

RS data

Programmable clock/ timer i.c. TMS 1601A

Stock number 308-821

The RS programmable clock/timer i.c. is a dedicated mask programmed microcomputer which has been designed as the basis of a versatile timing unit. In the normal mode the unit is a 24 hour 7 day timer; however use of the reset function allows any period cycle up to one week to be followed. Four independent switch outputs are available which can be used to control a wide range of peripherals with the correct interface circuitry.

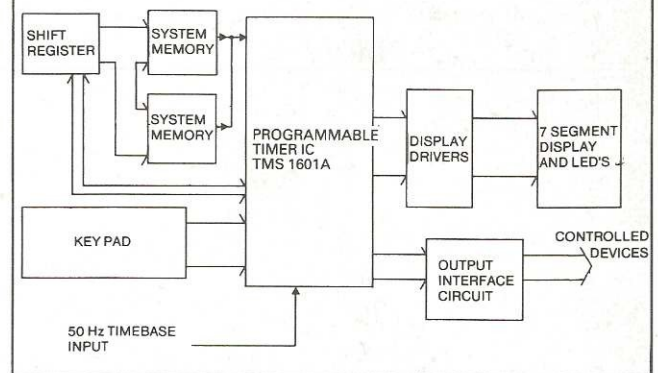
Absolute maximum ratings

Supply voltage, V_{DD} _____ -15V to 0.3V
 Data input _____ -15V to 0.3V
 Indicator outputs to buffers
 average output current _____ -24mA
 Indicator outputs to buffers
 peak output current _____ -48mA
 Row outputs average output current _____ -14mA
 Row outputs peak output current _____ -28mA
 Switch outputs average output current _____ -14mA
 Switch outputs peak output current _____ -28mA
 Continuous power dissipation _____ -600mW
 Operating temperature range
 (in free air) _____ 0°C to 70°C
 Storage temperature range _____ -55°C to 150°C
 (All voltages with respect to V_{SS})

Features

- 112 Daily switching functions
- 112 Weekly switching functions
- 4 switch outputs interface to thyristor, triac drives etc
- 4 digit 7 segment display to indicate real time, turn on-off times and reset times
- Individual outputs to drive day of week, switch and status LED's
- Reset function allows continual or manually initiated time looping from minutes up to one week
- Period feature to calculate and enter turn off time when an on period is entered
- Memory view facility
- Memory clear allowing total or specific switch deletions for correcting errors etc
- Data entry from a matrix keypad
- Manual control of any output

Block diagram of programmable timer system



Electrical characteristics $T_A = 25^\circ\text{C}$ $V_{DD} = -9\text{V}$

* Indicator outputs

Parameter	Conditions	Min	Typ	Max	Units
Supply voltage, V_{DD}		-7.5	-9	-10.5	V
Input current (COLUMN, DATA IN, 50Hz IN)	$V_I = 0\text{V}$	70	180	400	μA
High level output voltage	$I_O = -5\text{mA}$	-1.7			V
Low level output current	$V_{OL} = V_{DD}$		300 (900)		μA
Average supply current from V_{DD}			17		mA
Average power dissipation			153		mW
Internal oscillator frequency		500		550	kHz
Small signal input capacitance (COLUMN, DATA IN, 50Hz IN)	$V_I = 0\text{V}$ $f = 1\text{kHz}$		10		pF

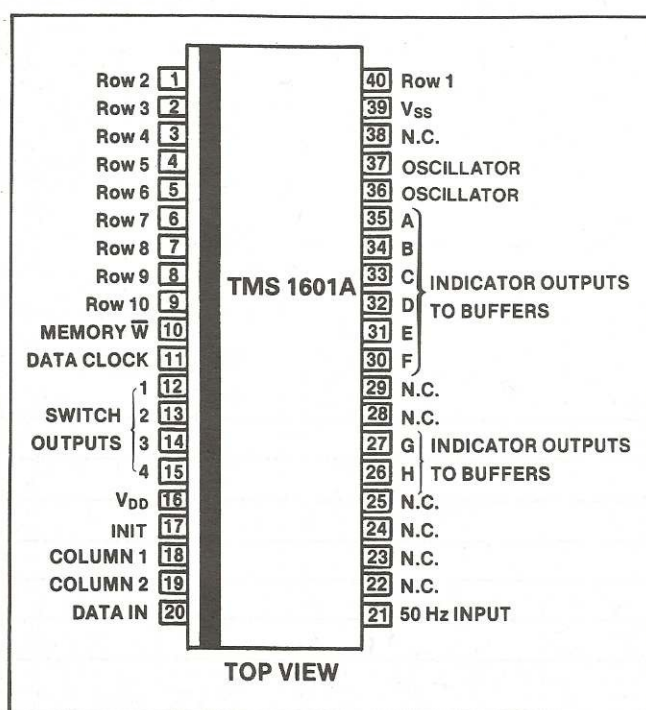
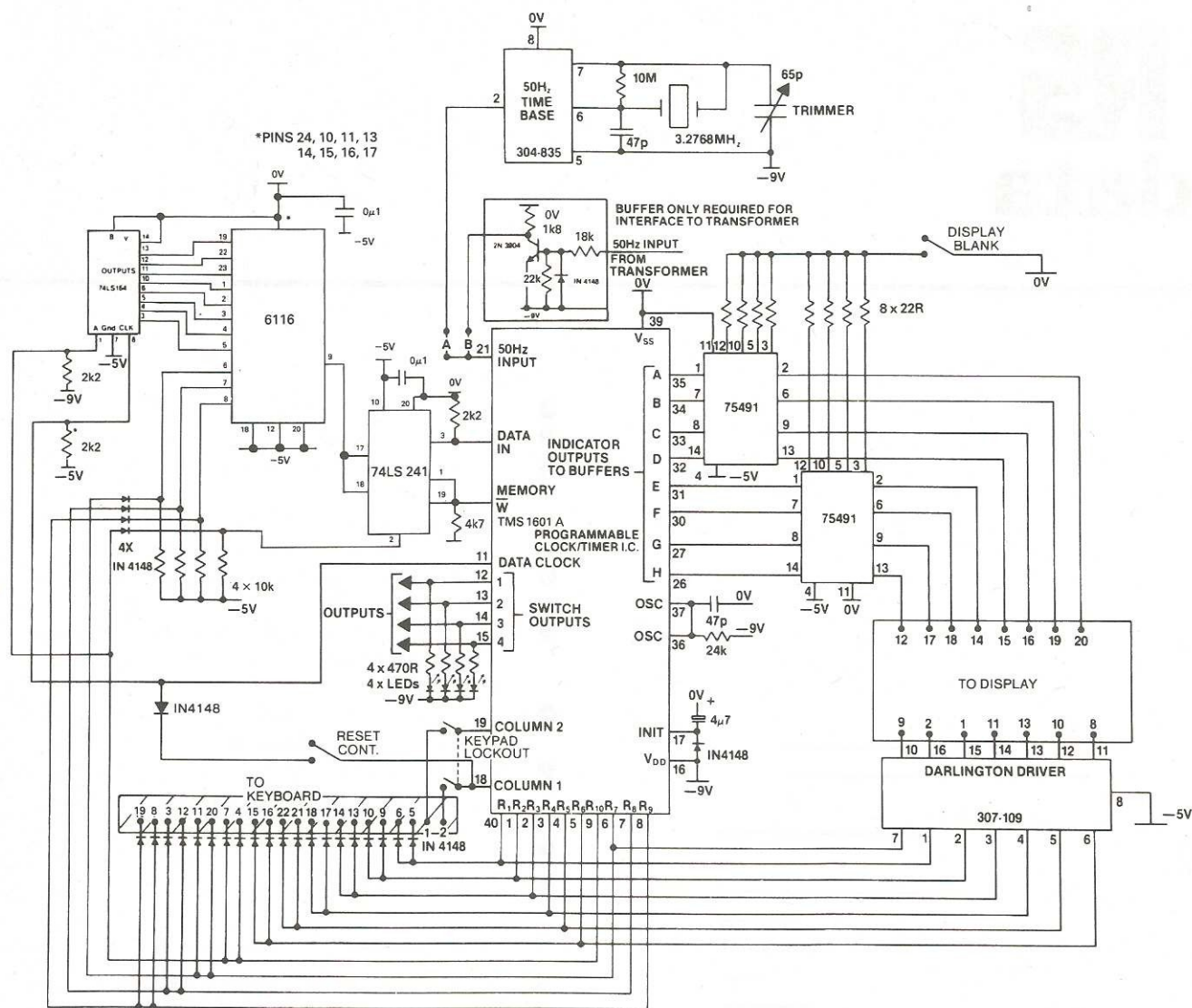
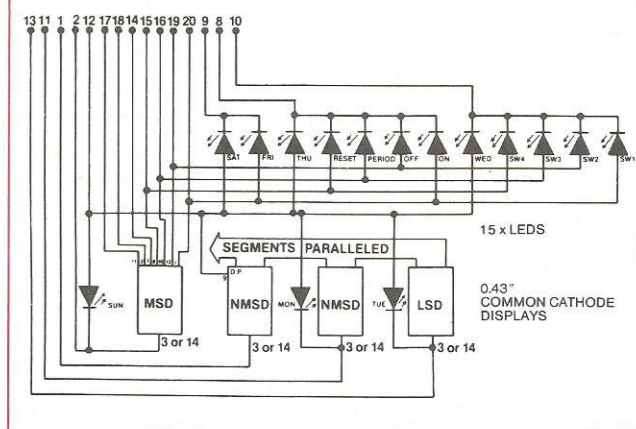


Figure 3 Display



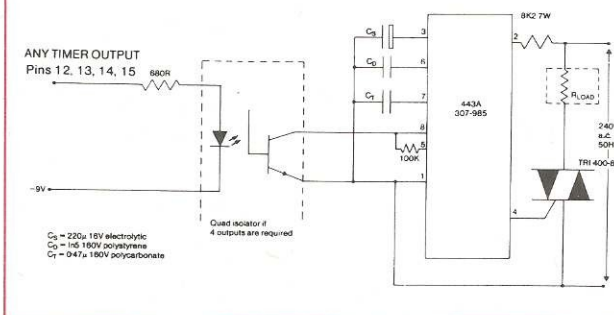
Interface circuits

The following circuits interface between the programmable timer i.c. and the controlled device(s). The circuit chosen will be dependent on the type of load being driven.

Zero voltage switching using ZVS i.c.

This zero voltage switching circuit can be used in applications requiring a minimum of interference which may be caused by firing the triac at points away from the zero voltage switching point. See data sheet 3611 for further details.

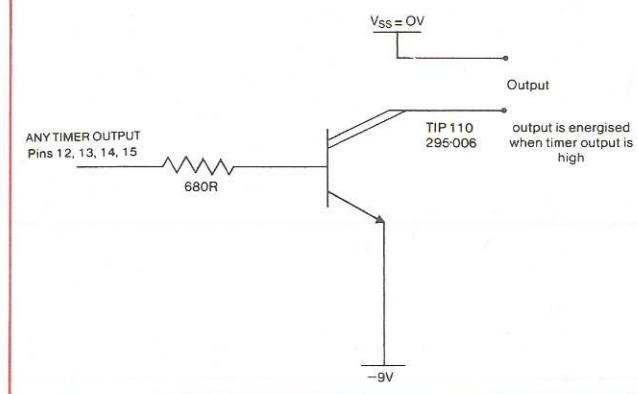
Figure 4



Output switching using a darlington transistor

Simple low voltage switching without isolation may be achieved using a darlington transistor.

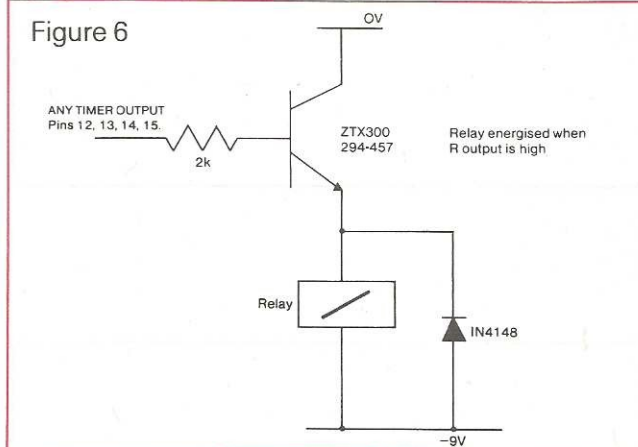
Figure 5



Relay driving circuit

The following circuit uses a relay as the isolating and switching unit.

Figure 6

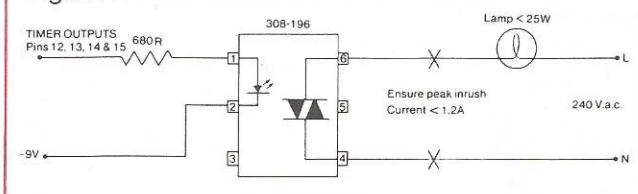


General interface circuits

These circuits form triac interfaces with optical isolation of the load from the timer circuit.

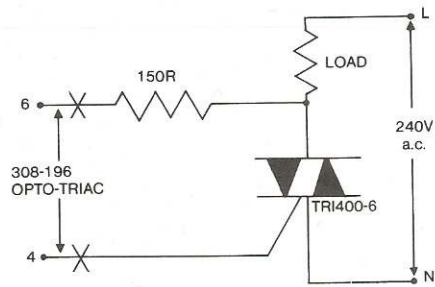
Opto-coupled triac (see data sheet 3958) for direct low power switching.

Figure 7



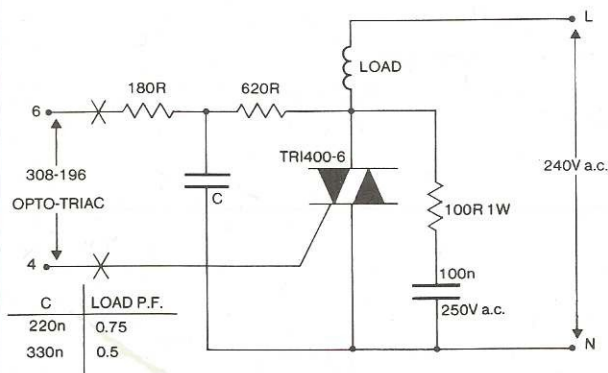
If larger load currents are required, use one of the following two circuits at points X-X.

Figure 8



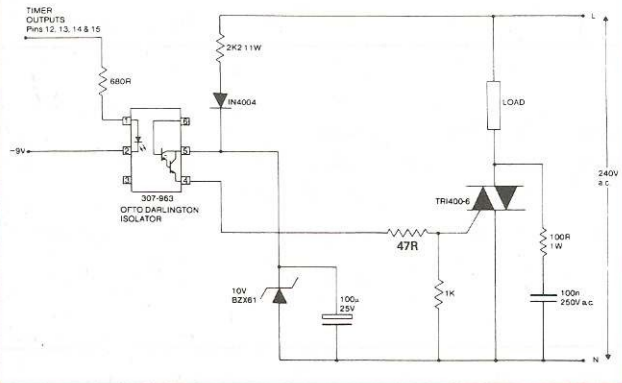
Inductive load

Figure 9



Additional triac interface circuit

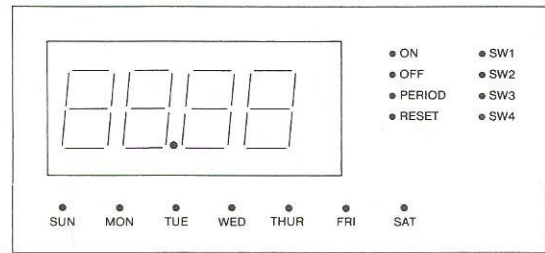
Figure 10



Programming guide

The following display layout is recommended and will be used throughout this data sheet.

Figure 11



The following symbols will be used

• = LED illuminated ✱ = LED flashing

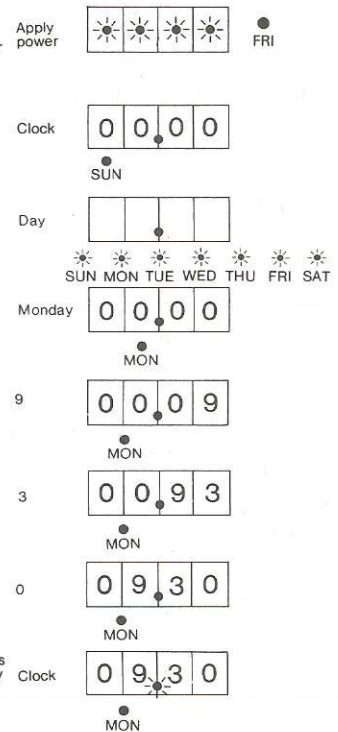
Data entry

Clock setting

On initial power up the display flashes up 8's and the Friday LED is illuminated. The clock key is depressed which sets the timer into the default mode of Sunday 00.00, all switches are in the off state. Depressing the day key starts the day LED's flashing. Day and time is then entered.

Key operation Resultant display

Eg. set clock to Monday 9.30



When the clock key is depressed this causes the clock to start counting and is signified by the colon flashing at 1/2Hz, thus allowing synchronisation to a time signal reference.

Setting switching times

The timer has four independent switches which can be controlled by settings stored in the system memory or by manual instructions. Each switch can have up to 28 on/off times for operation on a weekly basis and 4 which occur every day.

Selects day entry mode and shows which days can be entered by flashing LED's

Enters day

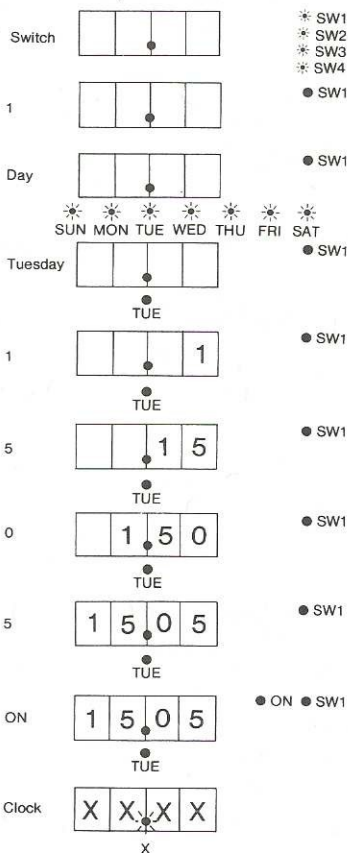
Time entry
(Unlike in the clock mode, leading zero blanking occurs when entering switching times.)

On or off command

Reverts back to real time clock with time and day displayed.

Eg. set switch 1 on at 15.05 Tuesday

Initially in clock mode,



Eg. set switch 2 off at 9.36 Wednesday

Initially in clock mode

To turn a switch off the same sequence is followed except an off is entered instead of an on.

Selects day entry mode and shows which days can be entered by flashing LED's.

Enters day

Time entry

On or off command

Display reverts back to a real time clock showing time and day.

Direct ON and OFF

Should any of the switches require direct operation the following method can be used.

This procedure will directly turn a switch on or off.

On or off entry

Reverts display back to clock and day

Using Everyday Key To Set Times

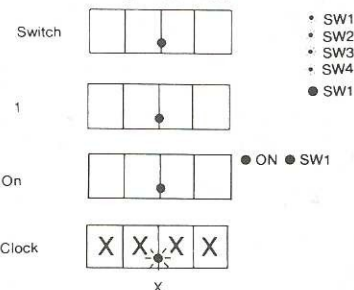
If it is required that a switch operation occurs everyday then use of the everyday key instead of a specific day key should be made.

Selects day entry mode and shows which days can be entered by flashing LED's

Enters everyday for the operation.

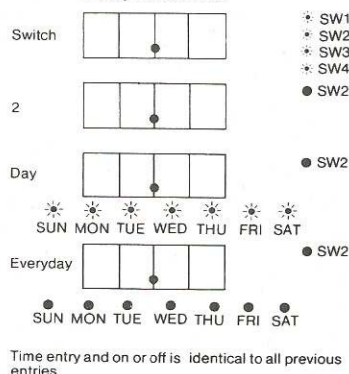
Eg. To turn switch 1 on directly

Initially in clock mode



Eg. Operate switch 2 everyday at 8.20

Initially in clock mode



Time entry and on or off is identical to all previous entries

Multiple entries for one switch on the same day

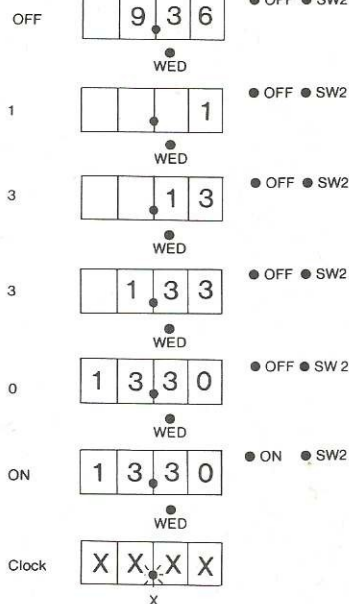
Enter the first setting as previously described but do not revert back to the clock display. Enter next setting time following by on or off command. This may continue until all the required settings have been entered or all of the available memory has been filled. (See note below)

Further entries may now be made.

Reverts back to clock and day display.

Eg. also turn switch 2 ON at 13.30
Wednesday etc.

From above
OFF operation

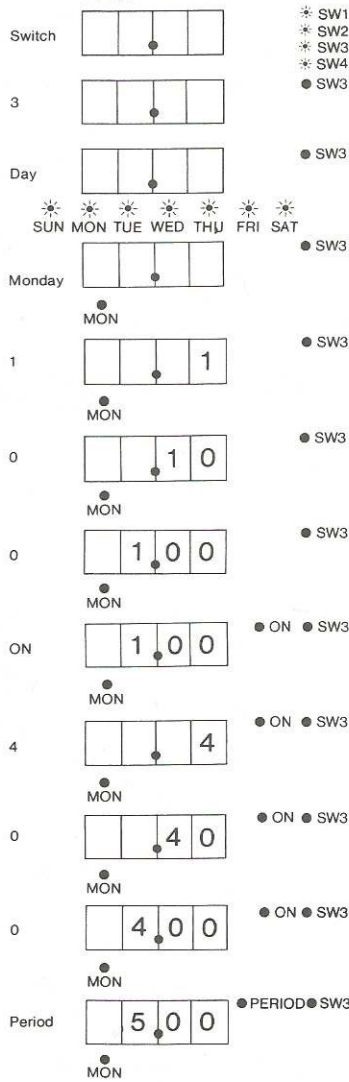


Period setting

As an alternative way of entering off times this function may be used. It must occur directly after an on entry where the desired on period is entered. On pressing the period key the correct off time is displayed and stored in the system memory. The maximum period length allowed is 23 hours 59 mins.

Eg. To turn switch 3 on at 1.00 Monday for a period of 4 hours

Initially in clock mode



On time entry

On command

After display has settled enter in period length. Maximum length 23.59. Note, if the period selected takes the off time into the next day the display will show the off time and next day when the period key is depressed.

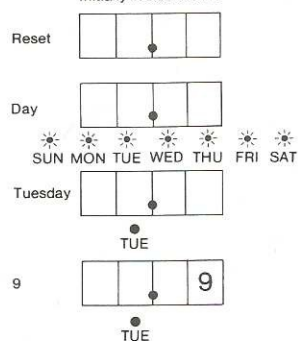
Pressing period calculates correct off time which is displayed and stored in the system memory.

Reset setting

Using the reset setting puts the unit into the timer mode where it will run up to the reset time then either automatically reset to Sunday 00.00 and commence counting again or wait for a start input depending which mode is selected. A reset time from Sunday 00.01 to Saturday 23.59 may be programmed allowing a looping period from 1 min up to 7 days in which all the switches may be used. When a looping period is required enter reset point to give required loop length. Set clock to Sunday 00.00 and start clock when period is required to commence. The reset mode is set with the reset/continuous toggle switch. Reset continuous (automatic) is effected when the RESET CONT. switch is closed; when open, resetting is effected manually through the RESET key. Note: all programming features are available during a time loop.

Eg. Set reset time to Tuesday 9.40

Initially in clock mode



Reverts back to clock and day. Reset LED illuminated, stays illuminated until reset is cleared.

The clock will run until Tuesday 9.40 where it will reset. If continuous reset is selected it will automatically reset to Sunday 00.00 and start counting again. If non-continuous reset is selected it will reset to Sunday 00.00 with the display flashing up zeros and wait there until a start command is given. On pressing the start key the clock will commence counting from Sunday 00.00 until the reset point is reached again.

Memory display

To display the memory contents of any of the switches it is necessary to enter into the specific switch mode. Its contents may then be viewed chronologically from Sunday to Saturday by depressing the switch select key. The contents are displayed numerically on every double depression with the single day entries followed by the everyday ones. If no single day entries are present the everyday entries will be shown first. Should no entries be present the display will show 88.88 and all the day LED's will be illuminated.

Reverts back to clock and day.

Clear single memory entries

Enter the memory display mode, obtain the setting to be deleted and press memory clear. The entry will be removed and further sequential viewing and deletions may then be performed. Note: If only one switching time is stored this cannot be deleted by the above method and must be removed by "clear memory for a specific switch" as shown below or the "clear all memory" operation.

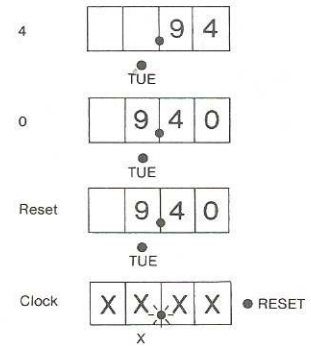
Clear memory for a specific switch

This operation will delete all the entries for a selected switch.

Select switch for which entries need to be cleared.

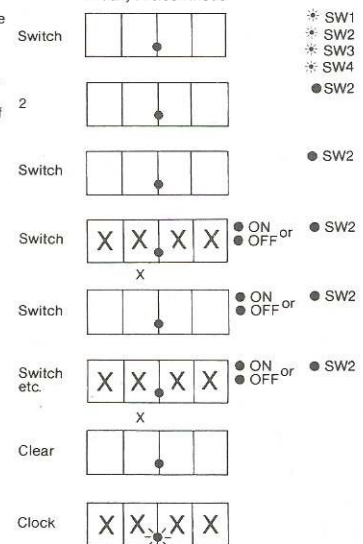
Clears entries

Reverts back to clock and day.



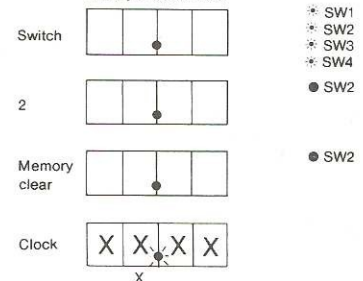
Eg. To display the memory contents of switch 2

Initially in clock mode



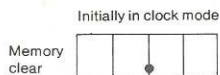
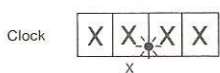
Eg. Clear switch 2 entry

Initially in clock mode



Clear all memory

Pressing Memory Clear switch twice clears all the switch on and off times stored in the system memory.

**Clear system memory****Reverts back to clock and day****Clear clock**

This operation clears the clock setting allowing a new day and time to be entered.



Press day key followed by day and time as for setting clock.

Display of reset time

To display the reset time it is necessary to enter a double reset with the display initially in the clock mode. The reset time and day will then be displayed. To revert back to the clock press clock once.

Clear reset time

With the timer initially in clock mode the reset time may be deleted by keying reset followed by memory clear. This clears the point where the clock was due to reset to Sunday 00.00 and thus puts the timer into the real time clock condition. A new reset may now be entered if required.

Correction for miss-operation

Should an incorrect data entry be made it is possible to re-write the data before pressing clock period, reset, ON or OFF.

Errors**Clock setting error**

Entry of a clock setting greater than 23.59 will not allow the clock to run when the clock key is pressed. Re-entry of a time less than 24.00 followed by clock will start the timer running.

Memory time setting errors

The timer has provision for 28 on and off times on a weekly basis and 4 on an everyday operation for each switch. If entry of more data is attempted the display will show 88.88 as an overload indication, to revert back to the clock display requires the pressing of clear followed by clock. If a period of greater than 24 hours is entered using the period key the display will show 88.88. It is necessary to enter clear clock and re-enter the data within the restraints given.

Overlapping times

If any switch is instructed to turn on and off at the same time the following priority will take place.

- If the switch is already ON then it will turn OFF
- If the switch is already OFF then it will turn ON

Should any switch be operating in the period mode and an OFF time is programmed which conflicts with the period ON time, the OFF time will override the period mode making the period shorter. However the period OFF time will still be present in the system memory.

General operating notes

Multiple switching times entry

When entering switching times for the same day one week hence, it may be necessary to safeguard against inadvertently switching the outputs of the *current* day (which will be the *same* day as far as the counter is concerned). To avoid the switches turning on and off as subsequent times are entered, it is necessary to enter times which occur *before* the actual time shown on the clock in reverse order i.e. working backwards to 00.01 hours from the actual clock time. Switching times *beyond* the actual clock time and for other days of the week should be entered in chronological order.

Everyday switch operations

When everyday switch operations are being used and the clock setting is altered to a time earlier in the current week, correct switch operations may not occur until the next day commences.

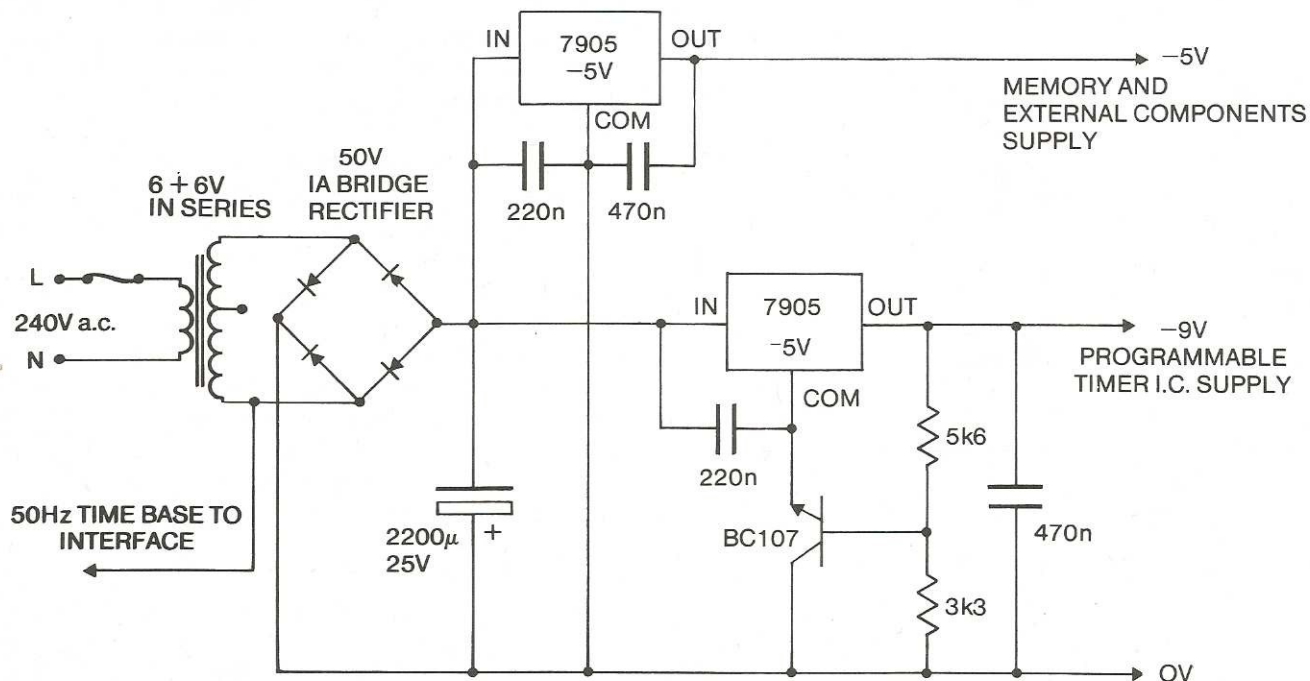
Display blanking

Display blanking for conserving power during battery backup operation may be achieved by inserting a switch in the 0V line to the display current limiting resistors. On opening the switch the display is blanked (see main circuit diagram).

Keypad lockout

Should the entry of data need prohibiting at any time for reasons of security a single pole double throw key switch can be inserted in the column connections as shown on the main circuit diagram. With this switch in the open position the keyboard will be locked out preventing further data entries etc which would alter the timer settings.

Figure 12 Power supply for use with programmable timer



Note: Supply line ripple must not exceed 0.2V peak to peak in the operating frequency range.

List of components

1x	Pcb (for Figures 1 and 3)	434-699	1x	3.2768MHz crystal	307-777
2x	20 way speedbloc pcb right angle plugs and cable to suit	467-346	2x	7905 -5V regulators	306-049
2x	20 way speedbloc sockets	467-289	2x	Heat sinks	401-863
1x	Pcb plug 5 way	467-576	8x	22R high stability carbon film	131-053
1x	Pcb socket 5 way	467-627	4x	470R high stability carbon film	(optional) 131-211
	Crimp terminals	467-598	1x	1k8 high stability carbon film	131-283
1x	10 way speedbloc pcb right angle plug		3x	2k2 high stability carbon film	131-299
	(optional) 467-330		1x	3k3 high stability carbon film	131-312
1x	10 way speedbloc socket	(optional) 467-273	1x	4k7 high stability carbon film	131-334
1x	Keyboard and connectors	335-182	1x	5k6 high stability carbon film	131-340
15x	0.2" LEDs high intensity types	587-822	4x	10k high stability carbon film	131-378
4x	0.43" common cathode 7 segment displays	587-383	1x	18k high stability carbon film	131-407
1x	Display bezel 4 digit	587-204	1x	22k high stability carbon film	131-413
4x	Subminiature LEDs	(optional) 587-721	1x	24k 0.4W metal film	148-821
27x	1N4148 diodes	271-606	1x	10M 0.5W carbon film	(optional) 133-330
1x	2N3904 transistor	(optional) 294-312	1x	65p Trimmer	(optional) 125-660
1x	BC107 transistor	293-527	2x	47p polystyrene	(1 optional) 113-241
1x	Darlington driver	307-109	2x	220n polyester film	115-118
2x	Display drivers 75491	303-157	2x	470n polyester film	115-130
1x	6116 memory	300-215	1x	4µ7 35V tantalum	101-793
1x	74LS 241	308-304	1x	2200µ 25V elect	105-010
1x	50Hz time base i.c.	(optional) 304-835	2x	0µ1 ceramic types	
1x	74LS 164	305-018	1x	40-pin DIL socket	
1x	TMS 1601A	308-821	3x	18-pin DIL socket	
1x	1A 50V Bridge rectifier	262-141	3x	16-pin DIL socket	
			1x	8-pin DIL socket	
			1x	Mains transformer	207-633