SGS-THOMSON MICROELECTRONICS

QN111 QUALITY NOTE

PRELIMINARY QUALIFICATION INFORMATION for NEW FABRICATION FACILITIES for EPROM

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The Product Change Notice MPG/NV/6008 was issued recently to announce the transfer of EPROM production to a new wafer fabrication plant in Phoenix, USA. This is a very modern plant processing 8" wafers in technologies down to 0.35 micron.

The EPROM technology running in this plant uses two processes: E5-U35 which is an 0.8 micron process that has been upgraded by 35%, and the E6-DM which is a new 0.6 micron, double metal process. A test vehicle product was chosen for the qualification of each of these processes:

- The 8Mb M27C801 EPROM for the E5-U35 process
- The 4Mb M27C4001 EPROM for the E6-DM process

The qualification has taken into account three aspects: the intrinsic fabrication facility quality, the characterisation and electrical stability of the products compared to the previous fabrication facility and the reliability tests performed on test lots.

INTRINSIC FABRICATION FACILITY QUALITY

A well accepted and formalised quality index to compare wafer fabrication plants is the "average defectivity per square centimeter per mask level". This defectivity is derived from the electrical wafer testing yields by applying simple statisatical models. The results for the D0 index show that up at the end of March 1997 the defectivity of the new Phoenix, USA fabrication facility was 10% better than the previously used facility in Agrate, Italy. This is an expected result for this more modern plant.

Table 1. Defectivity D0 (Defects/cm^2/Mask level)

Fabrication Facility	Parameter	Previous Year 1996	Jan. 1997	Feb. 1997	Mar. 1997
Phoenix, USA. 8" wafers	D0 Total	0.025	0.027	0.032	0.030
	D0 Top Ten Runners	0.025	0.027	0.032	0.030
Agrate, Italy. 6" wafers	Do Total	0.0331	0.043	0.0379	0.0327
	D0 Top Ten Runers	0.0273	0.027	0.0262	0.0261

RELIABILITY

The process architecture of the products, the process controls, equipment, chemicals and photoresist were unchanged, leading to the expectation of excellent reliability results. In accordance with ST Standard Operating Procedures both test vehicles have been submitted to intensive reliability tests with the very positive result that no defects have currently been found.

The reliability tests and results are in Tables 2 to 5.

CHARACTERISTICS AND STABILITY OF ELECTRICAL PARAMETERS

Reflecting the overall stability of the products' design, a comparison of the main electrical characteristics of both test vehicles in the worst case conditions of supply voltage and/or temperature, does not show any significant variations from the previous fabrication facility.

The results are shown in Tables 6 to 9.

A complete Qualification Report will be published. For more information please contact your nearest SGS-THOMSON Sales Office.

Table 2. M27C4001 UV EPROM version, FDIP32W package, E6-DM Process, Phoenix USA

Sub-group	Test Procedure	MIL-STD-883 Procedure	Test Conditions	Results			Note
				Lots	Samp.	Fail	
1	Operating Life Test	1005	140°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	3	 228 228 228 228	 0 0 0 0	
2	Operating Life Test	1005	–40°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	3	 108 108 108 108	 0 0 0 0	
3	Retention Bake	1008	250°C, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	3	 300 300 300 300	 0 0 0 0	
4	Temperature Cycling	1010	–65 to 140°C, – 100 cycles – 500 cycles – 1000 cycles	2	 103 103 103	 0 0 0	

Table 3. M27C4001 OTP EPROM version, PLCC32 package, E6-DM Process, Phoenix USA

Sub-group	Test Procedure	MIL-STD-883 Procedure	Test Conditions	Results			Note
				Lots	Samp.	Fail	
1	Operating Life Test	1005	140°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	3	 170 170 170 170	 0 0 0 0	
2	Retention Bake	1008	150°C, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	3	 185 185 185 185	 0 0 0 0	
3	Temperature, Humidity, Bias	CECC 90,000	85°C, RH = 85%, V_{CC} = 5.5V, – 168 hrs – 500 hrs – 1000 hrs	3	 180 180 180	 0 0 0	
4	Temperature Cycling	1010	–65 to 150°C, – 100 cycles – 500 cycles	3	 180 180	 0 0	
5	Pressure Pot		121°C, 2 Atm, – 96 hrs – 168 hrs – 240 hrs	3	 180 180 180	 0 0 0	

Table 4. M27C801 UV EPROM version, FDIP32W package, E5-U35 Process, Phoenix USA

Sub-group	Test Procedure	MIL-STD-883 Procedure	Test Conditions	Results			Note
				Lots	Samp.	Fail	
1	Operating Life Test	1005	140°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	5	 420 420 420 420	 0 0 0 0	
2	Operating Life Test	1005	–40°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	2	 57 57 57 57	 0 0 0 0	
3	Retention Bake	1008	250°C, – 168 hrs – 500 hrs – 1000 hrs – 2000 hrs	6	 508 508 508 508	 0 0 0 0	

Table 5. M27C801 OTP EPROM version, PLCC32 package, E5-U35 Process, Phoenix USA
Formal Product Qualification on-going on further lots

Sub-group	Test Procedure	MIL-STD-883 Procedure	Test Conditions	Results			Note
				Lots	Samp.	Fail	
1	Operating Life Test	1005	140°C, V_{CC} = 7V, – 168 hrs – 500 hrs – 1000 hrs	1	 70 70 70	 0 0 0	
2	Retention Bake	1008	150°C, – 168 hrs – 500 hrs – 1000 hrs	1	 70 70 70	 0 0 0	
3	Temperature, Humidity, Bias	CECC 90,000	85°C, RH = 85%, V_{CC} = 5.5V, – 168 hrs – 500 hrs – 1000 hrs	1	 60 60 60	 0 0 0	
4	Temperature Cycling	1010	–65 to 150°C, – 100 cycles – 500 cycles – 1000 cycles	1	 60 60 60	 0 0 0	
5	Pressure Pot		121°C, 2 Atm, – 96 hrs – 168 hrs – 240 hrs – 336 hrs	1	 60 60 60 60	 0 0 0 0	

Table 6. M27C4001 E6-DM Process, Phoenix USA - Read Mode DC Characteristics

Symbol	Parameter	Test Condition	Measurement	Fabrication Facility		Data Sheet	Unit
				Agrate, Italy	Phoenix, USA		
I_{CC2}	Supply Current (Standby) CMOS	$\overline{E} > V_{CC} - 0.2V$, $V_{CC} = 5.5V$, $T_A = 0°C$	Min	13	10		µA
			Avg	13	11		
			Max	14	12	100	
			Std Deviation	0	0.4		
I_{CC1}	Supply Current (Standby) TTL	$\overline{E} = V_{IH}$, $V_{CC} = 5.5V$, $T_A = 0°C$	Min	0.31	0.28		mA
			Avg	0.32	0.28		
			Max	0.33	0.28	1	
			Std Deviation	0	0		
I_{CC}	Supply Current	$\overline{E} = V_{IL}$, $\overline{G} = V_{IL}$, $I_{OUT} = 0mA$, $V_{CC} = 5.5V$, $T_A = 0°C$, Static	Min	10.3	9.1		mA
			Avg	10.5	9.2		
			Max	10.9	9.4	–	
			Std Deviation	0.2	0.1		
I_{CC}	Supply Current	$\overline{E} = V_{IL}$, $\overline{G} = V_{IL}$, $I_{OUT} = 0mA$, $V_{CC} = 5.5V$, $T_A = 0°C$, f = 5MHz	Min	13.0	11.8		mA
			Avg	13.2	12.0		
			Max	13.4	12.2	30	
			Std Deviation	0.1	0.14		
I_{PP}	Program Current	$V_{PP} = V_{CC} = 5.5V$, $T_A = 0°C$	Min	–0.50	–3.00		µA
			Avg	–0.20	–1.06		
			Max	0.20	0.40	10	
			Std Deviation	0.20	0.91		
V_{IL}	Input Low Voltage	$V_{CC} = 4.5V$, $T_A = 70°C$	Min	1.20	1.22		V
			Avg	1.22	1.24		
			Max	1.24	1.26	0.8	
			Std Deviation	0.01	0.01		
V_{IH}	Input High Voltage	$V_{CC} = 5.5V$, $T_A = 0°C$	Min	1.50	1.52	2	V
			Avg	1.53	1.55		
			Max	1.54	1.56		
			Std Deviation	0.01	0.01		
V_{OH}	Output High Voltage TTL	$I_{OH} = –400µA$, $V_{CC} = 4.5V$, $T_A = 70°C$	Min	4.30	4.24	2.4	V
			Avg	4.30	4.25		
			Max	4.30	4.25		
			Std Deviation	0	0.01		
V_{OL}	Output Low Voltage	$I_{OL} = 2.1mA$, $V_{CC} = 4.5V$, $T_A = 70°C$	Min	0.16	0.14		V
			Avg	0.16	0.15		
			Max	0.16	0.15	0.4	
			Std Deviation	0	0		
V_{CC} (min)	Supply Voltage	$T_A = 0°C$, function	Min	2.80	2.55	4.5	V
			Avg	2.90	2.72		
			Max	3.60	2.95		
			Std Deviation	0.2	0.11		
V_{CC} (max)	Supply Voltage	$T_A = 70°C$, function	Min	7.50	7.50		V
			Avg	7.50	7.50		
			Max	7.50	7.50	5.5	
			Std Deviation	0	0		

Table 7. M27C4001 E6-DM Process, Phoenix USA - Read Mode AC Characteristics

Sym-bol	Alt	Parameter	Test Condition	Measurement	Fabrication Facility		Data Sheet	Unit
					Agrate, Italy	Phoenix, USA		
t_{AVQV}	t_{ACC}	Address Valid to Output Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	48	50		ns
				Avg	48	51		
				Max	50	53	70	
				Std Deviation	1	1		
t_{AVQV}	t_{ACC}	Address Valid to Output Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	55	58		ns
				Avg	57	61		
				Max	60	65	70	
				Std Deviation	2	2		
t_{ELQV}	t_{CE}	Chip Enable Low to Output Valid	$\overline{G}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	48	48		ns
				Avg	49	49		
				Max	50	50	70	
				Std Deviation	1	1		
t_{ELQV}	t_{CE}	Chip Enable Low to Output Valid	$\overline{G}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	55	58		ns
				Avg	58	60		
				Max	60	63	70	
				Std Deviation	1	2		
t_{GLQV}	t_{OE}	Output Enable Low to Output Valid	$\overline{E}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	25	23		ns
				Avg	25	23		
				Max	25	23	35	
				Std Deviation	0	0		
t_{GLQV}	t_{OE}	Output Enable Low to Output Valid	$\overline{E}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	28	25		ns
				Avg	28	28		
				Max	28	33	35	
				Std Deviation	0	2		

Table 8. M27C801 E5-U35 Process, Phoenix USA - Read Mode DC Characteristics

Symbol	Parameter	Test Condition	Measurement	Fabrication Facility		Data Sheet	Unit
				Agrate, Italy	Phoenix, USA		
I_{CC2}	Supply Current (Standby) CMOS	$\overline{E} > V_{CC} - 0.2V$, $V_{CC} = 5.5V$, $T_A = 0°C$	Min	10	10		µA
			Avg	13	13		
			Max	18	16	100	
			Std Deviation	2	2		
I_{CC1}	Supply Current (Standby) TTL	$\overline{E} = V_{IH}$, $V_{CC} = 5.5V$, $T_A = 0°C$	Min	0.33	0.32		mA
			Avg	0.32	0.31		
			Max	0.33	0.31	1	
			Std Deviation	0	0		
I_{CC}	Supply Current	$\overline{E} = V_{IL}$, $\overline{G} = V_{IL}$, $I_{OUT} = 0mA$, $V_{CC} = 5.5V$, $T_A = 0°C$, Static	Min	9.1	8.6		mA
			Avg	9.2	8.9		
			Max	9.4	9.1	–	
			Std Deviation	0.1	0.13		
I_{CC}	Supply Current	$\overline{E} = V_{IL}$, $\overline{G} = V_{IL}$, $I_{OUT} = 0mA$, $V_{CC} = 5.5V$, $T_A = 0°C$, f = 5MHz	Min	14.4	14.0		mA
			Avg	14.6	14.2		
			Max	14.8	14.5	30	
			Std Deviation	0.1	0.1		
I_{PP}	Program Current	$V_{PP} = V_{CC} = 5.5V$, $T_A = 0°C$	Min	0.00	0.00		µA
			Avg	0.00	0.00		
			Max	0.00	0.00	10	
			Std Deviation	0.00	0.00		
V_{IL}	Input Low Voltage	$V_{CC} = 4.5V$, $T_A = 70°C$	Min	1.10	1.10		V
			Avg	1.10	1.11		
			Max	1.12	1.12	0.8	
			Std Deviation	0.01	0.01		
V_{IH}	Input High Voltage	$V_{CC} = 5.5V$, $T_A = 0°C$	Min	1.58	1.58	2	V
			Avg	1.59	1.60		
			Max	1.60	1.62		
			Std Deviation	0.01	0.02		
V_{OH}	Output High Voltage TTL	$I_{OH} = –400µA$, $V_{CC} = 4.5V$, $T_A = 70°C$	Min	4.06	4.04	2.4	V
			Avg	4.06	4.05		
			Max	4.06	4.06		
			Std Deviation	0	0.01		
V_{OL}	Output Low Voltage	$I_{OL} = 2.1mA$, $V_{CC} = 4.5V$, $T_A = 70°C$	Min	0.10	0.10		V
			Avg	0.11	0.11		
			Max	0.11	0.11	0.4	
			Std Deviation	0	0		
V_{CC} (min)	Supply Voltage	$T_A = 0°C$, function	Min	2.50	2.90	4.5	V
			Avg	2.60	2.75		
			Max	2.75	2.65		
			Std Deviation	0.08	0.08		
V_{CC} (max)	Supply Voltage	$T_A = 70°C$, function	Min	7.50	7.50		V
			Avg	7.50	7.50		
			Max	7.50	7.50	5.5	
			Std Deviation	0	0		

Table 9. M27C801 E6-DM Process, Phoenix USA - Read Mode AC Characteristics

Sym-bol	Alt	Parameter	Test Condition	Measurement	Fabrication Facility		Data Sheet	Unit
					Agrate, Italy	Phoenix, USA		
t_{AVQV}	t_{ACC}	Address Valid to Output Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	68	65		ns
				Avg	68	67		
				Max	70	70	90	
				Std Deviation	1	1		
t_{AVQV}	t_{ACC}	Address Valid to Output Valid	$\overline{E}$ = V_{IL}, $\overline{G}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	83	83		ns
				Avg	84	86		
				Max	85	90	90	
				Std Deviation	1	2		
t_{ELQV}	t_{CE}	Chip Enable Low to Output Valid	$\overline{G}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	68	65		ns
				Avg	68	67		
				Max	70	70	90	
				Std Deviation	1	1		
t_{ELQV}	t_{CE}	Chip Enable Low to Output Valid	$\overline{G}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	83	83		ns
				Avg	84	86		
				Max	85	90	90	
				Std Deviation	1	2		
t_{GLQV}	t_{OE}	Output Enable Low to Output Valid	$\overline{E}$ = V_{IL}, V_{CC} = 5.5V, T_A = 0°C	Min	25	25		ns
				Avg	25	25		
				Max	25	25	45	
				Std Deviation	0	0		
t_{GLQV}	t_{OE}	Output Enable Low to Output Valid	$\overline{E}$ = V_{IL}, V_{CC} = 4.5V, T_A = 70°C	Min	33	33		ns
				Avg	33	33		
				Max	33	35	45	
				Std Deviation	0	1		