

Matrix Lane Hardware Manual

Version: February 2007

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Introduction

The following manual describes the Hardware configuration of the VanTech Comscore Matrix Model of Tenpin Bowling Scoring Equipment. The system that has been created around this hardware is the result of fifteen years of experience in producing and servicing scoring systems. The name Matrix results from the fact that the main display hardware controls a maximum of six lanes.

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 High Speed CPU, separate PCI (Peripheral Component Interconnect) Video controllers, 100Mbit Ethernet Networking and Windows XP technology results in a system capable of impressive performance.

The VanTech Comscore system has been designed to divide the hardware into separate logical modules in order to simplify Troubleshooting and Maintenance. In most cases 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 module 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 VanTech Comscore Agent for service.

Hardware Overview

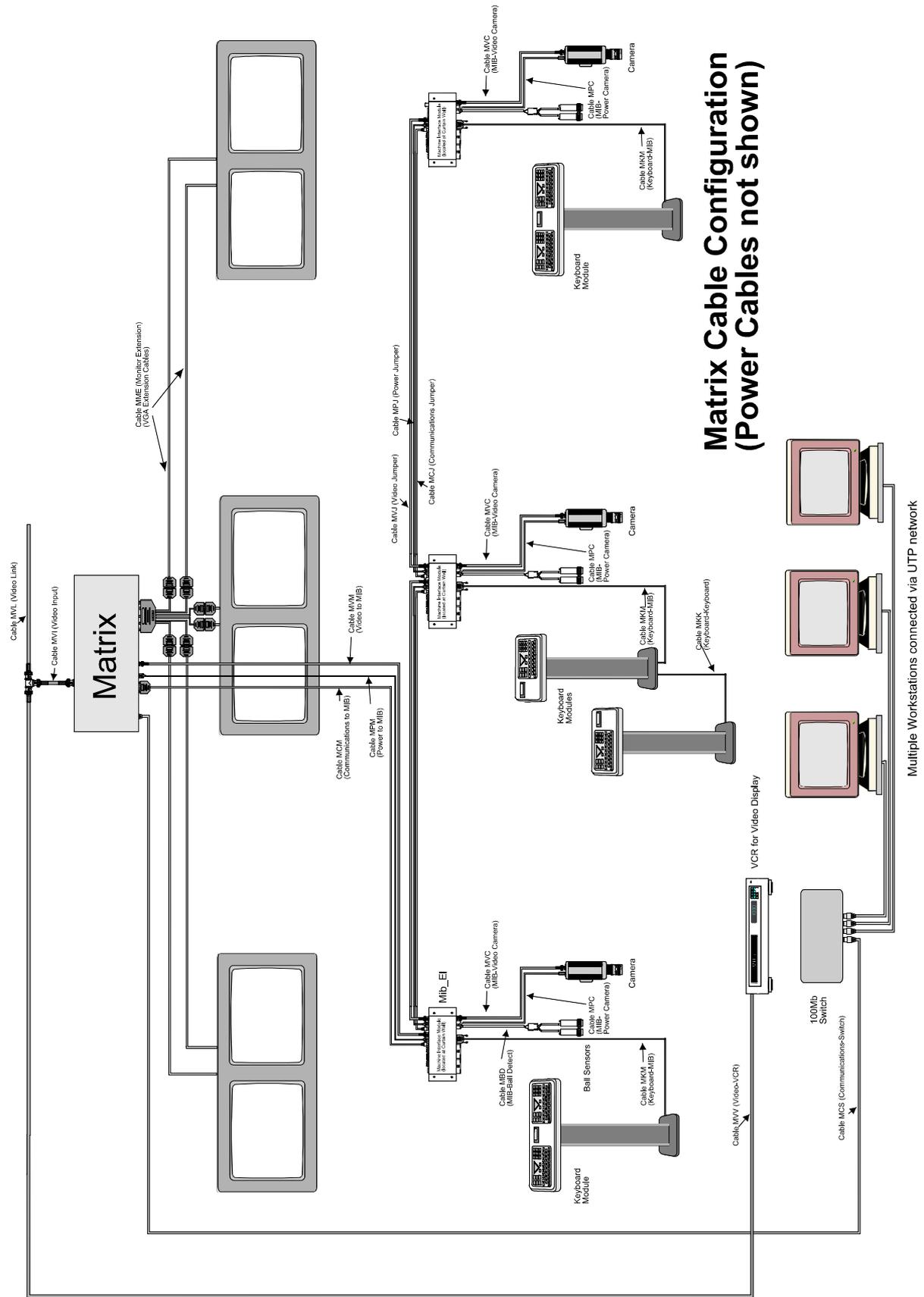


figure 1 Matrix Cable Configuration

There are six electronics subsystems that comprise the Lane Hardware for the system. These are,

1. **Matrix Chassis** :- Located in a Display Units (controlling up to three lane pairs).
2. **SVGA Display Monitor** :- Located in the Display Units.
3. **Keyboard Module** :- Located in front of the Players Area (configured either in tandem or individually).
4. **Machine Interface Module** :- Located on the Curtain Wall.
5. **Lane Scoring Camera** :- Located on the middle capping 4.01m (13 ft 2 inches) from the end of the flat gutter. (optional for Brunswick GS machines)
6. **Ball Speed Sensor** :- Located just in front of the Lane Scoring Camera

Each of the modules is described in further detail in following sections of this manual.

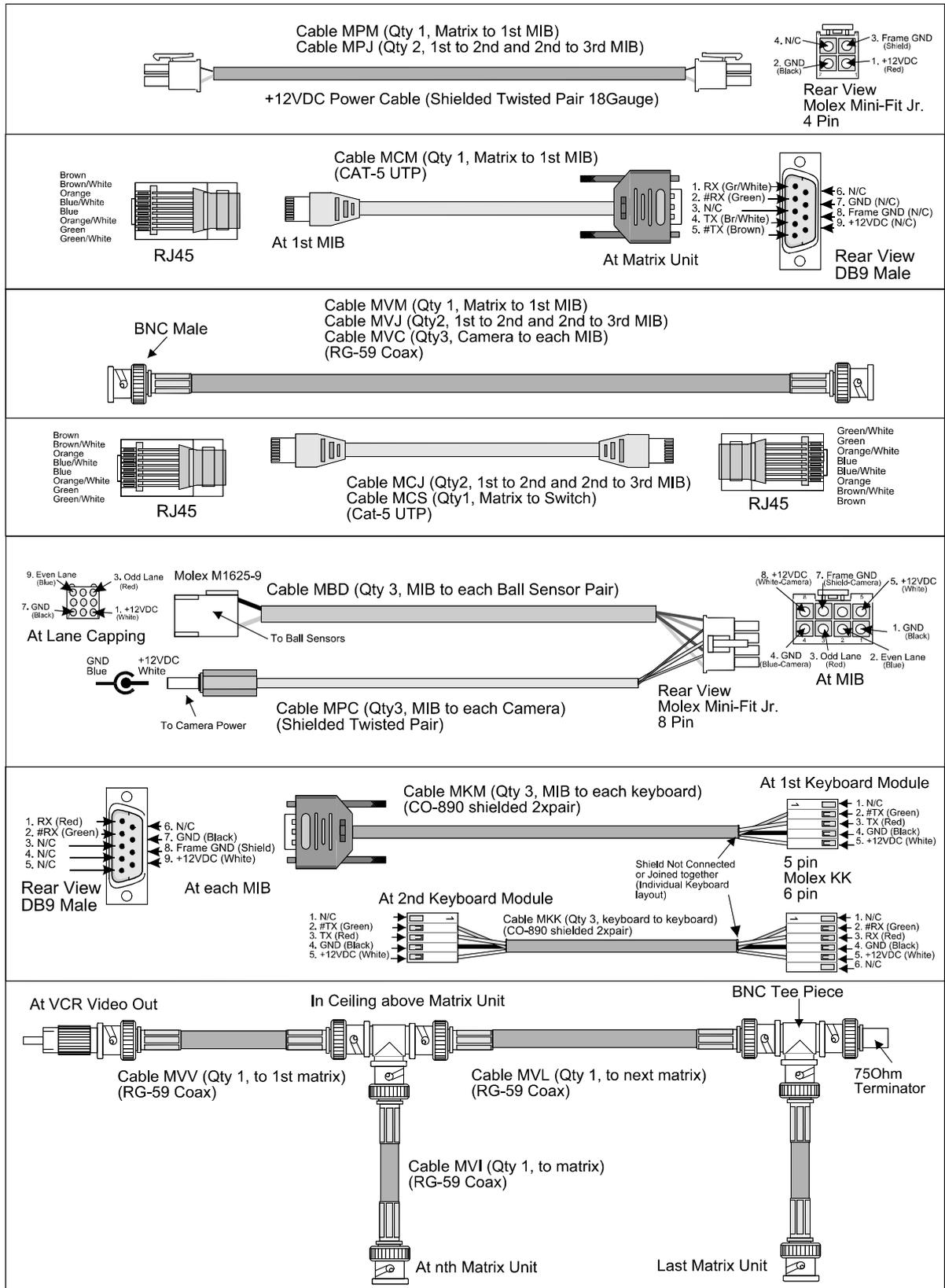


figure 2 System Cables.

Matrix Chassis.

The Matrix Chassis is a self-contained enclosure mounted one of the Display units controlling up to six lanes. 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, Keyboards & Machine Interface Modules, displaying the Lane Score Grids, displaying Video and determining the Score based on the input from the Lane Scoring Cameras. It is designed so that the only service to be performed by the center technician on the Matrix 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 VanTech Comscore agent only.

The Matrix chassis is the main lane electronics and therefore plays a central role in the operation of the lane pairs. The chassis enclosure is a 4-slot MicroBOX Industrial Personal Computer Chassis. It contains its own 150W switch mode power supply (115VAC or 230VAC 50/60Hz switchable) 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 Matrix Chassis has a number of input and output connectors (see figure 3).

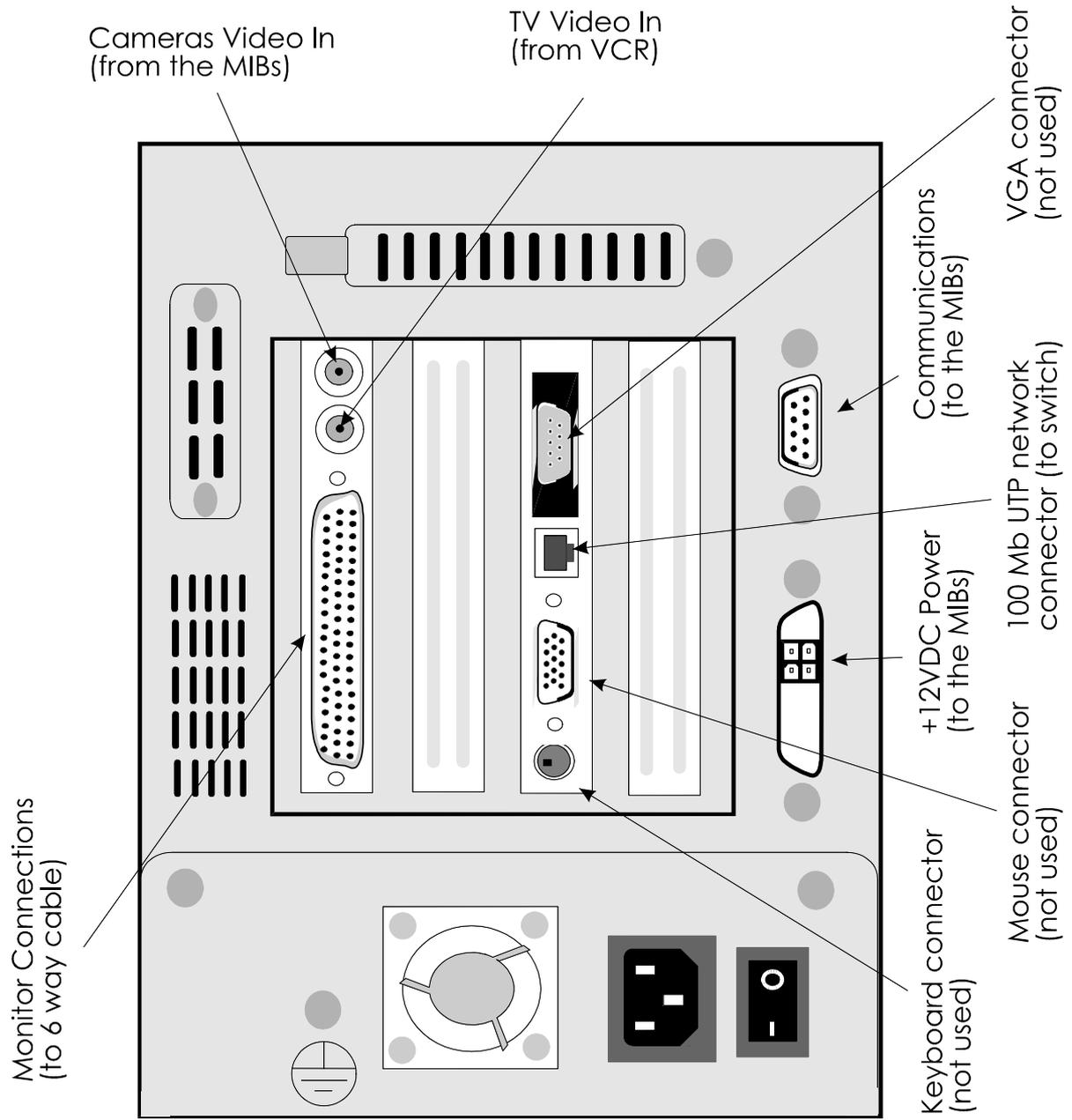
The Matrix Chassis integrated switch mode power supply produces +12VDC which is available on a connector for use by the Machine Interface Modules, the Lane Scoring Cameras and the Keyboard Modules. The +12VDC is protected by a 1500mA resettable fuse and Transient Absorber. Switching the Matrix chassis Off at the Power Switch on the chassis will turn off this voltage and therefore power down all lane hardware modules except the SVGA monitors if the +12VDC is being used to drive the other electronic modules. Note that due to the potential voltage drop incurred when transporting this voltage down to the other modules in the system it is recommended that a separate +15VDC supply is used which is attached to an outlet in the Display Unit. In this case turning the Matrix Chassis off at its power switch will NOT power down the other modules in the system.

The Matrix chassis has a DC fan inside which is used to cool the electronics and repel dust. If this fan is not operating the Matrix Chassis is either not receiving input power from the outlet, is switched off or needs service by a VanTech Comscore Agent.

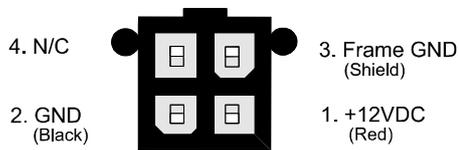
Checking the +12VDC system voltage

1. Open the display unit rear access panel.
2. Turn the Matrix chassis Off at its power switch.
3. Remove the connection to +12VDC Power Connector (if used). (see figure 3)
4. Turn the Matrix chassis On and check with a multimeter +12VDC from pin 2 to pin 1.
5. Turn the Matrix chassis Off , reconnect (if used) the +12VDC Power Connector.

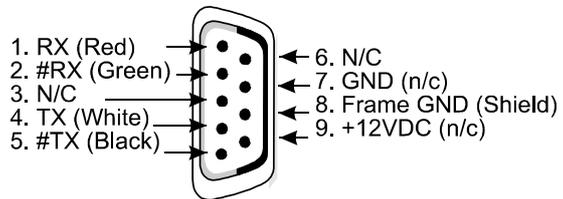
The Matrix Chassis uses Windows XP Embedded technology.



Matrix Unit



+12VDC Power Connector



Keyboard/Machine Interface Connector (connects to MCM Cable)

figure 3. Rear of Matrix Chassis

+15VDC Power Configuration (Frame Ground and Ground Reference Connections Included)

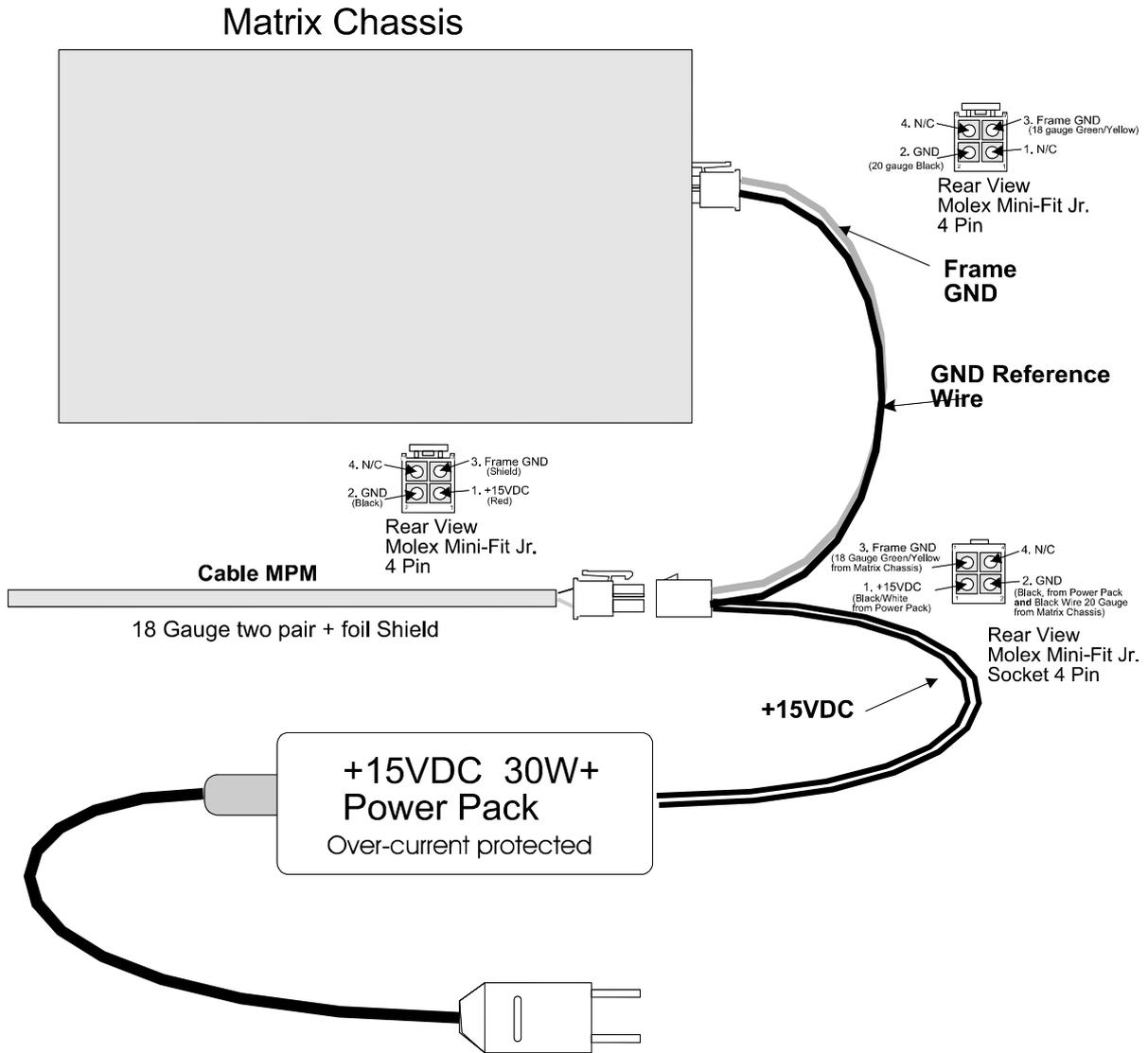


figure 4. Alternate +15VDC connection

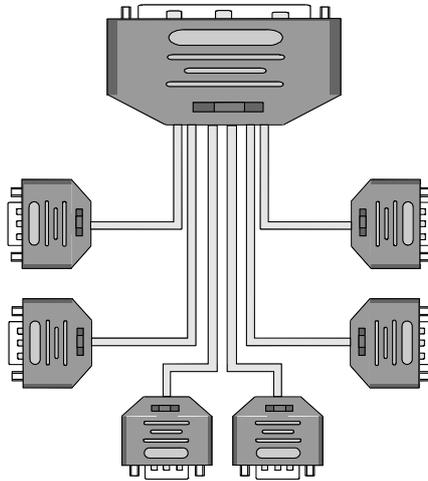
Video Matrix Card Link cable pin description

Code Matrix01

DB15HD Female x 6
Pins

1. Red n
2. Green n
3. Blue n
4. NC
5. Black n
6. Brown n
7. Brown n
8. Brown n
9. NC
10. Black n
11. NC
12. NC
13. White n
14. Yellow n
15. NC

Shield of cable connected
to casing



DB44HD Male
Pins

1. White 6
2. Green 6
3. Yellow 5
4. Blue 5
5. NC
6. White 4
7. Green 4
8. Yellow 3
9. Blue 3
10. NC
11. White 2
12. Green 2
13. Yellow 1
14. Blue 1
15. Red 1
16. Black 6
17. Brown 6
18. Red 6
19. White 5
20. Green 5
21. Black 4
22. Brown 4
23. Red 4
24. White 3
25. Green 3
26. Black 2
27. Brown 2
28. Red 2
29. White 1
30. Green 1
31. Yellow 6
32. Blue 6
33. Black 5
34. Brown 5
35. Red 5
36. Yellow 4
37. Blue 4
38. Black 3
39. Brown 3
40. Red 3
41. Yellow 2
42. Blue 2
43. Black 1
44. Brown 1

Shield of all cables connected
to casing

figure 5. Matrix Six Monitor Connector

SVGA Display Monitors

The two SVGA Display Monitors located in the Display Unit are industry standard superVGA display monitors. The exact brand and size monitor varies.

They have an industry standard superVGA DB15HD input which is connected to the Matrix Chassis via the six Monitor Connector (see figure 2). They use the same style of signal that travels between a standard Computer & Monitor. They have a 115VAC or 230VAC (depending on the brand of monitor) 50/60Hz voltage power input and are connected to a Power Outlet located inside 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 monitor manufacturer's Service and Safety Instructions for more details relating to monitor adjustments. Contact your VanTech Comscore Agent for this information.

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

There are two types of Keyboard Modules (the Dual or Individual Units). Both types use the same components internally but they are arranged in different configurations. The Dual Keyboard Configuration is located in the player's area behind the ball return and contains both odd and even lane keyboards.

The Dual keyboard receives Power and sends keystrokes via one cable from the Machine Interface Module (the MKM Cable). Each lane has an individual membrane keyboard for bowler input. The membrane keyboard consists of a four-layer sandwich. The top layer is a 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 that a key is pressed and transmits the appropriate information to the Machine Interface Module, which in turn transmits this to the Matrix Chassis.

Brunswick Fouls (or other foul units that have a voltage free contact output) can be connected to the Keyboard PCB for foul detection in the system.

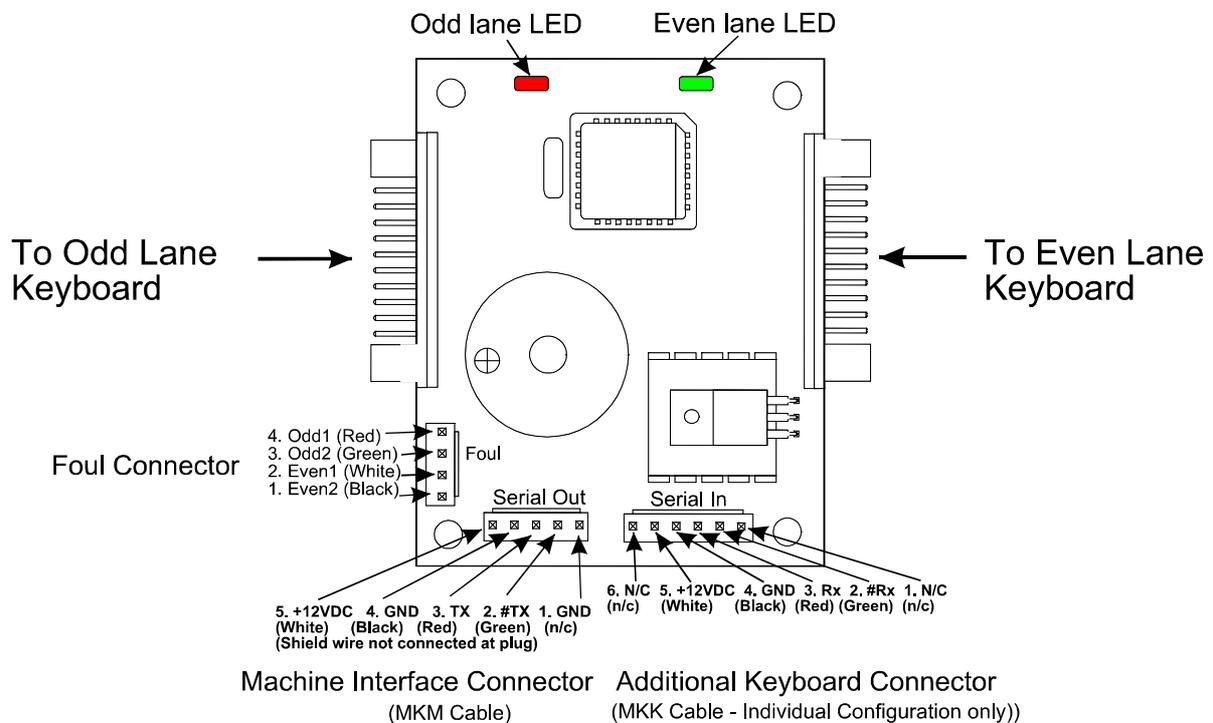
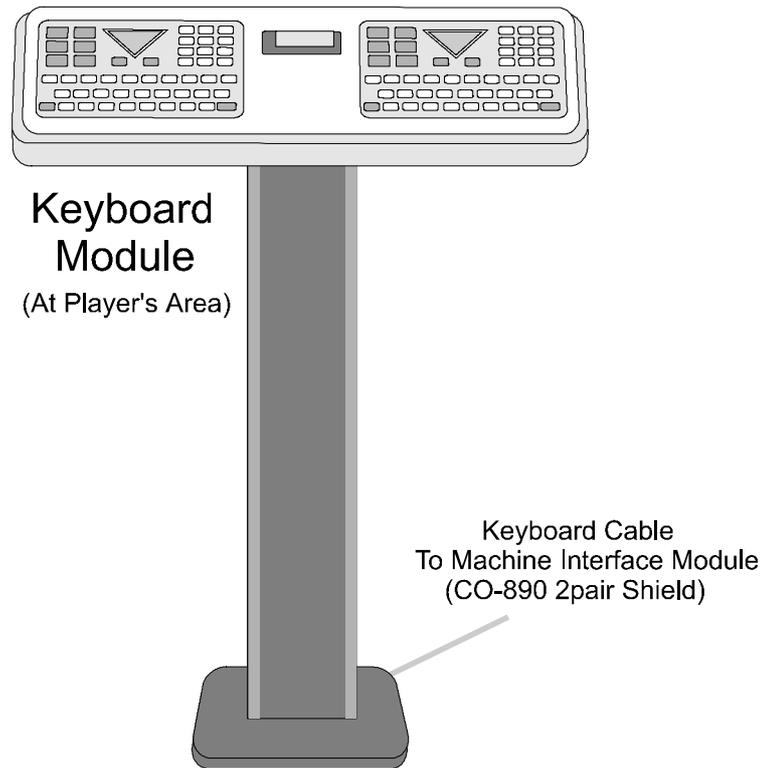
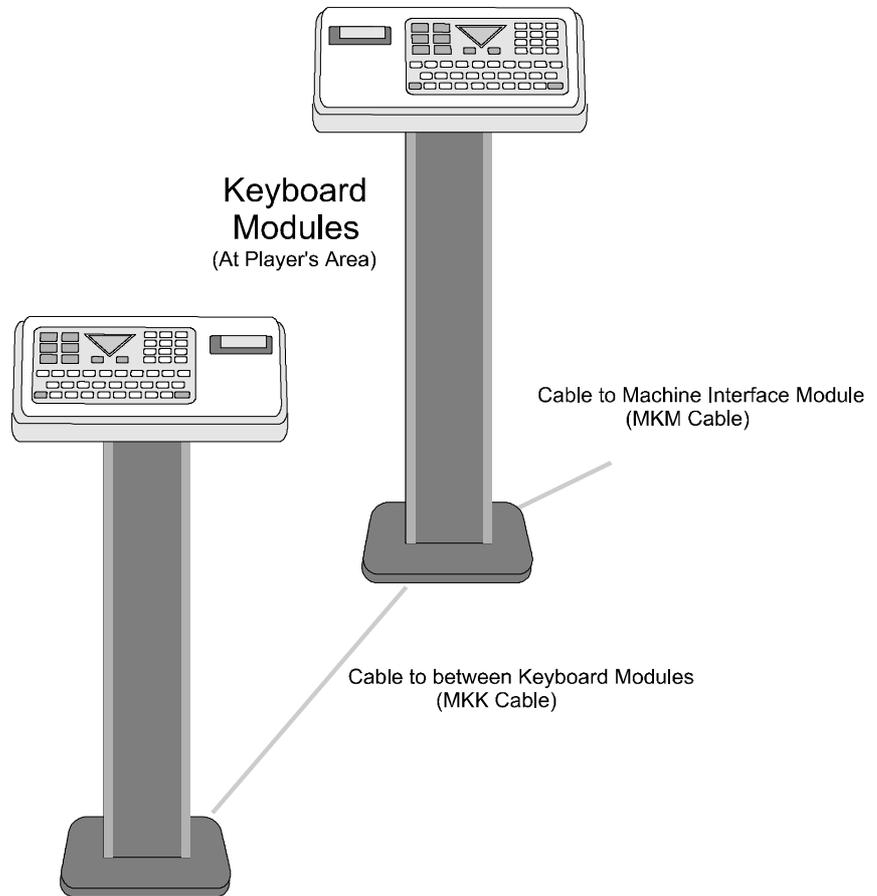


figure 6 Keyboard PCB and Pinouts

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 two short tones when the +12VDC power is first applied from the Matrix chassis (or separate Power Supply). 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). The Keyboard PCB has two indicating LEDs (Light Emitting Diode). The Red LED indicates a key press on the Odd Lane. The Green LED indicates a key press on the Even Lane.

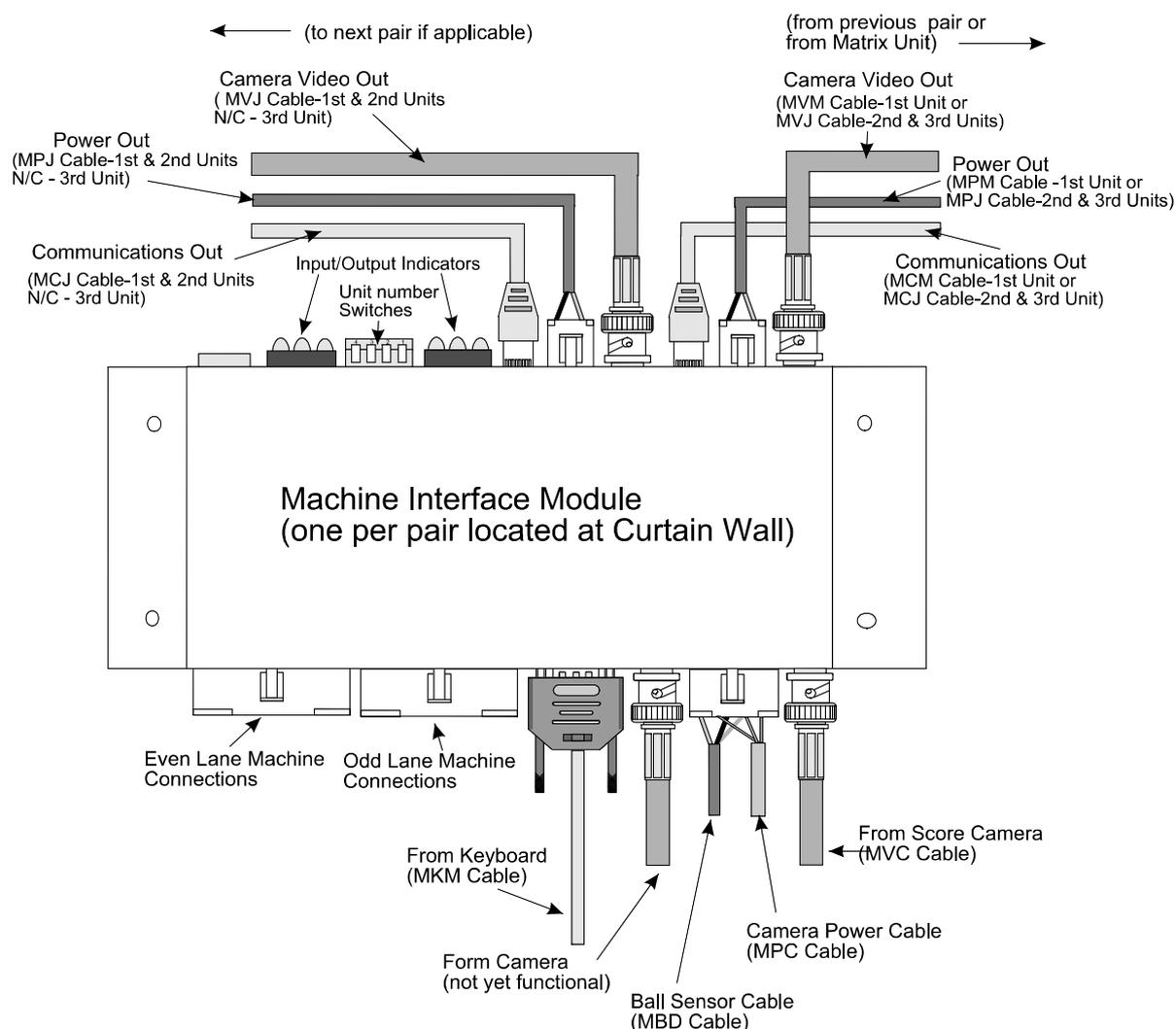
The Individual Keyboard configuration consists of two separated Keyboard Modules (one for the odd lane and the other for the even lane) located in line with each individual lane.

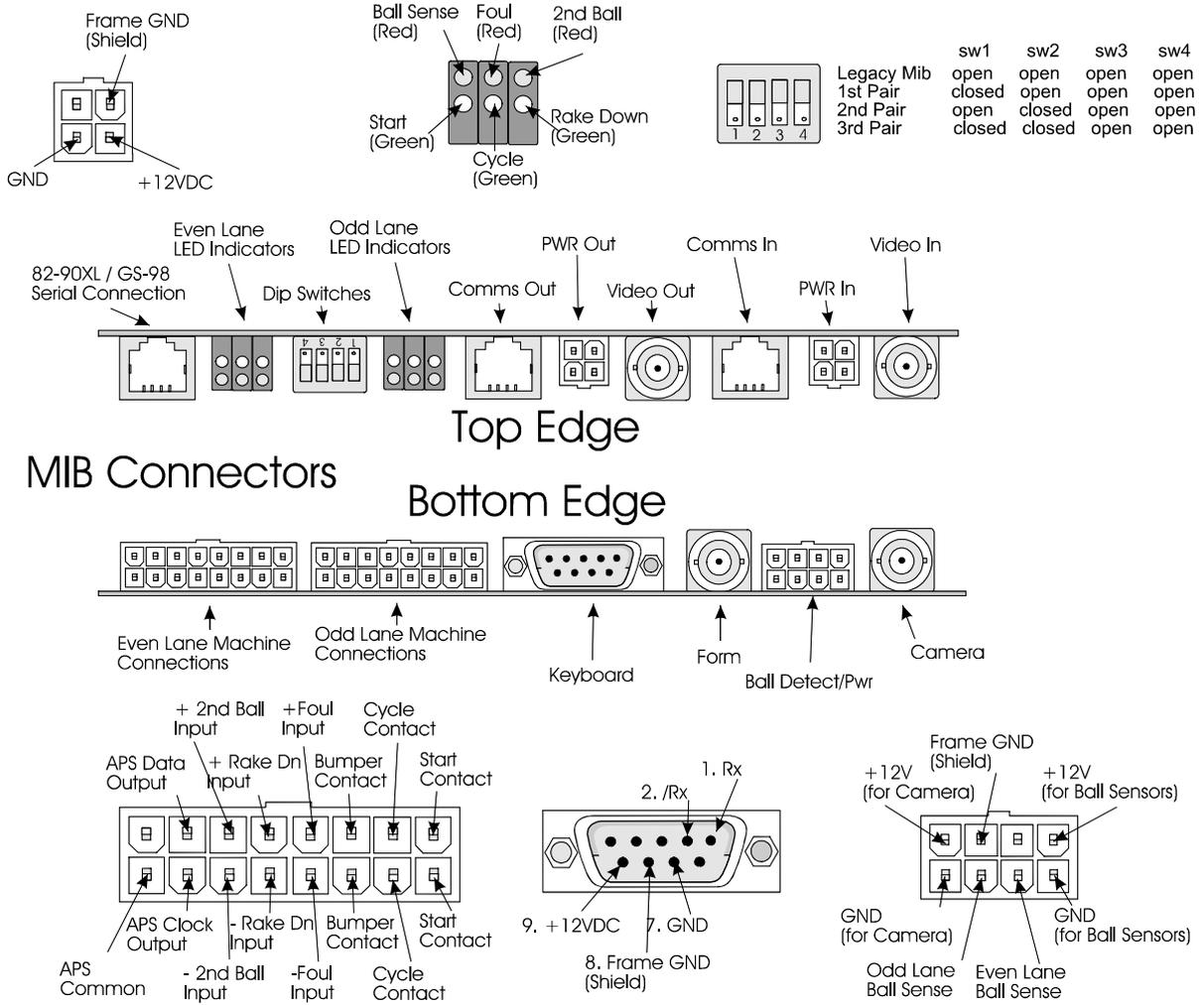
The Individual Keyboard configuration uses two Keyboard PCBs. The Main Keyboard PCB can be either the Odd or Even Lane Module (depending on convenience during install) with the other module connected via the MKK (Matrix Keyboard-Keyboard) Cable. The Odd Lane Module has the Keyboard membrane attached to the Odd Lane input of its Keyboard PCB (refer figure 6). The Even Lane Module has the Keyboard membrane attached to the Even Lane input of its Keyboard PCB.



Machine Interface Module

The Machine Interface Module is located near 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, Ball Detection, Auto Bumper Connection, Strike Cycle Indication, 82-90XL (small chassis) connection, Brunswick GS-9x machine connection and 82-70 MP chassis connection (2nd ball, sweep down and APS connections). Most of these inputs and outputs have an indicating LED as shown in figure 4b. The Machine Interface Module inputs, outputs and power are ALL LOW VOLTAGE. The Machine Interface Module is NOT to be connected to or near high voltage. There is a maximum of three Machine Interface Modules attached to the same Matrix Chassis. The each Machine Interface Module has four DIP switches which are used to set which unit number (1, 2 or 3) the Module is (e.g. Lanes 7-8 (1) 9-10 (2) 11-12 (3)).





figures 7a,7b 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 opens and closes depend on factors such as the type of game (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 Matrix Chassis determines that 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).

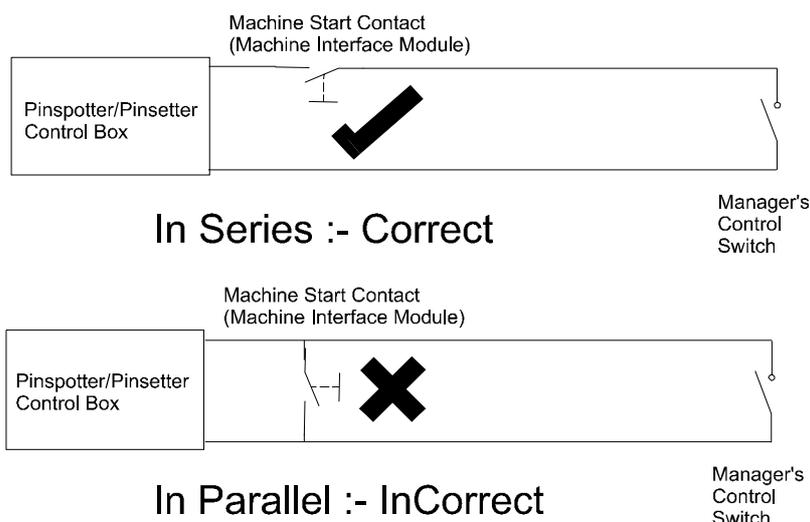


figure 8 Wire Machine Start so as to allow for Emergency Cut-off

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 Matrix 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 illuminate when a foul has occurred.

4. Ball Speed Sensing

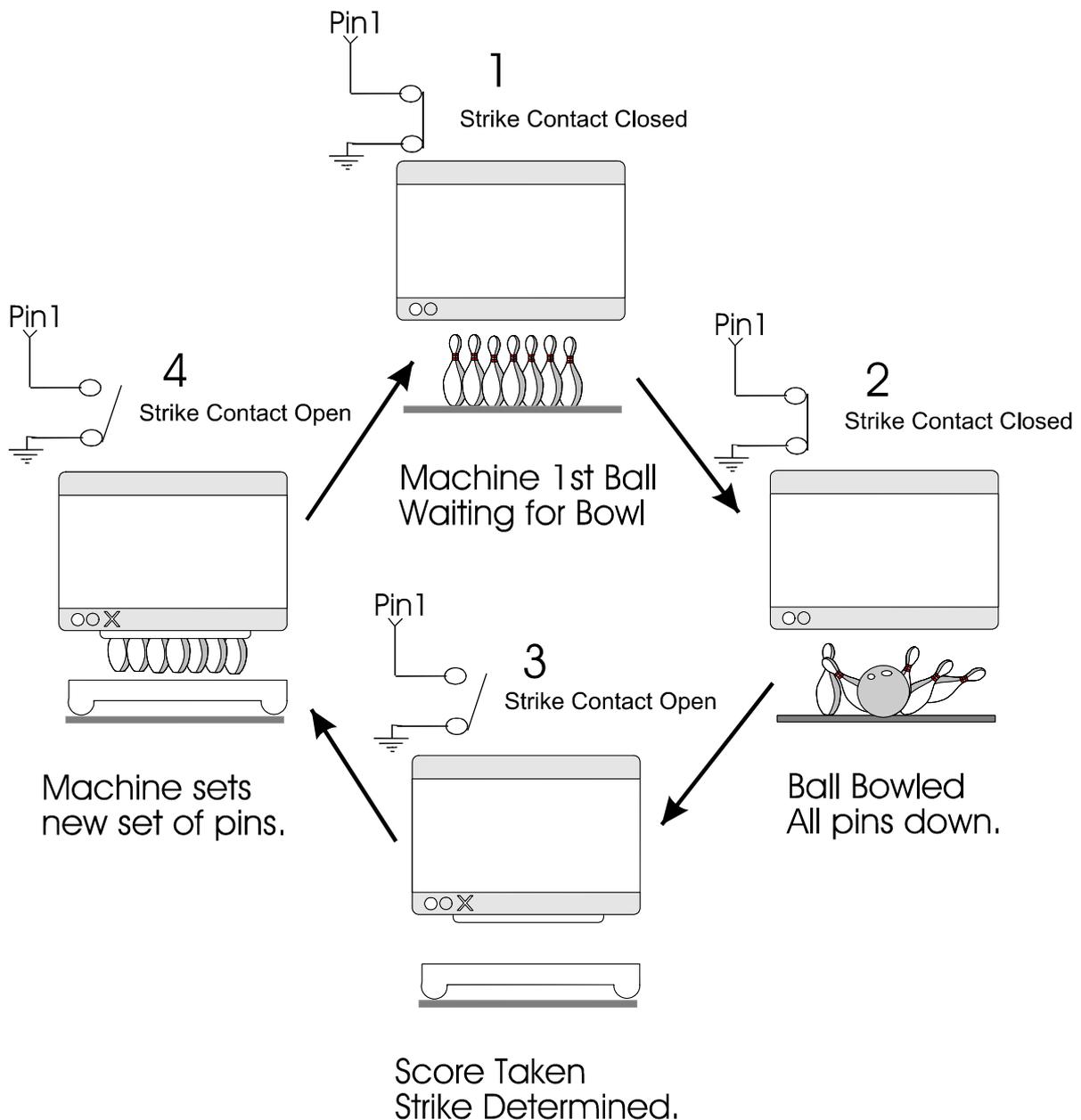
The Ball Speed Sensing input of the Machine Interface Module for each lane is used to determine the speed of a ball bowled on the lane. It is attached via the Ball Speed Sensor Cable (MBD Cable) to a pair of Infrared Photo-switches located near the lane Scoring Camera. This feature allows the bowlers to view their bowling speed. It also notifies the system that a ball has been bowled prior to a machine cycle. The Matrix Chassis uses this information to determine whether the current score 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 Matrix Chassis will not display any score that 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 is 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. The Matrix Chassis does, however, have facilities within its software to communicate with separate light ball triggering software. Ebonite-Vantage has produced such a program (called VanTechTrigger.exe). VanTechTrigger.exe can be loaded onto the Matrix Chassis. This program communicates with the Matrix Software and it able to determine when Ball Speed Sensing inputs have occurred and subsequently order the Matrix to cycle the lanes (via the Machine Cycle Contact of the Machine Interface Module) at the appropriate time. Computer Score accepts no liability for the Safety of any such system used. Refer to Ebonite-Vantage for all information regarding the operation and safety of this software.

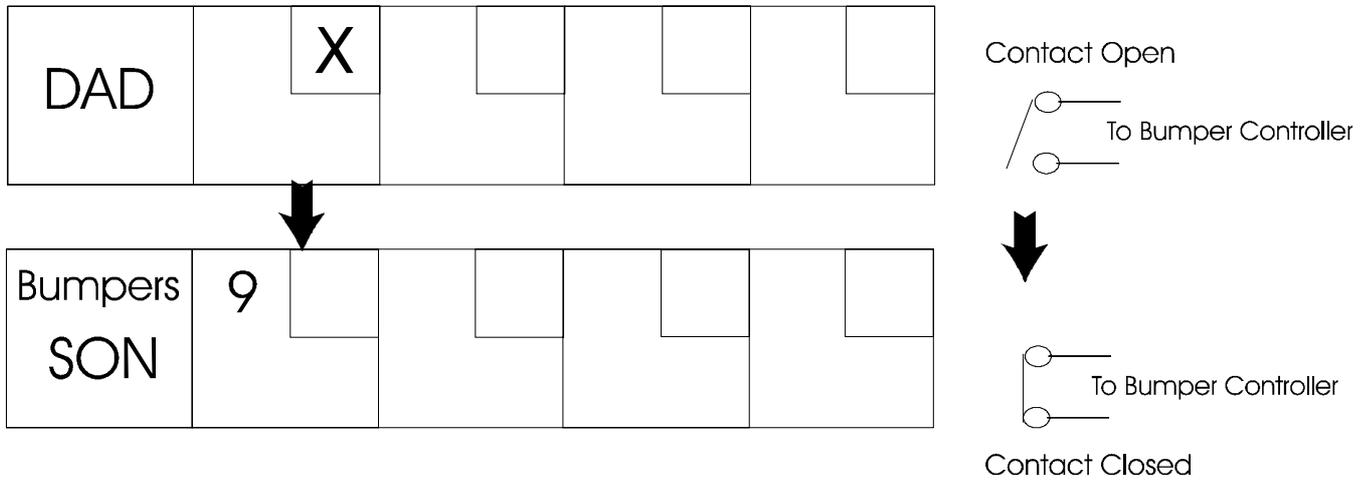
5. Strike / Bumper Bowling Contacts

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

- A. Strike Cycle - 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. Bumper Bowling - Open and 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.



Connection to various Pinsetter/Pinspotter brands & types

The following diagrams are presented as a guide only. As wiring installations vary from center to center, it is essential that the center technician be responsible for all aspects of the connection to the pinsetters/pinspotters. If the center technician has any queries regarding connection to the center's particular machine they should contact their Vantech Comscore Agent.

1. AMF 8270 - 5 board or Omega Tek (No APS) chassis

The Vantech Comscore system will operate with AMF 8270 equipment and only the basic machine Start, Cycle and Foul connections. Determination of the score and second ball are achieved in the system software. Machine type selected in options as AMF Model 82-70.

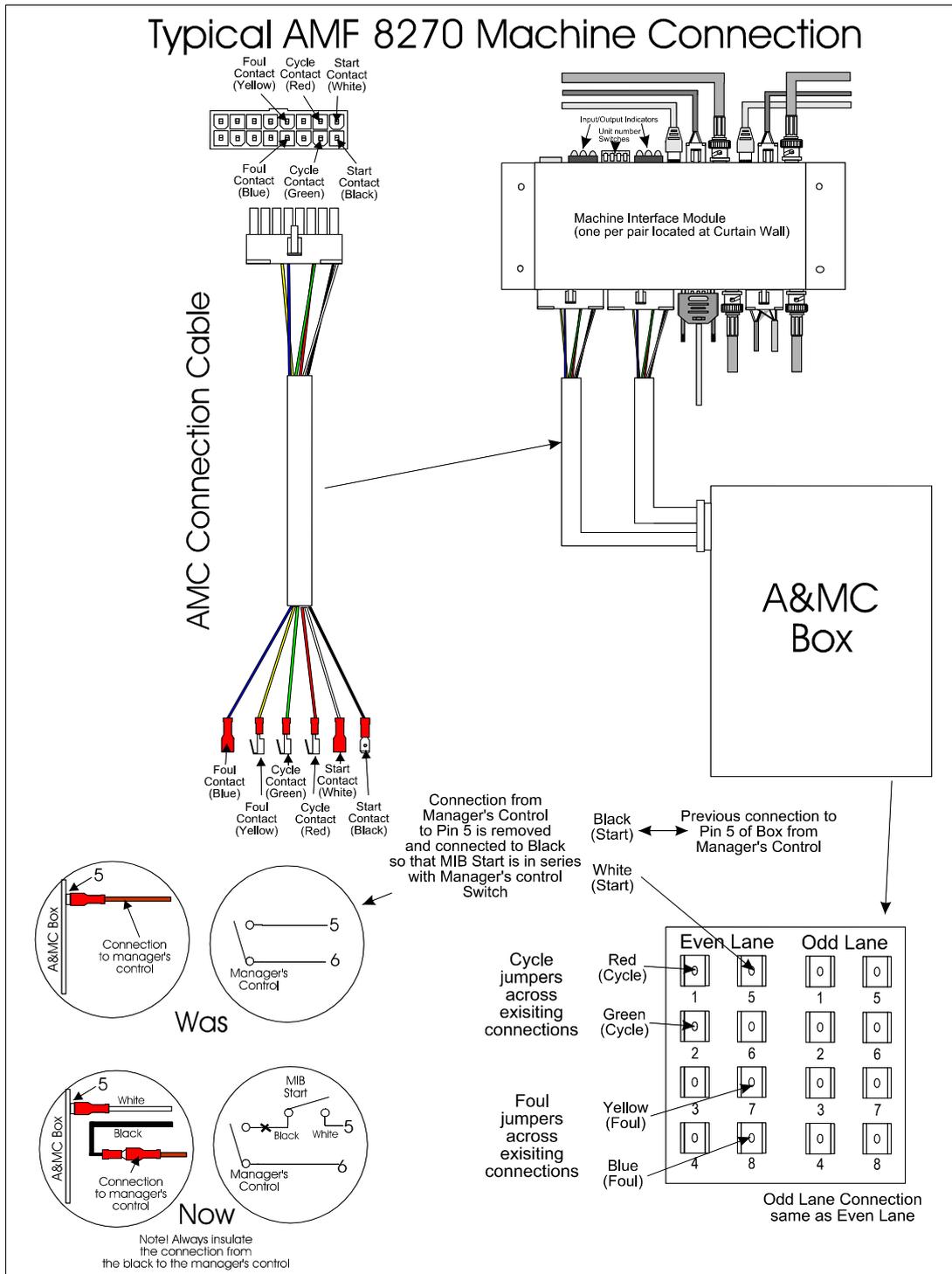


figure 9.1. Typical AMF 8270 connection – No APS

2. Brunswick Model A and A2

The Vantech Comscore system will operate Brunswick A and A2 pinsetters with minimal machine connection (pinsetter Start and Cycle). Foul connection (not shown) is via the Keyboard Module. Machine type selected in Options as Brunswick Model A (or Bright.) or Brunswick Model A2 (or Bright.).

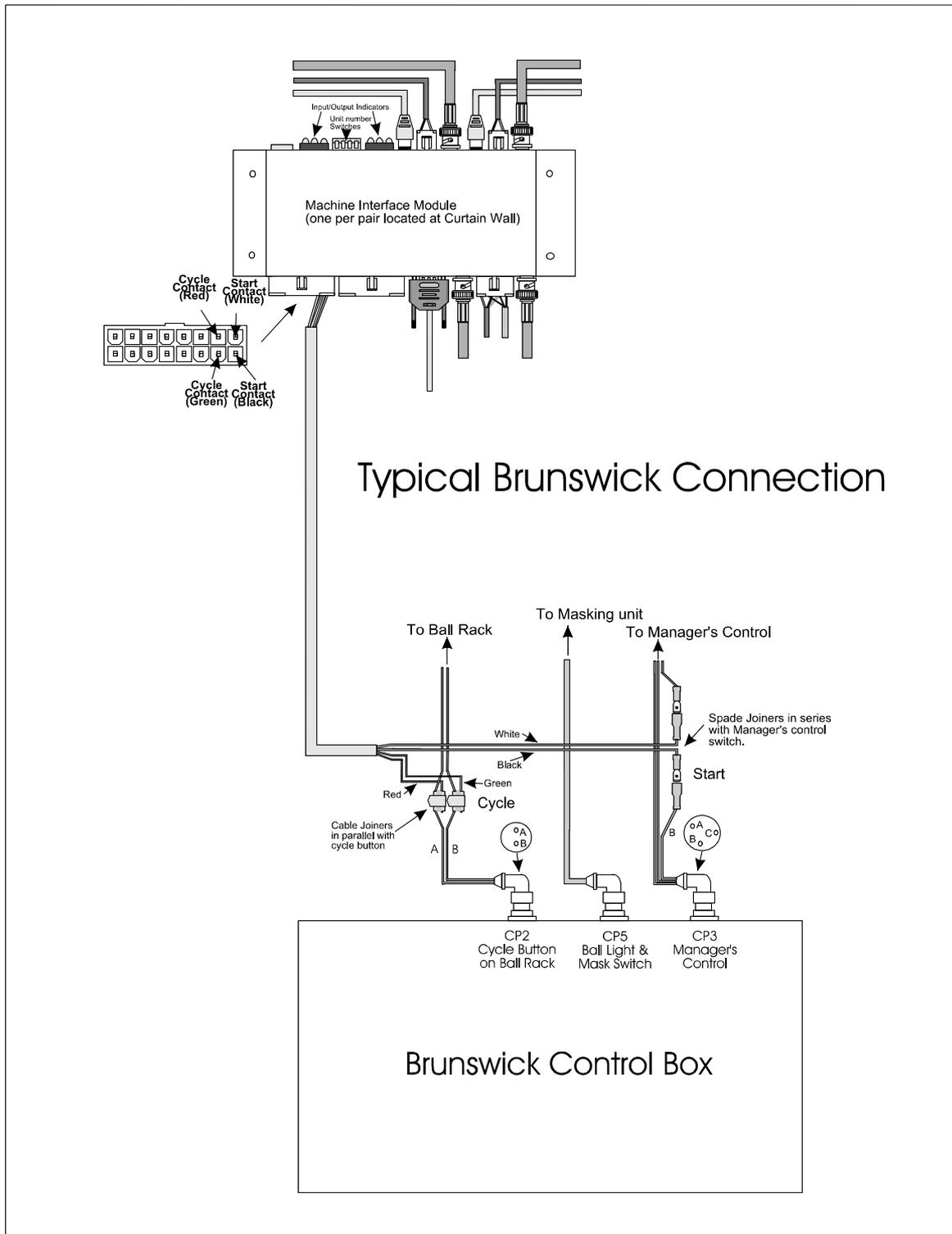


figure 9.2. Typical Brunswick A and A2 connection

3.1 AMF 8270 (MK expander Board fitted) – Rake Switched fitted.

Pinspotters with the Omega Tek MK expander Board fitted are able to accept APS signals from the Machine Interface Module. These signals inform the pinspotter chassis of the score prior to the table sensing the pins, which allows for sweep reverse on first ball for a score of Miss or 7-10 pick off as well as performing short strike cycles. In addition to the connections outlined in part 1, the Vantech Comscore system requires connection to a). Second ball light, b). A rake down switch, c). The APS input plug of the MK expander in order to utilise the APS capabilities.

Machine type selected in Options is either Model 8270 (with Rake Switches fitted selected in Advanced Options) or Model 8290XL (with connection via APS selected in the Advance Options). Note! The Take Data Delay (this is the delay from Rake dropping to the score being taken), in the Advanced Options, should be set so that the score is taken and the APS sent to the MK expander prior to the table moving downwards on first ball.

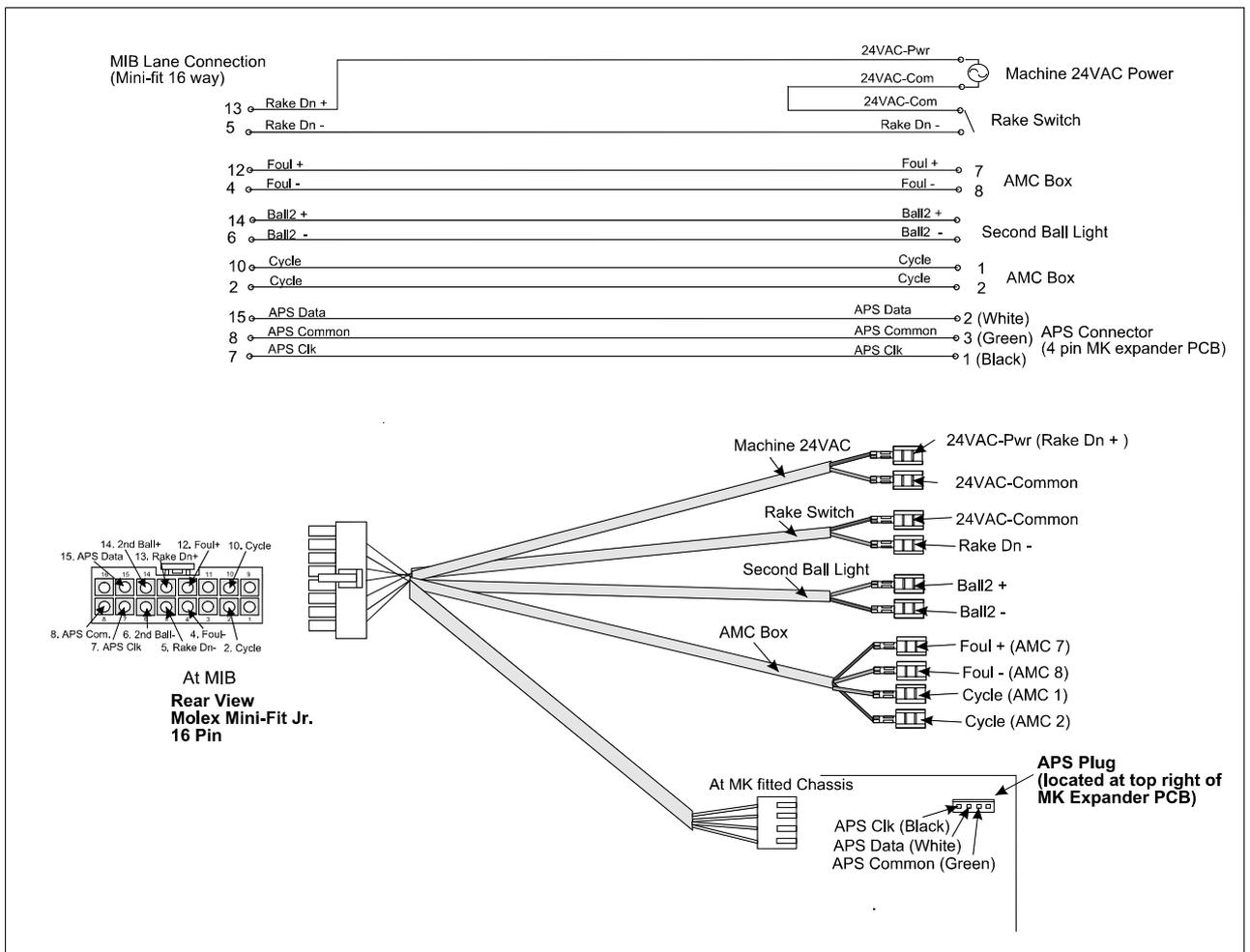


figure 9.3. Additional AMF 8270 (with MK expander fitted) connections

3.2 AMF 8270 (MP chassis or CT chassis) – (Rake Switches Fitted).

AMF 8270 Pinspotters with MP chassis are able to accept APS signals from the Machine Interface Module. These signals inform the pinspotter chassis of the score prior to the table sensing the pins, which allows for sweep reverse on first ball for miss and 7-10 scores as well as short strike cycles. In addition to the connections outlined in part 1, the Vantech Comscore system requires connection to a). MP chassis APS plug, b). A rake down switch, in order to utilise the APS capabilities. Note! The Machine Cycle connection is part of the APS plug. Machine type selected in Options as Model 8270 (with Rake Switches fitted selected in Advanced Options) or Model 8290XL (with connection via APS selected in the Advance Options). Note! The Take Data Delay (this is the delay from Rake dropping to the score being taken), in the Advanced Options, should be set so that the score is taken and the APS sent to the MP Chassis prior to the table moving downwards on first ball.

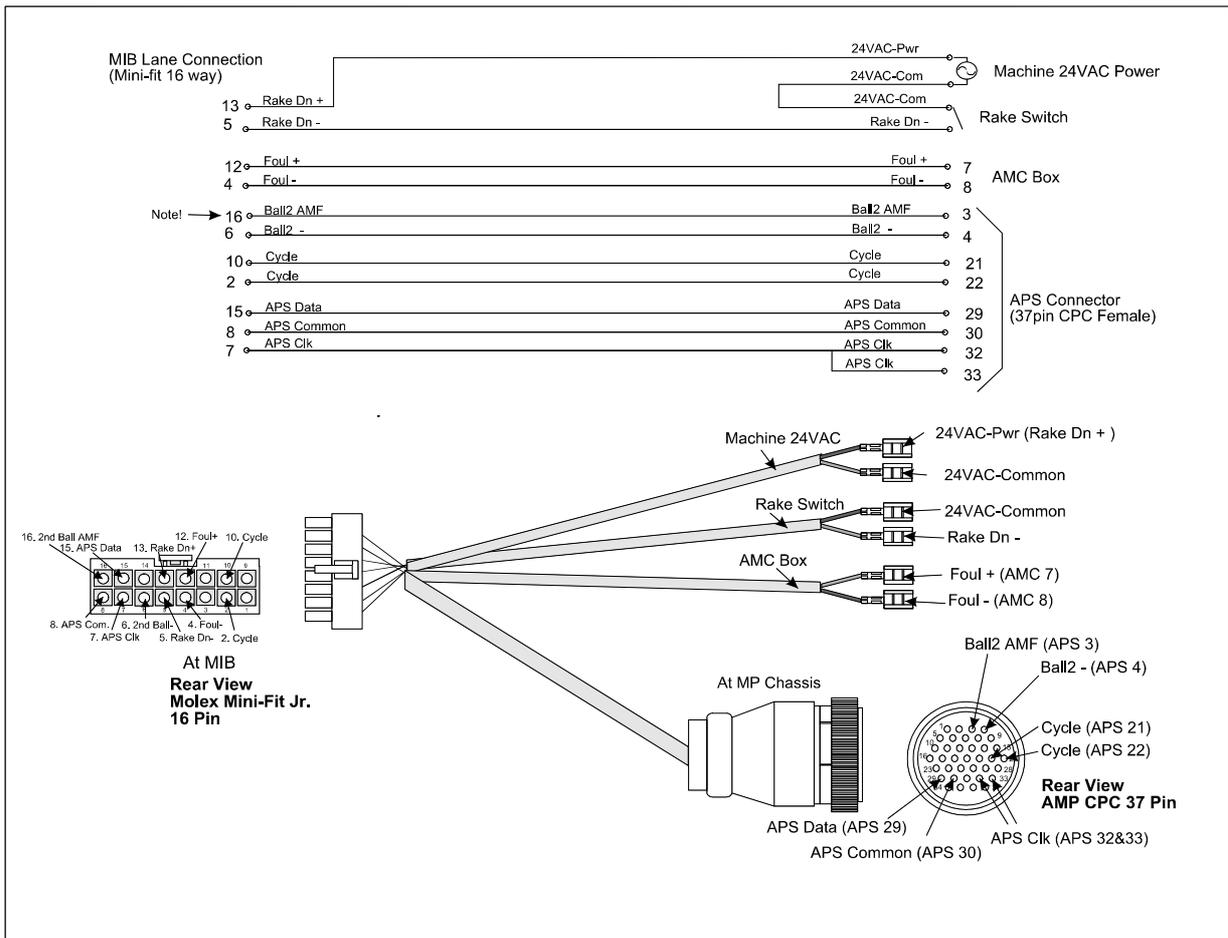


figure 9.4a. Additional AMF 8270 (MP chassis) connections

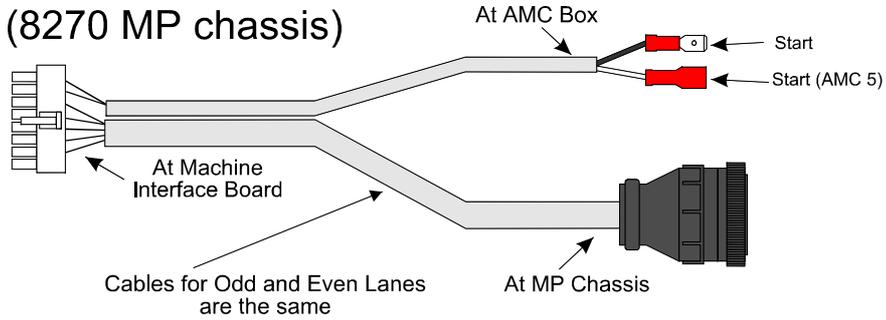
3.3 AMF 8270 (MP Chassis or CT chassis) – (No Rake Switched fitted)

It is possible to operate the APS function without Rake switches fitted but Ball detectors must be fitted and enabled and Rake switches must be disabled in the Advanced Options Menu.

Matrix to APS Connection (8270 MP chassis)

Pin	Function
1	Start
2	Cycle 1
3	Not Connected
4	Foul -
5	Not Connected
6	2nd Ball -
7	APS Clock
8	APS Common
9	Start
10	Cycle 2
11	Not Connected
12	Foul +
13	Not Connected
14	2nd Ball +
15	APS Data
16	Not Connected

Rear View
Molex MiniFit.
16 Pin
Odd & Even Lanes
are wired the same



Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	Foul +	11	Not Connected	21	Cycle 1	31	Not Connected
2	Foul -	12	Not Connected	22	Cycle 2	32	APS Clk
3	2nd Ball +	13	Not Connected	23	Not Connected	33	APS Clk
4	2nd Ball -	14	Not Connected	24	Not Connected	34	Not Connected
5	Not Connected	15	Not Connected	25	Not Connected	35	Not Connected
6	Not Connected	16	Not Connected	26	Not Connected	36	Not Connected
7	Not Connected	17	Not Connected	27	Not Connected	37	Not Connected
8	Not Connected	18	Not Connected	28	Not Connected		
9	Not Connected	19	Not Connected	29	APS Data		
10	Not Connected	20	Not Connected	30	APS Common		

Rear View
AMP CPC
37 Pin

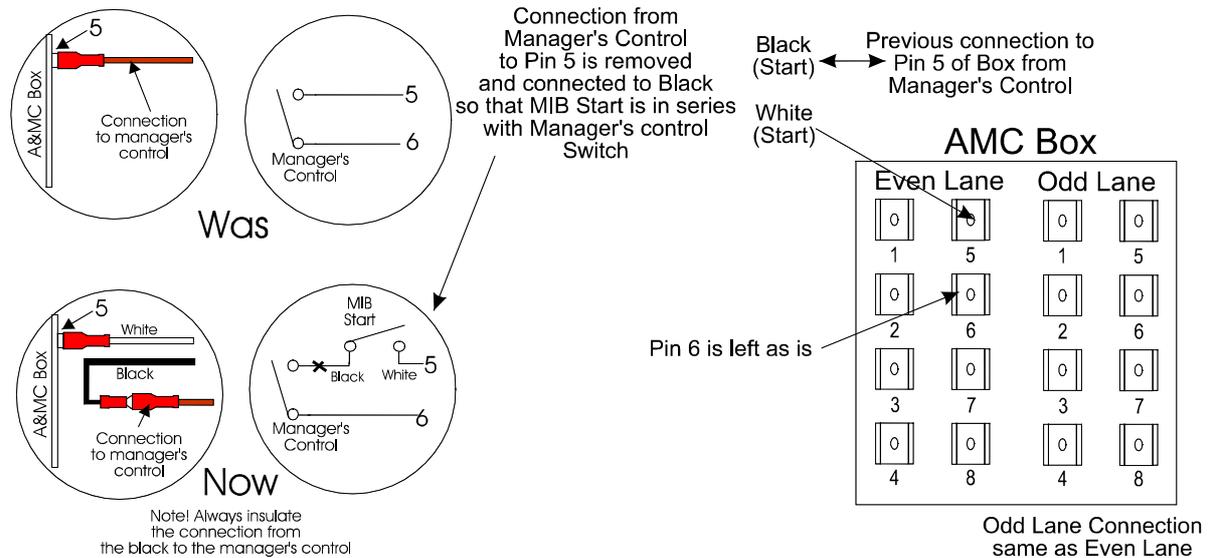
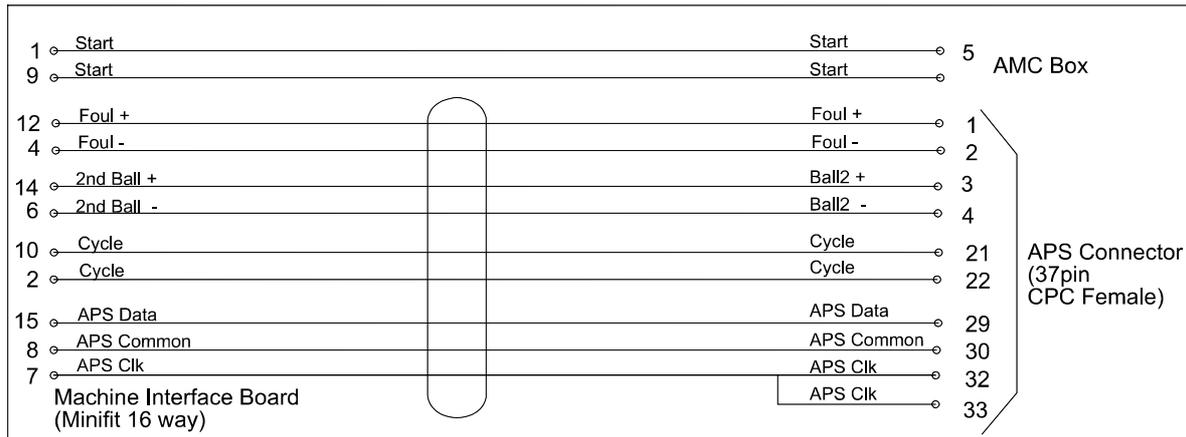


figure 9.4b AMF 8270 (MP chassis) connection – No Rake Switches fitted.

4. AMF 8290XL Small Chassis Connection.

The AMF brand 92-90XL pinspotter (small chassis) requires a connection to the Scorer in order to operate as intended. The Scorer and the chassis communicate via a RS422 serial connection (refer figure 9.5a). The chassis communicates machine state information (Foul, Take Score etc) to the Scorer and the Scorer returns the pin count information, for use in short cycles etc. To operate under this mode the Model type AMF Model 82-90XL must be selected in the Options and Pinspotter Connection set to “via scoring plug” in the Advanced Options. Note! Machine Start can be achieved via a central connection to the MCU (Manager’s Control Unit, if present).

AMF 8290XL Scoring Connection

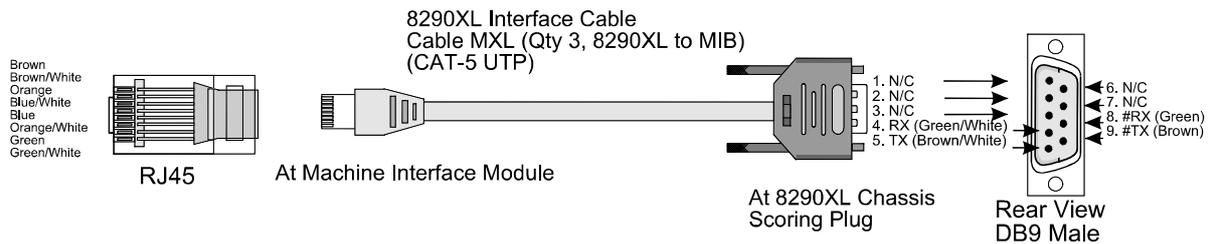


figure 9.5a AMF 8290XL Interface Cable

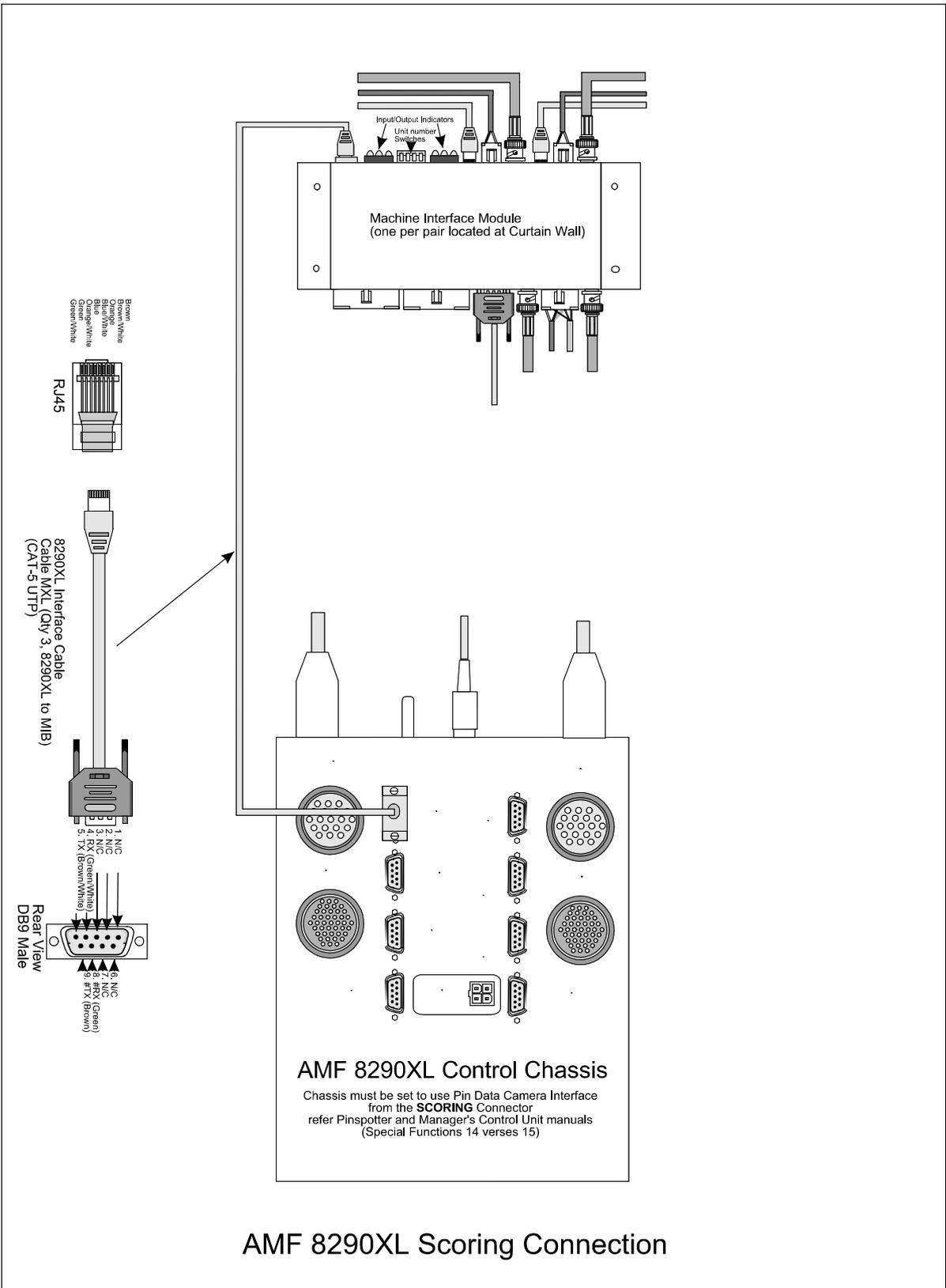
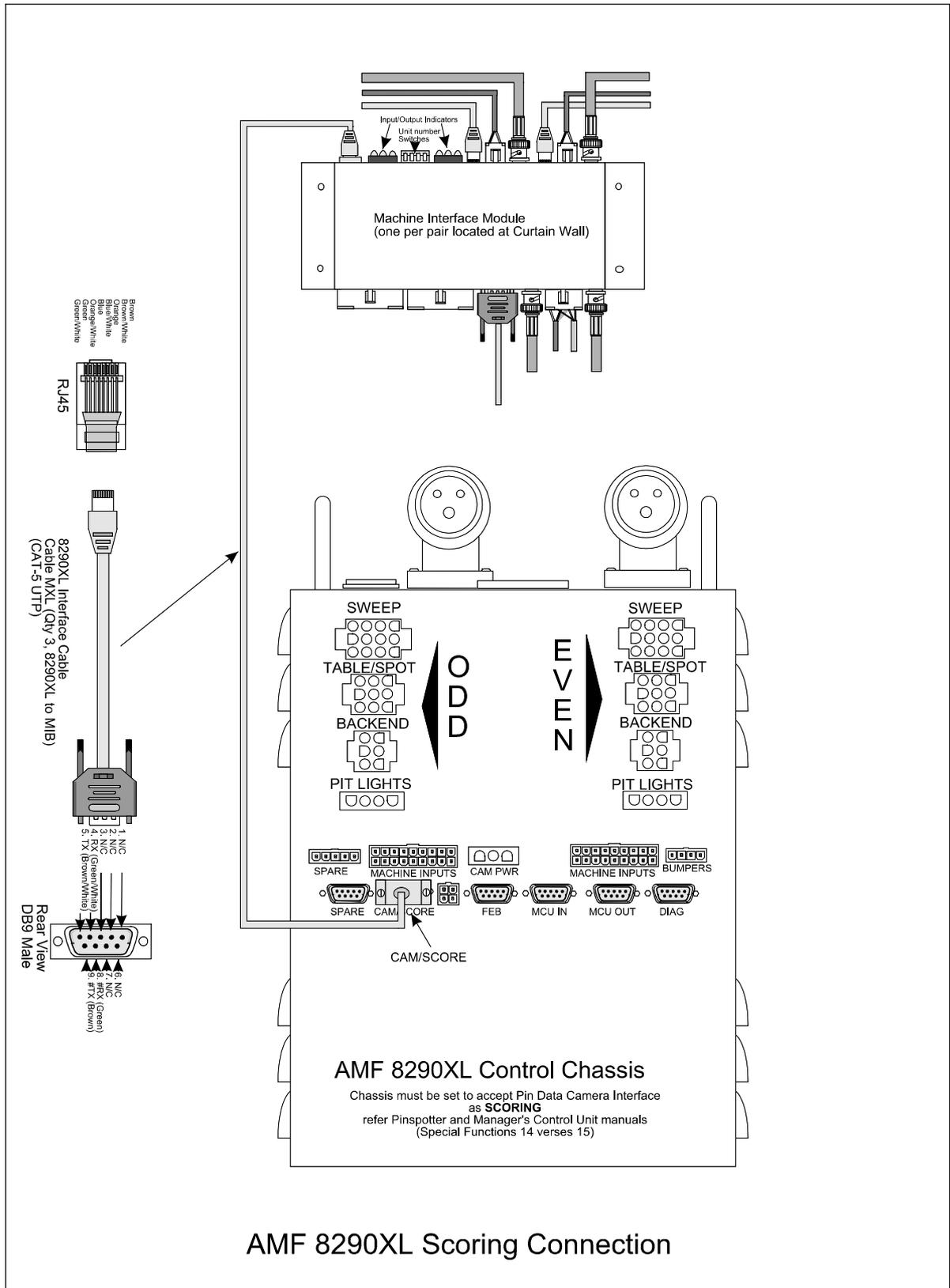


figure 9.5b AMF 8290XL (small Chassis connection)



AMF 8290XL Scoring Connection

figure 9.5c AMF 8290XL (small Chassis connection) Type II

5. AMF 82-90 Large Chassis or existing AccuScore Connection

The AMF brand 82-90 pinspotter (large chassis) or an AMF brand 82-70MP chassis pinspotter that have previously been wired to accept AMF brand AccuScore scoring has the rake down, 2nd ball light, foul etc connections available for use by the Vantech Comscore system. The following diagram describes the conversion harness for attachment to the Machine Interface Module. Note! other brands of machines that have been wired previously for AMF Accuscore can make use of the extra machine connections. To operate under this mode the Model type AMF Model 82-90XL must be selected in the Options and Pinspotter Connection set to “via APS” in the Advanced Options. Note! Machine Start can is achieved via a central connection to the MCU (Manager’s Control Unit, if present). Care must be taken to check that the Take Data Delay is set such that the score is reported prior to the table moving on first ball. Alternatively a replacement cable can be provided as per figure 9.6c.

Conversion from Accuscore connections to MIB Connection

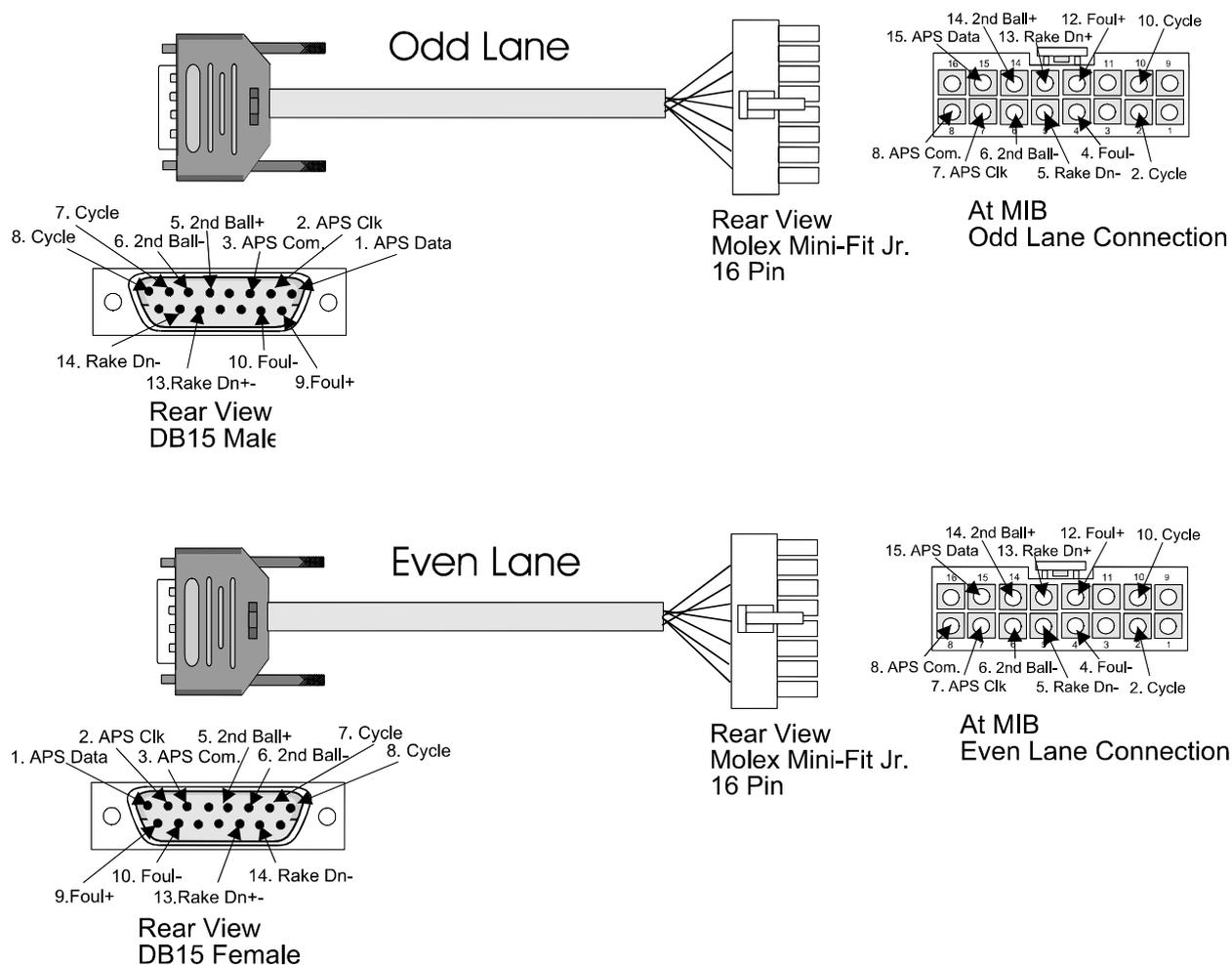


figure 9.6a Accuscore to Machine Interface Module Conversion cable.

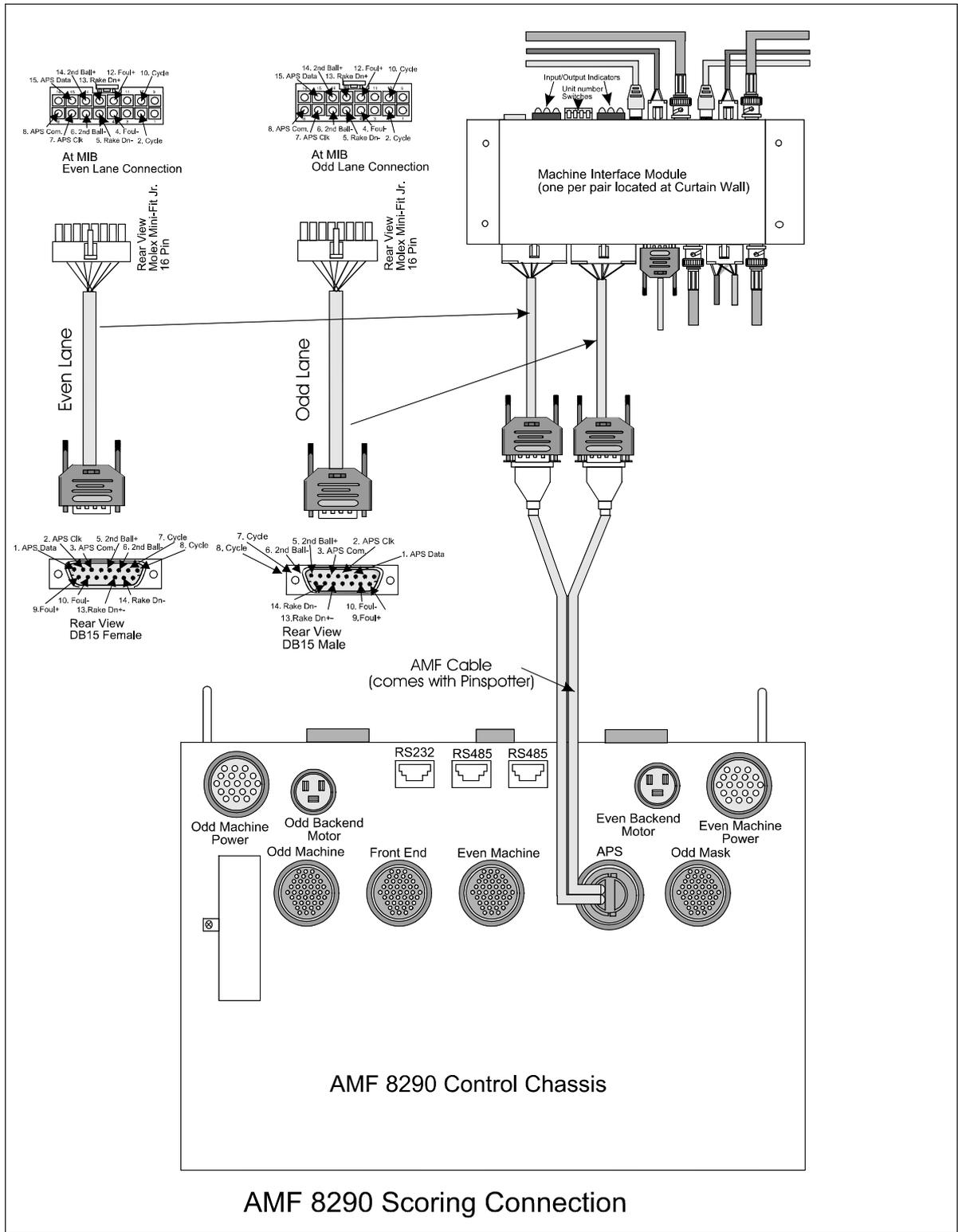


figure 9.6b AMF 8290 (large chassis) connection

Matrix - AMF 8290 Wiring Diagram

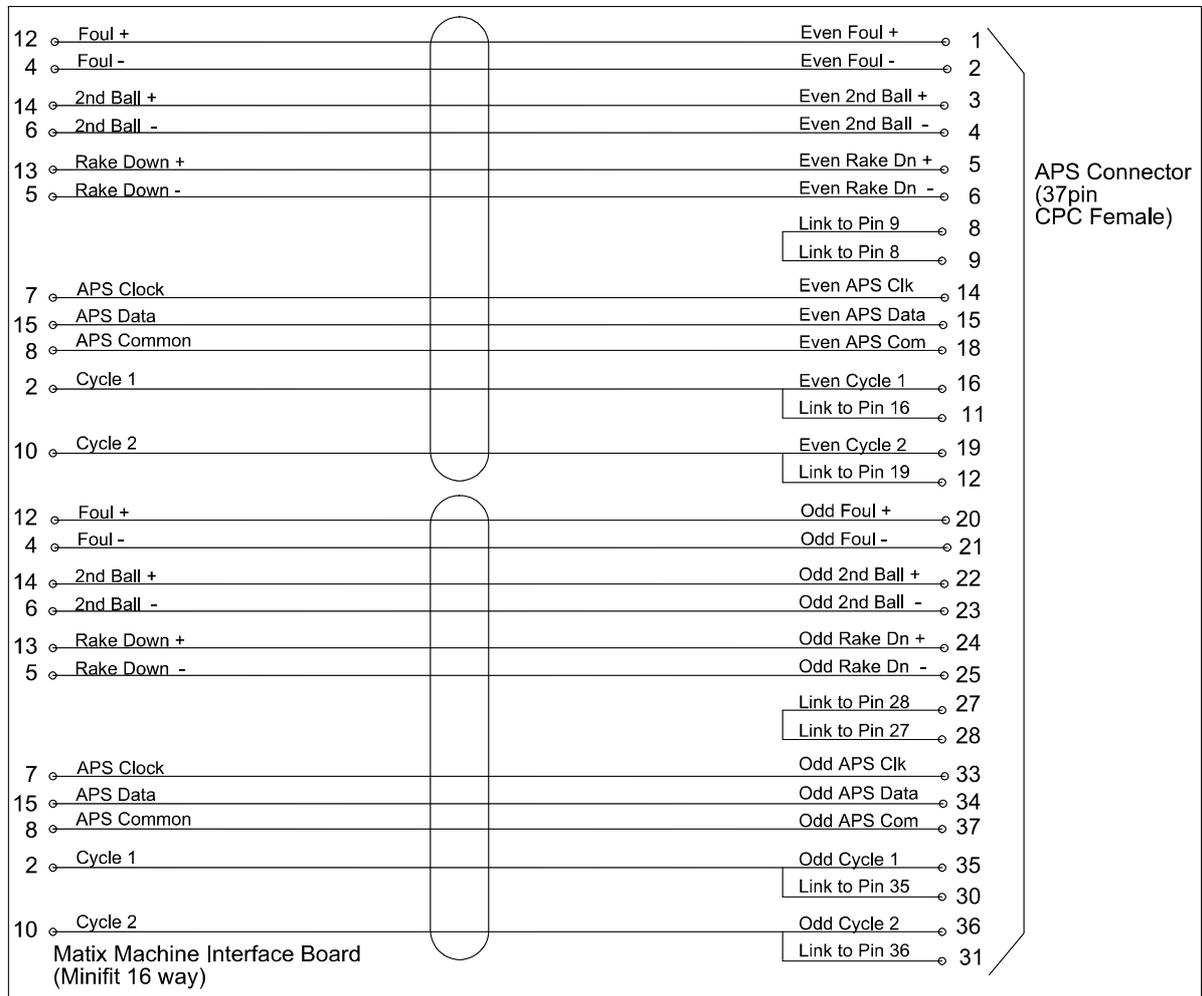
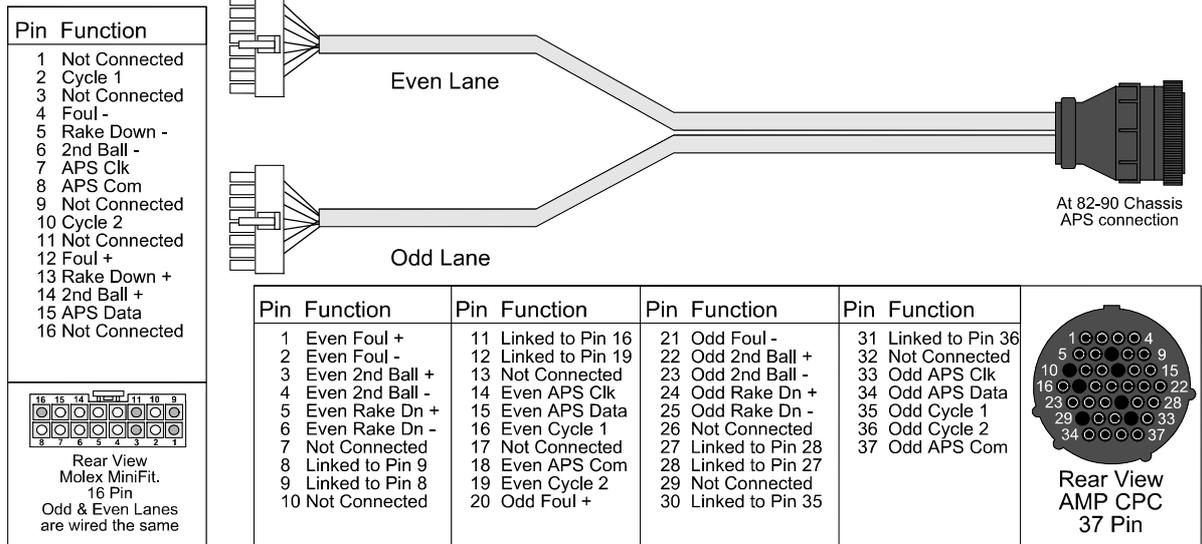


figure 9.6c AMF8290 (large chassis) connection – (Replacement cable).

Connection to AMF MCU (Manager's Control Unit) for machine control.

AMF 8290XL and 8290 pinpotters use a MCU (Manager's Control Unit) to centrally control the Starting and Options for the machinery. In these cases, it is necessary to connect a cable from the Comscore Host computer to the MCU as per below.

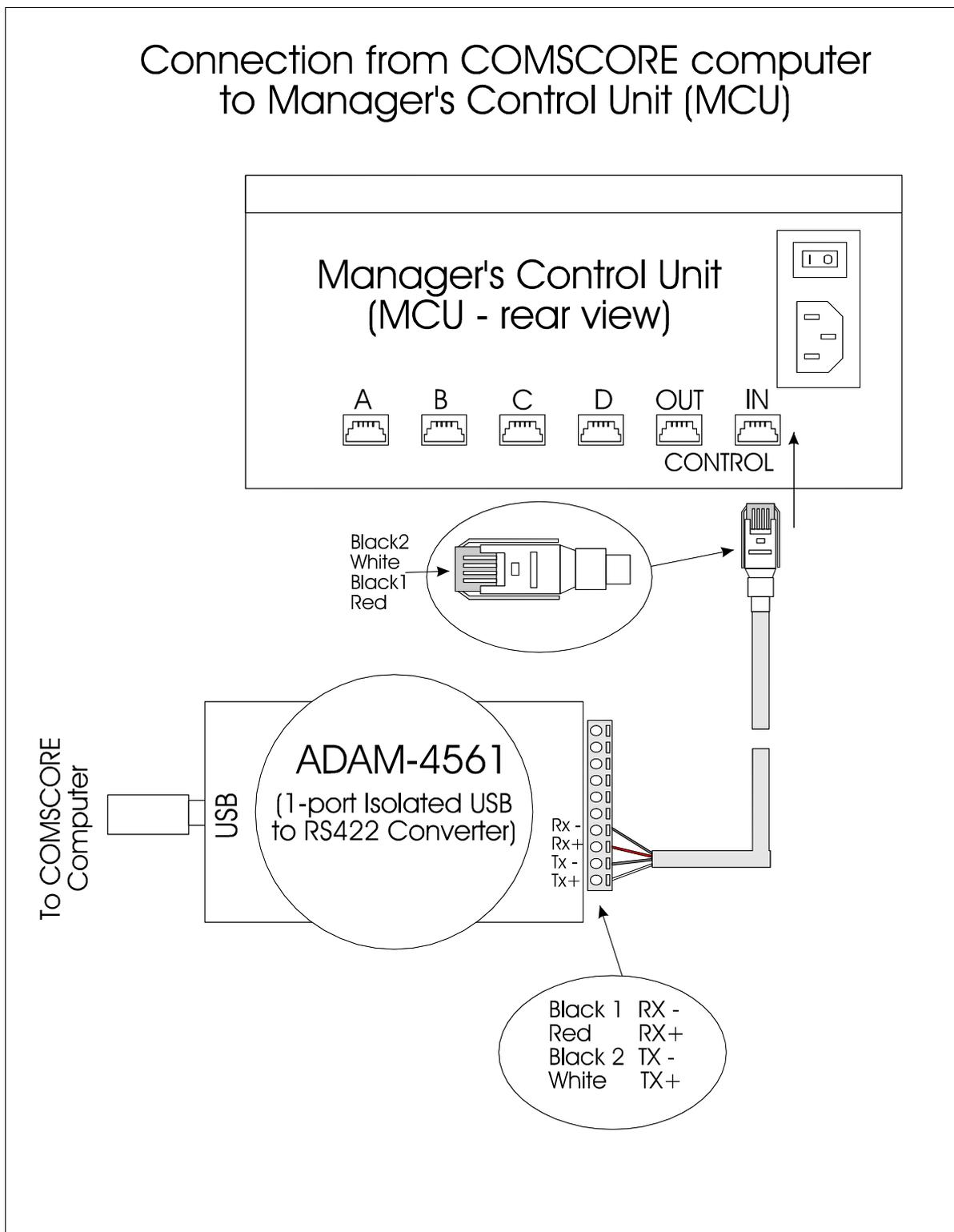


figure 9.7 AMF MCU to Comscore Connection

6. Brunswick GS92-98 Brands Connection

When connected to Brunswick GS brands (not including GS-X & GS10) the scoring utilises scoring information coming from the PCS (Player Control Station) output of the pinsetter. The scoring camera can still be connected to the system but is only used for pin action replay and late pinfall correction. The following diagram shows the connections of these pinsetters. Model type Brunswick GS92..98 must be selected in the options menu and the pinsetter must be set to Tenpins operation.

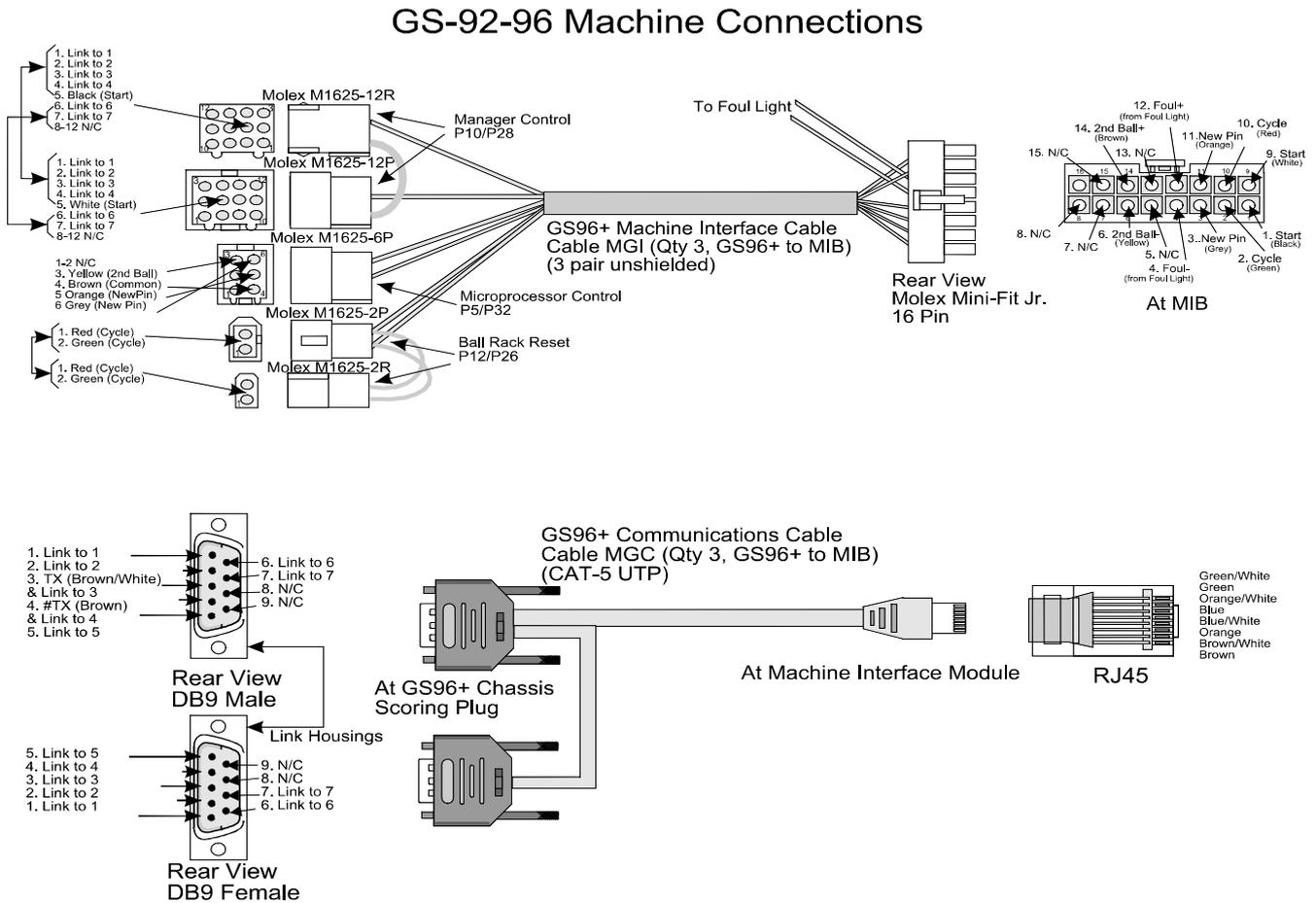


figure 9.8 Brunswick GS92..98 Connections

7. Brunswick GS-X Connection

The Brunswick GS-X pinsetters are designed for direct connection to the scoring system via the LLAN plug of the NexGen chassis. The Lane Scoring Camera and Ball Detector Module is optional using this method, as the pinsetter communicates scoring and ball detect information directly to the scoring system. The Lane Scoring Camera and Ball Detector Modules are only used for Pin Action Replay, Ball Speed and Late Pin fall correction. An interface box is fitted between the COM1 port of the Matrix Chassis and the NexGen chassis LLAN plug for the three units connected to the Matrix as follows. Model type is set to Brunswick GS-X and the pinsetter set to the Frameworkx option.

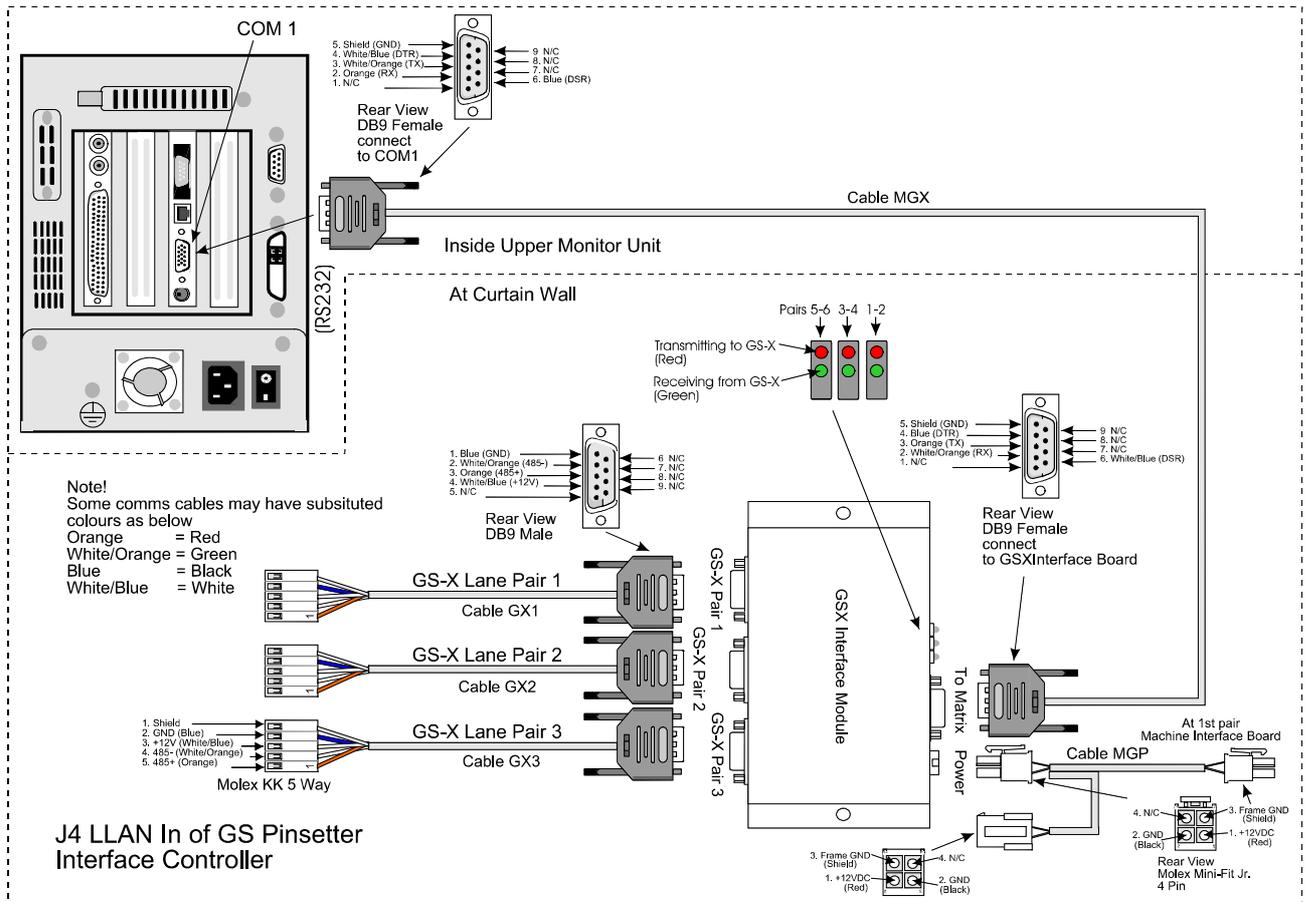


figure 9.8a Brunswick GS-X Connections – for GS96 Pinsetters with GS Pinsetter Interface Controllers Installed.

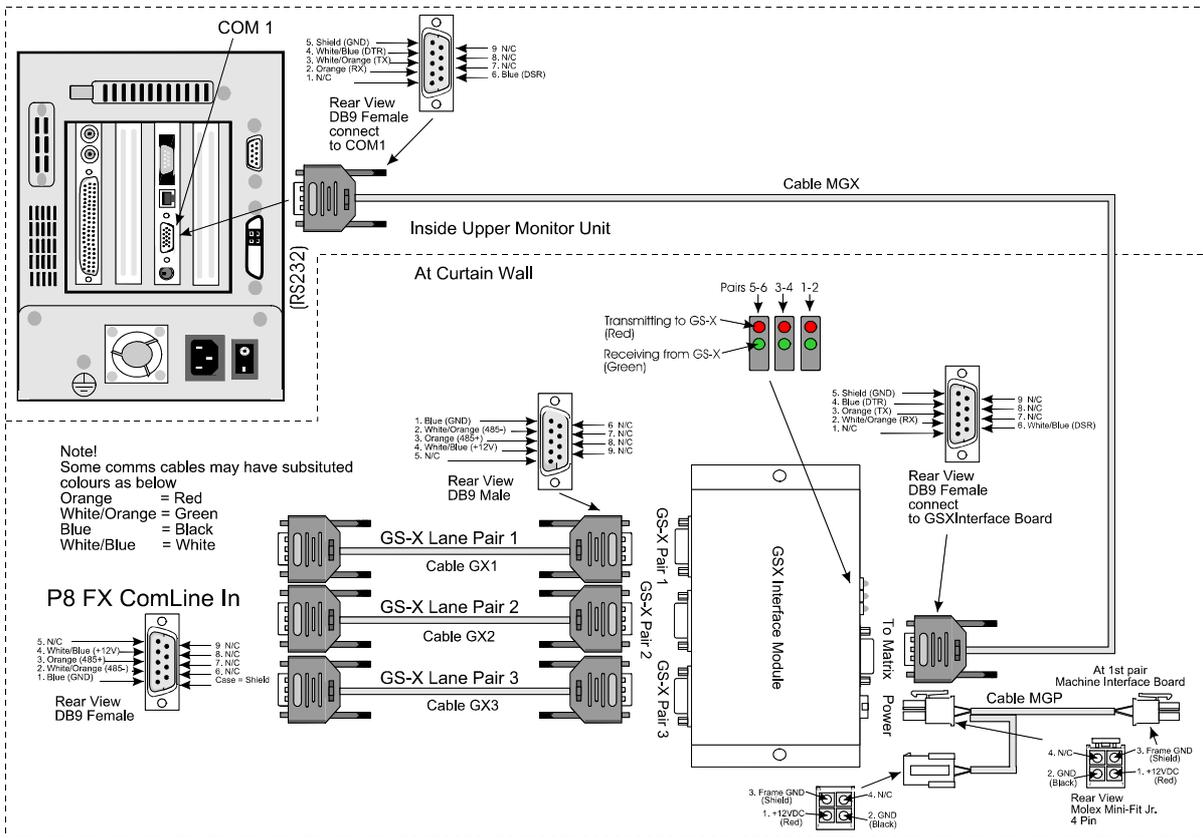
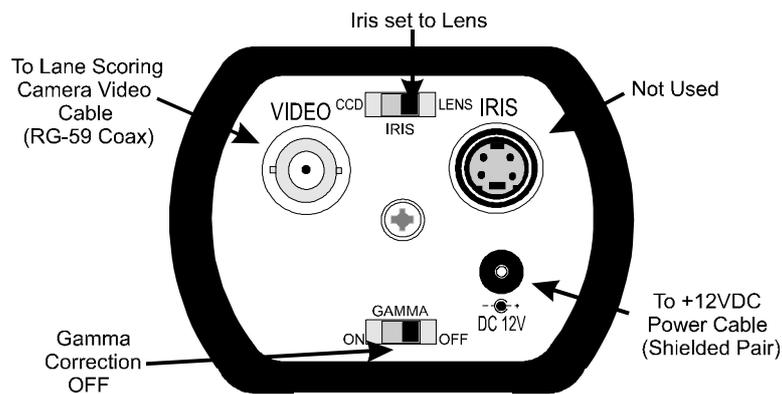


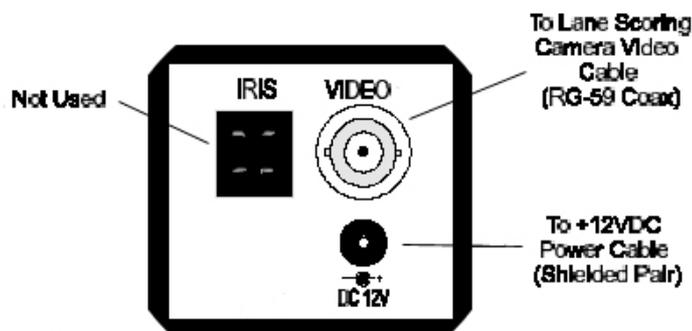
figure 9.8b Brunswick GS-X Connections – for GSX Pinsetters.

Lane Scoring Camera

The Lane Scoring Camera is located on the capping between the lanes at a distance of 4.01 metres (13 ft 2 inches) from the end of the Flat gutter. The Lane Scoring Camera is a EIA (Black and White NTSC compatible) standard CCD Camera. It receives either +12VDC input from the Matrix Chassis or +15VDC via a separate power pack in the Display Unit (refer figure 4) and transmits a 1Vpp video signal to the Machine Interface Module. The Machine Interface Module multiplexes the Video signal to the Matrix Chassis in sequence with the Video Signal from the other Lane Scoring Camera in the group. The Matrix 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 DC power is applied. 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 alignments, along with 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 with a VCR for future reference or debugging. The Scoring Software was originally developed using pre-recorded tapes of various bowling centres. A VCR tape can be used by VanTech Comscore Agents to check a Lane Scoring Cameras Operation.



Lane Scoring Camera
(Rear View)
Type I



Lane Scoring Camera
(Rear View)
Type II

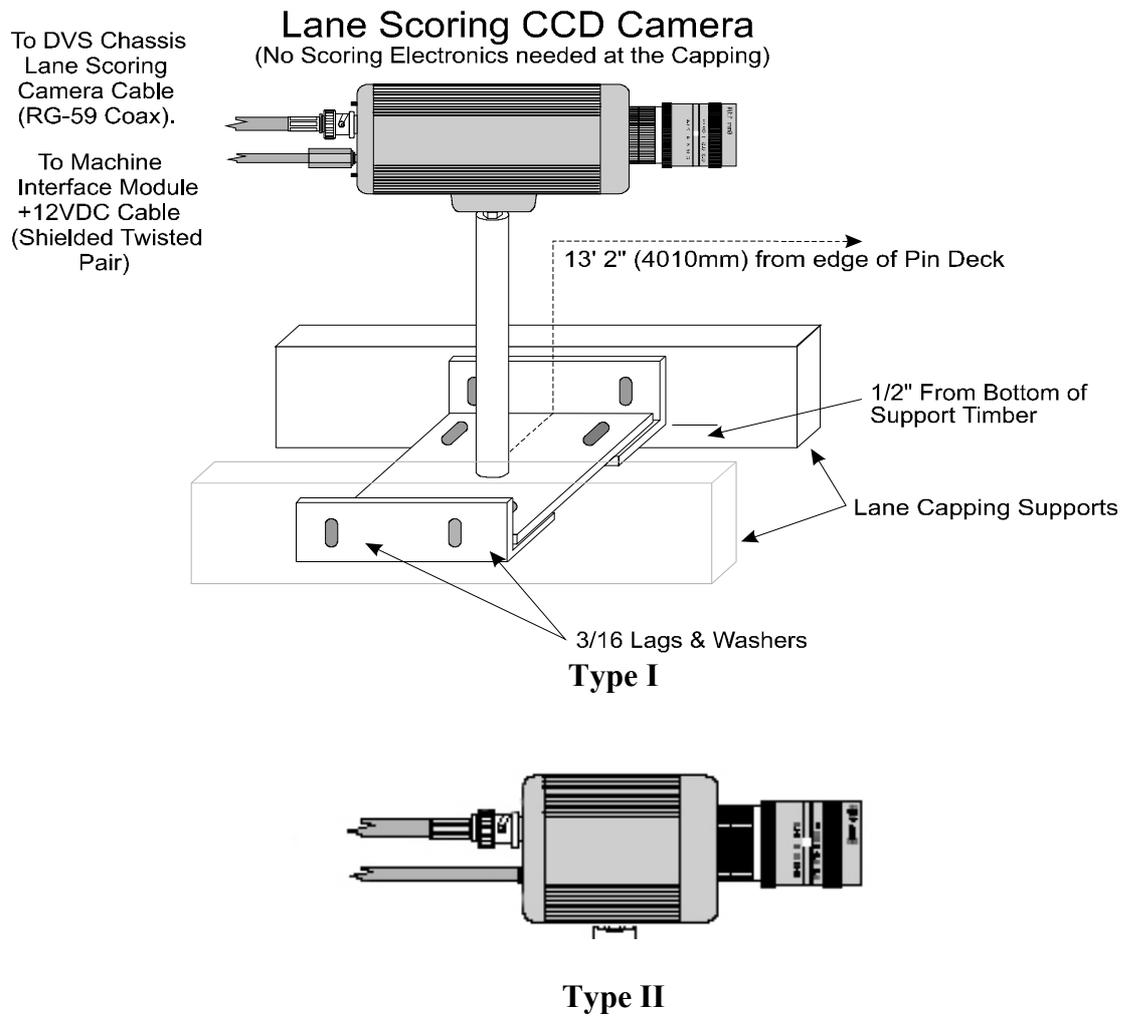


figure 10a & 10b Camera and Support and Rear View for connectors
(Camera Types I & II)

Ball Speed Sensor

The Ball Speed Sensor unit consists of a pair of retroreflective (need a reflector) Infrared Photo-switches that are located near the Lane Scoring Camera. The Ball Speed Sensors receive power from and send beam cut signals to the Machine Interface Module via the MBD Cable. The Photo-switches have an indicator LED that will illuminate when the beam is cut or the unit is out of adjustment. To adjust the unit, loosen the four Adjustment Locking Screws on the top of the eyeball mounting. The Photo-switch will now be free to move vertically and horizontally. Move the photo switch left and right and up and down until the LED goes off. Holding the unit vertically, move the unit left and right to determine the central horizontal position. Repeat the process in the vertical direction. Having determined the central position for the LED being off, hold the unit from moving and gently tighten four Adjustment locking screws. Take care to note that two locking glands that hold the photo-switch to the eyeball mount are tight so that the photo-switch can not move and cause a false ball speed signal.

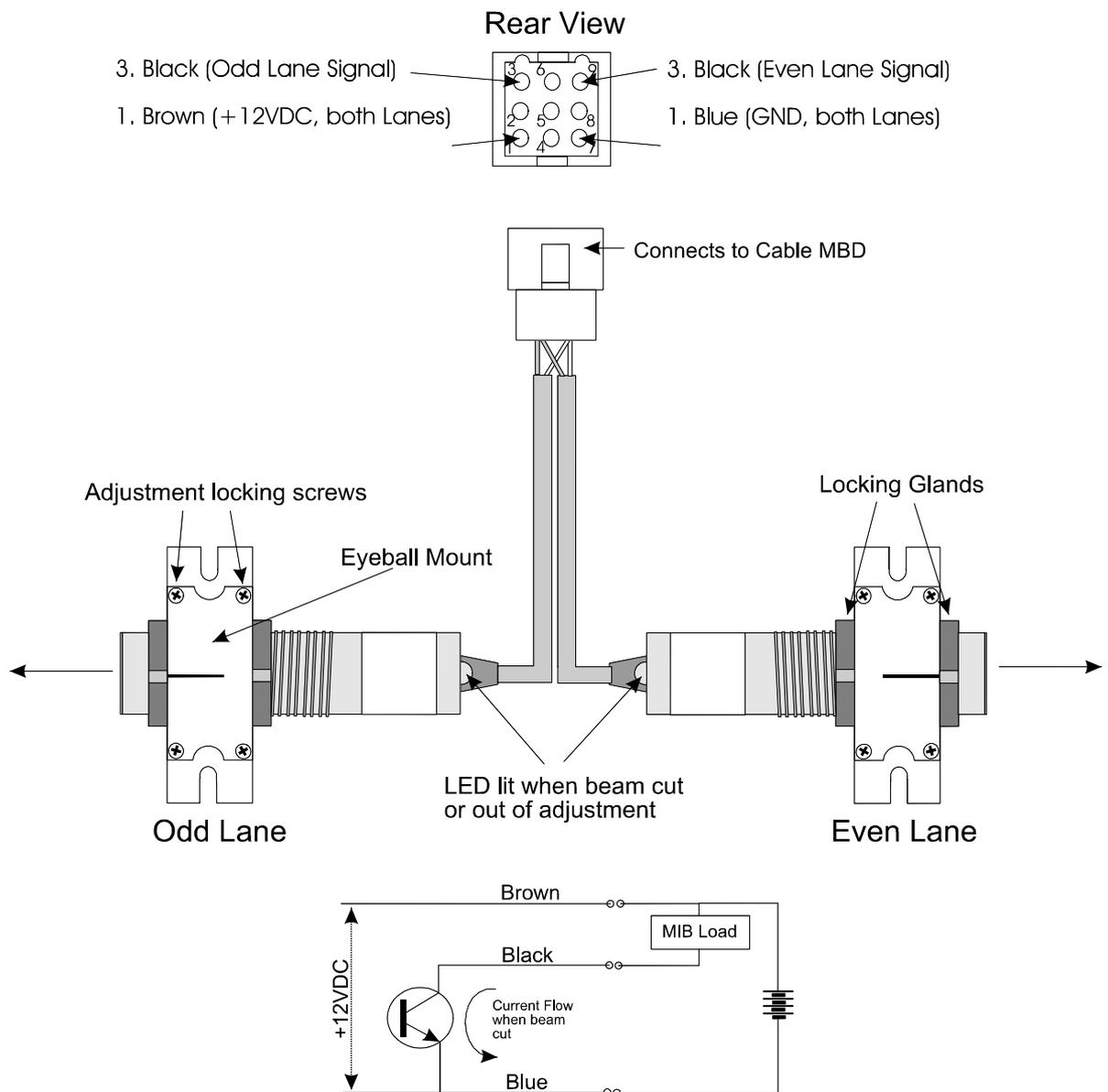


Figure 11 Ball Speed Sensor

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 Matrix chassis enclosure has UL approval as do 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 be removed only by authorised service personnel. 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 or endanger the public.
- The Matrix chassis contains no user serviceable parts and all service to the Matrix chassis, other than replacing the unit, is to be done by approved VanTech Comscore agents. Turning off the Matrix chassis using the power switch located on the chassis itself only turns off the Matrix chassis. 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. Under no circumstances should a Pinsetter/Pinspotter Machine be entered while operating. Never enter a Pinsetter/Pinspotter unless it is switched off at the power. Never rely on the Computer Score Machine Contact as it may be operated without warning. 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 scoring system to determine ball speed and to differentiate between valid scores and invalid scores. Cycling of the Pinsetter/Pinspotter Machine in the case of a light ball is the responsibility of a separate program supplied by Ebonite-Vantage. 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). Refer to Ebonite-Vantage for any information regarding the VanTechTrigger program.

Hardware Issues

Matrix Chassis

This unit has a central role in the operation of all hardware components and therefore is a potential cause of a range of problems that may be encountered. It is possible to move a matrix chassis to another location within the center to trial its operation prior to returning it to an Authorised VanTech Comscore agent. Note, when a Matrix Chassis is moved, its lane information (lane number, camera configuration, ball-speed calibration) will need to be updated to match the new location, this can be done via the lane software. The Matrix Chassis stores both program and configuration information, refer to the Lane Software Manual for information on the operating software including configuring the Scoring and Ball Speed.

The Matrix Chassis has an internal system watchdog timer that will automatically reset the chassis in the event of a major fault (hardware or software) halting system operation. During this reset the lane monitors will go blank and display the Matrix sign-on screen while the system software restarts. This event may indicate a fault in the Matrix chassis or it may indicate the Matrix chassis recovering from an external effect (e.g. power fluctuation, faulty communications with the counter computer, as opposed to no communications). If the Matrix Chassis is unable to communicate with the counter computer it will automatically go to stand-alone mode and will return to normal operation when communications has been re-established.

Generally, problems with the operation of the Matrix Chassis hardware, as distinct from software issues, will affect all lanes in the group controlled by the Matrix Chassis. For example, all lanes blank (no power to or from the Matrix Chassis), all lanes resetting (system watchdog recovering from a fault).

The Matrix Chassis has been designed for rapid replacement to minimise down time.

SVGA Display Monitors

Problems with a SVGA Display Monitor generally are restricted to the picture on its particular lane (e.g. no picture, rolling picture, too bright, incorrect color etc.). It is necessary to first determine whether the problem is the display monitor or the signal from the Matrix Chassis. To do this, simply exchange the VGA connectors between each monitor in a lane pair (e.g. connect lane 5 monitor to lane 6 matrix connection and vice versa). If the picture problem remains on the same SVGA display monitor then it will need service by an authorised technician. If the problem moves to the other display, then the Matrix Chassis output is at fault and the Matrix Chassis needs returning to an authorised VanTech Comscore agent for service.

Keyboard

Problems with the keyboard module generally relate to one or all keys not being displayed.

If only one or a line of keys are not responding, the problem is most likely in the keyboard membrane itself (i.e. a broken track on the keyboard membrane or the keyboard housing pinching the keyboard membrane and holding a key down). It is however possible that the keyboard PCB has had one or more of its inputs damaged by static electricity (Note special design features have been incorporated to minimise this occurrence). The quickest way to isolate the problem is to exchange the keyboard PCB with another lane pair. If the problem follows the keyboard PCB it will need to be returned to an authorised VanTech Comscore agent for service. If the problem stays on the original lane pair it may be a faulty keyboard membrane or a fault with the keyboard housing crushing the keyboard membrane. Keyboard membranes are self-adhesive and are replaced by peeling off one unit and sticking

down another. Note that a keyboard membrane that has been peeled off is usually unable to be re-used.

If no keys respond, the problem is generally not due to keyboard membrane. Keyboard power and information travels from the Machine Interface Module at the curtain wall to the Keyboard Module via the MKM Cable. If the problem exists on more than one keyboard pairs in the Matrix Chassis group or other Machine Interface Module functions are not operating (e.g. Machine Cycle, Start or Ball Speed), then refer to the Machine Interface Module section. If not, the problem will be either with the Keyboard PCB or the MKM Cables. Listen for the keyboard buzzer and check the indicator LEDs when a key is pressed. Also check if the keyboard beeps three times on start up. Exchange the Keyboard PCB with another lane pair, if the problem follows the Keyboard PCB then it needs to be returned to an authorised Vantech Comscore agent for repair. If the problem stays with the lane pair than damage to the MKM Cable is the most likely cause.

In the case of an Individual Keyboard configuration, The Slave module transmits its key information to the Master module via the MKK Cable. The LED on the Master module will flash to indicate a key press on the slave module. It would be possible for a faulty master unit or MKK cable to cause no keyboard response from the slave module.

Voltage free contact (switch closure) style foul units can be connected to the keyboard module Foul Connector. Most of these foul units have an isolated pair of contacts for odd and even lane (four wires). Some units, however, one side of each contact connected together in common (sometimes three or sometimes four wires). The Keyboard PCB Foul Connector pins 1 and 3 are connected to ground inside the Keyboard PCB. In the case of voltage free contacts with a common pair, the common wire(s) need to be connected to pins 1 and(or) 3 of the Foul Connector.

Machine Interface Module

Up to three Machine Interface Modules can be part of the same Matrix group. Each Machine Interface Module is identified by a unique combination of dip switches. The Machine Interface Module uses the 1st dip switch combination for connectors 1 & 2 of the Matrix Chassis Link Cable (e.g. lanes 1&2) etc. It is important that the dip switch combinations of all Machine Interface Modules in the group are set appropriately.

The Lane Scoring Cameras are multiplexed on the Machine Interface Module group, i.e. the Matrix chassis uses the Machine Interface Modules to switch to each lane camera image in a repeating sequence. Only one video cable (MVM) is placed across the ceiling from the curtain wall to the Matrix Chassis. Note that if two of the three video signals in the sequence are blank then the Matrix chassis will be unable to correctly lock on the remaining signal. This is overcome in the Lane Software Advanced Setting Menu. Refer to the Lane software manual for instructions on how to notify the Matrix chassis that one or more camera signals are not present.

It is possible to check the state of each input and output by checking the corresponding indicating LED on the Machine Interface Module. For example, if the pinsetter is not turning on, check whether the green LED for Machine Start is illuminated. If so the problem is most likely a wiring problem within the pinsetter (although it is still possible that the Machine Interface Module is faulty, this can easily be checked by exchanging the Machine Interface Module with another pair and setting the appropriate dip switch combinations. If the problem moves with the Machine Interface Module then it needs to be returned to an authorised VanTech Comscore agent).

If the pinsetter fails to turn off, again check the start LED. If it is On then the problem most probably is software related (the software decides when to turn the pinsetter Off based on its understanding of whether the pinsetter is idle or not)

If the Machine Interface Module is suspected of causing false pinsetter cycles, check the green cycle LED. If it does not illuminate, the problem is most likely a pinsetter problem. It is possible to completely remove the pinsetter cycle connection to the Machine Interface Module connector to ultimately prove whether the scoring system is a fault in such a case.

Each of the Machine Interface Module output contacts have a 900mA resettable thermal fuse in series for protection. If excessive current flows through the contact, the thermal fuse will halt current flow to avoid damage to the Machine Interface Module.

If none of the Machine Interface Modules in the Matrix group are operating, the problem may be related to the Matrix chassis or the cables (MCM, MVM or MPM). Power for the Machine Interface Modules in the group comes from the Display Unit via the MPM cable. This includes power to the Keyboard Modules.

Lane Scoring Camera

The image produced by the Lane Scoring Camera is sent to the Machine Interface Module and switched in sequence to the Matrix Chassis. The Matrix Chassis captures the image for use by the software in determining the scores for the lane pair. There are, therefore, a number of factors that could be the cause of scoring problems. These include

1. *The image of the Pinsetters:*

Look for the following items

- Replace shiny or reflective curtains.
- Ripped curtains will swing when a ball hits the cushion of the Pinsetter causing the pin light to be reflected back into the camera.
- Block out 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-phosphorus 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.
- To ensure that the Table/Deck is visible under cosmic/glow bowling, place an 8¹/₂” wide x 3¹/₄” high piece of glow material on the very bottom of the front of the deck shield. An 8¹/₂” wide x 2” high piece on the very top of the front of the deck shield will help keep the deck visible as it sets 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.

2. *The power to the camera.*

The camera needs a clean source of +12VDC or greater to operate without causing a fluctuation in its image. As a result a separate +15VDC power supply may have been installed in the display unit to compensate for voltage drop down the MPM cable. Make sure that all cables are routed away from sources of interference, including fluorescent lights, electric motors and gaps in the ball track (sources of static discharge). Also check that the power plug of the MVC cable is tight and the correct hole size (2.1mm).

3. *The focus, brightness and physical adjustment of the camera.*

All cameras have factory set focus and iris (brightness) adjustments. These adjustments are locked in place at the camera lens using two fine screws. If the camera image appears out of focus on the camera set up menu, it is possible to loosen these screws and manually adjust focus and brightness. It is strongly advised that such adjustment should only be undertaken in consultation with an authorised VanTech Comscore agent. Also, excessive vibration of the camera may lead to loosening of the camera's lens or casing screws.

Although the Lane Scoring Software configuration process is designed to automatically determine the position of all the pins on the lane pair, the system benefits from a correctly positioned camera. The most critical physical adjustment is the tilt across the lane pair, i.e. make sure the image of the camera appears horizontal with the pins of the odd lane being at the same height as the even lane. The pins should be approximately in the centre of the image both vertically and horizontally. Make sure that the camera is locked onto its support pedestal via a locking bolt and star washer. Check that the mounting lags are secured properly to the sub-frame and that the sub-frame is secure. Check that the capping does not touch the mounting pole and that the camera shield does not touch the camera.

4. *The camera's hardware*

Inspection of the captured camera image on the Camera Set-up Menu, may reveal a blank, rolling or fluctuating image from the Camera. If so it is advised that the camera be swapped with another to check if the problem follows the camera.

5. *The cables leading to the Machine Interface Module*

As per the above, if the problem stays on the original lane pair, the cables will need inspection for potential breaks or damage (particularly cables resting on the ball track or being squashed by part of the machine).

6. *The Machine Interface Module's hardware and the cables leading to the Matrix Chassis.*

Refer Issues in the Machine Interface Module section.

7. *The Matrix Chassis hardware and software.*

Refer Issues in the Matrix Chassis section as well as the Lane Software manual regarding Camera Setup Menu.

Ball Speed Sensors

If Ball Detection is enabled in the Options Menu for the lane pair and the system fails to be notified of a ball being bowled, then the system will not register the score. This feature is very useful in eliminating unwanted score corrections from pin stands etc. but will cause a problem if the ball speed sensor is mis-aligned or malfunctioning. The photo-switches have an LED to indicate when the beam has been cut. If this LED is continuously on, then re align the photo-switch. If the photo-switch is unable to be placed in a position where the LED is off, then the unit may be faulty, the reflector may be mis-aligned or photo-switch voltage may be low (this can be a cabling, Machine Interface Module or power supply problem).

If the LED comes on as the beam is cut but the system is still not scoring, check the LED indicator on the Machine Interface Module. This LED indicator should also illuminate when the beam is cut. If it does not, the problem may be in the cabling to the Machine Interface Module, be a faulty Machine Interface Module or may be an internal fault in the photo-switch. Check the MBD cable for breakage or crushing, particularly over the ball track or around the pinsetter.

It is possible to disable the Ball Detection feature in the Lane Software Options Menu, the scoring will still function but all pinsetter cycles will generate a score. This is a rapid way

of determining if the ball detection is the cause of the no score and also allows bowling to continue until such a time that the lanes are available.

Refer to the Lane Software Manual for calibrating ball speed.

Note that there are many different types of photo-switches. The type used for this application are described as retroflective, NPN transistor output, Dark On.