

Cypress Semiconductor Product Qualification Report

QTP# 002703 VERSION 2.0
June, 2003

| Full Speed CYUSB Family | |
|--|--|
| CY7C64601 CY7C64603 CY7C64613 | EZ-USB FX USB Microcontroller |

CYPRESS TECHNICAL CONTACT FOR QUALIFICATION DATA:

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PRODUCT QUALIFICATION HISTORY

| Qual Report | Description of Qualification Purpose | Date Comp |
|--------------------|---|------------------|
| 000602 | New 0.35um TLM Technology/New CY7C64613 EZ-FX Product Qualification | Jun 00 |
| 002703 | CY7C64613 ESD/HBM fix at HME (Hyundai) | Aug 00 |

| PRODUCT DESCRIPTION (for qualification) | | | |
|---|---|--|--------|
| Qualification Purpose: ESD/HBM Fix AT HME Hyundai, CY7C64613 and its CYUSB product family, 0.35umTLM Technology, Fab 25 | | | |
| Marketing Part #: | CY7C64601/CY7C64603/CY7C64613 | | |
| Device Description: | Full Speed Microcontroller, Commercial available in PQFP 52L, 80L and 128L Package. | | |
| Cypress Division: | Cypress Semiconductor Corporation – Interface Product Division (IPD) | | |
| Overall Die (or Mask) REV: | | | Rev. C |
| What ID markings on Die: | 7C646000A | | |

| TECHNOLOGY/FAB PROCESS DESCRIPTION | | | |
|---|----------------------------------|--------------------|--|
| Number of Metal Layers: | 3 | Metal Composition: | Metal 1: Al-Si-Cu/Ti/TiN Metal 2: Al-Si-Cu/Ti/TiN/W-PLUG Metal 3: Al-Si-Cu/Ti/TiN/W-PLUG |
| Passivation Type and Materials: | Double Layer, Nitride, Oxide | | |
| Generic Process Technology/Design Rule (μ -drawn): | CMOS, Triple Metal /0.35 μ m | | |
| Gate Oxide Material/Thickness (MOS): | N/A | | |
| Name/Location of Die Fab (prime) Facility: | Fab 25-Hyundai-Korea (HME) | | |
| Die Fab Line ID/Wafer Process ID: | Fab 25 / 0.35TLM | | |

PACKAGE AVAILABILITY

| PACKAGE TYPE | ASSEMBLY SITE FACILITY |
|---------------------|---------------------------------------|
| 128-pin PQFP | Hyundai-Korea (HME), Anam Korea |
| 52-pin, 80-pin PQFP | Hyundai-Korea (HME), Anam Philippines |

Note: Package Qualification details upon request

| MAJOR PACKAGE INFORMATION USED IN THIS QUALIFICATION | |
|---|--------------------------------------|
| Package Outline, Type, or Name: | 128-pin Plastic Quad Flatpack (PQFP) |
| Mold Compound Name/Manufacturer: | Sumitomo EME-6300 |
| Mold Compound Flammability Rating: | V-O per UL 94 |
| Oxygen Rating Index: | >28% |
| Lead Frame Designation: | N |
| Lead Frame Material: | Alloy 42 1/2H |
| Lead Finish, Composition / Thickness: | 85%Sn, 15%PB |
| Die Backside Preparation Method/Metallization: | N/A |
| Die Separation Method: | Wafer Saw |
| Die Attach Supplier: | Ablestik |
| Die Attach Material: | 84-1 |
| Wire Bond Method: | UTC |
| Wire Material/Size: | Au, 1.2um |
| Thermal Resistance Theta JA °C/W: | 52 |
| Package Cross Section Yes/No: | N/A |
| Assembly Process Flow: | 49-10999M |
| Name/Location of Assembly (prime) facility: | Hyundai-Korea (HME) |

| ELECTRICAL TEST / FINISH DESCRIPTION | |
|---|---------------------|
| Test Location: | Hyundai-Korea (HME) |
| Fault Coverage: | 100% |

RELIABILITY TESTS PERFORMED PER SPECIFICATION REQUIREMENT

| Stress/Test | Test Condition (Temp/Bias) | Result P/F |
|--|--|-----------------------|
| High Temperature Operating Life Early Failure Rate | Dynamic Operating Condition, Vcc = 3.8V, 150°C | P |
| High Temperature Operating Life Latent Failure Rate | Dynamic Operating Condition, Vcc = 3.8V, 150°C | P |
| Temperature Cycle | MIL-STD-883C, Method 1010, Condition C, -65°C to 150°C Precondition: JESD22 Moisture Sensitivity Level 3 (192 hrs, 30°C/60%RH+3IR-220Reflow) | P |
| High Accelerated Saturation Test (HAST) | 130°C, 3.63V, 85%RH Precondition: JESD22 Moisture Sensitivity Level 3 (192 Hrs, 30°C/60%RH+3IR-220Reflow) | P |
| Electrostatic Discharge Human Body Model (ESD-HBM) | Cypress Spec. 25-00020 (2,200V) | P |
| Electrostatic Discharge Charge Device Model (ESD-CDM) | Cypress Spec. 25-00020 (500V) | P |
| Long Life Verification | Cypress Spec. 29-00020 (150°C, 3.8V) | P |
| High Temperature Steady State Life | Cypress Spec. 29-00020 | P |
| High Temperature Storage (Plastic) | 150°C, ± 5°C. No bias | |
| Age Bond Pull | Cypress Spec. 12-00092 | P |
| Pressure Cooker | 121°C/100%RH Precondition: JESD22 Moisture Sensitivity Level 3 (192 Hrs, 30°C/60%RH+3IR-220Reflow) | P |
| Acoustic Microscopy | Cypress Spec. 25-00104 | P |
| Low Temperature Operating Life | Cypress Spec. 25-00089 (-30°C,6.5V,8MHZ) | P |
| Current Density | Cypress Spec. 01-40021 | P |
| SEM | MIL-STD-883, Method 2018-2/ Cypress Spec. 25-00009 | P |
| Latchup Sensitivity | In accordance with JEDEC 17. Cypress Spec. 01-00081 (± 300mA) | P |

RELIABILITY FAILURE RATE SUMMARY

| Stress/Test | Device Tested/ Device Hours | # Fails | Activation Energy | Acceleration Factor ³ | Failure Rate ⁴ |
|--|--------------------------------|------------|----------------------|-------------------------------------|---------------------------|
| High Temperature Operating Life Early Failure Rate | 1,000 | 0 | N/A | N/A | 0 PPM |
| High Temperature Operating Life ^{1,2} Long Term Failure Rate | 400,160DHRs | 0 | 0.7 | 170 | 13 FIT |

¹ Assuming an ambient temperature of 150°C and a junction temperature rise of 15°C.

² Chi-squared 60% estimations used to calculate the failure rate.

³ 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 = 8.62×10^{-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.

⁴ FIT Rate based on LFR and LLV.

Reliability Test Data

QTP #: 000602

| <i>Device</i> | <i>Fab Lot #</i> | <i>Assy Lot #</i> | <i>Assy Loc</i> | <i>Duration</i> | <i>Samp</i> | <i>ReJ</i> | <i>Failure Mechanism</i> |
|--|------------------|-------------------|-----------------|-----------------|-------------|------------|--------------------------|
| STRESS: ACOUSTIC | | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | COMP | 15 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | COMP | 15 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | COMP | 15 | 0 | |
| STRESS: AGE BOND PULL TEST | | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | COMP | 3 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | COMP | 3 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | COMP | 3 | 0 | |
| STRESS: DYNAMIC LATCH-UP TESTING (5.78v) | | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | COMP | 3 | 0 | |
| STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE (150C, 3.8V, Vcc Max) | | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 48 | 336 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 48 | 334 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | 48 | 330 | 0 | |
| STRESS: ESD-CHARGE DEVICE MODEL (500V) | | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 500V | 3 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 500V | 3 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | 500V | 3 | 0 | |

Reliability Test Data

QTP #: 000602

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Re | Failure Mechanism |
|--------|-----------|------------|----------|----------|------|----|-------------------|
|--------|-----------|------------|----------|----------|------|----|-------------------|

STRESS: ESD-HUMAN BODY CIRCUIT PER MIL STD 883, METHOD 3015 (1,100V)

| | | | | | | | |
|--------------|--------|-----------|--|------|---|---|--|
| CY7C64613-NC | NZ0241 | OB09 | | COMP | 3 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | COMP | 3 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | COMP | 3 | 0 | |

STRESS: HI-ACCEL SATURATION TEST (130C, 85%RH, 3.63V), PRE COND 192 HR 30C/60%RH

| | | | | | | | |
|--------------|--------|-----------|--|-----|----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 128 | 54 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 128 | 47 | 0 | |

STRESS: HIGH TEMPERATURE STORAGE, PLASTIC, 150C

| | | | | | | | |
|--------------|--------|-----------|--|------|----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 500 | 48 | 0 | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 1000 | 48 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 500 | 50 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 1000 | 50 | 0 | |

STRESS: HIGH TEMP STEADY STATE LIFE TEST (150C, 3.63V, Vcc MAX)

| | | | | | | | |
|--------------|--------|----------|--|-----|----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 80 | 76 | 0 | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 168 | 76 | 0 | |

STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE (150C, 3.8V, Vcc Max)

| | | | | | | | |
|--------------|--------|-----------|--|-----|-----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 80 | 336 | 0 | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 500 | 116 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 80 | 334 | 0 | |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 500 | 116 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | 80 | 330 | 0 | |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | 500 | 116 | 0 | |

STRESS: LONG LIFE VERIFICATION, 150C, 3.8V

| | | | | | | | |
|--------------|--------|----------|--|------|-----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 1000 | 116 | 0 | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 2000 | 116 | 0 | |

STRESS: LOW TEMPERATURE OPERATING LIFE (-30C, 6.50V, 8MHZ)

| | | | | | | | |
|--------------|--------|----------|--|-----|----|---|--|
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 500 | 45 | 0 | |
|--------------|--------|----------|--|-----|----|---|--|

Reliability Test Data

QTP #: 000602

| <i>Device</i> | <i>Fab Lot #</i> | <i>Assy Lot #</i> | <i>Assy Loc</i> | <i>Duration</i> | <i>Samp ReJ</i> | <i>Failure Mechanism</i> |
|---|------------------|-------------------|-----------------|-----------------|-----------------|--------------------------|
| STRESS: PRESSURE COOKER TEST (121C, 100%RH), PRE COND 192 HR 30C/60%RH | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 168 | 48 | 0 |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 168 | 50 | 0 |
| STRESS: STATIC LATCH-UP TESTING (125C, 7.5V, +-300mA) | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | COMP | 3 | 0 |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | COMP | 3 | 0 |
| CY7C64613-NC | NZ0350 | OB01/2/4 | | COMP | 3 | 0 |
| STRESS: TC COND. C -65C TO 150C, PRECONDITION 192 HRS 30C/60%RH (MSL3) | | | | | | |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 300 | 48 | 0 |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 500 | 48 | 0 |
| CY7C64613-NC | NZ0311 | OB01/2/5 | | 1000 | 48 | 0 |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 300 | 48 | 0 |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 500 | 47 | 1 (see note 1) |
| CY7C64613-NC | NZ0349 | OB01/7/12 | | 1000 | 47 | 0 |

Note 1: The cratering was noticed on 1 pad 1 die. HME performed ball shear and bond pull on material from same lot, no further issues found.

Reliability Test Data

QTP #: 002703

| <i>Device</i> | <i>Fab Lot #</i> | <i>Assy Lot #</i> | <i>Assy Loc</i> | <i>Duration</i> | <i>Samp</i> | <i>ReJ</i> | <i>Failure Mechanism</i> |
|---|------------------|-------------------|-----------------|-----------------|-------------|------------|--------------------------|
| STRESS: ESD-HBM (2,200V) | | | | | | | |
| CY7C64613-NC | NZ0815-1 | OB03 | | 2200V | 9 | 0 | |
| CY7C64613-NC | NZ0815-1 | OB03 | | 3300V | 3 | 0 | |
| STRESS: STATIC LATCH-UP TESTING (125C, 7.5V, +/-300mA) | | | | | | | |
| CY7C64613-NC | NZ0815-1 | OB03 | | COMP | 3 | 0 | |

Electrical Stress Test Results

| Test Items | Conditions | # of Lot | S.S per Lot | Total Units | #of Fail | Duration | LTPD | Results |
|--|-------------------------------------|----------|-------------|-------------|----------|----------|------|---------|
| H.T.O.L (High Temperature Operating Life Test) | Ta=145I, Dynamic Vcc= 3.6V | 3 | 77 | 231 | 0 | 1000Hrs | 5% | PASS |
| L.T.O.L (Low Temperature Operating Life Test) | Ta=I 10I,Dynamic Vcc= 3.6V | 3 | 22 | 66 | 0 | 1000Hrs | 10% | PASS |
| T.H.B (Temp. & Humidity with Bias) | Ta=85I, R.H=85% Static,Vcc= 3.3V(*) | 3 | 38 | 114 | 0 | 1000Hrs | 10% | PASS |

Notes)

1. No Failures counted for this qualification test.
2. “*”: Starting reliability test after preconditioning test according to JEDEC-STD JESD22 A113 Level III.

Mechanical Stress Test Results

| Test Items | Conditions | # of Lot | S.S per Lot | Total Units | #of Fail | LTPD | Results |
|--------------------|--|----------|-------------|-------------|----------|------|---------|
| Physical Dimension | per specification | 3 | 5 | 15 | 0 | 50% | PASS |
| Lead Integrity | MIL-STD 883 Method 2004 Test Con.A/B2 -Tension -Lead Fatigue | 3 | 22 | 66 | 0 | 10% | PASS |
| Solderability | MIL-STD 883 Method 2003 Aging : 7 ± 1Hrs Ta=245±5I | 3 | 22 | 66 | 0 | 10% | PASS |
| Marking Permanency | Using M.P.T Chemical | 3 | 11 | 33 | 0 | 20% | PASS |

- M.P.T Chemical
 1 Isopropyl alcohol : 3 (Kerosene 80% + ethylbensene 20%)

Notes)

1. No Failures counted for this qualification test.

Environmental Stress Test Results

| Test Items | Conditions | # of Lot | S.S per Lot | Total Units | #of Fail | Duration | LTPD | Results |
|---|---------------------------------------|----------|-------------|-------------|----------|----------|------|---------|
| T/C (Temperature Cycle) | Ta=1 65I 150I Air to Air , (*) | 3 | 77 | 231 | 0 | 1000Cycs | 5% | PASS |
| P.C.T (Pressure Cooker Test) | Ta=121I, 2Atm, R.H=100%, (*) | 3 | 32 | 96 | 0 | 200Hrs | 7% | PASS |
| H.T.S.T (High Temperature Storage Test) | Ta=150I, No Biased | 3 | 22 | 66 | 0 | 1000Hrs | 10% | PASS |
| L.T.S.T (Low Temperature Storage Test) | Ta= 1 65I, No Biased | 3 | 22 | 66 | 0 | 1000Hrs | 10% | PASS |
| T/S (Thermal Shock) | Ta=1 65I 150I Liquid to Liquid , | 3 | 22 | 66 | 0 | 200Cycle | 10% | PASS |
| Salt Atmosphere | Ta=35 I R.H=5% Nacl | 3 | 22 | 66 | 0 | 96Hrs. | 10% | PASS |
| Soldering Stress Test | VPS(*) Ta=215I ,3Times | 3 | 22 | 66 | 0 | 90sec | 10% | PASS |
| | IR(*)-Reflow Ta=235I ,3Times | 3 | 22 | 66 | 0 | 10sec | 10% | PASS |

Notes)

1. No Failures counted for this qualification test.
2. "**": Starting reliability test after preconditioning test according to JEDEC-STD JESD22 A113 Level III.

Electric/Mechanical and Environmental Stress Test Result, pages number 8 and 9 are from HME. Done on test chip with identical technology/process.