

Q: Can I measure for pin-to-pin continuity?

Pin-to-pin Continuity

The standard HiLevel continuity test simply tests for the protect diode on the DUT pins by forcing a voltage and observing the current (and vice-versa). But this may not always detect a pin-to-pin short, because if two device pins are shorted together, the net current through each diode does not change. Twice as much current is forced through the parallel combination of two diodes. Therefore the shorted circuit configuration will result in the expected voltage drop across each diode, yielding a passing continuity test. The problem can be solved by performing a continuity test on each pin while grounding the remaining pins, as illustrated below.

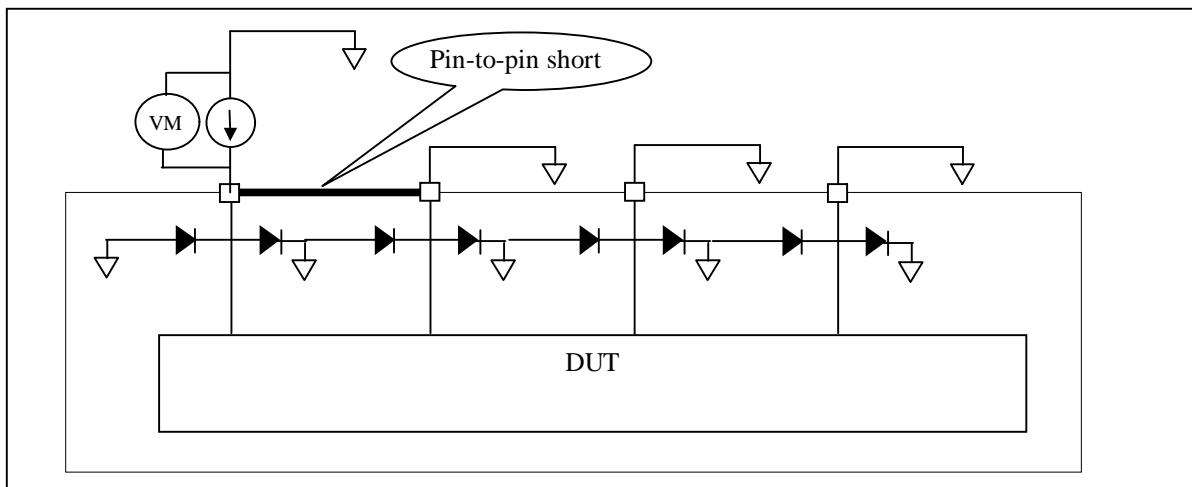


Figure 1. Pin-to-pin short testing

By forcing current and measuring the voltage drop, a complete continuity test results can be done. A simple combination of set files and DC tests can implement this test technique for HiLevel test systems. First, create a set file with all DUT pins defined as "DUT Output" pins. All the pins may be placed in one or many groups; you can use an existing set file and just change the pin direction for every group to "Output". Next, for all groups switch on the programmable loads feature with the commutation voltage set to 0V. The Programmable load current for both IOL and IOH should be set at the same value. This value is typically in the range of 800uA to 5mA, depending on DUT protective diode characteristics and the leakage current specs. It should be no less than 5 times the

continuity test force current. By using programmable loads, the grounding circuit for all pins is created. Make sure to set all power supplies to 0V.

Use the DC PMU window to define the pin-to-pin continuity test. Set the test type to "Force Current Measure Voltage", give the test a name, and define the pin group for the test so that it contains all the device pins. Define the test conditions as "Run To Vector 0" and "DUT Power off". Set the force current at least twice the highest leakage current from all DUT pins, but no less than 100uA (actual current value depends on protective diodes characteristic). Set the Limit to 1V and pass condition to "Pass if above 200mV". Then save set file and the corresponding vector file, with only one vector included. The current settings rule is as follows:

$$I_{\text{Prog. Loads}} \gg I_{\text{Force}} \gg I_{\text{max. leakage}}$$

The example set file and test results for a 74161 device is shown below:

```
$SetFile 'C:\74F161\74f161.set'
$VectorFile 'C:\74F161\74f161.TRN'
$ProgramFile (none specified)
$ScanFile (none specified)

;SysCh Pin# Name Grp Type (IOBS)
10 7 CEP 1 O ; C= 25.00
11 6 D3 1 O ; C= 25.00
12 5 D2 1 O ; C= 25.00
13 4 D1 1 O ; C= 25.00
14 3 D0 1 O ; C= 25.00
15 2 CLK 1 O ; C= 25.00
16 1 MR 1 O ; C= 25.00
25 9 PE 1 O ; C= 25.00
26 10 CET 1 O ; C= 25.00
27 11 Q3 1 O ; C= 25.00
28 12 Q2 1 O ; C= 25.00
29 13 Q1 1 O ; C= 25.00
30 14 Q0 1 O ; C= 25.00
31 15 TC 1 O ; C= 25.00

$PowerSupply 1 0.000 V
$PowerSupply 2 0.000 V
$PowerSupply 3 0.000 V
$SequenceMode Sequencing ;
$StopMode Halt ;
$BreakOnMode Vector ;
$DisplayMode Decimal ;
$StopVector 90
$LastVector 90
$DualThreshold OFF
$ShortForce -0.300 V
$OpenForce -1.200 V
$Frequency 10.000 MHz

$TimeForPass 2000

$MultiSiteMode OFF
$TimingStrobe 1 25.000% ; 25.0 ns
$TimingStrobe 2 25.000% ; 25.0 ns
```

```
$TimingStrobe 3 0.000% ; 0.0 ns
$TimingStrobe 4 0.000% ; 0.0 ns
$TimingStrobe 5 0.000% ; 0.0 ns
$TimingStrobe 6 12.000% ; 12.0 ns
$TimingStrobe 7 20.000% ; 20.0 ns
$TimingStrobe 8 0.000% ; 0.0 ns
$TimingStrobe 9 30.000% ; 30.0 ns
$TimingStrobe 10 0.000% ; 0.0 ns
$TimingStrobe 11 0.000% ; 0.0 ns
$TimingStrobe 12 0.000% ; 0.0 ns
$TimingStrobe 13 0.000% ; 0.0 ns
$TimingStrobe 14 0.000% ; 0.0 ns
$TimingStrobe 15 0.000% ; 0.0 ns
$TimingStrobe 16 0.000% ; 0.0 ns
$TimingStrobe 17 0.000% ; 0.0 ns
$TimingStrobe 18 0.000% ; 0.0 ns
$TimingStrobe 19 0.000% ; 0.0 ns
$TimingStrobe 20 0.000% ; 0.0 ns
$TimingStrobe 21 0.000% ; 0.0 ns
$TimingStrobe 22 0.000% ; 0.0 ns
$TimingStrobe 23 0.000% ; 0.0 ns
$TimingStrobe 24 0.000% ; 0.0 ns
$TimingStrobe 25 0.000% ; 0.0 ns
$TimingStrobe 26 0.000% ; 0.0 ns
$TimingStrobe 27 0.000% ; 0.0 ns
$TimingStrobe 28 0.000% ; 0.0 ns
$TimingStrobe 29 0.000% ; 0.0 ns
$TimingStrobe 30 0.000% ; 0.0 ns
$TimingStrobe 31 0.000% ; 0.0 ns
$TimingStrobe 32 0.000% ; 0.0 ns
```

\$Group 1

GroupName 'ALLPINS'

Display BINARY

HeaderMode PinName

PinFormat Output

StimFormat NRZ

StimStrobe 5; 0.0ns

TrailingStimStrobe 5; 0.0ns

InhibitStrobe 5; 0.0ns

CompareStrobe 1; 25.0ns

LowLogic 0% Of 1 # 0.000 V ;

HighLogic 0% Of 1 # 4.800 V ;

Threshold 0% Of 1 # 2.000 V ;

Hi_Threshold 0% Of 1 # 0.000 V ;

ProgrammableLoad ON

IOL mA 5.000

IOH mA 5.000

CommutationVoltage 0% Of 1 # 0.000 V ;

ParallelLoad OFF

TerminationVoltage 0% Of 1 # 0.085 V ;

\$DcParameters ; Parameters pertaining to the DC PARAMETRIC UNIT

TEST 1: ptopcont ShowMeasurementDetails ;

ForceCurrentMeasureVoltage PowerOff RunToVector 0 (dec) ;

ForceValue = 600.000 uA ;

Limit = 1.000 V ;

PassRange Between 0.400 V and 8.000 V ;

DcPinGroup all_pins ;

TEST 2: ; Undefined

```

TEST 3:      ; Undefined
TEST 4:      ; Undefined
TEST 5:      ; Undefined
TEST 6:      ; Undefined
TEST 7:      ; Undefined
TEST 8:      ; Undefined
TEST 9:      ; Undefined
TEST 10:     ; Undefined
TEST 11:     ; Undefined
TEST 12:     ; Undefined
TEST 13:     ; Undefined
TEST 14:     ; Undefined
TEST 15:     ; Undefined
TEST 16:     ; Undefined
$DcPinGroups
all_pins    10 11 12 13 14 15 16 25 26 27 28 29 30 31 ;
output      27 28 29 30 31 ;
$NullPinGroup 3 4 5 6 7 8 9 10 11 12 13 14 15 16 ; PinGroups with 'null
name'

$EndDcParameters

$End

```

Sample Set File for 74f161

Here is an example of test results for pins 10 and 11 shorted together. Note that the test fails for both of the pins (highlighted in yellow).

```

----- Device# 2 -----
Test 'ptopcont':      *** Failed ***
LowLimit: 0.400 V, HighLimit: 8.000 V, Compliance: 1.000 V

```

Chan	Pin	Name	Status	Forced	Measured
10	7	CEP	Passed	600.000 uA	583.426 mV
11	6	D3	Passed	600.000 uA	1.365 V
12	5	D2	Passed	600.000 uA	1.360 V
13	4	D1	Passed	600.000 uA	1.360 V
14	3	D0	Passed	600.000 uA	1.360 V
15	2	CLK	Passed	600.000 uA	811.098 mV
16	1	MR	Passed	600.000 uA	1.360 V
25	9	PE	Passed	600.000 uA	1.360 V
26	10	CET	Failed	600.000 uA	29.096 mV
27	11	Q3	Failed	600.000 uA	29.096 mV
28	12	Q2	Passed	600.000 uA	835.845 mV
29	13	Q1	Passed	600.000 uA	835.845 mV
30	14	Q0	Passed	600.000 uA	835.845 mV
31	15	TC	Passed	600.000 uA	835.845 mV

Test results for pins 10 and 11 shorted

System channels 26 and 27 (DUT pins 10 and 11) measure far less current than do the passing pins. On the next page, see test results in which all of the device pins are passing (no short).

Example result for all pins passing:

```
----- Device# 3 -----  
Test 'ptopcont':      $ Passed $  
LowLimit: 0.400 V,  HighLimit: 8.000 V,  Compliance: 1.000 V  
Chan  Pin   Name      Status      Forced      Measured  
10   7    CEP       Passed      600.000 uA  578.477 mV  
11   6    D3        Passed      600.000 uA  1.360 V  
12   5    D2        Passed      600.000 uA  1.360 V  
13   4    D1        Passed      600.000 uA  1.365 V  
14   3    D0        Passed      600.000 uA  1.360 V  
15   2    CLK       Passed      600.000 uA  811.098 mV  
16   1    MR        Passed      600.000 uA  1.365 V  
25   9    PE        Passed      600.000 uA  1.360 V  
26  10    CET       Passed      600.000 uA  1.360 V  
27  11    Q3        Passed      600.000 uA  830.895 mV  
28  12    Q2        Passed      600.000 uA  835.845 mV  
29  13    Q1        Passed      600.000 uA  835.845 mV  
30  14    Q0        Passed      600.000 uA  835.845 mV  
31  15    TC        Passed      600.000 uA  835.845 mV
```

Test results with all pins passing

See also:

Q'nApp #P1 on the PinList function

Q'nApp #P35 on the Programmable Loads, DCPMU

Q'nApp #P51 on Fast Continuity

Q'nApp #P61 on Pin-to-pin resistance