Lane Hardware Manual

Introduction

The Computer Score DVS Hardware Model is the fourth generation of Tenpin Bowling Scoring Equipment developed by Computer Score. The system that has been created around this hardware therefore represents the result of ten years experience in producing and servicing Scoring Systems. DVS stands for Display, Video and Scoring, these are the main functions performed by the major piece of custom designed hardware in the system.

The following design principles were used to create the system.

1.   Safety

Please refer to the following Section Safety Precautions.

2.   Simplicity, Reliability, Ease of installation and Servicing.

These four principles relate to each other. Eliminating unnecessary complications to the hardware configuration results in a system that is easy to install and Service as well as improving reliability. An intelligent mix of industry standard and custom designed hardware results in a system that is tailored for bowling combining the flexibility of readily available diagnostic tools without an awkward configuration. All inputs in the lane hardware are Transient Absorber (Transorb) and Ferrite Bead Protected to reduce the possibility of damage to the electronics due to electrical fluctuations. Use of reliable, solid mountings and connectors with consideration to vibration and dirt, results in improved reliability.

3.   Performance.

A 32bit protected mode Processor, PCI (peripheral component interconnect) Video controller, Hardware Animation Overlay, 10Mbit Ethernet Networking and Solid State Flash Technology results in a system capable of impressive performance.

The Computer Score system has been designed to divide the hardware into separate logical modules in order to simplify Troubleshooting and Maintenance. In most occasions it should be obvious in which module the problems lies. These modules do however relate to each other and therefore can sometimes require some testing to determine which is at fault.

A general guiding principle is to trial the suspected faulty module in another known good pair in order to establish that the problem follows the suspect module. Once it has been definitely established that the module is faulty, it can be returned to a Computer Score Agent for service.

Hardware Overview

There are six electronics subsystems for each pair of lanes. These are,

1.	**DVS Chassis**	:- Located in the Display Units.
2.	**SVGA display monitor**	:- Located in the Display Units.
3.	**Keyboard module**	:- Located in front of the Players Area.
4.	**Machine Interface module**	:- Located on the Curtain Wall.
5.	**Lane Scoring Camera**	:- Located on the middle capping 4.01m from the end of the flat gutter.
6.	**Ball Speed Sensor**	:- Located just in front of the Lane Scoring Camera

+12VDC Power Cable (Shielded Twisted Pair)

GND Blue +12VDC White

At Lane Capping

At Curtain Wall

At Display Unit

4. N/C   3. Frame GND (Shield)
2. GND (Blue)   1. +12VDC (White)

Rear View
Molex Mini-Fit Jr.
4 Pin

4. N/C   3. Frame GND (Shield)
2. GND (Blue)   1. +12VDC (White)

Rear View
Molex Mini-Fit Jr.
4 Pin

Keyboard/Machine Interface Cable (CO-890 shielded 2xpair)

6. N/C
7. GND (n/c)
8. Frame GND (Shield)
9. +12VDC (n/c)

1. TX (Red)
2. #TX (Green)
3. N/C
4. RX (White)
5. #RX (Black)

Rear View
DB9 Female

At Curtain Wall

At Display Unit

1. RX (Red)
2. #RX (Green)
3. N/C
4. TX (White)
5. #TX (Black)

6. N/C
7. GND (n/c)
8. Frame GND (Shield)
9. +12VDC (n/c)

Rear View
DB9 Male

BNC Male

Lane Scoring Camera Video Cable (RG-59 Coax)

At Display Unit

At Lane Capping

Ball Speed Sensing Cable (2xpair)

(Optional)

9. Even Lane (Blue)   3. Odd Lane (Red)
7. GND (Black)   1. +12VDC (White)

Molex M1625-9

At Lane Capping

8 7 6
Link Together

5. +12VDC (White)
1. GND (Black)
2. Even Lane (Blue)
3. Odd Lane (Red)
4. N/C

Rear View
Molex Mini-Fit Jr.
8 Pin   At Curtain Wall

Keyboard Cable (CO-890 shielded 2xpair)

1. RX (Red)
2. #RX (Green)
3. N/C
4. N/C
5. N/C

6. N/C
7. GND (Black)
8. Frame GND (Shield)
9. +12VDC (White)

Rear View
DB9 Male

At Curtain Wall

Shield Not Connected

1. N/C
2. #TX (Green)
3. TX (Red)
4. GND (Black)
5. +12VDC (White)

Molex KK
5 pin
At Keyboard Module

In Ceiling above Display Unit

BNC Tee Piece

At VCR Video Out

VCR Video Cable (RG-59 Coax)

75Ohm Terminator

At Display Unit

Last Display Unit

Network Cable Coax Ethernet (RG-58)

50 Ohm Terminator   Main Computer

At Display Unit

50 Ohm Terminator
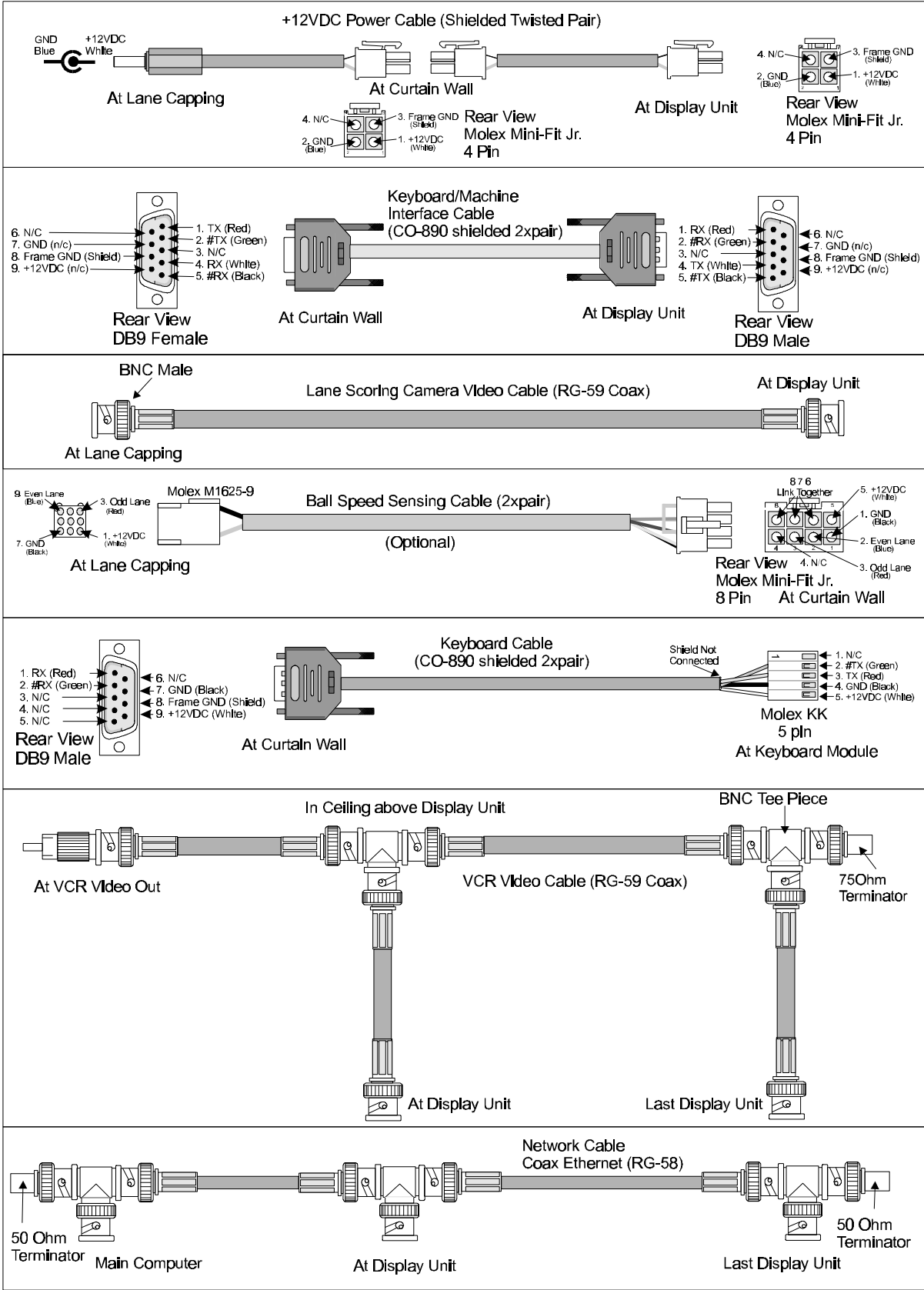Last Display Unit

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figure 1   System Cables.

DVS Chassis.

The DVS Chassis is a self-contained enclosure mounted in the Display units. Access can be gained by opening the access door in the rear of the display units, between the two SVGA display monitors. This chassis is responsible for communicating with the Front Office Computer, Keyboard and Machine Interface Modules, Displaying the Lane Score Grids, Displaying Video and Determining the Score based on the input from the Lane Scoring Camera. It is designed so that the only service to be performed by the center technician on the DVS Chassis is to replace it with a spare if necessary. All other service to the electronics inside the chassis is to be done by an authorised Computer Score agent only.

The DVS chassis is the main lane electronics and therefore has a central role in the operation of the lane pair. The chassis enclosure is a 4-slot MicroBOX Industrial Personal Computer Chassis. It contains its own 65W switch mode power supply (85-132VAC or 180-264VAC 50/60Hz) and Expansion Slots. The chassis receives its input power from the outlet located below it in the Display Unit. There is an On/Off switch on the chassis which turns the power off to the electronics. THIS SWITCH DOES NOT TURN OFF THE POWER TO THE SVGA MONITORS IN THE DISPLAY UNIT (refer following section Safety Precautions). The rear of the DVS Chassis has a number of input and output connectors (see figure 2).

The DVS Chassis integrated switch mode power supply produces the +12VDC used by the DVS electronics, the Machine Interface Module, the Lane Scoring Camera and the Keyboard Module. The +12VDC is protected by a 750mA resettable fuse and Transient Absorber. Switching the DVS chassis Off at the Power Switch on the chassis will turn off all lane hardware modules except the SVGA monitors. The DVS chassis has a DC fan inside which is used to cool the electronics and repel dust. If this fan is not operating the DVS Chassis has either not receiving input power from the outlet, is switched off or needs service by a Computer Score Agent.

Checking the +12VDC system voltage
1. Open the display unit rear access panel.
2. Turn the DVS chassis off at its power switch.
3. Remove the connection to +12VDC Power Connector. (see figure 2)
4. Turn the DVS chassis on and check with a multimeter +12VDC from pin 2 to pin 1.
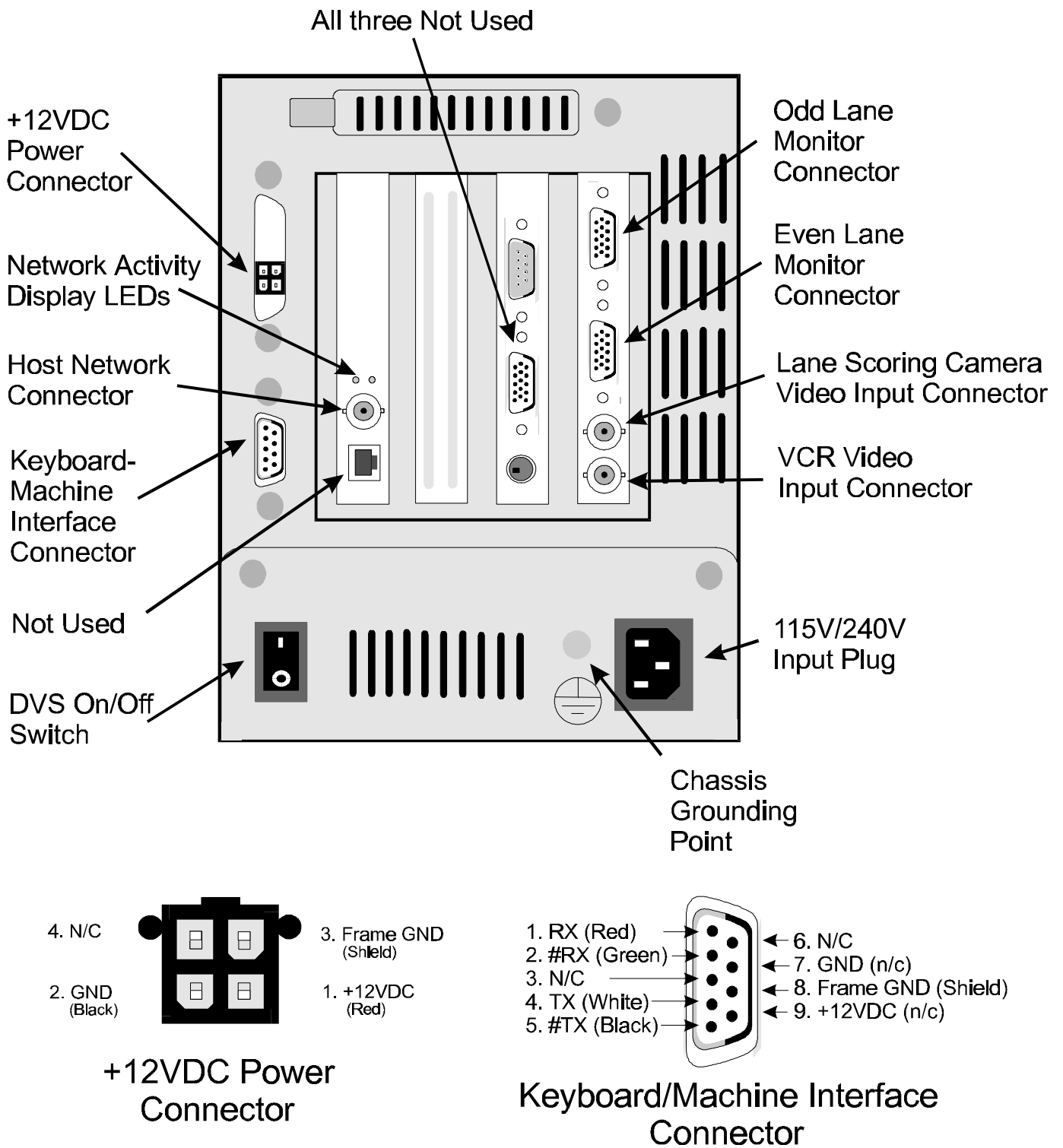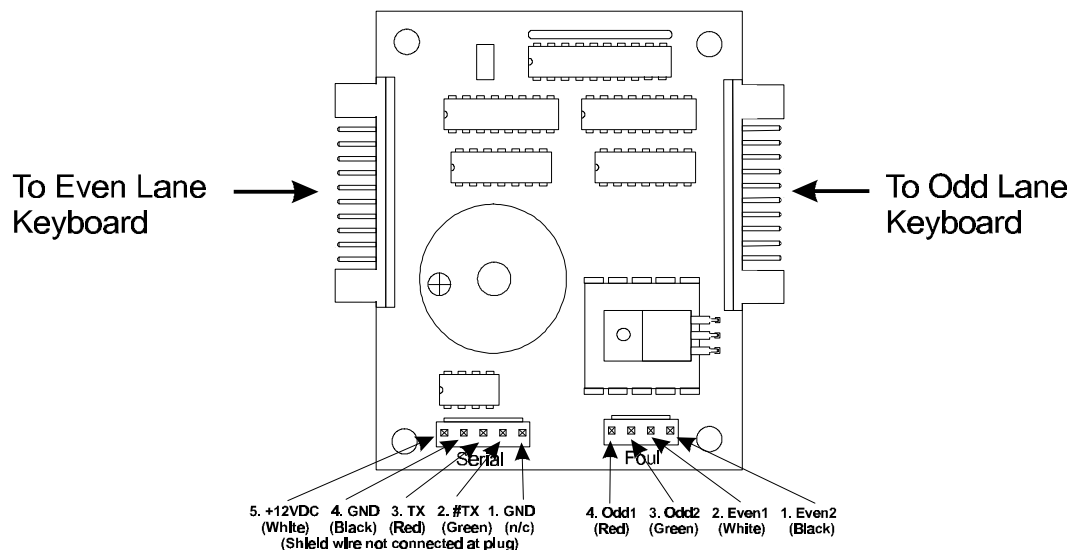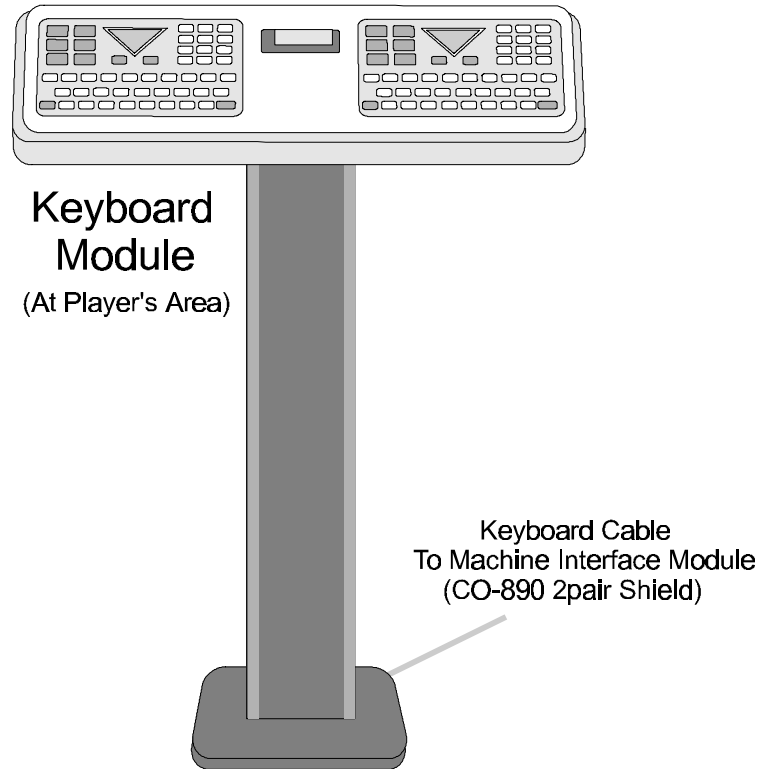5. Turn the DVS chassis off , reconnect the +12VDC Power Connector.

All three Not Used

+12VDC Power Connector

Network Activity Display LEDs

Host Network Connector

Keyboard-Machine Interface Connector

Not Used

DVS On/Off Switch

Odd Lane Monitor Connector

Even Lane Monitor Connector

Lane Scoring Camera Video Input Connector

VCR Video Input Connector

115V/240V Input Plug

Chassis Grounding Point

+12VDC Power Connector

4. N/C

2. GND (Black)

3. Frame GND (Shield)

1. +12VDC (Red)

Keyboard/Machine Interface Connector

1. RX (Red)
2. #RX (Green)
3. N/C
4. TX (White)
5. #TX (Black)

6. N/C
7. GND (n/c)
8. Frame GND (Shield)
9. +12VDC (n/c)

figure 2.   Rear of DVS Chassis

SVGA Display Monitors

The two SVGA Display Monitors located in the Display Unit at each lane are either Wells Gardner Model 27K3003 or Nanao MS-2931A. They have a industry standard superVGA input which is connected to the DVS Chassis (see figure 2). They receive the same signal that travel between a standard Computer & Monitor. They have a 90-260VAC 50/60Hz voltage input and are connected to the Outlet located under the DVS Chassis inside the centre access door in the rear of the Display Units. There are a number of adjustments on the SVGA monitors that allow the scoring grids to be widened, positioned within the screen and brightened, Refer to manufacturers Service and Safety Instructions for more details relating to monitor adjustments. The monitors are a high voltage device and as such should only be serviced by Authorised Personnel. They are accessed via an individual cover at the rear of the Display Unit, which should never be removed with the monitors operating (refer following section Safety Precautions).

Keyboard Module

The keyboard module is located in the players area behind the ball return. The keyboard receives Power and sends keystrokes via one cable from the Machine Interface Module (see figures 1&3). Each lane has a separate membrane keyboard for bowler input. The membrane keyboard consists of a four layer sandwich. The top layer is screen printed lexan used to display the different keys. The other three layers are bonded together to form a matrix of switches that are connected to the Keyboard Printed Circuit Board (PCB). The Keyboard PCB detects the pressing of key and transmits the appropriate information to the Machine Interface Module which in turn transmits this to the DVS Chassis.

Brunswick Fouls which have a voltage free contact output can be connected to the Keyboard PCB for foul detection in the system.

Keyboard
Module
(At Player's Area)

Keyboard Cable
To Machine Interface Module
(CO-890 2pair Shield)

To Even Lane Keyboard

To Odd Lane Keyboard

Serial

Foul

5. +12VDC 4. GND 3. TX 2. #TX 1. GND
(White)   (Black) (Red) (Green) (n/c)
(Shield wire not connected at plug)

4. Odd1 3. Odd2 2. Even1 1. Even2
(Red)   (Green) (White)   (Black)

Machine Interface Connector   Foul Connector

figure 3 Keyboard PCB and Pinouts

The Keyboard Printed Circuit Board (PCB) has a piezo-electric buzzer which beeps when a key is pressed on either lane and will give a long tone followed by a two short tones when the +12VDC power is first applied from the DVS chassis. If a key is locked down by a fault in one of the membrane keyboards, the keyboard will indicate another short tone (4 beeps at start up).
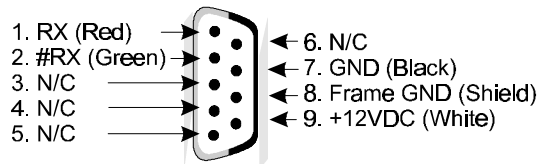
Machine Interface Module

The Machine Interface Module is located at the machines behind the Curtain Wall. This component is designed to interface to the Pinsetter/Pinspotters for Machine Start, Tenth Frame (& No-Tap) Cycle, AMF style foul input and Ball Detection (if fitted). Each of these inputs and outputs have an indicating LED as shown in figure 4b. There is also a relay contact pair available for either Strike cycle or Bumper Bowling. The Machine Interface Module inputs, outputs and power are all low voltage. The Machine Interface Module is not to be connect to or near high voltage.

To DVS
Chassis

Lane Scoring Camera Video Cable (RG-59)

+12VDC Power Cable (Shielded Twisted Pair)

Keyboard/Machine Interface Cable
(CO-890 - 2 pair shielded)

Ball Speed Sensor Cable (Optional)
(2xTwisted Pair)

Machine Interface Module
(located at Curtain Wall)

Even Lane
Start Contacts
Cycle Contacts
Strike Contacts
Foul Input

Odd Lane
Start Contacts
Cycle Contacts
Strike Contacts
Foul Input

Keyboard
Cable

To Camera

Machine Interface Board Connections
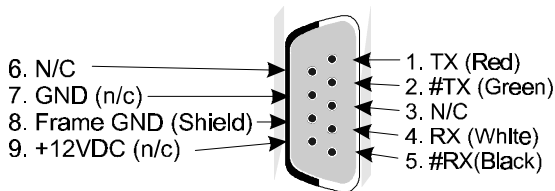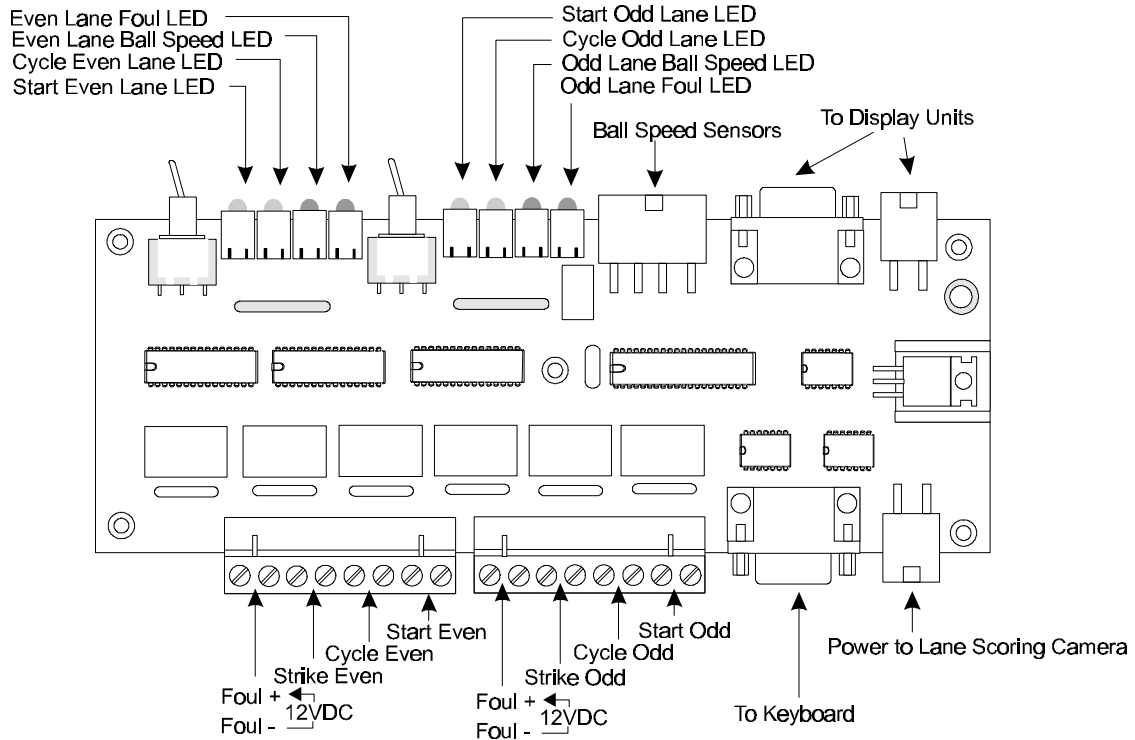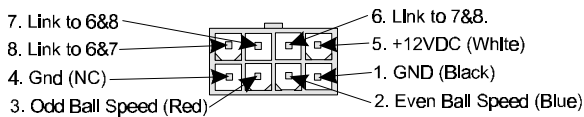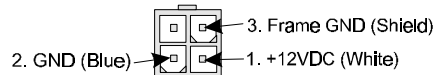
figures 4a,4b Machine Interface Module connections & pinouts.

1. Machine Start Connection

The Machine Interface Module has one relay contact per lane designated to Machine Start. This contact will close when the scoring determines that the lane is available to bowl on (based on customers purchasing games etc.). The times at which this contact open and close depend on factors such as the type of bowling (Open or League). To avoid the problem of the machine being turned off before its cycle is completed the Start contact will not open again to stop the machine until the scoring software in the DVS Chassis determines the machine is at rest. The Machine Start Contact is available for the center technician to wire in SERIES with the Managers Control Switch from the front control counter. The Machine Start Contact must not be placed in parallel across the Managers Control Switch as the Manager Control must be available at all times to turn off the machines in an emergency situation. (Refer Section Safety Precautions for further information).
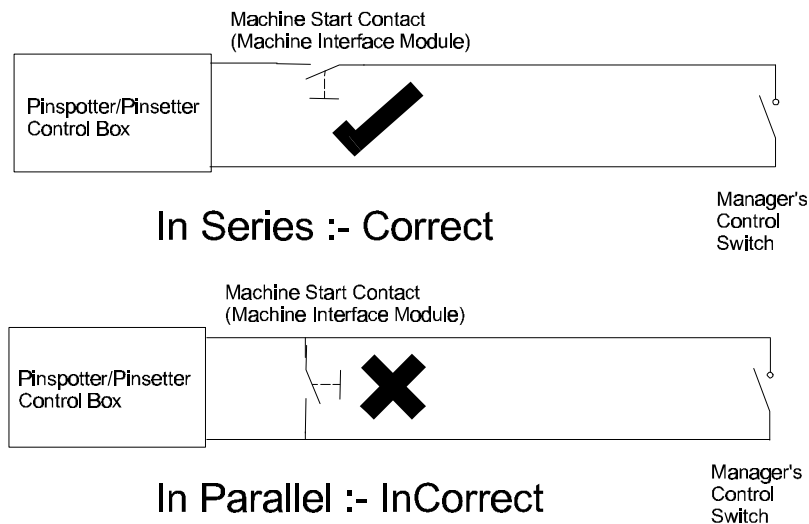
figure 5 Wire Machine Start so as to allow for Emergency Cut-off

2. Tenth Frame (& No-Tap) Cycle

There is one relay contact per lane on the Machine Interface Module that can be used to cycle the machines when required by Tenth Frame, No-Tap, Certain Brunswick Fouls and Bowler requested re-racks. The center technician can use this contact to cycle the machine under these conditions.

To avoid Brunswick Machine lock outs and minimise the possibility of bowling into the rake/sweep the Tenth Frame Cycle contact will close as soon as the DVS Chassis determines that the machine is back at rest from the previous cycle.

3. AMF Style Foul Input

As discussed previously, voltage free contact (relay) type foul units can be attached to the scoring system via the Keyboard PCB. AMF style foul systems can be inputted into the scoring system via a set of inputs on the Machine Interface Module. The foul input of the Machine Interface is an opto-coupler capable of accepting 12-24V AC or DC. The Red indicating LED of the Machine Interface Board will indicated when a foul has been received.

4. Ball Speed Sensing

The Ball Speed Sensing input of the Machine Interface Module for each lane is used to determine the speed of a ball bowled on the lane. It is attached via the Ball Speed Sensor Cable to a pair of Infrared Photoswitches located near the lane Scoring Camera. This is an optional feature which allows the bowlers to determine their bowling speed. It can also allow the system to be notified of a ball being bowled prior to a cycle. The DVS Chassis uses this information to determine whether a score that has been determined by the machine operating is a valid score bowled by the bowler or a cycle operated by the ball return or mechanics cycle button. If the ball detection facility has been enabled in the system settings, the DVS Chassis will not display any score which was not preceded by a ball speed signal from the Machine Interface Module. This feature is not essential to scoring but is convenient to reducing the number of score corrections produced by machine faults. Ball Speed Sensing and ball detection is a completely separate function to Light Ball triggering which the feature of triggering (cycling) the machine by sensing a ball passing through the front of the machine. Computer Score does not implement Light Ball triggering. The Scoring system does not require the machines to be triggered via light ball triggering devices. Computer Score considers light ball triggering to be a dangerous feature and expressly advises customers not to use such systems. Computer Score accepts no liability for the Safety of any such system used.

5. Strike / Bumper Bowling Contacts

The Machine Interface Module has a pair of Normally Closed Contacts for each lane which can be selected to either,

A. Open when a strike is determined by the Lane Scoring Camera and close again at the end of the machine cycle This contact is not used by the Scoring System and is therefore available to a center technician in an AMF 82-70 center to use in cases of table gripper wiring faults. i.e. some centers have the table wiring removed and one pin contact permanently grounded (no strike cycle). It is possible to recover the machine strike cycle by using the strike contact to isolate the pin gripper contacts from ground during a strike thus forcing the machine into a strike cycle. This contact is strictly LOW VOLTAGE and the implementation of this facility is solely the responsibility of the trained, authorised center technician. Computer Score accepts no responsibility for any consequences arising from the use of this contact.

B. Open or Close to indicate whether the current bowler requires bumpers. This contact can be used to interface to Power Bumpers that have a scoring system auxiliary input. Computer Score accepts no responsibility for any consequences arising from the use of this contact.

Lane Scoring Camera

The Lane Scoring Camera is located on the capping between the lanes at a distance of 4.01 metres from the end of the Flat gutter. The Lane Scoring Camera is a EIA (Black and White NTSC compatible) standard CCD Camera. It receives its +12VDC input from the DVS Chassis and transmits to the chassis a conventional 1Vpp video signal. The DVS Chassis interprets this signal to determine the lane scores. The Camera has a red LED Power indicator located at the front which will illuminate when the +12VDC power is applied from the DVS chassis. Once the camera is located in a level position pointing towards the lane there are no other adjustments to the camera. Up, Down, Left and Right alignment as well as all other configuration parameters are handled by the software of the system. As the Camera is compatible with North American Video standards it is possible to display the output from the camera on a standard TV monitor or record the signal for future reference or debugging. The Scoring Software was originally developed using pre-recorded tapes of various bowling centres and a VCR tape can be used by Computer Score Agents to check a Lane Scoring Cameras Operation. Refer to following section Troubleshooting - Lane Scoring Software Operation for details of how the score is determined.
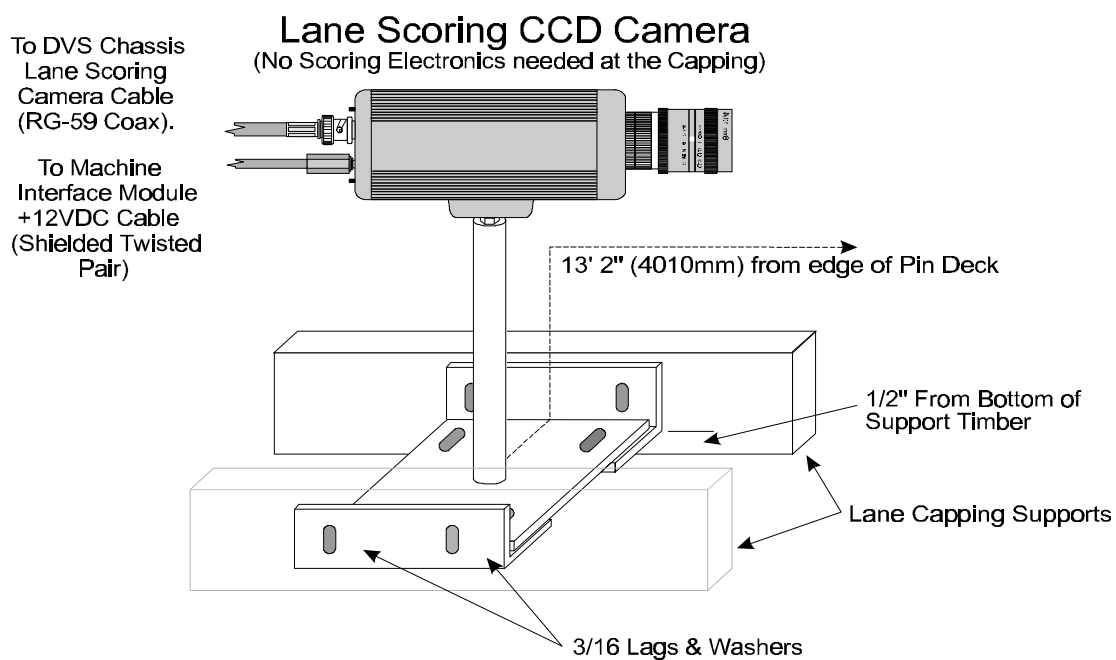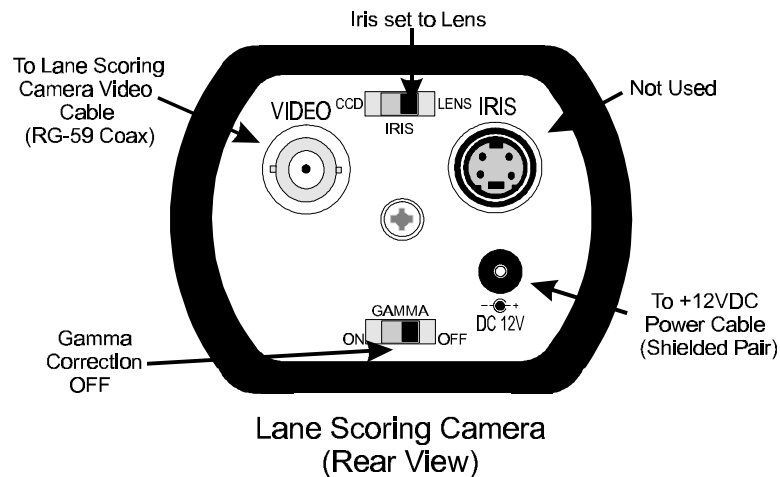

figure 6a & 6b   Camera and Support and Rear View for connectors

Safety Precautions & Hardware Disclaimer

- Always ensure that the system has been installed and electrically wired in accordance to all relevant safety codes by authorised electrical contractors. The DVS chassis enclosure has UL approval as does the SVGA Monitors. For protection from Electric Shock ensure that all metal parts are adequately grounded.
- The SVGA monitors operate on High Voltage. The rear cover to the SVGA monitors should only be removed with both SVGA monitors Off and with all Plugs removed from their Outlets. The covers should only be removed by authorised Service Personnel and the monitors serviced by authorised Service Personnel according to the monitor manufacturer Service and Safety Procedures. When replacing a SVGA monitor always ensure that the ground point of the replacement unit is securely grounded to the display unit ground point. Refer to the monitor manufacturer Service manual for safety precautions. Computer Score accepts no liability for the Safety of the SVGA monitors.
- Under no circumstances operate the display units with the rear monitor covers removed while in the presence of the general public or any unauthorised personnel. Always clean the approach surface of the lanes after servicing the Display units or Keyboard Module so no dust or other material can cause a fall.
- The DVS chassis contains no user serviceable parts and all service to the DVS chassis, other than replacing the unit, is to be done by approved Computer Score agents. Turning Off the DVS chassis using the power switch located on the chassis only turns off the DVS chassis, Machine Interface Module, Lane Scoring Camera and Keyboard Module. It does not turn off the SVGA monitors.
- Unless installation was done by Computer Score. Computer Score accepts no responsibility for the Safety of the system regarding physical security of installation mounting etc.
- Never use the Lane Scoring Camera as a handle when moving its support shaft.
- The Machine Start Relay Contacts are only to be installed so that the Pinsetting/Pinspotting Machine is still able to be turned off immediately at a convenient location at the control counter and the machine in case of emergency. This will usually involve wiring the contacts in Series (not Parallel) with the existing managers control switches. An open Machine Contact is under no circumstances to be considered adequate protection from the machine starting unexpectedly. The tenth frame cycle feature (if connected by the Centre Technician) results in the machine being cycled at possibly any time without a ball being bowled. As a result under no circumstances should a Pinsetter/Pinspotter Machine be entered while operating. Always switch the Pinsetter/Pinspotter off prior to anyone entering it. Computer Score accepts no responsibility or liability for the Safety or Operation of any brand of Pinspotter/Pinsetter Machines or associated equipment or the actions of anyone regarding this equipment. The Machine Start, Tenth Frame Cycle and Strike relay contacts are for low voltage only. Do not connect any of the Machine Interface Module Inputs or Outputs to or near high voltage.
- The ball speed sensor input option of the Machine Interface Module is only used by the system to determine ball speed and to differentiate between valid scores and invalid scores. It does not involve the cycling of the Pinsetter/Pinspotter Machine should a light weight ball fail to trigger the machine cycle. Computer Score does not implement, recommend or require this feature for the operation of the Scoring System. (Refer the previous section Hardware Overview - Ball Speed Sensing).

Troubleshooting & Maintenance

The following is a list of possible problems and the steps required to identify the most likely module at fault. It is not possible to guarantee that there may be other items at fault. The following is merely a guide to speed debugging.

The system will not display a Key on the Screen when it is pressed on the Keyboard.
Does the keyboard beep when keys are pressed?
> **Yes** - Possible causes Keyboard PCB, Keyboard Cable, Machine Interface Module, Machine Interface Module communications cable or DVS Chassis.
> **No** - *Does the Keyboard beep when the system if first turned on*?
>> **Yes** - *Is there 3 or 4 beeps ?*
>>> **3** - Keyboard PCB in Keyboard Module most likely needs replacing. Try in known good pair to test.
>>> **4** - One of the membrane keyboards is damaged or faulty, causing a key to be permanently pressed down. Unplug one side at a time from the Keyboard PCB to test.
>> **No -** *Are the Lane Scoring Camera & Machine Interface Module Power LEDs illuminated. ?*
>>> **Yes -** Possible Causes Keyboard PCB, Broken Keyboard Cable or Keyboard Connections at the Machine Interface Module.
>>> **No -** *Is there +12VDC at the DVS Chassis? (see Hardware Overview-DVS Chassis)?*
>>>> **Yes -** Possible broken cable from DVS Chassis +12VDC Power Connector to Machine Interface Module.
>>>> **No** - Test DVS Chassis in known good lane.

Machine will not Start when Players Enter Names and Press Play
Is the Green LED indicating Machine Start on the Machine Interface Module Illuminated?
> **Yes** - Check all relevant machine off switches (refer Bowling Machine Manuals). Disconnect the lane connections (see figure 4a) for that lane.
> *Is there continuity across the machine start terminals on the Machine Interface Module?*
>> **Yes** - Reconnect lane connections - Bowling Machine Fault.
>> **No** - Trial Machine Interface Module in known good lane.
> **No** - *Is the Machine Interface Module and Lane Scoring Camera Power LEDS ON?*
>> **Yes** - Possible causes Machine Interface Module, Machine Interface Communications Cable or DVS Chassis
>> **No -** *Is there +12VDC at the DVS Chassis (see Hardware Overview-DVS Chassis)?*
>>> **Yes -** Possible broken cable from DVS Chassis +12VDC Power Connector to Machine Interface Module.
>>> **No** - Test DVS Chassis in known good lane.

Score Grid will not display Foul.

Is foul enabled in the system software?

No - Refer Software Instructions

Yes - *Is the Foul Connected at Keyboard Module (usual for Brunswick) or at the Machine Interface Module (usual for AMF).*
Refer Section Hardware Overview-Machine Interface Module.

AMF - *Is the RED Foul LED On when the machine foul light is On?*

Yes - *Does the Keyboard still operate?*

Yes - Re-check Software options and trial Machine Interface Module in known good lane. Check that foul light stays on for required period.

No - *Is the Machine Interface Module and Lane Scoring Camera Power LEDS ON?*

Yes - Possible causes Machine Interface Module, Communications Machine Interface Cable or DVS Chassis.

No - *Is there +12VDC at the DVS Chassis (see Hardware Overview-DVS Chassis)?*

Yes - Possible broken cable from DVS Chassis +12VDC Power Connector to Machine Interface Module.

No - Test DVS Chassis in known good lane.

No - *Is there a 12-24VDC/AC signal across the Foul Inputs of the Machine Interface Module when the machine foul light is on?*

Yes - Trial Machine Interface Module in known good lane.

No - Foul Unit Fault

Brunswick - *Does the Keyboard Module Beep when foul occurs?*

Yes - *Does the Keyboard still operate? (See AMF)*

No - *Is there continuity across foul input of Keyboard PCB when foul occurs?*

Yes - Trial Machine Interface Module in known good lane.

No - Foul unit fault.

A lane or lane pair is not scoring properly

Steps that can be taken.

1. **Re-configure the Lane Pair using configuration menu.**
    - Check the image is visible and approximately centralised in the configuration screen.
    - Trail Scoring without Ball detect enabled.
    - Trial Scoring without Frame Sync enabled.
2. **Check the Lane Scoring Camera**
    - Check Power LED On, Check +12VDC.

- Check Mounting is firm and free from vibration from the capping.
- Check Lens is still secure. Gently clean with lens blower.
- Connect Lane Scoring Camera output to video input of NTSC TV monitor.
- Check picture is sharp and stable.
- Check picture does not flutter when camera is slightly jarred.
- Trial pointing Lane Scoring Camera slightly further up, down, left or right.
- Trial replacement Camera.

3. **Check Power and Signal Cable and Connectors between DVS Chassis and Lane Scoring Camera.**
4. **Trial DVS Chassis in known good lane.**
5. **Check Machines.**
   - Replace shiny or reflective curtain.
   - Remove any large amounts of natural light streaming into the machine pit.
   - Remove oil streaks etc. on curtain.
   - Remove or repair pins with neck or head damage.
   - Adjust Sweep/Rake to operate at correct height.
   - Repair faulty time delay modules in Pinsetters.
   - Replace old and dull or unreliable pit lights. Tri-phophorus tube recommended.
   - Clean or install pit light reflectors.
   - Trial different (preferably clean) pin set.
   - Repair or remove white frayed sections of the curtain.
   - Trial scoring with sweep/rake advertisements removed.
   - Trial Sweep/Rake reflection tape (30mm White Tape) on sweep/rake.
   - Trial some Sweep/Rake reflection tape on the front of Table/Deck (to make Table/Deck more visible).
   - Trial blacking out Sweep/Rake (allow the Lane Scoring Software to recognise it falling past the pins).
   - Ensure Colored pins have white around the neck during moonlight bowling.
   - Use same brand of pin in each machine.
   - Repair no strike cycle problems in the machine.