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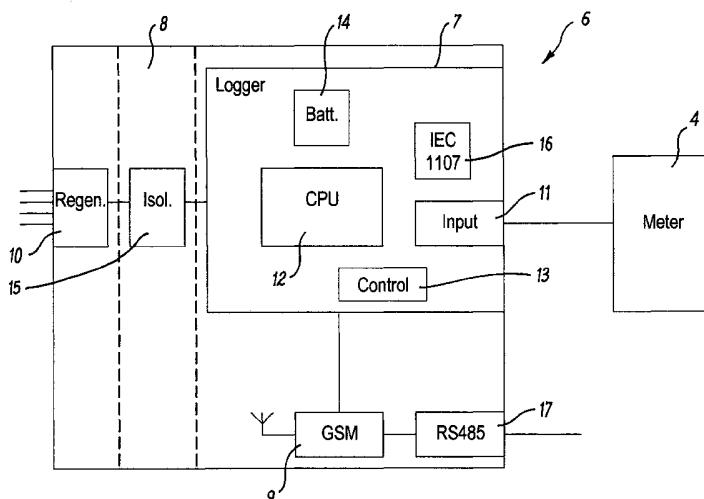
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(54) Title: AUTOMATED METER READER



(57) Abstract: An automated meter reader and method are provided suitable for monitoring and recording the data output of 4 a utility meter, such as a gas, water or electricity meter. The meter reader comprises a data logger, an isolation barrier, a regeneration unit a communication controller. The isolation barrier can be an optical isolator, providing electrical isolation greater than 10kV (rms). The invention removes the requirement for a separate isolation component, such as a chatterbox, to be placed between the data logger and the utility meter and provides a reader that is efficient and cost effective to install and maintain.

1 **Automated Meter Reader**

2

3 The present invention relates to the field of utility
4 meters employed to monitor the volume of electricity, gas
5 or water consumed by a user. In particular the present
6 invention relates to an automated meter reader for use in
7 conjunction with such a utility meter.

8

9 Utilities provide both industrial and domestic users with
10 commercial electricity, gas and water. From a business
11 stance it is clearly very important that the volume of
12 the supplied commodity is correctly measured so as to
13 provide a means for accurately billing the user or for
14 carry out load analysis. In the UK alone it is estimated
15 that there are approximately $3/4$ million water meters, 18
16 million gas meters and 22 million electricity meters.
17 Therefore, it can be appreciated that the monitoring of
18 these meters involves a large scale, labour intensive
19 process especially if each of the meters requires manual
20 retrieval of the output data.

21

22 Attempts have been made to automate the reading of the
23 large-scale utility consumers (referred to as Automated

1 Meter Reading or AMR). Two different methods of
2 automation are known in the art. The first method
3 involves the employment of so-called "intelligent meters"
4 1 i.e. a meter with data-logging functionality that is
5 coupled to a controlled off of the shelf modem 2, see
6 Figure 1. The major drawback of such systems would be
7 the major expense involved in replacing all the existing
8 utility meters as well as the fact that such meters are
9 not particularly suited for use as gas meters for reasons
10 discussed below.

11

12 Alternatively, purpose built modem/interface units 3 have
13 been designed and thereafter installed with existing
14 utility meters 4, see Figure 2. The modem/interface unit
15 3, commonly referred to as a data logger, is in fact the
16 preferred option, as they tend to be more cost effective
17 than intelligent meters. A data logger 3 effectively
18 acts as a data capture and storage unit that employs a
19 separately powered modem to transfer data to a remote
20 processing site on a daily, weekly or monthly basis.

21

22 The data for capture, referred to above, results from the
23 utility meter 4 generating contact closures commensurate
24 with the volume of flow. Thus, as the utility meter 4
25 operates or passes the product to the end user it causes
26 mechanics within the utility meter 4 to update the
27 reading dials while simultaneously opening and closing
28 internal switches that are normally accessed from the
29 bottom of the utility meter 4. It is these switch
30 closures, referred to as pulses, which are actually
31 monitored and counted by the data logger 3.

32

1 It is known to those skilled in the art that the switch
2 closures suffer from the effects of bouncing. Bouncing
3 acts to add extra data pulses that appear as noise on an
4 electrical output signal from the utility meter 4. This
5 is a problematic feature that increases as the switches
6 deteriorate with time. Therefore, AMR systems are
7 required to incorporate signal processing in order to
8 compensate for the addition of noise through bouncing.

9
10 A significant advantage of data loggers 3 is that they
11 can be calibrated for a particular utility meter 4 by
12 simply programming the pulses to a supplied commodity
13 ratio. i.e. typically 600 pulses per kilowatt/hour for an
14 electricity meter or 100 pulses per cubic meter of gas
15 for a gas meter. Therefore, the same data logger 3 can
16 be employed with different utility meters 4 provided that
17 the conversion ratio is known.

18
19 Within the gas utility market an additional isolation
20 component 5 is required to be installed between the
21 utility meter 4 and any data logger 3. This isolation
22 component 5 is required since if a faulty data logger 3
23 were to be installed with a faulty gas meter 4 then there
24 would be a significant risk of a gas explosion.
25 Consequently, gas suppliers are required to operate under
26 strict guidelines that require any equipment proposed to
27 be connected directly to a gas meter 4, to undergo
28 extensive testing.

29
30 Under these guidelines the isolation component 5 must
31 demonstrate isolation levels greater than 10kV(rms). Any
32 connection to the associated utility meter 4 must not be
33 capable of carrying power greater than a few milliwatts.

1
2 In accordance with such requirements isolation components
3 5 are designed that employ relays to provide the
4 necessary electrical isolation. A voltage free pulse
5 from the gas meter 4 acts to operate a transistor within
6 the isolation component 5 that in turn operates a relay.
7 In practice the data pulse is transferred to the safe
8 side of the isolation component 5 by having the data
9 logger 3 read the data pulse generated by the relay.
10 During periods of high consumption pulses flow through
11 the isolation component 5 fairly rapidly causing a number
12 of relays to quickly open and close. A chattering noise
13 emanating from the isolation component 5 results and as
14 such the devices are commonly referred to in the art as
15 chatterboxes.
16
17 Such chatterbox isolation components 5 suffer from
18 several inherent limitations. In the first instance
19 relay devices require power to operate. Consequently it
20 is necessary to replace the battery power sources within
21 a chatterbox isolation component 5 every six months or
22 so. Typically each device employs six such battery power
23 sources.
24
25 It is also known in the art that relay switches can
26 suffer from mechanical failure causing them to jam. With
27 the systems taught in the prior art such a jam can result
28 in the associated battery being permanently electrically
29 connected such that it quickly drains of power and so
30 requires to be replaced more frequently than expected.
31
32 As with the utility meter 4, chatterbox isolation
33 components 5 suffer from the effects of bouncing. As

1 these effects increase with age, regular on site
2 maintenance is required in order to re-synchronise the
3 data logger 3 to the utility meter 4.

4

5 Working guidelines for chatterbox isolation components 5
6 specify that single gas utility meters outputs should be
7 capable of being regenerated to two or more outputs.
8 However, the chatterbox isolation devices taught of in
9 the art are incapable of easily producing more than two
10 regenerated signals.

11

12 A further disadvantage of chatterbox isolation component
13 5 is that they are expensive to produce, install and
14 maintain. Therefore, a more cost effective alternative
15 would certainly be of financial benefit to utility
16 suppliers.

17

18 It is an object of aspects of the present invention to
19 provide an automated meter reader suitable for use with a
20 standard gas utility meter that removes the requirement
21 for a separate isolation component to be placed between
22 the data logger and the gas utility meter.

23

24 It is a further object of aspects of the present
25 invention to provide an automated meter reader suitable
26 for use with a standard utility meter that is efficient
27 and cost effective to install and maintain.

28

29 According to a first aspect of the present invention
30 there is provided a solid-state automatic meter reader
31 suitable for monitoring and recording the data output of
32 a utility meter comprising a data logger, an isolation

1 barrier, a regeneration unit and a communication.
2 controller.

3

4 Most preferably the isolation barrier is located so as to
5 electrically isolate the data logger from the
6 regeneration unit.

7

8 Preferably, the isolation barrier is located so as to
9 electrically isolate the communications controller from
10 the regeneration unit.

11

12 Alternatively, the isolation barrier is located so as to
13 electrically isolate the data logger from the
14 communications controller.

15

16 Preferably the data logger comprises one or more
17 electrical inputs, a computer processor, a memory unit
18 and a power source.

19

20 Most preferably the computer processor provides a means
21 for signal processing the data output of the utility
22 meter.

23

24 Preferably the power source comprises a battery.

25

26 Most preferably the isolation barrier comprises an
27 optical isolator.

28

29 Alternatively the isolation barrier comprises two or more
30 optical isolators wherein at least one optical isolator
31 communicates with the regeneration unit and at least one
32 optical isolator communicates with the communication
33 controller.

1

2 Preferably each optical isolator provides electrical
3 isolation to a level greater than approximately 10 kV
4 (rms).

5

6 Preferably the regeneration unit comprises one or more
7 outputs suitable for providing a regenerated data utility
8 meter output signal.

9

10 Most preferably, the communications controller comprises
11 a modem and a radio transceiver.

12

13 Typically the radio transceiver is a GSM transceiver.

14

15 Optionally, the communications controller comprises a
16 modulator and a radio transmitter.

17

18 Alternatively, the communication controller comprises a
19 computer processor, a modem and a telephone line wherein
20 the telephone supplies the required power for the
21 computer processor and the modem.

22

23 Alternatively the communication controller comprises a
24 computer processor, a modem, a battery and a telephone
25 line.

26

27 Typically the solid state automatic meter reader further
28 comprises an optically isolated communications interface
29 connected to said data logger.

30

31 Preferably, said optically isolated communications
32 interface comprises a light source and a photo receptor.

33

1 Preferably, said optically isolated communications
2 interface comprises an IEC1107 interface.

3

4 Typically the solid state automatic meter reader further
5 comprises an electrically isolated communications
6 interface connected to said data logger and said
7 communications controller.

8

9 Preferably, said electrically isolated communications
10 interface comprises an RS485 interface.

11

12 According to a second aspect of the present invention
13 there is provided a method for automating the monitoring
14 and recording of a utility meter comprising the steps of:

- 15 1) Electrically connecting a solid state data logger
16 to the utility meter;
- 17 2) Employing an isolation barrier to electrically
18 isolate the solid state data logger;
- 19 3) Reading and recording output data from the utility
20 meter;
- 21 4) Creating output signals representative of the
22 output data from the utility meter;
- 23 5) Employing an optoelectronic means for transferring
24 the output signals across the isolation barrier.

25

26 Most preferably a computer processor is employed to read
27 the output data from the utility meter. A memory unit
28 then records the output data read by the computer
29 processor.

30

31 Preferably the computer processor carries out signal
32 processing on the output data from the utility meter
33 before generating two or more output signals.

1

2 Preferably the signal processing comprises the removal of
3 noise on the output data from the utility meter caused by
4 switch bouncing.

5

6 Most preferably at least one output signal is transferred
7 to a communication controller such that it may be relayed
8 to a remote site in order to allow a customer's account
9 to be updated.

10

11 Optionally, said at least one output signal is
12 transferred across the isolation barrier to said
13 communication controller.

14

15 Preferably said at least one output signal is relayed to
16 the remote site on a daily basis.

17

18 Optionally utility load analysis is carried out at the
19 remote site on the output signal.

20

21 Preferably at least one output signal is transferred
22 across the isolation barrier to a regeneration unit so as
23 to be available for use by a third party.

24

25 Preferably the computer processor provides a means for
26 multiplexing the output data from the utility meter and
27 one or more output signals transferred to the regenerated
28 unit.

29

30 Embodiments of the present invention will now be
31 described, by way of example only and with reference to
32 the accompanying Figures, in which:

33

- 1 Figure 1 presents a schematic presentation of an
2 intelligent meter as described in the
3 Prior Art;
- 4 Figure 2 presents a schematic presentation of a
5 purpose built modem interface unit as
6 described in the Prior Art;
- 7 Figure 3 presents a schematic presentation of an
8 automated meter reader having a GSM
9 communications controller, in situ with a
10 standard gas meter, in accordance with a
11 preferred embodiment of the present
12 invention;
- 13 Figure 4 presents a schematic presentation of an
14 automated meter reader having a line
15 powered modem communications controller,
16 in situ with a standard gas meter, in
17 accordance with an embodiment of the
18 present invention;
- 19 Figure 5 presents a circuit diagram of the input
20 ports;
- 21 Figure 6 presents a circuit diagram of the
22 regeneration and isolation units;
- 23 Figure 7 presents a circuit diagram of the
24 processor;
- 25 Figure 8 presents a circuit diagram of the
26 control, clocking and memory of the
27 processor support hardware;
- 28 Figure 9 presents a circuit diagram of the GSM
29 communications controller;
- 30 Figure 10 presents a circuit diagram of the IEC1107
31 interface;
- 32 Figure 11 presents a circuit diagram of the RS845
33 interface;

1 Figure 12 presents a circuit diagram of the logger
2 to line powered modem isolation circuit;
3 and

4 Figure 13 presents a circuit diagram of the line
5 powered modem.

6
7 A schematic representation of an automated meter reader 6
8 in accordance with a preferred embodiment of the present
9 invention is presented in Figure 3.

10

11 The automated meter reader 6 is a solid state device
12 comprising a data logger 7, an isolation barrier 8, a
13 communications controller 9 and a regeneration unit 10.

14 Locating the data logger 7 on the meter side of the
15 isolation barrier 8 provides the required electrical
16 isolation necessary for employment of the automated meter
17 reader 6 with the gas meter 4.

18

19 The data logger 7 comprises input ports 11, a computer
20 processing unit (CPU) 12 (e.g. a Hitachi HD 3664
21 processor), an on-board memory unit in the control,
22 clocking and memory support hardware 13, a battery 14 and
23 optical isolators 15. By connecting the data logger 7 to
24 the utility meter 4 data output is transmitted to the CPU
25 12 via the input ports 11.

26

27 The CPU 12 then carries out signal processing of the
28 utility meter output data. Initially this involves
29 detecting the closing of a relay on the utility meter 4.
30 This allows for erroneous data produced as the result of
31 relay bouncing removed and for output pulses to be
32 generated that are characterised by being both short and
33 of a constant width regardless of the length of the input

1 pulses. These pulses are then transmitted for storage
2 purposes to the on-board memory unit of 13 while separate
3 signals are transmitted to the regeneration unit for use
4 by third parties. The described signal processing
5 techniques allow for greater accuracy to be obtained in
6 recording the output data while avoiding the problematic
7 feature of battery drainage through mechanical failure of
8 the relays.

9
10 Optical isolators 15 are employed to pass information
11 across the isolation barrier 8 to the regeneration unit
12 10, while simultaneously providing the required
13 electrical isolation. These are well known devices in
14 the field of optoelectronics and basically comprise of a
15 light emitting diode (LED) and a semiconductor detector
16 separated by a short optical transmission path. The
17 optical transmission path may be air or a dielectric
18 waveguide and it is this optical transmission path that
19 provides the required electrical isolation between the
20 elements in the circuit.

21
22 The battery 14 provides the power for the data logger 7.
23 Although the battery 14 will eventually be required to be
24 replaced, its lifetime is significantly increased by
25 employing the de-bouncing signal processing techniques
26 within the CPU 12. It is estimated that a single battery
27 will be capable of providing power for a minimum period
28 of four years.

29
30 In a preferred embodiment of the present invention the
31 communication controller 9 is a GSM (Global System for
32 Mobile communications) modem. Data stored within the
33 memory unit of 13 is then transferred to the

1 communication controller 9 that has a modem and
2 transceiver that transmits the data to a remote site via
3 the GSM telecommunications network.

4

5 Although the above preferred embodiment comprises a GSM
6 communication controller 9 it would be obvious to one
7 skilled in the art that any radio based communication
8 controller could also be used, for example, GPRS (General
9 Packet Radio Service), WiFi Wireless Local Area Network,
10 or Bluetooth. Rather than connecting directly to the GSM
11 telephone network, the radio connection would then be to
12 another network.

13

14 The automated meter reader also includes an RS485
15 communication port on the data logger side of the
16 isolation barrier that allows data to be transferred
17 through the on-board GSM modem for connection to external
18 equipment. The port is voltage and current limited in
19 order to comply with the guidelines for connection to a
20 gas meter.

21

22 In an alternative embodiment presented in Figure 4 the
23 communication controller 18 comprises a CPU 19 (e.g. a
24 Hitachi HD 3664 processor) and a modem 20 that are both
25 powered via a current carried by a telephone line 21,
26 employing a technique as taught by the present author
27 within PCT Application WO 0237824. Data stored within
28 the memory unit of 13 is then transferred across the
29 isolation barrier 8 to the CPU 19 via the optical
30 isolators 22. Thereafter, the modem 20 retrieves the
31 data from the CPU before transmitting it to a remote site
32 via the telephone line 21.

33

1 Although the above alternative embodiment comprises a
2 communication controller 18 that employs a telephone line
3 power supply technique it would be obvious to one skilled
4 in the art that a standard communication controller could
5 also be used. Typically such a communication controller
6 (not shown) comprises a CPU a standard modem and a
7 designated battery power source. However, the employment
8 of such a standard communication controller would
9 increase both the installation and maintenance costs of
10 the automatic meter reader.

11

12 Figure 5 presents a circuit diagram of the input port
13 circuitry 11 which connects to (up to 4) gas meters.
14 These inputs are current limited to comply with approval
15 standards, and also have components fitted which help
16 with the debouncing of the gas output relays.

17

18 Figure 6 presents a circuit diagram of the regeneration
19 10 and isolation 15 units, the opto-isolators replace the
20 function of the conventional chatterbox.

21

22 Figure 7 presents a circuit diagram of the processor
23 (CPU) 12.

24

25 Figure 8 presents a circuit diagram of the control and
26 clocking support hardware 13 for the processor. Also
27 included in this section is the memory and temperature
28 measuring circuits.

29

30 Figure 9 presents a circuit diagram of the GSM
31 communication controller 9 (including modem) of the
32 preferred embodiment of the present invention.

33

1 Figure 10 presents a circuit diagram of the IEC1107
2 interface 16. This includes the infrared diodes which
3 allow data to be input/output from the logger locally.

4

5 Figure 11 presents a circuit diagram of the RS485
6 interface 17.

7

8 Figure 12 presents a circuit diagram of the logger to
9 line powered modem isolation circuit 22 of the
10 alternative embodiment of the present invention. This
11 provides the isolation between the conventional line
12 powered modem communications controller 18 and the logger
13 section 7.

14

15 Figure 13 presents a circuit diagram of the line powered
16 modem 20.

17

18 In general the CPU on the data logger monitors and counts
19 the data produced by the meter in thirty minute cycles
20 before transferring this data to the memory unit. At the
21 end of the day the data is then transferred to the remote
22 location such that a customers bill may be updated. In
23 addition the data may be used to calculate a user's load
24 profile. If all the customer load profiles for a
25 particular day are collated then this information may be
26 used to make accurate predictions regarding the total
27 volume requirement of the utility for the next day,
28 inclusive of peak and off peak periods.

29

30 The automated meter reader 6 is based on solid state
31 electronics that permit for communication functionality
32 to be included. Therefore, the automated meter reader 6
33 may be supplied and installed with a gas meter at

1 substantially lower costs than the three component unit
2 systems presently provided i.e. those that comprise the
3 chatterbox, data logger and modem.

4

5 By adapting the signal processing carried out by the CPU
6 12 the automated meter reader 6 also provides a means for
7 converting data from old fashioned styled utility meters
8 into that produced by the new meter types e.g. IEC 1107
9 meters. This functionality allows for a cost effective
10 means for updating the technology of presently installed
11 meters while at the same time producing a common
12 interface standard for all the meters, namely the IEC
13 1107 European Standard.

14

15 In addition to being more cost effective to install than
16 those systems taught in the prior art the automatic meter
17 reader 6 is also cheaper to maintain as there are no
18 mechanical parts and generally fewer batteries that
19 require to be replaced. In addition, when employed with
20 a gas meter the requirement for a separate chatterbox is
21 removed along with the need to systematically re-
22 calibrate this component and to filter out additional
23 noise caused as a result of relay bouncing.

24

25 An advantage of aspects of the present invention is that
26 the optical isolators provide a simplified means for
27 electrically isolating a gas meter to the standards
28 required the regulatory bodies.

29

30 A yet further advantage of aspects of the present
31 invention is that the employment of the CPU allows for
32 accurate de-bouncing of the incoming data. This allows
33 for output pulses to be generated that are both short and

1 of a constant width regardless of the length of the input
2 pulses. Such features act to considerably reduce battery
3 consumption. On average the battery lifetime will be
4 extended to have a minimum lifetime of four years. In
5 addition, as the CPU is programmable multiplexing may
6 take place, wherein any of the input data lines may be
7 transferred to any one of or combination of the outputs
8 on the regeneration unit.

9
10 The above embodiments have been described primarily for
11 use with a gas meter. However, it will be obvious to
12 those skilled in the art that the same automated meter
13 reader may readily be employed in systems for automating
14 both water and electricity meters, even although there is
15 no requirement to provide the same levels of electrical
16 isolation within these systems.

17
18 The foregoing description of the invention has been
19 presented for purposes of illustration and description
20 and is not intended to be exhaustive or to limit the
21 invention to the precise form disclosed. The described
22 embodiments were chosen and described in order to best
23 explain the principles of the invention and its practical
24 application to thereby enable others skilled in the art
25 to best utilise the invention in various embodiments and
26 with various modifications as are suited to the
27 particular use contemplated. Therefore, further
28 modifications or improvements may be incorporated without
29 departing from the scope of the invention herein
30 intended.

1 **Claims**

2

3 1. A solid-state automatic meter reader suitable for
4 monitoring and recording the data output of a utility
5 meter, the solid-state automatic meter reader
6 comprising a data logger, an isolation barrier, a
7 regeneration unit and a communication controller.

8

9 2. The solid-state automatic meter reader of Claim 1,
10 wherein the isolation barrier is located so as to
11 electrically isolate the data logger from the
12 regeneration unit.

13

14 3. The solid-state automatic meter reader of any
15 previous claim, wherein the isolation barrier is
16 located so as to electrically isolate the
17 communications controller from the regeneration unit.

18

19 4. The solid-state automatic meter reader of any of
20 Claims 1 to 2, wherein the isolation barrier is
21 located so as to electrically isolate the data logger
22 from the communications controller.

23

24 5. The solid-state automatic meter reader of any
25 previous claim, wherein the data logger comprises one
26 or more electrical inputs, a computer processor, a
27 memory unit and a power source.

28

29 6. The solid-state automatic meter reader of Claim 5,
30 wherein the computer processor provides a means for
31 signal processing the data output of the utility
32 meter.

33

1 7. The solid-state automatic meter reader of any of
2 Claims 5 to 6, wherein the power source comprises a
3 battery.
4

5 8. The solid-state automatic meter reader of any
6 previous claim, wherein the isolation barrier
7 comprises an optical isolator.
8

9 9. The solid-state automatic meter reader of any
10 previous claim, wherein the isolation barrier
11 comprises two or more optical isolators wherein at
12 least one optical isolator communicates with the
13 regeneration unit and at least one optical isolator
14 communicates with the communication controller.
15

16 10. The solid-state automatic meter reader of any of
17 Claims 8 to 9, wherein each optical isolator provides
18 electrical isolation to a level greater than
19 approximately 10 kV (rms).
20

21 11. The solid-state automatic meter reader of any
22 previous claim, wherein the regeneration unit
23 comprises one or more outputs suitable for providing
24 a regenerated data utility meter output signal.
25

26 12. The solid-state automatic meter reader of any
27 previous claim, wherein the communications controller
28 comprises a modem and a radio transceiver.
29

30 13. The solid-state automatic meter reader of Claim 12,
31 wherein the radio transceiver is a GSM transceiver.
32

- 1 14. The solid-state automatic meter reader of any
2 previous claim, wherein the communications controller
3 comprises a modulator and a radio transmitter.
4
- 5 15. The solid-state automatic meter reader of any of
6 Claims 1 to 13, wherein the communication controller
7 comprises a computer processor, a modem and a
8 telephone line wherein the telephone supplies the
9 required power for the computer processor and the
10 modem.
11
- 12 16. The solid-state automatic meter reader of any of
13 Claims 1 to 13, wherein the communication controller
14 comprises a computer processor, a modem, a battery
15 and a telephone line.
16
- 17 17. The solid-state automatic meter reader of any
18 previous claim, further comprising an optically
19 isolated communications interface connected to said
20 data logger.
21
- 22 18. The solid-state automatic meter reader of Claim 17,
23 wherein said optically isolated communications
24 interface comprises a light source and a photo
25 receptor.
26
- 27 19. The solid-state automatic meter reader of any of
28 Claims 17 to 18, wherein said optically isolated
29 communications interface comprises an IEC1107
30 interface.
31
- 32 20. The solid-state automatic meter reader of any
33 previous claim, further comprising an electrically

1 isolated communications interface connected to said
2 data logger and said communications controller.

3

4 21. The solid-state automatic meter reader of Claim 20,
5 wherein said electrically isolated communications
6 interface comprises an RS485 interface.

7

8 22. A method for automating the monitoring and recording
9 of a utility meter comprising the steps of:

- 10 1) electrically connecting a solid state data
11 logger to the utility meter;
- 12 2) employing an isolation barrier to
13 electrically isolate the solid state data
14 logger;
- 15 3) reading and recording output data from the
16 utility meter;
- 17 4) creating output signals representative of
18 the output data from the utility meter; and
19 5) employing an optoelectronic means for
20 transferring the output signals across the
21 isolation barrier.

22

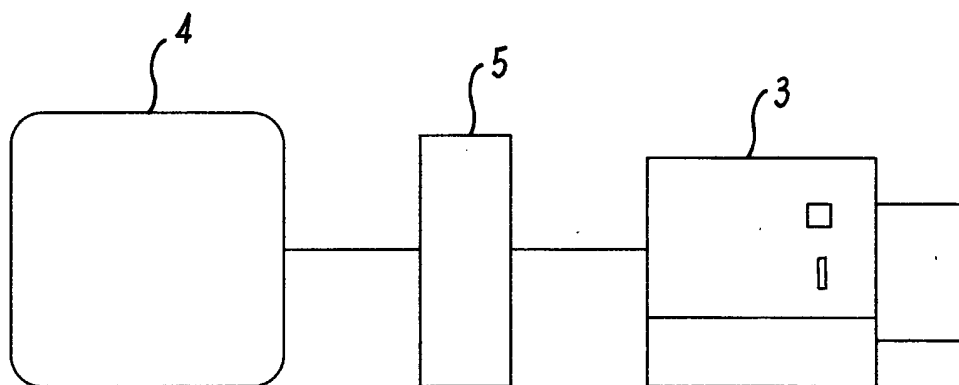
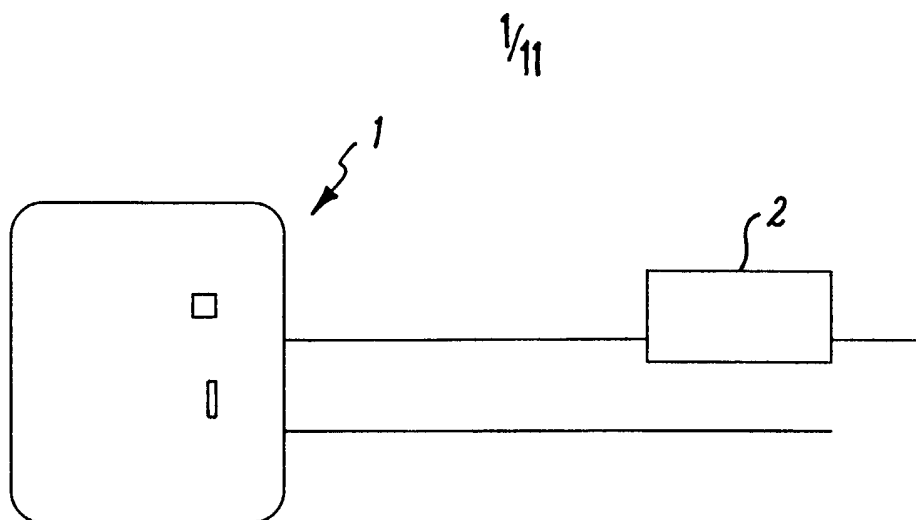
23 23. The method of Claim 22, wherein a computer processor
24 is employed to read the output data from the utility
25 meter, and a memory unit then records the output data
26 read by the computer processor.

27

28 24. The method of Claim 23, wherein the computer
29 processor carries out signal processing on the output
30 data from the utility meter before generating two or
31 more output signals.

32

- 1 25. The method of Claim 24, wherein the signal processing
2 comprises the removal of noise on the output data
3 from the utility meter caused by switch bouncing.
4
- 5 26. The method of any of Claims 22 to 25, wherein at
6 least one output signal is transferred to a
7 communication controller such that it may be relayed
8 to a remote site in order to allow a customer's
9 account to be updated.
10
- 11 27. The method of Claim 26, wherein said at least one
12 output signal is transferred across the isolation
13 barrier to said communication controller.
14
- 15 28. The method of any of Claims 26 to 27, wherein said at
16 least one output signal is relayed to the remote site
17 on a daily basis.
18
- 19 29. The method of any of Claims 26 to 28, wherein utility
20 load analysis is carried out at the remote site on
21 the output signal.
22
- 23 30. The method of any of Claims 22 to 29, wherein at
24 least one output signal is transferred across the
25 isolation barrier to a regeneration unit so as to be
26 available for use by a third party.
27
- 28 31. The method of any of Claims 23 to 30, wherein the
29 computer processor provides a means for multiplexing
30 the output data from the utility meter and one or
31 more output signals transferred to the regenerated
32 unit.



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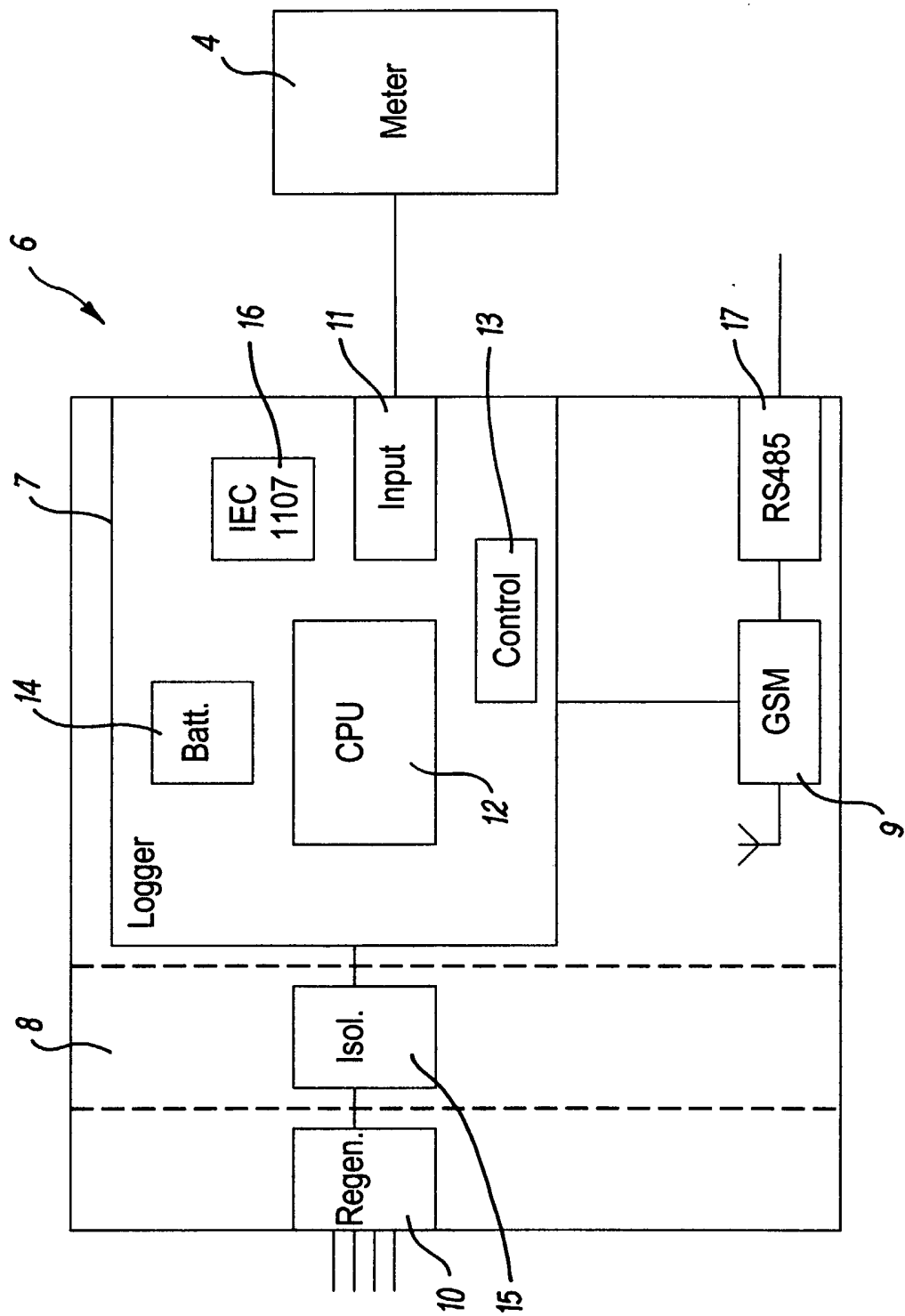


Fig. 3

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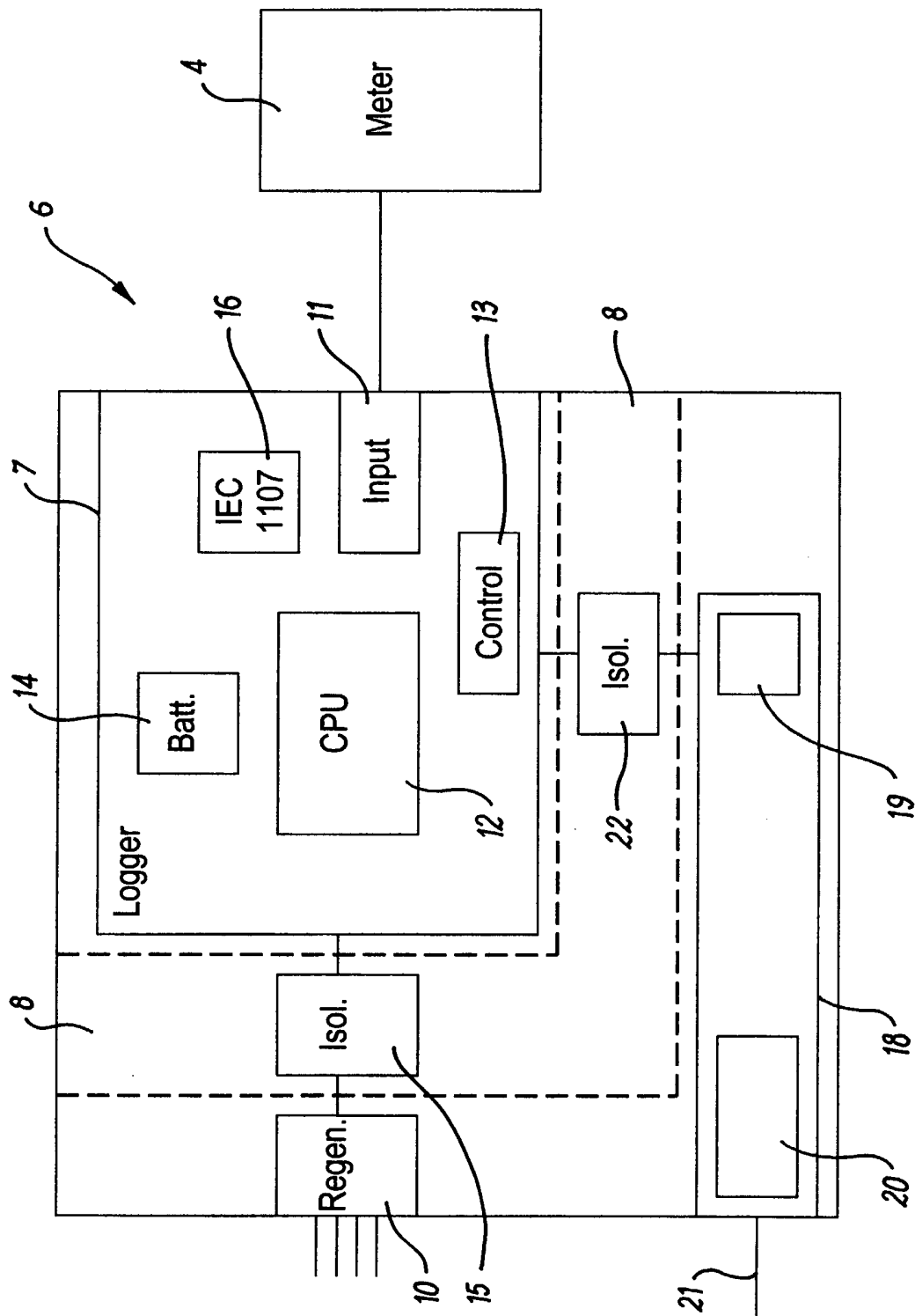
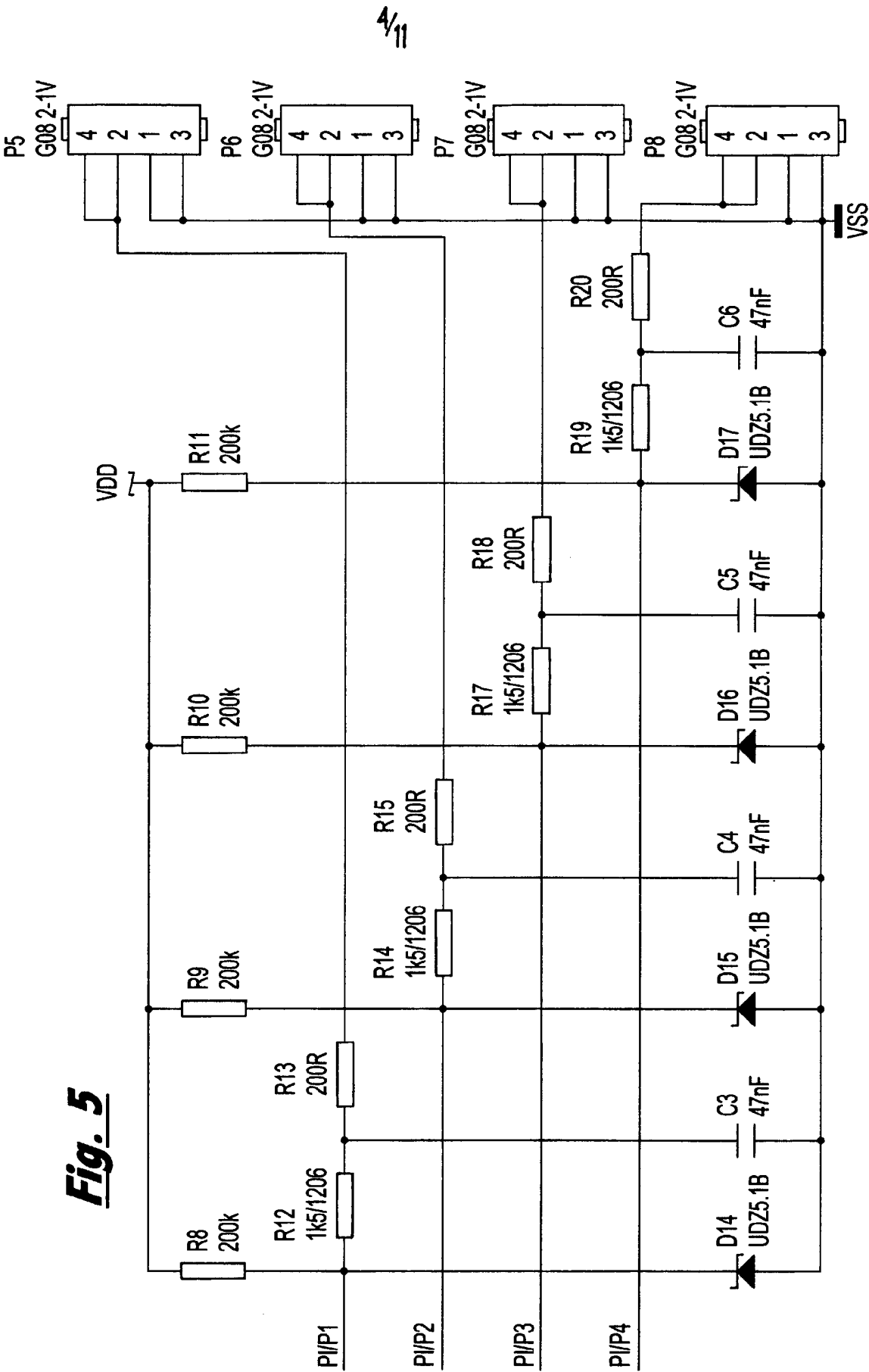
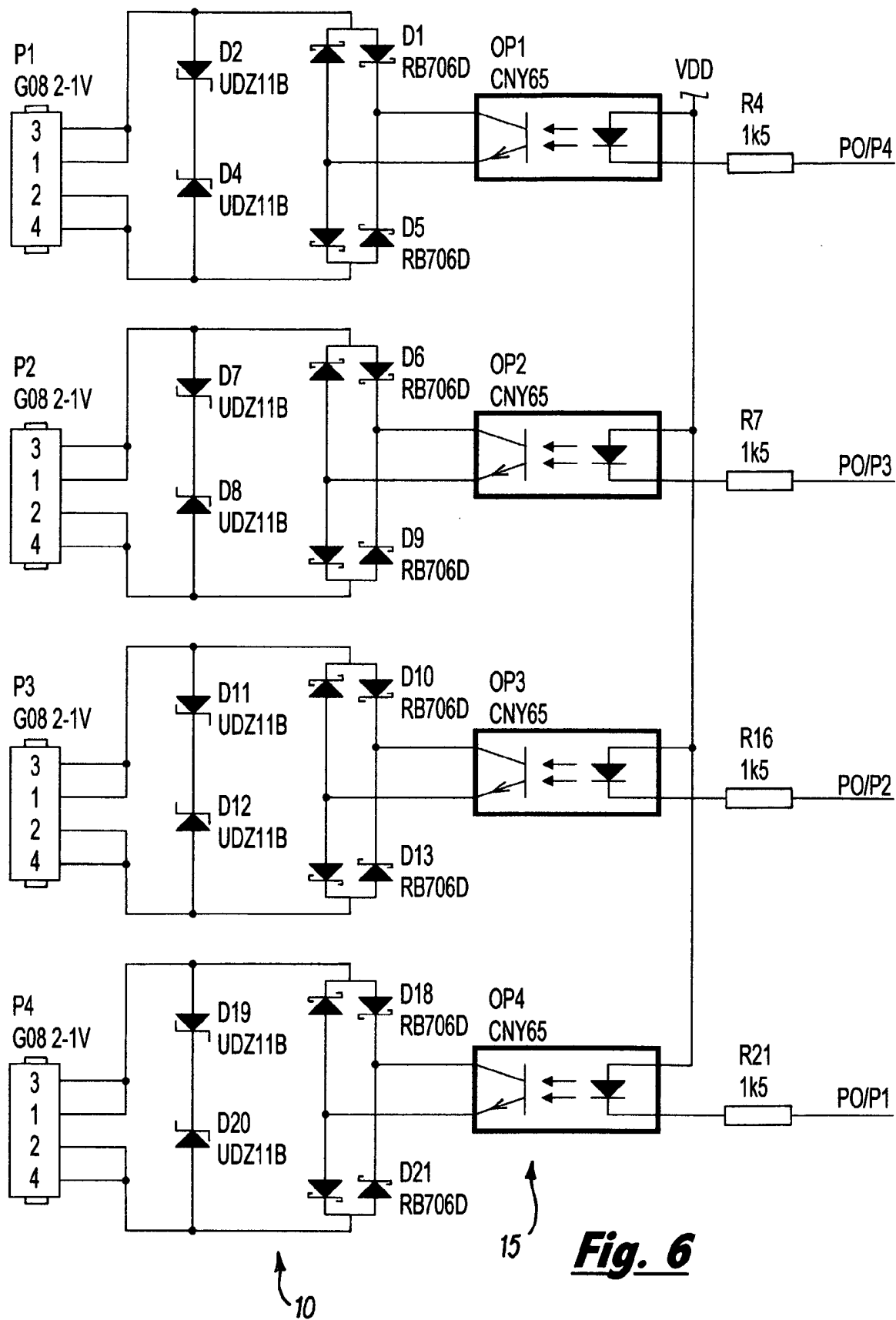


Fig. 4



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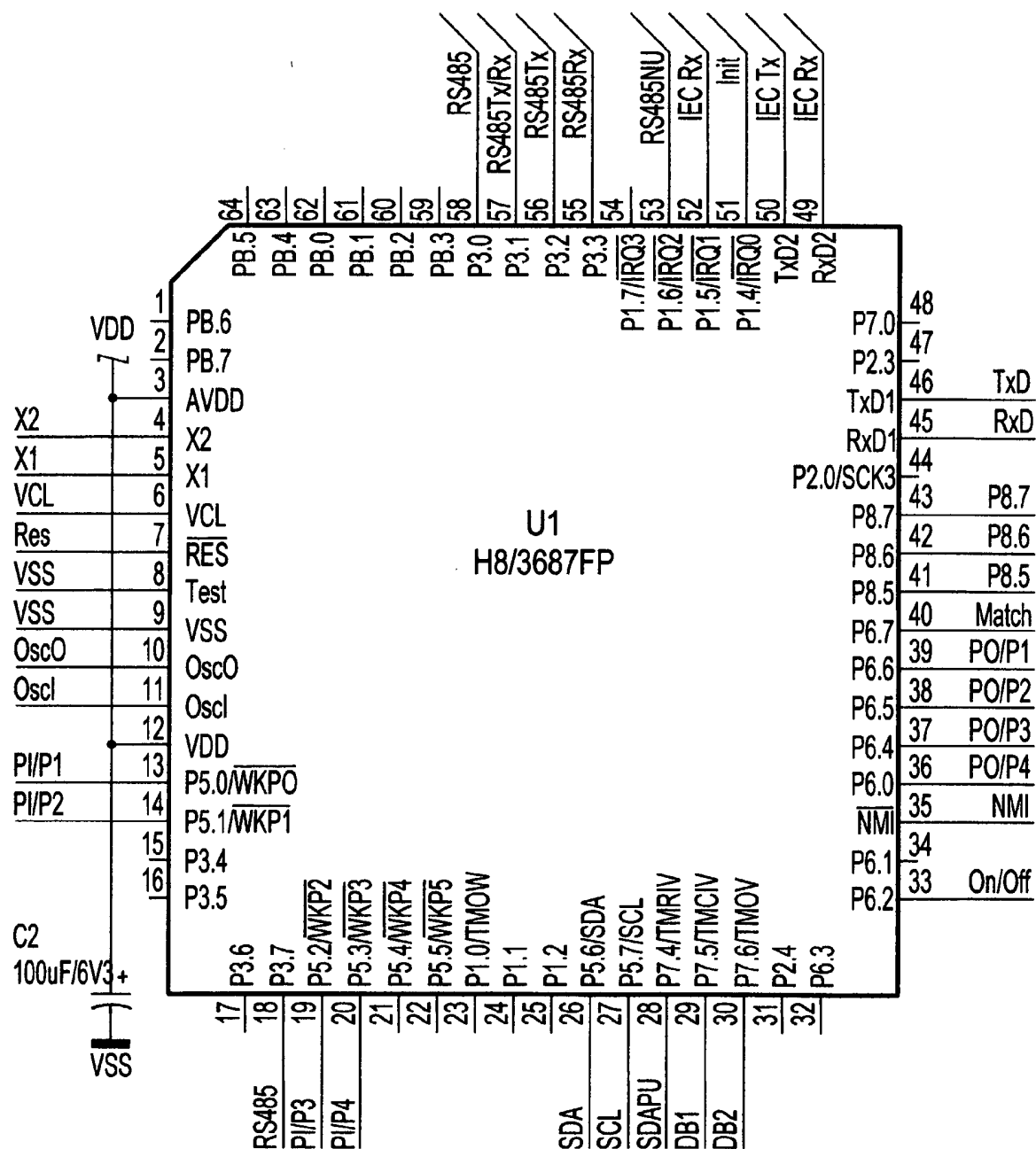


Fig. 7

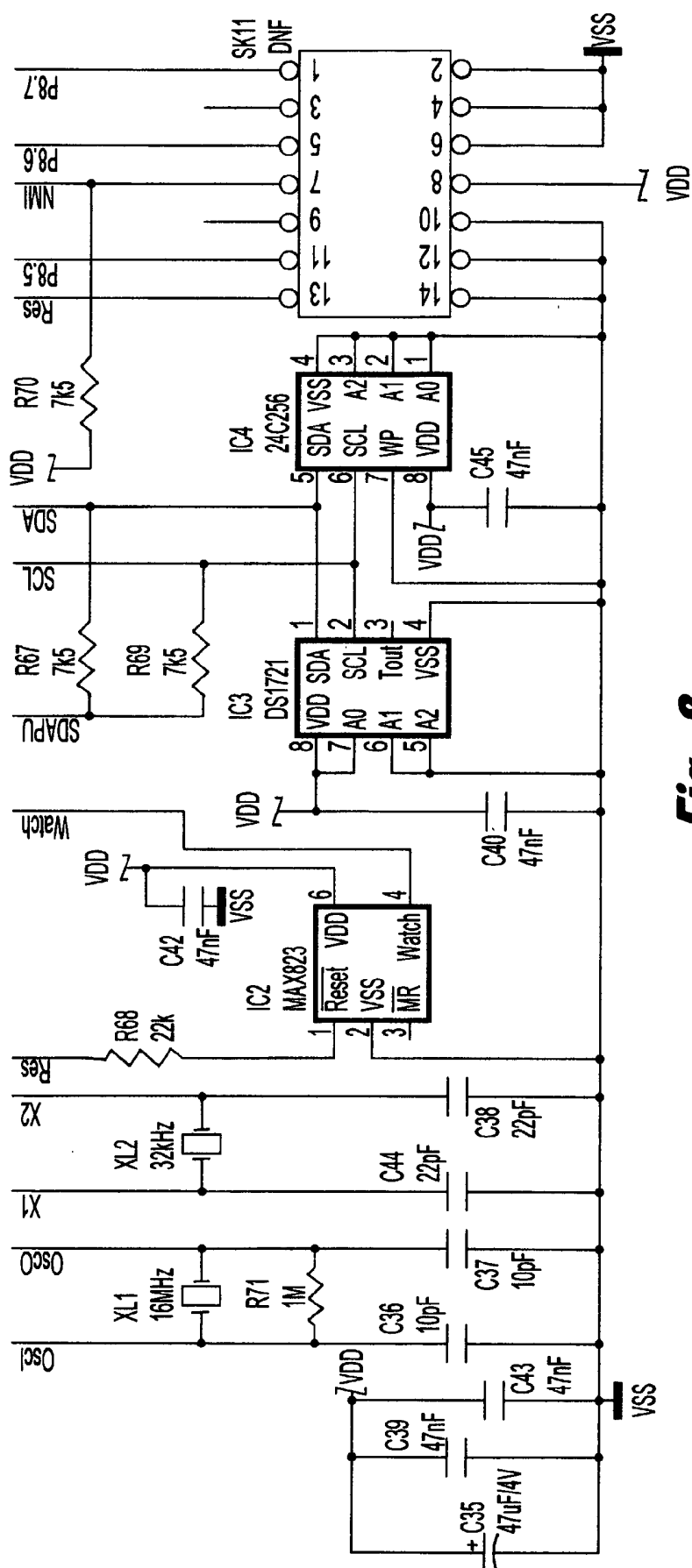
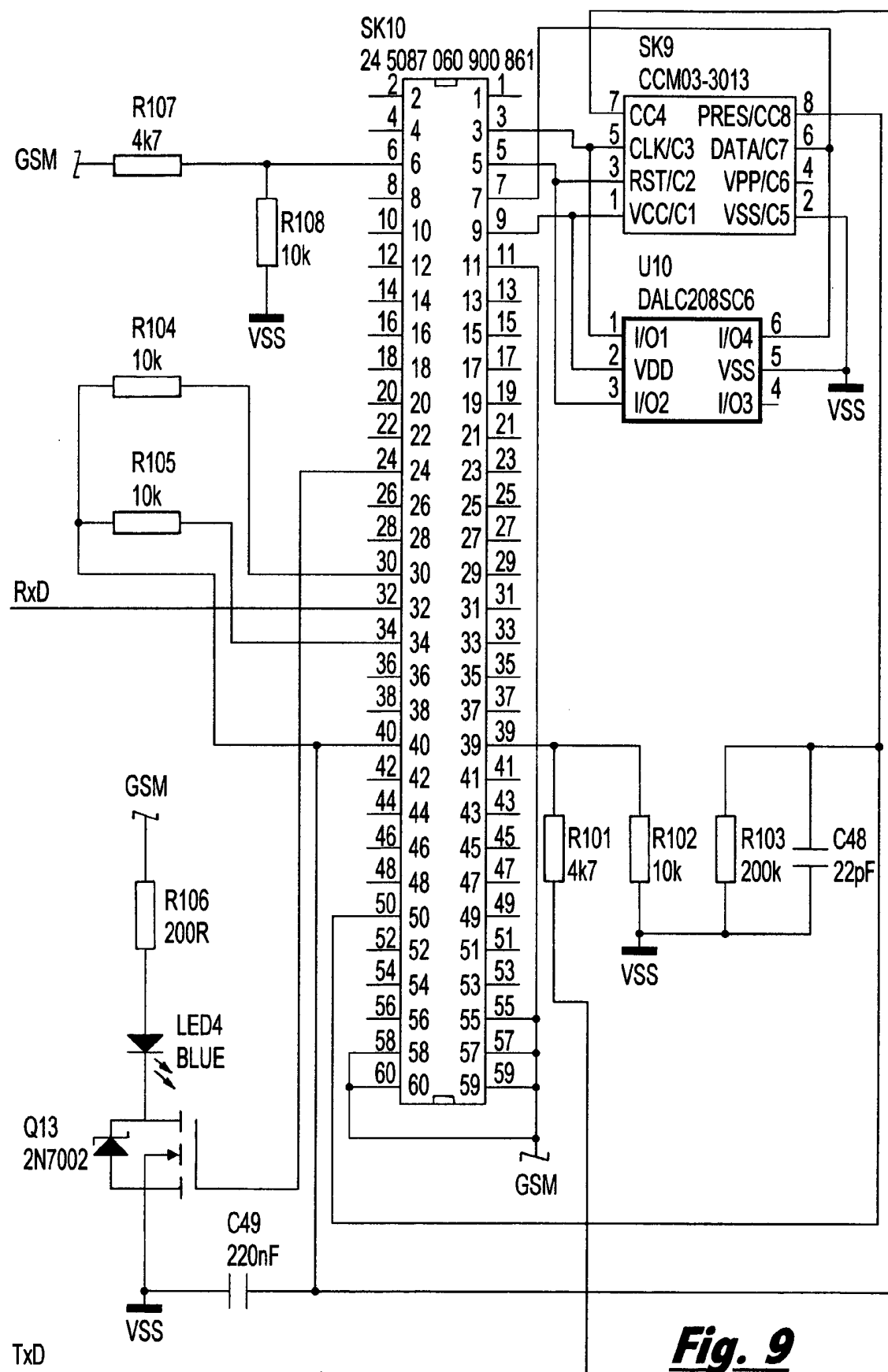
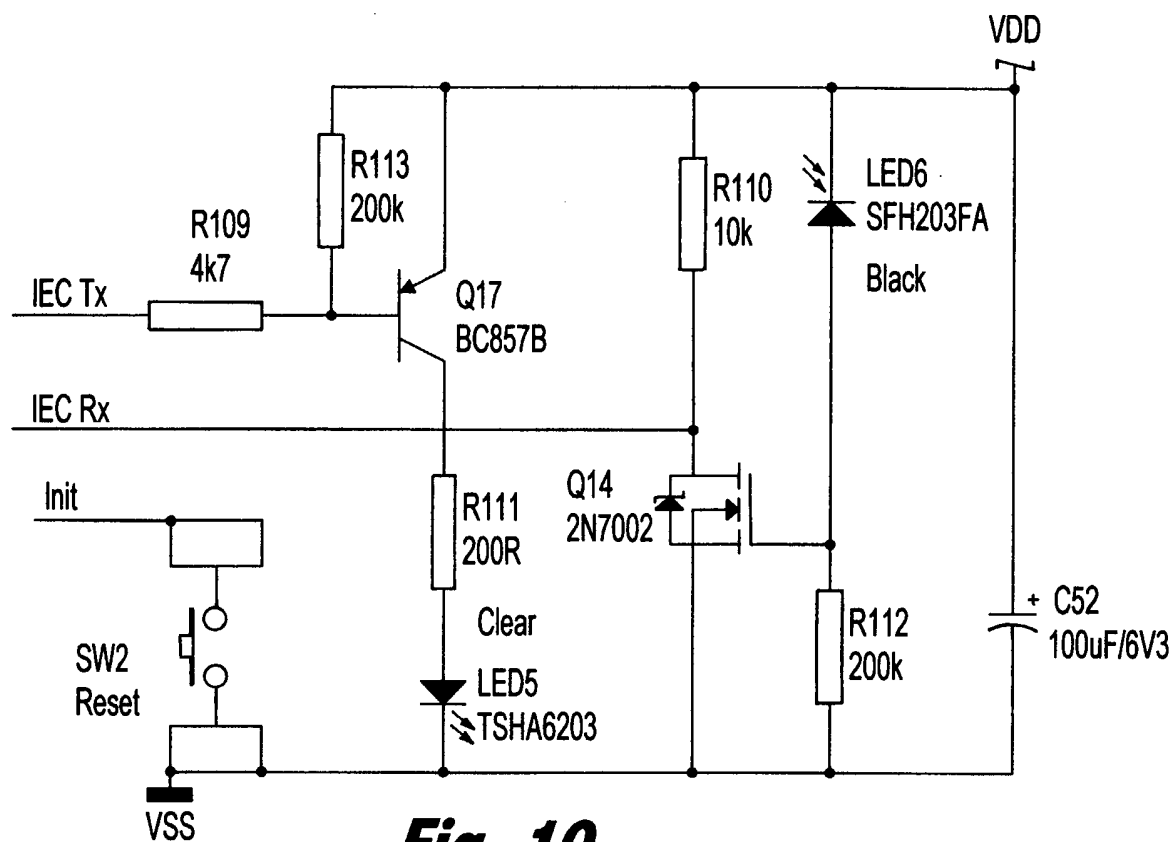
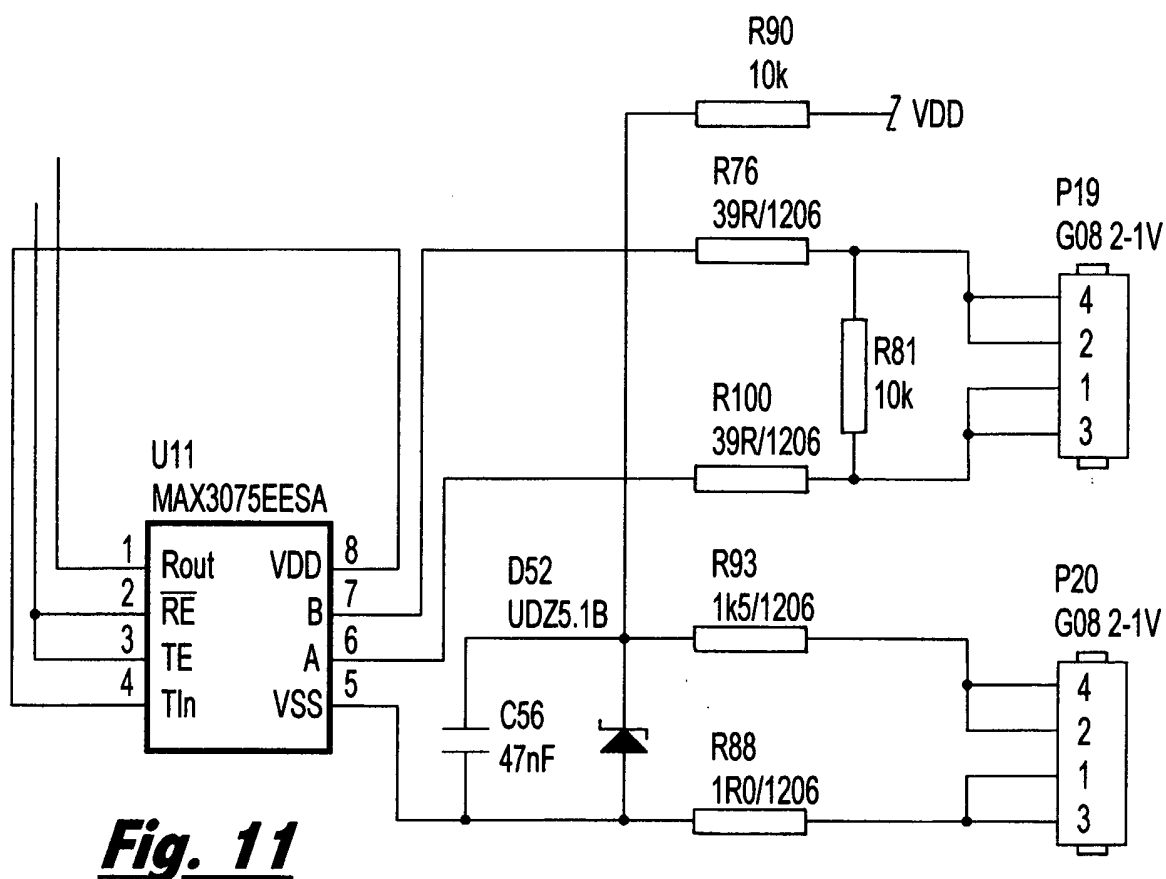


Fig. 8

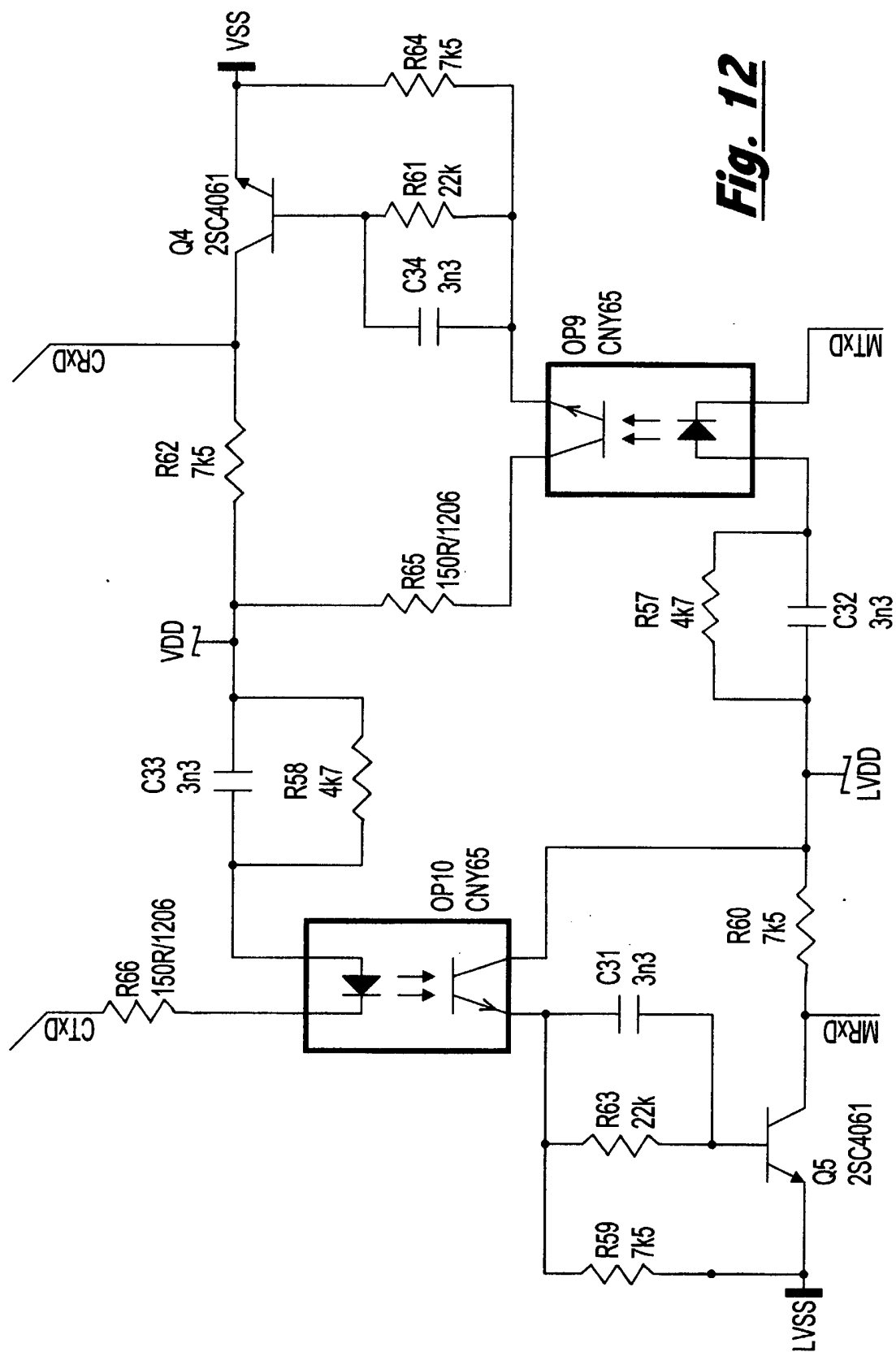
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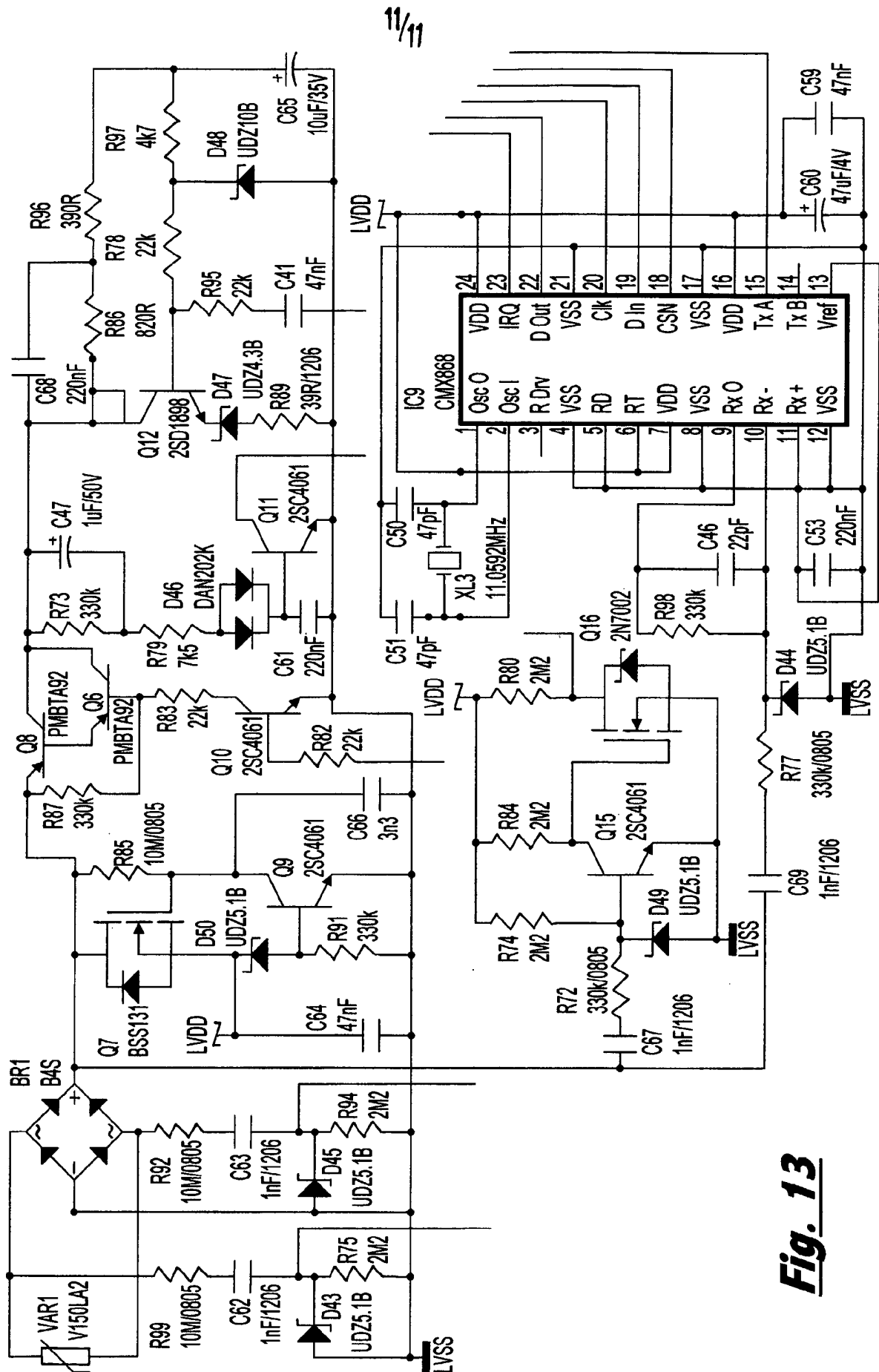
**Fig. 9**

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***Fig. 10******Fig. 11***

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**Fig. 12**

**Fig. 13**