MICROBEE CONSTRUCTION MANUAL

Microworld Publication MWP 28/82.

MICROBEE CONSTRUCTION MANUAL

MICROBEE DESIGN PHILOSOPHY:

The MICROBEE as supplied in kit form is intended to give electronic enthusiasts the opportunity to build their own computer and then enjoy the fruits of their work as they learn to program it and make it work for them. We at Applied Technology are also electronic enthusiasts and can see the real need to make the MICROBEE available for this purpose. Our approach is to support you in your efforts to make sure each buyer of a MICROBEE kit succeds in reaching this goal. Our exclusive NO APOLOGIES coupon is intended to extend our support should you have trouble completing your MICROBEE.

INTRODUCTION:

This manual describes the construction of the MICROBEE computer when supplied in kit form. While the use of solder masked and plated through printed circuit boards has greatly simplified the construction process we strongly advise against starting work on this computer unless you are reasonably confident of your ability to solder. If you are not sure that you can carry out the soldering and assembly in a workmanlike manner, we strongly suggest you approach a friend to do the job for you or, fill out the NO APOLOGIES coupon included with the kit and return your MICROBEE with $50 and we will assemble and test the unit for you.

Construction of the MICROBEE has been divided into logical FUNCTIONAL TEST ELEMENTS (FTE) which greatly simplify the process of construction and testing. To build your MICROBEE you will need the following equipment :

1. Low wattage (20W approx) soldering iron with a fine tip
2. Small sidecutters and long nosed pliers
3. Small screwdriver
4. Multimeter
5. Logic probe (optional)
6. Fine gauge multicore solder

WARNING: IF YOU ARE UNABLE TO ACHIEVE OPERATION AT A SPECIFIC STAGE DO NOT PROCEED TO THE NEXT STAGE.

Our NO APOLOGIES service coupon available with every kit can be used at any stage of construction. In other words, if you are unable to complete stage 2 DO NOT PROCEED but fill in the coupon and return your MICROBEE for service. We will complete the assembly for you and return your MICROBEE tested and ready for use no matter what stage you had reached. However we must

reserve the right to return kits that, in our opinion, have been not constructed EXACTLY in accordance with this manual, or mishandled or too badly damaged to be repaired. Please keep this in mind and stop construction the moment you can see problems arising. All repairs carried out will carry a full description of the faults found together with helpful comments.

MICROBEE PARTS LIST: REV D MOD 0 16K VERSION

Listed below are the parts supplied in the MICROBEE kit. Please identify and check each off against this list before proceeding. If you find any damaged or missing parts, notify your supplier quoting the DATE you purchased your MICROBEE and the SERIAL NUMBER.

To simplify construction we have supplied the MICROBEE 16K core board fully assembled and tested ready to use. Should you wish to expand your MICROBEE to a 32K or even 48K you will need to return this 16K board before receiving the memory upgrade. This will ensure that you always have full software compatability as your system expands. Any modifications to the core board not carried out by Applied Technology or an authorized agent will invalidate the warrantee on your MICROBEE.

If you have purchased a 32K MICROBEE you will have been supplied a 32K CORE BOARD in lieu of the 16K CORE BOARD mentioned in this manual. Should you wish to upgrade your 16K MICROBEE you will need to purchase a 32K changeover CORE BOARD invalidate your warranty and will require an updated BASIC anyhow.

Your MICROBEE has been packed in 7 separate packs. You should first ensure that each of these has been received in good order and condition before proceeding to check the individual contents off against the lists below.

PACK 1	MICROBEE 16K core board with 16K MICROWORLD BASIC
PACK 2	MICROBEE case top, metal base and main PCB
PACK 3	MICROBEE integrated circuit pack, sockets
PACK 4	MICROBEE passive and active components
PACK 5	MICROBEE power supply components
PACK 6	KEYBOARD assembly
PACK 7	Construction and BASIC users manuals

MICROBEE PARTS LIST

CONTENTS OF INDIVIDUAL PACKS:

PACK 1

MICROBEE 16K core board
16K MICROWORLD BASIC
User agreement
User registration card

PACK 2

P/N 1248 MICROBEE main printed circuit board

P/N 1250 MICROBEE moulded noryl top cover

P/N 1260 MICROBEE metal base plate

SPKR 10cm loudspeaker with 50 cm of connecting wire

PACK 3 INTEGRATED CIRCUITS

IC1	Z80 PIO	[ ]
IC2*	74LS157	[ ]
IC3*	74LS157	[ ]
IC4	74LS151	[ ]
IC5	6116P	[ ]
IC6*	74LS157	[ ]
IC7*	74LS156	[ ]
IC8*	74LS157	[ ]
IC9	6545	[ ]
IC10*	74LS157	[ ]
IC11	74LS245	[ ]
IC12	74LS166	[ ]
IC13	2516 with MBFONT	[ ]
IC14*	74LS245	[ ]
IC15*	74LS175	[ ]
IC16	82S123 with MICROBEE VDU program	[ ]
IC17	74LS86	[ ]
IC18	6116P	[ ]
IC19	74LS245	[ ]
IC20	74LS02	[ ]
IC21*	74LS157	[ ]
IC22	74LS244	[ ]
IC23	74LS04	[ ]
IC24	74LS244	[ ]
IC25	Z80 CPU	[ ]
IC26*	74LS161	[ ]
IC27*	74LS85	[ ]
IC28	74LS244	[ ]
IC29	74LS00	[ ]
IC30*	74LS27	[ ]
IC31*	74LS04	[ ]
IC32*	74LS92	[ ]
IC33	74C74	[ ]
IC34*	74LS139	[ ]

IC37	7805/309K TO3 regulator	[ ]

Note: "*" means that a non LS chip may be substituted for this device.

IC SOCKETS	40 pin	[3]
	24 pin	[3]
	20 pin	[6]
	16 pin	[14]
	14 pin	[8]
	8 pin	[ ]

PACK 4: PASSIVE COMPONENTS

RESISTORS

R0	3K3	[ ]
R1,2,3	1K5	[3]
R4	470 ohm	[ ]
R5,6	3K3	[2]
R7	4K7	[ ]
R8	1K5	[ ]
R9,10,11	4K7	[3]
R12	330 ohm	[ ]
R13,14	470 ohm	[2]
R15	2K2	[ ]
R16	1K5	[ ]
R17	4K7	[ ]
R18	820 ohm	[ ]
R19	330 ohm	[ ]
R20	82 ohm	[ ]
R21	4K7	[ ]
R22	10K	[ ]
R23	3K3	[ ]
R24	470 ohm	[ ]
R25	4K7	[ ]
R26	1K	[ ]
R27	27 ohm	[ ]
RN1,2,3	3K3 to 4K7 resistor package	[3]

CAPACITORS

BP represents bypass capacitors which are not critical in value and can be .01, .1 etc in value.

C1	.1 uF monolithic	[ ]
C2	BP	
C3	4u7 tag tantalum	[ ]
C4,5,6,7,8,9	BP	
C10,11,12,13	BP	
C14	.01 uF ceramic	[ ]

MICROBEE PARTS LIST

C22	BP	
C23	.1 uF monolithic	[ ]
C24	.1 uF monolithic	[ ]
C25,26,27	4u7 tag tantalum	[3]
C28	BP	
C29	4700 uF special filter electrolytic	[ ]
C30	BP	
BP	Total bypass caps	[18]

ACTIVE COMPONENTS

TR1	BC558 type transistor	[ ]
TR2,3	BC548 type transistors	[2]
G1	12.000 Mhz crystal	[ ]
D1-13	1N914 diodes	[13]
D14	1N4001 diode	[ ]
D15	18 to 30 zener diode	[ ]

CONNECTORS:

X1,X4	25 way strip sockets	[2]
X3	RS232 "D" connector	[ ]
X5	Board mounting DIN socket	[ ]

MISCELLANEOUS

12mm x 6BA screws and nuts (6), 6 mm PCB spacers (2), #6x5 mm self tapping screws (6), 4BA nuts, washers (4), heatsink compound, 4 rubber feet.

PACK 5 POWER SUPPLY COMPONENTS

PP	12V PLUG PACK	[ ]
P1	5 pin DIN plug	[ ]
P2	3.5mm plug RED (or GREY)	[ ]
P3	3.5mm plug BLACK	[ ]
P4	Belling Lee TV plug	[ ]
	1.5 metres twin fig 8 14/0076 w marker	[ ]
	3.0 metres single shielded cable	[ ]

PACK 6 KEYBOARD

MP	Metal mounting frame	[ ]
SW	Key switch mechanisms	[60]
SB	Space bar with mounting hardware	[ ]
DS	Dummy switch mechanism	[ ]
KT2.0	One double width keytop	[ ]
KT1.5	Three key tops 1.5 units wide	[3]
KT1.0	Normal keytops	[55]

MICROBEE PARTS LIST

PACK 7	DOCUMENTATION	
MWP24/82	MICROWORLD BASIC USERS MANUAL	[ ]
MWP26/82	MICROBEE Construction Manual	[ ]
MWP45/81	Supplement from Feb 82 YOUR COMPUTER	[ ]
MWP27/82	NO APOLOGIES coupon	[ ]

CONSTRUCTING THE MICROBEE

Detailed below is a STEP-BY-STEP assembly procedure for constructing the MICROBEE. It is strongly recommended that you assemble the computer in this order and that you DO NOT START the next stage before you have completed the stage at hand and satisfied yourself that the required performance tests have been met.

Don't forget that the NO APOLOGIES coupon is available to support you should you run into trouble at any point in the assembly. Note that while every effort has been made to simplify the construction as much as possible, this is definately NOT a project for beginners or those who are not proficient in soldering techniques. If you are not confident of your abilities, either ask a friend to build it for you or return the kit unopened and receive your money back. You can, of course, complete the NO APOLOGIES service coupon at any stage (even before you start assembling) and it will be assembled and tested for you.

Now it's over to you. With a little care and patience and after a few evenings of systematic assembly your MICROBEE will be up and running. When you have finished, don't forget to complete the MICROWORLD BASIC USERS REGISTRATION card and send for your free software cassette and copy of the latest edition of the MICROWORLD NEWSLETTER!

STAGE 1: POWER SUPPLY

This is an ideal starting point since we will need the power supply to be fully operational before we proceed with the other tests as we assemble the MICROBEE. It also enables you to practise a little soldering before actually starting on the main PCB work.

The MICROBEE external power supply consists of a transformer in a PLUG PACK connected to a DIN plug which in turn plugs into the back of the MICROBEE. Also connected to this DIN plug are 3 lengths of shielded cable to connect the MICROBEE to the TV monitor and cassette recorder.

ASSEMBLY PROCEDURE:

1. Take the plug pack supplied and the 1.5 metre length of twin cable. Depending on the supplier, this may be already connected to the plug pack. If not, carefully strip 5mm of the insulation from both wires at one end and attach these to the screw terminals on the plug pack. It is a good idea to

connect the wire with the marker stripe to the terminal marker 'POS +'. The unmarked wire will then connect to the terminal marker '- NEG".

STEP COMPLETED [✓]

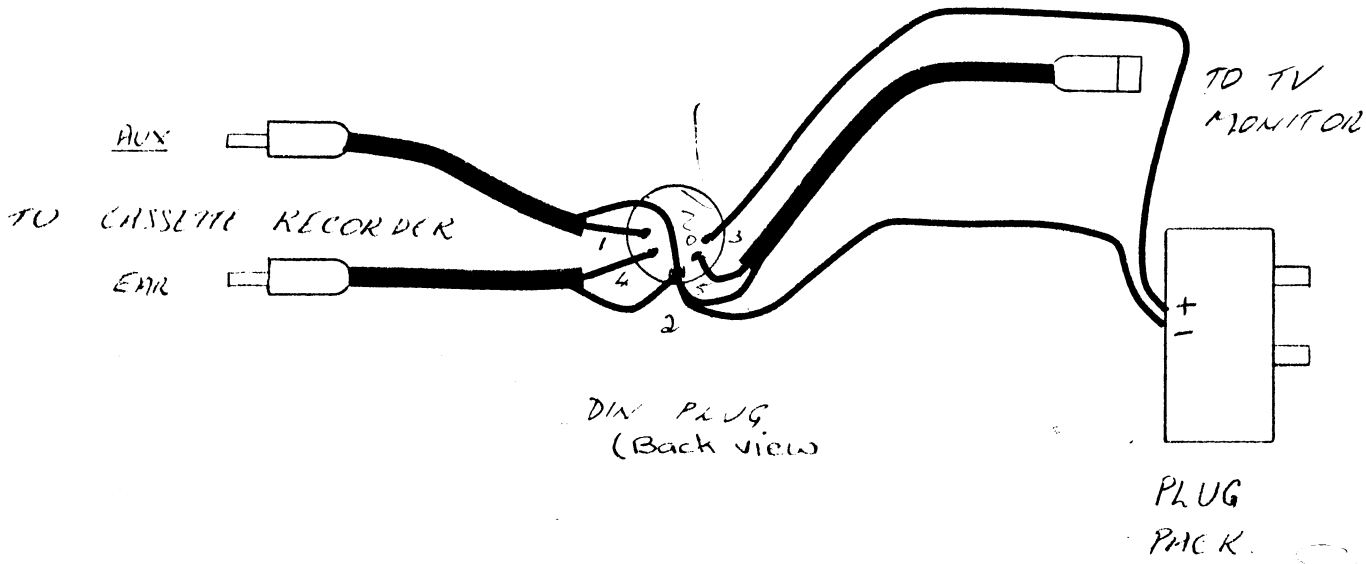


FIG 1: MICROBEE POWER SUPPLY WIRING DIAGRAM

2. Now select the DIN plug remove the cover and examine the designation numbers on the pins. Refer to FIG 1 above and then take the plug pack and cabling completed in step 1 and strip approx 2mm of insulation from each wire on the end not attached to the transformer/plug pack and thread the DIN plug cover over the power cable. Carefully solder the wire from the terminal marked "POS +" to pin 1 on the DIN plug. Make absolutely sure that no loose wires can short to other pins in the DIN plug. Next solder the wire from "- NEG" to pin 2 on the DIN plug.

TICK WHEN COMPLETED [ ]

3. Next cut the single shielded cable into three equal 1 metre lengths and select one length. Carefully strip the insulation back about 3mm on one end and prepare to solder it to the DIN plug. First thread it through the DIN plug cover that should be on the low voltage supply cable from the plug pack. Now solder the insulated centre wire to pin 3 on the DIN plug and connect the shielding braid to pin 2 on the DIN plug. This is the Video OUT cable from the MICROBEE. Connect the Belling LEE plug onto the other end of this cable.

TICK WHEN COMPLETED [ ]

4. Now for the connections to the tape recorder. This requires that you solder wires to pins 4 and 5 on the DIN plug with the shielding braid connected to pin 2 as

before. Take the two lengths of shielded cable remaining and thread both through the cover for the DIN plug. Carefully strip 3 mm off the end of each and solder the centre connectors to pins 4 and 5 on the DIN plug. Solder the shielding braid to pin 2 on the DIN plug. Next connect the RED 3.5 mm plug (RED for RECORD) to the lead connected to pin 4 on the DIN plug. Repeat this step with the BLACK 3.5 mm plug connected to the lead from pin 5 on the DIN plug.

TICK WHEN COMPLETED [ ]

5. Now you should have completed all connections to the DIN plug. Inspect your work closely at the DIN plug end and resolder any pin that looks suspect or likely to short against adjacent pins. If the wires connected to pin 2 are too bulky (as well may be the case) remove some and resolder again making sure that the finished joint will fit snugly inside the plastic cover for the DIN plug. Next slip the cover along the wires and push it home onto the DIN plug. You should now have a completed assembly with a DIN plug radiating leads to a plug pack, TV connector and two 3.5 mm plugs for the cassette recorder.

TICK WHEN COMPLETED [ ]

6. TESTING

Now take your multimeter and select the OHMs range. Hold one probe on pin 2 of the DIN plug and test each other pin in turn for shorts or even intermittent connections. If you find one, remove the cover from the DIN plug and check internally. Next, also using the OHMs range check that the following points are in fact connected:

DIN PLUG	DESTINATION
PIN 1	CASSETTE via RED plug (to AUX input)
PIN 2	-NEG on the plug pack, shields on all other cables
PIN 3	+12V from plug pack
PIN 4	CASSETTE to BLACK plug (to earphone)
PIN 5	VIDEO output via centre pin on BELLING LEE plug

Lastly, with your multimeter set to measure voltage plug in the plug pack, turn on the 240 V power and measure the voltage across pins 3 and 2 on the plug pack. It should read between 9 and 11 Volts. If it does all is well and you have completed the testing of STAGE 1.

TICK WHEN COMPLETED [ ]

This completes STAGE 1. You should be eager to move on to stage 2 but it is a good idea to hasten slowly. Read the STAGE 2 notes through carefully before commencing work.

STAGE 2: PCB POWER SUPPLY

Now to start assembling the components on the main printed circuit board. The object of this stage is to assemble and test the on-board components that will eventually supply the regulated voltages required by the MICROBEE. Reference to the schematic diagram will indicate that this stage only requires the installation of a couple of diodes, a TO3 regulator and filter capacitors. However, as you no doubt realise, it is vital that this power supply be operating correctly before we can proceed to test the main circuit logic blocks. Not to be forgotten is the fact that TTL logic when operating produces spurious 'spikes' even on a well regulated power rail so although the regulator is the major section of the power supply, the bypass capacitors we will install next stage are very necessary for trouble free operation.

STEP 1 Identify and select the following components from the component packs:

X5	5 pin DIN socket (PCB mounting)
C29	4700 uF electrolytic capacitor
C26,27	4.7 uF tag tantalum capacitors
D14	1N4001 diode (WATCH that it is marked 1N4001)
D15	Zener diode (any value 18V to 30 V)
IC37	TO3 regulator (7805K/309K)
	2 6BA screws with nuts
	2 PLASTIC spacers with #6 self tappers
	4 4BA nuts with washers

STEP 2 Unlike all other components, the TO3 power regulator mounts UNDER the main PCB. This allows the MICROBEE to utilize the metal baseplate as a heatsink for this device. When mounted this regulator also helps to space the main PCB off from the metal baseplate so it is necessary that IC37 is soldered in at the correct height. This is achieved as follows:

a) Take the IC37 (309K) and temporarily position is from the underside of the PCB as indicated on the overlay. Note that the leads will be soldered on the TOP of the PCB and the TO3 case (the metal body of the 309K regulator) will be connected to the ground rail on the PCB using the 6BA screws.

b) Remove the 309K and insert the 6BA screws from the COMPONENT side of the main PCB (this is the side which has the white component numbers silk screened onto it) so that the head of each screw is on the COMPONENT side of the PCB and the threaded section of each will pass through the body of the 309K voltage regulator.

c) Now hold the two 6BA screws in place with one hand and turn the main PCB upside down so the screws are pointing upwards. Take 2 4BA nuts (they will be a sloppy fit on the 6BA

screws) and place them on each of the 6BA mounting screws to act as a spacer.

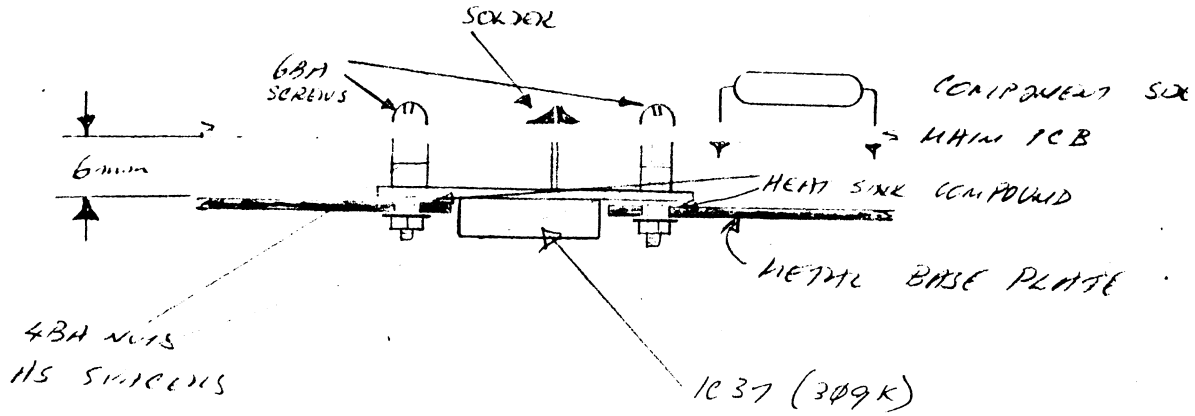
d) Take the 309K regulator and try positioning it onto the 6BA screws with the other leads passing through the PCB. Using a ruler measure the distance from the underside of the PCB (the solder side) and the upper case of the regulator as indicated in FIG 2 below. This will vary according to the brand of 309K regulator supplied so you may need to add extra packing using the extra 4BA nuts or the washers supplied however the final height must be 6mm from the underside of the PCB and the top of the flange of the 309K regulator.

e) Once you have found the correct combination of packing to mount the regulator at the required 6mm spacing, bolt the entire assembly onto the PCB as indicated in FIG 2. Solder the pins marked IN and OUT on the topside of the PCB and cut off the excess lead protruding through the PCB.

TICK WHEN COMPLETED

This completes this step. You should now have a main PCB with the TO3 voltage regulator mounted underneath the board and spaced so the assembly when mounted in the metal baseplate will be 6mm above it. You will of course need to finally use the 6BA screws to mount the assembly to the base plate but we will temporarily bolt the regulator assembly together without the baseplate.

FIG 2 MOUNTING DETAILS IC37 (309K) VOLTAGE REGULATOR



Now for the easy parts!

f) Carefully select the diode marked 1N4001 (or 1N4004) and bend the leads to fit in the PCB at the location marked D14. Watch carefully that the end marked with a bar corresponds with that on the silk screened component overlay. Insert the leads through and solder them on the underside of the PCB. Cut

off the excess leads.

TICK WHEN COMPLETED [✓]

g) Now select the zener diode (18 to 30V). This device usually looks like the 1N4001 you have just used but will carry a number like 1N4761. It is physically larger than all the other diodes which are type 1N914. Insert this zener diode at location D15 again with the bar end as per the component overlay. Note that a diode inserted with the wrong polarity (ie not as per the component overlay) will almost always stop the computer from operating correctly. Solder and clip the leads as before.

TICK WHEN COMPLETED [✓]

h) Now take 2 only 4.7mfd tag tantalum capacitors and insert them at locations C26 and C27. Watch the polarity carefully as these components will definately not handle reverse voltages!!. Insert each capacitor, solder and clip the leads.

TICK WHEN COMPLETED [✓]

i) Next select the large 4700mfd yellow capacitor and locate it according to the overlay at C29. This device has three pins which should make it virtually impossible to insert it the wrong way. Again solder and clip the leads.

TICK WHEN COMPLETED [✓]

j) Take the DIN socket, X5, and insert it onto the PCB as indicated. Press it firmly into position, solder and clip the leads.

TICK WHEN COMPLETED [✓]

This completes STAGE 2. Now to test everything.

WARNING: DO NOT CONNECT POWER TO THE 309K REGULATOR IF THE MOUNTING BOLTS ARE NOT CONNECTING THE CASE TO THE GROUND RAIL ON THE PCB. This can result in excessive voltages which will damage components on the PCB!

TESTING: Make sure the regulator assembly (309K) is temporarily bolted together. There is no need to mount the heatsink/metal mounting chassis at this stage. Plug in the power supply into the DIN socket (X5) and switch on the 240V to the plug pack. Using your voltmeter measure the voltage between the IN and OUT pins of IC37, the 309K voltage regulator. The input voltage should read between 8 and 11 Volts while the output voltage MUST read between 4.9 and 5.1 Volts.

TICK WHEN COMPLETED [✓]

If the voltages are correct then you should take a short break, make yourself a cup of coffee or something and take a well earned break.

If the output voltage in particular is too high you should recheck your work carefully and especially check that the mounting screws are earthing the case of the 309K to the PCB. If the output voltage is too low or even ØV you may have a short on the printed circuit board. Check carefully and also recheck the polarity of C26, C27 and D14. If you are unable to obtain the correct voltages it may be a good idea to return your kit with the NO APOLOGIES coupon.

DO NOT PROCEED TO STAGE 3 UNTIL STAGE 2 IS WORKING!.

STAGE 3: CAPACITORS, RESISTORS, DIODES and RESISTOR NETWORKS

Now we will insert the various passive components. A large number of the capacitors are used as power supply bypass devices and since it is possible for short circuits to occur because of faulty components or workmanship we strongly recommend a systematic approach of TEST, INSERT and SOLDER, then TEST again. Although this may seem 'long winded' it will save hours of troubleshooting later. Because the board components have been numbered from left to right it is a good idea to insert the components in strict number order to avoid mistakes.

CAPACITORS:

Insert each capacitor as detailed below. After insertion solder and clip the leads and test for short circuits using an ohmmeter. Remember that a short circuited bypass capacitor will short the entire power supply rails.When each component has been tested tick the box before proceeding to the next component.

C1	Ø.1 mfd monolithic or ceramic	[✓]
C2	bypass capacitor Ø.Ø1 to Ø.1	[✓]
C3	4.7 mfd tag WATCH POLARITY	[✓]
C4,5,6,7,8,9	bypass capacitors	[✓]
C1Ø,11,12,13	bypass capacitors	[✓]
C14	Ø.Ø1 mfd ceramic	[✓]
C15,16,17	bypass capacitors	[✓]
C18	4.7 mfd tag WATCH POLARITY	[✓]
C19	bypass capacitor	[✓]
C2Ø	22 mfd electrolytic. Note the +end should be towards R2Ø	[✓]
C21	47 pfd ceramic	[✓]
C22	Bypass capacitor	[✓]

C23,24	0.1 mfd monolithic or ceramic	[ ]
C25	4.7 mfd tags WATCH POLARITY	[✓]
C28,30	bypass capacitor	[✓]

This completes the capacitors. It is a good idea to re-check the parts list against the actual capacitors you have soldered onto the board. Also, re-check the polarity or all the tag tantalum capacitors to ensure that they match that marked on the PCB.

TESTING: If all is well, reconnect the power pack and switch on. Using your multimeter measure the voltage across the power OUT on the regulator IC37. IF this is still 5 Volts all is well. If not and a low or 0V reading is indicated you have most likely developed a short circuit across the power rail. Look carefully for solder bridges and splashes across the PCB tracks.

RESISTORS:

Resistors are non polarized devices as you may know. It is good practice to mount them all with the tolerance band (gold or silver) pointing in the same direction. We suggest you mount all resistors pointing across the PCB with their tolerance bands to the RIGHT and all those pointing down the PCB with their tolerance bands towards the keyboard part of the board. Again you should work systematically by inserting each resistor in order, soldering and clipping the leads before proceeding to the next.

R0	3K3	(ORANGE ORANGE RED GOLD)	[✓]
R1,2,3	1K5	(BROWN GREEN RED GOLD)	[✓]
R4	470	(YELLOW VIOLET BROWN GOLD)	[✓]
R5,6	3K3	(ORANGE ORANGE RED GOLD)	[✓]
R7	4K7	(YELLOW VIOLET RED GOLD)	[✓]
R8	1K5	(BROWN GREEN RED GOLD)	[✓]
R9,10,11	4K7	(YELLOW VIOLET RED GOLD)	[✓]
R12	330	(ORANGE ORANGE BROWN GOLD)	[✓]
R13,14	470	(YELLOW VIOLET BROWN GOLD)	[✓]
R15	2K2	(RED RED RED GOLD)	[✓]
R16	1K5	(BROWN GREEN RED GOLD)	[✓]
R17	4K7	(YELLOW VIOLET RED GOLD)	[✓]
R18	820	(GREY RED BROWN GOLD)	[✓]

** WATCH CAREFULLY YOU DON'T CONFUSE R18 WITH R20! **

R19	330	(ORANGE ORANGE BROWN GOLD)	[✓]
R20	82	(GREY RED BLACK GOLD)	[✓]
R21	4K7	(YELLOW VIOLET RED GOLD)	[✓]
R22	10K	(BROWN BLACK ORANGE GOLD)	[✓]
R23	3K3	(ORANGE ORANGE RED GOLD)	[✓]
R24	470	(YELLOW VIOLET BROWN GOLD)	[✓]
R25	not required in this version		
R26	1K	(BROWN BLACK RED GOLD)	[✓]
R27	27	(RED VIOLET BLACK GOLD)	[✓]

This completes the resistors. While we are at it let's install the resistor networks. These are the ceramic looking components

with 10 pins and are called single in-line packages (SIPs). Essentially each package consists of 9 resistors of identical value connected at one end to one of the pins and at the other to a commom point which is in turn connected to pin 1 on the package. Inspection of one of the devices will show an identifying code on one side together with an obvious mark or dot to indicate which end is pin 1. It is vital that you mount these devices according to this mark and its corresponding marking on the component overlay on the PCB. Failure to observe this precaution will result in faulty operation.

RESISTOR PACKS:

RN1 3K3 to 4K7 resistor pack WATCH POLARITY [ ]
RN2 3K3 to 4K7 resistor pack WATCH POLARITY [ ]
RN3 3K3 to 4K7 resistor pack WATCH POLARITY [ ]

DIODES AND TRANSISTORS:

By now you should have developed the soldering technique so we will just indicate the device and you will know to insert it, solder and clip the leads to length.

NOTE: Because the CORE BOARD plugs onto the MAIN PCB it is necessary to restrict the maximun component height to 5mm above the PCB. Be sure to insert transistors in particular so that the body of the device is not so high as to obstruct the CORE BOARD when it is plugged into place at a later stage.

TR1 BC558 transistor mounted as indicated [ ]
TR2,2 BC548 transistors [ ]
D1 to D11 1N914 diodes [ ]

** NOTE: D11 was shown incorrectly on the component overlay on some of the earlier boards. If your PCB has D11 already soldered in place, the error has been corrected for you.

** NOTE D12,D13 are not required in this version of the MICROBEE and MUST NOT BE FITTED! Instead a link is required where D12 is indicated.

D12 Fit a wire link where D12 is indicated [ ]

CRYSTAL:

G1 12 MHZ crystal mounted as indicated [ ]

This completes STAGE 3. Now we insert the sockets and other hardware. There is little to test at this point and the best approach is to carefully recheck your work against this manual.

STAGE 4: IC SOCKETS AND HARDWARE

This is a relatively simple stage which can be completed without a great deal of trouble. It is a good idea to watch your soldering carefully because it is easy to 'bridge' solder from one joint to another. Another point to watch is that each socket is fully inserted hard against the PCB before you start to solder it into place. The order you insert the IC sockets is of little consequence so, to be systematic, we will start with the largest and proceed down to the smallest. Note also that all ICs on the PCB are mounted with the notch or pin 1 end pointing towards the keyboard. If you look at the sockets closely they usually have and indication as to which end is pin 1 so to be tidy and follow good practice you should observe this as well when mounting these devices.

40 pin	3 sockets for IC1,IC9 and IC25	[✓]
24 pin	3 sockets for IC5,IC13 and IC18	[ ]
20 pin	6 sockets for IC11,14,19,22,24,28	[✓]
16 pin	14 sockets for various ICs	[✓]
14 pin	8 sockets for various ICs	[✓]
8 pin	1 socket for IC35	[ ]

Now we have installed the IC sockets we can also fit the RS232 socket and those for the CORE BOARD.

X3 'D' type connector PCB mounting. Bolted onto PCB first using 6BA bolts then soldered.

TICK WHEN COMPLETED [✓]

X1 and X4 These are the sockets which accept the pins on the CORE BOARD. Note carefully that the pins are offset and that the sockets must be inserted so that they mount within the area marked on the PCB overlay. If you mount either socket the wrong way around you will have trouble installing the CORE BOARD.

A good procedure to follow is to position X1 and X4 and then, before soldering each, plug in the CORE BOARD. Now, providing all is in order the CORE BOARD should line up exactly with the back left-hand corner of the main board. If it does, leave the CORE BOARD plugged in and, holding the CORE and MAIN boards together, turn the assembly over and solder X1 and X4. When you have completed the soldering remove the CORE BOARD ready to start STAGE 5.

STAGE 5: KEYBOARD

This is a particularly satisfying stage because your MICROBEE will rapidly start to look like a computer from now on.

Take the keyboard pack and, if you have not done so already, check off the parts against the parts list.

Although things look easy let's be systematic and proceed as follows:

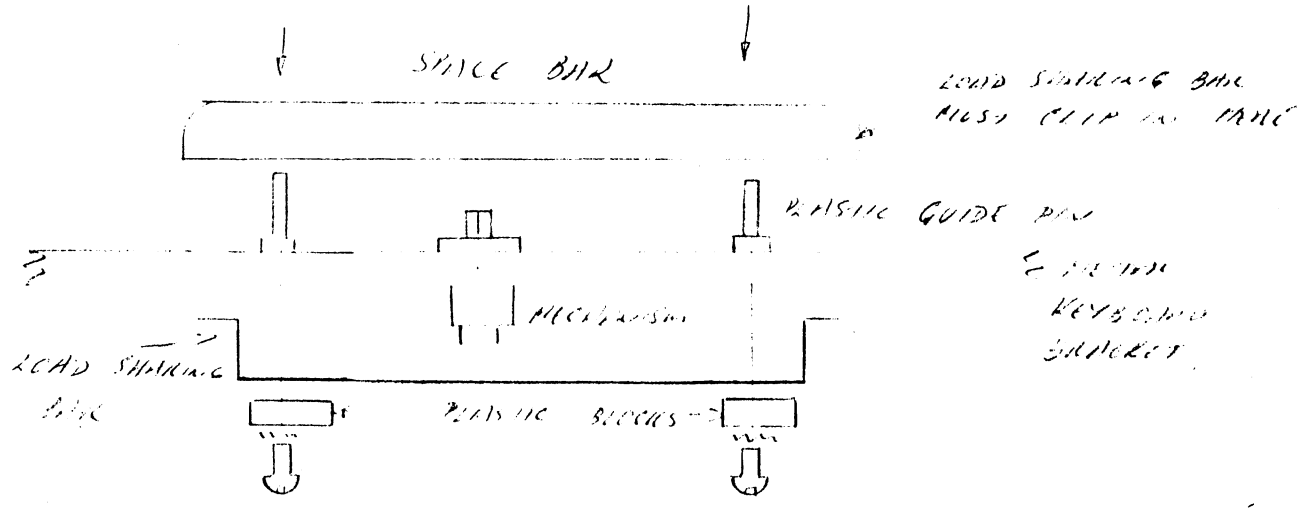
a) SPACE BAR ASSEMBLY: Refer to FIG 3 and you will see that the space bar assembly consists of the SPACE BAR (longest key top), a metal load sharing bar, 2 plastic guides, 2 mounting blocks complete with screws and washers. Finally there is one switch mechanism (identical to the others) to complete the assembly. You MUST mount this space bar assembly before proceeding to solder any mechanism to the MAIN PCB.

b) REFER to FIG 2 and insert the 2 plastic guide pins as indicated. Note that there are 2 holes prepunched in the keyboard bracket ready to accept the 'top hat' ends of these guides. Press each guide firmly into the metal bracket. Check that you understand the function of these guides by placing the space bar onto them to be sure it slides easily.

c) Now take any switch mechanism and insert it in the correct cutout mid way between the guides inserted in the last step. Examine the underside of the space bar and you will notice a slot in each end which will accept the metal load sharing bar. Position the space bar over the plastic guides and the mechanism so that the open end of these slots faces the edge of the metal keyboard support bracket and press the space bar firmly home (taking care not to bend the pins on the switch mechanism).

d) Now thread the load sharing bar from the underside of the keyboard bracket into the slots in the space bar. Hold the load sharing bar in place and mount it permanently using the plastic blocks and the screws provided.

FIGURE 2: MOUNTING THE SPACE BAR ASSEMBLY



e) Now examine the overlay on the MAIN PCB and, holding the metal keyboard mounting frame in one hand, insert the SPACE mechanism SW32 as indicated. Carefully insert mechanisms for ESCAPE (SW1) and BS (SW56) through the appropriate holes in the keyboard mounting frame and insert them through the holes in the PCB as well. Hold the assembly carefully and turn it over to solder these three mechanisms firmly in place. You should now have the keyboard mounting frame held firmly into place with 3 switch mechanisms soldered to the MAIN PCB. Test that the SPACE BAR assembly operates freely before proceeding.

f) Now carefully insert the rest of the mechanisms, first through the keyboard support bracket until they 'click' home then soldering each to the main PCB. Check that each mechanism operates freely and that each switch mechanism does in fact operate smoothly and correctly. Note that there is no active mechanism between SW52 (SHIFT) and SW59 (RPT). A 'dummy' mechanism is provided to fill this position and this dummy actually mounts under the larger SHIFT key top provided.

g) This step really gets things moving. We will now put on the key tops. Arrange all the key tops in front of you face up so that you can see the designations and select the top marked ESC. This ESC key top will be mounted on SW1, the top left-hand switch mechanism. Press it firmly onto the mechanism so that the keytop rests firmly on the top of the key switch mechanism when it is pushed down firmly. Repeat this step positioning each top according to the following layout:

ESC 1 2 3 4 5 6 7 8 9 Ø : - ^ BACK SPACE

TAB Q W E R T Y U I O P [ ] LINE RETURN FEED

CTRL LOCK A S D F G H J K L ; @ \ DEL BREAK

SHIFT Z X C V B N M , . / SHIFT REPT

Before you position the larger SHIFT key top make sure you have mounted the blank mechanism between SW52 and SW59.

This completes STAGE 5 and your MICROBEE should be starting to look like a complete computer at last. The next stages will serve to check your work and it is strongly recommended that you proceed SLOWLY from now on.

STAGE 6: TESTING THE Z8Ø CPU AND PIO

Now we come to testing the actual circuit elements. This stage has been considerably simplified because the CORE BOARD has been preassembled and tested. Essentially your MICROBEE BASIC and USER RAM is fully operational and we will use this fact to check the actual integrated circuit elements. This step can be performed without the use of any special test equipment if you follow the following steps:

a) Take the small loudspeaker and connect it via a pair of wires 2ØØ mm long to the point marked SPKR adjacent to the main voltage regulator IC37 (3Ø9K). Reference to the SCHEMATIC diagram of the MICROBEE will indicate that this loudspeaker is driven by transistor TR3 which is in turn driven from IC1 (Z8Ø PIO) pin 33.
To check that the speaker is working connect a temporary wire to +5 Volts and touch the other end onto pin 33 of IC1. You should hear audible 'clicks' from the speaker which indicates that it is operational.

TICK WHEN COMPLETED [√]

BEFORE WE PROCEED CHECK THE VOLTAGE ACROSS THE +5 V LINE. IF IT IS GREATER THAN +5V DON'T PROCEED TO THE NEXT STEP AS YOU WILL DAMAGE SOME COMPONENTS.

b) Now we will insert some of the ICs. NOTE CAREFULLY THAT EACH IC FACES THE SAME WAY (towards the keyboard). Also take care when inserting each IC that you don't bend pins over

instead of plugging them into the socket. Check carefully after inserting every IC both visually and preferably using your multimeter to ensure that each pin does in fact go into the relevant socket.

Insert the following ICs:

IC	TYPE	FUNCTION
IC23	74LS04	Master clock oscillator
IC32	74LS92	12Mhz to 2Mhz divider
IC25	Z80	CPU
IC22	74LS244	Address buffer
IC24	74LS244	Address buffer
IC28	74LS244	Control buffer
IC19	74LS245	Data buffer
IC33	74C74	Reset flip flop
IC20	74LS02	Logic
IC29	74LS00	Logic
IC30	74LS27	Logic
IC31	74LS04	Logic
IC27	74LS85	Port decoder
IC34	74LS139	Port decoder
IC1	Z80	PIO

TICK WHEN COMPLETED [ ]

NOW FOR THE SMOKE TESTS!!!

c) Next mount the MAIN BOARD onto the metal baseplate as follows:

1) Bolt the regulator IC37 (309K) to the metal baseplate as per FIG 2. It is a good idea to smear a little heatsink compound onto the base plate where the voltage regulator flange will make contact. Then bolt the PCB/regulator assembly in place using the 6BA screws.

2) Bolt the RS232 connector to the rear of the chassis using 6BA screws provided.

3) Mount 2 plastic spacers in the holes under the keyboard and screw these in place using the #6 self tappers provided.

Now we can proceed with the tests. Plug on the CORE BOARD. Take care to ensure that the top pins line up with the bottom (they are offset so you will be able to see if you have the CORE BOARD incorrectly installed).
Connect the power supply and switch on. If all is in order you should hear a short tone from the loudspeaker. This is because the BASIC is executing a COLD START. If you do not hear the

tone then recheck your work carefully. DO NOT PROCEED TO THE NEXT STAGE UNTIL YOU CAN HEAR THE POWER ON TONE. Note also that this power on tone only sounds when the memory is fully corrupted. Switch off the power and wait about a minute before trying again. Naturally the backup battery must not be connected at this stage.

TICK WHEN COMPLETED [✓]

d) Next we will test the keyboard scanning circuit. Carefully plug in the following ICs:

IC	TYPE	FUNCTION
IC26	74LS161	Generates LOAD for 6545
IC9	6545-1	VDU controller
IC15	74LS175	VDU attribute latch
IC4	74LS151	Keyboard scanning
IC7	74LS156	Keyboard scanning

TICK WHEN COMPLETED [✓]

e) Next connect the power supply and switch on. You will here the tone in the speaker as per step c). Now hold down the CTRL key and while you continue to hold it down press G. You should here the same tone as before. If you continue to hold down both CTRL and G the AUTO REPEAT should come into play and you will here the tone bursts at regular intervals. If this happens you are well on the way to having an operational MICROBEE. In effect you have an operational computer without a VDU and you could even write some BASIC programs but let's proceed.

TICK WHEN COMPLETED [ ]

f) Next we will work on the VDU section. Insert the following ICs:

IC	DEVICE	FUNCTION
IC5	6116-3	Screen RAM
IC2,3,8	74LS157	Multiplexers between CPU and VDU
IC6,10,21	74LS157	Multiplexers to select characters
IC12	74LS166	Shift register for video
IC14,11	74LS245	Data bus buffers
IC17	74LS86	Video logic
IC16	82S123	Control ROM

DO NOT INSERT IC13 (2516 character ROM) or IC18 (6116 PCG RAM) at this stage.

TICK WHEN COMPLETED [✓]

g) Power up the MICROBEE again and this time connect the VIDEO OUT from the DIN plug to a TV monitor or a modified TV set. Switch on the TV monitor and you should see a large white area on

the screen surrounded with a black border on all 4 sides. If so all is well. If not check all your work again.

TICK WHEN COMPLETED [✓]

h) Now insert IC13 and IC18 and power up the MICROBEE again. You now should have characters on the screen and should be able to run BASIC programs (see the BASIC manual for more details). Check the PCG RAM is operational by typing INVERSE and seeing if the text on the screen becomes white on black. Repeat this for UNDERLINE and seeif text becomes underlined. If so your MICROBEE is almost ready for use.

TICK WHEN COMPLETED [✓]

i) Let's check the cassette interface. Because this is software controlled, there are no adjustments required except possibly to the cassette recorder VOLUME and TONE controls. Insert IC35 CA3140/3130 and connect a tape recorder to the DIN plug leads. Connect the RED (or GREY) lead to the AUX input on the recorder and the BLACK lead to the EAR output of the recorder, connect the recorder to the 240V mains and you are ready to go. If you have a prerecorded cassette in MICROWORLD BASIC insert it into the tape recorder, rewind the tape to the beginning, press the PLAY button on the tape recorder and type LOAD <CR> on the MICROBEE.

NOTE: You actually type LOAD and press the key marked RETURN to set up this command.

If all is well you will soon see a tape file name appear on the screen and your tape is loading. When the program has loaded the MICROBEE will sound a tone to indicated a complete load. If a BAD LOAD has occured you may have to rewind the tape and adjust the volume control before starting again.

If you do not have a prerecorded tape you can write a file under BASIC (see the BASIC MANUAL for more details) and type SAVE <CR> after pressing down the PLAY and RECORD buttons on the tape recorder. This will SAVE a file onto tape and then you can test the LOAD as above.

TICK WHEN COMPLETED [ ]

j) Lastly you can test the RS232 port if you have access to a 1200 BAUD serial printer. Refer to TABLE 1 below and connect the printer to your MICROBEE as indicated. Next type in a program and then type LLIST <CR> and watch the printer. If all is well your program will be listed on the printer.

TICK WHEN COMPLETED [ ]

TABLE 1: MICROBEE RS232 CONNECTIONS

MICROBEE CONNECTOR		PRINTER
PIN 7 GND	———	PIN 7 GND
PIN 2 TxD	———	PIN 3 Rxd
PIN 3 RxD	———	PIN 2 TxD
PIN 5 CTS	———	PIN 20 BUSY
PIN 20 (tied high internally)		no connetion
PIN 9 +12V		no connection
PIN 24 CLOCK		no connetion

FINISHING OFF YOUR MICROBEE ASSEMBLY

By now you will need little prompting to finish off the assembly of your MICROBEE. Connect a 3V backup battery (not supplied) as indicated on the CORE BOARD and test for memory retention by switching the power on and off a few times. Your program should remain intact at all times.

Using a piece of double sided tape (not supplied), mount the loudspeaker against the PCB on top of the area where IC37 is located. You may experiment with fastening the speaker to the top of the case if you prefer.

Fitting the case should present no problem. Use the #6 self tapping screws and mount the NORYL top using a screw in each corner of the metal baseplate. Take the four rubber feet, remove the backing paper and press a foot into each corner of the base plate.

Now sit back and read the BASIC manual then you can really enjoy the fruits of your labours. Happy computing!!!