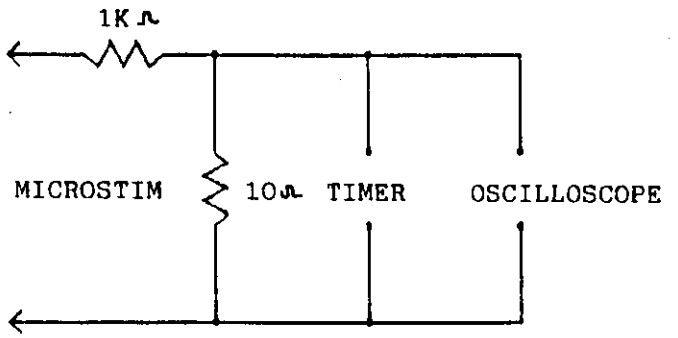
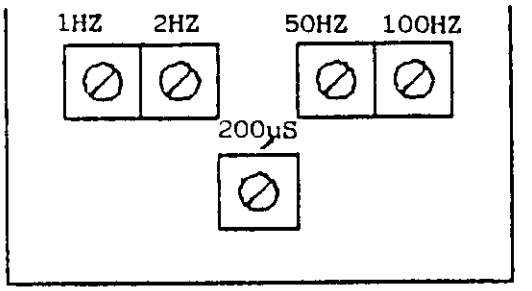
MICROSTIM

1) Inspect all components for correct values.
2) Inspect printed circuit board for any faults.
3) Assemble P.C.B. with all components.
4) Attach battery clip and output leads.
5) Assemble switches and solder lightly to P.C.B.
6) Allow to cool for a minimum of 30 minutes.
7) Connect to TEST RIG.





8) Set oscilloscope to 0.1 Volts/Division; 200u Seconds/Division.
9) Adjust all potentiometers to mid-positions.
10) Attach power supply adjusted to 9 Volts.
11) Activate 50 Hz output switch.
12) Adjust output of stimulator to 7 divisions (70mAmps).
13) Set timer to measure pulse width.
14) Adjust pulse width to 200u Seconds.
15) Set timer to measure interval between pulses.
16) Adjust interval for 20mSeconds.
17) Adjust on 100 Hz for 10mSeconds.
18) Adjust on 2 Hz for 500mSeconds.
19) Adjust on 1 Hz for 1000mSeconds.
20) Repeat steps 13 to 19.
21) Reduce power supply on 50 Hz observing
    a) 9 Volts - flash GREEN
    b) 8 Volts - flash YELLOW
    c) 7 Volts - flash RED
22) Inspect CASE for good condition.
23) Attach all labels to clean facias.
24) Use sharp scalpel to remove label holes.
25) Insert sockets, L.E.D. bezel,
26) Remove switches from P.C.B. and place in CASE.
27) Solder P.C.B. to switches.
28) Assemble CASE and attach knob.
29) Label knob with line adjacent to intensity marking.
30) Insert serial number label and sponge into battery compartment.
31) Allow to cool for minimum of 30 minutes.
32) Check all times and output control on test rig for correct function.
33) Place in holder, seal and attach test label signed and dated.

VIAMED

Clinical Trial Reports

No formal clinical trials were carried out.

Dr N Harper of MRI was a pioneer in the development of stimulators in Regional anaesthetics and assisted in the original design and testing of the product.

No formal papers on the microstim have been written

VIAMED

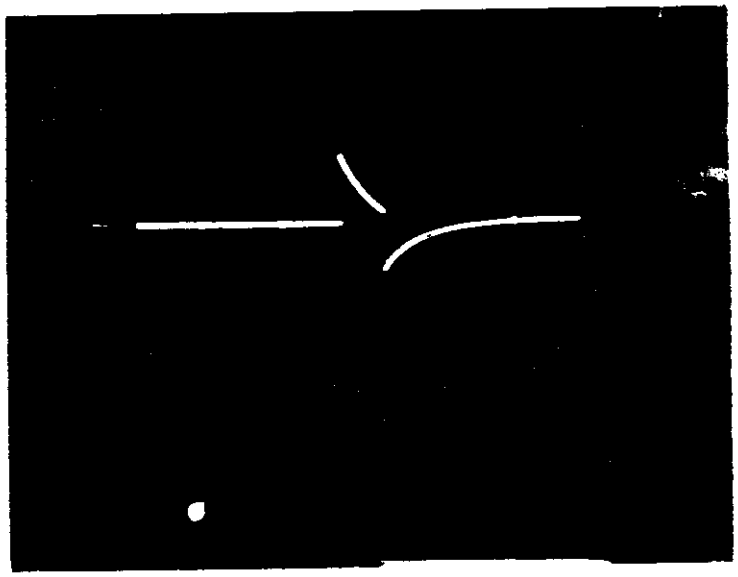
Compatibility Trials

Manchester RI Medical Physics department compared the outputs of the Microstim to existing Nerve stimulators during the design phase.

The microstim was found to provide an output current superior to other stimulators on the market (1984/5/) under normal patient load conditions.
i.e. resistive load of approximately 1K ohm or less. Investigation took place to compare the response of wave shape and current levels under abnormal loads of resistance and capacitance. i.e. Poor connection to the patient
Photos and the comparison curves show the microstim behaving similar to other stimulators on the market. Although the stimulators would not be expected to function effectively under high patient impedance's it was important to know that nothing dramatic occurred to the output or to the circuit components of the microstim.

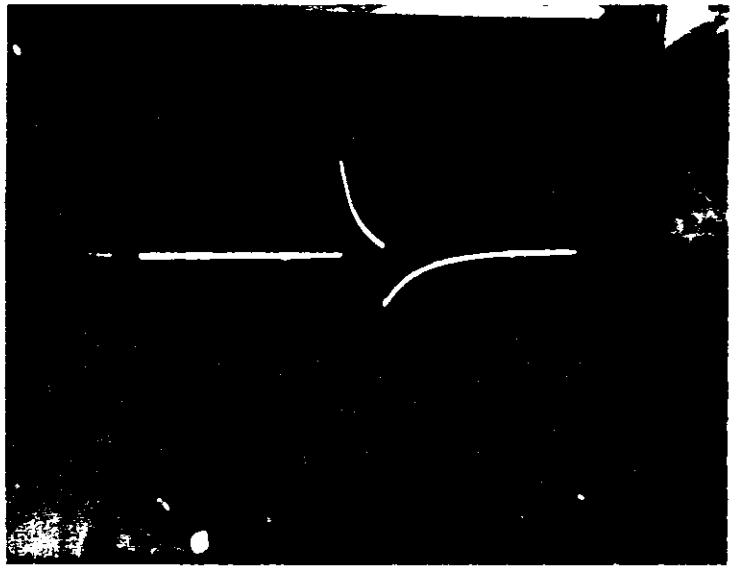
MP 1986.

THE MICROSTIM WAS FOUND TO PROVIDE AN OUTPUT CURRENT SUPERIOR TO OTHER STIMULATORS ON THE MARKET UNDER NORMAL PATIENT LOAD CONDITIONS i.e. resistive load of approximately 1K Ω Ω. INVESTIGATION TOOK PLACE TO COMPARE THE RESPONSE OF WAVE SHAPE AND CURRENT LEVELS UNDER ABNORMAL LOADS OF RESISTANCE AND CAPACITANCE. i.e. POOR CONNECTION TO THE PATIENT. PHOTOS AND THE COMPARISON CURVES SHOW THE MICROSTIM BEHAVING SIMILAR TO OTHER STIMULATORS ON THE MARKET. ALTHOUGH THE STIMULATORS WOULD NOT BE EXPECTED TO FUNCTION EFFECTIVELY UNDER HIGH PATIENT IMPEDENCES, IT WAS IMPORTANT TO KNOW THAT NOTHING DRAMATIC OCCURRED TO THE OUTPUT OR TO THE CIRCUIT COMPONENTS OF THE MICROSTIM.

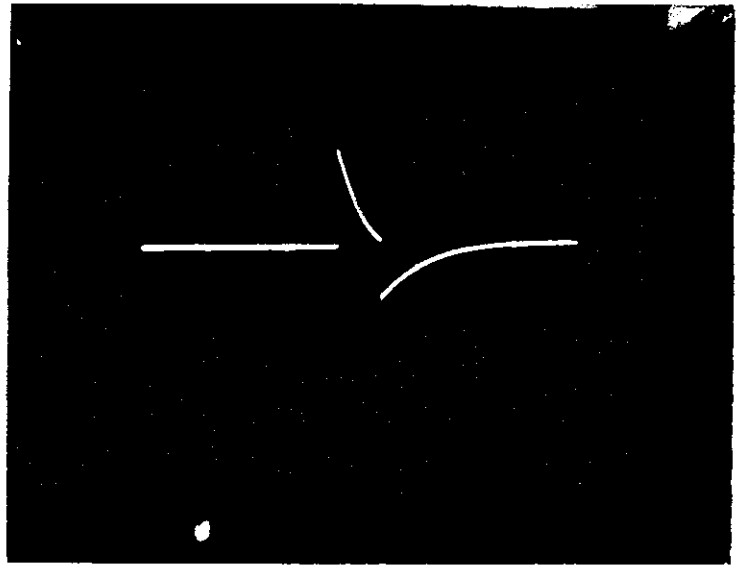


O/C

·047μF



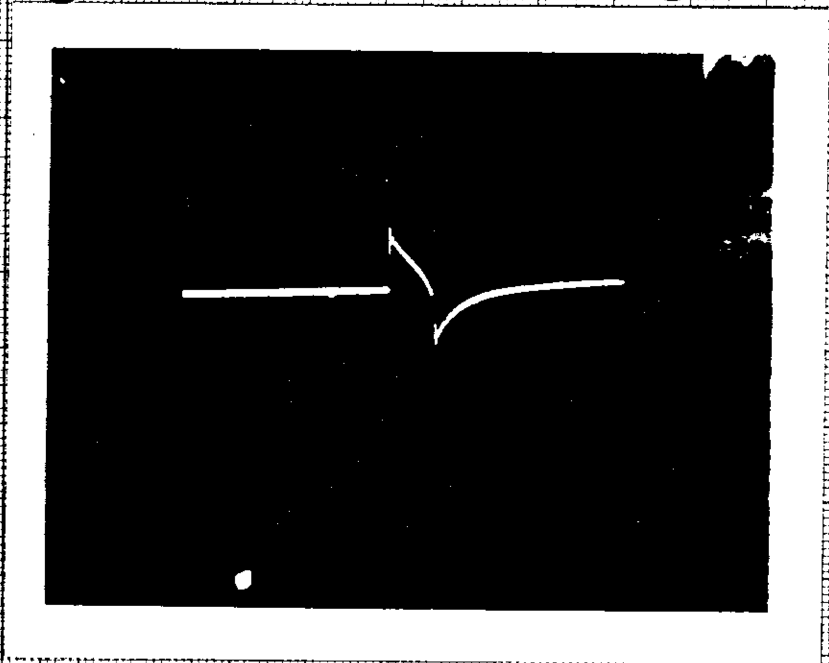
·022μF



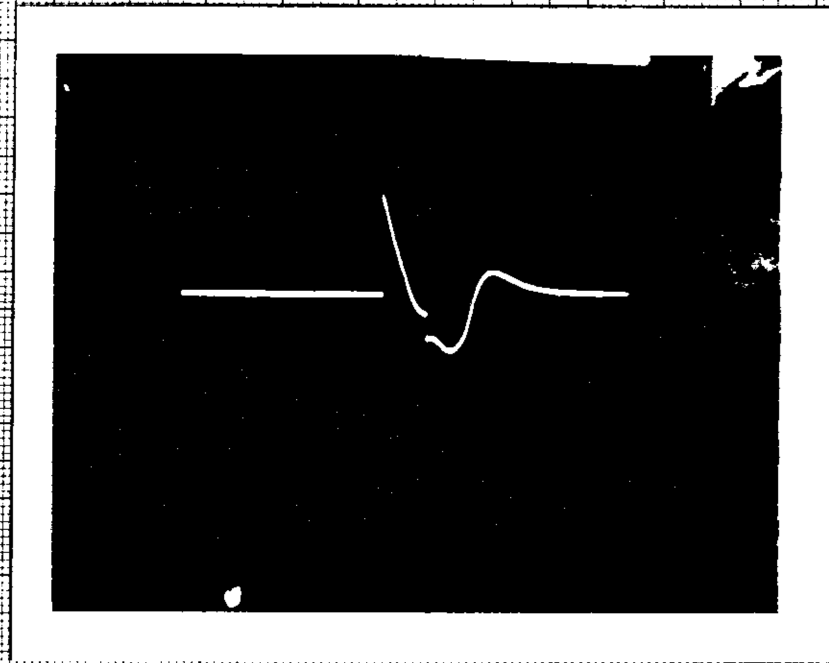
·068μF

10 of 16

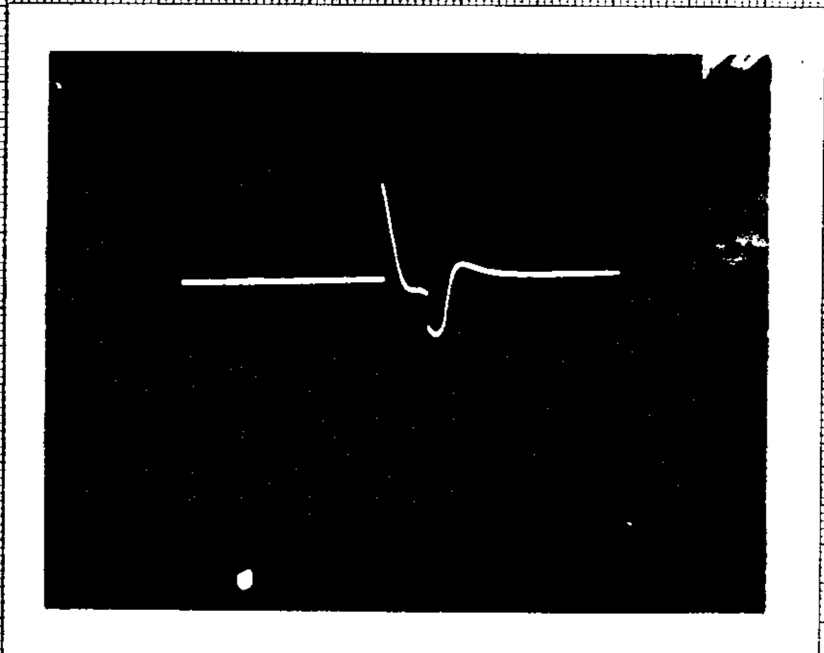
MED. PHYS. (x= 100) (20K)



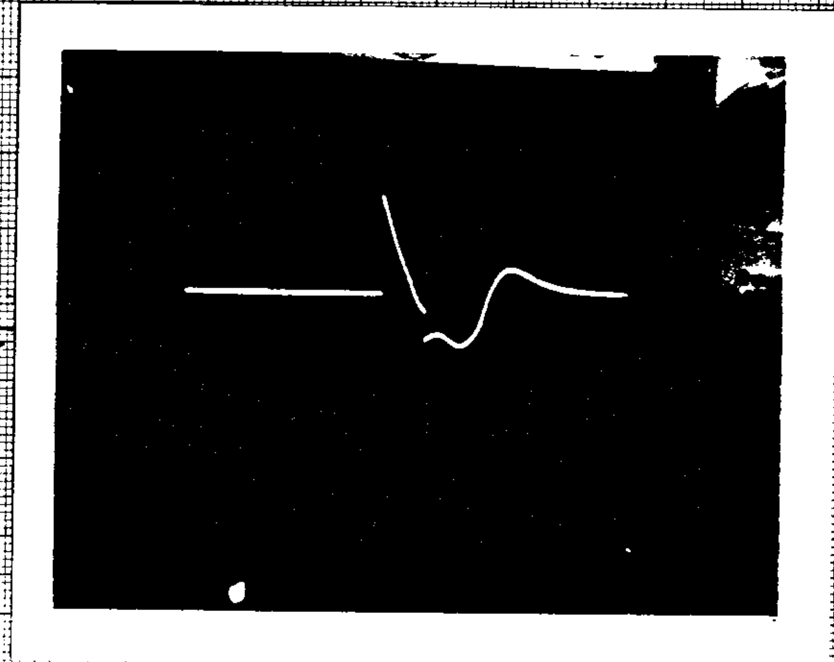
O/C (x5)



·0·47µF



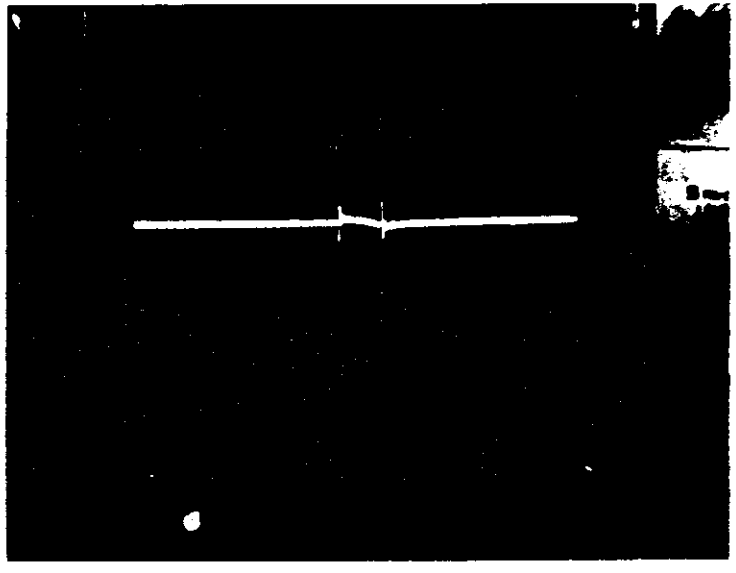
·022µF



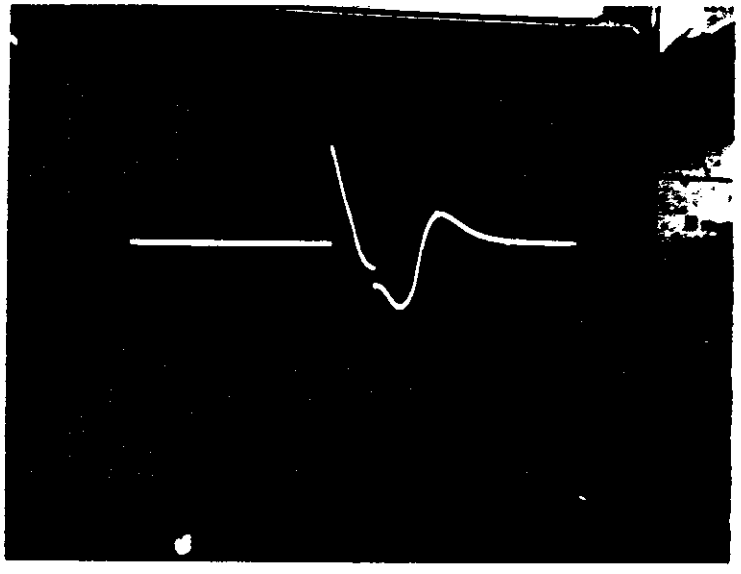
·068µF

21102

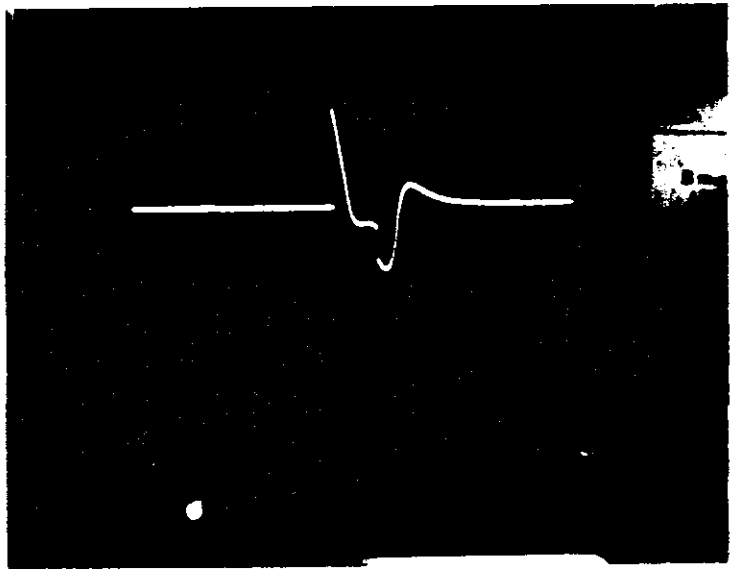
MED. PHYS. (EXPTL) (200)



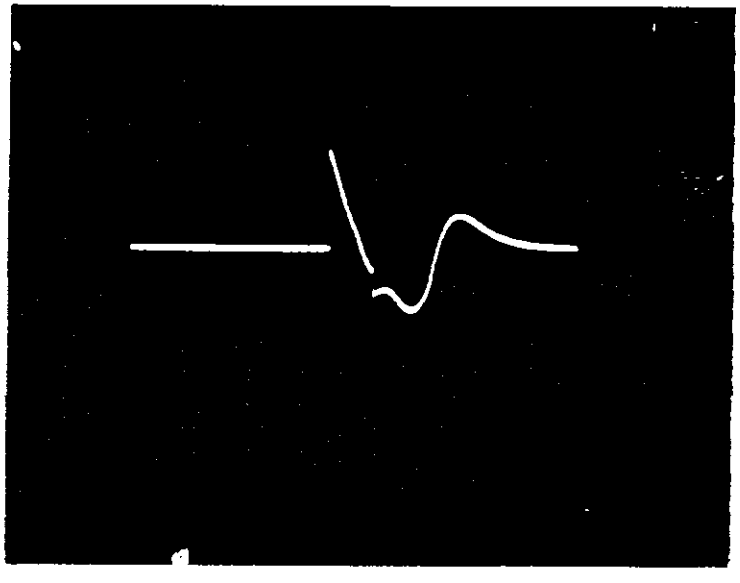
0/c
(x5)



.047μF



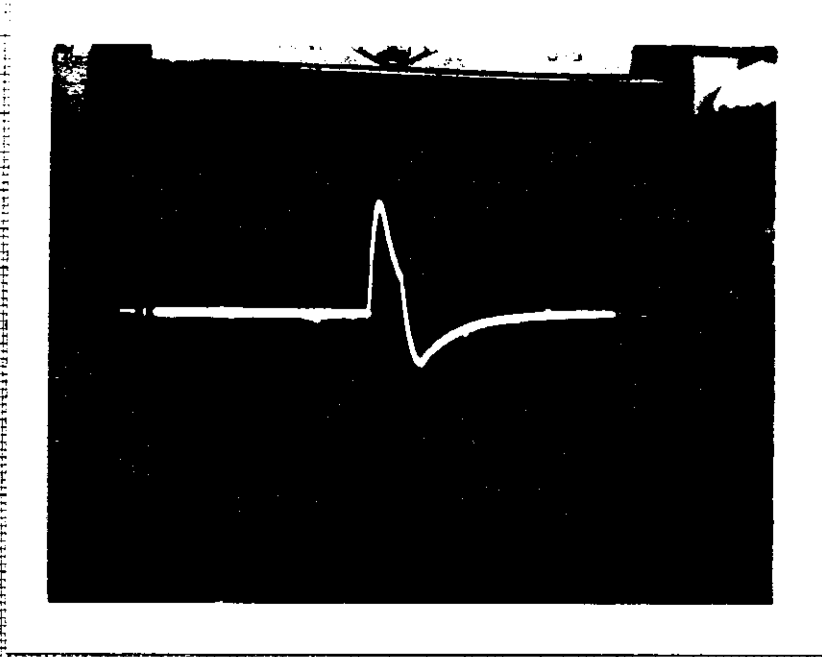
.022μF



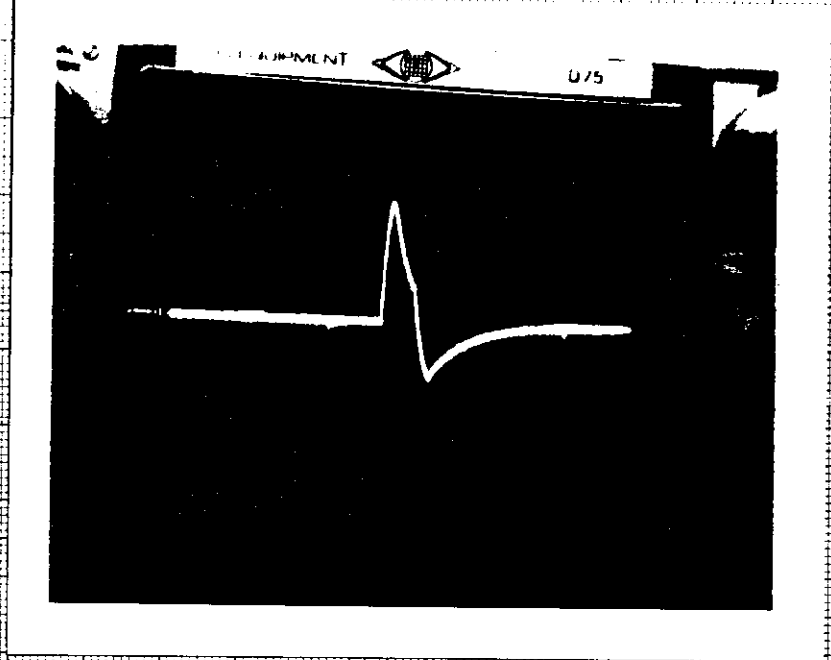
.068μF

9/02

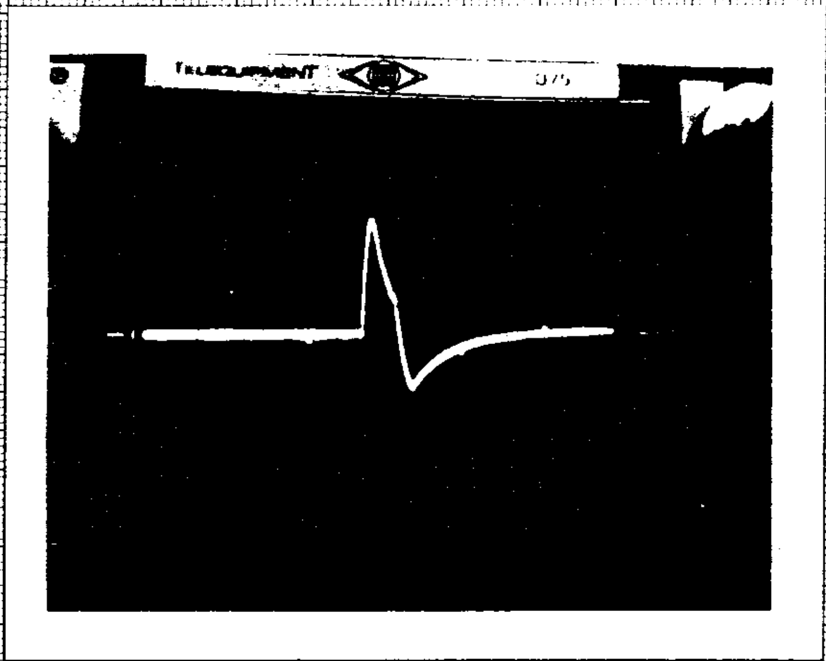
NEWSTIM (2K)



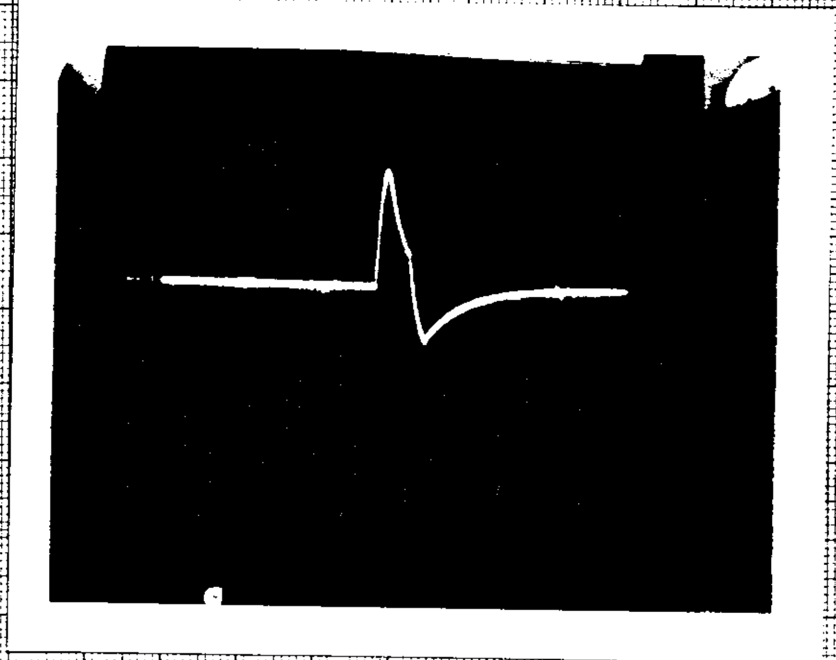
O/C



·047µF



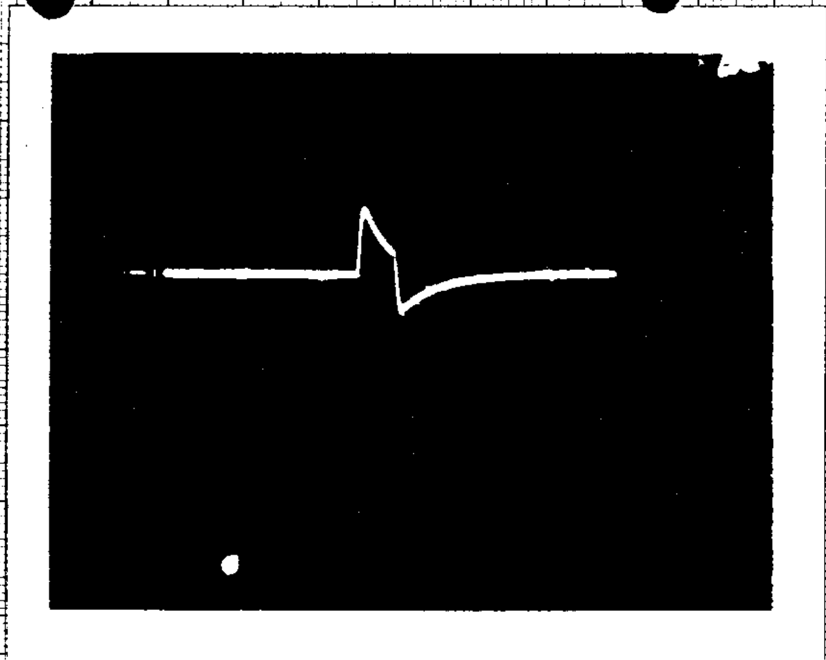
·022µF



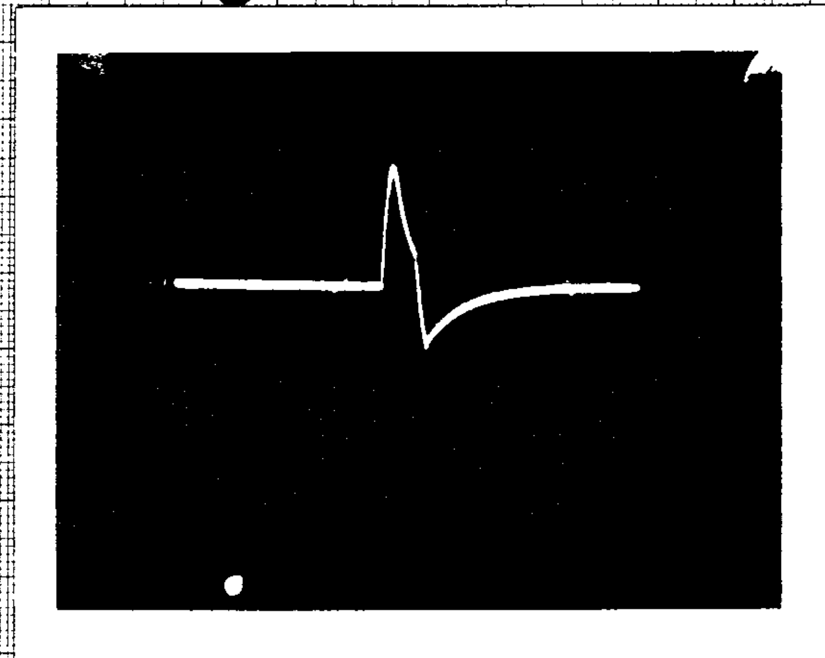
·068µF

Chartwell

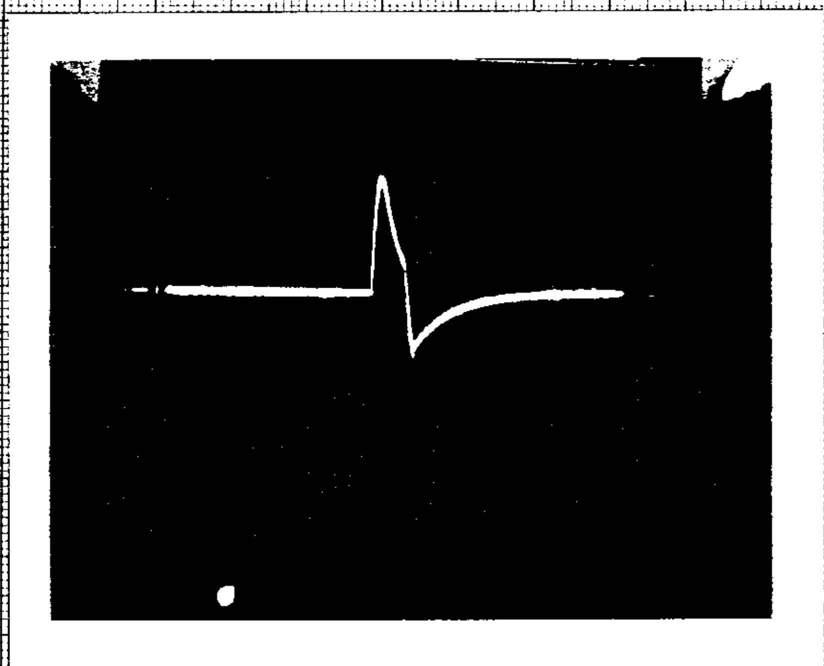
NEWSHM (20K)



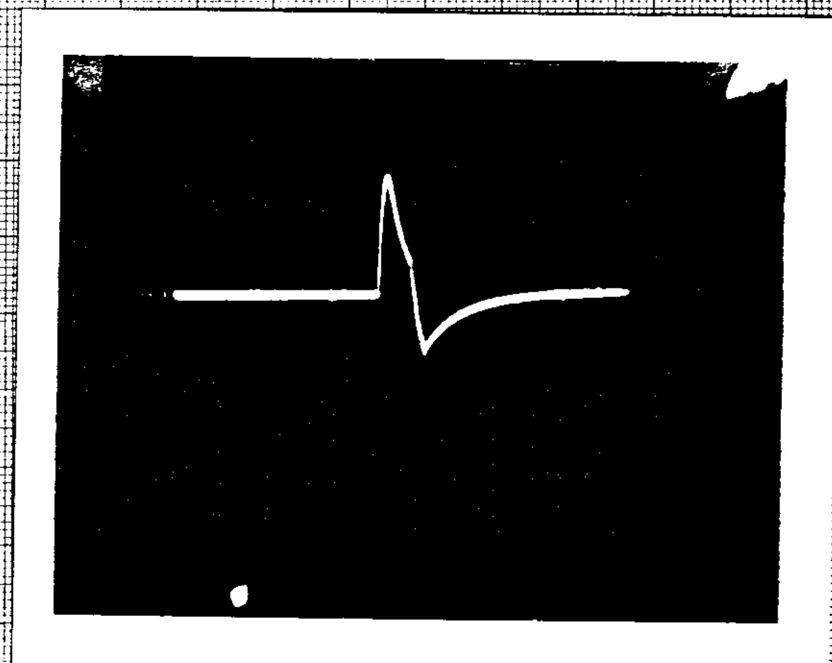
o/c



·047μF

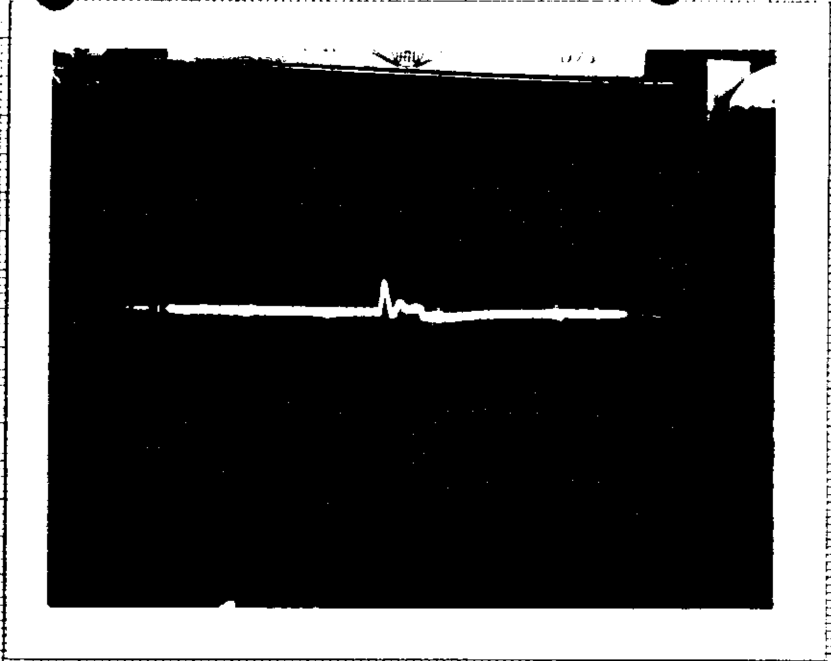


·022μF

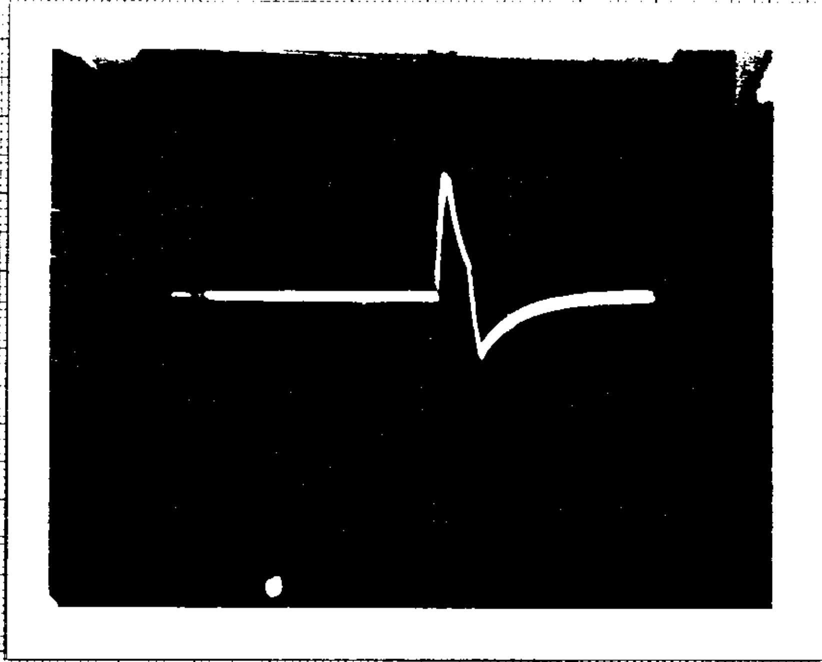


·068μF

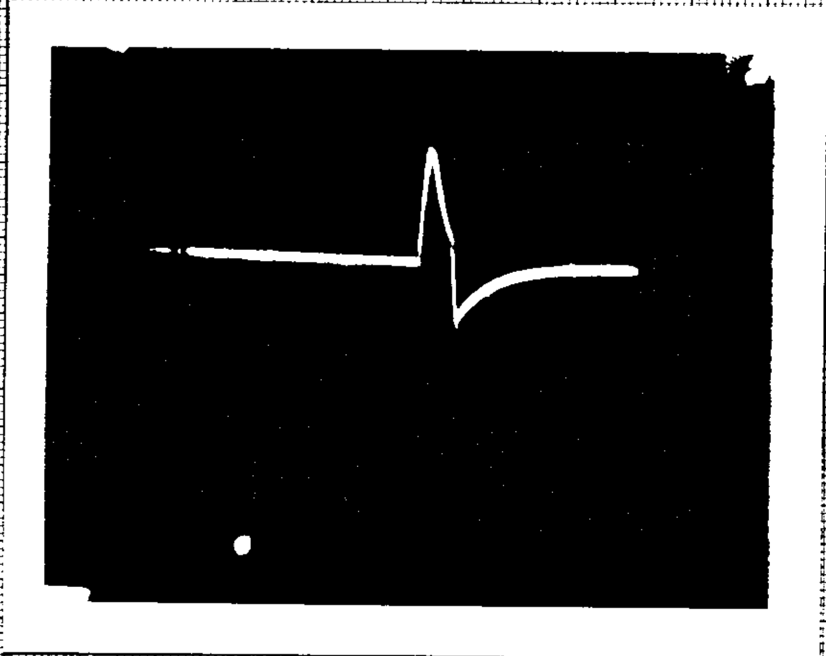
NEWSTIM (200K)



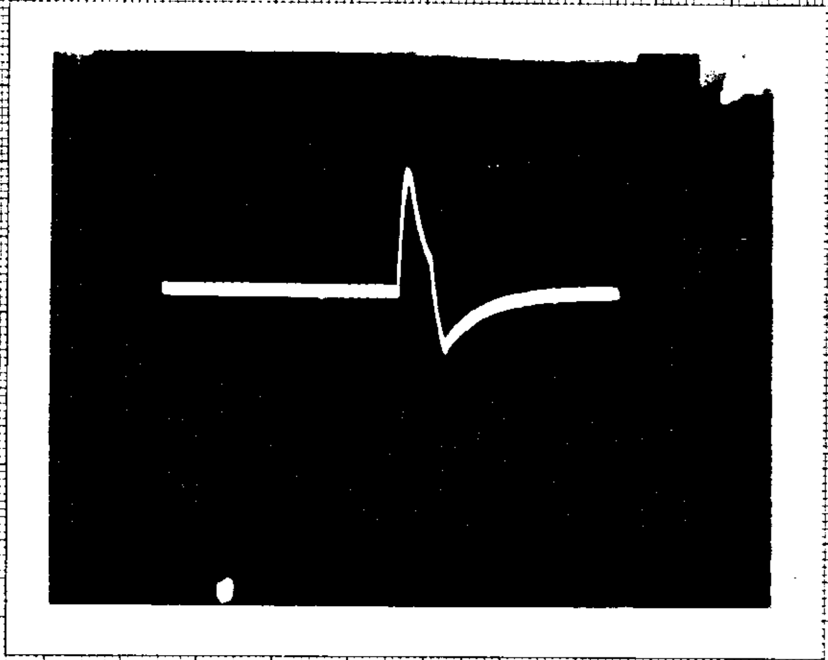
O/C



·047µF



·022µF

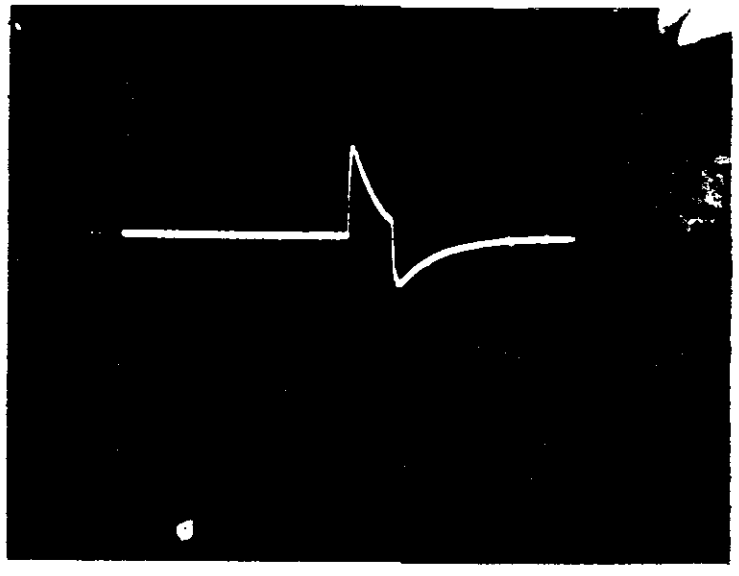


·068µF

9/106

Chartwell

MINISTIM (ZR)



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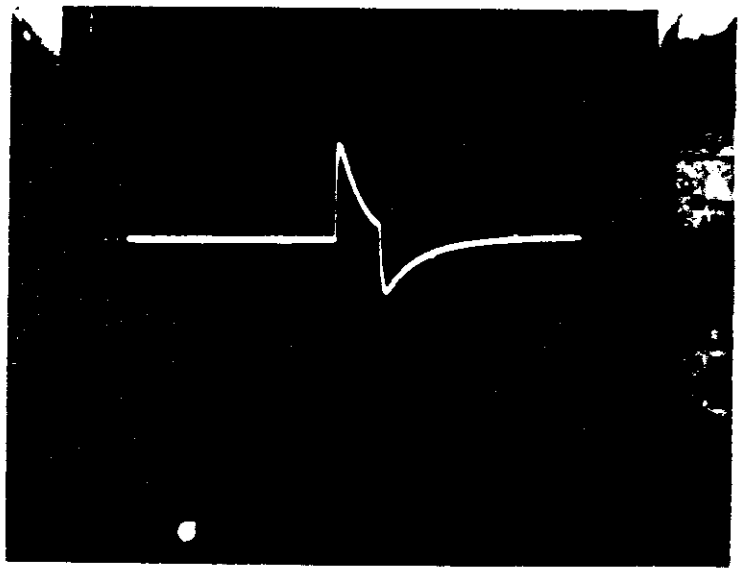
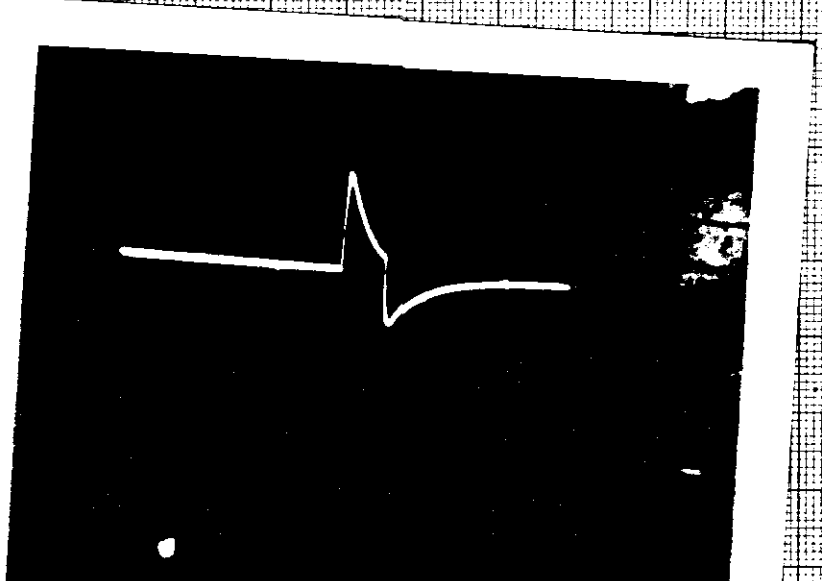
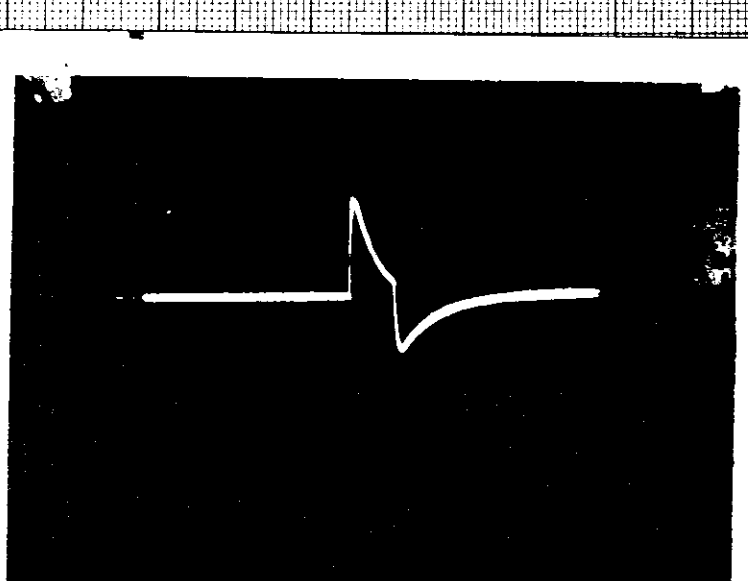


·047μF



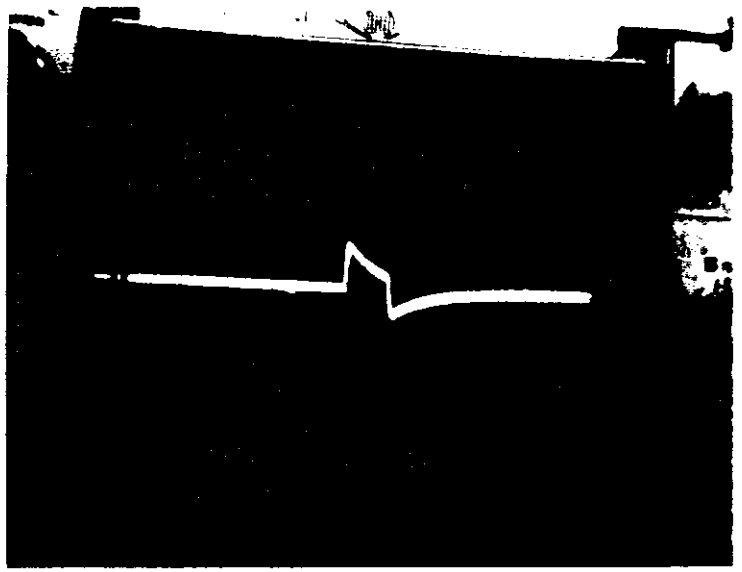
022μF



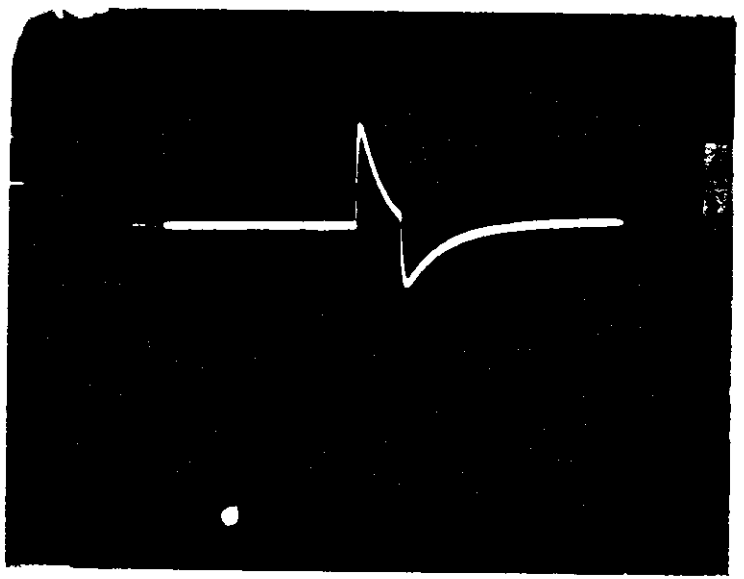
·068μF

8107

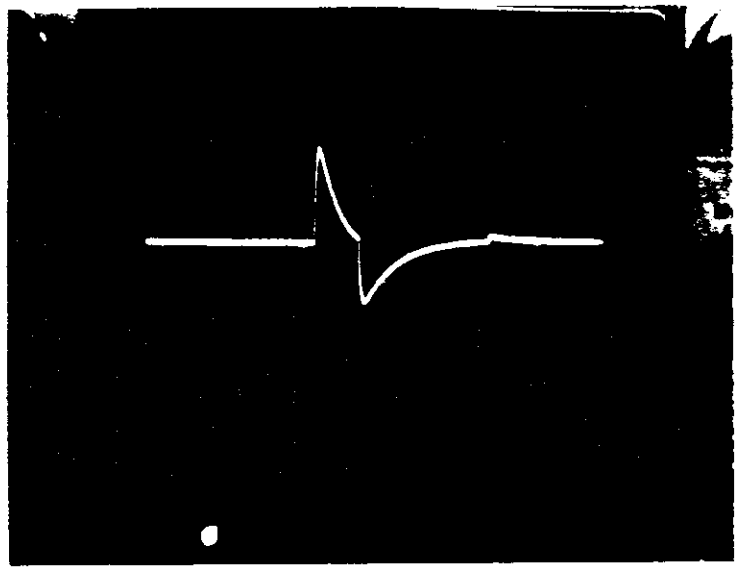
MINISTIM (20K)



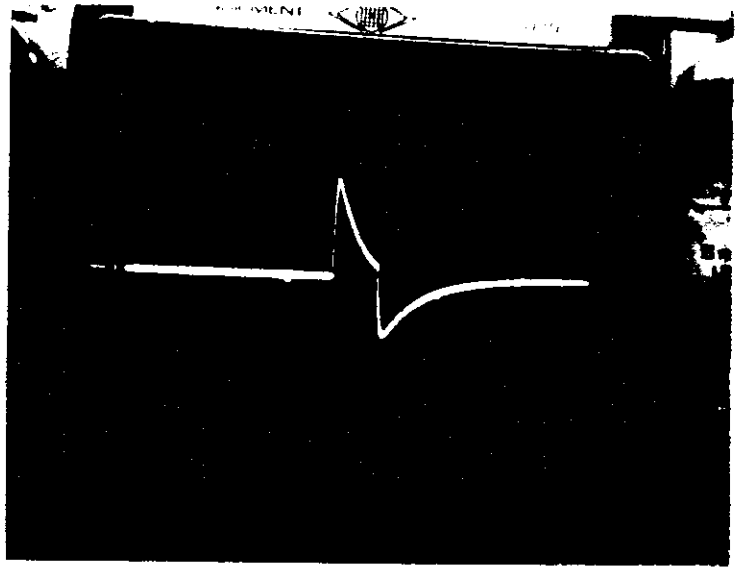
O/C



·047μF

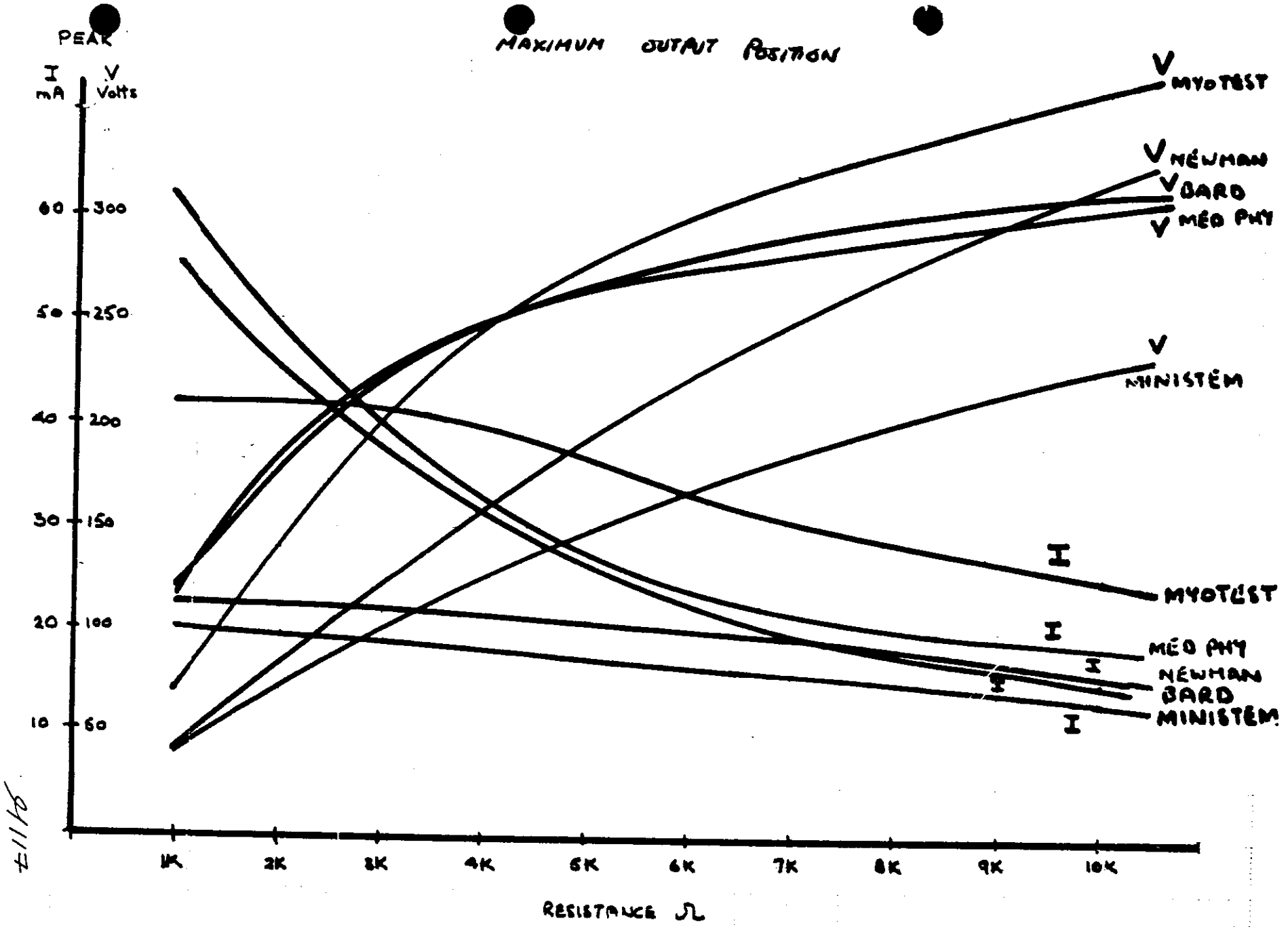


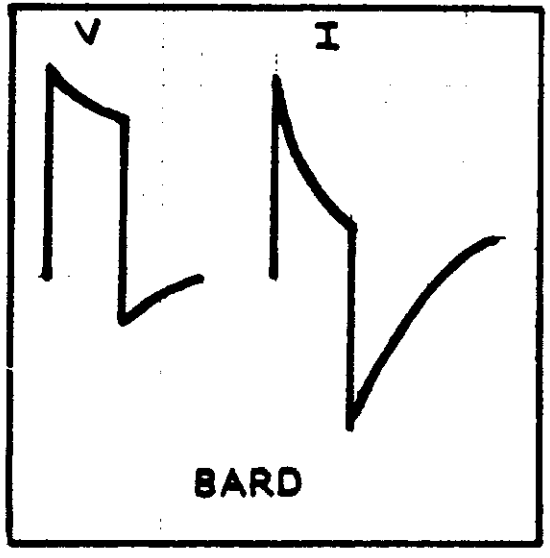
·022μF

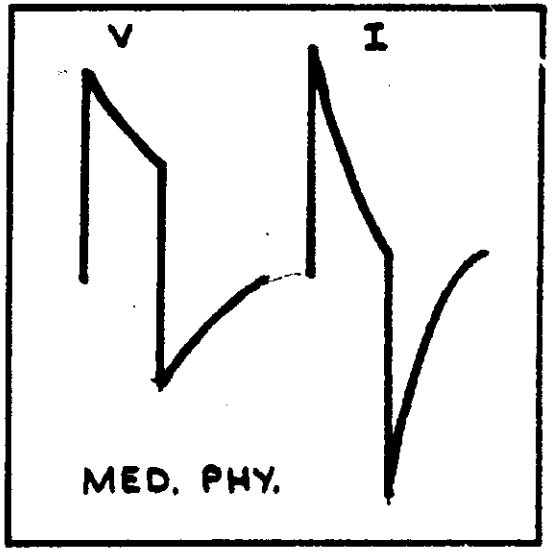


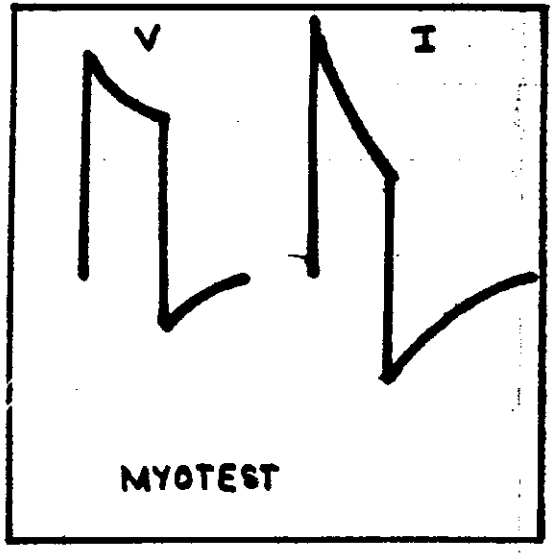
·068μF

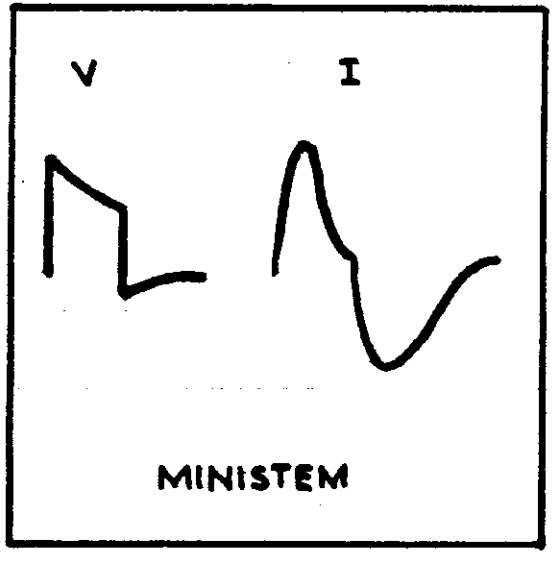
8016

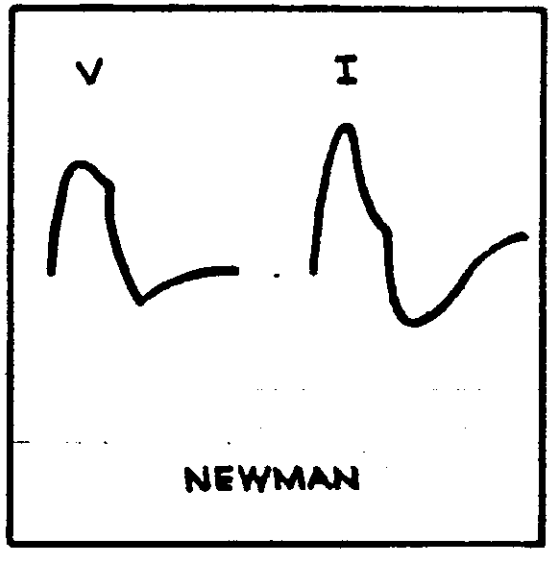

PEAK
MAXIMUM OUTPUT POSITION
I mA
V Volts
60
50
40
30
20
10
300
250
200
150
100
50
V MYOTEST
V NEWMAN
V BARD
V MED PHY
V MINISTEM
I
MYOTEST
I
MED PHY
I
NEWMAN
I
BARD
I
MINISTEM
1K
2K
3K
4K
5K
6K
7K
8K
9K
10K
RESISTANCE Ω











LOAD RESISTANCE 5KΩ

8118

VIAMED

Bio-Compatibility & Toxicity Evaluation

This is not required as the only part of te equipment that comes into contact with the patient are the disposable electrodes

VIAMED

Bio-Compatibility & Toxicity Evaluation

This is not an issue as the only part of the device in contact with a patient is the disposable ECG Electrode supplied by the user.

4126

VIAMED

Clinical Trial Reports

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No formal papers on the microstim have been written

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MP 1986.

```
        FF25  6E
        FF26  20
        FF27  4D
        FF28  61
        FF29  78
        FF2A  77
        FF2B  65
        FF2C  6C
        FF2D  6C
        FF2E  20
        FF2F  20
0246                TEXT '      27/01/1991    '
        FF30  20
        FF31  20
        FF32  20
        FF33  32
        FF34  37
        FF35  2F
        FF36  30
        FF37  31
        FF38  2F
        FF39  31
        FF3A  39
        FF3B  39
        FF3C  31
        FF3D  20
        FF3E  20
        FF3F  20
```

```
0247  FF40
0248  FF40
0249  FFFA          AORG >FFFA
0250  FFFA
0251  FFFA  E3      BYTE >E3          TIMER1 vector
0252  FFFB  00      BYTE >00
0253  FFFC  FF      BYTE >FF          TIMER2 vector
0254  FFFD  FF      BYTE >FF
0255  FFFE  E8      BYTE >E8          RESET vector
0256  FFFF  00      BYTE >00
```

NO ERRORS, NO WARNINGS

8615

```
0001 0000
0002        ************************************************************************
0003        *
0004        *                          MICROSTIM DB Version 1.0
0005        *                        © Colin Maxwell  :  27th January 1991
0006        *
0007        ************************************************************************
0008        *
0009        *  PORT USAGE      :
0010        *                  :
0011        *                  : PORT A    BIT 0       OUTPUT
0012        *                              BIT 1       PATIENT DETECT
0013        *
0014        *                  : PORT B    BIT 0       SOUNDER
0015        *
0016        *
0017        *                  : PORT C    BIT 0       SWITCH INPUT
0018        *                              BIT 1       SWITCH INPUT
0019        *                              BIT 2       SWITCH INPUT
0020        *                              BIT 3       SWITCH INPUT
0021        *                              BIT 7       LED OUTPUT
0022        *
0023        *
0024        *
0025        *
0026        *       I/O CONTROL REGISTERS
0027        *
0028   0000      IOCNTO     EQU  P0      INTERRUPTS 1,2,3 AND EXPANSION MODE
```

```
0029  0002      IOCNT1    EQU P2     INTERRUPTS 4,5
0030  0001      IOCNT2    EQU P1     INTERRUPT POLARITY AND LEVEL
0031    *
0032    *
0033    *
0034    *       PORTS
0035    *
0036  0004      APORT     EQU P4     PORT A DATA REGISTER
0037  0006      BPORT     EQU P6     PORT B DATA REGISTER
0038  0008      CPORT     EQU P8     PORT C DATA REGISTER
0039  000A      DPORT     EQU P10    PORT D DATA REGISTER
0040  0005      ADDR      EQU P5     PORT A DATA DIRECTION REGISTER
0041  0009      CDDR      EQU P9     PORT C DATA DIRECTION REGISTER
0042  000B      DDDR      EQU P11    PORT D DATA DIRECTION REGISTER
0043    *
0044    *
0045    *
0046    *     TIMER REGISTERS
0047    *
0048  000F      T1CTL0    EQU P15    TIMER 1 CONTROL REGISTER 0
0049  000E      T1CTL1    EQU P14    TIMER 1 CONTROL REGISTER 1
0050  000D      T1LSDA    EQU P13    TIMER 1 LSB RELOAD REGISTER
0051  000C      T1MSDA    EQU P12    TIMER 1 MSB RELOAD REGISTER
0052  0013      T2CTL0    EQU P19    TIMER 2 CONTROL REGISTER 0
0053  0012      T2CTL1    EQU P18    TIMER 2 CONTROL REGISTER 1
0054  0011      T2LSDA    EQU P17    TIMER 2 LSB RELOAD REGISTER
0055  0010      T2MSDA    EQU P16    TIMER 2 MSB RELOAD REGISTER
0056    *
0057    *
```

```
0058        *
0059        *       UART REGISTERS
0060        *
0061   0017         T3DATA     EQU  P23     TIMER 3 RELOAD REGISTER
0062   0014         SMODE      EQU  P20     SERIAL PORT MODE CONTROL REGISTER
0063   0015         SCTLO      EQU  P21     SERIAL PORT CONTROL REGISTER 0
0064   0016         SSTAT      EQU  P22     SERIAL PORT STATUS REGISTER
0065   0018         SCTL1      EQU  P24     SERIAL PORT CONTROL REGISTER 1
0066   0019         RXBUF      EQU  P25     RECIEVER BUFFER
0067   001A         TXBUF      EQU  P26     TRANSMITER BUFFER
0068   0000
0069   0000
0070   0000
0071   0000
0072   E300         INT        AORG >E300
0073   E300
0074   E300  A2               MOVP %?00000000,T1CTL0      stop timer1
       E301  00
       E302  0F
0075   E303  0B               RETI
0076   E304
0077   E304
0078   E800         INIT       AORG >E800
0079   E800
0080   E800  06               DINT                        prevent interrupts during set-up
0081   E801  A2               MOVP%?00000000,APORT        set-up port A to prevent any output pulse during power up.
       E802  00
       E803  04
0082   E804  A2               MOVP%?00000001,ADDR
```

```
      E805  01
      E806  05
0083  E807  52          MOV  %>C8,B              set stack pointer in upper RAM
      E808  C8
0084  E809  0D          LDSP
0085  E80A  A2          MOVP%?00101110,IOCNTO    set registers
      E80B  2E
      E80C  00
0086  E80D  A2          MOVP%?00000000,IOCNT1
E80E  00
      E80F  02
0087  E810  A2          MOVP %?00000000,IOCNT2
      E811  00
      E812  01
0088  E813  A2          MOVP %?10000000,CDDR
      E814  80
      E815  09
 0089 E816  A2          MOVP %?00000000,T1CTL1
      E817  00
      E818  0E
0090  E819  A2          MOVP %?01000000,T2CTL1
      E81A  40
      E81B  12
0091  E81C  A2          MOVP %?00000000,T2MSDA
      E81D  00
      E81E  10
0092  E81F  A2          MOVP %?10110010,T2LSDA
      E820  B2
      E821  11
```

```
0093  E822
0094  E822  72          MOV  %>80,R21        0.25 second delay
      E823  80
      E824  15
0095  E825  72    X2    MOV  %>00,R20        to enable circuit to charge
      E826  00
      E827  14
0096  E828  DA    X1    DJNZ R20,X1          at switch on
      E829  14
      E82A  FD
0097  E82B  DA          DJNZ R21,X2
      E82C  15
      E82D  F7
0098  E82E
0099  E82E  05    EINT                       ok.  allow interrupts
0100  E82F
0101  E82F  80    RDKEYS MOVP CPORT,A        read key status
      E830  08
0102  E831  23          AND  %#?11110000,A
      E832  0F
0103  E833  2D          CMP  %>04,A          check for TOF
      E834  04
0104  E835  E6          JNE  ON1
      E836  03
0105  E837  8E          CALL @TOF
      E838  E851
0106  E83A  2D    ON1   CMP  %>08,A
      E83B  08
0107  E83C  E6          JNE  ON2             check for DBS
```

```
      E83D  03
0108  E83E  8E              CALL  @DB
      E83F  E876
0109  E841  2D    ON2       CMP   %>01,A
      E842  01
0110  E843  E6              JNE   ON3                 check for TET
      E844  03
0111  E845  8E              CALL  @TET
      E846  E8C7
0112  E848  2D    ON3       CMP   %>02,A
      E849  02
0113  E84A  E6              JNE   ON4                 check for 1 Hz
      E84B  03
0114  E84C  8E              CALL  @ONEHZ
      E84D        E917
0115  E84F  E0    ON4       JMP   RDKEYS              repeat for ever
      E850  DE
0116  E851
0117  E85
0118  E851  A2    TOF       MOVP  %?11110100,T1MSDA   set timer 1
      E852  F4
      E853  0C
0119  E854  A2              MOVP  %?00100100,T1LSDA   for a cycle of 1 second
      E855  24
      E856  0D
0120  E857  72              MOV   %>04,R7             set TOF counter
      E858  04
```

```
      E859  07
0121  E85A  A2     TOFL2     MOVP %?10001011,T1CTL0
      E85B  8B
      E85C  0F
0122  E85D  8E               CALL @PULSE
      E85E  E936
0123  E860  72               MOV  %>10,R6          set LED on time
      E861  10
      E862  06
0124  E863  8E     TOFL1     CALL @DELAY
      E864  E954
0125  E866  DA               DJNZ R6,TOFL1
      E867  06
      E868  FA
0126  E869  A3               ANDP %?01111111,CPORT set LED off
      E86A  7F
      E86B  08
0127  E86C  A2               MOVP %?00000000,T2CTL0 set SOUNDER off
      E86D  00
      E86E  13
0128  E86F  01               IDLE                  wait for timer1
0129  E870  DA               DJNZ R7,TOFL2         do 4 pulses
      E871  07
      E872  E7
0130  E873  E0     TOFL3     JMP  TOFL3            idle forever
      E874  FE
0131  E875  0A               RETS
0132  E876
0133  E876
```

9816

```
0134  E876
0135  E876  72     DB        MOV  %>03,R17          set for 3 pulses
      E877  03
      E878  11
0136  E879  A2               MOVP%?01110101,T1MSDA  set up timer 1
      E87A  75
      E87B  0C
0137  E87C  A2               MOVP%?00110000,T1LSDA  for a cycle of 20ms
      E87D  30
      E87E  0D
0138  E87F  A2     DBL2      MOVP%?10000000,T1CTL0  start timer1
      E880  80
      E881    0F
0139  E882    8E             CALL @PULSE
      E883   E936
0140  E885  72               MOV  %>02,R6           set delay for LED on
      E886  02
      E887  06
0141  E888  8E     DBL1      CALL @DELAY
      E889  E954
0142  E88B  DA               DJNZ  R6,DBL1
      E88C  06
      E88D  FA
0143  E88E  A3               ANDP %?01111111,CPORT  turn LED off
      E88F  7F
      E890  08
0144  E891  A2               MOVP%?00000000,T2CTL0  turn SOUNDER off
      E892  00
```

```
       E893  13
0145   E894  01                IDLE                      wait for timer1
0146   E895  DA                DJNZ  R17,DBL2           repeat 3 times
       E896  11
       E897  E7
0147   E898  A2                MOVP%?10001110,T1MSDA     set timer 1
       E899  8E
       E89A  0C
0148   E89B  A2                MOVP%?11110110,T1LSDA     for delay of 1 second
       E89C  F6
       E89D  0D
0149   E89E  A2                MOVP%?10010111,T1CTL0
       E89F  97
       E8A0  0F
0150   E8A1  01                IDLE                      wait for timer 1
0151   E8A2  72                MOV  %>02,R17             set for 2 pulses
       E8A3  02
       E8A4  11
0152   E8A5  A2                MOVP%?01110101,T1MSDA     and repeat as above
       E8A6  75
       E8A7  0C
0153   E8A8  A2                MOVP%?00110000,T1LSDA
       E8A9  30
       E8AA  0D
0154   E8AB  A2    DBL4        MOVP%?10000000,T1CTL0
       E8AC  80
       E8AD  0F
0155   E8AE  8E                CALL @PULSE
       E8AF  E936
```

```
0156  E8B1  72          MOV  %>02,R6
      E8B2  02
      E8B3  06
0157  E8B4  8E    DBL3  CALL @DELAY
      E8B5  E954
0158  E8B7  DA          DJNZ R6,DBL3
      E8B8  06
      E8B9  FA
0159  E8BA  A3          ANDP %?01111111,CPORT
      E8BB  7F
      E8BC  08
0160  E8BD  A2          MOVP%?00000000,T2CTL0
      E8BE  00
      E8BF  13
0161  E8C0  01          IDLE
0162  E8C1  DA          DJNZ R17,DBL4
      E8C2  11
      E8C3  E7
0163  E8C4  E0    DBL5  JMP  DBL5                 idle for ever
      E8C5  FE
0164  E8C6  0A          RETS
0165  E8C7
0166  E8C7
0167  E8C7
0168  E8C7
0169  E8C7  A2    TET   MOVP%?01110101,T1MSDA     set up timer 1
      E8C8  75
      E8C9  0C
```

```
0170  E8CA A2          MOVP%?00110000,T1LSDA     for a  cycle of 20ms
      E8CB 30
      E8CC 0D
0171  E8CD 72          MOV  %>FA,R8
      E8CE FA
      E8CF 08
0172  E8D0 A2    TETL2 MOVP%?10000000,T1CTL0     start timer
      E8D1 80
      E8D2 0F
0173  E8D3 8E          CALL @PULSE
      E8D4 E936
0174  E8D6 72          MOV  %>02,R6              set LED on time
      E8D7 02
      E8D8 06
0175  E8D9 8E    TETL1 CALL @DELAY
      E8DA E954
0176  E8DC DA          DJNZ R6,TETL1
      E8DD 06
      E8DE FA
0177  E8DF A3          ANDP %?01111111,CPORT     turn off LED
      E8E0 7F
      E8E1 08
0178  E8E2 A2          MOVP%?00000000,T2CTL0     turn off SOUNDER
      E8E3 00
      E8E4 13
0179  E8E5 01          IDLE                      wait for timer 1
0180  E8E6 DA          DJNZ R8,TETL2             dec counter & do again
      E8E7 08
      E8E8 E7
```

0690

```
0181  E8E9  72          MOV  %>0C,R7          delay of x seconds
      E8EA  0C
      E8EB  07
0182  E8EC  72    TETL4 MOV  %>32,R6
      E8ED  32
      E8EE  06
0183  E8EF  8E    TETL3 CALL @DELAY
      E8F0  E954
0184  E8F2  DA          DJNZ R6,TETL3
      E8F3  06
      E8F4  FA
0185  E8F5  DA          DJNZ R7,TETL4
      E8F6  07
      E8F7  F4
0186  E8F8  A2          MOVP%?11111110,T1MSDA set up timer 1
      E8F9  FE
      E8FA  0C
0187  E8FB  A2          MOVP%?11000001,T1LSDA for 1 HZ cycle
      E8FC  C1
      E8FD  0D
0188  E8FE  A2    TETL6 MOVP?10010110,T1CTL0
      E8FF  96
      E900  0F
0189  E901  8E          CALL @PULSE
      E902  E936
0190  E904  72          MOV  %>10,R6          set up LED on time
      E905  10
      E906  06
```

```
0191  E907  8E     TETL5    CALL @DELAY
      E908  E954
0192  E90A  DA              DJNZ R6,TETL5
      E90B  06
      E90C  FA
0193  E90D  A3              ANDP %?01111111,CPORT      turn LED off
      E90E  7F
      E90F  08
0194  E910  A2              MOVP%?00000000,T2CTL0      turn SOUNDER off
      E911  00
      E912  13
0195  E913  01              IDLE                       wait for timer 1
0196  E914  E0              JMP  TETL6                 repeat cont. 1hz output
      E915  E8
0197  E916  0A              RETS
0198  E917
0199  E917
0200  E917
0201  E917
0202  E917  A2     ONEHZ    MOVP%?11111110,T1MSDA      set up timer 1
      E918  FE
      E919  0C
0203  E91A  A2              MOVP%?11000001,T1LSDA      for a cycle of 1 second
      E91B  C1
      E91C  0D
0204  E91D  A2     ONEL2    MOVP%?10010110,T1CTL0
      E91E  96
      E91F  0F
0205  E920  8E              CALL @PULSE
```

```
      E921  E936
0206  E923  72          MOV  %>10,R6          set up delay for LED on time
      E924  10
      E925  06
0207  E926  8E    ONEL1 CALL @DELAY
      E927  E954
0208  E929  DA          DJNZ R6,ONEL1
      E92A  06
      E92B  FA
0209  E92C  A3          ANDP %?01111111,CPORT turn off LED
      E92D  7F
      E92E  08
0210  E92F  A2          MOVP%?00000000,T2CTL0 turn off SOUNDER
      E930  00
      E931  13
0211  E932  01          IDLE                  wait for timer 1
0212  E933  E0          JMP  ONEL2            then repeat for ever
      E934  E8
0213  E935  0A          RETS
0214  E936
0215  E936
0216  E936
0217  E936  A4    PULSE ORP  %?00000001,APORT set OUTPUT hi
      E937  01
      E938  04
0218  E939  A4          ORP  %?10000000,CPORT set LED hi
      E93A  80
      E93B  08
```

```
0219  E93C 72          MOV  %>2F,R3          delay for 200 us pulse
      E93D 2F
      E93E 03
0220  E93F DA    PL1   DJNZ R3,PL1
      E940 03
      E941 FD
0221  E942 80          MOVP APORT,A          read PORT A
      E943 04
0222  E944 23          AND  %?00000010,A     check PATIENT DETECT
      E945 02
0223  E946 E2          JEQ  PJ1              jump to JP1 if no patient
      E947 05
0224  E948 A2          MOVP %?10000000,T2CTL0  turn on SOUNDER
      E949 80
      E94A 13
0225  E94B E0          JMP  PJ2              jump to PJ2
      E94C 03
0226  E94D A2    PJ1   MOVP %?00000000,T2CTL0  turn off SOUNDER
      E94E 00
      E94F 13
0227  E950 A3    PJ2   ANDP %?11111110,APORT   turn off OUTPUT
      E951 FE
      E952 04
0228  E953 0A          RETS                  exit PULSE subroutine
0229  E954
0230  E954
0231  E954
0232  E954
0233  E954 72    DELAY MOV  %>06,R4          Use registers R4 & 5
```

176 16

```
      E955  06
      E956  04
0234  E957  72    DL2         MOV  %>E1,R5          to create a delay of
      E958  E1
      E959  05
0235  E95A  DA    DL1         DJNZ R5,DL1           10 milliseconds
      E95B  05
      E95C  FD
0236  E95D  DA                DJNZ R4,DL2
      E95E  04
      E95F  F7
0237  E960  0A      RETS
0238  E961
0239  E961
0240  E961
0241  E961
0242  FF00        AORG >FF00
0243              TEXT ' MICROSTIM-MSDB '
      FF00  20
      FF01  4D
      FF02  49
      FF03  43
      FF04  52
      FF05  4F
      FF06  53
      FF07  54
      FF08  49
      FF09  4D
```

```
      FF0A  2D
      FF0B  4D
      FF0C  53
      FF0D  44
      FF0E  42
      FF0F  20
0244                TEXT ' Version 1.0  '
      FF10  20
      FF11  20
      FF12  56
      FF13  65
      FF14  72
      FF15  73
      FF16  69
      FF17  6F
      FF18  6E
      FF19  20
      FF1A  31
      FF1B  2E
      FF1C  30
      FF1D  20
      FF1E  20
      FF1F  20
0245                TEXT ' Colin Maxwell'
      FF20  20
      FF21  43
      FF22  6F
      FF23  6C
      FF24  69
```

Price List — Citadel Products Ltd. — April 1993

Device testing & programming

PC82 (Expro-60)	Universal Programmer (40 pin Textool)	£ 395
Expro-80	Universal Programmer (42 pin Textool)	£ 349
SAC101A	Extra interface card and cable for PC82	£ 49
PC86 (Picker 20)	Handy pocket I.C. tester, TTL, CMOS & DRAM/SRAM	£ 149

Adaptors for PC82 & Expro-80 — [To special order 3-4 weeks #]

Code	Make of Device	Description	No of Sockets	Price	
ADP-1210	Altera	EP1200/EP1210 Series	1	£ 129	
ADP-1810PGA	Altera/Texas	EP1800/1810 PGA	1	£ 149	#
ADP-1810PLCC	Altera/Texas/Intel	EP1800/1810, 5C180 PLCC	1	£ 139	
ADP-26CV12	Lattice/AMD	GAL 26CV12/B, PALCE26CV12, PALCE24CV10	1	£ 129	#
ADP-451	Signetics	87C451 PLCC	1	£ 139	
ADP-48F		8748 series MPU	1	£ 95	
ADP-51F		8751 series MPU	4	£ 95	
ADP-51GB	Intel	PLCC 87C51GB	1	£ 129	
ADP-552	Signetics	87C552 PLCC	1	£ 139	
ADP-552-QFP	Signetics	87C552	1	£ 139	
ADP-5AC324	Intel	5AC324	1	£ 129	
ADP-63705	Hitachi	HD63705V0/A05V0/B05V0	1	£ 95	#
ADP-68701	Motorola	68701U4	1	£ 129	
ADP-68705	Motorola	MC68705 Series:R3/R5,U3/U5,P3/P5	2	£ 129	
ADP-68HC705	Motorola	MC68HC705C8	1	£ 129	
ADP-68HC711	Motorola	MC68HC711K4	1	£ 129	
ADP-68HC711D3	Motorola	MC68HC711D3 40 pin DIP MPU	1	£ 129	
ADP-68HC711E9	Motorola	MC68HC711E9	1	£ 129	
ADP-751	Signetics	87C751/752	1	£ 95	
ADP-7C33X	Cypress	CY7C330/331/332. DIP & PLCC	2	£ 129	#
ADP-8796PGA	Intel	8796BH/8797BH PGA	1	£ 139	
ADP-8796PLCC	Intel	8795/96/97/196 MPU	2	£ 129	
ADP-87C96MC	Intel	87C96MC	1	£ 139	
ADP-87C196MC	Intel	87C196MC 64 pin SDIP	1	£ 139	
ADP-87C196MC-PLCC	Intel	87C196MC 84 pin PLCC	1	£ 139	
ADP-ATV 2500Y	Atmel	ATV2500	2	£ 139	#
ADP-ATV5000	Atmel	ATV5000 PLCC	1	£ 139	
ADP-CE16V8	AMD	PAL CE16V8/Q	4	£ 129	
ADP-CE20V8	AMD	PAL CE20V8H/Q	4	£ 129	
ADP-EP32		32-pin DIP 8 Bit Wide EPROM	4	£ 99	
ADP-EP32A-PLCC		PLCC EPROM 2764-27512	4	£ 139	
ADP-EP32B-PLCC		PLCC EPROM 1Mbit and over	4	£ 139	
ADP-EP40		40-pin DIP 16 Bit Wide EPROM	4	£ 129	
ADP-EP40-PLCC		PLCC EPROM Word Wide	4	£ 139	
ADP-EPM7032	Altera	44 pin PLCC EPM4032, EPS464	1	£ 129	
ADP-GAL16V8	Lattice/N.S./ST	GAL16V8/A	4	£ 129	
ADP-GAL20V8	Lattice/N.S./ST	GAL20V8/A	4	£ 129	
ADP-MACH	AMD	MACH110/210	1	£ 129	
ADP-MAPL128	N.S.	PLCC MAPL128 IC	1	£ 129	
ADP-MAPL44	N.S.	44 pin PLCC MAPL144/244 IC	1	£ 129	
ADP-MAX	Altera	EPM5016/5032	2	£ 139	
ADP-MAX50B	Altera	EPM5064 PLCC	1	£ 129	
ADP-MAX50C	Altera	EPM5128 PLCC	1	£ 139	
ADP-MB7100	Fujitsu	MB71 PROM Series	1	£ 105	#
ADP-N3001	Toshiba	EPROM N3001-008/016,THA16PO100, TC578200, KM23C4100	4	£ 185	
ADP-PALTEST		To test all popular PALs with JEDEC test vectors	1	£ 99	
ADP-NSDPAL	NS	D-type PAL	2	£ 99	
ADP-PEEL18CV8	AMI/Gould/ICT/Hyundai	PEEL18CV8	4	£ 129	
ADP-PIC16	Microchip	PIC16C54/55/56/57 (not required for Expro-80)	2	£ 129	
ADP-PLCC-51		PLCC MPU 8741/48/49/51 Series	1	£ 129	#
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ADP-PLCC-PAL		All 20 & 28 pin PLCC PALS	3	£ 129	
ADP-PLHS473	Signetics	PLHS473	1	£ 129	#
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ADP-PML2552	Signetics	PML2552 PLCC	1	£ 139	#
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ADP-RM1A		DRAM module tester: SIP-SIMM		£ 139	
ADP-TICPAL	Texas	TICPAL 16L8-55/R4-55/R6-55/R8-55	1	£ 129	
ADP-TMS320E	Texas	TMS320E25	1	£ 139	
ADP-TMS320E1	Texas	TMS 320E15/E17	1	£ 95	#
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ADP-UPD75P3XX	N.E.C.	UPD75P308/75P316 80 pin QFP	1	£ 139	#
ADP-X2212	Xicor	X2212/1/M, X2210/1/M	1	£ 80	#
ADP-Z86E08	Zilog	Z86E08	1	£ 105	

91232

EXPRO-60

Product Introduction:

EXPRO-60 is an Universal Programmer and Tester. It performs parallel communication and control through PC-Bus. EXPRO-60's functions surpass most stand-alone programmers, because it shares all sources of a PC: CPU memory, I/O, key board, display, hard disk and power supply. Its low cost is a great benefit to design engineers.
EXPRO-60's hardware circuits are composed of 40 set Pin-Driver circuits, each with TTL I/O control, D/A voltage output control, Ground control, Noise filter circuit control and OSC crystal frequency control. With such a compact circuit architecture and sound software design, EXPRO-60 can process as many as 1200 different ICs, including: EPROM, E/EPROM, Serial PROM, BPROM, MPU, PLD, EPLD, PEEL, GAL, EPL ...etc. with less than 40-Pin. Once you apply our expansion adapters or PLCC socket converters, ICs can also be processed up to 68-Pin.
EXPRO-60's software is based on SUNSHINE's long-term experience in programming and our customers' precious suggestions. Its powerful and efficient function is exceedingly user friendly. The advanced software updates enable us to undertake custom design of new devices; meanwhile, we have sent EXPRO-60s to IC makers for approval. All these prove our sincere commitment to customer service and an extraordianry software update.
EXPRO-60's software provides not only programming files but also multifunction IC test files. It can test digital ICs like TTL 74/54 series, CMOS 40/45 series, DRAM and SRAM. Furthermore, It has a PLD JEDEC VECTOR test program enabling you to set up test vectors of ICs you personally design.
This function to fully utilize the hardware circuits is superior to most other programmers.

UNIVERSAL PROGRAMMER AND TESTER

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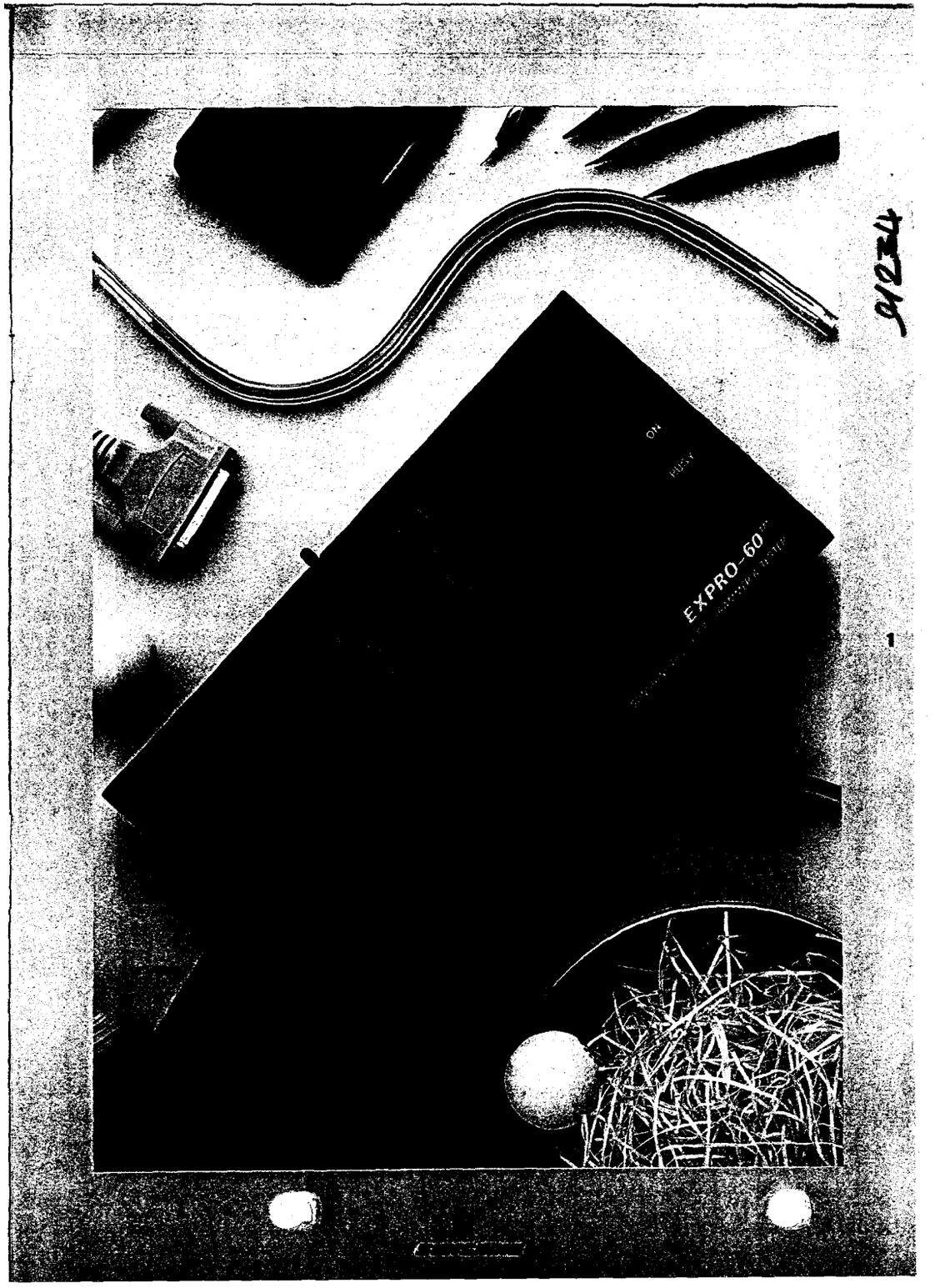
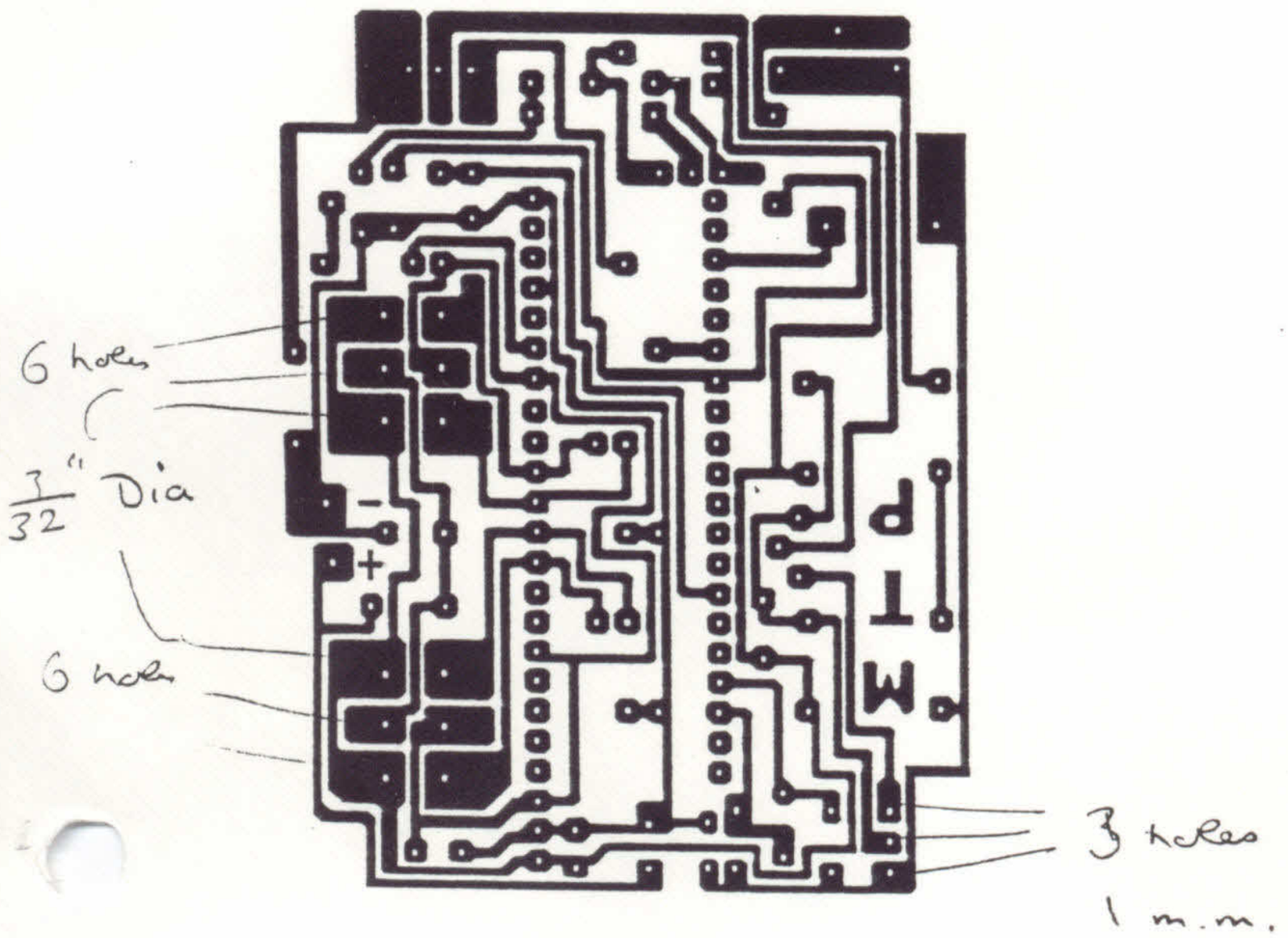
CP Citadel

PC-82





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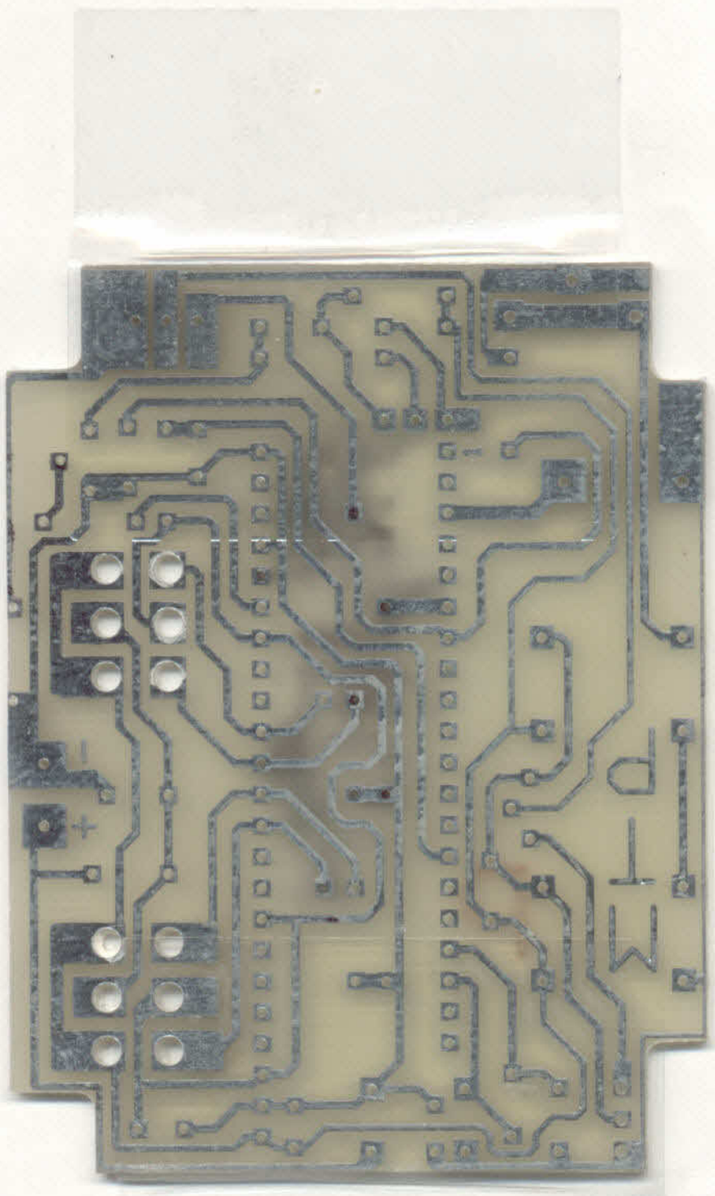
Board cut as close to tracks as possible



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Please let us know if you have any further queries.

Best Regards

Peggy Unwin

M. Unwin
DIRECTOR

P. & M. SERVICES
(Rochdale) Ltd.

ESTABLISHED 1964

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Viamed Ltd
15 Station Road
Cross Hills
Keighley
West Yorkshire
BD20 7DT

10th May 1994

For the attention of Mr John Lamb. O/N 7385

Ref. DB 11 Printed Circuit Board

Following our telephone conversation earlier today, please find enclosed sample printed circuit boards for evaluation. Due to a design error on our part we do not feel these boards are suitable for assembly. However, we would appreciate your views on the enclosed boards, which should enable the circuit to be checked out and approved.

We look forward to your early reply.

Yours sincerely

SAMPLE ONLY.

Lesley Thompson

Lesley Thompson
SALES & PROGRESS MANAGER

Dispatched 24/5/94

1225

DESIGN & DEVELOPMENT REQUEST

REQUESTED BY	POSITION
John Lamb Viamed Limited 15, Station Road Cross Hills Keighley West Yorkshire BD20 7DT	Managing Director
DATE 1st March 1999	**TELEPHONE NUMBER** 01535 634542

DESCRIPTION/SPECIFICATION/BRIEF

Modification to Microstim DB Stimulator

Introduction:

The "Mode" controller TMS77C82 used in the Microstim DB is to be withdrawn from the market in July 1999. A modification is required to introduce a replacement microcontroller.

Brief:

1. Choose replacement microcontroller.
2. Produce new programme to suite.
3. Design modification to circuit board.
4. Provide drawings for manufacture of circuit board.
5. Provide updated circuit board layout drawing for user manual.
6. Provide updated circuit diagram for user manual
7. Provide updated component list for user manual

TRIAL REQUIREMENTS

Test and validate modified Microstim DB under normal working conditions in the hospital theatre environment.

MICROSTIM DB

(PIC 16F84)

PARTS AND COMPONENTS

Part No.	Item	Description
DB 01	R1	1K RESISTOR
DB 02	R2	1K RESISTOR
DB 04	R4	10K RESISTOR
DB 05	R5	1K RESISTOR
DB 06	R6	470R RESISTOR
DB 07	R7	1K RESISTOR
DB 08	R8	1K RESISTOR
DB 09	R9	1K RESISTOR
DB 10	R10	1K RESISTOR
DB 11	R11	4K7 RESISTOR
DB 13	C2	220 uF CAPACITOR
DB 14	C3	100 uF CAPACITOR
DB 15	C4	4.7 nF CAPACITOR
DB 16	C5	220 uF CAPACITOR
DB 19	T1	TRANSFORMER
DB 20	T2	TRANSFORMER
DB 21	TR1	BC 107 TRANSISTOR
DB 22	TR2	BC 107 TRANSISTOR
DB 23	TR3	BD 131 TRANSISTOR
DB 24	TX1	AUDIO TRANSDUCER
DB 25	D1	DIODE
DB 26	D2	DIODE
DB 27	ZD1	3V9 ZENER DIODE
DB 28	ZD2	3V9 ZENER DIODE
DB 29	ZD3	3V9 ZENER DIODE
DB 30	VR1	5 VOLT REGULATOR

MICROSTIM DB

(PIC 16F84)

PARTS AND COMPONENTS

Part No.	Item	Description
DB 31	IC1	I.C. PIC 16F84
DB 32	SC1	18 PIN I.C. SOCKET
DB 33	CS1	CASE
DB 34	LB1	FRONT LABLE GREEN
DB 35	LB2	BACK LABLE
DB 36	LB3	TOP LABLE
DB 37	RV1	10K POTENTIOMETER
DB 38	S1	2 MM SOCKET BLACK
DB 39	S2	2 MM SOCKET RED
DB 40	KN1	22 mm KNOB
DB 41	XT1	4 MHZ CRYSTAL
DB 42	L1	TRI COLOUR L.E.D.
DB43	LR1	LED CLIP
DB44	SW1	SWITCH
DB45	SB1	SWITCH BEZEL
DB46	SR1	SWITCH ROCKER
DB47	SW2	SWITCH
DB48	SB2	SWITCH BEZEL
DB49	SR2	SWITCH ROCKER
DB50	PCB	PRINTED CIRCUIT BOARD
DB51	B	BATTERY
DB52	LB4	KNOB LABLE
DB53	LB5	FRONT LABLE WELCOME
DB54	SL	STIMULATOR LEADS
DB55	M	INSTRUCTION MANUAL
DB56	CCS	CARRYING CASE SOFT
DB57	CCH	CARRYING CASE HARD

Dr. Nigel J.N. Harper
MB.ChB, FRCA

Fuchsia Cottage
15 Hough Lane
Wilmslow
Cheshire SK9 2LQ

Tel/Fax: 01625.525.868
E.Mail: nigel.harper@man.ac.uk

Mr. M. Purnell

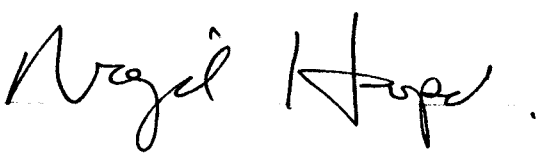
1st November 1999

Dear Malcolm,

Re: MICROSTIM upgrade

Further to our telephone conversation I can confirm that I have performed adequate clinical testing on this equipment in Operating Theatre and Intensive Care Unit environments and its performance is entirely satisfactory.

Yours sincerely,



Dr. N.J.N. Harper
Consultant Anaesthetist

RS Components UK
PO Box 99, Corby, Northants, NN17 9RS

TECHNICAL FAX

COMPANY : VIAMED,

FAX NO : 01535 635582

ATTENTION OF : MR JS LAMB

FROM : Dilip Chauhan
Customer Technical Information Services

DATE : 12 February 1999

ENQUIRY NO: 1728963

NO. OF PAGES : 1

REFERENCE NO: DCH/2519399

RE : 659-359 I.C. TMS77C82 NL

THIS IS TO CONFIRM THAT THE ABOVE IC WILL BE DISCONTINUED WHEN OUR STOCK IS EXHAUSTED. ABOUT JULY 1999.

REGARDS

DC.

MICROCHIP

PIC16C84

8-bit CMOS EERPOM Microcontroller

High Performance RISC CPU Features:

- Only 35 single word instructions to learn
- All instructions single cycle (400 ns @ 10 MHz) except for program branches which are two-cycle
- Operating speed: DC - 10 MHz clock input
  DC - 400 ns instruction cycle
- 14-bit wide instructions
- 8-bit wide data path
- 1K x 14 EEPROM program memory
- 36 x 8 general purpose registers (SRAM)
- 64 x 8 on-chip EEPROM data memory
- 15 special function hardware registers
- Eight-level deep hardware stack
- Direct, indirect and relative addressing modes
- Four interrupt sources:
  - External RB0/INT pin
  - TMR0 timer overflow
  - PORTB<7:4> interrupt on change
  - Data EEPROM write complete
- 1,000,000 data memory EEPROM ERASE/WRITE cycles
- EEPROM Data Retention > 40 years

Peripheral Features:

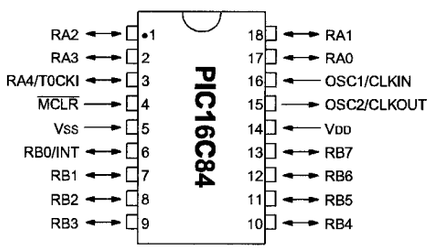
- 13 I/O pins with individual direction control
- High current sink/source for direct LED drive
  - 25 mA sink max. per pin
  - 20 mA source max. per pin
- TMR0: 8-bit timer/counter with 8-bit programmable prescaler

Special Microcontroller Features:

- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Watchdog Timer (WDT) with its own on-chip RC oscillator for reliable operation
- Code protection
- Power saving SLEEP mode
- Selectable oscillator options
- Serial In-System Programming - via two pins

Pin Diagram

PDIP, SOIC



CMOS Technology:

- Low-power, high-speed CMOS EEPROM technology
- Fully static design
- Wide operating voltage range:
  - Commercial: 2.0V to 6.0V
  - Industrial: 2.0V to 6.0V
- Low power consumption:
  - < 2 mA typical @ 5V, 4 MHz
  - 60 µA typical @ 2V, 32 kHz
  - 26 µA typical standby current @ 2V

1.0 GENERAL DESCRIPTION

The PIC16C84 is a low-cost, high-performance, CMOS, fully-static, 8-bit microcontroller.

All PIC16/17 microcontrollers employ an advanced RISC architecture. PIC16CXX devices have enhanced core features, eight-level deep stack, and multiple internal and external interrupt sources. The separate instruction and data buses of the Harvard architecture allow a 14-bit wide instruction word with a separate 8-bit wide data bus. The two stage instruction pipeline allows all instructions to execute in a single cycle, except for program branches (which require two cycles). A total of 35 instructions (reduced instruction set) are available. Additionally, a large register set is used to achieve a very high performance level.

PIC16CXX microcontrollers typically achieve a 2:1 code compression and up to a 2:1 speed improvement (at 10 MHz) over other 8-bit microcontrollers in their class.

The PIC16C84 has 36 bytes of RAM, 64 bytes of Data EEPROM memory, and 13 I/O pins. A timer/counter is also available.

The PIC16CXX family has special features to reduce external components, thus reducing cost, enhancing system reliability and reducing power consumption. There are four oscillator options, of which the single pin RC oscillator provides a low-cost solution, the LP oscillator minimizes power consumption, XT is a standard crystal, and the HS is for High Speed crystals. The SLEEP (power-down) mode offers power savings. The user can wake the chip from sleep through several external and internal interrupts and resets.

A highly reliable Watchdog Timer with its own on-chip RC oscillator provides protection against software lock-up.

The PIC16C84 EEPROM program memory allows the same device package to be used for prototyping and production. In-circuit reprogrammability allows the code to be updated without the device being removed from the end application. This is useful in the development of many applications where the device may not be easily accessible, but the prototypes may require code updates. This is also useful for remote applications where the code may need to be updated (such as rate information).

Table 1-1 lists the features of the PIC16C84. A simplified block diagram of the PIC16C84 is shown in Figure 3-1.

The PIC16C84 fits perfectly in applications ranging from high speed automotive and appliance motor control to low-power remote sensors, electronic locks, security devices and smart cards. The EEPROM technology makes customization of application programs (transmitter codes, motor speeds, receiver frequencies, security codes, etc.) extremely fast and convenient. The small footprint packages make this microcontroller series perfect for all applications with space limitations. Low cost, low power, high performance, ease of use and I/O flexibility make the PIC16C84 very versatile even in areas where no microcontroller use has been considered before (e.g., timer functions, serial communication, capture and compare, PWM functions and co-processor applications).

The serial in-system programming feature (via two pins) offers flexibility of customizing the product after complete assembly and testing. This feature can be used to serialize a product, store calibration data, or program the device with the current firmware before shipping.

1.1 Family and Upward Compatibility

Those users familiar with the PIC16C5X family of microcontrollers will realize that this is an enhanced version of the PIC16C5X architecture. Please refer to Appendix A for a detailed list of enhancements. Code written for PIC16C5X can be easily ported to the PIC16C84 (Appendix B).

1.2 Development Support

The PIC16CXX family is supported by a full-featured macro assembler, a software simulator, an in-circuit emulator, a low-cost development programmer and a full-featured programmer. A "C" compiler and fuzzy logic support tools are also available.

TABLE 1-1 PIC16C8X FAMILY OF DEVICES

		PIC16F83	PIC16CR83	PIC16F84	PIC16CR84
Clock	Maximum Frequency of Operation (MHz)	10	10	10	10
Memory	Flash Program Memory	512	—	1K	—
	EEPROM Program Memory	—	—	—	—
	ROM Program Memory	—	512	—	1K
	Data Memory (bytes)	36	36	68	68
	Data EEPROM (bytes)	64	64	64	64
Peripherals	Timer Module(s)	TMR0	TMR0	TMR0	TMR0
	Interrupt Sources	4	4	4	4
Features	I/O Pins	13	13	13	13
	Voltage Range (Volts)	2.0-6.0	2.0-6.0	2.0-6.0	2.0-6.0
	Packages	18-pin DIP, SOIC	18-pin DIP, SOIC	18-pin DIP, SOIC	18-pin DIP, SOIC

All PICmicro™ Family devices have Power-on Reset, selectable Watchdog Timer, selectable code protect and high I/O current capability. All PIC16C8X Family devices use serial programming with clock pin RB6 and data pin RB7.

2.0 PIC16C84 DEVICE VARIETIES

A variety of frequency ranges and packaging options are available. Depending on application and production requirements the proper device option can be selected using the information in this section. When placing orders, please use the "PIC16C84 Product Identification System" at the back of this data sheet to specify the correct part number.

There are two device "types" as indicated in the device number.

1. **C**, as in PIC16**C**84. These devices have EEPROM program memory and operate over the standard voltage range.
2. **LC**, as in PIC16**LC**84. These devices have EEPROM program memory and operate over an extended voltage range.

When discussing memory maps and other architectural features, the use of **C** also implies the **LC** versions.

2.1 Electrically Erasable Devices

These devices are offered in the lower cost plastic package, even though the device can be erased and reprogrammed. This allows the same device to be used for prototype development and pilot programs as well as production.

A further advantage of the electrically erasable version is that they can be erased and reprogrammed in-circuit, or by device programmers, such as Microchip's PICSTART® Plus or PRO MATE® II programmers.

3.0 ARCHITECTURAL OVERVIEW

The high performance of the PIC16CXX family can be attributed to a number of architectural features commonly found in RISC microprocessors. To begin with, the PIC16CXX uses a Harvard architecture. This architecture has the program and data accessed from separate memories. So the device has a program memory bus and a data memory bus. This improves bandwidth over traditional von Neumann architecture where program and data are fetched from the same memory (accesses over the same bus). Separating program and data memory further allows instructions to be sized differently than the 8-bit wide data word. PIC16CXX opcodes are 14-bits wide, enabling single word instructions. The full 14-bit wide program memory bus fetches a 14-bit instruction in a single cycle. A two-stage pipeline overlaps fetch and execution of instructions (Example 3-1). Consequently, all instructions execute in a single cycle (400 ns @ 10 MHz) except for program branches.

The PIC16C84 addresses 1K x 14 program memory. All program memory is internal.

PIC16CXX devices can directly or indirectly address its register files or data memory. All special function registers including the program counter are mapped in the data memory. An orthogonal (symmetrical) instruction set that makes it possible to carry out any operation on any register using any addressing mode. This symmetrical nature and lack of 'special optimal situations' make programming with the PIC16CXX simple yet efficient. In addition, the learning curve is reduced significantly.

The PIC16C84 has 36 x 8 SRAM and 64 x 8 EEPROM data memory.

PIC16CXX devices contain an 8-bit ALU and working register. The ALU is a general purpose arithmetic unit. It performs arithmetic and Boolean functions between data in the working register and any register file.

The ALU is 8-bits wide and capable of addition, subtraction, shift and logical operations. Unless otherwise mentioned, arithmetic operations are two's complement in nature. In two-operand instructions, typically one operand is the working register (W register), and the other operand is a file register or an immediate constant. In single operand instructions, the operand is either the W register or a file register.

The W register is an 8-bit working register used for ALU operations. It is not an addressable register.

Depending on the instruction executed, the ALU may affect the values of the Carry (C), Digit Carry (DC), and Zero (Z) bits in the STATUS register. The C and DC bits operate as a $\overline{\text{borrow}}$ and $\overline{\text{digit borrow}}$ out bit, respectively, in subtraction. See the SUBLW and SUBWF instructions for examples.

A simplified block diagram for the PIC16C84 is shown in Figure 3-1, its corresponding pin description is shown in Table 3-1.

FIGURE 3-1: PIC16C84 BLOCK DIAGRAM

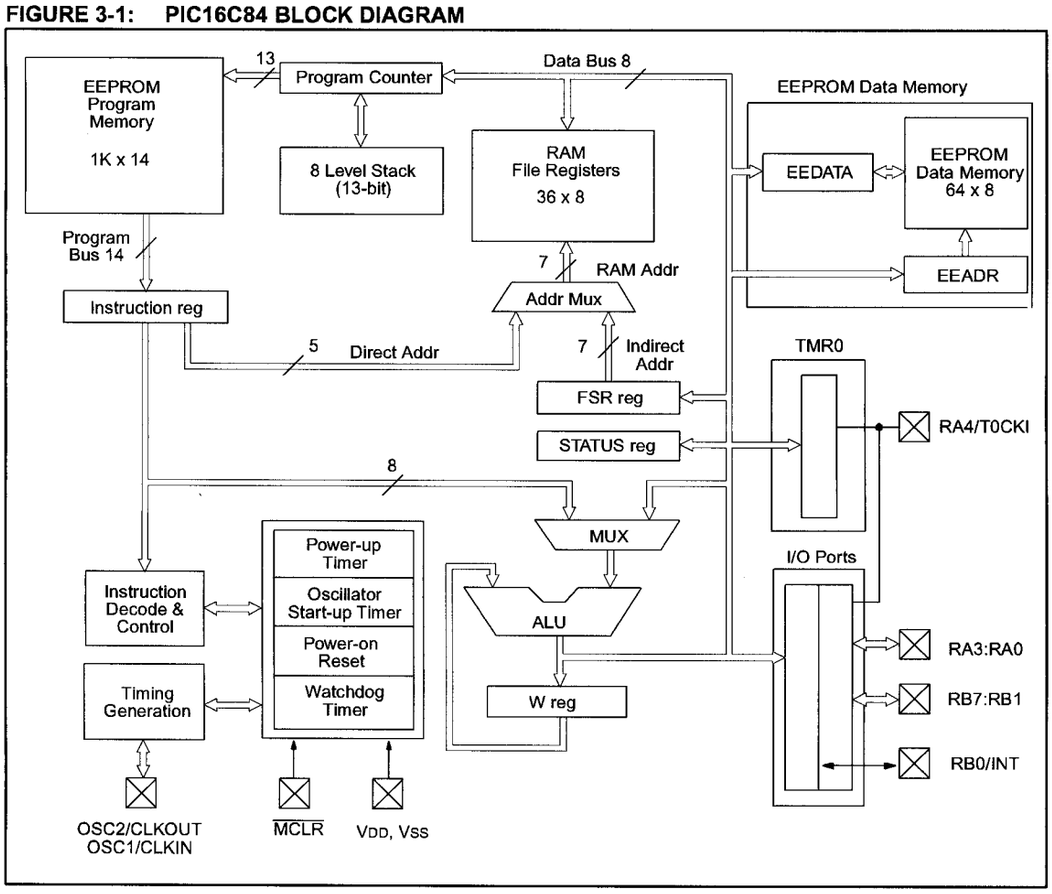


TABLE 3-1 PIC16C8X PINOUT DESCRIPTION

Pin Name	DIP No.	SOIC No.	I/O/P Type	Buffer Type	Description
OSC1/CLKIN	16	16	I	ST/CMOS (1)	Oscillator crystal input/external clock source input.
OSC2/CLKOUT	15	15	O	—	Oscillator crystal output. Connects to crystal or resonator in crystal oscillator mode. In RC mode, OSC2 pin outputs CLKOUT which has 1/4 the frequency of OSC1, and denotes the instruction cycle rate.
$\overline{MCLR}$	4	4	I/P	ST	Master clear (reset) input/programming voltage input. This pin is an active low reset to the device.
					PORTA is a bi-directional I/O port.
RA0	17	17	I/O	TTL	
RA1	18	18	I/O	TTL	
RA2	1	1	I/O	TTL	
RA3	2	2	I/O	TTL	
RA4/T0CKI	3	3	I/O	ST	Can also be selected to be the clock input to the TMR0 timer/counter. Output is open drain type.
					PORTB is a bi-directional I/O port. PORTB can be software programmed for internal weak pull-up on all inputs.
RB0/INT	6	6	I/O	TTL	RB0/INT can also be selected as an external interrupt pin.
RB1	7	7	I/O	TTL	
RB2	8	8	I/O	TTL	
RB3	9	9	I/O	TTL	
RB4	10	10	I/O	TTL	Interrupt on change pin.
RB5	11	11	I/O	TTL	Interrupt on change pin.
RB6	12	12	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming clock.
RB7	13	13	I/O	TTL/ST (2)	Interrupt on change pin. Serial programming data.
VSS	5	5	P	—	Ground reference for logic and I/O pins.
VDD	14	14	P	—	Positive supply for logic and I/O pins.

Legend: I= input O = output I/O = Input/Output P = power
— = Not used TTL = TTL input ST = Schmitt Trigger input

Note 1: This buffer is a Schmitt Trigger input when configured in RC oscillator mode and a CMOS input otherwise.
2: This buffer is a Schmitt Trigger input when used in serial programming mode.

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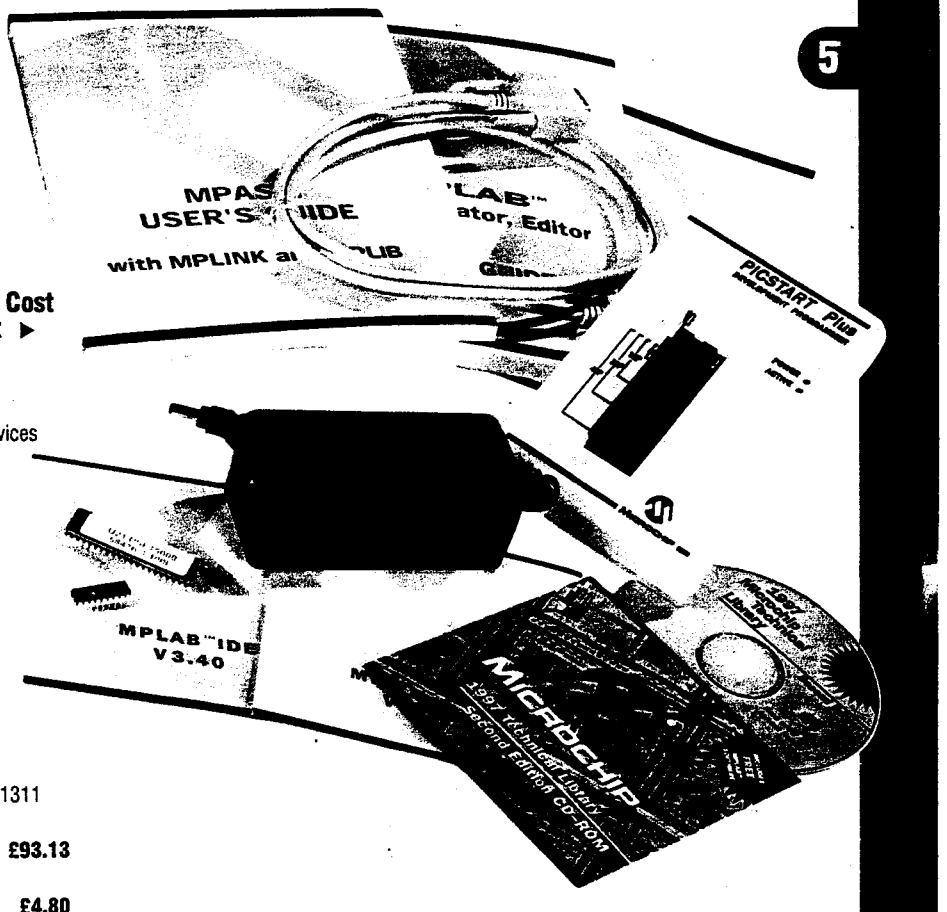


PICSTART Plus -Low Cost PIC Development Kit ▶

- ◆ Provides a highly flexible low cost microcontroller design tool for all PIC 8-bit one-time-programmable devices (DIL packs up to 40 pin)
- ◆ Allows the user to write, develop and de-bug programmes
- ◆ Supplied with software and cables to operate on a PC running Windows 3.1 or '95
- ◆ Full Microchip documentation supplied on CD.You will need to buy a standard IEC style mains lead for the power supply. Electronics catalogue page 1311

Development Kit
728-9753 **£93.13**

Mains lead
152-575 **£4.80**

ou get **far more** from **Farnell**

```
C  OBJECT CODE     LINE SOURCE TEXT
VALUE

                   00001 ;//================================================================
                   00002 ;//
                   00003 ;// msdb.asm    (PIC 16x84)
                   00004 ;//
                   00005 ;//================================================================
                   00006
00000000           00007 INDIR    equ     H'00'
00000001           00008 RTCC     equ     H'01'
00000002           00009 PCL      equ     H'02'                    ; Program counter low byte
00000003           00010 STATUS   equ     H'03'                    ; Status register
00000000           00011 CY       equ     H'0'                     ; Carry / borrow bit
00000001           00012 DC       equ     H'1'                     ; Digit carry
00000002           00013 Z        equ     H'2'                     ; Zero flag
00000003           00014 PD       equ     H'3'                     ; Power down
00000004           00015 T0       equ     H'4'                     ; Time-out bit
00000005           00016 RP0      equ     H'5'                     ; Register page select bits
00000006           00017 RP1      equ     H'6'                     ; Not used in 16C84
00000007           00018 RP2      equ     H'7'                     ; Not used in 16C84
00000004           00019 FSR      equ     H'4'                     ; Indirect pointer
00000001           00020 OPTREG   equ     H'1'                     ; OPTION register
00000005           00021 PORTA    equ     H'5'                     ; PORT A
00000006           00022 PORTB    equ     H'6'                     ; PORT B
00000008           00023 EEDATA   equ     H'8'                     ; Eeprom data
00000009           00024 EEADR    equ     H'9'                     ; Eeprom address
0000000A           00025 PCLATH   equ     H'A'                     ; Program counter high byte
0000000B           00026 INTCON   equ     H'B'                     ; Interrupt control
00000085           00027 TRISA    equ     H'85'                    ; Data direction port A
00000086           00028 TRISB    equ     H'86'                    ; Data direction port B
00000088           00029 EECON1   equ     H'88'                    ; Eeprom control
00000000           00030 W        equ     H'0'                     ; W reg. as destination
00000001           00031 F        equ     H'1'                     ; F file as destination
                   00032 ;
00000000           00033 LED      equ     H'0'                     ;  RA0...Led
00000002           00034 SNDR     equ     H'2'                     ;  RB2...sounder output
00000003           00035 OUTPUT   equ     H'3'                     ;  RB3...output pin
00000002           00036 FBACK    equ     H'2'                     ;  RA2...patient feedback
                   00037
                   00038
                   00039
                   00040
00                 00041          org     H'0000'
00 1283            00042          bcf     3, 5
01 0186            00043          clrf    PORTB
02 0185            00044          clrf    PORTA
03 1683            00045          bsf     STATUS , 5
04 3004            00046          movlw   4
05 0085            00047          movwf   PORTA
06 30F0            00048          movlw   H'F0'
07 0086            00049          movwf   PORTB
08 1283            00050          bcf     STATUS , 5
09 0806            00051 go       movf    PORTB,0
0A 39F0            00052          andlw   H'F0'                    ;isolate switches
0B 009F            00053          movwf   H'1F'
0C 081F            00054          movf    H'1F',0
0D 3C40            00055          sublw   H'40'
0E 1903            00056          btfsc   STATUS,Z
0F 281D            00057          goto    tof
10 081F            00058          movf    H'1F',0
```

```
11 3C80           00059          sublw   H'80'
12 1903           00060          btfsc   STATUS,Z
13 2822           00061          goto    dbs
14 081F           00062          movf    H'1F',0
15 3C10           00063          sublw   H'10'
16 1903           00064          btfsc   STATUS,Z
17 2834           00065          goto    ptc
18 081F           00066          movf    H'1F',0
19 3C20           00067          sublw   H'20'
1A 1903           00068          btfsc   STATUS,Z
1B 2849           00069          goto    onehz
1C 2809           00070          goto    go
                  00071 ;
                  00072 ;
1D 2058           00073 tof      call    _2hz
1E 2058           00074          call    _2hz
1F 2058           00075          call    _2hz
20 2058           00076          call    _2hz
21                00077 tofdone
21 2821           00078          goto tofdone
                  00079 ;
                  00080 ;
22 2067           00081 dbs      call    _50hz
23 2067           00082          call    _50hz
24 2067           00083          call    _50hz
25 3004           00084          movlw   H'04'
26 009A           00085          movwf   H'1A'
27 30F4           00086 dbsl3    movlw   H'F4'
28 009B           00087          movwf   H'1B'
29 30FF           00088 dbsl2    movlw   H'FF'
2A 009C           00089          movwf   H'1C'
2B 0B9C           00090 dbsl1    decfsz  H'1C',1
2C 282B           00091          goto    dbsl1
2D 0B9B           00092          decfsz  H'1B',1
2E 2829           00093          goto    dbsl2
2F 0B9A           00094          decfsz  H'1A',1
30 2827           00095          goto    dbsl3
31 2067           00096          call    _50hz
32 2067           00097          call    _50hz
33                00098 dbsdone
33 2833           00099          goto    dbsdone
                  00100 ;
                  00101 ;
34 30FB           00102 ptc      movlw   H'FB'
35 0095           00103          movwf   H'15'
36 2067           00104 ptc1     call    _50hz
37 0B95           00105          decfsz  H'15',1
38 2836           00106          goto    ptc1
39 1485           00107          bsf     PORTA,1
3A 3011           00108          movlw   H'11'
3B 00A9           00109          movwf   H'29'
3C 30E6           00110 ptcl3    movlw   H'E6'
3D 00A8           00111          movwf   H'28'
3E 30FF           00112 ptcl2    movlw   H'FF'
3F 00A7           00113          movwf   H'27'
40 0BA7           00114 ptcl1    decfsz  H'27',1
41 2840           00115          goto    ptcl1
42 0BA8           00116          decfsz  H'28',1
43 283E           00117          goto    ptcl2
44 0BA9           00118          decfsz  H'29',1
45 283C           00119          goto    ptcl3
46 1085           00120          bcf     PORTA,1
47 204B           00121 ptc2     call    _1hz
48 2847           00122          goto    ptc2
```

```
                00123 ;
                00124 ;
49 204B         00125 onehz   call    _1hz
4A 2849         00126         goto    onehz
                00127 ;
                00128 ;
4B 2069         00129 _1hz    call    pulse
4C 3005         00130         movlw   H'05'
4D 0096         00131         movwf   H'16'
4E 0197         00132 do3     clrf    H'17'
4F 30FE         00133 do2     movlw   H'FE'
50 0098         00134         Movwf   H'18'
51 0B98         00135 do1     decfsz  H'18',1
52 2851         00136         goto    do1
53 0B97         00137         decfsz  H'17',1
54 284F         00138         goto    do2
55 0B96         00139         decfsz  H'16',1
56 284E         00140         goto    do3
57 0008         00141         return
                00142 ;
                00143 ;
58 2069         00144 _2hz    call    pulse
59 3005         00145         movlw   H'05'
5A 0096         00146         movwf   H'16'
5B 0197         00147 dt3     clrf    H'17'
5C 307C         00148 dt2     movlw   H'7C'
5D 0098         00149         Movwf   H'18'
5E 0B98         00150 dt1     decfsz  H'18',1
5F 285E         00151         goto    dt1
60 0B97         00152         decfsz  H'17',1
61 285C         00153         goto    dt2
62 0B96         00154         decfsz  H'16',1
63 285B         00155         goto    dt3
64 3005         00156         movlw   H'05'
65 0096         00157         movwf   H'16'
66 0008         00158         return
                00159 ;
                00160 ;
67 2069         00161 _50hz   call    pulse
68 0008         00162         return
                00163 ;
                00164 ;
69 1106         00165 pulse   bcf     PORTB,SNDR
6A 1586         00166         bsf     PORTB,OUTPUT
6B 1405         00167         bsf     PORTA, LED
6C 3021         00168         movlw   H'21'
6D 00A0         00169         movwf   H'20'
6E 0BA0         00170 l1      decfsz  H'20', 1
6F 286E         00171         goto    l1
70 1D05         00172         btfss   PORTA,2                 ;read patient
71 288D         00173         goto    pns
72 3020         00174 pws     movlw   H'20'
73 00A0         00175         movwf   H'20'                   ;20 for 200 microseconds
74 0BA0         00176 l2      decfsz  H'20', 1
75 2874         00177         goto    l2
76 1186         00178         bcf     PORTB,OUTPUT
77 304D         00179         movlw   H'4D'                   ;number of beeps
78 00A3         00180         movwf   H'23'
79 3004         00181 lp1     movlw   H'04'
7A 0686         00182         xorwf   PORTB,  1
7B 3028         00183         movlw   H'28'                   ;frequency
7C 00A2         00184         movwf   H'22'
7D 0BA2         00185 lp2     decfsz  H'22',1
7E 287D         00186         goto    lp2
```

```
7F 0BA3           00187          decfsz  H'23',1
80 2879           00188          goto    lp1
                  00189 ;
81 1005           00190          bcf     PORTA,LED               ;led off
                  00191 ;
82 302D           00192          movlw   H'2D'                   ;number of beeps
83 00A3           00193          movwf   H'23'
84 3004           00194 lp3      movlw   H'04'
rning[202]: Argument out of range.  Least significant bits used.
85 0606           00195          xorwf   PORTB,  SNDR
86 3048           00196          movlw   H'48'                   ;frequency
87 00A2           00197          movwf   H'22'
88 0BA2           00198 lp4      decfsz  H'22',1
89 2888           00199          goto    lp4
8A 0BA3           00200          decfsz  H'23',1
8B 2884           00201          goto    lp3
8C 0008           00202          return
                  00203 ;
                  00204 ;
8D 3020           00205 pns      movlw   H'20'
8E 00A0           00206          movwf   H'20'                   ;20 for 200 microseconds
8F 0BA0           00207 lx2      decfsz  H'20', 1
90 288F           00208          goto    lx2
91 1186           00209          bcf     PORTB,OUTPUT
92 304D           00210          movlw   H'4D'                   ;number of beeps
93 00A3           00211          movwf   H'23'
94 3004           00212 lpx1     movlw   H'04'
rning[202]: Argument out of range.  Least significant bits used.
95 0606           00213          xorwf   PORTB,  SNDR;
96 3028           00214          movlw   H'28'                   ;frequency
97 00A2           00215          movwf   H'22'
98 0BA2           00216 lpx2     decfsz  H'22',1
99 2898           00217          goto    lpx2
9A 0BA3           00218          decfsz  H'23',1
9B 2894           00219          goto    lpx1
                  00220 ;
9C 1005           00221          bcf     PORTA,LED               ;led off
                  00222 ;
9D 302D           00223          movlw   H'2D'                   ;number of beeps
9E 00A3           00224          movwf   H'23'
9F 3004           00225 lpx3     movlw   H'04'
A0 1086           00226          bcf     PORTB,  1
A1 3048           00227          movlw   H'48'                   ;frequency
A2 00A2           00228          movwf   H'22'
A3 0BA2           00229 lpx4     decfsz  H'22',1
A4 28A3           00230          goto    lpx4
A5 0BA3           00231          decfsz  H'23',1
A6 289F           00232          goto    lpx3;
A7 0008           00233          return
                  00234          end
```

MBOL TABLE

LABEL	VALUE
	00000000
	00000001
ADR	00000009
CON1	00000088
DATA	00000008
	00000001
ACK	00000002
R	00000004

```
DIR                             00000000
TCON                            0000000B
D                               00000000
TREG                            00000001
TPUT                            00000003
L                               00000002
LATH                            0000000A
                                00000003
RTA                             00000005
RTB                             00000006
0                               00000005
1                               00000006
2                               00000007
CC                              00000001
DR                              00000002
ATUS                            00000003
                                00000004
ISA                             00000085
ISB                             00000086
                                00000000
                                00000002
hz                              0000004B
hz                              00000058
0hz                             00000067
16C84                           00000001
s                               00000022
sdone                           00000033
sl1                             0000002B
sl2                             00000029
sl3                             00000027
1                               00000051
2                               0000004F
3                               0000004E
1                               0000005E
2                               0000005C
3                               0000005B
                                00000009
                                0000006E
                                00000074
1                               00000079
2                               0000007D
3                               00000084
4                               00000088
x1                              00000094
x2                              00000098
x3                              0000009F
x4                              000000A3
2                               0000008F
ehz                             00000049
s                               0000008D
c                               00000034
c1                              00000036
c2                              00000047
cl1                             00000040
cl2                             0000003E
cl3                             0000003C
lse                             00000069
s                               00000072
f                               0000001D
fdone                           00000021


MORY USAGE MAP ('X' = Used,  '-' = Unused)
```

```
00 : XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
40 : XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX
80 : XXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXX XXXXXXXX-------- ----------------

1 other memory blocks unused.

ogram Memory Words Used:   168
ogram Memory Words Free:   856


rors   :     0
rnings :     2 reported,     0 suppressed
ssages :     0 reported,     0 suppressed
```

M Purnell
28, Edinburgh Road
Little Lever
Bolton
BL3 1TG

Mr J Lamb
Viamed Ltd

Dear John,

Please find enclosed the layout for the new circuit board. Could you please proceed with arranging a prototype to be made.

PLEASE NOTE:

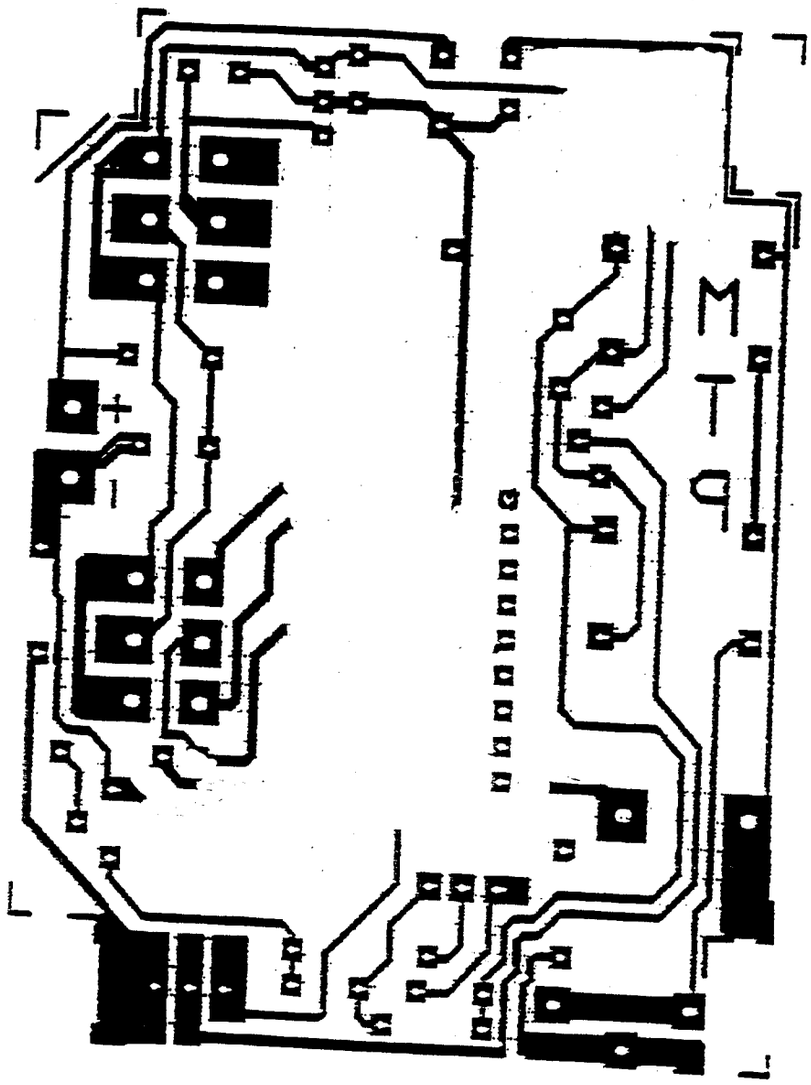
1. The new circuit board is based on the original. Some tracks and components have been removed and new ones put in place.

2. There are two components which have changed position. The transistor marked XX on the board layout has been moved and the holes marked YY for the intensity pot have been moved forward by 1mm. I mention this because both these components have larger holes than the other components (see original layout).

The manufacturer should find enough information to modify the old design.

Regards,

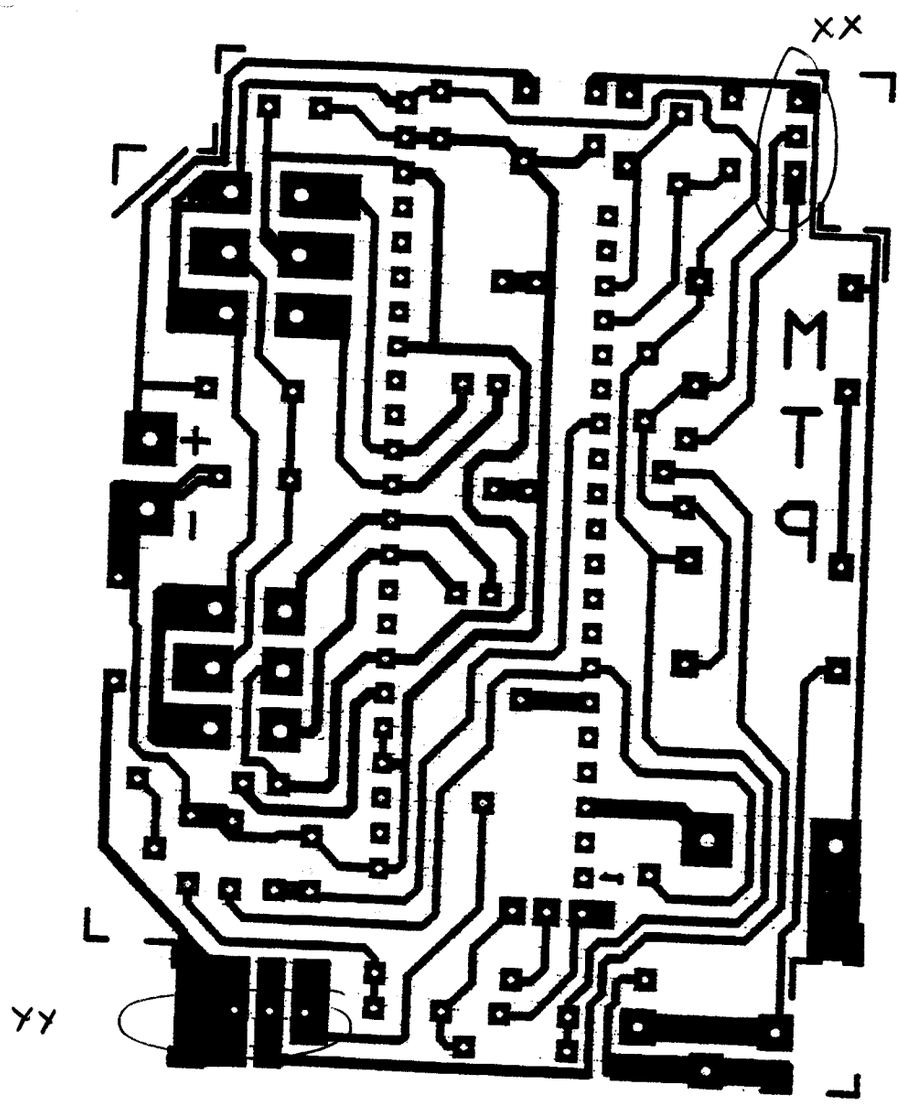
Malcolm Purnell



Viewed from Component side of Board.

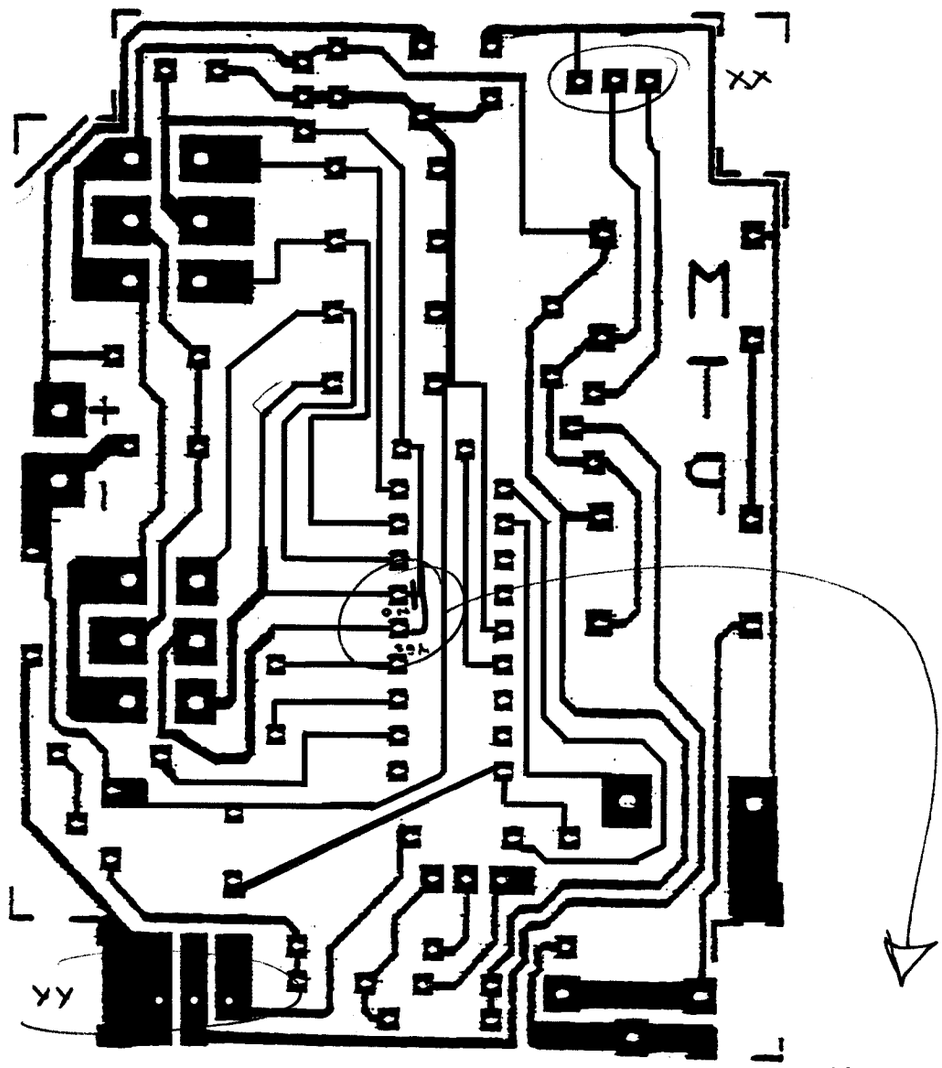
REMOVED AREA

CCJSL

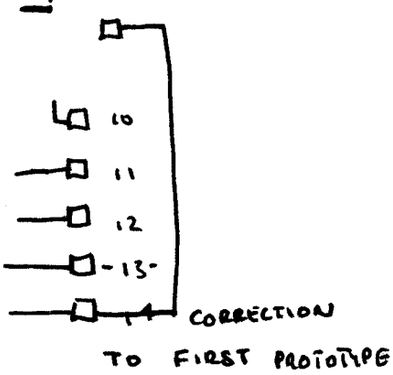


Viewed from Component side of Board.

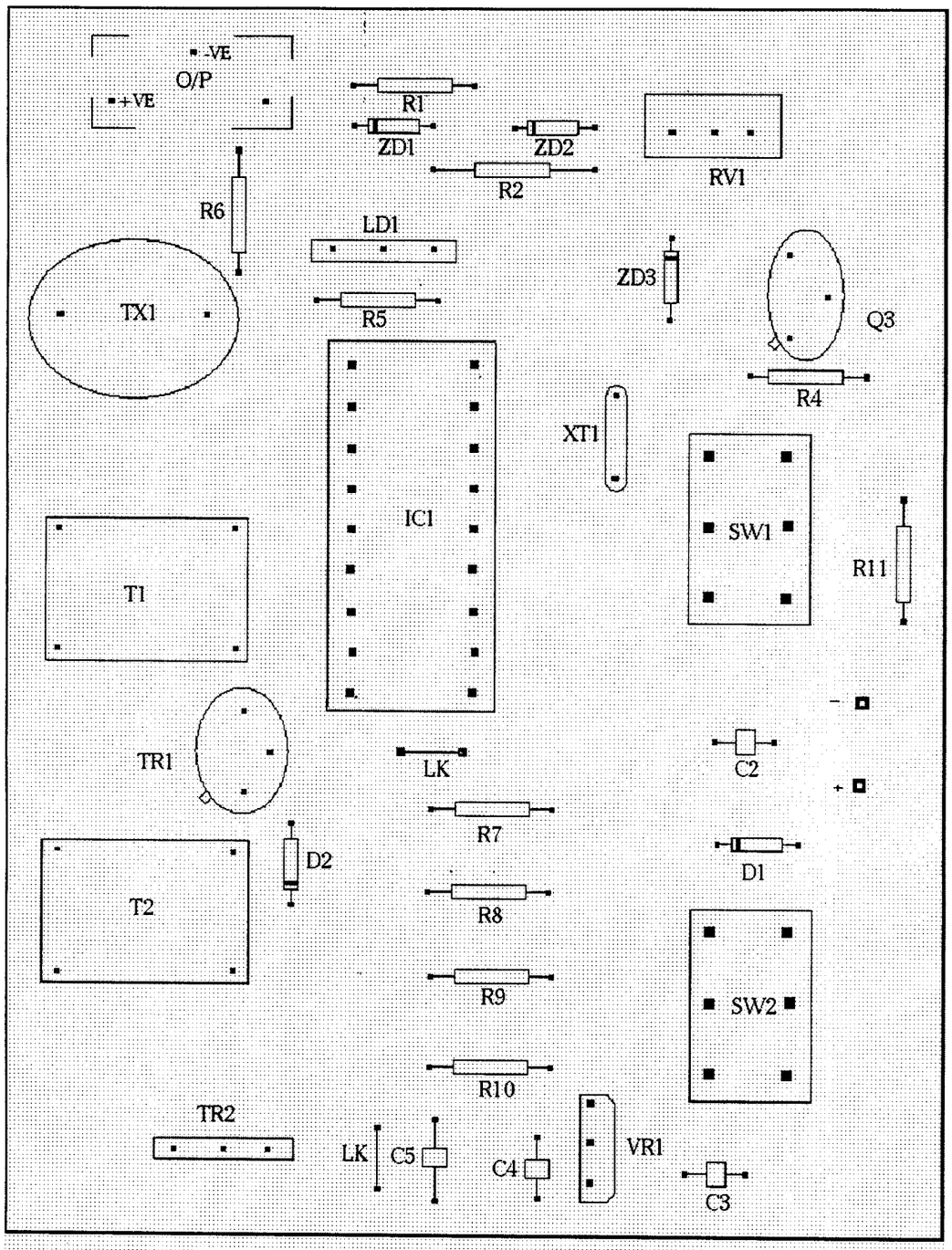
OLD



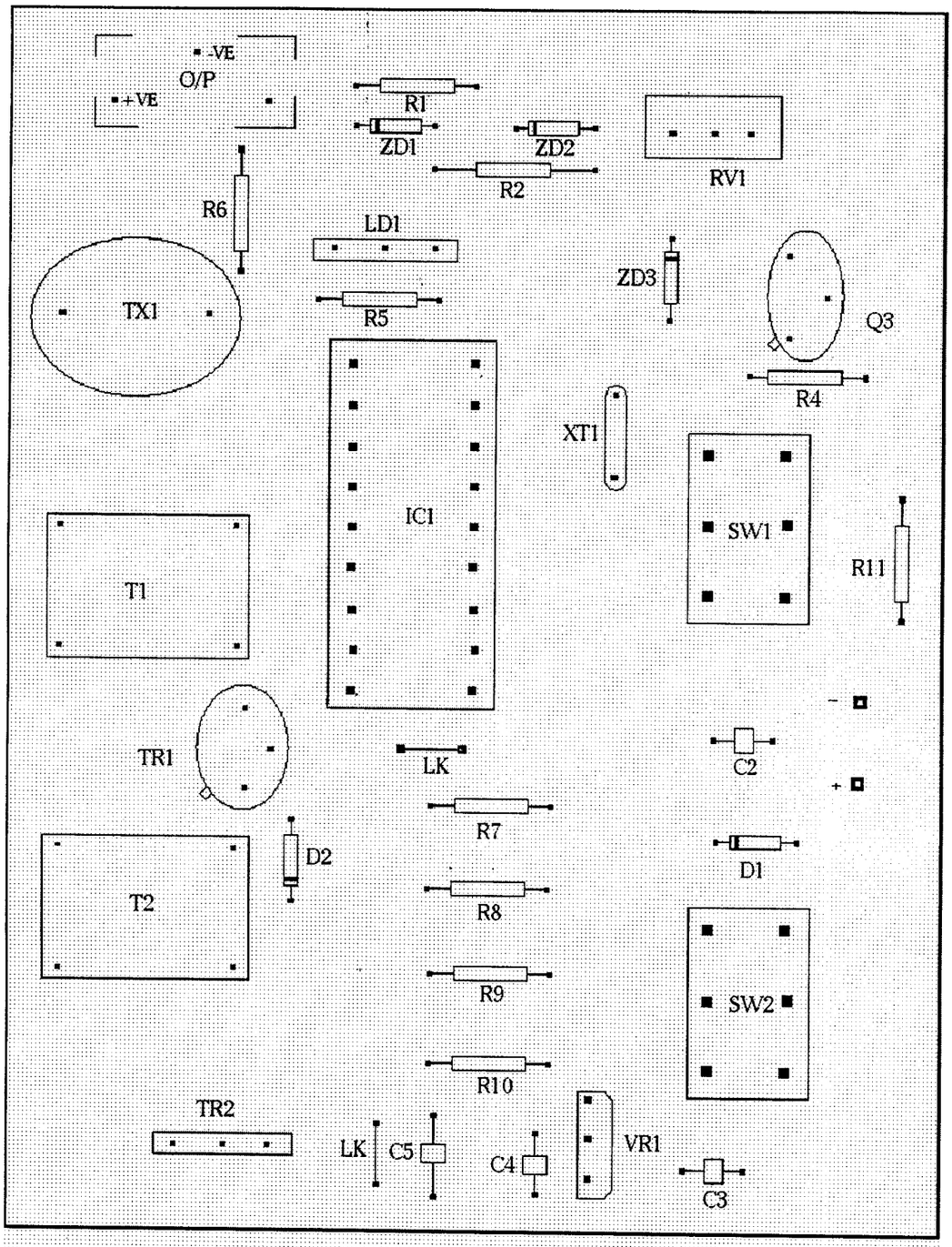
NEW



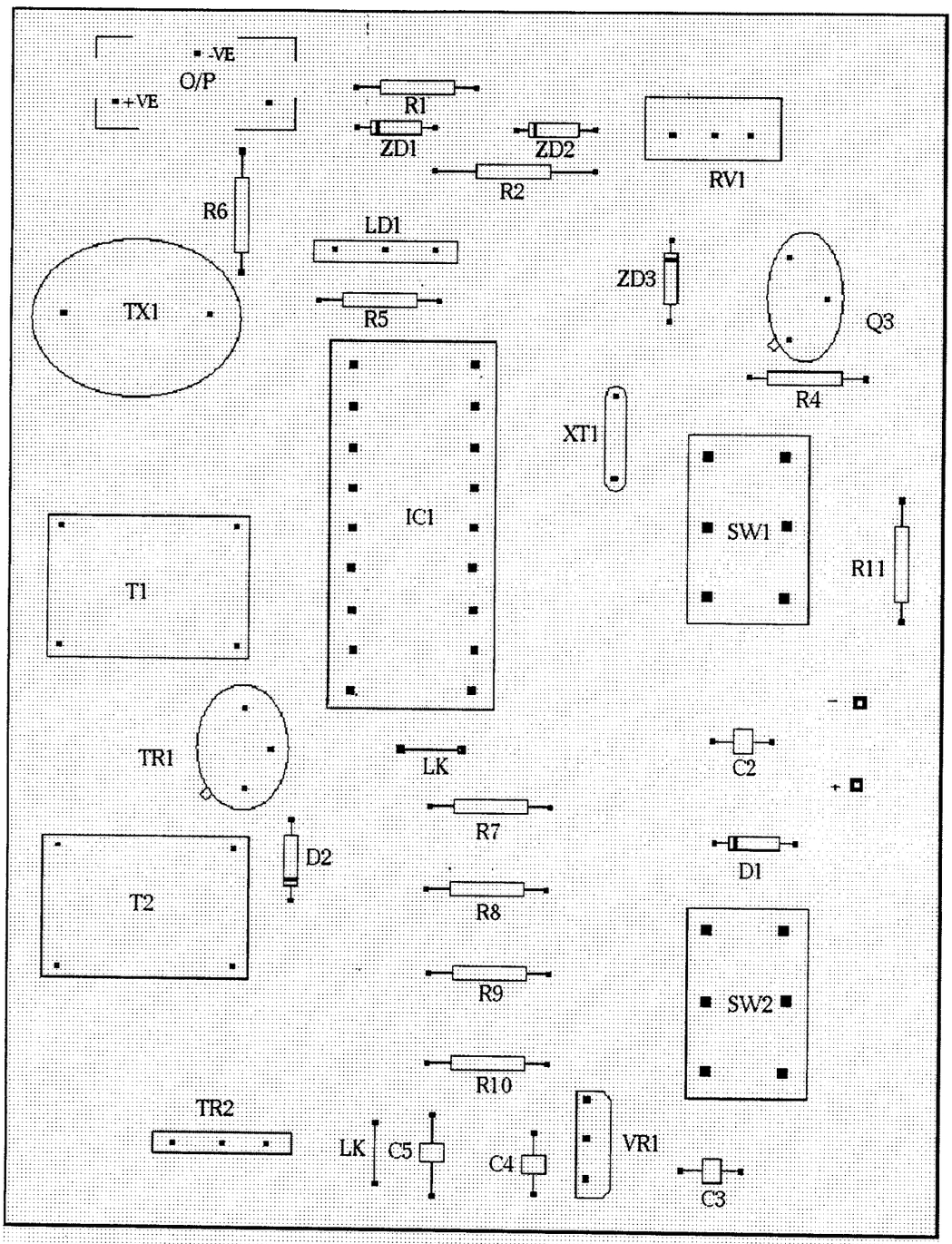
COMPONENT SIDE



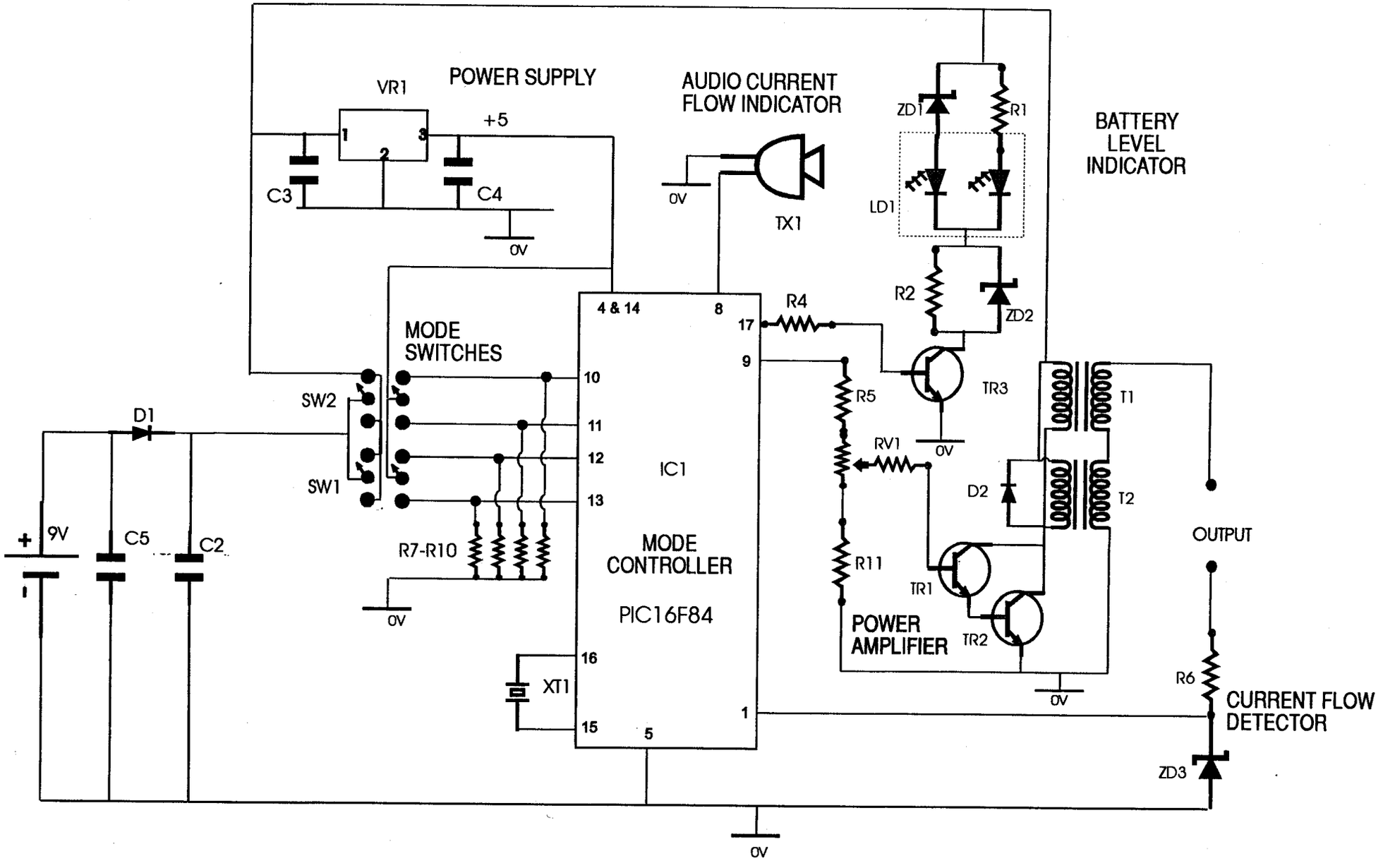
MICROSTIM DB COMPONENT LAYOUT (PIC 16F84)



MICROSTIM DB COMPONENT LAYOUT (PIC 16F84)



MICROSTIM DB COMPONENT LAYOUT (PIC 16F84)



MICROSTIM DB

ESTIMATED COST SAVINGS

- REPLACEMENT COMPONENT PARTS FOR MICROSTIM DB MODIFIED BOARD LAYOUT –

PART NO.	DESCRIPTION	COST (Using Microstim DBS price list May 1995)	REPLACEMENT PART (Using Farnell catalogue April 1999)	FARNELL PART NUMBER	FARNELL ONE OFF PRICE	ESTIMATED SAVING
		£			£	
DB03	10K resistor	0.02	Not Required		0.00	
DB12	0.33uF capacitor	0.84	Not Required		0.00	
DB17	12pF capacitor	0.07	Not Required		0.00	
DB18	12pF capacitor	0.07	Not Required		0.00	
DB41	6 MHz crystal	0.77	4 MHz crystal	492-917	0.57	
DB32	40 pin IC socket	0.85	18 pin IC socket	877-372	0.24	
DB31	IC TMS77C82	9.92	IC PIC 16F84	789-586	3.47	
		£12.54			***£4.28***	***£8.26***

VIAMED

Project Validation

Project Microstim DB v2

	Subject	Y/N	Comments
1	Does the finished product meet the original specification	Y	
2	Is the quality of construction satisfactory	Y	
3	Will the equipment be durable	Y	
4	Does it comply with the safety standards	Y	
5	Does it comply with the MDD	Y	
6	Has the project remained in budget	Y	
7	Can the project be improved	?	
8	Can the product be extended	Y	
Date	**26 November 1999**		**QC30**

M. Purnell
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BL3 1TG
Tel: 01204 792295

Mr J Lamb
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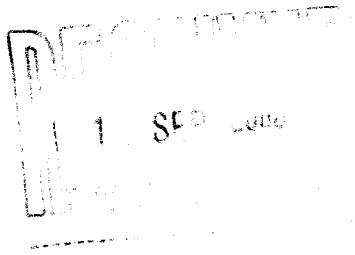
15, Station Road
Cross Hills
Keighley
West Yorkshire
BD20 7DT



Dear John,

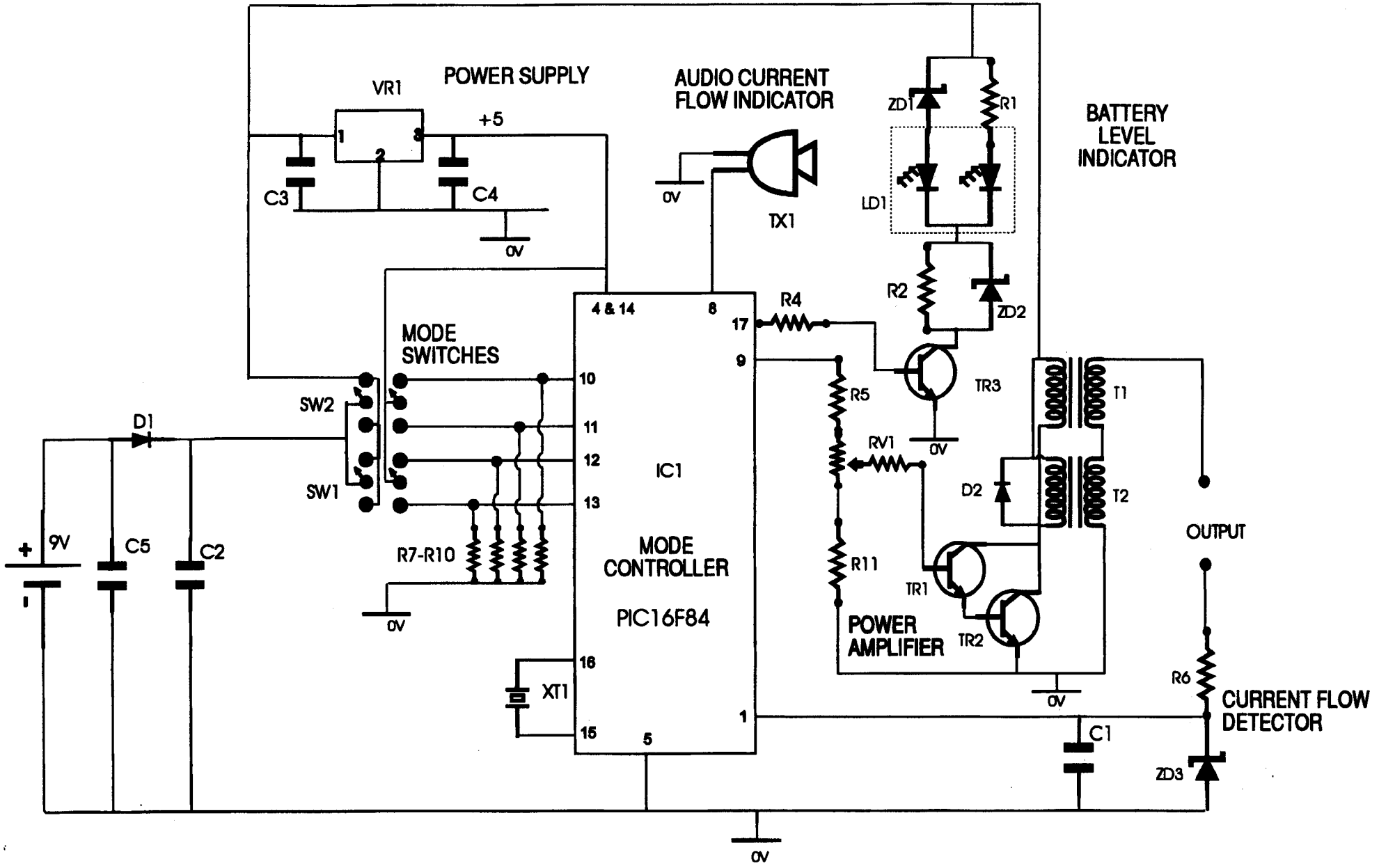
please find enclosed details of a minor addition to the Microstim DB. The prototypes did not exhibit a phenomenon which appeared on production and can be attributed to different chips having slightly different sensitivities.

Audio occurs by feeding back a fraction of the output pulse across a 3.9V zener diode in series with the patient. I.e. no patient load - no feedback and hence no audio. However, it was noted that a minority of stimulators produced an audio noise although the device was open circuit. Investigation showed that an open circuit spike was enough to trigger the audio input. A small capacitor 4.7nF, the same value as C4 (DB15), was placed across the zener diode and the problem disappeared. Both the first and the second batch of 25 (under completion) have had the capacitor added by soldering it onto the back of the circuit board. Although it looks perfectly professional, if you thought necessary, a small modification could be done to the circuit board when a new batch of boards is ordered from the suppliers. The addition is not a product change as all production has the capacitor. The only change is an additional capacitor (C1) on the circuit diagram.

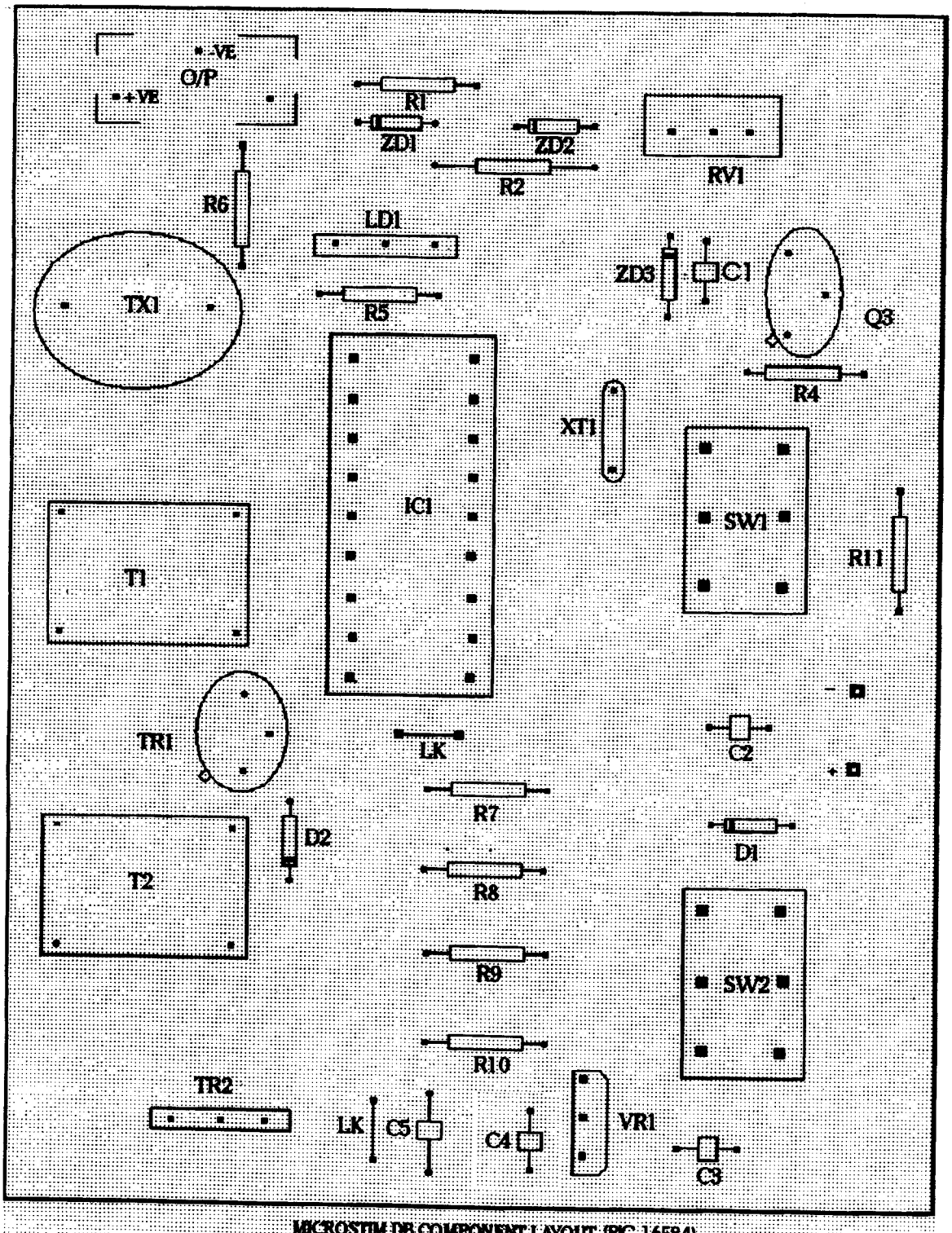
Enclosed is the modified circuit diagram and layout together with a photo of the present location of the capacitor. A proposed modification to the circuit board which is two pads next to the zener diode is also enclosed if required.

Regards,

M. Purnell



MICROSTIM DB



MICROSTIM DB COMPONENT LAYOUT (PIC 16F84)