9732 Parallel Configuration for Increased Current Output

NOTE: If the proper diodes are not implemented (outlined below), damage may occur resulting in a void of warranty. If in doubt, contact Quantum Composers for additional information.

Scope:

This document overviews the basic theory and operation pertaining to wiring output channels A & B in parallel for the purpose of increasing output current.

Theory:

The 9732 Series Current Generator allows for the outputs on Channels A & B to be wired together in a parallel configuration; thus, potentially allowing for current levels **up to** 12 Amps through the load. This can be accomplished **ONLY** with the implementation of 2 external blocking diodes. When operating in this mode, the limitations on each channel remain constant; although, the current settings will now be additive through the load. The user may also incorporate a “piece-wise” current waveform by properly altering the pulse widths and delays.

The following example setup represents the potential capabilities of this configuration:

Channel Parameters	Load Parameters	Diode Characteristics
CHA: Amplitude = 5 Amps	Impedance ≤ 3 Ω (includes cabling)	Forward Voltage Drop ≤ 1V
CHA: Width = 0.0001000 s		Reverse Voltage Breakdown ≥ 30V
CHA: Delay = 0 s		DC Current Rating ≥ 30A
CHB: Amplitude = 5 Amps		
CHB: Width = 0.0001000 s		
CHB: Delay = 0 s		

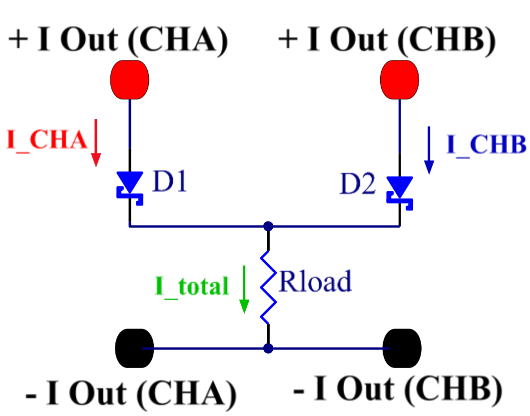

Figure 1- Parallel Schematic Representation

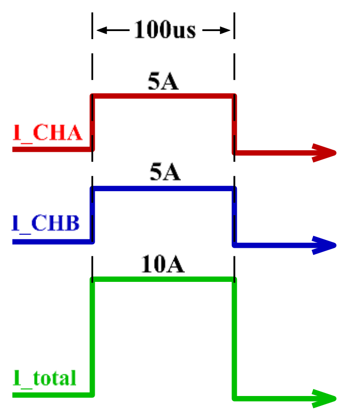

Figure 2 – Resulting Current Waveforms

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Implementation:

The figure shown below represents the recommended wiring to achieve the parallel configuration. Note that the blocking diodes are placed immediately at the output on each channel's positive terminal. To prevent damage to the 9732, it is **EXTREMLY** important that the anodes of both diodes be connected to the positive channel terminals (shown below). Refer to the following list of suggested diodes to use in this configuration:

Suggested Diodes Used at D1 & D2:

-On Semiconductor: MBRB4030T4G
-STMicroelectronics: STPS30M60ST
-Vishay: VT4045BP-M3/4W

Voltage Monitors:

As seen below, the voltage monitors of either channel may be placed before or after the blocking diodes, depending on what measurements are required. If the voltage prior to the diodes is to be monitored, connect the positive voltage monitor to the anode of the corresponding blocking diode. If the voltage at the load is to be monitored, connect the positive voltage monitor as close to the load as possible. Connecting the voltage monitors as shown below allows one to monitor both the voltage across the load as well as the inherent voltage drop across the blocking diodes.

Current Monitors:

The current monitors on each channel represent each channel's individual current. The total current through the load can simply be measured as the summation of the two current monitor signals.

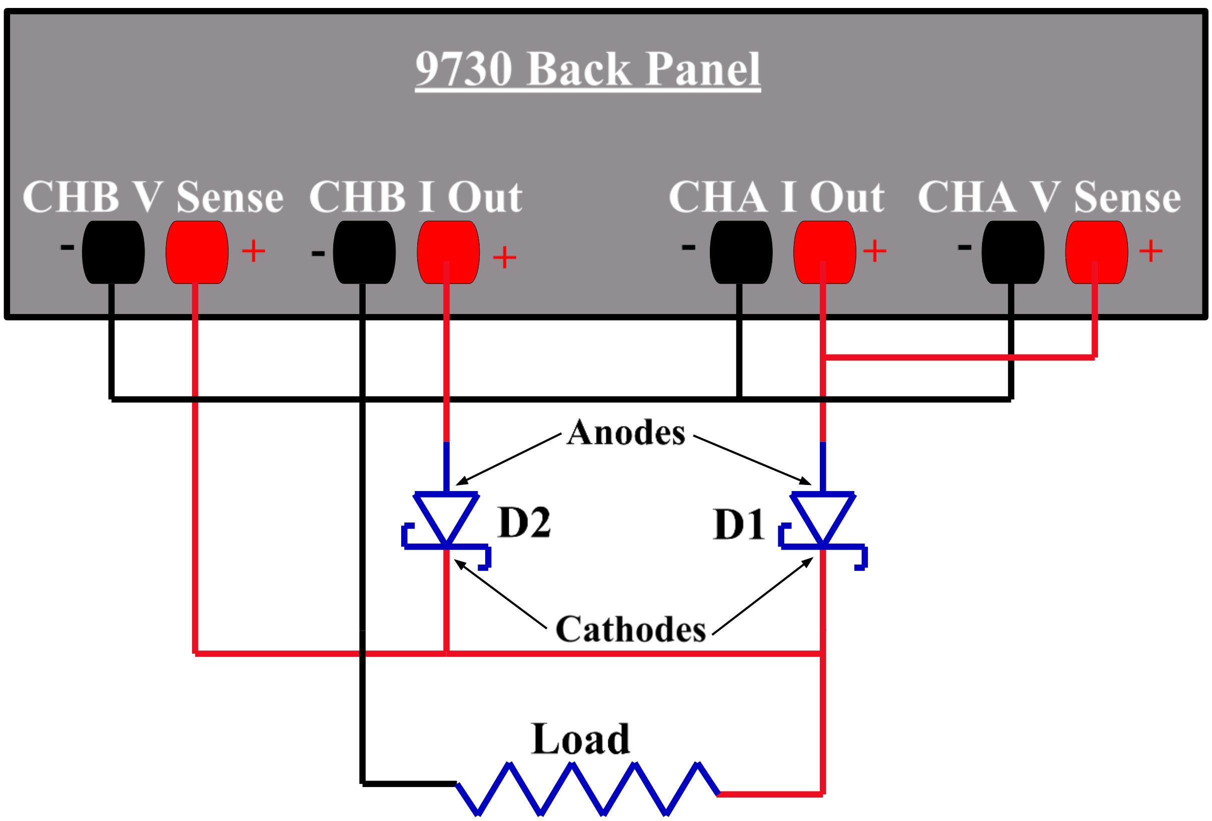

Figure 3 – Parallel Configuration Wiring

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Limitations:

Due to internal power supply limitations, the total current may not exceed **12A** regardless of the load's impedance.

If the channels are wired in parallel, only the current output has the opportunity to increase as the bank voltage will remain constant (~19V Compliance). In this scenario, the available voltage will be further decreased due to the inherent voltage drop from the blocking diodes; thus, it is highly recommended that a diode be used with a small forward voltage rating (see above for suggested diodes).

Example: A total load impedance of 4 Ω is being placed at the output of CHA & CHB in parallel. If blocking diodes are used with a forward voltage rating of 0.7V, what is the maximum current allow by the unit?

1) The compliance voltage will be approximately:

$$V = (19V – [2 * 0.7V]) = 17.6V.$$

2) The maximum allowable current by each *individual* channel would be:

$$I \leq 17.6V/4\ \Omega \rightarrow I \leq 4.4\ \text{Amps}$$

3) The maximum allowable current by the unit in the parallel configuration:

$$I \leq 2*(4.4\ \text{Amps}) \rightarrow I \leq \mathbf{8.8\ Amps}$$

Operating Results:

The following tests show results upon wiring channels A & B in parallel. It should be noted that on all 3 tests, the voltage monitor (CH4 in the scope shots) was placed after the blocking diodes and immediately at the load.

Test 1

Channel Parameters

CHA: Amplitude = 2 Amps
CHA: Width = 0.0005000 s
CHA: Delay = 0 s

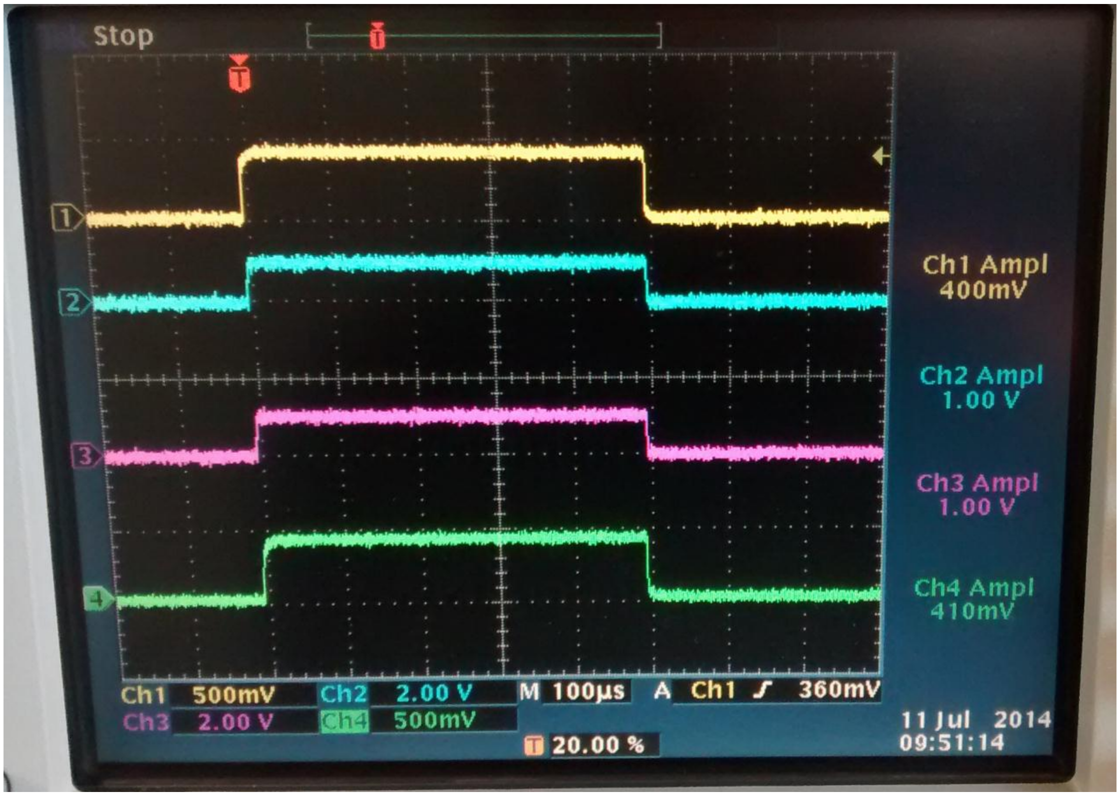
CHB: Amplitude = 2 Amps
CHB: Width = 0.0005000 s
CHB: Delay = 0 s

Load Parameters

Total Load Impedance = 0.75 Ω (includes cabling)

Diode Characteristics

Forward Voltage Drop ≤ 1V Reverse Voltage Breakdown = 50V DC Current Rating ≥ 30A



CH1: Pearson I Monitor(0.1V/1A) CH2: I Monitor CHA(0.5V/1A) CH3: I Monitor CHB(0.5V/1A) CH4: V Monitor(0.2V/V)

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Test 2

Channel Parameters

CHA: Amplitude = 5 Amps
CHA: Width = 0.0005000 s
CHA: Delay = 0 s

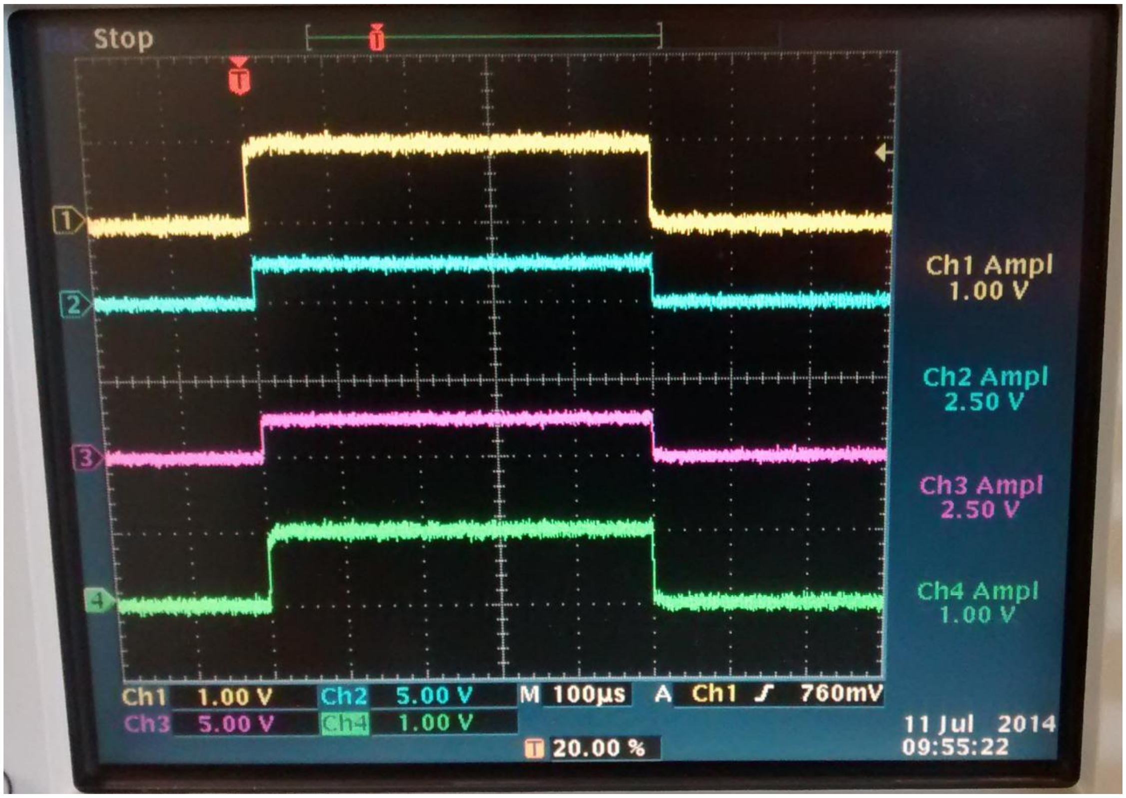
CHB: Amplitude = 5 Amps
CHB: Width = 0.0005000 s
CHB: Delay = 0 s

Load Parameters

Total Load Impedance = 0.75 Ω (includes cabling)

Diode Characteristics

Forward Voltage Drop ≤ 1V Reverse Voltage Breakdown = 50V DC Current Rating ≥ 30A



CH1: Pearson I Monitor(0.1V/1A) CH2: I Monitor CHA(0.5V/1A) CH3: I Monitor CHB(0.5V/1A) CH4: V Monitor(0.2V/V)

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Test 3 – Piecewise Waveform

Channel Parameters

CHA: Amplitude = 3 Amps
CHA: Width = 0.0003000 s
CHA: Delay = 0.0001000 s

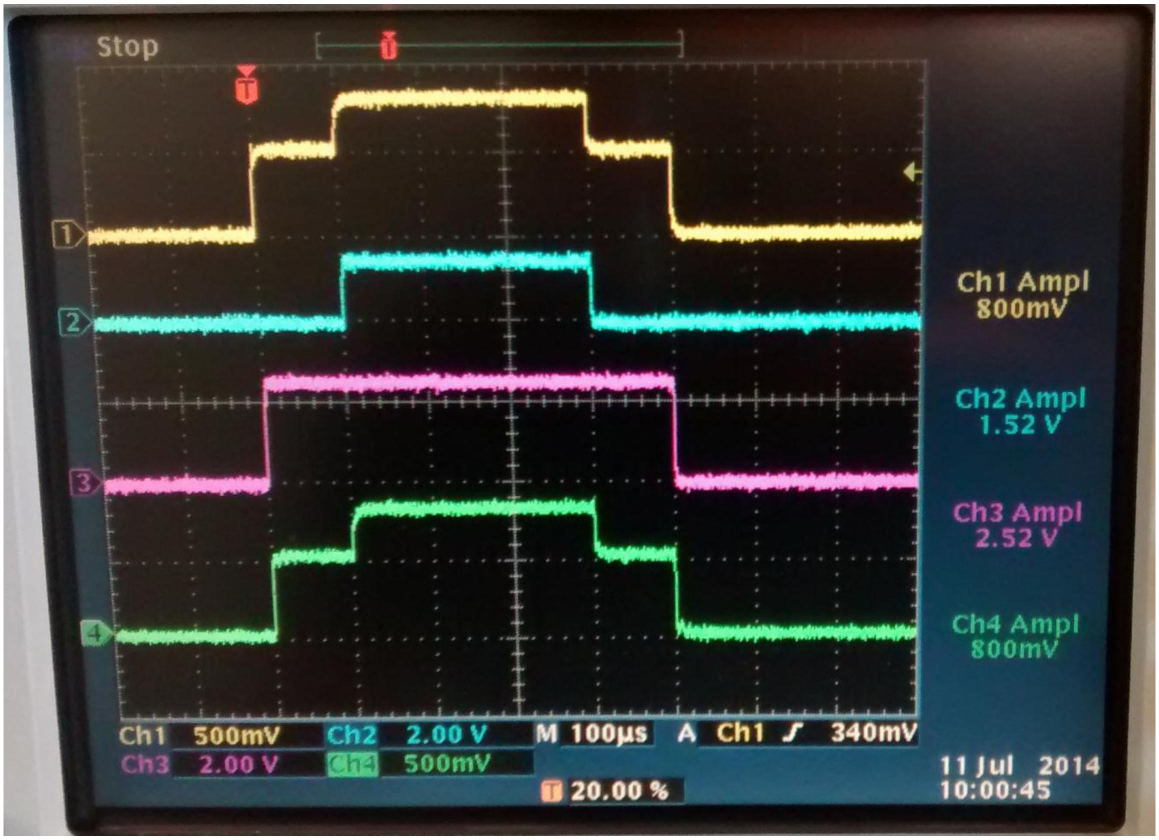
CHB: Amplitude = 5 Amps
CHB: Width = 0.0005000 s
CHB: Delay = 0 s

Load Parameters

Total Load Impedance = 0.75 Ω (includes cabling)

Diode Characteristics

Forward Voltage Drop ≤ 1V   Reverse Voltage Breakdown = 50V   DC Current Rating ≥ 30A



CH1: Pearson I Monitor(0.1V/1A) CH2: I Monitor CHA(0.5V/1A) CH3: I Monitor CHB(0.5V/1A) CH4: V Monitor(0.2V/V)

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