Dexerials

IMAPS 2021

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Solderless Anisotropic Conductive Film For Compact Package Designs, High-Frequency Signal Integrity, Robust Connections

Dexerials America Corporation

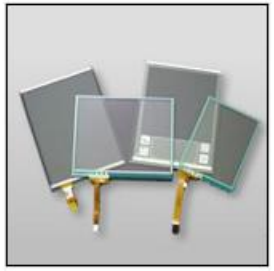
Agenda

- Introduction
  - ACF Applications
  - ACF Functions
- ACF Lamination Process
- Packaging Benefits
  - Downsizing
  - Low Process Temperature
  - Fine-pitch Interconnect
  - Signal Integrity
  - Unit Cost Savings
- Automotive Reliability
- Conclusion

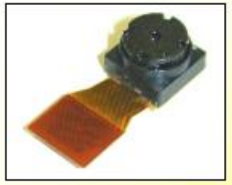
INTRODUCTION

ACF Applications Track Record

Touch Panel （FPC/Panel）



Camera Module
（FPC/PWB）

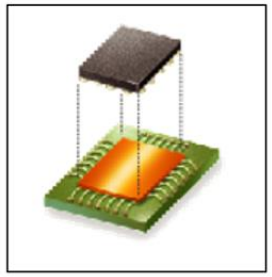


Mobile Phone
（FPC/PWB）

Camera / DSC（FPC/Device）

Printer Head（FPC/Ceramic）

Chip Size Packaging（PWB / IC）



IC Card / IC Tag

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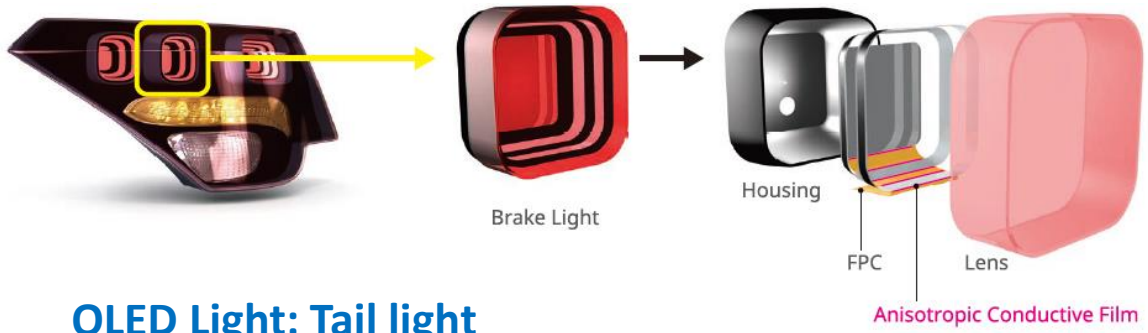
001101

ACF Applications for Automotive

Flat-panel displays, various types of sensors, sensor boards, organic EL lighting devices, etc.

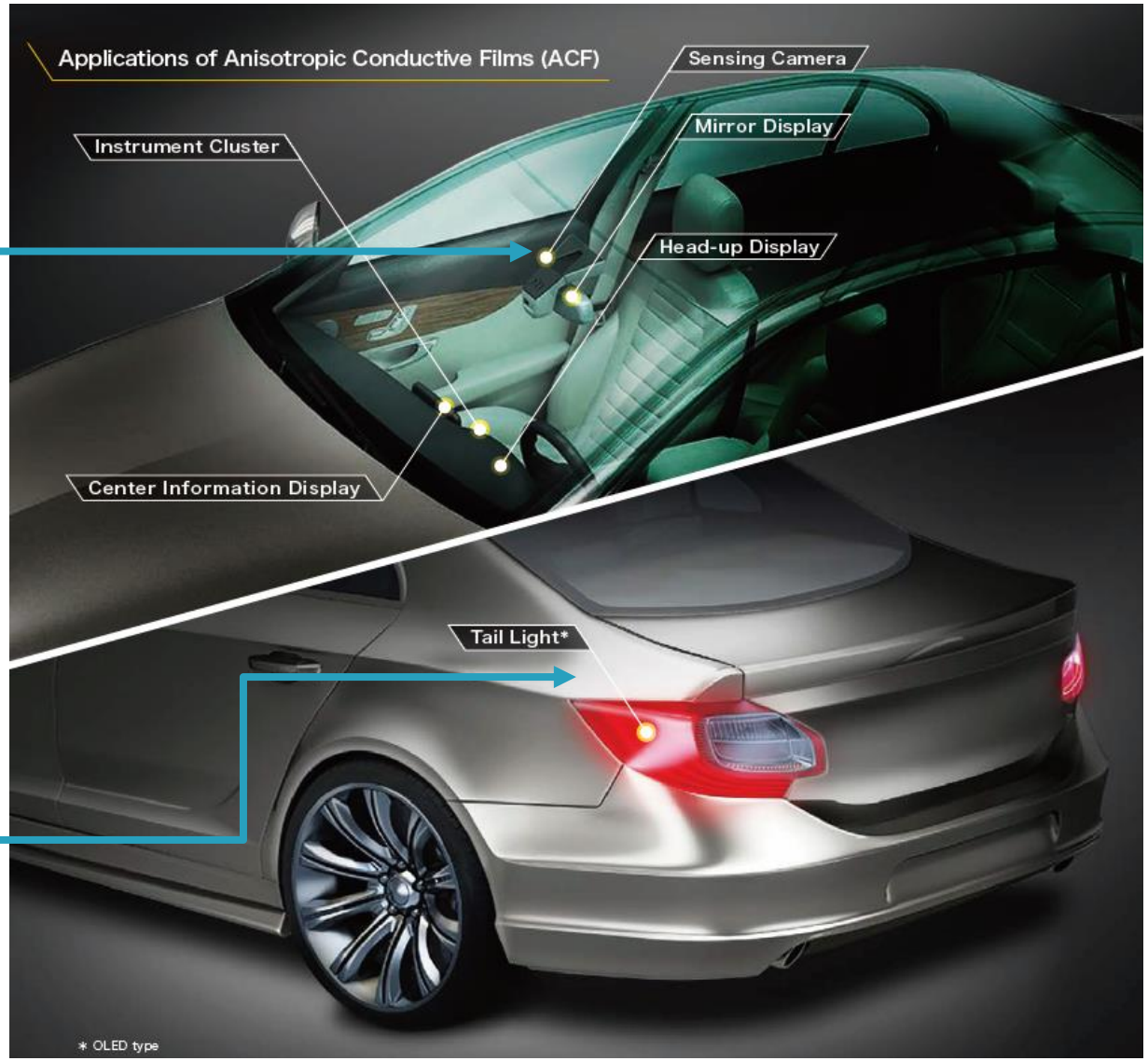
ADAS & Display: camera, mirror display

Connection: FPC + PWB



OLED Light: Tail light

Connection: FPC + Glass



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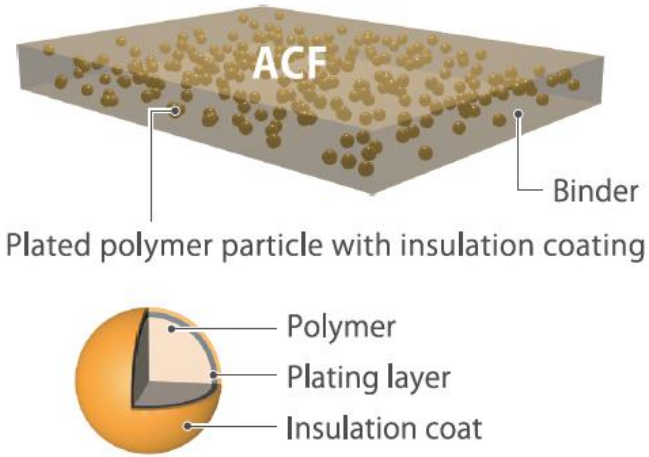
Anisotropic Conductive Film (ACF)

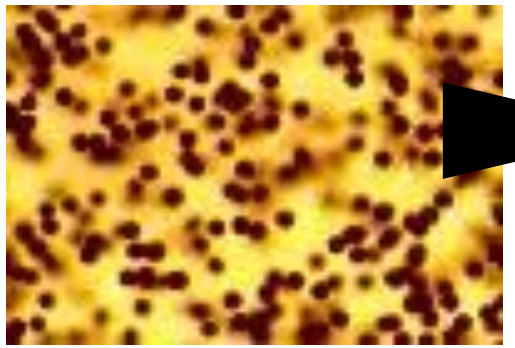
ACF is a combination of thermosetting adhesive and conductive particles.

Structure

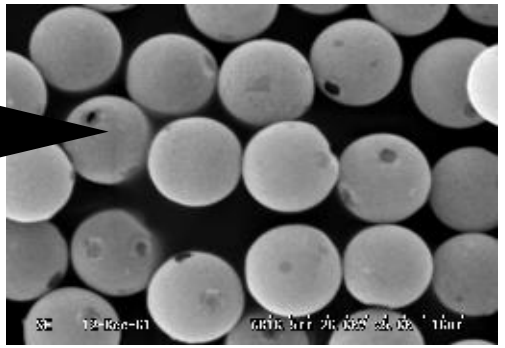


ACF is supplied in a reel form with a homogeneous density of conductive particles and even thickness distribution.

Microscope image



SEM image of conductive particles



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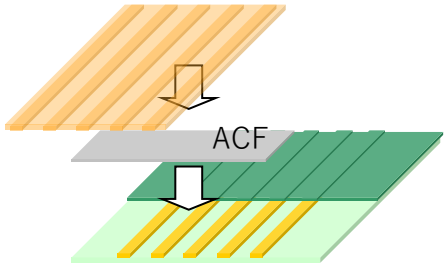
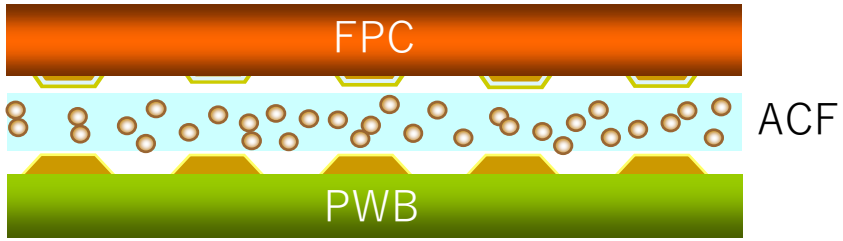
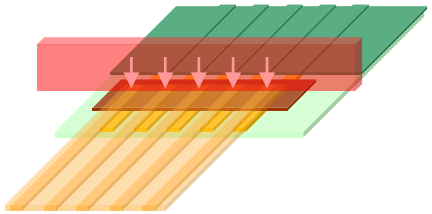
ACF Functions

ACF provides 3 main functions ”Conductive Interconnect, Insulation, and adhesion” with 1 lamination process.

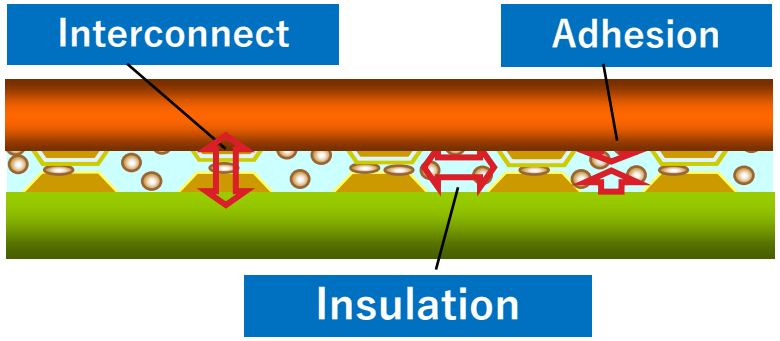




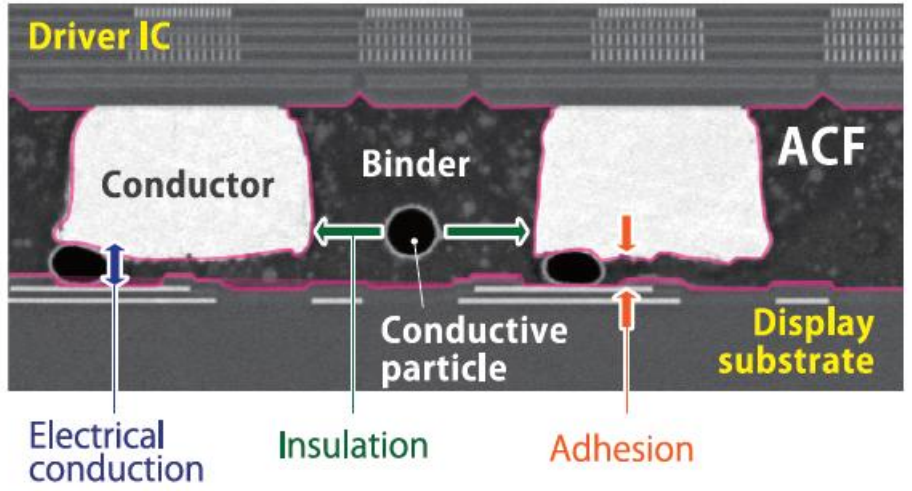
Heat-Head & Tooling



Thermal Compression



〈Cross-sectional image of the interconnection〉



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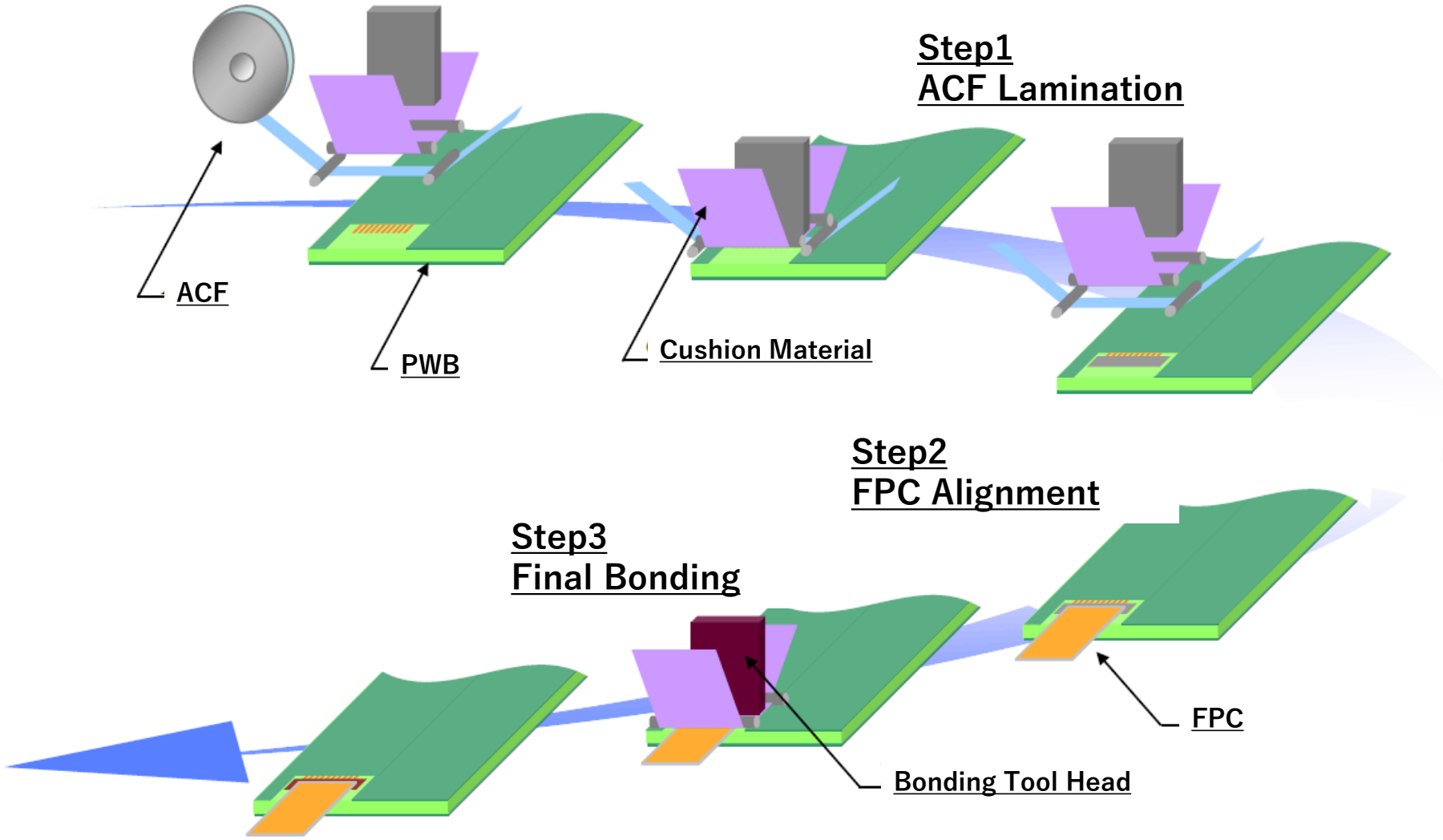
ACF LAMINATION PROCESS

Lamination Process

ACF Bonding Process Flow: 3 Steps

1. ACF Lamination
2. FPC Alignment
3. Final Bonding



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Automated ACF Lamination Video

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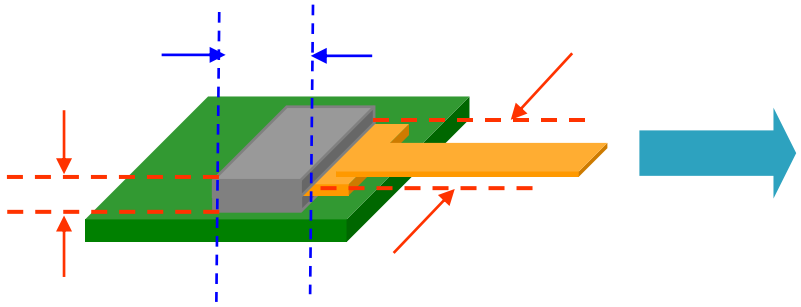
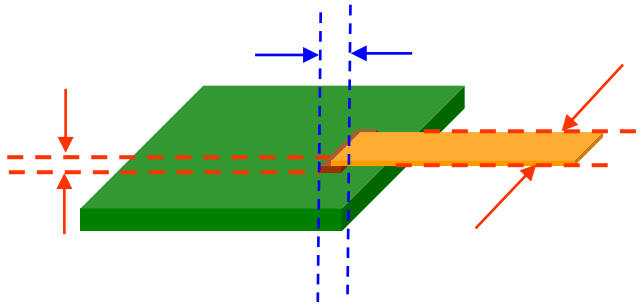
PACKAGING BENEFITS

Connector Down-Sizing

Mechanical Connector



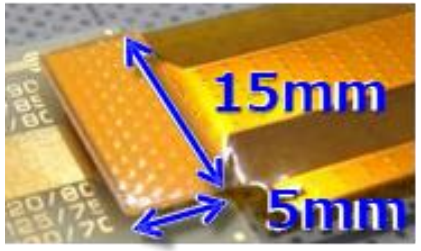
ACF

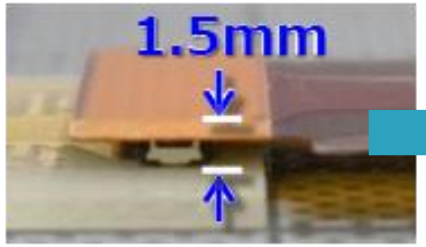


Size Comparison

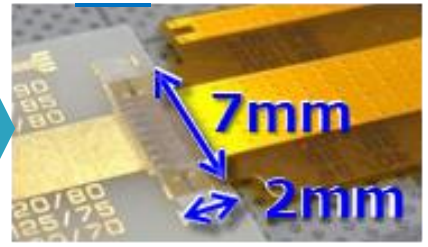
*ACF Interconnect requires minimal height & uses less space compared to Mechanical Connector.

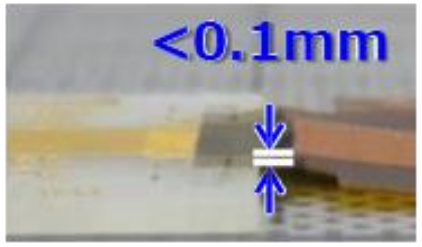
BtoB





ACF





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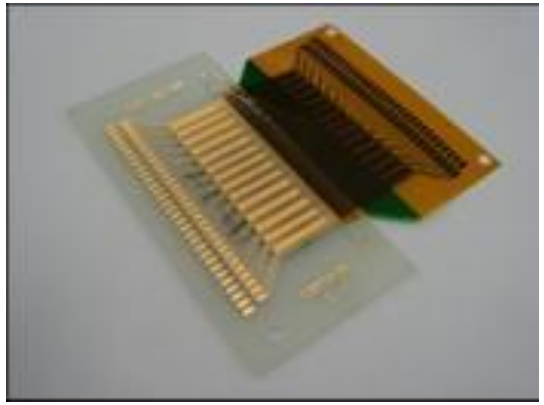
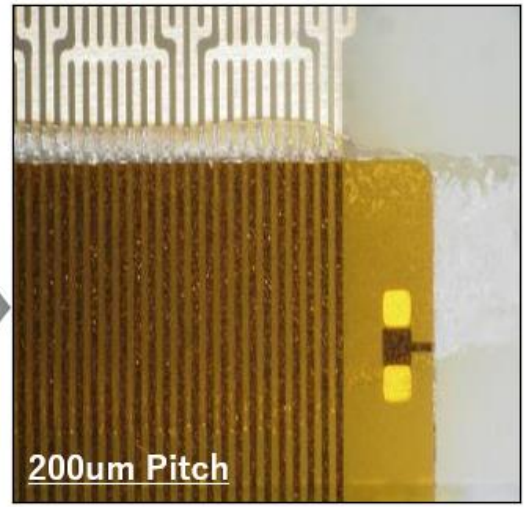
Fine Pitch Interconnect



ACF Interconnect



ACF interconnect allows Fine Pitch Solution.

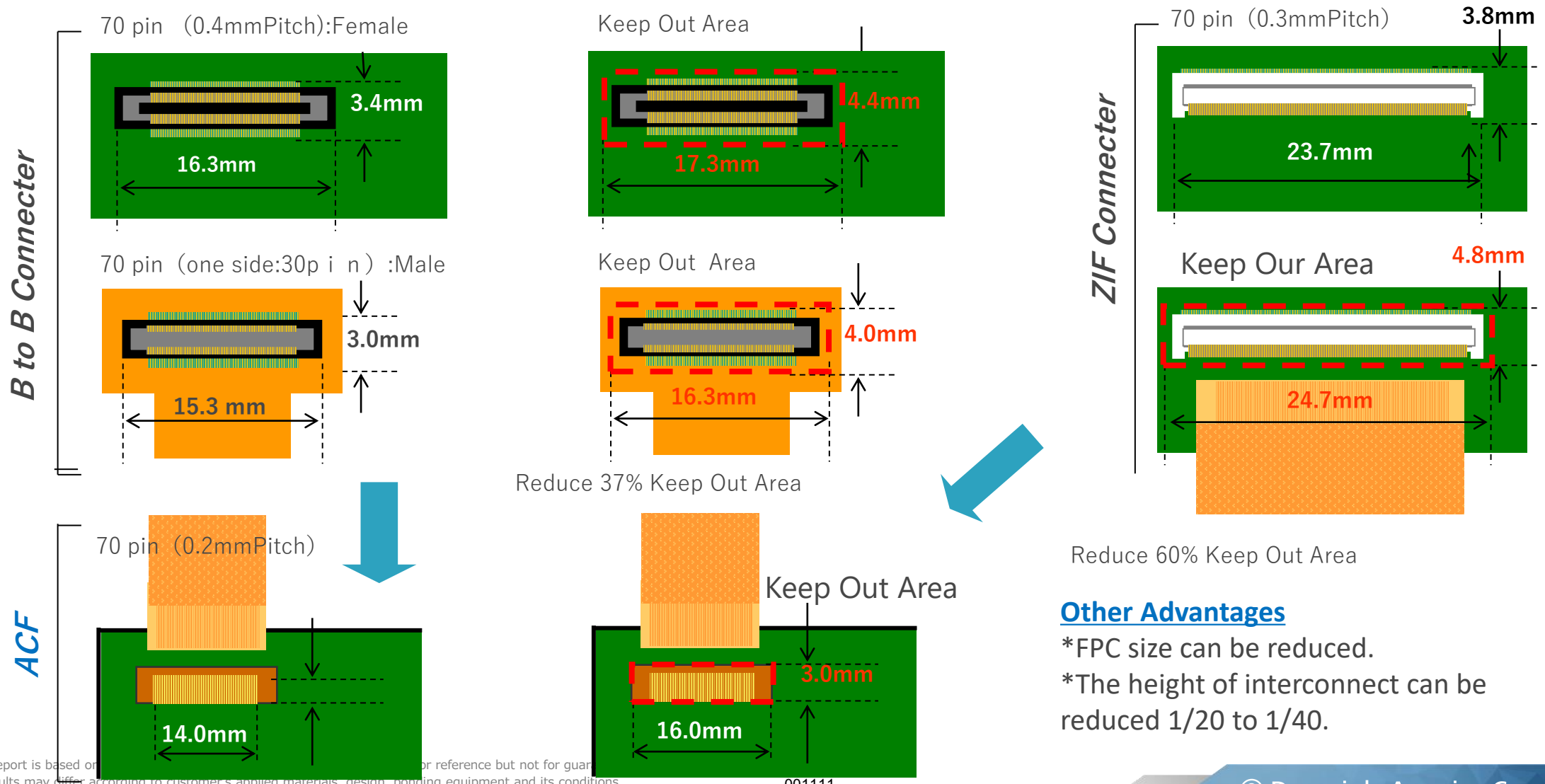
(Minimum 150 to 200um Pitch)

Interconnect Pitch Size

*With properly designed FPC / PWB, pitch size can be reduced.

Downsize and Fine Pitch Connection (BtoB, ZIF, ACF)

SMT populated area can be extended in case of ACF design compare with that of BtoB and ZIF connector. The assumption below is made based on 70 pin.



Other Advantages

*FPC size can be reduced.

*The height of interconnect can be reduced 1/20 to 1/40.

Note : This report is based on [illegible] or reference but not for guar
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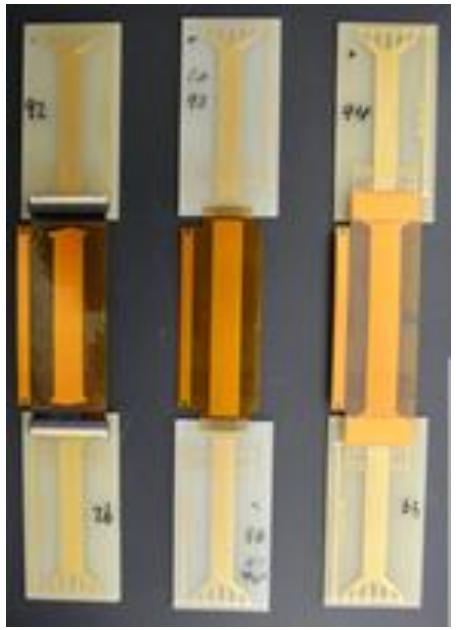
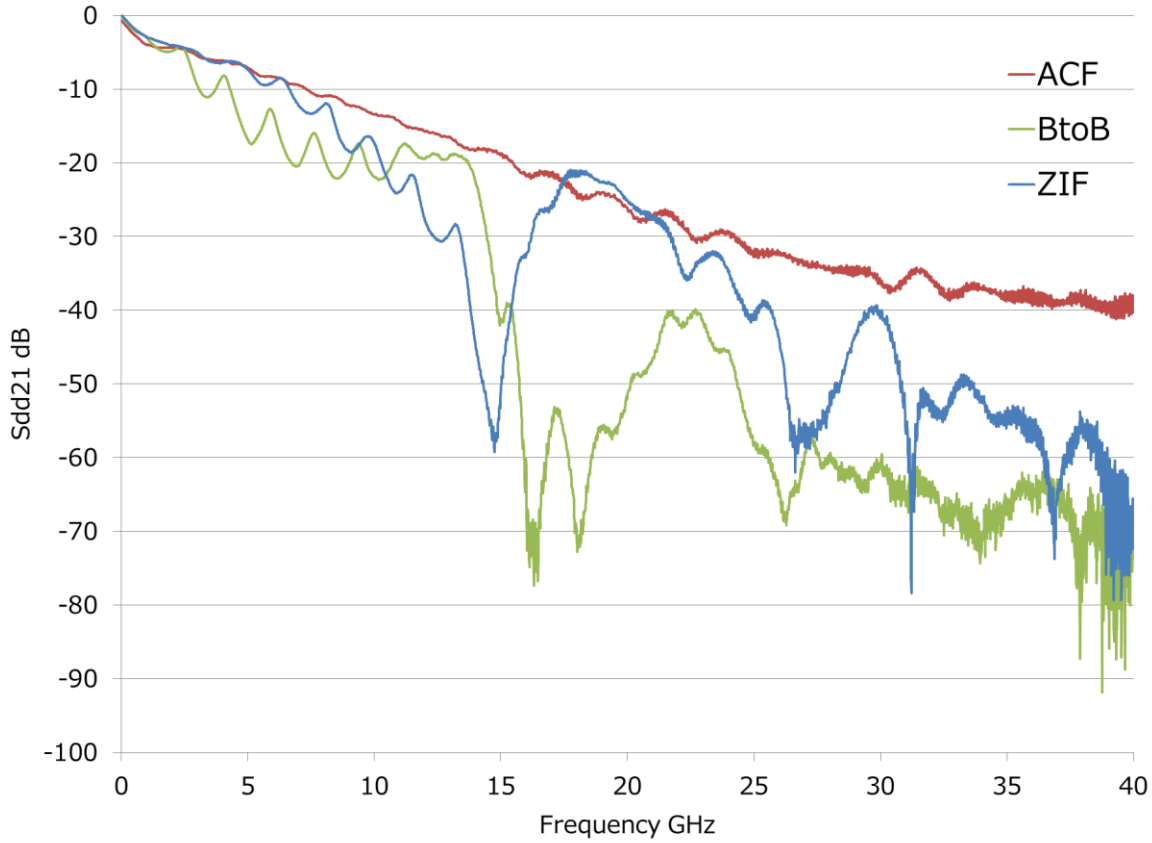
High Frequency Characteristics Comparison

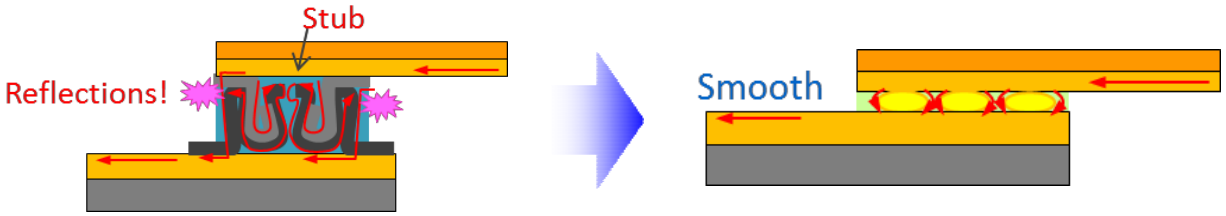


ZIF **ACF** **BtoB**



Signal Integrity

*Signal loss is minimal for all connectors <8 GHz.
*At higher frequencies, ACF interconnect's signal stability is better.
*ACF has minimal reflections at interconnect site.



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001112

Comparison of Connector Technologies

	ACF	Solder	Mechanical Connector
Fine Pitch Connection	Best	Good	Average
Pb Free	Best	Good	Good
Low Temp Process	Good	Average	Best
Thin Connection	Best	Best	Average
Material Selectivity	Good	Average	Average
Process Complexity	Good	Good	Best
Automation	Best	Good	Average

Material	Process Temp.
Sn-Pb Solder (Sn-37Pb)	184C (Melting Point)
Pb free Solder (Sn-Ag-Cu)	217 – 219C (Melting Point)
ACF	**From 180C (Epoxy) From 130C (Acrylic)**

Process Comparison

*Lamination of ACF interconnect allows for lower temperature processing conditions.

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AUTOMOTIVE RELIABILITY OF ACF

ACF for Automotive Specification

Item			Unit	CP881AM-35AC	CP881AM-45AC
ACF	Thickness		μm	35	45
	Adhesive		-	Thermosetting	
	Conductive Particle	Material	-	Ni/Au plated Resin	
		Diameter	μm	10	
	Minimum Insulation Space		μm	75	
	Minimum Conductive Area		μm^2	75,000	
Base Film	Color		-	White	
	Thickness		μm	50	
Storage	-10 to 5C			7 months	
	Room Temp.(23C65%RH)			20 days	

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001115

Standard Bonding Conditions

Bonding Conditions		Unit	CP881AM-35AC	CP881AM-45AC
Lamination	Temperature	C	70 to 90	
	Time	sec	1 to 3	
	Pressure	MPa	0.5 to 1.5	
Main-Bonding	Temperature	C	180 to 200	
	Time	sec	From 10	
	Pressure	MPa	2 to 4	

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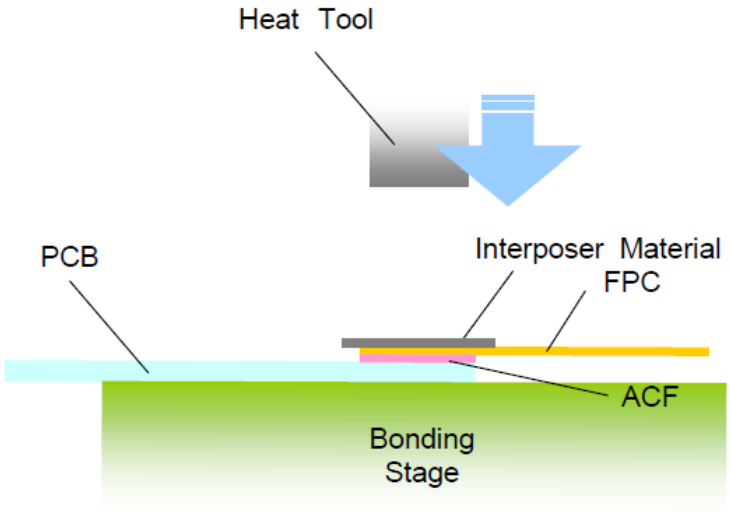
001116

Test Setup

ACF	: 2.0mm width
Heat tool	: 2.0mm width
Interposer	: Silicon Rubber / 200um Thickness
PCB	: 200um Pitch (Line/Space=1/1), Cu=35um (Ni-Au Plated)
CA Type FPC	: 200um Pitch (Line/Space=1/1), PI=25um, Cu=12um (Ni-Au Plated)



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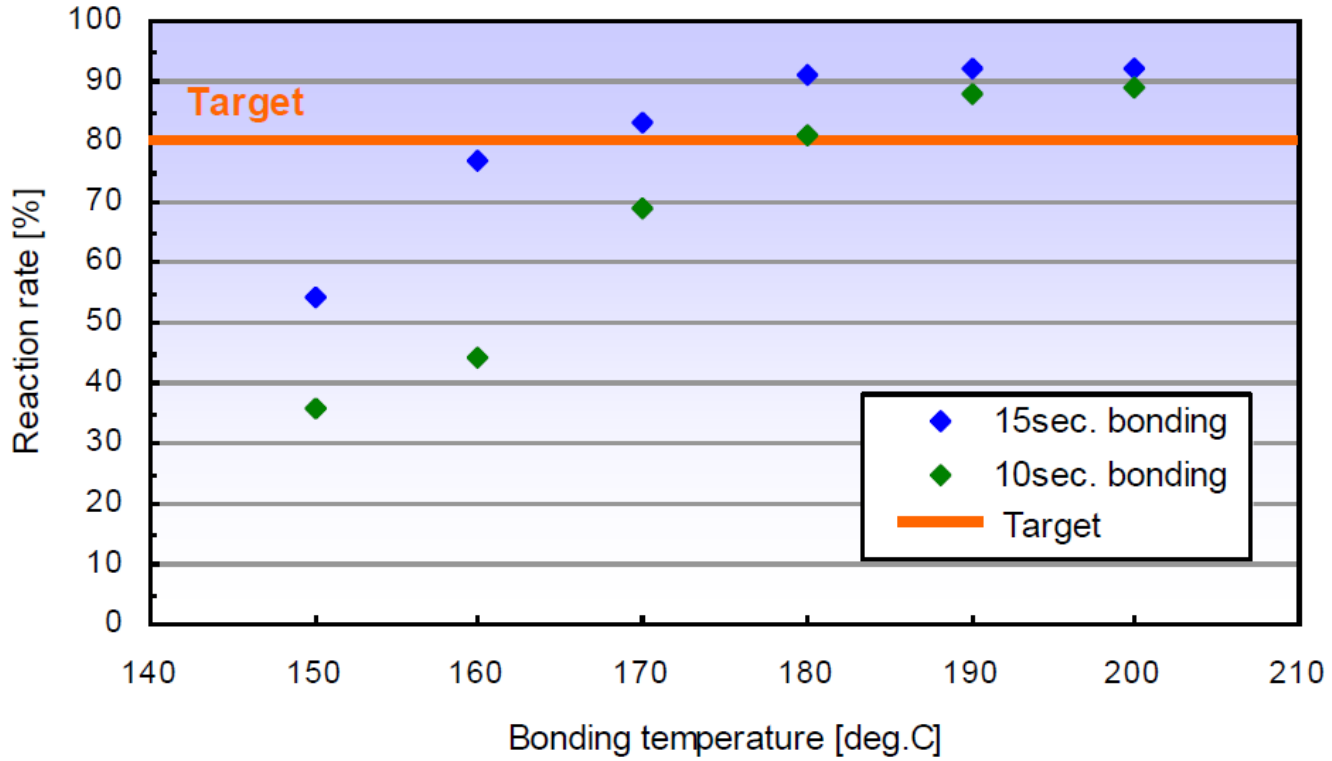
001117

Reaction Rate

Bonding Conditions

Temperature	: 150 to 200deg.C
Pressure	: 3MPa
Time	: 10sec, 15sec
Stage Temperature	: 40deg.C
Measurement Method	: FT-IR



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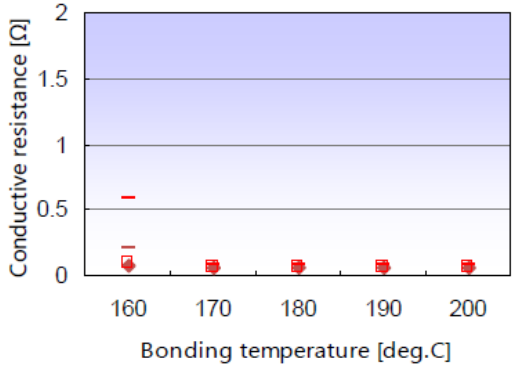
001118

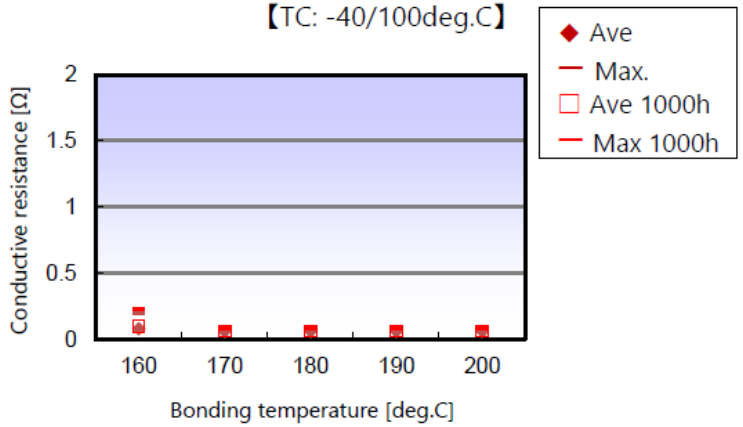
Conductive Resistance – 85C/85% & Thermal Cycle

Bonding Temperature Dependence
Temperature: 160 to 200 deg.C
Pressure : 3MPa
Time : 10sec

【85deg.C/85%RH】

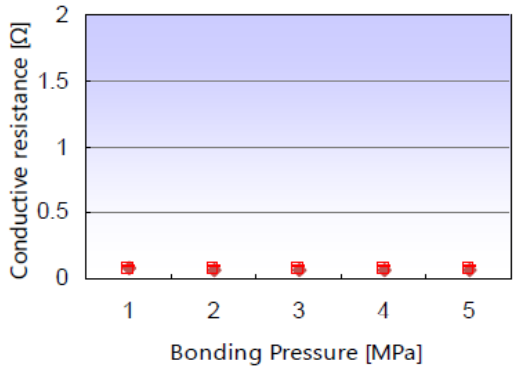


【TC: -40/100deg.C】

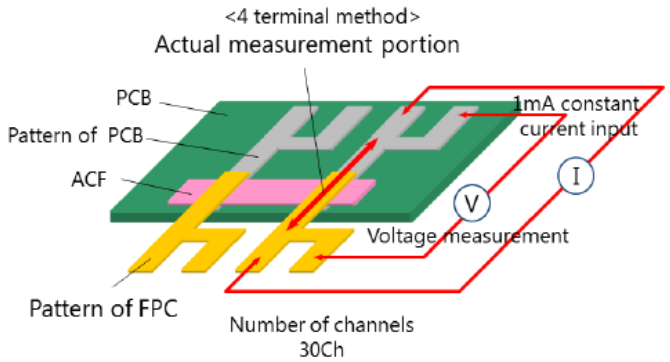


Bonding Pressure Dependence
Temperature: 190deg.C
Pressure : 1 to 5MPa
Time : 10sec

【85deg.C/85%RH】



Measurement Method



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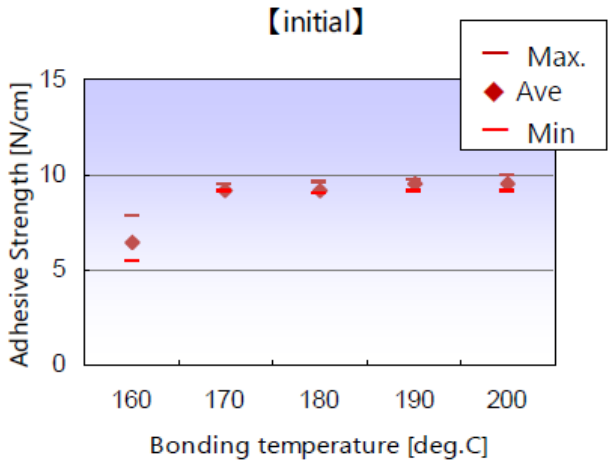
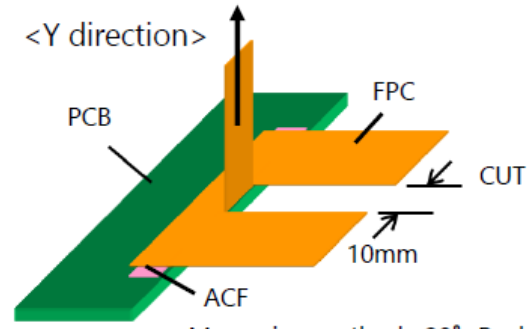
001119

Adhesion Strength – 85C/85% & Thermal Cycle

Bonding Temperature Dependence
- Temperature: 160 to 200 deg.C
- Pressure : 3MPa
- Time : 10sec



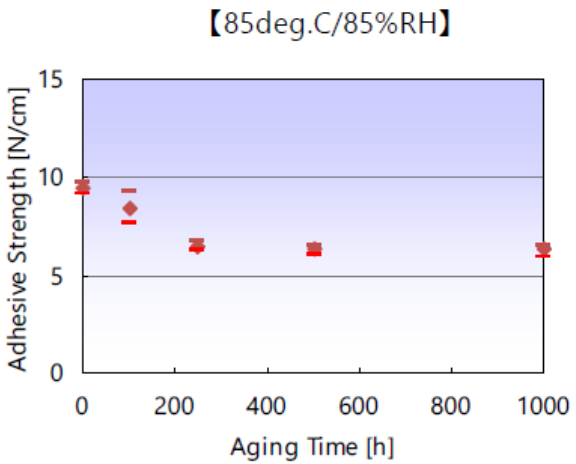
Measurement method

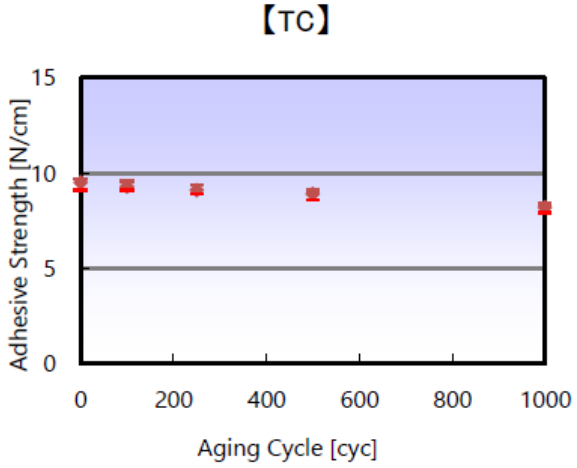


Measuring method : 90° Peel
Measuring speed : 50mm/min

Aging Conditions
- A. 85deg.C/85%RH
- B. TC (-40deg.C/30min, 100deg.C/30min)

Bonding Conditions
- Temperature: 190deg.C
- Pressure : 3MPa
- Time : 10sec





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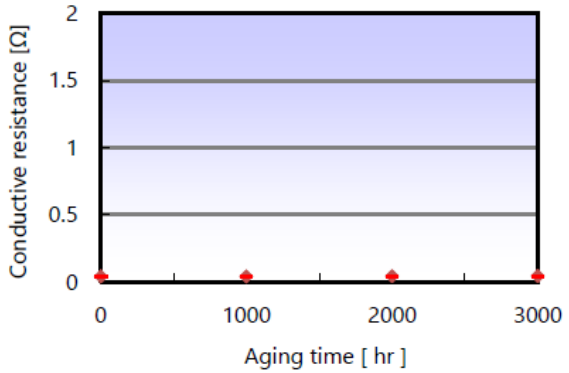
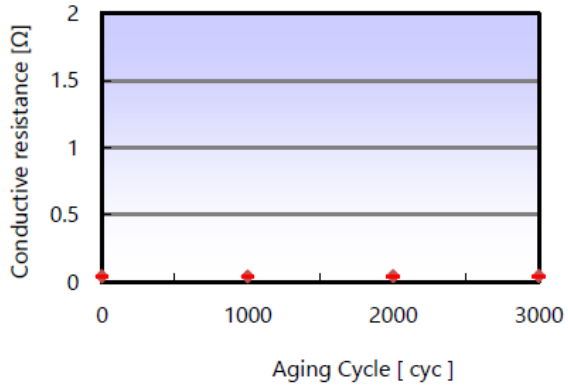
3000hr Reliability Results – 85C/85% & Thermal Cycle

Bonding Conditions
Temperature: 190deg.C
Pressure : 3MPa
Time : 10sec

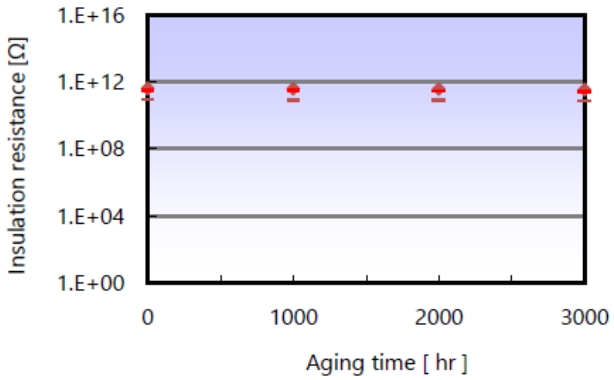
Conductive Resistance
【85℃85%RH】



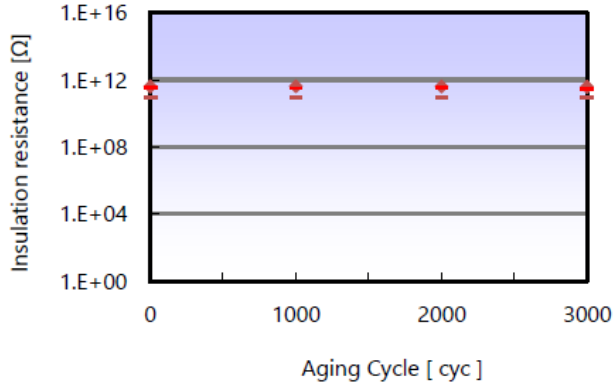
Conductive Resistance
【-40℃(30min) / 100℃(30min)】



Insulation Resistance
【85℃85%RH】



Insulation Resistance
【-40℃(30min) / 100℃(30min)】



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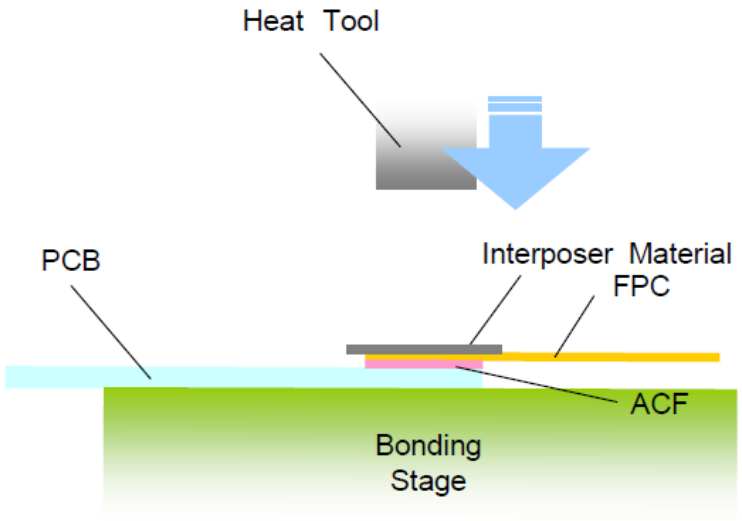
001121

Thermal Shock Setup

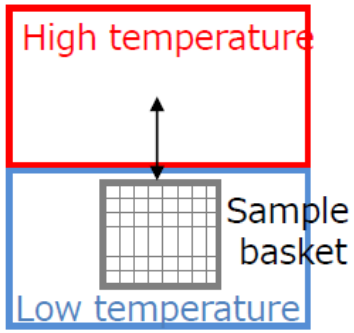
ACF : 2.0mm width
Heat tool : 2.0mm width
Interposer : Silicon Rubber / 200um Thickness
PCB : 400um Pitch (Line/Space=1/1),
Cu=35um (Ni-Au Plated)
CA Type FPC : 400um Pitch (Line/Space=1/1),
PI=25um, Cu=18um (Ni-Au Plated)

Bonding Conditions
Temperature: 190deg.C
Pressure : 3MPa
Time : 10sec

Aging Conditions
TS (-55deg.C/15min, 125deg.C/15min)
Transition time: 10sec



TS TEST EQUIPMENT : TSE-12-A (ESPEC CORP.)
Elevator type



Note : This report is based on Dexerials testing vehicle and testing equipment only for reference but not for guarantee.
Data and results may differ according to customer's applied materials, design, bonding equipment and its conditions.

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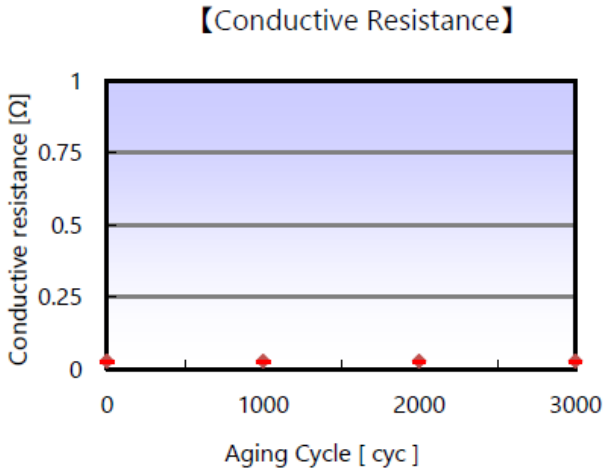
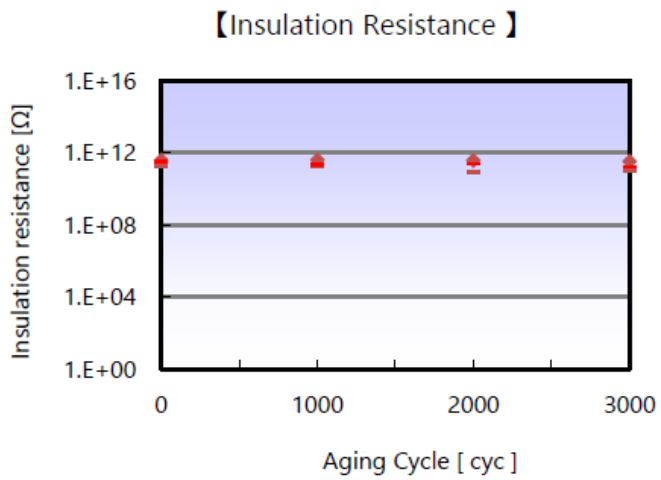
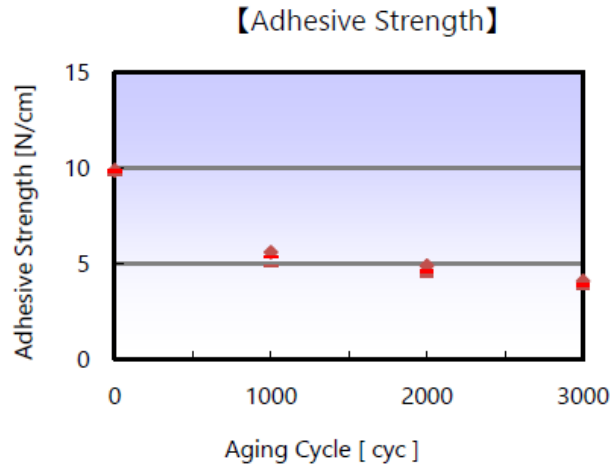
Thermal Shock Results







Note : This report is based on Dexerials testing vehicle and testing equipment only for reference but not for guarantee.
Data and results may differ according to customer's applied materials, design, bonding equipment and its conditions.

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Conclusion

- **Electronic components integration is becoming more prevalent along with the need for downsizing packaging for OEMs and Tier 1 suppliers.**
- **ACF technology can provide a path towards automated interconnect bonding.**
- **ACF technology can support downsizing, increased signal integrity, and improve reliability of interconnect.**

Value Matters

Unprecedented innovation, unprecedented value.