BS ISO 11452-9:2012

BSI Standards Publication

Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy

Part 9: Portable transmitters

raising standards worldwide™

National foreword

This British Standard is the UK implementation of ISO 11452-9:2012.

The UK participation in its preparation was entrusted to Technical Committee AUE/16, Electrical and electronic equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 58062 8

ICS 33.100.20; 43.040.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2012.

Amendments issued since publication

Date	Text affected

BS ISO 11452-9:2012

INTERNATIONAL STANDARD

ISO 11452-9

First edition
2012-05-15

Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 9: **Portable transmitters**

Véhicules routiers — Méthodes d'essai d'un équipement soumis à des perturbations électriques par rayonnement d'énergie électromagnétique en bande étroite —

Partie 9: Émetteurs portables

Reference number
ISO 11452-9:2012(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11452-9 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 3, *Electrical and electronic equipment*.

ISO 11452 consists of the following parts, under the general title *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy*:

— *Part 1: General principles and terminology*

— *Part 2: Absorber-lined shielded enclosure*

— *Part 3: Transverse electromagnetic mode (TEM) cell*

— *Part 4: Harness excitation methods*

— *Part 5: Stripline*

— *Part 7: Direct radio frequency (RF) power injection*

— *Part 8: Immunity to magnetic fields*

— *Part 9: Portable transmitters*

— *Part 10: Immunity to conducted disturbances in the extended audio frequency range*

— *Part 11: Reverberation chamber*

Introduction

Immunity measurements of complete road vehicles can generally only be carried out by the vehicle manufacturer, owing to, for example, high costs of absorber-lined shielded enclosures, the desire to preserve the secrecy of prototypes or a large number of different vehicle models.

For research, development and quality control, a laboratory measuring method can be used by both vehicle manufacturers and equipment suppliers to test electronic components.

Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy —

Part 9:
Portable transmitters

1 Scope

This part of ISO 11452 specifies test methods and procedures for testing electromagnetic immunity to portable transmitters of electronic components for passenger cars and commercial vehicles, regardless of the propulsion system (e.g. spark-ignition engine, diesel engine, electric motor). The device under test (DUT), together with the wiring harness (prototype or standard test harness), is subjected to an electromagnetic disturbance generated by portable transmitters inside an absorber-lined shielded enclosure, with peripheral devices either inside or outside the enclosure. The electromagnetic disturbances considered are limited to continuous narrowband electromagnetic fields.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 11452-1, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology*

Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz). International Commission on Non-Ionizing Radiation Protection (ICNIRP)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 11452-1 apply.

4 Test conditions

The applicable frequency range of the test method is 26 MHz to 5,85 GHz.

The user of this International Standard shall specify the test severity level or levels over the frequency bands. The test severity level shall take into account

— typical portable transmitter characteristics (frequency bands, power level and modulation), given in Annex A, and

— the characteristics of the antenna(s) used for this test.

NOTE Users of this International Standard are advised that Annex A is for information only and cannot be considered as an exhaustive description of various portable transmitters available in all countries.

Standard test conditions are given in ISO 11452-1 for the following:

— test temperature;

— supply voltage;

— dwell time;

— test signal quality.

5 Test location

The purpose of such an enclosure is to create an isolated electromagnetic compatibility test facility which simulates open field testing. Basically, an absorber-lined shielded enclosure consists of a shielded room with absorbing material on its internal reflective surfaces, optionally excluding the floor. The design objective is to attenuate the reflected energy in the test area by at least 10 dB compared with the direct energy.

6 Test instrumentation

6.1 General

The field-generating device can be

— commercial portable transmitters with integral antennas, or

— simulated portable transmitters, with an antenna used as described in 6.3.4 and an amplifier.

To reduce test error, the operation of the DUT is usually monitored by fibre-optic couplers.

Test personnel shall be protected in accordance with ICNIRP Guidelines.

NOTE National or other regulations can apply.

6.2 Commercial portable transmitters

Commercial portable transmitters having an integral antenna are a convenient and readily available field-generating device.

6.3 Simulated portable transmitters

6.3.1 General

Simulated portable transmitters consist of

— radio frequency (RF) signal generating equipment, and

— RF power monitoring equipment and antennas.

6.3.2 RF signal generating equipment

Signal sources with internal or external modulation capability.

Power amplifier(s): multiple RF amplifiers may be required to cover the range of test frequencies.

6.3.3 RF power monitoring equipment

An in-line power meter is required when using simulated portable transmitters for measuring power to the antenna. Both forward and reverse power shall be measured and recorded.

6.3.4 Antennas

Unless otherwise specified, the simulated portable transmitter antenna characteristics shall be a passive antenna as detailed in B.2. Examples of other antennas which may be used are presented in Annex B.

All antennas should be tuned for a minimum voltage standing wave ratio (VSWR) of typically less than 4:1 unless otherwise specified in the test plan. The resulting VSWR has to be compatible with the design of the RF source. As a minimum, the VSWR value shall be recorded at the lower and upper band edges and at middle frequency.

6.4 Stimulation and monitoring of the DUT

The DUT shall be operated in accordance with the test plan by actuators which have a minimum effect on the electromagnetic characteristics.

EXAMPLE Plastic blocks on the push-buttons, pneumatic actuators with plastic tubes.

Connections to equipment monitoring electromagnetic interference reactions of the DUT may be accomplished by using fibre-optics or high-resistance leads. Other types of leads may be used but require extreme care to minimize interactions. The orientation, length and location of such leads shall be carefully documented to ensure repeatability of test results.

CAUTION — Any electrical connection of monitoring equipment to the DUT could cause malfunctions of the DUT. Extreme care shall be taken to avoid such an effect.

7 Test set-up

7.1 Ground plane

7.1.1 General

The ground plane shall be made of 0,5 mm thick (minimum) copper, brass or galvanized steel.

The minimum width of the ground plane shall be 1 000 mm. The minimum length of the ground plane shall be 2 000 mm, or the underneath of the entire equipment plus 200 mm, whichever is larger.

The height of the ground plane (test bench) shall be (900 ± 100) mm above the floor.

The ground plane shall be bonded to the shielded enclosure such that the DC resistance does not exceed 2,5 mΩ. In addition, the bond straps shall be placed no greater than 0,3 m apart.

7.2 Power supply and artificial networks

Each DUT power supply lead shall be connected to the power supply through an artificial network (AN).

Power supply is assumed to be negative ground. If the DUT utilizes positive ground then the test set-up shown in Figures D.1 and D.2 need to be adapted accordingly. Power shall be applied to the DUT via a 5 µH/50 Ω AN. Whether two ANs or only one is required depends on the intended DUT installation in the vehicle:

— for remotely grounded DUTs (vehicle power return line longer than 200 mm), two ANs are required — one for the positive supply line and the other for the power return line (see Annex D);

— for locally grounded DUTs (vehicle power return line 200 mm or shorter), only one AN is required, for the positive supply (see Annex D).

The AN(s) shall be mounted directly on the ground plane. AN cases shall be bonded to the ground plane.

The power supply return shall be connected to the ground plane, between the power supply and the AN(s).

The measuring port of each AN shall be terminated with a 50 Ω load.

7.3 Location of the DUT

The DUT shall be placed on non-conductive material of low relative permittivity (dielectric constant) ($\varepsilon_r \leq 1,4$) at (50 ± 5) mm above the ground plane.

The case of the DUT shall not be grounded to the ground plane unless it is intended to simulate the actual vehicle configuration.

The face of the DUT shall be located at least 100 mm from the edge of the ground plane.

7.4 Location of the test harness

The total length of the test harness between the DUT and the load simulator (or RF boundary) shall be $1\,700^{+300}_{0}$ mm unless otherwise specified in the test plan. The wiring type is defined by the actual system application and requirement.

The test harness shall be placed on non-conductive material of low relative permittivity (dielectric constant) ($\varepsilon_r \leq 1,4$) at (50 ± 5) mm above the ground plane.

The test harness shall be located at least 200 mm from the edge of the ground plane.

7.5 Location of the load simulator

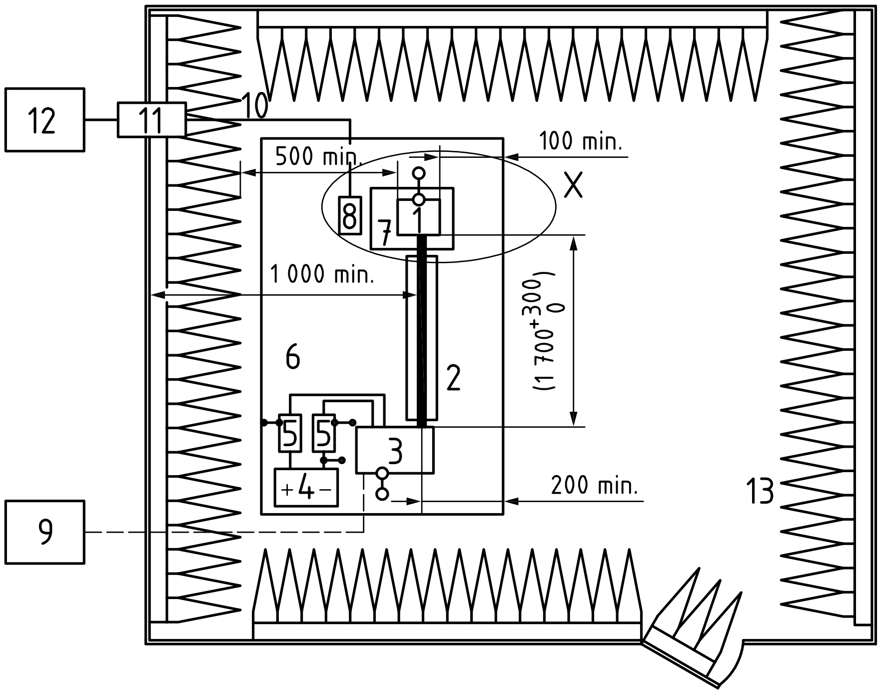
The load simulator shall be placed directly on the ground plane. If the load simulator has a metallic case, this case shall be bonded to the ground plane.

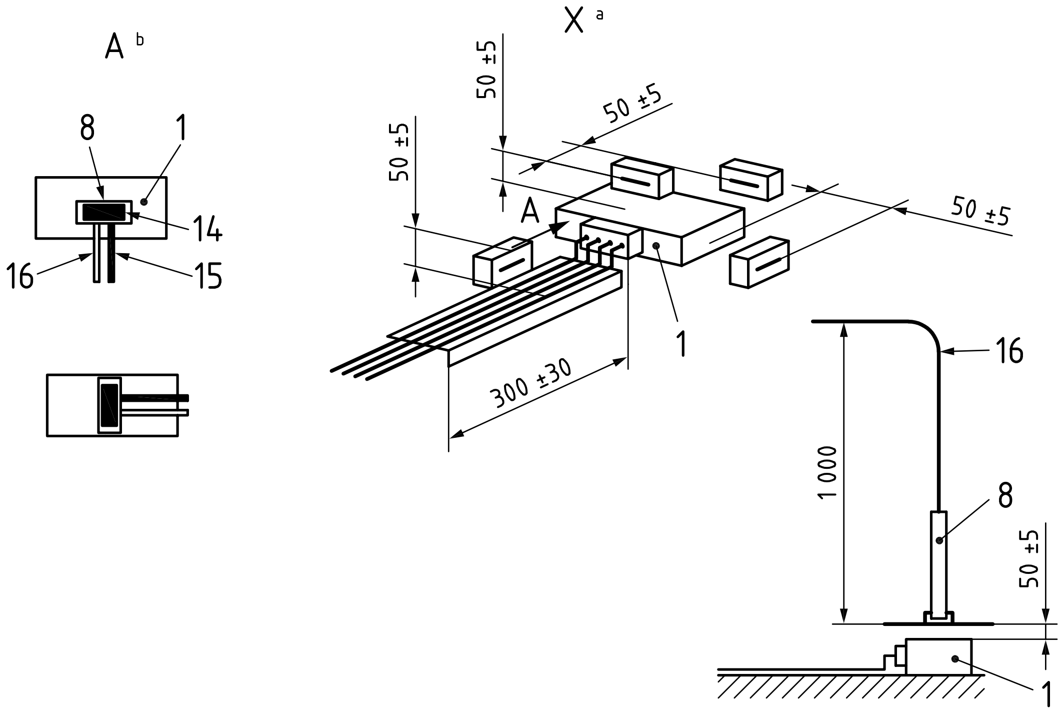
The load simulator may be located adjacent to the ground plane, with the case of the load simulator bonded to the ground plane, or outside the test chamber, provided the test harness from the DUT passes through an RF boundary bonded to the ground plane.

When the load simulator is located on the ground plane, the DC power supply lines of the load simulator shall be connected through the AN(s).

Dimensions in millimetres

Upper view





Key

1 DUT (grounded locally if required in test plan)
2 test harness
3 load simulator (placement and ground connection according to 7.5)
4 power supply (location optional)
5 artificial network (AN)
6 ground plane (bonded to shielded enclosure)
7 low relative permittivity support ($\varepsilon_r \leq 1,4$)
8 simulated portable transmitter antenna or commercial transmitter
9 stimulation and monitoring system
10 high-quality double-shielded coaxial cable (50 Ω)
11 bulkhead connector
12 RF signal generator, amplifier, directional coupler and power meter for the simulated portable transmitter
13 RF absorber material
14 dipole axis or patch plane
15 insulating support
16 coaxial cable

a View A: simulated portable transmitter position for different polarizations.
b View X: simulated portable transmitter positions (DUT and harness).

Figure 1 — Example of test set-up

8 Tests

8.1 General

The general arrangement of the disturbance source and connecting harnesses represents a standardized test condition. Any deviations from this International Standard shall be agreed upon prior to testing.

The DUT load simulator shall be designed to simulate typical loading as in the vehicle. The DUT shall be tested under the most significant conditions, e.g. in stand-by mode and in a mode by which all the actuators can be excited. These operating conditions shall be clearly defined in the test plan to ensure supplier and customer perform identical tests.

8.2 Test plan

Prior to performing the tests, a test plan shall be generated which includes

— test set-up,

— frequency range,

— DUT mode of operation,

— DUT acceptance criteria,

— test severity levels,

— DUT monitoring conditions,

— DUT exposure methodology,

— simulated portable transmitter antenna or commercial transmitter location,

— test report content, and

— any special instructions and changes from the standard test.

8.3 Test methods

8.3.1 General

CAUTION — Hazardous voltages and fields can exist within the test area. Ensure that all requirements for limiting the exposure of humans to RF energy are met.

The reference parameter for the test is the net power at the simulated portable transmitter antenna feed point. Typical power values are given in Annex A.

NOTE The adjustment of the net power can be made according to ISO 11451-3:2001, Annex B.

8.3.2 Simulated portable transmitter test method

8.3.2.1 General

This method is performed in two phases:

— test level setting;

— testing of the DUT with wiring harness and peripheral devices connected.

8.3.2.2 Test level setting

The adjustment of the net power level shall be performed in continuous wave (CW), with the simulated portable transmitter antenna placed at a minimum distance of 1 m from any part of the DUT, from the ground plane and from the test enclosure, and 0,5 m from any absorber, until the predetermined level is achieved.

Record the net power level and the forward power level.

NOTE If a PEP (peak envelope power) meter is used, the modulated signal can be used during the power adjustment.

8.3.2.3 DUT test

There are two alternative ways, either of which may be used, to expose the DUT after the test level setting phase:

a) approach the simulated portable transmitter at the various positions indicated in the test plan without switching off the power of the simulated portable transmitter;

b) switch off the power of the simulated portable transmitter, approach the simulated portable transmitter at the various positions indicated in the test plan, then switch on the power of the simulated portable transmitter.

The test on the DUT shall be performed at the various positions indicated in the test plan (antenna positioning for coupling to the DUT and harness are defined in 8.3.4 and 8.3.5), with CW and/or modulated signals as indicated in Annex A.

The test on the DUT shall be performed without any change in the forward power level recorded during the determination of the net power (test level setting).

For amplitude modulation (AM) and pulse modulation (PM) signals, the test on the DUT shall be performed with power level adjustment, in order to fulfil the peak conservation principle given in ISO 11452-1. The power adjustments shall be performed in the same condition of simulated portable transmitter location as described for test level setting.

NOTE Due to the position of the simulated portable transmitter antenna close to the DUT, variations in transmitter net power can occur. If a variation of net power occurs, readjustment of net power is not required.

If manual positioning of the antenna is required while the RF power is switched on, then care shall be taken, according to ICNIRP Guidelines, to minimize the exposure of the operator to the generated field. It is recommended that a minimum distance of 0,5 m from the operator to the simulated portable transmitter be maintained in order to limit operator influence.

NOTE National or other regulations can apply.

Perform the test at frequencies within the designed bandwidth of the test antenna — at least at the lower and upper band edges, at middle frequency and at frequency steps not greater than those defined in ISO 11452-1.

Continue testing until all frequency bands, modulations, polarizations and simulated portable transmitter locations specified in the test plan are completed.

8.3.3 Commercial portable transmitter test method

This method uses a single phase of the test of the DUT with wiring harness and peripheral devices connected.

The test shall be performed with unmodified commercial portable transmitter characteristics (power, modulation). Any exception to this practice shall be specified in the test plan.

NOTE In general, the output power for commercial portable transmitters considered for this test is the declared value of rated power.

In accordance with the test plan, activate the commercial portable transmitter and place it at the various defined positions (antenna positioning for coupling to the DUT and harness are defined in 8.3.4 and 8.3.5).

Continue until testing of all transmitter(s) specified in the test plan has been completed.

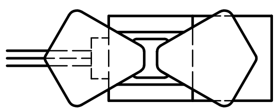
8.3.4 Antenna positioning for coupling to DUT

8.3.4.1 Testing with broadband antennas

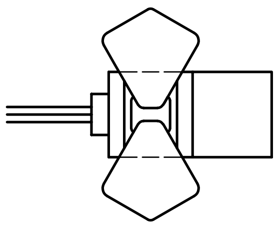
The usable test area of the broadband antenna described in B.2 is 100 × 100 mm when testing at a separation of 50 mm from the DUT to the antenna. It is therefore necessary to move the antenna in steps of 100 mm.

All surfaces of the DUT which are to be tested shall be partitioned to square cells of 100 × 100 mm. The antenna shall be placed at a distance of 50 mm and the centre of each cell shall be exposed to the centre and the elements of the antenna in two orthogonal orientations (four exposures in total). It is necessary to expose each cell to the centre of the elements of the antenna because the E and H fields are in different places and move with the test frequency.

a) Place the antenna parallel with the DUT harness and aligned with the centre of the first cell and expose the DUT to the stress levels given in the test plan.

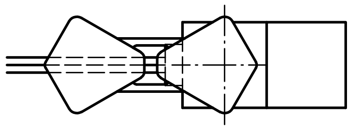


b) Repeat step a) with the antenna rotated 90°.

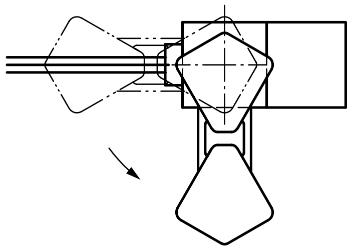


c) Align the antenna with the centre of the next cell and repeat steps a) and b) until all the cells have been exposed to two orthogonal orientations of the antenna.

d) Move the antenna back to the first cell. Align the antenna element in the centre of the test cell (edges of the element aligned with the centre of the cell) and expose the DUT to the stress levels given in the test plan.



e) Repeat step d) with the antenna rotated 90°.



f) Repeat steps d) and e) until all cells have been exposed. When testing DUTs with multiple cells, some cells will be exposed to the elements of the antenna when steps a) to c) are performed on an adjacent cell. If this happens, and duplicate testing would result, it is not necessary to carry out steps d) and e). However, if there is any doubt over the effective exposure of cells to the elements of the antenna, steps d) and e) shall nevertheless be repeated.

g) Repeat steps a) to f) for each DUT surface defined in the test plan for electromagnetic compatibility (EMC). Testing requires rotation of the DUT such that the surface to be tested is parallel to the ground plane. Material of low permittivity shall be used to support the DUT so that the surface under test is facing upwards, towards the antenna.

8.3.4.2 Testing with other antennas

For each surface of the DUT, place the antenna with its centre at a distance of 50 mm from the DUT's surface (see Figure 1).The axis of the monopole, dipole, sleeve or plane of the patch antenna shall be parallel to the surface of the DUT.

The placement of the portable transmitters — at specific position(s) or scanning along the DUT — should be defined in the test plan. Move the portable transmitter along the surface for two orientations (polarizations) of the antenna, parallel to the surface of the DUT.

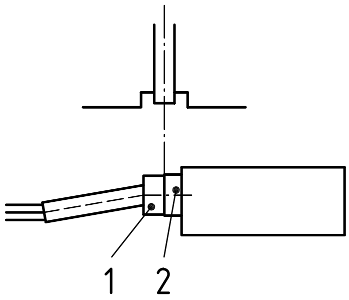
8.3.5 Antenna positioning for coupling to harness

8.3.5.1 Testing with broadband antennas

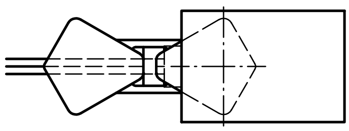
Position the antenna central to the connector under test and parallel to the harness. Align the centre of the antenna with the outermost edge of the DUT connector. Expose the DUT to the test signals specified in the test plan. In cases where the DUT has multiple connectors or connectors that are wider than 100 mm, the test shall be repeated multiple times.

Place the antenna with its centre at a distance of 50 mm from the harness.

Carry out the test by moving the portable transmitter along the harness, in 100 mm increments, for a length of 300 mm, starting at the DUT connector.



Side view



Plan view

8.3.5.2 Testing with other antennas

Place the antenna with its centre at a distance of 50 mm from the harness.

The axis of the antenna shall be parallel to the harness; for a patch antenna, ensure that the polarization of the antenna is parallel to the harness. Alternatively, if the polarization is unknown, perform tests for both polarizations.

Carry out the test by moving the portable transmitter along the harness, in 100 mm increments, for a length of 300 mm, starting at the DUT connector.

8.4 Test report

According to the test plan, a test report shall be submitted detailing information regarding the test equipment, test area, systems tested, frequencies, test modulation, power levels, DUT exposure methodology, the portable transmitter used, VSWR values (except for commercial transmitters), system interactions and any other relevant information regarding testing.

Annex A
(informative)

Typical characteristics of portable transmitters

Examples of typical characteristics of portable transmitters are given in Table A.1, and an explanation of the terms used is given in Table A.2. These characteristics are for information only: frequency bands may be different from one region to another, and the use of power levels greater than those indicated can be expected.

Table A.1 — Typical characteristics for portable transmitters

Transmitter designation	**Frequency band** MHz	**Power** W	**Typical transmitter modulation**	**Test modulation**
10 m	26–30	10 (RMS)	Telegraphy, AM, SSB, FM	AM 1 kHz, 80 %
2 m	146–174	10 (RMS)	Telegraphy, AM, SSB, FM	CW
70 cm	410–470	10 (RMS)	Telegraphy, AM, SSB, FM	CW
TETRA/ TETRAPOL	380–390 410–420 450–460 806–825 870–876	10 (peak)	TDMA/FDMA Tetra: $\pi/4$ DQPSK	PM 18 Hz 50 % duty cycle
AMPS/ GSM850	824–849	10 (peak)	GMSK, PSK, DS	PM 217 Hz 50 % duty cycle or PM 217 Hz Ton = 577 µs t = 4 600 µs
GSM900	876–915	16 (peak) or 2 (peak)	GMSK	PM 217 Hz 50 % duty cycle or PM 217 Hz Ton = 577 µs t = 4 600 µs
PDC	893–898 925–958 1429–1453	0,8 (peak)	TDMA	PM 50 Hz 50 % duty cycle
PCS GSM 1 800/1900	1 710–1 785 1 850–1 910	2 (peak) or 1 (peak)	GMSK	PM 217 Hz 50 % duty cycle or PM 217 Hz Ton = 577 µs t = 4600 µs

Table A.1 *(continued)*

Transmitter designation	Frequency band MHz	Power W	Typical transmitter modulation	Test modulation
IMT-2000	1 885–2 025	CW-1 (RMS) PM-1 (peak)	QPSK	CW and PM 1 600 Hz, 50 % duty cycle
Bluetooth/ WLAN	2 400–2 500	0,5 (peak)	QPSK	PM 1 600 Hz 50 % duty cycle
IEEE 802.11a	5 725–5 850	1(peak)	QPSK	PM 1 600 Hz 50 % duty cycle

Table A.2 — Abbreviated terms

Modulation/ Access system	Description	Example for use
AM	Amplitude modulation	Broadcast
AMPS	Advanced mobile phone system	—
BT	Bluetooth	—
DQPSK	Differential quadrature phase shift keying	Iridium satellite telephone
FDMA	Frequency division multiplex access	—
FM	Frequency modulation	Broadcast
GMSK	Gaussian minimum shift keying	GSM
GSM 850	Global system of mobile phones 850 MHz band	—
GSM 900	Global system of mobile phones 900 MHz band	—
GSM 1800/1900	Global system of mobile phones 1 800/1 900 MHz band	—
IEEE 802.11a	802.11 refers to a family of specifications developed by the IEEE for wireless LAN technology	WLAN
IMT-2000	International mobile telecommunications 2000	UMTS
PCS	Personal communications service	—
PDC	Personal digital cellular	—
PM	Pulse modulation	PDC
PSK	Phase shift keying	CDMA
QPSK	Quadrature phase shift keying	UMTS, W-LAN
SSB	Single side band	Military, ham radio
telegraphy	Morse telegraphy coded work	—
TDMA	Time division multiple access	Tetra 25, DECT, GSM
TETRA	Terrestrial trunked radio	—
TETRAPOL	Terrestrial trunked radio police	—
WLAN	Wireless local area network	—
10 m/2 m/70 cm	HAM radio band as wavelength	—

Annex B
(informative)

Examples of simulated portable transmitter antennas

B.1 Introduction

This annex provides details of the miniature broadband antenna, together with examples of other simulated portable transmitter antennas, which can be used to perform the tests according to this International Standard:

— miniature broadband antenna;

— sleeve antennas;

— monopole antennas.

All dimensions indicated in the figures of this annex are in millimetres.

B.2 Miniature broadband antenna

B.2.1 General

The small broadband antenna acts comparably to a symmetrical broadband dipole antenna. In contrast to an ordinary dipole antenna, the radiating elements have been designed especially for wide bandwidth, close distance to the DUT and good field uniformity. Due to the wide frequency coverage, a significant time reduction for testing can be achieved.

B.2.2 Typical characteristics

Input impedance: 50 Ω

Balun transformation ratio: 1:1

Frequency range: 360–2 700 MHz

Radiating element dimensions: 240 × 109 mm

Maximum power input 20 W

Connector: Type-N female

VSWR characteristic: see Figure B.1

The geometrical characteristics of the miniature broadband antenna for simulated portable transmitters are indicated in Figure B.2.

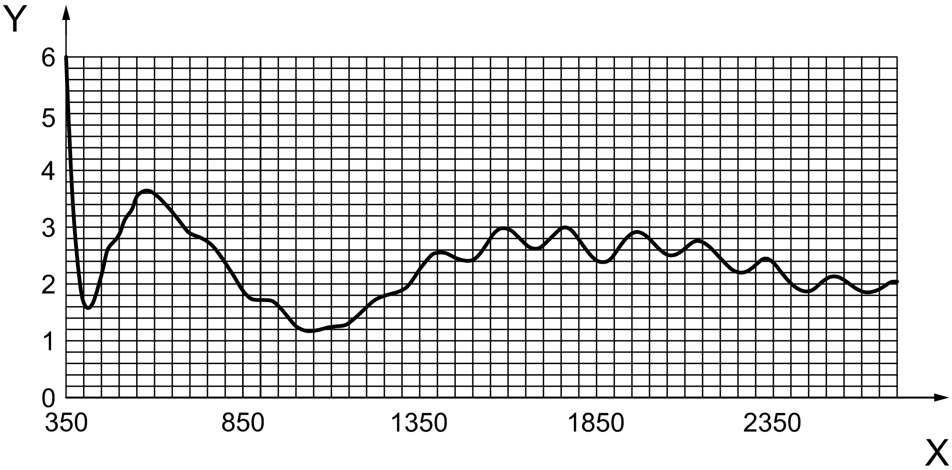
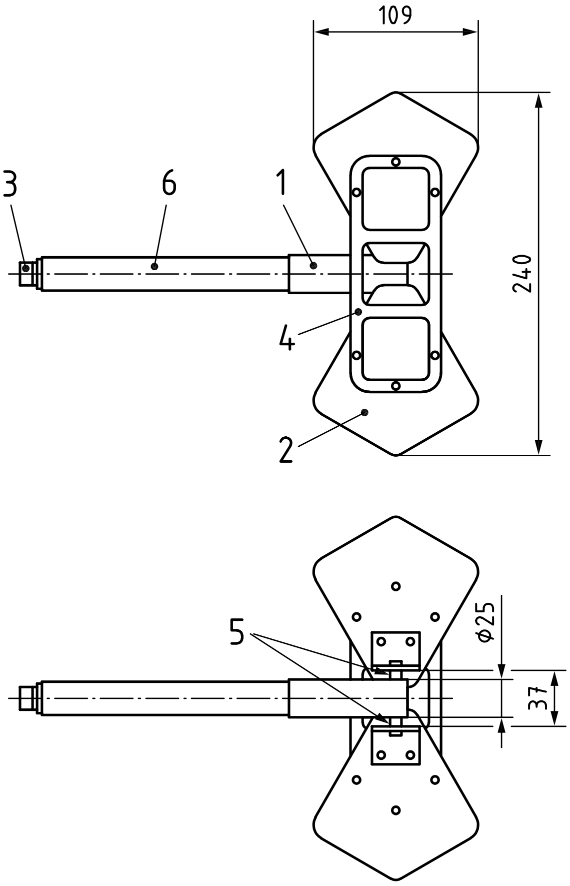


Figure B.1 — Typical VSWR characteristics



Key

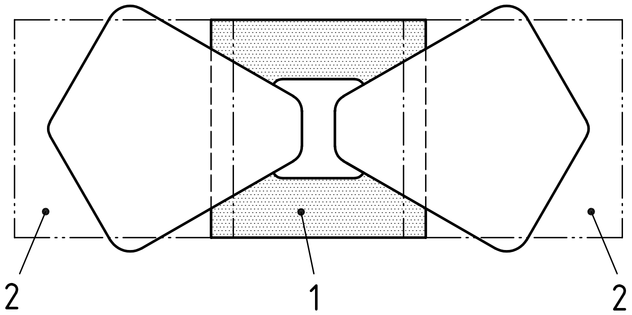
1 broadband low loss balun 1:1
2 flat antenna elements
3 N-female connector
4 element fixture and spacing frame (5 mm, non-metallic)
5 symmetrical terminals, M4
6 22 mm tube for handling or fixture

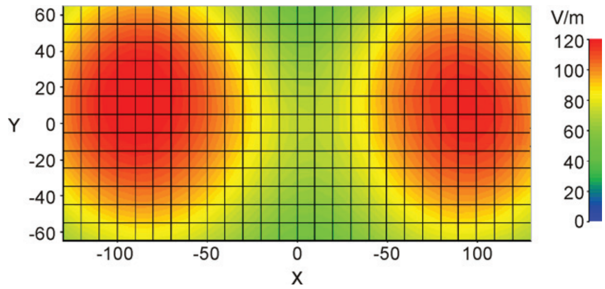
Figure B.2 — Construction details of broadband antenna

B.2.3 Electric fields generated by the antenna

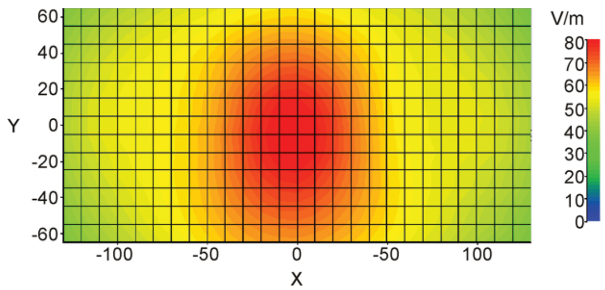
The test antenna has 3 100 × 100 mm test zones where field uniformity is better than ± 3 dB. In the frequency range 360–480 MHz, the E field is concentrated under the elements of the antenna and moves to the centre after 800 MHz. The average field severity is calculated by averaging the field in these zones.

Figure B.3 shows field distribution and peak amplitudes in volts per metre (V/m) for a 1 W net input at a 50 mm distance from the antenna elements. The greenest areas (the mid-grey areas toward the grid edges when viewed in monochrome) show a greater than 6 dB field degradation from the maximum field.

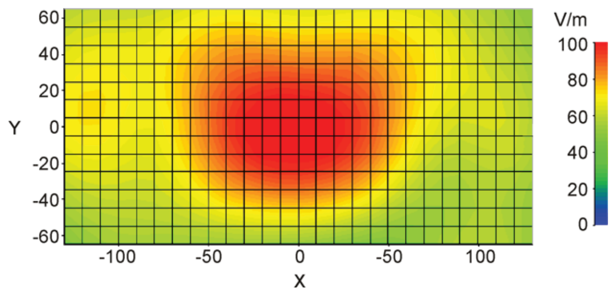




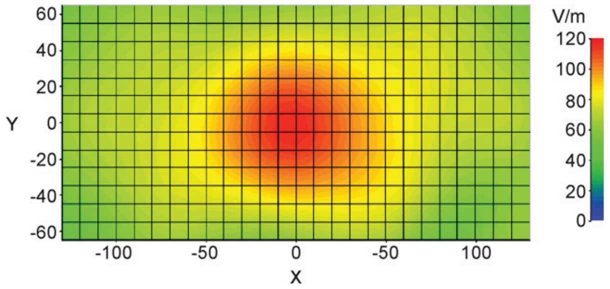
400 MHz; 1 W net; average field strength: 100 V/m



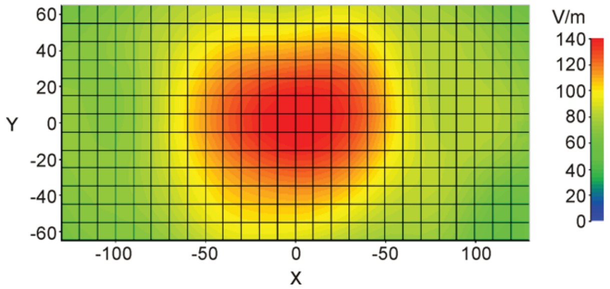
900 MHz; 1 W net input; average field strength: 67 V/m



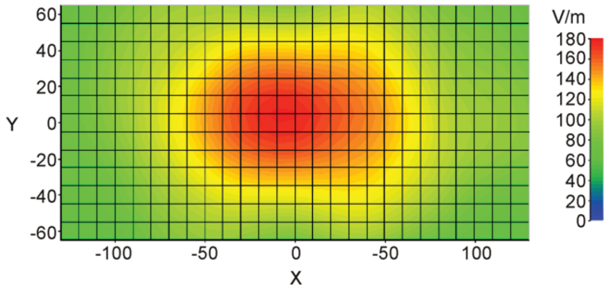
1 800 MHz; 1 W net input; average field strength: 84 V/m



2 000 MHz; 1 W net input; average field strength: 89 V/m



2 450 MHz; 1 W net input; average field strength: 114 V/m



2 600 MHz; 1 W net input; average field strength: 137 V/m

Key

1 uniform E field for 800 ≤ f ≤ 2700 MHz and uniform H field for 360 ≤ f ≤ 2700 MHz

2 uniform E field for field 360 ≤ f ≤ 480 MHz

Figure B.3 — E field pattern for the broadband antenna

B.3 Sleeve antenna

B.3.1 General

An explanation of the antenna and sleeve length for each frequency band is given in Table B.1. These characteristics are for information only. An example of a sleeve antenna configuration for simulated portable transmitters is shown in Figure B.4.

B.3.2 Typical characteristics

Input impedance: 50 Ω

Permissible power: 30 W

Connector: Type-BNC

Gain: 2,15 dB ± 1 dB

VSWR: < 2:1

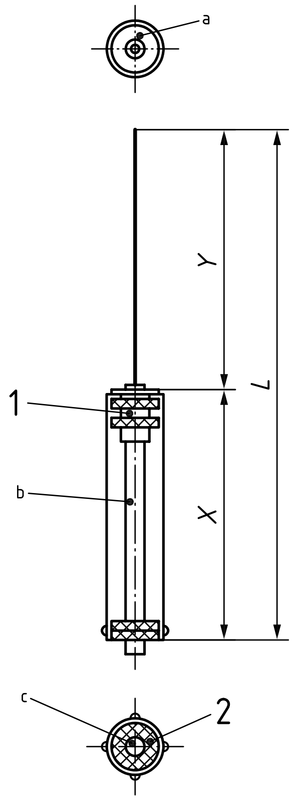
Table B.1 — Example of antenna and sleeve element length for each band

Dimensions in millimetres

Transmitter	Frequency band MHz	Centre Frequency MHz	X Antenna element length Tolerance: $X \pm 5$ %	Y Sleeve length Tolerance: $Y \pm 5$ %
TETRA/TETRAPOL	380–390	395	198 ± 9	162 ± 8
	410–420	415	189 ± 9	155 ± 8
	450–460	455	172 ± 8	141 ± 7
	806–876	841	93 ± 5	76 ± 4
70cm	420–450	435	180 ± 9	147 ± 7
AMPS/GSM 850	824–849	836,5	94 ± 5	77 ± 4
GSM 900/PDC	876–915	895,5	88 ± 4	72 ±4
PDC	925–958	941,5	83 ± 4	68 ± 3
PDC	1440–1453	1446,5	54 ± 3	44 ± 2
PCS/GSM 1 800/1 900	1710–1910	1810	43 ± 2	35 ± 2
NOTE Antenna element and sleeve lengths can be tuned to attain the specific VSWR.				

B.3.3 Antenna configuration

The antennas are designed as typical 1/4λ sleeve antennas. Each band antenna utilizes a 3D-2V cable, a BNC connector, a brass rod as the antenna element and a steel pipe as the sleeve element. For keeping a constant cross section along the sleeve and cable, a cable fixing plastic screw and four polycarbonate screws may be applied at the bottom of sleeve element.



$L = X + Y = \lambda/2 \times 0{,}95$

$L = X + Y = \lambda/2 \times 0{,}95$

$X: Y = 55: 45$ (based on the configuration samples)

where λ, in millimetres, is the wave length of centre frequency.

Fractional shortening: 95 %

Sleeve outer diameter: 20 mm (equivalent to S45RP)

Antenna diameter: 2 mm (brass rod)

Sleeve inner diameter: 18,5 mm (equivalent to S45RP)

Connector: BNC (UG-625/U, BNC-P-3)

Cable: 3D-2V

Key

1 BNC connector

2 polycarbonate screw: M3

[a] Tightening with a 14,9 mm diameter nut.

[b] Cable.

[c] Cable-fixing plastic screw: material, nylon MC; outer diameter, 13 mm; inner diameter, 6 mm; thickness, 6 mm; screw hole, M3.

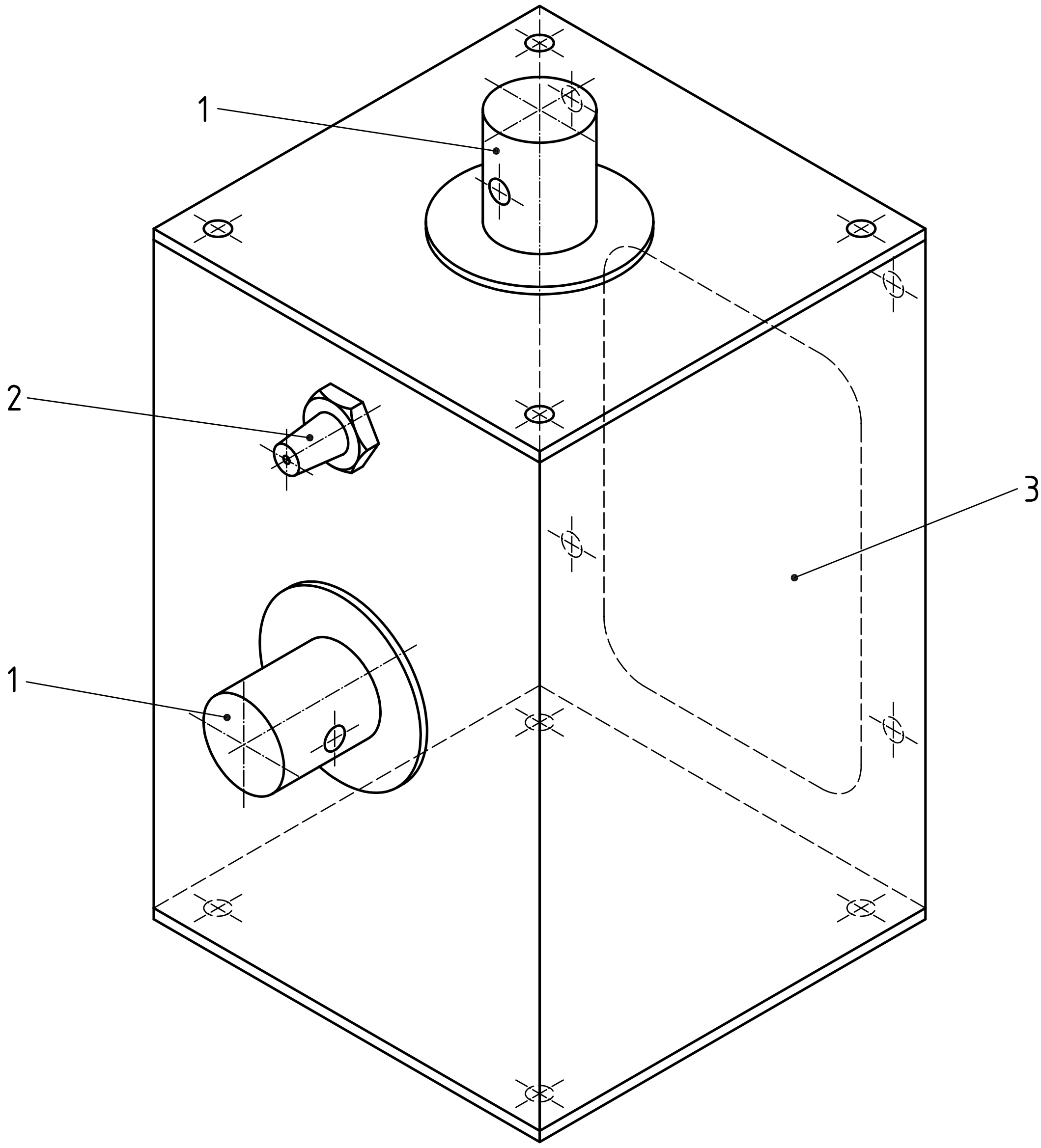
NOTE The surfaces of the antenna element and sleeve are recommended to be of a rust-resistant metallic material (e.g. Ni).

Figure B.4 — Example of 1/4λ sleeve antenna configuration

B.4 Monopole antenna

B.4.1 General

The antenna is integrated into a PVC casing fitted with a PMMA [poly(methyl methacrylate)] window for the sighting of the antenna inside. This casing is also equipped with an SMA-type bulkhead and a mechanical connector into which a handle is fitted to hold the antenna at a distance. The construction characteristics common to all such antennas of this casing are shown in Figures B.5 and B.6.



Key

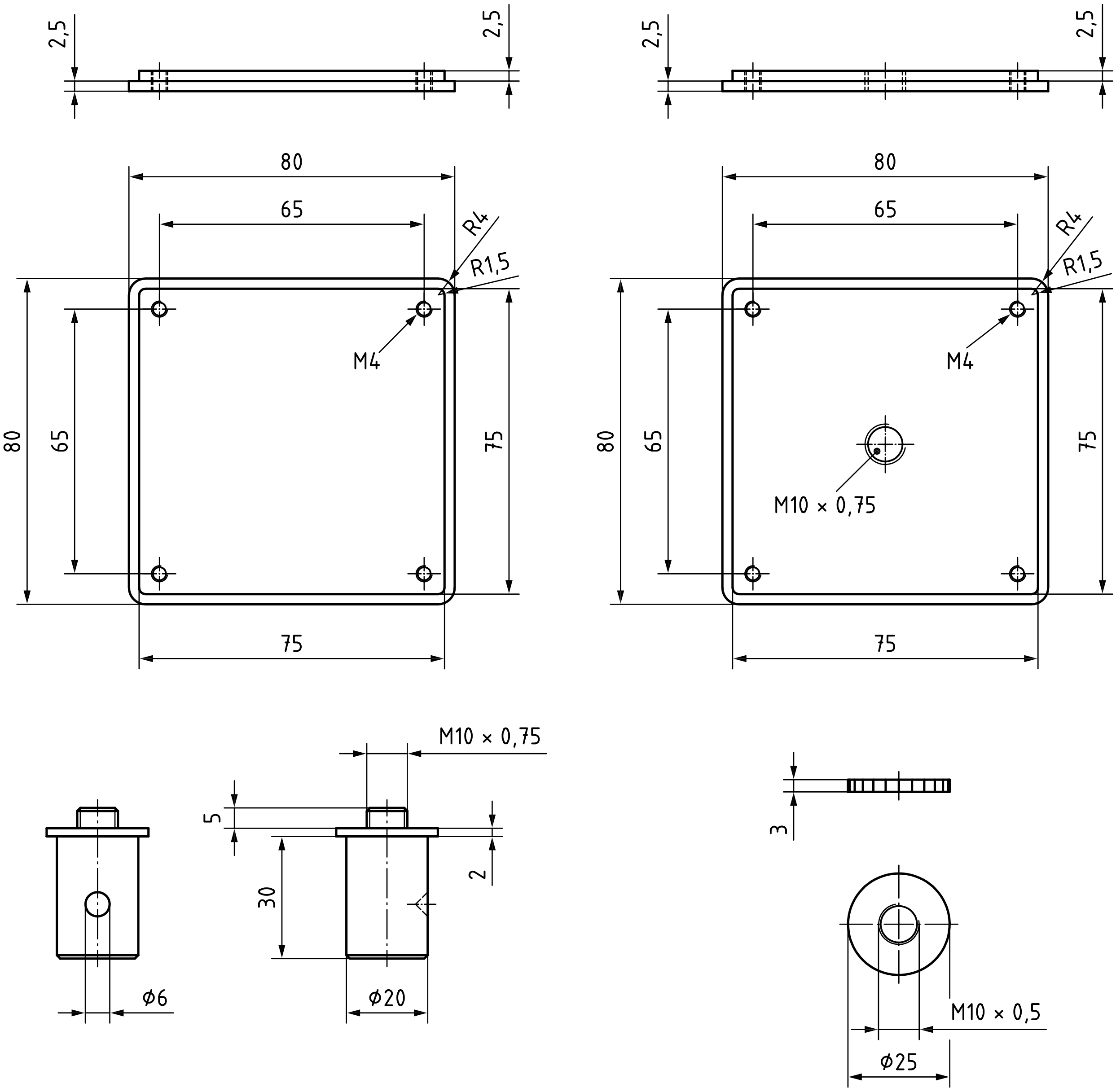
1 male support for antenna mast

2 coaxial connector

3 altuglas[1)] window (built into housing)

Figure B.5 — Common casing construction characteristics — General

1) Altuglas® is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.



NOTE The use of this casing in performing tests with the antenna positioned at 50 mm from the DUT also requires the use of a 10 mm shim. In order to avoid using the shim, the casings can be manufactured with an outside dimension of 100 mm instead of 80 mm.

Figure B.6 — Common casing construction characteristics — Detail

B.4.2 Antenna for 890–915 MHz frequency band

B.4.2.1 Typical characteristics

Antenna bandwidth: 890–915 MHz (min.)

Input impedance: 50 Ω

Permissible power: 20 W

Connector: Type-SMA

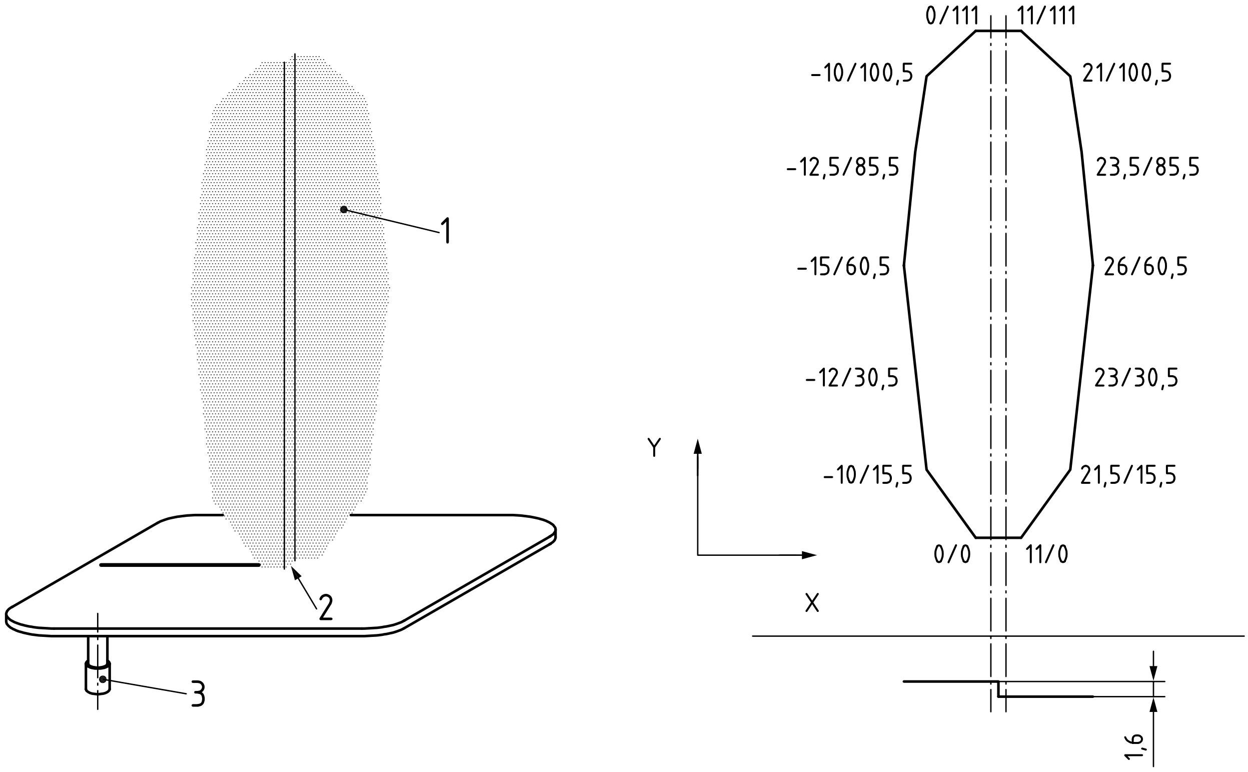
Gain: Typically 0,5 dB ± 0,5 dB

VSWR < 2:1 over the entire band

B.4.2.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a single pole in the shape of a leaf placed vertically in relation to the ground plane. The geometrical characteristics of the assembly are indicated in Figures B.7 a) and b).

The construction details of the casing are indicated in Figure B.7 c).



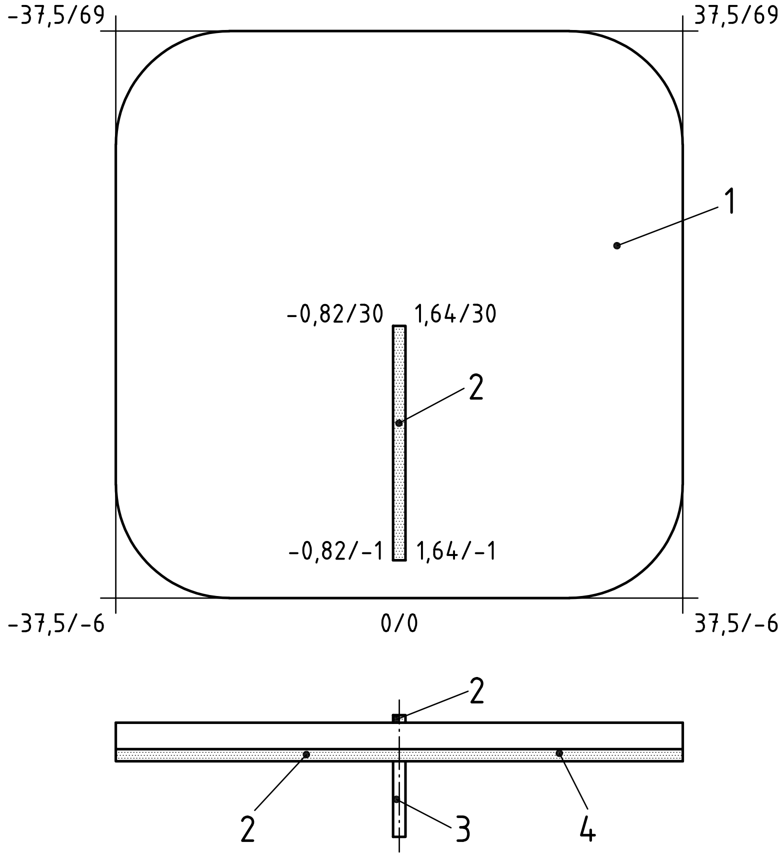
Key

1 aerial element

2 brazing

3 RG 402 + SMA female connector

a) Antenna geometrical characteristics — General



Key

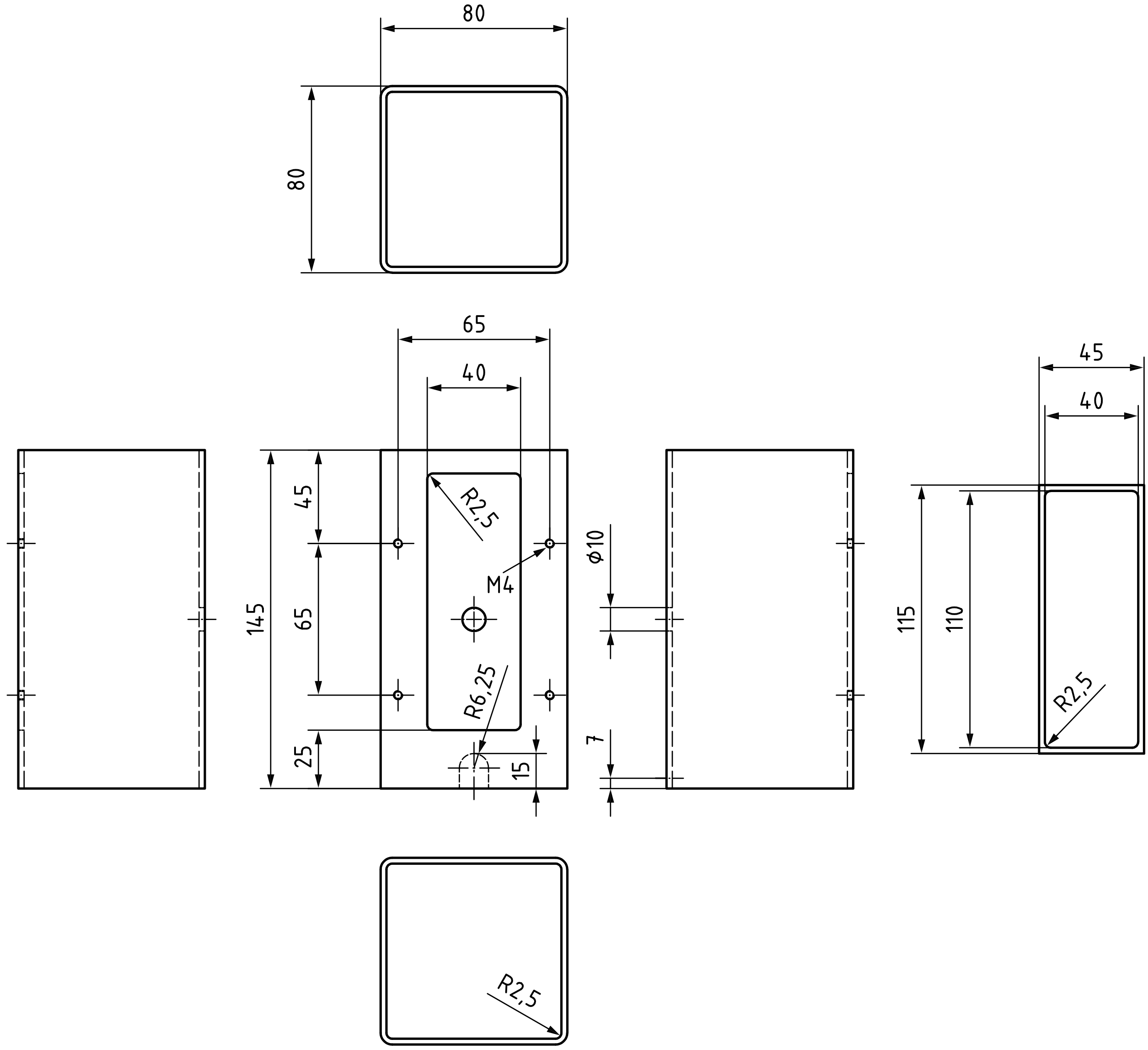
1 card dimension 75/75 mm

2 copper (Cu)

3 RG 402 + SMA female

4 FR4 1,6 mm/35 µ Cu: ground plane on lower side

b) Antenna geometrical characteristics — Detail



c) Casing construction — Detail

Figure B.7 — 890–915 MHz antenna

B.4.3 Antenna for 1 710–1 785 MHz frequency band

B.4.3.1 Typical characteristics

Antenna bandwidth: 1 710–2 025 MHz (min.)

Input impedance: 50 Ω

Permissible power: 20 W

Connector: Type-SMA

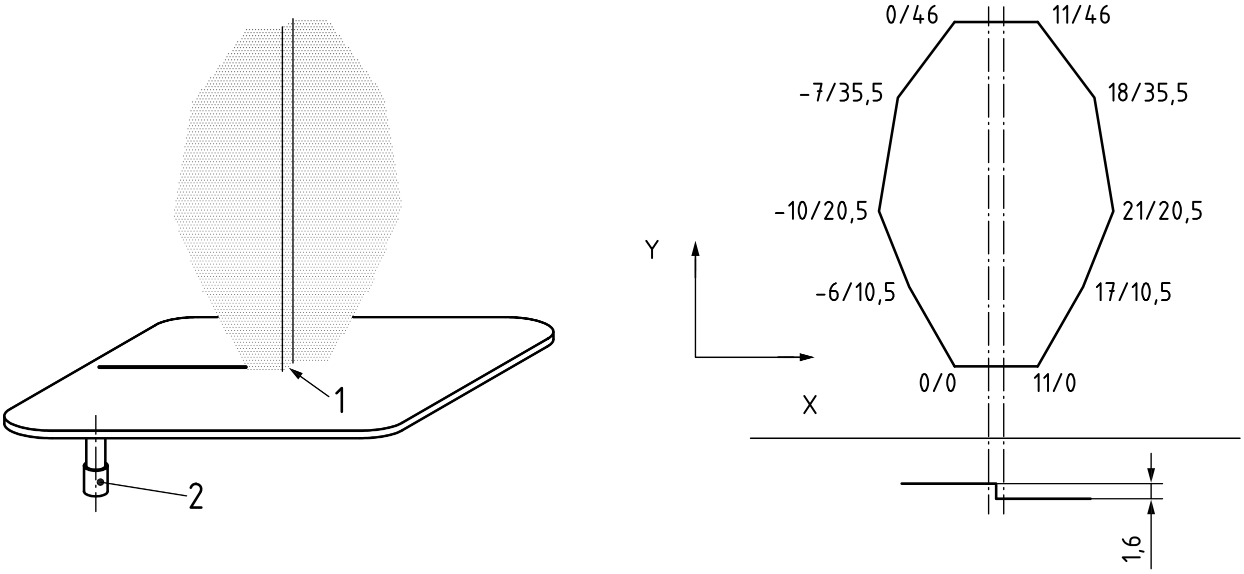
Gain: Typically 0 dB ± 1 dB

VSWR < 2:1 over the entire band.

B.4.3.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a single pole in the shape of a leaf placed vertically in relation to the ground plane. The geometrical characteristics of the assembly are indicated in Figure B.8 a) and b).

The construction details of the casing are indicated in Figure B.8 c).

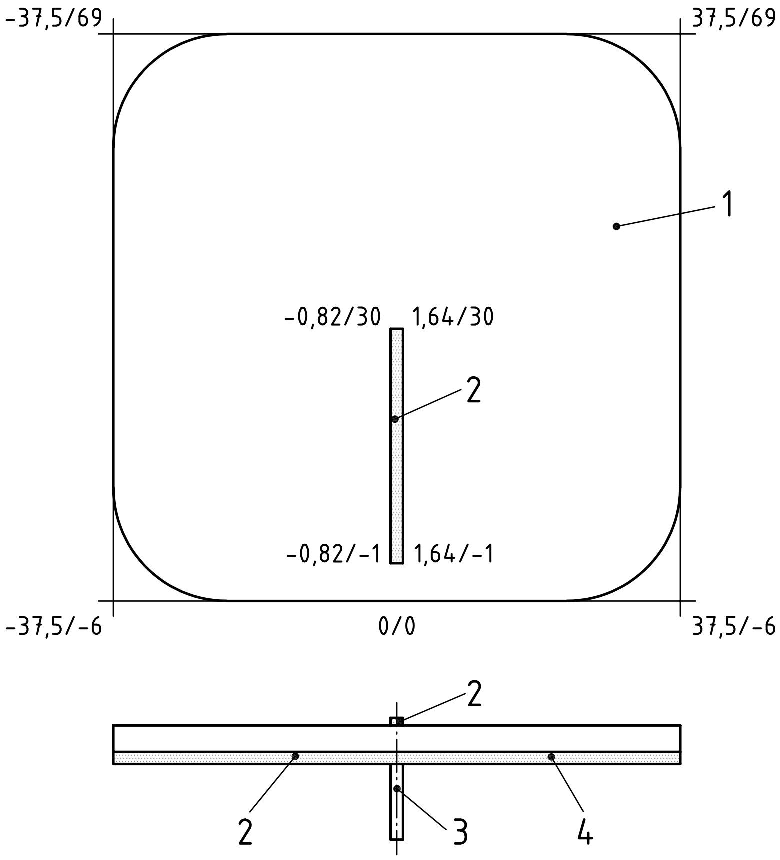


Key

1 brazing

2 RG 402 + SMA female connector

a) Antenna geometrical characteristics — General



Key

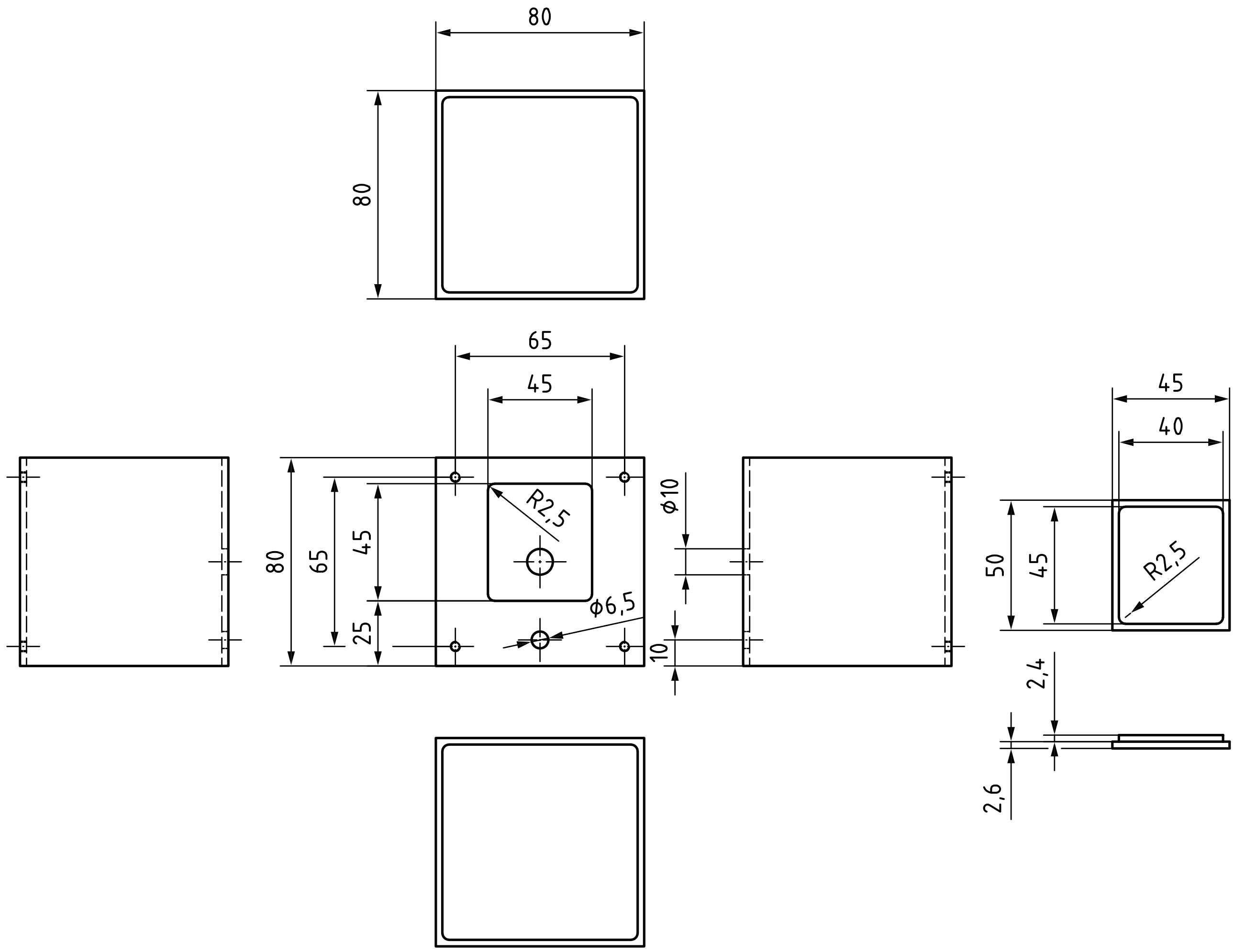
1 card dimension 75/75 mm

2 copper (Cu)

3 RG 402 + SMA female

4 FR4 1,6 mm/35 µ Cu: ground plane on lower side

b) Antenna geometrical characteristics — Detail



c) Casing construction — Detail

Figure B.8 — 1 710–2 025 MHz antenna

B.4.4 Antenna for 2 402–2 480 MHz frequency band

B.4.4.1 Typical characteristics

Antenna bandwidth: 2 402–2 480 MHz (min.)

Input impedance: 50 Ω

Permissible power: 20 W

Connector: Type-SMA

Gain: Typically

0 dB ± 0,5 dB at 2 402 MHz

–1 dB ± 0,5 dB at 2 420 MHz

–2 dB ± 0,5 dB at 2 440 MHz

–3 dB ± 0,5 dB at 2 460 MHz

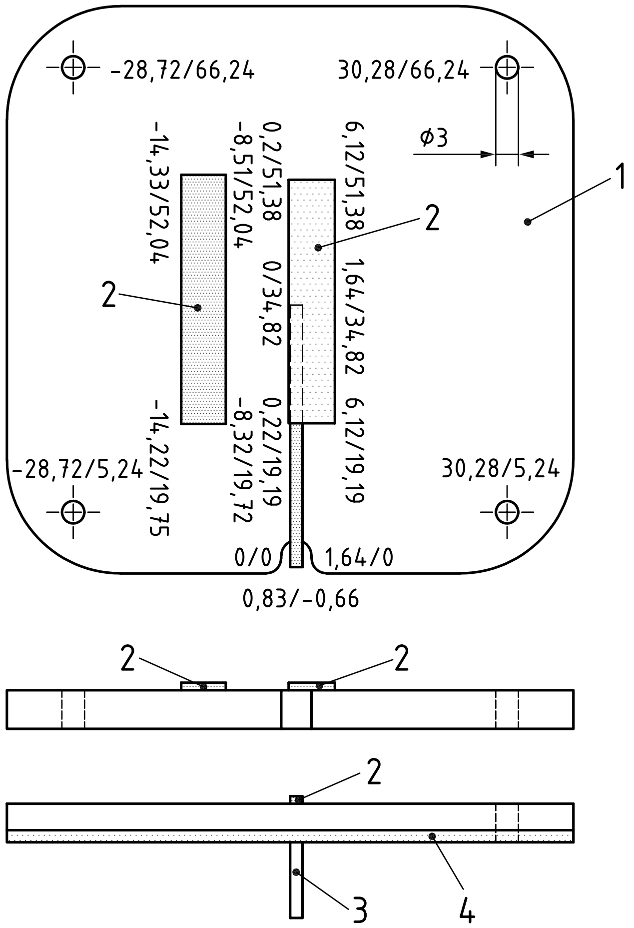
–5 dB ± 0,5 dB at 2 480 MHz

VSWR < 2:1 over the entire band.

B.4.4.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a printed dipole coupled with an interference dipole parallel to the first one. The geometrical characteristics of the assembly are indicated in Figure B.9 a).

The construction details of the casing are indicated in Figure B.9 b).



Key

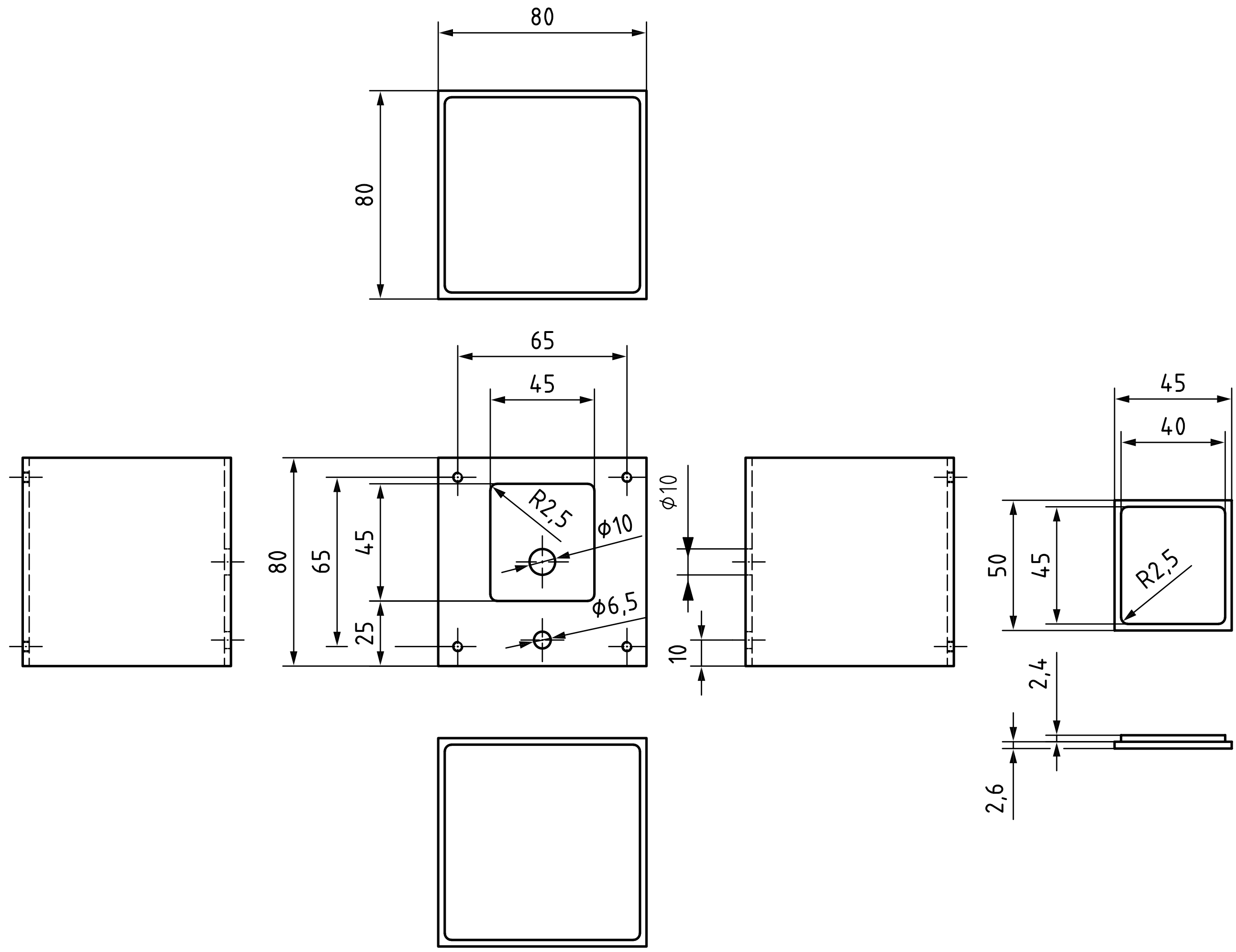
1 card dimension 75 / 75 mm

2 copper (Cu)

3 RG 402 + SMA female

4 FR4 1,6 mm/35 µ Cu: ground plane on lower side

a) Antenna geometrical characteristics



b) Casing construction — Detail

Figure B.9 — 2 402–2 480 MHz antenna

B.4.5 Antenna for 26,96–27,4 MHz frequency band

B.4.5.1 Typical characteristics

Antenna bandwidth: 26,96–27,4 MHz (min.)

Input impedance: 50 Ω

Permissible power: 50 W

Connector: Type-SMA

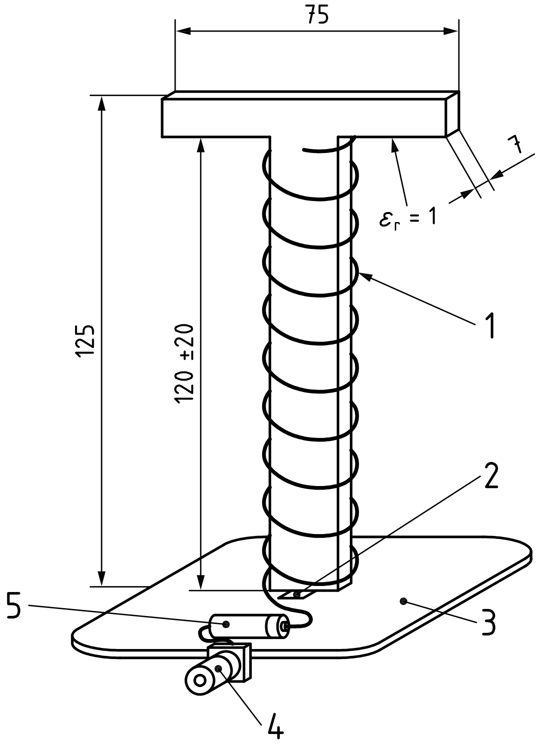
Gain: Typically 0,5 dB ± 0,5 dB

VSWR < 2:1 over the entire band.

B.4.5.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a single pole at the bottom of which is placed a serial helicoidal coil as described in Figure B.10 a).

The construction details of the casing are indicated in Figure B.10 b) and c).



Key

1 coated copper wire: diameter 1 mm/710 mm (diameter of the winding, number of turns: 9 ± 0,5)

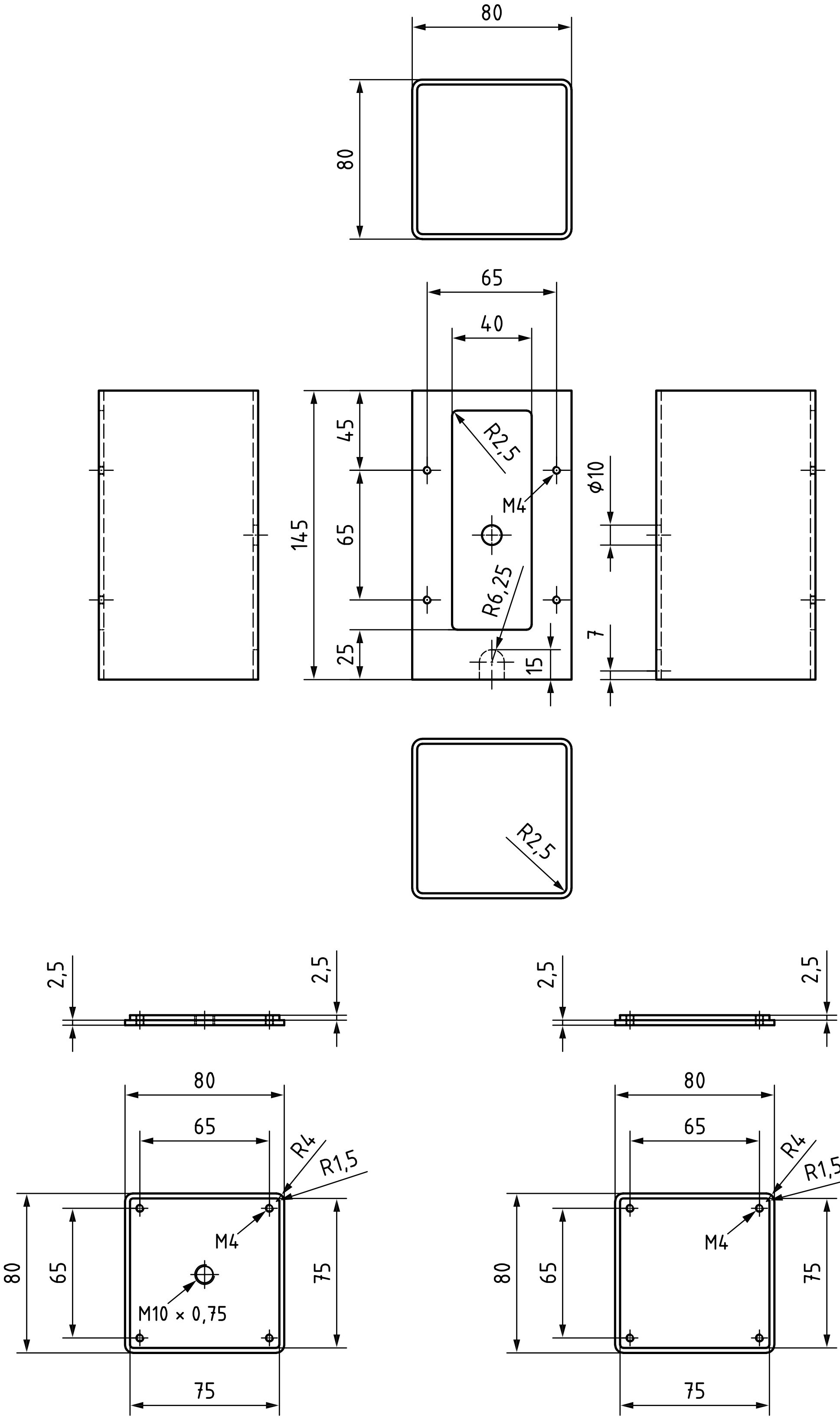
2 copper patch: dimension 5/5 mm

3 FR4 1,6 mm/35 µ Cu: ground plane on lower side; dimension, 74/74 mm

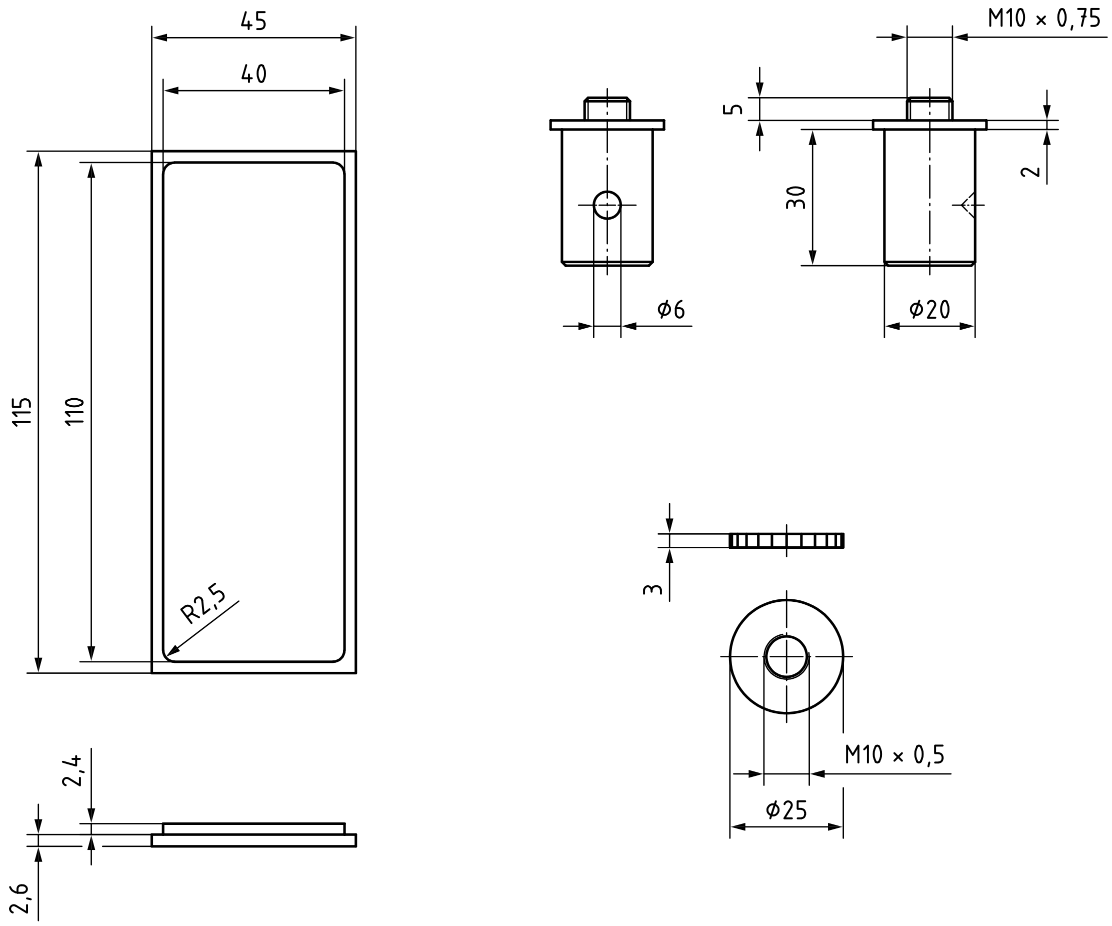
4 BNC connector (EMERSON ref: VBM511-1502)

5 adjustable coil 20W (4–10 µH)

a) Antenna geometrical characteristics



b) Casing construction — Detail



c) Casing construction — Detail (*continued*)

Figure B.10 — 26,96–27,4 MHz antenna

B.4.6 Antenna for 144–148 MHz frequency band

B.4.6.1 Typical characteristics

Antenna bandwidth: 144–148 MHz (min.)

Input impedance: 50 Ω

Permissible power: 50 W

Connector: Type-BNC

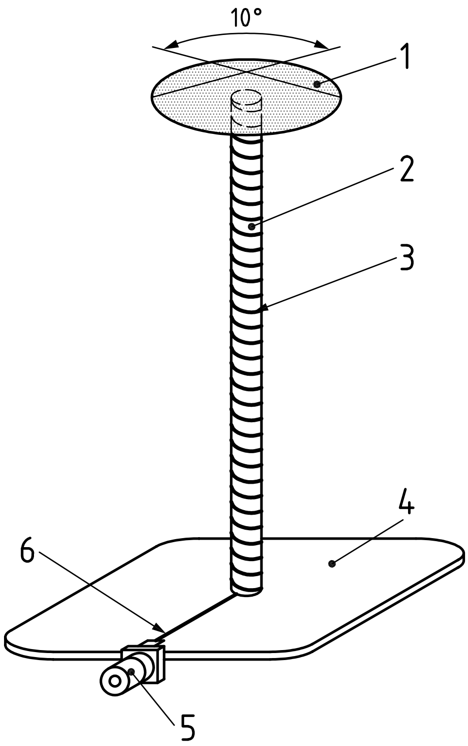
Gain: Typically –13,5 dB ± 1 dB

VSWR < 2,1:1 over the entire band.

B.4.6.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a helicoidal single pole at the top of which is placed a perpendicular metallic cylinder as described in Figure B.11 a).

The construction details of the casing are indicated in Figure B.11 b) and c).



Key

1 brass cone diameter, 50 mm; thickness 0,1 mm

2 PVC cylinder: $\varepsilon_r = 3{,}3$; diameter, 10 mm; length, 127 mm

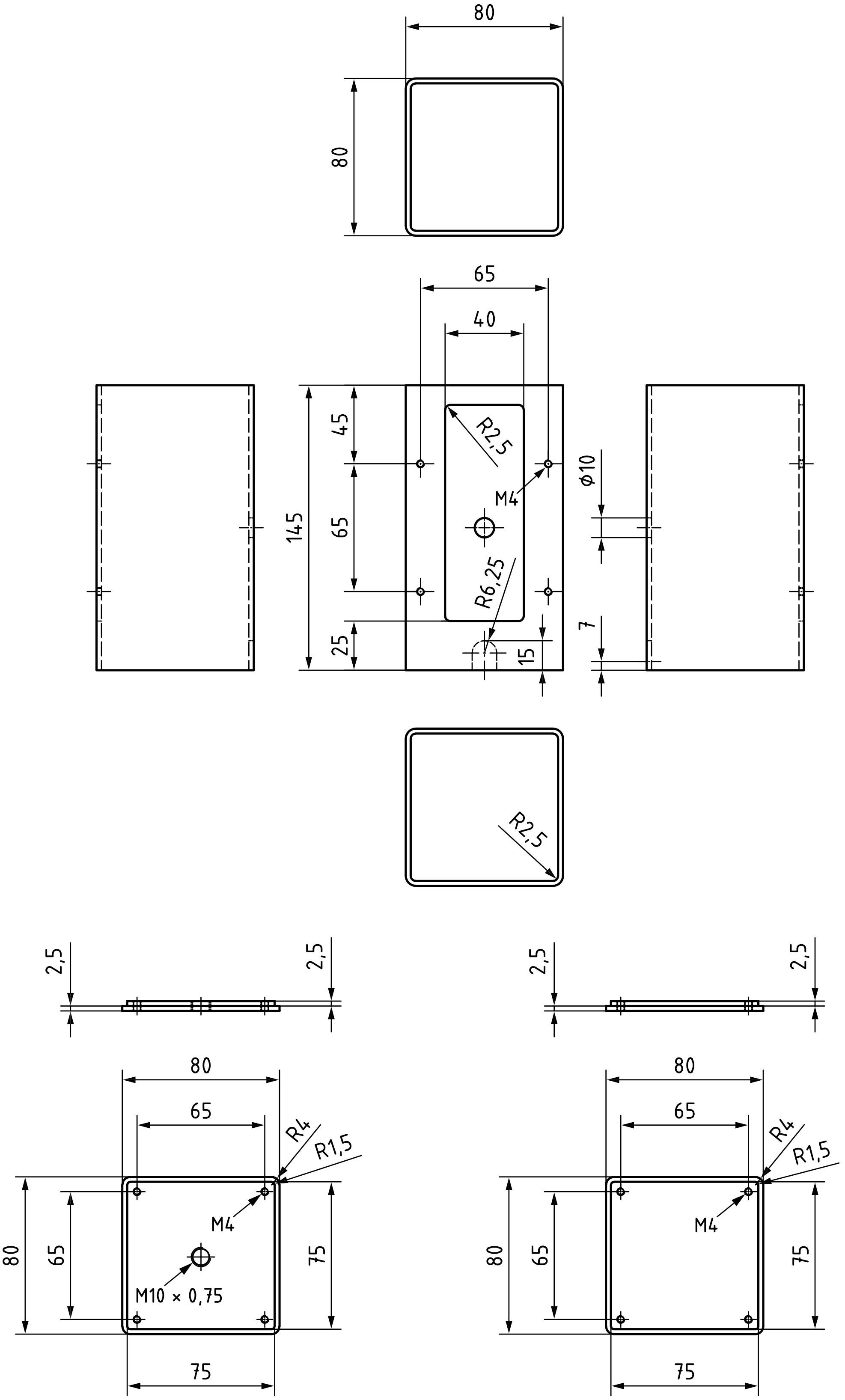
3 coated copper wire: diameter 1 mm/900 mm; number of turns, 29

4 FR4 1,6 mm/35 µ Cu: ground plane on lower side; dimensions, 74/74 mm

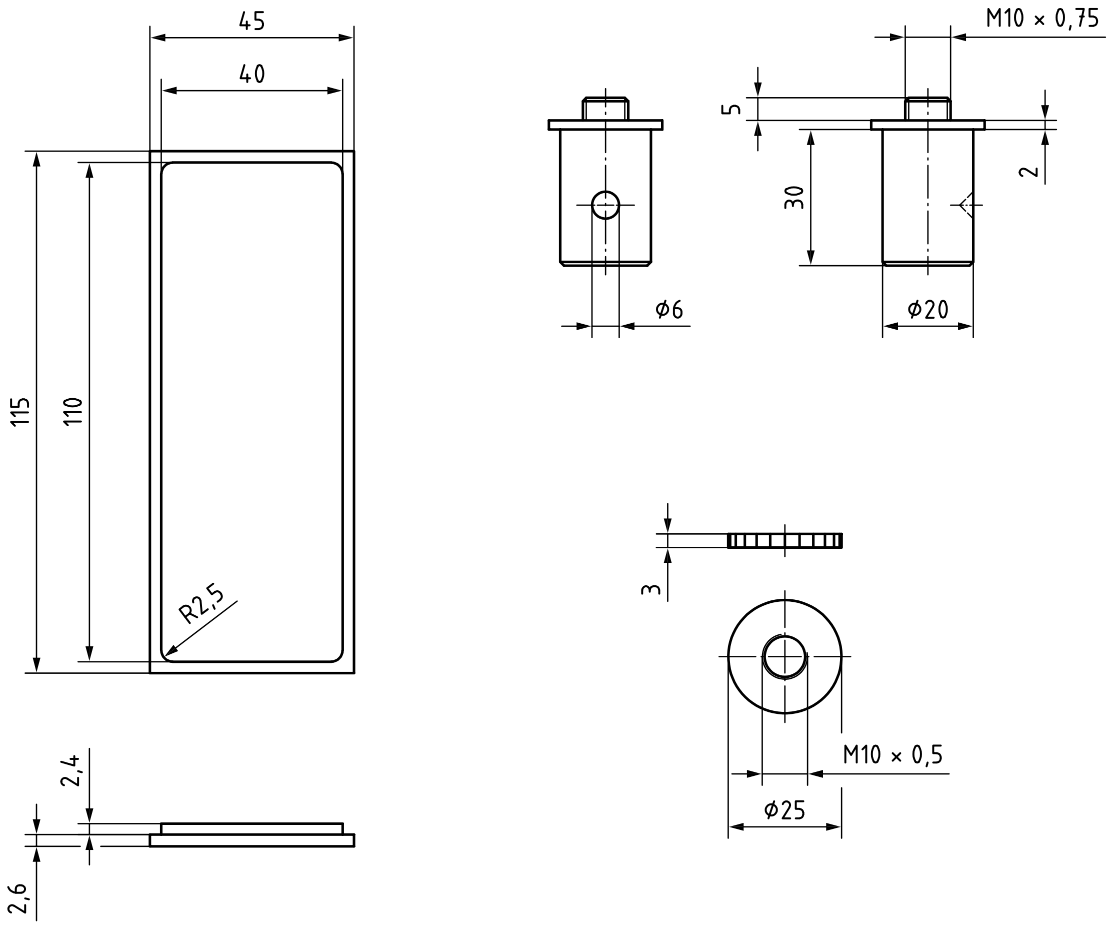
5 BNC connector (EMERSON ref: VBM511-1502)

6 microstrip line 35/2/0,8 mm

a) Antenna geometrical characteristics



b) Casing construction — Detail



c) Casing construction — Detail (*continued*)

Figure B.11 — 144–148 MHz antenna

B.4.7 Antenna for 168–173 MHz frequency band

B.4.7.1 Typical characteristics

Antenna bandwidth: 169,8–173 MHz (min.)

Input impedance: 50 Ω

Permissible power: 50 W

Connector: Type-BNC

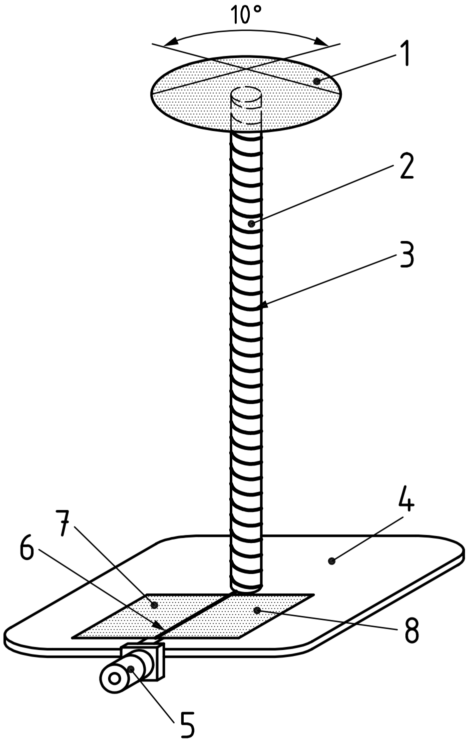
Gain: Typically –16 dB ± 1 dB

VSWR < 2,6:1 over the entire band.

B.4.7.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The radiating element consists of a helicoidal single pole at the top of which is placed a perpendicular metallic cylinder as described in Figure B.12 a).

The construction details of the casing are indicated in Figure B.12 b) and c).



Key

1 brass cone diameter, 50 mm; thickness, 0,1 mm

2 PVC cylinder: $\varepsilon_r = 3{,}3$; diameter, 10 mm; length, 127 mm

3 coated copper wire: diameter, 1 mm/900 mm; number of turns, 29

4 FR4 1,6 mm/35 µ Cu: ground plane on lower side; dimensions, 74/74 mm

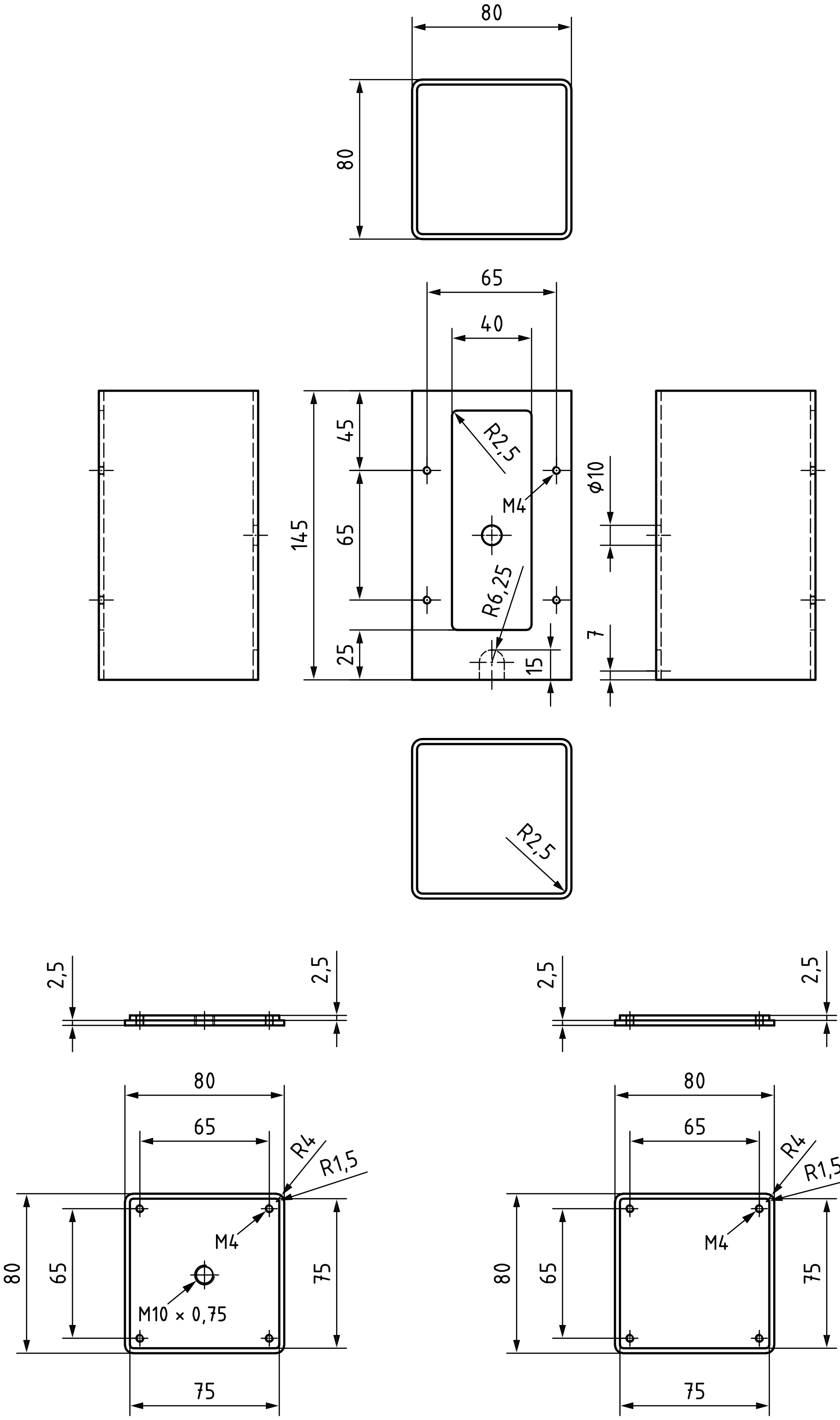
5 BNC connector (EMERSON ref: VBM511-1502)

6 microstrip line 35/2/0,8 mm

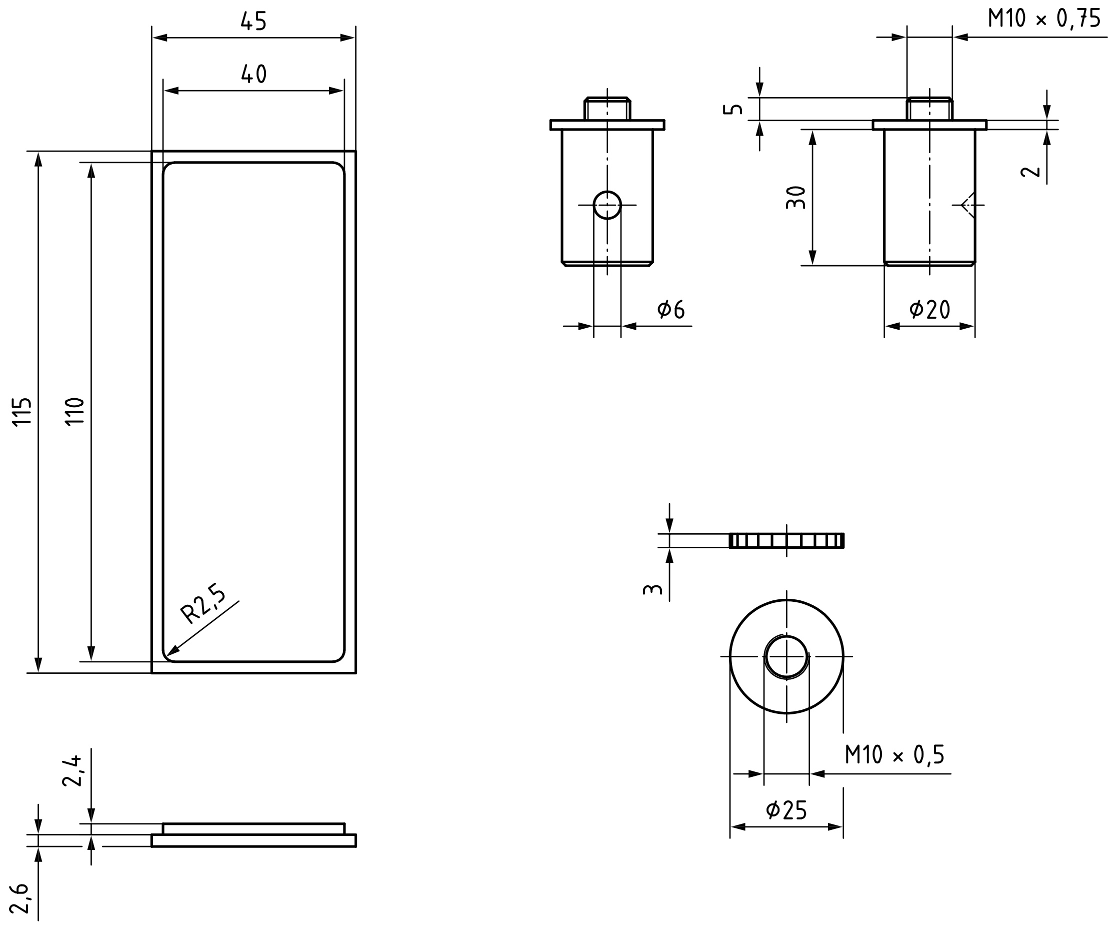
7 C1 = 15 to 25 pF

8 C2 = 15 to 25 pF

a) Antenna geometrical characteristics



b) Casing construction — Detail



c) Casing construction — Detail (*continued*)

Figure B.12— 168–173 MHz antenna

B.4.8 Antenna for 380–430 MHz frequency band

B.4.8.1 Typical characteristics

Antenna bandwidth: 380–430 MHz (min.)

Input impedance: 50 Ω

Permissible power: 50 W

Connector: Type-BNC

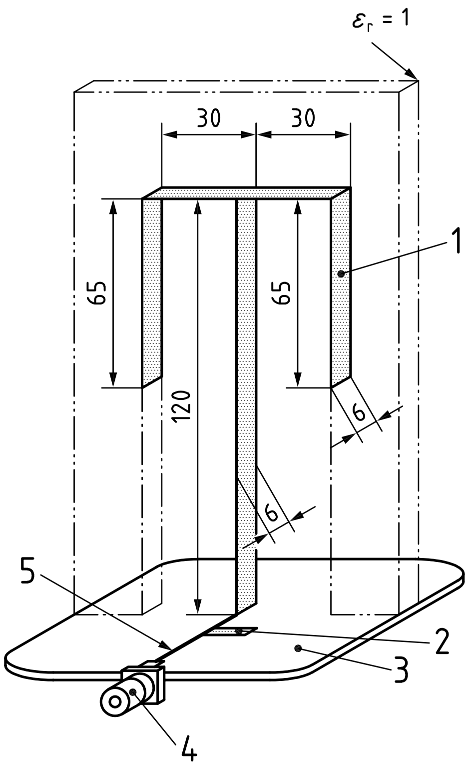
Gain: Typically −9 dB ± 1 dB

VSWR < 2:1 over the entire band.

B.4.8.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The enlarged, symmetrically folded radiating element is as shown in Figure B.13 a).

The construction details of the casing are indicated in Figure B.13 b) and c).



Key

1 brass thickness, 0,5 mm

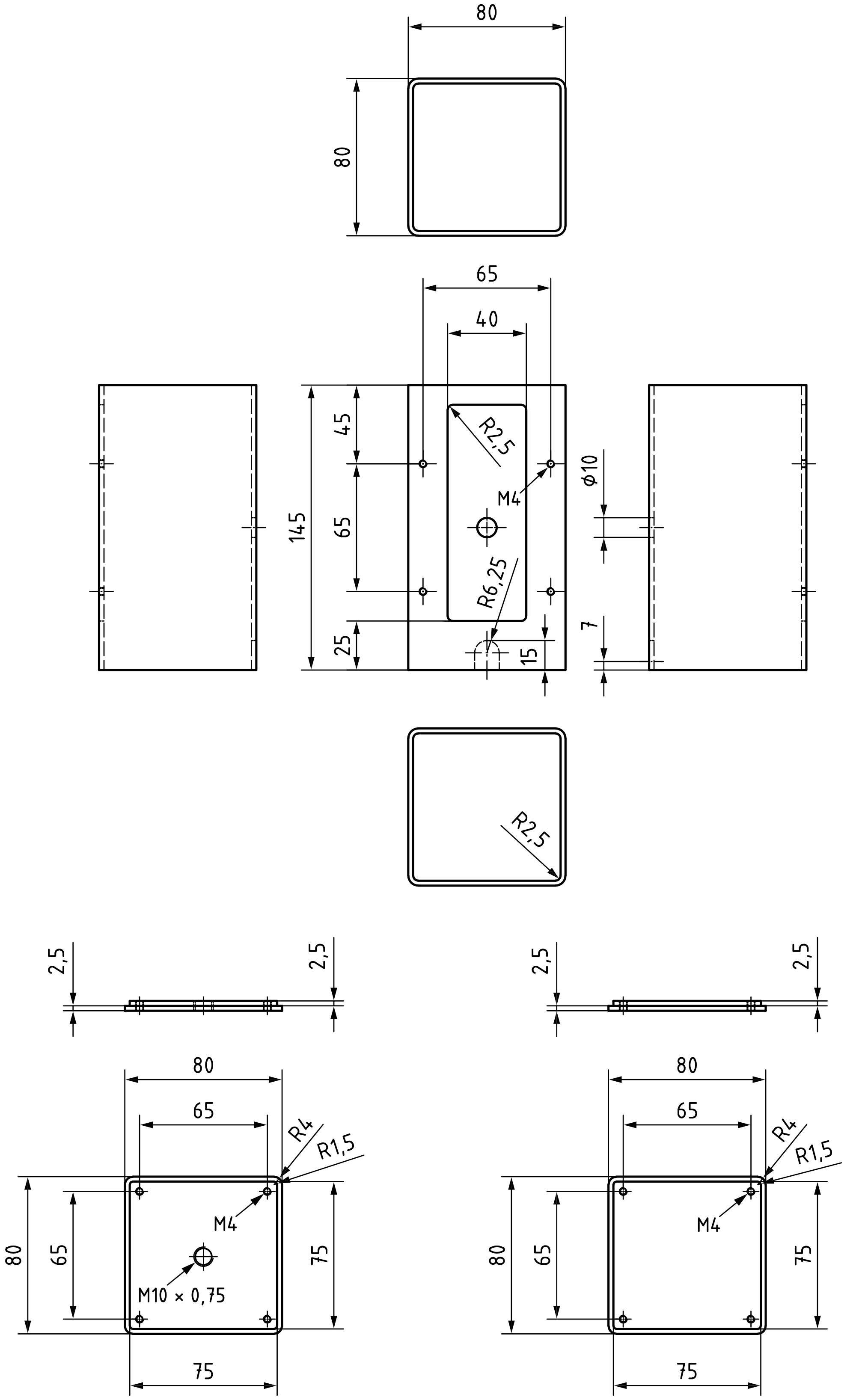
2 stub 12/2 mm (for movement along microstrip line for frequency adjustment)

3 FR4 1,6 mm/35 µ Cu: ground plane on lower side; dimension, 74/74 mm

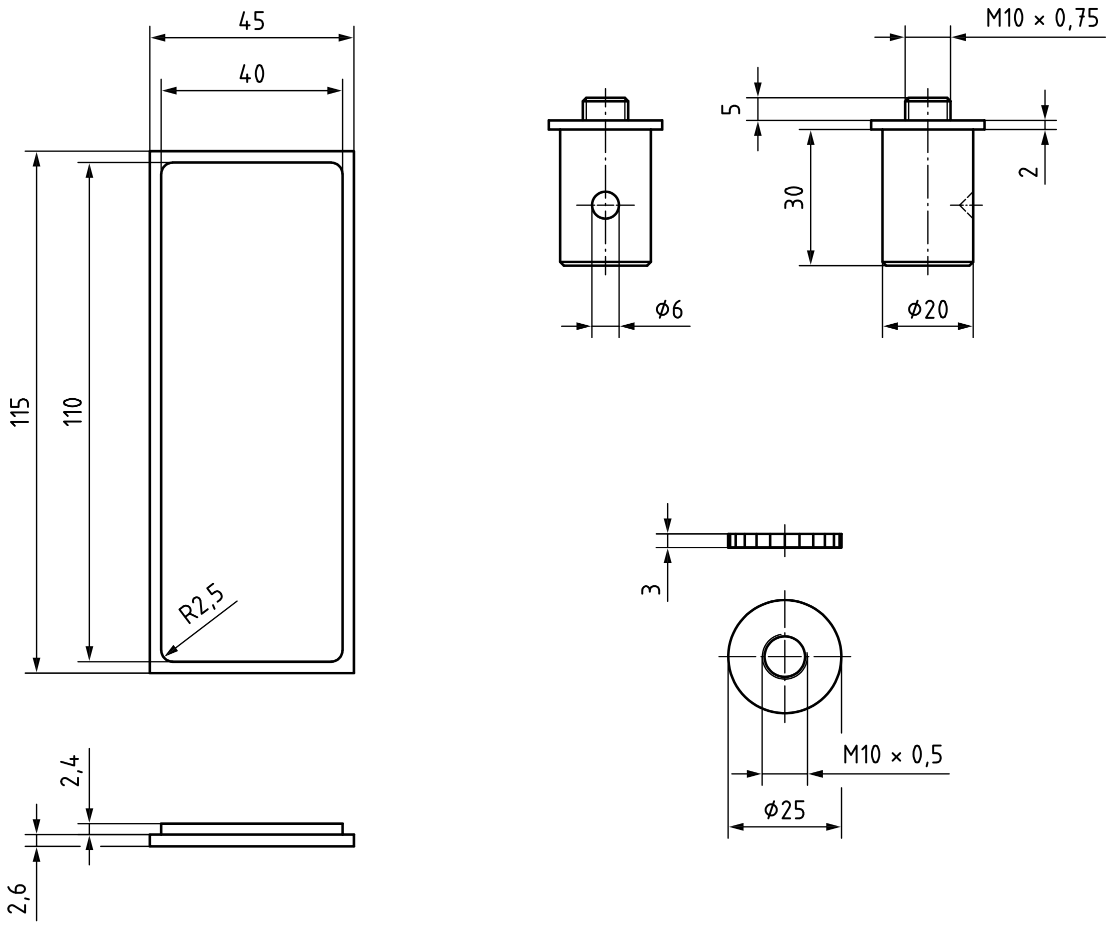
4 BNC connector (EMERSON ref: VBM511-1502)

5 microstrip line 35/1,2/0,8 mm

a) Antenna geometrical characteristics



b) Casing construction — Detail



c) Casing construction — Detail (*continued*)

Figure B.13 — 380–430 MHz antenna

B.4.9 Antenna for 430-470 MHz frequency band

B.4.9.1 Typical characteristics

Antenna bandwidth: 430–470 MHz (min.)

Input impedance: 50 Ω

Permissible power: 50 W

Connector: Type-BNC

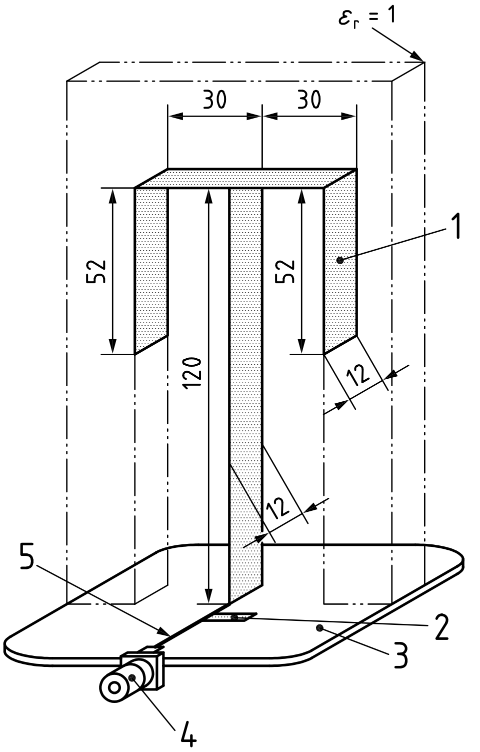
Gain: Typically −8 dB ± 1 dB

VSWR < 2:1 over the entire band.

B.4.9.2 Antenna construction and integration into casing

The antenna is produced from a type-FR4 printed circuit and supplied in its centre by a microstrip line. The enlarged, symmetrically folded radiating element is as shown in Figure B.14 a).

The construction details of the casing are indicated in Figures B.14 b) and c).



Key

1 brass thickness, 0,5 mm

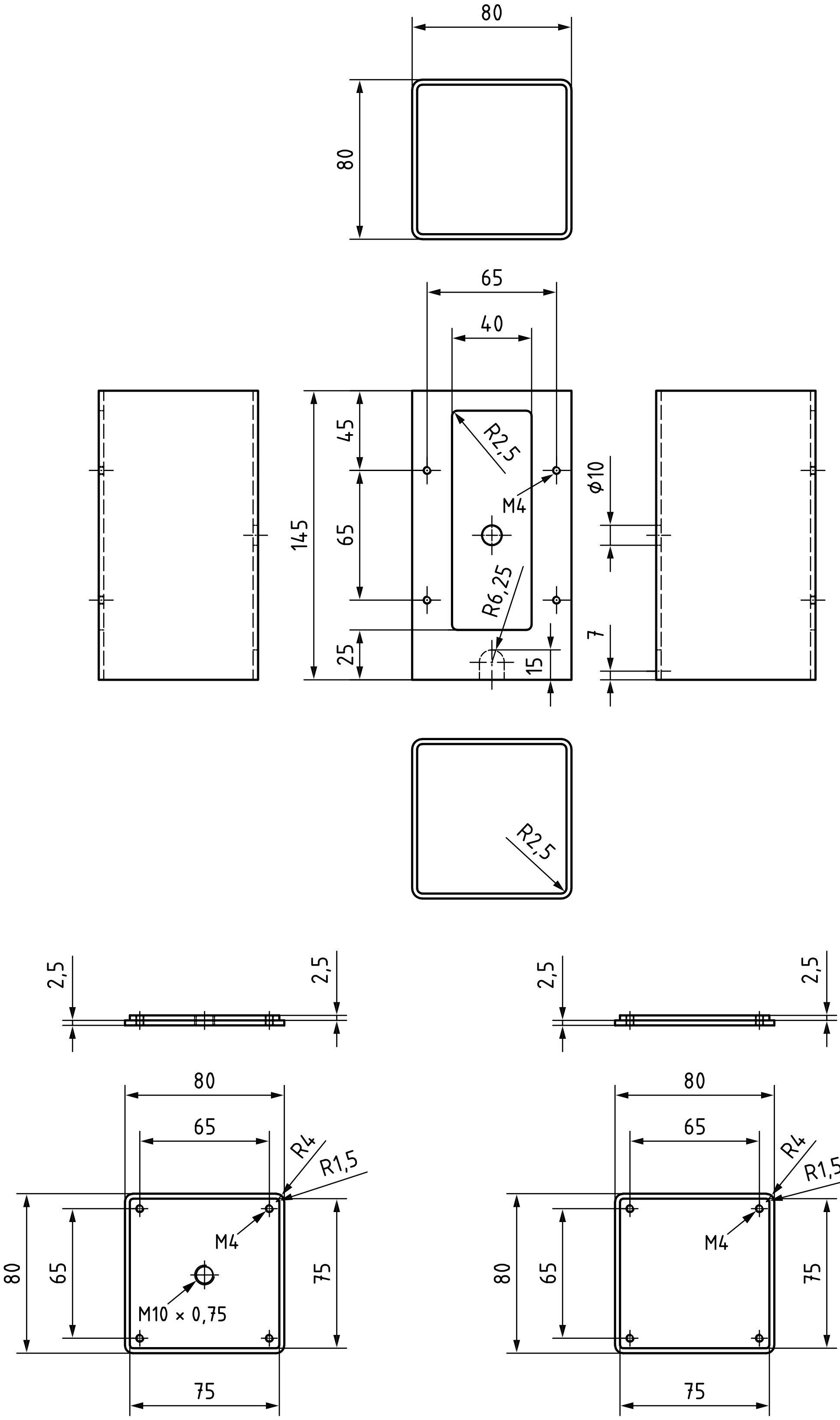
2 stub 20/2 mm (for movement along microstrip line for frequency adjustment)

3 FR4 1,6 mm/35 µ Cu: ground plane on lower side; dimension 74/74 mm

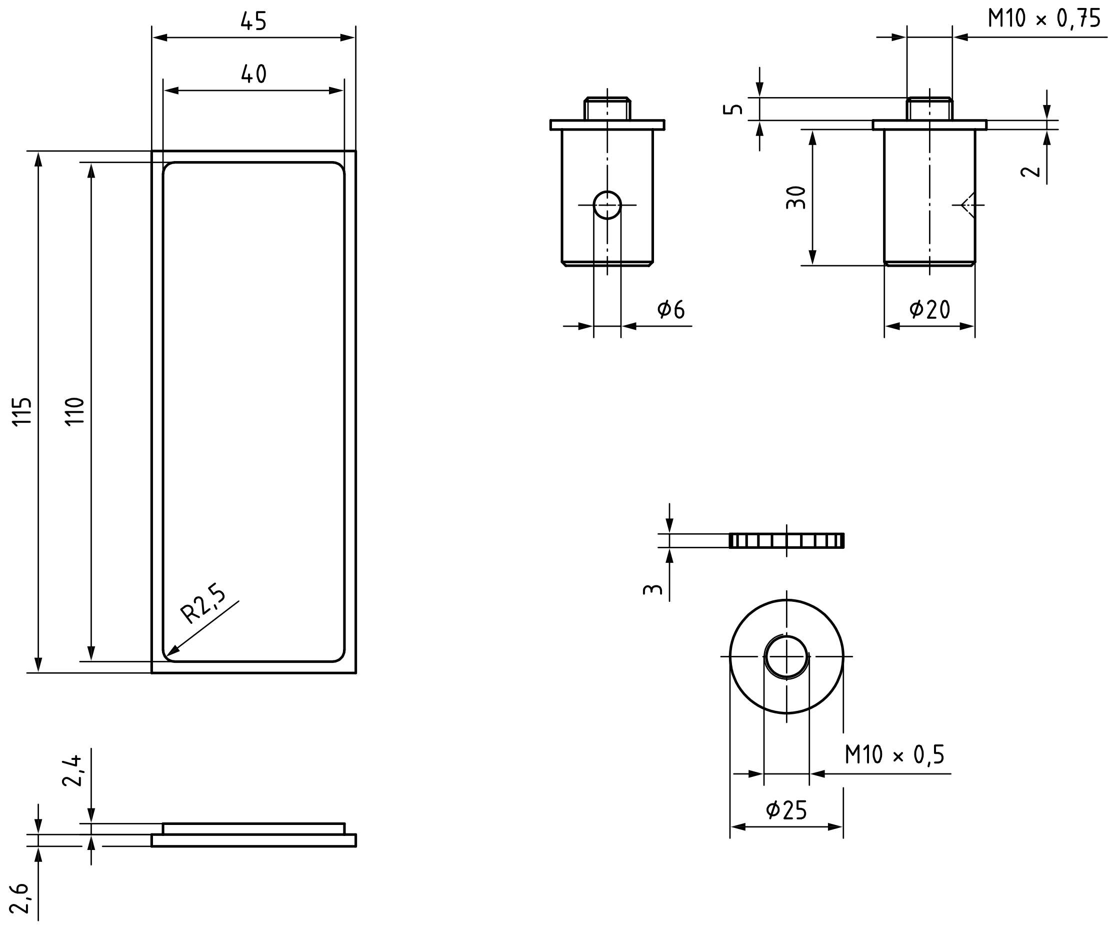
4 BNC connector (EMERSON ref: VBM511-1502)

5 microstrip line 35/1,2/0,8 mm

a) Antenna geometrical characteristics



b) Casing construction — Detail



c) Casing construction — Detail (*continued*)

Figure B.14 — 430–470 MHz antenna

Annex C
(informative)

Example of test severity levels associated with function performance status classification

C.1 General

This annex gives examples of test severity levels which should be used in accordance with the principle of function performance status classification (FPSC) given in ISO 11452-1.

C.2 Example of severity levels

An example of severity levels in GSM band is given in Table C.1.This table can be different for each frequency range.

Table C.1 — Example severity levels in GSM band

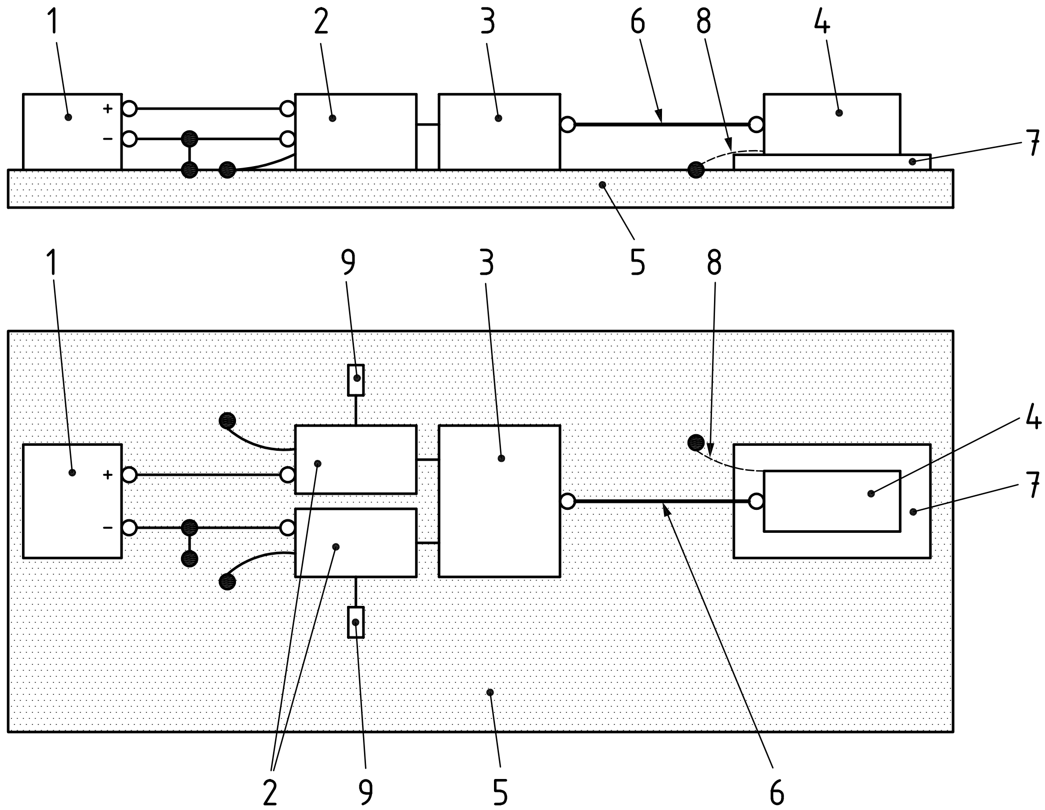
Test severity levels	**Category 1** W	**Category 2** W	**Category 3** W
L_{4i}	2	6	10
L_{3i}	2	6	6
L_{2i}	1	2	2
L_{1i}	1	1	1

Annex D
(informative)

Remote/local grounding

D.1 DUT remotely grounded

The principle for connecting a remotely grounded DUT is shown in Figure D.1.



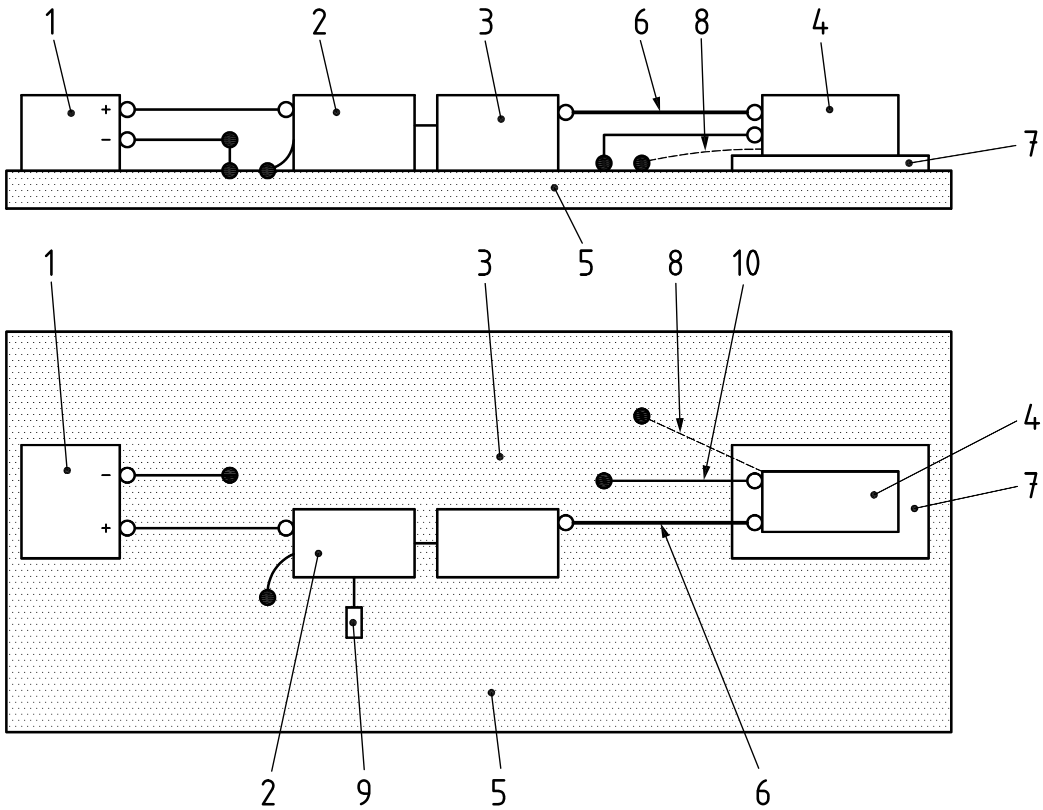
Key

1 power supply/battery
2 AN
3 simulator (power configuration through AN or directly to the power supply to be defined in test plan)
4 DUT
5 ground plane
6 wiring harness (containing power supply and return line)
7 insulating support
8 housing of the DUT not connected to ground plane unless specified in the test plan (see 7.3)
9 50 Ω load.

Figure D.1 — DUT remotely grounded

D.2 DUT locally grounded

The principle for connecting a locally grounded DUT is shown in Figure D.2.



Key

1 power supply/battery
2 AN
3 simulator (power configuration through AN or directly to the power supply, to be defined in test plan)
4 DUT
5 ground plane
6 wiring harness (not containing power return line)
7 Insulating support
8 DUT not connected to ground plane unless specified in test plan (see 7.3)
9 50 Ω load.
10 power return line (max. length 200 mm)

Figure D.2 — DUT locally grounded

ICS 33.100.20; 43.040.10

Price based on 47 pages

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards and other standards-related publications, information and services. It presents the UK view on standards in Europe and at the international level.

BSI is incorporated by Royal Charter. British Standards and other standardisation products are published by BSI Standards Limited.

Revisions

British Standards and PASs are periodically updated by amendment or revision. Users of British Standards and PASs should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using British Standards would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Similary for PASs, please notify BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001

BSI offers BSI Subscribing Members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of British Standards and PASs.

Tel: +44 (0)20 8996 7669 Fax: +44 (0)20 8996 7001
Email: plus@bsigroup.com

Buying standards

You may buy PDF and hard copy versions of standards directly using a credit card from the BSI Shop on the website **www.bsigroup.com/shop.** In addition all orders for BSI, international and foreign standards publications can be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

In response to orders for international standards, BSI will supply the British Standard implementation of the relevant international standard, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Knowledge Centre.

Tel: +44 (0)20 8996 7004 Fax: +44 (0)20 8996 7005
Email: knowledgecentre@bsigroup.com

BSI Subscribing Members are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards and PASs via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about British Standards is available on the BSI website at **www.bsi-group.com/standards**

Copyright

Tel: +44 (0)20 8996 7070
Email: copyright@bsigroup.com

BSI

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™