QA-ES
User & Service Manual

QA-ES Electrosurgical Analyzer

METRON

P/N 14025

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Manual Revision Record

This record page is for recording revisions to your *QA-ES User & Service Manual* that have been published by METRON AS or its authorized representatives. We recommend that only the management or facility representative authorized to process changes and revisions to publications:

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Rev No	Date Entered	Reason	Signature of Person Entering Change
1.30-1	4-30-01	General Update	

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1. Introduction

This chapter describes the METRON QA-ES Electrosurgical Analyzer, including its features and specifications.

1.1 QA-ES Description

The METRON QA-ES Electrosurgical Analyzer (QA-ES) is a precision instrument designed to perform tests on high-frequency electrosurgical units (ESU) in accordance with national and international standards, and is designed to be used by trained service technicians. Tests include:

- automatic power distribution measurement;
- crest factor measurement;
- RF leak measurement, and;
- return electrode monitor (REM) test

Testing is accomplished by measuring the ESU output against test loads that are set and adjusted in the QA-ES. The QA-ES can automatically execute a power distribution test with a load resistance ranging from 10 ohms to a maximum of 5200 ohms. The automatic measuring of the QA-ES, comprising crest factor measurements with a bandwidth of 10 MHz, ensures that the test result is reliable and reproducible.

Test results, shown in the QA-ES's LCD display, can be printed out directly, or transferred to a PC via the PRO-Soft QA-ES test automation software. PRO-Soft lets you design test protocols, remotely control the QA-ES, and store the test results.

1.2 QA-ES Specifications

Generator Output:	RF LEAKAGE: From active electrode or neutral plate with an open or closed load circuit.
Mode Of Operation:	Manual or user-programmable. Can be remotely controlled with PC utilizing accessory PRO-Soft QA-ES software and RS-232 communication cable connection.
Measurements:	True RMS value of applied waveform.
RMS Bandwidth:	30 Hz to 10 MHz (+3 dB).
Low Frequency Filter:	100 Hz filter to avoid low frequency disturbance and/or interference.
Current:	20 mA to 2200 mA.
Current Accuracy:	20 - 2200 mA ± 2% of reading.
Load Resistance:	10 - 2500 ohms in steps of 25 ohms (@ dc).

	2600 - 5200 ohms in steps of 100 ohms (@ dc).
Additional Fixed Load:	200 ohms, 500 watt maximum.
Crest Factor:	The higher of the two peak-measurements is used for calculation.
Range:	1.4 - 16 (V peak voltage / V RMS).
Foot Switch Output:	The output triggers the measurement after a programmed delay time, defined as the time period from the activation of the foot switch to the beginning of data processing. The delay time is 200 ms - 4000 ms.
Peak To Peak Voltage:	0 to 10 kV (closed load only) ± 10%. Measurement is taken between the active and dispersive electrodes with closed load only.
Oscilloscope Output:	5 V/A uncalibrated, 100 mA RF current minimum input.
Isolation:	10 kV isolation between measurement device and enclosure.

1.3 General Information

Temperature Requirements:

+15°C to +35°C when operating

0°C to +50°C in storage

Display:

Type	LCD graphic display
Alphanumeric format	8 lines, 40 characters
Graphics mode:	240 x 64 point matrix
Display control:	5 F-keys, enter, cancel and an encoder

Data Input/ Output (2): Parallel printer port (1); Bi-directional RS -232C (1) for Computer control

Power Source: From 115 VAC to 230 VAC, 48/66 MHz.

Mechanical Specifications:

Housing	Metal case
Height	13.2 cm / 4.48 in.
Width	34.2 cm / 11.61 in.
Length	39.5 cm / 13.41 in.
Weight	9.8 kg / 21.6 lbs.

Standard Accessories:

QA-ES Electrosurgical Analyzer	(P.N. 14010)
Power Cord	(P.N. 14300)
QA-ES User and Service Manual	(P.N. 14025)

Additional Accessories:

E-Input Measuring Cable - Black	(P.N. 11451)

E-Input Measuring Cable - Red	(P.N. 11452)
Alligator Clamp - Black	(P.N. 11461)
Alligator Clamp - Red	(P.N. 11462)
Carrying case	(P.N. 14100)
PRO-Soft QA-ES software	(P.N. 12200)
PRO-Soft QA-ES DEMO	(P.N. 14201)
PRO-Soft QA-ES User Manual	(P.N. 14225)

Storage:

Store in the carrying case in dry surroundings within the temperature range specified. There are no other storage requirements.

Periodic Inspection:

The unit should be calibrated every 12 months.

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2. Installation

This chapter explains unpacking, receipt inspection and claims, and the general procedures for QA-ES setup.

2.1 Receipt, Inspection and Return

1. Inspect the outer box for damage.
2. Carefully unpack all items from the box and check to see that you have the following items:
   - QA-ES Electrosurgical Analyzer (PN 14010)
   - E-Input Measuring Cable -- Black (PN 11411-B)
   - E-Input Measuring Cable -- Red (PN 11411-R)
   - Alligator Clamp -- Black (PN 11412-B)
   - Alligator Clamp -- Red (PN 11412-R)
   - Power Cord (No PN)
   - *QA-ES User and Service Manual* (PN 14025)
3. If you note physical damage, or if the unit fails to function according to specification, inform the supplier immediately. When METRON AS or the company's representative, is informed, measures will be taken to either repair the unit or dispatch a replacement. The customer will not have to wait for a claim to be investigated by the supplier. The customer should place a new purchase order to ensure delivery.
4. When returning an instrument to METRON AS, or the company representative, fill out the address label, describe what is wrong with the instrument, and provide the model and serial numbers. If possible, use the original packaging material for return shipping. Otherwise, repack the unit using:
   - a reinforced cardboard box, strong enough to carry the weight of the unit.
   - at least 5 cm of shock-absorbing material around the unit.
   - nonabrasive dust-free material for the other parts.

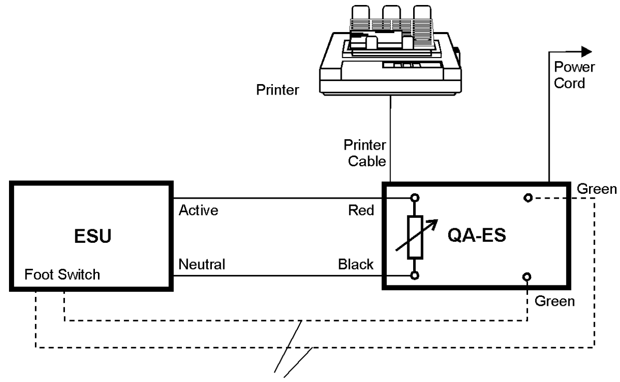
   Repack the unit in a manner to ensure that it cannot shift in the box during shipment.

   METRON's product warranty is on page ii of this manual. The warranty does not cover freight charges. C.O.D. will not be accepted without authorization from METRON A.S or its representative.

2.2 Setup

1. Equipment connection is as shown in the typical setup below (for Power Distribution Test).

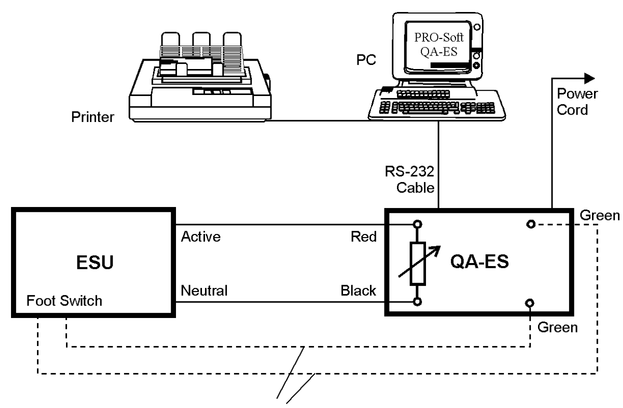
> ⚠ **CAUTION**
> The QA-ES uses a 3-wire power cord and plug for the user's safety. Use this power cord in conjunction with a properly grounded electrical outlet to avoid electrical shock.



The QA-ES can simulate the foot switch in "Singl. Oper.'

2. If you are using an oscilloscope, attach the BNC cable to the Scope Output connector, located on the front of the QA-ES.

3. If PRO-Soft QA-ES is being used, attach an RS-232 (null modem/data transfer configured) cable to the 9-pin D-sub outlet port located at the rear of the QA-ES. Do not attach the printer cable to the QA-ES. *See below*. However, if you are not using PRO-Soft QA-ES, and are sending directly to a printer for printouts, attach the printer cable to the 25-pin outlet port.



The QA-ES can simulate the foot switch in "Singl. Oper.'

2.3 PRO-Soft QA-ES

PRO-Soft QA-ES is a front-end test automation and presentation tool for METRON's ESU Performance Analyzer. It allows you to conduct the same tests, but by remote control via an IBM-compatible PC/XT with MS Windows (Version 3.1 or later). Additionally, the program has features to enhance your QA-ES's performance.

Each of the QA-ES tests can be run independently from PRO-Soft in the “Manual” test mode. Results are shown on the PC screen during testing, and the user is prompted to set the tested equipment accordingly. At the conclusion of tests, the user may print a report, store the test and results on disk, or both. Combinations of tests can be created and stored as “Test Sequences.” The program maintains a library of these sequences. In this way you can store and retrieve sequences that are appropriate for each ESU being tested at your facility.

Sequences can then be used independently, or can be attached to a checklist, written procedure, and equipment data in the form of a test "Protocol." The equipment data can be entered manually into the protocol, or it may be retrieved by PRO-Soft from a database program, or other equipment files. Protocols can be created easily for each ESU in your inventory, and stored for use. Test protocols with results can be printed, or stored on disk, and the results of testing can be sent back to the equipment database to close a work order and update the service history.

NOTE

PRO-Soft QA-ES has its own user manual, which contains all the information concerning the program. If you order a demonstration version of the program you also receive the manual.

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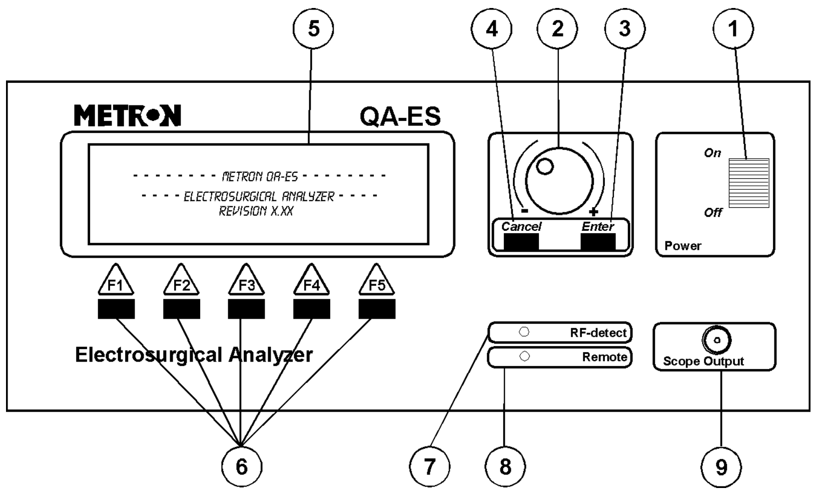
3. Operating QA-ES

This chapter explains the operating controls, switches and menus of the QA-ES, and details how to use them in ESU testing.

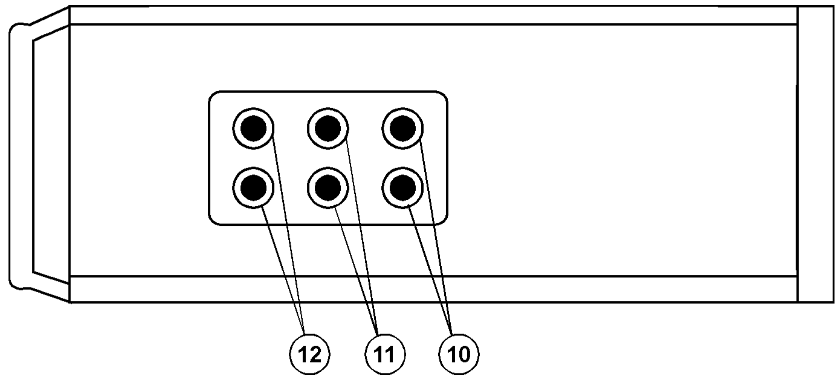
3.1 Control Switches and Connections

Front Panel



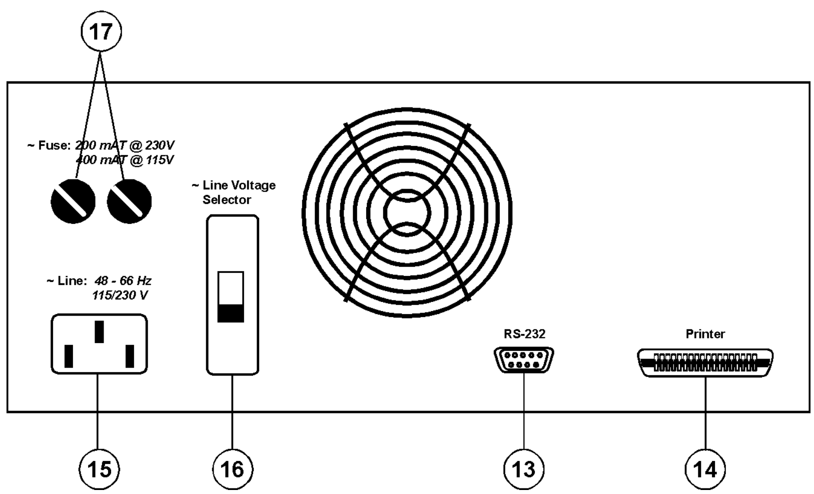
1.	**Power Switch**	Turns the power on and off.
2.	**Encoder**	Sets values according to the specified range and choose between different operations/ measurement ranges.
3.	**Enter**	Admits newly specified information.
4.	**Cancel**	Cancels a new value and returns to previously chosen value.
5.	**LCD Display**	Shows messages, test results and function menus.
6.	**Function Keys**	Fl - F5 are used to select the functions shown on the bottom line of the LCD display, i.e., for selecting the function that is directly above the key.
7.	**RF-Detect**	Indicates when the ESU is activated.
8.	**Remote**	Indicates that REMOTE CONTR. (F4) has been pressed.
9.	**Scope Output Connector**	BNC-cable connector for attenuator signal in real time. (When oscilloscope output is desired.)

Right Side Panel



10.	**Terminal RED and BLACK**	Connection for the electrode outputs of the VAR. LOAD ESU. Active electrode to the red terminal, and neutral electrode to the black terminal.
11.	**Terminal BLUE and BLUE**	Additional fixed load resistance of 200 ohms FIXED LOAD 500 watt for serial connection during leakage test.
12.	**Terminal GREEN and GREEN**	Foot switch output switch can be used to trigger the ESU.

Rear Panel

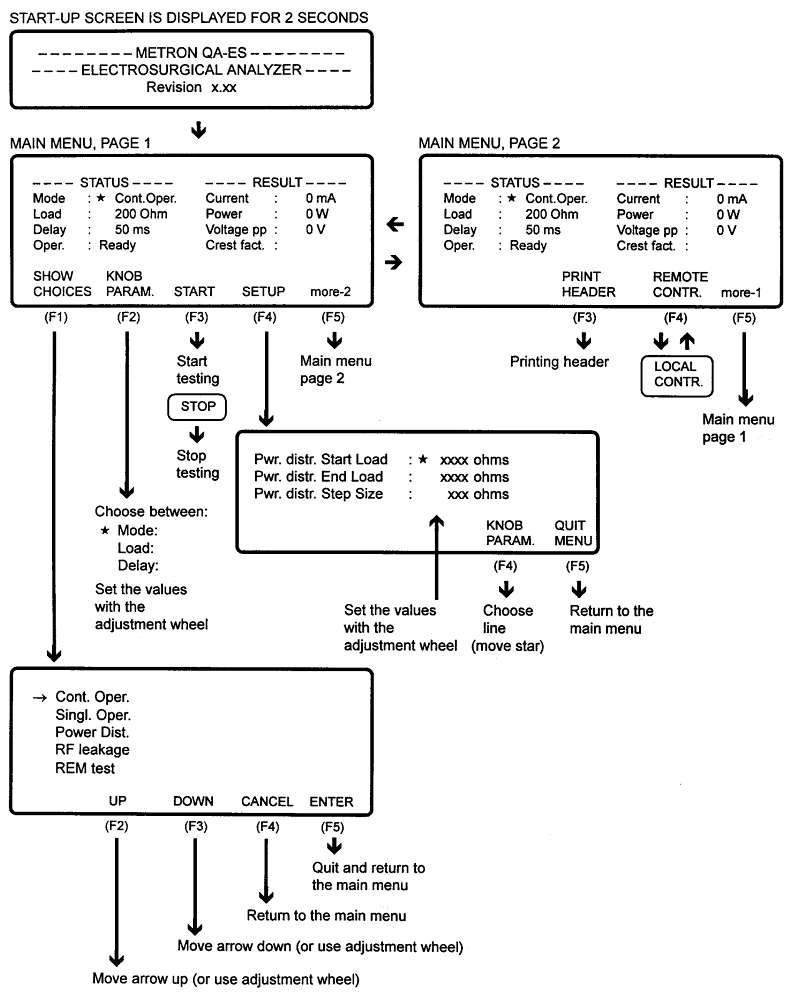


13.	**RS-232 Serial Port**	9-pin D-sub
14.	**Printer Outlet Port**	14-25 pin D-sub
15.	**Main Connector**	3-pin SCHUCO-plug
16.	**Voltage Selector**	115 VAC/230 VAC
17.	**Fuses**	T 200 mA @230 VAC / T 400 mA @ 11 5 VAC

3.2 QA-ES Menu and Function Keys

The QA-ES uses a display, programmable function keys and a setting regulator to provide flexibility and control over the operations. The upper part of the screen displays messages, status and results. The menu bar is at the bottom of the display. The function keys are numbered from Fl to F5. A function is selected by pressing the key located directly under the Menu Item displayed in the menu bar.

3.3 LCD Display Menu/ Messages (Overview)



3.4 Menu/ LCD Display Messages (Detail)

1. **Startup Screen**. The following screen will be displayed for 2 seconds after the QA-ES has been switched on.

```
- - - - - - - - METRON QA-ES - - - - - - - -
- - - - ELECTROSURGICAL ANALYZER - - - -
Revision x.xx
```

2. **Main Menu**

   a. First Menu Bar (Page 1)

- - - - - STATUS - - - -			- - - - - RESULT - - - -		
Mode	:	Cont. Oper.	Current	:	0 mA
Load	:	200 Ohms	Power	:	0 W
Delay	:	200 Ohms	Voltage pp	:	0 V
Oper.	:	Ready	Crest fact.	:	

SHOW CHOICES	KNOB PARAM.	START	SETUP	more-2
(F1)	(F2)	(F3)	(F4)	(F5)

   b. Second Menu Bar (Page 2)

		PRINT HEADER	REMOTE CONTR.	more-1
(F1)	(F2)	(F3)	(F4)	(F5)

3. **SHOW CHOICES (F1).** This function is activated when you see an asterisk (*) in the status field under 'Mode.' Choose a test function by pressing **UP (F2)** or **DOWN (F3)**. (The encoder can also be used for choosing a test function) Press **ENTER (F5)** to save it under Mode in the STATUS field. Press **CANCEL (F4)** to undo.

```
→ Cont. Oper.
  Singl. Oper.
  Power Dist.
  RF leakage
  REM test
```

UP	DOWN	CANCEL	ENTER
(F2)	(F3)	(F4)	(F5)

4. **KNOB PARAM. (F2).** With this function, you can choose between 'Mode,' 'Load' and 'Delay' in the STATUS field. (* marks the active item). If you choose 'Load', use the encoder to set the load from 10 ohms to 5200 ohms in steps of:

   - 25 ohms from 50 ohms to 2500 ohms.
   - 100 ohms from 2500 ohms to 5200 ohms.

   Save the selected load in 'Mode' under the STATUS field by pressing **ENTER (F5)**. Press **CANCEL (F4)** to undo. If you choose 'Delay', use the setting regulator to set the delay from 200 ms to 4000 ms in steps of:

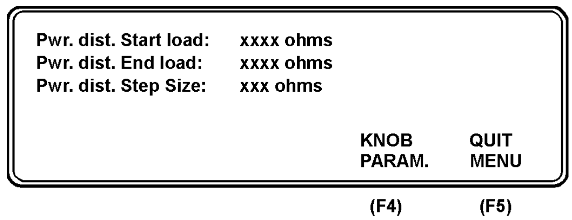
   - 50 ms from 200 ms to 1000 ms.

- 100 ms from 1000 ms to 4000 ms.

Save the chosen delay in ‘Delay’ under the STATUS field by pressing **ENTER (F5)**. Press **CANCEL (F4)** to undo.

5. **START (F3).** When you press on **START**, the test procedure will begin, and the text in the field ‘Oper.’ will change from ‘Ready’ to ‘Measuring’. If the unit is set to the position for a REM test, this text will change from ‘Ready’ to ‘lncr'. res.’ Press **STOP (F3)** to stop the test procedure.

6. **SETUP (F4).** Here you can set the power distribution level for start, stop and step in ohms.



Choose the ‘Start load’ by using **KNOB PARAM (F4)**. (see stars). Use the encoder to set the level. Save the level by pressing **ENTER (F5)**. Press **CANCEL (F4)** to undo. Go to ‘End load’ and ‘Step Size’ and repeat the same procedure.

Pwr. distr. Start load is the first load to be used during the measurements; it can be set from 10 ohms to 2100 ohms, with steps of 25 ohms starting at 25 ohms onwards.

Pwr. distr. End load is the last load used in the measurements; R can be set from 525 ohms to 5200 ohms, with steps of 25 ohms from 525 to 2500 ohms and step of 100 ohms from 2500 ohms to 5200 ohms

Pwr, distr. Step Size is the load set with steps of 25, 50, 100, and 200 ohms

Press **QUIT MENU (F5)** to return to the main menu.

7. **PRINT HEADER (F3).** Writes a heading for a new test protocol.

8. **REMOTE CONTR. (F4).** Enables you to control the QA-ES through a PC. Required software: PRO-Soft QA-ES.

3.5 Printout

Press **PRINT HEADER (F3)** before printing out a page if you want it to have a new heading. The QA-ES automatically prints out the test results via the printer output after every measurement. *See example below.*

METRON QA-ES Electrosurgical Analyzer Ver. x.xx

QA-ES Serial no :............

Establishment :..

Appliance code :..
Serial no. :..
Status :..
Group :..
Manufacturer :..
Model :..
Type :..
Location :..

Unit passed test :.............. Unit failed test:...............
Comments :..
....

Date :..............
Signature :..

Test#	Mode	Delay	Load	Current	Power	Vp.p	CF
1	Power. distr.	300 ms	10 ohms	1489 mA	25 W	49 V	1.6
2	Power. distr.	300 ms	25 ohms	1373 mA	49 W	121 V	1.8
3	Power. distr.	300 ms	50 ohms	1241 mA	76 W	174 V	1.5
4	Power. distr.	300 ms	75 ohms	1143 mA	99 W	250 V	1.5
5	Power. distr.	300 ms	100 ohms	1025 mA	107 W	326 V	1.6
6	Power. distr.	300 ms	125 ohms	961 mA	119 W	347 V	1.5
7	Power. distr.	300 ms	150 ohms	905 mA	124 W	432 V	1.7
8	Power. distr.	300 ms	175 ohms	825 mA	129 W	424 V	1.5
9	Power. distr.	300 ms	200 ohms	777 mA	123 W	446 V	1.5
10	Power. distr.	300 ms	225 ohms	735 mA	125 W	472 V	1.5
11	Power. distr.	300 ms	250 ohms	694 mA	122 W	476 V	1.4
12	Power. distr.	300 ms	275 ohms	655 mA	120 W	491 V	1.4
13	Power. distr.	300 ms	300 ohms	610 mA	114 W	573 V	1.6
14	Power. distr.	300 ms	325 ohms	586 mA	114 W	542 V	1.5
15	Power. distr.	300 ms	350 ohms	566 mA	114 W	549 V	1.4
16	Power. distr.	300 ms	375 ohms	543 mA	113 W	628 V	1.5
17	Power. distr.	300 ms	400 ohms	529 mA	112 W	587 V	1.4

3.6 Foot Switch Output

A Foot Switch Output is activated by use of relays (K11), and located on the right side of the unit. This is used to trigger the foot switch input on the ESU being tested.

3.7 Main Switch On/Off

The QA-ES has to be turned off for at least 5 seconds before turning it on again to allow the reset circuit to unload.

4. ESU Tests with QA-ES

This chapter explains the tests that can be conducted by the QA-ES on an ESU, as well as the features available with the PRO-Soft QA-ES software accessory.

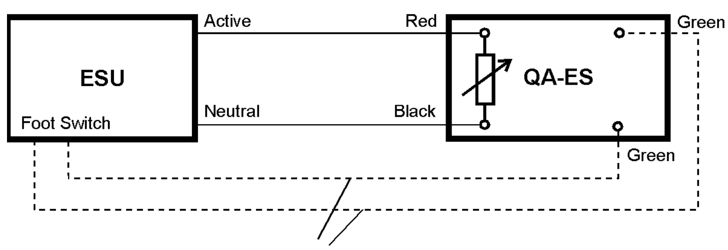
4.1 Power Distribution

This test checks the power provided by the ESU over a range of load resistances. The QA-ES allows you to specify a range of loads, over which you test the ESU output power to see if it is within the specified limits.

Per IEC 601-2-2 the power output cannot be reduced by more than 10W, or 5% of the minimum power output level. Per ANSI/AAMI HF18-1993 the power output must be within 20% of the ESU manufacturer’s specifications.

	Load Resistance Range	
Equipment	***IEC***	***ANSI/AAMI***
Monopolar	100 - 1000 ohms	50 - 2000 ohms
Bipolar	10 - 500 ohms	10 - 1000 ohms

Test setup for ESU power distribution test:



The QA-ES simulates the foot switch in "Singl. Oper.'

4.2 HF Current Leakage

This test checks to see whether or not the active and dispersive leakage currents are within acceptable limits. There are four test setups to accomplish this testing.

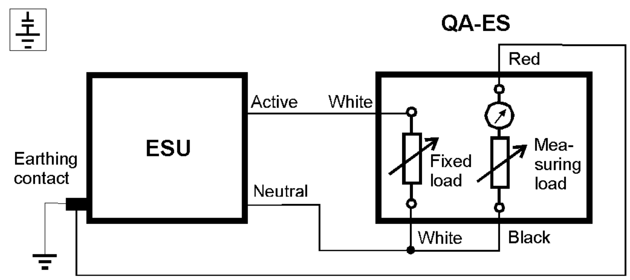
Per IEC 601-2-2 and ANSI/AAMI HF18-1993 the ESU shall be operated at the maximum output setting in each operating mode. The limits for the acceptable leakage currents depend upon the test configuration.

Test Configuration	*Limits of Acceptable Leakage Current*
Measured on electrodes	The leakage current should not exceed 150 mA

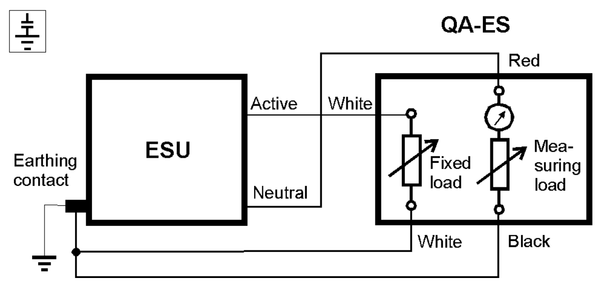
Test Configuration	Limits of Acceptable Leakage Current
Bipolar	The leakage current should not exceed 1% of the maximum bipolar rated power output.
Measured at equipment terminals	The leakage current should not exceed 100 mA.

1. **Grounded HF Equipment: Measurements of the HF current leakage.** The ESU is grounded. The test load is 200 ohms and the ESU must be operating at maximum power. The current leakage measured directly at the instrument's terminals must not exceed 100 mA.

   Test setup in compliance with IEC 601.2.2, sec. 19.101a, test 1, fig. 102 and sec. 19.102. (Adopted by ANSI/AAMI HF18-1993)

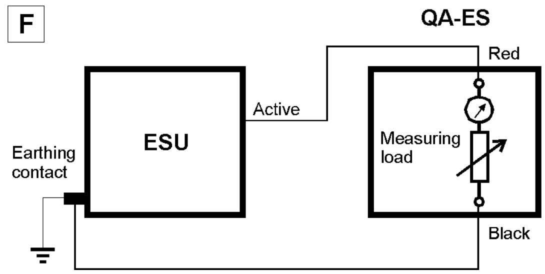


   Test setup in compliance with IEC 601.2.2, sec. 19.101a, test 2, fig. 103 and sec. 19.102. (Adopted by ANSI/AAMI HF18-1993)

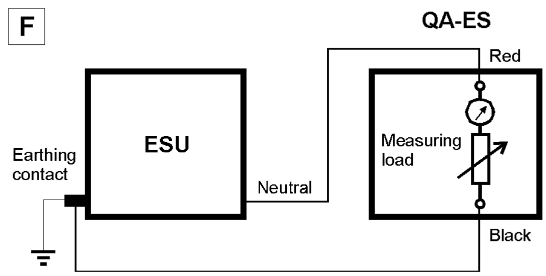


2. **HF Isolated Equipment: Measurements of the HF current leakage from the active and neutral electrodes.** The test load is 200 ohm and the ESU must be operating at maximum power. The current leakage measured directly at the instrument's terminals must not exceed 100 mA.

   Active electrode test setup in compliance with IEC 601.2.2, sec. 19.101b, fig, 104 and sec. 19.102. (Adopted by ANSI/AAMI HF18-1993)

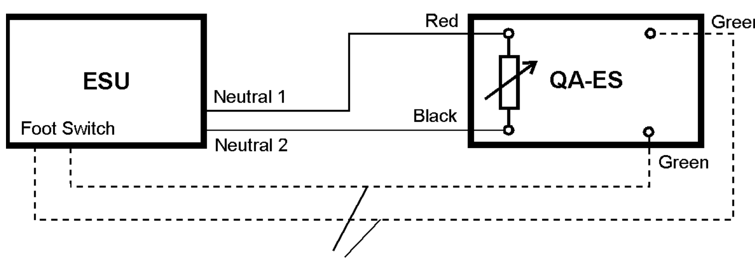


Neutral electrode test setup in compliance with IEC 601.2.2, sec. 19.101b, fig, 104 and sec. 19.102. (Adopted by ANSI/AAMI HF18-1993)



4.3 REM Alarm

This test ensures that the ESU will sound an alarm if the resistance between the two neutral electrodes exceeds your specified limit. The program directs the OA-ES to gradually increase the resistance. At a certain value, the ESU should sound an alarm. Test setup for ESU REM alarm test.



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5. Control and Calibration

This chapter explains the QA-ES maintenance procedures, including testing and calibration.

5.1 Required Test Equipment

- ESU, 200W in 75 ohms with 500 kHz
- Signal generator, 3 MHz, harmonics better than -40 dBc with 500 kHz, 0 dBm
- Digital multimeter
- Digital multimeter, HP 34401 or equivalent
- RMS / Peak Voltmeter, RHODE & SCHWARY URE 3 or equivalent
- Oscilloscope, 10 MHz
- Electrosurgical probe for QA-ES
- Computer (PC) with RS-232C interface
- Printer with parallel interface
- Short circuit SMB terminal, female
- Test cables

5.2 Preparation

WARNING!
HIGH VOLTAGES ARE CAPABLE
OF CAUSING DEATH!

USE EXTREME CAUTION WHEN PERFORMING TESTS AND CALIBRATION. USE ONLY INSULATED TOOLS WHEN THE UNIT IS PLUGGED IN, AND THE CASE HOUSING IS OFF.

> The QA-ES should be switched on for a minimum of 15 minutes before the test starts to ensure stable working temperatures.

Before performing testing and calibration, you must dismantle the housing. This is accomplished by removing the side plates fastened with Velcro® straps. Then, remove the bottom plate by loosening the four screws. Afterwards, move the bottom plate of the isolation box by loosening the 16 screws holding it in place. Adjust the voltage switch at the rear of the QA-ES so that is corresponds to the main voltage (115 or 230V).

5.3 Function Testing

> Measurements should be performed only on main supply, and not both 230V and 115V.

1. **Power Supply.** Connect the multimeter in series on one of the mains supply leads to measure the current consumption. Turn

on the *QA-ES*. Don't activate any functions. Measure the current. Required value:

230±10%: 80mA -10/+20mA
115±10%: 160mA -20/+40mA

2. **User Interface and Display.** Check that the display and the user interface are working normally.

3. **Cooling Fan.** Check that the fan increases speed when you press on **Start (F3)** in the main menu and that the speed decreases about 10 seconds after you press **STOP (F3)**.

4. **Serial and Parallel Interface.** QA-ES can be connected to a printer and a PC. Check that booth the serial and parallel interfaces work.

5. **Foot Switch.** Connect a multimeter to the foot switch output on the QA-ES (green). Check that the relay for the foot switch is connected when you press **START (F3)**.

6. **Fixed Load.** Measure the value of the fixed load with a multimeter (blue). Required value: 200 ohms ±10 ohms.

7. **Housing Isolation.** Use a multimeter to check the isolation between the housing and the measuring inputs. It is important to check all of the terminals on the housing: ‘Var. Load', 'Fixed Load' and 'Foot Switch’.

5.4 Calibration

1. **Offset Voltage**. Short-circuit the RF input on the sampling unit (J4). All the measurements and reference values in this section refer to the sampling unit. Measure the voltage at each of the following points and adjust them to the following values with the potentiometers specified between brackets. The voltage should be set as close to 0V as possible.

TP1 - GND (no adjust)	**TP3 - TP2** (R3)	**TP4 - GND** (R2)	**TP5 - GND** (R1)	**TP6 - GND** (R4)
OmV ∀100 ΦV	O ΦV ∀50 ΦV	O ΦV ∀100 ΦV	O ΦV ∀500 ΦV	OmV ∀5 mV

It is important to calibrate the resistance of the measuring leads on the multimeter itself **before** starting the test.

2. **Load Resistance**. Set the QA-ES in calibration mode by holding the function key **F1** while switching the instrument ON. Continue to press on the key until the main menu appears. Connect a multimeter (hp 34401A) to the 'Var. Load' input. The resistances are calibrated by turning the small wheel until the display shows a value as close as possible to the value read. To calibrate the next resistance, press on **UP (F1)** or **DOWN (F2)**.

3. **Measuring Resistance**. Set the QA-ES in calibration mode. Before mounting it, the measuring resistance R1 on the Load Board should be measured with hp 34401A. The measured value should be noted near R1 on the Load Board. Use this value for R1 in the following equation and for ‘Meas. Reas.’ in the calibration menu by using the wheel. Press **QUIT (F5)** to save calibrated values.

$$Meas\,\mathrm{Re}\,s = \frac{R1*100}{R1+100}$$

4. Measuring Device

Measuring The Effect. Set the QA-ES in test mode by holding F2 while switching the power on. Connect the signal generator to the RF input on the sampling unit. The signal applied is a pure sine of 500 kHz. URE 3 is connected in parallel with the sampling unit to measure the applied signal. Press **START (F3)** and read the measured effect in dB. Vary the level of the applied signal from -16 dBm to +10 dBm and find the average value for the difference between the value read on the QA-ES and the applied value measured with URE 3. Use the term below to calculate a linear percentage value from the difference value in dB.

KdB: Average value for the difference between the value read on QA-ES and the applied value measured with URE 3.

$$Clin = 10^{\frac{kdB}{20}}$$

Clin: Linear value of kdB.

$$Q_{gain} = Q_{gain} \bullet Clin$$

The following term will lead to a new value for **Q_gain**.

Turn the wheel and press **ENTER** to specify a new value for **Q_gain**. Repeat the test until the average value between the QA-ES and URE 3 is smaller than 0.1 dB. This corresponds to an error of 2.3%.

Peak Detector. Once the measuring device used in measuring the effect has been calibrated, you can calibrate the peak detector. Use the same test setup as for calibrating the effect. Measure with a signal level of 200 mVp and 1 VP applied from the generator. The applied amplitude is measured with URE 3. The difference between the value read on the QA-ES and URE 3 should not exceed 10% otherwise the **P_offset** and **N_offset** in the calibration menu must be changed until this requirement is met. If the positive peak value read is too small **P_offset** should be reduced. **N_offset** should be reduced if the negative peak value is too low. Press **QUIT (F5)** to save calibrated values.

5. **Measuring Accuracy of the total system**. Connect the coaxial cable from the Load Board to the RF-input (J4) on the Sampling Unit. Put the ground plate of the isolating box back into place. Connect a high voltage probe in the port for variable load resistance on the QA-ES. The probe's coaxial cable should be connected to URE 3. The banana adapters of the probe are connected with the high voltage generator. The following mathematical formula presents the applied effect in dBm as a curve of the effect on URE 3.

$$dBcoeff = 20 \bullet \log\left(\frac{R1 + R2}{R2}\right)$$

R1: Resistance in the high voltage probe. Specified on the probe. Nominal value 47 kohms.

$$P_m - P_{URE\#} + dBcoeff$$

R2: Measuring resistance in the high voltage probe. Specified on the probe. Nominal value 37.5 ohms.

The measuring accuracy of the QA-ES should be checked for the following resistance values and the corresponding signals applied.

R [ohm		neasured on URE3 [dBm]
75		52.0 - 54.0
300		50.0 - 53.0
150		47.0 - 52.0

NOTE
Remember to set the reference impedance in URE 3 to the same value as the load resistance used for measuring.

Calculate he difference between QA-ES and URE 3 and correct the value for **Q_gain** in the calibration menu by following the instructions given before under item 4 in this section.

Requirement:

$$P_{m[}[dBm] - P_{qa-es}[dBm] < 0.17 dB$$

$$I_{qa-es} > 50[mA]$$

In linear form this corresponds to:

$$\frac{P_m - P_{qa-es}}{P_m} < 4\%$$

Remember that the scope output is not calibrated!

6. **Scope Output**. Connect the high voltage generator to 'Var. Load' and the oscilloscope to 'Scope Output'. Set the QA-ES to continuous mode and start measuring by pressing on **Start**. Activate the high voltage generator and measure the peak-to-peak voltage on the oscilloscope. Check that this value equals the current flow read on the QA-ES.

Nominal value: 4.5 ∀ 0.4 V/A

6. Component Functions and Parts

This chapter provides a detailed description of the functions of the main components of the QA-ES, as well as a parts list for cross-reference. Reference is made to the component location and schematic diagrams to assist servicing personnel. These diagrams are foldouts, and are located in Appendix B.

6.1 Processor Board

(Refer to QA-ES Processor Board Component Location Diagram and Schematic Diagrams 1 and 2) The Processor Board is installed on the inside of the front plate. It comprises the:

- power supply;
- microprocessor system;
- display;
- function keys;
- interface towards Sampling Unit, and;
- RS 232 port and printer port

The Processor Board activates and controls the sampling procedure in the QA-ES. The data is routed back from the Sampling Unit to the microprocessor, where the results will be calculated before being displayed.

1. **Power Supply**

   (See QA-ES Processor Board Schematic Diagram 2). The Processor Board receives 12 VAC from the Transformer located at the rear of the QA-ES via J4. The voltage is then converted with diode D9 and filtered through C1. Voltage regulator U8 supplies the circuits with +5 V. The voltage is adjusted with resistors Rl0 and R11. Schottky diode D4 protects the 5V power supply to the printer interface to avoid any power flow between the printer and the Processor Board while the QA-ES is switched off. Capacitive switch regulator U9 generates -12 V from +12 V. V-comparator U10 monitors the +5V voltage and sends a reset signal to the microprocessor when the voltage drops under 4.75 V.

   Transistor Q4 controls the voltage to the compressor at the rear of the QA-ES. The compressor is connected to J5. The microprocessor issues a digital signal at PWMA, depending on the ventilation speed desired. Transistor Q2 controls the basic power in Q4. When Q4 is turned off (low ventilation speed), the compressor receives power via transistors R8 and R17, leading to a voltage drop.

2. **Microprocessor System**

(See QA-ES Processor Board Schematic Diagram 1). The microprocessor system is in PCMCIA card format (U1). It comprises a MC68HC16 microprocessor with I/O, 256K Flash ROM and 64K RAM. It can be reprogrammed or replaced when upgrading the software. The processor's I/O includes an asynchronous serial port (ACIA), synchronize serial port, parallel I/O, A/D converter and PWM output. In addition, 8 bit of the data bus are accessible, as well as chip-select lines for direct access to the external I/O.

The processor is timed with a 16.67 MHz timer frequency, controlled by an internal crystal in the component. To check the timer frequency, a 1024 Hz square signal is applied to one of the PWM outputs. The signal can be measured at pin TP 1.

Ul3 is an EEPROM connected to the processor component via a parallel I/O. Ul3 saves the calibration parameters for the Sampling Unit. The parameters can be stored independently of the processor component so that the QA-ES does not have to be recalibrated when upgrading the software.

3. **Function Keys**

(See QA-ES Processor Board Schematic Diagram 1). The QA-ES is operated by touch keys and a universal digital encoder. The encoder, or 'knob', will be given different functions depending upon the parameters that are to be changed. The encoder is connected to two touch keys with unchangeable functions, 'ENTER' and 'CANCEL'. The QA-ES is operated from 5 'soft-keys' linked to menus shown on the display.

Latch U2 buffers data from touch keys SW1-SW7. If you press one of the keys, power will flow into the base at Q1 via RP1, thus controlling an interrupter input on the processor unit. When the interrupter input is activated the processor reads latch U2 latch to find out which key was pressed. The same interrupter input is activated via diodes D1 and D2 when operating the encoder. The encoder is read via I/O ports on the processor component.

4. **Display**

(See QA-ES Processor Board Schematic Diagram 1). The QA-ES is equipped with a 240 x 64 dot graphic display with a built-in character generator. When in character mode, the display shows 40 x 8 characters. The display is controlled by the processor unit via the data bus. The display's contrasting voltage is regulated with voltage regulator U12. Voltage (and contrast) are controlled with the potentiometer R15. This is the only point of adjustment at the processor board.

The display offers EL background light to make it easier for the user to read. U11 is an oscillator generating an operating voltage of about 90 VAC for the EL component.

5. **Interface Towards Sampling Unit**

(See QA-ES Processor Board Schematic Diagram 1). All data transferred between the Sampling Unit and the Processor Unit is in serial format to simplify the optical interface on the sampling board. Communication is controlled by the synchronous serial interface on the processor unit. The signals are transmitted via pin board base J1.

6. **Serial Port**

   (See QA-ES Processor Board Schematic Diagram 2). The serial port is adapted to a 9-pin RS-232C format. The port is set to 9600 baud, 8 data bits, 1 stop bit and no parity. RS-232 driver U6 drives the data signals. The handshake is software-oriented. The command responses are returned via the D-sub terminal.

7. **Printer Output**

   (See QA-ES Processor Board Schematic Diagram 2). The Processor Board's printer output has a standard 25-pin D-sub contact for Centronix interface. The output is built around 3 HC-MOS circuits; U3, U4 and U5. The circuits are connected to the data bus and I/O ports of the processor unit. U3 is a latch for the 8 parallel data lines. U4 is the driver for the outgoing commands, while U5 acts as a buffer for incoming commands. RP3 comprises pull-up resistances for the input lines. All signals to the printer output are filtered to reduce high frequency radiation.

6.2 Sampling Unit

The QA-ES Sampling Unit is placed inside the internal protection box of the instrument. The card is fixed vertically on the right side of the protection box. The unit comprises:

- power supply;
- measuring device, and;
- interfaces towards the Processor Board and the Load Board.

The Sampling Unit converts the applied RF signal to a low frequency signal proportional to the mean square of the RF signal. The peak value of the applied signal is also measured. The measuring values are sampled with a 12 bits A/D converter and the data is transmitted to the Processor Board for calculation and presentation on the display.

1. **Power Supply**

   (See QA-ES Processor Board Schematic Diagram 1). The Sampling Unit receives -10 VDC and +10 VDC from the Load Board via J1). Voltage regulators U17 and U19 provide, respectively, +6V and -6V for the RMS DC converter. Voltage regulators U18 and U20 provide the peak detector with +9V and -9V. Voltage regulator U16 supplies the opto-coupler in the interface towards the Processor Board with + 5V.

2. **Measuring Device**

The measuring device consists of two blocks:

- a RMS DC converter for current measuring, and;
- a peak detector for measuring the peak voltage in the signal.

The peak detector is divided into two actions for measuring the positive and negative peak values.

3. **Input Filtration**

At the measuring system input, the incoming signal is filtered down to a lower level through a filter based on L1, L2, C5, C6 and C7. The 3dB frequency is set to 10 MHz. The filter can be found on diagram 1 of 3.

4. **RMS DC Converter**

(See QA-ES Processor Board Schematic Diagram 1). The RMS DC converter is based upon an analog multiplicator from analog devices AD834, U15. U15 and U25 form a circuit that calculates the mean square of the applied signal. A filter, consisting of C8, C9. C50, C51, R35 and R36, determines the constant time factor for the integration, which will correspond to the amplitude of the outgoing signal at U25. Further calculations of RMS values and current are carried out in the software on the Processor Board.

Two amplification steps following the mean square circuit ensure optimum dynamics in the measuring system. Both steps U13 and U14 provide 20 dB amplification. By measuring the signal before U13, and after U13 and U14, you can determine which signal level makes the best use of the A/D converter dynamics.

5. **Peak Detector**

(See QA-ES Processor Board Schematic Diagram 3). The peak detector is divided into two sections: one for detecting the positive peak voltage, and the other for detecting the negative peak voltage. The detector is based on a transistor diode connection. The positive peak voltage is detected by transistors Q1 and Q4, to which are attached various components. The same goes for the negative peak voltage with Q2 and Q5. The positive peak voltage is built up over the C27 capacitor, whereas the negative peak voltage is built up over the C28 capacitor. U23 drains small amounts of current from C27, and provides the AID converter with correct polarization and low impedance for the positive peak detector. U22 does the same for the negative peak detector. The peak detector ran be reset by short-circuiting C27 and C28 via octol analog switch U24 *(See QA-ES Processor Board Schematic Diagram 2)*.

6. **A/D Converter**

The measuring device uses a 12-bit A/D converter from linear, Ul. This circuit measures both RMS values, and positive and negative peak voltage. Each of the signals is multiplexed into the A/D converter via the U24 switch.

The sampling speed depends on the Processor Board's reading speed. Schottky diode D7 protects the A/D converter from incoming negative signals.

7. **Interface Towards Load Board and Processor Board**

   The measuring device and load resistances in the QA-ES are isolated from the processor unit and the housing by a galvanic shield. This protects the user if a fault in the QA-ES produces ground currents during the measurements. This interface is based upon opto-couplers and various mains transformers for the user interface and the measuring device in the QA-ES.

   Data is transferred digitally between the Sampling Unit and the Processor Board in serial form via J3 to simplify the optical interface. Opto-couplers U5, U6, U7 and U8 are used in transmitting signals from the processor system to the Sampling Unit. The Opto-coupler U9 transfers the measurement from the Sampling Unit back to the processor system on the Processor Board.

   The relays used in choosing load values on the Load Board are also controlled via terminal J3 on the Sampling Unit. The commands are then transmitted from the Sampling Unit to the Load Board via terminal J2.

8. **High Voltage Protection**

   Diodes D8-D15 are a protection device against high voltage signals entering the Sampling Unit.

6.3 Load Board

(Refer to QA-ES Load Board Component and Schematic Diagrams). The Load Board is located inside the internal protection box in the QA-ES. The card is fixed vertically inside the box. The unit includes a power supply, load resistances with corresponding control relays, and interface towards the processor system Sampling Unit, a measurement resistor with attenuators and measuring Transformer for the scope output.

The Load Board forms the load for the ESU being tested. The load can vary from 10 ohms to 5200 ohms, or be fixed to 200 ohms. A high voltage relay inside the Load Board (K1) connects the load to or from the ESU.

1. **Power Supply**

   The Load Board is supplied with 2 x 9 VAC from the Trafo in the front part of the protection box via J14. The voltage is converted with diode D9, and filtered through Cl and C2. U1 is a voltage regulator, providing the relay drivers +5 V. U1 also supplies Sampling Unit opto-couplers U10, U11 and U12 with 5

V. Cl and C2 provide relay drivers U2 and U3 with +10 VDC and -10 VDC. These voltages are used for controlling the relays on the Load Board.

2. **Load Resistances**

   There are two load resistances on the Load Board, seen from the ESU being tested. The first has a fixed load of 200 ohms, and is used to measure the current leakage. The other is a variable load resistance, which varies in steps of 25 ohms, from 10 ohms to 5200 ohms.

3. **Fixed Load Resistance**

   The fixed load resistance is based on the two 100 ohms non-inductive resistances (R17 and R18) connected in series. The total load can be 350 W continuously.

4. **Variable Load Resistance**

   The variable load resistance is also based on a non-inductive resistance (R3 - R16). In addition, relays (K2 - K10) have been used to offer the choice between different combinations of resistances. You can therefore obtain any value between 10 and 5200 ohms.

5. **Measuring Resistance and Attenuator**

   The measuring signal transmitted to the Sampling Unit is drained over a 2.0 ohms resistance (R1) in series with the variable load resistance (R3 - R16). Before the signal is transmitted to the measuring device, it passes through a variable attenuator, based on a 10 dB attenuator (R20 - R22) and a 20 dB attenuator (R26 - R30). By connecting these attenuators in series, you can obtain an attenuation of 30 dB.

6. **Interface Towards Sampling Unit**

When the signals pass through an optical barrier between the processor system and the rest of the electronics, the Sampling Unit's F1 terminal controls the relays, choosing the load and attenuator values on the Load Board.

7. **Scope Output**

The scope output is based on a measuring Transformer L1, mounted on the Load Board. The measuring Transformer is terminated with a 50 ohms resistance R31.

8. **Foot Switch**

The output foot switch is based on a relay (K11), and is used in triggering the ESU being tested.

6.4 Component Parts

COMPONENT PART	*TYPE/VALUE*	*QTY.*	*DIAGRAM REFERENCE*
HOUSING:		1	
Transformer ring core 1x12V 1A	ULVECO AA81002	1	
Transformer E-core 10kV 2x9V	ELTRAFO	1	
D-Sub 25p female	ELFA 43-674-54	1	
D-Sub 9p male	ELFA43-673-97	1	
Flat cable contact 10-polt	ELFA 43-646-00	1	
Flat cable contact 16-polt	ELFA 43-646-26	2	
Flat cable contact 26-polt	ELFA 43-646-42	1	
BNC Straight bulkhead jack	R141306000	1	
SMB coax. conn. Straight plug	RI14082000	1	
Security contact Red	Flat 4.8mm JHSupp 404-171	1	
Security contact Black	Flat 4.8mm JHSupp 404-137	1	
Security contact White	Flat 4.8mm	2	
Security contact Green	Flat 4.8mm	2	
Ventilator 12 VDC 92mm	Panasonic FBA09A12H1A	1	
Protection grate for ventilator	Sunon FG-9	1	
Turning knob		1	
Voltage regulator	C&K V802-12-SS-05-Q	1	
Apparatus input with netfilter	Corcom IED4	1	
Safety fuse 5x20 mm	Schurter 0031.1081 FEF	2	
Safety fuse 5x20 mm	Schurter 0031.1363 FIO	2	
Net switch	C&K DM22-J1-2-S2-05-N-Q	1	
Cable shoe		13	
ABIKO Ring cable shoe		1	
Screw dimension M3			
Flat cable		1	
Flat cable to printer	25-polt 44 cm	1	
Flat cable to serial port	9-polt 44 cm	1	
Flat to measuring board	16-polt 33 cm	1	
Coax. cable IRG174	45 cm Farn 125326	1	
Countersunk flat headed screw	DIN 965 M4x12	14	
Countersunk flat headed screw	DIN 965 M3x6	8	
Screw slot SH	DIN 84A M3x10	4	
Screw slot SH	DIN 84A M3x8	12	
Screw slot SH	DIN 84A M4x10	4	
Screw slot SH	DIN 84A M4x35	1	
Screw recessed head poz	DIN 7985 M2-5x10	8	
Screw recessed head poz	DIN 7985 M3x6	31	
Screw recessed head poz	DIN 7985 M3x8	4	

COMPONENT PART	***TYPE/VALUE***	***QTY.***	***DIAGRAM REFERENCE***
Screw recessed head poz	DIN 7985 M3x10	4	
Screw recessed head poz	DIN 7985 M4x30	4	
Nut M3		6	
Nut M4		4	
Safety nut M4		1	
Spring washer M4		4	
Washer M4	12mmø DIN 9021	1	
Spacer for fixing the front plate		5	
Contact plate		1	
RF protection box		1	
Front plate w/5 screws for circuit board		1	
Rear plate		1	
Front foilv		1	
PROCESSOR BOARD:			
Printed circuit board	Elprint AR075	1	
Micro Module	16MM16	1	U1
Latch	74HC574N	3	U2, U3, U5
Port	74HC05N	1	U4
RS 232-driver	MC145406P	1	U6
Voltage Reg.	LM337LZ	1	U12
Voltage Reg.	LM317T	1	U8
V-converter	ICL7662CPA	1	U9
V-comparator	Mc34064P-5	1	U10
V-converter	Nel-D32-49	1	U11
EEPROM	X24C02P	1	U13
Transistor	BC547B	2	Q1Q2
Transistor	BD140	1	Q4
Diode	1N4148	4	D1, D2, D5, D10
Diode	1N4002	1	D3
Schottky diode	1N5819	1	D4
Bridge	4A 200v	1	D9
LCD-display	Optrex DMF 5005N-EW	1	
Encoder	Bourns ECWIJ-B24-BC0024	1	SW8
LED	Gul 3mm Sie LY3360-K	1	D7
LED	Rød 3mm Sie LR 3360-FJ	1	D8
Resistor	22R 1% 0.5W	2	R8, R17
Resistor	240R 1% 0.5W	1	Rll
Resistor	330R 1% 0.5W	2	R4, R5
Resistor	750R 1% 0.5W	1	R104
Resistor	1K0 1% 0.5W	1	R9
Resistor	2K2 1% 0.5W	1	R14
Resistor	6K8 1% 0.5W	1	R16
Resistor	10K 1% 0.5W	5	R2, R7, R12, R18, R19
Resistor	22K 1% 0.5W	2	R3R13
Resistor	100K 1% 0.5W	1	R1
Resistor pack	5x2K2 SIL	1	RP4
Resistor pack	8x4K7 SIL	1	RP2
Resistor pack	8x10K SIL	1	RP3
Resistor pack	8x47K SIL	1	RP1
Varistor	20V	1	R6
Trimpot	10K 1-tørn Cermet	1	R15
Multilayercond.	100nF 50V	6	C8
El.lytt cond.	10 F 25V	4	C2, C3, C5, C6
El.lytt cond.	220 F 25V	1	C7
El.lytt cond.	2200 F 25V	1	C1
Tantal cond.	1 F 35V	1	C4
EMI-Filter	Murata DSS306-91YSS102M1	19	FI1 - FI19
PCM-CIA slot		1	(U1)
Display-connection	4 pin Berg 71991-410	1	(DISP1)

COMPONENT PART	TYPE/VALUE	QTY.	DIAGRAM REFERENCE
Display-connection	20 pin Berg 71991-410	1	(DISP1)
Board pin base	16 pin	1	J1
Board pin base	10 pin	1	J2
Board pin base	26 pin	1	J3
Pin base for display			(DISP1)
Pin base	36 pol	5	TP1-TP7
Screw clip basic part	2 pol	2	J4J5
Screw clip	2 pol	2	(J4J5)
Touch keys		7	SW1 - SW7 *1
Cover for touch keys		7	(SW1-SW7)
Safety holder	Schurter 0031-8201 OGN	1	F1
Safety fuse	600mA Slow	1	(F1)
Heat sink	Elfa 75-612-44	1	(Q4)
Screws	M2 x 10	2	
Nuts	M2	2	
Nylon screws	M3 x 12	4	
Nylon nuts	M3	12	
SAMPLING UNIT:			
Printed circuit board	Elprint AR-069	1	
Op.amp High Current	AD844AN	1	U21
Op.amp High Speed	AD711JN	1	U25
Op.amp Railto Rail	AD820AN	2	U13, U14
Op.amp Dual	LMC662CN	2	U22, U23
Analog Multiplier	AD834JN	1	U15
AiD-converter 12-Bit 250 kHz	LTC 1272- 5CCN	1	U1
Octal Analog Switch Array	DG485DJ	1	U24
Shift Register	74HC589AN	2	U2, U3
Quad Nand port	74HC00AN	1	U4
Opto Coupler	CNW2611	8	U5- U12
Voltage Regulator	LM317T	1	U16
Voltage Regulator	LM317LZ	1	U17
Voltage Regulator	LM2941T	1	U18
Voltage Regulator	LM337LZ	1	U19
Voltage Regulator	LM2991T	1	U20
Transistor	547BNPN	2	Q1, Q2
Transistor	560BPNP	2	Q4, Q5
Diode	LL4148	12	D1 - D6, D8- D13
Zener diode	1N5335. 39V	2	D14, D15
Schottky diode	PRLL5819	1	D7
Crystal	25 MHz	1	Y1
Resistor	4R7 1% 1/8W	2	R56, R57
Resistor	10R 1% 1/8W	4	R27, R34, R37, R58
Resistor	24R9 1% 1/8W	1	R24
Resistor	51R 1% 1/8W	2	R61, R72
Resistor	75R 1% 1/8W	2	R25, R26
Resistor	100R 0.25% 1/8W	4	R22, R23, R35, R36
Resistor	160R 1% 1/8W	1	R28
Resistor	249R 1% 1/8W	4	R42, R44, R46, R47
Resistor	390R 1% 1/8W	1	R90
Resistor	470R 1% 1/8W	18	R6 - R21, R64, R67
Resistor	750R 1% 1/8W	3	R5, R41, R55
Resistor	953R 1% 1/8W	2	R43, R45
Resistor	1K0 1% 1/8W	3	R54, R82, R83
Resistor	1K2 1% 1/8W	1	R75
Resistor	1K5 1% 1/8W	4	R48, R65, R73, R81
Resistor	1K8 1% 1/8W	4	R40, R52, R60, R71
Resistor	2K0 0.25% 1/8W	3	R38, R50, R77
Resistor	2K2 1% 1/8W	1	R89
Resistor	2K7 1% 1/8W	2	R63, R68
Resistor	3K3 1% 1/8W	1	R53

COMPONENT PART	***TYPE/VALUE***	***QTY.***	***DIAGRAM REFERENCE***
Resistor	3K6 1% 1/8W	1	R76
Resistor	4K7 1% 1/8W	11	R49, R59, R62, R69, R70, R78 - R80, R86 - R88
Resistor	10K 0.25% 1/8W	2	R30, R31
Resistor	18K 0.25% 1/8W	2	R39, R51
Resistor	22K 0.25% 1/8W	1	R29
Resistor	47K 0.25% 1/8W	2	R32, R85
Resistor	10M 1% 1/8W	2	R66, R74
Trimpot Multi.	10K	4	R1, R2, R3, R4
Chip ind.	10%	2	L1, L2
(Chip ind.	2%	2)	
Cond Multil. lpF0 5% 63V		1	C22
Cond Multi.	47pF 5% 63V	2	C2, C3
Cond Multi.	100pF 5% 63V	3	C11, C46, C47
Cond Multi.	150pF 5% 63V	2	C5, C7
Cond Multi.	470pF 5% 63V	1	C6
Cond Multi.	lnF0 5% 63V	2	C27, C28
Cond Multi.	10nF 10% 63V	20	C10, C11, C23-C26, C29, C31 - C34, C36, C37 - C39,C41, C42, C44, C45, C60
Cond Multi.	100nF 10% 63V	8	C4, C8, C9, C12, C2, C35, C71, C72
Tantal cond.	1,0 F 20% 15V	20	C30, C48, C49, C52, C53, C56 - C59 C61 - C70
Tantal cond.	10 F 20% 15V	5	C14, C16, C17, C18- C20
El.lytt cond.	10 F 20% 50V	4	C13, C15, C54, C55
Condenser	NC		C40, C43, C50, C51
Printer board contact	6-polt hunn	2	J1, J2
SMB coax conn.	Right angle PCB recept.	1	J4
Stifflist kort	16 pin	1	J3
18/36 pin base	36 pol (testpoints split)		TP1 -TP18
Screw	M3x6 Elzink Pan	3	
Nut	M3 Elzink	3	
LOAD BOARD:			
Printed circuit board	Elprint AR-061B1	1	
Voltage Regulator	LM317T	1	U1
Resistance bridge	4A 200V GBU4D	1	D2
Resistor	3K0 5% 50W	1	R16
Resistor	9R1 5% 100W	1	R3
Resistor	15R 5% 100W	1	R4
Resistor	620R 5% 100W	1	R15
Resistor	47R 5% 175W	1	R5
Resistor	100R 5% 175W	4	R8, R9, R17, R18
Resistor	200R 5% 175W	4	R6, R7, R10, R11
Resistor	330R 5% 175W	1	R12
Resistor	470R 5% 175W	1	R13
Resistor	1K0 5% 175W	1	R14
Resistor	2R0 1% 10W	1	R1
Resistor	10R 0.1% 0,6W	1	R30
Resistor	26R1 0.1% 0,6W	2	R20, R22
Resistor	34R8 0.1% 0,6W	1	R21
Resistor	82R 0.1% 0,6W	4	R26 - R29
Resistor	100R 0.1% 0,6W	2	R19, R25
Resistor	51R 1% 0,5W	1	R31
Resistor	240R 1% 0,5W	1	R23
Resistor	750R 1% 0,5W	1	R24
El.lytt cond.	10 F 2,5V 25mm rad.	1	C3
El.lytt cond.	2200 F 25V rad.	2	C1, C2
Circuit driver	UCN5842A	2	U2, U3
High voltage relay	Günther 33911290246	1	K1

COMPONENT PART	***TYPE/VALUE***	***QTY.***	***DIAGRAM REFERENCE***
Relay 24V	Takamisawa	10	K2 - Kll
Relay 24V 2-pol	Takamisawa RY-24W-OH-K	2	K12, K13
(Relay 24V 2-pol	Takamisawa RY-24W-K	2)	
Toroid	3F3 125x75x5 mm ELFA 58-755-21	1	L1
SMB coax conn.	Straight plug crimp	1	
SMB coax conn.	Straight PCB recept.	1	J13
Printer board contact	6-polt hannPhoe	1	J1, J2
Printer board clip	3-polt Phoe	1	J14
Safety holder	Farn 134477	2	F1, F2
Safety fuse	600mAT Farn 150202	2	(F1), (F2)
High voltage cable	35 cm 10-/m @ 100 m	2	
Coax. cable RG174	40 cm Farn 125326	1	
Coax terminator	Double leg right ang.	1	
Plastic Spacer	ENISO 3x25	38	
Plastic Spacer	ENISO 3x20	6	
Nylon Screw	M4x07x12 mm	36	
Screw pin	DIN 553 M4x22 mm	14	
Dekk-kappe todelt		30	
Bracket for power resistor		30	

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Appendix A - GLOSSARY OF TERMS USED

Bipolar Electrosurgery	Electrosurgery where current flows between two bipolar electrodes that are positioned around tissue to create a surgical effect. Current passes from one electrode, through the desired tissue, to the other electrode, thus completing the circuit without entering any other part of the patient's body. Neutral plates are not employed in the bipolar technique. Both electrodes are generally of the same size.
Bipolar Output	An isolated electrosurgical output where current flows between two bipolar electrodes that are positioned around tissue to create a surgical effect in that tissue (usually desiccation).
Blend	A waveform that combines features of cut and coag waveforms; current that cuts with varying degrees of hemostasis.
Crest Factor	The amount of heat generated is relative to the mean power value. The crest factor depends on the load resistance and is defined as the ratio of peak value to effective value. A sine wave has a crest factor of 1.4 and provides the cleanest form of cutting.
Diathermy, also Surgical Diathermy; Electrosurgery	A surgical technique used to cut or coagulate cellular tissue. To avoid muscle contractions, only high frequency currents and voltages of more than 100 kHz are used. The electric current directs the heat into the tissue. The patient is connected to two electrodes, allowing the current to flow through the body. The active electrode will generate a large amount of heat, due to the high current density and the small surface of the electrode.
ESU	Electrosurgical Unit. This is a term which is inclusive of both the electrosurgical generator and its connecting cables.
Cut (Cut Mode, Pure Cut)	A low voltage, continuous waveform optimized for electrosurgical cutting.
Isolated Output	The output of an electrosurgical generator that is not referenced to earth ground.
Monopolar Electrosurgery	A type of electrosurgery involving a small (active) electrode and a large neutral (neutral plate) electrode. The small surface of the active electrode provides very good results in coagulating and cutting. The neutral plate of modern units is split, thus controlling the circuit, including the contact between electrodes and patient.
Monopolar Output	A grounded or isolated output on an electrosurgical generator that directs current through the patient to a patient return electrode.
Resistance (Impedance)	Resistance to the flow of alternating current, including simple direct current resistance and the resistance produced by capacitance or inductance. The resistance of a material is its tendency, measured in ohms, to oppose the flow of electric current or, viewed another way, the material's tendency not to conduct the current.
REM	Return Electrode Monitor.

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Appendix B - DIAGRAMS

Processor Board Component Location Diagram..B-2

Schematic Diagram Part 1 (Processor Board)..B-3

Schematic Diagram Part 2 (Processor Board)..B-4

Sampling Unit Component Location Diagram..B-5

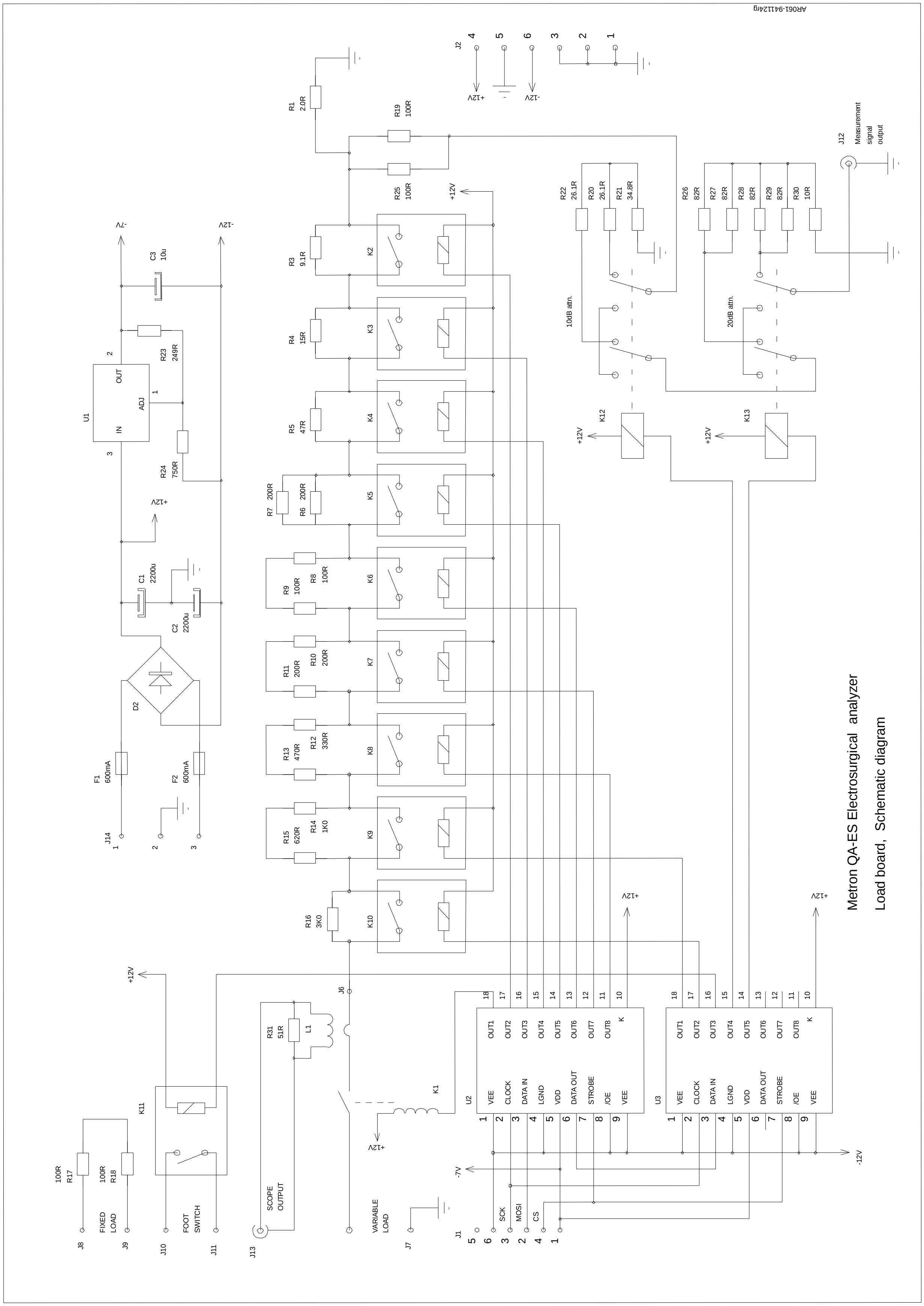
Schematic Diagram Part 3 (Sampling Unit)..B-6

Schematic Diagram Part 4 (Sampling Unit)..B-7

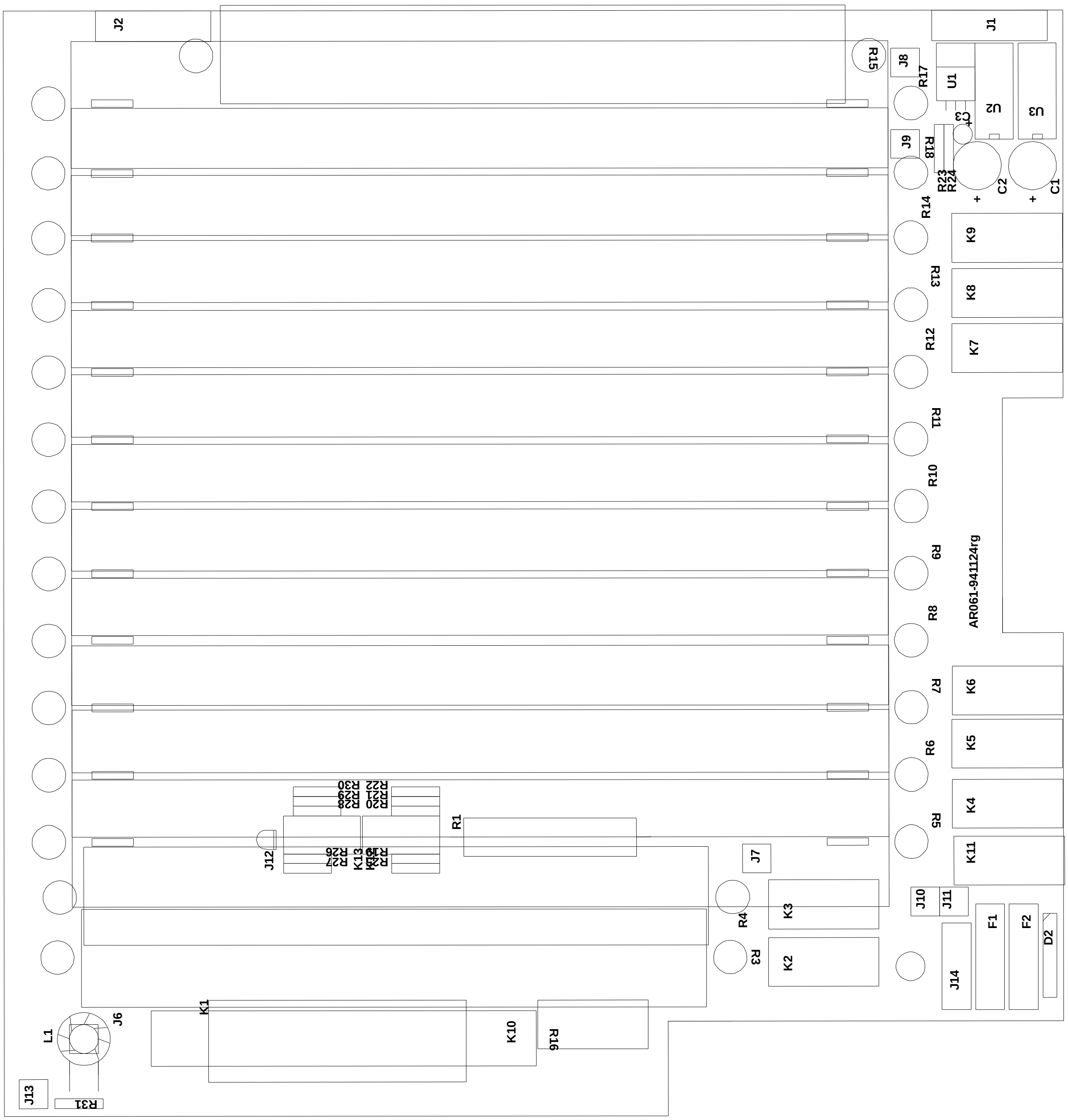
Schematic Diagram Part 5 (Sampling Unit)..B-8

Load Board Component Location Diagram..B-9

Schematic Diagram Part 6 (Load Board)...B-10



Metron QA-ES Electrosurgical analyzer
Load board, Schematic diagram


J1
J2
J6
J7
J8
J9
J10
J11
J12
J13
J14
R1
R3
R4
R5
R6
R7
R8
R9
R10
R11
R12
R13
R14
R15
R16
R17
R18
R19
R20
R21
R22
R23
R24
R26
R27
R28
R29
R30
R31
U1
U2
U3
C1
C2
C3
K1
K2
K3
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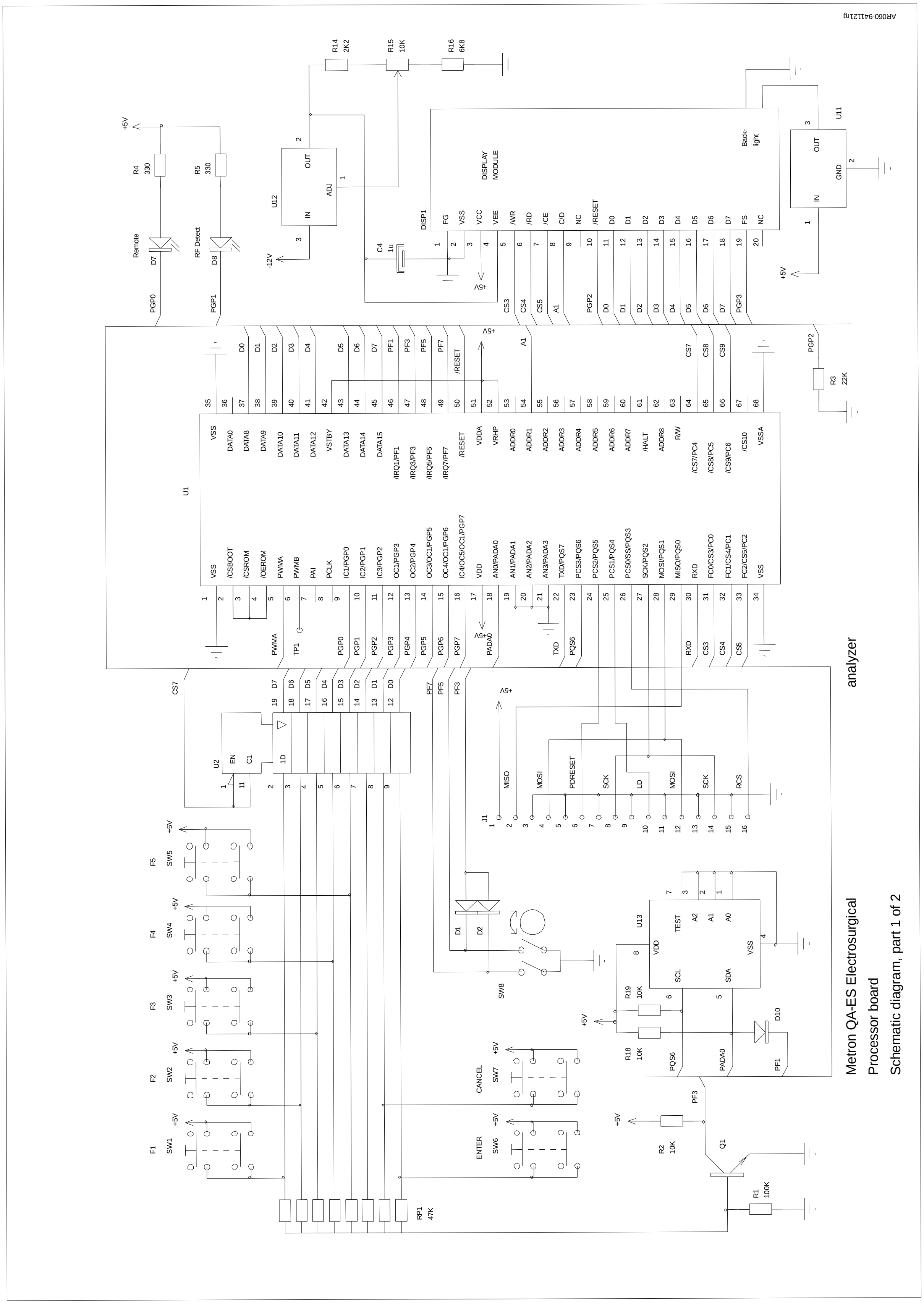
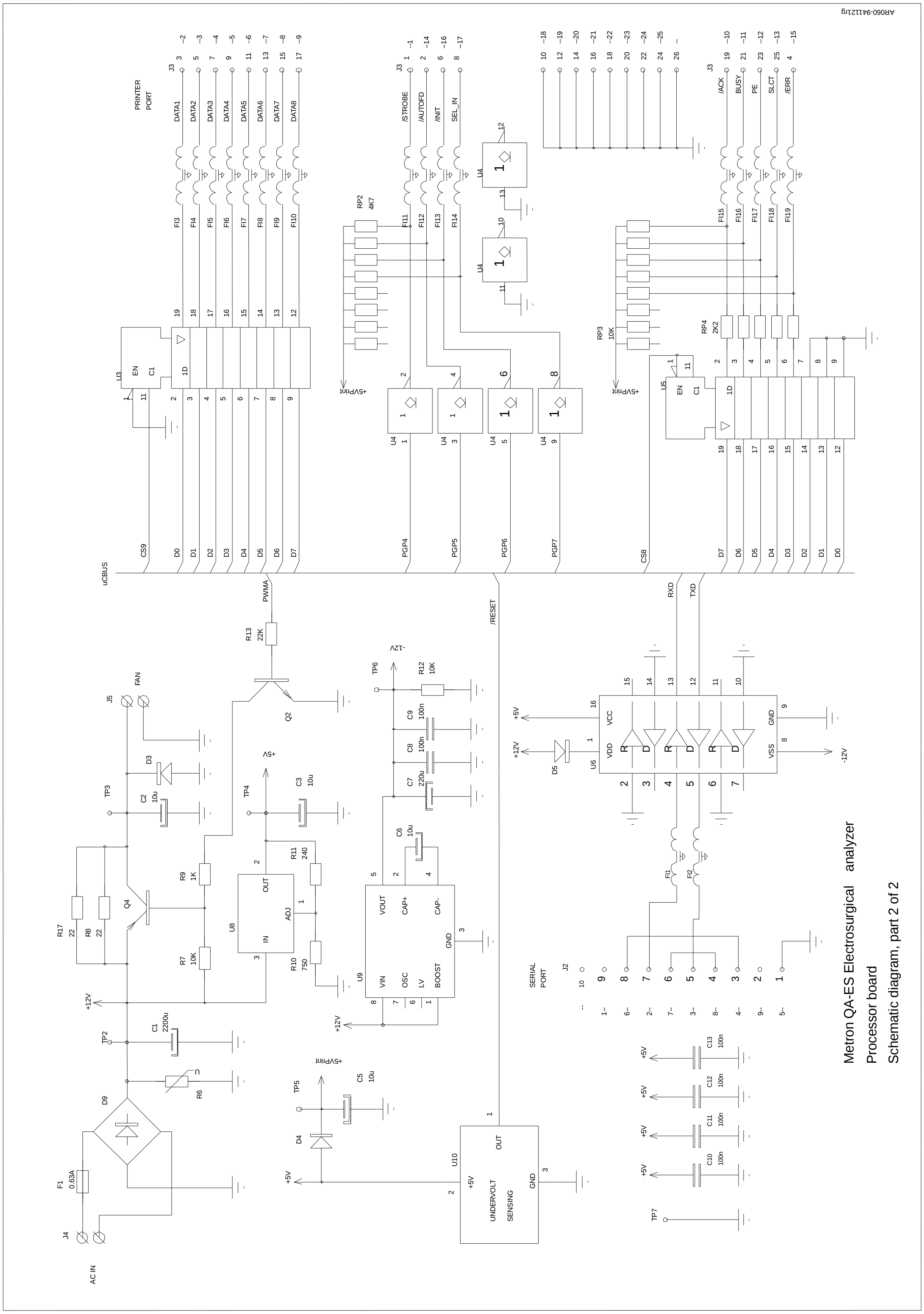
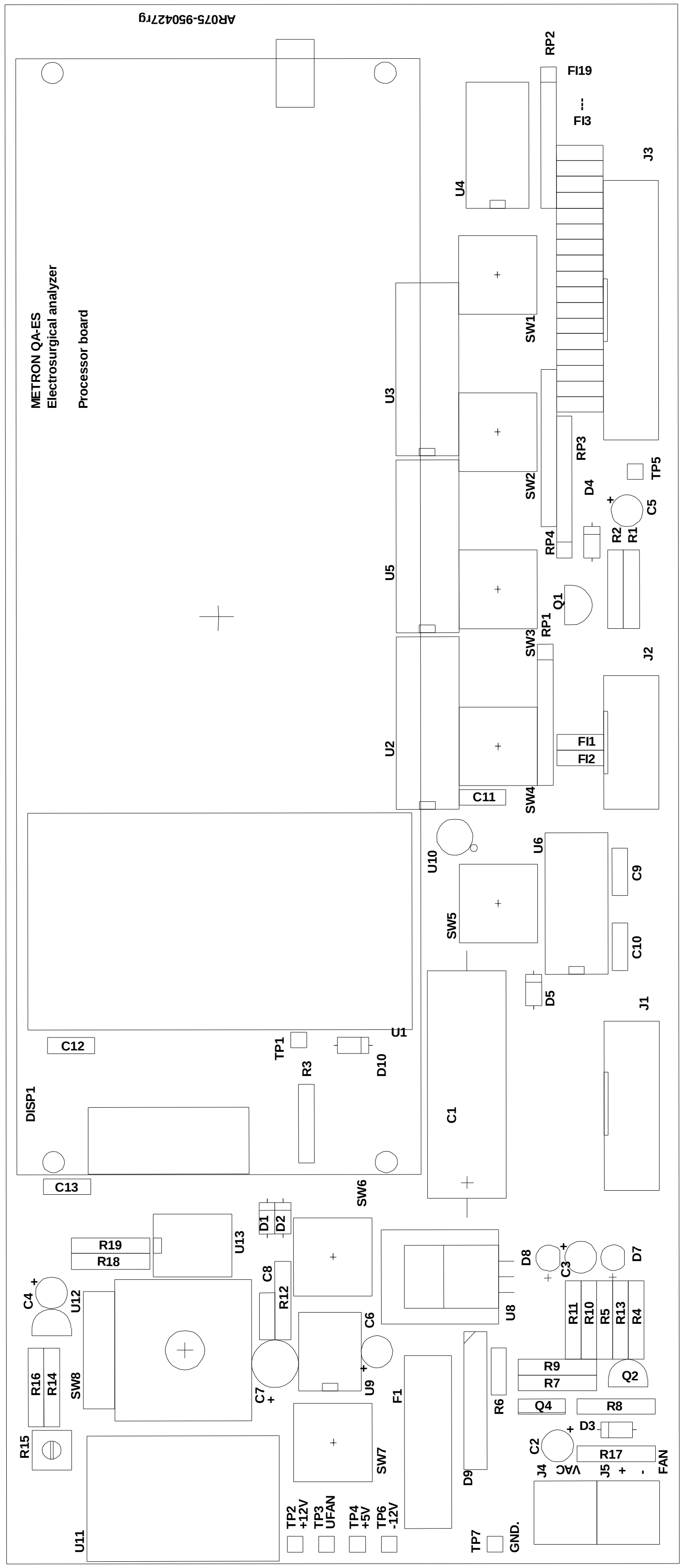
F1
F2
D2
AR061-941124rg


Metron QA-ES Electrosurgical analyzer
Processor board
Schematic diagram, part 1 of 2


Metron QA-ES Electrosurgical analyzer
Processor board
Schematic diagram, part 2 of 2
PRINTER PORT
SERIAL PORT
uCBUS
AC IN
FAN
UNDERVOLT SENSING


AR075-950427rg
METRON QA-ES
Electrosurgical analyzer
Processor board
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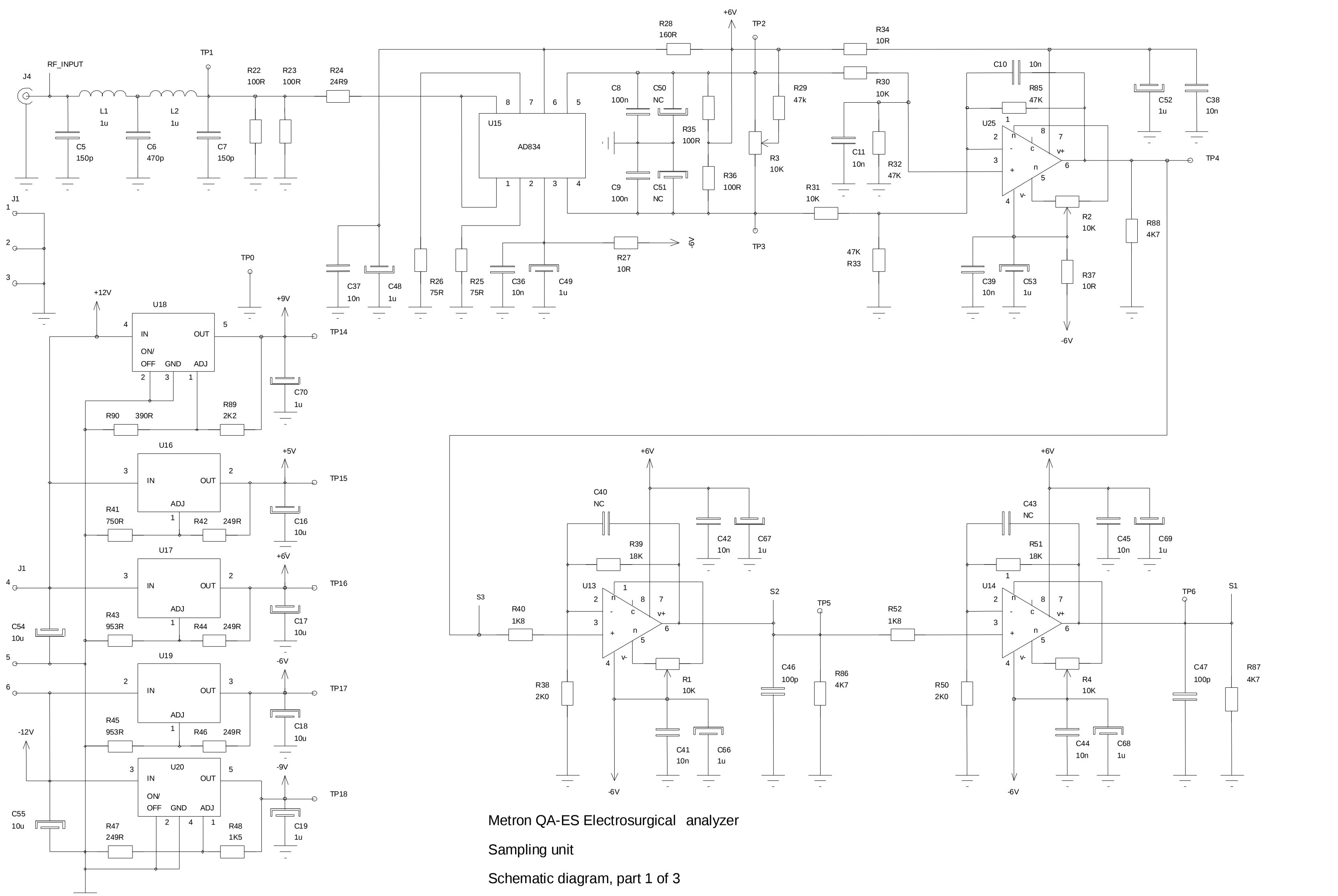
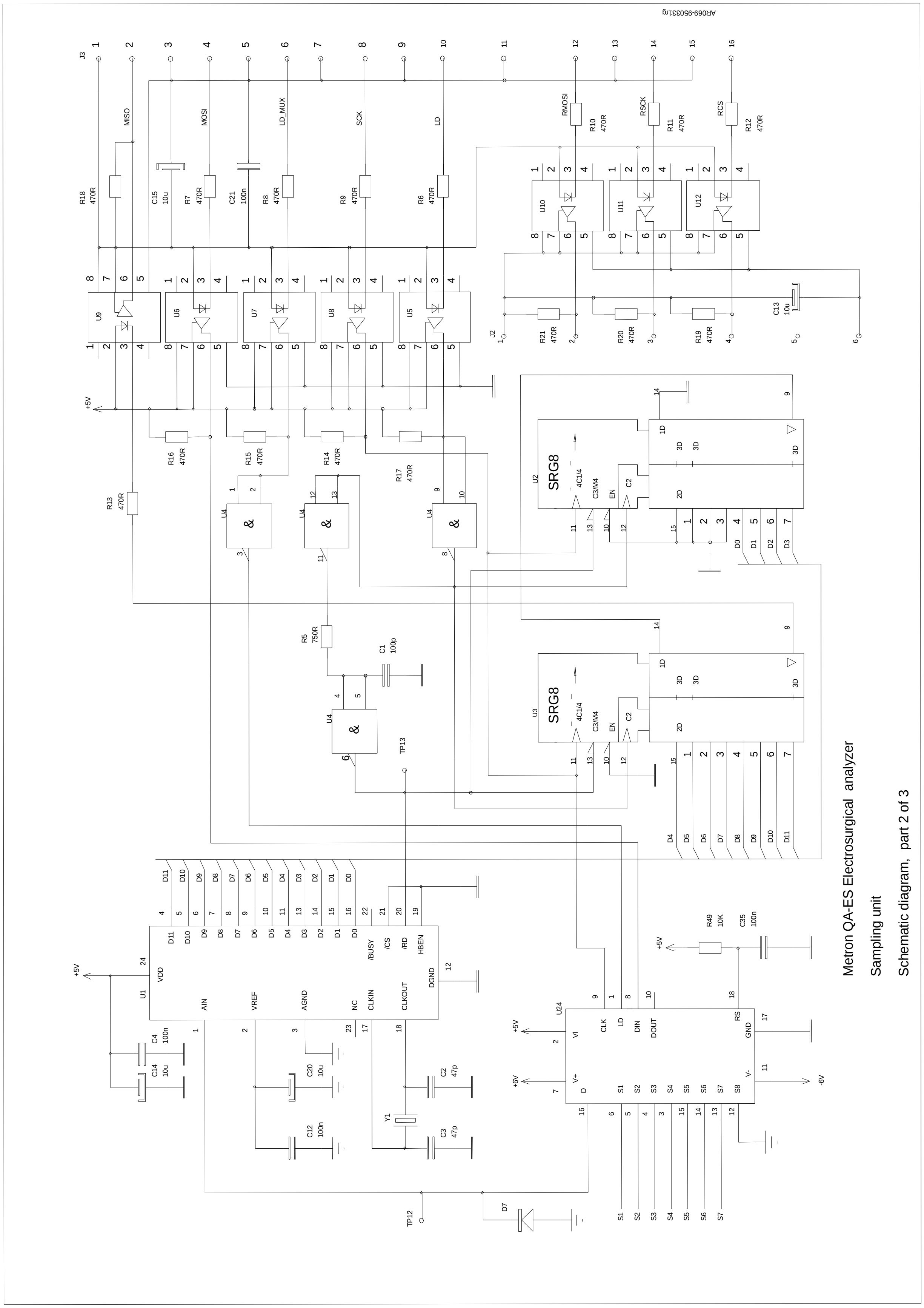
FI19
FI3
J3
U4
SW1
U3
SW2
RP3
TP5
D4
C5
R2
R1
RP4
U5
Q1
RP1
SW3
J2
U2
FI1
FI2
SW4
C11
U10
U6
C9
SW5
C10
D5
J1
U1
TP1
R3
D10
C12
DISP1
C1
C13
SW6
D1
D2
R19
R18
U13
C8
R12
D8
C3
D7
C4
U12
U8
R11
R10
R5
R13
R4
C6
R16
R14
SW8
C7
U9
F1
R9
R7
Q2
R6
Q4
R8
R15
D3
C2
R17
SW7
J4
VAC
J5
FAN
D9
TP2
+12V
TP3
UFAN
TP4
+5V
TP6
-12V
TP7
GND.
U11



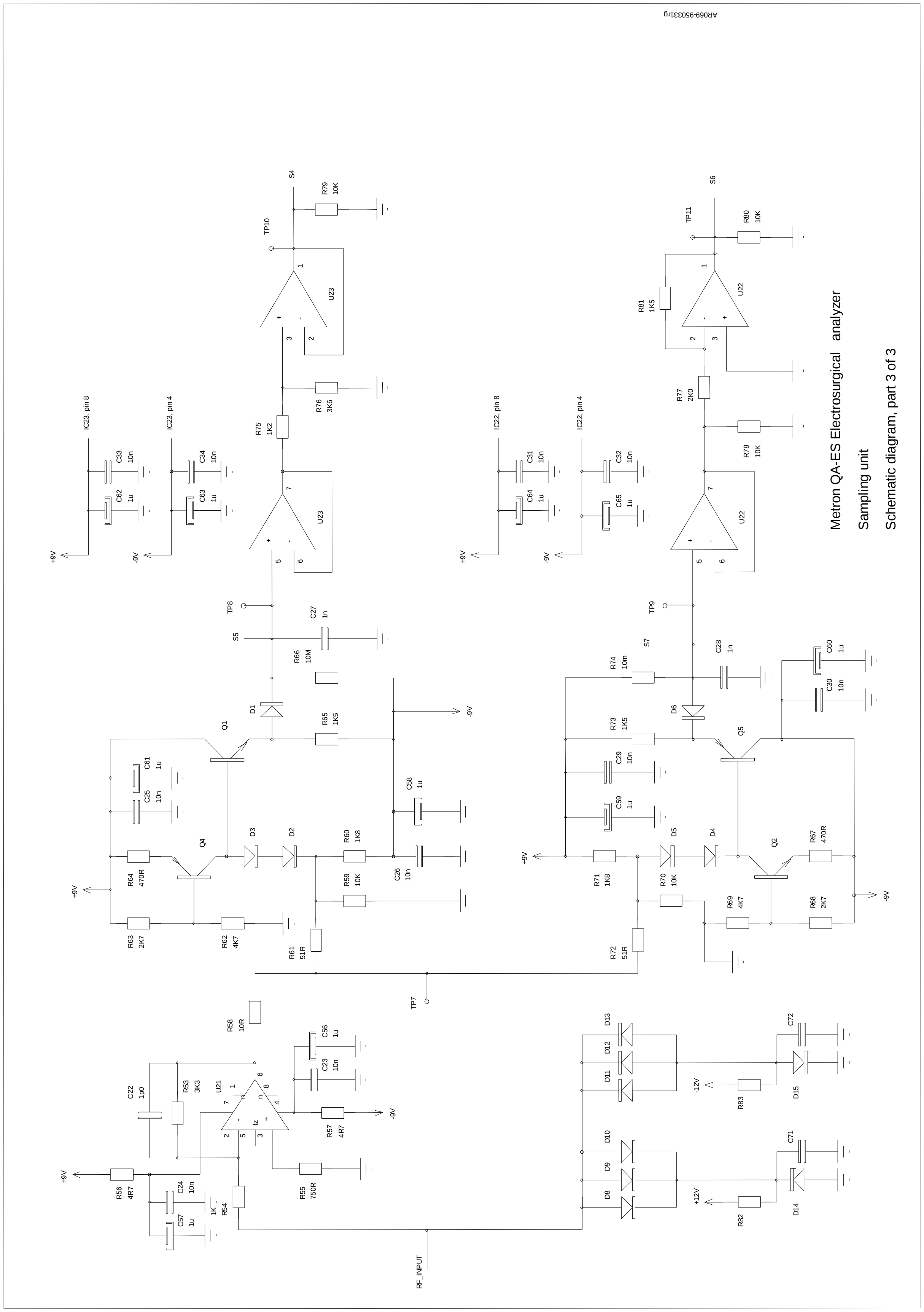
Metron QA-ES Electrosurgical analyzer

Sampling unit

Schematic diagram, part 1 of 3



Metron QA-ES Electrosurgical analyzer
Sampling unit
Schematic diagram, part 2 of 3


Metron QA-ES Electrosurgical analyzer
Sampling unit
Schematic diagram, part 3 of 3
AR069-950331rg
RF_INPUT
TP7
TP8
TP9
TP10
TP11
S4
S5
S6
S7
U21
U22
U23
Q1
Q2
Q4
Q5
IC23, pin 8
IC23, pin 4
IC22, pin 8
IC22, pin 4
+9V
-9V
+12V
-12V
R54 1K
R55 750R
R56 4R7
R57 4R7
R58 10R
R53 3K3
R59 10K
R60 1K8
R61 51R
R62 4K7
R63 2K7
R64 470R
R65 1K5
R66 10M
R67 470R
R68 2K7
R69 4K7
R70 10K
R71 1K8
R72 51R
R73 1K5
R74 10m
R75 1K2
R76 3K6
R77 2K0
R78 10K
R79 10K
R80 10K
R81 1K5
R82
R83
C22 1p0
C23 10n
C24 10n
C25 10n
C26 10n
C27 1n
C28 1n
C29 10n
C30 10n
C31 10n
C32 10n
C33 10n
C34 10n
C56 1u
C57 1u
C58 1u
C59 1u
C60 1u
C61 1u
C62 1u
C63 1u
C64 1u
C65 1u
C71
C72
D1
D2
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D4
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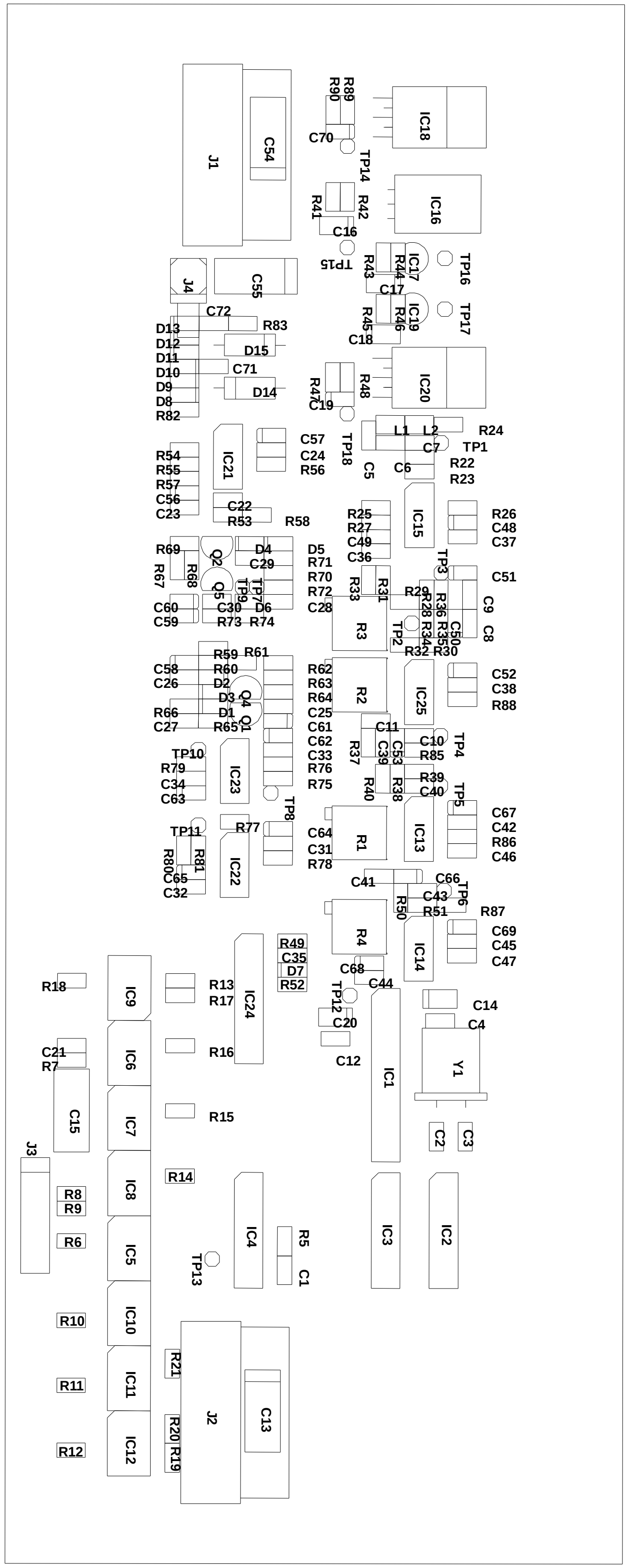
D13
D14
D15



J1
C54
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R90
C70
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R42
C16
IC16
TP15
R43
R44
IC17
TP16
J4
C55
C17
R45
R46
IC19
TP17
C72
R83
C18
D13
D12
D11
D10
D9
D8
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D15
C71
D14
R47
R48
C19
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L1
L2
R24
C7
TP1
R54
R55
R57
C56
C23
IC21
C57
C24
R56
TP18
C5
C6
R22
R23
C22
R53
R58
R25
R27
C49
C36
IC15
R26
C48
C37
R69
R67
R68
Q2
Q5
D4
C29
TP9
TP7
D5
R71
R70
R72
C28
R33
R31
TP3
C51
R29
R28
R36
C9
C60
C59
C30
R73
D6
R74
R3
TP2
R34
R35
C50
C8
R32
R30
R59
R61
C58
R60
C26
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Q4
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C10
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TP10
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R38
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TP8
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C45
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C68
C44
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IC7
R15
C2
C3
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R14
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IC2
R6
IC5
R5
TP13
C1
R10
IC10
R21
R11
IC11
J2
C13
R20
R19
R12
IC12

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Address: _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   Fax: _ _ _ _ _ _ _ _ _ _ _ _ _ _

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_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _   Date:

Error Report

Product: Version: Serial no.:

Description of the situation prior to the error:

Description of the error:

(METRON AS internally)

Comments:

Received date:	Correction date:	Ref No.	☐ Critical ☐ Normal ☐ Minor

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Fax: _ _ _ _ _ _ _ _ _ _ _ _ _ _

E-mail: _ _ _ _ _ _ _ _ _ _ _ _ _ _

Date: _ _ _ _ _ _ _ _ _ _ _ _ _ _

Improvement Suggestion

Product: _ _ _ _ _ _ _ _ _ _ _ _ Version: _

Description of the suggested improvement:

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Comments:

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