Keysight Technologies

N6700 Modular Power System: Determining Specifications when Paralleling Outputs

Application Note

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Introduction

The Keysight Technologies, Inc. N6700 is a small, flexible, and fast multipleoutput power supply. With 16 different DC power modules ranging from 5 V, 20 A to 100 V, 1 A, the N6700 offers a wide range of operating points at up to 100 W per output.

But there are applications where more than 100 W per output is needed. To address those needs, N6700 modules can be placed in parallel. By paralleling modules, you can achieve higher currents and higher wattage than from a single module. When paralleling modules, you should consider:

- Up to 4 outputs can be placed in parallel to achieve up to 400 W maximum.
- Module specifications will be impacted. In general, specifications related to voltage will be unchanged and specifications related to current will be multiplied by the number of modules in parallel. See section below “How are the specifications impacted by operation in parallel?”
- Wiring to the DUT needs to be properly configured. See section below “Wiring considerations when paralleling outputs”.
- All modules in parallel must be the same model number. Example: Four N6741B modules can be put in parallel to create a 5 V, 80 A, 400 W single output that fits in 1 U of rack space.
- All modules in parallel must have the same options installed. Example: Four N6752A modules with Option 054 High Speed Test Extensions can be placed in parallel to create a 50 V, 40 A, 400 W autoranging module with full LIST and digitizer capabilities.

Programming considerations when paralleling outputs

Traditionally, when using power supplies that have been connected in parallel, the burden of making the multiple power supplies behave like a single power supply has fallen on the programmer. For example, the user's program had to divide the required combined current among the outputs when programming the power supply output settings. When making current measurement, the user's program had to sum the current measurements to get the true current being delivered to the DUT. And when it comes to advanced features like over-voltage and over-current protection, triggering, and status monitoring, trying to write a control program that properly manages the paralleled modules can be very challenging.

In contrast to the traditional, complicated method of managing parallel outputs, the N6700 makes paralleling easy. To simplify programming when operating in parallel, the N6700 offers channel grouping, a firmware-based feature that allows the N6700 system to treat 2 to 4 channels as a virtual, single, synchronized channel with no extra programming on the part of the user. Any N6700 mainframe that has B.00.00 firmware or later installed can take advantage of the grouping feature. (The latest version of firmware is available as a free download at www.keysight.com/find/n6700firmware.) When using channel groups, the user is able to specify groups of paralleled outputs (between two and four modules per group) that will act like one channel. Using this feature, all commands are sent to only one channel, making programming the power supply much easier. Because the firmware in the mainframe manages the paralleling, all features behave as if you have one large module including:

- properly dividing programmed values between the paralleled outputs
- taking and summing measurements of voltage and current
- setting protection features
- monitoring status
- responding to trigger in and synchronizing trigger out
- operating the LIST mode and the Digitizer (available as part of the High Speed Test Extensions on the N6751A, N6752A High-Performance Autoranging DC Power Modules and the N6761A, N6762A Precision DC Power Modules)

Wiring considerations when paralleling outputs

Full information on how to configure the wiring between the parallel modules and your device under test is found in the document “N6700 User’s Guide” in the chapter on “Installation” in the section “Parallel Connections”. This document was provided with the N6700 or can be downloaded from the Internet at www.keysight.com/find/n6700

How are the specifications impacted by operation in parallel?

Paralleling outputs has a definite impact on some specifications, while it has no effect on others. The following pages provide a series of tables that show how paralleling outputs affects each specification for every type of N6700 module. For reference, the specifications for a single module are also provided so you can see how the specifications change from operating one module (not in parallel) versus two, three, or four modules (in parallel). The specifications that are impacted by paralleling are highlighted, while those specifications that remain unchanged (i.e., same value for one channel as for two, three, or four channels in parallel) are not highlighted.

To determine the specifications you will get when operating in parallel:

1. Identify the model number of the modules you will put in parallel
2. Identify the number of modules you will put in parallel (2, 3, or 4)
3. Find the table that covers the modules you will be using
4. Locate the column in the table that corresponds to the number of modules in parallel.
5. Read the parallel combination specification from the table

Specifications for Paralleled Outputs

N6751A/N6752A		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	50 V	50 V	50 V	50 V
	Current	5 A / 10 A	10 A / 20 A	15 A/ 30 A	20 A / 40 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	6 mV	6 mV	6 mV	6 mV
	CV rms	1 mV	1 mV	1 mV	1 mV
Load Effect	Voltage	2 mV	0.12% + 38 mV	0.12% + 38 mV	0.12% + 38 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	1 mV	0.12% + 38 mV	0.12% + 38 mV	0.12% + 38 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.06% + 19 mV	0.06% + 19 mV	0.06% + 19 mV	0.06% + 19 mV
	Current	0.1% + 20 mA	0.1% + 40 mA	0.1% + 60 mA	0.1% + 80 mA
Measurement Accuracy	Voltage	0.05% + 20 mV	0.05% + 20 mV	0.05% + 20 mV	0.05% + 20 mV
	Current	0.1% + 4 mA	0.1% + 8 mA	0.1% + 12 mA	0.1% + 16 mA
Load Transient Recovery Time	Voltage settling band	75 mV	75 mV	75 mV	75 mV
	Time	<100 µs	<200 µs	<300 µs	<400 µs

Specifications for Paralleled Outputs (continued)

N6761A/N6762A		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	50 V	50 V	50 V	50 V
	Current	1.5 A / 3 A	3 A / 6 A	4.5 A / 9 A	6 A / 12 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	6 mV	6 mV	6 mV	6 mV
	CV rms	1 mV	1 mV	1 mV	1 mV
Load Effect	Voltage	0.5 mV	0.032% + 12 mV	0.032% + 12 mV	0.032% + 12 mV
	Current (@0 – 7 V)	30 µA	60 µA	90 µA	120 µA
	Current (@0 – 50 V)	65 µA	130 µA	195 µA	260 µA
Source Effect	Voltage	0.5 mV	0.032% + 12 mV	0.032% + 12 mV	0.032% + 12 mV
	Current	30 µA	60 µA	90 µA	120 µA
Programming Accuracy	Voltage high range	0.016% + 6 mV	0.016% + 6 mV	0.016% + 6 mV	0.016% + 6 mV
	Voltage low range	0.016% + 1.5 mV	0.016% + 1.5 mV	0.016% + 1.5 mV	0.016% + 1.5 mV
	Current high range	0.04% + 200 µA	0.04% + 400 µA	0.04% + 600 µA	0.04% + 800 µA
	Current low range (@ 0-7 V)	0.03% + 15 µA	0.03% + 30 µA	0.03% + 45 µA	0.03% + 60 µA
	Current low range (@ 0-50 V)	0.04% + 55 µA	0.04% + 110 µA	0.04% + 165 µA	0.04% + 220 µA
Measurement Accuracy	Voltage high range	0.016% + 6 mV	0.016% + 6 mV	0.016% + 6 mV	0.016% + 6 mV
	Voltage low range	0.016% + 1.5 mV	0.016% + 1.5 mV	0.016% + 1.5 mV	0.016% + 1.5 mV
	Current high range	0.04% + 160 µA	0.04% + 320 µA	0.04% + 480 µA	0.04% + 540 µA
	Current low range (@ 0-7 V)	0.03% + 15 µA	0.03% + 30 µA	0.03% + 60 µA	0.03% + 80 µA
	Current low range (@ 0-50 V)	0.03% + 55 µA	0.03% + 110 µA	0.03% + 165 µA	0.03% + 220 µA
Load Transient Recovery Time	Voltage setting band	75 mV	75 mV	75 mV	75 mV
	Time	<100 µs	<200 µs	<300 µs	<400 µs

Specifications for Paralleled Outputs (continued)

N6731B/N6741B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	5 V	5 V	5 V	5 V
	Current	10 A / 20 A	20 A / 40 A	30 A / 60 A	40 A / 80 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	10 mV / 11 mV	10 mV / 11 mV	10 mV / 11 mV	10 mV / 11 mV
	CV rms	2 mV	2 mV	2 mV	2 mV
Load Effect	Voltage	5 mV	0.2% + 38 mV	0.2% + 38 mV	0.2% + 38 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	1 mV	0.2% + 38 mV	0.2% + 38 mV	0.2% + 38 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 19 mV	0.1% + 19 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Load Transient Recovery Time	Voltage settling band	80 mV / 0.1 V	80 mV / 0.1 V	80 mV / 0.1 V	80 mV / 0.1 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

N6732B/N6742B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	8 V	8 V	8 V	8 V
	Current	6.25 A / 12.5 A	12.5 A / 25 A	18.75 / 37.5 A	25 A / 50 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	12 mV	12 mV	12 mV	12 mV
	CV rms	2 mV	2 mV	2 mV	2 mV
Load Effect	Voltage	6 mV	0.2% + 38 mV	0.2% + 38 mV	0.2% + 38 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	2 mV	0.2% + 38 mV	0.2% + 38 mV	0.2% + 38 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 19 mV	0.1% + 19 mV	0.1% + 19 mV	0.1% + 19 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.15% + 10 mA	0.15% + 20 mA	0.15% + 30 mA	0.15% + 40 mA
Load Transient Recovery Time	Voltage settling band	80 mV / 0.1 V	80 mV / 0.1 V	80 mV / 0.1 V	80 mV / 0.1 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

Specifications for Paralleled Outputs (continued)

N6733B/N6743B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	20 V	20 V	20 V	20 V
	Current	2.5 A / 5A	5 A/ 10 A	7.5 A / 15 A	10 A / 20 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	14 mV	14 mV	14 mV	14 mV
	CV rms	3 mV	3 mV	3 mV	3 mV
Load Effect	Voltage	9 mV	0.2% + 40 mV	0.2% + 40 mV	0.2% + 40 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	2 mV	0.2% + 40 mV	0.2% + 40 mV	0.2% + 40 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.15% + 5 mA	0.15% + 10 mA	0.15% + 15 mA	0.15% + 20 mA
Load Transient Recovery Time	Voltage settling band	0.2 V / 0.3 V	0.2 V / 0.3 V	0.2 V / 0.3 V	0.2 V / 0.3 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

N6734B/N6744B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	35 V	35 V	35 V	35 V
	Current	1.5 A / 3 A	3 A / 6 A	4.5 A / 9 A	6 A / 12 A
	Power	52.5 W / 105 W	105 W / 210 W	157.5 W / 315 W	210 W / 420 W
Output Ripple and Noise (PARD)	CV peak-to-peak	15 mV	15 mV	15 mV	15 mV
	CV rms	5 mV	5 mV	5 mV	5 mV
Load Effect	Voltage	11 mV	0.2% + 70 mV	0.2% + 70 mV	0.2% + 70 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	4 mV	0.2% + 70 mV	0.2% + 70 mV	0.2% + 70 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 35 mV	0.1% + 35 mV	0.1% + 35 mV	0.1% + 35 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 35 mV	0.1% + 35 mV	0.1% + 35 mV	0.1% + 35 mV
	Current	0.15% + 4 mA	0.15% + 8 mA	0.15% + 12 mA	0.15% + 16 mA
Load Transient Recovery Time	Voltage settling band	0.2 V / 0.3 V	0.2 V / 0.3 V	0.2 V / 0.3 V	0.2 V / 0.3 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

Specifications for Paralleled Outputs (continued)

N6735B/N6745B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	60 V	60 V	60 V	60 V
	Current	0.8 A / 1.6 A	1.6 A / 3.2 A	2.4 A / 4.8 A	3.2 A / 5.4 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	25 mV	25 mV	25 mV	25 mV
	CV rms	9 mV	9 mV	9 mV	9 mV
Load Effect	Voltage	13 mV / 16 mV	0.2% + 120 mV	0.2% + 120 mV	0.2% + 120 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	6 mV	0.2% + 120 mV	0.2% + 120 mV	0.2% + 120 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 60 mV	0.1% + 60 mV	0.1% + 60 mV	0.1% + 60 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV	0.1% + 20 mV
	Current	0.15% + 4 mA	0.15% + 8 mA	0.15% + 12 mA	0.15% + 16 mA
Load Transient Recovery Time	Voltage settling band	0.4 V / 0.5 V	0.4 V / 0.5 V	0.4 V / 0.5 V	0.4 V / 0.5 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

N6736B/N6746B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
DC Output Ratings	Voltage	100 V	100 V	100 V	100 V
	Current	0.5 A / 1 A	1 A / 2 A	1.5 A / 3 A	2 A / 4 A
	Power	50 W / 100 W	100 W / 200 W	150 W / 300 W	200 W/ 400 W
Output Ripple and Noise (PARD)	CV peak-to-peak	30 mV	30 mV	30 mV	30 mV
	CV rms	18 mV	18 mV	18 mV	18 mV
Load Effect	Voltage	20 mV / 30 mV	0.2% + 200 mV	0.2% + 200 mV	0.2% + 200 mV
	Current	2 mA	4 mA	6 mA	8 mA
Source Effect	Voltage	10 mV	0.2% + 200 mV	0.2% + 200 mV	0.2% + 200 mV
	Current	1 mA	2 mA	3 mA	4 mA
Programming Accuracy	Voltage	0.1% + 100 mV	0.1% + 100 mV	0.1% + 100 mV	0.1% + 100 mV
	Current	0.15% + 20 mA	0.15% + 40 mA	0.15% + 60 mA	0.15% + 80 mA
Measurement Accuracy	Voltage	0.1% + 100 mV	0.1% + 100 mV	0.1% + 100 mV	0.1% + 100 mV
	Current	0.15% + 2 mA	0.15% + 4 mA	0.15% + 6 mA	0.15% + 12 mA
Load Transient Recovery Time	Voltage settling band	0.5 V / 1.0 V	0.5 V / 1.0 V	0.5 V / 1.0 V	0.5 V / 1.0 V
	Time	<200 µs	<400 µs	<600 µs	<800 µs

Specifications for Paralleled Outputs (continued)

N6751A/N6752A		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	20 mV - 51 V	20 mV - 51 V	20 mV - 51 V	20 mV - 51 V
	Current	10 mA - 5.1 A / 10 mA - 10.2 A	20 mA - 10.2 A / 20 mA - 20.4 A	30 mA - 15.3 A / 30 mA - 30.6 A	40 mA - 20.4 A / 40 mA - 40.8 A
Programming Resolution	Voltage	3.5 mV	3.5 mV	3.5 mV	3.5 mV
	Current	3.25 mA	3.25 mA	3.25 mA	3.25 mA
Measurement Resolution	Voltage	1.8 mV	1.8 mV	1.8 mV	1.8 mV
	Current	410 µA	820 µA	1230 µA	1640 µA
Programming Temperature Coefficient	Voltage	18 ppm + 160 uV	18 ppm + 160 uV	18 ppm + 160 uV	18 ppm + 160 uV
	Current	100 ppm + 45 µA	100 ppm + 90 µA	100 ppm + 135 µA	100 ppm + 180 µA
Measurement Temperature Coefficient	Voltage	25 ppm + 35 uV	25 ppm + 35 uV	25 ppm + 35 uV	25 ppm + 35 uV
	Current	60 ppm + 3 µA	60 ppm + 6 µA	60 ppm + 9 µA	60 ppm + 12 µA
Output Ripple and Noise (PARD)	CV peak-to-peak (typical)	4 mV	4 mV	4 mV	4 mV
	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	500 µA	1 mA	1.5 mA	2 mA
	peak-to-peak	<2 mA	<4 mA	<6 mA	<8 mA
Over – voltage Protection	Accuracy	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV
	Maximum setting	55 V	55 V	55 V	55 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming time with full resistive load	Voltage from 0 V to 10 V	0.2 ms	0.2 ms	0.2 ms	0.2 ms
	Voltage from 0 V to 50 V	1.5 ms	1.5 ms	1.5 ms	1.5 ms
Maximum up-programming settling time with full resistive load	Voltage from 0 V to 10 V	0.5 ms	0.5 ms	0.5 ms	0.5 ms
	Voltage from 0 V to 50 V	4.0 ms	4.0 ms	4.0 ms	4.0 ms
Maximum Down-programming Time with no load	Voltage from 10 V - 0 V	0.3 ms	0.3 ms	0.3 ms	0.3 ms
	Voltage from 50 V - 0 V	1.3 ms	1.3 ms	1.3 ms	1.3 ms
Maximum Down-programming Settling Time with no load	Voltage from 10 V - 0 V	0.45 ms	0.45 ms	0.45 ms	0.45 ms
	Voltage from 50 V - 0 V	1.4 ms	1.4 ms	1.4 ms	1.4 ms
Down-programming Time with 1000 uF load	Voltage from 10 V - 0 V	2.1 ms	2.1 ms	2.1 ms	2.1 ms
	Voltage from 50 V - 0 V	11 ms	11 ms	11 ms	11 ms
Down Programming Capability	Continuous power	7 W	14 W	21 W	28 W
	Peak current	7.0 A	14.0 A	21.0 A	28.0 A
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead
	Voltage, no load to full load	1 mV	0.12% + 38 mV	0.12% + 38 mV	0.12% + 38 mV
	Current, no load to full load	1 mA	2 mA	3 mA	4 mA

Specifications for Paralleled Outputs (continued)

N6761A/N6762A		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage high range	15 mV - 51 V	15 mV - 51 V	15 mV - 51 V	15 mV - 51 V
	Voltage low range	12 mV - 5.5 V	12 mV - 5.5 V	12 mV - 5.5 V	12 mV - 5.5 V
	Current high range	1 mA - 1.53 A / 1 mA - 3.06 A	2 mA - 3.06 A / 2 mA - 6.12 A	3 mA - 4.59 A / 3 mA - 9.18 A	4 mA - 6.12 A / 4 mA - 12.24 A
	Current low range	0.1 mA - 0.1 A	0.2 mA - 0.2 A	0.3 mA - 0.3 A	0.4 mA - 0.4 A
Programming Resolution	Voltage high range	880 uV	880 uV	880 uV	880 uV
	Voltage low range	90 uV	90 uV	90 uV	90 uV
	Current high range	60 µA	120µA	180 µA	240 µA
	Current low range	2 µA	4 µA	6 µA	8 µA
Measurement Resolution	Voltage high range	440 uV	440 uV	440 uV	440 uV
	Voltage low range	44 uV	44 uV	44 uV	44 uV
	Current high range	30 µA	60 µA	90 µA	120 µA
	Current low range	1 µA	2 µA	3 µA	4 µA
Programming Temperature Coefficient	Voltage high range	18 ppm + 140 uV	18 ppm + 140 uV	18 ppm + 140 uV	18 ppm + 140 uV
	Voltage low range	40 ppm + 70 uV	40 ppm + 70 uV	40 ppm + 70 uV	40 ppm + 70 uV
	Current high range	33 ppm + 10 µA	33 ppm + 20 µA	33 ppm + 30 µA	33 ppm + 40 µA
	Current low range	60 ppm + 1.5 µA	60 ppm + 3 µA	60 ppm + 4.5 µA	60 ppm + 6 µA
Measurement Temperature Coefficient	Voltage high range	23 ppm + 40 uv	23 ppm + 40 uv	23 ppm + 40 uv	23 ppm + 40 uv
	Voltage low range	30 ppm + 40 uV	30 ppm + 40 uV	30 ppm + 40 uV	30 ppm + 40 uV
	Current high range	40 ppm + 0.3 µA	40 ppm + 0.6 µA	40 ppm + 0.9 µA	40 ppm + 1.2 µA
	Current low range	50 ppm + 0.3 µA	50 ppm + 0.6 µA	50 ppm + 0.9 µA	50 ppm + 1.2 µA
Output Ripple and Noise (PARD)	CV peak-to-peak (typical)	4 mV	4 mV	4 mV	4 mV
	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	500 µA	1 mA	1.5 mA	2 mA
	peak-to-peak	<2 mA	<4 mA	<6 mA	<8 mA

Specifications for Paralleled Outputs (continued)

N6761A/N6762A (continued)		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Over – voltage Protection	Accuracy	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV
	Maximum setting	55 V	55 V	55 V	55 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming time with full resistive load	Voltage from 0 V to 10 V	0.2 ms	0.2 ms	0.2 ms	0.2 ms
	Voltage from 0 V to 50 V	1.5 ms	1.5 ms	1.5 ms	1.5 ms
Maximum Down-programming Time with no load	Voltage from 10 V - 0 V	0.3 ms	0.3 ms	0.3 ms	0.3 ms
	Voltage from 50 V - 0 V	1.3 ms	1.3 ms	1.3 ms	1.3 ms
Maximum Down-programming Settling Time with no load	Voltage from 10 V - 0 V	0.45 ms	0.45 ms	0.45 ms	0.45 ms
	Voltage from 50 V - 0 V	1.4 ms	1.4 ms	1.4 ms	1.4 ms
Down-programming Time with 1000 uF load	Voltage from 10 V - 0 V	4.5 ms	4.5 ms	4.5 ms	4.5 ms
	Voltage from 50 V - 0 V	23 ms	23 ms	23 ms	23 ms
Down Programming Capability	Continuous power	7 W	14 W	21 W	28 W
	Peak current	3.8 A	7.6 A	11.4 A	15.2 A
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead
Load Cross Regulation	Voltage, no load to full load	0.5 uV	0.032% + 12 mV	0.032% + 12 mV	0.032% + 12 mV
	Current, no load to full load	5 µA	10 µA	15 µA	20 µA

Specifications for Paralleled Outputs (continued)

N6731B/N6741B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	15 mV - 5.1 V	15 mV - 5.1 V	15 mV - 5.1 V	15 mV - 5.1 V
	Current	60 mA - 10.2 A / 60 mA - 20.4 A	120 mA - 20.4 A / 120 mA - 40.8 A	180 mA - 30.6 A / 180 mA - 61.2 A	240 mA - 40.8 A / 240 mA - 81.8 A
Programming Resolution	Voltage	3.5 mV	3.5 mV	3.5 mV	3.5 mV
	Current	7 mA	7 mA	7 mA	7 mA
Measurement Resolution	Voltage	3 mV	3 mV	3 mV	3 mV
	Current	10 mA	20 mA	30 mA	40 mA
Output Ripple and Noise (PARD)	CC rms	8 mA	16 mA	24 mA	32 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<15 mA	<30 mA	<45 mA	<60 mA
Over – voltage Protection	Accuracy	0.25% + 50 mV	0.25% + 50 mV	0.25% + 50 mV	0.25% + 50 mV
	Maximum setting	7.5 V	7.5 V	7.5 V	7.5 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

Specifications for Paralleled Outputs (continued)

N6732B/N6742B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	15 mV - 8.16 V	15 mV - 8.16 V	15 mV - 8.16 V	15 mV - 8.16 V
	Current	40 mA - 6.375 A / 40 mA - 12.75 A	80 mA - 12.75 A / 80 mA - 25.5 A	120 mA - 19.125 A / 120 mA - 38.25 A	160 mA - 25.5 A / 160 mA - 51 A
Programming Resolution	Voltage	4 mV	4 mV	4 mV	4 mV
	Current	4 mA	4 mA	4 mA	4 mA
Measurement Resolution	Voltage	4 mV	4 mV	4 mV	4 mV
	Current	7 mA	14 mA	21 mA	28 mA
Output Ripple and Noise (PARD)	CC rms	4 mA	8 mA	12 mA	16 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<10 mA	<20 mA	<30 mA	<40 mA
Over – voltage Protection	Accuracy	0.25% + 50 mV	0.25% + 50 mV	0.25% + 50 mV	0.25% + 50 mV
	Maximum setting	10 V	10 V	10 V	10 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

Specifications for Paralleled Outputs (continued)

N6733B/N6743B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	30 mV - 20.4 V	30 mV - 20.4 V	30 mV - 20.4 V	30 mV - 20.4 V
	Current	10 mA - 2.55 A / 10 mA - 5.1 A	20 mA - 5.1 A / 20 mA - 10.2 A	30 mA - 7.65 A / 30 mA - 15.3 A	40 mA - 10.2 A / 40 mA - 20.4 A
Programming Resolution	Voltage	7 mV	7 mV	7 mV	7 mV
	Current	3 mA	3 mA	3 mA	3 mA
Measurement Resolution	Voltage	10 mV	10 mV	10 mV	10 mV
	Current	3 mA	6 mA	9 mA	12 mA
Output Ripple and Noise (PARD)	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<10 mA	<20 mA	<30 mA	<40 mA
Over – voltage Protection	Accuracy	0.25% + 75 mV	0.25% + 75 mV	0.25% + 75 mV	0.25% + 75 mV
	Maximum setting	22 V	22 V	22 V	22 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

Specifications for Paralleled Outputs (continued)

N6734B/N6744B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	40 mV - 35.7 A	40 mV - 35.7 A	40 mV - 35.7 A	40 mV - 35.7 A
	Current	5 mA - 1.53 A / 5 mA - 3.06 A	10 mA - 3.06 A / 10 mA - 6.12 AA	15 mA - 4.59 A / 15 mA - 9.18 A	20 mA - 6.12 A / 20 mA - 12.24 A
Programming Resolution	Voltage	10 mV	10 mV	10 mV	10 mV
	Current	2 mA	2 mA	2 mA	2 mA
Measurement Resolution	Voltage	18 mV	18 mV	18 mV	18 mV
	Current	2 mA	4 mA	6 mA	8 mA
Output Ripple and Noise (PARD)	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<10 mA	<20 mA	<30 mA	<40 mA
Over – voltage Protection	Accuracy	0.25% + 100 mV	0.25% + 100 mV	0.25% + 100 mV	0.25% + 100 mV
	Maximum setting	38.5 V	38.5 V	38.5 V	38.5 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

Specifications for Paralleled Outputs (continued)

N6735B/N6745B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	70 mV - 61.2 V	70 mV - 61.2 V	70 mV - 61.2 V	70 mV - 61.2 V
	Current	2.5 mA - 0.85 A / 2.5 mA - 1.7 A	5 mA - 1.7 A / 5 mA - 3.4 A	7.5 mA - 2.55 A / 7.5 mA - 5.1 A	10 mA - 3.4 A / 10 mA - 6.8 A
Programming Resolution	Voltage	18 mV	18 mV	18 mV	18 mV
	Current	1 mA	1 mA	1 mA	1 mA
Measurement Resolution	Voltage	30 mV	30 mV	30 mV	30 mV
	Current	1 mA	2 mA	3 mA	4 mA
Output Ripple and Noise (PARD)	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<10 mA	<20 mA	<30 mA	<40 mA
Over – voltage Protection	Accuracy	0.25% + 200 mV	0.25% + 200 mV	0.25% + 200 mV	0.25% + 200 mV
	Maximum setting	66 V	66 V	66 V	66 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

Specifications for Paralleled Outputs (continued)

N6736B/N6746B		**1** **Data for** **1 module**	**2** **Data for** **2 modules** **in parallel**	**3** **Data for** **3 modules** **in parallel**	**4** **Data for** **4 modules** **in parallel**
Programming Ranges	Voltage	100 mV - 102 V	100 mV - 102 V	100 mV - 102 V	100 mV - 102 V
	Current	1.5 mA - 0.51 A / 1.5 mA - 1.02 A	3 mA - 1.02 A / 3 mA - 2.04 A	4.5 mA - 1.53 A / 4.5 mA - 3.06 A	6 mA - 2.04 A / 6 mA - 4.08 A
Programming Resolution	Voltage	28 mV	28 mV	28 mV	28 mV
	Current	0.5 mA	0.5 mA	0.5 mA	0.5 mA
Measurement Resolution	Voltage	50 mV	50 mV	50 mV	50 mV
	Current	0.5 mA	1 mA	1.5 mA	2 mA
Output Ripple and Noise (PARD)	CC rms	2 mA	4 mA	6 mA	8 mA
Common Mode Noise	rms	1 mA	2 mA	3 mA	4 mA
	peak-to-peak	<10 mA	<20 mA	<30 mA	<40 mA
Over – voltage Protection	Accuracy	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV	0.25% + 250 mV
	Maximum setting	110 V	110 V	110 V	110 V
	Response Time	50 µs	50 µs	50 µs	50 µs
Maximum up-programming and down-programming time with full resistive load	Voltage from 0 V to full	20 ms	20 ms	20 ms	20 ms
Maximum up-programming and down-programming settling time with full resistive load	Voltage from 0 V to full	100 ms	100 ms	100 ms	100 ms
Remote Sense Capability		1 V per lead	1 V per lead	1 V per lead	1 V per lead

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