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(54) **CIRCUITRY AND METHOD FOR DETERMINING A MAINS VOLTAGE IN AN ISOLATED SWITCHED DRIVER DEVICE**

SCHALTUNG UND VERFAHREN ZUR BESTIMMUNG EINER NETZSPANNUNG IN EINER ISOLIERTEN GESCHALTETEN TREIBERVORRICHTUNG

CIRCUIT ET PROCÉDÉ POUR DÉTERMINER UNE TENSION SECTEUR DANS UN DISPOSITIF DE COMMANDE DE COMMUTATION ISOLÉ

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Description

[0001] The invention relates to a driver device for driving a load, e.g. for driving a lighting means, and in particular to switched driver devices, e.g. in a flyback topology, implementing an isolation barrier. The invention concerns a circuit and a method for determining a mains supply voltage of the driver device.

[0002] Driver devices in a switched mode power supply (SMPS) topology are generally known in the area of standard driver devices for lighting applications, as well as in the specific field of emergency lighting applications.

[0003] Isolated driver devices implement an isolation barrier between a first circuit and a second circuit of the driver device using a transformer. The isolation barrier between the first circuit on a primary side of the transformer and the second circuit on the secondary side of the transformer enables to isolate galvanically circuit parts with high voltages from circuit parts with safe lower voltages, thereby fulfilling SELV (Safety Extra Low Voltage) requirements. The first circuit on the primary side of the isolation barrier (SELV barrier) includes the mains supply interface, and therefore includes portions on a mains supply voltage level. The second circuit on the secondary side of the isolation barrier provides a load current to connected lighting devices, which the driving device supplies.

[0004] A control circuit, often implemented based on a microcontroller, controls the switch arranged in the primary circuit of the driver device implemented in flyback topology. The driver device may arrange the microcontroller for controlling the switch on the primary side of the isolation barrier.

[0005] The microcontroller may also provide the capability to measure, monitor, process, and/or record a mains supply voltage. Monitoring the mains supply voltage is a characteristic feature for emergency driver devices, which switch into an emergency mode of operation backed by a battery when detecting a mains supply failure. Thus, information on mains supply voltage needs not to be transferred over the isolation barrier.

[0006] In driving devices using a secondary side processing, however, the information on the actual mains supply voltage needs to be transferred over the isolation barrier in order to process the transferred information in a control circuit on the secondary side of the isolation barrier.

[0007] In order to transfer information such as an actual value or an actual state of the mains supply voltage over the isolation barrier, additional electronic circuit elements such as an optocoupler (sometimes called opto-isolator, optical isolator, photocoupler) are necessary. The optocoupler represents an additional and expensive circuit element and requires additional space on a printed circuit board, and therefore increases cost and complexity of the driver device when monitoring or measuring the supply voltage is a requirement.

[0008] US 2021/006168 A1 discloses a power converter that powers an LED fixture from a power supply.

[0009] The power converter comprises a primary circuit with a primary winding, and a switch in series connection with the primary winding. In a conductive state, the switch connects the primary winding to the power supply. A secondary circuit comprises a secondary winding that is coupled magnetically with the primary winding for providing power to the LED fixture in response to a switching of the switch. The power converter further comprises a sensing circuit configured to generate a signal representative of the output voltage of the secondary winding. An edge of the signal represents an edge of the output voltage of the secondary winding in response to the switching of the switch. A detecting circuit derives timing data from the edges of the signal, to estimate a load of the power converter from at least one output parameter of the power converter, and to determine a momentary value of a voltage of the power supply from the timing data and the estimated load of the power converter. DE 20 2019 104171 U1 discloses a driver for operating LED loads. The driver comprises terminals for connecting at least one LED load, a circuit for providing a constant DC voltage starting from a mains voltage supply, a control unit, a switch in series with the LED load when connected to the terminals. The end of the switch opposite to the terminals is connected to ground potential. The control unit controls the switch with pulse width modulation for dimming. The driver comprises a detection circuit in parallel with the switch, which outputs a detection signal via a pin, the detection signal representing the potential at a connection point between the switch and the LED load.

[0010] Thus, it is an object of the invention to improve isolated, switched mode driver devices with a capability to at least detect, and even measure a mains supply voltage without increasing complexity and cost significantly.

[0011] The driver device in a first aspect and the method for operating the driver device in a second aspect according to the independent claims define the invention and provide solutions to the problem. The dependent claims define further advantageous features of the invention.

[0012] The driver device comprises a primary circuit including a controlled switch and supplied by a mains supply voltage, and a secondary circuit providing a load current. The driver device further comprises an isolation stage including a transformer with a primary winding and a secondary winding. The isolation stage is configured to isolate the primary circuit on a primary side and the secondary circuit on a secondary side by an isolation barrier. The driver device comprises a control circuit arranged on the secondary side of the isolation barrier. The transformer further comprises an additional secondary winding arranged on the secondary side. The additional secondary winding is in phase with the primary winding. The control circuit is configured to determine presence and/or a value of the mains supply voltage for a time in which the controlled switch is conducting based on a voltage signal provided by the additional secondary winding.

[0013] The driver device is a switched mode power supply (SMPS) in a flyback topology. The flyback topology provides isolation between a primary side and a secondary side by a SELV barrier.

[0014] The voltage signal provided by the additional secondary winding provides the basis for the control circuit on the secondary side of the transformer for determining presence or absence of the mains supply voltage. The voltage signal is in phase with the voltage across the primary winding of the transformer. The voltage induced in the secondary winding when the controlled switch is switched on (in a conducting state) is converted depending on a winding ratio between the primary winding and the additional secondary winding (measurement winding or auxiliary winding). The control circuit may accordingly determine presence or absence of a voltage over the primary winding of the transformer based on the voltage signal provided by the additional secondary winding. The control circuit may even determine (measure) a value of the voltage over the primary winding based on the voltage signal provided by the additional secondary winding, as long as this voltage signal depends on predetermined circuit parameters of the electronic circuit layout. The predetermined circuit parameters are in particular a winding ratio of the primary winding and the additional secondary winding.

[0015] Further predetermined electronic circuit parameters of the electronic circuitry are, e.g. for example electronic circuit parameters of resistive voltage divider stages, that process the voltage signal before it is supplied to the control circuit in form of a DC voltage. Thereby, a DC voltage provided to the control circuit tracks an actual value of the (rectified) mains supply voltage over the primary winding while the controlled switch is conducting. The rectified mains supply voltage depends on the mains supply voltage provided to the primary circuit of the driver circuit. The control circuit is enabled to convert the supplied DC voltage accordingly to an actual value (voltage amplitude value) of the mains supply voltage currently present at a mains supply input of the driver circuit.

[0016] Therefore, the driver device according to the first aspect provides the capability to determine presence, absence, or even an actual value of the mains supply voltage using the control circuit arranged on the secondary side of the isolation barrier without requiring an expensive optocoupler.

[0017] The voltage signal which is induced in the additional secondary winding is independent from a current load at a load output of the secondary circuit, as the voltage signal is induced during a time in which the switch of the primary circuit is in a conducting state. Thus load variations do not adversely affect the measurement of the mains supply voltage.

[0018] Determining values for the mains supply voltage enables to determine power consumption of the driver device and thereby to provide a key parameter for building automation and monitoring system, e.g. in order to perform power metering and collect power metering data from the individual devices connected to the communication interface.

[0019] The mains supply voltage may be a rectified AC mains supply voltage.

[0020] A dedicated primary side control circuit arranged on the primary side of the isolation barrier typically controls operation of the controlled switch of the primary circuit.

[0021] The dependent claims define further advantageous embodiments of the driver device.

[0022] The driver device according to a preferred embodiment comprises a rectifier circuit arranged on the secondary side of the isolation barrier. The rectifier circuit is configured to rectify the voltage signal provided by the additional secondary winding in order to generate a rectified voltage signal.

[0023] The rectifier circuit may include a first diode and a second diode.

[0024] The rectifier circuit may comprise a first resistor and a second resistor, wherein the first resistor and the second resistor are connected in series with the first diode.

[0025] According to an advantageous embodiment, the driver device comprises a peak detector circuit arranged on the secondary side of the isolation barrier for generating a DC voltage from the rectified voltage signal provided by the rectifier circuit.

[0026] The peak detector circuit can include a capacitor and a resistive divider network arranged in parallel with the capacitor.

[0027] The resistive divider network is configured to generate a DC voltage in a first voltage range from the rectified voltage signal for the AC mains supply voltage in a second voltage range. The first voltage range may be smaller than the second voltage range by at least one order of magnitude, in particular the second voltage range reaches from o V to 240 V and the first voltage range reaches from o V to 4 V.

[0028] Thus, the mains supply voltage can be measured by the control circuit after converting it into a usual voltage range for application to an analogue input of a microcontroller. The voltage applied to the control circuit is a stable DC voltage, which can be measured by the analogue to digital converter present in most current microcontroller circuits.

[0029] The control circuit according to an embodiment comprises an analogue-to-digital converter circuit configured to obtain the DC voltage provided by the peak detector circuit.

[0030] The control circuit can be configured to determine presence or absence of the mains supply voltage based on the DC voltage provided by the peak detector circuit. Alternatively or additionally, the control circuit is configured to calculate an actual value of the mains supply voltage based on the DC voltage provided by the peak detector circuit.

[0031] The control circuit according to an embodiment is configured to convert the DC voltage provided by the rectifier circuit to the value of the mains supply voltage based on (using) a predetermined winding ratio of the primary winding and the additional secondary winding.

[0032] The control circuit according to an embodiment is configured to convert the DC voltage provided by the rectifier circuit to the value of the mains supply voltage based on (using) electronic circuit parameter values of the rectifier circuit and the peak detector circuit.

[0033] According to an embodiment, the control circuit is configured to determine a frequency of the mains supply voltage based on the DC voltage.

[0034] The control circuit may be configured to record the determined value of the mains supply voltage in a memory.

[0035] The memory may be an internal memory of the control circuit, for example a memory storing a log file including one or more values of operating parameter(s) of the driver device. The memory may be a storage device arranged externally to the driver device, for example at a central control facility or a remote server.

[0036] The driver device comprises a transfer circuit configured to transfer mains supply voltage data determined by the control circuit over the isolation barrier to a communication interface of the driver device arranged on the primary side of the isolation barrier.

[0037] Thus, the mains supply voltage data, e.g. data on presence or absence of the mains supply voltage at a mains supply input of the driver device, or data including actual or historic voltage values of the mains supply voltage may be available externally to the driver device. Thus, power consumption calculations based on actual measurements or a monitoring of the mains supply concerning the individual driver device becomes possible without installing additional measurement equipment in the field. Optocouplers represent a possibility to implement the transfer circuit.

[0038] The communication interface may perform communication based on a wireless and/or wire-bound communication standard, in particular based on a DALI standard.

[0039] The Digital Addressable Lighting Interface (DALI^{RTM}) enables network-based light devices. The extension D4i of the certified DALI-2 standard in particular refers to collecting and storing of diagnostic and maintenance data, which explicitly include performance data of driver devices such as driver external supply voltage (mains supply voltage) and driver external supply frequency (electric grid frequency). The driver device according to the first aspect therefore offers advantages for implementing driver devices fulfilling corresponding requirements concerning measurement and/or monitoring of the external supply voltage of a driver device in a highly economical manner.

[0040] Determining amplitude values for the mains supply voltages enables to determine power consumption of the driver device and thereby to provide a key parameter for building automation and monitoring purposes.

[0041] According to an advantageous embodiment, the driver device includes the control circuit configured to determine a mains supply voltage frequency based on the voltage signal.

[0042] Knowledge on values or stability of the mains supply voltage at the input of the driver device may provide valuable insight into the AC supply network and support failure search in the AC supply network.

[0043] Preferably, the control circuit is a microcontroller circuit. Current microcontroller circuits include AD-converter circuits and corresponding AD-converter inputs and are therefore well suited to process the DC voltage provided by the rectifier circuit. Furthermore, the microcontroller circuit has the processing capability to convert the DC voltage to the corresponding value of the mains supply voltage based on the predetermined electric characteristics of the transformer, and the electric circuit parameters of the rectifier circuit and the peak detector circuit. The microcontroller circuit further offers the capability to record the determined AC mains supply voltage value in a memory of the driver device, for example in a log file including mains supply voltage data, or to generate a signal to a communication interface. The signal to the communication interface may include mains supply voltage data including one or more values for the mains supply voltage, and/or a time series of amplitude values of the mains supply voltage and/or frequency values of the mains supply voltage.

[0044] The driver device has a flyback converter topology. Additionally, the driver device may be an emergency driver device, in particular an emergency lighting driver device.

[0045] The second aspect concerns a method for operating a driver device comprising a switched mode power supply in a flyback topology, wherein the driver device comprises a primary circuit including a controlled switch. A mains supply voltage supplies the primary circuit. The driver device further comprises a secondary circuit providing a load current to a load, and an isolation stage including a transformer with a primary winding and a secondary winding. The isolation stage is configured to isolate the primary circuit on a primary side and the secondary circuit on a secondary side by an isolation barrier. The driver device comprises a control circuit arranged on the secondary side of the isolation barrier. The method is characterized by a step of providing a voltage signal by an additional secondary winding of the transformer on the secondary side, wherein the additional winding is arranged in phase with the primary winding. The method further comprises a step of determining, by the control circuit, presence of the mains supply voltage and/or an actual value (amplitude value) of the mains supply voltage for a time in which the controlled switch is conducting based on the voltage signal to generate mains supply voltage data.

[0046] The method further comprises a step of transferring, by a transfer circuit, the mains supply voltage data determined by the control circuit over the isolation barrier to a communication interface arranged on the primary side.

[0047] The discussion of embodiments refers to the figures, in which

Fig. 1 shows a simplified block diagram of a driver device according to a preferred embodiment,

Fig. 2 presents a chart for illustrating peaks of mains supply voltage to a driver device the embodiment uses,

Fig. 3 illustrates the interdependency between mains supply voltage and an input voltage (DC voltage) at an input of the control circuit according to an embodiment,

Fig. 4 shows a block diagram of a driver device according to a preferred embodiment including a communication interface, and

Fig. 5 shows a method for operating an isolated, primary side switched driver device according to an embodiment.

[0048] Same reference signs in different figures denote same or corresponding elements. The description of embodiments using the figures omits a discussion of same reference signs for different figures where considered possible without adversely affecting intelligibility for sake of a concise description.

[0049] Fig. 1 shows a simplified block diagram of a driver device 1 according to a preferred embodiment.

[0050] The driver device 1 comprises a primary circuit 5 including a controlled switch 10. The driver device 1 is an isolated switched mode power supply (lamp driver, ballast) in a flyback topology.

[0051] The primary circuit 5 of the driver device 1 comprises a mains supply input 2 for connecting to an AC mains voltage (mains supply voltage V_{AC}). The mains supply voltage V_{AC} may be a 230V/50 Hz mains supply, for example.

[0052] The primary circuit 5 according to fig. 1 includes characteristic elements of a mains supply interface, for example, an EMI filter 3 and a subsequent bridge rectifier 4. The bridge rectifier 4 provides a rectified mains supply voltage V_{AC_RECT} for the primary circuit 5 of the driver device 1.

[0053] The driver device 1 comprises an isolation stage including a transformer 13. The transformer 13 comprises a primary winding 6 forming part of the primary circuit 5 and a secondary winding 7 forming part of the secondary circuit 12.

[0054] The isolation stage isolates the primary circuit 5 on a primary side and the secondary circuit on a secondary side by the isolation barrier 9. The isolation barrier 9 is a SELV barrier providing galvanic separation (electric isolation) between the primary side and the secondary side.

[0055] Furthermore, the isolation barrier 9 provides galvanic isolation between the primary circuit 5 and the secondary circuit 12.

[0056] The primary circuit 5 arranges a controlled switch 10 in series with the primary winding 6. A

[0057] primary side control circuit not shown in fig. 1 controls the switch 10 to switch between a conducting state and a non-conducting state in a generally known manner for a SMPS, e.g. a flyback converter. The flyback topology provides isolation between the primary side and the secondary side by the isolation barrier 9.

[0058] The secondary winding 7 of the transformer 13 forms part of the secondary circuit 12.

[0059] The secondary circuit 12 of the driver device 1 generates a load current I_{LED} (DC load current) and provides the generated load current I_{LED} to a load 14. The secondary circuit 12 includes a diode D3 and further circuit elements such as a secondary side LED driver 15 actually outputting the load current I_{LED}.

[0060] The load may be a lighting module comprising one or more LEDs.

[0061] The transformer 13 further comprises an additional secondary winding 8 arranged on the secondary side. The additional secondary winding 8 is in phase with the primary winding 6 on the primary side. The additional secondary winding 8 provides a voltage signal V_{IND} on the secondary side of the isolation barrier. During a time in which the switch 10 is controlled to be in a conducting state, the voltage signal V_{IND} induced in the additional secondary winding 8 depends on the rectified mains supply voltage V_{AC_RECT} and therefore also on the mains supply voltage V_{AC}.

[0062] In particular, an amplitude value of the induced voltage signal V_{IND} depends on the rectified mains supply voltage V_{AC_RECT}, and further, additionally on a winding ratio of the transformer 13 comprising the additional secondary winding 8 and the primary winding 6.

[0063] During the time in which the switch 10 is in the conducting state, the effects of the actual load 14 at the output of the secondary circuit 12 will be small.

[0064] The voltage signal V_{IND} is input to a rectifier circuit 16. The rectifier circuit 16 applies the voltage signal V_{IND} to a resistor R1, a resistor R2 and a diode D1, which are arranged in series. The common terminal of the resistor R1 and the resistor R2 is connected to an anode of a (second) diode D2 of the rectifier circuit 16. At the cathode terminal of the diode D2, the rectifier circuit 16 provides a rectified voltage $V_{RECT.}$

[0065] The rectifier circuit 16 in particular enables to suppress influence from the load 14 on the rectified voltage V_{RECT}.

[0066] The rectified voltage V_{RECT} forms the input to a peak detector circuit 17. The peak detector circuit 17 applies the rectified voltage V_{RECT} over a capacitor C1. In parallel to the capacitor C1, the peak detector circuit 17 arranges a resistive divider network. The resistive divider network according to fig. 1 includes two resistors, a resistor R3 and a resistor R4, which are connected in series. The peak detector circuit 17 provides at the common terminal of the resistors R3 and R4 an output in form of the DC voltage V_{DC} over the resistor R4.

[0067] The peak detector circuit 17 in particular enables to generate a DC voltage in a suitable voltage range in order to be provided to an analogue-to-digital converter forming part of most current microprocessors.

[0068] The resistive divider network generates the DC voltage V_{DC} in a first voltage range from the rectified voltage signal V_{RECT}, The first voltage range is adapted to the input voltage range of the A/D-converter input terminal 11.1 of the control circuit 11. The first voltage range may range from 0 V to 4 V, for example.

[0069] The peak detector circuit 17 provides the generated DC voltage V_{DC} to the A/D-converter input 11.1 of the control circuit 11. The driver device 1 comprises the control circuit 11 arranged on the secondary side of the isolation barrier 9. The control circuit 11 preferably is a microcontroller circuit.

[0070] The control circuit 11 determines presence or absence of the mains supply voltage V_{AC} and V_{AC_RECT} for a time in which the controlled switch 10 is in a conducting state from the voltage signal V_{DC} provided by peak detector circuit 17. The voltage signal V_{DC} provided by peak detector circuit 17 bases on the voltage signal V_{IND} provided by the secondary winding 8.

[0071] Additionally or alternatively, the control circuit 11 determines a value of the mains supply voltage V_{AC} (and V_{AC_RECT}) for a time in which the controlled switch 10 is conducting from the DC voltage V_{DC} provided by peak detector circuit 17. The DC voltage V_{DC} provided by peak detector circuit 17 bases on the additional voltage signal V_{IND} provided by the secondary winding 8.

[0072] In particular, the control circuit 11 converts the actual value of the DC voltage V_{DC}, which is a value in the first voltage range, into a voltage value for the mains supply voltage V_{AC}, which is a voltage value in a second voltage range.

[0073] The first voltage range is typically smaller than the second voltage range by at least one order of magnitude. For example, the second voltage range reaches from o V to 240 V and the first voltage range reaches from 0 V to 4 V.

[0074] For determining from the actual value of the DC voltage V_{DC} the corresponding actual value of the mains supply voltage V_{AC}, the control circuit 11 may use a lookup-table. Alternatively, the control circuit 11 may be adapted to calculate the actual value of the mains supply voltage V_{AC} from the measured actual value of the DC voltage V_{DC} by using a mathematical formula, which regards the respective electric circuit parameters of the transformer 13, the rectifier circuit 16 and the peak detector circuit 17.

[0075] The control circuit 11 determines or measures the actual value of the mains supply voltage V_{AC_RECT} over the primary winding 6 based on the voltage signal provided by the additional secondary winding 8. The DC voltage V_{DC} depends on predetermined circuit parameters of the electronic circuit layout, in particular the winding ratio of the primary winding 6 and the additional secondary winding 8, and predetermined electronic circuit parameters of the electronic circuitry that processes the voltage signal V_{IND} in order to generate the DC voltage V_{DC}. Thereby, the DC voltage V_{DC} provided to the A/D-converter input 11.1 of the control circuit 11 tracks an actual value of the (rectified) mains supply voltage V_{AC_RECT} over the primary winding 6 while the controlled switch 10 is in the conducting state.

[0076] The control circuit 11 is enabled to convert the supplied DC voltage V_{DC} accordingly to an actual value (actual voltage amplitude value) of the mains supply voltage V_{AC} currently present at a mains supply input 2 of the driver circuit 1.

[0077] A dedicated primary side control circuit not shown in fig. 1 and arranged on the primary side of the isolation barrier 9 typically controls operation of the controlled switch 10 of the primary circuit 5.

[0078] The control circuit 11 may determine and/or calculate further parameters of the AC mains supply to the driver device 1.

[0079] In particular, the control circuit 11 may determine a frequency of the mains supply voltage V_{AC} based on the voltage signal V_{IND}.

[0080] The control circuit 11 may be configured to record the determined value of the mains supply voltage in a memory internal to the control circuit 11 or external to the control circuit 11.

[0081] The memory may be an internal memory of the control circuit 11, for example, a memory storing a log file including one or more values of operating parameter(s) of the driver device 1. The memory may be a storage device externally to the driver device, for example at a central control facility or at a remote server.

[0082] The rectifier circuit 16 and the peak detector circuit 17 correspond to filtering circuitry arranged on the secondary side of the isolation barrier 9 for rectifying and filtering the voltage signal provided by the secondary winding 8 in order to generate the DC voltage signal VDC provided to the control circuit 11.

[0083] The DC voltage V_{DC} represents the filtered and rectified voltage signal V_{IND} provided by the additional secondary winding 8. The DC voltage V_{DC} is scaled independently of the load current I_{LED} provided by the secondary circuit 12 to the load 14.

[0084] Fig. 2 presents a chart for illustrating peaks of mains supply voltage to a driver device 1 the embodiment uses for transfer over the isolation barrier 9. Fig. 2 depicts characteristic curves for a driver device 1 implemented in a flyback topology.

[0085] The upper curve 18 of fig. 2 depicts the actual mains power supply voltage V_{AC_RECT} with a first time resolution of 20 ms per division.

[0086] The lower part of fig. 2 depicts a curve 19 showing the actual mains power supply voltage V_{AC_RECT} with a second time resolution of 50 μs per division. The lower curve 19 represents a zoom view of a portion of the upper curve 18.

[0087] In particular, during a time period in which the switch 10 on the primary side of the isolation barrier 9 is in a conducting state, peaks of the mains power supply voltage V_{AC_RECT} induce a voltage signal in the further secondary winding 8. Thus, the further secondary winding 8 enables to transfer an information on the actual value of the mains power supply voltage V_{AC_RECT} from the primary side of the isolation barrier 9 to the secondary side of the isolation barrier 9.

[0088] Fig. 3 illustrates the interdependency between mains supply voltage and the DC voltage V_{DC} at an input of the control circuit 11 according to an embodiment.

[0089] The voltage V_{DC} is shown on the abscissa (x-axis) of the diagram in a range from 1200 mV to 2000 mV. The depicted range corresponds to a characteristic input voltage range of an A/D-converter input terminal 11.1 of a microcontroller implementing the control circuit 11.

[0090] The corresponding mains supply voltage V_{AC}, here the rectified mains supply voltage V_{AC_RECT}, is shown on the ordinate (y-axis) of fig. 3 ranging from 0 to 300 V.

[0091] Fig. 3 shows an almost linear dependency of the mains supply voltage V_{AC} and the DC voltage V_{DC} in a characteristic supply voltage amplitude range from 180 V to 270 V. Fig. 3 further shows that the linear dependency is independent from an actual load at the output of the driver device 1. This is achieved by the electric circuit parameters and layout of the rectifier circuit 16 and the peak detection circuit 17 with the resistive divider network.

[0092] Fig. 4 demonstrates that the circuit topology of the rectifier circuit 16 and the peak detection circuit 17 enables to minimize a shift in the conversion from the actual measured DC voltage $V_{DC.2}$ to the mains supply voltage $V_{AC,RECT}$ due to different loads 14 at the output of the driver device 1. The driver device 1 is therefore capable to provide an actual value for the mains supply voltage V_{AC_RECT}, which is independent from a current load at the output of the driver device 1.

[0093] Fig. 4 shows a block diagram of a driver device 1' according to an embodiment including a communication interface 22.

[0094] The driver device 1' corresponds in most aspects to the driver device 1 discussed with reference to fig. 1. The driver device 1' comprises a communication interface 22.

[0095] The communication interface 22 is connected via signal lines 21 to a transfer circuit 20. The transfer circuit 21 further is connected via signal lines 24 to the control circuit 11. The signal lines 21, 24 in combination with the transfer circuit 20 enable a bidirectional communication between the communication interface 22 arranged on the primary side of the isolation barrier 9 and the control circuit 11 on the secondary side of the isolation barrier 9.

[0096] The transfer circuit 20 may use optocouplers(s) for transferring signals over the isolation barrier 9 without compromising the galvanic isolation between the primary side of the isolation barrier 9 and the secondary side of the isolation barrier 9.

[0097] The control circuit 11 generates a signal including mains supply voltage information and transmits the signal to the communication interface 22 via the transfer circuit 20.

[0098] The communication interface 22 depicted in fig.4 is a DALI^{RTM} interface and is connected to an external bus via bus terminals 23.

[0099] The external bus may be a wireless or a wired bus. The driver device 1' can communicate with other devices via the external bus. In particular, the driver device 1' may generate communication signals for transmission to the other devices including data such as the mains supply voltage information received from the control circuit 11 via the transfer circuit 20. Data such as the mains supply voltage information received from the control circuit 11 via the transfer circuit 20 may be used to determine power consumption of the driver device 1' and thereby to provide a key parameter for a building automation and monitoring system, e.g., in order to perform power metering and collect power metering data from the individual devices as, e.g., driver device 1' connected to the communication interface 22.

[0100] Fig. 5 illustrates method steps performed by the control circuit 11 for operating an isolated, primary side switched driver device 1, 1' according to an embodiment.

[0101] In step S1, the control circuit 11 obtains an actual voltage value V_{DC} at the A/D-converter input terminal 11.1.

[0102] In step S2, control circuit 11 determines a mains supply voltage information based on the obtained DC voltage value V_{DC}. In particular, the control circuit 11 converts the obtained DC voltage value V_{DC} into a value of the actual mains supply voltage V_{AC} corresponding to the obtained actual voltage value of the DC voltage V_{DC}. The control circuit 11 may determine from the obtained actual voltage value of the DC voltage V_{DC} whether a mains supply voltage V_{AC} is currently present at the mains supply input 2 of the driver device 1, 1'.

[0103] The control circuit 11 may record the determined actual value of the mains supply voltage V_{AC} in the memory.

[0104] The control circuit 11 then proceeds with step S3 and generates a signal including data comprising mains supply voltage information. The data comprising mains supply voltage information may include data indicating whether the mains supply voltage V_{AC} is present or is not present at the mains supply input 2 of the driver device 1, 1'. The data comprising mains supply voltage information may further include data indicating whether the main supply voltage V_{AC} has an actual value within a specific voltage range. The mains supply voltage information may further include time series data including values of the mains supply voltage V_{AC} over time. The control circuit 11 then proceeds with step S4 and transmits the generated signal including data comprising mains supply voltage information via the transfer circuit 20 to the communication interface 22.

Claims

1. Driver device comprising a switched mode power supply in a flyback topology, the driver device comprising

   a primary circuit (5) including a controlled switch (10) and supplied by a mains supply voltage (VAC),
   a secondary circuit (12) configured to provide a load current (I_{LED}),
   an isolation stage including a transformer (13) with a primary winding (6) and a secondary winding (7), the isolation stage configured to isolate the primary circuit (5) on a primary side and the secondary circuit (12) on a secondary side by an isolation barrier (9), and
   a control circuit (11) arranged on the secondary side, and whereby
   the transformer (13) comprises an additional secondary winding (8) arranged in phase with the primary winding (6) on the secondary side, and
   characterized in that the control circuit (11) is configured to determine presence and/or a value of the mains supply voltage (V_{AC}) for a time in which the controlled switch (10) is conducting based on a voltage signal (V_{IND}) provided by the additional secondary winding (8) for generating mains supply voltage data, and
   the driver device comprises a transfer circuit (20) configured to transfer the mains supply voltage data determined by the control circuit (11) over the isolation barrier (9) to a communication interface (22) arranged on the primary side.

2. The driver device according to claim 1,
   characterized in that
   the driver device comprises a rectifier circuit (16) arranged on the secondary side of the isolation barrier (9) and configured to rectify the voltage signal (V_{IND}) provided by the additional secondary winding (8).

3. The driver device according to claim 2,
   characterized in that
   the rectifier circuit (16) includes a first diode (D1) and a second diode (D2).

4. The driver device according to claim 3,
   characterized in that
   the rectifier circuit (16) comprises a first resistor (R1) and a second resistor (R2), the first resistor (R1) and the second resistor (R2) connected in series with the first diode (D1).

5. The driver device according to one of claims 2 to 4,
   characterized in that
   the driver device comprises a peak detector circuit (17) arranged on the secondary side of the isolation barrier (9) for generating a DC voltage (V_{DC}) from the rectified voltage signal (V_{RECT}) provided by the rectifier circuit (16).

6. The driver device according to claim 5,
   characterized in that
   the peak detector circuit (17) includes a capacitor (C1) and a resistive divider network (R1, R2) arranged in parallel with the capacitor (C1).

7. The driver device according to claim 6,
   characterized in that n
   the resistive divider network (R1, R2) is configured to generate a DC voltage (V_{DC}) in a first voltage range from the rectified voltage signal (V_{RECT}) for the AC mains supply voltage (V_{AC}) in a second voltage range.

8. The driver device according to claim 7,
   characterized in that
   the first voltage range is smaller than the second voltage range by at least one order of magnitude, in particular the second voltage range is from 0 to 240 V and the first voltage range is from 0 to 4 V.

9. The driver device according to one of claims 5 to 8,
   characterized in that
   the control circuit (11) comprises an analogue-to-digital converter circuit configured to determine the DC voltage (V_{DC}).

10. The driver device according to one of claims 5 to 9,
    characterized in that

    the control circuit (11) is configured to determine presence and/or a value of the mains supply voltage (V_{AC}) for generating the mains supply voltage data by determining presence or absence of the mains supply voltage (V_{AC}) based on the DC voltage (V_{DC}), and/or
    calculating the value of the mains supply voltage (V_{AC}) based on the DC voltage (V_{DC}).

11. The driver device according to one of claims 5 to 10,
    characterized in that
    the control circuit (11) is configured to convert the DC voltage (V_{DC}) to the value of the mains supply voltage (V_{AC}) based on a predetermined winding ratio of the primary winding (6) and the additional secondary winding (8).

12. The driver device according to one of claims 5 to 11,
    characterized in that
    the control circuit (11) is configured to convert the DC voltage (V_{DC}) to the value of the mains supply voltage (V_{AC}) based on circuit parameter values of the rectifier circuit (16) and the peak detector circuit

(17).

13. The driver device according to one of the preceding claims,
characterized in that
the control circuit (11) is configured to determine a frequency of the mains supply voltage (V_{AC}) based on the DC voltage (V_{DC}).

14. The driver device according to one of the preceding claims,
characterized in that
the control circuit (11) is configured to record the determined value of the mains supply voltage (V_{AC}) in a memory.

15. The driver device according to one of the preceding claims,
characterized in that
the communication interface (20) is configured to perform communication based on a wireless and/or wire-bound communication standard, in particular based on a DALI-standard.

16. The driver device according to claim 15,
characterized in that
the driver device is designed to provide the mains supply voltage data determined by the control circuit (11) to the communication interface (22) as a key parameter for a building automation and monitoring system, preferably to perform power metering and collect power metering data from the individual devices as the driver device (1') connected to the communication interface (22).

17. Method for operating a driver device comprising a switched mode power supply in a flyback topology, wherein the driver device comprises

a primary circuit (5) including a controlled switch (10), wherein the primary circuit (5) is supplied by a mains supply voltage (VAC),
a secondary circuit (12) providing a load current (I_{LED}), and
an isolation stage including a transformer (13) with a primary winding (6) and a secondary winding (7), the isolation stage configured to isolate the primary circuit (5) on a primary side and the secondary circuit (12) on a secondary side by an isolation barrier (9), and
a control circuit (11) arranged on the secondary side, and the method is
characterized in
providing a voltage signal (V_{IND}) by an additional secondary winding (8) of the transformer (13) arranged in phase with the primary winding (9) on the secondary side, and
determining, by the control circuit (11), presence and/or a value of the mains supply voltage (V_{AC}) for a time in which the controlled switch (10) is conducting based on the voltage signal (V_{IND}) to generate mains supply voltage data, and
transferring, by a transfer circuit (20), the mains supply voltage data determined by the control circuit (11) over the isolation barrier (9) to a communication interface (22) arranged on the primary side.

Patentansprüche

1. Treibervorrichtung, umfassend ein Schaltnetzteil in einer Sperrwandlertopologie, die Treibervorrichtung umfassend:

eine Primärschaltung (5) einschließlich eines gesteuerten Schalters (10) und die durch eine Netzversorgungsspannung (V_{AC}) versorgt wird,
eine Sekundärschaltung (12), die konfiguriert ist, um einen Laststrom (I_{LED}) bereitzustellen,
eine Isolationsstufe einschließlich eines Transformators (13) mit einer Primärwicklung (6) und einer Sekundärwicklung (7), wobei die Isolationsstufe konfiguriert ist, um die Primärschaltung (5) auf einer Primärseite und die Sekundärschaltung (12) auf einer Sekundärseite durch eine Isolationsbarriere (9) zu isolieren, und
eine Steuerschaltung (11), die auf der Sekundärseite angeordnet ist, und wobei
der Transformator (13) eine zusätzliche Sekundärwicklung (8) umfasst, die mit der Primärwicklung (6) auf der Sekundärseite in Phase angeordnet ist, und
dadurch gekennzeichnet, dass die Steuerschaltung (11) konfiguriert ist, um ein Vorhandensein und/oder einen Wert der Netzversorgungsspannung (V_{AC}) für eine Zeit zu bestimmen, in der der gesteuerte Schalter (10) leitend ist, basierend auf einem Spannungssignal (V_{IND}), das durch die zusätzliche Sekundärwicklung (8) zum Erzeugen von Netzversorgungsspannungsdaten bereitgestellt wird, und die Treibervorrichtung eine Übertragungsschaltung (20) umfasst, die konfiguriert ist, um die Netzversorgungsspannungsdaten, die durch die Steuerschaltung (11) bestimmt werden, über die Isolationsbarriere (9) an eine Kommunikationsschnittstelle (22) zu übertragen, die auf der Primärseite angeordnet ist.

2. Treibervorrichtung nach Anspruch 1,
dadurch gekennzeichnet, dass
die Treibervorrichtung eine Gleichrichterschaltung (16) umfasst, die auf der Sekundärseite der Isolationsbarriere (9) angeordnet und konfiguriert ist, um das Spannungssignal (V_{IND}) gleichzurichten, das

durch die zusätzliche Sekundärwicklung (8) bereitgestellt wird.

3. Treibervorrichtung nach Anspruch 2,
dadurch gekennzeichnet, dass
die Gleichrichterschaltung (16) eine erste Diode (D_1) und eine zweite Diode (D_2) einschließt.

4. Treibervorrichtung nach Anspruch 3,
dadurch gekennzeichnet, dass
die Gleichrichterschaltung (16) einen ersten Widerstand (R_1) und einen zweiten Widerstand (R_2) umfasst, wobei der erste Widerstand (R_1) und der zweite Widerstand (R_2) mit der ersten Diode (D_1) in Reihe geschaltet sind.

5. Treibervorrichtung nach einem der Ansprüche 2 bis 4,
dadurch gekennzeichnet, dass
die Treibervorrichtung eine Spitzendetektorschaltung (17), die auf der Sekundärseite der Isolationsbarriere (9) angeordnet ist, zum Erzeugen einer Gleichspannung (V_{DC}) aus dem gleichgerichteten Spannungssignal (V_{RECT}) umfasst, das durch die Gleichrichterschaltung (16) bereitgestellt wird.

6. Treibervorrichtung nach Anspruch 5,
dadurch gekennzeichnet, dass
die Spitzendetektorschaltung (17) einen Kondensator (C_1) und ein Widerstandsteilernetz (R1, R_2) einschließt, das parallel zu dem Kondensator (C_1) angeordnet ist.

7. Treibervorrichtung nach Anspruch 6,
dadurch gekennzeichnet, dass:
das Widerstandsteilernetz (R1, R_2) konfiguriert ist, um eine Gleichspannung (V_{DC}) in einem ersten Spannungsbereich aus dem gleichgerichteten Spannungssignal (V_{RECT}) für die Wechselstromnetzversorgungsspannung (V_{AC}) in einem zweiten Spannungsbereich zu erzeugen.

8. Treibervorrichtung nach Anspruch 7,
dadurch gekennzeichnet, dass
der erste Spannungsbereich um mindestens eine Größenordnung kleiner als der zweite Spannungsbereich ist, insbesondere der zweite Spannungsbereich von 0 bis 240 V und der erste Spannungsbereich von 0 bis 4 V ist.

9. Treibervorrichtung nach einem der Ansprüche 5 bis 8,
dadurch gekennzeichnet, dass
die Steuerschaltung (11) eine Analog-Digital-Wandlerschaltung umfasst, die konfiguriert ist, um die Gleichspannung (V_{DC}) zu bestimmen.

10. Treibervorrichtung nach einem der Ansprüche 5 bis 9,
dadurch gekennzeichnet, dass

die Steuerschaltung (11) konfiguriert ist, um das Vorhandensein und/oder einen Wert der Netzversorgungsspannung (V_{AC}) zum Erzeugen der Netzversorgungsspannungsdaten durch Bestimmen des Vorhandenseins oder eines Nichtvorhandenseins der Netzversorgungsspannung (V_{AC}) basierend auf der Gleichspannung (V_{DC}) zu bestimmen, und/oder
Berechnen des Wertes der Netzversorgungsspannung (V_{AC}) basierend auf der Gleichspannung (V_{DC}).

11. Treibervorrichtung nach einem der Ansprüche 5 bis 10,
dadurch gekennzeichnet, dass
die Steuerschaltung (11) konfiguriert ist, um die Gleichspannung (V_{DC}) basierend auf einem vorbestimmten Wicklungsverhältnis der Primärwicklung (6) und der zusätzlichen Sekundärwicklung (8) in den Wert der Netzversorgungsspannung (V_{AC}) umzuwandeln.

12. Treibervorrichtung nach einem der Ansprüche 5 bis 11,
dadurch gekennzeichnet, dass
die Steuerschaltung (11) konfiguriert ist, um die Gleichspannung (V_{DC}) basierend auf Schaltungsparameterwerten der Gleichrichterschaltung (16) und der Spitzendetektorschaltung (17) in den Wert der Netzversorgungsspannung (V_{AC}) umzuwandeln.

13. Treibervorrichtung nach einem der vorstehenden Ansprüche,
dadurch gekennzeichnet, dass
die Steuerschaltung (11) konfiguriert ist, um eine Frequenz der Netzversorgungsspannung (V_{AC}) basierend auf der Gleichspannung (V_{DC}) zu bestimmen.

14. Treibervorrichtung nach einem der vorstehenden Ansprüche,
dadurch gekennzeichnet, dass
die Steuerschaltung (11) konfiguriert ist, um den bestimmten Wert der Netzversorgungsspannung (V_{AC}) in einem Speicher aufzuzeichnen.

15. Treibervorrichtung nach einem der vorstehenden Ansprüche,
dadurch gekennzeichnet, dass
die Kommunikationsschnittstelle (20) konfiguriert ist, um eine Kommunikation basierend auf einem drahtlosen und/oder drahtgebundenen Kommunikationsstandard, insbesondere basierend auf einem DALI-Standard, durchzuführen.

16. Treibervorrichtung nach Anspruch 15,
dadurch gekennzeichnet, dass
die Treibervorrichtung gestaltet ist, um die Netzversorgungsspannungsdaten, die durch die Steuerschaltung (11) bestimmt werden, als einen Schlüsselparameter für ein Gebäudeautomatisierungs- und Überwachungssystem der Kommunikationsschnittstelle (22) bereitzustellen, vorzugsweise um eine Leistungsmessung durchzuführen und Leistungsmessdaten von den einzelnen Vorrichtungen zu sammeln, wenn die Treibervorrichtung (1') mit der Kommunikationsschnittstelle (22) verbunden ist.

17. Verfahren zum Betreiben einer Treibervorrichtung, umfassend ein Schaltnetzteil in einer Sperrwandlertopologie, wobei die Treibervorrichtung umfasst:

eine Primärschaltung (5) einschließlich eines gesteuerten Schalters (10), wobei die Primärschaltung (5) durch eine Netzversorgungsspannung (V_{AC}) versorgt wird,
eine Sekundärschaltung (12), die einen Laststrom (I_{LED}) bereitstellt, und
eine Isolationsstufe einschließlich eines Transformators (13) mit einer Primärwicklung (6) und einer Sekundärwicklung (7), wobei die Isolationsstufe konfiguriert ist, um die Primärschaltung (5) auf einer Primärseite und die Sekundärschaltung (12) auf einer Sekundärseite durch eine Isolationsbarriere (9) zu isolieren, und
eine Steuerschaltung (11), die auf der Sekundärseite angeordnet ist, und das Verfahren **dadurch gekennzeichnet ist durch**
Bereitstellen eines Spannungssignals (V_{IND}) durch eine zusätzliche Sekundärwicklung (8) des Transformators (13), die in Phase mit der Primärwicklung (9) auf der Sekundärseite angeordnet ist, und
Bestimmen, durch die Steuerschaltung (11), des Vorhandenseins und/oder eines Werts der Netzversorgungsspannung (V_{AC}) für eine Zeit, in der der gesteuerte Schalter (10) leitend ist, basierend auf dem Spannungssignal (V_{IND}), um Netzversorgungsspannungsdaten zu erzeugen, und Übertragen, durch eine Übertragungsschaltung (20), der Netzversorgungsspannungsdaten, die durch die Steuerschaltung (11) bestimmt werden, über die Isolationsbarriere (9) an eine Kommunikationsschnittstelle (22), die auf der Primärseite angeordnet ist.

Revendications

1. Dispositif de pilotage comprenant une alimentation à découpage dans une topologie flyback, le dispositif de pilotage comprenant

un circuit primaire (5) comportant un interrupteur commandé (10) et alimenté par une tension d'alimentation secteur (VAC),
un circuit secondaire (12) configuré pour fournir un courant de charge (I_{LED}),
un étage d'isolation comportant un transformateur (13) avec un enroulement primaire (6) et un enroulement secondaire (7), l'étage d'isolation configuré pour isoler le circuit primaire (5) sur un côté primaire et le circuit secondaire (12) sur un côté secondaire par une barrière d'isolation (9), et
un circuit de commande (11) agencé sur le côté secondaire, et dans lequel
le transformateur (13) comprend un enroulement secondaire supplémentaire (8) agencé en phase avec l'enroulement primaire (6) sur le côté secondaire, et
caractérisé en ce que le circuit de commande (11) est configuré pour déterminer la présence et/ou une valeur de la tension d'alimentation secteur (V_{AC}) pour un temps pendant lequel l'interrupteur commandé (10) est conducteur sur la base d'un signal de tension (V_{IND}) fourni par l'enroulement secondaire supplémentaire (8) pour générer des données de tension d'alimentation secteur, et le dispositif de pilotage comprend un circuit de transfert (20) configuré pour transférer les données de tension d'alimentation secteur déterminées par le circuit de commande (11) au-dessus de la barrière d'isolation (9) vers une interface de communication (22) agencée sur le côté primaire.

2. Dispositif de pilotage selon la revendication 1,
caractérisé en ce que
le dispositif de pilotage comprend un circuit redresseur (16) agencé sur le côté secondaire de la barrière d'isolation (9) et configuré pour redresser le signal de tension (V_{IND}) fourni par l'enroulement secondaire supplémentaire (8).

3. Dispositif de pilotage selon la revendication 2,
caractérisé en ce que
le circuit redresseur (16) comporte une première diode (D_1) et une seconde diode (D_2).

4. Dispositif de pilotage selon la revendication 3,
caractérisé en ce que
le circuit redresseur (16) comprend une première résistance (R_1) et une seconde résistance (R_2), la première résistance (R_1) et la seconde résistance (R_2) sont connectées en série avec la première diode (D_1).

5. Dispositif de pilotage selon l'une des revendications 2 à 4,
caractérisé en ce que

le dispositif de pilotage comprend un circuit détecteur de crête (17) agencé sur le côté secondaire de la barrière d'isolation (9) pour générer une tension continue (V_{DC}) à partir du signal de tension redressé (V_{RECT}) fourni par le circuit redresseur (16).

6. Dispositif de pilotage selon la revendication 5, **caractérisé en ce que** le circuit détecteur de crête (17) comporte un condensateur (C_1) et un réseau diviseur résistif (R1, R_2) agencé en parallèle avec le condensateur (C_1).

7. Dispositif de pilotage selon la revendication 6, **caractérisé en ce que** n le réseau diviseur résistif (R1, R_2) est configuré pour générer une tension continue (V_{DC}) dans une première plage de tension à partir du signal de tension redressé (V_{RECT}) pour la tension d'alimentation secteur (V_{AC}) dans une seconde plage de tension.

8. Dispositif de pilotage selon la revendication 7, **caractérisé en ce que** la première plage de tension est inférieure à la seconde plage de tension d'au moins un ordre de grandeur, en particulier la seconde plage de tension est comprise entre 0 et 240 V et la première plage de tension est comprise entre 0 et 4 V.

9. Dispositif de pilotage selon l'une des revendications 5 à 8, **caractérisé en ce que** le circuit de commande (11) comprend un circuit convertisseur analogique-numérique configuré pour déterminer la tension CONTINUE (V_{DC}).

10. Dispositif de pilotage selon l'une des revendications 5 à 9, **caractérisé en ce que**

le circuit de commande (11) est configuré pour déterminer la présence et/ou une valeur de la tension d'alimentation secteur (V_{AC}) pour générer les données de tension d'alimentation secteur en déterminant la présence ou l'absence de la tension d'alimentation secteur (V_{AC}) sur la base de la tension continue (VDC), et/ou
du calcul de la valeur de la tension d'alimentation secteur (V_{AC}) sur la base de la tension continue (V_{DC}).

11. Dispositif de pilotage selon l'une des revendications 5 à 10, **caractérisé en ce que** le circuit de commande (11) est configuré pour convertir la tension continue (V_{DC}) à la valeur de la tension d'alimentation secteur (V_{AC}) sur la base d'un rapport d'enroulement prédéterminé de l'enroulement primaire (6) et de l'enroulement secondaire supplémentaire (8).

12. Dispositif de pilotage selon l'une des revendications 5 à 11, **caractérisé en ce que** le circuit de commande (11) est configuré pour convertir la tension continue (V_{DC}) à la valeur de la tension d'alimentation secteur (V_{AC}) sur la base des valeurs des paramètres de circuit du circuit redresseur (16) et du circuit détecteur de crête (17).

13. Dispositif de pilotage selon l'une des revendications précédentes, **caractérisé en ce que** le circuit de commande (11) est configuré pour déterminer une fréquence de la tension d'alimentation secteur (V_{AC}) sur la base de la tension continue (V_{DC}).

14. Dispositif de pilotage selon l'une des revendications précédentes, **caractérisé en ce que** le circuit de commande (11) est configuré pour enregistrer la valeur déterminée de la tension d'alimentation secteur (V_{AC}) dans une mémoire.

15. Dispositif de pilotage selon l'une des revendications précédentes, **caractérisé en ce que** l'interface de communication (20) est configurée pour assurer une communication basée sur une norme de communication sans fil et/ou filaire, en particulier sur la base d'une norme DALI.

16. Dispositif de pilotage selon la revendication 15, **caractérisé en ce que** le dispositif de pilotage est conçu pour fournir à l'interface de communication (22) les données relatives à la tension d'alimentation secteur déterminées par le circuit de commande (11) en tant que paramètre clé d'un système d'automatisation et de surveillance d'un bâtiment, de préférence pour effectuer la mesure de la puissance et recueillir les données de mesure de la puissance à partir des dispositifs individuels en tant que dispositif de pilotage (1') connecté à l'interface de communication (22).

17. Procédé permettant de faire fonctionner un dispositif de pilotage comprenant une alimentation à découpage dans une topologie flyback, dans lequel le dispositif de pilotage comprend

un circuit primaire (5) comportant un interrupteur commandé (10), dans lequel le circuit primaire (5) est alimenté par une tension d'alimentation secteur (VAC),
un circuit secondaire (12) fournissant un courant de charge (I_{LED}), et

un étage d'isolation comportant un transformateur (13) avec un enroulement primaire (6) et un enroulement secondaire (7), l'étage d'isolation configuré pour isoler le circuit primaire (5) sur un côté primaire et le circuit secondaire (12) sur un côté secondaire par une barrière d'isolation (9), et

un circuit de commande (11) agencé sur le côté secondaire, et le procédé est **caractérisé en** la fourniture d'un signal de tension (V_{IND}) par un enroulement secondaire supplémentaire (8) du transformateur (13) agencé en phase avec l'enroulement primaire (9) du côté secondaire, et

la détermination, par le circuit de commande (11), de la présence et/ou d'une valeur de la tension d'alimentation secteur (V_{AC}) pendant un temps où l'interrupteur commandé (10) est conducteur sur la base du signal de tension (V_{IND}) pour générer des données de tension d'alimentation secteur, et transférer, par un circuit de transfert (20), les données de tension d'alimentation secteur déterminées par le circuit de commande (11) sur la barrière d'isolation (9) vers une interface de communication (22) agencée sur le côté primaire.

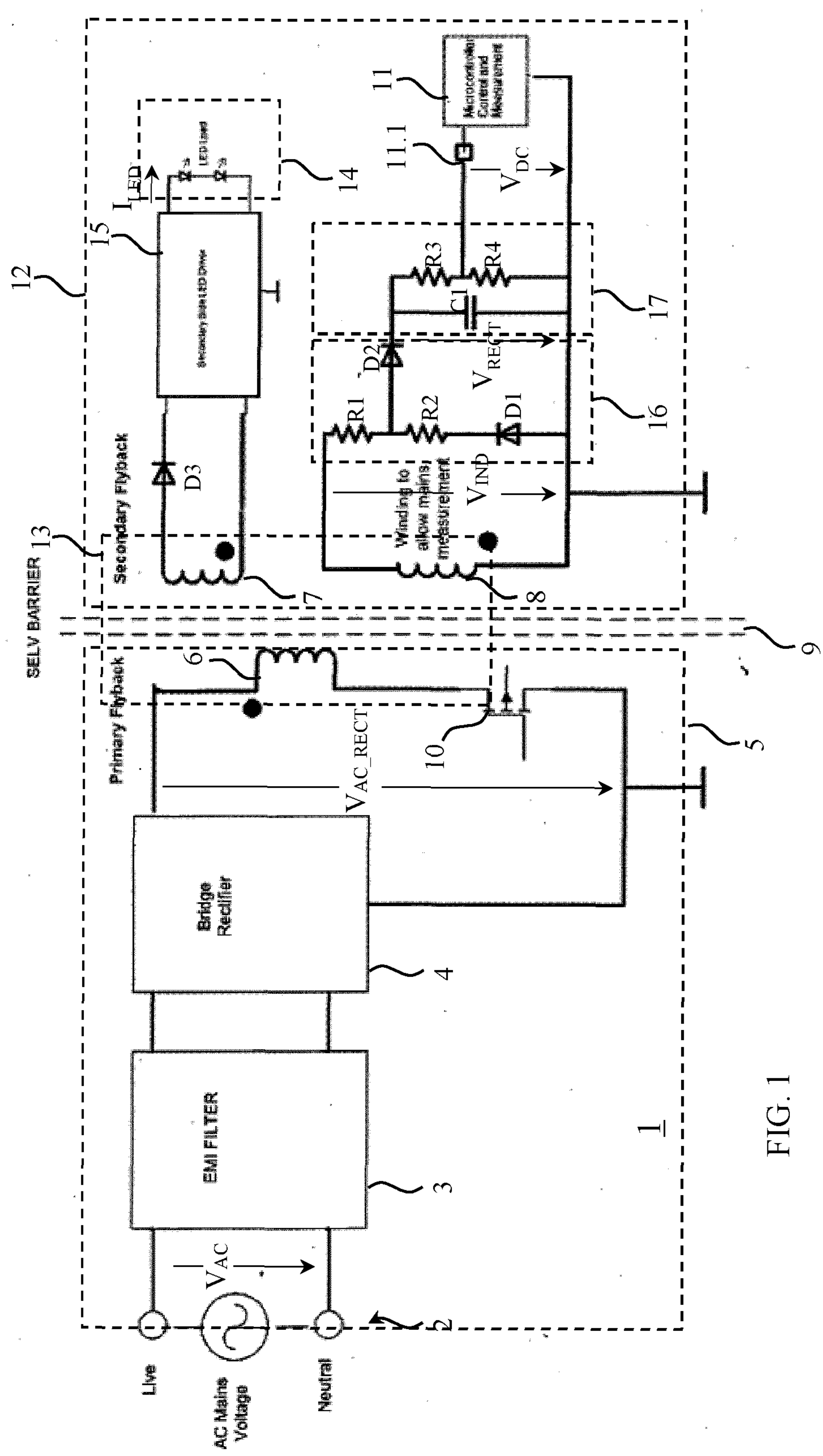

12
13
SELV BARRIER
Secondary Flyback
Primary Flyback
15
14
I_{LED}
D3
7
8
6
9
10
5
11
11.1
Microcontroller Control and Measurement
V_{DC}
R3
R4
C1
17
R1
D2
R2
D1
16
V_{RECT}
Winding to allow mains measurement
V_{IND}
V_{AC_RECT}
Bridge Rectifier
4
EMI FILTER
3
V_{AC}
2
1
Live
AC Mains Voltage
Neutral

FIG. 1

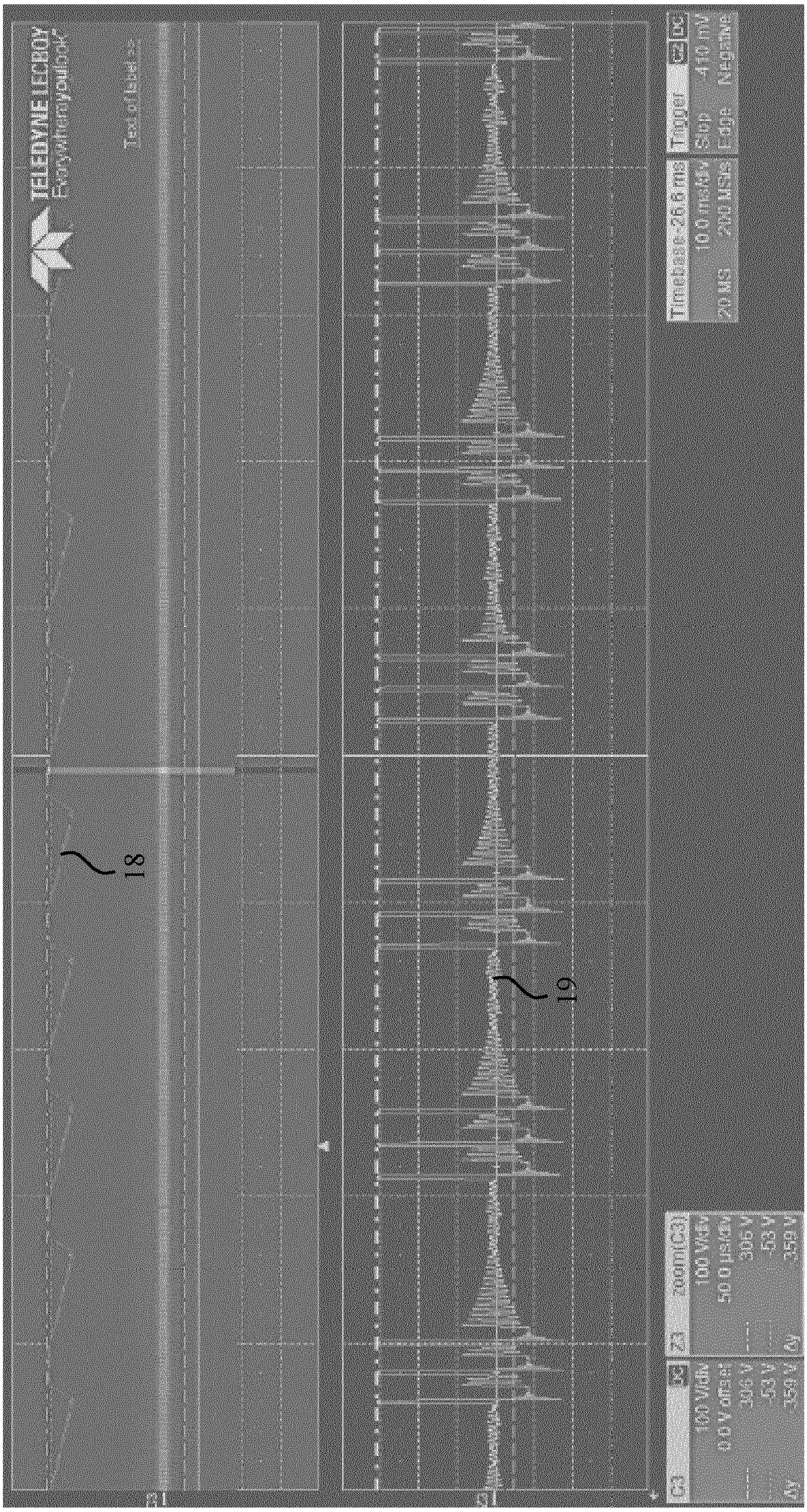


FIG. 2

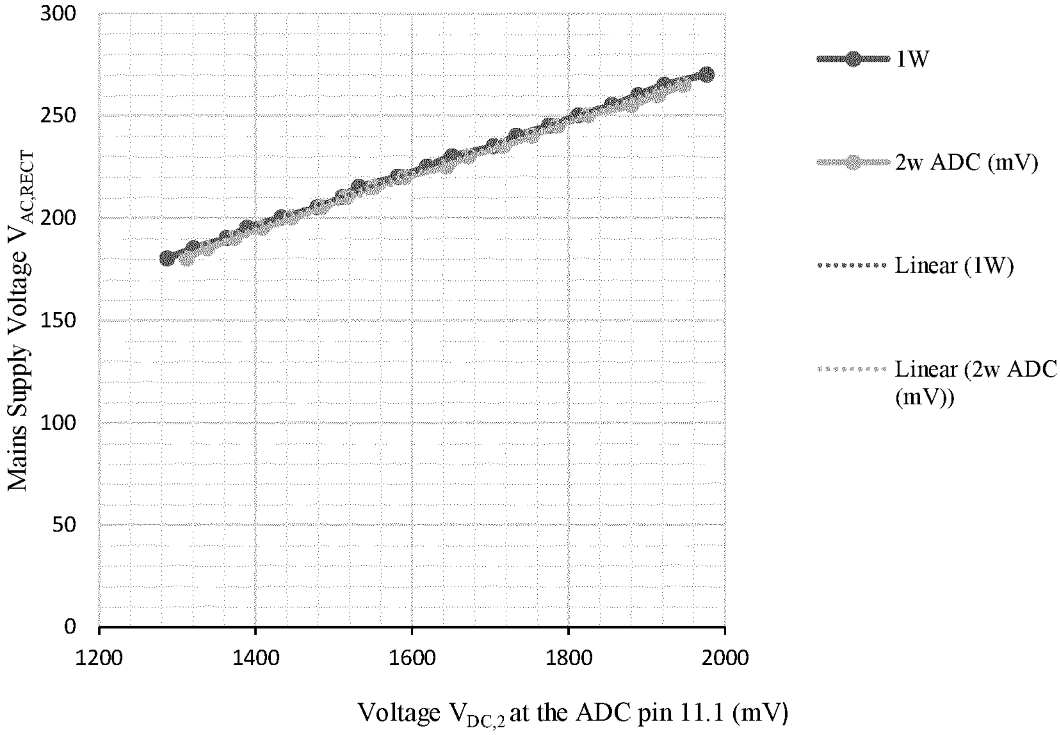
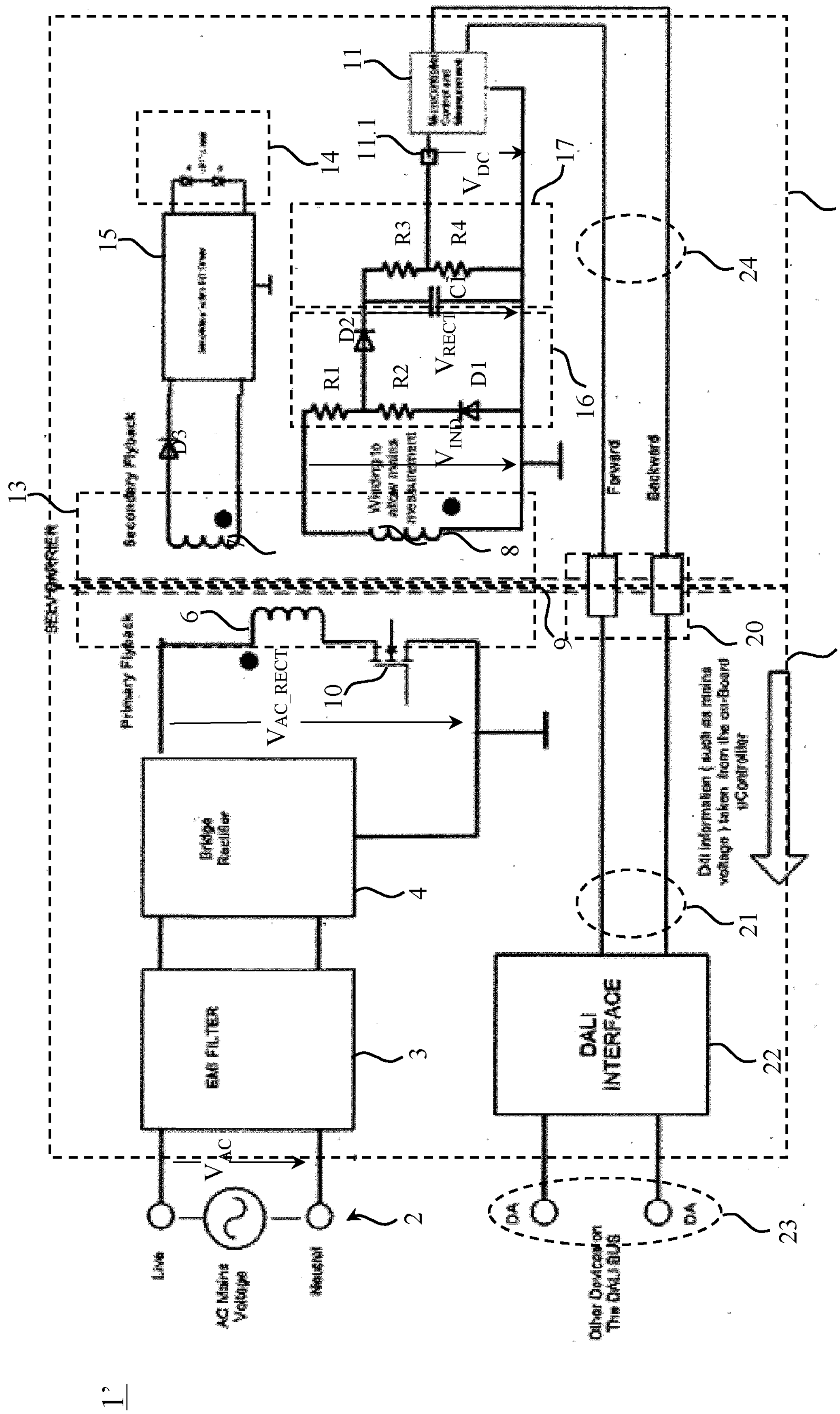

300
250
200
150
100
50
0
1200
1400
1600
1800
2000
Mains Supply Voltage $V_{AC,RECT}$
Voltage $V_{DC,2}$ at the ADC pin 11.1 (mV)
1W
2w ADC (mV)
Linear (1W)
Linear (2w ADC (mV))

FIG. 3


Live
AC Mains Voltage
Neutral
V_{AC}
2
EMI FILTER
3
Bridge Rectifier
4
V_{AC_RECT}
Primary Flyback
6
10
SELV BARRIER
9
Secondary Flyback
13
D3
15
14
Winding to allow mains measurement
8
V_{IND}
R1
R2
D1
D2
V_{RECT}
C1
R3
R4
16
17
V_{DC}
11.1
11
Forward
Backward
20
24
12
21
5
DALI INTERFACE
22
DA
DA
Other Devices on The DALI BUS
23

1'

FIG. 4

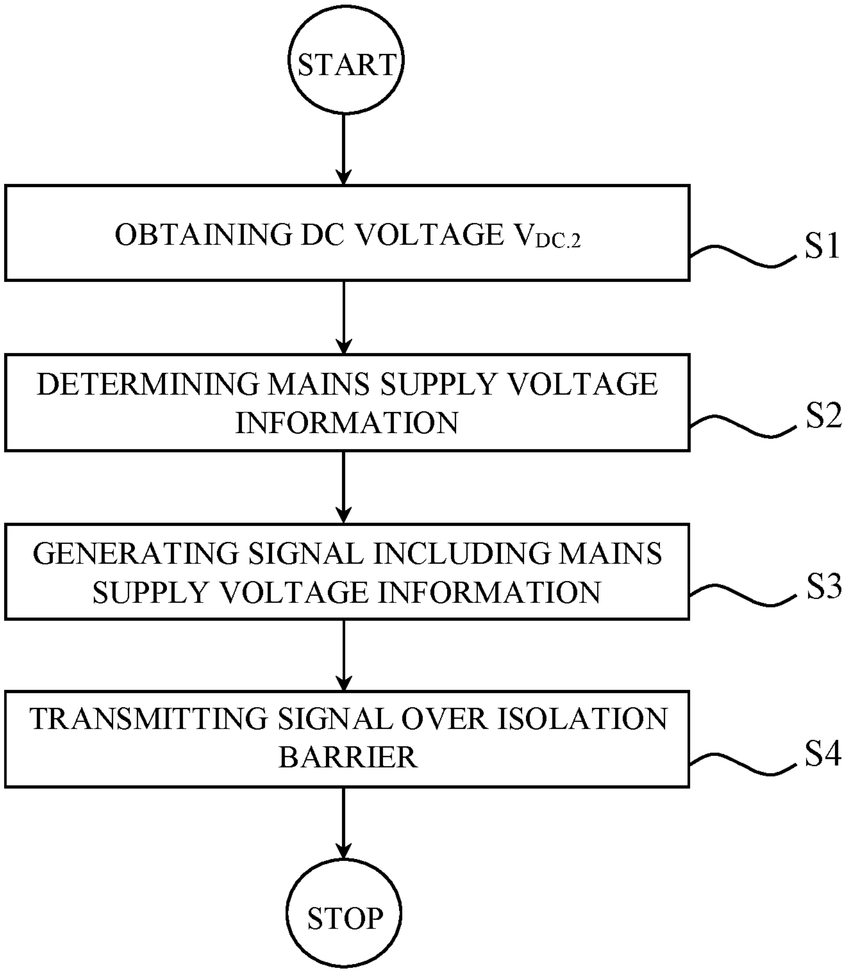

START
OBTAINING DC VOLTAGE $V_{DC.2}$
S1
DETERMINING MAINS SUPPLY VOLTAGE INFORMATION
S2
GENERATING SIGNAL INCLUDING MAINS SUPPLY VOLTAGE INFORMATION
S3
TRANSMITTING SIGNAL OVER ISOLATION BARRIER
S4
STOP

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- US 2021006168 A1 **[0008]**
- DE 202019104171 U1 **[0009]**