

DESIGN FOR A SCORING MACHINE

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Background

This design describes two similar machines for use with photographic competitions where multiple judges use silent scoring on personal handsets. One design is a maximum size, allowing for up to eight judges. The second is a subset design, allowing for up to three judges.

There are known to be other scoring machines available.

- Kodak produced a number of machines for 3 judges scoring 1-5. This is a complete hardware unit, with three handsets for judges also displaying their individual score, and a master unit displaying each judge's score and the total. The master unit has a reset button to clear the scores ready for the next item. The total score has to be announced and recorded separately: the unit does not integrate the score into the running order list.
- Other variations may not display the score on each judge's handset, and may have a separate master handset with the reset button.
- PAGB uses a machine for its assessments events. This accommodates 6 judges, and the scores are recovered on a computer and integrated into the running order list on an Excel spreadsheet.

I decided to make a machine where the hardware is minimal, and where the configuration and integration can be developed in software later as required.

Principle

A standard PC keyboard is wired in rows and columns, where each key is at a unique intersection between a column wire and a row wire. An encoder chip constantly polls the columns. When a key is pressed, the chip receives a signal on a row for the given column: the column/row combination defines the key.

Ignoring upper/lower case shift, there are 26 letters, 10 numbers, and 12 special characters keys on a standard keyboard. Of these 48 available keys, it is possible to select 40, to allow 8 judges each to have a handset with five buttons. It is as if a standard keyboard is cut up into fragments, with each judge being given a fragment to use. The encoder chip will send the relevant ASCII character, and software in the receiving PC maps each character into the judge and score values.

Although it is possible to select 40 keys for use, there are constraints in a practical design. All the handsets should be wired identically so that they are interchangeable. Any handset should be pluggable to any socket on the base unit: only the socket determines the judge identity. The number of cores in the cables should be minimised. It turns out that there are solutions for 40 buttons to enable 8 judges with handsets of 5 buttons each, to score 1-5.

Unlike some other scoring machines, secrecy is improved by not displaying anything eg, the score, on the judges' handsets. Secrecy of the individual scores can also be ensured in the PC software design.

Keyboard Encoder

There are two options for obtaining a keyboard encoder chip.

- Buy a bespoke unit. The Audon unit described below costs about £60.
- Buy a cheap keyboard and strip out the encoder board. This should be a USB keyboard, and I obtained a mini keyboard for about £8.

Bespoke unit

A keyboard encoder chip, with connector strips for the columns and rows, and with PS2 keyboard sockets in a wedge configuration, was available (March 2005) from Audon Electronics, 123 High Road, Chilwell, Nottingham, NG9 4AT (Model KBE-98). A revised design is available (November 2009) from the same supplier (Model KBE-629). This later design allows for either PS2 or USB direct connection.

Their website at www.audon.co.uk contains data sheets, and advice on how to avoid ghost characters if multiple keys are pressed simultaneously.

The Table lists the recommended graphic, and column/row combinations.

Judge	Score	Graphic	KBE-98 Row	Column	KBE-629 Row	Column
1	1	1!	8	E	W	L
	2	2"	8	F	W	M
	3	3£	8	G	W	N
	4	4\$	8	H	W	O
	5	7&	8	I	W	P
2	1	qQ	2	E	F	L
	2	wW	2	F	F	M
	3	eE	2	G	F	N
	4	rR	2	H	F	O
	5	uU	2	I	F	P
3	1	aA	3	E	D	L
	2	sS	3	F	D	M
	3	dD	3	G	D	N
	4	fF	3	H	D	O
	5	jJ	3	I	D	P
4	1	zZ	5	E	Z	L
	2	xX	5	F	Z	M
	3	cC	5	G	Z	N
	4	vV	5	H	Z	O
	5	mM	5	I	Z	P
5	1	8*	8	J	W	Q
	2	9(8	K	W	R
	3	0)	8	O	W	V
	4	5%	7	H	X	O
	5	6^	7	I	X	P
6	1	il	2	J	F	Q
	2	oO	2	K	F	R
	3	pP	2	O	F	V
	4	tT	1	H	E	O
	5	yY	1	I	E	P

Judge	Score	Graphic	KBE-98		KBE-629	
			Row	Column	Row	Column
7	1	kK	3	J	D	Q
	2	lL	3	K	D	R
	3	::	3	O	D	V
	4	gG	4	H	C	O
	5	hH	4	I	C	P
8	1	nN	6	I	Y	P
	2	bB	6	H	Y	O
	3	/?	6	O	Y	V
	4	.>	5	K	Z	R
	5	,<	5	J	Z	Q

There is a direct equivalence in the wiring required for KBE-98 and KBE-629. It is merely that the connections on the two boards are laid out and labelled differently.

NOTE: This design (revised November 2009, and used in software versions 207 onwards) avoids an error in the Audon data sheet for KBE-98, where row 7, column E is shown as sending #~ (key next to Return), but actually sends `~ (key next to 1).

Stripped Keyboard

Open the keyboard. Usually the keys operate a plastic membrane which is press connected to the keyboard encoder board. The encoder board carries the indicators for num-lock, caps-lock and scroll-lock. Recover the encoder board with its cable, and discard the remainder of the keyboard.

The encoder board may be marked where the keys membrane was attached. The markings should be C0 to C17 for columns, and R0 to R7 for rows. If the board is not marked, then it will be necessary to experiment with connection pairs to determine what characters are sent, and hence which pins are for which columns and rows.

Once the correct connections are identified, wires must be soldered to the relevant pins. The LED indicators can be cut off the board. During assembly, it will be necessary to unsolder the USB cable, and then reconnect after passing the cable through a grommet into the base unit.

The Table lists the recommended graphic, and column/row combinations. These have only been determined for the small design allowing up to three judges.

Judge	Score	Graphic	Row	Column
1	1	1!	7	1
	2	2"	7	2
	3	3£	7	3
	4	4\$	7	4
	5	7&	7	5
2	1	qQ	0	1
	2	wW	0	2
	3	eE	0	3
	4	rR	0	4
	5	uU	0	5
3	1	aA	2	1
	2	sS	2	2
	3	dD	2	3
	4	fF	2	4
	5	jJ	2	5

Both Encoder Types

The Tables shows, for all judges (handsets), that the row number is arranged to be the same for scores 1-3, and the same for scores 4-5. (In some cases, both of these are also the same, but that is ignored to make handset wiring identical.)

For letters, the character sent may be either lower case or upper case, depending on the concurrent shift setting. For numbers and special characters, the two cases are as shown on the standard key tops. Eg, 5 may be sent as 5 or %.

Handsets

Up to 8 scoring handsets may be used. The parts required for each handset are (with Maplin stock codes)

- Plastic box (1 of N70BQ (black))
- Square push switch (3 of JB00A (red); 2 of JB01B (black))
- 1N4148 signal diode (5 of QL80B)
- Grommet (1 from QT93B). Use a small cable tie to trap the cable inside.
- 8-core cable (eg, Cat5 solid core CW45Y, or stranded core VB10L). Recommended lengths are 4m for handsets 1-5; 6m for handsets 6-8.
- 9D plug (RK60Q)
- 9D shell with screwlock (KE94C)

The box is long enough to space the keys at 19mm (keyboard standard), with 15mm below key 1, and 19mm above key 5. The grommet is at the 5 end, and should be offset.

The keys layout is red for 1,3,5; and black for 2,4. Other arrangements may be made if required. Keys may be labelled eg, using cut-outs of address label stock, placed beside each key. For legibility in low light, use white numbers on a black ground.

The recommended wiring table for a scoring handset is:

Core	Handset	9D
Blue	SW1 col side	1
Blue/white	SW2 col side	2
Orange	SW3 col side	3
Orange/white	SW4 col side	4
Green	SW5 col side	5
Green/white	nc	nc
Brown	To 3 of 1N4148 diodes. One diode to each of SW1 to SW3, row side. Diode ring towards switch	6
Brown/white	To 2 of 1N4148 diodes. One diode to each of SW4 to SW5, row side. Diode ring towards switch	9

Base Unit

Audon Encoder

The base unit holds sockets for up to 8 handsets, and the encoder board. A metal box is preferred for strength, and Maplin LH73Q is a correct size.

The sockets are 9-pin D-sub type (Maplin RK61R), with jack posts (Maplin FP31J). After mounting and wiring the sockets (see Table), the encoder board may be screwed to wooden battens glued inside the box. The PS2 output socket on the board is accessed through a cutout. The input socket can remain inaccessible

The sockets may be labelled in the same style as the handset buttons. It is the socket which determines the judge identity, and each socket is wired to reflect this. There are 16 wire runs to the encoder board. The wiring density is tight: test all runs for short circuits during construction.

Run	KBE-98	KBE-629	Connections (socket#pin)
1	E	L	1#1, 2#1, 3#1, 4#1
2	F	M	1#2, 2#2, 3#2, 4#2
3	G	N	1#3, 2#3, 3#3, 4#3
4	H	O	1#4, 2#4, 3#4, 4#4, 5#4, 6#4, 7#4, 8#2
5	I	P	1#5, 2#5, 3#5, 4#5, 5#5, 6#5, 7#5, 8#1
6	J	Q	5#1, 6#1, 7#1, 8#5
7	K	R	5#2, 6#2, 7#2, 8#4
8	O	V	5#3, 6#3, 7#3, 8#3
9	1	E	6#9
10	2	F	2#6, 2#9, 6#6
11	3	D	3#6, 3#9, 7#6
12	4	C	7#9
13	5	Z	4#6, 4#9, 8#9
14	6	Y	8#6
15	7	X	5#9
16	8	W	1#6, 1#9, 5#6

For the KBE-98 board, the base unit is line powered by the PS2 cable from the PC keyboard socket. A 2m M-M PS2 cable is supplied as standard by Audon with the decoder. A 5m F-M PS2 extension cable may be added (Maplin PQ31). Laptop computers now rarely include a PS2 socket, and some desktops only use a USB keyboard. The KBE-98 board is compatible with USB by use of a PS2 to USB active adapter (widely available).

The KBE-629 board will operate either from a PS2 or a USB connection. It would be preferable to order the USB alternative cable with the board.

Stripped Keyboard Encoder

For up to three judges, and the smaller encoder board, a Maplin box N89BQ is suitable.

Three sockets are mounted, with jack posts, and wired with pins 1 thru 5 common to all three sockets and respectively to encoder columns C1 thru C5. Each socket has pin 6 wired to pin 9, and to its unique encoder row (R7 for judge 1; R0 for judge 2, R2 for judge 3). Label the sockets.

Drill a hole for the USB cable, and fit a grommet. Use a cable tie on the cable inside as a strain relief.

Restricted Handsets

The smallest scoring machine likely to be required needs only three handsets, and uses only scores 2-5. In this case, it may be simpler to use fixed cabling between the

handsets and the base unit ie, omitting the 9D plugs and sockets. As can be seen from the wiring tables, the first three handsets have one unique row per handset, and the columns are in common. A six-core cable would suffice, eg standard telephone cable.

Testing

The base unit is connected to a PC as an external keyboard, and running any software which can accept text input.

Using a PS2 connection, the unit must be plugged in before turning on the PC. Using a USB connection, the unit is likely to be plug-and-play.

Every handset should be tested in every socket. The character which should be received for each judge number and score number is as listed in the encoder Tables.

Software

This specification does not deal with the software required to use the handset system.

Software has been developed using MS-Access 2000 with VBA code. These versions are no longer supported.

Software (version E302) has been developed using MS-Excel 2000 with VBA code, including:

- Compatibility with versions of Excel from 2000 to 2010.
- Configuration setup (number of judges, the score range, scores visibility).
- Handset testing.
- Manual scoring machine.
- Optional integration with the running order for the event, with saving of scores against the entries.
- Optional saving of all individual judges' scores.

The general principle remains that the scoring machine hardware requires no modifications to work with any variety of software solutions which may be devised.