Film Capacitors
for
Power Applications

ILLINOIS CAPACITOR, INC.

CDE CORNELL DUBILIER
ENERGIZING IDEAS

Company Introduction

Illinois Capacitor is a leading manufacturer of miniature capacitors for electronics, energy and other markets. These products include: Aluminum Electrolytics, Film, Polymers, Supercapacitors and Supercapacitor Modules.

As of February 2015, Cornell Dubilier acquired Illinois Capacitor to bring two of the world's leading manufacturers of capacitors together.

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Why Choose Power Films?

Reliability

Designed for high reliability, long life

Enhanced environmental testing 100% with full traceability

Flexibility

High level of production automation
Flexibility with reduced set-up times

Knowledge & Skills

All products based on own reseach, design, testing and experience

Service

Short delivery time, local stock for popular parts

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Applications - Circuits

SERIES→ APPLICATION ↓	PWS	PPR	PPB	DCB	PHC	PHB	PMC	MHBA	MHBS	PPS	PPA	PSB	RSB	PMB	RMB	MAR	MAB
DC LINK				X	O	O	O	X	X							O	O
SNUBBER CIRCUITS	O	X	X							O	X	X	X	X	X		
IGBT CLAMPER		O	O	O	X	X	X	X	X	X	X	X	X	X	X	X	O
HIGH Irms OPERATION	O	O	O	X	X	X	X	X	X	X	X	X	X	X	X	X	O
HIGH PULSE	X	X	X							O	X	X	X	X	X		
HIGH FREQUENCY RIPPLE FILTER		O	O	X	X	X	X	X	X	X	O	O	O	O	O	X	O
HIGH FREQUENCY OPERATION	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	O
MOTOR RUN								O	O	O	O	O	O			O	X
GERNERAL PURPOSE AC OPERATION		O	O					X	X	X	O	O	O			X	X
RESONANT CIRCUITS	O	O	O			O	O	O	O	O	X	X	X	X	X	O	

X = Recommended
O = Possible Choice

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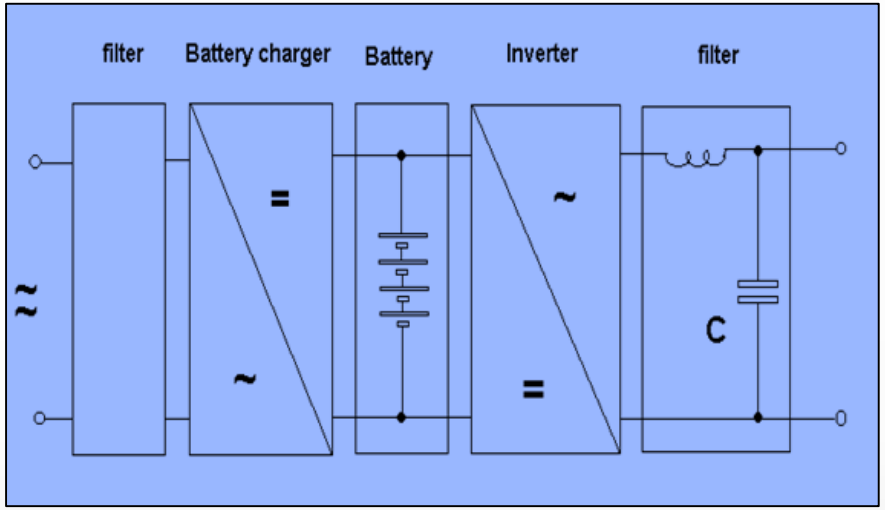
Applications - UPS



Application	Series
Output harmonics filtering	PHB, MHBS
Snubber for IGBT protection / lug type	PMB/RMB
Snubber for IGBT protection / pin type	PPR, PPB, PSB/RSB
DC link	MHBS, DCB

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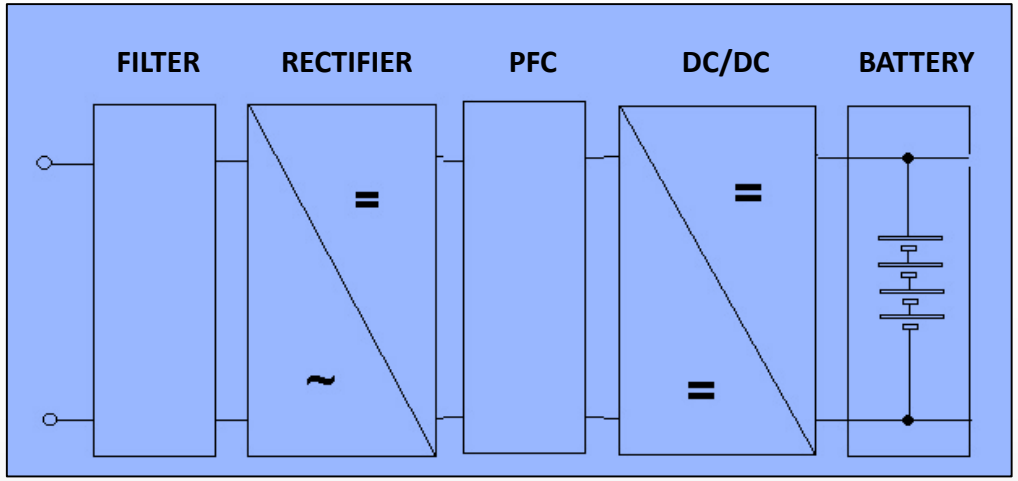
Applications - Battery Charger



Application	Series
Filtering	PHB, MHBS
Snubber for IGBT protection / lug type	PMB/RMB
Snubber for IGBT protection / pin type	PPR, PPB, PSB/RSB

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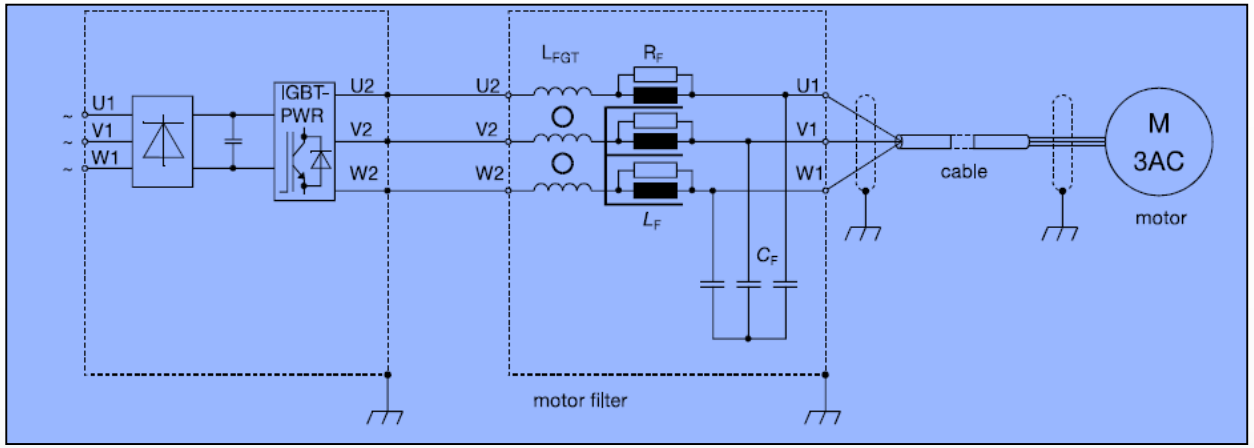
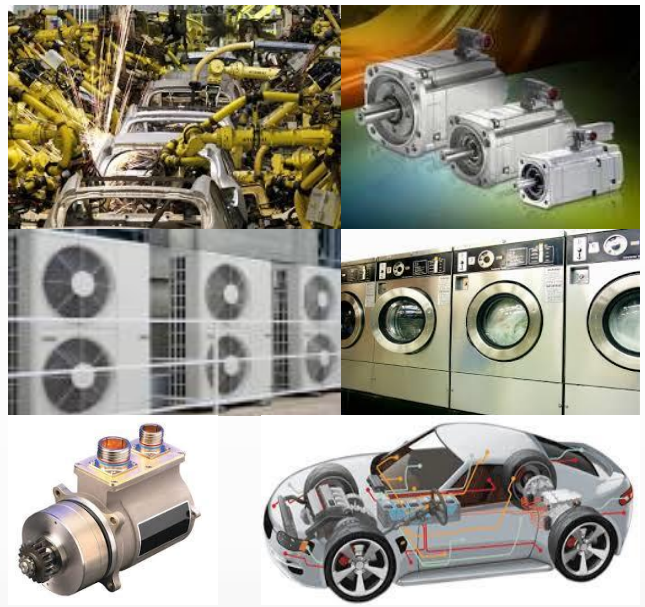
Applications - Motor Control





Application	Series examples
DC-link, smoothing	**MHBS**, **DCB**, **MHBA**
Filtering	PHB, **MHBA**, **MHBS**, MAB
Clamper, Snubber for IGBT protection - lug type	**PMB/RMB**
Clamper, Snubber for IGBT protection - pin type	**PPR**, **PPB**, **PSB/RSB**, **PWS**, **PPA**
AC fan capacitor	**MAB**, **MAR**

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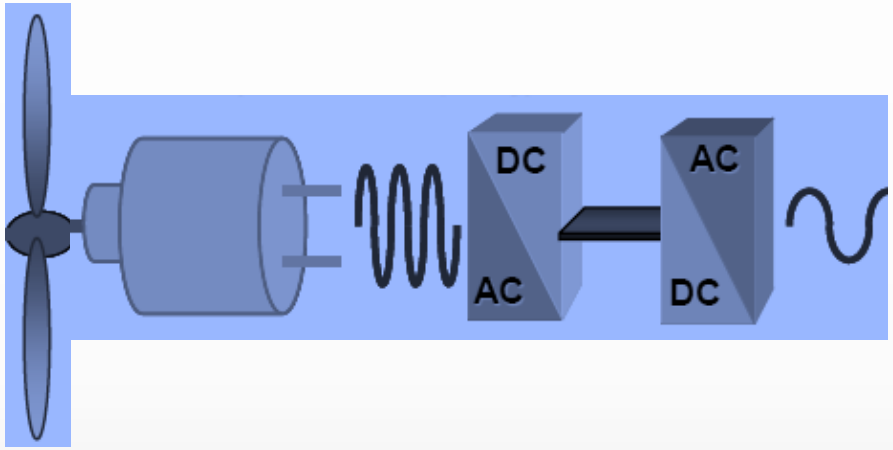
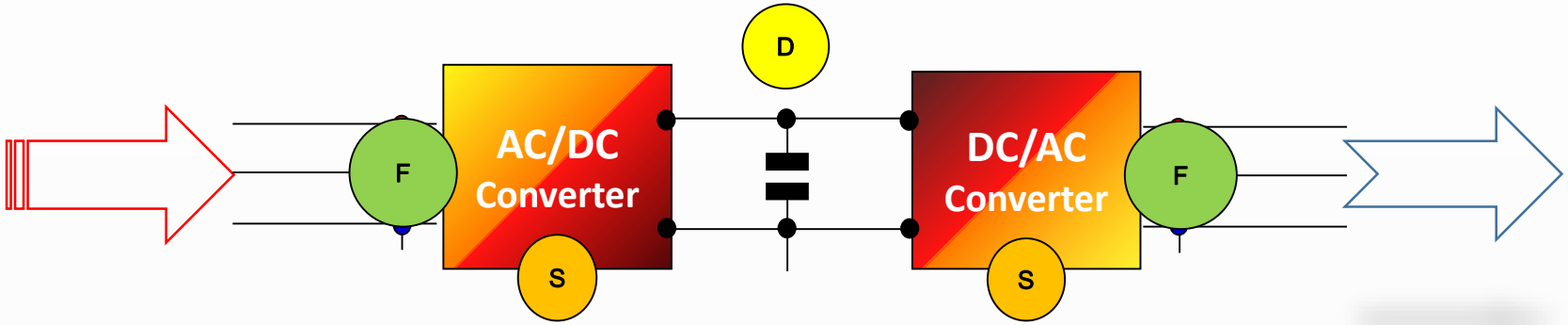
Applications - Wind & Solar

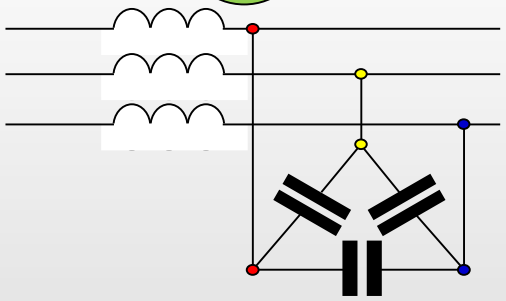


Application	Series
Output harmonics filtering	PHB, MHBS, PSB/RSB
Snubber for IGBT protection / lug type	PMB/RMB
Snubber for IGBT protection / pin type	PPR, PPB, PSB/RSB
DC-link	MHBS, DCB

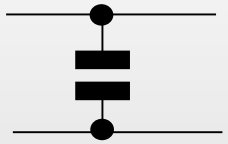
Power Conversion



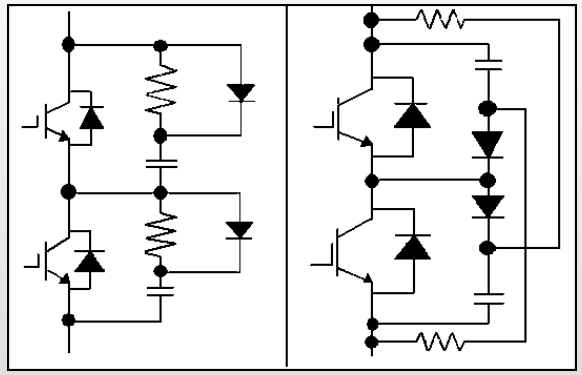
F **Filter**



D **DC Link**



S **Snubber**



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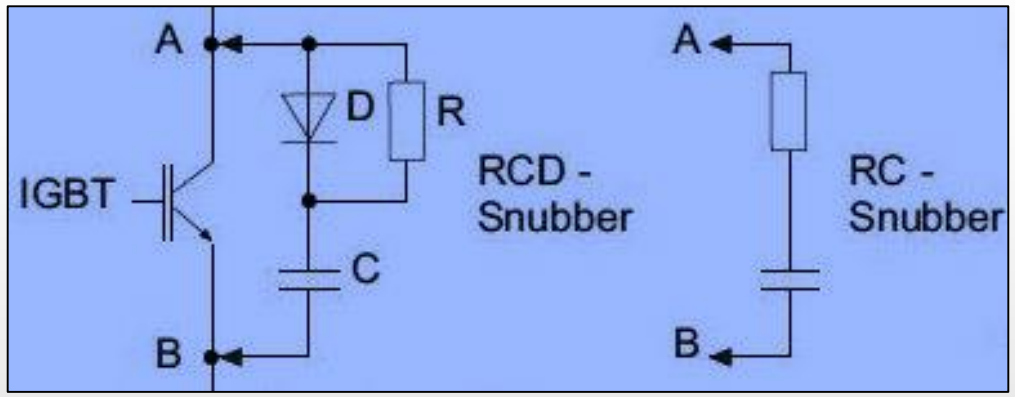
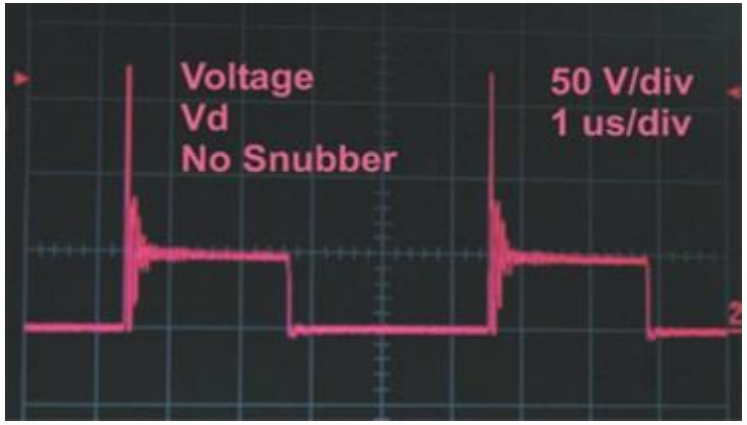
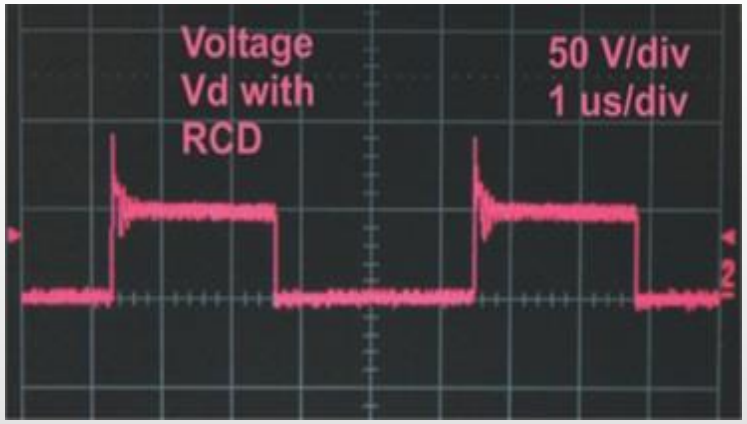
Snubber

Circuit connected across a switching device to protect and improve the operation by eliminating or reducing voltage or current spikes and ringing caused by the parasitic inductances.



Most common circuits used are the RC- and RCD- snubbers





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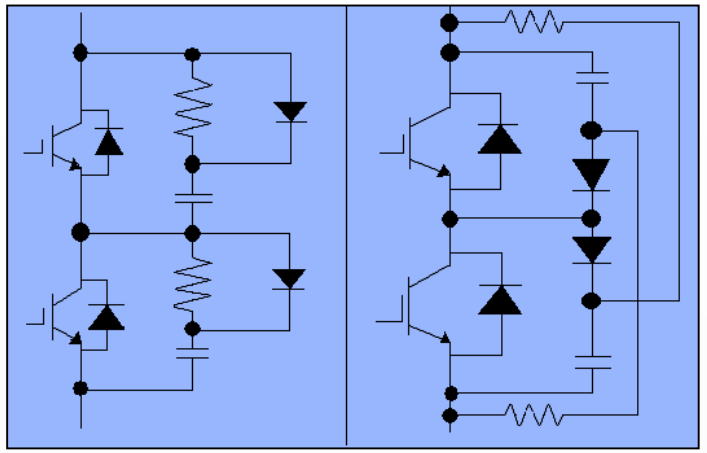
Snubber / Clamper

IGBT applications have different kinds of snubber circuits for protection against dangerous transients.

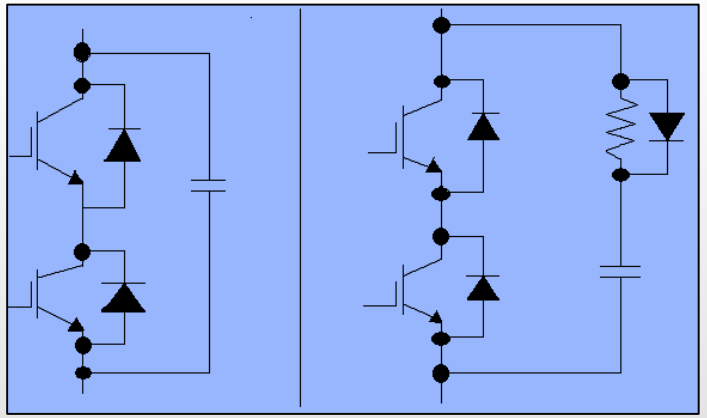
Important characteristics for snubber capacitors are:

- **Low ESL, ESR**
- **DV/DT**
- **Peak current, Irms**
- **Power dissipation capability**
- **High reliability, long life**

Capacitors should be placed close to the switch to keep the circuit inductances low. Lug terminals available for direct mounting on IGBT modules.

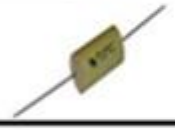


RCD CLAMPING



DC-COUPLING RCD

Snubber and Pulse Capacitors

	SERIES	C (µF)	WVDC	dv / dt (V / µs)	APPLICATIONS
	PPR	0.0022 – 15	250 – 2000Vdc (175 – 700Vac)	105 – 7000	Snubber High pulse High frequency
	PPB	0.001 – 6.8	250 – 2000Vdc (160 – 700Vac)	170 – 9000	Snubber/High pulse High frequency High performance
	PPS	0.0068 – 10	700 – 3000Vdc (420 – 750Vac)	90 – 1500	Switching/snubber Medium-high pulse High current
	PPA	0.0047 – 6.8	700 – 3000Vdc (420 – 750Vac)	300 – 5250	Snubber/pulse High pulse High current
	PSB RSB	0.0047 – 12	700 – 3000Vdc (420 – 750Vac)	285 – 6300	Snubber/pulse High pulse High current
	PMB RMB	0.047 – 12	700 – 3000Vdc (420 – 750Vac)	285 – 2500	Snubber/pulse High pulse High current
	PWS	0.001 – 0.56	630 – 2000Vdc (300 – 500Vac)	1800 – 27k	Snubber High frequency High pluse

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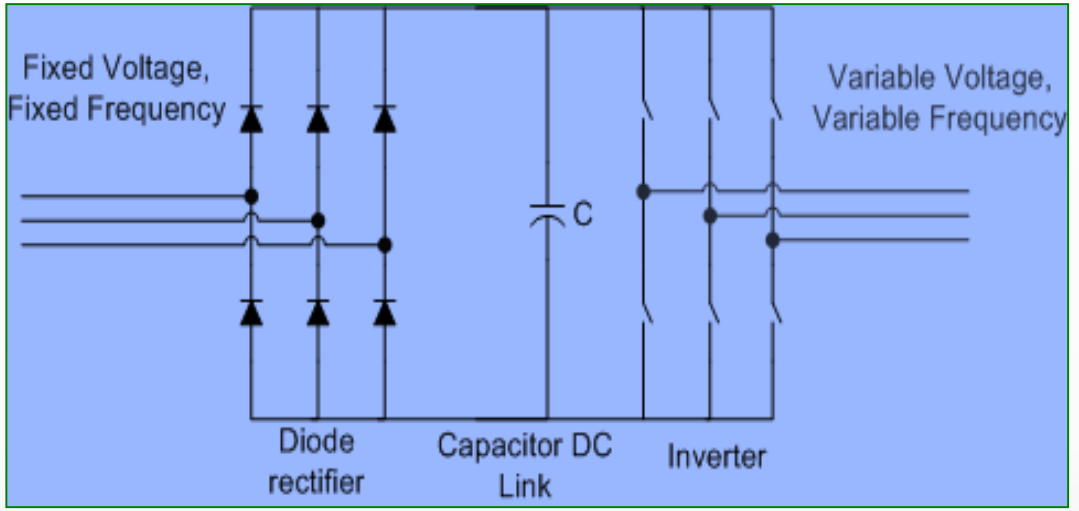
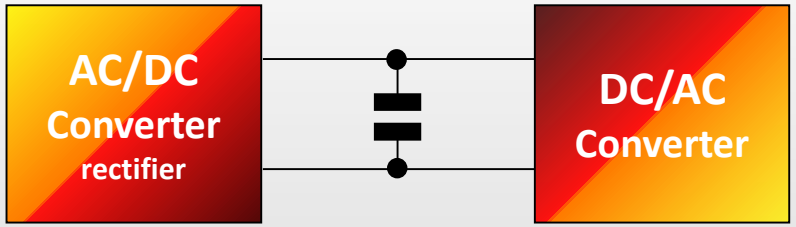
DC Link

Supporting DC-bus to maintain required ripple current by discharging the DC-link capacitors





Typical rated voltages for capacitors are 450Vdc; 700 Vdc; 900 Vdc; 1100 Vdc and 1300 Vdc

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DC-Link Capacitor

DC-link capacitors provide a low impedance path for ripple current.

Low inductance in DC-bus is important for high inverter efficiency.

The right capacitor reduces inductances which reduces spikes in power switching. Internal ESL and mechanical construction must be considered.

LOWER INDUCTANCE = LOWER LOSSES

Some benefits of film capacitor in DC-link application

- High voltage and current ratings,
- Good overvoltage performance
- Low ESR, low ESL and low dissipation factor
- Tight C tolerances,
- Low drift of parameters, good long term stability,
- High insulation resistance, low leakage current
- Long expected life, high reliability, wide temperature range
- Increased safety by self healing

DC-Link Capacitors

	SERIES	C (µF)	WVDC	dv / dt (V / µs)	APPLICATIONS
	MHBA	1 – 75	370 – 800Vdc (160 – 400Vac)	25 – 120	Switching / DC-Link High frequency/current AC applicators
	MHBS	0.68 – 100	575 – 1275Vdc (240 – 440Vac)	12.5 – 61	Switching / DC-Link High frequency/current AC applicators
	DCB	7.5 – 125	450 – 1100Vdc	7 – 20	DC-Link Medium-high frequency Medium-high current

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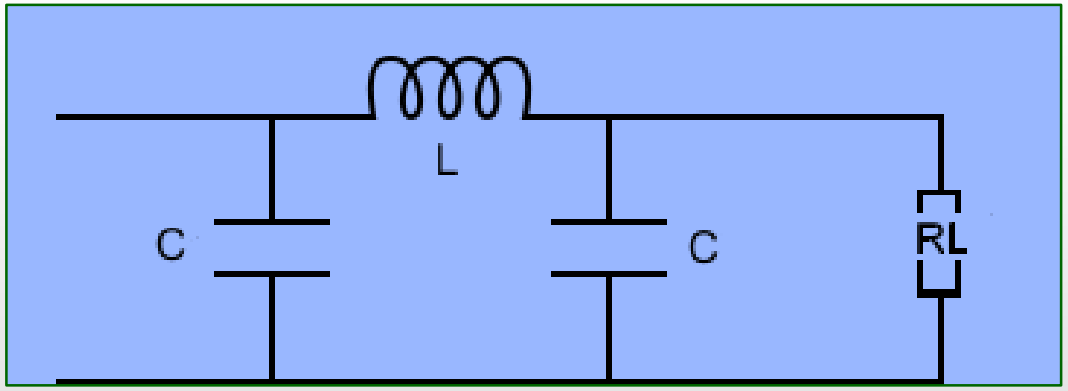
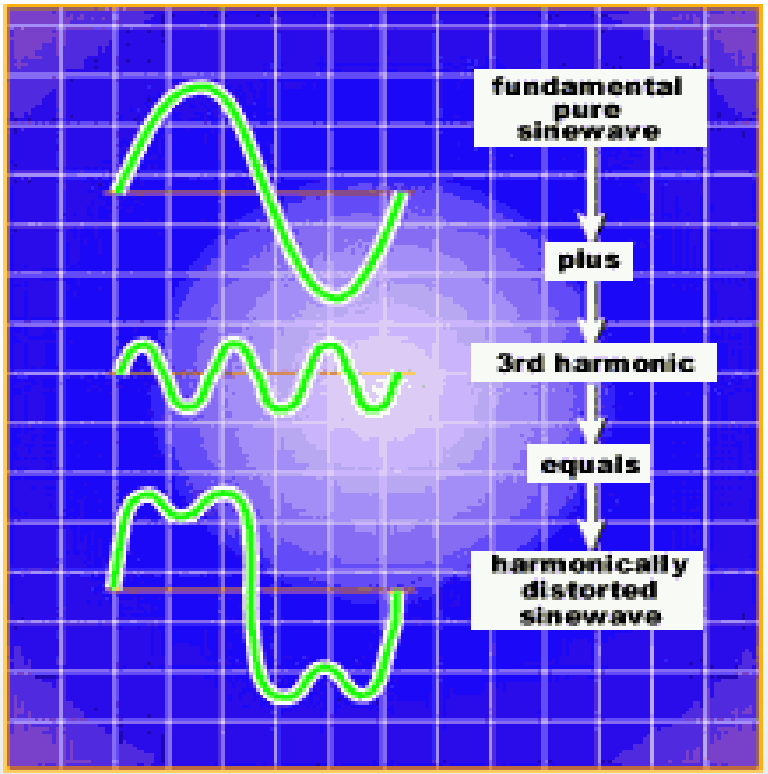
Filtering/Smoothing

Filtering circuits are used to remove or limit unwanted or undesired frequencies from the signal.

Example to reduce the distortion of the harmonic components on the fundamental frequency.





Filtering & Switching Polypropylene Capacitors

	SERIES	C (µF)	WVDC	dv / dt (V / µs)	APPLICATIONS
	PHC	0.1 – 60	250 – 850Vdc (160 – 500Vac)	15 – 375	Switching High frequency High current
	PHB	0.1 – 75	250 – 850Vdc (160 – 500Vac)	15 – 375	Switching High frequency High current
	PMC	1.2 – 75	250 – 700Vdc (160 – 400Vac)	15 – 70	Switching High frequency High current
	MHBA	1 – 75	370 – 800Vdc (160 ÷ 400Vac)	25 – 120	Switching / DC-Link High freq/current AC applications
	MHBS	0.68 – 100	575 ÷ 1275Vdc (240 ÷ 440Vac)	12.5 – 61	Switching / DC-Link High freq/current AC applications
	PPS	0.0068 – 10	700 ÷ 3000Vdc (420 ÷ 750Vac)	90 – 1500	Switching/snubber Medium-high pulse High current

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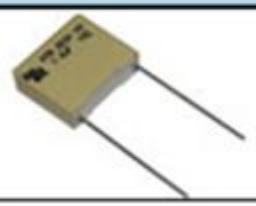
Polyester Capacitors

	SERIES	C (µF)	WVDC	dv / dt (V / µs)	APPLICATIONS
	MTB	0.001 – 150	63 – 1000Vdc (40 – 400Vac)	0.8 – 80	General purpose DC applications
	MWS	0.0015 – 0,56	2.5 – 10kVdc (500 – 1600Vac)	70 – 1200	High voltage DC applications

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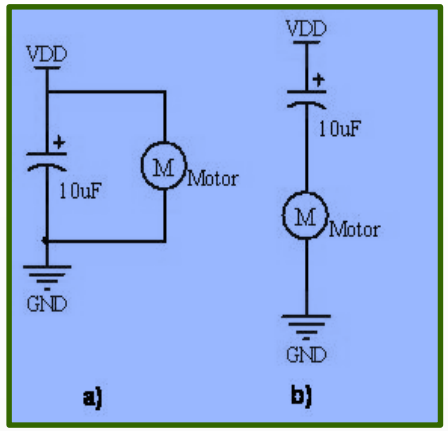
Motor Run Capacitors

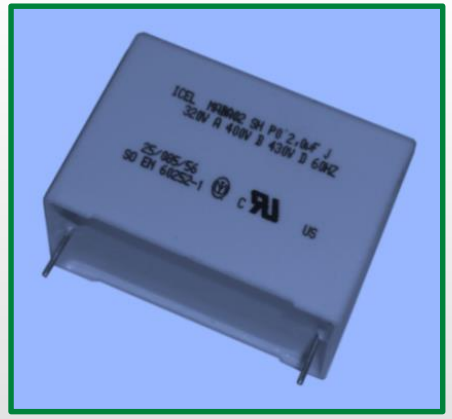
MAB series is a box style motor run capacitor for AC motor run and general AC applications.

Also for filtering applications

- **160 to 600Vac**
- **0.1 to 33uF**
- **Expected life up to 30,000h EN60252-1 Class A**

MABA01 and MABA02 series EN60252-1 approved
UL - CSA (construction only) approvals upon request





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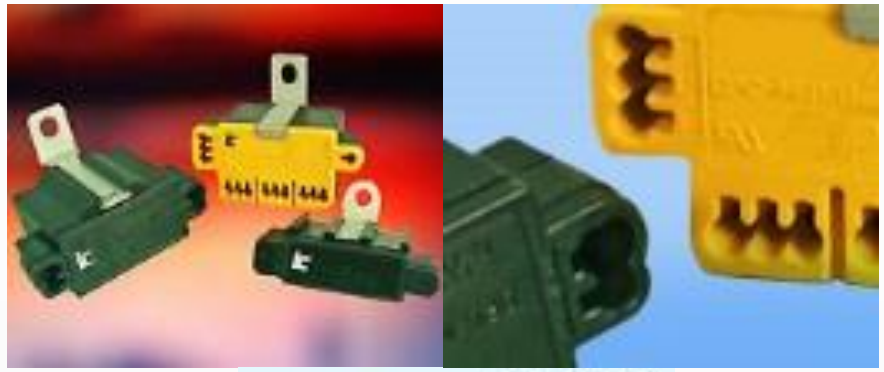
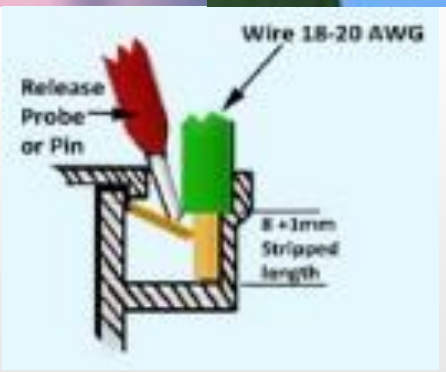
QPC – Motor Run Capacitors

QPC series is a quick release Motor Run capacitor.

This series offers quick installation with durability and reliability.





Capacitance range from 0.4 to 10µF

Voltage range from 250 to 450VAC

UL approved AC Motor Run Capacitor.

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Film Capacitor Life Expectancy

$$L_2 = L_1 \left(\frac{Vr}{Vo}\right)^7 2^X$$

Where

$X = \frac{Tm - (Ta+\Delta T)}{10}$

Ta = Ambient Temperature

Tm = Maximum temp rating of capacitor

ΔT = Temperature Rise from Ripple Current

Vr = Maximum voltage rating of capacitor

Vo = Operating voltage of application

L_1 = Load Life Rating

L_2 = Projected Life at Operating Conditions

Life Calculators available at
www.illinoiscapacitor.com

NOTE : The operating conditions affect the life of a film capacitor in a very similar manner to aluminum electrolytic capacitors. Voltage derating has a greater effect on the life as compared to an aluminum electrolytic capacitor.

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Conclusion

Illinois Capacitor has a wide range of board level Power Capacitors. With short lead time and high quality capacitors, we will be able to support any of your requirements.

For engineering support call your local representative or our Applications Engineering Department at (847)-675-1760

"Your Global Source for World-Class Capacitors"

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