APPLICATION NOTE: AN-83-001

TITLE: **Mechanical Switch**
Extended Life Test Report

Reference: RF Mechanical Switch, RF Relay Switch

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Contents

1 Purpose

To validate the extended life performance of the Mini-Circuits Mechanical Switch Product line in the defined environment under defined operating conditions.

2 Scope:

- MSP2T-18XL
- MSP2TA-18XL
- MTS-18XL-B

3 Background:

Prior to developing our Mechanical Switch, Mini-Circuits purchased a significant quantity of mechanical switches for use in our production test facilities. These switches utilized a combination of springs and solenoids to accomplish the switching. Most operated for less than 1 million cycles, or approximately 50 days in our production environment. This turnover prompted Mini-Circuits to develop our own design to address the short operating life, long lead times, and high cost of using commercially available Mechanical Relay switches.

4 Design Approach

Design Objective: Develop a long life mechanical switch

Design Criteria:

1. Eliminate the use of any springs
2. Select combinations of materials based upon compatibility and ability to mate with limited wear.
3. Simplicity of design with the minimum number of components possible
4. Cost effectiveness to meet internal and external market demands

5 Tests Performed

5.1 Life Testing

In a production test environment, a failure is very important. When using commercially available mechanical relays, we observed a number of cases where “good” products failed as a result of a bad switch in our test system.

It was commonly believed that a mechanical switch has "failed" when it fails to switch states (was closed when expected to be open, or open when expected to be closed), i.e. catastrophic failure. We learned that a mechanical switch will actually show many cycles of degraded performance prior to reaching catastrophic failure. For customer use purposes, the number of failed switching cycles is a more meaningful criteria for determining the "failure" of a mechanical switch. For example, many commercially available mechanical switches are specified at one-million cycle life expectancy; however, we have seen that these switches often exhibit failed performance starting at 800K cycles. In a test environment, every failed performance cycle can mean a rejected good DUT.

To determine if a switch has failed life test, we define "Life Test Failure" as an accumulation of individual cycle performance failures. The failure criteria of any one performance cycle is one that measures DC resistance exceeding 240 milliohms. That is equivalent to an increase in RF insertion loss at low frequencies of 0.021dB (see chart below).

The Mini-Circuits criteria for Mechanical Switch Life Test Failure is a unit which passes both of the following conditions:

1. First 10 cumulative cycle failures occurs at greater than 5 million total switch cycles (*equals 2 DPPM*)
   - and -
2. Cumulative of 1000 cycle failures occurs at greater than 10 million total switch cycles

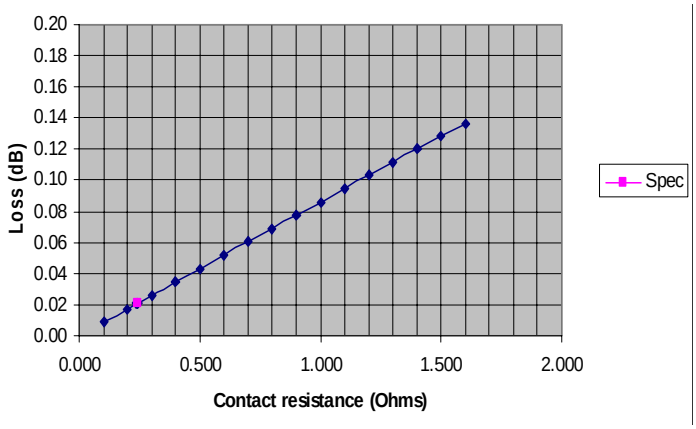

Figure 1 – First Failure

5.2 Sleep Mode Testing

Sleep testing validates the ability of a mechanical switch to remain in a fixed state for an extended period of time, and still switch reliably to another state when energized. This parameter is a result of applications where mechanical relay switches are used to switch-in

redundant paths in the event of a failure in the main path. A switch functioning in this mode is often referred to as operating in “sleep mode”.

Mini-Circuits’ has, and continues to test switches in this mode of operation. Sets of 10 switches are stored in a fixed state over a period a four (4) years. At specific intervals, switches are removed and tested for their ability to “switch” after the period of inactivity.

6 Switch Tune-Up

Even though the life of the Mini-Circuits switches is far greater than any other switch on the market today, even our switches will fail – at some point. Mini-Circuits unique construction makes it very practical to clean the switch contact assembly enabling switch performance recovery for extending the switch life to well over 100 million cycles.

Mini-Circuits also validated the effectiveness of the “tune-up” on our mechanical switches, subjecting switches to extended life testing with “tune-ups” after any switch reached 1000 cumulative failed cycles. We achieved a total life cycle of greater than 300 million cycles.

7 Production Life Testing

It is a Mini-Circuits internal quality requirement that each production lot of Mechanical RF Switches be subjected to sample life testing prior to Lot Acceptance. On each production lot, a minimum of two (2) switches are randomly selected and subjected to the same DC life test as outlined above. All units are required to pass the First Failure and the Cumulative Failure criteria for lot acceptance. Data is recorded on all lots and a sample summary is included herein

Production Life Test data is used in this report as basis for Life Testing. (referred herein in TEST 1: Life Testing - without Tune-Up)

8 Test Summary

8.1 TEST 1: Life Testing (without Tune-Up)

Seventy-five(75) switches tested over a period of 1 year

Model: MSP2T-18XL and MSP2TA-18XL

Test Results

	Units	Min	Avg	Max
First Failure Occurs at	Cycle Number	5,096,137	18,798,751	44,252,850
1000 Cum Failures Occur at	Cycle Number	10,476,000	33,045,867	83,526,000

Table 1 – Life Test Results

8.2 TEST 2: Extended Life Testing – after Tune-ups

Five (5) switches tested

Test Results: All units exceed 300 million cycles after

Unit No.	No. Cycles Achieved	No. Tune-Ups Req.'d
1	336 million	23
2	336 million	17
3	306 million	29
4	339 million	21
5	339 million	20

Table 2 – Extended Life Test Results

Testing terminated after 300 Million Cycles (units show no permanent wear and continue to operate)

8.3 TEST 3: Sleep Mode Testing

20 units tested (10 units MSP2T-18, 10 units MSP2T-18XL)

All units energized in State"1"

Units Energized to State "2" over 4 years

All units successfully switched to State "2"

9 Test Methods and Conditions

9.1 Life Tests (Tests 1 and Tests 2):

Test Conditions:

- Contact resistance is measured at DC, between the probes of the connectors in the ON path in every cycle.
- DC current = 2 mA
- The cycle time is ~110 milliseconds PORT X to PORT Y
- All tests performed at room temperature (+25C)

Failure Criteria:

Individual Switch Cycle Failure: Contact resistance >240 mΩ max

Switch Assembly Failure Recordings

a) First Failure: The first time a contact exhibits greater than 240 milliohms DC resistance

b) Cumulative Failures: A cumulative of 1000 cycles in which the DC resistance measures greater than 240 milliohms

9.2 Sleep time test

Mini-Circuits switches have passed four year sleep time test. Sleep Time defines the period over which switch is not energized and hence not switched.

Test Conditions:

- Frequency 1, 100 & 1000 MHz at low RF power, 0 dBm
- Twenty (20) switches randomly selected from production lot:
  - MSP2T-18 10 pcs
  - MSP2T-18XL 10 pcs
- RF test before sleep test.
- RF test after sleep test.

Failure Criteria:

- Must work when switched for the first time and meet specifications.

10 Detailed Test Results – Test 1: Life Tests (without Tune-Up)

10.1 TEST PROCESS – TEST 1 Life Test (without Tuneup)

Life Test Data is derived from results of Production Life Test process, performed as follows:

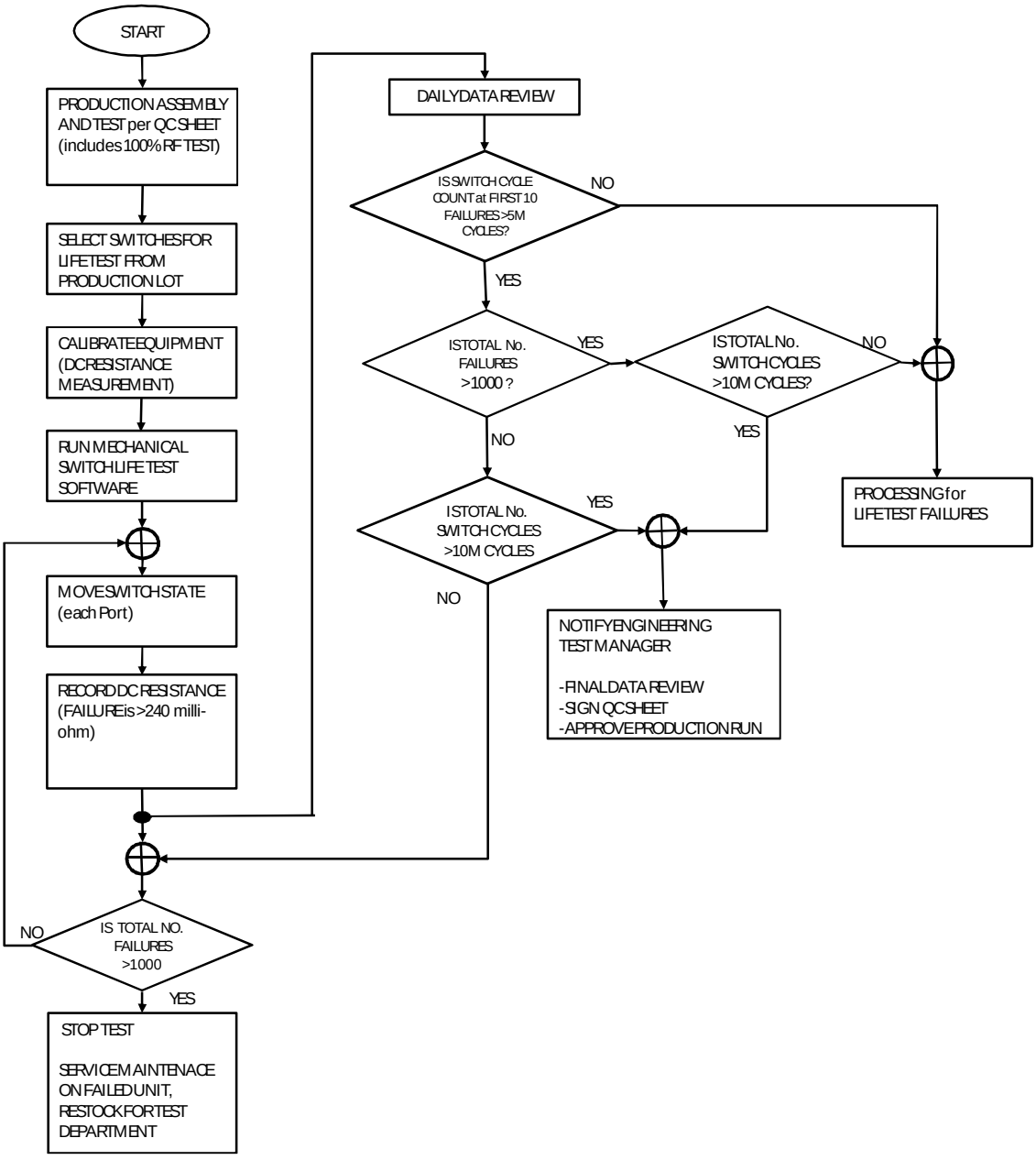

Figure 2 – Production Life Testing – Process Flow

10.2 DC Resistance Measurement

DC Resistance is measured at each switching cycle for each Port on Life Test units. Data is collected and reviewed on a daily basis. Life Test Units are tested to failure; i.e. Greater than 1000 Cumulative cycles with DC Resistance >240mΩ.

Typical DC Life test data on a single unit is presented below in Figure 3 below.

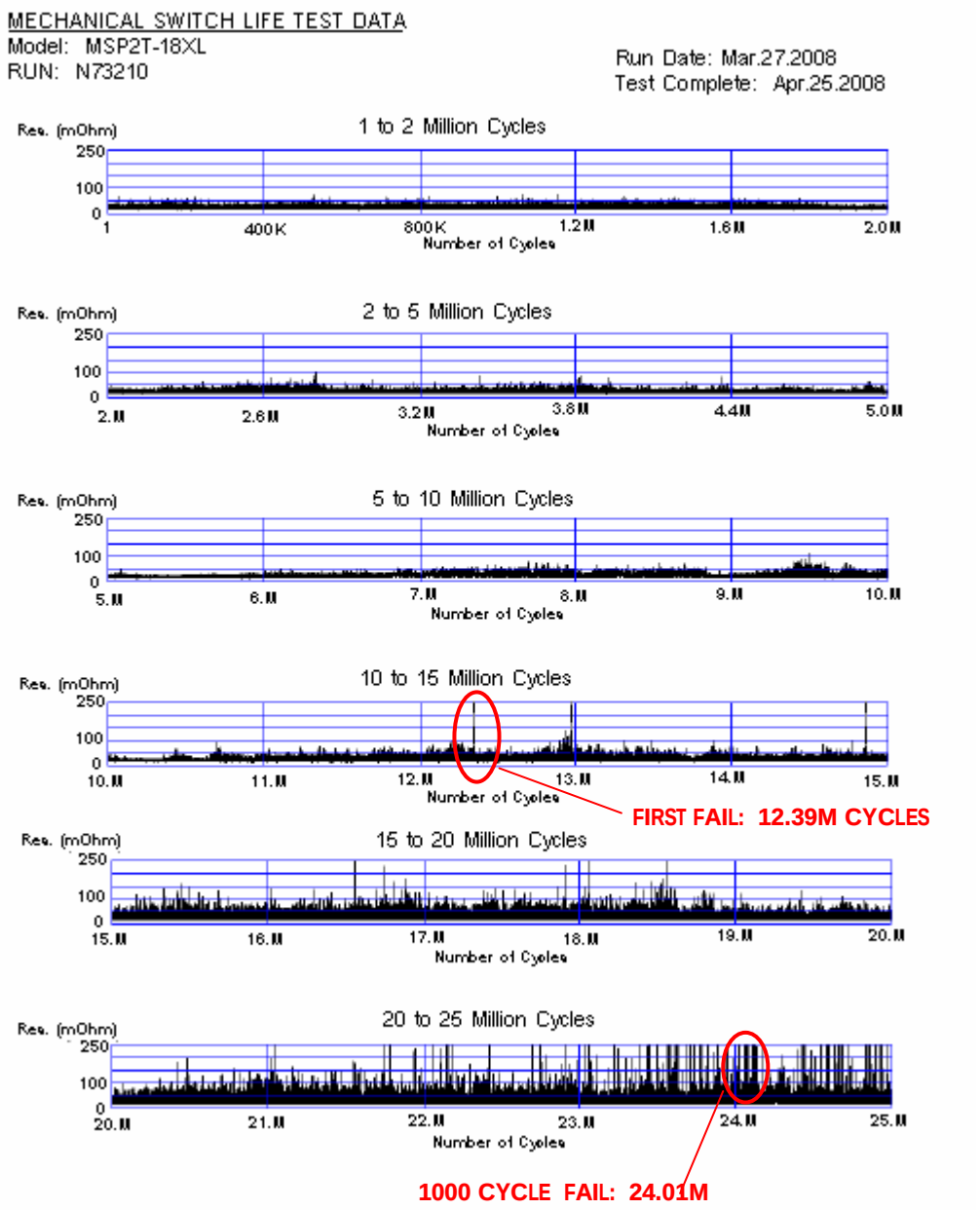

Figure 3 – Sample Life Test Data – one Switch

10.3 75 Unit Data Distribution – Test 1: Life Tests (without Tune-Up)

First Failure – Production Distribution Results

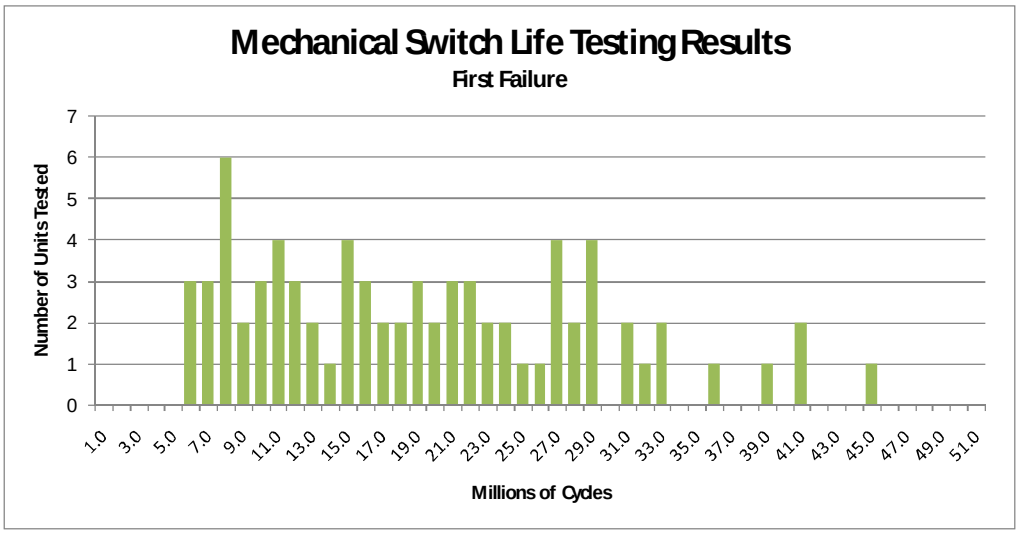

Figure 4 –Switch First Failures – Recorded Cycle - Distribution

1000 Cumulative Failures – Production Distribution Results

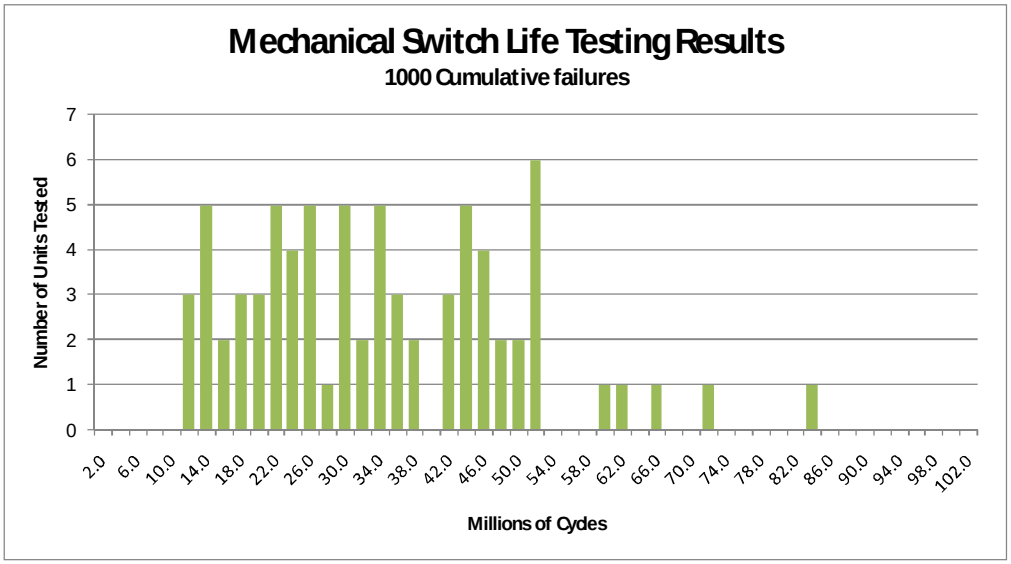

Figure 5 –Switch 1000 Cumulative Failures – Recorded Cycle - Distribution

10.4 DETAILED TEST DATA – Test 1: Life Tests (without Tune-Up)

LIFE TEST REPORT DATA

Models: MSP2T-18XL, MSP2TA-18XL

Time Period 01/18/08 – 01/12/09

	First Failure	1000 Cum Fail
No. Runs	75	75
Min	5,096,137	10,476,000
Max	44,252,850	83,526,000
Average	18,798,751	33,045,867
STDEV	9,675,126	15,422,011

CT	Run	No.	Run Number	Model No.	Unit No.	Run DATE	Run Qty	Release Date	Life Test Qty	First Failure	1000 Cum Fail	No. Failures at TEST STOP
1	5	7	N59890	MSP2T-18XL	0041	01/18/08	90	28-Jan-08	3	31,172,114	37,203,000	1000
1	5	8	N59890	MSP2T-18XL	0033	01/18/08	90			20,759,979	22,325,000	1000
1	5	9	N59890	MSP2T-18XL	0038	01/18/08	90			23,564,880	25,691,000	1000
1	7	1	N61840	MSP2T-18XL	0017	02/14/08	100	18-Feb-08	3	26,939,466	42,849,000	1000
1	7	2	N61840	MSP2T-18XL	0020	02/14/08	100			28,195,716	47,836,000	1000
1	7	3	N61840	MSP2T-18XL	0050	02/14/08	100			30,601,417	43,353,000	1000
1	8	7	N73210	MSP2T-18XL	0040	02/20/08	100	28-Feb-08	3	20,659,367	29,580,000	1000
1	8	8	N73210	MSP2T-18XL	0044	02/20/08	100			27,911,046	28,223,000	1000
1	8	9	N73210	MSP2T-18XL	0012	02/20/08	100			30,601,417	35,472,000	1000
1	12	1	N76230	MSP2T-18XL	0001	03/14/08	100	27-Mar-08	3	10,499,055	13,823,000	1000
1	12	2	N76230	MSP2T-18XL	0002	03/14/08	100			26,703,742	40,925,000	1000
1	12	3	N76230	MSP2T-18XL	0027	03/14/08	100			18,582,758	20,902,000	1000
1	14	1	N82720	MSP2T-18XL	0011	03/26/08	100	9-Apr-08	3	9,165,115	10,643,000	1000
1	14	2	N82720	MSP2T-18XL	0020	03/26/08	100			40,864,775	45,414,000	1000
1	14	3	N82720	MSP2T-18XL	0008	03/26/08	100			28,325,529	41,480,000	1000
1	8	4	N73210	MSP2T-18XL	0040	03/27/08	100	14-Apr-09	4	19,563,929	22,676,000	1000
1	8	5	N73210	MSP2T-18XL	0044	03/27/08	100			16,376,513	60,545,000	1000
1	8	6	N73210	MSP2T-18XL	0012	03/27/08	100			12,379,073	24,012,000	1000
1	16	1	N79510	MSP2T-18XL	0001	03/28/08	100	25-Apr-08	3	12,822,783	18,334,000	1000
1	16	2	N79510	MSP2T-18XL	0032	03/28/08	100			28,054,932	44,704,000	1000
1	16	3	N79510	MSP2T-18XL	0052	03/28/08	100			26,693,321	32,055,000	1000
1	8	1	N73210	MSP2T-18XL	0040	05/01/08	100	15-May-09	3	28,457,105	50,239,000	1000
1	8	2	N73210	MSP2T-18XL	0044	05/01/08	100			18,262,282	29,609,000	1000
1	8	3	N73210	MSP2T-18XL	0012	05/01/08	100			14,555,303	71,963,000	1000
1	19	1	N92790	MSP2T-18XL	0035	05/02/08	100	15-May-08	3	44,252,850	64,260,000	1000
1	19	2	N92790	MSP2T-18XL	0055	05/02/08	99			21,608,347	58,286,000	1000
1	19	3	N92790	MSP2T-18XL	0081	05/02/08	99			32,252,419	83,526,000	946*
1	24	1	N97820	MSP2T-18XL	0021	06/24/08	100	3-Jul-08	3	21,817,045	47,478,000	1000
1	24	2	N97820	MSP2T-18XL	0092	06/24/08	100			22,753,600	48,740,000	1000
1	24	3	N97820	MSP2T-18XL	0100	06/24/08	100			11,990,051	50,000,000	291*
1	25	1	N01200	MSP2TA-18XL	0019	06/30/08	100	7-Jul-08	3	11,483,701	32,275,000	1000
1	25	3	N01200	MSP2TA-18XL	0076	06/30/08	100			26,578,121	43,830,000	1000
1	26	1	N01210	MSP2TA-18XL	0023	07/09/08	100	16-Jul-08	3	22,459,922	44,584,000	1000
1	26	2	N01210	MSP2TA-18XL	0037	07/09/08	100			14,809,803	35,989,000	1000
1	26	3	N01210	MSP2TA-18XL	0045	07/09/08	100			19,115,307	37,028,000	1000
1	28	1	N01220	MSP2TA-18XL	0058	07/23/08	100	1-Aug-08	3	35,599,736	50,000,000	412*
1	28	2	N01220	MSP2TA-18XL	0061	07/23/08	100			17,523,486	42,901,000	1000
1	28	3	N01220	MSP2TA-18XL	0083	07/23/08	100			23,463,694	44,729,000	1000
1	29	1	N01230	MSP2TA-18XL	0021	07/30/08	100	8-Aug-08	3	7,344,686	32,790,000	1000
1	29	2	N01230	MSP2TA-18XL	0067	07/30/08	100			7,342,293	25,843,000	1000
1	29	3	N01230	MSP2TA-18XL	0088	07/30/08	100			21,364,154	34,155,000	1000
1	30	1	N05490	MSP2T-18XL	0010	08/05/08	100	13-Aug-08	3	20,055,732	42,004,000	1000
1	30	2	N05490	MSP2T-18XL	0052	08/05/08	100			18,870,088	50,000,000	496*
1	30	3	N05490	MSP2T-18XL	0093	08/05/08	100			40,649,155	50,000,000	3*
1	31	1	N05510	MSP2T-18XL	0001	08/06/08	100	13-Aug-08	3	38,331,892	49,241,000	1000
1	31	2	N05510	MSP2T-18XL	0002	08/06/08	100			27,598,369	40,208,000	1000
1	31	3	N05510	MSP2T-18XL	0003	08/06/08	100			25,385,306	50,000,000	604*
1	34	1	N05520	MSP2T-18XL	0021	09/10/08	49	16-Sep-08	2	10,737,191	25,619,000	1000
1	34	2	N05520	MSP2T-18XL	0041	09/10/08	49			10,399,379	22,772,000	1000
1	35	3	N01240	MSP2TA-18XL	0031	09/10/08	37	16-Sep-08	1	9,411,508	16,835,000	1000
1	35	1	N01240	MSP2TA-18XL	0041	09/26/08	63	3-Oct-08	2	17,015,585	22,434,000	1000
1	35	2	N01240	MSP2TA-18XL	0043	09/26/08	63			10,049,030	20,737,000	1000
1	36	1	N07280	MSP2T-18XL	0001	10/03/08	100	13-Oct-08	3	15,992,340	20,782,000	1000
1	36	2	N07280	MSP2T-18XL	0002	10/03/08	100			14,702,337	20,412,000	1000
1	36	3	N07280	MSP2T-18XL	0003	10/03/08	100			6,454,447	17,736,000	1000
1	37	1	N07290	MSP2TA-18XL	0001	10/15/08	100	24-Oct-08	3	11,348,571	12,029,000	1000
1	37	2	N07290	MSP2TA-18XL	0036	10/15/08	100			8,653,387	18,824,000	1000
1	37	3	N07290	MSP2TA-18XL	0088	10/15/08	100			6,633,372	13,499,000	1000
1	39	1	N07300	MSP2TA-18XL	0065	11/18/08	137	26-Nov-08	4	5,676,884	20,444,000	1000
1	39	2	N07300	MSP2TA-18XL	0096	11/18/08	137			13,326,921	30,748,000	1000
1	39	3	N07300	MSP2TA-18XL	0102	11/18/08	137			15,986,248	24,187,000	1000
1	39	4	N07300	MSP2TA-18XL	0130	11/18/08	137			14,867,459	19,616,000	1000
1	40	1	N12090	MSP2T-18XL	0030	11/20/08	100	26-Nov-08	3	15,609,451	26,409,000	1000
1	40	2	N12090	MSP2T-18XL	0033	11/20/08	100			16,387,139	28,144,000	1000
1	40	3	N12090	MSP2T-18XL	0048	11/20/08	100			32,946,303	32,946,000	1000
1	41	1	N07310	MSP2TA-18XL	0025	12/03/08	100	16-Dec-09	3	6,812,588	13,833,000	1000
1	41	2	N07310	MSP2TA-18XL	0062	12/03/08	100			9,556,473	11,139,000	1000
1	42	1	N14600	MSP2T-18XL	0031	12/16/08	150	22-Dec-08	4	7,416,966	31,190,000	1000
1	42	2	N14600	MSP2T-18XL	0053	12/16/08	150			7,334,380	16,385,000	1000
1	42	3	N14600	MSP2T-18XL	0110	12/16/08	150			7,337,631	29,561,000	1000
1	42	4	N14600	MSP2T-18XL	0127	12/16/08	150			24,230,600	32,696,000	1000
1	44	1	N07320	MSP2TA-18XL	0034	01/08/09	100	16-Jan-09	3	5,794,741	14,478,000	1000
1	44	2	N07320	MSP2TA-18XL	0040	01/08/09	100			7,244,288	14,138,000	1000
1	44	3	N07320	MSP2TA-18XL	0050	01/08/09	100			5,096,137	10,476,000	1000
1	45	1	N05520	MSP2T-18XL	0050	01/12/09	51	22-Jan-09	2	8,523,567	12,648,000	1000

* Life Test terminated prior to 1000 cycle failures for units exceeding 50 million cycles - Change instituted May.02.2008

Table 3 –Life Test Data (without Tune-up) – Details 75 Switches

(Specific Data from highlighted unit in Figure 3)

11 Detailed Test Results – Test 2: Extended Life Tests (with Tune-Up)

11.1 TEST PROCESS – TEST 2 Extended Life Test (with Tuneup)

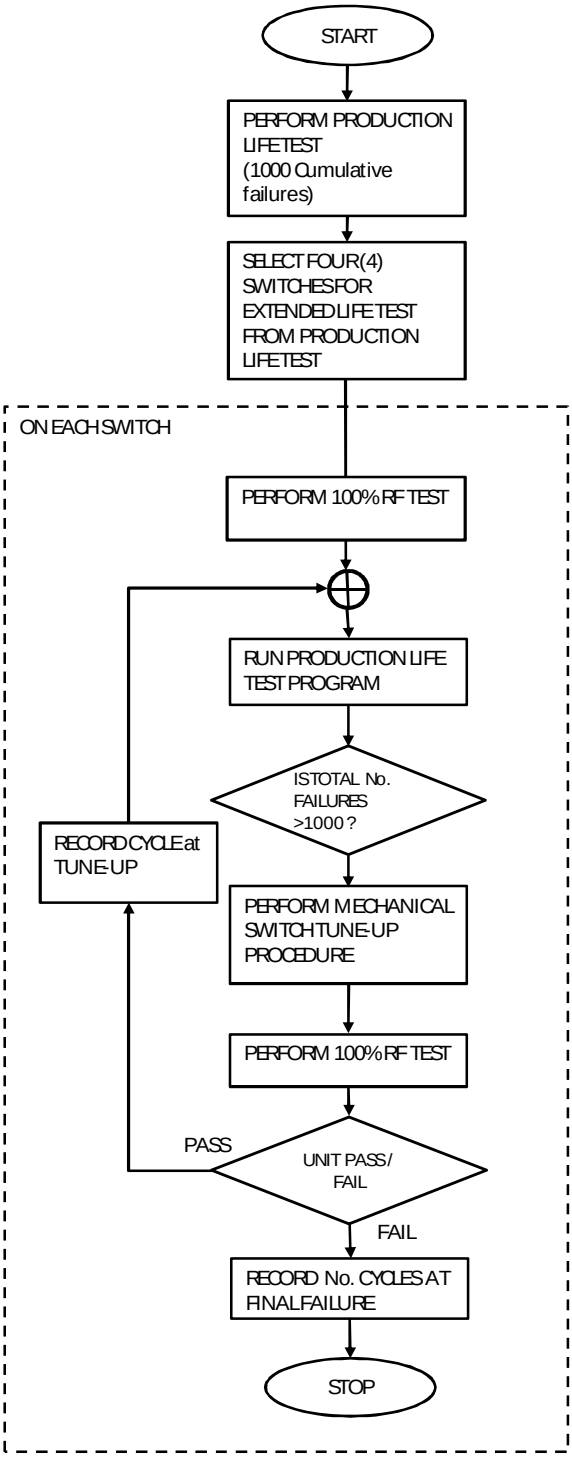

Figure 6 – Extended Life Test Data (with Tune-up) Process Flow

11.2 TEST RESULTS– TEST 2 Extended Life Test (with Tuneup)

Run: E39070 Start Date: October 19th, 2006 End: March 3rd 2008

	Tune-up #																												
Switch#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
2	8	30	61	76	93	151	170	190	206	225	238	240	247	255	256	260	264	276	291	299	311	322	336						
13	18	41	42	114	164	186	211	236	256	273	286	293	306	315	327	336													
15	19	45	63	79	87	100	106	116	123	133	142	150	154	159	166	178	191	202	210	219	230	232	246	259	264	274	285	292	306
17	9	38	57	66	100	140	174	193	211	227	242	252	258	270	282	292	304	310	319	327	339								
18	14	41	54	73	78	137	167	179	196	216	229	244	247	258	270	285	299	310	323	339									

Table 4 - Cumulative Number of Cycles Completed (in millions) prior to Each Tune-up

12 Detailed Test Results – Test 3: Sleep Testing

12.1 TEST PROCESS – TEST 3 Sleep Test

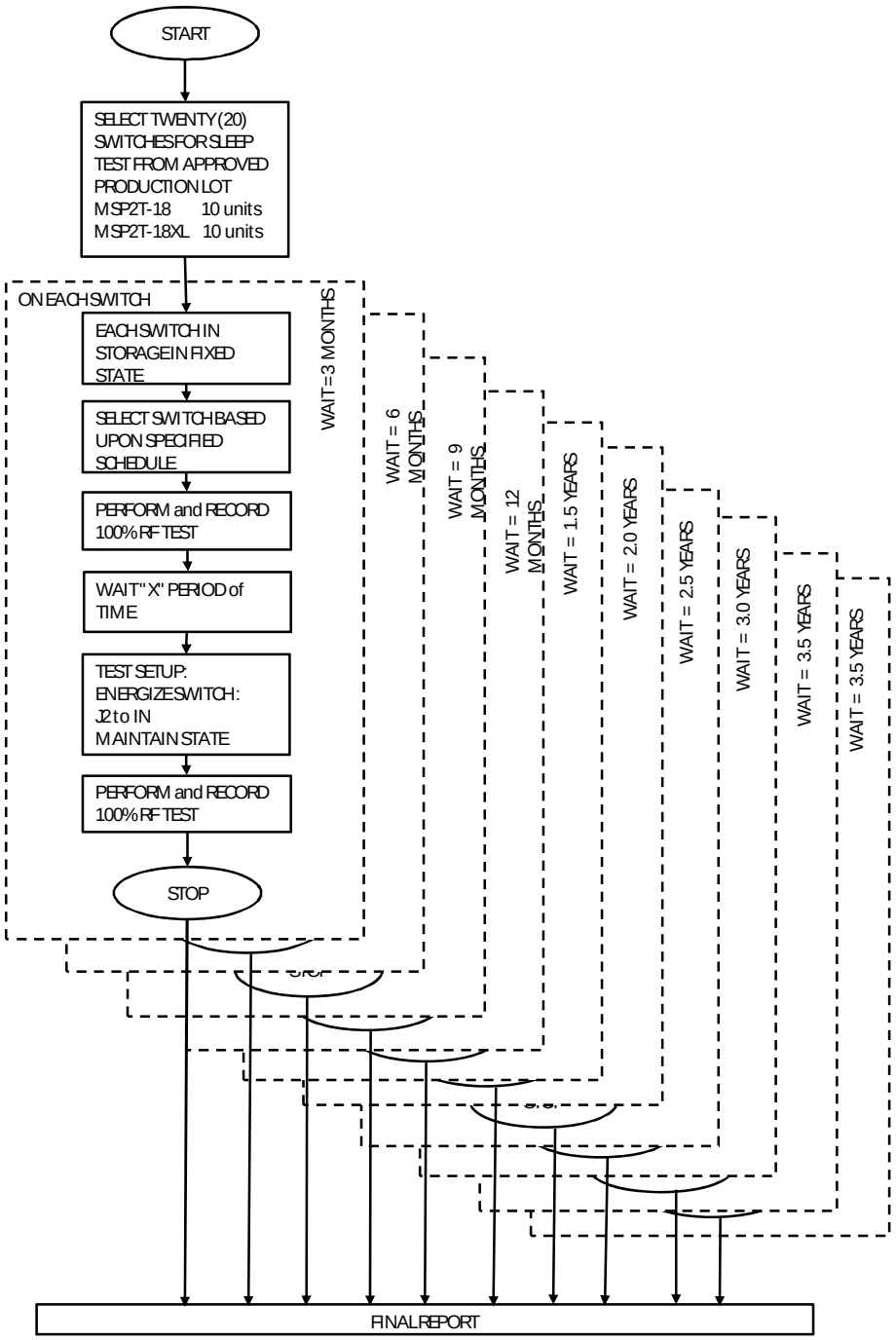

Figure 7 – Sleep Test Process Flow

12.2 TEST RESULTS – TEST 3 Sleep Tests

MODEL Number	Serial Number	Test Completed (Sched.)	Pre-Test Results	Sleep Time	Post-Test Results
MSP2T-18	N46550-0008	2/12/05	PASS	3 months	PASS
	N46570-0010	4/12/05	PASS	6 months	PASS
	N46570-0011	7/12/05	PASS	9 months	PASS
	N46570-0012	10/12/05	PASS	12 months	PASS
	N46570-0013	1/12/06	PASS	1.5 years	PASS
	N48290-0031	7/12/06	PASS	2.0 years	PASS
	N48290-0044	1/12/07	PASS	2.5 years	PASS
	N48290-0045	7/12/07	PASS	3.0 years	PASS
	N48290-0046	1/12/08	PASS	3.5 years	PASS
	N48290-0048	1/12/09	PASS	4.0 years	PASS
MSP2T-18XL	N05490-0033	3/18/2009	PASS	3 months	PASS
	N05490-0034	5/18/2009	PASS	6 months	PASS
	N05490-0035	7/18/2009	PASS	9 months	PASS
	N05490-0036	10/18/09	Sched.	12 months	PASS
	N05490-0037	02/18/10	Sched.	1.5 years	PASS
	N05490-0038	07/18/10	Sched.	2.0 years	PASS
	N05510-0045	02/18/11	Sched.	2.5 years	PASS
	N05510-0074	07/18/11	Sched.	3.0 years	PASS
	N05510-0081	07/18/12	Sched.	3.5 years	PASS
	N05490-0096	07/18/13	Sched.	4.0 years	PASS

Table 5 – Sleep Test Results

NOTE: Shaded models are in process at the time of this report

NOTE: Actual data for Model shaded in YELLOW is in APPENDIX 1

13 Conclusion

Due to the design approach as outlined in section 4, for all practical purposes, these switches do not wear out and have a lifetime far exceeding switches commercially available. They have the ability to be used in excess of 300 million cycles with periodic tune-up, meeting all electrical performance as outlined in our catalog datasheet.

14 Appendix RF TEST DATA

Typical Test Data taken on Switch, BEFORE and AFTER Sleep Test

14.1 BEFORE SLEEP TEST DATA

MINI-CIRCUITS DATA - SWITCH

INSERTION LOSS

RF PERFORMANCE OF MSP2T-18 MECHANICAL SWITCH

TEST CATEGORY: PRE (BEFORE SLEEPING) TEMPERATURE: ROOM

DATE: 01-12-2005 AT 13:04:40

MODEL: MSP2T-18 AP#: NDR REV:

TESTED BY: YB

PROD RUN: MN46570 DATE CODE: NA WAFER/LOT#: NA

QUANTITY: 1 S/N: #4

PURPOSE: To check performance before starting sleeping test. REQUESTED BY: ARON

FREQUENCY (MHz)	Pin (dBm)	IN-J1 (dB)	IN-J2 (dB)
100.0000	3.35	.03	.03
250.0000	3.19	.03	.03
500.0000	2.98	.04	.04
750.0000	3.24	.05	.04
1000.0000	3.18	.05	.05
1500.0000	2.90	.06	.06
2000.0000	3.30	.07	.07
2500.0000	2.85	.08	.07
3000.0000	2.34	.08	.08
3500.0000	2.35	.09	.09
4000.0000	2.10	.10	.10
4500.0000	1.76	.11	.11
5000.0000	1.68	.13	.12
6000.0000	1.86	.15	.14
7000.0000	1.28	.15	.15
8000.0000	1.22	.14	.14
9000.0000	.99	.13	.13
10000.000	.82	.14	.13
11000.000	.65	.15	.15
12000.000	1.15	.17	.16
13000.000	.06	.20	.19
14000.000	-.28	.22	.21
15000.000	.11	.20	.19
15500.000	-.52	.19	.18
16000.000	.72	.19	.18
16500.000	.90	.21	.19
16750.000	.87	.20	.18
17000.000	.76	.19	.17
17250.000	.72	.19	.17
17500.000	.97	.21	.19
17750.000	.36	.20	.18
18000.000	.19	.21	.19
18250.000	1.07	.19	.17
18500.000	.40	.20	.18
18750.000	.52	.18	.17
19000.000	-.33	.21	.19
19250.000	-.69	.21	.19
19500.000	-.62	.21	.19
19750.000	-.47	.17	.16
20000.000	-.17	.22	.21
Flatness		±.09	±.09

REMARK: AG N5230A NETWORK ANALYZER. 50 OHM SYSTEM. SN#: 65735. CAL DUE DATE: 12/10/05. TEST FIX#: N/R.
S/N 0012, D/C 0451, Vdc=24V, Idc= 86 mA.
File: "Z:\TEST DATA\ENGINEERING TEST DATA\Model80\Mech_switch\D_C&SLEEPING\msp2t-18\0451\#4"
Page 1

Figure 8a – RF TEST DATA - Before Sleep Test

INSERTION LOSS – RUN N46570 - S/N 0012 (D/C 0451)

MINI-CIRCUITS DATA - SWITCH

ISOLATION

RF PERFORMANCE OF MSP2T-18 MECHANICAL SWITCH
TEST CATEGORY: PRE (BEFORE SLEEPING) TEMPERATURE: ROOM

DATE: 01-12-2005 AT 13:04:40
TESTED BY: YB
QUANTITY: 1 S/N: #4

MODEL: MSP2T-18 AP#: NDR REV:
PROD RUN: MN46570 DATE CODE: NA WAFER/LOT#: NA
PURPOSE: To check performance before starting sleeping test. REQUESTED BY: ARON

FREQUENCY (MHz)	Pin (dBm)	IN-J1 (dB)	IN-J2 (dB)
100.0000	3.35	113.52	115.54
250.0000	3.19	118.29	109.44
500.0000	2.98	112.90	108.48
750.0000	3.24	109.90	110.99
1000.0000	3.18	102.04	114.07
1500.0000	2.90	101.56	107.85
2000.0000	3.30	98.35	108.69
2500.0000	2.85	101.31	118.62
3000.0000	2.34	105.74	104.05
3500.0000	2.35	106.13	119.67
4000.0000	2.10	109.14	109.51
4500.0000	1.76	107.89	112.08
5000.0000	1.68	116.15	117.97
6000.0000	1.86	114.40	111.44
7000.0000	1.28	117.20	106.63
8000.0000	1.22	101.78	101.72
9000.0000	.99	101.01	97.31
10000.000	.82	97.02	101.35
11000.000	.65	100.27	101.46
12000.000	1.15	97.85	94.44
13000.000	.06	91.94	93.01
14000.000	-.28	93.58	87.40
15000.000	.11	88.16	88.03
15500.000	-.52	86.07	85.11
16000.000	.72	85.55	85.90
16500.000	.90	84.82	85.07
16750.000	.87	84.67	85.11
17000.000	.76	85.66	84.81
17250.000	.72	82.77	83.76
17500.000	.97	84.15	83.70
17750.000	.36	84.30	83.77
18000.000	.19	81.61	81.78
18250.000	1.07	80.65	80.98
18500.000	.40	80.80	80.36
18750.000	.52	80.86	80.23
19000.000	-.33	79.38	79.47
19250.000	-.69	78.62	78.78
19500.000	-.62	77.54	78.20
19750.000	-.47	77.21	76.53
20000.000	-.17	76.34	76.45
Flatness		±26.45	±24.13

REMARK: AG N5230A NETWORK ANALYZER. 50 OHM SYSTEM. SN#: 65735. CAL DUE DATE: 12/10/05. TEST FIX#: N/R.
S/N 0012, D/C 0451, Vdc=24V,Idc= 86 mA.
File: "Z:\TEST DATA\ENGINEERING TEST DATA\Model80\Mech_switch\D_C&SLEEPING\msp2t-18\0451\#4"
Page 2

Figure 8b – RF TEST DATA - Before Sleep Test

ISOLATION – RUN N46570 - S/N 0012 (D/C 0451)

14.1 AFTERSLEEP TEST DATA

MINI-CIRCUITS **DATA - SWITCH**

TEST CATEGORY: FINAL (AFTER 1 YEAR)

DATE: 01-12-2006 AT 9:08 AM

MODEL: MSP2T-18 **AP#:** N/A **NORF REV:** N/A

TESTED BY: YB

PROD RUN: MN46570 **DATE CODE:** 0451 **WAFER/LOT#:** N/A

QUANTITY: 1 **S/N:** Unit 5

PURPOSE: SLEEPTIME TEST **REQUESTED BY:** ARON

TEST CONDITIONS: Z:50 OHM SYSTEM. TEMPERATURE: ROOM

FREQUENCY (MHz)	Pin (dBm)	I.LOSS IN-J1 (dB)	I.LOSS IN-J2 (dB)	ISOLATIO IN-J1 (dB)	ISOLATIO IN-J2 (dB)
1.0000	.00	.00	.01	110.54	111.51
100.0000	.00	.00	.00	108.17	107.38
1000.0000	.00	.02	.02	106.82	103.07
Flatness		±.01	±.02	±5.66	±4.22

REMARK: UNIT#5 AFTER 1 YEAR. Vdc=24 V, Idc= 85 mA.

DESCRIPTION	NETWORK ANALYZER
MODEL	AG E5071B
S/N	67040
CAL DUE DATE	05/07/06

File: "H:\TEST DATA\ENGINEERING TEST DATA\Model80\Mech_switch\D_C&SLEEPING\msp2t-18\0451-0508\#5_1year"
Test Program ManualNA.exe Ver 1.5
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Figure 9 – RF TEST DATA – After Sleep Test

INSERTION LOSS and ISOLATION – N46570 - S/N 0012 (D/C 0451)