



PowerMod Technology Breakthrough Brings High Availability to High Power Electronics

# PowerMod™

## Pilot-Plant Pulsed Electric Field (PEF) Processing System

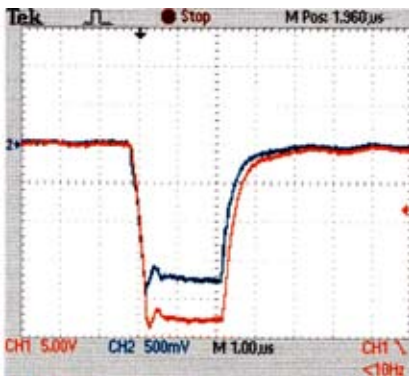


25 kW PEF treatment system. The enclosure containing the PEF treatment chamber is shown on the left. The tall cabinet contains the pulse modulator, controls, and high voltage power supply.

Pulsed Electric Field (PEF) processing passes liquid foods or other pumpable products through a treatment chamber, where the product is subjected to short (1  $\mu$ s – 20  $\mu$ s) pulses of very high voltage. The high voltage field created across the liquid (approximately 35-50 kV/cm) kills microorganisms via electroporation, the rupturing of the organism's cell membrane. Typically, multiple treatment chambers apply pulses to a stream of fluid, achieving kill ratios of 5-9 log, similar to those of pasteurization. Experiments have demonstrated that the shelf life of PEF processed food is comparable to that of pasteurization, with no adverse impact on the taste or nutritional value of the food. The same system, operating at lower electric field strength, can be used to make plant and meat tissues permeable to support extraction, drying, and other processes.

DTI's Pilot-Plant Scale PEF system is designed to support laboratory requirements, such as PEF process development, and low flow rate commercial processing. In process development, precise control of critical parameters is required to accurately represent the desired PEF treatment conditions, supporting accurate scale-up to larger PEF systems and flow rates. This system also provides an ideal platform for low throughput processing of critical food products and ingredients.

The 25 kW PEF processing system shown to the left can process 100 - 600 liters/hr (up to 2.5 GPM) at its peak flow rate. Electrical specifications are shown in the nearby table. The specific flow rates which can be treated with this Pilot Plant PEF system depend on both



A 2.5  $\mu$ s, 20 kV PEF processing system pulse into orange juice. The fast risetime and pulse flattop ensure optimal PEF treatment.

| PEF System Specifications    |  |
|------------------------------|--|
| <b>Input Power Source</b>    | 480VAC ( $\pm$ 10), 50A, 3 Phase, 5 wire, 60 Hz<br>120VAC, 20A, 1 Phase, 3 wire, 60 Hz |
| <b>Average Output Power</b>  | 25 kW maximum  |
| <b>Output Voltage</b>        | 25 kV maximum  |
| <b>Output Pulse Current</b>  | 300 A maximum  |
| <b>Polarity</b>              | Mono-polar, negative with respect to ground  |
| <b>Rise/Fall Time</b>        | ~ 1 $\mu$ s into resistive load  |
| <b>Pulse Width</b>           | 1 $\mu$ s – 10 $\mu$ s   |
| <b>Pulse Repetition</b>      | 3 kHz maximum  |
| <b>Operating Temperature</b> | 13°C to 27°C, relative humidity 80% non-condensing                                     |
| <b>Cooling</b>               | Tap water (4 GPM) and Forced Air   |
| <b>Size (rack only)</b>      | Approx. 28" x 36" x 72"  |
| <b>Weight</b>                | Approx. 2000 lbs.  |



the electrical conductivity of the fluid, and the specific treatment conditions desired. DTI can assist in the initial assessment of both of these parameters for your application.

DTI's PEF processing systems consist of three major subsystems. A DTI switching DC power supply transitions the AC power available from the utility into high voltage, DC power. A PowerMod high voltage pulse modulator, then transforms this power supply output into short, high peak power pulses. DTI's pilot plant system integrates the power supply and pulse modulator into a single 24" rack, with full solid state precision and reliability. Since this system is a 'hard switch', it does not need a pulse transformer. This provides nearly ideal, square pulses across a wide range of products, without the need for impedance matching or external system tuning.

The modulated high voltage pulses are applied to the food stream using two treatment assemblies mounted inside a treatment enclosure, as shown in the accompanying photograph. The food stream travels through the assemblies from top to bottom, receiving pulses as it passes the assembly's electrodes. Each of the assemblies has two treatment zones to insure complete processing.

These parameters shown in the table represent a typical food processing configuration. Treatment chambers can be adapted a range of fluids and process conditions.

| Treatment Chamber Specifications (Nominal)  |                             |
|---|-----------------------------|
| <b>Geometry</b>                             | Co-field flow chamber       |
| <b>Dual Treatment Chambers</b>              | 2 pairs (4 treatment zones) |
| <b>Gap Distance</b>                         | 0.8 cm                      |
| <b>Electrode Diameter</b>                   | 0.6 cm                      |
| <b>Conductivity (fluid being processed)</b> | 0.8 ~ 5.0 ms / cm           |
| <b>Electric Field Strength</b>              | 40 kV / cm maximum          |
| <b>Flow Rate</b>                            | 600 l/hr (2.5 GPM) maximum  |



The PEF treatment enclosure contains two, separate dual-chamber PEF treatment assemblies. The chambers are manufactured under an exclusive license from The Ohio State University Research Foundation.

DTI's Pilot-Plant PEF Processing system represents an optimized approach to PEF processing research, process development, and small-scale commercial installations. Please contact us for more information and an initial assessment of your requirements.

