Voltage Regulation and Noise Plots as Measured on some Power Supplies and AC adapters
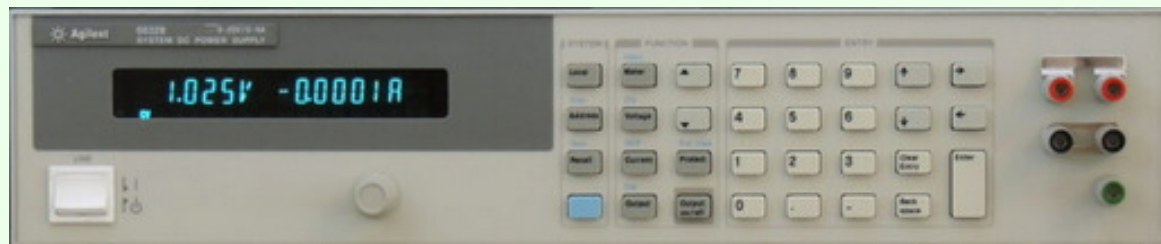
Using HP6632B and Fluke 8920A

Jacques Audet
VE2AZX
Dec. 2023

SUMMARY

- 50 points were generally used for I – V tests

- The measured negative output resistance (~ 0.1 Ω max.), does not seem to create instability.

- The HP6632B output voltage is set at 0 V while the current is varied.

- The HP6632B current settings must be offset in the sink mode: -13 mA

- All AC adapters measured behave differently.

- Measured voltage regulation, between the start and stop points, varied between -1.5% to 6% approx.
  The (-) sign indicates negative output resistance.

- Only the IBM adapter used a foldback regulator.

- The average resistance is measured between the start and stop points.
  It includes the resistance of the test cable and the unit cable if any.

- The Fluke 8920A voltmeter does NOT come with a data interface.
  My unit has a custom serial interface that measures the DC output voltage and detects the range being used.
  The design was done by Bertrand and myself. See YouTube, Electro-bidouilleur:
  EB_#368 Projet - Interface PC pour Voltmètre CA Fluke 8920A, Partie 1

- Noise is measured in 1 MHz bandwidth using an RC filter at the voltmeter input.
  The system residual noise measured between 230 to 240 uV @ 1 MHz BW

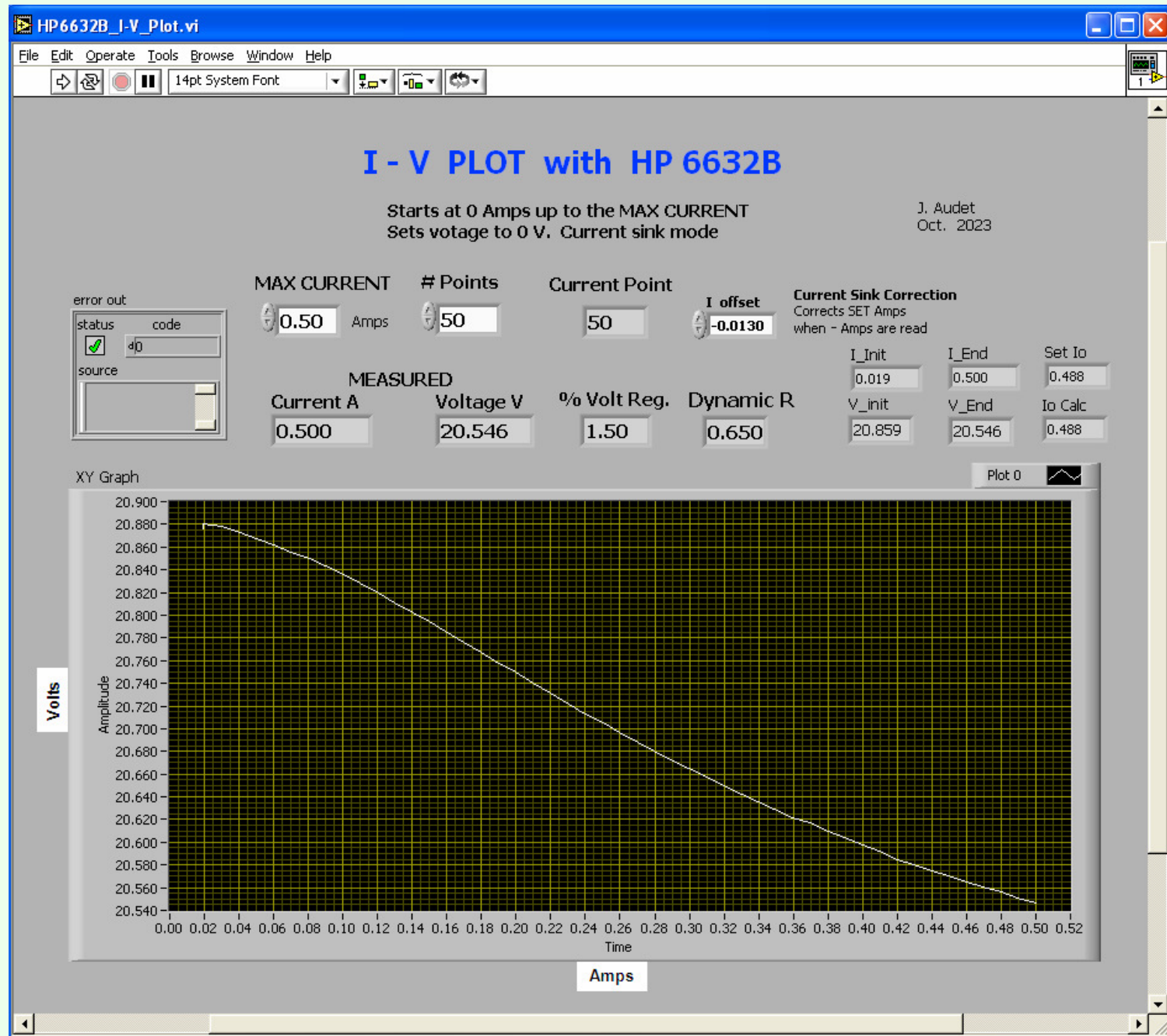18V battery #1
Used on my
portable drill.
After full
recharge

Average R is
calculated between
the first and last
I – V points:

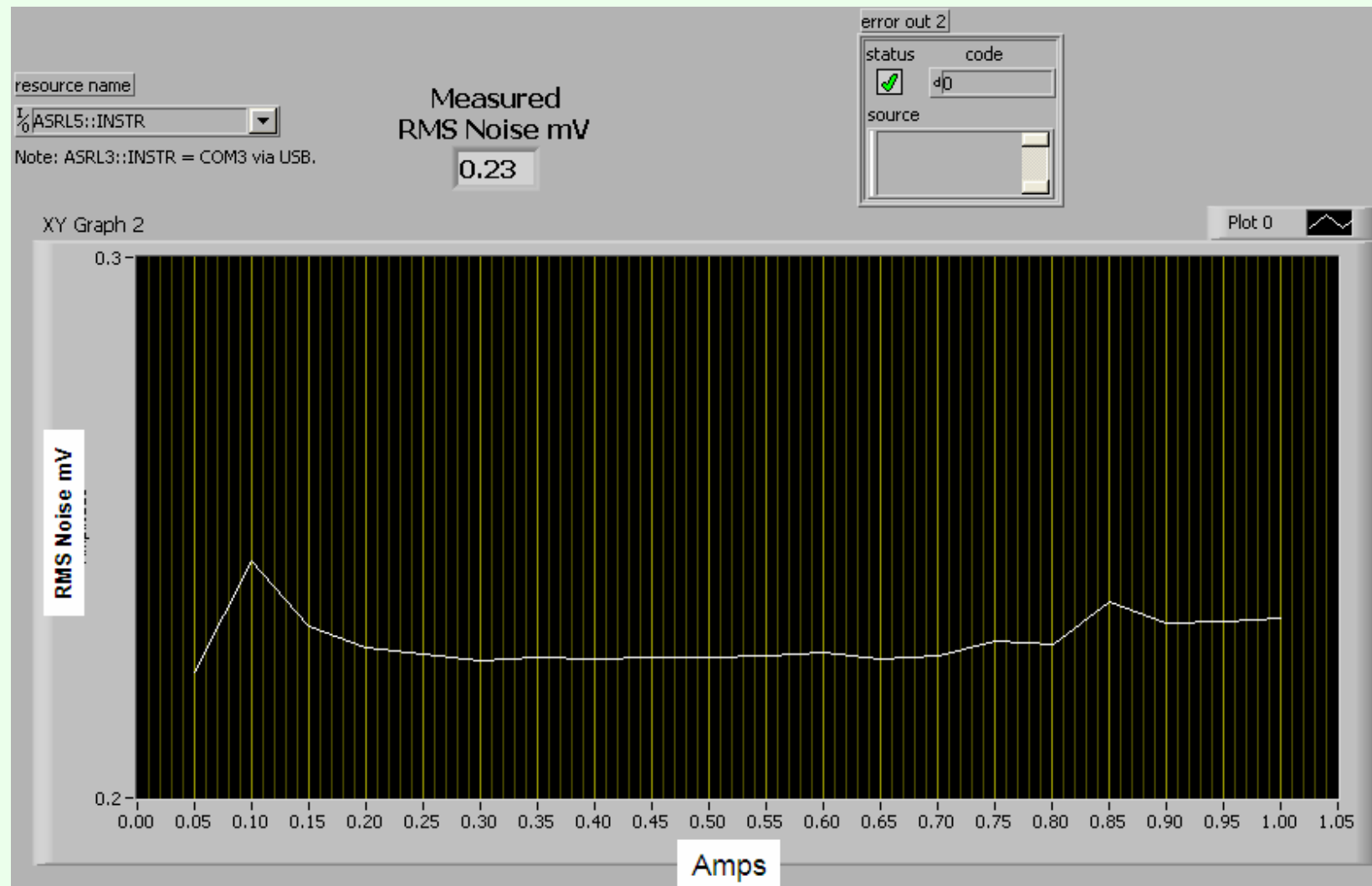$$\frac{V\_Init - V\_End}{I\_end - I\_Init}$$
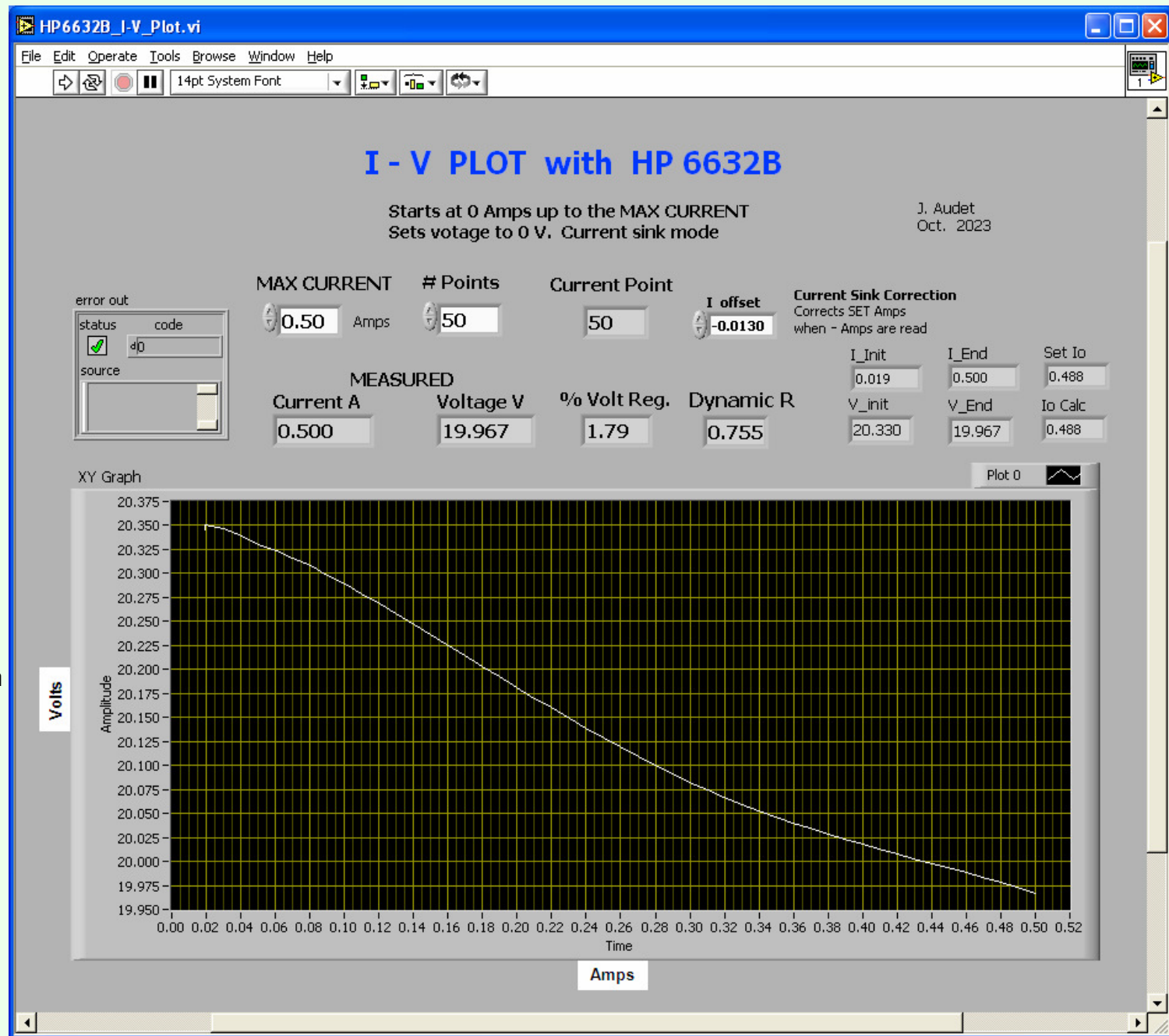
18V battery #2
Used on my
portable drill.
After full
recharge

Residual Noise Test of HP6632B using Battery #2

Noise measured between 230 to 240 uV @ 1 MHz BW

HP E3610A Power Supply Regulation
This is a linear power supply
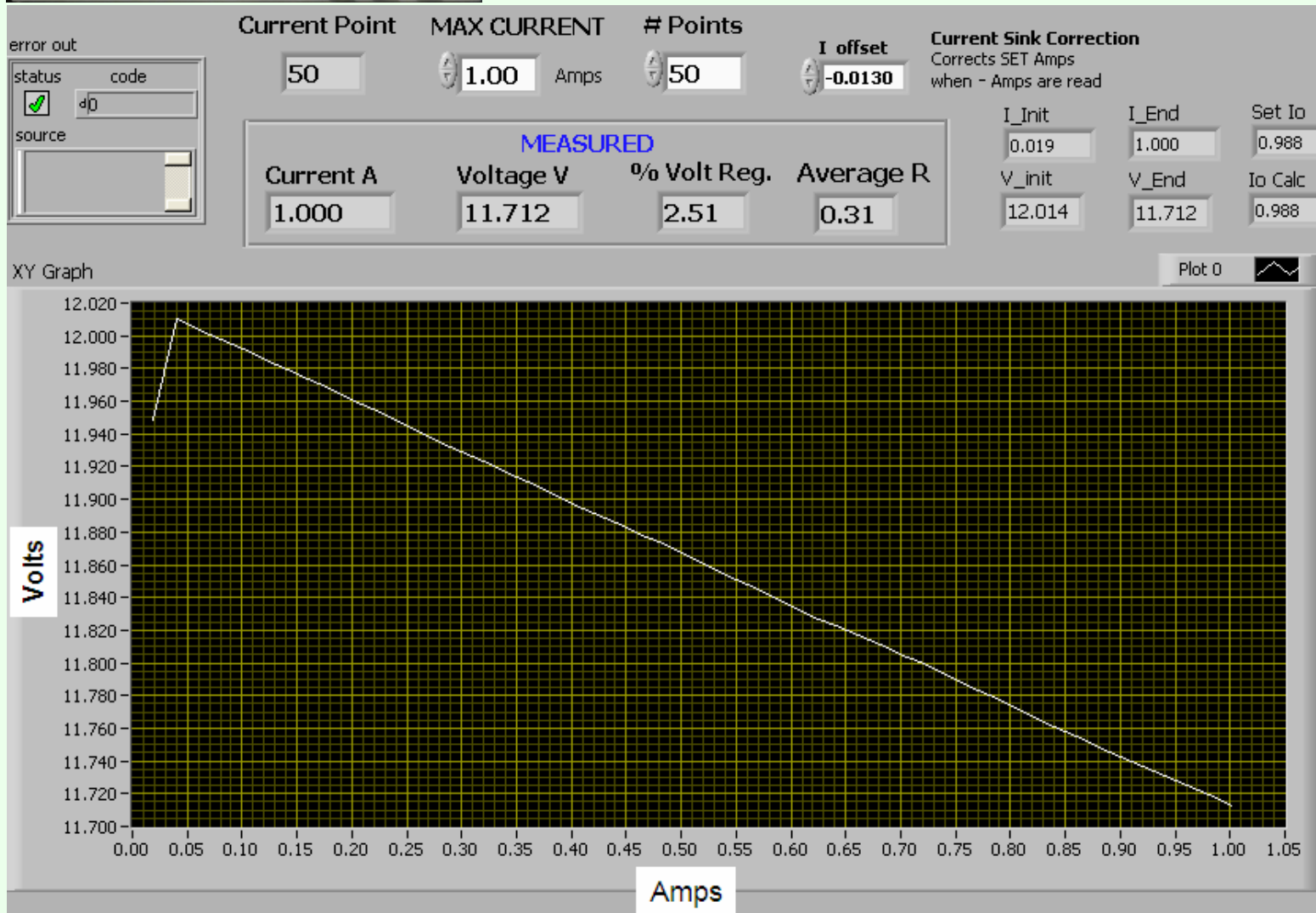
HP E3610A Power Supply Noise

Noise is measured in a 1 MHz BW using an R-C filter

error out 2

status   code
✓   d0

source

resource name
I/o ASRL5::INSTR

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV
0.31

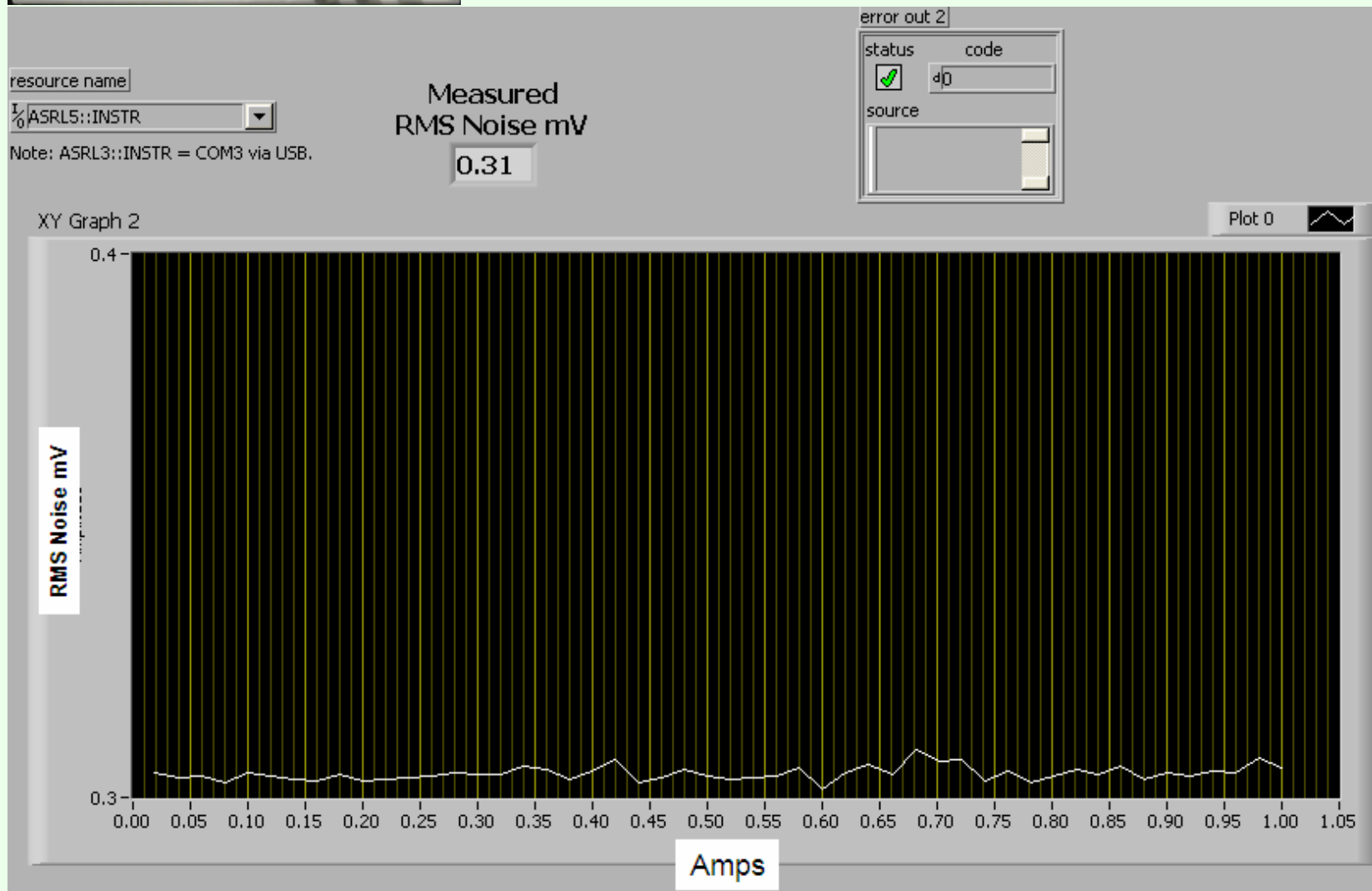XY Graph 2   Plot 0

Amps

HP 6205B Power Supply Regulation
This is a linear power supply

error out

status   code
✔   d0

source

Current Point
50

MAX CURRENT
0.30   Amps

Points
50

I offset
-0.0130

Current Sink Correction
Corrects SET Amps
when – Amps are read

MEASURED

Current A	Voltage V	% Volt Reg.	Average R
0.300	14.872	0.50	0.27

I_Init	I_End	Set Io
0.019	0.300	0.287

V_init	V_End	Io Calc
14.948	14.872	0.287

XY Graph

Plot 0
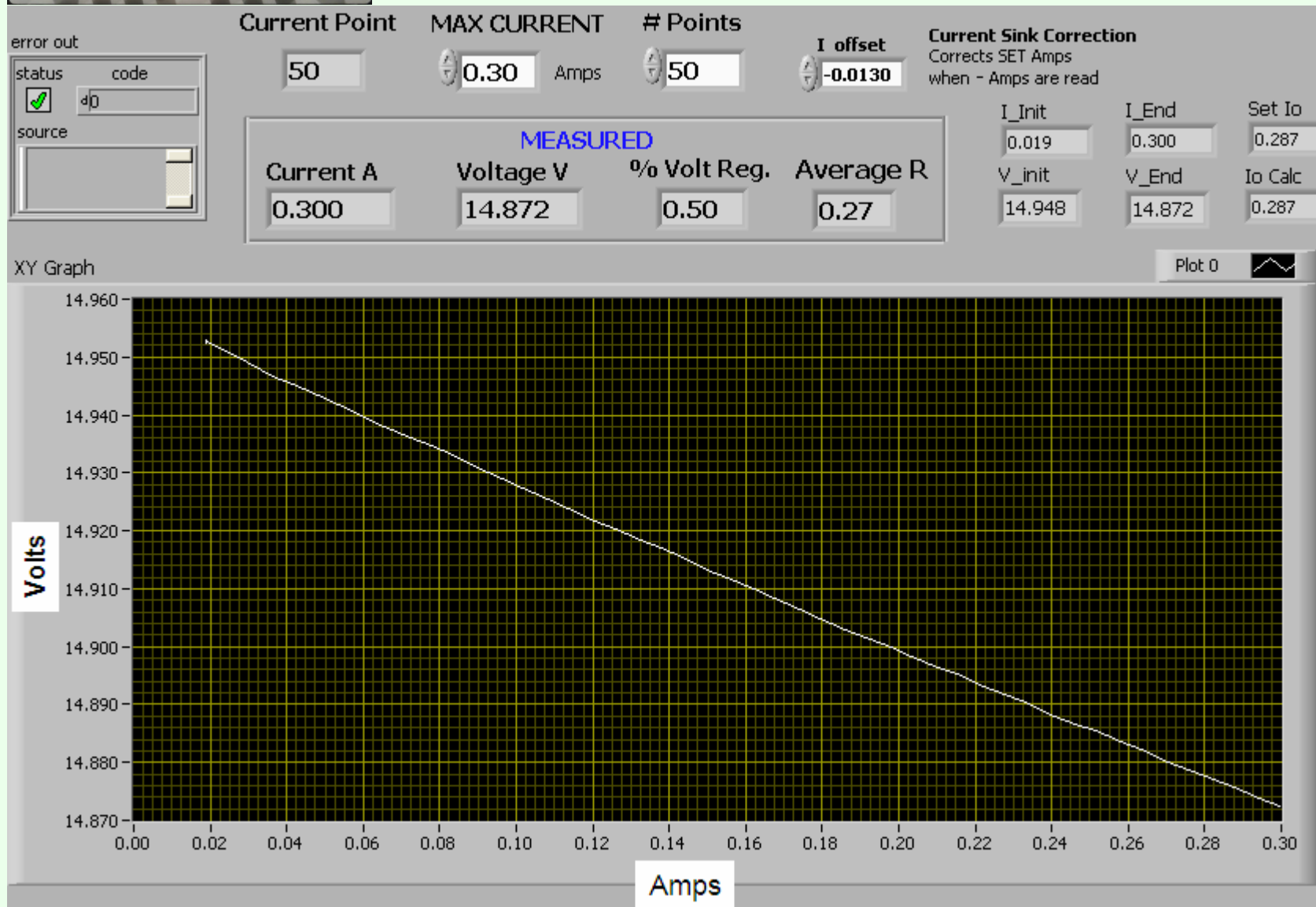
HP 6205B Power Supply Noise

Noise is measured in a 1 MHz BW using an R-C filter

MFJ-4125 13.7V / 25A Switching Supply

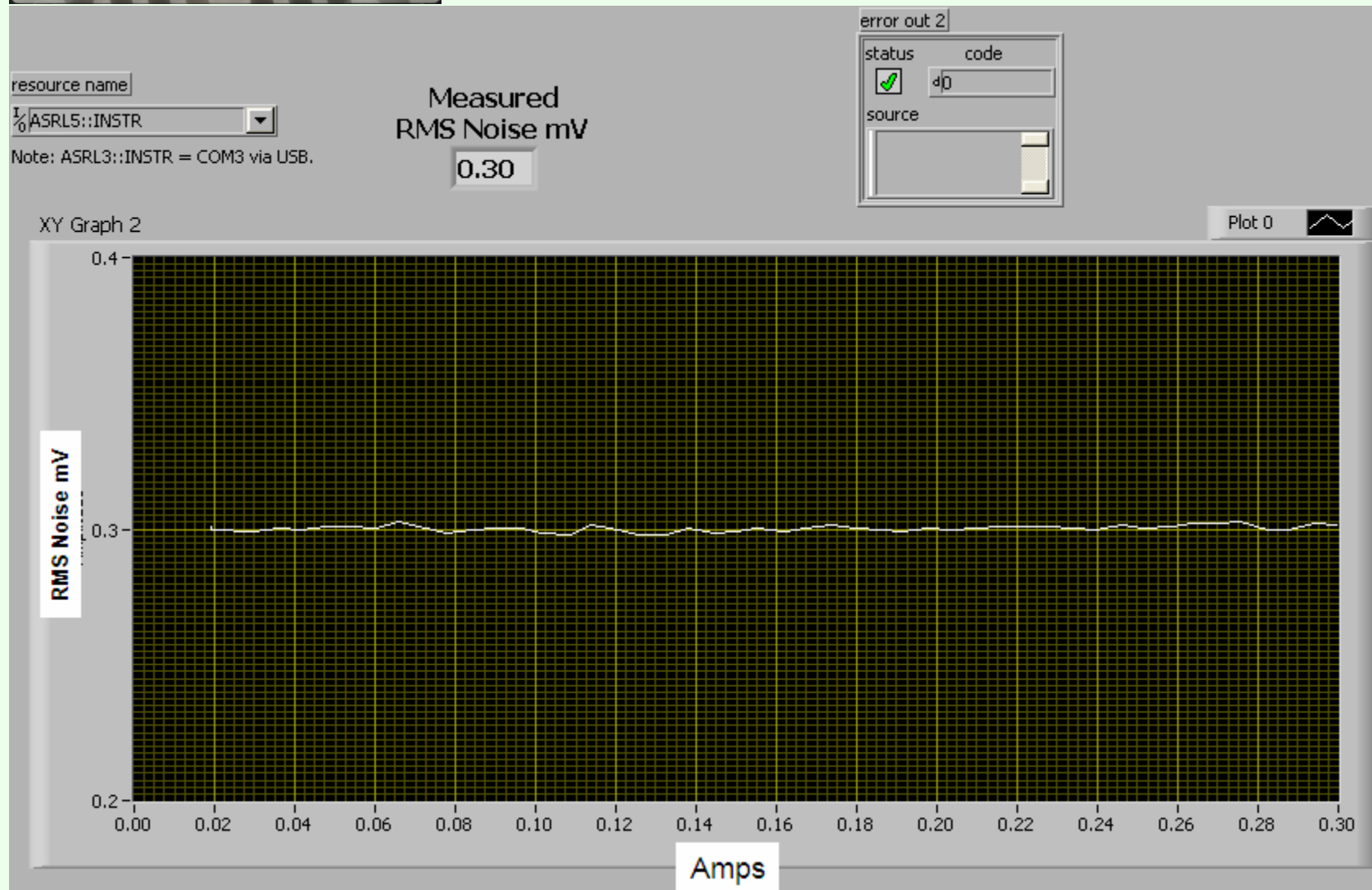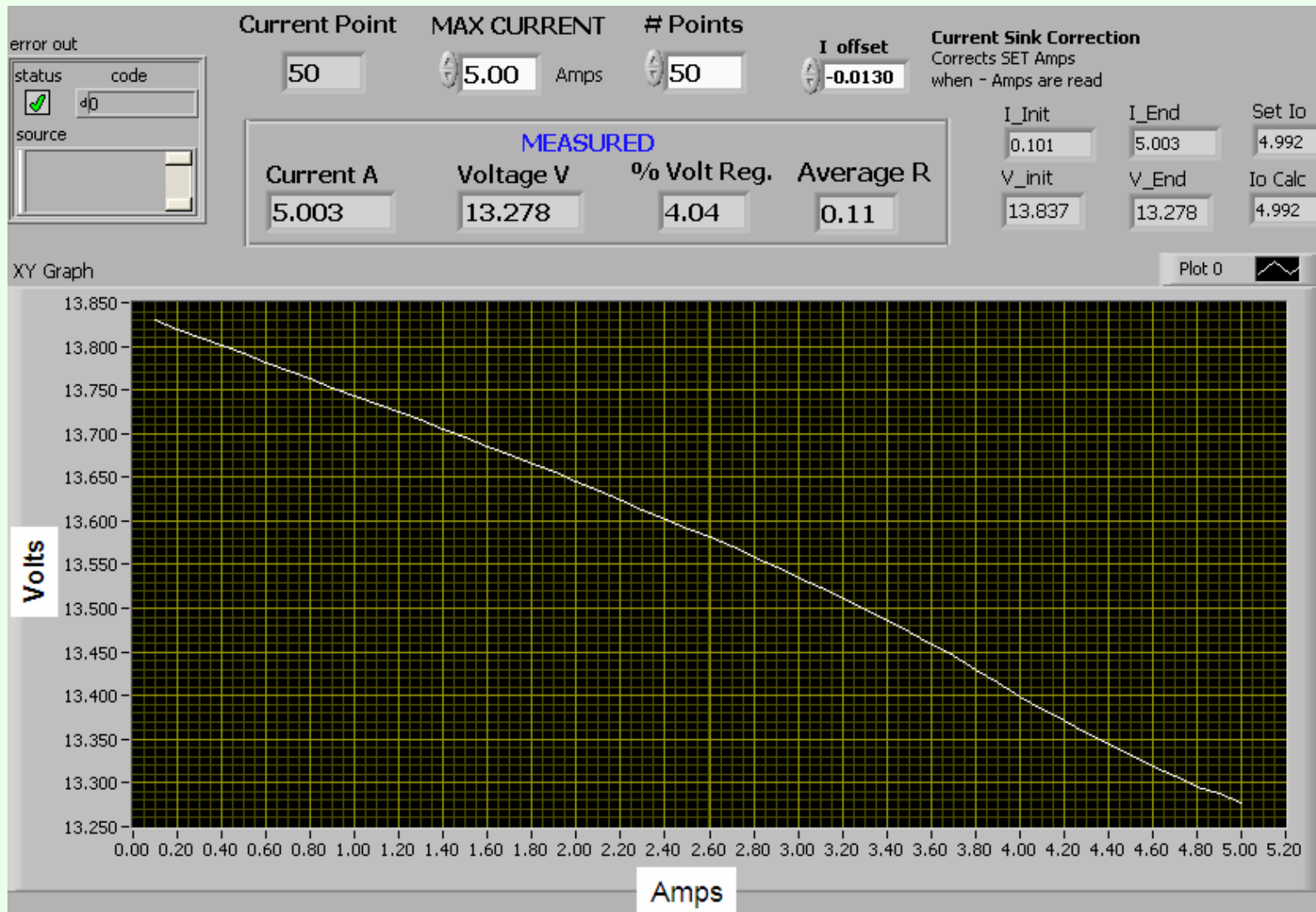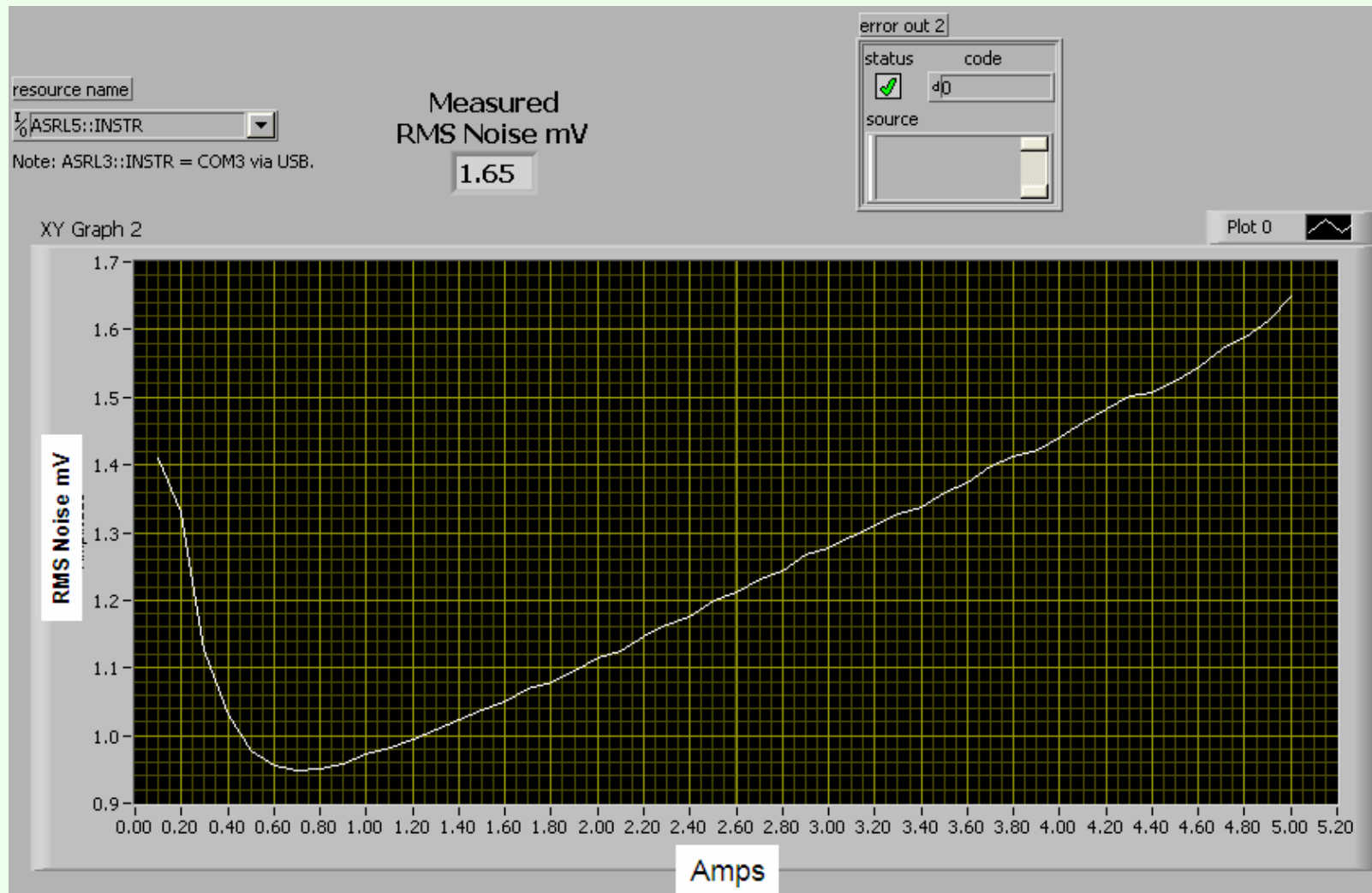| error out		Current Point	MAX CURRENT	# Points		I offset	Current Sink Correction

status | code
50 | 5.00 Amps | 50 | -0.0130 | Corrects SET Amps when – Amps are read

| | | | | | I_Init | I_End | Set Io |
| | | | | | 0.101 | 5.003 | 4.992 |

source

MEASURED

Current A	Voltage V	% Volt Reg.	Average R	V_init	V_End	Io Calc
5.003	13.278	4.04	0.11	13.837	13.278	4.992

XY Graph   Plot 0

(graph: Volts vs Amps, line decreasing from ~13.837 V at 0 A to ~13.278 V at ~5.00 A)

MFJ-4125 13.7V / 25A Switching Supply

IBM
AC to DC Adapter

16V / 3.36A

This one has a current limiting regulator that triggers at 3.43A
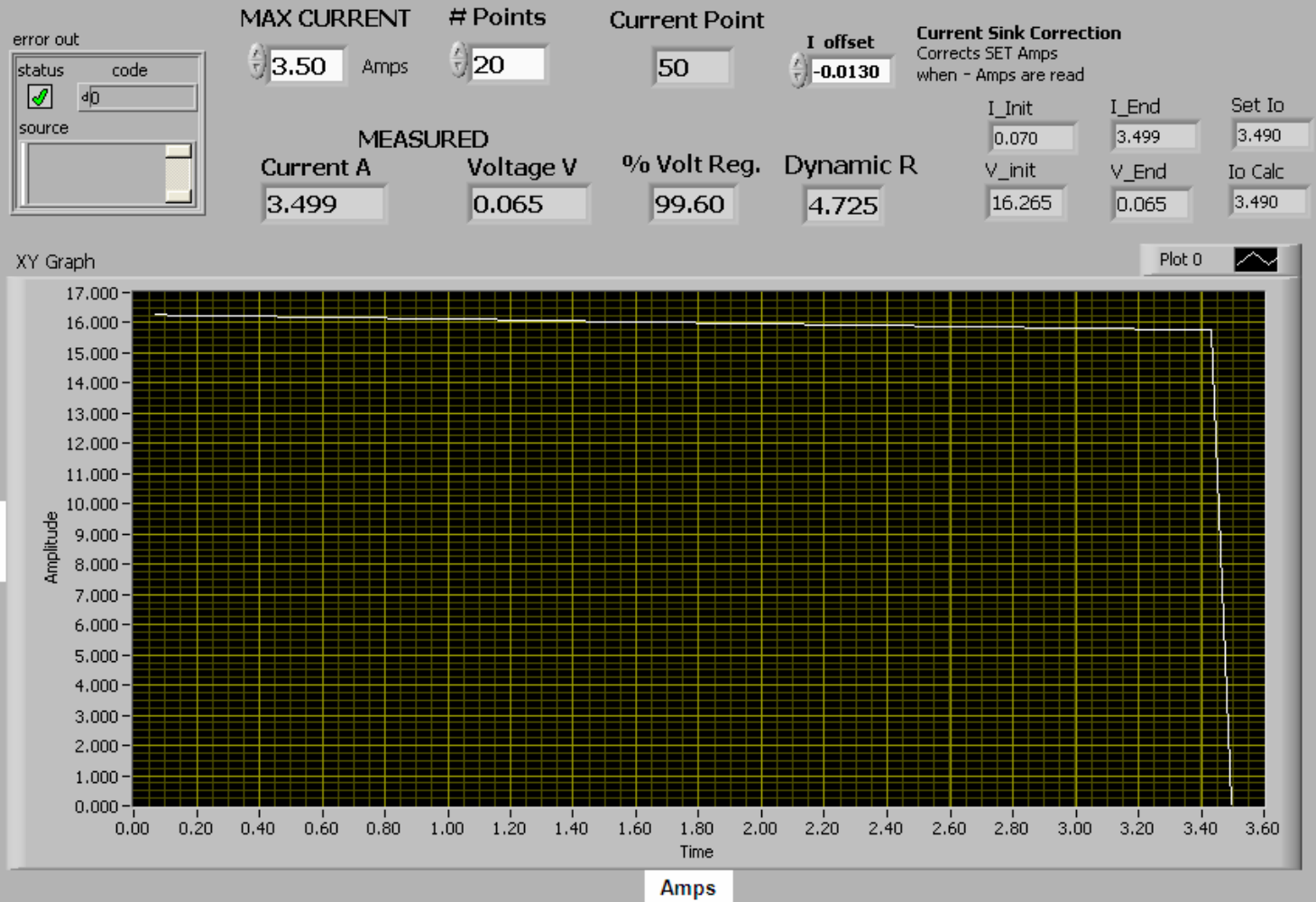
Noise is measured in a 1 MHz BW using an R-C filter

Last noise measurement
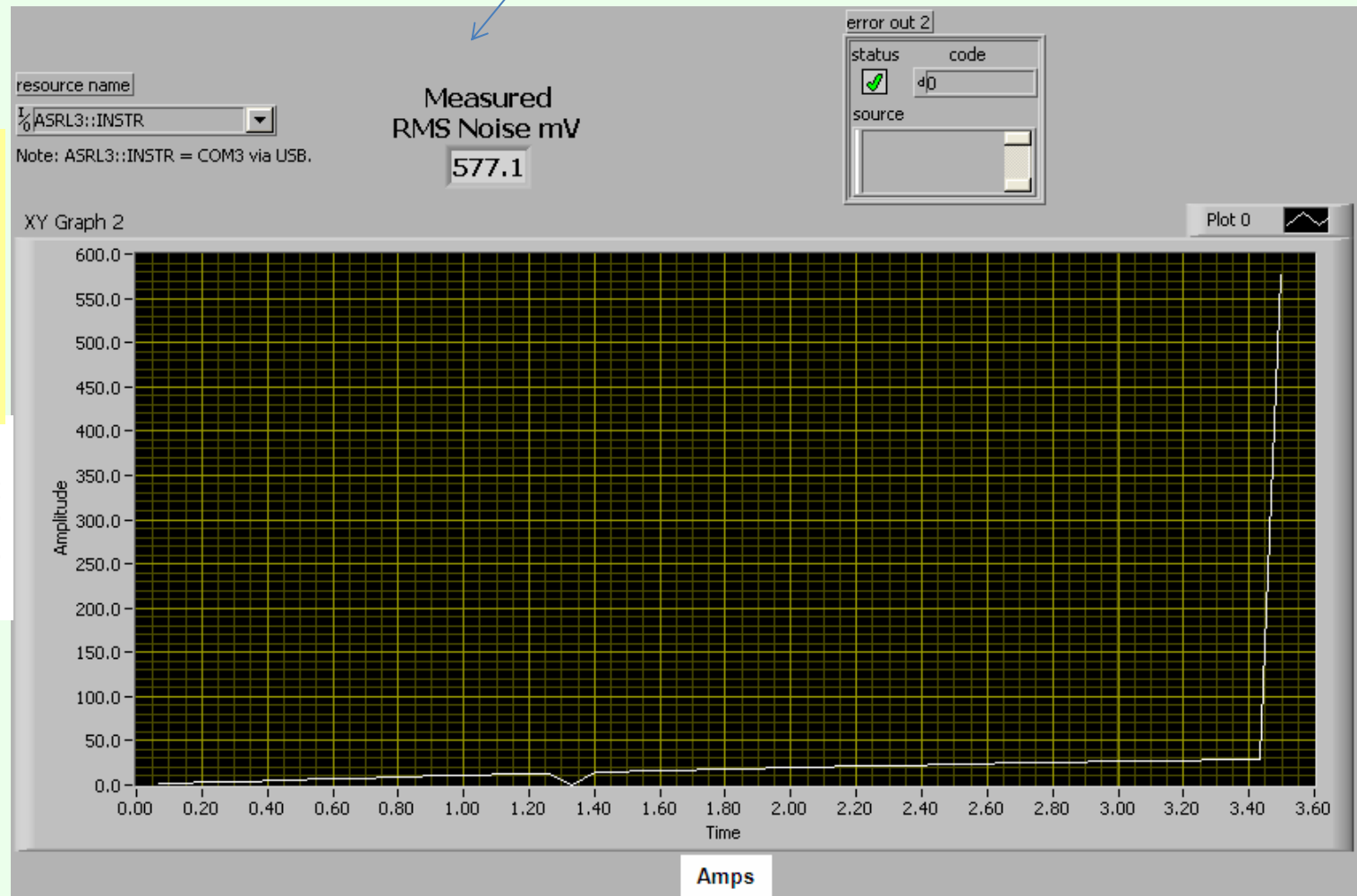
**IBM
AC to DC Adapter**

16V / 3.36A

This one has a current limiting regulator that triggers at 3.43A

resource name

⅙ ASRL3::INSTR

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

577.1

error out 2

status   code

d 0

source

XY Graph 2

Plot 0

RMS Noise mV

Amps

Delta Electronics   12V 1.25A   AC to DC Adapter

Delta Electronics   12V 1.25A   AC to DC Adapter

error out 2

status   code

☑   d0

source

resource name

⅙ ASRL3::INSTR   ▼

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

6.98

Low noise.

XY Graph 2

Plot 0

RMS Noise mV

7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0

0.05 0.10   0.20   0.30   0.40   0.50   0.60   0.70   0.80   0.90   1.00   1.10   1.20   1.30 1.35

Time
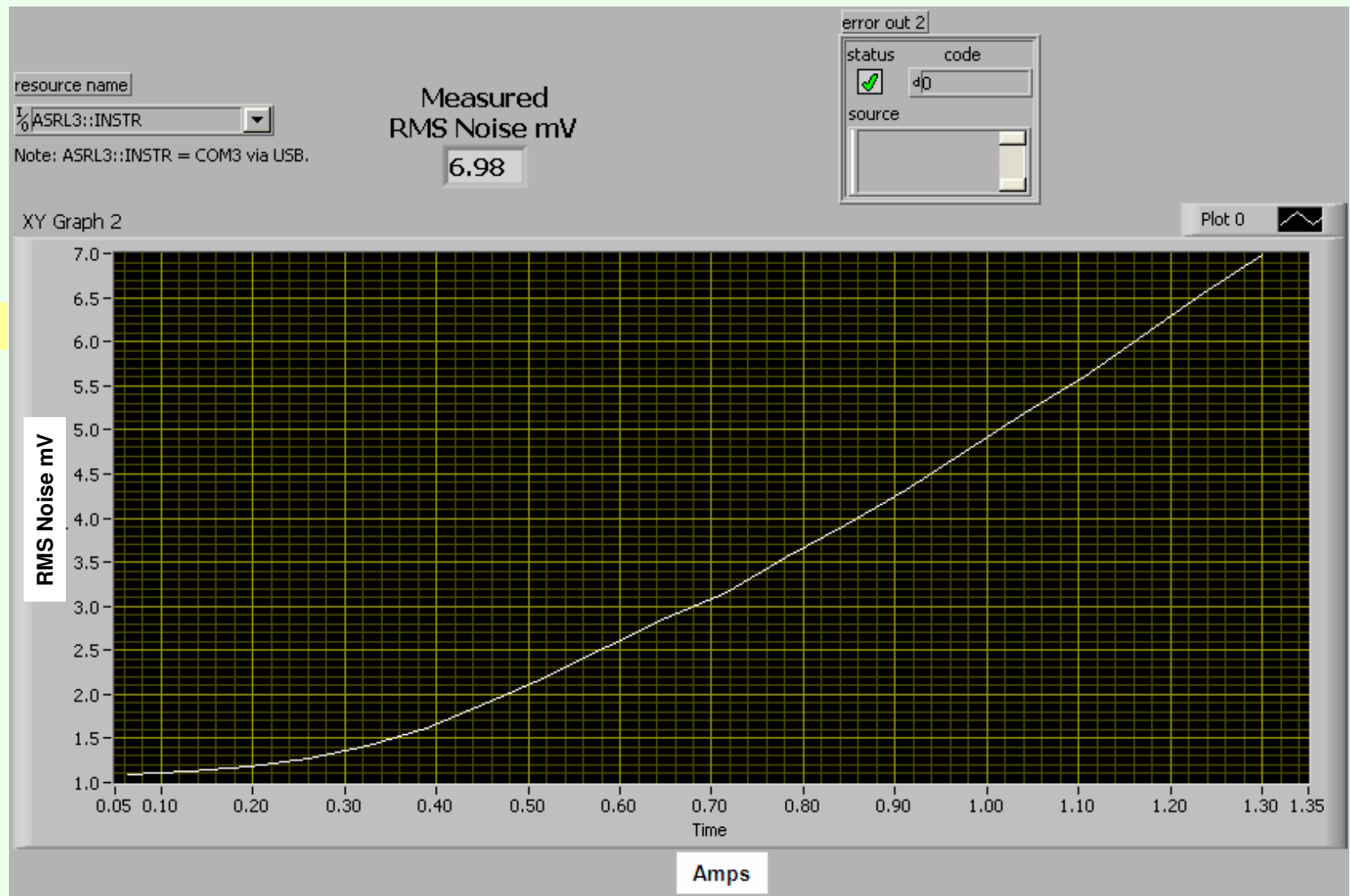
Amps

HIPRO
12V / 3.3A
AC to DC Adapter

Note the linear
I – V slope.

I - V PLOT with HP 6632B and Noise with Fluke 8920A

Starts at 0 Amps up to the MAX CURRENT
Sets votage to 0 V. Current sink mode

J. Audet
Oct. 2023

error out

status   code
✓   d0
source

MAX CURRENT   **# Points**   **Current Point**

3.50   Amps   20   20

I offset
-0.0130

Current Sink Correction
Corrects SET Amps
when - Amps are read

	I_Init	I_End	Set Io
	0.176	3.501	3.490

MEASURED

Current A	**Voltage V**	**% Volt Reg.**	**Dynamic R**	V_init	V_End	Io Calc
3.501	11.808	2.52	0.092	12.114	11.808	3.490

XY Graph   Plot 0

Volts   Amplitude

12.120
12.100
12.080
12.060
12.040
12.020
12.000
11.980
11.960
11.940
11.920
11.900
11.880
11.860
11.840
11.820
11.800

0.00 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.20 2.40 2.60 2.80 3.00 3.20 3.40 3.60
Time

Amps

HIPRO
12V / 3.3A
AC to DC Adapter

Higher noise
below 0.7A

error out 2

status   code

✓   d0

source

resource name

⅛ ASRL3::INSTR ▼

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

6.72

XY Graph 2   Plot 0 ⟍⟋

RMS Noise mV

16.0
15.0
14.0
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0

0.00   0.20   0.40   0.60   0.80   1.00   1.20   1.40   1.60   1.80   2.00   2.20   2.40   2.60   2.80   3.00   3.20   3.40   3.60
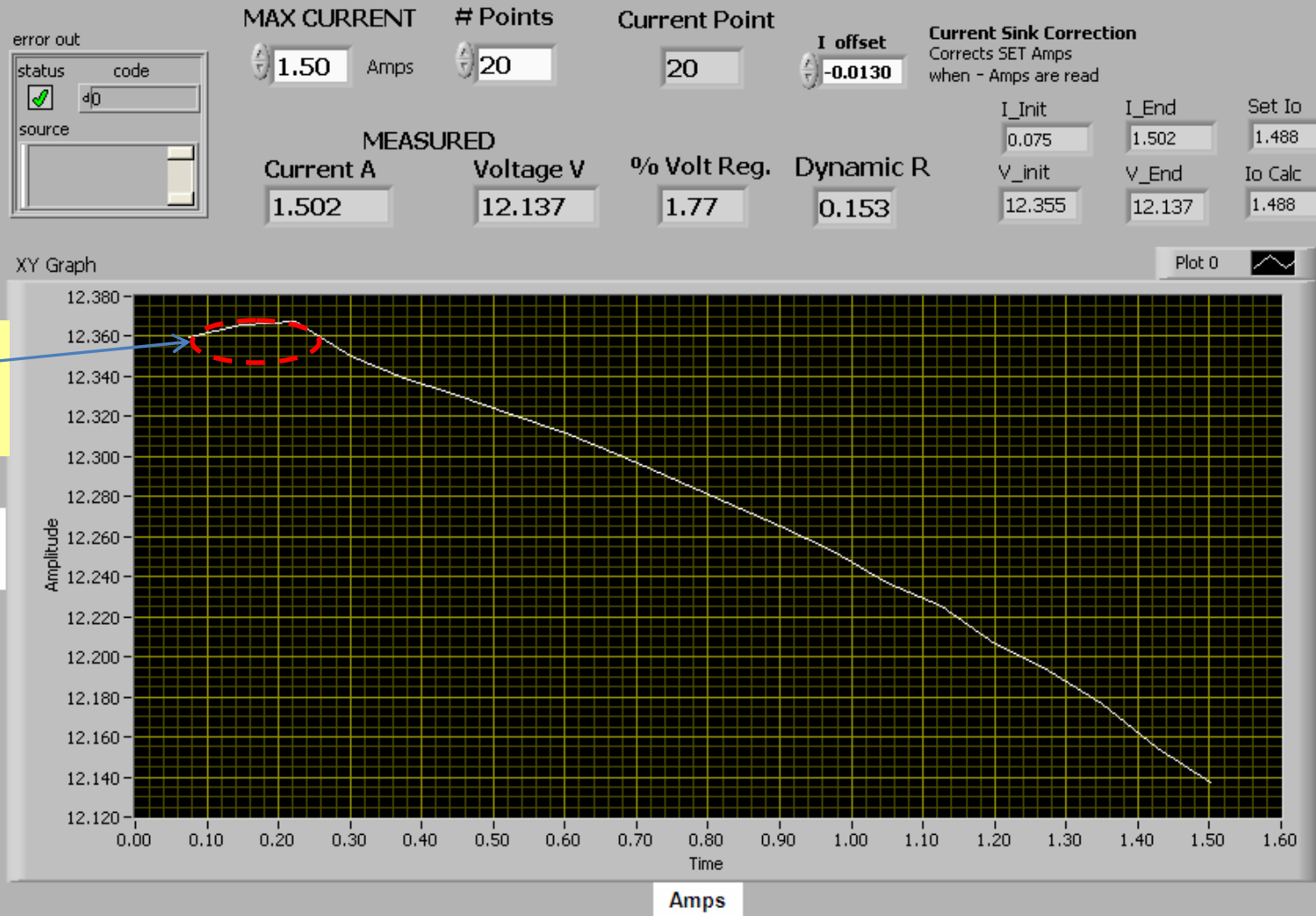
Time
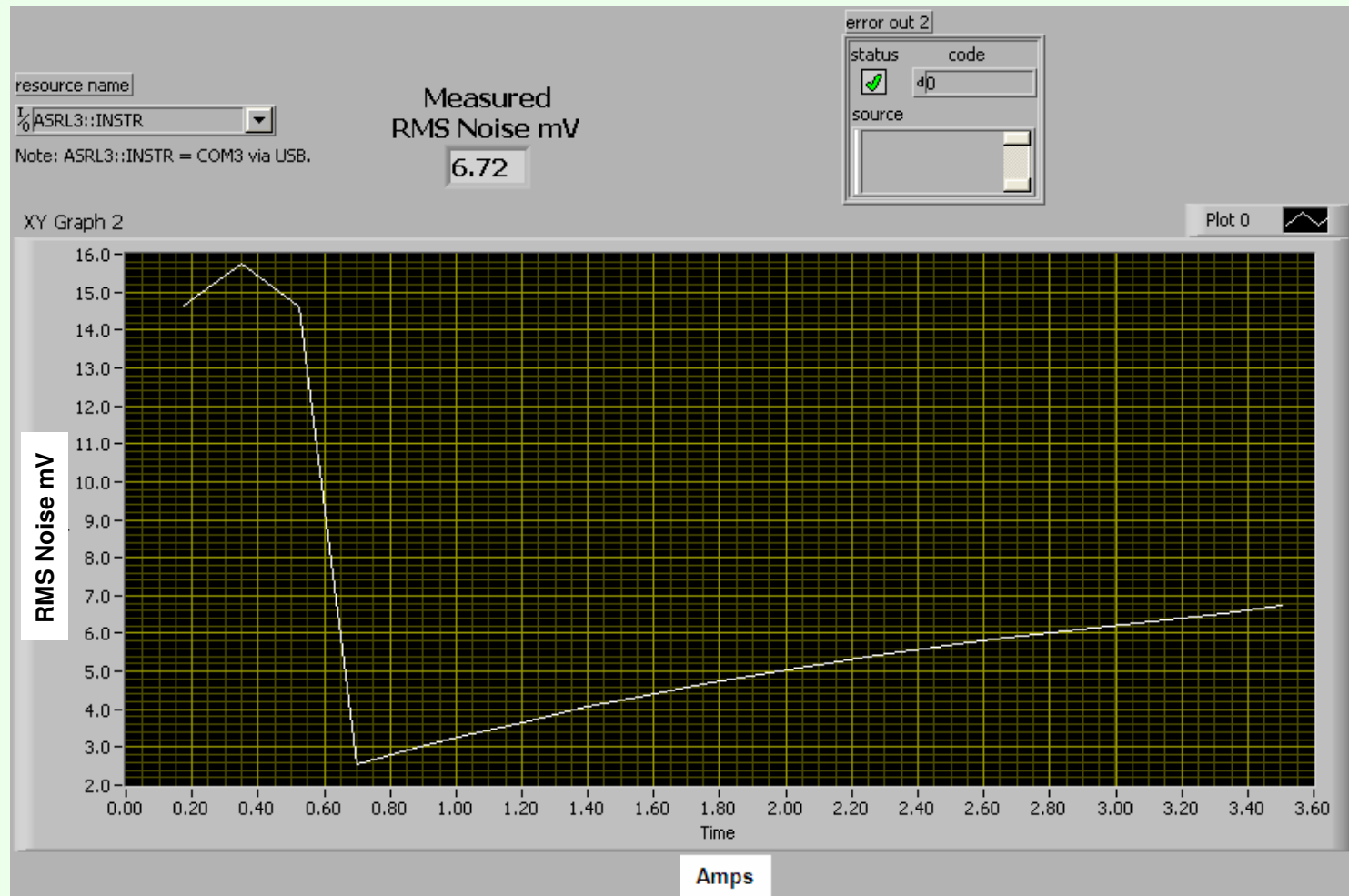
Amps

Asian Power Devices
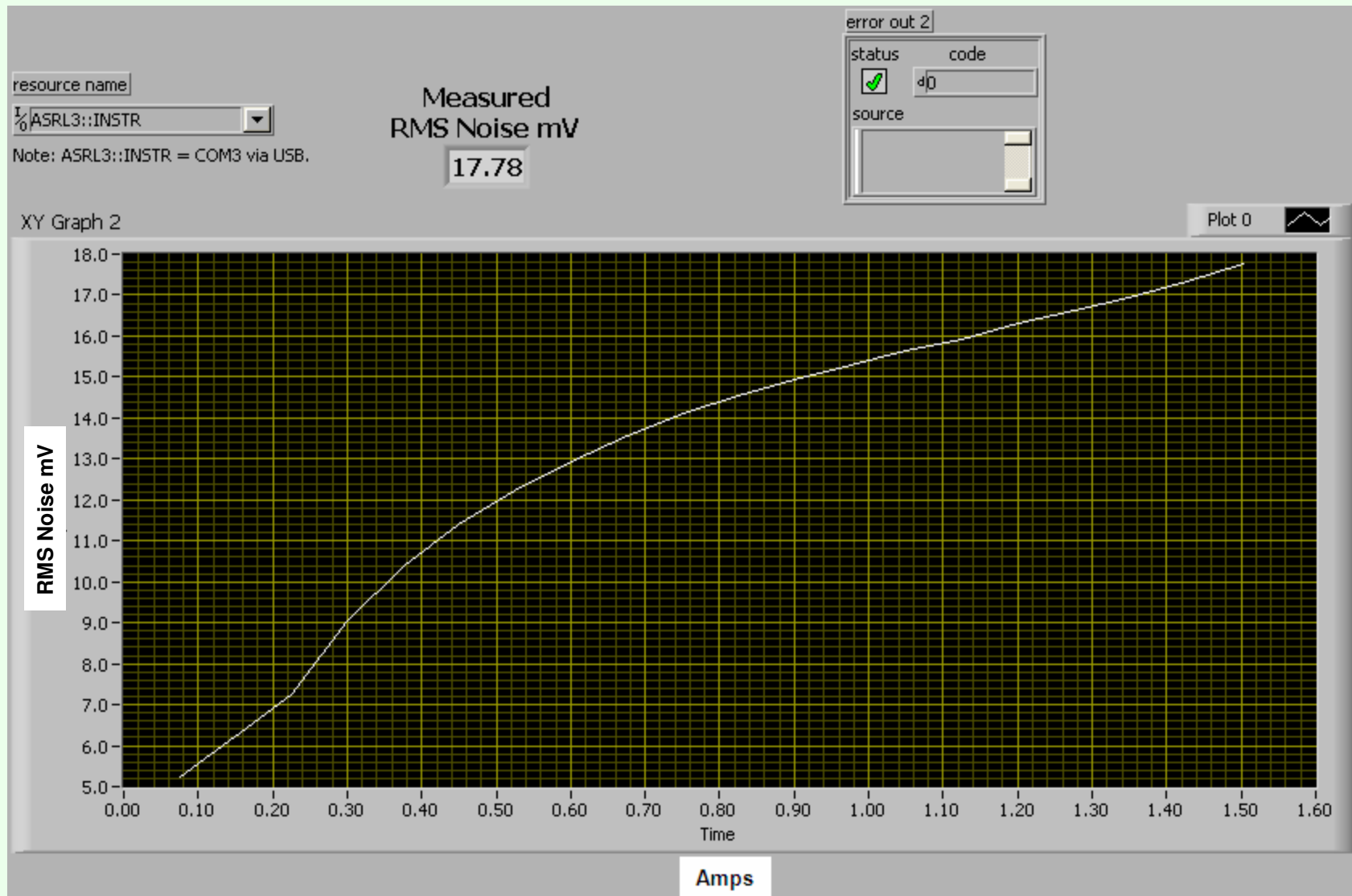**AC to DC Adapter**
12V / 1.5A

I - V PLOT with HP 6632B
and Noise with Fluke 8920A

Starts at 0 Amps up to the MAX CURRENT
Sets votage to 0 V. Current sink mode

J. Audet
Oct. 2023

error out

status	code
✓	d0

source

MAX CURRENT
1.50   Amps

 # Points
20

Current Point
20

I offset
-0.0130

Current Sink Correction
Corrects SET Amps
when - Amps are read

	I_Init	I_End	Set Io
	0.075	1.502	1.488

MEASURED

Current A	Voltage V	% Volt Reg.	Dynamic R	V_init	V_End	Io Calc
1.502	12.137	1.77	0.153	12.355	12.137	1.488

XY Graph

Plot 0

Negative resistance Zone !!!

Volts

Amplitude

Time

Amps
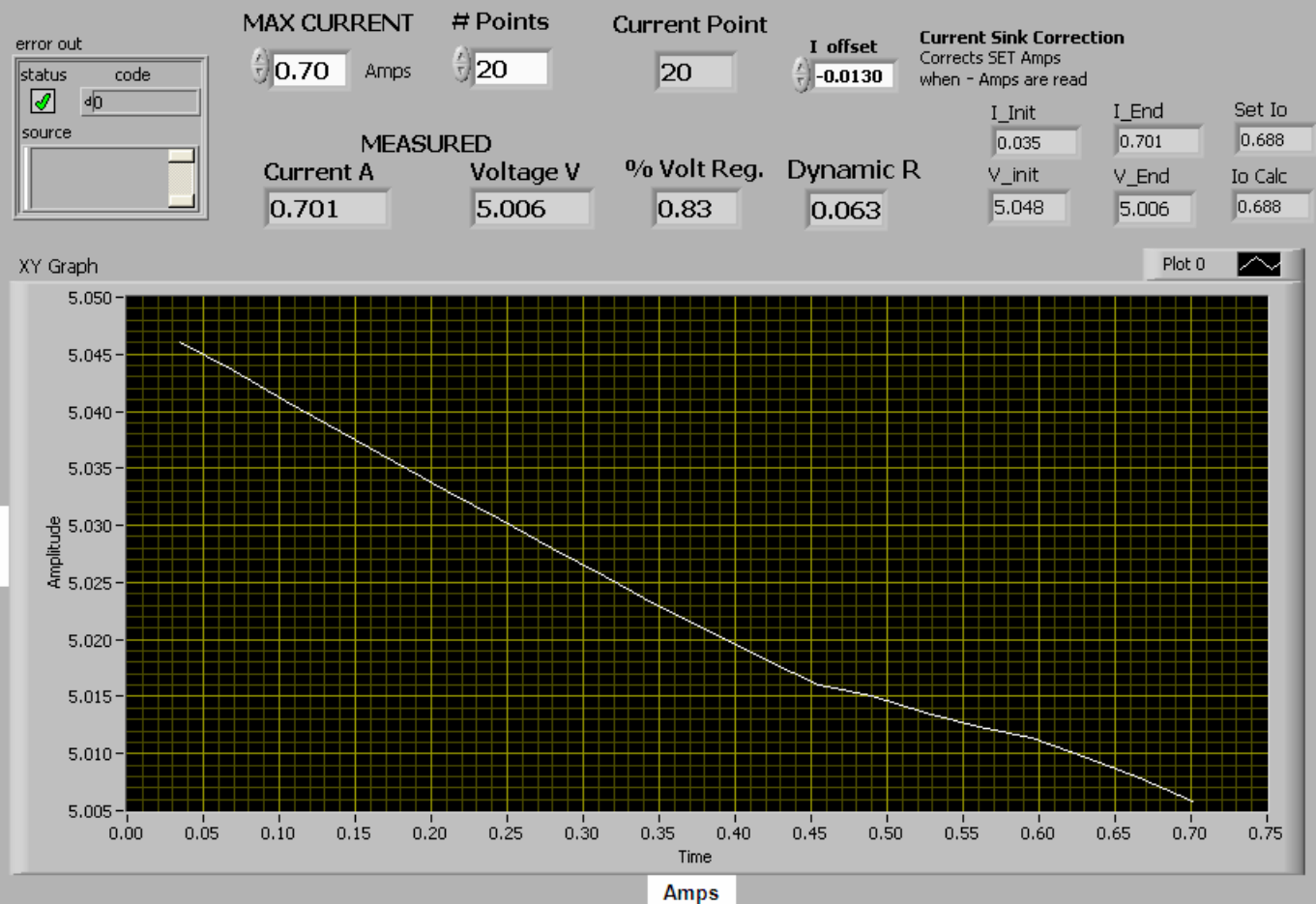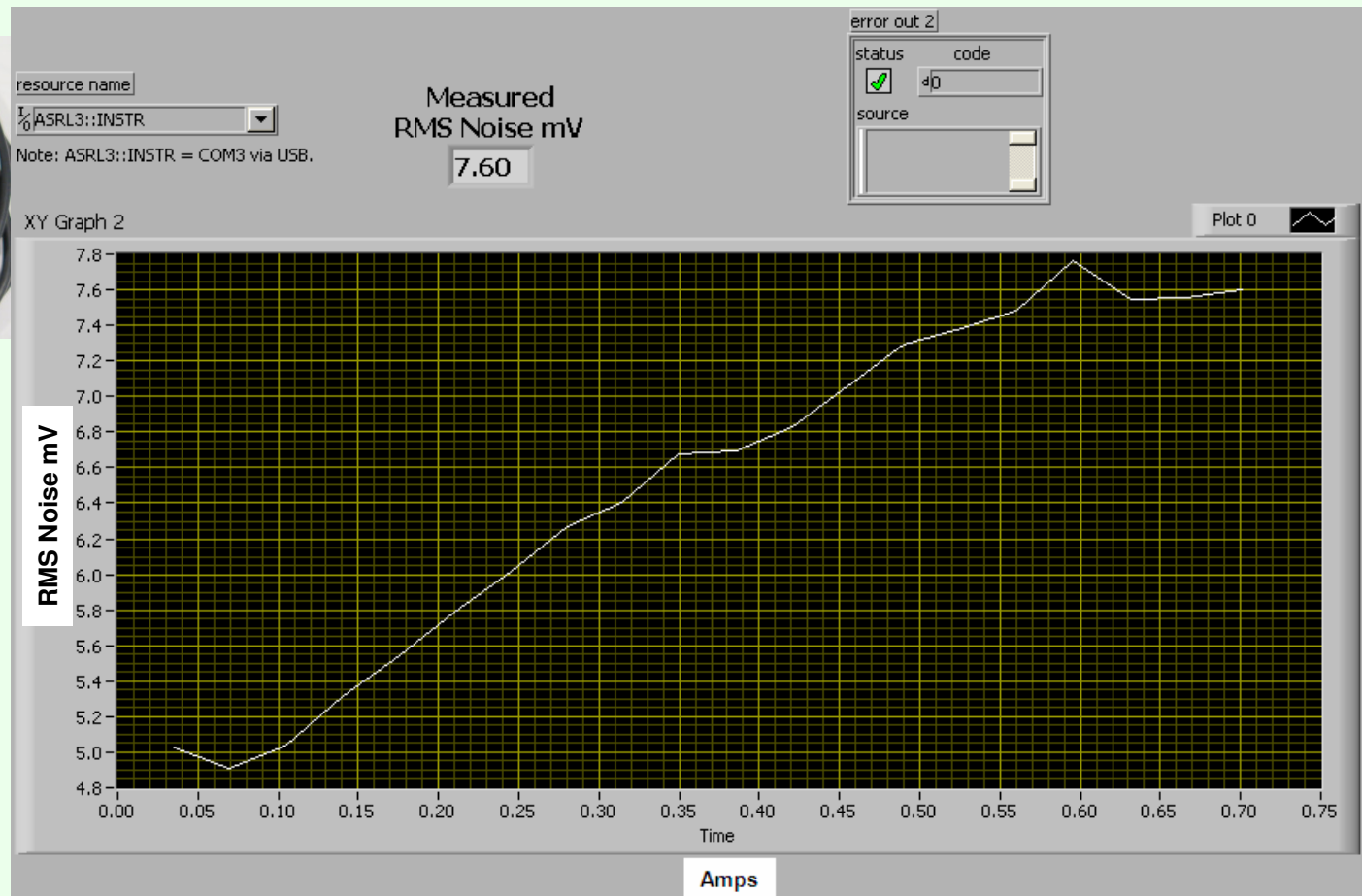
18

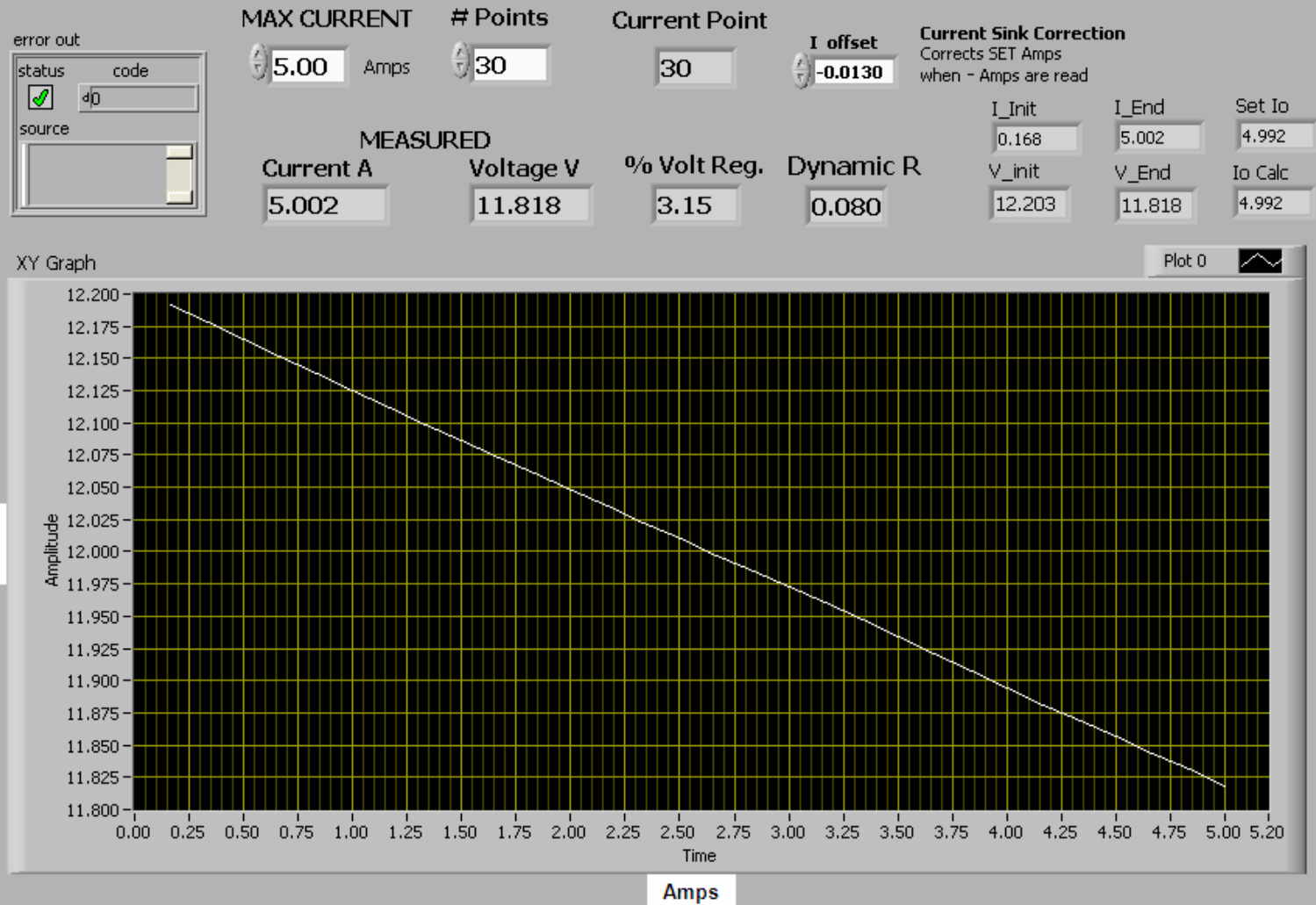**Asian Power Devices** AC to DC Adapter 12V / 1.5A
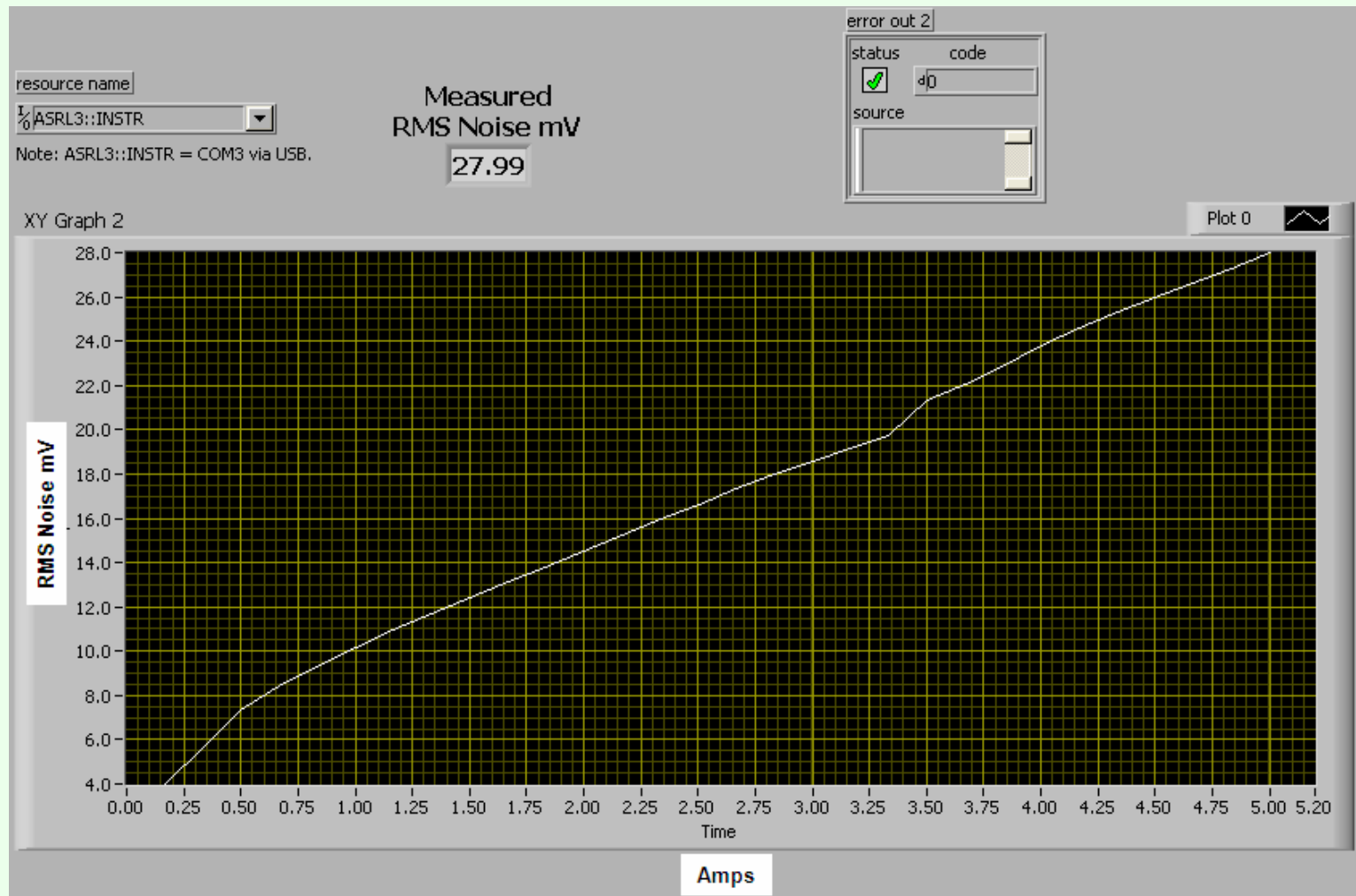
LG Adapter
AC to DC Adapter
5.1V 0.7A

I - V PLOT with HP 6632B
and Noise with Fluke 8920A

Starts at 0 Amps up to the MAX CURRENT
Sets votage to 0 V. Current sink mode

J. Audet
Oct. 2023

error out

status   code
✓   d0

source

MAX CURRENT   # Points   Current Point   I offset
0.70   Amps   20   20   -0.0130

Current Sink Correction
Corrects SET Amps
when - Amps are read

MEASURED
Current A   Voltage V   % Volt Reg.   Dynamic R
0.701   5.006   0.83   0.063

I_Init   I_End   Set Io
0.035   0.701   0.688

V_init   V_End   Io Calc
5.048   5.006   0.688

XY Graph   Plot 0

Volts

Amps

LG Adapter
AC to DC Adapter
5.1V 0.7A

NETGEAR
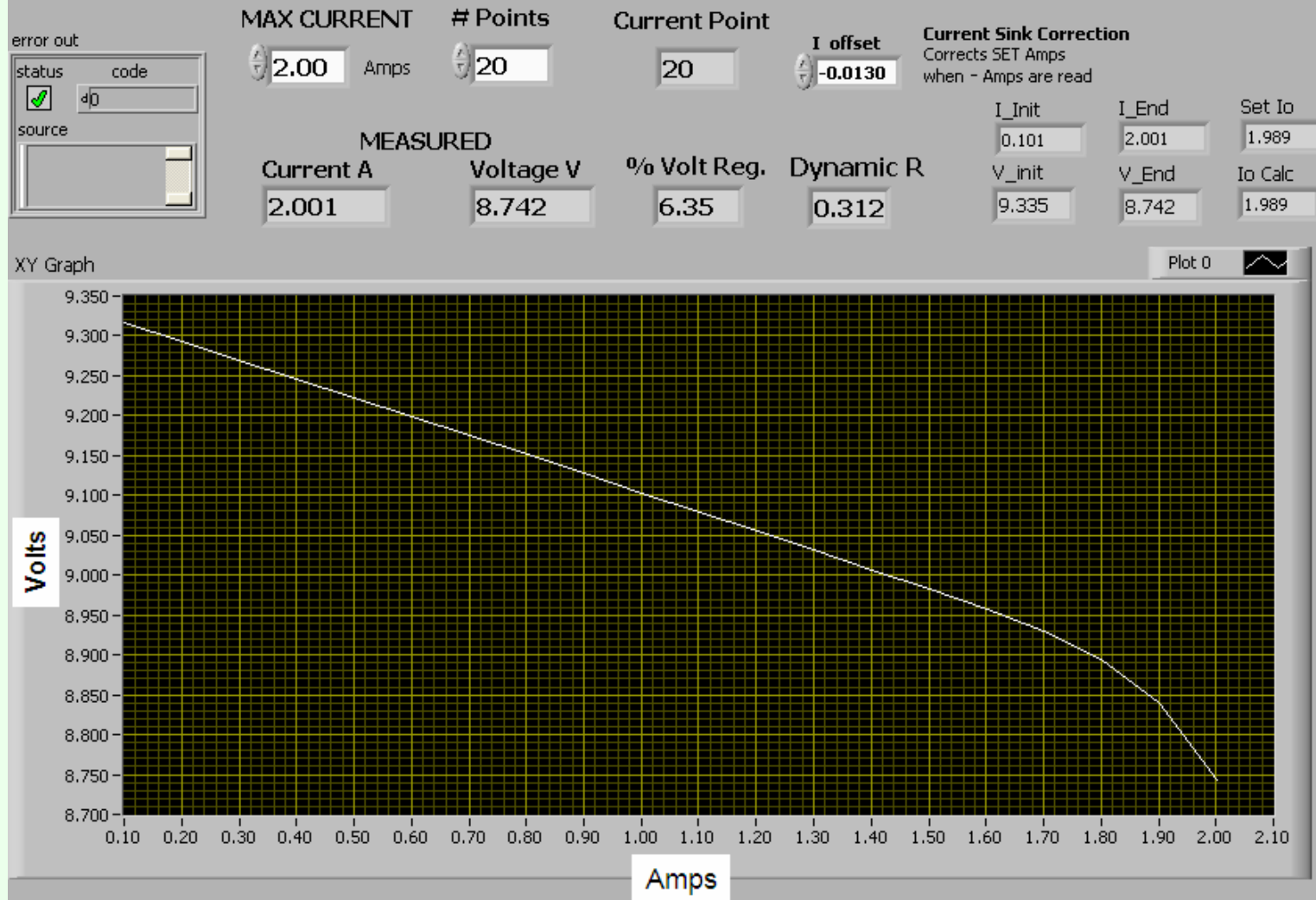**AC to DC Adapter**
12V   5A
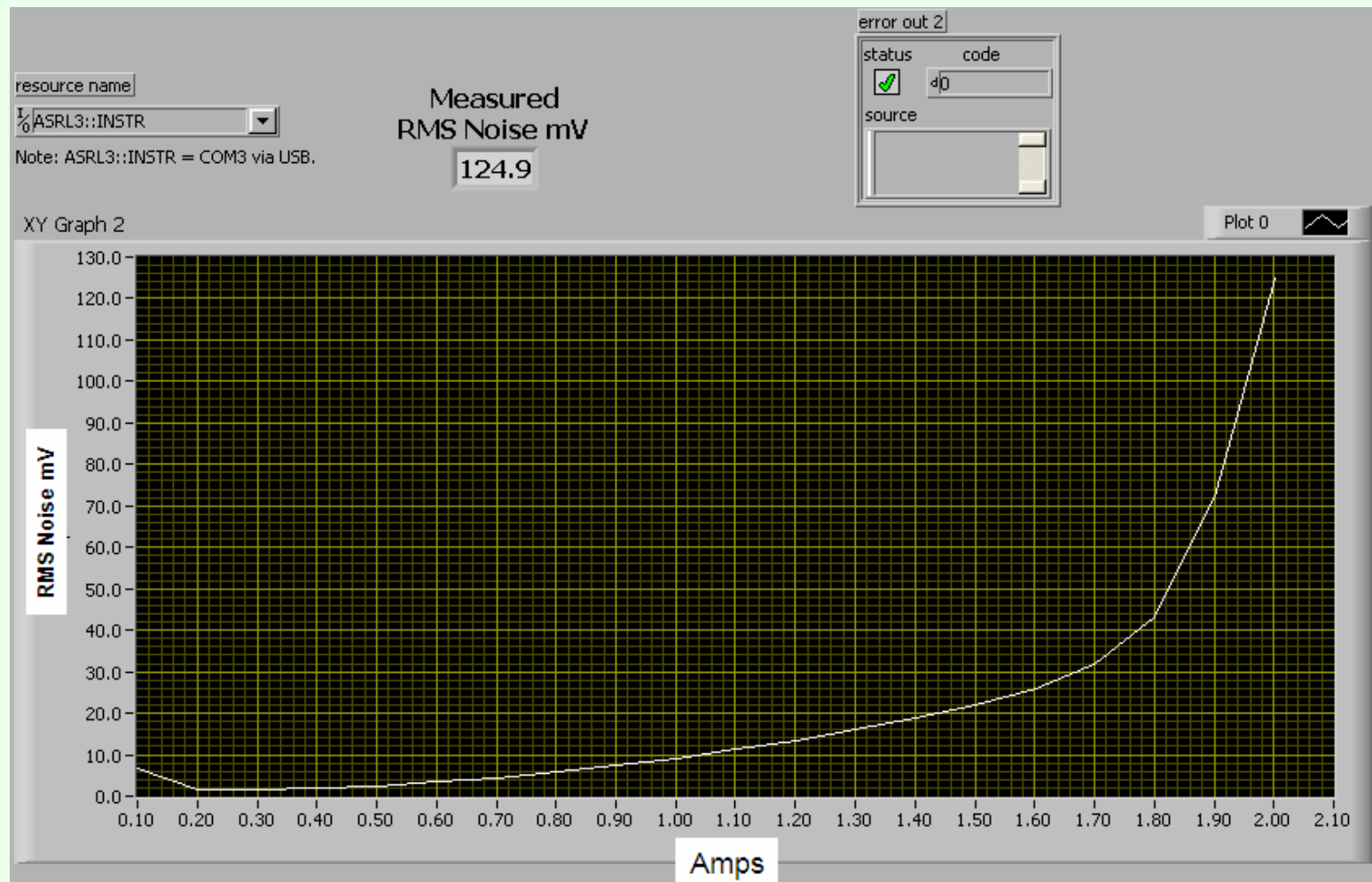
SDK-0601
AC to DC Adapter
9V 2A

I - V PLOT with HP 6632B
and Noise with Fluke 8920A

Starts at 0 Amps up to the MAX CURRENT
Sets votage to 0 V. Current sink mode

J. Audet
Oct. 2023

error out

status   code
☑   d0

source

MAX CURRENT   # Points   Current Point   I offset
2.00 Amps   20   20   -0.0130

Current Sink Correction
Corrects SET Amps
when - Amps are read

	I_Init	I_End	Set Io
	0.101	2.001	1.989

MEASURED

Current A	Voltage V	% Volt Reg.	Dynamic R	V_init	V_End	Io Calc
2.001	8.742	6.35	0.312	9.335	8.742	1.989

XY Graph

Plot 0

Volts / Amps

SDK-0601
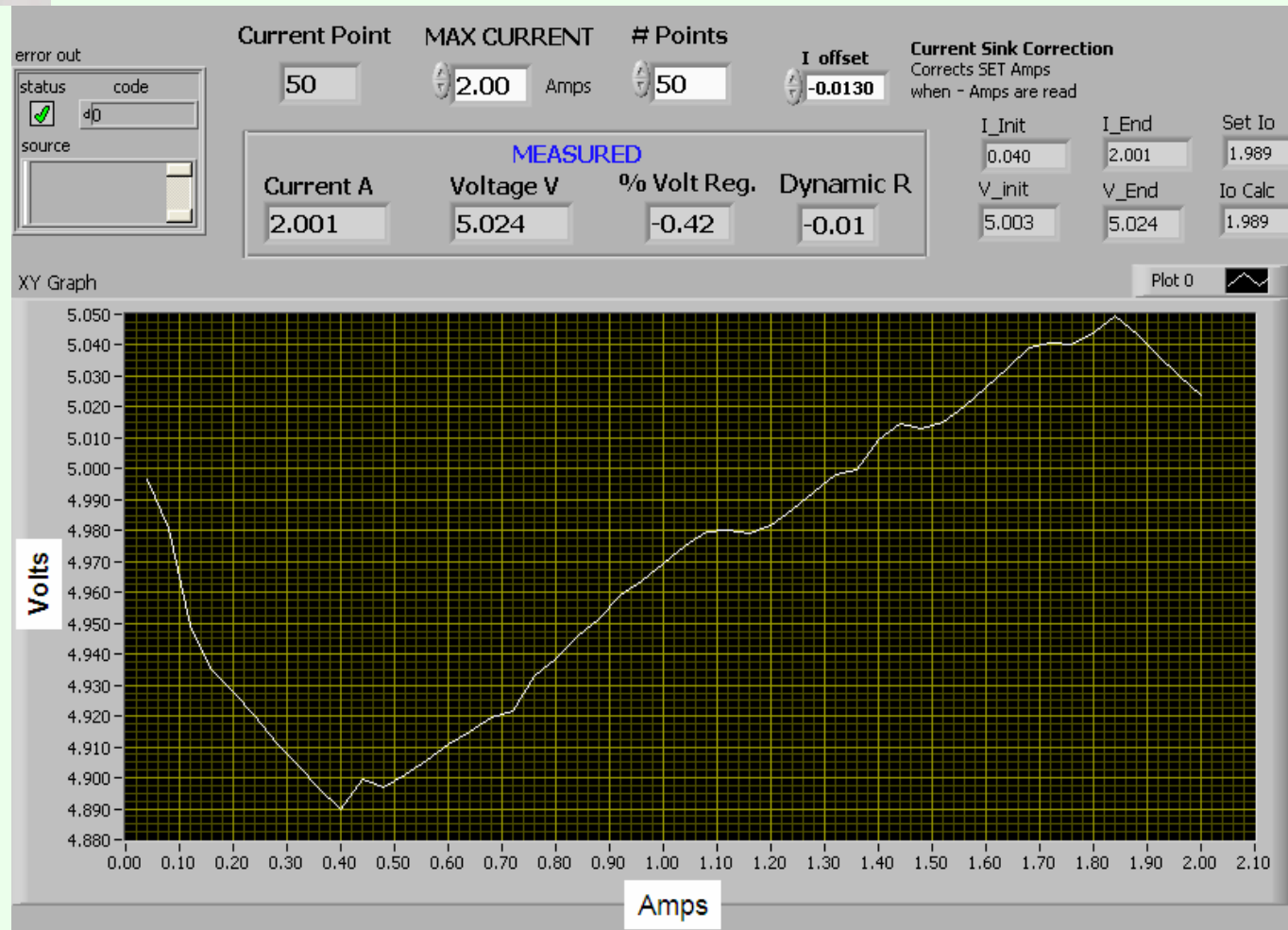**AC to DC Adapter**
9V 2A

Very noisy at
high currents

Should not be
used above 1.8A

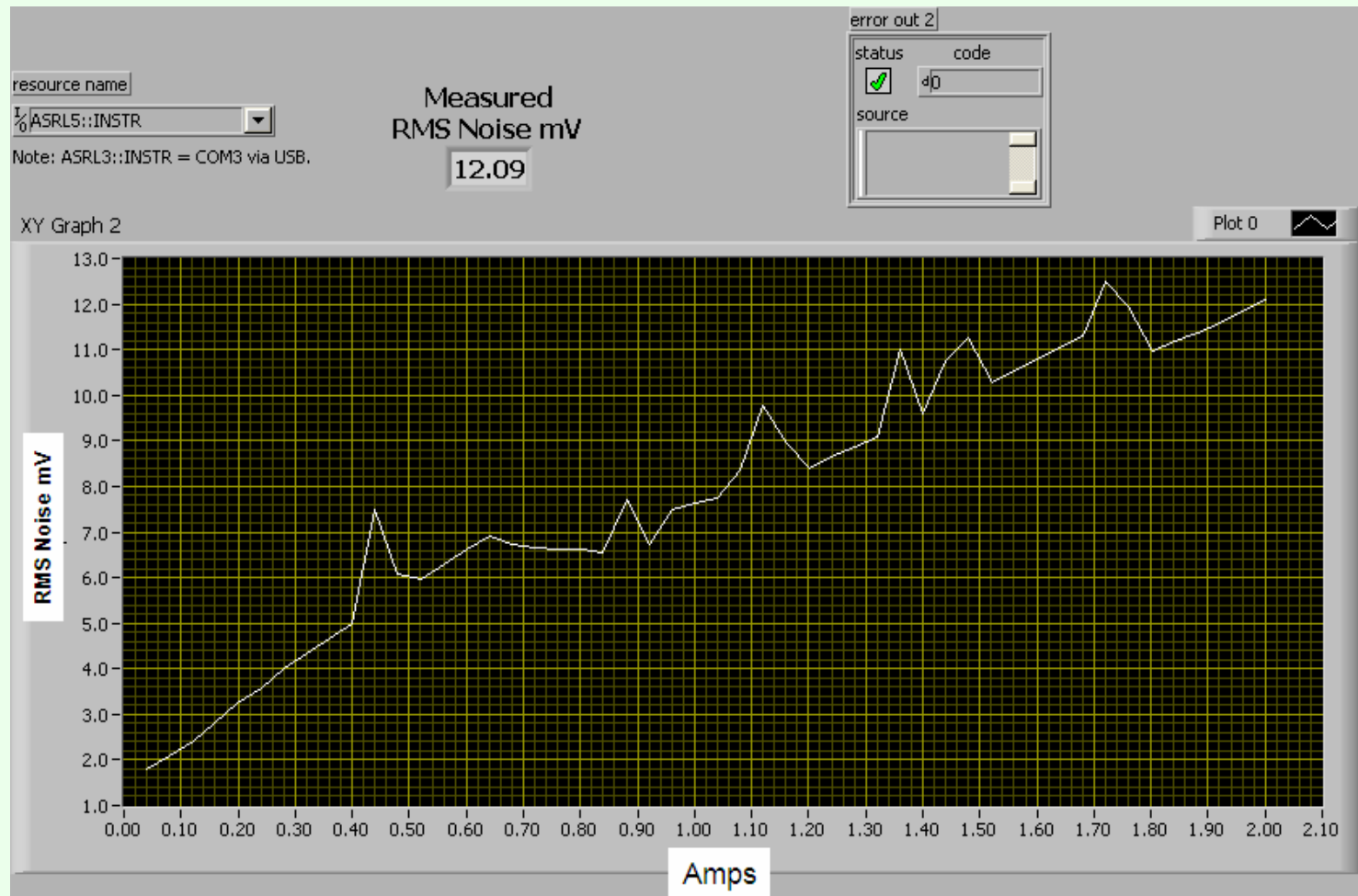Samsung Black Portable AC to DC Adapter ETA-P11X
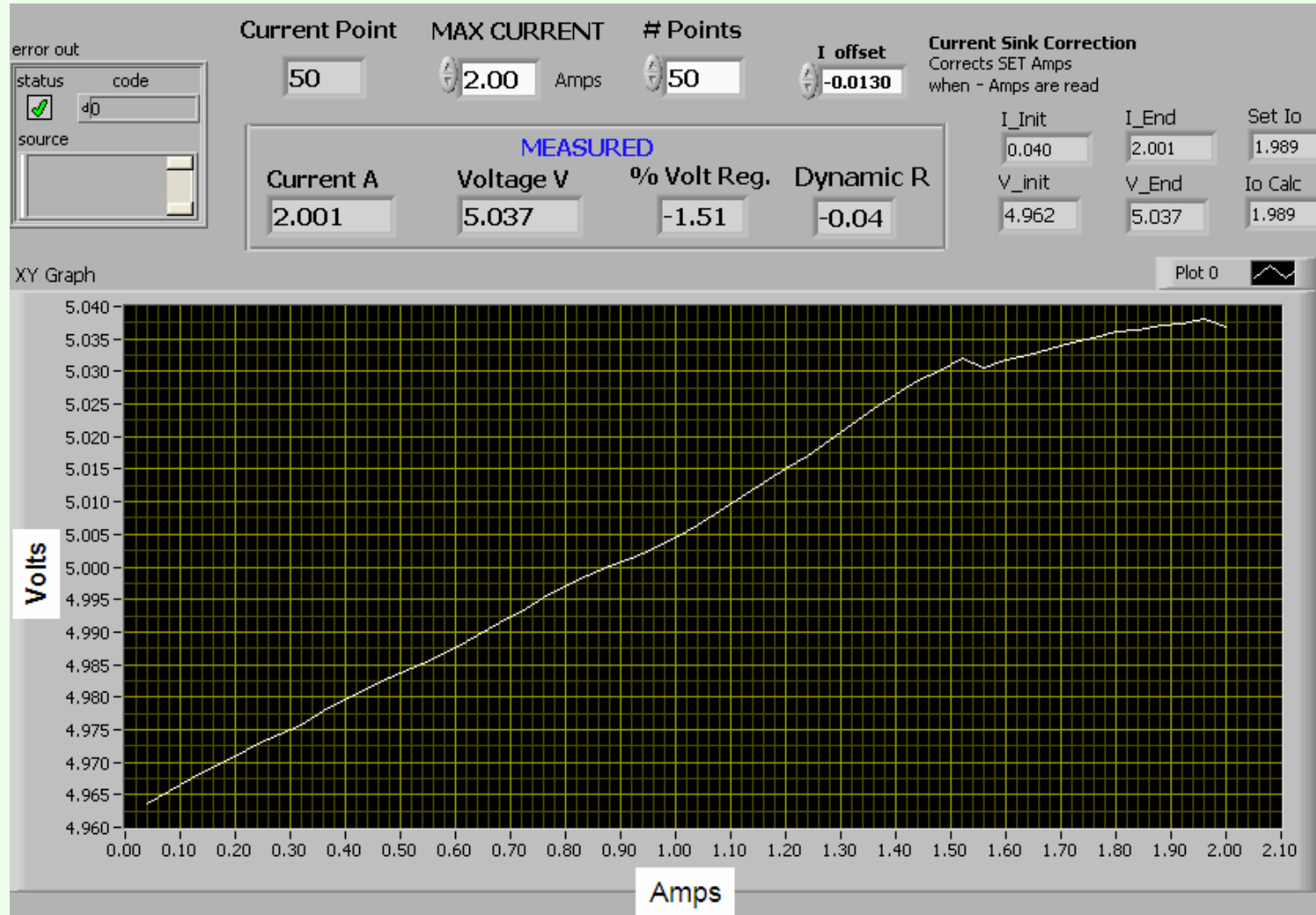**AC to DC Adapter**

Negative resistance zone !!!

Samsung Black   Portable AC to DC Adapter ETA-P11X
AC to DC Adapter

Low noise.

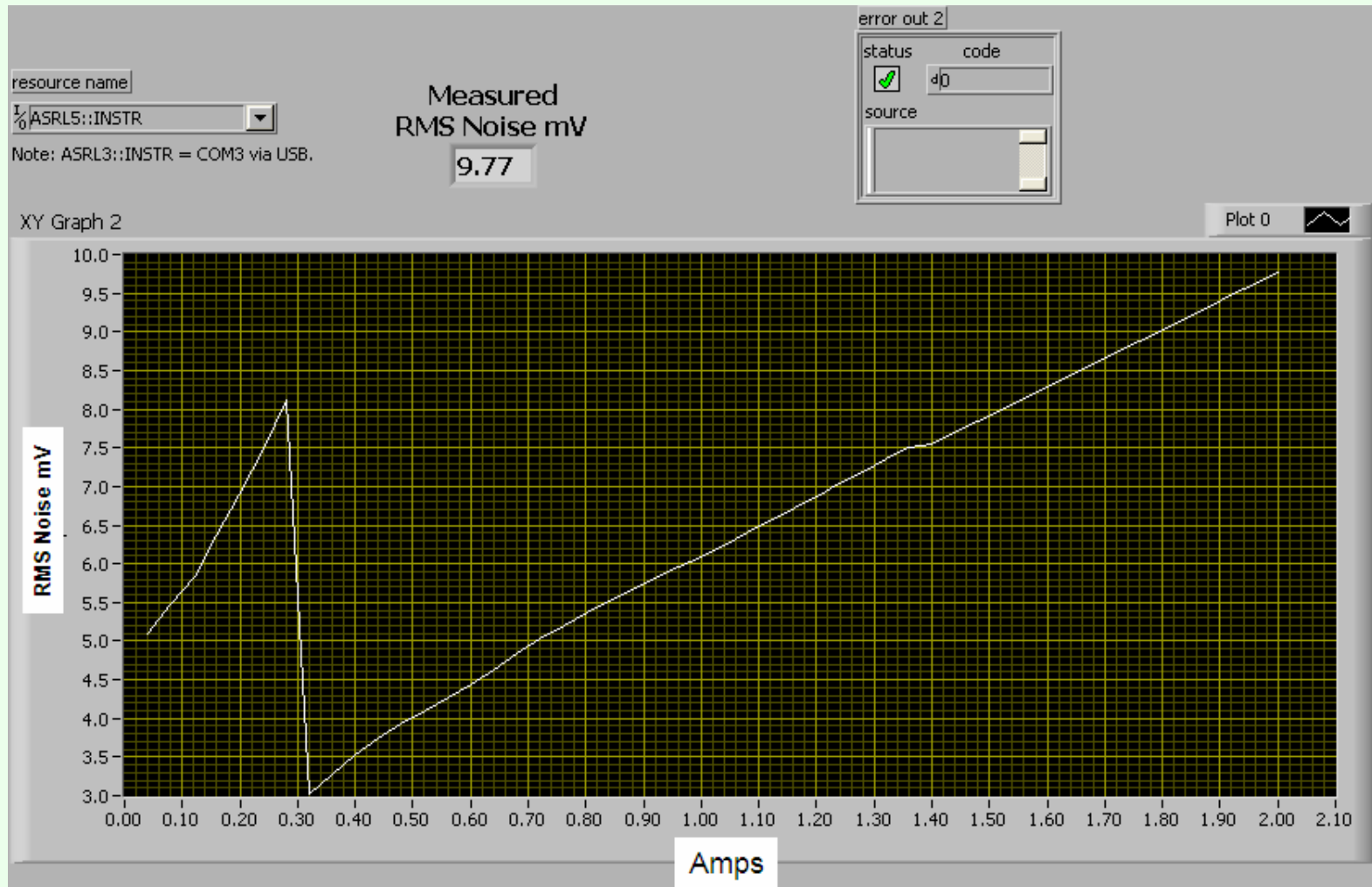# Samsung White   Portable 5V-2A /9V EP-TA20JWE
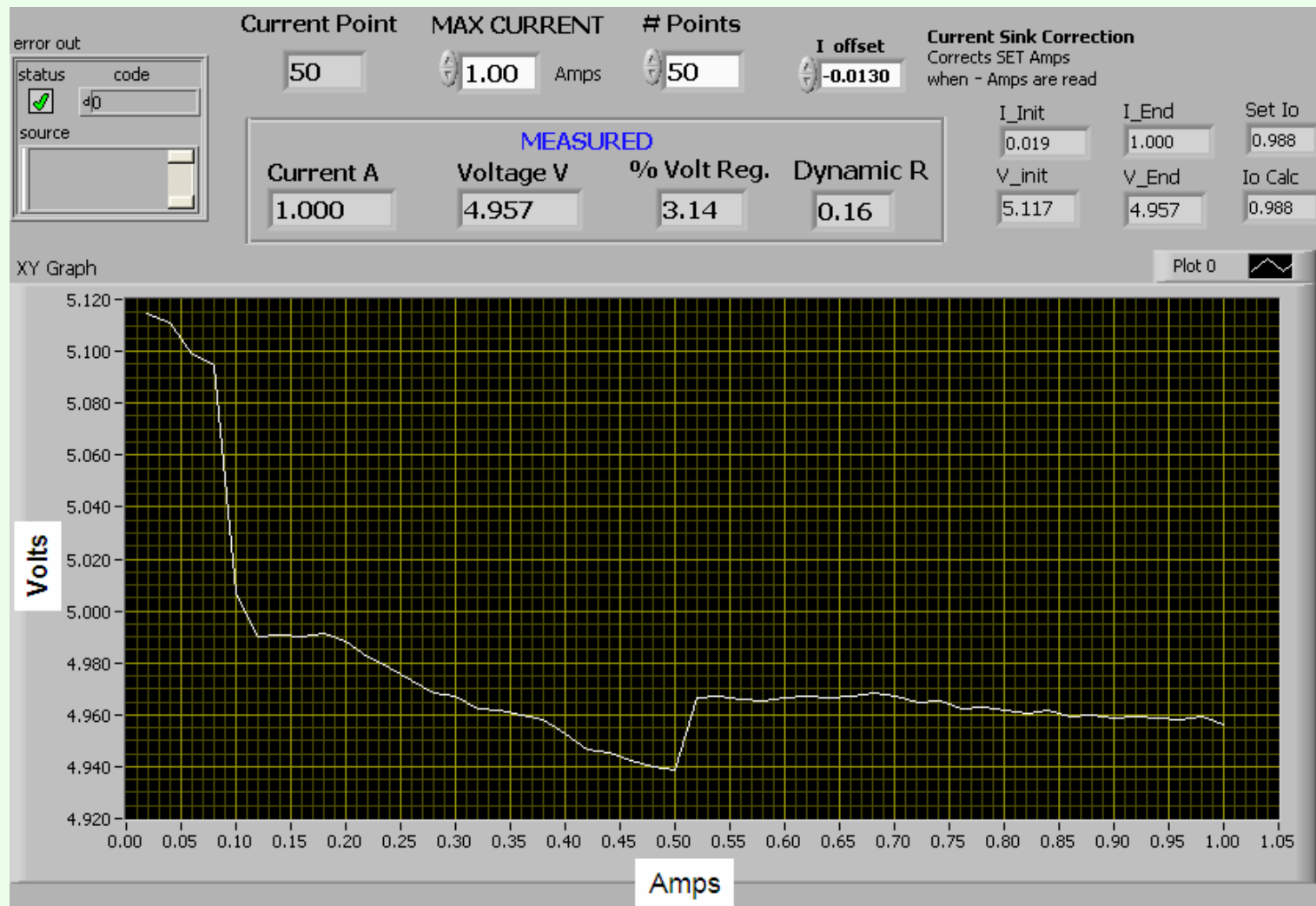**AC to DC Adapter**

Negative resistance zone !!!

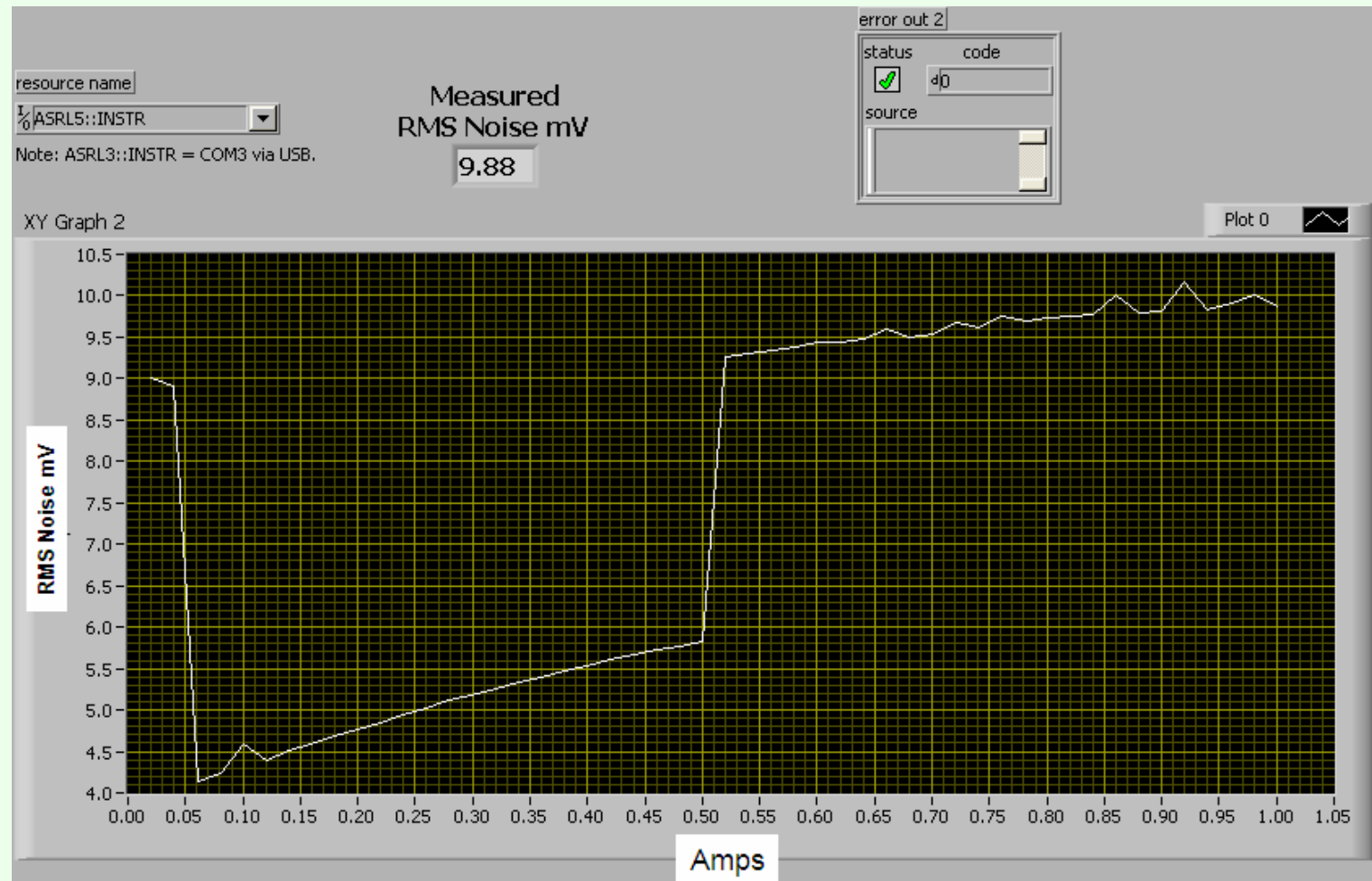# Samsung White Portable 5V-2A /9V EP-TA20JWE
AC to DC Adapter

Low noise.

Samsung White Portable 5V / 1A ETA0U61JWE
AC to DC Adapter

Samsung White Portable 5V / 1A ETA0U61JWE
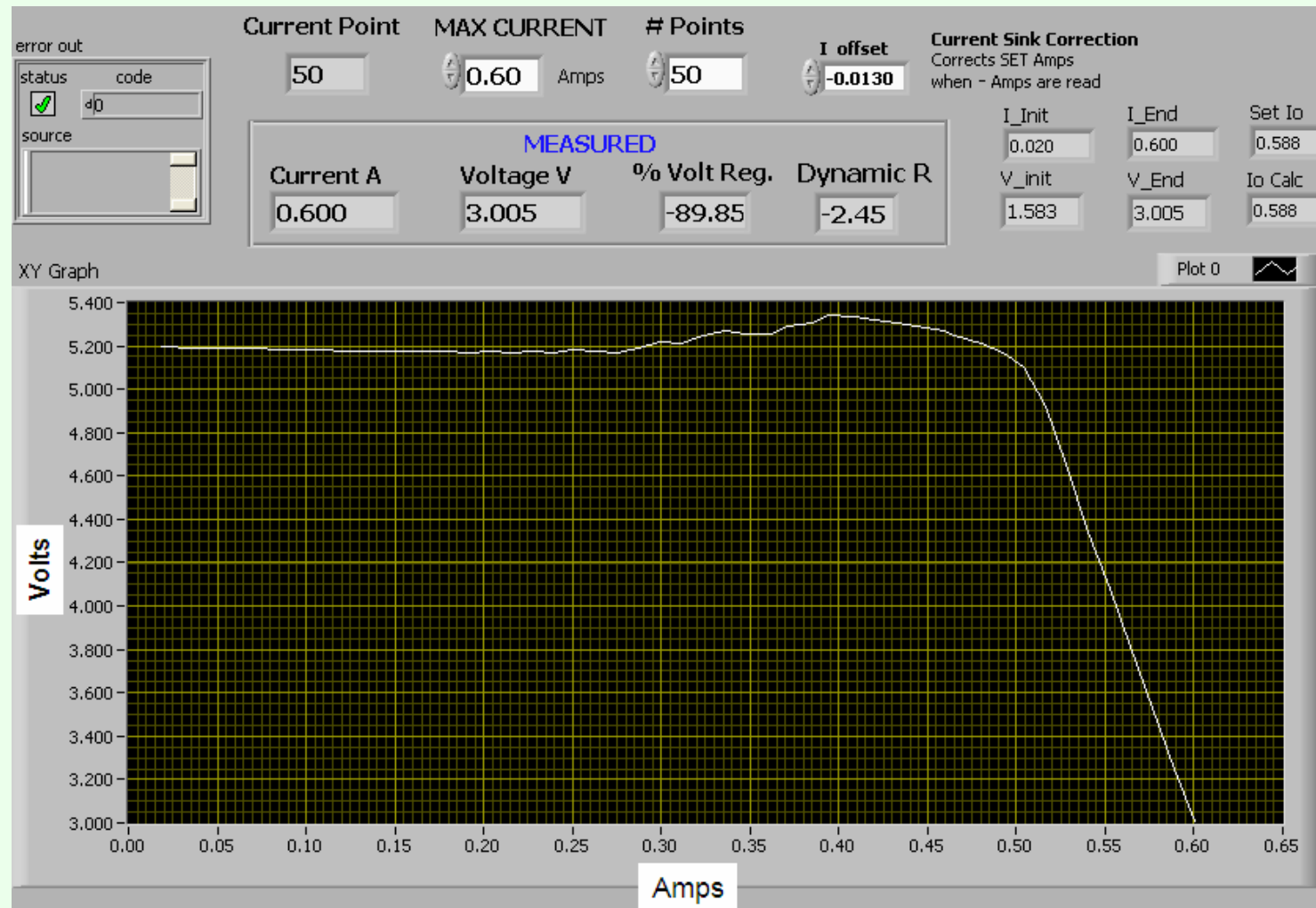**AC to DC Adapter**

Low noise. Sudden jump above 0.5A

Cheap Portable 5V / 1A Adapter #1
AC to DC Adapter

OK up to 0.5A

error out

status	code
✓	d0

source

Current Point	MAX CURRENT	# Points	I offset	Current Sink Correction
50	0.60 Amps	50	-0.0130	Corrects SET Amps when – Amps are read

MEASURED

Current A	Voltage V	% Volt Reg.	Dynamic R
0.600	3.005	-89.85	-2.45

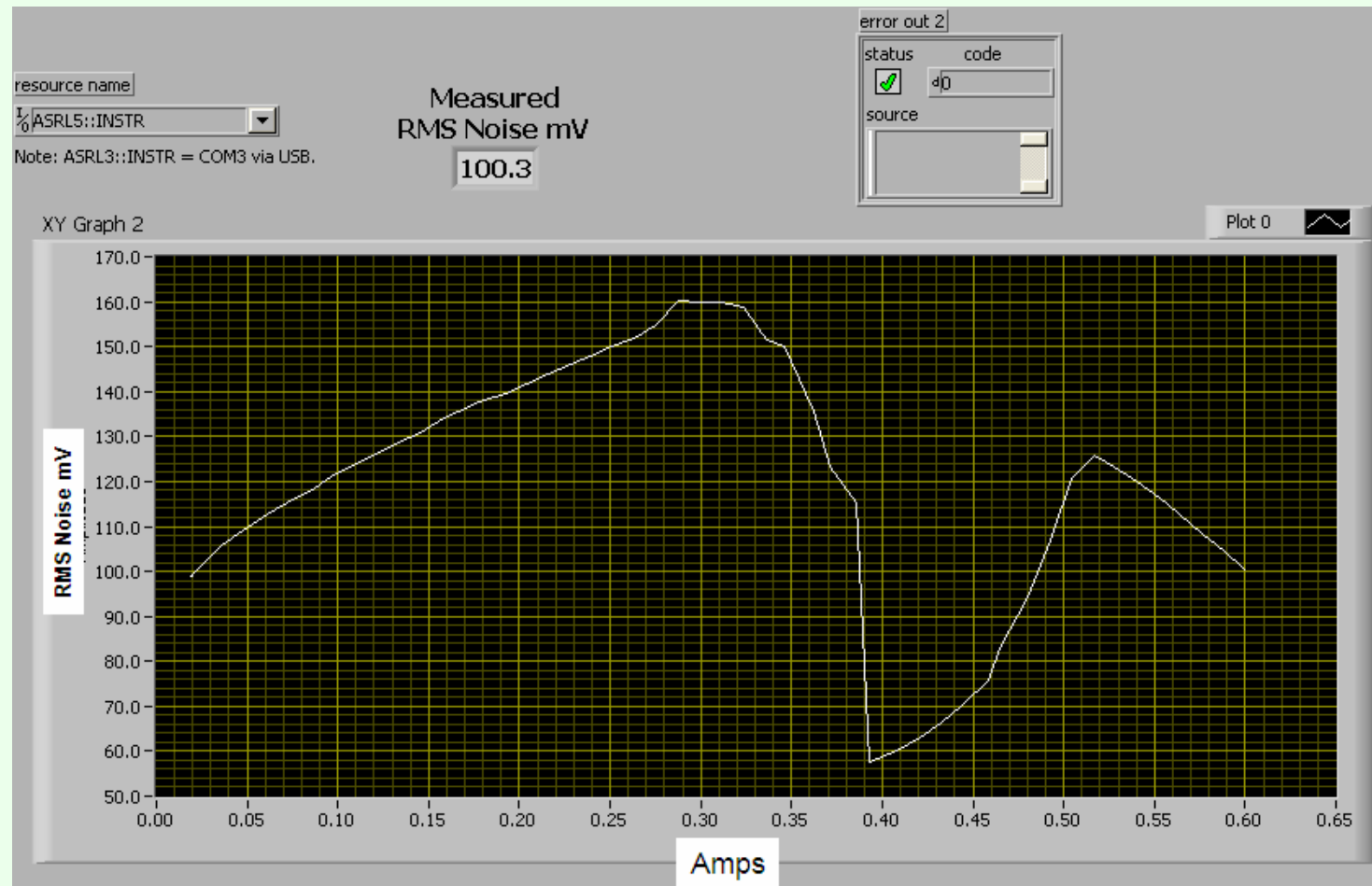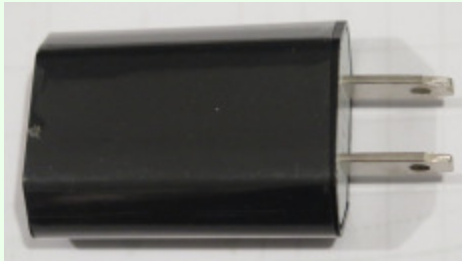|	I_Init	I_End	Set Io
	0.020	0.600	0.588
	V_init	V_End	Io Calc
	1.583	3.005	0.588

XY Graph

Plot 0

Cheap Portable 5V / 1A Adapter #1

AC to DC Adapter

OK up to 0.5A
VERY Noisy !

Cheap Portable 5V / 1A Adapter #2
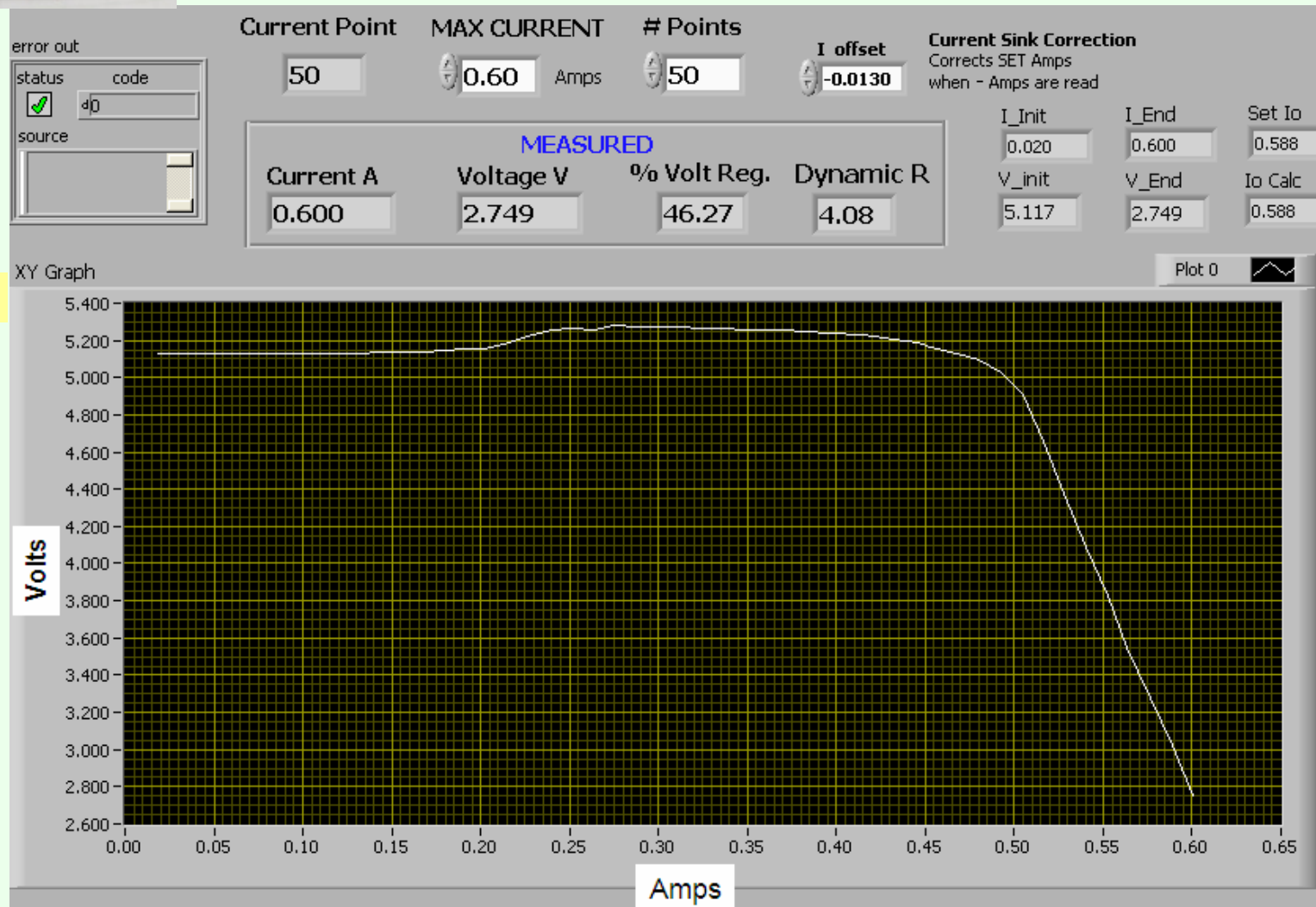
AC to DC Adapter

OK up to 0.5A

error out			Current Point	MAX CURRENT	# Points	I offset	Current Sink Correction
status	code		50	0.60 Amps	50	-0.0130	Corrects SET Amps when – Amps are read
source							

	I_Init	I_End	Set Io
	0.020	0.600	0.588

MEASURED

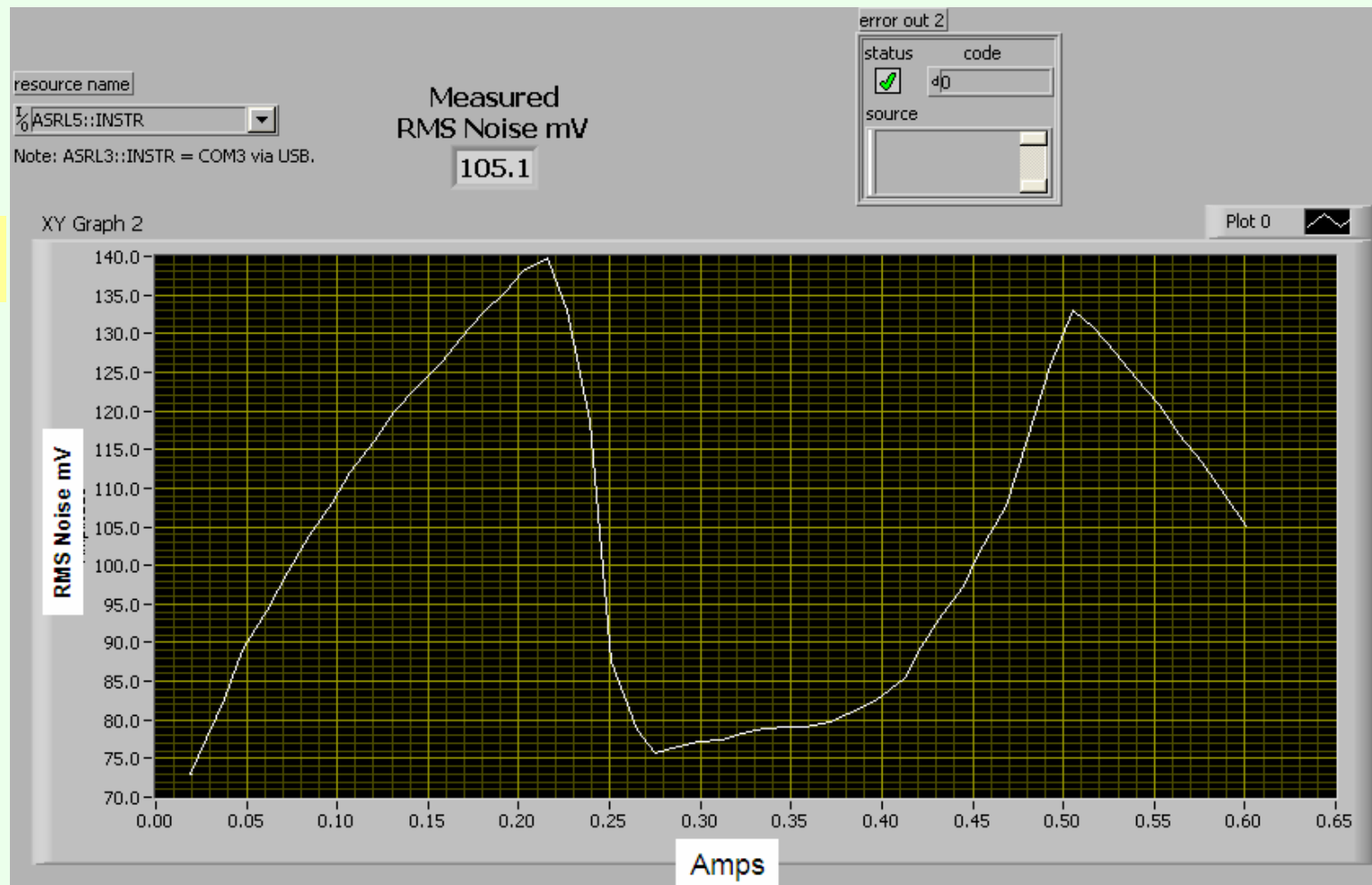| Current A	Voltage V	% Volt Reg.	Dynamic R	V_init	V_End	Io Calc
0.600	2.749	46.27	4.08	5.117	2.749	0.588

XY Graph

Plot 0

Cheap Portable 5V / 1A Adapter #2

AC to DC Adapter

OK up to 0.5A
VERY Noisy !

resource name
ASRL5::INSTR
Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV
105.1

error out 2
status   code
d0
source

XY Graph 2   Plot 0

Wall Plug Unit #RCA WP2UWR   Top USB port
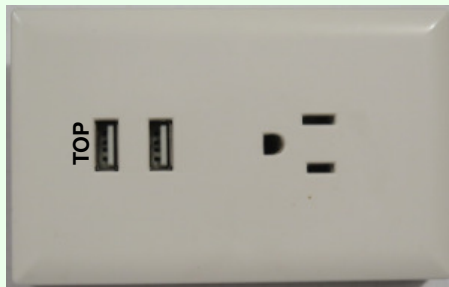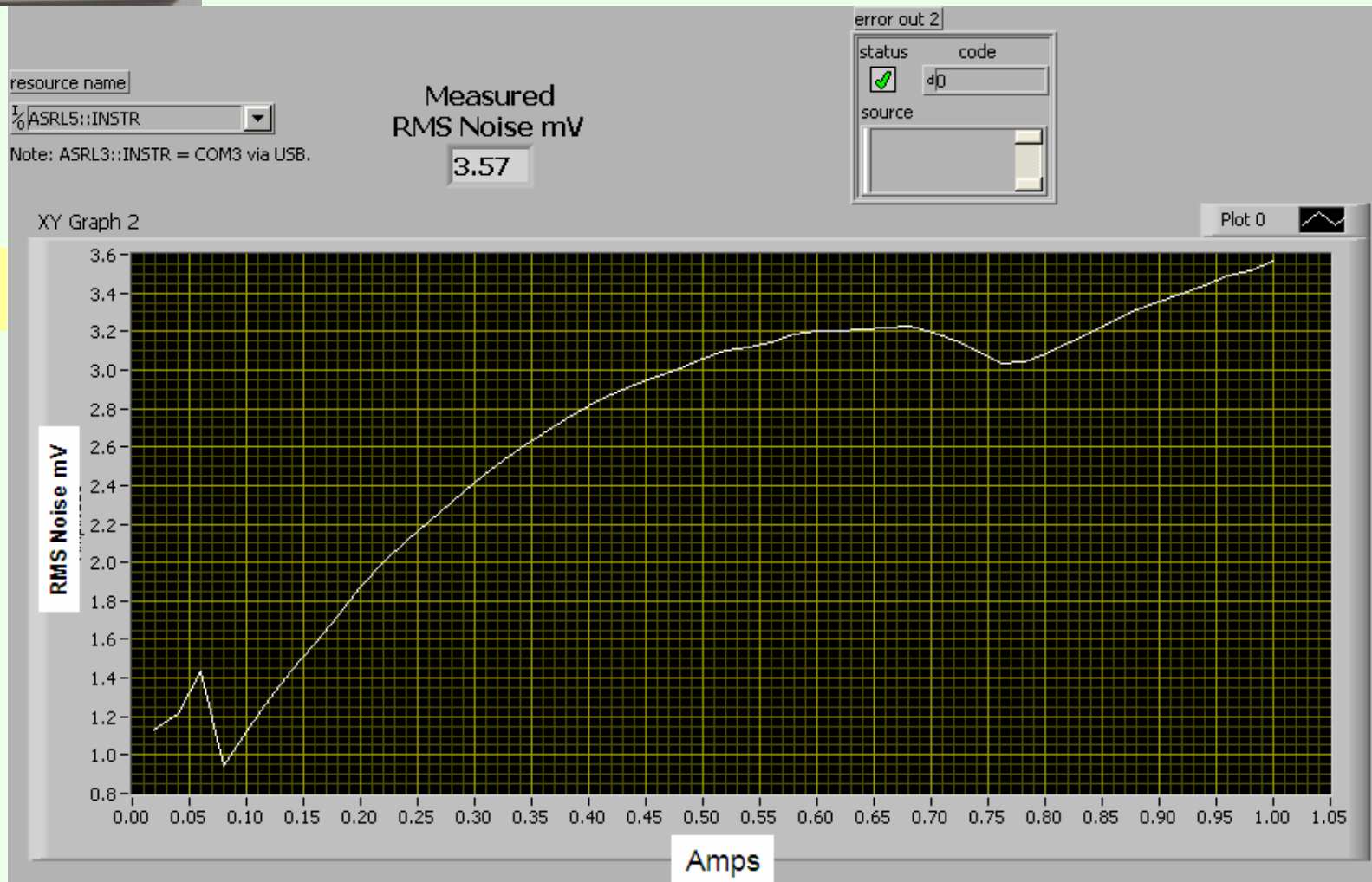**AC to DC Adapter**

Wall Plug Unit #RCA WP2UWR   Top USB port
AC to DC Adapter

LOWEST Noise measured

error out 2

status   code

☑   d0

source

resource name

I% ASRL5::INSTR

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

3.57

XY Graph 2

Plot 0
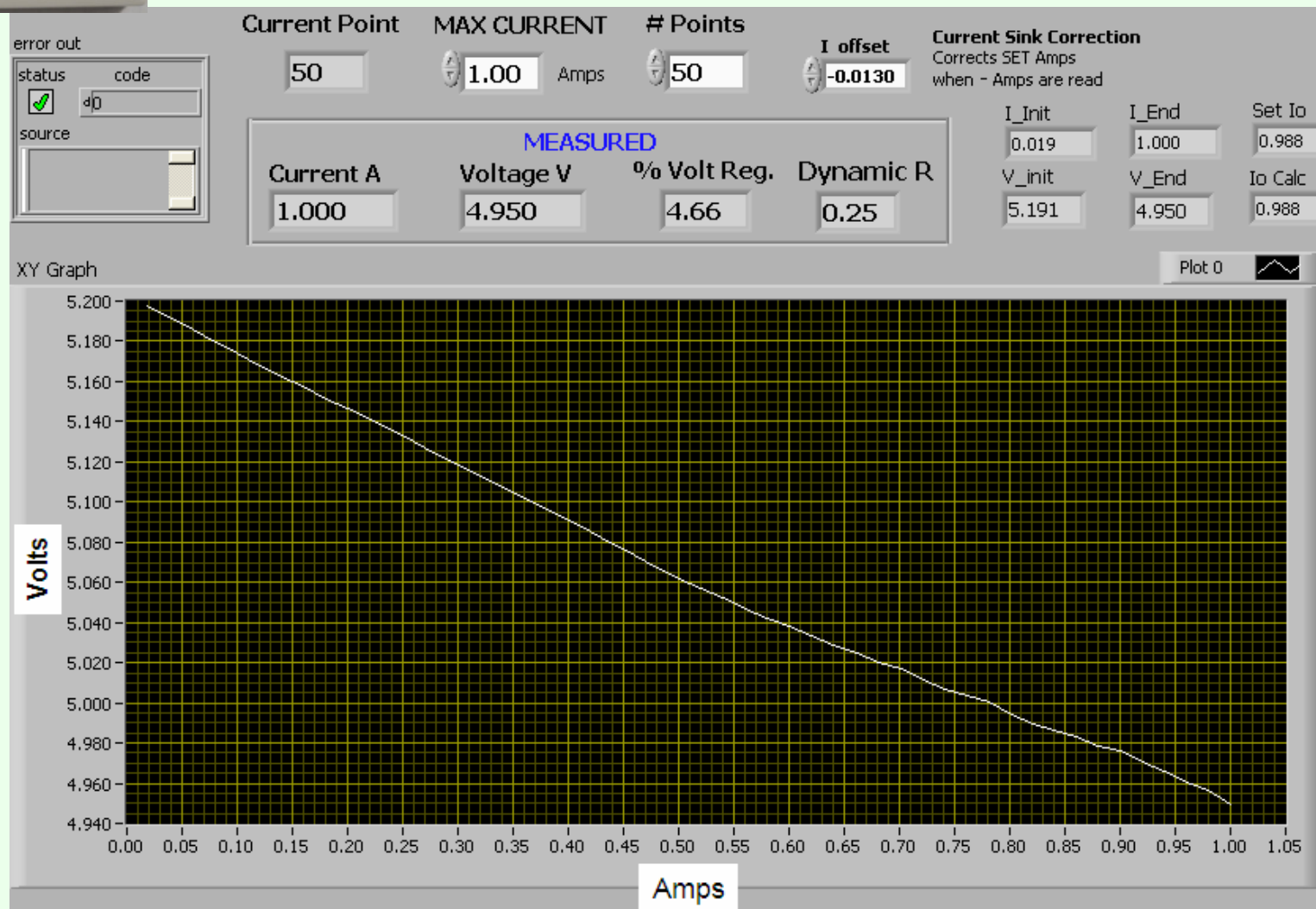
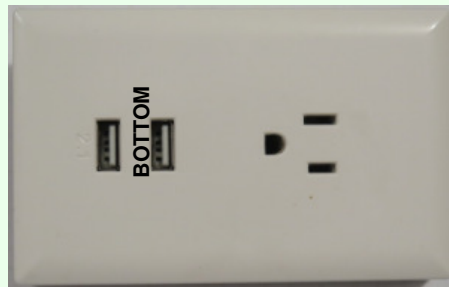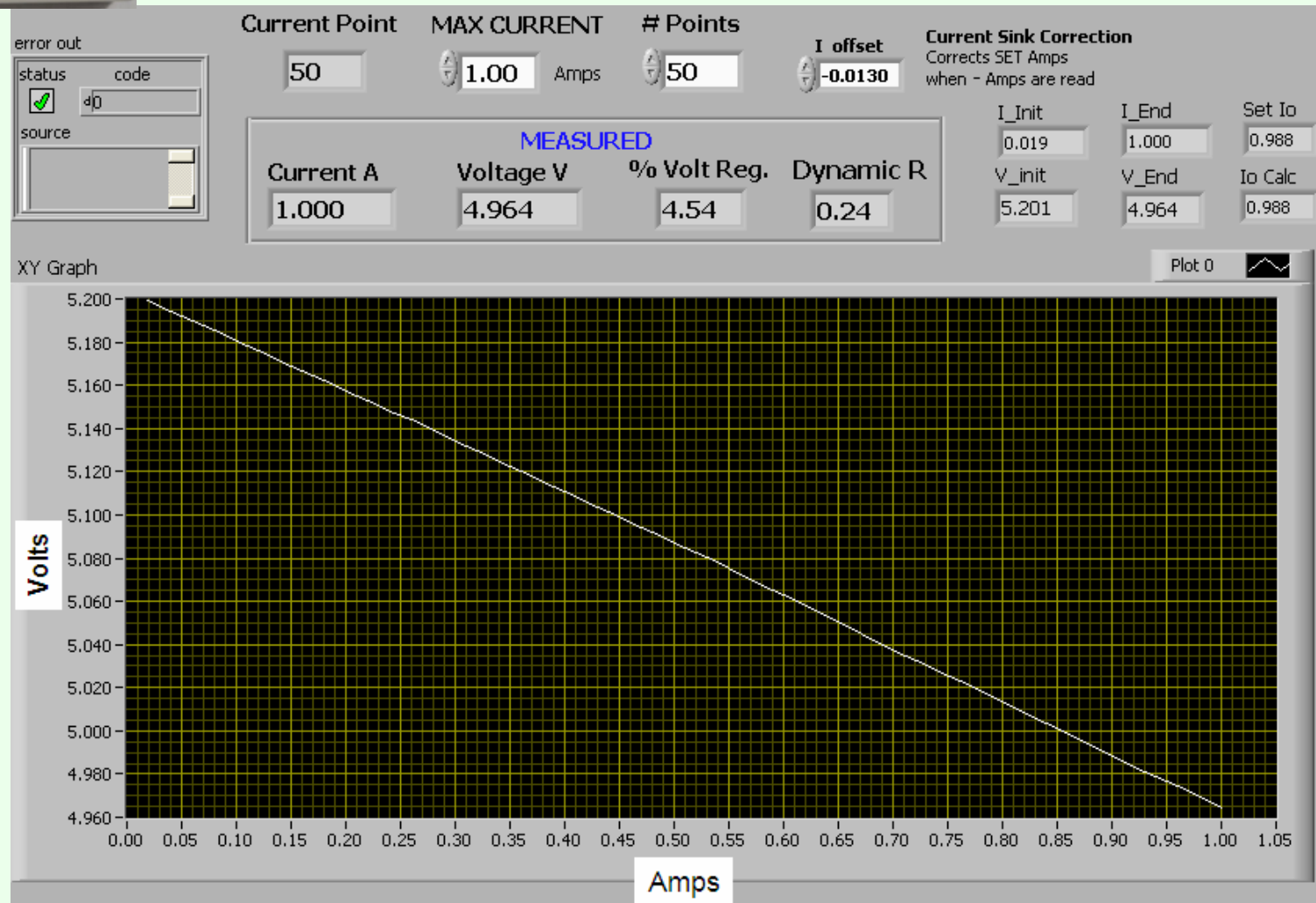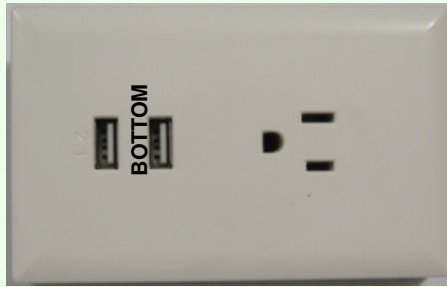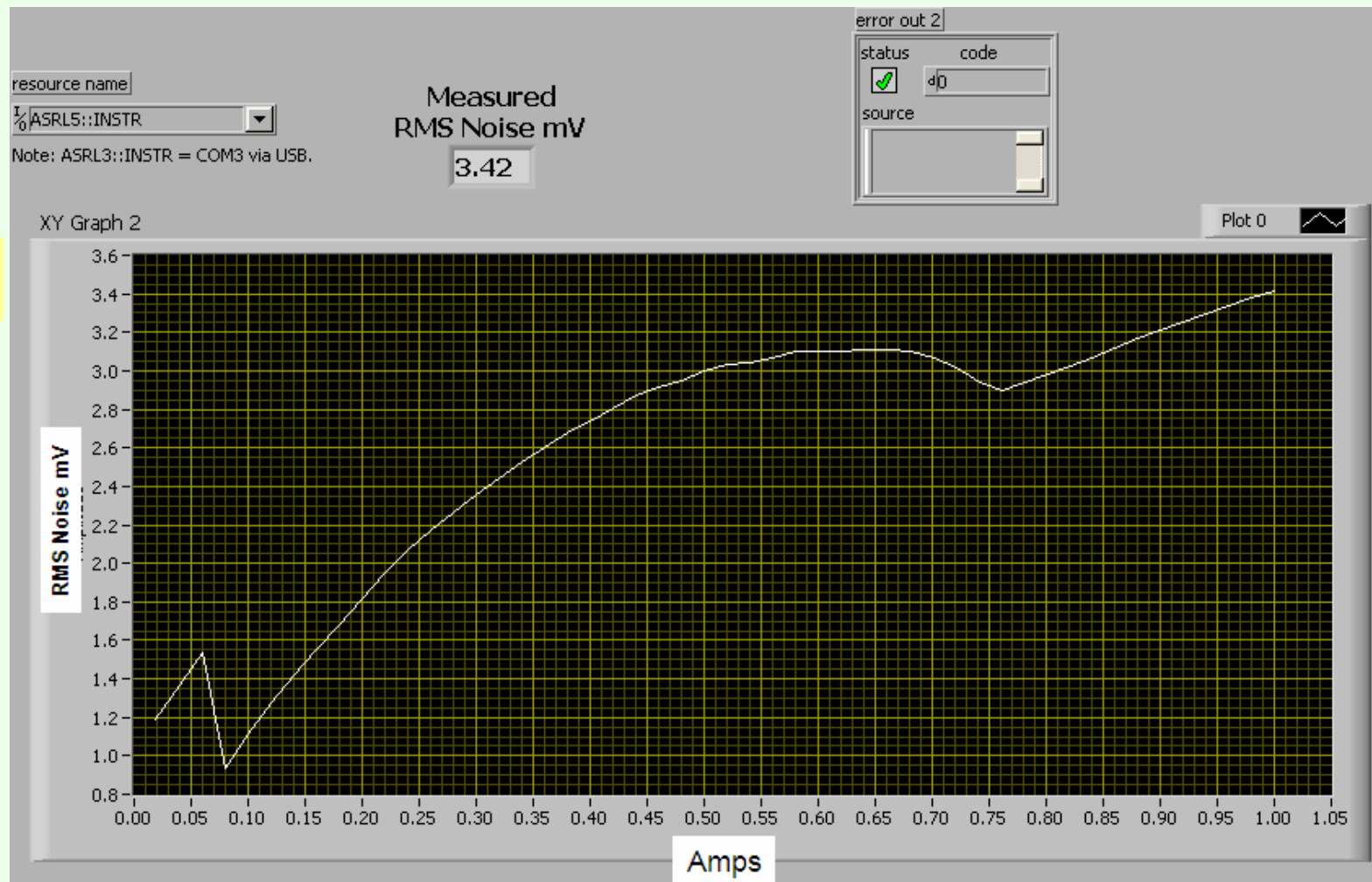# Wall Plug Unit #RCA WP2UWR   Bottom USB port
AC to DC Adapter

Wall Plug Unit #RCA WP2UWR   Bottom USB port
AC to DC Adapter

LOWEST Noise measured
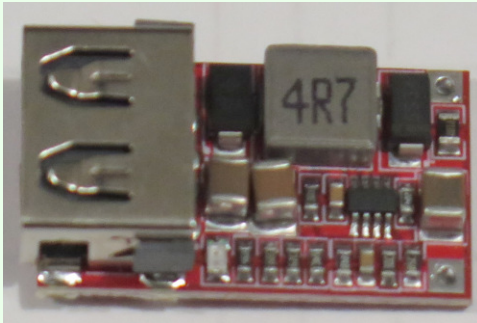
5V Converter @ 12V INPUT (~ $1.50 on EBAY)
DC to DC Adapter

Regulation = 6.1%

error out			Current Point	MAX CURRENT	# Points	I offset	Current Sink Correction
status	code		50	1.00 Amps	50	-0.0130	Corrects SET Amps when − Amps are read

	I_Init	I_End	Set Io
	0.019	1.000	0.988

MEASURED

Current A	Voltage V	% Volt Reg.	Dynamic R		V_init	V_End	Io Calc
1.000	4.805	6.11	0.32		5.118	4.805	0.988

XY Graph

Plot 0

Volts (y-axis: 4.800 to 5.140)

Amps (x-axis: 0.00 to 1.05)

40
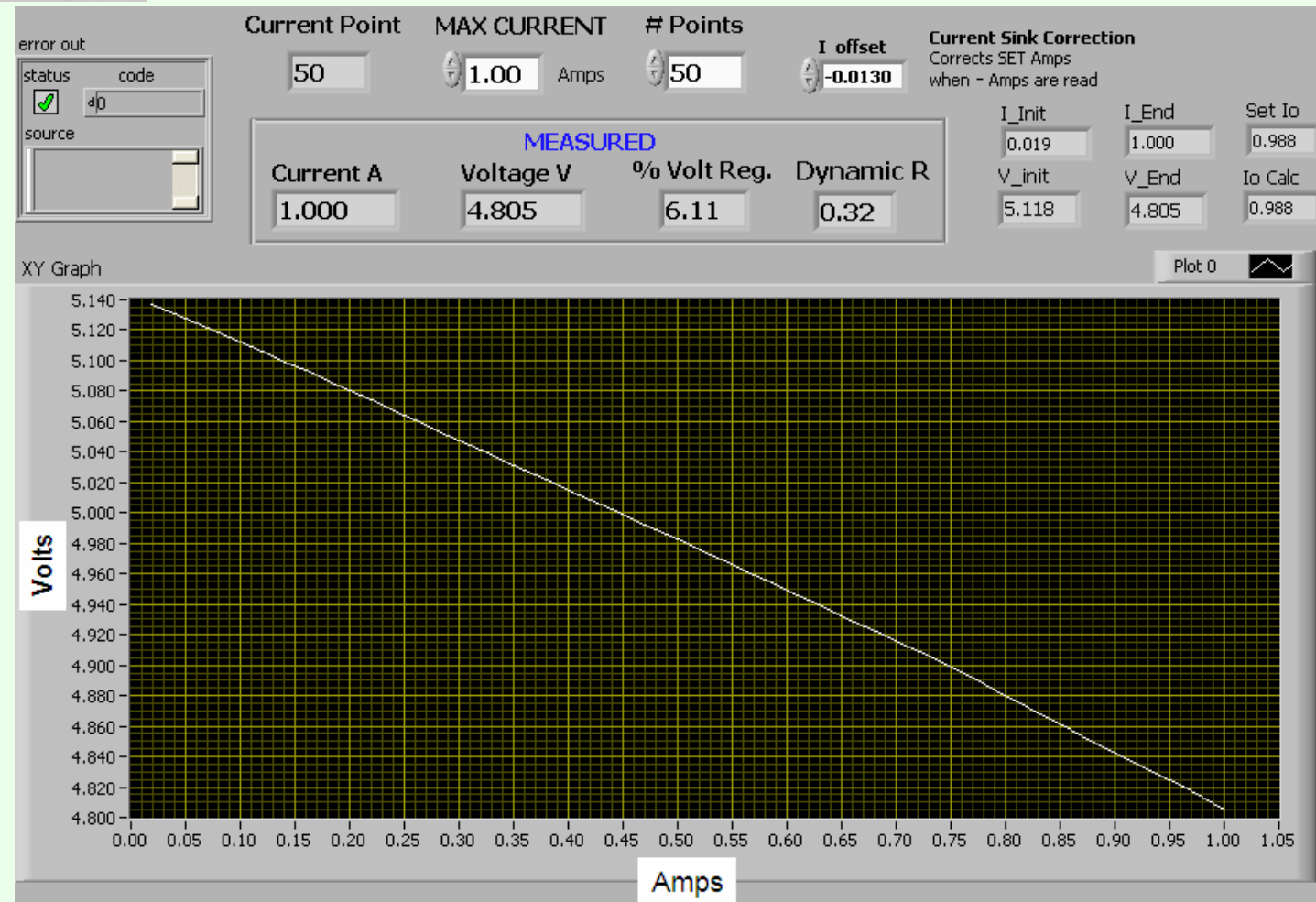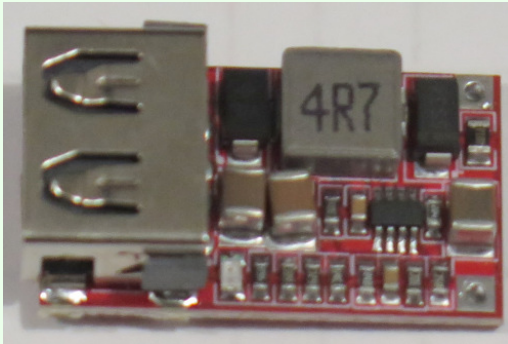
DC-DC USB 5V Converter @ 12V INPUT
DC to DC Adapter

LOW Noise,
decreasing with
increasing current

Generates EMI
in the FM band

resource name
⅛ ASRL5::INSTR
Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV
3.87

error out 2
status   code
✓   d0
source

XY Graph 2

Plot 0

RMS Noise mV vs Amps

DC-DC 12V Plug Adapter 1A
DC to DC Adapter

	Current Point	MAX CURRENT	# Points	I offset	Current Sink Correction
	50	1.00 Amps	50	-0.0130	Corrects SET Amps when – Amps are read

error out

status   code
✔   d0

source
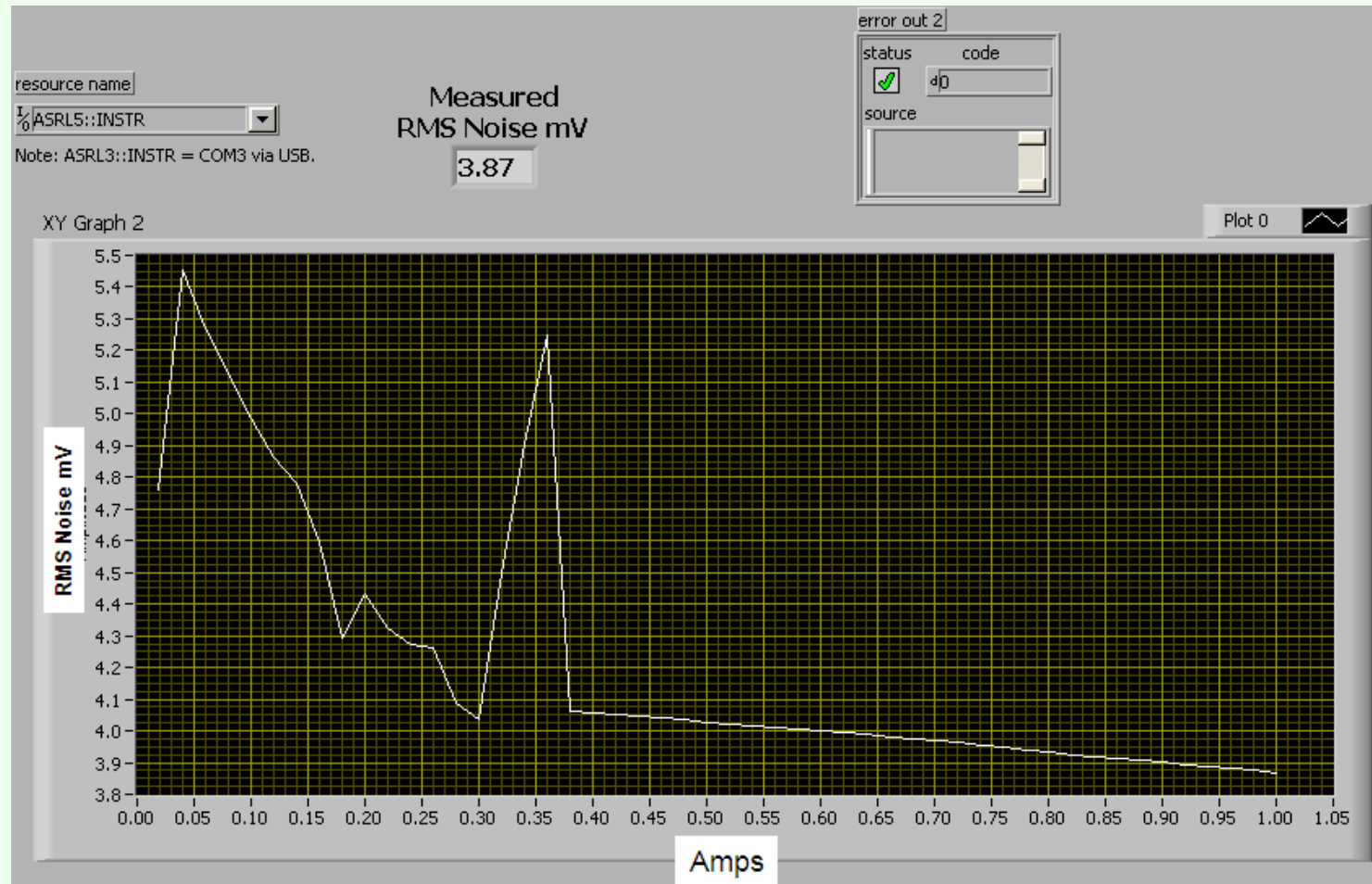
MEASURED

	Current A	Voltage V	% Volt Reg.	Dynamic R
	1.000	4.975	3.18	0.17

I_Init	I_End	Set Io
0.019	1.000	0.988

V_init	V_End	Io Calc
5.139	4.975	0.988
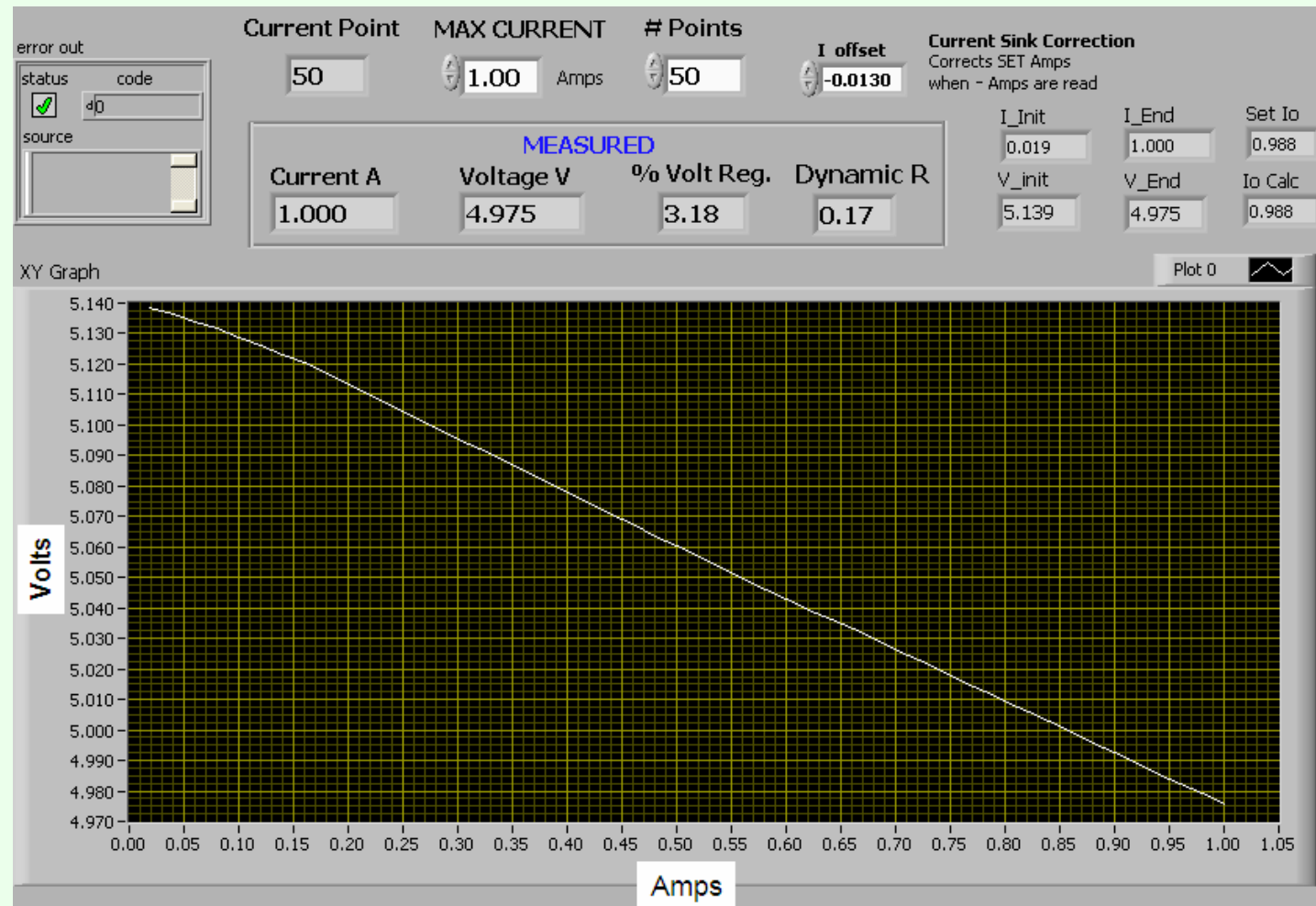
DC-DC 12V Plug Adapter 1A
DC to DC Adapter

LOW Noise

Generates EMI
in the FM band

error out 2

status   code

source

resource name

⅟₀ ASRL5::INSTR

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

5.56

XY Graph 2   Plot 0

RMS Noise mV (y-axis): 2.4 to 5.6

Amps (x-axis): 0.00 to 1.05

12V Plug Adapter   1A port
DC to DC Adapter

Input:DC12-24V
Output:DC5V-2.1A

error out

status	code
✓	d0

source

Current Point

50

MAX CURRENT

1.00   Amps

 # Points

50

I offset

-0.0130

Current Sink Correction
Corrects SET Amps
when - Amps are read

MEASURED

Current A	Voltage V	% Volt Reg.	Dynamic R
1.000	4.942	3.29	0.17

	I_Init	I_End	Set Io
	0.019	1.000	0.988
	V_init	V_End	Io Calc
	5.110	4.942	0.988

XY Graph

Plot 0

12V Plug Adapter   1A port
DC to DC Adapter

LOW Noise

Measured
RMS Noise mV

6.64

error out 2

status   code
✓   0

source

resource name

ASRL5::INSTR

Note: ASRL3::INSTR = COM3 via USB.

XY Graph 2

Plot 0

12V Plug Adapter   2A port
DC to DC Adapter

12V Plug Adapter   2A port
DC to DC Adapter

LOW Noise

error out 2

status   code

source

resource name

ASRL5::INSTR

Note: ASRL3::INSTR = COM3 via USB.

Measured
RMS Noise mV

7.99

XY Graph 2

Plot 0