RELIABILITY DATAPACK

CONTENTS

October 2003

LINEAR TECHNOLOGY

OPERATING LIFE TEST
By Product Group
October 2003

DEVICE TYPE	PACKAGE TYPE	DATE CODES	NO. UNITS	DEVICE HRS (K) 150°C	EQUIV. DEVICE HRS @ 125°C (K)	PARA FAIL	FUNC. FAIL	FAILURE RATE %/K HRS PARA(2)	FAILURE RATE %/K HRS FUNC.
OP AMP	D,F,H,J,M8,M10,N,S,T,W	9827-0337	26,441	4,814	26,354	4	0	0.019	0.003
High Speed Op Amp	J,N,S	9829-0237	3,441	527	2,951	0	0	0.031	0.031
DAC/ADC	D,F,G,J,M8,M10,N,S	9827-0337	5,730	1,612	5,376	5	1	0.070	0.022
Reference	H,J,M8,N,S,S3,Z	9827-0337	3,913	1,150	6,439	0	0	0.014	0.014
Filter	D,G,J,L,N,S	9831-0319	1,525	370	1,325	0	0	0.044	0.044
Switch	D,G,J,N,S	9834-0217	881	196	655	0	0	0.083	0.083
Comparator	D,G,H,J,L,M8,M10,N,S,W,Z	9827-0337	2,559	528	2,770	1	0	0.068	0.031
Interface	D,G,J,M8,N,S,S5	9827-0344	45,389	4,726	16,455	1	0	0.008	0.003
Other	D,G,J,M10,N,S,S5,S6	9827-0319	1,954	442	1,476	0	0	0.037	0.037
Regulator	D,F,G,H,J,K,M,M8,M10,N,P,Q,QF,R,S,S3,S5,S6,ST,T,W,Z	9827-0345	39,878	10,038	41,993	3	1	0.007	0.004
Mixer	G,F	9840-0341	1,592	336	1,880	0	0	0.049	0.049
—	**TOTAL**	—	**133,303**	**24,739**	**107,672**	**14**	**2**	**0.011**	**0.002**

TO-5 = H	TO-3P = P	PDIP = N	SOT-23 = S3, S5, S6, ST8	SO-8/14/16/20/24/28 = S
TO-3 = K	TO-92 = Z	CERDIP = J	SOT-223 = ST	SSOP = G
TO-46 = H	TO-220 = T	Sidebraze = D	MSOP = M8, M10	TSSOP = F
LCC = L	DD PACK = M, Q, R	Flat Pack = W	QFN/DFN = QF	

NOTES: (1) Parametric failures for precision operational amplifiers are defined as a V_{OS} drift exceeding 100mV.
(2) Equivalent failure rate calculated to a 60% confidence level assuming an activation energy of 1.0 eV for bipolar comparison purposes.

OPERATING LIFE TEST
By Technology Group
October 2003

DEVICE TYPE	PACKAGE TYPE	DATE CODES	NO. UNITS	DEVICE HRS (K) 150°C	EQUIV. DEVICE HRS @ 125°C (K)	PARA FAIL	FUNC. FAIL	FAILURE RATE %/K HRS PARA(2)	FAILURE RATE %/K HRS FUNC.
0.65µ CMOS	M,S	9928-0340	4,825	1,175	3,919	0	0	0.014	0.014
1.2µ CMOS	D,F,G,M8,M10,S,S5,S6	9827-0344	9,092	2,646	8,827	5	2	0.042	0.021
1.2µ BICMOS	M8,M10	9943-0345	974	257	859	0	0	0.064	0.064
2µ BICMOS	G,M8,M10,N,S,QF	9827-0337	4,357	1,118	3,728	0	0	0.015	0.015
2µ CMOS	D,G,M8,M10,N,S	9827-0337	2,613	681	2,272	1	0	0.053	0.024
2µ COMP BP	D,G,N,S	9827-0337	4,345	875	4,902	0	0	0.019	0.019
3µ BICMOS	D,G,N,S5,S	9844-9916	193	45	151	0	0	0.361	0.361
3µ CMOS	D,G,N,S	9827-0320	6,835	1,063	3,547	0	0	0.015	0.015
4µ CMOS	D,G,J,M8,M10,N,S,S5	9827-0337	48,395	5,350	17,843	2	0	0.010	0.003
4µ HS BP	D,F,G,H,J,L,M,M8,M10,Q,QF,S,S3,S5,S6,T	9827-0340	11,050	1,845	10,175	0	0	0.009	0.009
4µ STEPPER BP	N,S	9950-0337	1,612	243	1,359	0	0	0.067	0.067
7µ BIFET	D,J,N,S,T	9827-0311	1,979	369	2,068	1	0	0.098	0.044
7µ CMOS	D,M,Q,R,F,G,H,J,K,L,M,N,S3,S5,S,ST,T,P,W,Z	9829-0325	3,915	1,220	4,070	1	0	0.030	0.013
7µ COMP BP	D,F,J,N,S,T	9827-0318	5,846	667	3,728	1	0	0.054	0.025
7µ STD BP	D,F,G,H,J,K,M,M8,N,P,Q,R,S,ST,T,W,Z	9827-0337	25,680	6,847	38,345	3	0	0.011	0.002
RF	G,F	9840-0341	1,592	336	1,880	0	0	0.049	0.049
	TOTAL	—	**133,303**	**24,739**	**107,672**	**14**	**2**	**0.011**	**0.002**

TO-5 = H	TO-3P = P	PDIP = N	SOT-23 = S3, S5, S6, ST8	SO-8/14/16/20/24/28 = S
TO-3 = K	TO-92 = Z	CERDIP = J	SOT-223 = ST	SSOP = G
TO-46 = H	TO-220 = T	Sidebraze = D	MSOP = M8, M10	TSSOP = F
LCC = L	DD PACK = M, Q, R	Flat Pack = W	QFN/DFN = QF	

NOTES: (1) Equivalent failure rate calculated to a 60% confidence level assuming an activation energy of 1.0 eV for bipolar comparison purposes.

HAST (HIGHLY ACCELERATED STRESS TEST)
By Product Group
October 2003

Package: Plastic
HAST[2] at 131°C/85%RH,
Continuous Operation at Rated
Supply Voltage, Minimum Power

DEVICE TYPE	PACKAGE TYPE	DATE CODES	NO. UNITS	DEVICE HRS (K) 131°C	EQUIV. DEVICE HRS (K) 85°C[1]	PARA FAIL	FUNC. FAIL
Op Amp	N,S,T	9835-0334	10,813	660	13,207	0	0
High Speed Op Amp	N,S	9902-0101	299	14	287	0	0
Reference	N,S,Z	9836-0334	5,752	284	5,679	0	0
Switch		0106	75	7	144	0	0
Interface	M,N,S,Z	9827-0325	7,637	375	7,497	0	0
Regulator	G,N,S, F,G,M,N,P, Q,QF,R,S,S3, S5,ST,T,Z	9827-0340	3,578	320	6,400	0	0
—	**TOTAL**	—	**28,154**	**1,661**	**33,214**	**0**	**0**

TO-3P = P
TO-92 = Z
TO-220 = T
DD PACK = M, Q, R
PDIP = N
QFN/DFN = QF
SOT-23 = S3, S4, S5, ST8
SOT-223 = ST
MSOP = M8, M10
SO-8/14/16/20/24/28 = S
SSOP = G
TSSOP = F

NOTES: (1) Assumes 20X acceleration from 131°C/85%RH to 85°C/85%RH. (2) This test has replaced 85/85 testing.

HAST (HIGHLY ACCELERATED STRESS TEST)
By Package Type
October 2003

Package: Plastic
HAST[2] at 131°C/85%RH,
Continuous Operation at Rated
Supply Voltage, Minimum Power

PACKAGE TYPE	DATE CODES	NO. UNITS	DEVICE HRS (K) 131°C	EQUIV. DEVICE HRS (K) 85°C[1]	PARA FAIL	FUNC. FAIL
DD PACK	0310	46	2	44	0	0
F-20	0020	24	4	81	0	0
F-28	0127	10	1	10	0	0
G-16	9834-0026	193	34	680	0	0
N-08	9909-0105	990	77	1,541	0	0
N-14	9926-9926	37	4	75	0	0
M-08	9909-0046	309	33	665	0	0
M-10	0042	77	13	259	0	0
S-08	9815-0334	19,169	1,039	19,943	0	0
S-16	9827-0321	4,609	227	4,386	0	0
S-18	9827-0321	1,862	89	1,699	0	0
S-05	0046-0340	371	64	1,032	0	0
S-06	9943-0114	121	22	435	0	0
TO-220	9903-0029	112	36	725	0	0
TO-3P	9913	50	2	116	0	0
TO-92	0238	50	2	48	0	0
DFN-10	0238	22	2	32	0	0
QFN-16	0112	72	7	138	0	0
QFN-32	0111	30	3	58	0	0
–	**TOTAL**	**28,154**	**1,661**	**33,214**	**0**	**0**

NOTES: (1) Assumes 20X acceleration from 131°C/85%RH TO 85°C/85%RH. (2) This test has replaced 85/85 testing.

AUTOCLAVE TEST
By Product Group
October 2003

Package: Plastic
Autoclave Data: 15 PSIG, 121°C
No Bias Applied

DEVICE TYPE	PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE HRS	CUM FAILURE
Op Amps	N,S,T	9827-0334	118,542	10,749,458	0
High Speed Op Amp	N,S	9828-0249	3,120	252,355	0
DAC/ADC	G,M,N,S	9827-0327	21,277	3,776,396	0
Reference	N,S,Z	9827-0337	50,640	3,753,817	0
Filter	G,N,S	9831-0334	9,012	1,582,173	0
Switch	N,S	9835-0333	5,291	425,087	0
Comparator	M,N,S,Z	9828-0316	7,708	888,148	0
Interface	G,N,S	9827-0333	68,101	5,833,333	0
Other	G,N,S	9830-0317	9,871	961,637	0
Regulator	F,G,M,N,P,Q,R,S,S3, S5,ST,T,Z	9827-0337	253,887	24,381,121	0
Mixer	G,F	9840-0324	851	269,520	0
—	**TOTAL**	—	**548,300**	**52,873,044**	**0**

TO-3P = P
TO-92 = Z
TO-220 = T
DD PACK = M, Q, R
PDIP = N
QFN/DFN = QF
SOT-23 = S3, S4, S5, ST8
SOT-223 = ST
MSOP = M8, M10
SO-8/14/16/20/24/28 = S
SSOP = G
TSSOP = F

NOTE: Approximate duration is 168 hours

AUTOCLAVE TEST
By Package Type
October 2003

Package: Plastic
Autoclave Data: 15 PSIG, 121°C
No Bias Applied

PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE HRS	FUNC. FAILURE
DD PACK	9834-0333	21,063	750,059	0
F-14	9933-0316	1,868	183,120	0
F-16	0105-0335	6,004	905,752	0
F-20	9836-0329	7,908	612,775	0
F-28	0127-0323	813	112,748	0
F-48	0249	960	247,716	0
F-56	9903	609	177,506	0
F-64	0006	246	64,416	0
G-16	9827-0333	23,112	2,645,889	0
G-20	9831-0325	8,605	921,533	0
G-24	9831-0325	15,469	941,311	0
G-28	9831-0329	19,902	2,068,640	0
G-36	9839-0329	6,065	1,058,835	0
G-44	9928-0249	984	30,744	0
N-08	9827-0329	48,585	1,662,373	0
N-14	9828-0329	13,278	428,652	0
N-16	9830-0317	5,184	390,363	0
N-18	9835-0313	3,531	90,205	0
N-20	9833-0333	2,825	151,260	0
N-24	9837-0334	6,357	168,193	0
N-28	9839-0324	3,980	176,007	0
M-08	9829-0334	42,211	6,131,863	0
M-10	9833-0335	12,621	2,131,619	0
S-08	9827-0333	106,352	12,440,919	0
S-14	9829-0241	8,150	1,133,901	0
S-16	9827-0329	44,160	3,535,687	0
S-18	9828-0321	4,975	484,344	0
S-20	9829-0301	6,257	614,436	0
S-24	9835-0315	5,399	629,434	0
S-28	9827-0326	10,419	784,510	0
ST	9836-0332	22,388	1,278,956	0
S-03	9850-0249	1,991	88,464	0
S-05	9827-0331	18,975	2,725,899	0
S-06	9903-0331	16,422	2,817,042	0
ST8	0244-0328	1,075	288,680	0
TO-220	9835-0337	24,180	918,103	0
TO-3P	9836-0332	6,038	192,912	0
T0-92(Z)	9827-0337	8,396	307,105	0
DFN-08	0307-0334	1,568	408,993	0
DFN-10	0238-0317	407	114,156	0
DFN-12	0214	900	267,148	0
QFN-12	0215	327	96,222	0
QFN-16	0325	1,112	388,714	0
QFN-32	0332	6,225	1,204,432	0
QFN-38	0316	404	101,412	0
TOTAL	—	**548,300**	**52,873,040**	**0**

NOTE: Approximate duration is 168 hours.

TEMPERATURE CYCLE TEST
By Package Type
October 2003

Temperature Cycle Data:
Hermetic and Plastic: –65°C to 150°C
(Air to Air)

PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE CYCLES	FUNC. FAILURE
HERMETIC	9827-0324	2,970	472,098	0
PLASTIC	9827-0335	716,258	145,700,536	0
TOTAL	**—**	**719,228**	**146,172,634**	**0**

NOTE: Approximate duration is 500 cycles.

TEMPERATURE CYCLE TEST
By Package Type
October 2003

Temperature Cycle Data:
Hermetic and Plastic: –65°C to 150°C
(Air to Air)

PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE CYCLES	FUNC. FAILURE
METAL CAN				
TO-3	9832-0243	204	20,400	0
TO-5, TO-39, TO-46, TO-52	9827-0324	1,452	145,200	0
CERDIP				
J-08 to J-28	9904-0319	686	243,698	0
FLAT PACK				
W-10, W-14	9828-0307	492	49,200	0
LEADLESS CHIP CARRIER				
L-14 to L-20	9943-0226	68	6,800	0
SIDEBRAZE				
D-08 TO D-28	0121	68	6,800	0
SSOP/TSSOP				
F-14 to F-64	9836-0335	17,579	6,196,043	0
G-16	9827-0329	32,273	6,618,669	0
G-20	9831-0325	6,574	1,748,699	0
G-24	9835-0324	13,930	2,363,280	0
G-28	9836-0329	16,949	4,576,292	0
G-36	9839-0329	6,297	2,876,426	0
G-44	9928-0249	832	83,200	0
PLASTIC DIP				
N-08	9827-9804	11,963	2,062,483	0
N-14	9831-0329	4,123	1,042,308	0
N-16	9842-0317	3,496	640,250	0
N-18	9835-0313	3,461	752,600	0
N-20	9837-0333	2,462	571,500	0
N-24	9837-0334	6,378	730,800	0
N-28	9935-0324	2,830	756,123	0
SO				
M-08	9829-0334	189,958	26,926,086	0
M-10	9949-0331	46,684	7,899,452	0
S-08	9827-0333	66,934	25,875,252	0
S-14	9836-0241	5,058	2,160,635	0
S-16	9828-0329	20,005	5,987,781	0
S-18	9836-0321	4,366	1,153,052	0
S-20	9835-0249	5,500	1,378,650	0
S-24	9835-0315	5,172	1,598,096	0
S-28	9827-0325	9,625	1,759,851	0
POWER PACKAGE				
DD PACK	9835-0333	94,688	10,315,371	0
SOT-223	9834-0332	21,974	3,054,450	0
TO-220	9835-0333	66,212	7,128,802	0
TO-3P	9836-0329	5,469	1,478,600	0
OTHER PLASTIC				
SOT-23	9827-0329	35,206	12,813,929	0
T0-92(Z)	9832-0333	2,501	532,300	0
QFN/DFN	9827-0332	7,759	4,619,556	0
TOTAL	**—**	**719,228**	**146,172,634**	**0**

NOTE: Approximate duration is 500 cycles.

THERMAL SHOCK TEST
By Package Type
October 2003

Thermal Shock Data:
Hermetic and Plastic: –65°C to 150°C
(Liquid to Liquid)

PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE CYCLES	FUNC. FAILURE
HERMETIC	9827-0319	2,556	215,205	0
PLASTIC	9827-0334	297,313	83,319,647	0
TOTAL	**—**	**299,869**	**83,534,852**	**0**

NOTE: Approximate duration is 500 cycles.

THERMAL SHOCK TEST
By Package Type
October 2003

Thermal Shock Data:
Hermetic and Plastic: –65°C to 150°C
(Liquid to Liquid)

PACKAGE TYPE	DATE CODES	NO. UNITS	TOTAL DEVICE CYCLES	FUNC. FAILURE
METAL CAN				
TO-3	9832-0243	170	2,550	0
TO-5, TO-39, TO-46, TO-52	9827-0318	1,266	24,770	0
CERDIP				
J-08 to J-28	9904-0319	729	179,130	0
FLAT PACK				
W-10, W-14	9844-0307	255	6,715	0
LEADLESS CHIP CARRIER				
L-14 to L-20	9943-0226	68	1,020	0
SIDE BRAZE				
D-08 TO D-28	0121	68	1,020	0
SSOP/TSSOP				
F-14 to F64	9841-0331	16,647	5,487,107	0
G-16	9827-0333	12,361	3,300,670	0
G-20	9845-0325	5,292	1,284,990	0
G-24	9831-0321	9,058	1,474,558	0
G-28	9831-0329	12,012	3,104,498	0
G-36	9839-0329	4,734	2,100,410	0
G-44	0249	682	68,200	0
PLASTIC DIP				
N-08	9839-0314	4,711	1,328,220	0
N-14	9846-0305	1,084	457,500	0
N-16	9830-0250	1,772	503,800	0
N-18	9844-0240	1,415	417,800	0
N-20	9831-0237	504	189,000	0
N-24	9837-0303	2,003	241,500	0
N-28	9839-0236	690	179,400	0
SO				
M-08	9829-0334	32,235	9,008,846	0
M-10	9949-0331	11,216	3,819,420	0
S-08	9827-0333	46,074	16,648,818	0
S-14	9829-0238	3,536	1,133,000	0
S-16	9831-0329	15,037	4,049,845	0
S-18	9841-0314	2,904	757,900	0
S-20	9838-0249	3,983	941,400	0
S-24	9834-0315	3,496	1,071,863	0
S-28	9842-0325	7,653	1,493,510	0
POWER PACK				
DD PACK	9840-0332	16,725	2,506,815	0
SOT-223	9839-0332	16,871	2,700,400	0
TO-220	9838-0333	19,732	2,435,600	0
TO-3P	9839-0329	4,562	584,400	0
OTHER PLASTIC				
SOT-23	9827-0329	30,945	11,148,798	0
T0-92(Z)	9924-0333	2,700	546,300	0
QFN/DFN	9827-0332	6,679	4,335,079	0
TOTAL	**—**	**299,869**	**83,534,852**	**0**

NOTE: Approximate duration is 500 cycles.

MOISTURE SENSITIVITY OF PACKAGES

Moisture Sensitivity Classification testing is performed in accordance with J-STD-020. The next page shows the flow chart of the Surface Mount Preconditioning. This test is designed to identify package types and molding compounds that are susceptible to "Popcorn Cracking". This phenomenon usually affects higher pin count packages during PC board soldering processes like Infrared Reflow and Vapor Phase. As the molding compound expands, it can tear the bond wires off the die surface resulting in catastrophic failure. Newer state of the art molding compounds with lower moisture absorption and improved adhesion have been qualified for use at LTC, which solves this problem. The results of this testing, including extended reliability stress tests on packages exposed to the surface mount preconditioning, are detailed in the next three pages of this Data Pack. The levels, test conditions and associated floor life expectations and a summary of the actual levels are listed below.

Through Hole Package Technology – No moisture sensitivity classification testing required because these packages are not normally subjected to surface mount assembly conditions and are not prone to board level mounting induced popcorn problems. Through hole packages include:

- Plastic Dual-In-Line Packages (PDIP)
- TO-92
- TO-220
- TO-3P

Metal Can, CERDIP and Side Braze Package Technology – Surprisingly we occasionally get requests for moisture sensitivity classification on Hermetic Packages. Since they are Hermetic and also Through Hole, they are not evaluated for moisture sensitivity.

DD Pack – The molding compound for the DD Pack is currently a Level Three Molding Compound. This molding compound provides excellent thermal performance. We are planning on qualifying newer molding compounds in order to achieve Level One or Level Two moisture performance as soon as one is commercially available. We have always observed excellent reliability results even though we have found molding compound to die delamination during moisture sensitivity classification testing. Data exhibiting excellent reliability performance after surface mount preconditioning is included in the next 3 pages of this Data Pack. Since the package construction with a low pin count is not susceptible to a moisture induced popcorn problems, dry packing is not required.

SOT-223 – This package type will also occasionally exhibit die delamination so it is classified as Level Two. Although we do observe die delamination, reliability testing after surface mount preconditioning has consistently demonstrated excellent reliability performance. Data showing this performance is included in the next 3 pages of this Data Pack. Since the package construction with a low pin count is not susceptible to moisture induced popcorn problems, dry packing is not required.

SOIC, SSOP, MSOP, TSSOP and SOT-23 Package Technology – These surface mount packages all use a Level One molding compound. Extended reliability testing after surface mount preconditioning consistently demonstrates Level One moisture sensitivity performance and excellent reliability performance. Data showing this performance is included in the next 3 pages of this Data Pack.

MOISTURE SENSITIVITY CLASSIFICATION TESTING
TEST CONDITION VERSUS FLOOR LIFE

LEVEL	TEST CONDITIONS	SOAK TIME	FLOOR LIFE	FLOOR CONDITIONS
1	85°C / 85%RH	168 HOURS	UNLIMITED	≤30°C / 85%RH
2	85°C / 60%RH	168 HOURS	1 YEAR	≤30°C / 60%RH
2a	30°C / 60%RH	696 HOURS	4 WEEKS	≤30°C / 60%RH
3	30°C / 60%RH	192 HOURS	168 HOURS	≤30°C / 60%RH
4	30°C / 60%RH	96 HOURS	72 HOURS	≤30°C / 60%RH
5	30°C / 60%RH	72 HOURS	24 HOURS	≤30°C / 60%RH
5a	30°C / 60%RH	48 HOURS	24 HOURS	≤30°C / 60%RH
6	30°C / 60%RH	TOL	TOL	≤30°C / 60%RH

NOTE: TOL = Time on Label

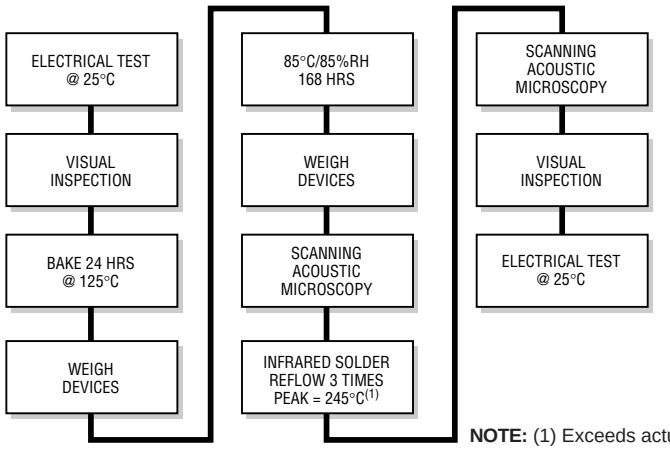
RELIABILITY DATA
J-STD-020
SURFACE MOUNT PRECONDITIONING

● J-STD-020

October 2003

PACKAGE TYPE	DATE CODES	SAMPLE SIZE	# FAILURE
F-14	9933-0316	4,305	0
F-16	0105-0335	6,206	0
F-20	9615-0329	30,169	0
F-28	0127-0323	2,300	0
F-48	0249	2,244	0
F-56	9903	1,454	0
F-64	0006	371	0
G-16	9649-0333	91,222	0
G-20	9803-0325	27,805	0
G-24	9633-0325	56,894	0
G-28	9612-0329	79,807	0
G-36	9624-0329	18,882	0
G-44	9638-0249	3,704	0
M-08	9637-0334	257,954	0
M-10	9820-0335	64,750	0
S-08	9601-0334	332,369	0
S-14	9443-0241	22,279	0
S-16	9418-0329	116,093	0
S-18	9632-0321	20,381	0
S-20	9603-0301	36,581	0
S-24	9634-0315	19,854	0
S-28	9644-0326	31,851	0
S-03	9644-0321	13,621	0
S-05	9644-0340	65,779	0
S-06	9903-0331	44,556	0
ST8	0238-0328	2,857	0
DFN-08	0307-0334	3,599	0
DFN-10	0238-0317	1,015	0
DFN-12	0214-0215	1,417	0
QFN-12	0112-0325	706	0
QFN-16	0112-0325	1,811	0
QFN-32	0113-0332	13,526	0
QFN-38	0312-0316	1,140	0
TOTAL	—	**1,377,502**	**0**

J-STD-020 FLOW CHART



NOTE: (1) Exceeds actual specification.

ALL LTC PRODUCT IN THE PACKAGES LISTED ABOVE HAVE BEEN CONVERTED TO LEVEL ONE MOLDING COMPOUNDS AND MEET THE REQUIREMENTS OF LEVEL ONE PER J-STD-020. THIS MEANS THEY ARE RATED FOR UNLIMITED FLOOR LIFE PRIOR TO ASSEMBLY AND DO NOT REQUIRE DRY PACKING.

RELIABILITY DATA
TEST RESULTS POST
J-STD-020 PRECONDITIONING
October 2003

● HAST 131°C/85%RH AFTER JEDEC PRECONDITIONING

PACKAGE TYPE	SAMPLE SIZE	DATE CODES	# OF DEVICE HRS @ 85°C (1)	# FAILURE
DD PACK	580	9549-9720	698,480	0
F-20	335	9615-0020	712,760	0
F-28	10	0127	10,000	0
G-16	241	9724-0026	841,320	0
G-36	243	9631-9709	660,600	0
M-08	357	9726-0046	756,980	0
M-10	77	0042	258,720	0
S-08	21,683	9637-0334	25,421,860	0
S-14	174	9737-9742	1,176,640	0
S-16	4,902	9702-0321	4,867,200	0
S-18	1,839	9827-0321	1,811,520	0
S-20	254	9722-9818	651,102	0
S-28	43	9644-9646	106,100	0
ST	239	9537	596,920	0
S-03	98	9644	499,800	0
S-05	495	9644-0340	1,731,400	0
S-06	121	9943-0114	435,440	0
DFN-10	22	0238	31,680	0
QFN-16	72	0112	138,240	0
QFN-32	30	0111	57,600	0
TOTAL	**31,815**	**—**	**41,464,362**	**0**

NOTE: Approximate duration is 500 cycles.

NOTE: (1) Assumes 20X acceleration from 131°C to 85°C.

● AUTOCLAVE 15 PSIG 121°C AFTER JEDEC PRECONDITIONING

PACKAGE TYPE	SAMPLE SIZE	DATE CODES	TOTAL DEVICE HRS	# FAILURE
DD PACK	8,451	9636-0332	668,560	0
F-14	1,405	9933-0316	178,800	0
F-16	2,211	0105-0335	308,832	0
F-20	9,091	9403-0329	926,411	0
F-28	813	0127-0323	112,748	0
F-48	960	0249	247,716	0
F-56	609	9903	177,506	0
F-64	126	0006	42,336	0
G-16	28,334	9649-0333	3,397,525	0
G-20	9,486	9803-0325	1,061,189	0
G-24	18,327	9633-0325	1,293,203	0
G-28	29,497	9612-0329	2,784,905	0
G-36	6,409	9624-0329	1,091,407	0
G-44	1,384	9638-0249	129,144	0
M-08	39,164	9637-0334	6,108,190	0
M-10	10,738	9820-0335	2,015,882	0
S-08	131,506	9601-0333	14,790,776	0
S-14	10,772	9443-0241	1,366,078	0
S-16	60,457	9418-0329	5,161,922	0
S-18	5,935	9632-0321	620,577	0
S-20	11,632	9603-0301	1,063,489	0
S-24	7,266	9634-0315	1,188,131	0
S-28	11,321	9644-0326	1,032,525	0
ST	20,657	9727-0332	1,356,782	0
S-03	3,154	9808-0249	267,636	0
S-05	19,861	9644-0331	3,030,874	0
S-06	16,095	9903-0331	2,800,170	0
ST8	1,075	0238-0328	288,680	0
TO-220	865	9905-0123	63,768	0
DFN-08	1,568	0307-0334	408,993	0
DFN-10	407	0238-0317	114,156	0
DFN-12	900	0214	267,148	0
QFN-12	327	0112-0215	96,222	0
QFN-16	1,112	0112-0325	388,714	0
QFN-32	5,389	0113-0332	1,157,512	0
QFN-38	404	0312-0316	101,412	0
TOTAL	**477,708**	**—**	**56,109,916**	**0**

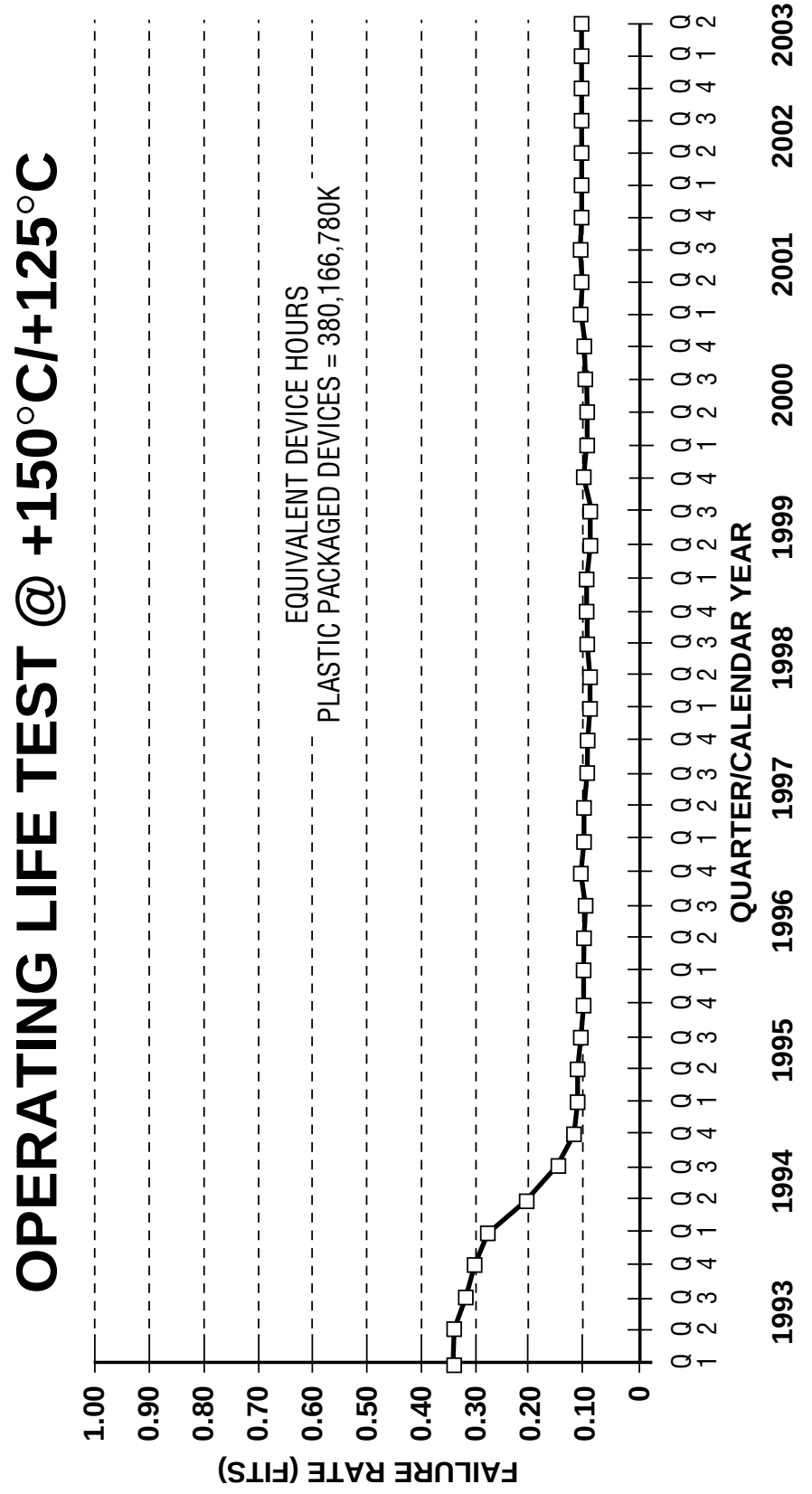
RELIABILITY DATA
TEST RESULTS POST
J-STD-020 PRECONDITIONING
October 2003

● **TEMPERATURE CYCLE (AIR TO AIR) –65°C TO 150°C AFTER JEDEC PRECONDITIONING**

PACKAGE TYPE	SAMPLE SIZE	DATE CODES	TOTAL DEVICE CYCLES	# FAILURE
DD PACK	7,520	9533-0332	1,976,089	0
F-14	1,126	9933-0316	320,500	0
F-16	2,103	0105-0335	909,950	0
F-20	9,091	9328-0329	2,377,880	0
F-28	737	0127-0323	272,035	0
F-48	941	0249	842,521	0
F-56	385	9903	356,510	0
F-64	125	0006	127,625	0
G-16	38,643	9649-0329	7,836,819	0
G-20	8,274	9803-0325	1,694,499	0
G-24	18,993	9633-0324	2,952,730	0
G-28	24,517	9612-0329	5,573,904	0
G-36	6,700	9624-0329	2,822,446	0
G-44	1,018	9638-0249	184,450	0
M-08	176,801	9637-0334	23,346,861	0
M-10	43,069	9820-0331	7,610,671	0
S-08	81,416	9602-0333	27,665,432	0
S-14	6,459	9615-0241	2,268,433	0
S-16	25,556	9625-0329	7,263,391	0
S-18	5,259	9806-0321	1,242,352	0
S-20	10,734	9722-0249	2,099,495	0
S-24	7,080	9644-0315	2,391,736	0
S-28	9,870	9644-0325	2,012,051	0
ST	19,806	9803-0332	3,044,650	0
S-03	4,745	9808-0321	1,022,100	0
S-05	18,514	9644-0327	7,479,591	0
S-06	13,171	9903-0329	5,412,566	0
ST8	1,025	0238-0328	750,586	0
TO-220	1,081	9849-0329	354,000	0
DFN-08	1,172	0303-0331	791,449	0
DFN-10	355	0238-0317	182,688	0
DFN-12	281	0214	285,730	0
QFN-12	227	0112-0215	205,754	0
QFN-16	375	0112-0325	266,828	0
QFN-32	4,330	0113-0332	2,536,229	0
QFN-38	406	0312-0316	289,578	0
TOTAL	**551,499**	**—**	**126,480,551**	**0**

● **THERMAL SHOCK (LIQUID TO LIQUID) –65°C TO 150°C AFTER JEDEC PRECONDITIONING**

PACKAGE TYPE	SAMPLE SIZE	DATE CODES	TOTAL DEVICE CYCLES	# FAILURE
DD PACK	7,169	9742-0332	1,293,665	0
F-14	1,225	9933-0316	329,500	0
F-16	1,892	0105-0331	767,200	0
F-20	6,724	9615-0329	1,579,724	0
F-28	740	0127-0323	263,103	0
F-48	343	0249	308,500	0
F-56	460	9903	403,380	0
F-64	120	0006	138,000	0
G-16	16,198	9649-0333	4,356,110	0
G-20	5,832	9803-0325	1,081,608	0
G-24	11,311	9640-0321	1,879,858	0
G-28	15,239	9612-0329	3,531,588	0
G-36	5,048	9645-0329	2,085,050	0
G-44	830	9638-0249	132,000	0
M-08	27,937	9637-0334	8,177,393	0
M-10	9,292	9820-0331	3,320,336	0
S-08	58,676	9633-0333	18,279,068	0
S-14	4,200	9708-0238	1,210,670	0
S-16	18,747	9625-0329	5,186,795	0
S-18	3,503	9716-0314	821,270	0
S-20	8,225	9639-0249	1,930,700	0
S-24	4,304	9735-0315	1,275,863	0
S-28	7,871	9803-0325	1,423,310	0
ST	17,052	9803-0332	2,926,400	0
S-03	3,880	9808-0321	849,700	0
S-05	15,188	9644-0327	6,307,132	0
S-06	11,114	9929-0329	4,320,004	0
ST8	757	0238-0328	706,130	0
TO-220	1,370	9847-0329	265,000	0
DFN-08	859	0307-0331	745,194	0
DFN-10	231	0238	231,385	0
DFN-12	236	0141	242,220	0
QFN-12	152	0112	167,200	0
QFN-16	252	0112-0320	226,160	0
QFN-32	3,777	0113-0332	2,327,920	0
QFN-38	330	0312-0316	280,000	0
TOTAL	**271,084**	**—**	**79,369,136**	**0**


OPERATING LIFE TEST @ +150°C/+125°C
EQUIVALENT DEVICE HOURS
PLASTIC PACKAGED DEVICES = 380,166,780K
FAILURE RATE (FITS)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0
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