PRODUCT SPECIFICATION

ALLGON

Product specification for product no. 82108.1 Retractable Bottom Helical Antenna System for Hyundai model MMD-1010 CDMA/AMPS hand portable unit.

DOCUMENT 82108.1 Issue 1

The product described in this document is protected by at least one of the following Patents and Patent Applications and any corresponding national rights: PCT/SE93/00886, PCT/SE94/00391,PCT/SE96/00147, PCT/SE94/01008, PCT/SE97/01046. US5,710,567, SE505119, PCT/SE97/01046.

The product specification is a complete description of the product only together with the specification drawing.

Please approve this product specification by signing it within two weeks from date of receipt. A faxed copy of the signed first page will be accepted as approval. If you have any comments on the product, please forward them to Allgon within two weeks from date of receipt. If no reply is received by Allgon within the two weeks period, this will be considered as your quiet approval.

Checked RF, date: October 6th, 2000

Franck Campagna
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1 LOG OF CHANGES

Issue no.	Item no.	From	To	Changed by	Date

2 GENERAL

2.1 PRODUCT DESCRIPTION

A retractable bottom helical antenna system, consisting of a helical element and a retractable whip through the helical element, for use in a portable unit for wireless communication (referred to as a handset).

2.2 PRODUCT NUMBER

Allgon Product Number	82108.1
Hyundai Product Number	MMD-1010

2.3 FIRST ARTICLE APPROVAL

20 samples from an early mass produced batch (produced under serial-like conditions) and form MB-006 "First Article Approval" are sent to Hyundai. When these are approved form MB-006 should be completed, signed and sent back to Allgon before further mass production batches can be delivered. This procedure is repeated prior to any major change in design or materials.

2.4 UNITS, DEFINITIONS AND ABBREVIATIONS

Unless otherwise stated, SI units are used.

Tx	Transmit Band
Rx	Receive Band
PCB	Printed Circuit Board
VSWR	Voltage Standing Wave Ratio
dBd	Antenna gain in dB relative to a Dipole
CW	Continuous Wave
g	Acceleration of gravity $\approx 9.8\ m/s^2$
RH	Relative Humidity

"Without mechanical damage" implies full mechanical functionality according to specification and compliance with visual requirements according to specification drawing.
"Without permanent mechanical damage" as above but allows reversible misalignment or deformation and minor visual damage.
"Unimpaired functionality" implies full mechanical functionality according to specification but allows visual damage (no through-cuts or holes).

2.5 INTERFACE

All properties are guaranteed under the condition that antenna/handset interface is designed in accordance with instructions provided by Allgon. Functionality with other equipment (such as couplers etc.) is not guaranteed unless this has been agreed upon separately.

2.6 CONDITIONS

Unless otherwise stated all temperature tolerances are ±3°C and all RH tolerances are ±5 percentage units.
Unless otherwise stated all values are valid at +20°C and 50% RH.
Unless otherwise stated all values are valid for the handset defined in 3.3.1.

2.7 COORDINATE SYSTEM.

The coordinate system for the handset is defined as follows:

- Origin in center of gravity
- Positive X axis is perpendicular to, and directed from, front plane
- Positive Y axis is perpendicular to, and directed from, right side plane (as seen from front)
- Positive Z axis is perpendicular to, and directed from, top plane.

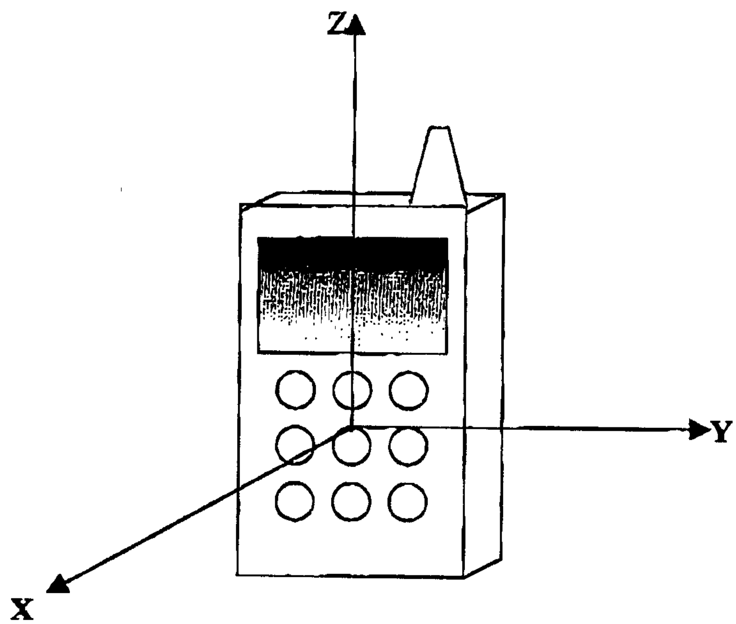


Figure 2.7.1 *Coordinate system for the handset*

3 ELECTRICAL PROPERTIES

3.1 FREQUENCY BANDS

3.1.1 Transmit Bands (Tx)

Tx: 824 - 849 MHz

3.1.2 Receive Bands (Rx)

Rx: 869 - 894 MHz

3.2 IMPEDANCE

3.2.1 Nominal Value

50 ohms

3.2.2 Method

Allgon will supply engineering assistance to ensure that the impedance over the frequency bands is as close to 50 ohms as possible after matching, both in extended and retracted modes. Both free space and talk position are considered, with priority given to talk position.

3.3 THE HANDSET

3.3.1 Handset Revision

Allgon chassis ID Number	1335
Received at Allgon	August, 2000

3.3.2 Matching

The matching on the PCB of the handset is according to figure 3.3.1. Optimum matching is highly dependant on the handset and thus, final matching layout and values will be defined when handset is available. The following matching components are used:

Capacitors: two 3.9 pF shunt capacitors
Inductors: 6.8 nH serie inductance

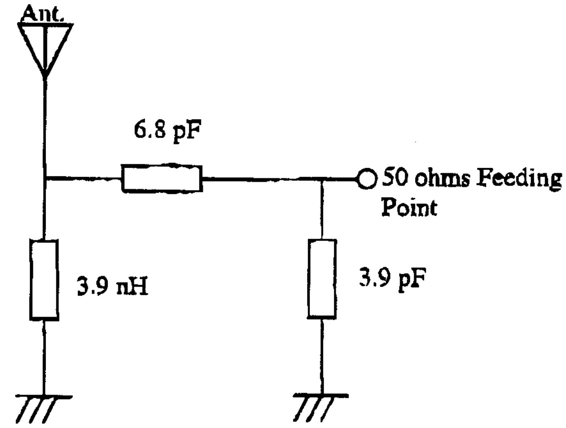


Figure 3.3.1 *Matching circuit*

3.4 VSWR

Below are listed the typical values of the worst matched frequency within each band.

3.4.1 Free Space

	Typical Maximum Values	
Mode	**Tx**	**Rx**
Extended	6.15	5.53
Retracted	5.21	3.45

Below are listed the maximum values of the worst matched frequency within each band including production variation influences.

3.4.2 Talk Position

	Maximum Values	
Mode	**Tx**	**Rx**
Extended	4.35	2.31
Retracted	4.47	1.75

3.4.3 Measuring Method

A 50 ohms coaxial cable is connected (soldered) to the 50 ohms feeding point (see fig. 3.3.1) on the PCB. The connection of the coaxial cable is done so as to introduce a minimum of mismatch. Ferrite beads are mounted on the cable outside the handset to reduce induced currents on the cable. The cable exits the handset in the negative Y direction. In the other end, the coaxial cable is connected to a network analyzer. The analyzer is calibrated so that the reference plane is at the 50 ohms feeding point.

The handset, including the PCB, must not in any significant way differ from the mass produced handset, e.g. the antenna feeding parts have to be equivalent to the parts in mass production.

Free space means that the handset is placed on a nonconductive surface of Styrofoam.

3.4.4 Electrical Performance Assurance

In order to guarantee the specified electrical performance in mass production the following procedure is used (example given for a single band antenna). From early production, two antennas are selected; one defining the lowest allowable resonance frequency (when measured on the handset), marked "low freq.", and one defining the highest allowable resonance frequency, marked "high freq.", see figure 3.4.1. These antennas are our reference antennas. These antennas are then measured on a ground plane used in mass production and define the highest and lowest allowable resonance frequencies on this ground plane and each produced antenna is automatically tested on this ground plane.

Only the retracted mode is considered when finding the reference antennas, since the production variation of the extended mode is negligible.

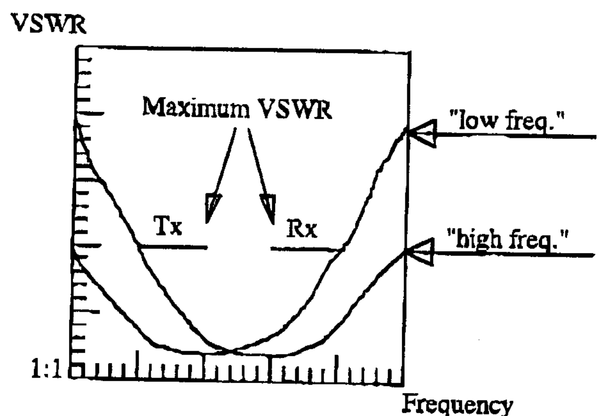


Figure 3.4.1 *Reference antennas defining the lowest and highest allowable resonance frequencies for a single band antenna.*

3.5 GAIN

Below are typical peak gain values (according to fig. 3.5.1 a) of the frequency with the lowest peak gain within each band.

3.5.1 Free Space

Typical Minimum Peak Values

Mode	**Tx**	**Rx**
Extended (dBd)	-8.1	-3.99
Retracted (dBd)	-5.23	-3.23

Below are minimum peak gain values (according to fig. 3.5.1 a) of the frequency with the lowest peak gain within each band including production variation influences.

3.5.2 Talk Position

Typical Minimum Peak Values

Mode	Tx	Rx
Extended (dBd)	-7.96	-5.44
Retracted (dBd)	-7.72	-6.1

Below is specified the maximum lobe tilt (see 3.5.4) for the extended case only, since the lobe tilt in the retracted mode is almost entirely determined by the handset.

3.5.3 Maximum Lobe Tilt (α)

Mode	Tx	Rx
Extended	45°	45°

3.5.4 Measuring Method

The connection is done according to 3.4.4. Radiation patterns are measured at the lowest, middle and highest frequency for each band defined in 3.1.1 and 3.1.2. The measurements are performed so as to minimize the influence of the cables. The specified gain values shall be found within the specified lobe tilt from the horizontal plane according to figures 3.5.1 a) and b). The total electric field is measured, i.e. the vector sum of two orthogonal polarizations. The antenna is measured in 2 orthogonal E-planes in free space, according to figure 3.5.1. The antenna is also measured in talk position. Calibration for absolute measurements is done with a reference antenna, which is in turn calibrated by a certified calibration company.

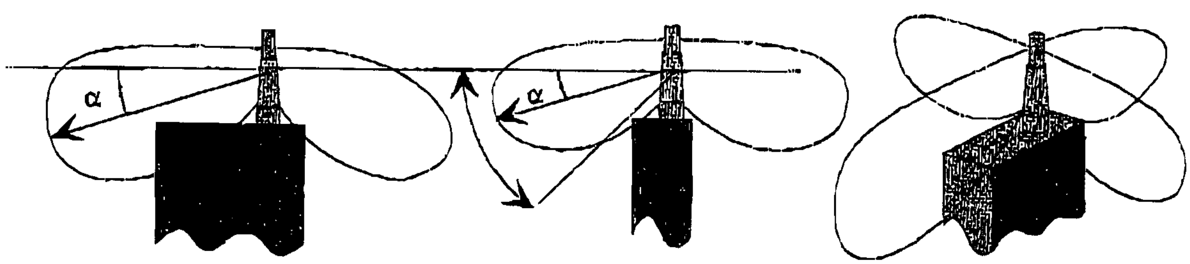


Figure 3.5.1 *Radiation patterns, a) E1-plane (YZ-plane) b) E2-plane (XZ-plane) c) 3-D view*

3.6 POWER RATING

3.6.1 Maximum Value

P = 2 W (CW)

3.6.2 Demands

Without mechanical damage and electrical performance according to 3.4.2, after the test.

3.6.3 Measuring Method

The connection is done according to 3.4.4. The specified power, P, is applied for 10 minutes at the middle frequency of each Tx band defined in 3.1.1. Immediately after the test the VSWR is measured.

4.1 APPEARANCE

The appearance shall be according to specification drawing S82108.1 revision A.

4.2 HELIX BENDING

4.2.1 Angle

$\beta = 30^{\circ}$

4.2.2 Bending Force

$F_b = 40$ N

4.2.3 Demands

Without permanent mechanical damage and electrical performance according to 3.4.2 after test.

4.2.4 Measuring Method

Antenna is assembled to the test equipment according to figure 4.2.1. Force is applied to the antenna in the Y direction 10 mm above the handset/antenna interface and increased until the specified angle, **β**, or the specified force, F_b, is reached.

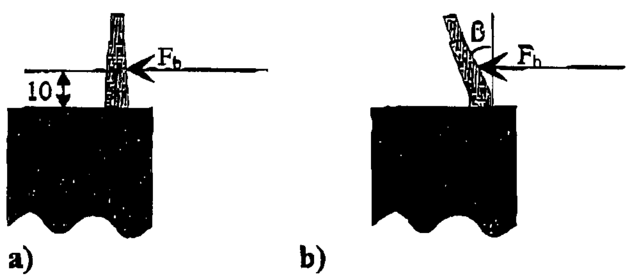


Figure 4.2.1 *Helix bending test a) F_b application b) F_b and β*

4.3 HELIX TORQUE

4.3.1 Minimum Value

T = 10 Ncm

4.3.2 Demands

Without mechanical damage and no rotation of the antenna cover after test. Electrical performance according to 3.4.2 after test.

4.3.3 Measuring Method

Antenna is assembled to the test equipment. A torque instrument is attached to the helical antenna without introduction of any radial forces. The specified torque, T, is applied in clockwise direction according to figure 4.3.1.

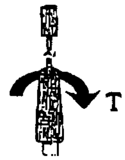


Figure 4.3.1 *Helix torque test*

4.4 HELIX TENSILE LOAD

4.4.1 Minimum Value

F_h=50 N between frame of antenna and handset

4.4.2 Demands

Without mechanical damage and electrical performance according to 3.4.2 after test.

4.4.3 Measuring Method

Antenna is assembled to the test equipment according to figure 4.4.1. The specified force, F_h, is applied during 30 s to the helix parallel to the antenna axis.

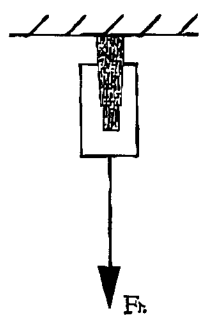


Figure 4.4.1 *Helix tensile load test*

4.5 WHIP BENDING

4.5.1 Bending Radius

R = 20 mm

4.5.2 Demands

Zone 1: Remaining deformation < 0.5 mm / 40 mm wire length.
The original straightness shall be possible to restore.
Zone 2: No fracture. The original straightness shall be possible to restore.
Electrical performance according to 3.4.2 after test.

4.5.3 Measuring Method

The antenna is bent 180° around a cylinder with radius R in extended mode, according to figure 4.5.1 a). The antenna is released and sprung back to vertical position. Zones 1 and 2, according to figure 4.5.1 b), are examined.

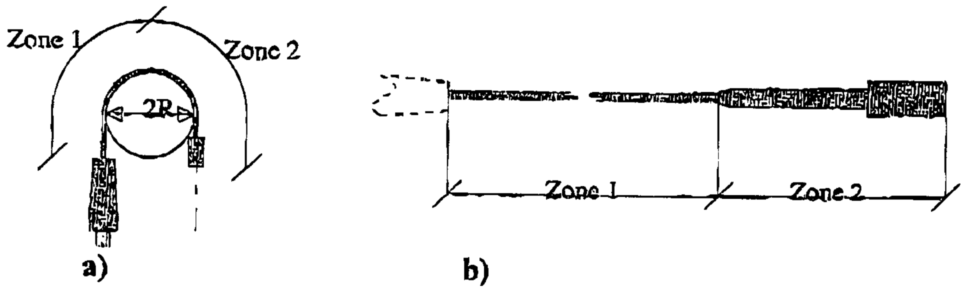


Figure 4.5.1 *Whip bending test   a) Bent whip   b) Whip zones*

4.6 WHIP BENDING ENDURANCE

4.6.1 Number of Cycles

1,500 cycles, according to figure 4.6.1.

4.6.2 Demands

Without mechanical damage and electrical performance according to 3.4.2 after test.

4.6.3 Measuring Method

The antenna is assembled to the test equipment in extended mode according to figure 4.6.1. The antenna is bent 90° left and 90° right (1 cycle) with 6 s cycle time. This is repeated for the duration of the test.

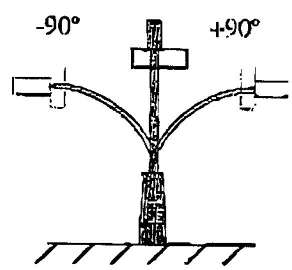


Figure 4.6.1 *Bending endurance test*

4.7 WHIP TENSILE LOAD

4.7.1 Force

$F_w = 50$ N

4.7.2 Demands

Without mechanical damage and electrical performance according to 3.4.2.

4.7.3 Measuring Method

The antenna is assembled to the test equipment according to figure 4.7.1. The specified force, F_w, is applied during 30 s to the top of the whip parallel to the antenna axis.

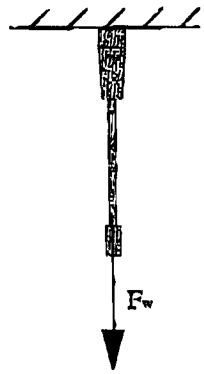


Figure 4.7.1 *Whip tensile load test*

4.8 WHIP RETRACTION/EXTENSION FORCES

4.8.1 Forces

Extension from retracted position:	0.5 - 5.0 N
Locking in extended position:	0.5 - 5.0 N
Retraction from extended position:	0.5 - 5.0 N
Locking in retracted position:	0.5 - 5.0 N

4.8.2 Retraction/Extension Cycles

The antenna is fully extended/retracted (1 cycle) with random rotation for 10,000 cycles with 2 s cycle time.

4.8.3 Demands

The mean value from 2 measurements of each force, made on each antenna, shall be within the specified limits for the duration of test. Without mechanical damage and electrical performance according to 3.4.2 after test.

4.8.4 Measuring Method

The antenna is pushed down or pulled up with a speed of 100 mm/min. The maximum force before the antenna is released or locked is registered.
The forces are measured after 1, 5 000 and 10 000 completed cycles.

4.9 DROP

4.9.1 Number of Drops

1 drop in extended mode and 1 drop in retracted mode.

4.9.2 Drop Height

0.75 m

4.9.3 Drop Angle

Handset is rotated 45° around positive or negative X-axis to ensure handset lands on antenna.

4.9.4 Handset Weight

130 grams

4.9.5 Demands

Without permanent mechanical damage and electrical performance according to 3.4.2 after test.

4.9.6 Measuring Method

The antenna is attached to handset (if available, otherwise to test fixture of equal weight). The handset is dropped with antenna downwards onto a steel surface covered with 20 sheets of copy paper (80 g/m^2).

Test meets or exceeds requirements of IEC 68-2-32 and EN 600 68-2-32.

4.10 ASSEMBLY

4.10.1 Demands

Snap-in interfaces are assembled to handset with maximum force in negative Z-direction of 60 N.

For one-way snap-in interface force is guaranteed for first time assembly only.

4.10.2 Measuring Method

For snap-in interfaces the handset is attached to the test fixture, tensile load instrument is attached to helix. Maximum force required to assemble or disassemble antenna/handset is registered.

5 ENVIRONMENTAL RESISTANCE PROPERTIES

5.1 ELECTRICAL OPERATIONAL TEMPERATURE

5.1.1 Low Operational Temperature

T_{LO} = -20°C

5.1.2 High Operational Temperature

T_{HO} = +70°C at 50% RH

5.1.3 Demands

Maximum VSWR increase in any of the bands defined in 3.1.1 and 3.1.2 less than 1 VSWR units in the extended mode and 1.5 VSWR units in the retracted mode.

5.1.4 Measuring Method

The connection is done according to 3.4.4.
The antenna is kept at +20°C at 50% RH for at least 1 hour.
The antenna is placed at temperature T_{LO} and after 1 hour the free space VSWR is measured.
The antenna is kept at +20°C at 50% RH for at least 1 hour.
The antenna is placed at temperature T_{HO} and after 1 hour the free space VSWR is measured.

5.2 TEMPERATURE CYCLING

5.2.1 Low Cycling Temperature

T_{LC} = -40°C

5.2.2 High Cycling Temperature

T_{HC} = +80°C at 50% RH

5.2.3 Demands

Without mechanical damage after a 24 hour relaxing period at +20°C and 50% RH and electrical performance according to 3.4.2, after a 1 hour relaxing period at +20°C and 50% RH.

5.2.4 Measuring Method

The antenna is placed in a climatic chamber. The temperature is cycled as follows: The temperature is kept constant at T_{LC} for 1 hour, increased to T_{HC} during 1 hour, kept constant at T_{HC} for 1 hour, and then decreased to T_{LC} during 1 hour. This procedure is repeated 10 times ending at +20°C and 50% RH, see figure 5.2.1.

Test meets or exceeds requirements of IEC-T2-14, test Nb.

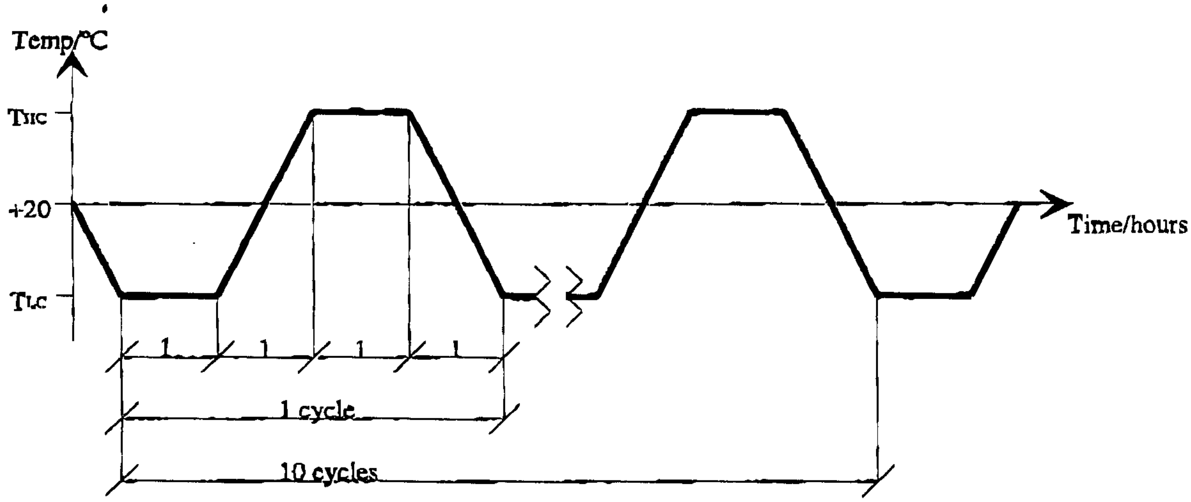


Figure 5.2.1 *Temperature cycling*

5.3 HUMIDITY

5.3.1 Humidity

95% RH

5.3.2 Temperature

+55°C

5.3.3 Demands

Without mechanical damage and electrical performance according to 3.4.2, after test.

5.3.4 Measuring Method

The antenna is placed in a climatic chamber for 24 hours. The antenna is taken out from the chamber and measured after another 24 hours in +20°C and 50% RH.

Test meets or exceeds requirements of IEC 68-2-3, test Ca and SEN 431603 Ca.

5.4 SINUSOIDAL VIBRATION

5.4.1 Vibration Frequencies

f = 5-55-5 Hz (1 cycle)

5.4.2 Sweep Rate

0.5 octave/min (logarithmic)

5.4.3 Maximum Amplitude

A = 1.5 mm

5.4.4 Maximum Acceleration

2 g

5.4.5 Crossover Frequency

18.2 Hz

The crossover frequency is the frequency where maximum acceleration first occurs when the frequency is increased. For higher frequencies the amplitude will decrease so that maximum acceleration is maintained.

5.4.6 Demands

Without mechanical damage and electrical performance according to 3.4.2 after test.

5.4.7 Measuring Method

The extended antenna is assembled to the test equipment. The vibration is done both in x- and z- directions, according to figure 5.4.1 a) and b), with a duration of 1 hour in each direction.

Test meets or exceeds requirements of IEC 68-2-6.

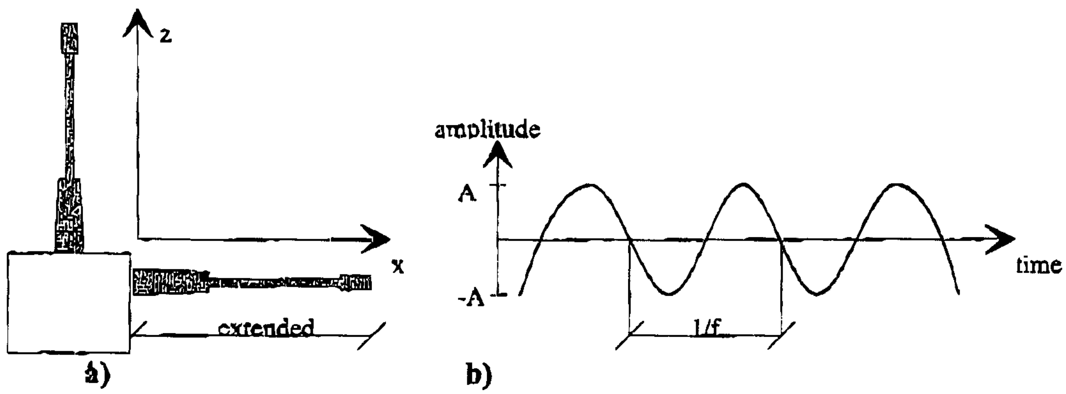


Figure 5.4.1 *Sinusoidal vibration a) Vibration directions b) Vibration form*

5.5 CORROSION

5.5.1 Demands

Without permanent mechanical damage and electrical performance according to 3.4.2 after test.

5.5.2 Measuring Method

The antenna is placed in an atmosphere saturated with 5% (by weight) sodium chloride solution for 96 hours at +35°C.

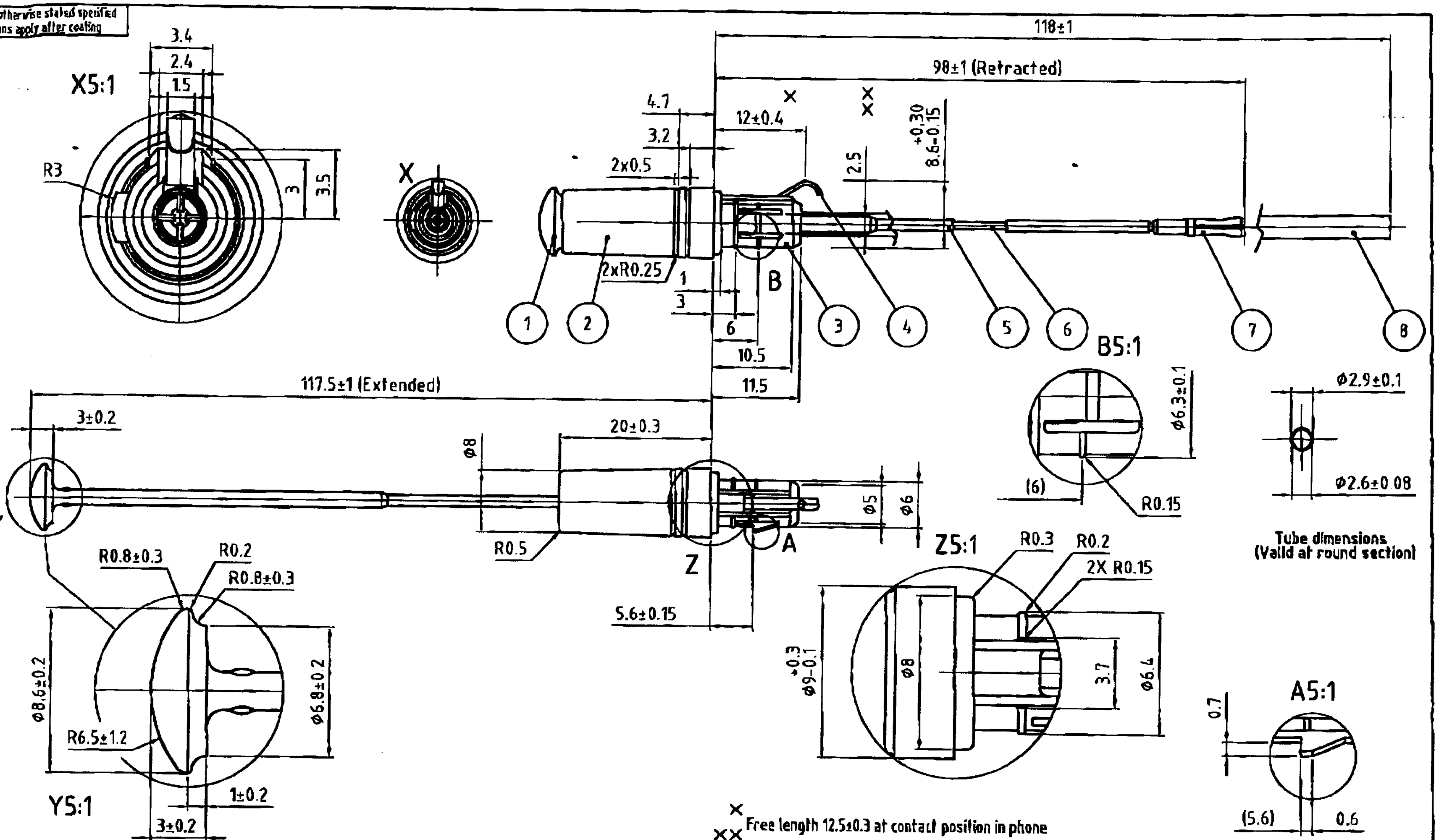
Test meets or exceeds the requirements in IEC 68-2-11.

5.6 AGING

Without mechanical damage and electrical performance according to 3.4.2 after equivalent of 3 years dark storage.

5.7 UV RESISTANCE

Unimpaired functionality and electrical performance according to 3.4.2 after being subjected to ultraviolet radiation according to IEC 68-2-5, Part 2, Test Sa, Procedure A (10 cycles, 40°C, no humidity, no operation).



x Free length 12.5±0.3 at contact position in phone

xx Free height 8.1 at contact position in phone

Note: Tolerance for nominal size below 0.5 is ±0.05 unless otherwise stated.

astic PA12	Colour black
cap AP1D	
-Ti-Cr Super elastic alloy	
astic PVC	
ainless steel	Gold plated
astic Delrin 100T BK602	Surface acc. to Charmilles VDI 3400 no. 24, Colour black
astic Dryflex 522450	Surface acc. to Charmilles VDI 3400 no. 30, Colour black
astic Zytel 66 F101	Surface acc. to Charmilles VDI 3400 no. 30, Colour black
ATERIAL	*SURFACE TREATMENT*

Name	Material / Drawing		
Format A3 Scale 2:1	Date/Sign 2000-10-02	Department R & D	Finish
Approved xxxxxx	Checked	General tolerance SS-ISO 2768-m	Surface treatment
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