



## **PRODUCT/PROCESS CHANGE NOTIFICATION**

---

**PCN IPD-PWR/12/7506**  
**Dated 10 Oct 2012**

---

**IPAK and Short IPAK in ECOPACK 2, graded Moulding  
Compound Assembly capacity expansion - Nantong Fujitsu  
Microelectronics (China) Subcontractor**

**Table 1. Change Implementation Schedule**

Forecasted implementation date for change	05-Oct-2012
Forecasted availability date of samples for customer	05-Oct-2012
Forecasted date for <b>STMicroelectronics</b> change Qualification Plan results availability	05-Oct-2012
Estimated date of changed product first shipment	09-Jan-2013

**Table 2. Change Identification**

Product Identification (Product Family/Commercial Product)	see attached list
Type of change	Package assembly location change, Testing location change
Reason for change	To increase capacity on IPAK and Short IPAK package
Description of the change	Continuing in the program to introduce ECOPACK 2, graded Moulding Compound products and in order to be ready to support the market demand of Power MOSFET Transistors, the products listed in this PCN will be manufactured also in Nantong Fujitsu Microelectronics (China) Subcontractor. Products are in agreement with ST standards and guarantee the same quality and the electrical characteristics as the current production. Devices used for qualification are available as samples.
Change Product Identification	1st two digits of the traceability code are "GF"
Manufacturing Location(s)	

**Table 3. List of Attachments**

Customer Part numbers list	
Qualification Plan results	



## DOCUMENT APPROVAL

Name	Function
Mottese, Anna	Marketing Manager
Aleo, Mario-Antonio	Product Manager
Falcone, Giuseppe	Q.A. Manager

Dear Customer,

Please be informed that IPAK and Short IPAK Package, manufactured in ST sites, will be also produced in Nantong Fujitsu Microelectronics (China) Subcontractor, according to the program to introduce ECOPACK 2 grade products.

The involved product series and affected packages are listed in the table below:

Product Family	Package	Commercial Product / Series
<b>Power MOSFET Transistors</b>	<b>Short IPAK</b>	<b>STUXXX-S</b>
	<b>IPAK</b>	<b>STUxxx/STDxxx-1</b>

**Qualification program and results availability:**

The reliability test report is provided in attachment to this document.

**Samples availability:**

Samples of the test vehicle devices will be available on request starting from week 40-2012.  
Any other sample request will be processed and scheduled by Power Transistor Division upon request.

Product Family	Part Number - Test Vehicle
<b>Power MOSFET Transistors</b>	<b>STU7NM60N</b> <b>STD4NK60Z-1</b> <b>STU60N3LH5</b>

**Change implementation schedule:**

The production start and first shipments will be implemented according to our work in progress and materials availability:

Product Family	1st Shipments
Power MOSFET Transistors	From Week 01-2013

Lack of acknowledgement of the PCN within 30 days will constitute acceptance of the change. After acknowledgement, lack of additional response within the 90 days period will constitute acceptance of the change (Jedec Standard No. 46-C). In any case, first shipments may start earlier with customer written agreement.

**Marking and traceability:**

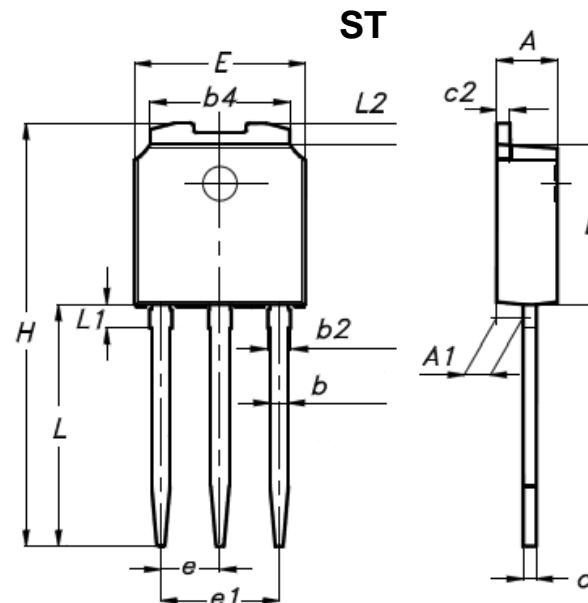
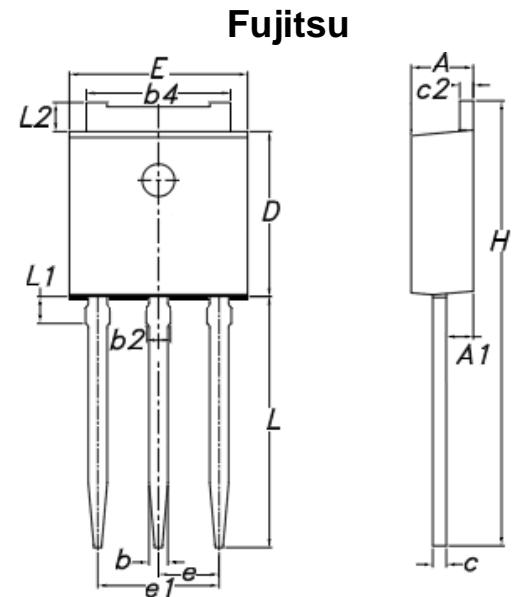
Unless otherwise stated by customer specific requirement, traceability of IPAK and Short IPAK ECOPACK 2 graded moulding compound products, manufactured in Nantong Fujitsu Microelectronics (China), will be ensured by the 1<sup>st</sup> two digits of the traceability code "GF".

Sincerely Yours.



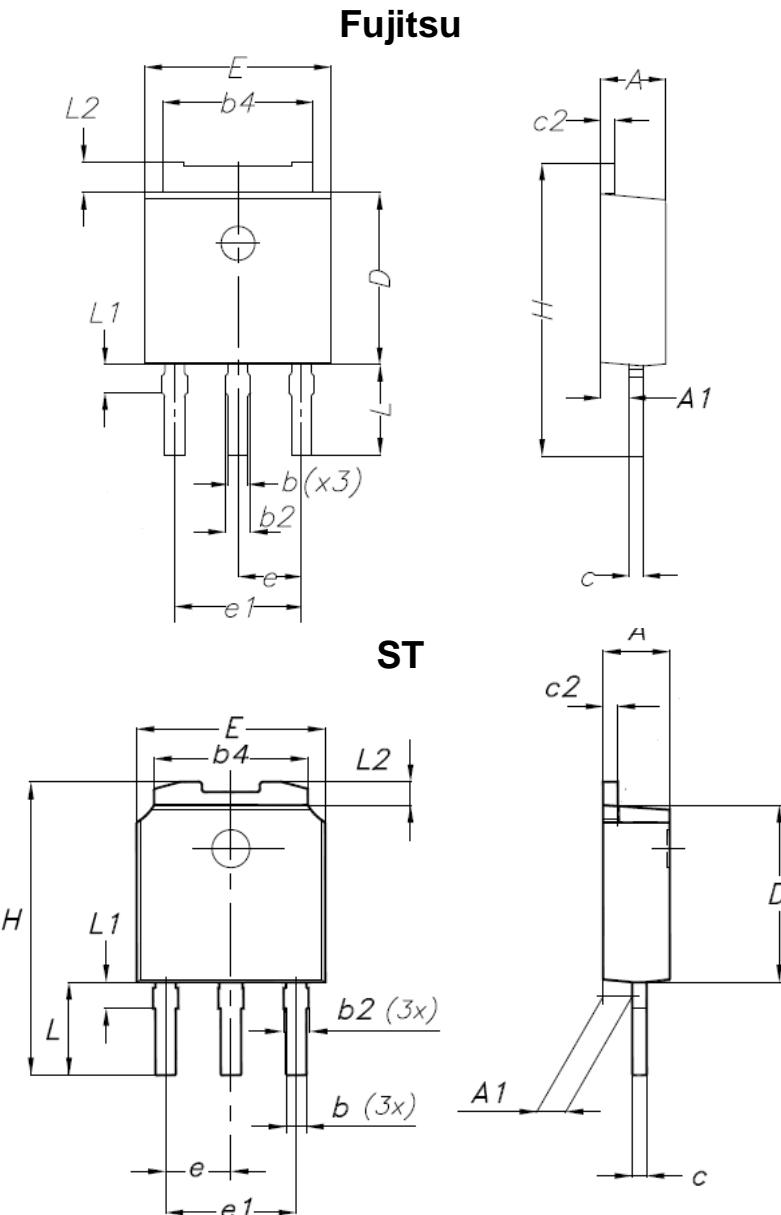
# IPAK package comparison Fujitsu Vs ST

SYMBOL	FUJITSU			ST		
	IPAK			IPAK		
	MIN	NOM	MAX	MIN	NOM	MAX
A		2.3	2.35	2.2	-	2.35
A1	0.9	1	1.1	0.9	-	1.1
b	0.58	-	0.79	0.64	-	0.9
b2	-	-	0.9	-	-	0.95
b4	5.23	5.33	5.43	5.2	-	5.4
c	0.46	-	0.59	0.45	-	0.6
c2	0.46	-	0.59	0.48	-	0.6
D	6	6.1	6.2	6	-	6.15
E	6.5	6.6	6.7	6.4	-	6.55
e		2.25		-	2.28	-
e1	4.4	4.5	4.6	4.4	-	4.6
H		16.48		-	16.1	-
L	9	9.3	9.6	9	-	9.4
L1	0.8	1	1.2	0.8	-	1.2
L2		1.08	1.25	-	0.8	1



# Short IPAK package comparison Fujitsu Vs ST

SYMBOL	FUJITSU			ST		
	Short IPAK			Short IPAK		
	MIN	NOM	MAX	MIN	NOM	MAX
A	2.2	2.3	2.35	2.2	-	2.35
A1	0.9	1	1.1	0.9	-	1.1
b	0.58	-	0.79	0.64	-	0.9
b2	-	-	0.9	-	-	0.95
b4	5.23	5.33	5.43	5.2	-	5.4
c	0.46	-	0.59	0.45	-	0.6
c2	0.46	-	0.59	0.48	-	0.6
D	6	6.1	6.2	6	-	6.15
E	6.5	6.6	6.7	6.4	-	6.55
e		2.25		-	2.25	-
e1	4.4	4.5	4.6	4.4	-	4.6
H	10.08	10.38	10.68	9.8	10.4	-
L	3	3.2	3.4	3	-	3.4
L1	0.8	1	1.2	0.8	-	1.2
L2		1.08	1.25	-	0.8	1



## Reliability Report

*IPAK and Short IPAK in ECOPACK 2, Graded Molding  
Compound Assembly capacity expansion –  
Nantong Fujitsu Microelectronics (China) Subcontractor*

General Information		Locations	
<b>Product Lines:</b>	M260 - EZ62 - 5H33	<b>Wafer Diffusion Plants:</b>	Ang Mo Kio (SINGAPORE) – M5 Catania (ITALY)
<b>Product Families:</b>	Power MOSFET	<b>EWS Plants:</b>	Ang Mo Kio (SINGAPORE) – M5 Catania (ITALY)
<b>P/Ns:</b>	STU7NM60N STD4NK60Z-1 STU60N3LH5	(M260) (EZ62) (5H33)	<b>Assembly plant:</b> Nantong Fujitsu Microelectronics (China)
<b>Product Group:</b>	IMS - IPD	<b>Reliability Lab:</b>	IMS-IPD Catania Reliability Lab.
<b>Product division:</b>	Power Transistor Division		
<b>Package:</b>	IPAK		
<b>Silicon Process techn.:</b>	MDmesh™ II, SuperMESH™, STripFET™ V		

### DOCUMENT INFORMATION

Version	Date	Pages	Prepared by	Approved by	Comment
1.0	September 2012	9	C. Cappello	G. Falcone	First issue

Note: This report is a summary of the reliability trials performed in good faith by STMicroelectronics in order to evaluate the potential reliability risks during the product life using a set of defined test methods.

This report does not imply for STMicroelectronics expressly or implicitly any contractual obligations other than as set forth in STMicroelectronics general terms and conditions of Sale. This report and its contents shall not be disclosed to a third party without previous written agreement from STMicroelectronics.

## TABLE OF CONTENTS

<b>1</b>	<b>APPLICABLE AND REFERENCE DOCUMENTS .....</b>	<b>3</b>
<b>2</b>	<b>GLOSSARY.....</b>	<b>3</b>
<b>3</b>	<b>RELIABILITY EVALUATION OVERVIEW</b>	<b>3</b>
3.1	OBJECTIVES .....	3
3.2	CONCLUSION.....	3
<b>4</b>	<b>DEVICE CHARACTERISTICS.....</b>	<b>4</b>
4.1	DEVICE DESCRIPTION.....	4
4.2	CONSTRUCTION NOTE .....	4
<b>5</b>	<b>TESTS RESULTS SUMMARY.....</b>	<b>7</b>
5.1	TEST VEHICLE.....	7
5.2	RELIABILITY TEST PLAN SUMMARY .....	7
<b>6</b>	<b>ANNEXES 6.0.....</b>	<b>9</b>
6.1	TESTS DESCRIPTION .....	9

## **1 APPLICABLE AND REFERENCE DOCUMENTS**

Document reference	Short description
JESD47	Stress-Test-Driven Qualification of Integrated Circuits

## **2 GLOSSARY**

DUT	Device Under Test
SS	Sample Size
HF	Halogen Free

## **3 RELIABILITY EVALUATION OVERVIEW**

### **3.1 Objectives**

Qualification of the IPAK and Short IPAK package graded Molding Compound manufactured in Nantong Fujitsu Microelectronics (China).

### **3.2 Conclusion**

Qualification Plan requirements have been fulfilled without exception. It is stressed that reliability tests have shown that the devices behave correctly against environmental tests (no failure). Moreover, the stability of electrical parameters during the accelerated tests demonstrates the ruggedness of the products and safe operation, which is consequently expected during their lifetime.

## **4 DEVICE CHARACTERISTICS**

### **4.1 Device description**

N-channel Power MOSFET

### **4.2 Construction note**

**D.U.T.: STU7NM60N LINE: M260 PACKAGE: IPAK**

<b>Wafer/Die fab. information</b>	
Wafer fab manufacturing location	Ang Mo Kio (Singapore)
Technology	MDmesh™ II
Die finishing back side	Ti/Ni/Au
Die size	2410 x 2400 $\mu\text{m}^2$
Metal	Al/Si
Passivation type	Nitride

<b>Wafer Testing (EWS) information</b>	
Electrical testing manufacturing location	Ang Mo Kio (Singapore)
Test program	WPIS

<b>Assembly information</b>	
Assembly site	NANTONG FUJITSU (China)
Package description	IPAK
Molding compound	HF Epoxy Resin
Frame material	Raw Copper - Ni on T-post
Die attach process	Soft Solder
Die attach material	Pb/Ag/Sn
Wire bonding process	Ultrasonic
Wires bonding materials	Al 5 mils Gate Al 5 mils Source
Lead finishing/bump solder material	Pure Tin

<b>Final testing information</b>	
Testing location	NANTONG FUJITSU (China)
Tester	JUNO

**D.U.T.: STD4NK60Z-1      LINE: EZ62      PACKAGE: IPAK**

<b>Wafer/Die fab. information</b>	
Wafer fab manufacturing location	Ang Mo Kio (Singapore)
Technology	SuperMESH™
Die finishing back side	Ti/Ni/Ag
Die size	3186 x 2654 $\mu\text{m}^2$
Metal	Al/Si
Passivation type	Nitride

<b>Wafer Testing (EWS) information</b>	
Electrical testing manufacturing location	Ang Mo Kio (Singapore)
Test program	WPIS

<b>Assembly information</b>	
Assembly site	NANTONG FUJITSU (China)
Package description	IPAK
Molding compound	HF Epoxy Resin
Frame material	Raw Copper - Ni on T-post
Die attach process	Soft Solder
Die attach material	Pb/Ag/Sn
Wire bonding process	Ultrasonic
Wires bonding materials	Al 5 mils Gate Al 5 mils Source
Lead finishing/bump solder material	Pure Tin

<b>Final testing information</b>	
Testing location	NANTONG FUJITSU (China)
Tester	JUNO

**D.U.T.: STU60N3LH5      LINE: 5H33      PACKAGE: IPAK**

<b>Wafer/Die fab. information</b>	
Wafer fab manufacturing location	M5 Catania (ITALY)
Technology	STripFET™ V
Die finishing back side	Ti/Ni/Ag
Die size	2300 x 1750 $\mu\text{m}^2$
Metal	Al/Cu
Passivation type	None

<b>Wafer Testing (EWS) information</b>	
Electrical testing manufacturing location	M5 Catania (ITALY)
Test program	WPIS

<b>Assembly information</b>	
Assembly site	NANTONG FUJITSU (China)
Package description	IPAK
Molding compound	HF Epoxy Resin
Frame material	Raw Copper - Ni on T-post
Die attach process	Soft Solder
Die attach material	Pb/Ag/Sn
Wire bonding process	Ultrasonic
Wires bonding materials	Al 5 mils Gate Al 10 mils Source
Lead finishing/bump solder material	Pure Tin

<b>Final testing information</b>	
Testing location	NANTONG FUJITSU (China)
Tester	JUNO

## 5 TESTS RESULTS SUMMARY

### 5.1 Test vehicle

Lot #	Process/ Package	Product Line	Comments
1	STU7NM60N	M260	Power MOSFET
2	STU7NM60N	M260	Power MOSFET
3	STU7NM60N	M260	Power MOSFET
4	STD4NK60Z-1	EZ62	Power MOSFET
5	STU60N3LH5	5H33	Power MOSFET

### 5.2 Reliability test plan summary

**Lot. 1÷3 - D.U.T.: STU7NM60N      LINE: M260      PACKAGE: IPAK**

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS		
						Lot 1	Lot 2	Lot 3
HTRB	N	JESD22 A-108	T.A.=150°C Vdss=480V	77 x 3 lots	168 H	0/77	0/77	0/77
					500 H			
					1000 H			
HTGB	N	JESD22 A-108	TA = 150°C Vgss= 30V	77 x 3 lots	168 H	0/77	0/77	0/77
					500 H			
					1000 H			
HTSL	N	JESD22 A-103	TA = 150°C	77 x 3 lots	168 H	0/77	0/77	0/77
					500 H			
					1000 H			
H3TRB	N	JESD22 A-101	Ta=85°C Rh=85%, Vdd=100V	77 x 3 lots	168 H	0/77	0/77	0/77
					500 H			
					1000 H			
TC	N	JESD22 A-104	TA=-65°C TO 150°C (1 HOUR/CYCLE)	77 x 3 lots	100 cy	0/77	0/77	0/77
					200 cy			
					500 cy			
TF/IOL	N	Mil-STD 750D Method 1037	$\Delta T_c=+105^\circ\text{C}$	20 x 3 lots	1000 cy	0/20	0/20	0/20
					5K cy			
AC	N	JESD22 A-102	TA=121°C – PA=2 ATM	77 x 3 lots	10K cy	0/77	0/77	0/77
					96 H			

## Lot. 4 - D.U.T.: STD4NK60Z-1 LINE: EZ62 PACKAGE: IPAK

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS	
						Lot 4	
HTRB	N	JESD22 A-108	T.A.=150°C Vdss=480V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
HTGB	N	JESD22 A-108	TA = 150°C Vgss= 30V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
HTSL	N	JESD22 A-103	TA = 150°C	77 x 3 lots	168 H	0/77	
					500 H		
					1000 H		
H3TRB	N	JESD22 A-101	Ta=85°C Rh=85%, Vdd=100V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
TC	N	JESD22 A-104	TA=-65°C TO 150°C (1 HOUR/CYCLE)	77 x 1 lot	100 cy	0/77	
					200 cy		
					500 cy		
					1000 cy		
TF/IOL	N	Mil-STD 750D Method 1037	$\Delta T_c = +105^\circ C$	20 x 1 lot	5K cy	0/20	
					10K cy		
AC	N	JESD22 A-102	TA=121°C – PA=2 ATM	77 x 1 lot	96 H	0/77	

## Lot. 5 - D.U.T.: STU60N3LH5 LINE: 5H33 PACKAGE: IPAK

Test	PC	Std ref.	Conditions	SS	Steps	Failure/SS	
						Lot 4	
HTRB	N	JESD22 A-108	T.A.=175°C Vdss=24V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
HTGB	N	JESD22 A-108	TA = 150°C Vgss= 20V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
HTSL	N	JESD22 A-103	TA = 175°C	77 x 3 lots	168 H	0/77	
					500 H		
					1000 H		
H3TRB	N	JESD22 A-101	Ta=85°C Rh=85%, Vdd=30V	77 x 1 lot	168 H	0/77	
					500 H		
					1000 H		
TC	N	JESD22 A-104	TA=-65°C TO 150°C (1 HOUR/CYCLE)	77 x 1 lot	100 cy	0/77	
					200 cy		
					500 cy		
					1000 cy		
TF/IOL	N	Mil-STD 750D Method 1037	$\Delta T_c = +105^\circ C$	20 x 1 lot	5K cy	0/20	
					10K cy		
AC	N	JESD22 A-102	TA=121°C – PA=2 ATM	77 x 1 lot	96 H	0/77	

## 6 ANNEXES 6.0

### 6.1 Tests Description

Test name	Description	Purpose
<b>HTRB</b> High Temperature Reverse Bias	The device is stressed in static configuration, trying to satisfy as much as possible the following conditions: <ul style="list-style-type: none"><li>• low power dissipation;</li><li>• max. supply voltage compatible with diffusion process and internal circuitry limitations;</li></ul>	To determine the effects of bias conditions and temperature on solid state devices over time. It simulates the devices' operating condition in an accelerated way.
<b>HTGB</b> High Temperature Forward (Gate) Bias		To maximize the electrical field across either reverse-biased junctions or dielectric layers, in order to investigate the failure modes linked to mobile contamination, oxide ageing, layout sensitivity to surface effects.
<b>HTSL</b> High Temperature Storage Life	The device is stored in unbiased condition at the max. temperature allowed by the package materials, sometimes higher than the max. operative temperature.	To investigate the failure mechanisms activated by high temperature, typically wire-bonds solder joint ageing, data retention faults, metal stress-voiding.
<b>AC</b> Auto Clave (Pressure Pot)	The device is stored in saturated steam, at fixed and controlled conditions of pressure and temperature.	To investigate corrosion phenomena affecting die or package materials, related to chemical contamination and package hermeticity.
<b>TC</b> Temperature Cycling	The device is submitted to cycled temperature excursions, between a hot and a cold chamber in air atmosphere.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.
<b>TF / IOL</b> Thermal Fatigue / Intermittent Operating Life	The device is submitted to cycled temperature excursions generated by power cycles (ON/OFF) at T ambient.	To investigate failure modes related to the thermo-mechanical stress induced by the different thermal expansion of the materials interacting in the die-package system. Typical failure modes are linked to metal displacement, dielectric cracking, molding compound delamination, wire-bonds failure, die-attach layer degradation.
<b>H3TRB</b> Temperature Humidity Bias	The device is biased in static configuration minimizing its internal power dissipation, and stored at controlled conditions of ambient temperature and relative humidity.	To evaluate the package moisture resistance with electrical field applied, both electrolytic and galvanic corrosion are put in evidence.
<b>PC</b> Preconditioning	The device is submitted to a typical temperature profile used for surface mounting devices, after a controlled moisture absorption.	To verify that the surface mounting stress does not impact on the subsequent reliability performance. The typical failure modes are "pop corn" effect and delamination.

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND / OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE ( AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION ), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners

© 2012 STMicroelectronics - All rights reserved.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -  
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)





## Public Products List

PCN Title : IPAK and Short IPAK in ECOPACK 2, graded Moulding Compound Assembly capacity expansion - Nantong Fujitsu Microelectronics (

PCN Reference : IPD-PWR/12/7506

PCN Created on : 03-OCT-2012

Subject : Public Products List

Dear Customer,

Please find below the Standard Public Products List impacted by the change:

### ST COMMERCIAL PRODUCT

STD12NF06L-1	STD2HNK60Z-1	STD2NC45-1
STD2NK60Z-1	STD2NK70Z-1	STD2NK90Z-1
STD3NK60Z-1	STD3NK80Z-1	STD4NK60Z-1
STD4NK80Z-1	STD5NM60-1	STD7NM80-1
STU10NM60N	STU12N65M5	STU13NM60N
STU150N3LLH6	STU16N65M5	STU2LN60K3
STU2N62K3	STU3LN62K3	STU3N45K3
STU3N62K3	STU4N52K3	STU4N62K3
STU5N52K3	STU5N62K3	STU5N95K3
STU60N3LH5	STU60N55F3	STU65N3LLH5
STU6N62K3	STU6N95K5	STU6NF10
STU75N3LLH6	STU75N3LLH6-S	STU7NM60N
STU85N3LH5	STU8N65M5	STU8N80K5
STU8NM50N	STU90N4F3	STU95N2LH5

**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND / OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE ( AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION ), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners

© 2012 STMicroelectronics - All rights reserved.

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan -  
Malaysia - Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)