



- ELDEC
- GENERAL TECHNOLOGY
- HYDRO-AIRE
- INTERPOINT
- LEAR ROMEC
- P.L. PORTER
- SIGNAL TECHNOLOGY
 - Keltec
 - Olektron

Crane Electronics Power Solutions Components (Interpoint)

SOLUTIONS

- Aircraft Electrical Power
- Cabin
- Fluid Management
- Landing Systems
- Sensing & Utility Systems
- Power
- Microwave Systems
- Electronic Manufacturing
- Microelectronics

DC/DC Converter
Application Considerations



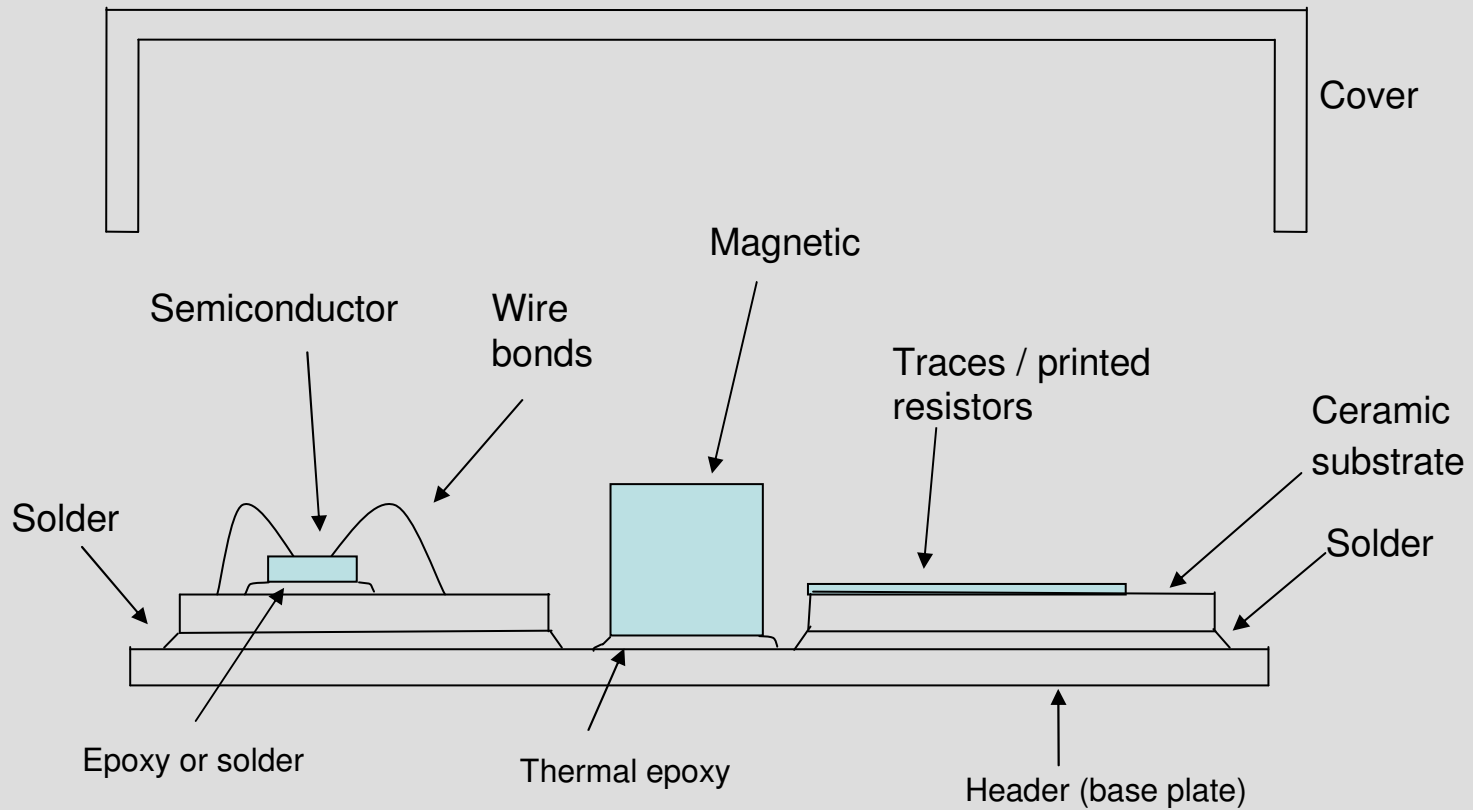
Interpoint Hybrids

Interpoint has been making hybrids since 1969 and is a pioneer in DC-DC converter hybrid technology

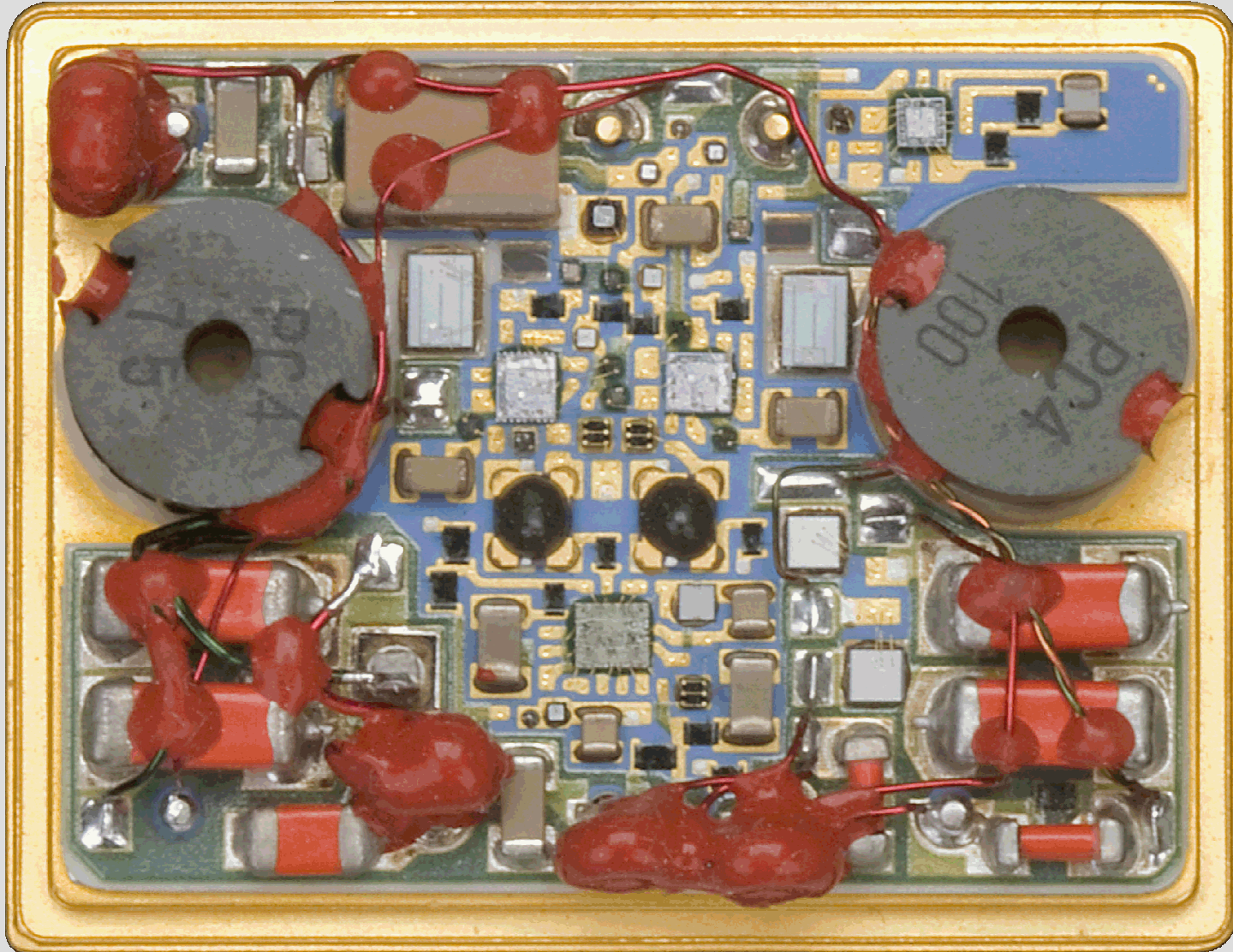
Advantages of Hybrids

- Hermetically sealed (90% dry nitrogen) – protects from humidity, corrosion, contaminants, and makes converters less susceptible to arcing at high elevations
- Completely enclosed, and sealed, in a metal case – reduces radiated EMI when case is grounded.
- Uses printed ink resistors – increases power density and eliminates solder connections.
- Uses low profile magnetics – improves vibrations
- No potting material – makes the converters easier to produce, trouble shoot and provides better thermal performance.
- Uses bare die – better heat transfer, higher power density, reduced parasitics, lighter weight and no hardware required for attachment.

Hybrid Assemblies

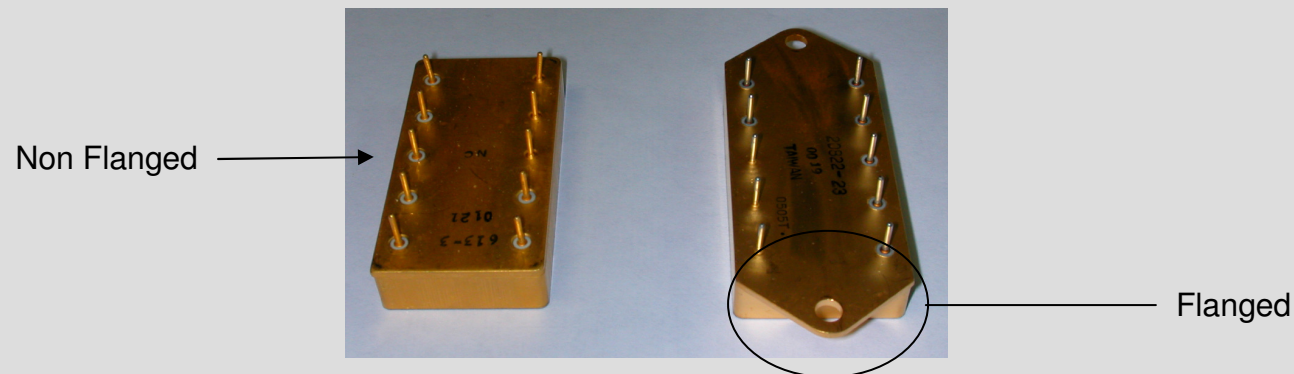


Interpoint Hybrids Cont.



What can be done to insure higher reliability

- Improve heat sinking. Every 25 degree C temperature rise will decrease MTBF numbers by approximately a factor of two.
- Order parts with a higher screening level
- Consider flanged parts – a converter bolted down will stand up to shock and vibration better than a converter whose only means of attachment having their pins soldered to a PCB. Flanges also provide additional heat sinking.



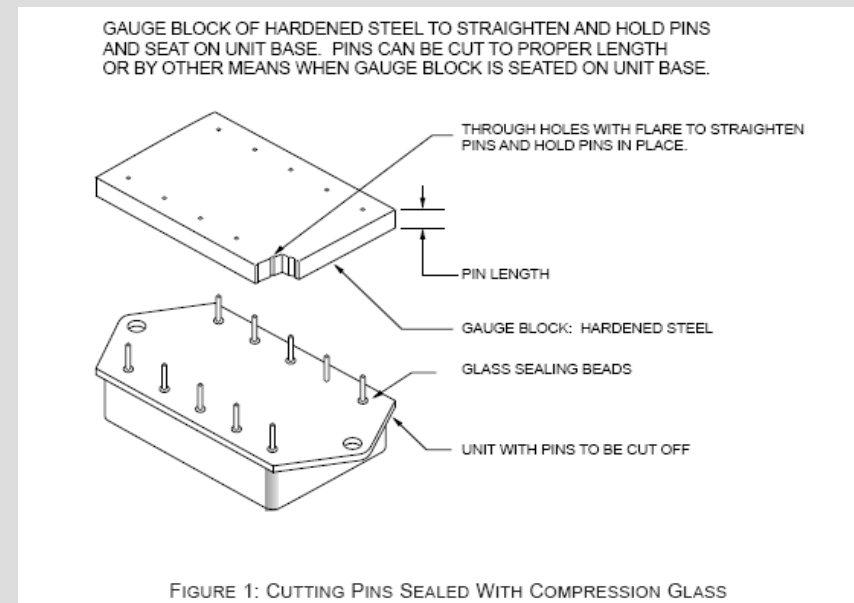
Handling

General Handling Precautions

- Parts should be handled carefully to protect the integrity of the compressions seals around the pins.
- A damaged seal, can result in loss of hermeticity.
- A bent pin can result in a damaged seal and a cracked substrate.
- If a part is dropped the seal can be compromised or the substrate could be cracked.

- Never cut an unsupported pin. The shock may damage the seal. A gauge block or other tool that slips over the pin, to provide support, should be used before cutting.

- Once a converter is soldered into a PCB the solder should have enough support to cut the pins.



More screening translates to higher reliability

Screening table from Interpoint data sheet

Crane Aerospace & Electronics Power Solutions

MFL Single and Dual DC/DC Converters

28 VOLT INPUT – 65 WATT

883, CLASS H, QML PRODUCTS – ENVIRONMENTAL SCREENING

TEST	125°C STANDARD non-QML	125°C /ES non-QML	Class H /883 QML
Pre-cap Inspection Method 2017, 2032	yes	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. C, -65°C to 150°C, ambient	no	no	yes
Method 1010, Cond. B, -55°C to 125°C, ambient	no	yes	no
Constant Acceleration Method 2001, 3000 g	no	no	yes
Method 2001, 500g	no	yes	no
Burn-In Method 1015, 160 hours at 125°C case, typical	no	no	yes
96 hours at 125°C case, typical	no	yes	no
Final Electrical Test MIL-PRF-38534, Group A Subgroups 1 through 6: -55°C, +25°C, +125°C case	no	no	yes
Subgroups 1 and 4: +25°C case	yes	yes	no
Hermeticity Test Fine Leak, Method 1014, Cond. A	no	yes	yes
Gross Leak, Method 1014, Cond. C	no	yes	yes
Gross Leak, Dip (1 x 10 ⁻³)	yes	no	no
Final Visual Inspection Method 2009	yes	yes	yes

Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

Testing options

Tests performed
(yes/no)

Screening table from Interpoint data sheet cont.

Screening affects MTBF results

Screening levels are Standard, ES, H (883), and K

Standard = x MTBF hours

ES = $\sim 2x$ MTBF hours

H (883) = $\sim 4x$ MTBF hours

K = $\sim 16x$ MTBF hours

"K" screening levels have approximately **16 times** the MTBF hours as a Standard screening level.

Crane Aerospace & Electronics Power Solutions

MFL Single and Dual DC/DC Converters

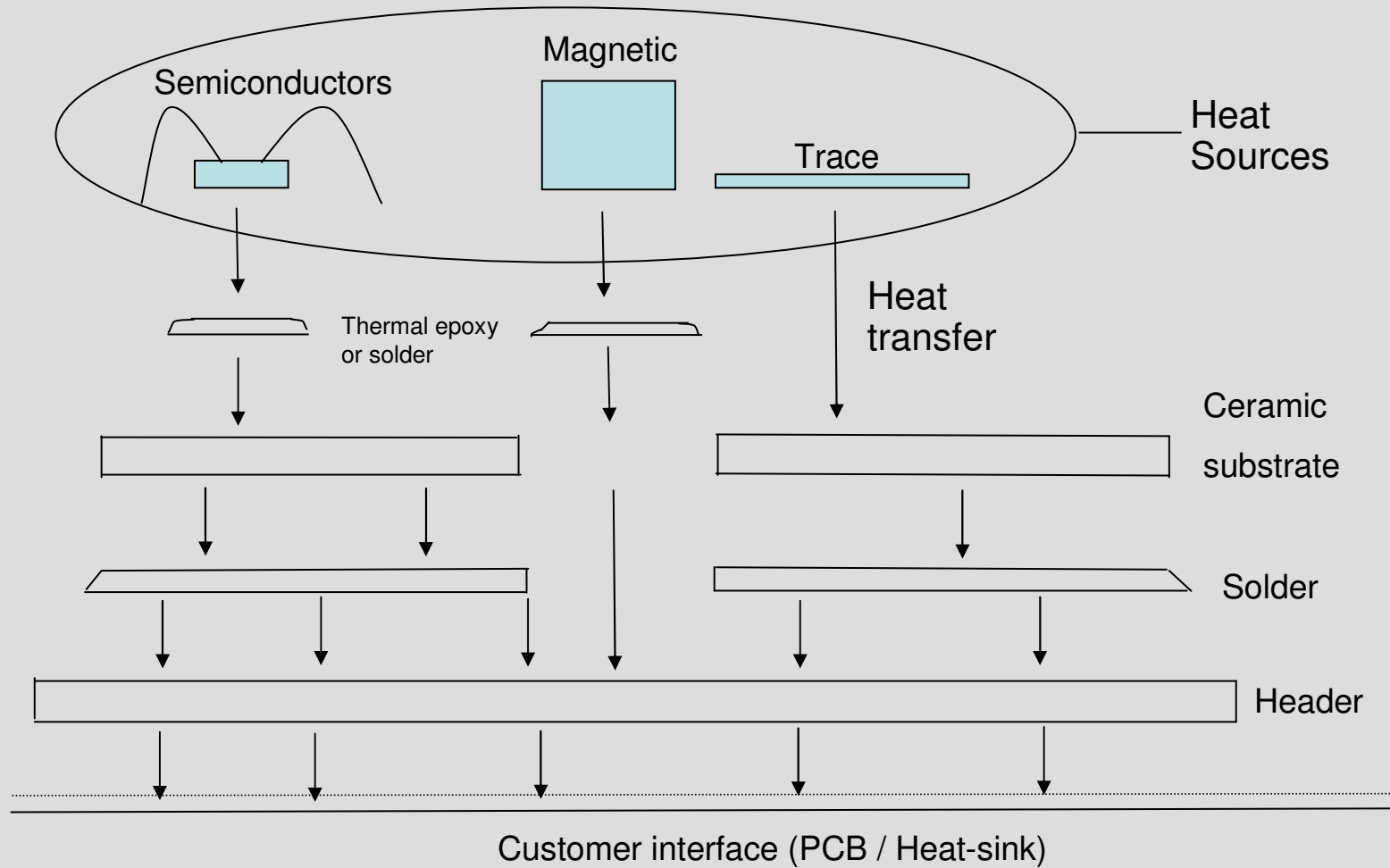
28 VOLT INPUT – 65 WATT

883, CLASS H, QML PRODUCTS – ENVIRONMENTAL SCREENING

TEST	125°C STANDARD non-QML	125°C /ES non-QML	Class H /883 QML
Pre-cap Inspection Method 2017, 2032	yes	yes	yes
Temperature Cycle (10 times) Method 1010, Cond. C, -65°C to 150°C, ambient Method 1010, Cond. B, -55°C to 125°C, ambient	no no	no yes	yes no
Constant Acceleration Method 2001, 3000 g Method 2001, 500g	no no	no yes	yes no
Bum-In Method 1015, 160 hours at 125°C case, typical 96 hours at 125°C case, typical	no no	no yes	yes no
Final Electrical Test MIL-PRF-38534, Group A Subgroups 1 through 6: -55°C, +25°C, +125°C case Subgroups 1 and 4: +25°C case	no yes	no yes	yes no
Hermeticity Test Fine Leak, Method 1014, Cond. A Gross Leak, Method 1014, Cond. C Gross Leak, Dip (1×10^{-3})	no no yes	yes yes no	yes yes no
Final Visual Inspection Method 2009	yes	yes	yes

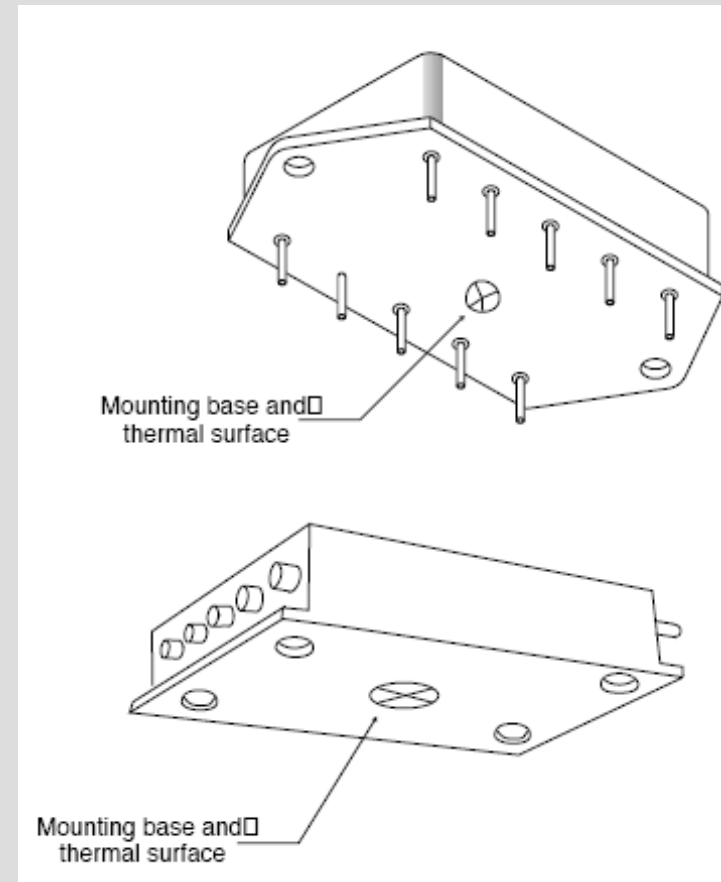
Test methods are referenced to MIL-STD-883 as determined by MIL-PRF-38534.

Thermal Management Cont.



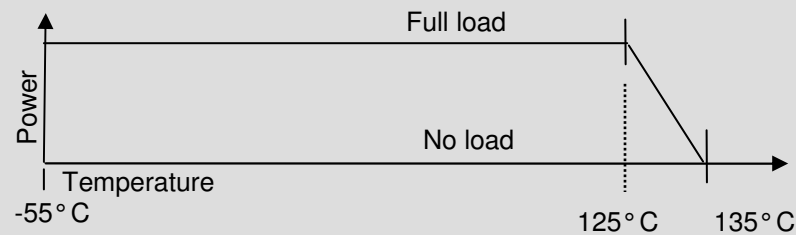
Thermal Management Cont.

- The operating temperature refers to the header (base plate) temperature of the converter
- Heat extraction is through the header. Interpoint converters are designed to be conduction cooled.
- Heat generating components are thermally attached to the header, either directly mounted (magnetics), or mounted to a ceramic substrate material that has is thermally connected to the header.
- Steel headers are **0.050in – 0.060in** (1.27mm – 1.52mm) thick providing a **low thermal impedance**.
- While power dissipation is not uniform across the header, the temperature **delta on the header should be < 1 - 2 °C**



Thermal Management Cont.

- Interpoint converter's should be de-rated linearly from 100% at “maximum full load operating temperature” (typically 125 degrees) to 0W at “absolute maximum operating temperature” (typically 135 degrees C).



Thermal Management Cont.

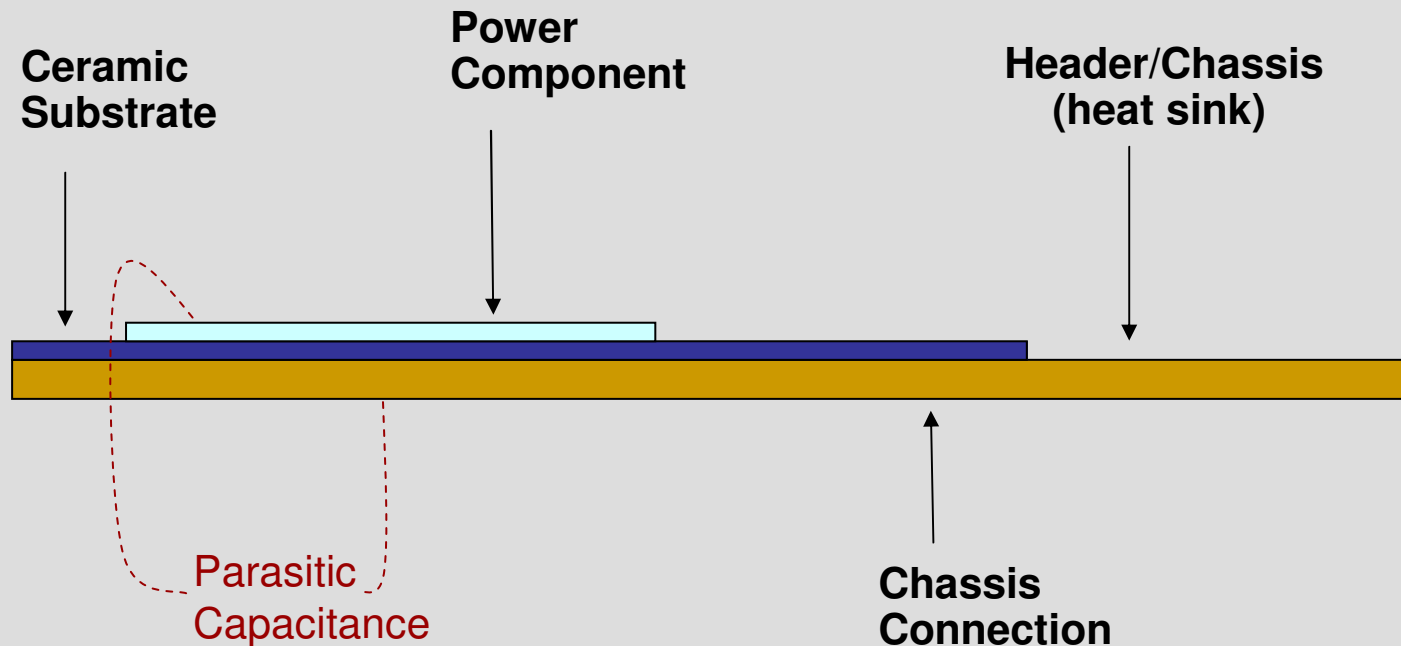
- Our converters do not have a single T_{jc} and **do not require calculations for junction temperature**. What matters is that the base plate / header does not exceed the “maximum operating temperature”.
- There is no internal temperature sensing, or over-temperature shutdown circuitry, built-in to Interpoint converters.
- Power dissipating components are spread out to create an even heat distribution.

What is EMI?

- EMI is **ElectroMagnetic Interference** which can be an electric field or a magnetic field. Electric fields are typically generated from voltage and magnetic fields are typically generated from currents.
- Interpoint converters are completely enclosed and, when the case is grounded to earth, short electric fields to earth ground. This reduces radiated EMI significantly. Some magnetic fields can escape but are typically not a problem.
- The measurement of EMI is the vector sum, or difference, of CM and DM noise.
- EMI consists of both common mode (CM) and differential mode (DM) noise. DM noise, also known as normal mode noise, is when the currents 180 degrees out of phase between positive input and input Common. CM noise is in is typically in phase in the input lines but can have some out of phase component if the line impedances are not balanced. CM noise is measured WRT chassis.

CM noise

CM noise is typically generated by capacitive coupling of power components to the chassis. During switching the high dv/dt of the power components, during turn on and turn off, pump currents into the chassis through the parasitic capacitance. Internally radiated noise conducted to the chassis and input leads can also become CM noise.



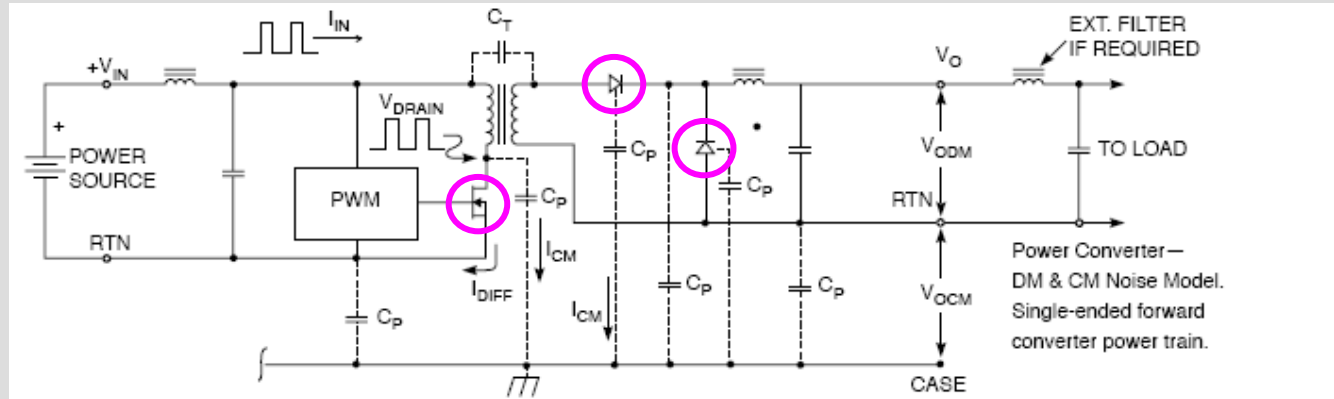
EMI Cont.

○ = Switching Power Components

C_p = Parasitic Capacitance

I_{CM} = CM current

Typical DC/DC Converter Block Diagram



Common mode currents should be bypassed back to their source. Any current that is not bypasses back to its source can take the path of the LISN and be measured.

How is EMI measured

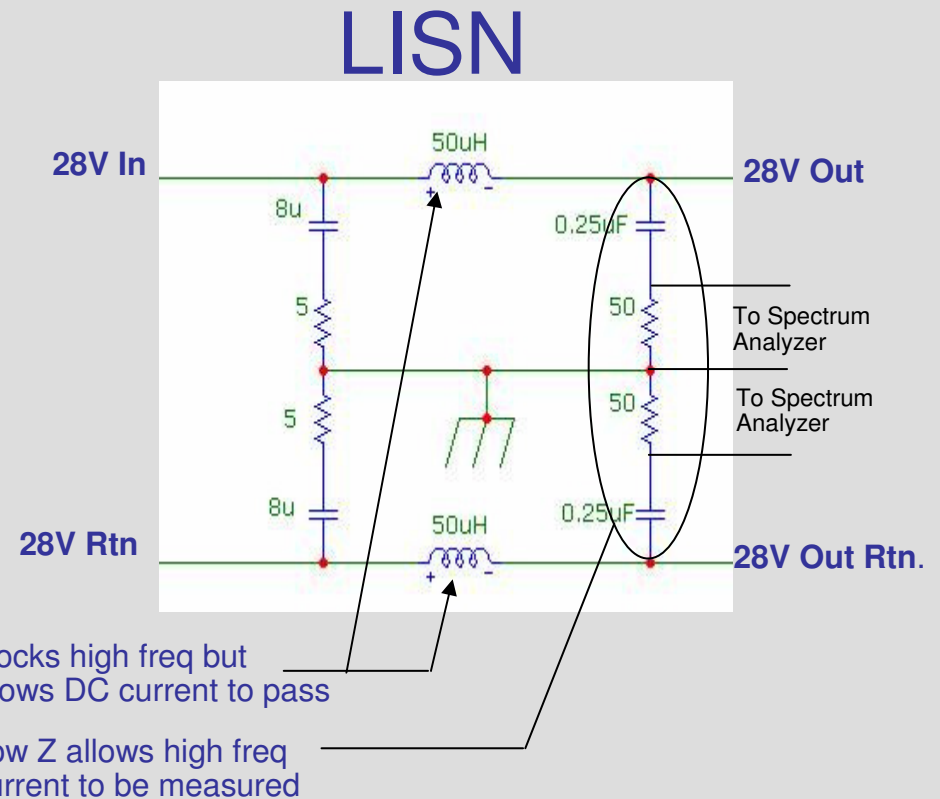
A device, known as a LISN (Line Impedance Stabilization Network), is used to measure noise (pollution) in each line. It allows DC to pass and provides a path for high frequency current / voltage to be measured.

EMI specs are typically concerned with high frequency noise. The high frequency takes the path of lowest impedance. Any current passing through the 50 ohm resistors (in the spectrum analyzer) will be measured.

Make sure when testing the unused LISN terminal is terminated with 50 ohms.

Two things can be done to prevent noise from being measured

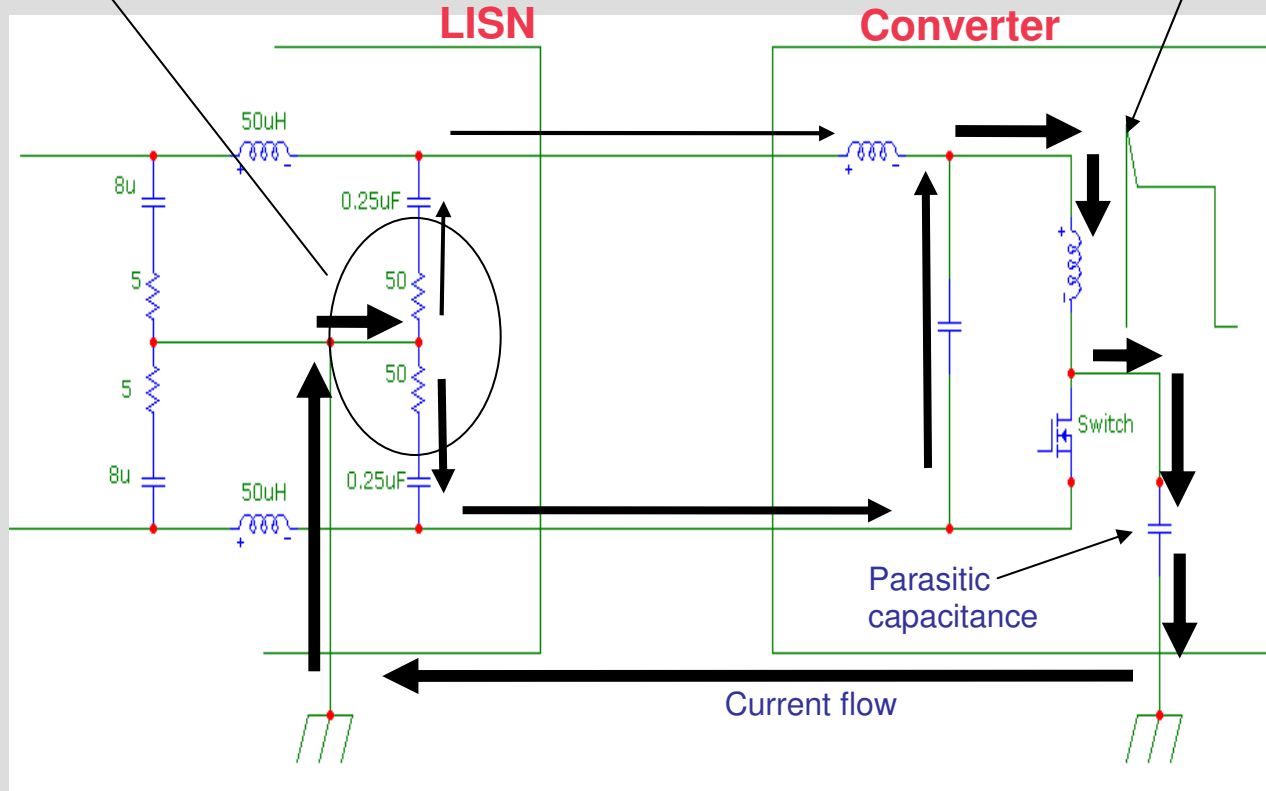
1. Add a high impedance between the LISN and converter.
2. Add a low impedance to shunt current away from the LISN



CM Noise - No CM Filtering

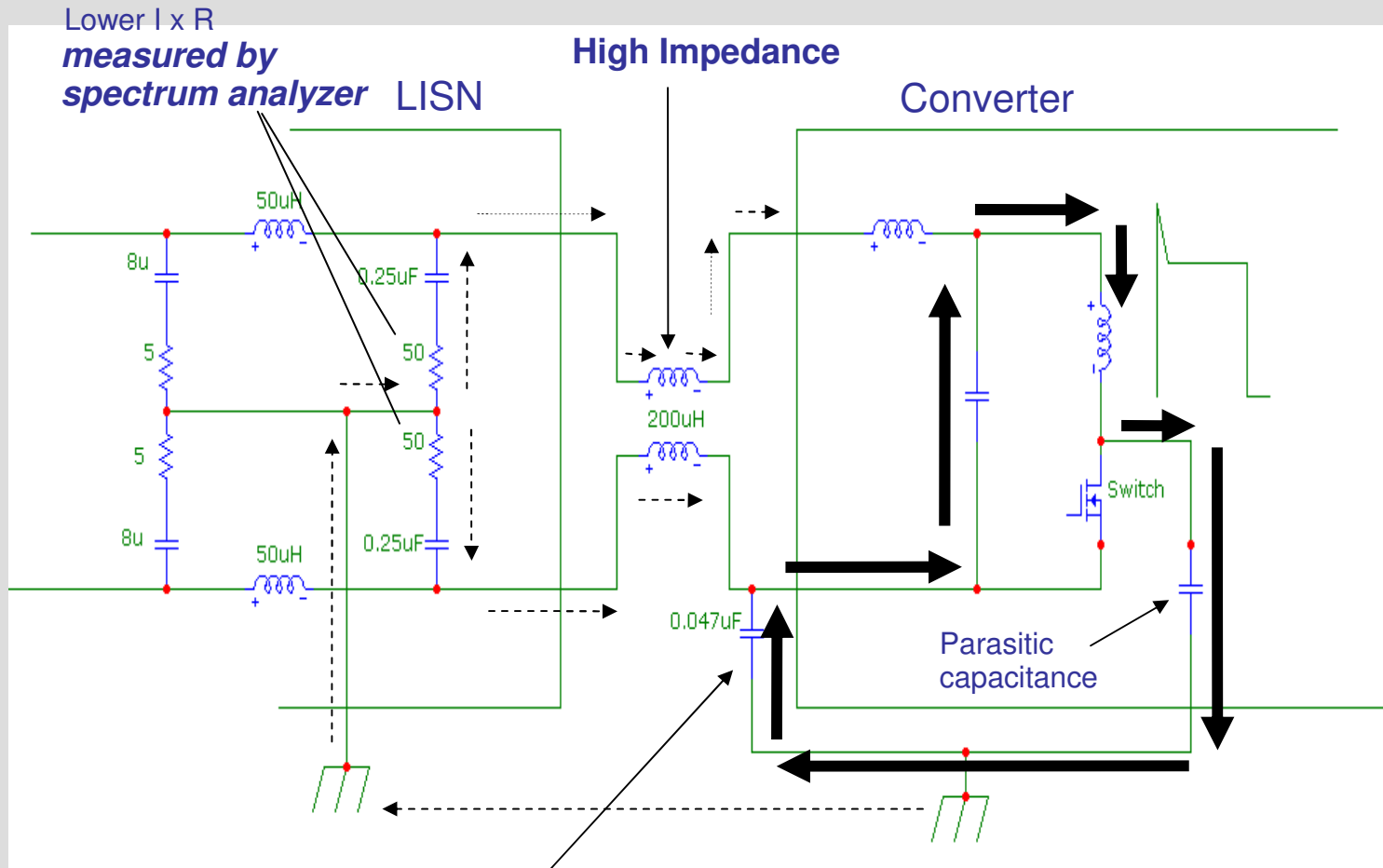
$I \times R$ measured by spectrum analyzer

Voltage rising due to switch turning off



There will be some *in-phase* and some *out-of-phase* components depending on the impedances of the current paths. This shows the main switch turning off. When it turns on, the current paths will change.

CM Noise - With CM Filter



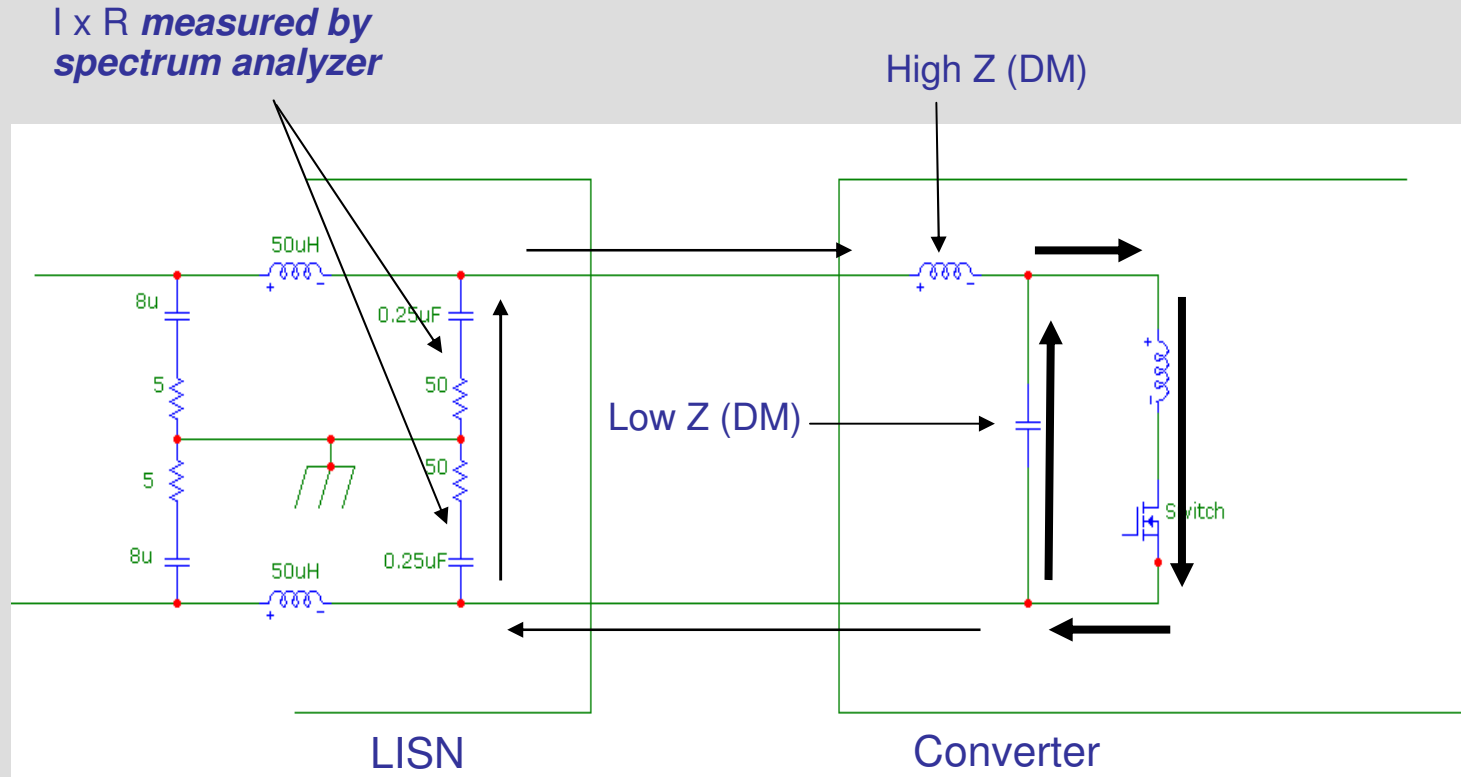
Lower $I \times R$
measured by
spectrum analyzer

High Impedance

Converter

Current takes path of
least impedance

DM Noise - No DM Filtering



Partial EMI filter, internal to converter, reduces ripple current but not enough to pass EMI specs

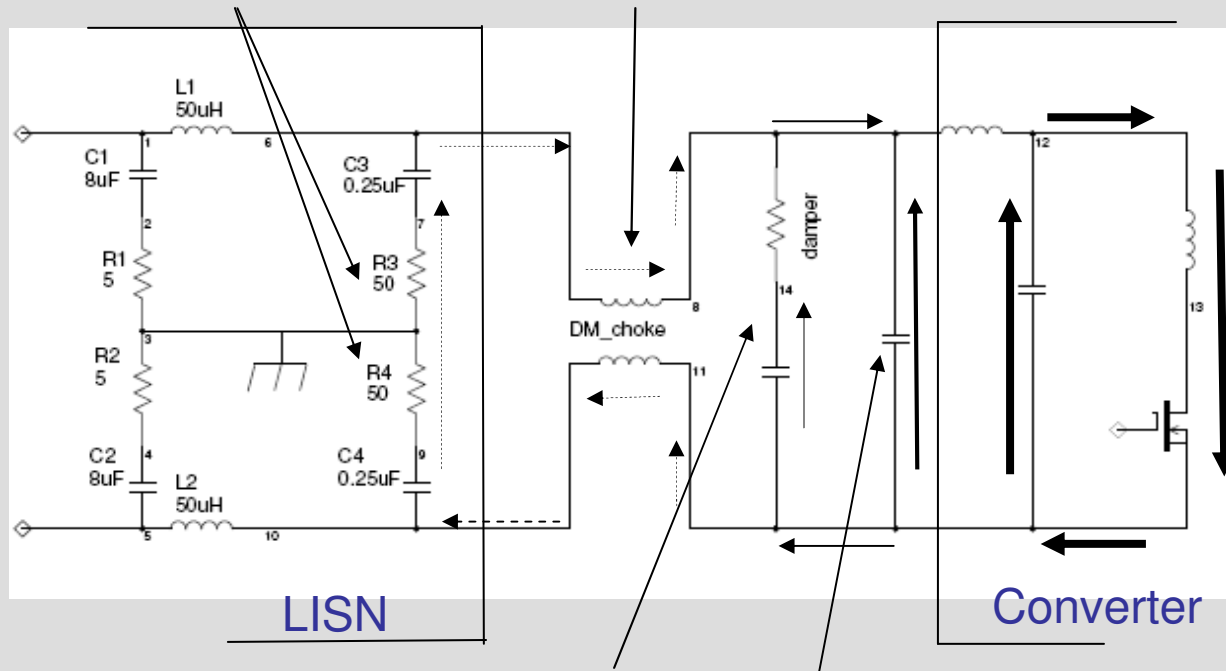
EMI cont.

DM Noise - With DM Filtering

Lower $I \times R$ drop
measured by
spectrum analyzer

DM choke – High Z and
lower ripple current

To DC
source



LISN

Converter

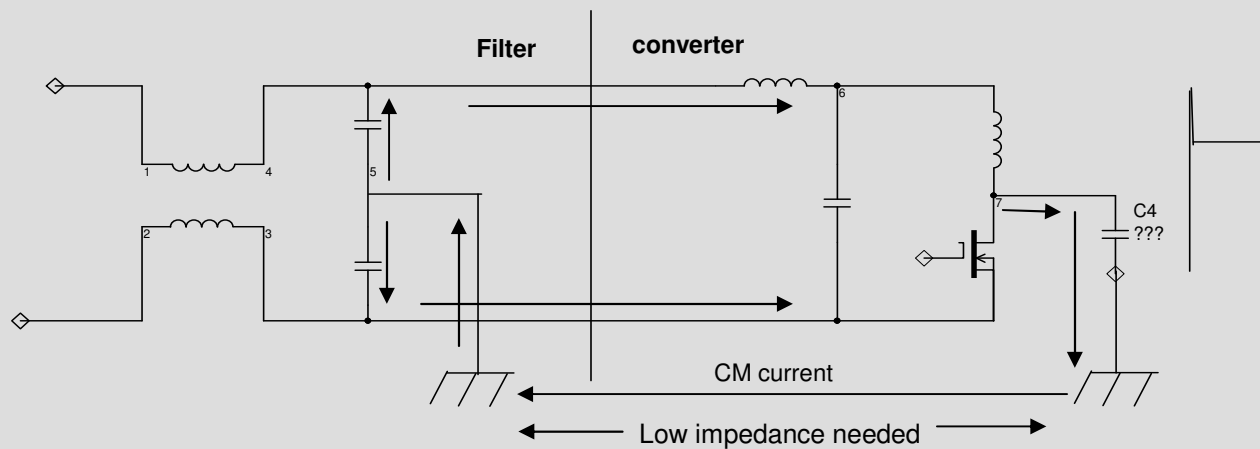
Dampening
network for low Q

Added DM cap – low Z
and stored charge

- Keep power traces short and wide and overlap them with **their** return path.
- If possible overlap Input Positive and Input Return traces. Overlap Vout with Output Common. Overlap a clock signal with its return signal. If traces can not be overlapped keep them as close together as possible - minimize the loop.
- Overlapping traces means one trace runs on one side of the board and the return path for that trace runs on the other side of the board **directly** above or below it. This included Sync and Sync return.
- Keeping traces short will help reduce radiated noise.
- Keeping traces wide will add capacitance when overlapping. Wide traces will also have a slight affect on reducing inductance (although inductance can be good in some cases).
- When possible, ground the converter's case to earth ground to minimize radiated noise.

EMI Cont.

- Keep a low inductance / resistive path between filter chassis and converter chassis to allow the CM noise can take the path of the CM filter caps (internal to the external filter) to get back to the converter.

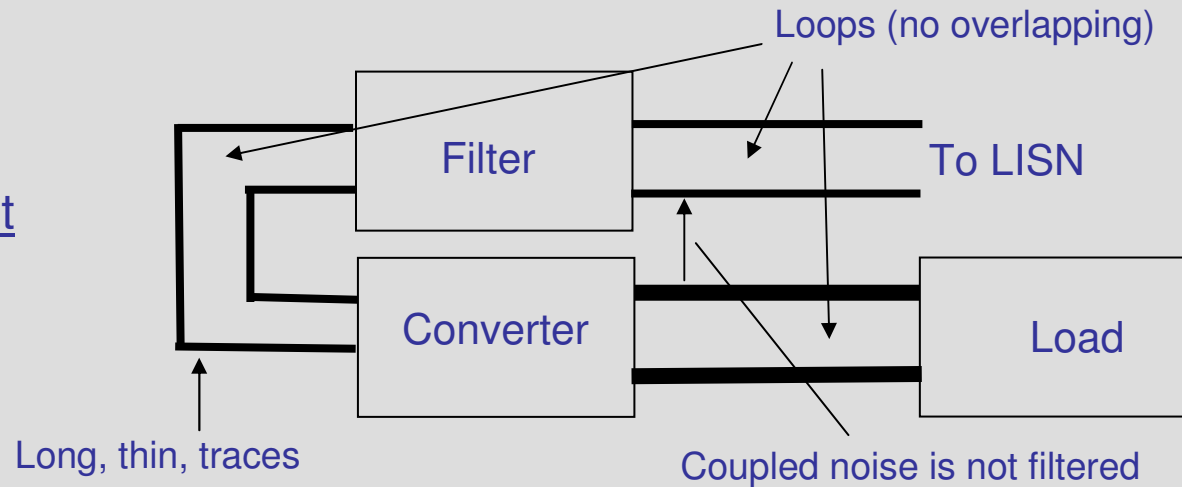


- Keep filter and converter as close together as possible and connect chassis to earth ground to reduce radiation.

EMI Filters Cont.

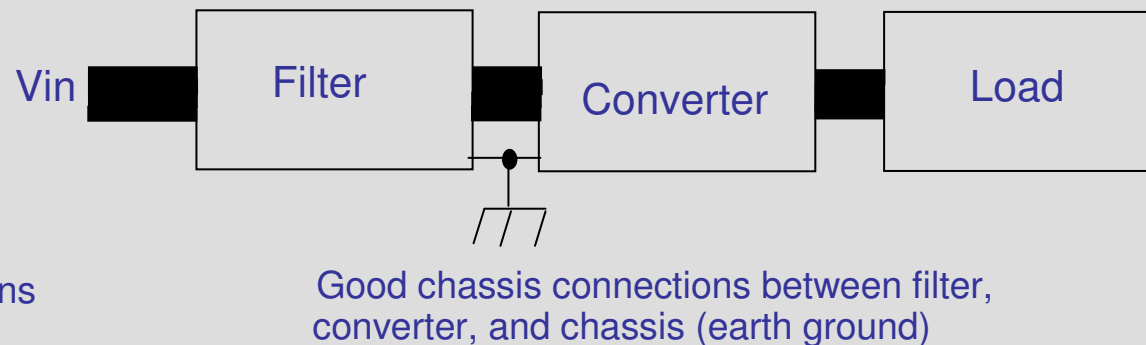
- Try and keep power flow in a straight line. The EMI filtering section should be in a noise free environment. Placing the EMI, or input section, by the output, or any other noise source, may allow the noise to couple to the input and be measured.

Non Ideal Layout



Ideal Lay-out

- Short traces
- Wide traces
- Straight flow →
- Over-lapping traces
- Good chassis connections



EMI Filters Cont.

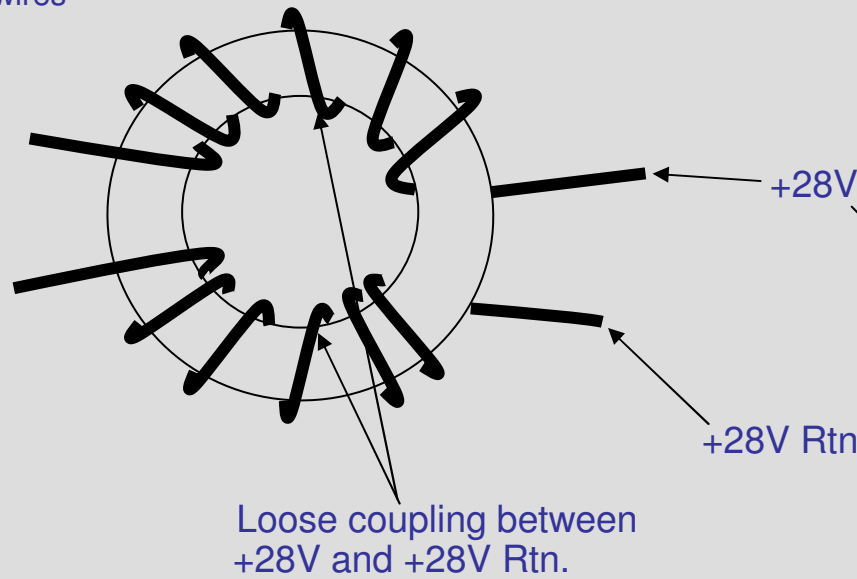
Capitalize on the Parasitics

If parasitics are not considered, a balun (CM choke) will act as a short to DM currents and act as a high impedance to CM currents.

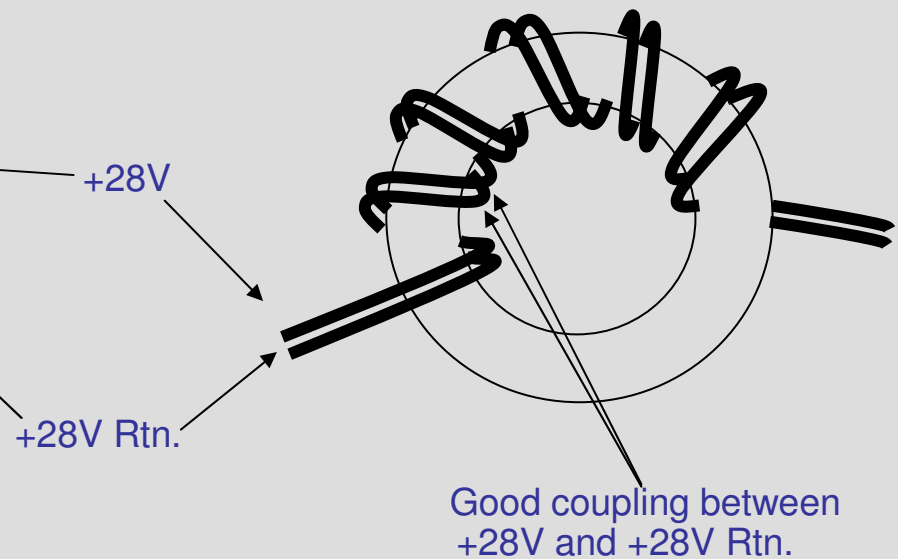
If using a balun consider segment winding a choke vs. bifilar winding. The poor coupling will create DM inductance (leakage inductance) free.

The diagrams below show a segment wound versus a bifilar wound CM choke.

Segment wound. Free DM inductance (good) and less likely to have a short between the 2 wires



Bifilar wound. Low DM inductance and more likely to have a short between the 2 wires



EMI Filters Cont.

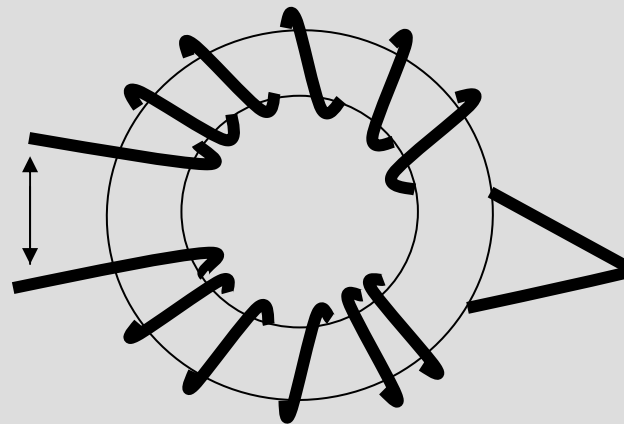
Measuring leakage inductance of a CM choke

Short the two Finish ends of the inductor (28V Out to Return Out)

Measure between the two start ends of the inductor (28V In to Return In)

The measured value will be the influence of both windings in series as seen by the DM noise.

Measure
between both
start leads



Short both
finish leads

Choosing a filter

- Size the filter for the maximum steady state current at the lowest input voltage. Maximum converter current = $P_{out_{Max}} / (V_{in_{Min}} \times \text{efficiency})$. For multiple converters add their currents.
- Surge currents during start up are typically not a concern.
- Check converter and filter data sheets for recommended filter / converter combinations.

From FMCE-1528
data sheet

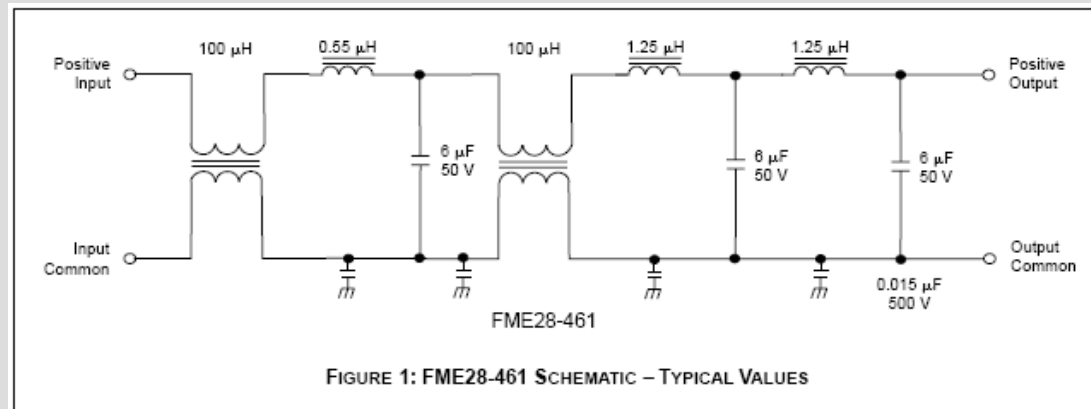
DESCRIPTION

The FMCE-1528™ EMI filters are specifically designed to reduce the reflected input ripple current of Interpoint's high frequency DC/DC converters. FMCE-1528 filters minimize electromagnetic interference (EMI) for the MFL, MOR, MTR, MHV, and MHF+ Series of converters. These filters are intended for use in 28 volt applications which must meet MIL-STD-461C CE03 and CS01 and/or MIL-STD-461D, E and F CE102 and CS101 levels of conducted emissions. One filter can be used with multiple converters up to the rated output current of the filter.

EMI Filters Cont.

- When using more than one converter with an EMI filter consider syncing converters to eliminate beat frequencies. Beat frequencies typically occur at frequencies below most EMI specs but not always.
- If using an external DM capacitor between a converter and filter consider adding a damping resistor in series with the cap. Modeling results to insure a low Q is recommended.
- For modeling purposes, filter schematics are typically available in our data sheets.
- Converter input filter schematics and EMI filter schematics can be obtained through Interpoint applications department.

Schematic from
FME28-461 data
sheet



Output Filtering

- For reducing DM output noise add DM capacitance at the output. Adding caps close to output pins of converter can will keep currents local and help prevent conducted noise from becoming radiated noise. Adding them at the load will clean up the noise where it counts.
- For greater noise reduction add an inductor to make an LC filter. Modeling is recommended to verify a low Q. Don't forget to incorporate load capacitance into your model.
- A higher C, and lower L, will decrease the Q of an external filter (Good). The leakage inductance from a CM choke will typically provide enough DM inductance to provide excellent results.
- An inductor can compromise output load transient performance (bad).

Output Filtering Cont.

- A higher C can improve output load transient performance (good) as long as it does not decrease the BW of the converter too much.
- To keep from interacting with the converter's control loop, external output LC filters should have their resonant frequencies greater than 100KHz, or be well damped.
- When using an external output LC filter, with a converter that has remote sensing, always sense before the output choke. Sensing after the output choke will add two poles to the compensation and could make the converter unstable.
- All high frequency caps should have low ESR/ESL. A larger value, low frequency cap, and damping resistor, can take care resonance if an inductor is used as part of the filter.
- Consider using different value caps. Smaller value caps typically work better at high frequency and larger value caps work better at low frequency. A 2.2uF, a 0.1uF and a 0.01uF cap in parallel may provide better noise attenuation than a 4.7uF cap.

Output Filtering Cont.

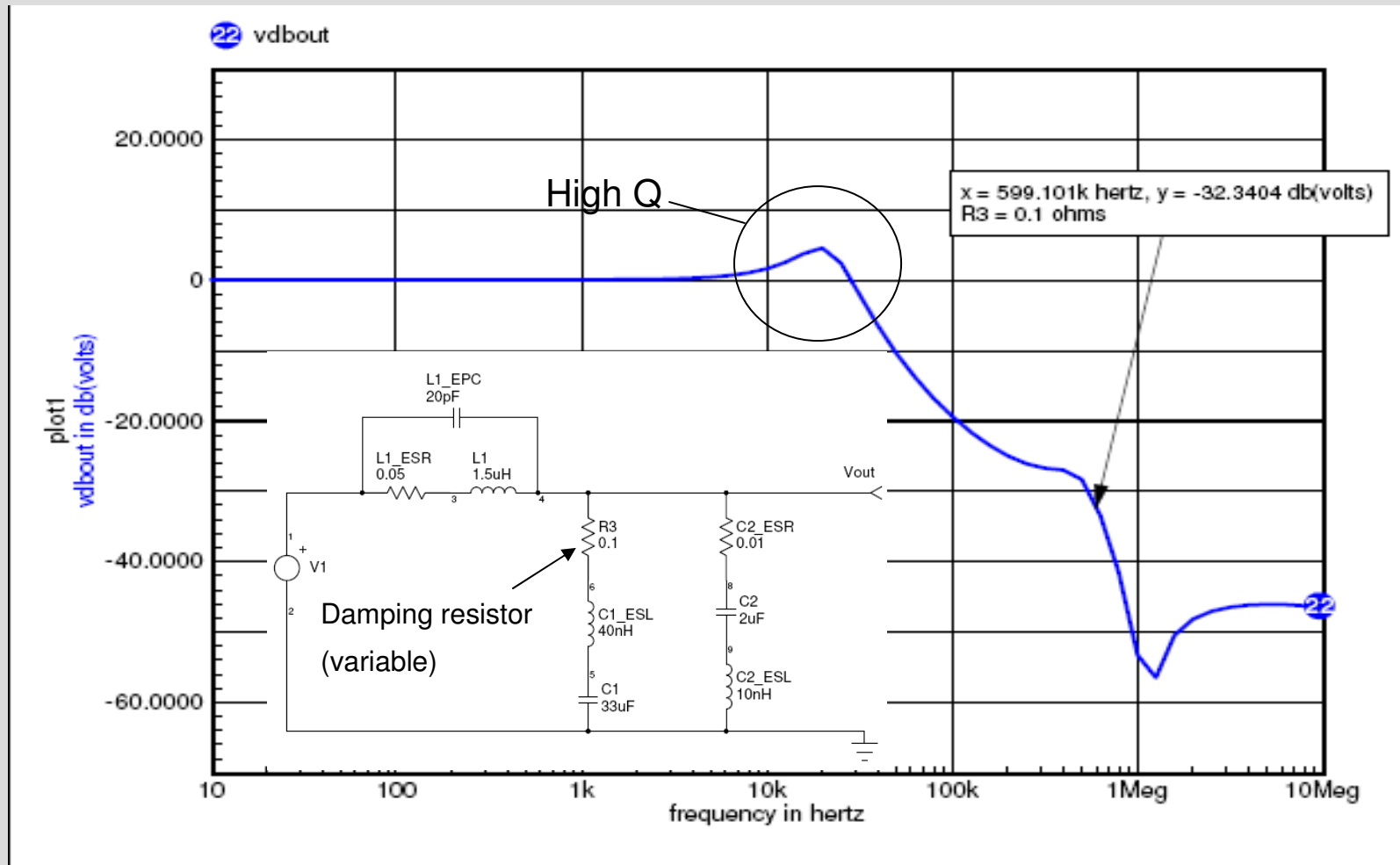
- Layout rules for EMI also apply for output noise.
- With typical measuring techniques CM noise can show up as DM noise. A CM choke, and CM capacitors, can greatly reduce the apparent DM noise (CM noise).
- Bypassing CM noise from Output Common to chassis with ceramic caps will reduce CM noise. Having a ceramic cap from Input Common to chassis will help re-direct some of the currents back to the primary if that is where it belongs. Make sure isolation specs are not being violated because of this.
- If designing a CM filter consider segment winding the balun (CM choke) to take advantage of the free DM inductance (leakage inductance).

Modeling

- The next few pages show results from making slight adjustments to a damping resistor of an output filter. It affects the Q and the attenuation of the output noise. Changes in any component can produce similar results.
- Modeling is highly recommended for optimization.

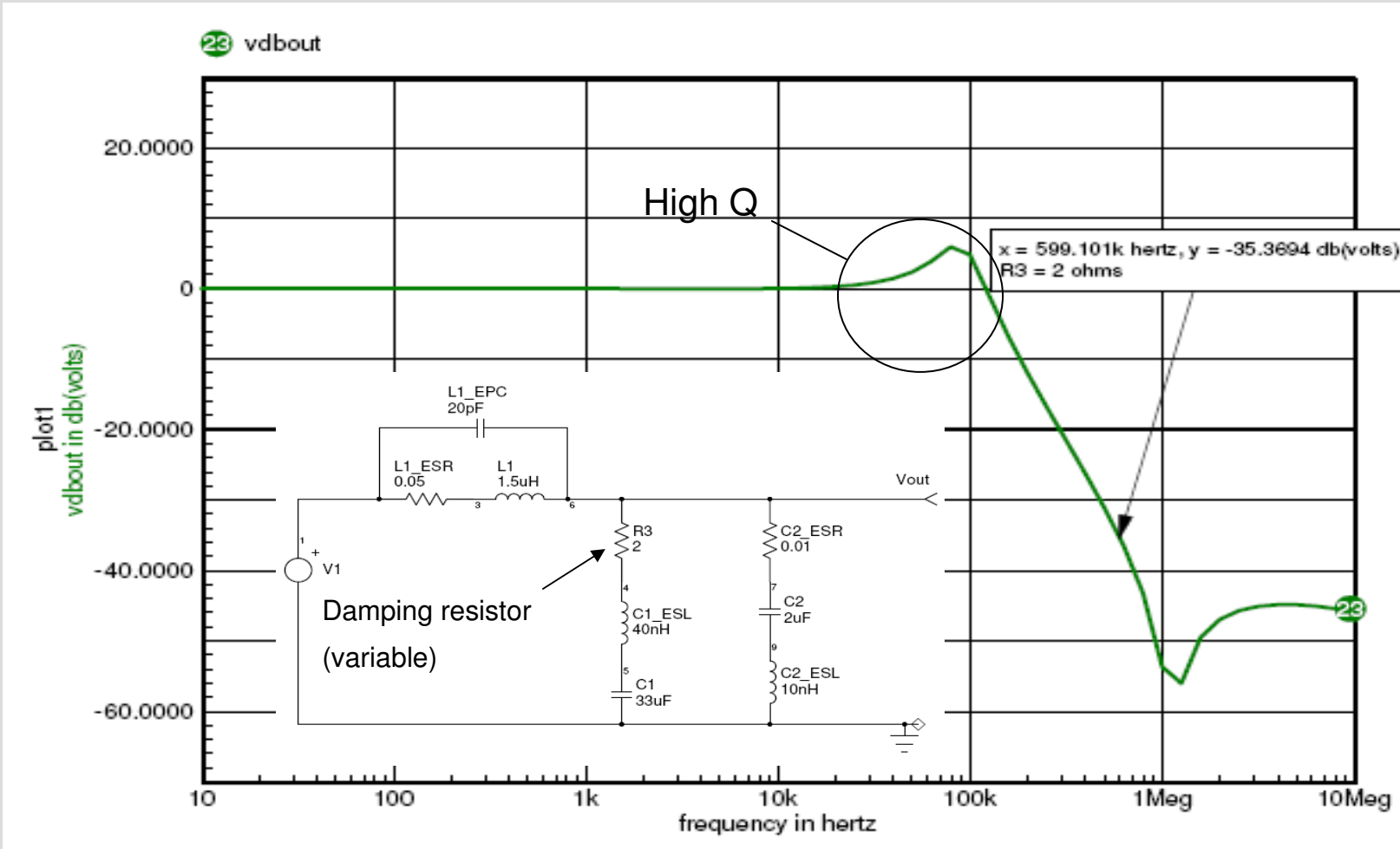
Output Filtering Cont.

Modeling a filter L1 will want to interact with the larger 33uF cap which can be damped by a resistor (R3). The damping resistor is so small that it does not burn much of energy in L1. This results in a high Q.



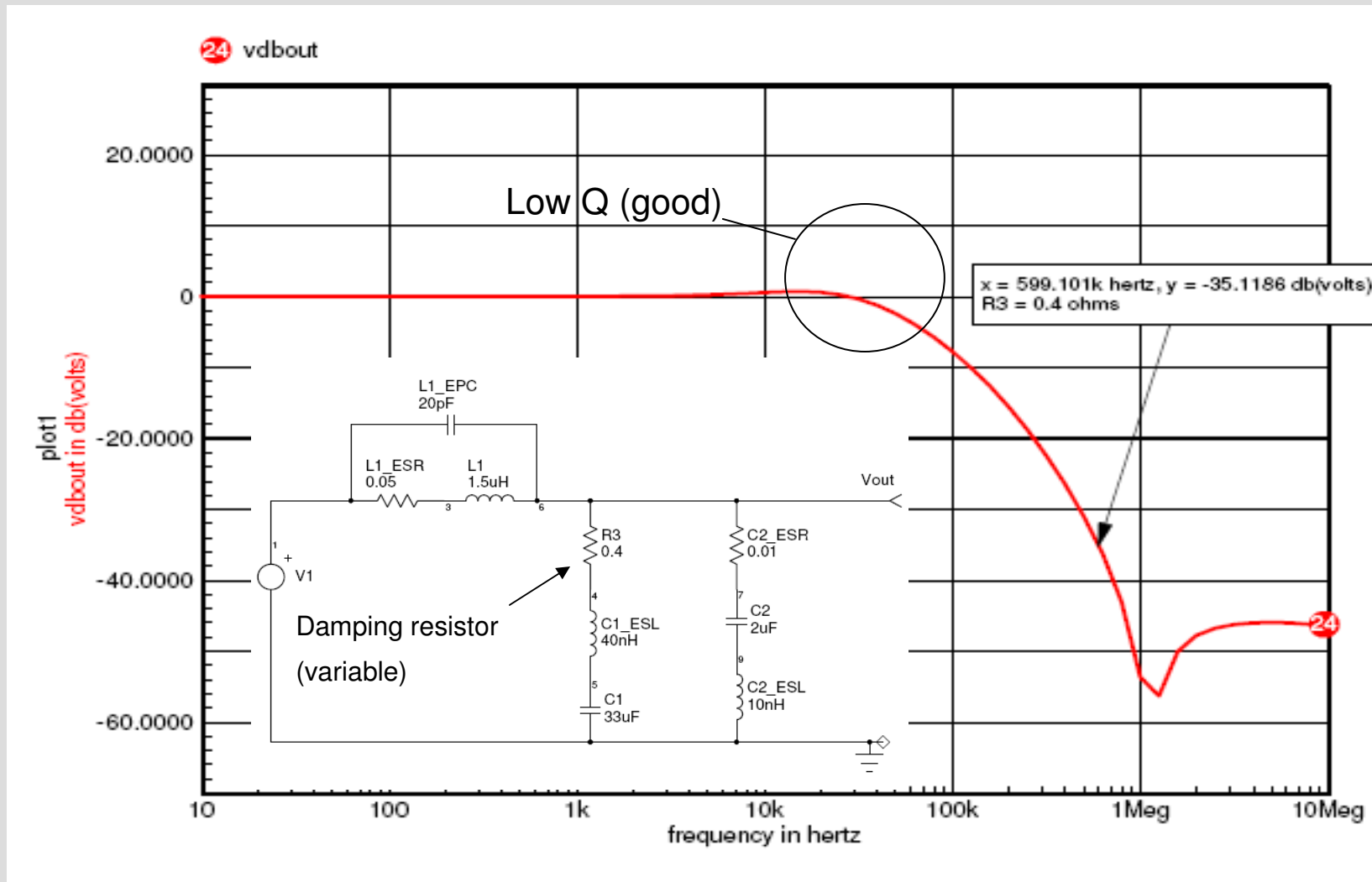
Output Filtering Cont.

Modeling a filter Here the damping resistor (R3) is too large and the 33uF cap is affectively not in circuit. The result is a high Q.



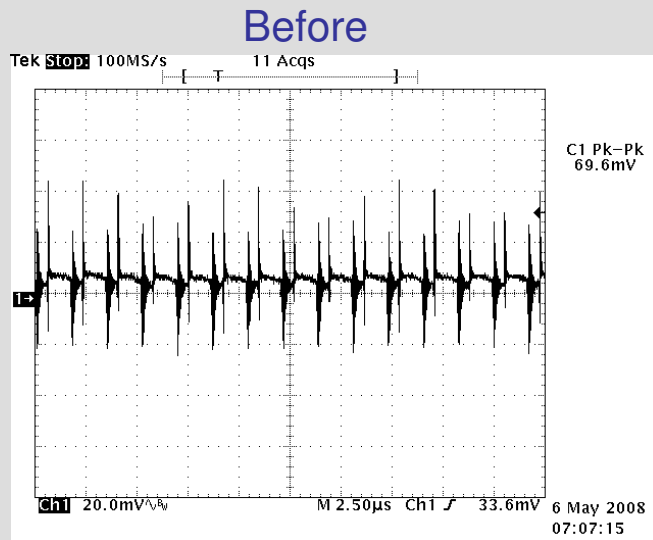
Output Filtering Cont.

Modeling a filter Here the damping resistor is small enough to allow the 33uF cap to interact with L1 yet big enough to burn the energy in L1. This results in a low Q (desirable) and the attenuation has not suffered.

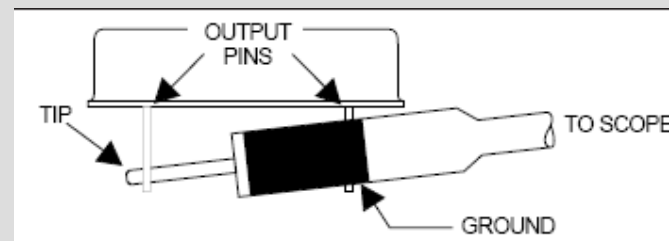
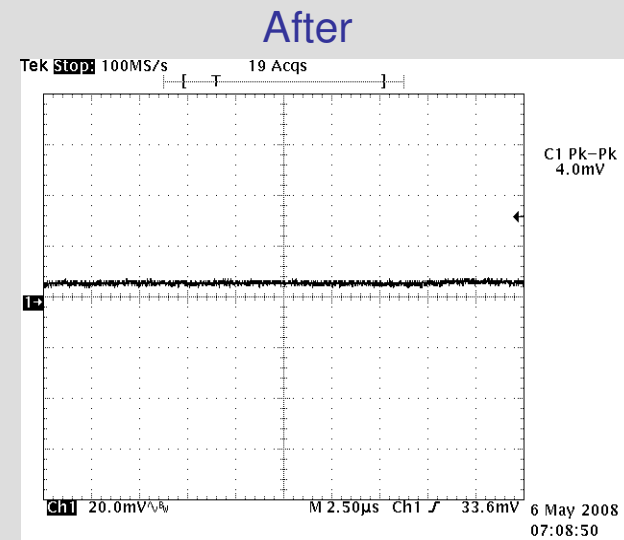


Output Filtering Cont.

Before and After results of a MTR2805S (full load) using a filter similar to the one shown in the previous slide, and an optimized layout. The inductor was a segment wound CM inductor to achieve a leakage inductance of around 1.5uH. In addition a CM cap was connected from Output Common to Chassis. Most of the 4mVpp noise shown here is not real as the scope shows 3mV without the converter on.



Scope set to
20MHz BW.



Use barrel of
scope probe for
measurement

✓ App note

Line Transients

- A line transient is a fast, dynamic, change in input voltage.
- The change in line voltage can be within the converter's normal operating range or out of its normal operating range.
- When operating out of the normal operating range a maximum value, and time, is imposed.
- The specified transient value is the maximum input voltage not a value added to the 28V bus. A 50V transient means the input will see 50V not 50V on top of 28V.

Excerpt from data sheet

PARAMETER	CONDITION	MIN	TYP	MAX	
INPUT VOLTAGE ¹ NO LOAD TO FULL	CONTINUOUS	16	28	40	VDC ← Normal operating range
	TRANSIENT 50 ms	—	—	50	V ← Transient (outside normal Operating range)
STEP LINE RESP.	16 – 40 – 16 VDC ←				mV pk ← Transient within normal Operating range
	TRANSIENT ⁵	—	±200	±300	
	RECOVERY ⁴	—	—	300	μs

Imposed time

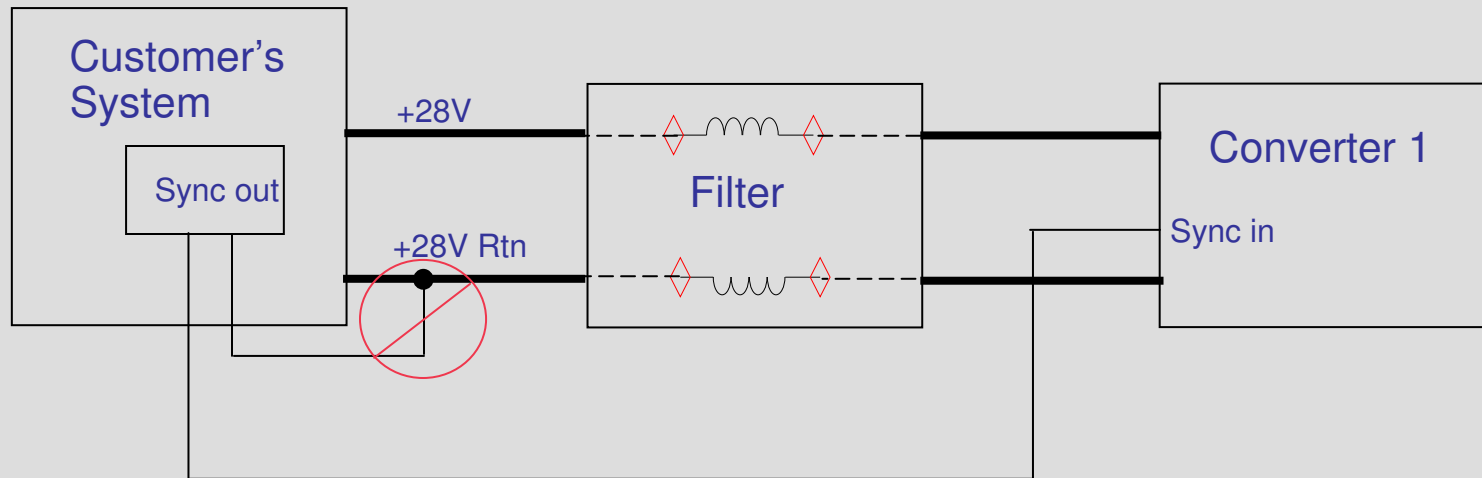
Synchronization Usage

- The Sync feature allows adjustment of the converter's switching frequency by an external clock.
- Noise injected into the sync input can adversely affect converter performance so place close attention to layout and recommendations for unused sync pins.

Applications include

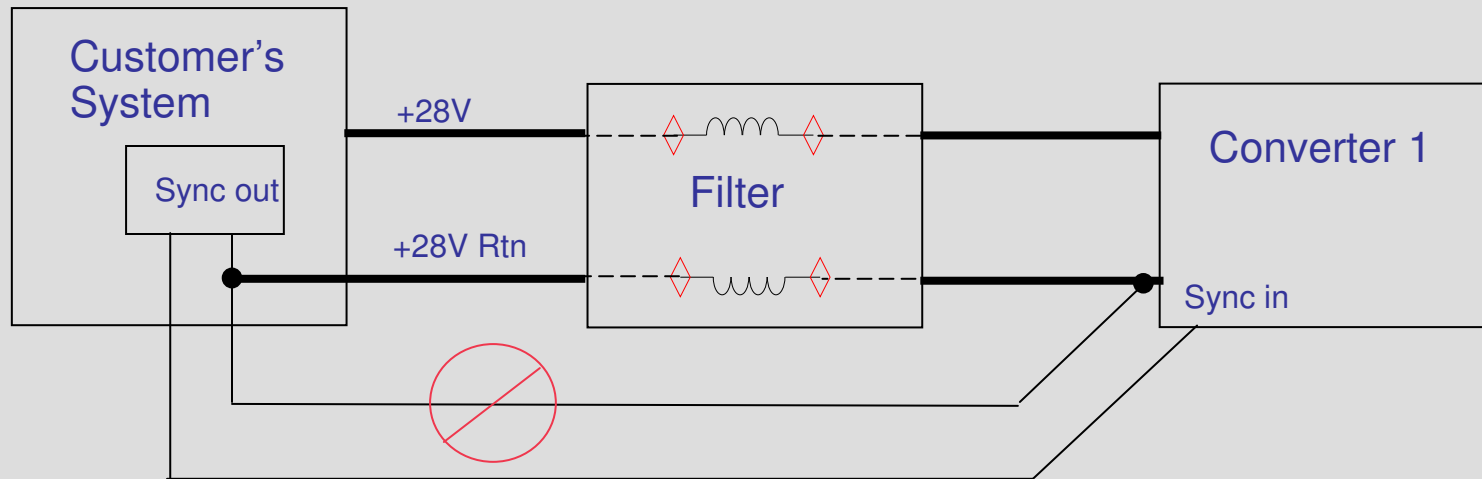
- Concentration of the noise generated by several converters into a narrower band.
- Shifting the noise away from sensitive frequencies of a system.
- Eliminating beat frequencies from parallel converter operation. No sum or difference frequencies are present. Low frequency noise is not attenuated significantly by an EMI filter.

Synchronization Usage



Do **not** connect Sync Return to Input Common of an EMI filter. High frequency currents run through the filter (noise) and the CM inductor can have several volts (noise) across it.

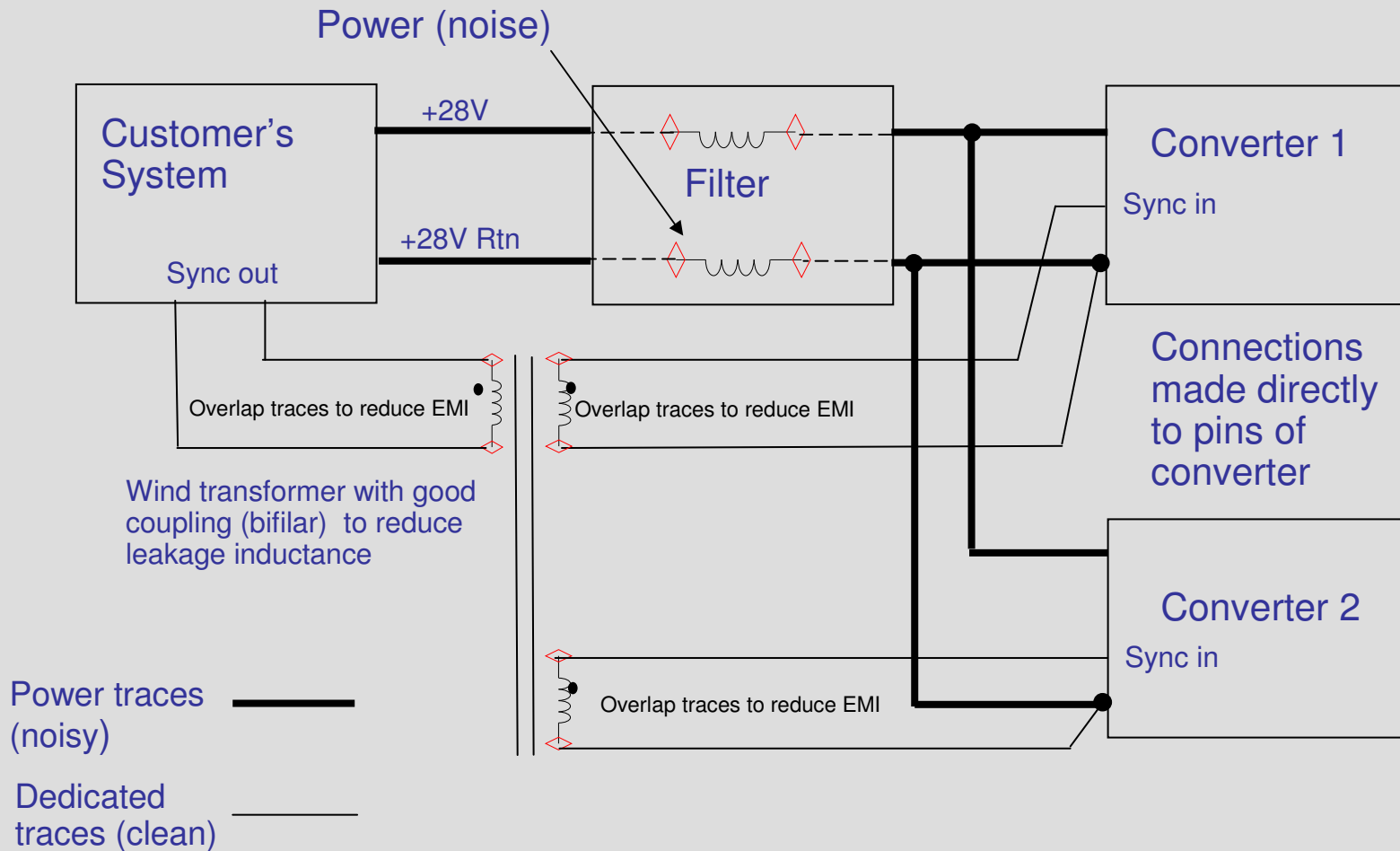
Synchronization Usage



- Here we have the Sync Return line going directly to the converter's Input Common as desirable. The problem is now you have shorted out the CM choke in the external filter and the high current on the +28V Return line will want to return through the Sync Return Trace – not good.

Synchronization Usage Cont.

Two converters & filter (recommended connections)



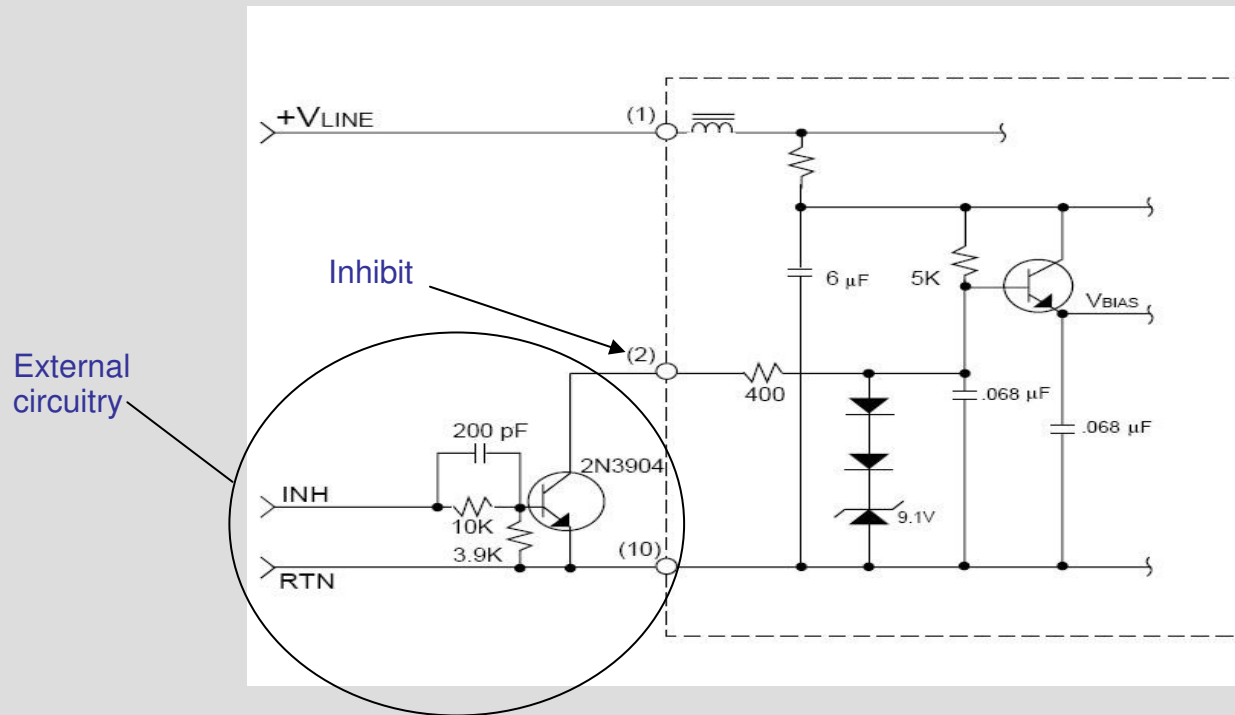
Synchronization Usage Cont.

- The application of the Sync signal can cause an output voltage transient. It is recommended to apply sync while the converter is Inhibited, then release Inhibit.
- If the converter can not be Inhibited, have the initial Sync signal transition be negative (i.e. from 5V to 0V). This has been shown to reduce output transients due to the application of the Sync.
- Do not deviate from the recommended sync range or the converter may be damaged. If the recommended range is from 500kHz to 600kHz a value of 200kHz may saturate magnetics and damage a converter. More benign deviations may cause the converters to run hot.
- If the Sync signal is not being used see data sheet recommendations for **unused pins**. Typically, if unused, the Sync pin is connected to Input Common. Although the converter will most likely run fine when floating following the “unused pin recommendations” makes the Sync signal less susceptible to noise.
- See data sheet for recommended amplitudes, duty cycles and frequency ranges.

✓ App note

Inhibit Usage Cont.

Primary Inhibit circuit used on many Interpoint converters



Inhibit should be open circuit for enable, and connected to Input Common for Primary Inhibit or to Output Common for Secondary Inhibit (check data sheets for recommendations).

An internal pull-up is present, no external pull-up is needed, or recommended. Do not apply voltage to the Inhibit pin.

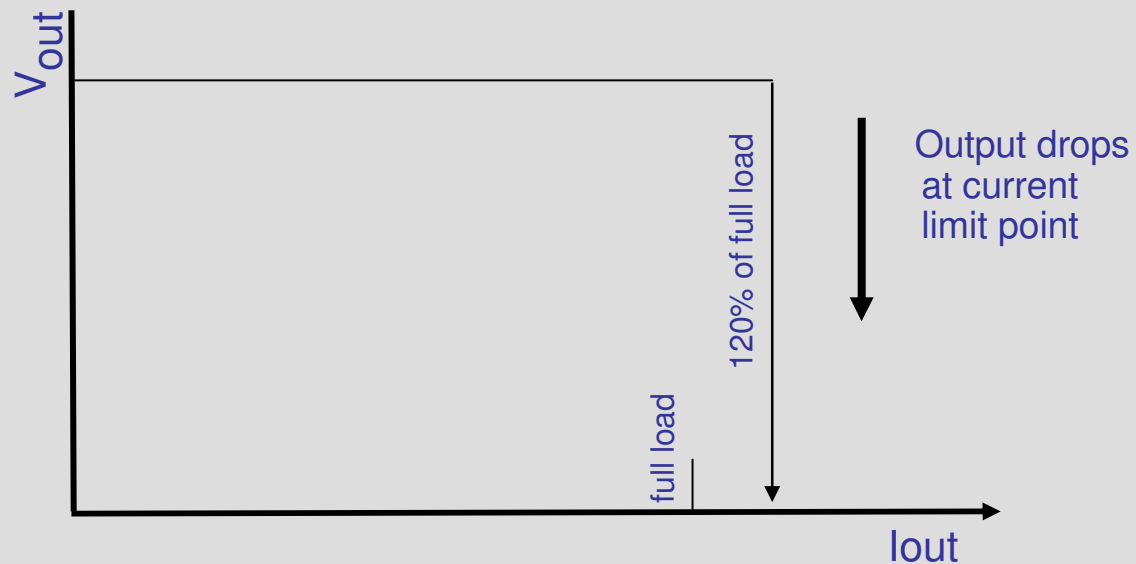
Inhibit Usage Cont.

- Transitions should be very fast. Do not use capacitors on the Inhibit pin to delay the rise.
- When using a common connection to inhibit several converters each inhibit may need to be isolated with a diode. Some converters already have internal isolation diodes. Check with Interpoint Applications if in doubt.

✓ App note

Current Limit

- Interpoint converters have current limit points that are **typically** 115% to 125% of full load. Check data sheet to be sure.
- Interpoint converters **typically** have a constant current, current limit. As current tries to increase past the current limit point the output of the converter drops sharply.



Short Circuit Protection

- Short circuit protection is current limit with any output shorted. The output will limit its current by causing the output voltage to drop. The output voltage, at the pins of the convert, will be equal to $I_{out} \times R_{out}$. R_{out} is the resistance seen by the output pins of the converter and I_{out} is current limit value.

Example

Current limit = 10A

$R_{out} = 0.02\text{ohms}$ (trace resistance and short resistance)

$V_{out} = 0.2\text{V}$ (10A x 0.02 ohms)

- It is good practice to heat sink for worst case power dissipation. This is **may** be during short circuit.

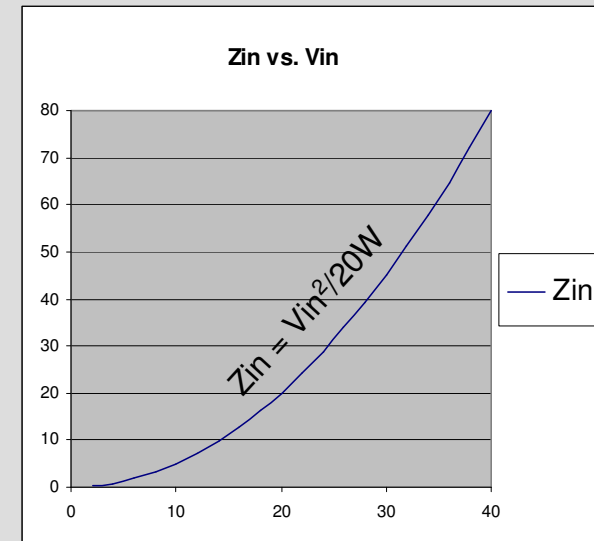
Input Impedance

Input filters should have low impedance

- Source impedance is the total impedance looking from converter input pins into the DC source, including the DC source.
- Source impedance includes PCB traces, external filters, inrush protection, DC source and anything else in between. Don't forget to consider dynamic impedances (inductors, capacitors)
- The total source impedance must be lower than the input impedance of the converter or the converter can oscillate causing damage to the converter.
- A dc-dc converter has a negative input impedance which means that as input voltage decreases, input current increases. This is the opposite of a resistive load and at low frequencies the input current will be 180 degrees out of phase from the input voltage

Input Impedance cont.

- With a converter P_{out} stays constant and the input impedance increases proportionally to V_{in}^2
- Low input voltage (high input current) translates to low converter input impedance. Compare the graph of Z_{in} to I_{in} .
- The input impedance of a DC converter is equal to V_{in}^2 / P_{in} .



Input Impedance cont.

Consider more than just steady state impedances

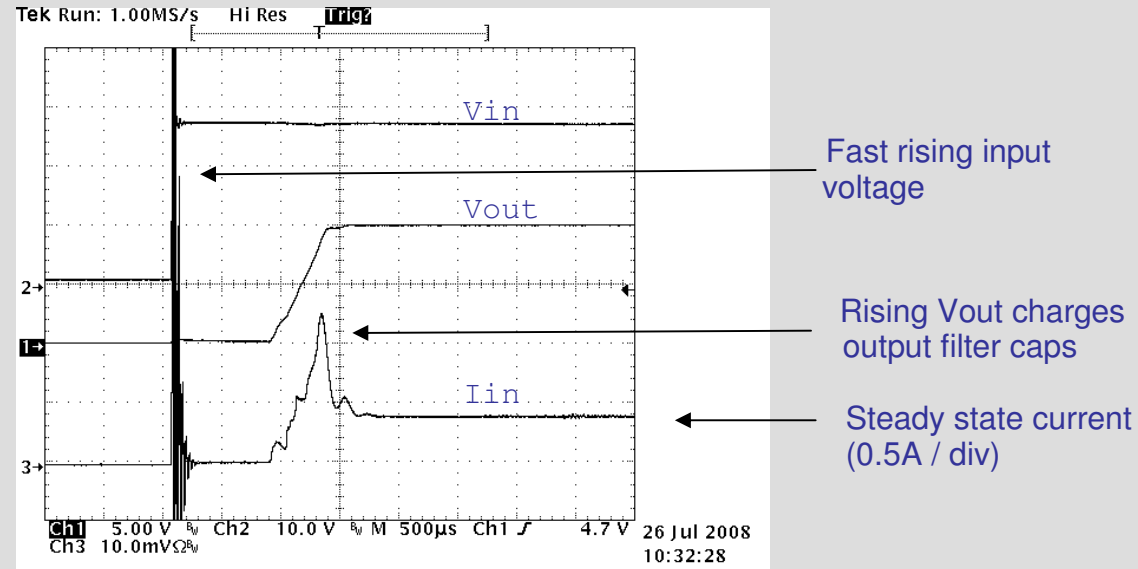
- Consider converter Input impedance during application of a slow rising input voltage bus. The converter may turn on at a low voltage (~14V) and the converter's input impedance will be lower than at nominal line voltage.

- When the converter turns on the output voltage rises very fast. The fast rise of output voltage will charge any internal output filter capacitance, and load capacitance. There can also be overshoot during turn on. This rise in output voltage can create higher Pout than steady state.

- Where possible, reduce input DM inductance and increase input DM capacitance.
 - DM capacitance decreases impedance seen by the converter
 - DM inductance increases impedance seen by the converter
 - Q is proportional to the square root of L/C (low L, hi C decrease Q)

✓ App note

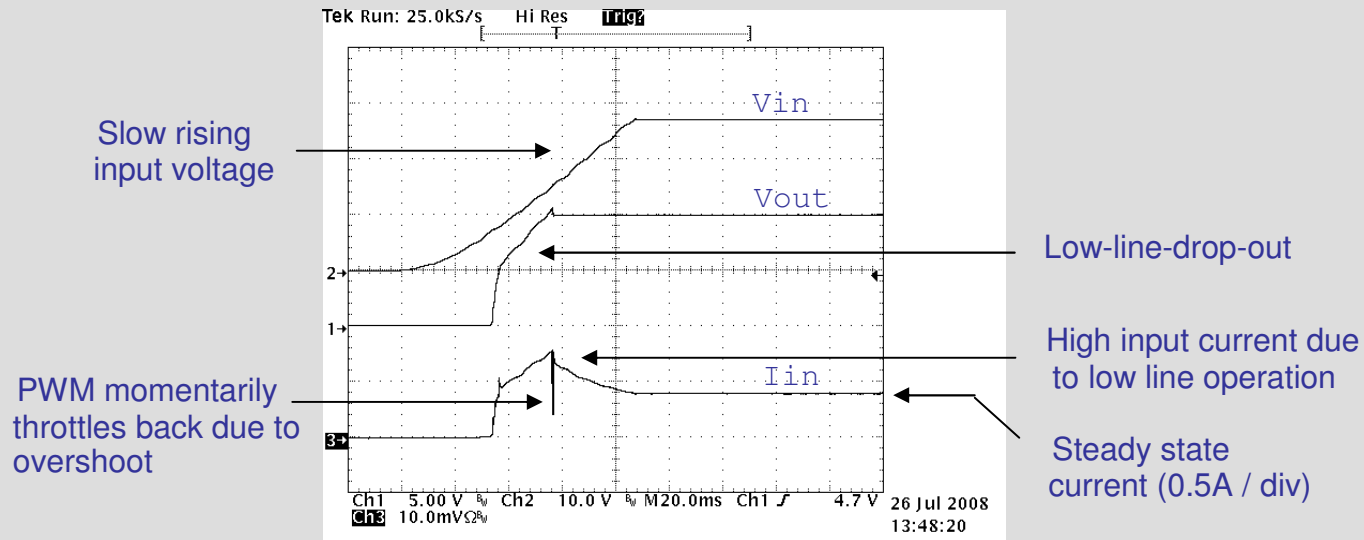
Input impedance continued Cont.



Turn on of MTR2805D (10V span voltage with 11.8 ohm load – less than ½ load)

- A mercury switch was used to apply an instantaneous voltage to the input of a MTR.
- The fast rising output voltage creates a surge current into the output filter capacitor. This is reflected back as input current. Adding load capacitance will increase this surge current.
- After the output filter capacitor is fully charged the converter operates in steady state and the input current can easily be calculated.

Input impedance continued Cont.



Turn on of MTR2805D (10V span voltage with 11.8 ohm load – less than 1/2 load)

- DC source comes up slowly and high current is demanded at low input voltages.
- The output rises slowly, with input voltage, due to the duty cycle being maxed out at low input voltage (low-line-drop-out).
- Slow rise in output voltage does not create high currents into output filter capacitor.
- The output overshoots and causes the converter's PWM to momentarily turn off until the output voltage drops to the regulation level.

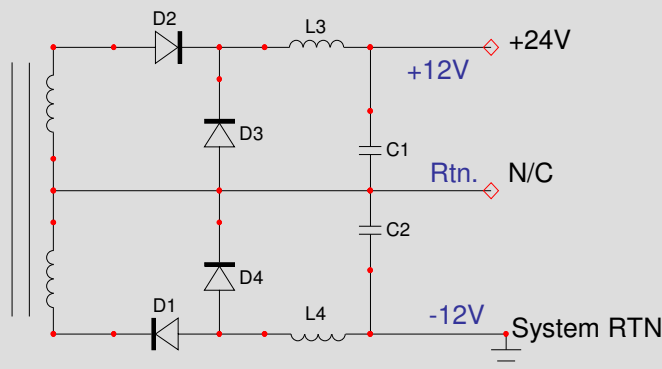
Using the Span voltage

- Interpoint's dual converters can be used as dual outputs or a single output. When used as a single output this is referred to as the "span voltage"

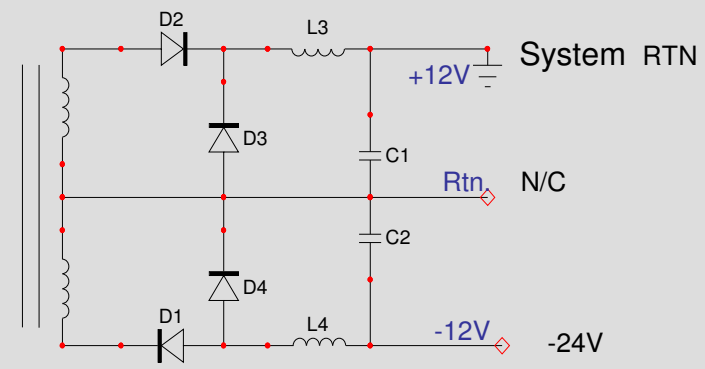
Example

- If a 12V dual is configured as a positive 24V output, the negative output would be used as Output Common, and the positive output would be used as the +24V output. Output Common of the converter would be left floating.

If a 12V dual is configured as a negative 24V output the positive output would be used as Output Common and the negative output would be used as the -24V output. Output Common of the converter would be left floating.



Float Output Common and use as +24V



Float Output Common and use as -24V

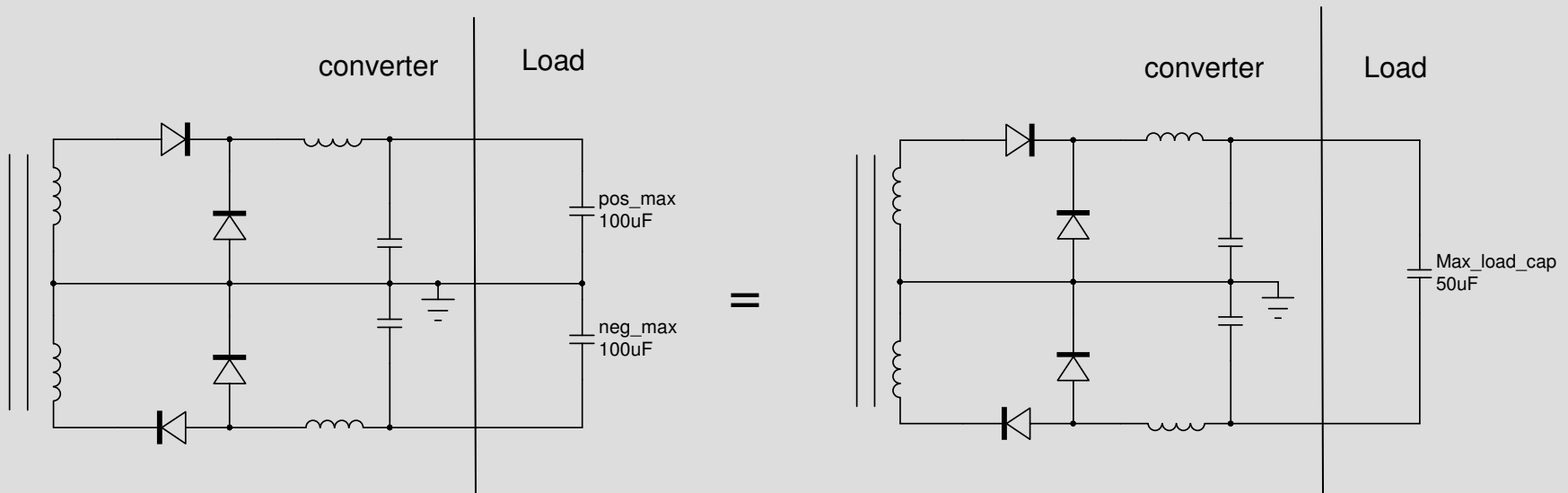
Using the Span voltage Cont.

Capacitance when using a span voltage

- When using a dual configured as a single output, the span voltage is capable of half the load capacitance of each output.

Example

If a 12V dual has a maximum capacitive rating of 100uF on each output, the total capacitance for the span voltage would be $\frac{1}{2}$ the max capacitance for each output or 50uF. An easy way to visualize this is to break the output common connection and the caps are in series which halves their value.



Maximum Output Capacitance

Load capacitance above maximum rating

- Adding output capacitance typically increases the output rise time. On some models it may cause output overshoot at turn on if the capacitance is significant.
- Adding output capacitance can also reduce the converter's BW making it a little more sluggish to load transients.
- The maximum output capacitance values range from 10uF(MHF+2812D and MHF+2815D) to 5000uF.
- Too large of value can interfere with control loop and can cause undesired operation.
- The SMDs, if available, list the maximums capacitance for Interpoint converters. All **new** data sheets will have this information.

Load Balance

- Load balance only pertains to dual converters (not all) and the auxiliary outputs of triple converters.
- Typical load balances are 10% / 90%, 20% / 80%, 30% / 70%.
- When deviating from the load balance spec the negative output can be out of regulation.

Example

Assume a 20% / 80% load balance spec and a full rated power of 10W (sum of both outputs).

At full load one output can supply 8W while the complimentary output can supply 2W. If one output is 8W and the other output is 1W the spec would be violated.

At 50% of full rated power (5W) one output could provide 4W if the complimentary output were at 1W or greater. If the complimentary output went to 0.8W while the other output was set to 4W the spec would be violated.

Accessing SMDs - DSCC website

Standard Microcircuit Drawings, also known as SMDs, are data sheets provided by the Defense Supply Center Columbus (DSCC) in their format.

They include parameters, and conditions, that may not be included on a Interpoint data sheet.

Shown to the right are three pages of an 18 page MSA2805S SMD

TABLE I. Electrical performance characteristics - Continued.

Test	Symbol	Conditions 1/2/3 -55°C ≤ T _c ≤ +125°C V _{IN} = 28 V dc ±0.5 V, C _L = 0 unless otherwise specified	Group A subgroups	Device types	Limits		Unit
					Min	Max	
Output voltage	V _{OUT}	I _{OUT} = 1A	1, 2, 3	01, 02, 03	4.95	5.05	V dc
					4.80	5.20	
					4.6	5.5	
					4.5	5.5	
Output current	I _{OUT}	V _{IN} = 16 V dc to 40 V dc	1, 2, 3	01, 02, 03	1		A
					1		
					1		
					1		
V _{OUT} ripple voltage	V _{rip}	I _{OUT} = 1A, BW = 10 kHz to 2 MHz	1, 2, 3	01, 02, 03	350		mV p-p
					450		
					525		
					675		
					1000		
					1000		
V _{OUT} line regulation	VR _{LINE}	V _{IN} = 16 V dc to 40 V dc, I _{OUT} = 1A	1, 2, 3	01, 02, 03	50		mV
					50		
					100		
					100		
V _{OUT} load regulation	VR _{LOAD}	I _{OUT} = 0 to 1A	1, 2, 3	01, 02, 03	50		mV
					50		
					100		
					100		
Input current	I _{IN}	I _{OUT} = 0 A, Inhibit (see figure 2) = 0	1, 2, 3	01, 02, 03	5		mA
					12		
					40		
					50		
					100		
					100		
I _{IN} ripple current	I _{rip}	I _{OUT} = 1A, BW = 10 kHz to 10 MHz	1, 2, 3	01, 02, 03	100		mA p-p
					200		
					150		
					300		
					300		
					500		

See footnotes at end of table.

STANDARD MICROCIRCUIT DRAWING		SIZE A	5962-93092
DEFENSE SUPPLY CENTER COLUMBUS COLUMBUS, OHIO 43218-3990		REVISION LEVEL H	SHEET 5

DSCC FORM 2234
APR 97

TABLE I. Electrical performance characteristics - Continued.

Device types	Limits		Unit
	Min	Max	
01		250	μs
02, 03		500	
01		1500	
02, 03		4500	
02		5	ms
01, 02, 03	-500	+500	mV pk
02		1000	
02		2000	
01, 03		900	μs
02		1000	
02		2000	
01, 02, 03		200	mV pk
02		500	
01, 02, 03		75	ms
02		150	
01, 02, 3/		75	ms
02		150	

5962-93092	
REVISION LEVEL H	SHEET 7

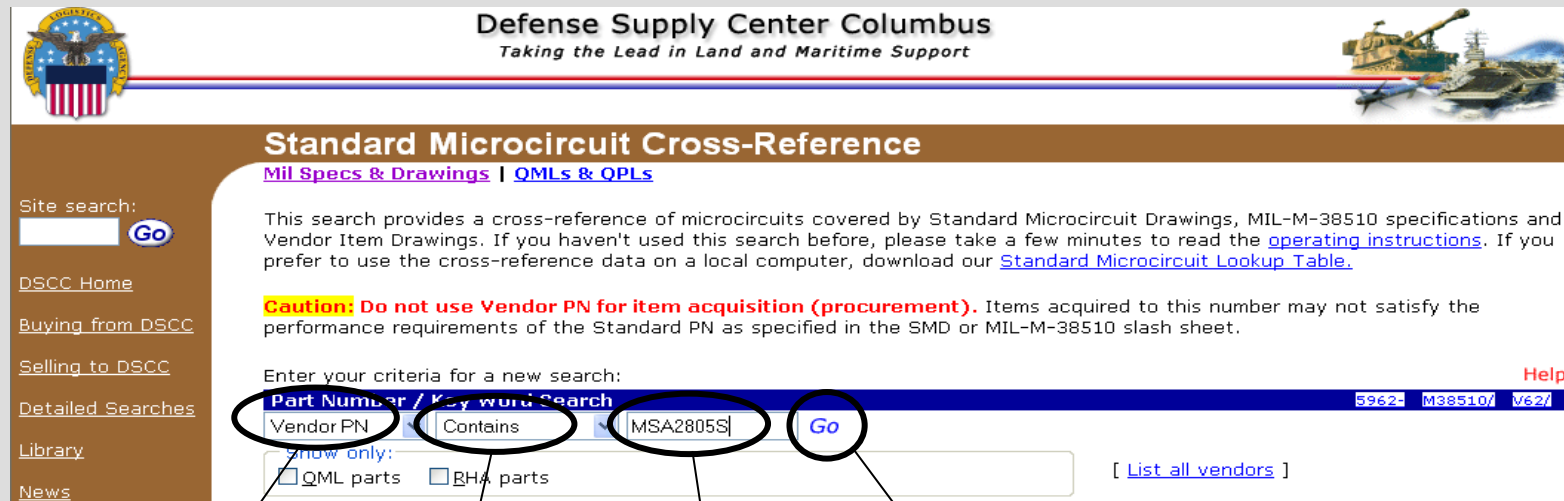
5962-93092	
REVISION LEVEL H	SHEET 6

Accessing SMDs - DSCC website Cont.

Enter www.dscclia.mil into browser and hit enter

At the bottom of the home page click on “Standard Microcircuit Cross-Reference”

Below shows the screen that should appear and how to access the desired part. In this case it is the MSA2805S



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Standard Microcircuit Cross-Reference

[Mil Specs & Drawings](#) | [QMLs & OPLs](#)

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This search provides a cross-reference of microcircuits covered by Standard Microcircuit Drawings, MIL-M-38510 specifications and Vendor Item Drawings. If you haven't used this search before, please take a few minutes to read the [operating instructions](#). If you prefer to use the cross-reference data on a local computer, download our [Standard Microcircuit Lookup Table](#).

Caution: Do not use Vendor PN for item acquisition (procurement). Items acquired to this number may not satisfy the performance requirements of the Standard PN as specified in the SMD or MIL-M-38510 slash sheet.

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Show only:
 QML parts GHA parts [\[List all vendors \]](#)

Select
Vendor PN

Select
Contains

Type in part
number

Click go

Application Notes

Interpoint has many application notes related to DC-DC converters and filters. These have a wealth of information that may make the difference between a successful or an unsuccessful design regardless of whose converters are used. They user friendly, **easy-to-read** and in an **easy-to-understand** format. A list of our app notes are provided below. We hope to increase this list soon.

- DC/DC Terminology
 - Provides a glossary of terms used in the industry
 - Allows for a better understanding of parameters used in Interpoint's data sheets.

- Designing with a Distributed Power Architecture
 - Explains the benefits of using a Distributed Power Architecture
 - Explains some of the issues when working with DC-DC converters.

- EMI Compliance Statement
 - Discusses some of the requirements of Mil-Std-461C
 - Addresses which of these requirements Interpoint converters typically meet

- EMI Conducted Interference
 - Explains what EMI is and how it is generated
 - Provides a tutorial on the design of EMI filters
 - Explains what can be done to reduce EMI
 - Contains precautions such as what happens with an un-dampened filter.
 - Explains and cautions about Input impedance issues.

Application Notes Cont.

- Inhibit & Synchronization
 - Provides an overview of Interpoint's Inhibit and Sync circuits including circuit diagrams
 - Provides "Do(s)" and "Don't(s)" when using Inhibit or Sync
 - Addresses the use with multiple converters
 - Provides Lay-out precautions

- Inrush Current
 - Provides an overview of the causes of Inrush current
 - Explains what can be done to reduce Inrush currents
 - Explains input impedance issues and provides precaution
 - Provides a schematic of a circuit that can be used to reduce Inrush currents

- Mechanical Mounting, Vibration and Shock
 - Addresses the handling, including the cutting of pins, of Interpoint converters
 - Touches some thermal issues
 - Addresses vibration and shock

- Measurement and Filtering of Output Noise
 - Explains sources of noise
 - Explains differences between CM noise and DM noise
 - Provides measuring techniques
 - Provides solutions for reducing CM and DM noise
 - Provides precautions

Application Notes Cont.

- Thermal Management
 - Explains how to calculate power dissipation (source of heat)
 - Explains convection, conduction, and radiation
 - Provide a basic understanding of thermal issues including calculations.
 - Explains thermal impedances of Interpoint converters

- Transient Suppression
 - Briefly touches some transient specs
 - Provides some solutions, including schematics, and outlines limitations
 - Provides precautions such as damping and impedance imbalances

[Link to app notes](#)

http://www.interpoint.com/resources/application_notes



Application Assistance

Interpoint has a dedicated applications department whose sole purpose is helping customers.

Application Goals

Respond to customers within 24 hours. We can usually be reached immediately by phone.

Provide customers with the answers they need to move forward.

Encourage all questions from the customer and make them feel all **their questions are welcome and important**

Always encourage customers to follow up if they are not satisfied with the answers

Provide the best service in the industry!

Application Engineers

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