Revision Author D. Baker	Date 2/26/13	Originator S. Templeton	Date 08/19/99

Approvals

Cognizant Product Engineer Tim Hazelton	Date	Document Control Manager Dexter Hansen	Date

REVISIONS

Rev. #	Description of Change	Date
A	Initial Document Release	8/19/99
B	Added additional FIT data; updated parts by similarity list.	8/19/08
C	Added additional FIT data; updated parts by similarity list; added 1500 VDC barrier life test.	2/26/13

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly "IL7xx Reliability Report")
Revision status:	C
Date of issuance/revision:	2/26/13

IsoLoop® Isolator Reliability Highlights

- Pre-seal Mechanical Tests – No Failures

- 125 °C Life Test
  - FIT 0.2 Per Billion Part Hours at 55°C
  - No Failures Observed
  - Observed "Zero Parameter" Shifts (<<10%)

- HAST Test
  - No Popcorning Observed
  - All Electrical Parameters "Good" After 200 Hours

- High Voltage Barrier Life
  - 44000 year barrier life at 100°C
  - Barrier Withstands 1500 Vrms for 2000 hrs at 125°C and 1500 Vdc for 10000 hrs at 125°C
  - Barrier Endurance (Indefinite Working Voltage) of 1000 Vrms / 1500 Vdc

Reliability Report

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly “IL7xx Reliability Report”)
Revision status:	C
Date of issuance/revision:	2/26/13

Scope

This report outlines the reliability screen which the IsoLoop Isolator family was subjected to and details the performance of these devices under stress.

Applicability

The original qualification vehicles were the IL710-2 and -3 models beginning in 1999. Since then, additional parts have been added and additional test data has been accumulated.

IsoLoop Isolators use identical isolation and control cells to produce the various family members. Digital input and passive input isolators use GMR sensor elements with different magnetic properties. Digital input interfaces have a CMOS buffer which drives the on-chip coil of the isolator die to transfer data across the isolation barrier. Passive-input isolators omit the interface buffer and the user drives the coil directly.

All mechanical and moisture related tests covered by the original IL710 qualification are assigned by similarity to the full family since package size, die size, and packaging materials are identical. Because of electrical and mechanical similarities, the following devices are covered by this report:

IL260-3E: 5-Channel Isolator, Narrow SOIC
IL260E: 5-Channel Isolator, Wide SOIC
IL261-3E: 5-Channel (4 transmit, 1 receive) Isolator, Narrow SOIC
IL261E: 5-Channel (4 transmit, 1 receive) Isolator, Wide SOIC
IL262-3E: 5-Channel (3 transmit, 2 receive) Isolator, Narrow SOIC
IL262E: 5-Channel (3 transmit, 2 receive) Isolator, Wide SOIC
IL3085-3E: Low-cost Isolated RS485 Transceiver, Narrow SOIC
IL3085E: Low-cost Isolated RS485 Transceiver, Wide SOIC
IL3122-3E: Low-cost Passive-Input Isolated RS422 Transceiver, Narrow SOIC
IL3122E: Low-cost Passive-Input Isolated RS422 Transceiver, Wide SOIC
IL3185-3E: Low-cost Passive-Input Isolated RS485 Transceiver, Narrow SOIC
IL3185E: Low-cost Passive-Input Isolated RS485 Transceiver, Wide SOIC
IL3222-3E: Fractional Load Passive-Input Isolated RS422 Transceiver, Narrow SOIC
IL3222E: Fractional Load Passive-Input Isolated RS422 Transceiver, Wide SOIC
IL3285-3E: Fractional Load Passive-Input Isolated RS485 Transceiver, Narrow SOIC
IL3285E: Fractional Load Passive-Input Isolated RS485 Transceiver, Wide SOIC
IL3422-3E: High-Speed Passive-Input Isolated RS422 Transceiver, Narrow SOIC
IL3422E: High-Speed Passive-Input Isolated RS422 Transceiver, Wide SOIC

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly "IL7xx Reliability Report")
Revision status:	C
Date of issuance/revision:	2/26/13

IL3485-3E: High-Speed Passive-Input Isolated RS485 Transceiver, Narrow SOIC
IL3485E: High-Speed Passive-Input Isolated RS485 Transceiver, Wide SOIC
IL3522E: High-Speed Passive-Input Isolated RS422 Transceiver, Wide SOIC
IL3585-3E: Very High Speed Isolated RS485 Transceiver, Narrow SOIC
IL3585E: Very High Speed Isolated RS485 Transceiver, Wide SOIC
IL3685-3E: PROFIBUS-Compatible Isolated RS-485 Interface, Narrow SOIC
IL3685E: PROFIBUS-Compatible Isolated RS-485 Interface, Wide SOIC
IL41050T-3E: Isolated CAN Transceiver, Narrow SOIC
IL41050TA-3E: High-Speed, Low-Power Isolated CAN Transceiver, Narrow SOIC
IL41050TAE: High-Speed, Low-Power Isolated CAN Transceiver, Wide SOIC
IL41050TE: Isolated CAN Transceiver, Wide SOIC
IL422: Isolated RS422 Transceiver, Wide SOIC (Pb)
IL422E: Isolated RS422 Transceiver, Wide SOIC
IL485: Isolated RS485/PROFIBUS Transceiver, Wide SOIC (Pb)
IL485E: Isolated RS485/PROFIBUS Transceiver, Wide SOIC
IL485W: Isolated RS485/PROFIBUS Transceiver w/Handshake, Wide SOIC (Pb)
IL485WE: Isolated RS485/PROFIBUS Transceiver w/Handshake, Wide SOIC
IL510-1E: 1-Channel Isolator, MSOP
IL510-3E: 1-Channel Isolator, SOIC
IL511-1E: 2-Channel Isolator, MSOP
IL511-3E: 2-Channel Isolator, SOIC
IL514-3E: 3-Channel (2 transmit, 1 receive) Isolator, Narrow SOIC
IL514E: 3-Channel (2 transmit, 1 receive) Isolator, Wide SOIC
IL515E: 4-Channel (all same direction) Isolator, Wide SOIC
IL516-3E: 4-Channel (2 each direction) Isolator, Narrow SOIC
IL516E: 4-Channel (2 each direction) Isolator, Wide SOIC
IL610-1E: 1-Channel Passive Input, CMOS-Output Isolator, MSOP
IL610-2E: 1-Channel Passive Input, CMOS-Output Isolator, PDIP
IL610-3E: 1-Channel Passive Input, CMOS-Output Isolator, SOIC
IL610A-1E: 1-Channel Passive Input, Open-Drain Isolator, MSOP
IL610A-2E: 1-Channel Passive Input, Open-Drain Isolator, PDIP
IL610A-3E: 1-Channel Passive Input, Open-Drain Isolator, SOIC
IL611-1E: 2-Channel Passive Input, CMOS-Output Isolator, MSOP
IL611-2E: 2-Channel Passive Input, CMOS-Output Isolator, PDIP
IL611-3E: 2-Channel Passive-Input, CMOS-Output Isolator, SOIC
IL611A-1E: 2-Channel Passive Input, Open-Drain Isolator, MSOP
IL611A-2E: 2-Channel Passive Input, Open-Drain Isolator, PDIP

IL611A-3E: 2-Channel Passive Input, Open-Drain Isolator, SOIC
IL612-2E: 2-Channel Passive Input, CMOS-Output Isolator, PDIP
IL612-3E: 2-Channel Passive Input, CMOS-Output Isolator, SOIC
IL612A-2E: 2-Channel Passive Input, Open-Drain Isolator, PDIP
IL612A-3E: 2-Channel Passive Input, Open-Drain Isolator, SOIC
IL613-3E: 3-Channel Passive Input, CMOS-Output Isolator, 0.15" SOIC
IL613E: 3-Channel Passive Input, CMOS-Output Isolator, 0.3" SOIC
IL614-3E: 3-Channel Passive Input, CMOS-Output Isolator, 0.15" SOIC
IL614E: 3-Channel Passive Input, CMOS-Output Isolator, 0.3" SOIC
IL710-1E: 1-Channel Isolator, MSOP
IL710-2: 1-Channel Isolator, PDIP (Pb)
IL710-2E: 1-Channel Isolator, PDIP
IL710-3: 1-Channel Isolator, SOIC (Pb)
IL710-3E: 1-Channel Isolator, SOIC
IL710S-1E: 150 Mbps 1-Channel Isolator, MSOP
IL710S-3E: 150 Mbps 1-Channel Isolator, SOIC
IL710T-1E: 125C, 1-Channel Isolator, MSOP
IL710T-2: 125C 1-Channel Isolator, PDIP (Pb)
IL710T-2E: 125C 1-Channel Isolator, PDIP
IL710T-3: 125C, 1-Channel Isolator, SOIC (Pb)
IL710T-3E: 125C, 1-Channel Isolator, SOIC
IL711-1E: 2-Channel (both same direction) Isolator, MSOP
IL711-2: 2-Channel (both same direction) Isolator, PDIP (Pb)
IL711-2E: 2-Channel (both same direction) Isolator, PDIP
IL711-3: 2-Channel (both same direction) Isolator, SOIC (Pb)
IL711-3E: 2-Channel (both same direction) Isolator, SOIC
IL711E: Widebody 2-Channel (both same direction) Isolator, 0.3" SOIC
IL711S-1E: 150 Mbps 2-Channel (both same direction) Isolator, MSOP
IL711S-3E: 150 Mbps 2-Channel (both same direction) Isolator, SOIC
IL711T-1E: 125C 2-Channel (both same direction) Isolator, MSOP
IL711T-2: 125C 2-Channel (both same direction) Isolator, PDIP (Pb)
IL711T-2E: 125C 2-Channel (both same direction) Isolator, PDIP
IL711T-3: 125C 2-Channel (both same direction) Isolator, SOIC (Pb)
IL711T-3E: 125C 2-Channel (both same direction) Isolator, SOIC
IL712-1E: 2-Channel (1 each direction) Isolator, MSOP
IL712-2: 2-Channel (1 each direction) Isolator, PDIP (Pb)
IL712-2E: 2-Channel (1 each direction) Isolator, PDIP

IL712-3: 2-Channel (1 each direction) Isolator, SOIC (Pb)
IL712-3E: 2-Channel (1 each direction) Isolator, SOIC
IL712S-1E: 150 Mbps 2-Channel (1 each direction) Isolator, MSOP
IL712S-3E: 150 Mbps 2-Channel (1 each direction) Isolator, SOIC
IL712T-1E: 125C 2-Channel (1 each direction) Isolator, MSOP
IL712T-2: 125C 2-Channel (1 each direction) Isolator, PDIP (Pb)
IL712T-2E: 125C 2-Channel (1 each direction) Isolator, PDIP
IL712T-3: 125C 2-Channel (1 each direction) Isolator, SOIC (Pb)
IL712T-3E: 125C 2-Channel (1 each direction) Isolator, SOIC
IL715-3: 4-Channel (all same direction) Isolator, Narrow SOIC (Pb)
IL715-3E: 4-Channel (all same direction) Isolator, Narrow SOIC
IL715: 4-Channel (all same direction) Isolator, Wide SOIC (Pb)
IL715E: 4-Channel (all same direction) Isolator, Wide SOIC
IL715T-3: 125C 4-Channel (all same direction) Isolator, Narrow SOIC (Pb)
IL715T-3E: 125C 4-Channel (all same direction) Isolator, Narrow SOIC
IL715T: 125C 4-Channel (all same direction) Isolator, Wide SOIC (Pb)
IL715TE: 125C 4-Channel (all same direction) Isolator, Wide SOIC
IL716-3: 4-Channel (2 each direction) Isolator, Narrow SOIC (Pb)
IL716-3E: 4-Channel (2 each direction) Isolator, Narrow SOIC
IL716: 4-Channel (2 each direction) Isolator, Wide SOIC (Pb)
IL716E: 4-Channel (2 each direction) Isolator, Wide SOIC
IL716T-3: 125C 4-Channel (2 each direction) Isolator, Narrow SOIC (Pb)
IL716T-3E: 125C 4-Channel (2 each direction) Isolator, Narrow SOIC
IL716T: 125C 4-Channel (2 each direction) Isolator, Wide SOIC (Pb)
IL716TE: 125C 4-Channel (2 each direction) Isolator, Wide SOIC
IL717-3: 4-Channel (3 transmit, 1 receive) Isolator, Narrow SOIC (Pb)
IL717-3E: 4-Channel (3 transmit, 1 receive) Isolator, Narrow SOIC
IL717: 4-Channel (3 transmit, 1 receive) Isolator, Wide SOIC (Pb)
IL717E: 4-Channel (3 transmit, 1 receive) Isolator, Wide SOIC
IL717T-3: 125C 4-Channel (3 transmit, 1 receive) Isolator, Narrow SOIC (Pb)
IL717T-3E: 125C 4-Channel (3 transmit, 1 receive) Isolator, Narrow SOIC
IL717T: 125C 4-Channel (3 transmit, 1 receive) Isolator, Wide SOIC (Pb)
IL717TE: 125C 4-Channel (3 transmit, 1 receive) Isolator, Wide SOIC
IL721-3E: 2-Channel (reverse configuration) Isolator, SOIC
IL721E: Widebody 2-Channel (1 each direction) Isolator, Wide SOIC
IL721T-3E: 125C 2-Channel (reverse configuration) Isolator, SOIC

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly "IL7xx Reliability Report")
Revision status:	C
Date of issuance/revision:	2/26/13

Part Numbering

The IsoLoop part numbering system is summarized below:

IL 7 11 T A - 3 E TR7

Product Family
- IL = Isolators

Base Part Number
- 2 = 5-Channel Digital Input
- 4 = Industry-Standard Xcvr
- 5 = 2 Mbps, DC-Correct
- 6 = Passive Input
- 7 = High Speed, Digital Input
- 30 = Digital-In, 4 Mbps Xcvr
- 31 = Passive-In, 5 Mbps Xcvr
- 32 = Passive-In, 1/8-Load Xcvr
- 34 = Passive-In, 20 Mbps Xcvr
- 35 = Digital-In, 40 Mbps Xcvr
- 36 = PROFIBUS Transceiver

Channel Configuration
- 10 = 1 Channel
- 11 = 2 Transmit
- 12 = 1 Xmit; 1 Receive
- 13 = 3 Transmit
- 14 = 2 Xmit; 1 Receive
- 15 = 4 Transmit
- 16 = 2 Xmit; 2 Receive
- 17 = 3 Xmit; 1 Receive
- 21 = 1 Receive; 1 Xmit
- 22 = RS-422
- 60 = 5 Transmit
- 61 = 4 Xmit; 1 Receive
- 62 = 3 Xmit; 2 Receive
- 85 = RS-485
- 1050 = CAN

Variant
- Blank = Standard
- A = Open Drain Output
- S = High Speed (150 Mbps)
- T = High Temperature (125˚C)
- W = RS-485 Handshake

Die Revision
- (A, B, C, etc., if applicable)

Package Size
- -1 = MSOP
- -2 = PDIP
- -3 = 0.15" SOIC
- -5 = Bare die
- Blank = 0.3" SOIC

Package Materials
- Blank = Lead (Pb)
- E = RoHS Compliant

Bulk Packaging
- Blank = Tube
- TR7 = 7" Tape and Reel
- TR13 = 13" Tape and Reel

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly "IL7xx Reliability Report")
Revision status:	C
Date of issuance/revision:	2/26/13

1. Reliability Screen

NVE subcontracts packaging to companies in Asia, so mechanical tests performed on wirebond and die are covered by reports from those contractors. The following tests were performed for the qualification.

Test	Sample Size	Result	Status
Wire Pull Strength	22	22/0	Pass
Ball Sheer Test	22	22/0	Pass
Die Sheer Test	22	22/0	Pass
Solderability	22	22/0	Pass
Delamination X-Ray Analysis	22	22/0	Pass

Table 1. Subcontractor Mechanical Tests

1.1 High Temperature Life Test

Parts were subjected to high temperature life test for 2000 hours at 125°C. The device was configured such that data was transmitted across the isolation barrier at a rate of 1 kHz. Results are shown below.

Model IL710-2
Oven Temp 125°C
Sample Size 96
Activation Energy (60% Confidence Level) 0.6 eV

Accelerated life testing device hour data and reliability calculations are shown in the following two tables:

Reliability Report

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly “IL7xx Reliability Report”)
Revision status:	C
Date of issuance/revision:	2/26/13

Read Point (Hours)	Functional Failures	Pass	Device Hours
0	0	96	0
168	0	96	16,128
504	0	96	32,256
1,008	0	96	48,384
2,040	0	96	99,072
8,760	0	96	840,960
17,520	0	96	1,681,920
26,280	0	96	2,522,880
35,040	0	96	3,363,840
43,800	0	96	4,204,800
52,560	0	96	5,045,760
61,320	0	96	5,886,720
70,080	0	96	6,727,680
78,840	0	96	7,568,640
87,600	0	96	8,409,600
96,360	0	96	9,250,560
105,120	0	96	10,091,520
113,880	0	96	10,932,480
122,640	0	96	11,773,440
Cumulative Device Hours			**88,496,640**

Accelera-tion Factor	Temp (°C)	Fail Rate (%/1000 hrs)	FITS (per billion hrs)	MTBF (yrs)
354	25	0.000002	0.0	4835003
241	30	0.000003	0.0	3291627
166	35	0.000005	0.1	2267262
157	40	0.000005	0.1	2144338
82	45	0.000010	0.1	1119973
58	50	0.000014	0.1	792176
42	***55***	***0.000020***	***0.2***	***573644***
30	60	0.000028	0.3	409746
22	65	0.000038	0.4	300480
16	70	0.000052	0.5	218531
12	75	0.000070	0.7	163898
9	80	0.000093	0.9	122924
7	85	0.000119	1.2	95607
5	90	0.000167	1.7	68291
4	95	0.000209	2.1	54633
3.2	100	0.000261	2.6	43706
2.5	105	0.000334	3.3	34146
1.9	110	0.000440	4.4	25951
1.5	115	0.000557	5.6	20487
1.2	120	0.000697	7.0	16390

Table 2. Reliability Calculations – Accelerated Life Testing

Specification no.:	REL0001
Specification title:	IsoLoop® Isolator Reliability Report (formerly "IL7xx Reliability Report")
Revision status:	C
Date of issuance/revision:	2/26/13

1.2 Zero Based Parameters

The table below shows the tested parameters and those designated "Zero Parameters," *i.e.*, those parameters whose stability is referenced to the zero hour read point by way of shift analysis. A maximum shift of 10% in published Data Sheet limits is allowed:

Parameter	Description	Units
T_{PLH}	Prop Delay Low to High	ns
T_{PHL}	Prop Delay High to Low	ns
Skew (PWD)	Pulse Width Distortion	ns
I_Q Receiver	Quiescent Current	mA

Table 3. Zero-Based Parameters

1.3 High Voltage AC Barrier Life Test

Originally, the device barriers were subjected to a 2000 hour test with a stress voltage of 1500 Vrms applied. The oven temperature was 125°C; the sample size was 96.

Read Point (Hours)	Functional Failures	Pass	Device Hours
0	0	96	0
168	0	96	16,128
504	0	96	32,256
1,008	0	96	48,384
2,040	0	96	99,072
Cumulative Device Hours			**195,840**

More recently, the test was repeated for 10000 hours with a DC stress voltage of 1500 V. Again, the oven temperature was 125°C; the sample size was 96.

Read Point (Hours)	Functional Failures	Pass	Device Hours
0	0	96	0
168	0	96	16,128
504	0	96	32,256
1,008	0	96	48,384
2,040	0	96	99,072
10,000	0	96	764,160
Cumulative Device Hours			**960,000**

1.4 Moisture Endurance Tests

The moisture endurance screen applied was as follows:

Electrical Test		40 / 0 Fails
96 Hours, 85°C/85% RH	Sample Size	40
Solder Preconditioning (Surface Mount)		40
HAST 135°C @ 85% RH (biased)		40
Bake 125°C for 24 Hours		40
Electrical Test		40 / 0 Fails