Stabiliser, battery charger, emergency light, inverter and UPS

Objectives: At the end of this lesson you shall be able to
- **state the general precaution to carryout for preventive maintenance**
- **explain the steps to follow the break down maintenance**
- **service the voltage stabilizer, emergency light, battery charger, inverter and UPS**
- **analyse the trouble shooting chart and find the problem/ repair the equipment.**

Use of flow chart and troubleshooting charts for fault location : The circuit diagram is in Fig 1 is given for your reference. The working of the mains cord, fuse, relay contacts, windings of the auto-transformer etc. can easily be ascertained by using a test lamp and/or a series lamp or by a voltmeter for checking the electronic circuit and relay coil winding. A multimeter in appropriate range is a must to localise the fault. A series lamp or test lamp should not be used to test these as they are liable to spoil while testing.

Method of trouble shooting : Referring to Fig 1, we find that the absence of control voltage from S_1, S_2 or DC voltages will make both the relays inoperative, and, hence, will be in the off position resulting in higher output voltage than input voltage with boost indication. The same result also occurs when both transistors are open.

When both the transistors are short i.e. collector to emitter is short or both zener diodes are short the relays are energised and the output voltage will be lower than input voltage.

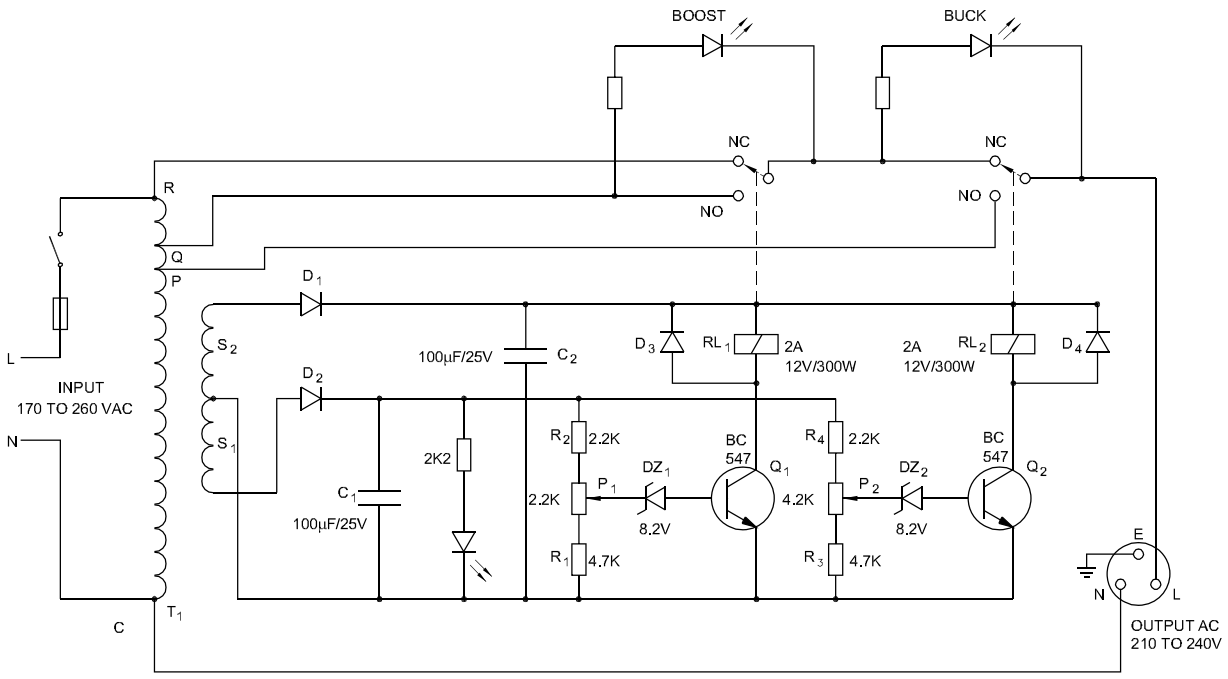
When one of the relay circuit is only not operating that particular function will be absent i.e. either back or boost function will be absent.

When a component mounted on PCB is suspected to be defective, first ascertain from all possible tests with in the circuit and then remove the component from PCB only when it is absolutely necessary. Even removing components for testing should be done as rarely as possible.

While removing the components from PCB, the component position with respect to the PCB, the terminal connections and hook up wire connections should be noted to enable the electrician to reconnect the component properly. When replacing the components procure the component of the same specification or equivalent so that the performance of the equipment is not affected after repair.

Troubleshooting chart given in Table 1 illustrates the problem, section to be suspected possible cause and action required for a stepped automatic voltage stabilizer.

Fig 1



TYPICAL CIRCUIT DIAGRAM OF A STABILZER

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General precautions for preventive maintenance

Maintenance for any equipment needs a working knowledge of that machine is very much essential to the person concerned. For example the volt ampere rating of voltage stabilizer is very important to carryout the preventive maintenance. Low quality, substandard components or materials never be used or recommended for use. Necessary steps to taken for safe temperature controlling and over loading conditions. Proper operating sequence or working steps to follow of all the equipments under maintenance.

Steps to follow break down maintenance

Break down can happen anytime, anywhere. Adequate protection might have provided to all equipments, for its smooth working. However continuous running or usage, lack of maintenance, human error and some unexpected reasons break down is happening.

Once break down maintenance or repair is required a detailed study of that equipment is essential. Always involve more persons pertain to the repair work or maintenance work for achieving a good result. A collective and competitive effort only will produce good results. Give value for everyones suggestion, expertise and workmanship. There must be a clean idea and vision to finalise the maintenance and repair. Ensure the services of experts, availability of spares, details of past records, diagrams and past history of the equipment such as its installation date, service records, number of break downs and its frequency etc; Servicing of voltage stabilizer by trouble shooting method.

Table 1

Trouble shooting chart for stepped automatic stabilizer

Sl. No.	Problem	Section to be suspected	Possible cause for defective	Action
1	No output voltage at output socket.	Input buck/boost relays.	Mains cord, switch, fuse, transformer and relays	Locate and repair or replace
2	The output voltage is more, do not regulate.	Electronic circuit or relays.	Open/shorted rectifier / diodes, or open zener diodes	Locate the defective part and replace.
3	Output voltage is same as input. Do not regulate.	Transformer or Electronic circuit	Transistor or held up relay contacts or Partial open transformer / leads.	Test, repair or replace.
4	Output voltage is low. Do not regulate.	Electronic circuit	Shorted zener diode or transistor or open resistors	Test and replace.
5	Chattering in relays	Electronic circuit/relays	Leakage capacitors	Replace.

Trouble shooting of UPS

The trouble shooting and repair of UPS is difficult as this circuit is so complicated with so many functions. A step by step trouble shooting approach with a reasonable analysing is very important to carryout the troubleshooting in the UPS circuit.

A trouble shooting chart of UPS is given for your reference in table - 2.

Table 2

Troubleshooting chart of UPS

Sl.No.	Fault	Possible Reason	Troubleshooting
1	UPS works on 240V VAC mains but does not operate on battery	1 Battery fuse is blown out 2 Battery is discharged	1 Check the battery fuse. If fuse is blown, replace it, if it is loose, tighten 2 Recharge the battery, also check the polarity of battery
2	When UPS is switched on, charger does not turn on	1 Mains input fuse may be blown	1 Change mains fuse, if fuse blown

Sl.No.	Fault	Possible reason	Troubleshooting
		2 Charger input fuse blown out	2 Check the battery polarity and conditions, correct it if wrong, replace the fuse 3 Check the supply from mains, if OK, then check relay wiring, check relay coil.
3	240 VAC mains supply NOT available	1 Mains supply fails 2 Input AC mains is very low 3 Loose connection in input wiring	1 Check the supply of mains 2 Check the voltage 3 Tight the connection of wiring coming from distribution board
4	DC voltage is OK, but UPS shows DC under voltage and trips	1 Inverter fuse is blown 2 Rust/loose connection in battery	1 Replace fuse 2 Check the connection
5	When the UPS is switched ON with out load but DC under voltage indicator turns ON at load.	1 Load too high 2 Loose connection of battery terminal 3 Short or earth fault in load	1 Check the load, add loads gradually. 2 Tight the connections and check the polarity of battery 3 Check the load circuit wiring
6	Where there is no AC mains supply and the UPS is operating on battery, DC under voltage indicator turns ON	1 Battery is discharged 2 Battery terminal dust or loose	1 Recharge the battery, use proper current capacity cable in the battery circuit. 2 Check the connection
7	DC fuse blows OFF	1 Overload or short circuit	1 Change DC fuse 2 Reduce the overload. If power transistors are short or leaky, replace them.
8	UPS does not switch ON	1 Supply fails due to blown out fuse or some break in cable 2 No DC supply in the control card due to dry soldering or desoldering	1 Replace fuse, check the cables 2 Check and correct dry soldering and de-soldering 3 Check control card wiring
9	UPS trips when full load is connected	1 Overload setting is wrong	1 Adjust the overload setting, check the power consumption of the load. Gradually increase the load.
10	UPS output is high	1 Some connection is broken in the feedback loop 2 Control card is not functioning properly 3 Over voltage sensing is faulty	1 Check feedback transformer wiring and adjust feedback voltage preset. 2 Check /Replace control card 3 Check overload sensing circuit
11	UPS does not switch on in battery mode	1 Mains earthing is not proper 2 Problem in inverter circuit	1 Check the earth connection 2 Check battery, MOSFET, oscillator section, driver section, output section
12	Battery wire getting burned	1 The relay points are joined together	1 Check / Replace relays

Sl.No.	Fault	Possible reason	Troubleshooting
13	Change over time high, computer connected to the UPS reboots during change over.	1 Check oscillator circuit	1 Check /replace IC and other components of oscillator section
14	Low backup time	1 Main filter capacitor problem 2 Battery get short circuit/discharge	1 Check and replace capacitor 2 Check battery, replace if required

Trouble shooting of battery charger and emergency light

As you have seen that the battery charger is a simple circuit compare to UPS. The main function of the charger circuit is to feed the DC voltage to battery at a prescribed level we discuss only the trouble shooting of charger circuit and its repair. Battery maintenance is not discussed in the trouble shooting chart.

Analyse the fault in battery charging circuit (Fig 1) with the help of trouble shooting chart given in Table 3 and 4.

Table 3

Sl. No.	Problems	Section to be suspected	Possible cause for defects	Action
1	No DC voltage at charging terminal	1 Faulty Ammeter (open circuit)	Aged/over current	Replaced Ammeter
		2 Blown fuse	Over current	Replace fuse
		3 Faulty rectifies diode	Aging/over loading	Replace all diodes
		4 Defective transformer	Aging/over loading	Replace transformer
		5 Faulty Relay contacts	Repeated closed open	Replace contact
		6 Open Relay coil	Over voltage/current	Replace relay
		7 Main fuse blown	Over loading	Replace fuse
		8 No link between meter to battery	Loose connection	Tighten the connection
		9 Defective auto transformer	Over loading	Replace transformer
2	Low terminal voltage	Anyone pain diode open circuited	Ageing	Replace all four diodes
		Partial short in transformer	Over heat	Replace transformer
3	No automatic charging voltage cut off	Defective potentiometer	Long use	Replace new potentiometer
		Driver diode open	Ageing	Replaced 2 diodes(D7)
		Defective electrolytic capacitor	Ageing	Replace capacitor (C_1)
		Defective bleeder resistor	Over current	Replaced same value resistor(R_1)
		Control circuit rectifier diode open	Ageing Over current	Replace both diodes(D_5 & D_6)
		LT winding transformer open	Ageing / over current	Replace new transformer (x_3)
		LT fuse open	Over current	Replace fuses (F_2)
		Defective auxiliary relay terminal	Repeated operation	Replace contact RLI(B)

Table 3 contd...

Sl. No.	Problems	Section to be suspected	Possible cause for defective	Action
4	Irregular over voltage cut off	Defective potentiometer	Loose contact in the disc (track)	replace new potentiometer (VP1)
		Shorted driver diode	ageing/over current	replace new diode (d7)
		Loose in relay contacts leaky electrolytic capacitor	Repeated contacts ageing	replace contacts replace electrolytic capacitor

Table 4

Trouble shooting chart for emergency light

Sl No	Problems	Section to be suspected	Possible cause for defective	Action
1	Lamp dead in both condition lamp	Defective tube	Ageing	Replace tube lamp
		Defective inverter transformer	Over loading/ageing	Replace inverter transformer
		Defective driver	Over loading/ageing transistor	Replace transistor (213055)
2	Lamp out glowing if AC fails	Low/ dead battery	Ageing	Replace New battery

Servicing of equipment are discussed based on a sample circuits. When servicing of other equipments with different circuits may differ from the troubleshooting sequences. However the basic principle based on the block diagram may be taken for guidance to service/repair the equipment.

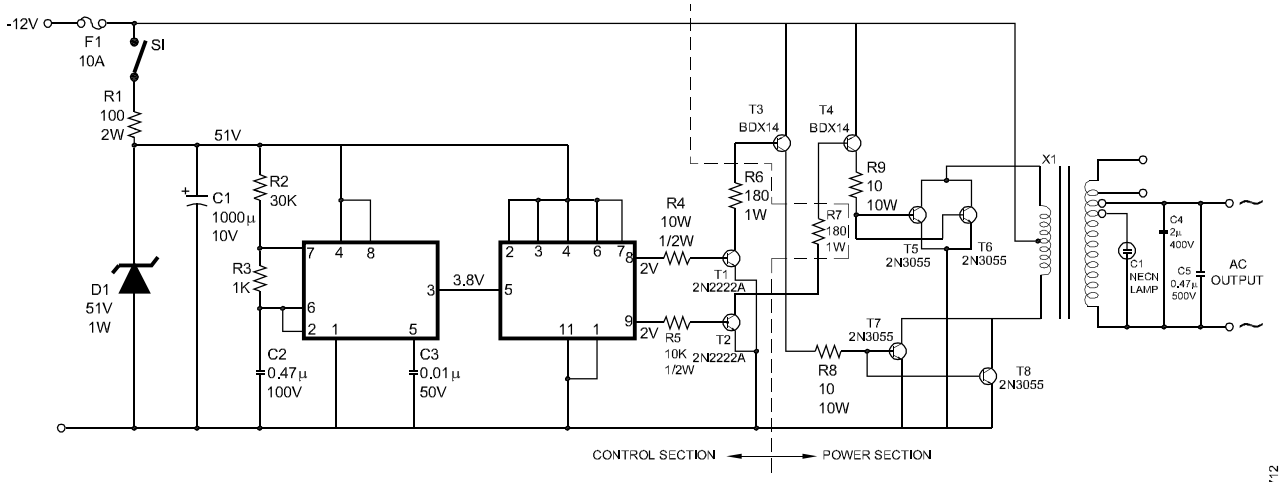
Trouble shooting of inverter

DC to AC inverter is quite complicated circuit, it consists of many functions. The switching circuit, oscillator circuit, control circuit power amplifier circuit, driver, finally the output circuit through the transformer. A feed back is also taken from the output transformer to regulate the output through the control circuits.

A constant DC source; either from a converter or battery is very much essential to keep the power output in a constant stage. DC to AC conversion with a specified frequency and a particular wave is difficult.

Analyse the fault in a inverter is explained (Fig 2) with the help of trouble shooting chart is given in Table 5. However the fault and problem are discussed while considering the 50Hz static inverter circuit is in Fig 2.

Fig 2



COMPELETE CIRCUIT DIAGRAM OF 50Hz STATIC INVERTER

ELN44118712

Table 5

Sl No	Problems	Section to be suspected	Possible cause for defects	Action
1	Output - Dead	- Output transformer	- Transformer open or short	Rectify transformer
		- DC source	- CT & transformer open	Rectify the CT connection
			- No DC from battery	Replace battery
			- Battery dead	
2	Low or high frequency	- Oscillator IC (555)	- Faulty IC	Replace IC
		- Control IC JK Flip-Flop	- Faulty IC	Replace IC
			- No supply to IC (series resistor open)	Replace resistor
			- Capacitor connected to IC 555 shorted	Charge faulty capacitor
3	Low voltage frequency ok	- Driver transistor	Fault in driver transistor	Charge the transistor
		- Power transistor (output transistor)	Fault in power transistor	Replace the power transistor
			Fault in output transformer Partial short in winding / cave	Rectify the transformer fault or Replace the transformer
4	Frequent cut-off the output	- Battery	- Low A/H capacitor of battery	Replace Battery
		- Fault in IC	- Over heat in IC	Provide heat
		- Fault in power transistor	- Over heat in power transistor	Sink to IC Sink to transistor

Installation of inverter in domestic wiring

Objectives: At the end of this lesson you shall be able to
- **enumerate the important points to be kept in your mind to select the inverter to be installed**
- **state how to select the place to install the inverter and battery**
- **explain how to install the inverter with battery and load, and check for its performance**
- **state the rating of inverter and its sample calculation.**

Important points to be considered before installing an inverter

Many time when a new inverter is not giving proper service, the fault is due to improper installation only, not in inverter.

Another most important point is when connecting an inverter to the line is, the total load connected to the inverter should not exceed 80% of capacity of inverter.

Before providing points to connect the loads to the inverter, the total connected load must be considered.

If over load occur, then the overload protection will 'cut OFF' the output and reduce the load then the reset key must be pressed, and if the inverter is not provided with overload protection, it may get damaged at the time of over load than the capacity of the inverter.

Selection of place for installation of inverter

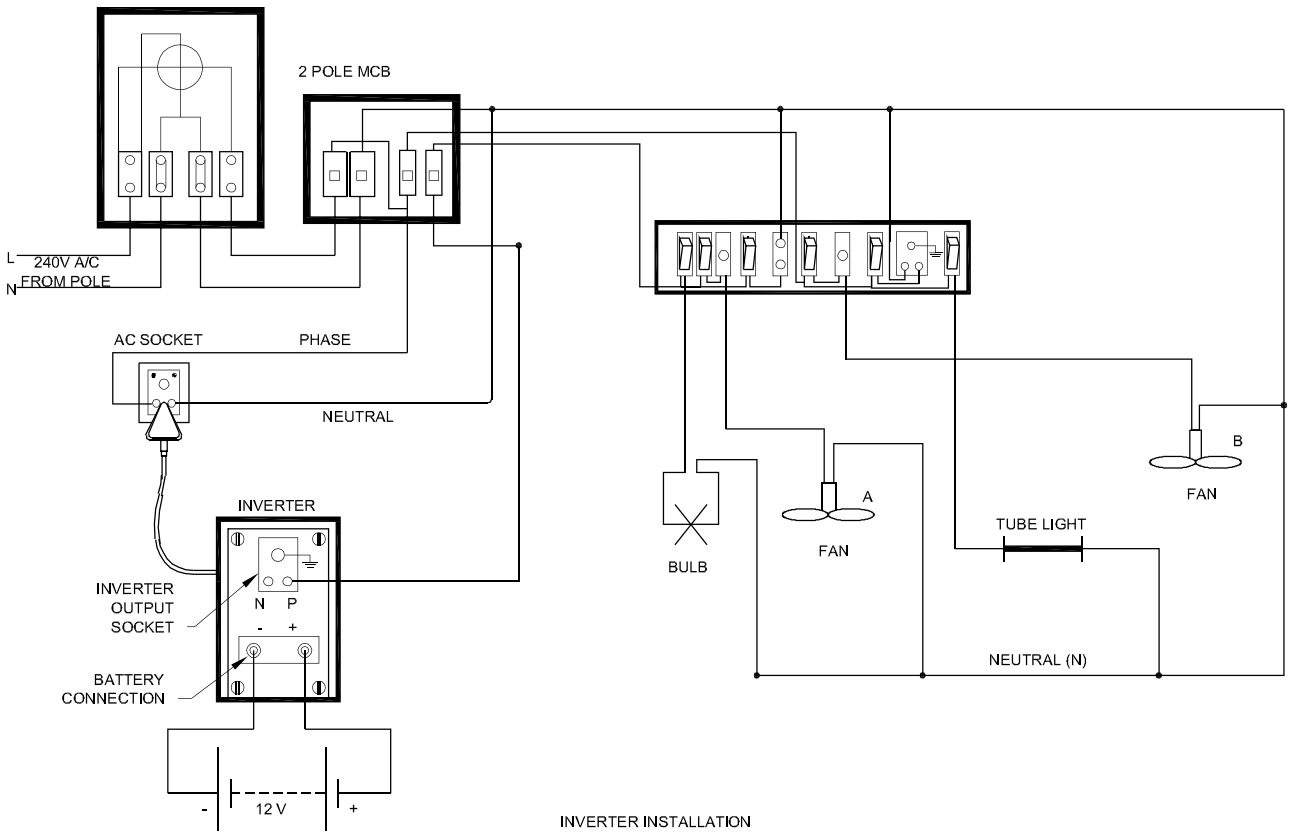
To connect inverter to the supply line, suitable place for the inverter is to be located. That place must be nearer to the service energy meter and ICDP switch and provide a 3 pin output socket from the mains supply line for the inverter and connect the inverter to the socket as in (Fig 1).

Installation of inverter

Collect the suitable inverter with sealed free maintenance battery to be installed, and check for their proper function

Place the inverter's battery to a suitable place near the inverter and connect the battery to the inverter.(Fig 1)

Fig 1



Keep the battery as close as possible to the inverter, so that the wire connecting the battery terminals to the inverter can be small and current loss is reduced. Make sure the battery is fully charged before installation.

The positive terminals of battery (red wire) is connected to the place provided for the positive terminal on the inverter and the negative terminal of the battery (blue or black wire), which is to be connected to the place provided for the negative terminal on the inverter.

When connecting battery terminals to the inverter, use special auto wires do not use common mains wiring with wires such as '3/20' and 7/20 etc.connecting battery using these wires will not provide proper connection between the battery and the inverter.

After connecting the battery, put some grease (or) vase-line on the battery terminals, which reducing the terminal corrosion.

All the connection is completed take the output from the inverters output socket and use it to power the load. Use 1/18 copper wire to the output of the load. Do not use 3/20, 3/22 or 7/20 wires, commonly used in house wiring.

The output is taken from the phase out 'pin of inverter' output socket, and is provided to the ON/OFF switches on the wall pause.(Fig 1)

The neutral line is common for both the inverter output and the mains A/C line. So, only one wire for the phase line can be drawn from the inverter output socket to the switches.

In Fig 1, one bulb, one fan and a 2 pin output socket are connected to the inverter output and the other devices in the room. (ie) the tube light, fan (2) and a 3 pin output socket are directly connected to the mains A/C line.

In the two pin socket, should not be connected with heavy load during power 'OFF' only small load like mosquito repeller can be connected.

As in (Fig 1) the load connected to the inverter will get the mains A.C supply. If the mains supply is 'On' at the same time, other devices will also work on the main supply, because they are connected directly to the mains A.C supply.

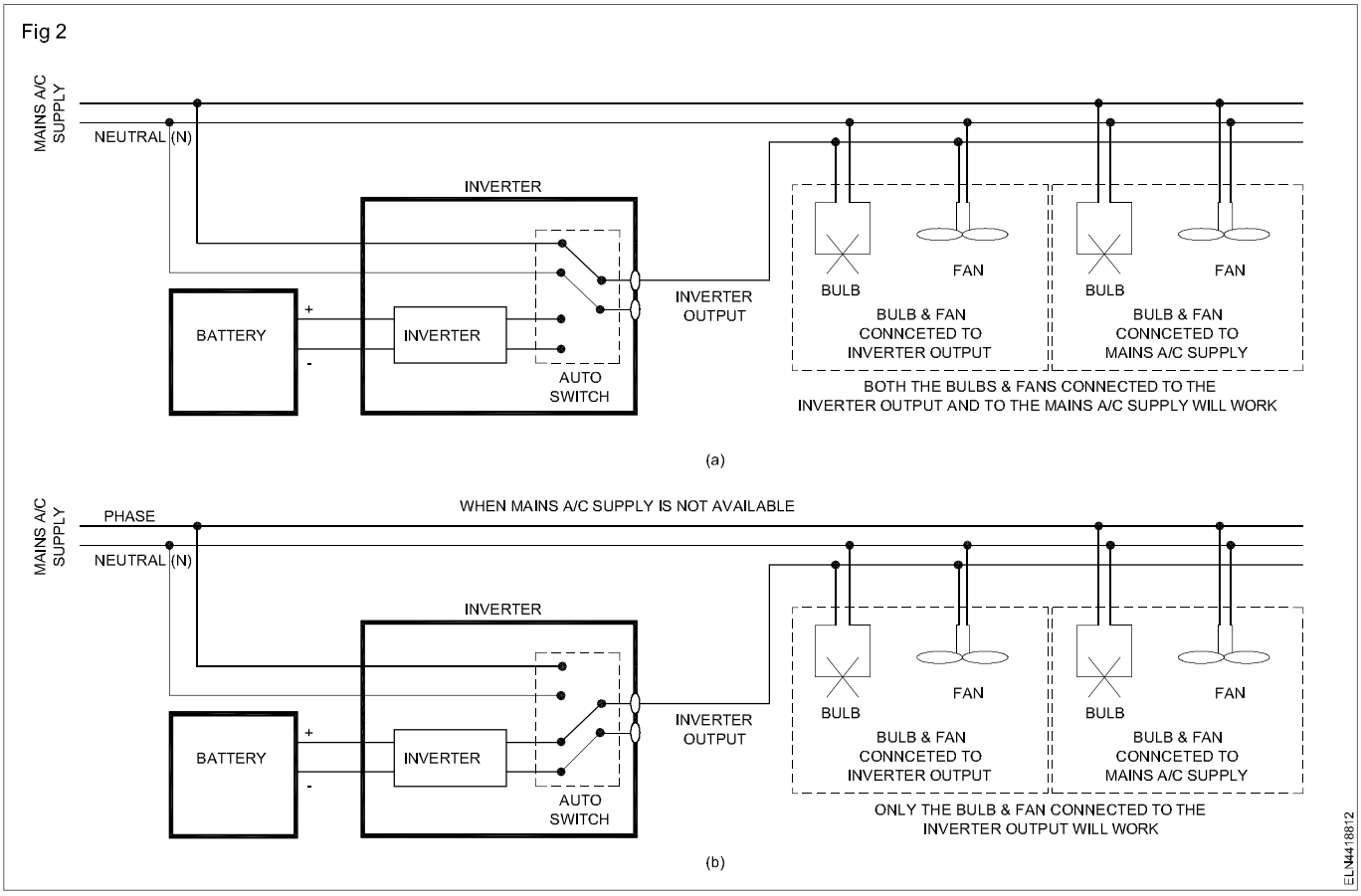
But at the time of power shut down, the devices directly are connected to the mains A.C will stop functioning and the devices, which are connected to the inverter output will keep on working on the inverter output.

Later, if the mains A.C supply returns, the inverter will once again connect the load, which are connected to its output to the main supply. This process is in Fig 2.

Inverter rating calculation

Generally, the inverters are available with ratings such as 200w,300w,400w,500w,600w,1000w,1200w,1500w and so on.

Fig 2



The cost of the inverter is proprotional to their capacity in wattage (or) VA. It must be considered before buying the Inverter.

Calculation of power consumption

True power = Apparent power x power factor
Let us assume,
The loads are - 2 tube lights,(ie) 2x40W = 80W
- 1 fan (ie) 1x60W = 60W
- 1 bulb (ie) 1x40W = 40W
Total load = 180 W

If the total load is 180W, the inverter capacity is to be selected for 300W, giving some safe margin.

Always, the inverter with high rating must be purchased by considering the future the household appliances may be added.

Power consumption Table

Device time	Approx Watts	P.f-0.8 (app) VA	Running for 1 unit of consumption (approx.) Hrs. - Min.
Incandecent bulbs (B.C bulbs)	25W	20	40-00
Incandecent bulbs	40W	32	25-00
Incandecent bulbs	60W	48	16-40
Incandecent bulbs	100W	80	10-00
Fluorescent tube 61 cms	20W	16	50-00
Fluroescent tube 122 cms	40W	32	25-00
4 feet night lamp	15W	12	66-40
Mosquito repellent	5W	4	200-00
Fans	60W	48	16-40
Air - coolers	170W	136	5-50
Air-conditioners (1 to 1.5 ton)	1500W	1200	0-40
Refrigerators (165 liters)	225W	180	4-30
Mixer/blender /juicer	450W	360	2-15
Toaster	800W	640	1-15
Hot plate	1000W	800	1-00
Oven	1000W	800	1-00
Electric kettle	1000W	800	1-00
Iron	450W	360	2-15
Water heater: (a)Instant geysers 1.5 - 2 liter)	3000W	2400	0-20
Water heater: (b)Storage type (10-12 liter)	2000W	1600	0-30
Water heater: (c) Immersion rod	1000W	800	1-00
Vacuum cleaner	700W	560	1-25
Washing machine	325W	260	3-00
Water pump	750W	600	1-20
TV	60W	48	16-00
Radio	15W	12	66-00
Video	40W	32	25-00
Tape recorder	20W	16	50-00
Stereo system	50W	40	20-00
PC Cop.	120W	150	8-20
PC/XT cop.	185W	230	5-25
PC/AT Cop.	255W	320	3-55
386& Higher Cop.	320W	400	3-08
Mono chrome monitor	44W	55	22-45
CGA monitor	64W	88	15-35
EGA monitor	80W	100	12-30
VGA monitor	120W	150	8-20
80-column dot-matrix printer	64W	80	15-40
160-240 cps printer	100W	125	10-00
132- column dot matrix printer	140W	175	7-08

Device time	Approx Watts	P.f-0.8 (app) VA	Running for 1 unit of consumption (approx.) Hrs. - Min.
Image writer II	80W	80	12-30
Laser write plus	880W	1100	1-08
HP Laser jet Printer	840W	1050	1-11
External Hard Disks	80W	100	12-30
Tape Back up	140W	175	7-08

Preventive and breakdown maintenance

Preventive maintenance : It improves the performance safety of a business instead of a large repairs being needed and major problems arising. Consistent maintenance is carried out to reduce these risks. This improves the performance of all equipment. It also helps to avoid unplanned repairs and unexpected maintenance needs.

Preventive maintenance further divided into two parts they are;

a Planned preventive maintenance and

b Unplanned preventive maintenance

a Planned preventive maintenance

A planned preventive maintenance cut-down maintenance cost and ensure the long life of equipment and a steady quality output. The following is the benefits of planned preventive maintenance.

a overtime costs reduced

b reduced risk of problems

c reduced no. of repairs

d small repairs can be carried out regularly

e ensures all equipment safe in good conditions

f If meets safety and environment standards

g Improves the safety and health of workers.

b Unplanned preventive maintenance

The unplanned preventive maintenance is nothing but a routine maintenance work. For example lubricating, cleaning, tightening of nuts and bolts etc, are same of the maintenance. This not involves any predetermined work associated. The following is the draw backs of unplanned preventive maintenance.

a Increases overall material cost

b Improper usage of manpower

c Not guaranteed of quality or quality or quantity in production

d No guarantee of machine condition

e Increased risk of problems

f Unexpected problems in production and quality.

Breakdown maintenance is a form of material or equipment remediation that is performed after the equipment or material has lost its functioning capabilities or properties.

Breakdown maintenance is maintenance performed an equipment that has broken down and is unusable. It is based on a breakdown maintenance trigger.

Demerits of breakdown maintenance

a Loss of production and business unexpected

b Huge expenses for restoration

c Non availability of spares and experts

d Accidents, environmental problems

e Leads to major accidents loss of life

f Wastage of raw material if time based supply

A well planned preventive maintenance can avoid breakdown of machines and keep maintain steady quality production and maintain company standards.