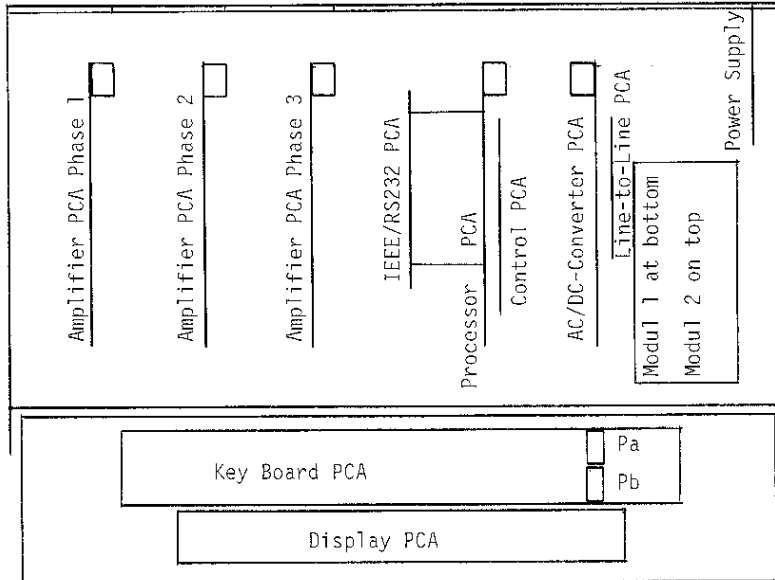


305A CALIBRATION AND SERVICE MANUAL

## 2.1. CIRCUIT BOARD LOCATION

**AMPLIFIER PCA**

The amplifiers phase 1, 2, and 3 have the same configuration. They contain a current isolation amplifier, a voltage isolation amplifier, and a common amplifier output section.

Refer to schematics "Voltage Amplifier", "Current Amplifier", and "Amplifier Output Section", and to the layout drawings "Amplifier PCA".

**PROCESSOR PCA, CONTROL PCA**

The processor PCA and the control PCA are on the same assembly separated by spacers. Refer to schematics "Processor" and "Control", and to the layout drawings "Processor PCA" and "Control PCA".

**AC/DC-CONVERTER PCA**

The AC/DC-Converter PCA contains circuitry and three modules, module 3, module 4, and module 5.

Refer to schematics "AC/DC-Converter" and to the layout drawing "AC/DC-Converter PCA".

#### MODULE 1 AND MODULE 2

Modules 1 and 2 are part of the AC/DC-Converter PCA. They are molded to keep out moisture.

#### POWER SUPPLY PCA

The power supply PCA contains 2 rectifiers, filters, and linear regulators to generate 2 times +5V, +15V, and -15V.

#### KEY BOARD PCA

All front panel keys and LED's are mounted on this PCA.

#### DISPLAY MODULE

The display module controls the vacuum fluorescent display.

#### OPTIONAL PCA'S:

##### IEEE-488 AND RS-232 INTERFACE PCA

The IEEE-488 Interface and/or the RS-232 Interface are on the same PCA. Refer to schematics "IEEE-/RS-232 Interface" and to the layout drawing "IEEE-/RS-232 PCA"

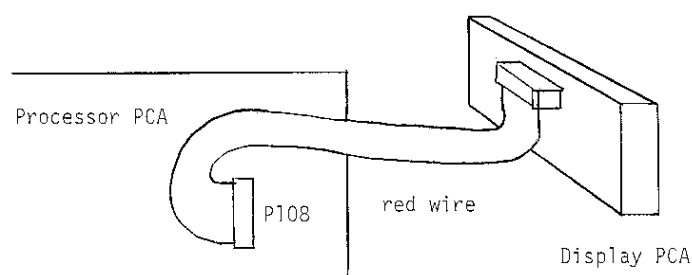
##### LINE-TO-LINE PCA

The line-to-line PCA is mounted on the back of the AC/DC-Converter PCA. It contains circuitry for the line-to-line voltage measurement. Refer to schematics "line-to-line" and to the layout drawing "line-to-line PCA".

## 2.2. CABLE CONNECTIONS

This section describes the interconnecting cables between the printed circuit board assemblies. If you remove cables make a note of its location and its mounting.

The most critical cable connection is between display and processor board. If you connect it the wrong way around you take the chance to damage the display PCA. Below the connection of the 20 pin. display cable is shown.



## LIST OF CABLE CONNECTIONS INCLUDING OPTIONS

From Print	Con No.	Leads	To print	Con No.
Processor	P106	14 pole	Key Board	Pa (lower)
Processor	P105	14 pole	Key Board	Pb (upper)
Processor	P108	20 pole	Display	
Processor	P102	14 pole	Amplifier Phase 1	P10/P11
Processor	P103	14 pole	Amplifier Phase 2	P10/P11
Processor	P104	14 pole	Amplifier Phase 3	P10/P11
Processor	P114	20 pole	AC/DC-Converter	P551
Processor	P112	14 pole	Line-to-line	P112
Processor	P110	14 pole	AC/DC-Converter	P553
Processor	P111	14 pole	AC/DC-Converter	P554
Processor	P109	20 pole	IEEE-/RS-232	J9f
Processor	P107	14 pole	Control	P906
Processor	P113	20 pole	Control	P905
Control	P901	14 pole	Amplifier Phase 1	P14
Control	P902	14 pole	Amplifier Phase 2	P14
Control	P903	14 pole	Amplifier Phase 3	P14
Control	P900	14 pole	to Rear Panel Printer	
Control	P904	14 pole	AC/DC-Converter	P552
AC/DC-Converter	P600	14 pole	to Module 1	
AC/DC-Converter	P700	20 pole	to Module 2	
AC/DC-Converter	P550	14 pole	to rear Panel dc-inputs	
IEEE/RS-232	P1	14 pole	to rear panel RS-232	
Line-to-line	P551	20 pole	AC/DC-Converter	P551
Line-to-line	P553	14 pole	AC/DC-Converter	P553

### 2.3. ALIGNMENT PROCEDURES

The dc-offset adjustment of section 1.10. is part of the alignment procedures.

#### 2.3.1. AMPLIFIER OUTPUT SECTION ALIGNMENT

This adjustment on the amplifier board equalizes the voltage- and current amplifier gain at 100Hz and 10kHz. It must in general be performed on the voltage amplifier section when U3 or U30 had to be replaced. The alignment on the current amplifier section must be performed when U12 or U38 had to be replaced.

### VOLTAGE SECTION

Select 7.5V-range. Apply 7.5V/100Hz. Measure dc voltage at pin 12 with respect to circuit ground (metal binding post on processor PCA). Adjust potentiometer R75 for 5V at pin 12.

Apply 7.5V/10kHz. Adjust R79 for 5V dc at pin 12 (connector P10/P11).

### CURRENT SECTION

Select 25mA-range (0.8A plug-in). Apply 25mA/100Hz. Measure dc-voltage at pin 6 of connector P10/P11. Adjust R110 for 5V dc at pin 6.

Apply 25mA/10kHz. Adjust R114 for 5V dc at pin 6 of connector P10/P11.

If you did alter the adjustment of the voltage section or the current section, we recommend to check calibration and if necessary recalibrate the 305A.

### 2.3.2 FREQUENCY NULL ADJUSTMENT

This adjustment is required, when U565 on the AD/DC-Converter PCA had to be replaced. Select **TRIG**-menu and choose I1\*.

Apply 25mA/100Hz to current input I1 (use 0.8A plug-in). Measure dc voltage at pin 13 of U565 on the AC/DC-Converter PCA and note value. Now apply 25mA/10Hz and adjust the voltage at pin 13 of U565 to 1/10 the value you measured at 100Hz. If you observed large deviations repeat the two measurements at 100Hz and 10Hz once or twice.

Check the frequency display value at 100Hz. If errors are too large perform the frequency calibration described in section 1 of this service manual.

### 2.4. LIST OF REPLACEABLE PARTS

Throughout the schematics and the assembly drawings you find the type of component written on the schematics or/and on one of the assembly drawings. If you order parts from Infratek, specify Model of instrument, print assembly, and component number such as U31, R121, Module 1, etc.

Below you find the type of components used in the 305A circuits which are not specified in the schematics.

All resistors, marked	M.F. Resistor, 0.1 %, 0.4W, 250V
All resistors, not marked	M.F. Resistor, 1 %, 0.4W, 250V
All potentiometers	Pot., Bourns 3296X
All capacitors < 1uF	Cap., Ceramic, 5 %, 100V
All capacitors 1uF-10uF	Cap., Tantal, 35V
All white capacitors	Cap., Polystyren, 2 %, 100V

305A CALIBRATION MANUAL

## 1. CALIBRATION PROCEDURE

The calibration procedure explains how the 305A Vector Wattmeter is calibrated. A calibrator (AC and DC), and a Voltmeter is required. A calibration cycle of one to two years is recommended.

### 1.1. CURRENT PLUG-IN ADJUSTMENT

The first step in the calibration process is to check the current plug-ins for proper setting. Remove the plug-ins from the 305A and connect a 14-pin Amphenol connector to the plug-in. Solder a 100kOhm (1 %) metal film resistor between pins 13 (Hi) and pin 11 (Low). Wait 10 minutes for the thermal stress to settle.

Now apply the dc-current shown in the following table. Measure the voltage across the 100kOhm resistor and adjust the potentiometer on the plug-in to obtain the reading shown in the table below.

Plug-in	Current Sens Resistor	Current Input Input DC	Voltage Across 100kOhm Resistor
0.8A	10hm	200mA	192mV
8A	0.10hm	2A	192mV
16A	0.0250hm	2A	48mV
40A	0.0050hm	10A	48mV

Above adjustment must be within  $\pm 0.04$  %.

For calibration it is by far the simplest to use the 0.8A plug-in. It requires small currents and power calibration can be done using a 1500hm precision resistor.

### 1.2. DOES 305A REQUIRE OFFSET ADJUSTMENT?

If you require the 305A to also meet the specifications at dc we recommend to perform the following test to determine whether you should perform the dc-offset adjustment described in section 1.9 or not.

Select the lowest current- and voltage range; select dc-coupling, and display  $A/V=$ . Now you apply a dc-current corresponding to  $\pm$ full scale (lowest current range). If any of the two readings is out of specifications you should perform the dc-offset adjustment described in section 1.9.

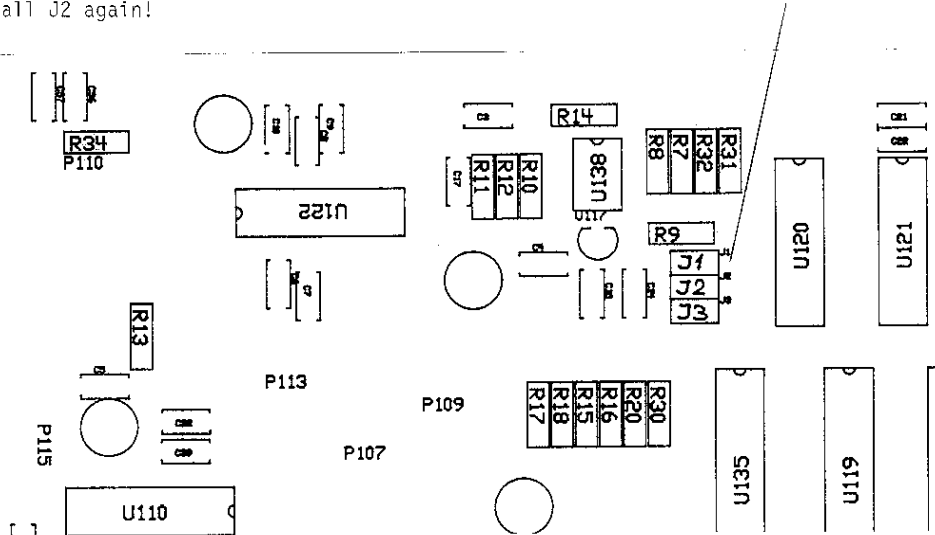
Finally, you apply a dc-voltage ( $\pm 7.5V$ ). If any of the two readings is out of specifications you should perform the dc-offset adjustment described in section 1.9.

### 1.3. PREPARING THE 305A FOR CALIBRATION

Remove the top cover of the 305A by removing the rear- and front panel screws along the top edge, and remove the 4 screws along the top edge of the two side panels. Lift the top cover from the case. All parts of the 305A are now accessible.

Now you turn on the 305A and enter the programming menu **TRIG**. Select **INIT** off (no \*). Turn off the 305A and set the two calibration jumpers J1 and J3 on the processor circuit board assembly (fourth print from left, or second print from right, seen from the front panel). Remove jumper J2.

When you have finished the calibration, do not forget to remove J1 and J3 and install J2 again!



Put the top cover on the case again without tightening screws. Turn on the 305A. The jumpers J1 and J3 in conjunction with **INIT** off activate the calibration state. You can operate the front panel control just like in the normal operating mode with the exception of the **START** control followed by a second control which tells the 305A which quantity needs to be calibrated.

The three phases are calibrated simultaneously, that is, the 3 voltage inputs are connected in parallel and the 3 current inputs are connected in series (for single phase- and two phase instruments connect accordingly). Before you proceed to section 1.4. allow 45 minutes warm-up time.

### 1.4. CURRENT CALIBRATION, SIX RANGES

We are assuming you are using three 0.8A plug-ins with current ranges 25/50/100/200/400/800mA for calibration.

If you are using 8A plug-ins instead, you must increase the input currents accordingly. (8A: 0.25/0.5/1/2/4/8A). The 16A plug-in can not be used because the current at the highest current range (32A) would overload the plug-in (16A: 1/2/4/8/16/32A max. 16A continuous).



The general procedure for current calibration is as follows: Select the lowest current range in manual ranging (25mA), select AC-coupling. Apply 25mA/60Hz to all three current inputs. Wait 5 seconds for the values to settle. Press **START** and then press **A=V=**. The display must show 25.000mA.

To calibrate the next higher current range (50mA) you proceed accordingly. Select the 50mA range, apply 50mA/60Hz, press **START** and then press **A=V=**.

In a similar manner the 100mA / 200mA / 400mA and the 800mA current ranges are calibrated.

This current calibration procedure calibrates the mean-, rms-, rectified mean-, and peak values of the broad band values (not harmonics).

### 1.5. VOLTAGE CALIBRATION, EIGHT RANGES

The general procedure for voltage calibration is as follows: Select the lowest voltage range (7.5V) in manual ranging, select AC-coupling. Apply 7.5V/60Hz to all three voltage inputs. Wait 5 seconds for the values to settle. Press **START** and then press **Ar/Vr**. The display must show 7.5000V.

To calibrate the next higher voltage range (15V) you proceed accordingly. Select the 15V range, apply 15V/60Hz, press **START** and then press **Ar/Vr**.

In a similar manner the 30V/60V/120V/240V/480V and the 960V ranges are calibrated.

This voltage calibration procedure calibrates the mean-, rms-, rectified mean-, and peak values of the broad band values (not harmonics).

### 1.6. POWER CALIBRATION

The power calibration is performed at the third current- and second voltage range (15V/100mA). This can be done in two ways:

- a) Use a voltage calibrator (15V) and a current transfer (100mA) to generate the required wattmeter inputs (positive power display).
- b) Use a voltage calibrator which can supply 100mA at 15-20V/60Hz and a precision 1500hm  $\pm 0.02$  % load. The current through the load is fed in series into the wattmeter current inputs and the voltage across the precision resistor is applied to the three wattmeter voltage inputs. Change the calibrator setting to obtain a display of 15.000V and 100.00mA on the 305A.

The procedure for power calibration is as follows. Turn the 305A off and on again. Wait 60 seconds. Within this time period the 305A will compensate offsets. Select the 100mA- and the 15V range, and select AC-coupling.

Now apply 100mA/15V at 60Hz and wait 10 seconds for the values to settle. Press **START** and then press **W/VA**. The display must show 1500.0mW.

For most applications the current-, voltage-, and power calibration is sufficient. If equipment is available the frequency calibration of section 1.7 and the harmonic equalization of section 1.8 can be performed. If you finish calibration at this point turn 305A off and remove the jumpers J1 and J3 and install J2 again.

### 1.7. FREQUENCY CALIBRATION

The frequency calibration is secondary to the calibration procedure and should only be performed when necessary. Use the wattmeter input configuration you used in section 1.6.

The calibration is performed as follows. Apply a 100Hz signal (any amplitude between 10 % to 100 % of full scale). Wait 5 seconds, press **START** and then press **Z/Phi**.

Apply a 1kHz signal. Wait 5 seconds, press **START** and then press **ΣVR/A**.

Apply a 100kHz signal. Wait 5 seconds, press **START** and then press **ΣW/VA**. If you terminate calibration at this point turn 305A off and remove the calibration jumpers J1 and J3 and install J2 again.

### 1.8. HARMONIC EQUALIZATION

The harmonic equalization normally must not be done. If you still decide to do it, you require a calibrator with a phase shifted auxiliary voltage output (such as Fluke 5700A). This phase shifted voltage is applied to the Ext. Trigger input of the 305A. Enter the 305A **TRIG**-menu and select **Ext\***. Now the 305A harmonic measurement is synchronized to the externally applied trigger signal.

Connect the 305A input in exactly the same manner as described in section 1.6. Apply 100mA/15V at 50Hz (not 60Hz).

**STEP 1:** Adjust the phase of the external trigger signal to the 305A to  $-2^\circ$  with respect to the 305A input (15V/100mA). Press **START** and then press **UP**.

**STEP 2:** Adjust the phase of the external trigger signal to  $-92^\circ$ . Press **START** and then press **DOWN**.

**STEP 3:** Adjust the phase of the external trigger signal to  $+178^\circ$ . Press **START** and then press **At/vt**.

**STEP 4:** Adjust the phase of the external trigger signal to  $+88^\circ$ . Press **START** and then press **HARM**.

For steps 1 through 4 the input to the 305A must be precisely 100mA/15V at 50Hz. The phase accuracy of the phase shifted external trigger signal to the 305A must be  $\pm 1^\circ$ .

If you terminate the calibration at this point turn 305A off and remove the calibration jumpers J1 and J3 and install J2 again.

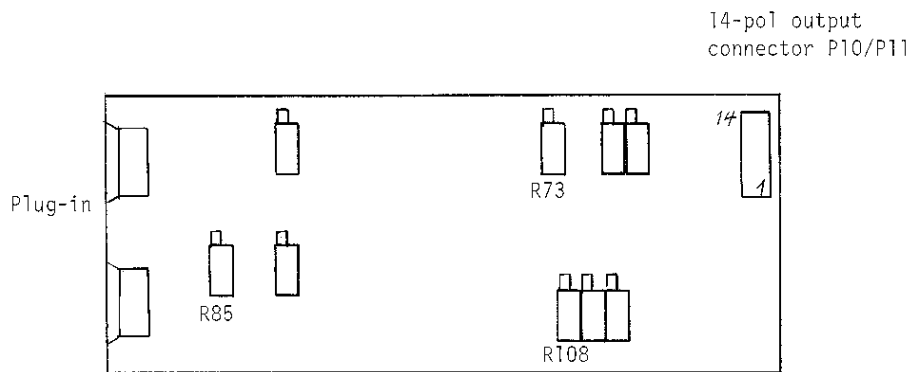
### 1.9. DC-OFFSET ADJUSTMENT

The dc-offset adjustment is performed on the input amplifier printed circuit board assembly. In each amplifier a plug-in is inserted from the rear of the 305A.

To get to the potentiometers for adjustment the two shields on the component side of each amplifier must be removed.

Proceed as follows: Turn 305A off. Remove the plug-ins. Disconnect the three 14-pol. cable connectors going to each amplifier. Remove the two screws holding the amplifier PCA. Now lift out the amplifier PCA and unscrew the two shields on the component side. Put amplifier in place again and connect the three 14-pol. connectors to the amplifier. Make sure to install amplifiers in their original slot and insert plug-in.

Turn on 305A and wait 15 minutes before you perform the offset adjustment.



#### VOLTAGE AMPLIFIER DC-OFFSET ADJUSTMENT

Connect the voltmeter reference point to the metal binding post on the processor PCA (fourth print from left, metal binding post along top edge towards rear of PCA).

Select lowest voltage range. Select dc-coupling. Measure voltage on 14-pol. output connector (pin 14). Adjust potentiometer R73 for 0mV on pin 14 (5mV = 0.1 % of full scale).

#### CURRENT AMPLIFIER DC-OFFSET ADJUSTMENT

Select dc-coupling.

- STEP 1: Select lowest current range. Adjust potentiometer R85 for 0mV on pin 8 of 14-pol. output connector.
- STEP 2: Select highest current range. Adjust potentiometer R108 for 0mV on pin 8 of 14-pol output connector.
- STEP 3: Cycle step 1 and step 2 once or twice.

Perform this offset adjustment for amplifiers phase 1, 2, and 3. When finished reinstall the amplifier shields again.

#### 1.10 REINSTALLATION OF TOP COVER

**CAUTION:** Have you removed the **c a l i b r a t i o n** jumpers J1 and J3 and reinstalled J2.

When you put the top cover in place again, make sure that all print assemblies properly fit into the slots of the top cover print guides. If they do not, you may experience transportation damage.

This is the best way for installation:

- Remove all plug-ins.
- Put cover in place and move it slightly. Most of the prints should fit the slots of the top cover print guides.
- Fasten cover with 2 side panel screws (1 each side, towards rear panel).
- Lower front panel and bring all prints into the slots of the top cover guides.
- Fasten the remaining two side panel screws towards front and install front panel.
- Check the print guides from the rear panel side. Are all prints in proper position? If you had prints removed then you can slide the prints into the slots of the print guides by loosening the two screws holding the prints. When prints are in the slot make sure to tighten the two screws again.
- Lift out the rear panel and also check the two prints covered by the rear panel. (The rear panel can be moved out 50mm).
- Now install the remaining front- and rear panel screws.
- Install plug-ins.