

# **INVERTERS**

## **(FOR EMERGENCY AND SOLAR PLANT)**

### **1. INTRODUCTION:**

An inverter is an electronic device that produces alternating current (AC) from direct current (DC). It is used to convert direct current - C source of electricity viz, Power Storage Battery cells in to alternating current - AC power to run Alternating current equipment viz. standard household appliances like lighting, fans, TV, Radio, computers etc. low power consuming gadgets.

An Inverter may also built up along with rectifier circuit design that converts AC power in to DC power to connect and charge storage battery units when power mains is on, while switches over to providing power from battery when AC supply is interrupted. Such systems are used to drives the "Critical" load such as computer systems or electronic control systems in process plants, without interruption. These systems are called Un-interrupted power supply or UPS system. Besides, these applications. The Solar power systems require inverters to convert DC electrical power generated by solar panels to AC home and grid connections.

### **2. PRODUCT & ITS APPLICATION:**

The inverter circuits have become popular and essential in view of the power shortages and frequent interruptions of power in rural areas. Besides the proliferation of electronic equipment has given rise to the need of UPS systems to ensure that the critical electronic equipment and control system is always kept on. This is made possible by Inverter systems.

Inverters are rated for power capacity in terms of VA/ KVA and they are made from 20 VA for individual gadgets to few thousand VA or KVA ratings. Domestic Inverters are popular with up to 500 VA while industrial products have up to 50 KVA capacities.

In UPS system AC power received from mains or grid is converted to DC system by rectifier circuit. This converted DC power is fed to inverter via storage battery bank through a special circuit. The end user equipment gets uninterrupted AC power from inverter which is fed DC power either from rectifier or battery. With this system, in case of interruption in AC main, the battery kicks in the DC supply to inverter thereby ensuring power supply.

Besides providing uninterrupted supply, the system is built with circuits that regulate and protect end equipment in case of power surge or transients / variations in voltage through protection circuits. Inverter system may be used in wide range of applications. From small switching power supplies to critical to large electric utility applications that transport bulk power.

The inverter system is inherent in solar power plant as the PV cells generate DC power which is combined from no of panels having multi watt cells. The DC power is inverted in to AC power system for home use / industrial use or foe connecting with grid to supply power commercially. At present these inverter systems technology is largely in the multinational companies.

### **3. DESIRED QUALIFICATIONS FOR PROMOTER:**

Any ITI, Diploma or graduate with experience in production or marketing experience.

### **4. INDUSTRY OUTLOOK/TREND**

Indian UPS market is a steadily growing with both Indian and multinational manufacturers contending for market share. The Indian inverter market comprises of organized and unorganized players jostling for space. The major driving factors are the poor quality and reliability in domestic and continuous process of manufacturing industries sectors. The critical nature of manufacturing processes cannot afford a millisecond of power disruption as the loss due to such interruptions or poor quality leads to quite huge financial loss.

In domestic segment there is remarkable change in attitude even in rural areas that has prospered and has installations of electrical gadgets and appliances. The rural markets as a result are a thriving prospective market for inverters/ UPS power systems. The decreasing tolerance for long power cuts among consumers has seen growth of this market and the for inverter industry market is pegged in 2010 at Rs 20 billion. The growth assessed is CAGR 8.9%.

The Inverter system technology trend is of efficient and low cost inverters and UPS systems. A new Green UPS systems using mechanical flywheel has also emerged, as it has efficiency rates of 94-97 per cent as against the usual 80-88 per cent efficiency units. This helps in conserving energy as well as reducing the carbon footprint. A new technology of is of transformer less systems with use of ferrites is another emerging area. The trend with usage towards solar system inverters is worth noting.

## **5. MARKET POTENTIAL AND MARKETING ISSUES. IF ANY:**

Digital Inverters, with latest technology and excellent performance, offer the safety and protection of the gadgets and precious home appliances is in high demand at present.

While the unorganized sector caters to the price-sensitive consumers and posing serious competition to organized players that target the brand-conscious consumers. The market for inverters and UPS in India is fragmented and there exist a large number of small unorganized players manufacturing inverters. The market is dominated by a few leading brands including Luminous, Microtek and Su-Kam. Luminous is the market leader with a share of 28% and Microtek is the second largest brand with 23% share. There are MNC brands in UPS viz Emerson, with 20% market share followed by APC with 18% share mostly in industrial consumer segments. Rural and urban domestic market segments are price sensitive and served by mainly by large no of SME units.

In solar inverter segment, there are many local players the market, top 10 global suppliers still account for over 90% of the shipments viz multinationals ABB,

Schneider, SMA, TMEIC and Hitachi and Chinese companies. Among the local units, Delta Electronics is clear market leader, followed by Su-Kam and Consul Neowatt.

The inverter market forecast estimates are pegged at Rs 120 billion 2019, of which the plain inverter systems used in electronic appliances and industry is 35 % while the UPS systems and solar plant inverters is 65%. The market for utility-scale solar projects in India is dominated by central inverters. The most common sizing/ rating are increasing from 1MW to 2.5MW and 1,000V. Most of the companies are now assembling their solar inverters systems in India.

The fact that the price of photovoltaic module, is going down, the solar plants are likely to be not only achieve grid parity and but, in the future, the solar industry would definitely be cheaper and in a very strong position. Once grid parity is realized, the payback period will come down drastically, leading to huge growth in solar plants and therefore of central inverter systems. Local units have very good scope as the Indian rooftop solar market is expected to add about 500MW of new capacity this year. In solar inverter segment, the rooftop solar market in India is expected to grow at an impressive 70-80% for the next few years.

There is a much larger room for newer companies to capture market share in domestic as well as solar inverter segments. Brand perception, effective distribution and competitive pricing are likely to be the key success factors in this segment.

## **6. RAW MATERIAL REQUIREMENTS:**

The raw materials required are thyristors, capacitors, inductors, filter chokes, power diodes, reactors coils, protection fuses, transistors, resistors, constant voltage transformers lamination, terminals and chassis boxes. Also as per the circuit designed, copper clad PCB s are obtained from PCB suppliers or circuit etching may be carried out by the unit. Other materials are cabinets/ enclosures to house the unit with IP 55 and IP 65 specs.

## **7. MANUFACTURING PROCESS:**

The process involves steps like:

- PCB are etched in a small etching plant or obtained from supplier. The PCB s are tested for the circuit tracks sanctity and quality.
- Various circuit components to be used are tested upon arrival from stores. These components are fed to mounting stations. At each mounting station components are inserted / mounted and soldered consecutively on printed circuit board as per the design.
- Finished PCB is inspected for solder quality and component, and each Circuits modules are tested for the output voltages, wave forms and output power. Where necessary, necessary adjustments are made by tuning the capacitors coils etc. to get designed voltage wave and output.
- The tested PCBs are fitted on to chassis along with terminals and indicating meters and housed in casings. The final product undergoes testing for various operating conditions meant for Inverters.
- The tested products are labeled and packed for dispatched.

Inverters and UPS of different power capacity are made with input voltage of 12 V/ 24 V DC and output of 230 V AC and power ratings of 200 VA to 20000 VA or more. The UPS system circuits may include rectifier circuits and may be supplied with Lead acid or sealed battery cell.

## **8. MANPOWER REQUIREMENT:**

The unit shall require highly skilled service persons. The unit can start from 15 employees initially and increase to 38 or more depending on business volume.

Sr No	Type of Employees	Monthly Salary	No of Employees				
			Year 1	Year 2	Year 3	Year 4	Year 5
1	Skilled Operators	18000	3	4	6	8	10
2	Semi-Skilled/ Helpers	8000	8	10	12	15	18
3	Supervisor/ Manager	30000	1	1	1	1	1

4	Accounts/ Marketing	16000	2	3	3	3	3
5	Other Staff	7000	1	3	6	6	6
	TOTAL		15	21	28	33	38

## 9. IMPLEMENTATION SCHEDULE:

The unit can be implemented within 3 months from the serious initiation of project work.

Sr No	Activities	Time Required in Months
1	Acquisition of Premises	-
2	Construction (if Applicable)	-
3	Procurement and Installation of Plant and Machinery	2
4	Arrangement of Finance	2
5	Manpower Recruitment and start up	2
	Total Time Required (Some Activities run concurrently)	3

## 10. COST OF PROJECT:

The unit will require total project cost of Rs 47.13 lakhs as shown below:

Sr No	Particulars	In Lakhs
1	Land	0.00
2	Building	0.00
3	Plant and Machinery	24.22
4	Fixtures and Electrical Installation	1.60
5	<i>Other Assets/ Preliminary and Preoperative Expenses</i>	1.00
6	Margin for working Capital	20.31
	TOTAL PROJECT COST	47.13

## 11. MEANS OF FINANCE:

The project will require promoter to invest about Rs 27.01 lakhs and seek bank loans of Rs 20.12 lakhs based on 70% loan on fixed assets.

Sr No	Particulars	In Lakhs
1	Promoters Contribution	27.01
2	Loan Finance	20.12
	TOTAL:	47.13

## 12. WORKING CAPITAL REQUIREMENTS:

Working capital requirements are calculated as below:

Sr No	Particulars	Gross Amount	Margin %	Margin Amount	Bank Finance
1	Inventories	17.51	40	7.00	10.50
2	Receivables	13.52	40	5.41	8.11
3	Overheads	3.23	100	3.23	0.00
4	Creditors	11.67	40	4.67	7.00
	TOTAL	45.93		20.31	25.62

## 13. LIST OF MACHINERY REQUIRED:

Sr No	Particulars	UOM	Quantity	Rate	Total Value
	<b>Main Machines/ Equipment</b>				
1	PCB Plant	Nos	1	450000	450000
2	Coil winding machine	Nos	2	35000	70000
3	Component Assembly /soldering	Nos	2	60000	120000
4	PCB Test Station	Nos	2	30000	60000
5	Component Test station	Nos	2	30000	60000
6	Assembly line for PCB	Nos	2	75000	150000
7	Assembly inspection Station	Nos	2	20000	40000
8	PCB Testing Station	Nos	2	60000	120000

9	Assembly Line of Final product	Nos	2	40000	80000
10	Testing station for final products	Nos	2	75000	150000
12	Packing Labeling Station	Nos	1	35000	35000
13	Oscilloscope single/ dual waves 350 MHz	Nos	4	130000	520000
14	Dimmer stats, Transformers	Nos	3	50000	150000
15	LCR bridges, meters	LS	3	25000	75000
<b>Sr No</b>	<b>Particulars</b>	<b>UOM</b>	<b>Quantity</b>	<b>Rate</b>	<b>Total Value</b>
16	DC power supply	Nos	3	40000	120000
17	Power, volt, amp etc. meters	Nos	8	4000	32000
	<u>Subtotal:</u>				2232000
	<b>Tools and Ancillaries</b>				
1	Jigs Fixture Tools for Assly line etc.	LS	1	150000	150000
2	Hand Tools and gauges	LS	1	40000	40000
	<u>Subtotal:</u>				190000
	<b>Fixtures and Elect Installation</b>				
	Storage and transport bins and trolleys	LS	1	60000	60000
	Office Furniture	LS	1	20000	20000
	Telephones/ Computer	LS	1	30000	30000
	Electrical Installation	LS	1	50000	50000
	<u>Subtotal:</u>				160000
	Other Assets/ Preliminary and Preoperative Expenses	LS	1	100000	100000
	<b>TOTAL PLANT MACHINERY COST</b>				2682000

All the machines and equipment are available from local manufacturers. The entrepreneur needs to ensure proper selection of product mix and proper type of dies and tooling to have modern and flexible designs. It may be worthwhile to look at reconditioned imported machines, dies and tooling. Some of the machinery and dies and tooling suppliers are listed here below:

1. Hakuto Singapore Private Limited  
No. 423, 1st Floor, 7th B Main, 1st Block HRBR Layout, Kalyan Nagar,  
Bengaluru-560043, Karnataka, India



2. Yogi Electronics  
B/37, GIDC, Electronics Estate, Sector 25,  
Ahmedabad-380001,  
Gujarat, India
  
3. Scientech Technologies Pvt. Ltd.  
94, Electronic Complex, Pardesipura,  
Indore-452010, Madhya Pradesh, India
  
4. Enthu Technology Solutions India Private Limited  
No. 88 & 89, Peelamedu Pudhur SSN Square,  
Coimbatore-641004, Tamil Nadu, India
  
5. Mohite Electronics Private Limited  
S. R. 2/1-B, Ganesh Krupa Building Ram Chandra Nagar,  
Dhankawdi, Pune - 411043

#### 14. PROFITABILITY CALCULATIONS:

Sr No	Particulars	UOM	Year Wise estimates				
			Year 1	Year 2	Year 3	Year 4	Year 5
1	Capacity Utilization	%	30	40	50	60	70
2	Sales	Rs. Lakhs	162.28	216.37	270.46	324.55	378.64
3	Raw Materials & Other Direct Inputs	Rs. Lakhs	140.05	186.73	233.41	280.09	326.78
4	Gross Margin	Rs. Lakhs	22.23	29.64	37.05	44.46	51.87
5	Overheads Except Interest	Rs. Lakhs	16.57	16.57	16.57	16.57	16.57
6	Interest	Rs. Lakhs	2.82	2.82	2.82	2.82	2.82
7	Depreciation	Rs. Lakhs	2.68	2.68	2.68	2.68	2.68
8	Net Profit Before Tax	Rs. Lakhs	0.16	7.57	14.98	22.39	29.80

The basis of profitability calculation:

The Unit will have capacity of total 3000 nos of up inverters/ UPS systems per year of different types/ ratings. The bulk sale/ distribution sales prices range from Rs 2500 for smaller units of 300 VA inverter systems to Rs 150000 for high capacity inverter / UPS products depending on type, size/ rating and volumes. For solar inverter the sales prices range from Rs to Rs 1200 per kg for special grades/ flux compositions/ ratings used for critical applications.

The raw material viz PCB laminates cost ranges from Rs1500 to Rs 10000 per sq. mtrs and that of inverter thyristor, diodes, etc. components cost range from Rs 50 to 10000 per piece. The material requirements are considered with wastage/ scrap etc. of 3 % of finished products. The unusable scrap is sold at @ Rs 18 ~ 50 per Kg. and the income of same is added. Energy Costs are considered at Rs 7 per Kwh. The depreciation of plant is taken at 10 % and Interest costs are taken at 14 -15 % depending on type of industry.

## **15. BREAK EVEN ANALYSIS**

The project is can reach break-even capacity at 42.02 % of the installed capacity as depicted here below:

<b>Sr No</b>	<b>Particulars</b>	<b>UOM</b>	<b>Value</b>
1	Sales at Full Capacity	Rs. Lakhs	540.92
2	Variable Costs	Rs. Lakhs	466.82
3	Fixed Cost incl. Interest	Rs. Lakhs	22.06
4	Break Even Capacity	% of Inst Capacity	29.78

## **16. STATUTORY/ GOVERNMENT APPROVALS**

The unit shall have to get state industrial unit registration from DIC, IEC Code for Export and local authority clearance. Depending on structure of finance the

company shall need to register company with registrar of companies. The registration and approval for factory plan, safety for Fire etc. requirement, registration as per Labour laws ESI, PF etc. shall be required as per rules and applicability. Before starting the unit will also need GST registration for procurement of materials as also for sale of goods. As such there is no pollution control registration requirements, except installation of chimney/ blowers for heat treatment furnace / pickling line and ensure safe environment as per rules of factory safety. Solid waste disposal shall have to meet the required norms. Entrepreneur may contact State Pollution Control Board where ever it is applicable.

### **17. BACKWARD AND FORWARD INTEGRATION**

The machines and equipment offer scope for diversification in to producing various types of electronic circuits and controllers based on design capabilities. The unit can also cater to other consumer and industrial products / components supply by using the spare capacities and design/ production capabilities. As such there is not much scope for organic backward or forward integration.

### **18. TRAINING CENTERS/COURSES**

There are no specific training centers for wire drawing technology. There are training for dies and tools development run by several centers of excellence viz Indo German Tool Room at Ahmedabad, Rajkot, Chennai, and CTTC Bhubaneswar etc. shall be helpful.

The most important scope of learning is in new product design and development by associating with institutes like NID etc. Entrepreneur may also study the new product designs, product range, features and specifications of leading Brands / competitors across the world by scanning the Internet and downloading data. Viz. North American, Europe, China etc. markets.

Udyamimitra portal ( link : [www.udyamimitra.in](http://www.udyamimitra.in) ) can also be accessed for hand-holding services viz. application filling / project report preparation, EDP, financial Training, Skill Development, mentoring etc.

Entrepreneurship program helps to run business successfully is also available from Institutes like Entrepreneurship Development Institute of India (EDII) and its affiliates all over India.

**Disclaimer:**

Only few machine manufacturers are mentioned in the profile, although many machine manufacturers are available in the market. The addresses given for machinery manufacturers have been taken from reliable sources, to the best of knowledge and contacts. However, no responsibility is admitted, in case any inadvertent error or incorrectness is noticed therein. Further the same have been given by way of information only and do not carry any recommendation.

Source:- Udyami Mitra/Sidbi