

Method and system for determining the dependence between device parameters of a mobile telephone and signal parameters

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The invention relates to a method and a system for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone.

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One important stage in the manufacture of mobile telephones, which is implemented in order to identify faulty mobile telephones at the end of the manufacturing process, is testing the quality of different signal parameters, for example, the error-modulation vector (EMV) or the code-domain parameters (CDP) of the signal transmitted or received by the mobile telephone under test dependent upon given device-parameter values in the reception and/or transmission channel of the mobile telephone, such as the offset voltage of the reception or transmission amplifier. For this purpose, the measured signal parameters are compared with threshold values, which define the correct tolerance range.

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In the case of purely static-process tests, in which the continuously-measured values of the individual signal parameters of the signals transmitted and/or received by mobile telephones are merely archived for evaluation at a subsequent time, a comparison of threshold values and the consequent separation of faulty mobile telephones are not required.

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For both fields of application, identification of faulty mobile telephones and static-process measurement of process parameters, a short testing time is desirable in addition to high-precision testing. Particularly in the context of
5 tests, in which the mobile telephone must be measured with regard to several signal parameters of the transmitted and received signal over a plurality of transmission and reception frequencies and respectively over a plurality of device-parameter values of several device parameters, the
10 testing time can have a negative influence.

The frequency and signal level of the signal received by the mobile telephone are conventionally transmitted from a superordinate procedural-control unit to the measuring
15 instrument, and the frequency and signal level of the signal transmitted by the mobile telephone are transmitted to the mobile telephone together with the device-parameter values of a device parameter to be set in the mobile telephone, and, after triggering with subsequent synchronisation of the
20 measuring instrument with the mobile telephone, the measurements of the individual, relevant signal parameters of the transmitted and/or received signal of the mobile telephone are then registered by the measuring instrument.

25 Transmission times for the transmission of the individual frequencies and signal level of the transmitted and/or received signal to be tested and for the individual device-parameter values in some cases of several device parameters of the mobile telephone are also disadvantageously added to
30 the actual testing time. This significantly increases the total time for measuring all signal parameters of the signal transmitted and/or received in all frequencies.

The invention is therefore based upon the object of providing a method and a system for testing a mobile telephone, with which the overall testing time for measuring
5 the dependence of several signal parameters of a signal transmitted or received by the mobile telephone upon several device-parameter values in some cases of several device parameters of the mobile telephone is significantly reduced by comparison with the prior art.

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The object of the invention is achieved by a method for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone with the
15 features of claim 1 and by a system for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone with the features of claim 17. Advantageous further developments of the invention are
20 specified in the dependent claims.

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In the method according to the invention and in the system according to the invention for determining the dependence between device parameters of a mobile telephone and signal
parameters of a signal transmitted and/or received by the mobile telephone, all of the frequencies and signal levels of the signal transmitted and received by the mobile
telephone and all of the device-parameter values of all of the device parameters, which can be set in the mobile
30 telephone during the type testing, are already present either in the mobile telephone or in the measuring instrument at the start of the tests.

These parameter values can be stored in advance in the mobile telephone or respectively in the measuring instrument and, after a triggering of the mobile telephone or
5 respectively the measuring instrument via an external triggering source, can be adjusted successively from the mobile telephone or respectively from the measuring instrument during the course of the type testing.

10 Alternatively, the individual parameter values are stored in the mobile telephone or respectively in the measuring instrument at the start of testing by a superordinate procedural-control unit, and, after successful storage, the individual tests are initiated with an adjustment of the
15 first parameter set.

A synchronised testing procedure between the mobile telephone and the measuring instrument is guaranteed by the simultaneous transmission from the superordinate procedural-
20 control unit of a synchronisation signal to the mobile telephone and respectively to the measuring instrument.

With a total of 4 frequency bands, 10 transmission channels per frequency band and 5 device-parameter values of a device
25 parameter for each transmission channel, the overall testing time of 30 to 80 seconds according to the prior art is reduced to less than 1 second with the method and the system according to the invention for determining the dependence
30 between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone.

The procedure of the method according to the invention can be realised in several embodiments.

In a first embodiment of the method according to the invention, the individual signal parameters of the transmitted signal are registered, and immediately following this, the individual signal parameters of the received signal are registered, in each case for one set frequency of the transmitted and received signal and for one set device-parameter value of a given device parameter.

In a second embodiment of the method according to the invention, in each case for one identically-set frequency of the transmitted and received signal and for one set device-parameter value of a given device parameter, the individual signal parameters of the transmitted and received signal are registered simultaneously in that the measuring instrument transmits a test signal corresponding to the frequency and signal level of the received signal, in each case via different connecting lines, to the mobile telephone, and, at the same time, the mobile telephone transmits a transmission signal to the measuring instrument.

In a third embodiment of the method according to the invention, the individual signal parameters of the transmitted signal are registered either coherently or in the reverse sequence initially at all set frequencies of the transmitted signal and at all set device-parameter values of all device parameters to be set, and following this, the individual signal parameters of the received signal are registered either coherently or in the reverse sequence at

all set frequencies of the received signal and at all set device-parameter values of all device parameters to be set.

In a fourth embodiment of the method according to the
5 invention, the individual signal parameters of the transmitted signal are initially registered at the same time, at a set frequency value of the transmitted signal and the received signal and with all set device-parameter values of all device parameters to be set, and following this, the
10 individual signal parameters of the received signal are registered either coherently or in reverse sequence with an identically-set frequency value with all set device-parameter values of all device parameters to be set, before the individual signal parameters of the transmitted and
15 received signal are then registered in a similar manner at a further frequency value.

In a first sub-embodiment variant of the first, second, third or fourth embodiment of the method according to the
20 invention, all adjustable frequencies of the transmitted and/or received signal are adjusted for one set device-parameter value of one device parameter adjustable in the mobile telephone, and the associated signal parameters of the transmitted and/or received signal relevant for type
25 testing are measured, before all adjustable frequencies of the transmitted and/or received signal are then adjusted successively for the further device-parameter values of all adjustable device parameters, and the associated signal parameters of the transmitted and/or received signal are
30 measured.

- In a second sub-embodiment variant of the first, second, third or fourth embodiment of the method according to the invention, all adjustable device-parameter values of the device parameters adjustable for the test are set in each
- 5 case for one frequency of the signal transmitted and/or received by the mobile telephone, and the associated signal parameters of the transmitted and/or received signal relevant for type testing are measured, before all adjustable device-parameter values of all adjustable device
- 10 parameters are then adjusted successively for the further adjustable frequencies of the transmitted and/or received signal, and the associated signal parameters of the transmitted and/or received signal are measured.
- 15 For reasons of efficiency, the variation of the device-parameter values of each device parameter adjustable in the mobile telephone are adjusted either decrementally or incrementally.
- 20 A timeslot is provided in each case for the measurement of the individual signal parameters of the transmitted or received signal or in the case of a simultaneous measurement of the transmitted or received signal. The timeslots for the individual measurements are either arranged immediately
- 25 following one another or separated by one or more timeslots without a measurement of a signal parameter of the transmitted or received signal.

In the case of a variation of the adjustable frequency of

30 the transmitted and/or received signal, a timeslot without a measurement of one of the signal parameters of the transmitted and/or received signal can be provided.

In a first embodiment of the system according to the invention, the measuring instrument and the mobile telephone are initialised, triggered and synchronised at the start of
5 the measurements by a superordinate procedural-control unit, and an evaluation of the measured values is implemented at the end of the measurements.

A second embodiment of the system according to the invention
10 allows an initialisation, triggering, synchronisation and measurement of the signal parameters of the transmitted and/or received signal between the measuring instrument and the mobile telephone via two transmission channels without the intermediate connection of a superordinate procedural-
15 control unit.

A third embodiment of the system according to the invention allows an initialisation, triggering, synchronisation and measurement of the signal parameters of the transmitted
20 and/or received signal between the measuring instrument and the mobile telephone via one transmission channel without the intermediate connection of a superordinate procedural-control unit.

25 The first embodiment of a system according to the invention for parallel determination of the dependence between device parameters of several mobile telephones and signal parameters of the signal transmitted and/or received by the respective mobile telephone allows the measurements of the
30 signal parameters of the transmitted and received signal respectively from a total of n mobile telephones via n test units, n ports and n connecting lines.

The second embodiment of the system according to the invention for parallel determination of the dependence between device parameters of several mobile telephones and signal parameters of the signal received by the respective mobile telephone allows the measurement of the signal parameters of the received signal respectively from a total of n mobile telephones via 1 test unit, 1 port and n connecting lines.

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Embodiments of the method and the system according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone are explained in greater detail below with reference to the drawings. The drawings are as follows:

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Figure 1 shows a block-circuit diagram of a first embodiment of a system according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone;

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Figure 2 shows a flow chart of a first sub-embodiment variant of a first embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone;

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- Figure 3 shows a flow chart of a second sub-embodiment variant of a first embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone;
- Figure 4 shows a flow chart of a second embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone;
- Figure 5 shows a flow chart of a third embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and received by the mobile telephone;
- Figure 6 shows a flow chart of a fourth embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and received by the mobile telephone;
- Figure 7 shows a time-dependency diagram for the first embodiment of the method according to the invention for determining the dependence between

the device parameters of a mobile telephone and signal parameters of a signal received by the mobile telephone;

5 Figure 8 shows a time-dependency diagram for the first embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted by the mobile telephone;

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Figure 9 shows a time-dependency diagram with several timeslots following in direct succession within a timeframe;

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Figure 10 shows a time-dependency diagram with several timeslots with a spacing distance within a time frame;

20 Figure 11 shows a time-dependency diagram of several timeframes each separated by one timeslot;

Figure 12 shows a block-circuit diagram of a second embodiment of a system according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone;

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30 Figure 13 shows a block-circuit diagram of a third embodiment of the system according to the invention for determining the dependence between

device parameters of a mobile telephone and
signal parameters of a signal transmitted and/or
received by the mobile telephone;

5 Figure 14 shows a block-circuit diagram of a first
embodiment of a system according to the
invention for parallel determination of the
dependence between device parameters of several
mobile telephones and signal parameters of the
10 signal transmitted and/or received by the
respective mobile telephone; and

Figure 15 shows a block-circuit diagram of a second
embodiment of the system according to the
15 invention for parallel determination of the
dependence between device parameters of several
mobile telephones and signal parameters of the
signal received by the mobile telephone.

20 Starting from Figure 1, which presents the block-circuit
diagram of a first sub-embodiment variant of the first
embodiment of the system according to the invention for
determining the dependence between device parameters of a
mobile telephone and signal parameters of a signal
25 transmitted and/or received by the mobile telephone, the
following section describes the first sub-embodiment variant
of the first embodiment of the method according to the
invention for determining the dependence between device
parameters of a mobile telephone and signal parameters of a
30 signal transmitted and/or received by the mobile telephone:

In procedural stage S10 of the method according to the invention, the signal level and frequencies of the transmitted signal of the mobile telephone, which are associated with fixed transmission channels in the individual frequency bands, and the device-parameter values to be set, which are associated with the individual device parameters, are transmitted by the superordinate procedural-control unit 1 via the port 9 and the connecting line 2 to the mobile telephone 3₁, and the signal level and the frequencies of the received signal of the mobile telephone, which are associated with fixed reception channels in the individual frequency bands, are transmitted via the port 10 and the connecting line 4 to the measuring instrument 5. These data transmissions to the mobile telephone 3₁ and the measuring instrument 5 can be implemented either in a preliminary phase before the measurements or at the start of the measurements.

In the next procedural stage S20, the start of the measurements is implemented by triggering the mobile telephone 3₁ and the measuring instrument 5. In the case of a data transmission at the start of the measurements, the mobile telephone 3₁ and the measuring instrument 5 are triggered by the data-transmission event. If the data have already been transmitted and are present in the mobile telephone device 3₁ and in the measuring instrument 5, the individual measurements must be started by an additional, external triggering signal from the superordinate procedural-control unit 1. The transmission of a synchronisation signal from the superordinate procedural-control unit 1 to the mobile telephone 3₁ and to the measuring instrument 5 is additionally implemented in

procedural stage S20. In this manner, the mobile telephone 3₁ is self-synchronised with the measuring instrument 5 and with the superordinate procedural-control unit 1. In this case, an additional device - an additional triggering or
5 synchronisation unit - for continuous synchronisation of the measuring instrument 5 with the mobile telephone 3₁ is not required.

In procedural stage S30, the first measurement is prepared
10 by setting the signal level and the first frequency value of the transmission signal and the first device-parameter value for the first device parameter to be set in the mobile telephone 3₁ and by setting the signal level and the first frequency value of a test signal in the measuring instrument
15 5, which is received by the mobile telephone 3₁ as a received signal.

In the next procedural stage S40, the transmission signal prepared in the preceding procedural stage S30 is
20 transmitted by the mobile telephone 3₁ via the connecting line 6 to the measuring instrument 5. This transmission signal is registered by the measuring instrument 5 at its ports 7 with regard to one or more signal parameters - signal level, frequency, phase etc. Further combined signal
25 parameters - for example, EVM, CDP etc - are determined from the measured signal parameters via a signal processing implemented in the measuring instrument 5. A timeslot is provided in each case as the measuring time for registering a signal parameter within a timeframe as shown in Figure 9.

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In a similar manner, in the next procedural stage S50, the measuring instrument 5 transmits the test signal

corresponding to the received signal prepared in procedural stage S30 via the same port 7 and the same connecting line 6 to the mobile telephone 3₁. The test signal transmitted by the measuring instrument 5 is received by the mobile
5 telephone 3₁ as a received signal and registered with regard to one or more signal parameters, from which further combined signal parameters are determined in the mobile telephone 3₁ via a signal processing unit.

10 In the next procedural stage S60, the next device-parameter value of the first device parameter is set in the mobile telephone 3₁, and the measurement of the signal parameters of the transmitted and received signal associated with this device-parameter value of the first device parameter is
15 measured or respectively determined in procedural stages S40 and S50.

In procedural stage S60, when all of the signal parameters of the transmitted and received signal associated with all
20 of the device-parameter values of the first device parameter have been registered, the first device-parameter value of the next device parameter is set in the mobile telephone 3₁, and the associated signal parameters of the transmitted and received signal are determined in procedural stages S40 and
25 S50.

In the next procedural stage S70, as soon as all device-parameter values of every device parameter have been set and the associated signal parameters of the transmitted and
30 received signal have been measured, the next frequency value of the transmitted and received signal from the measuring instrument 5 and respectively from the mobile telephones 3₁

- and, once again, the first device-parameter value of the first device parameter are set in the mobile telephone device 3₁, and accordingly, the signal parameters of the transmitted and received signal, which are set at the next frequency value of the transmitted and received signal and with the first device-parameter value of the first device parameter, must again be registered in procedural stages S40 and S50.
- 10 Finally, when the signal parameters of the transmitted and received signal associated respectively with all frequency values and every device-parameter value of every device parameter have been registered in the mobile telephone 3₁ and the measuring instrument 5, the correctness of the individual measured signal parameters of the transmitted and received signal can be checked in an optional procedural stage S80. For this purpose, the individual measured signal parameters of the transmitted and received signal are typically supplied from the mobile telephone 3₁ via the connecting line 2 and the port 9 and from the measuring instrument 5 via the port 8, the connecting line 4 and the port 10 to the superordinate procedural-control unit 1 and compared in each case with two threshold values defining the tolerance range for the respective signal parameter, which are stored in the superordinate procedural-control unit 1.

A second sub-embodiment variant of the first embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of the signal transmitted and/or received by the mobile telephone, for which a flow chart is shown in Figure 3, differs from the first sub-embodiment

variant of the first embodiment of the method according to the invention in that, instead of varying the individual device-parameter values of the individual device parameters in procedural stage S60, the individual frequency values are first tuned in procedural stage S150 and, instead of varying the individual frequency values in procedural stage S70, the individual device-parameter values of the individual device parameters are then tuned in procedural stage S160.

The other procedural stages S100, S120, S130, S140 and S170 of the second sub-embodiment variant of the first embodiment of the method according to the invention in Figure 3 correspond to procedural stages S10, S20, S30, S40, S50 and S80 of the first sub-embodiment variant of the first embodiment of the method according to the invention shown in Figure 2, and further description will therefore not be provided.

In the case of the second embodiment of the method according to the invention for determining the dependence between device-parameters of a mobile telephone and signal parameters of the signal transmitted and/or received by the mobile telephone as shown in Figure 4, the individual signal parameters of a transmitted and received signal are measured simultaneously in each case within one timeslot.

Two connecting lines 2' and 6 are required for the simultaneous measurements between the mobile telephone 3₁ and the measuring instrument 5 according to the second embodiment of the system according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal

transmitted and/or received by the mobile telephone as shown in Figure 12.

A superordinate procedural-control unit 1 is not provided in the second embodiment of the system according to the invention. The signal level and the individual frequency values of the transmitted and received signal and the individual device-parameter values of the individual device parameters must therefore already be stored in the mobile telephone 3₁ before the start of the measurements in the measuring instrument 5 and in the mobile telephone 3₁. The start of measurements is implemented by mutual triggering and mutual synchronisation between the mobile telephone 3₁ and the measuring instrument 5.

In the case of the first sub-embodiment variant of the second embodiment of the method according to the invention for determining the dependence between device-parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone, the procedural stages S40 and S50, in which the individual signal parameters of the transmitted and received signal are measured for every set signal level and every set frequency of the transmitted and received signal and for every set device-parameter value of the individual device parameters to be set, are combined in a procedural stage S230, in which the transmission signal is transmitted by the mobile telephone 3₁ and measured by the measuring instrument 5, and the test signal corresponding to the received signal is simultaneously transmitted by the measuring instrument 5 and measured by the mobile telephone 3₁ as a received signal.

Procedural stages S200, S210, S220, S240, S250 and S260 of the first sub-embodiment variant of the second embodiment of the method according to the invention shown in Figure 4 correspond to procedural stages S10, S20, S30, S60, S70 and
5 S80 of the first sub-embodiment variant of the first embodiment of the method according to the invention shown in Figure 2, and further description is therefore not provided.

The second sub-embodiment variant of the second embodiment
10 of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of the signal transmitted and/or received by the mobile telephone, in which the transmitted and received signals are measured simultaneously, and the
15 individual frequency values are tuned in a first iterative loop, and the individual device-parameter values of the individual device parameters are tuned in a second iterative loop superimposed over the first iterative loop, is derived from a combination of procedural stages S200, S210, S220,
20 S230 of the first sub-embodiment variant of the second embodiment of the method according to the invention shown in Figure 4 with procedural stages S150 and S160 of the second sub-embodiment variant of the first embodiment of the method according to the invention shown in Figure 3 and is
25 therefore not illustrated in further diagrams of the drawings or described in any greater detail.

In the case of the first sub-embodiment variant of the third embodiment of the method according to the invention for
30 determining the dependence between device parameters of a mobile telephone and signal parameters of the signal transmitted and/or received by the mobile telephone shown in

Figure 5, the individual associated signal parameters of the transmitted signal are first measured, and following this, the individual associated signal parameters of the received signal are measured respectively for every set signal level and every set frequency and for every set device-parameter value of every device parameter adjustable in the mobile telephone 3₁.

Procedural stages S300, S310, S320, S330, S340, S350 and S390 of the first sub-embodiment variant of the third embodiment of the method according to the invention shown in Figure 5 correspond to procedural stages S10, S20, S30, S40, S50, S60, S70 and S80 of the first sub-embodiment variant of the first embodiment of the method according to the invention shown in Figure 2, and no further description is therefore provided. Procedural stages S360, S370 and S380 of the first sub-embodiment of variant of the third embodiment of the method according to the invention, which relate to the variation of the individual frequencies and of the individual device-parameter values of the individual adjustable device parameters and to the measurement of the individual signal parameters of the received signal, correspond to procedural stages S330, S340 and S350 for the variation of the individual frequencies and the individual device-parameter values of the individual adjustable device parameters and for the measurement of the individual signal parameters of the transmitted signal.

The first sub-embodiment variant of the third embodiment of the method according to the invention, in which the individual signal parameters of the received signal are first measured, and following this, the individual signal

parameters of the transmitted signal are measured, merely leads to a switching of procedural stages S330 to S350 with procedural stages S360 to S380 in the flow chart of Figure 5.

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The second sub-embodiment variant of the third embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or

10 received by the mobile telephone, in which the individual frequency values are initially tuned in each case within an iterative loop for the measurement of the individual signal parameters of the transmitted and received signal, and following this, the individual device-parameter values of
15 the individual adjustable device parameters are tuned in a second iterative loop superimposed over the first iterative loop, is derived by switching the sequence of procedural stage S340 with S350 and procedural stage S370 with S380.

20 In the first sub-embodiment variant of the fourth embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone as shown in Figure 6, by
25 analogy with the first sub-embodiment variant of the third embodiment of the method according to the invention as shown in Figure 5, the individual signal parameters of the transmitted signal are initially measured respectively at tuned device-parameter values of the individual device
30 parameters, and following this, the individual signal parameters of the received signal are measured respectively at tuned device-parameter values of the individual device

parameters, before the individual frequency values for the measurement of the individual signal parameters of the transmitted signal and also of the received signal are jointly tuned in a further iterative loop. Procedural stages 5 S350 and S380 of the first sub-embodiment variant of the third embodiment of the method according to the invention for varying the individual frequency values are consequently merged into a single procedural stage S480 in the first sub-embodiment variant of the fourth embodiment of the method 10 according to the invention. Procedural stages S400, S410, S440, S450, S460, S470 and S480 of the first sub-embodiment variant of the fourth embodiment of the method according to the invention therefore correspond to procedural stages S300, S310, S340, S360, S370 and S380 of the first sub-embodiment variant of the third embodiment of the method 15 according to the invention, and further description is therefore not provided. The content of procedural stage S320 of the first sub-embodiment variant of the third embodiment of the method according to the invention is subdivided into 20 the two procedural stages S440 and S450 of the first sub-embodiment variant of the fourth embodiment of the method according to the invention.

The first sub-embodiment variant of the fourth embodiment of 25 the method according to the invention, in which the individual signal parameters of the received signal are initially measured, and following this, the individual signal parameters of the transmitted signal are measured, merely leads to a switching of procedural stages S440 to 30 S450 with procedural stages S470 to S480 in the flow chart shown in Figure 6.

The second sub-embodiment variant of the fourth embodiment of the method according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or
5 received by the mobile telephone, in which the individual frequency values are tuned respectively in an iterative loop in order to measure the individual signal parameters of the transmitted and received signal, and following this, the individual device-parameter values of the individual
10 adjustable device parameters are tuned in a second iterative loop superimposed over the first iterative loop, is derived by switching the contents of procedural stages S450 and respectively S470 with the content of procedural stage S480 of the first sub-embodiment variant of the fourth embodiment
15 of the method according to the invention.

As shown in Figure 11, the measurements of the individual signal parameters of the transmitted or received signal to be implemented for a transmission channel at a given
20 frequency value are disposed in a timeframe consisting respectively of several timeslots for each of the device-parameter values to be tuned for a given device parameter. If device-parameter values to be tuned for a further device parameter must be tuned in order to measure the individual
25 signal parameters of the transmitted and received signal, or if the device-parameter values to be tuned for a device parameter must be tuned for a further frequency value of the transmitted or received signal, as shown in Figure 11, a further timeframe, which is separated in time from the
30 preceding timeframe by a timeslot without measurement, is provided with new device-parameter values to be tuned for a given device parameter.

The measurements of the individual signal parameters of the transmitted or received signal in the individual timeslots of a timeframe can either follow in direct succession, as shown in Figure 9, or can be spaced apart in each case by one or more timeslots without measurements.

Figure 7 shows examples of signal parameters of the received signal to be tested with a variation of the device-parameter value of a device parameter adjustable in the reception channel of the mobile telephone 3₁ and with a variation of the frequency value over time. By analogy, Figure 8 provides examples of signal parameters of the transmission signal to be tested with a variation of the device-parameter value of a device parameter adjustable within the transmission channel of the mobile telephone 3₁ and with a variation of the frequency value over time.

The tuning of the individual device-parameter values of a device parameter, which is to be tuned, can be implemented either incrementally - for example, as illustrated in Figures 7 and 8 - or decrementally - for example, as illustrated in Figures 9, 10 and 11.

A third embodiment of the system according to the invention for determining the dependence between device parameters of a mobile telephone and signal parameters of a signal transmitted and/or received by the mobile telephone as shown in Figure 13 differs from the first and second embodiments of the system according to the invention, in that the transmission between the mobile telephone 3₁ and the measuring instrument 5 is implemented in both directions of

the transmission and reception operation of the mobile telephone 3 via a single port 7' and a single connection 6'. Accordingly, the third embodiment of the system according to the invention for simultaneous registration of the

5 individual signal parameters of the transmitted and received signal cannot be used in the second embodiment of the method according to the invention.

Figure 14 shows the block-circuit diagram for a system

10 according to the invention for parallel determination of the dependence between device parameters in several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ and signal parameters of a signal transmitted and/or received respectively by several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$. Since the measuring

15 instrument 5 provides a total of n test units and n ports $7_1, 7_2, \dots, 7_m, 7_n$, which are each connected via a connecting line $6_1, 6_2, \dots, 6_m, 6_n$ to one of the total of n mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$, a parallel determination of the dependence between device parameters in several mobile

20 telephones $3_1, 3_2, \dots, 3_m, 3_n$ and signal parameters of a signal transmitted and/or received respectively by several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ is possible.

Within the meaning of procedural stages S10, S100, S200,

25 S300 and S400 of the individual embodiments and their sub-embodiment variants of the method according to the invention as shown in Figures 2, 3, 4, 5 and 6, the signal level and the individual frequencies of the transmitted and received signal and the device-parameter values of the individual

30 device parameters to be set in the respective mobile telephone $3_1, 3_2, \dots, 3_m, 3_n$ are transmitted from the superordinate procedural-control unit 1 respectively via the

connecting lines 4 and 2 to the individual test units of the measuring instrument 5 and to the individual mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$.

5 After the triggering and synchronisation of the measuring instrument 5 with the individual mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ in procedural stages S20, S110, S210, S310 and S410 and the setting of the signal level and the first frequency value of the transmitted and received signal in
 10 the individual mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ and in the measuring instrument 5 and of the device-parameter value of the first device parameter to be set in the transmission or reception channel of the respective mobile telephone $3_1, 3_2, \dots, 3_m, 3_n$ in procedural stages S30, S120, S220, S320, S420
 15 and S430 as shown in Figures 2, 3, 4, 5 and 6, the individual signal parameters of the transmitted and received signal of the individual mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ are measured for every individual frequency value and every individual device-parameter value of every device parameter
 20 to be set in the individual procedural stages S40 to S70, S130 to S160, S230 to S250, S330 to S380 and S440 to S480 of the individual embodiments and their sub-embodiment variants of the method according to the invention as shown in Figures 2, 3, 4, 5 and 6.

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Finally, Figure 15 shows the block-circuit diagram for a second embodiment of the system according to the invention for parallel determination of the dependence between device parameters in several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ and
 30 signal parameters of a signal received respectively by several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$, which differs from the first embodiment in that it provides only a single

port 7'', to which all of the connecting lines $6_1, 6_2, \dots, 6_m, 6_n$ are supplied. By comparison with the embodiment of the system according to the invention for parallel determination of the dependence between device parameters in several
5 mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ and signal parameters of a signal transmitted and/or received respectively by several mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ as shown in Figure 14 with a total of n test units, the measuring instrument 5 in the second embodiment as shown in Figure 15 provides only a
10 single test unit.

Since all of the mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$ are supplied at the receiver end with an identical test signal corresponding to the received signal for the determination
15 of the individual signal parameters of the received signal dependent upon the respectively-adjusted device-parameter values of the respective device parameter, this test signal is generated uniquely by the measuring instrument 5, output by the measuring instrument 5 via the single port 7'' as
20 shown in Figure 15 and supplied via the individual connecting lines $6_1, 6_2, \dots, 6_m, 6_n$ to the individual mobile telephones $3_1, 3_2, \dots, 3_m, 3_n$.

The invention is not restricted to the embodiments
25 presented. In particular, the invention is not restricted to a given mobile-telephone standard. Mobile telephone devices with several transmission and reception antennae (so-called MIMO systems), and therefore also with several transmission and reception channels, are also covered by the invention.

Claims

1. Method for determining the respective dependence
between several device-parameter values of at least
5 one device parameter of a mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) and at least one signal parameter of a signal
transmitted and/or received by the mobile telephone
($3_1, 3_2, \dots, 3_m, 3_n$) by setting, respectively in at
least one mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), several
10 device-parameter values of at least one device
parameter of the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) for a given number of frequencies of the
transmitted and/or received signal and by measuring
the associated signal parameters of a signal
15 transmitted and/or received by the respective mobile
telephone ($3_1, 3_2, \dots, 3_m, 3_n$),
characterised in that
all of the frequencies and the respective device-
parameter values of at least one device parameter
20 associated with each frequency are present in the
respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) at the
start of the measurements.
2. Method according to claim 1,
25 **characterised in that,**
in each case, the measurements of all of the signal-
parameter values of the signal transmitted and
received by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which are associated respectively with one
30 frequency and one device-parameter value of a device
parameter, follow one another in direct succession.

3. Method according to claim 2,

characterised in that,

in each case, the measurements of all the signal-parameter values of the signal transmitted and/or received by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which are associated respectively with an identical frequency and a different device-parameter value of the device parameter, follow one another in direct succession.

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4. Method according to claim 3,

characterised in that,

in each case, the measurements of all signal-parameter values of the signal transmitted by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which are associated respectively with an identical frequency and a different device-parameter value of a device parameter, are implemented before or after the measurements of all of the signal-parameter values of the signal received by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which are associated respectively with an identical frequency and a different device-parameter value of a device parameter.

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5. Method according to claim 3,

characterised in that,

for every specified and mutually-associated frequency of the transmitted and received signal and every device-parameter value of every device parameter, the measurement of the associated signal-parameter value of the transmitted signal is implemented

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simultaneously with the measurement of the associated signal-parameter value of the received signal.

6. Method according to claim 3,
5 **characterised in that,**
for every specified and mutually-associated frequency of the transmitted and received signal and every device-parameter value of every device parameter, the measurement of the associated signal-parameter value
10 of the transmitted signal is implemented directly before or after the measurement of the associated signal-parameter value of the received signal.
7. Method according to any one of claims 3 to 6,
15 **characterised in that,**
for the measurement of all of the signal-parameter values of the signal transmitted and/or received by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which are associated respectively with an identical
20 frequency, the device-parameter values of the individual device parameters are incremented or decremented respectively.
8. Method according to any one of claims 1 to 7,
25 **characterised in that**
all of the measurements of the signal parameters of the transmitted and/or received signal, which are associated respectively with every device-parameter value of every device parameter and respectively with
30 one frequency of the transmitted and/or received signal, are implemented before all of the measurements of the signal parameters of the

transmitted and/or received signal, which are associated respectively with every device-parameter value of every device parameter and respectively with one further frequency of the transmitted and/or received signal.

5
9. Method according to any one of claims 1 to 7,
characterised in that
all of the measurements of the signal parameters of the transmitted and/or received signal, which are
10 associated respectively with every device-parameter value of a device parameter and with every specified frequency of the transmitted and/or received signal, are implemented before all of the measurements of the
15 signal parameters of the transmitted and/or received signal, which are associated respectively with every device-parameter value of a further device parameter and with every specified frequency of the transmitted and/or received signal.

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10. Method according to any one of claims 1 to 9,
characterised in that
a timeslot with a given duration is provided for every measurement of a signal-parameter value of the
25 signal transmitted and/or received, which is generated by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$).

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11. Method according to claim 10,
characterised in that
the timeslots for the measurements of the signal-parameter values associated respectively with a

specified frequency of the transmitted and/or received signal are directly adjacent to one another within a timeframe.

- 5 12. Method according to claim 10,
 characterised in that
 the timeslots for the measurements of the signal-
 parameter values associated respectively with a
 specified frequency of the transmitted and/or
10 received signal are arranged within a timeframe
 separated from one another in time in each case by a
 given number of time slots, in which no measurement
 is implemented.
- 15 13. Method according to any one of claims 10 to 12,
 characterised in that,
 in each case, a time slot, in which no measurement is
 implemented, is inserted in the transition between
 two specified frequencies of the transmitted and/or
20 received signal.
14. Method according to any one of claims 1 to 13,
 characterised in that,
 in the case of frequencies already stored in the
25 respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) and
 device-parameter values of the individual device
 parameters associated with the respective
 frequencies, the measurement of the signal-parameter
 values of the individual signal parameters, which are
30 associated with the individual device-parameter
 values of the individual device parameters, is

initiated externally by a triggering of the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$).

15. Method according to any one of claims 1 to 13,
 5 **characterised in that**
 the measurement of the signal-parameter values of the individual signal parameters associated with the individual device-parameter values of the individual device parameters is initiated after the storage in
 10 the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) of the frequencies and the device-parameter values of the individual device parameters associated respectively with the frequencies.
- 15 16. Method according to any one of claims 1 to 15,
characterised in that,
 before the implementation of the individual measurements, the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) is synchronised with a measuring instrument
 20 (5) and/or a superordinate procedural-control unit (1).
17. System for determining the dependence between several device-parameter values in each case of at least one device parameter in at least one mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) and at least one signal parameter of a signal transmitted and/or received by the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) with a measuring instrument (5) and at least one mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), which generates a transmitted and/or received signal respectively for a given number of
 25
 30 specified frequencies and for a given number of

device-parameter values of device parameters set in the respective mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$),

characterised in that,

all of the frequencies and the device-parameter values of at least one device parameter respectively associated with each frequency are present in every mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) at the start of the measurements.

10 18. System according to claim 17,

characterised in that,

at the start of the measurements, all of the frequencies of the transmitted signal and all of the device-parameter values of every device parameter are supplied to every mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$), and all of the frequencies of the received signal are supplied to the measuring instrument (5) from a superordinate procedural-control unit (1).

20 19. System according to claim 17 or 18,

characterised in that

the transmission of the signal transmitted to the measuring instrument (5) from at least one mobile telephone ($3_1, 3_2, \dots, 3_m, 3_n$) and received respectively is implemented in each case via a line connection ($6; 6'; 6_1, 6_2, \dots, 6_m, 6_n$).

20. System according to claim 17 or 18,

characterised in that

the transmission to the measuring instrument (5) of the signal transmitted from a mobile telephone (3)

and received is implemented via two line connections
(2'; 6).