

TERADYNE

TIM 2016

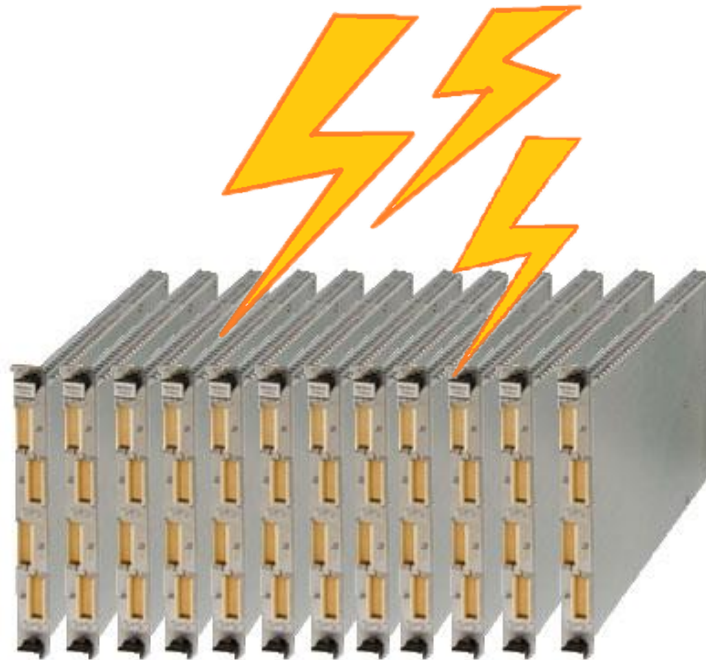
TESTING HIGH VOLTAGE LOGIC WITH DI-SERIES CARDS

Sidney Fluhrer

Lin Yang

Alliance Support Partners, Inc.

HOW DO YOU BREAK 12 DI CARDS!

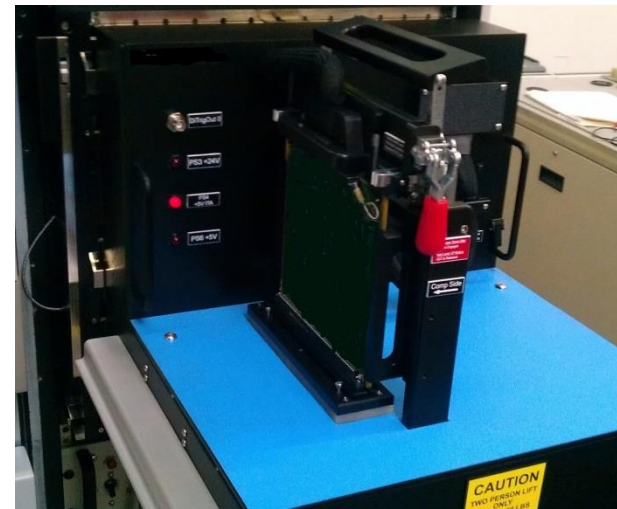


Back in 2012, between ASP and Navy Dahlgren, we depleted the world's supply of DI spares by damaging at least 12 DI cards in a very short period of time. The damage was traced specifically to the DI detect sensors.

This event got the full attention from Teradyne program manager and engineering.



- Rehost 15 test programs from L293 to S9100 using TPS Convert Studio
- Some test programs will share ITAs. Custom circuitry is placed inside ITA for signal switching and loads.



IS 24V SAFE FOR DI CARDS?

UUT

powered by

+5V

+24V



DI-050-12

Datasheet says

The voltage range is

+/- 30V

No Problem

- Original L293 ITA have voltage dividers to scale down output level from 24V to 5V. Those are removed.
- Original L293 ITA have pull up resistors to pull IOX'ed signals to power supply set to VIH. Those are removed.

- The highest protection voltage is determined by the programmed voltage value for the DI card
- The mere presence of the high voltage at the receiver is enough to damage the sensor even though digital tests are not performed.

- The default state for Di-Series is the lowest range which is - **2.2 to 3.3V**
- The default state for L to S conversion program set by TPS Convert Studio (TPSCS) is **-3 to +6V**.
- In the default state, the presence of a voltage that is **2V** beyond the range is enough to damage the sensors even though digital tests were not performed.
- The default pin state for L200 channels is DIGITAL



THEN CAN I SET EVERYTHING TO MAXIMUM VOLTAGE RANGE?

CAN I SET EVERYTHING TO MAXIMUM?

NO

Because each VXI slot can supply enough current to support only 32 Di-Series channels of high power levels

For these voltage ranges. . .			The power level is. . .
-30.0 to 0.0 V	-15.0 to +15.0 V	0.0 to +30.0 V	High
-15.0 to +5.0 V	-10.0 to +10.0 V	-5.0 to +15.0 V	Medium/High
-3.0 to 6.0 V			Medium/Low
-2.2 to 3.3 V			Low

VALID POWER LEVEL COMBINATION

Non-Specific Front Panel Connectors/Voltage Rails				Valid Combination?
A	B	C	D	
High	High	Medium/Low	Medium/Low	Yes
High	High	Medium/Low	Low	Yes
High	High	Low	Low	Yes
High	Medium/High	Medium/High	Medium/Low	Yes
High	Medium/High	Medium/High	Low	Yes
High	Medium/High	Medium/Low	Medium/Low	Yes
High	Medium/High	Medium/Low	Low	Yes
High	Medium/High	Low	Low	Yes
High	Medium/Low	Medium/Low	Medium/Low	Yes
High	Medium/Low	Medium/Low	Low	Yes
High	Medium/Low	Low	Low	Yes
High	Low	Low	Low	Yes
Medium/High	Medium/High	Medium/High	Medium/High	Yes
Medium/High	Medium/High	Medium/High	Medium/Low	Yes
Medium/High	Medium/High	Medium/High	Low	Yes
Medium/High	Medium/High	Medium/Low	Medium/Low	Yes
Medium/High	Medium/High	Medium/Low	Low	Yes
Medium/High	Medium/High	Low	Low	Yes
Medium/High	Medium/Low	Medium/Low	Medium/Low	Yes
Medium/High	Medium/Low	Medium/Low	Low	Yes
Medium/High	Medium/Low	Low	Low	Yes
Medium/High	Low	Low	Low	Yes
Medium/Low	Medium/Low	Medium/Low	Medium/Low	Yes
Medium/Low	Medium/Low	Medium/Low	Low	Yes
Medium/Low	Medium/Low	Low	Low	Yes
Medium/Low	Low	Low	Low	Yes
Low	Low	Low	Low	Yes

- When you change the level range, you need to consider how the level range may affect the other channel characteristics.
- Output impedance has to be 50 Ohm, not LOWZ.
- Driver resolution changes with range. Check the Driver specification for the Di-Series model for the details.

The problem was amplified by:

- The test adaptor was shared by 4 UUTs that use the same connectors. We assigned DI channels sequentially.
- UUTs had different power pins, and 24V logic output pins.
- So we end up with 24V logic pins spread thru 5 DI cards.
- Even a single damaged channel required replacement of the whole DI card.



Lessons
Learned

- Power and Ground
 - Assign power and ground channels to one DI card
- High Voltage Signals
 - Group potential high voltage pins to group of 16.
 - Allocate half of the DI cards for potential high voltage levels.

Programs converted by TPS Convert Studio are designed to match L200 capability. The program puts the S9100 tester in the L200 compatibility mode. When in CShell L-Series compatibility mode, the following are set as defaults for all channels.

- Level range is -3 to +6V.
- VMIN is -3 V, and VMAX is +6 V when creating level sets. Each pin that uses this level setup will be configured so that it will not be damaged during a test by voltages between VMAX and VMIN.
- Output impedance is set to LOWZ

- The easiest and safest way to get a channel into a desired level range is to define a level set that forces the pin into the range. The advantage of this approach is that only CShell functions are required.
- All channels in a channel group share the same voltage range. Setting one channel in a group of 16 to the 30 V range means all 16 channels are at the 30 V range. Once a channel group is in the 30 V range, none of the channels in that group can use LOWZ impedance.
- For example, to configure one channel to 0-30V range:
 - Define a level set with VOL set to 0 and VOH set to 30. The example uses an index of 30 so that it's clear that this one didn't come from the translation).
 - Assign this level set to your channels using the **set_digital** statement. You should also make sure that the channels are set to 50 Ohm impedance (by setting LOWZ to OFF in the **set_digital** statement)

- Here is the sample edit to do for **LtoM_main.c** after your translate step, before you build the CVI project. The **CshellSetLevelsVminVmax** need to be called before **CShellInit** call.

```
// Set default VMIN and VMAX for all level sets  
CShellSetLevelsVminVmax(0, 5);  
CShellInit();
```

- Below is a sample inhibit code to be put in your L200 source code. This should be executed before setting any channels to DIGITAL states.

```

!           ViReal64 saveVmin, saveVmax;

///first set the whole system default to LOWZ OFF.

!           //LOWZ and 0-30V range is not compatible

!           set_digital(           // if you don't specify a pinlist the
!
!                               // settings apply to the whole system.
!
!                               LEVELSET, A_, //default to ALEVEL
!
!                               LOWZ, OFF_, // 50 Ohms
!
!                               EOL);
    
```

```
// Create a level for pins that connect to 24 V logic  
  
!           // Save the current values so that we can restore  
!           CShellGetLevelsVminVmax(&saveVmin, &saveVmax);  
!  
!           // Set to max range for maximum protection  
!           CShellSetLevelsVminVmax(0, 30);  
!  
!           set_levels(30, //level set index  
!  
!           VIH, 20.0, VIL, 2.0,  
!  
!           VOH, 20.0,  
!  
!           VOL, 2.0, EOL);  
!  
!           set_digital(PINLIST,  
!  
!                   P_1_23, EOL, //end of channel list  
!  
!                   LEVELSET, 30,  
!  
!                   EOL);  
  
!// Restore the VMIN and VMAX  
  
!           // Dont want every level set in high voltage range  
!  
!           CShellSetLevelsVminVmax(saveVmin, saveVmax);
```

- In the test program entry point, we implement a function to set
 - All power and ground to ANALOG – this will disconnect them from DI digital circuitry
 - SET PIN(VCC GND P24V P24VRTN) STATE = \$ANALOG;
 - Sometimes you may need to set VCC and GND back to DIGITAL before functional test if they are expected in Guide Probe Diagnostics.
 - All analog channels to ANALOG
 - Only set channels actually used in the digital test to DIGITAL

- Di-Series driver v3.2 installs an alarm viewer which can be used to monitor the various alarms generated by the instrument. While it won't prevent damage to the board, it can be used to confirm that over-voltage alarm tripped.
- When alarm is tripped, DI will disconnect DI channel involved , as well as all channels in the group of 16 it is in.
- You should always have alarm viewer running.
- start Alarm Viewer, select **All Programs->Teradyne->Di-Series->Alarm Viewer.**

The screenshot shows the 'Di-Series Alarm Viewer' application window. The window title bar is blue and contains the text 'Di-Series Alarm Viewer' and standard Windows window controls (minimize, maximize, close). Below the title bar is a menu bar with 'File', 'Edit', and 'Help' options. The main area of the window contains a table with the following data:

Date and Time	Type	Source	Index	Interface	Chassis	Slot	Socket	Channel	Test Program
2012-04-13T20:32:57	Overvoltage	Channel	2, 4	0	0	8	0	4	C:\Program Files\Teradyne\TestStudio\TestStudio.exe

- Sometimes, you will encounter over voltage alarm between guided probe loops.
- It seems that the Di range and level are set properly before each burst. It is suspected that the GP may have reset some DI pin state between loops.
- A workaround was to set all pins involved in burst to NULL after the burst. Therefore none of the DI channels are connected between burst.

- ✓ Assign power and ground pins to one DI card
- ✓ Group potential high voltage pins
- ✓ Set all pins to known state – ANALOG, DIGITAL, NULL
- ✓ Know the default : -3V to 6V
- ✓ Set channels to HV range
- ✓ Disconnect HV pins after functional test if Guided Probe is used



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