
TECHNICAL SEMINAR
Powered by Vicor

Topics of Discussion

- Zero-current switching topology
- 2nd Generation advancements
- Using 2nd Generation power modules
- Web-based design tools
- Total solutions

Zero Current Switching Topology

ZCS vs. PWM: Differences

Zero Current Switching

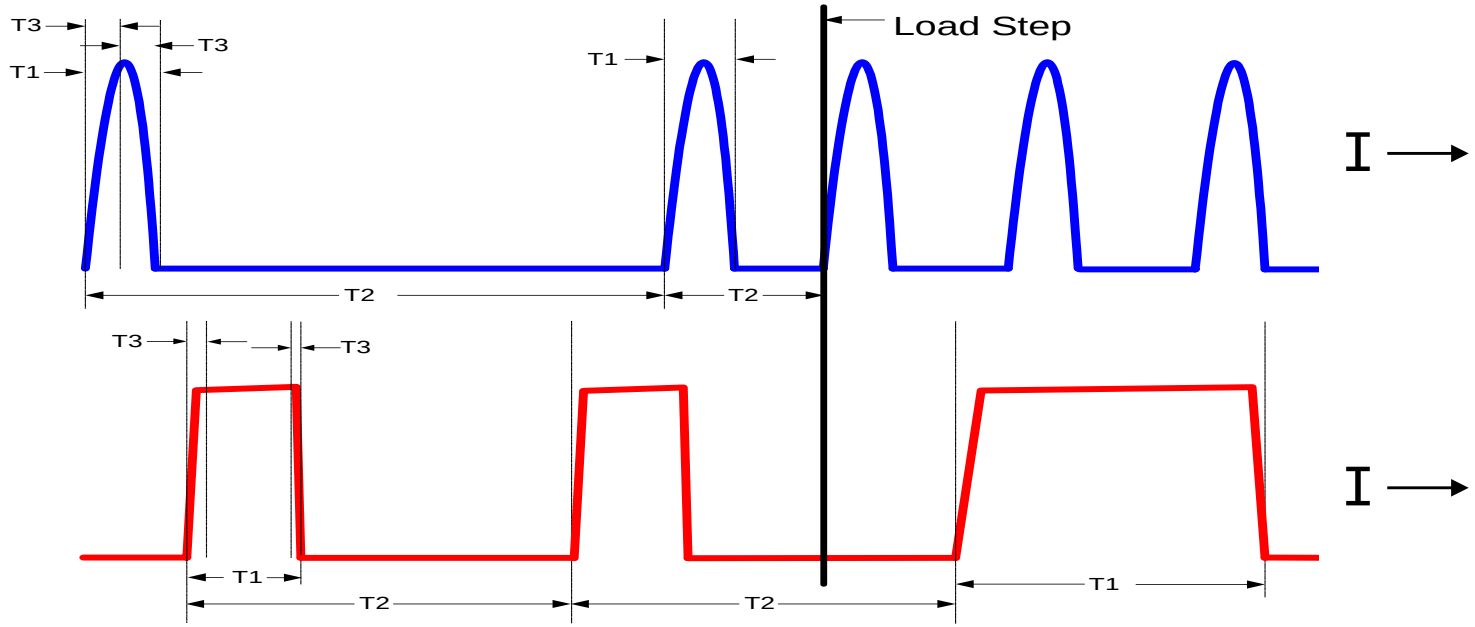
- Quantized (fixed) energy transfer
- Flatter efficiency curve
- Lower harmonic noise

Pulse Width Modulation

- Variable energy transfer
- Variable efficiency due to line and load
- Higher harmonic noise

Zero Current Switching Topology

Energy Transfer Differences

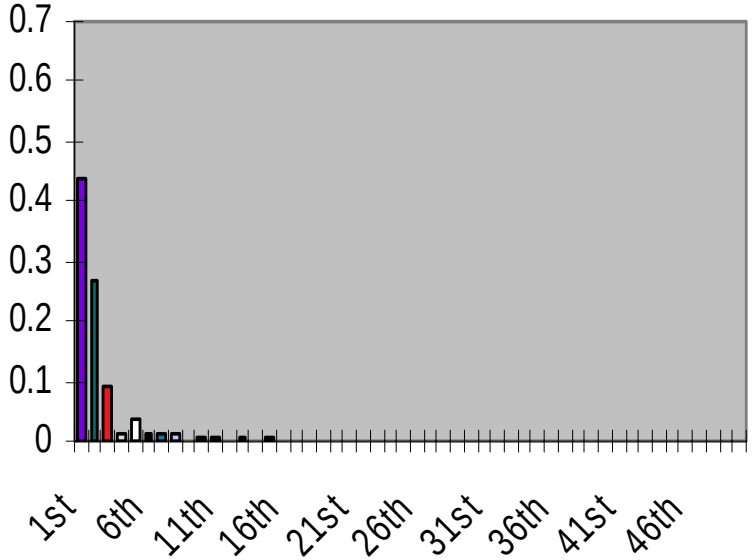


		PWM	ZCS
T1	On time of the switching	Variable	Fixed
T2	Pulse repetition rate or operating frequency	Fixed	Variable
T3	Rise and fall time of the current in the switching device	Fixed	Fixed

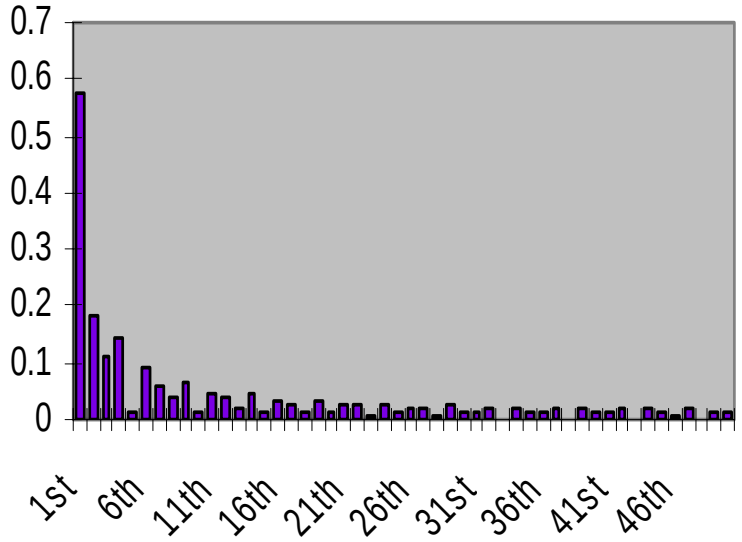
Zero Current Switching Topology

Harmonic Comparison

ZCS



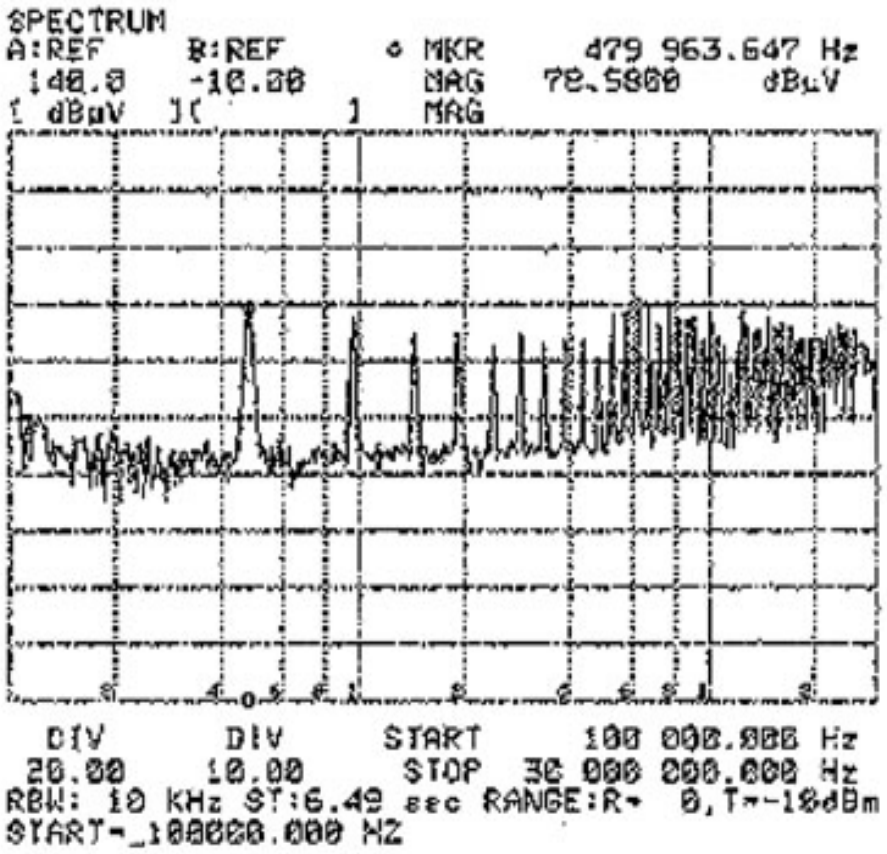
PW M



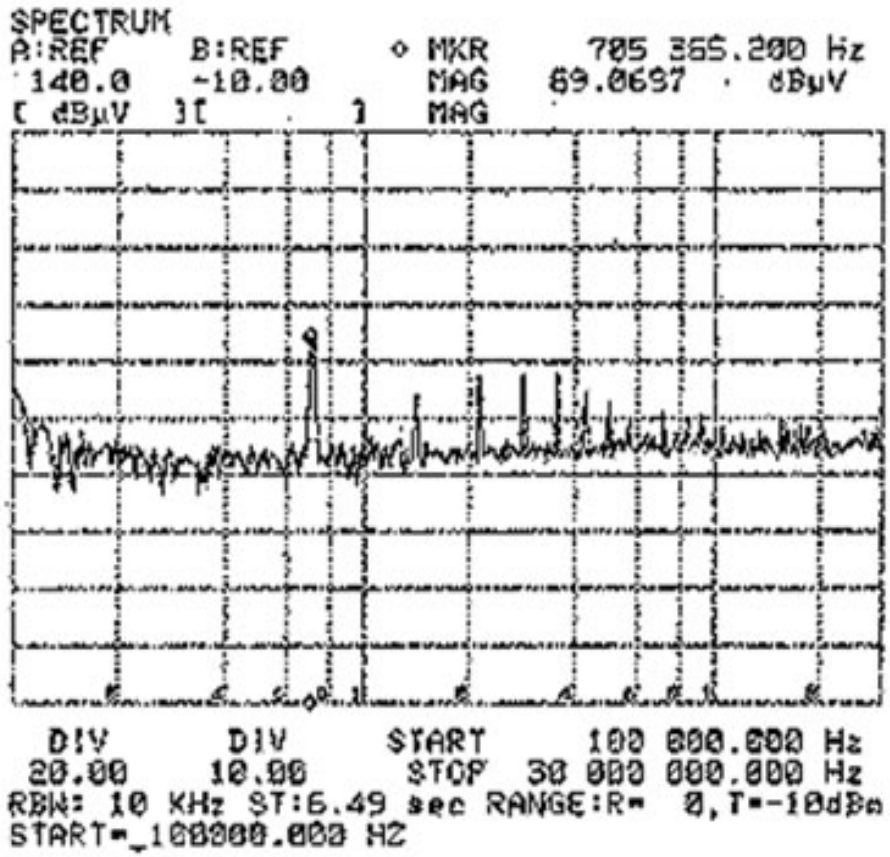
Zero Current Switching Topology

Conducted Input Noise

PWM with Common Mode Filter



ZCS with Common Mode Filter

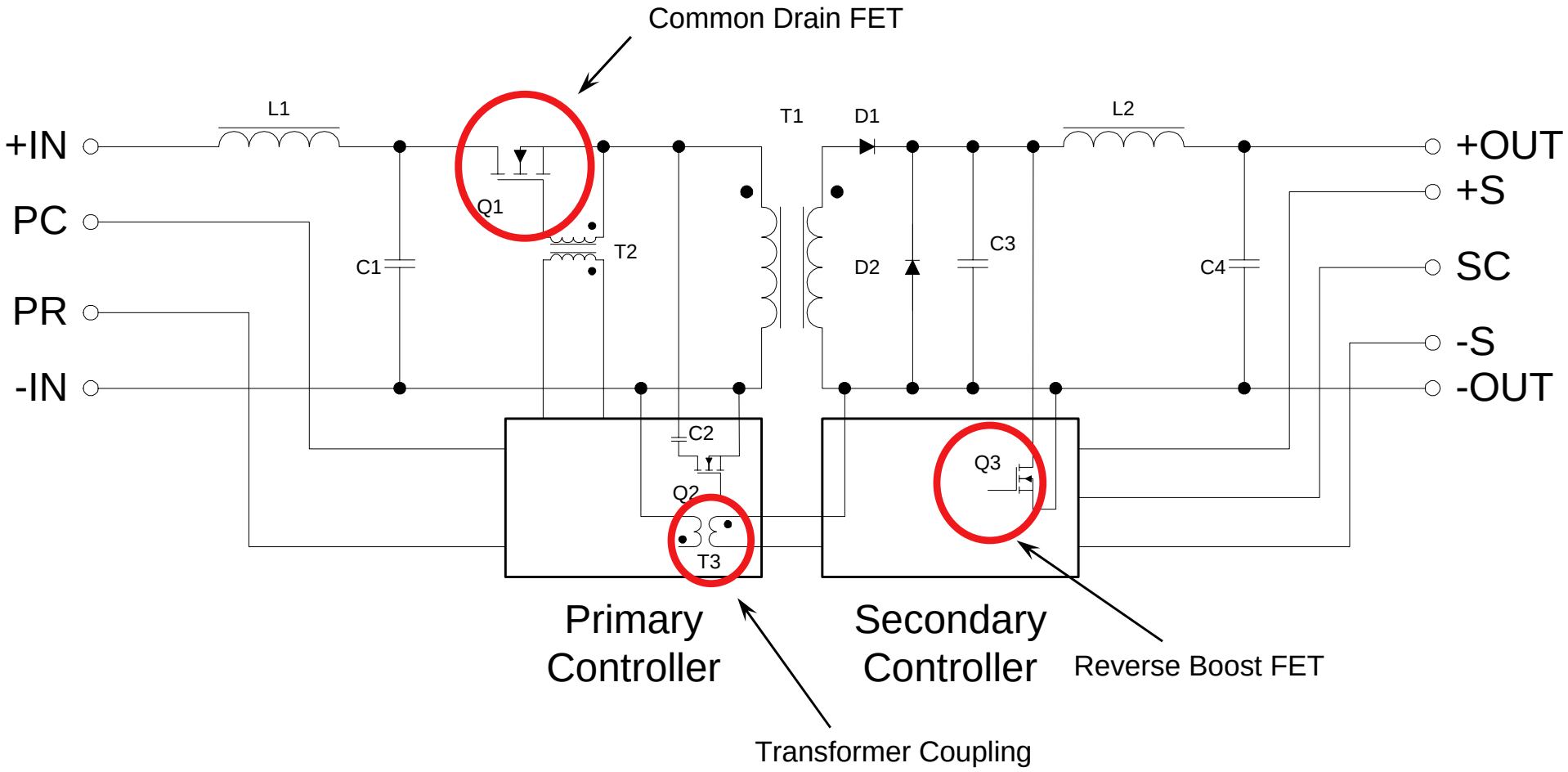


2nd Generation Advancements

- Design topology
- Integrated controls
- Reactive elements
- Switching elements
- Thermal and noise management
- Available options
- Factory automation
- Design automation

2nd Generation Advancements

Design Topology



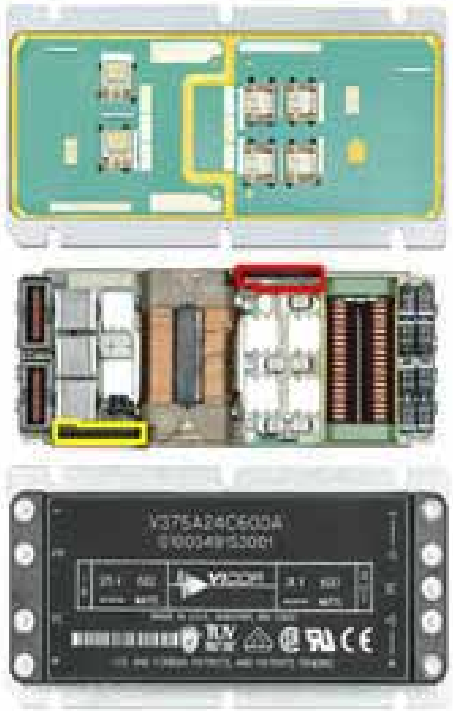
2nd Generation Advancements

Integrated Controls

1st Generation
VI-200

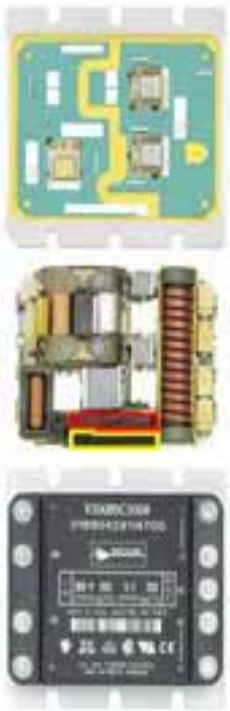
200W

2nd Generation
Maxi



600W

2nd Generation
Mini

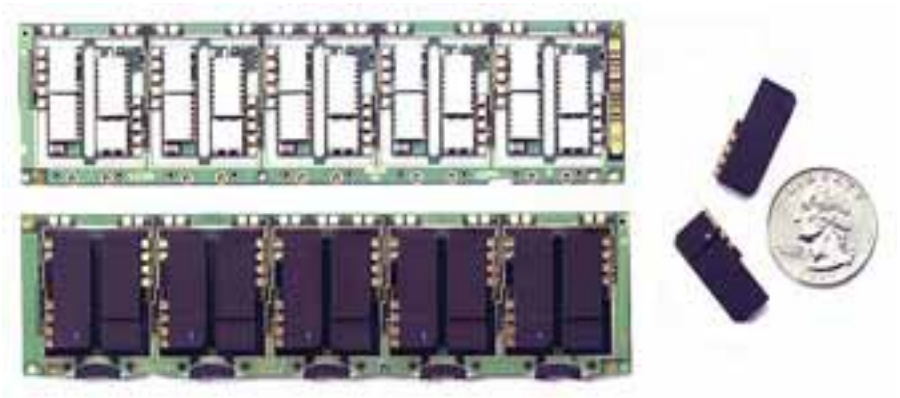


300W

2nd Generation
Micro

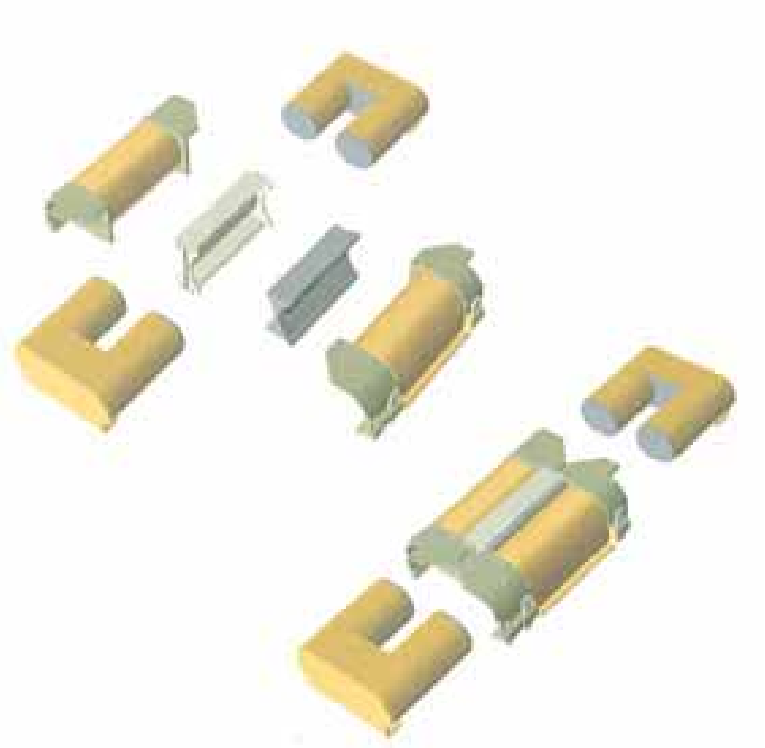
150W

2nd Generation Advancements
Integrated Controls



- Primary and secondary control circuitry integrated into proprietary chip sets
- Volume of less than 16.5mm^3
- Epoxy molded

2nd Generation Advancements
Reactive Elements



- Unique magnetic structures allow for high power density
- Proprietary plated cores
- Pre-wound bobbins
- “Dial a Henry” machinery to set precise leakage inductance

C_{PS}/P_{OUT} ~ 3pF/600W
$R_{\theta CB}$ ~ 1°C/W

2nd Generation Advancements

Switching Elements

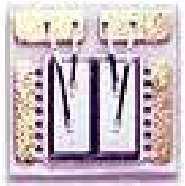
1st Generation

TO-220

$R_{\theta JB}$ ~ 3°C/W

2nd Generation

IPD

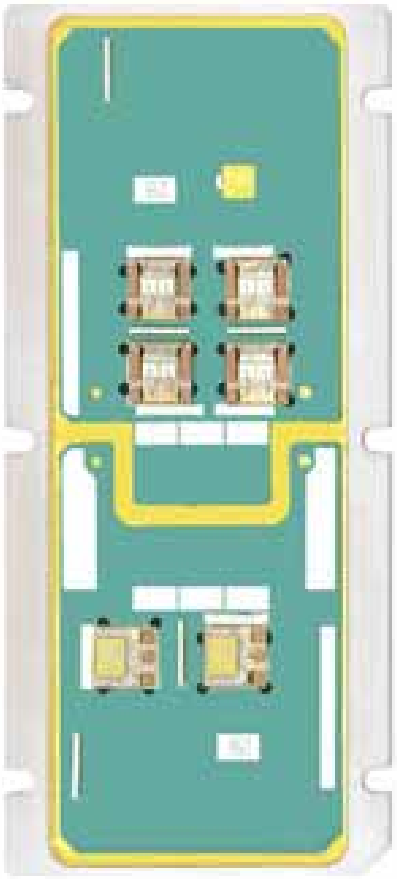


R_{OJB} ~ 1.5°C/W

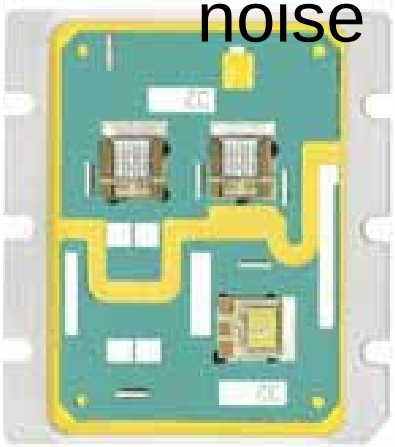
2nd Generation Advancements

Thermal and Noise Management

- IPD's are bonded directly to copper clad aluminum oxide for improved θ_{JB}
- PCB ground planes and internal shielding reduces noise



Maxi



Mini

Micro

2nd Generation Advancements
Available Options

Module Sizes

Micro	Mini	Maxi
		
2.28 x 1.45 x 0.5 in 57,9 x 36,8 x 12,7 mm	2.28 x 2.2 x 0.5 in 57,9 x 56 x 12,7 mm	4.6 x 2.2 x 0.5 in 117 x 56 x 12,7 mm

Product Grades

	C	T	H	M
Operating Temp.	–20 to 100°C	–40 to 100°C	–40 to 100°C	–55 to 100°C
Storage Temp.	–40 to 125°C	–40 to 125°C	–55 to 125°C	–65 to 125°C
Temp. Cycling	N/A	N/A	24 hours (–55 to 125°C)	24 hours (–65 to 125°C)
Burn-In	N/A	N/A	12 hours	24 hours
Low Temp. Test	N/A	N/A	–40°C	–55°C
High Temp. Test	N/A	N/A	100°C	100°C
Final Test Data	N/A	N/A	Available	

2nd Generation Advancements

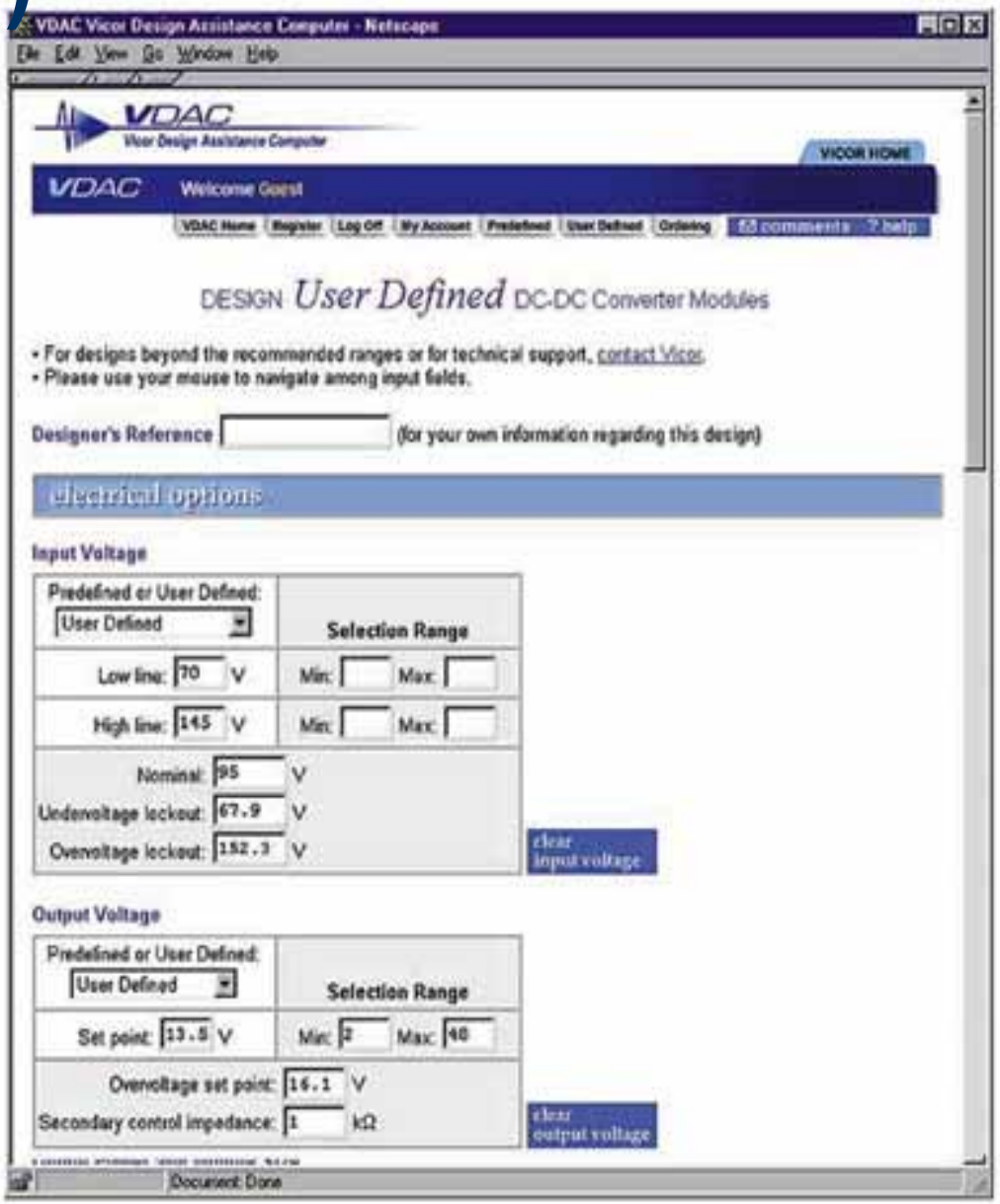
Pin Styles and Mounting Options

Pin Style	Pin Length	Board Thickness	Mounting	Connection	Height Above Board Including Baseplate
Short Solder	0.110 in (2,8 mm)	0.063 in (1,6 mm)	In-Board	Solder	0.450 in (11,4 mm)
Long Solder	0.200 in (5,1 mm)	0.094 in (2,4 mm)	In-Board	Solder	0.450 in (11,4 mm)
		0.063 in (1,6 mm)	On-Board	Solder	0.525 in (13,3 mm)
Short ModuMate	0.110 in (2,8 mm)	Any Thickness	On-Board	SurfMate	0.575 in (14,6 mm)
		0.063 in (1,6 mm) 0.094 in (2,4 mm)	In-Board	InMate	0.470 in (11,9 mm)
Long ModuMate	0.200 in (5,1 mm)	0.063 in (1,6 mm) 0.094 in (2,4 mm) 0.125 in (3,2 mm)	On-Board	InMate	0.063 in Board: 0.542 in (13,8 mm) Other Boards: 0.525 in (13,3 mm)

Baseplate Styles

Style	Description
Slotted	Six slots, 0.13 in (3,3 mm) wide — use 4-40 screw
Threaded	Six threaded holes, 4 -40 UNC-2B
Thru Hole	Six #30 holes (0.13 in; 3,3 mm)

VDAC (Vicor Design Assistance Computer)



2nd Generation Advancements

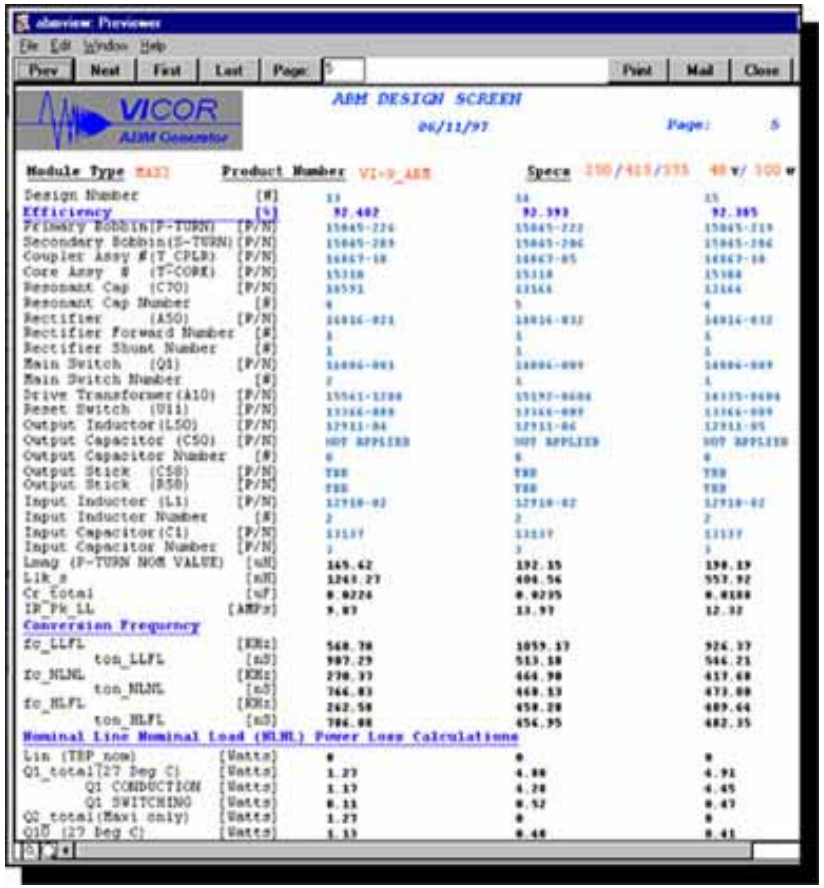
VDAC (Vicor Design Assistance Computer)

- Web-based interface that allows a power designer to:
  - Specify a module
  - Verify feasibility
  - Place an order
  - Receive prototype quantities
  - In under six weeks
- Eliminates the distinction between custom and standard DC-DC converters

2nd Generation Advancements

Design Automation

ABM (Internal)



VDAC (External)

Power Component Design

Power Component Design

- Electrical performance
- Control functions
- Module do’s and don’ts
- Mounting methods
- Applications examples

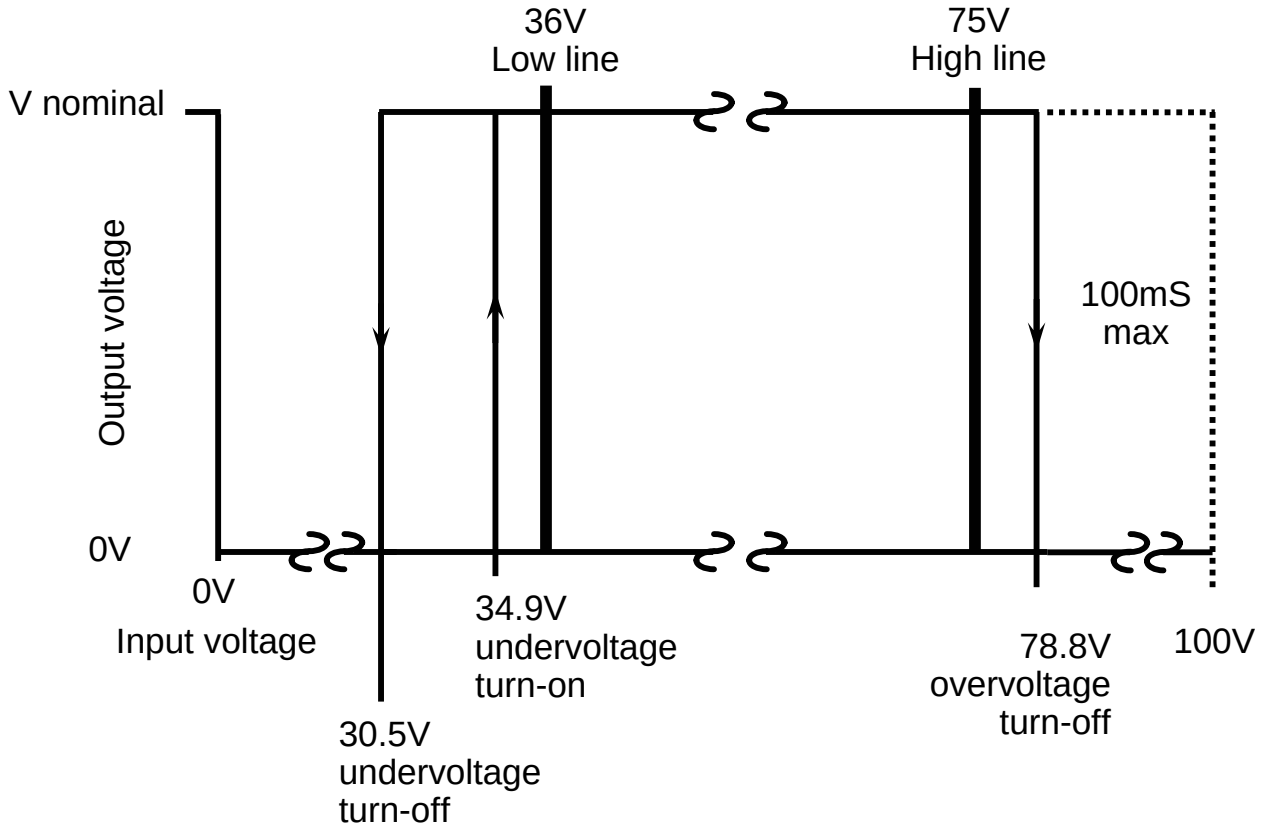
Electrical Performance

Standard Features

- Undervoltage lockout
- Over voltage protection
- Over current limiting
- No load to full load regulation
- Remote sensing
- Primary and secondary fault monitoring ability
- Over temperature limiting
- 10% to 110% trim range
- Scalability (paralleling)

Electrical Performance

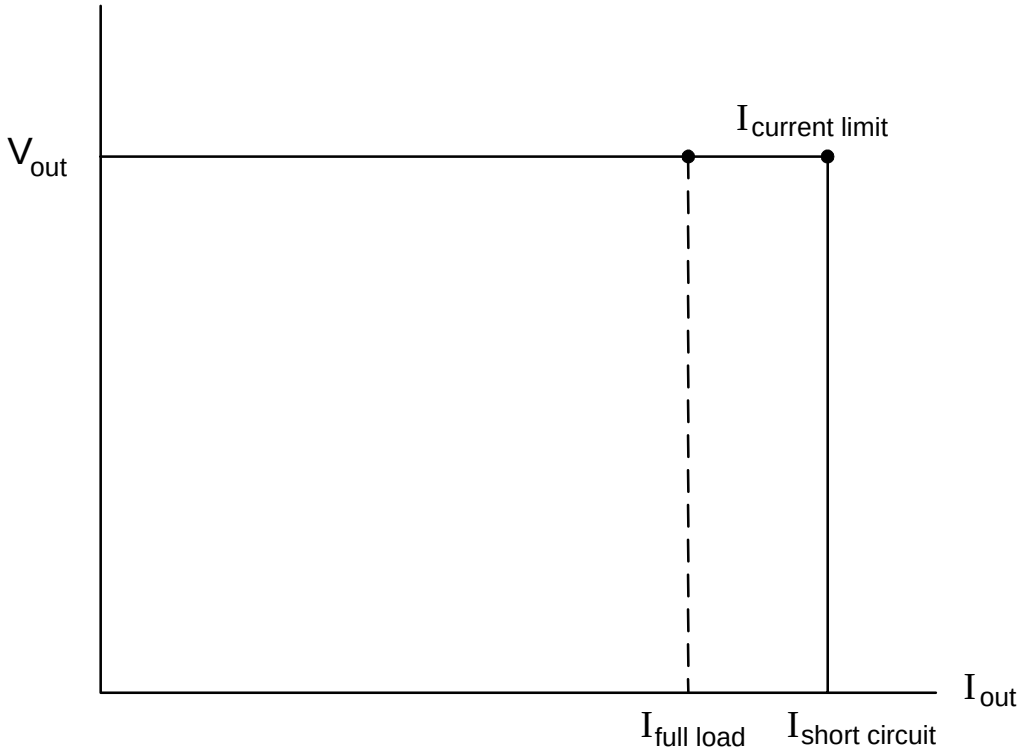
Input Voltage Range (48Vin Typical)



Electrical Performance

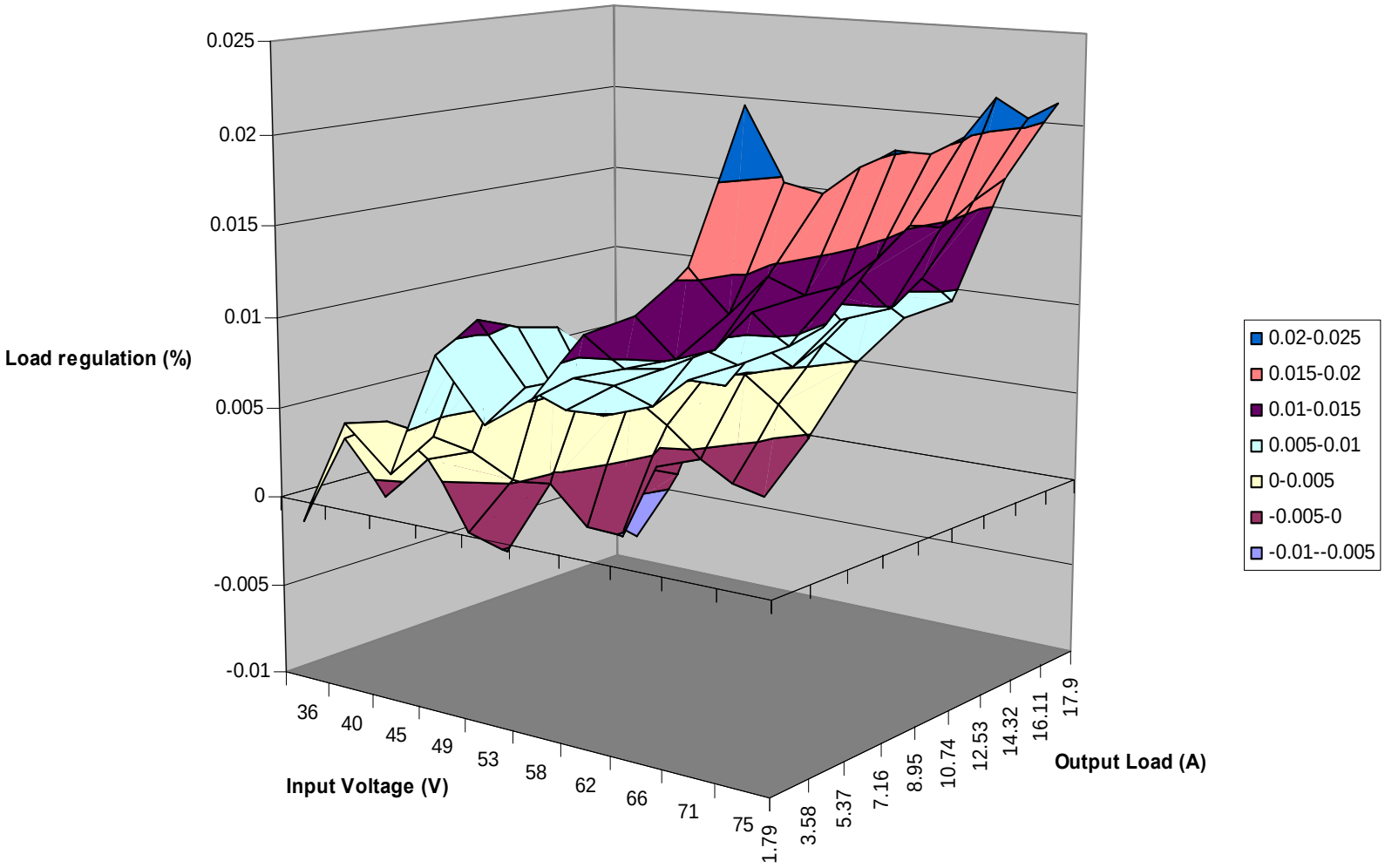
Over Current Limiting

- All 2nd Generation modules incorporate straight line current limiting
- Designed to avoid damaging load
- Current limit typically set to 115%



Electrical Performance

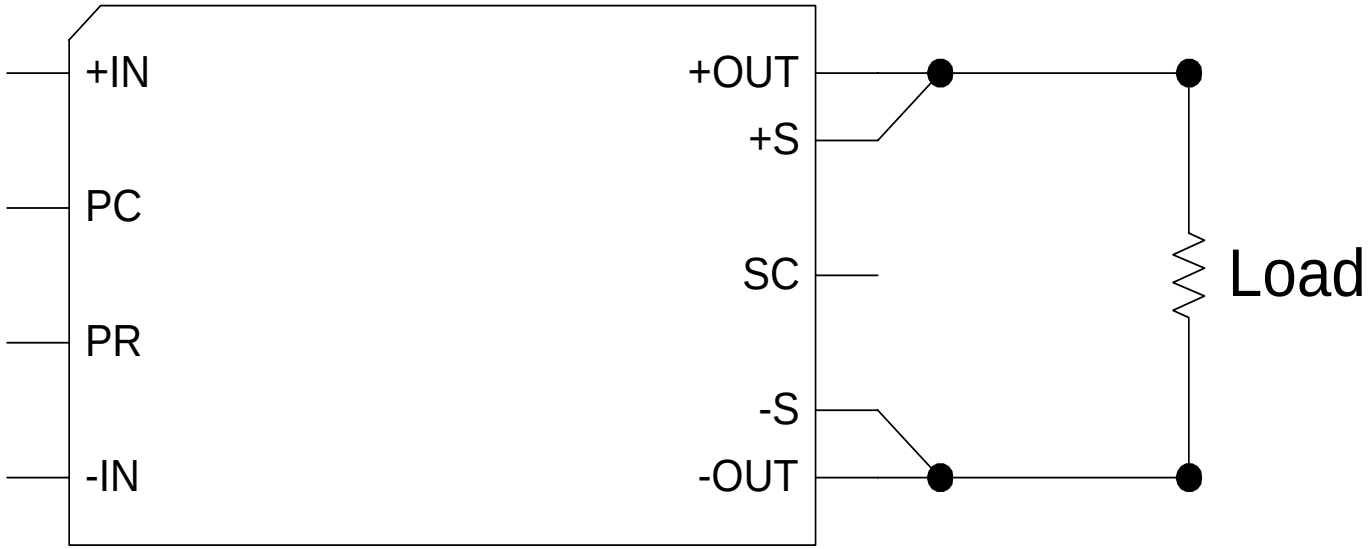
No Load to Full Load Regulation



Electrical Performance

Local Sense

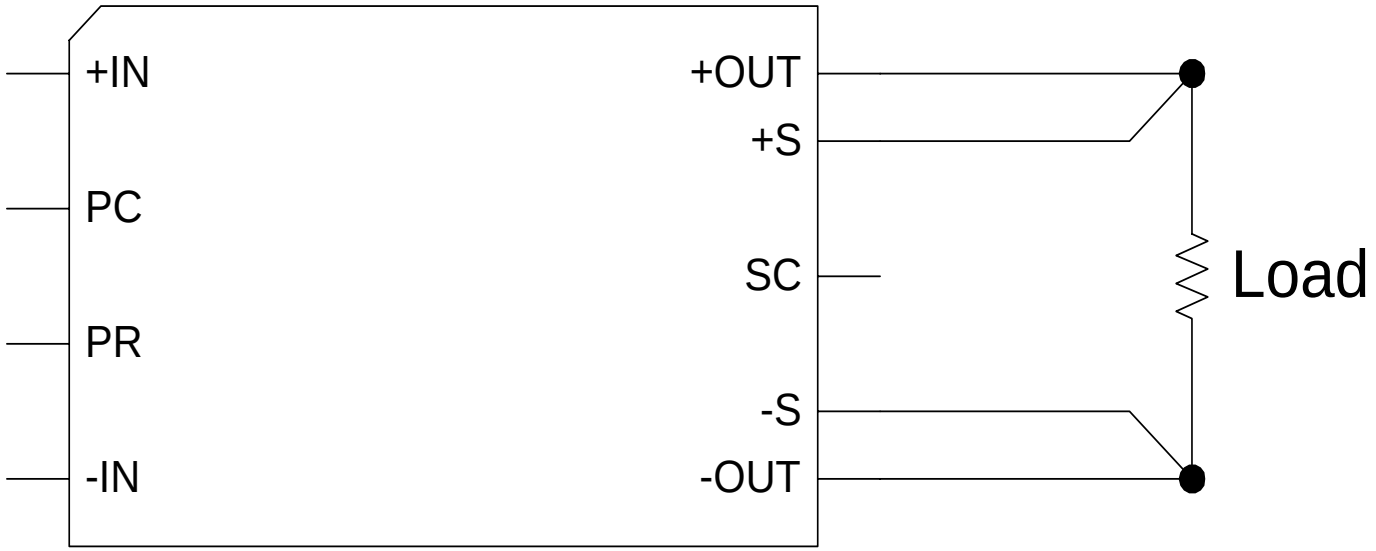
- Closed loop at module output
- No compensation for IR losses



Electrical Performance

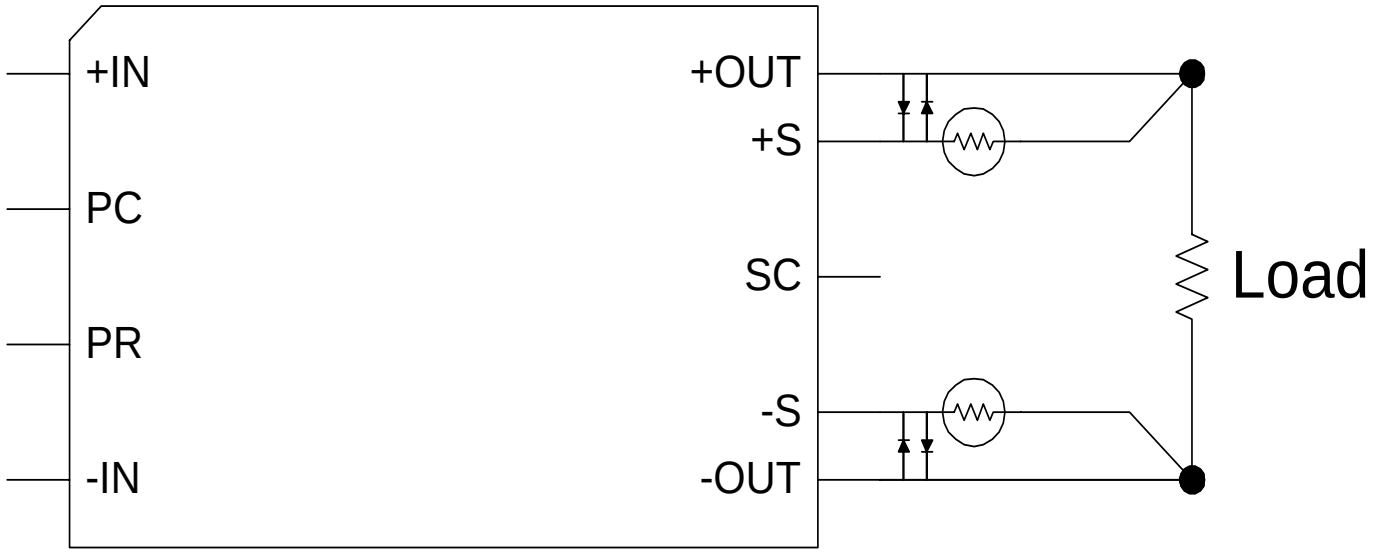
Remote Sense

- Compensation for IR losses
- Loop closed at load



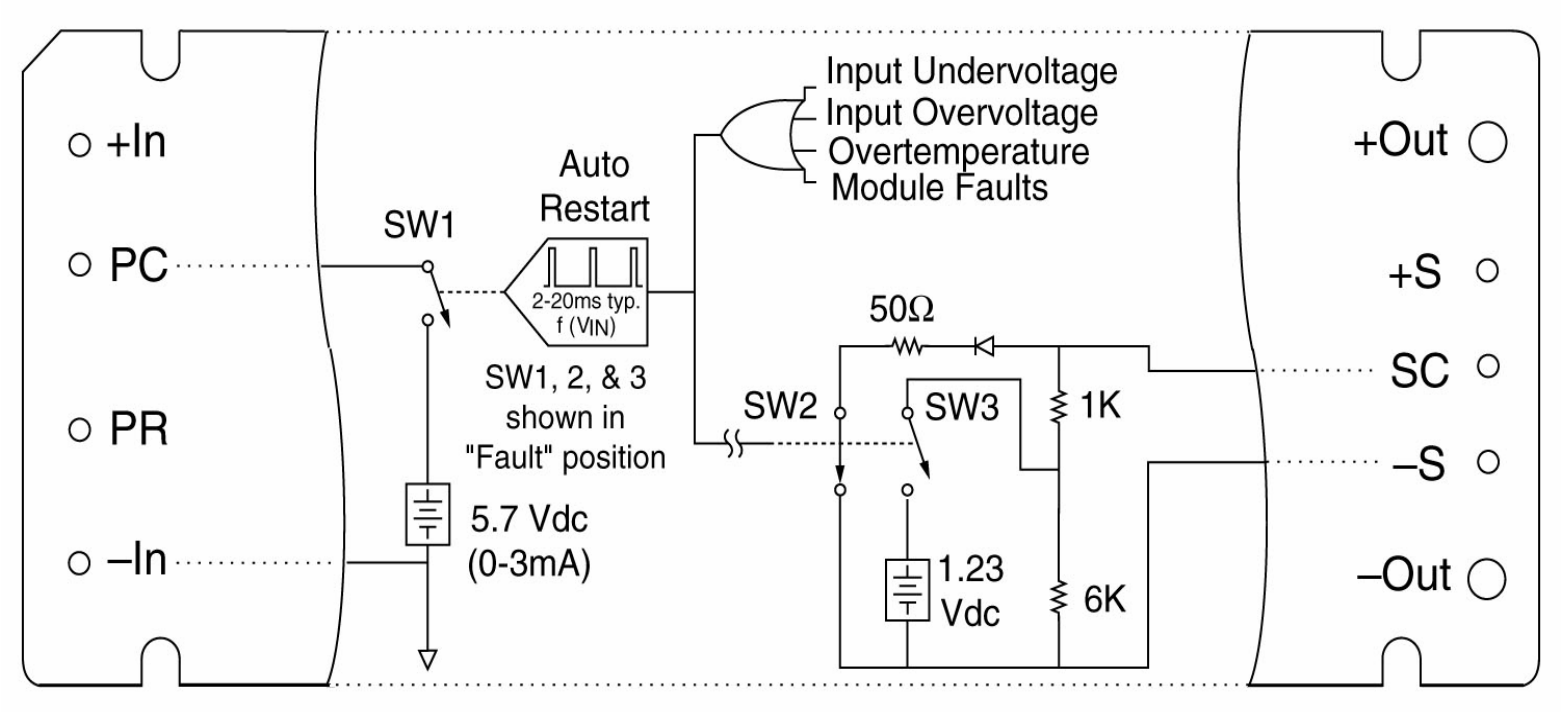
Electrical Performance

- Remote sense with reverse sense and open sense protection



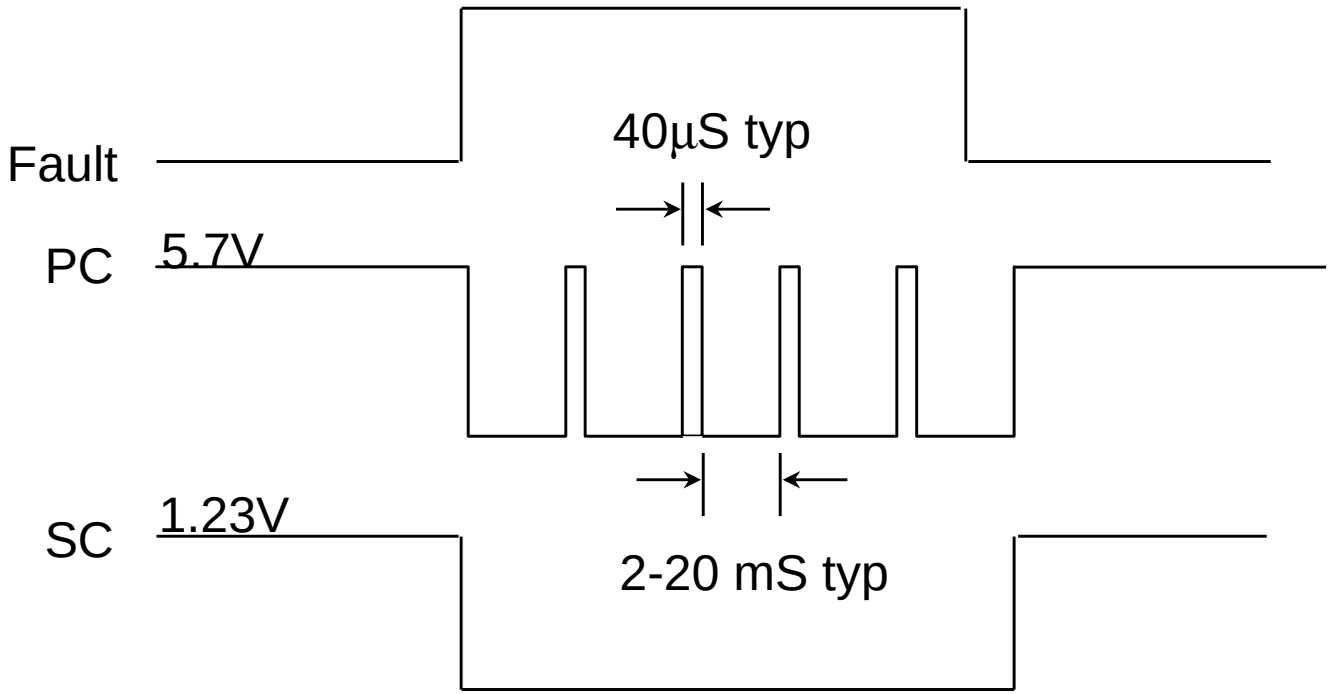
Electrical Performance

PC/SC Module Alarm Logic



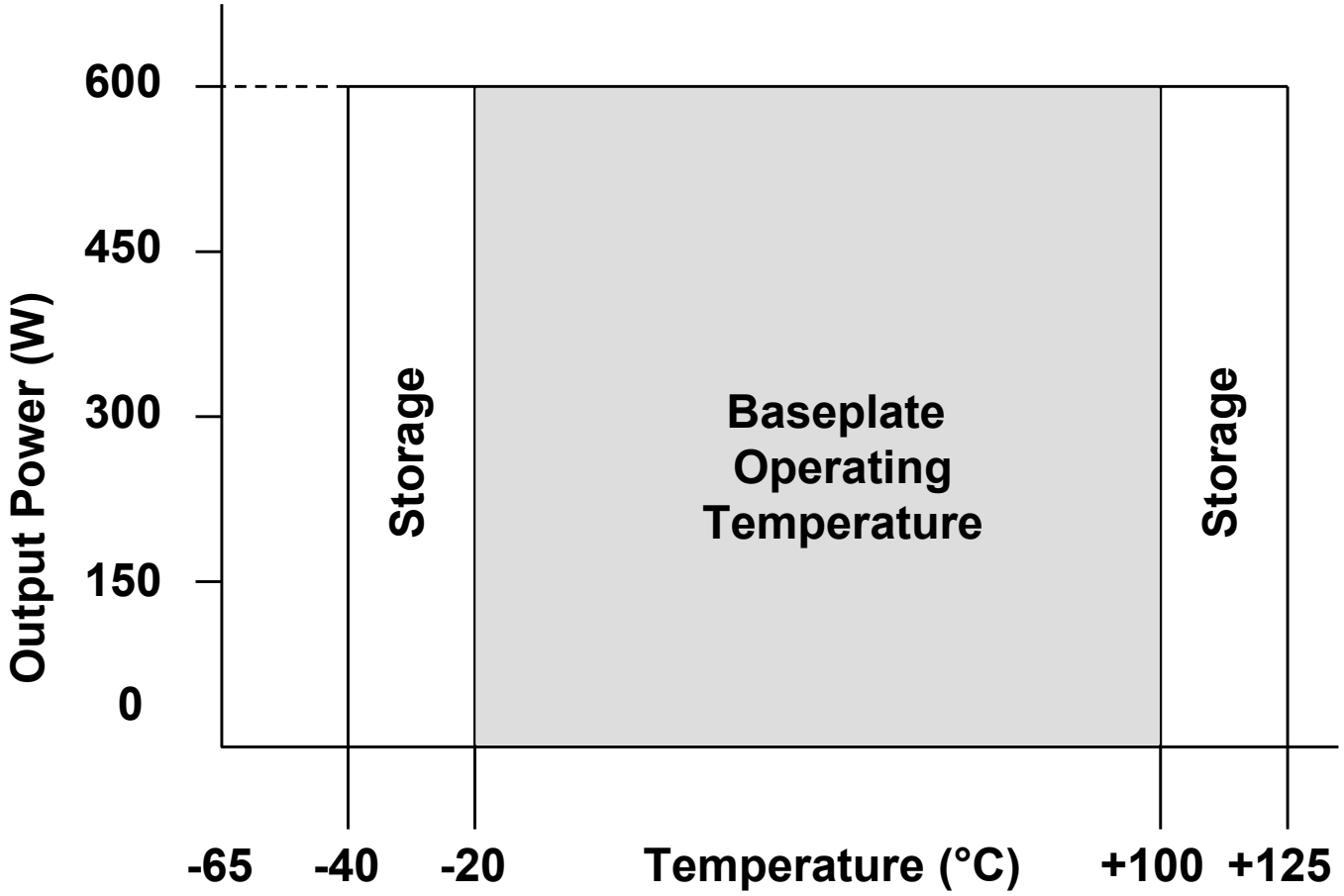
Electrical Performance

PC/SC Module Alarm Timing



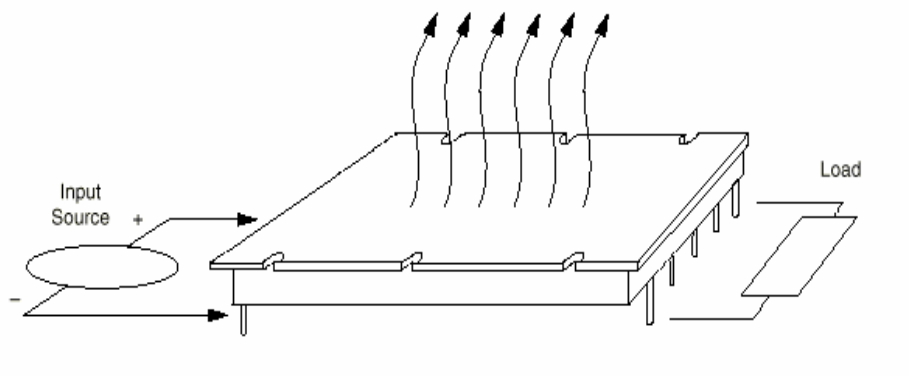
Electrical Performance

Thermal Considerations



Electrical Performance
Thermal Considerations

Power Input = Power Dissipated as Heat + Power Output

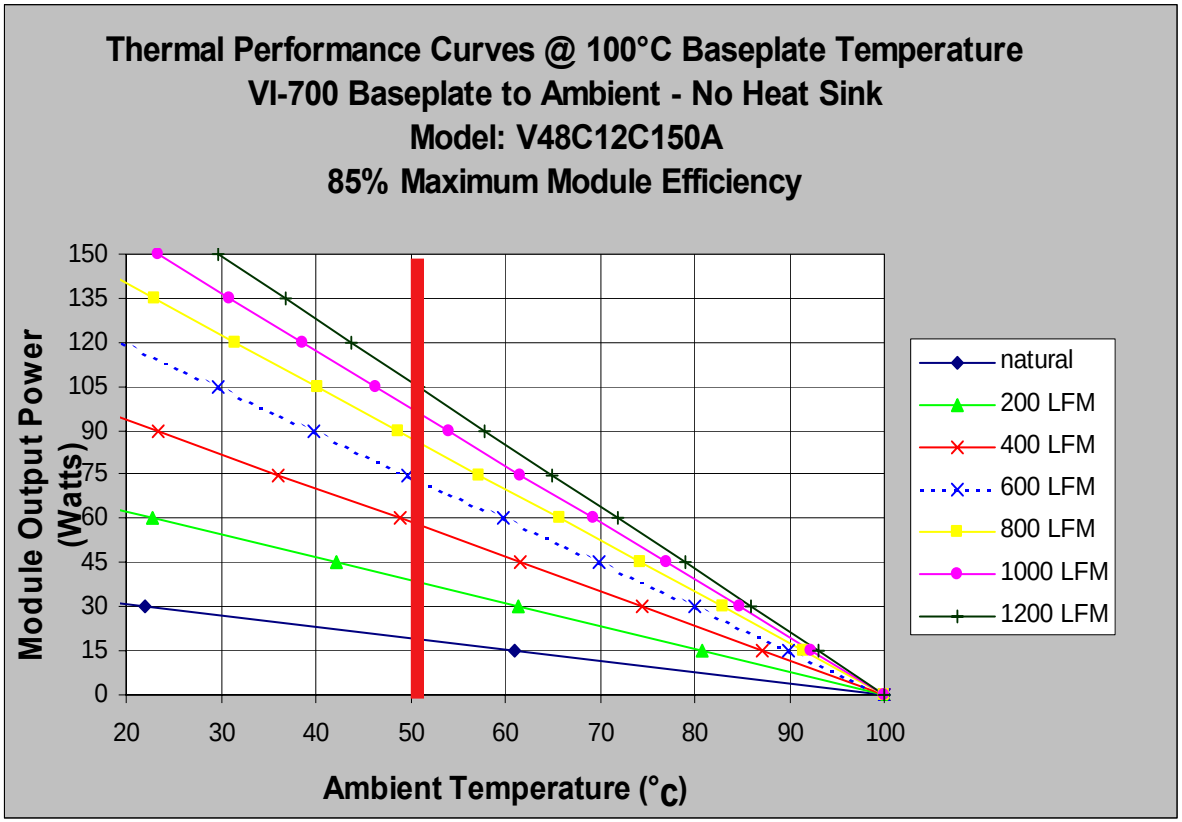


Power Dissipated = (1 – η)/ ηx Power Output
Power Input x Efficiency (η) = Power Output

- Heat is removed through the flat metal baseplate on top of the module
- The baseplate is thermally coupled to, but electrically isolated from heat generating components
- Methods of cooling:
  1. Conduction
  2. Convection
  3. Radiation

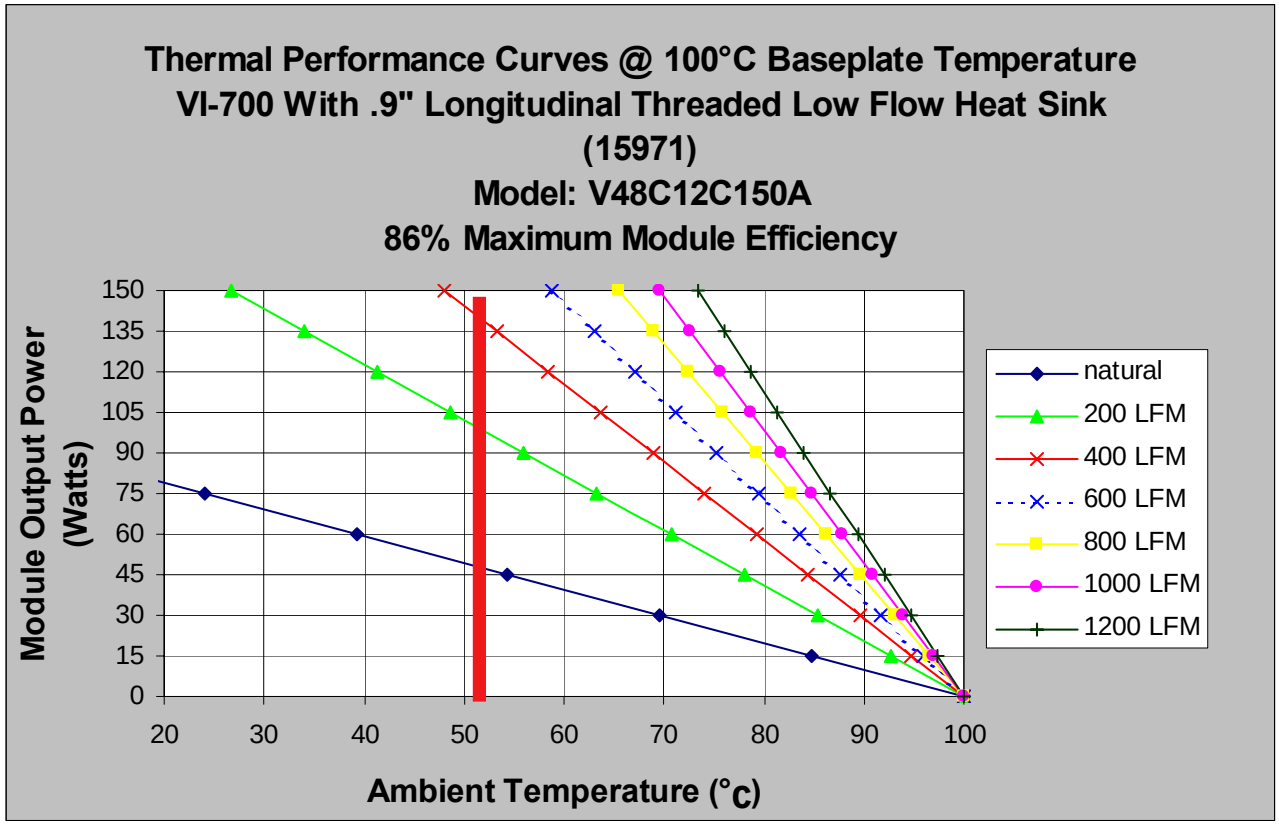
Electrical Performance

Thermal Considerations



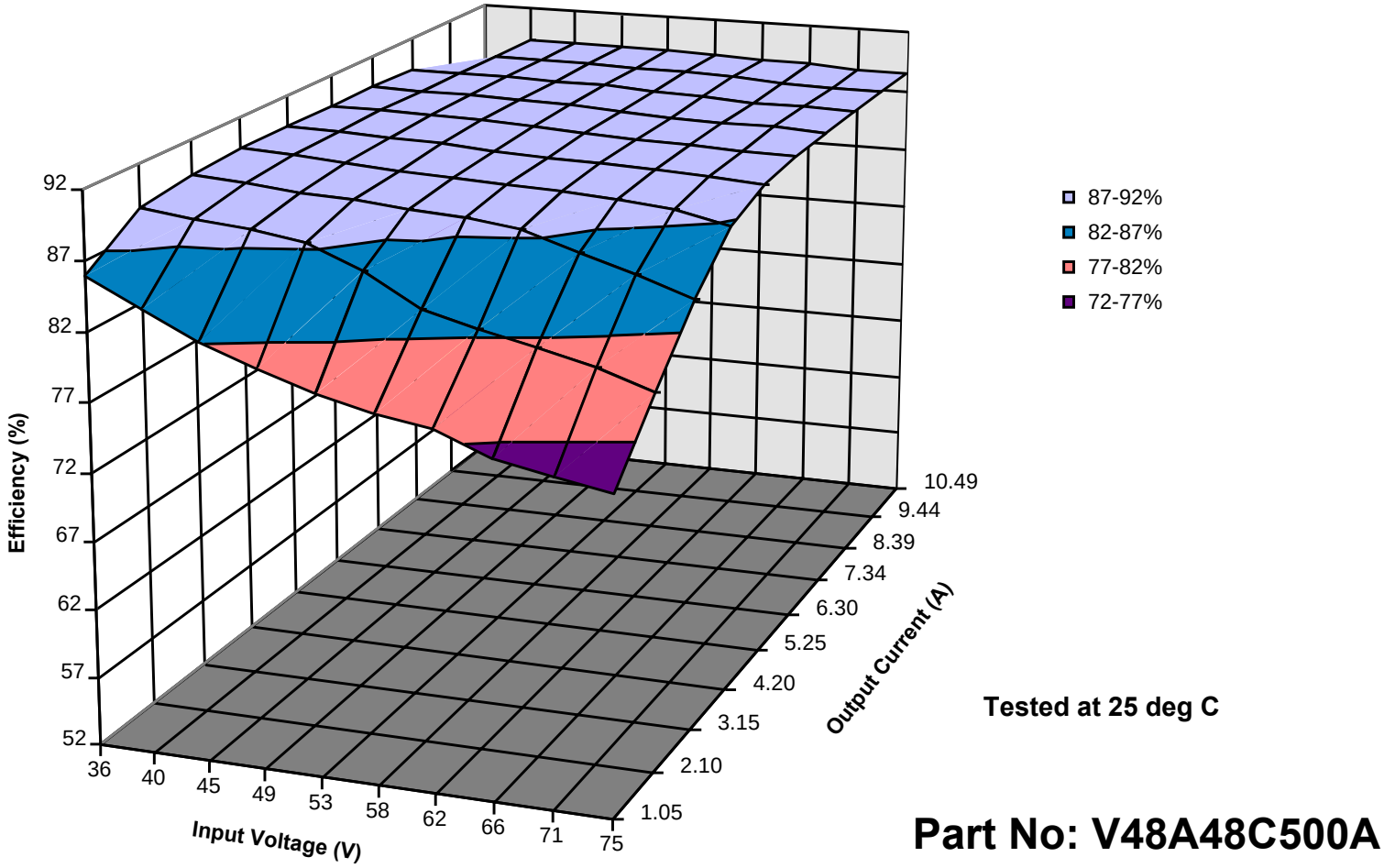
Electrical Performance

Thermal Considerations



Electrical Performance

Thermal Considerations

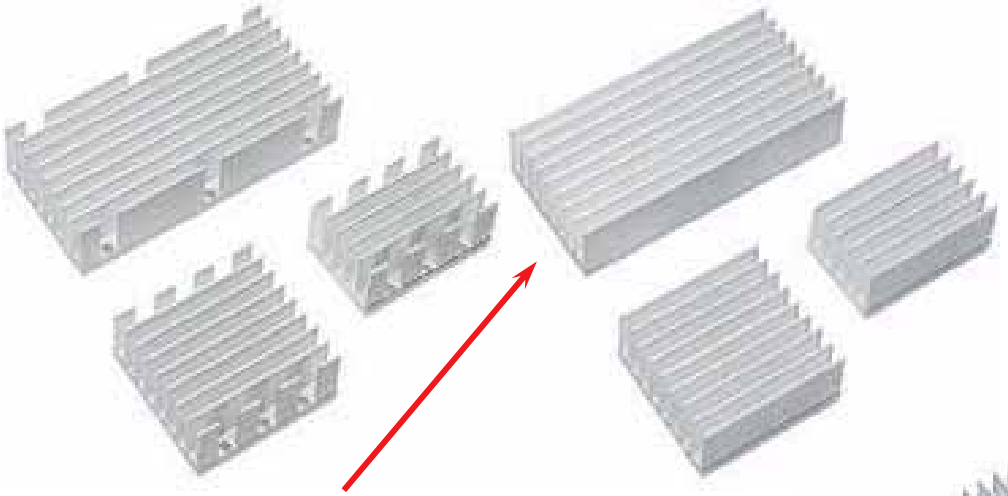


Efficiency vs. input voltage and output current

Electrical Performance

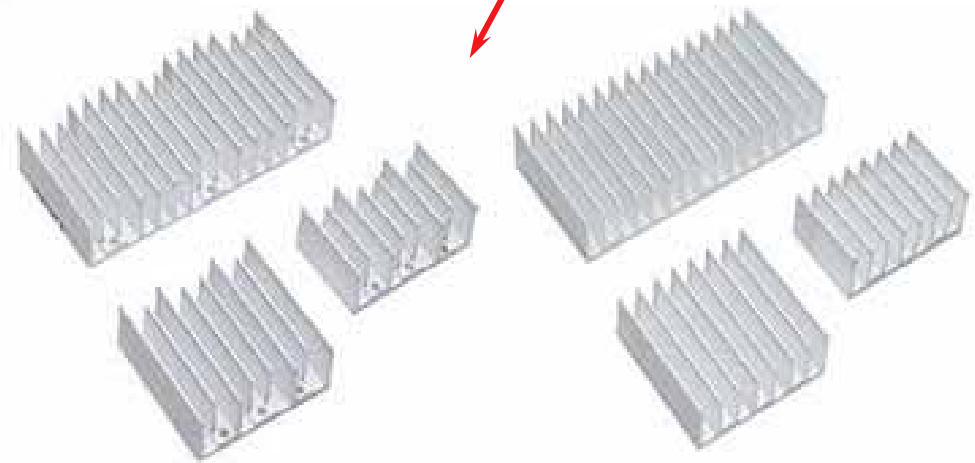
Thermal Considerations

Heat sinks



Longitudinal fins

Transverse fins



Electrical Performance

Thermal Considerations

Heat sinks – Low profile

Power Components Simplify Design

Thermal Considerations

Side fin heat sinks add only 0.125 inches to the module's height

Electrical Performance

Thermal Considerations

ThermMate

- Maxi, Mini and Micro size thermal pads utilizing phase change interface material

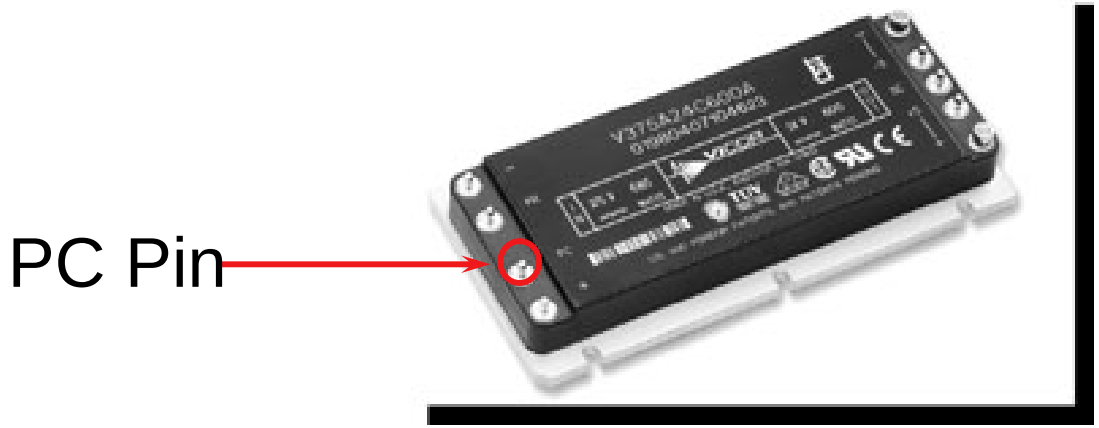
Power Component Design
Control Functions

Control Functions

- Primary control pin (PC)
  - Module enable/disable
  - On-state indicator
- Secondary control pin (SC)
  - Output voltage adjust
  - Module status
- Parallel pin (PR)

Control Functions

Primary Control

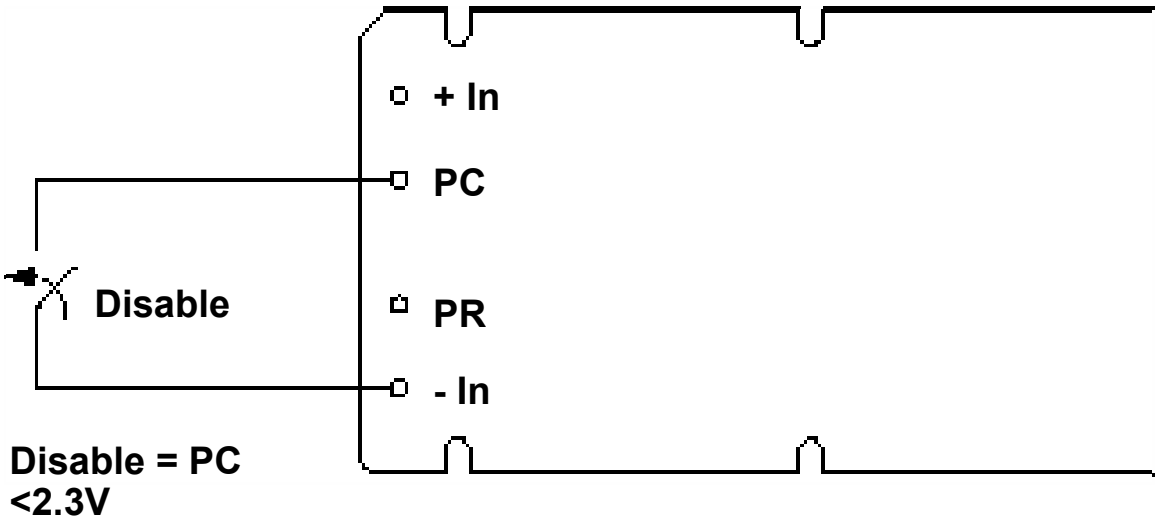


DC Only

- Primary side module disable
- 5.7 volt / 1.5mA primary referenced bias supply
- Module status

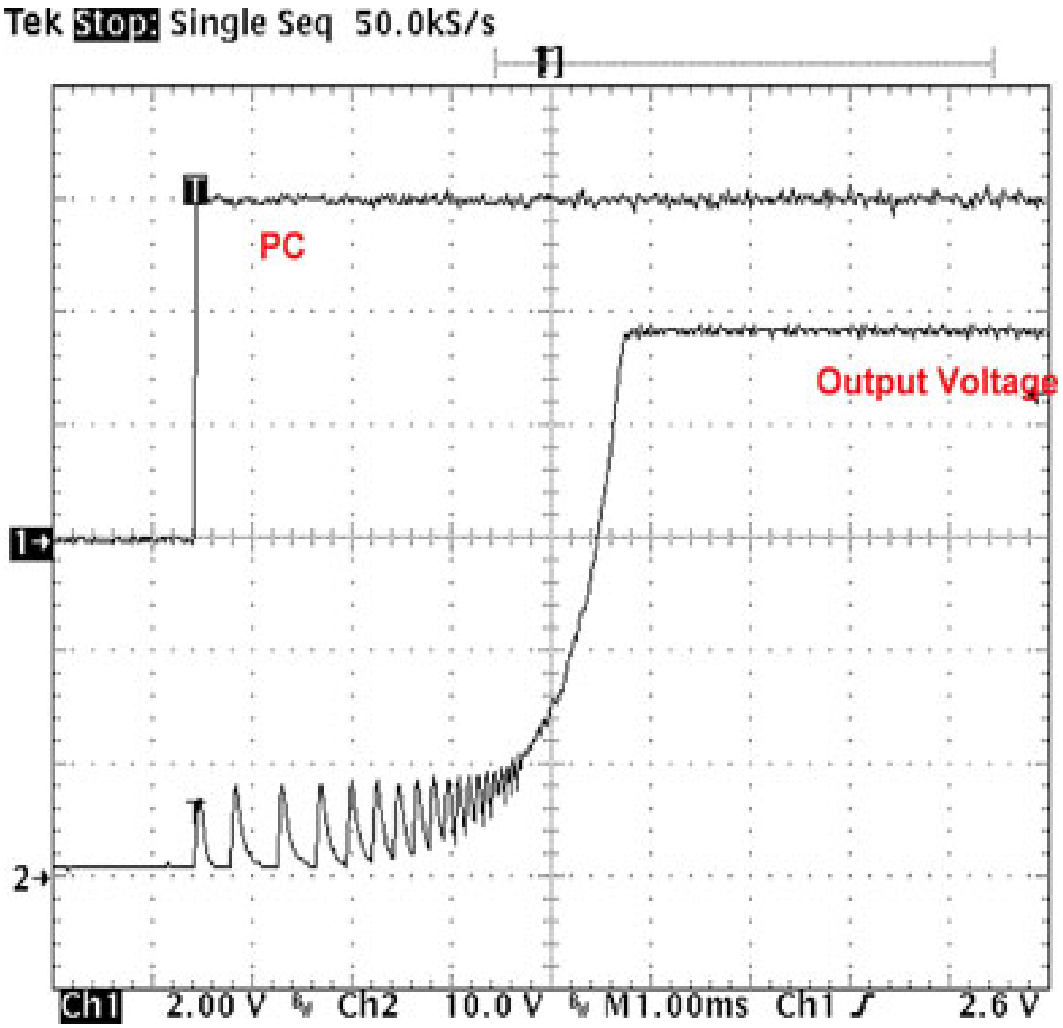
Control Functions

Module Enable/Disable



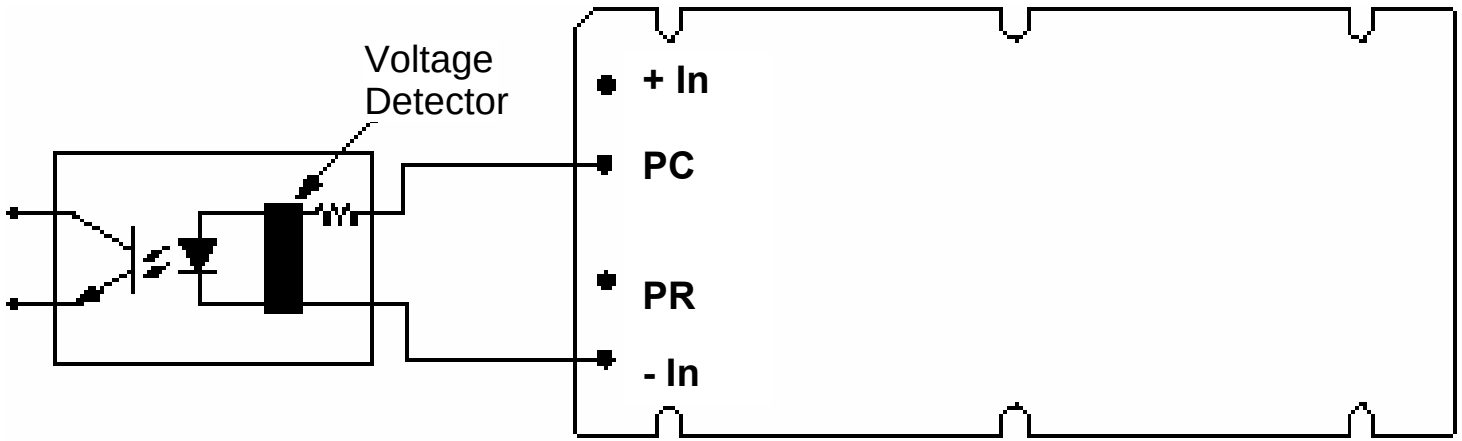
Control Functions

Turn-on Characteristics



Control Functions

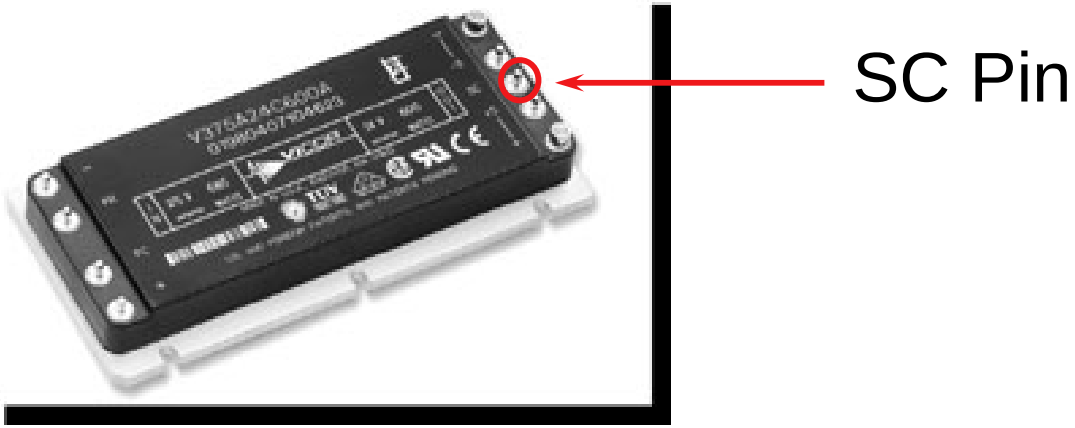
Isolated On-state Indicator



For non-isolated use a 4kΩ resistor and an LED

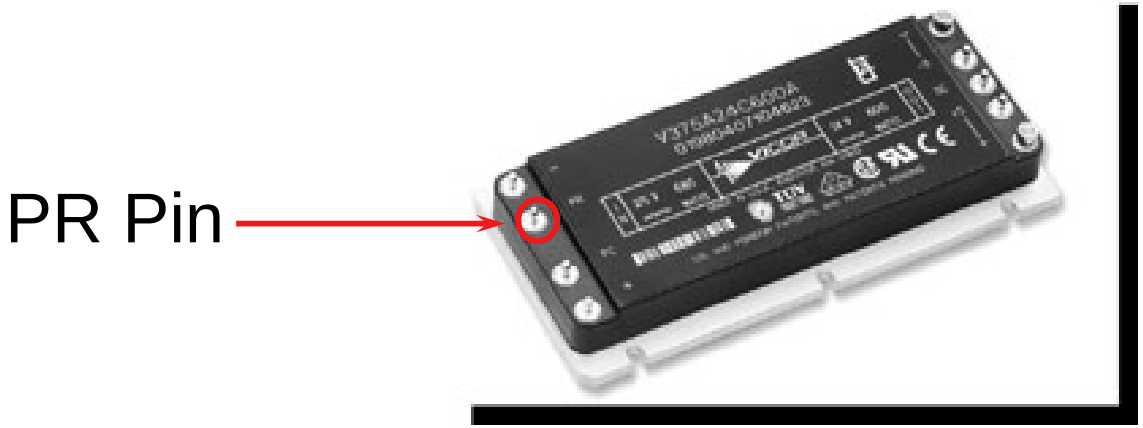
Control Functions

Secondary Control



- Output voltage programming
- Module status
- Converts driver to booster

Control Functions
Parallel (PR)



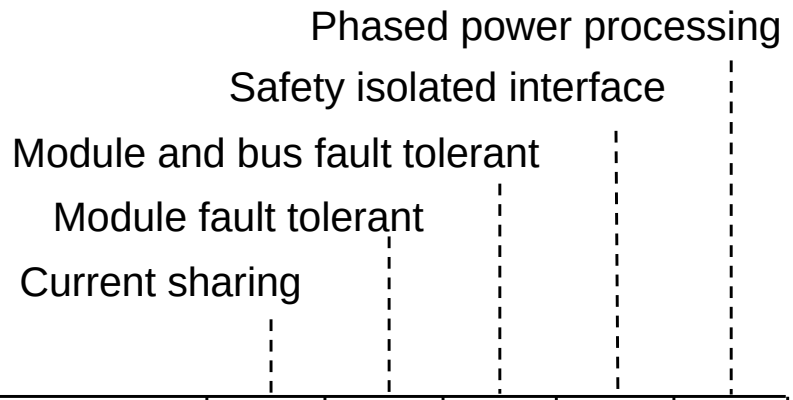
Input Side Connection For Parallel Operation

- Bidirectional transceiver bus
- DC or AC coupled
- Supports fault tolerant configurations

Unique Paralleling Methods

- Eliminates serial connections
- Single wire or fault tolerant architecture
- AC or DC connection
- Instantaneous current sharing

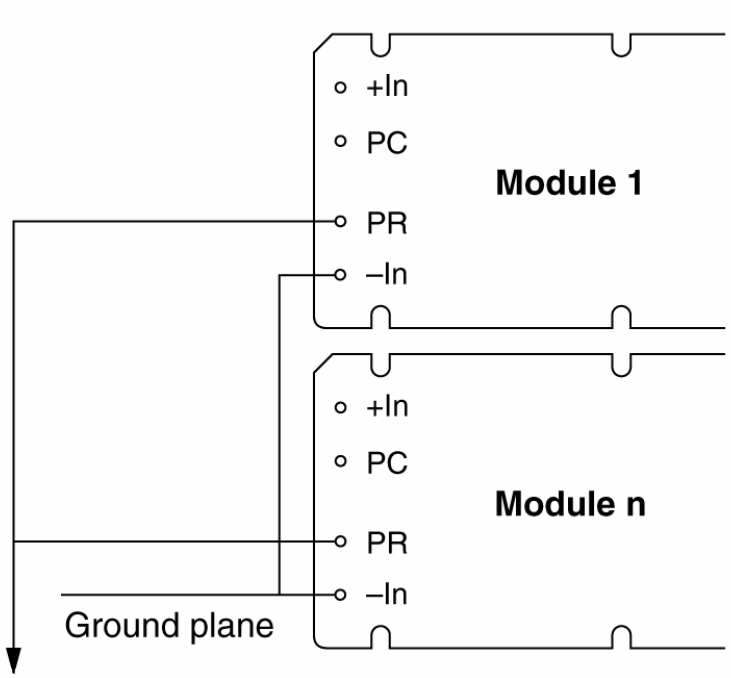
Unique Paralleling Methods
Architectures and Features



Architecture	Current sharing	Module fault tolerant	Module and bus fault tolerant	Safety isolated interface	Phased power processing
DC coupled single wire	✓				
AC coupled single wire	✓	✓			
AC coupled web	✓	✓	✓		
Transformer coupled	✓	✓		✓	
Phased array chip (PAC)	✓				✓

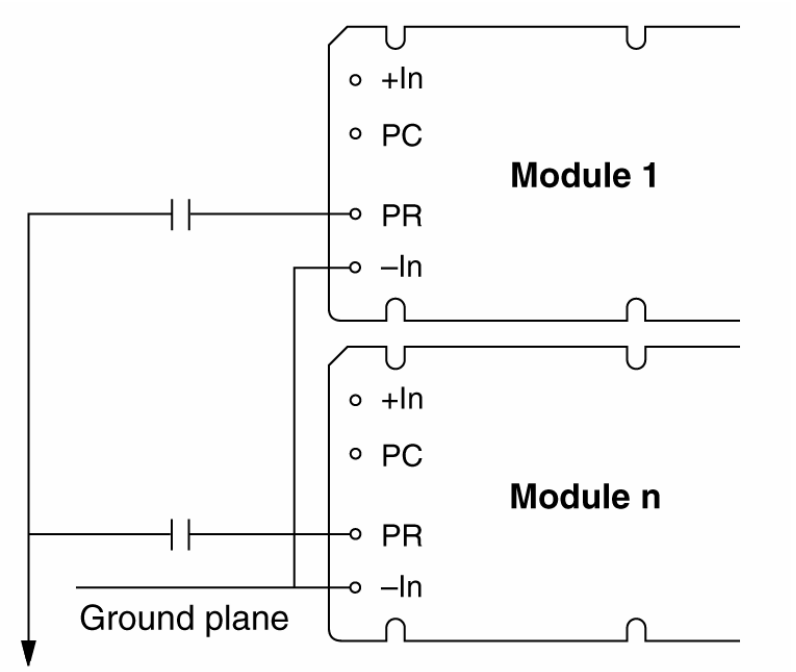
Unique Paralleling Methods
Single Wire DC Architecture

- Simple
- Not fault tolerant



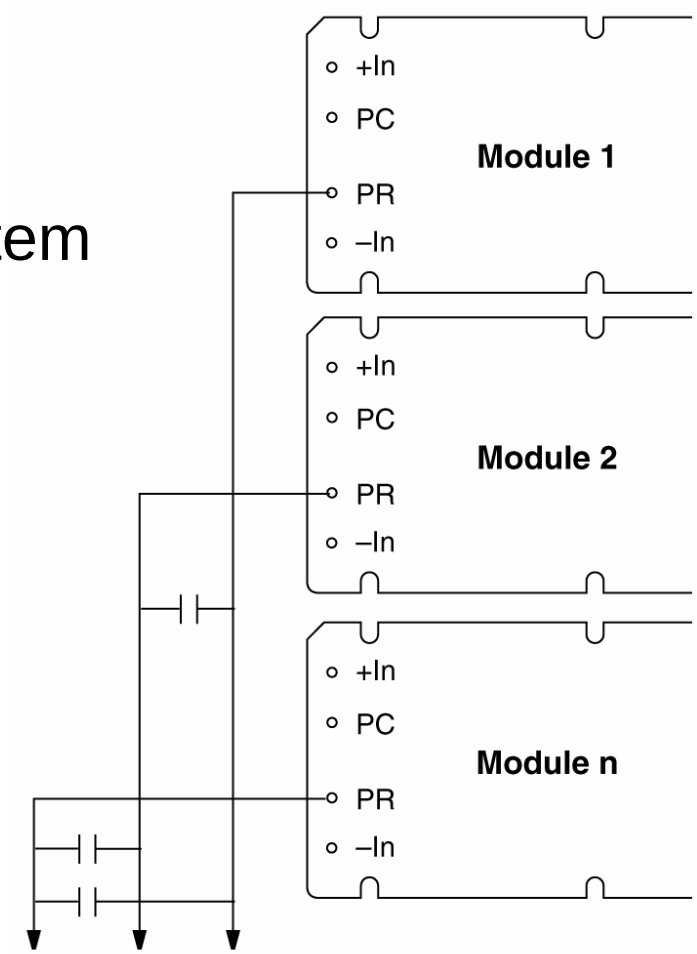
Unique Paralleling Methods
Single Wire AC Architecture

- Simple
- Fault tolerant



Unique Paralleling Methods
AC ‘Web’ Architecture

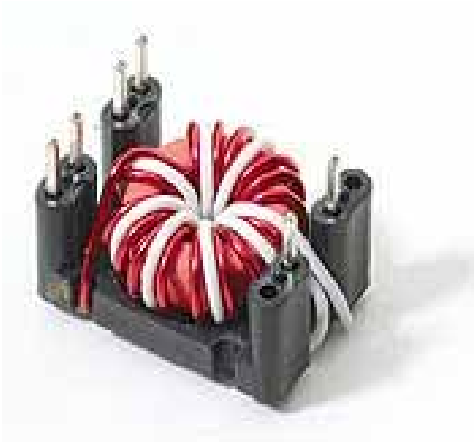
- True fault tolerance
- No single fault will compromise the system



Unique Paralleling Methods

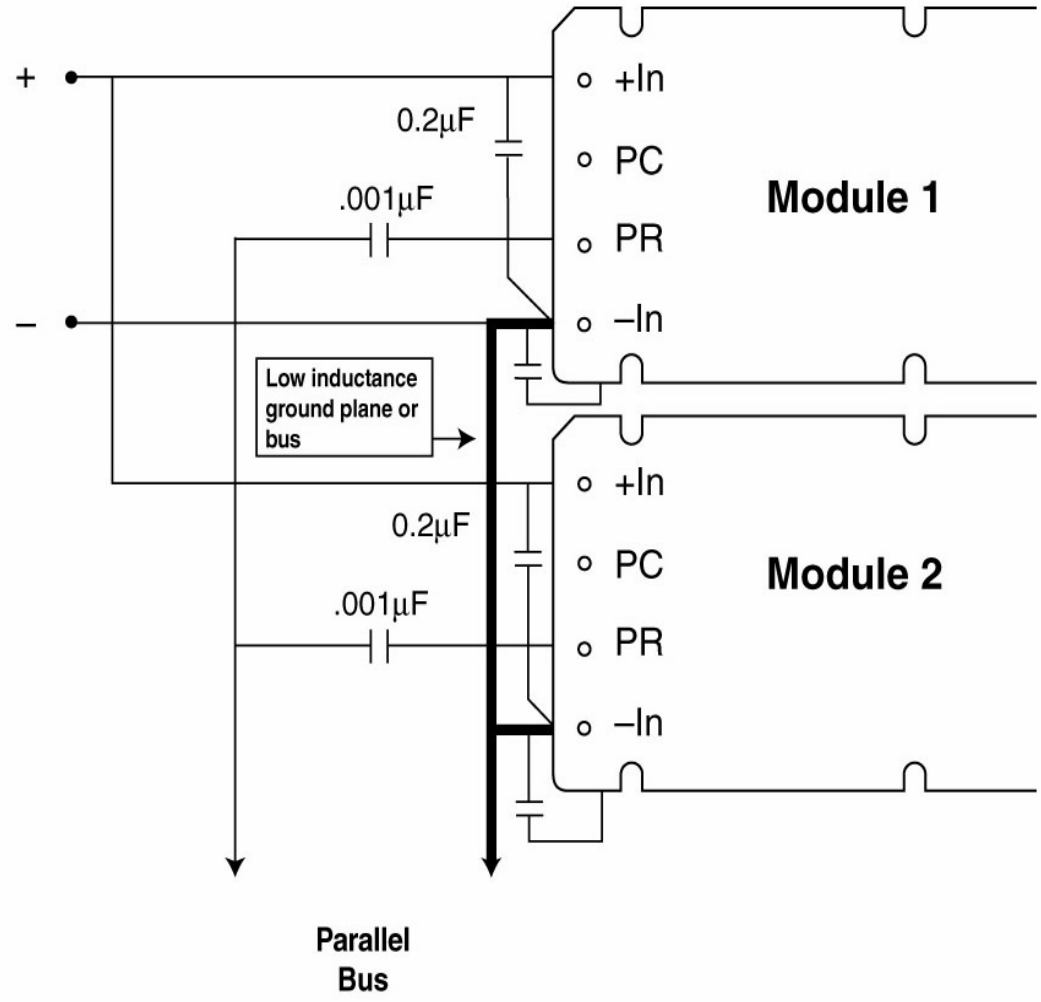
PR Bus Isolation Transformer

- Developed for isolation of PR Bus signal when used with 2nd Generation parallel configurations



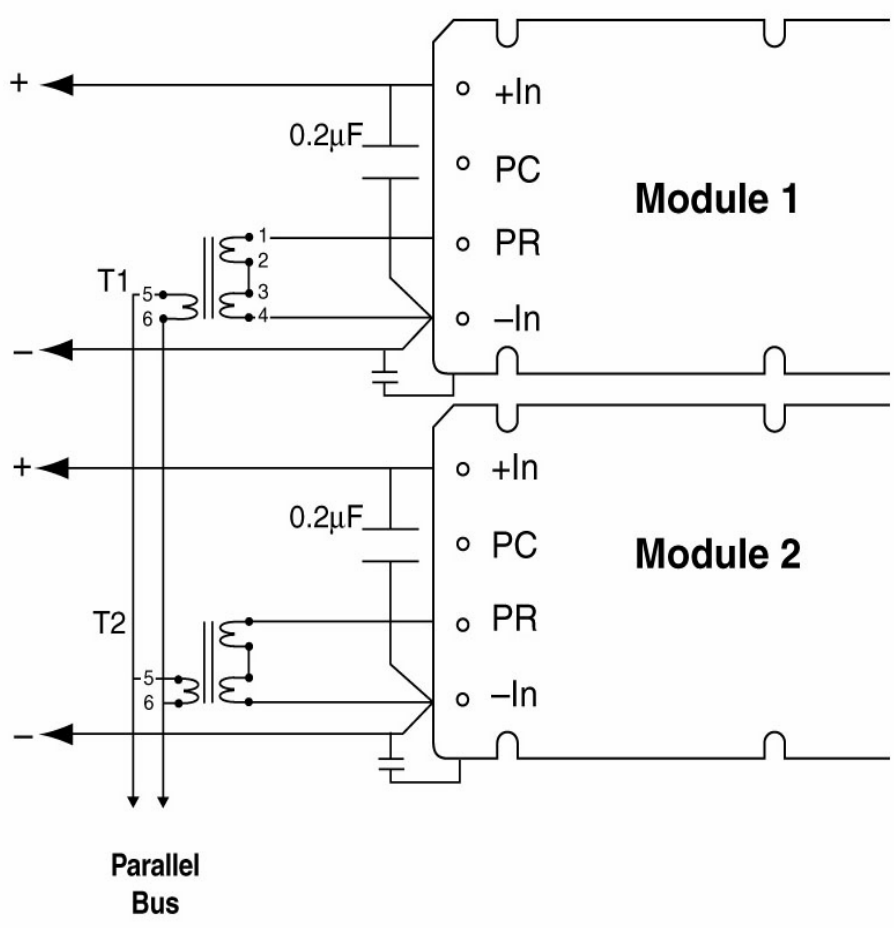
Unique Paralleling Methods

AC Coupled Single-wire Interface



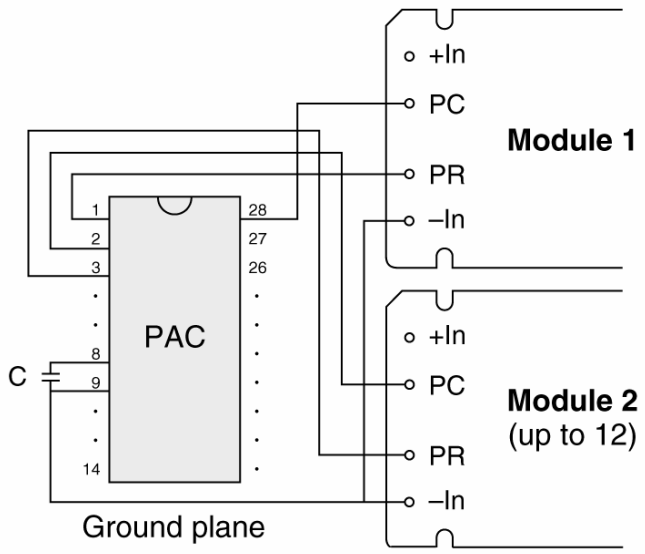
Unique Paralleling Methods

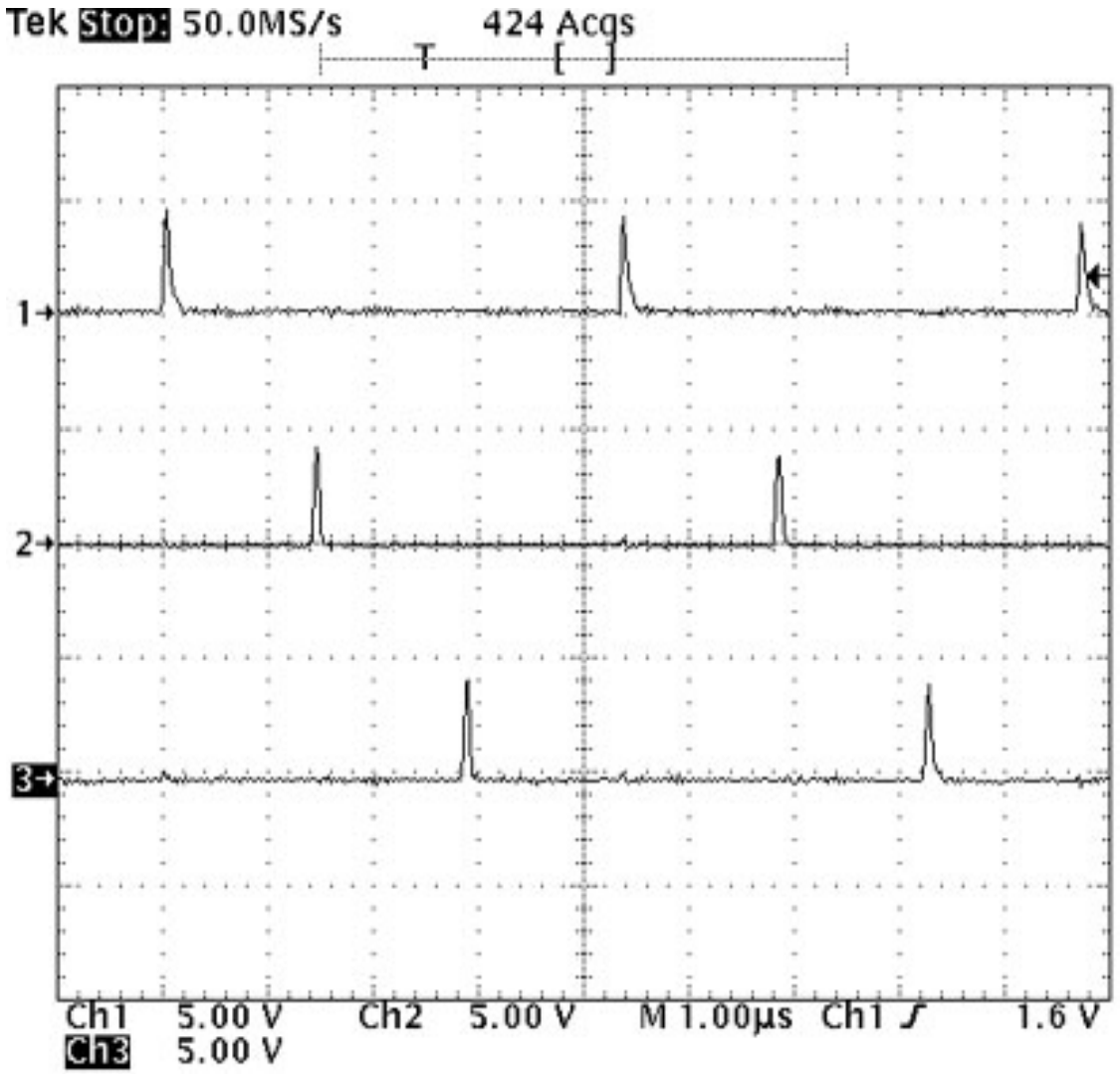
Transformer Coupled Interface



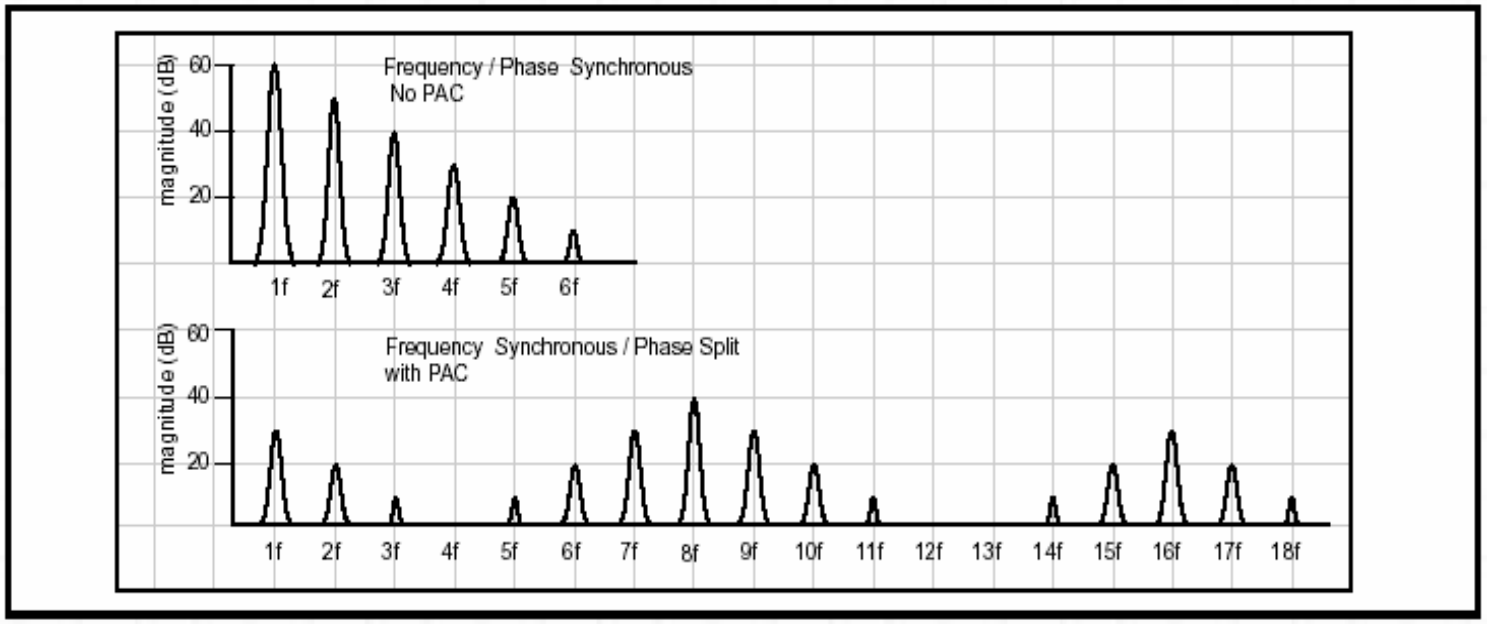
Unique Paralleling Methods

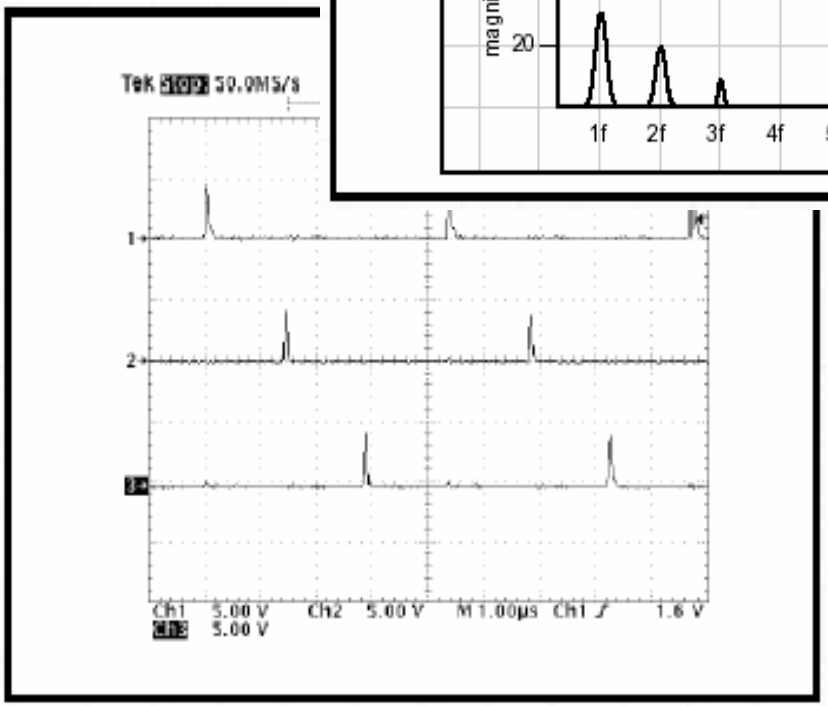
Phased Array Controller (PAC)

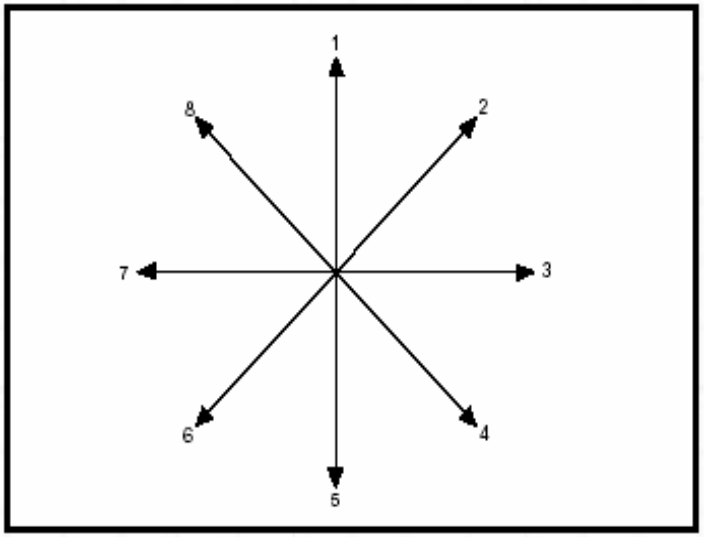




Unique Paralleling Methods







Module Do’s and Don’ts
Safety Considerations

- In accordance with safety agency requirements, if the baseplate is accessible, it must be connected to earth or chassis ground in the end product

Electrical Safety Concepts

Insulation Withstand: Terms and Definitions

Operational insulation:	Between secondary circuits and chassis/earth ground
Basic insulation:	Between primary circuits and chassis/earth ground
Reinforced insulation:	Between primary and secondary circuits
Class I:	Protection against electric shock is achieved by using basic insulation
Class II:	Protection against electric shock relies upon reinforced insulation

Electrical Safety Concepts

Safety Approval

Vicor products are safety approved as Class I equipment, incorporating Class II circuitry. The withstand voltages, as defined in the product documentation, are in accordance with Clause 5.3 Electric Strength of EN 60950, “Safety of Information Technology Equipment, including Electrical Business Equipment” and in accordance with the requirements stated on Page 3 of EN 50116, “Production Hi-pot”.

Electrical Safety Concepts

Vicor Engineering Type Tests

All isolation boundaries, i.e., operational, basic and reinforced are evaluated according to EN60950, Table 18 for a period of 60 seconds. Typical Hi-pot values are:

- 1500Vac / 2121Vdc input to baseplate
- 3000Vac / 4242Vdc input to output
- 500Vac / 707Vdc output to baseplate

Electrical Safety Concepts
Vicor Production Hi-pot

All isolation boundaries are Hi-pot tested according to EN50116, production Hi-pot, except as noted:

- 100% test: input to baseplate at 1500Vac / 2121Vdc for minimum of
  2 seconds for AC-DC and DC-DC products
- 100% test: input to output at 3000Vac / 4242Vdc for a minimum of
  2 seconds for isolation transformer
- 100% test: input to output at 3000Vac / 4242Vdc for a minimum of
  2 seconds for “Brains”
- Vendor-supplied isolation transformers are 100% pre-tested at 3000Vac / 4242Vdc
- Opto isolators are 100% pre-tested according to VDE0884

Electrical Safety Concepts
Hi-pot Requirements

- EN 60950 allows for certain electrical components in the power supply to be removed for type test. Capacitors connected between the power supply's output and chassis usually have a lower voltage rating than the Hi-pot voltage and can be damaged during Hi-pot type test; they can be removed for the test
- It is possible for a power supply to pass the original type test with those capacitors removed, subsequently pass the reduced production line test with them in place, but then fail during the end user's type test

Module Do’s and Don’ts

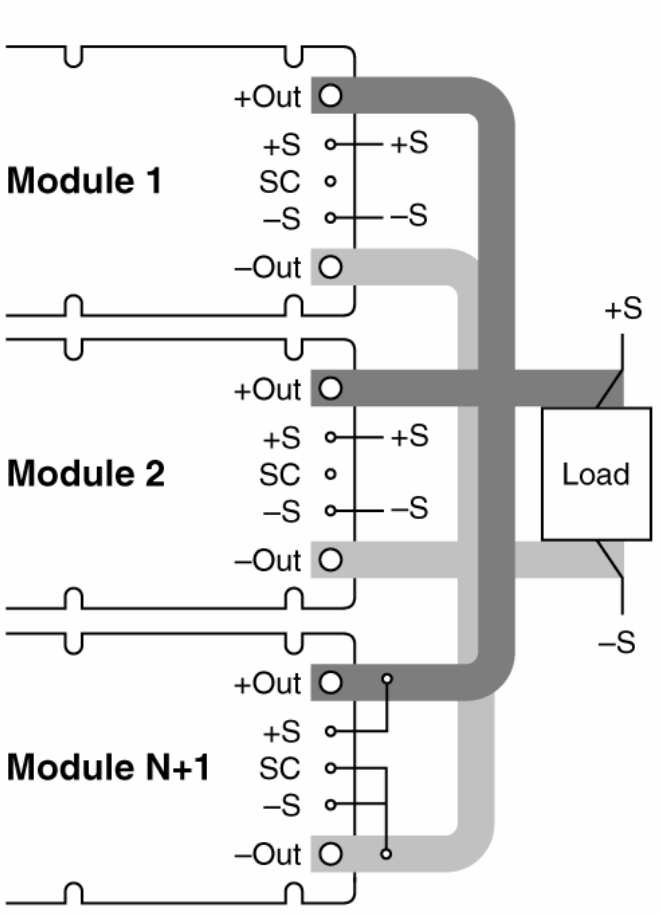
Closing the Loop

- Maxi and Mini DC-DC converters require proper termination of their sense pins in order to prevent an open loop condition

Module Do’s and Don’ts

Module Array Output Connections

- Large power bus to minimize and balance parasitic impedance from each module output to the load
- Sense pins should be tied to the same point on the respective power bus
- To minimize interconnections, modules may be configured as slaves by shorting SC to -S
- Or'ing diodes, in series with each +Out pin, provide module output fault tolerance

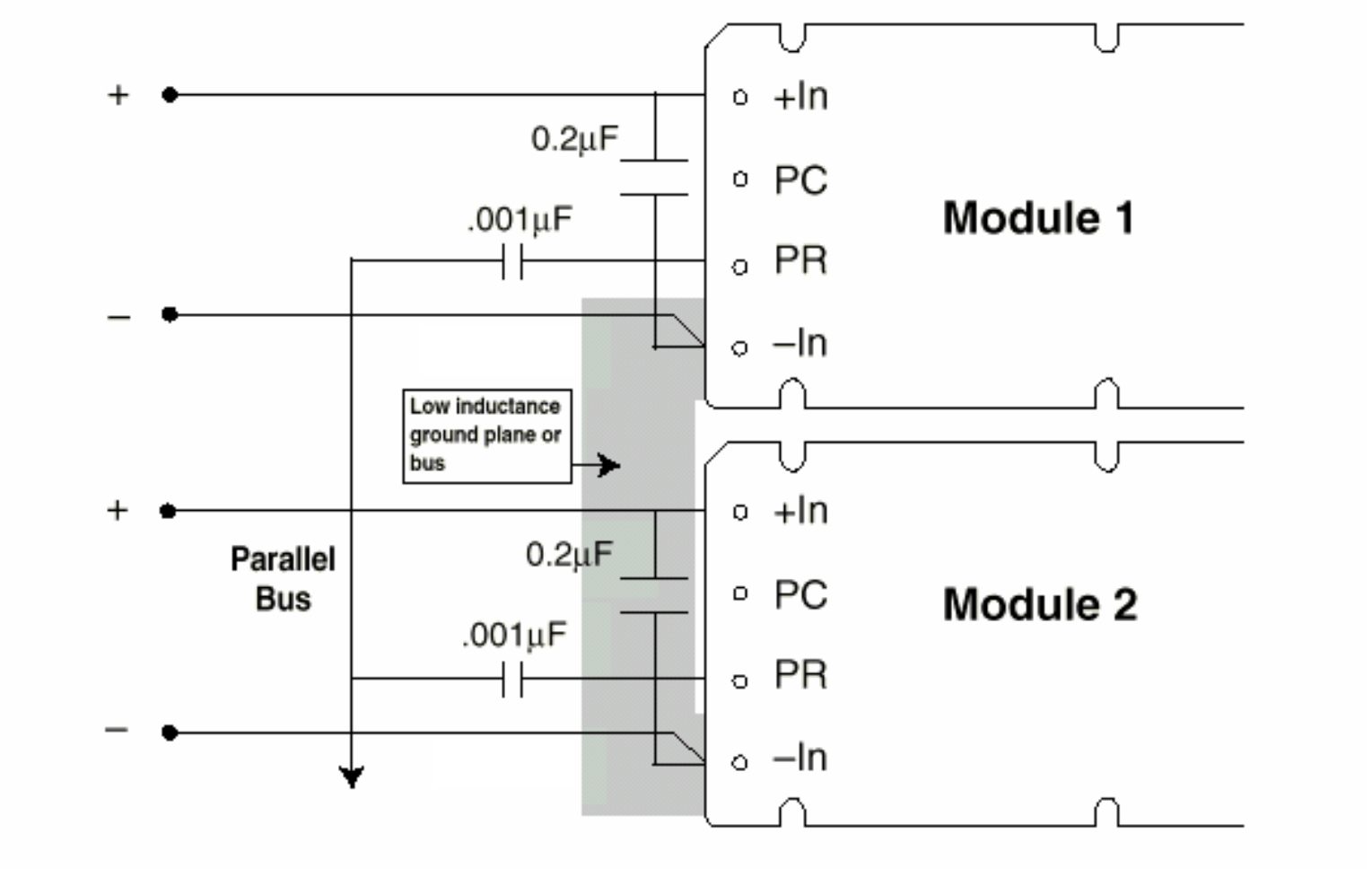


Module Do's and Don'ts

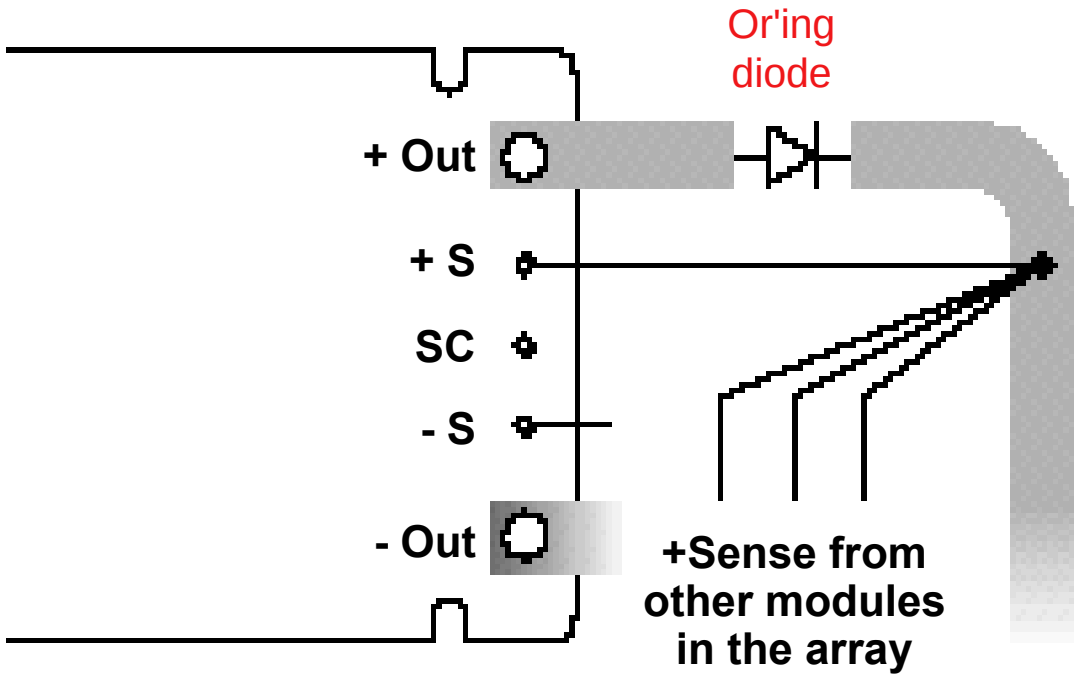
High Power Arrays

- Every module should be fused
- Every module should be by-passed using Y-type capacitors between each input lead and the baseplate and a capacitor across the input leads of the modules for lower input source impedance
- Up to 12 modules can be directly connected in parallel using the PR pin
- -In bus should have common low impedance as the
  PR pin is referenced to -In

Module Do's and Don'ts
Connection Technique



Module Do’s and Don’ts
Fault Tolerant

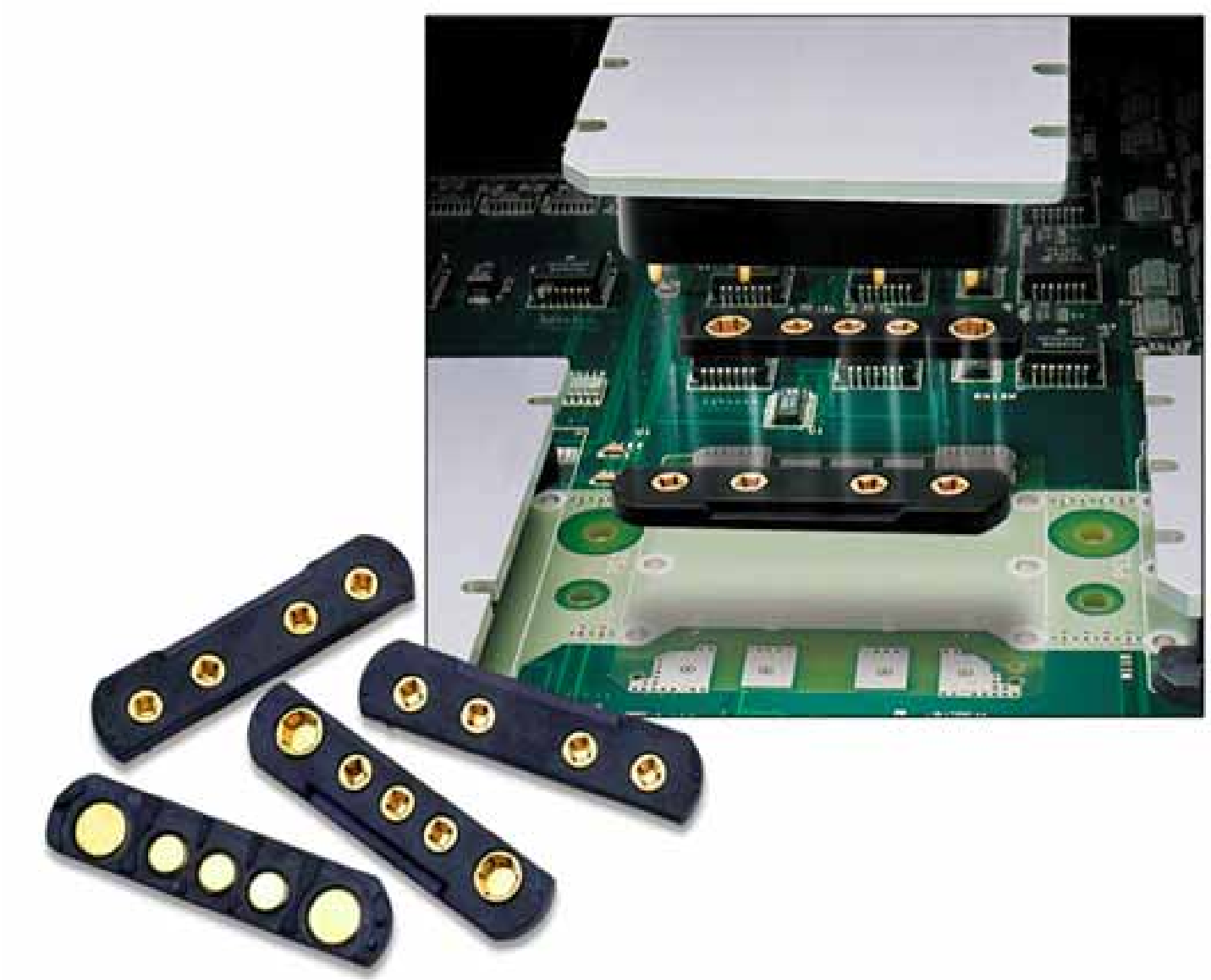


Power Component Design

Mounting Methods

In-board vs.On-board

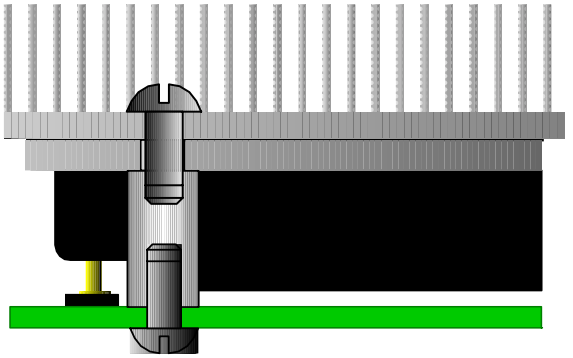
Mounting Methods



Mounting Methods

Surface Mount Socketing System

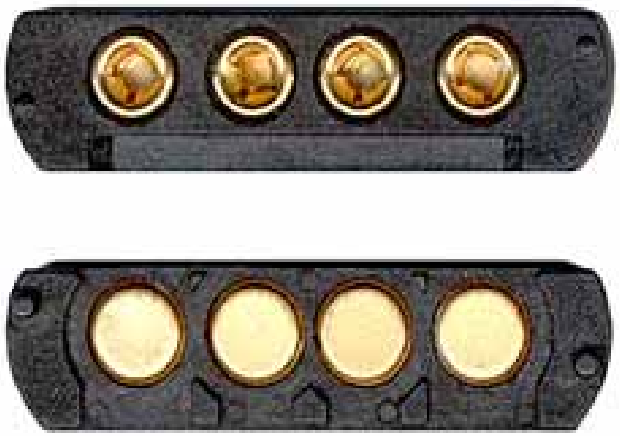
- Surface mount header
- Standoffs
- 2nd Generation module with ModuMate (gold plated pin) option
- Thermal pad
- Heat sink



Mounting Methods

SurfMate Sockets

- Surface mountable
- Qualified tested for up to 100 Amperes
- Rated for up to 5 module insertions and extractions
- Sockets are pre-installed on plastic headers
- Header is not removed after soldering



Mounting Methods
InMate Sockets

- Installs into plated thru-holes for on-board or in-board module mounting
- Qualified tested to 100 Amperes
- Rated for 5 module insertions and extractions
- InMates are shipped preinstalled on disposable plastic headers

Mounting Methods

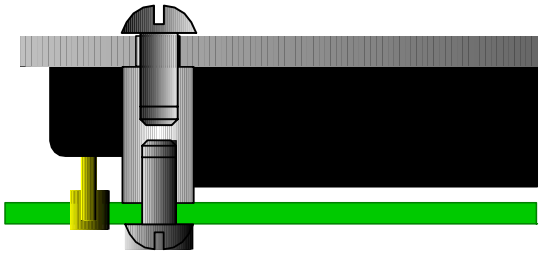
Socket Installation

- Header and socket assembly is first installed onto PCB
- Header insures proper installation height and alignment of sockets
- After soldering, the plastic header is removed and discarded

Mounting Methods

Socket Component System

- Sockets
- Standoffs
- 2nd Generation module with ModuMate (gold pin) option



Mounting Methods

Socket Component System

- Exchange tool allows for the proper removal of a socketed 2nd Generation module
- Prevents uneven stresses on socket fingers during module extraction which can degrade socket to pin interface
- Available for maxi, mini, and micro module sizes

Power Component Design

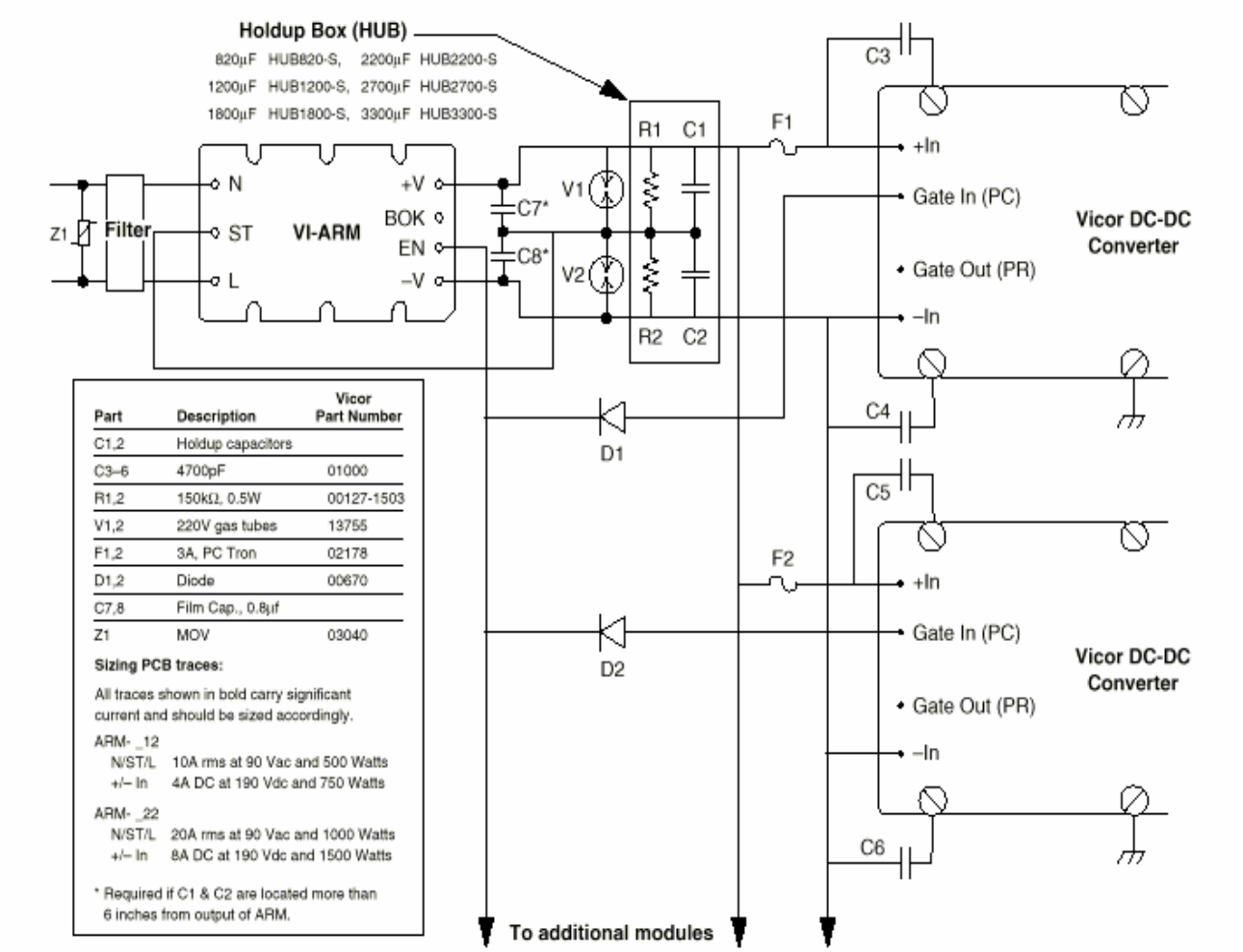
Applications Examples

Applications Examples

- High power array
- Hotswap application
- Implementing remote sense to micro modules

Applications Examples

High Power Array Application



Part	Description	Vicor Part Number
C1,2	Holdup capacitors	
C3–6	4700pF	01000
R1,2	150kΩ, 0.5W	00127-1503
V1,2	220V gas tubes	13755
F1,2	3A, PC Tron	02178
D1,2	Diode	00670
C7,8	Film Cap., 0.8µf	
Z1	MOV	03040

Sizing PCB traces:

All traces shown in bold carry significant current and should be sized accordingly.

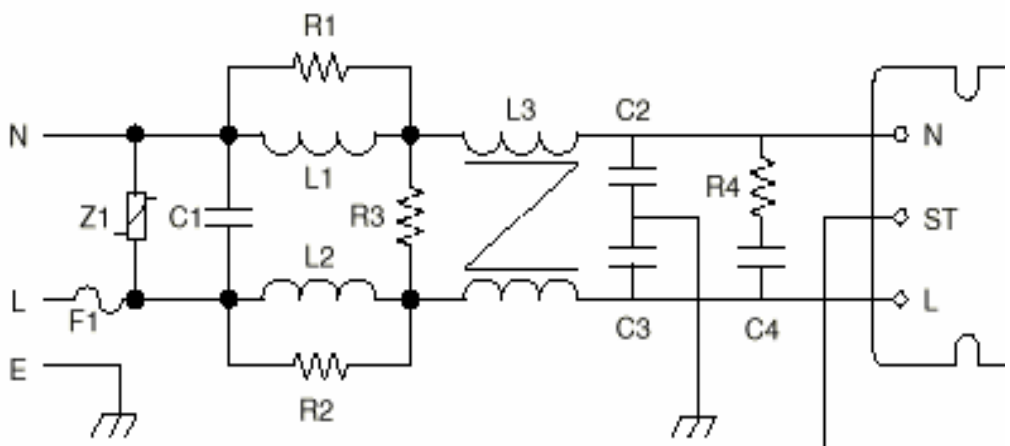
ARM- _12
N/ST/L 10A rms at 90 Vac and 500 Watts
+/– In 4A DC at 190 Vdc and 750 Watts

ARM- _22
N/ST/L 20A rms at 90 Vac and 1000 Watts
+/– In 8A DC at 190 Vdc and 1500 Watts

* Required if C1 & C2 are located more than 6 inches from output of ARM.

Applications Examples

High Power Array Application



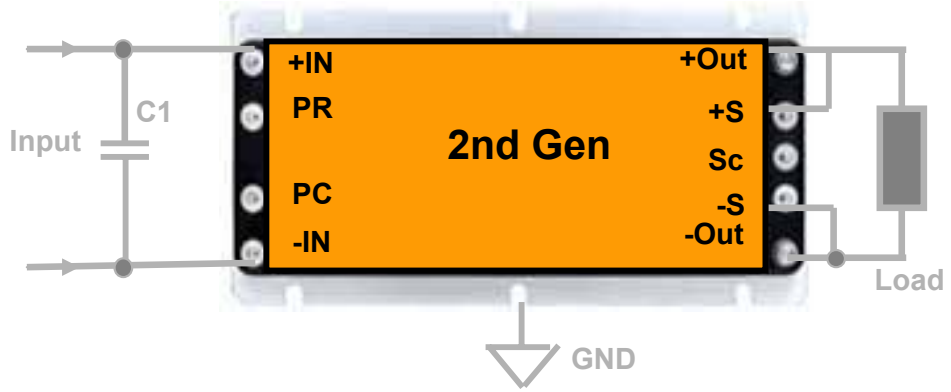
Part	Description	Vicor Part Number
C1	1.0µF	02573
C2, C3	4700pF	01000
C4	0.15µF	03269
F1	12A fuse	05147
L1, L2	27µH	14563
L3	1.3mH	15016
R1, R2	10Ω	
R3	150kΩ, 0.5W	00127-1503
R4	2.2Ω	
Z1	MOV	03040

- The recommended input filter consists of a common mode choke and Y-capacitors (line-ground) plus two additional inductors and an X-capacitor (line-line)
- This filter configuration provides sufficient insertion loss to comply with the Level-B conducted emissions limit

FARM (Filter/Autoranging Rectifier Module)

EMI Compliance

Differential-mode Capacitor

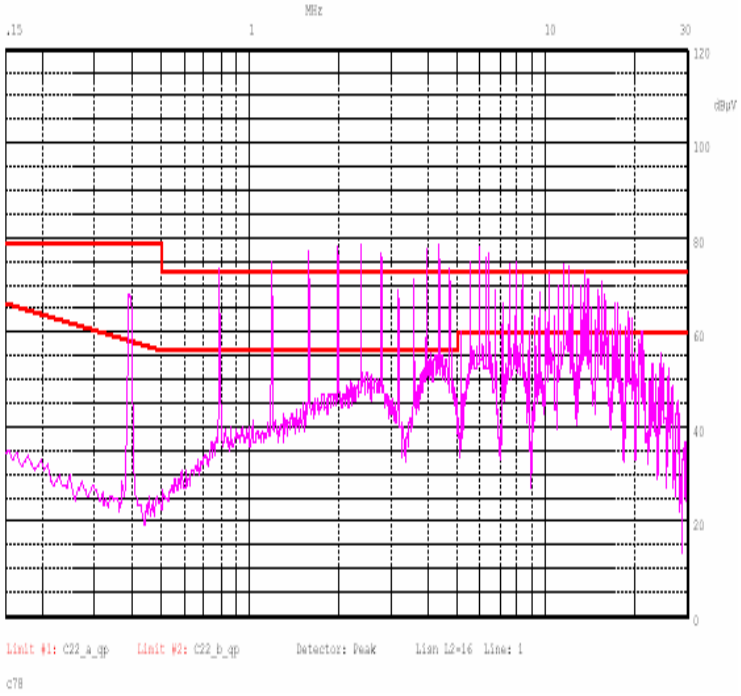


C1: 120µF 100V Electrolytic Capacitor

- Ensures low input impedance
- Creates stability and good transient response
- Should be as close as possible to the module input

EMI Compliance

Differential-mode Capacitor



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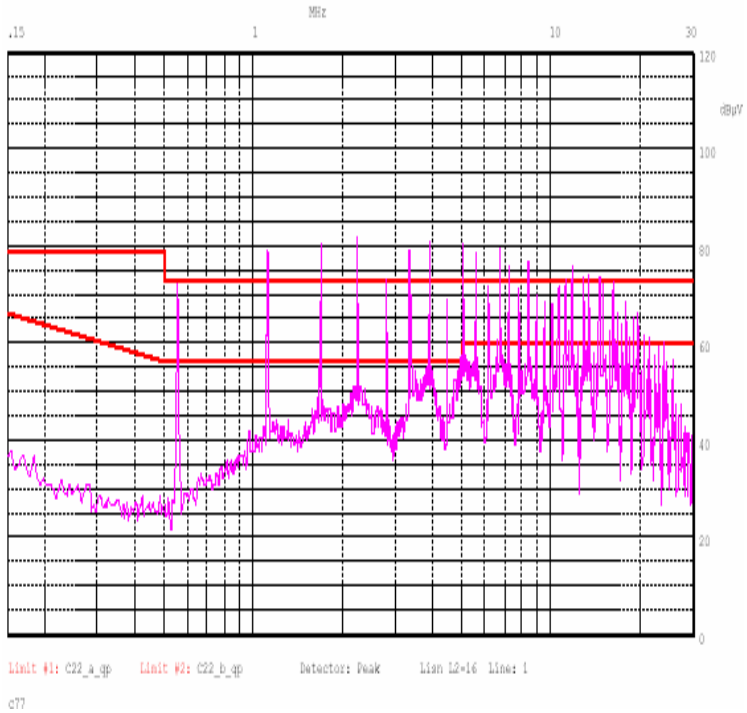
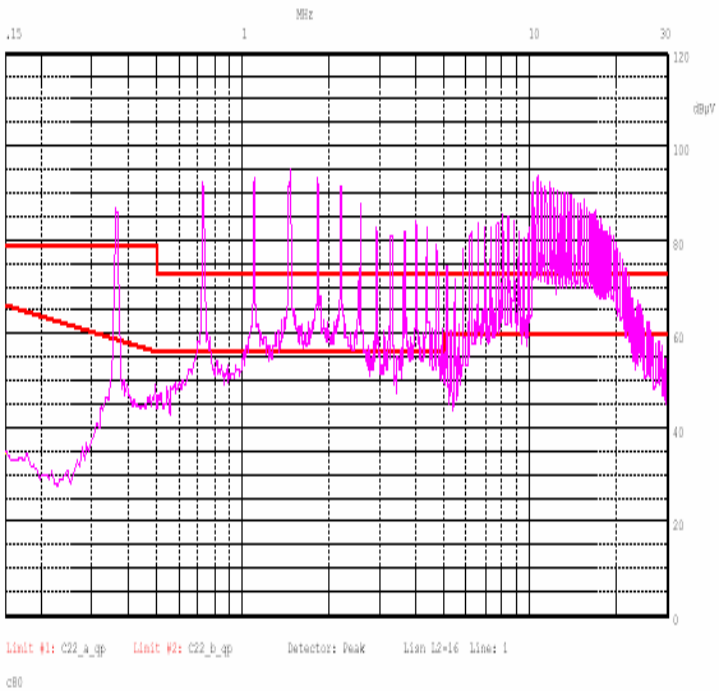


100% FL

V48C3V3C75AL

EMI Compliance

Differential-mode Capacitor



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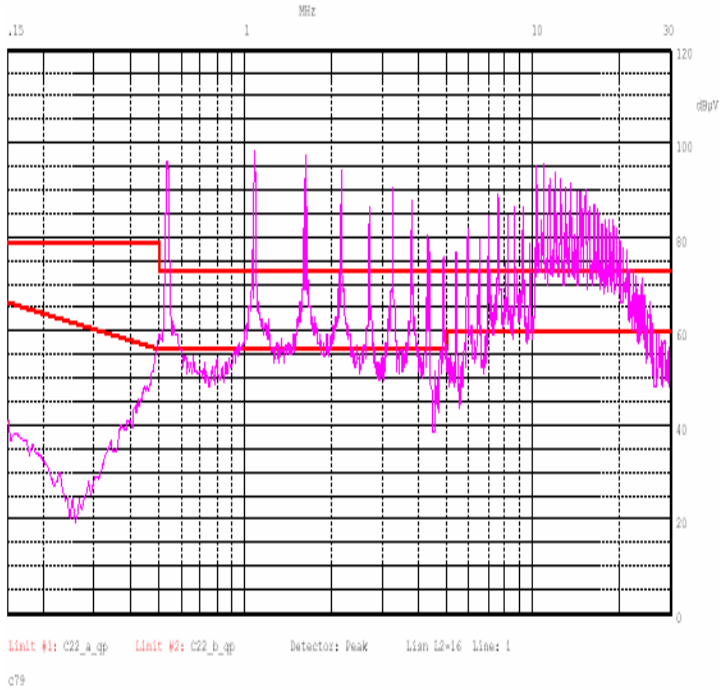

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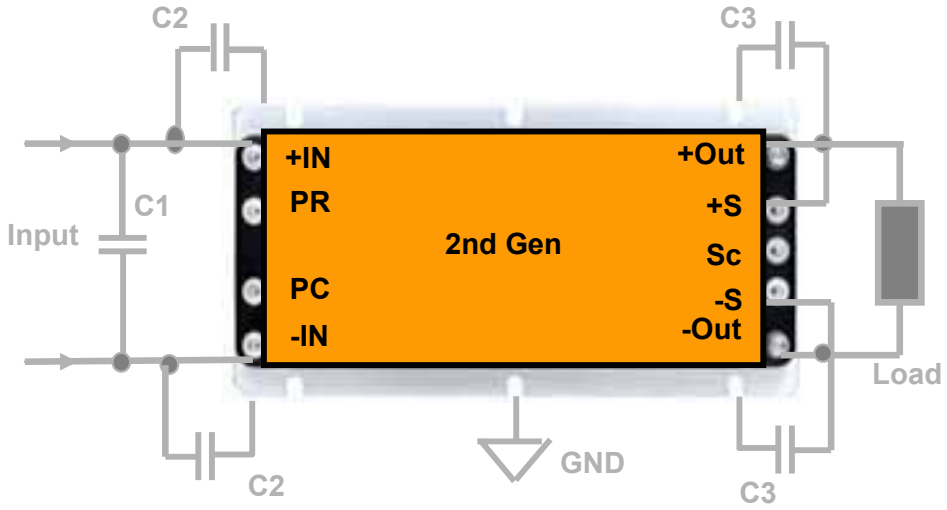
V48C48C150AL

EMI Compliance

Bypass Capacitors: Common-mode Attenuation

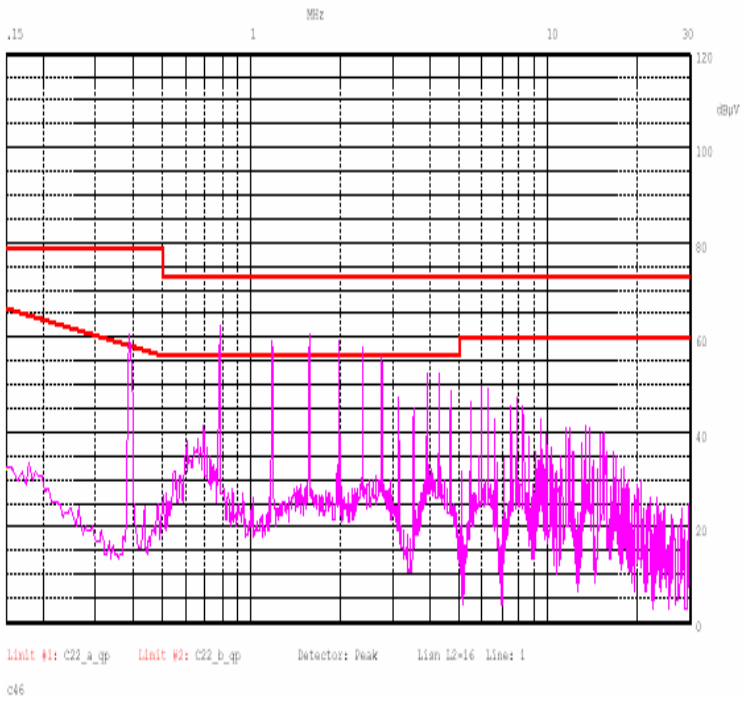


C1: 120µF 100V Electrolytic Capacitor
C2, C3: 4.7nF 'Y' Capacitors

- C2, C3, C4, C5 should be as close as possible to module input
- The baseplate GND connection should be available next to the input and output pins

EMI Compliance

Bypass Capacitors: Common-mode Attenuation



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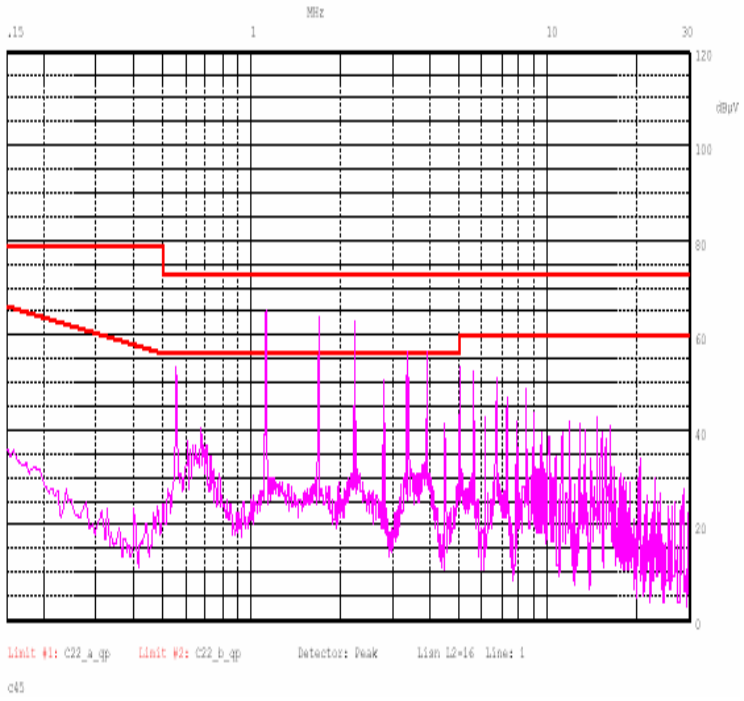

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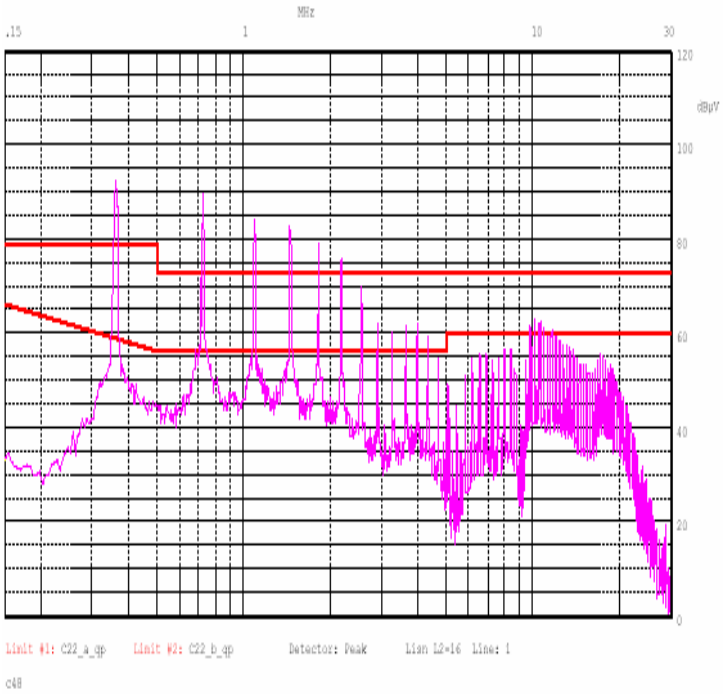
V48C3V3C75AL

EMI Compliance

Bypass Capacitors: Common-mode Attenuation



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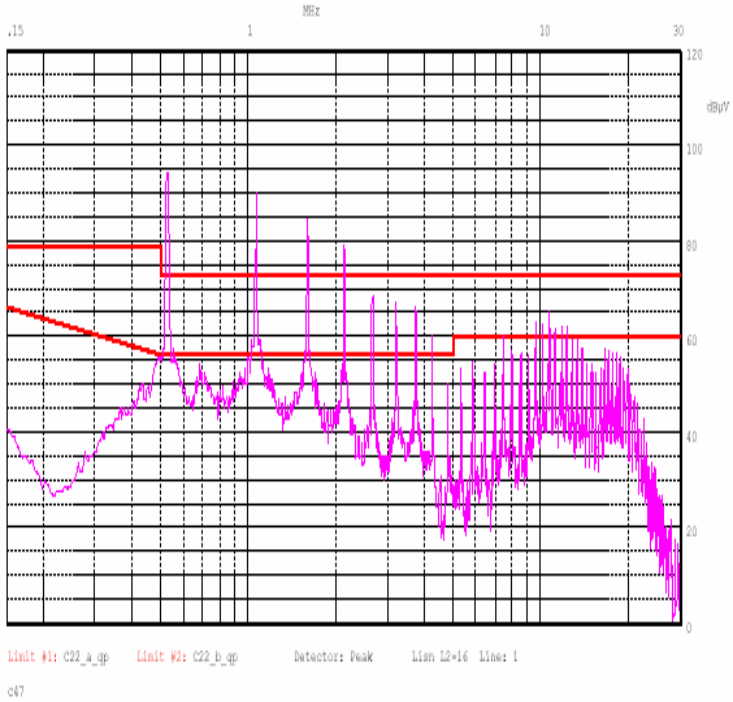

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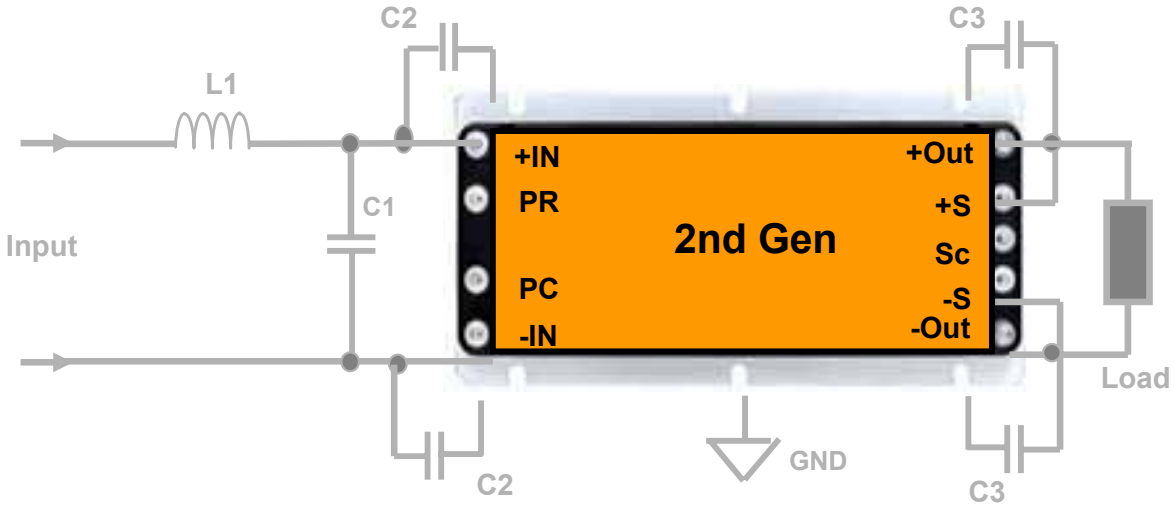
V48C48C150AL

EMI Compliance

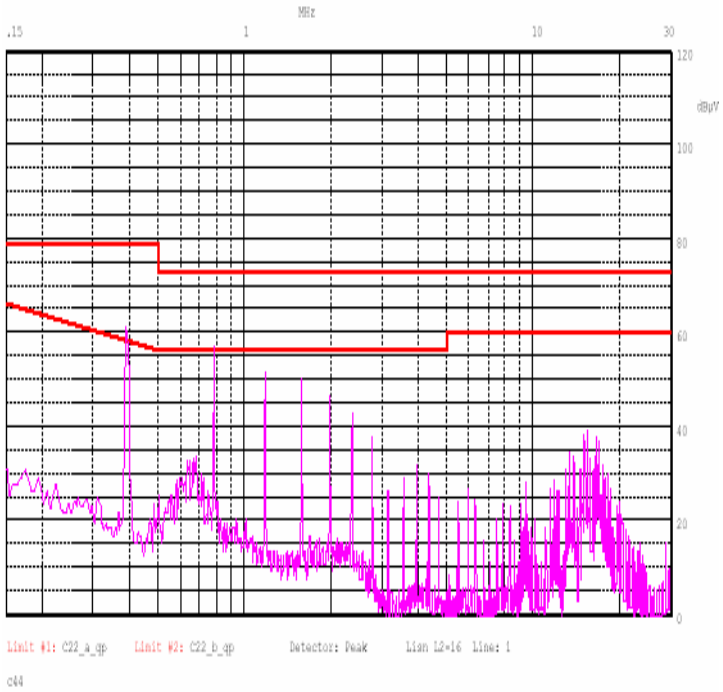
Differential-mode Inductor



C1: 120µF 100V Electrolytic Capacitor
C2, C3: 4.7nF ‘ Y ’ Capacitors
L1: 27µH P/N 14563 Differential-mode Inductor

EMI Compliance

Differential-mode Inductor



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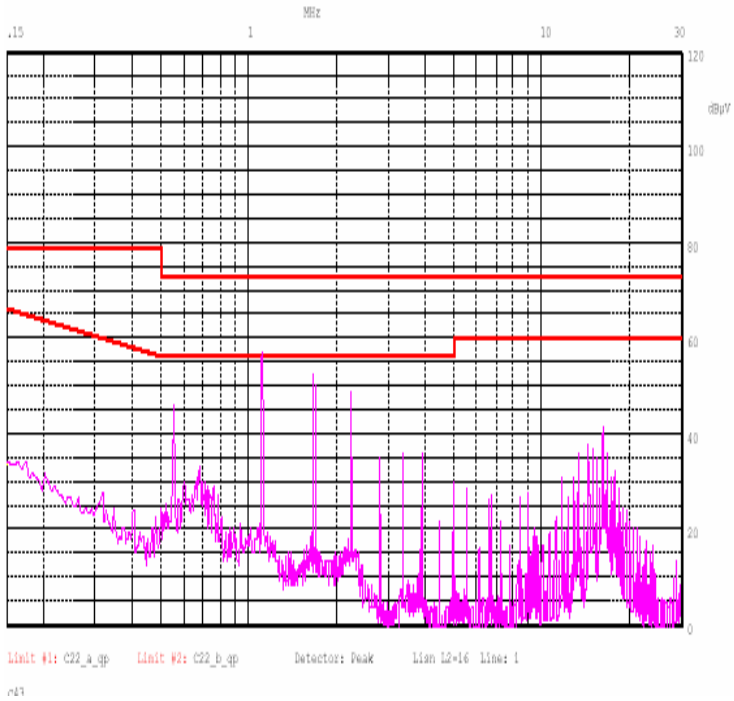

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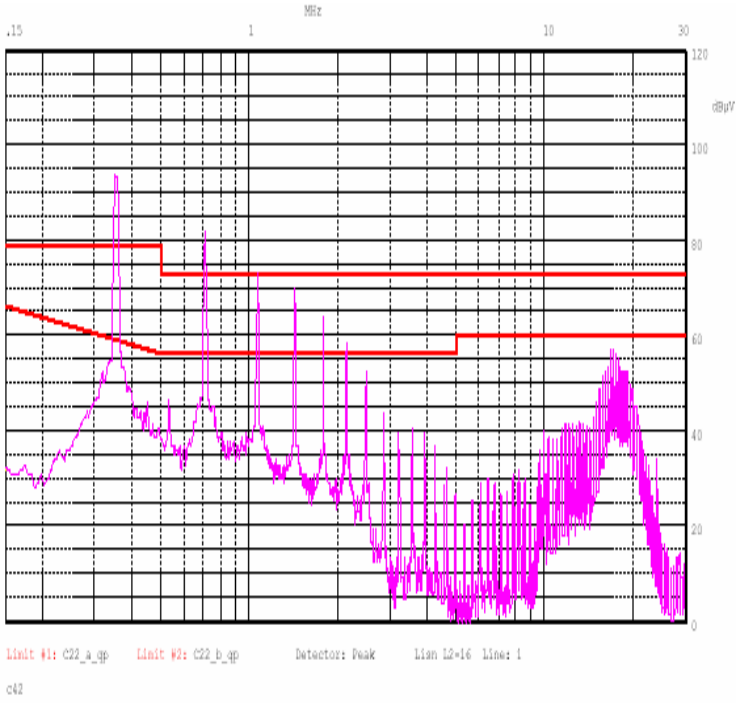
V48C3V3C75AL

EMI Compliance

Differential-mode Inductor



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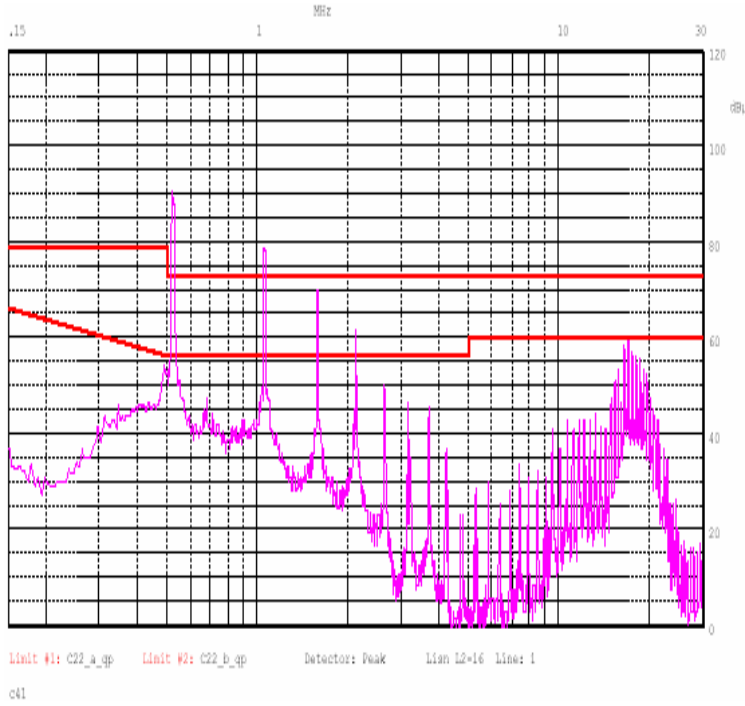

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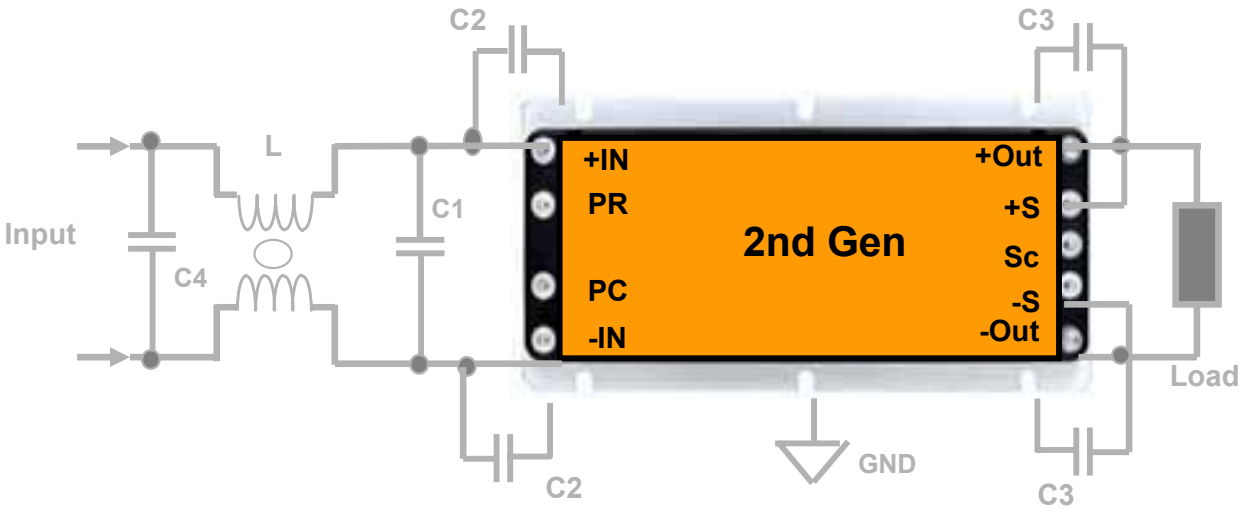
V48C48C150AL

EMI Compliance

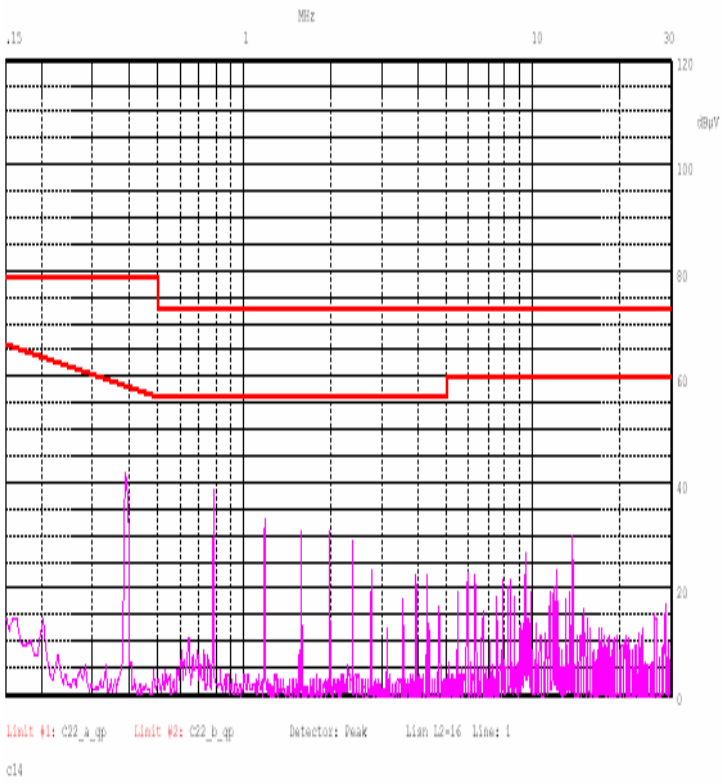
Common-mode Filter



C1: 120µF 100V Electrolytic Capacitor
C2, C3: 4.7nF ‘Y’ Capacitors
C4: 2.2µF Polyester Capacitor
L: 2x 0.42mH Vicor P/N 36-00037 Common-mode Inductor

EMI Compliance

Common-mode Filter



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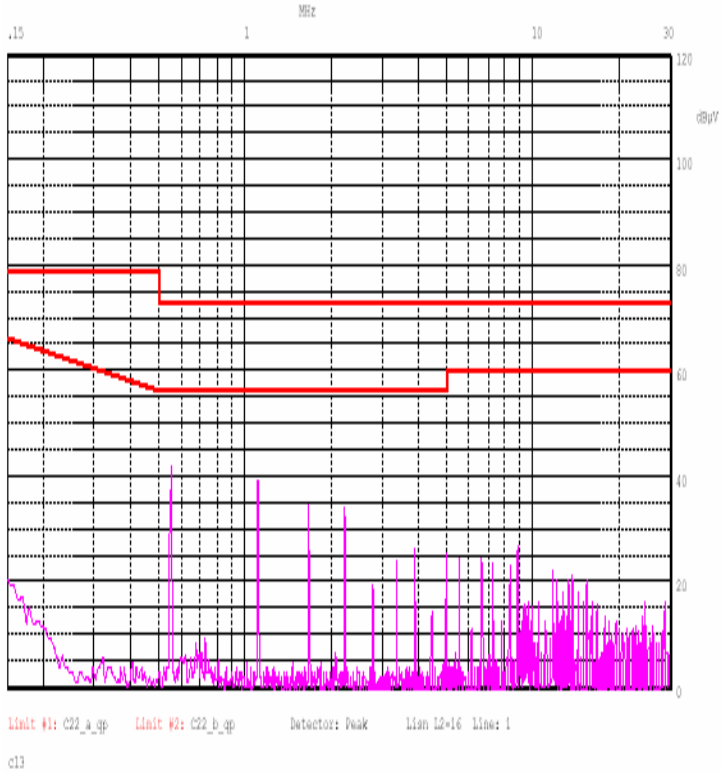

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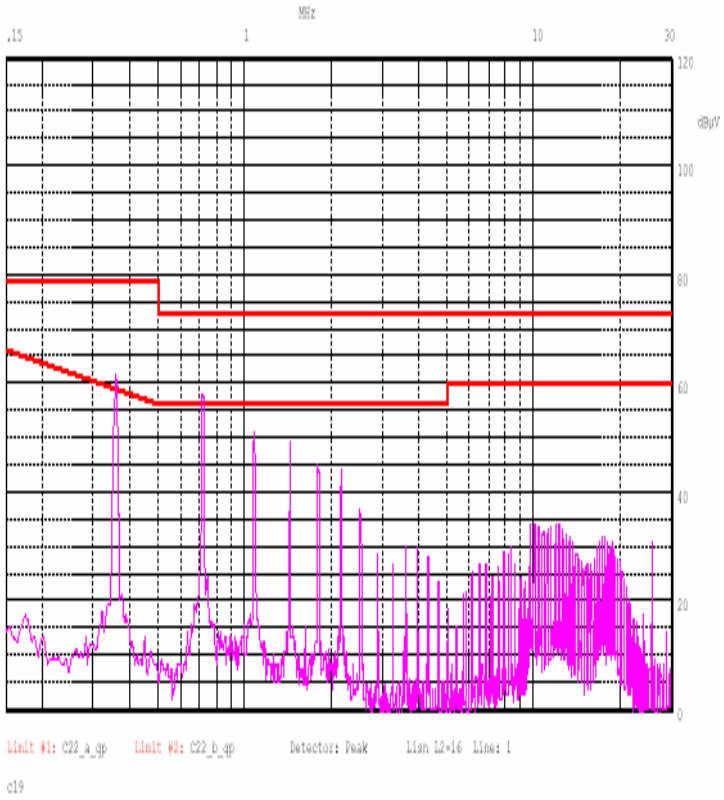
V48C3V3C75AL

EMI Compliance

Common-mode Filter



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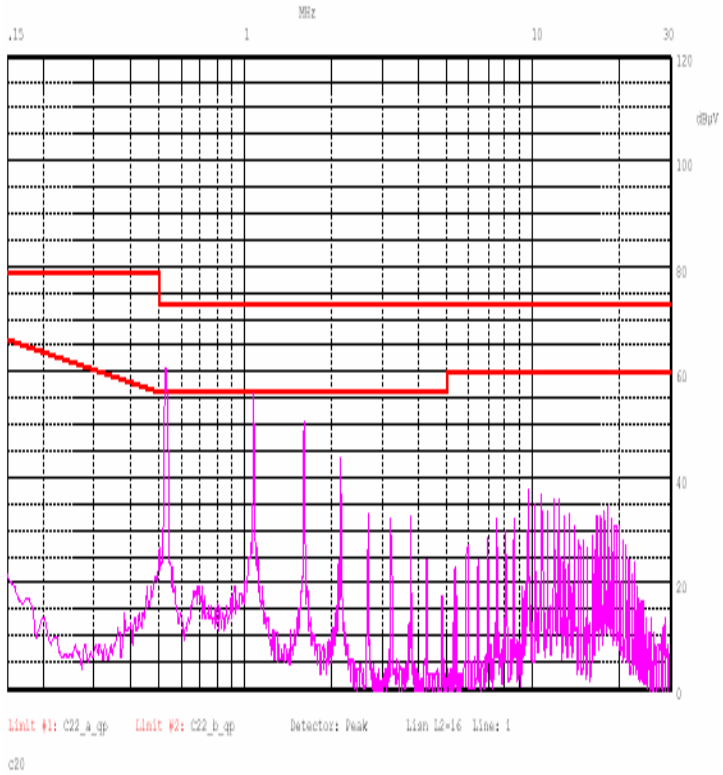

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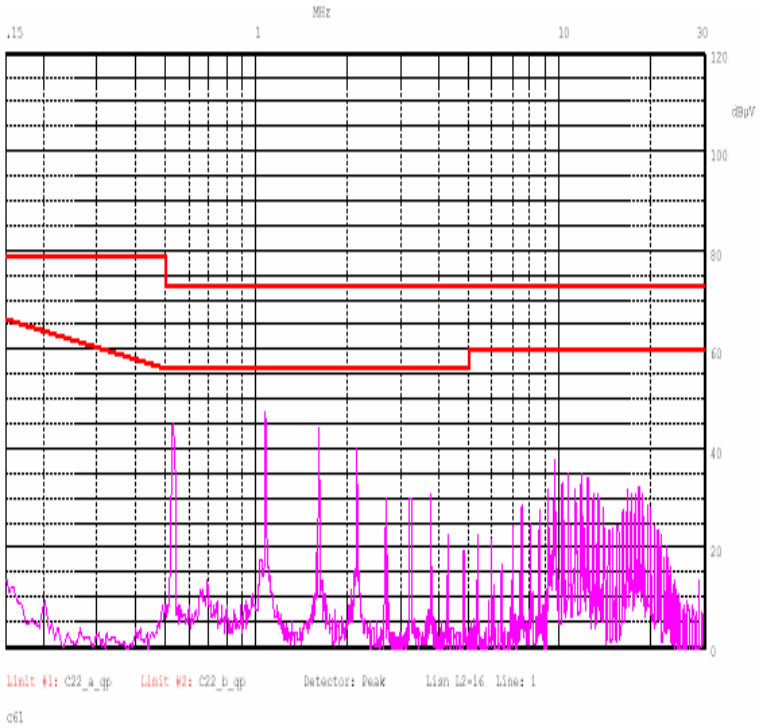
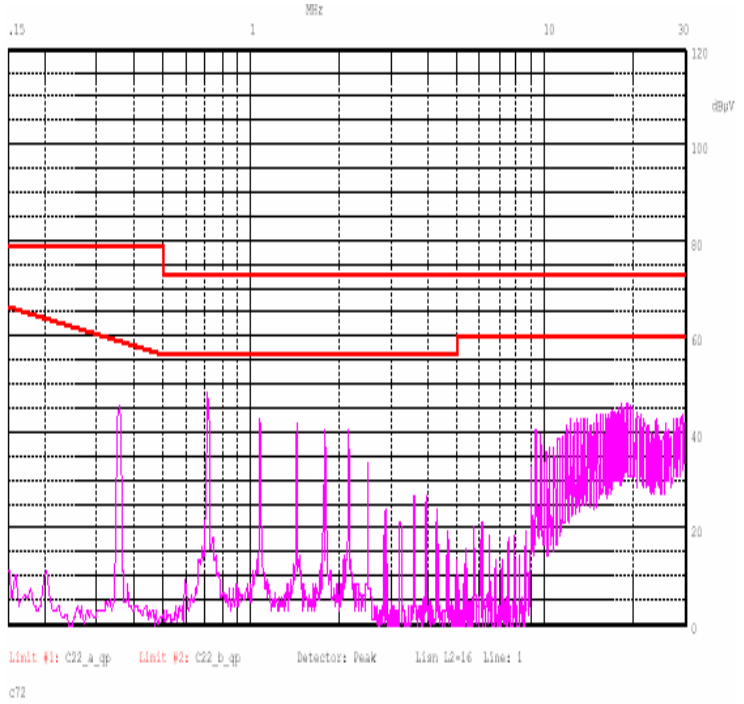
V48C48C150AL

EMI Compliance

Implementation Effect of Bypass Capacitors





Bypass capacitors next to the module

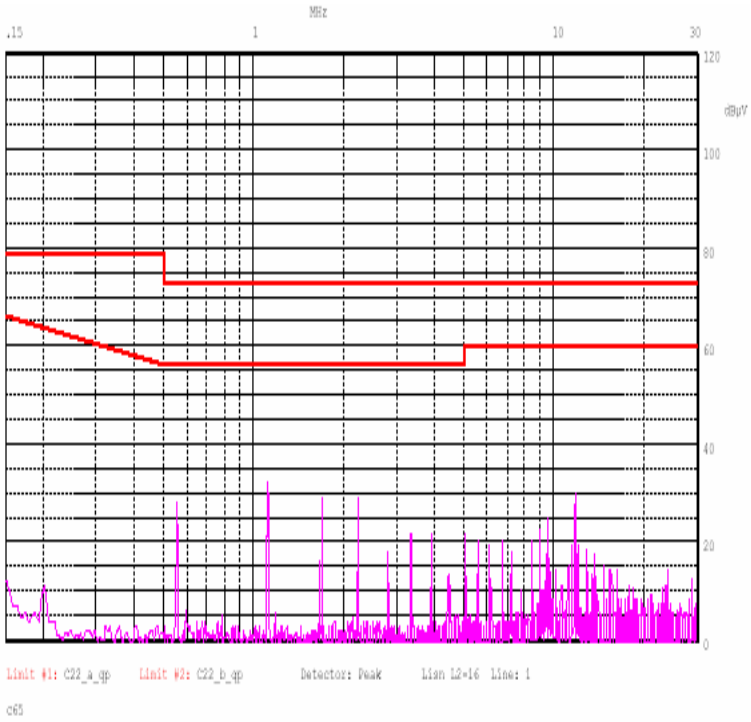
100% FL

Bypass capacitors far from the module

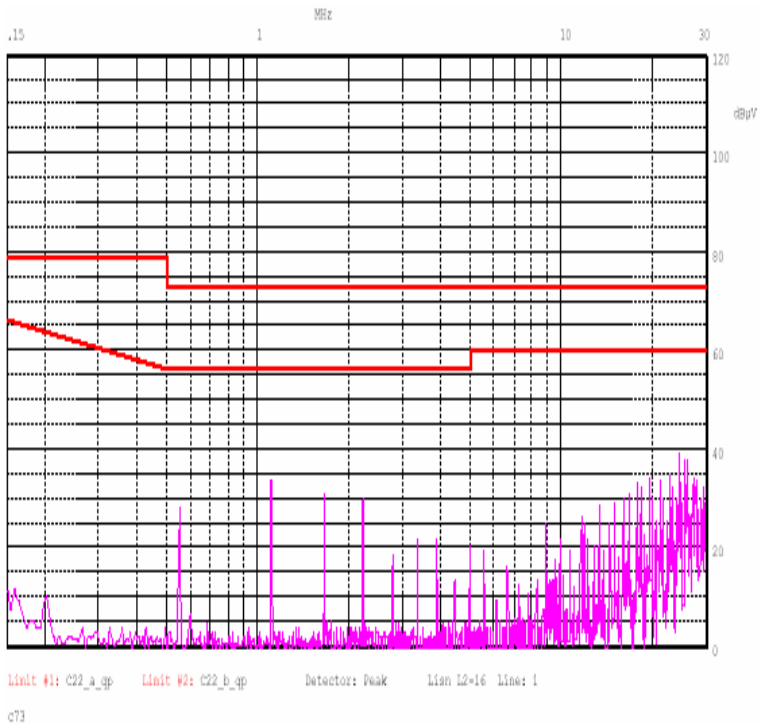
V48C48C150AL

EMI Compliance

Implementation Effect of Bypass Capacitors



Bypass capacitors
next to the module



Bypass capacitors
far from the module

100%F
L

V48C3V3C75AL

2nd Generation Products

DC Input Modules: M-FIAM

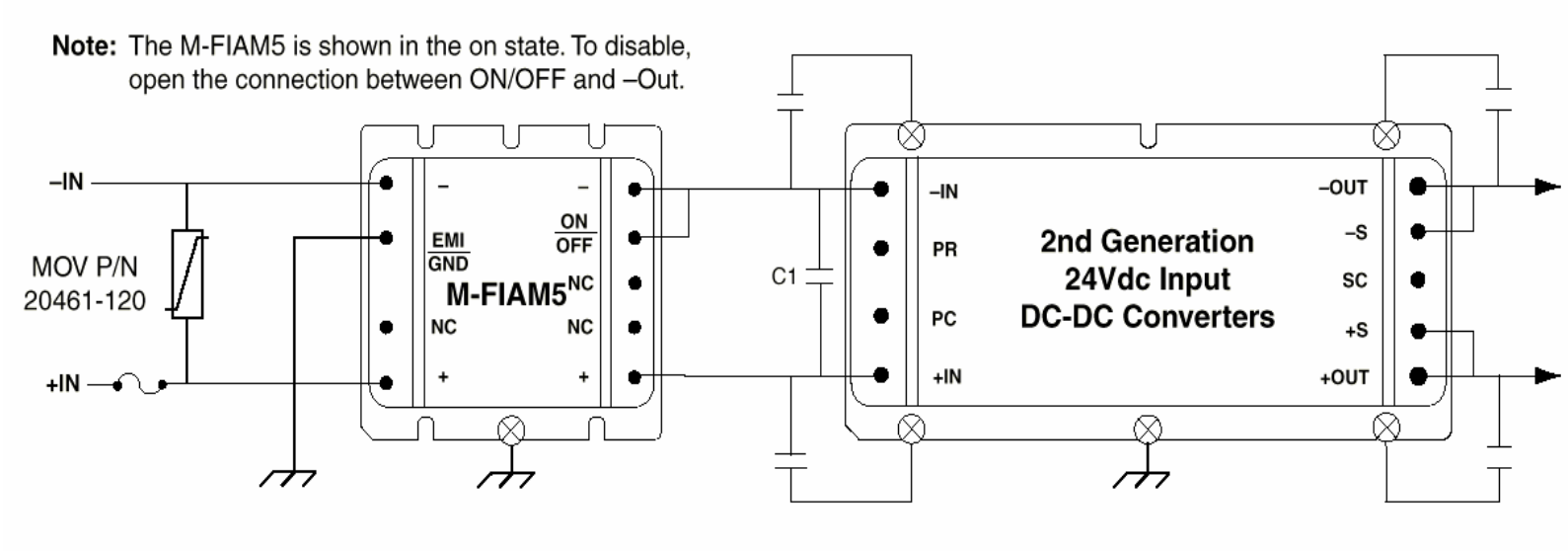
Filtered Input Attenuator Module

- EMI filtering to MIL-STD-461E
- Transient protection to MIL-STD-704E
- Qualified for use in MIL-STD-810 & 202 environments
- 3A and 20A versions

2nd Generation Products

DC Input Modules: M-FIAM5

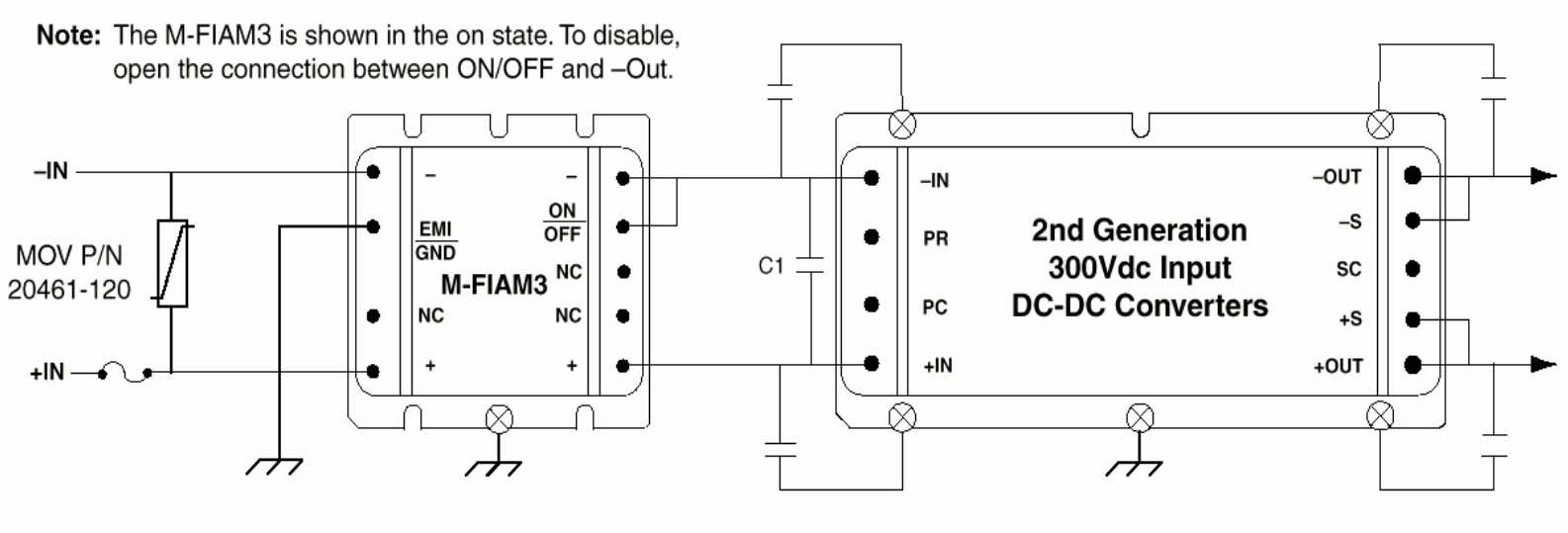
Connection Diagram



2nd Generation Products

DC Input Modules: M-FIAM3

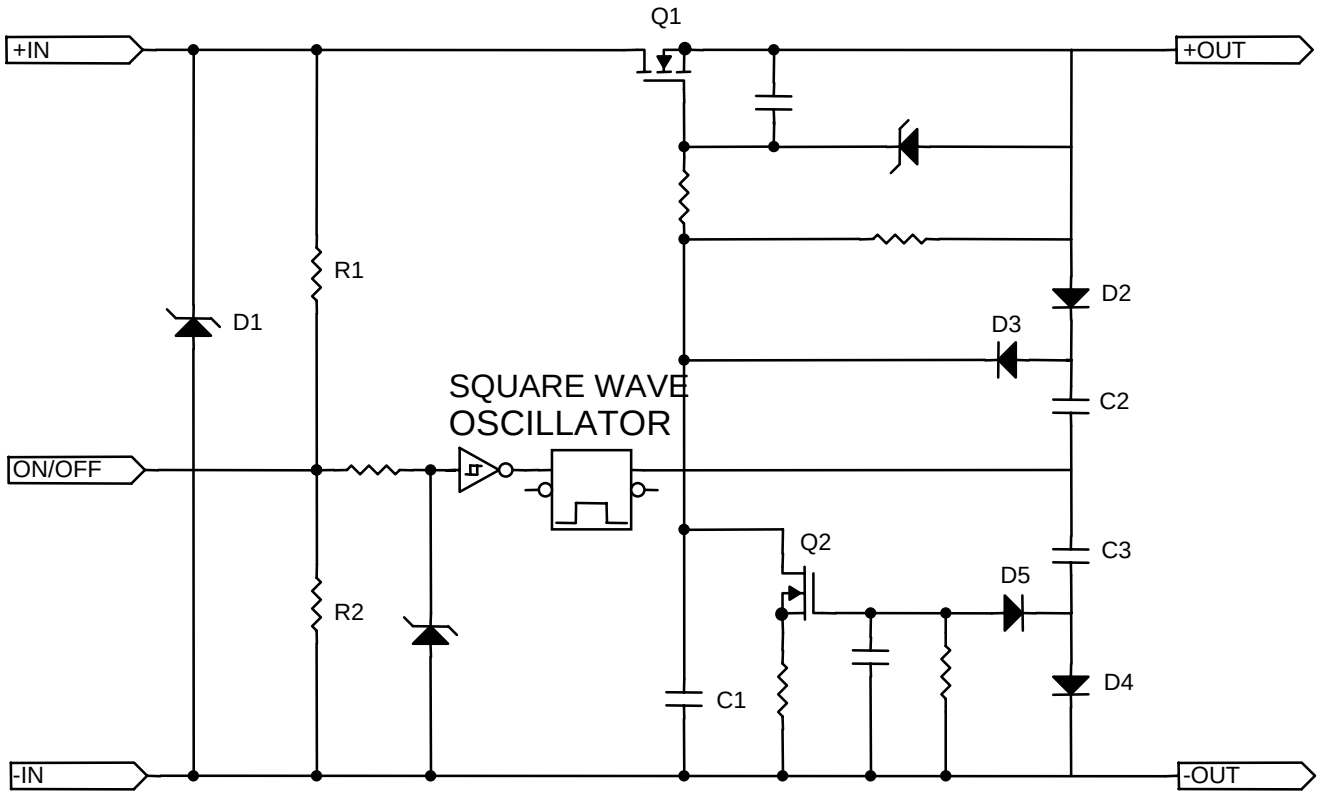
Connection Diagram



2nd Generation Products

DC Input Modules: M-FIAM

Simplified Schematic of Transient Protection



2nd Generation Products

DC Input Modules: M-FIAM5

Inrush Limiting

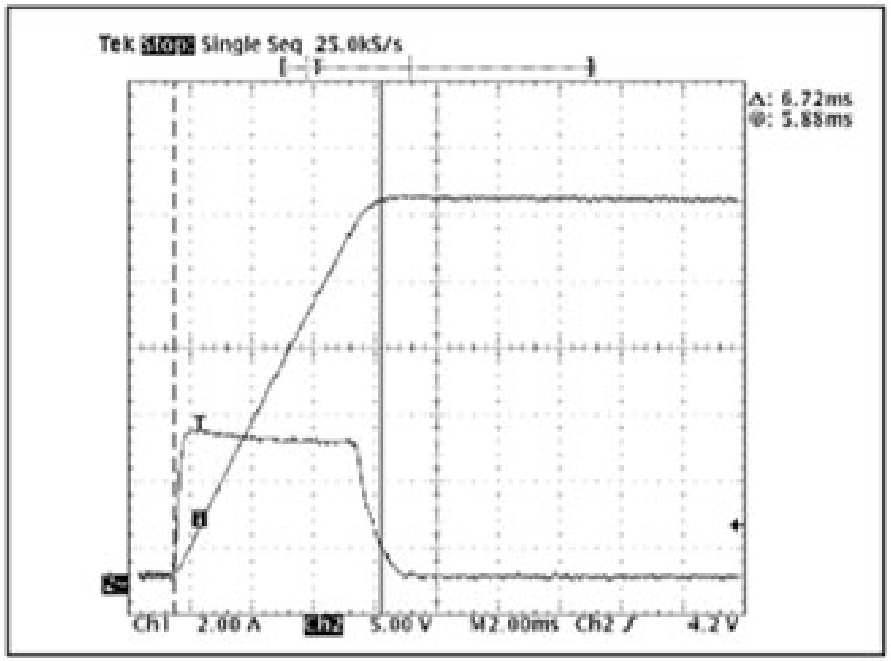


Figure 3– Inrush Limiting: Inrush current with 1000µF external capacitance.

2nd Generation Products

DC Input Modules: M-FIAM5

Transient Immunity

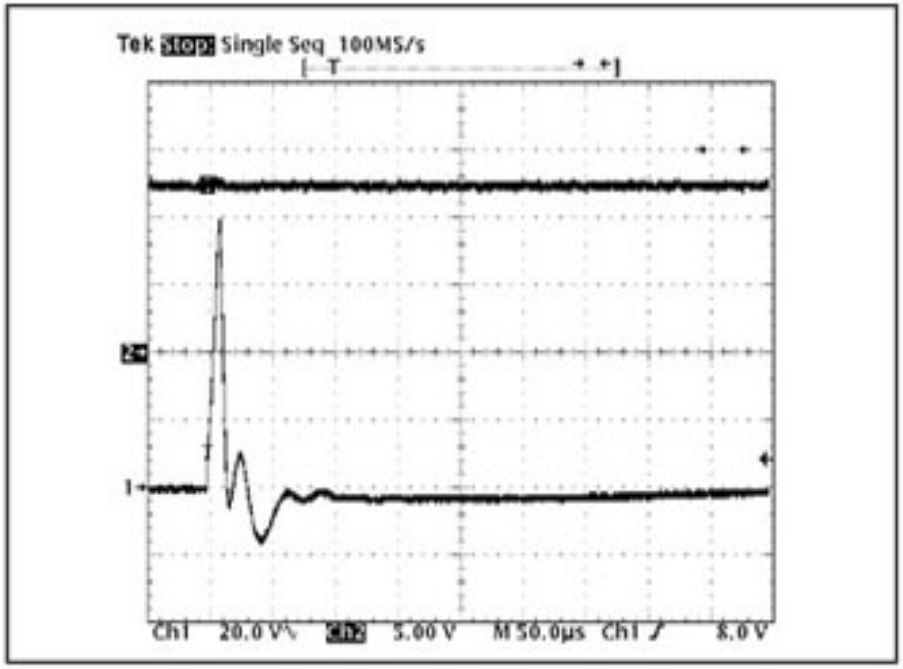
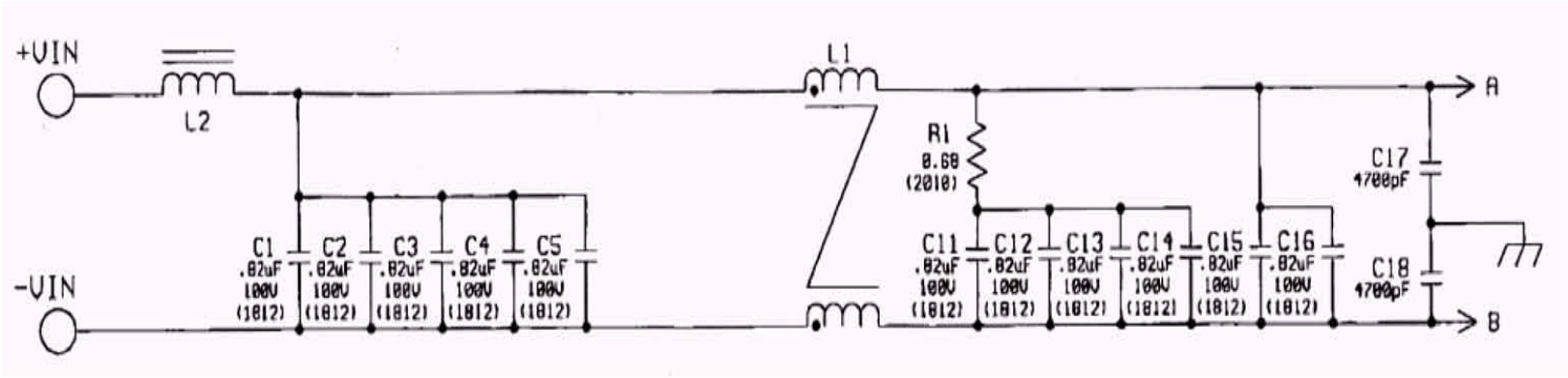


Figure 2 – *Transient Immunity: M-FIAM5 output response to an input transient.*

2nd Generation Products

DC Input Modules: M-FIAM5

EMI Filter



2nd Generation Products

DC Input Modules: M-FIAM5

Conducted Noise

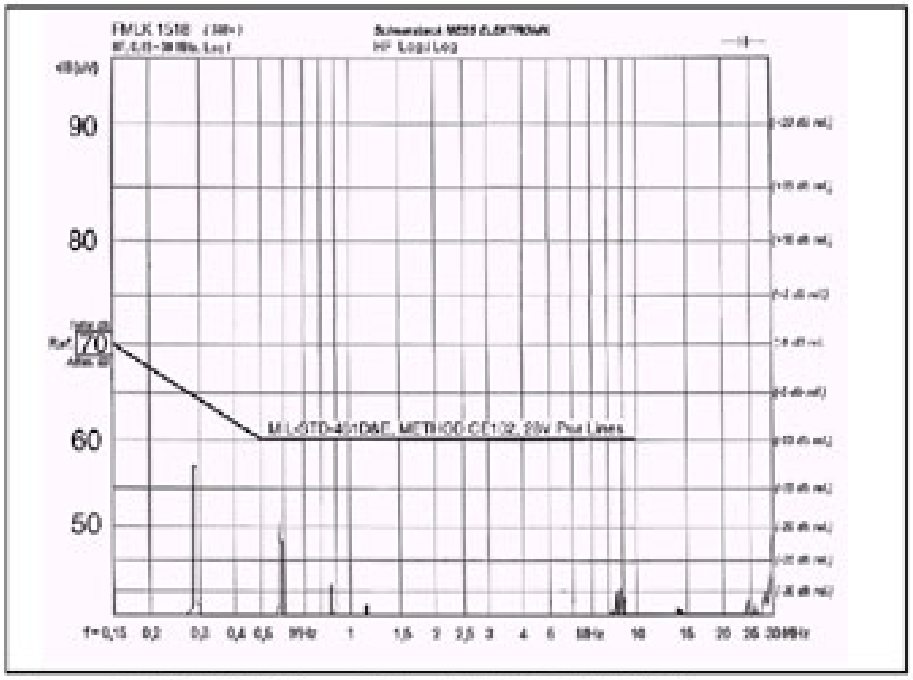


Figure 1– *M-FIAM5 and Model V24A12M400A DC-DC Converter operating at 28Vdc, 400W.*

2nd Generation Products

DC Input Modules: M-FIAM

COTS Features

Environmental Stress Screening

	H Grade	M Grade
Operating Temp.	-40°C to +100°C	-55°C to +100°C
Storage Temp.	-55°C to +125°C	-65°C to +125°C
Temp. Cycling:	24 hours, 12 cycles -55°C to +125°C	24 hours, 12 cycles -65°C to +125°C
Ambient Test @ 25°C	Yes	Yes
Power Cycling Burn-In:	12 hours, 28 cycles	24 hours, 56 cycles
Functional and Parametric ATE Tests:	-40°C and +100°C	-55°C and +100°C
AC Hi-Pot Test	Yes	Yes
Visual Inspection:	Yes	Yes
Test Data	www.vicr.com	www.vicr.com

Environmental Qualification

Altitude
MIL-STD-810C, Method 500.2, Procedure I & II, 40,000 ft. and 70,000 ft. Operational.

Explosive Atmosphere
MIL-STD-810F, Method 511.4, Procedure I, Operational.

Vibration
MIL-STD-810F, Method 514.5, Procedure I, Category 14, Sine and Random vibration per Table 514.5C for Helicopter AH-6J Main Rotor with overall level of 5.6 grams for 4 hours per axis.
MIL-STD-810F, Method 514.5C, General Minimum Integrity Curve per Figure 514.5C-17 with overall level of 7.7 grams for 1 hour per axis.

Shock
MIL-STD-810-F, Method 516.5, Procedure I, Functional Shock,40 G's.
MIL-S-901D, Lightweight Hammer Shock, 3 impacts/axis, 1,3,5 ft.
MIL-STD-202F, Method 213B, 60 G's, 9ms half sine.
MIL-STD-202F, Method 213B, 75 G's, 11ms Saw Tooth Shock.

Acceleration
MIL-STD-810F, Method 513.5, Procedure II, table 513.5-II, Operational, 2-7 G's, 6 directions.

Humidity
MIL-STD-810F, Method 507.4, Procedure I, Cycle I, 240 hrs, 95% RH.

Solder Test
MIL-STD-202F, Method 208, 8 hour aging.

2nd Generation Products

DC Input Modules: M-FIAM3

Military 270Vin
Compatible with V300 DC-DC Converters

Specifications

(typical at TBP = 25C, nominal line, 75% load, unless otherwise specified)

Parameter	Min	Typ	Max	Remarks
Input Voltage	180Vdc	270Vdc	375Vdc	Continuous
Output Current			3A	
Inrush Limiting			0.018A/µF	
Transient Immunity				Exceeds limits of MIL-STD-704E
EMI:MIL-STD-461E				
Conducted Emissions:	CE101, CE102			
Conducted Susceptibility:	CS101, CS114, CS115, CS116			
Dielectric Withstand		1,500Vrms		Input/Output to Base
		2,121Vdc		Input/Output to Base
Efficiency	96	98		
Internal Voltage Drop		3.0Vdc	5.0Vdc	@ 3A, 100°C baseplate
ON/OFF Control				
Enable (ON)	0.0Vdc		1.0Vdc	Referenced to –Vout.
Disable (OFF)	3.5Vdc		5.0Vdc	100KΩ internal pull-up resistor
External Capacitance				See illustration C1 on page 3.
	10µF		33µF	400V
Weight		3.1 (88)	4 (113)	ounces (grams)
Warranty			2	years

2nd Generation Products

DC Input Modules: M-FIAM5

Military 28Vin
Compatible with V24 DC-DC Converters

Specifications

(typical at TBP = 25°C, nominal line, 75% load, unless otherwise specified)

Parameter	Min	Typ	Max	Remarks
Input Voltage	18Vdc	28Vdc	36Vdc	Continuous
Output Current			20A	
Inrush Limiting			0.007A/µF	
Transient Immunity				Exceeds limits of MIL-STD-704E
EMI:MIL-STD-461E				
Conducted Emissions:	CE101, CE102			
Conducted Susceptibility:	CS101, CS114, CS115, CS116			
Dielectric Withstand		1,500Vrms		Input/Output to Base
		2,121Vdc		Input/Output to Base
Efficiency	96%	98%		
Internal Voltage Drop		0.5	1.0	@20A, 100°C baseplate
ON/OFF Control				
Enable (ON)	0.0Vdc		1.0Vdc	Referenced to –Vout.
Disable (OFF)	3.5Vdc		5.0Vdc	100kΩ internal pull-up resistor
External Capacitance				See illustration C1 on page 3.
	330µF		1000µF	50V
Weight		3.1 (88)	4 (113)	Ounces (Grams)
Warranty			2	Years

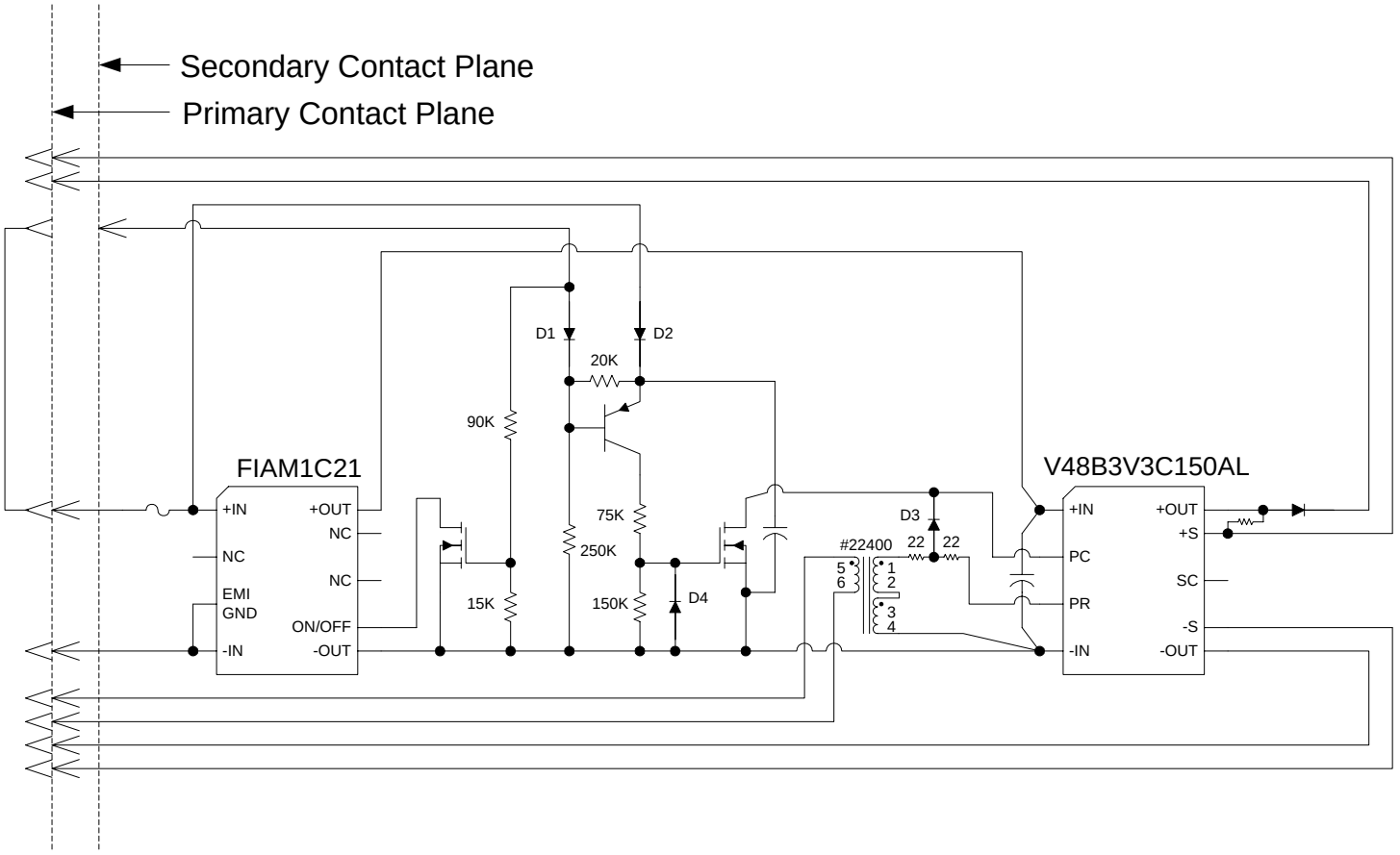
Applications Examples

Hotswap Application

- Terminal constraints or absolute maximum ratings of components must never be violated, even momentarily during live insertion/extraction
- A converter module must never be allowed to transfer energy, i.e., produce power pulses while disengaged from the load, or while it's sense lines are unterminated
- Some means of current share control must be employed
- Each module's sense lines must be terminated beyond the diodes, and preferably at the hot swap connector at the common bus

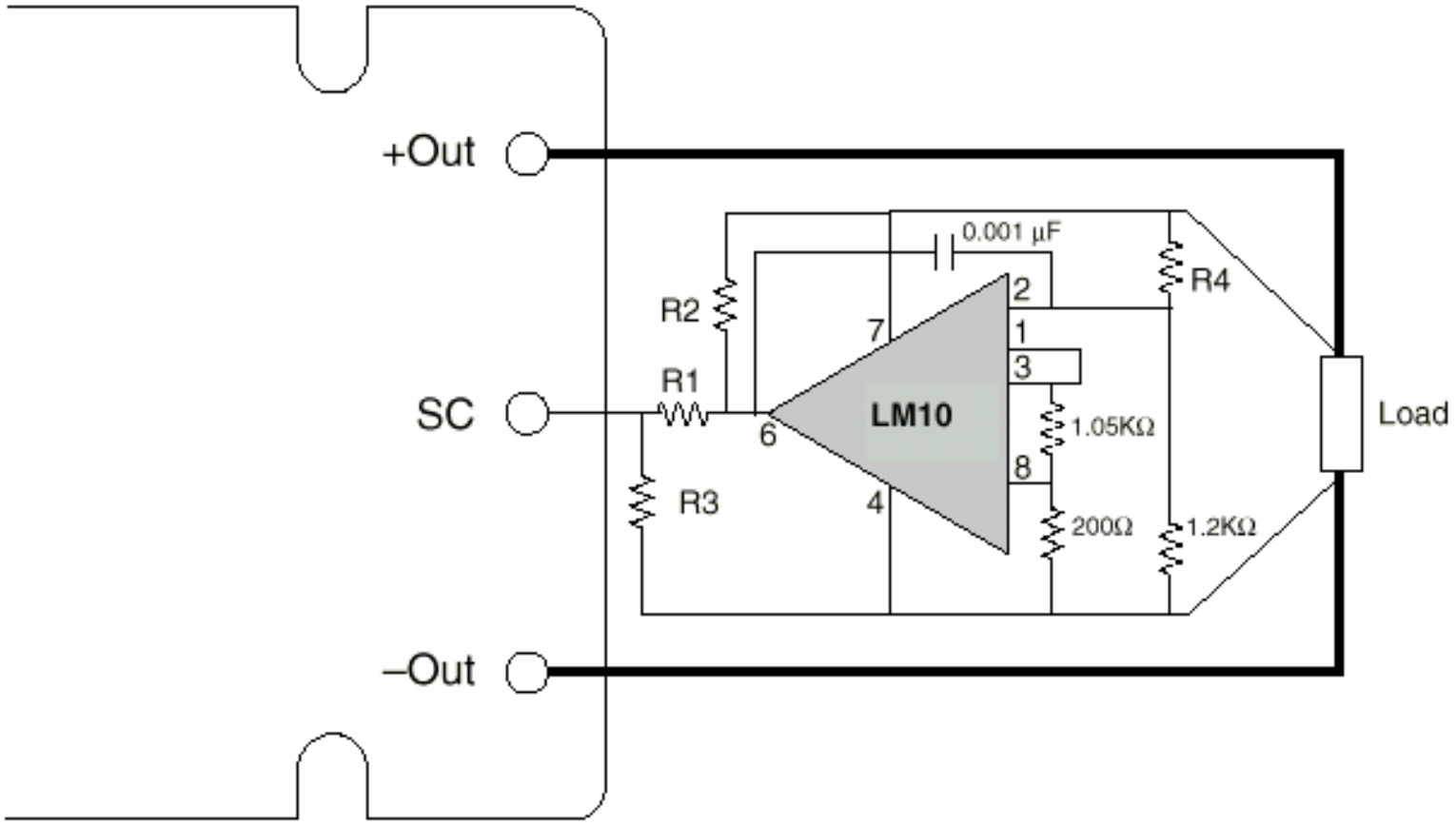
Applications Examples

Hotswap Application



Applications Examples

Voltage Drop Compensation (Micro)



Resistor Values for Micro Voltage Drop Compensation

Vo	R1	R2	R3	R4
1.8	1K	500	9K	550
2.0	1K	500	N/R	750
2.2	1K	500	1.0K	1.00K
2.5	1K	500	3.125K	1.25K
3.3	1K	N/R	N/R	2.05K
5.0	10K	N/R	N/R	3.75K
12.0	10K	N/R	N/R	10.8K
15.0	10K	N/R	N/R	13.75K
24.0	10K	N/R	N/R	22.75K
28.0	10K	N/R	N/R	26.75K
48.0	10K	N/R	N/R	46.75K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