J2103A

Power Stage Isolator

Operation Manual

Version 1.1 Dated: 06/07/2023

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1. Introduction to J2103A

All electronic products, whether powered by mains or batteries, contain power regulation circuits that can use either switching or linear power supplies, or both. Feedback control circuits are necessary to stabilize the output voltage of both types of power supplies. Therefore, the design of feedback control circuits has always been a focal point for young power engineers to learn. However, before designing the correct feedback control circuit, power engineers need to understand the frequency response of the power output circuit (Power stage) to be controlled.

In the past, we would use EDA with circuit models to analyze the circuit and predict the frequency response of the power output circuit (Power stage). Then, we would proceed with the first feedback control circuit design. If the circuit worked properly, we could use an FRA/VNA and J210XA injectors to measure the frequency response of the power output circuit (Power stage), and optimize the feedback control circuit according to the measurement results. However, the whole process was very time-consuming and cumbersome.

J2103A Power Stage Isolator is a device that replaces feedback control circuits to control the power output circuit (Power stage). The advantage of using J2103A before designing the feedback control circuit is that we can perform frequency response measurements on the power stage output circuit and design the feedback control circuit based on the actual measurement results. This allows us to achieve a nearly complete design process in one iteration. Finally, by integrating the power stage output circuit and the feedback control circuit, the overall design result is relatively accurate, and it significantly shortens the design timeline.

J2103A can be used in almost any power circuit that requires feedback control. Its feedback input (Vin) and reference voltage (Vref) use differential inputs without reference ground problems. Therefore, designs with isolated or non-isolated power sources, switching or linear power supplies, and positive or negative voltage feedback can all use J2103A.

2. J2103A Package Contents

Figure 1 displays the product contents. The contents include...

a. J2103A unit x 1 (includes 4 Lithium-Titanium-Oxide batteries)
b. Type C charging cable x 1
c. PWR-OPT03 Banana to USB converter x 1
d. Dupont testing cables x 2

Figure 1 J2103A Product Contents

*Note 1: For battery transportation, please refer to the lithium battery product transportation regulations in "The shipping resulations for lithium batteries.pdf".

*Note 2: For more information on the banana plug to USB converter, please refer to the PWR-OPT03 user manual in "Banana to USB Connecter1.pdf".

3. Side Panel Configuration 1

The configuration diagram of panel 1 for J2103A is shown in Figure 2.

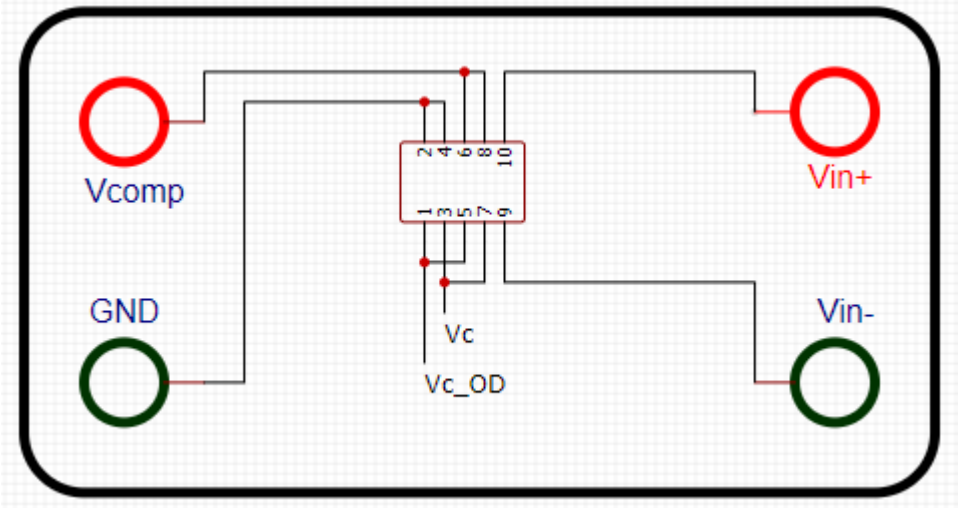

Figure 2 J2103A Panel Configuration I

According to Figure 2, J2103A provides two types of input/output ports: Banana jacks and Dupont connectors**:**

a. You can select Vcomp output using the Dupont terminals. By connecting pin 5 to pin 6 with a jumper cap, you can set Vcomp to open drain output. Alternatively, by connecting pin 7 to pin 8, you can set Vcomp to push-pull output. The factory setting for Vcomp is push-pull output.
b. Vin (Vin+, Vin-), and Vref(Vref+, Vref-) are the differential inputs, and Vin- and Vref- are not referenced to the GND port.
c. Vcomp open drain output can be connected to the Dupont cable output by using the Dupont terminal pin 1 (Vc_OD) and pin 2 (GND).
d. Vcomp push-pull output can be connected to the Dupont cable output by using the Dupont terminal pin 3 (Vc) and pin 4 (GND).
e. Vin can be connected to the Dupont line input by using the Dupont terminal pin 10 (Vin+) and pin 9 (Vin-).

4. Side Panel Configuration 2

The configuration diagram of panel 2 for J2103A is shown in Figure 3.

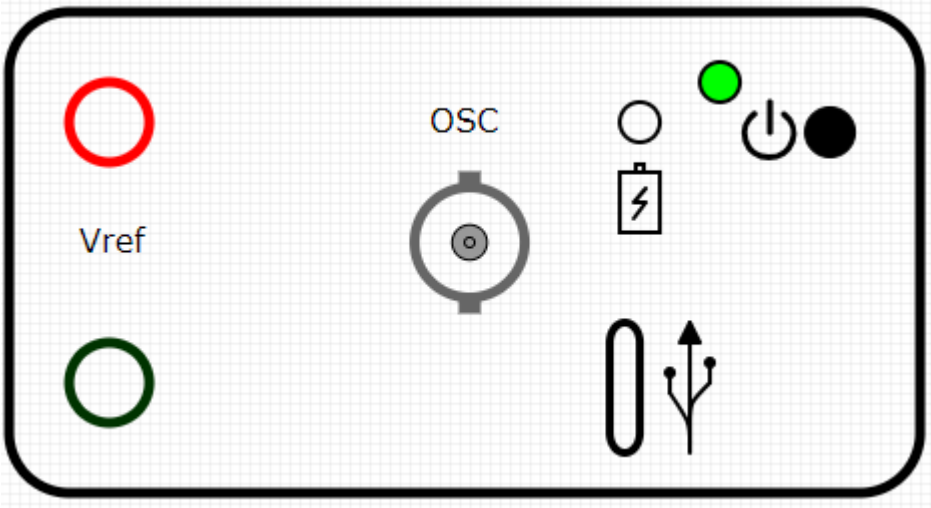

Figure 3 J2103A Panel Configuration 2

Figure 3-1 Power Indicator Lights

Figure 3-1 shows the Power indicator lights:

a. **Green light constantly on:** Power ON indicator light.
b. **Green light off:** Power OFF state.
c. **Flashing orange light:** Indicates low battery voltage (automatic power-off after 5-10 minutes).

Figure 3-2 Battery Charging Lights

Figure 3-2 shows the Battery charging indicator lights:

a. **Red light steady on:** Fast charging indicator (Battery level < 80%)

b. **Red light steady on + Green light blinking:** Battery level > 80%

c. **Green light steady on:** Charging completed

d. **Red light blinking:** Abnormal battery voltage.

Battery level control may be affected by variations in the characteristics of individual battery cells, which can result in imbalanced stored energy after usage or over-discharge due to prolonged periods of inactivity. This product is equipped with a self-repair mechanism that automatically balances the battery level or performs trickle charging to rectify abnormal conditions. The charging time varies depending on the actual differences in battery cell characteristics, and in some cases, it may take up to 8 hours for a complete charge. If the situation does not improve after 8 hours of charging, please contact with your local distributor for help.

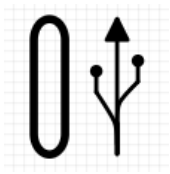

Figure 3-3 USB Type-C Charging Port

The USB Type-C charging port shown on Figure 3-3 is for charging only. When J2103A is being charged, the power switch will automatically turn off and cannot be operated. A 5V, 15W USB charger adapter can be used as the charging power source, **or the included USB to banana adaptor (PWR-OPT03) can be used along with a general desktop DC power supply set to output 5V and limit the current to 3A for charging.**

5. J2103A Operation Steps

Figure 4 is the circuit diagram of J2103A. Plesase operate according to the following instructions.

a. Turn off the DC power supplies A, B, and J2103A power.
b. Configure the DUT to be controlled by J2103A.
c. Connect the input terminal (Vin) of J2103A to the output terminal of the DUT.
d. Connect the output terminal (Vcomp) of J2103A to the control terminal of the DUT.
e. Connect the reference terminal (Vref) of J2103A to DC power supply B.
f. Turn on J2103A and DC power supply B, and set Vref to 0V.
g. Turn on DC power supply A and set the input voltage of the DUT.
h. Adjust the Vref voltage until the output voltage of the DUT is equal to the target voltage, Vout=Vref x 10.
i. Measure the power stage gain using FRA or VNA. The disturbance signal can be injected through J2103A's OSC port.

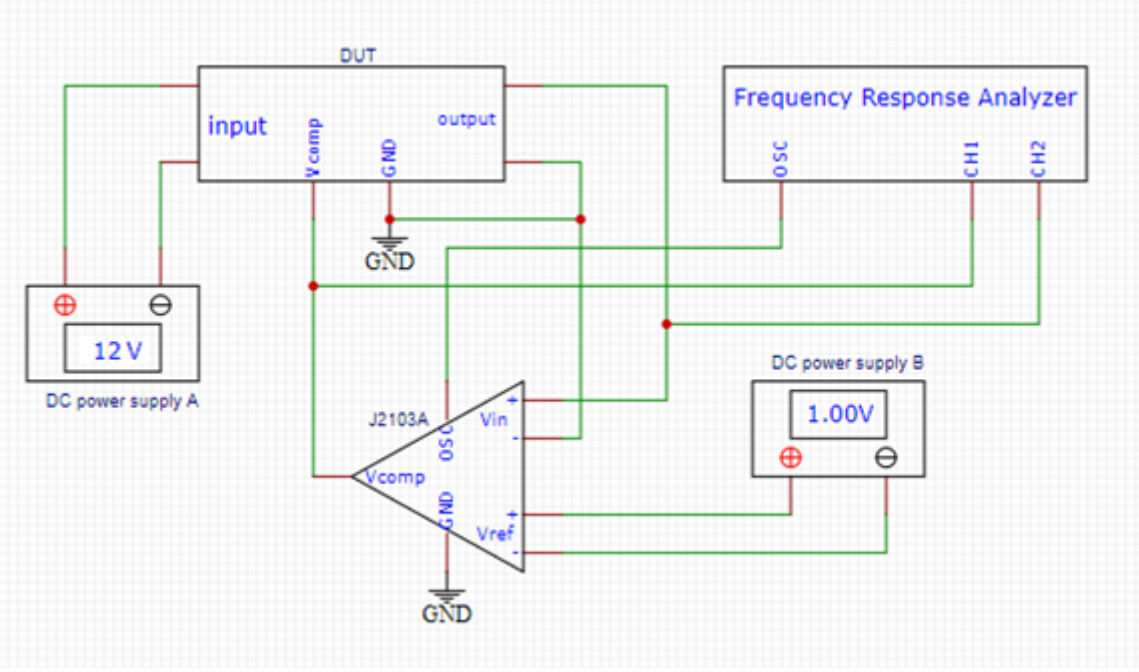

Figure 4 The General Circuit Diagram Using the J2103A to measure gain.

6. The OSC signal level for J2103A

a. The OSC port has an input impedance of 50ohm.
b. The maximum input signal allowed is +26dBm, and the voltage of 4.46Vrms (12.6Vpk-pk).
c. There is an OSC to Vcomp port signal attenuation ratio of 20dB.

The J2103A operates with a single power supply, and the Vcomp output range is 0~10V. Therefore, the strength of the OSC signal, represented by Vosc/10, must be lower than the DC bias value of Vcomp under no clamp condition. Figure 5 and Figure 6 show the waveforms with Vcomp_DC = 200mV and Vosc = 10dBm (2Vpk-pk) and Vcomp_DC=50mV, Vosc=10dBm(2Vpk-pk).

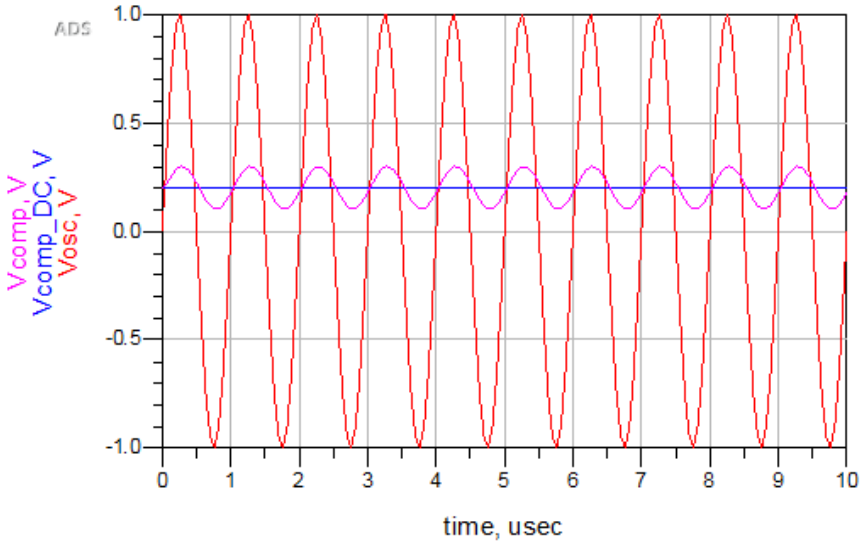

Figure 5 Vcomp_DC=200mV, Vosc=10dBm(2Vpk-pk)

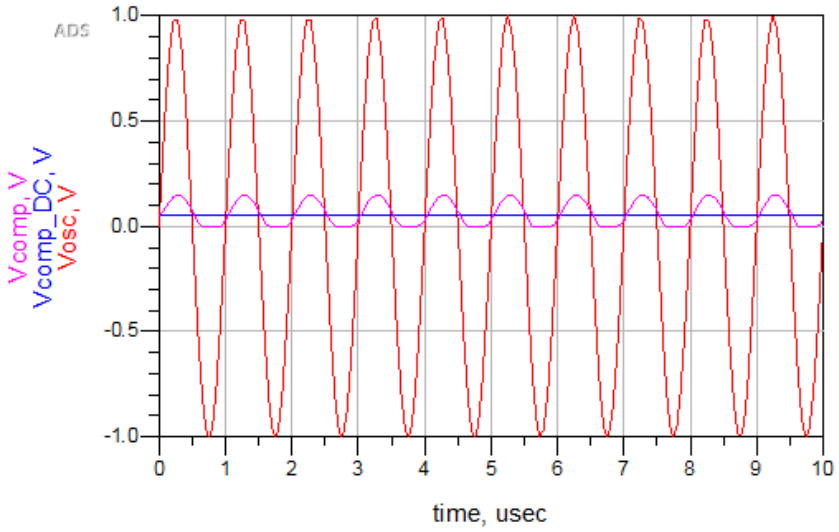

Figure 6. Vcomp_DC=50mV, Vosc=10dBm(2Vpk-pk)

7. Specifications

Here are some specifications related to the J2103A:

a. The Vref port is a differential input with a common mode input impedance of 10 kohm. The maximum input voltage is +/- 10V.
b. The Vin port is a differential input with a common mode input impedance of 100 kohm. The maximum input voltage is +/- 60V.
c. The OSC port is a single-ended input with an input impedance of 50 ohm. The maximum input power is +26dBm, and there is a 20dB attenuation from OSC to Vcomp. The bandwidth is greater than 1MHz.
d. Four LTO batteries are connected in series to power the J2103A. They can be fully charged in about 30 minutes and can work continuously for more than 8 hours with Vcomp=10V at no-load and the OSC port not connected.
e. At a frequency of 10Hz, the gain is approximately -48dB and the phase shift is 90 degrees.

8. Inspection

Figures 7 and 8 show the results of verifying the frequency response of Vin to Vcomp and OSC to Vcomp using an E5061B network analyzer.

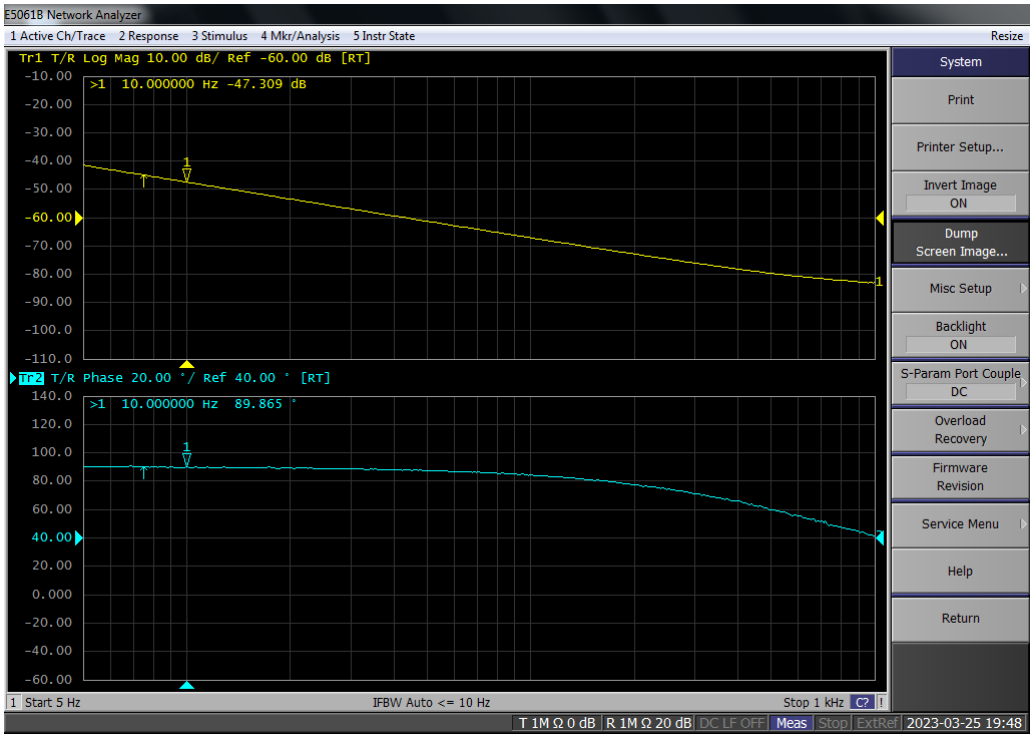

Figure 7 Frequency response of Vin to Vcomp

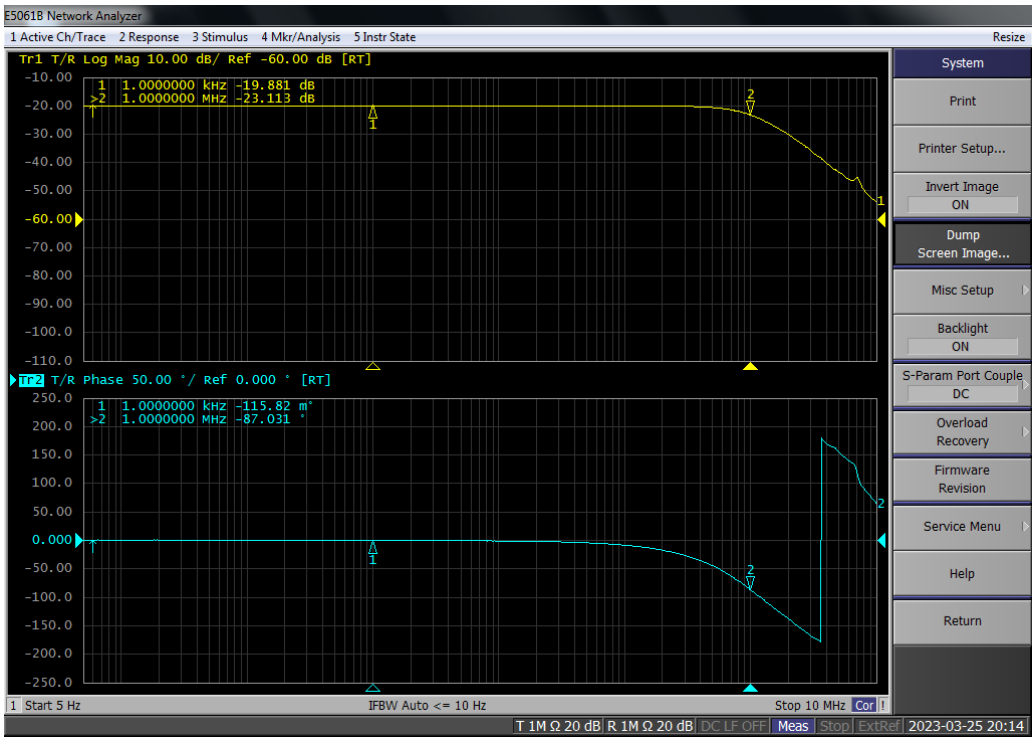

Figure 8 Frequency response of OSC to Vcomp