Lumina Technical Manual

Money Controls

Contents

Tables

Figures

1. Diary of changes

Issue 1.0 .... May 2001
Issue 2.0 .... September 2001
- ➢ Removed reference to Teach and Run.
- ➢ Amended last page disclaimer.
- ➢ Changed page layout.

Issue 3.0 .... July 2002
- ➢ Reformatted to TSP028 (Technical Manual Writing Procedure).
- ➢ Changed the terminology Accept to Inhibit.
- ➢ Changed the terminology Vend to Accept.
- ➢ **ccTalk** details added.
- ➢ Changed the 1st page header.
- ➢ Maintenance added.
- ➢ Fault finding added.
- ➢ Resetting the 6-digit security code added.

Issue 3.1 .... 6th Sept 2002
- ➢ Modification to disclaimer.

Issue 3.2 .... 5th Nov 2002
- ➢ Changes made to *Table 4*.

Issue 4.0 .... 22nd April 2003
- ➢ Applied TMWP 3.2
- ➢ Amended Figure 7 – Removed reference to 12V.
- ➢ Added Appendix 1 and Appendix 2.
- ➢ Added Encryption requirements to section 8.
- ➢ Service drawings improved.

Issue 4.1 ....6th August 2003
- ➢ Changed ccTalk$^{®}$ to ccTalk throughout the document.

Issue 4.2 ....2nd February 2004
- ➢ Added Torque Setting to Figure 9.

Issue 4.5 .... 24th February 2004
- ➢ Updated section 7.1 to include pulsed mode.
- ➢ Added section 8.2 Pulsed Mode.

Issue 4.6 ....31st March 2004
- ➢ Added connector descriptions to Figure 1 & Figure 3.

Issue 4.7 ....30th June 2004
- ➢ Changed footer

2. Introduction

Applications:
The Money Controls' Lumina Note Acceptor is a simple, compact, modular system that offers trouble free note handling. The Lumina has been developed as a cost effective high performance solution, ideally suited to the AWP, Amusement Games, Leisure and Change Machine industries.

Low cost, High Performance:
Lumina offers renowned Ardac Brand performance at amusement prices.

Euro-Capable:
Lumina was developed with the Euro in mind and features proven sensing technology. This combined with years of bank note recognition experience provides complete "Euro-Secure" assurance.

Note acceptance:
Lumina accepts note widths from 55mm to 80mm without modifications. An optional mounting escutcheon is available to accept notes up to a width of 82mm.

Euro Capability:
Designed for multi-currency and multi-denominations, Lumina's 16 note, 4-way memory recognition provides tremendous acceptance program flexibility.

Multiple Programming Techniques:
Lumina features multiple ways to program / update currency through EPROM & Flash download.

Optical Anti-Stringing:
Lumina utilises a proven optical anti-stringing design to deter and protect against cheating.

<u>**In Summary:**</u>

> - Low Cost High Performance Solution.
> - Proven Optical Sensor Technology.
> - Multiple Programming Techniques.
>   - EPROM.
>   - Flash Download.
> - "Euro Secure".
> - Simple, Modular, Compact.
> - Accepts 16 Notes x 4 Ways.
> - Optical Anti-Stringing Device.

3.   Operation

Detailed Note data is stored in the EPROM / Flash Memory of the Lumina. This consists of measurements taken at various points from a number of sensors along the length of the note. The data is repeated for each of the 4 possible directions of entry and for each denomination programmed.

Notes are inserted at the front of the Lumina and MUST be LEFT justified. The green arrows on the front escutcheon indicate the note position. This ensures almost perfect alignment with the sensors, which read the note data. Therefore narrower note tables can be programmed which reduces the possibility of frauds being accepted and therefore a more secure product.

There are 2 modes of operation utilising the Parallel protocol.

The following is based on the corresponding Inhibit line being low.

3.1   Non-Escrow Mode.

Once a note passes all the sensors and the readings taken match those stored in memory, the Lumina will accept the note and once the note passes the rear clear sensors, an accept signal will be issued.

3.2   Escrow Mode.

In Escrow Mode, the Escrow pin is held LOW (<1V) until a note is inserted and the Lumina determines if it is a valid note. The Lumina will then issue a 'pre-accept' signal for 100ms. After the 'pre-accept' signal has been sent to the host machine, the host machine then decides whether to accept or reject the note. To accept the note, the Escrow pin has to be taken high (>4V) within 30 seconds. After the note leaves the rear clear sensors the same accept signal is re-sent and the host machine then credits for the amount accepted.

If the machine ignores the 'pre-accept' signal and keeps the Escrow pin low for more than 30 seconds, the note will automatically be rejected.

The host machine can also switch the corresponding Inhibit pin high to reject the note, before the 30-second time-out has elapsed.

Once the Lumina determines the note is valid the Inhibit lines will be read. If the corresponding Inhibit line is high, the note will be rejected.

4. Electrical Connections

Figure 1: Lumina Connector 1

15 way SIL 0.1" Male Header.
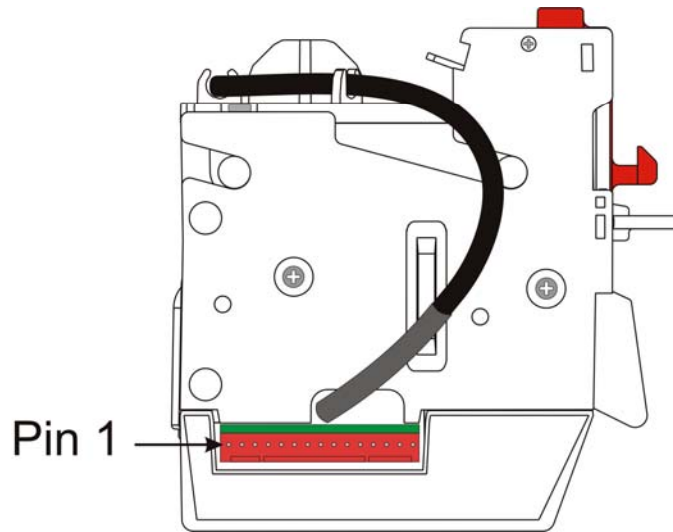
Table 1: Connector 1 Details.

Pin	Description	Active
1	$\overline{\text{Accept 1}}$	Low
2	$\overline{\text{Accept 2}}$	Low
3	$\overline{\text{Accept 3}}$	Low
4	$\overline{\text{Accept 4}}$	Low
5	$\overline{\text{Inhibit 1}}$	Low
6	$\overline{\text{Inhibit 2}}$	Low
7	$\overline{\text{Inhibit 3}}$	Low
8	$\overline{\text{Inhibit 4}}$	Low
9	ESCROW	High
10	ALARM	Low
11	+12V Power	
12	Supply Ground	
13	Not Used	Do not connect.
14	Not Used	Do not connect.
15	Not Used	Do not connect.

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5. Electrical Interface Requirements

Table 2: Power Supply

Voltage Nom:	+12V
Absolute:	Minimum +10V Maximum +15.75V
Ripple voltage:	Nominal 0 Volt pk-pk. Maximum 1 Volt pk-pk

Table 3: Current Consumption

Nominal - Idle:	200mA
Nominal – Running:	400mA
Maximum Stalled:	2.0A

Table 4: Environmental Ranges

	Min	Max
Operating °C range:	0°C	55°C
Storage °C range:	-20°C	70°C
Humidity: RH non-condensing	0%	95%

6. Parallel Interface Requirements

6.1 Parallel Interface Outputs

All signal outputs are open collector.

Table 5: Parallel Interface Outputs

Pin	Description	Value
1	$\overline{\text{Accept 1}}$	100mA Max. sink current
2	$\overline{\text{Accept 2}}$	100mA Max. sink current
3	$\overline{\text{Accept 3}}$	100mA Max. sink current
4	$\overline{\text{Accept 4}}$	100mA Max. sink current
10	Alarm	100mA Max. sink current

6.2 Parallel Interface Inputs

Table 6: Parallel Interface Inputs

Pin	Description	Characteristic
5	$\overline{\text{Inhibit 1}}$	
6	$\overline{\text{Inhibit 2}}$	Minimum 0V
7	$\overline{\text{Inhibit 3}}$	Maximum +5V
8	$\overline{\text{Inhibit 4}}$	
9	ESCROW	

Table 7: Standard Input DC characteristics

Characteristic	Value
V in Low (max)	+1V
V in High (min)	+4V

6.3 Accept Lines

Once a note passes all the sensors and the readings taken match those stored in memory, the Lumina will accept the note, once the note passes the rear clear sensors, an accept signal will be issued. Each accept output is open collector.

On acceptance of a true note the transistor is turned on for a period of 100ms (+/- 20%) to less than 0.7 volts. The host machine must look for a valid credit pulse NOT LESS THAN 50ms.

It is not sufficient to merely detect the edges of the credit pulses. This 'debounce' will prevent credits being registered by the result of any noise or false credit pulses being introduced on the output lines.

Table 8: Parallel Mode Accept Outputs.

Note	Accept 1	Accept 2	Accept 3	Accept 4
1	**1**	0	0	0
2	0	**1**	0	0
3	0	0	**1**	0
4	0	0	0	**1**

6.4 Alarm Signal

The Alarm signal will go low for 100ms when the following condition occurs.

> ➢ **If either of the rear opto sensors become covered while the unit is in idle the Alarm signal is sent.**

6.5 Inhibit Lines

The Inhibit inputs define whether a programmed note will be accepted or not.
If the Inhibit pin is not connected OR High (>4V) then the corresponding note will be rejected.

If the Inhibit pin is Low (<1V) then the corresponding note will be accepted if deemed to be true.

If all inhibit lines are held high the Lumina will not drive any notes into the sensor path. The green arrows will not be illuminated signifying that the unit is out of operation.

Note: The default setting is for ALL Inhibit inputs to be High and therefore notes are inhibited.

7. DIP Switch Options.

The DIP switch is used to inhibit notes & select the protocol required.

Figure 2: 8-way DIP switch
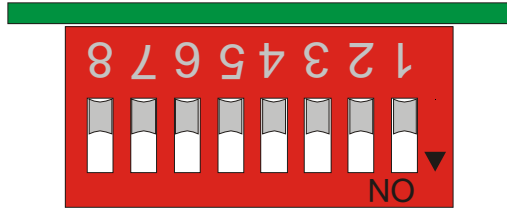
7.1 DIP Switch Functions

Switch	OFF	ON
1	Accept Note 1	Inhibit Note 1
2	Accept Note 2	Inhibit Note 2
3	Accept Note 3	Inhibit Note 3
4	Accept Note 4	Inhibit Note 4
5	Accept Note 5	Inhibit Note 5
6	N/A	Resets the 6-digit security code (see section 9.1) **In ccTalk Mode ONLY.**
7	Protocol Select (See Below)	Protocol Select (See Below)
8	Protocol Select (See Below)	Protocol Select (See Below)

NOTE: Inhibiting a note via the DIP switch overrides the Parallel connector Inhibit status.

Switch 6	Switch 7	Switch 8	Function
Off	Off	Off	N/A
Off	On	Off	**ccTalk**
Off	Off	On	Binary
On	Off	On	Pulsed

8. Protocols

<div style="border:1px solid red; background:yellow;">

Please note:-

For security reasons, the Lumina note acceptors ccTalk® commands are encrypted. The encryption document can be obtained from Money Controls by contacting Technical Services on +44 (0) 161 955 0124.

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8.1 Serial Interface

The serial interface can also be used instead of the parallel interface to communicate with the machine.
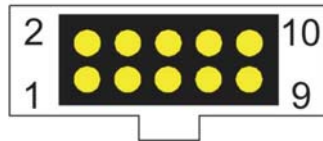
Protocol: **ccTalk** BACTA compliant implementation.

For further details on this section please refer to the current **ccTalk** generic standard.

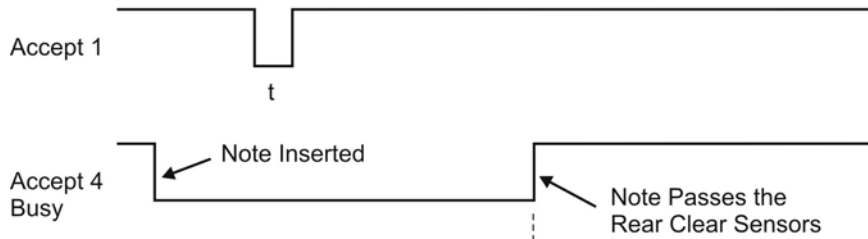*Figure 3: **ccTalk** Serial Connector*

10 way DIL 0.1" Male Header

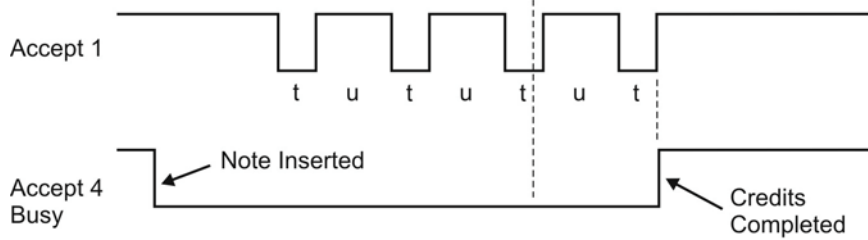

Pin 1 - DATA
Pin 2 - Not used
Pin 3 - Not used
Pin 4 - Not used
Pin 5 - Not used
Pin 6 - Not used
Pin 7 - +12 Volts   [Power]
Pin 8 - 0 Volts   [Power]
Pin 9 - Not used
Pin 10 - Not used

8.2 Pulsed Mode

Single Pulse

Accept 1

t

Accept 4
Busy

Note Inserted

Note Passes the
Rear Clear Sensors

Multi-Pulse

Accept 1

t u t u t u t

Accept 4
Busy

Note Inserted

Credits
Completed

Where t = 1ms to 65,536ms
u = 1ms to 65,536ms
and number of pulses = 1 to 255

9.   ccTalk Serial Messages

Table 9: Supported *ccTalk* Serial Commands

Refer also to Table 1 of the current '**ccTalk** Serial Communication Protocol - Generic Specification'.

Header	Function	Header	Function
254	Simple poll	178	Request bank select
249	Request polling priority	170	Request base year
247	Request variable set	169	Request address mode
246	Request manufacturer id	159	Read buffered bill events
245	Request equipment category id	158	Modify bill id
244	Request product code	157	Request bill id
242	Request serial number	156	Request country scaling factor
241	Request software revision	155	Request bill position
239	Operate motors	154	Route bill
238	Test output lines	153	Modify bill operating mode
237	Read input lines	152	Request bill operating mode
236	Read opto states	151	Test lamps
233	Latch output lines	150	Request individual accept counter
232	Perform self-test	149	Request individual error counter
231	Modify inhibit status	148	Read opto voltages
230	Request inhibit status	147	Perform stacker cycle
228	Modify master inhibit status	146	Operate bi-directional motors
227	Request master inhibit status	145	Request currency revision
226	Request insertion counter	144	Upload bill tables
225	Request accept counter	143	Begin bill table upgrade
216	Request data storage availability	142	Finish bill table upgrade
215	Read data block	141	Request firmware upgrade capability
214	Write data block	140	Upload firmware
213	Request option flags	139	Begin firmware upgrade
197	Calculate ROM checksum	138	Finish firmware upgrade
196	Request creation date	137	Switch encryption code
195	Request last modification date	136	Store encryption code
192	Request build code	004	Request comms revision
181	Modify security setting	003	Clear comms status variables
180	Request security setting	002	Request comms status variables
179	Modify bank select	001	Reset device

The following fault codes are supported.

Table 10: Supported Fault Codes

Refer to Table 4 of the current '**ccTalk** Serial Communication Protocol - Generic Specification'.

Code	Fault
1	EEPROM checksum corrupted
30	ROM checksum mismatch
36	Fault on bill validation sensor
37	Fault on bill transport motor
38	Fault on stacker
39	Bill jammed
40	RAM test fail
41	Fault on string sensor
255	Unspecified fault code

9.1   Resetting the 6-digit security code.

The 6-digit code is unique and is set at the factory. It is fundamental to the host machine that any change over of units from one machine to another that the unit is reset.

1. To reset this number place dip switch 6 into the up position
2. Power up the unit for around 15 seconds.
3. Place dip switch 6 back down to the off position.
4. Power down the unit.
5. Next time the unit is used the code will have defaulted to its initial factory setting.

10. ccTalk Interface Circuits

10.1 Circuit 1 – ccTalk Standard Interface

This circuit uses an open-collector transistor to drive the data line and a diode protected straight-through receiver.

*Figure 4: Circuit 1, **ccTalk** Standard Interface*
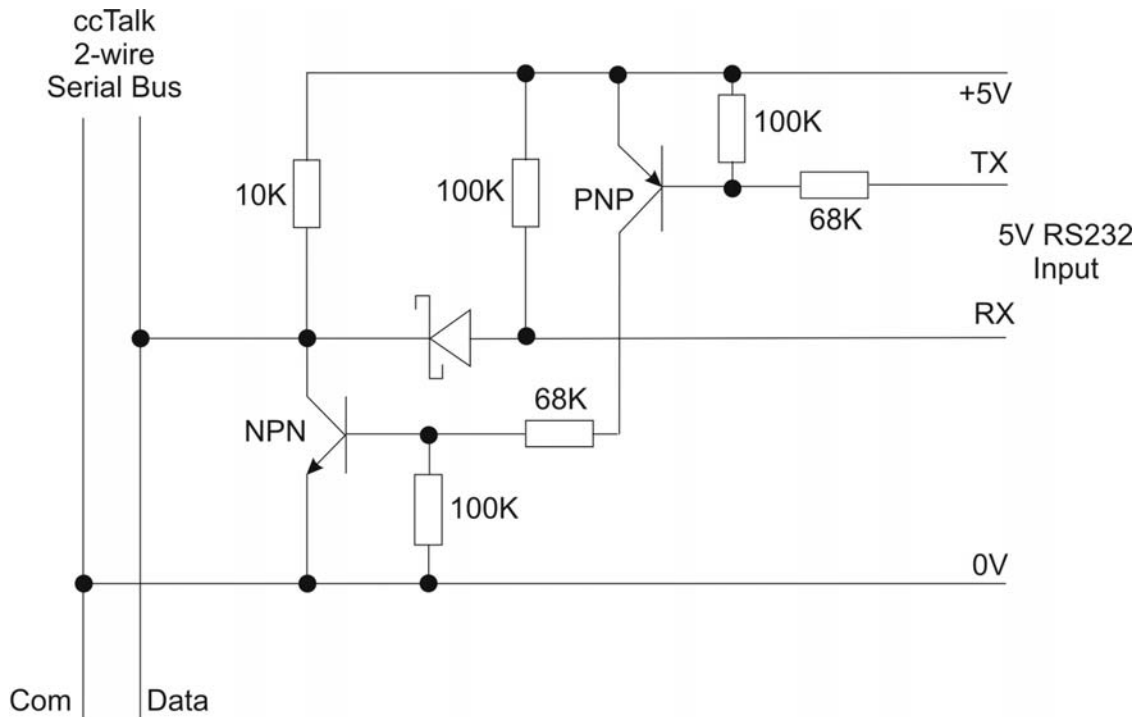
Typical Components

Diode	BAT54	Schottky Diode, low forward voltage drop
NPN	BC846B	High gain, medium signal, NPN transistor
PNP	BCW68	High gain, medium signal, PNP transistor

10.2   Circuit 2 – ccTalk Low Cost Interface

Assuming that the transmitting device is capable of sinking a reasonable amount of current, a direct diode interface can be used rather than a full transistor interface. Although cheaper to implement, this circuit does not have the drive capability or the robustness of other designs.

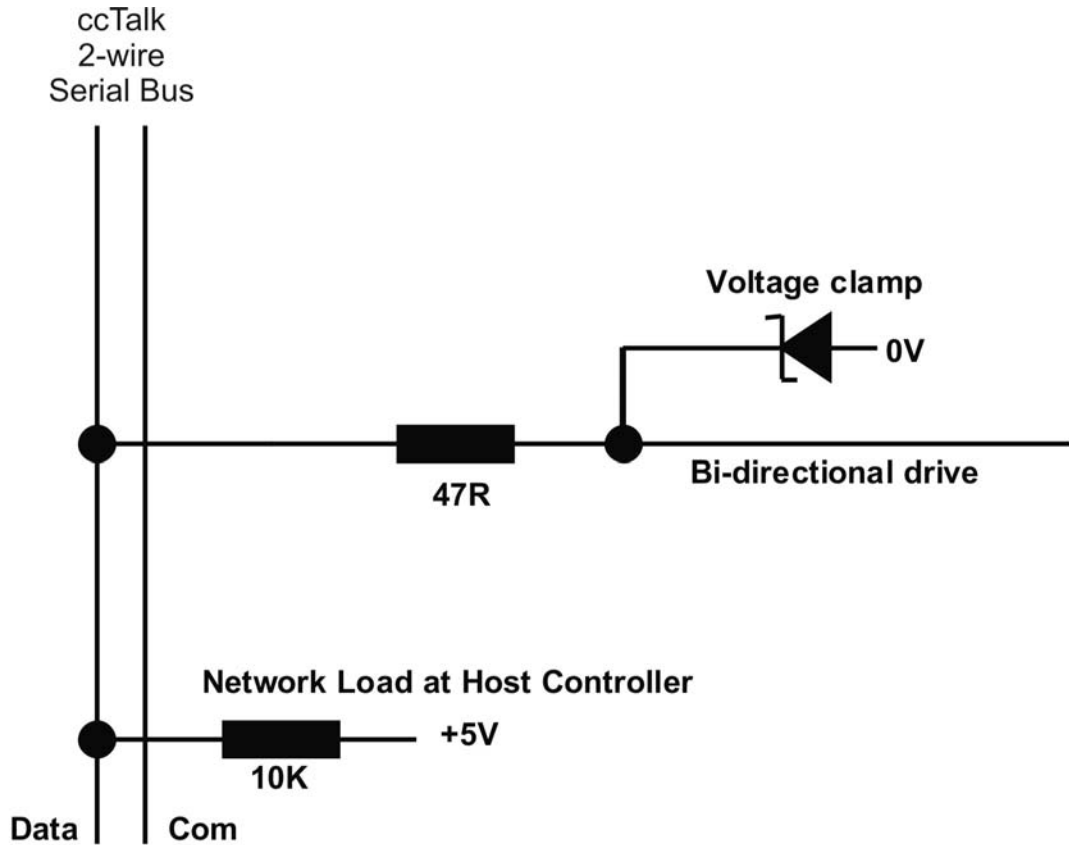*Figure 5: Circuit 2, **ccTalk** Low Cost Interface*
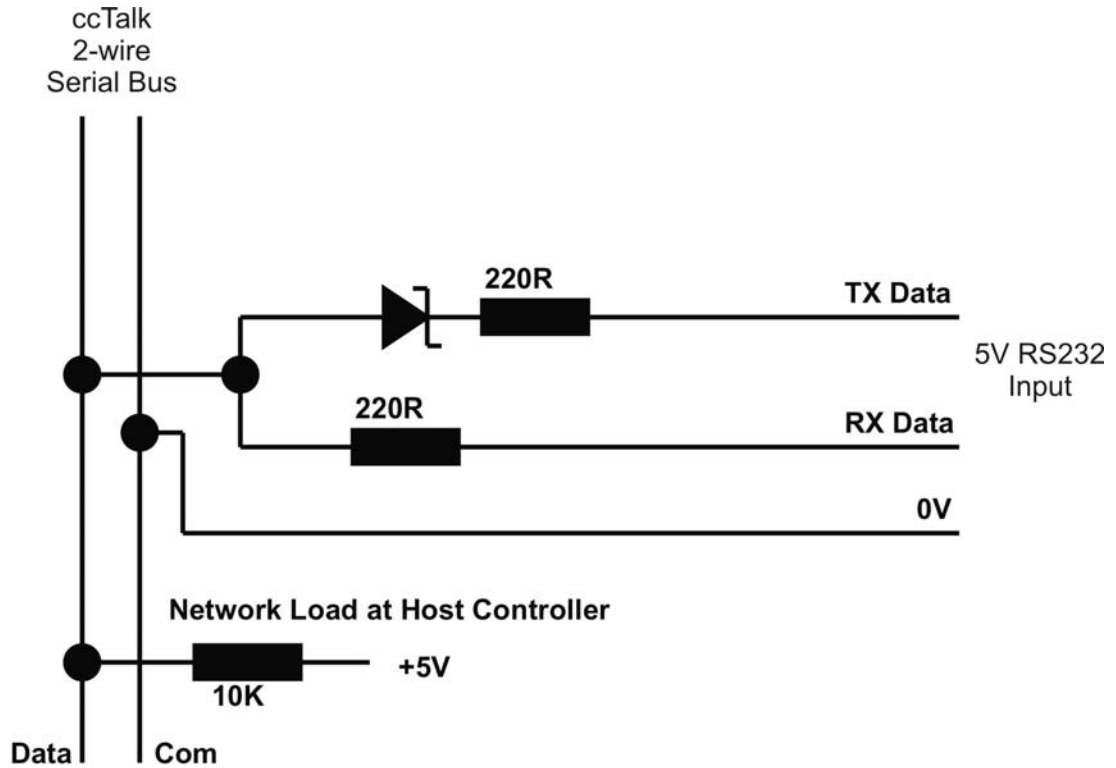
10.3 Circuit 3 – ccTalk Direct Interface

A very low cost solution is to interface a single pin on a microcontroller directly onto the **ccTalk** data line. The pin can be switched between active-low for transmitting and high-impedance tri-state for receiving.
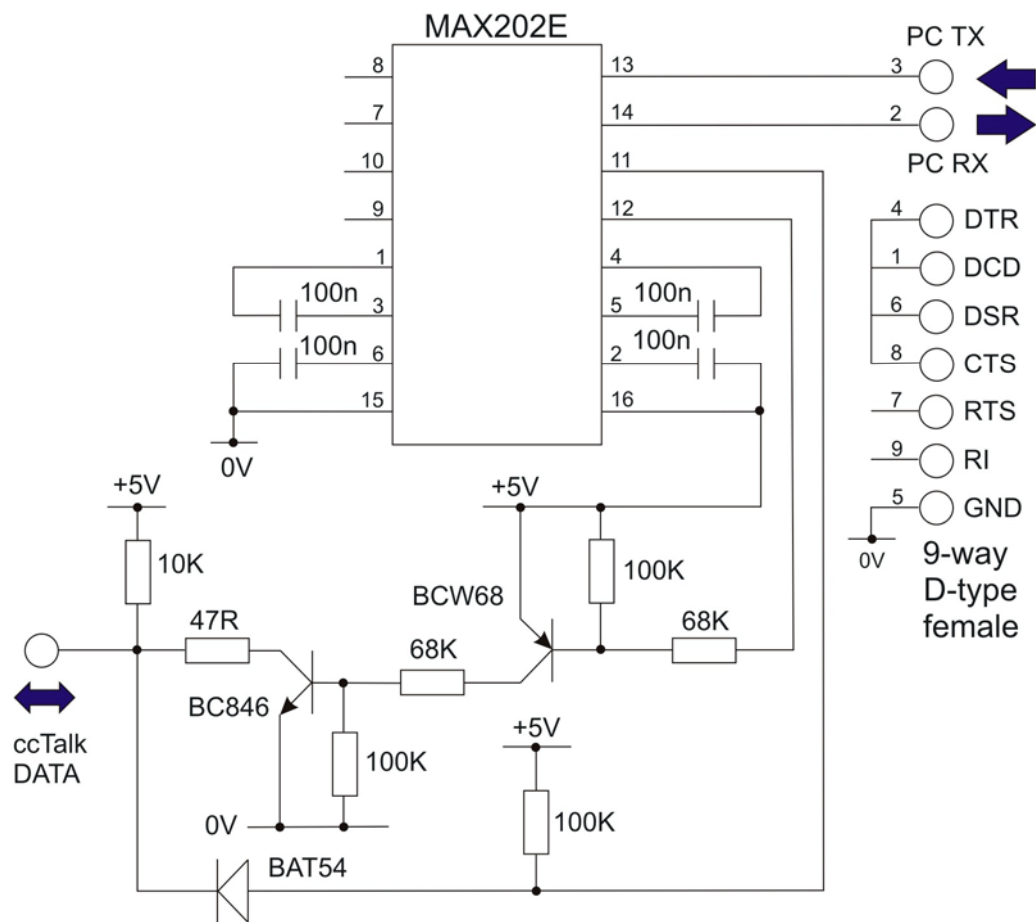
*Figure 6: Circuit 3, **ccTalk** Direct Interface*

10.4 Circuit 4 – ccTalk PC Interface

The circuit below shows how to connect the 9-pin serial port of a PC to the **ccTalk** data bus. The only integrated circuit required is a Maxim level-shifter, which operates off a single +5V supply. Any small-signal diodes and transistors can be used.

*Figure 7: Circuit 4, **ccTalk** PC Interface*

11. Fault Finding

The following information is presented for customers' guidance in rectifying a fault but does not cover all possible causes.

All acceptors with electronic faults should be returned to Money Controls Ltd. or to an approved service centre for repair.

Symptom	Investigate	Possible Cause
Acceptor does not work (All notes reject).	Connector.	Poor contact. Loose wire.
	Power supply.	Not switched on. Incorrect voltage. Inadequate current. Rise time too slow.
	Inhibit input.	Inhibit pins are high for programmed notes.
	Switches.	Inhibit switches are ON for programmed notes.
	Note path.	Obstructed.
RED 'X' on continuously.	Inhibit input.	Inhibit pins are all high.
	Top sensor module.	Not fully 'home'.
	Sensors & EEPROM	EEPROM checksum error[1]. Sensor faulty[2]. Rear clear sensors faulty[2]. Rear clear sensors blocked[2].
	RED 'X' flickers on/off.	Excessive noise on PSU. String sensors faulty[2].
	Sensor voltages.	Calibration required.
	Power supply	Voltage less than 10V. (NB voltage drops when motors are switched on).
Poor acceptance of true notes.	Top sensor module.	Not fully 'home'.
	Connector.	Loose.
	Note path.	Dirty.
	Pinch wheels.	Dirty.
	Sensor voltages.	Calibration required.
	Note path.	Dirty or mechanical damage.
Notes stick or jam.	EEPROM.	Note not programmed.
One of the true note types always rejects.	Inhibit switch	Inhibit switch ON.
	Inhibit x.	Inhibit line voltage high
	Switches.	Wrong protocol selected.
No accept signal.	Connector.	Loose or broken wire.

[1] This condition requires the Lumina to be reprogrammed.
**[2] These faults require to Lumina to be returned for repair.**

12. Service

Maintenance

The note path should be cleaned regularly to ensure accurate validation of notes.

To remove the Lumina from the frontplate push down on the button as shown by arrow 1.

The locking mechanism will also move down which will then release the Lumina from the frontplate. The Lumina can then be removed by following the directions of arrows in 2 then 3 below.
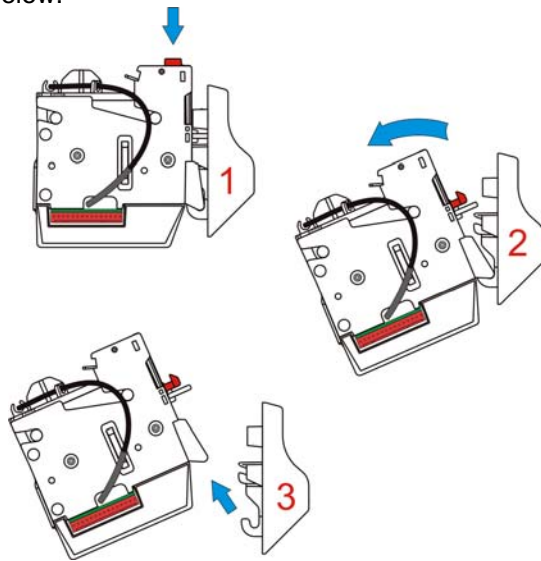
To gain access to the note path, push the lever in the direction as shown by arrow 1 below.

Holding the body in one hand and the top sensor assembly in the other hand, slide the 2 assemblies apart in the direction shown by arrows 2 and 3 below.
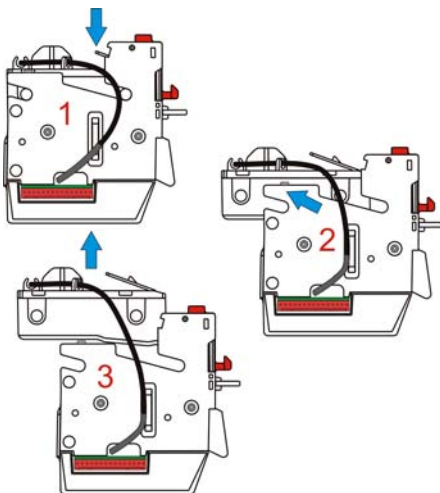

The two parts cannot be completely separated because of the interconnection cable.

The note path can now be cleaned using a damp cloth.

Under NO circumstances should any solvent, abrasive or foam type cleaner be used.

A damp cotton bud will be required to clean the recessed sensors such as the rear clear and the string sensors situated above the note path on the left and right hand sides at the front.
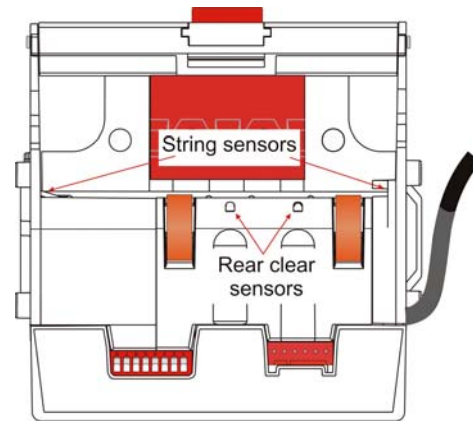
The same cleaning procedure should also be carried out on the bottom of the top sensor module.

While the two units are apart clean the eight pinch wheels as dirty wheels may cause the notes to slip and therefore give false readings and increase the possibility of notes being rejected.
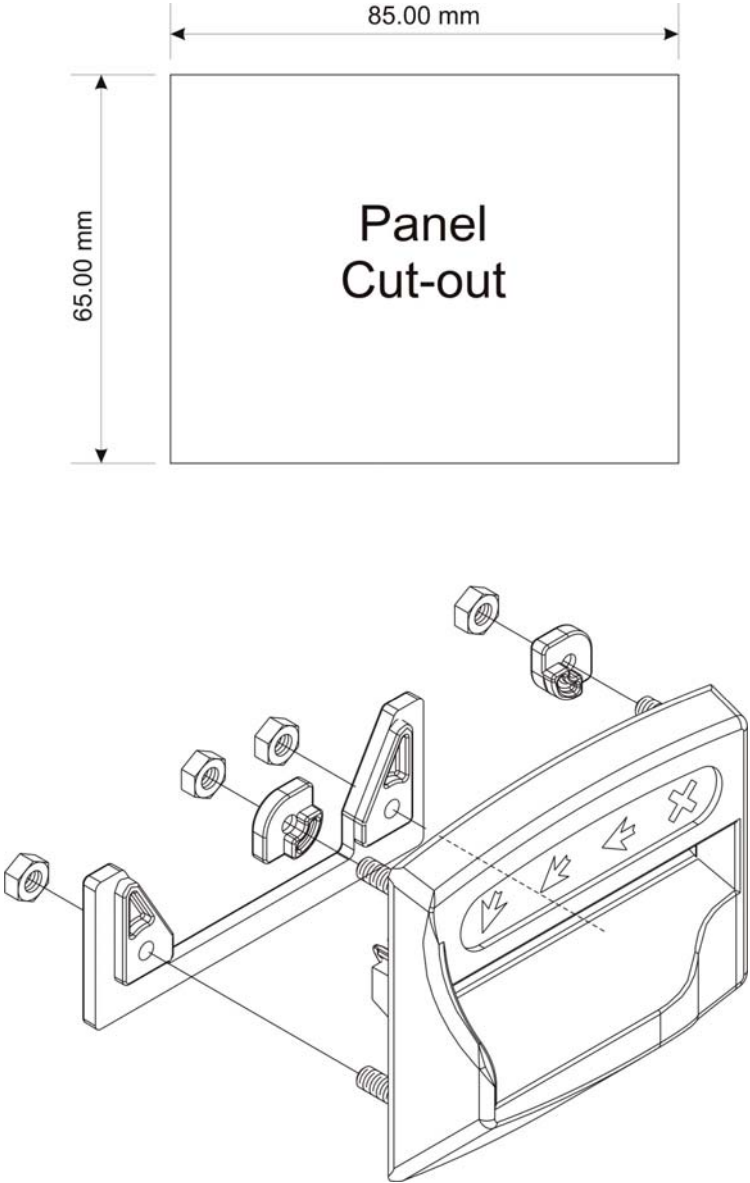
Once cleaned, ensure the two surfaces are dry and re-assemble.

Refitting the top sensor module to the main body is the opposite of taking the two units apart.

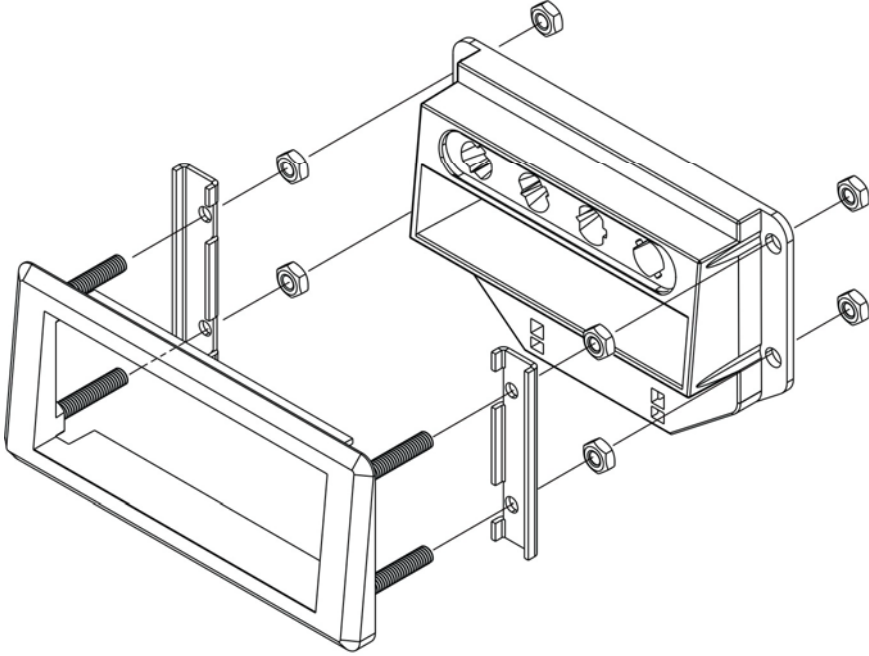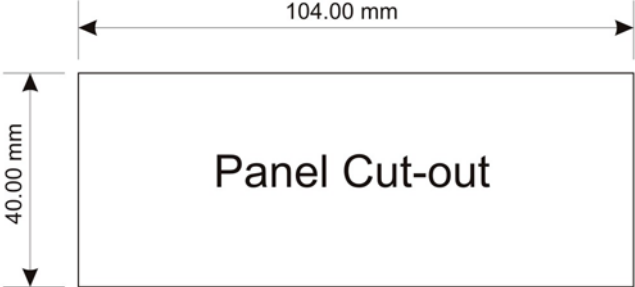Refitting to the frontplate is the opposite of the removal sequence.

13. Appendix 1

Figure 8: Standard Bezel Panel Cut-Out and Assembly

14. Appendix 2

Figure 9: Letterbox Bezel Panel Cut-out and Assembly

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