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(54) MICROWAVE OVEN

MIKROWELLENOFEN

FOUR À MICRO-ONDES

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Description

[0001] The present invention relates generally to the field of microwave ovens. More specifically, the present invention relates to a microwave oven which is controlled to make use of an interruption of or to actively pause the generation of microwaves in order to transmit/receive information via a wireless communication interface.

BACKGROUND OF THE INVENTION

[0002] Microwave ovens are well-known in prior art. Microwaves used in microwave ovens to heat food often have a frequency of 2.4 to 2.5 GHz. The electromagnetic waves produce oscillating magnetic and electric fields that excite water molecules in food, therefore generating heat.

[0003] Short-range wireless communication, specifically WIFI-communication, is also performed in the frequency band of 2.4 GHz to 2.5 GHz.

[0004] Disadvantageously, microwaves transmitted by the microwave generator of the microwave oven interfere with wireless communication signals provided by a wireless communication entity of the microwave oven which enables a wireless communication link of the microwave oven with a router or another wireless communication device.

[0005] Document WO 2004/034678 A2 discloses a microwave device. Quiescent periods of the microwave oven are detected in order to transmit / receive data.

[0006] US 2013008893 A1 discloses a microwave oven being provided with energy management means. The energy management means are configured to process a signal indicative of the current state of an associated energy supplying utility and to determine on whether to operate the microwave oven in one of a normal operating mode and an energy saving mode. According to some possible embodiments a controller of the microwave oven is configured to receive and process a signal indicative of a utility state. As the receipt of the signal may be disturbed due to the operation of the magnetron of the microwave oven the signal may be send while the magnetron is deactivated.

SUMMARY OF THE INVENTION

[0007] It is an object of the present invention to provide a microwave oven with improved wireless communication capabilities and low technical effort. The object is solved by the features of the independent claims. Preferred embodiments are given in the dependent claims. If not explicitly indicated otherwise, embodiments of the invention can be freely combined with each other.

[0008] According to an aspect, the invention refers to a microwave oven. The microwave oven comprises at least one microwave generator and a control unit or control entity for controlling said microwave generator. Said control unit or control entity is configured to control the microwave generator according to a duty cycle in which the microwave generator is activated in a first time period of the duty cycle and deactivated in a second time period of the duty cycle. The microwave oven further comprises a wireless communication unit or communication entity, said wireless communication unit or communication entity being controlled by said control unit or control entity in order to perform wireless communication in the second time period of the duty cycle.

[0009] The second time period of the duty cycle may cover 10% to 90% of the duration of the duty cycle.

[0010] The advantage of said microwave oven is that an internal control entity of the microwave may control the provision of microwaves according to a periodic duty cycle with predetermined relation of time periods in which the microwave generator is activated, respectively, deactivated. Additionally or alternatively, the control unit may advantageously make use of a programmed interruption of the operation of the microwave generator during the periodic duty cycle. In phases in which the microwave generation is disabled (also referred to as pauses or microwave pauses) an interference-free transmission/receipt of information based on the wireless communication entity is possible.

[0011] The duty cycle is adapted to the time needed for a complete information exchange for each communication process by way of wireless communication. In that way, the communication can be finalized during only one interruption of the operation of the microwave generator, i. e. during only one cycle period or second time period, respectively.

[0012] The control unit may be configured to control the power level of the microwave oven based on the ratio between the first time period and the sum of first and second time periods. So, the mean power or effective value of the power provided by the microwave generator is varied by the ratio of time periods in which the microwave generator is activated/deactivated. Preferably, the sum of first and second time periods which is the duration of the repetitive duty cycle is kept constant during wireless communication. Thereby an advantageous power control paired with interference-free wireless transmission/receipt is possible.

[0013] According to an embodiment, at maximum power level of the microwave generator, the second time period comprises a duration greater than zero. So, even at maximum power level requested by the user or by a selected cooking program, the microwave generator is periodically switched on/off in order to enable interference-free wireless transmission/receipt of information or at least to trigger or to request wireless communication particularly by an external communication device.

[0014] Preferably, the duration of one duty cycle is in the range of 20sec to 60sec, preferably in the range of 30sec to 50sec, specifically 40sec or essentially 40sec. The duration may be dependent on the power requested by the user or a selected cooking program. Using a fixed cycle rate which may be specified by the control unit as

a constant value, the control of the microwave oven is simplified.

[0015] A minimum duration of the second time period may be defined by the transfer size of a communication package. This is a preferred solution for the option to finalize the wireless communication during one cycle period. This may also go hand in hand with a maximum of an average power level providable by the duty cycle being dependent on the minimum duration of the second time period.

[0016] A preferred embodiment provides a microwave oven which is selectively operatable at a normal cooking mode and at a wireless communication mode, the latter one being a mode in which not only food preparation with microwaves but also wireless communication is enabled. In the normal cooking mode the microwave oven is operatable at most permanently, i. e. without any interruption, at a nominal power of the microwave generator. In the wireless communication mode, however, the microwave oven is operatable at most at a fraction of the nominal power of the microwave generator. Said fraction is defined by the ratio between the first time period and the summation of the first and second time periods, i.e. the duration of a duty cycle period. This may result in a pause which is created, thereby pulsing the microwave generator even if the user or a selected cooking program would require 100% power level, i. e. full power level.

[0017] The microwave oven may comprise at least one cooking program and during a cooking program or a cooking program sequence using the wireless communication mode at least one cooking parameter may be modified or modifiable compared with the respective cooking parameter of a cooking program or cooking program sequence with the normal cooking mode. Since during a cooking or food preparation or treatment program, in particular during a program which comprises program sequences with full power level, the cooking or food treatment is delayed or retarded, the finishing of the food may not be completed in case of reduced power delivery, i. e. average power delivery, due to the pauses needed for data or information transfer. In order to compensate this reduced average power level, the at least one cooking parameter may be modified. As an example, the cooking or food preparation or treatment program may be prolongated. Additionally or alternatively, the cooking profile may be modified, particularly cooking program sequences with a reduced power level (e. g. reduced to 40% of full power level) in normal cooking programs (hence without wireless communication) may be less reduced (e. g. reduced to 60%) if wireless communication takes place.

[0018] Another specific embodiment is characterized by a microwave generator which is operatable at an overboost operational mode, at least for a limited period of time and/or at least during the wireless communication mode. This may be an alternative or additional measure for compensating the afore-mentioned consequence of a reduced average power level when wireless communication modifies a cooking program which otherwise would comprise only program sequences operated at normal cooking mode.

[0019] Naturally, another option for cooking or food preparation or treatment programs comprising sequences with full power level and sequences with reduced power level could be to postpone the wireless communication to the sequences with reduced power level, particularly when a sequence with reduced power level will follow near-term.

[0020] The duty cycle, in particular the duty cycle time, may be adaptable to the frequency of wireless communication. That may cover the situation that in case of a reduction of a delay in information exchange is required, the duty cycle time is shortened, so that the control unit will quicker receive data or information by way of wireless communication. On the other hand, also the situation of a prolonged duty cycle time may be covered, in particular when there is no urgency or hurry in performing wireless communication.

[0021] According to an embodiment, the microwave generator comprises a magnetron. Thereby a reliable microwave generation at low costs is possible.

[0022] According to an embodiment, the microwave generator comprises one or more solid state microwave generators. Using solid state microwave generators which mainly comprise semiconductor components for generating and amplifying microwaves it is possible to reduce the duration of duty cycle which leads to reduced waiting times until information can be transmitted/received.

[0023] According to an embodiment, the control unit is directly coupled with the wireless communication unit via a control line or a bus or an electronic circuit. Thereby the control unit can directly send control information to the wireless communication unit in order to control said wireless communication unit according to the duty cycle.

[0024] According to an embodiment, the control unit is coupled with the wireless communication unit by a control line or a bus via a user interface or an electronic circuit. With said specific embodiment, all information related to the microwave generator is available inside of the appliance and there is no need for the WIFI system to check any occurrence of "noise" caused by said microwave generator.

[0025] The microwave generator may be coupled with the control unit or control entity by at least one control line and/or via a power interface. Said power interface is particularly allocated to or associated with a power board of the microwave oven. That way, a direct and unaltered control signal from the control unit or control entity to the microwave generator as well as a respective feedback signal in reversed direction is provided.

[0026] According to a further aspect, the invention relates to a method for operating a microwave oven. The microwave oven comprises at least one microwave generator and a control unit or control entity for controlling said microwave generator. The method comprises the

steps of:

- controlling the microwave generator according to a duty cycle by activating said microwave generator in a first time period of the duty cycle and deactivating said microwave generator in a second time period of the duty cycle; and

- performing wireless communication in the second time period of the duty cycle by means of a wireless communication unit or communication entity which is controlled by said control unit or control entity.

[0027] The duty cycle is adapted to the time needed for a complete information exchange for each communication process by way of wireless communication.

[0028] The duration of one duty cycle may be in the range of 20sec to 60sec, preferably in the range of 30sec to 50sec, specifically 40sec or essentially 40sec. Thereby, a balance between powering the microwave generator and transmitting/receiving information via the wireless communication entity is achieved.

[0029] According to an embodiment of said method, the power level of the microwave oven is controlled based on the ratio between the first time period and the sum of first and second time periods. So, the mean power or effective value of the power provided by the microwave generator is varied by the ratio of time periods in which the microwave generator is activated, respectively, deactivated. Preferably, the sum of first and second time periods which is the duration of the repetitive duty cycle is kept constant during wireless communication. Thereby an advantageous power control paired with interference-free wireless transmission/receipt is possible.

[0030] According to an embodiment of said method, at maximum power level, the ratio between the first time period and the sum of first and second time period is lower than 100%. So, even at maximum power level requested by the user, the microwave generator is periodically switched on/off in order to enable interference-free wireless transmission/receipt of information or at least to trigger or to request wireless communication particularly by an external communication device.

[0031] A preferred embodiment provides a microwave oven which is selectively operatable at a normal cooking mode and at a wireless communication mode, the latter one being a mode in which not only food preparation with microwaves but also wireless communication is enabled. In the normal cooking mode the microwave oven is operated at most permanently, i. e. without any interruption, at a nominal power of the microwave generator. In the wireless communication mode, however, the microwave oven is operated at most at a fraction of the nominal power of the microwave generator. Said fraction is defined by the ratio between the first time period and the summation of the first and second time periods, i.e. the duration of a duty cycle period. This may result in a pause which is created, thereby pulsing the microwave generator even if the user or a selected cooking program would require 100% power level, i. e. full power level.

[0032] Particularly, the control unit switches from the normal cooking mode to the wireless cooking mode for starting the wireless communication. The control unit may start the wireless communication by itself, usually when intending to provide specific information to a user, e. g. to a user's computer device. The switch to the wireless communication mode may also be triggered by such external computer device and, in that case, sending a demand to the control unit requesting from the control unit to enable the wireless communication by providing the necessary pause of microwave generation. Preferably, the microwave oven returns to the normal cooking mode after finalization of the wireless communication. The control unit may organize this return when recognizing the end of said communication.

[0033] According to an embodiment of said method, control information regarding enabling the wireless communication unit is directly transmitted from the control unit to the wireless communication unit or via a user interface. The transmission may be performed via a control bus which is also used for other data transmission or may be performed by a dedicated control line.

[0034] The second time period may be influenced by the requested power level. The lower limit of the second time period may be chosen such that transmission / receipt of information can be performed via the wireless communication unit without causing an information jam over multiple duty cycles.

[0035] According to a particular embodiment of the method, the wireless communication unit is recalling or downloading data information from an external data source during the second time period. Such external data source may be a smartphone or a computer, preferably a tablet computer. The control unit, in that specific operation, may then to some extent take over control on the external data source, at least as regards the timing of data retrieval. Ultimately, the control unit may postpone the data or information transfer to a later stage in case of a currently needed full power level.

[0036] The term "essentially" or "approximately" as used in the invention means deviations from the exact value by +/- 10%, preferably by +/- 5% and/or deviations in the form of changes that are insignificant for the function.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] The various aspects of the invention, including its particular features and advantages, will be readily understood from the following detailed description and the accompanying drawings, in which:

Fig. 1 shows a schematic diagram of a microwave oven according to a first embodiment;

Fig. 2 shows a schematic diagram of a microwave ov-

en according to a second embodiment;

Fig. 3 shows an example diagram illustrating the time dependency of power provided by the microwave generator;

Fig. 4 shows an example diagram illustrating the time dependency of power provided by the microwave generator with respect to nominal power of the microwave generator; and

Fig. 5 shows a state diagram of the microwave oven illustrating switching operations between microwave generator enabled/disabled and wireless communication entity enabled/disabled.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0038] The present invention will now be described more fully with reference to the accompanying drawings, in which example embodiments are shown. However, this invention should not be construed as limited to the embodiments set forth herein. Throughout the following description similar reference numerals have been used to denote similar elements, parts, items or features, when applicable.

[0039] Fig. 1 and 2 show schematic diagrams of a microwave oven 1. The microwave oven 1 may comprise a cavity for receiving food to be prepared. For providing microwaves into the cavity, the microwave oven 1 comprises a microwave generator 2. The microwave generator 2 may comprise a magnetron. According to another embodiment, the microwave generator 2 comprises one or more solid-state microwave generators. Such solid-state microwave generator may, for example, comprise a voltage controlled oscillator for generating a HF-signal with a certain frequency, phase and amplitude. In addition, the solid-state microwave generator may comprise an amplifier (e.g. a microwave amplifier using GaN on SiC solid-state technology) in order to adapt the electric power of the HF-signal.

[0040] In addition, the microwave oven 1 may comprise a control entity 3 which controls the operation of the microwave generator 2. The control entity 3 may be included in a power board of the microwave oven 1 or may be a separate entity which may also be operatively coupled with the power board, i.e. controls the power board.

[0041] The control entity 3 is operatively coupled with a wireless communication entity 4 by means of a control line or bus 5. According to the embodiment of Fig. 1, the control entity 3 is coupled via a user interface 6 with the wireless communication entity 4 (serial coupling). According to the embodiment of Fig. 2, the control line or bus provides a parallel coupling between the control entity 3 and the wireless communication entity 4, respectively the user interface 6.

[0042] The wireless communication entity 4 is coupled with an antenna 4.1 for transmitting/receiving information from a router or another wireless communication device. The wireless communication entity 4 may provide WIFI communication capabilities. For example, the wireless communication entity 4 may provide a communication interface according to WIFI standard family IEEE 802.11.

[0043] In order to reduce, respectively, avoid detrimental effects of the HF-signal provided by the microwave generator 2 on the wireless communication interface provided by the wireless communication entity 4, the microwave generator 2 is operated according to a duty cycle. More in detail, said duty cycle operation of the microwave generator 2 is controlled by control entity 3. The duty cycle comprises a first time period T1 in which the microwave generator 2 is activated, i.e. provides microwaves into the cavity, and a second time period T2 in which the microwave generator 2 is deactivated, i.e. the provision of microwaves into the cavity is stopped.

[0044] Fig. 3 shows a diagram illustrating the provision of microwave power into the cavity over time. It is worth mentioning, that - although only one duty cycle is shown - the duty cycle is periodically repeated.

[0045] Due to actively deactivating the provision of microwaves in the second time period T2, the pause can be used for transmitting/receiving information based on the wireless communication entity 4.

[0046] Preferably, the ratio between first time period T1 and second time period T2 is not fixed but depends on the power level, i.e. the microwave power requested by the user. In case that a higher power level is required, the first time period T1 is increased whereas the second time period T2 is decreased. On the other hand, in case that a lower power level is required, the first time period T1 is decreased whereas the second time period T2 is increased.

[0047] Preferably, the duration of the duty cycle (i.e. the time period between two subsequent rising edges) is kept constant. The duration of the duty cycle may be in the range of 20sec to 60sec, preferably in the range of 30sec to 50sec, specifically 40sec or essentially 40sec. The second time period T2 of the duty cycle may cover 10% to 90% of the duration of the duty cycle, which is the sum of first and second time period T1, T2. In other words, the ratio between the second time period T2 of the duty cycle and the sum of first and second time period T1, T2 is in the range of 10% to 90%.

[0048] It is to be noted that any microwave-generating system comprising at least one component based on said solid-state technology which additionally or alternatively may be used, allows to shorten the entire duty cycle from the above-mentioned particular 40sec to less than 1sec.

[0049] Even if maximum power level is requested, the operation of the microwave generator 2 is periodically stopped in order to provide a time window for wireless communication based on wireless communication entity 4. In other words, the second time period is not zero when requesting maximum power level, at least in order provide the possibility to trigger externally wireless commu-

nication, e.g. by an external computer device which may be a smartphone or a tablet computer.

[0050] In order to avoid a reduction of maximum power level due to the pause for wireless transmission, the power provided by the microwave generator 2 may be, as shown in Fig. 4, increased above nominal maximum power. For example, if the second time period T2 covers 10% of the duration of the duty cycle at maximum power level, the microwave generator 2 may be powered in the first time period T1 at a power level 10% above nominal maximum power. Thereby, the power mean value over the whole duty cycle is equal or essentially equal to the situation when powering the microwave generator 2 at nominal maximum power during the whole duty cycle. Such increase above nominal maximum power may be realized by providing the microwave oven with a microwave generator which can deliver a higher power level, which higher available power lever optionally could be kept secret in the declaration. Alternatively, the increase may be realized by operating the microwave generator at a, particularly timely limited, overboost operational mode.

[0051] Fig. 5 shows a state chart according to which the microwave generator 2 and the wireless communication entity 4 are controlled if the microwave oven 1 is switched on. In state S1, the microwave generator 2 is in transmission mode, i.e. activated and provides microwaves into the cavity. The wireless communication entity 4 is deactivated in order to avoid detrimental effects due to microwave transmission by the microwave generator 2. Based on the requested power, the control entity 3 may calculate a heating cycle duration which may be equal to the first time period T1 mentioned before. In addition, the control entity 3 may monitor the on-time of the microwave generator 2, i.e. the period of time, since which the microwave generator 2 is activated after terminating the last transmission/receive phase of the microwave generator 2. If the value of "on-time" crosses the value of "heating cycle duration" (decision D1), the state of microwave oven changes to state S2, i.e. the microwave generator 2 is disabled and the wireless communication entity 4 is enabled in order to perform transmission/receipt of information via the air interface, specifically WIFI-transmission.

[0052] After switching in state S2, the control entity 3 monitors the duration of the present duty cycle (variable "MWDutyCycle"). If the value of the duration of the present duty cycle crosses the value of maximum duty cycle duration (variable "MWMaxDutyCy-cle")(decision D2), the control entity 3 may initiate a switching in state S1, i.e. the wireless communication entity 4 is disabled and the microwave generator 2 is enabled in order to start a new duty cycle and to activate the provision of microwaves into the cavity again. In addition, the variable "on-time" may be checked whether it is equal to the variable "heating cycle duration".

[0053] Before switching to state S1, the variables "on-time" and "MWDutyCycle" may be resetted and a new duty cycle starts at state S1.

List of reference numerals

[0054]

1	microwave oven
2	microwave generator
3	control entity
4	wireless communication entity
4.1	antenna
5	bus
6	user interface
T1	first period of time
T2	second period of time

Claims

1. Microwave oven comprising at least one microwave generator (2) and a control unit or control entity (3) for controlling said microwave generator (2), wherein said control unit or control entity (3) is configured to control the microwave generator (2) according to a duty cycle in which the microwave generator (2) is activated in a first time period (T1) of the duty cycle and deactivated in a second time period (T2) of the duty cycle, wherein the microwave oven (1) further comprises a wireless communication unit or communication entity (4), wherein said wireless communication unit or communication entity (4) is controlled by said control unit or control entity (3) in order to perform wireless communication in the second time period (T2) of the duty cycle, and wherein the second time period (T2) of the duty cycle preferably covers 10% to 90% of the duration of the duty cycle;
characterized in that the duty cycle is adapted to the time needed for a complete information exchange for each communication process by way of wireless communication.

2. Microwave oven according to claim 1, wherein a minimum duration of the second time period (T2) is defined by the transfer size of a communication package and wherein particularly a maximum of an average power level providable by the duty cycle is dependent on the minimum duration of the second time period (T2).

3. Microwave oven according to anyone of the preceding claims, the microwave oven (1) being selectively operatable at a normal cooking mode and at a wireless communication mode, wherein in the normal cooking mode the microwave oven (1) is operatable at most permanently at a nominal power of the microwave generator (2) and in the wireless communication mode the microwave oven (1) is operatable at most at a fraction of the nominal power of the microwave generator (2), which fraction is defined by

the ratio between the first time period (T1) and the summation of the first and second time periods (T1, T2).

4. Microwave oven according to claim 3, the microwave oven (1) comprising at least one cooking program, wherein during a cooking program, which is using the wireless communication mode, at least one cooking parameter, in particular a cooking time and/or a cooking profile, is modified or modifiable compared with the respective cooking parameter of the normal cooking mode.

5. Microwave oven according to anyone of the preceding claims, wherein the microwave generator (2) is operatable at an overboost operational mode for a limited time period during the wireless communication mode.

6. Microwave oven according to anyone of the preceding claims, wherein the duty cycle, in particular the duty cycle time, is adaptable to the frequency of wireless communication.

7. Microwave oven according to anyone of the preceding claims, wherein the microwave generator (2) comprises a magnetron and/or one or more solid state microwave generators.

8. Microwave oven according to anyone of the preceding claims, wherein the control unit or control entity (3) is directly coupled with the wireless communication unit or communication entity (4) via a control line or a bus (5) or an electronic circuit.

9. Microwave oven according to anyone of the claims 1 to 7, wherein the control unit or control entity (3) is coupled with the wireless communication unit or communication entity (4) by a control line or a bus (5) via a user interface (6) or an electronic circuit.

10. Microwave oven according to anyone of the preceding claims, wherein the microwave generator (2) is coupled with the control unit or control entity (3) by at least one control line and/or via a power interface, in particular a power interface that is allocated to a power board of the microwave oven (1).

11. Method for operating a microwave oven (1) comprising at least one microwave generator (2) and a control unit or a control entity (3) for controlling said microwave generator (2), the method comprising the steps of:

- controlling the microwave generator (2) according to a duty cycle by activating said microwave generator (2) in a first time period (T1) of the duty cycle and deactivating said microwave generator (2) in a second time period (T2) of the duty cycle; and
- performing wireless communication in the second time period (T2) of the duty cycle by means of a wireless communication unit or communication entity (4) which is controlled by said control unit or control entity (3),

wherein the duration of one duty cycle is in particular in the range of 20sec to 60sec, preferably in the range of 30sec to 50sec, specifically 40sec or essentially 40sec;

characterized in that the duty cycle is adapted to the time needed for a complete information exchange for each communication process by way of wireless communication.

12. Method according to claim 11, the microwave oven (1) being selectively operatable at a normal cooking mode and at a wireless communication mode, wherein in the normal cooking mode the microwave oven (1) is operated at most permanently at a nominal power of the microwave generator (2) and in the wireless communication mode the microwave oven (1) is operated at most at a fraction of the nominal power of the microwave generator, which fraction is defined by the ratio between the first time period (T1) and the sum of the first and second time periods (T1, T2).

13. Method according to claim 12, wherein for starting wireless communication the control unit or control entity (3) switches, particularly on demand by an external device, preferably by an external communication and/or computer device, from the normal cooking mode to the wireless communication mode and preferably returns to the normal cooking mode after finalization of the wireless communication.

14. Method according to anyone of claims 11 to 13, wherein control information regarding enabling the wireless communication unit or communication entity (4) is directly transmitted from the control unit or control entity (3) to the wireless communication unit or communication entity (4) or via a user interface (6).

15. Method according to anyone of the claims 11 to 14, wherein the wireless communication unit or communication entity (4) is recalling or downloading data information from an external data source, in particular from a smartphone or a computer, preferably from a tablet computer, during the second time period.

Patentansprüche

1. Mikrowellenofen, umfassend mindestens einen Mikrowellengenerator (2) und eine Steuereinheit oder

Steuerentität (3) zum Steuern des Mikrowellengenerators (2), wobei die Steuereinheit oder Steuerentität (3) dazu ausgelegt ist, den Mikrowellengenerator (2) gemäß einem Arbeitszyklus zu steuern, in dem der Mikrowellengenerator (2) in einer ersten Zeitperiode (T1) des Arbeitszyklus aktiviert und in einer zweiten Zeitperiode (T2) des Arbeitszyklus deaktiviert wird, wobei der Mikrowellenofen (1) ferner eine drahtlose Kommunikationseinheit oder Kommunikationsentität (4) umfasst, wobei die drahtlose Kommunikationseinheit oder Kommunikationsentität (4) durch die Steuereinheit oder Steuerentität (3) gesteuert wird, um eine drahtlose Kommunikation in der zweiten Zeitperiode (T2) des Arbeitszyklus durchzuführen, und wobei die zweite Zeitperiode (T2) des Arbeitszyklus vorzugsweise 10 % bis 90 % der Dauer des Arbeitszyklus abdeckt;
dadurch gekennzeichnet, dass der Arbeitszyklus an die Zeit angepasst ist, die für einen vollständigen Informationsaustausch für jeden Kommunikationsprozess mittels drahtloser Kommunikation erforderlich ist.

2. Mikrowellenofen nach Anspruch 1, wobei eine Mindestdauer der zweiten Zeitperiode (T2) durch die Übertragungsgröße eines Kommunikationspakets definiert ist und wobei insbesondere ein Maximum eines durch den Arbeitszyklus bereitstellbaren durchschnittlichen Leistungspegels von der Mindestdauer der zweite Zeitperiode (T2) abhängt.

3. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei der Mikrowellenofen (1) gezielt bei einem normalen Garmodus und bei einem drahtlosen Kommunikationsmodus betreibbar ist,
wobei in dem normalen Garmodus der Mikrowellenofen (1) höchstens dauerhaft bei einer Nennleistung des Mikrowellengenerators (2) betreibbar ist und in dem drahtlosen Kommunikationsmodus der Mikrowellenofen (1) höchstens bei einem Bruchteil der Nennleistung des Mikrowellengenerators (2) betreibbar ist, wobei der Bruchteil durch das Verhältnis zwischen der ersten Zeitperiode (T1) und der Summe der ersten und zweiten Zeitperioden (T1, T2) definiert ist.

4. Mikrowellenofen nach Anspruch 3, wobei der Mikrowellenofen (1) mindestens ein Garprogramm umfasst, wobei während eines Garprogramms, das den drahtlosen Kommunikationsmodus nutzt, mindestens ein Garparameter, insbesondere eine Garzeit und/oder ein Garprofil, im Vergleich zu dem jeweiligen Garparameter des normalen Garmodus modifiziert oder modifizierbar ist.

5. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei der Mikrowellengenerator (2) für eine begrenzte Zeitperiode während des drahtlosen Kommunikationsmodus bei einem Überlast-Betriebsmodus betreibbar ist.

6. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei der Arbeitszyklus, insbesondere die Arbeitszykluszeit, an die Frequenz der drahtlosen Kommunikation anpassbar ist.

7. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei der Mikrowellengenerator (2) einen Magnetron und/oder einen oder mehrere Festkörper-Mikrowellengeneratoren umfasst.

8. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei die Steuereinheit oder Steuerentität (3) direkt mit der drahtlosen Kommunikationseinheit oder Kommunikationsentität (4) über eine Steuerleitung oder einen Bus (5) oder eine elektronische Schaltung gekoppelt ist.

9. Mikrowellenofen nach einem der Ansprüche 1 bis 7, wobei die Steuereinheit oder Steuerentität (3) mit der drahtlosen Kommunikationseinheit oder Kommunikationsentität (4) durch eine Steuerleitung oder einen Bus (5) über eine Benutzerschnittstelle (6) oder eine elektronische Schaltung gekoppelt ist.

10. Mikrowellenofen nach einem der vorhergehenden Ansprüche, wobei der Mikrowellengenerator (2) mit der Steuereinheit oder Steuerentität (3) durch mindestens eine Steuerleitung und/oder über eine Leistungsschnittstelle, insbesondere eine Leitungsschnittstelle, die einer Leistungsplatine des Mikrowellenofens (1) zugeordnet ist, gekoppelt ist.

11. Verfahren zum Betreiben eines Mikrowellenofens (1), der mindestens einen Mikrowellengenerator (2) und eine Steuereinheit oder Steuerentität (3) zum Steuern des Mikrowellengenerators (2) umfasst, wobei das Verfahren die folgenden Schritte umfasst:

- Steuern des Mikrowellengenerators (2) gemäß einem Arbeitszyklus durch Aktivieren des Mikrowellengenerators (2) in einer ersten Zeitperiode (T1) des Arbeitszyklus und Deaktivieren des Mikrowellengenerators (2) in einer zweiten Zeitperiode (T2) des Arbeitszyklus; und
- Durchführen einer drahtlosen Kommunikation in der zweiten Zeitspanne (T2) des Arbeitszyklus mittels einer drahtlosen Kommunikationseinheit oder Kommunikationsentität (4), die durch die Steuereinheit oder Steuerentität (3) gesteuert wird,
wobei die Dauer eines Arbeitszyklus insbesondere im Bereich von 20 Sek. bis 60 Sek., vorzugsweise im Bereich von 30 Sek. bis 50 Sek., insbesondere 40 Sek. oder im Wesentlichen 40 Sek., liegt;

dadurch gekennzeichnet, dass der Arbeitszyklus an die Zeit angepasst wird, die für einen vollständigen Informationsaustausch für jeden Kommunikationsprozess mittels drahtloser Kommunikation erforderlich ist.

12. Verfahren nach Anspruch 11, wobei der Mikrowellenofen (1) gezielt bei einem normalen Garmodus und bei einem drahtlosen Kommunikationsmodus betreibbar ist, wobei in dem normalen Garmodus der Mikrowellenofen (1) höchstens dauerhaft bei einer Nennleistung des Mikrowellengenerators (2) betrieben wird und in dem drahtlosen Kommunikationsmodus der Mikrowellenofen (1) höchstens bei einem Bruchteil der Nennleistung des Mikrowellengenerators betrieben wird, wobei der Bruchteil durch das Verhältnis zwischen der ersten Zeitperiode (T1) und der Summe der ersten und zweiten Zeitperioden (T1, T2) definiert wird.

13. Verfahren nach Anspruch 12, wobei zum Starten einer drahtlosen Kommunikation die Steuereinheit oder Steuerentität (3), insbesondere auf Anforderung durch eine externe Vorrichtung, vorzugsweise durch eine externe Kommunikations- und/oder Computervorrichtung, von dem normalen Garmodus zu dem drahtlosen Kommunikationsmodus umschaltet und vorzugsweise zu dem normalen Garmodus nach Beendigung der drahtlosen Kommunikation zurückkehrt.

14. Verfahren nach einem der Ansprüche 11 bis 13, wobei Steuerinformationen bezüglich eines Aktivierens der drahtlosen Kommunikationseinheit oder Kommunikationsentität (4) direkt von der Steuereinheit oder Steuerentität (3) zu der drahtlosen Kommunikationseinheit oder Kommunikationsentität (4) oder über eine Benutzerschnittstelle (6) übertragen werden.

15. Verfahren nach einem der Ansprüche 11 bis 14, wobei die drahtlose Kommunikationseinheit oder Kommunikationsentität (4) Dateninformationen von einer externen Datenquelle, insbesondere von einem Smartphone oder einem Computer, vorzugsweise von einem Tabletcomputer, während der zweiten Zeitperiode abruft oder herunterlädt.

Revendications

1. Four à micro-ondes comprenant au moins un générateur de micro-ondes (2) et une unité de commande ou entité de commande (3) pour commander ledit générateur de micro-ondes (2), dans lequel ladite unité de commande ou entité de commande (3) est configurée pour commander le générateur de micro-ondes (2) en fonction d'un cycle de service dans lequel le générateur de micro-ondes (2) est activé pendant une première période temporelle (T1) du cycle de service et désactivé pendant une seconde période temporelle (T2) du cycle de service, dans lequel le four à micro-ondes (1) comprend en outre une unité de communication ou entité de communication sans fil (4), dans lequel ladite unité de communication ou entité de communication sans fil (4) est commandée par ladite unité de commande ou entité de commande (3) afin de réaliser une communication sans fil pendant la seconde période temporelle (T2) du cycle de service, et dans lequel la seconde période temporelle (T2) du cycle de service couvre de préférence entre 10 % et 90 % de la durée du cycle de service ;
caractérisé en ce que le cycle de service est adapté au temps nécessaire pour un échange d'informations complet pour chaque processus de communication au moyen d'une communication sans fil.

2. Four à micro-ondes selon la revendication 1, dans lequel une durée minimale de la seconde période temporelle (T2) est définie par la taille de transfert d'un paquet de communication et dans lequel en particulier, un maximum d'un niveau de puissance moyen pouvant être fourni par le cycle de service dépend de la durée minimale de la seconde période temporelle (T2).

3. Four à micro-ondes selon l'une quelconque des revendications précédentes, le four à micro-ondes (1) pouvant fonctionner de façon sélective dans un mode de cuisson normal et dans un mode de communication sans fil, dans lequel dans le mode de cuisson normal, le four à micro-ondes (1) peut fonctionner au plus de façon permanente à une puissance nominale du générateur de micro-ondes (2) et dans le mode de communication sans fil, le four à micro-ondes (1) peut fonctionner au plus à une fraction de la puissance nominale du générateur de puissance (2), laquelle fraction est définie par le rapport entre la première période temporelle (T1) et la somme des première et seconde périodes temporelles (T1, T2) .

4. Four à micro-ondes selon la revendication 3, le four à micro-ondes (1) comprenant au moins un programme de cuisson, dans lequel pendant un programme de cuisson qui utilise le mode de communication sans fil, au moins un paramètre de cuisson, en particulier un temps de cuisson et/ou un profil de cuisson, est modifié ou peut être modifié par rapport au paramètre de cuisson respectif du mode de cuisson normal.

5. Four à micro-ondes selon l'une quelconque des revendications précédentes, dans lequel le générateur de micro-ondes (2) peut fonctionner dans un mode de fonctionnement en surrégime pendant une pério-

de temporelle limitée pendant le mode de communication sans fil.

6. Four à micro-ondes selon l'une quelconque des revendications précédentes, dans lequel le cycle de service, en particulier le temps du cycle de service, peut être adapté à la fréquence de la communication sans fil.

7. Four à micro-ondes selon l'une quelconque des revendications précédentes, dans lequel le générateur de micro-ondes (2) comprend un magnétron et/ou un ou plusieurs générateurs de micro-ondes à semiconducteurs.

8. Four à micro-ondes selon l'une quelconque des revendications précédentes, dans lequel l'unité de commande ou entité de commande (3) est directement couplée à l'unité de communication ou entité de communication sans fil (4) par le biais d'une ligne ou d'un bus de commande (5) ou d'un circuit électronique.

9. Four à micro-ondes selon l'une quelconque des revendications 1 à 7, dans lequel l'unité de commande ou entité de commande (3) est couplée à l'unité de communication ou entité de communication sans fil (4) par une ligne ou un bus de commande (5) par le biais d'une interface utilisateur (6) ou d'un circuit électronique.

10. Four à micro-ondes selon l'une quelconque des revendications précédentes, dans lequel le générateur de micro-ondes (2) est couplé à l'unité de commande ou entité de commande (3) par au moins une ligne de commande et/ou par le biais d'une interface d'alimentation, en particulier une interface d'alimentation qui est attribuée à une carte d'alimentation du four à micro-ondes (1).

11. Procédé d'utilisation d'un four à micro-ondes (1) comprenant au moins un générateur de micro-ondes (2) et une unité de commande ou entité de commande (3) pour commander ledit générateur de micro-ondes (2), le procédé comprenant les étapes suivantes :

la commande du générateur de micro-ondes (2) en fonction d'un cycle de service par l'activation dudit générateur de micro-ondes (2) pendant une première période temporelle (T1) du cycle de service et la désactivation dudit générateur de micro-ondes (2) pendant une seconde période temporelle (T2) du cycle de service ; et
la réalisation d'une communication sans fil pendant la seconde période temporelle (T2) du cycle de service au moyen d'une unité de communication ou entité de communication sans fil (4) qui est commandée par ladite unité de commande ou entité de commande (3),
dans lequel la durée d'un cycle de service est comprise en particulier dans la plage de 20 s à 60 s, de préférence dans la plage de 30 s à 50 s, spécifiquement de 40 s ou essentiellement de 40 s ;
caractérisé en ce que le cycle de service est adapté au temps nécessaire pour un échange d'informations complet pour chaque processus de communication au moyen d'une communication sans fil.

12. Procédé selon la revendication 11, le four à micro-ondes (1) pouvant fonctionner de façon sélective dans un mode de cuisson normal et dans un mode de communication sans fil, dans lequel dans le mode de cuisson normal, le four à micro-ondes (1) peut fonctionner au plus de façon permanente à une puissance nominale du générateur de micro-ondes (2) et dans le mode de communication sans fil, le four à micro-ondes (1) peut fonctionner au plus à une fraction de la puissance nominale du générateur de micro-ondes , laquelle fraction est définie par le rapport entre la première période temporelle (T1) et la somme des première et seconde périodes temporelles (T1, T2).

13. Procédé selon la revendication 12, dans lequel pour démarrer la communication sans fil, l'unité de commande ou entité de commande (3) commute, en particulier sur demande d'un dispositif externe, de préférence un dispositif de communication et/ou un dispositif informatique externe, du mode de cuisson normal au mode de communication sans fil et de préférence retourne au mode de cuisson normal après la finalisation de la communication sans fil.

14. Procédé selon l'une quelconque des revendications 11 à 13, dans lequel les informations de commande relatives à l'activation de l'unité de communication ou entité de communication sans fil (4) sont transmises de l'unité de commande ou entité de commande (3) à l'unité de communication ou entité de communication sans fil (4) directement ou par le biais d'une interface utilisateur (6).

15. Procédé selon l'une quelconque des revendications 11 à 14, dans lequel l'unité de communication ou entité de communication sans fil (4) rappelle ou télécharge des informations de données depuis une source de données externe, en particulier depuis un smartphone ou un ordinateur, de préférence depuis une tablette électronique, pendant la seconde période temporelle.

FIG 1

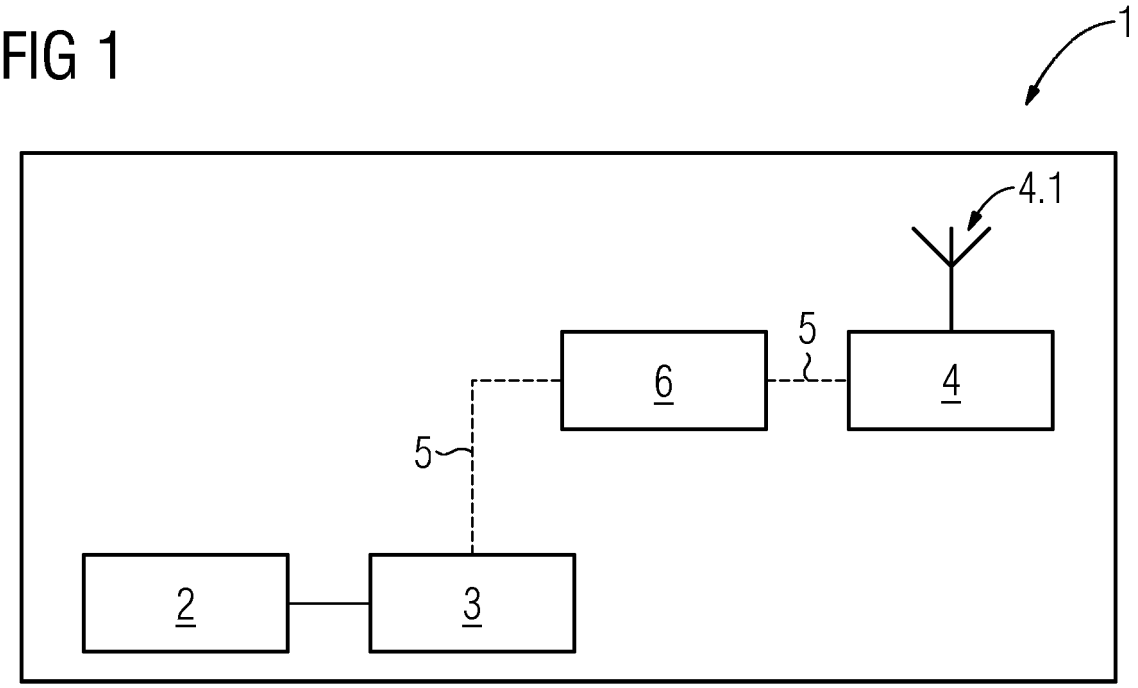


FIG 2

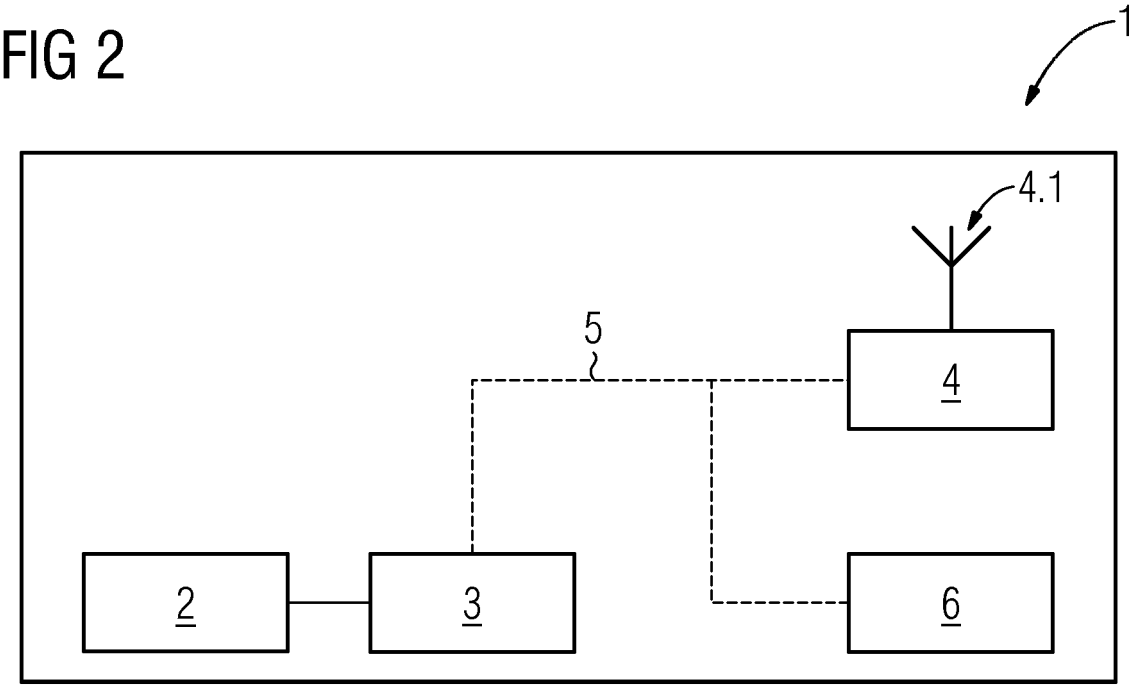


FIG 3

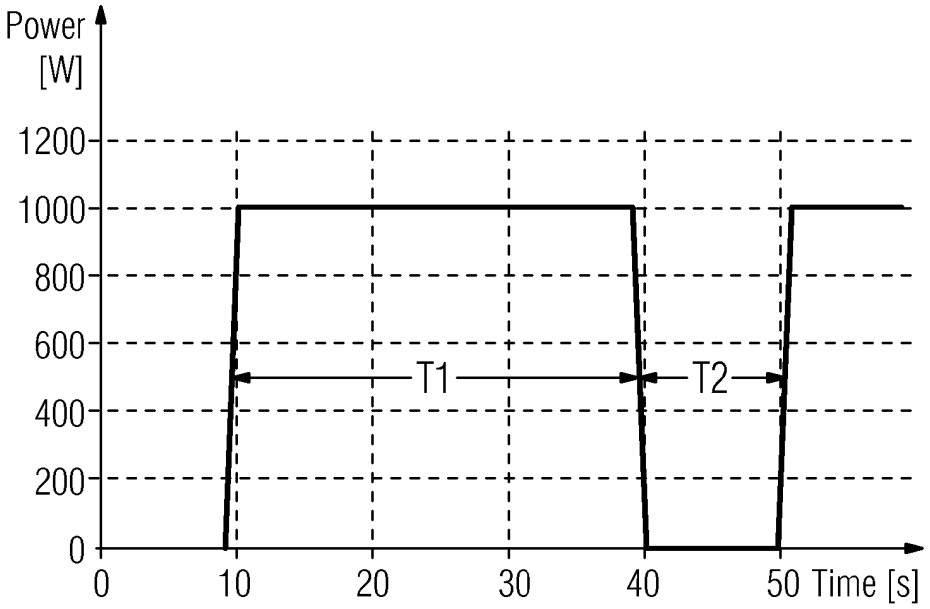

Power
[W]
1200
1000
800
600
400
200
0
T1
T2
0
10
20
30
40
50 Time [s]

FIG 4

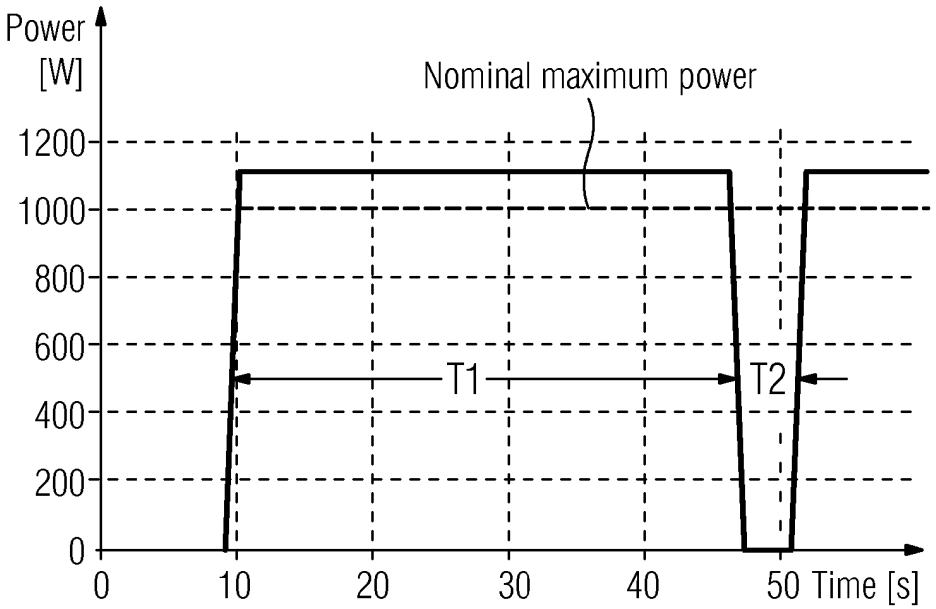
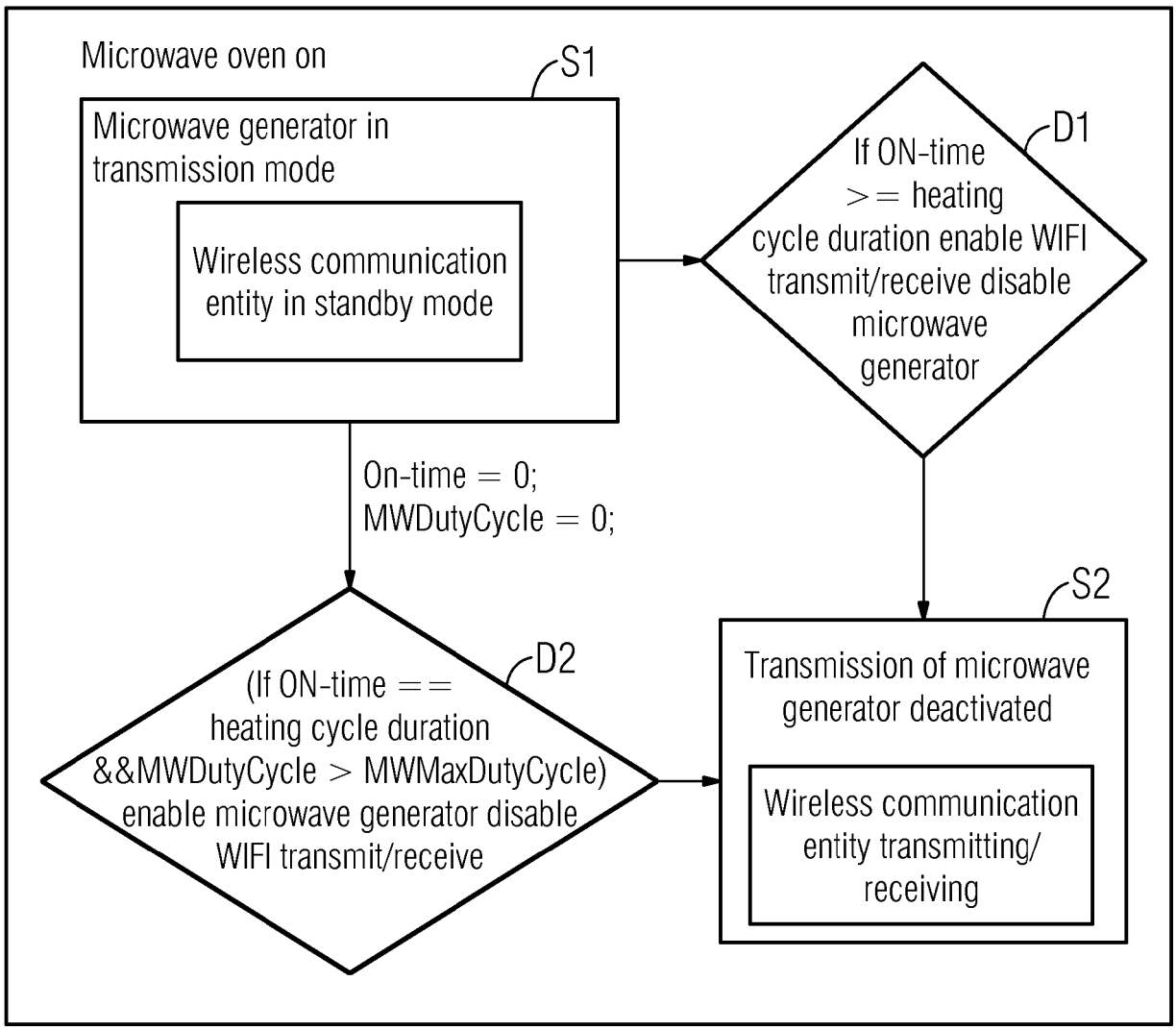

Power
[W]
Nominal maximum power
1200
1000
800
600
400
200
0
T1
T2
0
10
20
30
40
50 Time [s]

FIG 5


Microwave oven on
S1
Microwave generator in transmission mode
Wireless communication entity in standby mode
D1
If ON-time >= heating cycle duration enable WIFI transmit/receive disable microwave generator
On-time = 0;
MWDutyCycle = 0;
S2
Transmission of microwave generator deactivated
Wireless communication entity transmitting/ receiving
D2
(If ON-time == heating cycle duration &&MWDutyCycle > MWMaxDutyCycle) enable microwave generator disable WIFI transmit/receive

REFERENCES CITED IN THE DESCRIPTION

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- WO 2004034678 A2 **[0005]**
- US 2013008893 A1 **[0006]**