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Copper Clad Laminate (CCL) - Technical Data Sheet (ver. 2024.**09.30**)

[Thermal Properties]

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	Tg (Glass Transition Temperature)				Td (Decomposition Temperature)	T-288 (Time to Delamination)	CTE				Thermal Conductivity		Max. Operating Temperature	Z Expansion
Condition	DMA	DMA	TMA	DSC	TGA 5% Loss	TMA	X Axis a1	Y Axis a1	Z Axis a1	Z Axis a2	As received	As received	As received	As received
	As received	As received	As received	As received	As received	As received	As received	As received	As received	As received				
Test method	IPC-TM-650 2.4.24.4	IPC-TM-650 2.4.24.2	IPC-TM-650 2.4.24C	IPC-TM-650 2.4.25C	IPC-TM-650 2.3.40 (TGA)	IPC-TM-650 2.4.24.1	IPC-TM-650 2.4.41.2	IPC-TM-650 2.4.41.2	IPC-TM-650 2.4.24	IPC-TM-650 2.4.24	ASTM E 1461	ASTM D 5470	UL 796	IPC-TM-650 2.4.24.5
Unit	℃	℃	℃	℃	℃	min	ppm/℃	ppm/℃	ppm/℃	ppm/℃	W/m·K	W/m·K	℃	%
DS-7402		165	145		380	>10	15	14	38	230	0.4~0.5		130	2.8
DS-7402M		165	145		370	>5	15	14	39	235	0.4~0.5		130	2.9
DS-7402BS (DF)	185		150	169	360	>20	18~21	18~21	90~100	350~400	0.3~0.4		130	4.5~6.5
DS-7402BS (DFM)	185		150		360	120	23~26	23~26	100~110	350~400	0.3~0.4			
DS-7402LC		175	155		360	>15	11	10	19	150	0.6		130	1.5
DS-8402HL	190		165		380	>60	15	14	35	230	0.4~0.5		130	2.6~2.8
DS-8402H BS (DFL)	200		165		400	20	19~23	19~23	70~100	350~400	0.3			
DS-8502LC		280	230		430	>120	10	9	20	120	0.6		130	1.3
DS-8502SQ	260		200		420	>120	9~10	9~10	20~25	<150	0.5			<1.3
DS-8502SQN	260		200		420	>120	9~10	9~10	20~25	<150	0.5			<1.3
DSR-1000	160~180				345~360	>60	11~14	11~14	90~140	280~380	0.35~0.45			
DSF-900LC		280			360	>60	25	25	25	65	0.5			<1.2
DSF-900SQ		190			400	>120	25	25	25	65	0.5			1
DST-9000		130			380	30	30	30	30	105	1.3		160	
DST-9000S		130			380	30	25	25	25	55	2.5		160	
DST-9000HT		180			410	120	25	25	25	55	3		155	
DSflex-600		320			>500		22~25	22~25			0.2		130	
DSflex-600P		350			>500		18~22	18~22			0.2		130	
DSflex-600U		330			>500		18~22	18~22			0.2		200	
DSflex-600D		330			>500		22~25	22~25			0.2		130	
DSflex-600UY		260			>480		25~28	25~28			0.2		130	
DSflex-600UF (DS)		280			>500		18~22	18~22			0.2		130	
DSflex-600UK (SS)		280			>500		18~22	18~22			0.2		130	
DSflex-900		340			>500		22~25	22~25			0.2		130	

	Tg (Glass Transition Temperature)				Td (Decomposition Temperature)	T-288 (Time to Delamination)	CTE				Thermal Conductivity		Max. Operating Temperature	Z Expansion
Condition	DMA	DMA	TMA	DSC	TGA 5% Loss	TMA	X Axis a1	Y Axis a1	Z Axis a1	Z Axis a2	As received	As received	As received	As received
	As received	As received	As received	As received	As received	As received	As received	As received	As received	As received				
Test method	IPC-TM-650 2.4.24.4	IPC-TM-650 2.4.24.2	IPC-TM-650 2.4.24C	IPC-TM-650 2.4.25C	IPC-TM-650 2.3.40 (TGA)	IPC-TM-650 2.4.24.1	IPC-TM-650 2.4.41.2	IPC-TM-650 2.4.41.2	IPC-TM-650 2.4.24	IPC-TM-650 2.4.24	ASTM E 1461	ASTM D 5470	UL 796	IPC-TM-650 2.4.24.5
Unit	°C	°C	°C	°C	°C	min	ppm/°C	ppm/°C	ppm/°C	ppm/°C	W/m·K	W/m·K	°C	%
DS-7409DQN2	220		170		380	>120	9	9	25	150	0.4	0.7		
DS-7409DQN	220		170		380	>120	9	9	25	150	0.4	0.7		
DS-7409DJL2+	220		170		380	>120	10	10	25	230	0.4	0.7		2.3
DS-7409DJN2+	220		170		380	>120	10	10	25	230	0.4	0.7		2.3
DS-7409DJN+	220		170		380	>120	10	10	25		0.4	0.7		<1.4
DS-9530					500	>120	23	22	30		0.5		180	
DS-7409DJG (N)	220		170		400	>120	12	12	35	200	0.4	0.7		1.8
DS-7409DJG (S)	220		170		400	>120	12	12	35	200	0.4	0.7		1.8
DS-7409DJG	220		170		400	>120	12	12	35	200	0.4	0.7		1.8
DS-7409DV (N)	225		180	190	400	>120	14	14	40	220	0.4	0.7		<2.2
DS-7409DV (NT)	225		180	190	400	>120	14	14	40	220	0.4	0.7		<2.2
DS-7409DV (T)	225		180	190	400	>120	14	14	40	220	0.4	0.7		<2.2
DS-7409DV (C)	225		180	190	400	>120	14	14	40	220	0.4	0.7		<2.2
DS-7409DXG	280		230		430	>120	10	10	20	120	0.6	0.8		<1.3
RAPIDON-10W (N)	210		170		400	>120	13	13	25	100	1	1.2		1.8
RAPIDON-10W	210		170		400	>120	13	13	25	100	1	1.2		1.8
DS-7409DX (C)	220		175	185	365	60	16	16	35	260	0.4			
DS-7409S (N)	190		165	170	350	120	16	15	50	280				
DS-7402H	200		170	180	380	>30	15	14	40	220		0.6		2.6
DS-7402HD	210		180		380	>120	14	14	30	120	0.6			
DS-7409HG (FQ)	200		170		380	>120	3	3	12	50	0.7			
DS-7409HG (FU)	180				380	>120	2	2	12	50	0.7			
DS-7409HG (ZL)	300		270		380	>120	2	2	8	40	0.9			
DS-7409HG (X)	260		230		380	>120	5	5	12	50	0.8			
DS-7409HG (LE)	240		210		380	>120	8	8	20	80	0.7			
DS-7409HG (I)	270		240		380	>120	3	3	9	40	0.9			
DS-7409HG (Z)	270		240		380	>120	3	3	9	40	0.9			
DS-7409HG (ZU)	280				380	>120	2	2	8	40	0.9			
DS-7409HG (KN)	250		220		380	>120	10	10	20	90	0.7			
DS-7409HG (ZS)	280		250		380	>120	2	2	8	40	0.9			
DS-7409HG (IQ)	260		230		380	>120	7	10	15	60	0.8			

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[Mechanical Properties]

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	Young's Modulus	Flexural Strength	Storage Modulus	Tensile Strength		Peel Strength			Elongation	Dimensional Stability		Density	Poisson Ratio
Condition	As Received	As Received	DMA	As Received	-	As Received /STD Toz	As Received /VLP Toz	ED/RA, >12um(>Toz)	As Received	After Etching (B-A)	After Heating (C-A)	-	-
Test method	IPC-TM-650 2.4.18.3	IPC-TM-650 2.4.4B	IPC-TM-650 2.4.24.4	IPC-TM-650 2.4.18.3	IPC-TM-650 2.4.19C	IPC-TM-650 2.4.8C	IPC-TM-650 2.4.8C	IPC-TM-650 2.4.9.1	IPC-TM-650 2.4.19C	IPC-TM-650 2.2.4C	IPC-TM-650 2.2.4C	-	-
Unit	GPa	MPa	GPa	MPa	MPa	Kgf/cm	Kgf/cm	-	%	%	%	g/cm^3	-
DS-7402	24~25					1.15 (Hoz)						1.9	0.15~0.17
DS-7402M	24~25					1.25 (Hoz)						1.87	0.15~0.17
DS-7402BS (DF)	15~18	350~400	12~14		200~230	1			3~5			1.55~1.65	0.15~0.17
DS-7402BS (DFM)	11~14	400~450			220~240	1.2			3~5			1.55~1.65	
DS-7402LC	32~33					1.05 (Hoz)						2.03	0.15~0.17
DS-8402HL	22~24					1 (Hoz)						1.87	0.15~0.17
DS-8402H BS (DFL)	13~16	320~370			180~220		0.7		1.0~3.0			1.4~1.6	
DS-8502LC	29~30					0.95 (Hoz)						1.96	0.19~0.21
DS-8502SQ	28~32	500~550				1 (1oz)							
DS-8502SQN	28~32	500~550				1 (1oz)	0.7						
DSR-1000	10~14		10~14				0.7~0.8						
DSF-900LC	10						0.7					1.7~1.8	0.3
DSF-900SQ	10		10				0.7					1.65~1.75	0.28
DST-9000						2.2 (1oz)							
DST-9000S						1.5							
DST-9000HT						1.5 (1oz)							
DSflex-600	6.9			220				>1	35	<±0.1	<±0.1	1.42	0.34
DSflex-600P	4.6			180				>1.2	100	<±0.1	<±0.1	1.42	0.34
DSflex-600U	6.2			390				>1.2	65	<±0.1	<±0.1	1.42	0.34
DSflex-600D	4.2			290				>1.2	70	<±0.1	<±0.1	1.42	0.34
DSflex-600UY	7.7			185				>1	20	<±0.1	<±0.1	1.42	0.34
DSflex-600UF (DS)	7.5			280				>1.2	80	<±0.1	<±0.1	1.42	0.34
DSflex-600UK (SS)	7.5			280				>1.2	80	<±0.1	<±0.1	1.42	0.34
DSflex-900	5.4			300				>1	50	<±0.1	<±0.1	1.42	0.34

	Young's Modulus	Flexural Strength	Storage Modulus	Tensile Strength		Peel Strength			Elongation	Dimensional Stability		Density	Poisson Ratio
Condition	As Received	As Received	DMA	As Received	-	As Received /STD Toz	As Received /VLP Toz	ED/RA, >12um(>Toz)	As Received	After Etching (B-A)	After Heating (C-A)	-	-
Test method	IPC-TM-650 2.4.18.3	IPC-TM-650 2.4.4B	IPC-TM-650 2.4.24.4	IPC-TM-650 2.4.18.3	IPC-TM-650 2.4.19C	IPC-TM-650 2.4.8C	IPC-TM-650 2.4.8C	IPC-TM-650 2.4.9.1	IPC-TM-650 2.4.19C	IPC-TM-650 2.2.4C	IPC-TM-650 2.2.4C	-	-
Unit	GPa	MPa	GPa	MPa	MPa	Kgf/cm	Kgf/cm	-	%	%	%	g/cm^3	-
DS-7409DQN2						0.8 (HVLP 1oz)							
DS-7409DQN						0.8 (HVLP 1oz)							
DS-7409DJL2+						1							
DS-7409DJN2+						1							
DS-7409DJN+						1	0.8						
DS-9530	0.8			4.5		1			80	-0.05	-0.09	2.1	
DS-7409DJG (N)						1	0.8						
DS-7409DJG (S)	21~23					1	0.8						0.16~0.18
DS-7409DJG	21~23					1	0.8						0.16~0.18
DS-7409DV (N)	22~24	450~470				1.2	1						
DS-7409DV (NT)	22~24	450~470				1.2	1						
DS-7409DV (T)	22~24	450~470				1.2	1						
DS-7409DV (C)	22~24	450~470				1.2	1						
DS-7409DXG	24~27					1						1.71	0.17~0.19
RAPIDON-10W (N)	15		15				0.75 (HVLP Toz)						0.17
RAPIDON-10W	15		15				0.75 (HVLP Toz)						0.17
DS-7409DX (C)						1.2	1						
DS-7409S (N)	26					1.7							
DS-7402H						1.6							
DS-7402HD	24		26				0.75					1.7	0.2
DS-7409HG (FQ)	26		28				0.7					2	0.16
DS-7409HG (FU)	26		28				0.8					2	0.16
DS-7409HG (ZL)	33		35				0.75					2.1	0.19
DS-7409HG (X)	29		31				0.75					2	0.195
DS-7409HG (LE)	27		29				0.75					2.1	0.2
DS-7409HG (I)	31		33				0.7					2.1	0.194
DS-7409HG (Z)	31		33				0.7					2.1	0.194
DS-7409HG (ZU)	34		36				0.8					2.1	0.194
DS-7409HG (KN)	26		28				0.7					1.9	0.185
DS-7409HG (ZS)	32		34				0.8					2.09	0.194
DS-7409HG (IQ)	27		28				0.7					2.07	0.185

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[Electrical Properties]

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	Dk (Dielectric Constant)				Df (Dissipation Factor)				Surface Resistace	Volume Resistance	Comparative Tracking Index	Dielectric Breakdown
Condition	1GHz		10GHz		1GHz		10GHz		As Received	As Received	As Received	AC
Test method	2.5.5.9	SPDR	2.5.5.5	SPDR	2.5.5.9	SPDR	2.5.5.5	SPDR	2.5.17.1A	2.5.17.1A	IEC 60112	2.5.6.2A
Unit	-	-	-	-	-	-	-	-	MΩ	MΩ/cm	-	kV/mm
DS-7402	4.33		4.21		0.013		0.014		>1.00E+8	>1.00E+9	4	>30
DS-7402M	4.25		4.12		0.013		0.014		>1.00E+8	>1.00E+9	4	>30
DS-7402BS (DF)	3.8		3.7		0.016		0.017		>1.00E+6~1.00E+7	>1.00E+7~1.00E+8	4	>30
DS-7402BS (DFM)	4				0.013				>1.00E+6~1.00E+7	>1.00E+7~1.00E+8		
DS-7402LC	4.23		4.1		0.007		0.008		>1.00E+08	>1.00E+9	4	>30
DS-8402HL	3.4 (RC 70%)		3.6 (RC 70%)		0.008 (RC 70%)		0.012 (RC 70%)		5.00E+7~5.00E+8	1.00E+7~1.00E+8	4	>30
DS-8402H BS (DFL)	3.3		3.2		0.003		0.0039		1.00E+06	5.00E+06		>0.8
DS-8502LC	3.4 (RC 70%)		3.5 (RC 70%)		0.005 (RC 70%)		0.007 (RC 70%)		>1.00E+8	>1.00E+9	4	>30
DS-8502SQ	3.4 (RC 70%)		3.3 (RC 70%)		0.0015 (RC 70%)		0.003 (RC 70%)		1.00E+09	1.00E+10		
DS-8502SQN	3.2 (RC 70%)		3.1 (RC 70%)		0.001 (RC 70%)		0.0025 (RC 70%)		1.00E+09	1.00E+10		
DSR-1000	3.7		3.6		0.008		0.009		1.00E+06	5.00E+06		>0.8
DSF-900LC	3.1		3.1		0.004		0.006		>1.00E+6~1.00E+7	>1.00E+7~1.00E+8		>30
DSF-900SQ	3		3		0.0022		0.0025		>1.00E+6~1.00E+7	>1.00E+7~1.00E+8		>30
DST-9000	5.6				0.017				>1.00E+6	>1.00E+8	0	12
DST-9000S	6.5				0.01				>1.00E+6	>1.00E+8	600	50
DST-9000HT	6				0.015				>1.00E+6	>1.00E+8	0	6
DSflex-600		3.5		3.4		0.006		0.008	>1.00E+13	>1.00E+14	3	>5
DSflex-600P		3.3		3.2		0.006		0.008	>1.00E+13	>1.00E+14	3	>5
DSflex-600U		3.5		3.4		0.005		0.007	>1.00E+13	>1.00E+14	3	>5
DSflex-600D		3.4		3.3		0.005		0.007	>1.00E+13	>1.00E+14	3	>5
DSflex-600UY		3.5		3.4		0.002		0.0025	>1.00E+13	>1.00E+14	3	>5
DSflex-600UF (DS)		3.5		3.4		0.002		0.0025	>1.00E+13	>1.00E+14	4	>5
DSflex-600UK (SS)		3.5		3.4		0.002		0.0025	>1.00E+13	>1.00E+14	4	>5
DSflex-900		3.3		3.2		0.005		0.007	>1.00E+13	>1.00E+14	3	>5

	Dk (Dielectric Constant)				Df (Dissipation Factor)				Surface Resistace	Volume Resistance	Comparative Tracking Index	Dielectric Breakdown
Condition	1GHz		10GHz		1GHz		10GHz		As Received	As Received	As Received	AC
Test method	2.5.5.9	SPDR	2.5.5.5	SPDR	2.5.5.9	SPDR	2.5.5.5	SPDR	2.5.17.1A	2.5.17.1A	IEC 60112	2.5.6.2A
Unit	-	-	-	-	-	-	-	-	MΩ	MΩ/cm	-	kV/mm
DS-7409DQN2	2.79		2.69	2.7	0.0004		0.0011	0.0015	>1.00E+9	>1.00E+10		
DS-7409DQN	2.99		2.89	2.9	0.0006		0.0014	0.0017	>1.00E+9	>1.00E+10		
DS-7409DJL2+	2.79		2.7	2.7	0.0004		0.0011	0.0015				
DS-7409DJN2+	2.79		2.7	2.7	0.0004		0.0011	0.0015				
DS-7409DJN+	2.99		2.9	2.9	0.0006		0.0014	0.0017				
DS-9530	3		3	3	0.0013		0.001	0.001	1.00E+14	1.00E+15		
DS-7409DJG (N)	3.04		2.95	3.1	0.0009		0.0023	0.002	>1.00E+9	>1.00E+10		
DS-7409DJG (S)	3.2		3.11	3.3	0.0014		0.0028	0.0037	>1.00E+9	>1.00E+10		
DS-7409DJG	3.2		3.11	3.3	0.0014		0.0028	0.0037	>1.00E+9	>1.00E+10		
DS-7409DV (N)	3.09		3	3.1	0.001		0.0025	0.0037	>1.00E+9	>1.00E+10		
DS-7409DV (NT)	3.09		3	3.1	0.001		0.0025	0.0037	>1.00E+9	>1.00E+10		
DS-7409DV (T)	3.25		3.16	3.3	0.0015		0.003	0.0045	>1.00E+9	>1.00E+10		
DS-7409DV (C)	3.65		3.56	3.5	0.0015		0.003	0.0045	>1.00E+9	>1.00E+10		
DS-7409DXG	3.81		3.4	3.4	0.004		0.006	0.007				
RAPIDON-10W (N)	4.1		3.7	3.9	0.0012		0.0025	0.0025				
RAPIDON-10W	4.3		3.9	4.1	0.0015		0.003	0.003				
DS-7409DX (C)	3.8				0.004				1.00E+09	1.00E+09		
DS-7409S (N)	4.3				0.016				1.00E+09	1.00E+10		
DS-7402H	4		3.9	3.9	0.015		0.014	0.015	1.00E+09	1.00E+10		
DS-7402HD	3.5		3.4		0.007		0.008		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (FQ)	4		3.9		0.011		0.012		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (FU)	4.1		4		0.01		0.011		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (ZL)	4.1		4		0.009		0.01		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (X)	4.2		4.1		0.008		0.009		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (LE)	4.2		4.1		0.007		0.008		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (I)	4.1		4		0.009		0.01		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (Z)	4.1		4		0.009		0.01		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (ZU)	4.1		4		0.01		0.011		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (KN)	3.5		3.4		0.003		0.004		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (ZS)	4.2		4.1		0.01		0.011		5.00E+7~5.00E+8	1.00E+7~1.00E+8		
DS-7409HG (IQ)	4.3		4.5		0.009		0.01		5.00E+7~5.00E+8	1.00E+7~1.00E+8		

DOOSAN

Doosan Corporation
Electro-Materials

Copper Clad Laminate (CCL) - Technical Data Sheet (ver. 2024.09.30)

[Others]

https://www.doosanelectronics.com/en/

	Water Absorption		Flammability
Condition	D-24h/23°C	D-2h/100°C	-
Test method	IPC-TM 2.6.2.1A	-	UL94
Unit	%	%	-
DS-7402	0.11		V-0
DS-7402M	0.13		V-0
DS-7402BS (DF)	0.2~0.4		V-0
DS-7402BS (DFM)	0.2~0.4		V-0
DS-7402LC	0.1		V-0
DS-8402HL	0.08		V-0
DS-8402H BS (DFL)	0.1~0.3		V-0
DS-8502LC	0.15		V-0
DS-8502SQ	0.15		V-0
DS-8502SQN	0.15		V-0
DSR-1000	0.4~0.6		V-0
DSF-900LC	0.5		V-0
DSF-900SQ	0.25		V-0
DST-9000	0.5		V-0
DST-9000S	0.25		V-0
DST-9000HT	0.1		V-0
DSflex-600	1.1		VTM-0
DSflex-600P	1.1		VTM-0
DSflex-600U	1.1		VTM-0 (12,20um)
DSflex-600D	1.1		VTM-0
DSflex-600UY	0.8		VTM-0
DSflex-600UF (DS)	0.7		VTM-0 (12,25um)
DSflex-600UK (SS)	0.7		VTM-0 (12,25um)
DSflex-900	1.1		VTM-0

	Water Absorption		Flammability
Condition	D-24h/23°C	D-2h/100°C	-
Test method	IPC-TM 2.6.2.1A	-	UL94
Unit	%	%	-
DS-7409DQN2	0.08		V-0
DS-7409DQN	0.08		V-0
DS-7409DJL2+	0.06		V-0
DS-7409DJN2+	0.06		V-0
DS-7409DJN+	0.06		V-0
DS-9530	0.05	0.05	V-0
DS-7409DJG (N)	0.08		V-0
DS-7409DJG (S)	0.08		V-0
DS-7409DJG	0.08		V-0
DS-7409DV (N)	0.12		V-0
DS-7409DV (NT)	0.12		V-0
DS-7409DV (T)	0.12		V-0
DS-7409DV (C)	0.12		V-0
DS-7409DXG	0.15		V-0
RAPIDON-10W (N)	0.12		V-0
RAPIDON-10W	0.12		V-0
DS-7409DX (C)	0.13		V-0
DS-7409S (N)	0.15		V-0
DS-7402H	0.13		V-0
DS-7402HD	0.3	0.35	V-0
DS-7409HG (FQ)	0.3	0.35	V-0
DS-7409HG (FU)	0.25		V-0
DS-7409HG (ZL)	0.3	0.35	V-0
DS-7409HG (X)	0.3	0.35	V-0
DS-7409HG (LE)	0.3	0.35	V-0
DS-7409HG (I)	0.3	0.35	V-0
DS-7409HG (Z)	0.3	0.35	V-0
DS-7409HG (ZU)	0.25		V-0
DS-7409HG (KN)	0.2	0.3	V-0
DS-7409HG (ZS)	0.3	0.35	V-0
DS-7409HG (IQ)	0.3	0.35	V-0