# REPORT
ON
# PROMOTION OF SELF RELIEANCE
IN
# DOMESTIC INVERTER UPTO 5 KVA

**(Under the Public Procurement Policy of Mnisry of MSME , Govt .of .India)**

*"Go Vocal for Local"*

*A nation's strength ultimately consists in what it can do on its own, and not in what it can borrow from others*


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## BACKGROUND

At a time when the world is suffering from a deadly pandemic, India is converting this crisis as an opportunity to strengthen her efforts to become Aatmanirbhar or self-reliant. **Atmanirbhar Bharat** is the vision of new India envisaged by the **Hon'ble Prime Minister Shri.Narendra Modi**. **On 12 May 2020, Hon'ble Prime Minister made a clarion call to the nation giving a kick start to the Atmanirbhar Bharat Abhiyaan** (Self-Reliant India campaign) and announced a Special comprehensive economic package of Rs. 20 lakh crores which is equivalent to 10% of India's GDP. Atmanirbhar Bharat Abhiyaan aims to make the country and its citizens self-reliant. Hon'ble Prime Minister further outlined five pillars of Aatmanirbhar Bharat – Economy, Infrastructure, System, Vibrant Demography and Demand. The Government also initiated several bold reforms such as Supply Chain Reforms for Agriculture, Rational Tax Systems, Simple & Clear Laws, Capable Human Resource, Special package for MSMEs, Strong Financial System and many others. The self- reliance movement aims for local value addition and integration of Indian Enterprises with global value chain with an objective of making India a global hub of manufacturing and services.

**Development Commissioner (MSME), under the Ministry of Micro, Small and Medium Enterprises(MSME**), Government of India is implementing various programmes and policies for the development of Micro Small & Medium Enterprises (MSMEs) in the country. As per the **Public Procurement Policy of M/o MSME, Govt of India**; 25% of the total procurement by Government of India Departments & undertakings need to be sourced from MSEs (Micro & Small Enterprises) with price preference in purchase. There is also Government of India policy to give preference in public procurement for local supplier whose product meets the required local content.

As part of the Public Procurement Policy of Ministry of MSME, **358 items have also been exclusively reserved for purchase from MSEs . Central Government Ministries, Departments and Public Sector Undertakings** have to purchase these 358 items from MSE Manufactures only. However, it has been observed by the Government that even though there is a protection for these 358 items in Government purchase, the import

of some of these items are high which calls for further analysis to draw a road map to boost local manufacturing and export.

As per the vision of Atmanirbhar Bharath, the non-essential imports are to be discouraged and proper policies & programmes are being initiated to encourage domestic manufacturing in such sectors. In order to encourage further domestic manufacturing of these products, **Development Commissioner (MSME) has proposed to prepare a roadmap for self reliance for the identified items from the list of 358 reserved items. Inverter Domestic Type up to 5KVA (HSN Code 85044010)** is one such reserved item which is still being imported in the country.

As per the data available under Director General of Commercial Intelligence and Statistics (DGCIS) , the import of Electric Inverter ( HSN code 85044010) is as under :

| YEAR | AMOUNT IN US $ MILLION |
|---|---|
| **2017-18** | 197.89 |
| **2018-19** | 167.40 |
| **2019-20** | 180.74 |

The objective of this report is to find out the status of the Inverter industry, reasons for the imports , scope to boost domestic manufacturing, scope for exports, to find out the technological and testing needs of the sector, availability of raw material & components etc . Report also tries to outline a road map to promote self reliance in the product category.

## INTRODUCTION

** The Electronics industry is one of the fastest growing industrial segments in the world, set to reach over US$ 7 trillion by 2025. The Indian market is expected to be second only to China's, followed by Vietnam, South Korea and Taiwan. The Government of India is focusing on the manufacturing of Electronics hardware within India, which seems to be the conceptual origin for both the Make in India and the Digital India programmes. These initiatives encourage domestic manufacturing and exports across the Electronics System Design and Manufacturing (ESDM) value chain, aiming to achieve a market size of US$ 250 billion by 2023. As per Ministry of Electronics & information Technology (MeiTy), GoI; the Indian Electronics industry consists of seven main segments, including Consumer Electronics, Industrial Electronics, Communications and Broadcasting Electronics, Strategic Electronics, Computer Hardware, Electronic components and LED products.

**India's share in the global Electronics hardware production is 3.4%. The share of domestic Electronics production in India's GDP is 2.3%. The import of Electronic goods was of the order of USD 57 Billion in 2018-19. With the demand for Electronics hardware expected to rise rapidly to about USD 400 Billion by 2025, India cannot afford to bear a huge foreign exchange outgo on import of Electronic products alone. Therefore, promoting domestic Electronics hardware manufacturing, with high value addition is very significant. Domestic manufacturers are unable to fulfil the growing demand for Electronic goods in the country, with imports accounting for as high as 70 percent of the market in certain product segments. The demand of Electronic products in India is growing at a CAGR (Compound Annual Growth Rate) of about 40% during 2017-2020 leaving a huge gap for import.

Key verticals such as Industrial Electronics (including Automotive & Medical Electronics), Mobile Phones and Consumer Electronics account for about 75% of the market for Electronics in India. Without suitable interventions in the form of fiscal and non-fiscal support, Industry players estimate that imports of Electronic items may increase up to 3-4 folds in the coming years.

Government of India is very keen to reduce Electronics imports by creating a local ecosystem for Electronics manufacturing. In order to reduce the dependence on imports and to capitalize on the sector's potential; Government of India (GoI) has been proactively expanding efforts to provide an impetus to the sector.

As a result of the Initiatives of Govt of India, here are some key insights into Electronics trade in the Indian market:

- In FY 19, for the first time, Electronics imports declined as compared to the previous year. In contrast, both Electronics production and Electronics exports increased compared with the previous year.
- In FY 2019, for the first time, domestic production overtook imports largely due to the Make in India initiatives.
- In the Industrial Electronics segment, the focus is shifting, particularly to solar and cleaner energy due to the thrust given by Govt. of India for non conventional energy sectors . In the industrial Electronics segment, imports meet 50 per cent of the local demand.

Apart from policies like the Make in India initiative, the National Policy on Electronics (NPE) 2019 and Digital India, Govt of India has also backed the sector with the Electronics Development Fund (EDF), the Electronics Manufacturing Cluster (EMC) the Modified Special Incentive Package Scheme (MSIPS) *(new applications closed for MSIPS)*, the Phased Manufacturing Programme (PMP), Preferential Market Access (PMA) *(now called PMI- Preference to Make in India),* Production Linked Incentives (PLI) and by rationalising the duty structure. The PLI is reflection of India's bold shift of gear from an Import Substitution Led Strategy to an Export Led Manufacturing Strategy. With the raising manufacturing costs in other economies, increasing labour costs and trade wars, global organisations are expected to shift their units to India to serve domestic and global demand. Due to all these factors, it is expected that the Indian Electronics industry is likely to increase its share in the global market in the coming years

# CHAPTER- 1- COMMERCIAL DETAILS

## 1. A) NAME OF THE PRODUCT- Inverter Domestic Type up to 5 KVA

## 1. B) HSN CODE

Harmonized System of Nomenclature (HSN Code) 85044010 is used for the ELECTRIC INVERTERS products under Goods and Service Tax classification. First two digits (85) represent the chapter number which is Chapter 85 - Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and parts and accessories of such articles. Next two digits (04) represent the heading number which is Electrical transformers, Static converters (for example, rectifiers) and Inductors. Next two digits (40) represent the product code which is Static converters. Last two digits (10) are for final or deeper classification which is ELECTRIC INVERTERS. All 8 digits of HSN code is mandatory for export & imports for tax invoice of GST.

## 1. C) NIC CODE

National Industrial Classification 2008 (NIC-2008) Code **27900** is used for **Manufacture of other Electrical equipment**. National Industrial Classification 2008 seeks to provide a basis for the standardized collection, analysis and dissemination of industry (economic activity) wise economic data for India.

The structure for **NIC Code 27900** is illustrated below.

| **Level** | **Description** |
|---|---|
| Section C | Manufacturing |
| Division 27 | Manufacture of electrical equipment |
| Group 279 | Manufacture of other electrical equipment |
| Class 2790 | Manufacture of other electrical equipment |
| Sub-Class 27900 | Manufacture of other electrical equipment |

## 1. D) IDENTIFIED CLUSTERS IN THE PRODUCT CATEGORY

Inverter industry in India is scattered all over India. The hubs of Inverter manufacturing activities are concentrated in Maharashtra, Gujarat, Tamil Nadu, Uttar Pradesh, Delhi, Karnataka, Rajasthan, Madhya Pradesh, Haryana, West Bengal, Telangana etc. These states have attracted sizable investments and are the key industrial hubs. As per the list of 10 clusters of each district in the country identified by MSME DIs and as published in the website of DC (MSME), Ministry of MSME, there are two identified clusters in the country in the Power Electronics sector.

They are:

1) Stabilizer, UPS and Inverter Cluster in Bhubaneswar district in the Orissa State as identified by MSME-Development Institute, Cuttack.
2) Inverter Cluster, in JP Nagar district in UP as identified by MSME-Development Institute Agra
3) Cluster manufacturing outer cover of Inverters in Paramakkudi, Ramanathapuram District, Tamilnadu - ***as Informed by MSME-DI, Chennai***

## 1. E) POSSIBILITY TO CREATE / ESTABLISH CLUSTERS

As per the number of units registered as MSMEs in the Udyog Adhaar Memorandum (UAM) & Udyam Registration (UR portals of the Ministry of MSME, under the NIC code 27900 (Manufacture of other Electrical Equipments) maximum numbers of units are registered in the following states:

| State | Numbers of Udyog Adhaar Memorandum (UAM) registered units against NIC code 27900 is | Number of Udyam Registered( UR) units |
|---|---|---|
| Maharashtra | 8896 | 4173 |
| Gujarat | 4030 | 1632 |
| Tamil Nadu | 3439 | 1580 |
| Uttar Pradesh | 3302 | 1460 |
| Delhi | 3113 | 1401 |
| Karnataka | 2308 | 1062 |
| Rajasthan | 1917 | 897 |
| Madhya Pradesh | 1850 | 535 |
| Haryana | 1694 | 850 |
| West Bengal | 1626 | 696 |
| Telangana | 1425 | 579 |

Hence there is the possibility to create clusters in these states. Further as per the feedback received from the associations, there is scope to create clusters in the following places & states

| | |
|---|---|
| 1 | Maharashtra |
| 2 | Gujarat |
| 3 | Tamil Nadu |
| 4 | Uttar Pradesh |
| 5 | Delhi |
| 6 | Karnataka |
| 7 | Rajasthan |
| 8 | Madhya Pradesh |
| 9 | Haryana |
| 10 | West Bengal |
| 11 | Telangan |
| 12 | Kerala |

It is therefore suggested that MSME-DIs at Mumbai, Ahmedabad, Chennai, Kanpur, Delhi, Bangalore, Jaipur, Indore, Karnal, Kolkata, Hyderabad may try to create clusters in these states wherever feasible and try to create following common facilities as per the requirements

1. Testing Facilities as per National &International Standards
2. Common R & D & Design Centres to develop indigenous Design & Technology -– It has been reported that industry players may not together there on, hence Government of India may have to play key role in bringing them together to such centre.
3. Common Fabrication Centres for the design & manufacture cases
4. Common Electronic Waste processing Battery recycling centres.

**1. F) PROBABLE AREAS OR DISTRICTS WHERE THE PRODUCT IS MANUFACTURED**

Potential locations for investment in the Inverter sector in India are:

1. Maharashtra
2. Gujarat
3. Tamil Nadu
4. Uttar Pradesh
5. Delhi
6. Karnataka
7. Rajasthan
8. Madhya Pradesh
9. Haryana
10. West Bengal
11. Telangana

A brief profile of each of the above states based on the key parameters is furnished below.

**Maharashtra :** Maharashtra is one of the most industrialized states in the country . Business-friendly industrial policies, infrastructure facilities, proximity to the coast and the availability of large talent pool have made Maharshtra as one of the country's Electronics manufacturing hubs.

**Gujarat :** Gujarat's status as India's most industrialized state is reflected in its contribution to the national GDP and its management of exports. The State has come up with new Electronic policy to attract investment and achieve a turnover of US$ 16 billion by 2021 and an investment of US$ 6 billion to create employment opportunities for 500,000 people by 2021. The policy also strengthens the Electronics laboratories of premier engineering/science colleges in the state and to develop them as Centres of Excellence (CoEs). The State has also come up with E-governance policy, IT policy, Aerospace & Defence policy, Green energy policy and incentives to ESDM units.

**Tamil Nadu :** The State has come up with new Electronic policy to attract investment in Electronics manufacturing . One cluster at Paramakkudi, Ramanathapuram District of TN supports the manufacturers of inverters by manufacturing outer cover of inverters. Presence of testing facilities at Central Electrical Testing Laboratory, Kakkalur, Thiruvallur District, Tamil Nadu and Council Of Scientific And Industrial Research–Central Electronics Engineering Research Institute (CSIR–CEERI), Taramani, Chennai 600113 are added advantage for Power Electronics Industry.

**Uttar Pradesh:** UP has witnessed rapid industrialisation in the recent past and companies from China, Taiwan, Korea have shown interest to invest. To accelerate the ESDM ecosystem development, the UP Electronics manufacturing policy declared Noida, Greater Noida & Yamuna Expressway area as "**Electronic Manufacturing Zone**" and the incentives under the policy shall be applicable to all units setting up their base in the declared Zone. This Zone is proposed to have the seamless connectivity, state of the art infrastructure, Logistics hub, 24X7 water-power availability and Social Infrastructure.

**Delhi:** Delhi NCR is the manufacturing hub for Electronics components thus produce more than 30% of total Electronics components manufactured in India.. As per the new Industrial Policy for Delhi 2020-21, the Government is keen on developing and promoting the hi-tech, sophisticated, knowledge-based IT, Electronic and ITeS industries in the state.

**Karnataka:** Karnataka is the country's preferred destination for investing in Electronic System Design and Manufacturing. With 85+ chip designing

houses and ESDM skilled resources available, the state is well set to innovate in the sector. Major global players benefit from this ecosystem.

**Rajasthan:** Rajasthan enjoys a strategic geographical position wherein it is situated between Northern and Western growth hubs in the country and 40% of Delhi Mumbai Industrial Corridor (DMIC) runs through it. State policy attracts Investment in Information Technology, Electronics, Textiles, Chemicals, Agro-processing, Cement, Granite, and Engineering.

**Madhya Pradesh:** Madhya Pradesh strongly promotes ESDM sector in the State. The State is a front runner in the implementation of GoI schemes like Digital India, Electronics Manufacturing Cluster Scheme and National Solar Mission. To achieve the reduced Electronics import, the State is developing Electronics manufacturing clusters which provides state-of-art infrastructure. Additionally financial incentives are also being offered which provides concenssions including on land allottment, tax reimbursement, capital subsidy and interest subsidy.

**Haryana :** Haryana is fast emerging as one of the most favoured investment destinations in India.The State has formulated policies and programmes for popularizing the applications of various non -conventional and renewable sources which finds scope in promoting Inverter Industry in the State. The entire state falls in the influence zone of two industrial corridors, namely, Delhi Mumbai Industrial Corridor (DMIC) and Amritsar Kolkata Industrial Corridor (AKIC).

**West Bengal :** West Bengal is moving forward to provide energy access for all by 2022. West Bengal has enterprises & infrastrucre facility for manufacturing solar based equipments and has a concentration of solar companies. It is reported that GIZ is actively working with West Bengal Government in the field of Energy Access and Solar Roof Top installations. All these policies are conducive for the Inverter manufacturing sector.

**Telangana :** Telangana has been continuously striving to be in the forefront of Electronics manufacturing in the country. The traditional Entrepreneurial spirit, coupled with the access to skilled workforce and inherent supply chain advantages of the location have resulted in the growth of the Electronics industry over the last two decades. Hyderabad, currently, is marching towards establishing itself as one of the leading Electronic hubs globally. The Telangana Government is planning to make Hyderabad as the hub of Electronic System Design Manufacturing (ESDM). Government of Telangana is pursuing to attract investments into the two ESDM clusters at e-City Manufacturing Cluster

and Maheshwaram Science Park.

**Kerala** State Government in the industrial policy has identified "Electronics Manufacturing " as a thrust area and has accorded priority to create common infestructure through dedicated Industrial Parks. Keraal State with the excellent Physical & Social infrastructure is a suitable destination for investment in Electronics manufacturing.

## 1. G) NUMBER OF ENTERPRISES REGISTERED AS MSMEs FOR MANUFACTURING THE PRODUCT

The relevant NIC code is 27900 (Manufacture of other Electrical Equipments). The analysis of the data from the Ministry of MSME Registration portals UAM & UR against this NIC code is as under;

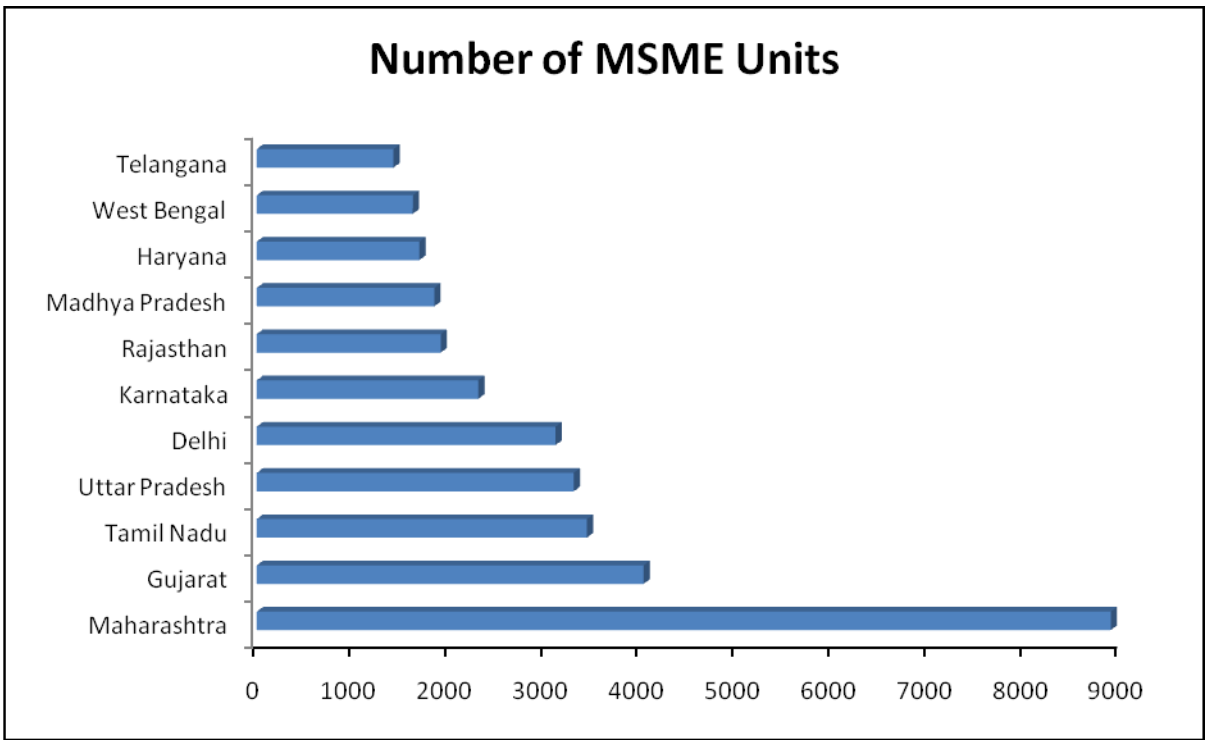



*Figure- 1:Major States manufacturing Inverter as on 30/06/2020 (Data Courtesy- UAM)*

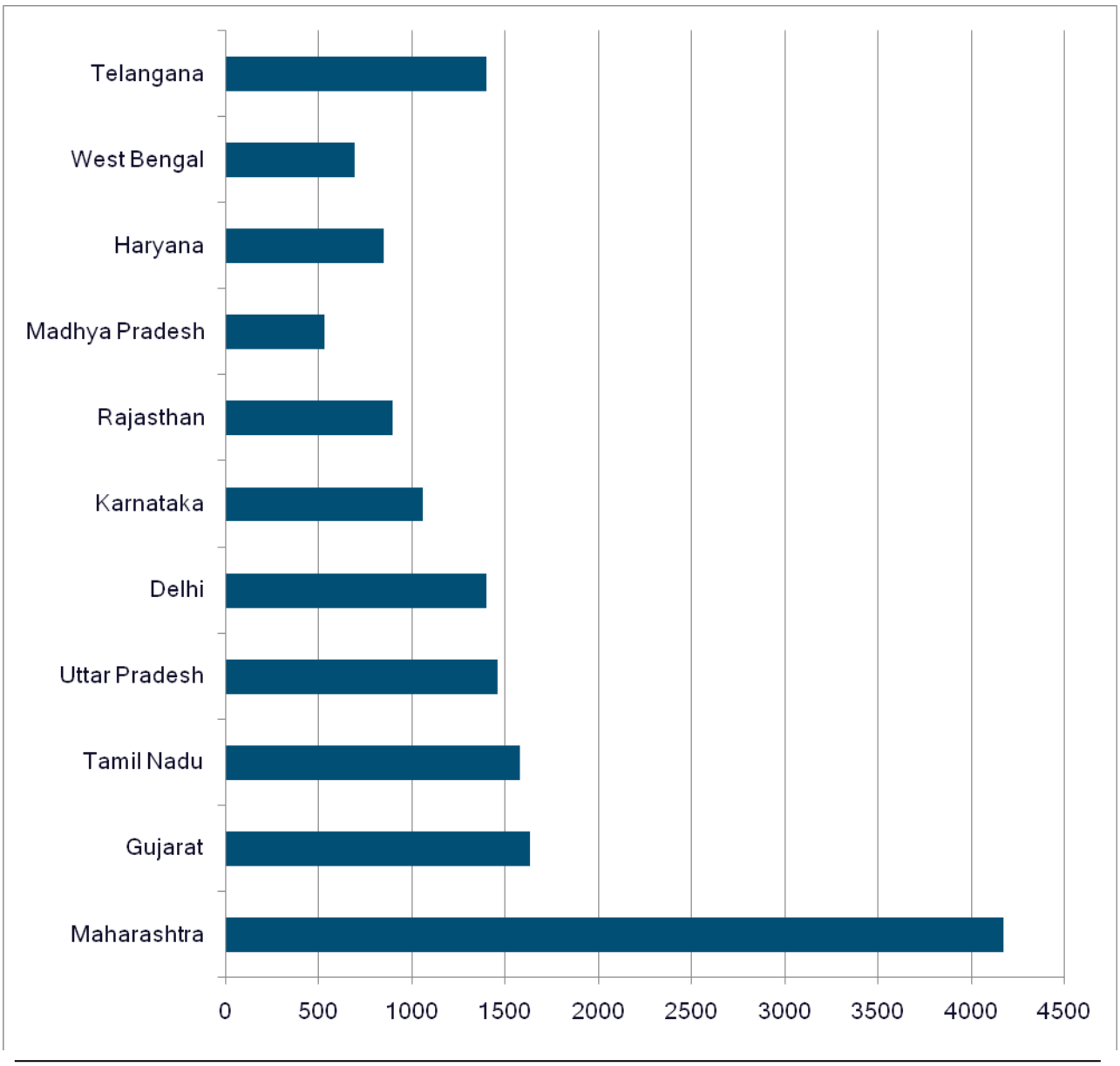



*Figure- 2: Details of Inverter manufacturing units filed Udyam Registration (major states) as on 21/05/2021*

| State wise details of Units under registered under NIC code 27900( Manufacture of other Electrical Equipments) | | |
|---|---|---|
| State | Numbers of Udyog Adhaar Memorandum (UAM) registered units against NIC code 27900 | Number of Udyam Registered( UR) units |
| Andhra Pradesh | 447 | 202 |
| Arunachal Pradesh | 6 | 5 |
| Assam | 113 | 54 |
| Bihar | 970 | 298 |
| Chattisgarh | 239 | 121 |
| Goa | 74 | 31 |
| **Gujarat** | **4030** | **1632** |
| **Haryana** | **1694** | **850** |
| Himachal Pradesh | 120 | 66 |
| Jharkhand | 631 | 308 |
| **Karnataka** | **2308** | **1062** |
| Kerala | 503 | 284 |
| **Madhya Pradesh** | **1850** | **535** |
| **Maharashtra** | **8896** | **4173** |
| Meghalaya | 5 | 14 |
| Mizoram | 3 | 9 |
| Nagaland | 1 | 3 |
| Odisha | 429 | 219 |
| Punjab | 886 | **405** |
| **Rajasthan** | **1917** | 897 |
| Sikkim | 4 | 2 |
| **Tamil Nadu** | **3439** | **1580** |
| **Telangana** | **1425** | **579** |
| Tripura | 24 | 8 |
| **Uttar Pradesh** | **3302** | **1460** |
| Uttarakhand | 284 | 139 |

| | | |
|---|---|---|
| **West Bengal** | **1626** | **696** |
| Andaman & Nicobar Islands | 37 | 29 |
| Chandigarh | 66 | 34 |
| Dadar & Nagar Haveli | 38 | 13 |
| Daman Diu | 31 | 16 |
| **Delhi** | **3113** | **1401** |
| Jammu & Kashmir | 74 | 141 |
| Ladakh | 1 | 5 |
| Lakshadweep | 0 | 0 |
| Puducherry | 36 | 16 |

*Table 1: Details of MSME units registered - Statewise*

*(Data Source- M/o MSME UAM& UR data base )*

| | Micro | Small | Medium | Total |
|---|---|---|---|---|
| Under UAM (till 30/06/2020) | 31036 | 7351 | 271 | 38658 |
| Under UR (as on 21/05/2021) | 14712 | 2234 | 342 | 17288 |

*(Data Source- M/o MSME UAM& UR data base )*

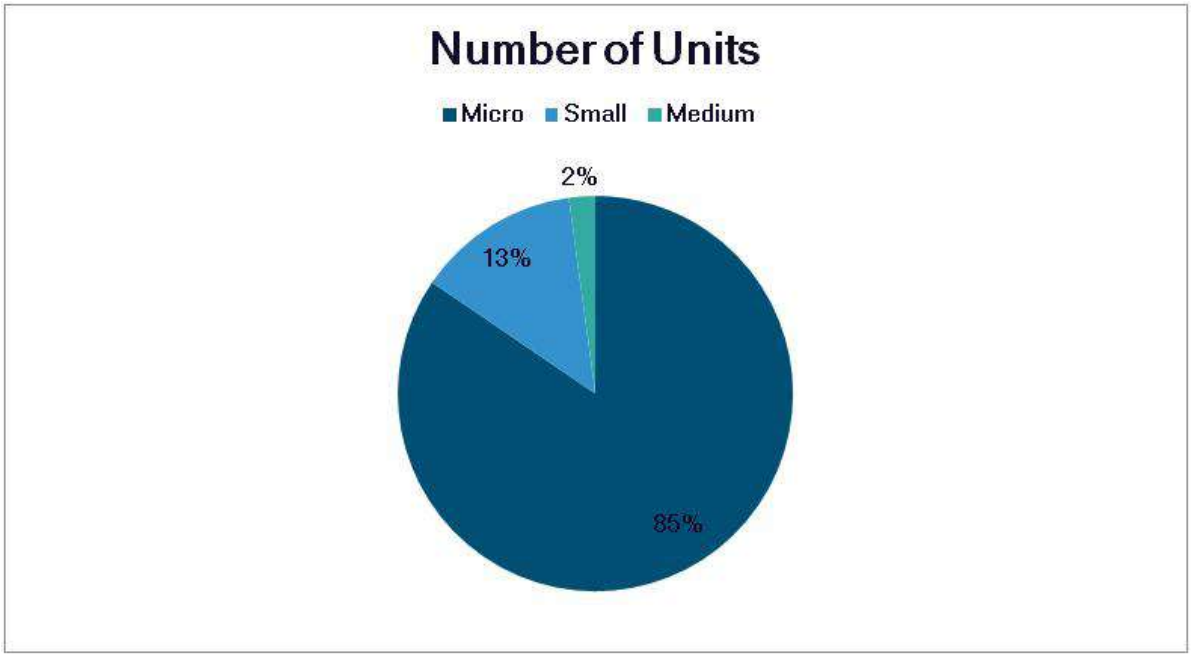



*Figure-3- Break up of number of units*

From the data it is clearly understood that, more than 80% units are in the micro sector.

## 1. I ) NUMBER OF INDUSTRIES AVAILABLE IN LARGE SCALE INDUSTRIES

In the UAM portal of the Ministry of MSME, 271 units are registered as Medium scale Enterprises. As per the revised classification of MSMEs, a medium scale Enterprise will have an investment between Rs 10 cr to Rs 50 cr and/or turnover between 50 cr to 250 cr. There are 342 units registered in Udyam Registration (UR) portal as per the revised classification of MSMEs. So there are 342 Enterprises in this Investment & Turnover category which may cover substantial part of the enterprises above Micro& Small catetegory. The following are the few identified top major players operating in the Indian Industrial Inverter Market:

1. Luminous Power Technologies Pvt Ltd
2. Su-Kam Power Systems Ltd
3. Genus Power Infrastructure
4. Microtek International Pvt Ltd
5. Hitachi Hi-Rel Power Electronics Pvt Ltd
6. Amara Raja Electronics Ltd
7. Aplab Limited
8. Uniline Energy Systems Pvt Ltd
9. Fuji Electric Consul Neowatt Pvt Ltd
10. True Power International Ltd
11. Vertiv Energy Pvt Ltd (Emerson Network)
12. Schneider Electric
13. Socomec Innovative Power Solutions Pvt Ltd
14. Techser Power Solutions Pvt Ltd
15. Tritronics India Pvt Ltd
16. Access Power Care System
17. Swelect Energy Systems
18. Delta Power Solutions (I) Pvt Ltd
19. Nexus Power Systems
20. Renutron Power Solutions India
21. Enertech UPS
22. Riello Power India Pvt Ltd
23. ABP Power Solutions
24. ARVI Systems & Controls Pvt. Ltd
25. Hykon India Limited
26. Numeric UPS
27. Switching Avo Electro Power
28. Cyber Power Systems India
29. Best Power Equipment (I) Pvt. Ltd.
30. Powerone Micro Systems
31. Elent Electronics Pvt. Ltd
32. Powernet Solutions
33. Kinara Power Systems & Projects Pvt. Ltd.
34. Total Power Conditioners Pvt. Ltd.
35. Cosmic Micro Systems Pvt. Ltd
36. Electronics & Controls Power Systems Pvt. Ltd
37. Better Power Services Pvt. Ltd
38. Ds Systems Pvt. Ltd.
39. PN Systems
40. TSI Elecpower Pvt Ltd
41. Frontline Systems & Services Pvt Ltd
42. Micro connect

*Data Courtesy : MAIT Report*

Details of a few units are given below:

| Sl.No | Company | Products |
|---|---|---|
| 1. | Luminous Power Technologies Pvt. Ltd. C-56, Mayapuri Industrial Area, Phase-II, Mayapuri, New Delhi -110064, Tel: 18001033039, E-mail: care@luminousindia.com | Power backup, home electrical and residential solar space that covers, inverters Batteries, Solar solutions to home electrical offerings such as Fans, Modular Switches and LED lighting |
| 2. | V-Guard Industries Ltd. Regd. Office: 42/962, Vennala High School Road, Vennala, Kochi - 682028 Ph: +91 484 433 5000, Fax: +91 484 300 5100, E-mail: mail@vguard.in | Inverter, DUPS, Solar Power Systems , Inverter Batteries & other consumer electronic goods |
| 3. | Microtek International Pvt Ltd H-57, Udyog Nagar, Rohtak Road , Delhi-110041, 011-71255500, scecom@microtekdirect.com | Power Backup solutions, Solar Energy, Voltage Solutions, Wires & Cables, Circuit Protection Devices (MCB, DBs), E-Vehicle Chargers, Surge & Lightning Protectors & Health Care range of products. Brand to make line interactive UPS in India |
| 4. | Su-Kam Power Systems Ltd Plot No.: 54, Udyog Vihar, Phase VI Sector-37, Gurgaon – 122001, 9599035315, 0124-4170500, kartik@su-kam.com | Inverters, batteries, UPS, solar power solutions, batteries |
| 5. | Exide Industries Ltd. Exide House, 59E Chowringhee, Kolkata – 700020, Phone: +91 33 2302 3400, 2283 2118/ 50/ 71 | Automotive Batteries, Industrial. Batteries, Inverter Batteries, Solar Batteries, Genset Batteries. Submarine Batteries, Home UPS. Systems etc |
| 6. | Amara Raja Electronics Ltd Terminal A, 1-18/1/AMR/NR, Nanakramguda, Gachibowli, Hyderabad-500032 India, Tel: +91 (40) | PCBA |

| | | |
|---|---|---|
| | 2313 9000, Fax: +91 (40) 2313 9001 | |
| 7. | Genus Power Infrastructures Ltd<br>SPL-3, RIICO Industrial Area, Sitapura, Tonk Road, Jaipur -302 022,<br>Fax: +91 141 7102503 / 2770319<br>+91 141 7102400 / 500, info@genus.in | Metering Solutions, Inverters, UPS, Solar Products |
| 8. | Arise India Limited<br>B-38 Cabin Office No. 1, 2nd Floor<br>Jain Chowk, Mangla Puri, Palam<br>New Delhi-110045 | Solar Batteries, Solar Submersible Pumpset, Solar Inverters, Solar Panel, Solar Charge Controller |
| 9. | Consul Neowatt Power Solutions<br>119,120,120A, Electrical and Electronics Industrial Estate, Perungudi, Chennai - 600 096<br>Email : enquiry.fei@fujielectric.com<br>Phone: +91 44 4000 4200 | Power conditioning & power back-up products, services and solutions - Online UPS, Industrial Inverters, Solar Inverters, Industrial Systems, Stabilizers, Isolation Transformers, Active Harmonic Filters, Static Transfer switches and customized power electronic solutions |
| 10. | Uniline Energy Systems Pvt Ltd<br>Uniline House, Ramesh Market, East of Kailash, New Delhi-110065, Delhi,<br>Anshit Bansal (Managing Director), Tel: 08048933056 | UPS System, UVC Disinfection Tower, Bench top UV Decontamination Chambers etc |
| 11. | Delta Power Solutions India Pvt Ltd<br>Ozone Manay Tech Park, A Block, 3rd Floor, Hosur Road, Hongasandra Village, Bengaluru-560068<br>Mrinalini Singh (Marcom)<br>Tel: 09901865495 | Uninterruptible power supplies, mission critical infrastructure solutions, power quality solutions, solar inverters, telecom power solutions, medium voltage drives, mega-watt wind converters, EV charging stations etc. |
| 12. | Hitachi Hi-Rel Power Electronics Pvt Ltd, B - 14/1, 171, 117 & 118, GIDC Electronics Zone, Sector-25, Gandhinagar – 382044, Gujarat<br>Phone+91-79-61700500 / +91-79-23287180 / 81, Fax +91-79- | UPS, drives, solar inverters and air compressors |

| | | |
|---|---|---|
| | 23287182 | |
| 13. | Riello PCI India Pvt Ltd<br>Plot no. 213A, Sector-4, IMT Manesar<br>122050 Gurgaon<br>Tel.: +91-124-2975498, 2975499 | UPS Systems, from 6 kVA to 6400 kVA |
| 14. | Aplab Limited<br>Aplab House, A-5, Wagle Estate,<br>Thane. 400 604. India.<br>Tel : +91-22-67395555, 25821861<br>Fax : +91-22-25823137<br>Email : response@aplab.com | UPS Systems, Solar Power Systems, DC Power Supplies, Test & Measurement Instruments and Banking & Retail Automation Products |
| 15. | Tritronics India Pvt Ltd<br>Shop No.143,,F.I.E.Patparganj, Plot Alpha, Delhi-110092, India<br>Lalit Mohan (Area Manager)<br>Call 08046066421 | UPS Systems, Solar Hybrid UPS Systems and other power conditioning equipments |
| 16. | True Power International Ltd<br>C-7 Mumty, 2nd Floor, Suraj Park,<br>Samaypur Badli, Delhi<br>Email: info@truepower.in<br>Phone: 1800115152 | Inverter, UPS, Stabilizer, Battery, Solar Powered Geysers |
| 17. | UTL Solar<br>Fujiyama Power Systems Pvt. Ltd,<br>Vill - Naryal, Sec - 4, Barrier Parwanoo,<br>Distt. - Solan Himachal Pradesh,<br>Email - info@utlups.com | Batteries, UPS, Solar solutions etc |
| 18. | Epoch Electronica Ltd<br>66 Salkia School Road, 'AAVAS', B Block, Howrah - 711 106, Phone : 033 26659123/9193 , Mobile : +91 8420007562, E-Mail : service@epochelectronica.com | Inverter, UPS, Stabilizer |

*Table- 2: Details of Large Scale Units manufacturing Inverter & UPS in India*

## 1. J) DATA ABOUT THE IMPORT OF INVERTER FOR THE PAST THREE YEARS

As per the data available under Director General of Commercial Intelligence and Statistics (DGCIS) , the import of Electric Inverter ( HSN code 85044010) is as under

| Year | Value in US $ Million | Value Rs cr |
|---|---|---|
| 2017-18 | 197.89 | 1434.245 |
| 2018-19 | 167.40 | 1213.263 |
| 2019-20 | 180.74 | 1309.947 |

*Table- 3- Data about imports of inverter for last three years*

*(Data source- DGCIS Website)*

As per the data available under Director General of Commercial Intelligence and Statistics (DGCIS), the Export data of Electric Inverter ( HSN code 85044010) is as under

| Year | Amount in US $ Million | Value Rs cr |
|---|---|---|
| 2017-18 | 104.90 | 760.283 |
| 2018-19 | 146.43 | 1061.279 |
| 2019-20 | 244.83 | 1774.814 |

*Table-4- Data about export of inverter for last two years*

*(Data source- DGCIS Website)*

## 1. K) DEMAND IN THE DOMESTIC MARKET & SCOPE FOR SETTING UP NEW ENTERPRISES

The demand of Electronic products in India is growing at a CAGR (Compound Annual Growth Rate) of about 40%percent during the last few years. The long-term growth potential for the industry is optimistic, primarily because the market penetration is still low. Besides, the positive outlook of higher GDP growth rate, rising disposable incomes, improving physical and social infrastructure, better logistics, the Digital India programme, and the expansion of retail will provide additional impetus. It is this promise of sustainable long-term growth that has attracted several international brands to India, many of whom have set up manufacturing facilities here. Increasing disposable income has led to increased consumer demand for Electronics products. Demand for Electronic products in

India is poised for significant growth in the next few years, driven by a strong economic outlook.

In the industrial Electronics segment, the focus is shifting, particularly to solar and cleaner energy due to the thrust given by Govt. of India for non conventional energy sectors. In the industrial Electronics segment, imports meet 50 per cent of the local demand. With the increase in the solar installation, Electronic vehicle (EV) segment, Hybrid and smart grid, the demand for Inverter & UPS are going to increase in the coming years. The technological innovation like IoT, 5G and smart power grids which allow remote controlling will increase the demand for smart power back up devices. The penetration of Smart phones and IT equipments will also increase the demand for power back up devices including portable power back up systems. Hence there is lot of scope for new units in these Emerging areas. Further the Government initiatives and preferences for local products will facilitate domestic manufacturing and the market now served by the imported products will be eventually be replaced by the products from domestic manufactures.

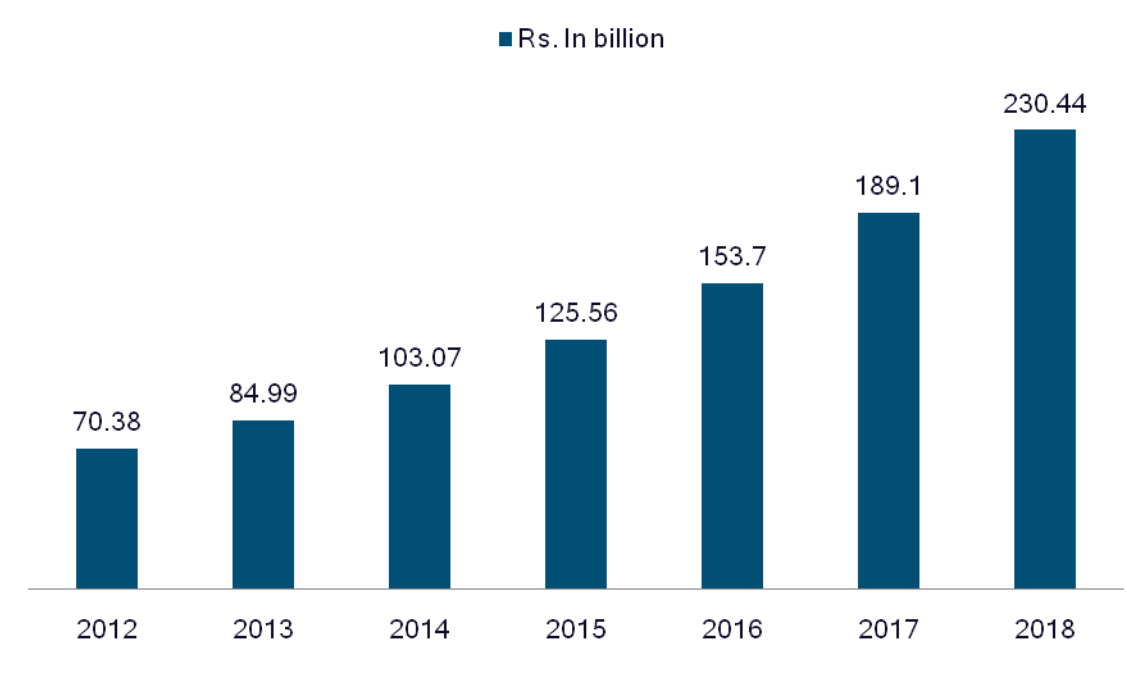



*Figure-4 Inverter market- Value wise (Data Courtesy- Netscribes)*

Indian power sector is undergoing a significant change that has redefined the industry outlook. The Government of India's focus on attaining 'Power for all' has accelerated capacity addition in the country. At the same time, there is substantial increase in the demand

for quality uninterrupted power due to the overall economic development and living standards of people from all walks of life.

According to data from the power ministry , India's power consumption increased to 50.15 billion units (BU), indicating an improvement in economic activity. 100% village electrification was achieved under Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY). Government of India has released its roadmap to achieve 227 GW capacity in renewable energy (including 114 GW of solar power and 67 GW of wind power) by 2022. The Union Government of India is proposing a 'rent a roof' policy for supporting its target of generating 40 gigawatts (GW) of power through solar rooftop projects by 2022. The increase in the installation of Renewable Energy will naturally drive for the need for power back up services and increase in the demand for Inverters.The Indian inverter market is expected to reach ₹ 277.83 billion in 2023, growing at Compound Annual Growth Rate ( CAGR) of 10%.

The Indian Industrial Inverter Market is segmented based on the product type, capacity, sales channel, and region. Based on the type, the market can be fragmented into pure sine wave, modified sine wave and square wave. The pure sine wave industrial inverter segment is expected to remain the largest segment through 2025, followed by square wave and modified sine wave segments.

Based on product type, the market can be bifurcated into single-phase and three-phase. The three-phase segment dominates the market owing to their higher efficiency and ease of operation. The market is dominated by direct sales channel as most of the users prefer to buy industrial inverters directly from the manufactures.

The market for inverters in India is highly fragmented due to the presence of unorganised and organised players. The unregulated players have about 40 per cent share in the market, primarily in Tier-3 towns and in rural areas, catering to consumers who are price sensitive. The organised sector is mostly dominated by branded products. The unorganised market is still a challenge to the organized sector.

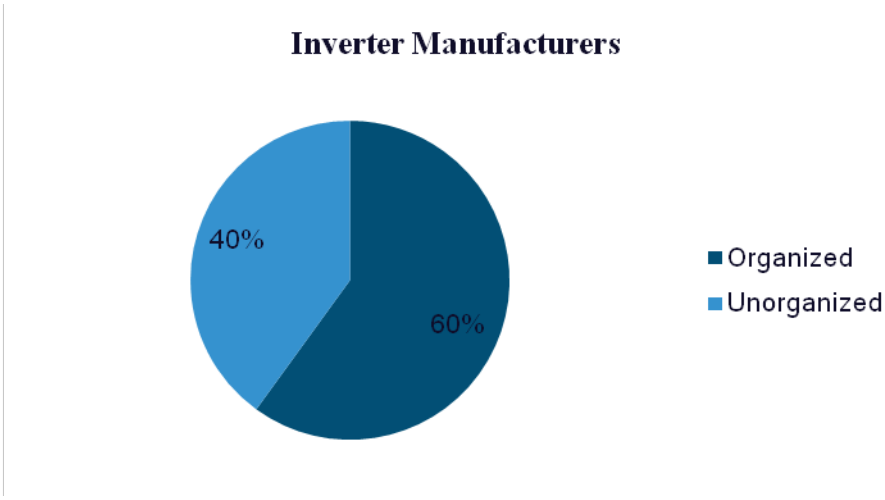



*Figure-5- Organized and Unorganized Inverter Manufacturers*

Extensive research by market research agencies on power backup systems market across rural and urban sectors brings up a number of trends. Suppliers operating in the Inverter industry are exploring contract manufacturing opportunities. Moreover, organised players operating in the Inverter market are increasingly focus on selling their products through large retail formats and on strengthening their channel sales. Inverters of lesser capacity are being sold through retail channels while large configurations that require technical support are mostly being sold through channel partners.

Previously, for hard-core backup power, people used gensets. Due to rising cost and storage challenges of diesel, people are starting to shift from gensets to power inverters. A lot of people today want to be independent of the grid. So in the inverter segment, people are exploring solar inverters today. Backup solutions given through solar are the most sought after. Ideally, people would install a solar system with batteries so that it not only serves their power needs but also provide back up services.

Another important business trend is an increasing demand for Small Office Home Office (SOHO) high-end Inverters as a lot of users are looking for uninterrupted power backup for commercial activities which save them huge money in comparison to generators. Due to errant power conditions, more and more industries and SOHO segment users are shifting from generators to inverters. This is because running costs of inverters are very low and these are more convenient. Furthermore, the popularity of solar technologies in both rural and urban India is driving the trend for solar hybrid inverters that combine solar panels

with an inverter, to address power requirements. Finally, there is also a trend of battery management in inverter batteries.

Inverter market in India is attributed based on following factors:

- ✓ Government initiatives to improve Electrification rate in India
- ✓ Increased adoption of connector solutions in the commercial and residential sectors
- ✓ Growing urbanization & rising demand and supply gap of electricity
- ✓ Growing investments in IT & the rapid development of the IT sector
- ✓ Rise in number of residential solar roof top installations
- ✓ A large inflow of investment in the renewable energy sector
- ✓ Rising demand from Tier-2 & Tier- 3 cities
- ✓ Widening gap between demand and supply of electricity
- ✓ Insufficient capacity and inefficiency of grid for distribution

**Key drivers to boost the demand**

✓ *Economic growth:* India is one of the fastest-growing economies in the world, with the GDP expected to grow consistently. The growing economic activity and deployment of the latest automation technologies across different sectors have positively influenced demand in the industrial and strategic Electronics domains.

✓ *Rapid urbanisation and income growth:* Rapid urbanisation, coupled with income growth, has led to greater affordability of goods and consequently an increase in demand for mobile phones, tablets, and other household appliances. This will definitely increase the demand for Inverter in the domestic and commercial sectors.

✓ *Evolving technology and innovation:* Rapid technology advancements and newer products with upgraded technology have led to shorter life cycles for Electronic products. Also, changing customer attitudes and consumer-to-consumer websites, such as Olx and Quikr, have made it easier for customers to replace their existing Electronic devices with newer products.

✓ *Increased demand for high-speed data* has also contributed towards burgeoning demand. This rising preference for advanced technology products has driven rapid

innovation. Emerging technologies such as IoT, AI, and the introduction of robotics and analytics in the industrial and strategic Electronics segment will lead to the overall development of various Electronic products, which has given a boost to the demand for power back up systems.

*Increasing focus on harnessing renewable energy is* another a key enabler for to boost the demand for the Inverter. The growth in the Electronics industry in India is driven by the growth in specific segments. The growth of each segment is, in turn, dependent on the dynamics of the existing ecosystem, the number of organised players, the level of imports, and the government's focus on the respective segment. As per reports by Mercom India Research; India has added 3.2 GW or 3,239 MW of solar capacity in 2020& 7,346 MW in 2019, adding the country's total solar installed capacity was at 39 (GW) as of December 2020.

## 1.L) DEMAND IN THE EXPORT MARKET

As per the data available under Director General of Commercial Intelligence and Statistics (DGCIS) , the Export data of Electric Inverter ( HSN code 85044010) is as under

| Year | Value in US $ Million | Value in Rs Cr |
|---|---|---|
| 2017-18 | 104.90 | 760.283 |
| 2018-19 | 146.43 | 1061.279 |
| 2019-20 | 244.83 | 1774.814 |

*Data about export of inverter for last two years*

*(Data source- DGCIS Website)*

* The global inverter market is projected to grow from USD 12.8 billion (Rs 1024 billion) in 2020 to USD 26.5 billion ( Rs 2120 billion) by 2025; it is expected to grow at a Compound Annual Growth Rate (CAGR) of 15% from 2020 to 2025. The global market is expected to be impacted significantly by COVID-19 as China is one of the major suppliers for the raw materials as well as the finished products. The industry is on the brink of facing a reduction in production, disruption in supply, and price fluctuations. While this can vastly encourage local manufacturers to step up and address the growing demand, the scarcity of components can still pose a challenge to this industry. India exported Electric inverter worth USD 245 million in 2019-2020 with the growth of 67%. Top markets are USA, UAE, Japan, Vietnam, Mexico, South Africa, Egypt, China & Nigeria. India exported Electric Inverter worth USD 146.43 million in 2018-19. India's share of this item is 0.0781 in its total export.

**(*Data Source:- www.FIEO.org*)**

## CHAPTER-2 - TECHNICAL DETAILS

2. **A) SECTOR IN WHICH THE PRODUCT IS FALLING** - Power Electronics

**Inverter and UPS are identical products under the category of Power Electronics**

Inverter & Uninterrupted Power Supply(UPS) are circuit configurations that store & supply uninterrupted power to the load in a manner that when the mains also known as the grid AC power source fails , it seamlessly switch to draw power from the DC storage, convert it into AC power and feed the load. Thus a UPS and an Inverter are from the same family of circuits, except that additionally the UPS by default supplies power from the AC grid. For many aspects like technology, use, application etc there are similarities in Inverters and UPS.

Inverters and UPS are generally classified on the following basis

- ✓ Commercial & Industrial
  Commercial can be further divided into Home & Enterprise
  The Home I&U are all typically less than 5 KVA capacity.
- ✓ Single phase & Three Phase - Upto 5 KVA& above can be single phase and three phase systems.

**From the Public Procurement Policy perspective, it may be considered to change the nomenclature of the product as Inverter & UPS of less than or equal to 5KVA single & three phase so that the entire category of this product would be brought under the purview of the policy.** As normally inverter & UPS above this category differ in terms of technical and other details.

**2. B) END USERS OF THE PRODUCTS/ SECTORS**

A power Inverter, or Inverter, is a power Electronic device or circuitry that changes direct current (DC) to alternating current (AC). The resulting AC frequency obtained depends on the particular device employed. Inverters do the opposite of “converters” which were originally large electromechanical devices converting AC to DC.

**Customer Segments and Use Cases for Inverters & UPS below 5KVA**

- Home Inverter for non IT application
- Home UPS for IT application
- Inverter for Home Solar Installations
- Inverter for use in Automobiles in long distance drives
- Inverter for geographically isolated solar powered instruments

The term Home Inverter– includes Home habitats, SOHO, Shops, Clinics, Customer service Counters, Bank Branches, Offices desktops/ 300 LT's, Field Stations off grid. Small Micro Data Centers, Laboratories, Schools, Colleges, Roof top solar inverters, Cold Chains, Cellular Base stations, Railway stations, Post offices. Bus stands, local offices, Primary Health centers and so on.

Some of the applications/ end uses of the product are as given below:

**1) DC power source usage**

An Inverter converts the DC Electricity from sources such as batteries or fuel cells to AC. The Electricity can be at any required voltage; in particular it can operate AC equipment designed for mains operation, or rectified to produce DC at any desired voltage.

**2) Uninterruptible power supplies**

An uninterruptible power supply (UPS) uses batteries and an Inverter to supply AC power when mains power is not available. When mains power is restored, a rectifier supplies DC power to recharge the batteries.

**3) Electric motor speed control**

Inverter circuits designed to produce a variable output voltage range are often used within motor speed controllers. The DC power for the Inverter section can be derived from a normal AC wall outlet or some other source. Control and feedback circuitry is used to adjust the final output of the inverter section which will ultimately determine the speed of the motor operating under its mechanical load. Motor speed control needs are numerous and include

things like: industrial motor driven equipment, Electric vehicles, rail transport systems, and power tools.

**4) In refrigeration compressors**

An Inverter can be used to control the speed of the compressor motor to drive variable refrigerant flow in a refrigeration or air conditioning system to regulate system performance. Such installations are known as Inverter compressors. Traditional methods of refrigeration regulation use single-speed compressors switched on and off periodically; Inverter-equipped systems have a variable-frequency drive that control the speed of the motor and thus the compressor and cooling output. The variable-frequency AC from the Inverter drives a brushless or induction motor, the speed of which is proportional to the frequency of the AC it is fed, so the compressor can be run at variable speeds—eliminating compressor stop-start cycles increases efficiency. A microcontroller typically monitors the temperature in the space to be cooled, and adjusts the speed of the compressor to maintain the desired temperature. The additional Electronics and system hardware add cost to the equipment, but can result in substantial savings in operating costs.The first Inverter air conditioners were released by Toshiba in 1981, in Japan.

**5) Power grid**

Grid-tied Inverters are designed to feed into the Electric power distribution system. They transfer synchronously with the line and have as little harmonic content as possible. They also need a means of detecting the presence of utility power for safety reasons, so as not to continue to dangerously feed power to the grid during a power outage.

Synchronverters are inverters that are designed to simulate a rotating generator, and can be used to help stabilize grids. They can be designed to react faster than normal generators to changes in grid frequency, and can give conventional generators a chance to respond to very sudden changes in demand or production. Large Inverters, rated at several hundred megawatts, are used to deliver power from high voltage direct current transmission systems to alternating current distribution systems.

A solar Inverter is a balance of system (BOS) component of a photovoltaic system and can be used for both grid-connected and off-grid systems. Solar Inverters have special

functions adapted for use with photovoltaic arrays, including maximum power point tracking and anti-islanding protection. Solar micro-Inverters differ from conventional Inverters, as an individual micro-Inverter is attached to each solar panel. This can improve the overall efficiency of the system. The output from several micro-Inverters is then combined and often fed to the Electrical grid. In other applications, a conventional Inverter can be combined with a battery bank maintained by a solar charge controller. This combination of components is often referred to as a solar generator.

**7) Induction heating**

Inverters convert low frequency main AC power to higher frequency for use in induction heating. To do this, AC power is first rectified to provide DC power. The Inverter then changes the DC power to high frequency AC power. Due to the reduction in the number of DC sources employed, the structure becomes more reliable and the output voltage has higher resolution due to an increase in the number of steps so that the reference sinusoidal voltage can be better achieved. This configuration has recently become very popular in AC power supply and adjustable speed drive applications. This new Inverter can avoid extra clamping diodes or voltage balancing capacitors

There are three kinds of level shifted modulation techniques, namely:

- Phase Opposition Disposition (POD)
- Alternative Phase Opposition Disposition (APOD)
- Phase Disposition (PD)

**8) HVDC power transmission**

For bulk power transmission, the HVDC transmission line has more advantages than the HVAC transmission line. In this transmission network, power generated in AC and converts in DC with the help of a rectifier and transmits this DC power for long-distance. The Inverters used to convert the power into AC at the receiving end of the transmission line.

**9) Electroshock weapons**

An Electroshock weapon is an incapacitating weapon. It delivers an Electric shock aimed at temporarily disrupting muscle functions and/or inflicting pain without usually causing significant injury. The circuit consists of DC/AC inverter to generate several tens of thousands of V AC out of a small 9 V DC battery.

**10) Miscellaneous**

Typical applications for power Inverters include:

- Portable consumer devices that allow the user to connect a battery, or set of batteries, to the device to produce AC power to run various Electrical items such as lights, televisions, kitchen appliances, and power tools.

- Use in power generation systems such as Electric utility companies or solar generating systems to convert DC power to AC power.

- Use within any larger Electronic system where engineering need exists for deriving an AC source from a DC source.

- Frequency conversion - if a user in (say) a 50 Hz country needs a 60 Hz supply to power equipment that is frequency-specific, such as a small motor. It is possible to convert the frequency by running an Inverter with a 60 Hz output from a DC source such as a 12V power supply running from the 50 Hz mains.

## 2. C) GOVERNING INDIAN SPECIFICATION

Organizations turn to standards for guidelines, definitions, and procedures that help them to achieve objectives such as:

- Satisfying their customers' quality requirements
- Ensuring their products and services are safe
- Complying with regulations
- Meeting environmental objectives

- Protecting products against climatic or other adverse conditions
- Ensuring that internal processes are defined and controlled

***As per Ministry of Electronics and Information Technology, Govt of India; Electric Inverters is under Compulsory Registration Scheme' for Self Declaration of conformity-of BIS.***

The relevant standards are as given below:

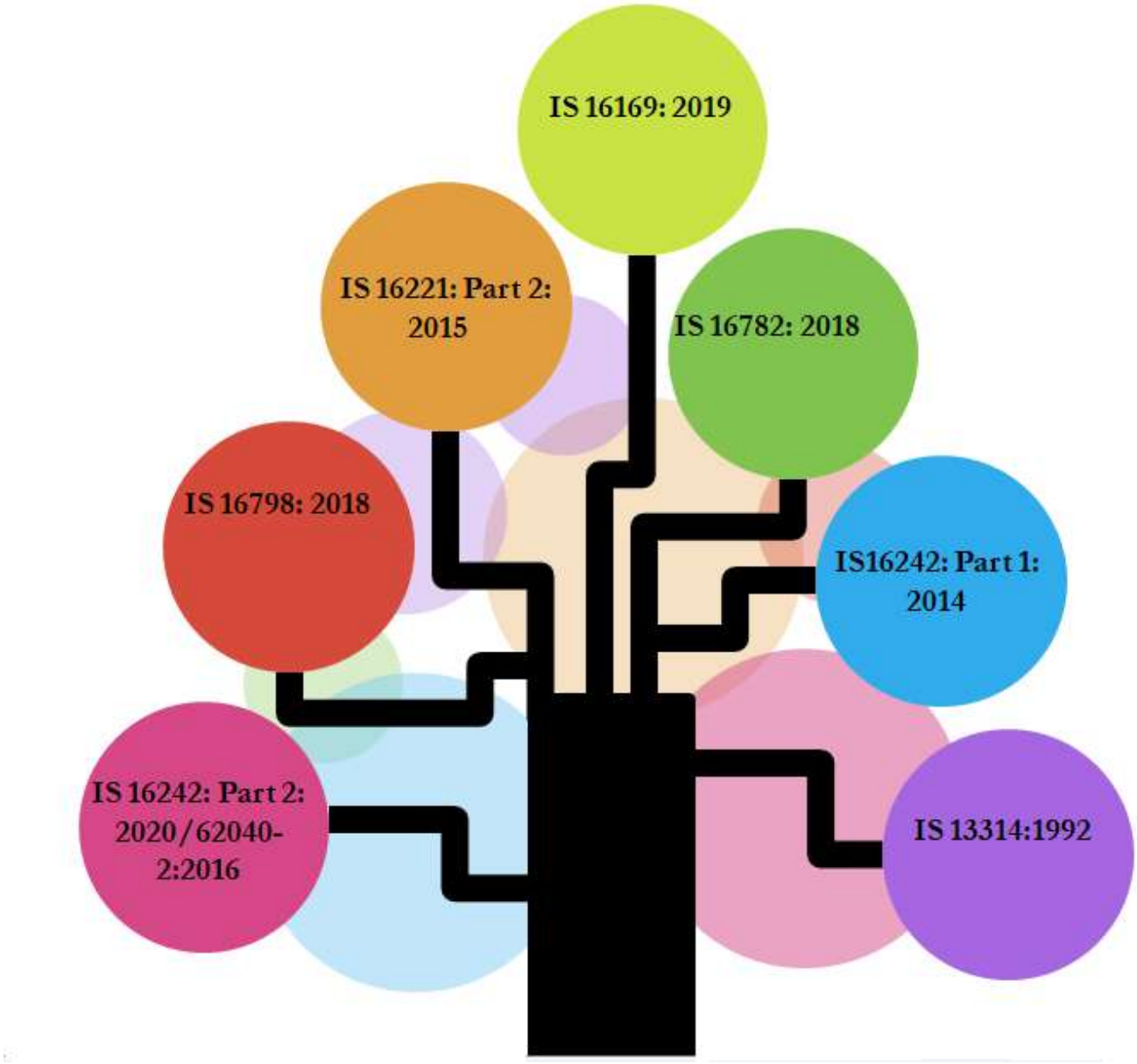



*Figure- 6- IS Standards of Inverter*

**1) IS 16169: 2019**
Utility-Interconnected Photovoltaic Inverters — Test Procedure of Islanding Prevention Measures (First Revision)

**2) IS 16221: Part 2: 2015**
Safety of Power Converters for Use in Photovoltaic Power Systems Part 2 Particular Requirements for Inverters

**3) IS 16782: 2018**
Utility-Interconnected Photovoltaic Inverters Test Procedure for Low Voltage Ride-Through Measurements

**4) IS 16798: 2018**
Photovoltaic Inverters — Data Sheet and Name Plate

**5) IS16242: Part 1: 2014**- Uninterruptible power systems (UPS): Part 1 general and safety requirements for UPS

**6) IS 16242: Part 2: 2020/62040-2:2016 (1 revision) -** Electromagnetic Compatibility EMC requirements (First revision)

**7) IS 16242: Part 3: 2014/IEC 62040-3:2011**- UPS method of specifying the performance and test requirements

**8) IS 13314:1992**- Solid state inverters run from storage batteries.

Indian Standards are now available free of cost especially for MSME sector, and can be downloaded from the Standardization Portal of e-BIS www.manakonline.in.

***Standards adopted from ISO/IEC are chargeable and MSMEs have to pay for procuring the standards. Hence it is recommended to provide subsidized rates for procuring standards to MSMEs for products coming under Compulsory registration.***

The Bureau of Indian Standards (BIS), the national standardization body in India, is a member of the IEC. In some of the IEC committees, India is a participating member whereas in others, it is an observer member. On an average, IEC committee meetings are held once in a year. Working groups and maintenance teams under the IEC Technical Committee also meet at least once a year. As a participating or observer member, India is entitled to participate in Technical Committee activities. It has been reported that very few industry experts participate in IEC activities from India, whereas participation from advanced countries is generally large from industry or the user segment, or from testing and R&D institutions. Technical experts from other countries, mostly dominated by Europe, develop these standards to suit the equipment being developed by their own industry. Of late, participation from China has substantially increased in IEC for the very reason. The standards, once developed, are then followed in India but may have little relevance since they are developed based on prevailing conditions in Europe or other countries. ***Hence it is recommended that the industry may increase participation in BIS Technical Committees, for each of the BIS committees and actively work on standardization. The industry may also sponsor technical experts for working at the IEC. The industry may collaborate with research groups and participate in IEC working groups and prepare new proposals for standards through BIS.***

A comprehensive list of standards for the various products in the Power Electronics sector is annexed at **Annexure I**

## 2.D) GOVERNING INTERNATIONAL SPECIFICATION

International Standards offer strategic answers for businesses in their attempt to decrease costs, increase productivity, access new markets and facilitate freer and fairer global trade. They also embody universally agreed procedure or practice, drawing on the experience and expertise of all interested parties. Whenever possible, requirements in IEC and ISO International Standards are normally expressed in terms of performance rather than design or descriptive characteristics.

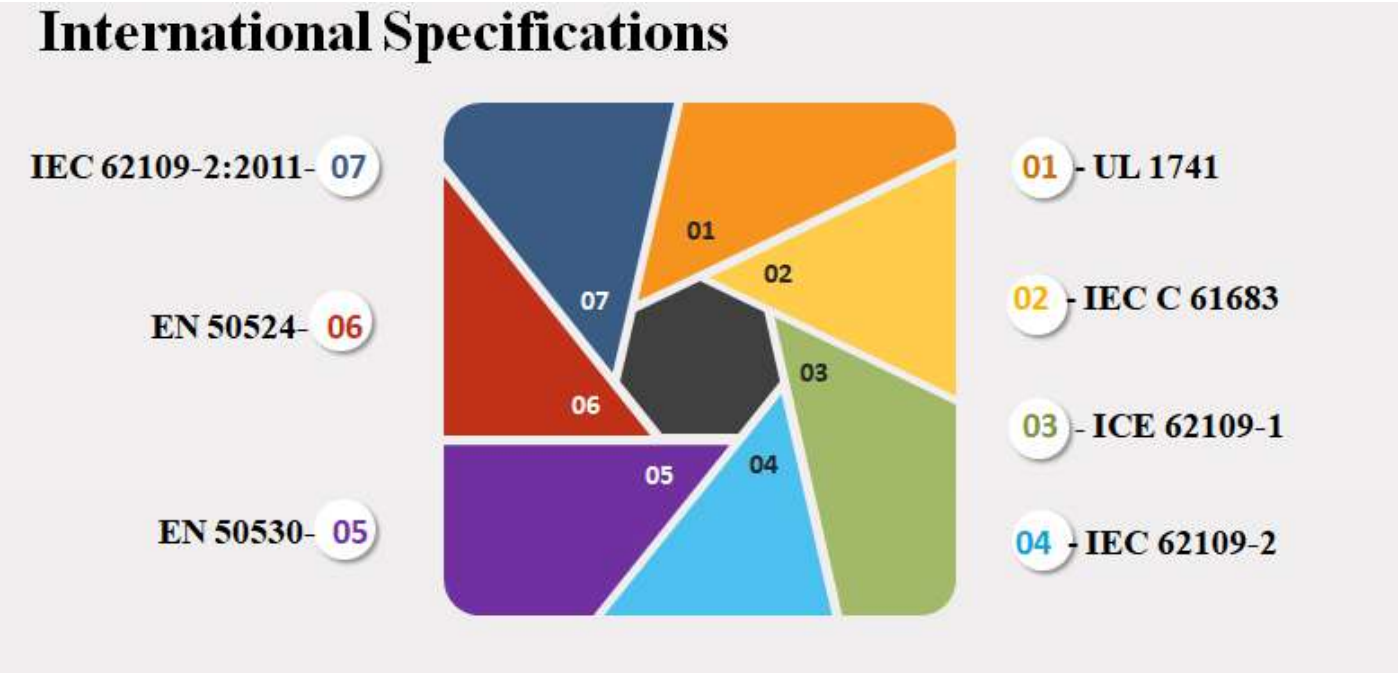



*Figure-7: International Specifications*

EN 50524- Data sheet & name plate for photovoltaic inverters
EN 50530- Overall efficiency of photovoltaic inverters
UL-1741- Inverters, converters, controllers & interconnection system equipment for use with distributed energy resources
IE C 61683- Power conditioners- procedure for measuring efficiency
IEC 62109-1- Safety of power converters for use in photovoltaic power systems- Part-1: General requirements
IEC 62109-2 – Safety of power converters for use in photovoltaic power systems- part 2: particular requirement for inverter

## 2.E) **FLOW PROCESS CHART OF THE MANUFACTURING**

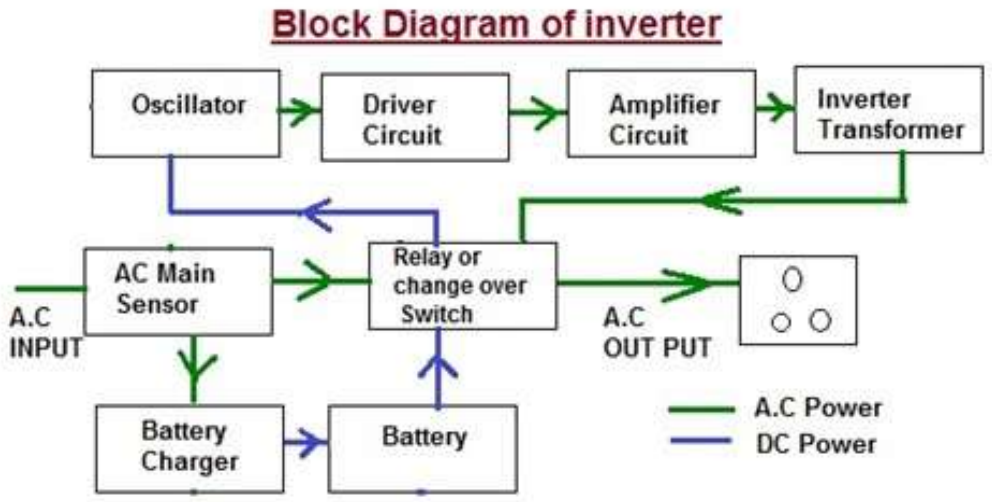



*Figure-8- Block Diagram of Inverter*

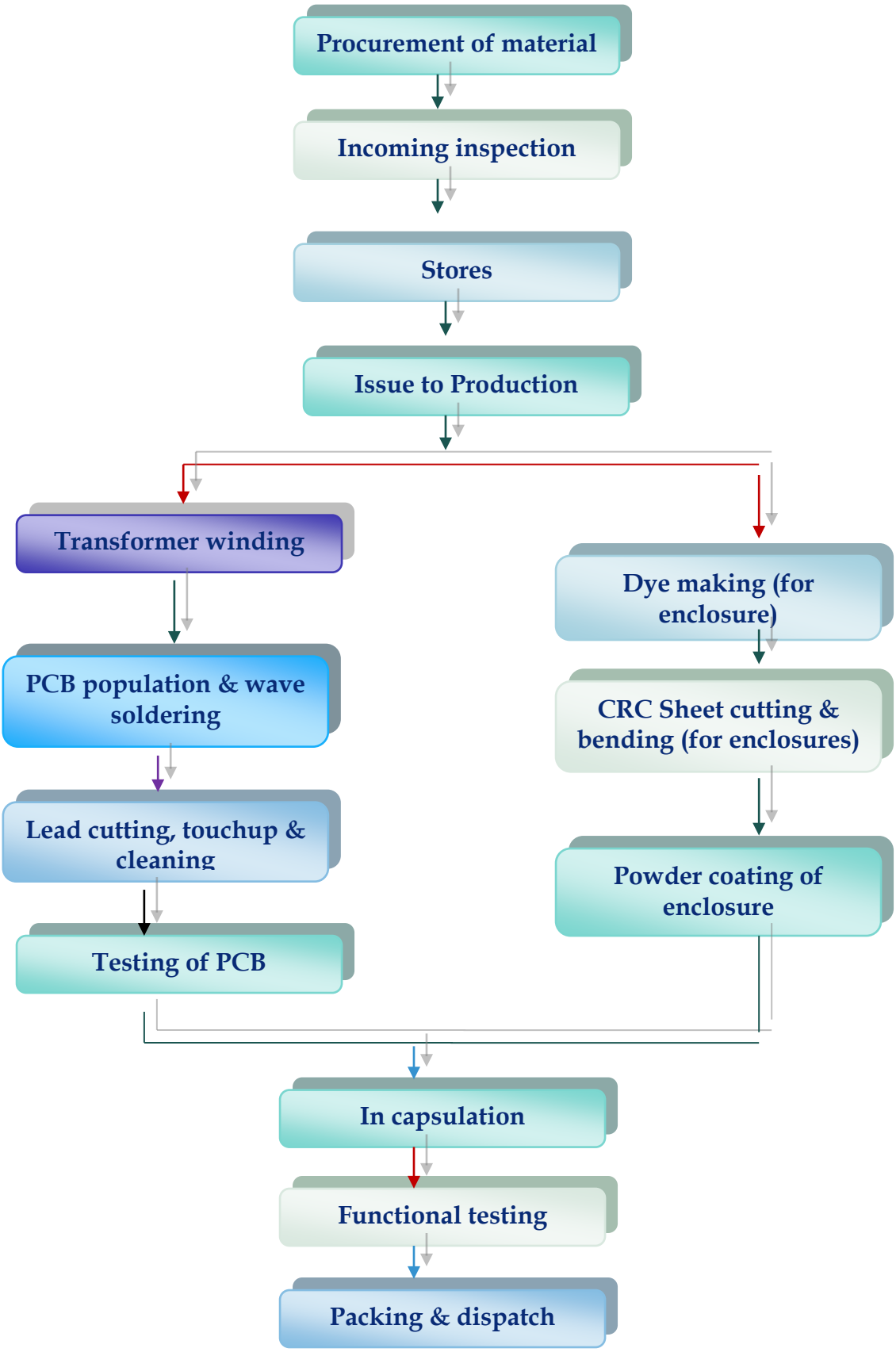
- Raw materials to be procured as per the specifications.
- Test the critical components.
- Transformer assembly.
- The components are fixed and soldered on a printed circuit board (PCB) according to the design.
- Additionally, assemble the controls and sockets individually.
- Control unit assembly
- Then mount the PCB transformers etc. on the chassis and make all the interconnections & cable assembly
- The waveforms at various checkpoints, output voltage, and power are checked adjustments are made so that the products meet the desired performance specifications.
- On completion of testing the instrument is kept for specific time period to ensure its quality and reliability.

**Building Blocks of an Inverter and UPS**

A UPS or Inverter consists of the following basic building blocks at a Subassembly Level.

1. The Rectifier circuit board.
2. The Snubber circuit board (typically in higher power configurations)
3. The Charger circuit board.
4. The inverter Board

*Process flow chart of Inverter manufacturing (Figure-9)*



## 2.F) QUALITATIVE PARAMETERS OF THE PRODUCT

Specifications provide the values of operating parameters for a given inverter. Common specifications are discussed below. Some or all of the specifications usually appear on the inverter data sheet.

**Maximum AC output power** - This is the maximum power the Inverter can supply to a load on a steady basis at a specified output voltage. The value is expressed in watts or kilowatts.

**Peak output power -** This is also known as the surge power; it is the maximum power that an Inverter can supply for a short time. For example, some appliances with electric motors require a much higher power on start-up than when they are running on a continuous basis. Common examples are refrigerators, air-conditioning units, and pumps.

**AC output voltage -** This value indicates to which utility voltages the Inverter can connect. For Inverters designed for residential use, the output voltage is 120 V or 240 V at 60 Hz and 230 V at 50 Hz.

**Peak Efficiency -** *The peak efficiency is the highest efficiency that the Inverter can achieve.* Most grid-tie inverters have peak efficiencies above 90%. The energy lost during inversion is, for the most part, converted into heat. It's important to note what this means: In order for an inverter to put out the rated amount of power, it will need to have a power input that exceeds the output.

**Maximum Input Current -** *This is the maximum direct current that the Inverter can utilize.*If a solar array or wind turbine produces a current that exceeds this maximum input current, the excess current is not used by the Inverter.

**Maximum Output Current -** *This is the maximum continuous AC that the Inverter supplies.* This value is typically used to determine the minimum current rating of the protection devices (breakers and fuses) and disconnects required for the output circuit.

**Peak Power Tracking Voltage -** *This is the DC voltage range in which the Inverter's maximum power point tracker operates.*

**Start Voltage -** *This value is the minimum DC voltage required for the Inverter to turn on and begin operation.* This is particularly important for solar applications because the solar module or modules must be capable of producing the voltage. If this value is not provided by the manufacturer, the lower end of the peak power tracking voltage range can be used as the inverter's minimum voltage.

**Total Harmonic Distortion -** *The total harmonic distortion (THD) is an indication of the purity, or the harmonic content, of the sinusoidal output of an Inverter.* Most filtered sine waves still contain some harmonics that distort the waveform to a minor degree.

**Miscellaneous Features-** Inverter features vary from one model to another and from one manufacturer to another. Common features found on many inverters are as follows.

**i) Weather-proof Enclosure** - Most Inverters, especially grid-tie inverters, are designed to be installed outdoors and have weather-proof enclosures

**ii) AC/DC Disconnects** - Some Inverters have built-in AC/DC disconnects for safety and to facilitate removing the Inverter if it needs to be serviced.

**iii) Ground Fault Protection** -The National Electric Code (NEC) requires that roof-mounted solar electric systems must be grounded. Most Inverters have built-in ground fault protection.

**iv) Maximum Power Point Tracking**- Tracking the peak power point of a solar panel array is important for maximizing energy obtained from a PV module or array. If a system does not have a charge controller that performs this function, the Inverter is connected directly to the PV source and requires MPPT.

**v) Transfer Switch -** *A transfer switch is also known as a transfer relay. Grid-tie inverters usually feature a built-in load transfer switch for backup emergency power applications.* As long as utility power reaches the inverter's AC input side, the transfer switch passes the AC grid power directly through the Inverter to the load. If the utility grid power is interrupted, the transfer relay automatically switches to the battery backup input to the Inverter.

**vi) Generator Start Switch -** Some inverters are available with a separate generator start switch and include a second AC input for an AC generator that is used for backup. The generator can be programmed to start when the utility grid fails or when a low battery charge is detected. In some applications, where the Inverter has a built-in battery charger, the

generator operates long enough to recharge the batteries. If there is no battery backup, the generator is used as the only power source until the grid is operating again.

**vii) Display Panel -** A remote display panel option is available for many Inverters to indicate the system status. This feature is particularly useful if the Inverter and battery bank are located in an area that is difficult to access. A standard interface allows data to be sent to a remote site.

**Standard specification provided by Ministry of New and Renewable Energy, Govt of India for Solar Power Inverter is as follows:**

| | |
|---|---|
| Switching Devices | IGBT/MOSFET |
| Control | Microprocessor/DSP |
| Nominal AC output voltage and frequency | 415 V, 3 phase/220/230 V for sigle phase , 50 Hz ( In case single phase Inverters are offered, suitable arrangement for balancing the phases must be made) |
| Output frequency | 50 Hz |
| Grid frequency synchronization range | +3 Hz or more |
| Ambient temperature considered | -20° C to 50° C |
| Humidity | 95% Non- condensing |
| Protection of Enclosure | IP- 20(Minimum) for indoor |
| | IP- 65 (Minimum) for outdoor |
| Grid frequency tolerance range | +3 or more |
| No- load losses | Less than 1% of rated power |
| Inverter Efficiency (minimum) | >93% (In case of 10 KW or above with in-built galvanic isolation)<br>>97% (In case of 10 KW or above without in-built galvanic isolation)<br>>90% (In case of less than 10 KW) |
| Total Harmonic Distortion | <3% |
| Power Factor | >0.9% |

***Table- 5- Specification by MNRE, Govt of India***

## 2.G) APPROVALS/ REGISTRATIONS REQUIRED

Inverter manufacturing is exempted from Industrial licensing. However to start an Inverter manufacturing, the following registrations & approvals from the respective authorities based on the type of Enterprise may be required

*1. For starting as a company/ LLP, Business registration with ROC-*

Registrar of Companies (ROC) is an office under the Ministry of Corporate Affairs (MCA), which is the body that deals with the administration of companies. It requires a certificate of incorporation issued by the Registrar of Companies after finalization of statutory requirements. These documents include Memorandum of Association (MoA), Articles of Association (AoA), the pre-incorporation agreement for appointing directors/ managing directors and the declaration by an authorized person confirming that requirements relating to registration have been adhered to. After authenticating the documents, the ROC inputs the company's name in the register of companies and releases the certificate of incorporation. The Registrar together with the certificate of incorporation also issues a certificate of commencement of business. A public limited company is required to get this certificate prior commencing business.

2. *Local body license-* Before commencement of operation, the necessary approvals from the Local Self Government / Local Bodies may have to be obtained.

3.*GST Registration-*

In the GST Regime, a business whose turnover exceeds Rs. 40 lakhs (Rs 10 lakhs for NE and hill states) is required to register as a normal taxable person. This process of registration is called GST registration.

Special registration provisions for MSME Sector:

As a trade facilitation measure based on turnover, following small and medium enterprises are not required to obtain GST registration:

(i) Persons involved in Intra–State taxable supply of goods, if his aggregate turnover in a financial year does not exceed prescribed amount of threshold exemption limit i.e. ₹ 40 Lakh (₹20 Lakh in case of certain States).

(ii) Persons involved in Intra–State taxable supply of SERVICES, if his aggregate turnover in a financial year does not exceed prescribed amount of threshold exemption limit i.e. ₹ 20 Lakh (₹ 10 Lakh in case of certain States).

4. *Udyam Registration-*

For MSME/Udyam registration, MSME unit may visit the online portal maintained by Ministry of MSME, Govt of India- https://udyamregistration.gov.in. The Udyam Registration Certificate (URC) filing replaces the earlier registration UAM, EM Part I and EM Part II. There shall be no fee / cost for filing Udyam Registration. Udyam Registration (UR) filing is based on owner Aadhaar No, PAN No, Bank Account No, and GST No as applicable under GST act.**Udyam Registration is mandatory for availing credit facilities from banks and also to avail benefits under various programmes and policies of Govt of India and State Governments.**

*5.* '*Consent to Establish' and 'Consent to Operate' from the Pollution Control Board.*

Under the provisions of the Water (Prevention & Control of Pollution) Act, 1974 and the Air (Prevention & Control of Pollution) Act, 1981, "any industry, operation or process or an extension and addition thereto, which is likely to discharge sewerage or trade effluent into the environment or likely to emit any air pollution into the atmosphere will have to obtain the Consent"

There are two types of the Consent i.e. Consent to Establish (CTE), and Consent to Operate (CTO).

Consent to Establish: This consent is required to be obtained before establishing any Industry, Plant, or Process. The Consent to Establish is the primary clearance.

Consent to Operate: Once the Industry, Plant, or Process being established according to mandatory pollution control systems, the units are required to obtain consent to operate.

**Inverter manufacturing unit should abide the rules and regulations set by Ministry of Environment and Forests under the Batteries (Management & Handling) Amendment Rules, 2020. As per the rule, the unit should have collection centre's for collection of used batteries for recycling and disposing purpose.**

6. *Factory license for medium and large-scale factory operation*.

To protect the workers and to ensure that the owner is providing a healthy environment, the government has introduced the Factory Act, 1948. As per the Factory Act 1948, every factory owner must register their premises with the local authorities before commencing their business. Factory License acts as a document of approval given by authorities to carry out manufacturing activities. The Department of Factories and Boilers issues Factory License. Also a factory registering under the Factories Act, 1948 must obtain its building plan approval from the labour

and employment department before covering themselves for a factory registration.

The government has laid down the guidelines that are required to be followed by those Factories which-

- Have a minimum of 10 workers and consumer power.
- Have a minimum of 20 workers and do not consume power.

7. *Employee State Insurance & Provident Fund*

Employee State Insurance Corporation or ESIC is a self-financing social security and health insurance program that provides medical coverage, sickness benefits, maternity benefits, disability benefits, and many other benefits to the employees and their families. Establishments of 10 or more employees receiving wages up to Rs. 21,000/- (15000/- Before 1st January 2017) are required to be registered for ESIC under the ESI Act 1948

PF is one of India's key savings platforms for the working class. If the total employee strength is 20 or more, an establishment or business is required to obtain EIN No. Employee total strength includes contractors or temporary employees in the company, such as housekeeping staff, security, or other temporary workers.

At present, registrations under the Employees' Provident Funds and Miscellaneous Provisions Act, 1952 ('EPF Act') and the Employees' State Insurance Act, 1948 ('ESI Act') are mandatory for companies which employ more than twenty and ten employees, respectively.

*8. Quality Certifications*

**Zero Effect Zero Defect Certification (ZED)** - Is a holistic approach of manufacturing goods with "Zero Defects" so that our exported goods are never returned and to ensure that the goods have "Zero Effect" that they should not have a negative impact on the environment. The MSME applicant is required to comply with certain parameters and MSMEs will be rated on these parameters. The certification costs for the MSMEs would be subsidized @ 80% for Micro, 60% for Small and 50% for Medium enterprises.

**CE Marking** - The CE marking is the manufacturer's declaration that the product meets EU standards for health, safety, and environmental protection. The CE mark indicates that the product may be sold freely in any part of the European Economic Area, regardless of its country of origin. CE marked products shall meet the set of regulations published by the European Union (EU) known as directives such as Machinery Directive (MD)- 2006/42/EC, Low Voltage Directive (LVD) - 2014/35/EU, Electromagnetic Compatibility Directive (EMC) - 2014/30/EU, Restriction of Hazardous Substances (RoHS) - 2015/863. To comply

with these directives, manufacturer may take help of harmonised standards published in the "Official Journal of European Union". By complying with relevant directives and harmonized standards, manufacturer can make sure that his product is safe and can ensure free movements of the product in the European Union.

As the product's manufacturer, the unit bears the sole responsibility for declaring conformity with all requirements. MSME unit don't need a license to affix the CE marking to their product, however, before doing so, they must:

- ensure conformity with all relevant EU-wide requirements
- determine whether they can assess their product by them self or if they have to involve a notified body
- put together a technical dossier documenting conformity: find out about technical documentation
- draft and sign an EU declaration of conformity

Once the product bears the CE marking — if the competent national authority requests — the unit must provide them with all the information and supporting documentation concerning CE marking.

**RoHS** - RoHS stands for Restriction of Hazardous Substances. RoHS, also known as Directive 2002/95/EC, originated in the European Union and restricts the use of specific hazardous materials found in Electrical and Electronic products (known as EEE). Products compliant with this directive do not exceed the allowable amounts of the following restricted materials: lead, mercury, cadmium, hexavalent chromium, poly brominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE), with some limited exemptions.This directive applies to manufacturers, authorized representatives, importers and distributors of products. Organizations often prove RoHS compliance with a letter of compliance issued by an employee of the company. There are third party testing services available that will test an organization's products for levels of the restricted materials.

**BIS License** - The unit is required to submit the BIS Certification application with required documents and requisite fee. After submitting the application, a preliminary factory evaluation is carried out by the BIS officer. Then samples are tested in the factory and also drawn for independent testing. BIS certification is provided if the sample is acceptable.

**Trade Mark** - A trademark is recognizable sign, design or expression which identifies products or services of a particular source from those of others, although trademarks used to identify services are usually called service marks. Tendered trademarks that are similar or identical to an already existing registered trademark cannot get registered. Besides this, trademarks that are deceptive, generic, offensive, similar, contains

exclusively protected emblems, etc. cannot be registered either. In India, trademarks get registered by the *Controller General of Patents Designs and Trademarks, Ministry of Commerce and Industry, Government of India*. Trademarks in India are registered under the Trademark Act, 2016 and authorises the trademark owner with a right to sue for damages when contraventions of trademarks occur. Following the registration of the trademark, '*R*' symbol can be used by the owner and the said trademark registration will be valid for a fixed period of 10 years. However, the registered trademarks approaching their expiry can be easily renewed by applying for a trademark renewal application for an extended period of another 10 years.

## 2. H) EQUIPMENTS REQUIRED FOR MANUFACTURE IVNERTER

| | | |
|---|---|---|
| 1. | CAD/CAM Software & Computer for PCB design | CAD/CAM software can be used for designing the circuit diagram/ layout of PCB. |
| 2. | Coil Winding Machine | Coil Winding machines are used to wind coils for transformer, stators of motor and chokes |
| 3. | Frequency counter | Frequency counters usually measure the number of cycles of oscillation, or pulses per second in a periodic Electronic signal |
| 4. | LCR Bridge (Digital) Ind | An LCR meter is a type of Electronic test equipment used to measure the inductance (L), capacitance (C), and resistance (R) |
| 5. | Oscilloscope dual trace | An oscilloscope enables to observe constantly varying signal voltages usually as a two-dimensional plot of two to four signals relative to time. A dual-trace oscilloscope is capable of plotting one or two signals simultaneously and features two independent input channels — one channel for each trace — each of which has its own connectors and controls. |

| | | |
|---|---|---|
| 6. | DC regulated power supply | DC regulated power supply devices supply stable voltage (or less often current) to a circuit or device that must be operated within certain power supply limits. The output from the regulated power supply may be alternating or unidirectional, but is nearly always DC (Direct Current) |
| 7. | Standard Voltage Source | A voltage source is a two-terminal device which can maintain a fixed voltage. An ideal voltage source can maintain the fixed voltage independent of the load resistance or the output current. |
| 8. | Multi-meter | A typical multi meter can measure voltage, resistance, and current, in which case it is also known as a volt-ohm-milli ammeter (VOM) |
| 9. | Flow soldering machine | Machine used to soldering process in PCB. |
| 10. | Surface mounting equipment | A surface-mount device or SMD is used to mount or place components directly onto the surface of the PCB. |
| 11. | Line frequency Monitor | Line Frequency Monitor is used to measure the power line frequency |
| 12. | True RMS meter | A true-RMS device (RMS = root mean square) is used to measure alternating current (ac) or ac voltage. |
| 13. | Dimmer Stat / Auto transformer | An autotransformer, also known as variac or dimmerstat, is a single winding transformer which has a common primary and secondary winding |
| 14. | HV tester | High Voltage testing is usually performed to qualify the device to operate safely during rated Electrical conditions, a way to check the effectiveness of its insulation. The objective sought during the high voltage testing will |

| | | |
|---|---|---|
| | | determine the type and amount of voltage applied and the acceptable current flow. |
| 15. | Rheostats | A rheostat is a variable resistor which is used to control current. |
| 16. | Electric Drill | Primarily used for making round holes or driving fasteners. |
| 17. | Megger | Usedfor measuring the resistance of the insulation. |
| 18. | Power Analyser | Power analysers can be used to measure the flow of energy in either alternating current (AC) or direct current (DC) systems – with distinct considerations for measuring AC circuits. |

*Table-6:- Details of machineries used*

## 2. I) TEST FACILITIES REQUIRED

Inverters play an extremely important role in the functioning of a variety of products and equipments. For that reason, they must be tested thoroughly including product performance testing, maintenance testing, and inspections in the event of a malfunction or failure.

Following are the equipments used for testing an Inverter in a manufacturing facility:

| **Instruments** | **Function** |
|---|---|
| Digital CRO | To check output waveform and parameter values |
| High voltage tester | Electric leakage, HV breakdown and shorting |
| Torque wrench | To check the torque of Electric and pneumatic screws/nut drivers |
| Weighing scale | To check the weight of the UPS/inverter |
| Humidity and temperature meter | To know the temperature and humidity |
| Test panel jig | To check all the Electric parameters of the inverter/UPS |
| Tube light, bulb load & CFL load test setup | To check working and Electric parameters on inductive and capacitive load along with bulb load |
| Hydro meter | To check the specific gravity of the battery |

| | |
|---|---|
| DC power supply | To check various components |
| Multi-meter | To know Electric parameters like voltage, current, etc to test the diode, resistance, capacitance etc |
| Clamp meter | To check AC and DC current |
| Variac | To vary AC voltage for measuring high cut and low cut |
| Oven/ Environmental Chamber | To check the Environmental parameters |
| Automatic optical measurement machine | Detects missing, reverse, wrong values and shorting |
| In circuit testing machine | Complete PCB component checking including missing/wrong value/reverse /lifting/shorting |
| Bar code scanner | Scanning of finished goods |

*Table-7: Details of testing equipment's used*

2. **J) EXISTING TECHNOLOGY** Inverters began in the late 19th century as Electro-mechanical devices in the form of rotary converters or motor-generator sets (MG-Set). An inverter is an electrical device, and it is capable of changing a DC current to an AC current at a given frequency as well as voltage.

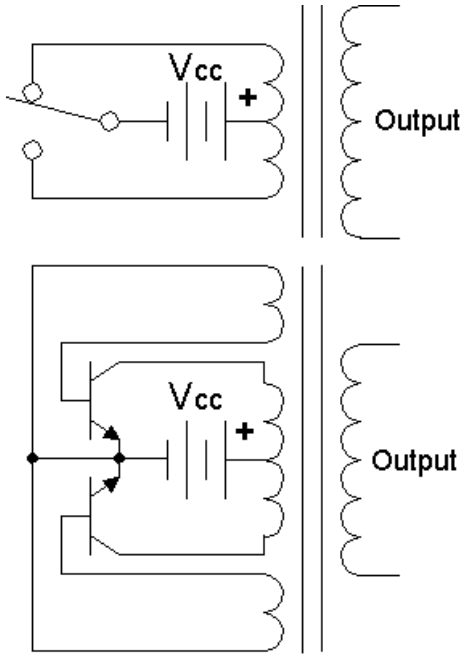
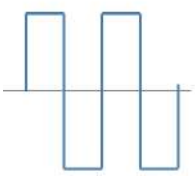
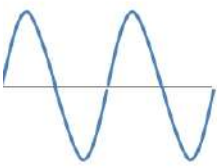
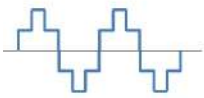


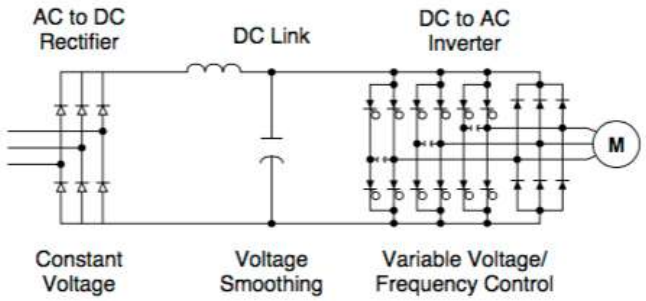
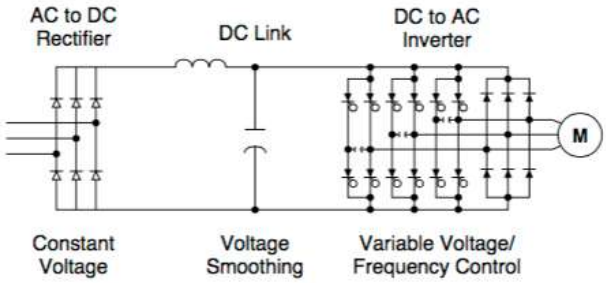

*Figure- 10- Simple inverter circuit shown with an electromechanical switch and automatic equivalent auto switching device implemented with two transistors and split winding auto-transformer in place of the mechanical switch*

Inverter can be classified into many types based on the technology . Below is the complete classification of the Invertersbased on the technology:

**I) According to the output characteristic of an inverter, there can be broadly three different types of inverters**

| | | |
|---|---|---|
| *Square Wave Inverter* |  Square wave | Output waveform of the voltage for this Inverter is a square wave.<br>Least used among all other types of inverter because most of the appliances are designed for sine wave supply. Supply of square wave to sine wave based appliances may lead to damage.<br>The cost of this Inverter may be low but the application is very less. |
| *Sine Wave Inverter* |  Pure sine wave | Output waveform of the voltage is a sine wave.<br>This is the major advantage of this Inverter because all the appliances are designed for the sine wave. So, this is the desired output.<br>This type of Inverters is more expensive but widely used in residential and commercial applications. |
| *Modified Sine Wave Inverter* |  Modified square wave | Output of this Inverter is neither pure sine wave nor the square wave. The output of such Inverter is the sum of two square waves. The output waveform is not exactly sine wave but it resembles the shape of a sine wave.<br>The construction of this type of Inverter is complex than simple square wave Inverter but easier compared to the pure sine wave Inverter. |

## II) According to the Source of the Inverter

| *Current Source Inverter* | |
|---|---|
|  | The current source Inverter is also known as current fed inverter.<br>This converts the input DC into AC<br>Output can be three-phase or single phase. This type of Inverters is used in the medium voltage industrial application, where high-quality current waveforms are compulsory. Use gate turn-off thyristors (GTOs) or symmetrical gate commutated thyristors (SGCTs), which are semiconductor switches that are turned on and off, creating a pulse width modulated (PWM) output with regulated frequency. |
| *Voltage Source Inverter* | |
|  | In VSI, the input is a voltage source.<br>These types of Inverter are used in all applications because it is more efficient and have higher reliability and faster dynamic response.<br>VSI is capable of running motors without de-rating.<br>Use insulated gate bipolar transistors (IGBTs), which create a PWM voltage output with regulated frequency and voltage.<br>Use capacitive storage, with capacitors in their DC link, which both stores and smooth's the DC voltage for the Inverter |

## III) According to the Number of Levels at the Output

- Regular Two-Level Inverter
- Multi-level Inverter

### 1) Regular two-level Inverter

These Inverters have only voltage levels at the output which are positive peak voltage and negative peak voltage. Sometimes, having a zero-voltage level is also known as a two-level Inverter.

### 2) Multilevel Inverters

These inverters can have multiple voltage levels at the output.

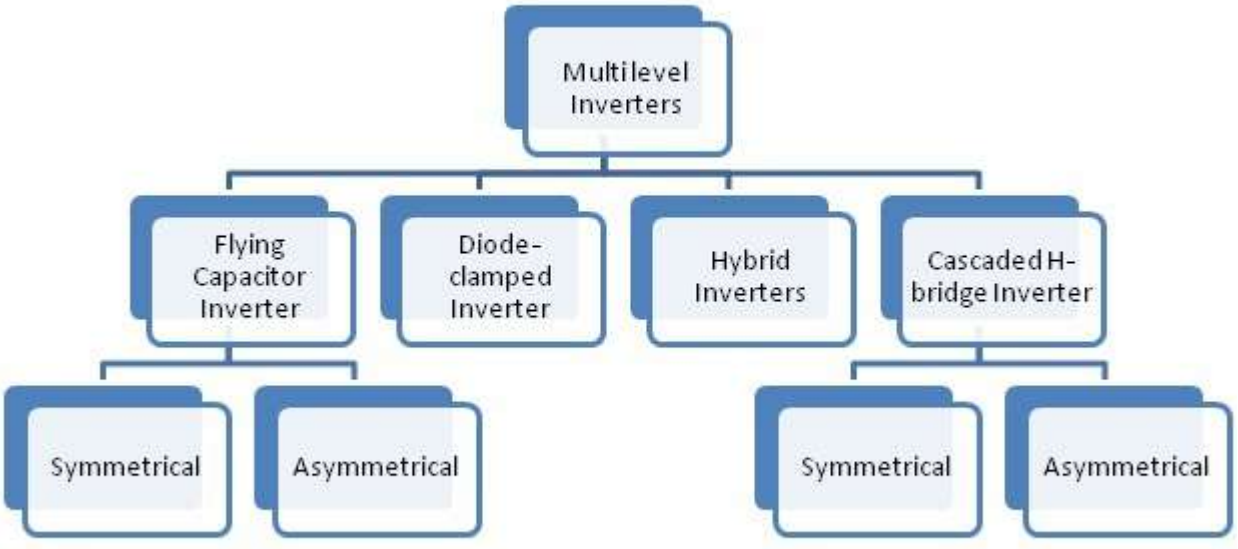



*Figure-11- Types of Multi- Level Inverter*

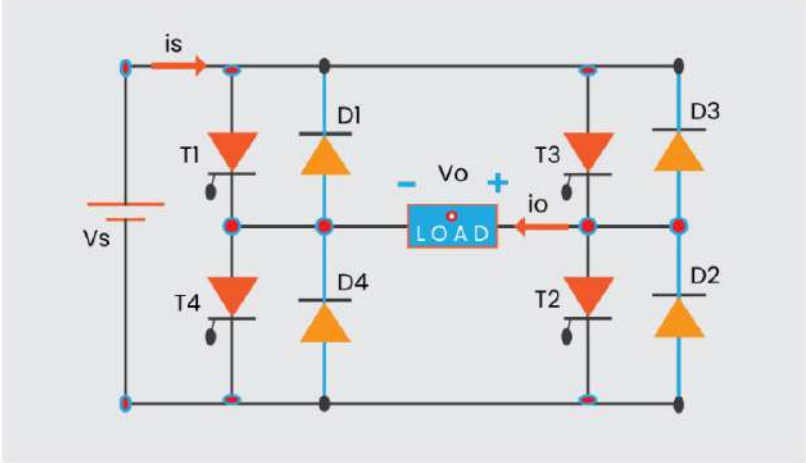
| Names | Advantages | Disadvantages | Applications |
|---|---|---|---|
| Diode Clamped Multilevel Inverter | Capacitance is low.<br>Back to back inverters can be used.<br>Capacitors are pre charged.<br>Efficiency is high at fundamental frequency, | Number of clamping diodes increases with the increase of each level.<br>DC level will discharge when control and monitoring are not precise | Static var compensation<br>Variable speed motor drives<br>High voltage system interconnections<br>High voltage DC and AC transmission lines |
| Flying Capacitors Multilevel Inverter | For balancing capacitors' voltage levels, phase redundancies are available.<br>It is possible to control reactive and real power flow. | Voltage control is difficult for all the capacitors<br>Complex start up<br>Poor Switching efficiency<br>Capacitors are expansive than diodes | Induction motor control both AC-DC and DC-AC Conversion applications.<br>Converters with harmonic distortion capability.<br><br>Sinusoidal current rectifiers. |
| Cascade H Bridge Multilevel Inverters | Output voltages levels are doubled the number of sources<br><br>Easy and quick Manufacturing<br><br>one can control it Easily with a transformer<br><br>Inexpensive | Every H Bridge needs a separate dc source<br>Due to large number of sources, Applications are Limited. | Motor Drivers<br>Active Filters<br>Electric vehicle drives<br>DC power source utilization.<br>Power factor compensators.<br><br>Interfacing with renewable energy resources. |

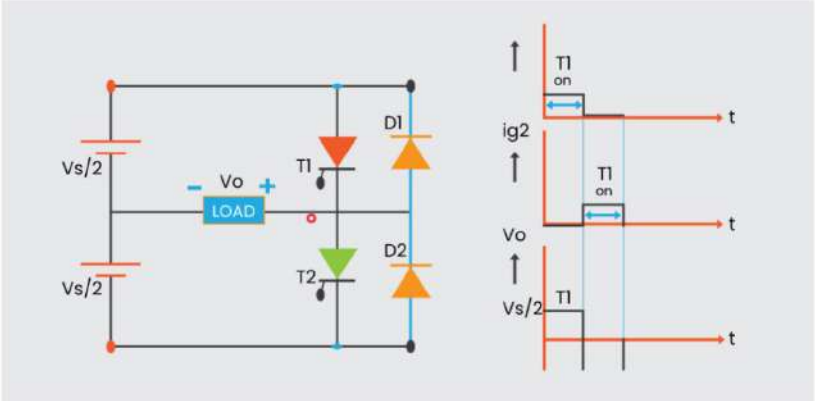
*Table- 8: Comparison and applications of multi-level inverters*

## IV) Classification According to Control Technique

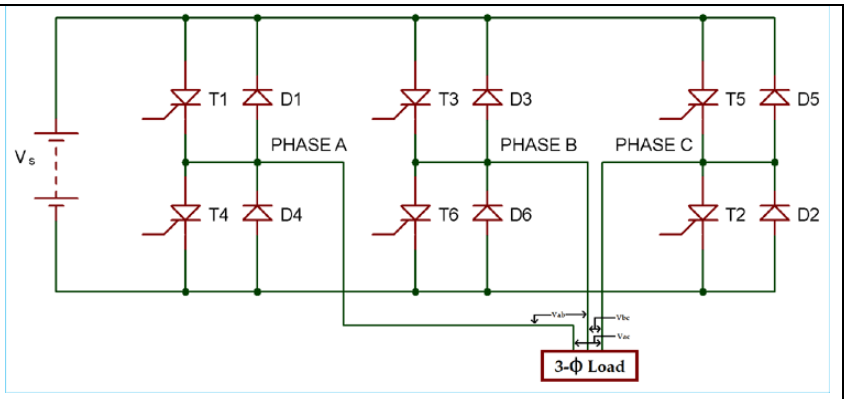
- Single Pulse Width modulation (single PWM)
- Multiple Pulse Width Modulation (MPWM)
- Sinusoidal Pulse Width Modulation (SPWM)
- Modified Sinusoidal Pulse Width Modulation (MSPWM)

## V) According to the Type of Load

<table>
<tr>
<td rowspan="2">Single-phase Inverter</td>
<td rowspan="2">Produces single phase power from the PV modules and connect to single phase equipment or the grid.</td>
<td> 

Single phase full bridged inverter</td>
</tr>
<tr>
<td> 

Single phase half bridged inverter</td>
</tr>
</table>

| | | |
|---|---|---|
| *Three-phase Inverter* | Produces three phase power from the PV modules and can be connected to three phase equipment or grid |  |

**VI) Solar Inverter-** A solar Inverter can be defined as an Electrical converter that changes the uneven DC (direct current) output of a solar panel into an AC (alternating current)

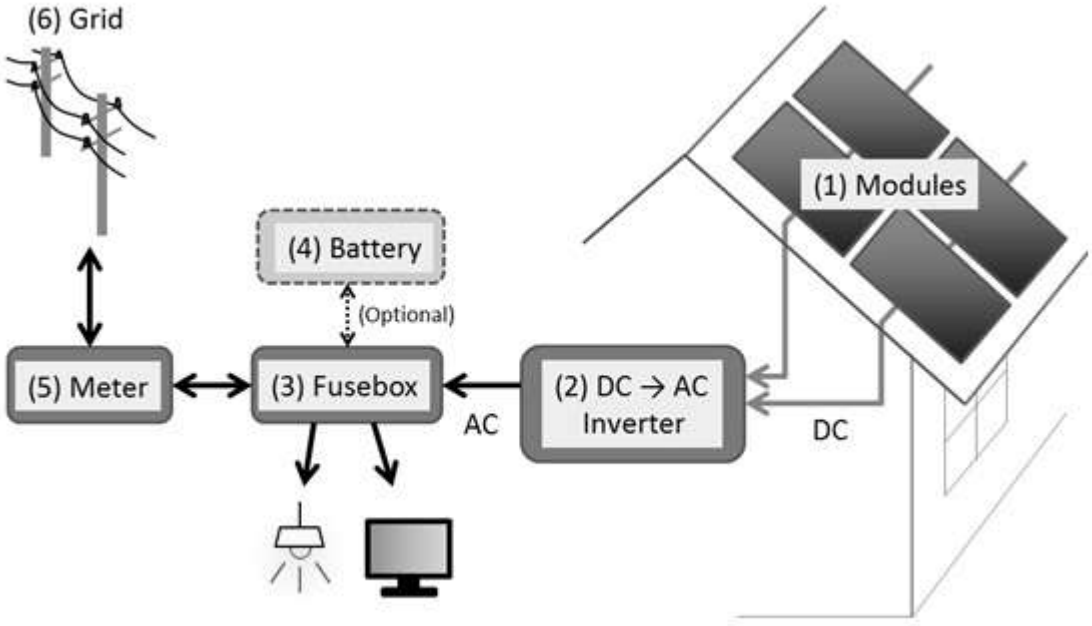
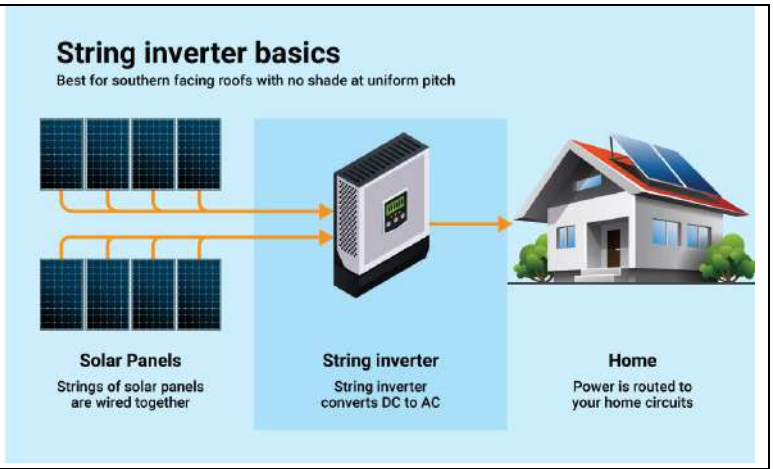
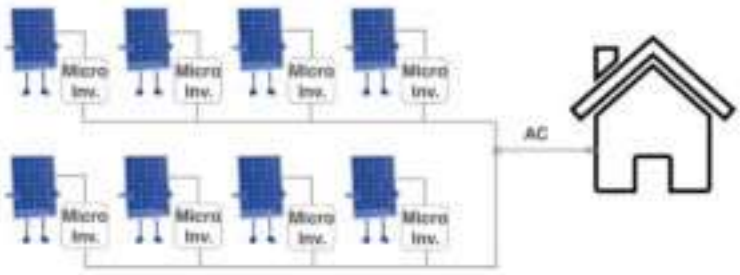
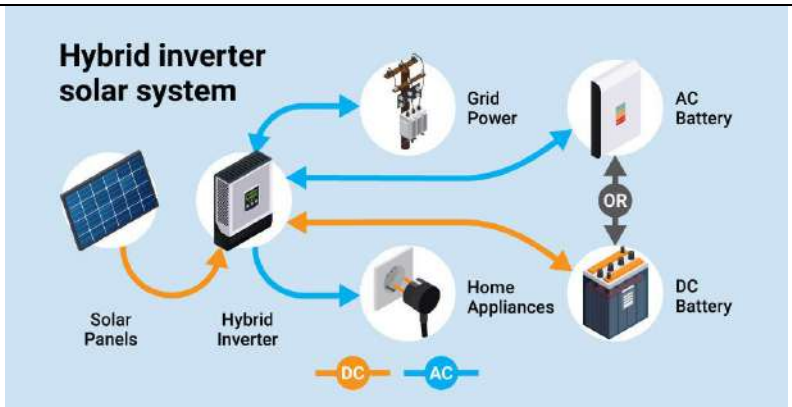
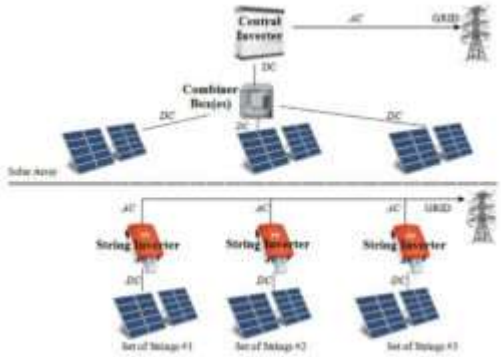



*Figure-11: Solar Inverter Working*

***There are mainly five types of solar Inverter, and they are as follows:***

| | |
|---|---|
| *String Inverter* |  |
| Multiples strings originating from the solar panels are attached to the inverters and the DC Electricity produced in them are then transformed into AC current. They are cheaper than other types of Inverters and kept in the closer proximity of fuse box and Electricity meter. The problem with this kind of Inverter is that if one panel is obstructed with shading, the remaining panels will be sabotaged too, and the efficiency will go down to a significant amount- besides, less scope to expand the solar panels for the future. This type of inverters is the main type of solar Inverter for home. | |
| *Micro Inverters* |  |
| A micro Inverter is a piece of Electronic equipment used in photovoltaic cells for changing the waveform of current. The Inverter is primarily used for the purpose of changing Direct Current (DC) into Alternating Current (AC). A micro Inverter is called so due to the fact that it converts the current from a single module source from DC to AC. | |

| | |
|---|---|
| *Hybrid Solar Inverters* |  |
| This is a multi-mode Inverter which involves a battery installation along with the set-up of the Inverters. Not only does the Inverter supply the DC power to the battery, but also it provides power to the grid and your home's appliances in the form AC current. Having equipped with MPPT, it can track the amount of charge your battery requires, and when it's the right time to draw the charge from the grid for a low price. When the battery is fully charged, the excess power can be sent back to the grid using this charge controller. Should any problem arise, this Inverter can go to a standby mode instead of the turning off completely. | |
| *Central Inverter* |  |
| It resembles the string Inverter, but instead of putting the strings of panels in the Inverter, it joints all of the strings of panels together and inserts it into a combiner box which is kept in a protected territory. Afterwards, the strings are then connected to an Inverter which receives the DC electricity from the combiner box and then converts it to AC. Since the Inverter involves using only a combiner box and a pad, its installation cost is very less. Besides, it is less vulnerable to any physical or natural damage since it's kept in a protected area, which is free from any harsh weather. Since they have more capacity compared with string and micro Inverter, they are mostly used in large-scale properties. | |

| | |
|---|---|
| *Battery-based Inverter/Charger* |  |
| Most of the off-grid solar systems tend to charge the battery on its own, but during winter or acute shading, it is often difficult for the solar system to fully charge the battery. Hence, the Inverter/charger kicks in to meet the energy requirement of the system. This type of Inverter is bi-directional, which means that it can work both as a battery charger and an Inverter. In this system, an AC generator is required to trigger the conversion of the AC Electricity to DC and vice versa. This type of Inverter can be off-grid, grid-tied, or grid-interactive. With the help of the Inverter/charger, AC power from the generator is converted into DC to feed the battery, whereas the DC is converted into AC to supply the continuous power of the critical loads. | |

**VII) High frequency inverter with Ferrite transformer**: These Inverters are light weight and mainly used in mobile applications like cars, cam sites, boats, vehicles etc

**Types of Inverter & UPS Circuit Configurations**

- Flying Capacitor
- Diode Clamped
- Hybrid Inverters
- Cascaded H Bridge Inverters

In terms of the types of UPS and its circuit configuration, a UPS can be classified as

- Offline or Standby UPS
- Line Interactive UPS
- Online Double Conversion UPS

## 2. J) EMERGING TECHNOLOGY SCENARIO

The overall current level of R&D in the MSMEs in the country is far below the international level. The technology available in the market with Indian companies are at least a few years older than other countries. At present Indian R&D centers develop technologies which may not be cost competitive or may not go for mass production

because of the complexity of wiring and assembling. So, MSME companies are forced to further develop & fine tune the technology again after purchasing the technology from R&D centres. R&D institutions may have to be supported for developing technologies which are on par with imported products in quality and is cost effective. Also institutions/ R&D centers should take up these projects with in a definite time frame for completion from start to end. The requirement in the market is moving toward Solar Grid Inverters and to transformer-less technology. As the above sector are growing the demand for Solar Grid Inverters and Off Grid inverters are likely to go up.

- Devices that use control circuits, which sense the phase for speed/voltage control, or devices that sense instantaneous zero voltage crossing (for timing control) must have a sine wave supply. As pointed above, sine wave changes polarity instantaneously and smoothly, when it crosses zero volts. The rise and fall of voltage is smooth as compared to the shape of the square wave. Due to this feature, inductive loads (as in motors or microwaves) run quieter, cooler and faster.
- Electronic items like printers, scanners and monitors have minimal harmonic distortion. Therefore, fewer glitches and irregular printouts are assured. This is important for sensitive commercial applications too. Even fans, audio amplifiers, TV etc. produce less audible noise in sine wave v/s square.
- Sine-wave inverters are predominantly iron-core transformer types. However, in recent times, development of ferrite-core based high-frequency Inverters is taking place. These Inverters are smaller in size and more efficient.

| *Iron core transformer type* | *Ferrite core based* |
|---|---|
| Iron core inverters use low frequency transformers to convert low AC voltage into high AC voltage. | Ferrite core inverters use high frequency choppers to convert low voltage DC to high voltage DC. |
| Efficiency of these inverters is not so high. | High efficiency |
| Iron core inverters are bulky, high size, high harmonic distortion and high noise. | Small in size &Low in weight |
| Iron core inverters also not suitable for solar inverters, because it lose the purpose to make system efficient and to extract maximum energy from solar panels due to low efficiency of iron core inverters. | Low cost &Heat generation is also less. |

*Table-9: Comparison of Iron core & ferrite core based transformer type*

The over all trend with respect to technology is moving towards solar. Today, high-power tracking systems such as maximum power point tracker (MPPT) based solar Inverters are being used. This is the latest technology shift that is occurring from the typical pulse-width modulation (PWM) Inverters.

| *PWM Type Solar Controllers* | *MPPT Solar Controllers* |
|---|---|
| – PWM controllers are built on a time tested technology. They have been used for years in Solar systems, and are well established<br>– These controllers are inexpensive,<br>– PWM controllers are available in sizes up to 60 Amps<br>– PWM controllers are durable, most with passive heat sink style cooling<br>– These controllers are available in many sizes for a variety of applications | – MPPT controllers offer a potential increase in charging efficiency up to 30%<br>– These controllers offer the potential ability to have an array with higher input voltage than the battery bank<br>– Available sizes up to 80 Amps<br>– MPPT controller warranties are typically longer than PWM units<br>– MPPT offer great flexibility for system growth<br>– MPPT is the only way to regulate grid connect modules for battery charging |
| – The Solar input nominal voltage must match the battery bank nominal voltage if you're going to use PWM<br>– There is no single controller sized over 60 amps DC as of yet<br>– Many smaller PWM controller units are not UL listed<br>– Many smaller PWM controller units come without fittings for conduit<br>– PWM controllers have limited capacity for system growth<br>– Can't be used on higher voltage grid connect modules | – MPPT controllers are more expensive, sometimes costing twice as much as a PWM controller.<br>– MPPT units are generally larger in physical size<br>– Sizing an appropriate Solar array can be challenging without MPPT controller manufacturer guides<br>– Using an MPPT controller forces the Solar array to be comprised of like photovoltaic modules in like strings |

*Table- 10- Comparison of Controllers*

**VIII) Hybrid Inverters** Another trend is towards hybrid Inverters. These Inverters use solar panels in combination with the main power to charge the battery, thus saving on the Electricity cost. These Inverters could help in integrating conventional energy sources with regular sources easily and are programmed to use conventional sources in a better way.

**IX) IoT technology** allows inverters to be accessible and controlled remotely. Internet of Things (IoT) is becoming more popular and embedded to day to day life because of its smartness and increased connectivity. IoT Trends can be easily integrated into energy management which will make the life more comfortable. The intermittency and variability nature of renewable energy sources may result into power system instability if intelligent interface is not provided. A power Electronics Inverter system with a digital design, robust software facilities and a two way communications make the system intelligent. Hence IoT based smart controlled Inverter with Wi-Fi technology for a two way communication with the user controlled & connected to load as well as monitor the load current & status of the connected devices through Mobile Application or Web URL. In this system , the user can connect / disconnect the devices based on the requirement/ choice. The load current is measured by current sensor and the acquired data is transferred to the Web URL through Wi-Fi module. The remote node can control the connected loads again via the same Wi-Fi module through internet.

**X) Power Storage/ Battery Technology** also plays a significant role in the technology scenario. The Li-ion battery is one of the latest trend in the battery technology.

**Lithium- ion battery**

The li-ion battery advantages include:

- ***High energy density:*** The high energy density is one of the chief advantages of Lithium ion battery technology.
- ***Self-discharge:*** One issue with many rechargeable batteries is the self-discharge rate. Lithium ion cells are that their rate of self-discharge is much lower than that of other rechargeable cells such as Ni-Cad and NiMH forms. It is typically around 5% in the first 4 hours after being charged but then falls to a figure of around 1 or 2% per month.
- ***Low maintenance:*** One major advantage of these types of batteries is that they do not require much maintenance to ensure their performance.
- ***Cell voltage:*** The voltage produced by each lithium ion cell is about 3.6 volts. Being higher than that of the standard nickel cadmium, nickel metal hydride and even

standard alkaline cells at around 1.5 volts and lead acid at around 2 volts per cell, the voltage of each lithium ion cell is higher, requiring less cells in many battery applications.

- ***Load characteristics:*** The load characteristics of a lithium ion cell battery are reasonably good.
- ***No requirement for priming:*** Some rechargeable cells need to be primed when they receive their first charge. One advantage of lithium ion batteries is that there is no such requirement.

**Energy storage Materials and Devices**

Rechargeable batteries are increasingly viewed as an important means of alleviating problems associated with an overdependence on fossil fuels, as they can serve as storage devices for renewable energy, such as wind and solar power, and as power sources in environmentally friendly vehicles (fully Electric and hybrid cars) as well as in a host of consumer Electronics, such as mobile phones and laptops. However, the low abundance and uneven distribution of lithium resources show the potential difficulties of the long-term and large-scale applications of lithium-ion batteries in terms of their availability and cost. Hence, the development of new types of batteries, such as sodium-ion and magnesium-ion batteries, is necessary. Among them, sodium-ion batteries (NIBs) possess electrochemical working principles that are similar to LIBs. In addition, sodium is inexpensive and abundant in nature. Sodium is the sixth richest element on earth. Therefore, NIBs could substitute LIBs in applications such as smart grids and large-scale energy storage for renewable solar power and wind power.

**XI) Super capacitor** is an emerging technology in the field of energy storage systems that can offer higher power density than batteries and higher energy density over traditional capacitors. Super capacitor is an attractive power solution to an increasing number of applications, such as renewable energy power generation, transportation, power system and many others, because of its advantages which include high charge/discharge current capability, very high efficiency, wide temperature range, etc. R&D on new materials for Aerogel based and graphene based super capacitors for potential applications in various sectors such as strategic, automobile, power electronics etc is in progress. **Centre for Material for Electronic Technology(C-MET), a scientific society under the Ministry of Electronics and Information Technology, Govt. of. India** is working on the development of Aerogel super capacitors for various applications starting from raw material production at pilot plant level to fabrication of

aerogel super capacitors up to 50F using in house indigenously established super capacitor fabrication facility. Currently aerogel super capacitor is being tested as a power source for VVPAT of Electronic Voting Machine. C-MET has established a process for the production of continuous graphene electrodes suitable for super capacitors. C-MET has developed graphene based super capacitors having capacitance of 0.1F to 100F and achieved an ESR of 10 milliohm. Aerogel, especially the carbon aerogel is a 3-dimensional nano structured porous material that has unique physical and chemical properties, suitable for energy storage and other applications. Graphene is also a promising material for super capacitor electrodes owing to its excellent electrical conductivity. C-MET has established a process for the production of graphene from natural graphite flakes through chemical route at laboratory scale. C-MET has also developed graphene based super capacitors.

**XII) Transformer-less Inverters** Another trend is the shift to transformer-less Inverter systems. These systems are efficient when it comes to handling IT loads and data management applications. They are installed with insulated-gate bipolar transistors (IGBTs) that regulate high voltages; as a result, a step-up transformer is not required after the Inverter. In addition, transformer-less UPS systems is light and has a small footprint.

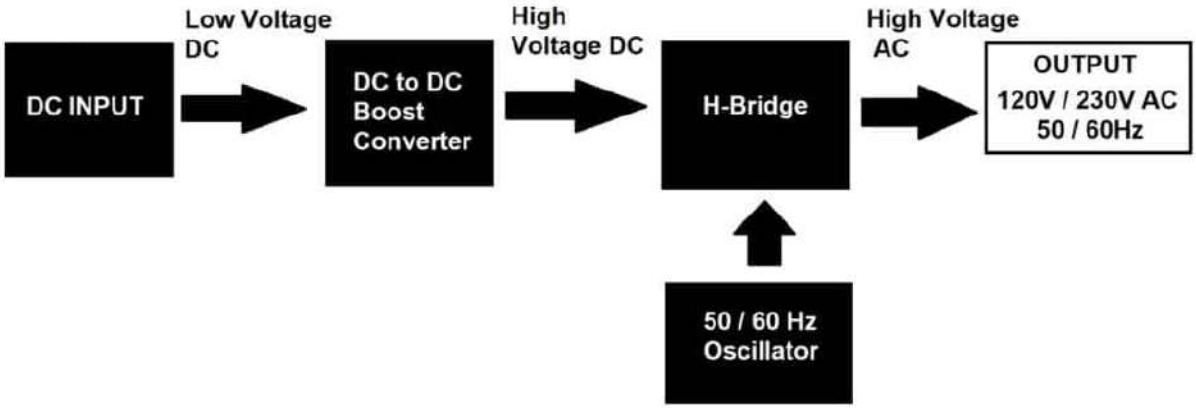



*Figure-12:- Transformer less inverter block diagram*

Comparison of Transformer less Inverter vs Transformer Based Inverter:

| Parameters | Transformer less Inverter | Transformer based Inverter |
|---|---|---|
| Input / output isolation | No Galvanic isolation exists between input and output. | Galvanic isolation exists between input and output due to the transformer. |
| Efficiency | Better efficiency, greater than 95%. | Reasonably (good) efficiencybut lesser than transformer less |
| Voltage step-up by | DC to DC boost converter. | Iron core step-up transformer. |
| Power | Typically used where power demand is low, less than 10KVA. | Used where power demand is high 100KVA or more. |
| Size | Overall smaller dimension. | Bulkier than transformer less type. |
| Weight | Light weight. | Heavy & can get heavier if power requirement is high. |
| Applications | Commonly used in solar farms, solar roof installations for best efficiency and data-centre's backup system where space is luxury. | Commonly used in line interactive backup UPS (uninterruptible power supply). |

*Table- 11: Comparison of transformer- less and transformer based inverters*

**EMERGING AREAS** While UPS/inverter industry is relatively stable these days, there is need to look out for new trends in advanced Electronics such as Internet of Things based systems and smart grid linked systems. This would help industry to have a different and futuristic perspective and see UPS and inverters beyond just power suppliers. R&D has become one of the major focus areas of the power backup systems market. For the overall development of the industry, and for players to be able to increase the profitability, it has become imperative for the companies to invest in R&D activities. Making power backup equipment available in smaller sizes would ensure greater revenue, especially from the SME and SOHO segments. Players can also look to foray in to e-commerce business models along with doorstep delivery systems. Another

emerging area is that of superior after-sales services. A widespread service centre network will help companies build trust and ensure recommendations from existing customers, thereby adding to their good will and brand value. Moreover, cross-selling platforms for low-voltage products via the diffused channels are expected to bring about a greater visibility amongst end users, thus leading to greater revenues.

## National level R&D Initiatives

### National Mission on Power Electronics Technology (NaMPET)

Power Electronics has revolutionized the concept of power control for efficient power conversion and for power quality improvement. It is expected that during the next few years, almost all of the Electrical energy will be processed through Power Electronics somewhere in the path from generation to end-use.Realizing the importance of Power Electronics Technology in the coming decades, Ministry of Electronics and Information Technology (MeitY), Govt. of India launched the programme, **National Mission on Power Electronics Technology (NaMPET)** in 2004 with the vision of making India a dominant player in Power Electronics at the global level. NaMPET is a National level R&D Programme facilitating Research, Development, Deployment and Commercialization of Power Electronics Technology by enhancing the indigenous R&D expertise and infrastructure in the country with active participation from R&D institutions, Academic institutions and Industries.

NaMPET has been successful in establishing a good network of Power Electronics community including Academic institutes, Industries, R&D institutions and Power electronics professionals in the country. The knowledge base of Academia and the R&D expertise are utilized for commercialization of technology through industries. NaMPET has nurtured a culture of significantly large R&D teams, consisting of members from different institutions and diverse disciplines, working towards a common multi-disciplinary objective important to the power Eectronic community. This synergy has led to successful implementation of major projects with national importance.

Various activities undertaken under NaMPET are:

***HIGHLIGHTS OF ACTIVITIES IN NAMPET-I***

(2005-2010) focused on R&D, infrastructure and awareness creation. NaMPET has been successful in establishing a good network of premier academic institutes and

industries around the nodal centre at Centre for Development of Advanced Computing(C-DAC). Highlights of activities under taken in NaMPET phase-1 are

- Development of State of the art technology for Grid-tied solar inverters, Full Spectrum Simulator, Matrix Converter etc.
- Major sponsored projects like STATCOM for IT Park from MoP, Vehicle Control Unit and Auxiliary Converter for Rolling Stock Application from Indian Railways etc.
- Sponsored projects on Front-End Converter, UPS Systems and AC Drives with industries, and the development of Power Conditioner for Fuel Cell for NMRL, a DRDO lab.
- Products like Hall Effect Current Sensors and IGBT Gate drivers are developed and commercialized through industry partners like M/s Electrohms, Bangalore and M/s Veeral Controls, Gandhi Nagar.
- Many research projects undertaken by Academic Institutions have resulted in proving concepts and publication of papers.
- Educational kits for hands on training of students in PE area developed and introduced in the academic institutions
- National Power Electronics Infrastructure built at the Nodal centre, and at 11 Academic institutes across the country

***HIGHLIGHTS OF ACTIVITIES IN NAMPET- II***

Vehicle Control Unit (VCU) technology for Indian Railways to replace the present imported proprietary VCU has been developed and transferred to 5 Industries and so far around 500 sets of VCU units installed by these industries in LOCO's.

DEPLOYMENT, UPGRADATION AND PRODUCT DEVELOPMENT

- Grid Connected Solar PV Power Conditioner
- Net Zero energy Building
- Wide Area Monitoring ( WAM )
- Full Spectrum Simulator
- The development of Position Controller for Akash Missile Launcher successfully completed and commercialized by CDAC for M/s Tata Power and around 500 Units per year is being produced by Tata Power with CDAC technology.
- Advanced technologies like High Voltage Power Supply, Medium Voltage Drives for process industries, Smart Energy Meter, System on Programmable Chip are successfully developed and demonstrated.

***HIGHLIGHTS OF ACTIVITIES IN NAMPET-III***

- NaMPET Phase-III was initiated on 30th January 2019 for a period of Five years to further strengthen the Power Electronics base in the country.

Technologies Developed Under NAMPET

- High Speed Reconfigurable Power Electronics Controller (HSRPEC)
- Grid Interactive Solar Photo Voltaic System (GISPV)
- Full Spectrum Simulator for Power Electronics & Power Systems (FSS)
- Miniature Model of Full Spectrum Simulator for Power Electronics & Power Systems (FSS Mini)
- STATCOM
- DC - DC converter for SPV applications (DC DC)
- Medical Electrical Safety Analyser (MEDSAFE)
- 400 Hz Inverters for Airborne Applications (Stat Inv)
- Non - Linear Load (NLL)
- Smart Energy Meter
- MW scale Grid Connected Solar Photovoltaic Power Plant
- Low Voltage Direct Current
- Dynamic Voltage Restorer
- Smart Plug for Net Zero Energy Buildings
- Vehicle Control Unit & Train Communication Network for Rolling Stock Application (VCU&TCN)
- Wide Area Monitoring using Phasor Measurement Unit (WAM)

**Details of *NAMPET* are available with**

**National Mission on Power Electronics Technology (NaMPET)**
**Power Electronics Group**
**Centre for Development of Advanced Computing**
**Vellayambalam, Thiruvananthapuram, Kerala - 695 033 INDIA**
**Tel: +91 471 2723333, 2723226 Fax: +91 471 2723456**

*** Source https://www.nampet.in*

2. **K) RAW MATERIAL REQUIRED AND AVAILABILITY**

Components used to manufacture Inverter are Capacitors, Resistors, PCB's, Connectors, Switches, Relay, Cables, Fuses, LED, Copper wire, IC, Diodes Transistors, MOSFET, IGBT, Cabinet, Lug, Sleeves Plastic frames, Heat sink, socket, tapes, impregnation compound, hardware fittings, jacks, tapes etc.

Reports by Ministry of Electronics & Information Technology and compilation of Imports and Exports data from Trademap.org indicates that the Indian Electronic Components Market (Excluding Imported PCB Assemblies) was estimated to be around USD 20.8 billion in 2019 with a growth of 8% over the previous year. The Indian Electronic Components Market seems to be largely dependent on imports which accounts for over 57% of the Indian Market requirement. Nearly 23% of the local production of Electronic Components is exported.

The Market Demand by various Electronic Components (Excluding Imported PCB Assemblies) categories is shown below:

2018-19 Electronic Components Market Demand (USD 20.8 B)



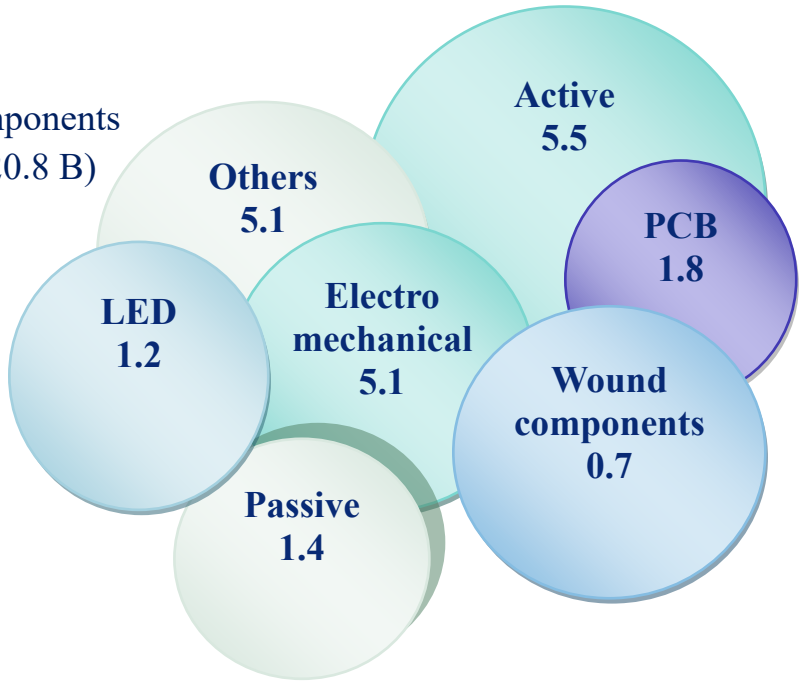
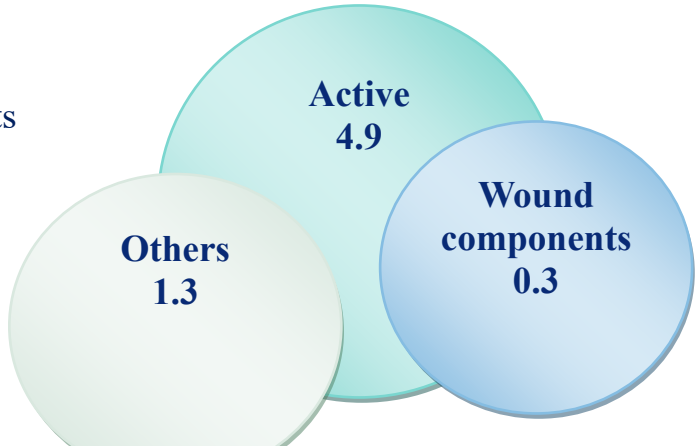



*Figure-13:- Market Demand of Electronic Components*

*(Data Source- Report by ELCINA 2019)*

2018-19 Electronic Components Imports (USD 13.1 B)



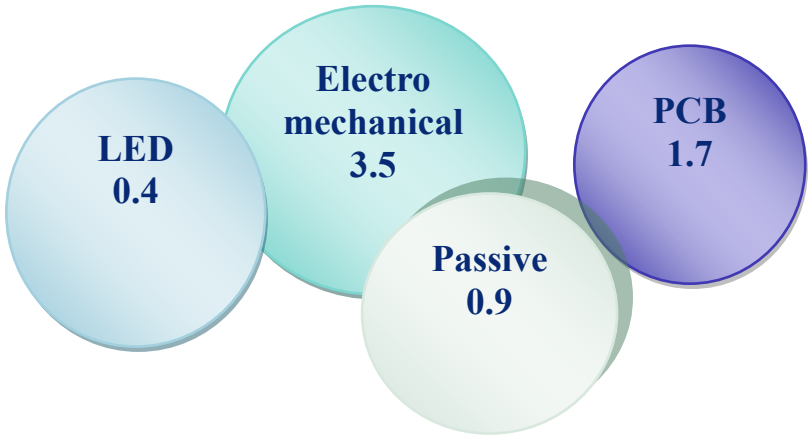



*Figure-14:- Imports of Electronic Components*

*(Data Source- Report by ELCINA 2019)*

2018-19 Electronic Components Exports (USD 2.2 B)



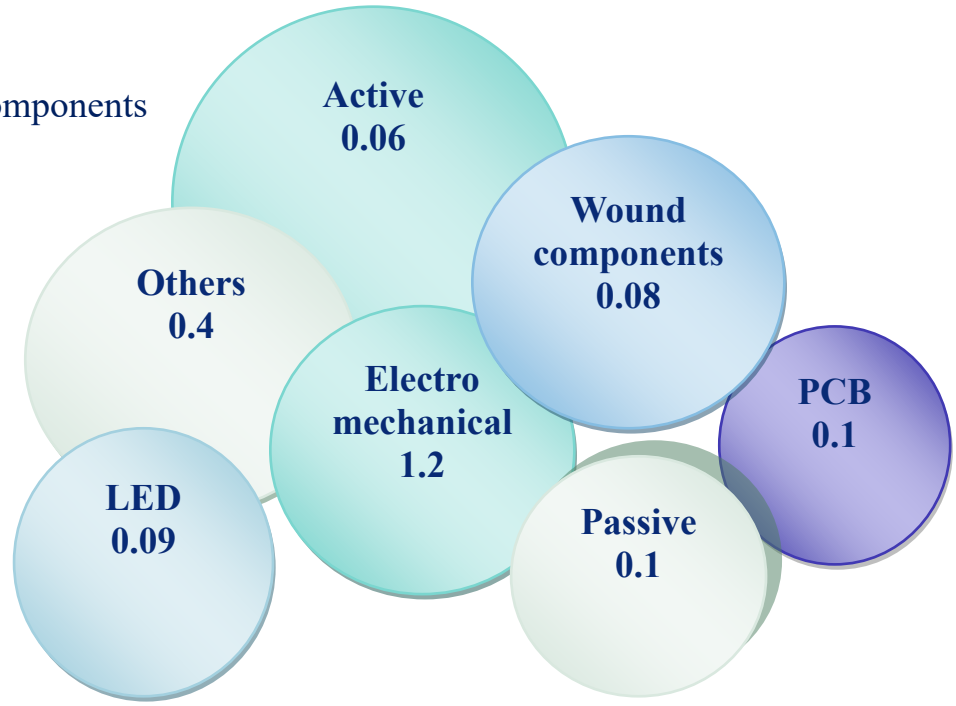



*Figure-15:- Exports of Electronic Components*

*(Data Source- Report by ELCINA 2019)*

**Passive Components**

The Passive Components consists of two key components – Capacitors and Resistors. The overall market situation for these compenents is shown below:

| 2018-19 US$ B | Capacitors | Resistors |
|---|---|---|

| | | |
|---|---|---|
| Domestic Production | 0.48 | 0.12 |
| Exports | 0.14 | 0.04 |
| Imports | 0.66 | 0.29 |
| Domestic Market | 1.01 | 0.37 |
| Domestic Production (% of Dom. Market + Exports) | 42% | 29% |

*Table-12:- Demand of Passive Components*

The Indian Resistors market seems to be imports dependent which accounts for 70% of the Indian market requirement, while in Capacitors it is about 58%. Nearly 30% of the local production in Capacitors is exported and is not sold in the country due to the availability of cheaper imports in India

*(Data Source- Report by ELCINA 2019)*

**Printed circuit board (PCB)**

PCB's mechanically supports and Electrically connects Electrical or Electronic components using conductive tracks, pads and other features etched from one or more sheet layers of copper laminated onto and/or between sheet layers of a non-conductive substrate

The overall situation of the Bare PCBs market in India is shown below USD B (2018 - 2019)

| 2018-19 US$ B | PCBs Bare | Total |
|---|---|---|
| Domestic Production | 0.23 | |
| Exports | 0.14 | |
| Imports | 1.72 | |
| Domestic Market | 1.81 | |
| Domestic Production (% of Dom. Market + Exports) | 12% | |
| Import of PCB Assemblies | | 10.95 |
| Total Domestic Demand for Components | | 31.8 |
| Total Demand for Components (Domestic + Exports) | | 34.0 |

*Table:- 13- Demand of PCB's*

*(Data Source- Report by ELCINA 2019)*

The Indian Bare PCBs market is also heavily dependent on imports accounting for over 88% of the Indian market requirement. Nearly 60% of the local production is exported and is not sold in the country due to the availability of cheaper imports in India.

Over the past couple of years, the demand for PCBs has increased significantly in India owing to increasing investments in digitization and other government schemes. According to various experts, this market is projected to cross US$ 5.35 billion by 2023, exhibiting a CAGR of 17.7 per cent by 2023.A report by electronicsb2b.com has stated that only 35 per cent of the demand for PCBs in India is met by local manufacturers. And for the remaining 65 per cent, India is still dependent on imports. There are around 200 PCB manufacturers in India, with more than 60 per cent of them being very small and in the unorganised sector. Nearly 60% of the local production is exported and is not sold in the country due to the availability of cheaper imports in India.**Recently, Government had increased the import duty on PCBAs to 20 per cent from 10 per cent. This has been done to promote local manufacturing in India**. Government estimates that this decision will help increase local production of PCBAs by more than 100 million units and currently, around 160 million PCBs are produced locally every year, according to a report by ET.

**Electro Mechanical Components**

The Electro Mechanical Components market comprises of Connectors, Switches, Relay, Cables and Fuses. The market demand for these components are shown below

| 2018-19 US$ B | Connectors | Switches | Relays | Fuse |
|---|---|---|---|---|
| Domestic Production | 0.78 | 0.69 | 0.02 | 0.08 |
| Exports | 0.56 | 0.54 | 0.02 | 0.05 |
| Imports | 1.45 | 0.88 | 0.08 | 0.05 |
| Domestic Market | 1.67 | 1.03 | 0.08 | 0.09 |
| Domestic Production (% of Dom. Market + Exports) | 35% | 44% | 24% | 62% |

*Table- 14:- Demand of Electro mechanical components*

The Indian Electro Mechanical Products market is moderately dependent on imports accounting for over 55% of the Indian market demand. Nearly 43% of the local production is exported and is not sold in the country due to the availability of cheaper imports in India

*(Data Source- Report by ELCINA 2019)*

**LEDs** The overall situation in the LEDs segment is as shown below: USD B (2018 - 2019)

| 2018-19 US$ B | LED |
|---|---|
| Domestic Production | 0.77 |
| Exports | 0.09 |
| Imports | 0.45 |
| Domestic Market | 1.14 |
| Domestic Production (% of Dom. Market + Exports) | 63% |

*Table- 15:- Demand of LEDs*

The Indian LED Lighting market is also dependent on imports accounting for nearly 37% of the Indian market demand. However it may be noted that India is almost 100% dependent on imported packaged LED chips. Most of the domestic value is constituted by the metal and plastic parts, connectors and cables and some LED drivers. Nearly 12% of the local production is exported.

*(Data Source- Report by ELCINA 2019)*

**Active Components**

The Active Components consists of IC, Diodes and Transistors. The overall market demand of these Active Components in India is shown below:

| 2018-19 US$ B | IC's | Diodes | Transistors |
|---|---|---|---|
| Domestic Production | 0.32 | 0.06 | 0.12 |
| Exports | 0.04 | 0.00 | 0.01 |
| Imports | 4.03 | 0.23 | 0.39 |
| Domestic Market | 4.31 | 0.29 | 0.50 |
| Domestic Production (% of Dom. Market + Exports) | 7% | 22% | 24% |

*Table- 16:- Demand of Active Components*

The Indian Active Components market is the most acutely dependent on imports accounting for nearly 89% of the Indian market demand. Only 10% of the Indian production is exported.

*(Data Source- Report by ELCINA 2019)*

**Copper Wire**

| Copper Wire HSN- 7408 | 2019-2020 | 2020-2021 |
|---|---|---|
| Export | 22 Crore | 17 Crore |
| Import | 33 Crore | 22 Crore |

*Table- 17:- Details of Import & Export of Copper Wire*

*(Data Source- www.commerce.gov.in)*

Apparent demand in 2020-2021 for Copper is 1971 tonnes and 56% of total demand is used by Electronics & Communication Industry. Presently India's position in copper has shifted from being net importer to a net exporter.

*(Data Source- Indian Bureau of Mines)*

As per the data available, among the raw materials, key components like IC's, Diodes, Transistors, LED, Capacitors, Resistors, PCBAs, Insulated Gate Bipolar Transistor (IGBT) modules, Digital Signal Processor (DSP) based controllers are the dominant imported components in India.

## 2. L) GOVERNING RAW MATERIAL STANDARDS INDIAN / INTERNATIONAL

| Sl.No | Raw Material | Indian Standard | International Standard |
|---|---|---|---|
| 1 | Resistor | IS 824 : 1965 (Reaffirmed Year : 2015 )<br>Preferred Values for Resistors and Capacitors<br><br>IS 3636 : 1966 (Reaffirmed Year : 2020 )<br>Method Of Test For Temperature Co-efficient Of Precision Resistor Wires<br><br>IS 5027 : 1969 (Reaffirmed Year : 2015 )<br>Method of measurement of current noise generated in fixed resistors<br>IS 5786 : Part 1 : 2018<br>Fixed Resistors for use in Electronic Equipment Part 1 Generic Specification (Second Revision) | IEC 60062:2016 and EN 60062:2016 |

| | | | |
|---|---|---|---|
| 2 | Diodes | IS 5469 : Part 2 : 1973 (Reaffirmed Year : 2015 ) Code of practice for the use of semiconductor junction devices: Part 2 Diodes<br>IS 14901 : Part 2 : 2020 Semiconductor Devices Part 2 Discrete Devices - Rectifier Diodes ( First Revision )<br>IS 14901 : Part 3 : 2016 Semiconductor Devices— Discrete Devices Part 3 Signal, Switching and Regulator Diodes | IEC 60747-2:2016 |
| 3 | Capacitors | IS 7305 : 2018 Fixed Capacitors for use in Electronic Equipment-Generic Specification (Second Revision) | IEC 62391-1 Fixed electric double-layer capacitors for use in electric and electronic equipment – Part 1: Generic specification |
| 4 | Switches | IS 3854 : 1997 Switches for domestic and similar purposes | IEC 61058-2-4 Switches for appliances – Part 2-4: Particular requirements for independently mounted switches |
| 5 | Connectors | IS 3010 : Part 1 : 1965 (Reaffirmed Year : 2019 ) Appliance-connectors and appliance-inlets (non-reversible three-pin type): Part 1 Appliance connectors<br>IS 3010 : Part 2 : 1965 (Reaffirmed Year : 2019 ) Appliance-connectors and appliance-inlets(non-reversible three-pin type: Part 2 Appliance inlet<br>IS 3826 : Part 2 : 1970 | IEC 61076-3-103 Connectors for electronic equipment – Part 3-103: Rectangular connectors – Detail specification for single row connectors with non-removable ribbon cable contacts on 1,25 mm pitch used for high speed serial data (HSSDC) |

| | | | |
|---|---|---|---|
| | | (Reaffirmed Year : 2016 ) Connectors for Frequencies below 3 Mhz - Part 2 : Battery Connectors for Electronic Equipment | |

*Table: 18- Details of testing of raw materials as per International Standards*

## 2.M) REASON FOR THE IMPORT INVERTERS

In the entry level Inverter & UPS of up to 1600 VA, single phase, today many manufactures are importing from China. The over all assembly, Branding and Batteries are added here in India to avail the lower duties on Parts of Inverter & UPS. It has been pointed out by the Industry Associations that majority of these Chinese imports are of standard design and made by one or two manufacturers in China.

The primary reason for the import in the less than 5KVA category is the lower cost of the product supplied from China. This has led to Indian MSMEs closing down their design and manufacturing and importing the Product as a whole or product in parts form, from China. They assemble it in India , Brand it in local Indian company name and sell in the Indian market. The cost disparity is such that some of them have set up units in China to work closely with their suppliers, to get better coordination on Product engineering, customization for India conditions, Quality control and derive Go To Market time advantage.

The Indian manufacturers though competent in terms of matching international quality standards face other limitations which are given below.

India may not be able to achieve 100% domestic & 0% Imports in Inverters and UPS so is the case with any other country, including China. The pragmatic goal is to reduce imports. Country may plan PMP i.e. Phased Manufacturing Program to wards maximizing the value addition in Inverter and UPS manufacturing in India.

**The Solar Grid inverters and High frequency inverter with Ferrite transformer are being imported** . The reason for import is that the technology for these type of inverters are not available in India especially for the MSME sector. So presently, in general , MSME sector is not manufacturing these types of inverters. These limitations have discouraged the development of the inverter manufacturing ecosystem . Policies backed by a clear vision can create a successful, vibrant Inverter manufacturing sector.

The need of a robust domestic manufacturing base lies on various factors such technology development, product standardization,scale of production , increase in foreign investment and decrease in foreign exchange outgo, talent creation, energy security and access and skilled employment generation. Many foreign companies, including Siemens, FIMER, TMEIC, Delta, Sungrow, and TBEA, have Inverter manufacturing facilities in India. However, they are mostly dependent on imports as India lacks a component manufacturing supply chain. The extent of local manufacturing varies with manufacturer. As per the feedback submitted by Manufactures Association of Information Technology (MAIT ), at a subassembly level and at a component level, the below table gives a guesstimate of the domestic manufacturing capability.

| Sl.No | Sub-Assembly | Conventional Process | Manufactured in India (Y/N) |
|---|---|---|---|
| 1 | Single L.C UPS | SMT Line | N |
| 2 | Rectifier/ Charger Card | SMT Line | Y & N* |
| 3 | Inverter Card | SMT Line | Y & N* |
| 4 | Control L.C | SMT Line | Y & N* |
| 5 | Control Panel L.C | SMT Line | Y & N* |
| 6 | Cabinet | Sheet Metal Fab | Y |
| 7 | Cabinet | Plastic Injection Molding | Y & N* |

**Y & N means some brands do so and others do not. Within a brand some models it is done and for others it is imported*

| Sl.No | Component | Manufactured in India (Y/N) |
|---|---|---|
| 1 | Auto transformer | N/Y^ |
| 2 | Electrolytic DC Cap | N/Y |
| 3 | Capacitors AC | N/Y |
| 4 | AC & DC Cables | N/Y^ |
| 5 | DC bus bars | Y |
| 6 | Current transformers | Not known |
| 7 | Chokes | Not known |
| 8 | PCB | Not known/Y |
| 9 | Relays | Not known |

| | | |
|---|---|---|
| 10 | SCR | N |
| 11 | IGBT's (Inverter) | N |
| 12 | Micro Controller | N |
| 13 | DC battery contactors | Not known |
| 14 | AC circuit breakers | Y |
| 15 | Output 3 pin AC points | N/Y |
| 16 | Fans | Not known |
| 17 | Fuses | Not known |
| 18 | Battery | Y |
| 19 | Cabinet | N/Y |

The Indian industry basicaly faces cost disadvantages which include high finance cost, technology cost , quality issues in power supply and high cost of logistics. These "disabilities" are faced by all manufacturers and are directly co-related with value addition in the manufacturing process. Higher the value addition, higher the disability cost suffered by the manufacturer.

The signing of ITA-1 under WTO in the year 1997 resulted in a zero-duty regime for 217 Tariff Lines of Electronic components and equipment including all Information and Communication Technology products. The growth as well as technological development of the Electronic component sector has been stymied causing a severe challenge for the Electronic System Design and Manufacturing (ESDM) sector in India. The Industry is looking forward Small, Medium and Large investments in manufacturing of raw materials, parts, components and also of PCB Assemblies. This would strengthen the ESDM value chain and strengthen us by enabling development of technology, R&D as well as IP creation.

Atmanirbhar Bharat aims to crate an eco-system that will allow Indian companies to be highly competitive on the global stage. India may be cheaper than developed nations as a low cost production base but other emerging countries are very competitive . The power costs on an average 11 cents a unit in India compared to 8 cents in Vietnam and 9 in China. Labour cost, in real terms, is low but if one has to factor productivity, it falls below China, Brazil and South Korea. When it comes to skillset India is ranked at 107 in the Global Competitiveness Index compared to China's 64th rank and South Korea's 27th rank. Vietnam and Brazil are ranked 93 and 96

respectively. Indian MSMEs may have to spend more on training its workforce. India's logistics cost is above its peers in the developed world. Indian companies also face higher regulatory and other compliance costs even though the Government has been working to reduce this through various measures including digitalization. Cost of the credit in India is relatively much higher than say in US or Japan.

Further following factors are attributed to the import :

***A complex value chain****:* The Electronics industry is constantly changing due to disruptive innovation, thereby increasing the pressure on the value chain to upgrade continuously. The sourcing and contractual interdependencies between OEMs and suppliers are now more complex due to the highly advanced technology of the components, the number of components required for a single finished product, the level of aggregation or assembly required, and the need to adapt to changes in product design. The Indian ecosystem for Electronic components is still evolving and has a long way to go.

***A capital intensive industry with inadequate raw material availability:*** The Electronics industry primarily dependent on Electronics components which involves high investment. Given the current scenario, India lacks most of the necessary ammunition for the development of domestic chip fabrication units. Thus, the design and development of Electronic products are often outsourced to ODMs (Original Design Manufacturers) in other countries with stronger designing and manufacturing capabilities.

***Sustainability****:* Emerging regulations and standards for cleaner and greener technology are forcing companies to be accountable for the manufacturing process as well as the final product. The entire recycling and disposal process for Electronics needs to be considered as a vital part of the product life cycle.

***Lack of Research & Development*** *:* Total investment in Research & Development and innovation has been on the decline over the years. It was 0.84 per cent of GDP in 2008 and in 2018 it was 0.6 per cent. Bulk of R&D spending happens in the defense and space sectors. In the private sector it is in auto and pharmaceutical industries. Investment in R&D cutting-edge technologies is clearly missing. A coordinated and focused approach is needed .

Limitations faced by Indian Manufacturers

- Logistics inefficiences & infrastructural bottle necks, resulting in longer turnaround time frames & higher costs.
- Insufficient Infrastructure
- Conflicting policies across the various levels within the Electronics industry
- Lack of low cost finance
- Green & eco-friendly manufacturing solutions
- Absence of a level playing field since companies from competing countries have access to finance at much lower costs.
- High CAPEX requirements
- Lack of access to new technology & state of art manufacturing facilities
- Undeveloped supply chain leading to high inventory cost & delivery time.

India has both Domestic & Global companies doing local manufacturing of Inverters & UPS. The Domestic companies fall into MSME & non MSME category. It may be pertinent to note that almost all the domestic manufacturers were once MSME and a few of them have now crossed the turn over limit of INR 250 cr for MSMEs .

Without suitable interventions in the form of fiscal and non-fiscal support, Industry players estimate that imports of electronic items will increase five-fold. In order to reduce the dependence on imports and to capitalize on the sector's potential; the Government of India (GoI) has been proactively expanding efforts to provide an impetus to the sector.

## CHAPTER-3:- SCHEMES AND CONSULTANCY SERVICES

### 3.A) EXISTING SCHEMES

*M/o MSME & O/o DC MSME Schemes*

### 1Prime Minister's Employment Generation Programme (PMEGP)

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| Prime Minister's Employment Generation Programme (PMEGP) ( For starting New enterprises ) Nature of assistance | The maximum cost of the project/unit admissible in manufacturing sector is ₹ 25 lakhs and in the business/service sector, it is ₹ 10 lakhs. Categories of Beneficiary's Rate of subsidy under PMEGP (of project cost) General category 15 %( Urban), 25 %( Rural), Special 25 %( Urban), 35 %( Rural) (including SC/ ST/ OBC/ Minorities/Women, Ex-servicemen, Physically handicapped, NER, Hill and Border areas, etc.) |
| Who can apply? | Any individual, above 18 years of age. At least VIII standard pass for projects costing above Rs.10 lakh in the manufacturing sector and above Rs. 5 lakh in the business / service sector. Only new projects are considered for sanction under PMEGP. |
| Guidelines | https://msme.gov.in/sites/default/files/pmegp.PDF |

### 2) Credit Linked Capital Subsidy Scheme

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| Eligibility/ Applicability | Any Micro and Small Enterprise (MSE) availing institutional credit to buy new Plant & Machinery approved under the scheme. 2. Special Benefits- In case of SC/ST, Women, NER / Hill States / Aspirational Districts /LEW Districts, the subsidy shall be admissible for investment in acquisition /replacement of Plant & Machinery /equipments & Technology up-gradation of any kind (Core plant & Machinery). Second hand & fabricated will not be eligible |
| Nature of Assistance | Upfront subsidy of 15% on institutional Credit up to Rs. 1.0 Crore (i.e. subsidy cap of Rs. 15.00 lakh) for identified sectors/ subsectors/ technologies. |
| Guidelines | http://dcmsme.gov.in/CLCS_TUS_Scheme/CLCS/Scheme_Guidelines.aspx |

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| Status of the Scheme | At present the Scheme is under revision and may be launched soon after obtaining the necessary approvals. |

### 3) Credit Guarantee Scheme for Micro & Small Enterprises (CGTMSE)


Scheme Guidelines- https://www.cgtmse.in/

### 4) Interest Subvention Scheme for MSMEs-2018

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| Eligibility/ Applicability | All MSMEs who have valid GSTN Number and registered on Udyam portal. Trading activities with KYC are also eligible. |
| Nature of Assistance | The interest relief will be calculated at two percentage points per annum (2% p.a.), on outstanding balance from time to time from the date of disbursal / drawl or the date of notification of this scheme, whichever is later, on the incremental or fresh amount of working capital sanctioned or incremental or new term loan disbursed by eligible institutions up to Rs100 lakhs |

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| Guidelines of the Scheme | http://dcmsme.gov.in/Notification_of_Interest_subvention_Scheme_2018.pdf |

**5) Procurement and Marketing Support (PMS) scheme**

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| Eligibility/ Applicability | Individual Manufacturing/ Service MSE having valid Udyam registration |
| Nature of Assistance | *Participation of Individual MSEs in domestic trade fairs/exhibition:*<br>80% of space rent paid for general category units and 100% for SC/ST/women/NER/PH units limited to Rs. 1.5 lakh for class A city; Rs 1.00 Lakh for class B/J&K/NER/Hilly states and for other cities Rs 0.80 Lakhs -or actual whichever is less.<br><br>*Organizing/ Participation in trade fairs/exhibitions (Regional/ National/International) by the Ministry/ Office of DC (MSME)/Government organizations:*<br><br>Maximum budgetary support for space rent and advt. & publicity for Regional/National events will be of Rs 30 lakhs and Rs 40 Lakhs respectively. For international event the budgetary support will be decided by Empowered Committee subject to approval of Department of Expenditure. 80% for General and 100% for SC/ST/Women/NER space rent subsidy.<br><br>*Capacity building of MSMEs in modern packaging technique:*<br>80% of total cost paid to empaneled agency / consultancy organisation for General category units and 100% for SC/ST/Women/NER/PH units limited to Rs.1.0 Lakh for ordinary packaging consultancy and Rs 1.5 lakh for green packaging consultancy. |
| Guidelines | https://msme.gov.in/sites/default/files/Guidelines_PMS.pdf |

## 6) International Co-operation Scheme


## 7) Public Procurement Policy

The Public Procurement Policy mandates 25% annual procurement from MSEs by Central Ministries /Departments/Public Sector Enterprises (CPSEs).

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| Eligibility/ Applicability | The Public Procurement Policy is applicable for manufacturing of goods and services rendered by MSEs. Traders/ sole agent/ distributor are excluded to avail the benefits of Public Procurement Policy and works contract is not covered under the purview |
| Nature of Assistance | The benefits/facilities provided to all registered MSEs are:-<br>• Tender set free of cost.<br>• Exemption from the payment of Earnest Money Deposit.<br>• In tender, participating MSEs quoting price within price band of L1+15% shall also be allowed to supply a portion of requirement by bringing down their price to L1 price in a situation where price is from someone other than a MSE and such MSE shall be allowed to supply at least 25% of the total tendered value.<br>• 358 items reserved for exclusive procurement from MSEs.<br>• Relaxation of norms for start- ups and the MSEs in Public |

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| | Procurement Policy on prior experience- prior turnover criteria. |
| Guidelines | http://dcmsme.gov.in/pppm.htm.aspx |

### 8) Government e-Marketplace (GeM)

Government e Marketplace (GeM), is an e- commerce platform which facilitates online procurement of common use Goods & Services required by various Government Departments / Organisations / PSUs from MSEs. GeM aims to enhance transparency, efficiency and speed in public procurement. It provides the tools of e-bidding, reverse e-auction and demand aggregation to facilitate the government users, achieve the best value for their money. Link- https://gem.gov.in/ Email: helpdesk-gem@gov.in Ph. No: 1800-419-3436; 1800-102-3436

### 9) MSE-Cluster Development Programme

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| Objectives of the Scheme | (i) To support the sustainability and growth of MSEs by addressing common issues such as improvement of technology, skills and quality, market access, access to capital, etc.<br><br>ii) To build capacity of MSEs for common supportive action<br><br>(iii) To create/upgrade infrastructural facilities in the new/existing industrial areas/ clusters of MSEs, including setting up of Flatted Factory Complexes.<br><br>(iv) To set up common facility centres (for testing, training centre, ramaterial depot, effluent treatment, complementing production processes, etc.) |
| Components | (i) Setting up of CFCs: Creation of tangible “assets” as Common Facility Centers (CFCs) like Common Production/Processing Centre (for balancing/correcting/improving production line that cannot be undertaken by individual units), Design Centres, Testing Facilities, Training Centre, R&D Centres, Effluent Treatment Plant, Marketing Display/Selling Centre, Common Logistics Centre, Common RaMaterial Bank/Sales Depot, etc. The GoI grant will be restricted to 70% of the cost of project of |

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| | maximum Rs 20.00 crore. GoI grant will be 90% for CFCs in NE & Hill States, Clusters with more than 50% (a) micro/ village (b) women owned (c) SC/ST units.<br><br>(ii) Infrastructure Development: Consist of projects for infrastructural facilities like power distribution network, water, telecommunication, drainage and pollution control facilities, roads, banks, ramaterials storage and marketing outlets, common service facilities and technological backup services for MSEs in the ne/ existing industrial estates/areas. The GoI grant will be restricted to 60% of the cost of project of Rs 10.00 crore. GoI grant will be 80% for projects in NE & Hill States, industrial areas/ estates with more than 50% (a) micro (b) women owned (c) SC/ST units. |
| Guidelines | http://www.dcmsme.gov.in/schemes/ModifiedGuidelinesofMSE.pdf |

**10) Design Expertise to manufacturing MSME sector**

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| Eligibility/ Applicability | All MSMEs having Udyam Registration and also MSMEs which are included as per executive orders issued by the office of DC, MSME consistent with MSME Act from time to time. |
| Nature of Assistance | Assistance for Professional Design & Student Design Projects.<br>• Design Projects: Financial assistance to the MSMEs for engagement of design consultants for design intervention (GoI contribution @ 75% for micro, 60% for SMEs for the project range Rs. 15 lakh to Rs. 40 lakh).<br>• Student Projects: Financial assistance to parent Design Institutions for reimbursing 75% of expenses incurred (max. up to Rs. 1.5 lakh) for final year student project done for MSMEs. |
| Guidelines | http://dcmsme.gov.in/CLCS_TUS_Scheme/Design_Scheme/Scheme_Guidelines.aspx |
| Status | The scheme is under upgradation and renewed guidelines will be issued after the approval from the competent authority |

**11) Lean Manufacturing Competitiveness Scheme (LMCS)**

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| Eligibility/ Applicability | All MSMEs having Udyam Registration and also MSMEs which are included as per executive orders issued by the office of DC, MSME consistent with MSME Act from time to time. The units are required to |

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| | form a Mini Cluster ideally of 10 units (minimum 4) in any of the forms |
| Nature of Assistance | Financial assistance to the lean Manufacturing consultant upto Rs 36 Lakhs per mini cluster of 4-10 units for a period of 18 months or till completion (GoI: Units:80:20) |
| Guidelines | http://dcmsme.gov.in/CLCS_TUS_Scheme/Lean_Manufacturing/Scheme_Guidelines.aspx |
| Status | The scheme is under upgradation and renewed guidelines will be issued after the approval from the competent authority |

**12) ZED Certification Scheme**

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| Eligibility/ Applicability | All MSMEs having Udyam Registration and as eligible under MSME Act from time to time. |
| Nature of Assistance | Reimbursement of 80% for Micro, 60 % for Small and 50% for Medium for ZED Certification. |
| Guidelines | http://dcmsme.gov.in/CLCS_TUS_Scheme/ZED_Scheme/Scheme_Guidelines.aspx |
| Status | The scheme is under upgradation and renewed guidelines will be issued after the approval from the competent authority |

13) **Building awareness on Intellectual Property Rights (IPR)**

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| Eligibility/ Applicability | For Patent, Geographical Indication and Trademark Reimbursement. All MSMEs having Udyam Registration and also MSMEs which are included as per executive orders issued by the office of DC, MSME consistent with MSME Act from time to time. |
| Nature of Assistance | Reimbursement for Patent /GI Registration/Trademarks, for setting up of IP Facilitation Centers, interactive Seminars /Workshops/Exhibitions and Awareness Programmes. |
| Guidelines | http://dcmsme.gov.in/CLCS_TUS_Scheme/IPFC/Scheme_Guidelines.aspx |
| Status | The scheme is under upgradation and renewed guidelines will be issued after the approval from the competent authority |

*SCHEMES BY DEPARTMENT FOR PROMOTION OF INDUSTRY AND INTERNAL TRADE, M/o COMMERCE AND INDUSTRY*

## 1) Public Procurement (Preference to Make in India)

The Public Procurement (Preference to Make in India), Order 2017, has introduced a concept of Class-I, II and non-local suppliers, based on which they will get preference in government purchases of goods and services. Class-I local suppliers will get the most preference in all government purchases because their domestic value addition is 50 per cent or more. They will be followed by Class-II suppliers, whose value addition range is more than 20 per cent but less than 50 per cent. Companies with less than 20 per cent of domestic content in their goods or services will not able to participate in most of the government tenders and they are categorised as "non-local suppliers".

Purchases of goods/services with an estimated value of less than Rs 200 core, global tender enquiry will not be issued except with the approval of the competent authority as designated by the Department of Expenditure. For more details: https://dipp.gov.in/public-procurements

## 2) Industrial Corridors

An industrial corridor is a package of infrastructure spending allocated to a specific geographical area, with the intent to stimulate industrial development. Industrial corridors constitute world-class infrastructure, such as:

- ✓ High-speed transportation network – rail and road
- ✓ Ports with state-of-the-art cargo handling equipment
- ✓ Modern airports
- ✓ Special economic regions/industrial areas
- ✓ Logistic parks/transhipment hubs
- ✓ Knowledge parks focused on catering to industrial needs
- ✓ Complementary infrastructure such as townships/real estate
- ✓ Other urban infrastructure along with enabling policy framework

At present there are 11 Industrial corridor projects in India and these projects are implemented through the National Industrial Corridor Development and Implementation Trust (NICDIT).

For more details: https://dipp.gov.in/programmes-and-schemes/infrastructure/industrial-corridors

***SCHEMES BY M/o ELECTRONICS & INFORMATION TECHNOLOGY***

**1) Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS)**

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| Tenure | SPECS will be open for applications for 3 years. Investments made within 5 years from the date of acknowledgement will be eligible for receiving incentive |
| Incentive | Incentive of 25% on Capital Expenditure pertaining to plant, machinery, equipment, associated utilities and technology, including Research & Development on reimbursement basis |
| Target segments | Electronic Components, Semiconductors, Specialized Sub-Assemblies and Capital Goods for these items |
| Eligibility | Applicable to Investments in New Units as well as Expansion of Existing Units |
| Scheme Guidelines | https://www.meity.gov.in/esdm/SPECS |

**2) Modified Electronics Manufacturing Clusters (EMC 2.0) Scheme**

Electronics Manufacturing Clusters (EMC 2.0) Scheme has been notified vide Gazette Notification No.CG-DL-E-01042020-218991 dated April 01, 2020 with the objective to address the disabilities, by providing support for creation of world class infrastructure along with common facilities and amenities, including Ready Built Factory (RBF) sheds / Plug and Play facilities for attracting major global electronics manufacturers along with their supply chain to set up units in the country in the country.

*Details are available at https://www.meity.gov.in/esdm/emc2.0 M/o ELECTRONICS & INFORMATION TECHNOLOGY is also coordinating various other schemes which are relevgant to Electronics sector https://www.meity.gov.in*

## *SCHEMES OF MINISTRY OF HEAVY INDUSTRIES & PUBLIC ENTERPRISES*

### 1) Production Linked Incentive (PLI) scheme for 'National Programme on Advanced Chemistry Cell (NPACC) Battery Storage'

It aims to give companies incentives on incremental sales from products manufactured in domestic units. It invites foreign companies to set up units in India, however, it also aims to encourage local companies to set up or expand existing manufacturing units. The plan is to set up 50 gigawatt hour (GWh) manufacturing capacity for ACC batteries by attracting investments totaling Rs. 45,000 crore. Requires each selected ACC battery Storage manufacturer to set-up an ACC manufacturing facility of minimum 5 GWh capacity, achieve a domestic value addition of at least 25% and incur the mandatory investment Rs.225 crore /GWh within 2 Years. Furthermore, the beneficiary firms need to ensure a minimum 60% domestic value addition at the Project level within five years. The incentive will be disbursed over a period of five years. It will be paid out on the basis of sales, energy efficiency, battery life cycle, and localization levels. Scheme was announced on 13th May 2021 and detailed guidelines are yet to come.

This NPACC Scheme will:

- Facilitate demand creation for battery storage in India.
- Facilitate Make-in-India and Atmanirbhar Bharat.
- Facilitate demand for Electric Vehicles (EVs), which are proven to be significantly less polluting.
  - ✓ A key contributing factor to reduce India's Green House Gas (GHG) emissions.
- Import substitution of around Rs. 20,000 crore every year.
- Impetus to Research & Development to achieve higher specific energy density and cycles in ACC.
- Promote newer and niche cell technologies

## *SCHEMES OF MINISTRY OF NEW AND RENEWABLE ENERGY (MNRE)*

### 1) Production Linked Incentive Scheme 'National Programme on High Efficiency Solar PV Modules

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| Objective | To promote manufacturing of high efficiency solar PV modules in India and thus reduce Import dependence in the area of Renewable Energy. |
| Implementing Agency | Indian Renewable Energy Development Agency (IREDA) |
| Details | The manufacturers will be selected through a transparent competitive bidding process and PLI will be disbursed for five years post the commissioning of the manufacturing plants, on sales of high efficiency solar PV modules |
| Scheme Guidelines | https://mnre.gov.in/img/documents/uploads/file_f-1619672166750.pdf |

## 3. B) RECOMMENDATIONS & WAY FORWARD

With nearly 70% of Country's Electronic product requirements being met through imports in many product segments, India needs to make sure that a suitable and thriving ecosystem for Electronic manufacturing is developed. Country imports about $10 billion PCBA's (Printed circuit Board Assemblies) . It is very clear that the largest contributors to imports are mainly key components like ICs, PCB's, Transistors, Capacitors and Diodes and Sub assemblies. **Apart from the job creation and the savings in forex, a thriving localized manufacturing ecosystem is vital from our National Security point of view as well.**

India is looking for a wave of growth in the Electronics sector. This transition will be fuelled by and large through young population, Innovative Start Ups, increasing research initiatives, strong manufacturing base and favourable policies. The impetus provided by the Government will give encouragement to domestic manufacturing as India prepares to be the next global hub for Electronics production and exports. Specific to the Electronics sector, several policies such as Make in India, National Policy of Electronics, Net Zero Imports in Electronics, Zero Defect Zero Effect maturity model, Cluster Development Programme etc augur well for the industry, as they signal a commitment to growth in domestic manufacturing, lowering import dependence, energizing exports, and encouraging environmental-conscious manufacturing. Incentives to attract capital and measures to develop the component supply base through the Phased Manufacturing Plan may have to be sustained at the supply side.

Despite the lockdown, the Government of India has been consistently expanding incentives through major schemes it launched in April 2020 with an outlay of ₹ 500 billion. The three major schemes announced by the Government of India recently are Production Linked Incentives (PLI), Scheme for the Promotion of Manufacturing of Components and Semiconductors (SPECS) and Modified Electronics Manufacturing Clusters (EMC 2.0).

Most Electronic components are covered under the Information Technology Agreement (ITA-1) and therefore can be imported into the country without payment of Basic Custom Duty. Given that duty differentials cannot be created to encourage

domestic production. Large investments in Electronics manufacturing may be attracted by offering a comparative cost advantage. Allowing zero duty imports of inputs/components for the assembly of high volume and high growth products such as mobile phones, PoS Machines, Micro ATM's, Set Top Boxes etc. has reduced the growth in demand of components and discouraged new investments in the segment. A strong component manufacturing base is essential for a sustainable Electronics System Design and Manufacturing (ESDM) ecosystem in India. Given that supply chain management is crucial to the viability of an Electronics manufacturing facility, incentivizing component manufacturing would go a long way in increasing local value addition. While fiscal incentives and duty differentials have helped promote assembly and manufacturing of products with large local demand, this success has not been replicated for Electronic components, a strong component manufacturing base in the country may be pre-requisite for a self reliant ESDM sector in the country.

In the past, the focus of policy was on manufacturing of Electronics products irrespective of the degree of value addition. Majority of inputs such as parts, Sub-Parts, Components are allowed for import at zero or minimal duty. This policy has encouraged low value-added manufacturing/assembling but simultaneously has stymied the growth of the existing component manufacturing base and FDI in the sector. Large Foreign or Domestic investments in value added manufacturing may happen if country offers a cost advantage in manufacturing.

The global Electronic manufacturing ecosystem is largely centered on China, ASEAN, and Taiwan. Manufacturers in China are particularly well positioned to offer extremely competitive pricing internationally. China's cost advantage has been driven by many factors including the locally sourced raw materials. As per the studies conducted by various Industry associations, material and indirect costs typically account for 75%-80% of the cost of a product. The average value addition in a typical Electronics manufacturing process is about 35%- 40% of the sale price. China remains globally competitive across a broad spectrum of Electronic products because of its large production capacities and local demand, substantial investments in automation, well-developed supply chain, steady advances in technology, intensives to the industry etc. Considering the above, it becomes imperative to understand the factors that contribute to the cost advantage offered by China and based on this the comparative disabilities faced

by India can be defined. The following study conducted by ELCINA (Electronic Industries Association of India) provides an analysis on this :

Indian companies compared to global peers, in terms of quality/ size and resultant cost effectiveness

| | Parameters | Indian Companies | Chinese, Other Asian & US Companies |
|---|---|---|---|
| Capital Cost | Land & Infrastructure | Availability at a competitive price is a constraint. Development of necessary infrastructure is additional cost of the project | Government allotted or at subsidized rates with integrated infrastructure provided |
| | Parts & Machinery | Partially available domestically, largely imported | Majority local, tax set-offs are available |
| | Project Finance | 9-10% interest for loans, comparatively shorter loan durations, higher interest rate | 0-5% per annum interest for loans with longer tenures & grant from Government along with grants. Eg: support by US Exim bank to US exports with low cost financing |
| | Hence, the total project cost for Indian companies may be higher around 10-15 % than some of these countries | | |
| Operational Cost | Raw material (RM) Cost | Coparatively higher as majority are imported | Low as majority sourced locally |
| | Utilities | Coparatively higher prices (due to cross-subsidization requirements) | Subsidized |
| | Manpower | Same | Same |
| | Interest Cost | Around 10-12% | 0-5% |
| | Hence, the total operational/ variable cost for Indian companies may be | | |

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| | higher (around 10-12 %) than a few other countries and in some cases higher as they are high in energy intensity like Poly- silicon, wafer production, etc. | | |
| Technology | Machinery | Mostly Imported | Mix of local & imported |
| | Up gradation | High obsolescence; Slow up-gradation due to non-availability of capital | High obsolescence; fast up-gradation due to availability of capital |
| | R &D | Lack of industry participation in the R&D initiatives of the Government as they are vested with R&D centres &Educational institutions which are not aligned with commercial requirements. | Matured at commercial scale and is vested in the hands of large industries |
| Quality | Standards | Meets international standards- has been exporting to European markets | Meets international standards- but quality of material being sent to India needs to be suitably checked from time to time & Extended Producer responsibility through a domestic producer organization may be considered |
| Sourcing-Raw material | Inventory Cost | High | Low (JIT) |
| | Lead Times | High | Low (across the fence) |
| | Supplier options | Lesser | Higher |
| | Bargaining Power | Low due to low volumes | Higher due to high volumes |
| | Exim benefits | Not clear | Available with buyer's credit finance |

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|---|---|---|---|
| | | | mechanism |
| Marketing Strategy | Logistic System | A comparative study conducted by the Sagarmala program shows that for exporting a container from India, the total inland transit time till loading onto a vessel is 7-15 days.<br><br>India relies heavily on roads for moving goods although the cost of transportation by rail and inland waterways is significantly lower. The cost of per ton cargo movement per kilometres by road is INR 2.50 compared to INR 1.36 by rail and Rs. 1.06 by water. As per estimates, a diversion of about 5% of cargo to coastal shipping will not only reduce pressure on rail and road traffic but also save approximately INR 230 billion and result in 6% reduction in harmful chemicals and pollutants | As per ELCINA study, similar route in China may take 5-6 days.<br><br>Well established and low transportation costs. |

*Table:19- Comparison of Indian companies to global peers, in terms of quality/ size and resultant cost effectiveness*

*Data courtesy: ELCINA, MAIT reports*

In this connection, the following are suggestions made based on the inputs received from Industry associations like ELCINA, MAIT, UPS &Inverter Manufactures associations, individual Entrepreneurs etc:

- Just like Department for Promotion of Industry and Internal Trade (DPIIT) Atma Nirbhar Product program on Set Top Box, an Atma Nirbhar Product program – championing the Inverter &UPS may be considered.

- GOI may consider to give additional 10% Price preference under PPP for an indigenously designed and manufactured (with at least 50% local content) Inverter in GEM & non-GEM procurement. This price preference may be considered in addition to the existing provisions under Public procurement & Make in India Local content policy. Government may like to examine whether Inverters are getting imported under the ASEAN FTA route and may act accordingly.

- Policies to support capital Investment in deep manufacturing may be considered. The investment subsidy on the CAPEX may be provided to MSMEs. The subsidy may be considered to such products which will have the desired domestic value addition. In this connection Ministry of MSME may consider to include provisions in the existing Credit Linked Capital Subsidy Scheme (CLCSS) scheme to provide 30% subsidy to such Inverter manufactures who meet the required local value addition. This provision may be considered under CLCSS so that the upfront subsidy will be adjusted in the loan account of the unit once they meet the targeted sales of product with the desired local content& value addition. MSMEs may be supported to acquire selected technologies which would help in high-end value addition and may be considered for providing 50% subsidy under CLCSS for acquiring such technologies. A provision to provide 30% subsidy to MSMEs to set up in house testing facilities under CLCSS or ZED scheme may also be considered

- High Cost of Finance is one great disadvantage for the Indian MSMEs. An Interest subvention scheme to provide 6% interest subvention may be considered for eligible MSMEs engaged in manufacturing selected value added products like Inverters. Further Electronic Components covered under ITA-1 or at Zero Duty under FTA's may be supported through either a Production Subsidy or through Refund / retention of CGST/ Interest Subvention.

- Investment promotion further may require overcoming disability cost faced by value added and components manufacturing in India. This may be considered by providing for Direct Tax Holiday for a suitable period for new investments and rebate in Tax for existing units. Providing ready-made Infrastructure and Plug & Play Facilities/Clusters for investors at reasonable terms on lease basis may also be considered. These facilities may include among others, all essential services such as electricity, water, transport, logistics, single window approvals and social infrastructure.

- Duty Free imports of PCBA's reduce the demand for domestically manufactured PCB & components. Existing eco-system of component manufacturing in the country lacks global scale and capability and thus remains uncompetitive. A strong component manufacturing base is a pre-requisite for a self-reliant Power Electronics sector in the country. Majority of inputs such as parts, sub-parts, components are allowed for imports at zero or minimal duty which has led to significant growth of assembly of Electronic products. Supply Chain is a key factor for the development of an effective, low cost and a secure manufacturing base. Entire components and raw materials cannot be produced locally as in globally competitive ecosystems but a strategic assessment and selection based on requirements and strength at various levels of supply chain may be developed. These may then be linked through various policies based on their advantages as per Indian conditions.

- Since the some of the export incentives are not available, suitable measures may be considered to provide a 4-5% fiscal support to exporters. These measures may include incentives such as the Government's Remission of Duties or Taxes on Export Product (RoDTEP), production subsidies and direct tax holidays which may encourage exports and attract investment.

- Making mandatory safety and performance standards for Inverters may work as an effective Non-Tariff barrier. This safety and performance standards as per the Indian conditions may be made mandatory for public procurement and also for other eligible customers. This may encourage manufactures to go for local design and manufacturing. Adequate and affordable testing facilities may be provided for Indian MSME manufacturers. MSMEs may be provided free or subsidised testing facilities for such

products. Ministry of MSME may consider to reintroducing the scheme or may include provision in the ZED scheme to reimburse testing charges of Inverters in approved testing labs as per National & International standards.

- Government may consider for a policy to attract large and technologically advanced global manufacturers in Electronic Component sector especially in focus areas like Printed Circuit Boards, Passive Components, Electromechanical Components, Sensors, Battery Packaging & Cells etc so that Electronic components on par with international quality & price would be available in the country. The Electronic manufacturing services (EMS) sector is an important axis to drive overall manufacturing in the world. Populating components on PCB's is a core operation of Electronic System Design and Manufacturing (ESDM) industry. A strong EMS ecosystem is a prerequisite for encouraging Component & PCB manufacturing in the country. Logistics Subsidy if permissible or Port Congestion Subsidy for a period of 5 years to make the Indian assembles competitive at global level may also be considered.

- Key to enabling a successful value-added Inverter manufacturing ecosystem in the country is to have a design-led Make-in-India. With a strong focus on demand enablement (demand-led design) , it may be considered to constitute a think-tank with domestic industry leaders, technical experts , R&D Institutes as well as empowered Government officials to define the strategy and policy for India, starting from design, manufacturing to systems. That, based on its recommendation, a suitable strategy is devised with its execution responsibility with the concerned stake holders.

- Government may consider conducting a focussed study by an expert agency like a competent Industrial association to draw a clear road map to achieve self reliance, specific action points, implementation & execution plan to achieve the Atmanirbhar Inverter & UPS sector.

The following are further suggested towards the goal of Atmanirbhar Inverter manufacturing ecosystem

- **Production Linked Incentive Scheme for Power Electronics Sector**

India's share in global merchandise trade is 1.7 percent and share in products like Electronics, computers, telecom, white goods, and machinery is as low as 0.7 percent. Since these products account major share in the world trade, country need to focus on manufacturing these products. The recently announced Production Linked Incentive (PLI) Scheme by Govt of India focuses on these products. Enhancing India's manufacturing capabilities and attracting investments in cutting-edge technologies are critical objectives of the PLI scheme. It may be considered to formulate PLI scheme to incentivize value added local manufacturing of Inverters &UPS. The PLI scheme may incentivize processes that involve deep manufacturing. This means no incentives for superficial processing or assembly operations. In Inverter assembly, Printed Circuit Board Assembly (PCBA) is a vital part. PCBA (PCB with all components fitted into it) as the input, production of an end-product would be just a superficial assembly. The significant value addition happens during the assembly of components like Electronic parts, components, chips etc, on the PCB, which results in the making of PCBA. Hence, incentivizing manufacturing of PCBA under the PLI scheme may be the better option for product like inverter, UPS and other power Electronics products.

- **Tariff measures to protect domestic manufacturing**

Domestic inverter manufacturing Industry may be protected from unfair imports. Focussing on deep manufacturing; appropriate duty structure and possible measures within the provisions of international trade agreements may be considered to check unfair imports which may help for self reliance in the sector. Government may introduce basic customs duty (BCD) on components used for manufacturing Inverter. By imposing BCD, manufacturing of components in India may become cheaper than importing to India.

- **Change in Nomenclature**

A UPS and an Inverter are from the same family of circuits, except that additionally the UPS by default supplies power from the AC grid. For many aspects like technology, use, application etc there are similarities in Inverters and UPS. Hence from the Public

Procurement Policy perspective, it may be considered to change the nomenclature of the product as ***Inverter & UPS of less than or equal to 5KVA Single & Three phase***

- **MSE-CDP Scheme of Ministry of MSME**

Majority of the manufactures of the Inverter are in unorganized sector and lack of R&D and testing facilities is the main problem faced by these manufactures. **Hence it is recommended to establish Common Facility Centres for R&D and design centers to develop technology & design, common testing facilities and common fabrication centre for hardware parts under MSE-CDP Scheme. It may be considered to establish such common facility centers in all such feasible places**.

**Utilising Electronics Manufacturing Clusters (EMC 2.0) Scheme under the *Ministry of ELECTRONICS & INFORMATION TECHNOLOGY &MSE-CDP scheme of Ministry of MSME , special power Electronics Manufacturing Zones may be created under the proposed Industrial Cooridors with state of the art manufacturing & common facilities to manufacture world class Inverters & UPS.***

- ***E-waste management****:* India ranks fifth globally among top E-waste producing nations. The exponential increase in the quantum of E-waste is driven by the rise in usage as well as the growing pace of upgrades. Inverters, UPS, Batteries and other Electronic products contribute significantly for Electronic waste, **it may be considered to set up common E waste processing centres for Inverters and UPS under the MSE CDP scheme of the Ministry of MSME. The common recycling units for the batteries used in the Inverter and UPS will go long way to reduce environmental hazards due to these used batteries and also will help the industry by way of value addition /diversification**

- *Competitive manufacturing ecosystem* Indian products may able to compete across the world if interest costs drop. Reducing power cost, Skilling and re-skilling needs of MSMEs may have to be taken care for a renewed focus. There may be a need to identify emerging skill sets and train people as per the requirements of MSMEs. The Government may consider encouraging and incentivising outsourcing to reduce logistics costs. Companies that outsource more than just transportation are seeing good results thanks to better visibility and better utilisation of assets.

- **Establishing Centre of Excellence/Technology Development Centre's/ R&D Centre's**

The major problem identified by the stake holders are lack of indigenous technology in commercial scale. Total investment in Research & Development and innovation has been on the decline over the years. It was 0.84 per cent of GDP in 2008 and in 2018 it was 0.6 per cent. Bulk of R&D spending happens in the defence and space sectors. In the private sector it is in auto and pharmaceutical industries. Investment in R&D cutting-edge technologies is clearly missing. A coordinated and focused approach is needed. Government may direct Electronic Research Development Centres to develop technologies for emerging sectors like Solar Grid Inverters and High Frequency Ferrite core inverters and the technologies may be made available at a subsidized rate or at free of cost to MSME manufacturers. Ministry of Electronics and Information Technology (MeitY), **Govt. of India launched the programme, National Mission on Power Electronics Technology (NaMPET) with the vision of making India a dominant player in Power Electronics at the global level**. NaMPET is a National level R&D Programme facilitating Research, Development, Deployment and Commercialization of Power Electronics Technology by enhancing the indigenous R&D expertise and infrastructure in the country with active participation from R&D institutions, Academic institutions and Industries. Centre for Development of Advanced Computing (C-DAC) Thiruvananthapuram is the nodal agency for the mission

**Ministry of MSME may consider to set up a centre of excellence in Power Electronics in a suitable Technology Centre (TC) under the Ministry of MSME to act as a bridge between the MSMEs and R&D Centres**.The proposed centre of excellence in Power Electronics at a suitable TC may create a linkage with all the R&D Institutes and academic institutes in the field and help the MSMEs to acquire the technology from R&D Institutes after necessary fine tuning to make it suitable for the Industry. IDEMI Mumbai & ESTC Ramnagar may be the two Technology Centers under M/o MSME dealing in the same or similar technology areas. **Fully fledged testing facilities for testing of Inverters and UPS may be created in feasible Technology Centres and Testing Centres under the Ministry of MSME and MSMEs may be provided services at a highly subsidised rates .**

- As per the Entrepreneurs in the Field, once the technology is developed by R&D centres, the SMD PCBs may have to be made available in bulk quantity, involving SMD manufacturers and bringing SMD manufacturers and inverter manufacturers into a

single platform. Then it may be easier to scale up the inverter production in MSME sector and as per the industry, control cards are readily available at a reasonable cost. Once the scaling up of manufacturing goes up in the MSME sector, the cost of product will come down. So it will be competitive with Chinese product and will boost the export. The survival and growth of the sector is critically dependent on its technological up-gradation. Credit Linked Capital Subsidy Scheme may be introduced at a larger scale for this sector and may be continued providing upfront capital subsidy to the tune of 30%.A one-time technology up-gradation scheme may also be considered to support the Inverter industry for the acquisition of Indigenous design and technology.

- While the government is pushing for manufacturing inverters in India, the pressing need is to promote critical inverter components like the PCBAs, insulated gate bipolar transistors (IGBT) to be manufactured in India. A collaborative approach with a long-term view is necessary. It will ensure the development of a complete supply chain within India. This supply chain will cater to local original equipment manufacturers and drive the segment holistically towards the objective of an Aatmanirbhar Bharat.

- The implementation of Procurement/ Payment Policy may be made more effective. For any MSME company the working capital is most important factor. For this MSMEs should be able to get the payment immediately after the sale of products to Govt. as well as public & private sector firms. This is not happening in reality.

- Assembling of inverters should be considered as a white category industry and they may not need for Factory & Boilers license.

- Domestic industry may have to play a proactive role to ensure global level quality products are manufactured with Quality Star rating for the products. They may Pool common resources to increase competitiveness and Increase domestic Value addition.

- At present inverters are having GST of 18%, Solar Inverters have 5%, batteries for both are having 28% GST. Presently it is reported that in few states, when solar inverters are supplied with batteries, each products are to be billed separately with individual tax tariffs. This is not an easy process in practice as inverters with batteries are considered as a total system. So it is suggested to have a single GST slab of 5% or 18% for all types of inverters with or without batteries in order to avoid litigations and

penalties from authorities. And inverters with battery may be considered as a single system with same GST slab.

- Standards adopted from ISO/IEC are chargeable and MSMEs have to pay for procuring the standards. Hence it is recommended to provide subsidized rates for procuring standards to MSMEs manufacturing products coming under Compulsory registration scheme. It is recommended that the industry may increase participation in BIS Technical Committees and actively work on standardization. The industry may also sponsor technical experts for working at the IEC. The industry should collaborate with research groups and participate in IEC working groups and prepare new proposals for standards through BIS.

The GST, Make in India, and other policies such as Preferential Market Access, have made the business environment far more conducive for local manufacturing. The government's flagship programmes, such as Smart Cities and Digital India, are also boosting demand for Electronic products. In April 2020, Government of India announced three additional schemes which were notified by the Ministry of Electronics and IT (MeitY), allocating a sum of ₹ 500 billion (~ US$ 7.2 billion) in total, for incentives under the schemes. These incentives are expected to bolster the local production of Electronics and promote anchor companies in the major Electronics clusters in India

## 3. C) DETAILS OF AGENCIES THAT CAN PROVIDE GUIDANCE (CSIR, MSME TCS, SECTOR COUNCILS)

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|---|---|
| 1 | CSIR-Central Mechanical Engineering Research Institute Mahatma Gandhi Avenue, Durgapur - 713209, West Bengal,<br>Director's Office: +91-343-2546749, 9434022951, Fax : +91-343—2546745; Reception: Mob.: 9434921623, 9232397449 Fax: +91-343-2548204; E-mail: ps2dir@cmeri.res.in |
| 2 | Central Electronics Engineering Research Institute Pilani – 333031; Director [Dr. P C Panchariya]<br>Tel- +91-1596-242111, +91-01596-252200<br>Email- director@ceeri.res.in |

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| 3 | Electronics Sector Skill Council of India<br>602, 6th Floor, Ansal Chambers II, BhikajiCama Place<br>New Delhi – 110066; Tel: +91 11 46035050; Email- info@essc-india.org |
| 4 | Power Sector Skill Council<br>Plot No. 4, Institutional Area, CBIP Building, MalchaMarg, Chanakyapuri<br>New Delhi – 110 021, Phone: 011-40793153/41643346<br>Email: mail@psscindia.org, pssc@cbip.org |
| 5 | Scientist 'F' & Director<br>ETDC, Bengaluru Peenya Industrial Estate, 100 Feet Road , Bengaluru - 560 058, Phone: 080 – 23722314, Fax: 080 -23722314<br>Email: kamalakar@stqc.gov.in |
| 6 | Central Power Research Institute<br>(A Government of India Society, Ministry of Power)<br>Prof.SirC.V.RamanRoad,Post Box No: 8066, Sadasiva Nagar (P;O), Bangalore,India , Pincode : 560 080<br>IPPBX: 82778 92280 /81,82,83...94,95 ; Fax: +91(80) -2360 1213<br>Email- dgcpri@cpri.in |
| 7 | Scientist G and Director<br>ERTL(East) DN Block, Sector V, Salt Lake City Kolkata - 700 091<br>Phone: 033 – 23672366; Fax: 033 – 23679472;<br>Email: bkmondal@stqc.gov.in |
| 8 | National Institute of Solar Energy<br>Gwal Pahari,Faridabad – Gurugram Road<br>Gurugram – 122003 |
| 9 | National Mission on Power Electronics Technology (NaMPET)<br>Power Electronics Group<br>Centre for Development of Advanced Computing<br>Vellayambalam, Thiruvananthapuram, Kerala - 695 033 INDIA<br>Tel: +91 471 2723333, 2723226 Fax: +91 471 2723456 |

Annexure- I

## IEC & IEEE Standards relevant to Power Electronics

| Sl No | Standard | Description |
|---|---|---|
| 1 | IEC 60028 | International standard of resistance for copper |
| 2 | IEC 60034 | Rotating electrical machinery |
| 3 | IEC 60038 | IEC Standard Voltages |
| 4 | IEC 60044 | Instrument transformers |
| 5 | IEC 60050 | International Electro technical Vocabulary |
| 6 | IEC 60055 | Paper-insulated metal-sheathed cables for rated voltages up to 18/30 kV |
| 7 | IEC 60059 | IEC standard current ratings |
| 8 | IEC 60060 | High-voltage test techniques |
| 9 | IEC 60062 | Marking codes for resistors and capacitors |
| 10 | IEC 60068 | Environmental Testing |
| 11 | IEC 60076 | Power transformers |
| 12 | IEC 60077 | Railway applications - Electric equipment for rolling stock |
| 13 | IEC 60083 | Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC |
| 14 | IEC 60085 | Electrical insulation |
| 15 | IEC 60086 | Primary batteries; |
| 16 | IEC 60092 | Electrical installations on ships |
| 17 | IEC 60095 | Lead-acid starter batteries |
| 18 | IEC 60099 | Surge arresters |
| 19 | IEC 60119 | The Electrical Performance of Semiconductor Rectifiers (Metal Rectifiers) |
| 20 | IEC 60134 | Absolute maximum and design ratings of tube and semiconductor devices |
| 21 | IEC 60137 | Bushings for alternating voltages above 1000V |
| 22 | IEC 60146 | Semiconductor Converters |
| 23 | IEC 60156 | Dielectric Strength |
| 24 | IEC 60183 | Guide to the selection of high voltage cables |

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| 25 | IEC 60204 | Safety of machinery |
| 26 | IEC 60214 | On-load tap changers |
| 27 | IEC 60228 | Conductors of insulated cables |
| 28 | IEC 60233 | Tests on Hollow Insulators for use in Electrical Equipment |
| 29 | IEC 60254 | Lead-acid traction batteries |
| 30 | IEC 60255 | Electrical Relays |
| 31 | IEC 60269 | Low voltage fuses |
| 32 | IEC 60270 | High-Voltage Test Techniques – Partial Discharge Measurements |
| 33 | IEC 60273 | Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V |
| 34 | IEC 60287 | Calculation of permissible current in cables at steady state rating |
| 35 | IEC 60296 | Mineral Insulating oils for transformers & switchgear |
| 36 | IEC 60298 | High voltage switchgear in metallic enclosure |
| 37 | IEC 60309 | Plugs, socket-outlets and couplers for industrial purposes |
| 38 | IEC 60317 | Specifications for particular types of winding wires |
| 39 | IEC 60331 | Tests for Electric Cables under Fire Conditions |
| 40 | IEC 60332 | Flame Retardant vs Fire Rate Cables |
| 41 | IEC 60335 | Safety of electrical household appliances |
| 42 | IEC 60364 | Electrical installations of buildings |
| 43 | IEC 60381 | Analogue signals for process control systems |
| 44 | IEC 60417 | Graphical symbols for use on equipment |
| 45 | IEC 60439 | Low voltage switchgear and control gear assemblies |
| 46 | IEC 60445 | Basic and safety principles for man-machine interface |
| 47 | IEC 60446 | Wiring colours |
| 48 | IEC 60479 | Effects of current on human beings and livestock |
| 49 | IEC 60502 | Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) |
| 50 | IEC 60519 | Safety in installations for electro heating and electromagnetic processing |
| 51 | IEC 60529 | Degrees of protection provided by enclosures (IP Code) |

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| 52 | IEC 60546 | Controllers with analogue signals for use in industrial-process control systems |
| 53 | IEC 60571 | Electronic equipment used on rail vehicles |
| 54 | IEC 60601 | Medical Electrical Equipment |
| 55 | IEC 60603 | Connectors for frequencies below 3 MHz for use with printed boards |
| 56 | IEC 60622 | Sealed nickel-cadmium prismatic rechargeable single cells |
| 57 | IEC 60623 | Vented nickel-cadmium prismatic rechargeable single cells |
| 58 | IEC 60669 | Switches for household and similar fixed-electrical installations |
| 59 | IEC 60688 | Electrical measuring transducers for converting AC electrical quantities to analogue or digital signals |
| 60 | IEC 60694 | Common Specifications For High-Voltage Switchgear and Control gear Standards |
| 61 | IEC 60695 | Fire Hazard Testing |
| 62 | IEC 60715 | Dimensions of low-voltage switchgear and control gear. Standardized mounting on rails for mechanical support of electrical devices in switchgear and control gear installations. |
| 63 | IEC 60721 | Classification of environmental conditions |
| 64 | IEC 60726 | Dry type power transformers |
| 65 | IEC 60747 | Semiconductor devices; Part 1: General |
| 66 | IEC 60748 | Semiconductor devices – integrated circuits |
| 67 | IEC 60760 | Flat, quick-connect terminations (merged into IEC 61210:2010-08) |
| 68 | IEC 60793 | Optical fibres |
| 69 | IEC 60801 | EMI and RFI Immunity |
| 70 | IEC 60811 | Common test methods for insulating and sheathing materials of electric cables and optical cables |
| 71 | IEC 60815 | Selection and dimensioning of high-voltage insulators intended for use in polluted conditions |
| 72 | IEC 60826 | Design criteria of overhead transmission lines |
| 73 | IEC 60840 | Power cables with extruded insulation and their accessories for rated voltages above 30 kV (Um = 36 kV) up to 150 kV (Um = 170 kV) – Test methods and requirements |

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| 74 | IEC 60865 | Short Circuit Current: Calculation of Effects |
| 75 | IEC 60884 | Plugs and socket-outlets for household and similar purposes |
| 76 | IEC TR 60890 | A method of temperature-rise verification of low-voltage switchgear and control gear assemblies by calculation |
| 77 | IEC 60898 | Electrical accessories. Circuit breakers for over current protection for household and similar installations. |
| 78 | IEC 60904 | Photovoltaic Devices (Part 1-10). |
| 79 | IEC 60906 | IEC system of plugs and socket-outlets for household and similar purposes: IEC 60906-1 for 230 VAC, IEC 60906-2 for 120 VAC, and IEC 60906-3 for safety extra-low voltage (SELV). |
| 80 | IEC 60909 | Short-circuit currents in three-phase a.c. systems - Part 0: Calculation of currents |
| 81 | IEC 60939 | Passive filter units for electromagnetic interference suppression |
| 82 | IEC 60947 | Standards for low-voltage switchgear and control gear |
| 83 | IEC 60976 | Medical electrical equipment – Medical electron accelerators –Functional performance characteristics |
| 84 | IEC 60977 | Medical electrical equipment – Medical electron accelerators –Guidelines for functional performance characteristics |
| 85 | IEC 61000 | Electromagnetic compatibility (EMC) |
| 86 | IEC 61008 | Residual current operated circuit-breakers without integral over current protection for household and similar uses (RCCBs) |
| 87 | IEC 61009 | Residual current operated circuit breakers with integral over current protection for household and similar uses (RCBO's) |
| 88 | IEC 61010 | Safety requirements for electrical equipment for measurement, control and laboratory use |
| 89 | IEC 61024 | Protection of structures against lightning |
| 90 | IEC 61058 | Switches for Appliances |
| 91 | IEC 61071 | Capacitors for power electronics |
| 92 | IEC 61084 | Cable trunking and ducting systems for electrical installations |
| 93 | IEC 61116 | Electromechanical equipment guide for small hydroelectric installations |

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| 94 | IEC 61131 | Programmable Logic Controllers |
| 95 | IEC 61140 | Protection against electric shock – Common aspects forinstallation and equipment |
| 96 | IEC 61156 | Multicore and symmetrical pair/qud cables for digital communications |
| 97 | IEC 61158 | Industrial communication networks – Fieldbus specifications |
| 98 | IEC 61194 | Characteristic parameters of stand-alone photovoltaic (PV) systems |
| 99 | IEC 61210 | Connecting devices – Flat quick-connect terminations forelectrical copper conductors – Safety requirements |
| 100 | IEC 61211 | Insulators of ceramic material or glass for overhead lines with a nominal voltage greater than 1 000 V - Impulse puncture testing in air |
| 101 | IEC 61238 | Compression and mechanical connectors for power cables forrated voltages up to 30 kV |
| 102 | IEC 61241 | Electrical apparatus for use in the presence of combustible dust |
| 103 | IEC 61277 | Terrestrial photovoltaic (PV) power generating systems –General and guide |
| 104 | IEC 61280 | Field testing method for measuring single mode fibre optic cable |
| 105 | IEC 61345 | UV test for photovoltaic (PV) modules |
| 106 | IEC 61364 | Nomenclature for hydroelectric power plant machinery |
| 107 | IEC 61378 | Converter Transformers |
| 108 | IEC 61400 | Wind turbines |
| 109 | IEC 61427 | Secondary cells and batteries for renewable energy storage - General requirements and methods of test |
| 110 | IEC TS 61430 | Secondary cells and batteries - Test methods for checking the performance of devices designed for reducing explosion hazards -Lead-acid starter batteries |
| 111 | IEC 61434 | Secondary cells and batteries containing alkaline or other non-acid electrolytes - Guide to designation of current in alkaline secondary cell and battery standards |
| 112 | IEC 61439 | Low-Voltage switchgear and controlgear assemblies |

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| 113 | IEC 61442 | Test methods for accessories for power cables with rated voltages from 6 kV (Um = 7,2 kV) up to 30 kV (Um = 36 kV) |
| 114 | IEC 61443 | Short-circuit temperature limits of electric cables with rated voltages above 30 kV (Um = 36 kV) |
| 115 | IEC TS 61463 | Bushings - Seismic qualification |
| 116 | IEC TS 61464 | Insulated bushings - Guide for the interpretation of dissolved gas analysis (DGA) in bushings where oil is the impregnating medium of the main insulation (generally paper) |
| 117 | IEC 61466 | Composite string insulator units for overhead lines with a nominal voltage greater than 1 000 V |
| 118 | IEC 61467 | Insulators for overhead lines - Insulator strings and sets for lines with a nominal voltage greater than 1 000 V - AC power arc tests |
| 119 | IEC 61496 | Safety of machinery - Electro-sensitive protective equipment |
| 120 | IEC 61508 | Functional safety of electrical/electronic/programmable electronic safety-related systems |
| 121 | IEC 61513 | Nuclear power plants – Instrumentation and control important to safety – General requirements for systems |
| 122 | IEC 61523 | Delay and Power Calculation Standards |
| 123 | IEC 61543 | Residual current-operated protective devices (RCDs) for household and similar use - Electromagnetic compatibility |
| 124 | IEC 61554 | Panel-Mounted equipment - Electrical measuring instruments - Dimensions for panel mounting |
| 125 | IEC 61557 | Equipment for measuring electrical safety in low-voltage distribution systems |
| 126 | IEC 61558 | Safety of power transformers, power supplies, reactors and similar products |
| 127 | IEC TS 61586 | Estimation of the reliability of electrical connectors |
| 128 | IEC TR 61592 | Household electrical appliances - Guidelines for consumer panel testing |

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| 129 | IEC TR 61597 | Overhead electrical conductors - Calculation methods forstranded bare conductors |
| 130 | IEC 61621 | Dry, solid insulating materials - Resistance test to high-voltage,low-current arc discharges |
| 131 | IEC 61631 | Test method for the mechanical strength of cores made ofmagnetic oxides |
| 132 | IEC TR 61641 | Enclosed low-voltage switchgear and control gear assemblies - Guide for testing under conditions of arcing due to internal fault |
| 133 | IEC 61642 | Industrial a.c. Networks Affected by Harmonics – Application ofFilters and Shunt Capacitors |
| 134 | IEC 61643 | Surge protective devices connected to low-voltage powerdistribution systems |
| 135 | IEC 61646 | Thin-film terrestrial photovoltaic (PV) modules – Designqualification and type approval |
| 136 | IEC 61660 | Short-circuit currents in d.c. auxiliary installations in powerplants and substations |
| 137 | IEC 61666 | Industrial systems, installations and equipment and industrialproducts – Identification of terminals within a system |
| 138 | IEC 61674 | Medical electrical equipment - Dosimeters with ionization chambers and/or semiconductor detectors as used in X-ray diagnostic imaging |
| 139 | IEC 61676 | Medical electrical equipment - Dosimetric instruments used fornon-invasive measurement of X-ray tube voltage in diagnostic radiology |
| 140 | IEC 61683 | Photovoltaic systems - Power conditioners - Procedure for measuring efficiency |
| 141 | IEC 61701 | Salt mist corrosion testing of photovoltaic (PV) modules |
| 142 | IEC 61709 | Electric components - Reliability - Reference conditions forfailure rates and stress models for conversion |
| 143 | IEC 61724 | Photovoltaic system performance monitoring – Guidelines formeasurement |
| 144 | IEC 61726 | Cable assemblies, cables, connectors and passive microwave components - Screening attenuation measurement by the reverberation chamber method |
| 145 | IEC 61727 | Photovoltaic (PV) systems – Characteristics of the utility |

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| 146 | IEC 61730 | Photovoltaic modules |
| 147 | IEC 61739 | Integrated circuits |
| 148 | IEC 61770 | Electric appliances connected to the water mains - Avoidance of back siphonage and failure of hose-sets |
| 149 | IEC 61773 | Overhead lines - Testing of foundations for structures |
| 150 | IEC TS 61774 | Overhead lines - Meteorological data for assessing climatic loads |
| 151 | IEC 61786 | Measurement of low-frequency magnetic and electric fields withregard to exposure of human beings |
| 152 | IEC 61788 | Superconductivity |
| 153 | IEC 61797 | Transformers and inductors for use in telecommunication andelectronic equipment - Main dimensions of coil formers |
| 154 | IEC 61800 | Adjustable speed electrical power drive systems |
| 155 | IEC 61803 | Determination of power losses in high-voltage direct current (HVDC) converter stations |
| 156 | IEC 61812 | Time relays for industrial and residential use |
| 157 | IEC 61821 | Electrical installations for lighting and beaconing of aerodromes -Maintenance of aeronautical ground lighting constant current series circuits |
| 158 | IEC 61822 | Electrical installations for lighting and beaconing of aerodromes -Constant current regulators |
| 159 | IEC 61823 | Electrical installations for lighting and beaconing of aerodromes -AGL series transformers |
| 160 | IEC TS 61827 | Electrical installations for lighting and beaconing of aerodromes -Characteristics of inset and elevated luminaires used on aerodromes and heliports |
| 161 | IEC 61829 | Crystalline silicon photovoltaic (PV) array – On-site measurementof I-V characteristics |
| 162 | IEC TS 61836 | Solar photovoltaic energy systems - Terms, definitions and symbols |
| 163 | IEC TR 61838 | Nuclear power plants - Instrumentation and control important tosafety - Use of probabilistic safety assessment for the classification of functions |
| 164 | IEC 61839 | Nuclear power plants - Design of control rooms - Functional analysis and assignment |

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| 165 | IEC 61850 | Communication Networks and Systems for Power Utility Automation |
| 166 | IEC 61851 | Electric vehicle conductive charging system |
| 167 | IEC TR 61852 | Medical electrical equipment - Digital imaging and communications in medicine (DICOM) - Radiotherapy objects |
| 168 | IEC 61853 | Photovoltaic (PV) module performance testing and energy rating |
| 169 | IEC 61854 | Overhead lines - Requirements and tests for spacers |
| 170 | IEC 61857 | Electrical insulation systems |
| 171 | IEC 61858 | Electrical insulation systems - Thermal evaluation of modifications to an established electrical insulation system (EIS) |
| 172 | IEC 61865 | Overhead lines - Calculation of the electrical component of distance between live parts and obstacles - Method of calculation |
| 173 | IEC 61881 | Railway applications - Rolling stock equipment - Capacitors for power electronics |
| 174 | IEC 61888 | Nuclear power plants - Instrumentation important to safety - Determination and maintenance of trip set points |
| 175 | IEC 61897 | Overhead lines - Requirements and tests for Stockbridge type aeolian vibration dampers |
| 176 | IEC 61910 | Medical electrical equipment - Radiation dose documentation |
| 177 | IEC TR 61912 | Low-voltage switchgear and control gear – Over current protective devices |
| 178 | IEC 61915 | Low-voltage switchgear and control gear - Device profiles for networked industrial devices |
| 179 | IEC TR 61916 | Electrical accessories - Harmonization of general rules |
| 180 | IEC 61921 | Power capacitors - Low-voltage power factor correction banks |
| 181 | IEC 61922 | High-frequency induction heating installations – Test methods for the determination of power output of the generator |
| 182 | IEC TR 61923 | Household electrical appliances - Method of measuring performance - Assessment of repeatability and |

| | | |
|---|---|---|
| | | reproducibility |
| 183 | IEC TS 61934 | Electrical insulating materials and systems - Electrical measurement of partial discharges (PD) under short rise time and repetitive voltage impulses |
| 184 | IEC 61936 | Power installations exceeding 1 kV a.c. |
| 185 | IEC 61950 | Cable management systems - Specifications for conduit fittings and accessories for cable installations for extra heavy duty electrical steel conduit |
| 186 | IEC 61951 | Secondary cells and batteries containing alkaline or other non-acid electrolytes - Portable sealed rechargeable single cells |
| 187 | IEC 61952 | Insulators for overhead lines - Composite line post insulators for<br>A.C. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria |
| 188 | IEC 61954 | Static var compensators (SVC) - Testing of thyristor valves |
| 189 | IEC 61959 | Secondary cells and batteries containing alkaline or other non- acid electrolytes - Mechanical tests for sealed portable secondary cells and batteries |
| 190 | IEC 61960 | Secondary cells and batteries containing alkaline or other non-acid electrolytes - Secondary lithium cells and batteries for portable applications |
| 191 | IEC 61967 | Integrated circuits - Measurement of electromagnetic emissions, 150 kHz to 1 GHz |
| 192 | IEC 61968 | Application integration at electric utilities – System interfaces for distribution management |
| 193 | IEC 61970 | Application integration at electric utilities – Energy management system application program interface (EMS-API) |
| 194 | IEC TS 61973 | High voltage direct current (HVDC) substation audible noise |
| 195 | IEC 61975 | High-voltage direct current (HVDC) installations - System tests |
| 196 | IEC 61980 | Electric vehicle wireless power transfer (WPT) systems |
| 197 | IEC 61982 | Secondary batteries (except lithium) for the propulsion of electric road vehicles - Performance and endurance tests |

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|---|---|---|
| 198 | IEC 61984 | Connectors - Safety requirements and tests |
| 199 | IEC 61987 | Industrial-process measurement and control - Data structures and elements in process equipment catalogues |
| 200 | IEC 61991 | Railway applications - Rolling stock - Protective provisions against electrical hazards |
| 201 | IEC 61992 | Railway applications - Fixed installations - DC switchgear |
| 202 | IEC TR 62001 | High-voltage direct current (HVDC) systems - Guidebook to the specification and design evaluation of A.C. filters |
| 203 | IEC 62003 | Nuclear power plants - Instrumentation and control important to safety - Requirements for electromagnetic compatibility testing |
| 204 | IEC 62007 | Semiconductor optoelectronic devices for fibre optic system applications |
| 205 | IEC 62011 | Insulating materials - Industrial, rigid, moulded, laminated tubes and rods of rectangular and hexagonal cross-section based on thermosetting resins for electrical purposes |
| 206 | IEC 62012 | Multicore and symmetrical pair/quad cables for digital communications to be used in harsh environments |
| 207 | IEC 62031 | LED modules for general lighting – Safety specifications |
| 208 | IEC 62040 | Uninterruptible power systems |
| 209 | IEC 62041 | EMC requirements for power transformers, power supplies, reactors and similar products |
| 210 | IEC TS 62046 | Safety of machinery - Application of protective equipment to detect the presence of persons |
| 211 | IEC 62052 | Electricity metering equipment (AC) General requirements, tests and test conditions |
| 212 | IEC 62061 | Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems |
| 213 | IEC 62068 | Electrical insulating materials and systems - General method of evaluation of electrical endurance under repetitive voltage impulses |
| 214 | IEC 62108 | Concentrator photovoltaic (CPV) modules and assemblies –Design qualification and type approval |

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|---|---|---|
| 215 | IEC 62133 | Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications |
| 216 | IEC 62138 | Nuclear Power Plants - Instrumentation and control important for safety - Software aspects for computer-based systems performing category B or C functions |
| 217 | IEC 62196 | Plugs and sockets for charging electric vehicles |
| 218 | IEC 62208 | Empty enclosures for low-voltage switchgear and controlgear assemblies - General requirements |
| 219 | IEC 62256 | Hydraulic turbines, storage pumps and pump-turbines - Rehabilitation and performance improvement |
| 220 | IEC 62262 | Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code) |
| 221 | IEC 62270 | Hydroelectric power plant automation – Guide for computer-based control |
| 222 | IEC 62271 | High-voltage switchgear and controlgear |
| 223 | IEC 62278 | Railway applications – Specification and demonstration of reliability, availability, maintainability and safety (RAMS) |
| 224 | IEC 62282 | Fuel cell technologies |
| 225 | IEC 62301 | Household electrical appliances – Measurement of standby power |
| 226 | IEC 62305 | Protection Against Lightning |
| 227 | IEC 62325 | Standards related to energy market models & communications |
| 228 | IEC 62351 | Power System Control and Associated Communications – Data and Communication Security |
| 229 | IEC 62353 | Medical electrical equipment - Recurrent test and test after repair of medical electrical equipment |
| 230 | IEC/TR 62357 | Power system control and associated communications - Reference architecture for object models, services and protocols |
| 231 | IEC 62384 | DC or AC supplied electronic control gear for LED modules –Performance requirements |
| 232 | IEC 62491 | Industrial systems, installations and equipment and industrial products - Labelling of cables and cores |

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|---|---|---|
| 233 | IEC 62505 | Railway applications – Fixed installations – Particularrequirements for a.c. switchgear |
| 234 | IEC 62606 | General requirements for arc fault detection devices |
| 235 | IEC 62680 | Universal Serial Bus (USB) interfaces for data and power |
| 236 | IEC 62700 | DC Power supply for notebook computer |
| 237 | IEC 62717 | LED modules for general lighting – Performance requirements |
| 238 | IEC 62776 | Double-capped LED lamps designed to retrofit linear fluorescentlamps – Safety specifications |
| 239 | IEC/TR 62794 | Industrial-process measurement, control and automation - Reference model for representation of production facilities (digital factory) |
| 240 | IEC 62798 | Industrial electroheating equipment – Test methods for infraredemitters |
| 241 | IEC/TR 62837 | Energy efficiency through automation systems |
| 242 | IEEE 295-1969 | Standard for Electronics Power Transformers |
| 243 | IEEE 388-1992 | Standard for Transformers and Inductors in Electronic PowerConversion Equipment |
| 244 | IEEE 389-1996 | Recommended Practice for Testing Electronics Transformers andInductors |
| 245 | IEEE 390-1987 | Standard for Pulse Transformers |
| 246 | IEEE 393-1991 | Standard for Test Procedures for Magnetic Cores |
| 247 | IEEE 518 | Guide for the installation of electrical equipment to minimizeelectrical noise inputs to controllers from external sources |
| 248 | IEEE 519 | Recommended practices and requirements for harmonic controlin electrical power systems |
| 249 | IEEE 519:1992 | Deals with Harmonics caused by Industrial loads |
| 250 | IEEE 1031-2011 | Guide for the Functional Specification of Transmission Static VarCompensators |
| 251 | IEEE 1159 | Recommended practice for monitoring electric power quality |

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| 252 | IEEE 1240-2000 | Guide for the Evaluation of the Reliability of HVDC Converter Stations |
| 253 | IEEE 1303-2011 | Guide for Static Var Compensator Field Tests |
| 254 | IEEE 1378-1997 | Guide for Commissioning High-Voltage Direct-Current (HVDC) Converter Stations and Associated Transmission Systems |
| 255 | IEEE 1409-2012 | Guide for Application of Power Electronics for Power Quality Improvement on Distribution Systems Rated 1 kV Through 38 kV |
| 256 | IEEE 1515-2000 | Recommended Practice for Electronic Power Subsystems: Parameter Definitions, Test Conditions, and Test Methods |
| 257 | IEEE 1566-2015 | Standard for Performance of Adjustable-Speed AC Drives Rated 375 kW and Larger |
| 258 | IEEE 1662-2016 | Approved Draft Recommended Practice for Design and Application of Power Electronics in Electrical Power Systems |
| 259 | IEEE 1676-2010 | Guide for Control Architecture for High Power Electronics (1 MW and Greater) Used in Electric Power Transmission and Distribution Systems |
| 260 | IEEE 1709-2010 | Recommended Practice for 1 kV to 35 kV Medium-Voltage DC Power Systems on Ships |
| 261 | IEEE 1789-2015 | Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers |
| 262 | IEEE 1826-2012 | Standard for Power Electronics Open System Interfaces in Zonal Electrical Distribution Systems Rated Above 100 kW |
| 263 | IEEE C57.110 | Recommended practice for establishing transformer capability when supplying non-sinusoidal load currents |
| 264 | IEEE C57.18.10-1998 | Standard Practices and Requirements for Semiconductor Power Rectifier Transformers |
| 265 | IEEE C57.21-2008 | Standard Requirements, Terminology, and Test Code for Shunt Reactors Rated Over 500 kVA |
| 266 | IEEE C57.129- | Standard for General Requirements and Test Code for Oil-Immersed HVDC Converter Transformers |

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|---|---|---|
| | 2007 | |
| 267 | IEEE C57-2002 | Standards Collection Special Edition: Power Distribution & Regulator Transformers on CD- ROM |
| 268 | IEEE C63.12 | Recommended practice for electromagnetic compatibility limits |
| 269 | IEEE P1433 | Power Quality definitions |
| 270 | IEEE P1564 | Voltage sag indices |
| 271 | EN6055 5-2:1987 & IEC555-2 | Disturbances in supply systems caused by household appliances and similar electrical equipment. Specification of harmonics |

# Part- 2

# Detailed Project Report

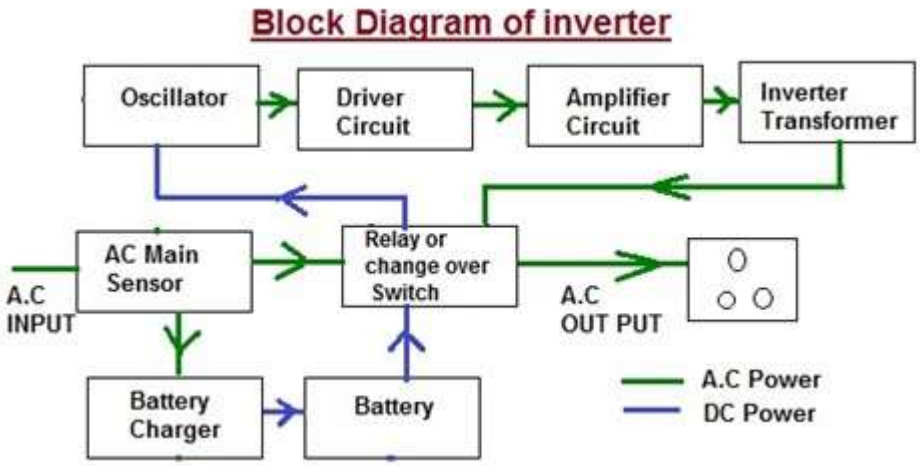
# On

# Domestic Inverter upto 5 KVA

## CONTENTS OF THE REPORT

## 1. INTRODUCTION

Inverters are widely used in the domestic as well as industrial environments to serve as second line of source in case of power cut from the Electricity utility grids. Inverter is the device that powers the Electric/Electronic appliances & equipments in the event of the power failure. Inverter as the name implies first converts AC to DC for charging the battery and then inverts DC to AC for powering the electric gadgets.




An inverter is used to provide stand by 220V A.C supply for connected Load circuit. When power available, Inverter will be in off mode and mains supply will be bypassed to the load. At power interruption, Inverter will turn on and supply power to load. The switching time and output wave depend up on the technological design. There are various types of Inverters depending up on the technology, application, requirement etc.

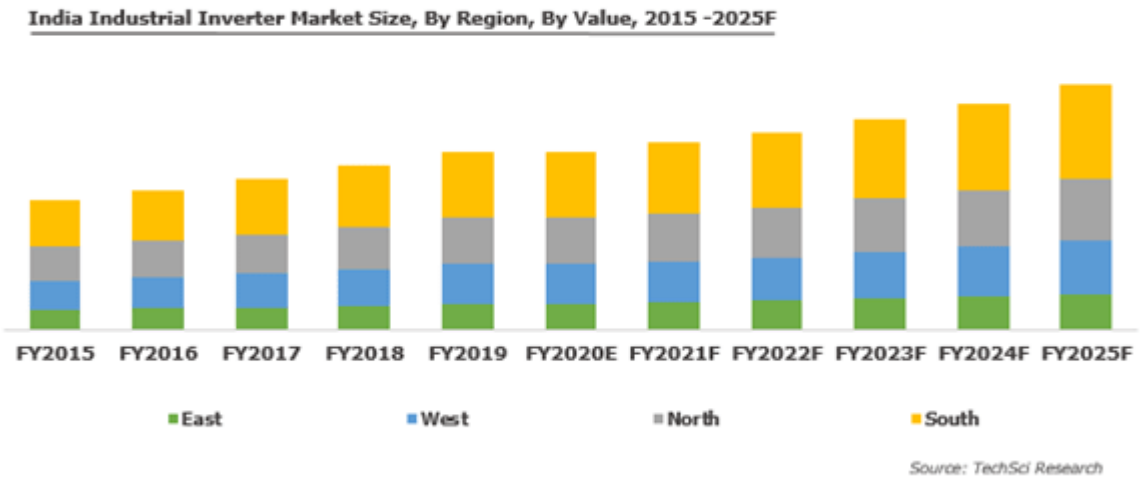
The Inverter system is a combination of Inverter circuit, charger circuit and a battery. The charger circuit is the constant voltage and current charger is to protect the battery. The charger circuit keeps the battery charged when the mains supply is available and as when the main AC fails, the inverter circuit draws the DC power stored in the battery and converts it into 220V/50Hz AC supply, which can be used to power common Electric/Electronic equipments. An inverter is used to power device that does not have the facility to connect to a DC power source or device that requires AC power source for its operation. MOSFET or IGBT based circuit is selected to get better efficiency.

Compared to other power generators, Inverters are lesser noisy, provide complete automatic switchover function; possess no environmental threats, compact and lesser expensive solution.

## 2. MARKET PERSPECTIVE

*The Indian inverter market is expected to reach ₹ 277.83 billion in 2023, growing at a CAGR of 9.33 per cent. Growth in the inverter market can be attributed to the demand for power backup solutions across the residential, commercial as well as industrial sectors. Additionally, factors such as growing urbanization and the rising demand and supply gap of Electricity are further propelling the market.

Government initiatives to improve electrification rate in India is further expected to spur the market. The Indian Industrial Inverter Market is segmented based on type, product type, capacity, sales channel, and region. Based on type, the market can be fragmented into pure sine wave, modified sine wave and square wave. The pure sine wave industrial Inverter segment is expected to remain the largest segment through 2025, followed by square wave and modified sine wave segments. Based on product type, the market can be bifurcated into single-phase and three-phase.




Due to the frequent power disruptions in the country, back-up power system market is undoubtedly growing with newer technologies and methodologies. Indian domestic Inverter market is a steadily growing market with both Indian and multinational manufacturers contending for a major chunk of market share. The Indian inverter market comprises several organized and unorganized players jostling for the space.

Industry reports and Market research reports by prominent Industry associations and experts in the field on power back up systems market across rural and urban sectors brings a number of trends. Major Suppliers operating in the Inverter industry are now exploring contract manufacturing opportunities.

While Inverter industry is relatively stable these days, the demand for Inverters

peaks during the summer season. Any Entrepreneur venturing into this sector need to look into the new trends in the power back up systems such as Solar Inverters, Smart grid linked systems. Internet of Things(IOT), New technologies in storage batteries, Super Capacitors, charging stations for Electrical Vehicles , power banks & mobile chargers etc This would help Entrepreneurs to have a different and futuristic perspective and see the Inverters beyond just power suppliers for conventional applications.

## 3. MANUFACTURING PROCESS

- ✓ Raw materials to be procured as per the specifications.
- ✓ Test the critical components, which go to make up the products.
- ✓ Transformer assembly
- ✓ The components are fixed and solder on a printed circuit board (PCB) according to the design.
- ✓ Additionally, assemble the controls and sockets individually.
- ✓ Control unit assembly
- ✓ Then mount the PCB transformers etc. on the chassis and make all the interconnections & cable assembly
- ✓ The waveforms at various checkpoints, output voltage, and power are checked adjustments are made so that the products meet the desired performance specifications.
- ✓ On completion of testing the instrument is kept for specific time period to ensure its quality and reliability.

## 4. QUALITY STANDARD AND SPECIFICATION

### Quality Standard

IS 16221: Part 2:2015: Safety of Power Converters for use in PV System: Particular requirements for Inverters

IS 16221: Part 1: 2016: Safety of Power Converters for use in PV System: General Requirements

IS 16169: 2019: Utility interconnected Photovoltaic Inverters – Test Procedure of islanding prevention measures

**Specifications**

| | |
|---|---|
| **Input Parameters** | |
| Mains AC Low cut | 110±5V |
| Mains AC Low cut recovery | 120±5V |
| Mains AC High cut | 280±5V |
| Mains AC High cut recovery | 270±5V |
| **Out Put Parameters** | |
| Mains output frequency | Same as Input (45Hz to 55Hz) |
| Inverter output frequency | 50±0.1Hz |
| Output Voltage with full load | 220±5V |
| Waveform | Sine Wave |
| Over load protection | Above 110% |

## 5. PRODUCTION ENVISAGED

| Items | Quantity /Annum | Rate/Unit (Rs.) | Value/ Annum (Rs.) |
|---|---|---|---|
| Inverter System,1000 VA with one 12V,150 AH Tall tubular battery | 550 | 19,000 | 1,04,50,000 |
| Inverter System,2000 VA with Two 12V,150 AH Tall tubular battery | 160 | 39,000 | 62,40,000 |
| Inverter System 4000 VA with Four 12V,150 AH Tall tubular battery | 70 | 68,000 | 47,60,000 |
| | **Total sales (Rs.)** | | **2,14,50,000** |

## 6. POLLUTION CONTROL

The Govt. accords utmost importance to control environmental pollution. The small-scale entrepreneurs should have an environmental friendly attitude and adopt pollution control measures by process modification and technology substitution.

India having acceded to the Montreal Protocol in Sept. 1992, the production and use of Ozone Depleting Substances (ODS) like Chlorofluoro Carbon (CFC), Carbon Tetrachloride, Halons and Methyl Chloroform etc. need to be phased out immediately with alternative chemicals/solvents. A notification for detailed Rules to regulate ODS phase out under the Environment Protection Act, 1986 have been put in place with effect from 19th July 2000.

## 7. ENERGY CONSERVATION

With the growing energy needs and shortage coupled with rising energy cost, a greater thrust in energy efficiency in industrial sector has been given by the Govt. of India since 1980s. The Energy Conservation Act, 2001 has been enacted on 18th August 2001, which provides for efficient use of energy, its conservation and capacity building of Bureau of Energy Efficiency created under the Act.

The following steps may help for conservation of electrical energy:

i) Adoption of energy conserving technologies, production aids and testing facilities.

ii) Efficient management of process/manufacturing machineries and systems, QC and testing equipments for yielding maximum Energy Conservation.

iii) Optimum use of electrical energy for heating during soldering process can be obtained by using efficient temperature controlled soldering and de-soldering stations.

iv)Periodical maintenance of motors, compressors etc.

v) Use of power factor correction capacitors. Proper selection and layout of lighting system; timely switching on-off of the lights; use of compact fluorescent lamps wherever possible etc.

## 8. BASIS AND PRESUMPTIONS CONSIDERED IN THE REPORT

(i) The maximum capacity utilization on single shift basis for 300 days a year. The Capacity Utilization of the unit is taken as 100% for financial analysis.

(ii) The salaries and wages, cost of raw materials, utilities, civil construction etc. are based on the prevailing rates in and around Kerala. These cost factors are likely to vary with time and location.

(iii) The cost of machinery and equipments refer to a particular make/model and prices are approximate.

(iv)The project preparation cost etc. whenever required could be considered under pre-operative expenses.

(v) The breakeven point percentage indicated is of full capacity utilization

(vi)Interest on term and working capital loan must be preferably on current rate. In this project it is taken as 9.5%. The rate may vary depending upon the policy of the financial institutions/agencies from time to time

(vii) The essential production machinery and test equipment required for the project have been indicated. The unit may also utilize common test facilities available at Electronics Test and Development Centers (ETDCs),C-DAC and Electronic Regional Test Laboratories (ERTLs), Other testing Labs set up by the GOI & State Governments , STQC Directorate of the Department of Information Technology, Ministry of Communication and Information Technology etc , to manufacture products conforming to Bureau of Indian Standards.

Further Assumptions as uner :

- The Turnover per annum of Rs. 2,14,50,000 was taken in the 1st Year(70%)
- Annual increase of salary & wages is 10%
- Other contingency expenses has an additional Rs.50,000 p.a
- Depreciation schedule is as per the Income Tax Act.
- Repayment schedule of Bank loan starts after six months moratorium period. No interest and principal amount pay in the initial six months.
- No unsecured loan taken during the period
- Pre-operative expenses in Machinery & Equipment have taken separately.

## 9. FINANCIAL ASPECTS

### A. NON-RECURRING EXPENDITURE

| | | |
|---|---|---|
| **1. LAND & BUILDING (Rented)** | | |
| 1. | Built up area | 1400 Sq.Ft |
| 2. | Office/ Stores | 400 Sq.Ft |
| 3. | Factory | 1000 Sq.Ft |
| 4. | Rent (per month) | **Rs.20,000** |

| 1. MACHINERY & EQUIPMENT: | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Description** | Ind./ Imp. | **Qty In nos** | **Amount (Rs.)** |
| 1. | Semi-Automatic Inverter Transformer Winding Machine | Ind | 2 | 2,80,000 |
| 2. | True RMS Power Analyzer /Data logger | Ind | 4 | 86,000 |
| 3. | 200MHz, 2 Channel Digital Storage Oscilloscope for Industrial purpose. | Ind | 2 | 85,000 |
| 4. | Automatic Wave Soldering Machine, 5.5kw | Ind | 1 | 2,45,000 |
| 5. | True RMS Multimeter | Ind | 4 | 36,800 |
| 6. | Temperature Sensor -Digital | Ind | 2 | 16,000 |
| 7. | Testing Panel | Ind | 2 | 30,000 |
| 8. | Power Analyzer | Ind | 1 | 7,500 |
| 9. | Linear Programmable 0-30 V, 15 Amps DC Power Supply with Voltage Current and Wattage Display | Ind | 1 | 26,000 |
| 10. | Autocompute LCR-Q Meter Sorter | Ind | 1 | 28,500 |
| 11. | Variable autotransformer | Ind | 2 | 12,000 |
| 12. | High Voltage Tester | Ind | 2 | 34,000 |
| 13. | Digital Thermo Hygrometer | Ind | 4 | 5,000 |
| 14. | Insulation Testers - 5KV Insulation | Ind | 2 | 14,000 |
| 15. | Humidity and temperature meter | Ind | 2 | 8,000 |
| 16. | Digital Soldering Station | Ind | 4 | 24,000 |
| 17. | Digital Clamp meter | Ind | 2 | 12,000 |
| 18. | Soldering Iron 150 W | Ind | 5 | 1,500 |
| 19. | Soldering Iron 25 W | Ind | 10 | 1,000 |
| 20. | Personal Computer with UPS and Printer | Ind | 2 | 2,40,000 |

| | | | | |
|---|---|---|---|---|
| 21. | Electrification charges @ 10% of machinery and equipments | | | 1,19,230 |
| 22. | Office Furniture, Working tables and Equipment's | | | 1,00,000 |
| 23. | Tools, Dies and Equipment's | | | 50,000 |
| | **Total fixed cost** | | | **14,61,530** |

| **2. PRE-OPERATIVE EXPENSES** | | |
|---|---|---|
| 1 | Pre-operative expenses | **50,000** |

| **3. TOTAL NON RECURRING EXPENDITURE/FIXED CAPITAL** | | |
|---|---|---|
| 1 | Land & Building (Rented) | 0 |
| 2 | Machinery & Equipment | 1,461,530.00 |
| 3 | Pre-Operative Expenses | 50,000.00 |
| Total | | 1,511,530.00 |

## B RECURRING EXPENDITURE

## 1 RAW MATERIALS CONSUMPTION & UTILITY

| **1.1** | **Raw Material Consumption(per Month)** | | | |
|---|---|---|---|---|
| Sl. No. | Description | Ind/Imp | Qty(nos) | Amount(Rs) |
| 1 | Tubular Battery 12V/150 Ah | Ind | 96 Nos | 8,16,000.00 |
| 2 | CRGO sheets | Ind | 110 Kg | 9,900.00 |
| 3 | Copper wire for primary winding(12 SWG) | Ind | 52Kg | 34,930.00 |
| 4 | Copper wire for secondary winding(20 SWG) | Ind | 100Kg | 65,000.00 |
| 5 | Accessories like harness, lugs, plug ,socket ,connectors, leads etc | Ind | 65 Set | 10,000.00 |
| 6 | MS Box | Ind | 65 Nos | 16,250.00 |
| 7 | Active and passive Electronic Components | Ind | 65 set | 1,82,000.00 |
| 8 | Printed Circuit Board | Ind | 65 Nos | 22,750.00 |
| 9 | Packing materials | Ind | 65 Nos | 6,500.00 |
| | **Total** | | | **1,163,330.00** |

| **1.2** | **UTILITY (PER MONTH)** | |
|---|---|---|
| Sl. No. | Description | Amount (Rs.) |
| 1 | Power | 8,000.00 |
| 2 | Water | 2,000.00 |

| | | |
|---|---|---|
| | **Total** | **10,000.00** |

## TOTAL RAW MATERIALS & UTILITY(PER ANNUM)

| | 1 st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
|---|---|---|---|---|---|
| Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| Raw Materials | 13960 | 15954.24 | 15954.24 | 17948.5 | 19942.8 |
| Utility | 120.00 | 137.14 | 137.14 | 154.29 | 171.43 |
| **TOTAL** | 14079.96 | 16091.38 | 16091.38 | 18102.81 | 20114.23 |

## 2. SALARY & WAGES (PER MONTH, FIRST YEAR)

| DESIGNATION | No | SALARY ₹ | TOTAL |
|---|---|---|---|
| **DIRECT WAGES** | | | |
| Quality Controller | 1 | 25000 | 25,000.00 |
| Production Manager | 1 | 30000 | 30,000.00 |
| Skilled workers | 4 | 15000 | 60,000.00 |
| Semi Skilled Workers | 2 | 10000 | 20,000.00 |
| Un Skilled Workers | 2 | 8000 | 16,000.00 |
| **Sub Total** | **10** | | **151,000.00** |
| **ADMINISTRATIVE SALARY** | | | |
| Accountant | 1 | 20000 | 20,000.00 |
| Sales/Service support Engineers | 2 | 20000 | 40,000.00 |
| Peon/watch man | 1 | 8000 | 8,000.00 |
| **Sub Total** | **4** | | **68,000.00** |
| **GRAND TOTAL** | **14** | | **219,000.00** |
| Perquisites@ 15% | | | 32,850.00 |
| **Total Salary & Wages** | | | **251,850.00** |

| **TOTAL SALARY & WAGES (PER ANNUM)** | | | | | In Thousands |
|---|---|---|---|---|---|
| | 1 st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
| Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| Salary & Wages | 2628.00 | 2890.80 | 3179.88 | 3497.87 | 3847.65 |
| Perquisites | 394.20 | 433.62 | 476.98 | 524.68 | 577.15 |
| **TOTAL** | **3022.20** | **3324.42** | **3656.86** | **4022.55** | **4424.80** |
| [*Basis: Annual Increase of Salary & Wages = 10%] | | | | | |

| 3 | OTHER CONTINGENT EXPENSES (PER MONTH) | |
|---|---|---|
| Sl. No. | Description | Amount Rs |
| 1 | Rent | 20,000.00 |
| 2 | Postage and stationery | 5,000.00 |
| 3 | Telephone /Telex/Fax/Internet | 3,000.00 |
| 4 | Repair & maintenance | 5,000.00 |
| 5 | Transport and Conveyance charges | 50,000.00 |
| 6 | Advertisement and Publicity | 50,000.00 |
| 7 | Insurance | 4,000.00 |
| 8 | Miscellaneous expenditure | 10,000.00 |
| | **Total** | **147,000.00** |
| | [*Basis: Annual Increase of Other charges = 50,000 ] | |

| TOTAL OTHER CONTINGENT EXPENSES (PER ANNUM) | | | | | In Thousands |
|---|---|---|---|---|---|
| | 1 st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
| Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| | 1764.00 | 1814.00 | 1864.00 | 1914.00 | 1964.00 |

| Sl.No | RECURRING EXPENDITURE (MONTHLY BASIS) [On 1st Year basis ] | Amount Rs |
|---|---|---|
| 1 | Raw Materials Consumption | 1,163,330.00 |
| 2 | Utility | 10,000.00 |
| 3 | Salary And Wages | 251,850.00 |
| 4 | Other Contingent Expenses | 147,000.00 |
| | **TOTAL** | **1,572,180.00** |

| | MEANS OF FINANCE | OWN SOURCE | | FINANCIAL INSTITUTE/BANK | | Total |
|---|---|---|---|---|---|---|
| Sl.No | Particulars Total Margin Amount Margin Amount | TOTAL | MARGIN | AMOUNT | MARGIN | AMOUNT |
| 1 | Land & Building | 0 | 0 | 0 | 0 | 0 |
| 2 | Machinery & Equipment | 1,461.53 | 35% | 511.54 | 65% | 949.99 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Pre-Operative Expenses | 50.00 | 35% | 17.50 | 65% | 32.50 |
| 4 | Wc Margin (Rounded) | 4,716.54 | 35% | 1650.79 | 65% | 3065.75 |
| | | **6,228.07** | | **2179.82** | | **4048.25** |

## 10.FINANCIAL ANALYSIS

### C COST OF PRODUCTION (PER ANNUM)

| | | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
|---|---|---|---|---|---|---|
| 1 | Raw Materials Consumption | 13959.96 | 15954.24 | 15954.24 | 17948.52 | 19942.80 |
| 2 | Utility | 120.00 | 137.14 | 137.14 | 154.29 | 171.43 |
| 3 | Salary And Wages | 3022.20 | 3324.42 | 3656.86 | 4022.55 | 4424.80 |
| 4 | Other Contingent Expenses | 1764.00 | 1814.00 | 1864.00 | 1914.00 | 1964.00 |
| | **Total** | **18866.16** | **21229.80** | **21612.24** | **24039.35** | **26503.03** |

### D TURNOVER (PER ANNUM)

| | **ANNUAL PROJECTED PRODUCT(PER ANNUM)** | | | |
|---|---|---|---|---|
| Sl.No | Item | Quantity /Annum | Rate/Unit (Rs.) | Value/ Annum (Rs.) |
| 1 | Inverter System 1000 VA with one 12V,150 AH Tall tubular battery | 550 | 19,000 | 1,04,50,000 |
| 2 | Inverter System 2000 VA with Two 12V,150 AH Tall tubular battery | 160 | 39,000 | 62,40,000 |
| 3 | Inverter System,4 KVA with Four 12V,150 AH Tall tubular battery | 70 | 68,000 | 47,60,000 |
| | **Total sales (Rs.)** | | | **2,14,50,000** |

| 2 | **TOTAL ANNUAL TURNOVER** (In Thousands) | | | | | |
|---|---|---|---|---|---|---|
| | | 1 st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
| | Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| 1 | Inverter System 1000 VA with one 12V,150 AH Tall tubular battery | 10450.00 | 11942.86 | 11942.86 | 13435.71 | 14928.57 |
| 2 | Inverter System 2000 VA with Two 12V,150 AH Tall tubular battery | 6240.00 | 7131.43 | 7131.43 | 8022.86 | 8914.29 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Inverter System,4 KVA with Four 12V,150 AH Tall tubular battery | 4760.00 | 5440.00 | 5440.00 | 6120.00 | 6800.00 |
| | **TOTAL** | **21450.00** | **24514.29** | **24514.29** | **27578.57** | **30642.86** |

## E PROJECT COST

| | **FIXED CAPITAL** | In Rs. |
|---|---|---|
| 1 | Land & Building (Rented) | 0 |
| 2 | Machinery & Equipment | 1,461,530.00 |
| 3 | Pre-Operative Expenses | 50,000.00 |
| | **TOTAL** | **1,511,530.00** |
| | **BLOCK CAPITAL** | |
| 4 | Working Capital Margin | 1,650,789.00 |
| | **PROJECT COST** | **3,162,319.00** |
| 5 | Bank Finance For Working Capital | 3,065,751.00 |
| | **TOTAL** | **6,228,070.00** |

## F TOTAL CAPITAL INVESTMENT

| | | |
|---|---|---|
| A | NON-RECURRING EXPENDITURE | 1,511,530.00 |
| B | WORKING CAPITAL ASSESSED | 4,716,540.00 |
| | **TOTAL** | **6,228,070.00** |

## G ASSESSMENT OF WORKING CAPITAL

| | Particulars | Basis | | | | |
|---|---|---|---|---|---|---|
| | Heads | Days | Months | Total | Own | Bank |
| | | | | 100% | 35% | 65% |
| 1 | Stock of Raw Materials | | 1 | 1,163.33 | 407.17 | 756.16 |
| 2 | Stock of Finished Goods | 15 | | 893.75 | 312.81 | 580.94 |
| 3 | Work - In - Progress | 15 | | 893.75 | 312.81 | 580.94 |
| 4 | Debtors (28 % of Sales) | | 3 | 1513.86 | 529.85 | 984.01 |
| 5 | Expense (Salary + Others) | | 1 | 251.85 | 88.15 | 163.70 |
| | TOTAL W.C. REQUIREMENT (Rounded) | | | 4,716.54 | 1,650.79 | 3,065.75 |

| | WORKING CAPITAL (YEAR WISE) | | | | | In Thousands |
|---|---|---|---|---|---|---|
| | | 1 st Year | 2nd Year | 3rd Year | 4th Year | 5th Year |
| | | 70% | 80% | 80% | 90% | 100% |
| 1 | Stock of Raw Materials | 1,163.33 | 1,329.52 | 1,329.52 | 1,495.71 | 1,661.90 |
| 2 | Stock of Finished Goods | 893.75 | 1021.43 | 1021.43 | 1149.11 | 1276.79 |
| 3 | Work - In - Progress | 893.75 | 1021.43 | 1021.43 | 1149.11 | 1276.79 |
| 4 | Debtors | 1513.86 | 1730.13 | 1730.13 | 1946.39 | 2162.66 |
| 5 | Expense (Salary + Others) | 251.85 | 287.83 | 287.83 | 323.81 | 359.79 |
| | **TOTAL W.C.(Year wise)** | **4,716.54** | **5,390.33** | **5,390.33** | **6,064.12** | **6,737.91** |

| | MODE OF FINANCE | | | | | |
|---|---|---|---|---|---|---|
| | Particulars | | OWN SOURCE | | FINANCIAL INSTITUTE/BANK | |
| | Total Margin Amount Margin Amount | TOTAL | MARGIN | AMOUNT | MARGIN | AMOUNT |
| 1 | Land & Building | 0 | 0 | 0 | 0 | 0 |
| 2 | Machinery & Equipment | 1,461.53 | 35% | 511.54 | 65% | 949.99 |
| 3 | Pre-Operative Expenses | 50.00 | 35% | 17.50 | 65% | 32.50 |
| 4 | Wc Margin (Rounded) | 4,716.54 | 35% | 1650.79 | 65% | 3065.75 |
| | | 6,228.07 | | 2179.82 | | 4048.25 |

| | | **RATIO** |
|---|---|---|
| Own Capital: | 2,179,824.50 | 0.35 |
| Term Loan: | 982,494.50 | 0.16 |
| Cash Credit: | 3,065,751.00 | 0.49 |
| **Debt Equity Ratio** | **1.86** | **:1** |

| 3 COST OF CAPITAL | | |
|---|---|---|
| | WEIGHT | WEIGHTED PERCENTAGE |
| TERM LOAN = 9.5% | 0.16 | 1.52 |
| CASH CREDIT= 9.5% | 0.49 | 4.66 |
| OWN CAPITAL= 9.5% | 0.35 | 3.33 |
| **COST OF CAPITAL** | | **9.51** |

**The cost of capital for equity (owners capital) is dependent on Dividend and it is assumed that no definite dividend policy exist for MSME units. It is therefore assumed that the cost of owners capital is the cost of Term Loan.

| J-1 | BREAK-EVEN ANALYSIS | | | | | In Thousands |
|---|---|---|---|---|---|---|
| | **PARTICULARS** | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
| | Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| **A** | **NET SALES** | **21450.00** | **24514.29** | **24514.29** | **27578.57** | **30642.86** |
| **B** | **VARIABLE COST** | | | | | |
| 1 | Raw Materials | 14079.96 | 16091.38 | 16091.38 | 18102.81 | 20114.23 |
| 2 | Salary/ Wages @ 75% | 2266.65 | 2493.32 | 2742.65 | 3016.91 | 3318.60 |
| 3 | Other Charges @ 75% | 1143.00 | 1180.50 | 1218.00 | 1255.50 | 1293.00 |
| 4 | Interest on Working Capital | 291.25 | 291.25 | 291.25 | 291.25 | 291.25 |
| | | **17780.86** | **20056.45** | **20343.28** | **22666.47** | **25017.08** |
| **C** | **FIXED COST** | | | | | |
| | Salary Wages @ 25% | 755.55 | 831.11 | 914.22 | 1005.64 | 1106.20 |
| | Other Charges @ 25% | 381.00 | 393.50 | 406.00 | 418.50 | 431.00 |
| | Lease Rent @ 100% | 240.00 | 240.00 | 240.00 | 240.00 | 240.00 |
| | Depreciation @ 100% | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| | Interest on Term Loan | 89.62 | 70.50 | 49.49 | 26.39 | 3.83 |
| | Pre-operative Expense W/o | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | | **1750.40** | **1754.71** | **1783.91** | **1831.87** | **1897.85** |
| **D** | **COST OF PRODUCTION(B+C)** | 19531.25 | 21811.16 | 22127.19 | 24498.34 | 26914.93 |
| **E** | **CONTRIBUTION(A-B)** | 3669.14 | 4457.84 | 4171.01 | 4912.10 | 5625.78 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **F** | **PROFIT BEFORE TAX(A-D)** | 1918.75 | 2703.13 | 2387.09 | 3080.23 | 3727.93 |
| | BREAK-EVEN POINT = | Fixed Cost x 100 (Fixed Cost + Profit) | | OR | Fixed Cost x 100 Contribution | |
| **G** | **BREAK-EVEN POINT (%)** | **48%** | **39%** | **43%** | **37%** | **34%** |
| **J-2** | **DSCR ANALYSIS** | | | | | |
| | DEBT SEVICE COVERAGE RATIO (DSCR) = | Net Cash Accured + Capital Interest Installment | | | | |
| **H** | **PROIT AFTER TAX** | 1322.44 | 1861.74 | 1644.01 | 2120.63 | 2566.04 |
| **I** | **ADD: DEPRECIATION** | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| **J** | **NET CASH ACCURED(H+I)** | 1596.67 | 2071.34 | 1808.22 | 2251.97 | 2672.86 |
| **K** | **CAPITAL INTEREST** | 89.62 | 70.50 | 49.49 | 26.39 | 3.83 |
| **L** | **INSTALLMENT** | 282.21 | 282.21 | 282.21 | 282.21 | 141.10 |
| **M** | **D.S.C.R** | **5.98** | **7.59** | **6.58** | **8.07** | **18.97** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **J-3** | **NET PRESENT VALUE (NPV)** | | | (PV = "Present Value") | | |
| | COST OF CAPITAL | 9.51% | | | | In Thousands |
| | **PARTICULARS** | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
| | Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| **A** | **PROIT AFTER TAX** | 1322.44 | 1861.74 | 1644.01 | 2120.63 | 2566.04 |
| **B** | **ADD: DEPRECIATION** | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| **C** | **NET CASH FLOW (A+B)** | 1596.67 | 2071.34 | 1808.22 | 2251.97 | 2672.86 |
| **D** | **DISCOUNTING FACTOR** | 0.913 | 0.834 | 0.761 | 0.695 | 0.635 |
| **E** | **PV OF NET CASH INFLOW** | 1458.00 | 1727.00 | 1377.00 | 1566.00 | 1697.00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **F** | **PV OF FIXED ASSETS AT THE END OF 5TH YEAR:** | | | | | 365.00 |
| **G** | **PV OF NET INFLOW (E+F)** | 1458.00 | 1727.00 | 1377.00 | 1566.00 | 2062.00 |
| **H** | **TOTAL PRESENT VALUE (PV) OF NET INFLOW** | 8190.32 | | | | |
| **I** | **PRESENT VALUE (PV) OF NET OUTFLOW** | 3162.32 | | | | |
| **J** | **PROFITABILITY INDEX (PI)** | 2.59 | | (P.I. >1 => THE PROJECT IS VIABLE) | | |
| **K** | **NET PRESENT VALUE (NPV) (I)-(H)** | 5042090.00 | | | | |

| **J-4** | **INTERNAL RATE OF RETURN (IRR)** | | | | | |
|---|---|---|---|---|---|---|
| | DISCOUNTING FACTOR FOR IRR:42% | | | | | |
| | **PARTICULARS** | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
| | Capacity Utilisation | 70% | 80% | 80% | 90% | 100% |
| **A** | **PROIT AFTER TAX** | 1322.44 | 1861.74 | 1644.01 | 2120.63 | 2566.04 |
| **B** | **ADD: DEPRECIATION** | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| **C** | **NET CASH FLOW (A+B)** | 1596.67 | 2071.34 | 1808.22 | 2251.97 | 2672.86 |
| **D** | **DISCOUNTING FACTOR** | 0.667 | 0.444 | 0.296 | 0.198 | 0.132 |
| **E** | **PV OF NET CASH INFLOW** | 1064.44 | 920.60 | 535.77 | 444.83 | 351.98 |
| **F** | **PV OF FIXED ASSETS AT THE END OF 5TH YEAR:** | | | | | 75.76 |
| **G** | **PV OF NET INFLOW (E+F)** | 1064.44 | 920.60 | 535.77 | 444.83 | 427.75 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **H** | **TOTAL PRESENT VALUE (PV) OF NET INFLOW** | 3393.39 | | | | |
| **I** | **PRESENT VALUE (PV) OF NET OUTFLOW** | 3162.32 | | | | |
| **K** | **NET PRESENT VALUE (NPV) (I)-(H)** | 231068.02 | | | | |
| | **I.R.R. OF THE PROJECT:** | | | | | |
| | AT 50% NPV : | 231,068.02 | | | | |
| | AT 9.5% NPV: | 5,042,090.00 | | | | |
| | **I.R.R** | 42 | % | | | |

## 10. PROJECT IMPLEMENTATION SCHEDULE

The major activities in the implementation of the project have been listed and the average time for implementation of the project is estimated at 12 months:

| **Sl.No.** | **Name of Activity** | **Period in Months (Estimated)** |
|---|---|---|
| 1. | Preparation of project report | 1 |
| 2. | Registration and other formalities | 1 |
| 3. | Sanction of loan by financial institutions | 3 |
| 4. | Plant and Machinery: | |
| (a) | Placement of orders | 1 |
| (b) | Procurement | 2 |
| (c) | Power connection/ Electrification | 2 |
| (d) | Installation/Erection of machinery/Test Equipment | 2 |
| 5. | Procurement of raw materials | 2 |
| 6. | Recruitment of Technical Personnel etc. | 2 |
| 7. | Trial production | 11 |
| 8. | Commercial production | 12 |

**Notes**

1. Many of the above activities shall be initiated concurrently.
2. Procurement of raw materials commences from the 8th month onwards.
3. When imported plant and machinery are required, the implementation period of project may vary from 12 months to 15 months.

## 11. FINANCIAL PATTERN

**Resources for finance**

1. Term loans from financial institutions ( 65% of fixed capital) @ 9.5 % p.a rate of interest
2. Bank Loans for 3 months (65% of working capital) @ 9.5 % p.a rate of interest
3. Self raised capital from even funds & loans from close ones to meet the margin money needs at a rate of 9.5% p.a rate of interest

| | |
|---|---|
| **I** | **REPAYMENT SCHEDULE & INTEREST CALCULATIONS ON LOANS** |
| | (No interest and principal is calculated as payable for first 6 months moratorium period) |

| **A . QUARTERLY REPAYMENT SCHEDULE PLANNING ON TERM LOAN** | | | | |
|---|---|---|---|---|
| **TERM LOAN** | **982494.50** | **RATE: 9.5%** | | |
| Year | Installment | Interest content | Principle Content | Loan Outstanding |
| Beginning | | | | 1,032,495.00 |
| 1st Quarter | 70,552.00 | 24,099.00 | 46,453.00 | 986,042.00 |
| 2nd Quarter | 70,552.00 | 22,987.00 | 47,565.00 | 938,477.00 |
| 3rd Quarter | 70,553.00 | 21,849.00 | 48,704.00 | 889,773.00 |
| 4th Quarter | 70,552.00 | 20,683.00 | 49,869.00 | 839,904.00 |
| **1st Year: Total** | **282,209.00** | **89,618.00** | **192,591.00** | |
| 1st Quarter | 70,552.00 | 19,489.00 | 51,063.00 | 788,841.00 |

| | | | | |
|---|---|---|---|---|
| 2nd Quarter | 70,551.00 | 18,266.00 | 52,285.00 | 736,556.00 |
| 3rd Quarter | 70,552.00 | 17,015.00 | 53,537.00 | 683,019.00 |
| 4th Quarter | 70,552.00 | 15,733.00 | 54,819.00 | 628,200.00 |
| **2nd Year: Total** | **282,207.00** | **70,503.00** | **211,704.00** | |
| 1st Quarter | 70,551.00 | 14,420.00 | 56,131.00 | 572,069.00 |
| 2nd Quarter | 70,551.00 | 13,077.00 | 57,474.00 | 514,595.00 |
| 3rd Quarter | 70,552.00 | 11,702.00 | 58,850.00 | 455,745.00 |
| 4th Quarter | 70,551.00 | 10,292.00 | 60,259.00 | 395,486.00 |
| **3rd Year: Total** | **282,205.00** | **49,491.00** | **232,714.00** | |
| 1st Quarter | 70,552.00 | 8,850.00 | 61,702.00 | 333,784.00 |
| 2nd Quarter | 70,551.00 | 7,372.00 | 63,179.00 | 270,605.00 |
| 3rd Quarter | 70,551.00 | 5,860.00 | 64,691.00 | 205,914.00 |
| 4th Quarter | 70,552.00 | 4,312.00 | 66,240.00 | 139,674.00 |
| **4th Year: Total** | **282,206.00** | **26,394.00** | **255,812.00** | |
| 1st Quarter | 70,551.00 | 2,726.00 | 67,825.00 | 71,849.00 |
| 2nd Quarter | 70,552.00 | 1,103.00 | 69,449.00 | 2,400.00 |
| 3rd Quarter | | - | - | |
| 4th Quarter | | - | - | |
| 5th Year: Total | **141,103.00** | **3,829.00** | **137,274.00** | |

| **B** | **ANNUAL REPAYMENT PLANNING ON WORKING CAPITAL LOAN INTEREST** | | | |
|---|---|---|---|---|
| | W.C Loan | 3,065,751.00 | RATE OF INTEREST | :9.5% |

| Year | Opening Balance | Loan Receipt from Bank | Closing Balance | Intrest Content (WC Loan) | Total Interest (Term + WC Loan) |
|---|---|---|---|---|---|
| Beginning | 0 | 3,065,751.00 | 3,065,751.00 | 0 | 0 |
| 1st Year | 3,065,751.00 | - | 3,065,751.00 | 291,246.35 | 380,864.35 |
| 2nd Year | 3,065,751.00 | 0 | 3,065,751.00 | 291,246.35 | 361,749.35 |
| 3rd Year | 3,065,751.00 | 0 | 3,065,751.00 | 291,246.35 | 340,737.35 |
| 4 th Year | 3,065,751.00 | 0 | 3,065,751.00 | 291,246.35 | 317,640.35 |
| 5th year | 3,065,751.00 | 0 | 3,065,751.00 | 291,246.35 | 295,075.35 |

| Depreciation Analysis (WDV method) (AS PER RATE OF DEPRECIATION UNDER INCOME TAX ACT FROM THE AY 2018-19 ONWARDS) | | | | |
|---|---|---|---|---|
| HEADS | MACHINARY | Furniture and fittings | Computer | TOTAL |
| DEPRECIATIONS | 15% | 10% | 40% | |
| Beginning | 1121.53 | 100 | 240 | 1461.53 |
| Depreciations | 168.23 | 10 | 96 | 274.23 |
| 1st Year | 953.30 | 90 | 144 | 1187.3 |
| Depreciations | 143 | 9 | 57.6 | 209.6 |
| 2nd Year | 810.30 | 81 | 86.4 | 977.7 |
| Depreciations | 121.55 | 8.1 | 34.56 | 164.21 |
| 3rd Year | 688.76 | 72.9 | 51.84 | 813.50 |
| Depreciations | 103.31 | 7.29 | 20.74 | 131.34 |
| 4th Year | 585.44 | 65.61 | 31.10 | 682.16 |
| Depreciations | 87.82 | 6.56 | 12.44 | 106.82 |
| 5th Year | 497.63 | 59.05 | 18.66 | 575.34 |

| J | PROJECT PROFITABILITY ANALYSIS | | | | |
|---|---|---|---|---|---|
| | **PARTICULARS** | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** |
| | ANNUAL TURNOVER | 21450.00 | 24514.29 | 24514.29 | 27578.57 |
| | **NET SALES** | **21450.00** | **24514.29** | **24514.29** | **27578.57** |
| **A** | **VARIABLE COST** | | | | |
| 1 | Raw Materials | 14079.96 | 16091.38 | 16091.38 | 18102.81 |
| 2 | Salary/ Wages @ 75% | 2266.65 | 2493.32 | 2742.65 | 3016.91 |
| 3 | Other Charges @ 75% | 1323.00 | 1360.50 | 1398.00 | 1435.50 |
| 4 | Interest on Working Capital | 291.25 | 291.25 | 291.25 | 291.25 |
| | | **17960.86** | **20236.45** | **20523.28** | **22846.47** |
| **B** | **FIXED COST** | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 1 | Salary Wages @ 25% | 755.55 | 831.11 | 914.22 | 1005.64 |
| 2 | Other Charges @ 25% | 441.00 | 453.50 | 466.00 | 478.50 |
| 3 | Depreciation @ 100% | 274.23 | 209.6 | 164.21 | 131.34 |
| 4 | Interest on Term Loan | 89.62 | 70.50 | 49.49 | 26.39 |
| 5 | Pre-operative Expense W/o | 10.00 | 10.00 | 10.00 | 10.00 |
| | | **1570.40** | **1574.71** | **1603.91** | **1651.87** |
| **C** | **COST OF PRODUCTION (A+B)** | 19531.25 | 21811.16 | 22127.19 | 24498.34 |
| **D** | **PROFIT BEFORE TAX** | 1918.75 | 2703.13 | 2387.09 | 3080.23 |
| | (Net Sales-Cost of Production) | | | | |
| **E** | **TAXATION LIABILITY** | 596.31 | 841.39 | 743.08 | 959.60 |
| | (30% Tax + 4% Cess) | | | | |
| **F** | **PROIT AFTER TAX** | 1322.44 | 1861.74 | 1644.01 | 2120.63 |
| **G** | **ADD: DEPRECIATION** | 274.23 | 209.6 | 164.21 | 131.34 |
| **H** | **NET CASH ACCRUED** | 1596.67 | 2071.34 | 1808.22 | 2251.97 |
| **I** | **LOAN REPAYMENT** | 192.59 | 211.70 | 232.71 | 255.81 |
| **J** | RETURN ON SALES (%) | 8.95% | 11.03% | 9.74% | 11.17% |
| **K** | RETURN ON INVEST.( %) | 31% | 43% | 38% | 49% |
| **L** | BREAK-EVEN POINT (%) | 48% | 39% | 43% | 37% |
| **M** | D.S.C.R | 5.98 | 7.59 | 6.58 | 8.07 |

| **L** | **PROJECTED CASH FLOW STATEMENT** | | | | | | In Thousands |
|---|---|---|---|---|---|---|---|
| | **SOURCE OF FUNDS** | Starting | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
| | | Period | | | | | |
| 1 | Net Profit Before Interest & Tax | 0.00 | 2,299.61 | 3,064.88 | 2,727.84 | 3,397.88 | 4,023.01 |
| 2 | Increase of Share Capital | 2,179.82 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | Un-Secured Loans | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | Depreciation | 0.00 | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| 5 | Increase of Term Loan | 1,032.49 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | Increase of Cash Credit | 3,065.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | Increase in current Liability | 0.00 | 1277.17 | 325.97 | 167.35 | 880.08 | 397.06 |
| 8 | Pre -Operative W/o | 0.00 | 10.00 | 10.00 | 10.00 | 10.00 | 10.00 |
| | | | | | | | |
| | TOTAL SOURCES (A): | **6278.07** | **3,861.01** | **3,610.45** | **3,069.39** | **4,419.30** | **4,536.89** |
| | **DISTRIBUTION OF FUNDS** | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Pre-operative Expenditure | 50.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | Increase in Fixed Assets | 1,461.53 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | Increase in Current Assets | 4,716.54 | 0 | 673.79 | - | 673.79 | 673.79 |
| 4 | Total Interest on Loan | 0.00 | 380.86 | 361.75 | 340.74 | 317.64 | 295.08 |
| 5 | Taxation Liabilities | 0.00 | 596.31 | 841.39 | 743.08 | 959.60 | 1161.89 |
| 6 | Repayment of Term Loan | 0.00 | 192.59 | 211.70 | 232.71 | 255.81 | 137.27 |
| 7 | Reserve at the Beginiinng | 0.00 | 0.00 | 1022.44 | 1461.74 | 1544.01 | 1920.63 |
| 8 | Dividend to Share-Holders/ Drawings | 0.00 | 300.00 | 400.00 | 100.00 | 200.00 | 300.00 |
| | TOTAL DISTRIBUTIONS (B): | **6,228.07** | **1469.77** | **3511.07** | **2878.27** | **3950.86** | **4488.67** |
| | OPENING BALANCE | 0.00 | 50.00 | 2441.25 | 2,540.63 | 2,731.75 | 3,200.19 |
| | NET SURPLUS (A - B) | 50.00 | 2391.25 | 99.38 | 191.12 | 468.44 | 48.22 |
| | CLOSING BALANCE | 50.00 | 2441.25 | 2,540.63 | 2,731.75 | 3,200.19 | 3,248.41 |

| K | **PROJECTED BALANCE SHEET** | | | | | | In Thousands |
|---|---|---|---|---|---|---|---|
| | **I. LIABILITIES** | Beginning | **1 st Year** | **2nd Year** | **3rd Year** | **4th Year** | **5th Year** |
| 1 | **CAPITAL & SHAREHOLDERS FUNDS** | | | | | | |
| a) | Capital | 2,179.82 | 2,179.82 | 2,179.82 | 2,179.82 | 2,179.82 | 2,179.82 |
| b) | Reserve and Surplus | 0.00 | 1022.44 | 1461.74 | 1544.01 | 1920.63 | 2266.04 |
| | SUB TOTAL | **2,179.82** | **3,202.26** | **3,641.56** | **3,723.84** | **4,100.46** | **4,445.86** |
| 2 | **LOAN FUNDS** | | | | | | |
| a) | Secured Term Loan from Bank | 1,032.50 | 839.90 | 628.20 | 395.49 | 139.67 | 2.40 |
| b) | Cash Credit from Bank | 3,065.75 | 3,065.75 | 3,065.75 | 3,065.75 | 3,065.75 | 3,065.75 |
| c) | Unsecured Loans | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | SUB TOTAL | **4,098.25** | **3,905.66** | **3,693.95** | **3,461.24** | **3,205.43** | **3,068.15** |
| 3 | **CURRENT LIABILITIES AND PROVISIONS** | | | | | | |
| a) | Creditors | 0.00 | | 0.01 | 586.68 | 1173.35 | 1290.67 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| b) | Provision for Taxation | 0.00 | 596.31 | 841.39 | 743.08 | 959.60 | 1161.89 |
| c) | Bank Interest | 0.00 | 380.86 | 361.75 | 340.74 | 317.64 | 295.08 |
| d) | Provision of Un-Secured Loan Repayment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| e) | Proposed Dividends/ Drawings | 0.00 | 300.00 | 400.00 | 100.00 | 200.00 | 300.00 |
| | SUB TOTAL | **0.00** | **1,277.17** | **1,603.15** | **1,770.50** | **2,650.59** | **3,047.64** |
| | **TOTAL LIABILITY** | **6,278.07** | **8,385.09** | **8,938.66** | **8,955.58** | **9,956.47** | **10,561.66** |
| II | **ASSETS** | | | | | | |
| 1. | **FIXED ASSETS** | | | | | | |
| a) | Machinery & Equipment: | 1121.53 | 1121.53 | 953.30 | 810.30 | 688.76 | 585.44 |
| b) | Furniture & Fixtures | 100.00 | 100.00 | 90.00 | 81.00 | 72.90 | 65.61 |
| c) | Computer | 240.00 | 240.00 | 144 | 86.40 | 51.84 | 31.10 |
| d) | Less: Depreciation | 0 | 274.23 | 209.6 | 164.21 | 131.34 | 106.82 |
| e) | NET BLOCK(a+b+c-d) | **1,461.53** | **1,187.30** | **977.70** | **813.50** | **682.16** | **575.34** |
| 2 | **INVESTMENTS** | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | **CURRENT ASSETS** | | | | | | |
| | a)Stocks (RM, Finished Goods,WIP) & Debtors | 4,716.54 | 4,716.54 | 5,390.33 | 5,390.33 | 6,064.12 | 6,737.91 |
| 4 | **CASH AND BANK BALANCE** | 50.00 | 2441.25 | 2,540.63 | 2,731.75 | 3,200.19 | 3,248.41 |
| 5 | **PRELIMINARY & PRE-OP. EXPENSES** | 50.00 | 40.00 | 30.00 | 20.00 | 10.00 | 0.00 |
| | **TOTAL ASSETS** | **6,278.07** | **8,385.09** | **8,938.66** | **8,955.58** | **9,956.47** | **10,561.66** |

## 12. ADDITIONAL INFORMATION

(a)The Project Profile may be modified/ tailored to suit the individual entrepreneurship qualities/capacity, production programme and also to suit the location characteristics, wherever applicable.

(b) The Electronics Technology is undergoing rapid strides of change and there is need for regular monitoring of the national and international technology scenario. The unit may, therefore, keep abreast with the new technologies in order to keep them in pace with the developments for global competition.

(c) The margin money recommended is 25% of the working capital requirement at an average. However, the percentage of margin money may vary as per bank's discretion.

## 13. ADDRESSES OF RAW MATERIAL SUPPLIERS & EQUIPMENTS

### A. ADDRESSES OF RAW MATERIAL SUPPLIERS

| Sl.No | Addresses |
|---|---|
| 1. | M/s.Powerline,Door No 36/546, Karithala Road Manorama junction, Panampilli Nagar , Ernakulam 682016 |
| 2. | M/s.ThomsanElectronics,MGRoad,Ernakulam |
| 3. | M/s.Bhanu Power Systems, Ayanavaram, Chennai-600023 |
| 4. | M/s. Sanghvi Electronics, Gamdevi, Mumbai-400004 |
| 5. | M/s. Electromagnetic cores coils, Colony Moulai Ali, Hyderabad-40. |
| 6. | M/s. Om Engineering works, D-19,20 Industrial Area, Mumtaz Nagar, Faizabad. |
| 7, | M/s.AsianContec Ltd, Plot no. 3E, 4th Main Road, Vijayanagar Velachery, Chennai-600042 |
| 7. | M/s.Textronix Industries Pvt Ltd GIDC Vatwa,Ahemmedabad,Gujrath |

### B. ADDRESSES OF TEST EQUIPMENTS SUPPLIERS

| Sl.No | Addresses |
|---|---|
| 1. | M/s.ACMEElectronics ,780/A, GIDC Industrial Estate,Makarpura,Vadodara - 390 010. Gujarat, INDIA Ph : 91-265-2632962,+91-265-2634891 |
| 2. | M/s.FLUKE TECHNOLOGIES PVT. LTD., IndiQube Brigade Opus 4th Floor, Office 'B', 2286, Kodigehalli main road, Sanjeevani Nagar, Bengaluru - 560092 |
| 3. | M/s.Novatek Electro India Pvt Ltd, C-13, Patparganj Industrial Area, F.I.E, Delhi-110092 |
| 4. | M/s NishkaTechnoligies ,NarodaRoad,Ahemmadabad,Gujrat. |
| 5. | M/s. Synthesis Winding Technologies,14/A,NearTCS,Electronis City,Bangalore.560100 |
| 6. | M/s.Salicon Nano Technology PvtLtd,NearNirmanvihar Metro Station,Delhi 110092 |

| | |
|---|---|
| 7. | M/s.Ravindra Electronics,A-215,Sunar waligali,HastalVillage,New Delhi-110059 |
| 8. | M/s.Q Max Test EquipmentsPvt.Ltd,<br>#6,IT Highway,Sholinganallur,<br>Chennai-600119 |

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*"Everyone wants to be strong and self sufficient, but few are willing to put in the work necessary to achieve worthy goals"- Mahatma Gandhi*