

Strand Lighting

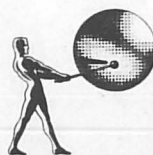
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M24 AGENTS MAINTENANCE



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M24 Agents Maintenance

Preface.

All Approved Service Centres will be supplied with one copy of this technical training handbook. This copy are supplied for information only. Strand Lighting will not approve the use of information contained within this handbook by persons who have not attended training courses at Strand Lighting.

The front cover, the contents pages and this introduction page form the header document for this handbook. This header document has a unique document number which should always be quoted when referring to the whole handbook.

Each time there is a change or an addition to the handbook a supplement will be written. The supplement will be put at the end of the main text and will have another document number.

Each time a supplement is written the header document is updated. The supplement is added to the contents pages and the issue number of the header document is incremented.

To check that your copy of this handbook is up to date contact Strand Lighting Engineering Service and quote the number and issue of the header document. If your document is not the latest issue you will be sent the latest header document and the missing supplements.

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The information within this handbook is believed to be correct and complete, however if you discover any omission or error, please contact Strand Lighting.

Strand Lighting accepts no responsibility or liability for any errors or omissions which may have occurred during the preparation of this guide.

Strand Lighting accepts no responsibility or liability for any damage, loss or injury, however caused from the use of information contained within this guide.

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Electricity at Work Regulations - 1989.

The Electricity at Work Regulations 1989 require :-

"No person shall be engaged in any work activity where technical knowledge or experience is necessary to prevent **danger** or, where appropriate, **injury**, unless he possesses such knowledge or experience, or is under such a degree of supervision as may be appropriate having regard to the nature of the work." (Guidance on regulations - published by HSE)

"It is for the employer to judge the level of competence required, and to ensure that no person is called on to carry out work for which he does not have the required competence. This is very much a matter of individual judgement, but the employer must always bear in mind the fact that he may be required to justify his decisions before a court of law in the event of an accident." (Guide to Electrical Safety at Work - John Whitfield - Published by E.P.A. Press)

Successful completion of the course and the assessment does not, by itself, necessarily provide the trainee with the knowledge or experience to comply with this requirement.

To satisfy the requirement the following three stages must be completed.

1. Pre-Qualification.

Before attending a course at Strand, the trainee must be able to demonstrate "adequate knowledge of electricity" and "adequate experience of electrical work". This knowledge and experience will probably have been gained from a BTEC, City and Guilds or other vocational qualification.

2. Theory and Identification of Hazards.

The course at Strand Lighting will include understanding of the system to be worked on, understanding of the hazards which may arise during the work and any precautions which need to be taken.

3. Practical Experience.

Finally the trainee must gain practical experience of the class of system which is being worked on. He must also be able to recognise at all times whether it is safe for work to continue. These requirements are not taught at Strand Lighting.

All maintenance courses are assessed. Engineers who pass the assessment will have demonstrated that they have the required theoretical understanding of the system, understanding of hazards and the precautions to be taken. The engineer may now proceed to the next stage which involves gaining practical experience of the type of electrical equipment covered in the course.

Engineers who have attended courses prior to the introduction of the assessments, and have had regular experience of the product, should still have sufficient understanding of the system and understanding of the hazards. Engineers who have not had regular experience should attend a refresher course and take the assessment.

A Guide To Agents Maintenance For Tempus M24

Introduction

This document is intended to be a reference manual for the procedures involved in dealing with a customer request for service of an M24 installation.

These procedures are applied in conjunction with the Rank Strand M24 Service Policy. The customer is responsible for the return of faulty equipment to, and the collection of repaired equipment from the point-of-service. It is important to establish, during the first contact, which part of the equipment is faulty.

Section 1 deals with the investigation and research into the customer's complaint, from the time of initial contact. In the first instance, the area of the fault must be determined. There is always a possibility that the M24 is not at fault, but that the problem is with the dimmers or installation. It is even possible that the problem is with the operator.

Section 2 deals with the cure, and lays out the activity at the point-of-service. Included is the procedure to use the M24 self-test package, which may locate a fault in the Console to a particular sub-assembly.

Section 3 deals with the termination of the customer service and makes direct reference to the communication and interchange of spares with Rank Strand.

Appendix 1 describes the procedures to strip down and rebuild the equipment.

Appendix 2 describes the self-test facilities for the M24 Equipment.

1. Diagnosis

Generally the initial customer contact will be over a telephone link, and the customer's own diagnosis will be 'it doesn't work'.

The first process is to establish the name of the customer, location of the equipment and what equipment is on site. This information may be available from your own records if you commissioned the equipment.

1.1 begin

Establish:- the customer's name;
 location of the equipment;
 equipment on site, including the type of dimmers and
 manual wing (if part of the system)

Verify the basis of the service - warranty, chargeable, or maintenance contract.

Request the nature of the fault in as much detail as possible.

It is unlikely that more than one piece of the equipment is faulty, although the symptoms may indicate otherwise. Alternatively, the fault may be caused by a poor interconnection.

Because the applied conditions of, and responsibility for, warranty will vary according to the equipment, it is important to establish which part of the system is at fault.

The equipment on site, and its applicable warranty, are set out below:-

1.1.1 "Return to point-of-service"

This is the general warranty set out in the M24 Service Policy.

Equipment covered:-

M24 Console
M24 Effects
Multiplex boxes

1.1.2 "Rank Strand Terms and Conditions of Sale August 1982"

This is the standard company warranty and allows for either work on site or on equipment returned to the point-of-service. If the manual wing is portable, it could be returned to the point-of-service. Additionally, if the dimmers are wired as a temporary installation (all connections by plug and/or socket) these could also be returned.

Equipment covered:-

Manual Wing (if supplied by Strand)
Dimmers (if supplied by Strand)

1.1.3 "Supplier's/Manufacturer's Warranty"

This covers parts not made by Rank Strand. If Strand have supplied the equipment, then they may be responsible to the customer for any standard warranty. This responsibility is generally only to act as a contact to the equipment manufacturer, and to pass on their benefits (which will operate on a return to manufacturer/distributor basis).

The equipment that may be covered is:-

Manual Wing
Dimmers
Cassette Recorder
Television/Monitor

n.b. When items such as monitors or dimmers have been supplied by a company other than Rank Strand, the customer should be instructed to contact the supplier directly, in the case of a failure. Rank Strand accepts no responsibility for the maintenance of equipment which has been supplied by other companies.

Also, if use of such equipment has adversely affected the parts supplied by Rank Strand, any necessary repairs may be 'chargeable' even if the installation is still covered by warranty.

The first logical area to be isolated is the equipment external to the M24 control system i.e. Manual wing and Dimmers. The nature of the complaint may have included sufficient information to by-pass this next step.

1.2 **continue**

Does the fault affect one dimmer output or a pattern which coincides with the installation? (e.g. all on one phase), or coincides with the type of dimmers (e.g. adjacent channels in a Tempus/Permus 10A circuit).

Explore the possibility of a defective dimmer or installation fault (it has been known for a dead circuit to be traced to a lantern without a lamp).

Alternatively, the fault could be one output from a Multiplex box to the dimmers.

Explore this possibility by directing the customer to crossplug the Multiplex box output connectors, under your control. The fault will either move to the new dimmer it is controlling, in which case it is the Multiplex box, or will stay on the same dimmer circuit.

If a manual wing is part of the control system, it could be used as an aid when attempting to isolate the control system.

If the fault is such that one circuit from the manual wing does not appear at the M24 Console, then the problem is either the Multiplex box or the manual wing.

Explore this possibility by directing the customer to crossplug the Multiplex box input connectors, under your control. The fault will either move to the new fader channel, in which case it is the Multiplex box, or stay on the same fader in the Manual wing.

It may also be necessary, in extreme cases, where a Manual wing forms part of the installation, to direct the Customer to by-pass the Multiplex box, by connecting the Manual wing output directly to the input of the Dimmers.

Hopefully, at this point in the dialogue, it should have proved possible to isolate the Manual wing and Dimmers/Installation from the M24 control system. The following part of this procedure considers the M24 control system only and the next step is to isolate the Multiplex boxes from the Console/Effects.

1.3 **continue**

Does the fault affect one or more channel outputs?

Hopefully we should have determined sufficient of the symptoms to eliminate a fault concerning one output, but we must always accept that the customer has not followed the instructions to the letter.

If the fault is affecting more than one dimmer, the affected channels could constitute an electronic (e.g. binary) pattern, every 2nd, 4th, 8th, 16th, etc., or every 2, 4, 8, 16 channels.

Is the fault affecting more than one Multiplex box?

If the fault affects only one box or only a pattern within one box, it is almost certainly in the affected box, or the MUX connecting cable may be damaged.

By by-passing the Multiplex box with a Manual wing, the dimmers have been proven. By disconnecting the Multiplex box from the Console/Effects, it will recirculate its manual input to the dimmer output. Any fault that continues in this mode of operation is caused by the Multiplex box.

If the fault seems to be located outside the Multiplex boxes we must continue. The next step is only applicable if the M24 Effects is available on the site.

1.4 **continue**

Allow the M24 Effects to drive the Multiplex boxes by either disconnecting the M24 Console or turning off its mains supply.

With the M24 Effects driving the outputs, does the fault persist? If it does, the customers previous replies and actions must be suspect as it is unlikely that the Mux outputs of both the M24 Console and Effects would fail at the same time.

However, we can direct further testing of the equipment by verifying the communication between the Console and the Effects.

1.5 **continue**

Is it possible to use the Effects numerical keyboard to load channels onto an Effects Master, and do those channels appear at the Console when the Effects and Manual Masters are raised?

If the answers are affirmative, we have established that basic communication exists between Console and Effects, and the Effects program is nominally running.

The next step is to verify full communication from the Console to the Effects.

1.6 **continue**

Is it possible to load the Console output onto the Effects masters using 'Load Output'? This test is most easily verified if a TV/VDU is available.

Assuming the customer has been co-operating, the fault should have been located to a unique part of the system. Further action will depend on which assembly is faulty, but, in most cases, this action will be an instruction to the customer to return the faulty assembly to the point-of-service.

Obviously, if the fault is in the Console, there is more information required before diagnosis is complete.

1.7 **continue**

Ask questions which should enable a diagnosis to be made as to which M24 sub-assembly is at fault.

Do the front panel displays change as expected in reaction to front panel operations? If so, the front panel is probably working correctly, as must be most of the motherboard.

Does the T.V. output work? The TV output is driven from the video interface card through a modulator. However the operation of the TV can be checked by connecting it to a normal aerial and tuning it to one of the broadcast stations.

Does the VDU output work? The VDU output is directly from the video interface. If it appears to be faulty, the customer should be directed to have the monitor checked locally, especially as a company other than Strand is probably responsible for that unit's maintenance.

Is the tape facility faulty? The Cassette Recorder should first be tested as a stand alone unit working on a standard audio signal. It is possible that the Recorder/Tape combination has not been adjusted to work with the M24 Console. As with the TV/VDU this unit may not have been supplied by Strand. It is important to eliminate the Recorder from the list of possible causes as its maintenance may not be the responsibility of Rank Strand.

Is the fault continuous - or does switching the system off, and on again, restore normal operation?

Did any outside action, such as switching on an arc follow spot, precede the failure?

Is the power supply at fault? If possible, the customer should check this, under your guidance.

These are only a few examples. Obviously further questions will be required depending upon the exact nature of the problem. Over the years, some obvious shortcuts to the final diagnosis will become apparent. There is always a danger that these shortcuts, when used with a new customer, will miss a vital symptom and lead to the wrong diagnosis.

Finally, having gathered all data pertinent to the fault, it should be possible to diagnose the fault to a unique sub-assembly. This diagnosis is only possible whilst the customer co-operates and provides fair and accurate answers to your questions. Do not assume that the customer always gives the right answer - double check by asking further questions.

1.8 Payment and order numbers

If site or bence repairs are required, make sure you will be paid for the work.

Three sources of payment are possible:-

1.8.1 Maintenance Contract.

If you have a maintenance contract with the customer, covering the faulty equipment, the appropriate contractual procedure must be followed.

1.8.2 Chargeable.

If the customer is to pay for the repair, he must give you an order number over the telephone before any work is commenced. A written order should then be collected at the site, or enclosed with any 'returned' units.

1.8.3 Warranty.

Strand will pay for repairs of units under warranty (see Conditions of Sale: Section 8). The supply/installation date of the equipment will have to be confirmed by quoting the number and date of the appropriate invoice. This may be taken either from your own records, or the customer's records, depending on exact circumstances. After validating warranty, Rank Strand Engineering Services Department will issue an order number; against which payment will be made. This order number must be obtained before any work is commenced.

2. The Cure

First of all the faulty equipment and the service engineer have to be in the same place. Remember that Rank Strand will not accept any charges for this part of the activity. Let the equipment come to you. After all, your point of service will be relatively clean, comfortable, and properly equipped for the job that you have to do.

Generally, the repair will be an exchange of the faulty sub-assembly, ensuring that whatever is fitted is working. A total exchange is not normally recommended as users tend to embellish (deface) the finish of the equipment, and what might suit one site might not suit another (or yourself).

The policy is to change the electronics, returning the original mechanical housing to the customer. The workspace must have sufficient bench area to hold two stripped-down units, each of which will require approximately 3 times the area of a completely assembled unit.

Other requirements in this workspace are:-

- TV/VDU: to monitor the self-test results on the motherboard, but also used to finally check the system and prove that the video output is working. Although either can be used with a M24 Console, using a TV is preferable as it will check the modulator fitted on the Video Connector Panel.
- Cassette Recorder: to prove the tape facility.
- Multiplex box: at least one to prove and test the Mux output.
- Interconnection Leads: for above, and to cross-connect the Multiplex box as described below
- Mains supply: for unit under test and equipment used in testing.

It is possible to check the M24 Mux output and Multiplex box outputs without any special test equipment other than a special lead to take advantage of the inherent remultiplex capability, whilst the box is connected to an M24 Console. The leads may either cross-connect one or two boxes. In the first case, outputs for channels 1 - 12 should be linked to the inputs for channels 13 - 24 and vice versa. In the second case, the dimmer outputs of box # 1 should be connected to the manual input of box # 2 and the dimmer outputs of # 2 to the manual input of # 1.

2.1 First find the problem

The customer has returned the 'faulty' item. It then is a matter of minutes rather than hours, to verify that it is faulty by connecting it to the rest of the system. The action will then depend on the unit affected.

2.2 Fix it

Cautions:

- (i) **M24 electronics are static sensitive. Many of the integrated circuits are fitted into sockets to facilitate easy replacement and because they may be damaged during soldering processes. These chips should be handled with care, but generally try to avoid any contact.**
- (ii) **Most of the interconnecting plugs and sockets have gold-plated contacts. Try to avoid touching any of these connections as the natural oils deposited will attract dirt leading to bad connections, and may start an electro-chemical reaction. Any contaminants must be washed off with a proprietary contact cleaning solvent without lubricant.**

Generally, the most that can be done at a point of service without specialist test equipment is to check for obvious faults such as blown fuses or broken wires, missed by the customer, and that socketted components have not fallen out. The final cure for each unit is discussed below. The dis-assembly and re-assembly procedures are detailed in Appendix 1.

- 2.2.1 Multiplex box: This unit comprises a main card and housing.
- Fit an exchange card of the same type from your own stock. It is a simple matter to change the voltage levels, but not the polarity. Remember to set the unit number to the same as the one brought in by the customer.
- 2.2.2 M24 Effects: This unit comprises two sub-assemblies, the power supply which is **not** the same as that fitted to the M24 Console, and the Effects Processor card.
- There is one further stage of point-of-service activity which is the replacement of faulty faders (as used on Tempus/AMC) and switches, if you have the items in stock.
- Execution of this level of service will require a good temperature controlled soldering iron, e.g. Weller TCP and a good desolder gun.
- Care must be taken that the through-hole-plating of the board is not damaged as a component is removed.
- 2.2.3 M24 Console: This unit normally comprises six or seven electronic sub-assemblies, the power supply which is **not** the same as that fitted to the Effects unit, the Front Panel, the Motherboard, the Video Interface, the Memory Expansion, the Video Modulator and the Wheel.
- Each of these items is mentioned separately as it is often possible to identify the faulty sub-assembly from the symptoms. The first stage of the procedure is to invoke the self-test package as a diagnostic aid if the Console is basically operative.
- The self-test operating instructions and results are described in Appendix 2.
- 2.2.3.1 Power Supply: supplies DC power +5V, +15V, -15V to the system. The +15V, -15V are derived from linear regulators and the +5V from a switching regulator
- The only checks on this unit are to measure the voltages with the rest of the electronics connected and all should be within 5% of their nominal value.
- 2.2.3.2 Front Panel: has its power supplied through its connection to the Motherboard.
- Its function is to scan the pushes and the Wheel and pass that information to the Motherboard. The Motherboard replies with mimic information which is processed by the Front Panel to drive the indicators.
- In self-test the Front Panel does not rely on any information from the Motherboard except for test A3 (refer Appendix 2)

2.2.3.3 Wheel: derives power from the Front Panel. Faults such as a slow count, or not counting in one direction, may be either the Wheel or the Front Panel. Faults such as a bad count in certain quadrants of the wheel only are likely to be the wheel.

2.2.3.4 Motherboard: this processes data from the Front Panel, interfaces the Tape and Multiplex Output, drives the Video Interface and generally controls the system.

If the Power Supply and Front Panel appear to be working correctly, then the Motherboard is the unit most likely to be faulty.

However, there are two faults which may be difficult to diagnose. These are the communication with the Front Panel and the Video Interface. Where this communication is suspect, the repair might require more than one sub-assembly to be changed. The order of exchange should be according to the stripdown procedure. Ref Appendix 1.

If the first item to be replaced does not clear the fault, refit that item before changing the second.

The faders mounted on the Front Panel are interfaced by the Motherboard directly.

2.2.3.5 Video Interface: this is driven by the Motherboard to produce a video output suitable for a Monitor.

A fault affecting this sub-assembly could be either itself or the Motherboard.

2.2.3.6 Video Connection Panel: provides a connection point for the video output to a Monitor and contains the UHF or VHF modulator to drive a television.

Apart from a bad connection, a fault on this sub-assembly will almost certainly affect the television output only.

2.2.3.7 Memory Expansion: this is only fitted to systems with a channel capacity greater than 72. It carries the additional memory required to enable larger systems to operate.

A fault may only affect high numbered memories, or may automatically reduce the channel capacity to 72.

After identifying the faulty sub-assembly, which could take more than one attempt, fit the replacement unit and re-assemble the equipment. Re-test the equipment and return it to the customer.

2.2.4 General Rules for Sub-Assembly Replacement

- a. Always disconnect the mains power before attempting any replacements.
- b. Obtain enough information to make a diagnosis before changing units.
 - Do not swap parts on "we'll get it right sooner or later" basis.
- c. If a replacement has cured the fault, it may be worth proving that the original will reproduce the fault, by refitting it.
- d. Ensure that replacement units are properly fitted - all connections are tight, screws are tight.
- e. If adjustment points are fitted to replacement units, ensure that these are set up correctly.
- f. Always ensure that the system configuration (option switches) is correct before despatching equipment to a customer.

Refer to section 2.5 of the M24 Commissioning Procedure for adjustment and configuration instructions.

3. Conclusion

During the opening stages of each job the status is determined. If the customer is claiming warranty, this must be validated by Strand before the repair, and Strand will issue an order number to cover your work as is normal procedure.

At the same time or if an exchange unit has to be supplied, Strand will issue a 'Returns' number which is used to identify the equipment you are likely to return to Engineering Service. This 'Returns' number must be shown on the equipment being returned to Strand.

Once Strand have been advised on a pending requirement, an exchange system will be reserved against that job for seven days only.

When Strand are advised of the faulty assembly, a replacement will be despatched within 4 working hours by the most expedient method (probably Securicor).

During these exchanges, serial numbers play an important role. These numbers are used to trace the production of every piece of M24 and to assist warranty validation.

Therefore, it is important for Strand to know the serial number of the exchange unit fitted to the customer's equipment.

The following procedures describe the method of reducing a complete unit to its component sub-assemblies. The procedure to rebuild each unit is the reverse of the method of reduction.

Apart from a clean workspace, surface area approximately 1m by 2m with a clear surface, the only tools required to work on the equipment are:-

Nos 1 & 2 Pozidriver
4.5 mm Screwdriver
M3 Nutdriver
Flat nose Pliers

Obviously, for component level maintenance at the most basic level, additional tools would be required.

A1.1

General Notes

A1.1.1

Screws/Nuts/Washers:

All sizes used in M24 are metric and thread sizes are either M3 or M4.

Screws are black, pan head, pozidrive, length as shown below. In some cases taptite (thread forming) screws are used to reduce assembly time. Thread types and lengths should not be confused, as this may damage the equipment.

Washers are identified as either S for Shakeproof or P for Plain.

A1.1.2

Internal Connections:

The majority of internal connections are made using "Molex" connectors (the little rectangular brown housings). Leads should be disconnected by pulling on the housing, not the lead.

A1.1.3

Re-assembly:

During re-assembly a number of LEDs and fader operating arms & switch knobs/spindle have to be fitted through the panel.

Excessive force could bend or break these items. If the panel does not fit, re-check the alignment.

A1.2

Console

(i)

Disconnect all leads: Mains input, Mux output, Cassette, TV/VDU. Remove the knobs from the Master and Playback faders. Clip the top cover onto the console to protect the front panel. Turn the unit over, to rest on its top cover, with the rear extrusion towards the front.

(ii)

Remove the 8 retaining screws on the perimeter of the base cover and lift the cover off the unit, standing it on its left-hand end.

Disconnect the two earth continuity wires from the earth stud on the power supply assembly.

Disconnect the DC power cable to the Motherboard. Move the base cover out of the way.

- (iii) Disconnect the internal cables from the rear panels to the Motherboard-Mux Output to PL4, Cassette to PL1 and the Video Modulator to the Video Interface. Remove the retaining screws and remove the Mux/Cassette panel and the Video Modulator.
- (iv) Undo the Video Interface retaining screw, open the card retaining clip and remove the Video Interface Card.
- (v) Remove the Memory Expansion Card in the same manner.
- (vi) Disconnect the interconnecting cable from the Motherboard to the Front Panel.

To remove the Motherboard, starting in one corner ease the PCB retaining clip away from the card and lift the card sufficiently to prevent the clip returning. When all the clips are released, lift the Motherboard out of the Console. Ensure that the Motherboard does not rest on any conductive material, as it incorporates a 3V battery to maintain lighting information in the onboard RAM.

- (vii) Remove the 6 retaining screws from the Front Panel ensuring that the pillars and washers, from the screws which would have been obscured by the Motherboard, are not lost.

Lift the Front Panel card on the left hand side and unplug the Record Lock Keyswitch - PL3 and then on the right-hand side to unplug the Wheel -SK1. The card may now be removed.

- (viii) Finally, undo the 2 nuts retaining the Wheel, which also have shakeproof washers fitted, and remove the Wheel. If you wish to carry on, remove the Record Keyswitch next.
- (ix) If you have gone this far, you should have the following subassemblies and fixings (assuming nobody has previously lost some of the bits) in your workspace:-

M24 Console Housing and Front Cover

Bottom Cover, with Power Supply, 8 screws M4x8 & washers M4S

Mux/Cassette Connector Panel, 2 screws M3x6 & washers M3S

Video Modulator/Connector Panel, 2 screws M3x6 & washers M3S

Video Interface, no loose screws or washers

Memory Expansion, no loose screws or washers.

Motherboard

Front Panel Card, 5 long screws M3x16, 1 short screw M3x8, 5 collars M3 clearance x 10 & 6 washers M3S

Wheel, 2 full nuts M3 & washers M3S

Keyswitch (if you went that far)

4 Fader knobs

To take the Motherboard and Front Panel Card out as one unit, omit step (vi).

A1.3 Multiplex Box

- i) Disconnect all leads: Mains input, Mux input, Mux output, Manual input(s), Dimmer output(s).
- ii) Remove the 4 screws and washers fixing the top cover, lift it off, detach the earth lead, and put the cover to one side.
- iiia) Cannon connectors - remove the Mux link lead to PL1.
- iiib) Bleecon connectors - remove the Mux link lead to PL1, remove the input/output leads

Channels	Input	Output
1 - 6	PL3	PL10
7 - 12	PL4	PL9
13 - 18	PL5	PL8
19 - 24	PL6	PL7

- iv) Remove the seven retaining screws and washers from the MUX/DEMUX card.
Disconnect the mains wiring to PL11

	110/120V	220/240V
PL11/ 1	E	E
3	N	N
5	Link to 9	Linked to 7 (leave connected)
7	Link to 3	Linked to 5 (leave connected)
9	L	L

Finally remove the card, taking care that the Leads and connectors do not foul on the housing.

- v) Once again we find a little heap of pieces that used to be a Multiplex box, and assuming that all the pieces were there to start with, that heap should contain the following:-

Housing

Top Cover, 4 screws M4 x 10 & washers M4S

MUX/DEMUX Card, 7 screws M3x8 & washers M3S

A1.4 M24 Effects

- i) Disconnect all leads: Mains input, Mux input, Mux output, Audio input. Remove the knobs from the faders and the rotary controls. Clip the cover on to the unit to protect the front panel. Turn the unit over, to rest on its cover, with the front extrusion towards the front.
- ii) Remove the 8 retaining screws (2 of which fix the outer front rubber feet) on the perimeter of the base cover and lift it clear of the unit.

Disconnect the earth continuity wire from the earth tag on the base cover.

Disconnect the DC power cable to the FX Processor Card.

Lay the base cover, bottom side down, on the work surface alongside the unit housing.

iii) Disconnect the internal cables from the rear panel to the FX Processor Card -Mux Input to PL2 and Mux Output to PL3.

iv) Remove the 8 FX Processor Card retaining screws (but not the 22 used for the faders)

Remove the bottom 2 rear extrusion fixing screws (remember that they are the two furthest away from the work surface) and slacken the top 2 rear extrusion fixing screws.

Tilt the rear extrusion such that the bottom edge is outside the line of the housing and remove the FX processor Card.

v) At this point, your kit form unit should be in the following pieces, assuming yet again that nothing was missing when you started.

M24 FX Housing, Front Cover

Bottom Cover, including Power Supply, 6 screws M3 taptite x 6, 2 screws M3 taptite x 12, 6 washers M3S, 2 washers M3P, 2 small rubber feet.

FX Processor Card, 8 screws M3x8 & washers M3S

Rear extrusion fixings - 2 screws M4 taptite x 12 & washers M4S

9 Fader Knobs

7 Round Knobs	1 large red	- Chase Length
	1 small red	- Audio Mid
	2 green	- Rate
	2 blue	- Mark/Space, Audio Bass
	1 yellow	- Audio Treble

Self Tests

Self Test is a facility which can assist a service technician/engineer or even a user to diagnose a faulty sub-assembly within the equipment. Wherever possible, error reporting is comprehensive and could point directly to the offending item.

However, these 'self tests' use the same hardware as the equipment and their program is contained within the same software storage as the normal equipment operating system (the program to control lights on stage)

Thus, if the fault is at all significant, e.g. a dead power supply, neither the ordinary program nor the test program will run, and consequently there will be no self-test information.

Self Test

A2.1

Console

Self test runs a two levels, the first is very simple and is invoked every time the system is turned on, the second must be instigated by operating the hidden switch through the small hole in the front panel (with a non-conductive object).

A2.1.1

Power-up:

As the Console powers up it runs a very simple sequence of tests on the memory, program, analogue (Mux) interface and tape interface.

Assuming that the unit has not developed any quirks or failed any of the tests, the result will be that the system powers up as expected:-

On the front panel the only "LED" illuminated will be that above the Channel push.

On the VDU/TV, the top line of the display will include the legend below for approximately 3 seconds.

TEMPUS M24 VERSION B1 SELF-TEST O.K.

The system may also restore the lighting state which was present when it was turned off, latch playback modes, select Memory 1, and/or start a fade, depending on how the configuration switches are set.

The Mux output should conform with the displayed channel levels.

If the unit has developed a fault which can be found by the simple tests, the error number will be displayed in the front panel Channel/Memory Number display (until Clear is pressed), and the description will be displayed on the VDU in place of 'SELF-TEST O.K.' (until "SHIFT" is pressed).

The errors are:-

NO PANEL RESPONSE:

The interface circuit to the Front Panel (on the Motherboard) is faulty, or the Front Panel is unplugged, or is faulty.

E1 MEMORY FAULT:

The Motherboard RAM is faulty.

E2 PROGRAM CHECKSUM ERROR:

One, or more, of the Program PROMs is faulty.

E3 ANALOG INTERFACE FAULT:

The Analog Interface on the Motherboard is faulty.

E4 TAPE INTERFACE FAULT:

The Tape Interface on the Motherboard is faulty.

E5 INSUFFICIENT MEMORY:

The Memory Expansion card is selected on the configuration switches, but is not fitted, or is faulty.

A2.1.2 "Instigated":

This package is considerably more comprehensive than that described above and runs under front panel control thus allowing a particular sub-test to be selected and repeated, and runs in two parts as described below.

A2.1.2.1 Front Panel:

This sequence of sub-tests is designed to test the front panel and basic communication with the Motherboard. These tests are sufficiently independent that the sequence will run even if the Motherboard is dead.

As the whole sequence of self-test is called up, Test 1 will automatically start (assuming as for all following statements, in this section and the next, that the equipment is basically working correctly).

CLEAR will cancel the current test
 +1 will select the sequentially next test
 The test number will select that test.

Test 1 - Mimics- causes all the LED mimics and all segments of the displays, to flash on and off, at about 2Hz.

Test 2 - Contacts- a unique number for each contact is displayed in both the "Active Memory" and the "Channel/Memory" display windows as the contact is made (the numbers are below) During this test Clear must be pressed twice, as its number is displayed on the first operation.

The wheel movement is displayed as a rolling-over count in the "Level" window.

The contact numbers are:-

Number	Contact	Number	Contact	Number	Contact
00	0	12	.	23	Return
01	1	13	F	24	Fade
02	2	14	Clear	25	Sequence
03	3	15	+1	26	Manual
04	4	16	Memory	27	Use Time
05	5	17	Cue	28	Blackout
06	6	18	Channel	29	Record Blind
07	7	19	Shift	30	Record Total
08	8	20	Link	31	Record Enable
09	9	21	Thru	32	Flash Out
10	+	22	@	33	Flash Full
11	-				

Test 3 - Communication - checks basic communication between the Front Panel and the Motherboard, and should result in a count in the Active Memory and Channel/Memory displays incrementing at approximately 1 Hz

Test 4 - Program Checksum - if the Checksum is OK the two displays will show 0.

The term "Program Checksum" refers to a simple mathematical routine which adds the contents of each location in the PROMs into an accumulator.

When the addition is completed, the result (sum) should be equal to a validation (check) figure held within the same PROM and should be the same. If the result is not equal, an error is indicated and means that one, or more, location is wrong. Depending on which location is wrong, the program will not run correctly and may result in a system crash or an unexpected reaction to a button operation.

Test 5 - enters the second series of tests applicable to the Motherboard and Video Interface.

A2.1.2.2 Motherboard/Video Interface:

This sequence of sub-tests is designed to test the Motherboard and Video Interface. All sub-tests are selected on the Front Panel by the test number followed by +1. In some cases a further +1 will select a sub-sub-test.

The sub-test number is shown in the Channel/Memory display. Any current error number is shown in the Active Memory display, and in certain tests the pass count is shown in the level display.

Certain tests produce error reports on the VDU which all take the same format.

ERROR SUBTEST ADDRESS GOOD DATA BAD DATA

The error numbers are described under each sub-test heading, however, the data displayed can sometimes be misleading and figures shown are for guidance only.

If the screen should fill up with error messages, the test will pause and a further message is displayed advising the operator to press +1, and the 'TAPE' LED on the front panel will flash.

When +1 is pressed, the test continues and the 'TAPE' LED is extinguished.

As this sequence of tests is entered, and between running each subtest, the VDU/TV will display a menu of available sub-tests.

M24 SYSTEM TESTS

1. VDU TEST (A)
2. VDU TEST (B)
3. MASTER & TIME FADERS
4. TAPE INTERFACE
5. PROGRAM CHECKSUM
6. CUE STORE (CLEARS MEMORY!)
7. ANALOG INTERFACE (FLASHES LIGHTS!)

TO RESUME NORMAL OPERATION, TURN SYSTEM OFF AND ON AGAIN.

ENTER TEST NUMBER FOLLOWED BY +1.

Each test is described below:-

Test 1 - VDU TEST (A) - This test writes all possible characters to the display and will indicate as 25 lines, the 1st and 5th etc bright, 2nd and 6th etc blinking, 3rd and 7th etc. reverse, 4th and 8th etc. dim.

The characters that should be displayed are:-

@ABCDEFGHIJKLMN OPQRSTUVWXYZ _ !"#%&'()*+,-. / 0123456789 ;: = ?

A further +1 will cause the same character to be displayed for every screen location starting with @ and working thru the sequence to ?. The first sequence in bright, next blinking, next reverse, next dim, next bright etc.

There are no pass or error numbers associated with this test.

Test 2 - VDU TEST (B) - This test initially writes the same information as Test 1, but starting in the bottom right hand corner of the screen, and working backwards.

A further +1 will cause the same data to be re-written with a different starting point, working from the top left hand corner each time.

Test 3 - MASTER & TIME FADERS - although the faders are mounted on the Front Panel Card, as analogue controls they are outside the capability of the front panel processor. Also, as the Motherboard includes analogue circuits for the Mux Input/Output, it can easily process the 4 faders.

The test performs a simple analogue to digital conversion for each fader and displays the result on the video display in percent where 100% indicates as F

The result of each conversion is shown in the front panel Level display. Initially the level from the Manual Fader is shown. +1 rotates the selection through each of the faders in turn.

Test 4 -

TAPE INTERFACE - this test uses an internal loop to check the tape interface (except for a couple of resistors, one capacitor and the wiring to the Tape Connector).

The test is to write an ascending data pattern to the tape output register and check that the same data is received in the tape input register (both of which are electronically connected for the duration of the test).

Successful passes are shown on the video display and in the Level display by an ascending count.

The possible errors are:-

- | | | | |
|----|----------------|---|----------------------|
| 41 | Output timeout | | |
| | ADDRESS | = | 8006 |
| | GOOD DATA | = | 00 |
| | BAD DATA | = | tape status register |
| 42 | Input timeout | | |
| | ADDRESS | = | 8006 |
| | GOOD DATA | = | 00 |
| | BAD DATA | = | tape status register |
| 43 | Status Error | | |
| | ADDRESS | = | 8006 |
| | GOOD DATA | = | 00 |
| | BAD DATA | = | tape status register |
| 44 | Data Error | | |
| | ADDRESS | = | 8007 |
| | GOOD DATA | = | Output Data |
| | BAD DATA | = | Input Data |

Any error reporting indicates a Motherboard fault.

Test 5 -

PROGRAM CHECKSUM - this checks the 3 PROMs on the Motherboard.

Successful passes are shown on the video display and in the level display by an ascending count.

The possible errors are:-

- 51 Error on 1st PROM
- 52 Error on 2nd PROM
- 53 Error on 3rd PROM

In all cases the rest of the error reporting is the same

- | | | |
|-----------|---|-------------------|
| ADDRESS | = | E000 |
| | | A000 |
| | | C000 |
| GOOD DATA | = | Expected Checksum |
| BAD DATA | = | Actual Checksum |

Test 6 - CUE STORE - This test will leave the memory totally cleared, including all recorded lighting states, except for the output lighting state at the time the test was started - that is why it says CLEARS MEMORY!

The test writes a sequence of data to the memory and then verifies that the same data can be read back.

Before the unit is turned off, the sub-test must be stopped by Clear and the video display allowed to revert to the Menu. Otherwise the memory may not be clear but full of random information.

Successful passes are shown on the video display and in the Level display by an ascending count.

The possible errors are:-

- 60 attempt to test the memory with the record keyswitch in the lock position - also displays 'CUE STORE LOCKED!!'
- 61 error on simple write/verify of entire memory
- 62 error on simple pattern test
- 63 address error
- 64 data error
- 65 error on complex pattern test
- 66 error on immediate write/verify
- 66 SUBTEST 6 failure of memory write protect circuitry.
- 69 Memory Expansion card selected but not accessible - also displays 'INSUFFICIENT MEMORY FITTED'

The rest of the error reporting is the same

ADDRESS	=	failing location
GOOD DATA	=	data written to memory
BAD DATA	=	data read from memory

Addresses 0000 - 3FFF correspond to Motherboard RAM

Addresses 4000 - 7FFF correspond to Expansion RAM

Test 7 - ANALOG INTERFACE - This test checks that the clean 0V, used for the MUX output, and the MUX output are correct. The MUX output levels for out and full are first asserted and the result is fed to an analogue to digital convertor to verify that they are correct.

If the output circuit passes these tests, an incrementing ramp is asserted on the output and this is verified. However, the high level of adjustment available for the MUX signal precludes any test for absolute results, instead it checks that the ramp is increasing.

Because the sync signals are inserted during this process, Multiplex boxes connected to the M24 will assume that the signal is correct. This will light the MUX OK Led and cause box # 0 to generate dimmer outputs -hence the caution

FLASHES LIGHTS!

Successful passes are shown on the video display and in the level display by an ascending count.

The possible errors are:-

In all cases:-

- | | | | |
|----|--|---|-------------------------------|
| | ADDRESS | = | 800A |
| | BAD DATA | = | data read from A/D converter |
| 71 | Clean 0V level too high | | |
| | GOOD DATA | = | 00 |
| | the bad data will probably indicate either a bit permanently set by the A/D convertor or an illegal offset. | | |
| 72 | Mux output low at full | | |
| | GOOD DATA | = | FF |
| | the lower limit of acceptance for bad data is C0 (hexadecimal) or 75% to allow for the range of adjustment, any error would probably indicate a faulty D/A convertor | | |
| 73 | Mux output high at zero | | |
| | GOOD DATA | = | 00 |
| | as above but the upper limit is approximately 40 (hexadecimal) or 25% | | |
| 74 | Analogue ramp failure | | |
| | GOOD DATA | = | data written to D/A convertor |
| | acceptable tolerances are +/- 25% or 40 (hexadecimal) | | |
| 75 | Sync level too high | | |
| | GOOD DATA | = | 00 |

General:

As successful completion of the Memory test will leave that memory cleared, it is worthwhile attempting a transfer of the data to tape before the test is invoked.

While the Front Panel tests are in progress, any fades running will continue, as will Auto Sequence, as these are controlled by the Motherboard.

Normal operation is resumed when the system is reset, which can be achieved by turning its power off and on.

A2.2

Effects

As the M24 FX unit exits reset, it checks itself, in a similar fashion to the Console power up tests.

The tests run are on the program checksum and the memory.

If the unit successfully passes the test it will sequentially display the following text:

POWERUP OK

If either of the tests fails, the unit will attempt to work, but will display either of the following messages:-

PROM FAIL - if the checksum is incorrect

DATA FAIL - if the memory data is incorrect (this message might appear if the system had been turned off for a period in excess of its memory retention period)

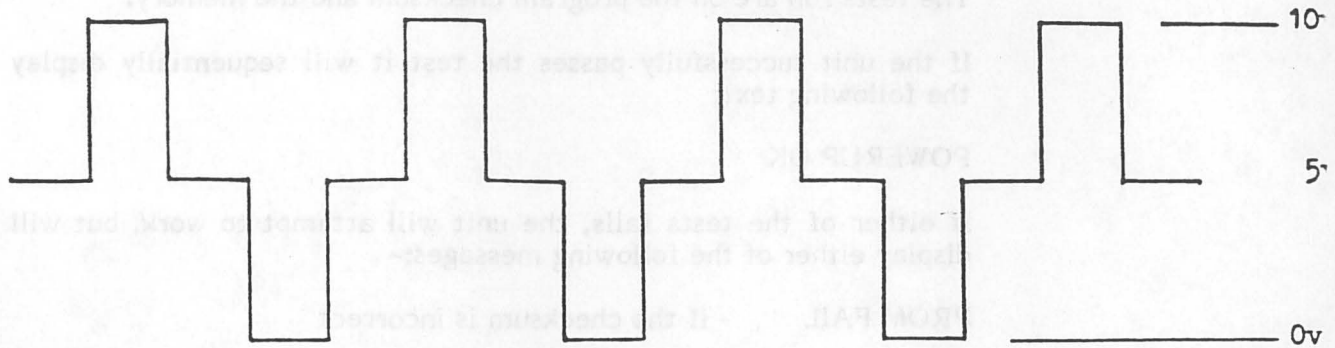
A2.3

Multiplex Boxes

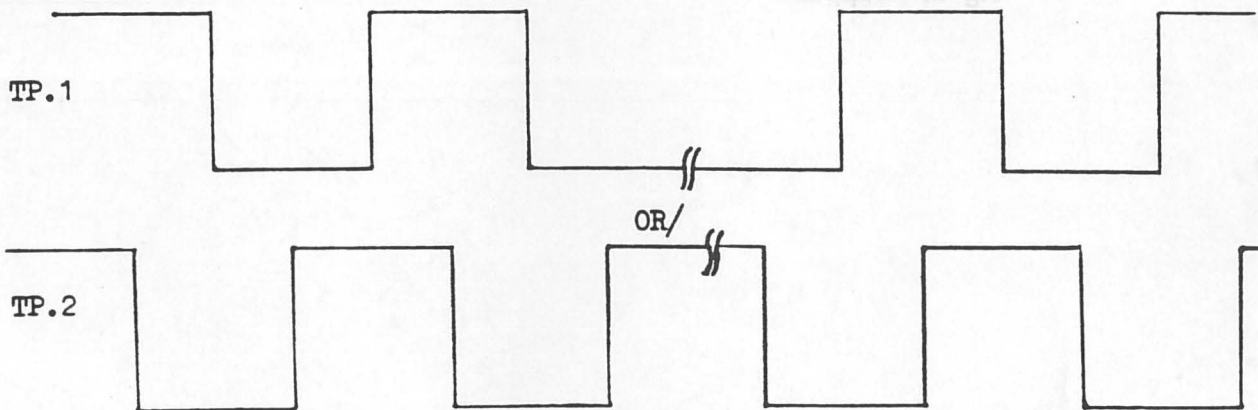
As the boxes do not incorporate a microprocessor, they cannot attempt to run any form of self-test. But they do check for the MUX input signal, which, if present, will cause the MUX OK LED to illuminate.

Each unit will also, individually and independently, pass its own manual inputs, to its own dimmer outputs, should the MUX input signal disappear.

Figure 2.5.4 Wheel Adjustment Waveforms.



If waveform with TP.1 voltage added to TP.2 voltage is not as shown above then check that individual waveforms from the test points are as shown below.



The exact phase relationship between the two sensor outputs depends on the direction of wheel movement, but a 'quadrature' phasing will always be observed if the wheel is set up correctly.

Each sensor gain must be set such that the output waveform has a unity mark:space ratio.