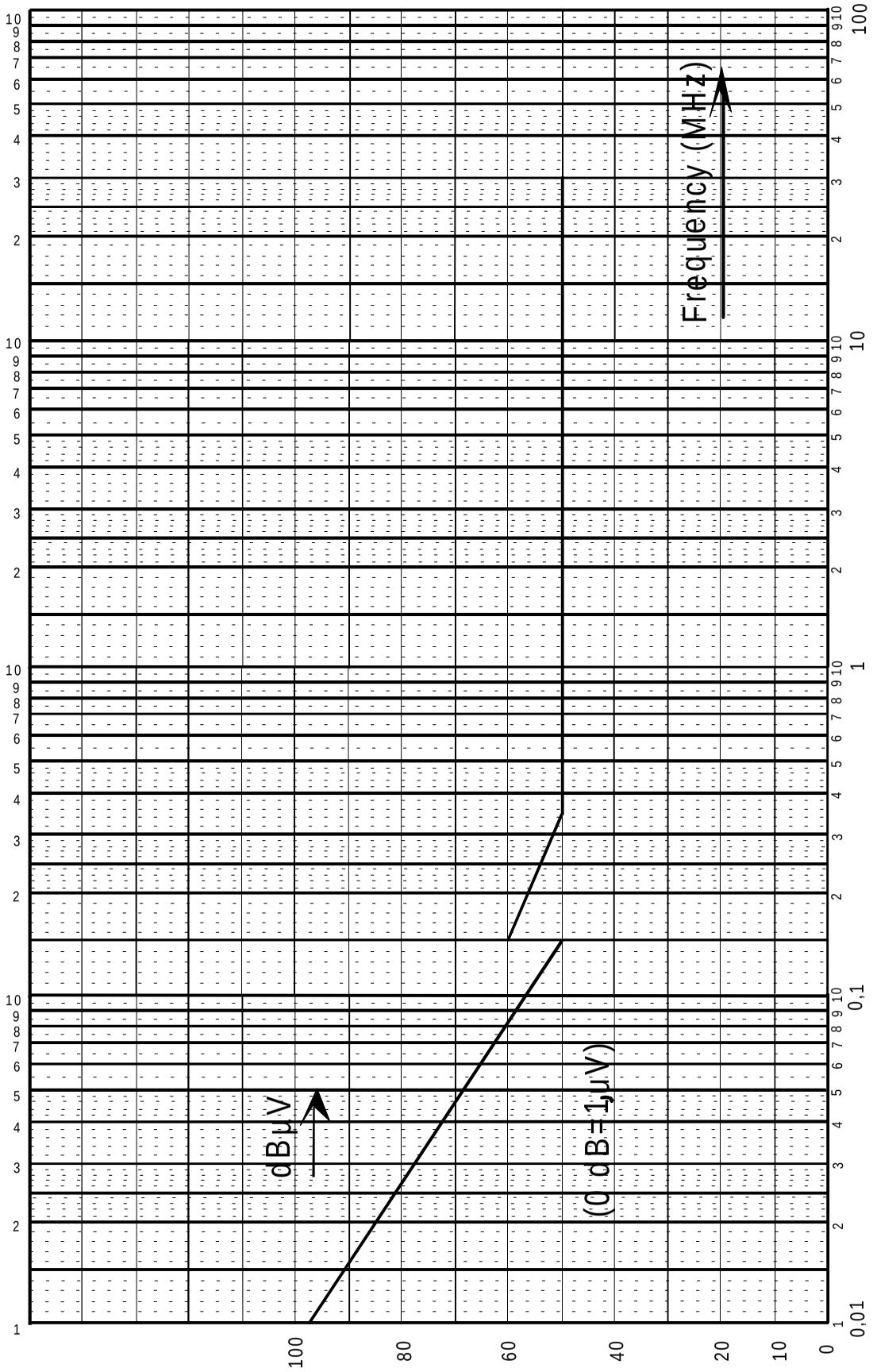


Figure 2: Limits for spurious signal components from radiotelex encoder


Frequency (MHz)
dBµV
(0 dB=1µV)
100
80
60
40
20
10
0
0,01
0,1
1
10
100

Annex A: Bibliography

International Maritime Organisation Assembly Resolution A.569 (14): "General requirements for ship-borne radio equipment forming part of the future Global maritime Distress and Safety System (GMDSS)".

International Maritime Organisation Assembly Resolution A.613 (15): "Performance standards for ship-borne MF/HF radio installations capable of voice communication, narrow-band direct printing and digital selective calling".

CEPT Recommendation T/R 34-01: "Specifications for maritime mobile radio equipment".

CCIR Recommendation 490 (1974): "The introduction of direct printing telegraph equipment in the maritime mobile service".

CCIR Recommendation 491-1 (1974-1986): "Translation between an identity number and identities for direct printing telegraphy in the maritime mobile service".

CCIR Recommendation 625 (1986): "Direct printing telegraph equipment employing automatic identification in the maritime mobile service".

CCITT Recommendation F.130 (1988): "Maritime Answer-back Codes".

CCITT Recommendation E.161 (1988): "Arrangement of figures, letters and symbols on telephones and other devices that can be used for gaining access to a telephone network".

CCITT Recommendation Q.11 (1988): "Numbering plan for the international telephone service".

CCITT Recommendation V.10 (1988): "Electrical characteristics for unbalanced double-current interchange circuits for general use with integrated circuit equipment in the field of data communications".

CCITT Recommendation V.24 (1988): "List of definitions for interchange circuits between data terminal equipment (DTE) and data circuit-terminating equipment (DCE)".

CCITT Recommendation V.28 (1988): "Electrical characteristics for unbalanced double-current interchange circuits".

Convention on the Safety of Life et Sea (IMO, 1974 as amended).

CISPR Publication 16 (1977): "Specification for radio interference measuring apparatus and measurement methods".

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