# Agilent N6780 Series
# Source/Measure Units (SMUs)
# for the N6700 Modular Power System

Data Sheet

N6781A *2-Quadrant Source/Measure Unit for Battery Drain Analysis*

N6782A *2-Quadrant Source/Measure Unit for Functional Test*

N6784A *4-Quadrant General Purpose Source/Measure Unit*

14585A *Control and Analysis Software for the DC Power Analyzer*

*Agilent-exclusive feature provides productivity gains and insights into power consumption never seen before.*

*Now you can view the complete current waveform, from nA to A, in one pass and one picture.*

*Anticipate* ___*Accelerate* ___*Achieve*

## Agilent Technologies

# Advanced Measurement Features
# Offer More Design Insights

*The N6781A and N6782A 2-quadrant SMUs offer advanced sourcing and measurement capabilities required to overcome test challenges associated with optimizing power consumption and maximizing battery life of battery-powered devices and their components.*

*The N6784A 4-quadrant SMU offers advanced sourcing and measurement capabilities in all four quadrants. It is designed to be a versatile tool for general purpose applications.*

## N6781A, N6782A, and N6784A SMUs are designed for both R&D and Automated Test Environments (ATE)

The new SMUs are a part of the N6700 modular power system, which consists of the N6700 low-profile mainframes for ATE and the N6705 DC power analyzer mainframe for R&D. The product family has four mainframes and 25 DC power modules to choose from providing a complete spectrum of solutions, from R&D through design validation and manufacturing.

**Key features** *(apply to all models unless otherwise noted)*
- Seamless, dynamic measurements down to nA and μV (N6781A and N6782A only)
- Glitch-free operation – change sourcing ranges or measurement ranges without any glitches
- Four current programming ranges – precisely source current down to μA (N6784A only)
- Excellent transient response for stable output voltage with dynamic loads
- 2-quadrant operation – use as an advanced power supply or electronic load (N6781A and N6782A only)
- 4-quadrant operation – use as an advanced bipolar power supply or bipolar electronic load (N6784A only)
- Stable operation with capacitive loads up to 150 μF
- Fast modulation of DC output – create arbitrary waveforms up to 100 kHz (sine) into a resistive load
- High-speed digitized measurements – capture/view the power consumption of the DUT up to every 5 μs with built-in 200 kHz digitizer
- Auxiliary voltage measurement input for battery run down test (N6781A only)
- Programmable output resistance from -40 m $\Omega$ to +1 $\Omega$ to simulate internal resistance of a battery (N6781A only)

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## Agilent patented feature:  Seamless Dynamic Measurements (N6781A and N6782A)

Measuring static current accurately can be a challenge. Measuring dynamic currents from nA to A is an even greater challenge. Depending on the level of current, a different precision measurement resistor must be used, representing a measurement range in the power supply.

The N6781A and N6782A both have four current measurement ranges making them tuned to measure the different operating states of a device; 3 A, 100 mA, 1 mA, and 10 µA. In addition, the top three ranges (3 A, 100 mA, and 1 mA) support an Agilent exclusive feature called "seamless measurement ranging." When you enable this feature, as the current drawn by the device under test (DUT) changes, the SMU automatically and instantaneously detects which current measurement range will return the most precise measurement and changes to that range seamlessly. When combined with the SMU's built-in 18-bit digitizer, seamless measurement ranging enables unprecedented effective vertical resolution of ~28-bits. This provides unrivaled productivity gains and insights into power consumption by enabling you to see the complete current waveform you were not able to see before, from nA to A, in one pass and one picture.

The N6784A has the same four current measurement ranges, but does not support seamless measurement ranging.

## 14585A Control and Analysis Software

The software for the DC power analyzer compliments the front panel of the N6705 mainframe, offering advanced functionality and PC control. It is a flexible R&D tool for any application. It can control any of the N6700 family's 25 DC power modules when installed in a N6705 mainframe.  When used to control an N6781A SMU, it can be used for advanced battery drain analysis applications.

**Key features**
- Compliments the N6705 DC power analyzer's front panel controls.
- Control and analyze data from up to four N6705 DC power analyzer mainframes and any installed modules at once – that's up to 16 power supplies simultaneously.
- Easily create complex waveforms to stimulate or load down a DUT by inputting a formula, choosing from built-in, or importing waveform data.
- Enhanced control and analysis of data with familiar PC controls and large display.
- Data log measurements directly to a PC.
- Perform statistical analysis of power consumption.

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## Applications

- **N6781A SMU** is tuned for battery drain analysis of any and all battery-powered devices including e-Book readers, MP3 players, wireless mice, and mobile phones.
- **N6782A SMU** is tuned for functional tests of devices such as DC/DC converters, PMUs, PMICs, and power amplifiers.
- **N6784A SMU** is designed to be a versatile tool for general-purpose applications in automated test systems or on an R&D bench.
- **14585A software** compliments the N6781A SMU when used with the N6705 DC power analyzer by adding advanced battery drain functionality such as statistical analysis. However, it is also useful as a generic R&D power analysis tool since any of the 25 other N6700 Series DC power modules can be controlled by the software when installed in an N6705 mainframe.

# Advanced Sourcing and Measurement Capabilities

## N6781A SMU is tuned for battery drain analysis

Unlike any other product available today, the N6781A offers the features neces-
sary to accurately capture the power consumption of portable, battery-powered
devices. When used with the new Agilent 14585A software, the N6781A
becomes an even more powerful battery drain analysis solution offering even
further insights into your measurements. Whether the DUT is an e-Book reader,
MP3 player, mobile phone, or pacemaker, the N6781A's seamless measurement
ranging, programmable output resistance, and auxiliary DVM combine to be the
best set of advanced features on the market for battery drain analysis.

**Key features**

- Seamless measurement ranging allows the N6781A to capture the
  dynamic current demands of modern battery-powered devices.
- Programmable output resistance enables the N6781A to more accurately
  emulate the internal resistance of a battery.
- For battery rundown test, the N6781A can be used in ammeter mode and
  becomes a zero-burden current measurement shunt. During this mode of
  operation, the built-in auxiliary voltage measurement system enables monitor-
  ing of the battery's voltage to perform real-world battery rundown tests.
- When used with the new 14585A software, the N6781A becomes an even
  more powerful battery drain analysis solution, providing the ability to do
  complementary cumulative distribution function (CCDF) statistical analysis.

## N6782A SMU is ideal for advanced functional test

The ability to modulate the output up to 100 kHz along with 2-quadrant opera-
tion makes the N6782A a perfect fit for advanced functional test of a variety of
devices such as DC/DC converters, power management units, power amplifiers,
and power management ICs (PMICs).

**Key features**

- Using the advanced arbitrary waveform generation feature, the input stage of
  the DUT can be stimulated with fast sourcing and waveforms up to 100 kHz.
- The output stage can be loaded down and measured with the electronic load
  capabilities of the N6782A, providing a total test solution.

## N6784A SMU is the ideal general-purpose tool

General-purpose applications can span many different industries and many different devices under test. The N6784A SMU's glitch-free operation ensures safe usage with the DUT during output and measurement range changes, even with capacitances of up to 150 μF. This enables use with a wide variety of DUTs. Its 4-quadrant operation enables it to act as a bipolar power supply or a bipolar electronic load, for added versatility.

**Key features**
- Glitch-free operation ensures that during programmed output or measurement ranges changes, the N6784A's output voltage and current remain steady and the DUT remains damage-free.
- Four current programming ranges (3 A, 300 mA, 100 mA, and 10 mA) enables the N6784A to be a precise current source or electronic load down to μA.

## Emulation modes to enhance usability

The N6781A, N6782A, and N6784A SMUs each have user-selectable emulation modes to improve usability and productivity by instantly configuring the SMU for the most common use cases. When one of the emulation modes is selected, the SMU optimizes all of its features and settings for that particular use case.

**Emulation modes**
- 4-quadrant power supply (N6784A only)
- 2-quadrant power supply
- Unipolar power supply (i.e. 1-quadrant)
- CC load
- CV load
- Voltage measure (i.e. voltmeter mode)
- Current measure (i.e. ammeter mode)
- Battery emulator (N6781A only)
- Battery charger (N6781A only)

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# N6781A/82A/84A Performance Specifications

*This is an abbreviated list of specifications and characteristics. For the full list of specifications and characteristics, please see Chapter 4 in the Agilent N6700 Series Power Modules Specifications Guide, literature number N6700-90001.*

|  | N6781A | N6782A | N6784A |
|---|---|---|---|
| **DC output ratings:** | | | |
| Voltage | + 20 V | + 20 V | ± 20 V |
| Current (derated 1% per °C above 30°C) | ± 3 A | ± 3 A | ± 3 A |
| Power | 20 W | 20 W | 20 W |
| **Output voltage ripple & noise (PARD):** (from 20 Hz – 20 MHz, at full load) | | | |
| CV peak-to-peak | 12 mV | 12 mV | 12 mV |
| CV rms | 1.2 mV | 1.2 mV | 1.2 mV |
| **Load effect (load regulation):** (For any load change, based on a load lead drop 1.0 V. The load lead drop reduces the maximum available voltage at the load.) | | | |
| Voltage, 20 V, 6 V ranges | 700 µV, 400 µV | 700 µV, 400 µV | 700 µV, 400 µV |
| Current, 3 A, 1 A ranges | 100 µA, 50 µA | 100 µA, 50 µA | 100 µA, 50 µA |
| **Source effect (line regulation):** | | | |
| Voltage | 300 µV | 300 µV | 300 µV |
| Current | 60 µA | 60 µA | 60 µA |
| **Programming accuracy:** (At 23 °C ±5 °C after 30 min. warm-up. Applies from minimum to maximum programming range at any load.) | | | |
| Voltage, 20 V range | 0.025% + 1.8 mV | 0.025% + 1.8 mV | 0.025% + 1.8 mV |
| Voltage, 6 V range | 0.025% + 600 µV | 0.025% + 600 µV | 0.025% + 600 µV |
| Voltage, 600 mV range | 0.025% + 200 µV | 0.025% + 200 µV | 0.025% + 200 µV |
| Current, 3 A & 1 A range | 0.04% + 300 µA | 0.04% + 300 µA | 0.04% + 300 µA |
| Current, 300 mA range | 0.03% + 150 µA | 0.03% + 150 µA | N/A |
| Current, 100 mA range | N/A | N/A | 0.03% + 12 µA |
| Current, 10 mA range | N/A | N/A | 0.025% + 5 µA |
| Resistance (in 20 V output range) | 0.1% + 3 mΩ | N/A | N/A |
| Resistance (in 6 V output range) | 0.1% + 1.5 mΩ | N/A | N/A |
| **Measurement accuracy:** (at 23 °C ±5 °C) | | | |
| Voltage, 20 V range | 0.025% + 1.2 mV | 0.025% + 1.2 mV | 0.025% + 1.2 mV |
| Voltage, 1 V range | 0.025% + 75 µV | 0.025% + 75 µV | 0.025% + 75 µV |
| Voltage, 100 mV range | 0.025% + 50 µV | 0.025% + 50 µV | 0.025% + 50 µV |
| Current, 3 A range | 0.03% + 250 µA | 0.03% + 250 µA | 0.03% + 250 µA |
| Current, 100 mA range | 0.025% + 10 µA | 0.025% + 10 µA | 0.025% + 10 µA |
| Current, 1 mA range | 0.025% + 100 nA | 0.025% + 100 nA | 0.025% + 100 nA |
| Current, 10 µA range | 0.025% + 8 nA | 0.025% + 8 nA | 0.025% + 8 nA |
| **Load transient response time – voltage priority:** | | | |
| In the 20 V output range: the time to recover to within the settling band for a load change from 0.1 A to 0.5 A. | | | |
| In the 6 V output range: the time to recover to within the settling band for a load change from 0.1 A to 1.5 A. | | | |
| Voltage settling band (20 V output range) | ± 10 mV | ± 10 mV | ± 10 mV |
| Voltage settling band (6 V output range) | ± 20 mV | ± 20 mV | ± 20 mV |
| Recovery time | ≤ 35 µs | ≤ 35 µs | ≤ 35 µs |

# Supplemental Characteristics *(continued)*

**Output Quadrant Characteristic**
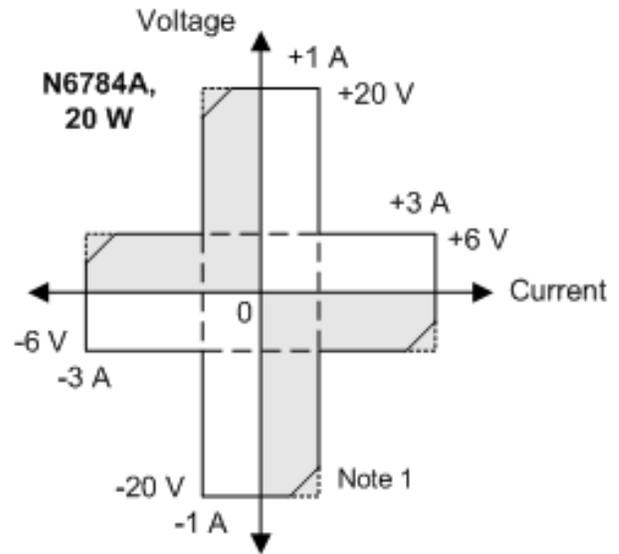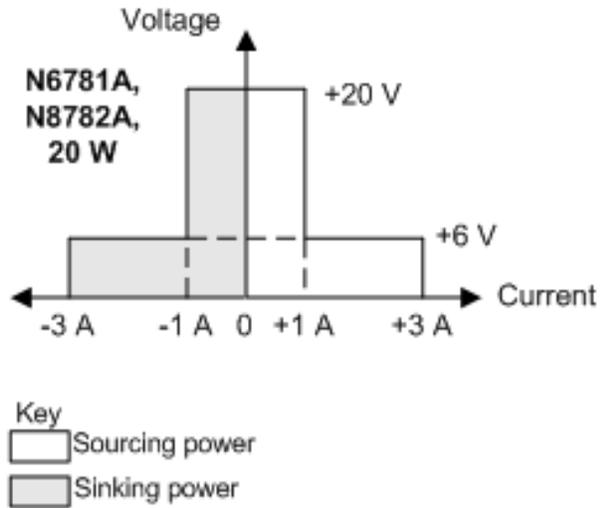




**Note 1**. When sinking power, the N6784A model can operate at the maximum rated output power for only a limited amount of time. The unit monitors the temperature of the internal power devices and latches the output off if the output power has exceeded its safe limits. A protect clear is required to resume normal operation. The condition is annunciated by the OT status bit. Refer to the downprogrammer derating figure for the values of the safe limit boundaries.
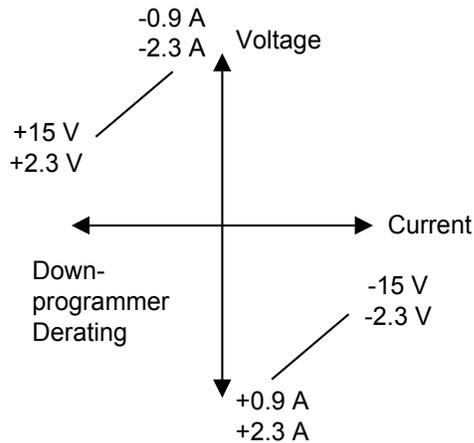
**N6781A SMU auxiliary measurement input**

| Specifications | |
|---|---|
| Measurement input rating: | ± 20 V |
| Measurement accuracy: (at 23 °C ±5 °C) | 0.025% + 5 mV |
| **Characteristics:** | |
| Measurement resolution | 800 µV |
| Temperature coefficient per °C: | 0.0007% + 200 µV |
| Differential input resistance | 10 M Ω |
| Maximum continuous differential input without damage | ± 60 V |
| Maximum voltage from chassis common | ± 240 Vdc |

*Unless otherwise noted, specifications are warranted over the ambient temperature range of 0 to 55°C after a 30-minute warm-up period. Unless otherwise noted, specifications apply at the mainframe output terminals, with each module´s sense terminals internally connected to its output terminals (local sensing).*

*For the setup conditions and all output specifications refer to the Agilent N6705 Service Guide (literature number N6705-90010).*

*Supplemental characteristics are not warranted but are descriptions of performance determined either by design or by type testing. All supplemental characteristics are typical unless otherwise noted.*

## Ordering information

| Model Number | Description |
|---|---|
| N6781A | 2-Quadrant Source/Measure Unit for Battery Drain Analysis |
| N6782A | 2-Quadrant Source/Measure Unit for Functional Test |
| N6784A | 4-Quadrant General Purpose Source/Measure Unit |
| N6705B-056 | Software License to Control N6705A/B with 14585A Control and Analysis Software (Option to the N6705B when ordered new) |
| N6705U-056 | Upgrade an N6705A/B DC Power Analyzer with 14585A Software License |

## Web resources

Visit our web sites for additional product information and literature.

**N6780 Series SMUs**
www.agilent.com/find/N6781
www.agilent.com/find/N6782
www.agilent.com/find/N6784

**14585A Control and Analysis Software**
www.agilent.com/find/14585

**N6705B DC Power Analyzer**
www.agilent.com/find/n6705

**N6700 Modular Power System**
www.agilent.com/find/N6700

## Related literature

*Agilent DC Power Analyzer Product Overview*, literature number 5989-6319EN
*Agilent N6705 DC Power Analyzer User's Guide*, literature number N6705-90001
*Agilent N6705 DC Power Analyzer Service Guide*, literature number N6705-90010
*Agilent N6700 MPS Low-Profile Modular Power System Product Overview,* literature number 5989-1411EN
*Agilent N6700 Series Power Modules Specifications Guide*, literature number N6700-90001.