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W8NUE

The NUEKey

A Touch Sensor Keyer Paddle

Presented by Milt Cram,
W8NUE

at Austin SummerFest

Austin, TX

August 7, 2004

The NUEKey
Outline of Presentation

- Objectives
- "No moving parts" Sensors
- Theory of Operation
- The Schematic
- Version 1
- Versions 2 & 3
- Conclusions
- Contact the Designer

Objectives:

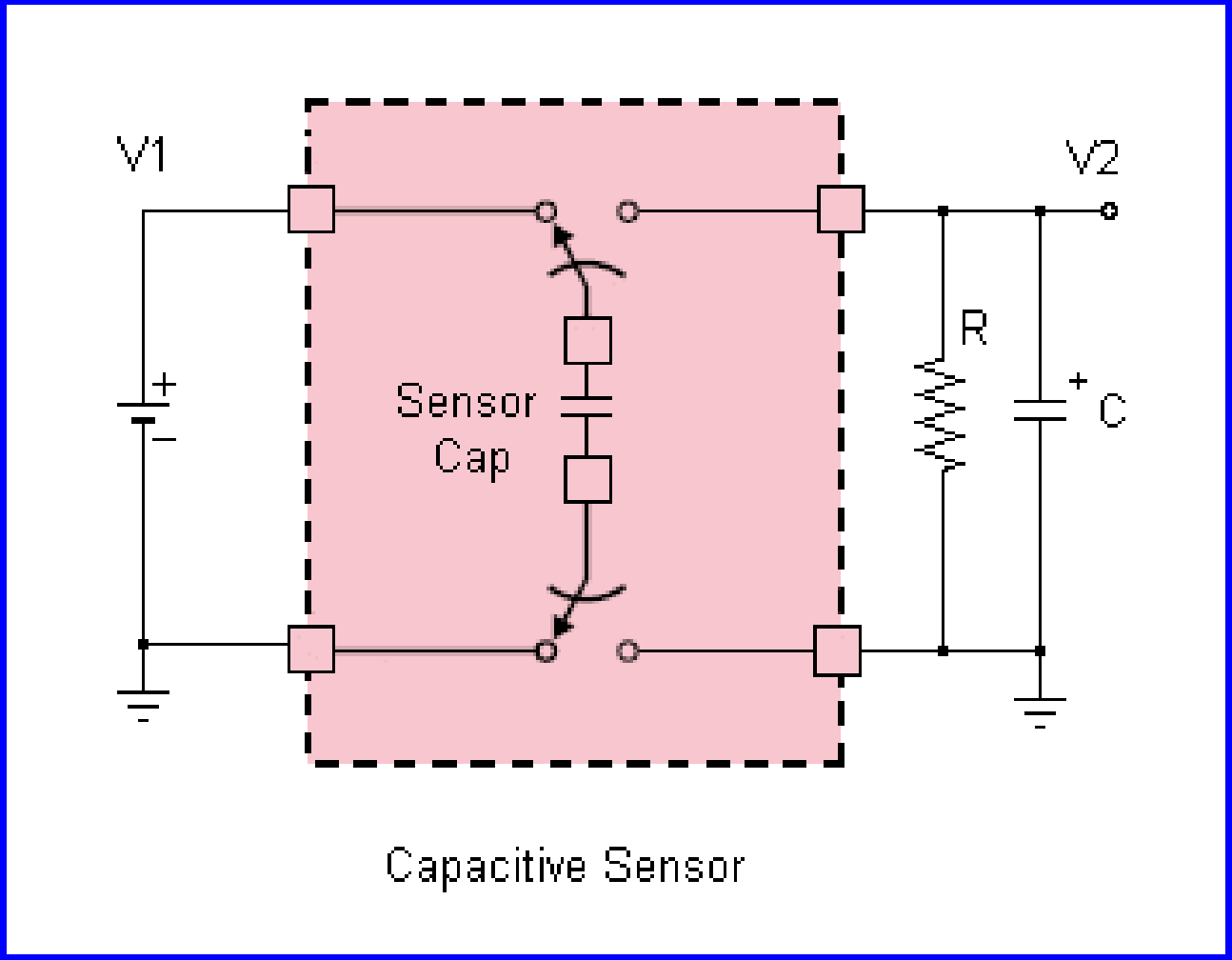
- Simple
- No Moving Parts--Rugged
- Low Power
- Easy to Replicate
- Small

"No moving parts" Sensors

- Capacitive
- Infrared
- Optical
- Thermal
- Skin resistance
- Nuclear Magnetism

The NUEKey
Theory of Operation

Switched Capacitor Sensor



Capacitive Sensor

A rapidly switched capacitor

is equivalent to a

Resistor

Variable Capacitance

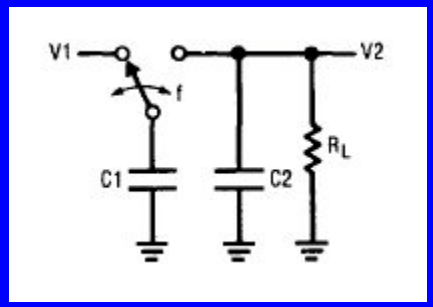
Variable Resistance

Variable Voltage

Electronic Switch

To understand the theory of operation of the LTC1043, a review of a basic switched capacitor building block is helpful.

In this first figure, when the switch is in the left position,



capacitor C1 will charge to voltage V1. The total charge on C1 will be q1=C1V1. The switch then moves to the right, discharging C1 to voltage V2. After this discharge time, the charge on C1 is q2=C1V2.

Note that charge has been transferred from the source, V1, to the output, V2. The amount of charge transferred is:

$\Delta q = q1 = q2 = C1(V1-V2)$.

If the switch is cycled f times per second, the charge transfer per unit time (i.e. current) is

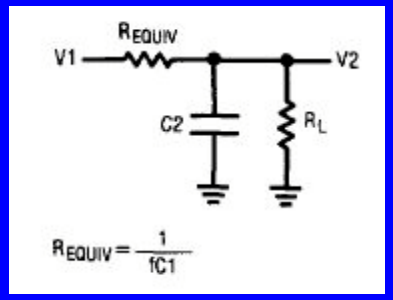
$I = f \times \Delta q = f \times C1(V1-V2)$

Rewriting in terms of voltage and impedance equivalence,

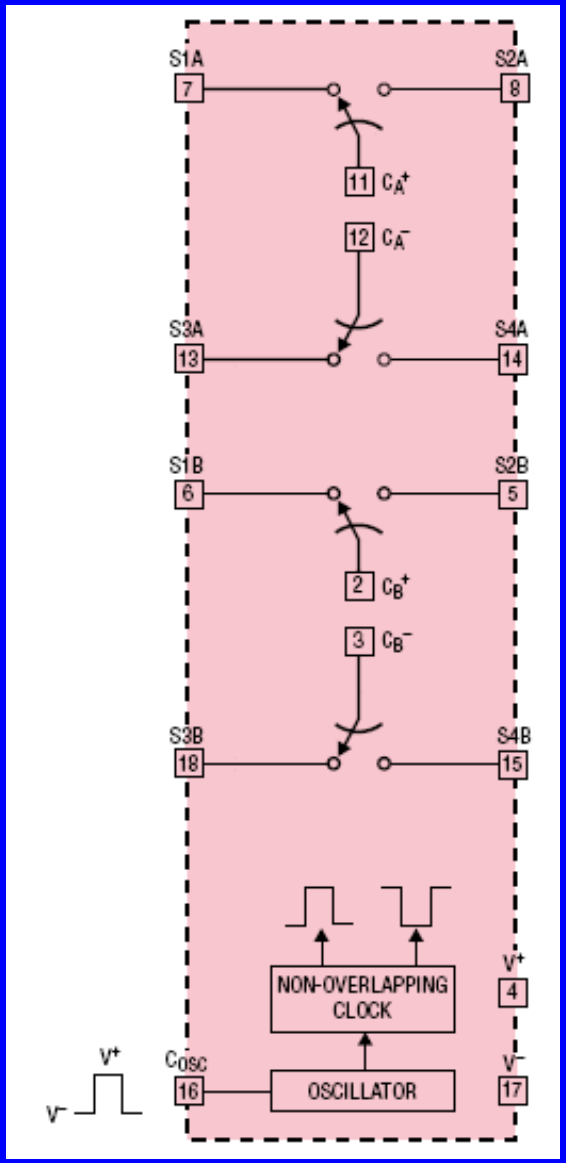
$$I = \frac{V1-V2}{1/fC1} = \frac{V1-V2}{Requiv}$$

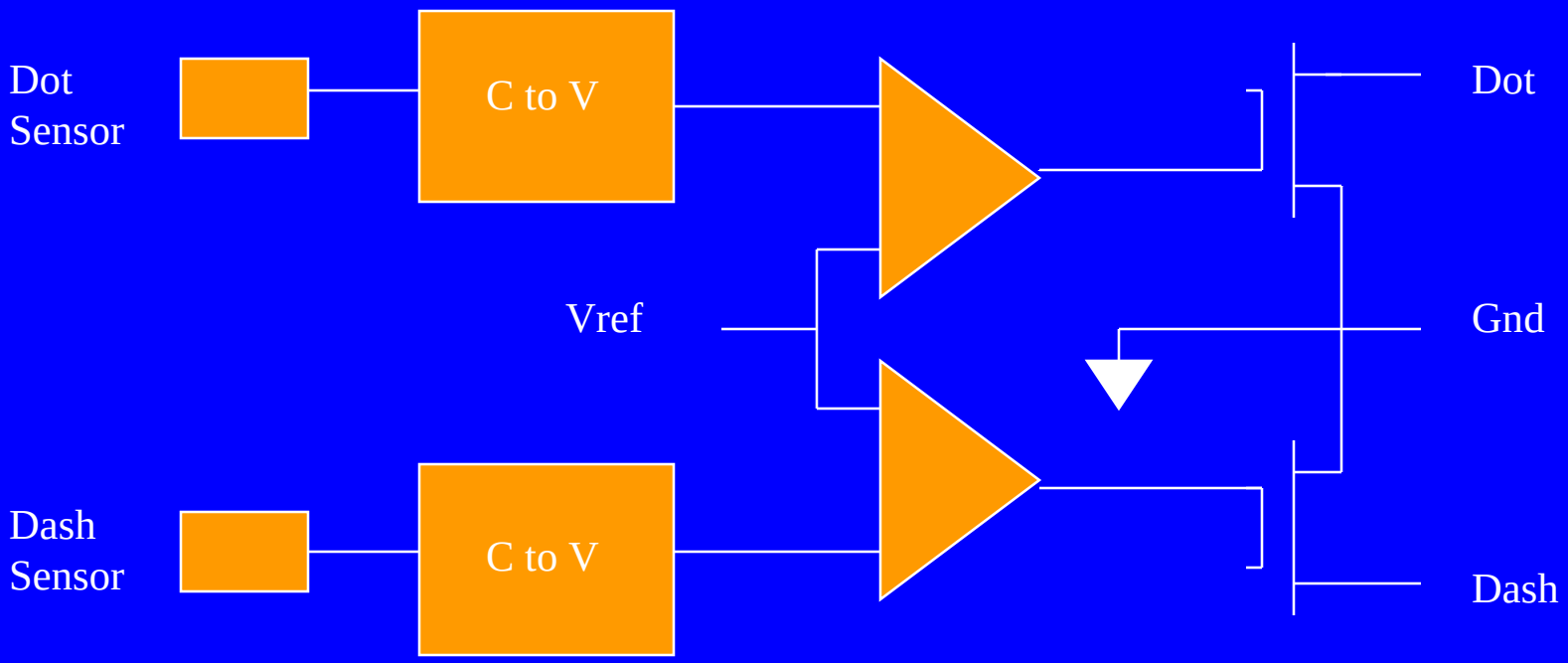
A new variable, Requiv, has been defined such that

Requiv = 1/fC1. Thus, the equivalent circuit for the switched capacitor network is as shown to the right.



The Linear Technology LTC1043

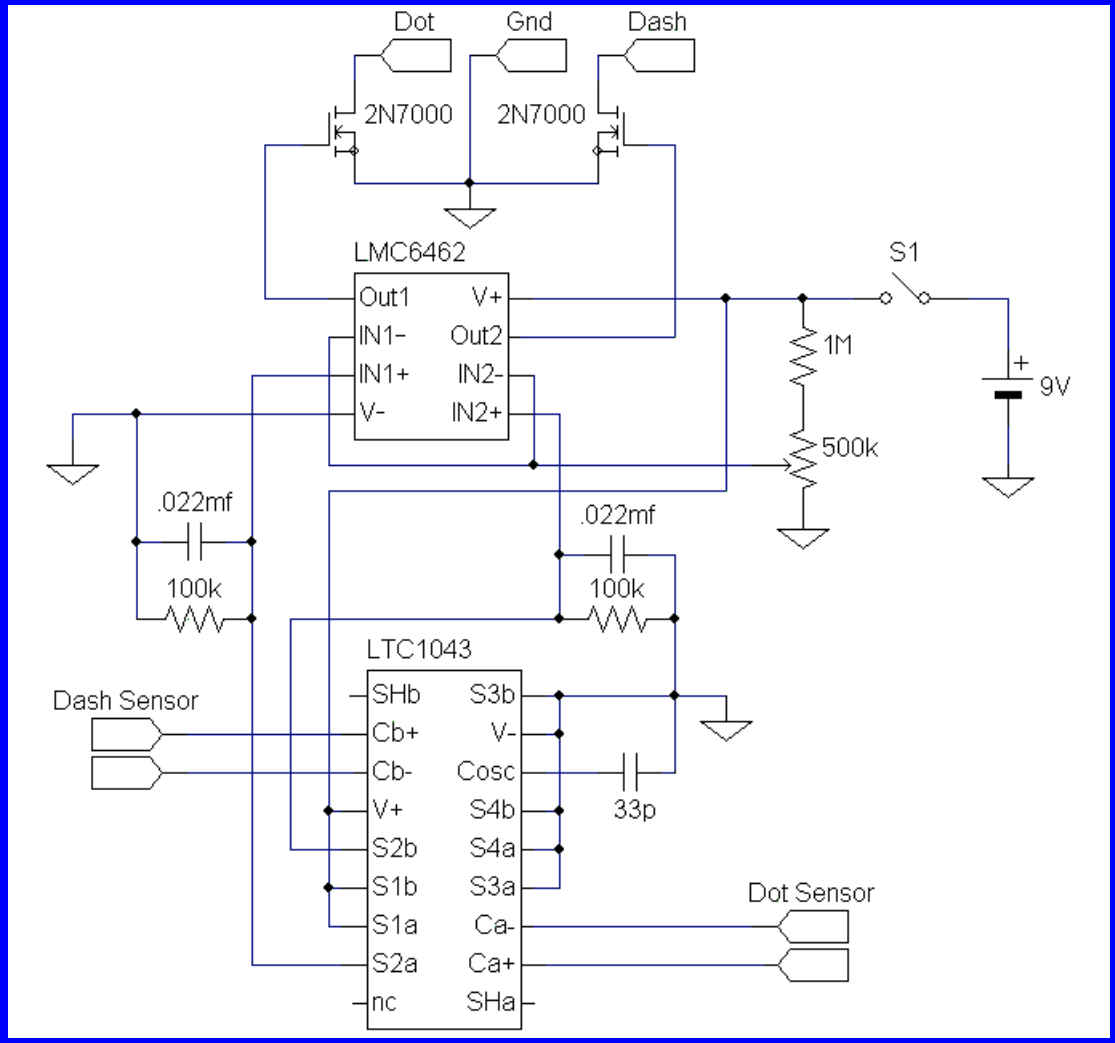




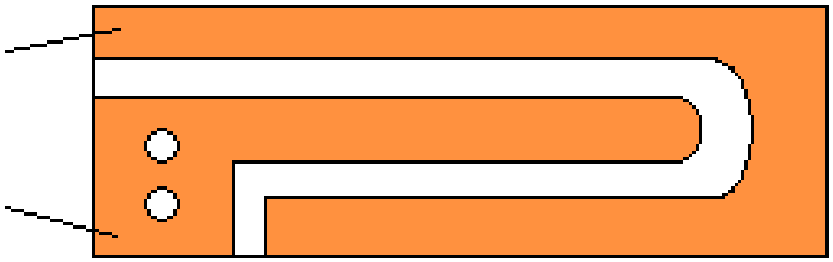
NUEKey Block Diagram

The NUEKey Schematic

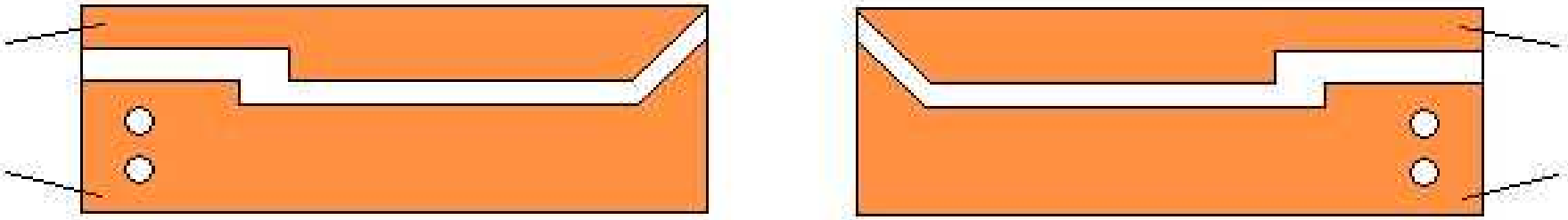
9V Version



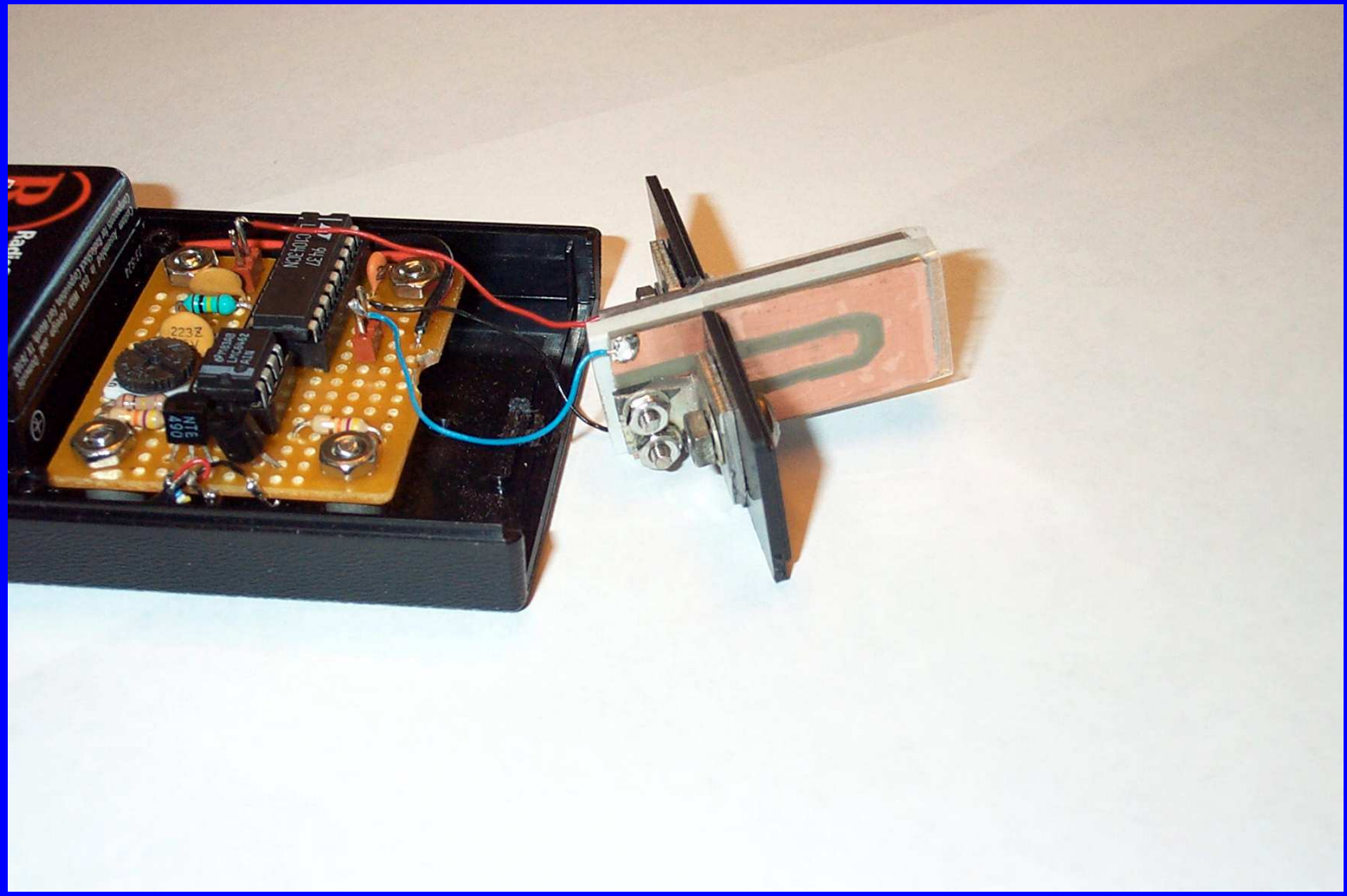
Sensor Electrode



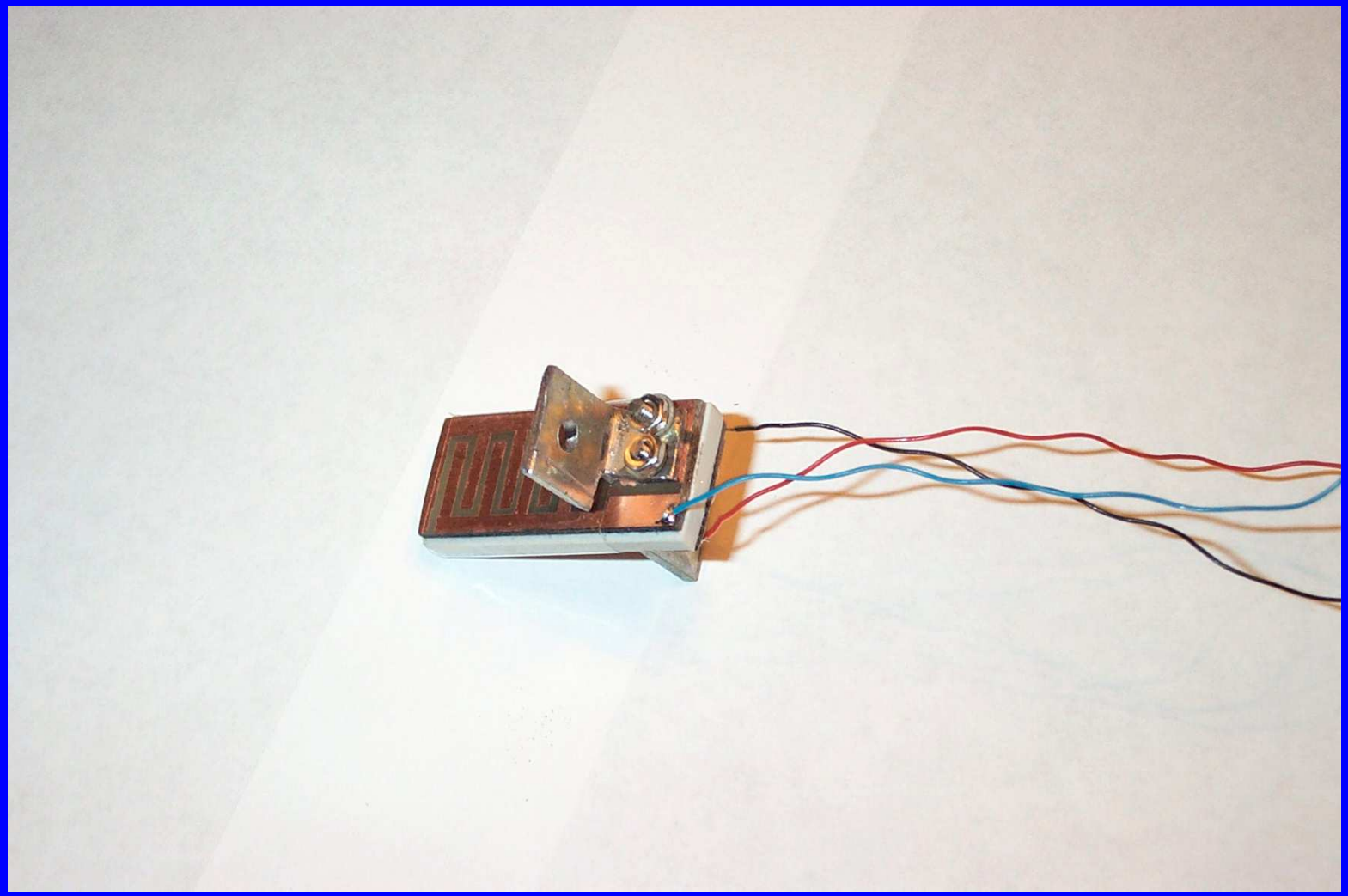
Another Version of Sensor



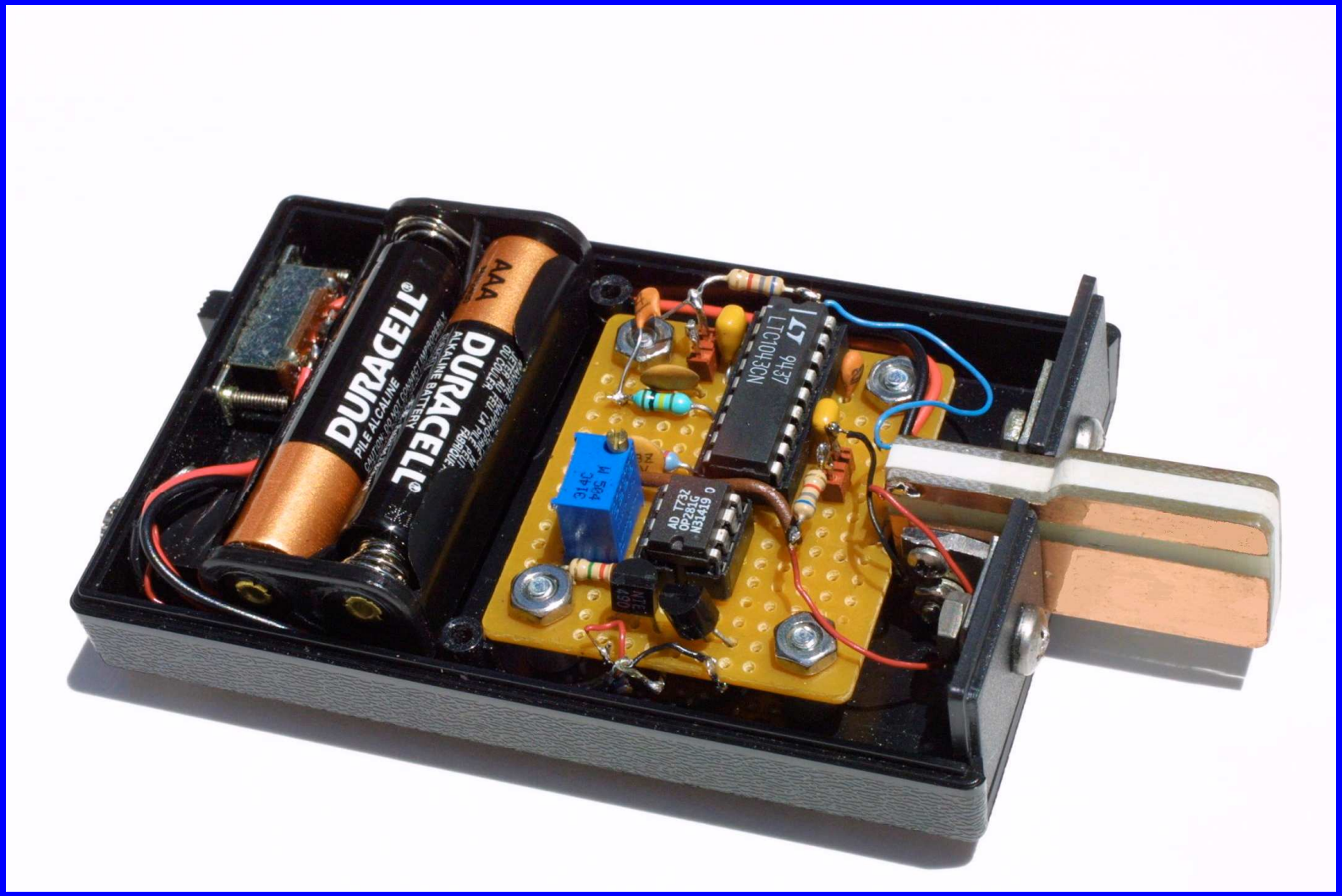
Details of Sensor Mounting



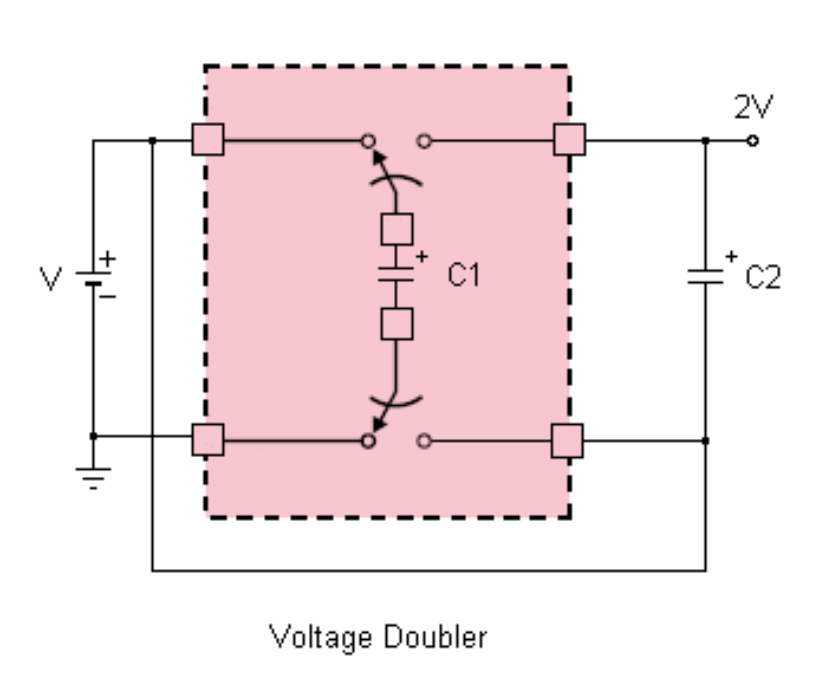
Interdigitated Sensor



The "Guts", photo by John Fisher, K5JHF



Voltage Doubler Circuit



Voltage Doubler

C1 Charged to V volts

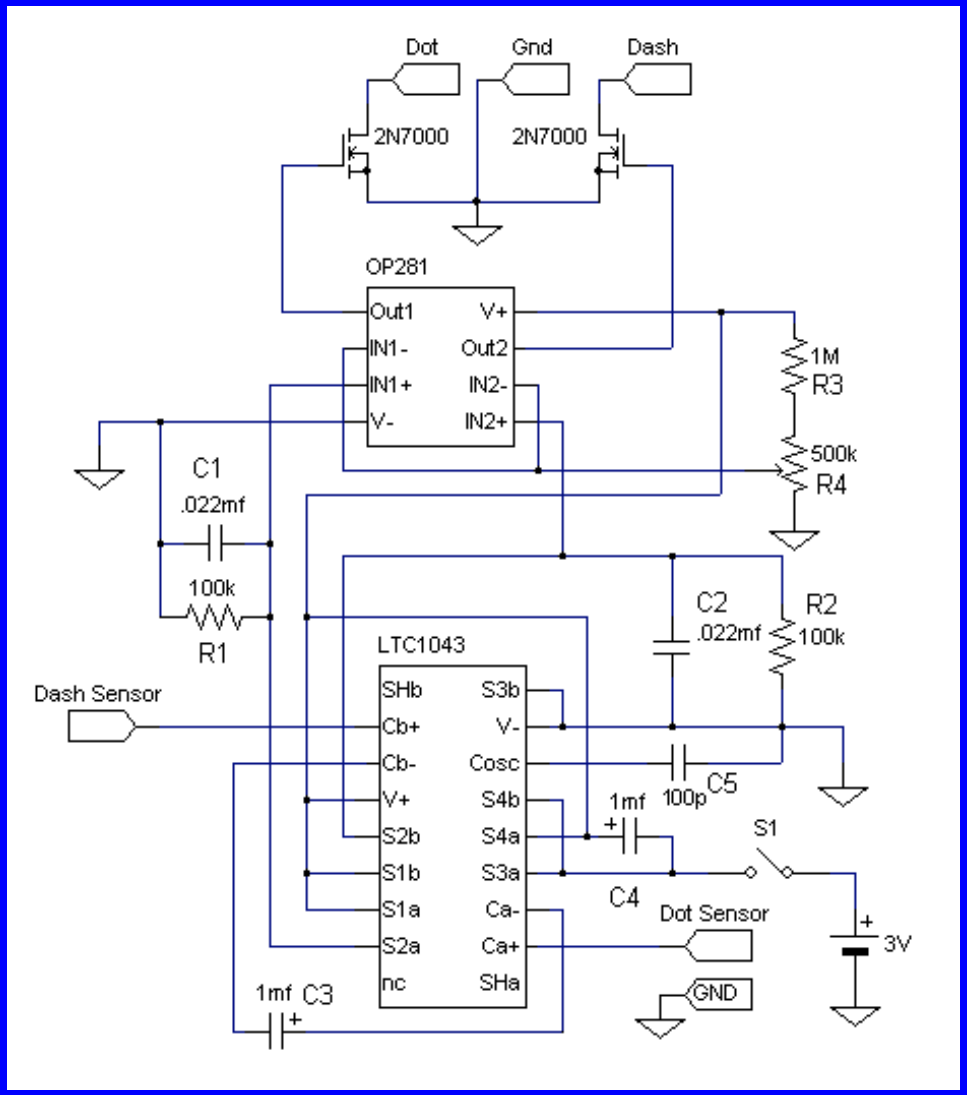
Charge on C1 transferred to C2

After repeated cycling, voltage on C2 is also V volts

C2 connected in series with the input voltage V

Output voltage is sum of V and the voltage on C2, or 2V volts

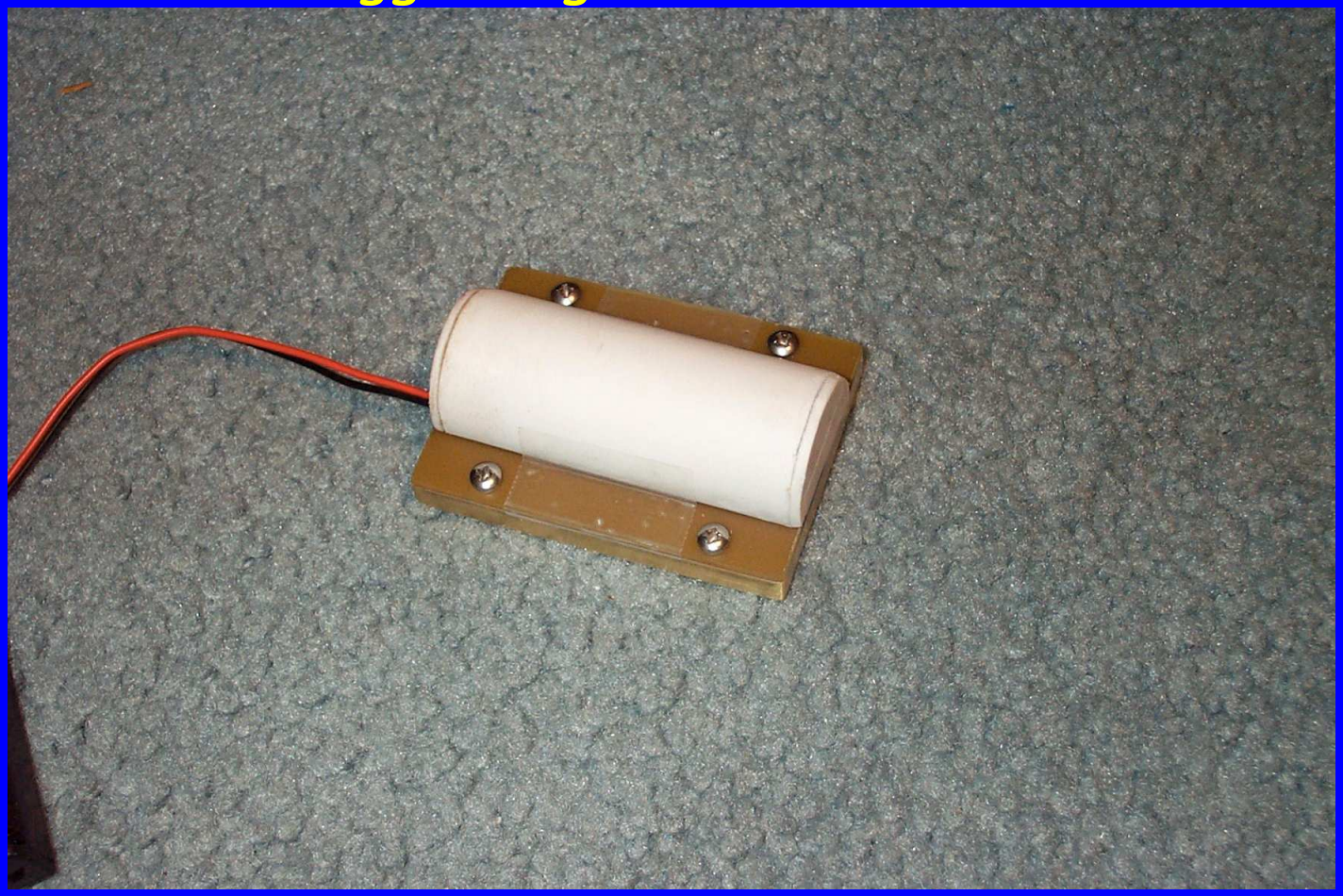
Schematic of 3V Version



The Finished Product

Version 2

Thanks to Gary, N2KTY for suggesting the form factor!



Version 2- Inside

Version 3 (Partial)

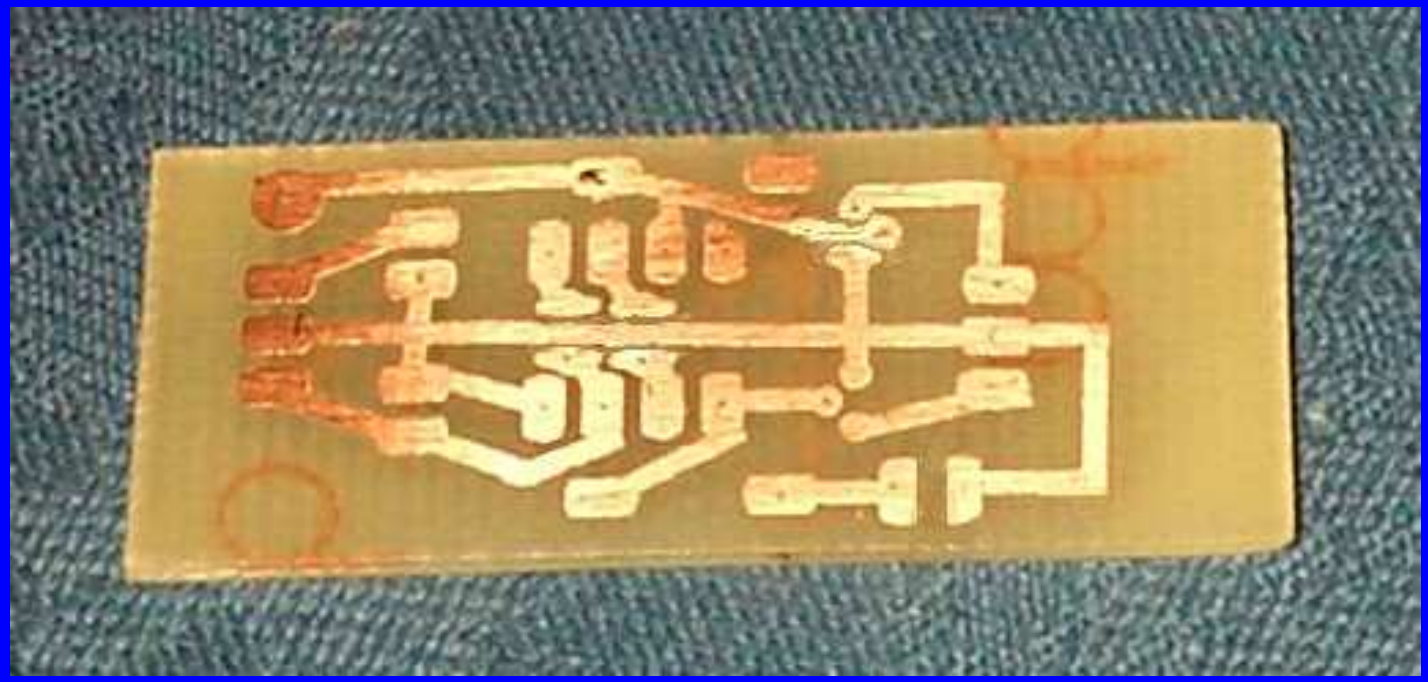
More Version 3

Version 3 Base

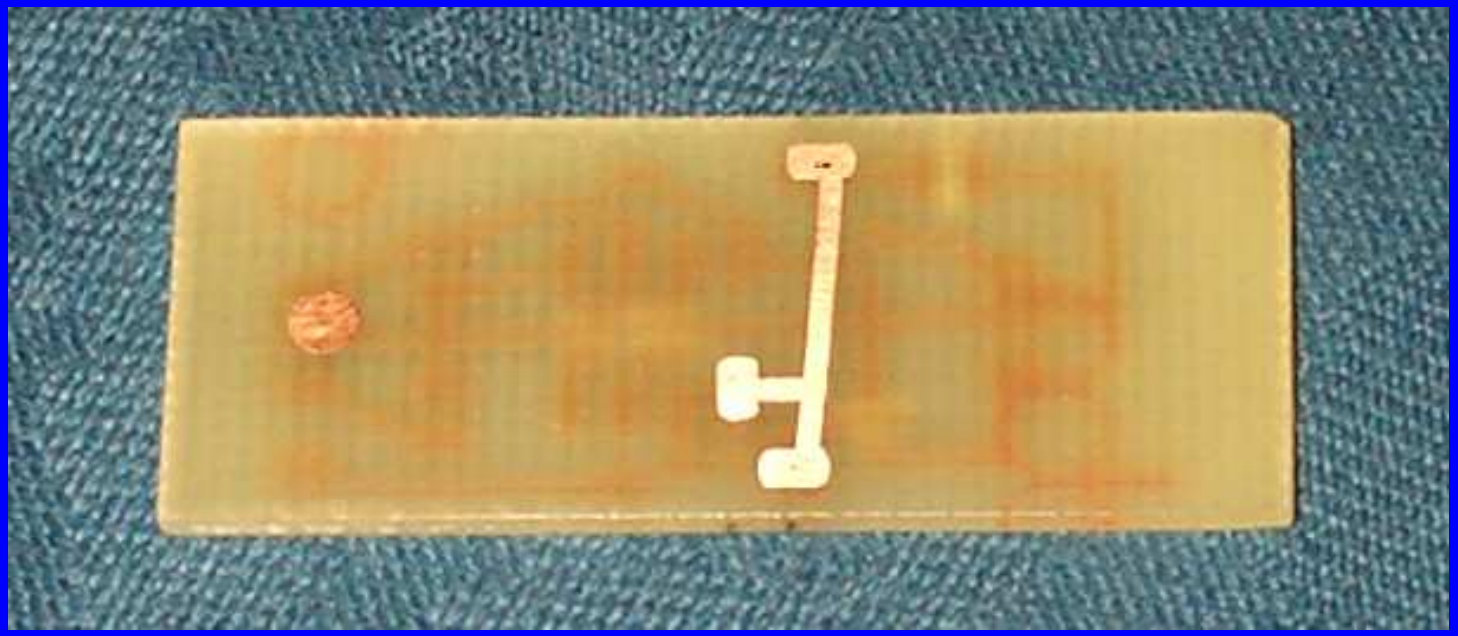
Underside of Version 3

Version 3

PCB for Versions 2 & 3



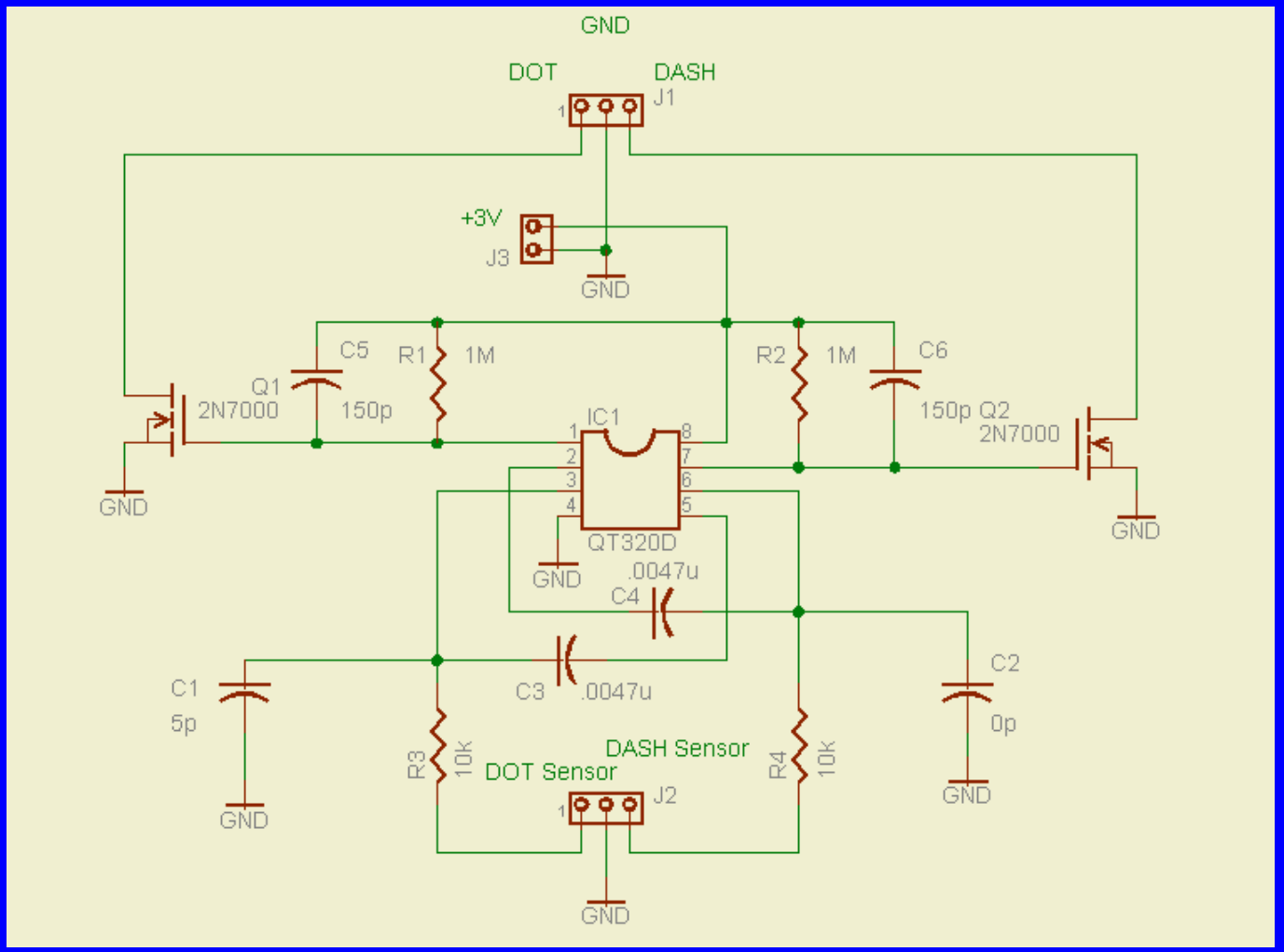
PCB for Versions 2 & 3

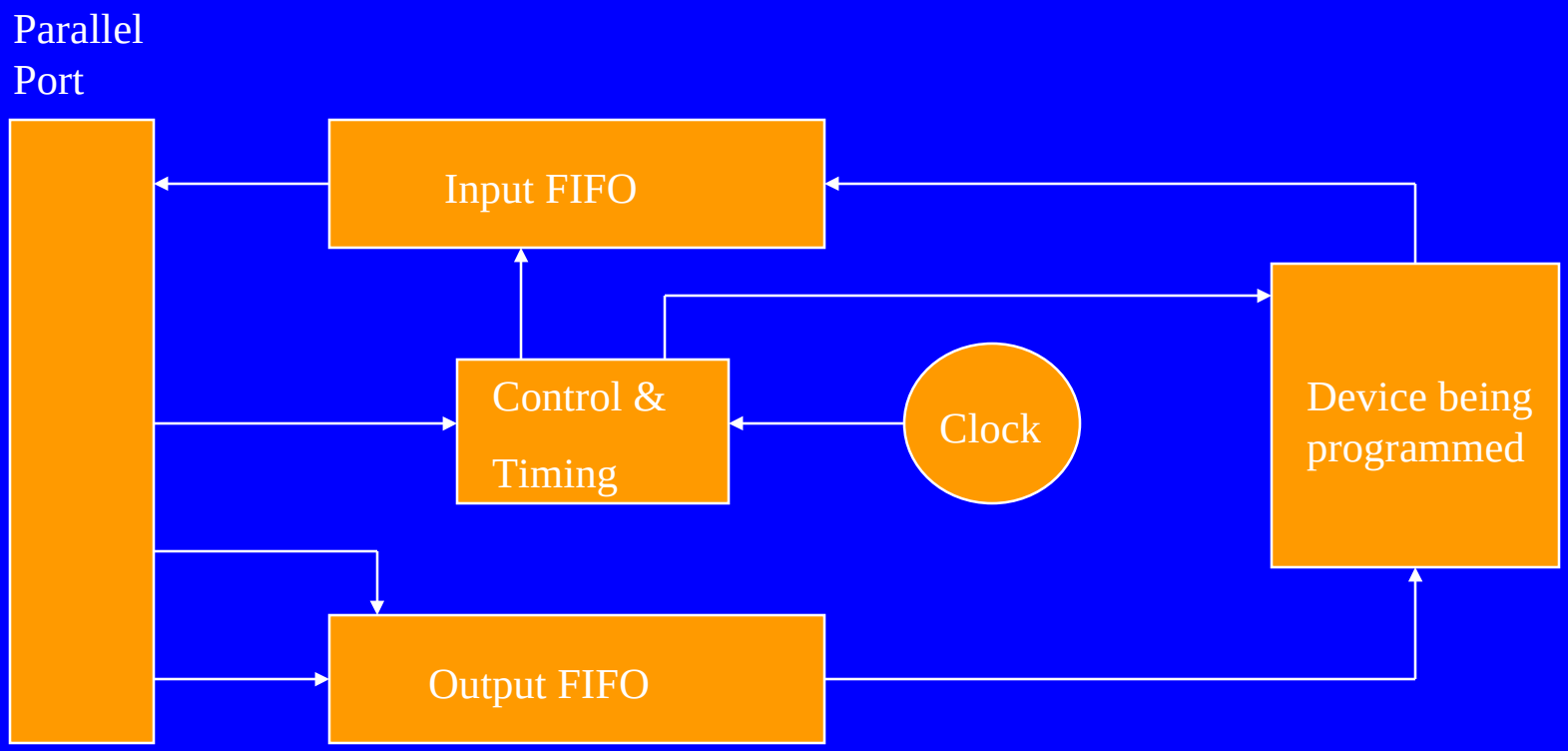


Version 3 - Finished!

Versions 1 and 3

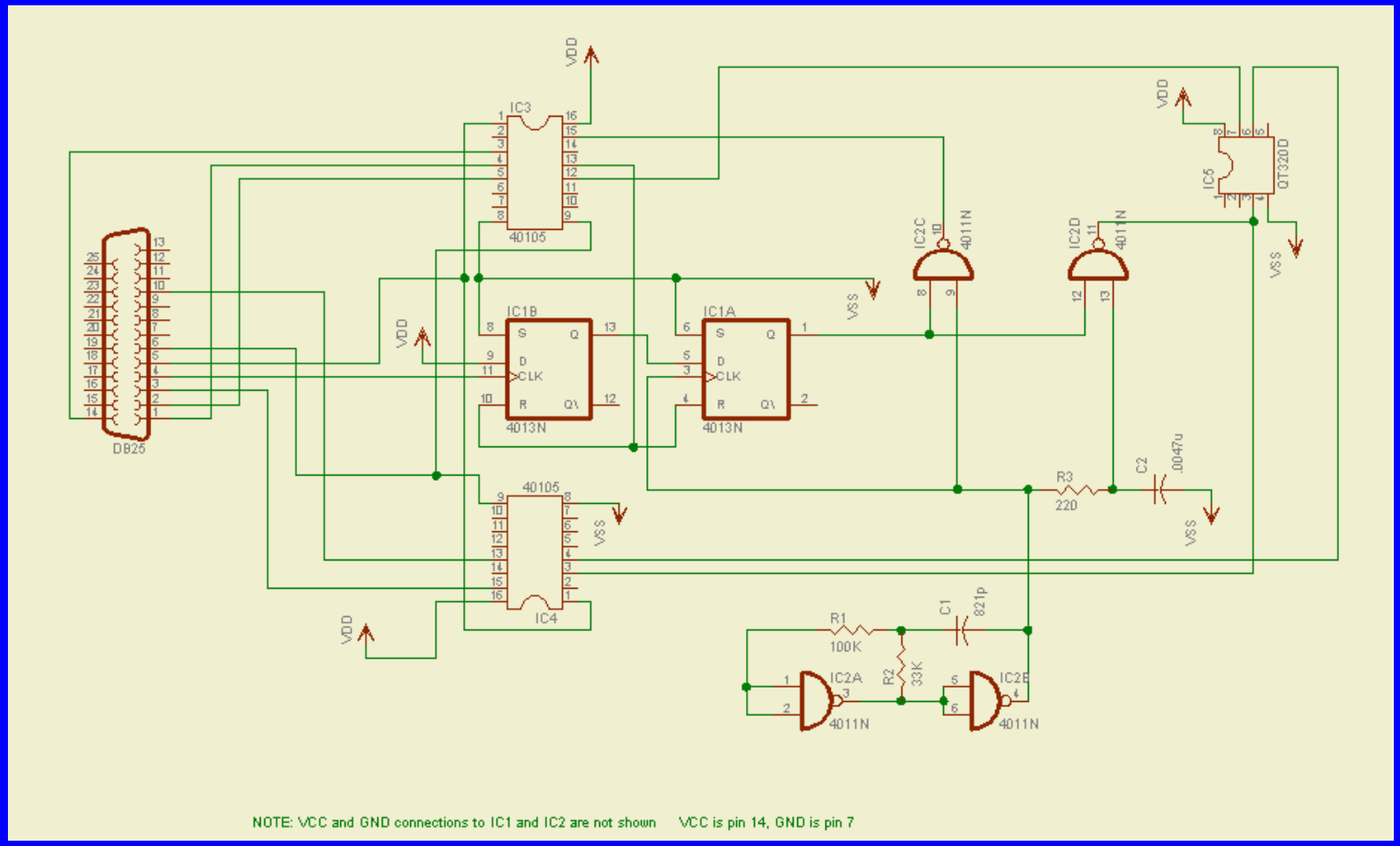
Schematic for Versions 2 and 3



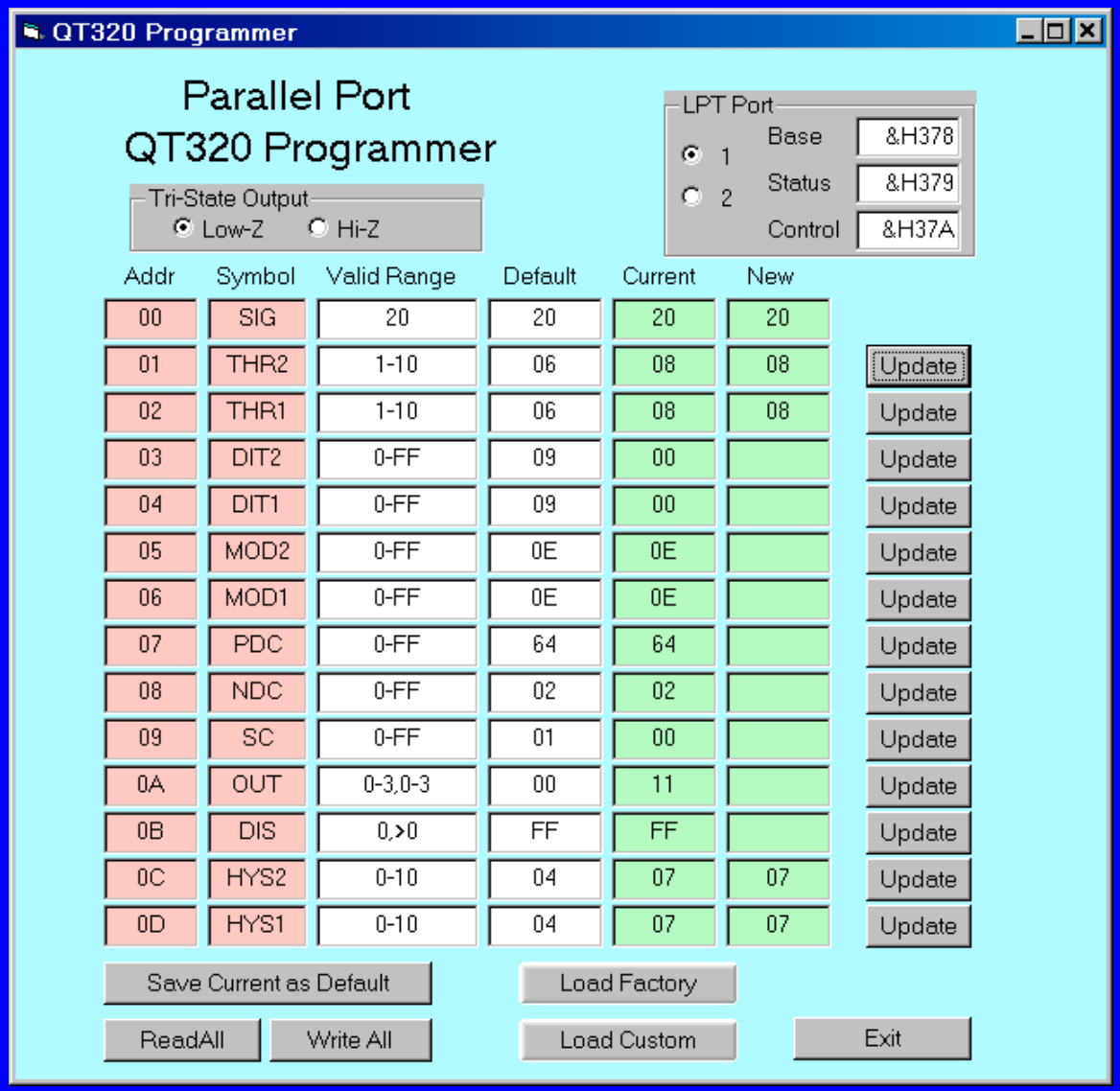


QT320 Programmer Block Diagram

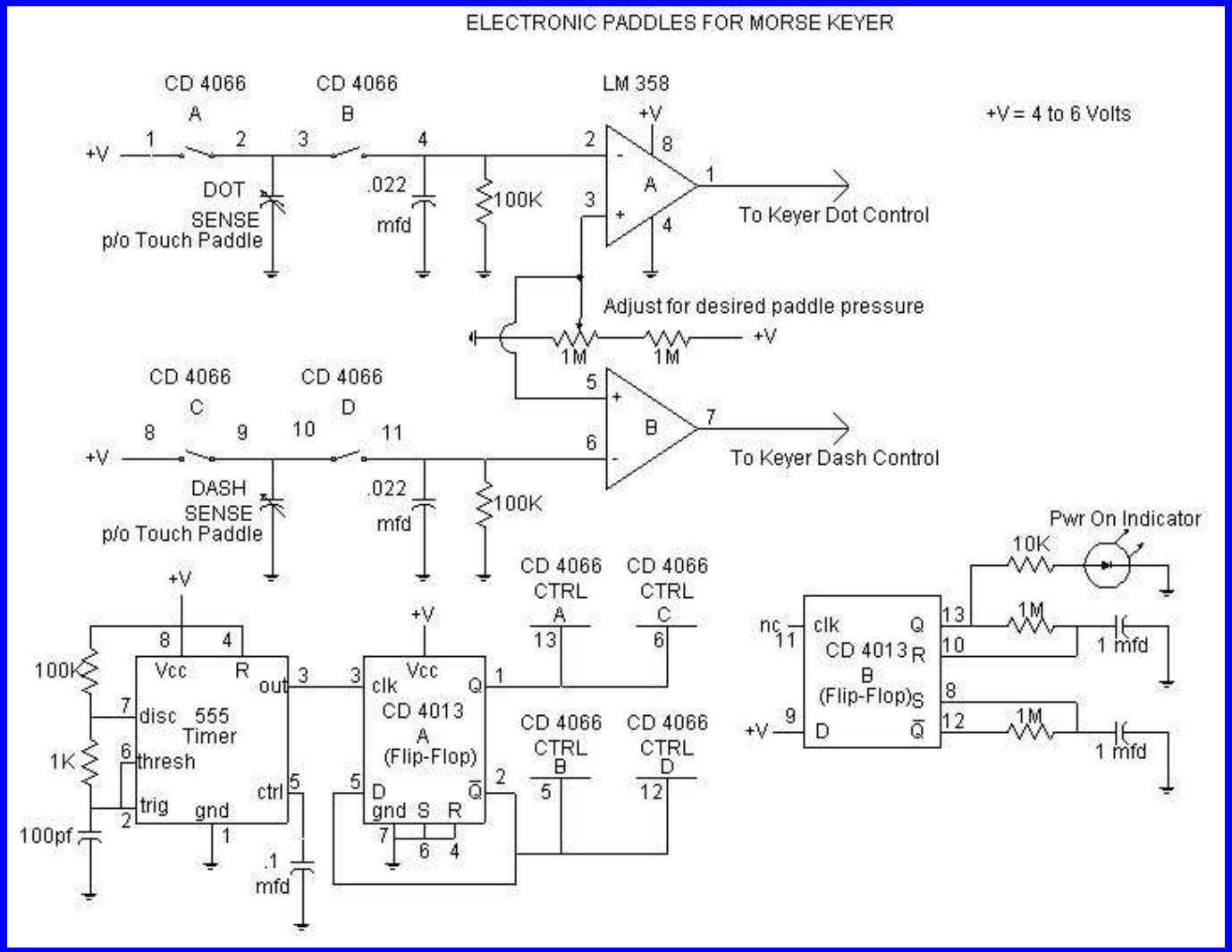
QT320 Programmer



Screenshot of QT320 Programmer



A Discrete Version by Chuck, NO2K



Advantages of Versions 2 & 3:

More compact

Disadvantages of Versions 2 & 3:

Higher current drain (0.7mA vs 0.25mA)
QT320 requires programming

Conclusions

The switched capacitor technology allows a simple, rugged, low cost, low power implementation of keyer paddles.

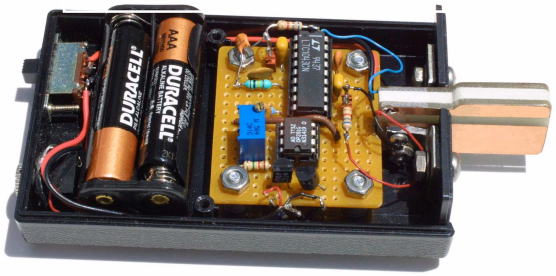
The compact size and low weight is ideal for portable operation as well as base station.

If mated with John Fisher's (K5JHF) MCD, it provides Iambic keying for rigs that do not have a built-in keyer.

Other Applications for Capacitive Sensors

- Liquid Level Monitoring
- Touch Controls (e.g. lighting)
- Proximity Detection (e.g. garage door)
- Capacitance Meter
- Materials Properties

The NUEKey



Contact the Author:

Milt Cram, W8NUE
9807 Vista View Dr
Austin, TX 78750

email: w8nue@arrl.net

Photos by W8NUE and K5JHF