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Cypress Semiconductor Product Qualification Report

QTP# 133202 VERSION*C
March, 2021

| 130nm F-RAM Device Family | |
|--|---|
| 130nm Technology, TI and Global Foundries Fab | |
| FM1608B | 64Kb Parallel (8192x8bits) 5V F-RAM Memory |
| FM16W08 | 64Kb Parallel (8192x8bits) Wide Voltage F-RAM Memory |
| FM1808B | 256kb Parallel (32,768x8bits) 5V F-RAM Memory |
| FM18W08 | 256kb Parallel (32,768x8bits) Wide Voltage F-RAM Memory |
| FM24C04B | 4Kb I2C (512Kx8bits) 5V Serial F-RAM Memory |
| FM24C16B | 16Kb I2C (2,048Kx8bits) 5V Serial F-RAM Memory |
| FM24C64B | 64Kb I2C (8,192Kx8bits) 5V Serial F-RAM Memory |
| FM24CL04B | 4Kb I2C (512Kx8bits) 3V Serial F-RAM Memory |
| FM24CL16B | 16Kb I2C (2,048Kx8bits) 3V Serial F-RAM Memory |
| FM24CL64B | 64Kb I2C (8,192Kx8bits) 3V Serial F-RAM Memory |
| FM24V01 | 128Kb (16,384Kx8bits) Serial 3V F-RAM Memory |
| FM24V02 | 256Kb (32,768Kx8bits) Serial 3V F-RAM Memory |
| FM24W256 | 256Kb I2C (32,768Kx8bits) Serial Wide Voltage F-RAM Memory |
| FM25040B | 4Kb I2C (512Kx8bits) 5V Serial F-RAM Memory |
| FM25640B | 64Kb SPI (8,192Kx8bits) 5V Serial F-RAM Memory |
| FM25C160B | 16Kb SPI (2,048Kx8bits) 5V Serial F-RAM Memory |
| FM25CL64B | 64Kb SPI (8,192Kx8bits) 3V Serial F-RAM Memory |
| FM25L04B | 4Kb I2C (512Kx8bits) 3V Serial F-RAM Memory |
| FM25L16B | 16Kb SPI (2,048Kx8bits) 3V Serial F-RAM Memory |
| FM25V01 | 128Kb (16,384Kx8bits) Serial 3V F-RAM Memory |
| FM25V02 | 256Kb (32,768Kx8bits) Serial 3V F-RAM Memory |
| FM25W256 | 256Kb SPI (32,768Kx8bits) Serial Wide Voltage F-RAM Memory |

130nm F-RAM Device Family

130nm Technology, TI and Global Foundries Fab

| | |
|-----------------|--|
| FM28V020 | 256Kb (32Kx8bits) Byte-wide F-RAM Memory |
| FM31256 | 256Kb Integrated Processor Companion with F-RAM Memory |
| FM31276 | 64Kb 5V Integrated Processor Companion with F-RAM Memory |
| FM31278 | 256Kb 5V Integrated Processor Companion with F-RAM Memory |
| FM3164 | 64Kb Integrated Processor Companion with F-RAM Memory |
| FM31L276 | 64Kb 3V Integrated Processor Companion with F-RAM Memory |
| FM31L278 | 256Kb 3V Integrated Processor Companion with F-RAM Memory |
| FM33256B | 256Kb 3V Serial F-RAM Memory |

FOR ANY QUESTIONS ON THIS REPORT, PLEASE CONTACT
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PACKAGE/PRODUCT QUALIFICATION HISTORY

| QTP Number | Description of Qualification Purpose | Date |
|---------------|--|------------|
| 133202 | Qualification of Additional Passivation Layers on F-RAM Products | March 2014 |

| PRODUCT DESCRIPTION (for qualification) | |
|---|--|
| Qualification Purpose: Qualification of Additional Passivation Layers on F-RAM Products | |
| Marketing Part #: | FM1608B, FM16W08, FM1808B, FM18W08, FM24C04B, FM24C16B, FM24C64B, FM24CL04B, FM24CL16B, FM24CL64B, FM24V01, FM24V02, FM24W256, FM25040B, FM25640B, FM25C160B, FM25CL64B, FM25L04B, FM25L16B, FM25V01, FM25V02, FM25W256, FM28V020, FM31256, FM31276, FM31278, FM3164, FM31L276, FM31L278, FM33256B |
| Device Description: | F-RAM |
| Cypress Division: | Cypress Semiconductor Corporation – Memory Product Division (MPD) |

| TECHNOLOGY/FAB PROCESS DESCRIPTION | | | |
|---|---|--------------------|--------------|
| Number of Metal Layers: | Proprietary* | Metal Composition: | Proprietary* |
| Passivation Type and Thickness: | Proprietary* | | |
| Generic Process Technology/Design Rule (μ -drawn): | CMOS / 130nm | | |
| Gate Oxide Material/Thickness (MOS): | Proprietary* | | |
| Name/Location of Die Fab (prime) Facility: | Texas Instruments / Dallas (Tile die), Global Foundries / Essex, Vermont (Base die) | | |
| Die Fab Line ID/Wafer Process ID: | DMOS 5 / E035.1 (Tile die), GF CMRF7TG (Base die) | | |

*Texas Instruments' proprietary information is available with signed NDA.

ALTERNATIVE PACKAGE AVAILABILITY

| PACKAGE | ASSEMBLY FACILITY SITE | QTP REFERENCE |
|-------------|------------------------|---------------|
| 8-Lead SOIC | UTAC, Thailand | QTP#133203 |

Note: **Package Qualification details upon request.**

| MAJOR PACKAGE INFORMATION USED IN THIS QUALIFICATION | |
|--|-----------------|
| Package Designation: | (SZ815) |
| Package Outline, Type, or Name: | 8-Lead SOIC |
| Mold Compound Name/Manufacturer: | G600/Sumitomo |
| Mold Compound Flammability Rating: | UL-97 – V0 |
| Oxygen Rating Index: | N/A |
| Lead Frame Material: | Copper |
| Lead Finish, Composition / Thickness: | Pure Sn |
| Die Backside Preparation Method/Metallization: | Backgrind |
| Die Separation Method: | 100% Saw |
| Die Attach Supplier: | Ablebond |
| Die Attach Material: | 8200T |
| Die Attach Method: | Epoxy |
| Bond Diagram Designation: | 001-85674 |
| Wire Bond Method: | Thermosonic |
| Package Cross Section Yes/No: | N/A |
| Assembly Process Flow: | 001-85816 |
| Name/Location of Assembly (prime) facility: | Lingsen, Taiwan |
| MSL Level | 3 |
| Reflow Profile | 260C |

| ELECTRICAL TEST / FINISH DESCRIPTION | |
|--------------------------------------|-----------------|
| Test Location: | Lingsen, Taiwan |

Note: Please contact a Cypress Representative for other package availability.

RELIABILITY TESTS PERFORMED PER SPECIFICATION REQUIREMENTS

| Stress/Test | Test Condition (Temp/Bias) | Result P/F |
|--|--|---------------|
| Acoustic Microscopy | J-STD-020 Precondition: JESD22 Moisture Sensitivity Level 3 192 Hrs, 30C/60%RH+ Reflow, 260°C+0, -5°C | P |
| Ball Shear | JESD22-B116 | P |
| Bond Pull | MIL-STD-883 – Method 2011, Cpk : 1.33, Ppk : 1.66 | P |
| Constructional Analysis | Criteria: Meet external and internal characteristics of Cypress package | P |
| Data Retention | 125°C, 1000 Hours JESD22-A117 and JESD22-A103 | P |
| High Accelerated Saturation Test (HAST) | JEDEC STD 22-A110: 130°C, 85%RH, 3.6V, Precondition: JESD22 Moisture Sensitivity Level 3 192 Hrs, 30C/60%RH+ Reflow, 260°C+0, -5°C | P |
| High Temperature Operating Life Early Failure Rate (EFR) | Dynamic Operating Condition, 125°C, 3.6V, 96 Hours JESD22-A-108 | P |
| High Temperature Operating Life Latent Failure Rate (LFR) | Dynamic Operating Condition, 125°C, 3.6V, 168,1000 Hours JESD22-A-108 | P |
| Pressure Cooker | JESD22-A102:121°C /100%RH, 15 PSIG Precondition: JESD22 Moisture Sensitivity Level 3 192 Hrs, 30C/60%RH+ Reflow, 260°C+0, -5°C | P |
| Temperature Cycle | MIL-STD-883, Method 1010, Condition C, -65 °C to 150°C Precondition: JESD22 Moisture Sensitivity Level 3 192 Hrs, 30C/60%RH+ Reflow, 260°C+0, -5°C | P |

RELIABILITY FAILURE RATE SUMMARY

| Stress/Test | Device Tested/ Device Hours | # Fails | Activation Energy | Thermal AF ³ | Failure Rate |
|---|--------------------------------|------------|----------------------|----------------------------|--------------|
| High Temperature Operating Life Early Failure Rate | 2,390 Devices | 0 | N/A | N/A | 0 PPM |
| High Temperature Operating Life Long Term Failure Rate | 1,009,000 DHRs | 0 | 0.7 | 170 | 16 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 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 = 8.62x10⁻⁵ eV/Kelvin.

T₁ is the junction temperature of the device under stress and T₂ is the junction temperature of the device at use conditions.

*LFR data leveraged from QTP# 124901 (T1 130nm F-RAM Process) and QTP# 125003 (128KB/256KB F-RAM AEC-Q100)

Reliability Test Data

QTP #: 133202

| <i>Device</i> | <i>Fab Lot #</i> | <i>Assy Lot #</i> | <i>Assy Loc</i> | <i>Duration</i> | <i>Samp</i> | <i>Rej</i> |
|--|------------------|-------------------|-----------------|-----------------|-------------|------------|
| STRESS: ACOUSTIC, MSL3 | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | 15 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | 15 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | COMP | 15 | 0 |
| STRESS: BALL SHEAR | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | 5 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | 5 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | COMP | 5 | 0 |
| STRESS: BOND PULL | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | 5 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | 5 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | COMP | 5 | 0 |
| STRESS: CLASS YIELD | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | EQUIVALENT | |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | EQUIVALENT | |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | COMP | EQUIVALENT | |
| STRESS: CONSTRUCTIONAL ANALYSIS | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | 5 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | 5 | 0 |
| STRESS: DATA RETENTION, 125C | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 500 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 75 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 500 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |

Reliability Test Data

QTP #: 133202

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej |
|--------|-----------|------------|----------|----------|------|-----|
|--------|-----------|------------|----------|----------|------|-----|

STRESS: HI-ACCEL SATURATION TEST (130C, 85%RH, 3.6V), PRE COND 192 HR 30C/60%RH (MSL3)

| | | | | | | |
|----------------------|---------|-----------|---------|-----|----|---|
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 128 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 256 | 72 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 256 | 72 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 128 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 256 | 73 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 256 | 73 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 128 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 256 | 72 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 256 | 72 | 0 |

STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE (125C, 3.6V, Vcc Max)

| | | | | | | |
|----------------------|---------|-----------|---------|----|-----|---|
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 96 | 800 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 96 | 792 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 96 | 799 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 96 | 799 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 96 | 800 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 96 | 799 | 0 |

STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE (125C, 3.6V, Vcc Max)

| | | | | | | |
|----------------------|---------|-----------|---------|------|----|---|
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 1000 | 77 | 0 |

Reliability Test Data

QTP #: 133202

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej |
|--|-----------|------------|----------|----------|------------|-----|
| STRESS: PRESSURE COOKER TEST (121C, 100%RH, 15 Psig), PRE COND 192 HR 30C/60%RH (MSL3) | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 288 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 288 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 168 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 288 | 77 | 0 |
| STRESS: SORT YIELD | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | COMP | EQUIVALENT | |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | COMP | EQUIVALENT | |
| STRESS: TEMPERATURE CYCLE (COND. C, -65C TO 150C), PRE COND 192 HR 30C/60%RH (MSL3) | | | | | | |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 500 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2327007 | 611340032 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 500 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329042 | 611340033 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 500 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 1000 | 77 | 0 |
| FM25V01-G (FM25V01A) | 2329041 | 611340037 | LINGSEN | 1000 | 77 | 0 |

Document History Page

Document Title: QTP#133202: 130NM F-RAM DEVICE FAMILY, 130NM TECHNOLOGY, TI FAB
Document Number: 001-91526

| Rev. | ECN No. | Orig. of Change | Description of Change |
|------|---------|-----------------|--|
| ** | 4308820 | JYF | Initial release. |
| *A | 4315968 | BECK | Standardized format, corrected typos |
| *B | 4803184 | BECK | Indicated "Proprietary" Items on the "TECHNOLOGY/FAB PROCESS DESCRIPTION" Table, Page 4, and removed proprietary items from Page 3 (Qualification History) and Page 4 (Product Description). |
| *C | 7106403 | JUMI | Clarified Global Foundries Fab site on title and page 4 (Technology/Fab Process Description). and aligned Qualification Report with current requirements. |
| | | SLLO | Removed Distribution and Posting from document history page. |