

PCB 77904, PCB 77905 and PCB 77907

8.1 Introduction

The input module consists of two printed circuit boards, interconnected with ribbon cable. The module plugs into a steel case to prevent corruption of the measurements by external or internal fields. It is located at the extreme left-hand side of the case.

Its functions are:

- Input termination impedance selection (up to four values)
- Input selection (A, B or Oscillator)
- Conversion of balanced signals to unbalanced for internal processing
- Input protection against very high level signals
- Attenuation of high level signals
- Initial gain for low level signals
- Gain offsets for different 0 dBm reference voltages
- Buffering of signals for the rear panel oscilloscope outputs
- Level and level difference measurement
- Phase difference measurement

The circuit can be subdivided into the following blocks:

- Termination switching
- Input selection
- 40 dB and 20 dB attenuators
- Overload protection
- Switched-gain amplifiers
- Balanced to unbalanced converters
- Gain offsets
- Rear panel buffers
- Selection of frequency meter source channel
- RMS level detectors and level difference divider
- Squarers and illegal waveform detection
- Phase measurement and output
- Control logic and front panel switches
- Internal voltage reference

Many of the circuit blocks appear twice because of the need to measure phase difference between two identical channels.

Figure 8.1.1 below shows the block diagram of the input module.

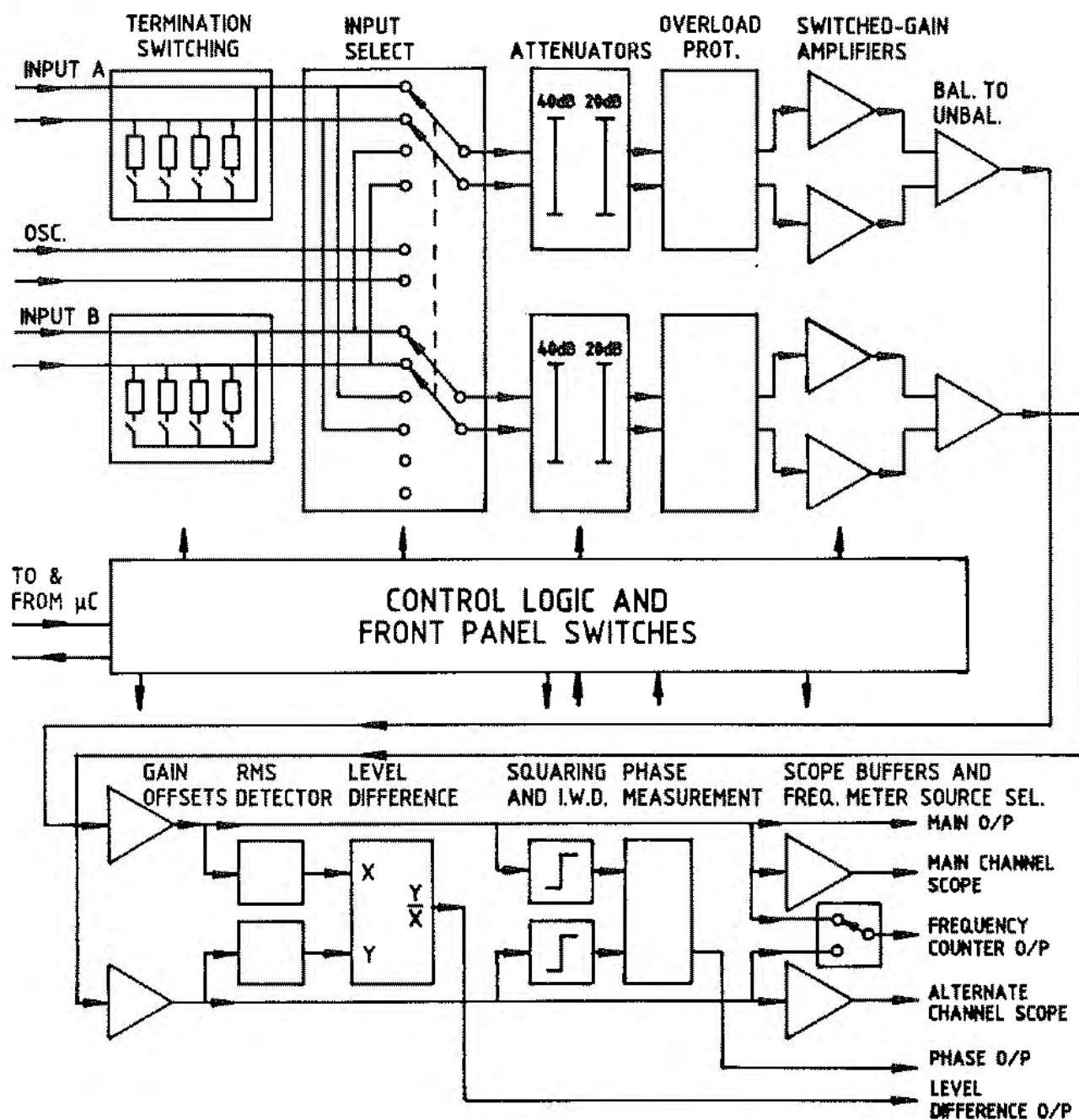


Figure 8.1.1 Input Module - Block Diagram

The channels are designated X and Y. Most of the circuitry for channel X appears on the main PCB (with the DIN 41612 connector), and most of the circuitry for channel Y appears on the subsidiary PCB. In the Level, Read Osc, THD+N, IMD, Noise, W&F, Rumble and FIM functions, only channel X is active, carrying the single selected input's signal (in the Read Osc function, the selected input is the oscillator). In the X-Talk function, channel X carries the signal from the selected input, and channel Y carries the signal from the non-selected input, in the hope that this signal is of a high enough level to use as the reference frequency. In the Phase/Level Difference and Phase (only) functions, channel X carries the signal from input A, and channel Y carries the signal from input B.

8.2 Circuit Description

8.2.1 Termination Switching

Up to four termination networks are fitted. In order to match the customer's requirements as closely as possible, the terminations may be of particular values, different from those shown in this circuit diagram. The terminations are identical for inputs A and B.

RL11-RL14 select the termination for input A, with RL28-RL31 performing the same function for input B. The groups of relays are energised by the outputs of 1-of-4 decoders IC17 and IC41. The circuit impedance is selected by bits 2 and 3 of IC9. Bit 0 enables or disables the termination for input A; bit 1 similarly for input B. In this way the condition "TERM" or "THRU" is selected. Both enables are active low.

8.2.2 Input Selection

Inputs to the channels X and Y are selected by groups of three relays arranged in "T" formation. Relays RL9 and RL6, for example, form the transmission path which selects input A to channel X. RL8 is the shunt path which is energised whenever input A is NOT selected to channel X. Table 8.2.1 below shows all five paths and their respective relays.

Source	Destination	Transmission path		Shunt path
A	X	RL9	RL6	RL8
B	X	RL1	RL4	RL2
Osc	X	RL17	RL15	RL16
A	Y	RL18	RL21	RL19
B	Y	RL27	RL23	RL25

Table 8.2.1 Input select relays

The relays are controlled by IC20, IC24-26, and IC28-30, which generate non-overlap signals, in order not to short any input to ground at any time. The control signals originate from bits 0, 2 and 3 of IC10.

8.2.3 40 dB and 20 dB Attenuators

R30, R74, R75 and VR5 form a 40 dB attenuator, controlled by RL7 and RL10. R16, R71, R70, VR4, RL5 and RL3 form a 20 dB attenuator. Only one of these attenuators is active at once. Identical attenuators are in the other three paths. The control signals come from bits 6 and 7 of IC9 (channel X) and bits 6 and 7 of IC10 (channel Y).

8.2.4 Overload Protection

FETs TR14-22 form a bilateral current limiter in the live path to channel X. VR7 and TR22 set the limit for positive signals; TR14 and VR3 set the limit for negative signals. It is most important to set the limits to be identical, otherwise overload signals charge up C10, possibly to a destructive voltage. In any case, such a charge will take time to settle out again, and lengthen measurement settling time.

TR5-13, VR6 and VR8 form an identical limiter for the return path to channel X; TR41-49, VR18 and VR20, TR30-38, VR17 and VR19 form identical limiters in

channel Y.

D8 and D7 prevent input voltages from exceeding 10,6 V at the non-inverting input of IC11. TR1 prevents voltages from exceeding 0,6 V more than that of the inverting input pin. Similar clamps exist for negative voltages. This clamp system appears on both live and return inputs of both channels X and Y.

8.2.5 Switched-Gain Amplifiers

IC11, IC12 and IC27 are arranged as an instrumentation amplifier. Differential input signals at IC11 and IC12 are amplified by either 0 dB, 10 dB or 20 dB according to the control signals. The signal switch elements are TR28 (10 dB) and TR27 (20 dB). L1 and R125 provide compensation for the phase response of the op-amps. VR10 adjusts the 10 dB gain step; VR9 adjusts the 20 dB step. The control signals are from bits 4 and 5 of IC9 (channel X), and bits 4 and 5 of IC10 (channel Y).

8.2.6 Balanced to Unbalanced Converters

IC27 converts the differential (balanced) signals emerging from IC11 and IC12 to unbalanced. Common mode signals are rejected and do not appear. VR11 adjusts common mode rejection at low to mid frequencies; C35 adjusts at high frequencies.

8.2.7 Gain Offsets

IC19 is an inverting op-amp stage. Gain is nominally unity (0 dB), set by R107 and R113. Gains can be increased by switching in R108 and R105, or R109 and R110, by sections of IC18. According to the connection of LK1, R112 and R111 can be made to either increase or decrease the gain of the stage. These gain steps are to compensate for different 0 dBm voltages. For instance, the voltage corresponding to 0 dBm in 140 Ω is +6,3 dB ref. 0 dBm in 600 Ω . The control signals are from bits 5 and 6 of IC5. Bit 7 of IC5 disables the gain steps in channel X only.

8.2.8 Rear Panel Buffers

IC40 buffers the output of channel X to the rear panel 'scope socket. IC46 buffers channel Y. The somewhat unusual connection of feedback results in a gain of +1, but without any compensation capacitor, which would reduce the slewing rate of the stage.

8.2.9 Selection of Frequency Meter Source Channel

IC23 buffers the output of channel X or Y to the frequency meter section of the microcomputer card. Switching of the source is performed by two sections of IC33. The source select control signal originates from the microcomputer as a direct line, via pin 14 of the DIN connector. TR29 is an inverting level shifter from 5 V to 18 V.

8.2.10 RMS Level Detectors and Level Difference Divider

IC34 is an RMS detector with unity gain, i.e. 1 V RMS at pin 13 causes 1 V DC to emerge from pin 14. This DC output is sent to the microcomputer for auto-set-level purposes, and also to IC38, an analogue multiplier/divider connected so as to divide the level of channel Y by the level of channel X.

8.2.14 Internal Voltage Reference

IC50 provides a highly stable reference voltage of approximately 5 V. This is used to power IC1 in order that its logic "high" level, and therefore the phase difference signal, are highly predictable. The reference voltage is adjusted until 180° phase difference produces exactly 10 V output from IC16. The reference voltage, therefore, may not be exactly 5 V.

The level difference divider, IC38, also uses a reference current derived from the 5 V reference. Because of the way the adjustments work and interact, it is important to set up VR34 (for 10 V from 180°) before setting up VR22 (for level difference).

8.3 Removal/Disassembly/Replacement

8.3.1 Module Removal

The input module is a plug-in assembly located at the left front of the TT402 front panel.

First remove the two screws retaining the module front panel to the test set housing.

XLR VERSION

Insert an XLR type plug into the INPUT B socket. Pull gently to slide the module forward out of its housing.

JACK VERSION

Insert a jack plug into each of the two input sockets. Gently squeeze them together and pull outward to slide the module out of its housing.

EURO VERSION

Insert a Siemens 3 pole plug into each of the two input sockets. Gently squeeze them together and pull outward to slide the module out of its housing.

8.3.2 Module Disassembly

The two PCBs and a screen plate are held together in a sandwich-like construction. The sub(sidiary) PCB is retained by six short M3 screws into hexagonal pillars. Remove these screws and carefully fold the two PCBs apart. To remove the screen plate, unscrew the front four hex pillars. The screen plate is earthed via a flexible wire. This may be unsoldered if the screen plate gets in the way, but the wire must be reconnected before the module is reassembled, or the screen plate will not perform its task.

8.4 Fault Finding

Use Extender Card PCB 75038, Issue 2 or above.

8.4.1 Common Mode Rejection Problems

For "dB Coarse" settings of -10 dB to -90 dB the principal adjustments occur at the balance-to-unbalance converters, IC27 and IC47. This stage must be working and calibrated satisfactorily before the attenuator stages are adjusted. See Section 8.2.6 "Balanced to Unbalanced Converters", Section 8.5.5 and Section 8.5.8.

For "dB Coarse" settings of +10 dB and 0 dB the balance of the 20 dB attenuators is critical. For "dB Coarse" settings of +40 dB to +20 dB the balance of the 40 dB attenuators is critical. See Section 8.2.3 "40 dB and 20 dB Attenuators", Section 8.5.8 and Section 8.5.9.

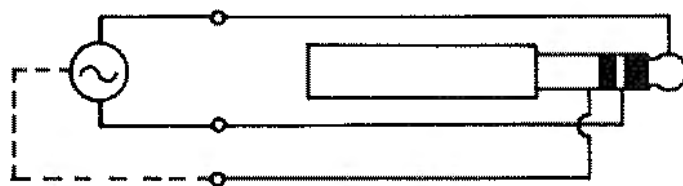
Severe errors can probably be traced to attenuator relays failing to open or close, or major amplifier malfunctions. Both can be traced by comparing signal levels in each leg, either simultaneously using a genuinely balanced signal (but check the balance of the incoming signal first!), or sequentially using an unbalanced signal, first to the live and then to the return input. This type of problem will normally be uniform with frequency.

8.4.2 Gain Error Problems (All Level-Like Functions)

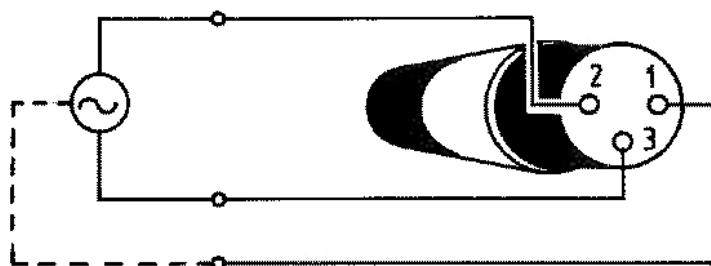
Constant Gain Error at All Sensitivities

Connect the source in balanced mode to input "B" as shown below.

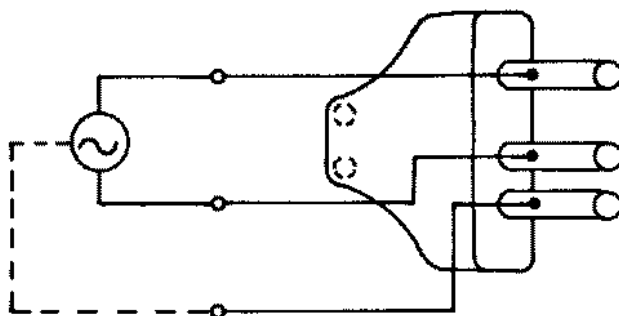
Jack Version



XLR Version



Euro Version



TT402 Front Panel Setup

Input	Cct	imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B	600	Thru	Level	Off	RMS	dB Norm	-10	Manual	

Set the source frequency to 1 kHz.

Connect a DVM between the module main output (pin 9a) and analogue 0 V (pin 8), set to measure AC volts.

The signal level at the module output should be approx. 0.5 dB higher than at the input. If it is, the fault is NOT in the input module and we suggest a complete recalibration to find the cause. If there is a discrepancy, check the stage around IC19, especially if the fault is associated with a particular circuit impedance.

If the fault only occurs at certain ranges, proceed as follows:-

dB Coarse +40 to +20 Only

Look at the 40 dB attenuator. See Section 8.2.3.

dB Coarse +10 and 0 Only

Look at the 20 dB attenuator. See Section 8.2.3.

dB Coarse +20, 0 and -20 Only

Look at the 10 dB gain step. See Section 8.2.5.

dB Coarse -30 and below Only

Look at the 20 dB gain step. See Section 8.2.5.

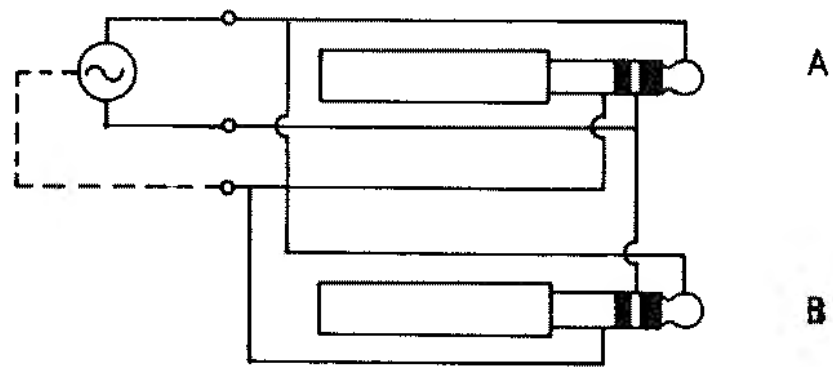
dB Coarse -40 and below

The problem is not in this module. See Gain Chain, Section 7.

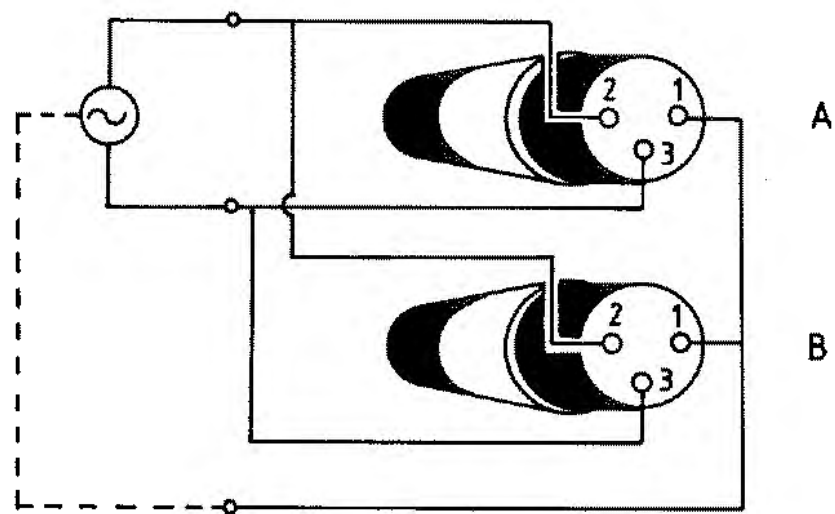
8.4.3 Gain Error Problems (Level Difference Function)

Connect the source in balanced mode to both inputs in parallel as shown below.

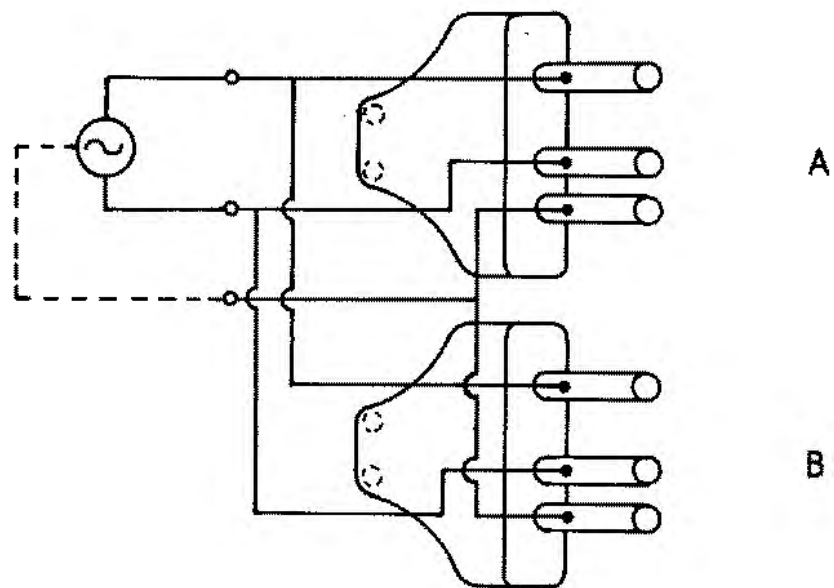
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TT402 Front Panel Setup

Input	Cct	imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
---	600		Thru	Lev Diff	---	---	---	---	Manual

Set the source frequency to 1 kHz.

Connect a DVM between IC37 pin 6 and analogue 0 V, on the 2 V DC range.

The measured voltage should be about 1.0 V for all input levels. If it is, the fault is NOT in the input module and is probably in the signal rectifier, meter driver or interconnections. If there is a discrepancy, check the voltages at IC34 pin 14 and IC39 pin 14. If they are equal, suspect the stage around IC38 and IC37. If not, trace back through the attenuator and gain steps, comparing channel X to channel Y, which should be identical at each stage.

8.4.4 Switch Selection Problems

Check that the switch closures appear as active low states at the appropriate inputs of IC4. These should be clean states which exactly reach the +5 V supply rail and ground. Check that the Select input of IC4 is being toggled through both states every 16384 μ s. Check that the outputs of IC4 correctly follow the switch inputs of IC4 while the Select input is in the appropriate state. If all these tests are correct, then the fault is either in the Microcomputer (see Section 3) or in the interconnections from the Input Module to the Microcomputer (see Section 2).

8.5 Calibration

8.5.1 Equipment Required

For accurate calibration an AC Calibrator is required, together with a DVM capable of measuring DC volts and AC volts, an ordinary oscilloscope, and a 10 Ω resistor, preferably $\pm 1\%$. It is convenient to have miniature probes or crocodile clips on the resistor. If an AC Calibrator is not available, a stable low-distortion sinewave oscillator may be used instead. In this case the AC DVM must be used to set the level of the oscillator. If the AC Calibrator or DVM has not been calibrated in the last 6 months, have it calibrated by a laboratory with traceable standards before using it to calibrate the TT402. An ordinary 3 $\frac{1}{2}$ digit DVM is almost certainly not adequate for this purpose; it is unusual for such a DVM to have sufficient bandwidth or accuracy.

Recommended specifications:

AC CALIBRATOR Frequency range 50 Hz - 10 kHz.
Voltage range 10 mV to +30 dBu (24.51 V RMS) minimum.
Resolution 0.01% of setting.

DC DVM 3 $\frac{1}{2}$ digit minimum.
200 mV and 20 V ranges.

OSCILLOSCOPE Input impedance 1 M Ω .
Bandwidth >500 kHz.

AC DVM 4 $\frac{1}{2}$ digit minimum resolution.
Bandwidth 1 kHz minimum for specified accuracy.

If an AC calibrator is not available:

OSCILLATOR Frequency range 50 Hz to 10 kHz.
<1% distortion.
Level stability <0.05 dB over 30 minutes.
Output level controllable over a range greater than 60 dB
without serious degradation of signal-to-noise ratio.
TT402 is suitable.

8.5.2 General

Check D.C. conditions in the Level function with no signal input:

IC11 pin 6	+10 mV to -40 mV
IC12 pin 6	+10 mV to -40 mV
IC27 pin 6	± 50 mV
IC19 pin 6	± 60 mV
IC40 pin 6	± 70 mV
IC34 pin 14	± 100 mV
IC35 pin 6	+10 mV to -40 mV
IC36 pin 6	+10 mV to -40 mV
IC47 pin 6	± 50 mV
IC44 pin 6	± 60 mV
IC46 pin 6	± 70 mV
IC39 pin 14	± 100 mV

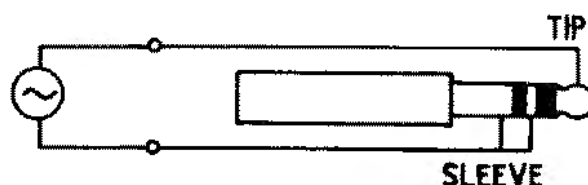
IC23 pin 6	± 80 mV
IC50 pin 3	+5,5 V to +4,5 V
IC15 pin 1	± 20 mV
IC15 pin 7	± 20 mV
IC15 pin 8	± 20 mV
IC49 pin 1	± 20 mV
IC49 pin 7	± 20 mV
IC49 pin 8	± 20 mV

Ensure basic functionality by inputting a balanced signal and switching "dB COARSE" from +40 dB to -30 dB, with appropriate source levels at 1 kHz. Check a rough frequency response from 100 Hz to 10 kHz. Errors of more than 1 dB indicate a probable fault in the system. Smaller errors may be cured by recalibration.

8.5.3 Live Current Limits

Connect the source in unbalanced mode to input "A" as shown below.

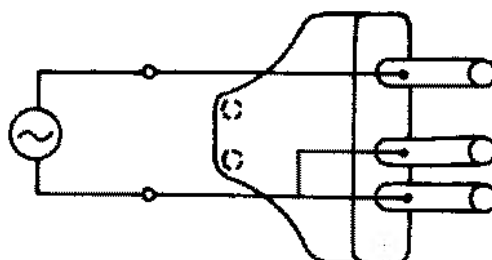
Jack Version



XLR Version



Euro Version



TT402 Front Panel Setup

Input	Oct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
A	600	Thru	Level	Off	RMS	dB Norm	-10	Manual

Set the source to 10 V RMS or so at 1 kHz (this signal is not critical).

Clip the 10 Ω resistor from test point TP1 to ground. Connect the 'scope probe across the 10 Ω resistor. Connect the DVM from TP2 to ground and set to the 20 V range. Set the 'scope sensitivity (including the probe) to 20 mV/cm, i.e. 20 mV/cm with a x1 probe or 2 mV/cm with a x10 probe. Set DC coupling.

Adjust VR7 so that the positive peaks are 60 mV above ground. Adjust VR3 for a near-zero DVM reading.

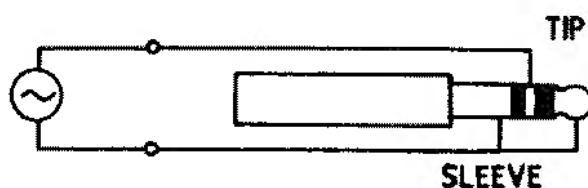
Select X-talk function and Input "B". Clip the 10 Ω resistor and 'scope from TP10 to ground. Connect the DVM to TP9.

Adjust VR20 so that the positive peaks are 60 mV above ground. Adjust VR18 for a near-zero DVM reading.

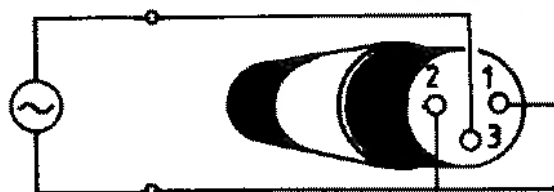
8.5.4 Return Current Limits

Connect the source in unbalanced mode to the return of input "A" as shown below.

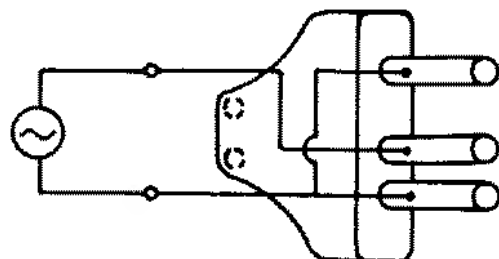
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TT402 Front Panel Setup

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
A	600	Thru	Level	Off	RMS	dB Norm	-10	Manual

Set the source to 10 V RMS or so at 1 kHz (this signal is not critical).

Clip the resistor and 'scope from TP4 to ground. Connect the DVM from TP3 to ground.

Adjust VR8 so that the positive peaks are 60 mV above ground. Adjust VR6 for a near-zero DVM reading.

Select X-talk function and Input "B". Clip the resistor and 'scope from TP8 to ground. Connect the DVM to TP7.

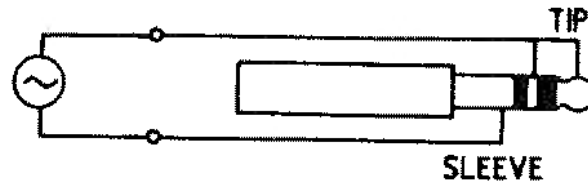
Adjust VR19 so that the positive peaks are 60 mV above ground. Adjust VR17

for a near-zero DVM reading.

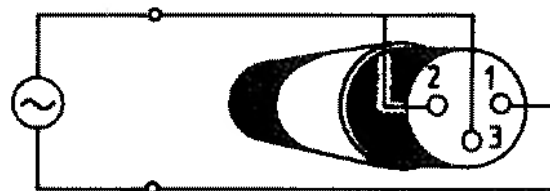
8.5.5 Common Mode Rejection - Sensitivity of -10 dB to -90 dB

Connect the source in common mode to input "B" as shown below.

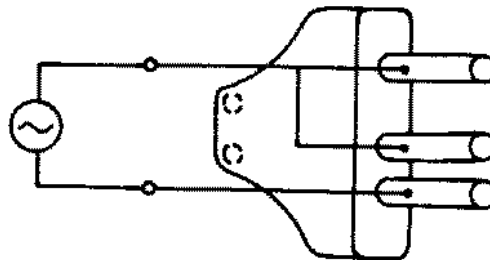
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TT402 Front Panel Setup

Input	Cct	imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B	600	Thru	Level	Off	RMS	dB Norm	-10	Manual	

Set the source to 6 V RMS at 1 kHz. Adjust VR11 for minimum meter reading.

Increase meter sensitivity by turning "dB COARSE" clockwise until the reading is near mid-scale. Again adjust VR11 for minimum meter reading.

Continue until no further improvement can be made.

Change the source frequency to 10 kHz. Adjust C35 in the above manner to achieve a minimum reading on the meter.

Repeat 1 kHz - VR11

10 kHz - C35

until no further improvement can be made.

Meter should be <-50 dB at 1 kHz
<-50 dB at 10 kHz.

Select the Phase function. Connect the 'scope to the "ALTERNATE CHANNEL" BNC connector on the back panel and select AC coupling. Set the source to 6 V RMS at 1 kHz.

Adjust VR21 for flattest possible 'scope trace. Increase 'scope sensitivity as required.

Set the source frequency to 10 kHz. Adjust C82 in the same manner for flattest possible 'scope trace.

Repeat 1 kHz - VR21
10 kHz - C82
until no further improvement can be made.

8.5.6 Adjustment of RMS detectors' Offset

Unplug all inputs from the input module. Set to either the Phase/Level Difference or the Phase function. Set Circuit Impedance 600 Ω and Term.

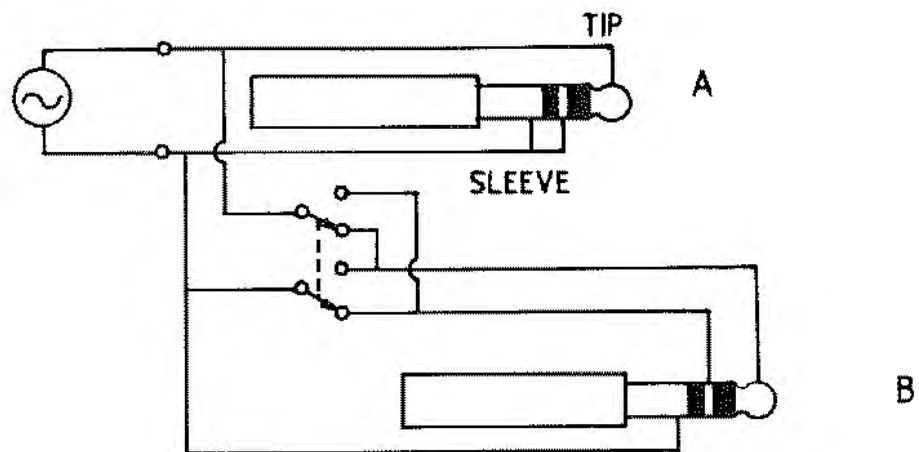
Connect the DVM between IC34 pin 14 and analogue 0 V, on the 200 mV DC range. Adjust VR23 for a reading of 0 mV $\pm$ 1 mV.

Similarly, connect the DVM between IC39 pin 14 and analogue 0 V. Adjust VR26 for a reading of 0 mV $\pm$ 1 mV.

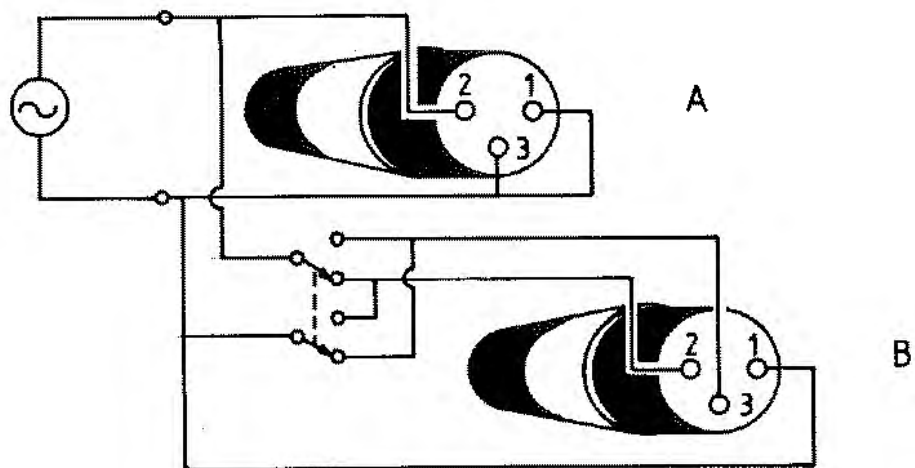
8.5.7 Adjustment of Phase Detector

Apply a signal of approx. 1 V at 1 kHz to both inputs via a switch as shown. This enables the signal to one channel to be inverted, thereby generating phase differences of 0° and 180° at the flick of a switch.

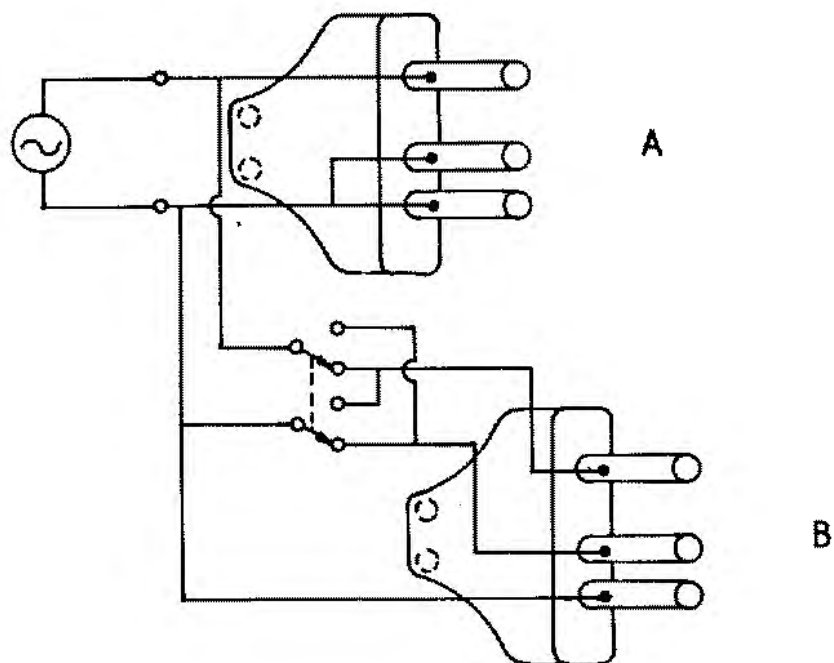
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Select the Phase/Level Difference function. Connect the DVM between the edge connector pin 16 and analogue 0 V, set to DC volts, 20 V range.

Set the switch for 180° shift. Adjust VR34 for a reading of 10,00 V on the DVM.

If the TT402 has the Phase (only) function, connect the DVM between the edge connector pin 23 and analogue 0 V. Select the Phase function.

With the switch set to the 180° position, link IC3 pin 5 to IC3 pin 7. Adjust VR16 for a DVM reading of 0,000 V. Now link IC3 pin 5 to IC3 pin 14 and adjust VR15 for a DVM reading of 1,264 V.

The above two adjustments are interactive. Repeat them as many times as necessary. If the analogue meter doesn't indicate $\pm 180^\circ$, don't worry; the calibration of the signal rectifier and meter driver boards also affect the result.

8.5.8 Gain Step and Attenuator Adjustment, Channel X

Connect the source in unbalanced mode to input B as shown in Section 8.5.3.

TT402 Front Panel Setup

Input	Cct	imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B		600	Thru	Level	Off	RMS	dB Norm	-10	Manual

Set the source frequency to 1 kHz.

Connect the DVM between the module main output (pin 9a) and analogue 0 V (pin 8), set to measure AC volts.

ADJUST	dB COARSE	SETTING	DVM READING	PURPOSE
Source level	-10		0,7746 V (0 dBu)	Reference level
VR10	-20		2,451 V (+10 dBu)	Set 10 dB gain step
VR9	-30		7,746 V (+20 dBu)	Set 20 dB gain step

Set dB COARSE control to +10 dB. Measure the source level, note it, and increase it by a factor of EXACTLY 10. Reconnect the DVM to the module output if necessary.

VR4	+10		0,7746 V (0 dBu)	Set 20 dB attenuator "In-Phase" leg
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Set dB COARSE control to +30 dB. If the source is able to reach over 75 V RMS, set it to a factor of EXACTLY 100 times the earlier reading, then make the following adjustment.

VR5	+30		0,7746 V (0 dBu)	Set 40 dB attenuator "In-Phase" leg
-----	-----	--	------------------	--

VR5 +30 0,0775 V (-20 dBu) Set 40 dB attenuator
"In-Phase" leg

Connect the source in common mode to input B as shown in Section 8.5.5.

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B	600	Thru	Level	Off	RMS	dB Norm	0	Manual

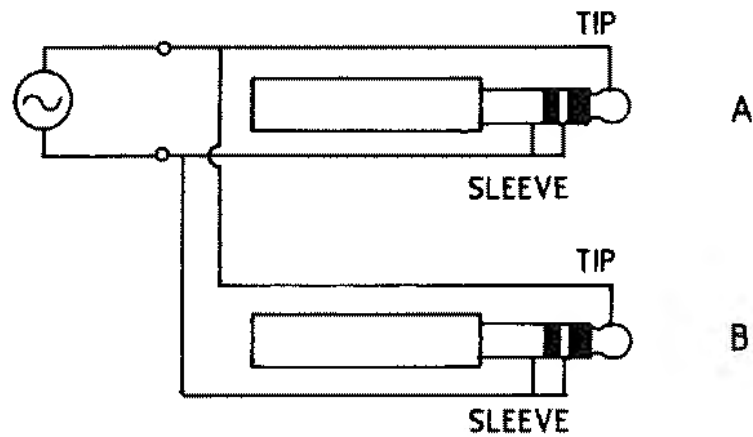
Adjust VR1 for the flattest possible 'scope trace. To assist this, increase the sensitivity of the 'SCOPE ONLY. DO NOT INCREASE THE SENSITIVITY OF THE TT402!

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B	600	Thru	Level	Off	RMS	dB Norm	+20	Manual

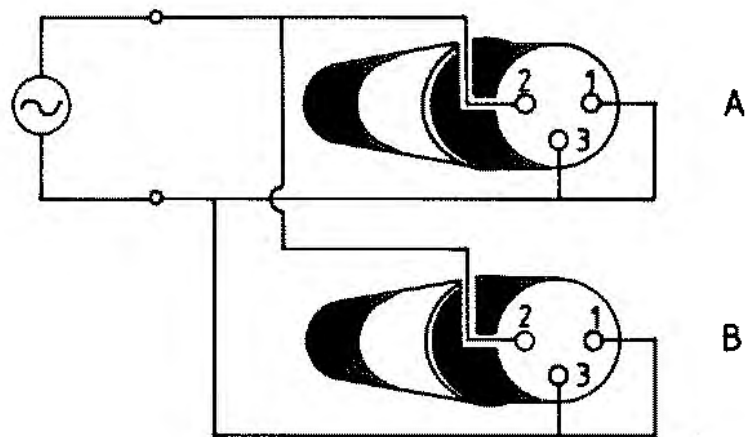
Adjust VR2 for the flattest possible 'scope trace. To assist this, increase the sensitivity of the 'SCOPE ONLY. DO NOT INCREASE THE SENSITIVITY OF THE TT402!

Connect the source in unbalanced mode to both inputs in parallel as shown below.

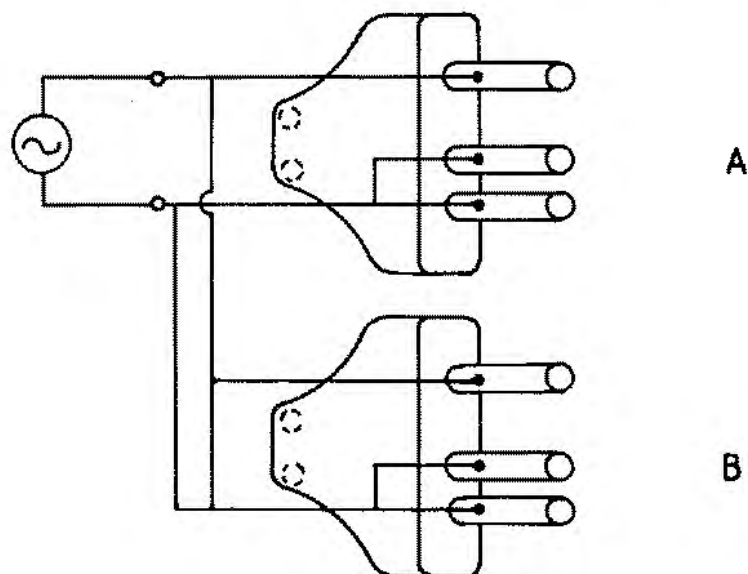
Jack Version



XLR Version



Euro Version



TT402 Front Panel Setup

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
---	600	Thru	Lev Diff	---	---	---	---	Manual

Set the source to 1 kHz, +6 dBu (1.55 V) approximately.
Connect the DVM between IC37 pin 6 and analogue 0 V, on the 2 V DC range.

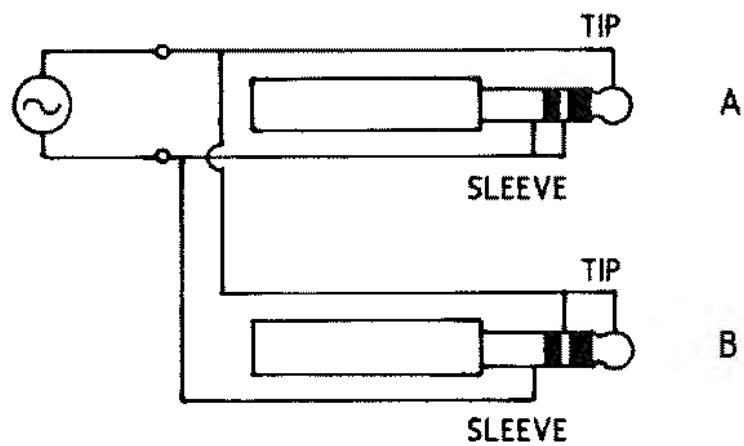
SOURCE LEVEL	ADJUST	METER READING
+6 dBu	VR22	1,000 V
-4 dBu	VR25	1,000 V
-14 dBu	VR24	1,000 V
+16 dBu	VR27	1,000 V
+36 dBu	VR28	1,000 V

If the source will not reach +36 dBu, set it as high as possible. In any case it must reach at least +30 dBu in order for the correct attenuation step to be selected.

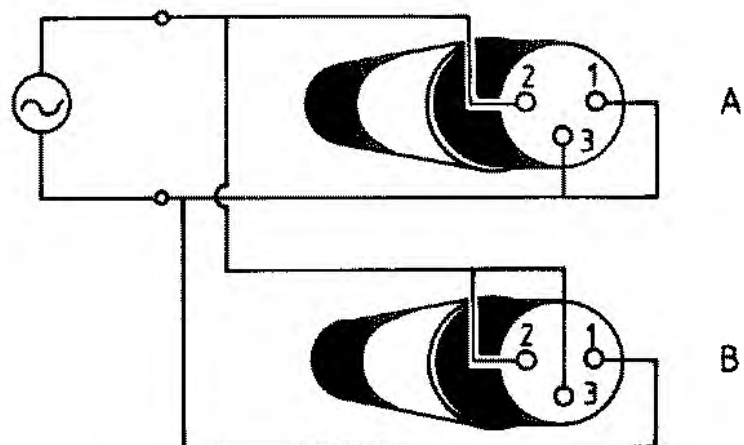
8.5.11 "Anti-Phase" Attenuator Leq Adjustments, Channel Y

Connect the source to both inputs as shown below.

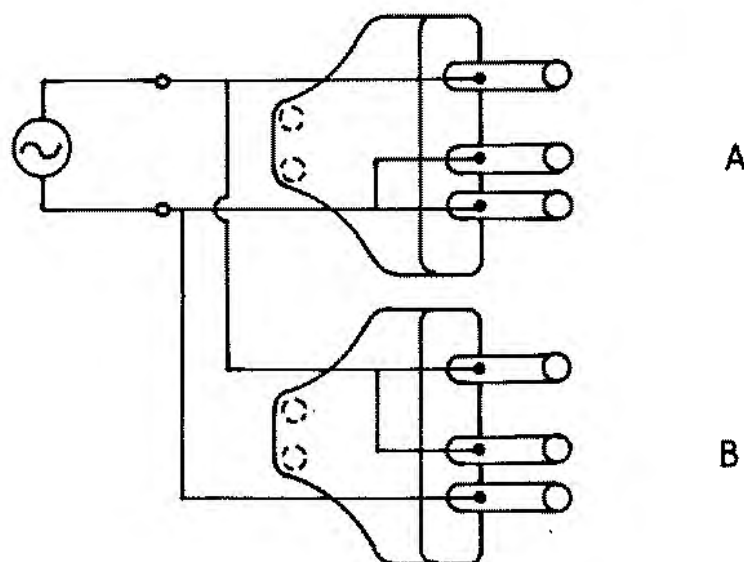
Jack Version



XLR Version



Euro Version



TT402 Front Panel Setup

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
---	600	Thru	Lev Diff	---	---	---	---	Manual

Set the source to 1 kHz and +36 dBu.

Connect the 'scope to the "ALTERNATE CHANNEL" BNC connector on the back panel and select AC coupling.

Adjust VR30 for the flattest possible 'scope trace. To assist this, increase the sensitivity of the 'scope.

If the source will not reach +36 dBu, set it as high as possible. In any case it must reach at least +30 dBu in order for the correct attenuation step to be selected.

Set the source to +16 dBu.

Adjust VR29 for the flattest possible 'scope trace. To assist this, increase the sensitivity of the 'scope.

8.5.12 Circuit Impedance Gain Adjustments, Channel X

Connect the source in unbalanced mode to input "B" as shown in Section 8.5.3.

TT402 Front Panel Setup

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
B	600	Thru	Level	Off	RMS	dB Norm	0	Manual

Set the source frequency to 1 kHz.

Connect the DVM between the module main output (pin 9a) and analogue 0 V (pin 8), set to measure AC volts.

ADJUST	CIRCUIT IMPEDANCE	DVM READING	PURPOSE
Source level	600	0,7746 V	Reference level
VR12	140	1,6044 V	Set 140 R gain step
VR13	75	2,192 V	Set 75 R gain step

8.5.13 Circuit Impedance Gain Adjustments, Channel Y

Connect the source in unbalanced mode to both inputs in parallel as shown in Section 8.5.10.

TT402 Front Panel Setup

Input	Cct imp	Term	Function	Filters	Rectifier	Scale	Coarse	Range
---	600	Thru	Lev Diff	---	---	---	---	Manual

Set the source frequency to 1 kHz.

Connect the DVM between IC37 pin 6 and analogue 0 V, on the 2 V DC range.

ADJUST	CIRCUIT IMPEDANCE	DVM READING	PURPOSE
Source level	600	1,000 V	Reference level
VR31	140	1,000 V	Set 140 R gain step
VR32	75	1,000 V	Set 75 R gain step