WAVETEK

SYSTEM USER'S HANDBOOK

Model 4950

Multifunction Transfer Standard

System User's Handbook

for

The Model 4950
Multifunction Transfer Standard

(for details of the 4950 Instrument, refer to the Instrument User's Handbook)

WAVETEK

ISO 9002
Wavetek Ltd
CERTIFICATE
No. FM 29700

For any assistance contact your nearest Wavetek Sales and Service Center.
Addresses can be found at the back of this handbook.

Due to our policy of continuously updating our products, this handbook may contain minor differences in specification, components and circuit design to the instrument actually supplied. Amendment sheets precisely matched to your instrument serial number are available on request.

Software Registration Form.

Product 4 9 5 0 **Date** DD 1 1 MM 1 0 YY 9 9

Version No. 3 . 0 9 **Serial No.** 3 3 6 3 3

FAX Return:-

To: Wavetek Datron Division, Software Support Dept.

Fax Number: (011 44) 603 483670 Outside the United Kingdom.

0603 483670

Registering your product is important, because it lets us know who you are and that you are a valued owner of a Wavetek product. The benefits of registering your software include:

- **Information from Wavetek about new, enhanced versions of your product.**
- **Full access to Wavetek's Customer service and technical support.**

Software User Details:

Title

Surname

First Name

Company

Job Title

Address

Country

Postal Code

Telephone No.

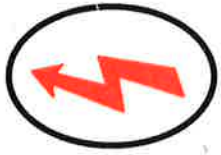
Fax No.

On completion either fax or return by post to the following address.

Wavetek, Hurricane Way, Norwich, NR6 6JB, United Kingdom.

DANGER
HIGH VOLTAGE

THIS SYSTEM IS CAPABLE OF DELIVERING A LETHAL ELECTRIC SHOCK !



Interconnections can carry High Voltages

THESE CAN KILL !

Overvoltage can damage your instruments !

Unless **you** are **sure** that it is **safe** to do so,

DO NOT TOUCH

any **interconnections** between **instruments**

DANGER

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April 1, 1994

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Section 1 The 4950 MTS System - Introduction

Handbook Contents

What is the Purpose of This Handbook?

This handbook briefly describes:

1. the component parts of the 4950MTS system
2. the procedures used to transfer the system from lab to lab
3. the procedures involved in putting the system to work

How is this Handbook Divided?

System Components

What is the 4950 MTS System?

The 4950 MTS System consists of all the transferrable parts needed to set up a programmable transfer standard, capable of fully-traceable, high-accuracy calibration of the latest generation of high-performance multifunction calibrators.

At the heart of the system is the Datron Model 4950 MTS instrument. This is designed to carry traceability from a Standards Lab to a Calibration Lab (or Labs) for DC and AC Voltage, DC and AC Current, and Resistance functions.

The remainder of the system includes:

- required accessories (such as a characterized 10A shunt and a characterized input lead; power cables, IEEE-488 connectors and analog cables);
- a protective transit case, together with a shockwatch and hygrometer / max-min thermometer;
- hardware and software elements required for the '4950MTS Control Software';
- This handbook, an instruction leaflet and the 4950 Instrument User's Handbook.

N.B.
The system may not include a computer. For minimum and recommended configurations, refer to *Section 3* of this handbook.

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Closed-Loop Transfer Processes

Introduction

Where does the 4950 Normally Reside?

The 4950 system is designed to transfer multifunction traceability from Standards Laboratory to Calibrator, sometimes over considerable distance. It may be owned by, and reside with, the user organization which also owns the calibrator, or it may form part of a calibration service bought by the user, being owned by the service operator.

Open-Loop Transfer

In either case, traceable accuracy flows from the Standards Laboratory to the user's calibrator. This is also true for a system in which the calibrator is sent away for its own calibration, a normal arrangement in which the transfer is open-loop, relying on the stability and reliability of the calibrator to avoid damage or excessive drift in transit. The down-time due to the calibrator's absence causes a break in the calibrator use, sometimes causing a user to obtain duplicate facilities.

Closed-Loop Transfer

As well as being specially designed to withstand travel in normal freight channels, the 4950 instrument makes it possible to close the loop by checking its own transit drift. To do this it retains its original adjustment factors, known as 'Baseline Corrections', which are not affected by calibration to the standard, and so its performance before travelling can be compared with that after it returns. A major advantage of employing a parallel process to effect the transfer is the reduction in downtime, allowing the calibrator to remain in use.

Two Ways to Close the Loop

Method A: User Owns the 4950 *(Fig. 1.1)*

The 4950 normally resides in the user's calibration laboratory, and will need to be sent to the standards laboratory for its 'Certified Corrections' to be updated to traceable standards. Then it is sent back to calibrate the user's calibrator(s).

To check whether there has been excessive drift during transit, or whether it has been damaged, all functions and ranges of the 4950 are checked before transportation to the standards laboratory, and then again on its return. For these checks, only the invariant 'baseline' corrections are applied. The checks compare the 4950 against a stable device in the user's laboratory, usually the calibrator it is to calibrate (or the most stable one - the 'check' calibrator - if there are a number). For the best results, the check calibrator should be left switched on in the same environment while the 4950 is away.

There are really two processes here:

Process 1. *Baseline Comparison Loop*:

Stages ① ② ④ & ⑤

This checks the performance of the 4950 against the same device before and after travelling to and from the Standards Laboratory, using only the invariant Baseline corrections for the 4950.

Because the 4950 can be involved in calibrating one or more calibrators on return from its visit to the Standards Laboratory, the (historically) most stable calibrator should be used for the Baseline comparisons.

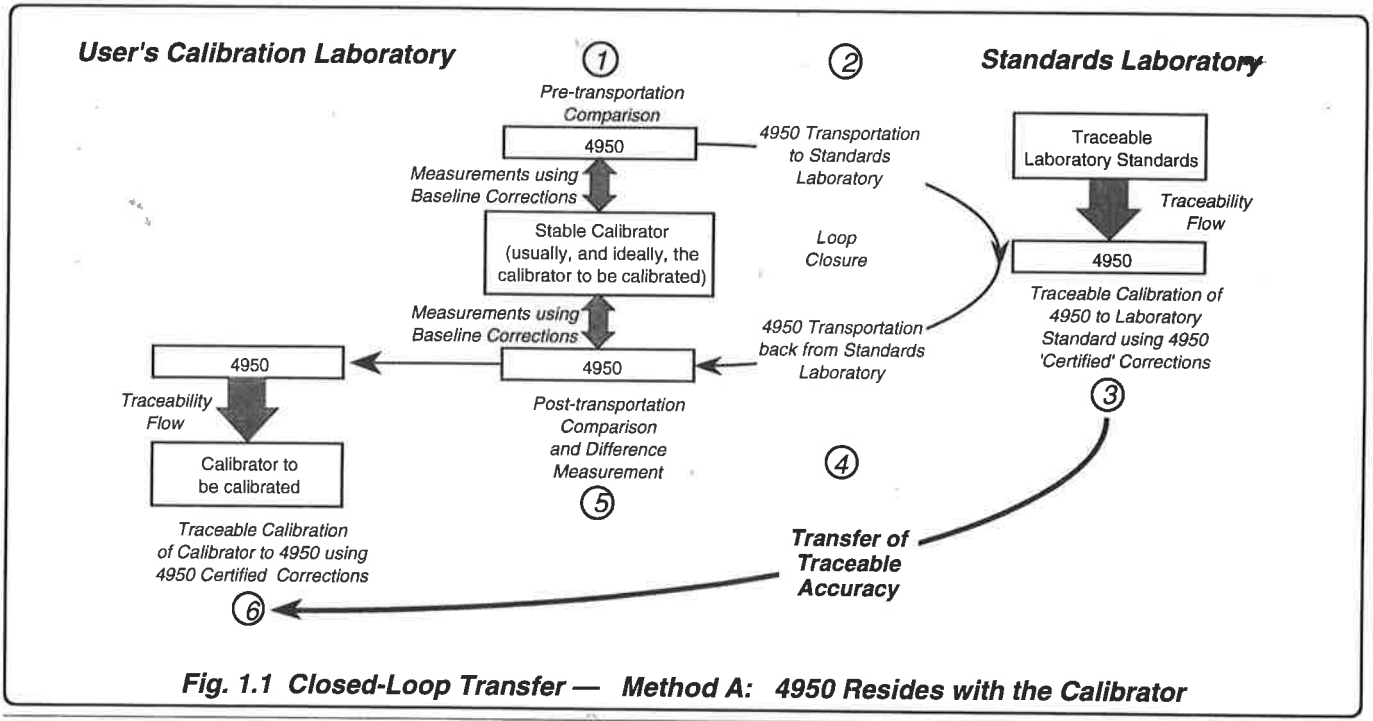


Fig. 1.1 Closed-Loop Transfer — Method A: 4950 Resides with the Calibrator

Process 2. *Certified Calibration*:

Stages ③ ④ & ⑥

The Certified corrections are updated by calibrating the 4950 at the Standards Laboratory, returning with the 4950 to calibrate the owner's calibrator(s). Note that the post-transportation comparison stage 5 (process 1) *must* be carried out before the calibration stage 6 (process 2).

The only difference between the configurations in the two processes is the type of correction applied to the measurements. The 4950 hardware, firmware and internal processes remain identical.

A one-to-one dependency therefore exists between the measurements taken in the comparison loop and in certified calibration, justifying the complementary use of the two processes to convey traceability.

Because the same 4950 will be used by the owner of the calibrator(s) for subsequent calibrations, a history can be built up over a number of calibration cycles. Also, by dedicating the 4950 to the owner's calibrators; extra certified comparisons between calibrators and the resident 4950 can be interposed. This generates confidence in the performance of the overall system, and can lead to the introduction of 'Statistical Process Control' (SPC) to improve efficiency by controlling the period between calibrations.

The second method of closing the loop is described overleaf.

Two Ways to Close the Loop (Contd.)

Method B: 4950 Resident in the Standards Laboratory *(Fig. 1.2)*

When the 4950 resides in the standards laboratory of an organization offering a calibration service, it will need to be calibrated and certified at the user's target values, and sent to the user's calibration laboratory for Certified calibration of calibrator(s). Then it is sent back to the standards laboratory.

To check whether there has been excessive drift during transit, or whether it has been damaged, all functions and ranges of the 4950 are checked before transportation to the user, then again on its return. For these checks, only the invariant 'baseline' corrections are applied. The checks compare the 4950 against stable standards (check standards) in the standards laboratory.

For the best results, the check standards should remain switched on in the same environment while the 4950 is away.

Again, there are two processes *(Fig 1.2)*:

1. *Baseline Comparison Loop*:

   Stages ② ③ ⑤ ⑥ & ⑦

   This checks the performance of the 4950 against the same device before and after travelling to and from the User's Laboratory, using only the invariant Baseline corrections for the 4950, which were stored at manufacture.

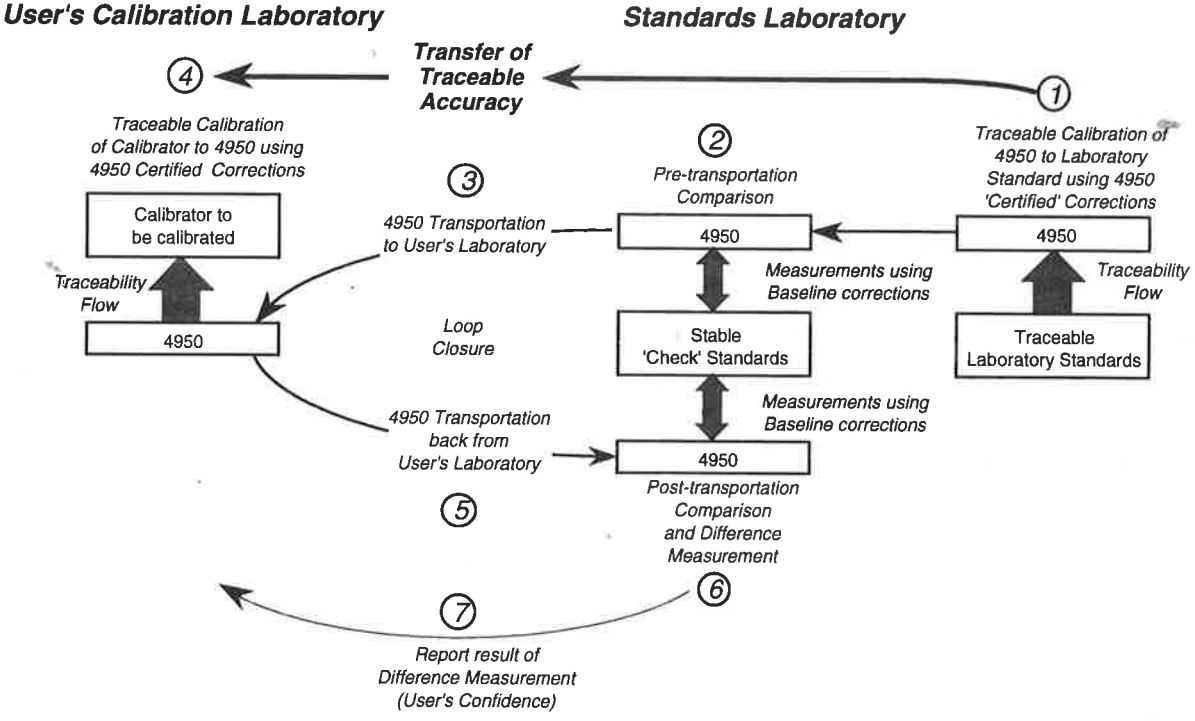


Fig. 1.2 Closed-Loop Transfer — Method B: 4950 Resides in the Standards Laboratory

2. *Certified Calibration*:

   Stages ① ③ ④ & ⑦

   The stored Certified corrections are updated by calibrating the 4950 at the Standards Laboratory, then sending the 4950 to calibrate the owner's calibrator(s).

The only difference between the configurations in the two processes is the type of correction applied to the measurements. The 4950 hardware, firmware and internal processes remain identical.

A one-to-one dependency therefore exists between the measurements taken in the comparison loop and in certified calibration, justifying the complementary use of the two processes to convey traceability.

User-confidence in the calibration comes from the confirmation that the baseline loop comparison was successful. Therefore the communication at stage 7 is essential in the process. From the user's point of view, the process is open-loop until this report has been given.

As for the user-owned case, an integral history can be built up over a number of calibration cycles, but if the same 4950 is not used, then the traceable uncertainty will increase, reducing confidence.

Auto Baseline Comparison

Note that the 4950MTS Control Software allows the two processes described above to be combined into a single measurement sequence, using the Auto Baseline Comparison feature.

Section 2 4950 MTS System - Receipt from Transit

This section contains information and instructions for unpacking and checking the Wavetek Datron Division 4950 Multifunction Transfer Standard System.

External Damage

The 4950 MTS system is packed in shock-absorbent material inside a special transit case to ensure that it will reach you in perfect condition.

If the equipment has been maltreated in transit, this may be evident by signs of damage to the transit case exterior. Examine this before lifting the lid.

Transit Case Contents

The transit case has space to accommodate the MTS System items printed on the Transit Checklist. Items contained in the case for the present shipment should have been checked in the previous 'dispatch' column:

Unpacking and Inspection

Internal Environment

N.B. Carry out the following environment checks *immediately* after opening the transit case.

Release the two catches at the front of the case, and lift the lid. The transit checklist leaflet and a combined hygrometer/max-min thermometer are in Compartment 1 attached to the underside of the lid. Record readings on the checklist in the next empty 'Receipt' column as follows:

MAX Press the 'MAX' button once, and enter the max. temp value from the right of the LCD display onto the checklist. Repress 'MAX' to return to the present temperature reading.

MIN Press the 'MIN' button once, and enter the min. temp value from the right of the LCD display onto the checklist. Repress 'MIN' to return to the present temperature reading.

4950 Instrument - Silica-gel Desiccant Pack

Carefully lift the zipper bag out of *Compartment 2* on the left. This contains the 4950 instrument. Unzip the bag and remove the 50 gram silica-gel desiccant sachet. This can be regenerated by placing in a drying oven at 120°C for 15 minutes just before packing for its next transit. Alternatively, spare sealed packs are fitted in *Compartment 5*, the front right corner of the transit case.

Instrument Damage

Gently lift the 4950 out of the zipper bag, and examine the 'Shockwatch' phial attached to the rear of the instrument. This is normally clear (white), but if the system has been roughly handled, it may have fractured internally, showing red instead of white. Record the condition as follows:

S/W Enter the color of the Shockwatch (*White* or *Red*) on the checklist in the next empty 'Receipt' column.

Examine the external condition of the 4950 instrument for signs of damage.

Remainder of Contents

N.B

In the following, 'Base' is the location where the 4950 normally resides - refer to Methods A and B in Section 1.

The contents of the transit case should be present as described in the previous 'Dispatch' column of the checklist.

Note

If this is the first shipment from manufacture, check that the contents of the Transit Case correspond to the ordered items.

The list is designed to cover two journeys: *outward* from the base, and *return* to the base. Completed checklists should be filed at base.

Unpack the remainder of the equipment (which should appear in the previous 'dispatch' column of the list). Check off each item in the receipt column of the list as it is removed. Examine all items for external damage. If damage is found notify the carrier and your service representative immediately. Retain the relevant evidence for examination.

Record the Date

When you are satisfied that you have

1. accurately recorded the condition of the shockwatch and the Max and Min temperatures from the Thermometer;
2. checked off the contents of the Transit Case in the 'Receipt' column of the checklist; and
3. examined the whole assemblage for damage;

sign your initials and the enter the date in the spaces at the base of the Receipt column.

CAUTION!

Do Not Power the 4950 On Yet!

To ensure that the 4950 instrument is not damaged, do not apply line power until the Voltage Selector and line fuses have been examined. The procedure is detailed in *Section 3*.

Blank Transit Checklists

A blank master copy of the transit checklist is printed in *Section 10*. A photocopy can be made for use in subsequent transits.

Section 3 4950 MTS System - Commissioning for Use

This section contains information and instructions for installing and commissioning the Datron 4950 MTS System.

Unpacking and Inspection

This section assumes that the system has been unpacked and inspected in accordance with *Section 2*.

Actions following an Adverse Receipt Report

The Transit Checklist should have been checked off in the latest 'Receipt' column, with date and initials in the spaces at the column base.

Max and Min Transit Temperatures

Examine the 'Checks' block of the Transit Checklist, and take the following actions:

MAX It is not anticipated that high temperatures will affect the traceability of the system. So if the maximum temperature recorded in transit is less than 50°C; no further action is required.

For a maximum reading greater than 50°C: as it will not be clear when that temperature was recorded, a 1-Hour cooling-off period should be allowed in a cool environment before applying line power to the 4950 instrument.

A maximum reading greater than 71°C invalidates the traceability of the MTS system, which should be returned to base for 'baseline' comparison. Refer to Methods A and B in Section 1.

MIN Minimum temperatures above 0°C are unlikely to affect the traceability of the system. So if the minimum temperature recorded in transit is greater than 0°C; no further action is required.

For a minimum reading between 0°C and -10°C: it is remotely possible that the instrument main reference may have undergone a step drift approaching ±1ppm. It is therefore advisable to allow a blanket widening of all specification figures by a margin of ±2ppm.

A minimum reading below -10°C invalidates the traceability of the MTS system, which should be returned to base for 'baseline' comparison. Refer to Methods A and B in Section 1.

Excessive Acceleration Shocks

Examine the 'S/W' record in the 'Checks' block of the Transit Checklist, and take the following actions:

S/W The 'Shockwatch' is fitted to the rear of the 4950 instrument to record excessive acceleration shocks in transit. Under normal handling conditions, the shockwatch will not be affected, and the phial will remain white in color. It will not fracture internally until it suffers excessive acceleration shocks; when this occurs the phial will change from white to red.

1. Re-examine the shockwatch to confirm that its color is as recorded on the checklist.
2. If the color is white, no further action is necessary.
3. If the color is red, initiate an investigation by contacting your Wavetek-Datron Service Center.

Preparation for Operation

DANGER

THIS INSTRUMENT IS CAPABLE OF DELIVERING A LETHAL ELECTRIC SHOCK IF IT IS CONNECTED TO A HIGH VOLTAGE SOURCE. THE INPUT CONNECTOR PANEL IS MARKED WITH THE SYMBOL TO WARN USERS OF THIS DANGER.

UNDER NO CIRCUMSTANCES SHOULD USERS TOUCH ANY LEADS CONNECTED TO THE INPUT CONNECTOR CABLE UNLESS THEY ARE FIRST SATISFIED THAT NO DANGEROUS VOLTAGE IS PRESENT.

CAUTION: E-M INTERFERENCE

Electro-magnetic radiation from local sources, such as poorly-screened computer monitors and high alternating-current generators, can affect the performance of the 4950. Refer to *Page 3-5* before arranging the bench or rack layout.

Line Input Voltage Selector and Line Fuses

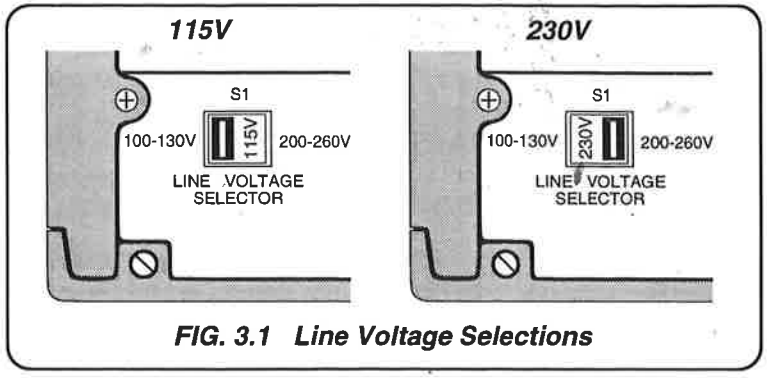


FIG. 3.1 Line Voltage Selections

When shipped, the instrument should have been packed ready for use at the voltage of the local line supplies; but **BEFORE CONNECTING TO THE LINE SUPPLY, EXAMINE THE VOLTAGE SELECTOR AND LINE FUSES** to check that they are correct for the local line supply voltage.

115V Line Supply

For 90V to 145V supplies, the legend '115' must be visible in the window of the line voltage selector switch (S1) on the rear panel, fuse F1 must be rated at 1.0A, and fuse F3 must be rated at 10A.

230V Line Supply

For 187V to 292V supply; the legend '230' must be visible in the window of the line voltage selector switch (S1) on the rear panel, fuse F1 must be rated at 500mA, and fuse F3 must be rated at 6.25A.

Line-Power Connections

System Line-Power Cable

The correct local version of the line supply cable should have been shipped in the cable compartment of the Transit Case. It comprises two metres of 3-core PVC sheath cable moulded to a fully-shrouded 3-pin socket at the 4950 end, with the local 3-pin plug on the other. It fits into a plug (PL10) at the rear of the instrument

The supply end of the cable should be connected to a grounded outlet, ensuring that the Ground lead is connected.

4950 Line Power Distribution and Rear-Panel Fuse Ratings

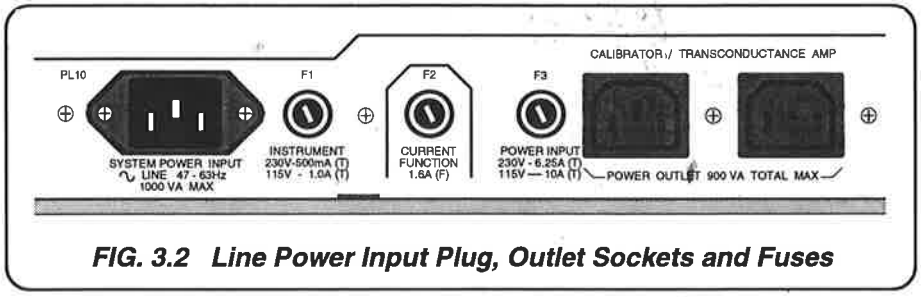


FIG. 3.2 Line Power Input Plug, Outlet Sockets and Fuses

Instrument Line Power

The line input is passed through Fuse F1 and filter before being applied to the instrument circuits.

Instrument Line Power Fuse F1

The power fuse F1 is situated next to the power input plug on the rear panel. It should be of the anti-surge type. Its rating is dependent on the supply voltage:

for 100V to 130V - 1.0A SLO-BLO,
for 200V to 260V - 500mA SLO-BLO.

System Outlets

Two line outlet sockets are provided on the rear of the 4950 instrument. One is intended to supply power to a Datron 47 or 48 series Calibrator, and the other to power the Datron Model 4600 Transconductance Amplifier. The system kit includes two male-female leads for connection to these instruments.

These outlets are provided with a separately filtered supply derived from the main line-input plug.

CAUTION: IF THE SYSTEM IS NOT CONFIGURED IN THIS MANNER, THEN RESULTS MAY BE AFFECTED BY LINE VOLTAGE NOISE ERRORS.

System Line Power Fuse F3

The power fuse F3 protects both outlets. It is situated to the left of the two power outlets on the rear panel. It should be of the anti-surge type. Its rating is dependent on the supply voltage:

for 100V to 130V - 10A SLO-BLO,
for 200V to 260V - 6.25A SLO-BLO.

Current Function Fuses

Current Fuse F2:

The center fuse is *not* a line power fuse. F2 is a quick-acting fuse, protecting the Current Function signal input. It has high breaking capacity, and is rated at 1.6A.
The recommended type is BESWICK S501.

Replacement Fuses

SPARE FUSES SHOULD HAVE BEEN SHIPPED IN THE TRANSIT CASE. ENSURE THAT ALL FITTED FUSES ARE OF THE CORRECT TYPE, WITH THE SPECIFIED RATING.

AVOID THE USE OF MENDED FUSES AND DO NOT SHORT-CIRCUIT THE FUSE HOLDERS. SUCH PRACTICES ARE DANGEROUS; AND WILL RENDER THE WARRANTY VOID.

Other Instrument Connections

Signal Input

All signals are input via the 5-pole plug on the front panel, whose input connections and orientation are described in the *Instrument User's Handbook, Section 2 page 2-12*:

Note: The 4950 Transfer Standard signal input cable has been designed to match the calibration process. Any attempt to extend this cable will result in reduced measurement performance.

SK7 - IEEE 488 Input/Output

The IEEE input/output is a 24-way Amphenol connector which is directly compatible with the IEEE 488 interface and the IEC 625 Bus. Pin designations are described in the *Instrument User's Handbook, Section 2 page 2-13.*

Positioning of the 4950 to Avoid E-M Interference

Sources of Error

Interference from Computers

Problems can be caused by interference from computer monitors. E-M radiations from EHT supplies can introduce noise at an unacceptable level, particularly when the computer's line power cables run close to the 4950 line supplies.

Proximity Interference

Radiated interference can occur when other equipment is too close to the 4950, particularly from high alternating-current sources.

Avoidance

Separate the Power Supplies

Plug in any computer at a power outlet remote from that used for the 4950 (but where 3-phase supplies are present, always use an outlet on the same phase of the line supply as the 4950). The computer and its line supply cables should be more than 2 meters from any part of the 4950 system and cabling.

Do not mount *any* other equipment on top of the 4950

Do not mount the 4950 *directly* on top of other equipment

Maintain a vertical separation of at least 300mm. This is particularly important when mounting the 4950 in a rack.

A recommended arrangement of system units is shown *overleaf.*

Recommended Arrangement of System Units

The placement of instruments involved in calibration operations should conform as closely as possible to the arrangements shown in *Figs. 3.3* and *3.4*.

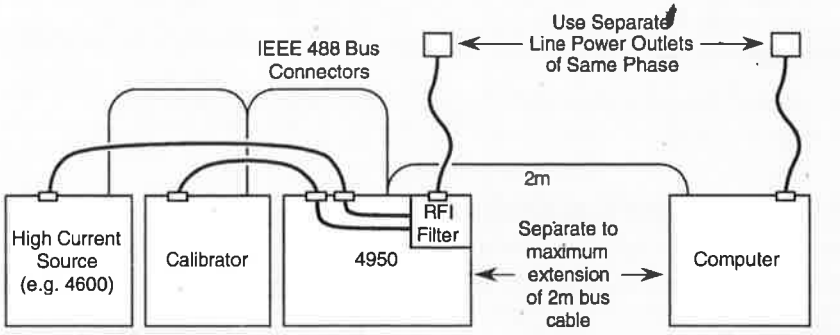


Fig. 3.3 Recommended Arrangement - General Case

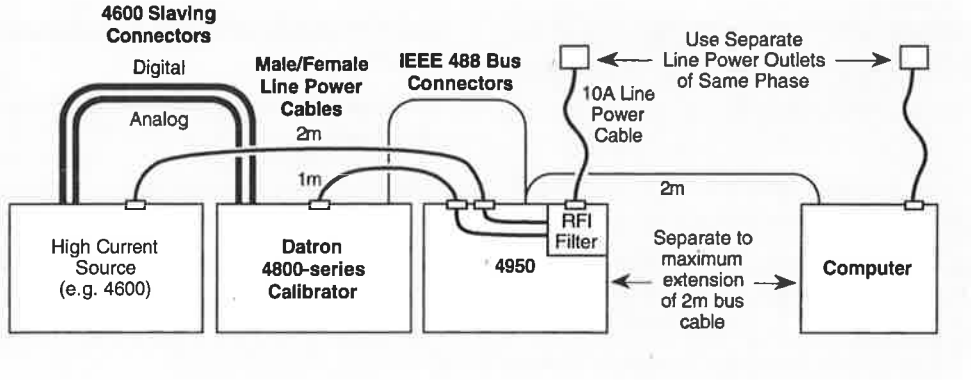


Fig. 3.4 4950 with 4800 Series Calibrator and 4600 Transconductance Amplifier - Recommended Arrangement

Design for System Use

Introduction

Many operations are necessary to complete all the processes required for traceable calibration of a calibrator, on all its functions and ranges. The two scenarios described on *pages 1-2 to 1-5* each involve four complete sets of measurements. Calibrating manually from the front panel can be time-consuming, with distinct possibilities of operator-error, so automation of the processes will bring several benefits.

The 4950 is therefore designed primarily to form part of a remote control system, conforming to IEEE 488.2 Standard Digital Interface.

Remote control information is given in *Section 5* of the *Instrument User's Handbook*.

To simplify remote operation, a suite of software programmes has been constructed which can drive the 4950 and a Datron calibrator through all the 'Closed Loop Transfer Processes' described on *pages 1-2 to 1-5*.

Transfer Process — Automated Control

The application software for calibration of Datron calibrators runs on hardware which meets the following criteria:

Minimum Computing Hardware:

Host computer:	PC compatible with 80286 processor, 12MHz clock, 4MB of RAM, keyboard and mouse operation
Operating System:	DOS 3.3 or later, Microsoft Windows™ version 3.0 or later
Hard Disk:	20 Mbyte
Floppy Disk:	1.44 Mbyte 3.5"
Monitor:	VGA (color or mono)
Printer:	9-pin dot-matrix

Recommended Computing Hardware:

Host computer:	PC compatible with 80386DX processor, 25MHz clock, 4MB of RAM, keyboard and mouse operation
Operating System:	DOS 5.0 or later, Microsoft Windows™ version 3.1 or later
Hard Disk:	40 Mbyte or greater
Floppy Disk:	1.44 Mbyte 3.5"
Monitor:	VGA color
Printer:	Laser

Switching Power On and Familiarizing with the 4950 System

1. Ensure that the 4950 Instrument and its line fuses are correctly configured for the local supply voltage *(pages 3-3 & 3-4 - Preparation for Operation; see Fig 3.1)*.

2. Ensure that the Calibrator / 4950 System is correctly connected *(pages 3-3 to 3-6 - see Figs. 3.2, 3.3 and 3.4)*.

3. Ensure that the Calibration Enable switch (S2 on the 4950 Instrument Rear Panel) is set to **DISABLE**. Refer to the *4950 Instrument User's Handbook, page 2-1)*.

4. Turn on the 4950 Instrument line supply by pressing the Front Panel 'Power' key.

5. Allow the instrument to complete its warm-up. Note: The 4950 displays a continuous front-panel message indicating the amount of time to go before it reaches its specified stability.

6. Execute the 4950's Selftest function as described in *Section 4 - page 4-32* of the *4950 Instrument User's Handbook.*

7. Refer to the *4950 Instrument User's Handbook*, *Section 3* if you wish to familiarize yourself with the front panel controls during the 6-hour warm-up period. Otherwise, or in addition, make sure that your computer is correctly configured to be driven by MTS Control Software, as described below.

Configuring Your Computer

General Procedure

1. Ensure that your computer conforms *at least* to the minimum standard described on page 3-7.

2. Install the National Instruments AT-GPIB Interface card into your computer, but **do not** alter the card's default settings.

   (Refer to *page 2-2* of the National Instruments booklet *'Getting Started with Your AT-GPIB and the NI-488.2 ™ Software for MS-DOS* . Do not install the card's software as detailed in *Step 2 -Install the Software* on *page 2-2* as this will be automatically installed and configured as part of the 4950 MTS Control Software program.)

3. Switch on the computer.

4. Unless they are already installed, instal MS-DOS™ and Windows™ onto your computer by following the instructions in the appropriate MS-DOS™ or Windows™ software installation manual.

Installing the 4950 MTS Control Software

1. If your computer does not automatically boots up Windows™, start Windows™ running by typing:

   C:<ENTER>

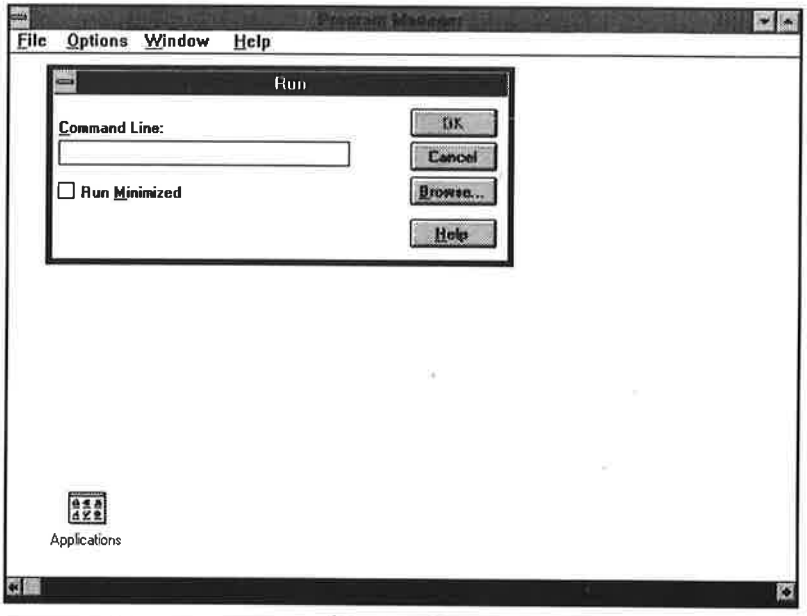
   at the DOS prompt,
   followed by:

   win<ENTER>

   at the C:\> DOS prompt.

2. Insert the **4950 MTS Control Software - Disk 1** into one of your computer's 3.5" floppy disk drives.
3. Locate the **Write** icon in the accessories program group and double click on it to open up the **Write** application.
4. Open the **README.WRI** file on the **4950 MTS Control Software - Disk 1** and read it to obtain the latest update information on the **4950MTS Control Software**. In particular, this file will give you the information you require to upgrade previous versions of the **4950MTS Control Software** with this new version.
5. Click and drag the Windows™ **File** menu to the **Run** option.

   A screen window similar to that shown below will appear, with an empty dialogue box.



Type:

<drive>:\setup

into the dialogue box, where **<drive>** is the drive designator for the floppy disk drive into which you placed the **4950 MTS Control Software - Disk 1** (for example, **a**, **b** etc.).

Click on the **OK** button.

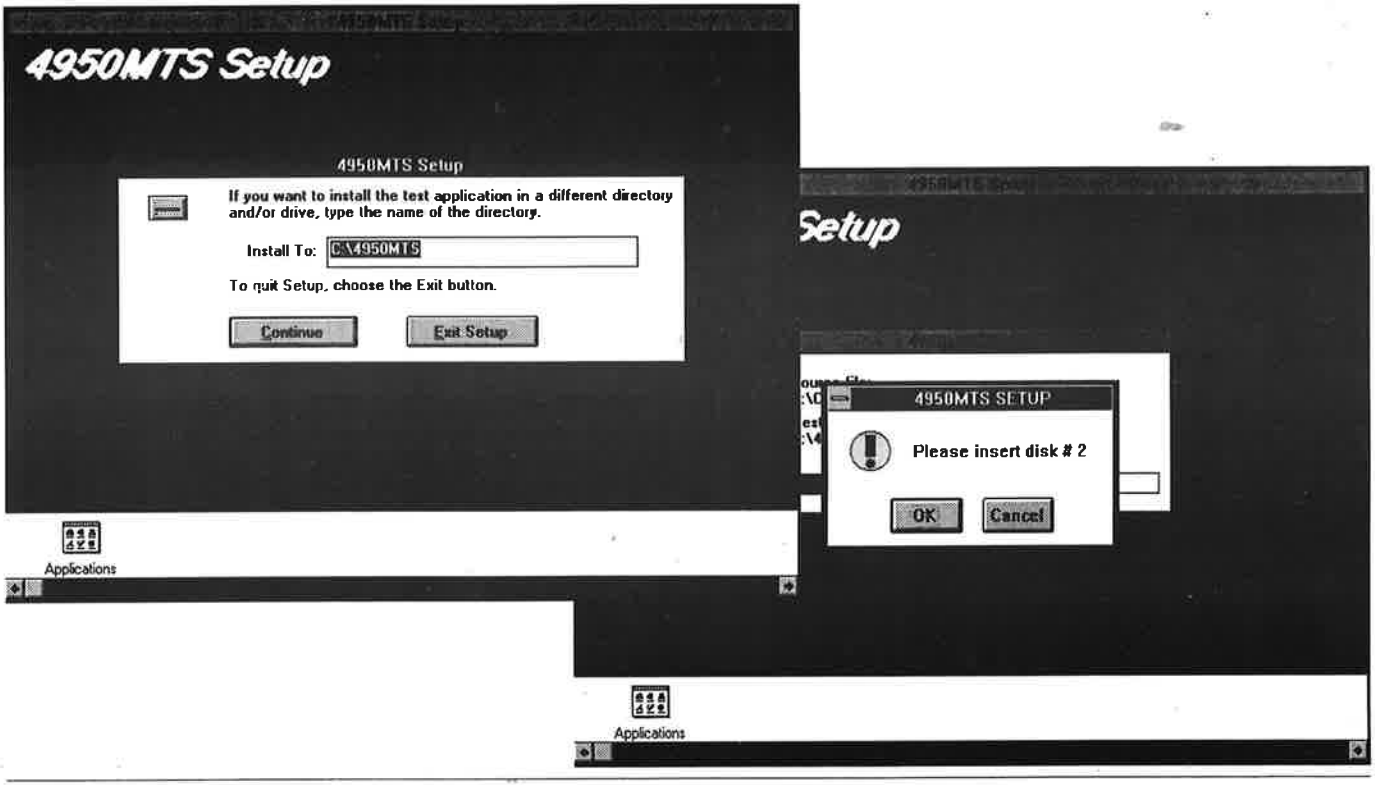
6. When the screen window shown below appears, you can optionally change the subdirectory in which the 4950 MTS Control Software will be installed.

   The default subdirectory **4950MTS** is already displayed and should be left unchanged unless their are overriding reasons why this default directory should not be used.

   Click on the **OK** button.

7. Eventually screen prompts will appear asking you to insert the 4950 MTS Control Software - Disks 2 and 3.

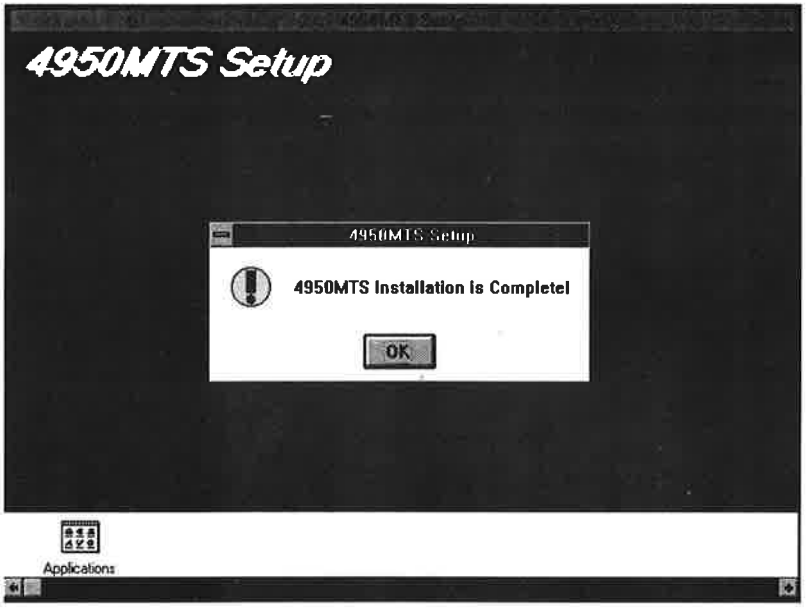
   Simply insert the appropriate disk (as indicated by the on-screen instructions) into the disk drive and click the **OK** button.



If installation is successful, the Windows™ desktop illustrated below will appear.

Do **NOT** start any of the 4950 MTS Control Software programs running by double-clicking on their icon until you have read the **README.WRI** file as detailed in step 4 of this installation procedure. Some of the files may need to be copied and/or amended before you run the software, and instructions for doing this are given as part of the file structure information.

As a general principle, to allow for flexibility in operation, the software files which control and report procedures have not been write-protected. The system, however, is very complex, cross-referring from one file to another, so ***it is not recommended that users carry out arbitrary, uncontrolled amendments to file contents***.



Error Messages

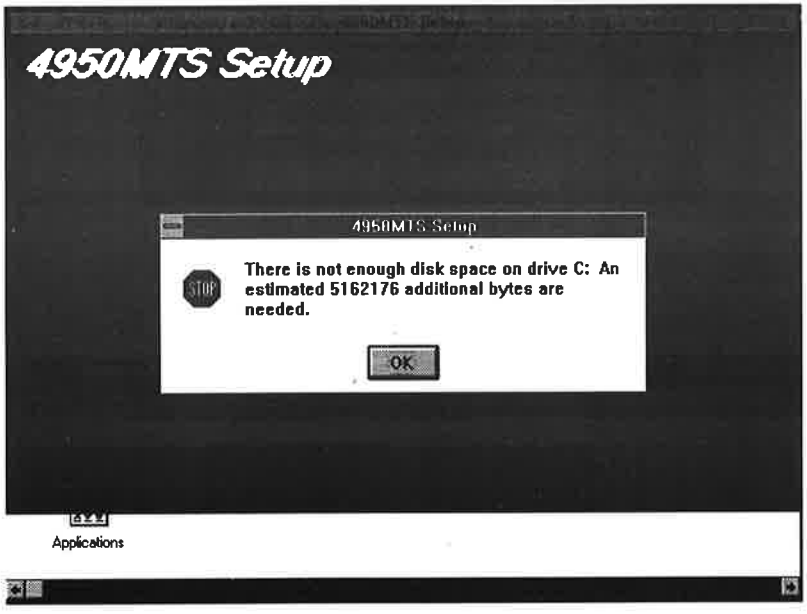
Before installing the 4950 MTS Control Software onto your computer, the installation program will check that you have sufficient space on your hard disk. If there is insufficient space on the hard disk, the following error message will appear.

Click the OK button to terminate the installation program and create additional disk space before re-attempting to install the software (Note: the 4950 MTS Control Software requires at least 10 Mbytes of free disk space.)

Suggested ways to increase the available disk space are as follows:-

1) Delete obsolete or duplicated programs and data.
2) Archive rarely used programs or data to floppy disks or magnetic tape.
3) Use a data compression utility such as PKzip to compress rarely used program or data files.
4) Purchase a larger hard disk drive or an additional hard disk drive.

After creating more disk space, repeat the 4950 MTS Control Software installation procedure from the beginning.



Notes for Advanced MS-DOS/Windows™ Users

The 4950 MTS Control Software will run faster if you configure your PC so that:-

1. Config.sys: Buffers=xx — Reducing xx to 10 allows smartdrv.sys to achieve better speed performance.
2. Config.sys: Files=xx — Set xx to 30.
3. Config.sys: Himem.sys — Set /m:x parameter to match your particular hardware configuration (Use 4 for Hewlett Packard computers).
4. Config.sys: — Make proper use of smartdrv.sys by using both parameters. e.g.

   DEVICEHIGH = C:\DOS\DRIVERS\smartdrv.sys 1024 512

   Note that this requires your computer to have at least 4 Mbytes of RAM, otherwise 'out of memory' errors will occur.
5. Autoexec.bat: Ensure that the TEMP environment variable is set to an empty subdirectory, preferably on a RAM disk. e.g. in Autoexec.bat set:-

   SET TEMP=E:\

   and in Config.sys set:-

   DEVICEHIGH=C:\DOS\DRIVERS\ramdrive.sys 3072 512 512 /e

6. Note that in both the above Config.sys statements the DEVICEHIGH command is used. This applies only to DOS 5.0 and only after the following lines have been added to Config.sys:

   DEVICE=C:\DOS\DRIVERS\HIMEM.SYS/m:4

   DEVICE=C:\DOS\EMM386.EXE NOEMS

   DOS = HIGH,UMB

MTS Control Software Directories and Files — Familiarization and Pre-Configuration

Main Directory

Unless you elected to place the 4950 MTS Control Software in another directory during the installation process, all of the installed files except two will be held on the hard disk **'c:'** in a directory called 4950MTS.

You can inspect the contents of this directory as follows:

1. From the main Windows™ desktop, double click the mouse on the **Program Manager** icon.
2. Locate the **File Manager** icon as illustrated below and double-click on it to open up the **File Manager** window.
3. Select the **c:** drive by clicking this drive's icon in the menu bar. (If the 4950 MTS Control Software was installed to another drive, click on the icon for that drive.)
4. Locate a directory named **4950MTS**, which is the 4950 MTS Control Software's root directory. This directory will contain both files and subdirectories. The files are the 4950MTS control programs and **must not be modified**.

The four sub-directories are named **4950MTS**, **CALIBRAT.ORS**, **CERTIFIC.ATE** and **DATAFILE**. These contain a variety of further sub-directories and/or files, as described on the following pages.

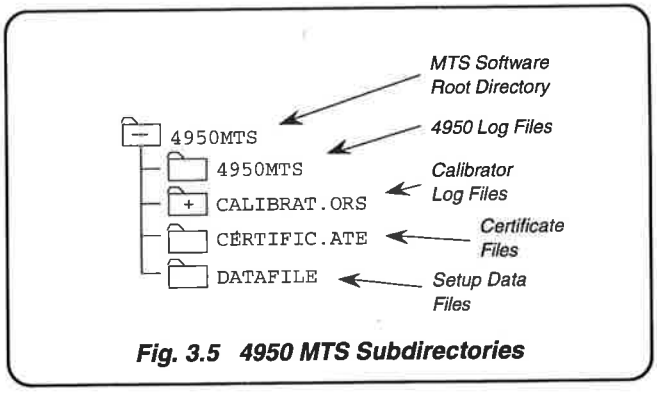


Fig. 3.5 4950 MTS Subdirectories

'4950MTS' Sub-Directory

1 To dislay the contents of the **4950MTS** subdirectory (the one below and to the right of the **4950MTS** root directory) click once on its icon.

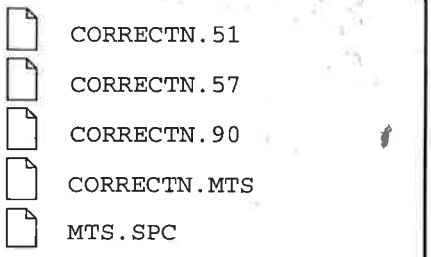


Fig. 3.6 4950MTS Subdirectory Contents — When First Used

When first used, this subdirectory will contain the following files:

a. **MTS.SPC**

This file provides the Adjust/Verify Procedure Specification which determines the sequence of calibrations performed by the MTS_CAL program, when calibrating the 4950 against a 'Golden Calibrator'. It also sets the validity tolerance limits for verifications. *(See Appendix A)*

After calibrating each Range/Band, a verification is carried out for the band, and the validity tolerance limits provide performance data for the calibration.

b. **CORRECTN.<calibrator type>**

Where **<calibrator type>** is a 2-digit number represents the model number of a particular type of calibrator — for example, **90** for the Wavetek Datron Division Model 9000 Calibrator, **57** for the Fluke 5700A Calibrator, **51** for the Fluke 5100B Calibrator. For consistency with previous versions of the 4950 MTS Control Software, the file relating to Wavetek Datron Division 4800-Series Calibrators is given the name **CORRECTN.MTS.**

These files provide templates for the correction data relating to each calibration point at which a 4950 Multifunction Transfer Standard must be calibrated against higher order standards so that it can subsequently be used to calibrate a calibrator of the type specified by **<calibrator type>**. For example, to calibrate a Wavetek Datron Division 4800-Series calibrator, the 4950 would need to be

characterized (traceably calibrated) at points such as 1V, 10V and 100V, whereas if it were to be used to calibrate a Fluke 5700A calibrator it would need to be characterized at points such as 3V, 30V and 300V. All correction data in these templates is initially set to zero.

When a 4950 Multifunction Transfer Standard is manually calibrated against higher order standards (i.e. **NOT** using the **MTS CAL** program to calibrate it against a 'Golden Calibrator'), a copy of the appropriate correction file template must be copied into the sub-directory that relates this particular 4950 unit, and the appropriate correction data entered by hand. In subsequent system use, this data corrects the 4950 instrument to establish traceability of its measurements. *See Appendix A.)* The process involved in establishing traceability is described in *Section 4*.

2. Close the **4950MTS** Sub-directory.

As you begin to use the system to calibrate Model 4950 Multifunction Transfer Standards, additional subdirectories will appear within the 4950MTS subdirectory. One subdirectory will be created for each Model 4950 calibrated on the system, the subdirectory name being derived from the 4950's code/serial number.

'CALIBRAT.ORS' Sub-Directory

Open the **CALIBRAT.ORS** subdirectory by double-clicking on its icon.

This subdirectory will contain several further subdirectories/files as detailed below:

a) **<calibrator type>** subdirectories — These subdirectories contain information specific to the type of calibrator designated by **<calibrator type>.** For example, the **4808** subdirectory contains information specific to Wavetek Datron Division Model 4808 Multifunction Calibrators.

b) a file called **CORRECTN.CAL**

A typical subdirectory tree is given in Fig. 3.7 below.

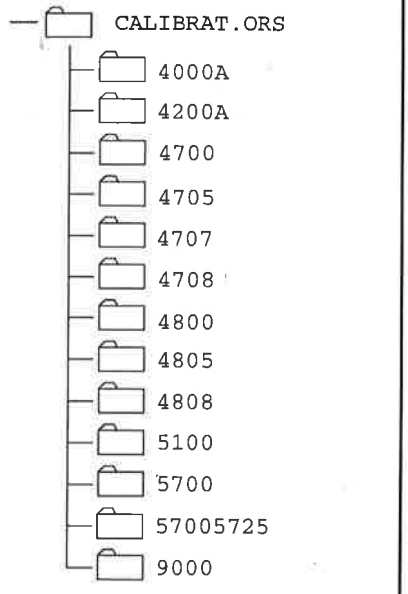


Fig. 3.7 CALIBRAT.ORS Sub-Directory — Calibrator Model Sub-Directories

<calibrator type> Subdirectories

To view the contents of a **<calibrator type>** subdirectory, click once on its icon.

Depending on the calibrator type, either one or two files will appear in the File Manager's right-hand contents window as follows:

a) **<calibrator type>.SPC**

This file is always present and provides the Adjust/Verify procedure specification which determines the sequence of calibrations performed by the type of calibrator specified in the **<calibrator>** part of the file name. It also sets the validity tolerance limits of noise, settling and pre/post-shipment comparisons for performance verification operations.

After calibrating each Range/Band, a verification is carried out for the band, and the validity tolerance limits provide performance data for the calibration.

b) **SPEC.<xxx>**

This file is only present if the calibrator does not have a 'specification readout' function that allows the calibrator's uncertainty at any calibration point to be obtained automatically via the IEEE-488 bus. It contains the calibrator's uncertainty figures are valid for the calibration interval in days specified by **<xxx>**. For example, the 180-day uncertainty figures for a Fluke 5100B calibrator are contained in a file called **SPEC.180** which resides in the subdirectory called **5100**.

To view the contents of any calibrator subdirectory in the **CALIBRAT.ORS** subdirectory, click once on the appropriate subdirectory icon.

As you begin to use the system to calibrate calibrators, additional subdirectories will appear within the **<calibrator type>** subdirectories. One subdirectory will be created for each calibrator calibrated on the system, the subdirectory name being derived from the calibrator's code/serial number.

The CORRECTN.CAL File

(Appendix B to this section; page 3-B20)

The **CORRECTN.CAL** file is located in the **CALIBRAT.ORS** subdirectory and can be seen underneath the **<calibrator type>** subdirectories in the right-hand File Manager window. Its purpose is to act as a template for the traceability data required when a 4950 Multifunction Transfer Standard is calibrated against a Wavetek Datron Division 4700-Series or 4800-Series 'Golden Calibrator' rather than directly against prime standards. (A 'Golden Calibrator' is merely a normal calibrator which has a known history, and is specially characterized). The MTS_CAL program drives the calibrator, and automatically corrects the 4950 'SET CAL' target values using the data contained in a **CORRECTN.CAL** file. The process involved in establishing traceability is described in *Section 4*.

As this traceability data is unique to a particular 4700-Series or 4800-Series calibrator, the actual **CORRECTN.CAL** file used in this process must be contained in a subdirectory specific to that calibrator. The destination sub-directory is created automatically during operation of the software. A copy of the **CORRECTN.CAL** file located in the **CALIBRAT.ORS** subdirectory must therefore be moved to this newly created, calibrator specific, subdirectory and the appropriate traceability data hand-entered into it. All correction data in the master file is initially set to zero and it is structured to accept traceable correction data resulting from a *non-automatic* calibration of the Golden Calibrator.

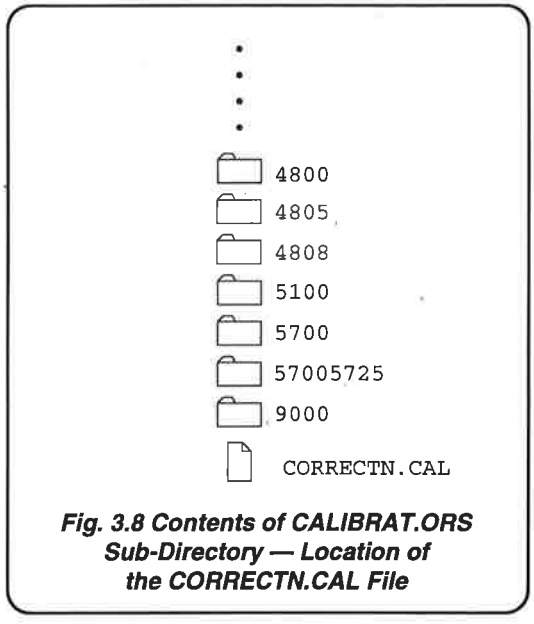


Fig. 3.8 Contents of CALIBRAT.ORS Sub-Directory — Location of the CORRECTN.CAL File

'CERTIFIC.ATE' Sub-Directory

This subdirectory contains sample certificate templates and uncertainty files which are used by the 4950MTS Control Software's **Certificate Generator** program.

These files are described in a text file called **CERT_GEN.WRI** which is located in the 4950MTS root directory and can be viewed using the **Write** Windows™ application.

'DATAFILE' Sub-Directory (Setup Data Files)

This sub-directory contains three files used by the 4950MTS Control Software to control error messages and result formats, and to store system setup information. These files must not be modified.

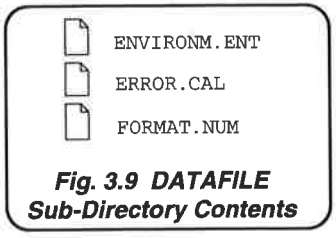


Fig. 3.9 DATAFILE Sub-Directory Contents

Section 4 Using the 4950 MTS System

4950 MTS System - Implementation of Traceability

Source of Traceable Accuracy

National Standards

The ultimate source of all traceable accuracy originates at national level. For quantities such as DC and AC Voltage, DC and AC Current, and Resistance, lower formations are obliged to send artifacts (Prime Standards) for calibration to the National Standards organization. As a result of this calibration, the Prime Standards are provided with 'Error' and 'Uncertainty' figures which permit the claim of 'Traceable' accuracy for the quantities that they represent.

Other artifacts at lower level can be made traceable to National Standards (albeit at wider accuracy tolerances) by being calibrated against the Prime Standards. The chain of calibrations from National Standards down to any lower formation must remain unbroken to support any claim to 'Traceability'

'Traceability' does not imply high accuracy. It merely guarantees that the errors and uncertainties embodied in a particular artifact are quoted with reference to National Standards.

Lower Formations

Standards Laboratories

A Standards Laboratory will usually claim traceability for some, if not all, of its Prime Standards. These laboratories are established either to support a manufacturing facility, or to offer a calibration service. It is to such laboratories that lower formations turn in order to obtain traceable accuracy figures for their products or test equipment.

Role of the 4950

The 4950 is designed to transfer traceable accuracy — from the relative seclusion of a Standards Laboratory (or even a National Standards Laboratory) to a more dynamic environment where 'calibrators' are used to invest electrical or electronic equipment under test with traceable accuracy. The ultimate aim of the 4950 is to calibrate these calibrators by an *automatic* process. The MTS Control Software suite provides the necessary programming for this automation.

4950 Traceability

Introduction

There are two principal modes of making the 4950 traceable:

Mode 1 — Send the 4950 to a Higher-Level Standards Laboratory *(Fig. 4.1)*

The 4950 is unlikely to be calibrated by an automatic process.

Calibration of the 4950

The 4950 must be certified by a standards laboratory at all the measurement points needed for the type of calibrator which you are intending to calibrate with it.

Form of Request for Calibration

In order to specify to the standards lab which measurement points in the 4950 need to be certificated, you can print out the appropriate correction file for use as a template. There is a separate correction file template for each calibrator type — CORRECTN.51 for a Fluke 5100-Series calibrator, CORRECTN.57 for a Fluke 5700-Series calibrator, CORRECTN.90 for a Wavetek Datron Model 9000 calibrator, and CORRECTN.MTS for a Wavetek Datron 4000, 4700 or 4800-Series calibrator. These templates can be found in the **4950MTS** subdirectory.

When the 4950 is returned, together with its calibration data in hard copy form, this data must be entered into an appropriate correction file for access by the MTS Control Software. To do this, create a copy of the template in the subdirectory for the 4950MTS (subdirectory name given by 4950MTS code/serial number) and enter the data into this copy.

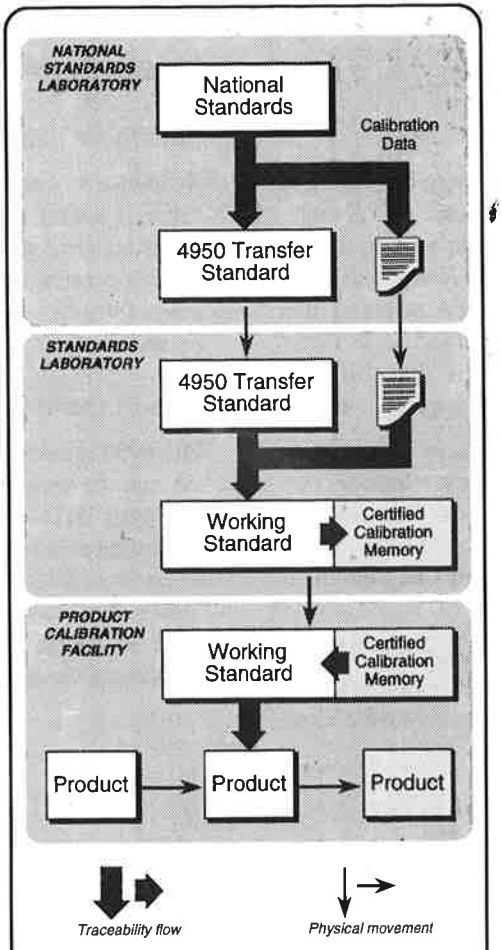


Fig. 4.1 Traceability flow for 4950, Calibrated by Non-Automatic Standards

Mode 2 — Send a 'Golden Calibrator' to a Higher-Level Standards Laboratory *(Fig. 4.2)*

The calibration process is unlikely to be automatic.

Form of Request for Calibration

The Golden Calibrator will return with calibration data in hard copy. For traceability to be incorporated into subsequent automatic calibration of a 4950, the correction data must be entered into a correction file (CORRECTN.CAL) located in the subdirectory created for the Golden Calibrator. It is most convenient for the results to return in the same form as in that file.

A **CORRECTN.CAL** template file, which can be copied to the appropriate subdirectory, is located in the **CALIBRAT.ORS** sub-directory. It is suggested that this file be printed-out and used as the form of request, with only the desired calibration points nominated.

Calibration of a 4950 to a Golden Calibrator

Once the calibration data is correctly entered into the appropriate **CORRECTN.CAL** file, this is used in conjunction with the Golden Calibrator and the MTS Control Software to calibrate the 4950. At this stage the software activates the 'Autocal' facility in the 4950, so that the 4950's corrections are stored in its internal 'Certified' memory.

Calibrating the Calibrators

After 4950 calibration, subsequent processes are handled by the MTS Control Software.

Mode 1: *(Refer to Fig. 4.1)*
For 4950 instruments which have been calibrated by a non-automatic process, calibration data must be entered by hand into the relevant correction file (e.g. CORRECTN.90) before the 4950 can be said to be traceable within the automatic system. This file is used to apply the certified corrections during the process of calibrating calibrators.

Mode 2: *(Refer to Fig. 4.2)*
When a 4950 has been automatically calibrated to a Golden Calibrator, certified corrections will have been placed in the 4950's non-volatile memory. However, if the 4950MTS is to be used to calibrate either a Fluke Model 5700 or Wavetek Datron Model 9000 calibrator, a corrections file will still be required. For current information on the requirement of these correction files, read the **README.WRI** file on the 4950MTS Control Software - Disk 1.

Calibration Processes

In the following pages, the processes involved in these two main modes of implementing traceable accuracy will be examined, so that decisions as to the most suitable choice can be made.

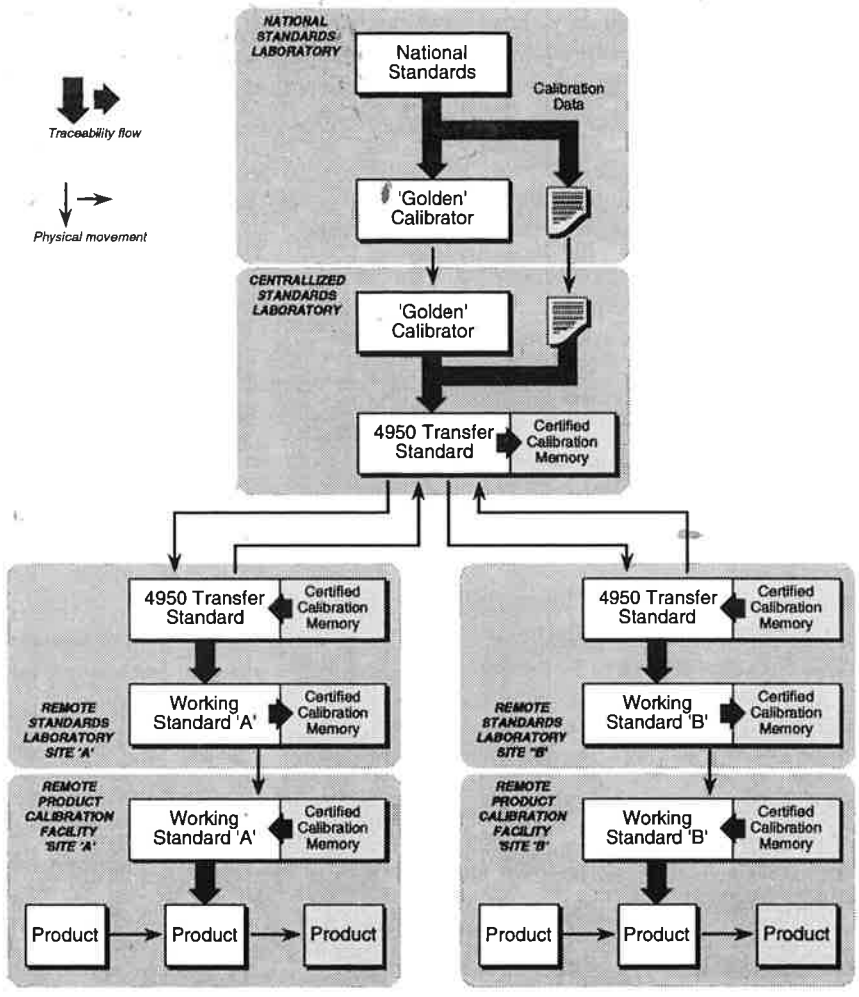


Fig. 4.2 Traceability flow for 4950, Calibrated to a 'Golden Calibrator' which obtains its traceability from Non-Automatic Standards

Implementation of Mode 1: Using the 4950 to Transfer Traceability from a Non-Automatic Standards Lab to a Calibrator *(Figs. 4.2 and 4.3)*

4950 Calibration Certificate

Usually, the certificate will show the value of the *Error* which was observed during the calibration. In the case of a measuring instrument such as the 4950, this may appear in one or both of two forms, illustrated by the following examples which report the same error:-

1. The absolute 'Indication', 'Reading' or 'Result' is given, for an accurately-defined input from the standard.

   e.g. For a DCV input of +10.000000V, the 'Result' given is +10.000050V. The calibrated instrument is reading high by 0.000050V at this value.

2. The absolute 'Error' is given, at an accurately-defined input from the standard.

   e.g. For a DCV input of +10.000000V, the 'Error' given is +0.000050V. This also means that the calibrated instrument is reading high by 0.000050V.

Under normal circumstances, the instrument will have had its input offsets removed before the measurement is made, so the result is always relative to a good zero.

Apply the Correction — Not the Error

Whatever the form used for reporting, the 'Error' will be defined as the difference obtained by subtracting the input value from its result. From the error, the 'Correction' is derived, and it is the *Correction* which must be entered into the **CORRECTN.MTS** file.

'Sign' Reversal Rule for Corrections Files

Obviously, the 'Sign' of the entered correction is paramount, and this depends on the way that the correction is implemented. In the case of the 4950 (being driven by the MTS Control Software to calibrate a calibrator), the digital value entered in the corrections file is always *added* to the digital value of the 4950's measurement of the calibrator's output *(see the + sign in Fig.4.3).*

The certificate tells us that the 4950 is reading high by 0.000050V, so -0.000050V must be added to the 4950's measurement to give the correct result. We must therefore always **reverse the sign** of the error before entering it into the correction file.

Applying All Corrections

For the measurements made by the 4950 to be traceable, all the corrections listed on the certificate must be entered into the appropriate lines of the correction file.

Calibrator Calibration

Running the relevant **CAL_<calibrator type>** program calibrates the calibrator taking into account the corrections contained in the corrections file, if one exists.

Results

Calibration results are stored in files that are placed in the calibrator's subdirectory. Results formats are described in Appendix A.

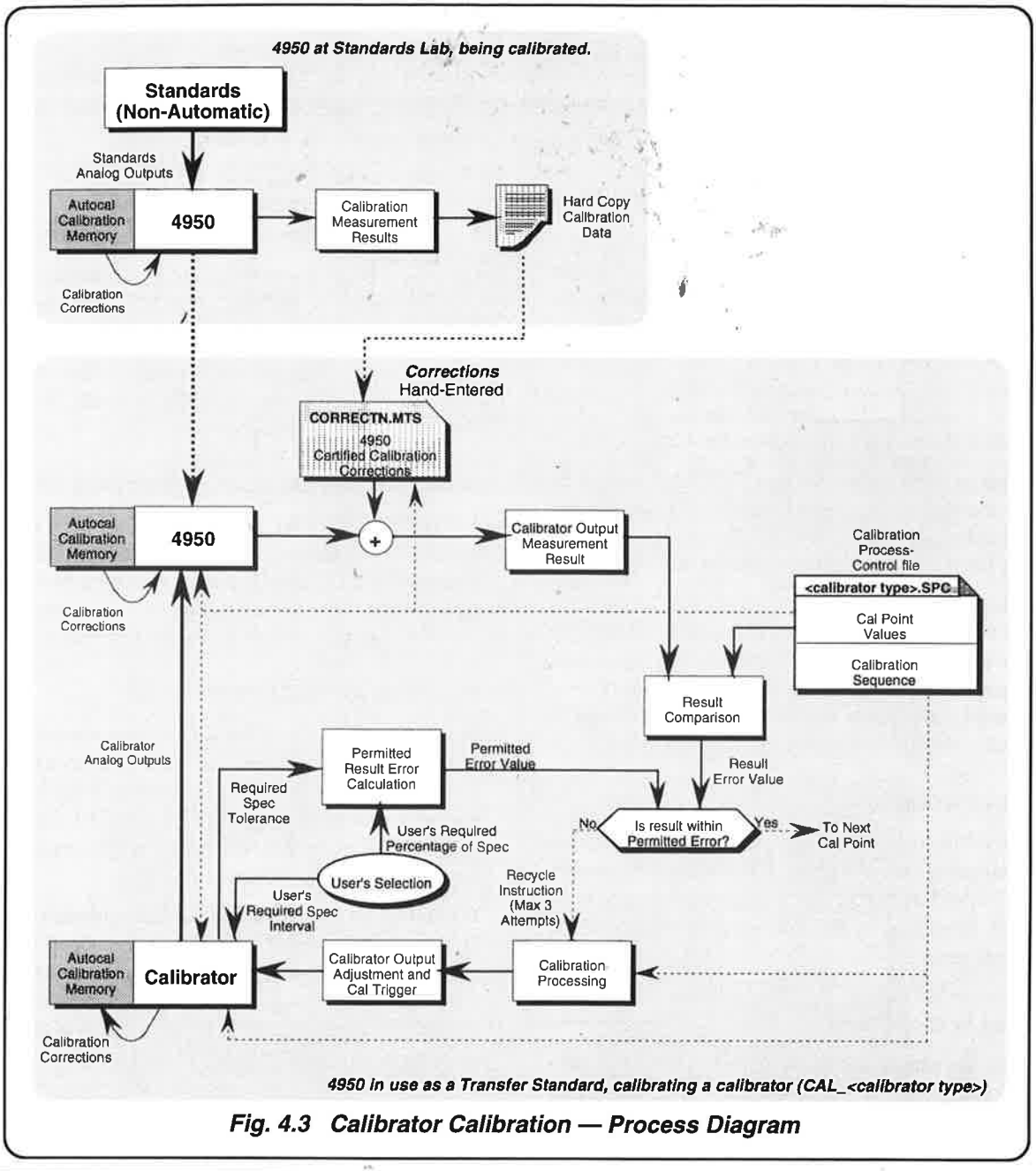


Fig. 4.3 Calibrator Calibration — Process Diagram

Implementation of Mode 2: Using a 'Golden Calibrator' to Transfer Traceability from a Non-Automatic Standards Lab to a 4950 Transfer Standard

(Figs. 4.2 and 4.4)

'Golden Calibrator' Calibration

The 4950 MTS Calibration System can use a Wavetek Datron Division 4700-Series or 4800-Series calibrator as a 'Golden Calibrator' to transfer traceability from a non-automatic standards laboratory to a 4950 Multifunction Transfer Standard. This process is illustrated in the upper part of Fig. 3.12 and Fig. 3.14.

Before Sending the Golden Calibrator for Calibration

A 4700-Series or 4800-Series 'Golden Calibrator' cannot be adjusted to nominal output values at all the measurement points required by a 4950MTS. It is therfore necesary to have a corrections file to transfer full traceability to the 4950 MTS.

As the Golden Calibrator calibration results are destined for entry into a **CORRECTN.CAL** file, it makes sense to indicate the required calibration points by providing an instruction document based on the template file, for the Standards Lab to use. An example of a line in the **CORRECTN.CAL** file is given *Appendix A* .

Nature of the Certificate

Usually, the certificate will show the value of the *Error* which was observed during the calibration, and in the case of a source such as the Golden Calibrator, this may appear in one or both of two forms, illustrated by the following examples, which report the same error:

1. The absolute 'Indication', 'Reading' or 'Result' is given, as measured by the standard.

   e.g. For an output demand of +10.000000V, the 'Result' given is +10.000050V. The calibrated source output is high by 0.000050V at this value.

2. The absolute 'Error' is given, as measured by the standard.

   e.g. For an output demand of +10.000000V, the 'Error' given is +0.000050V. This also means that the calibrated source output is high by 0.000050V.

Under normal circumstances, the source offsets will have been removed before the measurement is made, so the result is always relative to a good zero.

On the Golden Calibrator's Return from Calibration

A **CORRECTN.CAL** template file has been placed in the 4950 MTS sub-directory. When a **CORRECTN.CAL** file is required for a Golden Calibrator returning from calibration, this template file can be **copied** into the golden calibrator's sub-directory ready for entering the corrections.

'Sign' Rule for CORRECTN.CAL

Obviously, the 'Sign' of the entered correction is paramount, and this depends on the way that the correction is implemented. The MTS Control Software, calibrating a 4950, always *adds* the value entered in the **CORRECTN.CAL** file to the value of the 4950's calibration point value; producing a non-nominal target value *(see the + sign in Fig.4.3)*.

The certificate tells us that the Golden Calibrator output is high by 0.000050V, so 0.000050V must be added to the 4950's calibration point value to produce a non-nominal target value matching the Golden Calibrator output for nominal selection. You should therefore **NOT** change the sign of the error when entering it into the **CORRECTN.CAL** file.

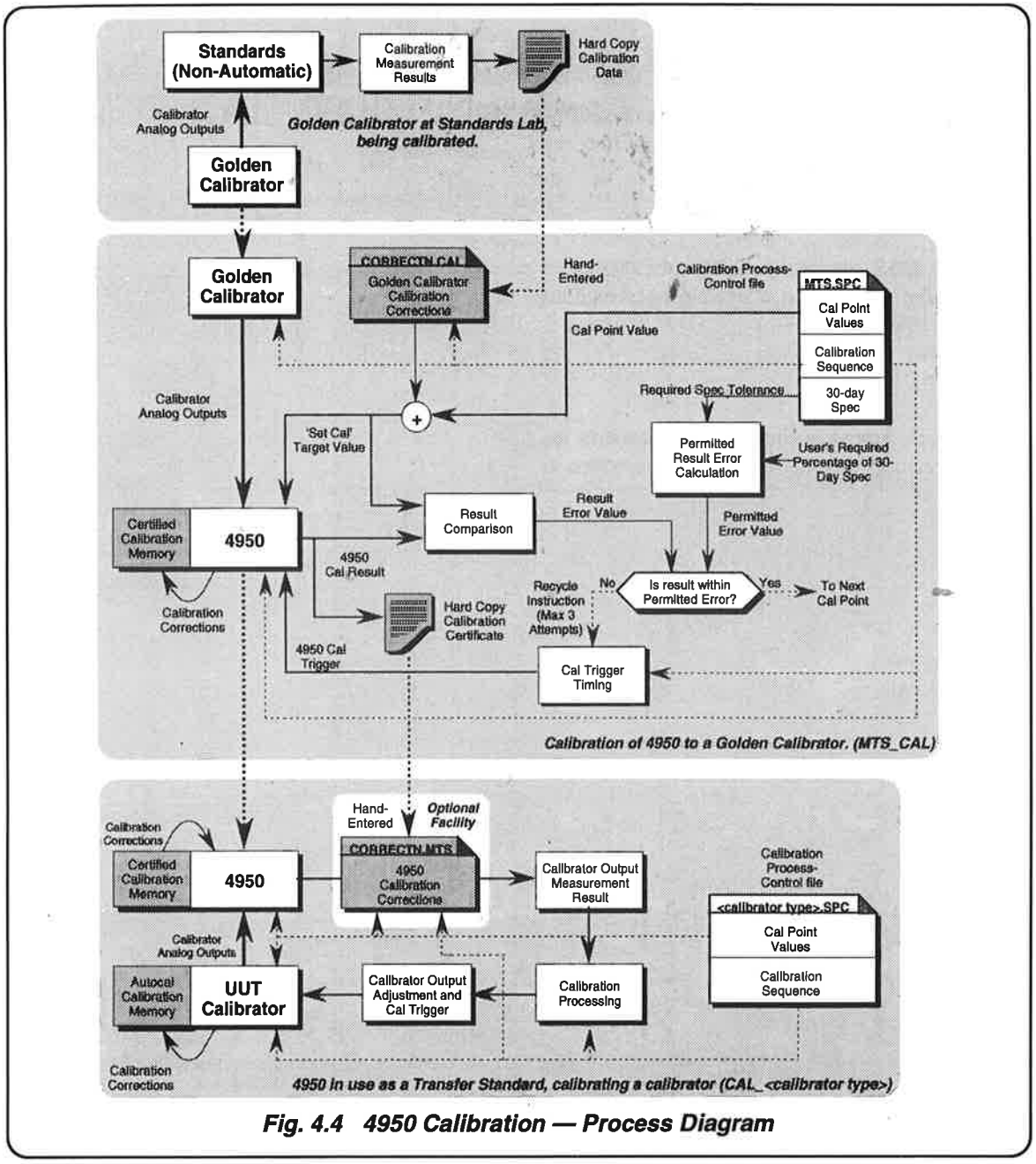


Fig. 4.4 4950 Calibration — Process Diagram

Applying All Corrections

For the measurements made by the 4950 to be traceable, all the errors listed on the certificate must be entered into the appropriate lines of the **CORRECTN.CAL** file.

4950MTS Calibration

Running the **MTS_CAL** program calibrates the 4950MTS taking into account the corrections contained in the corrections file.

Results

Calibration results are stored in files that are placed in the 4950MTS's subdirectory. Results formats are described in Appendix A.

Section 5 The CAL_4x0x, CAL_5100, CAL_5700 and CAL_9000 Programs

The CAL_4x0x, CAL_5100, CAL_5700 and CAL_9000 Programs — when to use them

The software suite is divided into two main programs, which run in 'Windows 3' environment. The following index shows how these programs are used during the 4950MTS calibration process for closed-loop methods A and B, and an additional method C. The CAL_4x0x, CAL_5100, CAL_5700 and CAL_9000 Programs should be used at the stages where the CAL_<calibrator type> program is indicated below.

Method A

Method A
4950 resides with the calibrator.
Refer to *Section 1 page 1-2 Fig. 1.1.*

Stage 1.	Perform a Pre-transportation baseline comparison, and store the results.	
	Program:	**CAL_<calibrator type>**
	Select:	**Pre transportation comparison**
Stage 2.	Transportation.	
Stage 3.	Perform Certified calibration of the 4950, to traceable laboratory standards.	
	Program:	**MTS-CAL**
	Select:	**Certified verify _adjust**
Stage 4.	Transportation.	
Stage 5.	Perform a Post-transportation baseline comparison, and store the results.	
	Program:	**CAL_<calibrator type>**
	Select:	**Post transportation comparison**
Stage 6.	Perform traceable Certified calibration of the Calibrator, to the 4950.	
	Program:	**CAL_<calibrator type>**
	Select:	**Adjust and verify**

Fig 5.1

Method B

Method B
4950 resides in the Standards Laboratory
Refer to *Section 1 page 1-5 Fig. 1.2.*

Stage 1.	Perform Certified calibration of the 4950, to traceable laboratory standards.	
	Program:	**MTS-CAL**
	Select:	**Certified verify _adjust**
Stage 2.	Perform a Pre-transportation baseline comparison, and store the results.	
	Program:	**CAL_<calibrator type>**
	Select:	**Pre transportation comparison**
Stage 3.	Transportation.	
Stage 4.	Perform traceable Certified calibration of the Calibrator, to the 4950.	
	Program:	**CAL_<calibrator type>**
	Select:	**Adjust and verify**
Stage 5.	Transportation.	
Stage 6.	Perform a Post-transportation baseline comparison, and store the results.	
	Program:	**CAL_<calibrator type>**
	Select:	**Post transportation comparison**
Stage 7.	Report result of difference measurement.	

Fig 5.2

Method C

The 4950 resides in the Standards Laboratory and is calibrated by a Wavetek Datron 4700-Series or 4800-Series 'Golden Calibrator'.

If a 4950 MTS is regularly being cycled round the closed loop calibration process, you can take advantage of the **Auto Baseline Comparison During Certified Measurement** feature in the MTS_CAL program to dramatically reduce the number of measurement operations. This scenario is illustrated in Fig 5.3.

When this feature is enabled, results are obtained for both the 'certified' and 'baseline' modes of the 4950MTS at each measurement point. The certified results appear in the normal results files, while the baseline results provide the post-transportation loop-closure information for the previous cycle and the pre-transportation loop-closure information for the next cycle.

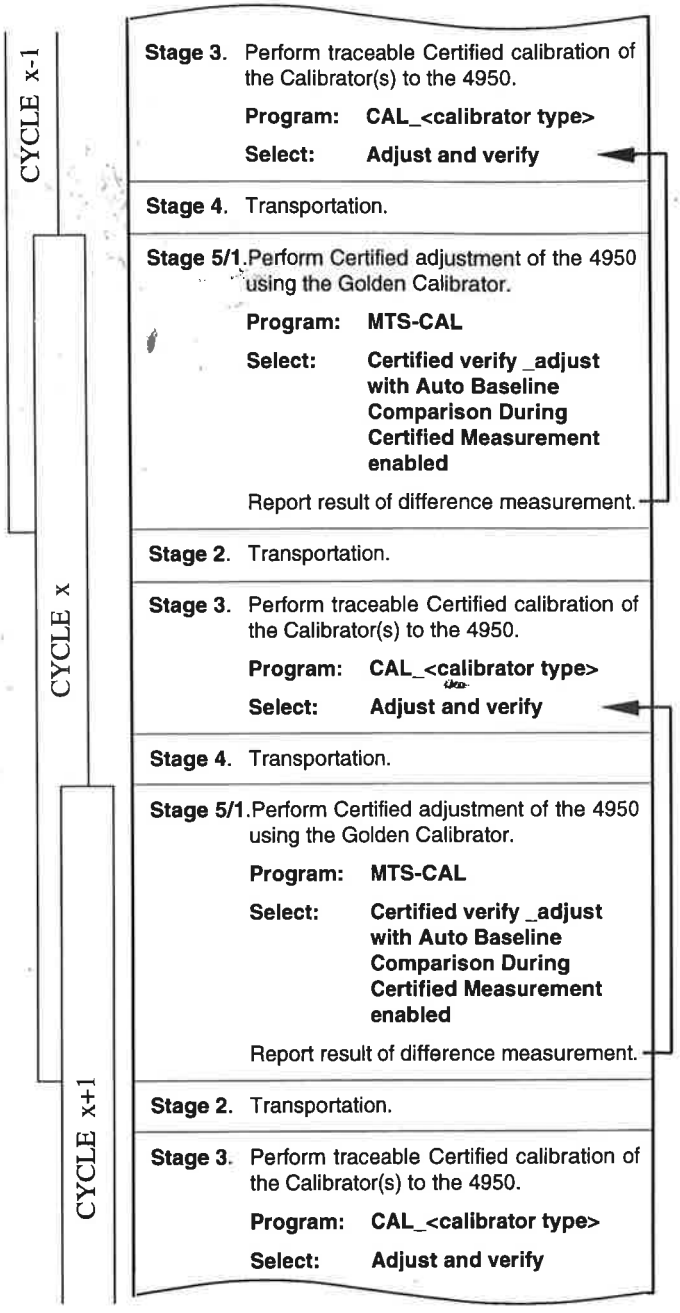


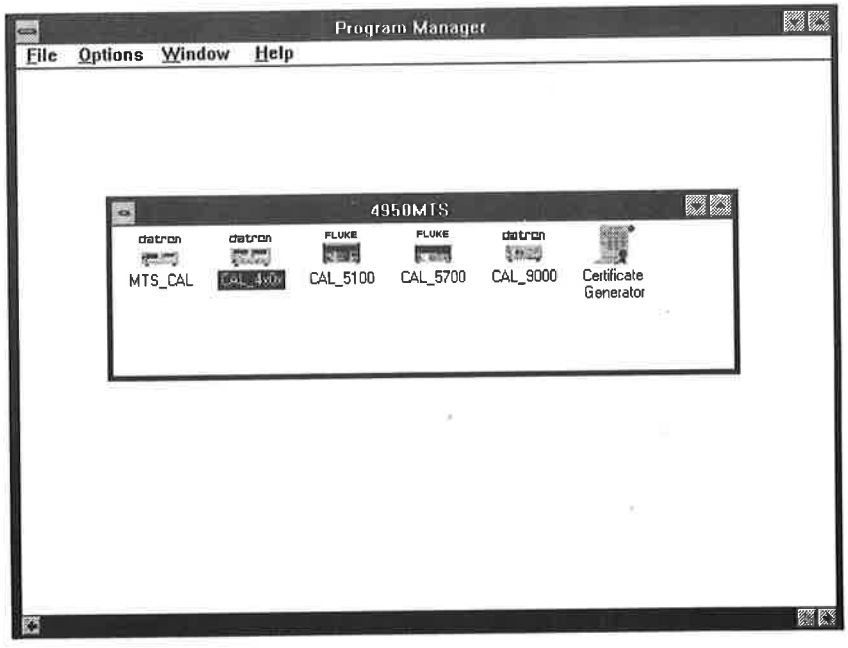
Fig 5.3

Running the CAL_4x0x, CAL_5100, CAL_5700 and CAL_9000 Programs

1. Starting the Program

From the Windows™ desktop, double-click on the 4950MTS icon to open up the menu window of 4950MTS Control Software programs shown below.

To start the **CAL_4x0x**, **CAL_5100**, **CAL_5700** or **CAL_9000** program running, simply double-click on the appropriate program icon.

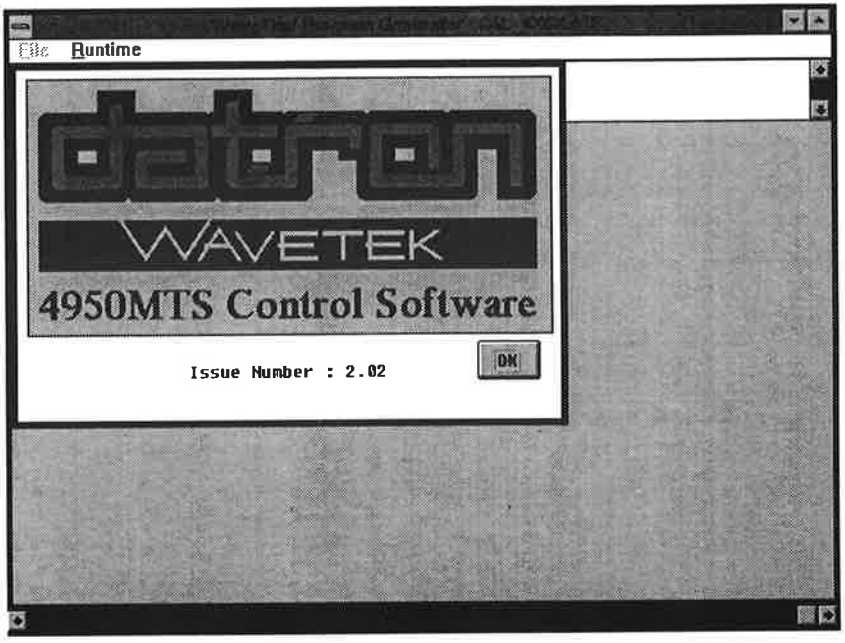


2. Title Page

When the title page shown below appears, click on the **OK** button or press the **Space Bar** to continue.

Note: The space bar cannot be used to move to the next screen unless the only control on the screen is the **OK** button. This is the case for the head page and all graphical user instructions, such as IEEE-488 and analog connection instructions.

The title page also displays the version number of the software. This should be quoted in all communications with Wavetek concerning this software package.



3. System Environment Details.

The time and date displayed are obtained from the system. If they are in error, then the system must be halted and returned to DOS and the appropriate action taken. This may be via use of the date and time commands or by use of a utility to access the battery backed RAM.

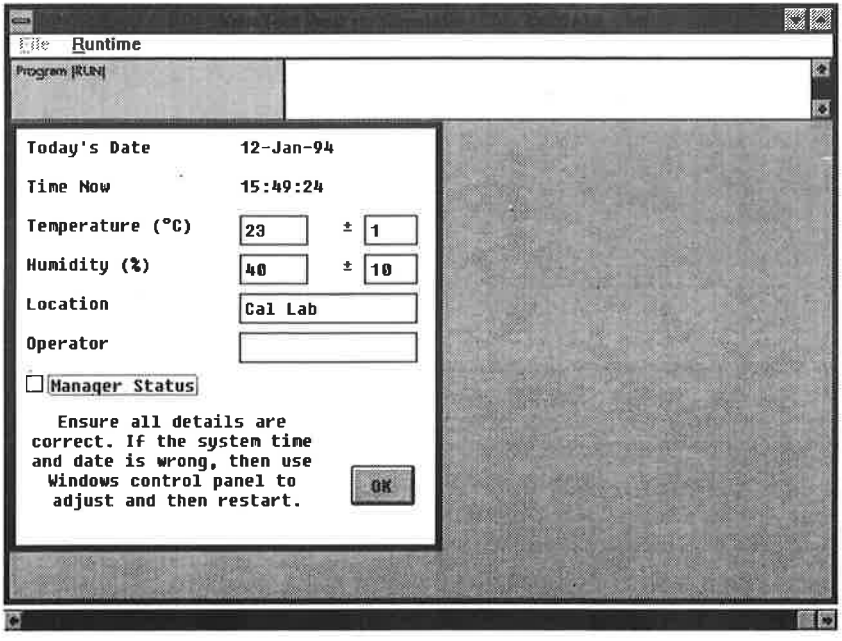
Note: If it is desired to terminate the program , follow these steps:

a. If an operator window (a screen with an **OK** button on it) is displayed, press and hold the **Ctrl** key, press and release the **Break** key, release the **Ctrl** key and then click on the **OK** button. Depending on whether or not the bus has been initialised yet, the system will either stop with a break error message or perform a system shut down.

b. If the system is running (taking readings or performing a time delay) simply press the **Esc** key which will cause a system shut down to occur. Note that if the system is occupied with taking a reading, that reading will be completed before the system responds to the request to abort.

The remainder of the data displayed is read from a file called **ENVIRONM.ENT** which is stored in the **DATAFILE** subdirectory. Edit the displayed data until it is correct, and if you are a **System Manager** click on the **Manager Status** box to enable the software's system manager functions. Finally, click the **OK** button with the mouse pointer. At this point, the data on this screen is written back to the environment file.

Note: Only data within the various field boxes can be edited.



4. Password Protection.

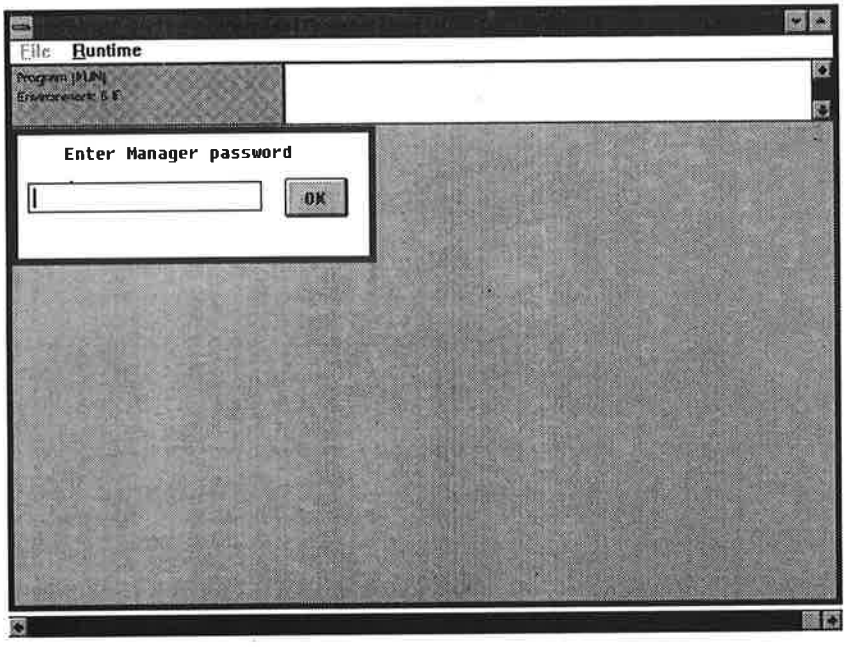
If the **Manager Status** box was checked on the environment page, then you will be asked to enter a valid password. Entering a valid **Manager Password** at this point gives you access to the following facilities:

i. The ability to perform a delayed start.
ii. Multiple runs.
iii. The ability to bypass the need for input zeros.
iv. Debugging.

If you get the password wrong three times then you are declared as a manager level intruder in the action window, and you are only allowed access to the facilities granted to a normal user.

You can obtain a **Manager Password** by filling out the **'Declared Manager'** reply card which was shipped to you with the 4950 MTS Control Software and returning it to your nearest Wavetek Service Center. A unique password will then be forwarded to you and you will also be registered to receive 4950 MTS software support. When you receive the password, keep it in a secure place or commit it to memory.

Warning: Misuse of password-protected software could invalidate the calibration process. **Wavetek cannot accept liability for the misuse of password-protected software.**



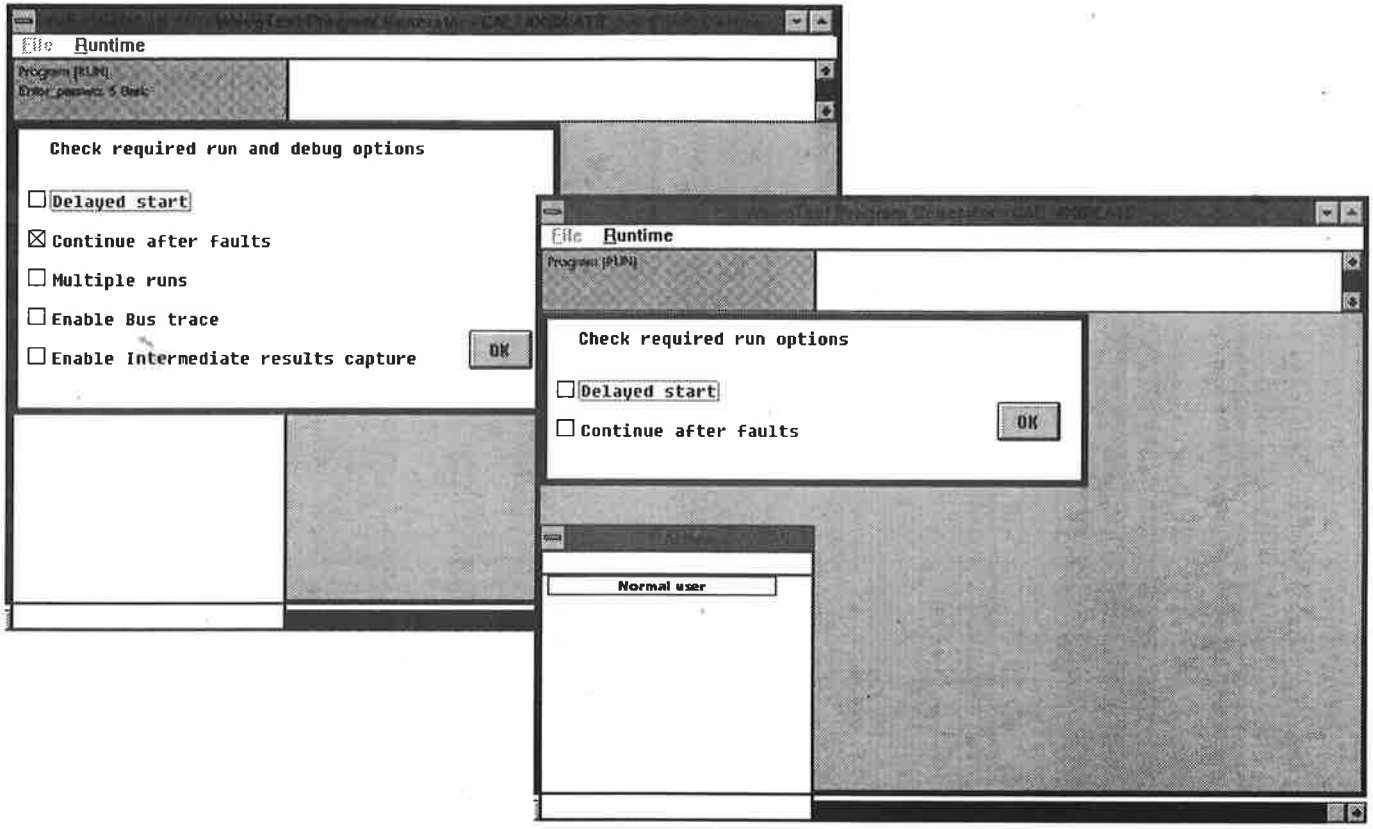
5a. Run and Debug Options (Manager Level)

If you entered a valid **Manager Password**, you will presented with the **Run and Debug Options** screen shown below. This screen allows you to select and deselect the various run-time options that are made available to system managers. Enable or disable all the options you require before clicking on the **OK** button. If any additional data is required by the enabled options — for example, the time delay required before a delayed start — it will be requested in subsequent screen windows.

5b. Run and Debug Options (User Level)

If you are a normal user (i.e. not a System Manager) the **Run Options** screen shown below will appear, containing only the **Delayed Start** and **Continue After Faults** options. Operation of these two options is described in steps **6** and **7** on the following pages.

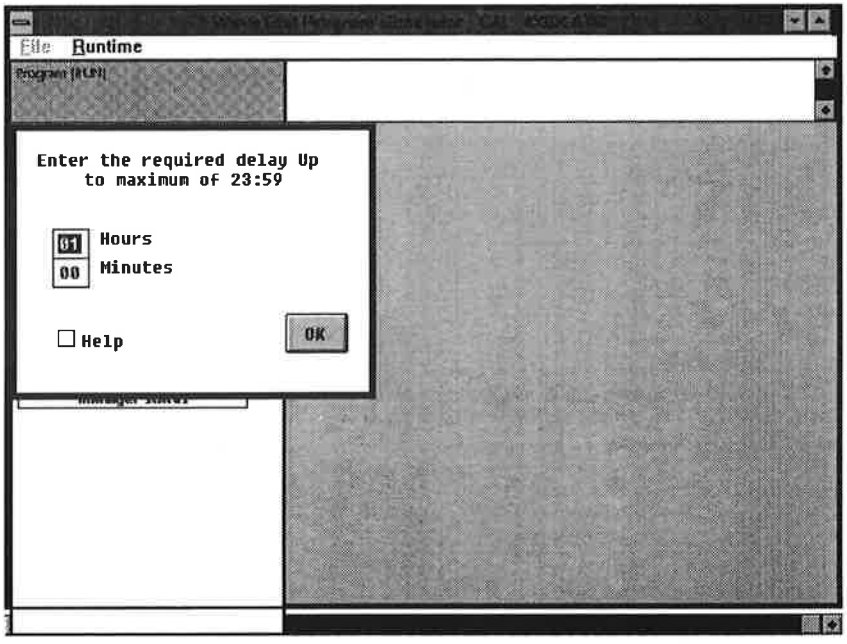
The different **Run/Debug** options are explained on the following pages.



6. Delayed Start (Manager and User Level)

This option allows additional time over and above any warm up time required by the 4950 MTS. The 4950 MTS knows how long it has to go until it is warm, but the calibrator does not. Therefore, you can use this facility if the 4950 MTS has already warmed up but the calibrator has not, or it can be used to delay a run until there is less electrical noise in the environment — for example, until nightime hours.

Enabling the **Delayed Start** option opens up the screen window shown below. Enter the required time delay in hours and minutes. The maximum allowable delay is 23 hours and 59 minutes.



7. Continue After Faults (Manager and User Level)

Any faults which occur during operation of the system are detected by the 4950MTS Control Software. The way in which the software responds to these faults depends on the whether the **Continue After Faults** option is enabled or disabled.

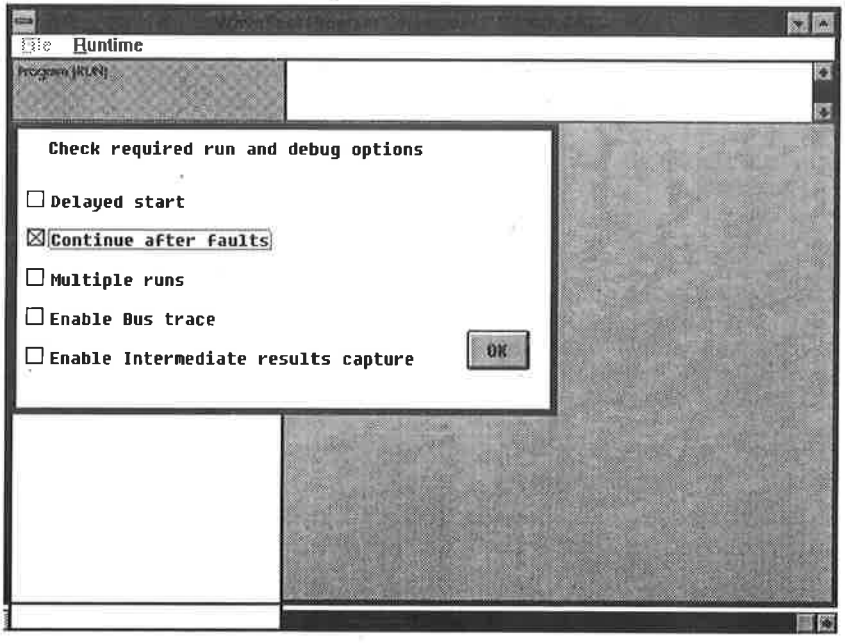
a. If **Continue After Faults** is enabled (☒), any faults which occur will be displayed in the bottom line of the **Results** window, but the program will continue. As a result, the displayed fault will always be the last fault that occurred, if any, even at the end of the run. This fault information is also reflected in any result files that are retained for later use — e.g. Lotus 123 and ASCII files.

b. If **Continue After Faults** is disabled (☐), the program will halt whenever a fault is detected, the nature of the fault being displayed in the bottom line of the **Results** window.

The user will then be presented with a screen window that allows him/her to either:

i. **Continue:** The system will attempt to continue. If an error occurred that involves the re-sending of an IEEE-488 bus query command, the act of so doing may create a "query' error in its own right. This will be reported and if continue is re-selected the system should recover.
Note: The system should not encounter any such faults. If they should occur, please note them, plus any available information about the current configuration of both instruments and any data displayed on the screen, and report all this information to Wavetek Datron Division.

ii. **Abort:** The system will perform a controlled system shut down.

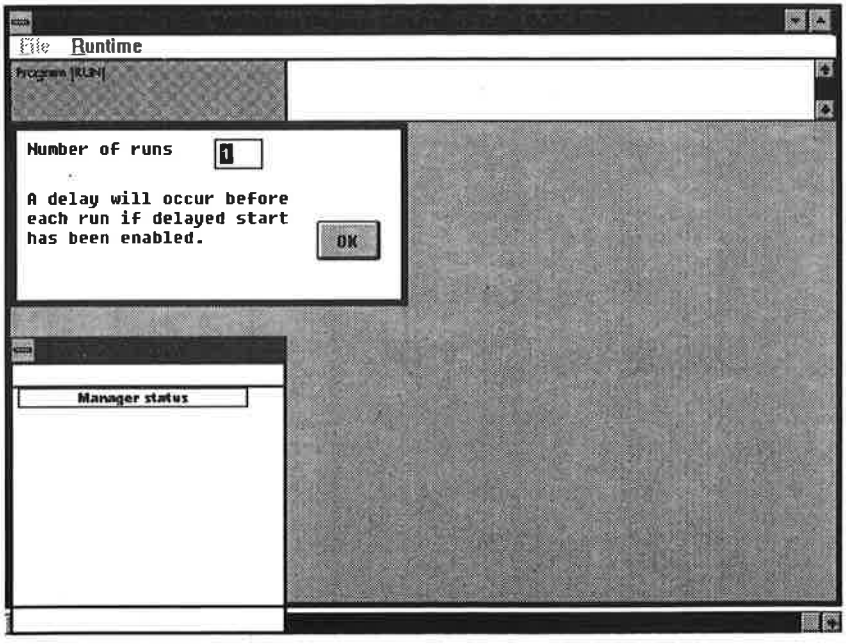


8. Multiple Runs (Manager Level Only)

This facility can be used to prove repeatability of 4950 MTS measurements, or to exercise instruments through burn in procedures etc. If selected, it will cause the same procedure to be run the selected number of times, test data being stored in one contiguous block in the results files.

Enabling the multiple run option results in the screen shown below being displayed, in which you should enter the number of runs required. This should be a whole number between 1 and 32767. (Note, however, that 32767 runs would typically take about 15 years!)

Note: If a delayed start is requested in conjunction with multiple runs, the delay will be performed before every run in the multiple run.



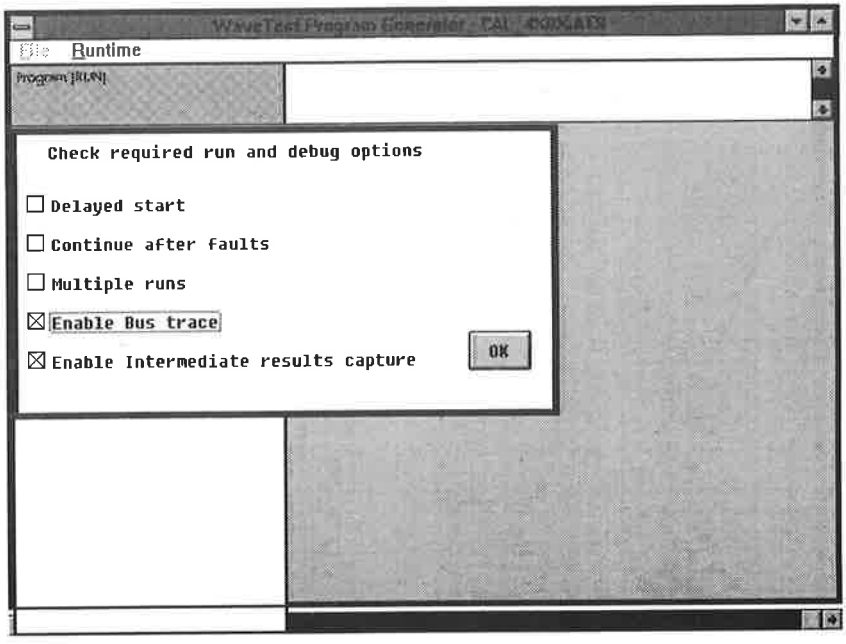
9. Enable Bus Trace (Manager Level Only)

If this option is enabled a file is generated called **BUS_TRCE.DBG** in the software's root directory. This file records all IEEE-488 bus traffic in a well laid out and understandable format.

Note: Use this option with care as it will generate a file of about 2MBytes!

10. Enable Intermediate Results Capture (Manager Level Only)

When enabled, this option re-directs the screen information from the bottom three data windows into files. These files, which contain the Action, Dynamic Settling and Readings information are called **ACTION.DBG**, **SETTLE.DBG** and **READINGS.DBG** respectively, and are stored in the software's root directory. This is useful, for example, during a calibration in which four readings may have been taken, (with adjustments after the first three) but only the last one is reported on the certificate.



11. Calibrator Type

After you have pressed **OK** in the Run/Debug Options window and entered any additional data required by the enabled options, a **Calibrator Type** selection screen similar to that shown below will appear. The calibrator model numbers listed in this screen will depend on which **CAL-<calibrator type>** program you selected from the Windows™ desktop.

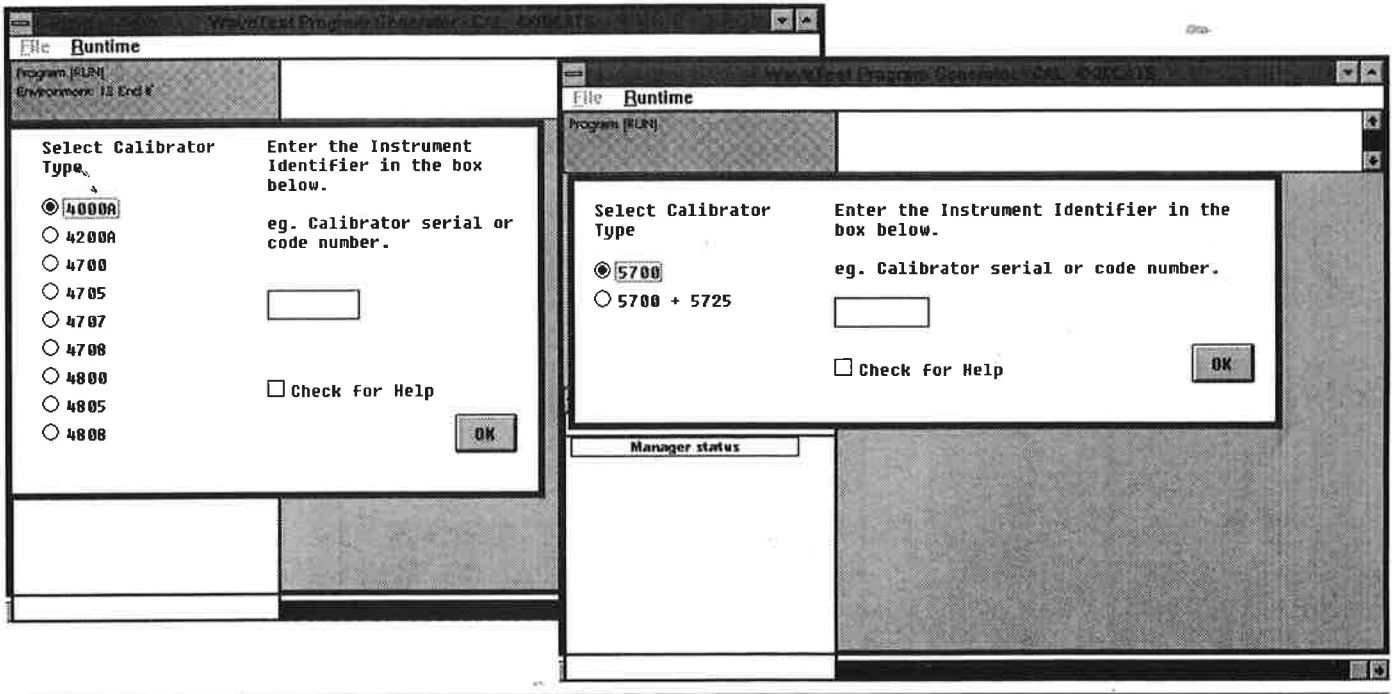
The screen shown below left, which lists all Wavetek Datron Division 4000, 4700 and 4800 Series calibrators, is the one which appears if you chose to run the **CAL_4x0x** program. The **CAL_5700** program screen is shown below right. The **CAL_5100** and **CAL_9000** programs are similar but do not have calibrator type selection radio buttons.

Select the appropriate model of calibrator by clicking on its radio button, then enter the serial number of the calibrator you are calibrating into the **Serial/Code Number** and click **OK**.

Note: The calibrator type and code number must be selected with care as these define the sub-directory in which data files relating to the calibrator will be stored.

As the serial/code number is used as the subdirectory name for files stored for this calibrator, it must conform to MS-DOS file naming conventions. If it does not conform to these conventions an error message/help screen will prompt you to select one that does. If this screen appears, click **OK** to return to the calibrator type window and edit the serial/code number information.

Note: The code/serial number used does not have to be the calibrator's serial number, but it must uniquely identify it.



12. Instrument Not Found

If the subdirectory defined by the serial/code number cannot be found (for example, if this calibrator has never been calibrated on the system before) the screen shown below will appear.

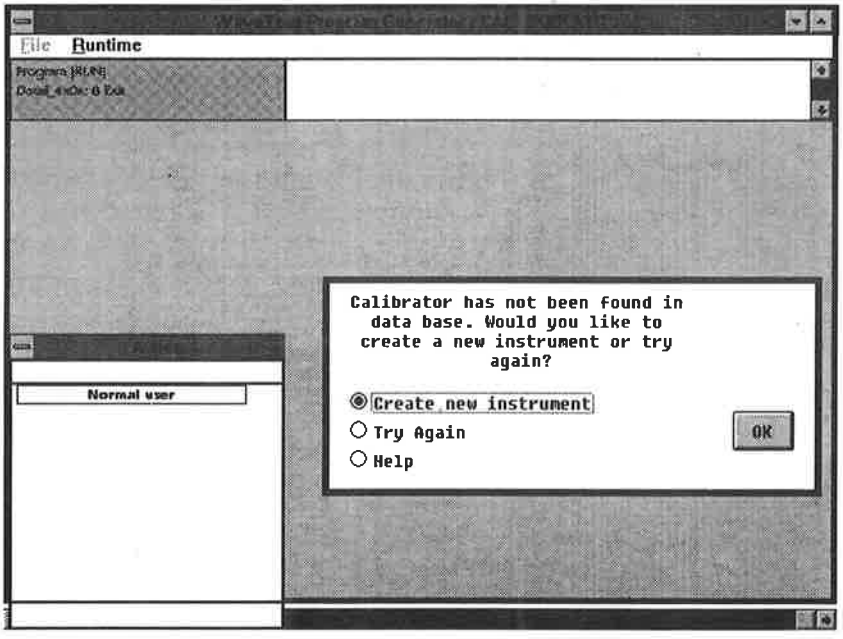
At this point you have the option to either:

a) Create a new subdirectory with this name by selecting the **Create New Instrument** option .

b) Return to the calibrator type screen by selecting the **Try Again** option.

c) Obtain on-line help by selecting the **Help** option.

After selecting the required option, click on **OK** to continue.

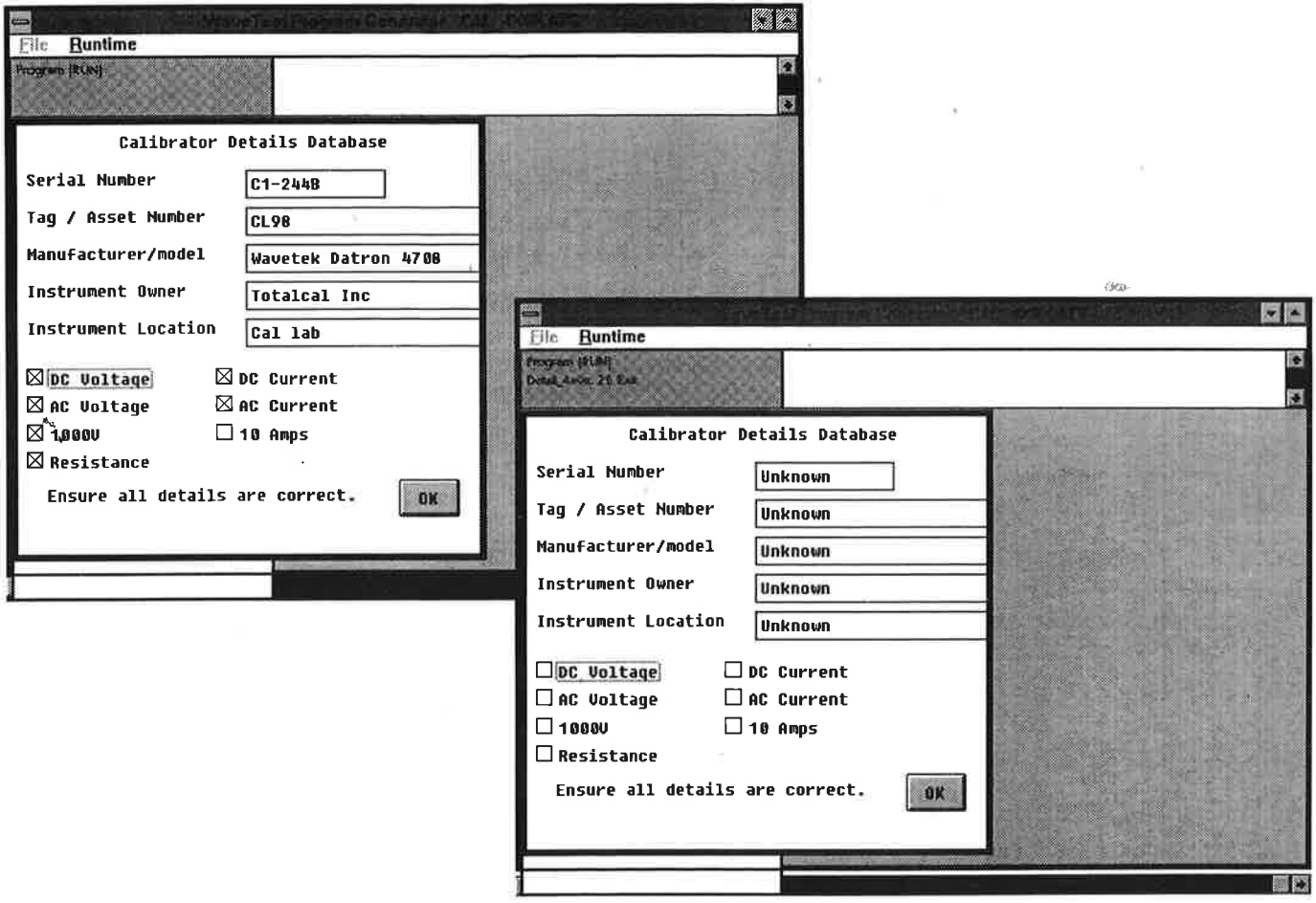


13. Calibrator Details Database

Check that the information contained in the boxes is correct for the calibrator being calibrated. If not, edit it accordingly.

If no database file previously existed for this calibrator all the boxes will contain the word **Unknown** and all functions will be deselected (☐). Appropriate data must now be entered into each box and the functions available in the calibrator selected.

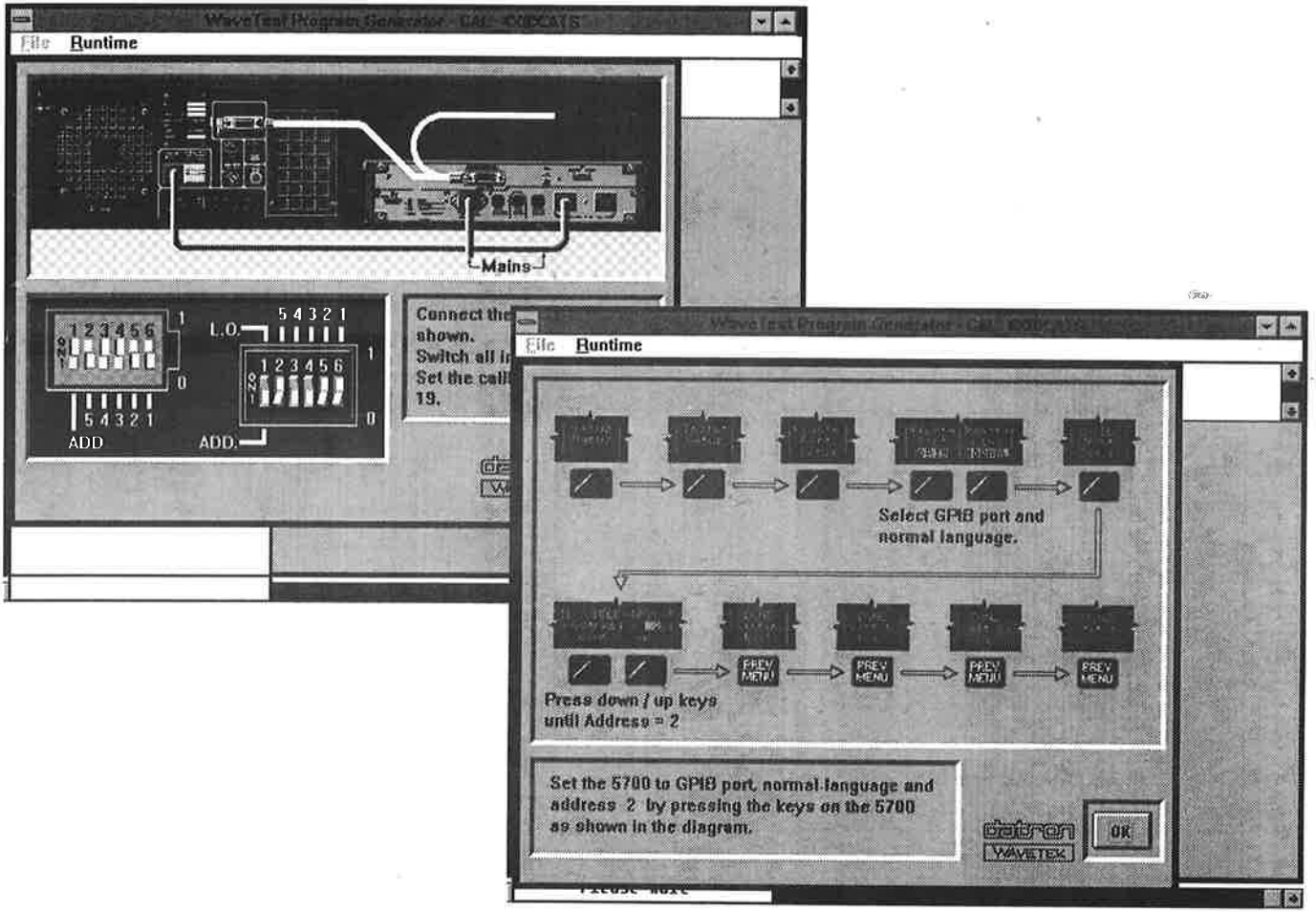
Note: The function boxes that are checked in the lower half of this window are **NOT** the functions that will be run in the procedure, but are a reflection of the 'available functionality' or the 'option fit' of the instrument.



14. IEEE-488 Connections

This is a user instruction screen that shows the operator the correct way to connect IEEE-488 and power cables between the calibrator and the Model 4950 Multifunction Transfer Standard. For example, as illustrated below left, it indicates that for Wavetek Datron Division calibrators the IEEE-488 Bus leads should be connected from the computer to the 4950MTS and from the 4950MTS to the calibrator. It also indicates that the power for the calibrator must be supplied via the power outlet on the 4950MTS rear panel. It also prompts the operator to switch all instruments on and set the calibrator to the correct IEEE-488 bus address.

Additonal screens, such as the one shown below right, will appear for some calibrators, indicating how to set up their active I/O port, IEEE-488 address, programming language etc.

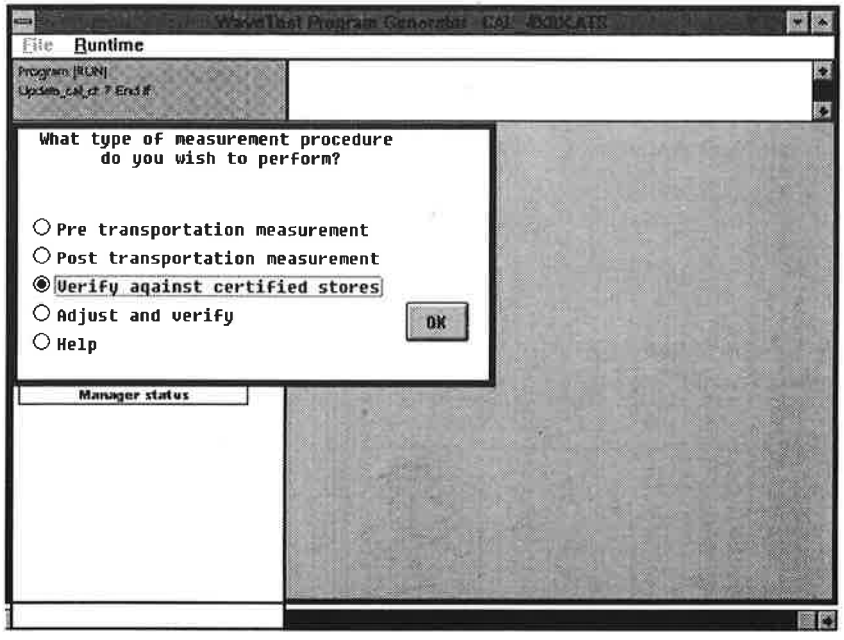


15. Procedure Type

Select the type of procedure you wish to run by selecting the radio button associated with that task and clicking on **OK**. Note that if you are running the **CAL_5100** or **CAL_5700** programs, you will not be presented with an adjust and verify procedure in this window. This is because the Fluke 5100B calibrator cannot be automatically adjusted via the IEEE-488 bus (it requires internal 'screwdriver' adjustments) and the Fluke 5700A calibrator requires 'artifact cal' sources, rather than a measurement instrument such as the 4950MTS, to calibrate it. However, for 5700A calibrators the 4950MTS System is an excellent way to check the integrity of artifact cal.

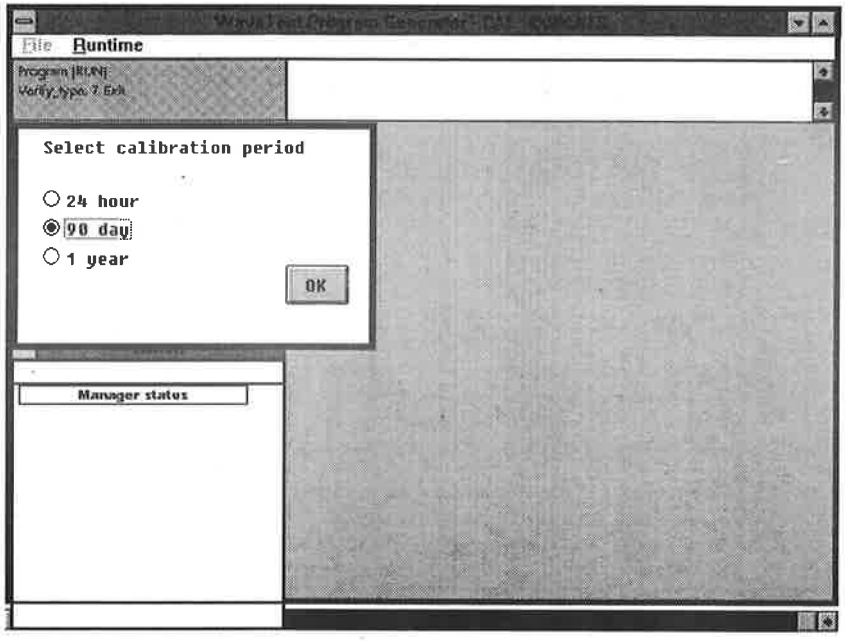
Note: A **Pre Transportation Measurement** and a **Verify Against Certified Stores** procedure may be performed at any point. However, a **Post Transportation Measurement** must only be performed after a **Pre Transportation Measurement** and a **Adjust and verify** should only be performed after verification of the pre/post transportation mesurement results.

For further information on the correct procedure to run refer to *Section 3* of this handbook.



16. Calibration Period

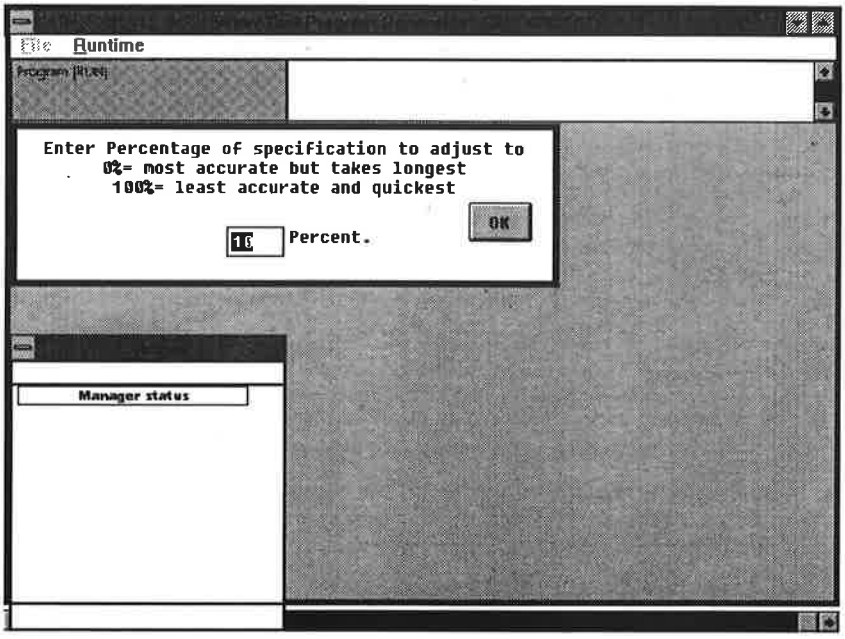
If you select a procedure that verifies the calibrator's performance against defined specifications — i.e. the **Verify Against Certified Stores** or **Adjust and Verify** procedures — the appropriate specifications are either obtained directly over the IEEE-488 bus from the 'Specification Readout' function of the calibrator (as in Wavetek Datron Division calibrators or the Fluke 5700A calibrator) or from a specification file in your computer. As illustrated below, several sets of data are normally stored, corresponding to different calibration intervals for the calibrator.



17. Percentage Of Specification.

If you select the **Adjust and Verify** procedure, the window illustrated below will prompt you to specify the percentage of specification to which you want the calibrator adjusted. It is usually desirable to calibrate the calibrator so that its outputs are as close as possible to the nominal calibration point values. However, the tighter you make this specification (i.e. the lower the number you enter into the **Percentage of Specification** window) the longer it will take to achieve this goal. The compromise is left up to the user, but a percentage of specification of 10% is normally recommended.

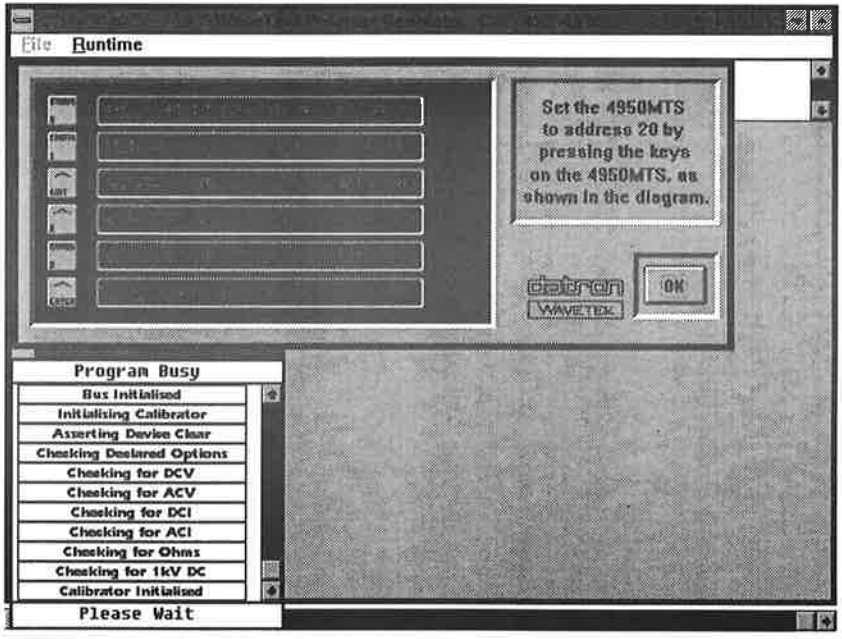
Note: The system will never make more than three attempts to adjust the accuracy of any one calibration point to nominal. Assuming that the adjustment procedure achieves an order of magnitude improvement at each attempt (i.e. it improves a 200 ppm error to around 20 ppm, or a 100 ppm error to around 10 ppm) the percentage of specification will depends to some extent on the initial degree of calibrator innaccuracy. For example, if a calibrator's specification limit is 100 ppm, but it has an actual initial error of 1000 ppm, three attempts will reduce the error to around 10 ppm. There is therefore little point in setting the percentage of specification variable below 10% (equivalent to 10 ppm).



18. 4950MTS Address

As the 4950MTS must be set to IEEE-488 bus address 20, the screen illustrated below indicates the keystroke sequence on the 4950MTS required to achieve this. When the address is set correctly, click on the **OK** button.

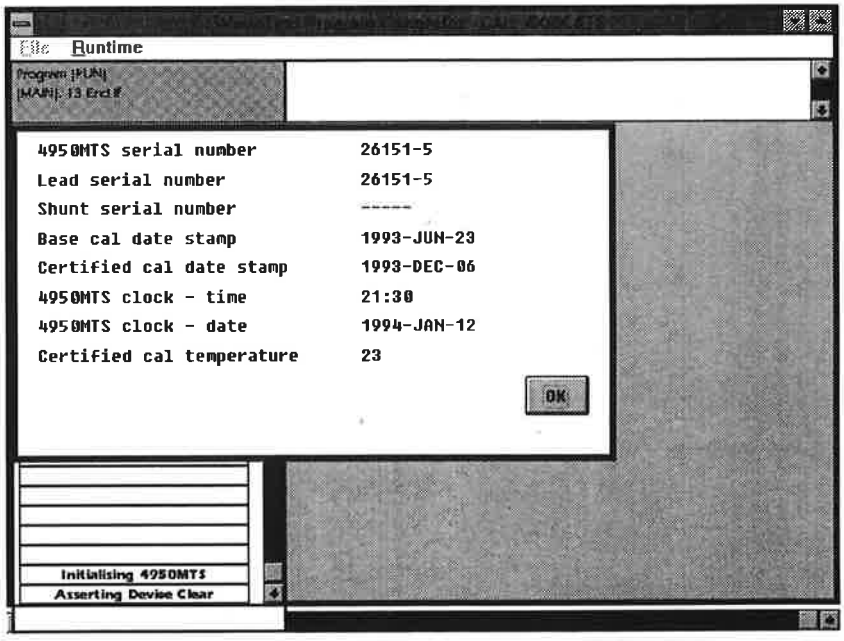
The system can now interrogate the 4950MTS for identification and status information.



19. 4950MTS Information

In the 4950MTS information screen that appears, a typical example of which is illustrated below, all the displayed information has been obtained directly from the 4950MTS via the IEEE-488 bus.

While this screen is displayed you should check that the indicated lead set and current shunt serial numbers match those that are being used. The 4950MTS must be used with the lead set and shunt indicated on the screen. For further information on the addition of the current shunt option refer to *Section 4* of the *4950 Users Handbook*.



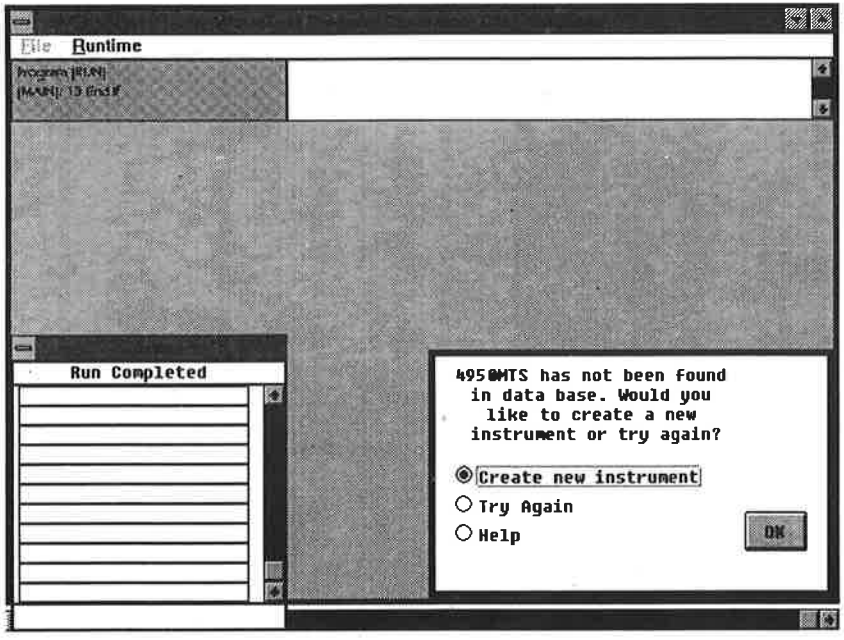
20. Instrument Not found

If the 4950MTS has not been used on the system before the error message shown below will be displayed.

If you wish to add this 4950MTS to the system, select the **Create New Instrument** option and click on the **OK** button. This will create a new subdirectory, with a name derived directly from the 4950MTS serial number displayed in the **4950MTS Information** screen, in which information relating to this unit can be stored.

If you have inadvertently connected the wrong 4950MTS into the system, and you wish to replace it with the correct one, select the **Try Again** option and click on **OK**. This will terminate and reset the program so that you can replace the 4950MTS and re-run from the beginning.

To obtain on-line help, select the **Help** option and click on **OK**.



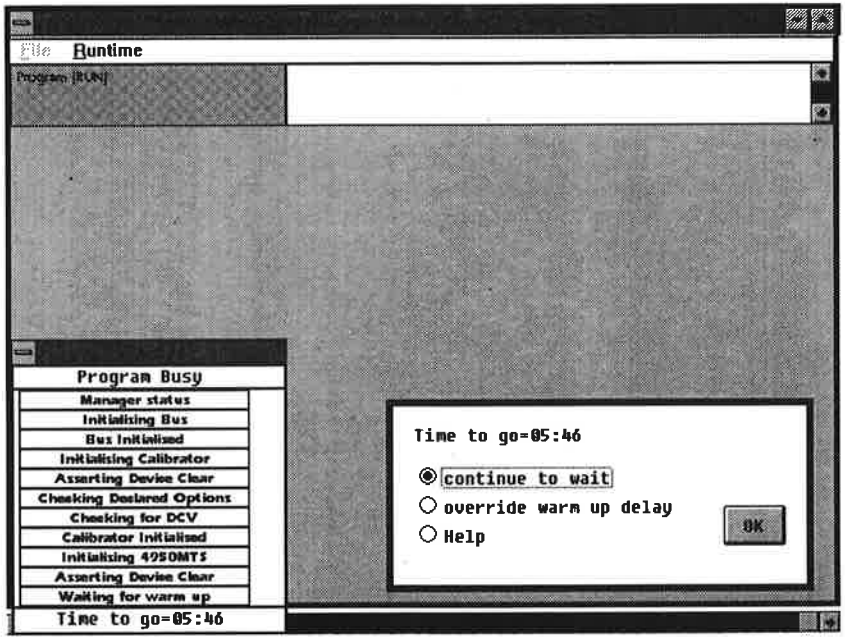
21. Warm Up Delay

Depending on the type of calibrator it is calibrating, the 4950MTS needs between 2.5 and 6 hours to warm-up before it meets the required accuracy specifications. If the 4950MTS has not been plugged in and turned on for the full warm-up period, then the time remaining will be indicated in a screen window similar to that shown below.

If you are a **System Manager**, this window will give you the option of overriding the warm-up delay. If you choose to do so, this fact will be logged and will appear in all results files. To overrride the warm-up delay, select **Override Warm Up Delay** and click **OK**.

If you are a normal system user, you have no option other than to wait until the warm-up delay period has expired. This will be indicated in the **Action** window at the bottom left of the screen.

To obtain on-line help, select the **Help** option and click on **OK**.



22. Results Format

The 4950MTS Control Software can store calibration results in a variety of different formats as indicated by the **Results Format** screen which is illustrated below. The available formats and their different uses are as follows:-

a) **ASCII text file**: A general purpose format which can be imported into virtually all word processors, DOS and general utilities.

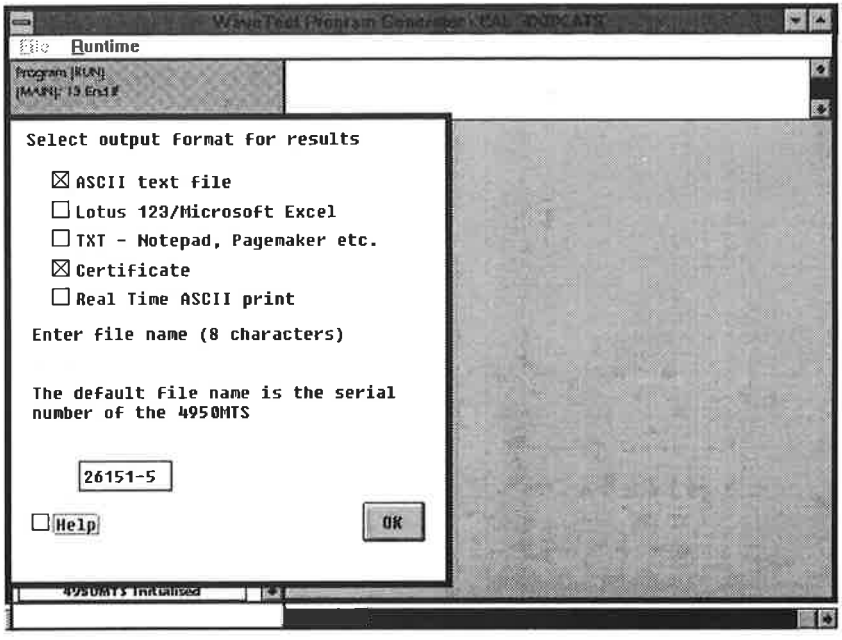
b) **Lotus 123/Microsoft Excel**: A format which can be imported into Lotus 1-2-3™ or Microsoft Excel™.

c) **TXT**: For more sophisticated, higher quality reports with headers, logos, different fonts etc, this format provides tab separated data suitable for direct importing into desktop publishing packages such as Aldus PageMaker™.

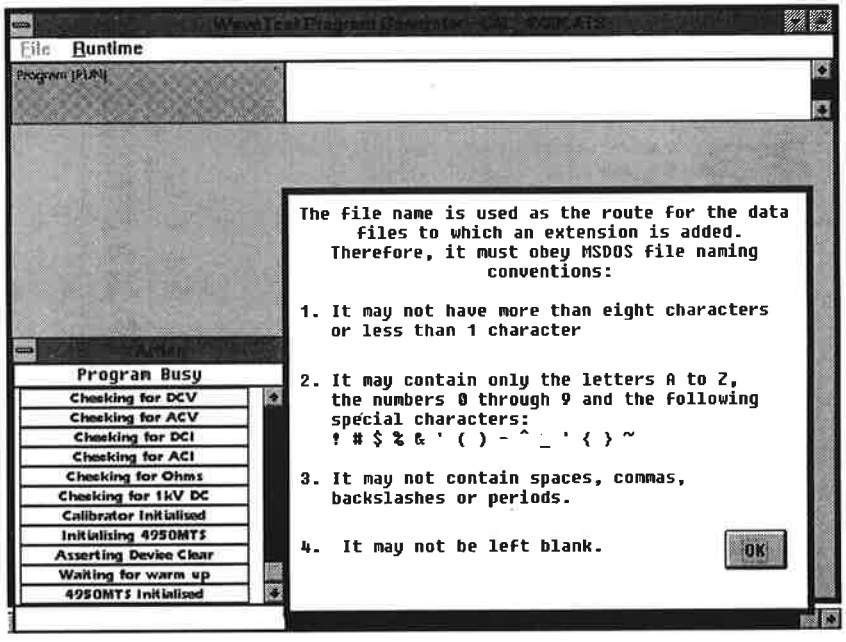
d) **Certificate**: Produces a results file which can be used by the 4950MTS Control Software's **Certificate Generator**, which allows you to customize certificates with header/footer information. For more information on the use of the **Certificate Generator** refer to *Section x* of this handbook.

e) **Real Time ASCII Print:** Selecting this option prints out the calibration results as the procedure runs, in addition to storing them in the selected file formats. To ensure that this process does not interrupt system operation, check that a suitable printer is connected to your computer's parallel printer port, and that it is on-line and operating in a condensed mode with a minimum of 120 characters per line.

You can select as many of the indicated options as you require.



The default filename given to the results file is the serial number of the 4950MTS. You have the option to change this filename, but it must conform to MS-DOS filenaming conventions. Note that you should not enter a file extension (**.<xxx>**) after the filename as this will automatically be inserted according to the different file formats that have been selected. If you enter an invalid filename — i.e. one that does not conform to MS-DOS filenaming conventions — you will be prompted by the error message shown below to edit the filename.



23. Duplicate File Name

If the filename that you specified for the results files already exists, the screen shown below will appear, giving you the option to:

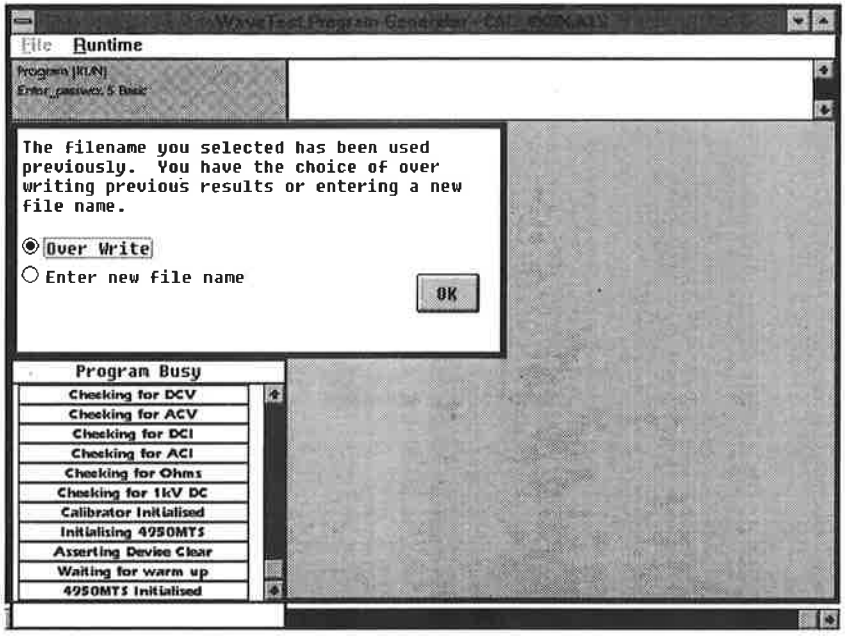
a) Over write the existing file.

b) Enter a new file name.

Click the appropriate button and then click on **OK**.

Note: If the procedure type is a pre transportation comparison, then an extra file will be created. This file is named using the 4950MTS serial number as the filename and **.PRE** as the extension. For example 715299.PRE. The format of this file is similar to the ASCII file. It is created to enable the intercomparison with the post transportation comparison results.

Note: If the procedure type is a post transportation comparison, then two extra files may be created. These files are named using the 4950MTS serial number as a filename and .DFA and .DFT as file extensions. For example 715299.DFA is the ASCII file containing the differences between the pre and post transportation comparisons, whilst 715299.DFT is the equivalent tab delineated text file. The .DFA file is only generated if the ASCII output is requested and the .DFT file is only generated if the TXT output is requested.



24. No Corrections File Found

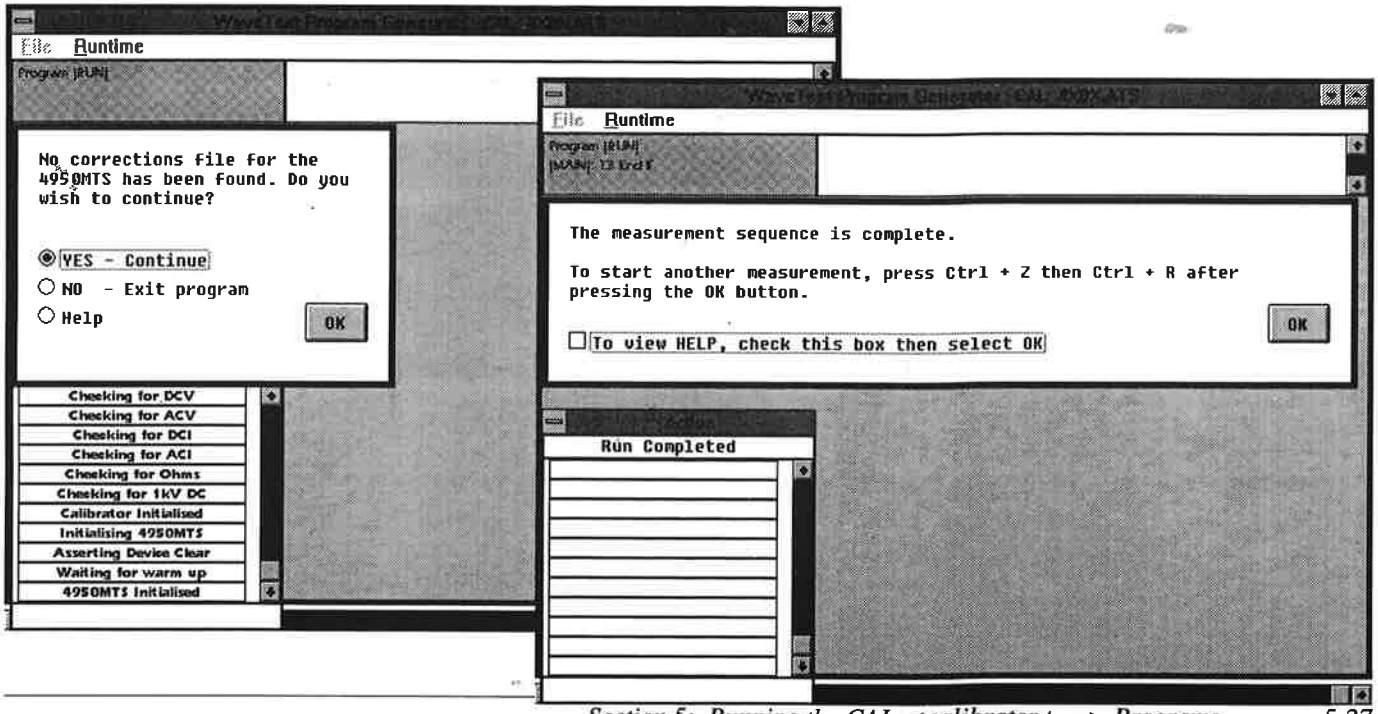
If your 4950MTS has been calibrated by a laboratory that documents the 4950MTS errors but does not adjust the instrument, or if the 4950MTS is to be used at non-nominal points for which internal adjustments cannot be made, then the appropriate calibration errors must be entered into a computer resident corrections file. The system can then access this file in order to compensate the errors.

The 4950MTS Control Software will automatically search for this file. If it cannot be located, or if its date stamp and serial number do not match those of the 4950MTS, the screen window shown below will be displayed.

If you select the **Yes** option and click **OK**, the software assumes that the 4950's certified cal stores contain correction factors which automatically correct its outputs to nominal values — i.e. that it has been **calibrated and adjusted**.

If you select the **No** option and click **OK**, the screen window illustrated at bottom right of this page will be displayed, prompting you to create a suitable corrections file for the 4950MTS. When you click the **OK** button in this window the 4950MTS Control Software will be halted and you should then click and drag the **File** menu to the **Quit** option. You can now create or modify an appropriate corections file as detailed in *Section 3* of this handbook.

Note: If you are using the 4950MTS to calibrate a Wavetek Datron Division Model 9000 calibrator or a Fluke Model 5700 calibrator (i.e. if you are running the **CAL_9000** or **CAL_5700** programs), you will not be given the option to continue. This is because a correction file must be used for these calibrators.



25. Function Request

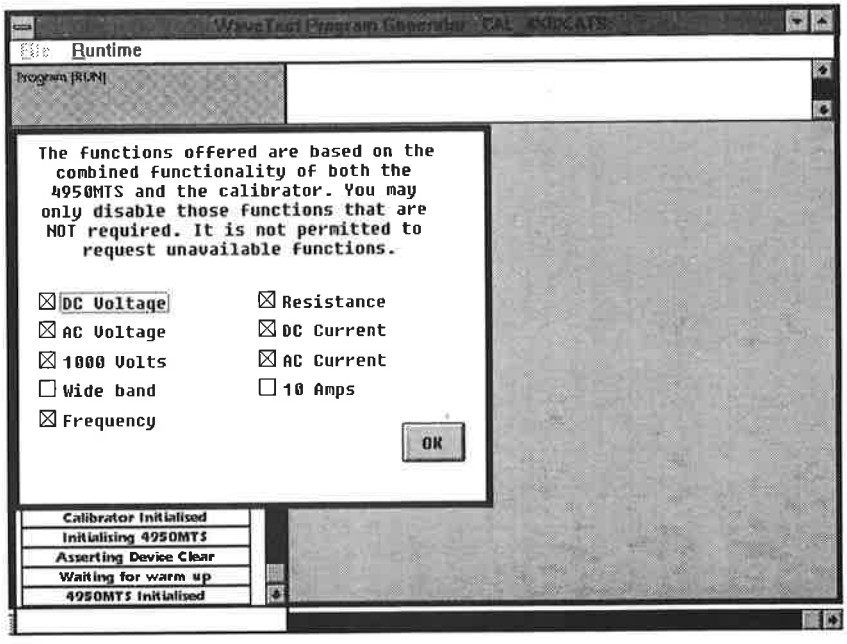
When a screen similar to that illustrated below appears, you can disable any calibrator functions which you do not wish the 4950MTS to calibrate. The displayed list of functions includes all those functions which are available in the calibrator, but only those functions which can be calibrated by the 4950MTS will appear enabled (i.e. with a ☒ box alongside them). For example, if no current shunt is specified in the 4950MTS details, then you will not be able to enable the 10A function on a Wavetek Datron Division Calibrator even if it has the high current option (Model 4600 Transconductance Amplifier) fitted to it.

To disable calibration of a particular function click in its selection box, which will then appear unchecked — i.e. ☐

To re-enable a particular function, click again on its selection box and it will reappear checked — i.e. ☒

Note: the 1000 Volts option is an additional range for the DCV and ACV functions of Wavetek Datron 4000, 4700 and 4800-Series calibrators. If neither DCV or ACV is selected then the 1000V function will not be run. This also applies to the 10Amps with respect to DCI & ACI on these calibrators.

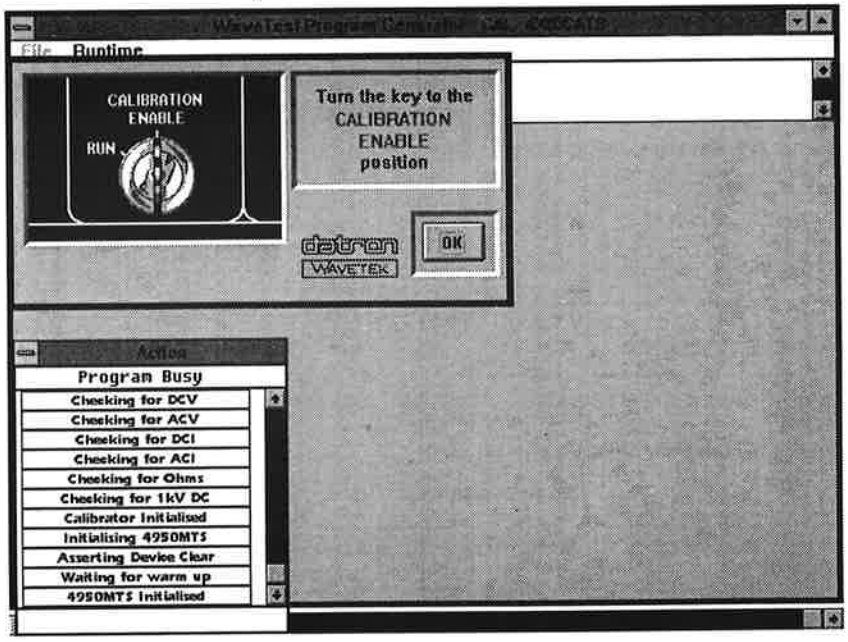
If you attempt to enable functions which cannot be enabled, an error message will appear.



26. Calibration Enable (Adjust and Verify Procedures Only)

If the procedure you selected involves adjustment of the calibrator a screen window will be displayed prompting you to carry out whatever actions are required to enable the calibrator's calibration function. As can be seen from the screen ilustrated below, for a Wavetek Datron Division calibrator, this involves turning its rear-panel calibration key to the 'CALIBRATION ENABLE' position.

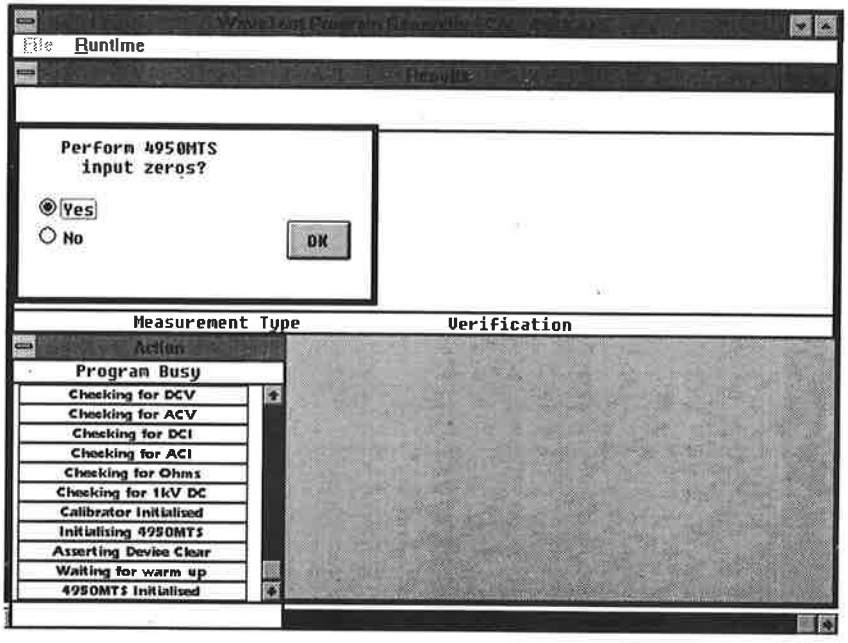
If the calibrator has an IEEE-488 controlled calibration function, the 4950MTS software will now check over the IEEE-488 bus that it is enabled. If for any reason it is not, an error message will appear. Clicking on this message's OK button wil return you to the calibration enable prompt screen.



27. Disabling Input Zeros

If you are a **System Manager** (i.e. you entered a valid system manager password at the begining of the procedure), you can optionally bypass those steps in the procedure which input zero the 4950MTS.

Input zeros should normally be performed every time the system is used, because the 'zero' point of virtually all instruments drifts to some extent with time and temperature etc. Performing input zero operations immediately prior to calibrating a calibrator with the 4950MTS eliminates any errors this might introduce. However, if you want to carry out a test run on the system simply to ascertain whether all the instruments are operating correctly, you can disable the input zero operations to save time.

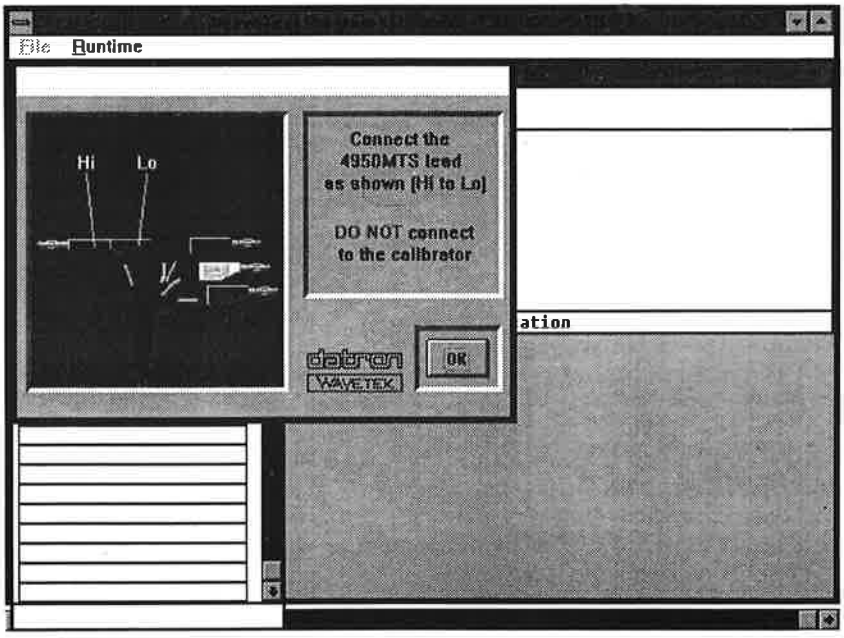


28. Input Zero Operations

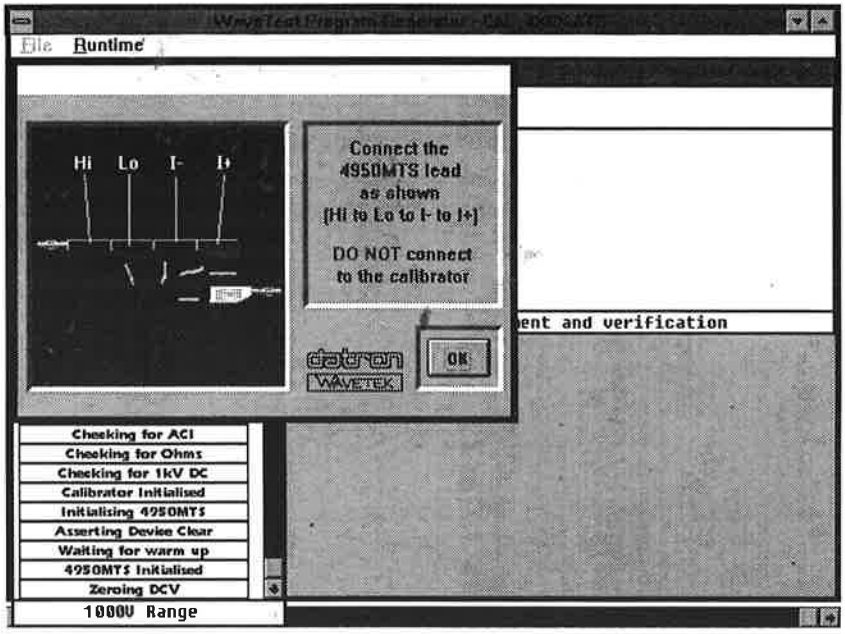
If input zero operations have not been disabled a series of screens will appear which prompt you to carry out these operations for each of the 4950MTS's measurement fucntions. When you have made the lead connections indicated in each screen, clicking on **OK** will initiate an appropriate IEEE-488 bus controlled input zero operation.

The sequence of functions for which input zero operations are carried out, and the corresponding operator prompts which appear, are as follows:-

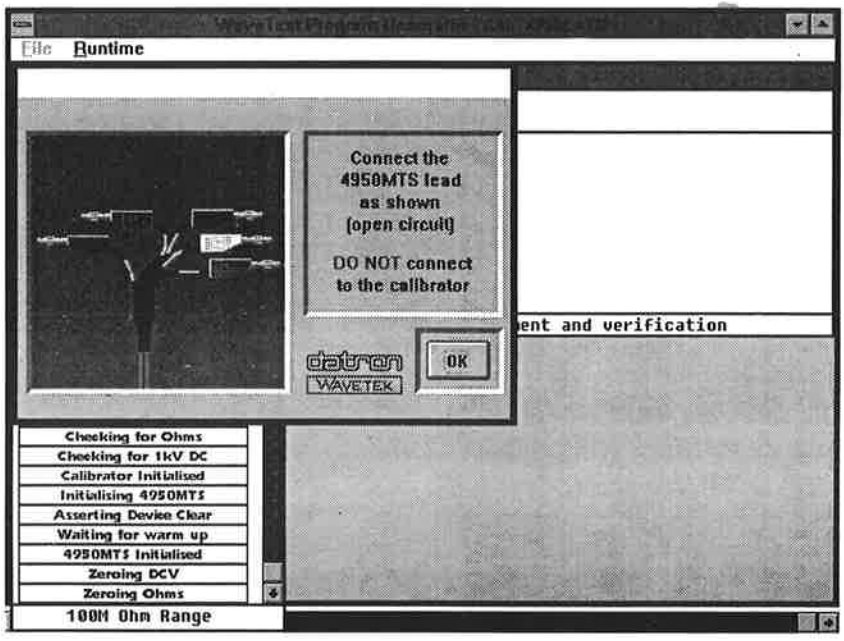
DCV, ACV and 1kV Zero Short



Resistance

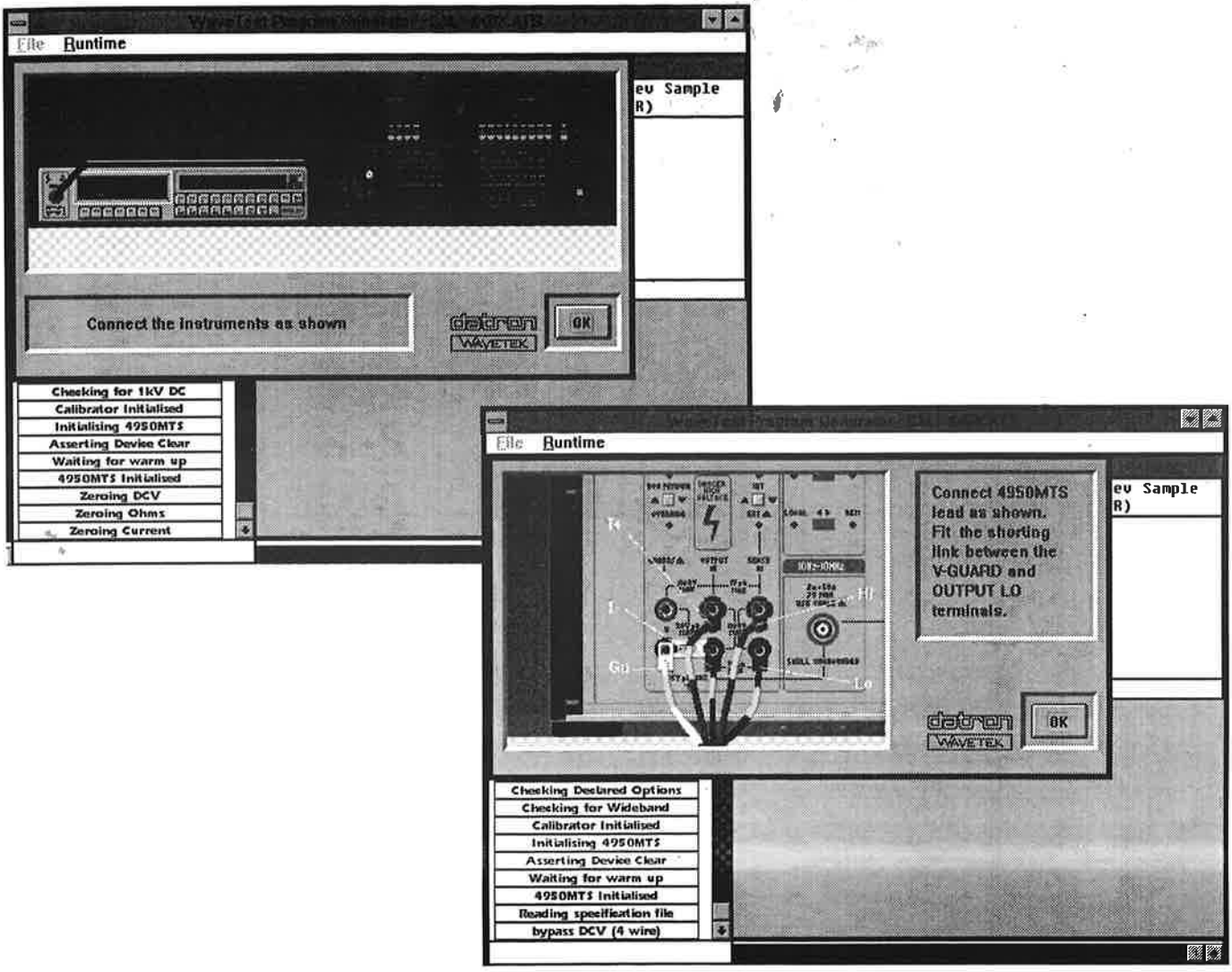


DCI, ACI and 10Amps



29. 4950MTS to Calibrator Connection

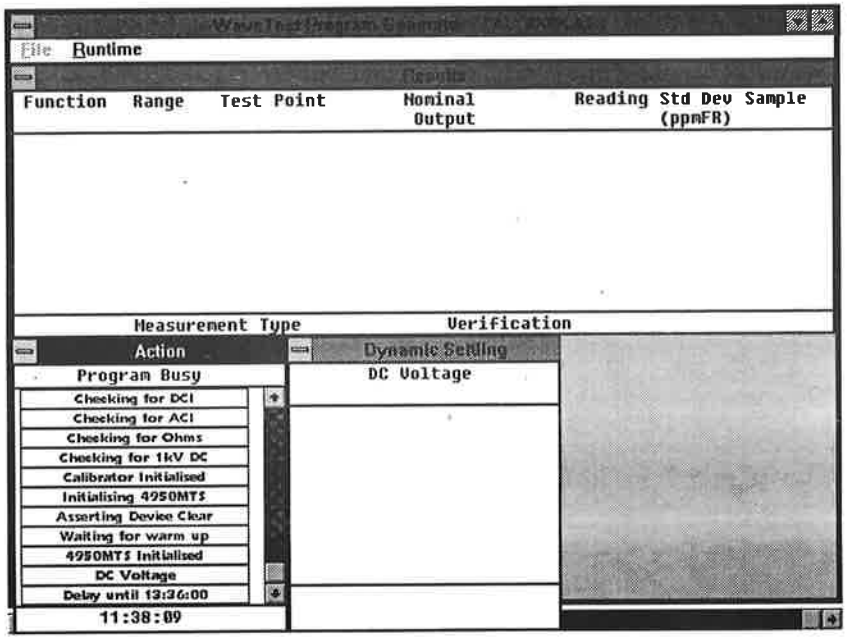
Whenever you need to change the lead connections between the 4950MTS and the calibrator, you will be prompted to do so by a screen similar to that shown below. Simply follow the instructions given in the screen before clicking on **OK**.



30. Delayed Start

If a delay was requested, then this will be reflected here. The target time will be shown in the Action window body, and the current time in the Action window footer, as shown:

When the two times match, processing will continue.



31. Taking Readings

While performance verification or adjustment of the calibrator is taking place, a readings screen similar to that shown below will be displayed.

The upper half of this screen indicates those test points which have been completed, together with the overall results obtained.

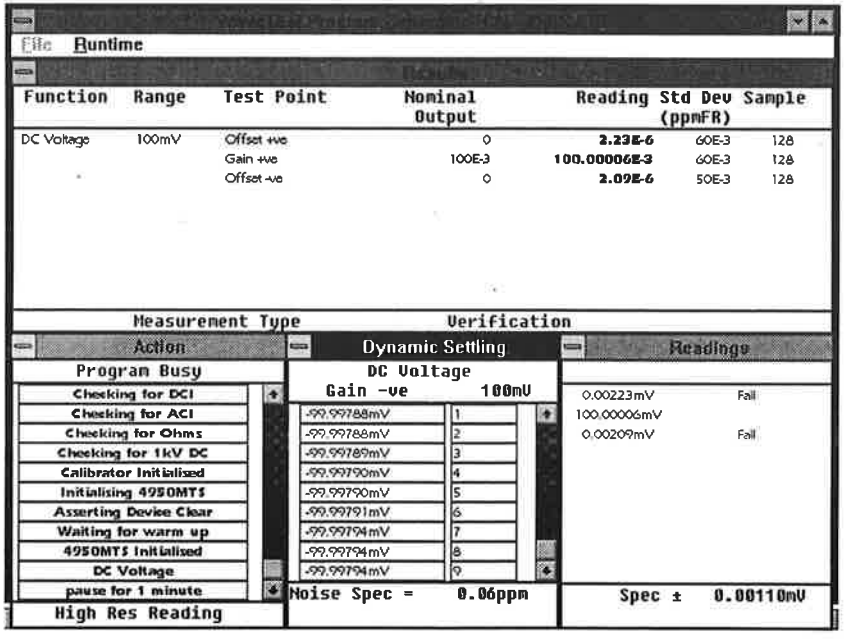
The lower half of the screen is divided into three separate windows which display the following information:-

Action Window: displays the last 11 program steps in chronological order from top to bottom, plus the current program step at the bottom.

Dynamic Settling Window: displays the last 9 readings which have been taken by the system in chronological order from top to bottom.

Readings Window: displays the final result of each test point, together with its pass/fail status, in chronological order from top to bottom.

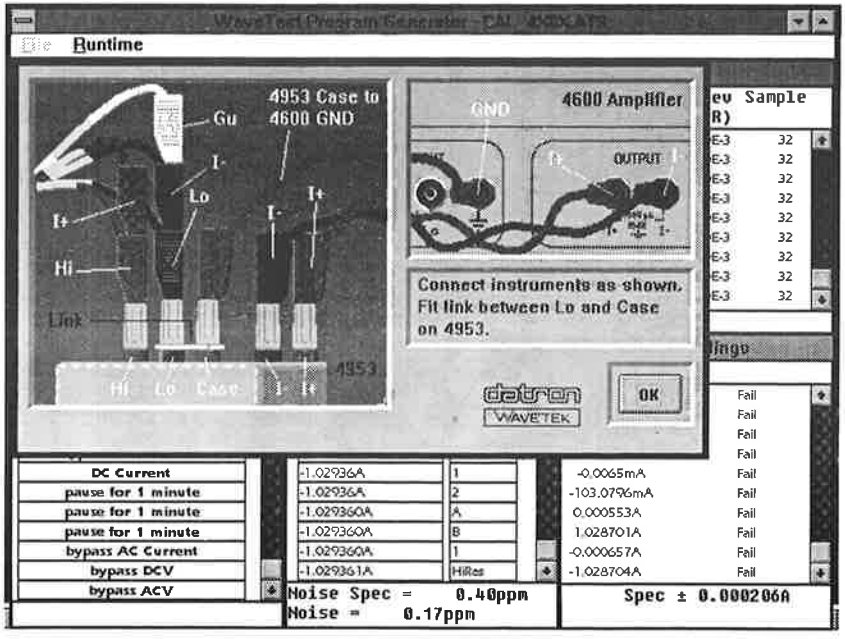
If the **Enable Intermediate Results Capture** option was selected in the **Run/Debug Options** screen, all of the above results will be stored in the results files.



32. Using the 4950MTS Current Shunt

If during the running of a procedure a 10A function is requested, a user instruction window similar to that shown below will be displayed, prompting you to connect the 4950MTS current shunt between the calibrator and the 4950MTS.

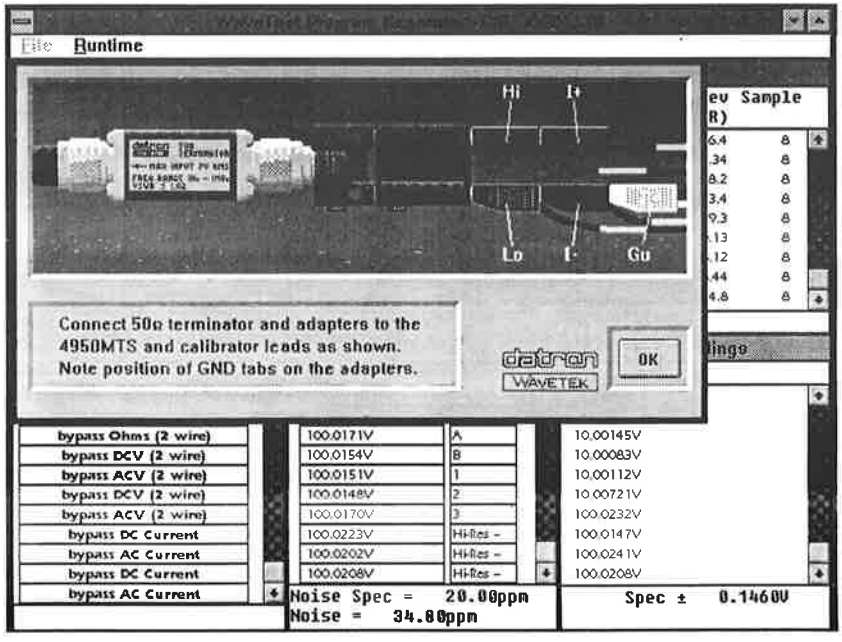
When you have made the appropriate connections, click on the **OK** button.



33. Using the 4950MTS to Measure a Wideband Function

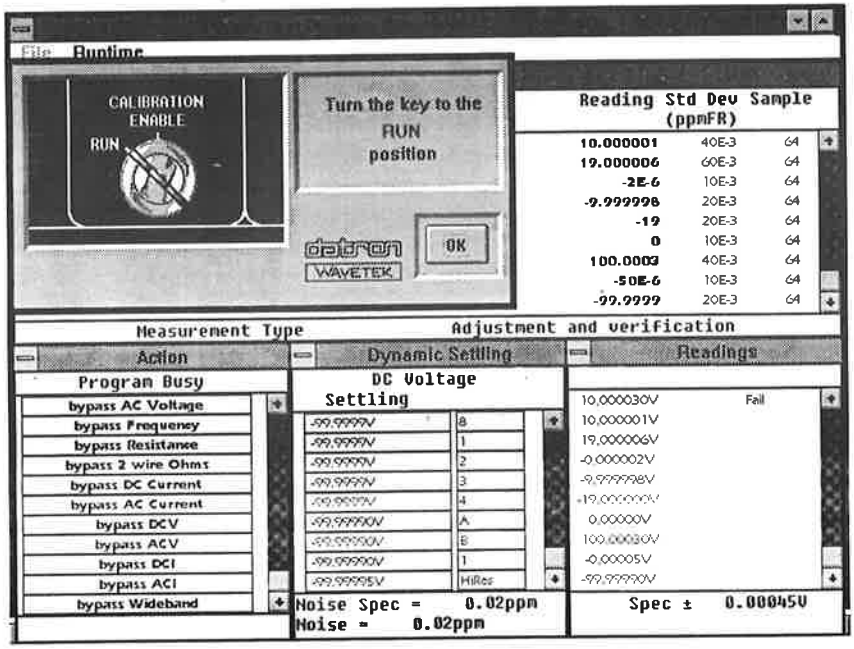
If during the running of a procedure a wideband AC function is requested, a user instruction window similar to that shown below will be displayed, prompting you to connect the 4950MTS to the wideband AC output of the calibrator.

When you have made the appropriate connections, click on the **OK** button.



34. Cal Disable (Adjust and Verify Procedures Only)

If you have just carried out the **Adjust and Verify** procedure, at the end of the run you will be prompted to disable the calibrator's calibration function by an instruction screen similar to that illustrated below.



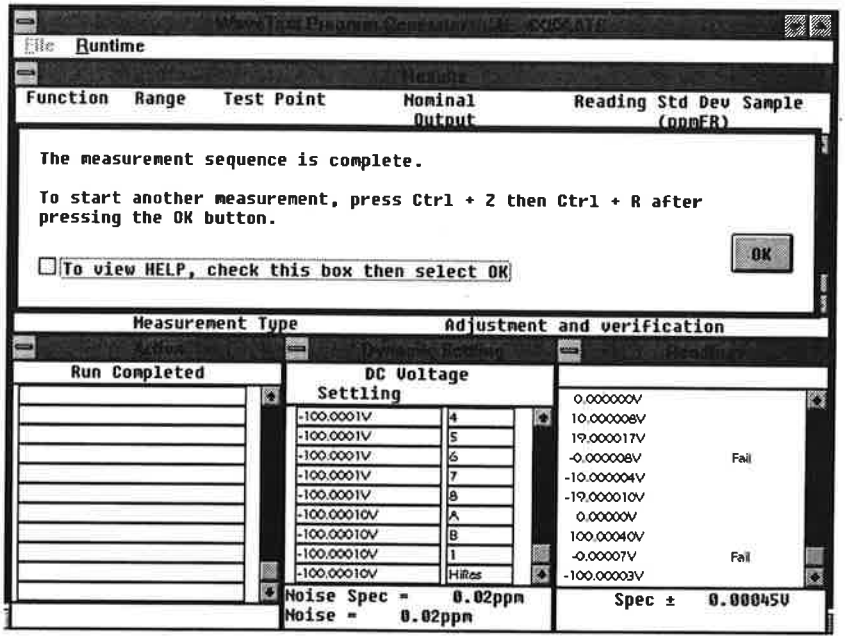
35. Program Completion

Once the run has finished, the **Action** window will clear and display the message **'RUN COMPLETED'** in its header bar. Both the 4950MTS and the calibrator will be put into a safe condition and returned to local control.

If any runtime errors occurred during the run, this fact will be indicated by the message **'Bus error or Esc'** displayed in the footer bar at the bottom of the **Action** window.

If this error message is displayed the measurement or adjustment process carried out by the procedure may be incomplete and you should **NOT** continue with subsequent calibration or verification operations on the calibrator until the source of the error has been located and overcome. As an initial course of action, review the results and if necessary rerun the CAL_<calibrator type> program to see if the error recurs.

The program may be terminated by clicking on the **OK** button and dragging the **File** menu to the **Quit** menu option.



Section 6 The MTS_CAL Program

The MTS_CAL Program — when to use it

The software suite is divided into two main programs, which run in 'Windows 3' environment. The following index shows how these programs are used during the 4950MTS calibration process for closed-loop methods A and B, and an additional method C. The MTS_CAL Program should be used at the stages where it is indicated below.

Method A

Method A 4950 resides with the calibrator. Refer to *Section 1 page 1-2 Fig. 1.1.*	
Stage 1.	Perform a Pre-transportation baseline comparison, and store the results. **Program:** **CAL_<calibrator type>** **Select:** **Pre transportation comparison**
Stage 2.	Transportation.
Stage 3.	Perform Certified calibration of the 4950, to traceable laboratory standards. **Program:** **MTS-CAL** **Select:** **Certified verify _adjust**
Stage 4.	Transportation.
Stage 5.	Perform a Post-transportation baseline comparison, and store the results. **Program:** **CAL_<calibrator type>** **Select:** **Post transportation comparison**
Stage 6.	Perform traceable Certified calibration of the Calibrator, to the 4950. **Program:** **CAL_<calibrator type>** **Select:** **Adjust and verify**

Fig 6.1

Method B

Method B 4950 resides in the Standards Laboratory Refer to *Section 1 page 1-5 Fig. 1.2.*	
Stage 1.	Perform Certified calibration of the 4950, to traceable laboratory standards. **Program:** **MTS-CAL** **Select:** **Certified verify _adjust**
Stage 2.	Perform a Pre-transportation baseline comparison, and store the results. **Program:** **CAL_<calibrator type>** **Select:** **Pre transportation comparison**
Stage 3.	Transportation.
Stage 4.	Perform traceable Certified calibration of the Calibrator, to the 4950. **Program:** **CAL_<calibrator type>** **Select:** **Adjust and verify**
Stage 5.	Transportation.
Stage 6.	Perform a Post-transportation baseline comparison, and store the results. **Program:** **CAL_<calibrator type>** **Select:** **Post transportation comparison**
Stage 7.	Report result of difference measurement.

Fig 6.2

Method C

The 4950 resides in the Standards Laboratory and is calibrated by a Wavetek Datron 4700-Series or 4800-Series 'Golden Calibrator'.

If a 4950 MTS is regularly being cycled round the closed loop calibration process, you can take advantage of the **Auto Baseline Comparison During Certified Measurement** feature in the MTS_CAL program to dramatically reduce the number of measurement operations. This scenario is illustrated in Fig 6.3.

When this feature is enabled, results are obtained for both the 'certified' and 'baseline' modes of the 4950MTS at each measurement point. The certified results appear in the normal results files, while the baseline results provide the post-transportation loop-closure information for the previous cycle and the pre-transportation loop-closure information for the next cycle.

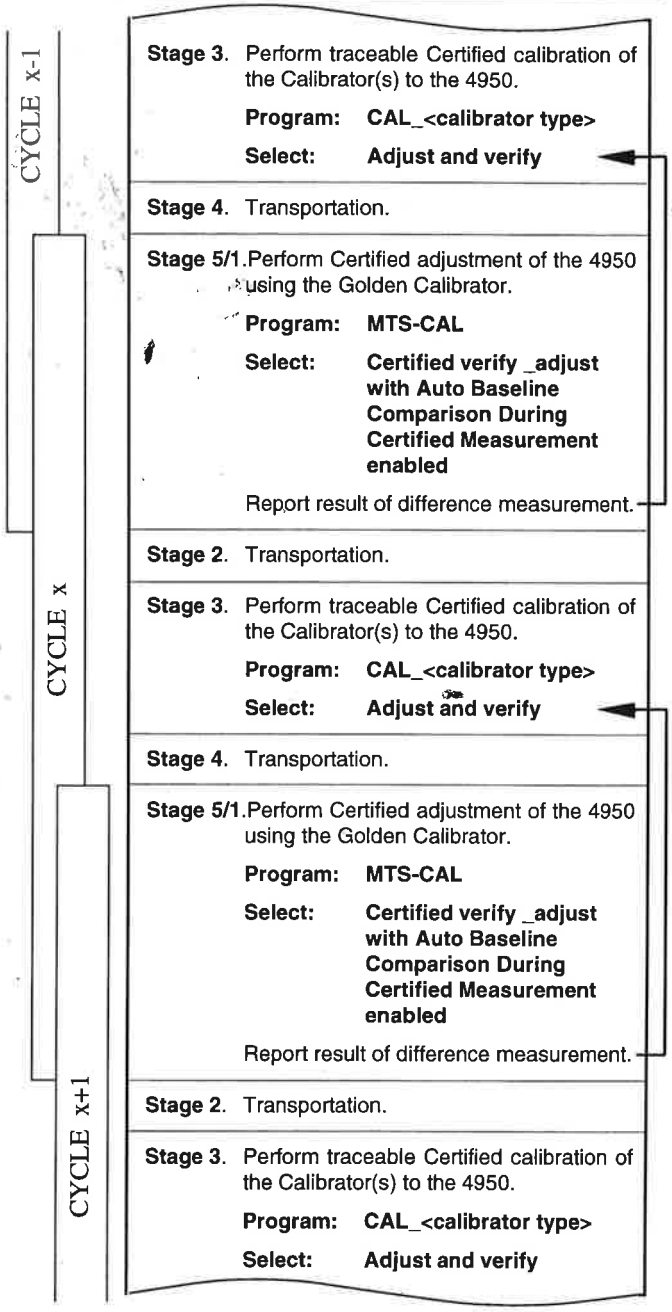


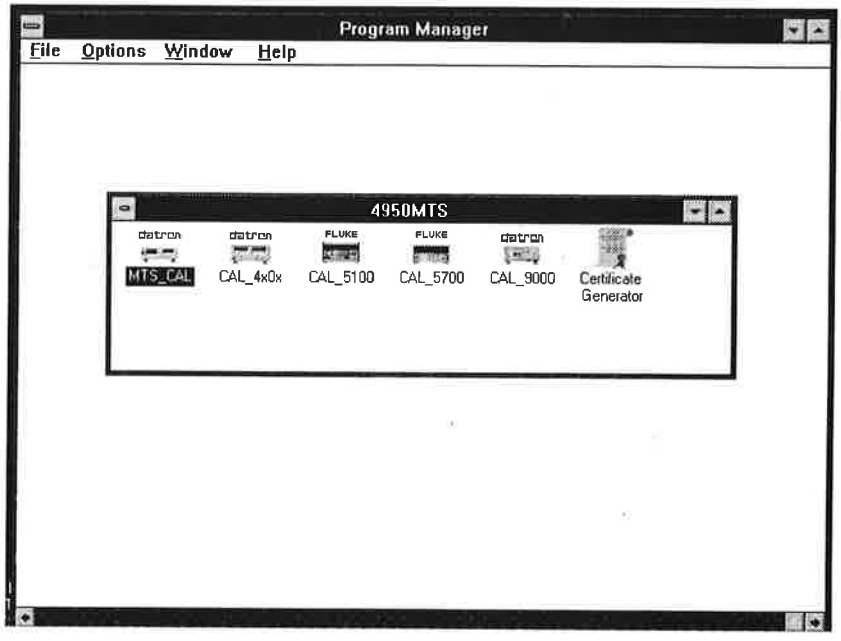
Fig 6.3

Running the MTS_CAL Program

1. Starting the Program

From the Windows™ desktop, double-click on the 4950MTS icon to open up the menu window of 4950MTS Control Software programs shown below.

To start the **MTS_CAL** program running, simply double-click on its program icon.

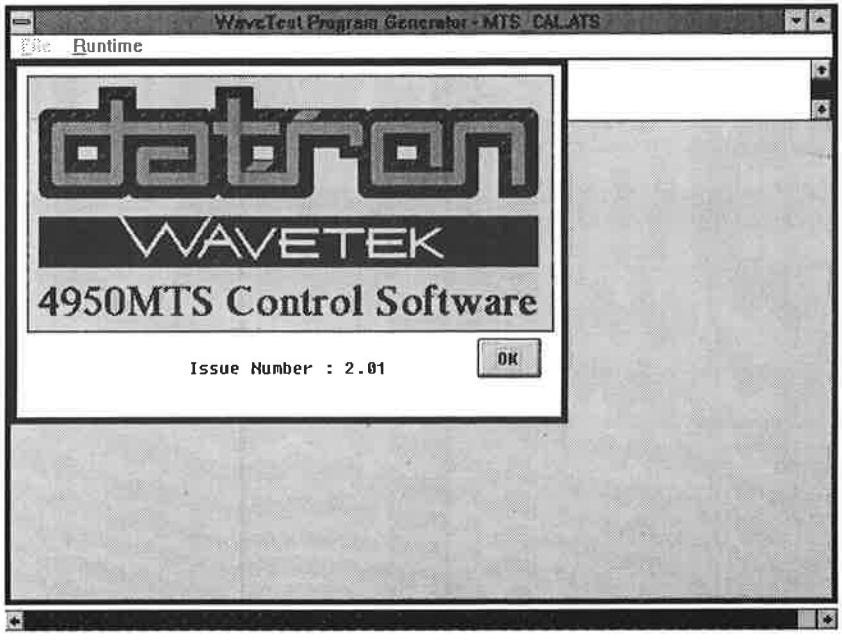


1. Title Page

Using the mouse, click on the **OK** button or press the **Space Bar**.

Note: The space bar cannot be used to move to the next screen unless the only control on the screen is the **OK** button. This is the case for the head page and all graphical user instructions, such as IEEE-488 and analog connection instructions.

The title page also displays the version number of the software. This should be quoted in all communications with Wavetek concerning this software package.



2. System Environment Details.

The time and date displayed are obtained from the system. If they are in error, then the system must be halted and returned to DOS and the appropriate action taken. This may be via use of the date and time commands or by use of a utility to access the battery backed RAM.

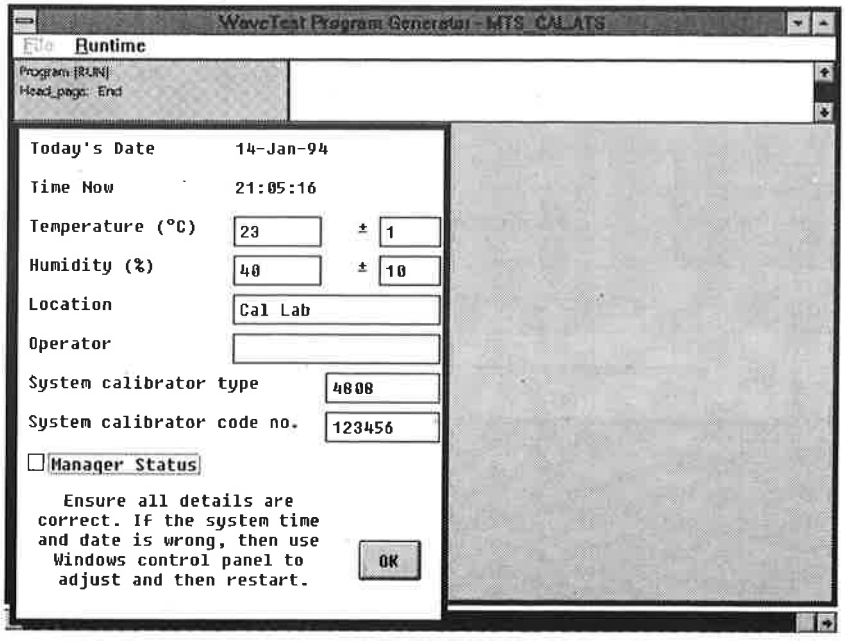
Note: If it is desired to terminate the program, follow these steps:

a. If an operator window (a screen with an **OK** button on it) is displayed, press and hold the **Ctrl** key, press and release the **Break** key, release the **Ctrl** key and then press the **OK** button. Depending on whether or not the bus has been initialised yet, the system will either stop with a break error message or perform a system shut down.

b. If the system is running (taking readings or delaying) simply press the **Esc** key which will cause a system shut down to occur. Note that if the system is occupied with taking a reading, that reading will be completed before the system responds to the request to abort.

The remainder of the data displayed is read from a file called **ENVIRONM.ENT** which is stored in the **DATAFILE** subdirectory. Ensure that the **System Calibrator Type** is either a 4000A, 4200A, 4700, 4705, 4707, 4708, 4800, 4805 or 4808. Any other type will not be recognised by the system, and the calibrator type will have to be reselected.

Edit the data until it is correct and press the **OK** button with the mouse pointer. At this point, the data on this screen will be written to the environment file.



3. Password Protection.

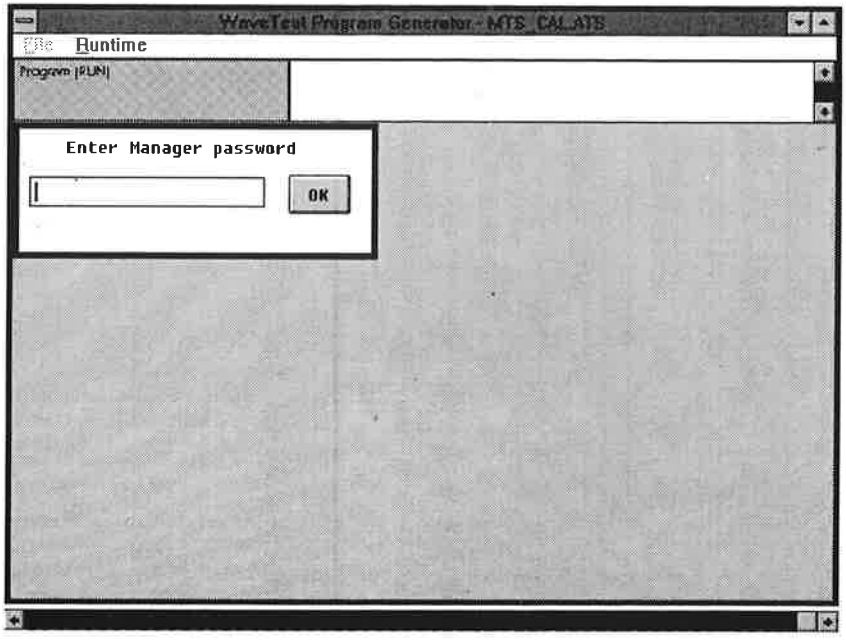
If the "Manager Status" box was checked on the environment page, then you will be asked to enter a valid password. Entering a valid **Manager Password** at this point gives you access to the following facilities:

i. The ability to perform a delayed start.
ii. Multiple runs.
iii. The ability to bypass the need for input zeros.
iv. Debugging.

If you get the password wrong three times then you are declared as a manager level intruder in the action window, and you are only allowed access to the facilities granted to a normal user.

You can obtain a **Manager Password** by filling out the **'Declared Manager'** reply card which was shipped to you with the 4950 MTS Control Software and returning it to your nearest Wavetek Service Center. A unique password will then be forwarded to you and you will also be registered to receive 4950 MTS software support. When you receive the password, keep it in a secure place or commit it to memory.

Warning: Misuse of password-protected software could invalidate the calibration process. **Wavetek cannot accept liability for the misuse of password-protected software.**



4. Calibrator Details Database

If a database file already exists for the calibrator code number entered in the **System Environment Details**, its contents will be displayed in a **Calibrator Details Database** screen window similar to that shown below.

If necessary, edit the information contained in the database fields and then click **OK**.

Instrument Not Found

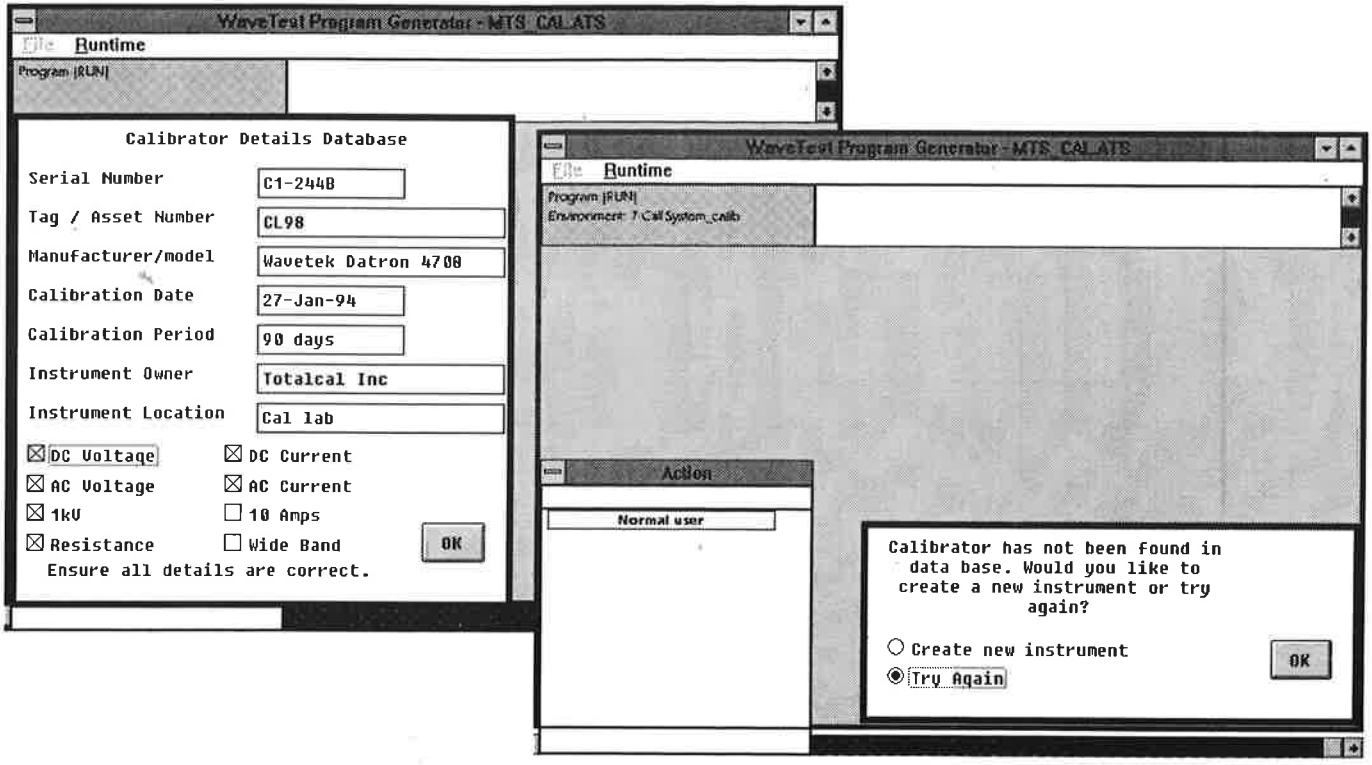
If no database file exists for the calibrator code number entered in the **System Environment Details** (for example, if this calibrator has never been calibrated on the system before) the screen shown below will appear.

At this point you have the option to either:

a) Create a new file with this filename by selecting the **Create New Instrument** option .

b) Enter a new calibrator type and serial number by selecting the **Try Again** option.

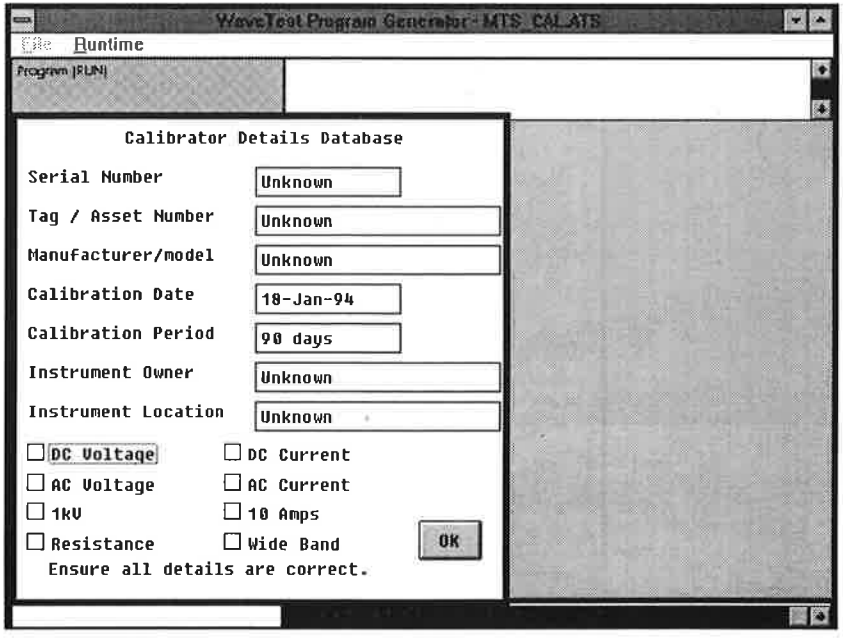
After selecting the required option, click on **OK** to continue.



Empty Calibrator Details Database

If you selected the **Create New Instrument** option, the empty **Calibrator Details Database** screen shown below will appear. Enter appropriate data into each box and then click on **OK**.

Note: The function boxes that you select/deselect in the lower half of this window are **NOT** the functions that will be run in the procedure, but are a reflection of the 'available functionality' or the 'option fit' of the instrument.

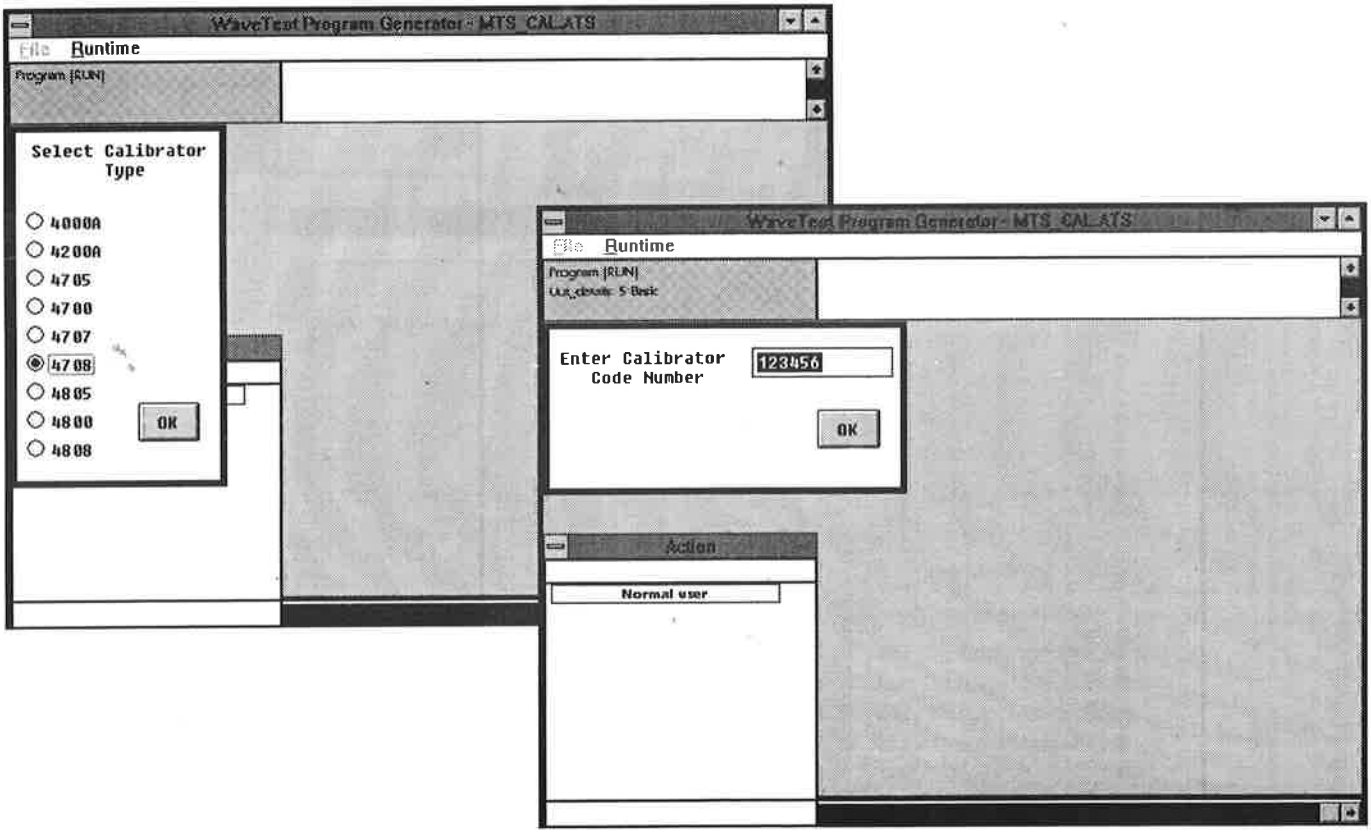


Try Again Selection of Calibrator

If you selected the **Try Again** option, the **Select Calibrator Type** screen shown below left will appear. Click on the radio button for the model of calibrator you wish to reselect and then click on **OK**.

A screen window will then appear asking you to enter the calibrator's code number.

Note: The calibrator's code number is not necessarily its serial number. It is the code number which the system uses to uniquely identify the calibrator, by creating a sub-directory in which all test results relating to this calibrator will be stored. It must therefore conform to MS-DOS filename conventions.

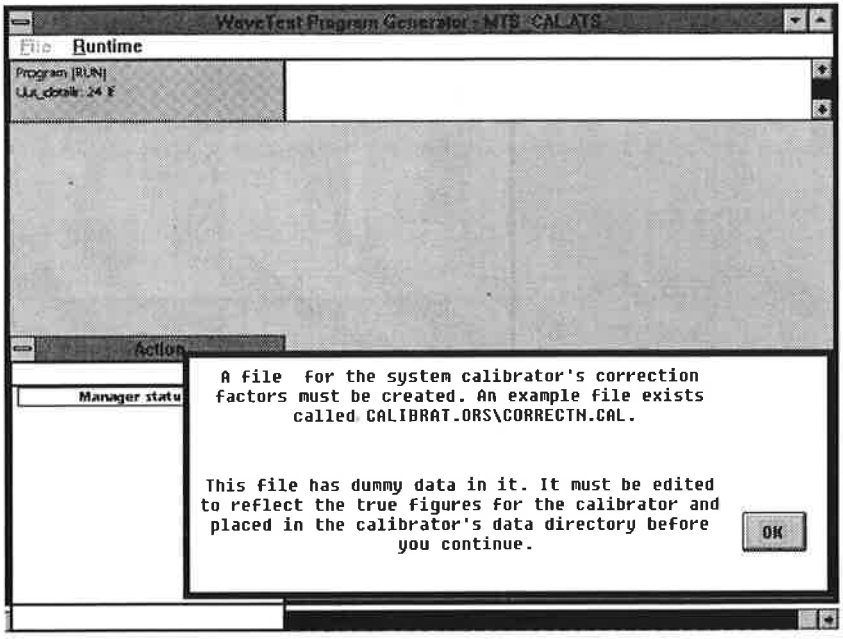


5. Calibrator Corrections File

One of the uses of the **MTS_CAL** program is to calibrate a 4950MTS against a 'golden' Wavetek Datron Division calibrator. Because the 4950MTS uses many more calibration points than can be corrected by the **Autocal** calibration facilities in these calibrators, correction factors for all the calibration points must exist in a corrections file contained in your computer. The correction factors will be derived from the calibration data provided by the calibration laboratory which calibrates the 'golden' calibrator.

At this point in the program the 4950MTS Control Software will search for this corrections file in the calibrator's data subdirectory.

If it is not found the prompt message shown below will be displayed. When you click on this message's **OK** button, the **MTS_CAL** program will terminate and should be re-run after you have created the appropriate corrections file.



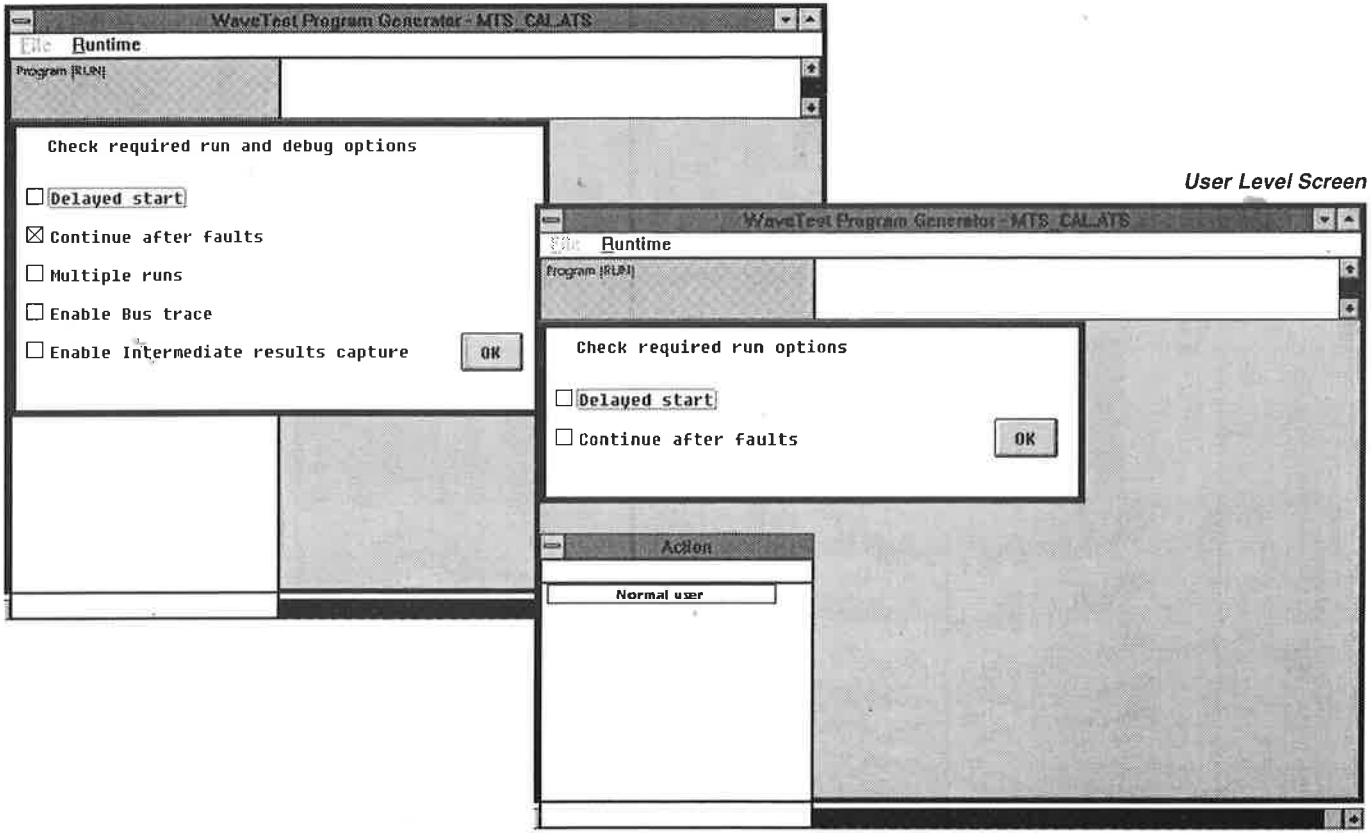
6. Run and Debug Options (Manager Level)

If you entered a valid **Manager Password**, you will presented with the **Run and Debug Options** screen shown below left. This screen allows you to select and deselect the various run-time options that are made available to system managers. After you enable or disable each of the options detailed on the following pages and enter any required data, you will be returned to the **Run and Debug Options** screen. When you have enabled or disabled all the required options, click on the **OK** button.

Run and Debug Options (User Level)

If you are a normal user (i.e. not a System Manager) the **Run Options** screen shown below right will appear, containing only the **Delayed Start** and **Continue After Faults** options. Operation of these two options is described on the following pages.

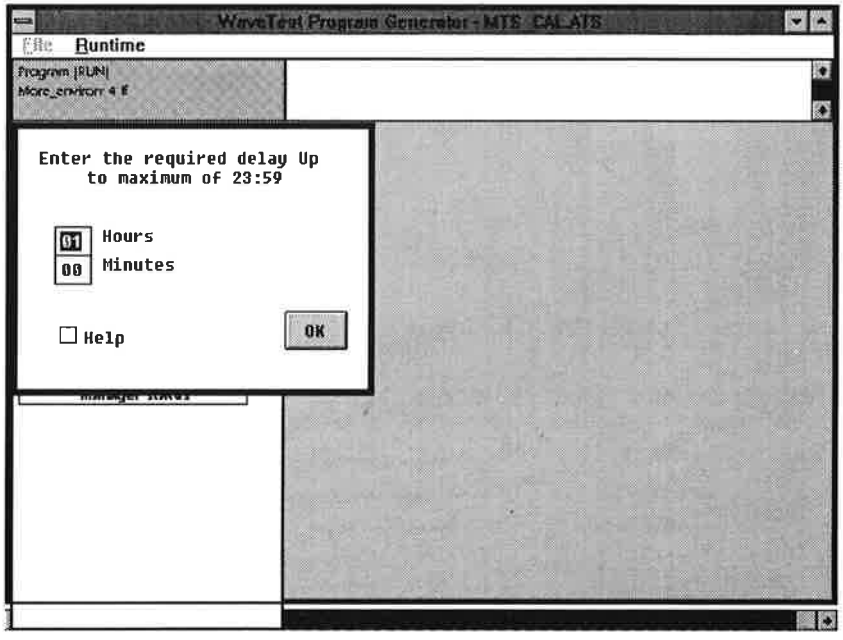
Manager Level Screen



6a. Delayed Start (Manager and User Level)

This option allows additional time over and above any warm up time required by the 4950 MTS. The 4950 MTS knows how long it has to go until it is warm, but the calibrator does not. Therefore, you can use this facility if the 4950 MTS has already warmed up but the calibrator has not, or it can be used to delay a run until there is less electrical noise in the environment — for example, until nightime hours.

Enabling the **Delayed Start** option open up the screen window shown below. Enter the required time delay in hours and minutes. The maximum allowable delay is 23 hours and 59 minutes.



6b. Continue After Faults (Manager and User Level)

Any faults which occur during operation of the system are detected by the 4950MTS Control Software. The way in which the software responds to these faults depends on whether the **Continue After Faults** option is enabled or disabled.

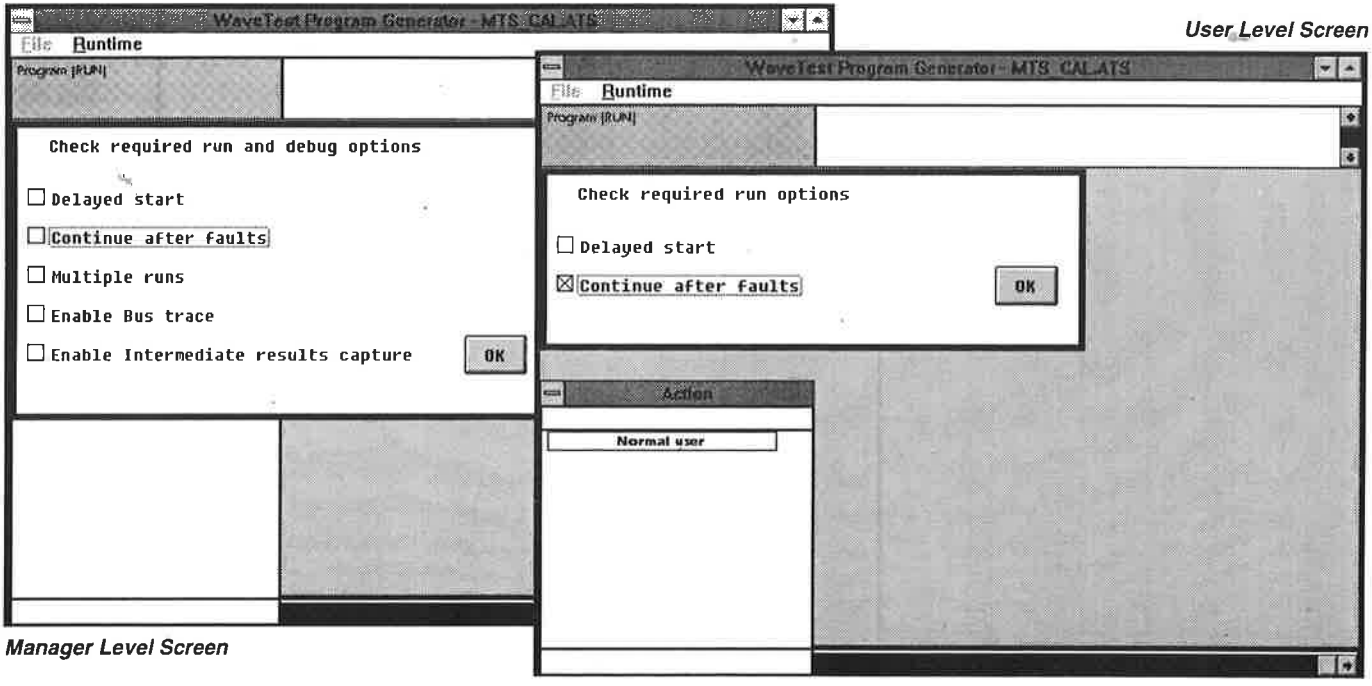
a. If **Continue After Faults** is enabled ☒, any faults which occur will be displayed in the bottom line of the **Results** window, but the program will continue. As a result, the displayed fault will always be the last fault that occurred, if any, even at the end of the run. This fault information is also reflected in any result files that are retained for later use — e.g. Lotus 123 and ASCII files.

b. If **Continue After Faults** is disabled ☐, the program will halt whenever a fault is detected, the nature of the fault being displayed in the bottom line of the **Results** window.

The user will then be presented with a screen window that allows him/her to either:

i. **Continue:** The system will attempt to continue. If an error occurred that involves the re-sending of an IEEE-488 bus query command, the act of so doing may create a "query' error in its own right. This will be reported and if continue is re-selected the system should recover. **Note:** If this type of fault occurs, please note it, together with any available information about the current configuration of both instruments and any data displayed on the screen, and report all this information to Wavetek Datron Division.

ii. **Abort:** The system will perform a controlled system shut down.



User Level Screen

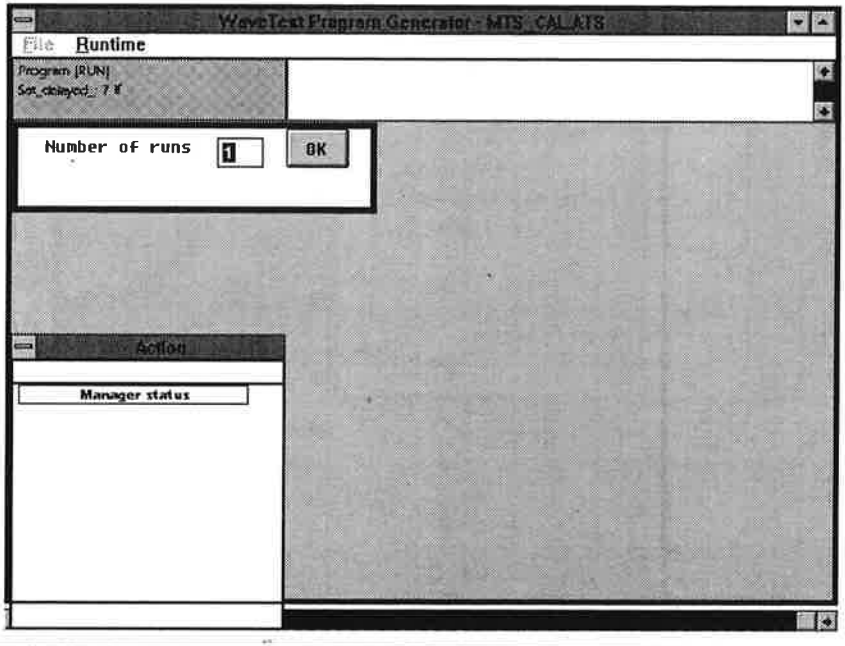
Manager Level Screen

6c. Multiple Runs (Manager Level Only)

This facility can be used to prove repeatability of 4950 MTS measurements, or to exercise instruments through burn in procedures etc. If selected, it will cause the same procedure to be run the selected number of times, test data being stored in one contiguous block in the results files.

Enabling the multiple run option results in the screen shown below being displayed, in which you should enter the number of runs required. This should be a whole number between 1 and 32767. (Note, however, that 32767 runs would typically take about 15 years!)

Note: If a delayed start is requested in conjunction with multiple runs, the delay will be performed before every run in the multiple run.



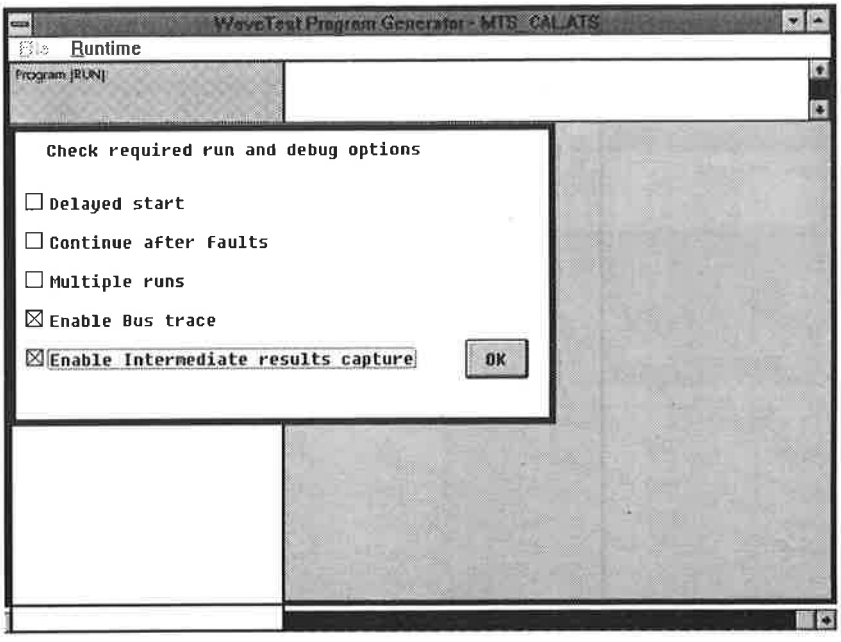
6d. Enable Bus Trace (Manager Level Only)

If this option is enabled a file is generated called **BUS_TRCE.DBG** in the software's root directory. This file records all IEEE-488 bus traffic in a well laid out and understandable format.

Note: Use this option with care as it will generate a file of about 2MBytes!

6e. Enable Intermediate Results Capture (Manager Level Only)

When enabled, this option re-directs the screen information from the bottom three data windows into files. These files, which contain the Action, Dynamic Settling and Readings information are called **ACTION.DBG**, **SETTLE.DBG** and **READINGS.DBG** respectively, and are stored in the software's root directory. This is useful, for example, during a calibration in which four readings may have been taken, with adjustments after the first three, but only the last one is reported on the certificate.



7. Procedure Type (Manager Level)

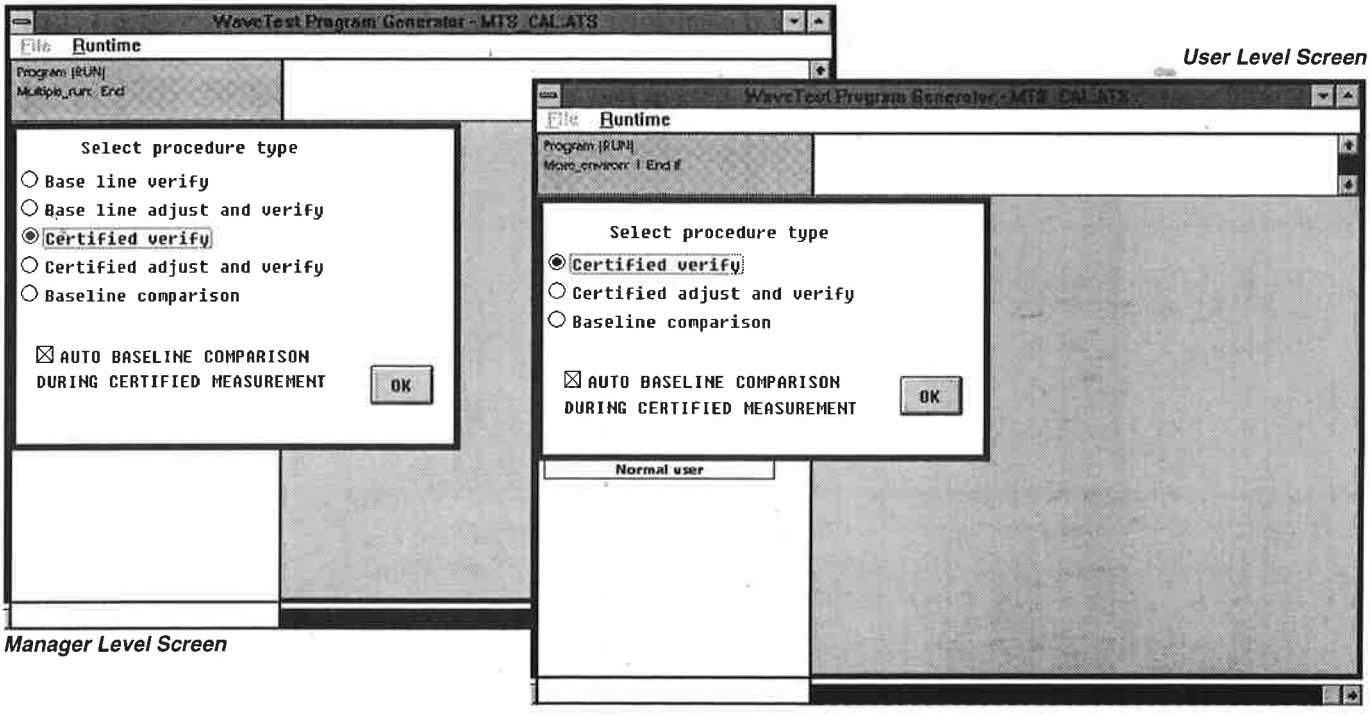
If you are a **System Manager**, after you have selected the required Run/Debug options and entered any additional data required by the enabled options, the **Procedure Type** selection screen shown below left will appear. Note that as you are a system manager you can select procedures which verify or adjust and verify both the **Baseline** and **Certified** cal stores of the 4950 Multifunction Transfer Standard.

Select the appropriate procedure by clicking on its radio button and then click **OK**.

Procedure Type (User Level)

If you are a normal **System User**, the **Procedure Type** screen which appears will be the one shown below right. Note that this screen only allows you to select procedures which verify or verify and adjust the **Certified** cal stores of the 4950 Multifunction Transfer Standard.

Select the appropriate procedure by clicking on its radio button and then click **OK**.



Auto Baseline Comparison

An additional check box at the bottom of the procedure list allows you to select or deselect **Auto Baseline Comparison During Certified Measurement**. If this function is selected, each time the **Certified Verify** or **Certified Adjust and Verify** programs check one of the 4950MTS's calibration points, they will also record the 4950MTS's calibration error with respect to its baseline calibration stores, storing the results in a separate file.

When a 4950MTS is returned from the field after being used to calibrate a number of calibrators, the **Auto Baseline Comparison During Certified Measurement** function can be used in conjunction with the **Certified Adjust and Verify** procedure to simultaneously adjust the 4950's outputs to nominal, and produce the error files required to check the 4950MTS's baseline performance has not changed when it is next returned.

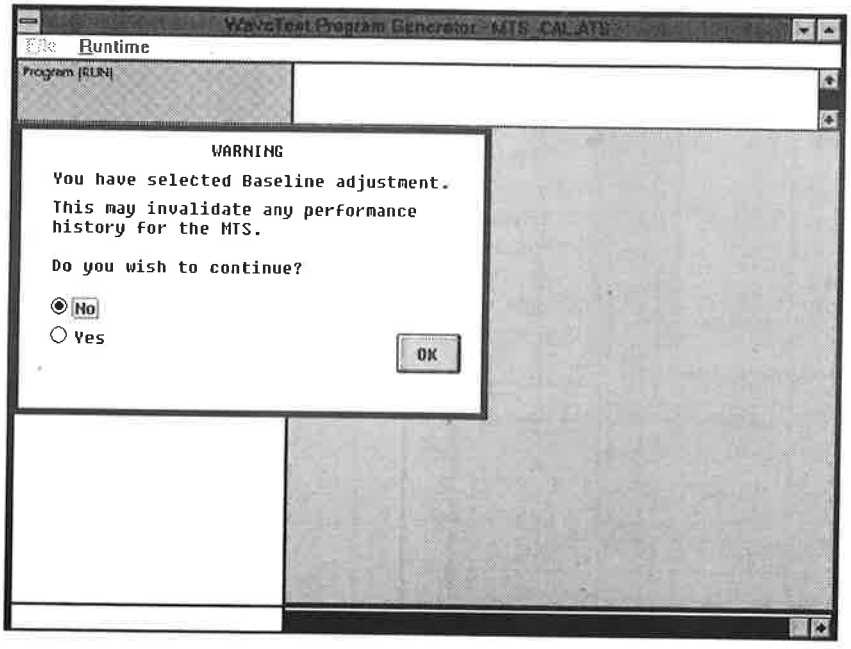
Baseline Calibration Warning

If, as a system manager, you selected the **BaselIne Adjust and Verify** procedure, the warning shown below will be displayed. This is merely to remind you that a baseline adjustment may affect the performance history of the 4950MTS.

You now have the option to:-

a) Continue by selecting the **Yes** option.

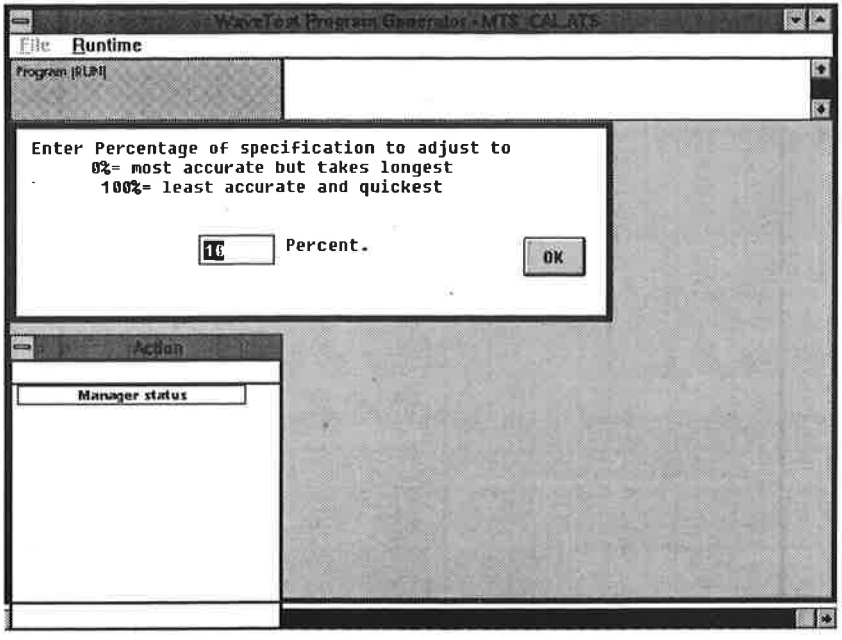
b) Abort the procedure by selecting the **No** option.



8. Percentage of Specification (Adjustment Procedures Only).

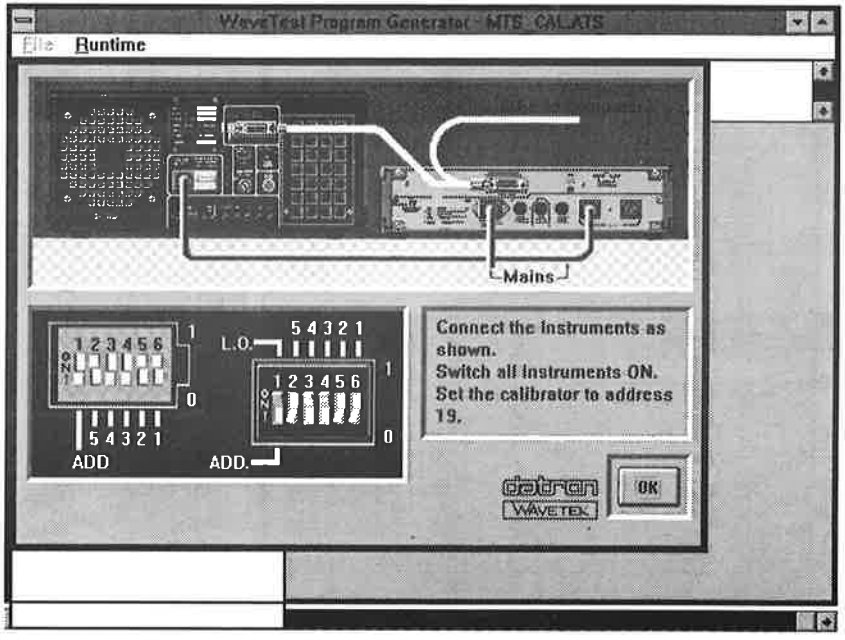
If you select a procedure which will adjust the 4950MTS — i.e. an **Adjust and Verify** procedure — the window illustrated below will prompt you to specify the percentage of specification to which you want the 4950MTS adjusted. It is usually desirable to calibrate it so that its measurements are as close as possible to the nominal calibration point values. However, the tighter you make this specification (i.e. the lower number you enter into the **Percentage of Specification** window) the longer it will take to achieve this goal. The compromise is left up to the user, but a percentage of specification of 10% is normally recommended.

Note: The system will never make more than three attempts to adjust the accuracy of any one calibration point to nominal. Assuming that the adjustment procedure achieves an order of magnitude improvement at each attempt (i.e. it improves a 200 ppm error to around 20 ppm, or a 100 ppm error to around 10 ppm) the optimum percentage of specification will depends to some extent on the initial degree of 4950MTS innaccuracy.



9. IEEE-488 Connections

This is a user instruction screen that shows the operator the correct way to connect IEEE-488 and power cables between the calibrator and the Model 4950 Multifunction Transfer Standard. For example, as illustrated below, it indicates that the IEEE-488 bus leads should be connected from the computer to the 4950MTS and from the 4950MTS to the calibrator. It also indicates that the power for the calibrator must be supplied via the power outlet on the 4950MTS rear panel. It also prompts the operator to switch all instruments on and set the calibrator to the correct IEEE-488 bus address.



10. Instrument Not Found

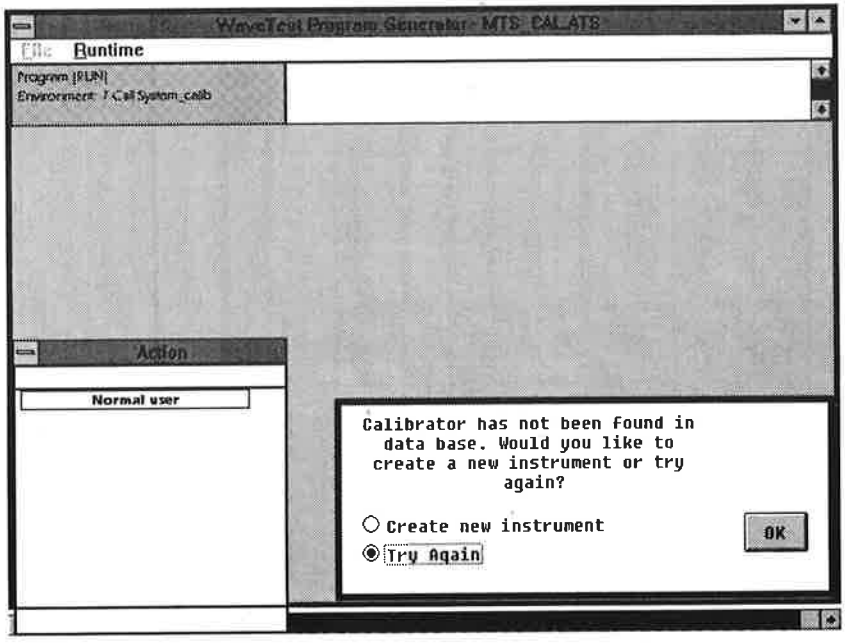
The 4950MTS Control Software now reads identification data from the calibrator via the IEEE-488 bus and checks it against the calibrator data contained in the **System Environment Details** database. If a mismatch occurs, the error message shown below will be displayed.

You can now select either:-

a) **Create New Instrument:** Select this option if the calibrator has not been used on the system before. When you click on **OK**, you will be presented with an **Empty Calibrator Details Database** similar to the that which appeared earlier in the **MTS_CAL** program. Enter appropriate data into each box and then click on **OK**.

b) **Try Again:** Select this option if you think you may have made a mistake with either the calibrator type or code number. You will be presented with two consequetive windows — the first allowing you to reselect the calibrator type and the second allowing you to enter a new calibrator code number.

If a calibrator corrections file does not exist for the calibrator you have defined above, you will be asked to create one and re-run the program.



11. Cal Store Mismatch

At this point, the system checks via the IEEE-488 bus that the calibrator complies with the functionality declared in the **Calibrator Details Database**. The calibrator identification data, held in the calibrator's user store, is also checked for a match with the data stored in the system data base.

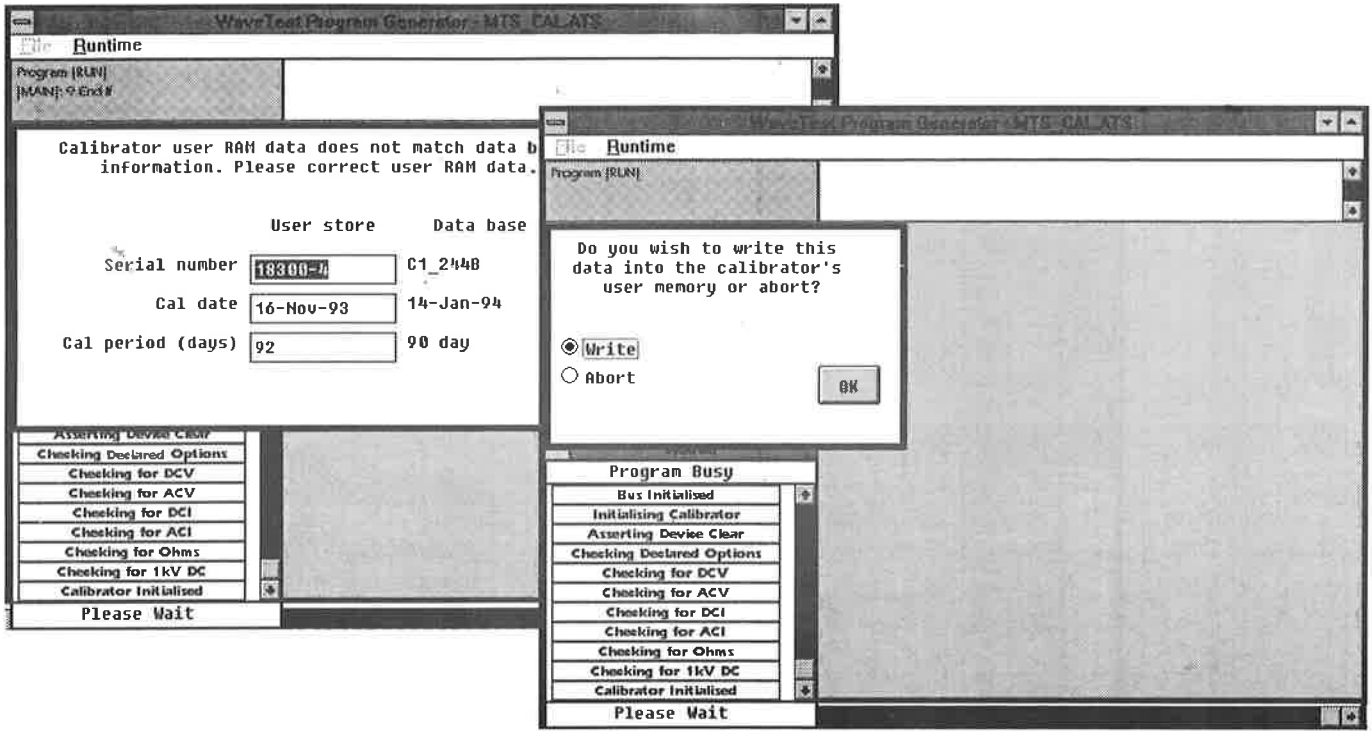
If a mismatch is detected between the calibrator's user store identification data and that held in the databse, both sets of data are displayed on screen as illustrated below left. It is now up to the user to edit the calibrator user store data to make it match the database. When the data matches, click on the **OK** button.

Write Data To Memory

The screen shown below right now appears, giving you the opportunity to write the new data into the calibrator's user store.

Only select the **Write** option if you are sure the data is correct.

If you select the **Abort** option, the **MTS-CAL** program will terminate after switching all the instruments to local control and closing all open files.

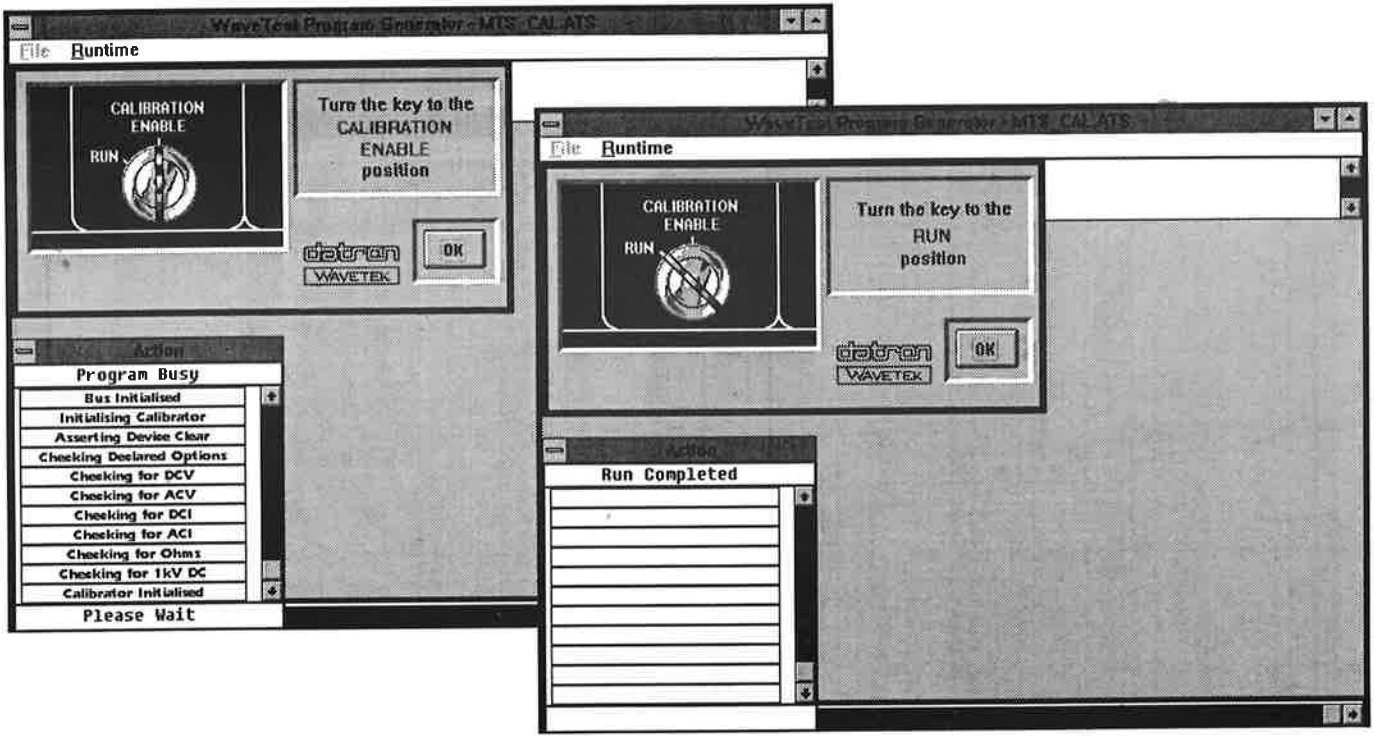


Cal Enable

The next screen, which is illustrated below, prompts you to insert the calibrator's cal key and turn it to the **Calibration Enable** position. This is done to enable writing of the calibrator's identification and cal date/period into its user RAM. If this is not done then an error message will be displayed asking you to check the key position before continuing.

Cal Disable

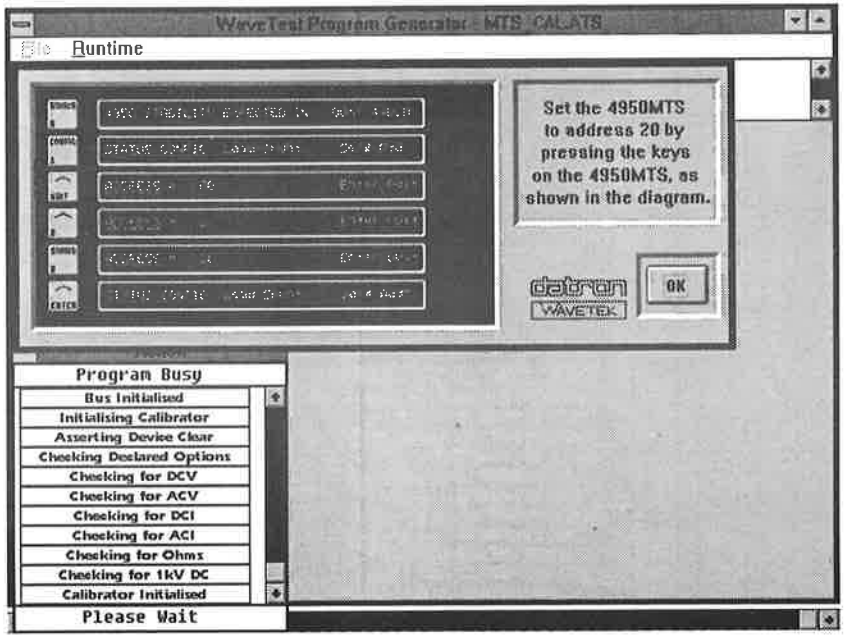
This screen, which is illustrated below, prompts you to return the calibrator's cal key to the **Run** position, disabling further writing of data to its calibration and user RAM. If the system detects that the cal mode has not been disabled, an error message will appear asking you to check the key position before continuing.



12. 4950 MTS Address

The 4950 MTS must be set to address 20. This is achieved by pressing the sequence of buttons on the front panel of the 4950 MTS as indicated by the screen display shown below. When the address is set correctly, click on the **OK** button.

The system will then interrogate the 4950MTS for its identification data and other important information. about its functionality.



13. 4950 MTS Details (Manager Level)

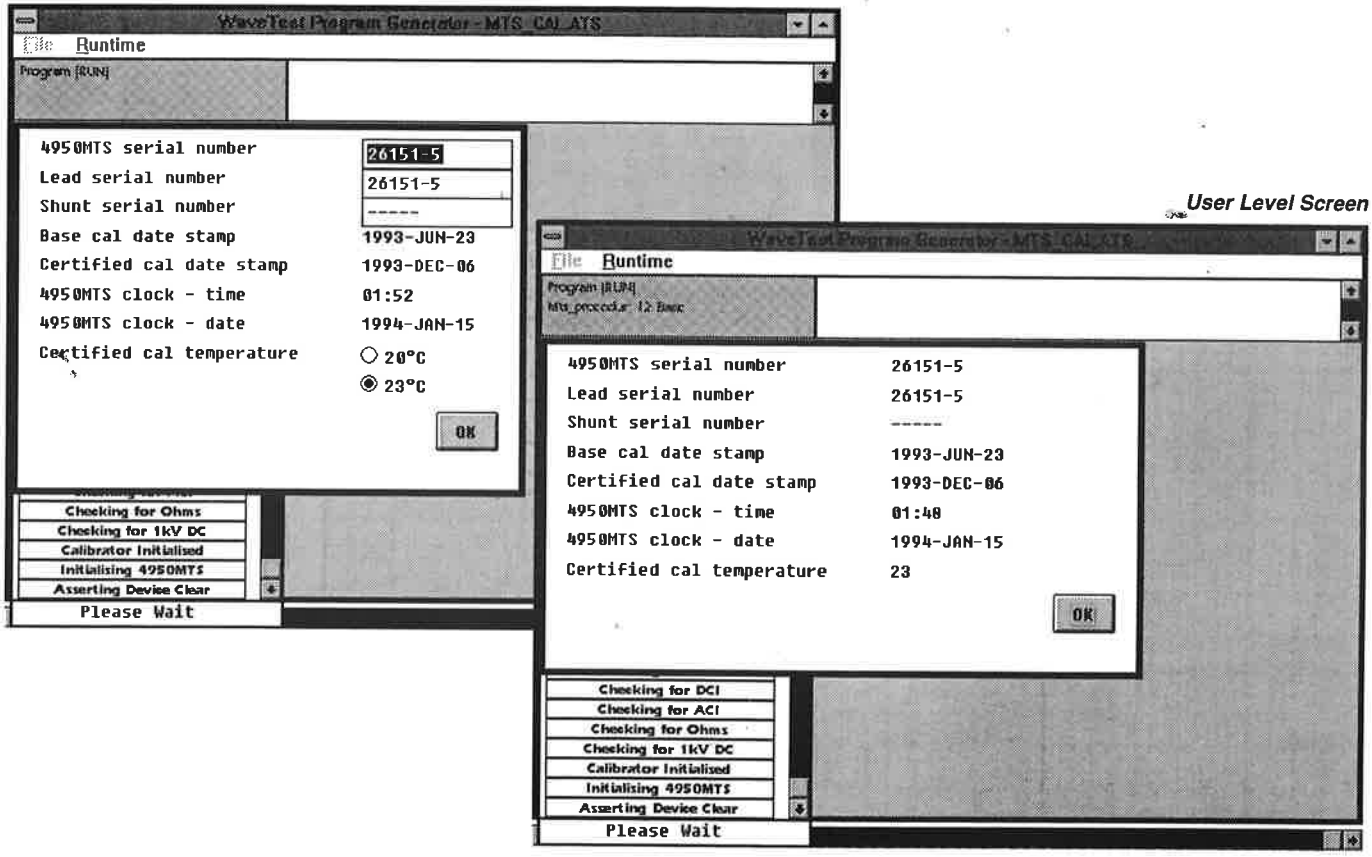
In the **4950MTS Details** window that appears — an example of which is shown below left — the details shown all come from the 4950 MTS itself and not from any data file. If you are a **System Manager** you can alter serial numbers and the nominal calibration temperature.

When satisfied with the information, click on the **OK** button. If any of the data was changed then the new data will be written into the 4950 MTS's internal memory.

4950 MTS Details (Normal User)

If you do not have System Manager status, then you will be presented with a screen similar to that shown below right, without the ability to edit the data in the 4950 MTS.

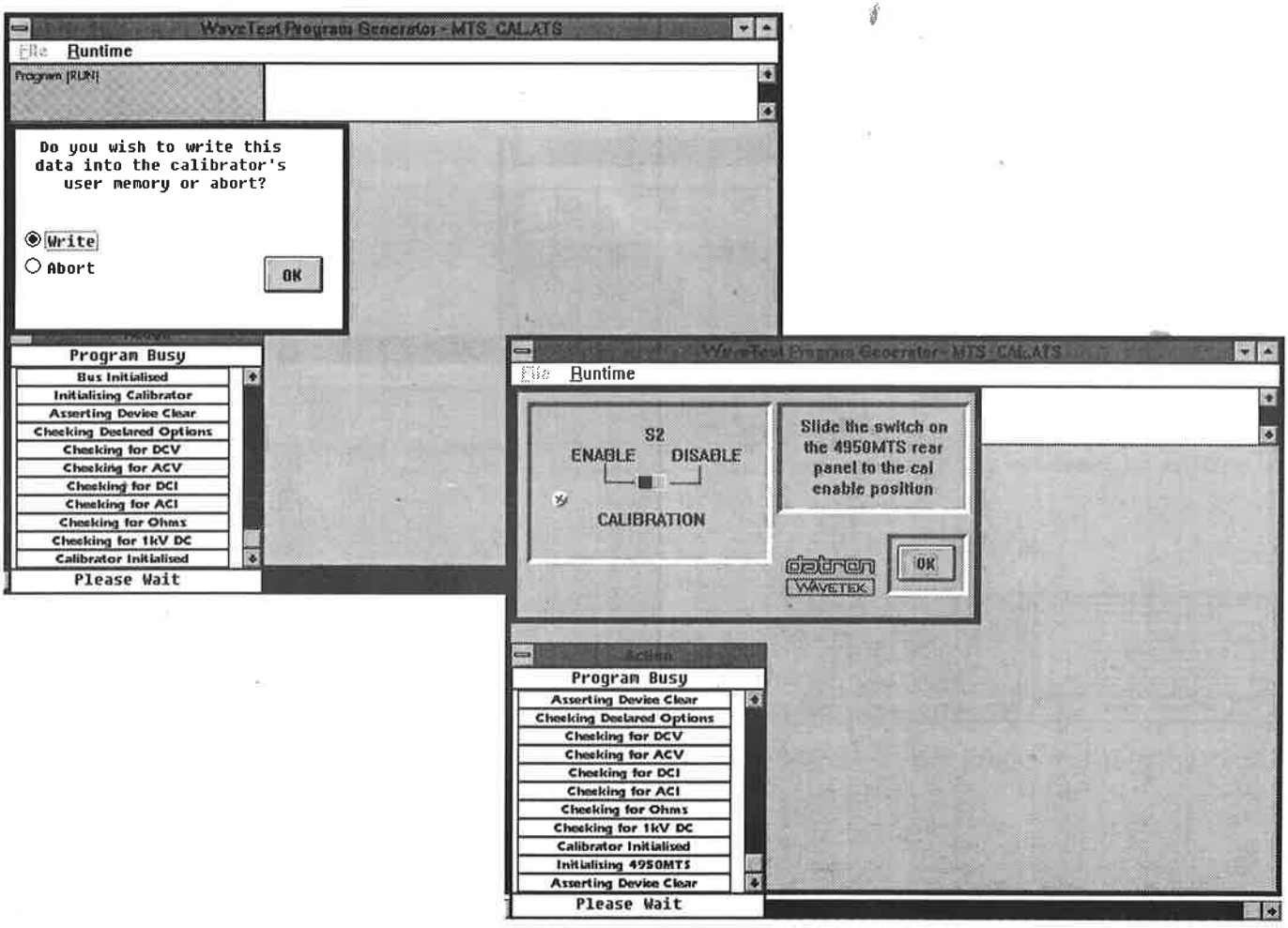
Manager Level Screen



4950 MTS Cal Enable

If as a **System Manager** you changed the 4950MTS information in the **4950MTS Details** screen, the window shown below left will be displayed, asking whether or not you want to write this information back to the instrument's non-volatile memory.

In order to write the information back to the 4950MTS, its calibration switch must be placed into the **Enable** position. If it is not already in the **Enable** position, then the instruction window shown below right will be displayed. Comply with its instructions and click on the **OK** button.

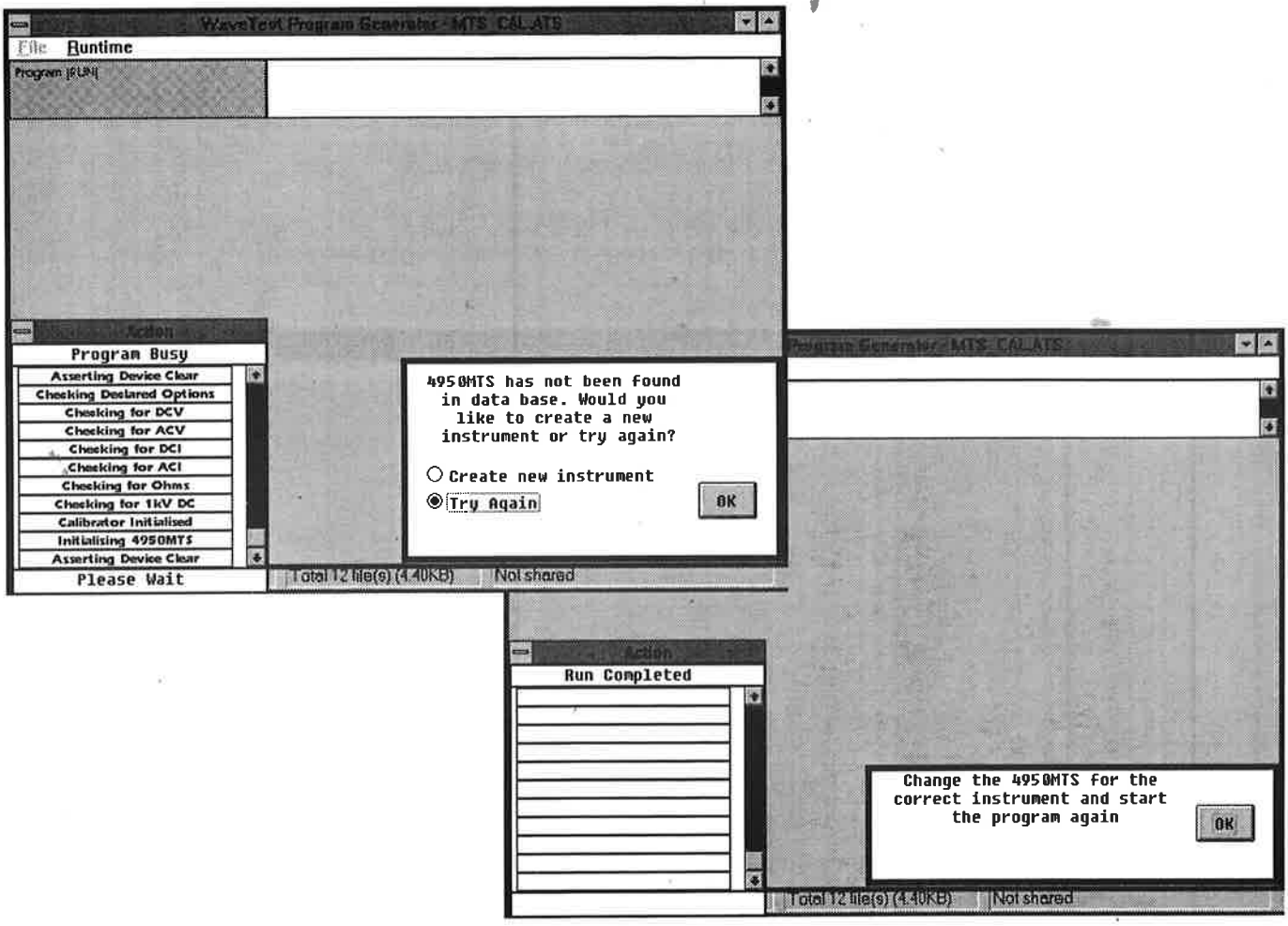


14. Instrument Not Found in Directories (4950 MTS)

The 4950MTS Control Software will now search for the appropriate subdirectory in which to place information relating to this 4950MTS. If this subdirectory is not found, the screen shown below will appear giving you the following options:-

a) **Create New Instrument:** This option automatically creates a subdirectory using the 4950MTS serial number as the subdirectory name.

b) **Try Again:** This option allows you to edit the 4950MTS data before continuing.

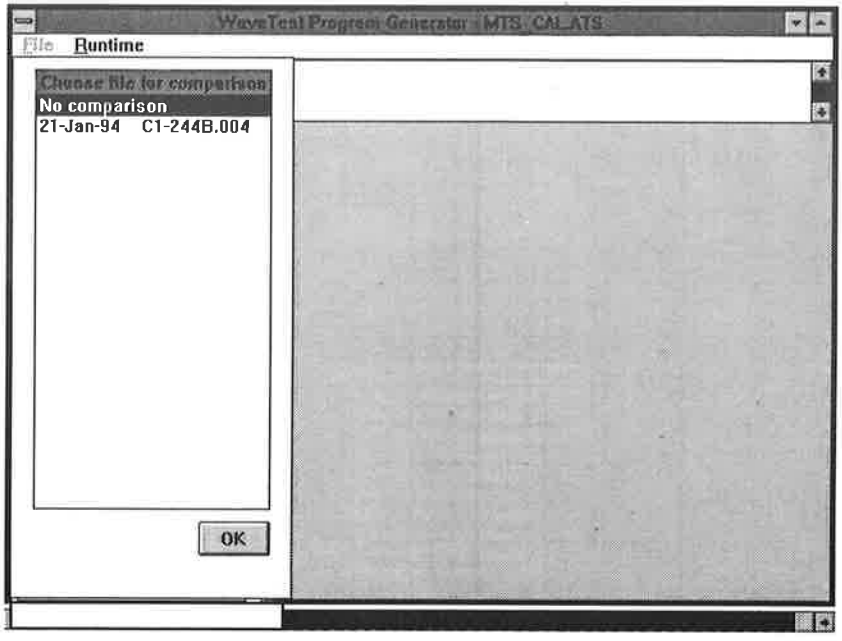


15. Baseline Comparison

If you are running the **Certified Verify** or **Certified Adjust and Verify** procedure and you selected the **Auto Baseline Comparison During Certified Measurement** function, a screen window similar to that shown below will be displayed. This window lists all previous files which have been generated by the **Auto Baseline Comparison During Certified Measurement** function, the files being listed in chronological order with a date stamp and run number stamp (the run number being indicated by the .XXX filename extension).

If you select one of these files by clicking on it, the 4950MTS Control Software will automatically compare the results of the current baseline performance check (the one which will be performed as part of this procedure) with the baseline performance results contained in the selected file. The comparison results will then be stored for later print-out on a **Difference Certificate** (See *Section 6* on the **4950MTS Control Software Certificate Generator**).

If you do not want to carry out this comparison, click on the **No Comparison** option in the list.



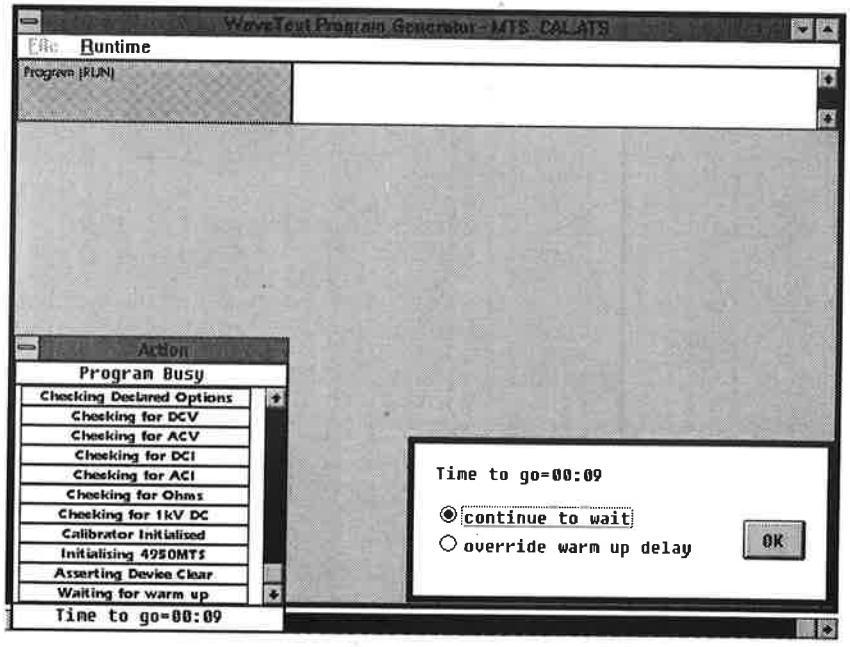
16. Warm Up Delay

The 4950 MTS has a requirement for a 6-hour warm-up period before its quoted specifications are met. If the 4950 MTS reports that it has not been plugged in and turned on for the full 6 hours, then the time remaining will be shown in the bottom field of the **Action** window of the **Taking Readings** screen.

If you are a **System Manager** you will be presented with the screen window shown below, giving you the option of overriding the warm-up delay. Note, however, that this fact will be reported on all certificates that relate to the procedure run.

To override the warm-up delay select **Override Warm Up Delay**. Otherwise select the **Continue To Wait** option before clicking on **OK**.

Note: If you are not a System Manager, you must wait until the warm-up time period expires. The time to go will be continuously updated in the **Action** window at the bottom left of the **Taking Readings** screen.

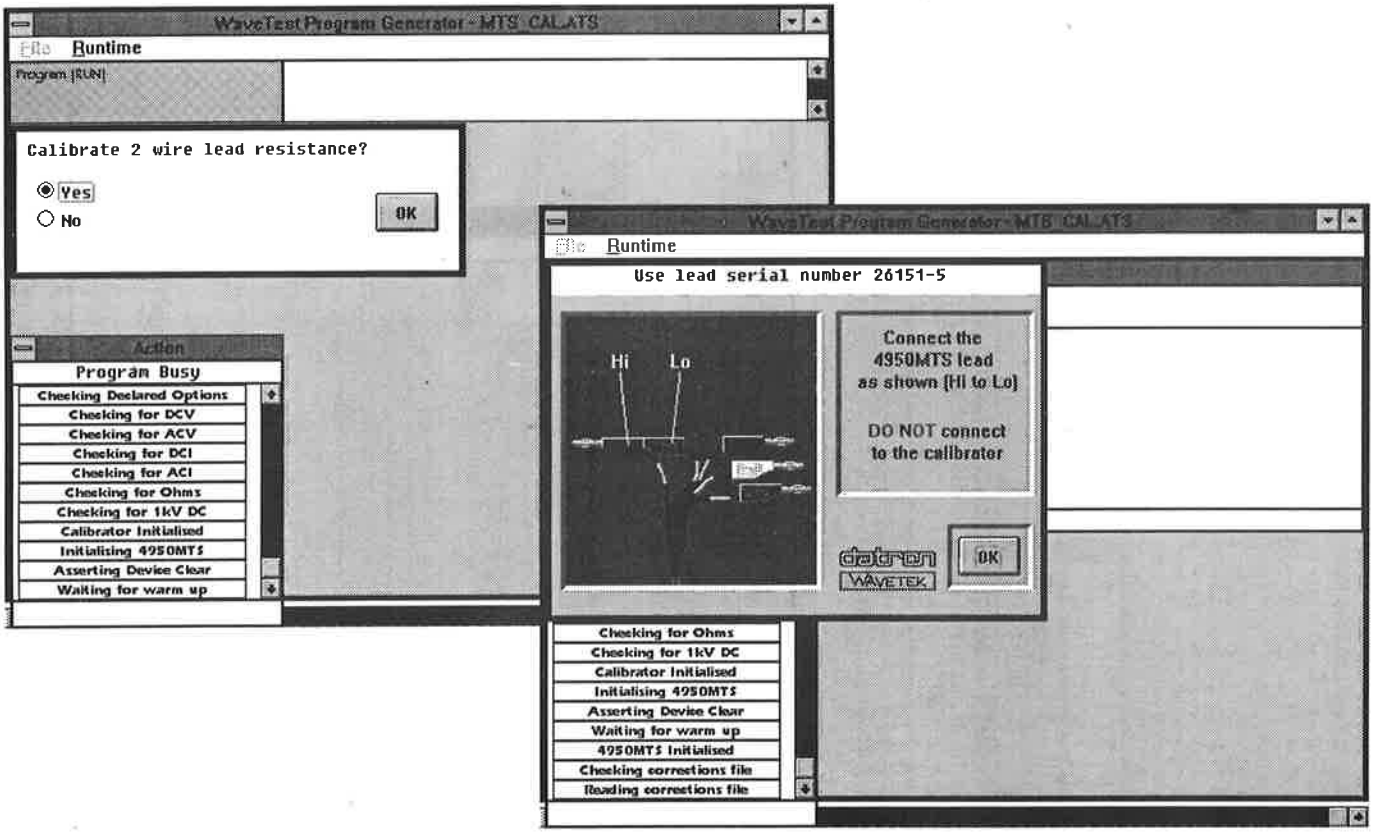


17. Two-wire lead resistance calibration (Baseline Adjustment Procedures Only)

If you are a **System Manager** and selected the **Baseline Adjust and Verify** procedure in the earlier **Procedure Selection** window, you will now be presented with the screen shown below left, which gives you the opportunity to calibrate the 4950MTS's two-wire resistance function. This will automatically compensate for the lead resistance of the lead set connected to the 4950MTS's front-panel analog input connector.

If you select the **Yes** option, the screen shown below right will appear. Connect the leads as shown and click on the **OK** button.

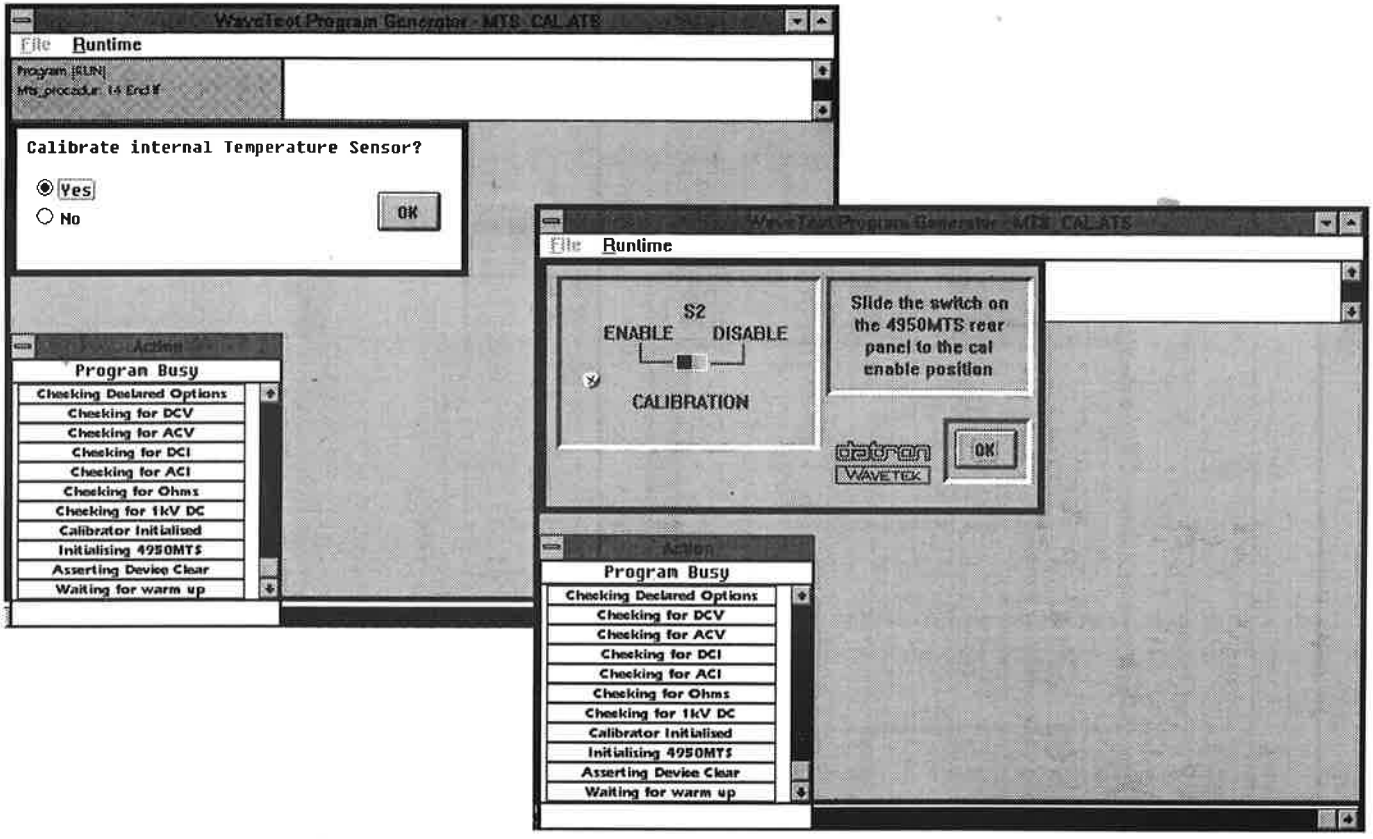
In order to perform the lead calibration, the 4950MTS calibration switch must be placed into the **Enable** position. If it is not, then an instruction window will be displayed showing you how to enable the calibration mode of the 4950MTS.



18. Internal Temperature Sensor Calibration (Baseline or Certified Adjustment Procedures Only)

If you are a **System Manager** and selected the **Baseline Adjust and Verify** procedure or the **Certified Adjust and Verify** procedure in the earlier **Procedure Selection** window, you will now be presented with the screen window shown below left, giving you the opportunity to calibrate the 4950 MTS's internal temperature sensor. Selecting the **Yes** option and clicking on **OK** will result in the 4950MTS's internal temperature sensor being automatically calibrated to the system environment temperature declared in the **System Environment Details** screen window which appeared at the beginning of the procedure.

In order to perform the 4950 MTS's internal temperature sensor calibration, the calibration switch must be placed into the enable position. If it is not, then the instruction window shown below right will be displayed. Comply with the instructions given in this screen window and click on the **OK** button.



19. Results Format

The 4950MTS Control Software can store calibration results in a variety of different formats as indicated by the **Results Format** screen which is illustrated below. The available formats and their different uses are as follows:-

a) **ASCII text file**: A general purpose format which can be imported into virtually all word processors, DOS and general utilities.

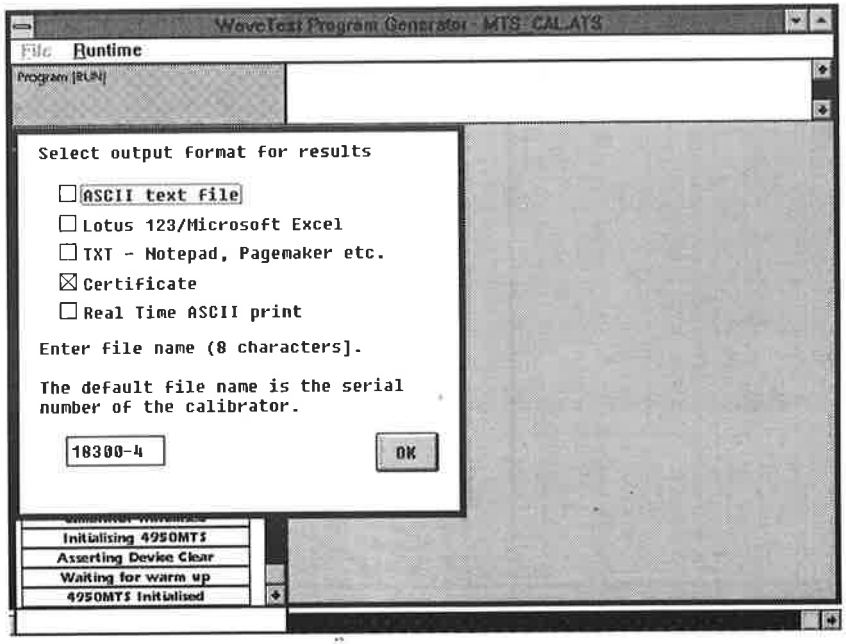
b) **Lotus 123/Microsoft Excel**: A format which can be imported into Lotus 1-2-3™ or Microsoft Excel™.

c) **TXT**: For more sophisticated, higher quality reports with headers, logos, different fonts etc, this format provides tab separated data suitable for direct importing into desktop publishing packages such as Aldus PageMaker™.

d) **Certificate**: Produces a results file which can be used by the 4950MTS Control Software's **Certificate Generator**, which allows you to customize certificates with header/footer information. For more information on the use of the **Certificate Generator** refer to *Section x* of this handbook.

e) **Real Time ASCII Print:** Selecting this option prints out the calibration results as the procedure runs, in addition to storing them in the selected file formats. To ensure that this process does not interrupt system operation, check that a suitable printer is connected to your computer's parallel printer port, and that it is on-line and operating in a condensed mode with a minimum of 120 characters per line.

You can select as many of the indicated options as you require.



The default filename given to the results file is the serial number of the 4950MTS. You have the option to change this filename, but it must conform to MS-DOS filenaming conventions. Note that you should not enter a file extension (**.<xxx>**) after the filename as this will automatically be inserted according to the different file formats that have been selected. If you enter an invalid filename — i.e. one that does not conform to MS-DOS filenaming conventions — you will be prompted by the error message shown below to edit the filename.

Duplicate File Name

If a file name already exists with the name that has just been requested, then you are given the opportunity here to re-enter the file name or over-write it. When satisfied with the selection and naming of files, these files will be created in the UUT's data directory.

20. Corrections File Serial Number Mismatch

The 4950MTS Control Software now checks the appropriate calibrator corrections file. If the serial number contained in the database and the calibrator's user store do not match the one in the calibrator's corrections file then the software will display the message shown below left and terminate in the usual way once you press the **OK** button. After rectifying the situation, restart the software.

Corrections File Calibration Date Mismatch

If the calibration date contained in the database and the calibrator's user store do not match the one in the calibrator's corrections file then the software will display the message shown below right and terminate in the usual way once you press the OK button. After rectifying the situation, restart the software.

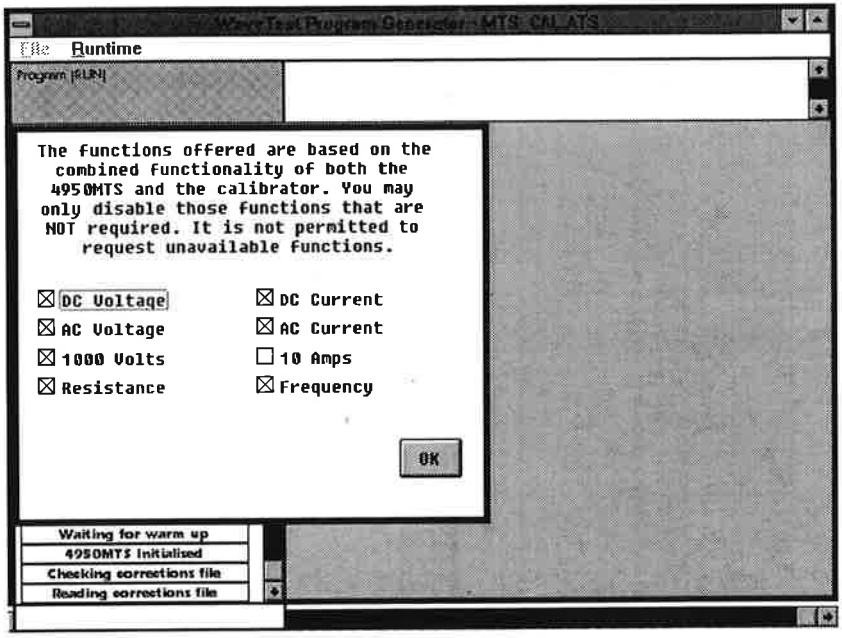
If the corrections file passes these tests, the system states in the **Action** box that it is reading the corrections file. This can take up to one minute.

21. Function Request

At this point it is possible to disable those functions which are not required, by selecting ☒ or deselecting ☐ them in the screen window shown below left.

Note: the 1000 Volts option is an additional range for the DCV and ACV functions of Wavetek Datron 4000, 4700 and 4800-Series calibrators. If neither DCV or ACV is selected then the 1000V function will not be run. This also applies to the 10Amps with respect to DCI & ACI on these calibrators.

If you attempt to enable those functions which have been disabled then an illegal function message while be displayed as shown below right.



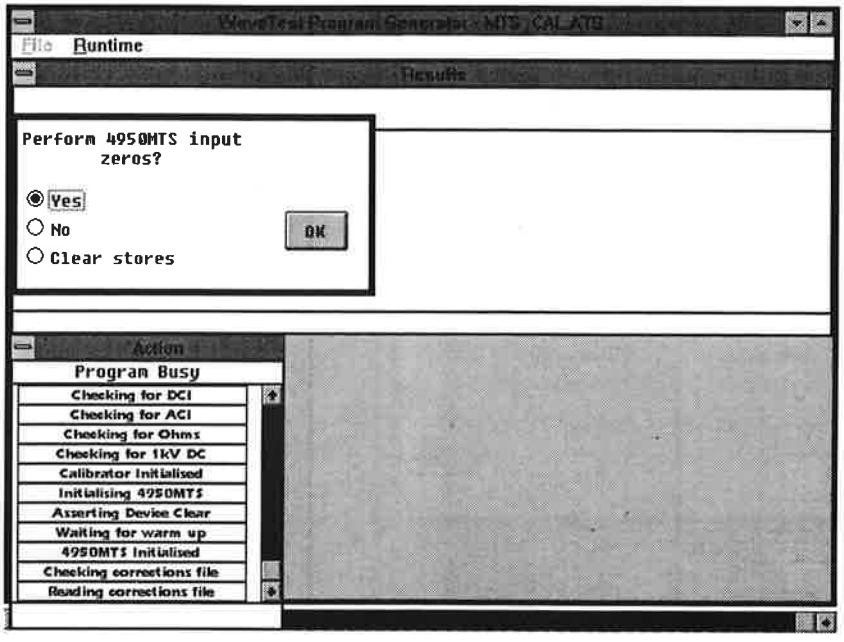
22. Input Zeros (Verify Procedures Only)

If the procedure type is a verify only procedure, you will be asked to 'input zero' the 4950MTS. If you are a **System Manager** (i.e. you entered a valid system manager password at the begining of the procedure), you can optionally bypass those steps in the procedure which perform this input zeroing.

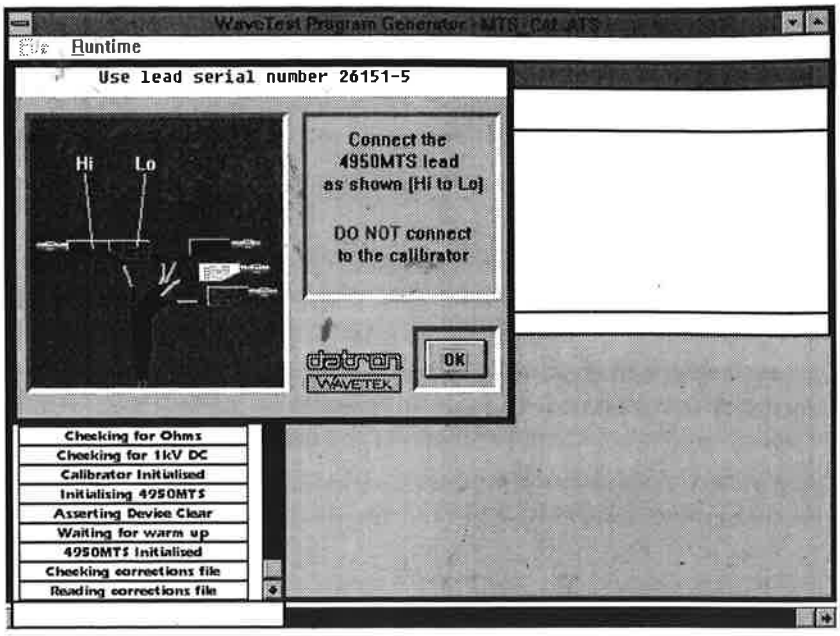
Input zeros should normally be performed every time the system is used, because the 'zero' point of virtually all instruments drifts to some extent with time and temperature etc. Performing input zero operations imdiately prior to calibrating a calibrator with the 4950MTS eliminates any errors this might introduce. However, if you want to carry out a test run on the system simply to ascertain whether all the instruments are operating correctly, you can disable the input zero operations to save time.

If input zero operations have not been disabled a series of screens will appear which prompt you to carry out these operations for each of the 4950MTS's measurement fucntions. When you have made the lead connections indicated in each screen, clicking on **OK** will initiate an appropriate IEEE-488 bus controlled input zero operation.

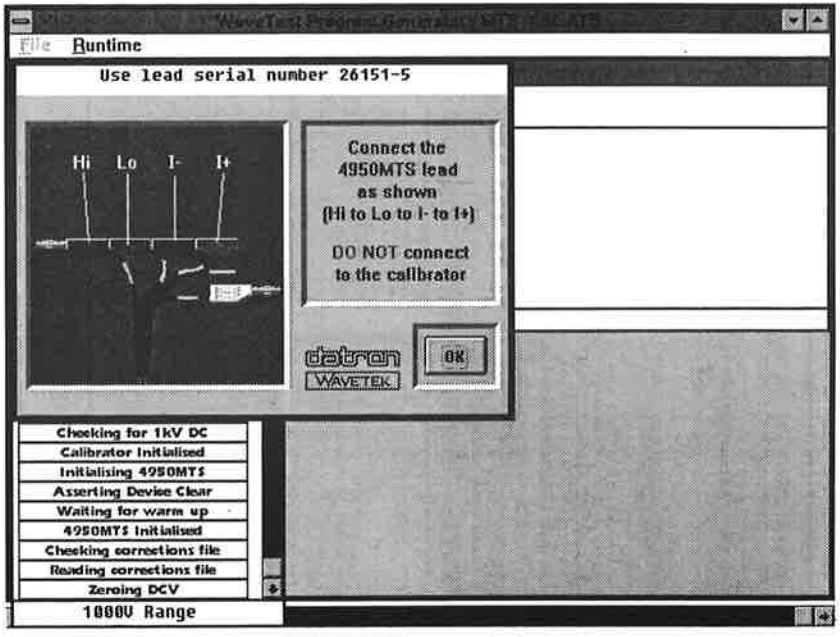
Selecting **Clear Stores** will cause the 4950 MTS to be placed into its cal mode and then back out of its cal mode again. This has the effect of clearing the calibration stores for the input zeros.



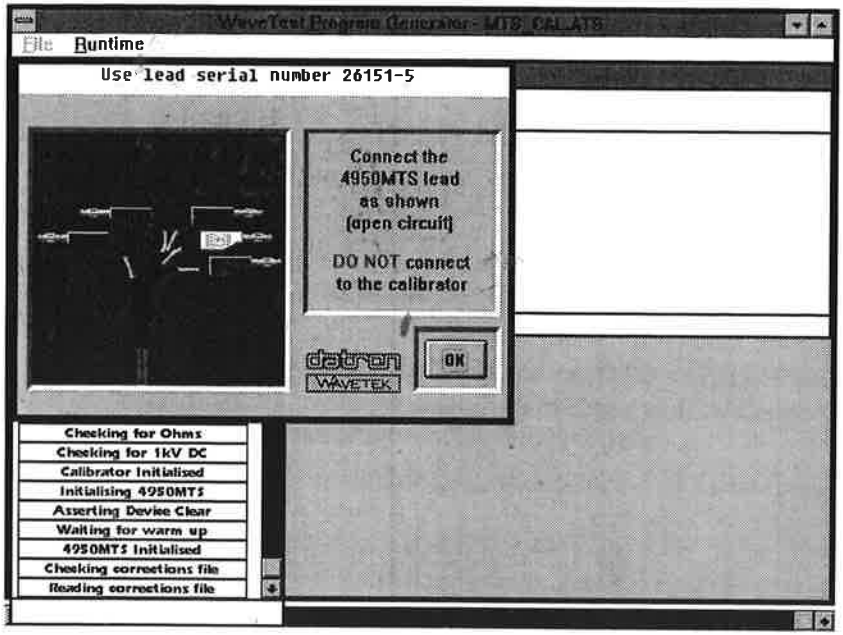
DCV, ACV and 1kV Zero Short



Resistance



DCI, ACI and 10Amps



25. Taking Readings

While performance verification or adjustment of the 4950MTS is taking place, a readings screen similar to that shown below will be displayed.

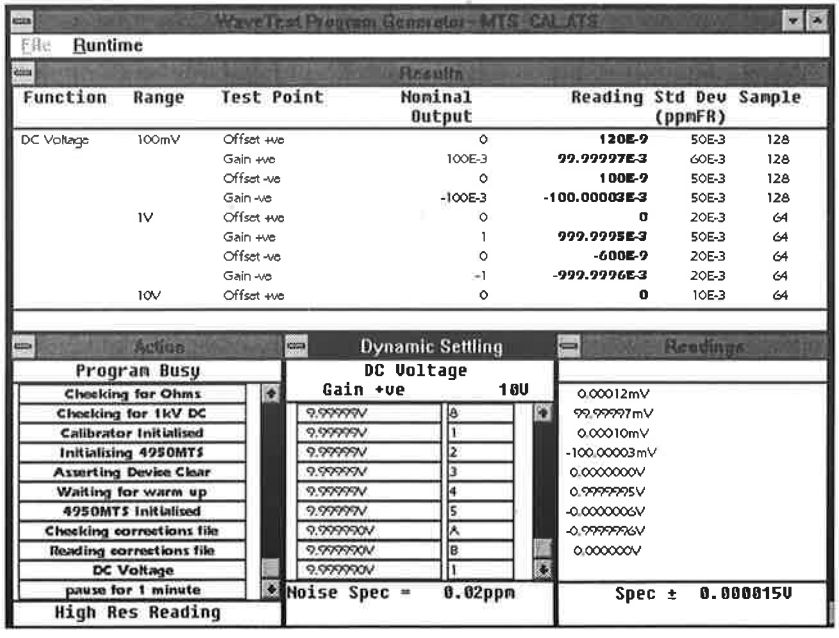
The upper half of this screen indicates those test points which have been completed, together with the overall results obtained.

The lower half of the screen is divided into three separate windows which display the following information:-

Action Window: displays the last ten program steps in chronological order from top to bottom, plus the current program step at the bottom.

Dynamic Settling Window: displays the last eight readings which have been taken by the system in chronological order from top to bottom. If the **Enable Intermediate Results Capture** option was selected in the **Run/Debug Options** screen, all of these results will be stored in the results file.

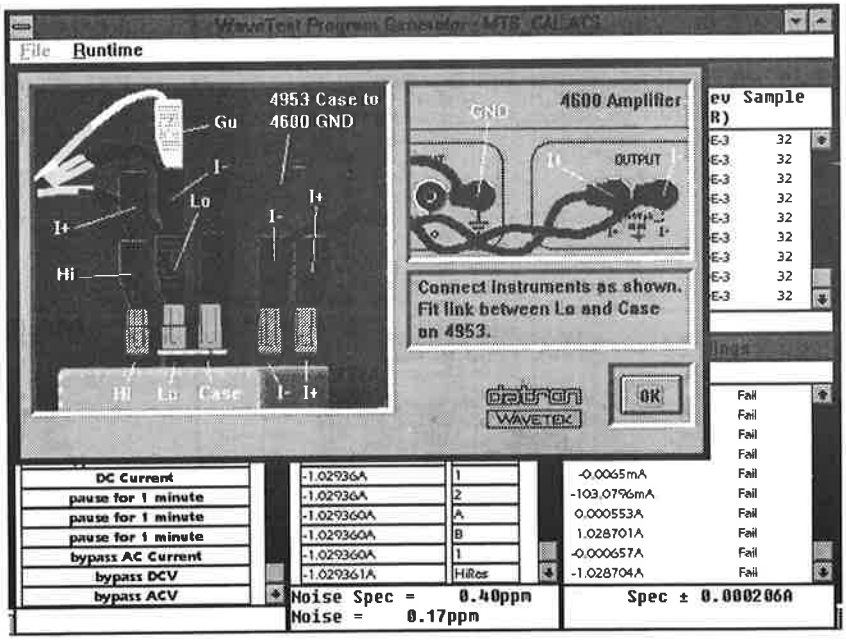
Readings Window: displays the final result of each test point, together with its pass/fail status, in chronological order from top to bottom.



26. Analogue And Digital Connections

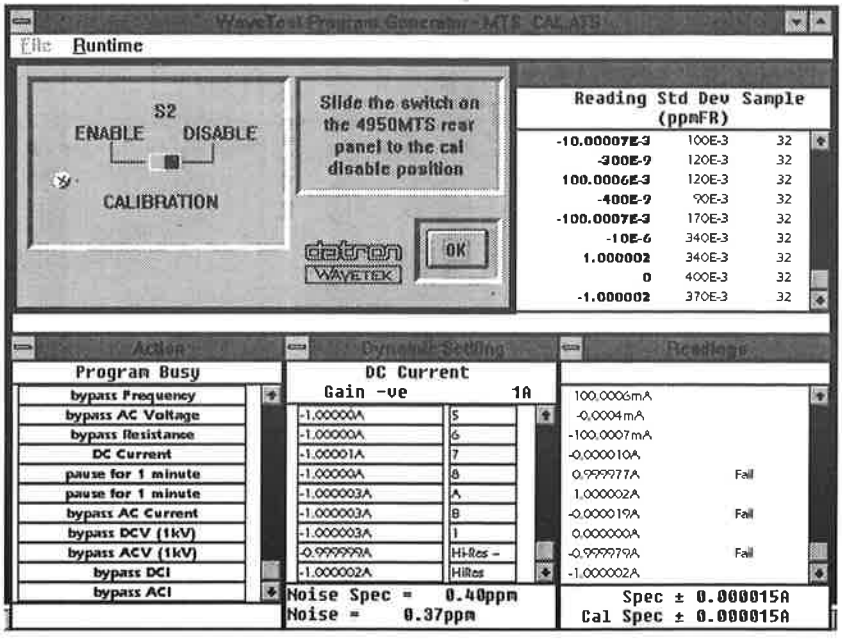
If during the running of a procedure a 10A function is requested, a user instruction window similar to that shown below will be displayed, prompting you to connect the 4950MTS current shunt between the calibrator and the 4950MTS.

When you have made the appropriate connections, click on the **OK** button.



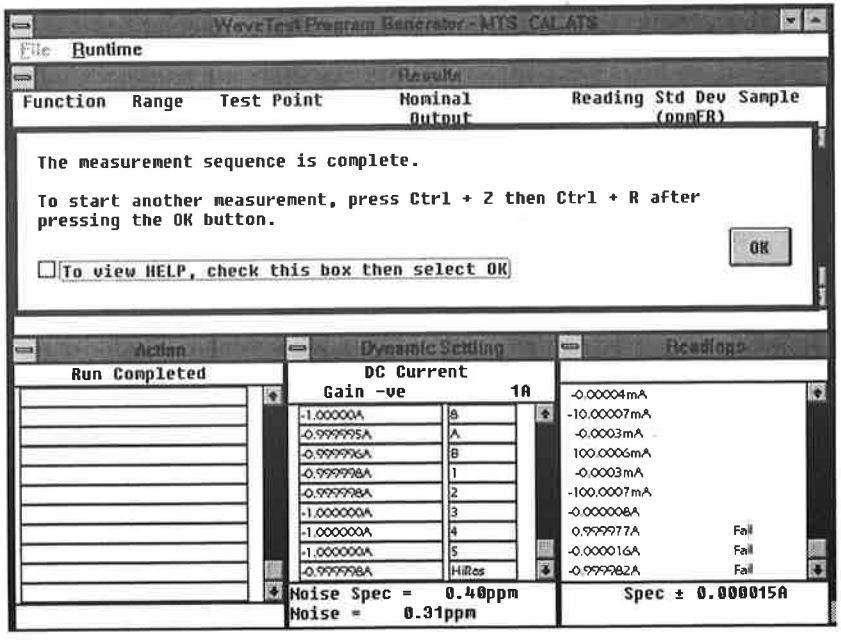
27. Cal Disable

If you have just carried out the an adjust and verify procedure, at the end of the run you will be prompted to disable the 4950MTS's calibration function by an instruction screen similar to that illustrated below.



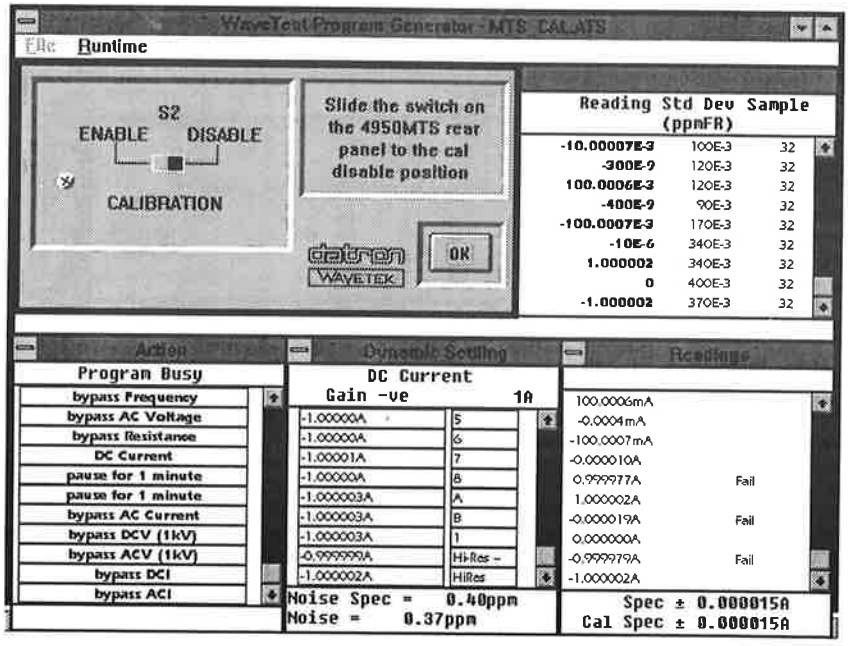
28. Program Completion

Once the run has finished, the **Action** window will clear and display the message **RUN COMPLETED** in its header. Both the 4950MTS and the calibrator will be put into a safe condition and returned to local control. At this point the program may be terminated by clicking and dragging the **File** menu to the **Quit** menu option.



27. Cal Disable

If you have just carried out the an adjust and verify procedure, at the end of the run you will be prompted to disable the 4950MTS's calibration function by an instruction screen similar to that illustrated below.



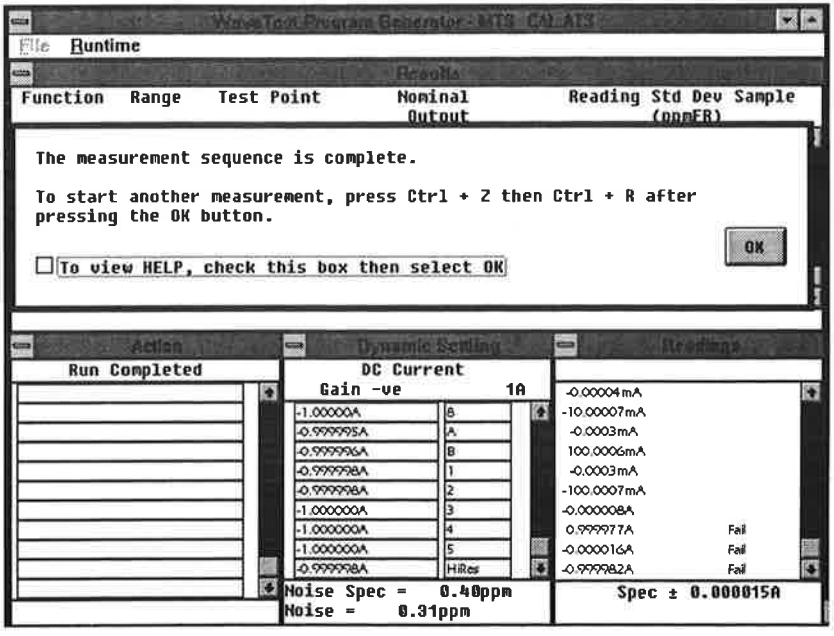
28. Program Completion

Once the run has finished, the **Action** window will clear and display the message **'RUN COMPLETED'** in its header bar. Both the 4950MTS and the calibrator will be put into a safe condition and returned to local control.

If any runtime errors occurred during the run, this fact will be indicated by the message **'Bus error or Esc'** displayed in the footer bar at the bottom of the **Action** window.

If this error message is displayed the measurement or adjustment process carried out by the procedure may be incomplete and you should **NOT** continue with subsequent calibration or verification operations on the 4950MTS until the source of the error has been located and overcome. As an initial course of action, review the results and if necessary rerun the MTS_CAL program to see if the error recurs.

The program may be terminated by clicking on the **OK** button and dragging the **File** menu to the **Quit** menu option.



Section 7 The Certificate Generator

Running the 4950MTS Certificate Generator

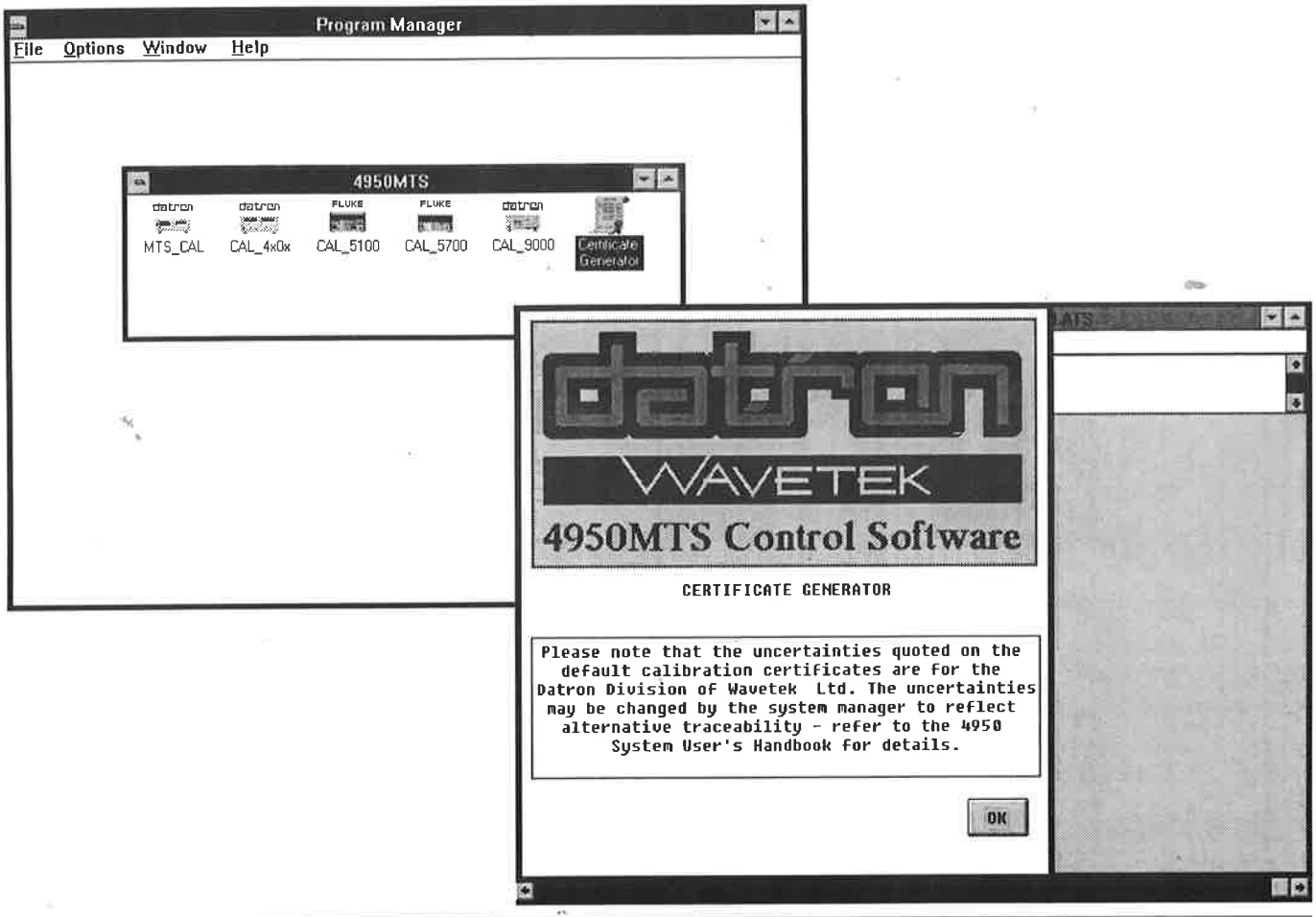
1. Starting the Program

From the Windows™ desktop, double-click on the **4950MTS** icon to open up the menu window of 4950MTS Control Software programs shown below.

To start the Certificate Generator program running, simply double-click on the **Certificate Generator** icon.

2. Title Page

When the title page shown below right appears, click on the **OK** button.



3. Instrument Selection

The first screen window displayed will be the **Instrument Selection** window shown below. The left-hand side of this window lists all the instrument types which the 4950MTS Control Software recognises, while the right-hand side allows you to enter the code/serial number for a specific instrument, to define the data source (disk drive) on which files relating to this instrument are stored, and to select the type of certificate you wish to print.

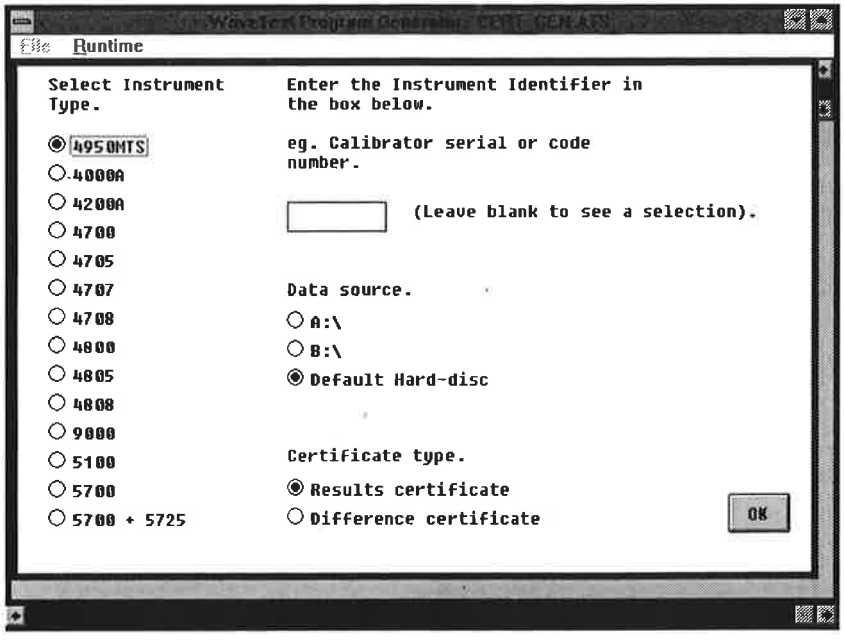
To select an instrument type, data source or certificate type, proceed as follows:-

Instrument Type: click on the radio button next to the required instrument type.

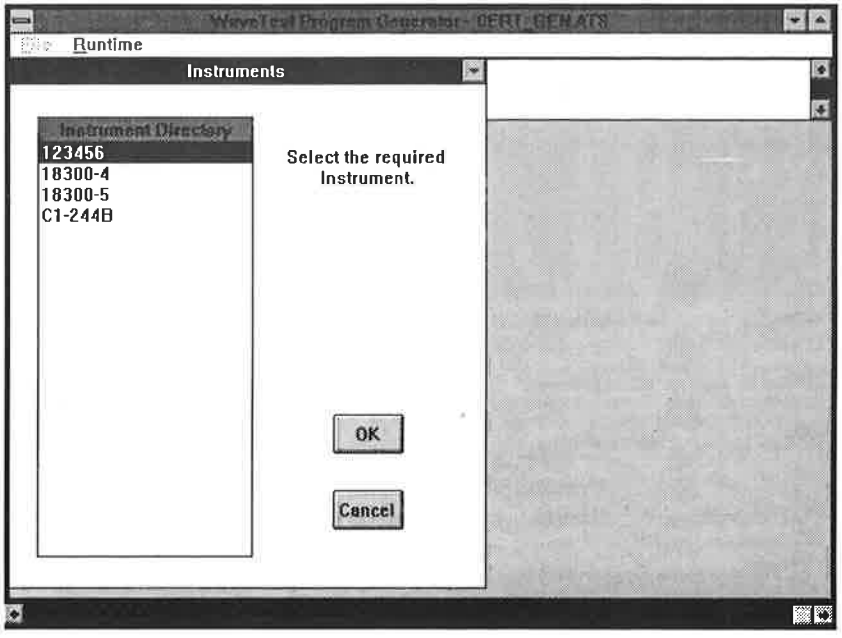
Data Source: click on the radio button corresponding to the disk drive from which the system should attempt to read **results** files for the selected instrument.

Certificate Type: click on the radio button next to the required certificate type. **Results Certificates** print out the results of calibrator or 4950MTS calibration as appropriate. **Difference Certificates** print out the results of a comparison between two 4950MTS baseline verifications, generated as a result of the **MTS_CAL** program's **Auto Baseline Comparison During Certified Measurement** function *(see Section 5 — running the MTS-CAL Program).*

To enter an instrument code/serial number, click the mouse in the **Instrument Identifier** box to activate the cursor, and type in the required serial/code number of the instrument.



If you are not sure of the instrument serial/code numbers for which the system holds calibration records, simply leave the **Instrument Identifier** box blank. When you click on the **OK** button you will then be presented with a list of instrument serial/code numbers (of the selected instrument type) for which the system currently holds results files. An example of this screen is shown below. To select an instrument serial/code number form this list, click on the required serial/code number and then click on **OK**.

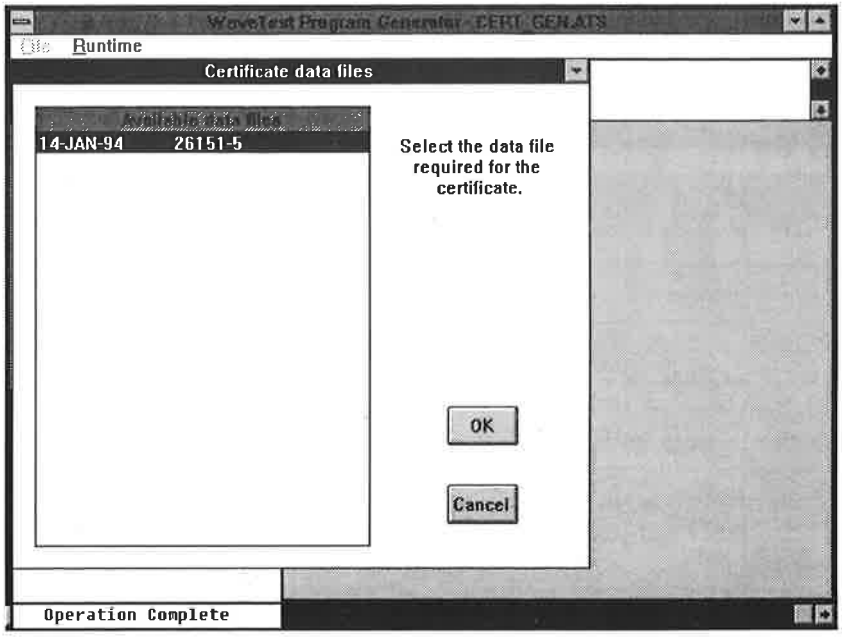


4. Certificate Data File

The **Certificate Data File** window which now appears lists all the certificate data files which exist on the selected disk drive *(see step 3).*

Each certificate data file is date-stamped with the date on which it was generated, and unless you changed the default filename displayed in the **CAL_<calibrator type>** or **MTS_CAL** program's **Results Format** screen (see *Sections 5* and *Section 6*) , it will have a filename given by the instrument's serial/code number. (This is done deliberately so that the instrument's subdirectory and filename always identify both the instrument being calibrated and the instrument which calibrated it.)

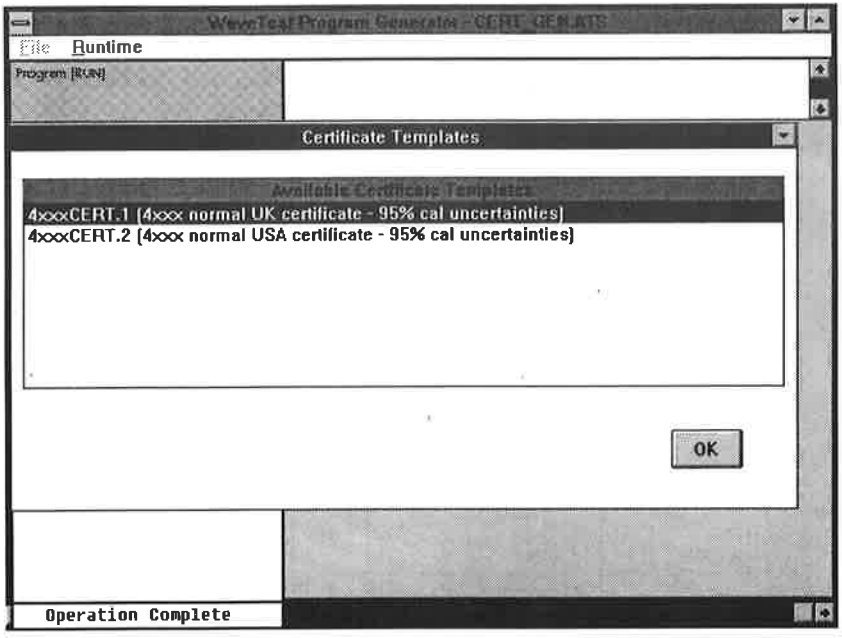
Select the certificate datafile that you require by clicking on its filename, and then click **OK**.



5. Certificate Templates

The certificate template window which appears lists all the certificate templates, for the selected instrument type, which are currently installed in the certificate generator's **CERTIFIC.ATE** subdirectory. (For information on how to generate and install new certificate templates refer to *Section 8.*)

Select the certificate template that you require by clicking on its name, and then click **OK**.

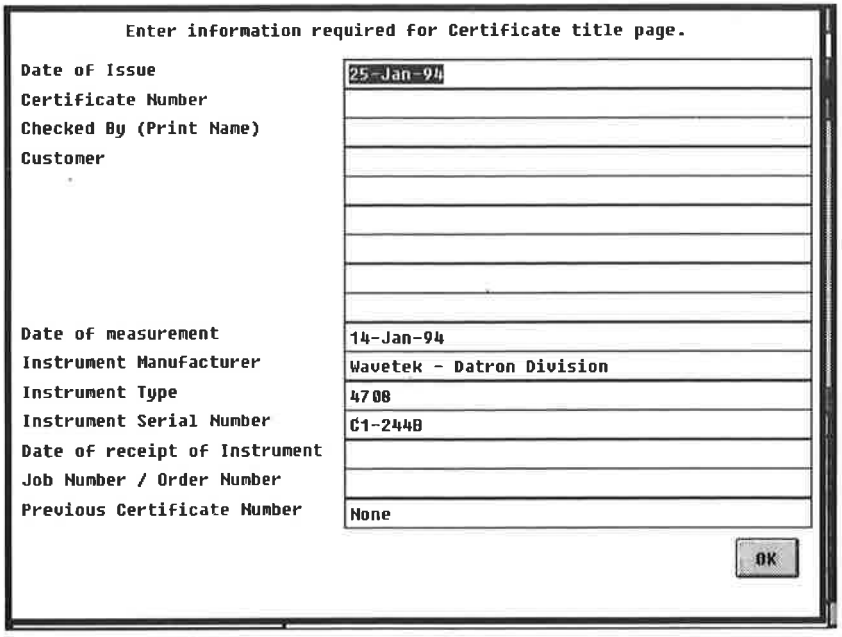


6. Certificate Title Page

The **Certificate Title Page** asks you to enter information which will be printed on the title page of the certificate. Note that some details — such as the date, instrument type and instrument serial number — have been automatically entered using data contained in the 4950MTS Control Software's databases. Edit any of this information which is incorrect and enter other relevant data into the empty fields.

Note: If you make changes to the information which was extracted from the 4950MTS Control Software's databases, these changes will **not** be written back to the database files, although they will appear on the printed certificate.

When you are happy that all the information is correct, click **OK**.



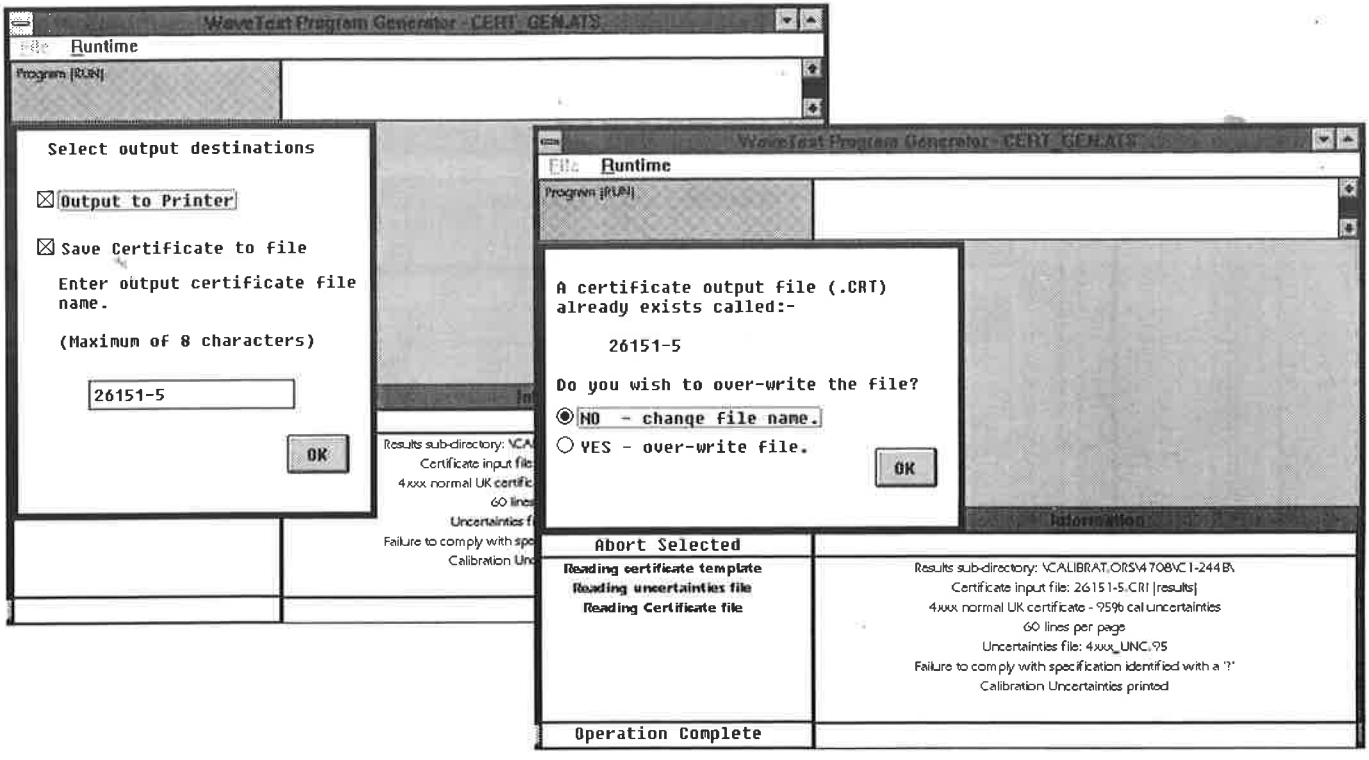
7. Output Destination

You can direct the print-out either to the printer that is connected to your computer's parallel printer port and/or to a disk file. By default, the disk-file name will be the 4950MTS serial/code number for a calibrator calibration certificate and the calibrator serial/code number for a 4950MTS calibration certificate (for the reasons outlined earlier).

The **Output Destination** screen window, which is shown below left, allows you to select either or both of these options.

Select or deselect each option as required and edit the default filename if necessary (being sure to comply with MS-DOS file naming rules). Then click **OK**.

If a certificate file already exits with the same name as that just specified, a warning message screen — similar to that shown below right — will appear asking you if you wish to overwrite it. If you click on the **No** option and then click on **OK**, you will be returned to the **Output Destination** window where you can edit the filename accordingly.

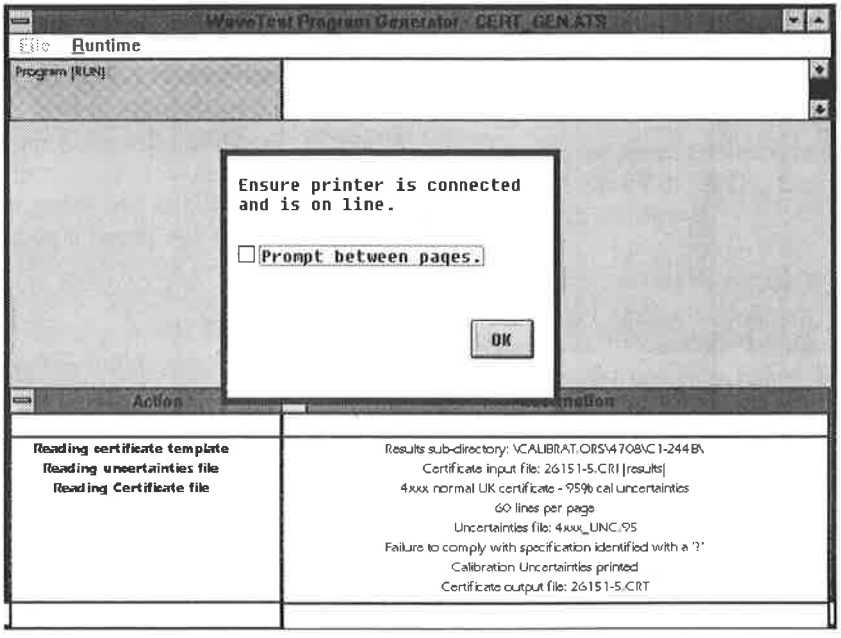


8. Print Initiate

Clicking the **OK** button in the **Print Initiate** window illustrated below will result in the certificate being printed and/or output to the specified disk file.

If you are using a printer with a cut-sheet feed that requires manual intervention to load the next sheet of paper, you should select the **Prompt Between Pages** option provided in this screen window.

Before clicking on **OK**, check that the printer is connected, on-line and operating in a mode that provides at least 120 characters per line.



Section 8 Customizing Certificates

Introduction

One of the new facilities added in Version 2.0 of the 4950MTS Control Software is the Certificate Generator. In addition to producing pre-defined 'standard' certificates, this program can also produce calibration certificates in a format defined by the user.

The format of these 'custom' ceritificates is defined by producing a certificate template file which is stored in the 4950MTS Control Software's **CERTIFIC.ATE** subdirectory. There may be up to 20 such templates for each instrument group (see groupings below).

Measurement uncertainties used in the certificate are contained in second file, the name of which is defined within the template file. A field in the template file also determines the format of the uncertainties, either in parts per million (ppm) or Test Accuracy Ratio (TAR).

The measurement data which is input to the Certificate Generator is a special 'intermediate' file created by the 4950MTS Control Software when the certificate option is selected. If the data source is the hard-disk then the input file must be in the appropriate sub-directory for the instrument. If the data is on a floppy disk then it must be in the root directory.

The output of the program is in ASCII format and can be directed to a file or a non-Postscript printer connected to the port used by the computer as PRN.

The certificate defined by the template file has the following major features:

1) Separate title page, 1st results page, remaining results pages and supplementary pages

2) Title, results and supplementary pages with unique headers, footers and data sections.

3) A variable number of lines per page.

4) Variable number of lines for header and footer information, allowing use with pre-printed certificate forms.

5) Automatic page numbering from any starting page.

6) Inclusion of 'failure to meet spec at measurement points' if required.

7) Measurement uncertainty file selection.

The 4950MTS Control Software installation process places example templates and uncertainty files in the sub-directory called **CERTIFIC.ATE,** which is located in the main **4950MTS** directory.

It is these files which should be copied and edited to create the special certificate formats requiremed by the user. It should be noted that the uncertainties provided in the uncertainties template reflect the traceability of Wavetek Datron Division's calibration laboratories, and they **must** be amended if the 4950MTS is calibrated in any other calibration lab.

The instruments that can be calibrated by the 4950MTS are divided into 5 instrument groups (inst group) for certificate generation purposes:

Inst Group	Instrument Model No.
MTS	Wavetek 4950MTS
4XXX	Wavetek 4000A Wavetek 4200A Wavetek 4700 Wavetek 4705 Wavetek 4707 Wavetek 4708 Wavetek 4800 Wavetek 4805 Wavetek 4808
9000	Wavetek 9000
5100	Fluke 5100
5700	Fluke 5700 Fluke 5700 + 5725

The contents of a certificate are determined by 2 files:

Template file: **<inst group>CERT.<No>**
Uncertainties file: **<inst group>_UNC.<ext>**

File **<inst group>CERT.<No>** is the template file. It defines the certificate format including header, footer and message text and additionally provides the text for user prompts which appear at run time. Each instrument group may have up to 20 template files. Each template for an instrument group has a unique file extension **<No>** which is an integer in the range 1 to 20. For example, if you require two forms of certificate for the model 9000, the template files might be named **9000CERT.1** and **9000CERT.2**

A field in the template file defines which uncertainty file is used in the certificate. The number of different uncertainty files for each instrument type is limited only by the number of combinations available in the 3 character file extension. For example, two files containing uncertainties to 95% and 99% probability for a Model 4808 calibrator might be named **4XXX_UNC.95** and **4XXX_UNC.99**.

If the uncertainty file specified in the template file is not found, the Certificate Generator will leave the uncertainty column of the certificate blank.

Description of template file <inst group>CERT.<No>

Template and uncertainty files must be produced using a text editor capable of ASCII output — for example, the **MS-DOS 5.0** program **EDIT.COM**.

The first 4 lines are comment lines and must be present. The first comment line of each template file is presented on screen to the user when they are asked to select a template, in order to aid identification. The 2nd 3rd and 4th comment lines may be left blank.

From line 5 to the end of the file, each line is split into Comment and Data fields. The Comment field may be up to 10 characters wide and can be used as an aide memoir. It is discarded by the Certificate Generator program at run time. The end of the Comment field is marked with the > character which must be present even if the Comment field is of zero length (i.e. there must be a > character at line position 11 or less).

The Data area of each line starts immediately after the first > character. A second > character on a line will be considered to be part of the Data field.

Lines 5 to 10 inclusive contain page layout details. There must be exactly one colon (:) in each of the lines. The data after the colon sets a format parameter as follows:

Line 5 The maximum number of lines that can appear on each page of the certificate.

Line 6 Page number of the first certificate page (title page). This allows the use of a cover page.

Line 7 Number of spaces in the left margin, which can be zero, It is used for alignment and applies to every line in the certificate.

Line 8 Uncertainties confidence probability percentage. Used as <ext> in <inst group>_UNC.<ext> to define the uncertainty file.

Line 9 Defines whether TAR is required on certificate. Valid entries are Yes or No (or Y or N). If No, uncertainty is shown in ppm.

Line 10 Defines whether failure to conform to spec indication is required on certificate. Valid entries are Yes or No (or Y or N). If Yes, a query mark ("?") appears against results that do not meet specification.

Fig 8.1 shows an example of the top 10 lines of a typical certificate template.

Line 11 of the template should be left blank.

```
                >4xxx normal certificate - 95% cal uncertainties
                >Version 1.0
                >Last edited by Stephen Self on 29th October 1993

Page            >Number of lines on page                    : 60
Details         >Starting page number of certificate        : 1
                >Number of spaces for margin                : 0
                >Uncertainties confidence probability (%)   : 95
                >TAR printout required (Y/N)                : N
                >Fails to confirm to spec indication (Y/N)  : Y
```

Fig 8.1 The first 10 lines of a typical certificate template

Subsequent sections of data lines are identified by section headers marked by leading and trailing asterisks. The section headers, which must appear exactly as shown and in the order shown are:

TITLE PAGE HEADER
TITLE PAGE DATA
TITLE PAGE MESSAGE
TITLE PAGE FOOTER
RESULTS PAGE HEADER
RESULTS PAGE DATA
RESULTS PAGE MESSAGE
RESULTS PAGE FOOTER
SUPPLEMENTARY PAGE HEADER
SUPPLEMENTARY PAGE FOOTER
COLUMN TITLES

The data in the last line of the template file must be End of file.

Page layout

The diagrams opposite show the basic page layouts and the areas effected by the various section headers.

All data after line 10 in the template file is text. The *TITLE PAGE DATA*, *RESULTS PAGE DATA* and *COLUMN TITLES* sections have special formats described later.

HEADER, MESSAGE and FOOTER sections contain text data which is inserted line by line, as it appears in the template, into the appropriate sections of the certificate. Space characters can be used to position text blocks horizontally and vertically but care should be taken to ensure page size limits are not exceeded.

A maximum 75 characters per line is recommended for a printer set to 10 characters per inch on Quarto and A4 paper (this includes the margin which is set by line 7 of the template).

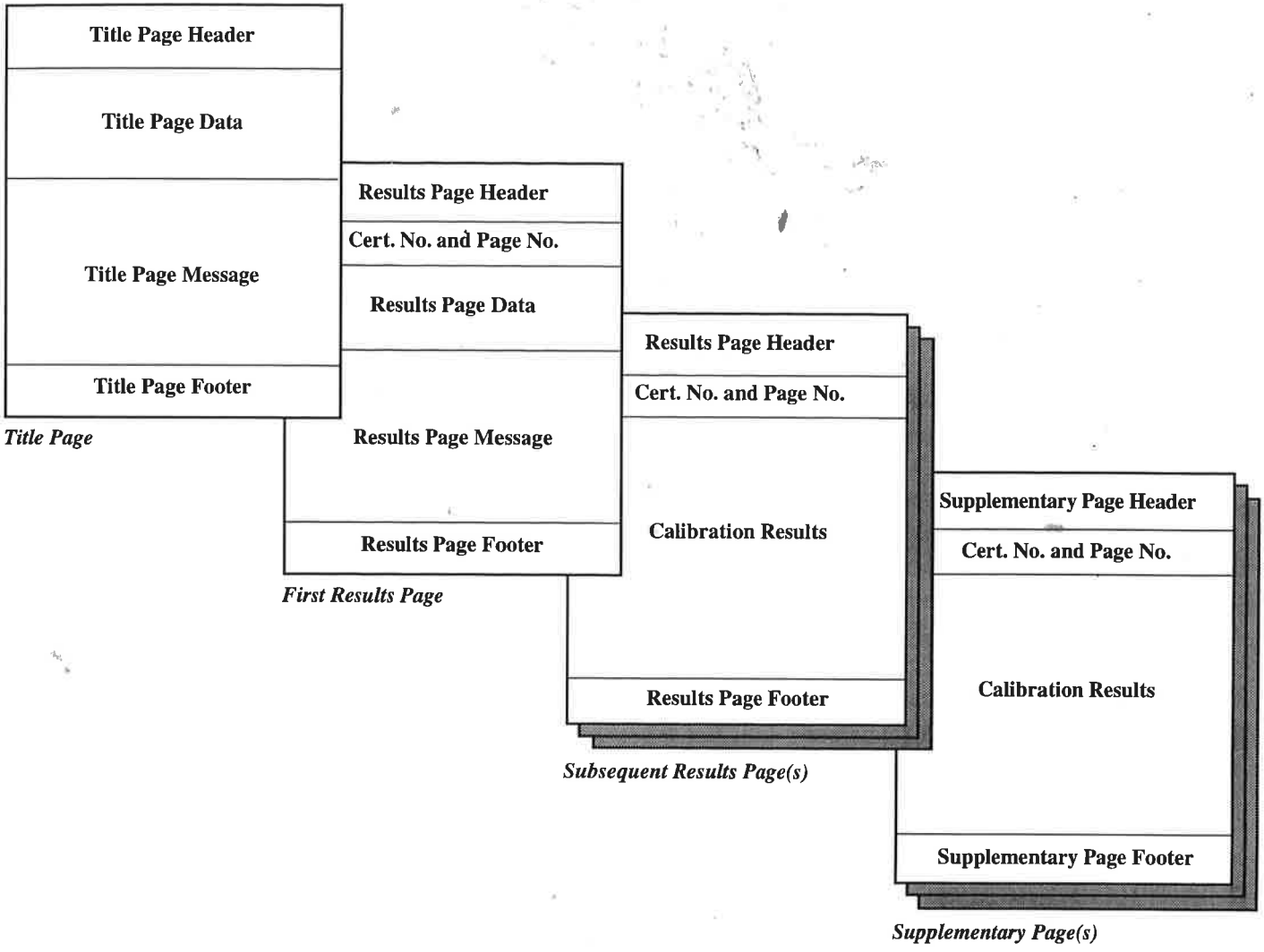
For HEADER, MESSAGE and FOOTER sections, the amount of vertical space allocated is determined by the number of lines of text data in the template file. Any of these sections can have zero length. For example, to set the HEADER section of results pages to zero lines, the *RESULTS PAGE DATA* section header should appear immediately under the *RESULTS PAGE HEADER* section header:

```
>*RESULTS PAGE HEADER*
>*RESULTS PAGE DATA*
>Environment details:
>   Date              etc.
```

Similarly, if pre-printed paper with a 4 line header area is to be used, the first 4 lines of each HEADER section should contain spaces, e.g:-

```
>*TITLE PAGE HEADER*
>
>
>
>
>certificate template text
>more text
>*RESULTS PAGE DATA*
>Environment details:
>   Date              etc.
```

The limits to the amount of data that can be fitted into each section are wide enough to allow maximum flexibility in certificate presentation. Clearly, however, the sum of the number of lines in each section on a page (including calibration results where applicable) must not be greater than the maximum number of lines that will fit on a page. The upper limit to lines per section is 20 each for Headers and footers and 60 for Messages. There must be room for column headings, inter section blank lines and at least two lines of calibration data on results and supplementary pages.


Title Page Header
Title Page Data
Title Page Message
Title Page Footer
Title Page
Results Page Header
Cert. No. and Page No.
Results Page Data
Results Page Message
Results Page Footer
First Results Page
Results Page Header
Cert. No. and Page No.
Calibration Results
Results Page Footer
Subsequent Results Page(s)
Supplementary Page Header
Cert. No. and Page No.
Calibration Results
Supplementary Page Footer
Supplementary Page(s)

TITLE PAGE DATA

Note: The example template file 4XXXCERT.1 is used to illustrate this section. As the example template files are 120 characters wide, printouts should be done with printer set to 17 or more characters per inch (condensed mode) to maintain the correct format.

The *TITLE PAGE DATA* section consists of exactly 18 lines (in the example file, the lines are numbered in the comments field). The data in each line contains 2 or 3 comma delimited text parameters. Commas are not allowed within the text fields.

Because line items 1 to 15 are place holders for data extracted from the intermediate file, the meaning of parameters 1 and 2 of line items 1 to 15 must not be changed. Line items 16, 17 and 18 may be changed to suit the users requirement or left blank.

Parameter 1 appears on the computer screen as a user prompt for data entry at run time.

Parameter 3 is optional. If present, it appears on the screen as default data next to the user prompt defined by parameter 1. This facility means that common data such as Signatory, Instrument type and Manufacturer does not have to be typed in by the every time the template is used.

Any data entered for parameter 3 in item 1, 4 and 12 is ignored. The computer generates the information for items 1, 3 and 12 at run time.

Parameter 2 is printed on the certificate to the left of information entered by the user or created by the program.

For the data item at line 14, the text of the 3rd parameter will be preceded by the instrument type. Similarly, the text of the 3rd parameter of line item 15 will be preceded by the instrument serial number.

The data items are printed double spaced on the certificate except for the customer address items 6 to 11 and items 5 and 6 which are separated by three blank lines. Each line item is described below:

1. Date of Issue is set to current system date automatically.
2. Certificate Number appears on all pages
3. Defines the form of the page number which appears on all pages (in the form of page number and total number of pages). The '_' character identifies where the page number will appear within the text. For example, 'Page_of' will produce Page 4 of 8. The third parameter must be an integer. This sets the number of blank lines that are inserted under the page number line on the results and supplementary pages.
4. A space for the approved signatory to sign.
5. Approved signatory's printed name.

6-11. Customer details name and address etc..

12. Date of measurement (set by the program to the date the measurement finished from .CRI or .CRD file.
13. Instrument Manufacturer.
14. Instrument Type — set by the program to the type selected at runtime.
15. Instrument Serial Number — set by the program to the number entered at runtime.
16. Date of Receipt of Instrument (optional).
17. Job Number / Order Number (optional).
18. Previous Certificate Number (optional).

RESULTS PAGE DATA

This data section must contain exactly 16 lines of single parameter text. The text appears on the first results page where all items except 1, 6 and 11 are followed on the certificate by data extracted from the certificate intermediate file. Note that items 1, 6 and 11 are sub headings and do not have data from the intermediate file printed against them. In the example file, the lines are numbered in the comments field. Line item numbers are described below:

1. Environment Details - sub title
2. Date - at the end calibration measurements
3. Time - at the end of calibration measurements.
4. Temperature - of laboratory
5. Humidity - of laboratory
6. Calibrator details title
7. Calibrator Type
8. Code Number
9. Serial Number
10. Manufacturer/model number
11. 4950MTS details title
12. Serial Number
13. Lead Serial Number
14. Shunt Serial Number
15. Measurement Type
16. Calibration specification period

COLUMN TITLES.

The final section in the template file describes results column headings. Seven lines of data are required with each line representing a column of data. All seven lines must be represented, but the data field of any one may be blank. In this section a line can contain 1 or 2 text parameters. A column heading in the certificate may be two lines. Where two parameters are present, the second forms the lower line of the column heading.

So that all the required data fits into the standard 75 column width format of a certificate, Function titles appear in the 1st column but on a separate line to the rest of a line of results data. The first certificate column therefore doubles for Function and Range (line item 2 in the example file).

Column widths are fixed by the Certificate Generator. Headings longer than the allocated column width will cause columns and data to be misaligned. Column widths are shown in square brackets with the line item numbers below:

Template Line	Certificate Column	Printed Data	No. of Characters
2	1	Function or Range	20 6
3	2	Test Point	11
4	3	Indicated/applied value	13
5	4	Measured value	13
6	5	Difference	13
7	6	TAR/uncertainty	13

Template line 1: The column represented by this line is normally left blank. If used, the text in parameter 1 appears in front of the Function field from the intermediate file e.g.

line 1, parameter 1 = FUNCTION:
input from intermediate file = AC Voltage

Certificate shows FUNCTION: AC Voltage

Last line

The last line of the template must contain the statement:-
End of file

Difference Certificates

Another new feature of the 4950MTS Control Software is its ability to conduct 4950MTS Baseline measurements while adjusting or verifying the Certified performance. When this feature is enabled, the difference between two baseline measurements can be reported in a Difference Intermediate Certificate File (.CRD) which has a similar format to the normal Intermediate File (.CRI).

The template file for a difference certificate is the same as for a standard calibration certificate except that the column headings should reflect the different type of data in columns 4 and 6:

line 5, column 4. Difference value.

line 6, column 5. Difference specification.

Page Layout Calculations

Once the template and intermediate certificate files have been read in, the amount of space available for data and hence the number of pages required are calculated. The program counts the number of lines between each Section Header to calculate the page layouts. The number of lines required by the data from the template file is calculated as follows:-

Title page = number of title header lines
+ number of title message lines
+ number of title footer lines
+ 33

First result page = number of result header lines
+ number of result message lines
+ number of result footer lines
+ 23

Result page = number of result header lines
+ number of result footer lines
+ number of column heading lines
+ 8 (including the minimum 2 result lines)

Supplementary page = number of result header lines
+ number of result footer lines
+ number of column heading lines
+ 8 (including the minimum 2 result lines)

The number of lines must not be greater than the page length set at the top of the template file.

Description of <inst group>_UNC.<ext> uncertainty files

Uncertainty files must be produced using a text editor capable of ASCII output.

The first 4 lines are comment lines and must be present. The fourth line is usually left blank. Data always starts on the fifth line.

Each data line contains 4 parameters which are:

1. **Index number**: This is the same number used in the .SPC and correction file for the required measurement point. An index of 000 denotes a function change and is used to identify a comment which is not used by the program. A line with an index of 000 must be preceded by a blank line and should contain only the first 2 parameters.

2. **Comment**: This parameter is present to make reading the file easier and is not used by the program.

3. **Calibration Uncertainty** in text form: This parameter will be printed in the certificate without modification unless TAR is selected in the template file.

4. **Calibration Uncertainty** in absolute form: This parameter will be used to calculate the TAR if a TAR output has been selected in the CERT file. A non-numerical character other than the "#" character (ie. *) at the end of this parameter will be printed when TAR is selected. This allows the point to be referred to by text elsewhere in the certificate.

The "#" character in parameter 3 or 4 indicates a measurement point which must appear in the supplementary page(s). The "#" character does not appear on the certificate.

The last line of the uncertainty file must be End of file.

Test Accuracy Ratio (TAR) Calculation

Test Accuracy Ratio (TAR) is calculated from measurement specifications (from the intermediate file) and uncertainties (from the uncertainty file). Two formulae are used:

1. Where specification is relative to local standards (measurement uncertainty is not included) — i.e. 4950 certificates

$$TAR = \frac{(spec + uncertainty)}{uncertainty}$$

2. Where the uncertainty contribution is included in the accuracy specification — i.e. 4XXX, 5XXX and 9000 certificates.

$$TAR = \frac{spec}{uncertainty}$$

SECTION 9 4950 MTS System - De-commissioning After Use

Selecting, Reviewing, Printing and Saving Results Files

On completion of the required software task, it is recommended that the measurement results are reviewed and printed. *(See Section 7 and Appendix A)*

Windows software contains print utilities which will enable you to configure your printer.

Refer to the section of the *MicroSoft Windows User's Guide* entitled *'Print Manager'*.

Backup Copies of Programs and Results

It is recommended that you make backup copies of your MTS Control Software floppy disks, especially if you are running a 'hub and satellite' calibration organization.

In any case it is wise to put your results files onto two backup floppy disks, in case of accidental erasure from the hard disk.

Refer to the section of the *MicroSoft Windows User's Guide* dealing with disk copy backup procedures.

Inspection and Packing

This section assumes that the system will be inspected and packed in accordance with *Section 5*.

Power Down and Dismantling

Ensure that the 4950 instrument, calibrator(s) and computer **Line Power** has been switched **OFF**.

Disconnect and remove all interconnecting cables.

Line Input Voltage Selector and Line Fuses

Prepare for use at the next location by checking or resetting the voltage to that of the local line supplies:

115V Line Supply

For 90V to 145V supplies, the legend '115' must be visible in the window of the line voltage selector switch (S1) on the rear panel, fuse F1 must be rated at 1.0A, and fuse F3 must be rated at 10A.

230V Line Supply

For 187V to 292V supply; the legend '230' must be visible in the window of the line voltage selector switch (S1) on the rear panel, fuse F1 must be rated at 500mA, and fuse F3 must be rated at 6.25A.

Line-Power Connections

System Line-Power Cable

The correct local version of the line supply cable should be shipped in the cable compartment of the Transit Case.

System Line-Power Outlets

Two line outlet sockets are provided on the rear of the 4950 instrument. One is intended to supply power to a Datron 47 or 48 series Calibrator, and the other to power the Datron Model 4600 Transconductance Amplifier. Two male-female leads, for connection to these instruments, should be shipped in the Cable compartment of the Transit Case.

Replacement Fuses

SPARE FUSES SHOULD BE SHIPPED IN THE TRANSIT CASE. ENSURE THAT ALL FUSES ARE OF THE CORRECT TYPE, WITH THE SPECIFIED RATING.

AVOID THE USE OF MENDED FUSES. IT IS DANGEROUS TO SHORT-CIRCUIT FUSE HOLDERS: SUCH PRACTICES WILL RENDER THE WARRANTY VOID.

Signal Input Cable

All signals are input via the 5-pole plug on the front panel, whose input connections and orientation are described in the *Instrument User's Handbook, Section 2 page 2-12*:

The input cable provided with the system kit may have been characterized for 2-wire Ohms function in the 4950 instrument non-volatile memory. The characterized cable should be shipped in the Cable compartment of the Transit Case.

Model 4953 10A Shunt

The model 4953 10A shunt which may have been provided with the system kit will have been characterized for the 10A range in DCI and ACI functions in the 4950 instrument non-volatile memory. This shunt should be shipped in the Shunt compartment of the Transit Case.

Assembling Items for Transit

Ensure that all items required for use at the next location are assembled ready for packing into the Transit Case.
Use a photocopy of the Shipment Assembly List (*Appendix A* to this section) to detail the items to be shipped.

Section 5 details the packing procedure.

4950 MTS System — Shipment Assembly List

Note quantities; and place a check in the last column for items are to be assembled for shipment.

Item	Qty	Item Part No.	Item Description	Serial No./ Version No	Check if Items to be shipped
1.		850915	This Transit Checklist		
2.		630386	Hygrometer / Max-min Thermometer		
3.		630373	Sealed Sachets of Silica-gel Desiccant		
4.		450967	Zipper Bag		
5.		401009	Model 4950 Instrument		
6.		630393	Shockwatch (Attached to rear of Instrument)		
7.		630373	Activated Sachet of Silica-gel Desiccant		
8.		401034	Model 4953 10A Shunt Kit		
9.		920030	Shunt Shorting Link		
10.		850917	Model 4953 10A Shunt Kit Packing List		
11.		401035	4950 Instrument Input Cable Assembly		
12.		920179	10A Line Power Lead *or*		
13.		920233	Connector MIL-C028777/8		
14.		920133	2m Male-Female Line Power Lead		
15.		920260	1m Male-Female Line Power Lead		
16.		920084	0.5A Fuse		
17.		920114	6.25A Fuse		
18.		920175	10A System Fuse		
19.		920116	1A Instrument Fuse		
20.		920071	1.6A Current Function Fuse		
21.		850270	4950 Instrument User's		
22.			Configured System Computer		

Date of Assembling Shipment	
Signature of Assembler	

Section 10 4950 MTS System - Dispatch to Transit

This section contains information and instructions for checking and packing the Wavetek Datron 4950 Multifunction Transfer Standard System.

Spare Checklists

A master copy of the Transit Checklist is provided at the end of this section. This may be used to generate new photocopies as required.

Transit Case Protective Material

The 4950 MTS system is packed in shock-absorbent material inside a special transit case to ensure that it will travel in perfect condition.

If the equipment has been previously maltreated, this will be evident by signs of damage to the shock-absorbent material. Examine this before packing any equipment.

Transit Case Contents

The transit case has space to accommodate the MTS System items printed on the Transit Checklist. Items contained in the case for the present shipment should have been assembled ready to pack. *Section 4* includes a list of items to be assembled, some of which will be packed separately, and not inside the main transit case.

Inspection and Packing

Order of Packing

Except for certain items in compartments 1 and 2, the contents can be packed in any sequence.

Inspect and pack into compartments 3 and 4; the relevant items on the Assembly List. Check off each item in the next Dispatch column of the Transit Checklist as it is packed.

Sealed Desiccant Sachets

Stow the required number of *sealed* desiccant sachets into compartment 5. Check them off in the next Dispatch column of the Transit Checklist as they are packed.

Handbooks and Fuses

Stow the handbooks and fuses into the space at the bottom of compartment 2. Check off each item in the next Dispatch column of the Transit Checklist as it is packed.

Check the Shockwatch

Ensure that the 'Shockwatch' phial attached to the rear of the 4950 instrument shows **white**, with no traces of red. If the shockwatch has fractured internally and **is** red, report the fact to your supervisor for investigation of rough handling.

Pack the Zipper Bag

Set the protective zipper bag with the Datron logo uppermost and the zip fastener towards you. Carefully insert the 4950 instrument into the bag, top up and rear to the right of the bag. Place a regenerated desiccant sachet into the bag and immediately zip up the bag (alternatively, if no regeneration facilities are available, take a new desiccant sachet out of its sealed packet and use it instead - refer to *Section 2*).

Carefully place the bag and its contents to fit between the shock-absorbent material in compartment 2, with the Datron logo uppermost and the zip fastener *away* from the hinge of the case. Check off each item in the next Dispatch column of the Transit Checklist as it is packed.

MAX/MIN Thermometer

N.B. Set up the combined hygrometer/max-min thermometer *just before* closing the transit case lid.

Ensure that the hygrometer / max-min thermometer is stowed correctly in compartment 1.

Reset the MAX and MIN temperature readings as follows:

Ensure that the IN/OUT slider switch is set to '**IN**'.

Reset Maximum Temperature Memory:
Press the MAX button and hold for 1 to 2 seconds, then while the button is held, simultaneously press the 'MIN' button. All segments will appear on the LCD display to indicate that the MAX memory has been cleared. Release both buttons.

Reset Minimum Temperature Memory:
Press the MIN button and hold for 1 to 2 seconds, then while the button is held, simultaneously press the 'MAX' button. All segments will appear on the LCD display to indicate that the MIN memory has been cleared. Release both buttons.

Transit Checklist

Complete all relevant parts of the current 'Dispatch' column on the Transit Checklist, including today's date. Initial the column beneath the date.

Stow the checklist in its transparent folder in compartment 1.

Secure the Case

Check each case compartment to make sure that all items are secure. Close the lid and fasten the catches.

4950 MTS System Transit Checklist

Generation of New Transit Checklists

The copy of the Transit Checklist, overleaf, can be used as a master to generate photocopies for use when shipping 4950 systems on their closed loop journeys.

Use of the Transit Checklist

The form is intended to cover transits outward from the location where the 4950 system normally resides, and return.

For Example:(Refer to *Section 1*)

For closed-loop method A, Stage 2 is the outward Dispatch/Receipt, and Stage 4 the return.

For closed-loop method B, Stage 3 is the outward Dispatch/Receipt, and Stage 5 the return.

Datafile Descriptions

The process defining files required by the 4950MTS Control Software during a measurement sequence are listed below. The 4950MTS Control Software's data files can be modified using a text editor capable of producing ASCII format files — e.g. **EDIT.COM** included with MSDOS 5.0 or later. The files described below contain comma-delimited data. It is essential that the format is maintained. A missing blank line or comma will cause either an unrecoverable error to be reported, or worse, a difficult to detect calibration error.

Procedure Files

Purpose

Procedure files determine the sequence of measurements, which points are adjusted (if adjustment is requested), control instrument configuration and settling delays. Procedure files are indexed to measurement points in other control files and, for **MTS_CAL**, provide measurement specifications.

Name

Procedure files are named according to their use. e.g. **4808.SPC** or **MTS.SPC**.

Location

Procedure files are located in the sub-directory for the instrument to which they relate — e.g. if the main 4950MTS Control Software directory is

C:\4950MTS

then the full path to a 4950MTS procedure will be

C:\4950MTS\4950MTS\MTS.SPC

Similarly, the full path to the procedure for Fluke 5700 calibrators will be

C:\4950MTS\CALIBRAT.ORS\5700.SPC

Structure

Procedure files are complex and should not be changed without reference to your local service centre.

Correction Files

Purpose

Correction files maintain measurement performance where adjustment to nominal values has not been made, and are indexed to measurement points in other control files.

Location/Name

Correction file templates are provided. Assuming that the main 4950MTS Control Software directory is

C:\4950MTS

then template files **CORRECTN.MTS**, **CORRECTN.51**, **CORRECTN.57** and **CORRECTN.90** will be located in the subdirectory

C:\4950MTS\4950MTS

The template **CORRECTN.CAL** will be located in the subdirectory

C:\4950MTS\CALIBRAT.ORS

The relevant file(s) must be copied into the unique subdirectory for the traceable instrument and correction factors inserted. The purpose of correction files is as shown below.

CORRECTN.CAL - corrections for a Wavetek 4X0X when calibrating a 4950MTS

CORRECTN.51 - corrections for a 4950MTS when calibrating a Fluke 5100

CORRECTN.57 - corrections for a 4950MTS when calibrating a Fluke 5700

CORRECTN.90 - corrections for a 4950MTS when calibrating a Wavetek 9000

CORRECTN.MTS - corrections for a 4950MTS when calibrating a Wavetek 4X0X.

Structure

(See Fig A.1)

Line 1: Must contain three comma delimited parameters - the serial number of the instrument to which it relates, the date of calibration of the instrument and the issue number of the 4950MTS Control Software. If serial number and date do not match the data for the traceable instrument connected to the system, an error will be reported during the set up phase of a measurement sequence.

Lines 2 & 3: Free for use as comments, no delimited data, commas are ignored.

Line 4: Blank

Line 5: First line of correction data. This line is used to indicate a function title. Function titles may be used anywhere in the file from this point on and are identified by the 1st parameter being 000. A function identification line must have at least two parameters. The second parameter of a function line is not used by the 4950MTS Control Software.

Line 6 onwards: A line containing 4 parameters is required for each measurement point (unless the line is identified as a function title by 000 as the first parameter).

Parameter 1 - index number cross reference to other data files.

Parameter 2 and 3 - identify the test point, are not used by the 4950MTS Control Software.

Parameter 4 - the correction as an absolute value eg a correction of -5nA would be shown as -0.000000005

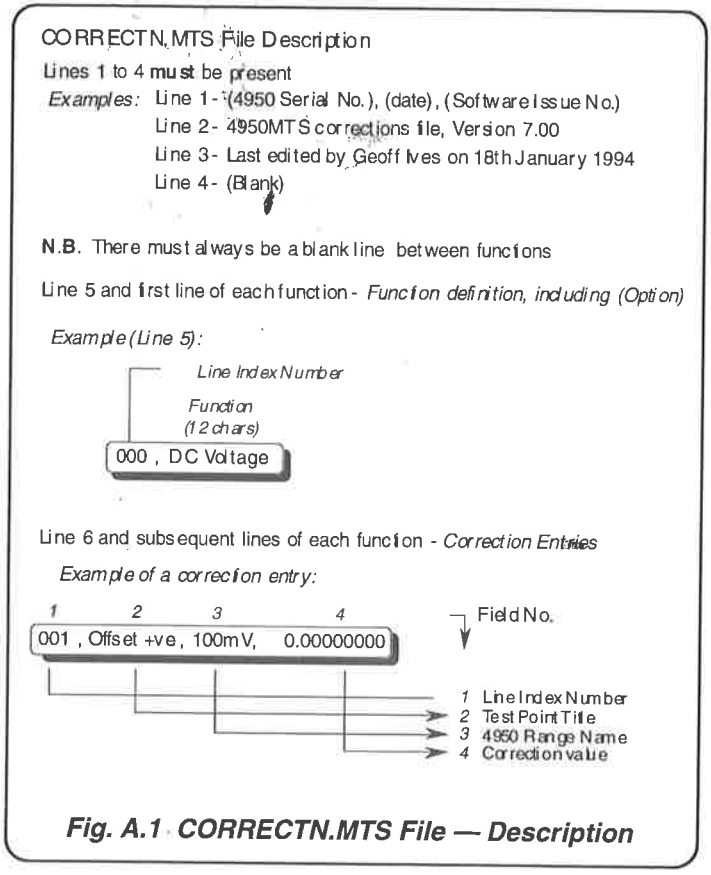


Fig. A.1 CORRECTN.MTS File — Description

Specification Files

Purpose

Where required, specifications files contain the pass/fail test limits for calibration. Only Fluke 5100 series and Wavetek Datron model 9000 require specification files. Specifications for Fluke 5700 series and Wavetek Datron 4700 and 4800 series calibrators are recalled from the instrument during calibration, specification for the 4950MTS is contained in the procedure file **MTS.CAL**. Specifications files are indexed to measurement points in other control files.

Name

Specifications files are named according to their use — e.g. **SPEC.1Y** contains 1 year specifications, **SPEC.180** contains 180 day specifications.

Location

Specifications files are located in the sub-directory for the instrument to which they relate— e.g. if the main 4950MTS Control Software directory is

C:\4950MTS

then

C:\4950MTS\CALIBRAT.ORS\5100.180

is the full path to a Fluke 5100 file for 180 day specification.

Structure

The layout of specification files is similar to correction files.

Lines 1, 2 & 3: Free for use as comments, no delimited data, commas are ignored.

Line 4: Blank

Line 5: First line of specification data. This line is used to indicate a function title. Function titles may be used anywhere in the file from this point on and are identified by the 1st parameter being 000. A function identification line must have at least two parameters. The second parameter of a function line is not used by the 4950MTS Control Software.

Line 6 onwards: A line containing 4 parameters is required for each measurement point (unless the line is identified as a function title by 000 as the first parameter).

Parameter 1 - index number cross reference to other data files.

Parameter 2 - identifies the test point, is not used by the 4950MTS Control Software.

Parameters 3 and 4 - The specification as absolute upper and lower limits eg if the specification for a 100V measurement is 5mV, parameter 3 would be 100.005 and parameter 4 would be 99.995 (for -100V, parameter 3 would be -99.995 and parameter 4 -100.005).

4950MTS Control Software Results files

The name given to results files is made up of two parts — a filename and a 3-character extension

<filename>.<ext>

During the set up of a measurement sequence, the user is asked to specify which results formats are required. The choice of formats determines which **.<ext>** files are produced. The user also has the opportunity to change the default file name to an alernative filename if required. This sets **<filename>**. The types of file extension, **.<ext>**, common to all 4950MTS Control Software programs are described below. All of these files are placed in the unique sub-directory created for the Instrument being calibrated by the 4950MTS Control Software.

<filename>.ASC - ASCII format, space separated, may be read by most text editors, word processors, DOS and general utilities.

<filename>.TXT - Tab separated format which is used by most windows based editors, word processors and desktop publishers.

<filename>.WK1 - Worksheet format which can be imported directly into spreadsheets such as LOTUS 1-2-3™ and EXCEL™.

<filename>.CRI - A special format 'intermediate' file for use by the Certificate Generator program.

All the files start with a header containing information provided during the set-up phase of a measurement sequence. This includes information on the environment (date, time, temperature and humidity) and details of both the traceable standard instrument and the Instrument being calibrated. Under this header are further details about the results being presented, which vary with the instrument being measured. The final part of results files are the results themselves. Table A.1 shows the layout of results. In addition to the files described above a file called **LASTRUN.TXT** will be found in the main sub-directory of the 4950MTS Control Software (e.g. **C:\4950MTS**) This file is over written during every measurement sequence but is provided to give a simple to locate 'quick look' file that can be accessed using the Windows™ Notebook or Write™ applications.

Further special files may be generated depending on the 4950MTS Control Software program in use and on the type of measurement selected. These files must not be edited or moved. They may be deleted once the loop closure measurement sequence they belong to is complete.

The **MTS_CAL** program allows baseline comparison measurements to take place at the same time as a **Certified Verify** or **Certified Adjust and Verify**. The baseline results are placed in a sub-directory called **PRE** , which is a subdirectory within the unique sub-directory for the 4950MTS being calibrated. These files have a unique three figure integer as the **.<ext>** part of their filename to allow up to 999 files to be stored for each 4950MTS before over-writing occurs. Except for the first measurement, each time an **Auto Baseline Comparison** measurement takes place, a 'difference' file is placed in the unique sub-directory for the 4950MTS being calibrated. The **.<ext>** part of these file depends on the format chosen for the main results file(s) ie **.DFA** and/or **.DFT** for ASCII and/or text formats, **.CRD** for a difference certificate intermediate file.

The other programs, **CAL_4X0X**, **CAL_5100**, **CAL_5700** and **CAL_9000** will also produce special baseline files if **PRE** or **POST TRANSPORTATION** measurements are selected. Files from **PRE TRANSPORTATION** measurements have **PRE** as their **.<ext>** and are placed in the unique sub-directory for the calibrator being calibrated. A **.PRE** file is over-written every time the calibrator it relates to is calibrated, unless a unique filename is specified during the set up of each measurement sequence — i.e. unless you change the default filename. The additional file(s) resulting from **POST TRANSPORTATION** measurements are **DFA (ASCII) and/** or **DFT** (text) format files.

Note: The two types of **PRE** files are not interchangeable as they are produced by different processes and have different formats.

A file called **PERFORMA.NCE** is placed in the instrument type sub-directory (e.g. **C:\4950MTS\CALIBRAT.ORS\4800**) during each measurement run. This file is for service center use only. The **PERFORMA.NCE** file for a particular type of instrument is over-written each time a 4950MTS Control Software procedure is run on that type of instrument. (Note that performance files are not specific to particular instrument serial numbers.)

Note:
Test points marked as Gain have had the respective offset subtracted.

Points marked with a against the Std Dev are considered to be noisy readings.

Function	Range	Test Point	Output	Reading	Std Dev	Sample	Spec	% Spec	P/F
DC Voltage	100mV	Offset +ve	0.00000mV	0.00012mV	0.06ppm	128	0.00030mV	40.00%	
		Gain +ve	100.00010mV	99.99999mV	0.07ppm	128	0.00030mV	-36.67%	
		Offset -ve	0.00000mV	0.00001mV	0.07ppm	128	0.00030mV	3.33%	
		Gain -ve	-100.00010mV	-100.00009mV	0.08ppm	128	0.00030mV	3.33%	
	1V	Offset +ve	0.0000000V	0.0000000V	0.01ppm	64	0.0000020V	0.00%	
		Gain +ve	1.0000027V	1.0000027V	0.02ppm	64	0.0000020V	0.00%	
		Offset +ve	0.0000000V	-0.0000002V	0.02ppm	64	0.0000020V	-10.00%	
		Gain +ve	-1.0000030V	-1.0000030V	0.02ppm	64	0.0000020V	-0.00%	
	10V	Offset +ve	0.000000V	0.000002V	0.01ppm	64	0.000015V	133.33%	
etc...									
AC Voltage	1mV	1kHz	1.00000mV	0.999942mV	14.14ppm	8	0.00202mV	-2.97%	
		1MHz	0.99600mV	0.99561mV	13.40ppm	8	0.00330mV	-11.82%	
		10Hz	0.99980mV	0.99981mV	6.29ppm	8	0.00202mV	0.50%	
		20Hz	1.00010mV	1.00011mV	7.74ppm	8	0.00202mV	0.50%	
		⋮							
	(100mV)	10Hz	100.0014mV	100.0018mV	6.82ppm	8	0.0030V	-13.33%	
		⋮							
	100V	1kHz	100.0015V	100.0014V	1.02ppm	8	0.0010V	-10.00%	
		200kHz	99.9769V	99.9749V	1.72ppm	8	0.0050V	-40.00%	
		10Hz	100.00025V	100.0011V	5.35ppm	8	0.0010V	-140.00%	Fail

etc to end of results...

Table A.1 Results File — Examples of Results Format

Transit Checklist

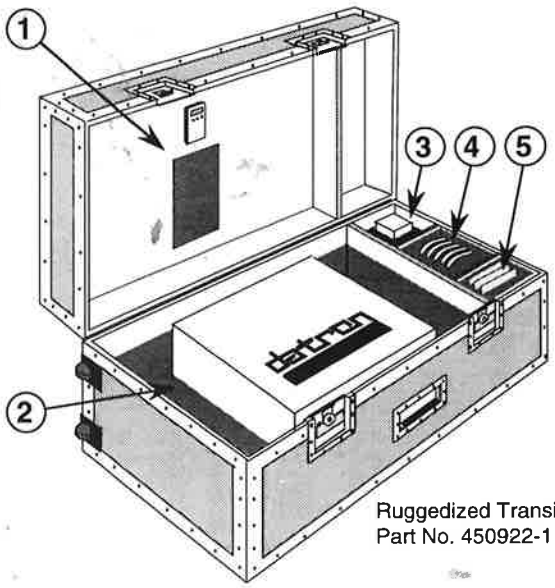
IMPORTANT: Follow Recording and Unpacking Instructions in the System User's Handbook (in separate software package)

The Transit Case is designed with five major compartments, to hold the listed items.

Compartments:

1. Underside of lid.
2. Instrument (Left).
3. 10A Shunt (Right Rear).
4. Connectors (Right Center).
5. Desiccant.

Check the spaces in the appropriate columns to show which items were dispatched or received.



Ruggedized Transit Case
Part No. 450922-1

List of Checks and Items

Check Name	Check Description	Outward Dispatch	Outward Receipt	Return Dispatch	Return Receipt
MAX	Maximum Recorded Temperature since closing the Transit Case	Reset		Reset	
MIN	Minimum Recorded Temperature since closing the Transit Case	Reset		Reset	
S/W	Record of Handling in shipment: *White:* Normal; *Red:* Rough	White		White	

Cmpt	Item Part No.	Item Description	Serial No./ Version No	Outward Dispatch	Outward Receipt	Return Dispatch	Return Receipt
1.	850915	This Transit Checklist					
	630386	Hygrometer / Max-min Thermometer					
2.	450967	Zipper Bag, containing:					
	401009	Model 4950 Instrument					
	630393	Shockwatch (Attached to rear of Instrument)					
	630373	One Activated Sachet of Silica-gel Desiccant					
Under Zipper Bag	850280	4950 System User's Handbook					
	850270	4950 Instrument User's Handbook also containing a wallet with spare fuses:					
either	920084	0.5A Instrument Fuse (230V)					
	920114	6.25A System Fuse (230V)					
or	920116	1A Instrument Fuse (115V)					
	920175	10A System Fuse (115V)					
	920071	1.6A Current Function Fuse					
3.	401034	Model 4953 10A Shunt Kit					
	920030	Shunt Shorting Link					
	850917	Model 4953 10A Shunt Kit Packing List					
4.	401035	4950 Instrument Input Cable Assembly					
	401077	50Ω Terminator					
	440154	Output Cable Assembly for Datron Model 4600					
	630382	'N' to Dual 4mm Adaptor					
	630416	Double Banana Splice Adaptor					
	920133	2m Male-Female Line Power Lead					
	920260	1m Male-Female Line Power Lead					
	920179	10A Line Power Lead (UK) *or* (EUR) *or*					
	920233	Connector MIL-C028777/8 (USA)					
	920291	2 x 25mm Shorting Link (for Model 9000)					
5.	630373	Five Sealed Sachets of Silica-gel Desiccant					

Date of Packing/Unpacking

Initials of Packer/Unpacker

WAVETEK datron

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