QEP3 Service Manual

By
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Corrected and Updated March 2016
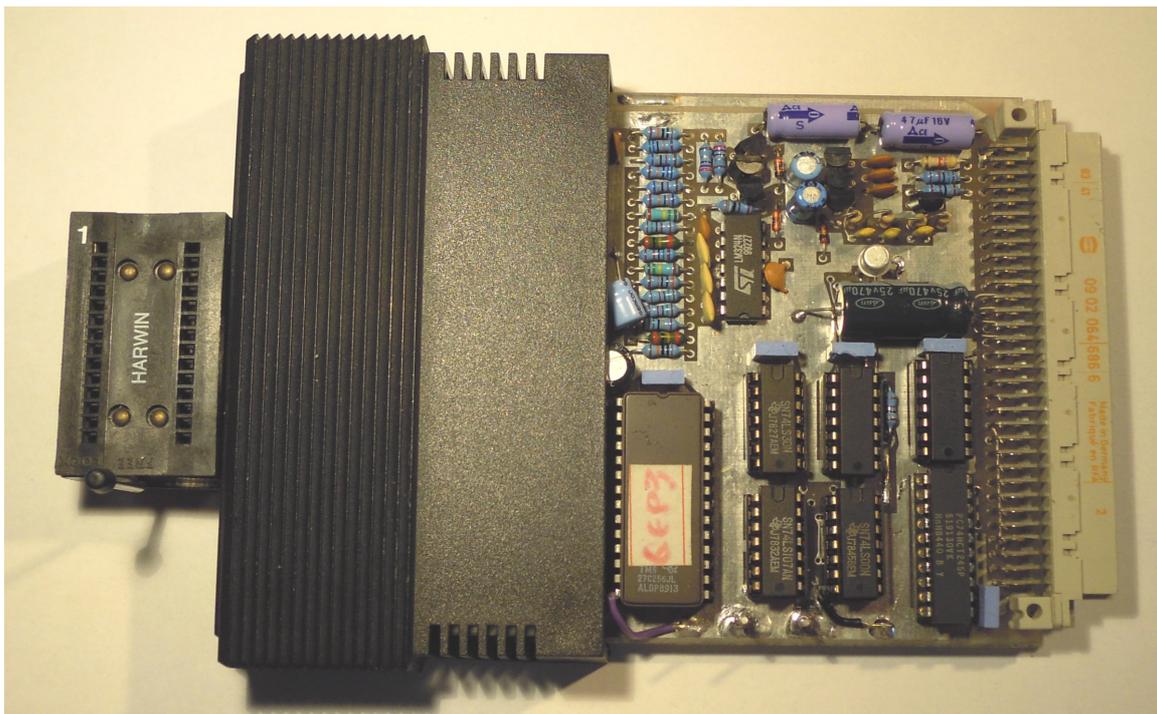
Contents

Introduction

This manual is the result of my investigations after I found my own card had developed a fault. As a result I traced the PCB, which was not easy. But did lead me to a fuller understanding of how this card works.

This manual is designed for people who have some understanding of electronics. If you are unsure then do not attempt to repair your own card, you may do more damage than good. I cannot give 100% guarantee that my work in reverse engineering this card is 100% accurate. But I believe it is not far off. I did get my card card working again.

This manual is provided for guidance only. All errors and omissions are entirely mine. Also any work that you may carry out on your card is entirely at your own risk. No guarantees are provided. Any copyright remains with Care Electronics and/or QUBBESoft P/D

Please also note this quality of the PCB reflects the time in which it was manufactured. Tracks lift ever so easy, so great care is need in replacing any of the none socketed components. The PCB holes are plated though, so do check continuity after carrying out any repair.

Another warning, sorry. DO NOT adjust either of the two pot's unless you have to. These are the two blue devices on the edge of the card next top the Eprom programming socket. Two things could happen, one the 5V supply voltage on the card could go to high and damage chips second your may not be able to blow eproms. I will go into this further later. Not having the original set up information can make this difficult to set correctly.

Warnings and disclaimers now out of the way.

The QEP3 card was originally produced and sold by Care Electronics and in later years was sold by QUBBESoft P/D.

So what is the QEP3 card. It is a Eprom Programmer which plugs into the expansion socket (J1) of a Black Box QL. It can program a limited range of Eprom's.

Eprom Types supported are as follows:-

        2516
        2716
        2732
        2532
        2764
        2564
        27128
        27256
        27512

Do read the User Manual for more user information.

What follows is a block diagram and circuit diagram (3 pages of !) and simplified PCB layouts. Also additional information regarding pin outs of the semiconductor devices used and logic tables.
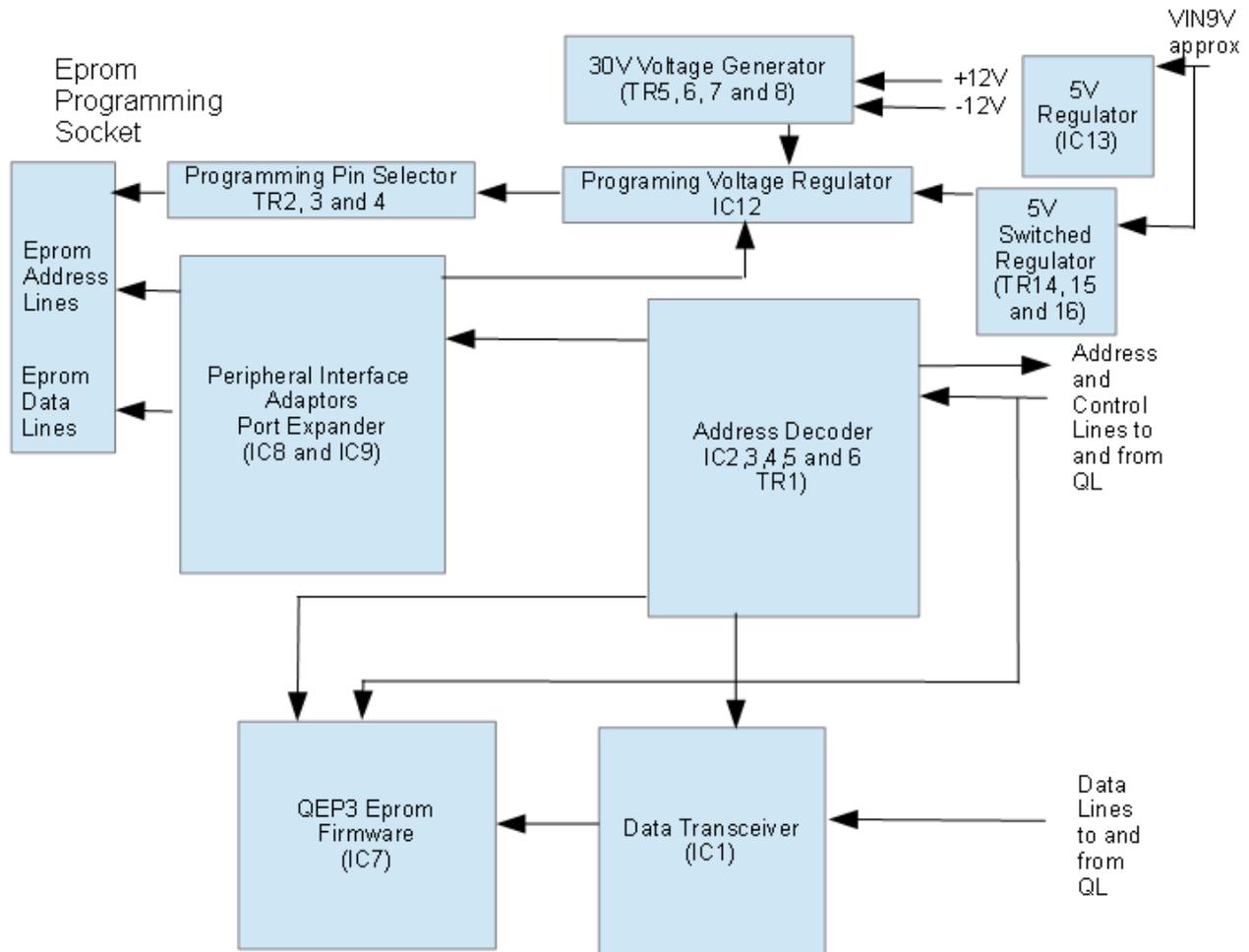
QEP3 Block Diagram

Brief Circuit Description

Please read this in conjunction with the block diagram above and the circuit diagrams below. This is not a complete blow by blow account of how the QEP3 programmer works, but should give you a good idea of the basics.

Staring with the power supply sections. IC13 (LM317) adjustable voltage regulator supplies 5V to all the logic IC's (IC1, 2, 3, 4, 5, 6, 7, 8, 9, 10 and 11) This supply is on all the time the unit is powered. The 5V supply is adjustable via VR1, the left hand pot looking from the Eprom socket edge. As already warned DO NOT ADJUST UNLESS ABSOLUTELY NECESSARY. There is a second 5V (TR13, 14 and 15) supply that is switched by the firmware to supply 5v to the Eprom socket. The Eprom socket is only powered when required by the firmware, also this supply will not come on unless an Eprom is properly fitted or the test jig is inserted into the Eprom socket. The firmware checks for the presence of the Eprom in the Eprom socket. More details on the test jig later.

The third and final part of the power supply is the programming voltage generator. This is made up of transistors (TR5, 6, 7 and 8). TR2 with the associate resistors and capacitors make a phase shift oscillator. This runs at a frequency of 60kHz. This feed what can be best described as a power amplifier stage made up of transistors TR6, 7 and 8). The power for this programming voltage generator is provided from the QL's +12V and -12V supplies. So the output after rectification by

diodes D2 and D3 and smoothing by C11 results in 30V to power IC12 which regulates the required programming voltages.

Transistors TR2, 3 and 4 are controlled by the firmware via IC9 and IC10 to select the correct programming pin (not the voltage value) for a given Eprom. The programming voltage comes from the programming voltage generator already described.
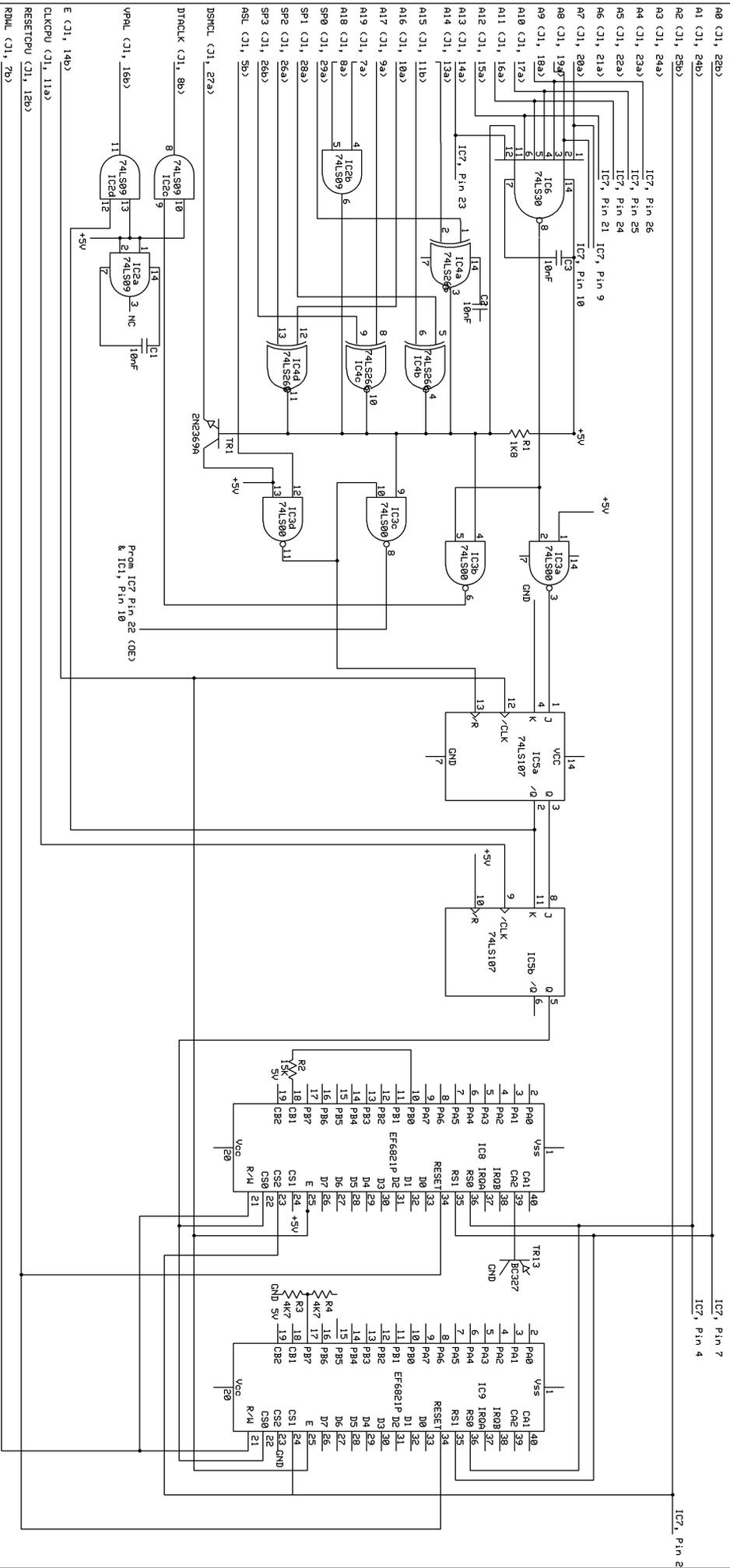
Address decoding and flow control is carried out by IC2, 3, 4, 5, 6 and TR1. The pulse duration is partly controller by the feed back to the QL via TR1 to the DSMCL (Data Strobe – Master Chip) pin . IC5 JK flip flop ensures the correct timing of the address decoding output for IC8 and 9 (Peripheral Interface Adaptor). This done so the the data pins on IC8 and 9 (Peripheral Interface Adaptors) are stable before enabling them.

Note that IC2, 4 and 6 have open collector outputs, that is a pull up resistor is required, which in this case is R1.

Enable control of the 8 bit transceiver device (IC1) is also derived from the address decoder. The directional control of IC1 is derived from the RDWL line from the QL itself.

The two Peripheral Interface Adaptors act as a form of port expanders. Each device provides two 8 bit parallel ports giving a total of four 8 bit ports or if you prefer 32 input/output lines. The ports can be bi directional. In this case only port B on IC8 is used in this manner , these represent the data lines for the Eprom socket, all the others are in output mode only. Data for IC8 and 9 are fed to and from the data transceiver IC1. Also the data lines from the firmware eprom IC7 also are fed via the data transceiver IC1. The outputs PA from IC8 and outputs from IC9 PA and PB are used to provide the address lines to the Eprom sockets and programming voltage selection and programming Eprom pin selection.

The Programming voltage selection is done buy selection of the resistors feeding IC12, this includes VR2 which sets the programming voltage. As already warned DO NOT ADJUST UNLESS ABSOLUTELY NECESSARY. The programming voltage is adjustable via VR2, the right hand pot looking from the Eprom socket edge.

A0 (J1, 22b)
A1 (J1, 24b)
A2 (J1, 25b)
A3 (J1, 24a)
A4 (J1, 23a)
A5 (J1, 22a)
A6 (J1, 21a)
A7 (J1, 20a)
A8 (J1, 19a)
A9 (J1, 18a)
A10 (J1, 17a)
A11 (J1, 16a)
A12 (J1, 15a)
A13 (J1, 14a)
A14 (J1, 13a)
A15 (J1, 11b)
A16 (J1, 10a)
A17 (J1, 9a)
A18 (J1, 8a)
A19 (J1, 7a)
A20 (J1, 6a)
SP0 (J1, 29a)
SP1 (J1, 28a)
SP2 (J1, 26a)
SP3 (J1, 26b)
ASL (J1, 5b)
DSMCL (J1, 27a)
DTACLK (J1, 8b)
VPAL (J1, 16b)
E (J1, 14b)
CLKCPU (J1, 11a)
RESETCPU (J1, 12b)
RDWL (J1, 7b)

IC7, Pin 26
IC7, Pin 25
IC7, Pin 24
IC7, Pin 21
IC7, Pin 9
IC7, Pin 23
IC7, Pin 10
IC7, Pin 7
IC7, Pin 4
IC7, Pin 2

IC6
74LS30
14
8

IC2b
74LS09

IC4a
74LS26

IC4d
74LS26

IC4c
74LS26

IC4b
74LS26

IC2d
74LS09

IC2c
74LS09

IC2a
74LS09

IC3a
74LS00

IC3b
74LS00

IC3c
74LS00

IC3d
74LS00

10nF C3
10nF C4
10nF C2
10nF C1

+5V
GND

R1
1K8

TR1
2N2369A

Prom IC7 Pin 22 (OE)
& IC1, Pin 10

IC5a
74LS107
VCC 14
GND 7
J K CLK R Q /Q

IC5b
74LS107
J K /CLK R Q /Q
+5V

R2
15K
5V

IC8
EF6821P

IC9
EF6821P

PA0 PA1 PA2 PA3 PA4 PA5 PA6 PA7
PB0 PB1 PB2 PB3 PB4 PB5 PB6 PB7
CA1 CA2 CB1 CB2
IRQA IRQB RS0 RS1 RESET
D0 D1 D2 D3 D4 D5 D6 D7
E CS0 CS1 CS2 R/W
Vcc Vss

TR13
BC327
GND

R3 4K7
R4 4K7
GND 5V

Care Electronics
Rev 1.0
16-08-2014
Page 1

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QEP3 Programing Logic

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IC Socket, Pin 28 (Vcc)

+12V

Switched 5V

-12V

IC10, Pin 12
IC10, Pin 10
IC10, Pin 8
IC10, Pin 6
IC11, Pin 8
IC8, Pin 39
IC11, Pin 9
IC11, Pin 10
IC11, Pin 11
IC11, Pin 8

IC8, Pin 5
IC11, Pin 6
IC8, Pin 6

IC11, Pin 12

BC327 TR2
BC327 TR3
BC327 TR4

R11 4K7
R12 4K7
R13 4K7

R8 4K7
R9 4K7
R10 4K7

R5 2K1
R6 2K1
R7 2K1

D4 5V

VR3 2K
C14 10nF
R35 560k

R29 1M5
R30 300k
R31 150k
R32 7K5

R28 5K

R33 100K

R36 68K

R37 560k
R38 68K

GND

R26 100K

R34 15K

R27 20K

R39 680k
R40 150k

R41 20K

R42 15K

C16 4n7
C15 4n7
C14 4n7
C12 4n7

IC18d LM324 13 12 14
IC18c LM324 9 10 8
IC18b LM324 5 6 7

Note, This section not used

IC7, Pin 1

IC2a LM324 3 2 1 4 11

D3

C10 10nF
C11 10uF 16V

R14 4K7
R15 4K7
R16 4K7
R17 4K7

C4 1nF
C5 1nF
C6 1nF

R18 1K8
D1

TR5 BC337

R20 15K
R19 4K7

C7 10nF

BC337 TR6
TR8 BC327
TR7 BC337

TR9 BC337
R21 270
TR10 BC337
TR11 BC337
R22 3K9
R23 270

C8 10uF 64V

D2

R24 390
R25 100
C9 100uF 16V

TR12 BC327

IC Socket Pin 26

+5V

VR1 2K
R43 4K7
C17 47uF 16V

D5

LM317 IC13 Out Adj In
C22 1nF

R44 750

R45 33
TR14 BC337

R46 330
R47 330
TR13 BC327
GND

TR15 TIP31A

C19 10nF
C20 10nF
C21 47uF 16V
C22 47uF 16V

C18 470uF 12V

GND

IC8, Pin 39

GND (J1, 1a)
GND (J1, 1b)

-12V VM12 (J1, 31a)
+12V VP12 (J1, 30a)

VIN (J1, 31b)
VIN (J1, 32a)
VIN (J1, 32b)

Ian Burkinshaw
QEP3 Power Supplies
Care Electronics
Rev 1.0
06/10/2014
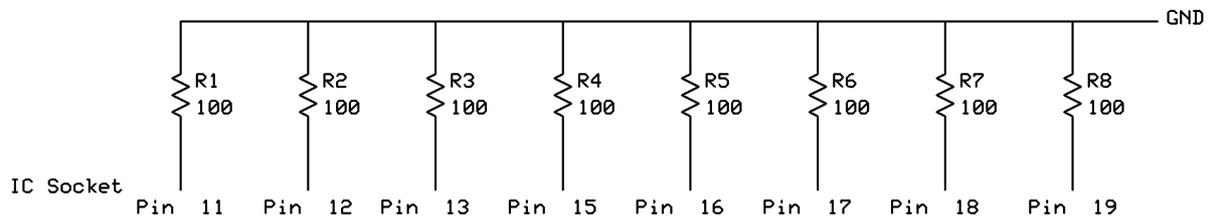Page 3

Test Jig and Use

A test jig is required to be able to use the test routine that is contained with the QEP3 firmware. The following circuit needs to be built.

```
                                                                                    GND
          R1       R2       R3       R4       R5       R6       R7       R8
          100      100      100      100      100      100      100      100

IC Socket
        Pin  11  Pin  12  Pin  13  Pin  15  Pin  16  Pin  17  Pin  18  Pin  19

Test Pin's

Pin 1

Pin 14 GND

Pin 22

Pin 23

Pin 26

Pin 28
```
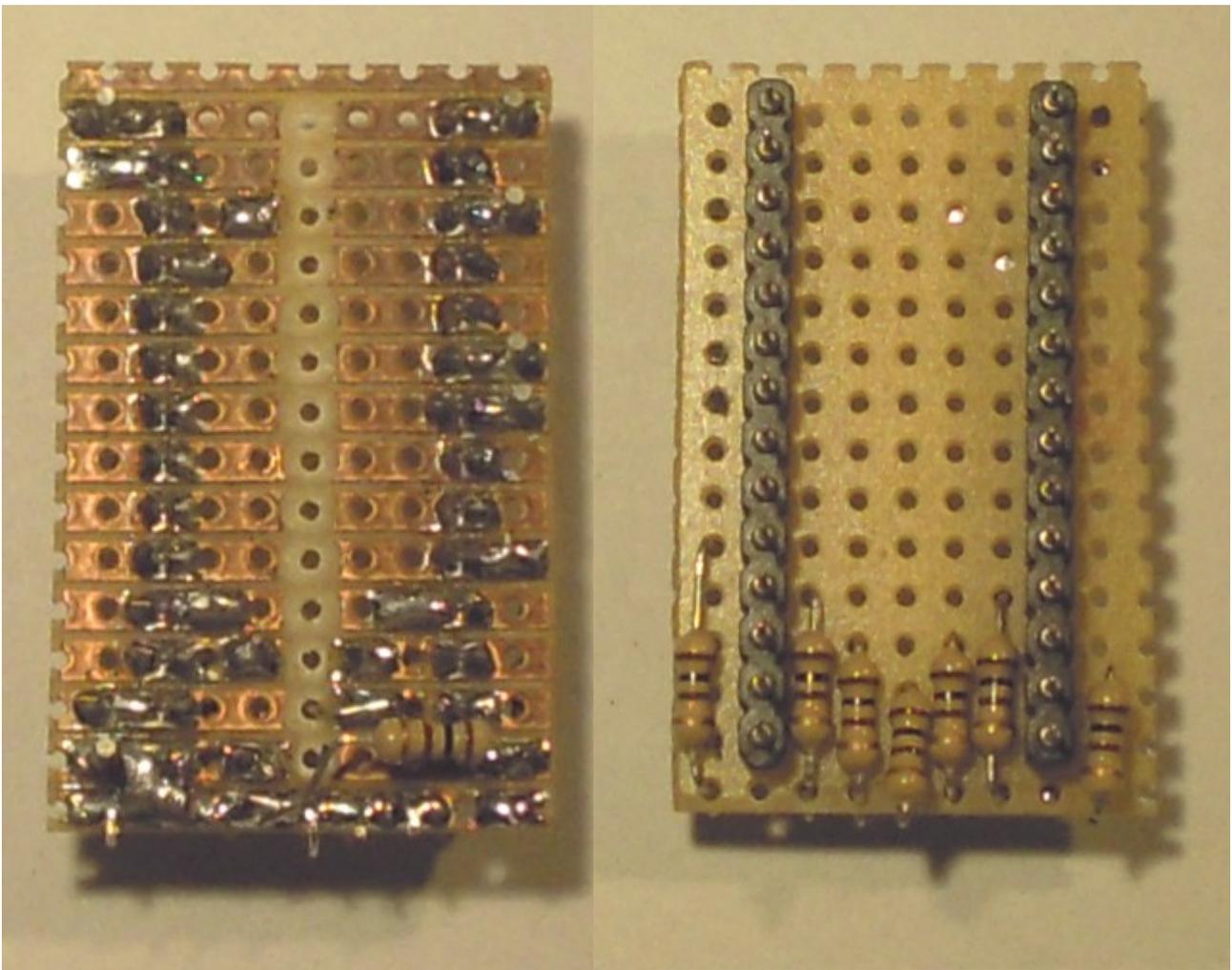
Photo's of such a test jig. Provided as a guide.

The 100 ohm resistors are there to current limit in the event of a fault condition.

To use the jig inset in to the Eprom socket on the QEP3. Turn on the system. Once booted. Under the Options tab select Test. This will than take you thought the following test points.

Pin 28 Low
Pin 28 5V
Pin 28 3.98V to 4.02V
Pin 28 5.98V to 6.02V
Pin 26 5.95V to 6.05V
Pin 1 Low
Pin 1 5.5V to 5.8V
Pin 1 12.7V to 12.8V
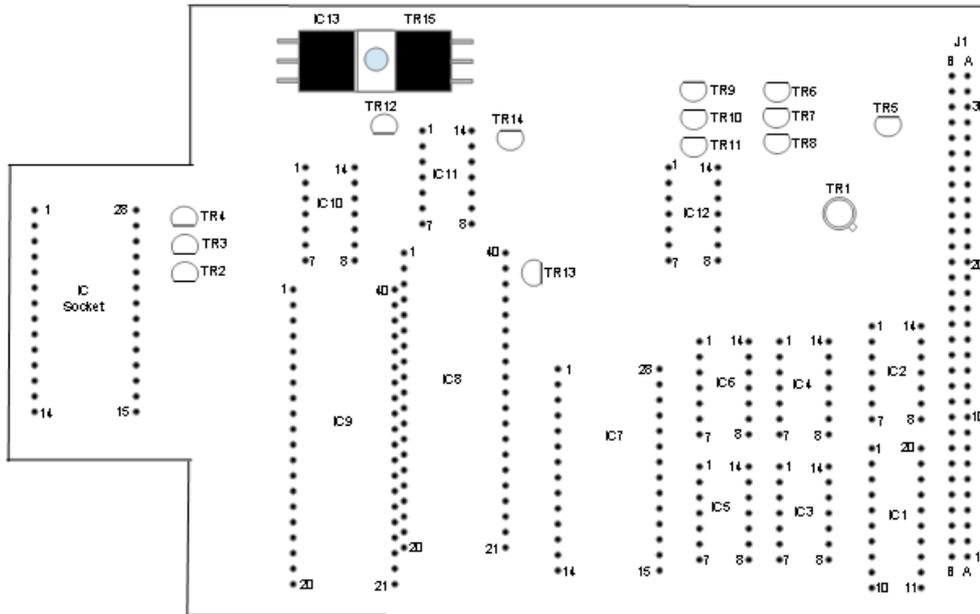Pin 1 20.8V to 21.2V
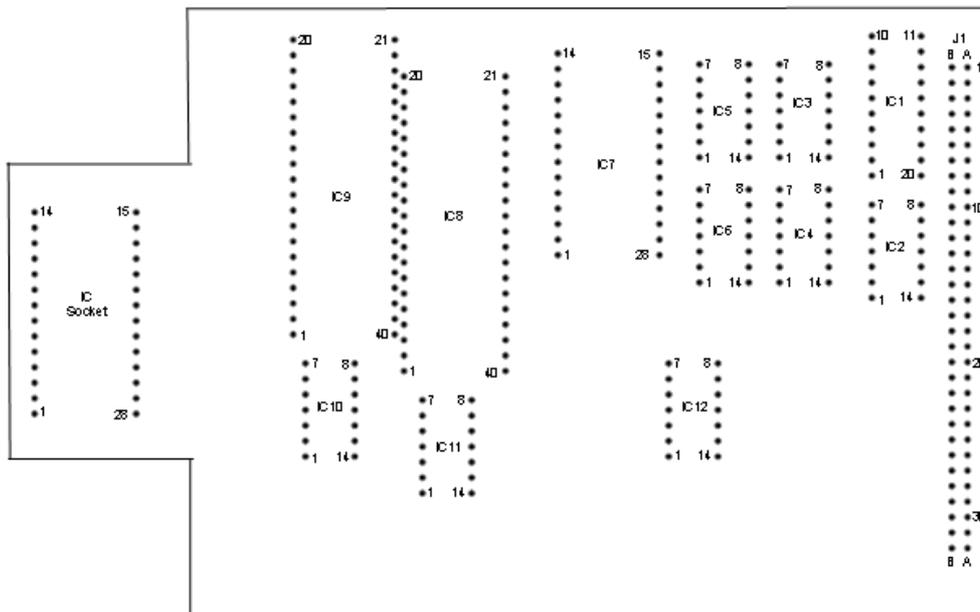Pin 1 24.8V to 25.2V
Pin 22 Low
Pin 22 24.8V to 25.2V
Pin 23 Low
Pin 23 24.8V to 25.2V

Card Layout

Top

IC13 TR15 J1 B A

IC11 TR9 TR6 TR5 30

IC10 TR10 TR7

TR4 TR11 TR8 TR1 20

TR3 IC12

TR2 TR13 IC8

IC Socket IC6 IC4 IC2 10

IC9 IC7 20

IC5 IC3 IC1 B A 1

10 11

Bottom

20 21 J1 10 11

20 21 IC5 IC3 IC1 B A 1

IC9 IC7 20

IC Socket IC6 IC4 IC2 10

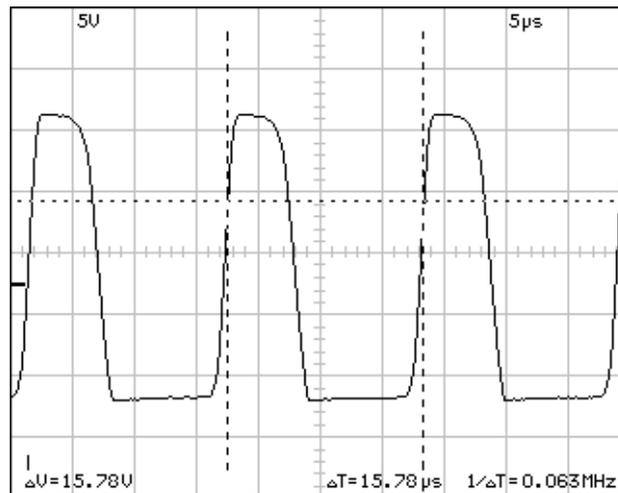IC8 20

IC10 IC12

IC11 30

B A

The card is a double sided PCB, the diagram below show the tracks that run on the top of the card as view from below.
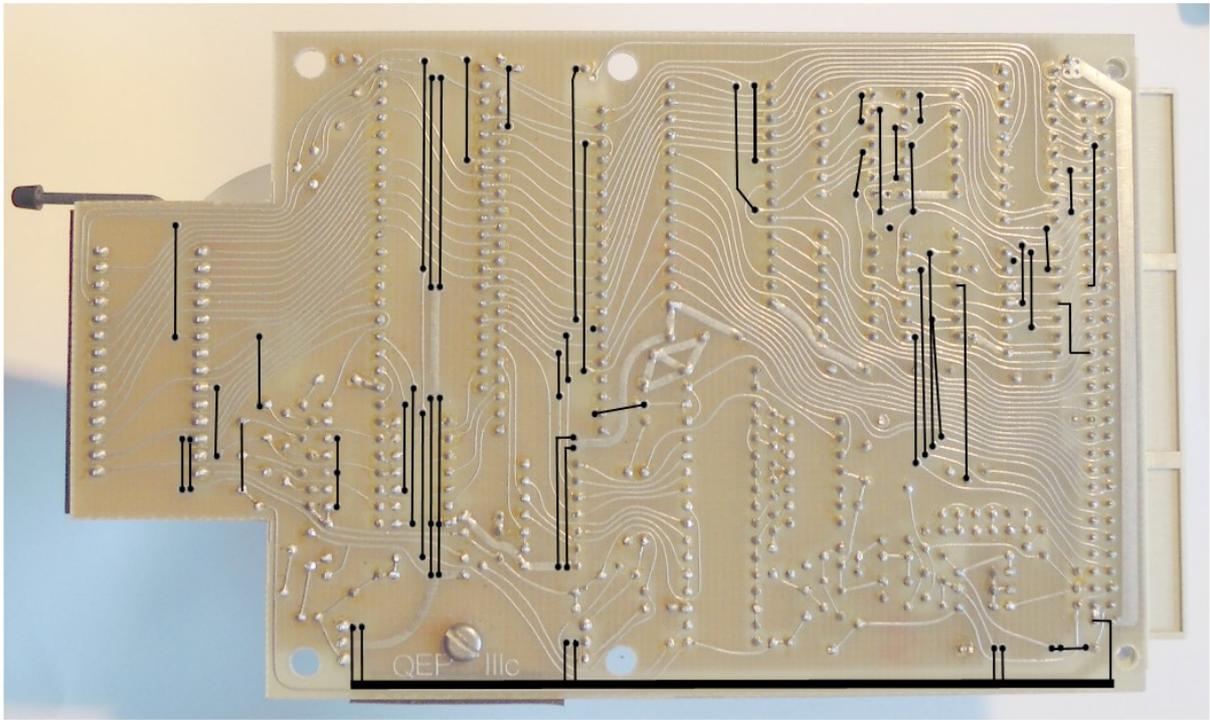
Waveforms for the Programming Voltage Generator.
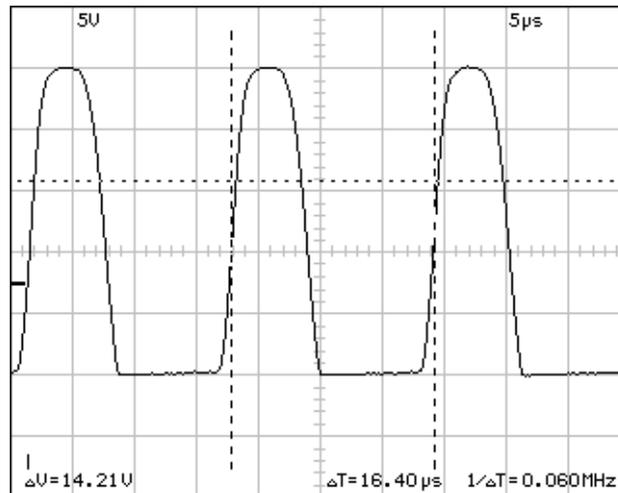
Collector of TR5

Junction of Anode D3 and Cathode D2

Please see associated Excel spread sheet for test results from a fully working card for comparison purposes to aid fault finding.

Data sheets for all the semiconductors use on this card are available from:-

www.datasheetcatalog.com

With the exception of the EF6821P (IC8 and 9) all the semiconductor for this card are available from regular suppliers such as Farnel, RS etc.
However the EF6821P's are very hard to come by if at all.
Also note the EF6821P could be a MC6821P they are the same device from different manufactures