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Foreword

This European Telecommunication Standard (ETS) has been produced by the Paging Systems (PS) Technical Committee of the European Telecommunications Standards Institute (ETSI).

This ETS comprises seven parts with the generic title "Paging systems; European Radio Message System (ERMES)". The title of each part is listed below:

- ETS 300 133-1: "Part 1 - General aspects"
- ETS 300 133-2: "Part 2 - Service aspects"
- ETS 300 133-3: "Part 3 - Network aspects"
- ETS 300 133-4: "Part 4 - Air interface specification"
- ETS 300 133-5: "Part 5 - Receiver conformance specification"
- ETS 300 133-6: "Part 6 - Base station specification"
- ETS 300 133-7: "Part 7 - Operation and maintenance aspects"

This part, ETS 300 133-5, specifies the receiver performance requirements and the conformance test and measurement methods.

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1 Scope

This part of the seven part European Telecommunication Standard (ETS) 300 133 defines the receiver conformance specification which the different categories of paging receiver must comply with before they can be operated on the European Radio Message System (ERMES). Essential features are covered which make up the basic version receiver of each paging receiver category and also the optional receiver features which, if implemented, must conform to this specification.

2 Normative references

This ETS incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

[1] ETS 300 133-4: (1992) "Paging Systems (PS); European Radio Message System (ERMES) Part 4: Air interface specification".

[2] ISO Standard 1073 parts 1 & 2: "Alphanumeric character sets for optical recognition".

3 Definitions

For the purposes of this part of ETS 300 133 the following definitions shall apply.

Basic RIC: the prime identity of a paging receiver allocated by the network operator when service is initiated. It shall not be changed without safeguards against unauthorised changes.

Batch number: the 4 bit number corresponding to a particular batch type. Batch type A shall correspond to batch number 0000. Batch type P shall correspond to batch number 1111.

Codeword: the standard information unit of 30 bits length.

Codeblock: the unit of nine codewords used in the message partition.

Country code: binary representation of the country number defined in ETS 300 133-4 [1], Annex A. The country code consists of 7 bits.

External Message: a paging message sent to a receiver which is not in its home network.

External Receiver: a receiver operating in a network which is not its home network.

Home Network: the operator network with which a mobile subscriber has signed a subscription.

Home Operator: the network operator to which a specific user has subscribed.

Initial Address: the 18 most significant bits of the local address.

Local Address: the number used by a network to identify the receivers subscribed to it. It consists of 22 bits. The four least significant bits of the local address denote the batch number of the receiver.

Operator code: the number used by the system on the radio path to identify an operator within a country. It consists of 3 bits.

Operator Identity: the number used by the system on the radio path to identify the home operator of a receiver. It has a total length of 13 bits and consists of three parts, the zone code the country code and the operator code.

Paging Area: the area controlled by a paging area controller. It is the minimum area to which a mobile subscriber is permitted to subscribe in order to receive his paging messages.

Paging Message: the tone-only, numeric, alphanumeric or transparent data information sent to a paging receiver.

Paging Signal: the signal sent on the radio path to a paging receiver.

Radio Identity Code (RIC): the number used by the system on the radio path to identify the receiver(s) for which the paging message is intended. The RIC has a total length of 35 bits and consists of five parts: the zone code (3 bits), the country code (7 bits), the operator code (3 bits), the initial address (18 bits) and the batch number (4 bits).

	Operator Identity			Local Address	
	Zone code	Country code	Operator Code	Initial address	Batch number
No. of bits	3	7	3	18	4

Reserved for future definition: the bits indicated are not specified in this edition of the standard but may be in future editions. The bits should be set to a default value and not used to convey information. The function of any equipment shall be independent of these bits. No fixed pattern of reserved bits should be assumed and no combination of reserved bits shall cause equipment to malfunction.

Zone code: binary representation of the zone number defined in ETS 300 133-4 [1], Annex A. The zone code consists of 3 bits.

4 Abbreviations

AII	Additional Information Indicator
AIF	Additional Information Field
AIT	Additional Information Type
AIN	Additional Information Number
APT	Address Partition Terminator
BAI	Border Area Indicator
CTA	Common Temporary Address
CTAP	Common Temporary Address Pointer
EB	External Bit
EOM	End of Message
ETI	External Traffic Indicator
FSI	Frequency Subset Indicator
IA	Initial Address
MD	Message Delimiter
PA	Paging Area
PR	Preamble
RF	Radio Frequency
RIC	Radio Identity Code
RSVD	Reserved
SI	System Information
SSI	Supplementary System Information
SSN	Subsequence Number
SYN	synchronisation
TEM	Transverse Electro Magnetic
UMI	Urgent Message Indicator

5 General test requirements

5.1 Number of receivers to be submitted for conformance testing

Six samples of receivers shall be provided for testing.

These receivers shall be programmed with RIC numbers:

```
010 0000001 010 1100011000111001 00 0000
010 0000001 010 1100011000111001 01 0011
010 0000001 010 1100011000111001 10 0110
010 0000001 010 1100011000111001 11 1001
010 0000001 010 1100011000111001 00 1100
010 0000001 010 1100011000111001 01 1111
```

The frequency subset number of these receivers shall be set to 01000.

5.2 Normal test conditions

The normal test conditions shall be temperature + 15 °C to + 35 °C and relative humidity from 20 % to 75 %, non condensing.

The normal test voltage shall be that declared by the manufacturer.

5.3 Extreme test conditions

The temperature range shall be - 10 °C to + 55 °C and relative humidity from 20 % to 75 %, non condensing.

The extreme test voltages shall be declared by the manufacturer.

5.4 Test fixture

A TEM cell shall be used for all tests unless otherwise stated. Test fixtures to enable tests under extreme voltage conditions shall be provided by the manufacturer if required by the approved testing laboratory.

5.5 Test paging signal

The transmissions shall be in accordance with ETS 300 133-4 [1].

The batch structure used during testing shall contain one address in the address partition followed by one message in the message partition as shown in subclause 8.1.1 unless otherwise specified.

The test paging message to the receiver under test may be tone only, 10 numeric characters or 55 alpha-numeric characters according to the feature under test.

For successful calls the receiver shall respond to the transmitted test paging message correctly without error except as allowed in the average usable sensitivity test defined in Annex A, Clause A.1.

6 RF characteristics

6.1 Performance requirements

The following receiver parameters shall be measured and the specified performance achieved:

i) average usable sensitivity under normal conditions : 25 dBµV/m
This value of 25 dBµV/m shall be referred to as the reference figure;

ii) average usable sensitivity under normal conditions but with a transmitter frequency offset of ± 200 Hz shall be the same as the reference figure;

iii) average usable sensitivity under switching conditions shall be the same as the reference figure;

iv) average usable sensitivity under extreme temperature and voltage conditions : + 6 dB on the reference figure;

v) average usable sensitivity under extreme temperature and voltage conditions with a transmitter frequency offset of ± 200 Hz shall be + 6 dB on the reference figure;

vi) co-channel rejection : 10 dB;

vii) adjacent channel selectivity under normal conditions : 60 dB;

viii) adjacent channel selectivity under extreme conditions : 50 dB;

ix) spurious response immunity : 76 dBµV/m;

x) intermodulation immunity : 70 dBµV/m;

xi) blocking immunity or desensitisation : 84 dBµV/m;

xii) usable input level range : The receiver shall operate on channel at a field strength of 3 V/m;

xiii) sensitivity for combined multipath and quasi synchronous transmissions : 15 dB above the reference figure;

xiv) spurious emissions:

100 kHz - 1 GHz	: 2 nW
1 GHz - 4 GHz	: 20 nW
ERMES channels	: 2 pW;

xv) channel switching : Receiver is receiving system information on one channel and does not find its initial address in the address partition. It then switches channels and prepares to receive signals in its batch on that channel. The receiver shall suffer no degradation in sensitivity.

6.2 Method of measurement

Measurements shall be conducted on ERMES frequency number 8 (see ETS 300 133-4 [1], subclause 9.2) unless otherwise stated. The measurements shall be conducted according to the following steps:

a) the average usable sensitivity expressed as the field strength shall be measured as described in Annex A, Clause A.1. The test site shall be complemented with a "simulated man" (see Annex B, Clause B.1). Any ERMES frequency may be used. All six receivers shall be measured;

b) the measurement procedure for spurious radiations shall be carried out as described in Annex A, Clause A.2. All six receivers shall be measured;

c) the measurement of the average usable sensitivity shall be repeated for all six receivers under normal and extreme conditions in the test fixture according to Annex A, Clause A.1;

d) the average usable sensitivity on the lowest and highest ERMES frequencies shall be measured for all six receivers;

e) measurement of usable input level range: All receivers shall correctly receive four messages out of four.

All the following measurements shall be carried out on the best and the worst receivers of the six supplied with respect to sensitivity measured under normal conditions in the test fixture:

f) measurement of the co-channel rejection shall be carried out as described in Annex A, Clause A.3;

g) the measurement of the adjacent channel selectivity under normal and extreme conditions shall be carried out as described in Annex A, Clause A.4;

h) the measurement of the spurious response immunity shall be carried out as described in Annex A, Clause A.5;

i) the measurement of intermodulation immunity shall be carried out as described in Annex A, Clause A.6;

j) the measurement of the blocking immunity or desensitisation shall be carried out as described in Annex A, Clause A.7;

k) the measurements of quasi synchronous sensitivity combined with multipath shall be made at a simulated speed of 3 km/h. A second signal with the same data content but delayed 50 µs, 1 dB weaker and 30 Hz RF frequency offset shall be added. The reference test procedure is given in Annex A, Clause A.8;

l) channel switching: The average usable sensitivity shall be measured with the following test signal: A batch shall be transmitted consisting of 139 initial addresses numerically higher than the initial address of the receiver under test. This shall be immediately followed by the test message shown in subclause 8.1.1 transmitted on the appropriate channel (see ETS 300 133-4 [1], figure 2). Both shall be of the same batch type (i.e. same batch number), within the same subsequence and neither shall contain the home operator identity.

7 User functions

7.1 General

Receiver functions are qualified as essential or optional.

Essential functions shall be implemented in so far as they are relevant to the particular receiver paging category and shall be subject to type approval. Implementation of optional functions shall be left to the manufacturers' discretion.

The basic version receiver within each receiver paging category is the receiver offering only the essential functions.

Additional functions not mentioned in this standard are permitted provided that they do not conflict with the radio interface and do not adversely affect the functions listed in this standard.

Any additional functions incorporated into the receiver shall be declared by the manufacturer.

Each receiver shall be individually identifiable.

7.2 Radio Identity Code

Each receiver shall have one basic Radio Identity Code (RIC).

Further additional RICs may be incorporated so long as the full receiver specification is satisfied for each RIC.

Discrimination between calls on different RICs shall be offered.

7.3 Receiver paging categories

7.3.1 Tone only

A receiver providing this function shall respond to at least one combination of the alert signal indicator bits. Responses to the remaining seven alert indicator bits shall (if implemented) be clearly distinguishable.

7.3.2 Numeric

A receiver including this function shall provide for the reception of a 20 digit numeric message. The numeric character set is included in Annex C. Receivers having this function shall also have the tone-only function.

7.3.3 Alphanumeric

A receiver including this function shall provide for the reception of a 400 character text message. The alphanumeric character set is included in Annex C. Receivers having this function shall also have the numeric and the tone only functions.

7.3.4 Transparent data

A receiver including this function shall provide for the reception of an arbitrary data message.

7.4 Mandatory functions

7.4.1 Alert functions

Receivers shall respond to at least the type zero alert signal indicator (see ETS 300 133-4 [1], subclause 6.5.1.1) for each RIC.

Provision shall be made for manual termination of an alert signal.

7.4.2 Silent mode

It shall be possible for the user to inhibit the sounding of an audible alert. The receiver shall still receive and store paging calls even when the alert tone is set to silent mode.

7.4.3 Battery low indication

An indication shall be given of battery exhaustion.

7.5 Optional functions

Optional features, if implemented, shall conform with the relevant part of ETS 300 133-4 [1]. When not defined in this part of the ETS, manufacturers shall supply test methods and results demonstrating conformance.

7.5.1 Long message

All receiver categories (other than tone-only) may be capable of handling long messages.

7.5.2 Indication of lost message

All receiver categories, except tone-only, shall have the capability to detect message numbers (see ETS 300 133-4 [1], subclause 6.5.1) and compare the last received number with the number previously received. If there are one or more numbers missing an indication shall be given.

7.5.3 Urgent message indicator

Receivers shall indicate reception of an urgent message.

7.5.4 Message storage and retrieval

Receivers may have memory to store the information received. All receivers having this function shall be able to use the storage capacity for storing messages of varying length. It shall be possible for the stored messages to be retrieved.

7.5.5 Memory full

If the receiver memory is full the oldest message not protected against deletion should be erased. The memory management may be performed differently for the different RICs.

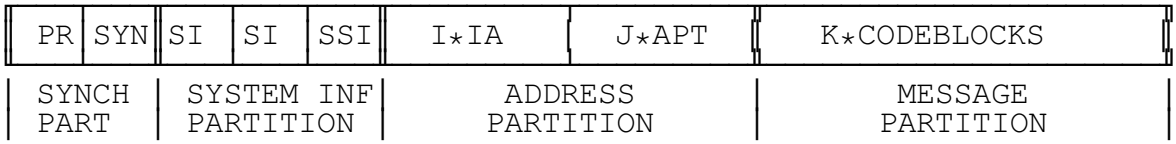
7.5.6 Repeated call indication

In the case where a receiver receives more than one transmission of a message an indication shall be given accordingly.

8 Tests for essential features

This section defines tests covering the essential requirements of ERMES receivers. All tests shall be performed with a signal level + 30 dB relative to the average usable sensitivity. Unless otherwise stated, the tests should be carried out after the receiver has reached steady state conditions. The best and worst (total of two) receivers of the six supplied shall be used for these tests.

The test protocol used in this Clause complies with ETS 300 133-4 [1]. Part of subclause 5.4 of that document is reproduced here to identify the test parameters.



PR	-	preamble word
SYN	-	synchronisation word
SI	-	system information word
SSI	-	supplementary system information word
IA	-	initial address
APT	-	address partition terminator
CODEBLOCK	-	interleaved message codeword
I	-	number of initial addresses
J	-	number of address partition terminators
K	-	number of codeblocks in the message partition

Codeword composition of a batch satisfies the following relationships:

$0 \leq I \leq 139$	
$J = 9 - MOD\{(4+I),9)\}$	where MOD {M,N} = M - N*INT(M/N) and INT returns the integer part of a number.
$K \leq (149 - I - J)/9$	first 15 batches of a subsequence.
$K \leq (185 - I - J)/9$	last batch of a subsequence.

8.1 Message reception in home network

The purpose of this section is to ensure that the receiver can receive a message in all legitimate locations within a transmission. The zone and operator details contained within the system information partition shall indicate home network transmissions to the receiver. The border area indicator shall be set to zero.

8.1.1 First message in batch

The receiver shall successfully receive a message which is located in the first possible position in the message partition. The test transmission shall be constructed as follows:

PR	SYN	SI	SI	SSI	IA	4*APT	MD	Message	MD

Message - a message appropriate to receiver under test.
MD - message delimiter.
"‖" - limits of partition.

8.1.2 Last message in batch

The receiver shall successfully receive a message which is located in the last possible position in the same batch. The test transmission shall be as follows:

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	FILL	MD	Message	MD

PAD - an Initial Address, higher than the receiver under test, used to occupy start of address partition.
FILL - codewords other than MD and having no EOM characters used to occupy inactive parts of the message partition.

8.1.3 Message continued in next batch

The receiver shall successfully receive a message which commences in one batch and finishes in the next. The sequence shown below has the message delimiter MD, which prefaces the message, as the last codeword in the first batch. The message is completed in the following batch:

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	FILL	MD

PR	SYN	SI	SI	SSI	PAD	4*APT	Message	MD

8.1.4 Message in last available batch

The receiver shall be capable of receiving a message which appears in any batch before the next addressing opportunity on that channel. The following test transmission illustrates the last possible position for a message.

NOTE: This may require transmissions on channels other than number 9.

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	FILL

followed by 14 batches constructed as:

PR	SYN	SI	SI	SSI	5*APT	FILL

and a final batch of:

	PR	SYN	SI	SI	SSI	4*PAD	APT	FILL	MD	Message	MD

The batch containing the message should be in the subsequence following the subsequence containing the initial address.

8.1.5 Tenure of message

The receiver shall be sent an .i.Initial Address; (IA) with the associated message delayed by 16 batches. The receiver shall not receive the message.

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	FILL	

followed by 15 batches constructed as:

	PR	SYN	SI	SI	SSI	5*APT	FILL	

and a final batch of:

	PR	SYN	SI	SI	SSI	4*PAD	APT	FILL	MD	Message	MD

8.1.6 Two messages in same batch

The receiver shall be capable of receiving two messages in the same transmission. The following test transmission illustrates a batch containing two messages for the same IA.

PR	SYN	SI	SI	SSI	2*PAD	IA	IA	APT	MD	Message1	MD	Message2	MD

8.1.7 Message continued in the next subsequence

Receiver shall successfully receive a message which commences in one subsequence and finishes in the next. The test transmission has the MD, which prefaces the message, as the last codeword in the last batch of the subsequence. The message shall be completed in the first batch of the next subsequence.

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	FILL	MD	

PR	SYN	SI	SI	SSI	PAD	4*APT	Message	MD

8.2 Message reception in non-home networks

The purpose of this section is to ensure that the receiver can receive messages in areas away from the home network.

8.2.1 Message reception on all ERMES channels

An external message, constructed as follows shall be successfully received by the receiver on each ERMES channel. The operator code shall not be recognisable to the receiver.

PR	SYN	SI	SI	SSI	IA	4*APT	MD	Message	MD

Bit and word synchronisation shall not be maintained between channels and at least two transmissions shall be at the extreme of allowable network co-ordination (see ETS 300 133-4 [1], subclause 13.4).

8.2.2 Recognition of zone code

A transmission shall be constructed which contains a message to a home receiver with the same local address as the receiver under test. The zone code in the SSI word shall be different from the home zone of the receiver. The receiver shall not receive the message.

8.2.3 Two messages in the same batch

The receiver shall successfully receive a message when the batch also contains a message to a home receiver with the same local address. A transmission shall be constructed as below. Message 1 is for the home receiver, message 2 is for the external receiver under test.

NOTE: The PAD in this case will be an initial address lower than that of the receiver under test.

PR	SYN	SI	SI	SSI	IA	IA	2*PAD	APT	MD	Message1	MD	Message2	MD

8.2.4 Message reception in overlap regions (BAI=1)

A continuous transmission indicating the home network shall be sent to the receiver. The BAI shall be set to one. The receiver shall then successfully receive an external message on another channel as illustrated below.

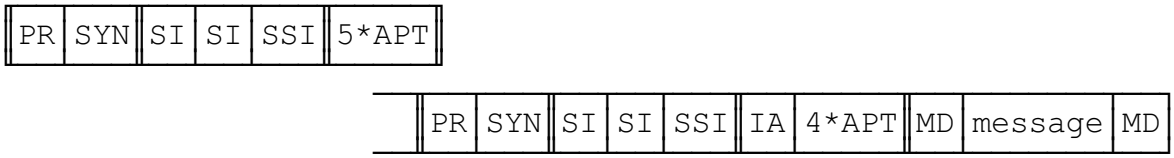
PR	SYN	SI	SI	SSI	5*APT

	PR	SYN	SI	SI	SSI	IA	4*APT	MD	message	MD

8.2.5 Message reception in overlap regions (BAI=0)

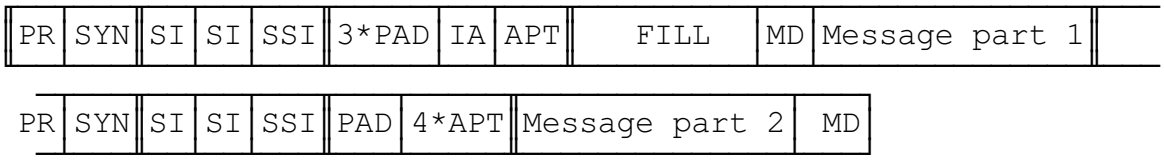
A continuous transmission indicating the home network shall be sent to the receiver. The BAI shall be set to zero. The reception quality on the channel shall then be reduced to a level corresponding to a call success rate not less than 60 %. The receiver shall then successfully receive an external message on another channel as illustrated below.

The method to simulate insufficient quality of reception (BER, codeword error rate, erroneous system information) and the time constraints shall be stated by the receiver manufacturer.



8.3 Maximum length message

A receiver offering the numeric feature shall be capable of receiving a 20 character numeric message. 400 character messages must be received by receivers offering the alphanumeric feature. The message shall be sent as shown below:



The message shall be split equally between the end of the first batch and the start of the next batch.

The message shall consist of every character specified in Annex C except DC1, repeated as necessary to form a 400 character message. The receiver shall be examined to ensure the characters have been presented correctly. The control characters ESC, LF, and CR shall not cause any character to be displayed. If the control characters are used in conjunction with any other characters specified by the manufacturer, these combinations shall not be sent for this test.

8.4 Alert function

A message as defined in subclause 8.1.1 shall be sent to the receiver. The receiver shall successfully receive the message.

8.4.1 Normal operation

The receiver shall give an alert when the alert signal indicator bits in the message header are set to 000. The other alert bit combinations shall also be tested. If the receiver gives an alert to one or more of them, the alerts shall be clearly distinguishable.

8.4.2 Silent mode operation

The receiver shall have a switch by which it can be set to silent mode i.e. no audible alert given.

The silent mode shall not affect the receiver's other operations. The effect of all alert bit combinations in the silent mode shall be tested and compared to normal operation as defined in subclause 8.4.1.

8.5 Termination of numeric messages

A receiver offering a numeric feature shall not present any character of the numeric message after having received a codeword in error.

A message as defined in subclause 8.1.1 shall be sent to the receiver. The receiver shall successfully receive the message.

In the message part after the message header, 18 numeric characters shall be transmitted namely 123456789012345678. The second codeword shall contain three bits in error. The receiver shall present characters 1234. In the message header the external bit and All shall both be set to zero.

8.6 Termination of alphanumeric messages

A receiver offering an alphanumeric feature shall not present any subsequent character after having received in error:

- the EOM character; or
- the Message Delimiter; or
- two consecutive codewords.

NOTE: A codeword in error is defined as having three bits in error.

A message constructed as follows shall be sent to the receiver:

PR	SYN	SI	SI	SSI	IA	4*APT	MD	message	EOM	MD	3*characters

The receiver shall not present any subsequent characters after transmissions containing the following errors:

(a) the codeword containing the EOM is in error;
(b) the message delimiter is in error;
(c) both the codeword containing the EOM and the message delimiter are in error.

8.7 Repeated call indication

A message as defined in subclause 8.1.1 shall be sent to the receiver. The receiver shall successfully receive the message. The transmission shall be repeated with an identical message and message number. The receiver shall give an appropriate indication.

8.8 Group call

The receiver shall be capable of receiving a group message which appears in any batch before the next addressing opportunity on that channel. The transmission shown below illustrates the last possible position for a message.

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	MD	Message 1	MD	FILL

followed by 14 batches constructed as:

PR	SYN	SI	SI	SSI	5*APT	FILL

and a final batch of:

PR	SYN	SI	SI	SSI	4*PAD	APT	FILL	MD	Group Message	MD

Message 1 contains the CTAP in accordance with ETS 300 133-4 [1], subclause 11.3. The receiver shall successfully respond to group messages which contains the CTA in the message header. The test shall be repeated for all values of CTAP.

8.9 Tenure of group message

The receiver shall not receive a group message which appears any later than the batch before the next addressing opportunity on that channel. The following transmission shall be transmitted to the receiver.

PR	SYN	SI	SI	SSI	3*PAD	IA	APT	MD	Message 1	MD	FILL	

followed by 15 batches constructed as:

PR	SYN	SI	SI	SSI	5*APT	FILL	

and a final batch of:

PR	SYN	SI	SI	SSI	4*PAD	APT	FILL	MD	Group Message	MD

The contents of message 1 and the group message shall be identical to subclause 8.8. The receiver shall not respond to the group message.

8.10 Low battery indication

The receiver shall be supplied from a variable source set to the nominal voltage. The voltage shall be reduced to the lower extreme test voltage + 10 %. No low battery indication shall be given. The voltage shall then be reduced at a suitable rate until an indication of low battery is given. The indication shall be given before the supply voltage is reduced below the lower extreme test voltage - 10 %.

8.11 Battery life

Battery life under the following three conditions shall be calculated by measuring the average current consumption at the nominal battery voltage. The battery life shall be recorded as:

$$\frac{\text{nominal battery capacity}}{\text{average current consumption}}$$

The nominal battery capacity shall be stated by the manufacturer.

8.11.1 No signals on any channel

The receiver shall be switched on and isolated from any transmissions. The average current consumption shall be measured.

8.11.2 Unloaded system

The receiver shall receive the transmission illustrated below for one subsequence per cycle. No other transmissions shall be sent.

PR	SYN	SI	SI	SSI	5*APT

The system information shall indicate the home operator of the receiver. The average current consumption shall be measured with the BAI equal to 0 and repeated with the BAI equal to 1.

8.11.3 Fully loaded system

The receiver shall receive the transmission illustrated below, in every batch it is capable of receiving, on all ERMES channels.

PR	SYN	SI	SI	SSI	2*PAD	3*APT

The system information shall not indicate the home operator of the receiver and 5 % of batches shall have the External Traffic Indicator (ETI) equal to 1. The average current consumption shall be measured.

8.12 Network acquisition time

The time in which a receiver is unable to receive calls shall be recorded for the following conditions.

8.12.1 Time from receiver switch on

The transmission specified in subclause 8.1.1 shall be transmitted continuously in the appropriate batch. All other batches shall be as shown in subclause 8.11.2. The receiver shall be switched on and the time before the receiver alerts shall be recorded.

8.12.2 Time from loss of signal

The test signal shall be continuous messages as specified in subclause 8.12.1. The transmissions shall be suspended for a period exceeding 10 minutes. The message number shall be incremented by 1 and the time, from resumption of transmissions until the receiver gives an alert, shall be recorded.

8.13 RSVD Bits

Receiver behaviour shall not be modified by any combination of RSVD bit values.

9 Tests for optional features

This section defines tests covering some optional features of ERMES receivers. Where a receiver offers these features they shall conform with the tests in this section. All tests shall be performed with a signal level + 30 dB relative to the average usable sensitivity. Unless otherwise stated, the tests should be carried out after the receiver has reached steady state conditions.

9.1 Operation of long message option

Where this option is provided the manufacturer shall state the longest message that the receiver is capable of receiving. A message of this size shall be split into at least four submessages of different length. The submessages shall be transmitted to the receiver in accordance with subclause 8.1.1 and ETS 300 133-4 [1] subclause 11.4. The test shall be repeated for all combinations of Additional Information Number (AIN) and the results shall be recorded.

9.2 Indication of lost message

The receiver shall be sent a transmission as specified in subclause 8.1.1. The message number shall be increased by 4 and the message sent again to the receiver. The receiver shall indicate that messages are missing.

9.3 Urgent message indicator

The receiver shall be sent a transmission as specified in subclause 8.1.1. The Urgent Message Indicator (UMI) shall be equal to 1. The receiver shall indicate the reception of an urgent message.

9.4 Message storage

Where storage of messages is provided by the receiver the following minimum capacity shall be present:

Feature	Number of Messages	Storage Capacity
Tone only	8	
Numeric	10	200 digits
Alphanumeric	10	1000 characters

The receiver shall be sent sufficient messages to verify that the requirements are met.

9.5 Memory full

Where receivers are supplied with a message storage feature, the memory shall be filled by transmission of messages to the receiver. An additional message shall then be transmitted. The memory contents shall be retrieved to verify that the oldest message has been deleted and the latest message retained.

Annex A (normative): Measurement procedures

A.1 Average measured usable sensitivity expressed as field strength

A.1.1 Definition

The average measured usable sensitivity expressed as field strength for messages is the average of eight measurements of field strength, expressed in dBµV/m, at the nominal frequency of the receiver and with specified test modulation which produces after demodulation a message acceptance ratio of 80 %, when the receiver is rotated in 45° increments, starting at the reference orientation.

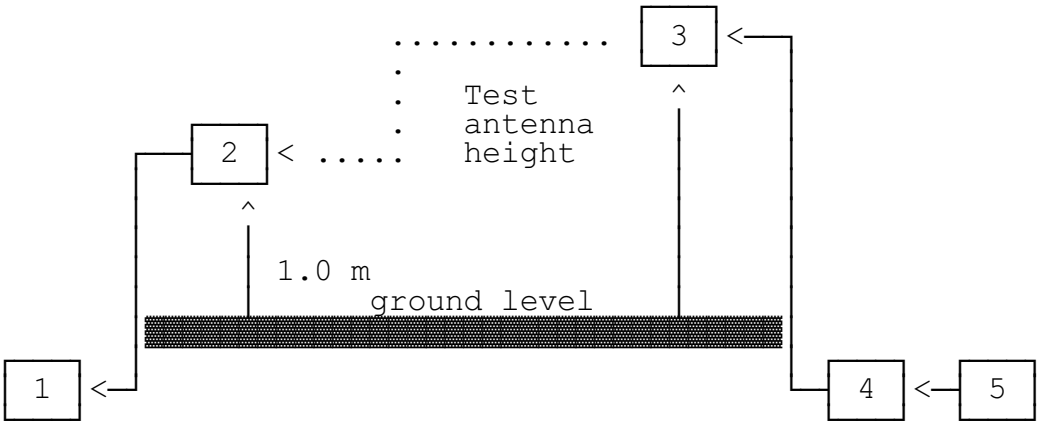
For the purposes of this Annex, the following definition shall apply:

Successful alphanumeric message - recovery of a 55 character message with a maximum of four contiguous characters in error. The full error capability of the code may be used.

(Successful tone only and numeric messages shall comply with the definition given in subclause 5.5).

A.1.2 Method of measurement

This measurement method produces after demodulation a message acceptance ratio of 80 %.



1. Response measuring test set.
2. Receiver under test.
3. Test antenna.
4. Signal generator.
5. Message generator.

Figure A.1: Measurement arrangement No. 1 (Clause A.1)

a) A test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented for vertical polarisation and shall not be varied in height.

A signal generator shall be connected to the test antenna. The signal generator shall be at the nominal frequency of the receiver and shall be modulated by the test paging signal (see subclause 5.5). The receiver under test shall be placed on the "simulated man" (see Annex B (normative)) at 1,0 ± 0,1 metre above ground level and oriented so that a face, specified by the manufacturer, is normal to the direction of the test antenna. This is the reference orientation for the measurement.

b) The level of the RF signal shall be such that a successful message response ratio of less than 10 % is obtained.

c) The test paging signal shall be transmitted repeatedly while observing in each case whether or not a successful response is obtained. The input level shall be increased by 2 dB for each occasion that a successful response is not obtained. The procedure shall be continued until three consecutive successful responses are observed.

d) The input signal level shall be reduced by 1 dB and the new value recorded. The test paging signal shall then be continuously repeated. In each case, if a response is not obtained, the input level shall be increased by 1 dB and the new value recorded. If a successful response is obtained, the input level shall not be changed until three consecutive successful responses have been observed. In this case, the input level shall be reduced by 1 dB and the new value recorded. No input signal levels shall be recorded unless preceded by a change in level. The measurement shall be stopped after 10 changes of level have been recorded.

e) The average of the dB values recorded in step d) shall be calculated.

f) Steps b) to e) above shall be repeated for the eight positions, 45° apart, of the receiver and the corresponding average values of the generator output shall be determined and noted.

g) Using the calibration of the test site, calculate the eight field strengths X_i (µV/m) corresponding to the eight average values determined in step f). The average measured usable sensitivity expressed as field strength X_{mean} (dBµV/m) is given by:

$$X_{mean} = 20 \log \left[\frac{8}{\sum_{i=1}^{i=8} (1 / X_i^2)} \right]$$

h) Using the test fixture shown in measuring arrangement No. 2 of figure A.2, the measurement may also be performed under extreme test conditions.

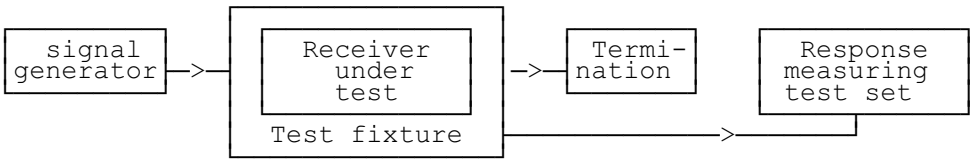


Figure A.2: Measurement arrangement No. 2 (Clause A.1)

i) The test signal input level providing a message acceptance ratio of 80 % is determined under normal and extreme test conditions and the difference in dB is recorded.

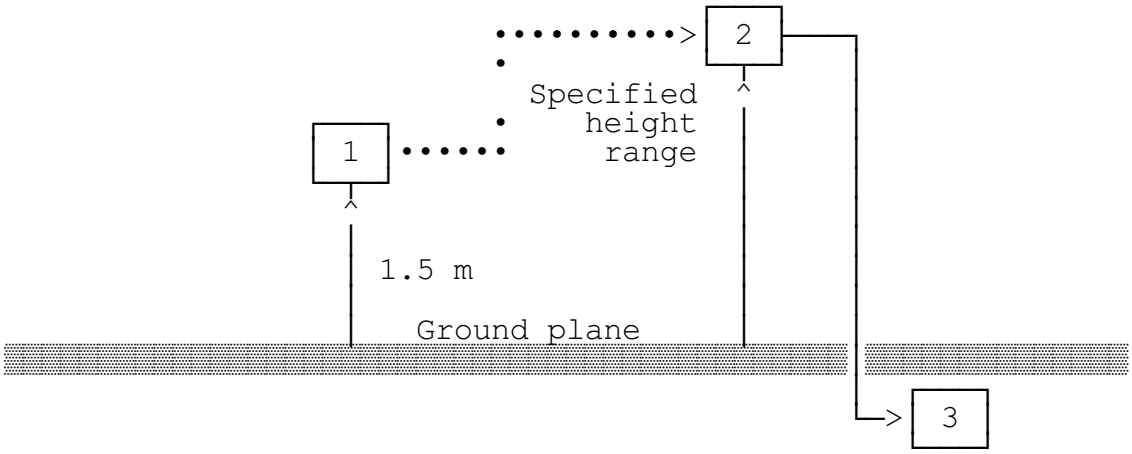
A.2 Radiated spurious components

A.2.1 Definition

Radiated spurious components are emissions radiated by the antenna and the cabinet of the receiver. They are specified as the radiated power of any discrete signal.

A.2.2 Method of measurement

This method of measurement applies to receivers having an integral antenna. The following method produces, after demodulation, a message acceptance ratio of 80 %.



1 : Receiver under test.
2 : Test antenna.
3 : Spectrum analyser or selective voltmeter.

Figure A.3: Measurement arrangement No. 1 (Clause A.2)

a) A test site which fulfils the requirements of the specified frequency range of this measurement shall be used. The test antenna shall be oriented for vertical polarisation and connected to a spectrum analyser or a selective voltmeter. The bandwidth of the spectrum analyser or selective voltmeter shall be between 10 kHz and 100 kHz. The specified height range of the test antenna above the ground plane shall be between 1,0 metres and 3,0 metres.

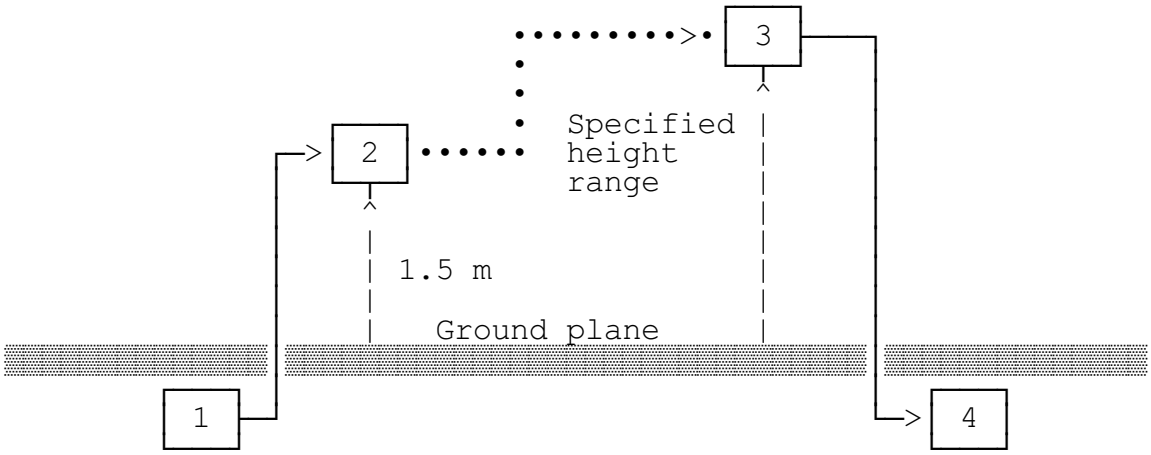
   The receiver under test shall be placed on a non-conducting support in its standard position.

b) The radiation of any spurious component shall be detected by the test antenna and receiver over the specified frequency range. The frequency of each spurious component shall be recorded. If the test site is disturbed by radiation coming from outside, this qualitative search may be performed in a screened room with reduced distance between the transmitter and the test antenna.

c) At each frequency at which a component has been detected, the spectrum analyser or selective voltmeter shall be tuned and the test antenna shall be raised or lowered through the height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter.

d) The receiver shall be rotated up to 360° about a vertical axis, until higher maximum signal is received.

e) The test antenna shall be raised or lowered again through the specified height range until a maximum is obtained. This level shall be recorded.



1 : Signal generator.
2 : Substitution antenna.
3 : Test antenna.
4 : Spectrum analyser or selective voltmeter.

Figure A.4: Measurement arrangement No. 2 (Clause A.2)

f) Using measurement arrangement No. 2 of figure A.4, the substitution antenna shall replace the receiver antenna in the same position and in vertical polarisation. It shall be connected to the signal generator.

g) For each frequency at which a component has been detected, the signal generator and spectrum analyser or selective voltmeter shall be tuned and the test antenna shall be raised or lowered through the specified height range until the maximum signal level is detected on the spectrum analyser or selective voltmeter. The level of the signal generator giving the same signal level on the spectrum analyser or selective voltmeter as in item e) above shall be recorded. This value, after correction due to the gain of the substitution antenna and the cable loss between the signal generator and the substitution antenna, is the radiated spurious component at this frequency.

h) Measurements b) to g) above shall be repeated with the test antenna oriented in horizontal polarisation.

A.3 Co-channel rejection

A.3.1 Definition

Co-channel rejection is a measure of the capability of the receiver to receive a wanted modulated signal at the nominal frequency without exceeding a given degradation due to the presence of an unwanted modulated signal also at the nominal frequency.

It is defined as the ratio in decibels of the level of the unwanted signal to the specified wanted signal level at the receiver input, for which the message acceptance ratio is 80 %. The wanted signal level shall correspond to the reference figure.

A.3.2 Method of measurement

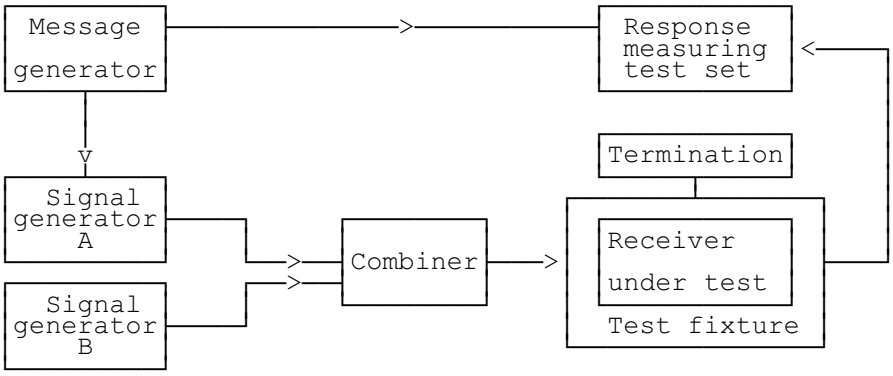


Figure A.5: Measurement arrangement (Clause A.3)

a) Two signal generators A and B shall be connected to the receiver input via a combining network. The wanted signal, represented by the 4-PAM/FM signal generator A, shall be at the nominal frequency of the receiver and shall be modulated by the test paging signal defined in subclause 5.5. The unwanted signal, represented by signal generator B, shall have the test modulation defined in Annex B, Clause B.2. Both input signals shall be at the nominal frequency of the receiver under test.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the wanted signal level when measured at the receiver input.

c) Generator B, shall then be switched on, and its input level adjusted until a message response ratio of less than 10 % is obtained.

d) The wanted signal shall then be transmitted whilst observing the message response ratio. The level of the unwanted signal shall be reduced in steps of 1 dB until a message response ratio of 80 % or better is obtained. The level of the unwanted signal shall then be recorded.

e) The co-channel rejection ratio for messages shall be recorded as the ratio in dB of the levels of the wanted signal to the level of the unwanted signal, at the receiver input.

A.4 Adjacent channel

A.4.1 Definition

The adjacent channel selectivity for paging messages is a measure of the capability of the receiver to receive a wanted signal at the nominal frequency modulated by a test signal without exceeding a given degradation due to the presence of an unwanted modulated signal which differs in frequency from the wanted signal by an amount equal to the adjacent channel separation for which the equipment is intended. The wanted signal level shall correspond to the reference figure.

It is defined as the lower value of the ratios in dB for the upper and lower adjacent channels of the level of the unwanted signal to a specified level of the wanted signal for which the message acceptance ratio is 80 %.

A.4.2 Method of measurement

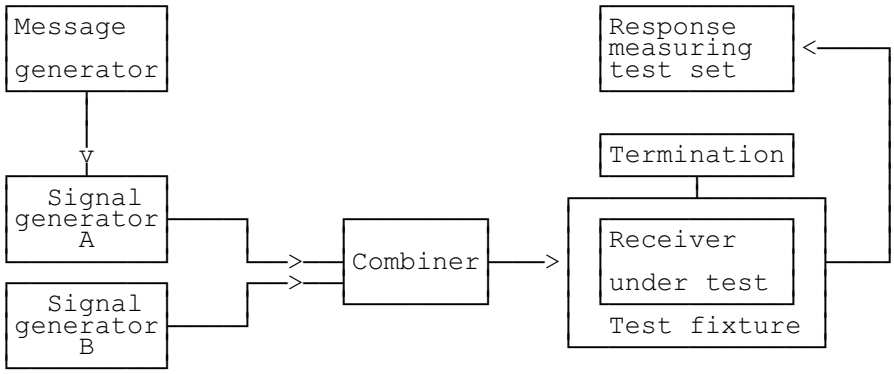


Figure A.6: Measurement arrangement (Clause A.4)

a) Two signal generators, A and B shall be connected to the receiver via a combining network. The wanted signal, produced by the 4-PAM/FM signal generator A, shall be at the nominal frequency of the receiver and shall be modulated with the test signal defined in subclause 5.5. The unwanted signal, produced by signal generator B, shall have the modulation defined in Annex B, Clause B.2 and shall be adjusted to the frequency of the channel immediately above that of the wanted signal.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the wanted signal level when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded.

e) The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

f) The measurement shall be repeated with the unwanted signal at the frequency of the channel below that of the wanted signal.

g) The adjacent channel selectivity for messages shall be recorded for the upper and lower adjacent channels as the average of the levels of the unwanted signal recorded in steps d) and e) to the level of the wanted input signal.

h) The measurement shall be repeated under extreme test conditions using the relevant value of the wanted signal level.

A.5 Spurious response immunity

A.5.1 Definition

The spurious response immunity for paging messages is a measure of the capability of the receiver to discriminate between the wanted signal modulated by a test signal at the nominal frequency and an unwanted signal at any other frequency at which a response is obtained. Unwanted signal frequencies shall

be tested from 100 kHz to 1 GHz except for frequencies within 25 kHz of the wanted frequency. The wanted signal level shall correspond to the reference figure.

Spurious response immunity is defined as the level of the unwanted signal for which the message acceptance ratio is 80 %.

A.5.2 Method of measurement

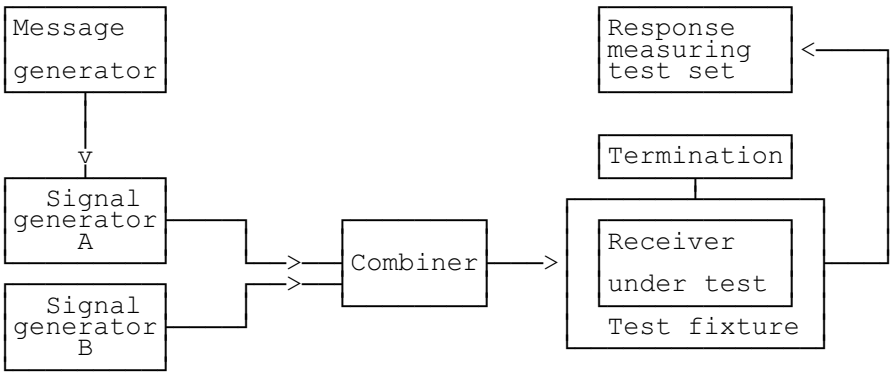


Figure A.7: Measurement arrangement (Clause A.5)

a) Two signal generators, A and B shall be connected to the receiver via a combining network. The wanted signal, produced by the 4-PAM/FM signal generator A, shall be at the nominal frequency of the receiver and shall have the test modulation defined in subclause 5.5. The unwanted signal, produced by signal generator B, shall have the signal format defined in Annex B, Clause B.2 and shall be adjusted to a frequency within the specified frequency range at which it is calculated that a spurious response could occur.

b) Initially signal generator B shall be switched off. The amplitude of signal generator A shall be adjusted to the wanted signal level when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The input level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded.

e) The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

f) The measurement shall be repeated at each frequency within the specified frequency range at which it is calculated that a spurious response could occur.

g) The spurious response immunity for messages shall be recorded for the frequency concerned as the average of the levels of the unwanted signal recorded in steps d) and e) and expressed as the ratio in dB with respect to 1µV/m.

A.6 Intermodulation immunity

A.6.1 Definition

The intermodulation immunity for paging signals is a measure of the capability of a receiver to receive a wanted signal at the nominal frequency modulated by a test signal without exceeding a given degradation due to the presence of two or more unwanted signals with a specific frequency relationship to the wanted signal frequency.

For the purpose of this measurement it is defined as the ratio in dB of the common level of two equal unwanted signals to a specified level of the wanted signal at the receiver input, for which the message acceptance ratio is 80 %. The amplitude of the wanted signal shall correspond to the reference figure.

A.6.2 Method of measurement

a) Three signal generators, A, B and C shall be connected to the receiver via a combining network. The wanted signal, represented by the 4-PAM/FM signal generator A, shall be at the nominal frequency of the receiver and shall have the test modulation defined in subclause 5.5. The first unwanted signal, represented by the signal generator B, shall be unmodulated and adjusted to the frequency 50 kHz above the nominal frequency of the receiver. The second unwanted signal, represented by the signal generator C, shall have the test modulation defined in Annex B, Clause B.2 and shall be adjusted to a frequency 100 kHz above the nominal frequency.

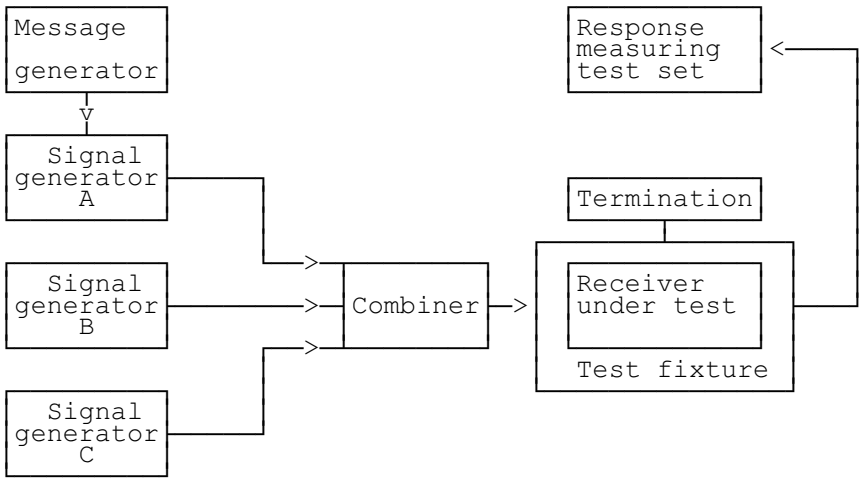


Figure A.8: Measurement arrangement (Clause A.6)

b) Initially signal generators B and C will be switched off and the amplitude of signal generator A shall be adjusted to the wanted signal level when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and signal generators B and C shall be switched on. The output levels of the two signal generators shall be maintained equal and adjusted to a value such that a successful message ratio of less then 10 % is obtained.

d) The levels of the unwanted signals shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded.

e) The unwanted input signals shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case if a response is not obtained the level of the unwanted signals shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signals shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signals shall be increased by 1 dB and the new value recorded. No levels of the unwanted signals shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

f) The intermodulation immunity for messages shall be recorded as the average of the levels of the unwanted signals recorded in steps d) and e) and expressed as the ratio in dB with respect to 1 µV/m.

g) The measurements shall be repeated with the unwanted signal generator B at the frequency 50 kHz below that of the wanted signal and the frequency of the unwanted signal generator C at the frequency 100 kHz below that of the wanted signal.

A.7 Blocking immunity

A.7.1 Definition

Blocking immunity for paging messages is a measure of the capability of the receiver to receive the wanted modulated signal at the nominal frequency without exceeding a given degradation due to the presence of an unwanted unmodulated high input signal.

It is defined as the level of the unwanted signal for which the message acceptance ratio is 80 %. The wanted signal amplitude shall correspond to the reference figure.

A.7.2 Method of measurement

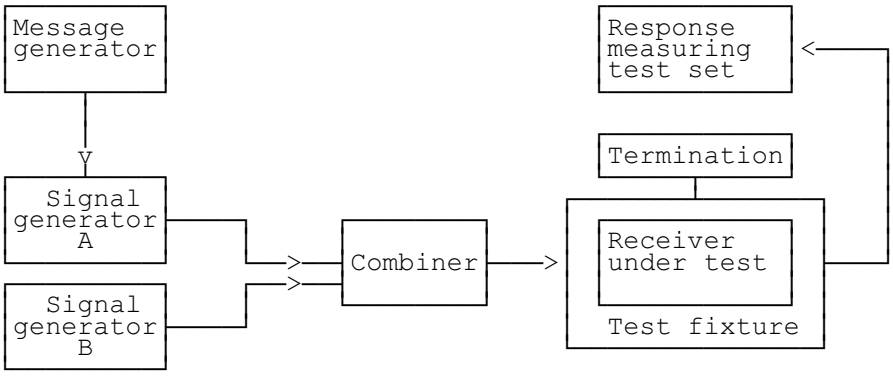


Figure A.9: Measurement arrangement (Clause A.7)

a) Two signal generators A and B shall be connected to the receiver input via a combining network. The wanted signal, represented by the 4-PAM/FM signal generator A, shall be at the nominal frequency of the receiver and shall have the test modulation defined in subclause 5.5.

b) Initially the unwanted signal, represented by the signal generator B, shall be switched off and the amplitude of signal generator A shall be adjusted to the wanted signal level when measured at the receiver input.

c) The wanted signal shall then be transmitted repeatedly and the signal generator B shall be switched on. The unwanted signal shall be unmodulated and its frequency shall be selected in the range + 1 MHz ± 10 % relative to the nominal frequency of the receiver. This frequency shall be one at which no spurious response has been detected. The level of the unwanted signal shall be adjusted until a successful message ratio of less than 10 % is obtained.

d) The level of the unwanted signal shall be reduced by 2 dB for each occasion that a successful response is not observed. The procedure shall be continued until three consecutive successful responses are observed. The level of the input signal shall then be recorded.

e) The unwanted input signal shall then be increased by 1 dB and the new value recorded. The wanted signal shall then be continuously repeated. In each case if a response is not obtained the level of the unwanted signal shall be reduced by 1 dB and the new value recorded. If a successful response is obtained, the level of the unwanted signal shall not be changed until three consecutive successful responses have been obtained. In this case the unwanted signal shall be increased by 1 dB and the

new value recorded. No levels of the unwanted signal shall be recorded unless preceded by a change in level. The measurement shall be stopped after a total of 10 values have been recorded.

f) Repeat the measurements for frequency of the unwanted signal selected in the range - 1,1 MHz ± 10 % relative to the nominal frequency of the receiver.

g) The blocking level for messages is recorded as the lower value of the ratios in dB, of the two measurements above, of the unwanted signal recorded in steps d) and e) relative to 1 µV/m.

A.8 Combined multipath and quasi synchronous transmissions

A.8.1 Definition

The multipath combined with simulcast sensitivity of the receiver is the rms value of the level of the stronger Rayleigh fading signal, at the receiver input, at the nominal frequency of ERMES channel 9 with normal ERMES test modulation signal and a produced successful message ratio of 80 %. The wanted signal level shall correspond to the reference figure.

A.8.2 Method of measurement

a) The two 4-PAM/FM signal generators (A and B) shall be connected to the receiver under test via Rayleigh fading simulators and a combiner. The signal from generator A shall be on the nominal RF frequency and the signal from generator B on the nominal frequency + 30 Hz. The fading simulators shall be adjusted for the simulated speed of 3 km/h. The difference in contribution to the signal strength from the signal generators shall be 1 dB, (higher signal from signal generator A).

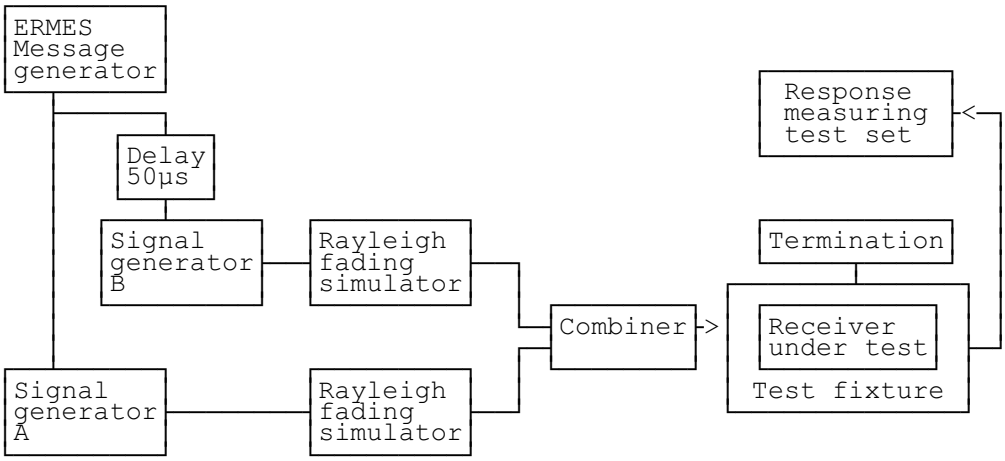


Figure A.10: Measurement set-up (Clause A.8)

The delay between the two signals shall be 50 µsec.

b) The method of measurement of measured usable sensitivity for messages specified in Annex A, Clause A.1 steps b) through e) shall then be used with the exception that 50 values instead of 10 should be recorded.

c) The sensitivity figure shall be recorded as the ratio in dB of the value recorded in step b) above and the reference figure.

Annex B (normative): Ancillary test data

B.1 Simulated man

The simulated (sometimes known as "salty") man comprises a rotatable acrylic tube filled with salt water placed on the ground.

The container shall have the following dimensions:

Height	1,7 ± 0,1 m
Inside diameter	300 ± 5 mm
Sidewall thickness	5 ± 0,5 mm

The container shall be filled with a salt (NaCl) solution of 1,5 g per litre of distiled water.
The equipment shall be fixed to the surface of the simulated man, at the appropriate height for the equipment.

B.2 Definition of unwanted test signal

The unwanted signal shall be a carrier frequency modulated by a sinusoidal signal with a 6 kHz peak to peak deviation. The centre frequency and amplitude of this unwanted test signal shall be as specified in the respective test.

Annex C (normative): Character sets in the ERMES system

C.1 Characters for numeric paging

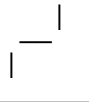
Numerical messages are coded with 4 bits per character. A numeric or alphanumeric receiver shall be capable of presenting the characters of table C.1.

Table C.1

b4	b3	b2	b1	Character
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	/
1	0	1	1	(space)
1	1	0	0	U
1	1	0	1	- (hyphen)
1	1	1	0	.(full stop)
1	1	1	1	%

NOTE: The characters of this set, when displayed, should approximate to the appearance of the relevant characters specified in ISO standard 1073. For a simple seven segment display the symbols "/", "." and "%" should be represented in the following way:

Table C.2

b4	b3	b2	b1	Character	Representation
1	0	1	0	/	
1	1	1	0	. (full stop)	
1	1	1	1	%	

Better representations of these characters may be used.

C.2 Characters for alphanumeric paging

Alphanumeric characters shall be coded with 7 bits per character.

All alphanumeric receivers shall use the character set in table C.3.

Table C.3

				b7	0	0	0	0	1	1	1	1
				b6	0	0	1	1	0	0	1	1
				b5	0	1	0	1	0	1	0	1
b4	b3	b2	b1		0	1	2	3	4	5	6	7
0	0	0	0	0	@	Δ	SP	0	¡	P	¿	p
0	0	0	1	1	£	DC1	!	1	A	Q	a	q
0	0	1	0	2	$	Φ	"	2	B	R	b	r
0	0	1	1	3	¥	Γ	#	3	C	S	c	s
0	1	0	0	4	è	Λ	¤	4	D	T	d	t
0	1	0	1	5	é	Ω	%	5	E	U	e	u
0	1	1	0	6	ù	Π	&	6	F	V	f	v
0	1	1	1	7	ì	ψ	'	7	G	W	g	w
1	0	0	0	8	ò	Σ	(	8	H	X	h	x
1	0	0	1	9	Ç	θ	)	9	I	Y	i	y
1	0	1	0	10	LF	Ξ	*	:	J	Z	j	z
1	0	1	1	11	Ø	ESC	+	;	K	Ä	k	ä
1	1	0	0	12	ϕ	Æ	,	<	L	Ö	l	ö
1	1	0	1	13	CR	æ	-	=	M	Ñ	m	ñ
1	1	1	0	14	Å	ß	.	>	N	Ü	n	ü
1	1	1	1	15	å	É	/	?	O	§	o	à

NOTE 1: DC1 shall be used only at the End Of Message (EOM) character.

NOTE 2: The characters of this set, when displayed, should approximate to the appearance of the relevant characters specified in ISO 1073 [2] and the corresponding national standards.

History

Document history	
July 1992	First Edition
January 1996	Converted into Adobe Acrobat Portable Document Format (PDF)