



**NDTS India (P) Limited**  
619 & 620 The Great Eastern Galleria  
Plot No. 20, Sector 4, Nerul, Navi Mumbai - 400 706  
Tel. : + 91-22-6138 0600, 2770 3913, 2770 3923, 2772 9077  
Fax: +91-22-2770 3903, Email: info@ndts.co.in  
Website: www.ndts.co.in



## Instrumentation for High-Power Ultrasonic Applications

Rev. T-I-A10

© 2010 Innerspec Technologies, Inc.  
All Rights Reserved

This Material May Not Be Published, Rewritten,  
or Redistributed Without Express Permission

---

**Innerspec**Technologies

[www.innerspec.com](http://www.innerspec.com)

4004 Murray Place  
Lynchburg, VA 24501, USA  
Tel: +1-434.948.1301  
Fax: +1-434.948.1313



## Table of Contents

1. temate® PowerBox Instrumentation.....	3
1.1. temate® PowerBox 1, 2 & 8 Technical Specifications.....	4
1.2. temate® PowerBox Hardware Schematic .....	6
1.3. temate® PowerBox Software Specifications .....	7
1.4. Software Context Diagram:.....	8
1.5. RF Pulser Performance.....	9
1.5.1. 8KW RF Pulser.....	9
1.5.2. 20Kw RF Pulser.....	10
2. temate® Tone Burst Amplifiers.....	11
3. temate® Magnet Pulsers .....	13



Innerspec Technologies offers high-power ultrasonic equipment using patented technology. The **temate® PowerBox** line is a one-stop instrumentation solution with the most advanced hardware and software, while our **temate® TB Amplifiers** and software packages are designed to give researchers both state-of-the-art tools and flexibility to conduct experiments and design their own applications.

### 1. temate® PowerBox Instrumentation

The **temate® PowerBox** line is a collection of portable, high-power and high-speed instruments designed for the most energy-demanding and high-speed non-destructive testing. The **temate® PowerBox H, 1, 2 and 8** incorporate intelligent processors with integrated digitizers and broadband pulsers/receivers to perform a variety of flaw inspection, thickness, and material property measurements in factory or field environments. Spike and tone-burst pulses at frequencies from 50 kHz to 7MHz can be generated to excite a full range of ultrasonic wave modes, including guided waves, in pulse-echo and pitch-catch arrangements.

The **temate® PowerBox H** is the first hand-held, battery operated instrument capable of generating up to 1200V or 8kW of peak power at speeds of up to 100Hz. For pulse-echo operation, a built-in transmitter/receiver switch permits connecting directly to the instrument with no additional hardware. A built-in thermocouple port permits taking temperature readings to correct Time-Of-Flight measurements, and a one-axis encoder input can be used for integration with an automated or manual scanner. The instrument can be used with EMAT sensors from Innerspec Technologies or piezoelectric crystals and sensors from other manufacturers. A setting of 600Vpp (approx. 3kW) is also available to maximize battery life if the application does not require full power. Embedded software **PowerUT® H** permits the user to modify the triggering and receiving patterns, use advanced filters to enhance signal-to-noise and present the information on A, B, C and Line Scan formats. Screen captures, device settings and data can be downloaded to a PC using additional software provided with the instrument.

The **temate® PowerBox 1, 2 and 8** are designed for portability without sacrificing power or speed. These systems generate up to 2000Vpp or 20kW of peak power per channel at speeds of up to 2000Hz. Control is performed through an external PC over a PCMCIA or Ethernet connection. A built-in encoder, and 12 programmable Inputs/Outputs facilitate integration with a scanner and other external equipment. **PowerUT®** software is supplied for PC data logging, imaging and analysis. The **temate® PowerBox 1** also includes a built-in magnet-pulser that provides the ability to use electromagnetic probes used for scanning ferromagnetic materials without adhering to the surface, and generating unique wave modes.





1.1. temate® PowerBox H Technical Specifications

Specifications - temate® PowerBox H	
Part Number	245A0183
Ultrasonic Channels	1
Bandwidth	100kHz to 6MHz
Pulse Repetition Rate	100 Hz
RF Pulser	Spike, Toneburst Waveforms 8 kW Power Output 1200Vpp @ 25App into 50 Ohms 0.1% Maximum Duty
Receiver	<b>Pulse-Echo Mode</b> 1 kΩ Input Impedance 30 dB to 70 dB Gain <0.05 dB Gain Resolution <b>Pitch-Catch Mode</b> 50 Ω Input Impedance -20 dB to 60 dB Gain <0.1 dB Gain Resolution
P/R Modes	Pulse-Echo, Pitch-Catch
A/D Converters	12-bit, 100MHz
Filtering	FIR Digital Filters
Rectification	Full-wave, +/- half-wave, and RF mode
Evaluation Gates	Interface plus 2 Gates Amplitude and Time Measurements
Encoder Interface	A/B Quadrature
PC Communication	USB MiniAB Drag-n-drop
Software	<b>PowerUT® H</b> with A, B, C and Line Scans plus PC Interface Software
Probe Connector	Lemo 0B
Operating Temperature	0°C (32°F) to 40°C (105°F)
AC Power Input	100-240VAC, 50-60Hz
Other I/O	Magnet Pulser Trigger Thermocouple Input (Type K) General Purpose I/O (5V TTL) Encoder/Signal Cond. Power VGA output Ethernet 10/100 SD Card
Dimensions	8"W x 9"H x 4"T
	203mm x 229mm x 100mm
Weight	2.27Kgs (5lbs)
Battery Life	4-8 Hours





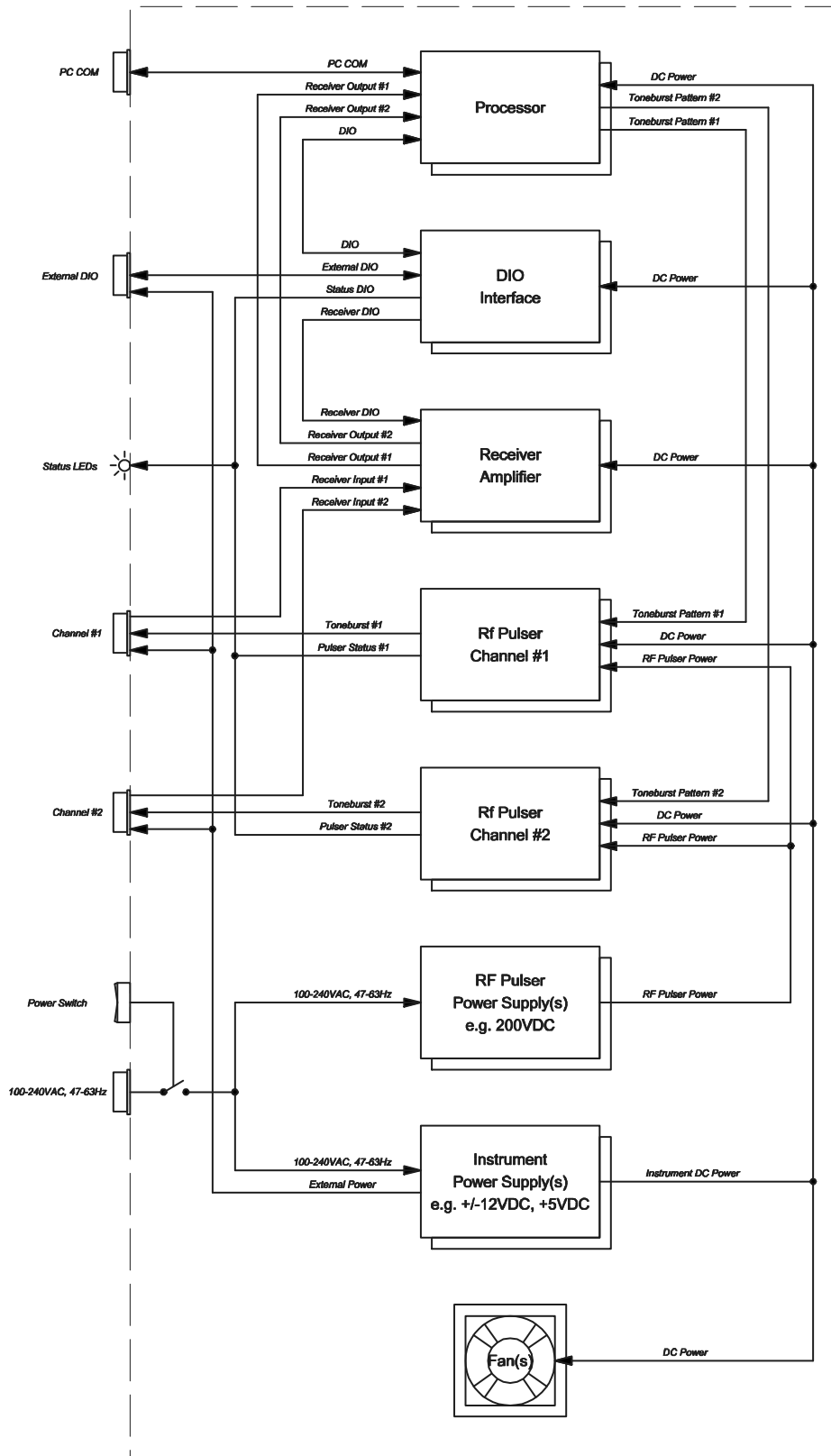
1.2. temate® PowerBox 1, 2 & 8 Technical Specifications

	temate® PowerBox 1	temate® PowerBox 2	temate® PowerBox 8
<b>Part Number</b>	245A0118	245A0101	245A0144
<b>Ultrasonic Channels</b>	1	2	8
<b>Bandwidth</b>	50 kHz to 7 MHz	50 kHz to 7 MHz	100 kHz to 7 MHz
<b>Pulse Repetition Frequency</b>	Up to 2kHz	Up to 2kHz	Up to 2kHz
<b>RF Pulser</b>	Spike, Toneburst Waveforms 8 kW Power Output 1200Vpp @ 25App into 50 Ohms 1% Maximum Duty	Spike, Toneburst Waveforms 8 kW Power Output per Channel 1200Vpp @ 25App into 50 Ohms 1% Max. Duty per Channel	Spike, Toneburst Waveforms 2.5 kW to 20 kW Power Output per Channel 200Vpp to 2000Vpp @ 40App into 50 Ohms 1% Max. Duty per Channel
<b>Magnet Pulser</b>	45A Peak Current 9 kW Peak Power 1% Maximum Duty	NA	NA
<b>Receivers</b>	50 Ω Input Impedance -20 dB to 60 dB Gain 0.3 dB Gain Resolution 8 Low Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz) 8 High Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz)	50 Ω Input Impedance -20 dB to 60 dB Gain 0.3 dB Gain Resolution 8 Low Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz) 8 High Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz)	50 Ω Input Impedance -20 dB to 60 dB Gain 0.3 dB Gain Resolution 8 Low Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz) 8 High Pass RF Filters; (Off, .1, .2, .5, 1, 2, 5, 10 MHz)
<b>P/R Modes</b>	Pulse-Echo, Pitch-Catch	Pulse-Echo, Pitch-Catch	Pulse-Echo, Pitch-Catch
<b>A/D Converters</b>	14-bit, 100MHz	14-bit, 100MHz	14-bit, 100MHz
<b>Filtering</b>	IIR/FIR Digital Filters	IIR/FIR Digital Filters	IIR/FIR Digital Filters
<b>Rectification</b>	Full-wave, +/- half-wave, and RF mode	Full-wave, +/- half-wave, and RF mode	Full-wave, +/- half-wave, and RF mode
<b>Evaluation Gates</b>	4 Gates per Channel Amplitude and Time Measurements	4 Gates per Channel Amplitude and Time Measurements	4 Gates per Channel Amplitude and Time Measurements
<b>Encoder Interface</b>	A/B Quadrature or Clock/Direction	A/B Quadrature or Clock/Direction	A/B Quadrature or Clock/Direction
<b>Alarms &amp; Auxiliary I/O</b>	12 User Programmable TTL I/O	12 User Programmable TTL I/O	12 User Programmable TTL I/O
<b>PC Communication</b>	PCMCIA Interface Records to any MS Windows Device	PCMCIA Interface Records to any MS Windows Device	Ethernet Interface Records to any MS Windows Device
<b>PC Software</b>	<b>PowerUT®</b> Imaging and Analysis Software	<b>PowerUT®</b> Imaging and Analysis Software	<b>PowerUT®</b> Imaging and Analysis Software
<b>Operating Temperature</b>	32°F (0°C) to 105°F (40°C)	32°F (0°C) to 105°F (40°C)	32°F (0°C) to 105°F (40°C)
<b>Electrical Power Input</b>	100-240VAC, 47-63Hz	100-240VAC, 47-63Hz	100-240VAC, 47-63Hz
<b>Dimensions</b>	12.750" x 13.250" x 9.250"	12.750" x 13.250" x 9.250"	12" x 18" x 9.250"
	324mm x 336mm x 235mm	324mm x 336mm x 235mm	305mm x 457mm x 235mm



### 1.3. temate® PowerBox Hardware Schematic

(Example for temate® PowerBox 2)





### 1.4. temate® PowerBox Software Specifications

Innerspec Technologies offers different Software Packages for laboratory use and a complete suite designed for the unique requirements of EMAT testing.

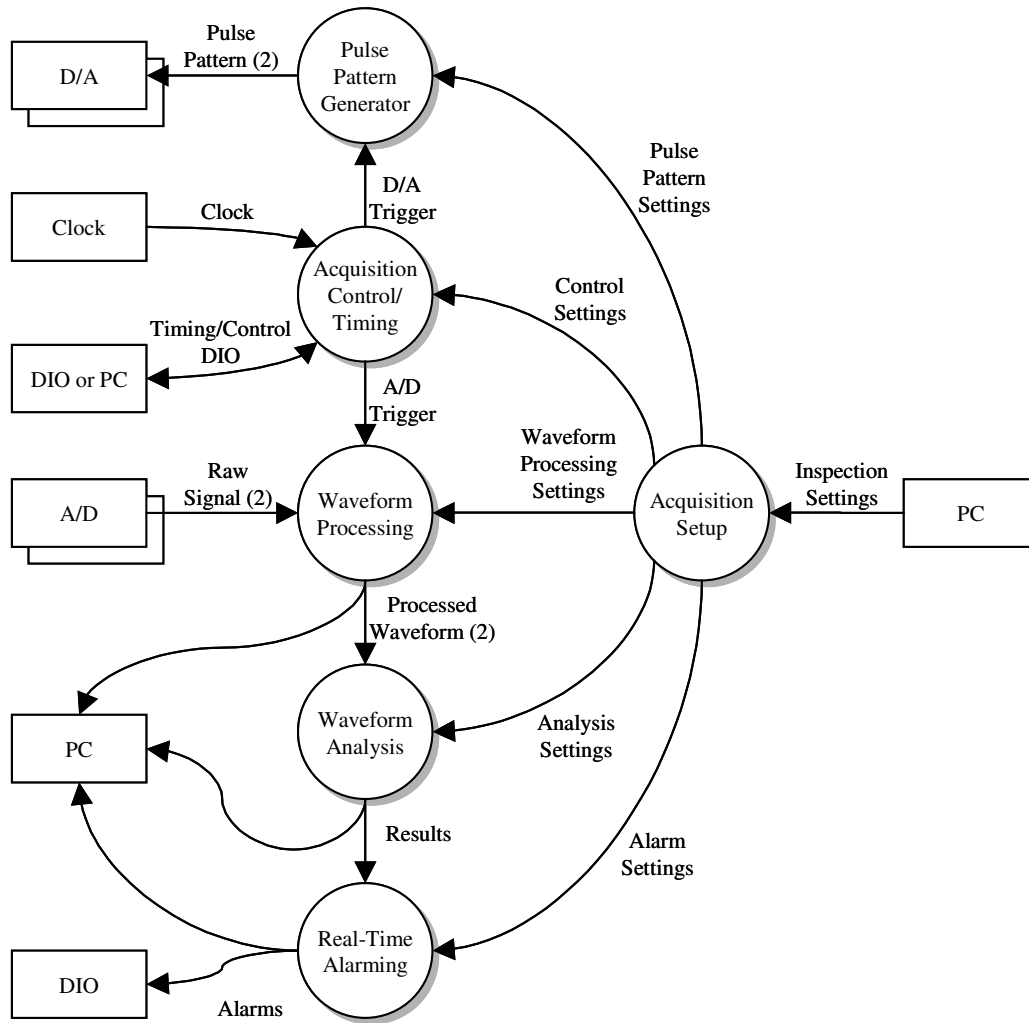
- **PowerUT®**. Designed specifically for EMAT testing. It controls the **temate® PowerBox 1, 2 and 8**, and provide a complete suite of analysis and presentation features to perform the most complex inspections and measurements in automated and manual environments.
- **PowerUT® Lab**. Developed with the researcher in mind for any type of technique (air-coupled, high-power PZT), **PowerUT® Lab** integrates all the basic control features for the **temate® PowerBox 1, 2 and 8** with an open architecture that researchers can use to export data and perform analyses using their own software tools.

The following is a list of features included with PowerUT® and PowerUT® Lab.

Features	PowerUT®	PowerUT® Lab
MS Windows XP Interface	Yes	Yes
A-Scan	Yes	Yes
Transmitter and Receiver Timing Capabilities for RF and Magnet Pulser	Yes	Yes
Real-Time Waveform Export	Yes	Yes
IIR/FIR Band-Pass Filter Controls	Yes	Yes
Built-In Advanced Software Filters and Data Analysis Algorithms	Yes	No
Waveform Analysis Module with Gated Peak Detection, Time-Of-Flight Measurements, B, C Scans and Strip Charts and Real-Time Alarming to PC and DIO	Yes	No
Built-In Communication Tools (I/O, RS-232, TCPIP, Ethernet, X-Y Encoder)	Yes	Limited
External Trigger for Automatic Operation	Yes	No

1.5. Software Context Diagram:

- Acquisition Setup module receives and manages inspection setup parameters from either internal memory or via PC link
- Acquisition Control/Timing module controls DIO settings and triggers pulsing and digitization upon DIO, PC control, or internal clock based on settings (counter/divide to interpret DIO encoder input)
- Pulse Pattern Generator module, upon trigger, outputs a pre-defined pulse pattern via D/A
- Waveform Acquisition module, upon trigger, receives ultrasonic signal via A/D, applies IIR/FIR digital filters to waveforms and real-time algorithms (only with **PowerUT<sup>®</sup>**), and sends to PC and based on settings



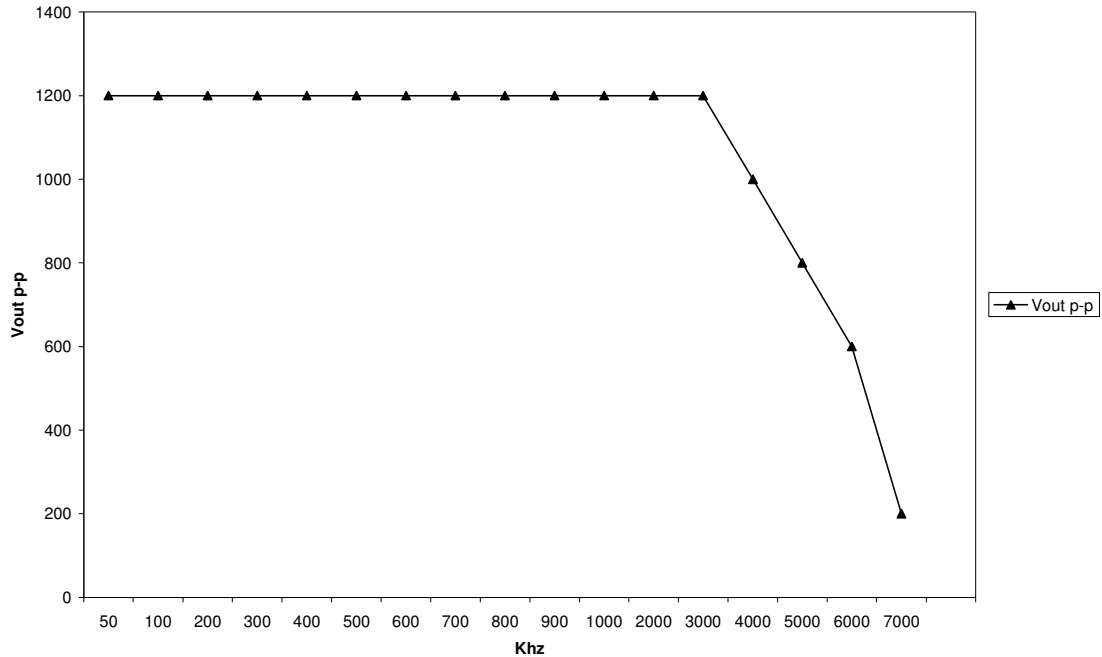


### 1.6. RF Pulser Performance

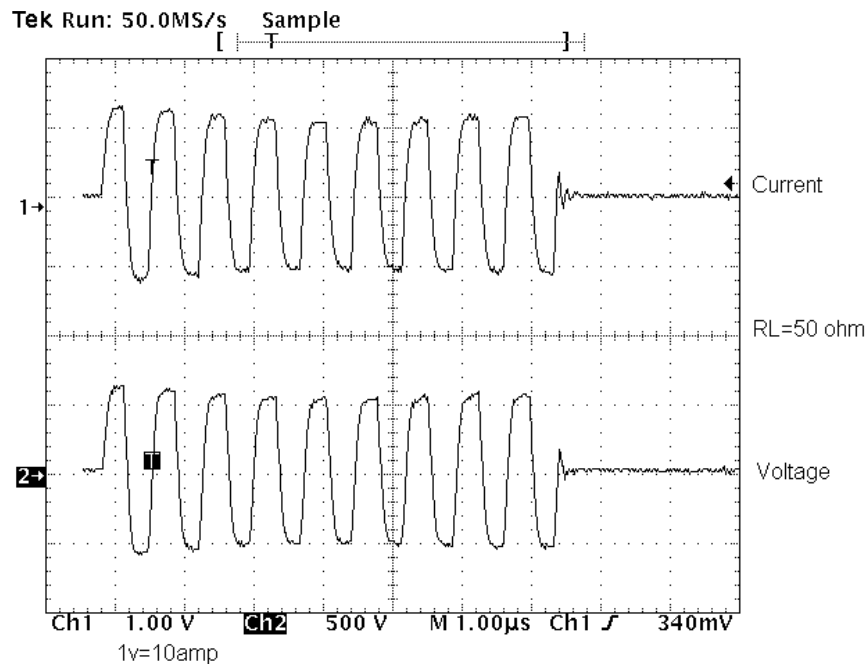
The **temate**<sup>®</sup> **PowerBox** and the **temate**<sup>®</sup> TB Amplifiers include high-power RF pulsers for ultrasonic EMAT non-destructive testing. The typical power curves are from 50Khz to 7mhz into a 50 ohm load. Custom versions for higher frequencies can be developed upon request. Contact Innerspec Technologies for details.

#### 1.5.1. 8KW RF Pulser

Output power Vs Frequency



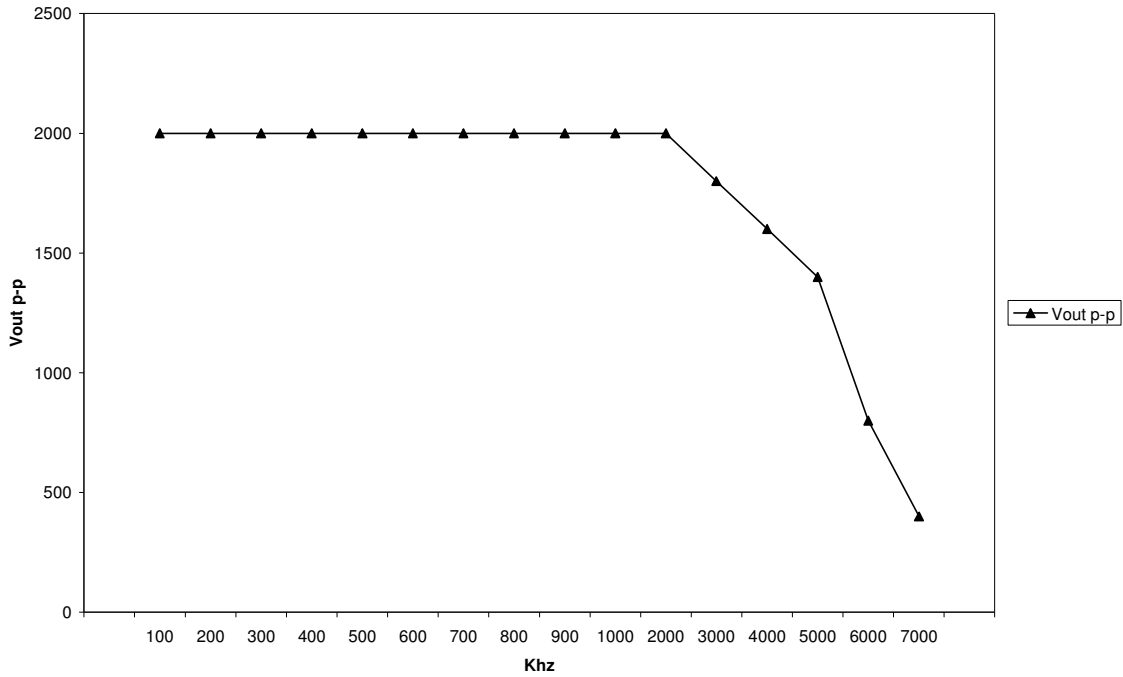
Typical output currents and voltages 8Kw RF pulser at 1.5Mhz



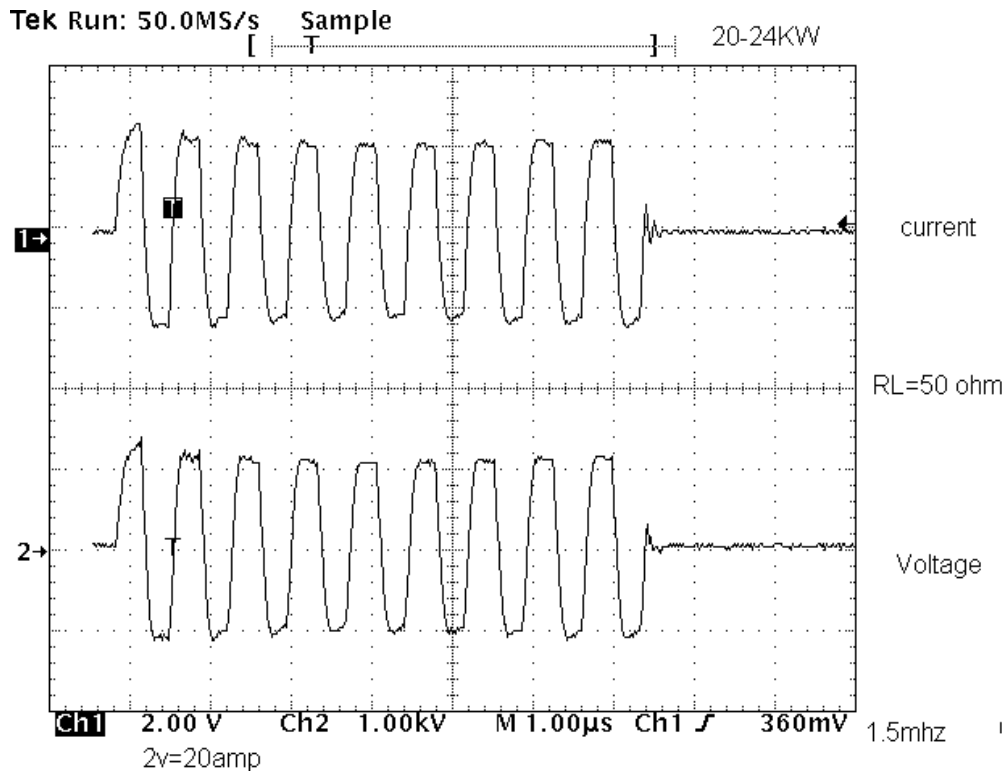


1.5.2. 20Kw RF Pulser

Output power Vs Frequency



Typical output currents and voltages 20Kw RF pulser at 1.5Mhz.





2. temate® Tone Burst Amplifiers

The temate® Tone Burst Amplifiers take low-voltage signals and convert them into high-power pulse trains for the most power-demanding applications. Our temate® TB Amplifiers come standard in 1, 2 and 24 channel configurations and are designed to be used in standard rack-mount configurations to facilitate integration. Check 1.6. in this document for performance charts.

	1 Channel Standard	2 Channel Standard	1 Channel HP Programmable	2 Channel HP Programmable
Part Number	245A0096	245A0088	245A0139	245A0140
Output Power Peak	8kW	8kW+8kW	2.5kW-20kW	2x 2.5kW-20kW
Max. Duty cycle	1% per Channel			
Maximum PRF	2000 Hz			
Output Power Average	80W per Channel		200W per Channel	
Voltage peak to peak	1200V		400V-2000V	
Input signal	2V p-p sine, triangular and square with dead time		5V p-p TTLx2*	
Signal In	1 BNC	2 BNC	2 SMB	4 SMB
Signal Out	1 Triax	2 Triax	1 BNC	2 BNC
Enable Signal	2 Pin Terminal Strip			
Monitor (O-Scope) connector	1 BNC	2 BNC	1 BNC	2 BNC
Frequency range	0.075MHz to 5MHz		0.100MHz to 5 MHz	
Airflow requirement	38cfm/1.08cmm	46 cfm/1.30cmm	46 cfm/1.30cmm	54 cfm/1.53cmm
Indicators	Power on, Voltage out, Fuse and Thermal indicator			
Temperature	32°F (0°C) to 105°F (40°C)			
Humidity	95% non condensing Humidity			
Protection	Thermal, fuse (including open circuit operation)			
Electric Power Input	90/253 VAC 50/60 Hertz			
Dimensions	6.875" L x 12.875" W x 1.640" H (1U Standard Rack-Mount)			
	429mm L x 327mm W x 44mm H (1U Standard Rack-Mount)			
Weight	7.5 lbs (3.4 kg)	8.5 lbs (3.9 kg)	9.5 lbs (4.3 kg)	10.5 lbs (4.8 kg)

\* Optional External Synchronization Module available to connect TB Amplifier to conventional Function Generators

1 and 2 Channel temate® Tone-Burst Amplifiers





	24 Channel Standard	24 Channel High-Power
Part Number	245A0110	245A0137
Output Power Peak	8kW per Channel	20kW per Channel
Max. Duty Cycle	1% per Channel	
Maximum PRF	2000 Hz	
Output Power Average	80W per Ch.	200W per Ch.
Voltage peak to peak	1200V	2000V
Input Signal	2V p-p sine, triangular and square with dead time	5V p-p TTLx2
Signal In	24 SMB	
Signal Out	24 BNC	
Enable Signal	2 Pin Terminal Strip	
Monitor (O-Scope) connector	1 BNC	
Frequency range	0.075MHz to 5MHz	0.100MHz to 5 MHz
Airflow requirement	162cfm/4.60cmm	
Indicators	Power on, Voltage out, Fuse and Thermal indicator	
Indicators	Power on, Voltage out, Fuse and Thermal indicator	
Temperature	32°F (0°C) to 105°F (40°C)	
Humidity	95% non condensing Humidity	
Protection	Thermal, fuse (including open circuit operation)	
Electric Power Input	200VDC Current: 9000 x 24 x Duty Cycle)/200	400VDC Current: 21000 x 24 x Duty Cycle)/400
Dimensions	22" L x 12.875" W x 6.560" H (4U Standard Rack-Mount)	
	559mm L x 327mm W x 167mm H (4U Standard Rack-Mount)	
Weight	45 lbs (20.4 Kgs)	

24 Channel temate® Tone-Burst Amplifier





2.1. temate® HP Pulser

The temate® HP Pulser is a 2U Rackmount instrument that combines a digitally controlled tone burst pattern generator with our 2-channel high-power programmable tone burst amplifier.

	2 Channel Low Frequency	2 Channel High Frequency
Part Number	245A0178	245A0179
Digital Controller Features	<ul style="list-style-type: none"> <li>• LCD Display with Keypad to Select Frequency, Number of Cycles, Delays and Other Configuration Settings</li> <li>• Memory to Save, Recall Configuration Settings</li> <li>• Internal or External Trigger Mode</li> <li>• External 5VDC Trigger Input with Configurable Divider (e.g. Encoder Trigger)</li> <li>• External Trigger Output for Electromagnet Pulser Control</li> <li>• Synchronized 5VDC Output</li> </ul>	
Frequency range*	0.100MHz to 5 MHz	1MHz to 20 MHz
Output Power Peak	2 Channels x 2.5kW-20kW @50 Ohms	
Max. Duty cycle	1% per Channel	
Maximum PRF	2000 Hz	
Output Power Average	200W per Channel (Maximum Power)	
Voltage peak to peak	400V-2000V	
High Power Signal Out	2 BNC	
Monitor (O-Scope) connector	2 BNC	
Indicators	Power on, Voltage out, Fuse and Thermal indicator	
Temperature	32°F (0°C) to 105°F (40°C)	
Humidity	95% non condensing Humidity	
Protection	Thermal, fuse (including open circuit operation)	
Electric Power Input	90/253 VAC 50/60 Hertz	
Dimensions	6.875" L x 12.875" W x 3.5" H (2U Standard Rack-Mount)	
	429mm L x 327mm W x 89mm H (2U Standard Rack-Mount)	
Weight	15 lbs (7 kg)	

\* Standard Frequency Configurations. Other options available upon requests.



### 3. temate® Magnet Pulsers

Magnet Pulsers permit rapid pulsing of electro-magnetic probes used for EMAT applications. These short-duration magnetic fields have some advantages over those generated with permanent magnets. Namely:

- Permit scanning of ferrous parts without adhering to the part
- Increase signal-to-noise ratio in some applications
- Permit generation of strong tangential fields

Innerspec offers Magnet Pulser as stand alone (**temate® PowerBox MP**) and rack-mount configurations for in-line integration.

	temate® PowerBox MP	Rack-Mount MP	Rack-Mount MPHP
Part Number	245A0105	245A0087	245A0099
Output Power Peak	12kW into 550µH – 2mH		15kW into 550µH – 2mH
Peak Current Intermittent	150A, 1ms Max, Current and Thermally Limited		
Peak Current Repetitive 100A	0.5 Hours On, 10 Minutes Off		0.5 Hours On, 15 Minutes Off
Peak Current Repetitive 75A	Continuous		
Duty Cycle 100Hz	Time On: 2.35ms Max, Time Off: 1.35ms Min		
Input Signal	TTL up to 400Hz		
Input Voltage	150VDC @ 4App, 0.6kW	300VDC @ 5App, 1.5kW	300VDC @ 10App, 3kW
RMS Current	54A Max		
Current Shape	$v(t) = L di(t)/ dt$ for charge $I = E/R(1 - e^{-t/L})$ discharge		
Monitor (O-Scope) connector	None	25 amp = 1 volt	
Airflow requirement	60 cfm		
Indicators	Power on, Volts in, Amps in, Ground Fault	Power on, Over current, IGBT Sat, Over Temp, Ground Fault	
Temperature	32 °F (0 °C) to 105 °F (40 °C)		
Humidity	95% non condensing Humidity		
Protection	Thermal, fuse (including open circuit operation)		
Electric Power Input	100/240 VAC 50/60 Hertz		
Dimensions	12.750" x 13.250" x 9.250"	19" x 3.5" x 13" (2U)	
	324mm x 336mm x 235mm	485mm x 330mm x 89mm (2U)	
Weight	17 lbs (8 kg)	15 lbs (8 kg)	

temate® PowerBox MP

