# Cypress Semiconductor
# Product Qualification Report

**QTP# 071502 VERSION 2.1**
**August 2008**

| Ovation 1 Family<br>S4AD-5/C8QR-3R Technology, Fab2/4 | |
|---|---|
| **CYONS1001**<br>**CYONS1001L**<br>**CYONS1001G**<br>**CYONS1001LR**<br>**CYONS10017**<br>**CYONS1001T0**<br>**CYONS10800**<br>**CYONS10810**<br>**CYONS10820** | **Laser Optical Sensor** |

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**PRODUCT QUALIFICATION HISTORY**

| QUAL REPORT | DESCRIPTION OF QUALIFICATION PURPOSE | DATE COMP. |
|---|---|---|
| 071502 | CYONS1001 (Laser Optical Sensor) VCSEL and GOOBI Qualification | Aug 07 |
| 072206 | CYONS1001 (Optical Navigation System) Ovation 1A (New Digital Die – 7CN1200AC) Qualification | Aug 07 |
| 080804 | CYONS1001 (Optical Navigation Sensor) S4 die Metal Mask (minor change) | Mar 08 |

**Cypress products are manufactured using qualified processes. The technology qualification for this product is referenced above and must be considered to get a complete and thorough evaluation of the reliability of the product.**

| PRODUCT DESCRIPTION (for qualification) | |
|---|---|
| Qualification Purpose: | CYONS1001 (Laser Optical Sensor) VCSEL and GOOBI Qualification |
| Marketing Part #: | CYONS1001, CYONS1001L, CYONS1001G, CYONS1001LR, CYONS10017, CYONS1001T0, CYONS10800/10/20 |
| Device Description: | 2.7V-3.6V two piece laser optical sensor with integrated source, available in QFN 42L |
| Cypress Division: | Cypress Semiconductor Corporation – Silicon Light Machine |

| TECHNOLOGY/FAB PROCESS DESCRIPTION (Analog Die : 7CN0000A) | | | |
|---|---|---|---|
| Number of Metal Layers: | 2 | Metal Composition: | Metal 1: 500A Ti / 6000A Al 0.5% Cu / 1200A TiW<br>Metal 2: 500A T i/ 8000A A1 0.5% Cu / 300A TiW |
| Passivation Type and Materials: | | | 7000A TEOS / 6000A $Si_3N_4$ |
| Generic Process Technology/Design Rule (µ-drawn): | | | Single Poly, Double Metal, 0.35 µm |
| Gate Oxide Material/Thickness (MOS): | | | $SiO_2$/ 11 |
| Name/Location of Die Fab (prime) Facility: | | | Cypress CTI-Texas |
| Die Fab Line ID/Wafer Process ID: | | | Fab2, S4AD-5 |

| TECHNOLOGY/FAB PROCESS DESCRIPTION (Digital Die: 7CN1001A) | | | |
|---|---|---|---|
| Number of Metal Layers: | 4 | Metal Composition: | Metal 1: 300A Ti / 3200A Al 0.5% Cu / 300A TiW<br>Metal 2: 150A Ti / 4000A A1 0.5% Cu / 300A TiW<br>Metal 3: 150A Ti / 4000A A1 0.5% Cu / 300A TiW<br>Metal 4: 150A Ti / 4000A A1 0.5% Cu / 300A TiW |
| Passivation Type and Materials: | | | 1000A TEOS / 9000A $Si_3N_4$ |
| Generic Process Technology/Design Rule (µ-drawn): | | | CMOS/ 0.3µm |
| Gate Oxide Material/Thickness (MOS): | | | $SiO_2$ DGOX 32/55A |
| Name/Location of Die Fab (prime) Facility: | | | Cypress CMI-Minnesota |
| Die Fab Line ID/Wafer Process ID: | | | Fab4, C8Q-3R |

| TECHNOLOGY/FAB PROCESS DESCRIPTION (VCSEL) | | | |
|---|---|---|---|
| Number of Metal Layers: | 1 | Metal Composition: | Metal 1: Ti: Pt: Au |
| Passivation Type and Materials: | | | SiN |
| Generic Process Technology/Design Rule (µ-drawn): | | | Oxide VCSEL |
| Gate Oxide Material/Thickness (MOS): | | | N/A |
| Name/Location of Die Fab (prime) Facility: | | | Bookham/Zurich, Switzerland |
| Die Fab Line ID/Wafer Process ID: | | | N/A |

## PACKAGE AVAILABILITY

| PACKAGE | ASSEMBLY FACILITY SITE |
|---|---|
| **42-Lead QFN** | **CML Philippines** |

Note: Package Qualification details available upon request.

| MAJOR PACKAGE INFORMATION USED IN THIS QUALIFICATION | |
|---|---|
| **Package Designation:** | LB42 |
| **Package Outline, Type, or Name:** | 42-lead Quad Flat No Lead (QFN) |
| **Mold Compound Name/Manufacturer:** | Sumitomo G700H Type A |
| **Mold Compound Flammability Rating:** | V-0 UL-94 |
| **Mold Compound Alpha Emission Rate:** | N/A |
| **Oxygen Rating Index:** | NA |
| **Lead Frame Material:** | Copper |
| **Lead Finish, Composition / Thickness:** | NiPdAu (20-80uinch Ni, 0.8-1.2uinch Pd, 0.12-0.5uinch Au) |
| **Die Backside Preparation Method/Metallization:** | Backgrind |
| **Die Separation Method:** | 100% Saw |
| **Die Attach Supplier:** | Dexter/Ablestik |
| **Die Attach Material:** | QMI 509 - Analog and Digital Die<br>84-1LMISR4 - VCSEL die |
| **Die Attach Method:** | Epoxy Dispensing |
| **Bond Diagram Designation:** | 001-07289 |
| **Wire Bond Method:** | Thermosonic |
| **Wire Material/Size:** | Au 1.0mil |
| **Thermal Resistance Theta JA °C/W :** | 30°C/W |
| **Package Cross Section Yes/No:** | N/A |
| **Assembly Process Flow:** | 11-20099 |
| **Name/Location of Assembly (prime) facility:** | CML |
| **MSL Level:** | 3 |
| **Reflow Profile:** | 260C |

| ELECTRICAL TEST / FINISH DESCRIPTION | |
|---|---|
| **Test Location:** | CML-R |

## RELIABILITY TESTS PERFORMED PER SPECIFICATION REQUIREMENTS

| Stress/Test | Test Condition (Temp/Bias) | Result P/F |
|---|---|---|
| Electrostatic Discharge Human Body Model (ESD-HBM) | 2200V<br>JEDEC EIA/JESD22-A114-B<br>JEDEC EIA/JESD22-A114-E | P |
| Electrostatic Discharge Charge Device Model (ESD-CDM) | 500V<br>Cypress Spec 25-00020 | P |
| Electrostatic Discharge Human Body Model (ESD-HBM) (Special/VCSEL Anode and Cathode bonded out) | 2200V<br>JEDEC EIA/JESD22-A114-B<br>JEDEC EIA/JESD22-A114-E | P |
| High Temperature Operating Life Early Failure Rate (Silicon) | Dynamic Operating Condition, Vcc = 4.2V, 125 C | P |
| High Temperature Operating Life Early Failure Rate (VCSEL) | Dynamic Operating Condition, Vcc = 4.2V, 40 C | P |
| High Temperature Operating Life Latent Failure Rate (Silicon) | Dynamic Operating Condition, Vcc = 4.2V, 125 C | P |
| High Temperature Operating Life Latent Failure Rate (VCSEL) | Dynamic Operating Condition, Vcc = 4.2V, 40 C | P |
| High Temp Storage | 100C | P |
| Static Latch-up | 125C, ± 200mA<br>Cypress Spec 01-00081 | P |
| Temperature Cycle | -40°C to 85C<br>Precondition: JESD22 Moisture Sensitivity MSL3<br>192 Hrs 30°C/60%RH+3IR-Reflow, **260°C**+0, -5°C | P |
| Temperature Humidity Bias | 85C, 85%RH<br>Precondition: JESD22 Moisture Sensitivity MSL3<br>192 Hrs 30°C/60%RH+3IR-Reflow, **260°C**+0, -5°C | P |
| Wafer Level Data Retention | 250C | P |
| Assy Bond Pull | Cypress Spec 12-00292 | P |
| Die Shear | Cypress Spec 12-00292 | P |
| External Visual | Cypress Spec 12-00292 | P |
| Internal Visual | Cypress Spec 25-00017 | P |
| Mechanical Shock | JEDEC JESD22-B104 | P |
| Mechanical Vibration | JEDEC JESD22-B103 | P |
| Physical Dimension | Cypress Spec 25-00031 | P |
| Solderability | Cypress Spec 25-00018 | P |
| X-Ray | Cypress Spec 12-00292 | 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 (Silicon) | 1,963 Devices | 1 | N/A | N/A | 509 PPM |
| High Temperature Operating Life Early Failure Rate (VCSEL) | 2, 988 Devices | 0 | N/A | N/A | 0 PPM |
| High Temperature Operating Life[1,2,3] Long Term Failure Rate (Silicon) | 9,705,903 | 0 | 0.7eV | 147 | .0094% / 1K hrs |
| High Temperature Operating Life[2,3,4] Long Term Failure Rate (VCSEL) | 1,596,995 | 0 | 0.7eV | 4 | .0574% / 1K hrs |

[1] For Silicon Assuming an ambient temperature of 45°C and a junction temperature rise of 5°C.
[2] Chi-squared 60% estimations used to calculate the failure rate.
[3] Thermal Acceleration Factor is calculated from the Arrhenius equation
[4] For VCSEL Assuming an ambient temperature of 25°C and a junction temperature rise of 5°C.

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

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 #: 071502

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej | Failure Mechanism |
|---|---|---|---|---|---|---|---|
| ***STRESS: BOND PULL*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 5 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 5 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 5 | 0 | |
| ***STRESS: DATA RETENTION, WAFER LEVEL 250C*** | | | | | | | |
| CYONS1001 (7CN1001A) | 2613676 | | | 5 | 257 | 0 | |
| ***STRESS: DIE SHEAR*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 15 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 15 | 0 | |
| CYONS1001L (7CN1001AT) | N/A | N/A | CML-R | COMP | 15 | 0 | |
| ***STRESS: ELECTROSTATIC DISCHARGE HUMAN BODY MODEL PER JEDEC EIA/JESD22-A114-B)*** | | | | | | | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 1100V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 2200V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 3300V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 1100V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 2200V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 3300V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 1100V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 2200V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 3300V | 3 | 0 | |
| ***STRESS: ELECTROSTATIC DISCHARGE CHARGE DEVICE MODEL*** | | | | | | | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 200V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 500V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 750V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610626811 | CML-R | 1000V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 200V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 500V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 750V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 1000V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 200V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 500V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 750V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632941 | CML-R | 1000V | 3 | 0 | |

# Reliability Test Data

## QTP #: 071502

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej | Failure Mechanism |
|---|---|---|---|---|---|---|---|
| ***STRESS: ELECTROSTATIC DISCHARGE HUMAN BODY MODEL PER JEDEC EIA/JESD22-A114-B (Special VCSEL)*** | | | | | | | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 1100V | 3 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 2200V | 9 | 0 | |
| CYONS1001 (7CN100AT) | 2602074 | 610632280 | CML-R | 3300V | 3 | 0 | |
| ***STRESS: EXTERNAL VISUAL*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 25 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 25 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 25 | 0 | |
| ***STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE, 125C, 4.2V, Vcc Max*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2613673 | 610716161 | CML-R | 72 | 339 | 0 | |
| CYONS1001L (7CN1001AT) | 2628786 | 610718715 | CML-R | 72 | 332 | 1 | (Bin6, Non-visual |
| CYONS1001L (7CN1001AT) | 2632383 | 610721350 | CML-R | 72 | 337 | 0 | from VCSEL EFR/LFR) |
| ***STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE, 40C, 4.2V, Vcc Max(VCSEL)*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2613673 | 610716161 | CML-R | 168 | 1009 | 0 | |
| CYONS1001L (7CN1001AT) | 2628786 | 610718715 | CML-R | 168 | 989 | 0 | |
| CYONS1001L (7CN1001AT) | 2632383 | 610721350 | CML-R | 168 | 990 | 0 | |
| ***STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE, 125C, 4.2V, Vcc Max*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2613673 | 610716161 | CML-R | 180 | 228 | 0 | |
| CYONS1001 (7CN1001AT) | 2613673 | 610716161 | CML-R | 300 | 220 | 0 | |
| ***STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-LATENT FAILURE RATE, 40C, 4.2V, Vcc Max(VCSEL)*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2613673 | 610716161 | CML-R | 336 | 227 | 0 | |
| CYONS1001 (7CN1001AT) | 2613673 | 610716161 | CML-R | 650 | 227 | 0 | |
| CYONS1001L (7CN1001AT) | 2628786 | 610718715 | CML-R | 336 | 233 | 0 | |
| CYONS1001L (7CN1001AT) | 2628786 | 610718715 | CML-R | 650 | 232 | 0 | |
| CYONS1001L (7CN1001AT) | 2632383 | 610721350 | CML-R | 336 | 235 | 0 | |
| CYONS1001L (7CN1001AT) | 2632383 | 610721350 | CML-R | 650 | 235 | 0 | |
| ***STRESS: HIGH TEMP STORAGE*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | 500 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | 1000 | 45 | 0 | |

# Reliability Test Data

## QTP #: 071502

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej | Failure Mechanism |
|---|---|---|---|---|---|---|---|
| ***STRESS: INTERNAL VISUAL*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 5 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 5 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 5 | 0 | |
| ***STRESS: MECHANICAL SHOCK PER JESD22-B104*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | COMP | 17 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 15 | 0 | |
| ***STRESS: MECHANICAL VIBRATION PER JESD22-B103*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | COMP | 17 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 15 | 0 | |
| ***STRESS: PHYSICAL DIMENSIONS*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 10 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 10 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 10 | 0 | |
| ***STRESS: SOLDERABILITY*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 3 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 3 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 3 | 0 | |
| ***STRESS: STATIC LATCH-UP 125C, ± 200mA*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610626811 | CML-R | COMP | 3 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 3 | 0 | |
| CYONS1001 (7CN1001AT) | 2630056 | 610703842 | CML-R | COMP | 3 | 0 | |
| ***STRESS: TC COND. -40C TO 85 C, PRECONDITION 192 HRS 30C/60%RH, MSL3*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610626811 | CML-R | 300 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610626811 | CML-R | 500 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | 300 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | 500 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610632941 | CML-R | 300 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610632941 | CML-R | 500 | 44 | 0 | |

# Reliability Test Data

## QTP #: 071502

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej | Failure Mechanism |
|---|---|---|---|---|---|---|---|
| ***STRESS: TEMP HUMIDITY BIAS, PRECONDITION 192 HRS 30C/60%RH, MSL3*** | | | | | | | |
| CYONS1001 (7CN1001AT) | 2602074 | 610626811 | CML-R | 168 | 45 | 0 | |
| CYONS1001 (7CN1001AT) | 2602074 | 610322280 | CML-R | 168 | 45 | 0 | |
| ***STRESS: X-RAY*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2630056 | 610703642 | CML-R | COMP | 15 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | 610703184 | CML-R | COMP | 15 | 0 | |
| CYONS1001L (7CN1001AT) | 2631220 | | CML-R | COMP | 15 | 0 | |

# Reliability Test Data

## QTP #: 072206

| Device | Fab Lot # | Assy Lot # | Assy Loc | Duration | Samp | Rej | Failure Mechanism |
|---|---|---|---|---|---|---|---|
| ***STRESS: ELECTROSTATIC DISCHARGE HUMAN BODY MODEL PER JEDEC EIA/JESD22-A114-E)*** | | | | | | | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 1100V | 3 | 0 | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 2200V | 8 | 0 | |
| CYONS10820 (7CN1002AT)) | 4634005 | 610725319 | CML-R | 3300V | 3 | 0 | |
| ***STRESS: ELECTROSTATIC DISCHARGE CHARGE DEVICE MODEL*** | | | | | | | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 500V | 9 | 0 | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 750V | 3 | 0 | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 1000V | 3 | 0 | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | 1250V | 3 | 0 | |
| ***STRESS: HIGH TEMP DYNAMIC OPERATING LIFE-EARLY FAILURE RATE, 125C, 4.2V, Vcc Max*** | | | | | | | |
| CYONS1001L (7CN1001AT) | 2631219 | 610729933 | CML-R | 72 | 955 | 0 | |
| ***STRESS: STATIC LATCH-UP 125C, ± 200mA*** | | | | | | | |
| CYONS10820 (7CN1002AT) | 4634005 | 610725319 | CML-R | COMP | 3 | 0 | |