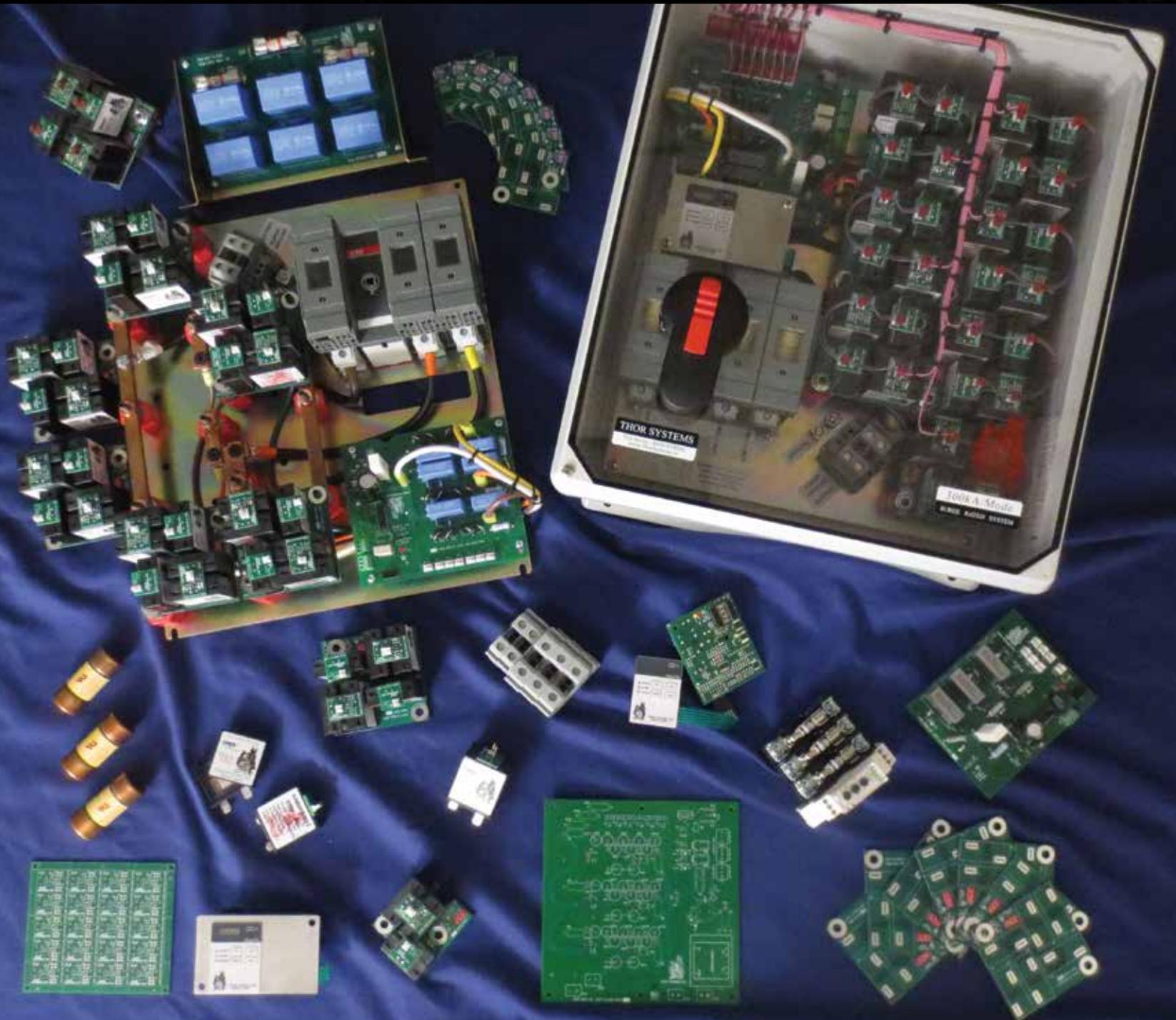




THOR SYSTEMS SURGE PROTECTION





The Company

THOR SYSTEMS is built on a foundation of the highest standards of excellence and exceptional quality. With primary focus on company performance and product quality, our goal is to redefine the concept of Surge Protection using advanced applied technologies and innovative features designed to enhance our products as well as anticipate the needs of our customers.

Our products range from service entrances of large facilities to primary and secondary building distribution systems. These systems can include large computer rooms and data processing centers as well as manufacturing process control, small business data processing and individual residential surge protection.

Surge protection can help businesses improve operating efficiencies with applications such as computer-aided design (CAD), computer-aided manufacturing (CAM), digital graphic creation, software development and financial/economic modeling. There is no single Surge Protective Device (SPD) that is right for all applications, which is precisely the niche and focus of THOR SYSTEMS' product offering.

Our Culture – To Be Innovative, Responsive, Flexible

We are committed to expanding our business through continued innovation, outstanding performance and new product introductions to the increasingly digital world and ever-changing power-quality requirements of that environment.



Our culture incorporates:

- Partnering with our customers to provide solutions to improve their operating efficiencies.
- Embracing change and delivering innovative and superior-value products in the surge protection industry.
- Pursuing business-smart and challenging opportunities to build our customer base and strengthen our competitive position.

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Delivering Product Value

In our quest to become the **leader** in the surge protection industry, we are introducing a high-performance/feature-filled surge protection product line.

We have developed the product series, TSr and TSn. The **TSr Series** is a modular, field replaceable design for higher power service entrance and main distribution panel applications while the **TSn Series** is a self-contained, non-replaceable design for lower power applications.

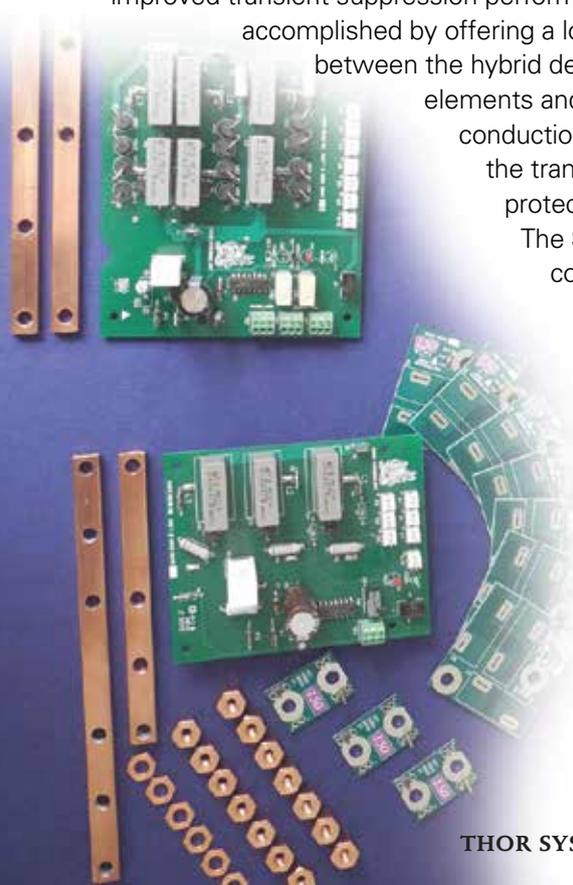
Both product series utilize the **StakTraks™** design concept comprised of multiple arrays of hybrid suppression elements which are interconnected and bussed with multiple, independent surge planes, surge paths and solid copper buss structure.

Multiple, parallel surge paths offer the means to enhance the "skin effect" phenomenon; the flow of electrical current is greatest at the conductor surface. As the frequency of the system increases, so does the rate of alternating flux, thereby intensifying the "skin effect" condition. In a typical transient event, frequencies of up to 50 kHz are not uncommon; thus, "skin effect" should always be taken into consideration in the design of surge protection systems.

Our **StakTraks™** design is comprised of Thermally Protected Metal Oxide Varistors (TpMOVs), Filter Capacitors, TVS Diodes (SADs), and parallel surge paths. These multiple parallel paths are key elements in providing improved transient suppression performance which is

accomplished by offering a lower impedance between the hybrid design suppression elements and their multiple conduction paths to direct the transient away from protected equipment.

The **StakTraks™** concept also provides an opportunity to condense the product package size. This smaller, more effective design increases overall system performance.



Design Philosophy

The fundamental philosophy used in the development of *THOR SYSTEMS'* products is a hybrid surge protection design comprised of high power **Thermally Protected Metal Oxide Varistors (TpMOVs)**, **Filter Capacitors** and **TVS Diodes (SADs)**.

THOR SYSTEMS uses the **Thermally Protected MOV (TpMOV)** as the foundation of the surge protection design. MOVs have long been the basis of surge protection systems providing high current handling capability and fast response to transient events with little degradation over time. Adding the thermal protection to the MOV (TpMOV) maximizes the safety of Surge Protection in the event of exposure to extended overvoltage conditions.

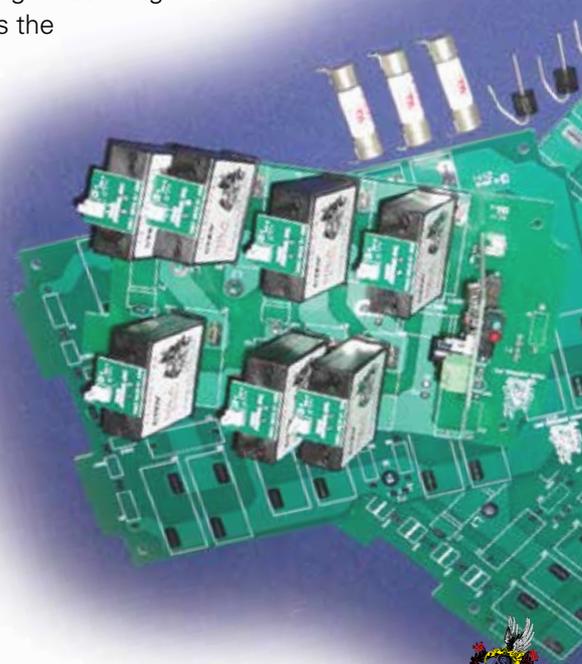
The next element of our hybrid design is the **Filter Capacitor**. Specifically added to attenuate electromagnetic and radio frequency interference (EMI/RFI) or "electrical noise," which causes data errors, system lock-ups and restarts, Filter Capacitors act on high frequency events that fall below the voltage diversion levels of TpMOVs and SADs.



Thermally Protected Metal Oxide Varistor (TpMOV) "Fail Safe Device"

TVS Diodes (commonly called **SADs** – Silicon Avalanche Diodes) are often referred to as the most ideal transient suppression device, having the sharpest knee and the lowest (or closest to nominal) clamping voltage of any clamping or diverting technology. It also has the fastest response to transient events with virtually no degradation over time. The disadvantages of using SADs *only* are limited surge current levels.

The final design philosophy incorporated by *THOR SYSTEMS* is the use of



Design Philosophy continued

fewer large MOVs. While MOVs are the most accepted suppression elements in use today, there are definite differences in larger MOVs versus multiple smaller ganged/paralleled MOVs. The improper sharing of current between multiple devices can cause a single device to operate beyond its limits, triggering individual and cascading component failures. The larger TpMOV has a lower let-through voltage, increased pulse life (100x) and maximum system reliability and, in addition, fuse coordination is accomplished *within* the TpMOV itself. This coordination provides *THOR SYSTEMS* the ability to offer fully-rated surge paths for each mode of protection.

Modular Surge Protection

TSr Series

THOR SYSTEMS' TSr series is a **Modular** Hybrid Design, featuring field replaceable individual suppression modules. Modular products are specifically designed for the more harsh service entrance and main distribution environments, where protected equipment criticality is a vital consideration. The TSr units are available in various voltage configurations with models ranging from 100kA to 300kA per mode surge current capacity.

The TSri (Industrial) is a three (3) tier Hybrid Design with Thermally Protected Metal Oxide Varistors (TpMOV), TVS Diodes (SADs), and EMI/RFI Filter Capacitors. The TSrc (Commercial) is a two (2) tier Hybrid Design with TpMOV and EMI/RFI Filter Capacitors. All TSr units consist of individual surge suppression modules bolted to solid copper buss structure providing robust products with superior performance and the ability to quickly and easily replace any failed modules. The TSr products are housed in a NEMA 4X, Fiberglass enclosure with a hinged, clear front door that displays the status of each individual Surge Protection module.



Replaceable Modules



TSri Series

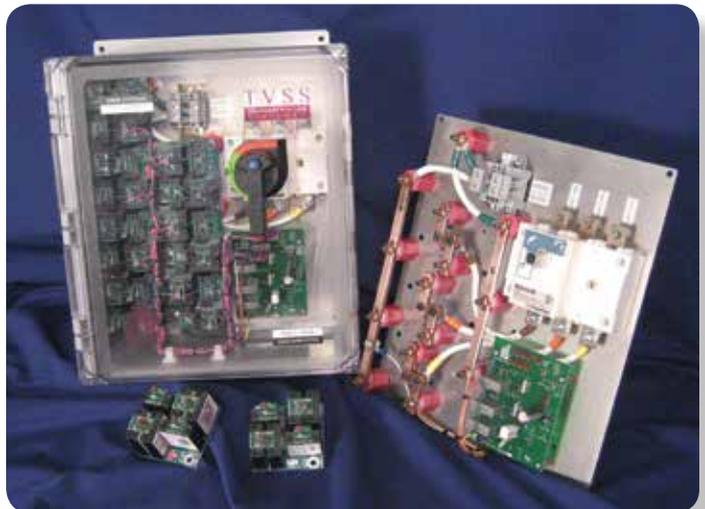
- Modular Industrial
- Full three (3) tier Hybrid Design comprised of:
 - TpMOVs
 - Filter Capacitors
 - SADs
- Fiberglass NEMA 4X Enclosure
- Short Circuit Current Rating (SCCR) 100,000 Amps



TSri 100-300kA • "Industrial" Modular Design

TSrc Series

- Modular Commercial
- Two (2) tier Hybrid Design comprised of:
 - TpMOVs
 - Filter Capacitors
- Fiberglass NEMA 4X Enclosure
- Short Circuit Current Rating (SCCR) 100,000 Amps



TSrc 100-300kA • "Commercial" Modular Design



TSn Series

THOR SYSTEMS' **TSn** Series is a Non-modular, compact high performance UL 1449 4th Edition Surge Protective Device (SPD). These high performance SPDs are suitable for service entrance or distribution panel applications. Our Single-**TILE** Architecture (using the StakTraks™ design) is the base building block for the **TSn** product platforms, offering 50, 100, and 150kA per mode surge protection utilizing an optional two (2) or three (3) tier Hybrid Design - each housed in a polycarbonate NEMA 4X enclosure with a clear cover.

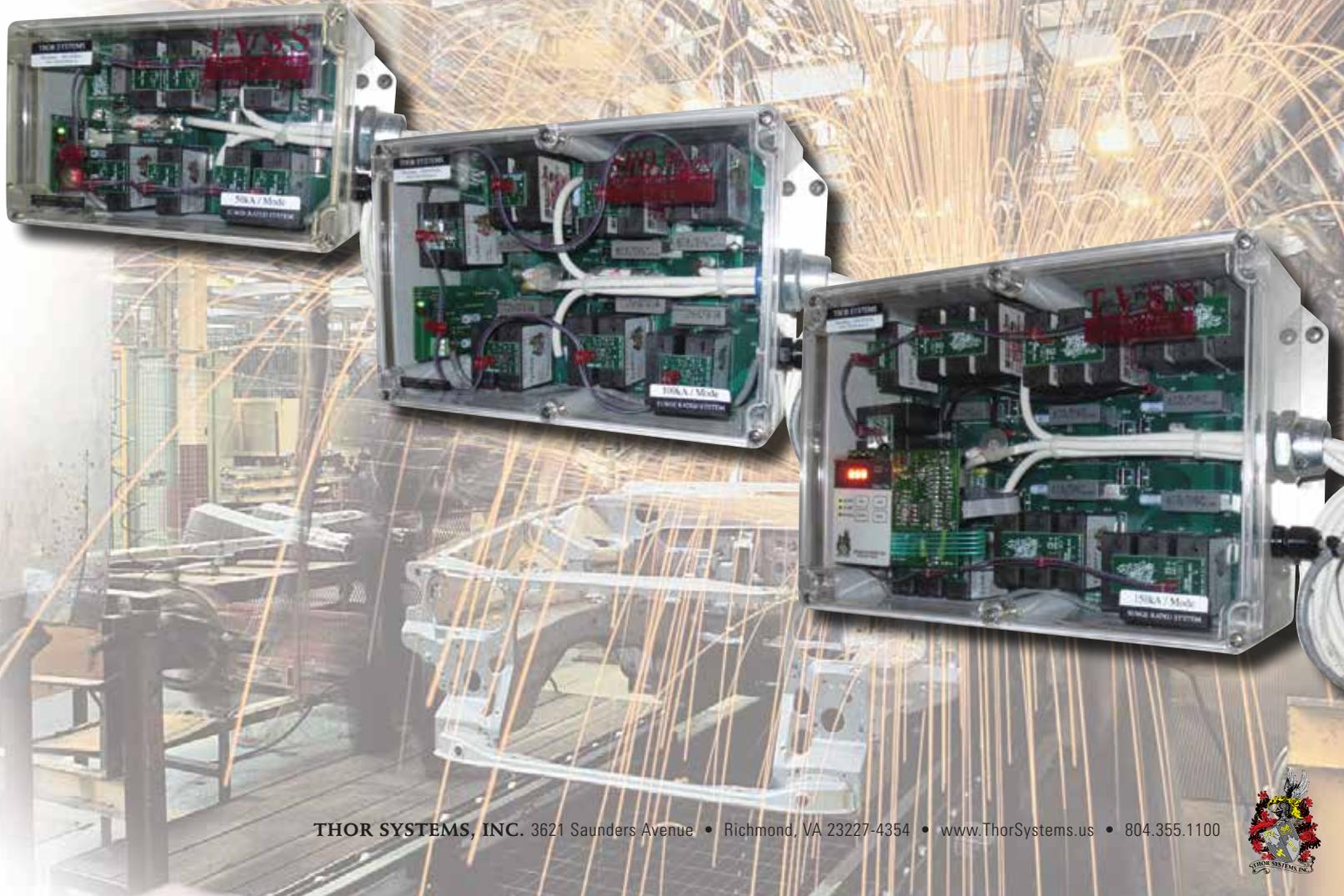
The TSn Series is available in two configurations for all three surge ratings. The **TSni** (Industrial) is a three (3) tier Hybrid Design with Thermally Protected Metal Oxide Varistors (**TpMOVs**), TVS Diodes (**SADs**), and EMI/RFI **Filter Capacitors**. The **TSnc** (Commercial) is a two (2) tier Hybrid Design (**TpMOVs** and EMI/RFI **Filter Capacitors**). The SPDs are prewired with low impedance Rope Lay wire which improves suppression performance (8-12%) by reducing "skin-effect" losses.

TSni Series – 50 to 150kA

- Non-modular, self-contained Industrial
- Full three (3) tier Hybrid Design comprised of:
 - TpMOVs
 - SADs
 - Sinewave tracking Filter Capacitors
- Polycarbonate NEMA 4X Enclosure
- Short Circuit Current Rating (SCCR) 100,000 Amps

TSnc Series – 50 to 150kA

- Non-modular, self-contained Commercial
- Two (2) tier Hybrid Design comprised of:
 - TpMOVs
 - Sinewave tracking Filter Capacitors
- Polycarbonate NEMA 4X Enclosure
- Short Circuit Current Rating (SCCR) 100,000 Amps



Monitoring for TSr and TSn Products

TSm270a optional monitor has solid state indicators for system status, alarm conditions, horn enable and active surge. There is a four (4) character smart LED display. This 5x7 font amber, alpha-numeric display provides a counter for total number of surges as well as Alarm Status indication. Our monitoring system offers a graphic overlay featuring four (4) individual LEDs for status/alarm/counter enable/active surge, a clear protective window for the four (4) character display, and four (4) membrane switches for monitoring functions.



The standard monitoring package has solid state indicators for system status. This monitoring system provides two (2) individual LEDs for visual indication of Green (Power On) and Red (Service Required).

All THOR SYSTEMS monitoring offers optional Form "C" contacts for remote status information.

Residential & Light Commercial AC, Data & Signal/Telcom Surge Protection

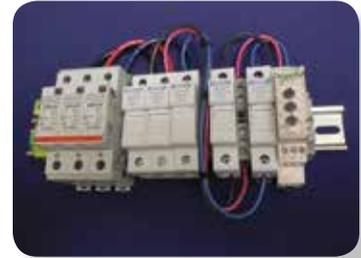
TSnc050 Residential

- Non-modular
- Flange Mount
- NEMA 1 Enclosure (3.13"W x 4.56"L x 1.88"D)
- UL94-5VA ABS
- 50kA per Mode



DIN Rail HVAC/ Chillers/Generator Applications

- Control Cabinets DIN Rail SPD Assembly
- 3 Phase AC with Multi-function Relay (Phase Loss/Sequence/Adj Over-under Voltage/Adj Time Delay), Form "C" Contacts
- Three (3) Field Replaceable Surge Modules
- 40kA per Mode



AC Compact

- Compact, Non-modular
- DIN Rail Mount
- 3/4"-14 Nipple or Bracket Mount (provided with unit)
- NEMA 4X Polycarbonate Enclosure (3.26"W x 3.26"L x 3.26"D)
- 50kA per Mode



AC (Parallel) Power SPD Type 4

- DIN Rail Mount
- 120-480Vac
- 40kA per Mode



Ethernet Applications

- Rack 19"
- RJ45 Jack Input/Output
- 16-Port Applications



Telephone & Coax SPD

- Wall Mount
- (3) Phone Lines: 30kA (8x20) Surge Current Per Line
- (1) DSL Line: 10kA (8x20) Surge Current
- (1) Coax Line: 10kA (8x20) Surge Current



Coax Type "F" SPD

- Wall Mount
- 10kA (8x20) Surge Current
- Protects (1) Coax Line
- 900MHz or 2.3GHz



Coax Type "F" SPD

- Wall Mount
- 10kA (8x20) Surge Current
- Protects (4) Coax Line
- 900MHz or 2.3GHz



Coax Type "BNC" SPD

- DIN Rail Mount
- Inline Female BNC Connector
- 25kA (8x20) Surge Current



4-20mA Applications

- Series Connection 24V
- 1 Pair In/Out Applications
- Wire Leads
- 10kA (8x20) Surge Current Per Pair
- 1/2" PVC Conduit Hub



Phone, ISD or Ethernet Applications

- DIN Rail or Wall Mount
- Single RJ45 Jack
- 1 Port (4) Pair Applications
- 2kA (8x20) Surge Current



Power Distribution (Wall Mount) – Mac Victor Power Network

The Mac Victor Power Network (MVPN) centralized, isolated power system provides clean and continuous power (battery backup) for critical electronics such as Point of Sale (POS), Back Office, Network Rack and Telephone/ Security panels.

MVPN Features

- UL1778 Edition Listed
- Available in 2.0 and 3.0kVA configurations
- Reduces both operating and maintenance expenses from downtime due to software lockups, data losses and hardware failures
- Wall mounted design (saves vital floor space)
- Bypass Switch (make before break) provides seamless power during UPS maintenance
- True on-line double conversion UPS provides voltage and frequency regulation to support and protect mission critical applications
- Integral shielded low impedance isolation transformer
- 40kA input and output surge protection with EMI/RFI filtering
- Patented Product: U.S. Patent 7,408,271 (August 5, 2008)



MVPN Applications

- Convenience Stores, Fast Food Restaurants
- Gas Stations, POS Equipment, Back Office Electronics
- Customer Kiosks
- Printers, Monitors
- Wastewater Treatment Controls
- Location Servers/ Communication Racks



Problems

We are increasingly reliant upon sensitive electronics to perform critical functions for manufacturing processes, communications, commerce and government, which are inherently susceptible to power quality problems. Facilities for data processing and automated process control can improve operating efficiencies by the implementation of Surge Protection.

Some of these power disturbances are obvious while many are almost unnoticeable; but they all cause problems that can seriously disrupt productivity.

Factors which increase susceptibility of equipment/systems:

- Large capital investments in commercial and industrial automation
- Magnitude/frequency of electrical transients (surges) that worsen with dramatically increased use of electrical and electronic equipment
- Large scale integration and miniaturization of electronics in computers, communication and factory automation has significantly increased sensitivity to poor Power Quality

Results of Poor Power Quality

- System upsets, lock-ups, restarts for no apparent reasons
- Hardware and logic card failures
- Premature equipment failure
- Corrupted and lost data
- Motor failures requiring rewinding or replacement
- Interrupted production causing material and capacity losses

Sources of Poor Power Quality

- **Internally generated transients:** 80% of voltage surges and transients are caused by changes in electrical demand (starting and stopping of electrical motors, machine processes, computers, printers, elevators, pumping equipment, HVAC systems, etc.)
- **Externally generated transients:** 20% of electrical problems are caused by external sources (lightning, utility grid switching, high winds causing power line arcing, electrical accidents, etc.)

Power outages are the most visible of power quality problems but are infrequent compared to disturbances such as electrical noise, spikes and voltage transients which are less visible but present – to some degree – all the time.

The three most prevalent types of system failure are:

Catastrophic Failure, caused by arcing components or destroyed printed circuit traces; **System Degradation** of the sensitive electronic components and chip sets, continuously weakening until the component fails (normally this damage is not visible); and **System Disruption** power quality disturbances which are responsible for most of the unexplained and more elusive system lock-ups, data errors, system operation faults and restarts.

Transients may occur either in repeatable fashion or as random impulses. **Repeatable** transients, such as commutation voltage spikes, inductive load switching, etc., are more easily observed, defined and suppressed. **Random** transients are more elusive. They occur at unpredictable times, at remote locations and require installation of monitoring instruments to detect their occurrence. Random transients are generally caused by switching parallel loads on the distribution system or lightning.

Power lines running overhead or even underground can have voltage induced either by a direct or indirect lightning strike. The voltage induced on wiring is typically a very short but very high-energy pulse.

Solutions

Surge Protection Systems eliminate harmful transients, surges and electrical line noise, thus preventing damage to sensitive electrical equipment. Each year millions of dollars of hardware will be spared by installing Surge Protection.

The necessity of providing protection for multiple surge-coupling modes has long been understood. Lightning typically couples between line and ground (common mode);



however, significant normal mode (L:N, L:L) transients can also be generated. In either case, transients will follow the path of least resistance along a distribution system.

Effective transient voltage protection requires that impulse energy be dissipated by the surge protection system at a voltage low enough to ensure survival of the protected circuit components. A practical solution to protect against disturbances such as electrical noise, spikes and voltage transients is to install a hybrid surge protection system which addresses very fast, high energy transients and has integrated electrical noise filtration.

Applications

The best overall applications should match the specifications of the SPD to the installation parameters, requiring evaluation not only of the Surge Protective Device but also the electrical environment of the facility.

Susceptibility is often referred to when describing the probability of a facility to be affected by surge events. Susceptibility can encompass much more than geographic location.

The first component of susceptibility is the **Electrical System Size**. In general, the larger the electrical system, the more exposure to surge events because there is more equipment connected to generate a surge and also less impedance to resist an incoming event from an outside source.

The next component of susceptibility is the **Geographic Location** of the facility. It is well documented that geographic locations play a role in frequency and probability of lightning strikes. By using an isokeraunic and a ground flash density map ([see pg. 9](#)), the likelihood of sustaining a surge event due to lightning can be charted.

The **Distribution System Configuration** defines how power is distributed. It not only addresses the configuration (WYE, Delta, Split Phase, etc.) but also **Available Short Circuit Current** at installation point of SPD.

With regard to equipment protection and system susceptibility, **Equipment Location Categories** are documented in surge protection but are not as well defined. These locations basically refer to Categories A, B and C as listed in IEEE C62.41.1. Experienced users of these categories will realize there is no distinct definition for each category and the boundary line is "unclear." For the purpose of system susceptibility, these categories have been divided into three areas:

- **Service Entrance** - This application is considered to be on the secondary side of the main disconnect as it applies to SPD systems under UL1449. Service Entrance equipment, which has the highest level of susceptibility within the distribution system due to location, can be affected by internal as well as external sources and has the greatest exposure to lightning events.
- **Distribution** - Considered to be the point at which the power system is divided to supply connected equipment, Distribution is located at the service entrance in some instances; in others, it is actually fed from the secondary of an isolation transformer. If the system Distribution is not at the service entrance, the susceptibility level normally decreases as there is less exposure to external and lightning events.
- **Branch Circuits** - Sometimes described as "Sub-distribution," are supplied from a distribution source without an isolation transformer. A typical application is a circuit breaker within a larger distribution panel supplying a smaller branch panel in a location away from the main distribution panel.



Other Factors to Consider

The SPD **installation** should always be as close as physically possible to the specific equipment to be protected, as cabling impedance can add as much as 100V per foot to the voltage suppression level.

Another factor is the **grounding system**, as the majority of transient events occur in the common mode. A faulty or high impedance grounding system can render a SPD system ineffective. Most grounding installations of critical equipment call for the grounding system impedance to be 5-10 ohms or less.

We also address the vital consideration of **Equipment Criticality**. Although assessments from the consulting engineer and electrical contractor are helpful, only the end user can determine the true cost of damaged and/or non-functioning equipment. Based on the importance of the protected equipment, the perceived susceptibility of the power distribution system may increase. Critical equipment may require an evaluation at a higher susceptibility due to the requirement of little or no down time.

Although not always considered a part of the installation environment, **Features and Benefits** are an important aspect of the application process. Along with exposure levels and equipment location categories, features and benefits may drive the selection of a particular model or system. Features or benefits promoting serviceability, performance, inter-connectability and available system information may influence the requirement of a certain series or product selection. The installation environment may dictate certain features, a disconnect switch, as well as field replaceable suppression elements providing the means to be back online quickly in the event of a surge protection system fault.

Site Risk Assessment:

How is Electrical Power Quality Impacting Your Business?

The Site Risk Assessment Spreadsheet below will help define the appropriate surge protection for specific applications from Service Entrance throughout the electrical Distribution system in a given facility.

Susceptibility and **Risk Assessment** are often referred to when describing the ability of a specific facility to be affected by surge events. We have defined seven susceptibility factors: **(1) Electrical System Size; (2) Geographical Location; (3) System Voltage; (4) Voltage Configuration; (5) Available Short Circuit Current (kAIC) at the point of installation; (6) SPD Location (within the Distribution System); and (7) Criticality of Equipment to be Protected** – all factors to be evaluated during coordination of multiple SPDs and their respective locations in the facility. (Suggest SPD coordination using the Site Risk Assessment Spreadsheet available at www.ThorSystems.us.)

Modular designs are specifically for the more harsh Service Entrance, Main Distribution, and where protected equipment criticality is a vital consideration. **Non-modular** designs are typically applied for lower ampacity distribution, sub-distribution and branch circuit panels.

Often the Site Risk Assessment Spreadsheet will define the selection of modular or non-modular by recommended surge current rating per mode, reducing the required surge protection rating as the applications move from Service Entrance to the Distribution, Sub-distribution and Branch Circuits.

During a Site Risk Assessment, critical equipment/processes with their respective incurred service expenses should be documented, often providing the necessary information to identify poor power quality as the root cause of a problem.



Site Risk Assessment Spreadsheet: Coordination of Multiple Surge Protective Devices (SPDs) & Locations

The best overall applications should match the specifications of the Surge Protective Device (SPD) to the installation parameters, requiring evaluation not only of the installed Surge Protective Device but also the electrical environment of the facility.



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Determine Surge Protective Device (SPD) placement within facility. Complete Criteria Selections 1-7 below for each facility location (seven locations can be assessed on form). Total the value (refer to **Table B** for recommended SPD series/size). See **Example Application** below.

Assessment Criteria Selection	Location(s)							Example Application
	A	B	C	D	E	F	G	
1. Electrical System Capacity (at installation point) 9 (2500-6000A) 7 (1200-2000A) 4 (600-1000A) 3 (225-400A) 2 (125-200A) 1 (Up to 100A)								9 2,500A Switchgear
2. Geographical Location (see Maps below) Isokeraunic Map (Thunderstorm Days/Year): 4 (80-100) 3 (60-70) 2 (40-50) 1 (5-30) Mean Ground Flash Map (Mean Ground Flashes/Yr): 4 (13-16) 3 (9-12) 2 (5-8) 1 (1-4)								3 Dallas, TX 60 Storm Days 2 8 Flashes
3. System Voltage 4 (600V) 3 (480V) 2 (240 or 208V) 1 (120V)								3 480V
4. Distribution System Configuration 3 (WYE) 2 (Delta)(Hi-Res Gnd) 1 (Single Ph)								3 WYE
5. Short Circuit Current (at installation point) 6 (101-200kA) 5 (51-100kA) 3 (26-50kA) 2 (15-25kA) 1 (5-14kA)								5 65kA/C
6. SPD Location (within electrical system) 8 (Svc Entrance w/Transfer Switch; power from utility) 7 (Svc Entrance w/o Transfer Switch; power from utility) 3 (Dist Panel ≥1000A; power from switchgear) 2 (Sub-dist Panel ≤1000A; power from panel; no Xfmr) 1 (Branch Panel ≤400A; power Xfmr)								8 Svc Entrance w/Transfer Switch
7. Load Criticality Range: 3 (least) to 10 (most)								10 Tx24 Data Cr
8. Numerical Value Total (see Table B)	0	0	0	0	0	0	0	43 43 = Tsr300

Model Number (See Table "A")										Install Location - Description		Qty
Key	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)		
Example	Tsr	I	300	F	x	3Y4	P	2	01	BFI	MSB1; 2500A, 480/277Vac	1
A												
B												
C												
D												
E												
F												
G												

Table "A" MODEL NUMBER

Example Model #: TsrI300Fx3Y4P201BFI

Key (1) (2) (3) (4) (5) (6) (7) (8) (9) (10)

(1) Thor Series
Tsr Modular Design
Tsn Non-Modular Design

(2) Grade *
i Industrial (with SADs)
c Commercial (without SADs)

(3) Surge Current Rating
Tsn or Tsr
050 (50kA/Mode) 200 (200kA/Mode)
100 (100kA/Mode) 250 (250kA/Mode)
150 (150kA/Mode) 300 (300kA/Mode)

(4) Input Connection Type
D Dist Block (Up to 10AWG) (Tsr Only)
F Fused Disc Switch (Up to #6AWG) (Tsr Only)
T Terminal Block (Up to #4AWG) (Tsr Only)
W Pre-Wired with #12AWG Wire (Tsn Only)

(5) SAD Type
s 1.5kW Series
x 15kW Series
z No SADs

(6) Voltage (ac) Configuration
251 (240/120V Single Phase; 3W + G) 302 (240V 3-Phase Delta; 3W + G)
252 (240V Single Phase; 3W + G) 304 (480V 3-Phase Delta; 3W + G)
254 (480V Single Phase; 2W + G) 3H (240V Hi-Leg Delta; 4W + G)
3Y2 (208/120V 3-Phase Wye; 4W + G) *3R2 (208/120V Hi-Res Gnd; 3W + G)
3Y4 (480/277V 3-Phase Wye; 4W + G) *3Y4 (480/277V Hi-Res Gnd; 3W + G)

(7) Enclosure Type
P Fiberglass, NEMA 4X (Tsr Only)
Polyarbonate, NEMA 4X (Tsn Only)
M Metal, NEMA 4 (Tsn or Tsr)
S Stainless Steel, NEMA 4X (Tsn or Tsr)

(8) Monitor Type
1 Status Lights Only
2 Status Lights Plus Surge Counter & Audible Alarm

(9) Options
00 No Options Tsr or Tsn
01 Form C
02 Extended EMI/RFI Filter
03 Phase Loss relay
04 Multi-Function Relay
05 Combo of 01 & 02
06 Combo of 01 & 03 Tsr Only
07 Combo of 01 & 04
08 Combo of 02 & 03
09 Combo of 03 & 04
10 Combo of 01, 02 & 03
11 Combo of 01, 03 & 04

(10) Orientation (Tsr Only)
TF Top Feed
TFI Top Feed / Internal Mfg Type 2 Monitor
BF Bottom Feed
BFI Bottom Feed / Internal Mfg Type 2 Monitor

*SPD Built as Delta Configured - Neutral Conductor is not Connected.

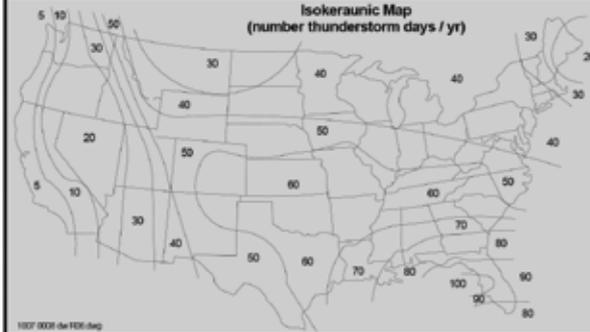
Table "B" Numerical Total Recm'd SPD kA/Mode

Numeric Total	kA Rating	Product Series
42 - 48	300kA	Tsr300
35 - 41	250kA	Tsr250
28 - 34	200kA	Tsr200
21 - 27	150kA	Tsr/Tsn150
16 - 20	100kA	Tsr/Tsn150
11 - 15	50kA	Tsr/Tsn150

Ground Improvement Required?

Ohms	Best	No
< 5 Ohms	Best	No
5-10 Ohms	Typical	No
> 10 Ohms	High	Yes

Isokeraunic Map (number thunderstorm days / yr)



Mean Ground Flash Map (flash / km² / yr)



TSI 0119/10

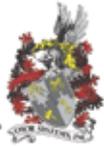
(Available for download at www.ThorSystems.us)



New Series of Application Papers

In response to an increasing number of application questions by Specifying Engineers, Facilities Managers, Contractors and Field Service Staff, THOR SYSTEMS has created a series of technical application papers i.e. . . . "Surge Apps". Each individual document is focused on a very specific issue, they are typically one (1) page in length, presenting information that is directly applicable to the Surge Protection Application being addressed.

The first Surge App SA-001 Why THOR SYSTEMS' Surge Protection? addresses "Design Philosophy" and defining the surge protection "Solution". Please feel free to download (www.ThorSystems.us). We welcome your comments.



THOR SYSTEMS, INC. SURGE APPS SA-001: INTRODUCTION (Guidelines and application tools to promote improved Power Quality)

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SURGE PROTECTION . . . WHY THOR SYSTEMS?

THOR SYSTEMS, manufacturer of Surge Protective Devices (SPDs), was founded on the dedication of exceeding the expectations of our customers and all of our business partners. Our five senior staff members have 117 years' cumulative experience in the power quality/surge protection industry and are pleased to support technical questions and specific applications, including site visits for power quality problem evaluation. THOR SYSTEMS' commitment is evident in all facets of our business from delivering product value, high performance/full surge rated designs to providing the correct power quality solution for specific applications.

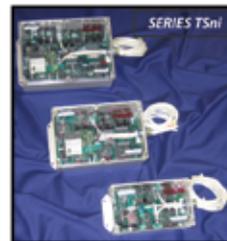
DESIGN PHILOSOPHY

- Applying a small number of large block TpMOVs (34 mm square/50kA with "Fail Safe Design"):
 - 100 times pulse life vs. 18 to 20mm dia. MOVs used in arrays by a number of competitors;
 - Prevents cascading failures which can result in increased voltage let-through levels.
- Hybrid design utilizing SADs, TpMOVs, and FILTER CAPACITORS for optimum surge protection:
 - Silicon Avalanche Diodes (SADs): Non-linear diverting element/speed of turn-on/low clamping levels;
 - Thermally Protected Metal Oxide Varistors (TpMOVs): High energy handling capacity;
 - FILTER CAPS: EMI/RFI noise suppression reducing data errors, lockups, and reboots.



Modular TSr Product Series
(50, 100, 150, 200, 250 & 300kA/Mode)

- **Modular Designs Offered – Series TSr Products**
 - Field replaceable, upgradable modules;
 - 50 through 300kA per mode (all modes protected);
 - Applications: Service Entrance, Main Distribution, and where protected equipment criticality is a vital consideration.
- **Non-modular Designs Offered – Series TSn Products**
 - Compact, non-field replaceable modules;
 - 50 through 150kA per mode (all modes protected);
 - Applications: Lower ampacity Distribution, Sub-distribution, and Branch Panels.



Non-Modular TSn Product Series
(50, 100, & 150kA/Mode)

PROVIDING SOLUTIONS

- Coordinated surge protection provides ability to dissipate transient/surge energy from **external** (20%) and **internal** (80%) sources.
- Surge protection matched to the facility's electrical environment using a 3G Site Shield Risk Assessment Spreadsheet (utilizing seven factors of susceptibility for each specific application to assure proper sizing vs. risk).

We would like to become an information resource for your surge protection applications. THOR SYSTEMS offers products and services that provide protection from the more *obvious external* to the more *frequent internal* transient voltage sources. Our consistent focus on improved product performance and increased value to the customer is conveyed by our products' transparent cover enclosures, showcasing the TILE Architecture, Innovative Design Configurations, and per Mode Status Indication.

Ref. Documents:	
Sa-002	Bottom Feed SPDs
Sa-004	3G Site Shield Risk Assessment
Sa-005	Modular vs. Non-modular
Sa-010	Hybrid SPDs
AG-09	Features/Benefits
TSI 092	Case Study/Mfg

Should you have any questions, please feel free to contact us (804.355.1100) or visit our Web site, www.ThorSystems.us.

Ph 804.355.1100
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www.ThorSystems.us

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Upcoming Topics

- Risk Assessment – Sizing Surge Protection
- Modular vs. Non-Modular, Which & Why?
- Specs Define Effective Surge Protection
- Identify and Realize Profit Opportunities
- Case Study – Manufacturer
- Bottom Feed SPD
- Growing Necessity of Surge Protection
- Why Cascade Surge Protection
- Cause and Effect of UL 1449 3rd Edition
- Integral vs Non-Integral Surge Protection



Testing

THOR SYSTEMS uses state-of-the-art equipment for R&D and production testing to ensure maximum product performance. Each surge protection device is thoroughly tested during production and is checked for functionality, accuracy and reliability. As previously stated, *THOR SYSTEMS'* surge protection products are listed under UL1449 and UL1283. Our participation with the Standards Panels for UL, IEEE and NEMA keeps us informed of the latest industry standards.

Industry Standards

THOR SYSTEMS' products are designed, manufactured, and tested in compliance with the following codes and standards:

- American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/IEEE C62.41.1, C62.41.2, C62.45, C62.62 and C62.72)
- National Electrical Manufacturers Association (NEMA)
- National Fire Protection Association (NFPA 70 NEC)
- Underwriters Laboratories (UL1449 and UL1283)

THOR SYSTEMS' products are UL listed and labeled under UL1449 Standard for Surge Protection Devices and UL1283 Standard for Electromagnetic Interference Filters.

Service

Engineering and Customer Service – *THOR SYSTEMS* Engineering and Customer Service staff has extensive SPD and critical power industry knowledge. We are available to assist our customers with application, Surge Protection sizing, installation and site evaluation requirements, as well as answer any questions that may arise.

SERVICE

service@ThorSystems.us
Phone: 804.355.1100
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Quality Assurance Thru Six Sigma

Our ability to improve company performance is enabled by ongoing dedication to the Six Sigma principles of business development, which are an integral part of our work processes.

The methodology of Six Sigma provides the tools to continuously improve the business processes. This increase in performance and decrease in process variation lead to defect reduction and vast improvements in efficiency, employee morale and quality of products.

Six Sigma is a rigorous and systematic utilization of information (management by facts) and statistical analysis to measure and improve a company's operational performance, practices and systems by identifying and preventing "defects" in manufacturing and service-related processes in order to anticipate and exceed the expectations of our customers and business partners.

SALES

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TECHNICAL SUPPORT

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Fax: 804.355.8900



Pyramid

Vision

Our vision is to:

- Provide high-performance, quality-built products to the Surge Protection industry
- Be the preferred provider, constantly exceeding the capabilities of our strongest competitors
- Redefine value in our marketplace

Innovation

To provide state-of-the-art products, we will:

- Be dedicated to continual research and development to fuel new products tailored to meet the most demanding power quality applications
- Focus significant effort to integrate high-performance product design with advanced quality manufacturing principles

Leadership

Our idea of leadership is:

- Setting high standards in product performance and quality, embracing the necessity of change and delivering results
- Positioning ourselves closer to our customers, providing superior products and services which are consistently delivered with dedication

Commitment

Our core traits and strengths are to:

- Set bold and competitive goals and deliver results with urgency and dedication
- Guarantee success by our commitment to excellence
- Assure quality products utilizing the principles of Six Sigma



People

In order for a company to thrive, we believe:

- The commitment and outstanding work of our employees drive our company's success
- Training and development opportunities for personal and professional growth are imperative
- Management is focused on ensuring we have the "best of the best" through a defined recruiting process and continuous training

Values

With our values system in place:

- We take responsibility for our actions and are passionate about exceeding expectations
- We are dedicated to high performance, quality products, effective business models and the discipline to continuously improve





Symbolism

THOR SYSTEMS' logo was conceived to project and convey the culture and philosophy of our corporation. Named after the god of thunder in Norse mythology, Thor was the wielder of lightning bolts and one of the most powerful gods. Our logo, an icon for performance and quality in the surge protection industry, incorporates the following symbols:



Shield, portraying protection



Lightning, depicting harmful electrical disturbances



Hammer, representing the manufacturing process



Inverted Gates, symbolizing a threshold or beginning



Single Key, providing the means to unlock solutions



Cross Keys, illustrating unity with our customers



Helmet, signifying a protective element



Wings, indicating the ability to respond swiftly

SALES

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THOR SYSTEMS, INC.

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Philosophy

THOR SYSTEMS has the passion and unwavering commitment to provide uncompromising product performance, packaging design and quality-process manufacturing to fulfill the company's potential. In order to reach this level of development, we recognize that passion and commitment must be constantly exercised.

It is our objective to redefine value in our marketplace and offer uncompromising performance and execution for all with whom we conduct business.

At *THOR SYSTEMS* we are continuously striving to improve our products so, from time to time, there may be changes in features or optional equipment that are not reflected in this brochure. All equipment specifications contained in this printed material are based on the latest product information available at the time of printing. *THOR SYSTEMS* reserves the right to implement changes, without notice, in specifications and equipment services. Further information may be obtained through our authorized sales representatives or our Web site (www.ThorSystems.us).



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