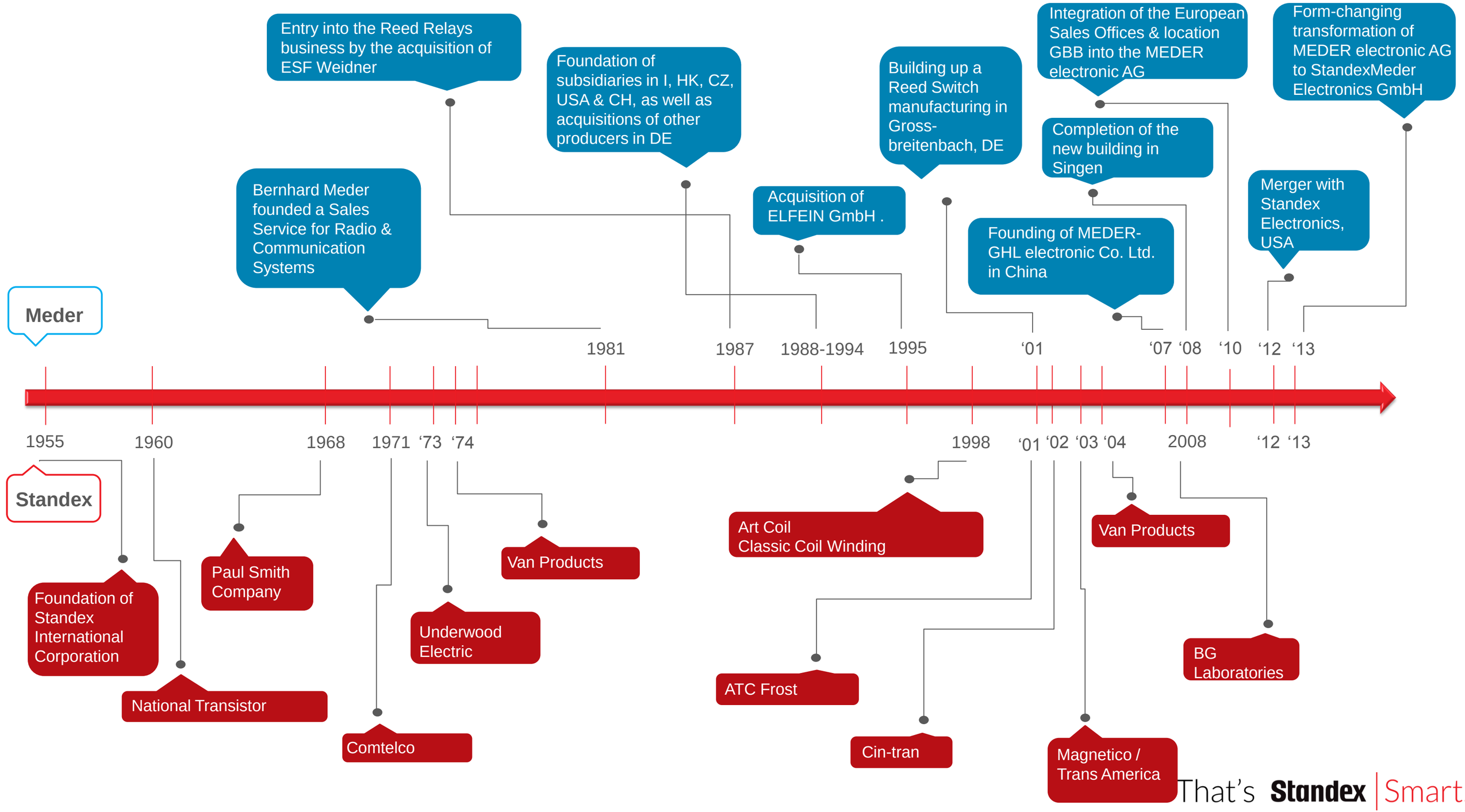
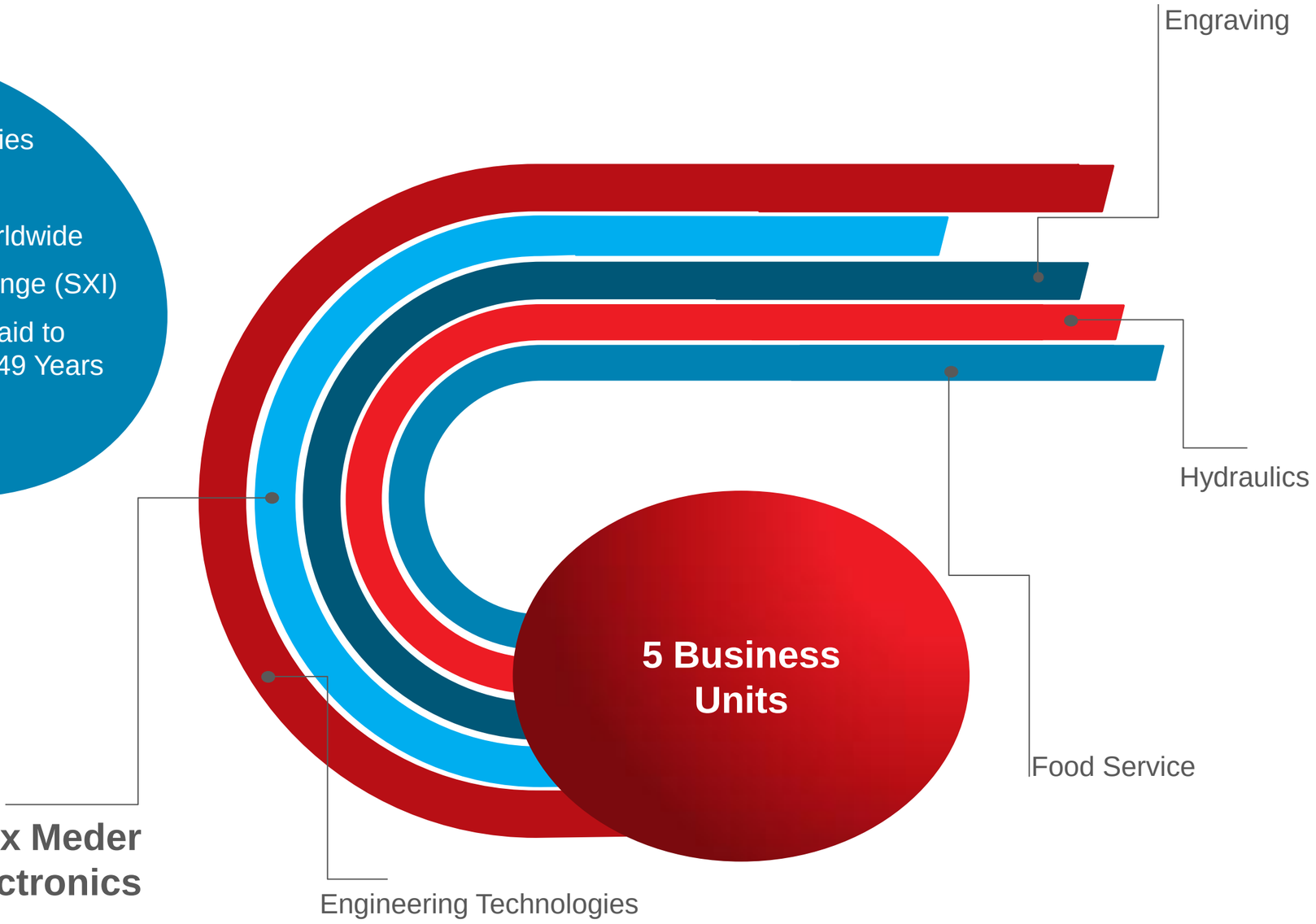

Standex
MEDER
ELECTRONICS



That's **Standex** | Smart.

Standex

- Facilities in 16 Countries
- 716 Mio US$ in 2014
- 3,800 Employees Worldwide
- New York Stockexchange (SXI)
- Profitable dividends paid to stockholders for past 49 Years

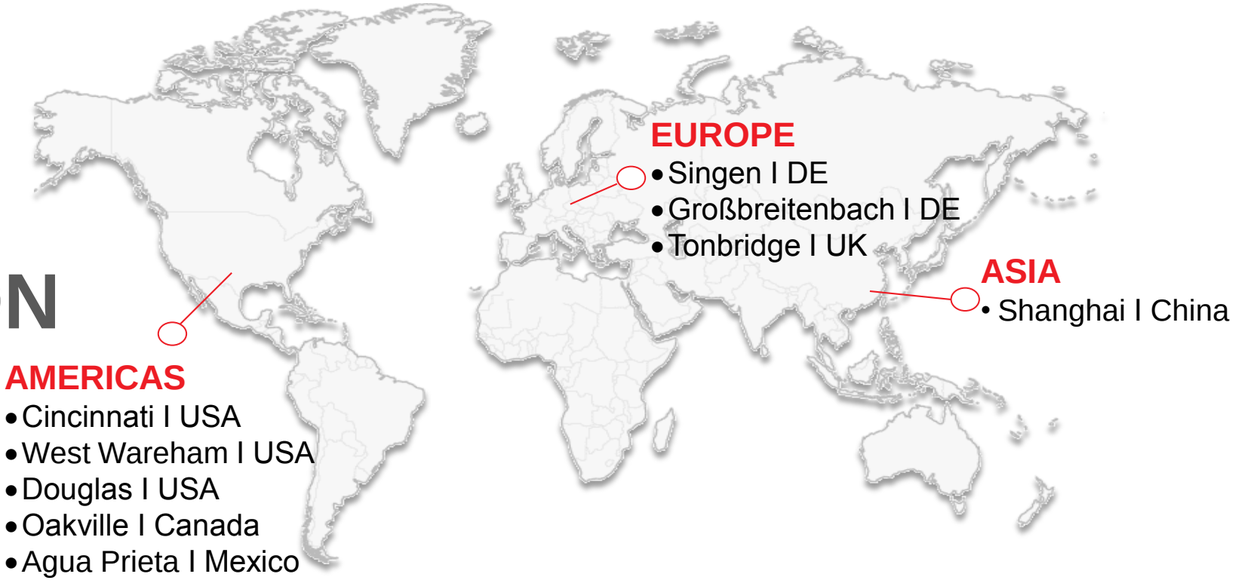


That's Standex | Smart.

More than 1.300 global Employees

130 Mio US$ in FY 2016

STRONG GLOBAL ORGANIZATION



AMERICAS
- Cincinnati I USA
- West Wareham I USA
- Douglas I USA
- Oakville I Canada
- Agua Prieta I Mexico

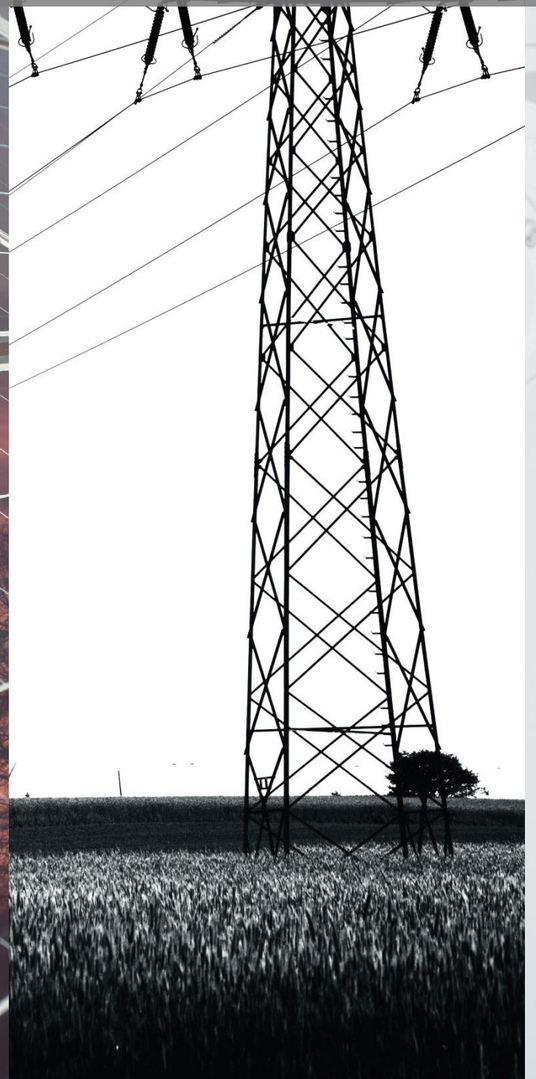
EUROPE
- Singen I DE
- Großbreitenbach I DE
- Tonbridge I UK

ASIA
- Shanghai I China

Headquartered in Cincinnati, OH, USA

ALTERNATIVE ENERGY

ELECTRIC POWER



MEDICAL

MILITARY & AEROSPACE

AUTOMOTIVE & TRANSPORTATION

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ALTERNATIVE ENERGY

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TRANSPORTATION

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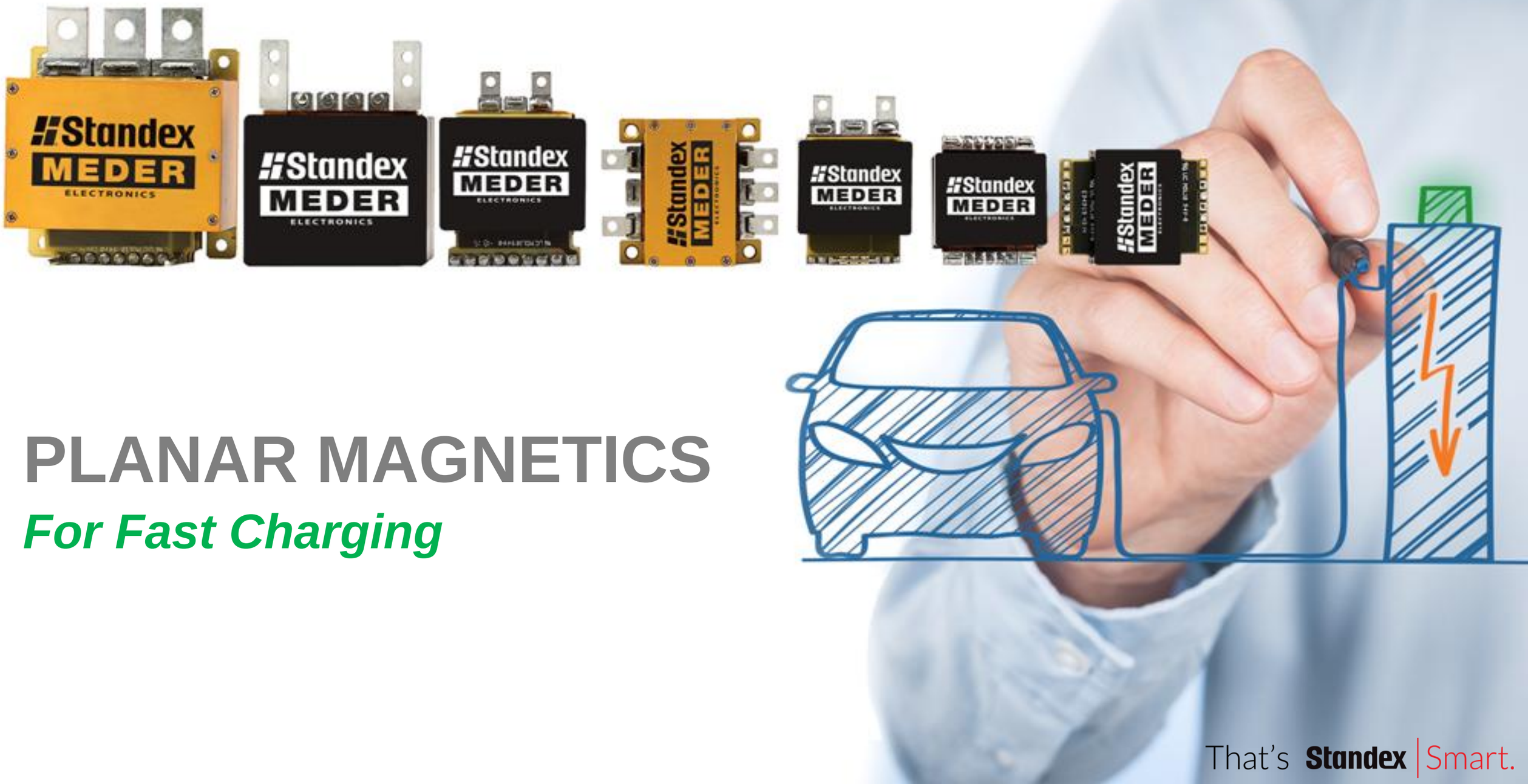
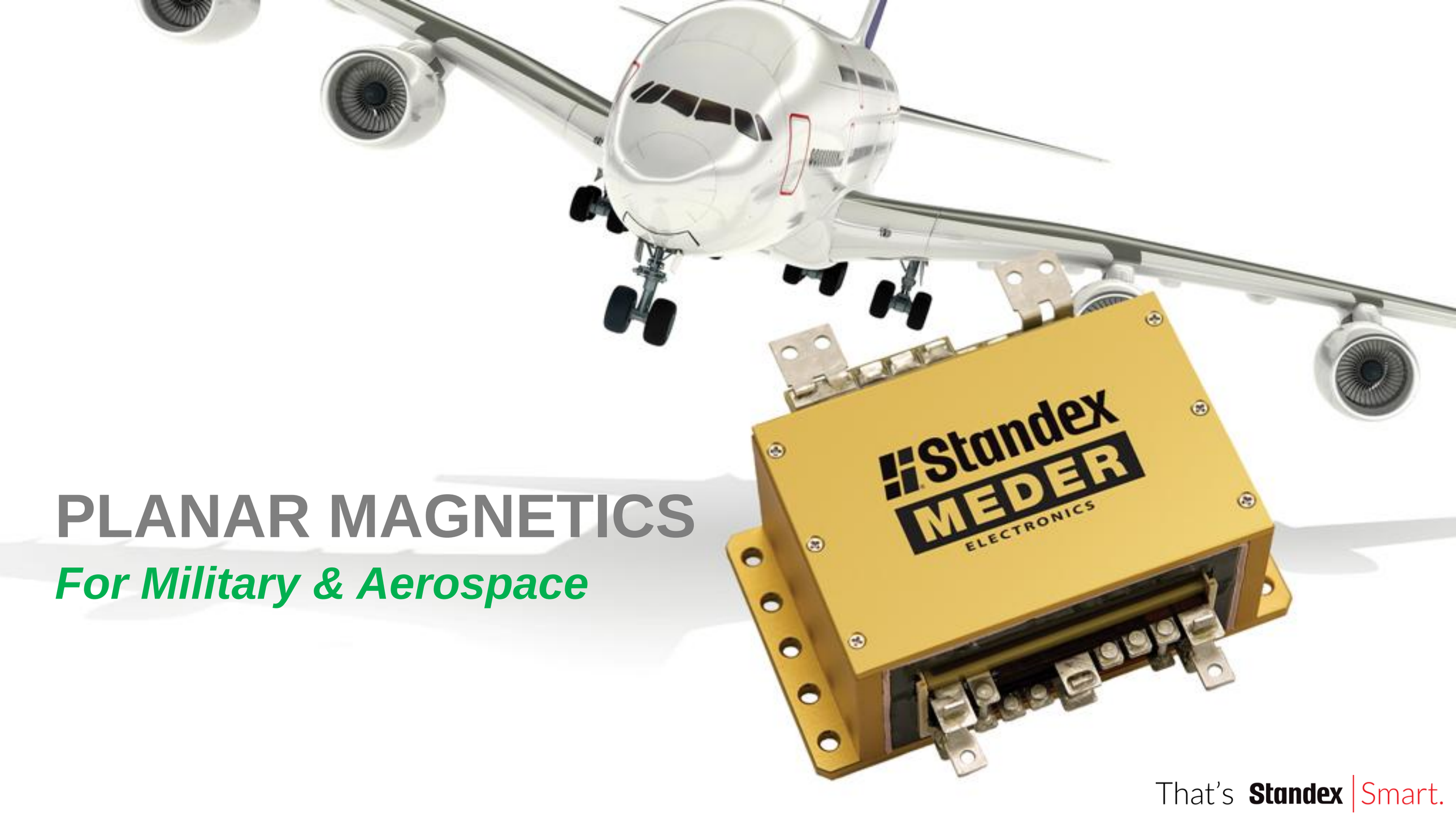


PLANAR MAGNETICS

For Fast Charging

That's **Standex** | Smart.



PLANAR MAGNETICS

For Military & Aerospace

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QUALITY CERTIFICATIONS

TS16949

ISO9000

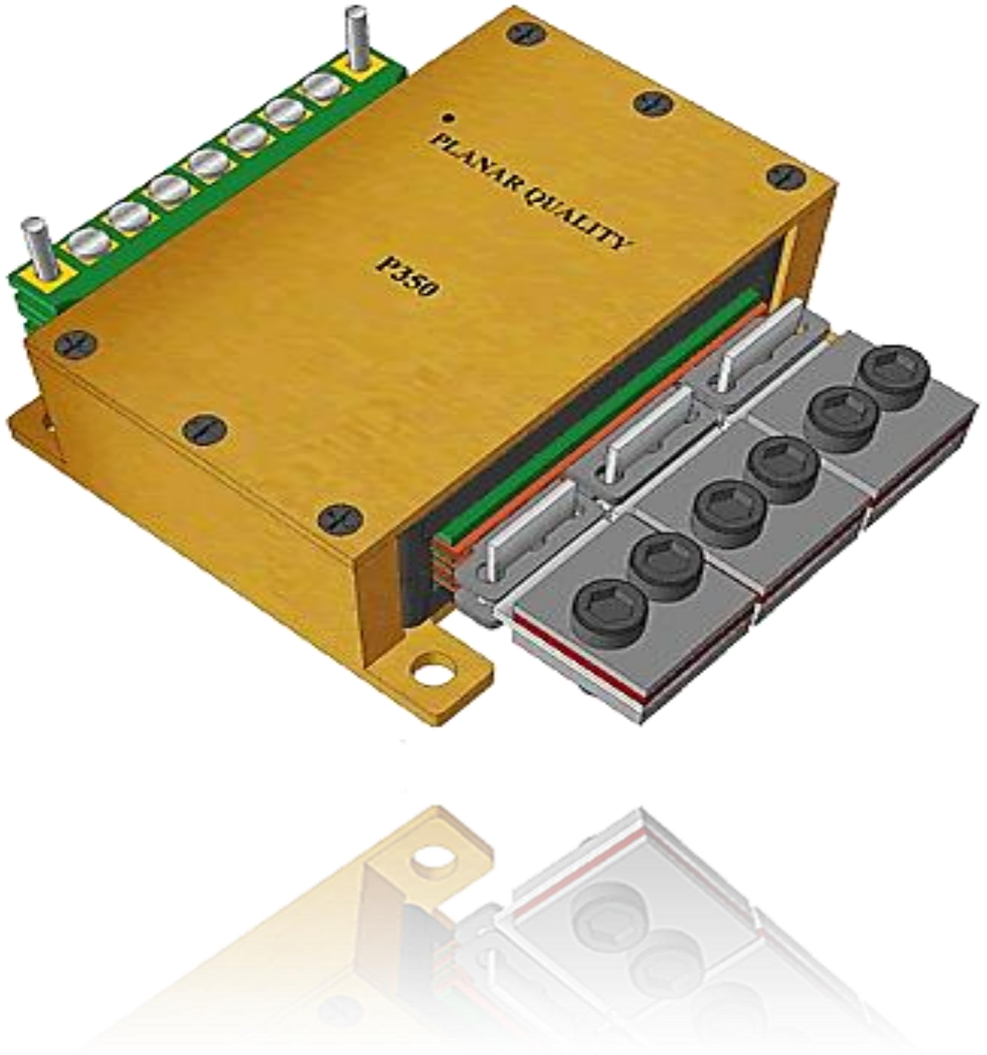
AS9100

ITAR

Planar Definition

Wikipedia: Manufacturers etch spiral patterns on a printed circuit board to form the "windings" of a planar transformer, replacing the turns of wire used to make other types.

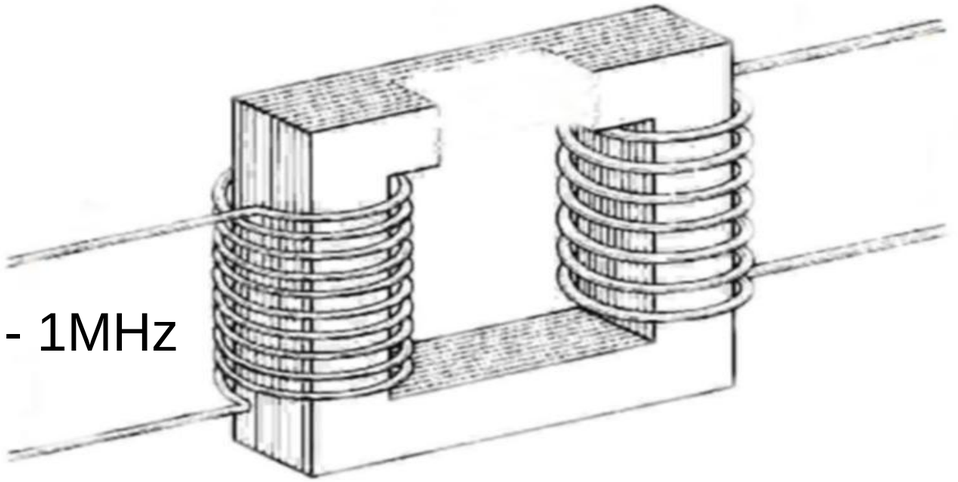
A planar transformer can be thinner than other transformers, which is useful for low-profile applications or when several printed circuit boards are stacked. Almost all planar transformers use a ferrite planar core.



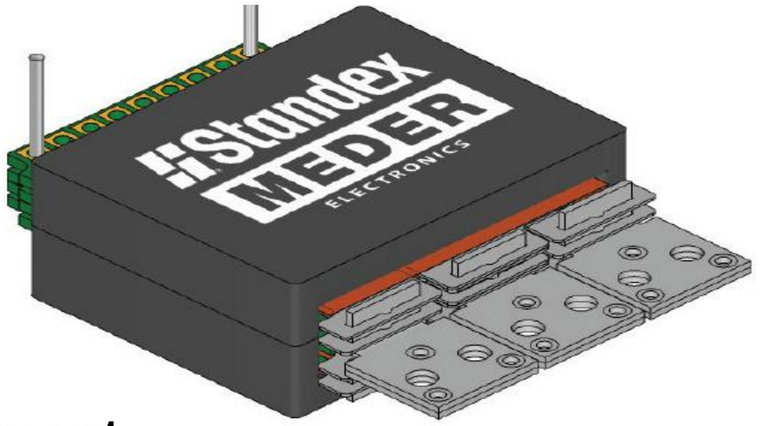
Planar Magnetics Custom Design Guide

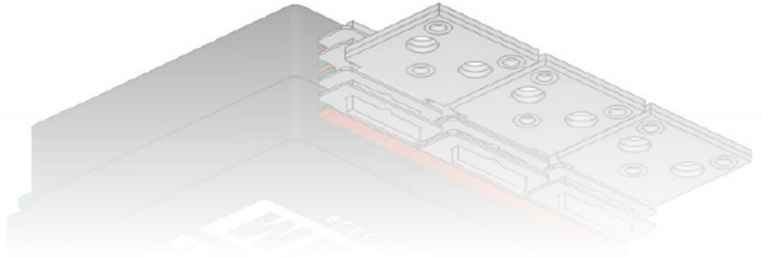
Size	Page #	Optimum Power Range	Max Current Rating	Typical Topology	Optimum Frequency Range kHZ	Typical Dimensions L x W x H (1) mm	Isolation Voltage Pri - Sec (VDC) Pri - Core (VDC)
P025 (3)	6	10W - 50W	20A (2)	Forward, Flyback	300 - 500	17.0 x 15.7 x 6.3	500 - 2000 VDC
P035 (3)	7	20W - 150W	30A (2)	Half Bridge, Forward, Flyback	200 - 400	22.9 x 19.8 x 7.6	500 - 2000 VDC
P055 (3)	8	50W - 200W	50A	Half Bridge, Forward, Flyback	175 - 300	24.1 x 21.8 x 9.1	500 - 2000 VDC
P075 (3)	9	100W - 500W	50A (2)	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull, Flyback	150 - 300	35.0 x 26.3 x 10.2 28.7 x 26.3 x 10.2	5000 VDC 500 - 2000 VDC
P110 (3)	10	150W - 700W	60A (2)	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	100 - 250	39.9 x 28.4 x 12.7 33.5 x 28.4 x 12.7	5000 VDC 500 - 2000 VDC
P135	11-12	300W - 1.2kW	100A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	100 - 250	44.4 x 32.0 x 15.2 38.1 x 32.0 x 12.7	5000 VDC 500 - 2000 VDC
P220	13-14	1kW - 3.0kW	250A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	60 - 200	50.8 x 40.6 x 20.3 45.7 x 40.6 x 17.8	5000 VDC 500 - 2000 VDC
P350	15-16	2kW - 6kW	300A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	40 - 150	58.4 x 50.8 x 25.4 53.3 x 50.8 x 21.6	5000 VDC 500 - 2000 VDC
P560	17-18	3kW - 10kW	400A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	40 - 125	71.1 x 64.0 x 30.5 66.0 x 64.0 x 25.4	5000 VDC 500 - 2000 VDC
P900	19-20	10kW - 20kW	500A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	40 - 125	118.1 x 110.7 x 43.9	5000 VDC
P1100	21	10kW - 30kW	600A	Full Bridge, Half Bridge, Full Bridge ZVS, Push-Pull	20 - 125	144.8 x 94.0 x 38.1	5000 VDC

How does planar technology differentiate from wire-wound:

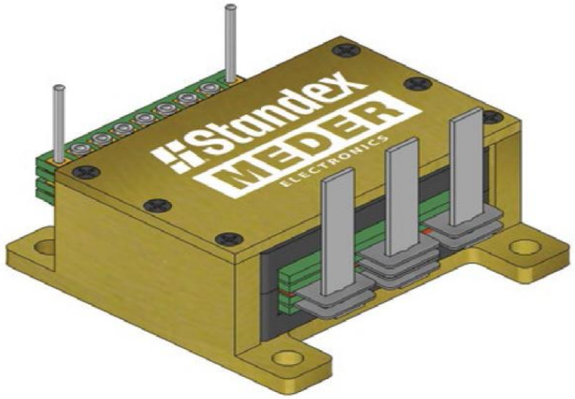


- **Low package profile** relative to wire wound equivalent
- Very efficient at high frequency operation, **98-99%** to 40kHz - 1MHz
- **Excellent repeatability** thanks to pre-tooled components
- **Low leakage inductance**
- Easily termination of multiple windings
- **Minimum skin effect –** flat windings (Low AC losses)
- Standard outlines compatible with **custom designs**
- Usable in both square and sine-wave topologies
- Lend themselves to **sophisticated and effective thermal management**

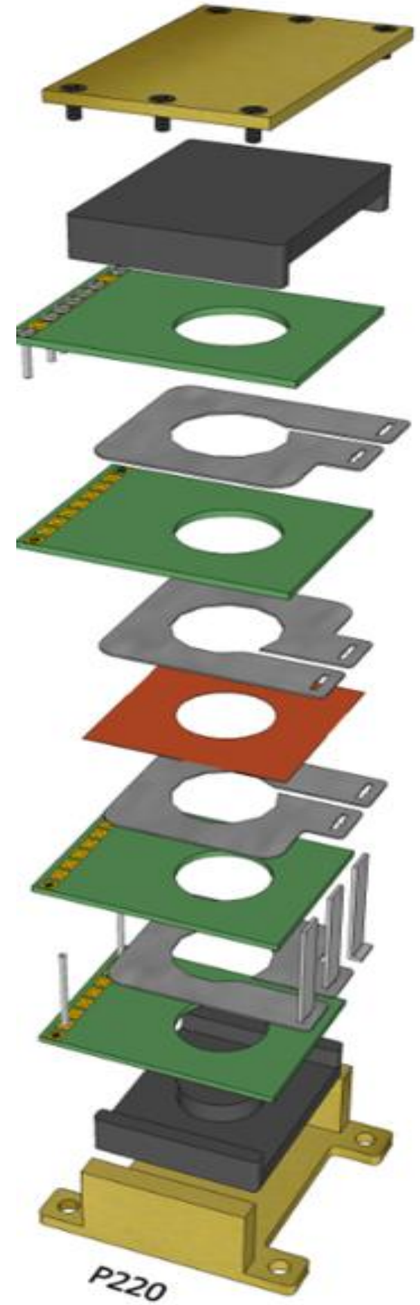




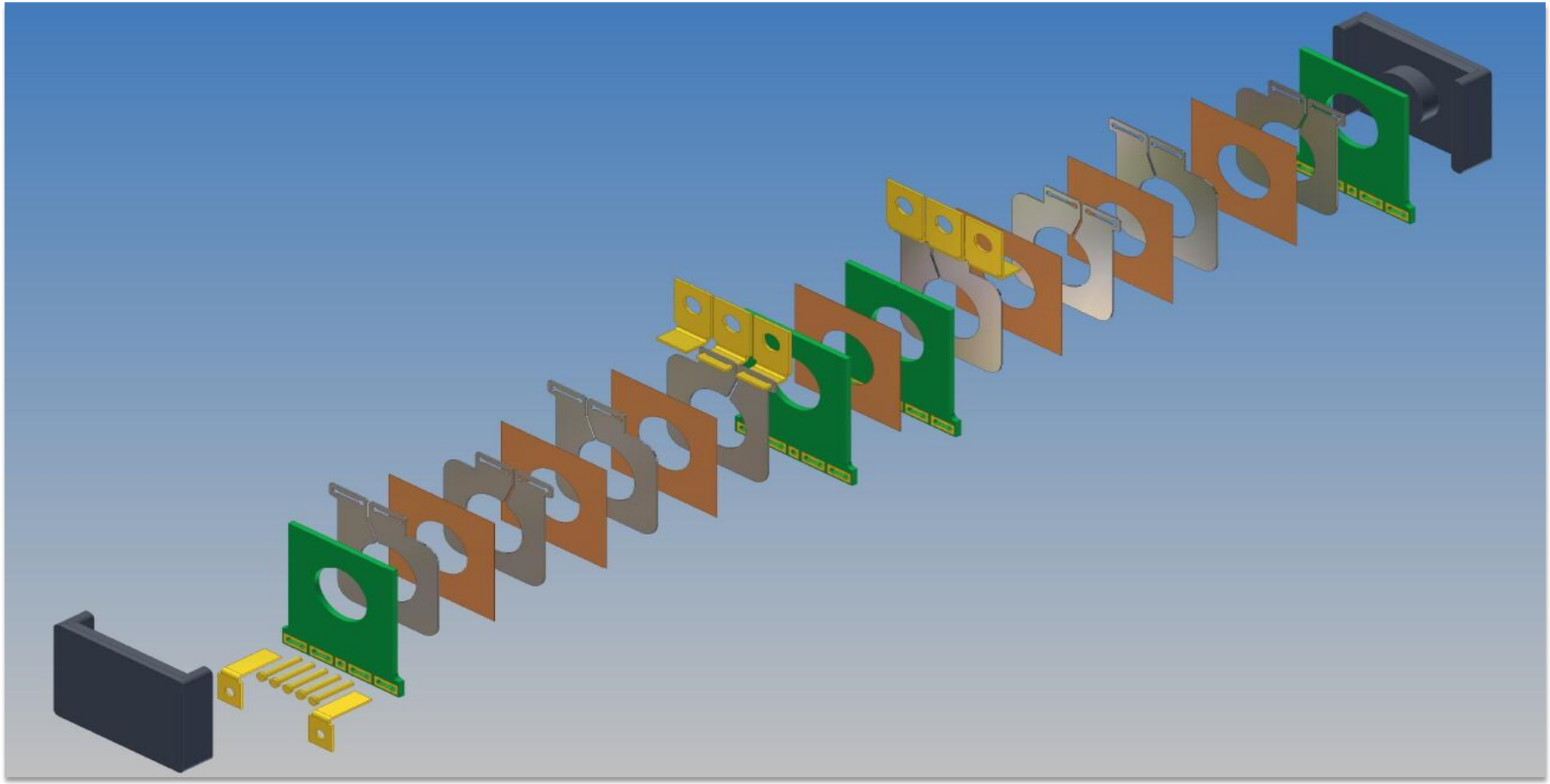
Planar Mechanical Construction



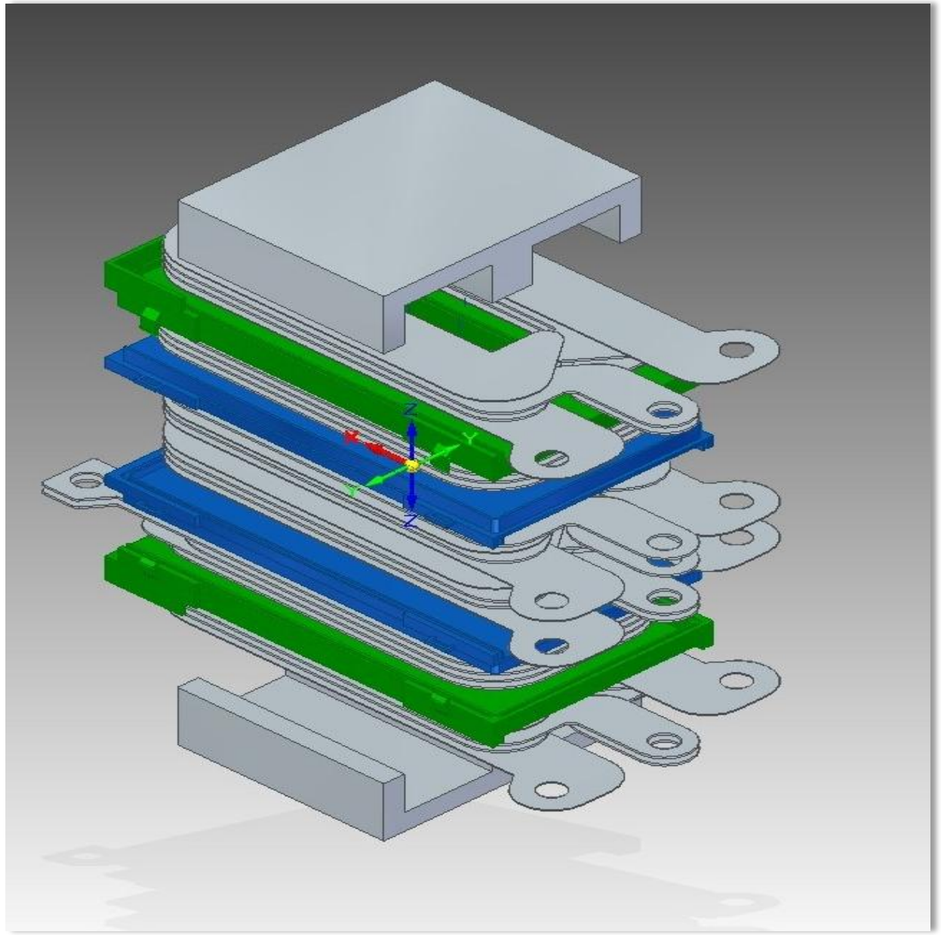
- Lower current windings: Multi Layer PCB's
- High current windings: Stamped lead frames
- Stacked with insulators and soldered connections
  - Interleaving…alternating primary and secondary
  - Multiple PCBs and lead frames soldered in series make for continuous or parallel windings
- Terminations: Patented resilient terminals, PCB mount pins, surface mount headers
- Heat sinks / thermal gap - thermally conductive materials are common

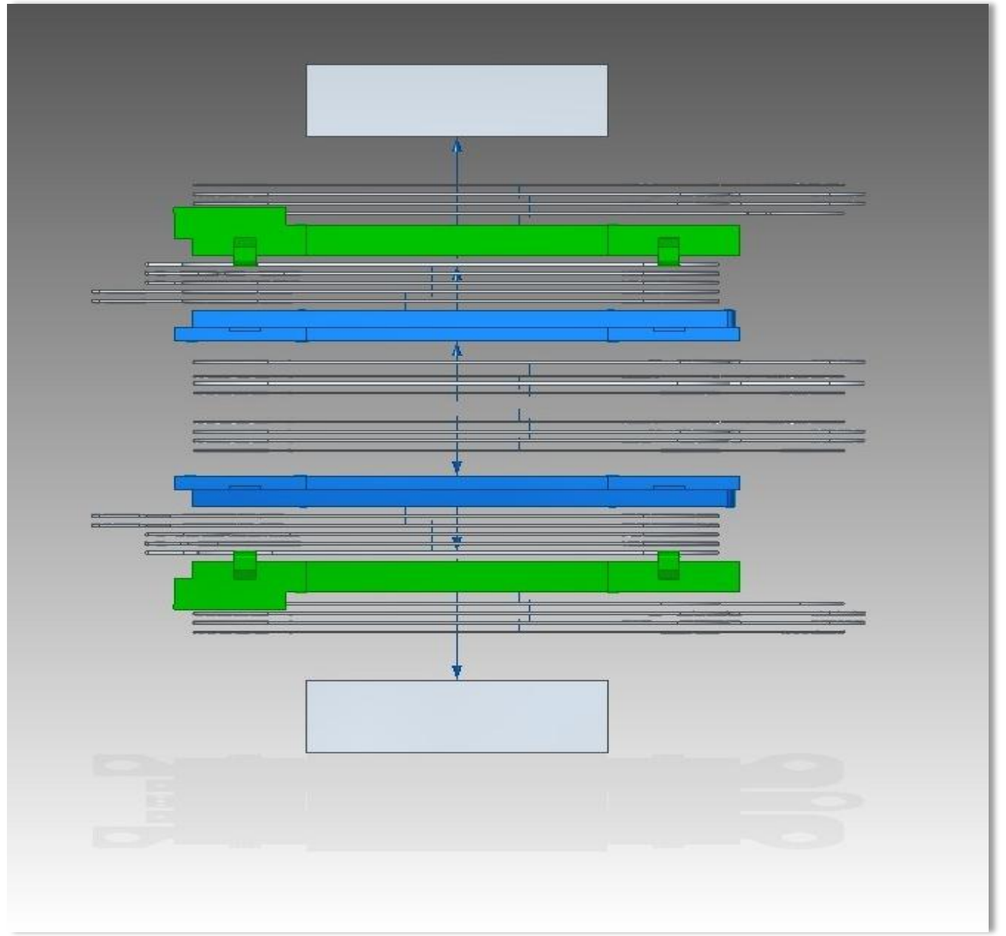


P560 Explosion Drawing

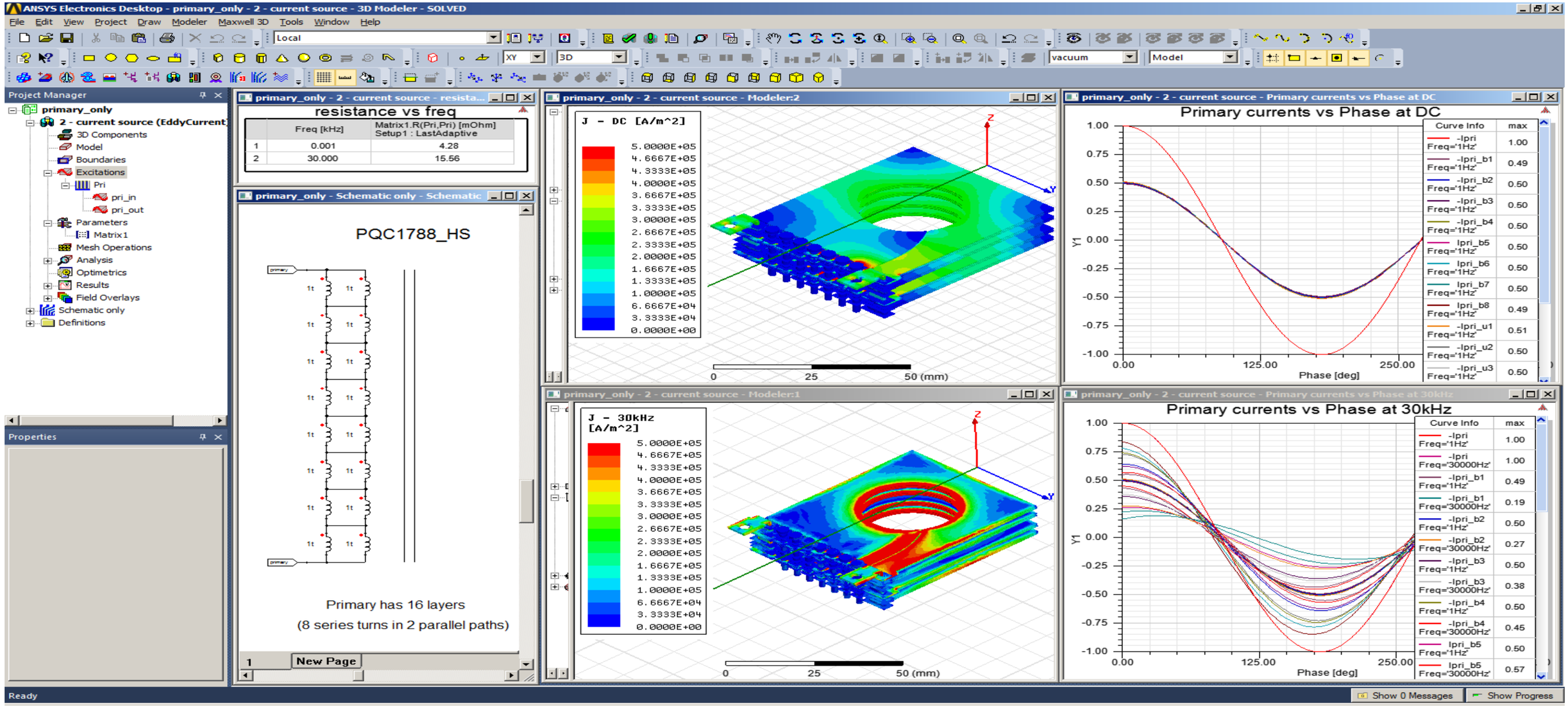


Competitor Comparison



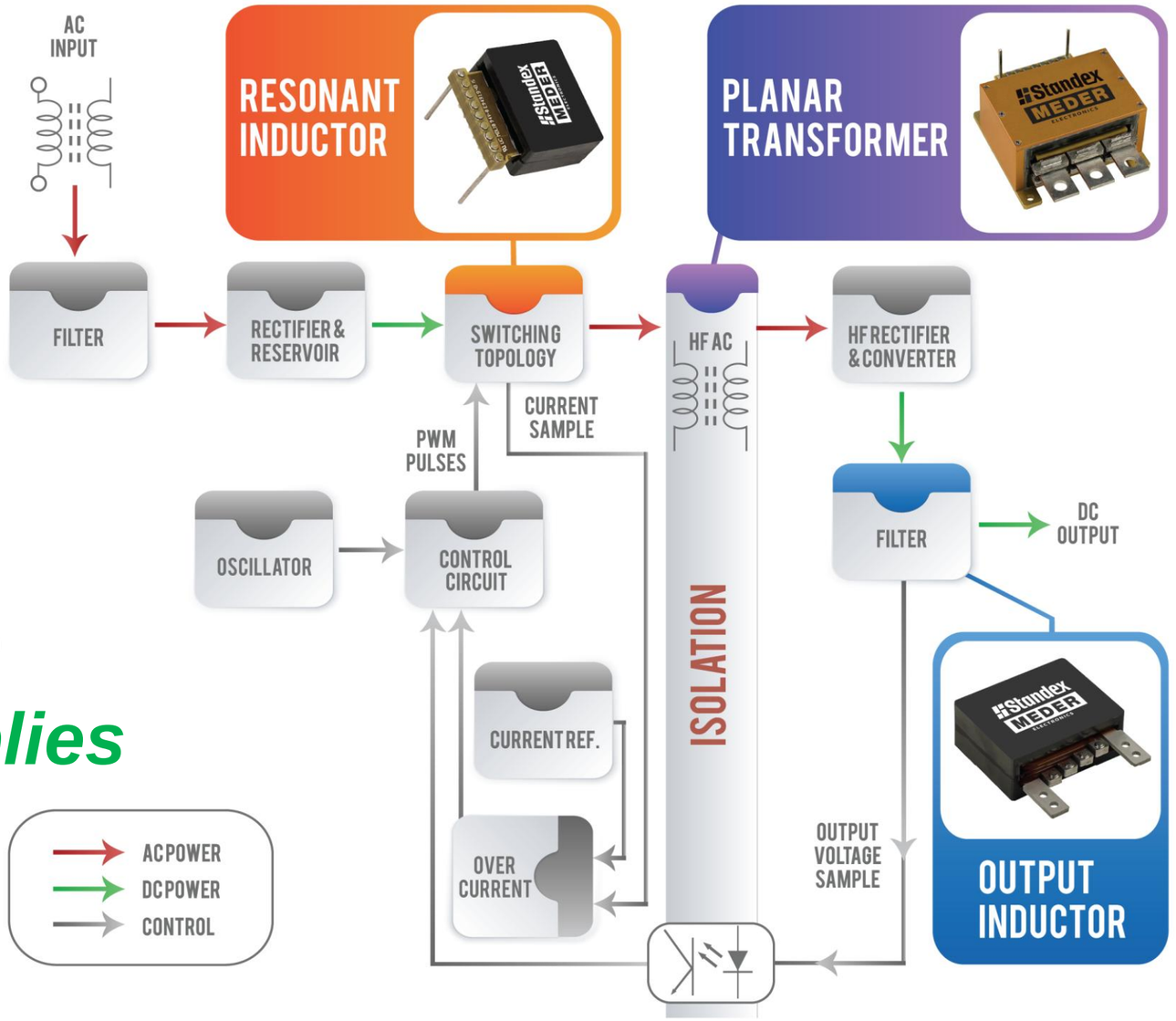


Thermal Simulation - Capabilities

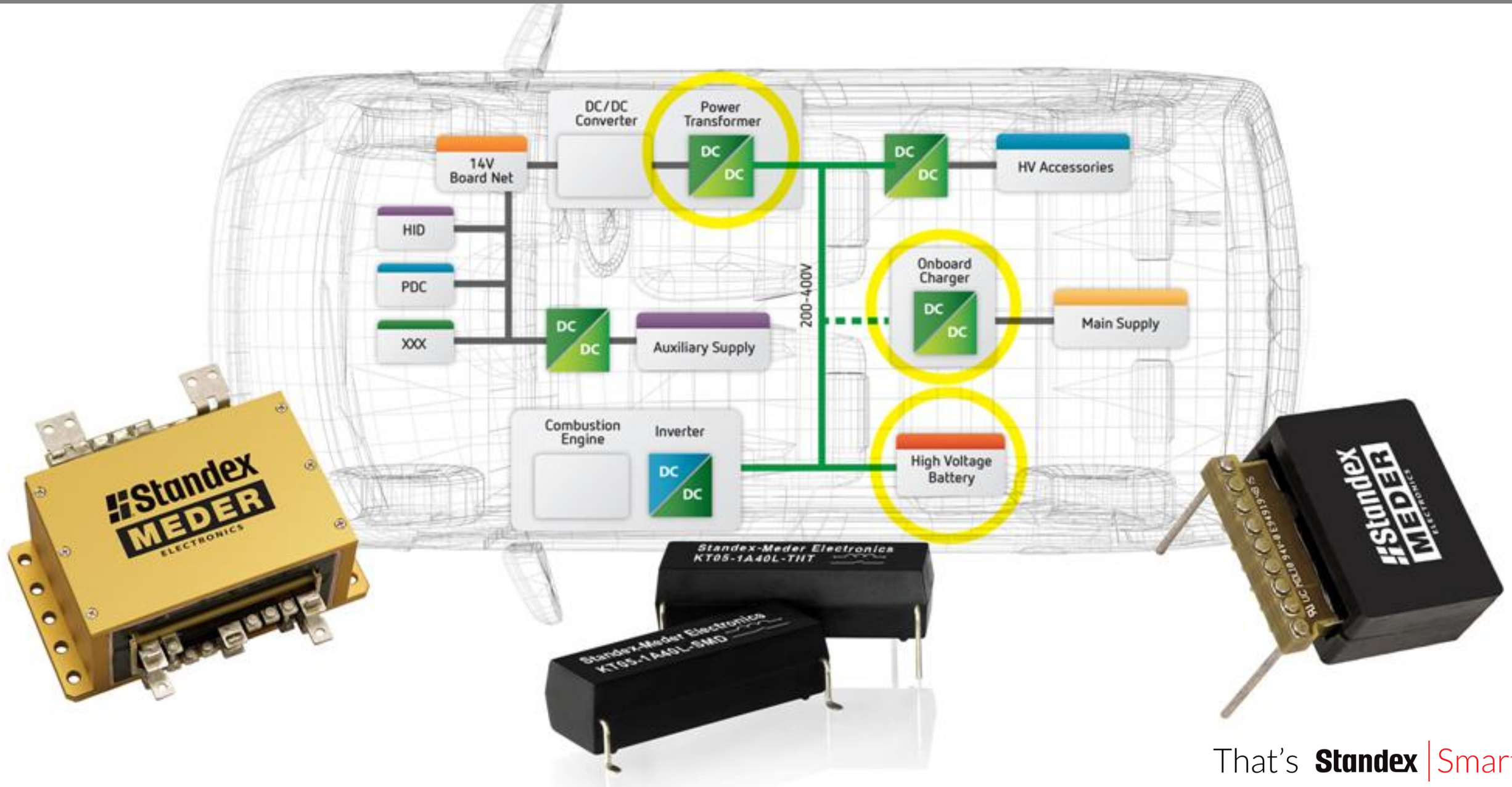


PLANAR MAGNETICS

For Switch-Mode Power Supplies



xEV Solutions



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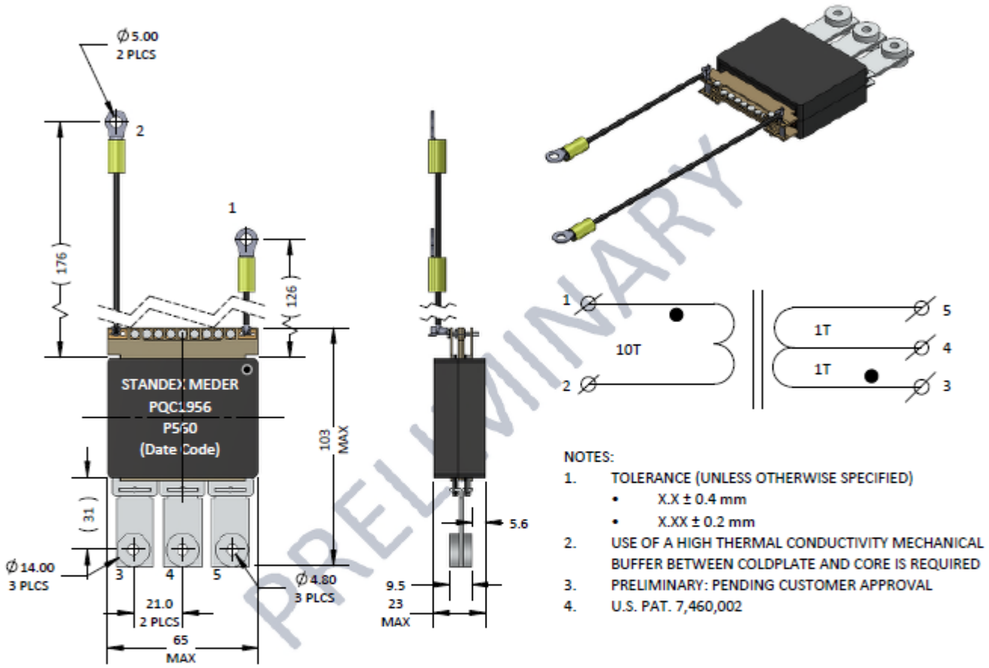
STANDEX PQC1956

Mechanical Specifications



NOTES:

1. TOLERANCE (UNLESS OTHERWISE SPECIFIED)
   - X.X ± 0.4 mm
   - X.XX ± 0.2 mm
2. USE OF A HIGH THERMAL CONDUCTIVITY MECHANICAL BUFFER BETWEEN COLDPLATE AND CORE IS REQUIRED
3. PRELIMINARY: PENDING CUSTOMER APPROVAL
4. U.S. PAT. 7,460,002

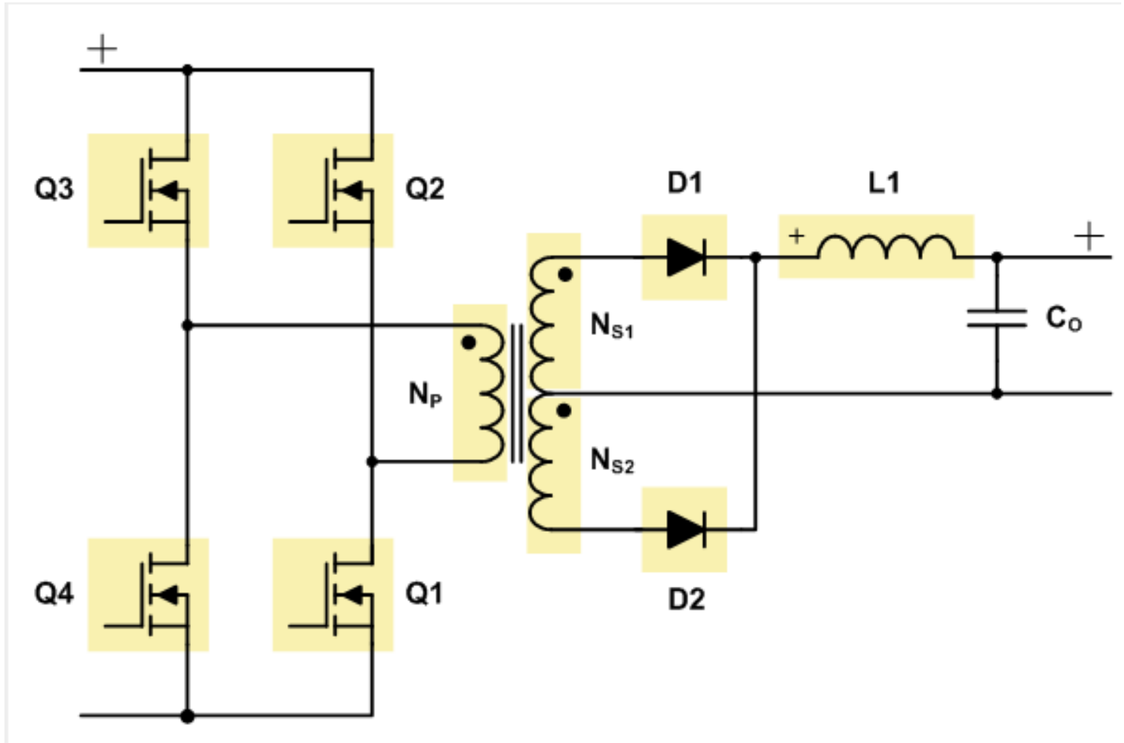
Electrical Specifications

1. Topology:	Full Bridge ZVS	9. Temperature Rise: Hot spot - heat sink, max.:	+33 °C
2. Transformer Input Voltage Range:	300-680 VDC	10. Isolation voltage, min.:	
3. Converter Output after Rectification:	3500W(28V/125A)	Primary to Secondary and Core:	2500 VAC
4. Turns ratio Np / Ns1 / Ns2:	10T/1T/1T	Secondary to Core:	500 VDC
5. Transformer switching frequency:	100 kHz	11. Primary Inductance,Np min.:	1000 µH
6. Duty Cycle, max.:	97%	12. Primary resistance (1-2),max.:	15 mOhm
7. Efficiency at Full Power (calc.):	99.4% (21W losses)	13. Secondary resistance(3-4) pus (4-5),max.:	0.3 mOhm
8. Heatsink max. temperature:	+65 °C	14. Max. Weight:	TBD grams
		15. Leakage Inductance 1-2/3-4-5 shorted, typ.:	500 nH

Part Number	Revision	Engineer	Date	Page Number
PQC1956	PRELIM	Sagar Kane	02/18/2016	1 of 1

Full Bridge ZVS

- Application: On Board Charger (EV)
- Output Voltage: 28V
- Output Power: 3500W
- Primary Ring Terminals for robust connection
- Secondary bushings improve contact resistance
- 2500VAC Dielectric Withstand Voltage



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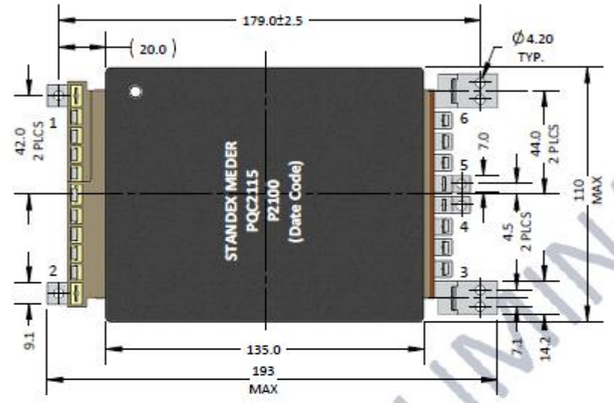
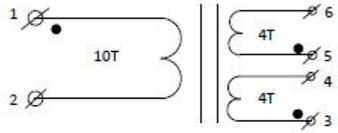
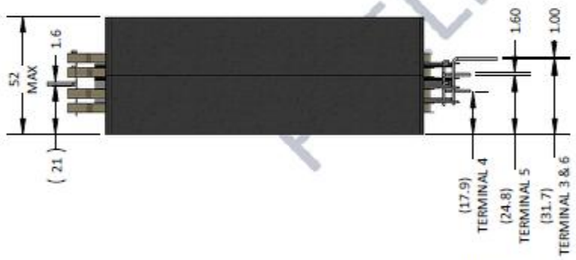
STANDEX PQC2115

Mechanical Specifications







NOTES:

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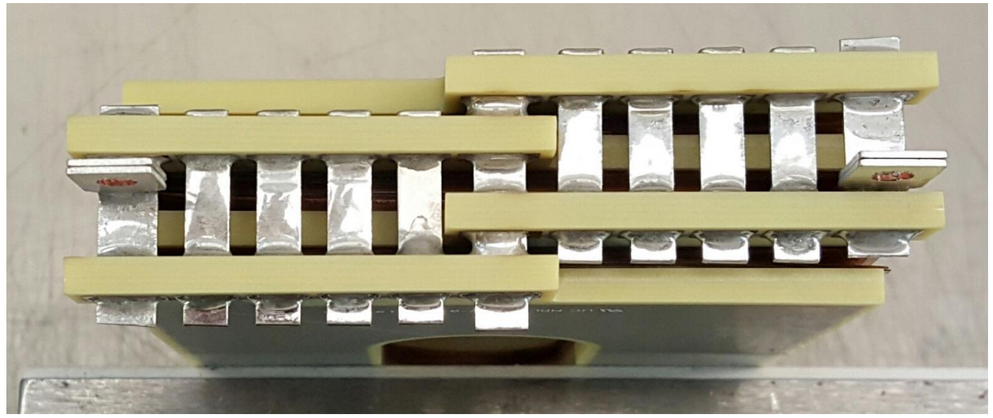
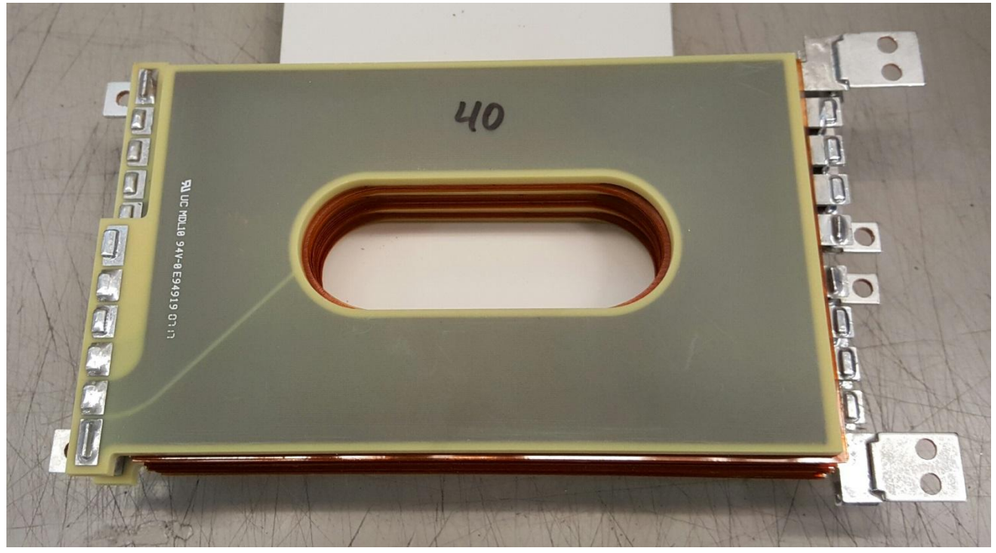
   - X.XX ± 0.2 mm
2. USE OF A HIGH THERMAL CONDUCTIVITY MECHANICAL BUFFER BETWEEN COLDPLATE AND CORE IS REQUIRED
3. PRELIMINARY: PENDING CUSTOMER APPROVAL
4. U.S. PAT. 7,460,002

Electrical Specifications

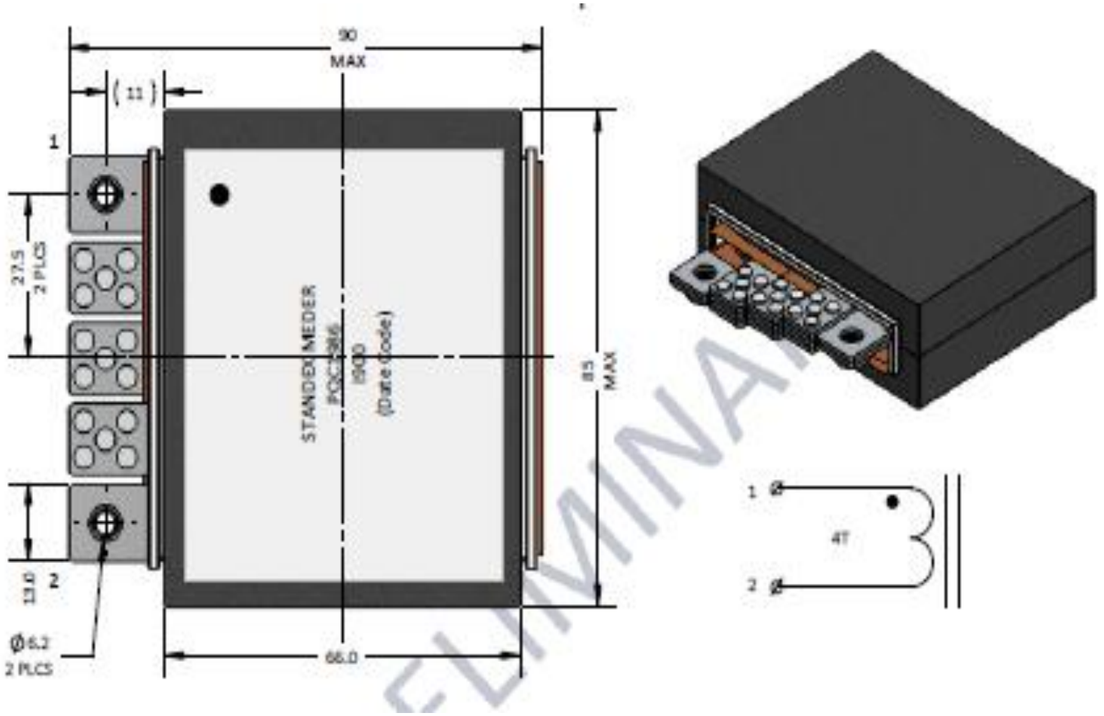
1. Topology:	LLC ZVS Converter	9. Temp. Rise: Hot spot - Ambinet, max.:*	+45 °C
2. Transformer Input Voltage:	730-880 VDC	10. Minimum Isolation Voltage:	
3. Converter ouput after rectification:	60kW (400VDC/75A;400VDC/75A)	Primary to Secondary:	1750 VAC
4. Turns Ratio Np/Ns1/Ns2:	10T/4T/4T	Primary and Secondary to Core:	2000 VAC
5. Transformer Switching Frequency:	80 kHz (60-104 kHz range)	11. Primary Inductance, Np, min.:	39 µH ± 5%
6. Duty Cycle at Vin=800V Vout=400V, max.:	99% (after rectification)	12. Primary Resistance,Rdc, Np, max.:	3 mOhm
7. Efficiency at 60kW output power (calc.):	99.5% (150W losses)	13. Secondary Resistance, Rdc, Ns1 or Ns2, max:	1 mOhm
8. External Heatsink Temp.,max.:	+65 °C	14. Max. Weight:	TBD grams
Ambient Temp.:	+45 °C	15. Leakage Inductance 1-2/sec. shorted, typ.:	0.5 µH
*Transformer clamped to heatsink.		16. Thermal Impedance:Hot spot - external heatsink:	0.3 °C/W

Part Number	Revision	Engineer	Date	Page Number
PQC2115	PRELIM-3	Sagar Kane	04/20/2017	1 of 1





Planar Inductor (Low Inductance – High Current)



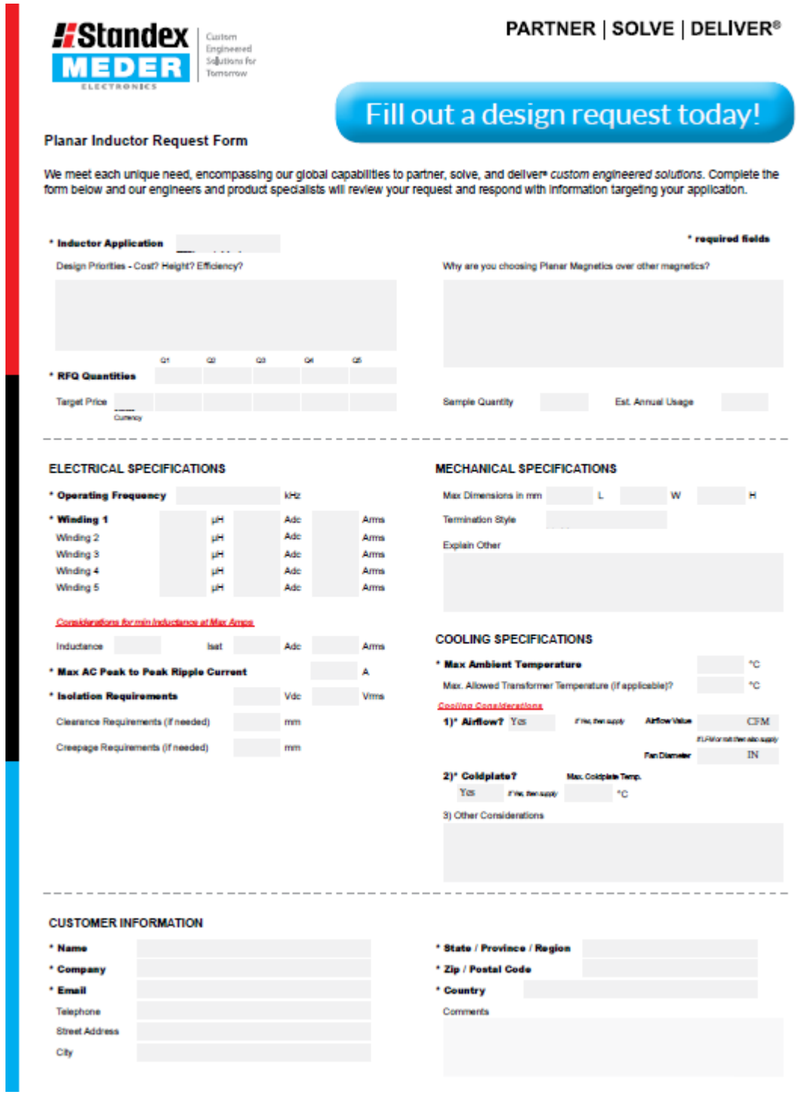
Electrical Specifications

1. Nominal Inductance range:	3.0 µH ±10%
2. Rated Current continuous:	320A
3. Ripple Current:	50A peak to peak
4. Ripple Frequency:	200 kHz
5. Base plate/Heatsink temp. max.:	+ 70 °C
6. Air flow temp.:	N/A
7. Temp. Rise: Hot spot - Base plate typ.:*	+ 48 °C
8. Minimum Isolation Voltage:	
Winding to core and heatsink	2000 VAC for 1min
9. Max. Resistance Rdc of winding:	0.4 mOhm
10. Total losses, calculated:	55W
12. Max. Weight:	TBD grams

*Customer provides heatsink

2000VAC Hipot with Low Leakage Bobbin

Planar Transformer/Inductor Request Form



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Planar Inductor Request Form

We meet each unique need, encompassing our global capabilities to partner, solve, and deliver® *custom engineered solutions*. Complete the form below and our engineers and product specialists will review your request and respond with information targeting your application.

* required fields

* Inductor Application

Design Priorities - Cost? Height? Efficiency?

Why are you choosing Planar Magnetics over other magnetics?

Q1 Q2 Q3 Q4 Q5

* RFQ Quantities

Target Price Currency

Sample Quantity Est. Annual Usage

ELECTRICAL SPECIFICATIONS

* Operating Frequency kHz

* Winding 1	µH	Adc	Arms
Winding 2	µH	Adc	Arms
Winding 3	µH	Adc	Arms
Winding 4	µH	Adc	Arms
Winding 5	µH	Adc	Arms

Considerations for min Inductance at Max Amps

Inductance Isat Adc Arms

* Max AC Peak to Peak Ripple Current A

* Isolation Requirements Vdc Vrms

Clearance Requirements (if needed) mm

Creepage Requirements (if needed) mm

MECHANICAL SPECIFICATIONS

Max Dimensions in mm L W H

Termination Style

Explain Other

COOLING SPECIFICATIONS

* Max Ambient Temperature °C

Max. Allowed Transformer Temperature (if applicable)? °C

Cooling Considerations

1)* Airflow? Yes If Yes, then supply Airflow Value CFM

If LFM or not then also supply

Fan Diameter IN

2)* Coldplate? Max. Coldplate Temp.

Yes If Yes, then supply °C

3) Other Considerations

CUSTOMER INFORMATION

* Name

* Company

* Email

Telephone

Street Address

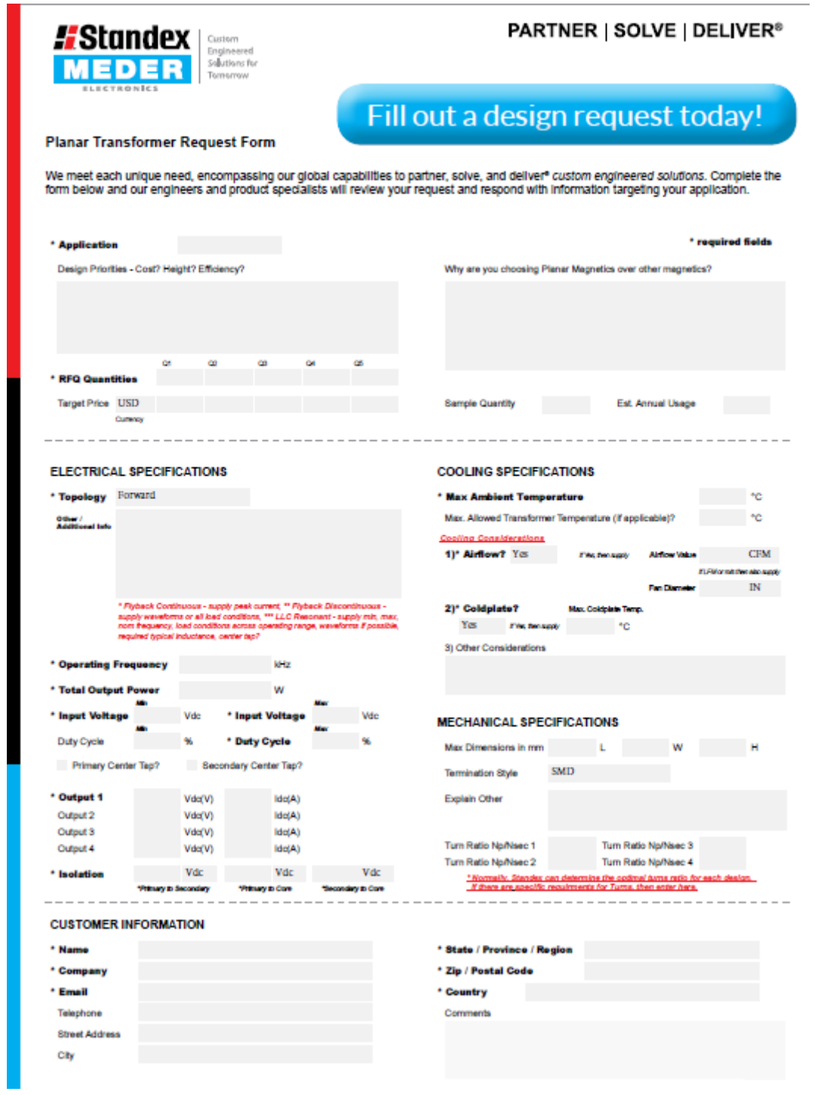
City

* State / Province / Region

* Zip / Postal Code

* Country

Comments



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* required fields

* Application

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Why are you choosing Planar Magnetics over other magnetics?

Q1 Q2 Q3 Q4 Q5

* RFQ Quantities

Target Price USD Currency

Sample Quantity Est. Annual Usage

ELECTRICAL SPECIFICATIONS

* Topology Forward

Other / Additional Info

* Flyback Continuous - supply peak current, ** Flyback Discontinuous - supply waveforms or all load conditions, *** LLC Resonant - supply min, max, nom frequency, load conditions across operating range, waveforms if possible, required typical inductance, center tap?

* Operating Frequency kHz

* Total Output Power W

* Input Voltage Min Vdc * Input Voltage Max Vdc

Duty Cycle Min % * Duty Cycle Max %

Primary Center Tap? Secondary Center Tap?

* Output 1	Vdc(V)	Idc(A)	
Output 2	Vdc(V)	Idc(A)	
Output 3	Vdc(V)	Idc(A)	
Output 4	Vdc(V)	Idc(A)	
* Isolation	Vdc *Primary to Secondary	Vdc *Primary to Core	Vdc *Secondary to Core

COOLING SPECIFICATIONS

* Max Ambient Temperature °C

Max. Allowed Transformer Temperature (if applicable)? °C

Cooling Considerations

1)* Airflow? Yes If Yes, then supply Airflow Value CFM

If LFM or not then also supply

Fan Diameter IN

2)* Coldplate? Max. Coldplate Temp.

Yes If Yes, then supply °C

3) Other Considerations

MECHANICAL SPECIFICATIONS

Max Dimensions in mm L W H

Termination Style SMD

Explain Other

Turn Ratio Np/Nsec 1 Turn Ratio Np/Nsec 3

Turn Ratio Np/Nsec 2 Turn Ratio Np/Nsec 4

* Normally, Standex can determine the optimal turns ratio for each design. If there are specific requirements for Turns, then enter here.

CUSTOMER INFORMATION

* Name

* Company

* Email

Telephone

Street Address

City

* State / Province / Region

* Zip / Postal Code

* Country

Comments

THANK YOU!

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