Electrical Properties of SCHOTT Glass

SCHOTT offers a wide range of glass types produced in various hot forming technologies. These glasses have applications throughout the electronic industry. Glasses have a high breakdown strength[1)] as well as good dielectric properties and are used in mm-wave packages where antenna compounds and different semiconductor components are integrated into a single package. Excellent thermal properties make high power packages possible. Smooth glass surfaces and industrial established metallization technologies enable excellent and accurate high-frequency designs. Some of the main areas where glasses can be applied are as interposer in the semiconductor industry, mm-wave packages, including antennas for 5G applications, gesture recognition, and automotive radar operating in the range above 30 GHz as well as high power packages in 5G transmission applications.

Material	Frequency in GHz [2)] [3)]												Specific electrical volume resistivity ρ_D at 50 Hz	
	Dielectric constant (permittivity) ε_r'						Loss tangent $tan(\delta)$ in 10^{-4}						log10 ρ_D at $\vartheta = 250$ °C in $\Omega \cdot cm$	log10 ρ_D at $\vartheta = 350$ °C in $\Omega \cdot cm$
	1	5	10	24	77	110	1	5	10	24	77	110		
D 263® T eco	6.4	6.4	6.4	6.4	6.3	6.3	73	106	127	160	228	276	$1.6 \cdot 10^8$	$3.5 \cdot 10^6$
AF 32® eco	5.1	5.1	5.1	5.1	5.1	5.1	35	49	60	82	113	132	$7.9 \cdot 10^{11}$	$1.1 \cdot 10^{10}$
AS 87 eco	7.3	7.2		–	–		133	172		–	–		–	–
MEMpax®	4.4	4.4	4.4	4.4	4.4	4.4	58	73	88	105	140	165	$1.18 \cdot 10^8$	$4.24 \cdot 10^6$
BOROFLOAT® 33	4.5	4.5	4.5	4.4	4.4	4.4	51	65	75	93	127	153	$1.0 \cdot 10^8$	$3.2 \cdot 10^6$
B 270® Thin	6.6	6.6		–	–		52	77		–	–		$2.4 \cdot 10^8$	$5.8 \cdot 10^6$
B 270®	6.7	6.7		–	–		59	84		–	–		$6.1 \cdot 10^7$	$1.6 \cdot 10^6$
SCHOTT Low Loss Glass (lab material)[4]	4.05	4.05	4.05	4.05	4.05	4.05	6	16	22	28	47	60		
SCHOTT® AF 35 G	5.2	5.2	5.2				38	52	63					
Poweramic® GHz 33	33.2	33.2	33.2	33.2	33.2	33.2	5	13	20	34	77	104		

[1)] The dielectric strength of glasses depends on many factors like frequency, rate of increase in voltage, temperature, glass composition and external test conditions. Furthermore, the breakdown field strength increases substantially with decreasing glass thickness. For ultra-thin glasses, the dielectric breakdown strength can show extremely large values. For example, a breakdown strength of 1200 kV/mm was measured on 12 µm thick alkaline free glass specimen.
[2)] The data at 1 GHz, 2 GHz and 5 GHz are measured using a split-post-dielectric resonator and have an accuracy for the loss tangent of approx. 10^{-5}.
[3)] The data at 24 GHz, 77 GHz and 110 are obtained with a Fabry Perot open resonator (FPOR) technique.
[4)] Preliminary Data. All data subject to chance.

Main Properties of SCHOTT Glass

For many of the challenges of innovations and new products, glass offers the right path to the solution. The properties of each glass are unique and can be customized individually if necessary. In more than 130 years of development SCHOTT AG has created a wide range of different specialty glasses and glass-ceramics for many different applications. A selection of the fundamental physical and chemical properties of our most commonly used thin glass types are mentioned below. Further information about a specific type can be received at www.schott.com.

Material	Glass type	CTE α (20 °C; 300 °C) in 10^{-6} K^{-1}	Transformation temperature T_g in °C	Density ρ in g/cm³	Young's modulus E in GPa	Refractive index (as drawn) n_D
D 263® T eco	Borosilicate	7.2	557	2.51	72.9	1.5230
AF 32® eco	Alumino-Borosilicate	3.2	717	2.43	74.8	1.5099
AS 87 eco	Aluminosilicate	8.7	621	2.46	73.3	1.5040
MEMpax®	Borosilicate	3.3	532	2.22	62.7	1.4714
B 270® Thin	Soda-lime	9.4	536	2.56	69.8	1.5230
B 270®	Soda-lime	9.4	542	2.56	71.0	1.5229
BOROFLOAT® 33	Borosilicate	3.25	525	2.23	64.0	1.4714

Material	Glass type	UV transmission at a thickness of 1 mm [5]			
		λ in nm = 308		λ in nm = 355	
		τ in %	τ_i in %	τ in %	τ_i in %
D 263® T eco	Borosilicate	0.2	0.2	87.4	96.1
AF 32® eco	Alumino-Borosilicate	64.2	70.4	88.3	96.6
AS 87 eco	Aluminosilicate	30.9	34.2	79.2	87.2
MEMpax®	Borosilicate	74.1	80.3	91.8	99.4
B 270® Thin	Soda-lime	58.9	64.8	90.2	99.1
B 270®	Soda-lime	–	–	–	–
BOROFLOAT® 33	Borosilicate	88.2	–	92.4	–

The **thermal conductivity** λ at ϑ = 90 °C is approx. 1 W/(m·K) for all glass types.

[5] Numbers for 1 mm thick glass are based on transmission measurements and calculations.

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