

AUGUST 21, 1975

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RELIABILITY REPORT

Product Line: Optoisolator (MCT2 Type)

- I. **PURPOSE:** To summarize the result of Monsanto's Product Reliability Assurance Program for the Optoisolator product line (MCT2).
- II. **OBJECTIVE:** To document the reliability performance and capabilities of Monsanto's Optoisolator line (MCT2).
- III. **APPLICABILITY:** Data presented applies to the following Monsanto products:
- A. MCT2 4N27
 - MCT26 4N28
 - MCT2E 4N35
 - 4N25 4N36
 - 4N26 4N37
 - B. Following products on a generic basis:
 - MCT4 4N30
 - MCT6 4N31
 - MCA230 4N32
 - MCA231 4N33
 - MCA255 MCS2
 - MCD2 MCS2400
 - MCD4 MCS6200
 - 4N29 MCS6201
- IV. **CONCLUSION:** All tests completed showed that the device meets or exceeds the requirements of MIL-STD-883, Condition B.

V. TEST RESULTS: Details of all test results follow.

A. SUMMARY OF RELIABILITY TESTS — Product Line: Coupled Pair: MCT2

| Generic Tests | | | | | | | MTFF (Hours) | | |
|--|-----------|-------------|------|---------------|------------|---------|----------------------|----------------|----------------|
| Test | No. Tests | Total Units | Good | Total Rejects | Elec Rej | Vis Rej | Unit Hours in 1000's | 60% Conf Level | 90% Conf Level |
| Temp Cycle | 43 | 873 | 872 | 1 | 1 0.12% | 0 | — | — | — |
| Temp Cycle Step Stress (See Section D.1) | 15 | 414 | 397 | 17 4.1% | 17 4.1% | 0 0% | — | — | — |
| Thermal Shock | 19 | 479 | 479 | 0 | 0 | 0 0% | — | — | — |
| Moisture Resistance | 20 | 461 | 460 | 1 | 1 | 0 0% | 110.6 | 55K | 28.5K |
| High Temp Storage | 28 | 934 | 932 | 2 | 2 | 0 0% | 933 | 300K | 175K |
| Low Temp Storage | 13 | 362 | 359 | 3 1.7% | 3 1.7% | 0 0% | 279.3 | 66.5K | 41.7K |
| Temp-Humidity (See Section D.2) | 30 | 846 | 842 | 4 | 4 | 0 0% | 1661 | 320K | 210K |

B. SUMMARY OF LIFE TEST RESULTS — Product Line: Optoisolators

| Attribute Results | | | | | | | Mean Time-to-Failure | | | |
|-------------------|---|-----------|-------------|------|--------|----------|----------------------|--------------------|-------------------|---------------------|
| Product | Test Conditions | No. Tests | Total Units | Good | Reject | % Reject | Total Unit-Hours | 60% | 90% | % Chg. CTR @ 1K hrs |
| MCT2 | DC Op Life $T_A = 25^\circ\text{C}$ $I_F = 60\text{ mA}$ $I_C = 10 - 15\text{ mA}$ | 60 | 1667 | 1656 | 11 | .65% | 2,089,000 | 175K | 122.5K | -14.8% |
| | Hi Temp Op Life $T_A = 125^\circ\text{C}$ $I_F = 5\text{ mA}$ $I_C = 5\text{ mA}$ | 3 | 105 | 105 | 0 | | 105,000 | 113K _{hr} | 46K _{hr} | -15% |
| | HTRB $T_A = +125^\circ\text{C}$ $V_{CE} = 24\text{ V}$ $I_F = 0$ $V_R = 0$ | 6 | 254 | 253 | 1 | | 219,900 | 112,000 | 58,000 | -10% |
| MCT4 | $T_A = 125^\circ\text{C}$ Time = 168 hrs $I_F = 5\text{ mA}$ $I_C = 5.5\text{ mA}$ | 46 | 8361 | 8356 | 5 | .06 | 1,403,808 | 220,000 | 152,000 | |

C. TEST CONDITIONS

1. Temperature Cycle:

Condition: MIL-STD-883, Method 1010

-55°C to 125°C, ten cycles, 15 minutes per temperature and 2 minutes transfer time.

2. Temperature Cycle Step Stress: (See Section D.1)

Conditions: (15 minutes/temperature, 2 minutes transfer time)

| Min. Temp. (°C) | Max. Temp. (°C) | Number Cycle | Cumulative Cycle |
|--------------------|--------------------|-----------------|---------------------|
| -40 | +100 | 10 | 10 |
| -40 | +125 | 10 | 20 |
| -55 | +125 | 10 | 30 |
| -55 | +150 | 10 | 40 |
| -65 | +150 | 10 | 50 |

3. Thermal Shock:

Condition: MIL-STD-883, Method 1011

0°C to 100°C, fifteen cycles, 5 minutes per temperature, 5 seconds transfer time.

4. Moisture Resistance:

Conditions:

a) MIL-STD-883, Method 1004 (omit initial conditioning and step 7).

b) Relative Humidity Range of 90-98%, ten days, temperature cycle between 25°C and 65°C.

5. High Temperature Storage:

Conditions: Storage at 150°C for 1000 hours.

6. Low Temperature Storage:

Conditions: Storage at -40°C for 1000 hours.

7. Temperature Humidity Test:

Test Conditions: 85°C and 85% Relative Humidity for 1000 hours.

D. NOTES

1. Temperature cycle step stress is a stringent test, far exceeding MIL-STANDARD requirements. The test matrix is designed to obtain failures (test to destruct mode). The low failure rates typically observed on the temperature cycle step stress reflect the inherent integrity of the Monsanto package design.
2. The Temperature Humidity test is a stringent requirement for the plastic encapsulated device. Due to the non-hermetic nature of the plastic encapsulant, the devices could show a significant failure rate when subjected to 85°C, 85% RH for an extended period of time.

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