

### **To Customers**

### 0. <u>PCN MT5ZGD00047</u>

Production expansion at Fuji Electric Shenzhen

### 1. Scope of PCN

Improvement of production capacity and risk avoidance

### 2. Products to be affected

Product type name : 7<sup>th</sup> generation "X-series" EconoPIM<sup>™</sup> (M719,M720) (Note : EconoPIM<sup>™</sup> is registered trademark of Infineon Technologies AG, Germany)

#### 3. Description of the products changing and its evaluation results

#### 3-1 Key points

(1) Chemicals & Materials :

The chemicals & materials to be used for the IGBT Module assembling in Fuji Electric Shenzhen (hereinafter SZF) are purchased with same spec as Fuji Electric Power Semiconductor Omachi Factory(hereinafter Omachi factory).

(2) Equipment :

All of the equipment and the test equipment provided for the production & test process in SZF are the same design and performances as compared with Omachi factory. Please refer to table(1).

#### (3) Process & Conditions :

The process flow, the process conditions and the control limits of the production in SZF are the same as in Omachi factory. Please refer to table(1).

### 3-2 Intension of the change

In order to correspond the customer's demand stably, Fuji completed for setting up the assembling production line in SZF in terms of the delivery flexibility and also avoiding the risks of disasters like an earthquake.

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### 3-3 Qualification test results

- (1) Electrical characteristics As comparison results of VGE(th), VCE(sat) and VF between SZF and Omachi products, no obvious difference was confirmed. Please refer to fig.(1).
- (2) Solder joint analysis The solder joint layers under the DCB substrate and the chips were observed by using scanning acoustic tomography. As results, no obvious difference was confirmed. Please refer to photo(2),(3).
- (3) AL-wire bonding characteristics As comparison results of AL-wire shape and pull force test, no obvious difference was confirmed shown as photo(4).
- (4) Reliability test results Considering the influence of assembly, two kinds of reliability tests were selected and carried out. As a result, SZF products passed all the reliability tests.
  - (a) Environment test : Please refer to table(2).

### 4. Products changing schedule

We would like to start these changing from October 2021.

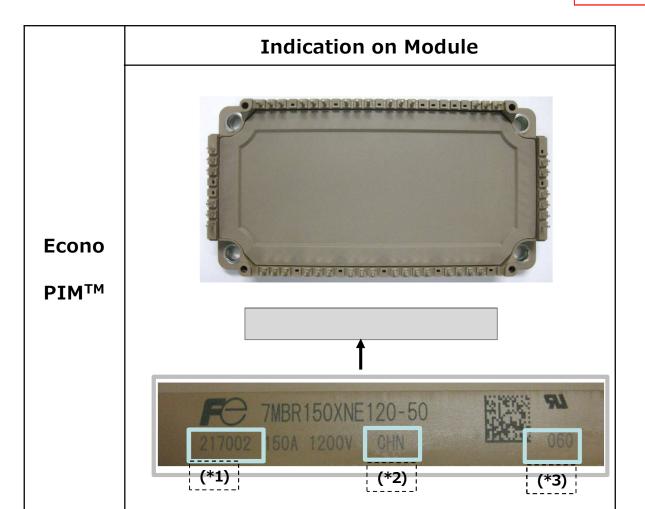
Approval				
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(Note : EconoPIM<sup>™</sup> is registered trademark of Infineon Technologies AG, Germany)

	1st 2 digit	Next 1 digit	Next 3 digit
Omachi products	Last 2 digit of product year	Product month	Production LOT number
SZF products	Last 2 digit of product year	Product month	Production LOT number

## (\*2)

Omachi products	: JAPAN O
SZF products	: CHN

# (\*3)

<b>、</b>	
	3 digit
Omachi products	Serial number in the production Lot
SZF products	Serial number in the production Lot

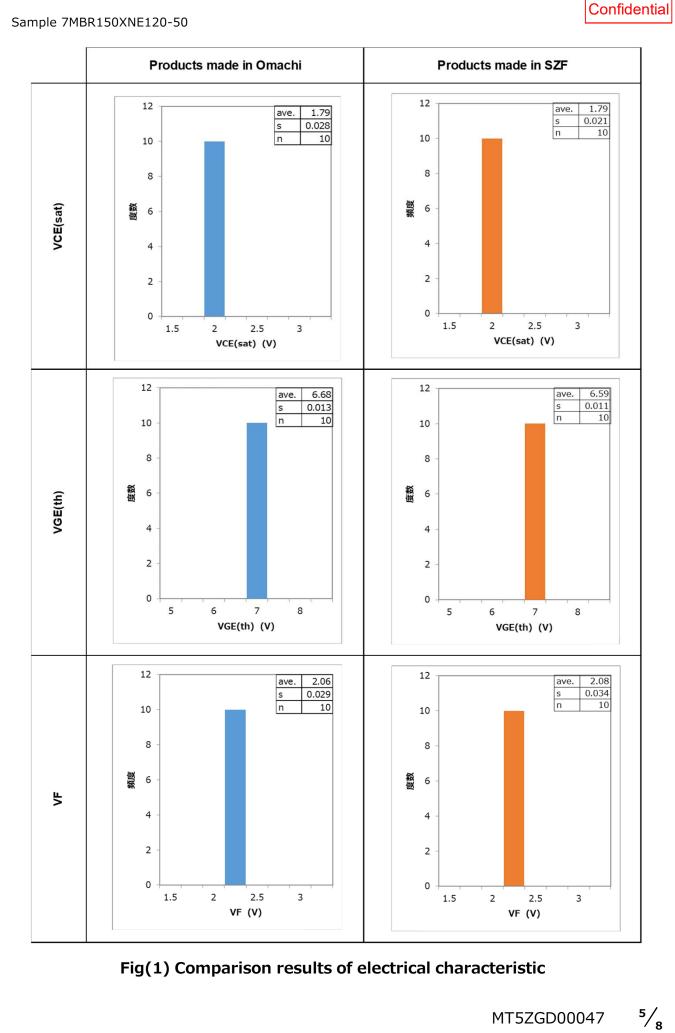
# Photo(1) Indication on Module

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# Table(1) Process comparison between Omachi and SZF

Process flow	Process name	Process condition & control limit etc	At present facilities
▼IGBT,FWD chips ▼DCB substrate ▼Solderplate ▼Cu plate	) Chip mounting and Soldering	Same as Omachi	Same design as Omachi
∀Terminal case ∀Silicone glue			
(	Case gluing	Same as Omachi	Same design as Omachi
¢	Laser marking	Same as Omachi	Same design as Omachi
¢	AL-wire bonding_1	Same as Omachi	Same design as Omachi
¢	AL-wire bonding_2	Same as Omachi	Same design as Omachi
⊽Silicone gel			
Ç ⊤Lid	) Silicone gel injection and gel curing	Same as Omachi	Same design as Omachi
ζ	Cover-lid assembly (with glue curing)	Same as Omachi	Same design as Omachi
<	Outgoing test, Visual inspection	Same as Omachi	Same design as Omachi
7	7 Packing, Shipment	Same as Omachi	Same design as Omachi

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Sample 7MBR150XNE120-50

	Products made in Omachi	Products made in SZF	
Solder joint analysis (Under the DCB)			

# Photo(2) Comparison results of solder joint analysis(Under the DCB)

Sample 7MBR150XNE120-50

	Products made in Omachi	Products made in SZF
Solder joint analysis (Under the chips)		

Photo(3) Comparison results of solder joint analysis(Under the chips)

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#### Sample : 7MBR150XNE120-50

Aurning Wiggingson       Image: Constraint of the constraint o		Products made in Omachi Products made in S				in SZF	
No         Pulling strengting(r)         Pulling intending(r)         Pulling strengting(r)         Pulling(r)         Pulling(r)         Pulling(r)         Pulling strengting(r)         Pulling strengting strengting strengting r)	unction form						
No1       1031       C       No1       1050       C         No2       1060       C       No2       1068       C         No3       1048       C       No3       1050       C         No4       1064       C       No4       1060       C         No5       1047       C       No5       1053       C         No6       1039       C       No6       1045       C         No6       1039       C       No6       1045       C         No6       1039       C       No6       1045       C         No8       1063       C       No7       1035       C         No8       1063       C       No9       1024       C         No9       1060       C       No9       1029       C         No10       1053       C       No10       1035       C $\sigma$ 11.9 $\sigma$ 14.0 $\sigma$ 14.0         Restrict AL-wire       NG         G       IGBT chip       IGBT chip       IGBT chip       IGBT chip			Pulling strength(gf)	Failure mode		Pulling strength(gf)	Failure mode
No2       1050       C       No2       1068       C         No3       1044       C       No3       1050       C         No4       1064       C       No4       1060       C         No5       1047       C       No6       1053       C         No6       1039       C       No6       1045       C         No7       1069       C       No7       1035       C         No8       1063       C       No8       1024       C         No9       1060       C       No8       1029       C         Ave       1052       Ave       1044.9       G $\sigma$ 11.9 $\sigma$ 14.0       G    (Target:Pulling strength>=800gf) Photo(4) Comparison results of AL-wire bonding characteristics Failure mode			1031	С		1050	С
No3         1048         C         No3         1050         C           No4         1064         C         No4         1060         C           No5         1047         C         No5         1053         C           No6         1039         C         No6         1045         C           No6         1039         C         No6         1045         C           No7         1089         C         No6         1024         C           No8         1063         C         No8         1024         C           No9         1060         C         No9         1029         C           No10         1053         C         No10         1035         C           Ave         1044.9         σ         14.0         (Target:Pulling strength>=800gf)							
Tensile strength (gf)       No4       1064       C       No4       1060       C         No5       1047       C       No5       1053       C         No6       1039       C       No6       1045       C         No7       1069       C       No6       1045       C         No7       1069       C       No6       1024       C         No8       1063       C       No8       1024       C         No9       1060       C       No9       1029       C         No10       1053       C       No10       1035       C         Ave       1062       Ave       1044.9 $\sigma$ 14.0 $\sigma$ 11.9 $\sigma$ 14.0       (Target:Pulling strength>=800gf)    Photo(4) Comparison results of AL-wire bonding characteristics Failure mode          OK       AL-wire       NG         IGBT chip       IGBT chip       IGBT chip       IGBT chip				С			
Image: Participation (gf)       No5       1047       C       No5       1053       C         No6       1039       C       No6       10445       C         No7       10069       C       No7       1035       C         No8       1063       C       No7       1035       C         No8       1060       C       No8       1024       C         No9       1060       C       No9       1029       C         No10       1052       Ave       1044.9       σ         σ       11.9       σ       14.0       (Target:Pulling strength>=800gf)    Photo(4) Comparison results of AL-wire bonding characteristics Failure mode          OK       AL-wire       NG       IGBT chip       IGBT chip	Tamaila sturn ()						
(gf)       No6       1039       C       No6       1045       C         No7       1069       C       No7       1035       C         No8       1063       C       No8       1024       C         No9       10600       C       No9       1029       C         No10       1053       C       No7       1355       C         Ave       1060       C       No9       1029       C         No10       1053       C       No10       1035       C         Ave       1052       Ave       1044.9       o       14.0         rarget:Pulling strength>=800gf)       Photo(4) Comparison results of AL-wire bonding characteristics         Failure mode	-						
No7         1069         C         No7         1035         C           No8         1063         C         No8         1024         C           No9         1060         C         No9         1029         C           No10         1053         C         No10         1035         C           Ave         1052         Ave         1044.9         C           σ         11.9         σ         14.0         C	(gf)						
No8         1063         C         No8         1024         C           No9         1060         C         No9         1029         C           No10         1053         C         No10         1035         C           Ave         1052         Ave         1044.9         C         C           σ         11.9         σ         14.0         C         C           (Target:Pulling strength>=800gf)           Photo(4) Comparison results of AL-wire bonding characteristics           Strength = 800gf)           Photo(4) Comparison results of AL-wire bonding characteristics           Strength = 800gf)           Photo(4) Comparison results of AL-wire bonding characteristics           Strength = 800gf           NG           OK         AL-wire         NG           OK         AL-wire         NG           OK         NG           OK         NG           OK         NG           OK         NG							
No9         1060         C         No9         1029         C           No10         1053         C         No10         1035         C           Ave         1052         Ave         1044.9         G         14.0           σ         11.9         σ         14.0         G         (Target:Pulling strength>=800gf)           Photo(4) Comparison results of AL-wire bonding characteristics           Failure mode           OK         AL-wire         NG           IGBT chip         IGBT chip         Index         Index         Index			1063	С		1024	С
No10       1053       C       No10       1035       C         Ave       1052       Ave       1044.9       0       0         σ       11.9       σ       14.0       0       (Target:Pulling strength>=800gf)         Photo(4) Comparison results of AL-wire bonding characteristics         Failure mode         OK       MG         OK       IGBT chip       IGBT chip       Index			I I				
Ave       1052       Ave       1044.9 $\sigma$ 11.9 $\sigma$ 14.0         (Target:Pulling strength>=800gf)         Photo(4) Comparison results of AL-wire bonding characteristics         Failure mode         OK       AL-wire         IGBT chip							
σ     11.9     σ     14.0       (Target:Pulling strength>=800gf)       Photo(4) Comparison results of AL-wire bonding characteristics       Failure mode       NG       OK       IGBT chip							
(Target:Pulling strength>=800gf) Photo(4) Comparison results of AL-wire bonding characteristics Failure mode OK AL-wire IGBT chip							
Photo(4) Comparison results of AL-wire bonding characteristics		0	11.9		0	14.0	
Failure mode		Ŭ	11.8		С		ngth>=800gf)
	Phot	o(4) Co	mparison resu	Its of AL-wire	e bondi		
	Failure mode	OK Broken at th		AL-wire IGBT chip <u>Mode A:Li</u>	NC	ng characteris	otics

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### Table(2) Reliability test results

				Reference	Test result	
Test cate- gories	Test items	Test	Test methods and conditions		Number of Sample	Number of failure
	1 Temperature			Test Method 105A		
	Cycle	Test temp.	: Low temp40 +0/-10 deg.C High temp. 125 +15/-0 deg.C			
sts					5	0
Environment tes		Dwell time	: High ~ Low 70min. 70min.			
mn		Number of cycles	: 100 cycles			
vira	2 Temperature	Test temp.	: 85+/-2 deg.C	Test Method 102A		
Ē	Humidity Bias	Relative humidity	: 85+/-5%	Condition code C		
	(IGBT/FWD)	Bias voltage	: VCE = $0.8 \times VCES$		5	0
		Bias method	: Applied DC voltage to C-E VGE = 0V		5	0
		Test duration	: 1000hrs.			

### Table(3) Failure Criteria

Item	Characteristic		Characteristic Sym		Symbol	Failure criteria		Unit	Note
				Lower limit	Upper limit				
Electrical	Leakage cu	rrent	I CES	-	USL×2	uA			
	Gate leakag	je current	± <i>I</i> GES	-	USL×2	nA			
	Gate thresh	old voltage	VGE(th)	LSLX0.8	USLX1.2	V			
characteristic	Saturation	voltage	VCE(sat)	-	USLX1.2	V			
	Forward vol	tage	VF	-	USLX1.2	V			
	Thermal	IGBT	ΔVCE	-	USLX1.2	mV			
	resistance	FWD	ΔVF	-	USLX1.2	mV			
	Isolation vo	ltage	<i>V</i> iso	Broken ir	nsulation	-			
Visual	Visual inspection								
inspection	Peeling Plating		-	The visua	al sample	-			
	and the	others							

LSL : Lower specified limit.

USL : Upper specified limit.

Note : Each parameter measurement read-outs shall be made after stabilizing the components at room ambient for 2 hours minimum, 24 hours maximum after removal from the tests. And in case of the wetting tests, for example, moisture resistance tests, each component shall be made wipe or dry completely before the measurement.

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