



# Providing Power Electronics Solutions For Defense Sector

*Since 1993*



**GROWCONTROLS<sup>TM</sup>**

*We Provide Solutions....*

## ABOUT US

**GROWCONTROLS** is a research based Power Electronics organization, established in the year 1993. Our main focus is in Design and Development of Power Electronics solutions for Defense sector.

**GROWCONTROLS** is headed by Power Electronics engineer with more than two decades research experience in development of specialised power supply solutions.

Being a research based organization we have more than 30 engineers to undertake Design and Development activities. Our total workforce is more than 100 employees.

Having expertise and experience in our core areas. We have successfully developed mission critical systems for Army, Air force, Navy, Defense Research labs and Defense Production units.

With our experienced engineers and good infra-structure, we develop solutions and systems from concept to product level.





### Our Expertise

- Core competency in Power Electronics, Pulsed Power, Magnetics, Radiofrequency, Thermal management and allied fields.
- We specialize in High-tech Power Electronics Solutions for Defense, Research and Industrial applications.
- With Creative and Innovative ideas, we design and implement Solutions from Concept to Product level.
- We can offer complete solutions including thermal management.

### In House Facilities

- Electronics Systems Design and Development
- Magnetics Design and Fabrication
- Dust free Electronics assembly and testing
- High-voltage lab
- Electrical panel manufacturing
- Mechanical workshop
- Thermal Management lab
- Vacuum Impregnation and encapsulation system
- In-house test facilities for thermal, vibration and environmental testing





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### Technologies / Systems Developed

- TWTA amplifier Power Supplies
- Microwave Power Modules
- Magnetron Modulators
- Klystron Modulators
- Floating deck Modulators
- Electronic Warfare Power Supplies
- Capacitor Charging Power Supplies
- Pulsed Power Systems
- High Voltage Switches
- DC power supplies

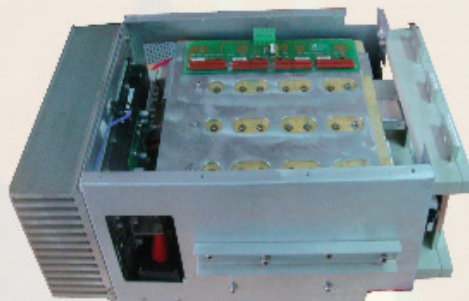
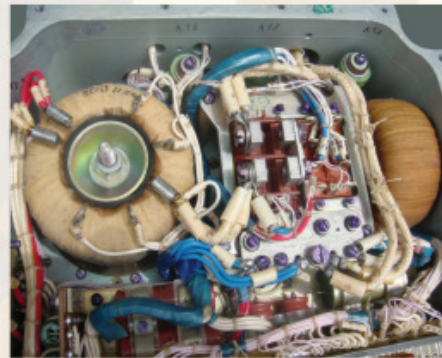
### Systems & Equipment for Arms & Ammunition Manufacturing

- System Specific Power Supplies
- Magnetic Pulse forming systems
- Induction Hardening Systems
- Induction Brazing Systems
- DC power supplies
- Testing Systems
- Fuel Cell/Thermal battery test setups
- Customised machinery /  
systems for Defense production



### Services Offered

- Power Electronics Designing Proto-type Development and Manufacturing
- Technology Development & Technology Transfer
- Contract Research
- Indigenisation / Modifications of existing system
- Manufacturing Services
- Thermal Management Solutions
- Technical Consultancy





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## TWT Power Supplies, Modulators for TWT Amplifiers and Microwave Power Modules



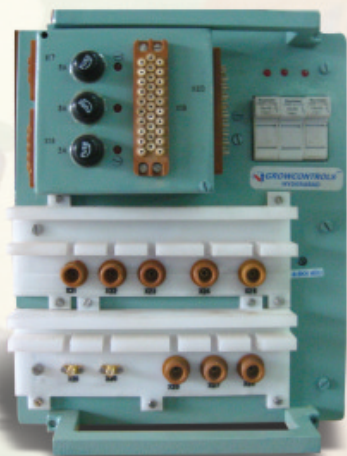
**GROWCONTROLS** has developed high frequency resonant converter based high voltage power supplies with integral floating-deck modulator for TWT amplifiers & Microwave Power Modules. These rugged power supplies are highly efficient, reliable, and protected against overload and short circuits. High frequency resonant converters are very compact, have low output ripple and very low arc dump energy. Stabilized feedback loop ensures highly stable helix voltage.

Various levels of voltages are generated, rectified filtered and stabilised as required by helix and various collectors of TWT.

Typical modulator parameters are:

- (i) Pulse width : 200 ns to 500 ms & CW
- (ii) PRF : >200KHz
- (iii) Rise Time : 30ns
- (iv) Fall Time : 30ns
- (v) Throughput : 100ns Delay

Our TWT power supplies find applications in Electronics War fare in Defense sector.

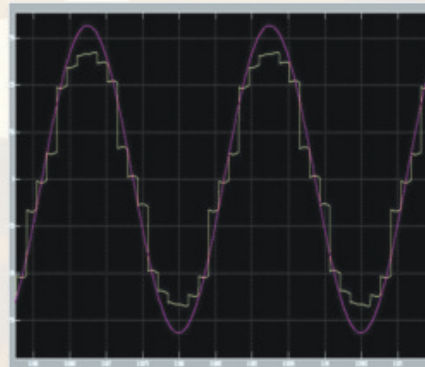




## Auto Transformer Rectifier Unit

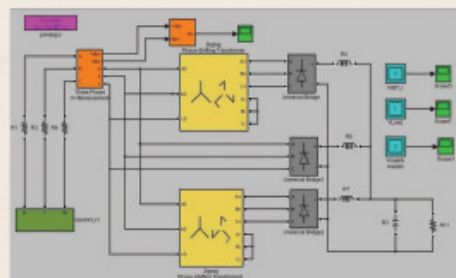
**GROWCONTROLS** has indigenously developed 18 pulse Auto-Transformer AC-DC Rectifier units, for aircraft application where the fundamental requirements is high reliability, compact size and lightweight, are met by careful design and optimum selection of components. Our power supplies are rugged efficient and reliable.

These units offer unity input power factor. These units find application in RADAR, PULSED POWER and other Electronics Warfare systems.



### Features:

- Unity input power factor
- Isolated / Non-Isolated output
- THD < 6%
- Forced air cooled
- Capable of handling pulsed loads
- Most suitable for Aircraft application
- Light weight
- Customised design
- Designed as per MIL STDS: 704F, 810.





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## High Voltage Power Supplies



Most of defense systems require reliable and compact high voltage power supplies.

**GROWCONTROLS** has developed. High voltage power supplies, using latest technology in Power Electronics. Resonant inverter topology, special multiple winding rectification scheme, completely encapsulated high voltage section ensures highly reliable power supplies in demanding defense environments



### Our HV Power supplies finds application in:

- TWT / Klystron Power Supplies
- Magnetron Power Supplies
- RADAR Power Supplies
- Electronic Warfare Systems
- Marx Generators
- Capacitor Charging Power Supplies
- LASER Power Supplies
- Plasma Power Supplies







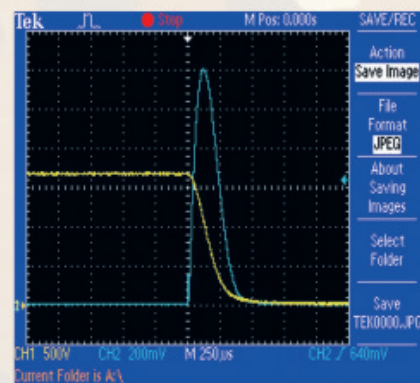
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## Laser Power Supplies

**GROWCONTROLS** has developed LASER Power Supplies. For flash lamp/ arc lamp based LASER systems and Diode LASERS. We have also developed Q-Switch drivers, TEC controllers and other subsystems for LASER application.

### Features:

- Solid-State design
- PFN networks for Discharge lamps
- Diode laser DC Power supplies
- Q-Switch driver
- TEC controller
- Computer interface & control



TECHNOLOGY DEVELOPMENT



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## High Voltage Switches



Modern Electronic warfare systems require pulsed power. Generation of High voltage, high current pulses in demanding environment requires highly reliable switching elements.

**GROWCONTROLS** has developed High power switches with Thyristors, IGBTs, MOSFETS, thyatrons, Psuedospark-gaps, triggered spark-gaps, and Rail-gaps, to match specific requirement.

Specially designed trigger sources are developed for specific components.

### Features:

- Fast switching.
- Mill-watt to Giga-watt Power output.
- Wide range component selection for system specific requirement.
- Customised design for specific application.
- Optical fiber or current loop isolation.

### Applications:

- Magnetron Modulators
- RADAR Power Systems
- Klystron / TWT Modulators
- LASER Power supplies
- Electronic Warfare
- Marx generators
- Magnetic Pulse Compression





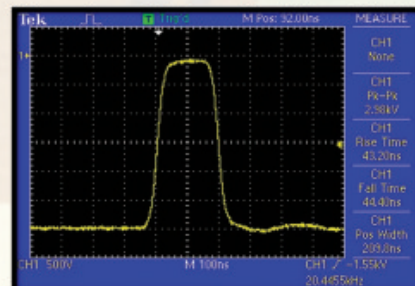
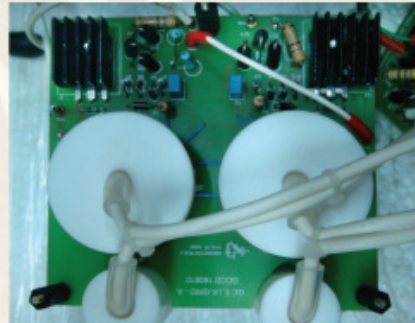


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### Floating Deck Modulator

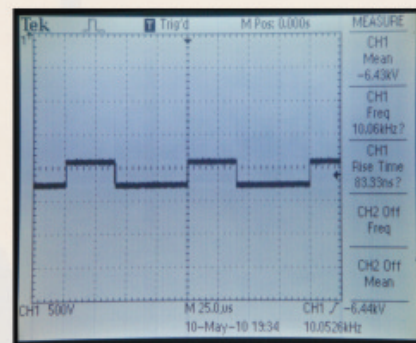
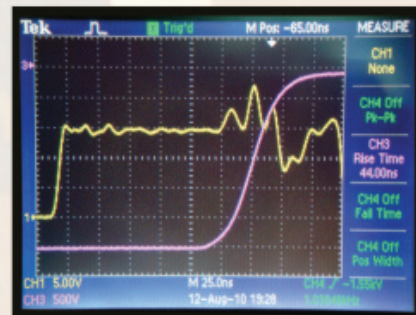
RADAR, Electronics Warfare systems require floating deck modulators, these modulators float at very high voltages. The challenge is to modulate these voltages with logic level signals from control system, and the through put delay, rise and fall times of modulating voltage should be very minimum.

**GROWCONTROLS** has developed, optically coupled/ current loop coupled floating deck modulators, with minimum through put delay and modulating pulse frequencies >300KHz.



### Features:

- Optically / current loop isolated
- Solid state switches
- Floating voltages > 100 KV
- Through put delay < 50 nSec
- Rise time < 40 nSec.





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## Magnetics

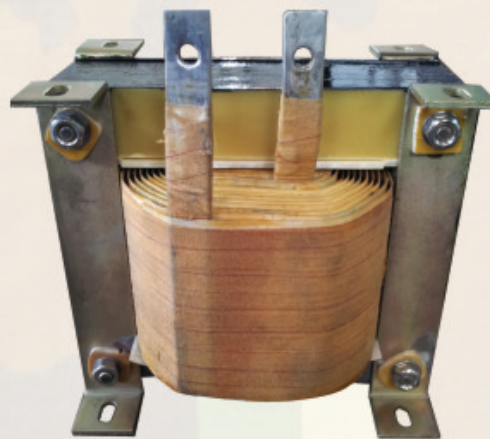
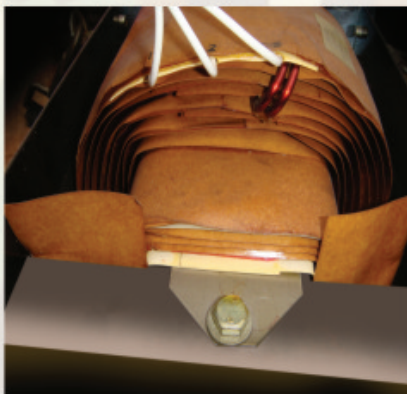


**GROWCONTROLS** is capable of developing customised special purpose magnetic components for specific applications.

We can develop transformers, Inductors and magnetic switches etc.

### Our expertise is in development of:

- Mains frequency transformers
- High frequency transformers
- Inductors
- Pulse forming networks
- Magnetic switches
- Partial turn high voltage pulse transformers
- Special purpose magnetic components



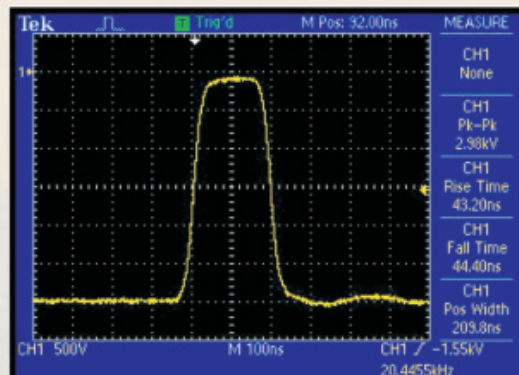


## EIK Power Supply, Modulator & Control Unit

**GROWCONTROLS** has successfully developed high-voltage power supply. Floating deck modulator, and control unit for GRID MODULATED EXTENDED INTERACTION KLYSTRON. The system is having complete operating and protection features suitable for EIK. This system consists manual control panel as well PC interface with LAN connectivity.

### Technical Specifications :

Heater Voltage	: 6.3V@1.1 Amps.
Cathode Voltage	: -16 KV adjustable.
Collector Voltage	: -4.9 KV.
Grid bias	: -3 KV.
Grid Modulation	: MOSFET based Floating Deck Modulator, rise and fall times < 50 nS.
Pulse width	: 200 nS CW
PRF	: Up to 40 KHz
Duty Cycle	: 5%





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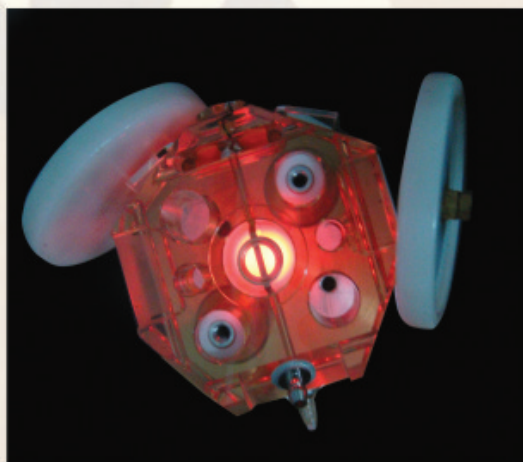
## Technology Development & Contract Research



**GROWCONTROLS** is having technical expertise, Manpower Resources and Facilities to undertake customised Research and Developmental Activities for customer Specific Requirements in Defense Power Electronics field.

With our experience and facilities we have, we can develop front end technological solutions for mission critical applications.

We have proven track record of Developing Innovating Power Electronics Solutions for Defense Sector for last Twenty Years.





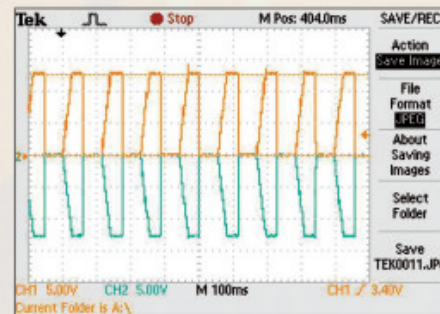
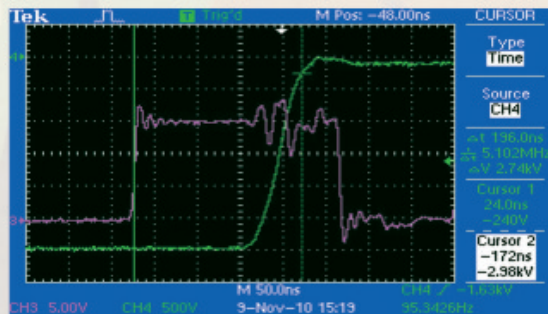
## Pulsed Power Systems

Electronic Warfare Systems, Scientific research and Industrial applications have requirements for pulsed power of milli-watt to Giga-Watt range.

Having expertise in Power Electronics **GROWCONTROLS** is developing Pulsed Power systems consisting of Capacitor Charging Power Supply, Capacitor bank, High Voltage-high current switches, trigger units etc.

### Features:

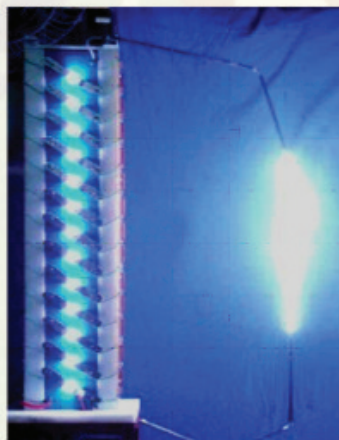
- Solid state current sources capacitor charging power supply.
- Pulse capacitor banks
- Rail-gap, spark-gap, thyatron, Psuedospark switch, solid state switches are used as per system requirement.
- Customer specific design.





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## Marx Generators



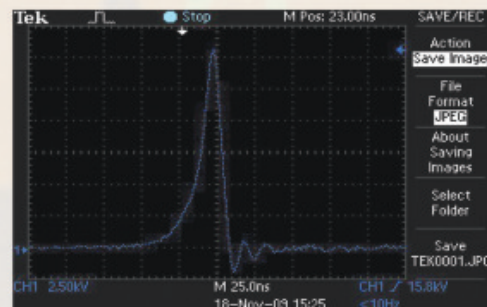
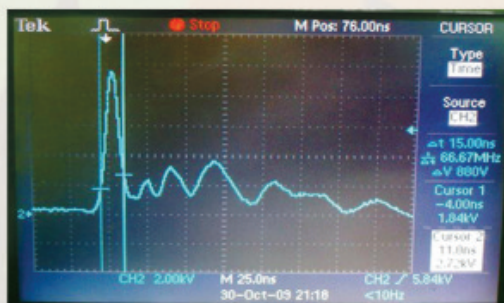
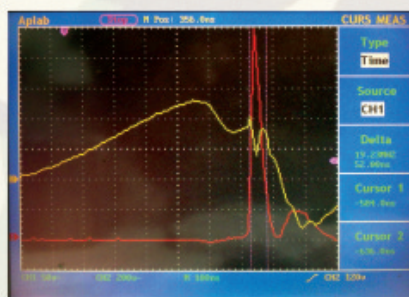
Electronics Warfare systems require fast rising high voltage pulses of very high amplitude, and high power. To meet this requirement. **GROWCONTROLS** has developed Marx generators, using different topologies as per system requirements.

We have developed triggered spark-gap based marx- generators. Solid state switch based marx- generators & induction adder systems.

## Applications :

- Electro-magnetic Pulse (EMP) Systems
- Electronic Warfare
- Plasma applications
- Q-Switch

TECHNOLOGY DEVELOPMENT





## Repair services and Indigenisation of Defense Power supplies

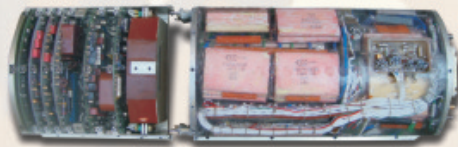
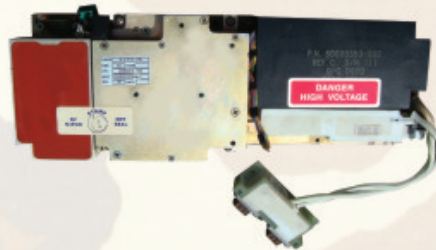
With core competency in Power Electronics and expertise in developing defense power equipment over twenty years, **GROWCONTROLS** is offering repair/ indigenisation services for defense systems. We have successfully indigenized foreign RADAR power supplies and modulators, TWT power supplies and modulators, DC Power Supplies, Laser Drivers for Electronic Warfare, Airborne ECM systems.

### Capabilities:

- Technology up-gradation
- Replacement of absolute components
- Indigenisation of foreign equipment
- Reverse engineering
- Repairing existing systems

### Areas of operations:

- RADAR Systems
- Fire control
- Electronic Warfare Systems
- DC Power Supplies
- LASER Systems
- Magnetics
- Thermal Management, etc.





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## Capacitor Charging Power Supplies



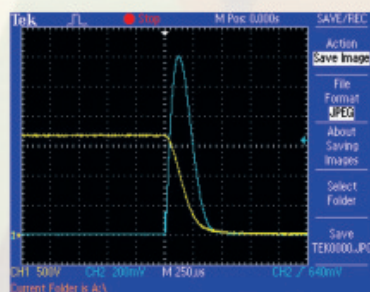
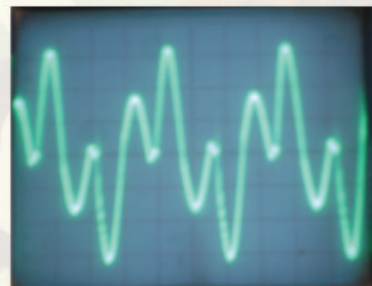
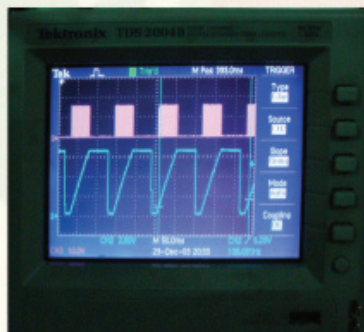
Pulsed Power is the basic requirement of Electronic Warfare systems. **GROWCONTROLS** has developed resonant current source output power supplies suitable for capacitor charging applications.

### Features:

- Resonant inverter topology
- Constant Current output
- Output power can be extended to MW range
- Capacitor charging voltage can be > 100KV
- Programmable charging current/voltage
- Systems can be interfaced to PC/PLC
- Optical fiber interface

### Applications:

- Railgun system
- Electronic Warfare
- UWB
- LASER
- RADAR
- Magnetic pulse forming
- PLASMA





## Thermal Management Systems / Heat Pipes

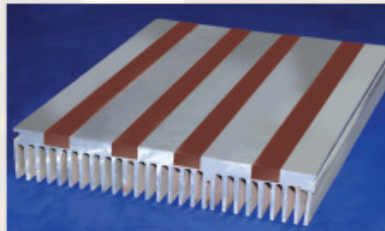
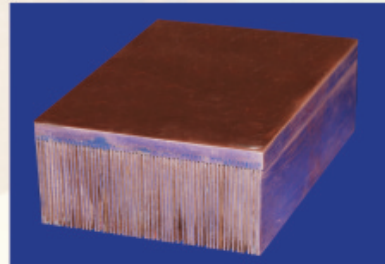
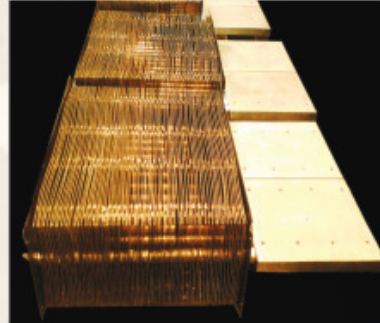
**GROWCONTROLS** is involved in development of thermal management solutions for Defense power supplies, RADAR systems, Microwave Antenna couplers, phased array antennas and other Electronic War Fare power supplies and systems. We have developed heat pipe based heat sinks and thermal dissipators for various applications.

**GROWCONTROLS** has indigenously developed Heat-pipes which are made up of copper tube having a wick material on its inner surface. This Tube is evacuated and filled with phase change medium. These Heat-pipes come in various shapes and sizes to suit the applications.

Whenever one end of the heat pipe is heated, the phase change material evaporates and reaches the cooling end, which is at the lower temperature. Here this vapours transfer the heat to the chamber walls and condenses to liquid droplets. This liquid rushes back to hot zone region by wick capillary action. This process repeats at supersonic speeds. The temperature between hot and cold zones is almost equal.

### Heat Pipe Thermal Cycle :

- Working fluid evaporates by absorbing thermal energy.
- Vapor migrates along the cavity to lower temperature.
- Vapor condenses back to fluid and is absorbed by the wick, releasing thermal energy.
- Working fluid flows back to high temperature end by wicking action.





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### Rail Gun Systems

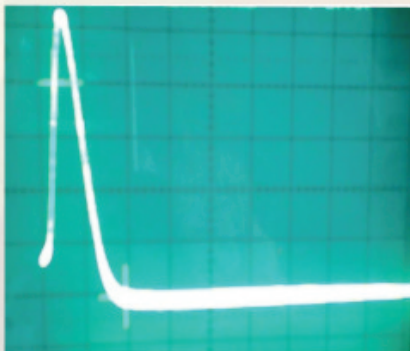


**GROWCONTROLS** having expertise in pulsed Power, Offers to develop Electro Magnetic Rail gun systems. We offer complete system solution including capacitor charging power supply. Capacitor Banks, Discharge Switches trigger systems as per customer requirements.



#### Features :

- Complete Pulsed power System
- Lab models for Defense Research Labs
- Energy Levels Reaching MJ





## High Power Pulse Modulators

**GROWCONTROLS** has developed Solid-State High Power Modulators for Magnetrons and other High power MICROWAVE Devices.

This modulator uses IGBTs and partial turn induction adder to generate High Power & High Voltage Pulses Suitable for High power Microwave devices.

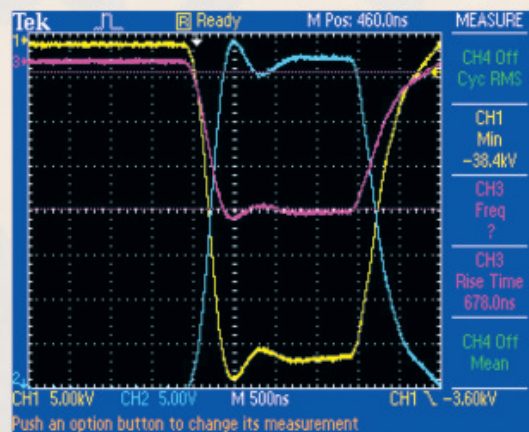
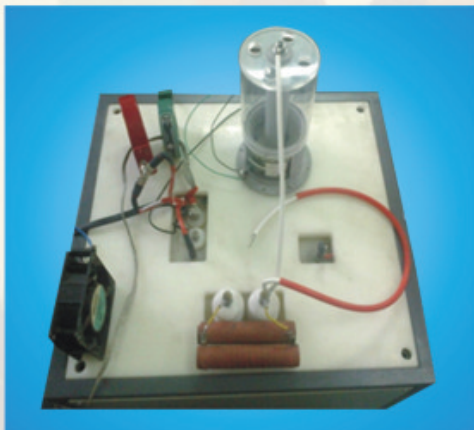


### Features :

- Completely Solid-State
- Latest IGBT / MOSFET Technology
- MW level Peak Power
- Faster Pulse rise time

### Applications :

- RADAR
- Electronic Warfare
- Defense
- Medical
- Research





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### Magnetic Pulse Forming System



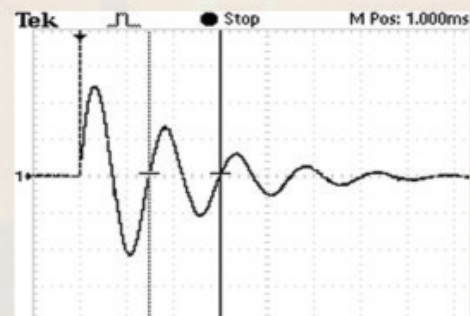
Magnetic pulse forming / welding is a cold welding process finds application in defense Ammunition manufacturing process.

**GROWCONTROLS** is having expertise in pulsed power field. We have developed magnetic pulse forming system for Crimping of stabilizing rings to Ammunition shell bodies and other application.



#### Features :

- Resonant inverter based capacitor charging power supply.
- Solid State design
- Compact & reliable
- Solid State High Voltage / High Current switches.
- Customised design for specific job requirement.





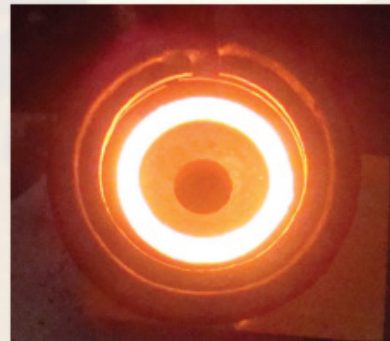
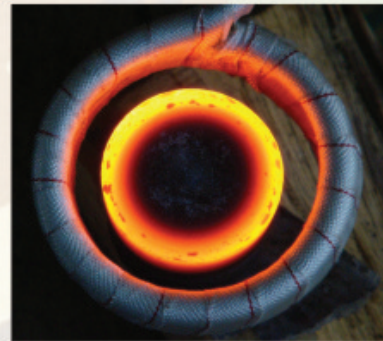
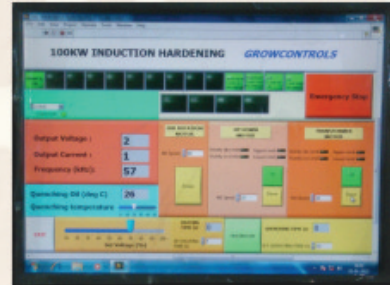
## Induction Hardening System

**GROWCONTROLS** having experience in Design & Development of Resonant Power Converters, has developed customised induction inverters for case hardening application of critical defense components.

Our system delivers consistent output power and repeatable accuracy to meet stringent requirements of defense components.

### Features :

- Solid state IGBT/MOSFET based design
- Resonant inverter controlled by PLL based feed back control ensures stable output power.
- Highly efficient and reliable system.







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### Cartridge case Induction Annealing System



**GROWCONTROLS** has developed complete reliable cartridge case annealing system. This system consists of component orientation hopper, component feeding system, and component conveyor.

Component conveyor feeds components to induction annealing coil. Components are rotated while passing through induction coil, to anneal cartridges uniformly.

System also consists of IGBT resonant inverter based induction inverter panel. This system delivers stable High Frequency heating power to induction coil.

PLC based supervisory control will ensure proper quality of components system in having temperature monitoring and data logging facilities.

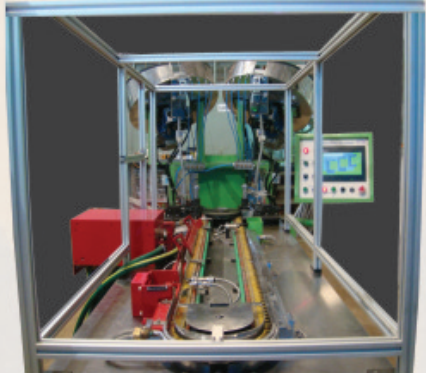
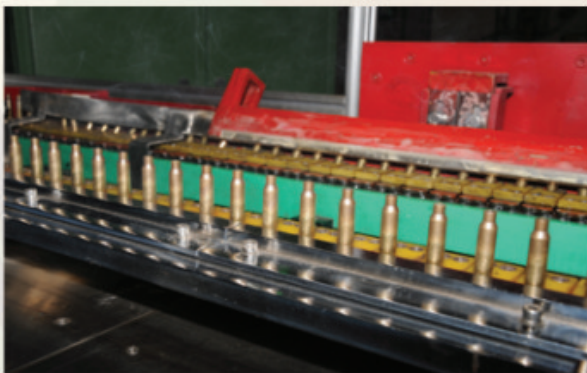
This system is capable of processing more than 15000 components per hour.





### Features :

- IGBT based resonant induction inverter
- Highly efficient & reliable
- Complete system consisting of component feeding hopper, component orientation mechanism and conveyor
- Rejection of unprocessed components
- Component counter
- Online temperature measurement
- Can be integrated with continuous production line
- Can be customised for different size components
- Can be customize for body annealing or tip annealing





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### Induction Brazing System



**GROWCONTROLS** has developed special purpose Induction Brazing Machine for production of brazed gun parts and subsystems.

IGBT based Resonant induction inverter delivers precise heating power to the location where subsystems are to be brazed. Semi automated system facilitate faster and accurate brazing of subsystems



#### Features :

- Solid State IGBT based design
- PLL based resonant inverter
- Highly reliable and efficient
- Feed back stabilized output power for repeatable production quality
- Semi automated system
- Customised for specific requirement.





## Load Banks

Alternators on Naval ships and Submarine batteries require frequent testing as per specification.

**GROWCONTROLS** has developed specially designed load banks capable of loading Alternators / Batteries to given specific loading condition.

Our customised load bank can be used for testing AC and DC power sources.

We have also developed special purpose load banks for testing Fuel Cells & Thermal batteries for mission critical applications.

These computerized precision loading systems are capable of loading power sources as per programmed profile.

Complete solid-state load bank can draw currents to the precise levels as programmed. Set load current can be realized in < milli second to test the systems for pulsed power applications.

Higher Power Versions are having grid interactive regeneration feature.

Which enable the power to be feed back to electric utility grid instead of wasting it in load elements.





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