PRODUCT/PROCESS CHANGE NOTIFICATION

PCN APG-PTS/12/7486
Dated 02 Oct 2012

COPPER WIRE CONVERSION ON BCD2 - PowerSO-20/36 MUAR

Table 1. Change Implementation Schedule

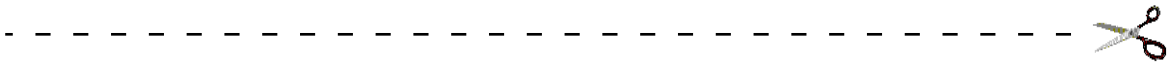
Forecasted implementation date for change	03-Dec-2012
Forecasted availability date of samples for customer	02-Oct-2012
Forecasted date for **STMicroelectronics** change Qualification Plan results availability	02-Oct-2012
Estimated date of changed product first shipment	02-Jan-2013

Table 2. Change Identification

Product Identification (Product Family/Commercial Product)	BCD2 products assembled in PowerSO 20/36 package
Type of change	Package assembly material change
Reason for change	Company program roadmap
Description of the change	Replacement of gold wires with 2mil copper wires for BCD2 products assembled in PowerSO 20/36 package.
Change Product Identification	No marking change: dedicated traceability printed on labels
Manufacturing Location(s)	1]St Muar - Malaysia

Table 3. List of Attachments

Customer Part numbers list	
Qualification Plan results	



Customer Acknowledgement of Receipt	**PCN APG-PTS/12/7486**
Please sign and return to STMicroelectronics Sales Office	**Dated 02 Oct 2012**
☐ Qualification Plan Denied	Name:
☐ Qualification Plan Approved	Title:
	Company:
☐ Change Denied	Date:
☐ Change Approved	Signature:

Remark

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DOCUMENT APPROVAL

Name	Function
Foletto, Giovanni	Marketing Manager
Rivolta, Danilo	Product Manager
Pintus, Alberto	Q.A. Manager

COPPER WIRE CONVERSION

2mil Cu WIRE ON BCD2 - PowerSO-20/36 MUAR

Aim of the current evaluation is to enlarge the scope of 2mil copper wire qualification in PowerSO-20/36 package, including products from BCD2 process technology. The qualification is based on:

- Generic data previously collected: the copper wire bonding has been qualified and implemented on ST automotive products in BCD3, BCD4 and BCD5 process technologies during 2010 and 2011. In PowerSO-20/36 package lines, 2mil and 2.5mil Cu wire are released for mass production in these technologies. Qualification results for the above-mentioned configurations are summarized in SECTION 1.

- Specific qualification trials performed on a BCD2 test-vehicle using 2mil copper wire, organized as follows and detailed in SECTION 2:

    - Dedicated wire-bonding process study to optimize the process parameter window on the specific bond-pad structure of BCD2, similar to the other BCD and especially to BCD3 2 metal option.
      A “process window” has been defined for the key input parameters of the wire bonder, Bond Force and Bond Power: the window is defined by two corner points (High-High, Low-Low) and a middle point NN. The absence of critical wire-bonding responses inside the defined window has been checked, also exploring the “robustness margin” of the process by increasing / decreasing the a.m. parameters outside the allowed window. A thermal ageing has been performed to ensure that the responses are stable against the key field stress factor for CuAl intermetallic phases.

    - Reliability stress tests on three assembly lots of the BCD2 test-vehicle, bonded with nominal and corner parameters in terms of bonding force and power as defined during the process optimization.
      The stress conditions have been set according to AEC-Q100 Grade 1 requirements.

SECTION 1: GENERIC DATA

TEST NAME (AEC-Q100)	CONDITIONS [SPEC]	UH27 REJ./S.S.	UK43 REJ./S.S.	UT29 REJ./S.S.	U478 REJ./S.S.
TC (1)	Ta=-50/+150°C,1000 cycles (PC before test according to JEDEC-020D)	0/120	0/120	0/120	0/154
AC	96h @2atm, 121°C (PC before test according to JEDEC-020D)	0/80	0/80	0/80	-
HTSL	Ta=150°C, 1000h	0/120	0/120	0/120	0/110
PTC	Ta=-40/+95°C,1000h Ts =121 °C	NA	NA	0/50	-
WBS	30 wrs / 5 dev. / C_{PK}>1.33	PASSED	PASSED	PASSED	PASSED
WBP	30 wrs / 5 dev. / C_{PK}>1.33	PASSED	PASSED	PASSED	PASSED

NOTES:

1 Wire pull and ball shear test performed after 1000 TC according to AEC-Q100 requirements

Test-vehicles construction detail

Technical code	:	G8CD*UH27BF1	G9ZS*UK43BCH	G977*UT29BCM	G977*U478CA6
Diffusion process	:	BCD4	BCD5S	BCD5S	BCD3
Wafer diameter	:	8”	6”	8”	6”
Diffusion site	:	AGRATE AG8	CARROLLTON	AGRATE AG8	ANG MO KIO
Die size (mm^2)	:	2.98 x 4.17	3.75 x 4.89	3.13 x 3.61	5.24 x 4.05
Metal levels	:	3, AlCu	3, AlSiCu	3, AlCu	2, AlSiCu
Passivation	:	USG-PSG-SiON-Polyimide	PSG+SiON+Polyimide	Teos+PTeo+SiOn+Polyimide	USG+SiON+Polyimide
Back finishing	:	Cr/Ni/Au	Cr/Ni/Au	Cr/Ni/Au	Cr/Ni/Au
Package name	:	PowerSO 20 SLUG UP	PowerSO 36 .43 SLUG UP	PowerSO 20 SLUG DOWN	PowerSO 20 SLUG DOWN
Assembly site	:	MUAR	MUAR	MUAR	MUAR
Leadframe	:	FRAME PSO19+1	FRAME PSO 36L OptB	FRAME PSO-20	FRAME PSO-20
Die attach	:	Pb/Ag/Sn 97.5/1.5/1	Pb/Ag/Sn 97.5/1.5/1	Pb/Ag/Sn 97.5/1.5/1	Pb/Ag/Sn 97.5/1.5/1
Wire bonding	:	Cu, 2 mil	Cu, 2 mil	Cu, 2 mil	Cu, 2.5 mil
Molding compound	:	HITACHI CEL 9240HF10	HITACHI CEL 9240HF10	HITACHI CEL 9240HF10	HITACHI CEL 9240HF10
Lead finishing	:	Matte Sn	Matte Sn	Matte Sn	Matte Sn

SECTION 2: QUALIFICATION TRIALS

2.1 WIRE BONDING PROCESS CENTERING

– ST Internal –

2.0mil Cu on BCD2-PSO20L
Bond Pad Validation

Adrian Pastoral / Nurhashimah Hashim
(NPI Lead frame – Muar)
November 2011

STMicroelectronics

Materials and Equipments

Materials and Equipment	
Leadframe	5FT18518
Lead Finishing	Spot Ag
Device	G977*U705BC6
Bond Pad Metallization	2M
BPO	178 X 178um
Wire Bonder	ASM Extreme (XT19-093)
Wire	HERAEUS 2.0mil Cu DHF Wire – 5XC13887
Capillary	GAISER (P/N: 2CA5797M) *[follow HQ64L – 2.0mil Cu On BCD3/4/5 150umBPO]*
WCTP Configuration	STD WC and 2deg Slope TP
Plasma Cleaning	March – Strip Plasma
Tester	Dage 4000
Measuring Scope	Olympus – Model STM6-F21-3

BPV A: 2.0mil Cu on BCD2 Bond Pad Validation (LL-10% – LL – NN – HH – HH+10%)

Machine Type: ASM Extreme (XT19-093)
Wire Type:2.0mil Cu
Bond Pad Metallization: 2M
Last Metal Layer: AlSiCu / 3.00um

- **Objective :** To validate LL-10%-LL-NN – HH - HH+10% 1st bond parameter.

TIME ZERO RESPONSE

LEG		BOND POWER (dac)	BOND FORCE (gF)	Lifted metal / cratering @ Bonding SS: 1 frame/408 wires	Lifted metal / cratering @ manual pull (SS: 306 wires)	Lifted metal / cratering @ std pull (SS: 51 wires)	Lifted metal / cratering @ Ballshear (SS: 51 wires	Cratering test (agua regia) SS: 3 units/51 wires	Pull Test (LSL: 17gm) SS: 51 wires		Individual Ball Shear LSL = 80g ..... USL = 226g .....Target = 153g SS: 51 wires		Ball Size (Spec: 115 - 140) Target: 130um SS: 10 balls		Ball Height (Spec: 23 - 38) Target: 30um SS: 10 balls		BAR LSL = 3 .....USL = 6 .....Target = 4 SS: 10 balls	
A1	LL-10%	50	86	0	0	2	0	0	Max	58.26	Max	141.7	Max	133.40	Max	32.30	Max	4.46
									Ave	50.60	Ave	121.04	Ave	131.29	Ave	30.50	Ave	4.31
									Min	28.83	Min	102.45	Min	128.10	Min	28.70	Min	4.06
									CpK	2.31	CpK	1.84						
A2	LL	55	95	0	0	0	0	0	Max	59.76	Max	156.55	Max	134.50	Max	31.70	Max	4.74
									Ave	51.84	Ave	129.38	Ave	131.57	Ave	29.99	Ave	4.39
									Min	44.74	Min	107.29	Min	129.40	Min	28.00	Min	4.19
									CpK	3.27	CpK	1.70						
A3	NN	60	100	0	0	0	0	0	Max	59.92	Max	172.61	Max	134.40	Max	32.40	Max	4.53
									Ave	51.44	Ave	149.85	Ave	131.57	Ave	31.48	Ave	4.18
									Min	41.02	Min	132.58	Min	128.80	Min	28.80	Min	4.03
									CpK	2.83	CpK	2.58						
A4	HH	65	105	0	0	0	0	0	Max	58.02	Max	179.41	Max	134.00	Max	33.30	Max	4.54
									Ave	51.87	Ave	156.10	Ave	132.00	Ave	31.71	Ave	4.17
									Min	44.79	Min	140.08	Min	128.40	Min	28.60	Min	3.86
									CpK	3.52	CpK	2.89						
A5	HH+10%	72	116	0	0	0	0	0	Max	60.19	Max	199.89	Max	135.00	Max	32.80	Max	4.72
									Ave	51.40	Ave	160.24	Ave	131.73	Ave	30.35	Ave	4.35
									Min	42.62	Min	144.77	Min	128.80	Min	27.70	Min	4.06
									CpK	2.56	CpK	2.30						

- Fixed Parameters: Gas Flow: 0.8 L/min = C-nozzle, 0.3 L/min = E-torch
  - Base Time: 25 msec EFO Current: 150mA EFO Time: 1.25 mseC
- Machine: ASM Extreme (XT19-093)

Summary:

1. **LL-10% encountered Lifted Metal during Standard Pull.**
2. **LL, NN,HH,HH+10% setting passed all response requirements including Ballshear and Pulltest CPK>1.67.**

BPV A: 2.0mil Cu on BCD2 Bond Pad Validation (LL-10% – LL – NN – HH – HH+10%)

Machine Type: ASM Extreme (XT19-093)
Wire Type:2.0mil Cu
Bond Pad Metallization: 2M
Last Metal Layer: AlSiCu / 3.00um

- **Objective :** To validate LL-10%-LL-NN – HH - HH+10% 1st bond parameter.

TIME = 168hrs RESPONSE @175degC STORAGE

LEG		BOND POWER (dac)	BOND FORCE (gF)	Lifted metal / cratering @ manual pull (SS: 306 wires)	Lifted metal / cratering @ std pull (SS:51 wires)	Lifted metal / cratering @ Ballshear (SS:51 wires)	Pull Test (LSL: 17gm) SS: 51 wires		Individual Ball Shear LSL = 80g ..... USL = 226g .....Target = 153g SS: 51 wires	
A1	LL-10%	50	86	0	0	0	Max	61.47	Max	192.26
							Ave	50.44	Ave	155.13
							Min	43.39	Min	98.18
							CpK	2.91	CpK	1.61
A2	LL	55	95	0	0	0	Max	58.86	Max	204.86
							Ave	50.16	Ave	165.45
							Min	43.97	Min	132.90
							CpK	2.78	CpK	1.94
A3	NN	60	100	0	0	0	Max	59.90	Max	229.97
							Ave	50.54	Ave	181.38
							Min	41.51	Min	153.25
							CpK	2.68	CpK	2.16
A4	HH	65	105	0	0	0	Max	60.46	Max	216.43
							Ave	50.52	Ave	188.97
							Min	42.24	Min	159.90
							CpK	2.66	CpK	3.34
A5	HH+10 %	72	116	0	0	0	Max	59.63	Max	247.08
							Ave	50.15	Ave	196.83
							Min	37.62	Min	161.97
							CpK	2.63	CpK	2.63

- Fixed Parameters: Gas Flow: 0.8 L/min = C-nozzle, 0.3 L/min = E-torch
  - Base Time: 25 msec EFO Current: 150mA EFO Time: 1.25 mseC
- Machine: ASM Extreme (XT19-093)

Summary:

1. **LEG A1 having low Ballshear CpK <1.67.**
2. **LEGS A2, A3, A4 and A5 passed all response requirements including Ballshear and Pulltest CpK >1.67.**

BPV A: 2.0mil Cu on BCD2 Bond Pad Validation (LL-10% – LL – NN – HH – HH+10%)

Machine Type: ASM Extreme (XT19-093)
Wire Type:2.0mil Cu
Bond Pad Metallization: 2M
Last Metal Layer: AlSiCu / 3.00um

- **Objective :** To validate LL-10%-LL-NN – HH - HH+10% 1st bond parameter.

TIME = 336hrs RESPONSE @175degC STORAGE

LEG		BOND POWER (dac)	BOND FORCE (gF)	Lifted metal / cratering @ manual pull (SS: 306 wires)	Lifted metal / cratering @ std pull (SS:51 wires)	Lifted metal / cratering @ Ballshear (SS:51 wires)	Pull Test (LSL: 17gm) SS: 51 wires		Individual Ball Shear LSL = 80g ..... USL = 226g .....Target = 153g SS: 51 wires	
A1	LL-10%	50	86	0	0	0	Max	60.86	Max	172.55
							Ave	52.04	Ave	148.83
							Min	37.08	Min	125.73
							CpK	2.58	CpK	2.44
A2	LL	55	95	0	0	0	Max	58.97	Max	187.42
							Ave	51.43	Ave	161.28
							Min	44.73	Min	132.08
							CpK	3.38	CpK	2.84
A3	NN	60	100	0	0	0	Max	60.16	Max	184.46
							Ave	50.61	Ave	168.49
							Min	44.17	Min	132.99
							CpK	2.80	CpK	2.79
A4	HH	65	105	0	0	0	Max	58.73	Max	189.79
							Ave	50.57	Ave	172.33
							Min	41.63	Min	140.89
							CpK	2.67	CpK	3.27
A5	HH+10%	72	116	0	0	0	Max	58.54	Max	191.96
							Ave	50.39	Ave	176.63
							Min	40.87	Min	144.55
							CpK	2.62	CpK	3.18

- Fixed Parameters: Gas Flow: 0.8 L/min = C-nozzle, 0.3 L/min = E-torch
  - Base Time: 25 msec EFO Current: 150mA EFO Time: 1.25 mseC
- Machine: ASM Extreme (XT19-093)

Summary:

- **All LEGS passed Response requirements including CpK at >1.67.**

2.0mil Cu on BCD2 Bond Pad Validation
Robust Validation

Machine Type: ASM Extreme (XT19-093)
Wire Type:2.0mil Cu
Bond Pad Metallization: 2M
Last Metal Layer: AlSiCu / 3.00um

- **Objective :** To do robust validation beyond the LL and HH parameter setting..

Robust Validation Response				
LEG	BOND POWER (dac)	BOND FORCE (gF)	Lifted metal / cratering @ Wirebond (SS: 102 wires)	Lifted metal / cratering @ Manual Pull (SS: 102 wires)
LL-20%	44	76	0	1
LL-30%	39	67	0	3
LL-40%	33	57	0	11
LL-50%	28	46	0	19
LL-60%	22	36	2	22

Robust Validation Response				
LEG	BOND POWER (dac)	BOND FORCE (gF)	Lifted metal / cratering @ Wirebond (SS: 102 wires)	Lifted metal / cratering @ Manual Pull (SS: 102 wires)
HH+20%	78	126	0	0
HH+30%	85	137	0	0
HH+40%	91	147	5	18
HH+50%	_	_	_	_
HH+60%	_	_	_	_

- Fixed Parameters: Gas Flow: 0.8 L/min = C-nozzle, 0.3 L/min = E-torch
  - Base Time: 25 msec EFO Current: 150mA EFO Time: 1.25 mseC
- Machine: ASM Extreme (XT19-093)

Summary:

1. **Low parameter side encountered Lifted Metal during WB at LL-60%, but Lifted @ Manual pull seen from LL-20%.**
2. **High parameter side encountered Cratering during WB at HH+40%. Manual Pull Cratering also seen at HH+40%.**

2.2 RELIABILITY EXERCISE

Reliability Test Status								
No	Test Name	Prec	Condition/ Method	Steps	Steps	Fails/SS		
						9920507205 Lot A (NN Parameter)	99205072ZY Lot B (LL Parameter)	99205072ZZ Lot C (HH Parameter)
1	PC (JL3 STD)		Reflow Profile = J-STD-020D (Tmax = 245°C)	Final	ATE	0 def / 159pcs	0 def / 159pcs	0 def / 159pcs
					TSAM	0 del / 30pcs	0 del / 30pcs	0 del / 30pcs
					CSAM TOP	0 del / 30pcs	0 del / 30pcs	0 del / 30pcs
2	TC	Yes	Ambient Temp Range = -50°C / +150°C	500 Cycle	ATE	0 def / 82pcs	0 def / 82pcs	0 def / 82pcs
					TSAM	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM TOP	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
				1000 Cycle	ATE	0 def / 77pcs	0 def / 77pcs	0 def / 77pcs
					TSAM	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM TOP	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM BOT	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
3	ENV SEQ	Yes	Ambient Temp Range = TC = -50°C / +150°C + PPT = 121°C / 2 Atm	100 Cycle + 96hrs	ATE	0 def / 77pcs	0 def / 77pcs	0 def / 77pcs
					TSAM	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM TOP	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
4	HTS	No	Ambient Temp Range = 150°C	500Hrs	ATE	0 def / 50pcs	0 def / 50pcs	0 def / 50pcs
					T-SAM	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM TOP	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
				1000Hrs	ATE	0 def / 45pcs	0 def / 45pcs	0 def / 45pcs
					TSAM	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM TOP	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs
					CSAM BOT	0 del / 15pcs	0 del / 15pcs	0 del / 15pcs

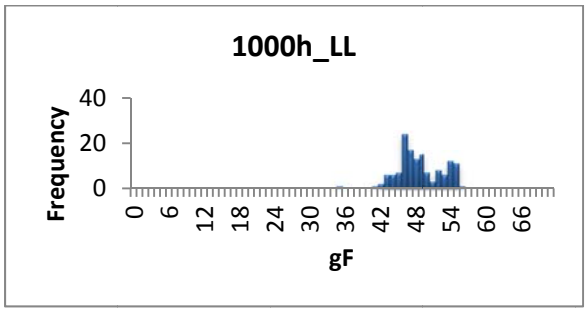
READOUT ITEMS LEGENDA:

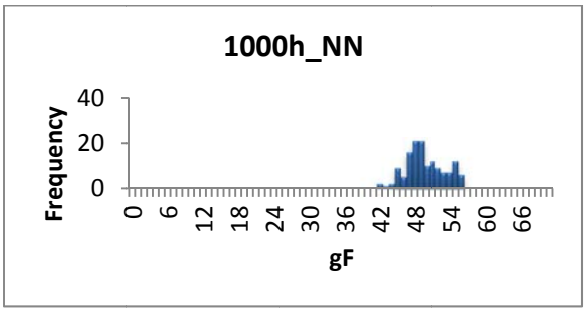
ATE: Automatic Test Equipment (“X def” means X functional failures)

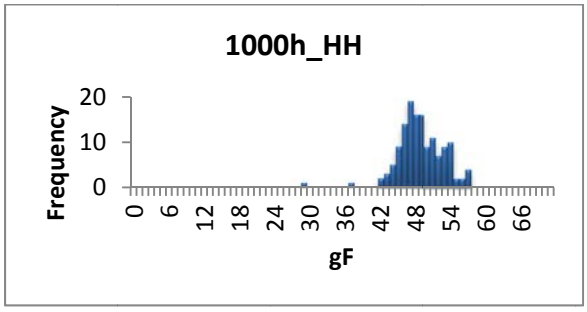
TSAM: Transmission Scanning Acoustic Microscope (“X del” means X delaminated units)

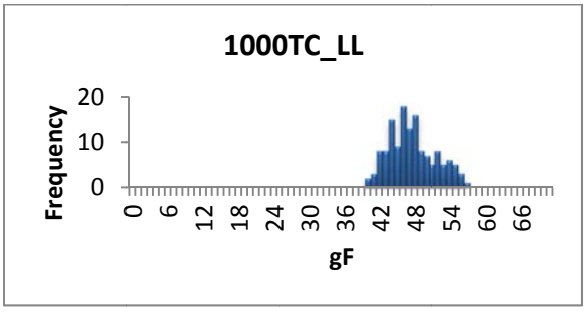
CSAM TOP: Reflection Scanning Acoustic Microscope (“X del” means X delaminated units)

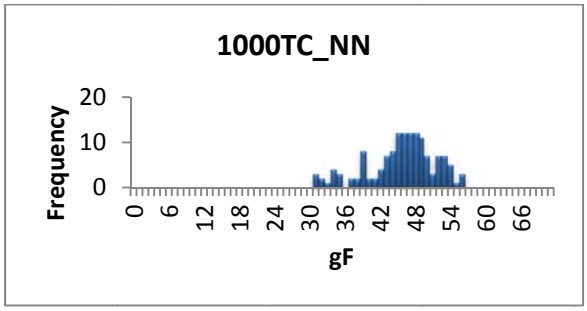
WPT has been performed after HTSL and TC stress tests for wire bonding integrity check; correct readings have been observed and no ball lifts occurred. Relevant force distributions are here below reported.

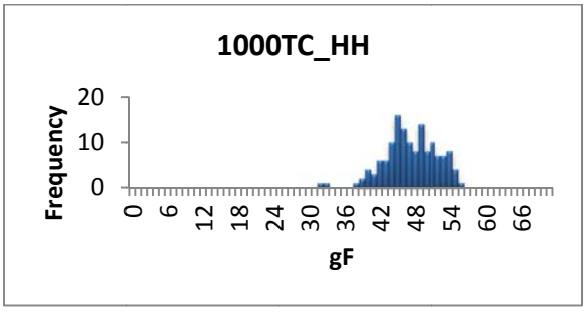












Test-vehicles construction detail

Technical code	:	A977*UB25CA6
Diffusion process	:	BCD2
Wafer diameter	:	8”
Diffusion site	:	ANG MO KIO
Die size (mm^2)	:	5.21 x 4.51
Metal levels	:	2, AlSiCu
Passivation	:	SiN (nitride)
Back finishing	:	RAW Silicon

Package name	:	PowerSO 20 SLUG DOWN
Assembly site	:	MUAR
Leadframe	:	FRAME PSO-20
Die attach	:	Pb/Ag/Sn 97.5/1.5/1
Wire bonding	:	Cu, 2 mil
Molding compound	:	HITACHI CEL 9240HF10
Lead finishing	:	Matte Sn

CHANGE TRACEABILITY:

Full traceability of the change is guaranteed through dedicated finished good codifications printed on product labels.

CHANGE IMPLENMENTATON:

We are ready to implement the change in production from beginning of December 2012 onward, upon customer’s agreement.

Qualification samples are available, on demand, through our Sales offices.

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Public Products List

PCN Title : COPPER WIRE CONVERSION ON BCD2 - PowerSO-20/36 MUAR
PCN Reference : APG-PTS/12/7486
PCN Created on : 28-SEP-2012

Subject : Public Products List

Dear Customer,

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

ST COMMERCIAL PRODUCT

L9651	L9651-TR	L9822EPD
L9822EPD013TR		

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