| | | | | |
|---|---|---|---|---|
| **Vizsgálati jegyzőkönyv sz.:** *Test Report No.:* | **28231499 001** | **Rendelés sz.:** *Order No.:* | **93349605** | **Oldal 1 / 40** *Page 1 / 40* |
| **Megbízó:** *Client:* | **MTB Invest Kft** 1141 Budapest Szentes utca 8, Hungary | | | |
| **Gyártó:** *Manufacturer:* | **Inventors: Attila Szűcs, Sándor Csernák** | | | |
| **Vizsgálat tárgya:** *Test item:* | **Fast charger testing on Winston Battery LP12V20AHB battery.** | | | |
| **Azonosítás:** *Identification:* | **Prototype 1** | **Széria sz.:** *Serial No.:* | - | |
| **Raktározási szám.:** *Receipt No.:* | - | **Átvételi dátum:** *Date of receipt:* | - | |
| **Vizsgálati tárgy állapota:** *Condition of test item:* | **Hiánytalan, sérülésmentes** *Complete, undamaged* | **Vizsgálat ideje:** *Duration of test:* | **2016. 02.22-2016.03.03.** | |
| **Vizsgálati előírás:** *Test specification:* | **Lásd a jegyzőkönyvben** *See test report* | | | |
| **Vizsgálat helyszíne:** *Testing location:* | **TÜV Rheinland InterCert Kft.** H-1135 Budapest, Béke út 41-43, Hungary | | | |
| **Vizsgáló laboratórium:** *Testing Laboratory:* | **TÜV Rheinland InterCert Kft.** H-1135 Budapest, Béke út 41-43, Hungary | | | |
| **Vizsgálati eredmény:** *Test Result:* | **Lásd a jegyzőkönyvben** *See test report* | | | |

**Vizsgálta/** *tested by:*

Tamás Wald

| **Dátum** *Date* | **Név, feladatkör** *Name, function* | **Aláírás** *Signature* |
|---|---|---|

**Ellenőrizte/** *reviewed by:*

Gábor Kazi

| **Dátum** *Date* | **Név, feladatkör** *Name, function* | **Aláírás** *Signature* |
|---|---|---|

**Egyéb szempontok/** *Other Aspects:*

**Tartalomjegyzék/Contents:**



**Mellékletek:** --

| Rövidítések: | | | | *Abbreviations:* | | | |
|---|---|---|---|---|---|---|---|
| | P(ass) | = | megfelelő | | *P(ass)* | = | *passed* |
| | F(ail) | = | nem megfelelő | | *F(ail)* | = | *failed* |
| | N/A | = | nem vonatkozik | | *N/A* | = | *not applicable* |
| | N/T | = | nem vizsgált | | *N/T* | = | *not tested* |

## 1. Measurement procedure

### Goal of testing

Verification of the energy loaded into a battery, using the fast charger, and standard DC charger with discharging with the same method (DC CC mode 1C) and logging the data with accurate, and calibrated instruments (power analyzer).

Verification of the operation of resonance frequency charger with reference battery.

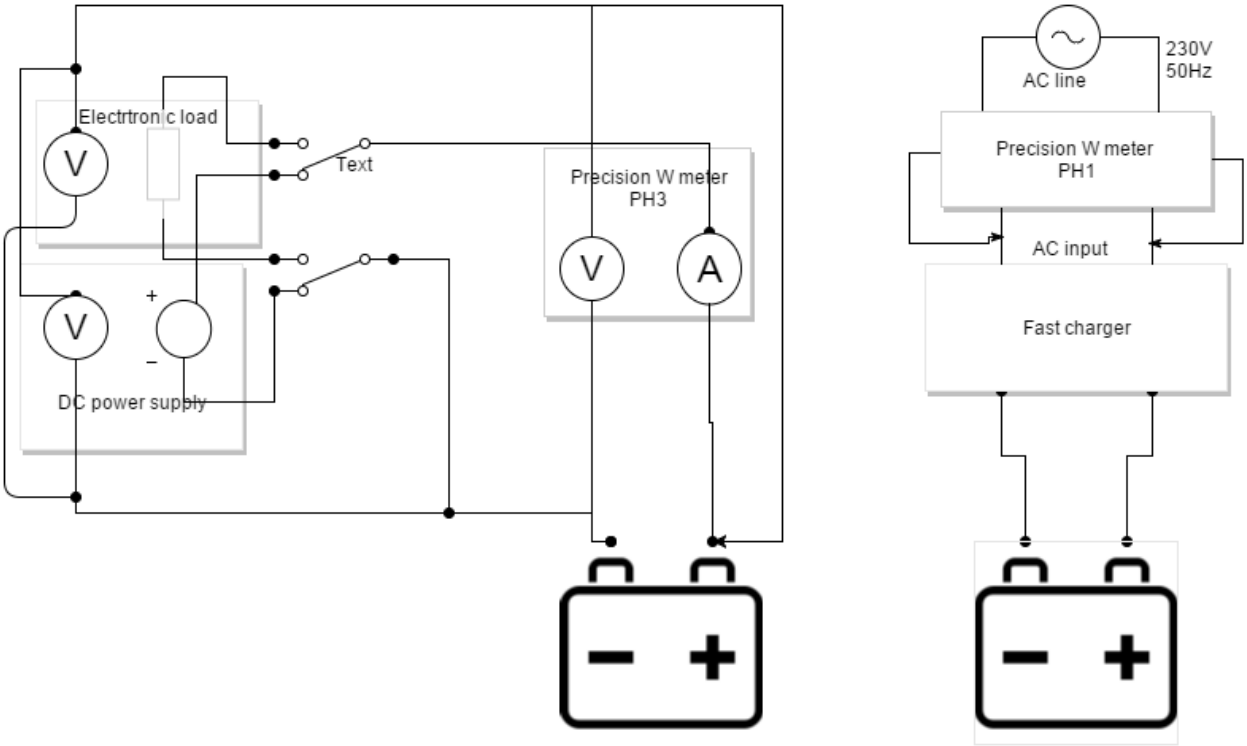
This verification consist of measuring the amount of input AC power of the charger, battery temperature during charge, and basic safety of the battery. (No explosion, no fire, no leakage)

The battery is discharged with a calibrated electronic load.

## 2. Test schedule:

1. Charging battery with fast charger (Charger's input AC power logged for information)
2. Discharging the battery with constant current to the specified voltage.
   During discharge, data logging, voltage, current, time SoC/Ah (Integrated current by time), Wh with (precision power analyzer), Temperature measured with thermocouple connected to precision multimeter.
3. Charging battery with DC power supply, CC-CV method.
   During charge, data logging, voltage, current, time SoC/Ah (Integrated current by time), Wh with (precision power analyzer), Temperature measured with thermocouple connected to precision multimeter.
4. Discharging the battery with constant current to the specified voltage.
   During discharge, data logging, voltage, current, time SoC/Ah (Integrated current by time), Wh with (precision power analyzer), Temperature measured with thermocouple connected to precision multimeter
5. Charging battery with fast charger (Charger's input AC power logged for information)
6. Discharging the battery with constant current to the specified voltage.
   During discharge, data logging, voltage, current, time SoC/Ah (Integrated current by time), Wh with (precision power analyzer), Temperature measured with thermocouple connected to precision multimeter.

## 3. Test arrangement



## 4. Measurement equipment

| *Measuring equipment* | Manufacturer | *Type* | *Inventory No.* | *Next calibration* | Additional equipment /notes | Channels |
|---|---|---|---|---|---|---|
| Precision power analyzer | Newton's4th | KinetiQ PPA5530 | 01633002 | 2016.08.06. | | PH1: Fast charger AC input<br>PH3: Battery<br>Details see below |
| Precision multimeter | Picotest | M3510A | 01625042 | 2016.08.06. | K type thermocouple | Temperature |
| Multichannel datalogger | Graphtec | GL-220 | 01625074 | 2016.08.26. | K type thermocouples | Temperature_ g[1..4] |
| Electronic load (for CC discharging to specified voltage "Battery mode") | BK-Precision | 8510 | 01623043 | 2016.05.18. | Voltage sense input directly connected to battery. | No computer interface. |
| DC Power supply (for DC charging with CC-CV) | Ametek-Sorensen | XG-60-25 | 01623049 | 2016.05.18. | Voltage sense input directly connected to battery. | No computer interface. |

All used instrument's complete calibration reports attached.

Power analyzer channels at battery discharging and DC charging
Measured from voltage and current on PH3 inputs

- Accu_DC Current
- Accu_DC Voltage
- Accu_Watt
- Accu_Integrated RMS Current
- Accu_Integrated Watts

Power analyzer channels at fast charger's input power measurements
Measured from voltage and current on PH1 inputs

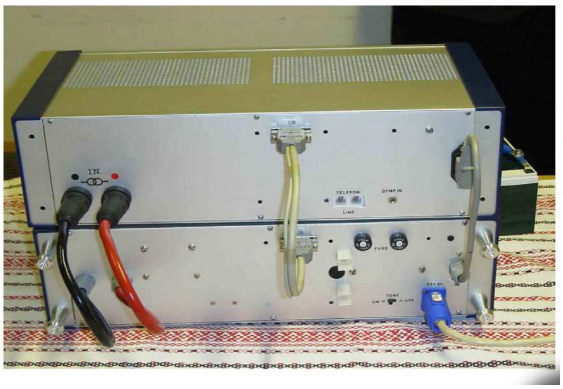
- AC_Charger_input_Frequency
- AC_Charger_input_Integrated VA
- AC_Charger_input_Integrated VAr
- AC_Charger_input_Integrated Watts
- AC_Charger_input_Power Factor
- AC_Charger_input_RMS Current
- AC_Charger_input_RMS Voltage
- AC_Charger_input_VA
- AC_Charger_input_VAr
- AC_Charger_input_Watt

For measuring/calculating principles see the instrument's manual.

## 5. Equipment under test

Fast Resonance Battery charger

| **Output** | **Pulse series on resonance frequency** |
|---|---|
| Charging voltage range | Regulated pulse series up to 30V |
| Charging current range | max 100A (impulses) |
| Charging time | Approx 25-40min |
| | |
| **Input** | |
| Voltage | 220-230V |
| Current | 10A |
| Frequency | 50Hz |

**METHOD AND CIRCUIT ARRANGEMENT FOR FAST RECHARGING BATTERIES HAVING ADHERENT ELECTROLYTE**

**Application number: P0700282**

**Registration number: 229590**

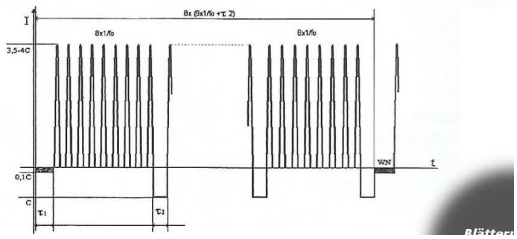
**ABSTRACT**

The invention is a method and/or a circuit arrangement suitable for quick charging of batteries containing fixed electrolyte on the basis of the dr. Wronski effect.

The resonance frequency of the battery is detected by digital frequency response-function analysis, by discharging white noise current, it is charged by superposed alternating current of 0.1 C, later 3.5-4 C, for 8 periods, then a discharging DC current of1 C is used for 0.1 ms time, this cycle is repeated 8 times, then the whole process is repeated again.

The signal shape of the superposed alternating current impulses is produced by an efficiency-improving circuit, which feeds the oscillating circuit of the battery with energy through a performance-impulse modulator (see figure 4).

The main point of the circuit arrangement is that its control unit controlling the main circuit sets the value of $f_0$ by an accuracy of ±2% during the charging by a circuit of digital frequency response-function analysis.

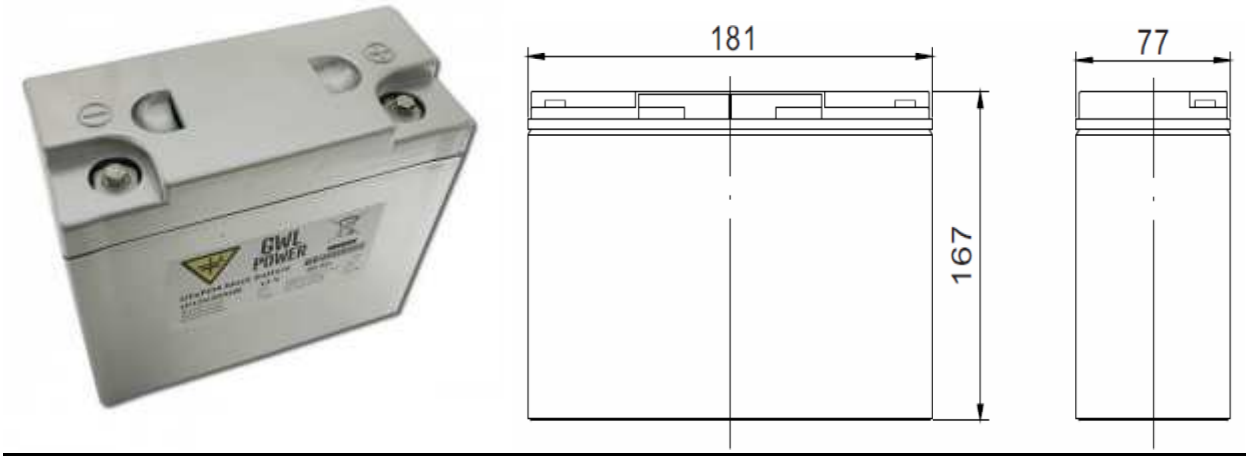


Battery

GWL/ Power Group Technology Solutions - Stay Powered for the Future

**LP12V20AHB battery specification**

| | | |
|---|---|---|
| Model name | LP12V20AHB | Alternative product marking LP12V-20AH |
| Nominal voltage | 12 V | Operating voltage under load is 12.0 V |
| Capacity | 20 AH | +/- 5% |
| Operating voltage | max 14.8V - min 11.5V | At 80% DOD, > 1500 cycles |
| Deep discharge voltage | 11 V | The cells is damaged if voltage drops bellow this level |
| Maximal charge voltage | 15V | The cells is damaged if voltage exceeds this level |
| Optimal discharge current | < 10 A | 0.5 C |
| Maximal discharge current | < 60 A | 3 C, continuous for max 15 minutes from full charge |
| Max peak discharge current | < 200 A | 10 C, maximal 5 seconds in 1 minute |
| Optimal charge current | < 10 A | 0.5 C |
| Maximal charge current | < 20 A | < 1 C with battery temperature monitoring |
| Working Temperature | Charging: >0°C | The battery temperature should not increase this level |
| | Discharging：-20°C～65°C | The battery temperature should not increase this level |
| Dimensions | 181 x 167 x 77 | Millimeters (tolerance +/- 2 mm) |
| Weight | 3.4 kg | Kilograms (tolerance +/- 150g) |




Before this test, the battery was charged more than 2000 times with the fast charger, and 500 times with standard DC charger.

## 6. Measurement results:

DC charging has **negative** sign, discharging has **positive** sign.

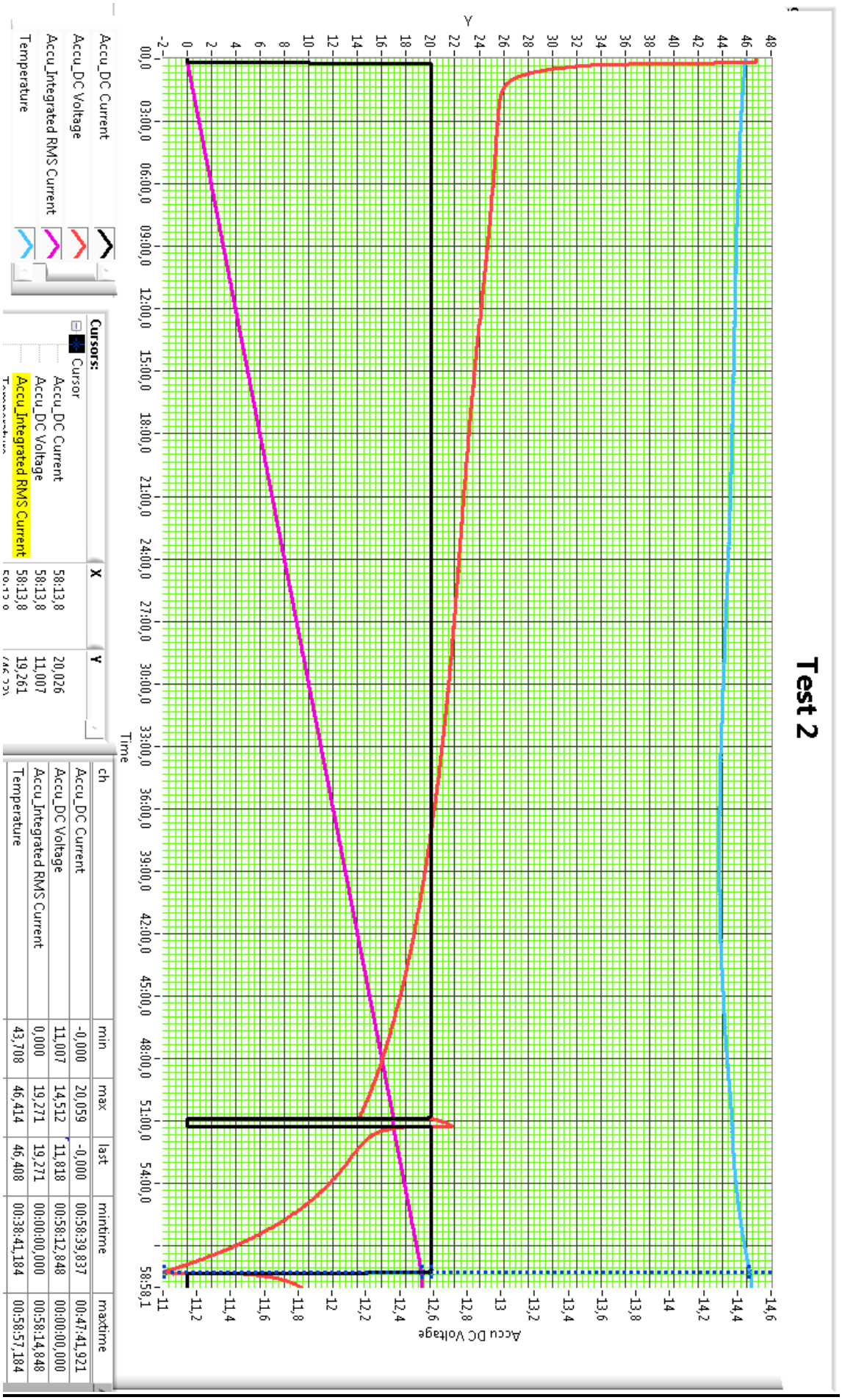
| Nr | Date 2016.- | Test | Duration [hh:mm:ss] | Start | Finish | | |
|---|---|---|---|---|---|---|---|
| | | | | Voltage | Voltage | Soc [Ah] | ΔTemp [°C] |
| 1 | Feb. 22 14:00 | Fast charging | - | - | 14,512 | - | - |
| 2 | Feb. 22 15:10 | Discharge 12,2V->11V 20A | 0:50:57 0:58:11 | 14,512 | 12,166 11,007 | 16,931 19,261 | 0,5 (45,9-46,4) (Session 1) |
| 3 | Feb. 22 16:42 | Long DC charging 2A, 13,2V | 21:34:04 | 12,571 | 17,272 | -19,356 | -19 (40,9-21,9) (Session 4) |
| 4 | Feb 23 17:22 | Discharging to 11V 20A | 0:57:53 | 16,287 | 10,998 | 19,026 | 16,9 (21,7-38,6) 5 |
| 5 | Feb. 24 15:47 | DC charging 2A, 13,7V | 17:13:30 | 12,891 | 13,921 | -18,692 | 0,4 (24,4-24,8) 6 |
| 6 | Feb 29 8:49 | Discharge to 11V 20A | 0:56:45 | 13,43 | 10,917 | 18,556 | 15 (22,7-37,7) (session 16) |
| 7 | Feb 29 9:52 | Fast charging Format switch off | 0:27:43 | - | - | - | 18 (37-55) 17 |
| 8 | Feb 29 10:25 | Discharge to 11V 20A | 0:53:49 | 13,38 | 10,985 | 17,831 | -4,1 (max 54,9) 18 |
| 9. | Feb 29 11:55 | Fast charge Format switch off | 0:19:47 | ** | - | - | 10,2 (43,2-53,4) 20 |
| 10 | Feb 29 12:36 | Discharge to 11V 20A | 0:36:43 | 13,279 | 10,986 | 12,164 | -3,1 (48,4-45,3) 21 |
| 11 | Feb 29 13:16 | Fast charge Format switch on | 0:30:39 | - | - | - | 15,5 (46,8-62,3) 22 |
| 12 | Feb 29 13:51 | Discharge to 11V 20A | 1:02:24 | 14,242 | 10,994 | 19,425 | 6,6 (58,8-52,2) 23 |
| 13 | Feb 29 15:46 | DC charge 13V 5A CC-CV | 16:09:25 | 12,468 | 13,093 | -3,717 | -18,3 (42,3-24) 24 |
| 14 | Marc 1 8:00 | Fast charge | 0:24:19 | - | - | - | 16 (23-49) 25 |
| 15 | Marc 1 8:29 | Discharge *12V 20A | 0:51:38 | - | 11,962 | 17,106 | 1,7 (48,9-47) 26 |
| 16 | Marc 1 9:24 | Fast charge | 0:27:40 | - | - | - | 10,8 (45,8-56,6) 27 |
| 17 | Marc 1 10:26 | Discharge *12V 20A | 0:50:52 | 13,356 | 11,966 | 16,816 | -3,8 (51,3-47,5) 28 |

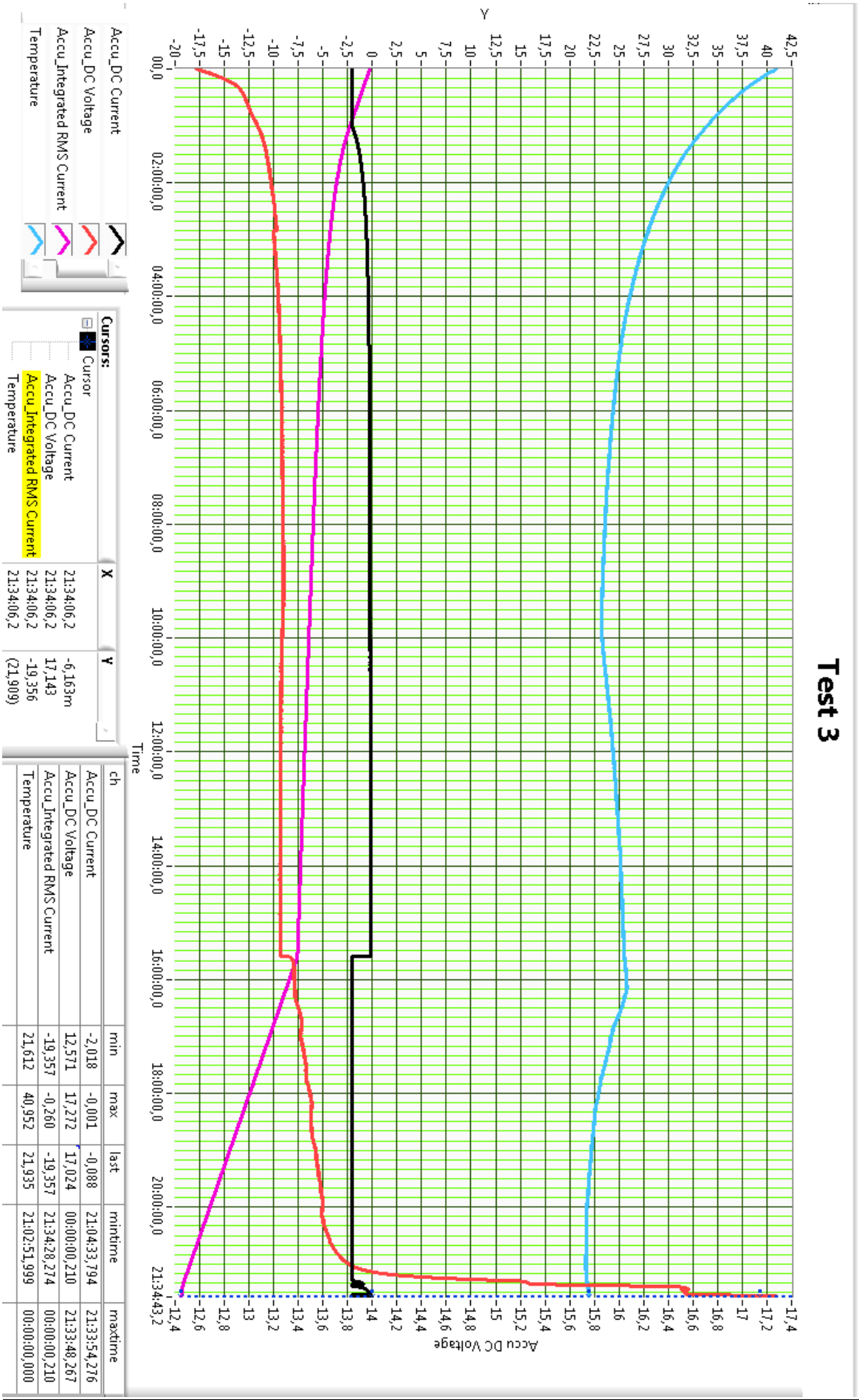
| Nr | Date 2016.- | Test | Duration [hh:mm:ss] | Start | Finish | | |
|---|---|---|---|---|---|---|---|
| | | | | Voltage | Voltage | Soc [Ah] | ΔTemp [°C] |
| 18 | Marc 1 11:28 | DC charge standard LiFe charger | 20:36:17 | 12,795 | 14,426 | -18,158 | -22,2 (46,1-23,9) 29 |
| 19 | Marc 2 8:56 | Discharge 20A 12V | 0:48:18 | 14,402 | 12,017 | 15,996 | - |
| 20 | Marc 2 9:03 | Fast charge | 0:24:25 | - | - | - | 17,7(33,4-51,1) 31 |
| 21 | Marc 2 9:35 | Discharge 20A 12V | 0:50:50 | 13,386 | 11,984 | 16,943 | -5,5(51,6-46,1) |
| 22 | Marc 2 10:56 | Fast charge | 0:13:56 | ** | - | - | 7,2(40,5-47,7) 33 |
| 23 | Marc 2 11:21 | Discharge 20A 12V | 0:26:03 | 13,258 | 11,983 | 8,597 | 1,3(47,3-46) 34 |
| 24 | Marc 2 11:53 | Fast charge | 0:32:03 | ** | - | - | 18,7(44,4-63,1) 35 |
| 25 | Marc 2 12:57 | Discharge 20A 11V | 1:00:47 | 15,817 | 10,974 | 20,252 | -3,7(54,2-50,5) |
| 26 | Marc 2 14:15 | Fast charge | 0:28:05 | - | - | - | 11,4 (46,3-57,7) |
| 27 | Marc 3 8:49 | Discharge 20A 11V | 0:48:20 | 13,302 | 10,9 | 16,145 | 12,6(22,6-35,2) |
| 28 | Marc 3 10:30 | Fast charge | 0:25:50 | ** | - | - | 22,6(32,8-55,4) 39 |
| 29 | Marc 3 11:04 | Discharge 20A 11V | 0:50:58 | 13,366 | 10,979 | 16,943 | -0,61(49,8-49,19) 40 |
| 30 | Marc 3 12:07 | Fast charge | 0:27:33 | ** | - | | 7,9(45,1-53) 41 |
| 31 | Marc 3 12:43 | Discharge 20A 12V | 0:45:53 | 13,365 | 11,959 | 15,268 | -11,2(60-48,8) 42 |
| 32 | Marc 3 14:10 | Fast charge | 0:27:31 | ** | - | | 20,1(36,8-56,9) 43 |
| 33 | Marc 3 14:46 | Discharge 20A 12V | 0:48:32 | 13,383 | 11,947 | 16,182 | -7,4(55,2-47,8) 44 |

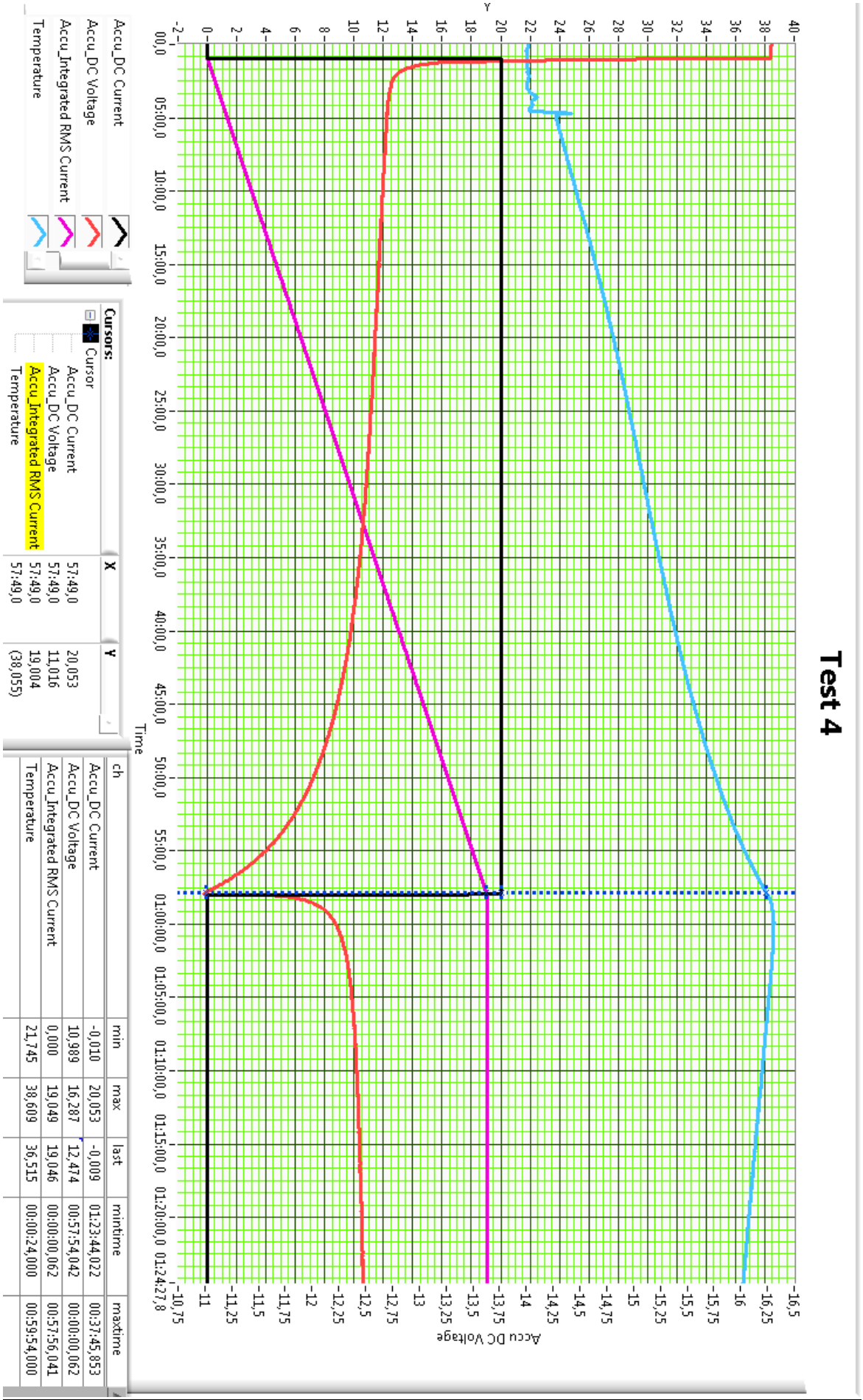
** Fast charger AC input power measured.

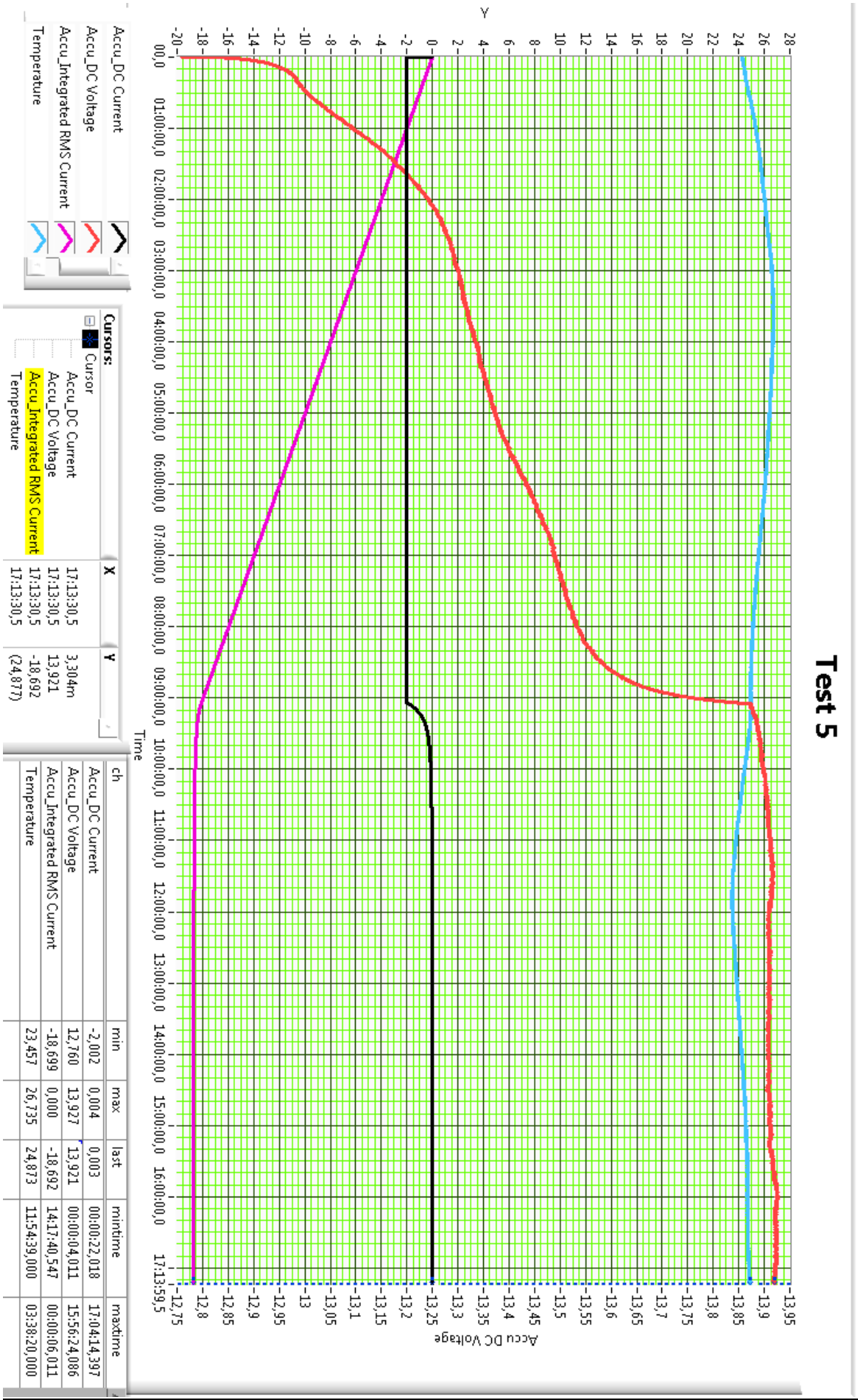
**Note:**

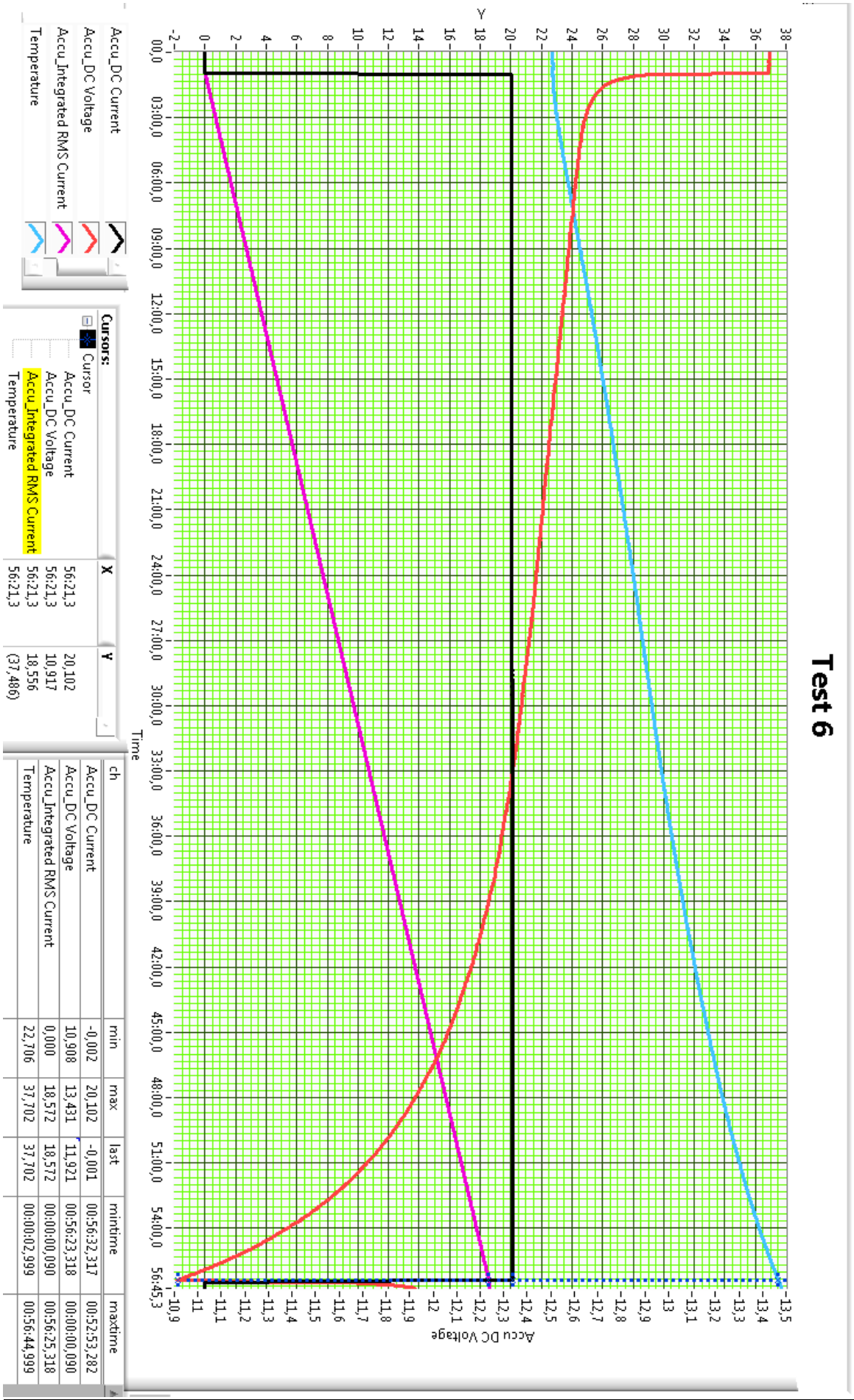
12V might be the voltage where the vehicle's electronic determines the battery empty state. Under this limit the voltage decreases fast in case of further load.

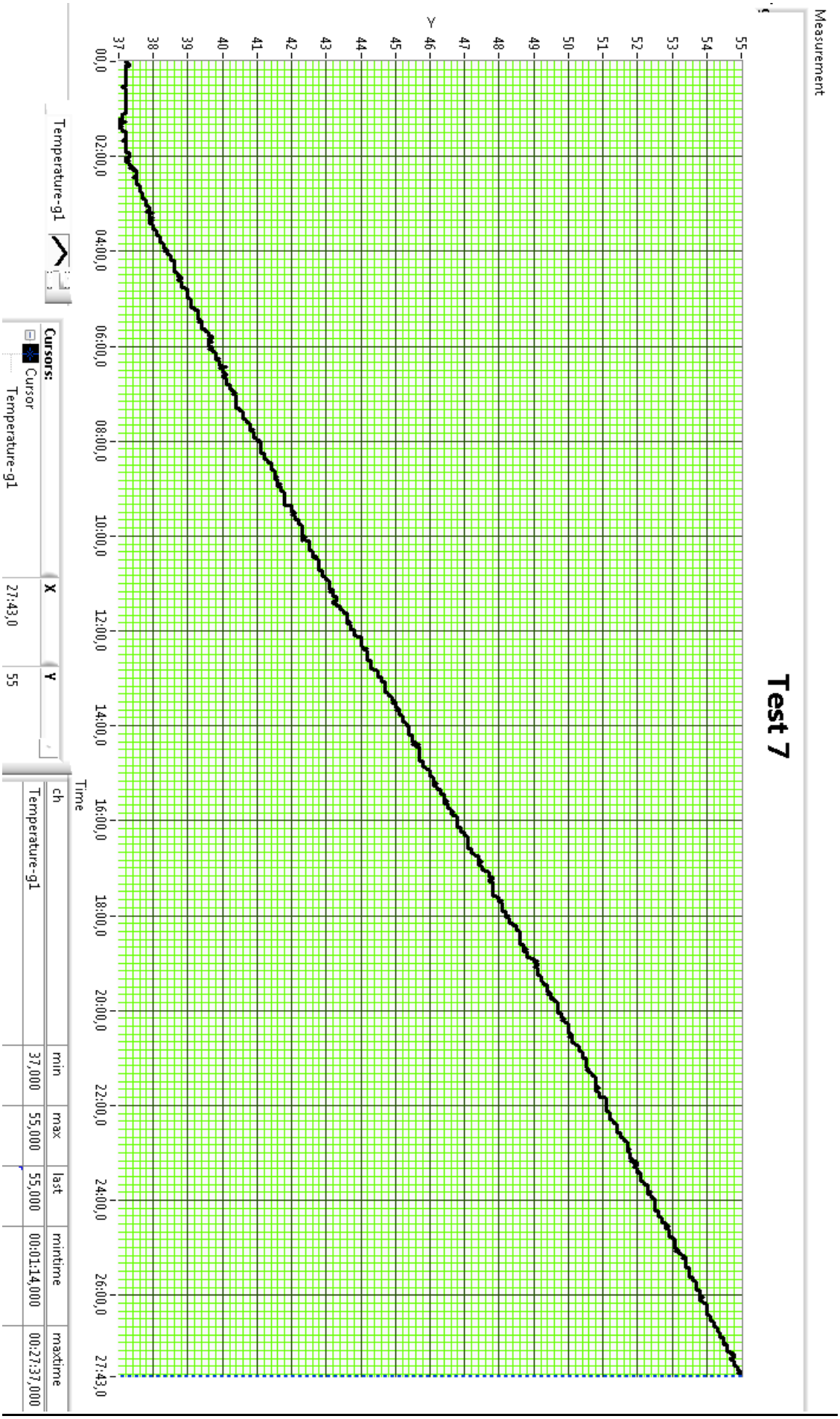

Test 2
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
X
Y
58:13,8
58:13,8
58:13,8
20,026
11,007
19,261
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,000
20,059
-0,000
00:58:39,837
00:47:41,921
Accu_DC Voltage
11,007
14,512
11,818
00:58:12,848
00:00:00,000
Accu_Integrated RMS Current
0,000
19,271
19,271
00:00:00,000
00:58:14,848
Temperature
43,708
46,414
46,408
00:38:41,184
00:58:57,184

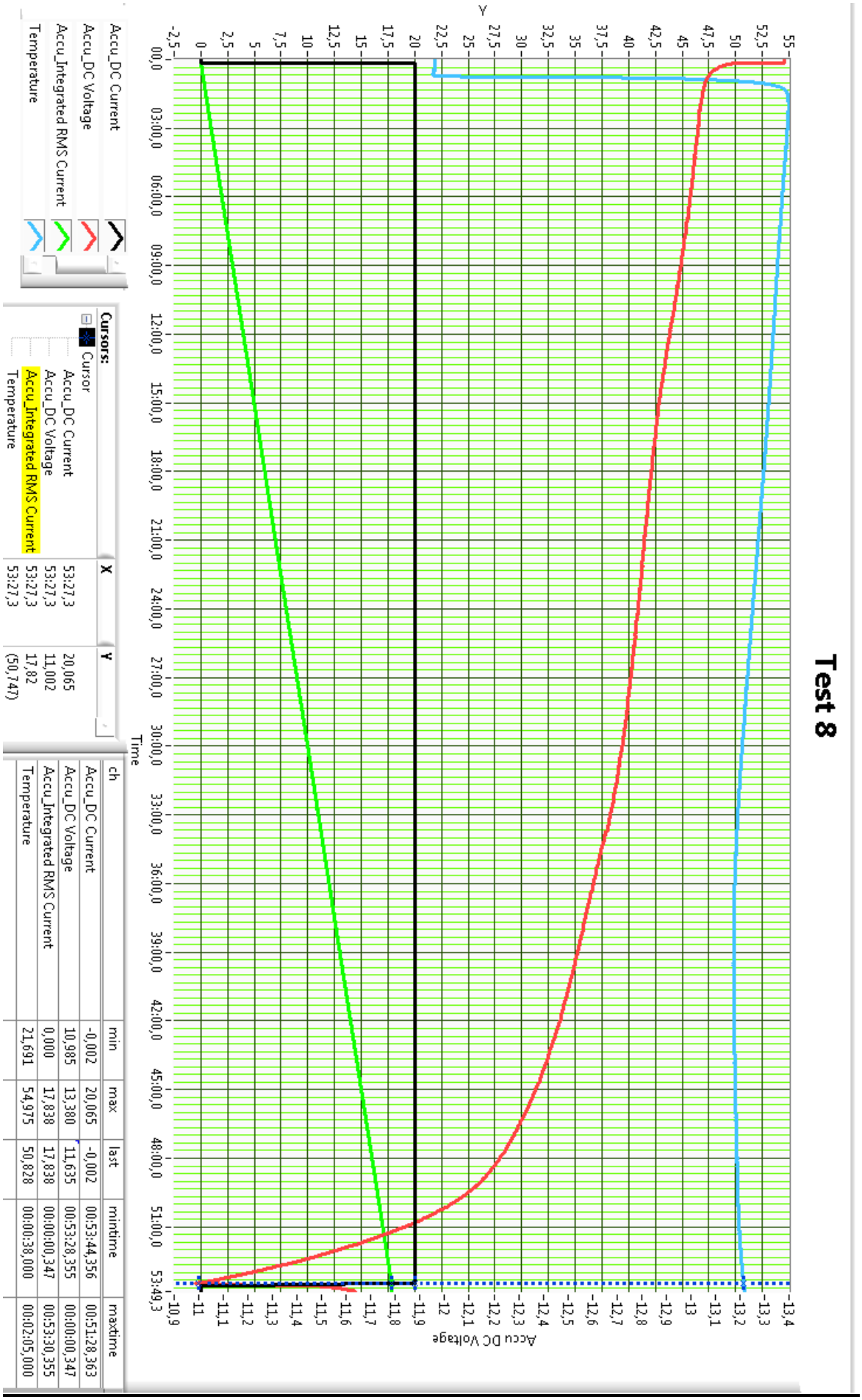

Test 3
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
21:34:06,2
-6,163m
17,143
-19,356
(21,909)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -2,018 -0,001 -0,088 21:04:33,794 21:33:54,276
Accu_DC Voltage 12,571 17,272 17,024 00:00:00,210 21:33:48,267
Accu_Integrated RMS Current -19,357 -0,260 -19,357 21:34:28,274 00:00:00,210
Temperature 21,612 40,952 21,935 21:02:51,999 00:00:00,000

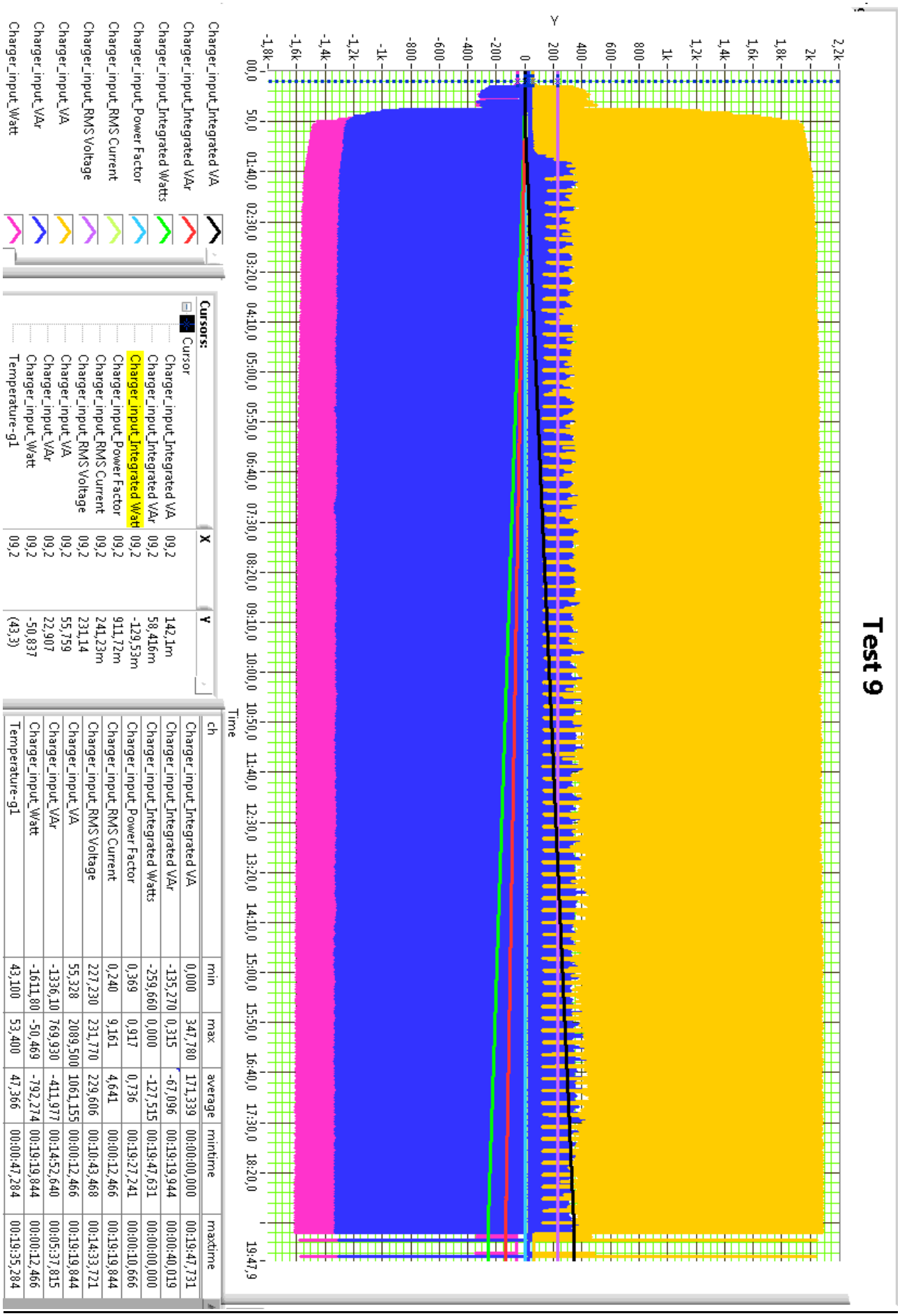

Test 4
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
57:49,0
57:49,0
57:49,0
57:49,0
20,053
11,016
19,004
(38,055)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -0,010 20,053 -0,009 01:23:44,022 00:37:45,853
Accu_DC Voltage 10,989 16,287 12,474 00:57:54,042 00:00:00,062
Accu_Integrated RMS Current 0,000 19,049 19,046 00:00:00,062 00:57:56,041
Temperature 21,745 38,609 36,515 00:00:24,000 00:59:54,000

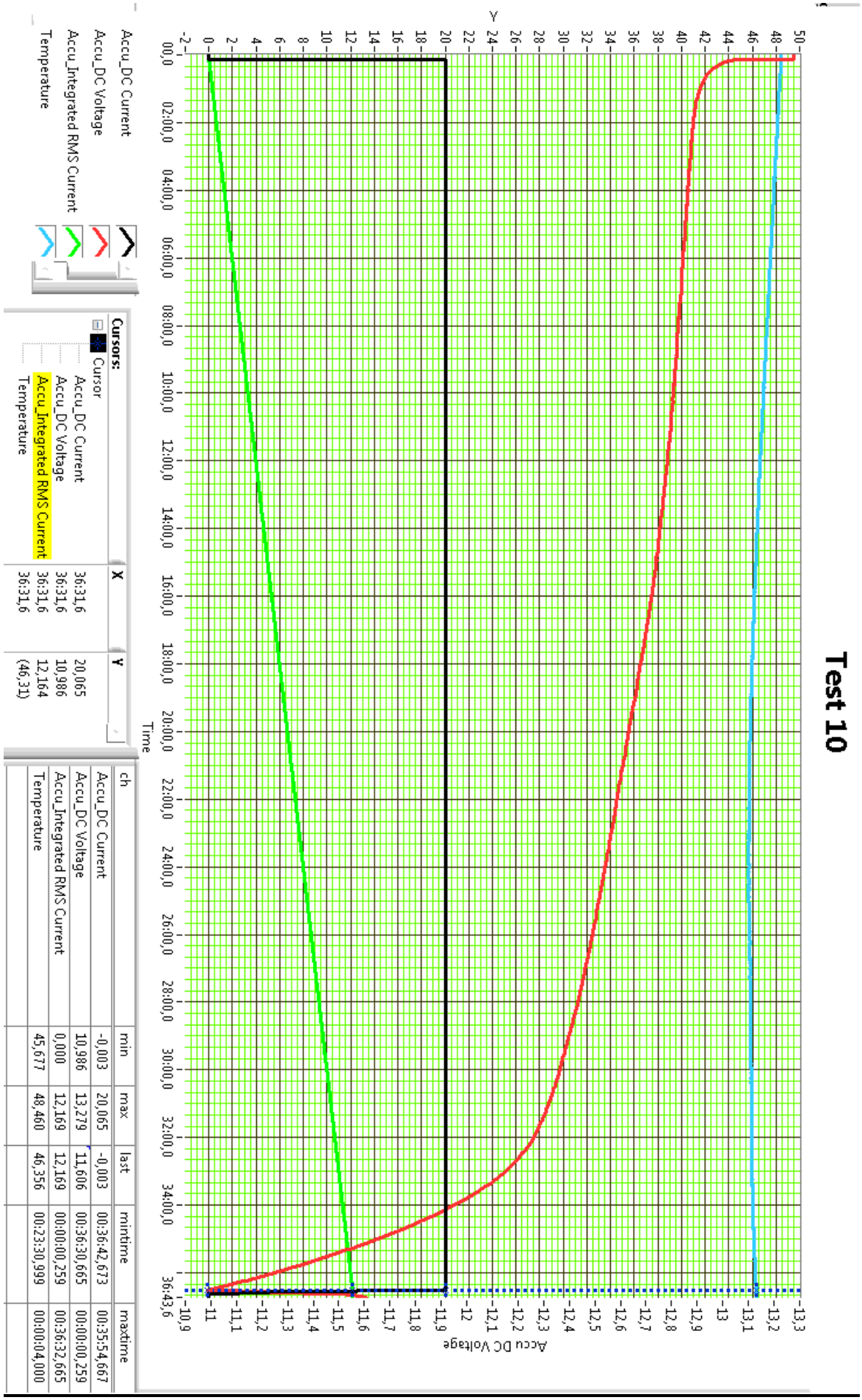

Test 5
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
17:13:30,5
17:13:30,5
17:13:30,5
17:13:30,5
3,304m
13,921
-18,692
(24,877)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -2,002 0,004 0,003 00:00:22,018 17:04:14,397
Accu_DC Voltage 12,760 13,927 13,921 00:00:04,011 15:56:24,086
Accu_Integrated RMS Current -18,699 0,000 -18,692 14:17:40,547 00:00:06,011
Temperature 23,457 26,735 24,873 11:54:39,000 03:38:20,000

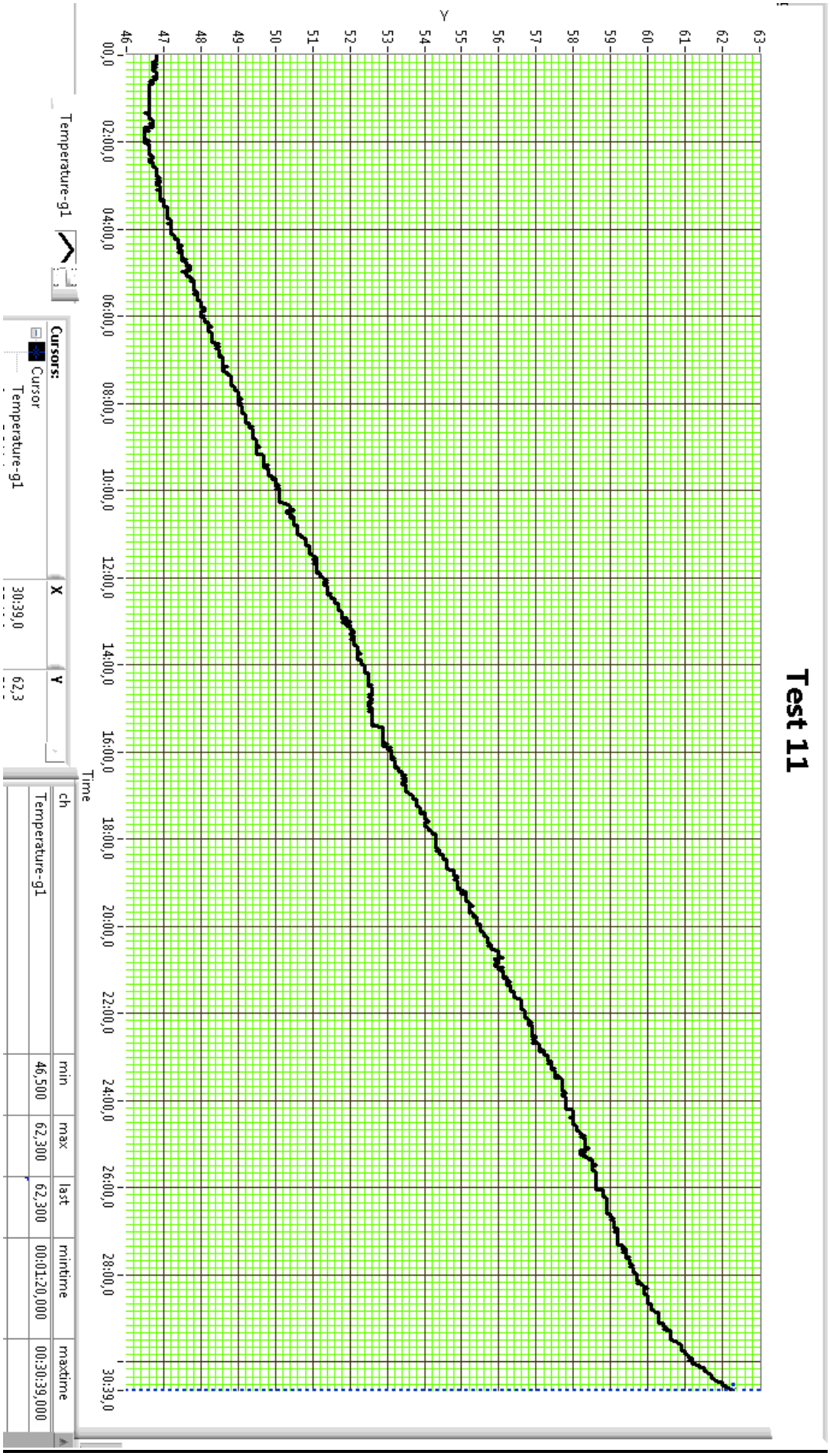

Test 6
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
56:21,3
56:21,3
56:21,3
56:21,3
20,102
10,917
18,556
(37,486)
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,002
20,102
-0,001
00:56:32,317
00:52:53,282
Accu_DC Voltage
10,908
13,431
11,921
00:56:23,318
00:00:00,090
Accu_Integrated RMS Current
0,000
18,572
18,572
00:00:00,090
00:56:25,318
Temperature
22,706
37,702
37,702
00:00:02,999
00:56:44,999

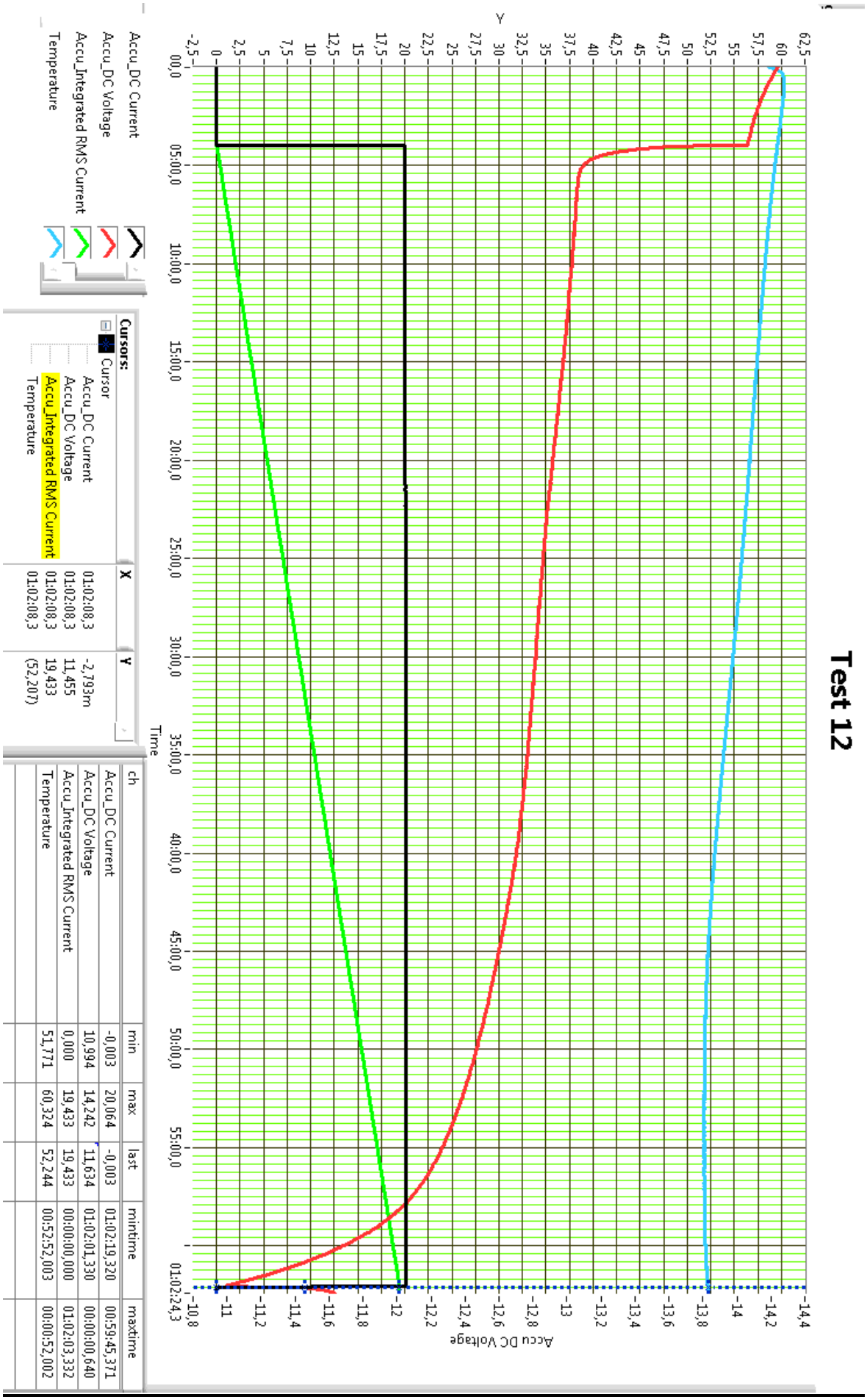

Measurement
Test 7
Temperature-g1
Cursors:
Cursor
Temperature-g1
X
27:43,0
Y
55
Time
ch
min
max
last
mintime
maxtime
Temperature-g1
37,000
55,000
55,000
00:01:14,000
00:27:37,000

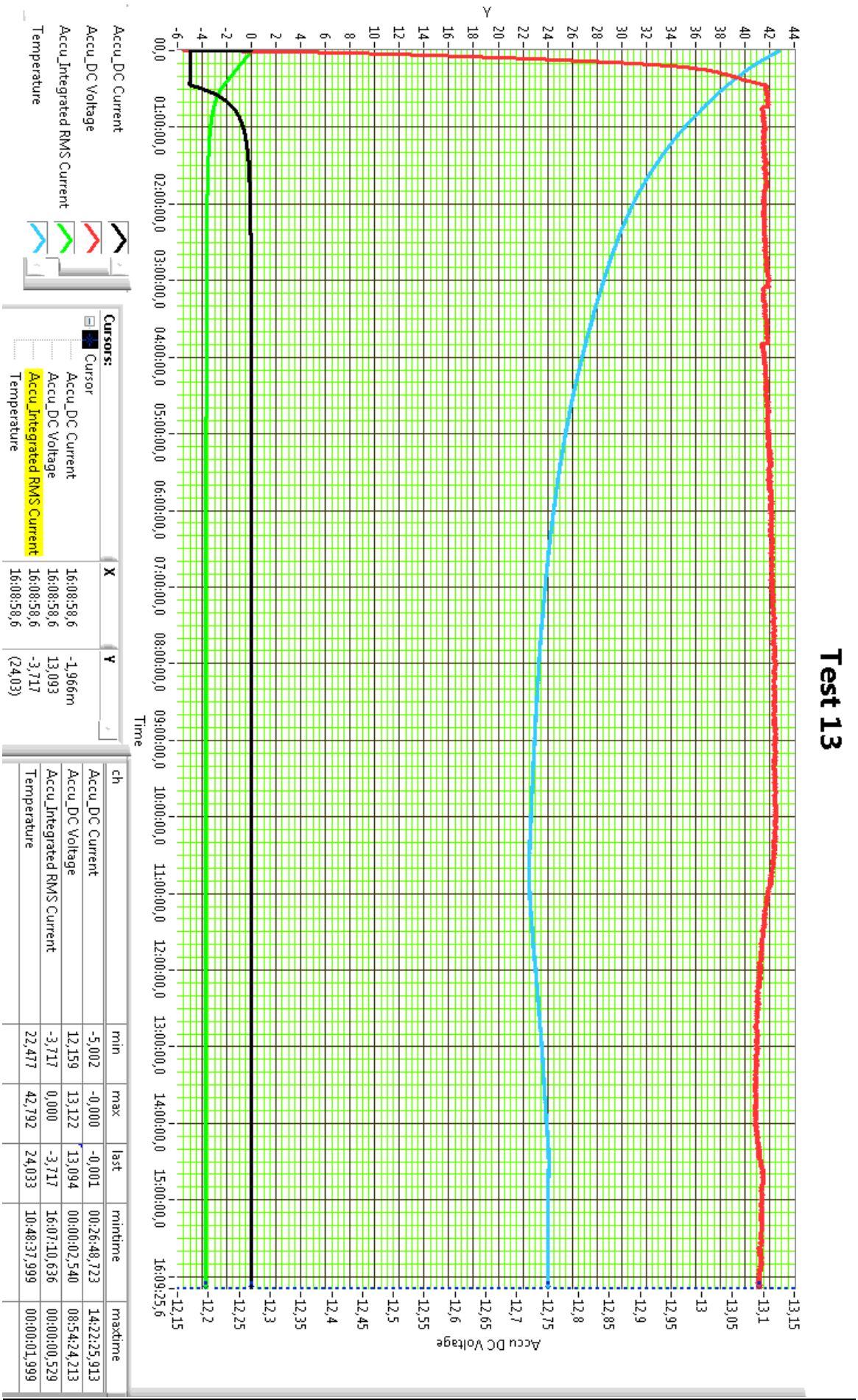

Test 8
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
53:27,3
53:27,3
53:27,3
53:27,3
20,065
11,002
17,82
(50,747)
Time
Accu_DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,002
20,065
-0,002
00:53:44,356
00:51:28,363
Accu_DC Voltage
10,985
13,380
11,635
00:53:28,355
00:00:00,347
Accu_Integrated RMS Current
0,000
17,838
17,838
00:00:00,347
00:53:30,355
Temperature
21,691
54,975
50,828
00:00:38,000
00:02:05,000


Test 9
Time
Charger_input_Integrated VA
Charger_input_Integrated VAr
Charger_input_Integrated Watts
Charger_input_Power Factor
Charger_input_RMS Current
Charger_input_RMS Voltage
Charger_input_VA
Charger_input_VAr
Charger_input_Watt
Cursors:
Cursor
Charger_input_Integrated VA 09,2 142,1m
Charger_input_Integrated VAr 09,2 58,416m
Charger_input_Integrated Watt 09,2 -129,53m
Charger_input_Power Factor 09,2 911,72m
Charger_input_RMS Current 09,2 241,23m
Charger_input_RMS Voltage 09,2 231,14
Charger_input_VA 09,2 55,759
Charger_input_VAr 09,2 22,907
Charger_input_Watt 09,2 -50,837
Temperature-g1 09,2 (43,3)
X
Y
ch min max average mintime maxtime
Charger_input_Integrated VA 0,000 347,780 171,339 00:00:00,000 00:19:47,731
Charger_input_Integrated VAr -135,270 0,315 -67,096 00:19:19,944 00:00:40,019
Charger_input_Integrated Watts -259,660 0,000 -127,515 00:19:47,631 00:00:00,000
Charger_input_Power Factor 0,369 0,917 0,736 00:19:27,241 00:00:10,666
Charger_input_RMS Current 0,240 9,161 4,641 00:00:12,466 00:19:19,844
Charger_input_RMS Voltage 227,230 231,770 229,606 00:10:43,468 00:14:33,721
Charger_input_VA 55,328 2089,500 1061,155 00:00:12,466 00:19:19,844
Charger_input_VAr -1336,10 769,930 -411,977 00:14:52,640 00:05:37,815
Charger_input_Watt -1611,80 -50,469 -792,274 00:19:19,844 00:00:12,466
Temperature-g1 43,100 53,400 47,366 00:00:47,284 00:19:35,284

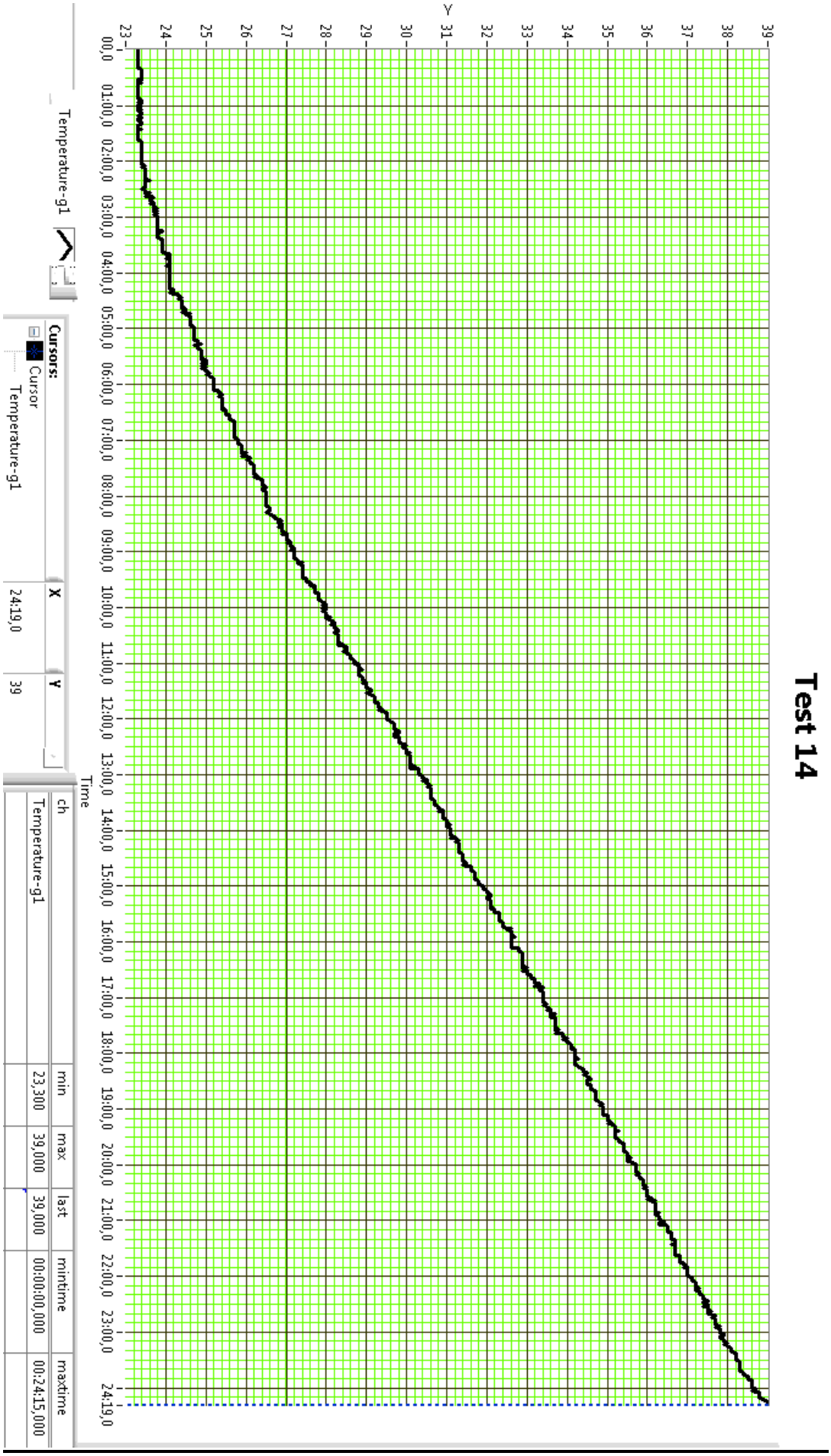

Test 10
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
X
Y
Accu_DC Current 36:31,6 20,065
Accu_DC Voltage 36:31,6 10,986
Accu_Integrated RMS Current 36:31,6 12,164
Temperature 36:31,6 (46,31)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -0,003 20,065 -0,003 00:36:42,673 00:35:54,667
Accu_DC Voltage 10,986 13,279 11,606 00:36:30,665 00:00:00,259
Accu_Integrated RMS Current 0,000 12,169 12,169 00:00:00,259 00:36:32,665
Temperature 45,677 48,460 46,356 00:23:30,999 00:00:04,000

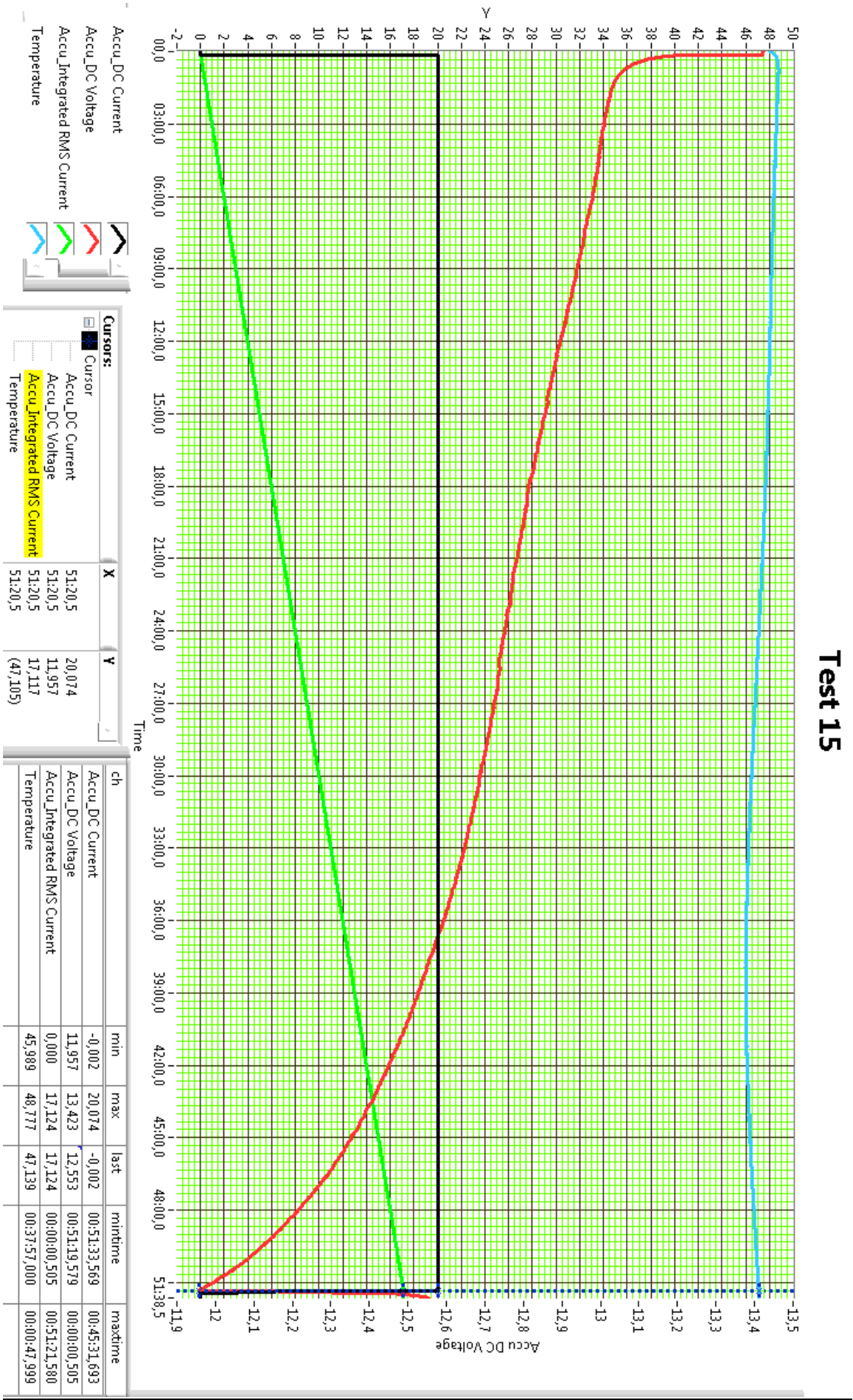

Test 11
Temperature-g1
Cursors:
Cursor
Temperature-g1
X
30:39,0
Y
62,3
Time
ch
min
max
last
mintime
maxtime
Temperature-g1
46,500
62,300
62,300
00:01:20,000
00:30:39,000

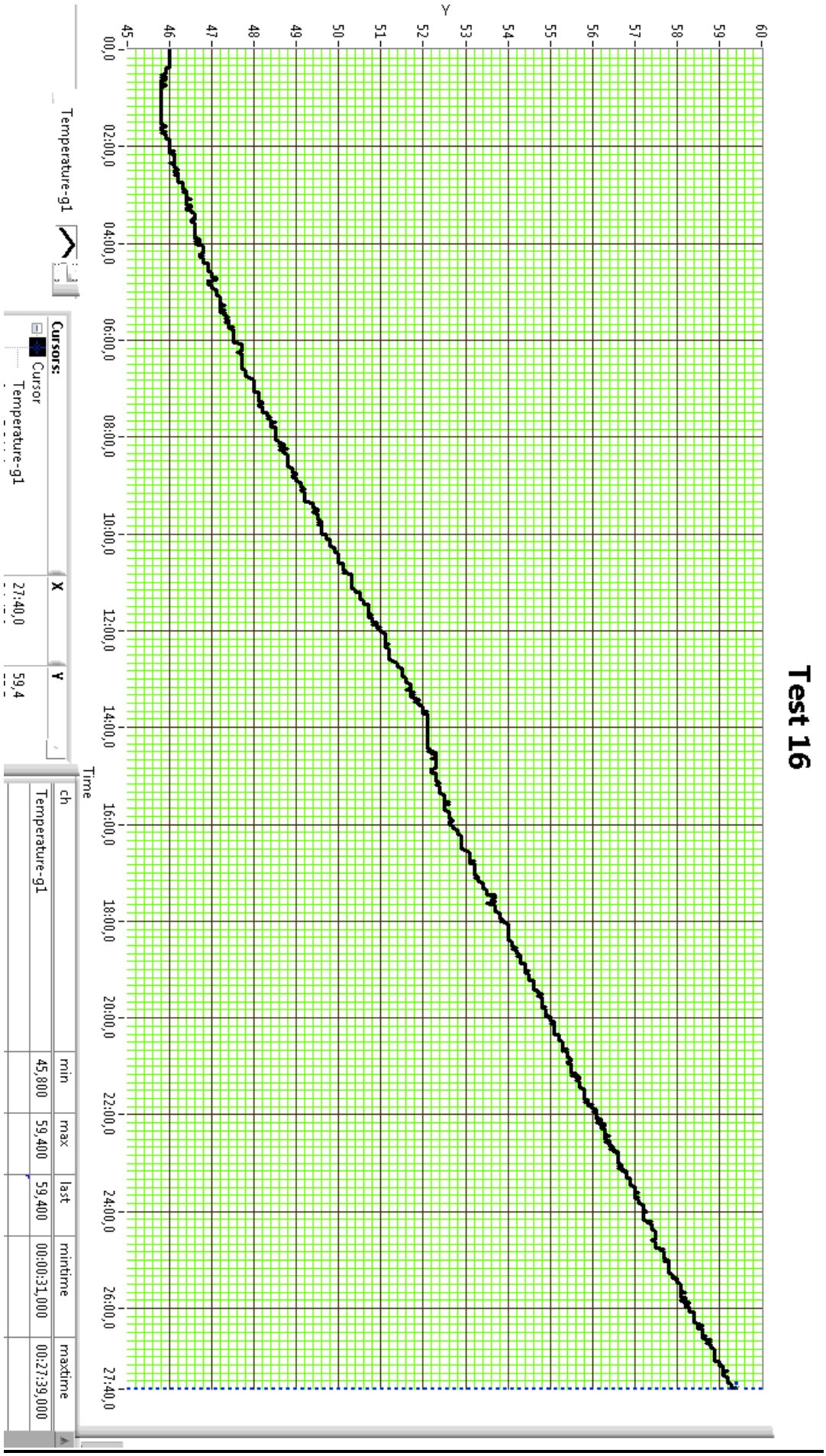

Test 12
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
01:02:08,3
01:02:08,3
01:02:08,3
01:02:08,3
-2,793m
11,455
19,433
(52,207)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -0,003 20,064 -0,003 01:02:19,320 00:59:45,371
Accu_DC Voltage 10,994 14,242 11,634 01:02:01,330 00:00:00,640
Accu_Integrated RMS Current 0,000 19,433 19,433 00:00:00,000 01:02:03,332
Temperature 51,771 60,324 52,244 00:52:52,003 00:00:52,002

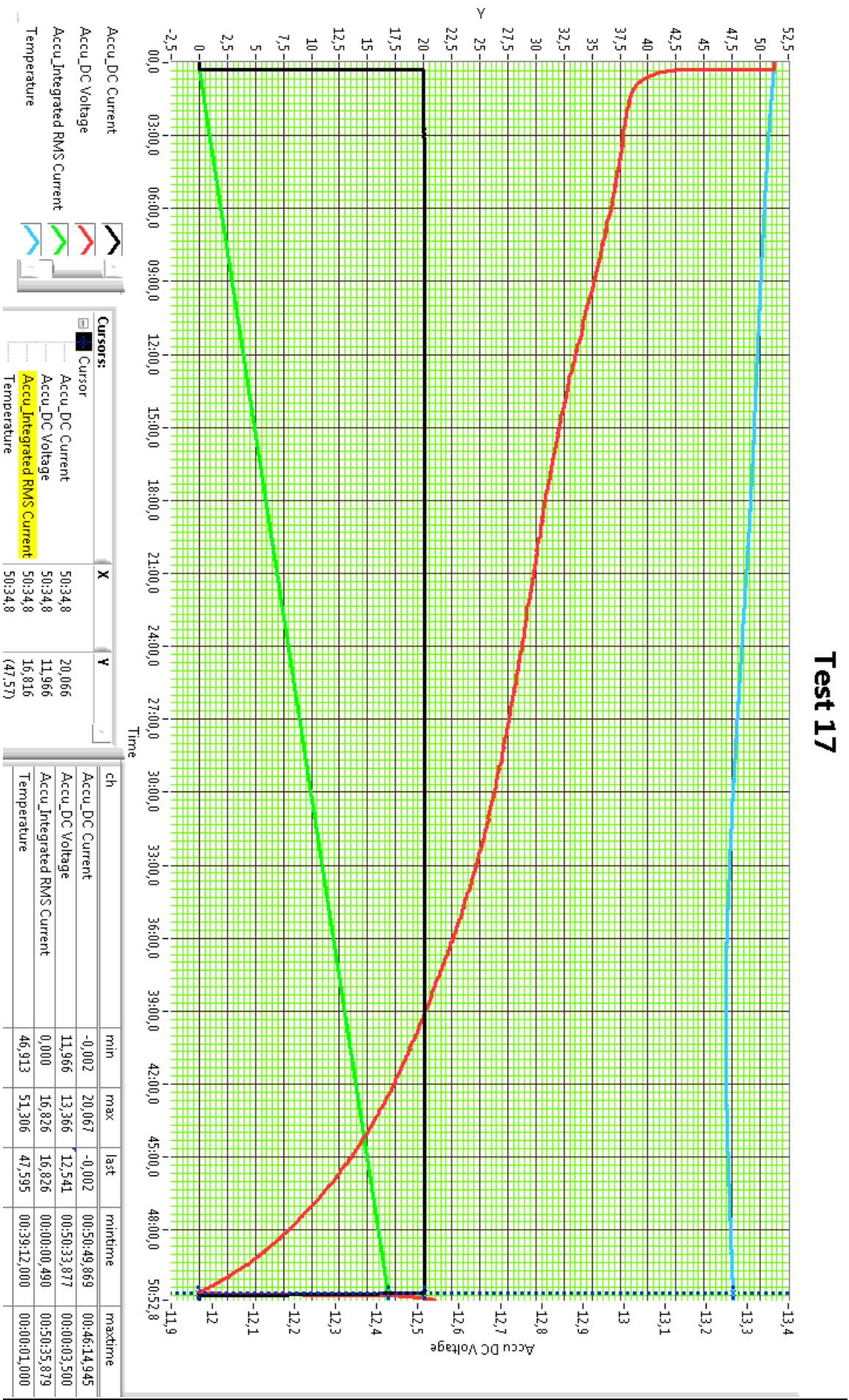


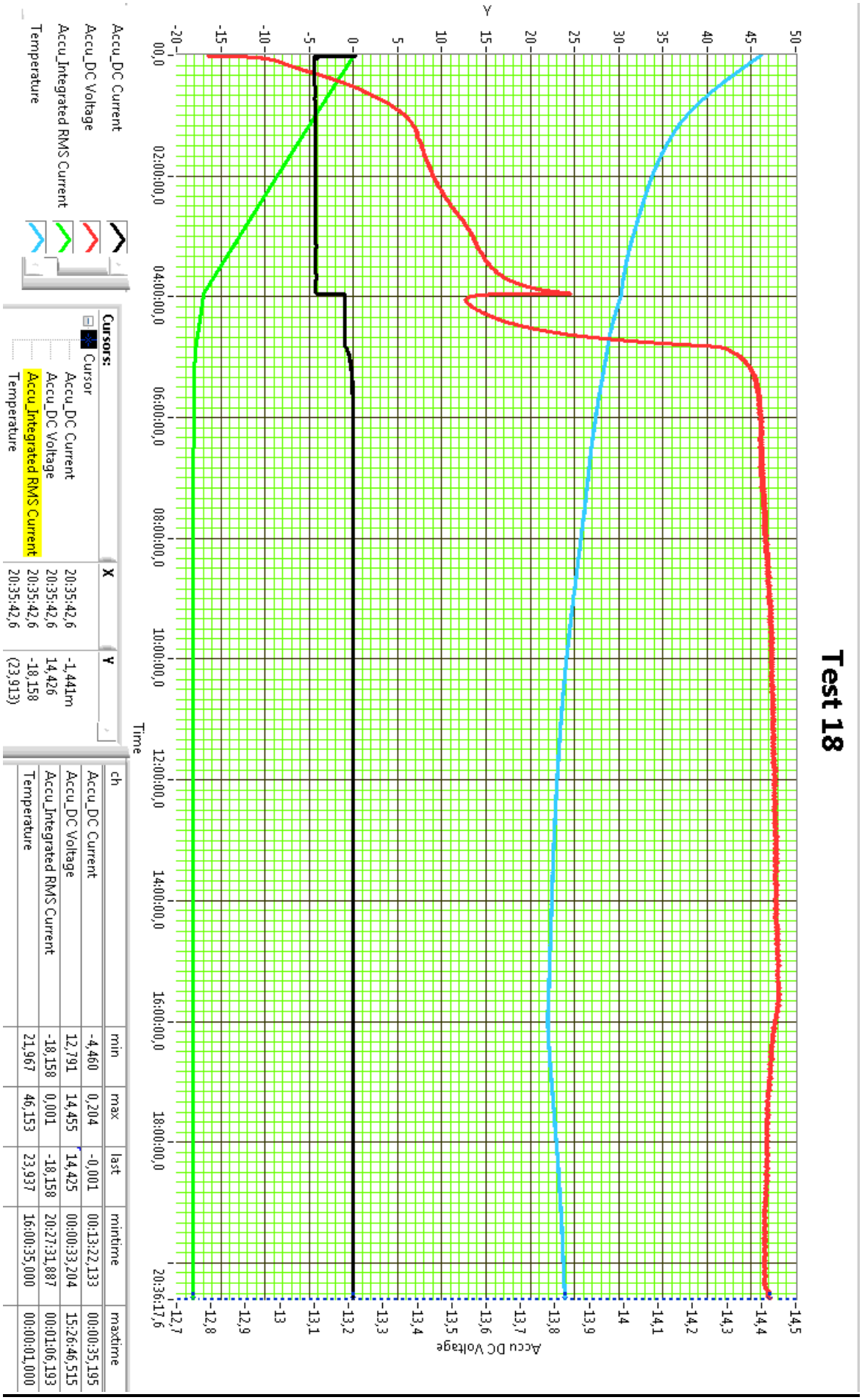

| ch | min | max | last | mintime | maxtime |
|---|---|---|---|---|---|
| Accu_DC Current | -5,002 | -0,000 | -0,001 | 00:26:48,723 | 14:22:25,913 |
| Accu_DC Voltage | 12,159 | 13,122 | 13,094 | 00:00:02,540 | 08:54:24,213 |
| Accu_Integrated RMS Current | -3,717 | 0,000 | -3,717 | 16:07:10,636 | 00:00:00,529 |
| Temperature | 22,477 | 42,792 | 24,033 | 10:48:37,999 | 00:00:01,999 |


Test 14
Temperature-g1
Cursors:
Cursor
Temperature-g1
X
24:19,0
Y
39
Time
ch
min
max
last
mintime
maxtime
Temperature-g1
23,300
39,000
39,000
00:00:00,000
00:24:15,000

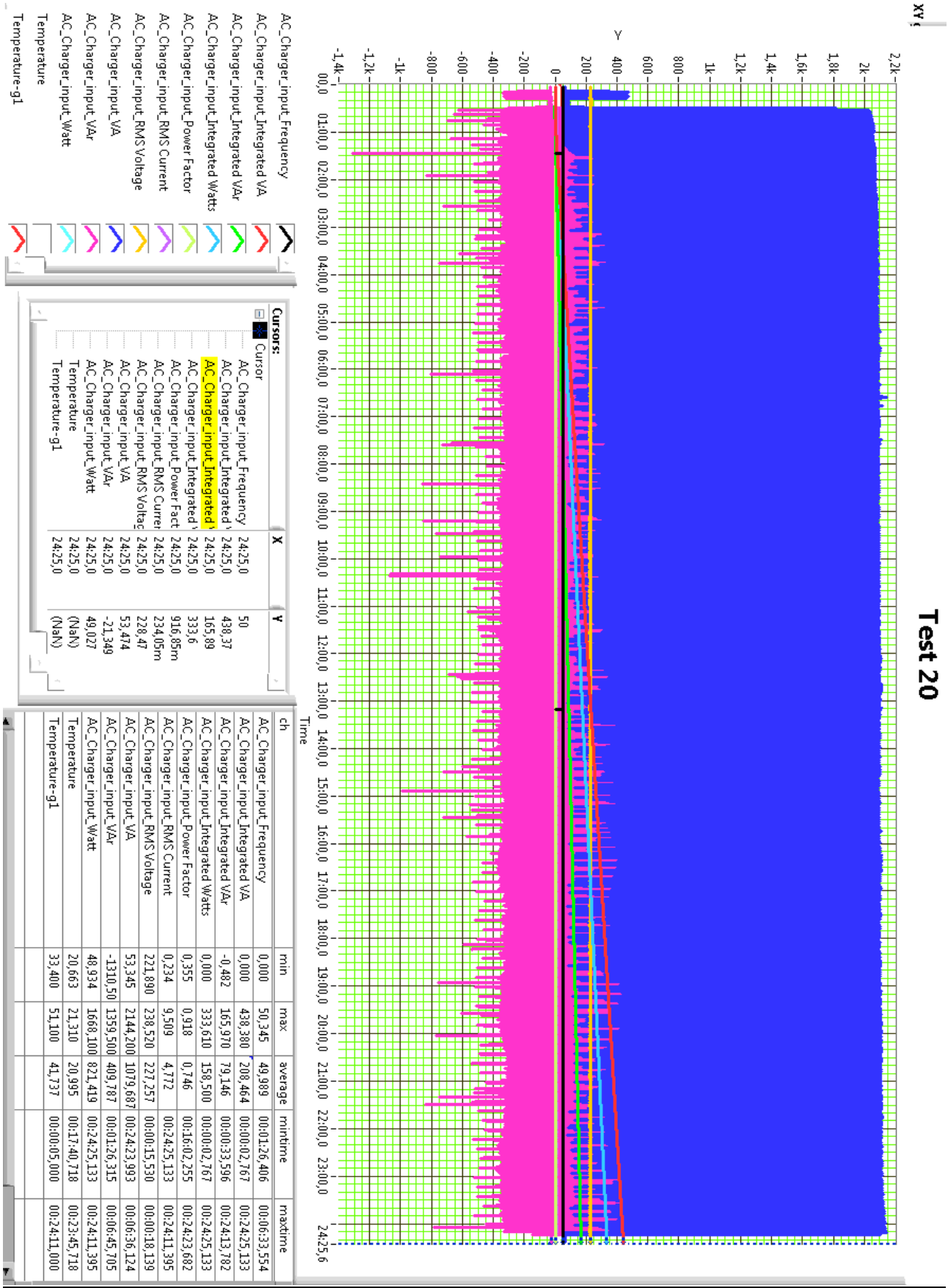

Test 15
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Time
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
51:20,5
51:20,5
51:20,5
51:20,5
20,074
11,957
17,117
(47,105)
ch min max last mintime maxtime
Accu_DC Current -0,002 20,074 -0,002 00:51:33,569 00:45:31,693
Accu_DC Voltage 11,957 13,423 12,553 00:51:19,579 00:00:00,505
Accu_Integrated RMS Current 0,000 17,124 17,124 00:00:00,505 00:51:21,580
Temperature 45,989 48,777 47,139 00:37:57,000 00:00:47,999


Test 16
Temperature-g1
Cursors:
Cursor
Temperature-g1
X
27:40,0
Y
59,4
Time
ch
min
max
last
mintime
maxtime
Temperature-g1
45,800
59,400
59,400
00:00:31,000
00:27:39,000

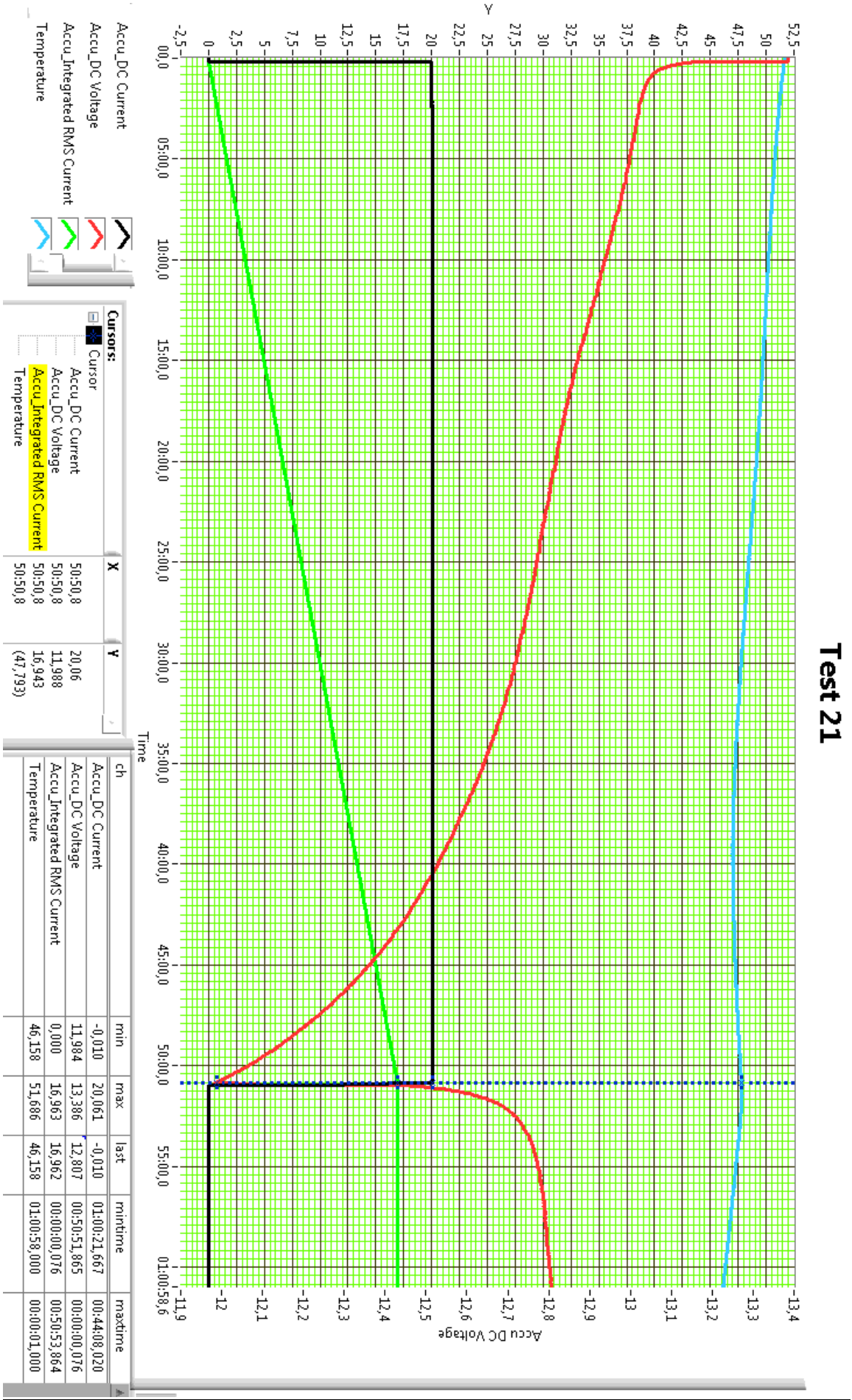

Test 17
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
50:34,8
50:34,8
50:34,8
50:34,8
20,066
11,966
16,816
(47,57)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -0,002 20,067 -0,002 00:50:49,869 00:46:14,945
Accu_DC Voltage 11,966 13,366 12,541 00:50:33,877 00:00:03,500
Accu_Integrated RMS Current 0,000 16,826 16,826 00:00:00,490 00:50:35,879
Temperature 46,913 51,306 47,595 00:39:12,000 00:00:01,000

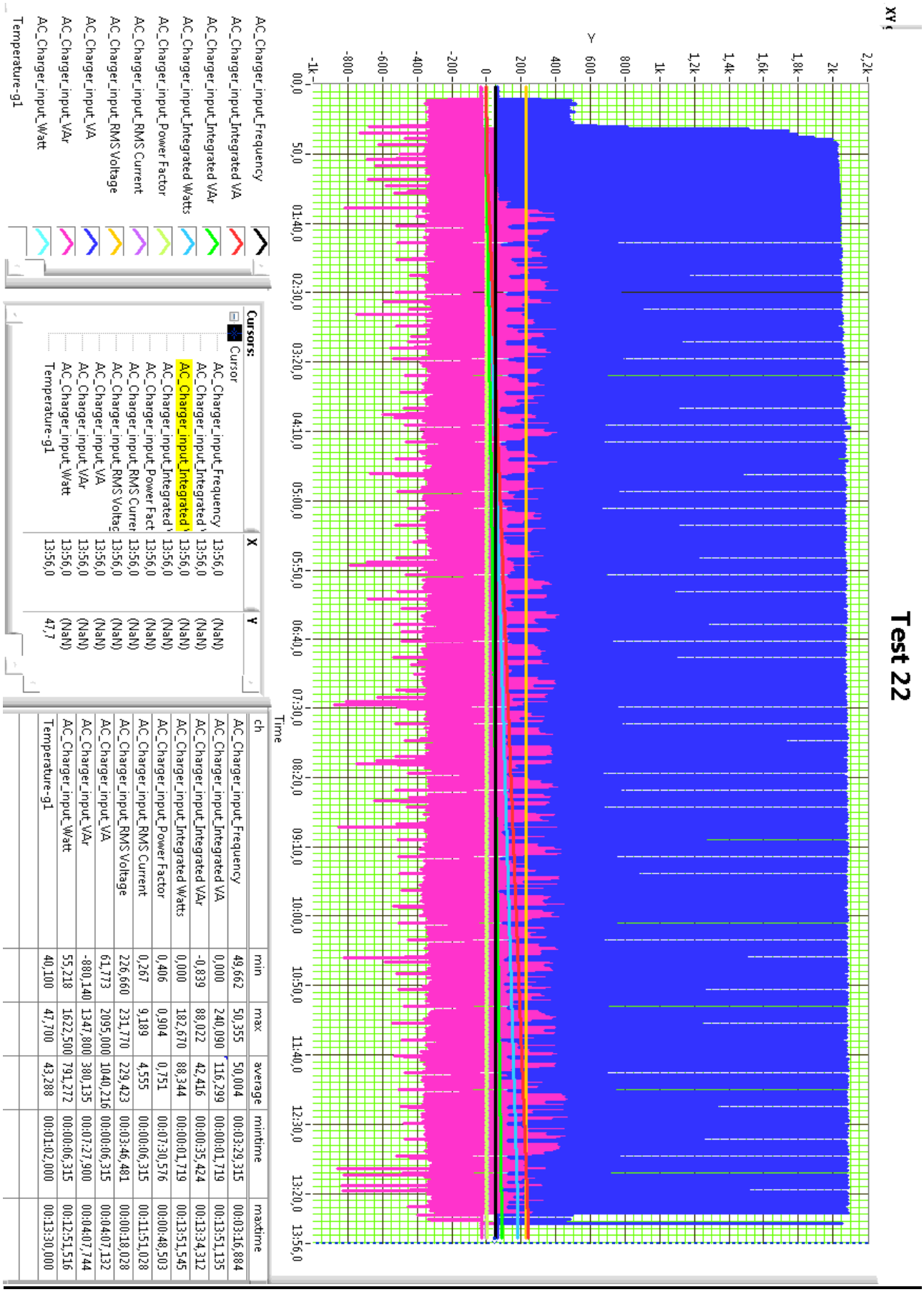

Test 18
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
20:35:42,6
20:35:42,6
20:35:42,6
20:35:42,6
-1,441m
14,426
-18,158
(23,913)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -4,460 0,204 -0,001 00:13:22,133 00:00:35,195
Accu_DC Voltage 12,791 14,455 14,425 00:00:33,204 15:26:46,515
Accu_Integrated RMS Current -18,158 0,001 -18,158 20:27:31,887 00:01:06,193
Temperature 21,967 46,153 23,937 16:00:35,000 00:00:01,000


Test 19
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
X
Y
47:56,6
47:56,6
47:56,6
20,072
11,952
15,986
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,002
20,073
-0,002
00:48:06,698
00:41:36,933
Accu_DC Voltage
11,952
14,403
12,674
00:47:56,699
00:00:03,999
Accu_Integrated RMS Current
0,000
15,996
15,996
00:00:00,000
00:47:58,698

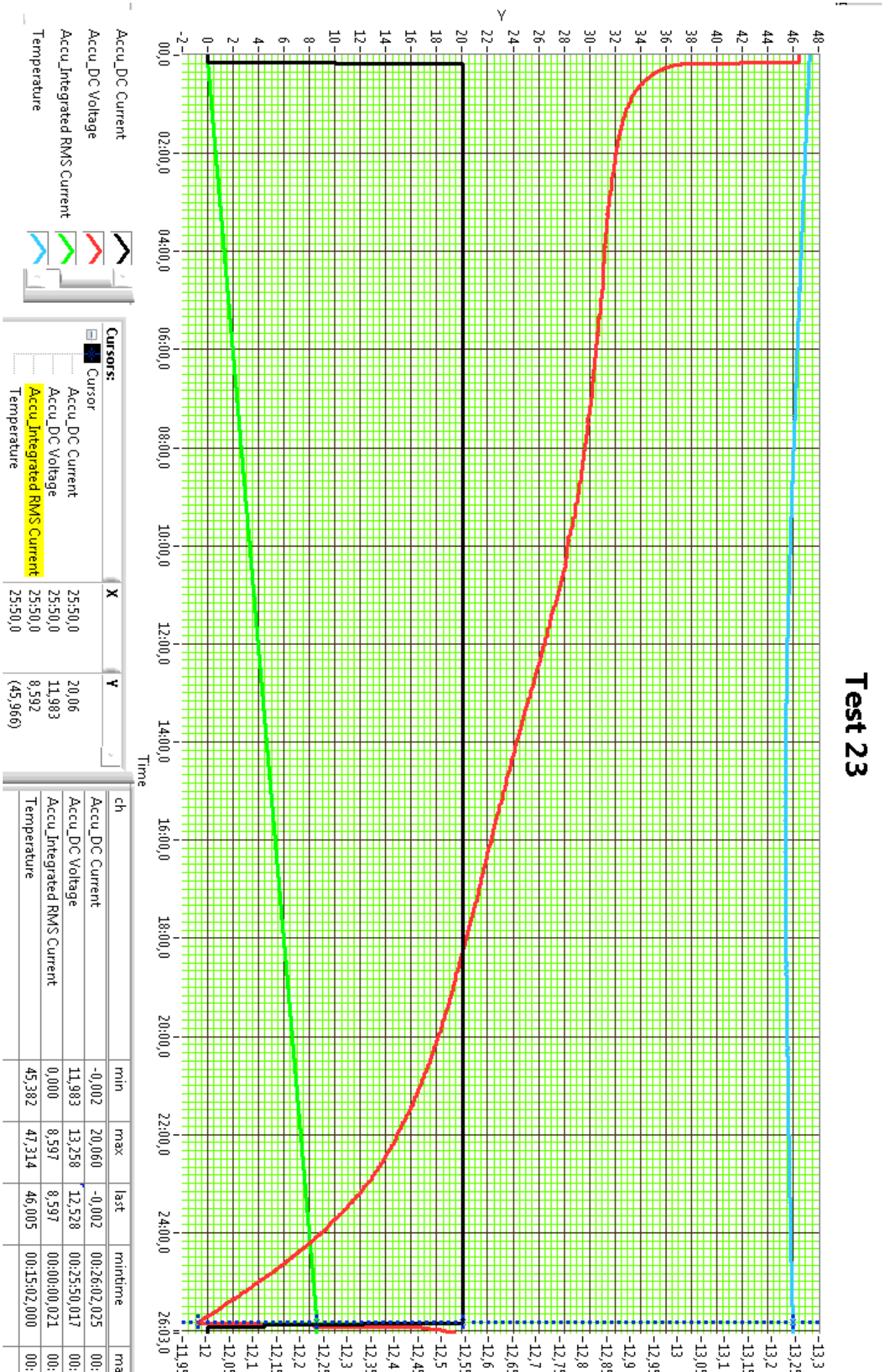


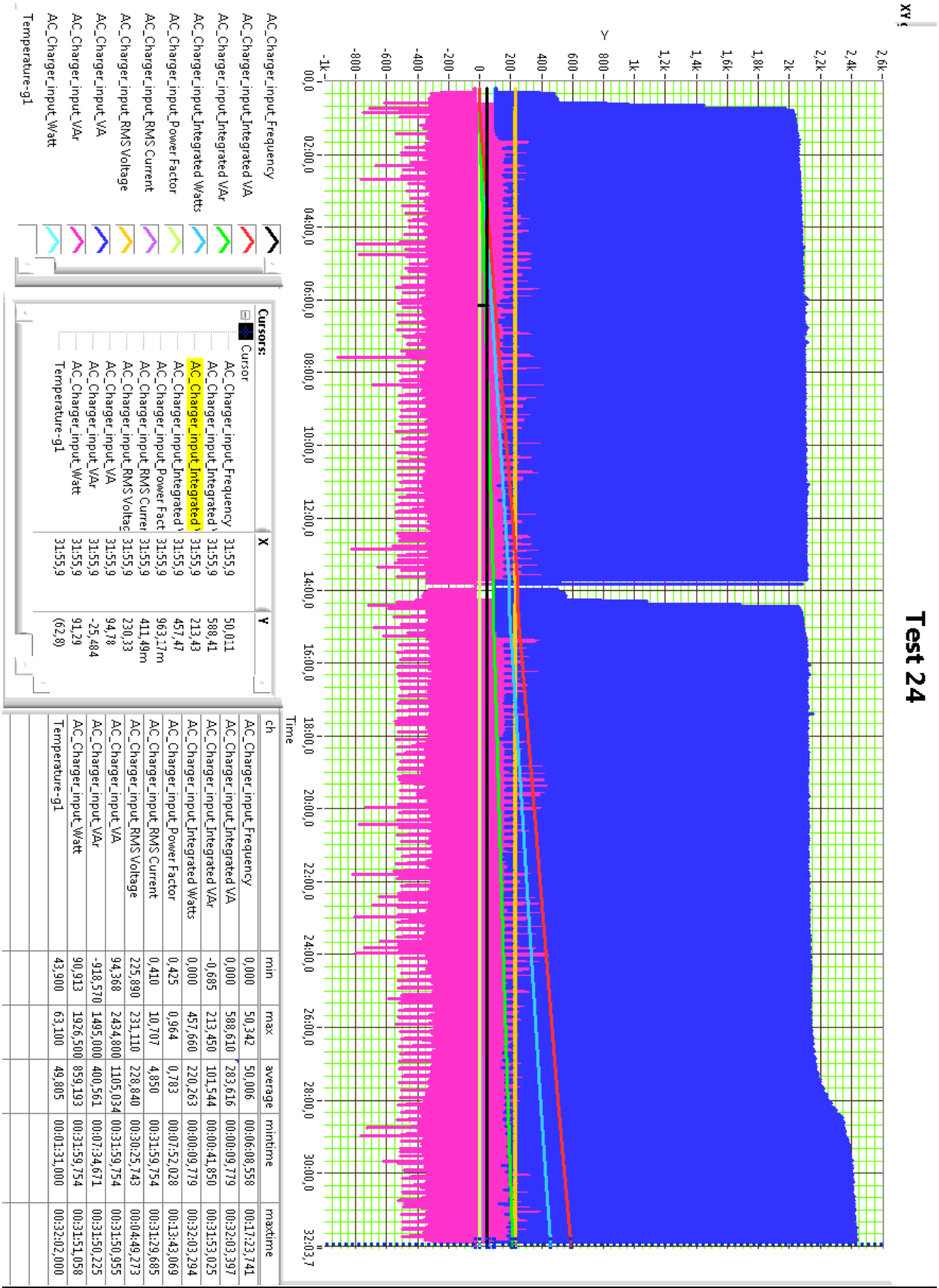

| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 0,000 | 50,345 | 49,989 | 00:01:26,406 | 00:06:33,554 |
| AC_Charger_input_Integrated VA | 0,000 | 438,380 | 208,464 | 00:00:02,767 | 00:24:25,133 |
| AC_Charger_input_Integrated VAr | -0,482 | 165,970 | 79,146 | 00:00:33,596 | 00:24:13,782 |
| AC_Charger_input_Integrated Watts | 0,000 | 333,610 | 158,500 | 00:00:02,767 | 00:24:25,133 |
| AC_Charger_input_Power Factor | 0,355 | 0,918 | 0,746 | 00:16:02,255 | 00:24:23,682 |
| AC_Charger_input_RMS Current | 0,234 | 9,509 | 4,772 | 00:24:25,133 | 00:24:11,395 |
| AC_Charger_input_RMS Voltage | 221,890 | 238,520 | 227,257 | 00:00:15,530 | 00:00:18,139 |
| AC_Charger_input_VA | 53,345 | 2144,200 | 1079,687 | 00:24:23,993 | 00:06:36,124 |
| AC_Charger_input_VAr | -1310,50 | 1359,500 | 409,787 | 00:01:26,315 | 00:06:45,705 |
| AC_Charger_input_Watt | 48,934 | 1668,100 | 821,419 | 00:24:25,133 | 00:24:11,395 |
| Temperature | 20,663 | 21,310 | 20,995 | 00:17:40,718 | 00:23:45,718 |
| Temperature-g1 | 33,400 | 51,100 | 41,737 | 00:00:05,000 | 00:24:11,000 |


Test 21
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
50:50,8
50:50,8
50:50,8
50:50,8
20,06
11,988
16,943
(47,793)
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,010
20,061
-0,010
01:00:21,667
00:44:08,020
Accu_DC Voltage
11,984
13,386
12,807
00:50:51,865
00:00:00,076
Accu_Integrated RMS Current
0,000
16,963
16,962
00:00:00,076
00:50:53,864
Temperature
46,158
51,686
46,158
01:00:58,000
00:00:01,000

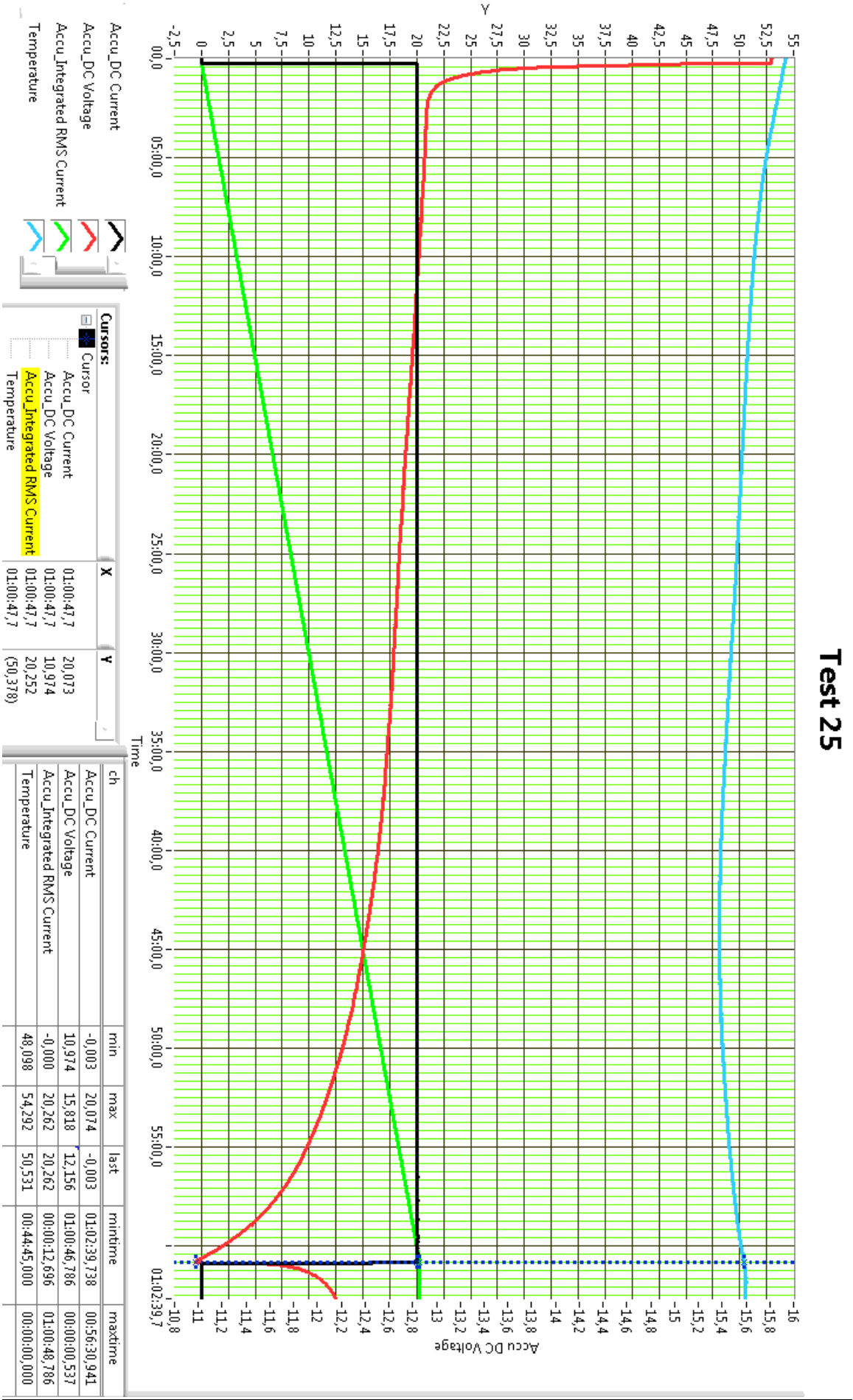


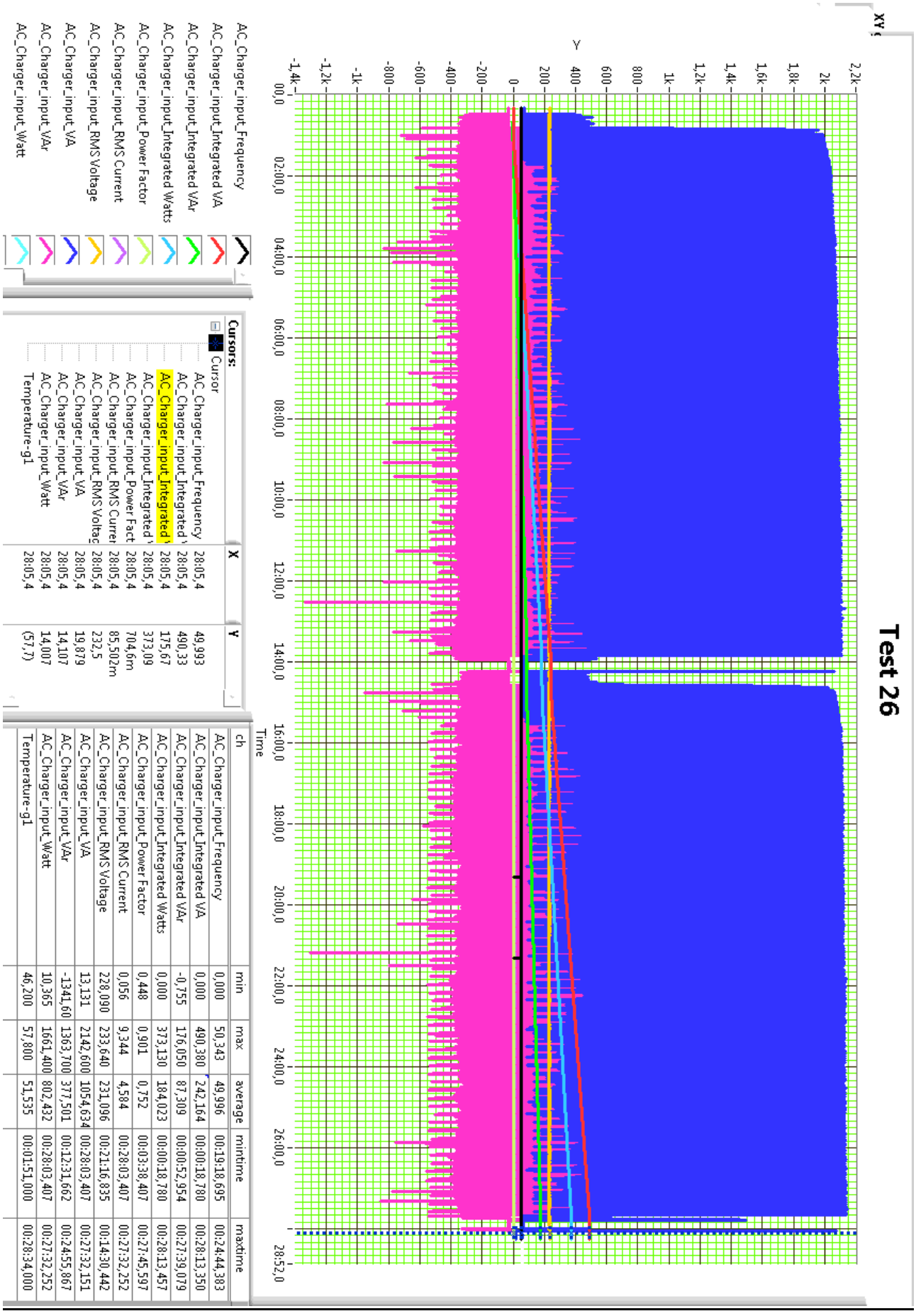

| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 49,662 | 50,355 | 50,004 | 00:03:29,315 | 00:03:16,804 |
| AC_Charger_input_Integrated VA | 0,000 | 240,090 | 116,299 | 00:00:01,719 | 00:13:51,135 |
| AC_Charger_input_Integrated VAr | -0,839 | 88,022 | 42,416 | 00:00:35,424 | 00:13:34,312 |
| AC_Charger_input_Integrated Watts | 0,000 | 182,670 | 88,344 | 00:00:01,719 | 00:13:51,545 |
| AC_Charger_input_Power Factor | 0,406 | 0,904 | 0,751 | 00:07:30,576 | 00:00:48,503 |
| AC_Charger_input_RMS Current | 0,267 | 9,189 | 4,555 | 00:00:06,315 | 00:11:51,028 |
| AC_Charger_input_RMS Voltage | 226,660 | 231,770 | 229,423 | 00:03:46,481 | 00:00:18,028 |
| AC_Charger_input_VA | 61,773 | 2095,000 | 1040,216 | 00:00:06,315 | 00:04:07,132 |
| AC_Charger_input_VAr | -880,140 | 1347,800 | 380,135 | 00:07:27,900 | 00:04:07,744 |
| AC_Charger_input_Watt | 55,218 | 1622,500 | 791,272 | 00:00:06,315 | 00:12:51,516 |
| Temperature-g1 | 40,100 | 47,700 | 43,288 | 00:01:02,000 | 00:13:30,000 |


Test 23
Time
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
25:50,0
25:50,0
25:50,0
25:50,0
20,06
11,983
8,592
(45,966)
ch
min
max
last
mintime
Accu_DC Current
-0,002
20,060
-0,002
00:26:02,025
Accu_DC Voltage
11,983
13,258
12,528
00:25:50,017
Accu_Integrated RMS Current
0,000
8,597
8,597
00:00:00,021
Temperature
45,382
47,314
46,005
00:15:02,000

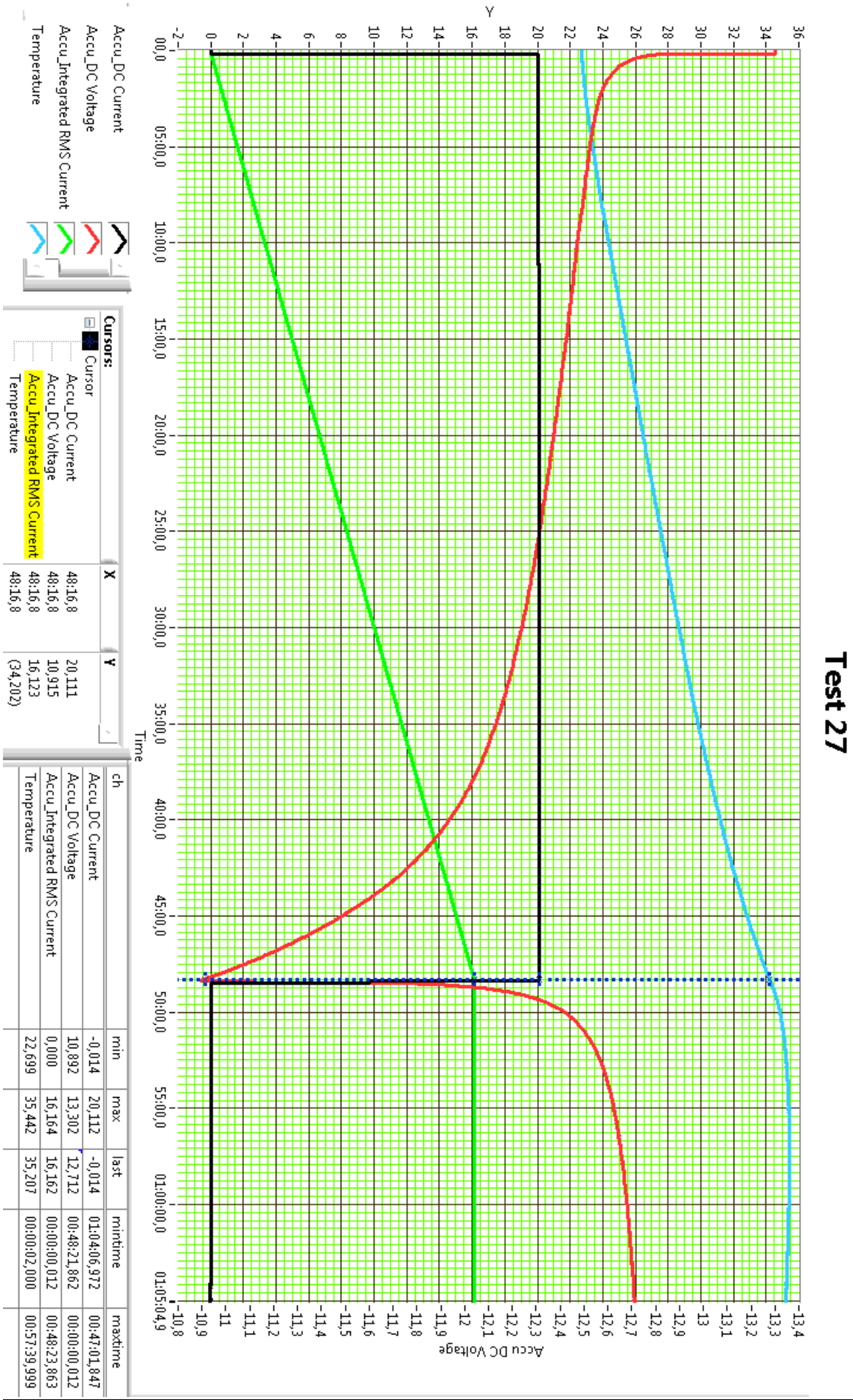


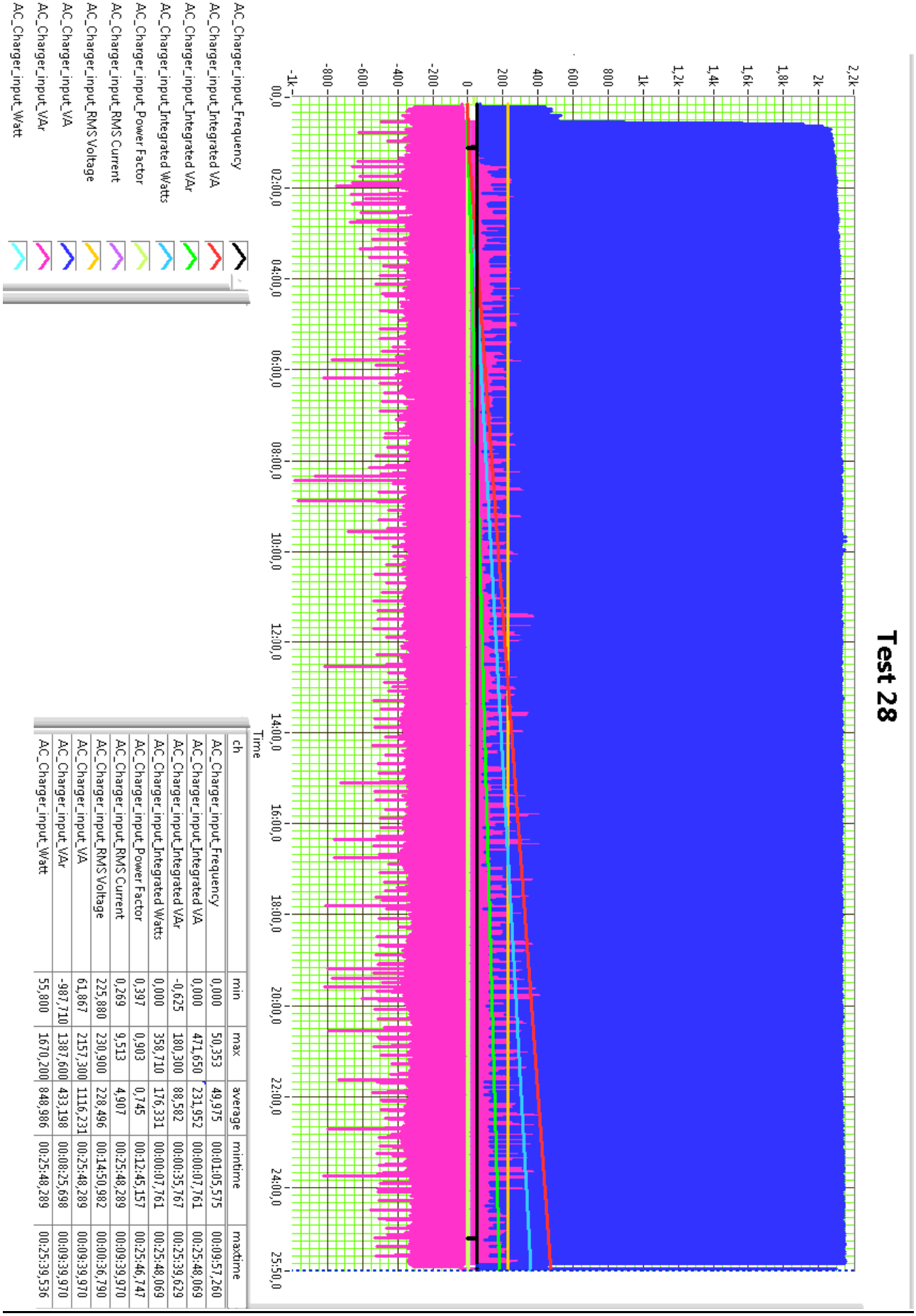

| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 0,000 | 50,342 | 50,006 | 00:06:08,558 | 00:17:23,741 |
| AC_Charger_input_Integrated VA | 0,000 | 588,610 | 283,616 | 00:00:09,779 | 00:32:03,397 |
| AC_Charger_input_Integrated VAr | -0,685 | 213,450 | 101,544 | 00:00:41,650 | 00:31:53,025 |
| AC_Charger_input_Integrated Watts | 0,000 | 457,660 | 220,263 | 00:00:09,779 | 00:32:03,294 |
| AC_Charger_input_Power Factor | 0,425 | 0,964 | 0,783 | 00:07:52,028 | 00:13:43,069 |
| AC_Charger_input_RMS Current | 0,410 | 10,707 | 4,850 | 00:31:59,754 | 00:31:29,685 |
| AC_Charger_input_RMS Voltage | 225,890 | 231,110 | 228,840 | 00:30:25,743 | 00:04:49,273 |
| AC_Charger_input_VA | 94,368 | 2434,800 | 1105,034 | 00:31:59,754 | 00:31:50,955 |
| AC_Charger_input_VAr | -918,570 | 1495,000 | 400,561 | 00:07:34,671 | 00:31:50,225 |
| AC_Charger_input_Watt | 90,913 | 1926,500 | 859,193 | 00:31:59,754 | 00:31:51,058 |
| Temperature-g1 | 43,900 | 63,100 | 49,805 | 00:01:31,000 | 00:32:02,000 |


Test 25
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
01:00:47,7
01:00:47,7
01:00:47,7
01:00:47,7
20,073
10,974
20,252
(50,378)
Time
Accu DC Voltage
ch min max last mintime maxtime
Accu_DC Current -0,003 20,074 -0,003 01:02:39,738 00:56:30,941
Accu_DC Voltage 10,974 15,818 12,156 01:00:46,786 00:00:00,537
Accu_Integrated RMS Current -0,000 20,262 20,262 00:00:12,696 01:00:48,786
Temperature 48,098 54,292 50,531 00:44:45,000 00:00:00,000

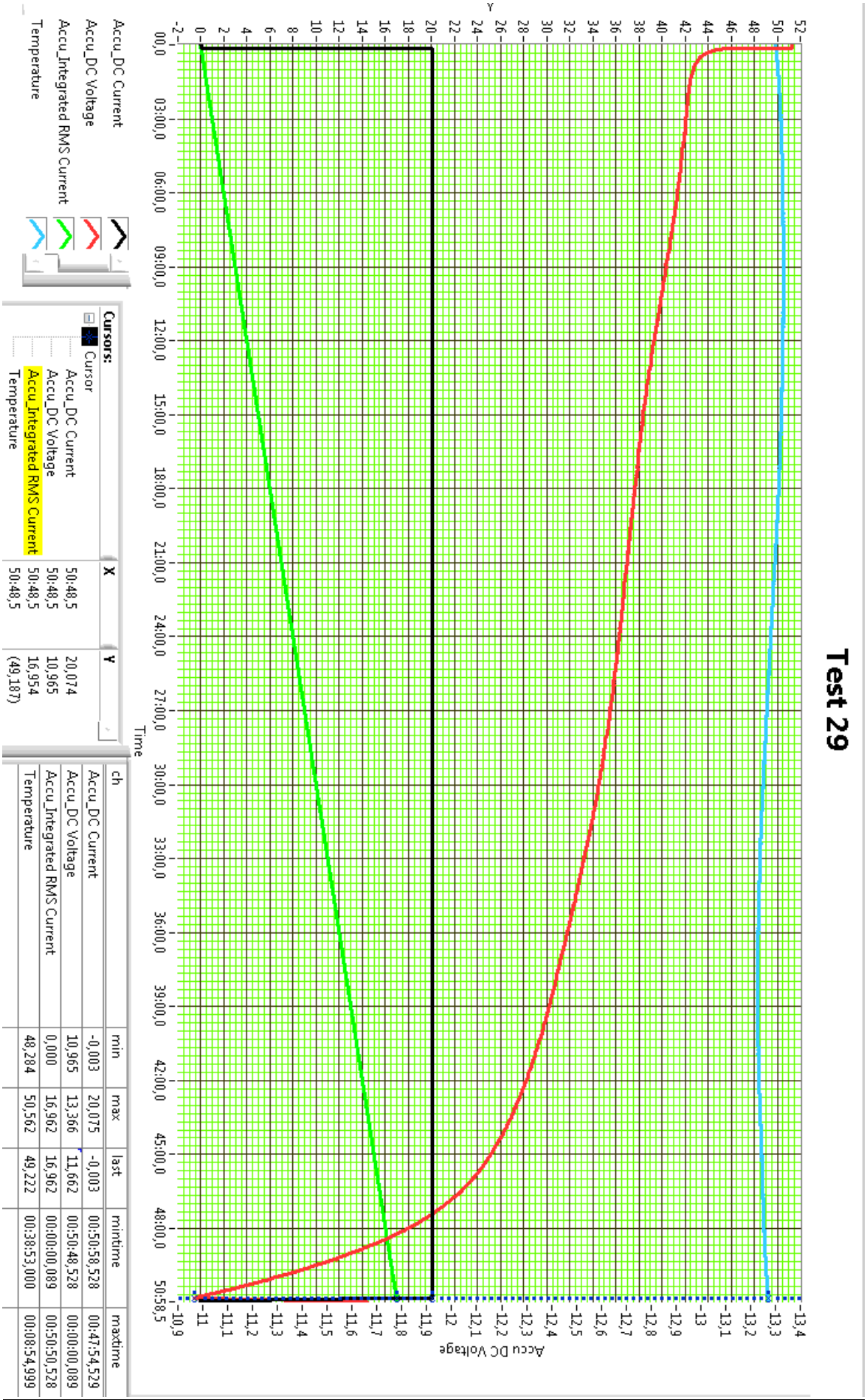


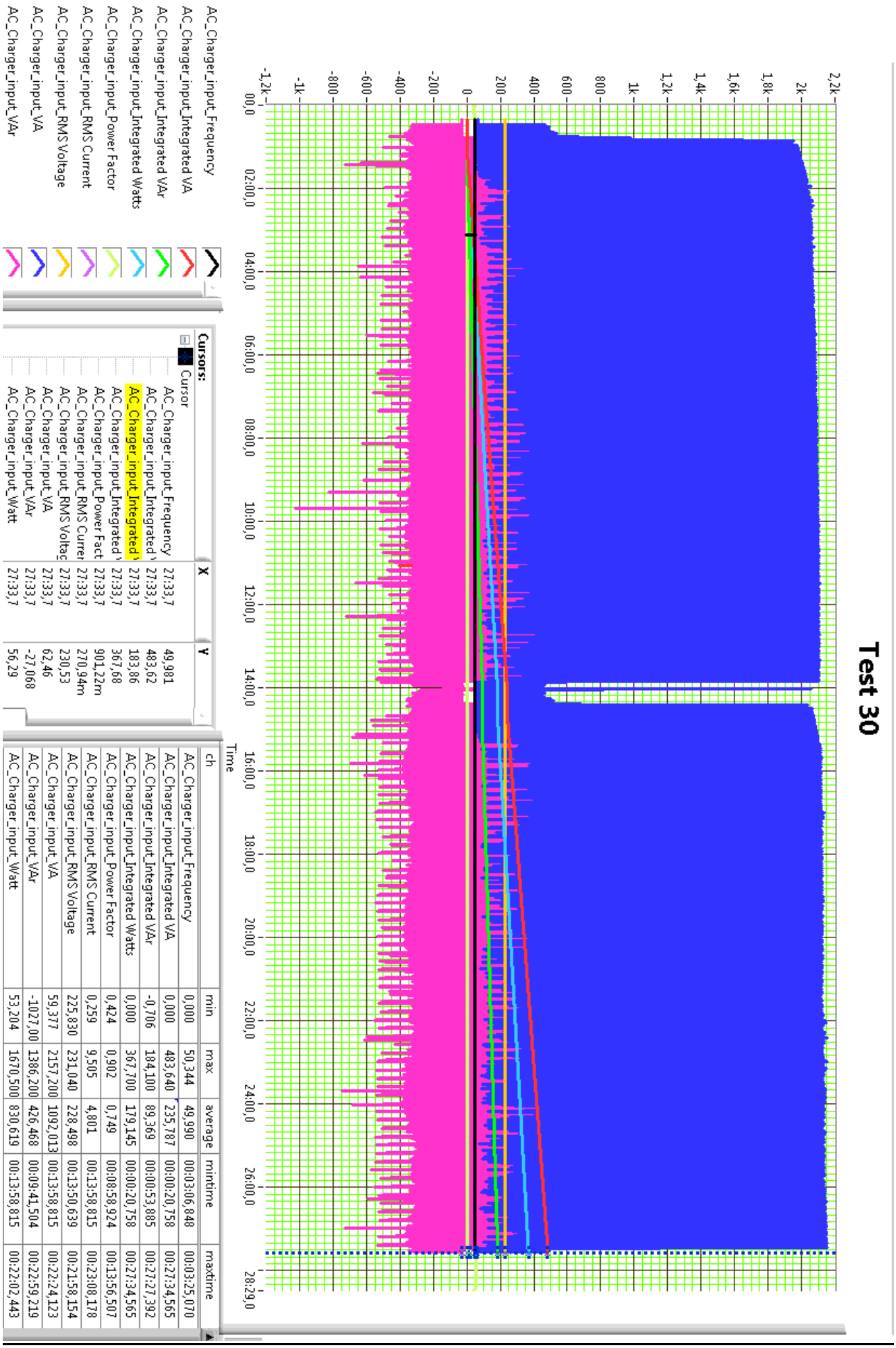

| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 0,000 | 50,343 | 49,996 | 00:19:18,695 | 00:24:44,383 |
| AC_Charger_input_Integrated VA | 0,000 | 490,380 | 242,164 | 00:00:18,780 | 00:28:13,350 |
| AC_Charger_input_Integrated VAr | -0,755 | 176,050 | 87,309 | 00:00:52,954 | 00:27:39,079 |
| AC_Charger_input_Integrated Watts | 0,000 | 373,130 | 184,023 | 00:00:18,780 | 00:28:13,457 |
| AC_Charger_input_Power Factor | 0,448 | 0,901 | 0,752 | 00:03:38,407 | 00:27:45,597 |
| AC_Charger_input_RMS Current | 0,056 | 9,344 | 4,584 | 00:28:03,407 | 00:27:32,252 |
| AC_Charger_input_RMS Voltage | 228,090 | 233,640 | 231,096 | 00:21:16,835 | 00:14:30,442 |
| AC_Charger_input_VA | 13,131 | 2142,600 | 1054,634 | 00:28:03,407 | 00:27:32,151 |
| AC_Charger_input_VAr | -1341,60 | 1363,700 | 377,501 | 00:12:31,662 | 00:24:55,867 |
| AC_Charger_input_Watt | 10,365 | 1661,400 | 802,432 | 00:28:03,407 | 00:27:32,252 |
| Temperature-g1 | 46,200 | 57,800 | 51,535 | 00:01:51,000 | 00:28:34,000 |

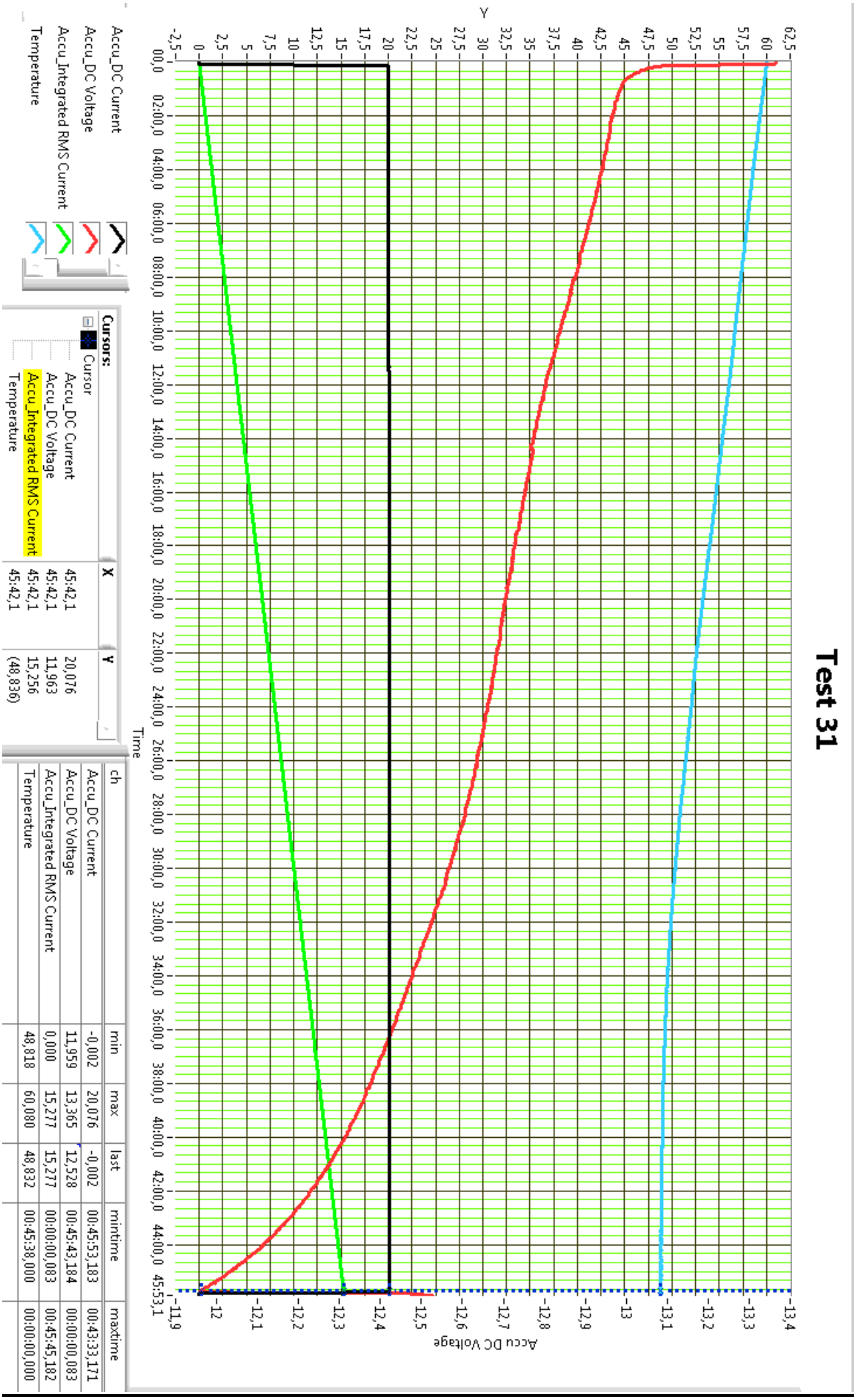

Test 27
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
48:16,8
48:16,8
48:16,8
48:16,8
20,111
10,915
16,123
(34,202)
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,014
20,112
-0,014
01:04:06,972
00:47:01,847
Accu_DC Voltage
10,892
13,302
12,712
00:48:21,862
00:00:00,012
Accu_Integrated RMS Current
0,000
16,164
16,162
00:00:00,012
00:48:23,863
Temperature
22,699
35,442
35,207
00:00:02,000
00:57:39,999



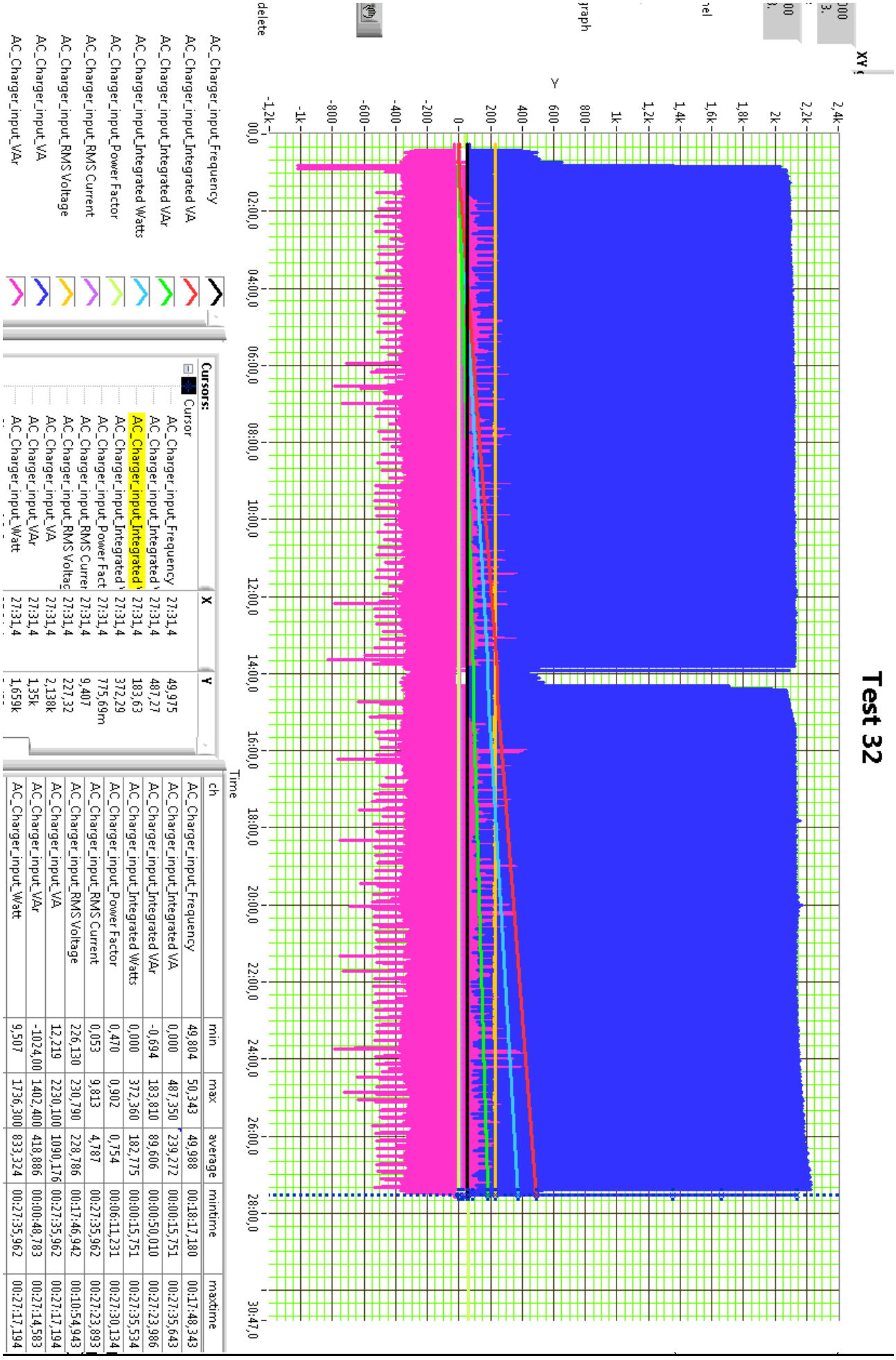

| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 0,000 | 50,353 | 49,975 | 00:01:05,575 | 00:09:57,260 |
| AC_Charger_input_Integrated VA | 0,000 | 471,650 | 231,952 | 00:00:07,761 | 00:25:48,069 |
| AC_Charger_input_Integrated VAr | -0,625 | 180,300 | 88,582 | 00:00:35,767 | 00:25:39,629 |
| AC_Charger_input_Integrated Watts | 0,000 | 358,710 | 176,331 | 00:00:07,761 | 00:25:48,069 |
| AC_Charger_input_Power Factor | 0,397 | 0,903 | 0,745 | 00:12:45,157 | 00:25:46,747 |
| AC_Charger_input_RMS Current | 0,269 | 9,513 | 4,907 | 00:25:48,289 | 00:09:39,970 |
| AC_Charger_input_RMS Voltage | 225,880 | 230,900 | 228,496 | 00:14:50,982 | 00:00:36,790 |
| AC_Charger_input_VA | 61,867 | 2157,300 | 1116,231 | 00:25:48,289 | 00:09:39,970 |
| AC_Charger_input_VAr | -987,710 | 1387,600 | 433,198 | 00:08:25,698 | 00:09:39,970 |
| AC_Charger_input_Watt | 55,800 | 1670,200 | 848,986 | 00:25:48,289 | 00:25:39,536 |


Test 29
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Time
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
50:48,5
50:48,5
50:48,5
50:48,5
20,074
10,965
16,954
(49,187)
ch
min
max
last
mintime
maxtime
Accu_DC Current
-0,003
20,075
-0,003
00:50:58,528
00:47:54,529
Accu_DC Voltage
10,965
13,366
11,662
00:50:48,528
00:00:00,089
Accu_Integrated RMS Current
0,000
16,962
16,962
00:00:00,089
00:50:50,528
Temperature
48,284
50,562
49,222
00:38:53,000
00:08:54,999

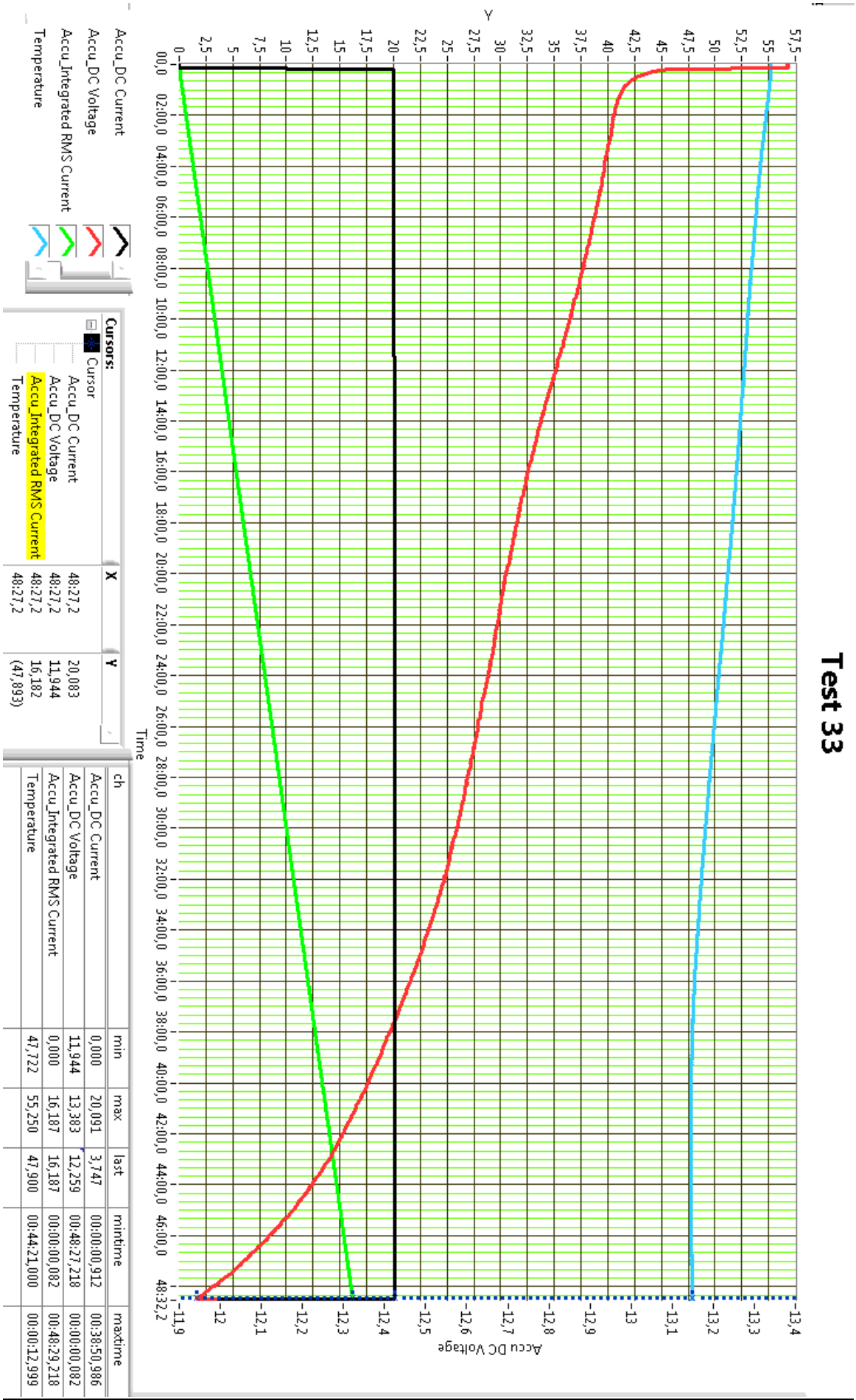

Test 30
Time
AC_Charger_input_Frequency
AC_Charger_input_Integrated VA
AC_Charger_input_Integrated VAr
AC_Charger_input_Integrated Watts
AC_Charger_input_Power Factor
AC_Charger_input_RMS Current
AC_Charger_input_RMS Voltage
AC_Charger_input_VA
AC_Charger_input_VAr
AC_Charger_input_VAr
Cursors:
Cursor
X
Y
AC_Charger_input_Frequency 27:33,7 49,981
AC_Charger_input_Integrated V 27:33,7 483,62
AC_Charger_input_Integrated V 27:33,7 183,86
AC_Charger_input_Integrated V 27:33,7 367,68
AC_Charger_input_Power Fact 27:33,7 901,22m
AC_Charger_input_RMS Curre 27:33,7 270,94m
AC_Charger_input_RMS Voltag 27:33,7 230,53
AC_Charger_input_VA 27:33,7 62,46
AC_Charger_input_VAr 27:33,7 -27,068
AC_Charger_input_Watt 27:33,7 56,29
ch min max average mintime maxtime
AC_Charger_input_Frequency 0,000 50,344 49,990 00:03:06,848 00:03:25,070
AC_Charger_input_Integrated VA 0,000 483,640 235,787 00:00:20,758 00:27:34,565
AC_Charger_input_Integrated VAr -0,706 184,100 89,369 00:00:53,885 00:27:27,392
AC_Charger_input_Integrated Watts 0,000 367,700 179,145 00:00:20,758 00:27:34,565
AC_Charger_input_Power Factor 0,424 0,902 0,749 00:08:58,924 00:13:56,507
AC_Charger_input_RMS Current 0,259 9,505 4,801 00:13:58,815 00:23:08,178
AC_Charger_input_RMS Voltage 225,830 231,040 228,498 00:13:50,639 00:21:58,154
AC_Charger_input_VA 59,377 2157,200 1092,013 00:13:58,815 00:22:24,123
AC_Charger_input_VAr -1027,00 1386,200 426,468 00:09:41,504 00:22:59,219
AC_Charger_input_Watt 53,204 1670,500 830,619 00:13:58,815 00:22:02,443




| ch | min | max | last | mintime | maxtime |
|---|---|---|---|---|---|
| Accu_DC Current | -0,002 | 20,076 | -0,002 | 00:45:53,183 | 00:43:33,171 |
| Accu_DC Voltage | 11,959 | 13,365 | 12,528 | 00:45:43,184 | 00:00:00,083 |
| Accu_Integrated RMS Current | 0,000 | 15,277 | 15,277 | 00:00:00,083 | 00:45:45,182 |
| Temperature | 48,818 | 60,080 | 48,832 | 00:45:38,000 | 00:00:00,000 |




| ch | min | max | average | mintime | maxtime |
|---|---|---|---|---|---|
| AC_Charger_input_Frequency | 49,804 | 50,343 | 49,988 | 00:18:17,180 | 00:17:48,343 |
| AC_Charger_input_Integrated VA | 0,000 | 487,350 | 239,272 | 00:00:15,751 | 00:27:35,643 |
| AC_Charger_input_Integrated VAr | -0,694 | 183,810 | 89,606 | 00:00:50,010 | 00:27:23,986 |
| AC_Charger_input_Integrated Watts | 0,000 | 372,360 | 182,775 | 00:00:15,751 | 00:27:35,534 |
| AC_Charger_input_Power Factor | 0,470 | 0,902 | 0,754 | 00:06:11,231 | 00:27:30,134 |
| AC_Charger_input_RMS Current | 0,053 | 9,813 | 4,787 | 00:27:35,962 | 00:27:23,893 |
| AC_Charger_input_RMS Voltage | 226,130 | 230,790 | 228,786 | 00:17:46,942 | 00:10:54,943 |
| AC_Charger_input_VA | 12,219 | 2230,100 | 1090,176 | 00:27:35,962 | 00:27:17,194 |
| AC_Charger_input_VAr | -1024,00 | 1402,400 | 418,886 | 00:00:48,783 | 00:27:14,583 |
| AC_Charger_input_Watt | 9,507 | 1736,300 | 833,324 | 00:27:35,962 | 00:27:17,194 |


Test 33
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
Cursors:
Cursor
Accu_DC Current
Accu_DC Voltage
Accu_Integrated RMS Current
Temperature
X
Y
48:27,2
48:27,2
48:27,2
48:27,2
20,083
11,944
16,182
(47,893)
Time
Accu DC Voltage
ch
min
max
last
mintime
maxtime
Accu_DC Current
0,000
20,091
3,747
00:00:00,912
00:38:50,986
Accu_DC Voltage
11,944
13,383
12,259
00:48:27,218
00:00:00,082
Accu_Integrated RMS Current
0,000
16,187
16,187
00:00:00,082
00:48:29,218
Temperature
47,722
55,250
47,900
00:44:21,000
00:00:12,999

## 7. Conclusion

According to the test results, there is no significant difference between the fast charged and DC charged energy amount.
Temperature measured between the two cell surfaces.
The battery does not exceed the 62,3°C at fast charge(4C charging), 40,9°C at DC (0,1C) charging, 60°C at (1C) discharging.

No fire, no explosion, no mechanical deformation, no leakage experienced.

# END OF TEST REPORT

**Calibration laboratory**
**Kalibráló laboratórium**

**KALIBRA 59 Műszaki, Szolgáltató Bt.**
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Fax:+36-27-358-876
E-mail:kalibra59@kalibra59.hu

A NAT által NAT-2-0141/2012 számon akkreditált kalibrálólaboratórium

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma:** **K/55201** **Pages / oldalak száma: 4**

# Calibration Certificate / Kalibrálási Bizonyítvány

| | |
|---|---|
| **Object of calibration / A kalibrálás tárgya:** | **Electronic load**<br>**Elektronikus terhelés** |
| **Manufacturer / Gyártó:** | BK Precision |
| **Type / Típus:** | 8510 |
| **Serial number / Gyártási szám:** | 174B17101 |
| **ID number / Azonosító szám:** | TRI 01623043 |
| **State / Állapot:** | Used / Használt |
| **Customer's name and address:**<br>**A vevő neve és címe:** | **TÜV Rheinland InterCert Kft**<br>**1132 Budapest**<br>**Váci út 48/a-b** |
| **Place and date of calibration / A kalibrálás helye és ideje:** | Fót, **2015.05.18.** |
| **Issue date / Kiadás dátuma:** | 2015.05.18. |

**Issued by certificate:**
**A bizonyítványt kiadta:**

Tóth Rudolf
Main Director
Ügyvezető igazgató

KALIBRA 59
Kalibráló laboratórium
2151 Fót, Béke utca 72
Adósz.: 21027567-2-13
www.meroeszkozkalibralas.hu

**Calibration technician:**
**Kalibráló technikus:**

Hosszú Márta

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma: K/55201**

**Calibration was made according to the procedure(s) below:**
**A kalibrálást az alábbi eljárás(ok) alkalmazásával végeztük:**

KE-01:2011/5 Calibration of digital multimeters
KE-01:2011/5 Digitális multiméterek kalibrálása

**Used standard, subsidiary measuring instrument:**
**Alkalmazott etalonok, egyéb mérőeszközök:**

| **Measuring instrument / Mérőeszköz** | **Serial number / Gyártási szám** | **Cal.Cert. number / Kal.Biz. szám** | **Expiration of Cal.Cert / Kal.Biz. lejárat** |
|---|---|---|---|
| Multifunctional calibrator / Multifunkciós kalibrátor | 9785009 | KAL/15-0180 | 2016.05.02. |
| Current generator / Áram generátor | 2336701 | 2336701-01-2013 | 2015.10.22. |
| Temp- and humidity meter / Hő- és páratartalom mérő | KI0143SK | KAL/15-0110 | 2017.05.02. |
| Main voltage meter / Hálózati feszültségmérő | 085382 | KAL/15-0130 | 2016.05.02. |

Measurement used in standard and subsidiary instrument is traceable to national standards, based on the indicated number of calibration certificate.

Az alkalmazott etalonokkal és egyéb mérőeszközökkel végzett mérések, a jelzett számú bizonyítványok alapján, a nemzeti etalonokra visszavezethetőek.

| | | |
|---|---|---|
| **Environmental conditions:**<br>**Környezeti feltételek:** | Temperature / Hőmérséklet | **23±3°C** |
| | Humidity / Légnedvesség | **40±20%RH** |
| | Main voltage / Hálózati feszültség | **230V±10%** |

**Note for measured values:**
**Megjegyzés a mérési eredményekhez:**

KALIBRA 59

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma:** **K/55201**

## Measured values:
## Mérési eredmények:

### DC Current measurement mode / Egyenáram mérés üzemmód

| Range/ Méréshatár | Standard value/ Helyes érték | Measured value/ Mért érték | Error/ Hiba | Allowed deviation/ Megengedett eltérés (+/-) | Uncertainty/ Mérési bizonytalanság (+/-) | Qualification/ Minősítés |
|---|---|---|---|---|---|---|
| 12 A | 0,10000 A | 0,106 A | 0,00600 A | | 0,58 mA | |
| 12 A | 6,0000 A | 5,998 A | -0,0020 A | | 4,2 mA | |
| 12 A | 12,0000 A | 12,000 A | 0,0000 A | | 6 mA | |
| 120 A | 10,0000 A | 9,99 A | -0,0100 A | | 5,9 mA | |
| 120 A | 20,0000 A | 19,98 A | -0,0200 A | | 6,4 mA | |
| 120 A | 100,000 A | 99,98 A | -0,020 A | | 15 mA | |

### DC Voltage measurement mode (Local) / Egyenfeszültség mérés üzemmód (Local)

| Range/ Méréshatár | Standard value/ Helyes érték | Measured value/ Mért érték | Error/ Hiba | Allowed deviation/ Megengedett eltérés (+/-) | Uncertainty/ Mérési bizonytalanság (+/-) | Qualification/ Minősítés |
|---|---|---|---|---|---|---|
| 18 V | 3,0000 V | 3,000 V | 0,0000 V | | 0,58 mV | |
| 18 V | 10,0000 V | 9,999 V | -0,0010 V | | 0,63 mV | |
| 18 V | 18,0000 V | 17,998 V | -0,0020 V | | 0,66 mV | |
| 120 V | 3,0000 V | 2,99 V | -0,0100 V | | 5,8 mV | |
| 120 V | 60,000 V | 59,98 V | -0,020 V | | 6,4 mV | |
| 120 V | 120,000 V | 119,97 V | -0,030 V | | 6,8 mV | |

### DC Voltage measurement mode (Remote) / Egyenfeszültség mérés üzemmód (Remote)

| Range/ Méréshatár | Standard value/ Helyes érték | Measured value/ Mért érték | Error/ Hiba | Allowed deviation/ Megengedett eltérés (+/-) | Uncertainty/ Mérési bizonytalanság (+/-) | Qualification/ Minősítés |
|---|---|---|---|---|---|---|
| 18 V | 3,0000 V | 3,000 V | 0,0000 V | | 0,58 mV | |
| 18 V | 10,0000 V | 9,998 V | -0,0020 V | | 0,63 mV | |
| 18 V | 18,0000 V | 17,998 V | -0,0020 V | | 0,66 mV | |
| 120 V | 3,0000 V | 2,99 V | -0,0100 V | | 5,8 mV | |
| 120 V | 60,000 V | 59,98 V | -0,020 V | | 6,4 mV | |
| 120 V | 120,000 V | 119,97 V | -0,030 V | | 6,8 mV | |

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma: K/55201**

The recorded calibration result are only valid for the metrological attribute of measuring instrument.
A közölt kalibrálási eredmények a mérőeszköz talált metrológiai jellemzőire érvényesek.

**Qualification / Minősítés**

The customer did not request qualification of measured values.
A vevő a mérési értékek minősítését nem kérte.

**Uncertainty of measurment**

The reported extended uncertainty of measurment is stated as the standard uncertainty of measurment multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurment has been determined in accordance with EA Publication EA-4/02 (Expression of the Uncertainty of Measurment in Calibration).

**Mérési bizonytalanság**

A közölt kiterjesztett mérési bizonytalanság a standard bizonytalanság k=2 -vel szorzott értéke, ami normális eloszlás eseténközelítőleg 95%-os megbízhatósági valószínűségnek felel meg. A standard bizonytalanság meghatározása az EA-4/02 ( A mérési bizonytalanság meghatározása kalibrálásnál) kiadványnak megfelelően történt.

**Note / Megjegyzés**

Certification stamping vignette is placed on the measuring instrument with the name of the Calibration Laboratory, date of calibration and No: **K/55201** of calibration certificates.

A mérőeszközön a kalibrálás elvégzését igazoló, a kalibráló laboratórium adatait tartalmazó, **K/55201** jelű levonóképes bélyeget helyeztünk el.

***** end of the document / a dokumentum vége *****

**Calibration laboratory**
**Kalibráló laboratórium**

**KALIBRA 59 Műszaki, Szolgáltató Bt.**
Office / Székhely: 2151. Fót, Béke u. 72
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Fax:+36-27-358-876
E-mail:kalibra59@kalibra59.hu

A NAT által NAT-2-0141/2012 számon akkreditált kalibrálólaboratórium

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma:** **K/55202** **Pages / oldalak száma: 4**

# Calibration Certificate / Kalibrálási Bizonyítvány

| | |
|---|---|
| **Object of calibration / A kalibrálás tárgya:** | **DC Power supply**<br>**DC Tápegység** |
| **Manufacturer / Gyártó:** | Sorensen |
| **Type / Típus:** | XG 60-25 |
| **Serial number / Gyártási szám:** | 1235A01932 |
| **ID number / Azonosító szám:** | TRI 01623049 |
| **State / Állapot:** | Used / Használt |
| **Customer's name and address:**<br>**A vevő neve és címe:** | **TÜV Rheinland InterCert Kft**<br>**1132 Budapest**<br>**Váci út 48/a-b** |
| **Place and date of calibration / A kalibrálás helye és ideje:** | Fót, **2015.05.18.** |
| **Issue date / Kiadás dátuma:** | 2015.05.18. |

**Issued by certificate:**
**A bizonyítványt kiadta:**

Tóth Rudolf
Main Director
Ügyvezető igazgató

Kalibráló laboratórium
2151 Fót, Béke utca 72
Adósz.: 21027567-2-13
www.meroeszkozkalibralas.hu

**Calibration technician:**
**Kalibráló technikus:**

Hosszú Márta

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma: K/55202**

**Calibration was made according to the procedure(s) below:**
**A kalibrálást az alábbi eljárás(ok) alkalmazásával végeztük:**

KE-09:2011/5 Calibration of calibrators, and supplies
KE-09:2011/5 Kalibrátorok és források kalibrálása

**Used standard, subsidiary measuring instrument:**
**Alkalmazott etalonok, egyéb mérőeszközök:**

| **Measuring instrument/ Mérőeszköz** | **Serial number / Gyártási szám** | **Cal.Cert. number / Kal.Biz. szám** | **Expiration of Cal.Cert / Kal.Biz. lejárat** |
|---|---|---|---|
| Digital multimeter/ Digitális multiméter | 4022549 | KAL/14-0310 | 2015.06.10. |
| Shunt / Sönt | 05061402 | KAL/13-0290 | 2015.06.10. |
| Temp- and humidity meter/ Hő- és páratartalom mérő | KI0143SK | KAL/15-0110 | 2017.05.02. |
| Main voltage meter / Hálózati feszültségmérő | 085382 | KAL/15-0130 | 2016.05.02. |

Measurement used in standard and subsidiary instrument is traceable to national standards, based on the indicated number of calibration certificate.

Az alkalmazott etalonokkal és egyéb mérőeszközökkel végzett mérések, a jelzett számú bizonyítványok alapján, a nemzeti etalonokra visszavezethetőek.

| | | |
|---|---|---|
| **Environmental conditions:** **Környezeti feltételek:** | Temperature / Hőmérséklet | **23±3°C** |
| | Humidity / Légnedvesség | **40±20%RH** |
| | Main voltage / Hálózati feszültség | **230V±10%** |

**Note for measured values:**
**Megjegyzés a mérési eredményekhez:**

KALIBRA 59

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma:** **K/55202**

## Measured values:
## Mérési eredmények:

### DC Current reproduction / Egyenáram reprodukálás

| Range/ Méréshatár | Standard value/ Helyes érték | Measured value/ Mért érték | Error/ Hiba | Allowed deviation/ Megengedett eltérés (+/-) | Uncertainty/ Mérési bizonytalanság (+/-) | Qualification/ Minősítés |
|---|---|---|---|---|---|---|
| 24 A | 2,00375 A | 2,00 A | -0,00375 A | | 1,1 mA | |
| 24 A | 10,01177 A | 10,00 A | -0,01177 A | | 1,1 mA | |
| 24 A | 20,00652 A | 20,00 A | -0,00652 A | | 1,1 mA | |
| 24 A | 23,99657 A | 24,00 A | 0,00343 A | | 1,1 mA | |

### DC Voltage reproduction / Egyenfeszültség reprodukálás

| Range/ Méréshatár | Standard value/ Helyes érték | Measured value/ Mért érték | Error/ Hiba | Allowed deviation/ Megengedett eltérés (+/-) | Uncertainty/ Mérési bizonytalanság (+/-) | Qualification/ Minősítés |
|---|---|---|---|---|---|---|
| 60 V | 2,998241 V | 3,00 V | 0,001759 V | | 0,15 mV | |
| 60 V | 9,998521 V | 10,00 V | 0,001479 V | | 0,33 mV | |
| 60 V | 17,99852 V | 18,00 V | 0,00148 V | | 1,8 mV | |
| 60 V | 60,0064 V | 60,00 V | -0,0064 V | | 3,3 mV | |

**Calibration certificate number:**
**Kalibrálási bizonyítvány száma: K/55202**

The recorded calibration result are only valid for the metrological attribute of measuring instrument.
A közölt kalibrálási eredmények a mérőeszköz talált metrológiai jellemzőire érvényesek.

**Qualification / Minősítés**

The customer did not request qualification of measured values.
A vevő a mérési értékek minősítését nem kérte.

**Uncertainty of measurment**

The reported extended uncertainty of measurment is stated as the standard uncertainty of measurment multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurment has been determined in accordance with EA Publication EA-4/02 (Expression of the Uncertainty of Measurment in Calibration).

**Mérési bizonytalanság**

A közölt kiterjesztett mérési bizonytalanság a standard bizonytalanság k=2 -vel szorzott értéke, ami normális eloszlás eseténközelítőleg 95%-os megbízhatósági valószínűségnek felel meg. A standard bizonytalanság meghatározása az EA-4/02 ( A mérési bizonytalanság meghatározása kalibrálásnál) kiadványnak megfelelően történt.

**Note / Megjegyzés**

Certification stamping vignette is placed on the measuring instrument with the name of the Calibration Laboratory, date of calibration and No: **K/55202** of calibration certificates.

A mérőeszközön a kalibrálás elvégzését igazoló, a kalibráló laboratórium adatait tartalmazó, **K/55202** jelű levonóképes bélyeget helyeztünk el.

***** end of the document / a dokumentum vége *****

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# CALIBRATION CERTIFICATE

6 May 2015 06:02  Script file: KinetiQ PPA5500-HC final electrical v2.07
Automatic Calibration Environment release ACE v2.87
NEWTONS4TH,PPA5530,165-04037,2.121
HP3458A,MY45048891
NEWTONS4TH,ACC-IV,01821,1.54

Summary report

Verify HV attenuator

| | [--- applied ----] | | range | phase 1 | phase 2 | phase 3 | [------- voltage ------- dev | spec | uncert] |
|---|---|---|---|---|---|---|---|---|---|
| OK: | 55.00 Hz | 248.87 V | 9 | 248.87 V | 248.85 V | 248.86 V | <-0.01%> | [0.38%] | {0.049%} |
| OK: | 55.00 Hz | 221.24 V | 8 | 221.24 V | 221.23 V | 221.24 V | <-0.00%> | [0.16%] | {0.050%} |
| OK: | 55.00 Hz | 107.77 V | 7 | 107.76 V | 107.76 V | 107.77 V | <-0.00%> | [0.10%] | {0.023%}* |
| OK: | 55.00 Hz | 52.577 V | 6 | 52.578 V | 52.578 V | 52.578 V | <+0.00%> | [0.08%] | {0.025%}* |
| OK: | 55.00 Hz | 10.823 V | 5 | 10.823 V | 10.823 V | 10.823 V | <-0.00%> | [0.11%] | {0.012%}* |
| OK: | 55.00 Hz | 3.6763 V | 4 | 3.6763 V | 3.6764 V | 3.6764 V | <+0.00%> | [0.13%] | {0.015%}* |
| OK: | 55.00 Hz | 877.40mV | 3 | 877.41mV | 877.43mV | 877.52mV | <+0.01%> | [0.24%] | {0.012%} |
| OK: | 55.00 Hz | 293.25mV | 2 | 293.20mV | 293.22mV | 293.23mV | <-0.02%> | [0.46%] | {0.016%} |
| OK: | 55.00 Hz | 82.259mV | 1 | 82.147mV | 82.179mV | 82.232mV | <-0.14%> | [1.35%] | {0.012%} |
| OK: | 400.0 Hz | 270.29 V | 9 | 270.27 V | 270.29 V | 270.29 V | <-0.01%> | [0.35%] | {0.048%} |
| OK: | 400.0 Hz | 243.21 V | 8 | 243.22 V | 243.21 V | 243.22 V | <+0.00%> | [0.15%] | {0.049%} |
| OK: | 400.0 Hz | 109.71 V | 7 | 109.71 V | 109.71 V | 109.72 V | <+0.01%> | [0.10%] | {0.023%}* |
| OK: | 400.0 Hz | 57.472 V | 6 | 57.474 V | 57.475 V | 57.474 V | <+0.01%> | [0.08%] | {0.025%}* |
| OK: | 400.0 Hz | 11.018 V | 5 | 11.018 V | 11.017 V | 11.018 V | <-0.01%> | [0.11%] | {0.012%}* |
| OK: | 400.0 Hz | 4.2298 V | 4 | 4.2301 V | 4.2298 V | 4.2301 V | <+0.01%> | [0.12%] | {0.014%}* |
| OK: | 400.0 Hz | 1.0219 V | 3 | 1.0219 V | 1.0220 V | 1.0220 V | <+0.01%> | [0.21%] | {0.012%} |
| OK: | 400.0 Hz | 341.55mV | 2 | 341.52mV | 341.52mV | 341.56mV | <-0.01%> | [0.40%] | {0.015%} |
| OK: | 400.0 Hz | 95.797mV | 1 | 95.715mV | 95.794mV | 95.807mV | <-0.09%> | [1.16%] | {0.012%} |
| OK: | 8.000kHz | 271.71 V | 9 | 271.69 V | 271.69 V | 271.71 V | <-0.01%> | [0.38%] | {0.068%} |
| OK: | 8.000kHz | 244.49 V | 8 | 244.48 V | 244.48 V | 244.48 V | <-0.00%> | [0.18%] | {0.069%} |
| OK: | 8.000kHz | 110.29 V | 7 | 110.29 V | 110.29 V | 110.30 V | <+0.01%> | [0.13%] | {0.024%}* |
| OK: | 8.000kHz | 61.176 V | 6 | 61.178 V | 61.171 V | 61.174 V | <-0.01%> | [0.10%] | {0.026%}* |
| OK: | 8.000kHz | 11.077 V | 5 | 11.077 V | 11.077 V | 11.078 V | <+0.01%> | [0.14%] | {0.019%}* |
| OK: | 8.000kHz | 4.1078 V | 4 | 4.1081 V | 4.1073 V | 4.1080 V | <-0.01%> | [0.15%] | {0.022%}* |
| OK: | 8.000kHz | 1.0943 V | 3 | 1.0944 V | 1.0943 V | 1.0944 V | <+0.01%> | [0.23%] | {0.019%} |
| OK: | 8.000kHz | 342.92mV | 2 | 342.88mV | 342.86mV | 342.88mV | <-0.02%> | [0.43%] | {0.023%} |
| OK: | 8.000kHz | 96.177mV | 1 | 96.098mV | 96.136mV | 96.182mV | <-0.08%> | [1.19%] | {0.020%} |
| OK: | 48.00kHz | 203.85 V | 9 | 203.94 V | 203.96 V | 203.95 V | <+0.05%> | [0.65%] | {0.133%} |
| OK: | 48.00kHz | 203.89 V | 8 | 203.99 V | 203.96 V | 203.99 V | <+0.05%> | [0.36%] | {0.133%} |
| OK: | 48.00kHz | 110.36 V | 7 | 110.38 V | 110.38 V | 110.38 V | <+0.02%> | [0.29%] | {0.047%}* |
| OK: | 48.00kHz | 61.150 V | 6 | 61.161 V | 61.152 V | 61.155 V | <+0.02%> | [0.26%] | {0.048%}* |
| OK: | 48.00kHz | 11.077 V | 5 | 11.079 V | 11.078 V | 11.079 V | <+0.01%> | [0.30%] | {0.044%}* |
| OK: | 48.00kHz | 4.1060 V | 4 | 4.1065 V | 4.1064 V | 4.1064 V | <+0.01%> | [0.31%] | {0.046%}* |
| OK: | 48.00kHz | 1.0938 V | 3 | 1.0939 V | 1.0939 V | 1.0939 V | <+0.01%> | [0.39%] | {0.044%} |
| OK: | 48.00kHz | 342.78mV | 2 | 342.77mV | 342.75mV | 342.76mV | <-0.01%> | [0.59%] | {0.047%} |
| OK: | 48.00kHz | 96.122mV | 1 | 96.076mV | 96.104mV | 96.153mV | <-0.05%> | [1.35%] | {0.044%} |
| OK: | 220.0kHz | 44.578 V | 6 | 44.599 V | 44.598 V | 44.596 V | <+0.05%> | [0.97%] | {0.438%}* |
| OK: | 220.0kHz | 11.108 V | 5 | 11.145 V | 11.145 V | 11.146 V | <+0.34%> | [0.99%] | {0.330%}* |
| OK: | 220.0kHz | 4.1249 V | 4 | 4.1271 V | 4.1271 V | 4.1269 V | <+0.05%> | [1.00%] | {0.344%}* |
| OK: | 220.0kHz | 1.0971 V | 3 | 1.0977 V | 1.0977 V | 1.0976 V | <+0.06%> | [1.07%] | {0.330%} |
| OK: | 220.0kHz | 344.36mV | 2 | 344.49mV | 344.48mV | 344.47mV | <+0.04%> | [1.28%] | {0.349%} |
| OK: | 220.0kHz | 96.427mV | 1 | 96.530mV | 96.582mV | 96.589mV | <+0.17%> | [2.03%] | {0.331%} |
| OK: | 700.0kHz | 9.7567 V | 5 | 9.7748 V | 9.7752 V | 9.7744 V | <+0.19%> | [2.92%] | {1.071%}* |
| OK: | 700.0kHz | 4.1049 V | 4 | 4.1167 V | 4.1165 V | 4.1162 V | <+0.29%> | [2.92%] | {1.084%}* |
| OK: | 700.0kHz | 1.0816 V | 3 | 1.0864 V | 1.0865 V | 1.0865 V | <+0.45%> | [3.00%] | {0.434%} |
| OK: | 700.0kHz | 338.99mV | 2 | 341.66mV | 341.75mV | 341.71mV | <+0.81%> | [3.20%] | {0.436%} |
| OK: | 700.0kHz | 95.070mV | 1 | 96.505mV | 96.618mV | 96.581mV | <+1.63%> | [3.97%] | {0.434%} |
| OK: | 1.200MHz | 1.7615 V | 5 | 1.7619 V | 1.7615 V | 1.7619 V | <+0.02%> | [5.39%] | {0.704%} |
| OK: | 1.200MHz | 1.7615 V | 4 | 1.7621 V | 1.7620 V | 1.7621 V | <+0.04%> | [5.05%] | {0.704%}* |
| OK: | 1.200MHz | 1.0444 V | 3 | 1.0420 V | 1.0418 V | 1.0417 V | <-0.26%> | [5.00%] | {0.698%} |
| OK: | 2.000MHz | 1.5984 V | 5 | 1.5989 V | 1.5990 V | 1.5990 V | <+0.03%> | [8.65%] | {1.131%} |

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```
 OK:  2.000MHz  1.5985 V   4  1.5991 V  1.5990 V  1.5991 V <+0.04%> [8.27%] {1.131%}*
 OK:  2.000MHz  946.96mV   3  947.17mV  946.98mV  947.03mV <+0.02%> [8.22%] {1.126%}
```

Verify phase accuracy of HV attenuator

```
      [------- applied -------]                                                [--------- phase ---------]
                                ranges   A1      V2      A2      V3      A3      dev      spec    uncert
 OK:  55.00 Hz  2.0491 V 0.000°  3  9 +0.002° +0.001° +0.002° +0.003° +0.002° <+0.003°> [0.006°] {0.002°}*
 OK:  400.0 Hz  2.0412 V 0.000°  3  9 +0.001° +0.001° +0.001° +0.001° +0.001° <+0.001°> [0.009°] {0.002°}*
 OK:  8.000kHz  2.0492 V 0.000°  3  9 -0.000° +0.001° -0.000° +0.001° -0.000° <+0.001°> [0.085°] {0.002°}*
 OK:  48.00kHz  2.0481 V 0.000°  3  9 -0.002° +0.000° -0.002° +0.002° -0.002° <-0.002°> [0.485°] {0.004°}*
 OK:  100.0kHz  2.0504 V 0.000°  3  9 -0.001° +0.001° -0.000° +0.002° -0.000° <+0.002°> [1.005°] {0.007°}*
 OK:  220.0kHz  2.0558 V 0.000°  3  9 -0.015° +0.005° -0.017° +0.005° -0.016° <-0.017°> [2.205°] {0.013°}*
 OK:  700.0kHz  2.0212 V 0.000°  3  9 -0.270° +0.014° -0.311° +0.044° -0.295° <-0.311°> [7.005°] {0.037°}*
 OK:  1.200MHz  1.9168 V 0.000°  3  9 -0.517° +0.011° -0.578° +0.028° -0.572° <-0.578°> [12.01°] {0.062°}*
 OK:  2.000MHz  1.7002 V 0.000°  3  9 +0.125° +0.067° +0.063° +0.106° +0.039° <+0.125°> [20.00°] {0.102°}*
```

Verify internal shunt calibration at low frequency

```
      [--- applied ----]      phase 1   phase 2   phase 3  [------- current -------]
                           range                            dev     spec    uncert
 OK:  55.00 Hz  3.3681 A   9  3.3659 A  3.3712 A  3.3677 A <+0.09%> [8.94%] {0.019%}
 OK:  55.00 Hz  3.3732 A   8  3.3740 A  3.3737 A  3.3729 A <+0.03%> [2.70%] {0.019%}
 OK:  55.00 Hz  3.3769 A   7  3.3774 A  3.3772 A  3.3772 A <+0.02%> [0.92%] {0.019%}
 OK:  55.00 Hz  3.3778 A   6  3.3773 A  3.3773 A  3.3775 A <-0.01%> [0.30%] {0.019%}*
 OK:  55.00 Hz  3.3813 A   5  3.3813 A  3.3814 A  3.3810 A <-0.01%> [0.12%] {0.019%}*
 OK:  55.00 Hz  1.4878 A   4  1.4877 A  1.4877 A  1.4878 A <-0.01%> [0.10%] {0.023%}*
 OK:  55.00 Hz  201.00mA   3  201.01mA  201.04mA  200.99mA <+0.02%> [0.32%] {0.029%}*
 OK:  55.00 Hz  145.96mA   2  145.98mA  145.97mA  145.95mA <+0.01%> [0.29%] {0.035%}*
 OK:  55.00 Hz  29.757mA   1  29.765mA  29.769mA  29.753mA <+0.04%> [1.13%] {0.025%}
 OK:  400.0 Hz  3.3724 A   9  3.3680 A  3.3729 A  3.3706 A <-0.13%> [8.93%] {0.019%}
 OK:  400.0 Hz  3.3852 A   8  3.3853 A  3.3851 A  3.3832 A <-0.06%> [2.69%] {0.019%}
 OK:  400.0 Hz  3.3894 A   7  3.3904 A  3.3898 A  3.3901 A <+0.03%> [0.92%] {0.019%}
 OK:  400.0 Hz  3.3890 A   6  3.3886 A  3.3886 A  3.3887 A <-0.01%> [0.30%] {0.019%}*
 OK:  400.0 Hz  3.3915 A   5  3.3915 A  3.3915 A  3.3912 A <-0.01%> [0.12%] {0.019%}*
 OK:  400.0 Hz  1.4919 A   4  1.4918 A  1.4918 A  1.4919 A <-0.01%> [0.10%] {0.023%}*
 OK:  400.0 Hz  201.77mA   3  201.78mA  201.78mA  201.77mA <+0.01%> [0.32%] {0.029%}*
 OK:  400.0 Hz  147.85mA   2  147.87mA  147.87mA  147.85mA <+0.01%> [0.29%] {0.035%}*
 OK:  400.0 Hz  30.141mA   1  30.164mA  30.147mA  30.145mA <+0.07%> [1.12%] {0.025%}
 OK:  8.000kHz  3.4448 A   9  3.4492 A  3.4486 A  3.4503 A <+0.16%> [8.77%] {0.030%}
 OK:  8.000kHz  3.4553 A   8  3.4615 A  3.4570 A  3.4584 A <+0.18%> [2.67%] {0.030%}
 OK:  8.000kHz  3.4641 A   7  3.4682 A  3.4645 A  3.4674 A <+0.12%> [0.93%] {0.030%}
 OK:  8.000kHz  3.4673 A   6  3.4678 A  3.4671 A  3.4681 A <+0.02%> [0.32%] {0.030%}*
 OK:  8.000kHz  3.4708 A   5  3.4714 A  3.4707 A  3.4715 A <+0.02%> [0.15%] {0.030%}*
 OK:  8.000kHz  1.5254 A   4  1.5257 A  1.5252 A  1.5259 A <+0.03%> [0.13%] {0.034%}*
 OK:  8.000kHz  203.23mA   3  203.28mA  203.26mA  203.26mA <+0.02%> [0.35%] {0.040%}*
 OK:  8.000kHz  148.76mA   2  148.81mA  148.80mA  148.80mA <+0.04%> [0.31%] {0.046%}*
 OK:  8.000kHz  30.188mA   1  30.212mA  30.205mA  30.212mA <+0.08%> [1.15%] {0.036%}
 OK:  48.00kHz  3.3621 A   6  3.3622 A  3.3620 A  3.3640 A <+0.06%> [0.49%] {0.069%}
 OK:  48.00kHz  3.3732 A   5  3.3729 A  3.3735 A  3.3748 A <+0.05%> [0.31%] {0.069%}*
 OK:  48.00kHz  1.4124 A   4  1.4122 A  1.4123 A  1.4131 A <+0.05%> [0.30%] {0.073%}*
 OK:  48.00kHz  201.62mA   3  201.66mA  201.65mA  201.63mA <+0.02%> [0.51%] {0.078%}*
 OK:  48.00kHz  147.48mA   2  147.50mA  147.51mA  147.49mA <+0.02%> [0.48%] {0.083%}*
 OK:  48.00kHz  30.167mA   1  30.184mA  30.174mA  30.174mA <+0.06%> [1.31%] {0.074%}
 OK:  100.0kHz  3.2704 A   6  3.2697 A  3.2693 A  3.2722 A <+0.05%> [0.70%] {0.152%}
 OK:  100.0kHz  3.2750 A   5  3.2721 A  3.2759 A  3.2757 A <-0.09%> [0.52%] {0.151%}*
```

Verify internal shunts at high frequency

```
      [--- applied ----]      phase 1  [------- current -------]
                           range           dev     spec    uncert
 OK:  220.0kHz  212.84mA   4  213.08mA <+0.11%> [1.46%] {0.541%}
 OK:  220.0kHz  212.95mA   3  212.94mA <-0.00%> [1.18%] {0.541%}*
 OK:  220.0kHz  145.60mA   2  145.60mA <-0.00%> [1.17%] {0.574%}*
```

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# CALIBRATION CERTIFICATE

```
 OK:  220.0kHz  32.481mA   1  32.484mA <+0.01%> [1.92%] {0.516%}
 OK:  700.0kHz  196.96mA   4  196.59mA <-0.19%> [3.43%] {0.716%}
 OK:  700.0kHz  197.64mA   3  197.35mA <-0.15%> [3.12%] {0.716%}*
 OK:  700.0kHz  130.92mA   2  130.86mA <-0.04%> [3.12%] {0.708%}*
 OK:  700.0kHz  31.223mA   1  31.359mA <+0.43%> [3.88%] {0.713%}
 OK:  1.200MHz  185.15mA   4  185.14mA <-0.01%> [5.47%] {1.165%}
 OK:  1.200MHz  185.52mA   3  185.56mA <+0.02%> [5.14%] {1.165%}*
 OK:  1.200MHz  139.08mA   2  139.16mA <+0.06%> [5.10%] {1.158%}*
 OK:  1.200MHz  29.644mA   1  29.693mA <+0.17%> [5.93%] {1.162%}
 OK:  2.000MHz  147.12mA   4  146.88mA <-0.16%> [8.84%] {1.891%}
 OK:  2.000MHz  147.19mA   3  146.91mA <-0.19%> [8.43%] {1.891%}*
 OK:  2.000MHz  108.05mA   2  107.86mA <-0.17%> [8.38%] {1.884%}*
 OK:  2.000MHz  22.460mA   1  22.441mA <-0.08%> [9.49%] {1.888%}

      [--- applied ----]      phase 2  [------- current -------]
                          range           dev     spec    uncert
 OK:  220.0kHz  208.12mA   4  208.65mA <+0.25%> [1.48%] {0.542%}
 OK:  220.0kHz  208.44mA   3  208.41mA <-0.02%> [1.19%] {0.542%}*
 OK:  220.0kHz  143.85mA   2  143.84mA <-0.01%> [1.17%] {0.576%}*
 OK:  220.0kHz  31.277mA   1  31.274mA <-0.01%> [1.96%] {0.517%}
 OK:  700.0kHz  196.58mA   4  196.19mA <-0.20%> [3.43%] {0.716%}
 OK:  700.0kHz  196.80mA   3  196.56mA <-0.12%> [3.12%] {0.716%}*
 OK:  700.0kHz  131.96mA   2  131.99mA <+0.02%> [3.12%] {0.708%}*
 OK:  700.0kHz  31.525mA   1  31.715mA <+0.60%> [3.87%] {0.713%}
 OK:  1.200MHz  186.60mA   4  186.58mA <-0.01%> [5.46%] {1.165%}
 OK:  1.200MHz  186.92mA   3  187.07mA <+0.08%> [5.14%] {1.165%}*
 OK:  1.200MHz  139.93mA   2  140.19mA <+0.19%> [5.10%] {1.158%}*
 OK:  1.200MHz  29.729mA   1  29.867mA <+0.46%> [5.93%] {1.162%}
 OK:  2.000MHz  148.47mA   4  148.17mA <-0.20%> [8.83%] {1.891%}
 OK:  2.000MHz  148.53mA   3  148.40mA <-0.09%> [8.42%] {1.891%}*
 OK:  2.000MHz  109.07mA   2  109.21mA <+0.13%> [8.38%] {1.884%}*
 OK:  2.000MHz  22.618mA   1  22.780mA <+0.72%> [9.48%] {1.888%}

      [--- applied ----]      phase 3  [------- current -------]
                          range           dev     spec    uncert
 OK:  220.0kHz  210.78mA   4  211.39mA <+0.29%> [1.47%] {0.541%}
 OK:  220.0kHz  210.68mA   3  210.63mA <-0.02%> [1.18%] {0.541%}*
 OK:  220.0kHz  144.78mA   2  144.74mA <-0.03%> [1.17%] {0.575%}*
 OK:  220.0kHz  31.497mA   1  31.513mA <+0.05%> [1.95%] {0.517%}
 OK:  700.0kHz  197.37mA   4  197.00mA <-0.19%> [3.43%] {0.716%}
 OK:  700.0kHz  197.34mA   3  197.08mA <-0.13%> [3.12%] {0.716%}*
 OK:  700.0kHz  131.26mA   2  131.22mA <-0.03%> [3.12%] {0.708%}*
 OK:  700.0kHz  31.492mA   1  31.660mA <+0.53%> [3.87%] {0.713%}
 OK:  1.200MHz  185.80mA   4  185.85mA <+0.03%> [5.47%] {1.165%}
 OK:  1.200MHz  186.26mA   3  186.43mA <+0.09%> [5.14%] {1.165%}*
 OK:  1.200MHz  139.65mA   2  139.83mA <+0.13%> [5.10%] {1.158%}*
 OK:  1.200MHz  29.585mA   1  29.704mA <+0.40%> [5.94%] {1.162%}
 OK:  2.000MHz  147.90mA   4  147.78mA <-0.08%> [8.83%] {1.891%}
 OK:  2.000MHz  147.86mA   3  147.77mA <-0.06%> [8.43%] {1.891%}*
 OK:  2.000MHz  108.52mA   2  108.51mA <-0.01%> [8.38%] {1.884%}*
 OK:  2.000MHz  22.454mA   1  22.537mA <+0.37%> [9.49%] {1.888%}

Verify internal shunt phase calibration
      [------- applied -------]                          [--------- phase ---------]
                               range  A1      A2      A3      dev      spec    uncert
 OK:  55.00 Hz  1.3743 A 0.000°  4 -0.000° +0.000° -0.001° <-0.001°> [0.006°] {0.002°}
 OK:  400.0 Hz  1.3922 A 0.000°  4 -0.000° -0.000° +0.000° <-0.000°> [0.013°] {0.002°}
 OK:  8.000kHz  1.3750 A 0.000°  4 +0.017° +0.018° +0.020° <+0.020°> [0.165°] {0.009°}
 OK:  48.00kHz  1.3863 A 0.000°  4 +0.003° +0.006° +0.003° <+0.006°> [0.965°] {0.049°}
 OK:  220.0kHz  1.2323 A 0.000°  4 -0.089° -0.080° -0.079° <-0.089°> [4.405°] {0.221°}
```

# CALIBRATION CERTIFICATE

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Verify external inputs

| | [------- applied -------] | | ranges | | [------- phase 1 --------] voltage | current | [---------- phase 2 ----------] voltage | current | [---------- phase 3 ----------] voltage | current | [------ magnitude ------] dev | spec | uncert | [--------- phase ---------] dev | spec | uncert |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OK: | 55.00 Hz | 1.2283 V 0.000° | 9 | 9 | 1.2283 V | 1.2283 A +0.000° | 1.2284 V +0.000° | 1.2283 A +0.000° | 1.2283 V +0.000° | 1.2284 A +0.000° | <+0.00%> | [0.09%] | {0.025%} | <+0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 498.18mV 0.000° | 8 | 8 | 498.18mV | 498.19mA -0.000° | 498.19mV -0.000° | 498.17mA -0.000° | 498.19mV -0.000° | 498.16mA -0.000° | <-0.00%> | [0.08%] | {0.014%} | <-0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 153.08mV 0.000° | 7 | 7 | 153.08mV | 153.08mA -0.000° | 153.08mV +0.000° | 153.07mA +0.000° | 153.08mV +0.000° | 153.07mA -0.000° | <-0.00%> | [0.08%] | {0.022%} | <+0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 48.603mV 0.000° | 6 | 6 | 48.599mV | 48.600mA +0.000° | 48.597mV -0.000° | 48.596mA -0.000° | 48.598mV -0.000° | 48.597mA -0.000° | <-0.01%> | [0.08%] | {0.014%} | <-0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 16.253mV 0.000° | 5 | 5 | 16.252mV | 16.253mA +0.000° | 16.252mV -0.000° | 16.252mA +0.000° | 16.252mV +0.000° | 16.252mA -0.000° | <-0.00%> | [0.08%] | {0.021%} | <+0.000°> | [0.006°] | {0.002°}* |
| OK: | 400.0 Hz | 1.4306 V 0.000° | 9 | 9 | 1.4305 V | 1.4305 A +0.000° | 1.4306 V +0.000° | 1.4305 A +0.000° | 1.4305 V +0.000° | 1.4306 A +0.000° | <-0.01%> | [0.08%] | {0.023%} | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 580.24mV 0.000° | 8 | 8 | 580.25mV | 580.27mA +0.000° | 580.28mV +0.000° | 580.23mA +0.000° | 580.25mV +0.000° | 580.23mA +0.000° | <+0.01%> | [0.07%] | {0.013%} | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 173.37mV 0.000° | 7 | 7 | 173.37mV | 173.37mA +0.000° | 173.37mV +0.000° | 173.36mA +0.000° | 173.38mV +0.000° | 173.37mA +0.000° | <-0.01%> | [0.07%] | {0.020%} | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 55.048mV 0.000° | 6 | 6 | 55.043mV | 55.044mA +0.000° | 55.040mV +0.000° | 55.038mA +0.000° | 55.041mV +0.000° | 55.040mA +0.000° | <-0.02%> | [0.08%] | {0.013%} | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 18.408mV 0.000° | 5 | 5 | 18.407mV | 18.408mA +0.000° | 18.407mV +0.000° | 18.406mA +0.000° | 18.406mV +0.000° | 18.407mA +0.000° | <-0.01%> | [0.08%] | {0.020%} | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 8.000kHz | 1.3678 V 0.000° | 9 | 9 | 1.3678 V | 1.3678 A -0.000° | 1.3678 V +0.000° | 1.3677 A +0.000° | 1.3677 V +0.000° | 1.3677 A +0.000° | <-0.01%> | [0.12%] | {0.031%} | <+0.000°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 616.80mV 0.000° | 8 | 8 | 616.81mV | 616.77mA -0.000° | 616.76mV +0.000° | 616.72mA -0.000° | 616.75mV +0.000° | 616.77mA -0.000° | <-0.01%> | [0.10%] | {0.021%} | <-0.000°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 163.73mV 0.000° | 7 | 7 | 163.73mV | 163.73mA -0.000° | 163.73mV +0.000° | 163.72mA +0.000° | 163.74mV +0.000° | 163.72mA +0.000° | <-0.01%> | [0.11%] | {0.028%} | <+0.000°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 51.131mV 0.000° | 6 | 6 | 51.128mV | 51.129mA -0.000° | 51.126mV +0.000° | 51.124mA +0.000° | 51.127mV +0.000° | 51.126mA +0.000° | <-0.01%> | [0.11%] | {0.021%} | <+0.000°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 16.415mV 0.000° | 5 | 5 | 16.415mV | 16.415mA -0.000° | 16.415mV +0.000° | 16.414mA -0.000° | 16.414mV +0.000° | 16.414mA -0.000° | <-0.01%> | [0.11%] | {0.028%} | <+0.000°> | [0.085°] | {0.002°}* |
| OK: | 48.00kHz | 1.3672 V 0.000° | 9 | 9 | 1.3675 V | 1.3674 A -0.001° | 1.3674 V +0.001° | 1.3674 A -0.001° | 1.3674 V -0.000° | 1.3674 A -0.000° | <+0.02%> | [0.28%] | {0.054%} | <-0.001°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 616.64mV 0.000° | 8 | 8 | 616.81mV | 616.76mA -0.002° | 616.78mV +0.001° | 616.74mA -0.002° | 616.74mV +0.001° | 616.72mA -0.001° | <+0.03%> | [0.26%] | {0.045%} | <-0.002°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 163.66mV 0.000° | 7 | 7 | 163.69mV | 163.70mA -0.001° | 163.70mV +0.001° | 163.69mA -0.001° | 163.70mV -0.001° | 163.69mA -0.000° | <+0.03%> | [0.27%] | {0.052%} | <+0.001°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 40.930mV 0.000° | 6 | 6 | 40.937mV | 40.937mA -0.001° | 40.934mV +0.002° | 40.936mA -0.001° | 40.935mV +0.000° | 40.935mA -0.000° | <+0.02%> | [0.29%] | {0.046%} | <+0.002°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 12.306mV 0.000° | 5 | 5 | 12.309mV | 12.308mA -0.001° | 12.308mV +0.002° | 12.308mA -0.002° | 12.307mV +0.001° | 12.308mA -0.001° | <+0.03%> | [0.29%] | {0.055%} | <+0.002°> | [0.485°] | {0.004°}* |
| OK: | 220.0kHz | 1.3706 V 0.000° | 9 | 9 | 1.3721 V | 1.3720 A -0.002° | 1.3721 V +0.011° | 1.3720 A -0.002° | 1.3720 V +0.003° | 1.3720 A -0.000° | <+0.11%> | [0.97%] | {0.390%} | <+0.011°> | [2.205°] | {0.013°}* |
| OK: | 220.0kHz | 619.02mV 0.000° | 8 | 8 | 619.69mV | 619.68mA -0.003° | 619.72mV +0.010° | 619.68mA -0.007° | 619.69mV +0.006° | 619.67mA -0.003° | <+0.11%> | [0.95%] | {0.336%} | <+0.010°> | [2.205°] | {0.013°}* |
| OK: | 220.0kHz | 164.22mV 0.000° | 7 | 7 | 164.40mV | 164.39mA +0.001° | 164.40mV +0.014° | 164.39mA -0.001° | 164.40mV +0.000° | 164.39mA +0.002° | <+0.11%> | [0.96%] | {0.379%} | <+0.014°> | [2.205°] | {0.013°}* |
| OK: | 220.0kHz | 41.030mV 0.000° | 6 | 6 | 41.069mV | 41.068mA +0.001° | 41.068mV +0.015° | 41.070mA +0.000° | 41.069mV +0.005° | 41.068mA +0.002° | <+0.10%> | [0.98%] | {0.344%} | <+0.015°> | [2.205°] | {0.013°}* |
| OK: | 220.0kHz | 12.333mV 0.000° | 5 | 5 | 12.345mV | 12.344mA -0.002° | 12.344mV +0.014° | 12.345mA -0.005° | 12.344mV +0.008° | 12.344mA -0.002° | <+0.10%> | [0.98%] | {0.398%} | <+0.014°> | [2.205°] | {0.013°}* |
| OK: | 700.0kHz | 1.3455 V 0.000° | 9 | 9 | 1.3614 V | 1.3610 A +0.029° | 1.3614 V +0.054° | 1.3613 A -0.014° | 1.3611 V +0.025° | 1.3611 A +0.002° | <+1.18%> | [2.89%] | {0.442%} | <+0.054°> | [7.005°] | {0.037°}* |
| OK: | 700.0kHz | 606.80mV 0.000° | 8 | 8 | 615.08mV | 614.89mA +0.024° | 615.07mV +0.053° | 615.02mA -0.032° | 614.97mV +0.037° | 614.94mA -0.005° | <+1.36%> | [2.87%] | {0.435%} | <+0.053°> | [7.005°] | {0.037°}* |
| OK: | 700.0kHz | 181.32mV 0.000° | 7 | 7 | 183.77mV | 183.71mA +0.037° | 183.76mV +0.063° | 183.75mA -0.009° | 183.73mV +0.019° | 183.72mA +0.008° | <+1.35%> | [2.87%] | {0.440%} | <+0.063°> | [7.005°] | {0.037°}* |
| OK: | 700.0kHz | 44.324mV 0.000° | 6 | 6 | 44.788mV | 44.775mA +0.037° | 44.787mV +0.064° | 44.787mA -0.007° | 44.781mV +0.035° | 44.779mA +0.008° | <+1.05%> | [2.89%] | {0.435%} | <+0.064°> | [7.005°] | {0.037°}* |
| OK: | 700.0kHz | 13.119mV 0.000° | 5 | 5 | 13.262mV | 13.258mA +0.030° | 13.262mV +0.062° | 13.262mA -0.026° | 13.260mV +0.043° | 13.259mA -0.001° | <+1.09%> | [2.90%] | {0.446%} | <+0.062°> | [7.005°] | {0.037°}* |
| OK: | 1.200MHz | 1.2896 V 0.000° | 9 | 9 | 1.3011 V | 1.3008 A +0.037° | 1.3011 V +0.067° | 1.3009 A -0.029° | 1.3010 V +0.016° | 1.3009 A -0.024° | <+0.89%> | [4.89%] | {0.698%} | <+0.067°> | [12.01°] | {0.062°}* |
| OK: | 1.200MHz | 581.44mV 0.000° | 8 | 8 | 586.79mV | 586.66mA +0.029° | 586.82mV +0.066° | 586.72mA -0.059° | 586.74mV +0.033° | 586.69mA -0.035° | <+0.93%> | [4.87%] | {0.699%} | <+0.066°> | [12.01°] | {0.062°}* |
| OK: | 1.200MHz | 185.20mV 0.000° | 7 | 7 | 186.86mV | 186.82mA +0.051° | 186.87mV +0.084° | 186.84mA -0.019° | 186.85mV +0.004° | 186.83mA -0.012° | <+0.90%> | [4.87%] | {0.703%} | <+0.084°> | [12.01°] | {0.062°}* |
| OK: | 1.200MHz | 46.357mV 0.000° | 6 | 6 | 46.772mV | 46.764mA +0.053° | 46.775mV +0.084° | 46.772mA -0.014° | 46.772mV +0.034° | 46.769mA -0.010° | <+0.90%> | [4.89%] | {0.700%} | <+0.084°> | [12.01°] | {0.062°}* |
| OK: | 1.200MHz | 13.571mV 0.000° | 5 | 5 | 13.696mV | 13.693mA +0.043° | 13.697mV +0.083° | 13.695mA -0.048° | 13.695mV +0.046° | 13.695mA -0.026° | <+0.93%> | [4.89%] | {0.706%} | <+0.083°> | [12.01°] | {0.062°}* |
| OK: | 2.000MHz | 1.2096 V 0.000° | 9 | 9 | 1.2096 V | 1.2095 A +0.031° | 1.2096 V +0.060° | 1.2097 A -0.042° | 1.2098 V -0.028° | 1.2097 A -0.068° | <+0.02%> | [8.09%] | {1.125%} | <-0.068°> | [20.00°] | {0.102°}* |
| OK: | 2.000MHz | 548.17mV 0.000° | 8 | 8 | 548.06mV | 547.95mA +0.017° | 548.04mV +0.056° | 548.02mA -0.089° | 548.09mV +0.000° | 548.03mA -0.085° | <-0.04%> | [8.07%] | {1.126%} | <-0.089°> | [20.00°] | {0.102°}* |
| OK: | 2.000MHz | 170.92mV 0.000° | 7 | 7 | 170.90mV | 170.86mA +0.058° | 170.89mV +0.087° | 170.88mA -0.025° | 170.90mV -0.046° | 170.89mA -0.047° | <-0.03%> | [8.07%] | {1.130%} | <+0.087°> | [20.00°] | {0.102°}* |
| OK: | 2.000MHz | 46.960mV 0.000° | 6 | 6 | 46.955mV | 46.946mA +0.060° | 46.952mV +0.087° | 46.952mA -0.016° | 46.958mV +0.001° | 46.956mA -0.047° | <-0.03%> | [8.09%] | {1.127%} | <+0.087°> | [20.00°] | {0.102°}* |
| OK: | 2.000MHz | 15.709mV 0.000° | 5 | 5 | 15.708mV | 15.705mA +0.045° | 15.708mV +0.081° | 15.706mA -0.065° | 15.708mV +0.026° | 15.708mA -0.068° | <-0.03%> | [8.08%] | {1.131%} | <+0.081°> | [20.00°] | {0.102°}* |

Verify phase accuracy across ranges

| | [------- applied -------] | | ranges | | A1 | V2 | A2 | V3 | A3 | [--------- phase ---------] dev | spec | uncert |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OK: | 55.00 Hz | 527.48mV 0.000° | 8 | 8 | +0.000° | +0.000° | +0.000° | +0.000° | -0.000° | <+0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 527.49mV 0.000° | 8 | 9 | -0.000° | +0.000° | -0.000° | +0.000° | -0.000° | <-0.000°> | [0.006°] | {0.002°}* |
| OK: | 55.00 Hz | 527.47mV 0.000° | 9 | 8 | +0.000° | +0.000° | +0.000° | +0.000° | +0.000° | <+0.000°> | [0.006°] | {0.002°}* |
| OK: | 400.0 Hz | 614.38mV 0.000° | 8 | 8 | +0.000° | +0.000° | +0.000° | +0.000° | +0.000° | <+0.000°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 614.38mV 0.000° | 8 | 9 | +0.001° | +0.000° | +0.001° | +0.000° | +0.001° | <+0.001°> | [0.009°] | {0.002°}* |
| OK: | 400.0 Hz | 614.37mV 0.000° | 9 | 8 | -0.001° | -0.000° | -0.001° | +0.000° | -0.001° | <-0.001°> | [0.009°] | {0.002°}* |
| OK: | 8.000kHz | 616.78mV 0.000° | 8 | 8 | -0.000° | +0.000° | -0.000° | +0.000° | -0.000° | <-0.000°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 616.77mV 0.000° | 8 | 9 | +0.008° | -0.000° | +0.008° | +0.000° | +0.009° | <+0.009°> | [0.085°] | {0.002°}* |
| OK: | 8.000kHz | 616.76mV 0.000° | 9 | 8 | -0.009° | +0.000° | -0.009° | +0.000° | -0.009° | <-0.009°> | [0.085°] | {0.002°}* |
| OK: | 48.00kHz | 616.79mV 0.000° | 8 | 8 | -0.002° | +0.001° | -0.002° | +0.001° | -0.001° | <-0.002°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 616.79mV 0.000° | 8 | 9 | +0.048° | +0.001° | +0.048° | +0.001° | +0.049° | <+0.049°> | [0.485°] | {0.004°}* |
| OK: | 48.00kHz | 616.72mV 0.000° | 9 | 8 | -0.051° | +0.001° | -0.052° | -0.000° | -0.050° | <-0.052°> | [0.485°] | {0.004°}* |
| OK: | 100.0kHz | 617.41mV 0.000° | 8 | 8 | -0.002° | +0.002° | -0.003° | +0.002° | -0.001° | <-0.003°> | [1.005°] | {0.007°}* |
| OK: | 100.0kHz | 617.41mV 0.000° | 8 | 9 | +0.101° | +0.002° | +0.102° | +0.002° | +0.103° | <+0.103°> | [1.005°] | {0.007°}* |
| OK: | 100.0kHz | 617.11mV 0.000° | 9 | 8 | -0.105° | +0.002° | -0.106° | +0.001° | -0.104° | <-0.106°> | [1.005°] | {0.007°}* |

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# CALIBRATION CERTIFICATE

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 OK:  220.0kHz  619.71mV 0.000°  8  8 -0.003° +0.010° -0.007° +0.006° -0.002° <+0.010°> [2.205°] {0.013°}*
 OK:  220.0kHz  619.71mV 0.000°  8  9 +0.226° +0.010° +0.225° +0.006° +0.228° <+0.228°> [2.205°] {0.013°}*
 OK:  220.0kHz  618.68mV 0.000°  9  8 -0.231° +0.012° -0.234° +0.003° -0.230° <-0.234°> [2.205°] {0.013°}*
 OK:  700.0kHz  611.04mV 0.000°  8  8 +0.025° +0.055° -0.026° +0.044° +0.004° <+0.055°> [7.005°] {0.037°}*
 OK:  700.0kHz  611.04mV 0.000°  8  9 +0.750° +0.055° +0.711° +0.044° +0.731° <+0.750°> [7.005°] {0.037°}*
 OK:  700.0kHz  609.74mV 0.000°  9  8 -0.693° +0.059° -0.743° +0.036° -0.714° <-0.743°> [7.005°] {0.037°}*
 OK:  1.200MHz  576.16mV 0.000°  8  8 +0.030° +0.069° -0.048° +0.047° -0.018° <+0.069°> [12.01°] {0.062°}*
 OK:  1.200MHz  576.15mV 0.000°  8  9 +1.259° +0.068° +1.204° +0.046° +1.212° <+1.259°> [12.01°] {0.062°}*
 OK:  1.200MHz  575.90mV 0.000°  9  8 -1.188° +0.073° -1.265° +0.034° -1.236° <-1.265°> [12.01°] {0.062°}*
 OK:  2.000MHz  497.41mV 0.000°  8  8 +0.020° +0.064° -0.067° +0.031° -0.049° <-0.067°> [20.00°] {0.102°}*
 OK:  2.000MHz  497.41mV 0.000°  8  9 +2.022° +0.062° +1.966° +0.031° +1.948° <+2.022°> [20.00°] {0.102°}*
 OK:  2.000MHz  497.55mV 0.000°  9  8 -1.960° +0.076° -2.044° +0.010° -2.028° <-2.044°> [20.00°] {0.102°}*

Verify dc accuracy
         applied  ranges   V1        A1        V2        A2        V3        A3       dev     spec    uncert
 OK: DC  1.7133 V  9  9  1.7134 V  1.7133 A  1.7135 V  1.7133 A  1.7133 V  1.7135 A <+0.01%> [0.14%] {0.005%}*
 OK: DC -2.0019 V  9  9 -2.0018 V -2.0017 A -2.0018 V -2.0016 A -2.0015 V -2.0016 A <-0.02%> [0.13%] {0.005%}*
 OK: DC  759.16mV  8  8  759.22mV  759.21mA  759.21mV  759.16mA  759.15mV  759.21mA <+0.01%> [0.12%] {0.007%}*
 OK: DC -667.33mV  8  8 -667.25mV -667.30mA -667.30mV -667.28mA -667.29mV -667.22mA <-0.02%> [0.13%] {0.007%}*
 OK: DC  156.62mV  7  7  156.61mV  156.63mA  156.59mV  156.60mA  156.61mV  156.59mA <-0.02%> [0.15%] {0.021%}*
 OK: DC -227.87mV  7  7 -227.87mV -227.86mA -227.90mV -227.85mA -227.87mV -227.87mA <+0.01%> [0.12%] {0.015%}*
 OK: DC  54.136mV  6  6  54.117mV  54.126mA  54.114mV  54.112mA  54.110mV  54.106mA <-0.06%> [0.15%] {0.060%}*
 OK: DC -42.715mV  6  6 -42.728mV -42.726mA -42.726mV -42.728mA -42.736mV -42.739mA <+0.06%> [0.18%] {0.076%}*

Verify torque and speed inputs
      applied    torque     speed       deviation    spec    uncert
 OK:  6.6749 V  6.6753 Nm  6.6752 rpm  0.01%  0.00% [0.12%] {0.005%}
 OK:  2.8627 V  2.8636 Nm  2.8637 rpm  0.03%  0.04% [0.22%] {0.007%}
 OK: -953.86mV -952.82mNm -953.07mrpm -0.11% -0.08% [0.57%] {0.014%}
 OK: -4.7744 V -4.7733 Nm -4.7736 rpm -0.02% -0.02% [0.15%] {0.006%}

NOTES

1) Nominal full scale range values:
                    voltage inputs:  300mV  1V     3V     10V    30V    100V   300V   1kV   3kV
                    current inputs:  100mA  300mA  1A     3A     10A    30A    100A   300A  1kA
                   external inputs:  300uV  1mV    3mV    10mV   30mV   100mV  300mV  1V    3V

2) Results not marked with * are verified with less than 50% input signal.

3) This instrument has been calibrated using standards traceable to natural physical constants from ratio
   measurements or compared to consensus standards as realised by the National Physical Laboratory (NPL) or
   other recognised national standards laboratories accredited by the United Kingdom Accreditation Service (UKAS).

4) The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor to give a
   level of confidence of approximately 95%.

All 273 tests passed
```

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|---|---|---|

# Azonosító szám: 01625074

JEGYZŐKÖNYV SZÁMA (OSZTÁLY/LELT.SZÁM/ÉV): KAL 1625-01625091-2015
MEGNEVEZÉS:ADATGYŰJTŐ
TÍPUS:GL220-UM-851
GYÁRTÓ:GRAPHTEC
GYÁRTÁSI SZÁM:H50428726

ETALON:Hőmérséklet és páratartalommérő HD 206-1 — KAL.BIZ.SZÁM:KAL 1307-023338-2015
ETALON:Hőmérő 0...+50°C (02014003) — KAL.BIZ.SZÁM:H56538
ETALON:Hőmérő +50...+100°C (02014004) — KAL.BIZ.SZÁM:H56539

HŐMÉRSÉKLET:21°C — PÁRATARTALOM:29%

ÉRTÉKELÉS: MEGFELELT ☒ — NEM FELELT MEG ☐

KALIBRÁLÁSI ELJÁRÁS AZONOSÍTÓJA:

ELLENŐRZÉS:2015.12.14. — ÉRVÉNYESSÉG: 2016.12.14.

| ÜZEMMÓD | MÉRT ÉRTÉK | HELYES ÉRTÉK | HIBA | A MEGENGEDETT HIBAHATÁR +/-(%+ÉRTÉK) | Σ HIBA ÉRTÉK | +/-MÉRÉSI BIZONYTALANSÁG** | * ÉRT |
|---|---|---|---|---|---|---|---|
| CH1 01629105/001/2015 Számú K hőelem | | | | | | | |
| T °C | 25,1 | 25,7 | 0,6 | 0,05 | 1,5 | 1,51255 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 92,6 | 93,2 | 0,6 | 0,05 | 1,5 | 1,5463 | 0,059 | Y |
| CH2 01629105/002/2015 Számú K hőelem | | | | | | | |
| T °C | 25,2 | 25,7 | 0,5 | 0,05 | 1,5 | 1,5126 | 0,059 | Y |
| T °C | 45,3 | 45,1 | -0,2 | 0,05 | 1,5 | 1,52265 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 93,1 | 93,2 | 0,1 | 0,05 | 1,5 | 1,54655 | 0,059 | Y |
| CH3 01629105/003/2015 Számú K hőelem | | | | | | | |
| T °C | 25,4 | 25,7 | 0,3 | 0,05 | 1,5 | 1,5127 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,6 | 55,6 | 0 | 0,05 | 1,5 | 1,5278 | 0,059 | Y |
| T °C | 60,8 | 60,5 | -0,3 | 0,05 | 1,5 | 1,5304 | 0,059 | Y |
| T °C | 93,3 | 93,2 | -0,1 | 0,05 | 1,5 | 1,54665 | 0,059 | Y |
| CH4 01629105/004/2015 Számú K hőelem | | | | | | | |
| T °C | 25,2 | 25,7 | 0,5 | 0,05 | 1,5 | 1,5126 | 0,059 | Y |
| T °C | 45,3 | 45,1 | -0,2 | 0,05 | 1,5 | 1,52265 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 93,1 | 93,2 | 0,1 | 0,05 | 1,5 | 1,54655 | 0,059 | Y |
| CH5 01629105/005/2015 Számú K hőelem | | | | | | | |
| T °C | 25,1 | 25,7 | 0,6 | 0,05 | 1,5 | 1,51255 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 92,6 | 93,2 | 0,6 | 0,05 | 1,5 | 1,5463 | 0,059 | Y |


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# Azonosító szám: 01625074

| ÜZEMMÓD | MÉRT ÉRTÉK | HELYES ÉRTÉK | HIBA | MEGENGEDETT HIBA HATÁR +/-(%+ÉRTÉK) | | Σ HIBA ÉRTÉK | +/-MÉRÉSI BIZONYTA-LANSÁG** | * ÉRT |
|---|---|---|---|---|---|---|---|---|
| CH6 01629105/022/2015 Számú K hőelem | | | | | | | | |
| T °C | 25,1 | 25,7 | 0,6 | 0,05 | 1,5 | 1,51255 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 92,6 | 93,2 | 0,6 | 0,05 | 1,5 | 1,5463 | 0,059 | Y |
| CH7 01629105/023/2015 Számú K hőelem | | | | | | | | |
| T °C | 25,4 | 25,7 | 0,3 | 0,05 | 1,5 | 1,5127 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,6 | 55,6 | 0 | 0,05 | 1,5 | 1,5278 | 0,059 | Y |
| T °C | 60,8 | 60,5 | -0,3 | 0,05 | 1,5 | 1,5304 | 0,059 | Y |
| T °C | 93,3 | 93,2 | -0,1 | 0,05 | 1,5 | 1,54665 | 0,059 | Y |
| CH8 01629105/024/2015 Számú K hőelem | | | | | | | | |
| T °C | 25,4 | 25,7 | 0,3 | 0,05 | 1,5 | 1,5127 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,6 | 55,6 | 0 | 0,05 | 1,5 | 1,5278 | 0,059 | Y |
| T °C | 60,8 | 60,5 | -0,3 | 0,05 | 1,5 | 1,5304 | 0,059 | Y |
| T °C | 93,3 | 93,2 | -0,1 | 0,05 | 1,5 | 1,54665 | 0,059 | Y |
| CH9 01629105/025/2015 Számú K hőelem | | | | | | | | |
| T °C | 25,1 | 25,7 | 0,6 | 0,05 | 1,5 | 1,51255 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,4 | 55,6 | 0,2 | 0,05 | 1,5 | 1,5277 | 0,059 | Y |
| T °C | 60,2 | 60,5 | 0,3 | 0,05 | 1,5 | 1,5301 | 0,059 | Y |
| T °C | 92,6 | 93,2 | 0,6 | 0,05 | 1,5 | 1,5463 | 0,059 | Y |
| CH10 01629105/026/2015 Számú K hőelem | | | | | | | | |
| T °C | 25,4 | 25,7 | 0,3 | 0,05 | 1,5 | 1,5127 | 0,059 | Y |
| T °C | 44,8 | 45,1 | 0,3 | 0,05 | 1,5 | 1,5224 | 0,059 | Y |
| T °C | 55,6 | 55,6 | 0 | 0,05 | 1,5 | 1,5278 | 0,059 | Y |
| T °C | 60,8 | 60,5 | -0,3 | 0,05 | 1,5 | 1,5304 | 0,059 | Y |
| T °C | 93,3 | 93,2 | -0,1 | 0,05 | 1,5 | 1,54665 | 0,059 | Y |

Jelmagyarázat: * Y/N = Megfelel/Nem felel meg a kalibrált műszer a műszerkönyvében megadott specifikációs adatoknak ! ** A fenti táblázatban megadott bizonytalanság a kettes tényezővel megszorzott standard bizonytalanság, azaz k=2. A bizonytalanság kiszámítása a használati etalontól, a kalibrálás módszeréből, a környezeti feltételekből és a kalibrált eszköz okozta rövid idejű hatásokból eredő részbizonytalanságokból, a NAR-EA-4/02 Dokumentum szerint történt.

A kalibrálást végezte:

Farkas Gyula
kalibráló

Ellenőrizte:

Kázi Gábor
műszergazda


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|---|---|---|

# Azonosító szám: 01625042

JEGYZŐKÖNYV SZÁMA (OSZTÁLY/LELT.SZÁM/ÉV):KAL 1625-01625042-2015
MEGNEVEZÉS:DMM
TÍPUS:M3510A
GYÁRTÓ:PICOTEST
GYÁRTÁSI SZÁM:TW00022512

ETALON:M-140 Kalibrátor (23326) MEATEST — KAL.BIZ.SZÁM:1095/2014
ETALON:HD206-1 Hőm. és páratartalom adatgyűjtő — KAL.BIZ.SZÁM:KAL 1307-023338-2015

HŐMÉRSÉKLET:22°C — PÁRATARTALOM:62%

ÉRTÉKELÉS: MEGFELELT ☒ NEM FELELT MEG ☐

KALIBRÁLÁSI ELJÁRÁS AZONOSÍTÓJA: MU-IT 05_03_4_0

ELLENŐRZÉS:2015.08.06. — ÉRVÉNYESSÉG:2016.08.06.

| ÜZEMMÓD | MÉRT ÉRTÉK | HELYES ÉRTÉK | HIBA | A MEGENGEDETT HIBAHATÁR +/-(%+ÉRTÉK) | | Σ HIBA ÉRTÉK | +/-MÉRÉSI BIZONYTALANSÁG** | * ÉRT |
|---|---|---|---|---|---|---|---|---|
| DC mV | 100,0064 | 100 | 0,0064 | 0,008 | 0,0045 | 0,0125005 | 0,0031 | Y |
| DC mV | -99,9909 | -100 | 0,0091 | 0,008 | 0,0045 | 0,0124993 | 0,0031 | Y |
| DC V | 0,999986 | 1 | -1,4E-05 | 0,009 | 0,00001 | 1E-04 | 0,000022 | Y |
| DC V | -0,999987 | -1 | 1,3E-05 | 0,009 | 0,00001 | 1E-04 | 0,000022 | Y |
| DC V | 9,99942 | 10 | -0,00058 | 0,012 | 0,0002 | 0,0013999 | 0,00022 | Y |
| DC V | -9,99912 | -10 | 0,00088 | 0,012 | 0,0002 | 0,0013999 | 0,00022 | Y |
| DC V | 99,9967 | 100 | -0,0033 | 0,012 | 0,002 | 0,0139996 | 0,0022 | Y |
| DC V | -99,9899 | -100 | 0,0101 | 0,012 | 0,002 | 0,0139988 | 0,0022 | Y |
| DC V | 1000,017 | 1000 | 0,017 | 0,013 | 0,02 | 0,1500022 | 0,022 | Y |
| DC V | -1000,023 | -1000 | -0,023 | 0,013 | 0,02 | 0,150003 | 0,022 | Y |
| ACmV 50Hz | 99,914 | 100 | -0,086 | 0,12 | 0,05 | 0,1698968 | 0,054 | Y |
| ACmV 20kHz | 100,014 | 100 | 0,014 | 0,25 | 0,05 | 0,300035 | 0,054 | Y |
| ACmV 100kHz | 99,889 | 100 | -0,111 | 0,65 | 0,08 | 0,7292785 | 0,054 | Y |
| AC V 50Hz | 0,99978 | 1 | -0,00022 | 0,12 | 0,0004 | 0,0015997 | 0,00032 | Y |
| AC V 20kHz | 1 | 1 | 0 | 0,25 | 0,0005 | 0,003 | 0,00047 | Y |
| AC V 100kHz | 0,99861 | 1 | -0,00139 | 0,65 | 0,0008 | 0,007291 | 0,00032 | Y |
| AC V 50Hz | 740,03 | 740 | 0,03 | 0,12 | 0,3 | 1,188036 | 0,42 | Y |
| DC I mA | 10,0002 | 10 | 0,0002 | 0,05 | 0,02 | 0,0250001 | 0,0015 | Y |
| DC I mA | -10,00136 | -10 | -0,00136 | 0,05 | 0,02 | 0,0250007 | 0,0015 | Y |
| DC I mA | 100,0008 | 100 | -0,0008 | 0,05 | 0,01 | 0,0600004 | 0,015 | Y |
| DC I mA | -100,0024 | -100 | 0,0024 | 0,05 | 0,01 | 0,0600012 | 0,015 | Y |
| DC I A | 1,001014 | 1 | -0,001014 | 0,15 | 0,0002 | 0,0017015 | 0,0003 | Y |
| DC I A | -1,001035 | -1 | 0,001035 | 0,15 | 0,0002 | 0,0017016 | 0,0003 | Y |
| DC I A | 10,0084 | 10 | -0,0084 | 0,25 | 0,005 | 0,030021 | 0,0017 | Y |
| DC I A | -10,00913 | -10 | 0,00913 | 0,25 | 0,005 | 0,0300228 | 0,0017 | Y |


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tel.: (+36)1/4611-100; fax: (+36)1/4611-199; e-mail: tuv@hu.tuv.com; honlap: www.tuv.com

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|---|---|---|

## Azonosító szám: 01625042

| ÜZEMMÓD | MÉRT ÉRTÉK | HELYES ÉRTÉK | HIBA | A MEGENGEDETT HIBAHATÁR +/-(%+ÉRTÉK) | | Σ HIBA ÉRTÉK | +/-MÉRÉSI BIZONYTALANSÁG** | * ÉRT |
|---|---|---|---|---|---|---|---|---|
| AC A 20Hz | 1,0009 | 1 | -0,0009 | 0,2 | 0,0004 | 0,0024018 | 0,00086 | Y |
| AC A 50Hz | 1,0014 | 1 | -0,0014 | 0,2 | 0,0004 | 0,0024028 | 0,00086 | Y |
| AC A 1kHz | 1,0001 | 1 | -1E-04 | 0,2 | 0,0004 | 0,0024002 | 0,0012 | Y |
| AC A 20Hz | 3,0029 | 3 | -0,0029 | 0,3 | 0,0018 | 0,0108087 | 0,0059 | Y |
| ACA 50Hz | 3,0028 | 3 | -0,0028 | 0,3 | 0,0018 | 0,0108084 | 0,0059 | Y |
| AC A 1kHz | 3,0012 | 3 | -0,0012 | 0,3 | 0,0018 | 0,0108036 | 0,0059 | Y |
| AC A 20Hz | 10,012 | 10 | -0,012 | 0,5 | 0,012 | 0,06206 | 0,0059 | Y |
| ACA 50Hz | 10,0105 | 10 | -0,0105 | 0,5 | 0,012 | 0,0620525 | 0,0059 | Y |
| AC A 1kHz | 10,0078 | 10 | -0,0078 | 0,5 | 0,012 | 0,062039 | 0,0059 | Y |
| R Ohm | 99,9908 | 100 | 0,0092 | 0,02 | 0,005 | 0,0249982 | 0,0055 | Y |
| R kOhm | 1,000069 | 1 | -6,9E-05 | 0,02 | 0,00002 | 0,00022 | 0,000055 | Y |
| R kOhm | 10,00141 | 10 | -0,00141 | 0,02 | 0,0002 | 0,0022003 | 0,00055 | Y |
| R kOhm | 100,0007 | 100 | -0,0007 | 0,02 | 0,002 | 0,0220001 | 0,005 | Y |
| R MOhm | 1,000083 | 1 | -8,3E-05 | 0,02 | 0,00004 | 0,00024 | 0,000076 | Y |
| R MOhm | 10,01 | 10 | -0,01 | 0,1 | 0,0004 | 0,01041 | 0,00051 | Y |
| R MOhm | 50,12 | 50 | -0,12 | 1,5 | 0,005 | 0,7568 | 0,29 | Y |
| 1nF | 1,007 | 1 | -0,007 | 2 | 0,008 | 0,02814 | 0,05 | Y |
| 10nF | 10,023 | 10 | -0,023 | 1 | 0,05 | 0,15023 | 0,5 | Y |
| 100nF | 100,35 | 100 | -0,35 | 1 | 0,5 | 1,5035 | 0,5 | Y |
| 1µF | 1,0011 | 1 | -0,0011 | 1 | 0,005 | 0,015011 | 0,5 | Y |
| 10µF | 10,087 | 10 | -0,087 | 1 | 0,05 | 0,15087 | 2 | Y |
| 100µF | 50,11 | 50 | -0,11 | 1 | 0,5 | 1,0011 | 2 | Y |
| f Hz | 30 | 30 | 30 | 0,03 | 0 | 0,009 | 0,00029 | Y |
| f kHz | 300 | 300 | 300 | 0,02 | 0 | 0,06 | 0,0077 | Y |
| K hőelem szimuláció | | | | | | | | |
| K hőelem °C | -99,69 | -100 | -0,31 | 0 | 1 | 1 | 1,4 | Y |
| K hőelem °C | 0,18 | 0 | -0,18 | 0 | 1 | 1 | 0,69 | Y |
| K hőelem °C | 100,07 | 100 | -0,07 | 0 | 1 | 1 | 0,69 | Y |
| K hőelem °C | 200,06 | 200 | -0,06 | 0 | 1 | 1 | 0,69 | Y |
| K hőelem °C | 300,09 | 300 | -0,09 | 0 | 1 | 1 | 0,76 | Y |
| K hőelem °C | 400,06 | 400 | -0,06 | 0 | 1 | 1 | 0,76 | Y |
| K hőelem °C | 499,97 | 500 | 0,03 | 0 | 1 | 1 | 0,84 | Y |

Jelmagyarázat: * Y/N = Megfelel/Nem felel meg a kalibrált műszer a műszerkönyvében megadott specifikációs adatoknak ! ** A fenti táblázatban megadott bizonytalanság a kettes tényezővel megszorzott standard bizonytalanság, azaz k=2. A bizonytalanság kiszámítása a használati etalontól, a kalibrálás módszeréből, a környezeti feltételekből és a kalibrált eszköz okozta rövid idejű hatásokból eredő részbizonytalanságokból, a NAR- EA-4/02 Dokumentum szerint történt.

A megfeleltetést végezte:

Riesz Gábor
kalibráló

Ellenőrizte:

Kazi Gábor
műszergazda


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