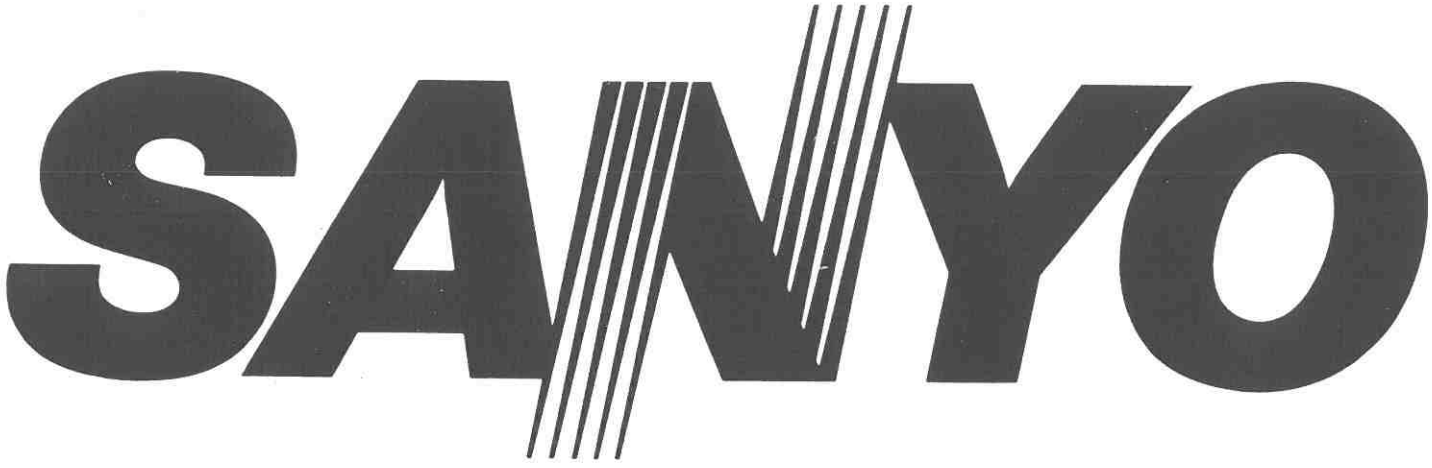
SANYO

SANYO GALLENKAMP

Fitotron™

PLANT GROWTH CHAMBER

INSTRUCTION MANUAL

CHAMBER MODELS COVERED:	SGC066.PPX.F
	SGC097.PPX.F
HANDBOOK DATE:	October 1997
HANDBOOK REFERENCE:	Z15086

CONTENTS PART ONE - THE CHAMBER

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PART TWO FORMAT 650 PROGRAMMING OPERATING INSTRUCTIONS

The contents list for Part 2 is at the beginning of that part.

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DOCUMENT REVISION HISTORY

Document revision	Date	Notes
Issue 1	01.10.97	New manual incorporating Format 650. Replaces Z01483

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Health and safety at work

SANYO Gallenkamp is required under the Health and Safety at Work, etc. Act. 1974 and other U.K. legislation as designers, manufacturers, suppliers and importers of articles for use at work to ensure that, as far as reasonably practicable, the articles which we design, produce, supply or import are safe and without risk to health, when properly used.

We are also required to provide information on the safety and handling precautions to be observed when installing, operating, maintaining and servicing our products. Such advice is contained in this manual.

We should also like to point out, however, that you as users have an important responsibility in the provision and maintenance of safe working practices and conditions. Accordingly we draw the following matters to your attention:

1. This apparatus should only be used as intended and within its design parameters by suitably qualified and trained personnel who have read and understood the relevant sections of this manual.

2. This manual should be readily available to such personnel at all times.

3. In addition to that which is written in the manual, normal commonsense safety precautions must be taken at all times to avoid the possibility of accidents. Particular care is required when working with apparatus at high temperature or pressure.

4. Installation, maintenance, servicing and connection to electrical supplies, should only be carried out by suitably trained personnel. The service department can provide these facilities if required.

If you are in any doubt whatsoever regarding the correct use of this apparatus, or if you require any technical data or assistance, please contact the SANYO Gallenkamp at:

SANYO Gallenkamp PLC
Monarch Way
Belton Park
Loughborough
Leicestershire LE11 5XG

Telephone: +44 (0) 1509 265265
Fax: +44 (0) 1509 269770

Service facilities

Customers in the United Kingdom should contact the Environmental Service Department at the address above. Overseas customers should contact their SANYO Gallenkamp distributor.

Electricity supplies: voltage and frequency

Electrical apparatus manufactured by SANYO Gallenkamp PLC is offered and labelled for one, or for a choice of two or more voltage ranges and, where necessary, different frequencies of electricity supply. SANYO Gallenkamp does not accept any responsibility for the operation of any such apparatus should it be connected to electricity supplies which are normally outside, or vary outside, the stated voltage and frequency values for which it is designed, nor for any consequential loss, damage or injury howsoever caused.

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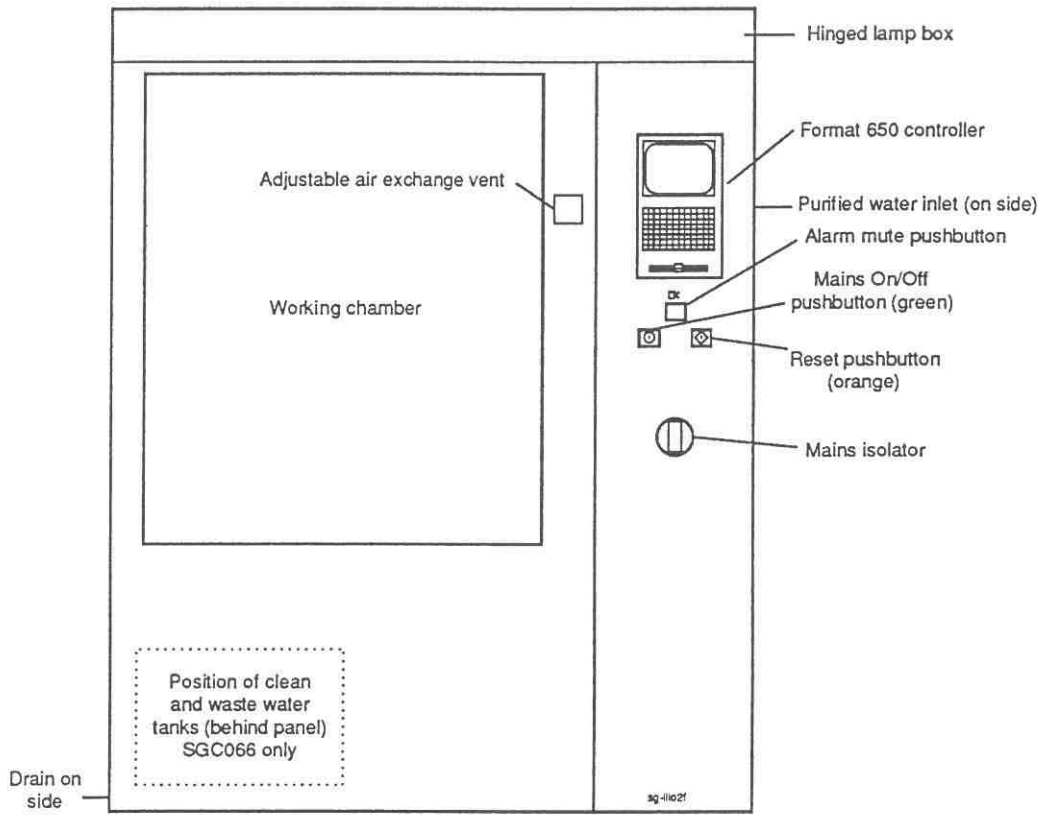
1.GENERAL DESCRIPTION

The SGC range of plant growth chambers are specifically designed to provide the highest standards of performance and reliability. The range covers models from 660 to 1700 litres working capacity with a wide choice of lighting systems. All models have sophisticated airflow systems ensuring minimum temperature gradients.

Humidification is achieved via atomised water generation with dew point dehumidification.

Multi-setpoint programming is provided by the Sanyo Gallenkamp Format 650 programmer with computer linking facilities.



General view of a SGC Plant Growth Chamber

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2.UNPACKING AND CHECKING CONTENTS

1. Check the contents of all packing materials for transit damage and report immediately to SANYO Gallenkamp, Leicester.
2. Accessories and spares

   Check that the following items have been supplied with the chamber:

   a) Air compressor spares kit containing diaphragm(s)

   b) Manufacturer's instructions for the recorder (if fitted)

   c) This instruction manual

3.PRE-INSTALLATION

3.1 SAFETY AND PRE-INSTALLATION CHECKS

This product is designed to conform to be operated within the following environmental conditions as defined by IEC 1010:

- indoor use
- altitude: up to 2000 metres
- ambient temperature: between +5°C and +25°C
- supply voltage: not to exceed +/-10% of nominal voltage
- maximum humidity: 80% at 31°C, decreasing linearly to 50% at 40°C
- pollution degree: 1

ELECTRICAL SUPPLY

Check that the electrical supply available conforms to the information on the product rating plate (to be found on the back of the chamber) and is of sufficient power to run the product.

- power supply is of the correct phase configuration (ie either single or three phase as stated on the chamber rating plate), AC (alternating current) of the stated frequency with neutral nominally at earth potential.
- the supply voltage is within the stated range.
- the current rating is within the capacity of the supply outlet
- the socket or outlet circuit is suitable fused.

FACILITY CHECKS

Check that the purified water supply for the chamber is of sufficient capacity.
Check that a waste water drain is available and is of sufficient capacity.

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AMBIENT TEMPERATURE

Check that the room where the chamber is to be installed is adequately ventilated, and that ambient conditions do not exceed the specification in terms of temperature and humidity. The maximum acceptable ambient temperature to achieve the published performance is +25°C. At higher ambient temperatures the minimum achievable temperature in the chamber will be affected.

All refrigeration equipment, from home freezers to air-conditioning plant, performs a heat exchange operation in which the refrigeration compressor acts as a heat pump to transfer heat from the cooling coil (called the evaporator because this is where the gas evaporates and absorbs heat) to the condensing coil (where the gas condenses and gives up heat). The condensing coil is air-cooled, and assisted by a fan.

All air-cooled condensers need air movement around them in order to be able to give up to the air the heat extracted from the cooling coil (and hence the chamber).

If the ambient temperature is high (above +25°C) more air will be required around the condenser to take up the same amount of heat. At the same time the higher ambient temperature transfers heat more quickly into the chamber through the insulation, giving the refrigeration unit more work to do to maintain low temperature conditions.

Excessively high ambient temperatures and poor ventilation will cause the refrigerator compressor to overheat and inevitably reduce its working life - possibly even causing it to burn out.

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4.INSTALLATION

4.1 POSITIONING THE CHAMBER

Place the chamber in a ventilated area, on a level site in such a position that air is free to circulate around it. The chamber should be placed at least 450mm (18ins) away from any obstruction, eg: a wall or workbench.

Lock the front castors to prevent movement.

If required, we can arrange for one of our engineers to commission the chamber. Should you feel that his services are required please telephone us at Loughborough to make the necessary arrangements. During his visit our engineer will run the chamber and check that its systems are functioning correctly and enable you assure that your staff are fully acquainted with the chamber and its operation.

CAUTION: Allow the chamber to stand for 24 hours before switching on to allow all oil to return to the refrigeration compressor sump. If the chamber is moved, allow it to stand again.

4.2 ELECTRICAL POWER SUPPLY CONNECTION

The chamber should be installed by a competent person to BS 7671, or your local wiring regulations.

WARNING: THIS PRODUCT MUST BE EARTHED

Chambers designed to be operated from a UK 13A type socket are fitted with a corresponding 13A type plug. If the plug requires changing for a local type the new plug should be a 3 pin non-reversible type and wired in accordance with:

green/yellow	earth	(ground)
blue	neutral	(common)
brown	live	(phase)

Chambers of higher current requirements are designed to be hard wired to a suitable power outlet by a qualified electrician.

Consult a qualified electrician if in doubt or the supply has any of the following:

- no earth
- a colour code different from the above
- reversible plugs
- supply and return leads that are both above earth potential

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4.3 PURIFIED WATER SUPPLY CONNECTION

EITHER
Connect the purified water supply to inlet connector situated on the right side or at the rear of the chamber. Maximum allowable head is 1500mm (5ft) above the inlet. It is safe for a container to stand on top of the chamber, but ideally any reservoir should have its own support to one side of the chamber.

OR
If the chamber is a SGC066 model with an inbuilt clean water supply tank refer to the instructions below.

4.4 CLEAN WATER SUPPLY TANK AND FILTER (SGC066 ONLY)

The clean water for the chamber is stored in a tank in the chamber base. It is accessed by removing the lower front panel. The tank is marked Clean Water .

This tank should be filled with distilled water prior to commencing a test. It should also be kept full during the test.

Water condensing or melting off the cooling coil and overspray from the atomiser is directed back into the clean water supply tank.

Although there is a filter in the water feed, scrupulous cleanliness is needed because the water system within the chamber uses a valve with a fine orifice.

See also note on cleaning in Health and Safety at Work at the beginning of this manual.

4.5 WASTE WATER DRAIN CONNECTION

An outlet pipe is fitted to the chamber (right hand side or back). Connect a suitable length of tubing and run to an open drain. The waste water drain also contributes to chamber air exchange and must not be fitted with a trap when connectng it to an open drain.

CAUTION: Connect a pipe to give a CONTINUOUS FALL to the drain. Drainage restriction could cause an airlock and consequent flooding of the treatment chamber.

If the chamber is a SGC066 model with an inbuilt waste water tank refer to the instructions below.

4.6 WASTE WATER TANK (SGC066 ONLY)

Dirty water leaving the working chamber via the drain is directed into the dirty water tank in the base of the chamber. The waste water tank is situated next to the clean water tank. Before a test is started this tank should be emptied. The tank can be emptied either by removing it from the chamber or by using the supplied drain pipe. The drain tank pipework can also be configured to drain directly to a drain via the outlet under the left hand side end of the chamber.

See also note on cleaning in Health and Safety at Work at the beginning of this manual.

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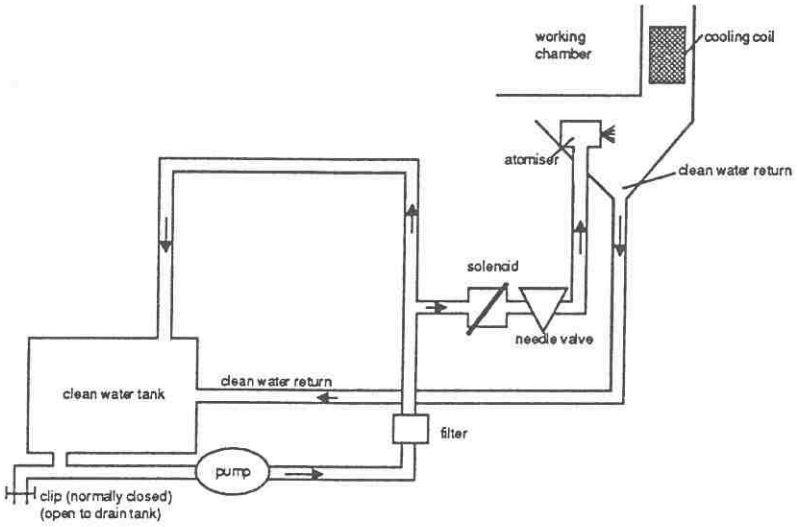
4.7 WASTE AND CLEAN WATER SYSTEMS - DELIVERY CONFIGURATION (SGC066 only)

Upon delivery the chamber's waste and clean water systems are configured to:

CLEAN WATER SYSTEM

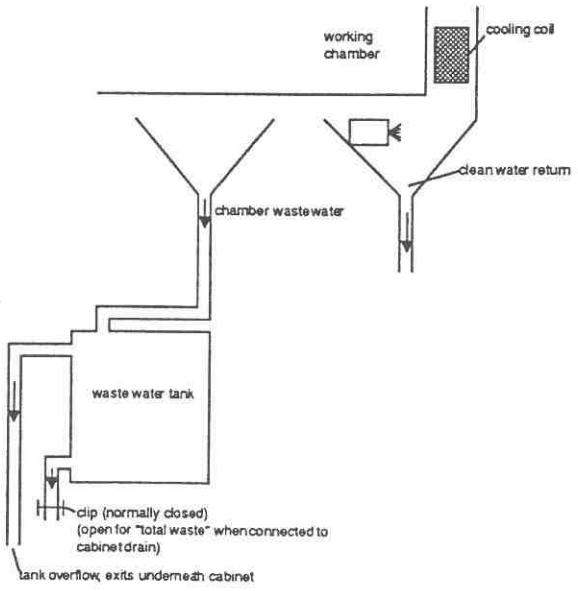
- all condensate from the cooling coil is directed back to the clean water tank
- all clean water feed to the atomiser and wet wick is from the clean water tank via the pump, filter and constant level device.



Diagrammatic representation of the SGC066 clean water system

WASTE WATER SYSTEM

- all waste water from the working chamber is directed back to the waste water tank.
- the overflow from the waste water tank is directed to chamber drain and will eventually overflow if the tank has not been emptied.



Diagrammatic representation of the SGC066 waste water system

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The waste water system can also be configured to drain all waste water to the drain connection without first filling the waste water tank. To achieve this, disconnect the overflow tube from the drain connection (inside compartment) and connect the bottom tube (without its clip or with the clip open) to the drain connection. Externally, the drain must be piped to an open drain, preferably below the chamber drain connector and in any case no higher than 100mm (4in) below the overflow connector from this tank.

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5.CHAMBER FACILITIES & CONTROLS

5.1 CONTROL PANEL INSTRUMENTATION

5.1.1 POWER push button

A latching (stayput) push button. Depress to provide power to the chamber - its internal light will glow green. When this push button is illuminated the yellow start push button also illuminates.

Switching the POWER enables the setting of all controls prior to the START push button being pressed.

5.1.2 START push button

A momentary action push button. Starts the chamber when power is switched ON. With the POWER enabled this button's internal light glows yellow until this button is depressed to start the chamber.

Note: this button will illuminate if the inbuilt safety devices shut down the chamber.

5.1.3 Fault/audible warning indicator/mute push button

This push button has a dual function. As a red indicator light it indicates a fault condition if the inbuilt safety devices are activated. As a push button it enables the muting of the audible alarm which is sounded during a fault condition.

The fault indicator light is not extinguished when the audible alarm is muted. It can only be extinguished by rectifying the fault and resetting the chamber.

5.2 FORMAT 650 PROGRAMMER/CONTROLLER

The Format 650 programmer/controller is a unit specially designed for simultaneous temperature and humidity control of climatic conditions. Full details on how to programme and operate the programmer are given in Part 2 of this manual.

5.3 ELECTRICITY POWER INTERRUPTION

If the electricity power supply to the chamber fails for any length of time the chamber will shut down and the program will terminate.

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5.4 SAFETY THERMOSTATS

Two safety thermostats, HIGH and LOW, are fitted to protect the chamber and plants in the unlikely event of failure of the chamber's temperature control system.

HIGH - set the high temperature safety thermostat about 5°C above the maximum cycle temperature.

LOW - set the low temperature safety thermostat about 5°C below the minimum cycle temperature.

If either safety thermostat operates the chamber will shut down and the alarm will sound. The temperature within the chamber will drift to the laboratory ambient.

To mute the alarm the press the illuminated alarmpush button.

IF EITHER SAFETY THERMOSTAT OPERATES - DO NOT ATTEMPT TO RESTART THE CHAMBER UNTIL THE FAULT HAS BEEN RECTIFIED.

The alarm facilities of the Format 650 are usually programmed to provide protection from over or under temperature errors, see Part 2 of this manual for further details.

5.5 DEFROST SYSTEM

The chamber is fitted with an automatic defrost system. The purpose of defrosting is to allow ice on the evaporator coil to melt. Both the frequency and length of defrost periods are automatically controlled and its action is transparent to the user.

The rate of ice build-up and hence the need for defrosting is determined by the automatic defrost system. Defrosting, by switching the refrigeration unit off, occurs every two hours providing the evaporator coil temperature is +1°C or below. When the evaporator temperature rises above +2°C, indicating that ice on the coil has melted, the refrigeration unit is switched back on. A second timer prevents any further defrosting within the two hour period (ie it is a one shot system). Note, it is unlikely that defrosting will occur during day periods.

5.6 RECORDER (if fitted)

The recorder should be set up and operated in accordance with the manufacturer's instructions, supplied with the chamber.

5.7 CHAMBER BREATHING VENTS

Two air vents are provided on the chamber, the air inlet port is situated on the front of the chamber; the air outlet is via the chamber waste water drain. By opening the air inlet port the air in the chamber can be changed up to approximately 6 times per hour. The chamber will not reach its minimum temperature with lights on with a high exchange rate because of the extra heat load imposed. A high exchange rate is not considered necessary at such low temperatures. Because the waste water drain contributes to chamber air exchange it must not be connected to an open drain via a trap.

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5.8 ENTRY PORT

One entry port is fitted on the left side of the chamber to enable:
a) samples of the chamber atmosphere to be extracted for analysis
b) gas to be injected for atmosphere doping or correction.
c) irrigation water to be directed into the growing chamber.
d) cables to measuring equipment to enter the growing chamber.

The port has two plugs, one inside, one outside the chamber and both plugs must be fitted when the chamber is in operation to maintain the chamber's excellent insulation. The plugs can be split or holes bored to enable wires/pipes to pass through the port. Wires/pipes should enter the chamber via the top of the outside plug and the bottom of the inside plug to prevent condensation accumulating between the plugs. Extra or replacement plugs can be obtained, see PART NUMBERS.

5.9 AIR DISTRIBUTION DEFLECTORS (SGC066 only)

Air is distributed throughout the chamber by the air deflector in the chamber base. The vanes of the deflector are adjustable, to give optimum air distribution. This will depend on shelf height and loading, and the amount of plant foliage. With the shelf in its lowest position, the bottom vanes will be horizontal. As the shelf is raised the vanes will need to be turned towards the vertical. If no air speed meter is available, air distribution can be checked by placing small pieces of tissue paper on the shelf with the chamber empty, or by leaf movement.

5.10 RS 232 SOCKET

A standard D type RS 232 is provided for communication with the programmer. The socket is situated on the control panel or on the top of the chamber at the front right. Connections for the socket are shown in Part 2 of this manual.

5.11 HUMIDITY PROBE

The chamber is fitted with a Rotronic direct reading humidity probe. The sensor head of the probe is accessed from inside the working. The probe is pre-calibrated, calibration information is given in section 7.2.10

IMPORTANT PRECAUTIONS REGARDING USE OF THE HUMIDITY PROBE
1. It is important that the humidity probe is not subjected to saturating humidity conditions (ie condensing).
2. It is probable that the probe, following a low temperature test will effectively form a dew point if the chamber door is opened to ambient conditions. This will cause condensation to form on the probe. It is recommended, to prevent this, that the chamber temperature is reset to the same as ambient with a low humidity. Only after the probe has attained ambient conditions should the door be opened.
3. It is recommended that the door is left ajar following a test. This is due to the fact that any residual water from ice melting on the refrigeration coil will cause the chamber interior to achieve saturated humidity conditions very quickly.

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5.12 TEST LOAD PROTECTION

A safety thermostat should be fitted to all equipment being powered inside the chamber. The thermostat should switch off equipment power if the air temperature in the chamber rises above safety level.

The thermostat will protect both the equipment and the chamber against damage in the event of failure or shut down of the chamber's temperature control system. Equipment dissipating only a few hundred watts inside the well insulated chamber, with no cooling, will heat sufficiently to cause severe damage.

Advice on suitable thermostats is available from our Technical Department.

SANYO GALLENKAMP will not be held responsible for any damage to either equipment or chamber, during or after the chamber guarantee period, caused by heat dissipation from unprotected equipment.

5.13 ADC2000 GAS MONITOR (if fitted)

Chambers fitted with an ADC2000 Series Gas Monitor enable monitoring and adjusting of the carbon dioxide concentration in the chamber's atmosphere. Full instructions for use of the unit are provided separately. Note, the unit is not supplied with a back-up battery facility.

Connect the carbon dioxide supply to the gas inlet at the rear of the chamber, as required, and set up the ADC2000 gas monitor. A gas flow meter is situated at the rear of the chamber above the carbon dioxide inlet connection. The maximum carbon dioxide inlet pressure is 2 psi.

If provided, data logging of carbon dioxide levels measured by the ADC2000 are recorded by the Format 650 programmer/controller, see Part 2 Section 5 for further details.

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6.OPERATION

Before setting up familiarise yourself with the controls and features described in Section 5. Full details of programming the Format 650 programmer are given in Part 2 of this manual.

In order to set up it is necessary that the chamber is correctly connected to the electricity power supply, see section 4.2.

6.1 SETTING UP PROCEDURE

a) Ensure the drain connection is correctly fitted. Or, if being used ensure that the waste water tank is empty (SGC066 only)

b) Ensure there is an adequate supply of purified water to the chamber. Or, there is sufficient purified water in the clean water supply tank (SGC066 only).

c) (SGC066 only) - ensure the AIR DISTRIBUTION DEFLECTORS are correctly set (see section 5.9).

d) Preselect the BREATHING VENT if necessary (see section 5.7).

e) Set the SAFETY THERMOSTATS (if fitted). Normally 5°C above and below the maximum and minimum temperatures set in the programme (see section 5.4).

f) The working and treatment chambers are CLEAN and DRY.

g) If applicable, connect the carbon dioxide supply to the gas inlet at the rear of the chamber, as required, and set up the ADC2000 gas monitor.

h) Ensure the correct program/logging diskette is inserted into the diskette drive underneath the Format 650 keypad.

6.2 START UP

Ensure that:

- you have SET UP correctly.
- you know how to SHUT DOWN (see section 4.3).

Then follow the procedure:

1. Plug the chamber into the electricity power supply if the chamber is fitted with a plug. If the chamber is hard wired to the electricity power supply then switch on the electricity power at the electricity power connection unit.
2. Switch the red/yellow electricity power isolator fitted to the control panel to ON.
3. Press the POWER push button on the front control panel to ON (illuminated green).
4. Power is now available to the Format 650 programmer and settings for Manual control or Programmed control are entered (see Part 2).
5. Start manual control or the desired program.
6. Providing the chamber temperature is within the conditions set on the high and low temperature safety thermostats (if fitted) then alarm will not be sounded.

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7. Pressing the START push button will start the chamber running and the chamber conditions will be brought to those set on the controllers.
8. The Format 650 will now control the chamber.

6.3 CHAMBER AND PROGRAM SHUT DOWN

TO SHUT DOWN THE CHAMBER - NORMAL SEQUENCE:

a) To terminate steady state control - see Part 2.

b) To terminate a program that is running -see Part 2.

c) When control by Format 650 has been completed or terminated, press the POWER push button. The push button will not remain illuminated. The chamber conditions will now drift slowly to ambient.

d) If applicable, if the chamber is to be left unpowered for more than 5 hours the ADC2000 gas monitor should be switched off to conserve its back up battery. Additionally, switch off the gas supply to the chamber.

EMERGENCY SHUT DOWN:

PRESS THE POWER PUSH BUTTON

AND

ISOLATE THE CHAMBER FROM THE ELECTRICITY SUPPLY

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7.MAINTENANCE AND CARE

WARNING Before entry into the instrument compartment, refrigeration compartment, or treatment chamber UNPLUG/DISCONNECT THE CHAMBER FROM THE ELECTRICITY POWER unless otherwise stated.

The chamber has been designed and built for a long life and requires minimal attention and maintenance. However, regular attention to the few points will ensure a long and trouble free life.

If the chamber does fail, the expertise of our service engineers is readily available for either diagnostic advice or on-site attendance. Service contracts are available after the one year guarantee period finishes and details are available from our Service Department.

This section contains a maintenance schedule to follow and a methods section giving instructions relating to the schedule.

Note: If the chamber is going to be left unused for more than a month, we suggest that the chamber is started up and run through all its functions on a monthly basis. This will ensure that the chamber is in perfect running order for when it is required.

7.1 MAINTENANCE SCHEDULE

BETWEEN TESTS OR AS REQUIRED

- Clean interior and exterior surfaces.
- Light box maintenance
- Clean water system

MONTHLY

- Lubricate
- Check thermostats
- Check drain
- Check water inlet filter
- Clean atomiser(s)

THREE MONTHLY (or more frequently dependent on cleanliness of environment)

- Clean refrigeration unit condenser

SIX MONTHLY

- Calibration of Rotronic temperature/humidity probes

YEARLY

- Air compressor maintenance

Note: If fitted, the recorder and ADC2000 gas monitor should be maintained in accordance with the manufacturer's instructions provided separately.

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7.2 MAINTENANCE METHODS

7.2.1 Interior and exterior cleaning

The exterior surfaces can be washed with warm soapy waterTAKING CARE WITH REFERENCE TO ELECTRICS.

The interior surfaces can be similarly cleaned and in fact should be kept especially clean as they reflect and diffuse light.

7.2.2 Cleaning of the clean and waste water systems - general

As with any laboratory equipment containing standing water regular cleaning is essential. Cleaning of the water system and pipe work should involve the use of a suitable biocide to remove bacterial contaminants, etc. Cleaning should be repeated as often as necessary.

7.2.3 Light box maintenance

Light box maintenance involves lifting the complete lightbox unit up away from the chamber. The light box incorporates gas struts to aid this operation. Always ensure that the lighting is not on before opening the lightbox.

DANGER - HIGH VOLTAGE - UNPLUG CHAMBER OR SWITCH OFF AT ELECTRICITY POWER ISOLATOR

The replacement of a PLL type fluorescent lamp involves twisting the lamp through 90° to enable removal.

The replacement of an incandescent lamp involves pushing one end of the lamp into the spring load end cap to enable removal.

Replacement of the lightbox is the reverse procedure.

7.2.4 Check thermostats

Adjust thermostats through the prevailing chamber temperature. Check for correct function. In the event of fault RECTIFY AT ONCE. The thermostats should switch the chamber OFF and sound the alarm.

7.2.5 Check drains

Accumulation of contaminants from the test sample can block the working chamber drain. Similarly (but less likely) the treatment chamber drain, returning clean water back to the clean water tank, can become blocked. To inspect both drains lift out the air louvre in the centre of the working chamber base and remove the chamber base. Both drains, in the chamber base should be free from contaminants that could block them.

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7.2.6 Cleaning the clean water system filter

SGC066 - Located behind the water tank access panel the clean water filter should be regularly cleaned/replaced. After draining the clean water system the clear plastic bowl can be unscrewed and the filter removed for cleaning.

SGC097 - The inlet water filter is situated behind the water inlet connection and is accessed by removing the instrument compartment panel. The plastic bowl can be unscrewed and the filter removed for cleaning/replacement.

DANGER - HIGH VOLTAGE - UNPLUG CHAMBER OR SWITCH OFF AT ELECTRICITY POWER ISOLATOR BEFORE REMOVING THE FILTER

7.2.7 Atomiser cleaning

If the atomiser becomes blocked, it can be cleaned as below, regular cleaning of the atomiser will prevent blockages.

The atomiser is removed for cleaning by unscrewing the union nuts. USE TWO SPANNERS or the atomiser and air supply pipes may be damaged. Clean and reassemble in reverse order.

7.2.8 Refrigeration unit cleaning

Unplug the chamber from the electricity poer supply, remove ventilation panels, gently brush/blow/vacuum dust etc from fins and tubes of condenser coils.

7.2.9 Air compressor - Charles Austen type

Change the diaphragm and valves in the air compressor yearly.

To change the valves:
Remove the centre nut between the hose connectors and lift off the cover. Note the respective position of the parts. Renew the valves and reassemble.

To change the diaphragm:
Remove the 4 corner bolts and lift off head. Remove the centre screw and the old diaphragm. Fit the new diaphragm. Avoid puckering the diaphragm by assembling with the crankshaft in the middle of a stroke. Remove the filter cylinder from the air compressor suction line and blow out the dust.

7.2.10 Calibration of Rotronic temperature/humidity probe

Checking of the calibration, and if necessary recalibration of the Rotronic probes is recommended after the first six months and then yearly, or as determined through experience, in accordance with the Rotronic instructions supplied separately. It is recommended that Sanyo Gallenkamp service engineers perform the calibration as detected errors may be caused by other factors, such as the humidity or temperature controllers.

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APPENDIX 1 - PRINCIPLES OF OPERATION

The chamber is effectively divided vertically into three sections: a treatment area, above it a growing chamber and above that a light box.

Air is conditioned in the treatment area and continuously recirculated through the growing chamber. The system is designed to give an airflow through the growing chamber that has minimal discrepancies in temperature and relative humidity. Care has been taken to achieve suitable air velocities throughout the recirculation system; eg: fast enough to prevent micro-climates in the growing chamber without unduly disturbing specimens.

Over the growing chamber, a glass panel separates it from the light box above. The light box houses PLL type fluorescent lamps supplemented with incandescent lamps chosen to simulate daylight. The incandescent lamps are fitted to supplement the red end of the light spectrum of the fluorescent lamps.

Temperature

Accurate, repeatable temperature levels are achieved by balancing continuous heat extraction with intermittent modulated heating controlled by an electronic controller.

Heating

An 'Inconel' sheathed electrical heating element is sited in the treatment area. The element operates at 'black heat', for long life and avoidance of excessive surface temperatures.

Cooling

The purpose of cooling within the treatment chamber is two-fold:

(a) to provide a continuous heat extraction against which to balance the heating.

(b) to introduce a cold surface on which to cause condensation for control of relative humidity.

The range of conditions over which the chamber is capable of operating involves the use of direct cooling. It uses a heat exchanger (evaporator coil) situated in the treatment chamber to extract heat from the chamber air. The extracted heat is passed through a compressor unit to an air-cooled condenser for dissipation to atmosphere.

Provision is made to prevent the progressive build up of ice on the evaporator by an automatic defrosting facility.

Relative humidity (RH)

Relative humidity is a measure of the ratio of the amount of water vapour present in an atmosphere to the amount of water vapour that atmosphere could hold, ie: the humidity present relative to the humidity possible.

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For each atmospheric rh/temperature relationship there is another relevant temperature, known as the dew point. Surfaces at or below this temperature chill the water vapour sufficiently to cause condensation. RH levels are maintained by balancing continuous, extraction of water by condensation with intermittent injection controlled by an electronic controller.

Humidity generation (RH increase)

Atomised water from a atomisation system is injected into the treatment chamber to cause a relative humidity increase.

Extraction (RH decrease)

Condensation is caused on surfaces at or below the dew point temperature. These dew points are created by heat loss through conduction or by deliberate cooling through a heat exchanger in the treatment area.

Control

In the chamber, conditioned air flows over a Rotronic humidity probe located in the working chamber. The relative humidity is determined by a Rotronic probe and associated RH transmitter and displayed as a direct % rh reading. Errors are corrected by the switching on or off the humidification system.

Lighting

The light box houses the lighting sources, PLL type fluorescent tubes and incandescent lamps, chosen to simulate daylight. Timing control is via the programmer to allow programming of photo periods.

The incandescent (Tungsten) lamps can either be programmed ON or OFF by selecting the Format 650 digital channel 1.

The fluorescent lighting can be selected OFF or from 30% to full ON in steps as determined by the % setting entered into the Format 650 programmer. The Format 650 display is adjustable from 10% to 100% , this corresponds to a controller output to the PLL ballasts of 10% to 100% power. This results in a light output ranging from 30% to 100%. For example to achieve 30% light output set 10% on the controller; for 50% light output the controller is set to approximately 40%. A light meter should be used to achieve an accurate light output reading.

Separate fans cool the light box. The walls and doors of the growing chamber are lined with a coating to minimise light losses and maximise diffusion.

Sequencing

All sequencing of the controlled parameters is via the Format 650 programmer to give:

(a) cyclic control of temperature and relative humidity
(b) photoperiods for fluorescent lighting
(c) photoperiods for incandescent lighting

(b) and (c) can be programmed to overlap to simulate dawn/dusk conditions. Night break can also be programmed.

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APPENDIX 2 - CHAMBER SPECIFICATIONS

DATA SGC066.PPX.F

General

Controlled parameters:		Temperature, relative humidity, light
Temperature range * :		+10°C to +40°C (lights on)
		0°C to +40°C (lights off)
Humidity range * :		30% to 95% rh at +40°C
		67% to 95% rh at +10°C
Max humidity, lights full on		90%
* Typical figures at 25°C ambient temperature, actual ranges depend upon actual ambient conditions.		
Sequential control:		Format 650 microprocessor controlled programmer
Dimensions internal:		1200 x 600 x 900 mm (w x d x h)
Growing height:		800 mm
Dimensions external:		1870 x 820 x 1860 mm (w x d x h)
Construction:	Interior:	Stainless steel with reflective coating in growing chamber
Shelves:		Two separate half depth shelves
Access:		Full width insulated door.
		Viewing window with light shield.
		66mm cable entry port in the left hand side.
Airflow:	Attitude:	Vertical, 0.2 m/sec.
	Pattern :	Turbulent
Safety:		Protected against electrical overload.
		Thermostatic temperature protection.

Heating

Heater type:	Inconel sheathed element
Heater number off:	1
Heating mode:	Black heat

Cooling

Type:	Mechanical refrigerator, single stage
Refrigerant:	R134A

Humidification/dehumidification

Humidification method:	Atomised water
Dehumidification method:	Condensation onto a cold surface (dewpoint)

Lighting

Method:	22 off 55 watt type PLL-55W/83/4P fluorescent tubes, plus 4 incandescent lamps, in air cooled light box. Variable intensity from 30% to 100% of maximum
Maximum Intensity:	95,000 lux (1,250 $\mu molm^{-2}sec^{-1}$, 274 Wm^{-2}) at 300mm from light box screen, with a supply voltage of 230/240 volts and a 25°C ambient.

Electrical

Supply*:	220/240 volts, 50Hz 1 phase
Demand:	as stated on the chamber rating plate
Additional Connections(s):	Earth

* check chamber rating plate for specific chamber supply requirements

Programmer and controller

Type:	Format 650
Sensor:	Rotronic temperature/humidity probe
Digital channels:	see Appendix 3

Recorder (if fitted)

Type:	PR100
Range:	Dual scale actual °C and % rh
Sensor:	Rotronic combined temperature/humidity probe

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SANYO

DATA SGC097.PPX.F

Serial No.: 9380

General

Controlled parameters:		Temperature, relative humidity, light
Temperature range * :		+10°C to +40°C (lights on)
		0°C to +40°C (lights off)
Humidity range * :		30% to 95% rh at +40°C
		61% to 95% rh at +10°C
Max humidity, lights full on		90%
* Typical figures at 25°C ambient temperature, actual ranges depend upon actual ambient conditions.		
Sequential control:		Format 650 microprocessor controlled programmer
Dimensions internal:		1200 x 600 x 1280 mm (w x d x h)
Growing height:		1250 mm
Dimensions external:		1870 x 820 x 1860 mm (w x d x h)
Construction:	Interior:	Stainless steel with reflective coating in growing chamber
Shelves:		Two separate half depth shelves
Access:		Full height insulated door.
		Viewing window with light shield.
		66mm cable entry port in the left hand side.
Airflow:	Attitude:	Vertical, 0.2 m/sec.
	Pattern :	Turbulent
Safety:		Protected against electrical overload.
		Thermostatic temperature protection.

Heating

Heater type:	Inconel sheathed element
Heater number off:	1
Heating mode:	Black heat

Cooling

Type:	Mechanical refrigerator
Stages:	Single
Refrigerant:	R134A

Humidification/dehumidification

Humidification method:	Atomised water
Dehumidification method:	Condensation onto a cold surface (dewpoint)

Lighting

Method:	22 off 55 watt type PLL-55W/83/4P fluorescent tubes,
	plus 4 incandescent lamps, in air cooled light box.
	Variable intensity from 30% to 100% of maximum.
Maximum Intensity:	95,000 lux (1,250 $\mu molm^{-2}sec^{-1}$, 274 Wm^{-2}) at 300mm from light box screen, with a supply voltage of 230/240 volts and a 25°C ambient.

Electrical

Supply*:	220/240 volts, 50Hz 1 phase
	200V 50 Hz 1 phase, mid earth (transformer fitted to provide 230V)
Demand:	as stated on the chamber rating plate
Additional Connections(s):	Earth

* check chamber rating plate for specific chamber supply requirements

Programmer and controller

Type:	Format 650
Sensor:	Rotronic temperature/humidity probe
Digital channels:	see Appendix 3

Recorder (if fitted)

Type:	PR100
Range:	Dual scale actual °C and % rh
Sensor:	Rotronic combined temperature/humidity probe

BF: IČO: 600 76658
DIČ: CZ-60076658

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APPENDIX 3 - FORMAT 650 DIGITAL CHANNELS

The Format 650 programming system fitted to the chamber has the following digital channel functions. A number of the channels (system channels) are for the control of the chamber but require selecting on or off to achieve certain conditions. If applicable, other user designated channels are also detailed below. All digital channels can be viewed form various programmer screens (see Part 2 of this manual).

Full operating instructions for the Format 650 programmer are given in Part 2 of this manual.

DIGITAL CHANNEL 1 TUNGSTEN LIGHTING

USER CHANNEL

This channel switches on the tungsten (incandescent) lighting.

Program this channel ON whenever tungsten (incandescent) lighting is required.

DIGITAL CHANNELS 2 to 8

Unused digital channels and should always be programmed off.

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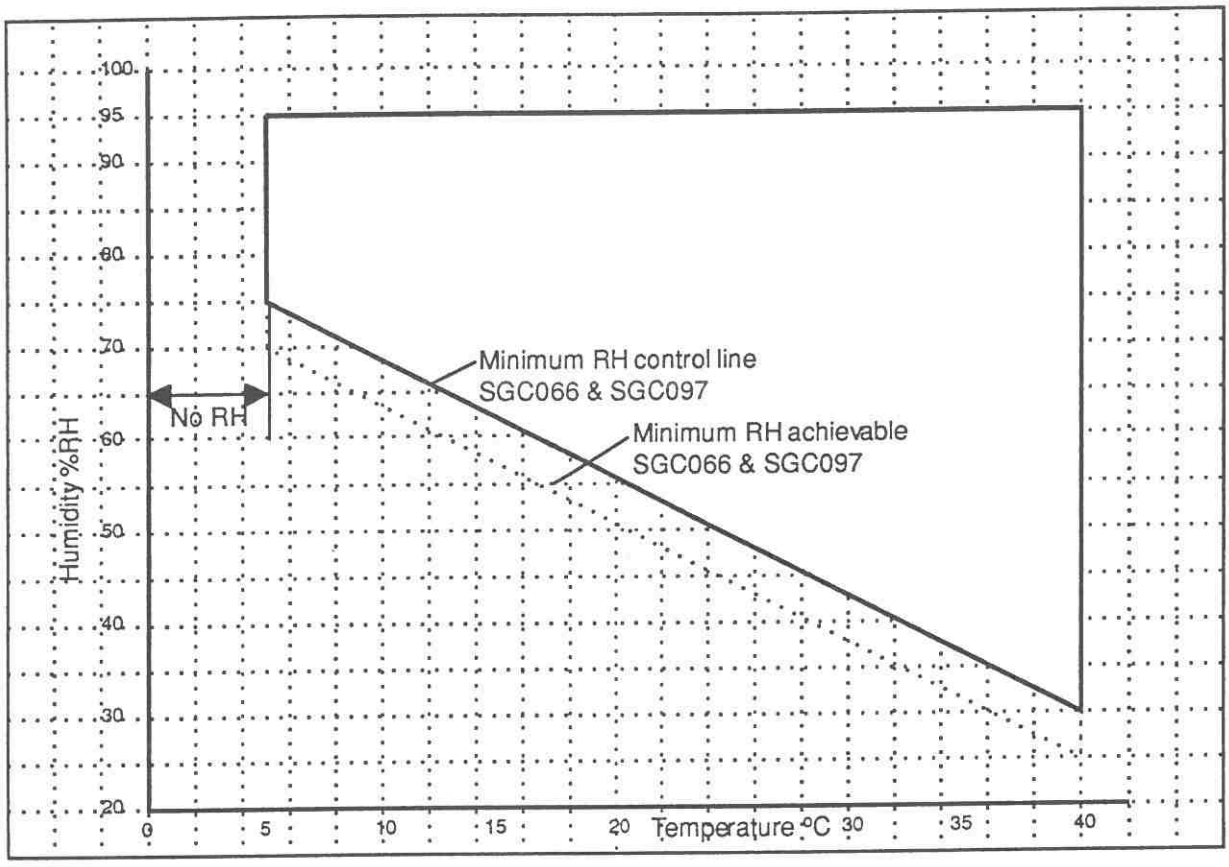
SGC PLANT GROWTH CHAMBER - PERFORMANCE ENVELOPE

SGC CHAMBER PERFORMANCE ENVELOPE (LIGHTS OFF)



Based on an ambient condition of 25 °C, 65%RH

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APPENDIX 4 PART NUMBERS

Note: some of the parts may not apply to your chamber.

Airflow motor		K04648
MCB	4 amp 1 pole	E10090
MCB	4 amp 1 pole high inrush	E10126
MCB	10 amp 1 pole	E10096
MCB	16 amp 1 pole	E10099
RELAY	P240D2	E69502
RELAY	Schrack MR306-240	E67544
RELAY	MCB 2amp 1 pole	E10087
RELAY	P240D2	E69502
RELAY	Latching 2 pole, 7.5A	E65740
RELAY	Timer on delay	E35031
SSR	25 amp	E69511
SSR	G40AC5A	E69512
FLUORESCENT LAMP	SGC066/097	PLL-55W/83/4P
FLUORESCENT LAMP HOLDER		E21528
FLUORESCENT LAMP SUPPORT		E21529
FLUORESCENT BALLAST	BPL225R	E22532
TUNGSTEN LAMP	striplight 221mm	E20505
TUNGSTEN LAMP HOLDER	strip light 60W	E21525
TUNGSTEN LAMP	pearl bulb 60W	E20512
TUNGSTEN LAMP HOLDER	bulb	E21509
FILTER	clean water system	K02311
AIR COMPRESSOR		K06005
SHELF	plastic coated SGC066/097	K06607

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PART 2 - FORMAT 650 INSTRUCTIONS

F650-PG 1.10.97

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1.Introduction

This section of the Operator's Handbook introduces you to the FORMAT 650 controller, and also suggests how to use this handbook to best effect.

1.1 Introduction to FORMAT

The FORMAT 650 programmer/controller is a powerful chamber control system offering advanced features such as data logging and program editing.

The FORMAT 650 programmer represents the ultimate level of user friendliness in a dedicated test chamber controller/programmer. Such ease of use has been achieved by specialised software providing easily comprehensible data entry and information display.

All information and data are displayed on a 6.4 inch LCD screen. Data is entered to the controller via a keypad or through the communications interface. At all times the actual chamber conditions are displayed in large figures at the top of the screen.

All of the command sequences are extremely simple to follow and hardly necessitate the in-depth learning of key sequences and alternatives.

Although the FORMAT will make programming the test chamber a simple task it will not make the test sequences themselves any less complex. For this reason Program Sheets for many of the popular standard tests and blank sheets for your own programs have been produced. As a service, if requested when the chamber was ordered, the FORMAT will be supplied with selected standard tests prestored.

As with any other high level system many error trapping and security systems are employed to ensure fool-proof operation.

1.2 FORMAT digital channels

The FORMAT programming system fitted to the chamber has up to eight digital channel functions. The digital channels are chamber dependent. A number of the channels are for the control of the chamber but require selecting on or off to achieve certain conditions. If applicable, other user designated channels are fitted, such as voltage free contacts for switching the test load. The selection of chamber dependent digital channels is predicted by FORMAT and its suggestions will in most cases be adequate. The digital channels can however be operator selected to match particular requirements. The digital channels descriptive names are listed on applicable windows (screens) of the FORMAT display.

Full details of the function of the digital channels fitted are given in Part 1 of this manual.

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1.3 How to use these instructions

These instructions are written for the end user, and is not intended to be an engineering manual. For this reason it omits unnecessary detail concerning how the controller works, and concentrates on information the operator needs in order to make the best use of FORMAT's powerful capabilities.

Some users will find they are familiar with the system after only a short time. For such users, these instructions may be used as a reference guide; the sections are split into controller functions.

If you prefer a methodical approach to familiarising yourself with the FORMAT programmer/controller, it is recommended that you read all sections in order, trying out the topics described "hands on" as you go along.

As a minimum you should read sections 2 and 3 of the handbook, which describe the basics of using the controller.

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2.Getting started

This section describes the basics of using the controller and the meaning of the various items of information presented on the screen.

2.1 The keyboard lock

To prevent unauthorised tampering the user can lock sensitive areas of the keyboard after setting up.

The default code is: ***1234/**

The user can configure this code (see section 7). The * and / have to remain but the 4 digits can be changed to any other 4 digits.

2.2 The display contrast adjustment

The display contrast can be adjusted (to suit changes in light levels etc.), by using the plus (+) and minus (-) keys, at any time except when the controller is on a page (screen) where these keys are already used (e.g. Steady State entry or Program Edit).

2.3 The menu system

FORMAT uses a menu system to allow the operator to select what function the controller should perform. This approach will be familiar to users with experience of using personal computers.

When the chamber is first switched on, FORMAT goes through its startup sequence (which lasts approximately 1 minute) and then displays the initial Main Menu screen:

The Main Menu displays a list of options which are available to you, one of which is highlighted (Steady State in Figure 1).

Unavailable options are "greyed out".

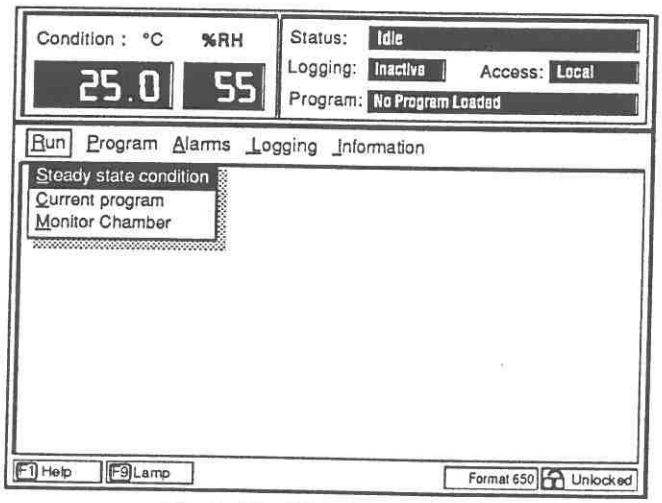

Fig. 1 The Main Menu Screen

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To select a menu from the heading bar, move to the option you require (using the <left arrow> and <right arrow> keys), or use the shortcut (underlined) key.

To select a menu option, move the highlight bar to the option you require (using the <up arrow> and <down arrow> keys), then press the <enter> key; or use the shortcut (underlined) key.

2.4 Using the on-line help

FORMAT 650 has a context sensitive on-line help system activated by the <F1> key. You can press the <F1> key at any time while using the controller to obtain an information window summarising what actions are possible from the current position.

The on-line help system is not intended to be a replacement for this handbook, but provides a useful reminder for keystrokes and menu options.

If you find you are unsure of what to do next, your first action should be to call for the on-line help. In most cases this will give you sufficient information to let you carry on.

2.5 Function keys

Function keys are keys which cause the controller to immediately action a task. FORMAT has two kinds of function keys, namely global and local:

2.5.1 Global function keys

These are keys which serve one fixed purpose and are operational all the time. An example is the <F10> key that shuts the chamber down. This can be thought of as an emergency stop button. It is active all the time, whatever the controller is doing. Global function keys are shown at the bottom of the screen (see Figures 1 and 3).

2.5.2 Local function keys

These are keys whose function may change from one task to another. They are shown at the bottom of the window that the user is currently interacting with (see Figure 2).

2.6 Using the data entry windows

When the controller needs information from you, it presents a data entry window. FORMAT has data entry windows for a multitude of different situations (e.g. asking you for a steady state condition or alarm setpoints), so they vary in appearance. Common to all of them, however, is a standard method of data entry and navigating the fields in the window.

2.6.1 Moving between fields

The <tab> or <right arrow> keys are used to move the input cursor to the next field of a data entry window (<tab> being preferable). The key to move the input cursor to the previous field is the <left arrow>. The <up arrow> and <down arrow> keys can be used to move to fields above or below the current field.

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<Enter> is used for specific purposes in different windows. e.g. in programming, it is used to move to the start of the next line and to simultaneously load the automatic digital channels (when the cursor is in the temp, humid. or third variable fields).

Information: If however, you do wish to edit the digital channels, you should use the <tab> or <right arrow> keys. These keys do not skip the digital channel fields. When editing a program, if you use the <enter> key to move to the first field of the next line, as stated above, the Digital Channel fields are skipped. This is because in most cases you would want to accept the suggested values prompted by the controller.

2.6.2 Types of data entry field

There are two types of data entry field. The most common is a value field. When the input cursor is on a value field, the operator should simply enter the appropriate value (e.g. temperature, digital channel state, file name, etc.). The other type of data entry field is a selection list. When the cursor is on a selection list, you should use the <up arrow> and <down arrow> keys to move the highlight bar to the appropriate selection, then press <Enter>.

2.7 The status (or actual conditions) bar

The status bar is the window of information displayed at the top of the screen (see Fig,1). It is visible at all times. The data items displayed on the status bar are:

CONDITION: The temperature and relative humidity (if the controller is configured for humidity) inside the chamber is constantly displayed. The values displayed are updated every second. If the controller is configured for open loop control of a third channel (e.g. light level), this is not displayed (since the actual level must always be equal to the set point, which is displayed in the Monitor screen).

STATUS: This field describes what the controller is currently doing. It can take the value idle, running steady state or running program.

LOGGING: This field describes the current status of logging. It may take one of the following values: inactive, sync, alarm or active. Sync indicates that logging will start when the chamber is run, and alarm indicates that logging will start when an alarm condition occurs.

PROGRAM: This field describes the state of the currently loaded program. It may contain the message "No Program Loaded" or, if there is a program loaded, the name and description appears here. If editing has started on a new program, but that program has not yet been saved, the message "Not Named" appears in this field.

ACCESS: This field indicates the method by which FORMAT 650 is being controlled. It may take the value local or remote. Under normal circumstances this field will indicate local, which means that FORMAT's own membrane keyboard is controlling it. If the value is remote, FORMAT is under the control of remote RS232 communications.

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Note: FORMAT 650 uses the following rules:

When running in steady state control mode:

- Temperature is in °C, humidity is in %RH.
- Lighting is in % of full on, usually the range 10% to full on (100%) for standard HF type fluorescent lamps, and 30% to 100% for PLL type fluorescent lamps*. HQI lamps are not dimmable and are usually switched on/off in groups via one or more of the programmer digital channels. The switching of the tungsten (incandescent) supplemental lighting is selected on/off by one of the digital channels.
- For digital channels 0 means OFF, 1 means ON.
- In manual mode control is continuous until stopped by the operator.

When running in program mode:

- Temperature is in °C, humidity is in %RH.
- Lighting is in % of full on, usually the range 10% to full on (100%) for standard HF type fluorescent lamps, and 30% to 100% for PLL type fluorescent lamps*. HQI lamps are not dimmable and are usually switched on/off in groups via one or more of the programmer digital channels. The switching of the tungsten (incandescent) supplemental lighting is selected on/off by one of the digital channels.
- In segmental mode, a data segment is a period of time, during which that data is relevant. In sequential mode, a data segment is a point in time when a change in the data on which the programmer is acting upon is required.
- Times are specified as DAYS:HOURS:MINUTES:SECONDS.
- In sequential mode, each segment's time is from the start of the program.
- In sequential mode, the first segment of a program has zero time and each segment thereafter must be sequential with time.
- The maximum number of segments in each program is 150.
- When a number of cycles of a program are programmed the Preconditioning segment (line 0) is not included in the second and subsequent cycles. Often no Preconditioning period is required and the Preconditioning Segment should not be programmed. This is performed by programming segment 0 at 1 second (Segmental mode) or segment 1 at 1 second (Sequential mode).
- For digital channels 0 means OFF, 1 means ON.
- Programs cannot be linked together.
- The mid-cycle start facility can operate at any time in the program's first cycle.

* For chambers fitted with PLL lighting the FORMAT 650 display is adjustable from 10% to 100%, this corresponds to a controller output to the PLL ballasts of 10% to 100% power. This results in a light output ranging from 30% to 100%. For example, to achieve 30% light output set 10% on the controller; for 50% light output the controller is set to approximately 40%. A light meter should be used to achieve an accurate light output reading.

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3. Steady state control

This section describes how to make the controller maintain a steady state condition.

GENERAL OPERATING SEQUENCE - STEADY STATE MODE

1. Select Steady State operation from the Main Menu
2. Enter the required **temperature** setpoint.
3. Enter the required **humidity** setpoint.
4. Enter the required lighting level (eg 0 or 10% to 100%)
5. FORMAT will suggest the correct digital channel selection. Set the digital channels for non-chamber dependent digital channels (VFTs , etc) as required. If applicable, also set the digital channels for tungsten (incandescent) and HQI lighting. Reset the suggested settings for the chamber dependent digital channels only if previous experience shows a need to.
6. Start steady state control and start the chamber.
7. Run the chamber under manual control for the desired length of time.
8. Stop manual control and switch off the chamber.

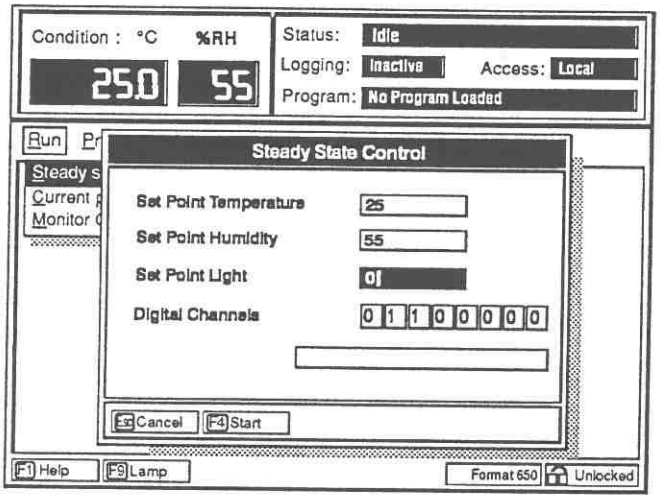

Fig. 2 Steady State Data Entry Window

3.1 Condition setting

To set a condition on the controller, select the Steady State menu option. You will then be presented with the Steady State Data Entry Window:

Type in the required temperature in °C and press <tab> or <enter>. If you make a mistake while typing, use the <backspace> key to strike out erroneous digits.

Type in the humidity (in % RH) in the same way.

3.2 Resetting steady state setpoints

After you have entered a condition FORMAT 650 will suggest digital channel settings. If you want to alter the suggested chamber dependent digital channel selections or if there are non-chamber dependent channels to be set (i.e. VFT), press the <tab> key until

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the input cursor reaches the required field and press 1 or 0. Entering 1 switches a digital channel ON and 0 switches it OFF.

When you are satisfied with the data in the window, press the <F4> function key to start the chamber running. The Status field at the top of the screen will change from idle to running steady state to indicate that the chamber has started running.

If at any point while entering information in the data entry window you decide that you do not want to start the chamber, you can press <Esc> to cancel. This takes you back to the Main Menu.

3.3 Condition monitoring

When the chamber is started in a steady state condition it automatically moves to the Monitoring screen, as shown in Fig 3, on which you can observe it's settings (including selected digital channels). If you move back to the main menu for some reason (via <Esc>), you can return to this screen by selecting the Monitoring option from the Main Menu. Note, the status bar shows the measured conditions.

Information When running a steady state condition, if you need to change to another condition it is not necessary to shut the chamber down first. You can go straight to the Steady State option on the Main Menu and enter the new conditions and/or digital channels while the chamber is running. The changes will not take effect until you press the <F4> function key.

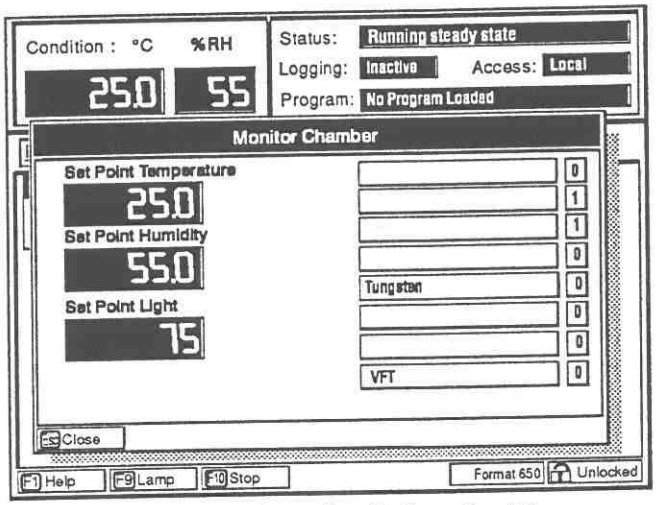

Fig. 3 Monitoring a Steady State Condition

3.4 Ending manual control

To end steady state control press F10. A safety catch message will ask you "Are you sure you want to stop the chamber running".

NOTE: - This procedure terminates the FORMAT 650 program. The electricity power should also be switched off.

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4.Programs

This section describes how to write, edit and run programs on the FORMAT 650.

GENERAL OPERATING SEQUENCE - ENTERING A NEW PROGRAM

1. Write out the program using the FORMAT program preparation sheets.
2. Select Program from the Main Menu.
3. Select New Program from the Program Menu.
4. Enter the program, segment by segment.
5. Save the program to diskette.

GENERAL OPERATING SEQUENCE - RUNNING A PROGRAM

1. Select Program from the Main Menu.
2. Select the Load from Disk from the Program Menu.
3. Select the name of the program to be run.
4. Select Run from the Main Menu.
5. Select Current program from the Run Menu
6. Enter the Number of Cycles to be run, and if required, the Guaranteed Soak, Program Start Time (mid-cycle start) and Countdown to Start (delayed start).
7. Start the program running, the FORMAT 650 automatically moves to the Monitor Chamber window.
8. If preferred, press <F2> to display a moving time graph of the program cycle.
9. When finished switch off the chamber.

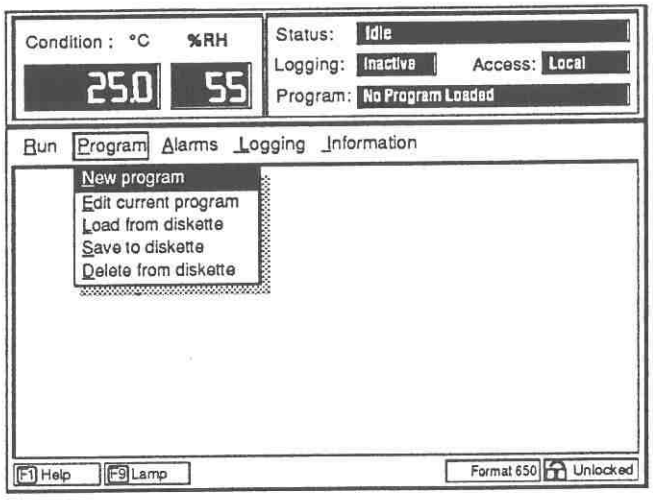

Fig. 4 The Program Menu

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4.1 Writing a Program

There are two methods of writing programs within FORMAT. You can select your preferred method from User Engineering (see Section 7).

a. SEGMENTAL: In this method, each segment (or line) of the program is a period of time during which the controlled conditions are maintained or the ramp (temp./hum. change) takes place.

b. SEQUENTIAL: In this method, each segment (or line) of the program is a point in time (from time zero) when a change in the controlled conditions (which may be the start or end of a ramp) takes place.

NOTE: Change of conditions can also mean change of digital channel status.

4.2 How to use FORMAT programming sheets

When preparing a program for entry into the FORMAT 650 programmer it is recommended that it is carefully written out in full beforehand on the specially prepared programming sheets which can be provided for this purpose.

Copies of programming sheets are available from Sanyo Gallenkamp (part number Z01442). A library of pre-prepared programming sheets and diskettes is also available covering many of the popular standard tests.

1. Draw out the graphic representation of the required test on the graph area of the programming sheet. This needs to indicate the changes (ramps) in temperature and humidity (if being programmed) and the dwells.

2. From the graph determine all data segments - the set of conditions for a time period (segmental mode) or the changes in the conditions, often called corners (sequential mode).

   A data segment is a period of time (segmental mode) or a point in time (sequential mode) when a change in the data on which the programmer is acting upon is required. For example:

   - a change in temperature, humidity or light from a ramp to a dwell.
   - a change in programmed temperature, humidity or light ramp rate.
   - switching on or off user digital channel(s).
   - a segment can reflect any number of changes providing they are required at the same time.

   The first segment is called the precondition segment and enables a condition to be programmed for a pre-set time prior to the actual program cycle starting. If a number of program cycles are programmed the pre-conditioning segment is not included in the second and subsequent cycles. Often no preconditioning period is required and the preconditioning segment should not be programmed. This is performed as follows:

   In segmental mode: by programming segment 0 at 1 second.

   In sequential mode: by programming segment 1 at 1 second.

   In sequential mode the segment time is from the start of the program not from the previous segment.

In sequential mode the last segment's time must be the desired finish time of the program.

3. Enter onto the program sheet the corresponding changes that occur at each segment. For future reference record on the sheet the program name used to store the program on floppy diskette and the number of program cycles to be used when the program is run. Also highlight segmental or sequential at the top left hand corner of table.

4.3 Entering the data into the programmer

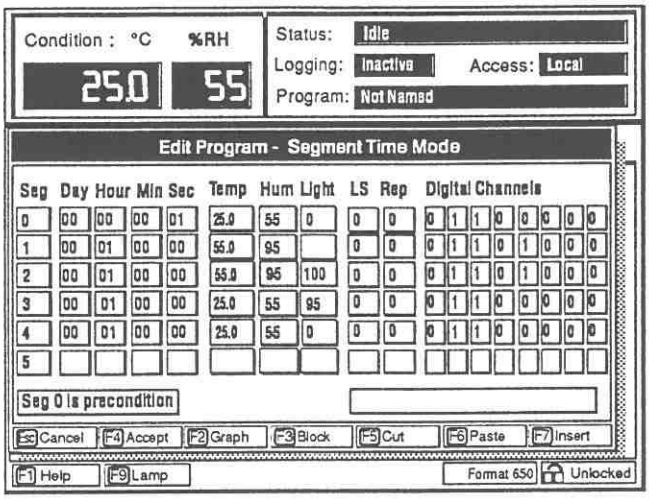

Fig. 5 Segmental Program Entry Window

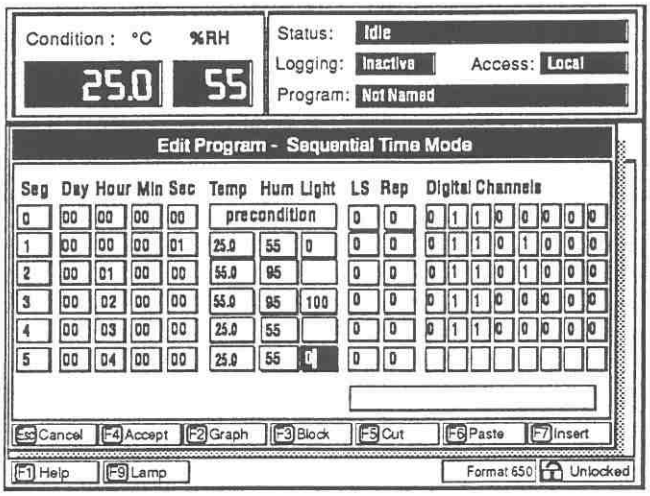

Fig. 6 Sequential Program Data Entry Window

Select the New Program option from the Program Menu (Fig.4). This brings up the program editing window (Figures 5 & 6). Following the FORMAT programming sheet enter the time and conditions into each segment line.

As you enter conditions, pressing <tab> between each field and pressing <enter> after the last required variable, you will notice that the digital channel fields are automatically populated by FORMAT. These are suggested digital channel values. If you wish to override the suggested values, move to the field you wish to change using the <tab> key. You can then freely edit the digital channels.

NOTE: The <right arrow> and <left arrow> keys can be used to move the cursor to individual digits.

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You can perform line cut and paste editing on your program. In order to cut a line (i.e. remove from program but remember it for future pasting) simply move the cursor to the line for cutting and press the <F5> key. To paste the line again, move the cursor to the line where the cut information is to be pasted, and press F6. You can also cut and paste blocks using the F3 key.

When you have finished editing, if you wish to view the graphical representation of your program, press <F2> then press <Esc> followed by <F4> to accept the program (if you don't wish to view the graph, just press <F4>). This takes you back to the Program Menu. If you now wish to keep the program, use the Save to diskette menu option, see section 4.4.

NOTE: Programs written on screen and not saved to the program/logging diskette are lost when the chamber is switched off or when there is a mains power interruption. Programs required for repeated use should always be saved.

4.3.1 Selecting digital channels when you know best

On some occasions the selection of digital channels suggested by FORMAT 650 is not the best for the particular circumstances you wish to control. Generally these cases involve loads which represent a significant thermodynamic load on the climatic systems. They could be active loads that dissipate heat within the chamber or they might be loads with significant mass, which need to be taken through a rapid temperature change. Finding the best selection for digital channels in these circumstances may need trial and error, but as simple guidelines:

- where the thermodynamic load looks large, increase the cooling power, typically from aux to main or indirect to direct cooling.
- where the required temperature fall rate is high, increase the cooling power.
- where high humidity is required with a load that tends to dehumidify, increase the humidifier power.
- loads that tend to dehumidify are those dissipating heat; remember that a large mass descending in temperature dissipates heat even though not powered.

One area where the FORMAT 650 cannot suggest selections is that concerning user digital channels (those other than system channels). No rules are pre-stored for them, other than that they are biased to off. Program them on when you want them on. A typical example is voltage free contacts (VFT). Here you will need to program 1 to switch it on, and 0 to switch it off. These instructions can share a program line with a condition segment or corner, or they can have a line of their own (e.g. occur in the middle of a dwell).

4.3.2 The Preconditioning Segment

The first segment (segment 0) of any program is the precondition segment. In segmental mode it is the length of time required for the precondition to run. Whereas in sequential mode this is always at time 00:00:00:00 [days, hours, minutes, seconds] and the pre-condition time is in line 1. This enables a conditioning period to be programmed before the start of the actual program cycle. If a number of cycles of a program are run the precondition segment is not repeated at the beginning of the second and subsequent cycles.

If no preconditioning period is required (as is usual in plant growth applications) segment 0 (segmental mode) or segment 1 (sequential mode) should be programmed at 1 second. For applications in sequential mode where the loss of 1 second per cycle is

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not acceptable, the end time of the program should be: END TIME (8, 12, 24 hours etc) PLUS 1 second, or the 1 second can be added onto each subsequent time if desired and the precondition time period must of course be added onto each subsequent time when there is an actual preconditioning period (because, in sequential mode, all times are from time zero [00:00:00:00] and subsequent cycles do not start from the same point). For example, for 24 hour cycle plant growth applications the end time of the program should be 24 hours 1 second, this will avoid the loss of 1 second on each daily cycle.

4.4 Loading and saving programs

When you save a program (Save to diskette) or load a program (Load from diskette) you must specify a file name to FORMAT 650. This can be up to 8 characters in length.

When loading, you can select the program you want to load from a list rather than type the file name if you wish (Fig.7).

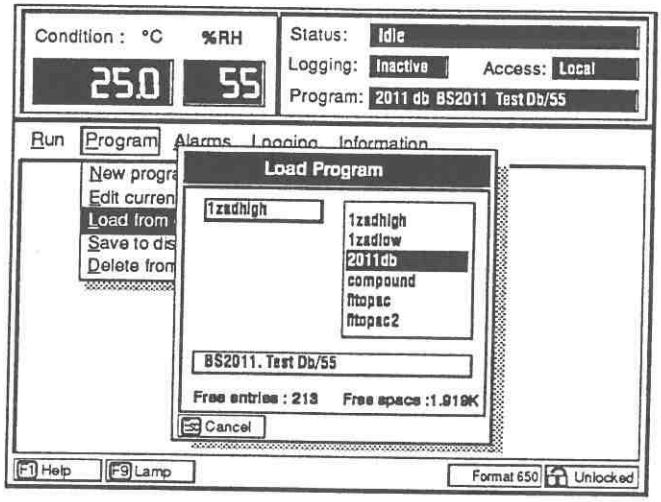

Fig. 7 Load Program Window

When saving, if you want to replace (i.e. update) a program that already exists, select the file name of the program you want to replace.

4.5 Running a program

When you choose Current program from the Run Menu (Fig.1), you will be presented with a data entry screen for run parameters (Fig.8). The options are:

NUMBER OF CYCLES: This is the number of times the program is repeated. This facility is of use for repetitive programs.

GUARANTEED SOAK: This option, when enabled, halts the program run time at each segment until the specified condition is reached.

PROGRAM START TIME: This specifies at what time into the program cycle you want the run to start, ie mid-cycle start.

COUNTDOWN TO START: This specifies a delay before the chamber starts running.

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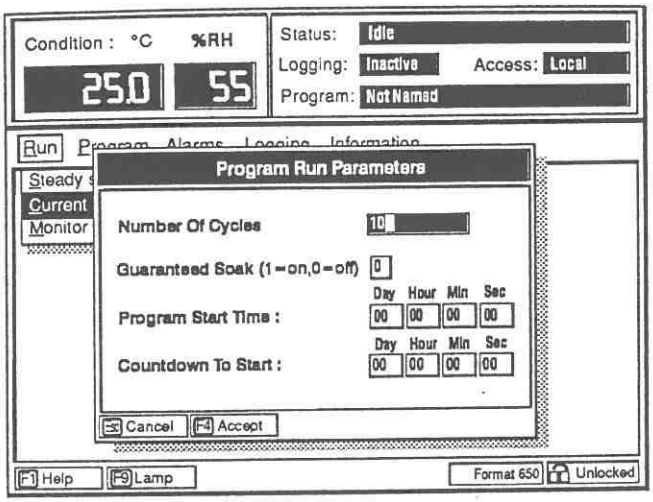

Fig. 8 Program Run Parameters Window

4.6 Program Monitor Window

When the run has started, the FORMAT 650 automatically goes into the Monitor Chamber window (Fig.9) in which you can observe the progress of the program.

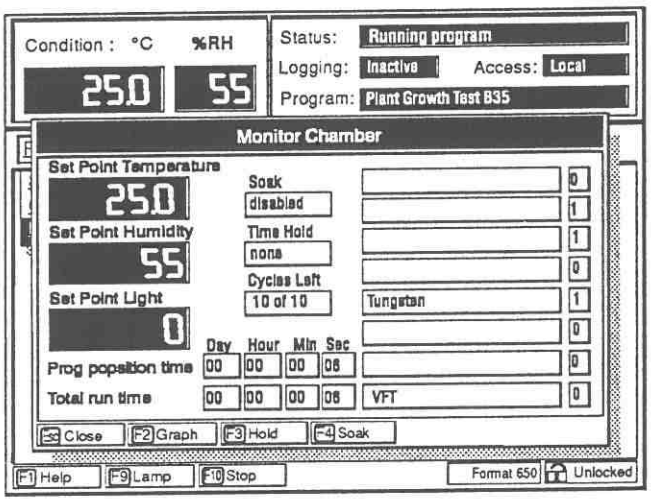

Fig. 9 The Program Monitor Window

If preferred, while in the Monitor Chamber window, if you press F2 the Monitor screen will be replaced with a Program Run graph (Fig.10). A dotted, flashing, vertical bar moves along the graph to show where you are in the program cycle. A fixed vertical bar indicates the end of the pre-conditioning period (i.e. the start of the actual program cycle) if applicable. This is lost on long programs if the pre-conditioning period is short.

On the Monitor Chamber window, in addition to the information displayed for a Steady State run, FORMAT 650 displays the Program Position Time (i.e. time into current cycle) Total Run Time (true total run time from start, i.e. carries on counting even during time holds), Cycles Left, Soak (enabled/disabled) and the Time Hold mode.

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The Time Hold mode can be Soak (if the Guaranteed Soak option was enabled at the Program Run window and the temperature and humidity are not within the preset limits), External (through a signal external to the controller, if fitted) or Manual. Manual Time Hold is effected by pressing the <F3> key. The effect is to instantly freeze the program run time until it is pressed again.

NOTE: Soak can also be enabled and disabled from the Monitor Chamber window. (Useful if you've forgotten to program it in or if you have and you change your mind).

To stop a program run before it is completed press the <F10> key.

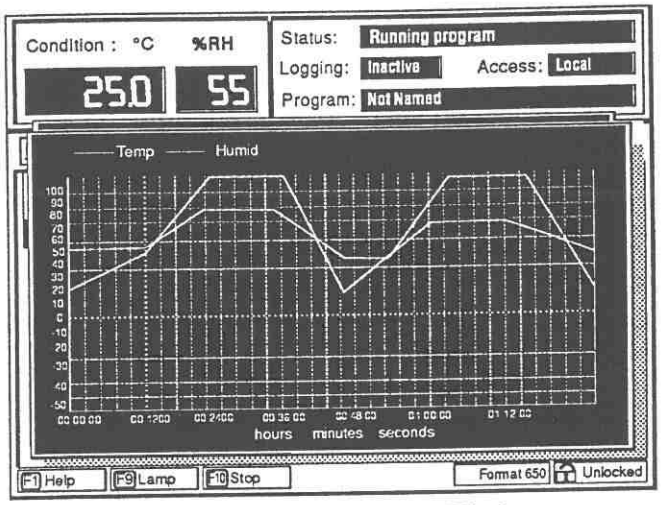

Fig. 10 Program Run Graph Window

4.7 Holding a program

To manually hold a program press <F3> from the Monitor Chamber window.

The effect of holding the program will be immediately apparent as the program position time counter will stop (the total run time counter will continue). When a program run is held the temperature and humidity levels are controlled at the values of the calculated setpoints at the time the hold was initiated, digital channel output status is also held as determined at that point in the program.

To remove the hold press <F3> again, and the program timebase will count again from where it was held.

4.8 Program completion

When a program has been completed (ie it has run through all of it's cycles) the FORMAT reverts to the Main Menu and shows the program status as idle and displays on a window the message "Program Run Ended".

4.9 Program deletion

This options enables the permanent deletion of a single program from diskette.

Select Delete from diskette, select the program to be deleted and press <Enter>.

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5.Data Logging

This section describes how to start and stop logging, and how to import data into industry standard spreadsheet packages.

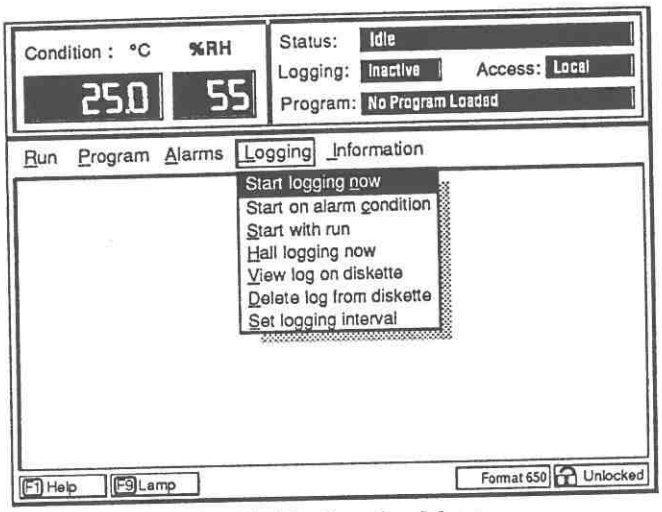

Fig. 11 The Logging Menu

5.1 Introduction to Data Logging

Data Logging is selected from the Main Menu. There are three different ways data logging can be initiated: start logging now, start on alarm condition and start with run. Whichever method you choose, you will be prompted for a file name for the data log. The logging interval is configurable from the Main Menu under Logging.

The log of data is recorded on the diskette placed in the disk drive on the control panel of the chamber. This disk also contains the program for the test being run.

5.2 Starting Data Logging

Ensure you have ample space on the logging diskette. As a guide, with the log interval set at 1 minute, a diskette with no log on it will last for 10 days (2 minutes = 20 days etc).

Select Logging from the Main Menu and then select Set logging interval and set to your required value between 1 and 60 minutes followed by <Enter>.

The simplest method to start data logging is to select the "Start logging now" menu option. This starts logging as soon as you have entered a file name.

You can also set logging to start at the same time that a program is run. Select "Start with Run" (synchronised start) for this. (You get extra log information in this mode, see note in section 5.6).

If you only want to start logging when an alarm condition occurs, select "Start on alarm condition".

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After selection of one of the 3 methods above, follow the menu system to enter a filename.

The logging field in the status banner at the top of the screen changes to reflect the start mode you have chosen.

5.3 Stopping Data Logging

To stop data logging, select the Halt logging now option from the Logging menu. The Logging window changes to Inactive.

NOTE: The Logging window also changes to Inactive if the logging is stopped by any other means e.g. electricity failure, diskette full or diskette removed.

5.4 Displaying Results

You can obtain a trend display of the data log from FORMAT using the View log on diskette option. This only displays the data in low level detail, i.e. it is intended only for observing if the system has performed correctly say overnight or over the weekend.

The log can be interrogated at any time either during logging or after the logging has been stopped. When interrogated during logging the display is not live (i.e. it is not updated), it is a snapshot at the moment it was requested, but the logged data continues to be saved to diskette throughout.

When View log on diskette has been selected, after it has loaded, the system will ask if you want to view the entire log or just the last portion (see Fig.12). If you reply that you want to see the last portion only (i.e. you've answered No) because your log file may be far too long to show any detail on this small scale, then you will get a graph looking something like Fig.13.

NOTE 1 The last portion of a log will not necessarily be 24 hours as shown, it will depend on how software specific for your chamber has been configured. If the current setting does not suit, you can request that it be changed to a period of your choosing (6 hours minimum).

NOTE 2 If the total log time is less than this last portion then the question in Fig.12 is not asked.

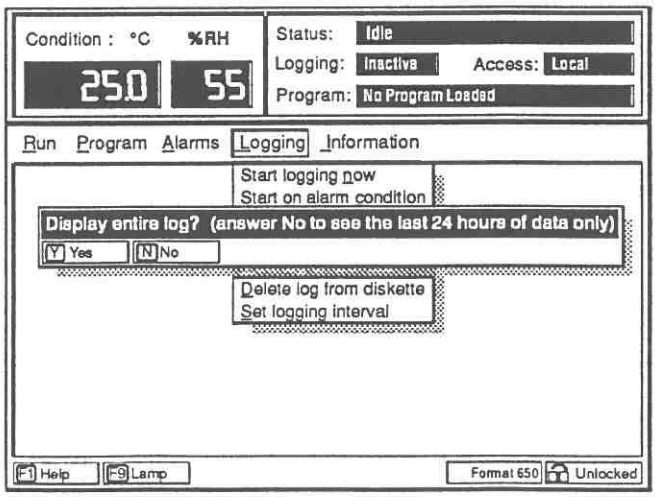

Fig. 12 View Log Period Screen

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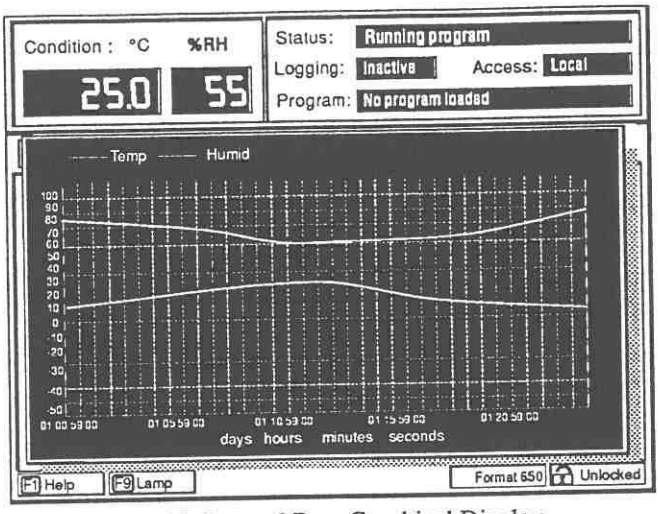

Fig. 13 Logged Data Graphical Display

NOTE: - There are only three lines showing above because the set temperature and actual temperature on top of one another.

5.5 Deleting Logs

You can delete unwanted logs from the Logging/program diskette.

Select Delete log from diskette option from the Logging menu, select the log you wish to delete then press <Enter>.

5.6 Loading into Spreadsheets

Data Logs in FORMAT 650 are stored as comma separated fields. Most industry standard spreadsheet packages support this data format for importing into them. Although the method varies between spreadsheet packages, the basic technique is similar. The order of the second and third points in the list below may be interchanged:

- Select the import option from your spreadsheet package.
- Specify the floppy disk drive and file name of the data log, and use the .LOG extension.
- Specify the type as comma separated values. A record size is 100 bytes.

The data log follows the format:
days,
hours,
minutes,
total minutes,
actual temperature,
actual humidity,
setpoint temperature (synchronised start only), see notes 1 and 2
setpoint humidity (synchronised start only), see notes 1 and 2

NOTE 1 The setpoints for temperature and humidity are only logged when a synchronised start log is performed.

NOTE 2 If the chamber is configured for logging of carbon dioxide and/or another parameter when the setpoint temperature and/or humidity logs are not recorded.

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The following shows a typical non-synchronous start log. Spaces have been added for clarity.

"Day"	"Hour"	"Min"	"Tot Mins"	"Temp"	"Humid
0	0	1	1	63.6	94
0	0	2	2	64.0	94
0	0	3	3	64.8	92
0	0	4	4	64.8	94
0	0	5	5	65.0	92
0	0	6	6	65.0	94
0	0	7	7	65.0	93
0	0	8	8	65.0	93
0	0	9	9	65.0	93

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6.Alarms

This section deals with setting alarms on the FORMAT controller.

6.1 Introduction to alarms

FORMAT 650 provides a comprehensive array of alarm triggers. Alarms are available on fixed high and low setpoints, or on deviation from control set point. The same alarm functionality is provided for both temperature and humidity channels.

Alarms can trigger several events:

- Shut the chamber down.
- If you have set logging to start on alarm, data logging of the condition will start.
- If your controller has been configured to use an alarm output, an external event may be triggered.

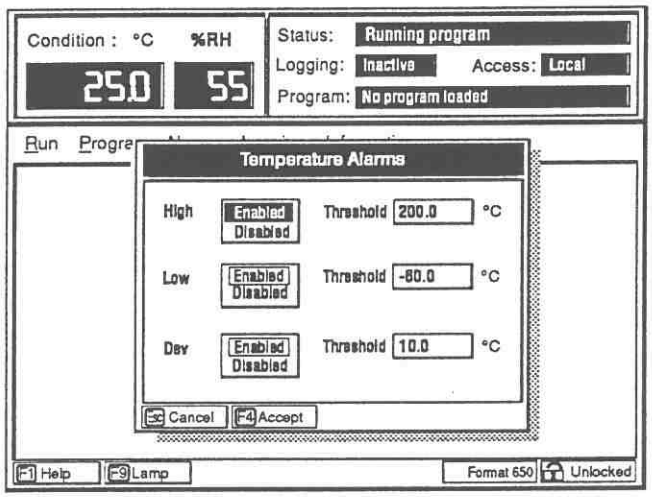

Fig. 14 Temperature Alarms Setpoint Window

6.2 Setting alarms

To set the alarm triggers, select the Alarms option on the Main Menu. This brings up a sub-menu from which you can select either Temperature Alarms or Humidity Alarms. After selecting one or the other, FORMAT presents a data entry window as shown above (Fig.14).

There are Alarm Setpoint data entry windows for both temperature and humidity alarms.

Set the alarm triggers by enabling the relevant type of triggers, and then enter the threshold values for the triggers. You can have any combination of triggers enabled.

If an alarm is triggered then the Temperature and/or Humidity display(s) flash and turn red and if logging is selected then the alarm condition is logged to diskette.

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7.Engineering

FORMAT 650 enables some of the engineering functions to be available to the user (e.g. changing the access code).

The Engineering Menu is not normally visible but is accessed, from the Main Menu screen, by a code.

The default code is: ***5678/**

The user can configure this code. The * and / have to remain but the 4 digits can be changed to any other 4 digits. The configuration is done as one of the options shown below, see Section 7.6, Change access codes.

7.1 Set keylock mode

With this option, you can decide if the <F10> (chamber shutdown) button will operate when the keyboard is locked or if the keyboard will have to be unlocked first.

7.2 Calibrate inputs

WARNING: - Calibration should only be carried out by AUTHORISED PERSONNEL. Incorrect calibration can cause inaccuracies in the controller/chamber performance.

Calibration of the inputs on the FORMAT 650 is not normally necessary as all chambers are calibrated prior to dispatch.

SANYO Gallenkamp will not be held responsible for any damage to either equipment or chamber, during or after the cabinet guarantee period, caused by recalibration of the FORMAT 650 inputs. Also, SANYO Gallenkamp will not be held responsible for any inadequate controller/chamber performance during or after the cabinet guarantee period, caused by recalibration of the FORMAT 650 inputs.

7.3 Change program mode

This allows you to select the programming mode you prefer, segmental or sequential.

7.4 Configure defrost timer

WARNING: - Configuration of the defrost time should only be carried out by AUTHORISED PERSONNEL. Incorrect configuration can cause poor or inadequate controller/chamber performance.

This allows the total cycle time and the period time of the defrost timer to be set. This needs trial and error setting as it is very condition dependent. It is recommended that the defrost timer total cycle and period time are not reset unless specifically indicated by the conditions you are controlling.

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Note: The actual operation (i.e. if and when defrost system operates) is determined by the controller logic and is not configurable by the user.

SANYO Gallenkamp will not be held responsible for any inadequate controller/chamber performance during or after the cabinet guarantee period, caused by reconfiguration of the FORMAT 650 defrost timer settings.

7.5 Create host config. diskette

This option is for users who have WinHost communications software. (see Section 8). It creates a floppy diskette to transfer controller specific files for use in the Program Editor portion of WinHost.

7.6 Change access codes

This option enables the keyboard lock and engineering access codes to be re-configured.

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8.COMPUTER INTERFACING

8.1 INTRODUCTION

Using the RS232 port on the FORMAT 650 the controller can be interfaced to PC compatible computers.

There are two methods available to the user to interface with the format as described below:

8.1.1 Windows host system - (WinHost)

This is a Windows based software package that can be installed onto the hard disk of a personal computer. It enables the connection of up to 8 FORMAT controllers. These can be a mixture of FORMAT 600 & FORMAT 650 controllers. Each can be addressed individually to allow all controller functions to be carried out from the PC plus on-line uploading and downloading of programs, external logging etc. Off-line, programs can be written and stored, enabling storage of an infinite number of programs. Other work can be carried out on your computer whilst WinHost is logging, so long as the computer remains in Windows (with more than 3 or 4 controllers connected this may become very difficult due to the frequency of interrogation).

The WinHost Installation Disk can be ordered from SANYO Gallenkamp PLC and there is a separate handbook entitled "WinHost Host Software for Windows" covering installation, connecting, using etc.

8.1.2 Computer interactive system

In this situation software is written by the user to enable his chamber to be slaved to some other intelligent device. Typically this might be a system controller or computer which is managing a test procedure being conducted on the test piece within the chamber. The system controller can make decisions and direct the operation of test device and/or chamber.

At a simple level this can take the form of the system controller requiring data about the chamber condition to add to a log already being acquired. A substantial protocol supports these interactions and a separate manual entitled "FORMAT Communications Protocol" is available from SANYO Gallenkamp PLC.

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Appendix 1 - Technical Specification

Temperature & humidity programmer/controller with in-built logic, chamber intelligence mapping, & data logging

Operator interface

Data entry: - dedicated alpha/numeric keypad.

Display: - colour LCD.

Operating temperature

5°C to 60°C.

Analogue inputs

Two 4 wire PRT inputs. Range -150°C to +350°C. Accuracy +/- 0.1°C. Dedicated to measuring temperature and humidity (relative humidity is derived from wet & dry bulb by psychrometric computation).

Calibration of the analogue inputs

Performed in software; there are no pre-sets to adjust.

Control Loops

Temperature: three term (P.I.D.) digital control, using trapezoidal approximation to interpolate between samples. Input sample and control period is 4 seconds. Output of control algorithm is heat digital mark space ratio (with -100% to +100% dead band adjustment). Set point resolution 0.1°C.

Relative Humidity: three term (P.I.D.) digital control, using trapezoidal approximation to interpolate between samples. Input sample and control period is 4 seconds. Output of control algorithm is humidify digital mark space ratio (with -100% to +100% dead band adjustment). Set point resolution 1 %RH.

Controller Intelligence

For all regions of the chamber performance envelope, a table pre-stores:

- a map of appropriate housekeeping facilities
- a map of appropriate P.I.D. controller coefficients

Maps are not displayed on the controller.

Housekeeping: Digital channel selection: - by autosuggestion from intelligence at setpoint entry.

Over-ride: - available at keypad.

Internal Defrost Clock

Invoked automatically if required (from intelligence).

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Steady State Control

The controller allows set point values to be entered for temperature and humidity. With auto-suggested or manually input digital channel selections.

Programs

Library capacity: 20 programs nominal (leaves space for 1 week log)

Program size 150 lines/segments max per program, 10 kbytes approx. per program

Segment/line content: time, temperature, humidity, digital channel, loop.

Time basis segmental: - segment length

sequential: - time from program start

Time units: days, hours, minutes, seconds

Editing facilities: line cut; paste; block copy

Loop: facility to repeat program sections

Nesting: (loops within loops) supported

File facilities: save, load, delete

Precondition: line 000 omits after 1st cycle.

NOTE: - The FORMAT 650 always runs programs in Sequential Mode (time from program start) but, if desired, programs can be written in Segmental Mode. Both methods of writing programs are supported. If written in Segmental Mode, the controller converts it to time from program start in order to run.

Program Run Options

Repeats: up to 9999 cycles

Guaranteed soak:

active: - at each program segment

arming: preset at run start, or manually during program run

criteria: temperature error 0.5°C, or relative humidity error 1%

action: program time base is arrested until the condition returns inside limits.

Run start facilities:

program start time (mid-cycle start): specify time into first cycle.

countdown to start (delayed start): allows unsupervised start.

Monitoring displays

Steady state: setpoints, digital channel status

Running program: setpoints, digital channel status, soak status, hold status, time into program run, number of cycles remaining.

Facilities: turn on/off timebase hold, turn on/off guaranteed soak.

Alarms

Parameters: temperature, humidity

Type: high, low, deviation

Range: chamber range

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Data Logging

Log content: actual temperature, actual humidity, time setpoint temperature (synch start), setpoint humidity (synch start)

Log interval: user configurable 1 to 60 minutes

Log information source: control probes

Log entry size: 100 bytes

Log triggers: manual, synchronised, alarm

Log preview: simple trend graphic

File facilities: load, delete

Log format: comma separated values (import to industry standard spreadsheets).

Storage media

Internal solid drive: - system

External floppy diskette: program/log data diskette

Digital outputs

50 way connector interfaces to SSR drives.

Digital input: dedicated to the external hold facility (internal access only, contact SANYO Gallenkamp PLC or your dealer for applications)

Data communication

RS232

Support software: WinHost:- available separately

Hard copy: program printouts are available using the above software

8.2 Cable connections

FORMAT 650 communications require a cable of the following connections to be fitted between the chamber and the communicating PC.

Computer RS232	Computer RS232	FORMAT 650 socket	
9 pin D type	25 pin D type	25 pin D type	
9	22	8	(CDR)
3	2	3	(RXR)
2	3	2	(TXR)
6	6	20	(DTR)
5	1 & 7	7	(GRD)
4	20	6	(DSR)
8 link to 7	5 link to 4	4	(RTS)
7 link to 8	4 link to 5	5	(CTS)
1	8	22	(RI)

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APPENDIX 2 - PROGRAM LOOPING AND NESTED LOOPS

You can program loops in FORMAT 650. In addition you can program loops within loops (nesting). This section tells you how, with simple examples.

Loop instructions

The loop instructions are achieved using the LS & Rep columns that appear on the program preparation sheet & on the program window of the system.

In the line from which you want to loop back:

- in column LS you specify which line you want the program to loop back to.
- in column Rep you specify how many times you want the program to repeat this part of the program.

Note: In Segmental mode, LS = Segment number + 1, this is because the programmer always runs sequentially however the program has been written. A Sequential version of the program below is shown on the next page and demonstrates clearly that each event has moved on one segment number, hence Segment number + 1.

The program loops back from the time line in which the loop is listed, to the first line in the loop.

EXAMPLE

Taking a simple example: You require the temperature to cycle from 25°C to 85°C, then to 35°C, then to 65°C, then to 15°C, before returning to 25°C. But you want to cycle through the 35/65/15 part three times in all (i.e. programmed + two loops) before emerging at the final 25°C. To do this you would program (in Segmental mode). Remember LS = LS +1:

PROGRAMMING IN SEGMENTAL MODE						
Seg	Time dd:hh:mm:ss	Temp °C	Hum %rh	LS (+1)	Rep	Digital Channels
000	00:00:00:01	25.0	75			
001	00:00:00:20	85.0				
002	00:00:00:20	35.0				
003	00:00:00:20	65.0				
004	00:00:00:20	15.0		3 (line 002)	2	
005	00:00:00:20	25.0	75			

Note: Line (segment) 000 is the preconditioning and is not repeated in subsequent cycles.

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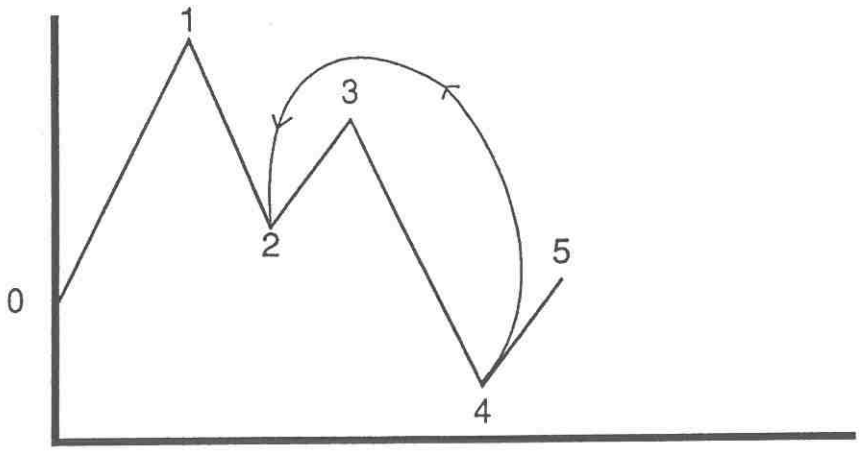
The times are unrealistic for environmental test purposes, but they provide a program that can be cycled quickly to see the effects.



Graph of above program

The same program written in sequential mode would be as below:

PROGRAMMING IN SEQUENTIAL MODE						
Seg	Time dd:hh:mm:ss	Temp °C	Hum %rh	LS	Rep	Digital Channels
000	00:00:00:00	Pre-condition				
001	00:00:00:01	25.0	75			
002	00:00:00:21	85.0				
003	00:00:00:41	35.0				
004	00:00:01:01	65.0				
005	00:00:01:21	15.0		3	2	
006	00:00:01:41	25.0	75			

When you run this program you will see that it causes the temperature to return to 25°C (point 6 in the graph), i.e. end of first cycle, at 3 minutes 1 second after the start of the cycle, not at 1 minute 41 seconds as listed. This is because, in sequential mode, the FORMAT cannot automatically take into account the time taken up by the looping and furthermore, the Program position time no longer counts up time from the start of the cycle once the system starts to loop. When it passes the point from which it must loop back, it displays the time flow within each loop. Once it has finished looping it continues to count up time from the beginning of the last loop. The Total run time continues to display true total time from when the program (not the cycle) was first started.

Due to this fact, when programming in sequential mode, the listing of events in a program which succeed loops is no longer derived directly from the start of the cycle. A calculation is required to determine when to program the time for each succeeding event.

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It must be stressed that the need for calculation when writing the program does not exist when writing in segmental mode. The above example and the following instructions are for those users who prefer the sequential mode method of program writing. However, it must also be stressed that, whichever programming mode is used, the system always runs sequentially and therefore the effects on the running timebase display are always as described later.

CALCULATION FOR SUCCEEDING EVENTS (in sequential mode only)

Call the programmed time for the succeeding event, the event program time. Call the time when the event is actually required the event actual time (both times being from the start of the cycle), then:

event program time = event actual time - total looping time

The total looping time is the total time taken to execute the loops as defined by LS & Rep.

If, in the above example, it is required to add a 25°C dwell to the end of the cycle and the total loop time is (2 x 40 seconds) = 1 minute 20 seconds (1:20) and the cycle is required to finish at 3 minutes 40 seconds (3:40) from the start of the cycle, then:

event program time = 3:40 - 1:20 = 2:20

Therefore, the program in sequential mode would be written as follows:

PROGRAMMING IN SEQUENTIAL MODE						
Seg	Time dd:hh:mm:ss	Temp °C	Hum %rh	LS	Rep	Digital Channels
000	00:00:00:00	Pre-condition				
001	00:00:00:01	25.0	75			
002	00:00:00:21	85.0				
003	00:00:00:41	35.0				
004	00:00:01:01	65.0				
005	00:00:01:21	15.0		3	2	
006	00:00:01:41	25.0				
007	00:00:02.20	25.0	75			

If this program is run, you will see that the first cycle ends at 3:40 (total run time), the second cycle at 7:20 and so on.

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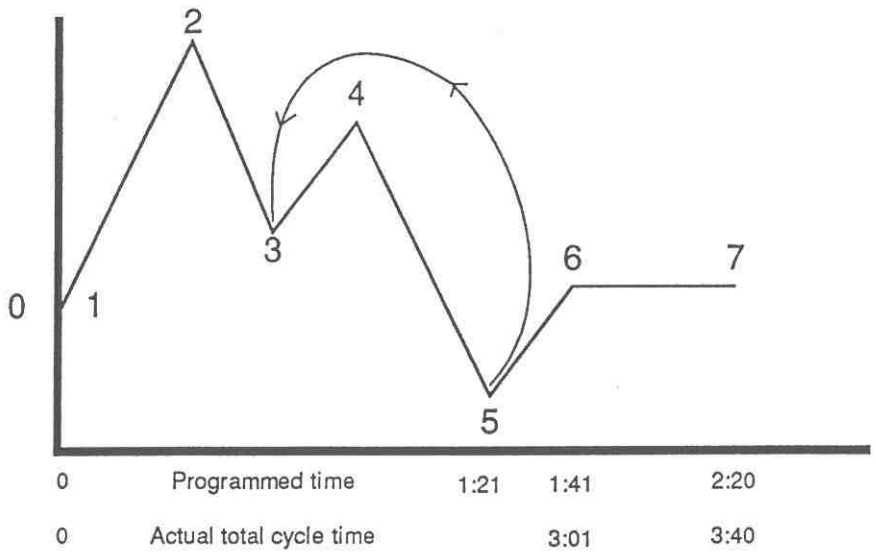


0	Programmed time	1:21	1:41	2:20
0	Actual total cycle time		3:01	3:40

Graph of above program

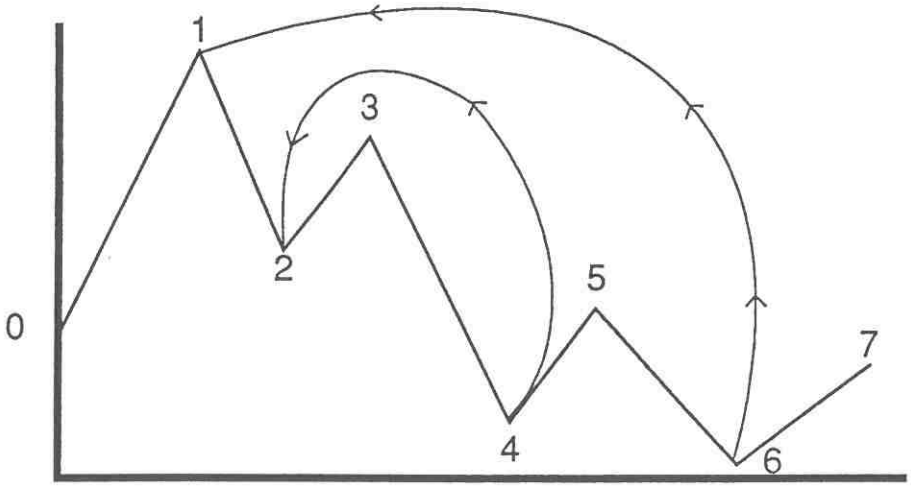
EFFECTS ON THE RUNNING TIMEBASE DISPLAY

As stated above, the program position time display becomes meaningless once the system has entered a looping portion of the program display and remains so throughout the rest of the program. For this reason, when running a program that includes loops, it may be found preferable to display the moving time graph. Whilst this doesn't show if it is in a loop or not, it at least displays realistically where the setpoint lies within the context of the cycle.

Nested loop instructions

Due to the complications of program timing calculations with nested loops in sequential mode; it is recommended that, in these cases, the segmental mode should always be used.

The following example shows the use of nested loops written in segmental mode. When this program is run you will see that it causes the temperature to return to 25°C (point 7 in the diagram) at 9 minutes 41 seconds after the start of the cycle, not at 2 minutes 21 seconds as listed on the program graphs, ie (7 x 20) +1 = 141 seconds = 2 minutes 21 seconds.



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PROGRAMMING IN SEGMENTAL MODE						
Seg	Time dd:hh:mm:ss	Temp °C	Hum %rh	LS	Rep	Digital Channels
000	00:00:00:01	25.0	75			
001	00:00:00:20	85.0				
002	00:00:00:20	35.0				
003	00:00:00:20	65.0				
004	00:00:00:20	15.0		3	2	
005	00:00:00:20	45.0				
006	00:00:00:20	5.0		2	2	
007	00:00:00.20	25.0	75			

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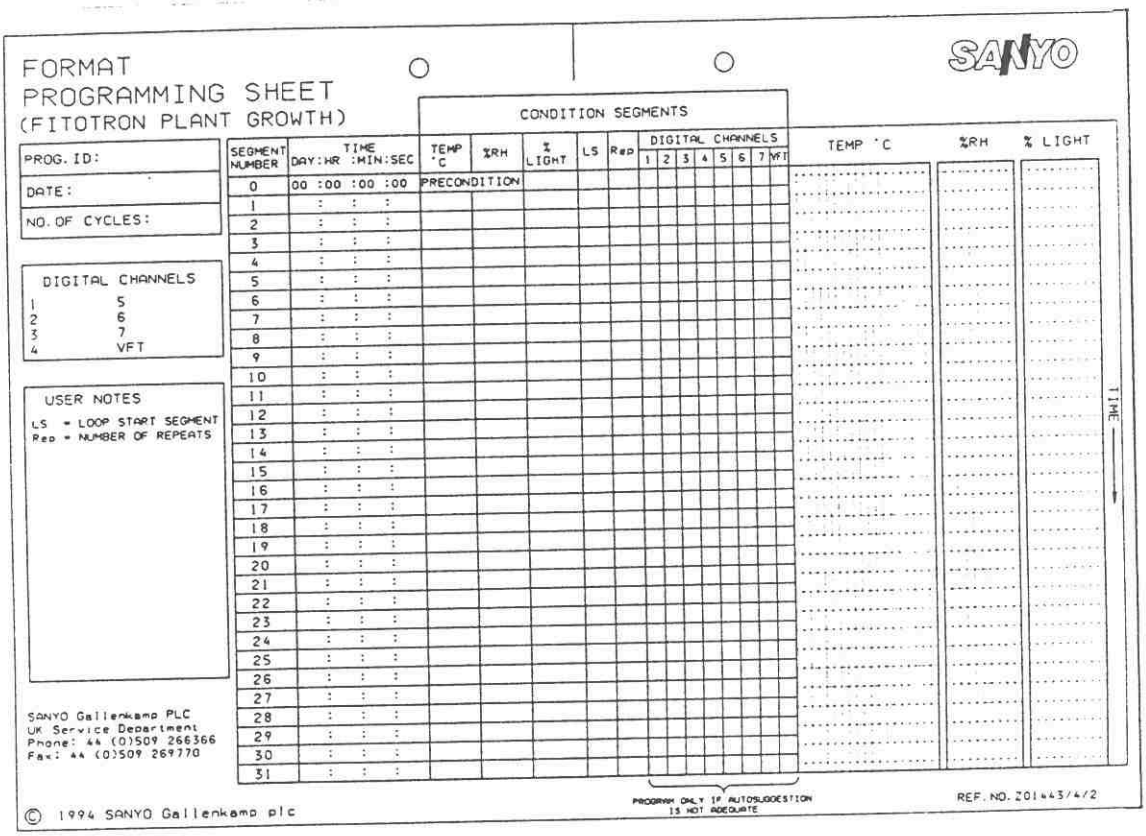
APPENDIX 3 - FORMAT 650 PROGRAMMING SHEET



FORMAT
PROGRAMMING SHEET
(FITOTRON PLANT GROWTH)

SANYO

PROG. ID:
DATE:
NO. OF CYCLES:

DIGITAL CHANNELS	
1	5
2	6
3	7
4	VFT

USER NOTES

LS = LOOP START SEGMENT
Rep = NUMBER OF REPEATS

SANYO Gallenkamp PLC
UK Service Department
Phone: 44 (0)509 266366
Fax: 44 (0)509 269770

SEGMENT NUMBER	TIME DAY:HR :MIN:SEC	CONDITION SEGMENTS TEMP °C	%RH	% LIGHT	LS	Rep	DIGITAL CHANNELS 1	2	3	4	5	6	7	VFT
0	00 :00 :00 :00	PRECONDITION												
1	: : :													
2	: : :													
3	: : :													
4	: : :													
5	: : :													
6	: : :													
7	: : :													
8	: : :													
9	: : :													
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28	: : :													
29	: : :													
30	: : :													
31	: : :													

PROGRAM ONLY IF AUTOSUGGESTION IS NOT ADEQUATE

TEMP °C | %RH | % LIGHT

TIME

REF. NO. 201443/4/2

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ADDITIONAL INFORMATION

Customer	Schoeller Instruments
Chamber reference:	9380
Date:	February 2002
Additional information ref:	52985.0007

CARBON DIOXIDE SYSTEM

The chamber is fitted with the facility to control the concentration of carbon dioxide in the working chamber. The facility consists of a Vaisala carbon dioxide probe, a 2408 controller and a flow meter.

The carbon dioxide supply connection inlet is at the rear of the chamber. The maximum supply pressure is 2 psi.

Carbon dioxide controller

When power is first switched on the carbon dioxide controller runs through a self-test sequence for about three seconds and then shows the actual carbon dioxide concentration in ppmwithin the working chamber in the upper readout and the setpoint in the lower readout.

To adjust the setpoint press the UP and DOWN arrow buttons at the bottom of the controller. Two seconds after releasing either button, the display blinks to show it has accepted the new value.

Many of the controller parameters are preconfigured during chamber commissioning are not available to the operator. For access to the other parameters see the Eurotherm operation manual provided separately. In order to access the other parameters a password may be required. The configuration password is set to (password not entered unless customer requested). Full details of the Eurotherm controller's operation are given in the manufacturer's operation handbook provided separately.

missing!

Carbon dioxide flow meter

The rate of carbon dioxide flow into the chamber is adjusted by the flow meter on the control panel. Set a suitable flow rate in cc/min. The flow will only been seen when the working chamber carbon dioxide concentration is below the controller setpoint.

Asphyxiant gas (CO_2) Safety

Although this advice is aimed primarily at users of conditioning cabinets, using enriched carbon dioxide atmospheres, consideration must be given to personnel who work in the vicinity of CO_2 cylinders. People may not be aware of the hazards posed by high concentrations of CO_2 gases. This document is intended as a guide to the hazards and what should be taken into consideration when using such gas.

Please note that this information is only intended as a guide - a local risk assessment related to the use of CO_2 gas, must be made by a suitably competent person, such as your Health and Safety advisor.

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CO_2 gas exists in the atmosphere at a level of approximately 0.03%. It is not usually considered as a toxic gas, though the Threshold Limit Value is usually taken to be 0.5%. This is the maximum level that can be tolerated over an 8 hour day. CO_2 gas is about 1.5 times heavier than air, so it will migrate to floor level and can collect in basement type rooms where ventilation can be restricted.

Even low concentrations of CO_2 can have an adverse effect on health. 2% CO_2 will cause an increase in breathing rate, some dizziness and muscular weakness. A 5% concentration will additionally increase the breathing to about 4 times the normal rate with feelings of intoxication. Around 10% concentration of CO_2 will result in rapid loss of consciousness leading to asphyxiation.

1kg of liquid (or solid) CO_2 will evaporate (or sublime) to form $0.5m^3$ of gaseous CO_2, therefore, a 30kg cylinder of liquid CO_2 could produce $15m^3$ of gaseous CO_2, enough to cause fatalities in most rooms with normal ventilation. Allowances must be made for adequate ventilation wherever CO_2 is to be used. Your Health and Safety advisor will take these factors into consideration. Simple precautions and instructions, if adhered to, can help to prevent an incident related to the escape of CO_2 gas.

1. Ensure that you are using the correct type of gas and check that all pipes are connected securely and cannot become disconnected. The gas cylinder should be filled with liquefied CO_2 gas, do not use a siphon (dip tube) type cylinder.
2. Ensure that you have the correct regulator attached to the CO_2 cylinder. This must be able to accurately control the gas pressure into the CO_2 incubator according to the manufacturer's specifications.
3. Ensure that the gas pressure is set at the value specified by the manufacturer.
4. Check that no gas is leaking at any point where the pipe connects with the CO_2 regulator or the CO_2 incubator.
5. The gas supply pipe is intended to be a consumable item and it is recommended that the pipe be replaced annually.

Enclosed or confined spaces

WARNING: As with any equipment that uses CO2 gas, there is a likelihood of oxygen depletion in the vicinity of the equipment. It is important that the work site be assessed to ensure there is suitable and sufficient ventilation. If restricted ventilation is suspected, then other methods of ensuring a safe environment must be considered. These may include atmosphere monitoring and warning devices.

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