



NON-CONFORMANCE CONTROL SHEET

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IDENTIFICATION	Component Family:	INTEGRATED CIRCUITS, SILICON MONOLITHIC, HCMOS 8-BIT LATCH/SHIFT REGISTER WITH FULLY BUFFERED OUTPUTS BASED ON TYPE 54HC597		ESCC Generic Spec. and Issue:	9000 Issue 6	
	ESCC Comp. Type No:	930605401F	Purchase Order No:	5015174	ESCC Detail Spec. and Issue:	9306054 Issue 3
			Order placed by:	ALTER PAIN		
	Manufacturer Name:	STMicroelectronics			Plant Location:	Rennes(F)
Lot No:	33247008ZS/1	Date Code see annex1 batches	1502A	Serial No or Range all	21parts	
NC DETECTED AT		Qualification/MoQ <input type="checkbox"/> Procurement <input type="checkbox"/> Receiving Insp. <input type="checkbox"/> Manufacturing <input type="checkbox"/> In-process Insp. <input type="checkbox"/> Precap Visual Insp. <input type="checkbox"/> Final Prod. Tests <input type="checkbox"/> Burn-In / Screening <input type="checkbox"/> Lot Accept. <input type="checkbox"/> Other <input checked="" type="checkbox"/>				
NON-CONFORMANCE DESCRIPTION	(a) Observed Non-Conformance In the frame of a dedicated project, the final Customer has submitted some above mentioned devices to radiation testing up to 100krad (with intermediate steps at 25-50- 62.5 -75- 87.5 krad) @ 370rad/h, followed by a 24h room temp annealing and then by a 168h @100°C annealing . The obtained results were different from the one provided by ST with the lot: ref RVT3323200D01 (wafer3 from diffusion runZ145-980): Customer results were: <ul style="list-style-type: none"> - IDDA and IDDB out of ESCC specification, - VTHN/VTHP no more measurable. 					
	(b) Suspected cause After looking at the data customer provided us, comparing them to our radiation test results and checking the whole Z145-980 wafer lot radiation behaviour, we could assess – as a potential root cause - that the sampling we performed on the wafer 3 was not representative of the whole wafer; Let us explain: we check our wafers availability on this device and found a single wafer lot Z145-980 from our Carrollton wafer fab (remind that Carrollton US wafer fab is closed since many years and that the qualification transfer to AMK6" is ongoing – ref to PCN16005). The radiation performance of this old wafer lot shown from a total of 6 tested wafers, 3 wafers failed and 3 other passed @50krad. So this wafer lot seems to be not optimum regarding radiation behavior.					
	Initiator :	S.Péron	Chief Inspector :	S.Péron	ESCC Executive:	J.Carron JP.Bussenot
Date :		Date:		Date:		LEVEL 2 : <input checked="" type="checkbox"/>
RESOLUTION	Place of NRB:	NRB members (Name and signature):				DCR Required
	Conf call/webex	<ul style="list-style-type: none"> - JP.Bussenot – CNES - J.Carron – CNES - S.Hernandez – ESA - G.Chaumont – ST - A.Uguen –ST - S.Péron -ST 				
	Date:	03/04/2018				
Actual/ detected cause of non-conformance:						



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NRB decision and actions (incl. individual(s) responsible for action(s) and due date(s)):			
CLOSE-OUT	NRB decision implemented	Chief Insp. Name:	Date
	ESCC Executive certification	Name:	Date
	Diffusion: ESCC secretariat, ESCC Executive, Chief Inspector		

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NC Summary / Status / Actions

HCMOS radiation testing summary:

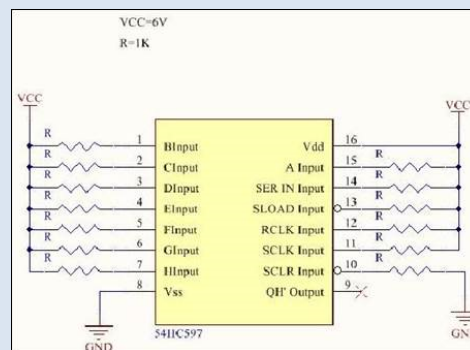
The radiation testing on this family is driven by ST internal procedure 0043082 that could be summarized as below (extract from the rev N applicable at that time of wafer 3 testing):

- Each wafer shall pass radiation testing prior any use in production,
- From each wafer, 5p (including 1 ref part) shall be submitted to Co60 radiation testing, dose rate should not exceed 300 rad/h and targeted total dose = 50krad,
- After irradiation, parts are transferred under bias from the Co60 lab to ST Rennes facilities for electrical testing (§2.3.1 and §2.9.2 of ESCC detail spec),
- Parts have to be submitted to 168h@100°C annealing under bias. Same polarization as during the irradiation,
- Last electrical test to be done per §2.3.1 DC and §2.9.2 of ESCC detail specification.

Wafer acceptance: Rad-Hard HCMOS wafers will be accepted if the post radiation measurements on all the 4 samples meet the §2.9.2 of ESCC detail specification, and if the post annealing measurements on the 4 samples satisfy the §2.3.1 DC of ESCC detail specification.

ST wafer 3 radiation testing results: Please refer to attached “total dose test report 3323200D01”

Polarisation schematic use during radiation testing :



MRB Actions follow-up:

1. ST to perform new radiation testing on available overage parts (Engineering model Quality level) from the same wafer (N°3) and using an external lab (TRAD located at Toulouse)
 - 7p from DC31429 (including 1 ref part)
 - 1p from DC31502

Testing conditions: Same condition as the one used by Alter (except dose rate 210rad/h instead of 370rad/h) with the following steps:

- o Initial measurements per ESCC detail specification
- o Irradiation up to 50krad within intermediate step at 25krad
- o Post-radiation electrical measurements
- o 24h Room temperature annealing
- o 168h / 100°Ctemperature annealing

Conclusion: After radiation, the observed drift on the consumption current is similar to the one observed by Atler. After annealing it recovers and go back into ESCC detail specification limit. Thus we confirmed that the ST



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trials done years ago and this actual one are different, nevertheless no rational could be given. But these last trials results, even with High consumption current, are not critical for the product use because the increase do not affect the reliability of the product. It is the typical behaviour of the HCMOS under radiation

2. ST to perform new trial on few returned parts (6p including 1 ref part) from Alter lot, targeting 75krad with intermediate steps at 25-50krad, and with lower dose rate 36rad/h.

Conclusion @25krad: all parts are functional with electrical parameters within ESCC specification. Thus it doesn't confirm higher dose rate testing.

Next steps are forecasted as follow:

- 50krad → April 20th
- 75krad → May 21st
- End of annealing → May 29th,

3. In order to delimitate the NC perimeter, ST will irradiate parts from wafer 12 (same waferlot). Available parts (5p including 1 ref part) from Overage DC1736

Testing conditions: Same condition as the one used by Alter (except dose rate 210rad/h instead of 370rad/h) with the following steps

- o Initial measurements per ESCC detail specification
 - o Irradiation up to 50krad within intermediate step at 25krad
 - o Post-radiation electrical measurements
 - o 24h Room temperature annealing
 - o 168h / 100°Ctemperature annealing
- Due date → April 17th
 - End of annealing → April 25th
4. Additional actions: ST will identify the deviation between the ESCC22900 and ST internal procedure for HCMOS radiation testing (i.e. time length between end of irradiation and first electrical testing, max dose rate), as well as some improvement based on the Mil-std-883 TM1019 "spirit" (ex: after radiation to check only device functionality, after annealing to check device electrical parameters). All these deviation/improvement will be first submitted to the Radiation Working Group

Next MRB: May 24th – 2:00pm

Minutes of Meeting MRB May 24th

MRB members: Jérôme Carron –CNES / Géraldine Chaumont, André Uguen, Sylvie Péron -ST

The pending actions have been reviewed and stated as below:

Action 2: Trials on wafer 3/ at very low dose rate (36rad/h) on Alter parts (trial that reflect Juice project environment).

- @ 50krad, results are much better than 360rad/h, still within specification limits,
- @75krad, results are quite good. Only the V_{thp} @ 75krad is slightly above 1.4V. All others parameters remain within the specifications all along the test, no significant drift observed on the consumption current. At that time, the behaviour at 36rad/h is in line with observations done by ST during the RVT.
ref to draft report: TRAD_TR_M54HC597_1502A_STM_JPA_1802_24h_Draft.pdf



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- Annealing = still running → to be available May 29th : as soon as ready ST will share the results

Action 3: Trials on wafer 12/same waferlot: Results are good and similar to what has been observed by ST on the RVT done on wafer 3. The $V_{th}@25krad$ values is linked to the increase of the I_{cc} . To obtain the real V_{th} values @ 25krad, the current setpoint might be increased accordingly to the I_{cc} value
ref to report : "TRAD_TR_M54HC597DT_1736A_STM_AM_1803_rev0.pdf"

Conclusion: this NC perimeter is limited to wafer 3 of this waferlot

Action 4: ST has proposed wording to the radiation working group that will be reviewed during their next meeting on June 14th.

Next MRB for closure: June 22th – 10:30am

Minutes of Meeting MRB June 22nd

MRB members: Jérôme Carron –CNES / Géraldine Chaumont, André Uguen, Sylvie Péron -ST

The pending actions have been reviewed and stated as below:

Action 2: Trials on wafer 3/ at very low dose rate (36rad/h) on Alter parts (trial that reflect Juice project environment).

Annealing @ 100°C ended as forecasted. No rebond observed.
ref to draft report: TRAD_TR_M54HC597_1502A_STM_JPA_1802_Rev0.pdf

Conclusion: these trials on wafer 3/ at very low dose rate (36rad/h) on Alter parts confirm the behaviour of our devices up to 50krad (level for which our family is qualified) is conform with RHA ESCC requirement for this family. The extended dose up to 75krad should answer to the expectation of Juice project environment.

Action 4: The ST proposed wording about deviation insertion into the ESCC detail specification of the HCMOS family – as below mentioned - to the radiation working group was reviewed during the session of June 14th.

"Time intervals for measurement:

Post irradiation electrical characterization starts more than 1 hour of completion of exposure

Flow chart for qualification and lot acceptance testing:

At the end of the irradiation test, only a functional test is done.

The duration of the room temperature anneal could be extended to an appropriate period of time to allow leakage-related parameters that may have exceeded their pre-irradiation specification to return to within specification"

The answer was positive and it will be mentioned in the MoM of the RWG that is still under community validation. So MRB is proposed to wait for this MoM report as well as formal DCR to be issued by ST to all ESCC detail specifications, for closing this NCCS. It will be then closed by correspondence.