Ganged DPS / MI Measurement Application Note

Rev A01: 09/02/2005

Document Revision History

Revision	Date	Description
A01	9/2/2005	Initial Draft
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Table of Contents

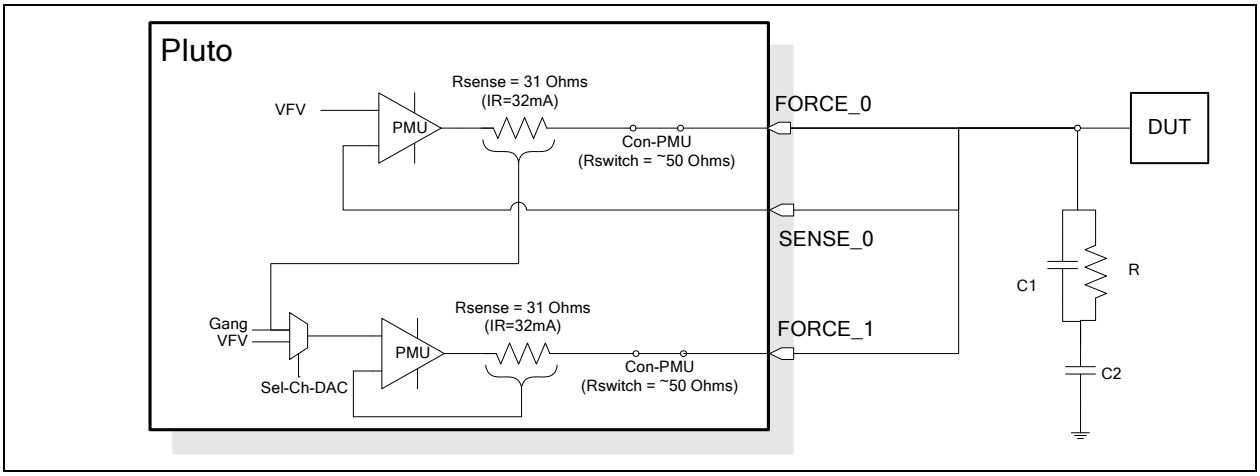
1 Introduction

This application note describes how to use the Pluto device in a DPS application. This document focuses on the Pluto device. The same concept can be applied to the other PlanetATE devices. Figure 1 illustrates the application configuration.

The 2 main obstacles to overcome are (these are discussed further below):

- How to tolerate large load current changes
- How to make small MI measurements (i.e. when DUT goes into a Sleep mode)

Figure 1: Pluto Configuration



1.1 Load Current Change

An application example is used to describe the cause and effect of load current change.

The Pluto device has a 31 ohm sense resistor (Rsense) and 50 ohm Con-PMU switch (Rswitch). Assuming the DUT required 3V and 100mA; which would imply 50mA for each Pluto channel. The 50mA load current will create a 4V drop across the Rsense + Rswitch which will make the PMU output voltage 7V to achieve 3V at the DUT. Now if the DUT load current changes to 50mA (25mA for each channel), then the PMU output will become 5V. The 2V delta will result in a glitch on the FORCE line. The time of the glitch is dependant on the PMU loop response time. To overcome the load current change, a large capacitor should be placed at the DUT to absorb the transient glitches.

For stability, a second smaller capacitor in parallel with a small resistor is placed in series of the large capacitor. This additional R+C is more critical when switching to lower current ranges when making small current measurements.

1.2 Small Current Measurements

Many applications require the DPS to make small current measurements on the DUT; for example when the DUT goes into Sleep or Power-Down mode. In order to make more precise small current measurements, the Slave devices need to be disconnected and the Master device would need to be configured into a smaller current range. The MI current range is dependant on how small the current is. More importantly, the MI current range determines the C1 load capacitor to ensure stability while in the MI current range. Section 1.3 provides a Cload vs Current table.

1.2.1 Isolating the Large Cload

Measuring small currents when a large capacitor is present is challenging regardless of the DPS architecture therefore it is recommended that a relay/switch be used to isolate the large capacitor. The relay/switch would be put in series of the R. Another option is to have a relay/switch with some amount of Ron.

1.3 Max Cload vs. Current Range

The following table shows the maximum capacitive load that Pluto will tolerate without isolation resistors. The definition of maximum capacitance is very subjective, so the table is more of a guideline.

Cload1 in the table below is the amount of capacitance where you may have substantial ringing, but it will not break into oscillation. These loads assume remote Kelvin sensing. The Cload2 numbers are more conservative numbers with much less ringing.

Ganging channels multiplies the capacitance that you can drive. So two channels ganged together in the 32mA range can drive 1uF.

Note: Empirical results have shown that these values can be double and not have the device break into oscillation, but the ringing is much worse.

Range	Cload1	Cload2
32mA	500nF	200nF
8mA	125nF	50nF
2mA	50nF	20nF
512uA	17nF	6.5nF
128uA	4.25nF	1.7nF
32uA	2.25nF	0.9nF
8uA	1.5nF	0.6nF
2uA	1.25nF	0.5nF

2 Software Procedures

This section describes the procedure to switch between current ranges in order to make small current measurements.

2.1 Configuration

Refer to the datasheet on how to configure Pluto into Ganging mode; this section only describes additional configuration aspects. Each slave device should configure their FV and FI DAC values as follows:

- FV = same voltage as the Master (desired DUT voltage)
- FI = 0uA

2.2 Switch Current Range and Measure MI Procedure

This example assumes the Master is on Channel #0 and the slaves are on Channel 1 – N.

Note: this example does not support the case when an isolation relay/switch is used. If a relay is used, then the large capacitor should be switched out right before changing to the smaller current range.

```
/*
 * Disconnect Slaves
 * Open slave Con-PMU then put slave into FV mode using Internal DAC,
 * this will be useful when reconnecting
 */
for ( ch = 1 ; ch <= num_slaves ; ch++ )
{
      /* Open (disconnect) Con-PMU switch */
      V100_write_bits(DevNumber, ch, PLUTO_DRV_CFG_SEL_RT_PMU, 0);
      /* Use internal DAC instead of Gang-MI */
      V100_write_bits(DevNumber, ch, PLUTO_EFS_SEL_CH_DAC, 0);
      /* Put in FV mode */
      V100_write_bits(DevNumber, ch, PLUTO_PMU_FI_FV, 0);
}

/* Switch IR range and do MI measurement */
V100_write_bits(DevNumber, V100_CHAN0, PLUTO_PMU_IR, V100_IR_8MA);
current = V100_meas_pmu_mi(DevNumber, V100_CHAN0, fv, 0);
V100_write_bits(DevNumber, V100_CHAN0, PLUTO_PMU_IR, V100_IR_32MA);

/*
 * Reconnect Slaves
 */
for ( ch = 1 ; ch <= num_slaves ; ch++ )
{
      /* Close (connect) Con-PMU switch; Slave is in FV mode */
      V100_write_bits(DevNumber, ch, PLUTO_DRV_CFG_SEL_RT_PMU, 2);
      /* Put into FI mode (using DAC = 0uA) */
      V100_write_bits(DevNumber, ch, PLUTO_PMU_FI_FV, 1);
      /* Source from Master's MI */
      V100_write_bits(DevNumber, ch, PLUTO_EFS_SEL_CH_DAC, 4);
}
```


3 Results

The following screen shots show the transient response for a load change and switching to the lower current range. The application conditions are:

- 2 Channels: 1 Master + 1 Slave
- FV = 1.66V in VR1
- IR=32mA (Normal mode) and IR=8mA (Sleep/measure MI mode)
- Imax = 128mA (64mA per channel)
- Isleep = 200uA (only Master is connected)
- R = 2 ohm ; C1 = 200nF ; C2 = 10uF

Figure 2: Load Change Response

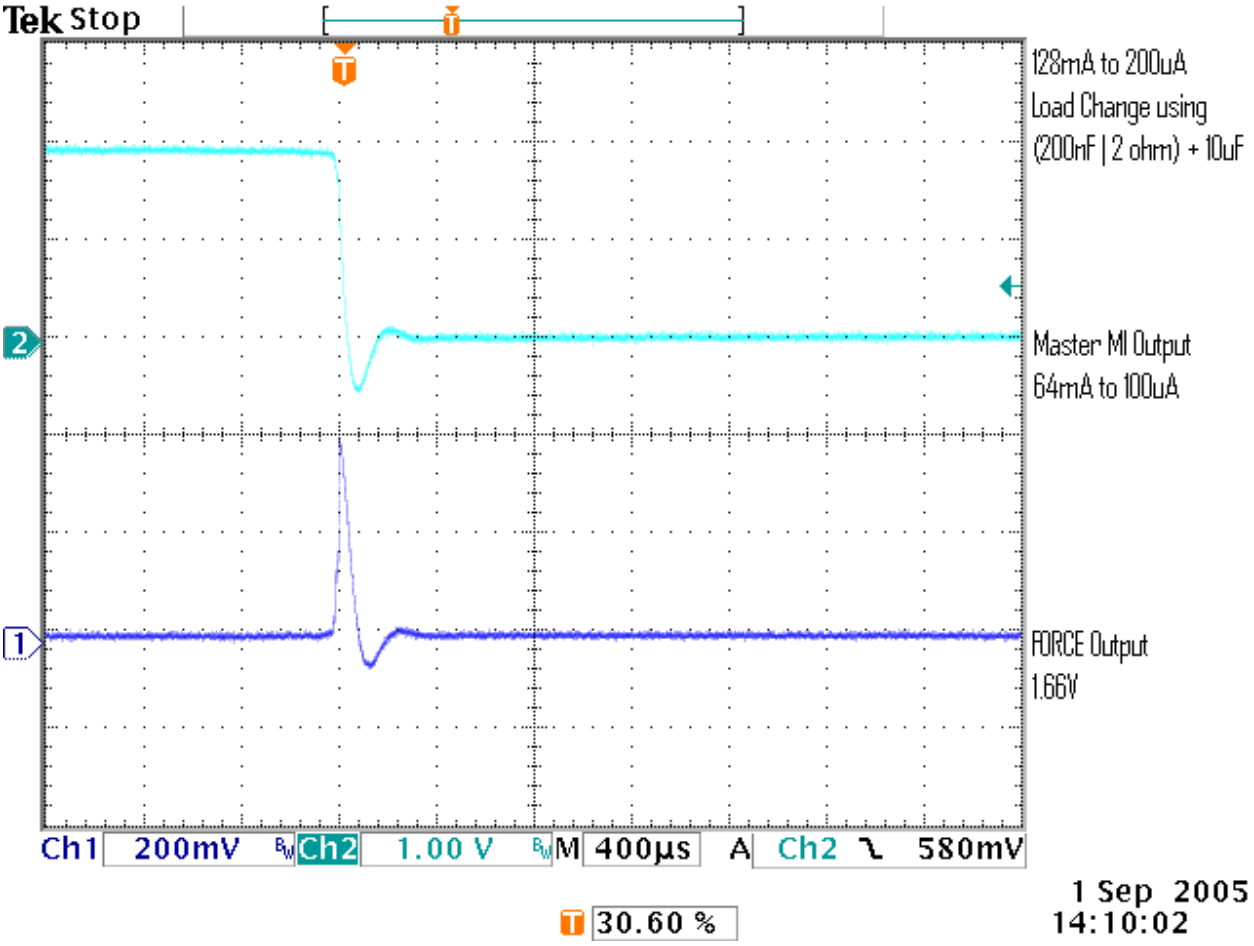


Figure 3: Switch IR Response