

The background of the entire page is a close-up, slightly blurred photograph of several high-voltage capacitors. These capacitors are cylindrical and feature a series of white, ribbed, conical protrusions (shells) that spiral around the central body. Some of the central bodies are dark brown or black, while others are light grey or white. The lighting is bright, highlighting the texture of the shells.

HIGH VOLTAGE CAPACITORS

CDOR, CDCT, CDHT

High quality and highly reliable
capacitors for circuit breakers,
capacitive voltage transformers
and laboratory use

CONDIS

Maxwell[®]
TECHNOLOGIES

Company Charter

Maxwell technologies SA – CONDIS HV Capacitors

CONDIS High Voltage Capacitors

› Our Mission

To provide products for the optimal management of electricity

› Our Goals

To assure a profitable growth while positioning ourselves as leader.

To be recognized as an enterprise where the employees are satisfied.

To anticipate the needs of the market due to permanent innovaton.

To develop strong partnerships internally and externally.

› Our Values

Entrepreneurial spirit

- › Own the job
- › Professionalism
- › Initiative
- › Courage

Integrity

- › Respect
- › Honesty
- › Objectivity
- › Authenticity

Team spirit

- › Communication
- › Support
- › Recognition
- › Satisfaction

Velocity

- › Goal oriented
- › Improvement
- › Renewal
- › Passion

› Contents

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› high Voltage Capacitors

Maxwell Technologies is the world leader in high voltage capacitor technology, due to:

are used for applications such as:

- › live tank circuit breakers
- › dead tank circuit breakers
- › GIS circuit breakers
- › voltage transformers (CVT)
- › laboratories
- › improved technology and quality with automation and in line quality controls
- › standardised construction
- › protection against corrosion
- › high mechanical strength
- › short delivery time
- › long lifetime
- › flexibility for new or special applications
- › intensive research to maintain our market position
- › re-furbishing of installed bases

Grading Capacitors

Maxwell technologies SA – CONDIS HV Capacitors

For live tank breakers



Live tank switchgear

Grading capacitors used in live tank circuit breakers allow the high voltage to be distributed uniformly in the interrupting chambers.

Our years of experience and know-how in the production of high voltage capacitors make them suitable for all types of applications in the transport and distribution of electrical energy.



> Capacitance min	from 200 pF
> Nominal voltage U_n	from 9kV to 250kV 50/60Hz
> Test voltage	up to 560kV 50/60Hz
> Lightning impulse voltage	up to 1200kV 1.2/50 μ s
> Switching impulse voltage	up to 1000kV 250/2500 μ s
> Lightning impulse voltage chopped wave	up to 2000kV 1.2/2 μ s
> Vibrations and mechanical shocks	up to 40g
> Cantilever strength	from 5kNm to 25kNm

Other values on request

› Porcelain Insulator

The tables give an overview of the standard porcelains and their maximum capacitance. Please bear in mind that only the insulators are standardised. Changing test voltage levels may result in a change of Cmax. Any capacitance less than or equal to Cmax may be selected. All standard porcelains are equipped with alternating long-short sheds and are in full compliance with IEC 60815.

Our «standard» fixing method offers the following advantages:

- › fixing independent of flange diameter
- › interchangeability of old and new CONDIS capacitors
- › compatibility with attachment of synthetic composite insulators

Other fixing methods available on request

distance between flanges L, [mm]	creepage min [mm]	Un max [kV]	Utest max [kV]	UBIL max [kV]	Uch max [kV]	Cmax in PF for flanges diam. (mm)			Weight in kg for flanges diam. (mm)		
						210	230	255	210	230	255
1200 1200-1280	4525	125	265	630	815	5000	6400	12000	75 90	95 112	120 125
1400 1400-1480	3700 4525	145	315	750	970	4000	5100	9500	78 95	107 121	125 144
1600 1600-1680	5260 5650	170	375	860	1110	3100	4000	7400	110 116	135 145	155 168
1800 1750-1830	4500 6315	180	435	950	1225	3200	5000	7500	100 118	130 171	152 187
2000 2000-2080	6300 7180 8800	300	520	1050	1355	2500	4000	6100	125 137 208	150 196 196	172 205 ---

See design details on page 9.

› Composite Insulator

The composite insulator consists of a cylindrical tube of fibre-reinforced epoxy coated with Silicon Rubber (SiR). The sheds are integrated into the coating.

The electrical and mechanical properties of the composite insulator exceed those of all known synthetic materials and porcelain. SiR maintains its superior hydrophobicity and resistance to creepage currents over decades of use. Composite insulators are lighter than those made of porcelain and they are

explosion-proof. Composite insulators are available with any desired length to diameter ratio. Low cross-section active parts of CONDOR thus lead to further weight and volume reductions, which are not possible with porcelain.

A standard range of products is given in the table below. If you have a specific request or if you wish to receive updates, please do not hesitate to contact us.

distance between flanges L, [mm]	creepage min [mm]	Un max [kV]	Utest max [kV]	UBIL max [kV]	Uch max [kV]	Cmax in pF for flanges diam. [mm]		weight in kg for flanges diam. [mm]	
						160	200	160	200
1224-1225	2990	125	265	630	815	4500	12500	25	45
1405-1416	3445	145	315	750	970	3800	10500	34	48
1495-1512	3670	160	350	800	1040	3300	9500	40	51
1608-1630	4010	170	375	860	1110	3200	9000	45	55
1800-1810	4575	180	435	950	1225	3000	8500	51	61
1990-1992	4910	210	520	1050	1355	2300	7900	57	701

See design details on page 9.

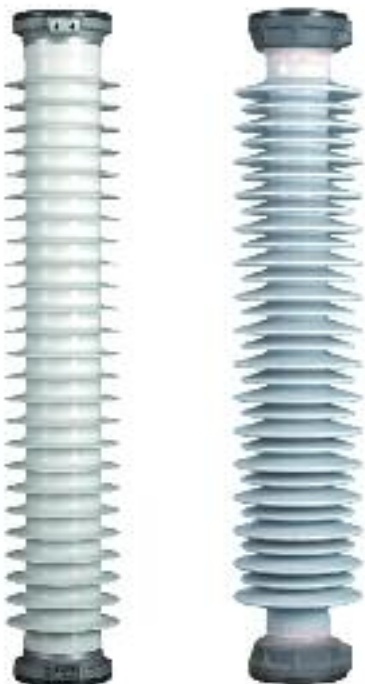
Coupling Capacitors

Maxwell technologies SA – CONDIS HV Capacitors

For dead tank breakers



Coupling capacitors are used on dead tank breakers to limit the over-voltage coming from a short distance fault on a low capacitive line.



> Capacitance min	from 300 pF
> Nominal voltage U_n	from 9kV to 250kV 50/60Hz
> Test voltage	up to 560kV 50/60Hz
> Lightning impulse voltage	up to 1200kV 1.2/50 μ s
> Switching impulse voltage	up to 1000kV 250/2500 μ s
> Lightning impulse voltage chopped wave	up to 2000kV 1.2/2 μ
> Vibrations and mechanical shocks	up to 40g
> Cantilever strength	from 5kNm to 25kNm

Other values on request

› Porcelain Insulator

The tables give an overview of the standard porcelains and their maximum capacitance. Please bear in mind that only the insulators are standardised. Changing test voltage levels may result in a change of Cmax. Any capacitance less than or equal to Cmax may be selected. All standard porcelains are equipped with alternating long-short sheds and are in full compliance with IEC 60815.

Our «standard» fixing method offers the following advantages:

- › fixing independent of flange diameter
- › interchangeability of old and new CONDIS capacitors
- › compatibility with attachment of synthetic composite insulators

Other fixing methods available on request

U nom [kV]	U BIL [kV]	Cmax [pF]	Total length [mm]	Distance between flange [mm]	Creepage distance [mm]	Diameter of flange [mm]	# of pieces in series
72.5	350	5200	780	550	2700	210	1
		12000	705	511	1700	255	1
145	650	3000	1550	1400	3700	210	1
		6000	1430	1250	3700	230	1
		12000	1396	1186	3500	285	1
		3000	1750	1600	5250	210	1
170	750	3000	1750	1600	5250	210	1
245	900	3000	1950	1800	4500	210	1
		5500	1790	1594	5250	255	1
		10000	1953	1743	5537	285	1
		15000	1825	1575	5500	380	1
	1050	5500	2327	2131	6140	230	1
		9000	2065	1871	3960	155	1
		12000	2215	2005	5210	285	1
		7000	2860	1440	7000	340	2
362	1300	7000	2860	1440	7000	340	2
550	1800	1250	4360	-	14360	255	2

See design details on page 9.

› Composite Insulator

The composite insulator consists of a cylindrical tube of fibre-reinforced epoxy coated with Silicon Rubber (SiR).

The sheds are integrated into the coating.

The electrical and mechanical properties of the composite insulator exceed those of all known synthetic materials and porcelain. SiR maintains its superior hydrophobicity

and resistance to creepage currents over decades of use. Composite insulators are lighter than those made of porcelain and they are explosion-proof.

Composite insulators are available with any desired length to diameter ratio. Low cross-section active parts of CONDOR thus lead to further weight and volume reductions, which are not possible with porcelain.

U nom [kV]	U BIL [kV]	Cmax [pF]	Total length [mm]	Distance between flange [mm]	Creepage distance [mm]	Diameter of flange [mm]	# of pieces in series
72.5	350	12000	977	847	1986	200	1
145	650	3000	1543	1424	5124	160	1
		6000	1347	1196	2907	200	1
		12000	1347	1196	2907	200	1
170	750	3000	1543	1414	5114	160	1
		5000	1556	1426	5038	200	1
		12000	1670	1530	3856	232	1
245	900	3000	1943	1808	6573	160	1
		10000	1871	1731	4309	200	1
		15000	1818	1628	3938	286	1
		30000	1825	1575	3918	344	1
362	1300	12000	2327	2187	5346	200	1
		2000	2809	2674	9832	160	1
		7000	2726	2596	6348	200	1
550	1800	8000	2538	2348	5816	232	1
		1250	4360	-	14990	160	2

See design details on page 9.

GIS Capacitors

Maxwell technologies SA – CONDIS HV Capacitors

For gas insulated circuit breakers



GIS circuit breakers

GIS circuit breakers for tough environments with extreme temperature variations, dust, pollution or confined space use grading capacitors.

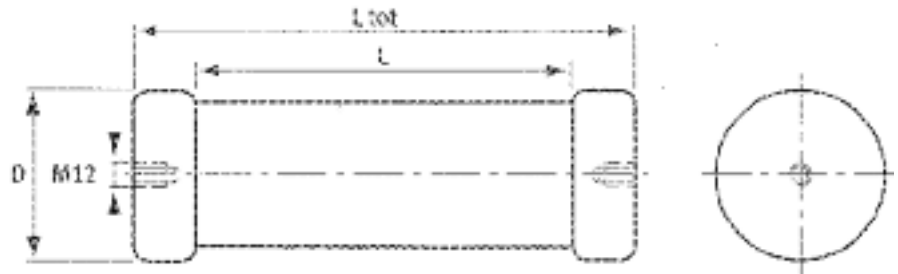
(Coupling capacitors for special applications are also available for this type of switchgear).



> Capacitance min	from 200 pF
> Nominal voltage U_n	up to 500kV 50/60Hz
> Test voltage	up to 720kV 50/60Hz
> Lightning impulse voltage	up to 1200kV 1.2/50 μ s
> Switching impulse voltage	up to 1000kV 250/2500 μ s
> Lightning impulse voltage chopped wave	up to 2000kV 1.2/2 μ
> Vibrations and mechanical shocks	up to 40g

Other values on request

› Typical GIS Capacitor Design



HV GIS capacitors are dedicated to various types of Gas Insulated Switchgear, and the design is therefore customer-specific. The general design can be seen in the diagram above.

Indoor HV capacitors are not envisaged as standard types due to their wide variety and short production runs. Please use the enquiry form to request a specific quotation.

For both kinds of application, please note that flanges, tubes, and field distribution will not be changed at

all. Backward compatibility with our former technology is 100% guaranteed. However, CONDOR technology will often permit new concepts and designs, i.e. by higher capacitance in a given space.

The following table featuring selected types of GIS capacitors gives an idea of the maximum capacitance possible with CONDOR technology.

flange diameter D, [mm]	overall length L tot, [mm]	flashover length L, [mm]	C max [pF]	UN max [kV]	Utest max [kV]	UBIL max [kV]	Uch max [kV]
100	600	546	700	180	460	1050	1150
100	750	696	600	280	570	1150	1270
120	600	530	1400	180	420	970	1150
120	750	680	1100	210	460	1050	1365
120	900	830	950	140	400	1160	1700
120	1300	1230	950	250	570	1500	2000
140	900	828	3100	110	300	800	1200
140	900	828	1500	140	440	1160	1700
140	1200	1128	1000	280	700	1700	2000
174	1300	1210	2000	250	570	1500	2000
174	1500	1410	3500	250	570	1500	2000

Capacitive Voltage Divider (CVD)

Maxwell technologies SA – CONDIS HV Capacitors



Capacitor voltage dividers (CVD) are a component used on complete capacitive transformers to measure the voltage and/or the power on a high voltage overhead power line.

› Capacitance min	from 1nF to 30nF
› Nominal voltage U_n	from 72.5kV to 765kV
› Test voltage	up to 1200kV resp. 525kV/section
› Lightning impulse voltage	up to 2425kV resp. 1050kV/section

Other values on request

References:

- IEC 60 044-05
- IEC 60358
- IEEE C93.1

Um ANSI / IEC [kV]	Maximum capacitance [pF]	Utest ANSI / IEC [kV]	UBIL ANSI / IEC [kV]	Overall length [mm]	Creepage distance [mm]	Number of section	Type of Design	Temp. range [°C]
72.5	23000	140/165	350	1040	2200	1	A*	-50/70
110/123	12000	230/265	550	1205	3160	1	A*	-25/71
110/123	15000	230/266	550	1320	3160	1	B*	-50/70
145	10000	230/266	550	1415	3880	1	A*	-25/70
145	11500	275/320	650	1530/1740	3880/4600	1	B*	-50/70
170	10000	325/370	750	1740/1940	4600/5315	1	B*	-50/70
220/250	9000	460/525	1050	2300/2440	6510/6990	1	B*	-50/70
300/330	7000	460/510	1050	3075/3495	7760/9200	2	B*	-50/70
362	5000	510/785	1175/1550	3495	9200	2	B*	-50/70
420	4500	630/680	1425	3895	10630	2	B*	-50/70
500/550	4500	680/900	1550/1800	4895	13980	2	B*	-50/70
750	3000	1150	2250	7350	20970	3	B*	-50/70

* See page 9 for example diagrams of the two design types

Speciality Capacitors

Maxwell technologies SA – CONDIS HV Capacitors

For lab or special applications

HV Capacitors can be used in the laboratory as a:

- › Coupling capacitor for PD measurement
- › HV divider for 50Hz voltage measurement
- › HV RC divider for impulse voltage measurement
- › Capacitive load for Serie resonance installation
- › Capacitive load for DC installation
- › Other applications



Specialized HV Capacitors can be used as a:

- › Coupling capacitor for on-site PD measurement
- › Coupling capacitor for generator circuit breaker
- › Other applications

› Capacitance	from 150pF to 500nF
› Nominal voltage U_n	from 20kV to 100kV
› Test voltage	1.2 x U_n or on demand
› PD level	< 1.2 pC



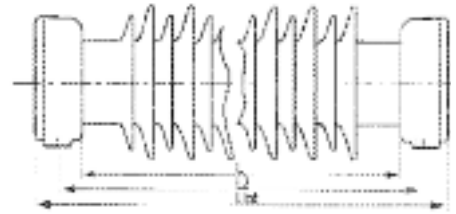
Design Details

Maxwell technologies SA – CONDIS HV Capacitors

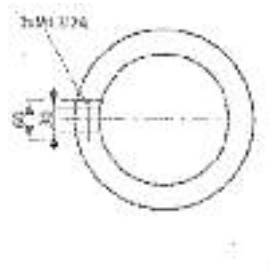
› Grading and Coupling Capacitors



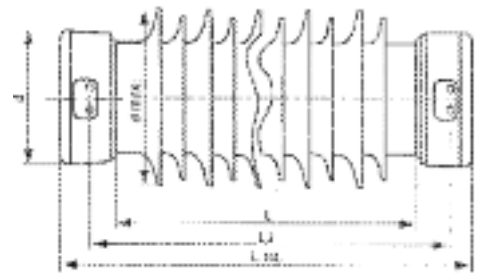
Porcelain Insulator



Flange diam. d,[mm]	Fixation length L2,[mm]	Total length L_tot	A [mm]
210	L+64...90	L+150	115
230	L+64...120	L+180	130
255	L+64...134	L+194	140

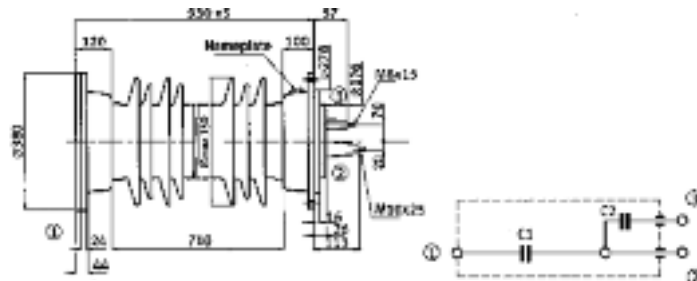


Composite Insulator

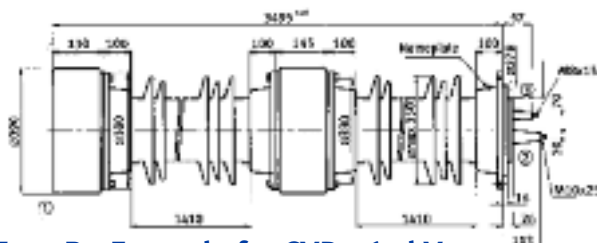


Flange diam. d,[mm]	Fixation length L2,[mm]	Total length L_tot	A [mm]
160	L+64...90	L+127	78
200	L+64...120	L+150	108

› Capacite Voltage Dividers

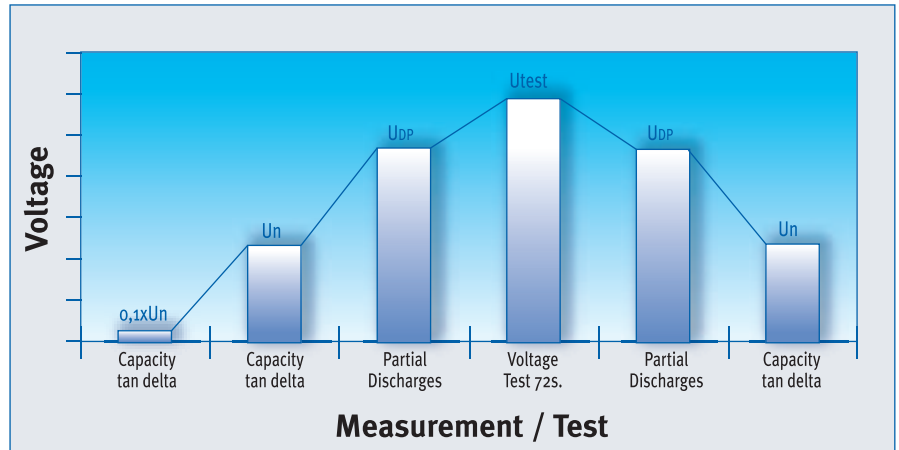


Type A - Example for CVD 72.5 kV



Type B - Example for CVD 362 kV

› Routine test program



As part of our quality process, all CONDIS capacitors are individually tested as shown in the graph above.

The capacitance measurement at 0.1 x nominal voltage and at nominal voltage ensures that no element has had a breakdown during the first voltage application.

The partial discharge measurement ensures that the capacitor has no fabrication defect which could destroy the capacitor.

The voltage test eliminates the risk of failure of the capacitor during the first period of service.

Testing conforms to the following standards:

› IEC 60060:	High voltage test technique
› IEC 60068:	Environmental testing
› IEC 60071:	Insulation co-ordination
› IEC 60233:	Tests on hollow insulators for use in electrical equipment
› IEC 60270:	Partial discharge measurements
› IEC 60358:	Coupling capacitors and capacitor dividers
› ANSI C93.1:	Power-line carrier coupling capacitors and coupling capacitor voltage transformers

or on request

Technical Specifications

Maxwell technologies SA – CONDIS HV Capacitors

› Capacitance range CN:	standard types up to about 10000 pF higher capacitance on request
› Tolerance on CN:	+/-5% or +/-2% other tolerances on request
› Operating voltage U_n :	up to 800 kV higher voltage on request
› Loss factor $\tan \delta$:	$< 20 \times 10^{-4}$ at 20°C, 50 Hz; $< 50 \times 10^{-4}$ CDHT
› Partial discharge level:	< 5 pC, lower levels on request
› Ambient temperature during operation	
indoor and GIS	-40°C to + 87.5°C
outdoor:	-55°C to + 75°C
› Storage temperature:	
indoor and GIS:	-55°C to + 90°C
outdoor:	-55°C to + 75°C
› Inductance:	ca. 1 nH per mm length, typical
› Lifetime expectancy:	› 20 years, typical
› Impregnation oil:	Blend of benzyltoluene (BT) and dibenzyltoluene (DBT). Guaranteed no PCB content.
› Installation:	in any position
› Max. permissible height above zero:	1000 m other heights on request

› CONDIS technology

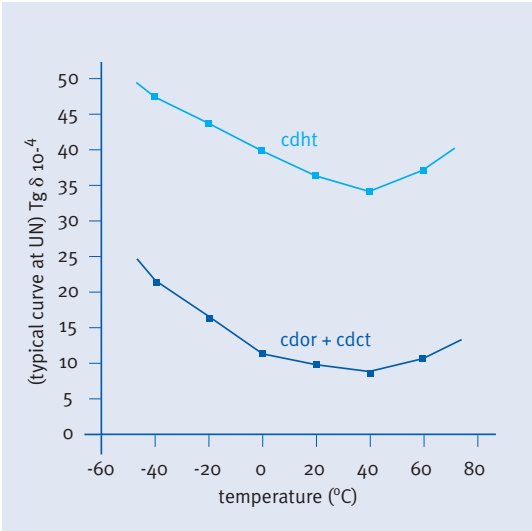
CDHT	CDCT	CDOR (CONDOR)
› Aluminium foil	› Aluminium foil	› Aluminium foil
› Paper dielectric	› Polypropylene-paper dielectric	› Polypropylene-paper dielectric
	› Contact points soldered	› Contact points without alien material (no tin)

Technical Data

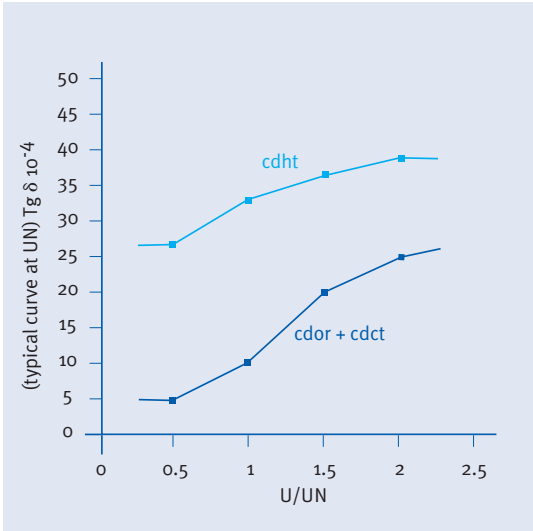
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› Tangent of Loss Angle

versus Temperature

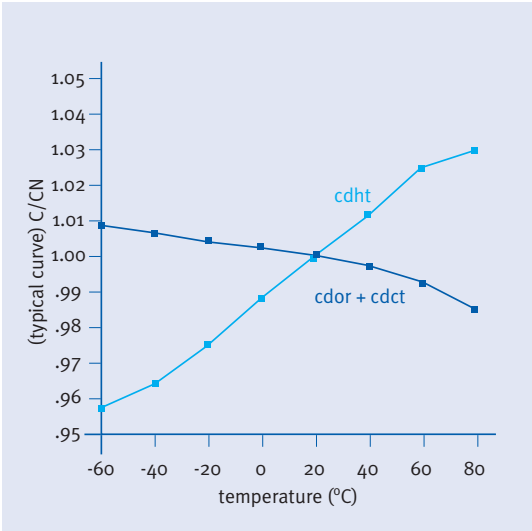


versus Voltage

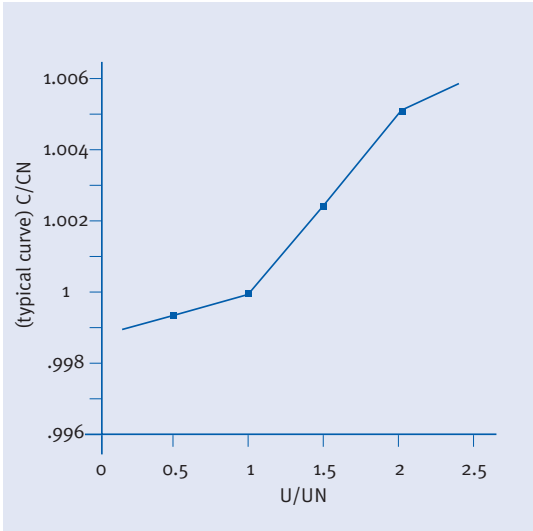


› Capacitance

versus Temperature



versus Voltage



Type Test

Maxwell technologies SA – CONDIS HV Capacitors

The type test performed by Maxwell Technologies cover or exceed the most severe conditions taken from all available national, international, and customer specific standards.

We are therefore sure to cover all customers' specifications and to establish a new yardstick for quality and reliability. The available tests-reports are listed below:

› Tests

Group 1: Outdoor capacitors, porcelain insulators

- › **RE 12.0187**¹⁾ Electrical type tests, full-size capacitors
- › **STC 95.002**¹⁾ Mechanical type test, full size capacitors
- › **RE 12.0107** Tightness tests (seal)
- › **RE 12.0108** Pressure-temperature tests (endurance)
- › **RE 12.0144** Corrosion test

Group 2: Outdoor capacitors, composite insulators

- › **RE 12.0181**¹⁾ Electrical type tests, full-size capacitors
- › **STC 95.024**¹⁾ Shock tests, full-size capacitors

Group 3: Indoor and GIS capacitors

- › **RE 12.0182**¹⁾ Electrical type tests, full-size capacitors
- › **RE 12.0186**¹⁾ Electrical type tests, full-size capacitors
- › **STC 93.013** Mechanical type tests, full-size capacitors
- › **RE 12.0109** Tightness tests, full-size capacitors
- › **RE 12.0110** Pressure-temperature tests (endurance)
- › **RE 12.0112** SF6-Penetration

Group 4: Tests valid for group 1, 2 and 3

- › **RE 12.0111** Mechanical behaviour of the internal part
- › **RE 12.0106** Electrical fatigue tests
- › **RE 12.0115** DC discharge test

Group 5: Outdoor Capacitor Voltage Divider

- › **RE 12.0182** Electrical type tests, full-size capacitors
- › **RE 12.0183** Electrical type tests, full-size capacitors
- › **RE 12.0188** HF-capacitance and series resistance, capacitance stability
- › **RE 12.0189** HF-capacitance and series resistance, capacitance stability

¹⁾ Type tests achieved on full-size capacitors produced on line under serial conditions

Certifications

Maxwell technologies SA – CONDIS HV Capacitors

Quality and Environmental

A reputation for quality is the key to Maxwell Technologies' future! The company invests heavily in the constant improvement to its organization and manufacturing processes.

The name CONDIS is already synonymous with quality for the major manufacturing companies who make up our international clientele.

Our main objective is to win your trust in us as a quality supplier.



14001
9001:2000

Maxwell Technologies

Maxwell technologies SA – CONDIS HV Capacitors

Other Products

› BOOSTCAP® Ultracapacitors

Maxwell Technologies' BOOSTCAP® ultracapacitors provide extended power availability, allowing critical information and functions to remain available during dips, sags, and outages in the main power source. In addition, it can relieve batteries of

BOOSTCAP®
ULTRACAPACITORS

burst power functions, thereby reducing cost and maximizing space and energy efficiency.

Feature

- › High power and energy density
- › Fast charging with high currents
- › Very high discharge currents
- › Deep discharge capability
- › Long lifetime
- › Several hundred thousand cycles
- › Resistant against reverse polarity
- › Ultra-low internal resistance
- › Reliable operation in harsh environments Virtually maintenance free
- › Wide operating temperature range
- › Environmentally friendly
- › Compact design
- › Safety vent



› Radiation-Hardened Microelectronics

Maxwell Technologies Microelectronics designs and manufactures patented radiationshielded integrated circuits, power modules and single board computers for space, military and commercial applications. Our proprietary RAD-PAK® shielding

technology allows our customers to use powerful, low-cost, off-the-shelf components, protected with the level of radiation shielding required for the orbit or environment in which satellites or spacecraft are to be deployed.

Available Components Include:

- › Single board computers
- › Memory
- › Data converters
- › Logic
- › Operational amplifiers
- › Nuclear Event Detectors



Enquiry form

Maxwell technologies SA – CONDIS HV Capacitors

Fill out and fax this entire form to +41 26 411 85 05

Your Name _____ Fax _____ Phone _____

› Capacitor Sizing Nominal values:

› Capacitance* _____ pF
› Nominal voltage* _____ kV
› Frequency* _____ Hz
› Creepage distance* _____ mm
› Flashover* _____ mm
› Insulator material* Porcelain Silicon
› Colour* Brown Grey

› Electrical Specifications Limit values:

› Partial discharge: _____ measured voltage
_____ level max.
› 50 Hz voltage test _____
› impulse: _____ lightning (BIL)
_____ switching (SIL)
_____ chopped wave

› Mechanical Specifications

› Total length _____ mm
› Bending strength _____ kNm
› Fixation gap _____ mm
› Fixation Side End Other

› Application

* _____

* MUST be specified to allow us to quote or for a valid order



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www.maxwell.com

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this specification at any time
without prior notice and without
necessarily revising this
document.

edition 04/08

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