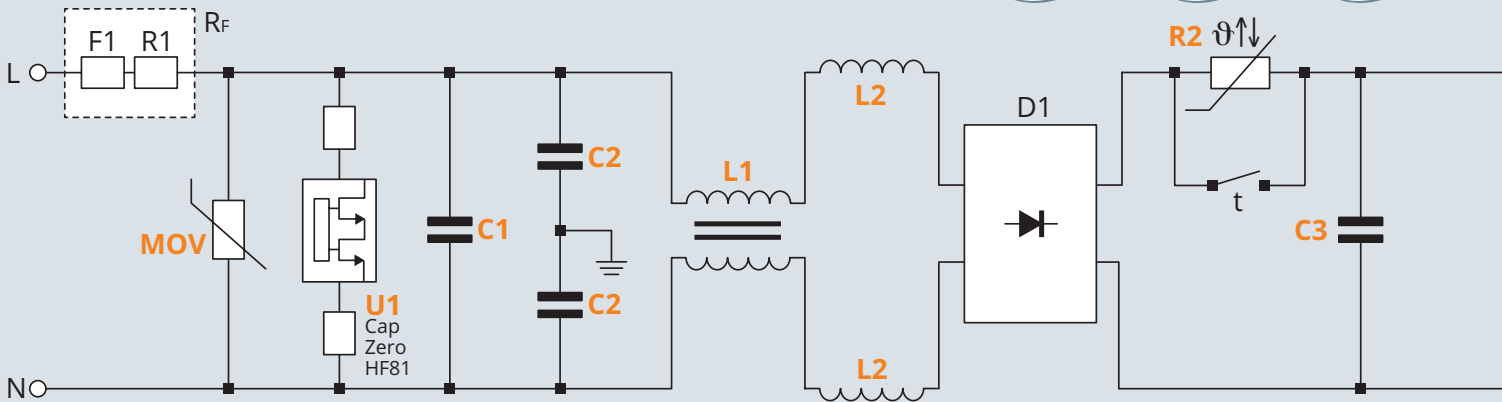


C O D I C O [®]

Volts & Amps

ACTIVE COMPONENTS | **PASSIVE COMPONENTS** | CONNECTORS

AC/DC CONVERTERS



AC/DC

AC/DC Konverter & Passive Bauelemente

Neben den richtigen Schaltreglern ist auch die Beschaltung mit den erforderlichen passiven Bauelementen essentiell für die richtige Funktionsweise des AC/DC-Wandlers. Niedrige Verlustleistung, geringe Störungen und lange Lebensdauer sind in diesem Bereich die Schlüsselfaktoren.

Auch im Bereich der passiven Bauelemente können wir Sie technisch unterstützen. Lebensdauerberechnungen von Elektrolytkondensatoren zählen ebenso wie die Dimensionierung des benötigten Transformators zu unseren Stärken.

U1: X-Cap Bleeder

In Anwendungen mit einem X-Kondensator am Eingang und einem Netzstecker muss der Kondensator in weniger als 1s auf <40V entladen werden. Normalerweise verwendet man hierzu Parallelwiderstände, welche aber die Effizienz während des Betriebs verringern. Ein X-Cap-Bleeder trennt diese Widerstände und schaltet sie erst dann auf Masse, sobald keine AC-Spannung am Eingang mehr anliegt.

C1, C2, L1, L2: Funkentstörung

CODICO bietet Gleich- und Gegentaktrosseln in verschiedenen Bauformen und für unterschiedliche Nennströme an. Diese Drosseln bilden zusammen mit Kondensatoren in den Netzzuleitungen Filter, die einerseits die Emission in das, und andererseits das Eindringen von Störungen aus dem Netz verhindern.

Keramik oder Folie?

Im Bereich der Funkentstörung können wir Ihnen sowohl Keramik- als auch Folienkondensatoren anbieten. Die Keramik Kondensatoren zeichnen sich durch höhere Temperaturbelastbarkeit aus, dafür punkten die Folienkondensatoren naturgemäß mit dem größeren Wertebereich und der geringeren Temperaturdrift. Kapazitätsstabile Langzeit Folienkondensatoren runden das Portfolio von CODICO ab.

C3, L3: Bauteile zur Power Factor Korrektur

Auch für eine eventuell benötigte PFC-Stufe bietet CODICO die idealen Komponenten. Als Kondensator eignet sich ein für diese Zwecke konstruierter MKP-Kondensator. Um mit Vielschichtkondensato-

ren den notwendigen Kapazitätswert zu erreichen, muss ein High-Dielectric Typ verwendet werden.

U2: PFC Controller

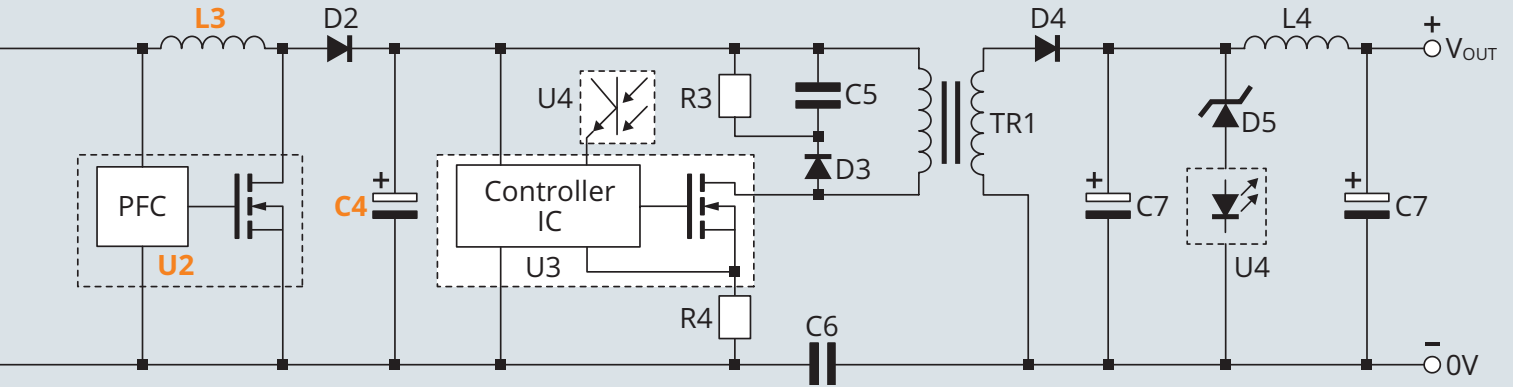
Der PFC Controller wird benötigt, wenn es um eine aktive Power Factor Korrektur geht und ermöglicht einen PF von bis zu 0,99. CODICO bietet entweder nur den Controller oder einen Controller mit integriertem FET und Diode an. Verfügbare Gehäuse sind SOIC, DIP-16, eSIP-16D und eSIP-16G.

C4: Zwischenkreis- & Eingangfilterkondensatoren

In diesem Bereich bietet der Hersteller RUBYCON ein großes Portfolio, wobei speziell auf die Faktoren Miniaturisierung, Strombelastbarkeit und Lebensdauer Wert gelegt wird.

	C1 X1/X2-Class Film Capacitors (THT)	C1 X1-Class Ceramic Capacitors (THT & SMD)	C1 X2-Class Ceramic Capacitors (SMD)	C2 Y-Class Film Capacitors (THT)	C2 Y-Class Ceramic Capacitors (THT & SMD)
Voltage Range	275Vac ~ 760Vac	250Vac ~ 760Vac	250Vac	300Vac ~ 500Vac	250Vac ~ 500Vac
Capacitance Range	1nF ~ 45µF	3pF ~ 12nF	3pF ~ 22nF	470pF ~ 1µF	3pF ~ 12nF
Vendor	Aishi, HJC, Kemet, Panasonic	Kemet	Kemet	Aishi, HJC, Kemet, Panasonic	Kemet

	L1 AC Common Mode Chokes 1phase	L2 Differential Mode Chokes	MOV Block, Thermally Protected (THT, SMD)
Rated Current Range	300mA ~ 40A	Rated Current Range	Max. Voltage (rms)
Rated Impedance	up to 600kΩ	Rated Inductance	Max. Voltage
		DCR (typical)	Peak Current @ 8/20µs
Vendor	Elytone, Kemet, Sumida	Vendor	Vendor



AC/DC Converters & Passive Components



In addition to the switching regulator, selecting the right passive components is also important to the proper functioning of an AC/DC converter. Low dissipation loss, low noise (or interference) and long operating life are just some of the key characteristics that these passive components provide. We, together with our selected suppliers in this segment, can also provide first-class technical support for passive components, such as calculating the lifetime of electrolytic capacitors or properly dimensioning the transformer.

U1: X-Cap Bleeder

In all applications with an X-capacitor and a pluggable power-cord the capacitor needs to be discharged to <40V in less than 1s. Usually resistors are used in parallel to the capacitor, but they lower the efficiency during normal operation. An X-Cap Bleeder disconnects these resistors during operation and shortens the resistors to ground when there is no AC-Input anymore.

C1, C2, L1, L2: Noise Suppression

Among the products CODICO offers, there are common and differential mode chokes in a wide range

of different sizes and for a variety of current levels. In combination with the necessary capacitors, these chokes are used to create line filter circuits. On one hand this is mandatory to suppress the emission into and on the other hand to prevent the infiltration of external noise from the grid.

CERAMIC OR FILM?

For noise suppression applications we offer ceramic and film capacitors. Ceramic caps provide a higher temperature range, whereas film caps achieve higher capacitance values and lower temperature drift. Long-term capacitance stable film caps complete the portfolio of CODICO.

C3, L3: Components für Power Factor Correction

If a PFC stage is required, CODICO can likewise offer you the ideal capacitors and coils for the application. As a capacitor, typically well-suited for this is an MKP capacitor designed for the purpose. To achieve the capacitance value needed with multi-layer capacitors means using a high-dielectric type.

U2: PFC Controller

The PFC Controller is needed to generate an active PFC, enabling a Power Factor up to 0.99. We offer either Controller only, or Controller with integrated FET and Diode, in Package SOIC, DIP-16, eSIP-16D & eSIP-16G.

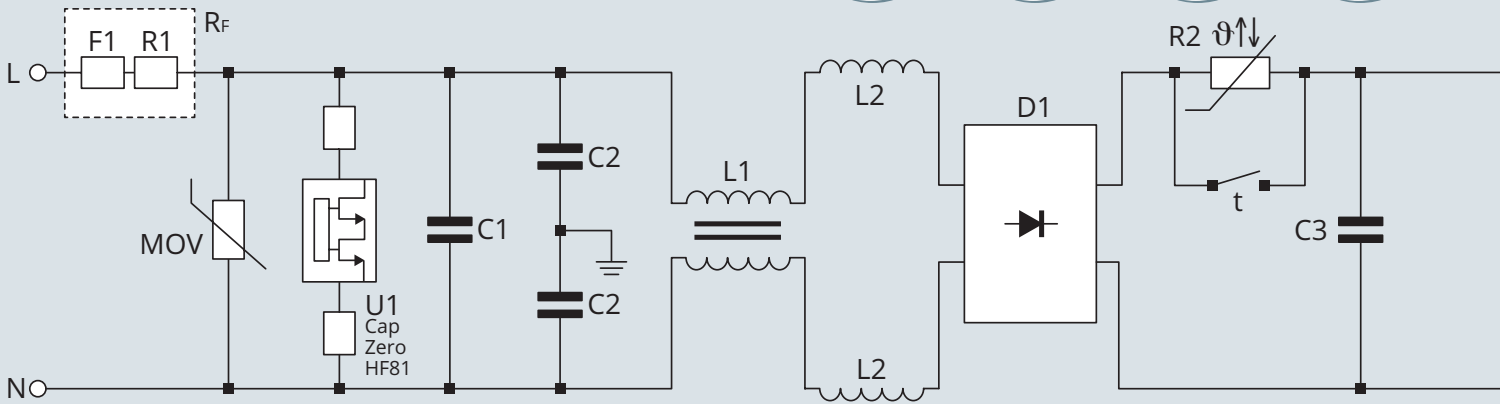
C4: DC-Link & Input Filter Capacitors

For these applications, RUBYCON offers a broad range of solutions that stand out for their degree of miniaturization, high current capability and long lifetimes.

	C3 Film Capacitors (THT)	C3 Ceramic Capacitors (SMD)	L3 Choke for Active PFC	R2 NTC for Inrush Current Suppression (THT)
Voltage Range	420Vdc ~ 1,100Vdc	250Vdc ~ 1kVdc	Rated Current Range	Resistance @ 25°C
Capacitance Range	10nF ~ 22µF	10pF ~ 5.6µF	Rated Inductance	Max. Current @ 25°C
Vendor	Aishi, HJC, Kemet, Panasonic	Kemet	Vendor	Thinking

	C4 Electrolytic Capacitors (Snap-in)	C4 Electrolytic Capacitors (THT)
Voltage Range	160Vdc ~ 600Vdc	160Vdc ~ 500Vdc
Capacitance Range	39µF ~ 3,300µF	1µF ~ 820µF
Rated Ripple Current (rms)	510mA ~ 5.75A	60mA ~ 4.46A
Temperature Range	-40°C ~ +105°C	-40°C ~ +125°C
Guaranteed Lifetime	Up to 10,000hrs at rated temperature and rated ripple current	Up to 20,000hrs at rated temperature and rated ripple current
Vendor	Aishi, Rubycon	Aishi, Rubycon

AC/DC CONVERTERS



AC/DC

U3: Controller-IC

Das Controller-IC stellt den eigentlichen Schalter im System dar und bestimmt, welche Energiemenge in einem bestimmten Zeitraum in den Transformator übertragen wird. Abhängig von der Applikation können wir ICs mit PWM-Kontrolle, Pulse-Skipping oder verschiedenen internen Schwellen anbieten, um zB den Eigenverbrauch bei Teil- oder Null-Last zu optimieren.

Das Controller-IC erhält seine Information, wann und wie lange es von der Sekundärseite schalten muss, entweder über Opto-Koppler (U4), über die Rückschlagspannung am Trafo oder bei neueren ICs direkt durch eine interne isolierte Kommunikation, was sekundär- und primärseitige Kontrolle in einem einzigen IC vereint.

C5: Snubberkondensatoren

Bei immer höheren Schaltfrequenzen kommt es zu starken Spannungsspitzen und störenden Hochfrequenzen am Schaltelement. Kondensato-

ren zum Schutz der Halbleiter werden elektrisch stark beansprucht und müssen daher bestimmte Kriterien erfüllen. Geringer Verlustfaktor und hohe Impulsstrombelastbarkeit sind die Schlüsselfaktoren. Realisiert werden diese entweder als doppelt metallisierte Polypropylenkondensatoren (MMKP) oder als Keramikcondensatoren mit speziell verlustarmer Keramik.

TR1: Transformier für Schaltnetzteile

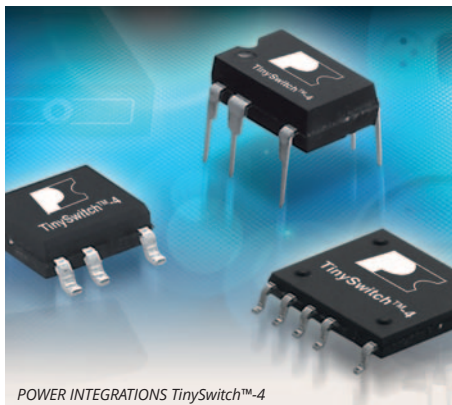
Standard Transformer zu Referenzdesigns von zB POWER INTEGRATION TOP oder TNY Reihe sind zwar praktisch, entsprechen jedoch in den wenigsten Fällen. Meistens führen mechanische und

elektrische Sonderwünsche zu kundenspezifischen Lösungen. Mit ELYTONE decken wir ein breites Spektrum an kundenspezifischen Transformatoren für alle gängigen Topologien ab.

C7, L4: Ausgangsfilter

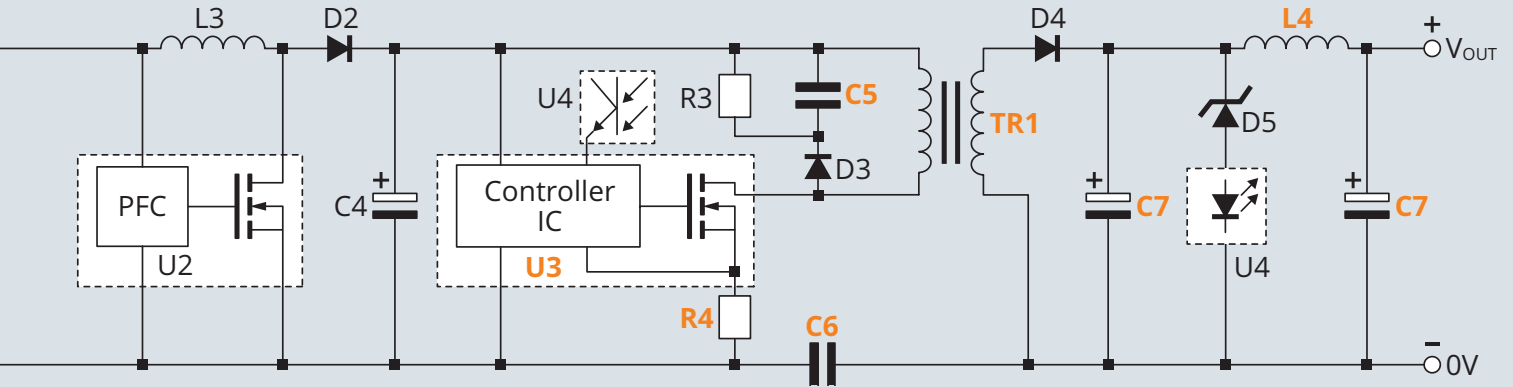
Bei den Ausgangsfilterkondensatoren sind niedrige Impedanz, hohe Strombelastbarkeit und lange Lebensdauer die Schlüsselfaktoren. CODICO bietet sowohl im radialen als auch im SMD Bereich Produkte der technologischen Marktführer an. Für das »Line Filtering« führt CODICO verschiedenste Gegentaktrosseln in allen gängigen Technologien.

	C5 Film Capacitors (THT)	C5 Ceramic Capacitors (THT & SMD)	C6 Y1-Ceramic Capacitors for Primary & Secondary Coupling
Voltage Range	100Vdc ~ 3kVdc	250Vdc ~ 10kVdc	250Vac ~ 500Vac
Capacitance Range	47pF ~ 15µF	10pF ~ 27nF	15pF ~ 4.7nF
Pulse Rise Time	Up to 54.000V/µs	-	-
Vendor	Aishi, HJC, Kemet, Panasonic	Kemet	Kemet



POWER INTEGRATIONS TinySwitch™-4

	C7 Electrolytic Capacitors (SMD)	C7 Electrolytic Capacitors (THT)	C7 Polymer-Hybrid Electrolytic Capacitors (SMD)	C7 Polymer-Hybrid Electrolytic Capacitors (THT)
Voltage Range	6.3Vdc ~ 100Vdc	6.3Vdc ~ 100Vdc	6.3Vdc ~ 125Vdc	16Vdc ~ 100Vdc
Capacitance Range	2.2µF ~ 12,000µF	1µF ~ 18,000µF	6.8µF ~ 1,000µF	10 ~ 1,000µF
Rated Ripple Current (rms)	42mA ~ 2.64A	20mA ~ 5A	380mA ~ 4.34A	380mA ~ 5.8A
Impedance	28mΩ ~ 2.9Ω max @ 20°C	10mΩ ~ 4.5Ω max @ 20°C	8mΩ ~ 150mΩ max @ 20°C	14mΩ ~ 100mΩ max @ 20°C
Temperature Range	-55°C ~ +150°C	-55°C ~ +125°C	-55°C ~ +150°C	-55°C ~ +150°C
Guaranteed Lifetime	Up to 10,000hrs at rated temperature	Up to 10,000hrs at rated temperature and rated ripple current	Up to 10,000hrs at rated temperature and rated ripple current	Up to 10,000hrs at rated temperature and rated ripple current
Vendor	Aishi, Panasonic, Rubycon, Sun	Aishi, Panasonic, Rubycon, Sun	Panasonic, Rubycon, Sun	Panasonic, Rubycon, Sun



U3: Controller IC



The Controller IC is the switch in the system, controlling the amount of energy that is transferred into the Transformer during a certain period of time. Depending on the application we can offer ICs with Cycle-Skipping, PWM, and different internal control schemes to guarantee a low no-load consumption. The Controller IC gets its information for switching from the secondary side, either by Opto-Coupler (U4), Reverse-Voltage of the Transformer or integrated Insulation, combining primary and secondary control in one IC.

C5: Snubber Capacitors

Higher switching frequencies lead to larger peak voltages and high frequency pulses at the switching element. The capacitors used to protect the semiconductor devices are thus subjected to high electrical stresses and must meet specialized criteria, with a low dissipation loss factor and high peak current capability key among them. Two technologies that achieve this are double metalized polypropylene capacitors (MMKPs) and special ceramic capacitors made of low-loss ceramics.

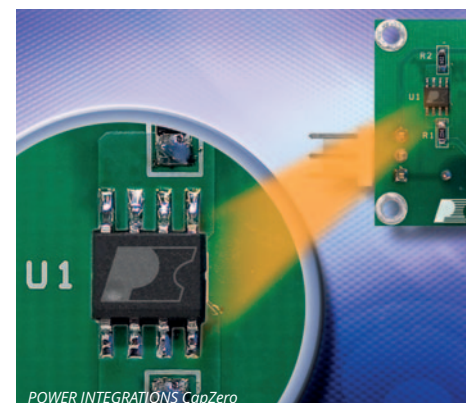
TR1: Transformer for Switch Mode Power Supplies

Standard transformer reference designs of e.g. POWER INTEGRATION TOP or TNY series are quite comfortable. But in nearly all cases they don't fulfil all mechanical or electrical requirements, which leads to a customized transformer. With ELYTONE we are covering a wide range of customized transformers for all common topologies.

C7, L4: Output Filter

With respect to output filter capacitors, the key factors are low impedance, high current capacity and long operating lifetimes. The CODICO range includes radial and SMD capacitors manufactured by the market's technological leaders. For line filtering CODICO provides various differential mode chokes in all common technologies.

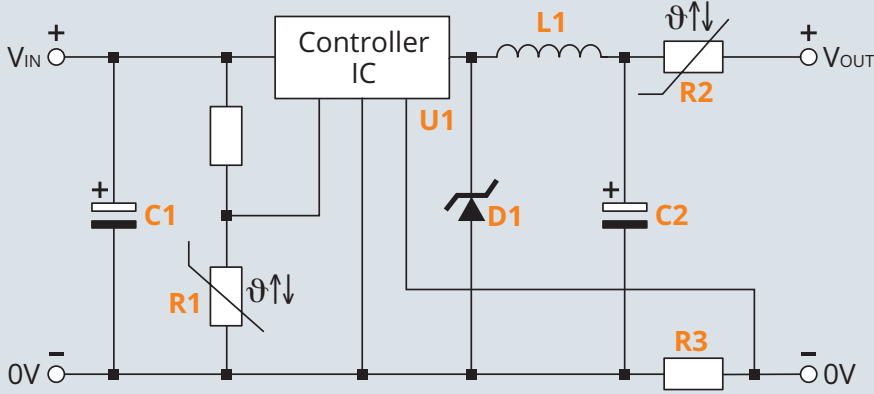
L4 Filter Chokes		TR1 Transformer		R4 Current Sense Resistor	
Rated Current Range	3A ~ 85A	Power Range	1W ~ 300W	Resistance	0.1mΩ ~ 4Ω
Rated Inductance	0.33μH ~ 100μH	Core size/ shape	Wide range of different shapes and sizes	Max. Power	500mW ~ 15W
DCR (typical)	0.7mΩ ~ 348mΩ			TCR	from 20ppm/K
Vendor	Eaton, Panasonic, Sagami, Sumida	Vendor	Elytone	Vendor	Isabellenhütte, Panasonic



POWER INTEGRATIONS InnoSwitch™-EP

POWER INTEGRATIONS CapZero

DC/DC CONVERTERS



Buck Converter



DC/DC & Passive Bauelemente

Höhere Schaltfrequenzen, größere Ströme und kleinere Abmessungen erfordern bei der passiven Beschaltung von DC/DC-Wandlern eine hochwertigere Technik. CODICO hat Kondensatoren und Wickelgüter im Programm, die wirklich allen Anforderungen gerecht werden. Ideale Ergebnisse mit kleiner Restwelligkeit, geringen Verlusten und kompakten Abmessungen können damit erzielt werden. Vor allem Stromtreiber für LED Applikationen fordern eine entsprechende Beschaltung mit speziellen Widerstandsprodukten wie Shunts oder Thermistoren.

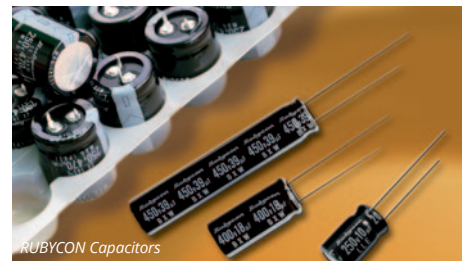
C1, C2: Kondensatoren für DC/DC Wandler

Für Kondensatoren in DC/DC Wandlern sind niedriger ESR und hohe Strombelastbarkeit die wesentlichen Anforderungen. CODICO kann Ihnen somit ein umfangreiches Spektrum an Kondensatoren verschiedenster Technologien anbieten.

Low-ESR Al-Elektrolytkondensatoren sind die traditionelle Möglichkeit, Restwelligkeit zu minimieren. Polymerbasierende Kondensatoren zeichnen sich durch wesentlich geringere Impedanzen und dadurch höhere Strombelastbarkeit aus, wodurch die Baugröße drastisch reduziert werden kann.

D1: Schottky Dioden

Als »schnelle« Dioden sind Schottky-Dioden für Hochfrequenzanwendungen bis in den Mikrowellenbereich geeignet. Die Schnelligkeit liegt vor allem an ihren kleinen Sättigungskapazitäten.

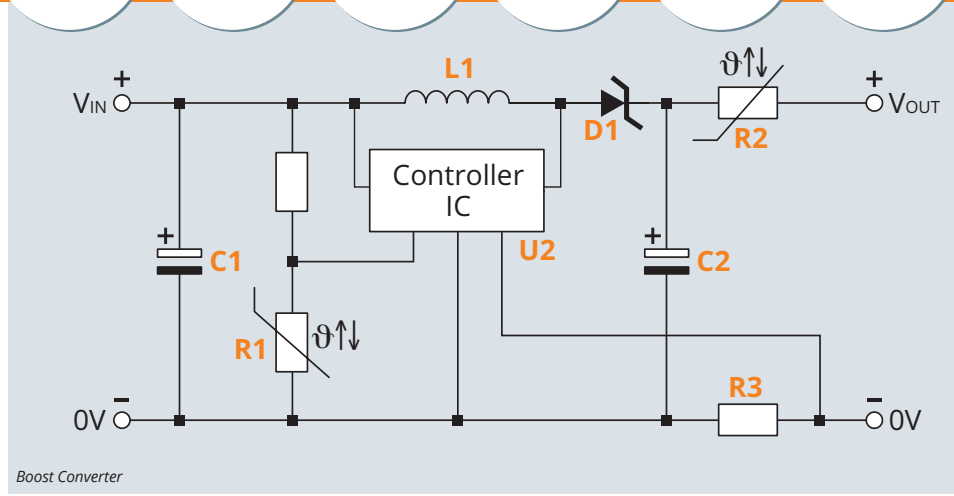


RUBYCON Capacitors

	C1, C2 Electrolytic Capacitors (SMD)*	C1, C2 Polymer-Hybrid Electrolytic Capacitors (SMD)*	C1, C2 Polymer Capacitors (SMD)	C1, C2 Polymer Multi Layer Capacitors (SMD)	C1, C2 Ceramic Capacitors (SMD)*
Voltage Range	6.3Vdc ~ 100Vdc	6.3Vdc ~ 125Vdc	2Vdc ~ 100Vdc	10Vdc ~ 200Vdc	4Vdc ~ 100Vdc
Capacitance Range	0.47µF ~ 12,000µF	6.8µF ~ 1,000µF	3.3µF ~ 2,700µF	0.1pF ~ 22µF	0.1pF ~ 100µF
Rated Ripple Current (rms)	4mA ~ 2.64A	380mA ~ 5.8A	289mA ~ 10.2A	-	-
Impedance	28mΩ ~ 2.9Ω max @ 20°C	8mΩ ~ 150mΩ max @ 20°C	3mΩ ~ 300mΩ max @ 20°C	-	-
Temperature Range	-55°C ~ +150°C	-55°C ~ +150°C	-55°C ~ +125°C	-55°C ~ +125°C	-55°C ~ +150°C
Guaranteed Lifetime	Up to 10,000hrs at rated temperature	Up to 10,000hrs at rated temperature and rated ripple current	Up to 20,000hrs at rated temperature and rated ripple current	-	-
Vendor	Aishi, Panasonic, Rubycon, Sun	Panasonic, Rubycon, Sun	Aishi, Kemet, Panasonic	Rubycon	Kemet

*anti-vibration versions available

R1 NTC for Temperature Sensing (THT & SMD)	R2 PTC for Circuit Protection (THT & SMD)	R3 Current Sense Resistor (Open Air & SMD)	D1 Schottky Barrier Diodes					
Initial Resistance @ 25°C	5kΩ ~ 470kΩ	Initial Resistance @ 23°C	From 2mΩ	Resistance	0.1mΩ ~ 4Ω	Voltage Range	30V ~ 60V	15V ~ 200V
Temp. Range	-40°C ~ +125°C	Hold Current	Up to 15A	Max. Power	0.5W ~ 15W	Current	100mA ~ 5A	100mA ~ 60A
Tolerance	1% ~ 10%	Operation Voltage	6Vdc ~ 250Vdc	TCR	From 20ppm/K	Options	Smallest Package	Several Variants
Vendor	Thinking	Vendor	Thinking	Vendor	Isabellenhütte, Panasonic	Vendor	Torex	Panjit



DC/DC & Passive Components



Today's higher switching frequencies, higher currents and smaller dimensions demand increasingly higher-grade technologies for the passive components used in DC/DC converters. Thanks to CODICO's wide range of capacitors and wire-wound products, our customers can be sure to meet the new challenges! Along with ideal results – e.g. low ripple, low power loss and compact size – we and our suppliers can help you achieve the optimal solutions. Power drivers for LED applications in particular need the appropriate circuitry with special resistor products like shunts or thermistors.

C1, C2: Capacitors for DC/DC Converters

Low ESR and a high ripple current capability are two essential requirements for capacitors used in DC/DC converters. CODICO can offer customers a broad selection of technologies as part of our comprehensive capacitor range. Low-ESR aluminum electrolytic capacitors are a tried-and-true solution for minimizing output ripple voltage.

Polymer-based capacitors enable significantly lower impedance values still, and thus offer an even higher ripple current capability. This feature can be used to reduce size and used PCB-space.

D1: Schottky Diodes

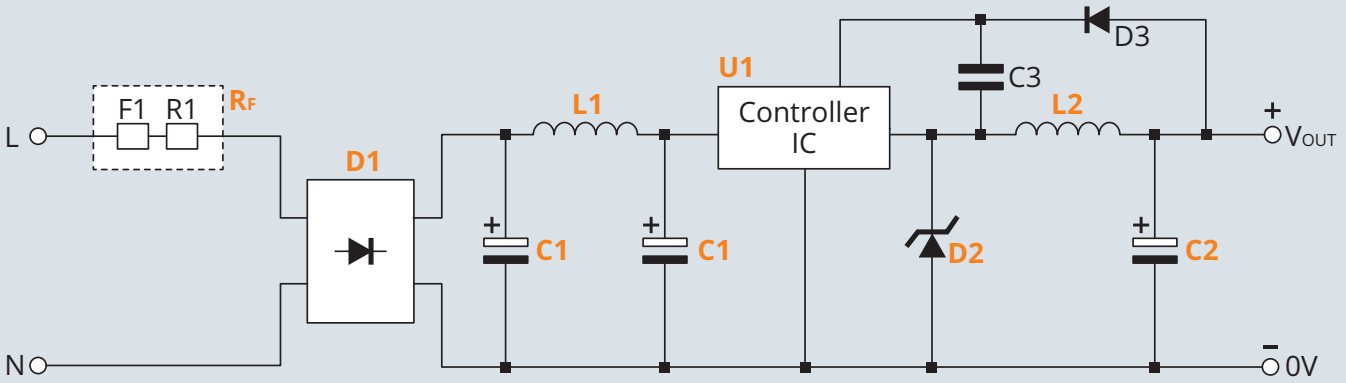
As »fast« diodes, Schottky diodes are well suited for high-frequency applications extending into the microwave range. Their speed is mainly due to their low saturation capacity.

	L1 Storage Chokes	
Technology	Ferrite Inductors (SMD)	Metal Composite
Available Size	3.2x3.2x3 ~ 12.5x12.5x8mm	2.7x2.2x1.0 ~ 22.78x22.3x13.0mm
Current Range (rms)	235mA ~ 14.7A	130mA ~ 66A
Saturation Current Range	239mA ~ 56A	1.7A ~ 118A
Inductance Range	294nH ~ 120mH	95nH ~ 100µH
Temperature Range	-40°C ~ +165°C	-55°C ~ +160°C
Vendor	Eaton, Sagami, Sumida	Eaton, Panasonic, Sumida



	U1 DC/DC Buck Converter					U2 DC/DC Boost Converter				
Input Voltage	1.8V ~ 36V	1.8V ~ 36V	2.3V ~ 75V	2V ~ 100V	2,2V ~ 40 V	0.65V ~ 6V	0.65V ~ 20V	0,6V ~ 20V	1,8V ~ 40V	
Current	200mA - 2A	50mA ~ 6A	300mA ~ 25A	100mA ~ 30A	300mA ~ 3,5A	100mA ~ 500mA	50mA ~ 1.5A	400mA ~ 25A	1A ~ 5A	
Frequency	1.2MHz ~ 3MHz	180kHz ~ 6MHz	140kHz ~ 4,2MHz	100kHz ~ 4MHz	100Hz ~ 2,4MHz	1.2MHz ~ 3MHz	50kHz ~ 3MHz	550kHz ~ 2MHz	100Hz ~ 2,4MHz	
Options	with Inductor	sync, non-sync	integr. Inductor, programmable, Multi-Output	sync, non-sync, programmable	sync, non-sync	with Inductor	sync, non-sync	sync, non-sync		
Vendor	Torex	Torex	MPS	MPS	NJR	Torex	Torex	MPS	NJR	

DC/DC CONVERTERS



High Voltage Buck Converter

High Voltage Buck Converter

In der Vergangenheit wurden kapazitive Spannungsteiler für Anwendungen eingesetzt, bei denen keine galvanische Trennung durch einen Transformator erforderlich ist und eine sehr geringe Ausgangsleistung bei konstanter Last betrieben wird. Aufgrund der Energiesparverordnungen der Europäischen Union und verschiedener anderer Vorteile wie zB Wirkungsgrad >80%, längere Lebensdauer usw. tendieren Entwickler dazu, für zukünftige Anwendungen stattdessen High Voltage Buck Converter zu verwenden.

High Voltage Buck Converter

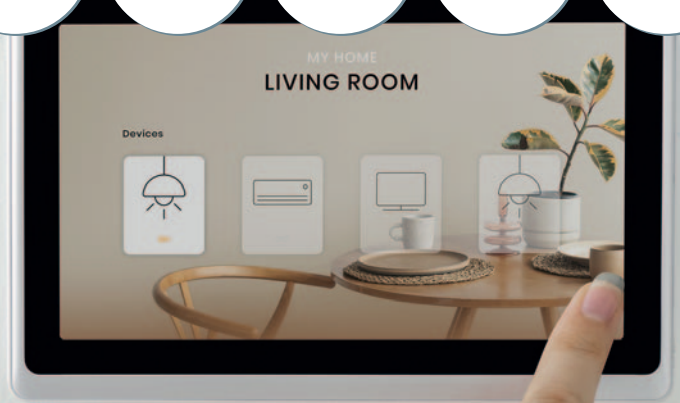
In the past, capacitive voltage dividers were used for applications where no galvanic isolation by a transformer is required and a very low output power is operated at constant load. Because of energy saving regulations of the European Union and several other benefits as e.g. efficiency >80%, longer lifetime, etc., designers tend to use High Voltage buck converters instead for future applications.



	U1 HV Buck Converter (for High Voltage DC/DC or AC/DC with 230VAC and 400VAC)			
Input Voltage	(6V+Vout) ~ 725V	(6V+Vout) ~ 750V	(6V+Vout) ~ 900V	(6V+Vout) ~ 700V
Current	80mA ~ 360mA	360mA	170 ~ 360mA	60mA ~ 600mA
Frequency	30 ~ 66kHz	30 ~ 66kHz	3 ~ 66kHz	33 ~ 66kHz
Requirement	HV Inductor	HV Inductor	HV Inductor	HV Inductor
Vendor	Power Integrations, LNK-TN2	Power Integrations, LNK-TN2Q	Power Integrations, LNK-TN2	MPS, MP17x

	L1 Filter Chokes	
Technology	Ferrite Inductors (SMD)	Metal Composite
Available Size	3.2x3.2x3 ~ 12.5x12.5x8mm	2.7x2.2x1.0 ~ 22.78x22.3x13.0mm
Current Range (rms)	235mA ~ 14.7A	130mA ~ 66A
Saturation Current Range	239mA ~ 56A	1.7A ~ 118A
Inductance Range	294nH ~ 120mH	95nH ~ 100µH
Temperature Range	-40°C ~ +165°C	-55°C ~ +160°C
Vendor	Eaton, Sagami, Sumida	Eaton, Panasonic, Sumida

	L2 Storage Chokes	
Technology	Ferrite Inductors SMD	Ferrite Inductors SMD
Available Size	6.5x6.5x3.0 ~ 10.5x10.5x6.8mm	12.5x12.5x8.0mm
Current Range (rms)	270mA ~ 1.56A	470mA ~ 1.70A
Saturation Current Range	200mA ~ 2.10A	730mA ~ 2.15A
Inductance Range	100uH ~ 1.0mH	150uH ~ 1.4mH
Voltage Rating	400VDC	600VDC
Vendor	Sagami	Sagami



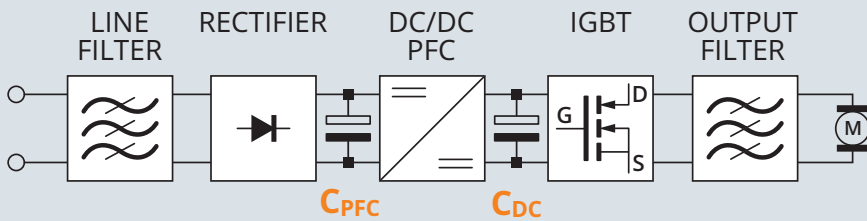
	RF Fusible Resistor
Resistance Range	1R ~ 470R
Rated Power	1.1W ~ 5W
Features	high pulse load (up to 6kV)
Vendor	Vitrohm

	D1 Rectifier Bridge			D2 Schottky Barrier Diodes		
Input Voltage	800V	800V	800V	Voltage Range	30V ~ 60V	15V ~ 200V
Current	0,5A	0,8A	1A	Current	100mA ~ 5A	100mA ~ 60A
Frequency	400Hz	400Hz	400Hz			
	R8S	MB08F-08	4x GS1K	Options	Smallest Package	Several Variants
Vendor	Panjit	Panjit	Panjit	Vendor	Torex	Panjit

	C1 Electrolytic Capacitors (SMD)*	C1 Electrolytic Capacitors (THT)	C2 Electrolytic Capacitors (SMD)*
Voltage Range	400Vdc ~ 450Vdc	400Vdc ~ 600Vdc	6.3Vdc ~ 100Vdc
Capacitance Range	2.2µF ~ 47µF	1µF ~ 270µF	0.47µF ~ 12,000µF
Rated Ripple Current (rms)	25mA ~ 600mA	18mA ~ 2,745mA	4mA ~ 2.64A
Impedance			28mΩ ~ 2.9Ω, max @ 20°C
Temperature Range	-40°C ~ +130°C	-40°C ~ +130°C	-55°C ~ +150°C
Guaranteed Lifetime	up to 10,000hrs at rated temperature	up to 20,000hrs at rated temperature	up to 10,000hrs at rated temperature
Vendor	Aishi, Panasonic, Rubycon, Sun	Aishi, Rubycon	Aishi, Panasonic, Rubycon, Sun

*anti-vibration versions available

POWER INVERTERS



Power Inverters



CPFC: PFC-Kondensatoren

Für die Leistungsfaktorkorrektur bieten unsere Hersteller spezielle Folienkondensatoren mit hoher Strombelastbarkeit. Liegt der Fokus auf höheren Kapazitätswerten oder extrem hohen Strömen bietet KEMET auch die Möglichkeit spezieller Designs, die optimal auf die Applikation abgestimmt sind. Es stehen dazu printbare Box-Kondensatoren ebenso zur Verfügung wie auch zylindrische Bauformen für die Schraubmontage.

CDc: DC-Link Kondensatoren

Im Bereich des Zwischenkreises bietet das Produktportfolio von CODICO eine umfangreiche Auswahl an Kondensatoren unterschiedlicher Technologien und Ausführungen. Dabei dreht es sich nicht nur um Standardprodukte, viel mehr bieten wir Ihnen speziell auf Ihre Anforderungen zugeschnittene Lösungen. Nennen Sie uns die gewünschten Anforderungen!

Mit einer optimierten Wärmeabfuhr aus dem Inneren von Schraubanschluss-Elkos und Snap-in Elkos wird durch die sogenannte »Extended Cathode Foil Structure« eine höhere Ripplestrom-Belastbarkeit bzw. Lebensdauer erzielt!

Durch die Verwendung thermischer Modelle lassen sich Verlustleistung, Wärmeabfuhr, notwendige Kühlmaßnahmen und damit die korrekten Einsatzbedingungen exakt berechnen (siehe Bild »Thermal Model«).

Höhere Schaltfrequenzen von zB SiC-MOS-Inverters stellen entsprechende Anforderungen an die Beschaltung und die notwendigen Snubber-Kondensatoren. Spezielle Designs der Screw-Terminal ELKOs reduzieren effektiv die parasitären Induktivitäten, was die Beschaltung deutlich vereinfacht und zusätzlich notwendige Komponenten reduziert.

CS: Snubber Kondensatoren

Zum Schutz der Halbleiter hat CODICO entsprechende Folienkondensatoren im Lieferprogramm. Für die Direktmontage am IGBT steht eine spezielle Ausführung mit Anschlussfahnen zur Verfügung.

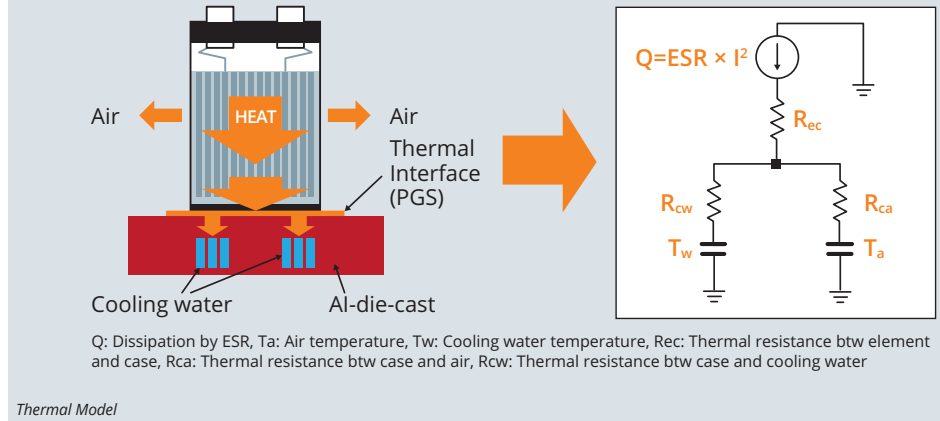
CGD: Gate Drive Low-ESR Kondensatoren

Zur stabilen Spannungsversorgung des IGBTs dienen entsprechende Low-ESR-Kondensatoren.

LPFC: Power Factor Correction Choke

Um eine Leistungsfaktorkorrektur gegen 1 erzielen zu können, werden spezielle Induktivitäten benötigt. Je nach Ausgangsleistung und der damit verbundenen Art der Korrektur gibt es unterschiedlichste Anforderungen. Aus diesem Grund gleicht keine Leistungsfaktorkorrektur-Anwendung der Anderen. Gerne nehmen wir Ihre Anforderungen entgegen und finden die optimale Lösung!

	CPFC PFC-Capacitors		CDc DC-Link Capacitors				
	Film Capacitors (2- and 4-Pins)	Film Capacitors with Screw Terminals	Film Capacitors (2- and 4-Pins)	Film Capacitors with Screw Terminals	Electrolytic Capacitors (THT)	Electrolytic Capacitors (Snap-in)	Electrolytic Capacitors with Screw Terminals
Voltage Range	160Vdc ~ 3kVdc	700Vdc ~ 2.3kVdc	500Vdc ~ 1.5kVdc	700Vdc ~ 1.3kVdc	160Vdc ~ 600Vdc	160Vdc ~ 550Vdc	160Vdc ~ 580Vdc
Capacitance Range	100pF ~ 33µF	10µF ~ 600µF	1µF ~ 210µF	50µF ~ 2,200µF	1µF ~ 820µF	39µF ~ 3,300µF	220µF ~ 3,300µF
Rated Ripple Current (rms)	5A ~ 29A	12A ~ 75A	2A ~ 35.5A	37A ~ 120A	24mA ~ 4.46A	510mA ~ 5.75A	900mA ~ 67.4A
Temperature Range	-55°C ~ +125°C	-40°C ~ +90°C	-40°C ~ +105°C	-40°C ~ +90°C	-40°C ~ +150°C	-40°C ~ +105°C	-25°C ~ +105°C
Guaranteed Lifetime	-	-	-	-	Up to 20.000hrs at rated temperature and rated ripple current	Up to 10.000hrs at rated temperature and rated ripple current	Up to 20.000hrs at rated temperature and rated ripple current
Vendor	Aishi, HJC, Kemet, Panasonic	Aishi, Kemet	Aishi, HJC, Kemet, Panasonic	Aishi, Kemet	Aishi, Rubycon	Aishi, Rubycon	Aishi, Rubycon



CPFC: PFC-Capacitors



For the power factor correction our suppliers provide special film capacitors with high current capability. If the focus is on higher capacitance or extremely high current KEMET also offers the possibility of special designs optimized to the application. Available are boxed capacitors for PCB mounting as well as cylindrical designs with screw terminals.

CDc: DC-Link Capacitors

The product portfolio of CODICO offers a wide selection of capacitors based on different technologies and versions. Not only talking about standard products, much more we provide solutions well fitted to your requirements. The so-called »extended cathode foil structure«, an optimized heat dissipation from the inside element of the screw terminal and snap-in e-cap, a higher ripple current capability respectively lifetime is achieved! The usage of thermal models offer exact calculation of power loss, heat dissipation

and necessary cooling measures. As a result, we get correct and realistic operating conditions (see picture »Thermal Model«). Higher switching frequencies of e.g. SiC-MOS-inverters put respective requirements to the circuit and the necessary snubber-capacitors. Special designs of screw terminal e-caps reduce effectively the parasitical inductances and so enable simplified circuits and reduces additional needed components.

Cs: Snubber Capacitors

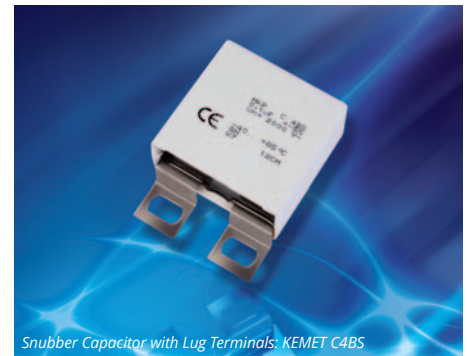
The product portfolio of CODICO offers specific film capacitors for the protection of the semiconductors. Special versions with lug terminals for direct mounting to the IGBT are available.

CGD: Gate Drive Low-Impedance Capacitors

A stable voltage supply of the IGBT is served by corresponding low impedance capacitors.

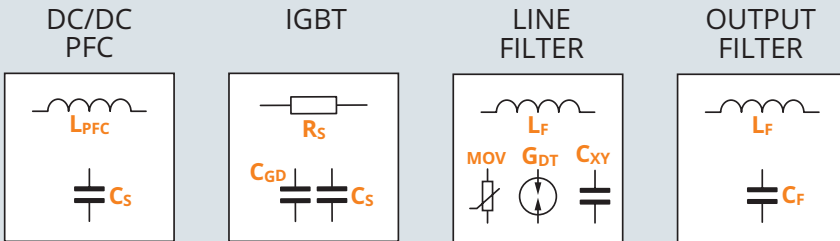
LPFC: Power Factor Correction Choke

Special inductors are required to achieve a power factor correction to 1. Depending on the output power and the associated type of correction, there are different requirements. For this reason, no power factor correction application is like the other. We will gladly accept your requirements and find the optimal solution.

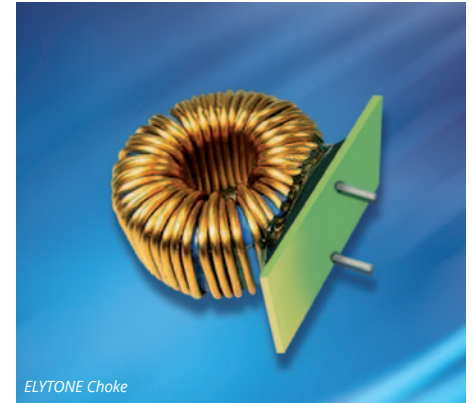


	Cs Snubber Capacitors					CGD Gate Drive Low-Impedance Capacitors	
	Film Capacitors (2- and 4-Pin)	Film Capacitors with Lug Terminals	Film Capacitors with Screw Terminals	Film Capacitors Axial Version		Electrolytic Capacitors (SMD)	Polymer-Hybrid Electrolytic Capacitors (SMD)
Voltage Range	630Vdc ~ 3kVdc	850Vdc ~ 3kVdc	1.2kVdc ~ 2.4kVdc	600Vdc ~ 3kVdc	Voltage Range	6.3Vdc ~ 100Vdc	6.3Vdc ~ 125Vdc
Capacitance Range	22nF ~ 8µF	47nF ~ 5µF	47nF ~ 4µF	10nF ~ 12µF	Capacitance Range	2.2µF ~ 12,000µF	6.8µF ~ 1,000µF
Peak Current	74A ~ 2,585A	97A ~ 2,350A	35A ~ 2,000A	25A ~ 5,400A	Rated Ripple Current (rms)	42mA ~ 2.64A	380mA ~ 5.8A
Impedance	-	-	-	-	Impedance	28mΩ ~ 2.9Ω max @ 20°C	8mΩ ~ 150mΩ max @ 20°C
Temperature Range	-40°C ~ +105°C	-40°C ~ +105°C	-40°C ~ +85°C	-40°C ~ +105°C	Temperature Range	-55°C ~ +150°C	-55°C ~ +150°C
Guaranteed Lifetime	-	-	-	-	Guaranteed Lifetime	Up to 10,000hrs at rated temperature	Up to 10,000hrs at rated temperature and rated ripple current
Vendor	Aishi, Kemet, Panasonic	Aishi, HJC, Kemet	Kemet	Aishi	Vendor	Rubycon, Sun	Panasonic, Rubycon, Sun

POWER INVERTERS



Power Inverters



CF: AC-Ausgangsfilter Kondensatoren

Neben den Standard X- und Y-Kondensatoren bieten unsere Hersteller spezielle Kondensatoren zur AC-Filterung. Diese Typen zeichnen sich durch hohe RMS Belastbarkeit und lange Lebensdauer aus.

LF: Filter Chokes

Während Funkentstörung bei AC/DC Konvertern hauptsächlich ein Thema am Eingang ist, muss man bei Invertern an Ein- und Ausgang mit unerwünschten symmetrischen und asymmetrischen Störungen rechnen.

Während Katalogtypen von Gleichtakt- und Gegentaktrosseln hauptsächlich auf 1-phasige Anwendungen abzielen, erfordern 3-phasige Applikationen häufig kundenspezifische Lösungen. Um das beste Filterresultat erzielen zu können, müssen sowohl Gleichtakt- als auch Gegentaktrosseln entsprechend Ihrer Anforderungen designt werden. CODICO deckt ein weites Spektrum von Katalogtypen von KEMET und SUMIDA ab, ebenso wie kundenspezifische und semi-kundenspezifische Lösungen von ELYTONE und KEMET.

Netzfilter

KEMET bietet ein breites Spektrum an kompletten kundenspezifischen Filterlösungen für unterschiedlichste Inverter-Anwendungen und Leistungsklassen.

MOV, GDT: Überspannungsschutz

Zum Schutz vor Spannungsschwankungen und gefährlichen Spannungsspitzen bietet THINKING eine breite Palette von Überspannungsschutzkomponenten (Varistoren und gasgefüllte Überspannungsableiter). Diese Varistoren werden ständig weiterentwickelt und verbessert.

Ein besonderes Highlight sind die Varistoren aus der TVT-Serie. Diese werden mit einer integrierten thermischen Sicherung versehen, welche das Element bei der Überlastung entkoppelt. Darüber hinaus ist die TVT-Serie mit einem Monitorausgang verfügbar, der im Falle einer Fehlfunktion ein optisches Signal ansteuern kann.

Rs: Strommesswiderstände

Produkte von ISABELLENHÜTTE und PANASONIC erfüllen höchste Ansprüche an Temperaturkoeffizienten (TK), Thermospannung, Langzeitstabilität, Induktivität und Belastbarkeit und eignen sich hervorragend für Applikationen wie Leistungsinverter.

Da diese Eigenschaften sowohl vom eingesetzten Widerstandsmaterial als auch von Bauart und Technologie beeinflusst werden, stehen zwei grundsätzlich verschiedene Fertigungstechnologien zur Auswahl: SMD oder elektronenstrahlver-schweißte Widerstände.

Rs Current Sense Resistors	
Power	0.5W ~ 15W
Resistance Range	0.1mΩ ~ 4Ω
TCR	from 20ppm/K
Type	SMD & Open Air
Vendor	Isabellenhütte, Panasonic

	Cxy Line Filter – Capacitors for Noise Suppression				Cf AC-Output Filter Capacitors			
	X1/X2-Class Film Capacitors (THT)	X1-Class Ceramic Capacitors (THT & SMD)	Y2-Class Film Capacitors (THT)	Y2-Class Ceramic Capacitors (THT)	Film Capacitors (2- and 4-Pin)	Film Capacitors with Lug Terminals for direct Mounting	Film Capacitors with Screw Terminals	Film Capacitors Axial Version
Voltage Range	275Vac ~ 760Vac	250Vac ~ 760Vac	300Vac	250Vac ~ 500Vac	160Vac ~ 450Vac	160Vac ~ 450Vac	330Vac ~ 1kVac	160Vac ~ 450Vac
Capacitance Range	1nF ~ 45μF	3pF ~ 12nF	1nF ~ 1μF	10pF ~ 12nF	220nF ~ 62μF	1μF ~ 60μF	68μF ~ 600μF	150nF ~ 40μF
Rated Ripple Current (rms)	-	-	-	-	2.1A ~ 39.9A	14A ~ 58A	16A ~ 75A	Peak Current: 28.2A ~ 600A
Vendor	Aishi, HJC, Kemet, Panasonic	Kemet	Aishi, HJC, Kemet	Kemet	Aishi, Kemet, Panasonic	Kemet	Aishi, Kemet	Aishi



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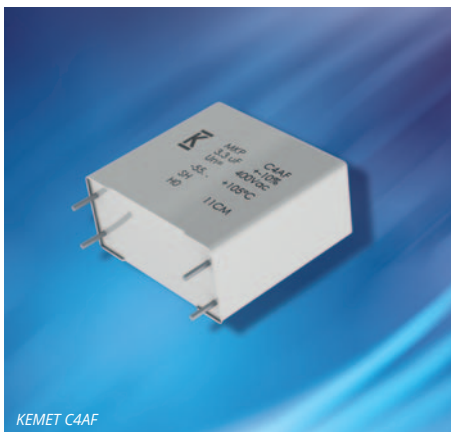
CF: AC-Output Filter Capacitors 

Beside the standard X- and Y-Capacitors our suppliers provide special capacitors for AC-filtering purpose. The main characteristics are high RMS ripple capability as well as long lifetime.

LF: Filter Chokes

While noise suppression is mainly a topic at the input in AC/DC converters, inverters need to handle undesirable symmetric and asymmetric interferences even at input and output.

Whilst catalogue Common and Differential Mode Chokes are mainly for 1-phase systems use, 3-phase applications require customer specific chokes. To achieve the best filter result Common and Differential Mode Chokes need to be designed according to your requirements. CODICO can cover a wide range of catalogue solutions from KEMET and SUMIDA as well as customized and semi customized solutions from ELYTONE and KEMET.



KEMET C4AF

Power Line Filter

KEMET offers a wide range of customer specific Power Line Filter solutions for different inverter applications and power categories.

MOV, GDT: Overvoltage protection

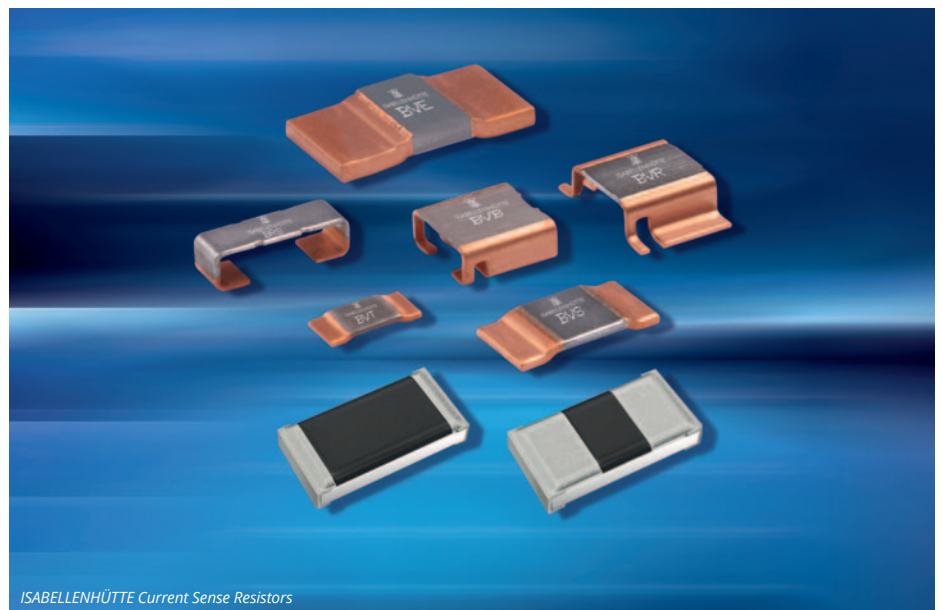
To provide protection against voltage fluctuations and dangerous over-voltages, THINKING provides a wide range of varistors and GDTs components, which ensure the reliable operation of electronic devices. MOV components are being constantly further developed and improved.

As an example, types with multiple high pulse load capacity are available now. One particular highlight is the TVT Series. These are equipped with an inte-

grated thermal cutoff, which isolates the element in the event of overload. Moreover, these components come with a monitor output, which gives a signal in case of any error function.

Rs: Current Sense Resistors

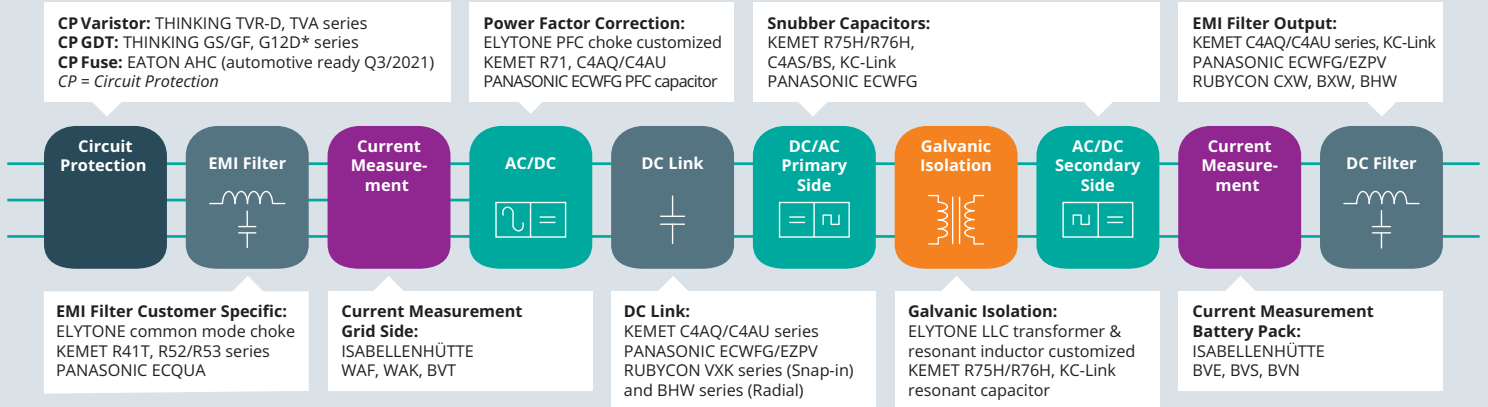
Products of ISABELLENHÜTTE and PANASONIC meet the highest requirements in temperature coefficient (TC), thermo-electric voltage against copper, long-term stability, inductance and load capacity, which make them perfectly suitable for applications such as power inverters. Since these characteristics are influenced by the resistive material as well as design and technology, there are two fundamentally different Shunt technologies to choose from: SMD or electron beam welded resistors.



ISABELLENHÜTTE Current Sense Resistors

EVSE APPLICATIONS

PART RECOMMENDATIONS



Relays used in charging applications

AC Relays with big contact gap:
 1 pole: 26 to 200A, series 110, 207X, 117, 118, 515, 511
 2 pole: 12 to 70A, series 210, 118, 510
Relay for DC Switch: 10 to 250A: series HD011, HD012, HD013, HD014, HD015, HD022, HD024, HD028

Figure 1

Overview Charging Station Technology

The charging infrastructure is one of the most important factors in the implementation of the new mobility solution. The following structures have developed into the current status.

Main Harbour Charging: This describes the charging stations that are located in the home area. At a standard socket (220V/10A) a power of 2.2kW is available. With the so-called wallboxes it is possible to charge up to a power of 22kW, a common value for home applications is 11kW, as the typical connection power is around 14kW.

Destination Charging: This describes charging stations located in front of shopping centres, for example. Here, there is a higher connection capacity of the power grid and therefore a higher charging capacity is available. This amounts up to 50kW. The limiting factor here is the on-board charger (OBC), which is defined according to the manufacturer and is not subject to any European standard.

Range Extension Charging: This describes charging stations located along highways that can provide a lot of energy very quickly. The charging power is well over 50kW and is limited to about 320kW. Here is no limitation from the OBC, because it is bypassed by a bypass line and the power

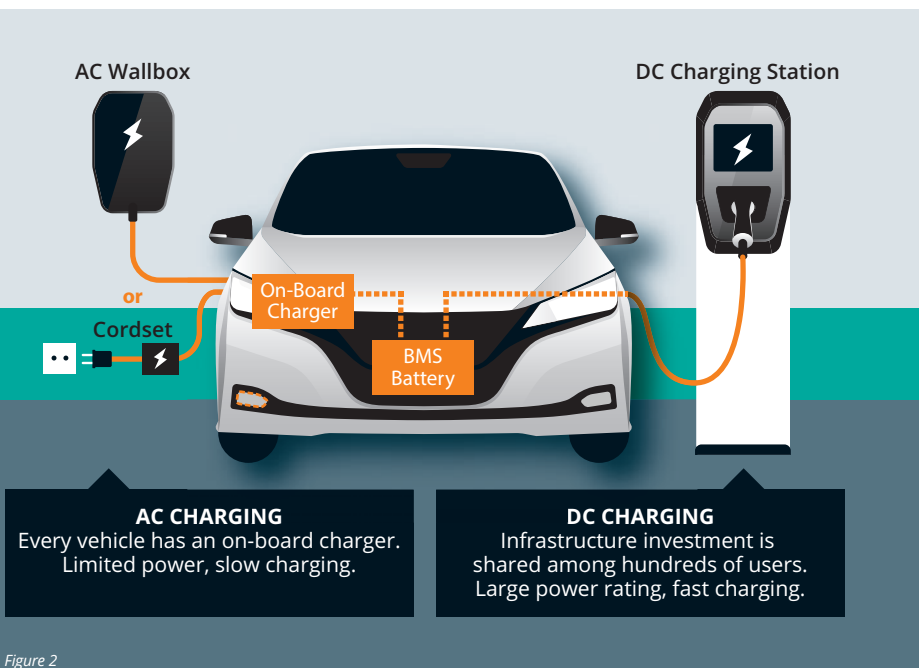


Figure 2





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is directly available to the battery management system (BMS).

Charging Stations in Detail

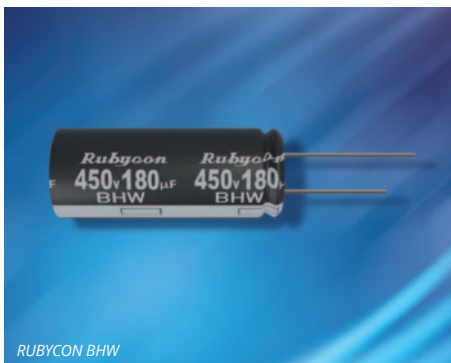
With the three different forms of charging, there is always talk of AC charging and DC charging. Figure 1 roughly shows the difference between AC and DC charging. With AC Charging it is meant that the alternating current coming from the grid is fed into the OBC. The OBC transforms the AC power into a DC power.

DC charging stations are designed according to the topology in Figure 2. In the first step, so-called fast transients are diverted, which can be caused by lightning, for example. This is achieved by using

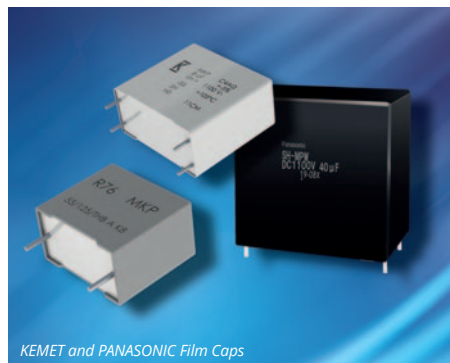
varistors and/or gas discharge tubes (GDT). In the second step, filter elements are used to reduce or suppress the interference from the mains to the device on the one hand, and to minimize the interference from the device to the mains on the other hand. This is realized by CMC, and X/Y capacitors. Next, the voltage is converted from AC to DC by power supply technology. The DC Link capacitor block is the key element in charging station applications, it ensures constant powerflow and is responsible for battery longevity. The capacitor block provides a low impedance jerk current path for the switching currents.

In summary, these capacitors are essential for battery life and EMC radiation performance. The DC

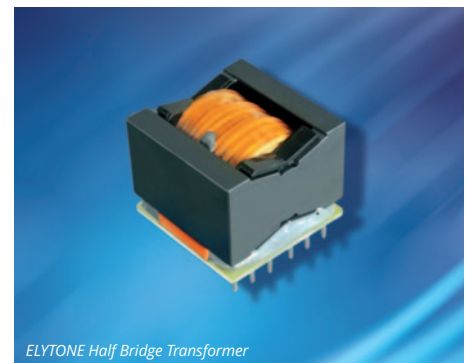
voltage is then transformed back into AC current for transmission via a galvanic isolation path. These transformers are customer-specific transformers, which are specially manufactured to offer the customer the best possible result. The AC voltage is then transformed back to DC, generating voltages of up to 1000V at a current of approximately 200A. In the penultimate step, the DC voltage is smoothed by means of an output filter. In the last step, the current flow is measured by means of a shunt. In figure 2 you can additionally see in each topology step the critical and recommended components for your charging application. In addition you find the selection of relays used in Wallboxes, Charging Cables as well as DC high Power Chargers.



RUBYCON BHW



KEMET and PANASONIC Film Caps



ELYTONE Half Bridge Transformer



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