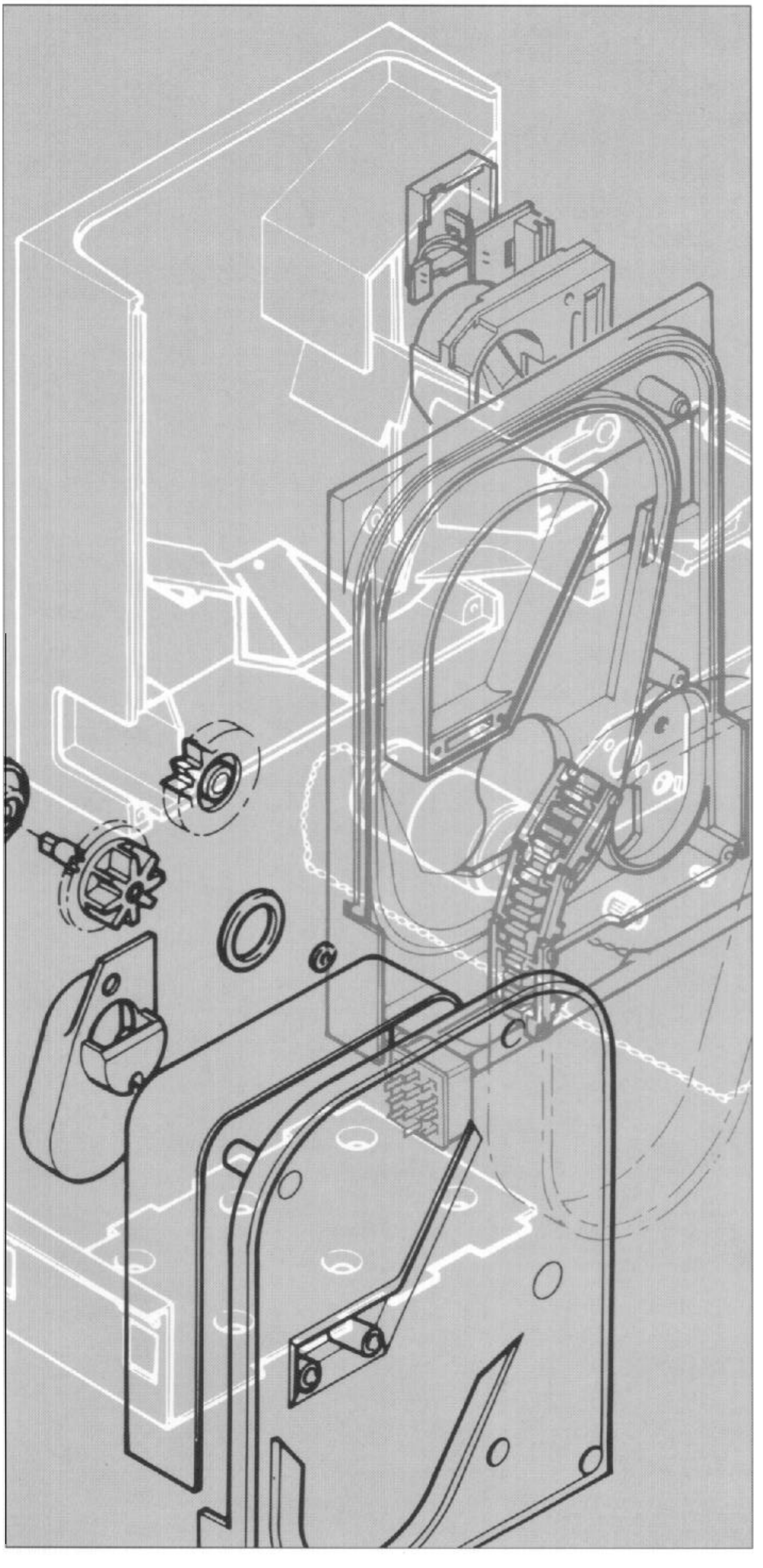
COIN CONTROLS INTERNATIONAL

Technical Manual

Universal Hopper Series



RETURN TO MAIN MANUAL

Contents

Universal Hopper Series

Coin Controls' Universal Hoppers were first introduced in 1984 The MkII and MkIII models proved themselves to be exceptionally reliable, with high count accuracy. The Mk4 is the latest generation of this extremely successful series.

The Mk4 Universal Hopper can be used as a direct replacement for MkII and MkIII Hoppers. Any specific variances are clearly indicated, where.appropriate, in this manual. When ordering Mk4 Universal Hoppers as a replacement, it is important to specify which version is being replaced.

Safety Note- Mk4 Hoppers only

To meet the requirements for EN 60950 the equipment must be installed according to the following requirements:

The equipment must be protected by a 3A fuse.

The equipment must be supplied from a SELV limited power source.

The equipment must be installed in an enclosure but positioned so that it is external to any fire enclosure area within the main enclosure.

GENERAL DESCRIPTION 1.0

1.1 Description

The Universal Hopper is an "intelligent" large capacity coin and token dispenser ideal for a wide range of applications including Gaming, Vending and Transportation systems.

MkII and MkIII hoppers will handle most coins in the range 16mm - 30mm diameter and 1.25mm - 3.5mm thick, giving the following approximate capacities:-

Coin Size		Capacity
Diameter	Thickness	
28.4mm	2.21 mm	800 approximately
24.25mm	1.75mm	1600 approximately

The Mk4 has extended the range to include 31 mm diameter and 1 mm thick coins.

The rate of payout, whilst being dependent on the coin dimensions and also the volumes of coins in the Hopper at any given time, is approximately 3 coins per second.

Precise payout is ensured through optical sensing and verifying of coin dispensing with an electronic security signal which alerts against coin jams, failed sensors and bad power supply. LED indicators are provided for easy visual checking of power supply, security status and coin sensors.

The Universal Hopper has the in-built facility to operate in 3 modes:-

Mode 0
the direct switching mode.

Mode 1
the hopper is controlled directly by a LOGIC CONTROL LINE. When the line is 'active', the motor runs.

Mode 2
the hopper is driven by pulses on the control line which allows the hopper to be used in place of a solenoid payout with no software and few hardware changes.

1.2 Options

There is a standard Universal Hopper handling coins in the diameter range of 21 mm - 30mm, and the small coin Universal Hopper handling coins in the diameter range of 16mm - 21 mm. Both of these models can be supplied with a number of options:-

1.2.1 Connector Position

The 12-pin connector can be in one of two positions, either on the opposite side of the coin exit, known as the standard position, or on the same side as the coin exit, known as the adjacent position.

1.2.2 Level Sensing

Universal Hoppers can be supplied with a choice of coin sensing positions, these can be either:-

High level or

Top level

All Hoppers are automatically supplied with a low level function to indicate coin starvation.

1.2.3 Connector Options

Mk4 Universal Hoppers are available with connectors compatible with MkII and MkIII Hopper installations. It is important, when ordering, Mk4 Hoppers as a replacement to specify which version is being replaced.
All of the above options must be specified when ordering.

1.3 Installation

Important: Power should not be applied until the installation is complete.

1. Secure the base plate in position, using the six fixing holes. The hole positions are shown in Fig.1 1 b.

2. Wire up the base plate connector to the host machine - see section 6.2 for connector details, and sections 4 & 5 for interfacing recommendations.

NOTE:

The wire to be used should have *a maximum length of 3 metres, and must be capable of handling the maximum currents and voltages specified in section 6.*

3. Slide the hopper into the baseplate and ensure that the two halves of the connector are securely mated.

4. Turn on the power.

1.4 Safety

1. Do not put a hand into the hopper while the motor is running.

2. Static
It is possible for coins paid out to have a static charge on them. Coins should be discharged to earth before being presented to the user.

IMPORTANT:
The hopper should not be installed/removed from baseplate with power connected. Avoid inhalation of coin dust during any servicing operations.

MECHANICAL DESCRIPTION 2.0

2.1 General

The hopper is mounted in a machine via the base plate. Electrical connection to the hopper is made via the 12 pin socket on the base plate which mates with the corresponding plug on the hopper body.
Coins are stored in the cashbox section of the hopper and fed onto the elevator belt via a passage in the centre plate. The cut-out in the centre plate has been designed to regulate the flow of coins onto the belt. The stirrer agitates the coins in the coin box in order to minimise the occurrence of bridging.
The elevator belt is driven by a motor, gear box, and idler gear. Coins are picked up at the bottom of the belt and carried up to the exit window. Optical sensors in the exit window detect the coins as they roll out of the hopper.
A cable connects the main control board to the 12 way socket and carries all power supplies and control signals.

2.2 Differences Between MkII, MkIII and Mk4 Hoppers

Feature	MkII	MkIII	Mk4
Motor drive	Belt	Belt	Direct
Gears	Plastic	Plastic	Metal & plastic
PCB location	Centre plate	Centre plate	Coin box
LEDs location	PCB	PCB	Exit window
Opto sensors	2 sets	1 set	3 sets
Track guard	Blue	Green	None

2.3 Trackguard Removal and Refitting (MkII and Mk III only) See Fig 12(b)

Firstly, locate cut away slots in Centre plate and End plate at the base of the track guard opposite the PCB.

Push track guard up to reveal a gap between body moulding and the guard. Insert broad flat bladed screw driver or equivalent into gap and gently lever out the guard until the leading edge is above the outside edge of the body mouldings. Now slide the guard down towards the cut out and gradually withdraw it.

Slide back the track guard to refit.

2.4 Coin Box Removal and Refitting

Removal

1. Place the hopper flat on a bench, with the end plate face down.
2. Remove the locking nuts from the level sense plates and disconnect the wires low level and high/top level, if fitted.
3. Remove the fixing screws.
4. Lift the coin box and stirrer clear of the end and centre plates.

Refitting

5. Place the coin box flat on a bench.
6. Fit the stirrer to the coin box, ensuring that the thin prong is located in the slot in the coin box.
7. Turn the stirrer shaft so that the square hole is aligned with the drive shaft which protrudes from the centre plate.
8. Hold the centre plate/end plate assembly above the coin box.
9. Feed the level sense wires through the holes in the coin box.
10. Lower the assembly onto the coin box and ensure that the mating walls are correctly located.
11. Turn the hopper over.
12. Insert and tighten the fixing screws.
13. Re-connect the level sense wires.

With Mk4 hoppers, the PCB also has to be located when refitting the coinbox.

2.5 Track and 12-Pin Plug access

To service the track, and 12 Pin Plug, follow instructions below and refer to figures 12(a) for Mk4 and 12(b) for MkII and MkIII.

1. MkII and MkIII Hoppers may be fitted with a metal strut. Removal of the strut will require the coin box to be removed first, see 2.4.
2. Remove the trackguard if fitted, see 2.3
3. Note how wiring is laid out and whether plug is on the left or the right of the centre plate (there should be a plug blanking plate in the side not used).
4. Place flat on a bench (coin box face down) and remove the fixing screws.
5. Remove end plate
6. Remove idler gear
7. Pull the track off the centre plate.
8. Reassemble by placing the track in the recess provided in the centre plate, making sure that the leg of the 'L' shape on the track plate is against the centre plate. To test the track is seated correctly, spin it, if it jams this means that one or more of the legs are not in the recess.
9. Refit idler gear, taking care not to disturb the track.
10. Place the end plate as horizontally as possible to the centre plate, making sure that the track is seated correctly. Press home and refit the screws (Bottom first, then top 2, then middle 3).

If the track jams, dismantle and start again.

Replace the track guard on MkII and Mk III hoppers as described in 2.3.

2.6
PCB Access

MkII and MkIII PCBs are located between the end and centre plates.
NOTE: MkII boards are hard-wired to the exit window and cannot be removed without unsoldering the 12 way header.
The Mk4 PCB is located in the coin box. To access the board, remove the coin box as described in 2.4.

ELECTRONIC DESCRIPTION 3.0

3.1
General Electronic Description

Operation of the hopper is controlled by a 4-bit micro-processor. The microprocessor allows the choice of 3 different operating modes. It also provides the motor control drive via a darlington bridge and an optical payout detection output.

Separate power supplies are recommended for the motor supply input and the logic supply input.

3.2
Operating Mode Selection

Three modes of operation are available, selected via inputs IN1 and IN2 (pins 4 and 8 of the 12 way connector). Input signals may be controlled by the host machine, or may be hardwired. Additionally, input IN3 (pin 12) is the logic control line, used in modes 1 and 2. These inputs are passive pull-up active pull-down. The signals therefore default to logic '1' if left open circuit.

NOTE:
It is strongly recommended that if these inputs are to be controlled by the host machine, then open collector NPN transistors, referenced to logic OV (connector pin 2) be used to set the input levels to IN1, IN2 and IN3.

With the exception of 'RESET' mode which can be applied at any time (with instantaneous effect) mode selection is determined at power-up. The hopper allows a 1 OOms time-out after power-up, then reads the inputs IN1 and IN2. The hopper will remain in the selected mode until the power is removed, ie, any further changes in the levels at IN1 and IN2 will be ignored. See fig 1

Refer to section 5.5 for recommendations for driving input signals on pins IN1, IN2 and IN3.

Mode	IN1	IN2
0	1	1
1	0	0
2	1	0
Reset	0	1

FIGURE 1: Mode selectlon input logic

3.2.1
Mode 0

This is the default operating Mode, and is selected when all of the input selectors are left open circuit.

When the 24V line is established, the motor starts in the forward direction and when the 24V power line is removed, the motor is braked.

3.2.2
Mode 1-W Logic Control

In this mode the logic and 24V power supplies can be permanently connected and motor function is determined via a logic level on the IN3 input.

When IN1 (pin 4) and IN2 (pin 8) are pulled down to logic OV at power up, mode 1 is selected. The operation of the motor is now controlled via a logic signal on IN3 (pin 12). With the 24V supply present, a low level on IN3 starts the motor and a high level on IN3 brakes the motor.

3.2.3
Mode 2 - Coin Counting

In this mode, the hopper will pay out a coin for every pulse it receives on input IN3.

Mode 2 is selected by setting IN1 (pin 4) high and IN2 (pin 8) low at power up. Once selected, the processor continually scans input IN3. When a pulse is detected on IN3, an internal register is incremented. When a coin is paid out, it is detected and the register is decremented.

The motor is started when the internal coin register is non-zero and is stopped when it returns to zero. The maximum count for the coin register is 4095 coins. Should the 24V line fail at any point, the motor is braked. When the 24V line re-appears, the payout of coins continues until the coin register returns to zero. Coin counting on IN3 can take place while coins are being paid out.

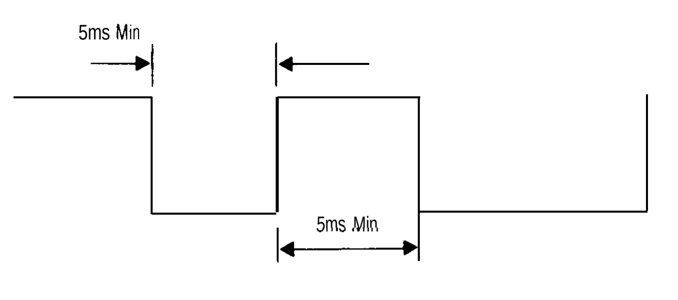


FIGURE 2: Inputs to IN3

A pulse is defined as a falling edge followed by a rising edge. Pulse edges may be no closer than 5ms (see fig.2). This is so that the processor has adequate time to poll the IN3 pin and de-bounce. This represents a maximum pulse rate of 1 00Hz. There is no lower limit. The waveform duty cycle is unimportant.

At power-up in mode 2, IN3 is high. The first falling edge will be recognised as the first pulse and the hopper motor will start running.

Pulsing on IN3 should not commence earlier than 130ms after the logic supply has been established. This will allow for the power-up time-out of 1 00ms and further processing time prior to running the main program.

3.3

Reset Function

The reset function is available on Mklll and, when specified on the Mk4 version.

In this mode the Hopper is reset, i.e. processor reset and motor drive disabled. This function is provided as added security enabling the host machine to immediately stop the Hopper irrespective of its mode of operation.

Whilst in this mode connecting IN3 (Pin 12) to ground turns the exit window sensor off in order to test it is operative. Confirmation would be given as a signal output on Pin 3 and 11 of the 12 Pin connector.

3.4

Optical Sensors

Optical sensors are fitted in the exit window to detect coin payout.

The signal on Pin 11 is the 'Raw' coin output signal. A de-bounced coin output is available on Pin 3. When no coins are present at the exit window, the optical sensors are clear, the output transistors are open circuit, and the LED indicator is off. Coins passing the optical sensors obstruct the light path causing the output transistors to pull down to OV and the LED indicator lights.

3.5

Optical Security Feature

The output of the optical sensor is monitored by the microprocessor and if the sensor remains obstructed for more than one second, the motor will be braked and will remain off until either the sensor is cleared or power down takes place. This action will result if a coin jams in the exit window or if the optical sensor fails which could be checked by toggling IN3 in Reset mode.

If the security feature should operate, the security output on output pin 5 and LED2 will be switched off. The optical security feature operates identically in all 3 modes.

3.6

Motor Operation

The DC motor is controlled by the processor via a transistor bridge. The motor will run provided that one of the sets of conditions shown below is met. If any single condition fails then the motor is braked and remains so until all conditions become true, or a power down occurs.

Mode 0 Motor Start Conditions:
Security feature true
24V line true

Mode 1 Motor Start Conditions:
Security feature true
24V line true
IN3 input low

Mode 2 Motor Start Conditions:
Security line true
24V line true
Internal coin count non-zero

When braking is initiated and for whatever reason, 50ms braking is carried out even if the fault condition recovers before that time. This guarantees that the motor is stationary when the bridge drivers change state, so that no excess current flows in the motor windings.

3.7

Motor Current Limit

The motor current is monitored by the processor. When the motor initially starts a high current flows generating maximum torque to force the coin belt up to speed. After a short time the motor current is reduced to a fraction of the initial surge current.

At any time after the initial surge, if the current rises above a preset value, then a jam is deemed to have occurred. The motor is braked for 50ms then reversed for 150ms. After a further 50ms braking, the motor is started in the forward direction. The current is tested after 1 00ms and if the jam has not been cleared the reversing cycle will be repeated. This action will continue until the jam has cleared. This reversing action is effective in clearing jams.

One further action is to test the current in the reverse direction during the final 50ms of the reversing cycle. If during that time period an overcurrent is detected, then the motor will be braked for 50ms and then disabled for 1 second. This action limits the duty cycle sufficiently in the case where a jam is solid in order to prevent motor damage.

3.8 Coins With Holes

The MkII hopper has not been designed to handle coins with holes and cannot be guaranteed to perform correctly with such coins.

The MkIII hopper can count most coins with holes correctly, but requires a jumper, on the control board, to be set in the right position for small or standard coins - see below.

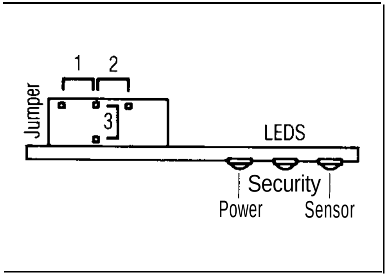


FIGURE 3: Label PCB Edge View Drawing

If a MkIII hopper is converted from one coin size to the other, the jumper position must be altered also. This is achieved by removing the track guard, as described in 2.3, placing the jumper in the required positions, then refitting the track guard.

Guide to coins catered for within normal build options:-

Coinage	**Position 2 Small Coin 16-21 mm**	**Position 1 Standard Coin 21-30mm**
Danish 1 Kroner	√	
Greek 5 Lepta	√	
Spanish 5 Peseta	√	
Danish 2 Kroner		√
Danish 5 Kroner		√

The Mk4 exit window has been designed so that more coins with holes will be counted correctly. No adjustments are necessary to cope with standard and small coins.

ELECTRICAL SPECIFICATION POWER SUPPLY REQUIREMENTS 4.0

4.1 Power Supply

For ease of use and maximum noise suppression, the 0 volt logic line (pin 2) and the motor 0 volt line (pin 1) are not commoned inside the hopper. This means the outputs from the hopper (OPT0 and security) are noise free.

4.1 .1 Suggested Connection

A suggested connection diagram is shown in fig 4.

A twisted wire pair is recommended for the motor power leads to reduce the radiated noise.

The TIP 126 arrangement shown would only be required for mode 0 operation where power line interruption is the method of motor control. In modes 1 and 2 the power line can be left permanently on and the TIP 126 and IK and 4K7 resistors can be omitted.

4.1.2 EMC

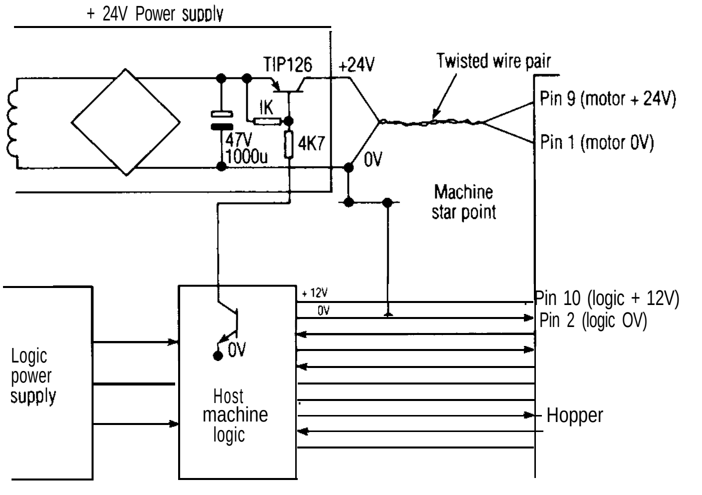
The Mklll hopper is EMC hardened. There is a version of Mk4 hopper which is also EMC hardened. This is to help users to meet the European EMC regulations (EN50081 & EN50082).

Further precautions should be taken with the installation to minimise the effects of electrical noise, i.e. -

i) Max cable length = 3 metres

ii) All wires to the hopper should be bundled together.

iii) Minimum capacitance between the logic supply rails = 100μF



GURE 4: Recommended Connection Diagram

APPLICATIONS 5.0

5.1 Output Sensor Interfacing

Both sensor outputs are open collector NPN transistors, as shown in Fig.5.

When a coin is paid out, the raw sensor output will switch on, connecting output Pin 11 to OV, The sensor output on Pin 3 will switch on approximately 5 ms later - see Fig.6. Both outputs will stay switched on until the coin has left the exit window.

The open collector outputs are provided for easy interfacing to TTL, CMOS or Relay inputs. see fig. 7.

NOTE:

A flywheel diode is required on any output which has an inductive load connected, e.g. a relay. A 30V maximum can be tolerated on these outputs (positive with respect to 0V).

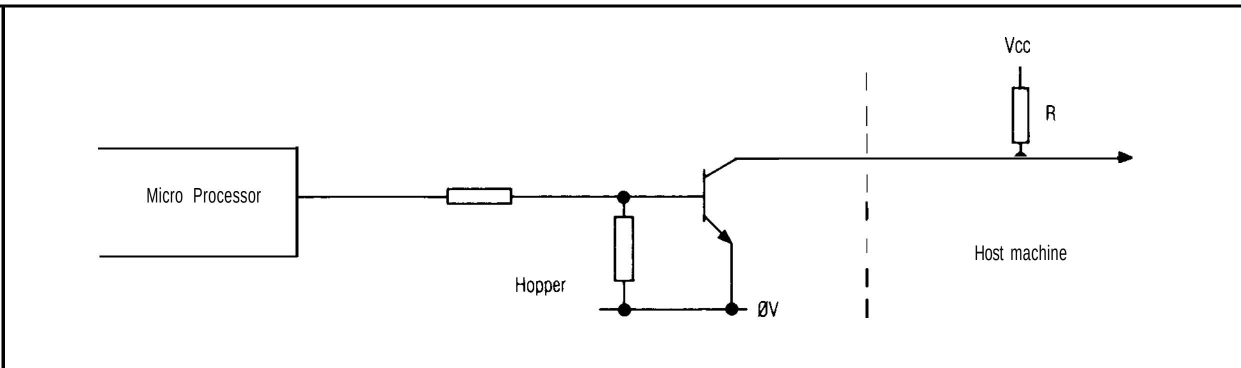


FIGURE 5: Output Transistor Arrangement

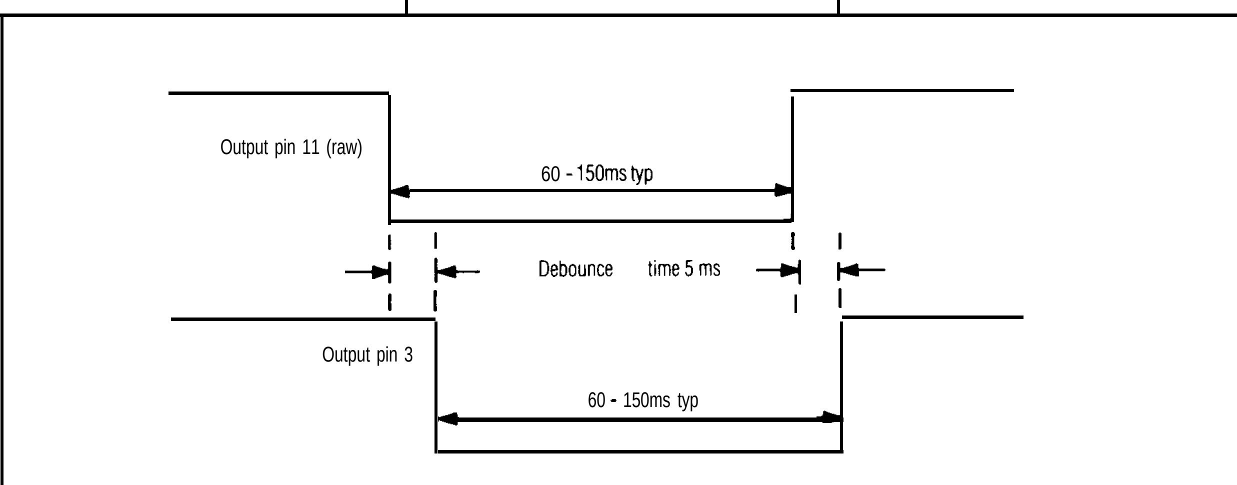


FIGURE 6: Sensor Output Waveforms

5.2

Motor Switch Off Time

When using the hopper in mode 0 (see section 3.2.1) the host machine applies power to the motor and monitors the payout sensors, disconnecting the motor power when it has counted out the correct quantity of coins. The motor power should be removed within 10ms of the leading edge of the o/p. Similarly, to avoid erroneous payout in mode 1, IN3 should be taken high within 10ms of the leading edge of the opto output (pin 3).

5.3

Security Output

The security output is an open collector NPN transistor which should be connected as shown in Fig.5 In normal operation the transistor will be switched on, i.e. the output pin will be connected to OV. The transistor will switch off if a fault is detected - see Section 3.5.

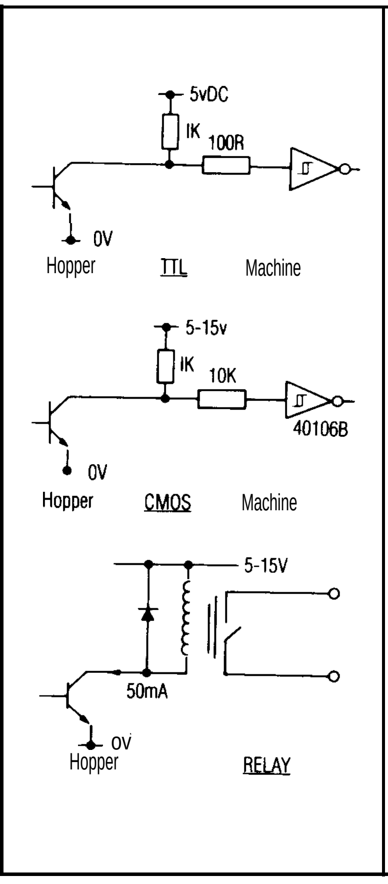


FIGURE 7: Recommended Sensor Interfaces

5.4

Level Sense Plates

Brass plates are used for level sensing. One plate is connected to the logic 0 volts and the other plates are wired to the 12 way connector - pin 7 for low level; pin 6 for either high or top level. See figure 8. The signal levels on these pins will be determined by the presence or absence of an electrical contact, via the coins, between the 0 volt plate and the other plates.

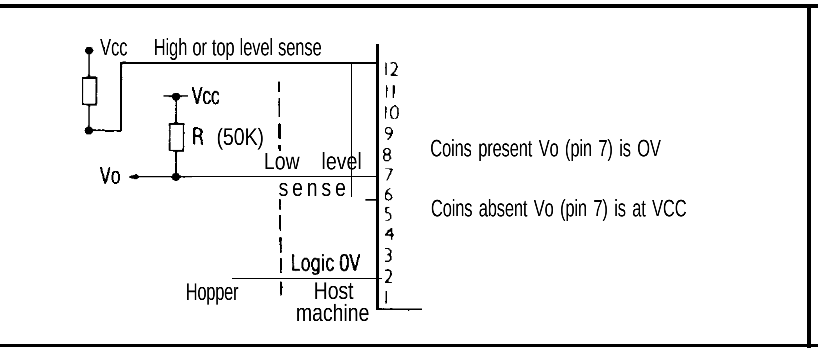


FIGURE 8: Suggested External Circuitry for level sense plates

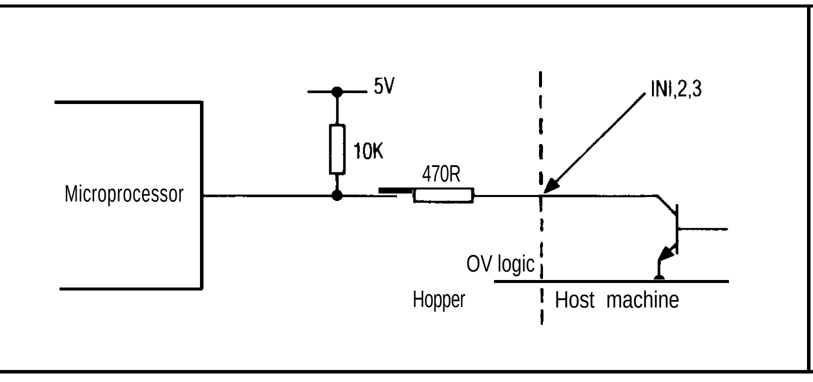


FIGURE 9: In1 to In3 Connections

5.5

IN1 to IN3 Inputs

These are the control signals from the host to the hopper which determine the mode of operation. These are input to the hopper microprocessor via a resistor as shown in fig. 9. IN3, if used, should always be driven via an open collector transistor referred to logic OV. IN1 and IN2 can also be driven via open collector transistors (see fig. 9) or if no change of mode is required, then strapped to logic OV or left floating (internal pull-up) depending on the mode required.

5.6

LED Indicators

Three LED indicators are fitted on the hopper. On Mkll and Mklll hoppers they are visible under the trackguard at the top corner, opposite the coin exit. Mk4 hoppers have the LEDs mounted in the coin exit area. From left to right, these are designated as follows:

1. Logic power ‘supply on’ indicator
2. Security (optical obstruction) indicator, normally on.
3. Coin sensor indicator shows coin passing the exit window opto.

TECHNICAL SPECIFICATIONS 6.0

6.1 Coin Sizes

	Thickness	Diameter
Standard Model	1.25 - 3.5mm	21 - 30mm
Small Coins Model	1.25 - 3.5mm	16 - 21 mm

The Mk4 hopper however has extended this range to include 31 mm diameter coins. Coins falling outside of the above ranges may be used but would require special qualification. For more information contact Coin Controls Technical Services Department.

Capacity

Approximate coin capacities can be estimated by applying the following formula.

$$\text{Capacity} = \frac{\text{Hopper Volume}}{\text{Coin Volume}} = \left[\frac{1{,}200{,}000}{\left(\frac{\pi \times D^2}{4}\right) \times T} \right]$$

Where D = Coin diameter (mm)
T = Coin thickness (mm)

6.2 Connections

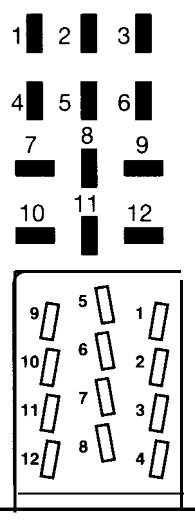


FIGURE 10: Pin Connections on External 12 Way Connectors

Pin 1	Motor supply 0 volt
Pin 2	Logic 0 volt
Pin 3	Sensor Output
Pin 4	IN1
Pin 5	Security output
Pin 6	High or top level sense output
Pin 7	Low level sense output
Pin 8	IN2
Pin 9	Motor supply
Pin 10	Logic supply
Pin 11	Raw Sensor Output
Pin 12	IN3

6.3 Motor Supply

Current consumption at 24V DC:-

Nominal running current	0.5A
Nominal reverse current	l.OA
Nominal cut-out current durina reverse	1.5A
Nominal start-up current	2.0A

Power supply requirement:-

24V DC at 2 amps

Nominal voltage	24V DC
Absolute minimum voltage	18V DC
Absolute maximum voltage	27V DC
Maximum rise/fall time	50ms
Absolute worst case ripple at 24V	+3V/-6V

6.4 Logic Supply

Nominal voltage	12V DC at l00mA
Absolute minimum voltage	11VDC
Absolute maximum voltage	27V DC
Maximum rise/fall time	100ms
Absolute worst case ripple	+/-1V

6.5 Logic Inputs (IN1, IN2 and IN3)

Absolute maximum logic 0 inputs	V in <= 0.6V
Absolute minimum logic 1 input	V in => 2.4V

6.6 Logic Outputs (Sensors, Security)

Absolute maximum 'true' output	v out<= 0.3V at 50mA
Absolute maximum sink current	100mA
Absolute maximum v off	30 Volts
Sensor output Typical Pulse width MkII/III	50- 100ms
Mk4	70-l 20ms

6.7 Supply Notes

1. Important

   The specified maximum motor and logic + ve voltages must not be exceeded, otherwise damage/injury could result.
2. Hopper speed (and payout rate) varies with applied motor voltage
3. The power supply fall time is critical if the hopper is being used in mode 0. When the host machine has counted out the required number of coins, it must disable the +24 volt supply. The motor is not disabled until the power line falls below a preset level of 18 volts DC, therefore there is a danger of extra coins being paid out if the power supply fall time is greater than 5ms. A power supply switching device such as a transistor, darlington or mosfet is therefore recommended.
4. The standby current is the current drawn when the motor is disabled, e.g. if the coin register is zero in mode 2 or if IN3 is high in mode 1.

6.6 Environment

Operating temp	0 to 60°C
Storage temp	-20 to 60°C
Life	up to 3 million coins
Mounting	±3° of vertical in any direction

NOTE:

Do not use the hopper in an explosive atmosphere.

6.9

Overall Dimensions (all dimensions in mm.)

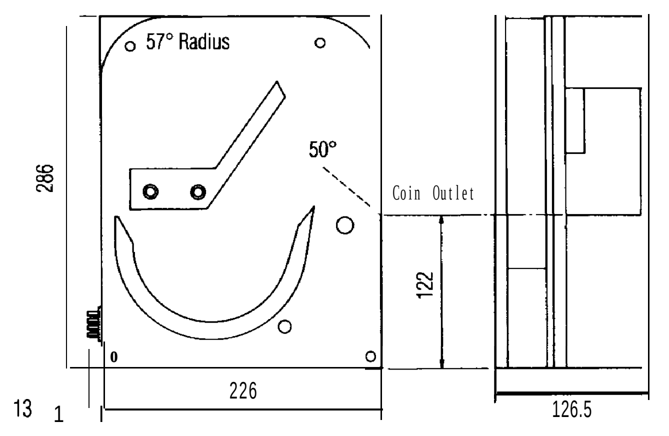


FIGURE 11 a: Overall Dimensions

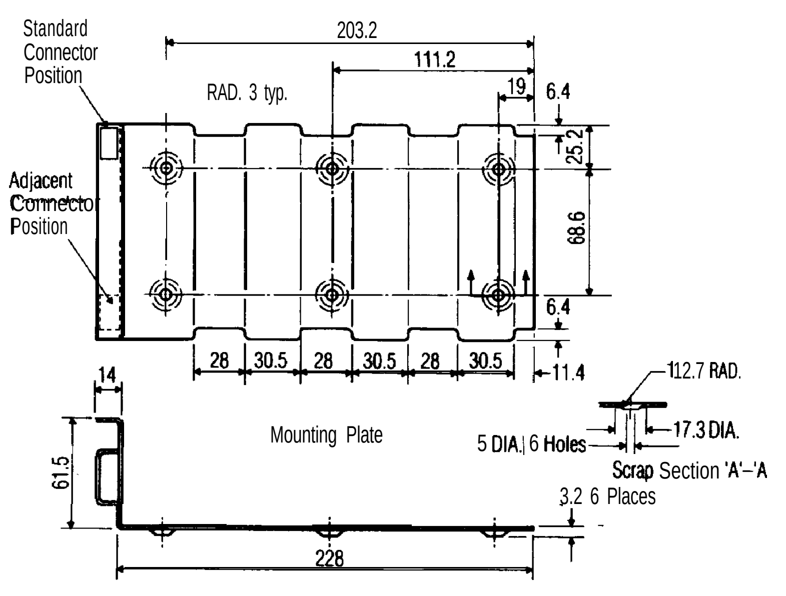


FIGURE 11 b: Hopper Mounting Plate

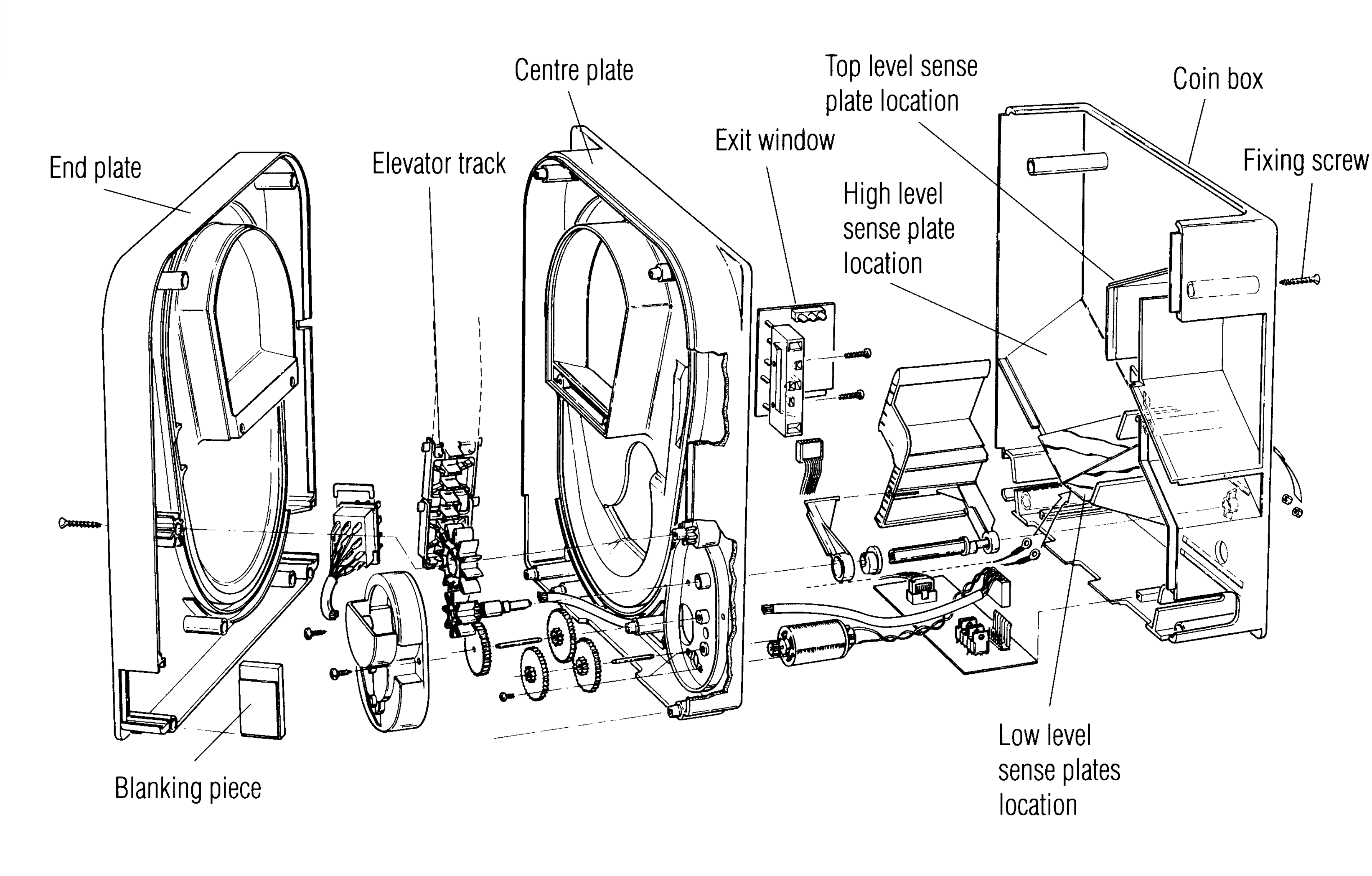


FIGURE 12(a): Universal Hopper Mk4 Exploded Diagram

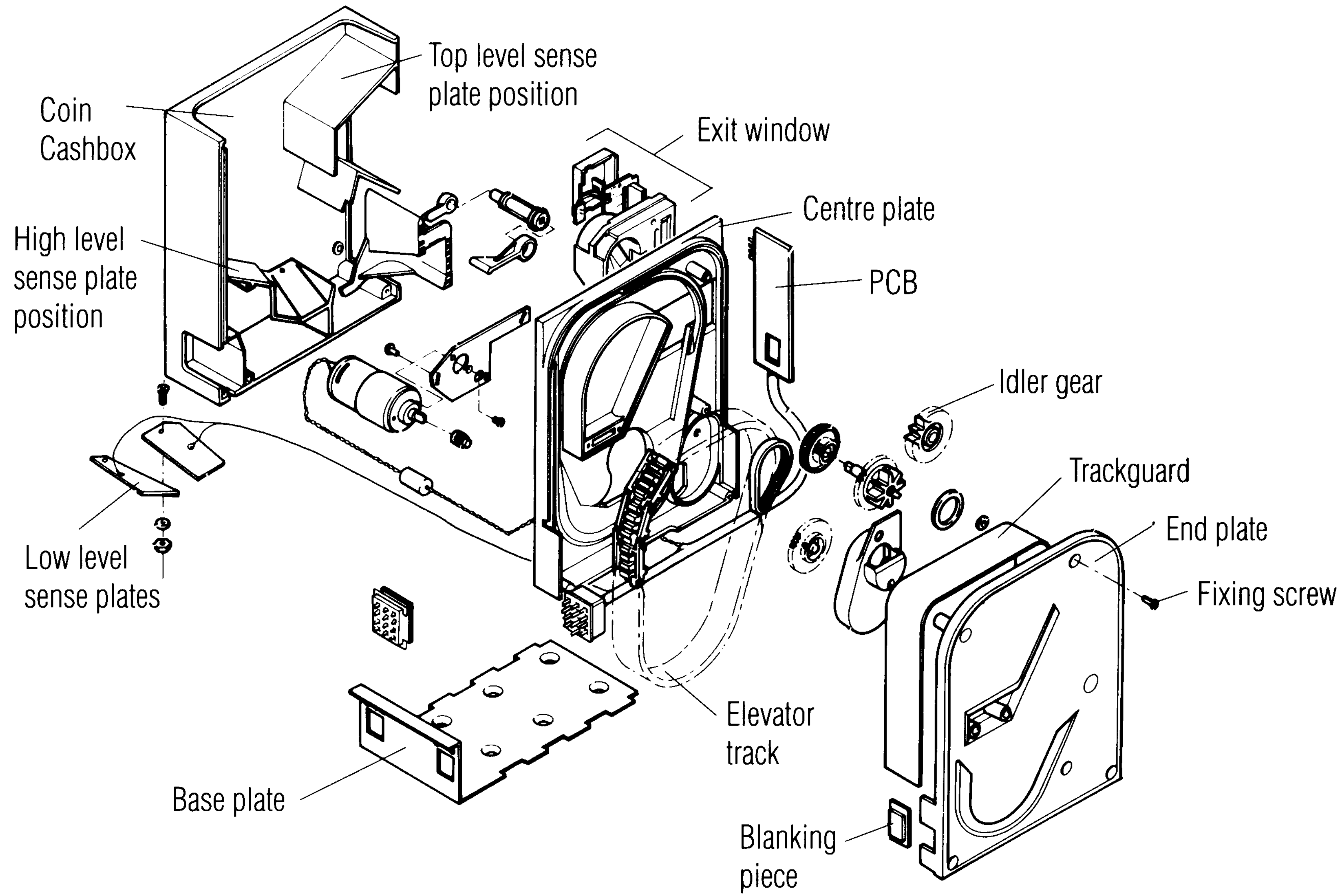


FIGURE 12(b): Universal Hopper MkII/MkIII Exploded Diagram

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Coin Controls Limited reserve the right to change product specifications on any item without prior notice.

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