

Test Report for Liquid Compatibility

Application for :
Immersion Liquid Cooling System

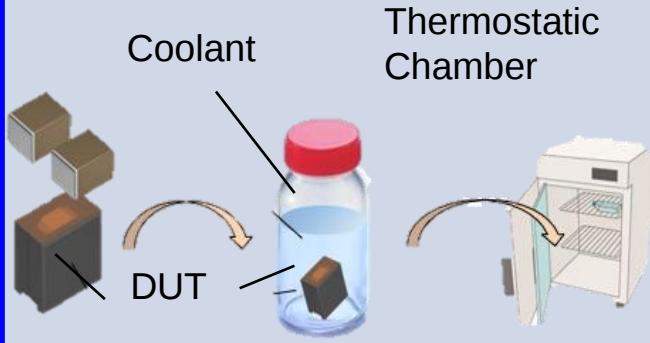
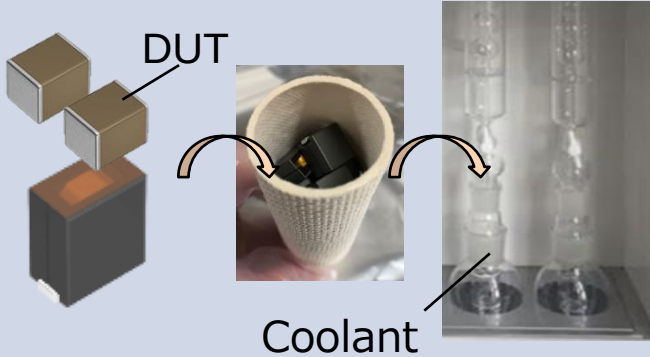
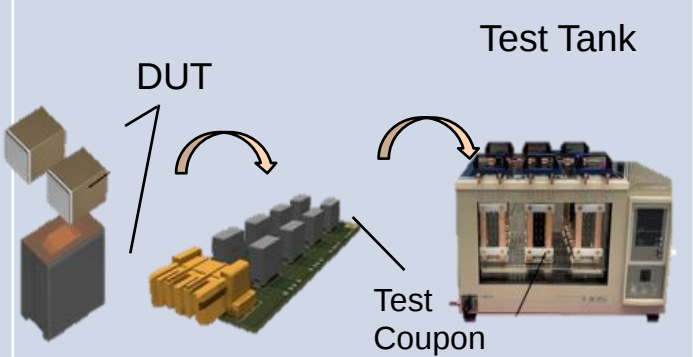
Item for :
Multilayer Ceramic Capacitor (MLCC)

TDK Corporation
Electronic Components Business Company



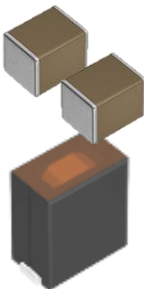
➤ **Test Setup of the Liquid Compatibility Testing**

Testing Method and Conditions for Coolant Compatibility

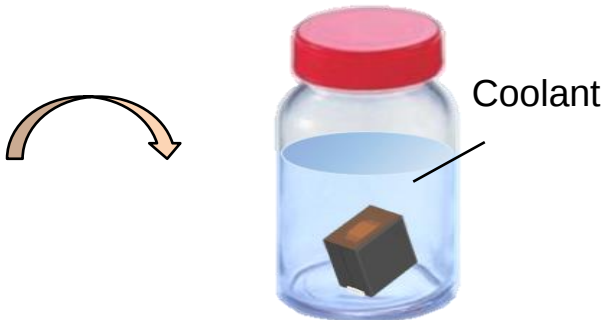
Test Method	Test-1 Non-Loaded Test (Performed for All Items)	Test-2 Soxhlet Extraction Test (Performed upon Request)	Test-3 Loaded Test (Performed upon Request)
Test Method Image			
Temperature	+25 degC and +80 degC	At Boiling Temp. of the coolant (96 Hrs * 4 Cycles)	+80 degC
Items Checked	• Appearance • Weight Deviations • Dimensions (L, W, T) • Electrical characteristics • Solder joint/adhesive strength • SEM-EDS analysis	- No Abnrmity on materials - SEM-EDS analysis - Weight Deviations - Electrical characteristics	• No Abnrmity on materials • Weight Deviations • Electrical characteristics • Solder joint/adhesive strength
Criteria	Compare Before / After Testing No Deviation	No Material Extracted in Coolant Compare Before / After Testing No Deviation	No Deviation No Abnrmity Observed during the Test

Test Setup

DUT (Numbered by Laser)



Bottle (vials)



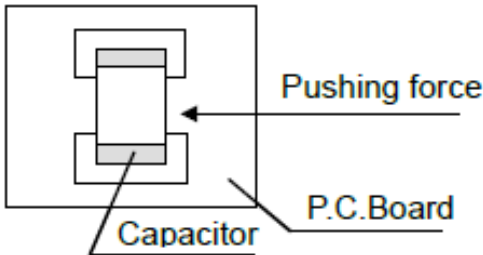
Put Bottles into Thermostatic Chamber



Test Conditions

Evaluation Item	Condition	Measurement / Method	Nr of Samples
Appearance	By piece	6side / Microscope	20
Dimensions	By piece	L, W, T / Micrometer	10
Electrical characteristics	By piece	Cap., DF, IR / LCR Meter	20
Robustness of Terminations	By piece	Terminal strength / Load testing machine	20

Inspection Method of Robustness of Terminations



➤ **Test Results of the Liquid Compatibility Testing**

Summary of Testing Results

Sample Information

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC
Applications	Commercial Grade
Case Size	L 2.00 [mm], W 1.25 [mm], T 1.25 [mm], B 0.20 Min. [mm], G 0.50 Min. [mm]
Capacitance	22 [μ F] $\pm$ 20 [%]
Rated Voltage	10 [VDC]
Temperature Characteristic	X6S (+/-22%) : -55 ~ 105 degC

Test Conditions

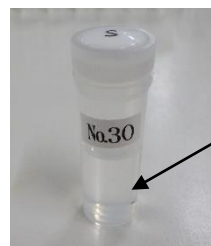
Test	Non-Loaded Coolant Liquid Compatibility
Temperature	80 [°C]
Time	Max 2,000 [hours]
Coolant Liquid	① Noah 3000A [PFAS] ② Synfluid PAO 6cSt [OIL]
Location	TDK Japan

①Noah 3000A・・・Noah
②Synfluid PAO 6cSt・・・Chevron Phillips Chemical

Evaluation Items

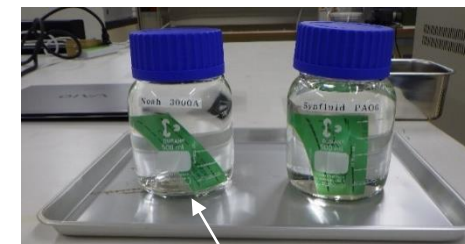
Evaluation Item		Number of Samples Tested	
		① Noah 3000A [PFAS]	② Synfluid PAO 6cSt [OIL]
1) Appearance	6side, Microscope	20	20
2) Dimensions	L, W, T	10	10
3) Electrical Characteristics	Cap., DF, IR	20	20
4) Robustness of Terminations	Terminal strength	20	20

Bulk



Put in
20 chips per bottle

Test Board



Put in
Max.20 test boards per bottle

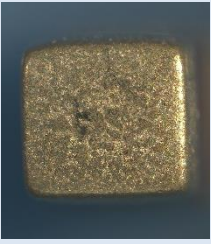
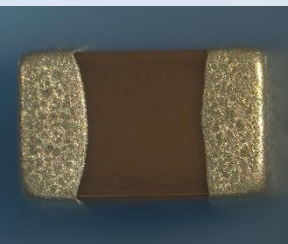
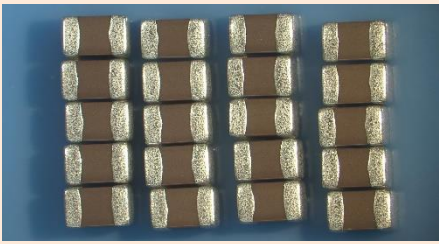
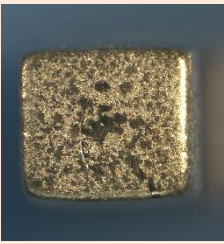
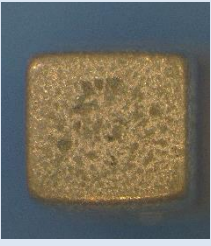
Test Result

Test has conducted successfully for all evaluation items.
There were no abnormality founded for two types of coolant liquids.

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

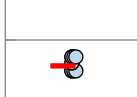
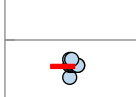
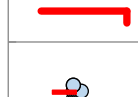
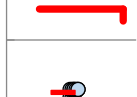
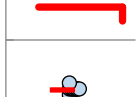
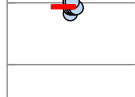
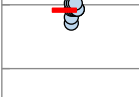
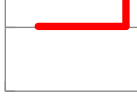
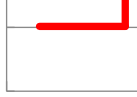
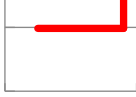
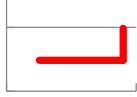
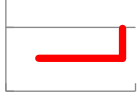
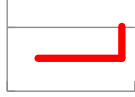
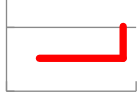
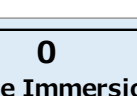
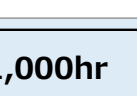
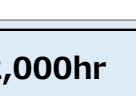
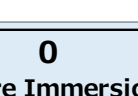
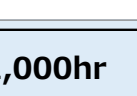
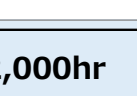
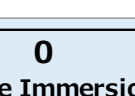
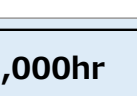
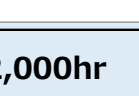
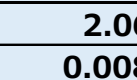
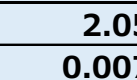
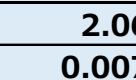
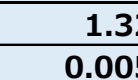
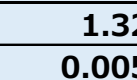
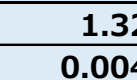
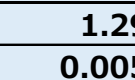
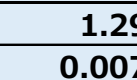
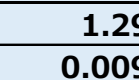
1. Appearance

	PFAS			OIL		
0 Before Immersion						
1,000hr						
2,000hr						

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

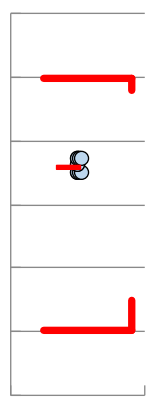
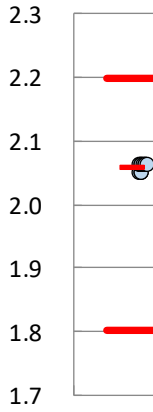
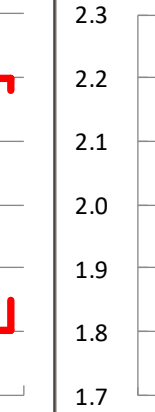
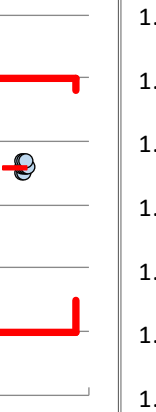
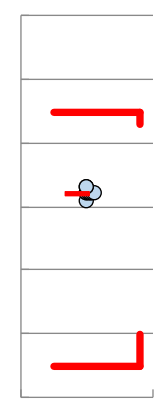
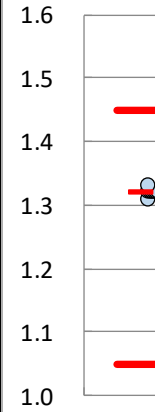
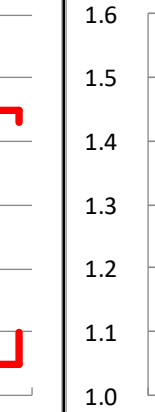
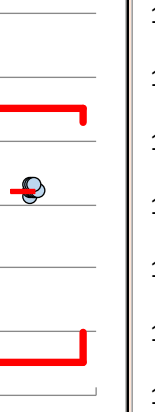
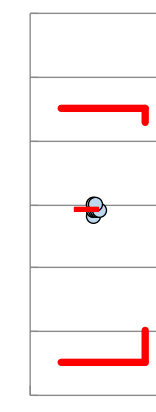
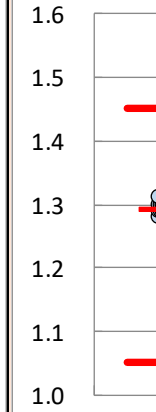
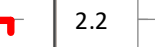
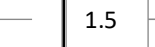
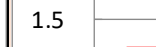
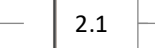
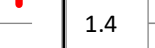
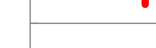
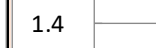
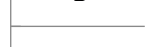
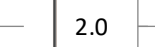
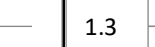
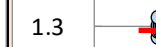
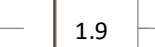
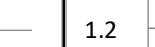
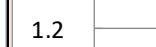
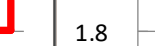
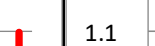
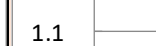
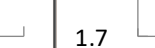
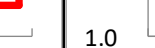
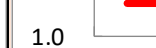
2. Dimensions

	PFAS																	
Dimensions	L [mm]						W [mm]						T [mm]					
Graph	2.3		2.3		2.3		1.6		1.6		1.6		1.6		1.6		1.6	
	2.2		2.2		2.2		1.5		1.5		1.5		1.5		1.5		1.5	
	2.1		2.1		2.1		1.4		1.4		1.4		1.4		1.4		1.4	
	2.0		2.0		2.0		1.3		1.3		1.3		1.3		1.3		1.3	
	1.9		1.9		1.9		1.2		1.2		1.2		1.2		1.2		1.2	
	1.8		1.8		1.8		1.1		1.1		1.1		1.1		1.1		1.1	
	1.7		1.7		1.7		1.0		1.0		1.0		1.0		1.0		1.0	
Time	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr
ave	2.06	2.05	2.06	1.32	1.32	1.32	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29	1.29
σ	0.008	0.007	0.007	0.005	0.005	0.004	0.005	0.007	0.009	0.005	0.007	0.009	0.005	0.007	0.009	0.005	0.007	0.009

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

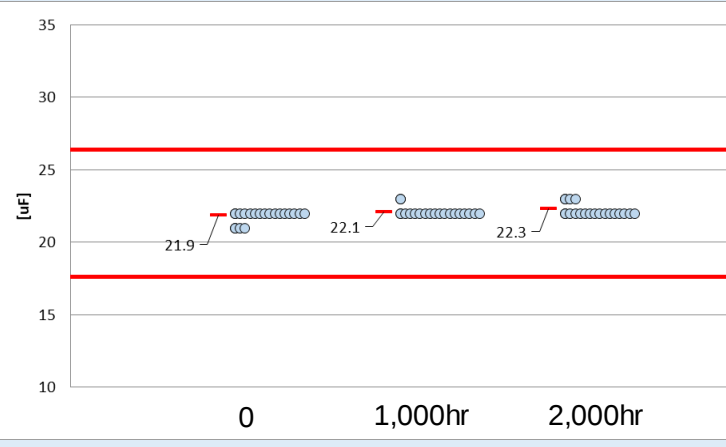
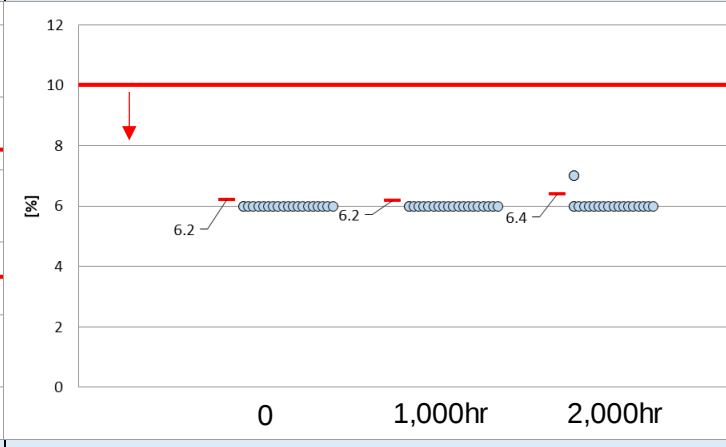
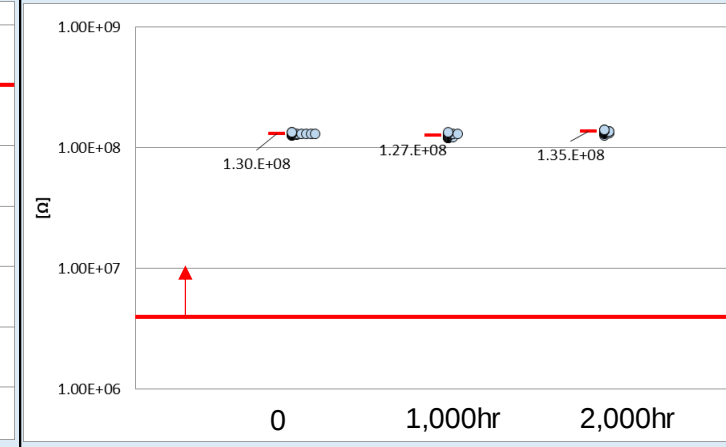
2. Dimensions

	OIL									
Dimensions	L [mm]			W [mm]			T [mm]			
Graph										
										
										
										
										
										
										
Time	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	
ave	2.06	2.06	2.06	1.32	1.32	1.32	1.29	1.29	1.29	
σ	0.008	0.006	0.006	0.005	0.004	0.005	0.005	0.007	0.007	

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

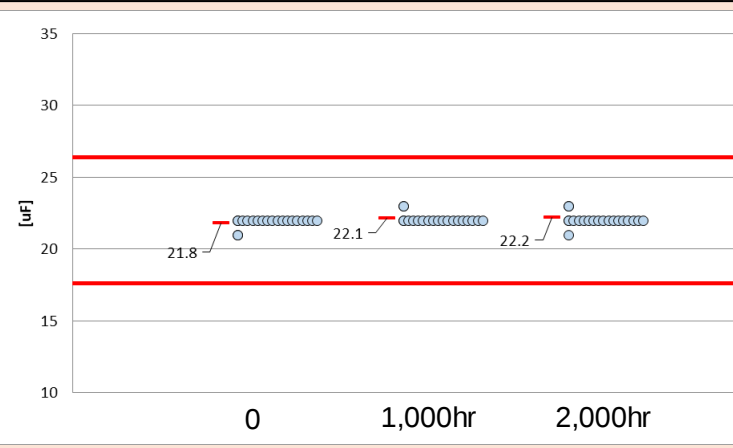
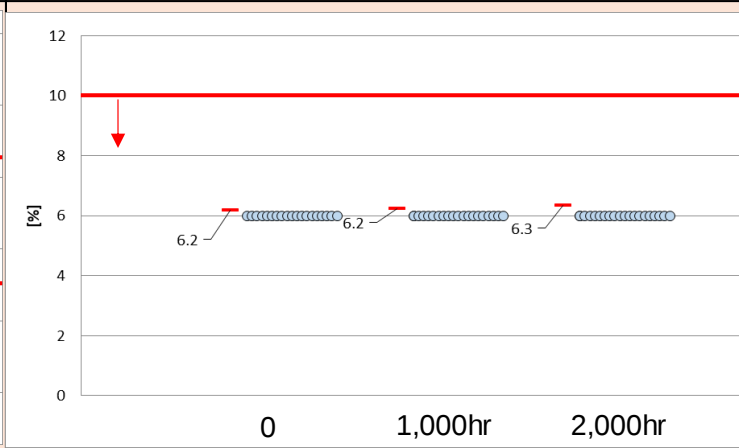
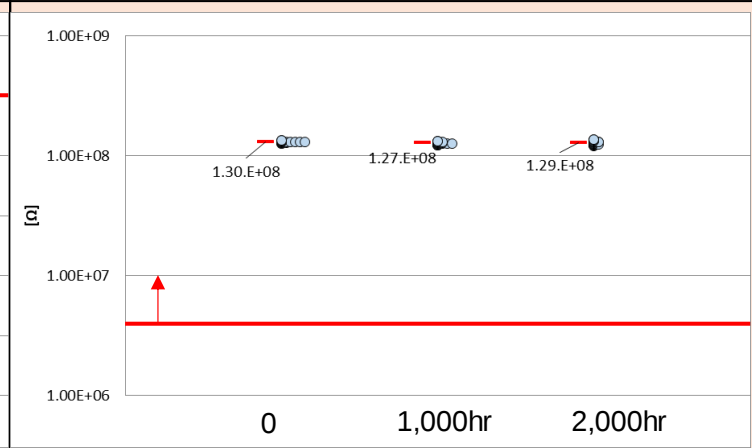
3. Electrical Characteristics

	PFAS											
Electrical Characteristics	Capacitance [μ F]			DF [%]			IR [Ω]					
Graph												
	Time	0 Before Immersion	1,000hr	2,000hr	Time	0 Before Immersion	1,000hr	2,000hr	Time	0 Before Immersion	1,000hr	2,000hr
	ave	21.9	22.1	22.3	ave	6.2	6.2	6.4	ave	1.30.E+08	1.27.E+08	1.35.E+08
	σ	0.37	0.24	0.28	σ	0.04	0.03	0.06	σ	1.98.E+06	4.31.E+06	3.36.E+06

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

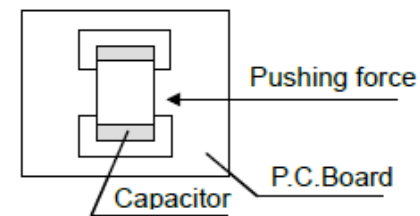
3. Electrical Characteristics

	OIL									
Electrical Characteristics	Capacitance [μF]			DF [%]			IR [Ω]			
Graph										
	01,000hr2,000hr			01,000hr2,000hr			01,000hr2,000hr			
	Time	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr	0 Before Immersion	1,000hr	2,000hr
	ave	21.8	22.1	22.2	6.2	6.2	6.3	1.30.E+08	1.27.E+08	1.29.E+08
σ	0.22	0.30	0.36	0.04	0.06	0.04	1.98.E+06	2.85.E+06	4.47.E+06	

Details of Testing Results

Item Category	MLCC
TDK P#	C2012X6S1A226M125AC

4. Robustness of Terminations



Inspection Method

