TECHNICAL SPECIFICATION

ISO/TS 22239-2

Second edition
2018-05

Road vehicles — Child seat presence and orientation detection system (CPOD) —

Part 2:
Resonator specification

Véhicules routiers — Système de détection de la présence d'un siège enfant et de son orientation (CPOD) —

Partie 2: Spécifications relatives aux résonateurs

Reference number
ISO/TS 22239-2:2018(E)

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety and impact testing*.

This second edition cancels and replaces the first edition (ISO 22239-2:2009), which has been technically revised to take account of the development in technology since the first edition was published. The main changes compared to the previous edition are as follows:

— coil geometry parameters have changed;

— CPOD resonator protocol has changed;

— modulation parameters have been updated;

— the temperature storage test has been redefined;

— the CPOD resonator test parameters have been updated; and

— the ESD test has been updated.

A list of all parts in the ISO/TS 22239 series can be found on the ISO website.

Road vehicles — Child seat presence and orientation detection system (CPOD) —

Part 2: Resonator specification

1 Scope

This document specifies the child seat presence and orientation detection (CPOD) resonator as part of the CPOD system. It defines the electrical and environmental requirements to be met by the resonators as a condition for CPOD compatibility.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 10605:2008, *Road vehicles — Test methods for electrical disturbances from electrostatic discharge*

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

ISO 11452-2, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 2: Absorber-lined shielded enclosure*

ISO 11452-3, *Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 3: Transverse electromagnetic (TEM) cell*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

ISO/TS 22239-1:2018, *Road vehicles — Child seat presence and orientation detection system (CPOD) — Part 1: Specifications and test methods*

ISO 22241-1, *Diesel engines — NOx reduction agent AUS 32 — Part 1: Quality requirements*

IEC 60068-2-11, *Environmental testing — Part 2: Tests. Test Ka: Salt mist*

IEC 60068-2-38, *Environmental testing — Part 2: Tests. Test Z/AD: Composite temperature/humidity cyclic test*

IEC 60068-2-60, *Environmental testing — Part 2: Tests — Test Ke: Flowing mixed gas corrosion test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 22239-1 apply.

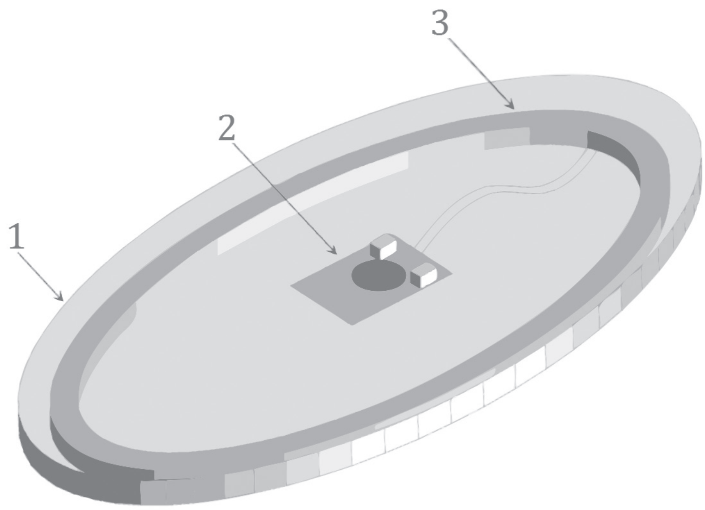
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

4 CPOD resonator components

The CPOD resonator shall consist of a coil and of electronics. It might be encapsulated by a housing as indicated in Figure 1. In order to pass the resonator compatibility test successfully, the different components shall meet the requirements defined. The transponders shall be passive, i.e. they shall take their energy out of the magnetic field produced by the CPOD sensor.



Key

1 encapsulation/housing

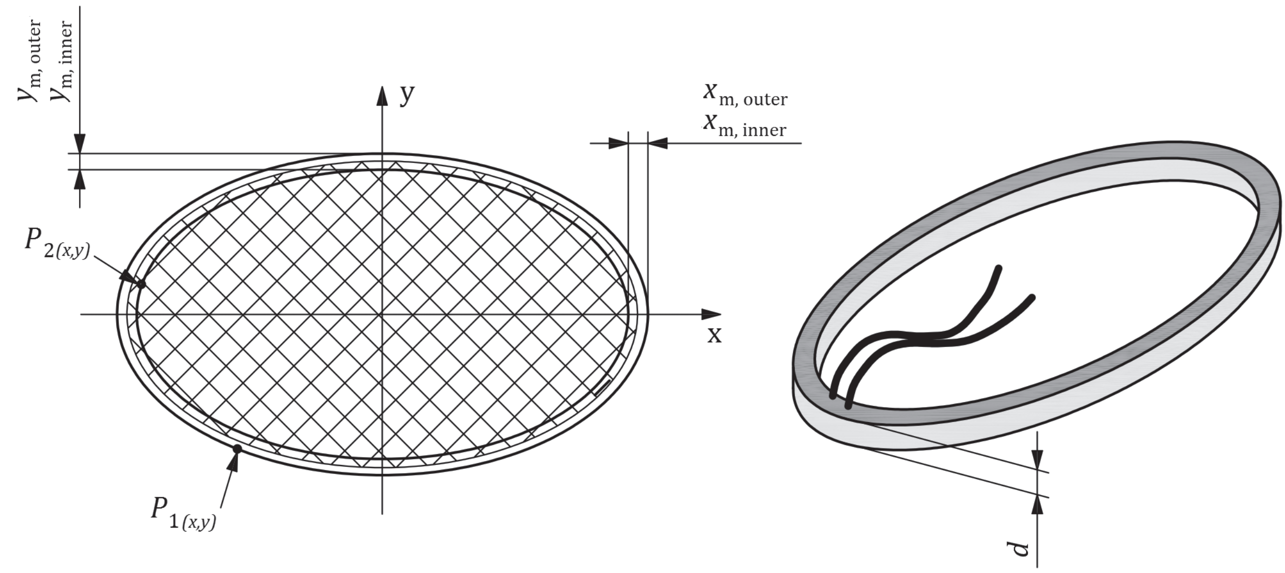
2 electronics

3 coil

Figure 1 — CPOD resonator components

5 Coil requirements

The CPOD resonator coil shall be an air coil with an elliptical shape. The geometry of the resonator probe coil is defined as indicated in Figure 2.



Key

$P_{1(x,y)}$, $P_{2(x,y)}$ position vectors determined by Formula (1)

Figure 2 — Resonator coil geometry

The position vectors of the inner and outer shape of the coil are described by Formula (1) with parameters as specified in Table 1:

$$P_{(x,y)} = \left(\frac{x}{x_m}\right)^2 + \left(\frac{y}{y_m}\right)^2 = 1 \qquad (1)$$

Table 1 — Coil geometry parameters

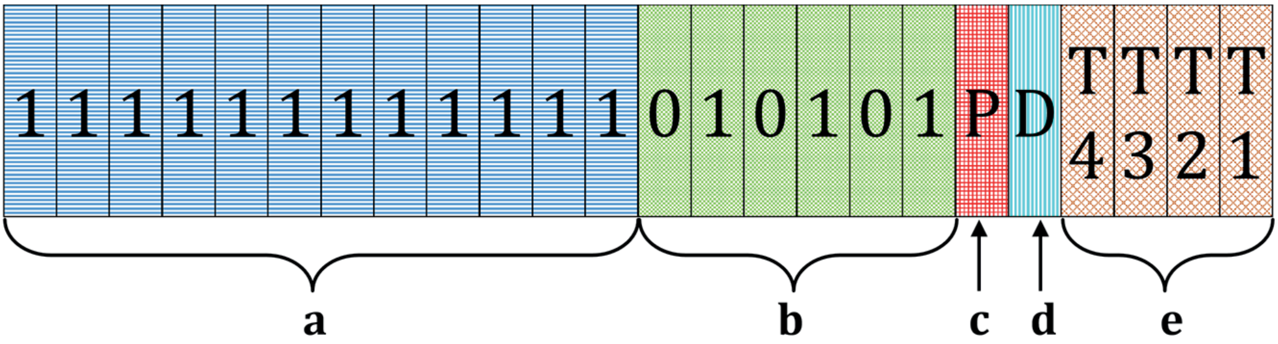
Dimensions in millimetres, measured at 25 °C

Parameter	min.	max.
$x_{m,outer}$	—	57,4
$y_{m,outer}$	—	32,8
$x_{m,inner}$	53,4	—
$y_{m,inner}$	28,6	—
d	—	1,5

6 Electrical properties

6.1 Digital resonator protocol

By generating a modulated magnetic field that is detected in the receiving antennae of the CPOD sensor in the seat, the resonator shall transmit a digital data protocol which is built up as indicated in Figure 3.



a	Header:	Sequence of 12 bits with logical bit value = 1.
b	Synchronization sequence:	Sequence of three logical 0/1 transitions.
c	Parity bit:	Odd parity for T4-, T1-bit.
d	Divider bit:	Subcarrier divider bit: 1 → divider by 40; 0 → divider by 56, right resonator.
e	Child seat type:	T4 ... T1.

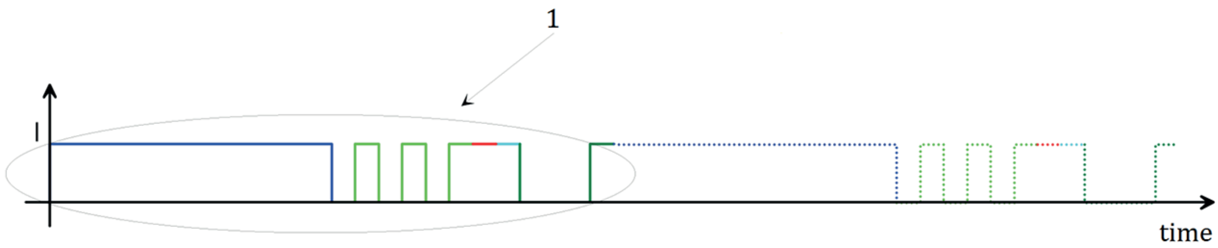
Figure 3 — CPOD resonator protocol

Additional information about the child seat is provided via the child seat type bits as defined in Table 2.

Table 2 — Child seat type classification

Type	T4	T3	T2	T1	Description
0	0	0	0	0	Not allowed
1	0	0	0	1	Rear-facing child seat
2	0	0	1	0	Forward-facing child seat
3	0	0	1	1	Convertible child seat, resonators in stiff connection with child seat
4	0	1	0	0	Convertible child seat, resonators not connected with child seat
5	0	1	0	1	Booster cushion
6	0	1	1	0	Carry-cots
7	0	1	1	1	Not yet defined
8	1	0	0	0	Not yet defined
9	1	0	0	1	Not yet defined
10	1	0	1	0	Not yet defined
11	1	0	1	1	Not yet defined
12	1	1	0	0	Not yet defined
13	1	1	0	1	Not yet defined
14	1	1	1	0	Not yet defined
15	1	1	1	1	Not yet defined

The protocol shall be repeated cyclically if the exiting magnetic field is still present. Thus, after the T4-bit, the next bit shall again be the first bit of the header part of the data protocol (see Figure 4).



Key

1 resonator protocol

Figure 4 — Cyclical sending of the resonator protocol

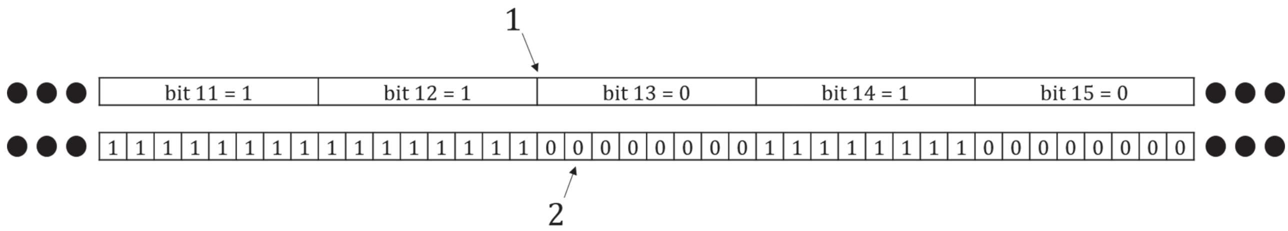
Depending on whether it is a left or a right resonator, the bit frequency of the data protocol varies as shown in Table 3.

Table 3 — Data protocol bit frequency

Resonator type	Parameter	Data protocol frequency
left	$f_{\text{data,left}}$	$f_{\text{TX}}/40/8 = f_{\text{TX}}/320$
right	$f_{\text{data,right}}$	$f_{\text{TX}}/56/8 = f_{\text{TX}}/448$

6.2 Subcarrier bitstream

Every resonator protocol bit value in accordance with Figure 3 logically summarizes eight consecutive bits of the same logical value (hereafter defined as subcarrier bits) with another, higher bit frequency (hereafter defined as subcarrier frequency). The relation between data protocol bits and subcarrier bits is indicated in Figure 5.



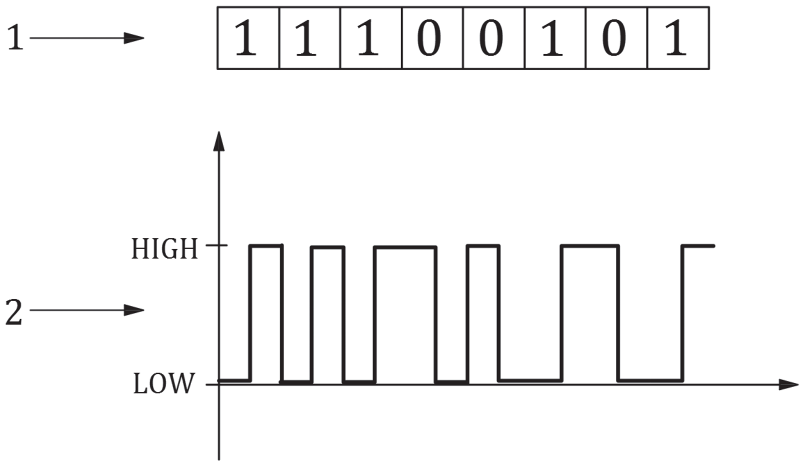
Key

1 resonator data protocol

2 subcarrier bitstream

Figure 5 — Difference between original and resonator Manchester coding

In order to prepare the subcarrier bits for transmission, every subcarrier bit value shall be Manchester coded, as indicated in Figure 6.



Key

1 subcarrier bit values

2 resulting Manchester code

Figure 6 — Manchester coding of subcarrier bit values

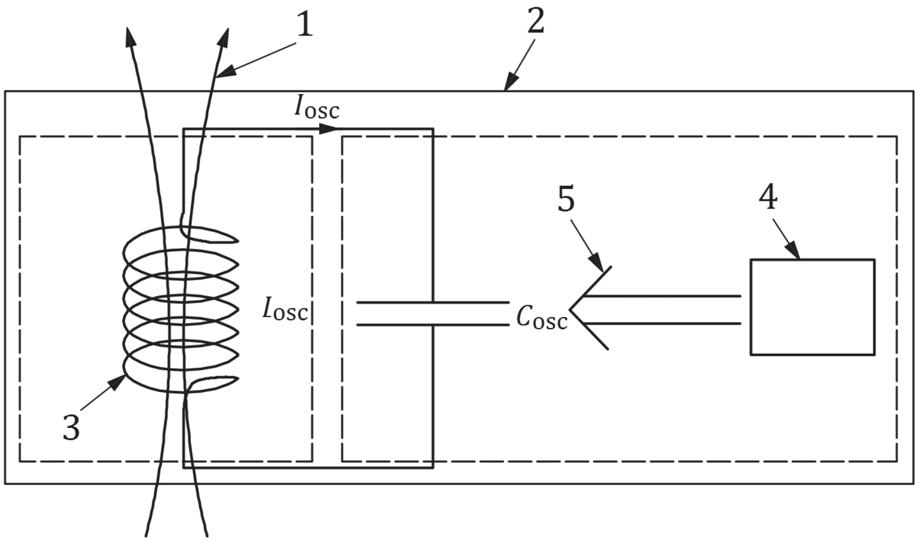
A subcarrier bit value of 1 shall cause a LOW to HIGH transition in the Manchester code pattern. A subcarrier bit value of 0 shall cause a HIGH to LOW transition on the Manchester pattern.

Table 4 — Subcarrier bit frequency, $f_{subcarrier}$

Resonator type	Parameter	Data protocol frequency
left	$f_{subcarrier}$	$f_{TX}/40$
right	$f_{subcarrier}$	$f_{TX}/56$

If there is a 0 to 1 transition or a 1 to 0 transition in the resonator data protocol, the resulting Manchester code shows a ±180° phase shift (phase shift keying, PSK).

The frequency of the subcarrier bitstream, as well as the phase angle of the concerned Manchester code, shall be used to modulate the magnetic field generated by the resonator, e.g. Figure 7 shows the main structure of the analogue front end of a resonator. The impedance of the LC oscillator is controlled by the Manchester code derived by the subcarrier bitstream, e.g. a HIGH level in the Manchester code leads to state one of the oscillators impedance (HIGH state); a low level in the Manchester code leads to state two (LOW state) of the oscillator’s impedance.



Key

1 magnetic field
2 resonator
3 resonator oil
4 control logic
5 impedance variation of LC oscillator

Figure 7 — Exemplified electrical structure of resonator analogue front end

6.3 Modulation

6.3.1 General

The resonators shall produce a phase modulation in the receiving antenna which is demodulated by the CPOD electronic control unit (ECU). Depending on the magnetic field supplying the resonators with energy, these shall produce a corresponding magnetic field that assures compatibility with all CPOD-compatible systems. The Manchester code of the bitstream specified in 6.2 shall be used to control physically the state of modulation.

The ability of a CPOD resonator to generate a phase modulation in the receiving antenna, which can be evaluated by the CPOD sensor, is characterized by two parameters: the parameter W determines the ability of the resonator to produce sufficient receiving amplitude in a CPOD-compatible sensor after demodulation; the parameter N specifies a maximum noise power at the demodulator's output.

Both parameters are derived using the following procedure, whose blocks are explained in 6.3.2 to 6.3.10.

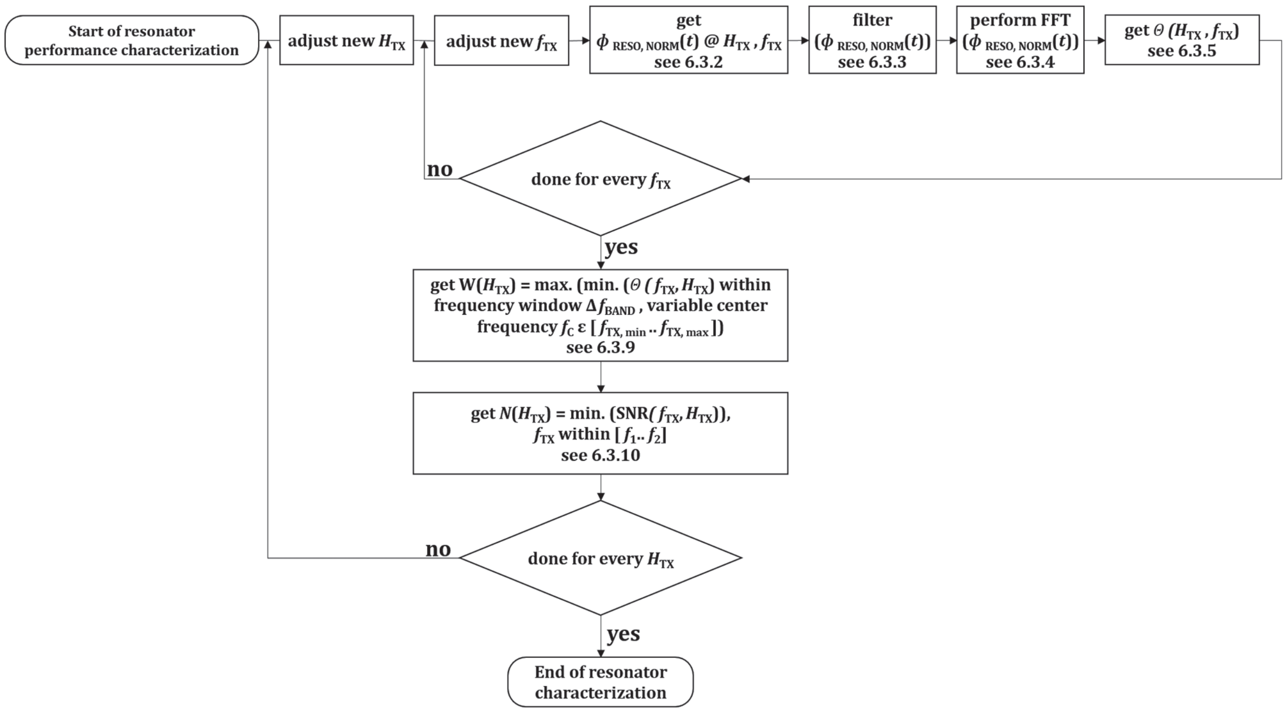
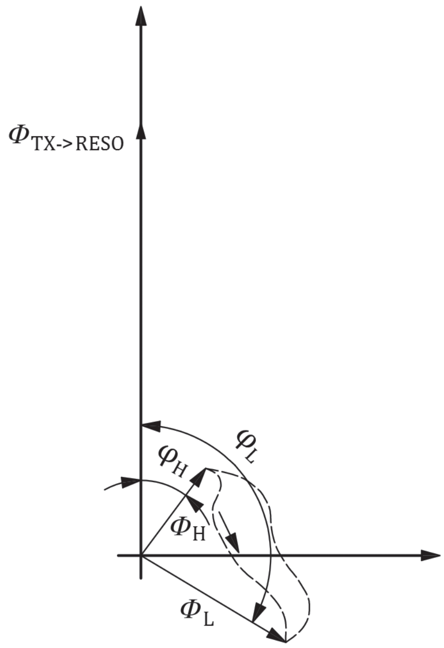


Figure 8 — Procedure to derive $W(H_{TX})$ and $N(H_{TX})$ for magnetic field strength, H_{TX}

6.3.2 Useful resonator signal, $\Phi_{RESO,NORM}(t)$

Since CPOD sensors usually have a high magnetic coupling between transmitting and receiving antennae, the useful resonator signal in the resonator magnetic field reduces to the component being perpendicular to the exiting magnetic transmitter field, which is also flooding the receiving antennae. The amplitude phase diagram in Figure 9 shows the relation between exciting magnetic field and resulting resonator magnetic flux.



Key

$\Phi_{TX \rightarrow RESO}$	transmitter magnetic flux component supplying resonator
φ_H	phase angle between resonator field and resonator magnetic flux, high state of modulation
Φ_H	amplitude of resonator magnetic flux, high state of modulation
φ_L	phase angle between transmitter field and resonator magnetic flux, low state of modulation
Φ_L	amplitude of resonator magnetic flux, low state of modulation

Figure 9 — Resonator amplitude phase diagram

The magnetic flux generated by the resonator, which is flooding the receiving antenna, superposes to the part of the magnetic flux generated by the transmitting antenna, which also floods the receiving antenna. The resulting magnetic flux, Φ_{RX}, in the receiving antenna is indicated in Figure 10.

