# Cypress Semiconductor
# Qualification Report

**QTP# 98116 VERSION 1.0**
**April, 1998**

## UltraLogic™ 32-Macrocell Flash CPLD

## CY7C371i

**PRODUCT/TECHNOLOGY INFORMATION**

| **PRODUCT DESCRIPTION (for qualification)** | | | |
|---|---|---|---|
| Qualification Purpose: Qualify 32-Macrocell Flash CPLD, CY7C371i, Rev. E (chop of 128-Macrocell Flash CPLD, CY7C374i/CY7C375i, Rev. E) | | | |
| Marketing Part #: | CY7C371i | | |
| Package: | 44 pins PLCC | | |
| Device Description: | UltraLogic™ 32-Macrocell Flash CPLD | | |
| Cypress Division: | Cypress Semiconductor Corporation - PLD Division | | |
| Overall Die (or Mask) REV Level (pre-requisite for qualification): | | Rev. E | |
| Die Size (stepping): | 231 mils x 86 mils | What ID markings on Die: | 7C371i |

| **TECHNOLOGY/FAB PROCESS DESCRIPTION - FLASH28** | | | |
|---|---|---|---|
| Number of Metal Layers: | 2 | Metal Composition: | Metal 1: 6,800Å AL-1%Si/1,200Å TiW<br>Metal 2: 1500Å TiW/10,000Å Al-1%Si/300Å Tiw |
| Passivation Type and Materials: | | 3,000A $SiO_2$ + 15,000A Oxynitride | |
| Free Phosphorus contents in top glass layer(%): | | None | |
| Die Coating(s), if used: | None | | |
| Generic Process Technology/Design Rule (µ-drawn): | | CMOS FLASH 0.65µm | |
| Gate Oxide Material/Thickness (MOS): | | Gox1 = 225Å, Gox2 = 165Å, Tunel ox = 100Å | |
| Name/Location of Die Fab (prime) Facility: | | Cypress Semiconductor - Round Rock, TX | |
| Die Fab Line ID/Wafer Process ID: | | Fab 2 / FLASH28 | |

**PACKAGE/ASSEMBLY INFORMATION**

| PLASTIC PACKAGE/ASSEMBLY DESCRIPTION | | | |
|---|---|---|---|
| Package Outline, Type, or Name: | 44-pin Plastic Leaded Chip Carrier (PLCC) | | |
| Mold Compound Name/Manufacturer: | Nitto-MP8000 | | |
| Lead Frame material: | Copper | | |
| Lead Finish, composition: | Solder Plated, 85%Sn, 15%Pb | | |
| Die Attach Area Plating: | Silver Spot | | |
| Die Attach Method: | Paste | Die Attach Material: | Silver Epoxy |
| Wire Bond Method: | Thermosonic | Wire Material/Size: | Gold / 1.3 mil |
| JESD22-A112 Moisture Sensitivity Level | Level 1 | | |
| Assembly Line ID and Process ID: | Cypress Bangkok, Thailand | | |

**Note:** Please contact a Cypress Representative for other packages availability.

**RELIABILITY TESTS PERFORMED**

| Stress/Test | Test Condition (Temp/Bias) | Result P/F |
|---|---|---|
| High Temperature Operating Life Early Failure Rate | Dynamic Operating Condition, Vcc = 5.75V, 150°C | P |
| High Temperature Operating Life Latent Failure Rate | Dynamic Operating Condition, Vcc = 5.75V, 150°C | P |
| Read and Record Life Test | Dynamic Operating Condition, Vcc = 5.75V, 150°C | P |
| High Temperature Steady State Life | Static Operating Condition, Vcc = 5.75V, 125°C | P |
| High Accelerated Saturation Test (HAST) | 140°C, 85%RH, 5.5V<br>Precondition: JESD22 Moisture Sensitivity Level 1<br>(168 Hrs , 85/85%RH) | P |
| Temperature Cycle (Plastic device) | MIL-STD-883C, Method 1010, Condition C, -65°C to 150°C<br>Precondition: JESD22 Moisture Sensitivity Level 1<br>(168 Hrs , 85/85%RH) | P |
| C-SAM | Cypress Spec. 25-00104 | P |
| Data Bake-Plastic | 165°C, no bias | P |
| Electrostatic Discharge Human Body Model (ESD-HBM) | MIL-STD-883, Method 3015.7 | 2,200V |
| Electrostatic Discharge Charge Device Model (ESD-CDM) | Cypress Spec. 25-00020 | 500V |
| Latchup Sensitivity | In accordance with JEDEC 17. Cypress Spec. 01-00081 | |
| Static Latchup | | 10.2 |
| Dynamic Latchup | | 7.7V |

**RELIABILITY FAILURE RATE SUMMARY**

| Stress/Test | Device Tested/ Device Hours | # Fails | Activation Energy | Thermal AF[4] | Failure Rate[3] |
|---|---|---|---|---|---|
| High Temperature Operating Life Early Failure Rate | 528 Devices | 0 | N/A | N/A | 0 PPM |
| High Temperature Operating Life[1,2] Long Term Failure Rate | 59,500 DHRs | 0 | 0.7 | 170 | 91 FIT |

[1] Assuming an ambient temperature of 55°C and a junction temperature rise of 15°C.
[2] Chi-squared 60% estimations used to calculate the failure rate.
[3] Failure rate estimates do not include the voltage acceleration factor.
[4] Thermal Acceleration Factor is calculated from the Arrhenius equation.

$$AF = \exp\left[\frac{E_A}{k}\left[\frac{1}{T_2} - \frac{1}{T_1}\right]\right]$$

where:

$E_A$ = The Activation Energy of the defect mechanism.
k = Boltzmann's constant = $8.62 \times 10^{-5}$ eV/Kelvin.
$T_1$ is the junction temperature of the device under stress and $T_2$ is the junction temperature of the device at use conditions.

**RELIABILITY TEST DATA**

**QTP#: 98116**

| DEVICE | ASSY-LOC | FABLOT# | ASSYLOT# | DURATION | S/S | REJ | FAIL MODE |
|---|---|---|---|---|---|---|---|
| STRESS: DATA BAKE-PLASTIC (165C, NO BIAS) | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 168 | 85 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 552 | 85 | 0 | |
| STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE (150C, 5.75V) | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 48 | 528 | 0 | |
| STRESS: ESD-CHARGE DEVICE MODEL, 500V | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2803994 | 219801255 | COMP | 3 | 0 | |
| STRESS: ESD-HUMAN BODY CIRCUIT PER MIL STD 883, METHOD 3015, 2200V | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2803994 | 219801255 | COMP | 3 | 0 | |
| STRESS: HI-ACCEL SATURATION TEST (140C, 5.5V), PRECOND. 168 HRS 85C/85%RH | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 128 | 50 | 0 | |
| STRESS: HIGH TEMP STEADY STATE LIFE TEST (125C, 5.75V) | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 80 | 85 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 168 | 85 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 336 | 85 | 0 | |
| STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE (150C, 5.75V) | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 80 | 119 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 500 | 119 | 0 | |
| STRESS: READ & RECORD LIFE TEST (150C, 5.75V) | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 48 | 12 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 80 | 12 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 500 | 12 | 0 | |
| STRESS: TC COND. C, -65 TO 150C, PRECOND. 168 HRS 85C/85%RH | | | | | | | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 300 | 50 | 0 | |
| CY7C371I-JC | ALPHA-X | 2740074 | 219711475 | 1000 | 50 | 0 | |

**DEVICE RELATED RELIABILITY TEST DATA**

**QTP#: 97301[1]/97305[2]/97373[3]**

| EVAL # | DEVICE | ASSY-LOC | ASSYLOT# | FABLOT# | ACTUAL TEMP /VOLT | TIME POINT | S/S | Ver. Rej | Fail Mode |
|---|---|---|---|---|---|---|---|---|---|
| STRESS: DATA BAKE-HERMETIC (250C, NO BIAS) | | | | | | | | | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 250C /N/A | 96 | 79 | 0 | |
| STRESS: DATA BAKE-PLASTIC (165C, NO BIAS) | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 165C /N/A | 168 | 79 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 165C /N/A | 552 | 79 | 0 | |
| STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE (125C, 5,75V) | | | | | | | | | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 125C /6.50V | 12 | 167 | 0 | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 125C /6.50V | 48 | 167 | 0 | |
| 97301 | CY7C374I-JC | ALPHA-X | 219701981 | 2636449 | 125C /6.5V | 48 | 184 | 0 | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | 125C /6.5V | 48 | 500 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /6.50V | 12 | 144 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /6.50V | 48 | 173 | 0 | |
| STRESS: ESD-CHARGE DEVICE MODEL | | | | | | | | | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | N/A /500V | COMP | 3 | 0 | |
| 97301 | CY7C375I-AC | KOREA-Q | 349612770 | 2630660 | N/A /500V | COMP | 3 | 0 | |
| STRESS: ESD-HUMAN BODY CIRCUIT PER MIL STD 883, METHOD 3015 | | | | | | | | | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | N/A /2200V | COMP | 3 | 0 | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | N/A /4400V | COMP | 3 | 0 | |
| STRESS: GROUP C, SUBGROUP 1, LIFE TEST (150C, 5.75V) | | | | | | | | | |
| 97301 | CY7C374I-YMB | ALPHA-X | 219613132 | 2630682 | 150C /5.75V | 184 | 50 | 0 | |
| STRESS: HI-ACCEL SATURATION TEST (140C, 5.5V), PRECOND. 192 HRS 30C/60%RH | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 140C /5.5V | 128 | 48 | 0 | |
| 97301 | CY7C375I-AC | KOREA-Q | 619700713 | 2645516 | 130C /5.5V | 128 | 48 | 0 | 2 EOS |
| STRESS: HIGH TEMP STEADY STATE LIFE TEST (125C, 5.75V) | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /5.75V | 336 | 79 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /5.75V | 168 | 79 | 0 | |

[1] QTP 97301, UltraLogic 128 Macrocell Flash CPLD, CY7C374i/CY7C375i (Rev. E), Flash 28 Process, Fab 2 qualification.

[2] QTP 97305, UltraLogic 128 Macrocell Flash CPLD, CY7C374i/CY7C375i (Rev. E), Flash 28 Process, Fab 2 qualification with 14 layer mask fix for erase and soft programming.

[3] QTP 97373, UltraLogic 128 Macrocell Flash CPLD, CY7C374i/CY7C375i (Rev. E), Flash 28 Process, Fab 2 qualification with FIT rate improved.

**DEVICE RELATED RELIABILITY TEST DATA**

**QTP#: 97301/97305/97373**

| EVAL # | DEVICE | ASSY-LOC | ASSYLOT# | FABLOT# | ACTUAL TEMP /VOLT | TIME POINT | S/S | Ver. Rej | Fail Mode |
|---|---|---|---|---|---|---|---|---|---|
| STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE (125C, 5,75V) | | | | | | | | | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 125C /6.50V | 80 | 76 | 0 | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 125C /6.50V | 500 | 76 | 0 | |
| 97301 | CY7C374I-JC | ALPHA-X | 219701981 | 2636449 | 125C /6.5V | 500 | 183 | 1 | 1 NON-VISUAL |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | 125C /6.5V | 80 | 80 | 0 | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | 125C /6.5V | 500 | 74 | 0 | 6 EOS |
| 97373 | CY7C374I-JC | ALPHA-X | 2199709954P | 2722822 | 125C /5.75V | 1000 | 174 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /6.50V | 80 | 77 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 125C /6.50V | 500 | 76 | 0 | 1 EOS |
| STRESS: PROGRAM VERIFICATION | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | N/A /N/A | 200CY | 48 | 0 | |
| STRESS: READ & RECORD LIFE TEST (150C, 5.75V) | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 150C /6.50V | 500 | 10 | 0 | |
| STRESS: READ & RECORD LIFE TEST (125C, 5.75V) | | | | | | | | | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | 125C /6.5V | 80 | 10 | 0 | |
| 97305 | CY7C374I-JC | ALPHA-X | 219705498 | 2715844 | 125C /6.5V | 500 | 10 | 0 | |
| STRESS: DYNAMIC LATCH-UP TESTING | | | | | | | | | |
| 97301 | CY7C375I-AC | KOREA-Q | 349612770 | 2630660 | N/A /10.57V | DATA | 3 | 0 | |
| STRESS: TC COND. C, -65 TO 150C, HERMETIC DEVICES | | | | | | | | | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 150C /-65C | 100 | 49 | 0 | |
| 97301 | CY7C374I-YC | ALPHA-X | 219613131 | 2630682 | 150C /-65C | 1000 | 49 | 0 | |
| STRESS: TC COND. C, -65 TO 150C, PRECOND. 192 HRS 30C/60%RH | | | | | | | | | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 150C /-65C | 300 | 48 | 0 | |
| 97301 | CY7C374I-JC | KOREA-A | 349611720 | 2629610 | 150C /-65C | 1000 | 48 | 0 | |
| 97301 | CY7C375I-AC | KOREA-Q | 619700713 | 2645516 | 150C /-65C | 300 | 50 | 0 | |
| 97301 | CY7C375I-AC | KOREA-Q | 619700713 | 2645516 | 150C /-65C | 1000 | 50 | 0 | |