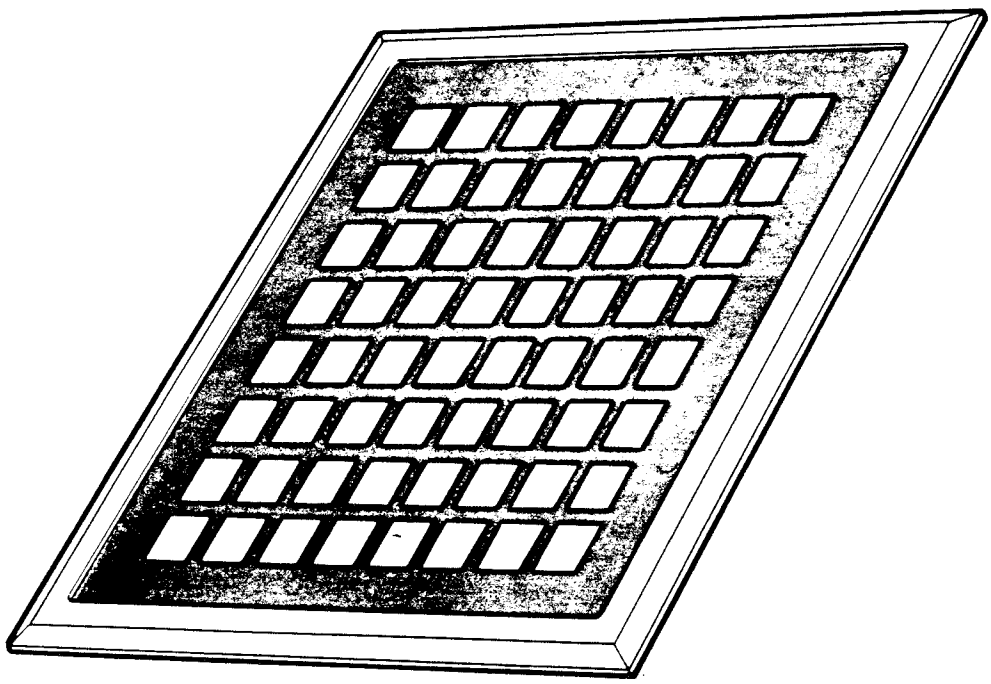
TACTILE KEYBOARD 9005



CONTENTS

1. INTRODUCTION

The 9005 Tactile Keyboard features a new form of tactile keypad which gives mechanical feedback of key operations. The keyboard can be connected to the Basic I/O highway or to the GEM 80 ESP serial link. Connection to a serial link allows for the additional features of auto repeat on key operations, audible and visual feedback of key operations, and the ability to connect up to 15 keyboards on a multi-drop serial link. The number of LED's has also been increased to 64 - one for each key position. The LED's can be illuminated in red, green, or yellow, determined by the user program. Output from the GEM 80 to the 9005 keyboard can be in any of four modes:

Mode 0

Individual LED's can be illuminated in any of the available colours.

Mode 1

A row of LED's can be illuminated in the same colour, either all at once, or individually.

Mode 2

Two adjacent LED's can be illuminated individually in any of the available colours.

Mode 3

The additional features of auto-repeat, visual feedback of key operation, and the buzzer are controlled in this mode.

All these modes are available on both the Basic I/O highway and on the ESP serial link. An additional mode - modified from Mode 3 - is also available, but only on the serial link.

Input from the 9005 keyboard to the GEM 80 is available in two basic options:

Option A

Keys are numbered consecutively in decimal, 1 to 64.

Option B

Keys are numbered in hexadecimal in groups of 16. Four groups or quarters are numbered:

10 to 1F - top left
20 to 2F - top right
40 to 4F - bottom left
80 to 8F - bottom right

The 9005 has its own switch mode power supply. The input for this can either be supplied via the Basic I/O ribbon cable, or from an external power supply in the range 9.5 - 80V d.c., or 20 - 55V a.c. (50/60Hz).

The audible feedback buzzer is mounted on the rear of the keyboard unit and can be controlled by the GEM 80 or used for the feedback of key operations. Its use as an alarm is not advised when the keyboard unit is secured in a panel or desk since the sound level will be reduced.

2. SPECIFICATION

Number of Keys	: 64
Arrangement	: 8 x 8 matrix
Key Size	: 24 x 20mm
Spacing	: 1mm
Key Life Expectancy	: 10^6 operations
Keypad Construction	: Individual switches operated through a membrane overlay
Operating Force	: 300g
Switch Travel	: Typically 0.5mm
Weight	: 1.1kg
Overall Dimensions	: 237 x 277 x 7mm/60mm high x wide x front/rear projection
	: Front mounting
Operating Temperature	: 0°C to 60°C
Humidity	: 35 to 90% non-condensing
Power Requirement	: +15V direct from basic I/O ribbon cable or
	: Plant power supply for operating voltage range 9.5V - 80V d.c. or 20V - 55V a.c. (45 - 63Hz) with negative, positive, or floating ground
Power Consumption	: 15W Max.
Basic I/O	: Equivalent to 32 bits 1 16-bit word for input 1 16-bit word for output
Speed of Serial Link	: 300 - 9600 bits/sec.
	: selected by controller. Keyboard self-configures to match selected speed
Connection	: Plug for Basic I/O ribbon cable.
	: 15-way plug-in terminal block for serial link and plant power supply

3.1 Connecting Up

3.1.1 The Basic I/O ribbon cable from the GEM 80 plugs into the connector mounted at the rear of the keyboard unit. A +15V d.c. power supply is provided via the Basic I/O ribbon cable.

3.1.2 Figure 3.1 shows the typical connection to be made for the serial link. In addition to this, an external power supply is also required. A set of screw terminals are provided for both the serial link and the external power supply.

More information on the serial link can be found in the GEM 80 Serial Links User Information Leaflet (T418).

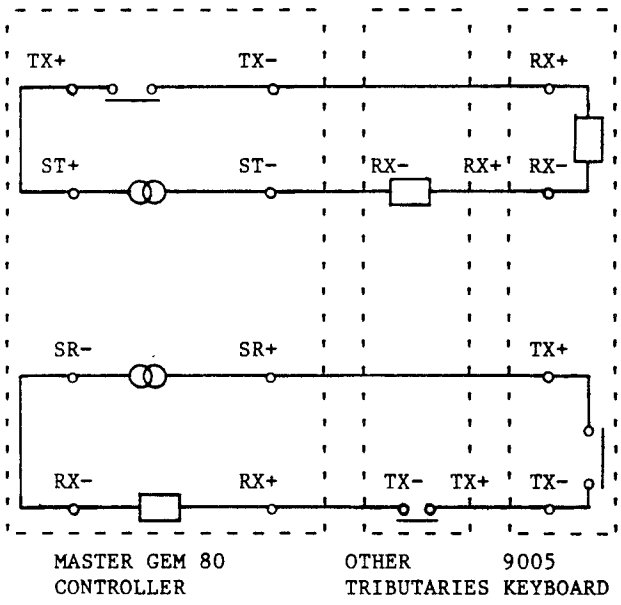


Figure 3.1 - Connecting the 9005 Tactile Keyboard to the ESP Serial Link

3.1.3 Isolation must be maintained between the plant-side power supply and the controller power supply. This is achieved internally when the keyboard unit is connected to either a Basic I/O ribbon cable, or to an external power supply. However, should the keyboard unit be connected to the Basic I/O ribbon cable and to an external power supply simultaneously, then the plant-side to controller isolation will be breached. The external power supply used in these cases must also be isolated, and should also provide a higher output voltage than that provided via the Basic I/O ribbon cable (a minimum of 20V d.c. or 25V a.c. is specified).

Blocking diodes are provided on both the external power supply input and the Basic I/O ribbon cable power supply input (see Figure 3.2). The diodes prevent damage occuring to either supply when connected simultaneously. They also prevent any damage to the keyboard unit occuring as a result of a reverse connected supply.

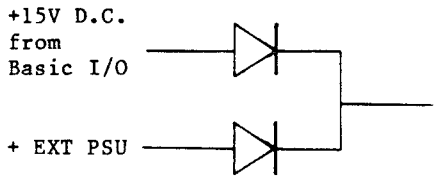


Figure 3.2 - Blocking Diodes on the Power Supply Inputs

It is important when using an external a.c. power supply that the peak voltage does not exceed 80V, and that the waveform is essentially sinusoidal. The blocking diode on the external power supply input half rectifies the a.c. supply, so the keyboard will only draw current for part of the cycle. If all the LED's are illuminated, this current can be up to 4A maximum during the conduction cycle (see Figure 3.3). As a result, the peak supply voltage must be at least 28V during the conduction cycle.

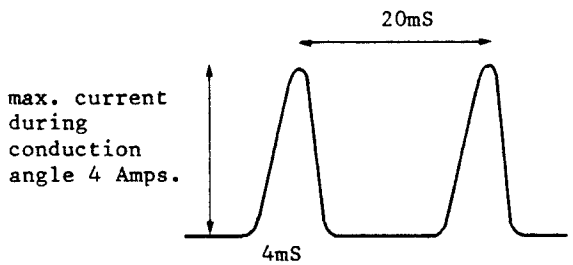


Figure 3.3 - Current Waveform

Figure 3.4 shows the variation of peak current drawn for a range of a.c. voltages. The maximum current is drawn for a 20V a.c. supply, so that if a voltage dip is to be avoided, a low impedance supply should be selected. If a transformer is used this should be rated at 50VA.

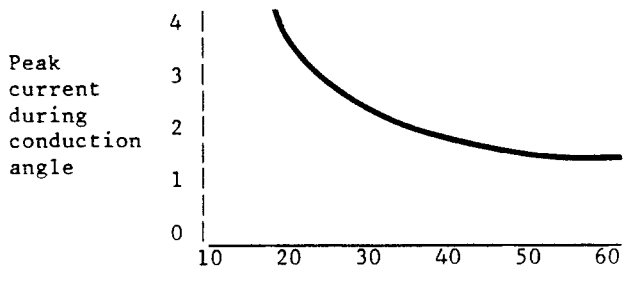


Figure 3.4 - Maximum Current for a Range of A.C. Voltages

3.2 Setting Up

A 16-position hexadecimal rotary switch is positioned at the rear of the keyboard unit for addressing purposes. Table 3.1 shows the corresponding addresses for each switch setting on both the Basic I/O highway and the ESP serial link. Up to fifteen 9005 Tactile Keyboards can be connected on a serial link.

Note: The keyboard unit can not process data sent simultaneously on the Basic I/O and serial link.

Switch Setting	Address on Serial Link	Address on Basic I/O Ribbon 1		Address on Basic I/O Ribbon 2	
		Inputs	Outputs	Inputs	Outputs
0	0	A0	B1	A16	B17
1	1	A2	B3	A18	B19
2	2	A4	B5	A20	B21
3	3	A6	B7	A22	B23
4	4	A8	B9	A24	B25
5	5	A10	B11	A26	B27
6	6	A12	B13	A28	B29
7	7	A14	B15	A30	B31
8	8	Basic I/O disabled			
9	9	Basic I/O disabled			
A	10	Basic I/O disabled			
B	11	Basic I/O disabled			
C	12	Basic I/O disabled			
D	13	Basic I/O disabled			
E	14	Basic I/O disabled			
F	15	Basic I/O disabled			

Table 3.1 - Using the 16-position Rotary Switch to Address the 9005 Keyboard.

A 4-way DIL switch is provided for pre-setting the feedback and key code options. Switch position 4 configures the 9005 keyboard so that it can be used as a direct replacement for the 8872 keyboard. These switch settings are listed in Table 3.2.

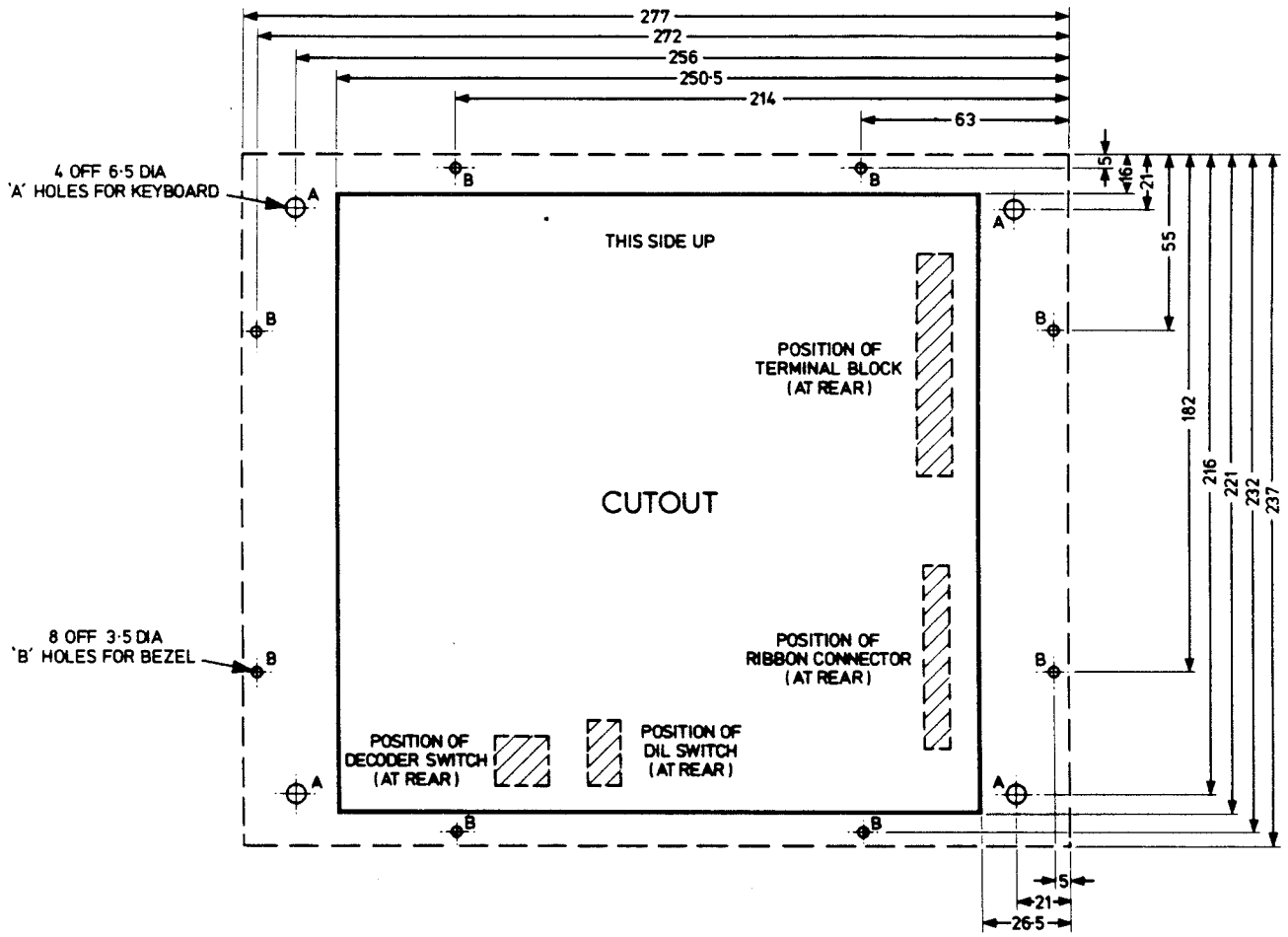
SW	OFF	ON
1	No audible feedback	Audible feedback
2	No visual feedback	Visual feedback
3	Keycode Option A	Keycode Option B
4	Normal use	Use as 8872

Table 3.2 - 4-way Pre-setting Switch

3.3 Mounting the Unit

Figure 3.5 shows the panel cut-out dimensions for the 9005 Tactile Keyboard and the relative positions of the Basic I/O ribbon connector, the screw terminal block, the 16 position rotary switch, and the 4 way DIL switch. Some overall dimensions are also shown. Great care should be taken when preparing the panel cut-out since the clearance around the keyboard is quite small.

The keyboard unit is mounted in place from the front of the panel, or desk, and is secured by four M4 nuts. Four fixed studs are provided on the keyboard unit for this purpose, and their positions are marked "A" in figure 3.5. The black aluminium bezel is then positioned over the keyboard. The bezel is fixed by eight M3 nuts on fixed studs provided in the positions marked "B".



MOUNTING DETAILS

Figure 3.5 - Cut-out and Fixing Dimensions for the 9005 Tactile Keyboard

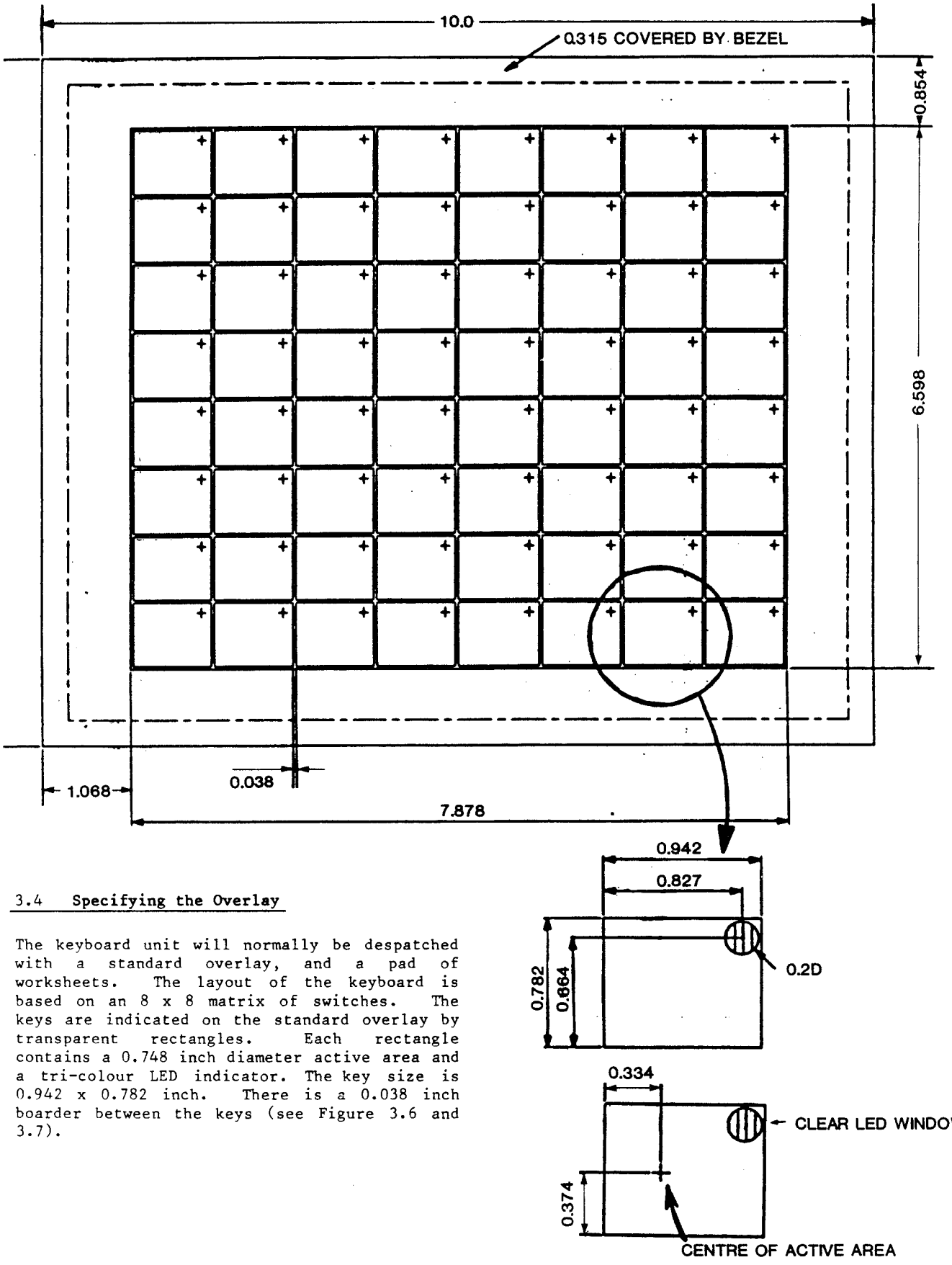


Figure 3.6 - Dimensions of Overlay, Key Area, LED Window and Centre of Active Area of Keyswitches

3.4 Specifying the Overlay

The keyboard unit will normally be despatched with a standard overlay, and a pad of worksheets. The layout of the keyboard is based on an 8 x 8 matrix of switches. The keys are indicated on the standard overlay by transparent rectangles. Each rectangle contains a 0.748 inch diameter active area and a tri-colour LED indicator. The key size is 0.942 x 0.782 inch. There is a 0.038 inch boarder between the keys (see Figure 3.6 and 3.7).

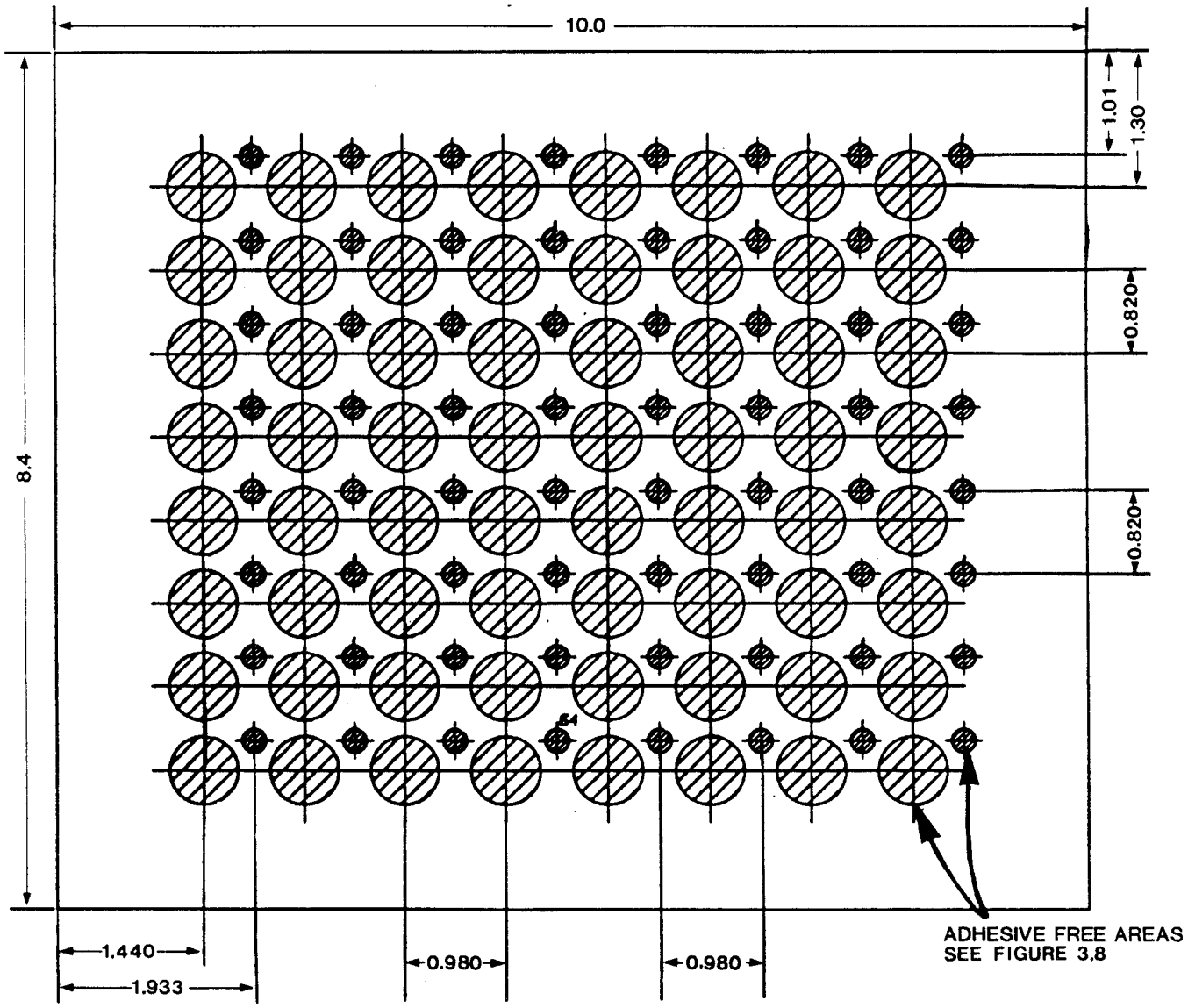
3.4.1 To make a temporary overlay, a worksheet is marked up as required for the use of the keyboard. It is not necessary to use all the keys or all the LED's. The black aluminium bezel is first removed from the keyboard. Then the worksheet is positioned on top of the keyboard, and the transparent overlay is placed on top of the worksheet. The bezel is then replaced, securing the overlay and the worksheet to the keyboard.

The standard overlay and worksheet can be used as a temporary measure, or where the use of the keyboard may change from time to time.

3.4.2 Once a fixed keyboard layout has been agreed upon, a custom made overlay can be manufactured. The recommended material for this is self-adhesive reverse screen printed matt clear PVC/MR labels, 0.008 inch thick. The LED windows and switch areas must remain clear of adhesive (see Figure 3.8).

There are a number of manufacturers of such labels, one recommended by GEC is:

E. Rudd & Co. Ltd.,
Island Works,
Holyhead Road,
Handsworth,
Birmingham, B21 0BS

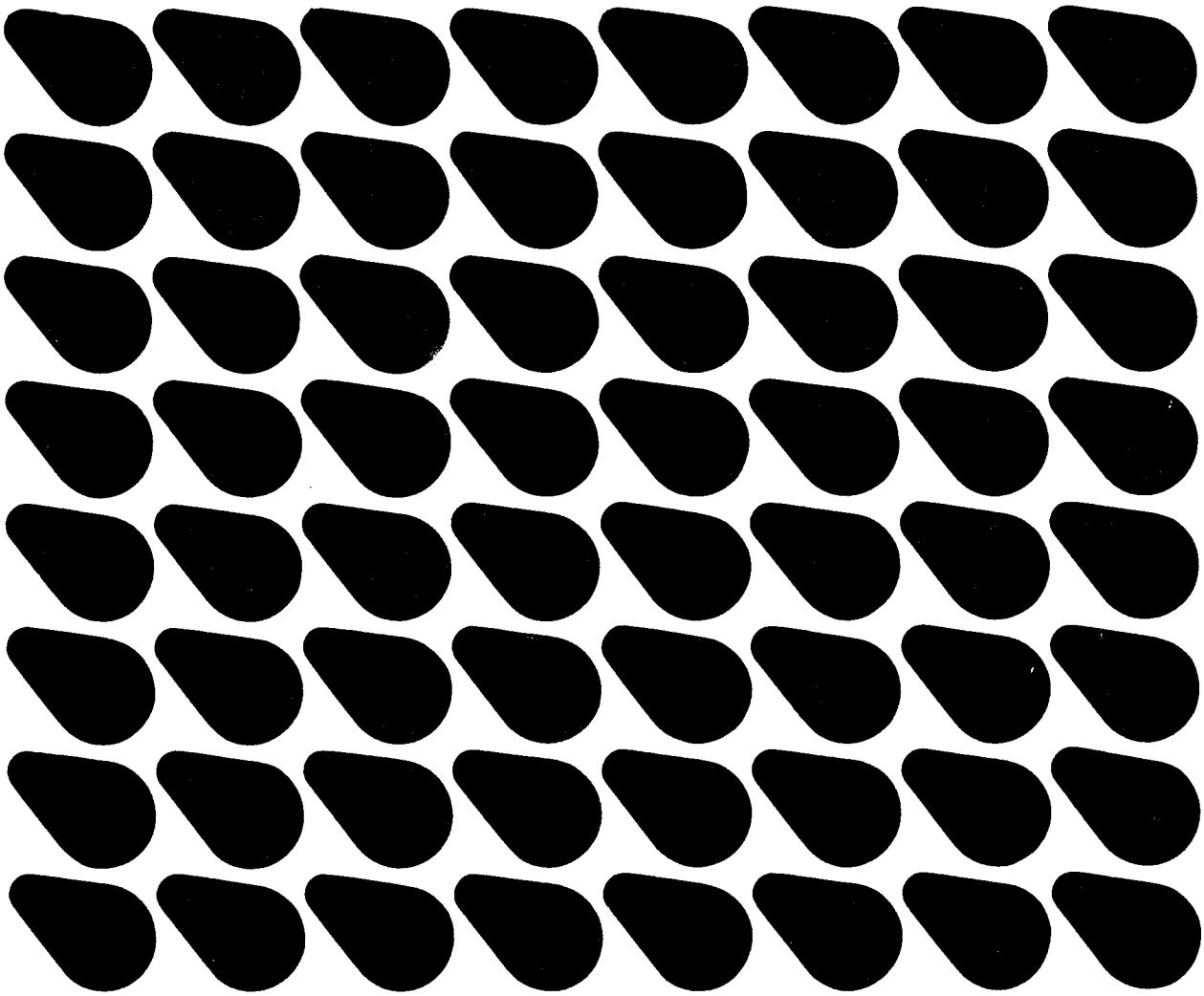


The large and small areas are 17mm and 6mm diameter respectively.
All other dimensions in inches.

Figure 3.7 - View of Keyboard Front Panel Showing Clearance for Key Switches and LED's

3.4.3 When a custom made overlay is to be permanently fitted to the keyboard, the bezel and any temporary overlay or worksheet should first be removed. The keyboard will have a protective plastic film attached to the front panel. This is to prevent the ingress of dirt or moisture. Now that an overlay is to be permanently fixed to the keyboard, this film can be removed.

Great care should be taken to position and stick down the overlay correctly. Keys and LED windows should align, and there should be no "bubbles" of air trapped between the overlay and the keyboard panel. It is best to peel away the backing paper from the overlay at one edge only and fold it back upon itself. Position the overlay, and then stick down this edge. The overlay can then be carefully stuck down as the remainder of the backing paper is peeled away.



For Dimensions See Figure 3.7

Figure 3.8 - Back View of Overlay Showing Adhesive Free Areas

The four output modes from the GEM 80 to the keyboard are selected by setting bits 14 and 15 in the output word. The format of the output word from the GEM 80 alters with each mode - only bits 14 and 15 have the same use. Table 4.1 shows the coding for each mode. The GEM 80 uses "A" tables for input and "B" tables for output when communicating on the Basic I/O highway.

BIT	15	14	
	0	0	MODE 0
	0	1	MODE 1
	1	0	MODE 2
	1	1	MODE 3

Table 4.1 - Mode Control

4.1 Mode 0 - Output

This mode is used to control individual LED's, switching them on and off independently, and selecting any of the available colours. Bit 3 controls the LED selected: 1 for ON; 0 for OFF.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	0	0	Column Number (0-7)			Row Number (0-7)			Not Used				On / Off	Code for LED Colour		

Mode 0 Word Format - Output Word from GEM 80 to 9005 Keyboard.

The LED is selected by using the row number and column number in co-ordinate fashion. Bits 8 to 13 are used for this purpose, and the coding for the rows and columns are shown in Tables 4.2 and 4.3.

Bits 0 to 2 select the colour of the LED. Table 4.4 shows the coding for the colours.

BIT CODE	ROW
0 0 0	1
0 0 1	2
0 1 0	3
0 1 1	4
1 0 0	5
1 0 1	6
1 1 0	7
1 1 1	8

Table 4.2 - Row Selection Code

BIT CODE	COLUMN
0 0 0	1
0 0 1	2
0 1 0	3
0 1 1	4
1 0 0	5
1 0 1	6
1 1 0	7
1 1 1	8

Table 4.3 - Column Selection Code

4.2 Mode 1 - Output

This mode is used to control a complete row of eight LED's. Bits 0 to 7 select the LED's: 1 for ON; 0 for OFF.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	0	1	Code for LED colour			Row Number (0-7)			Col 8	Col 7	Col 6	Col 5	Col 4	Col 3	Col 2	Col 1

Mode 1 Word Format - Output

Bits 8 to 10 select the row.

Bits 11 to 13 select the colour for all eight LED's. Only one colour can be selected, but this can be changed each time the control word is used, and all illuminated LED's will respond.

BIT CODE	COLOURS
0 0 0	RED
0 0 1	GREEN
0 1 0	YELLOW
0 1 1	FLASHING: RED/OFF
1 0 0	FLASHING: GREEN/OFF
1 0 1	FLASHING: YELLOW/OFF
1 1 0	FLASHING: RED/GREEN
1 1 1	FLASHING: GREEN/YELLOW
	FLASHING PERIOD: 300ms

Table 4.4 - LED Colour Selection Code

4.3 Mode 2 - Output

Pairs of LED's can be controlled in this mode. The first LED is at the position specified by the row and column numbers, and the second LED is the next one to the right, or the one at the beginning of the next row. A different colour can be specified for each LED. Bit 7 switches the first LED and bit 3 switches the second LED: 1 for ON; 0 for OFF. Bits 4 to 6 and 0 to 2 select the colour of the first and second LED's respectively.

The word format for Mode 2 is very similar to that for Mode 0.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	1	0	Column Number (0-7)			Row Number (0-7)			On/ Off	Code for LED colour at Position			On / Off	Code for LED Colour at next position		

Mode 2 Word Format - Output

Bit 9	Bit 8	Sounding Mode	Buzzer Operation
0	0	0	OFF
0	1	1	Buzzer sounds for the duration
1	0	2	Buzzer switches on and off continuously with a half period equal to the duration
1	1	3	Buzzer sounds continuously

Table 4.5 - Buzzer Mode Control

4.4 Mode 3 - Output

This is the buzzer and keyboard control mode.

Bit 13 clears all the LED's when set high.

Bit 12 is not used when operating on the Basic I/O. This bit controls the auto repeat facility when operating on the serial link.

Bit 11 turns on the visual feedback facility when set high.

Bit 10 turns on the audible feedback facility when set high.

Bits 8 and 9 control the buzzer operation. The buzzer can be operated in one of three ways:

i) Once for a specified duration;

ii) Switching on and off, where the time on and the time off are both equal to the specified duration;

iii) Continuously on.

The specified duration is supplied by bits 0 to 7. This gives a range of 0 to 255 in binary. 10ms steps are used, so this gives a range of 0 to 2.55s.

Table 4.5 shows the coding for bits 8 and 9.

NOTE: When a new mode word is input to the keyboard which is different from the old mode word, the new mode word is executed on the next I/O scan regardless of any previous data. For example if the buzzer is sounding countinuously for a duration set by the old mode word, when the new mode word is executed the buzzer will recommence sounding acording to the duration set by the new mode word, providing that bits 8 and 9 remain set. The previous duration and the time remaining to its completion are ignored.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	1	1	Clear	Auto Repeat	Visual Feed-back	Audible Feed-back	Sounding Mode		Code for duration Longest 2.55s. Shortest 0ms.							

Mode 3 Word Format - Output

4.5 Operation as an 8872 Direct Replacement - Output

The 9005 can be used as a direct replacement for the 8872 keyboard when switch 4 of the DIL switch is set on. Only eight LED's can be controlled and these are fixed in the positions shown in Figure 4.1. The word format is quite simple, only bits 0 to 7 are used to switch the LED's on and off: 1 for ON; 0 for OFF. The LED's can only be illuminated in yellow, and the buzzer sounds continuously while LED h is on.

Note: The 9005 keyboard does not respond to block sensing.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	Not Used								h on/off	g on/off	f on/off	e on/off	d on/off	c on/off	b on/off	a on/off

8872 Word Format - Output

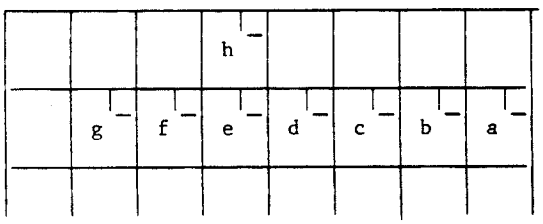


Figure 4.1 - LED's Controlled when the 9005 Keyboard is Used as a Direct Replacement for an 8872 Keyboard.

4.6 Input - All Modes

Two keycode options are available. The first option numbers each key with a consecutive decimal number. The second option numbers the keys in hexadecimal, and in four groups of 16. Each group, or quarter, is then identified by a different bit being set in the most significant byte. These keycode options are shown in Tables 4.6 and 4.7.

1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
17	18	19	20	21	22	23	24
25	26	27	28	29	30	31	32
33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48
49	50	51	52	53	54	55	56
57	58	59	60	61	62	63	64

Table 4.6 - Keycodes for Option A

10	11	12	13	20	21	22	23
14	15	16	17	24	25	26	27
18	19	1A	1B	28	29	2A	2B
1C	1D	1E	1F	2C	2D	2E	2F
40	41	42	43	80	81	82	83
44	45	46	47	84	85	86	87
48	49	4A	4B	88	89	8A	8B
4C	4D	4E	4F	8C	8D	8E	8F

Table 4.7 - Keycodes for Option B

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	Power up flag	Not Used (Returned value is always zero)							Key Code							

Input Word Format from 9005 Keyboard to GEM 80 - All Modes

Selection between the two options is made by setting switch 3 of the DIL switch: OFF for Option A; ON for Option B (see Table 3.2).

When no key is depressed, a zero keycode will be input to the GEM 80 controller. The word format is quite simple. Bits 0 to 7 are used for the keycode. When a key is pressed, the relevant keycode is sent for as long as the key is held down, or for a minimum of 100ms. Pressing a second key will have no effect until the first key is released.

Bit 15 is used as a flag on power up to alert the GEM 80 controller to the fact that the keyboard has been powered down. Any previously set up pattern of LED's will have been cleared by the power down, so the controller is alerted to this as soon as power is returned. Bit 15 remains set until the first two non-zero messages are received from the GEM 80.

This feature is not available when the 9005 is operating as a direct replacement for an 8872 keyboard.

The five output modes (including the 8872 mode of operation) available on the Basic I/O highway are also available on the serial link. The modes are used in exactly the same way as on the Basic I/O, the only difference being that the GEM 80 uses "J" tables for input and "K" tables for output on the serial link.

In additon to the five standard modes, the serial link uses a sixth mode, which is a modified form of Mode 3. In this mode up to 17 words or "K" tables can be output to the keyboard. The first word is the same as for Mode 3, and the following words are the LED on/off and colour data. Each word supplies the data for four LED's, so 16 words are required to set all 64 LED's.

An eight character buffer is provided by the keyboard unit to temporarily store the input word to the GEM 80. Successive keycodes are loaded into the buffer when keys are pressed in quick succession. Output from the buffer is on a first in - first out basis, the keycodes queueing up before being input to the GEM 80. The buffer is required when operating on the serial link so that key operations are not lost while the GEM 80 is reading data from another tributary.

The keyboard matches the baud rate of the GEM 80 controller automatically when connected to the serial link. The keyboard unit takes some time to self-configure its baud rates, so the first few messages sent by the GEM 80 will be lost. The number of messages lost is dependent on the baud rate, since the lower the baud rate the longer the keyboard unit will take to self-configure.

5.1 Modes 0 to 3 - Output

If only one "K" table is sent by the GEM 80, then the word format is the same as for Modes 0 to 3 on the Basic I/O highway. These modes are used in exactly the same way as for the Basic I/O, so allowing for easy adaption to serial link operation.

The auto repeat facility is now available in Mode 3 controlled by bit 12. If a key is depressed for more than 800ms, the key will auto repeat at 300ms intervals, or at the speed at which the GEM 80 is reading the keyboard, whichever is the slowest.

Note: Any previous keycodes which are in the buffer will be input to the GEM 80 before auto repeating begins.

5.2 Mode 3 With Multiple Tables - Output

When more than one "K" table is sent by the GEM 80, the first word is the Buzzer/Keyboard control word and successive words, up to 16, are the LED's on/off and colour data words (see Table 5.1).

K Table	Word Controls			
K(32n+0)	Buzzer/Keyboard control			
K(32n+1)	LED4	LED3	LED2	LED1
K(32n+2)	LED8	LED7	LED6	LED5
K(32n+3)	LED12	LED11	LED10	LED9
K(32n+4)	LED16	LED15	LED14	LED13
K(32n+5)	LED20	LED19	LED18	LED17
K(32n+6)	LED24	LED23	LED22	LED21
K(32n+7)	LED28	LED27	LED26	LED25
K(32n+8)	LED32	LED31	LED30	LED29
K(32n+9)	LED36	LED35	LED34	LED33
K(32n+10)	LED40	LED39	LED38	LED37
K(32n+11)	LED44	LED43	LED42	LED41
K(32n+12)	LED48	LED47	LED46	LED45
K(32n+13)	LED52	LED51	LED50	LED49
K(32n+14)	LED56	LED55	LED54	LED53
K(32n+15)	LED60	LED59	LED58	LED57
K(32n+16)	LED64	LED63	LED62	LED61

Table 5.1 - Corresponding 'K' Tables for the Buzzer/Keyboard Control Word and the LED Data Words - Where n is the Keyboard Address

Each LED is numbered in the same way as the keys in Option A, 1 to 64 in decimal. Each LED data word supplies the data for four LED's. Bits 3, 7, 11 and 15 control whether LED's 1, 2, 3 or 4 are on or off: 1 for ON; 0 for OFF. The following three bits control the colour of that LED. Using this format any LED on any row can be turned on or off in any colour independentaly, or all the LED's can be turned on at once. Not all the "K" tables need be sent. If only one LED is being changed, only the "K" tables up to, and including, the table which contains that LED are sent by the GEM 80. However, all LED data words must be preceded by the Buzzer/Keyboard control word which is the same as for Mode 3.

Because the first word received when multiple tables are sent is always the Mode 3 Buzzer/Keyboard control word, bits 14 and 15 (mode control) need not be set.

However, bit 13, the clear bit, is not used in this mode with multiple tables since, obviously, its use would cause the keyboard to try to clear data at the same time as it was attempting to set the data according to subsequent LED data words.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	mode		Clear	Auto Repeat	Visual Feed-back	Audible Feed-back	Sounding mode		Code for duration Longest 2.55s. Shortest 0ms.							

Buzzer/Keyboard Control Word Format (Mode 3) -
Output from GEM 80 to 9005 Keyboard on the ESP Serial Link

BIT IN OUTPUT WORD K (32n+x)	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	On/Off	Code for LED Colour			On/Off	Code for LED Colour			On/Off	Code for LED Colour			On/Off	Code for Colour		
	LED 4x				LED (4x-1)				LED (4x-2)				LED (4x-3)			

Where x = 1 to 16
LED Data Word, One of 16, Must Follow Control Word Above -
Output from GEM 80 to 9005 Keyboard on ESP Serial Link

5.3 Input - All modes

Input from the keyboard unit to the GEM 80 is almost the same as for the Basic I/O highway with the exception of bit 14, which is used for error reporting. Bit 14 is set if more than seventeen "K" tables are sent by the GEM 80 in any transmission. The extra tables are ignored. A reduction in the number of tables sent will reduce the loading on the serial link and increase the speed of reponse, leading to a more efficient use of the serial link.

BIT IN OUTPUT WORD	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
FUNCTION	Power up flag	Error 1	Not Used						Key Code							

Input Word from 9005 Keyboard to GEM 80
on the ESP Serial Link

Because the auto repeat facility is now available, a key code will only be sent once for each key press (unless the key is held down for longer than 800ms and the auto repeat facility is invoked). This differs from Basic I/O operation where the keycode is sent for a minimum of 100ms.

The self test feature is in four parts, each test following on from the other. Power must be connected for all the tests, and for the last test the keyboard should be connected to the Basic I/O highway and to the serial link if communications are also to be tested.

The first test is invoked by pressing the four corner keys marked "A" in Figure 6.1. This causes all of the LED's to be lit in red, then green, then yellow. The keyboard then progresses to the next test.

The second test lights each row and each column of LED's in turn in red.

The third test lights the LED for each key in turn. The LED remains lit until the key for that LED is pressed. On the first row the buzzer sounds with each key press.

The fourth test involves the use of the Basic I/O highway and the serial link. The top row of LED's counts up in binary the number of serial link messages correctly received. The second row of LED's counts up in binary the number of serial link messages incorrectly received. The third row of LED's counts up in binary the number of Basic I/O messages received. The lower five rows of LED's are used to display the address decoder switch setting as a 5 x 4 green dot matrix HEX digit.

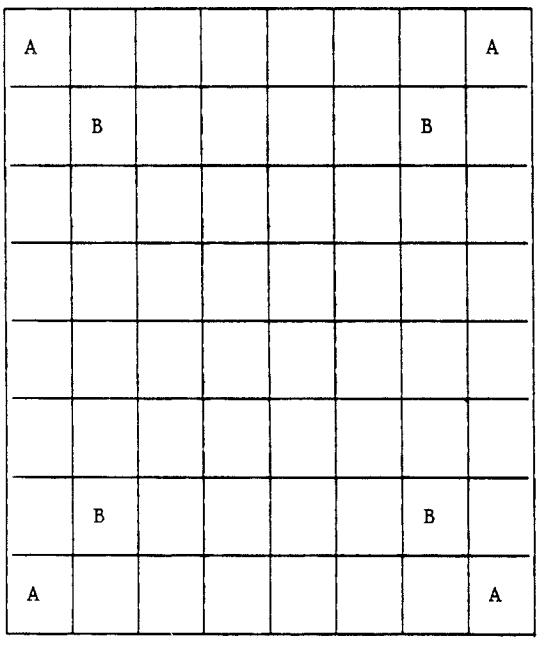


Figure 6.1 - Self-test Control Keys

Note that if messages are transmitted on both the Basic I/O and the serial link simultaneously, a significant number of serial link messages will be incorrectly received (these messages are re-transmitted).

Every time the four corner keys are pressed the keyboard unit will progress to the next test. To exit from the test feature the four keys diagonally in from the corner keys (marked "B" in Figure 6.1) must be pressed.

This test feature is provided to aid the commissioning of the keyboard unit on site, and it can only be used while all the keys and LED's are accessable. Any overlay which obscures keys and LED's which are not used will obviously reduce the effectiveness of the test.

Note that any previously set up conditions will be lost since the keyboard is reset on exit from the test feature.

(i) Program to Drive LED's when Keypad Used On Serial Link

Keyboard Address 0 - sending 17 tables

```
|                                                    |
|---] [---------- AND ---------+--(OUT)--|
| LIGHT   0000/0000/0000/1001   |   K1    |
| LED 1 GREEN                   |         |
|                               |         |
|---] [---------- AND ---------|          |
| LIGHT   0000/0000/1000/0000   |         |
| LED 2 RED                     |         |
|                               |         |
|---] [---------- AND ---------|          |
| LIGHT   0000/1010/0000/0000   |         |
| LED 3 YELLOW                  |         |
|                               |         |
|---] [---------- AND ---------'          |
| LIGHT   1110/0000/0000/0000             |
| LED 4 FLASHING                          |
| RED/GREEN                               |
|                                         |
```

(ii) Program to Drive LED's when Keypad Used on Basic I/O

Keyboard Address 0

```
|                                                    |
|---] [---------- AND ---------+--(OUT)--|
|  SOUND   1100/0001/0001/0100  |   B1    |
|  BUZZER  200ms DURATION       |         |
|                               |         |
|---] [---------- AND ---------|          |
|  CLEAR   1110/0000/0000/0000  |         |
|  LAMPS                        |         |
|                               |         |
|---] [---------- AND ---------'          |
| ILLUM-   1000/0000/1000/1111            |
| INATE                                   |
| LED's AT 2 TOP                          |
| LEFT POSITIONS                          |
| ROW 0, COL 0 RED                        |
| ROW 0, COL 1 FLASHING GREEN/YELLOW      |
|                                         |
```

8. ORDERING CODES

9005 Tactile Keyboard Aluminium Bezel (Black) Grey standard overlay with black inscription showing key positions Overlay Worksheet Pad Data Sheet	9005-4001
9005 Tactile Keyboard with non-standard key codes and/ or custom designed overlay (special order only) Aluminium Bezel (Black) Data Sheet	9005-xxxx (allocated by GEC) —

SPARES:

Keyboard unit	25X.9005/10
Bezel	78801/208
Overlay Work Sheet Pad	ICE 157
Standard Overlay	~~78801/243~~ 457 4520/01

GEC Industrial Controls Limited.
Programmable Controllers Division,
Kidsgrove, Stoke-on-Trent,
Staffordshire ST7 1TW, England.
Tel: Kidsgrove (07816) 3511
FAX (Group 3) Kidsgrove (07816) 76329
Telex: 36293 GECICK

Also at:
Mill Road, Rugby,
Warwickshire CV21 1BD.
Tel. Rugby (0788) 2121

Registered at London No. 540682
Holding Company: The General Electric Company p.l.c.,
1 Stanhope Gate, London, W1A 1EH.

A.0147M/D.1998M

9005 UI T444 ISSUE 1 Page 18