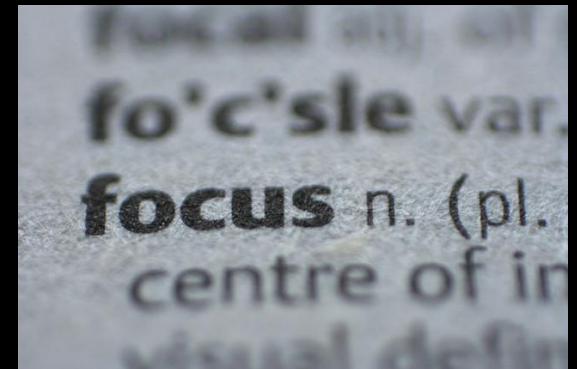


DIY Astronomy – Electronic Telescope Focuser



DIY Astronomy – Electronic Telescope Focuser

Fort McKavett – Fall 2014

**COOL GUY ASTRONOMERS
WITH ELECTRONIC FOCUSERS**



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Configuration difficult to focus



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COULD I BE A PART OF THE ULTRA COOL GUY ASTRONOMERS?



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Goal – Electronic Control for Feathertouch Focuser on 200mm Newtonian

Options:

1. Company 1: \$549
2. Company 2: \$514
3. Company 3: \$495
4. Company 4: \$835
5. Company 5: \$320



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Could this possibly be:

A:

DO-IT-YOURSELF
PROJECT



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Step 1 –
Check the source of all good things:



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1. The best commercially available focusing systems used **stepper motors**.
2. What would a stepper motor cost on eBay?

\$3.42 – Includes 28BYJ-48 stepper motor and driver board



Questions:

1. Will this motor have enough torque? **Answer – Yes**
2. Will this have small enough steps? Includes gear box, 0.087° per step. **Answer - Yes**

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Interfacing to:
Feathertouch Focuser

Miraculously – Feathertouch Focuser teeth
are 2mm spaced, same as MXL belts

eBay stepper motor

48MXL025 belt
\$3.84

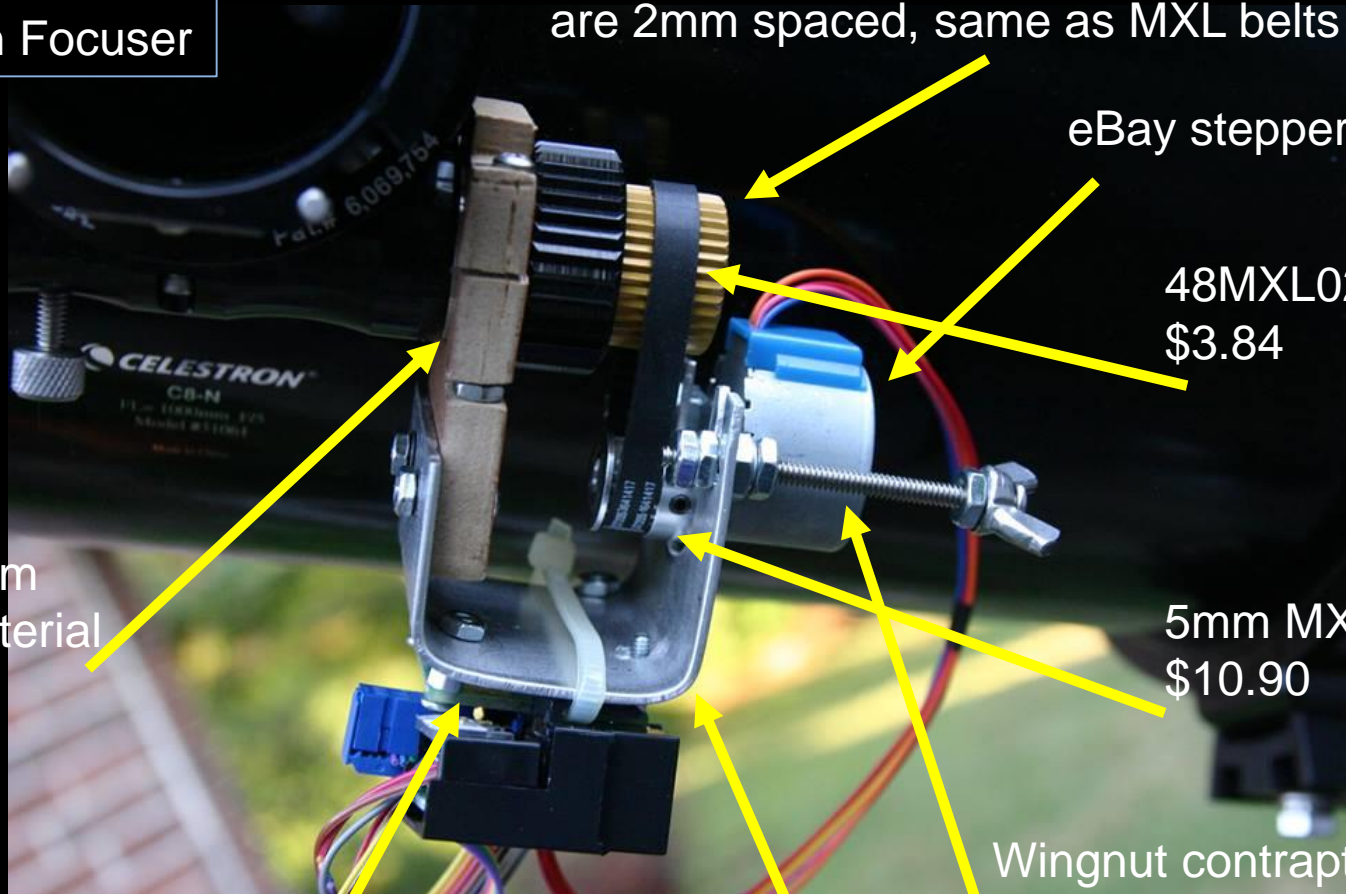
5mm MXL Pulley
\$10.90

Wingnut contraption to
allow manual focus

1/16" Aluminum

Dining Room
flooring material

eBay motor driver board

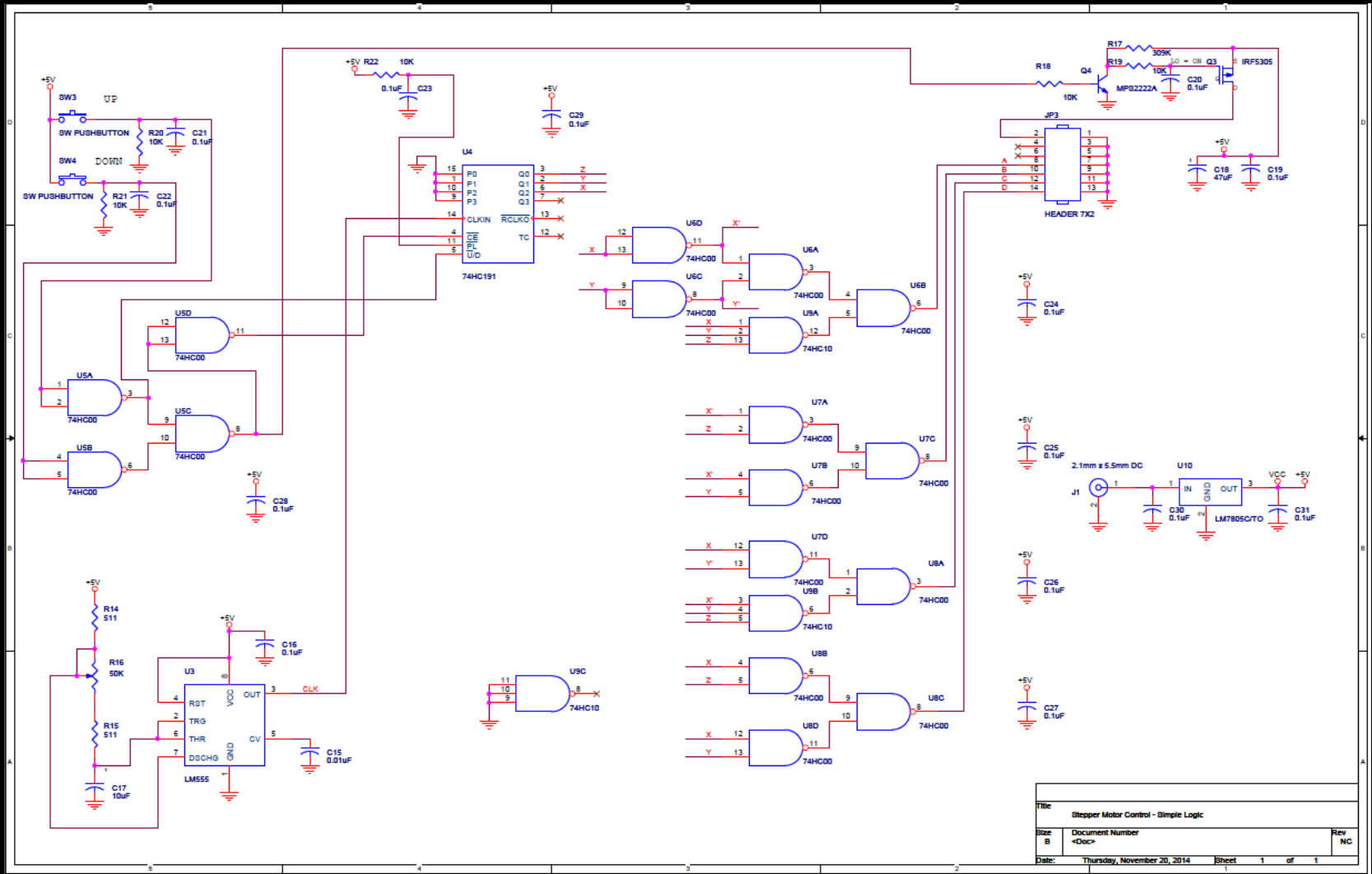


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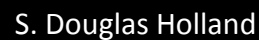
Next – Need a way to control motor

DRIVER LED LETTER	MOTOR CABLE#	MOTOR WIRE COLOR	step	step	step	step	step	step	step	step
4-STEP SEQUENCE				1		2		3		4
8-STEP SEQUENCE			1	2	3	4	5	6	7	8
	5	red	+	+	+	+	+	+	+	+
D	4	orange	0	0	0	0	0	1	1	1
C	3	yellow	0	0	0	1	1	1	0	0
B	2	pink	0	1	1	1	0	0	0	0
A	1	blue	1	1	0	0	0	0	0	1

Option 1 – Gate Logic



Option 2 – Programmable Logic



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```
1  -- Focuser Control
2  -- Control circuit for 28BYJ-48 stepper motor using ULN2003 IC
3  -- 11/4/14
4  -- 11/13/14 - Added motor power control.
5
6  TITLE "FOCUSER CONTROL EPLD1";
7
8  -- o = output, i = input, ff = flipflop, n = node
9
10 SUBDESIGN Focuser_Control
11 (
12  gclki, gclrni, cntupi, cntdowni, motor_pwr_goodi : INPUT;
13  Ao, Bo, Co, Do: OUTPUT;
14  -- Ao = Blue wire
15  -- Bo = Pink wire
16  -- Co = Yellow wire
17  -- Do = Orange wire
18  displayo[3..0] : OUTPUT; % Counter output for display %
19  motor_pwro      : OUTPUT; % Turns motor power on and off %
20
21 )
22
23 VARIABLE
24
25 gclkn, gclrn : NODE;
26
27 upsyncff      : DFF; % Sync cntupi to clock %
28 downsyncff    : DFF; % Sync cntdowni to clock %
29
30 motor_pwrff   : DFF; % Sync motor_pwr_goodi to clock %
31
32 countff[2..0] : DFF; % Up / down counter for motor control %
33
34 BEGIN
35
36 % DEFAULTS
37   countff[0].ena = GND;
38 END DEFAULTS; %
39
40 -- Global connections
41 gclkn = GLOBAL(gclki);
42 gclrn = GLOBAL(gclrni);
43
44 countff[2..0].clk = gclkn;
45 countff[2..0].clrn = gclrn;
46
47 upsyncff.clk = gclkn;
48 upsyncff.clrn = gclrn;
49
50 downsyncff.clk = gclkn;
51 downsyncff.clrn = gclrn;
52
53 motor_pwrff.clk = gclkn;
54 motor_pwrff.clrn = gclrn;
55
56 -- Input sync connections
57 upsyncff.d = cntupi;
58 downsyncff.d = cntdowni;
59 -- Motor power connections
60 motor_pwrff.d = motor_pwr_goodi;
61 motor_pwro = upsyncff.q # downsyncff.q;
62
```

```
63 -- Up / down counter
64 IF (upsyncff.q & motor_pwrff.q) THEN
65   countff[] = countff[] + 1;
66 ELSIF (downsyncff.q & motor_pwrff.q) THEN
67   countff[] = countff[] - 1;
68 ELSE
69   countff[] = countff[];
70 END IF;
71
72
73 -- Table for output motor control output connections
74 TABLE
75   countff[2..0] => Ao, Bo, Co, Do;
76   0              => 1,  0,  0,  0;
77   1              => 1,  1,  0,  0;
78   2              => 0,  1,  0,  0;
79   3              => 0,  1,  1,  0;
80   4              => 0,  0,  1,  0;
81   5              => 0,  0,  1,  1;
82   6              => 0,  0,  0,  1;
83   7              => 1,  0,  0,  1;
84 END TABLE;
85
86 -- Display binary output.
87 -- Converted to BCD to drive 7 segment display.
88 displayo[3] = GND;
89 displayo[2..0] = countff[2..0].q;
90
91 END;
92
```

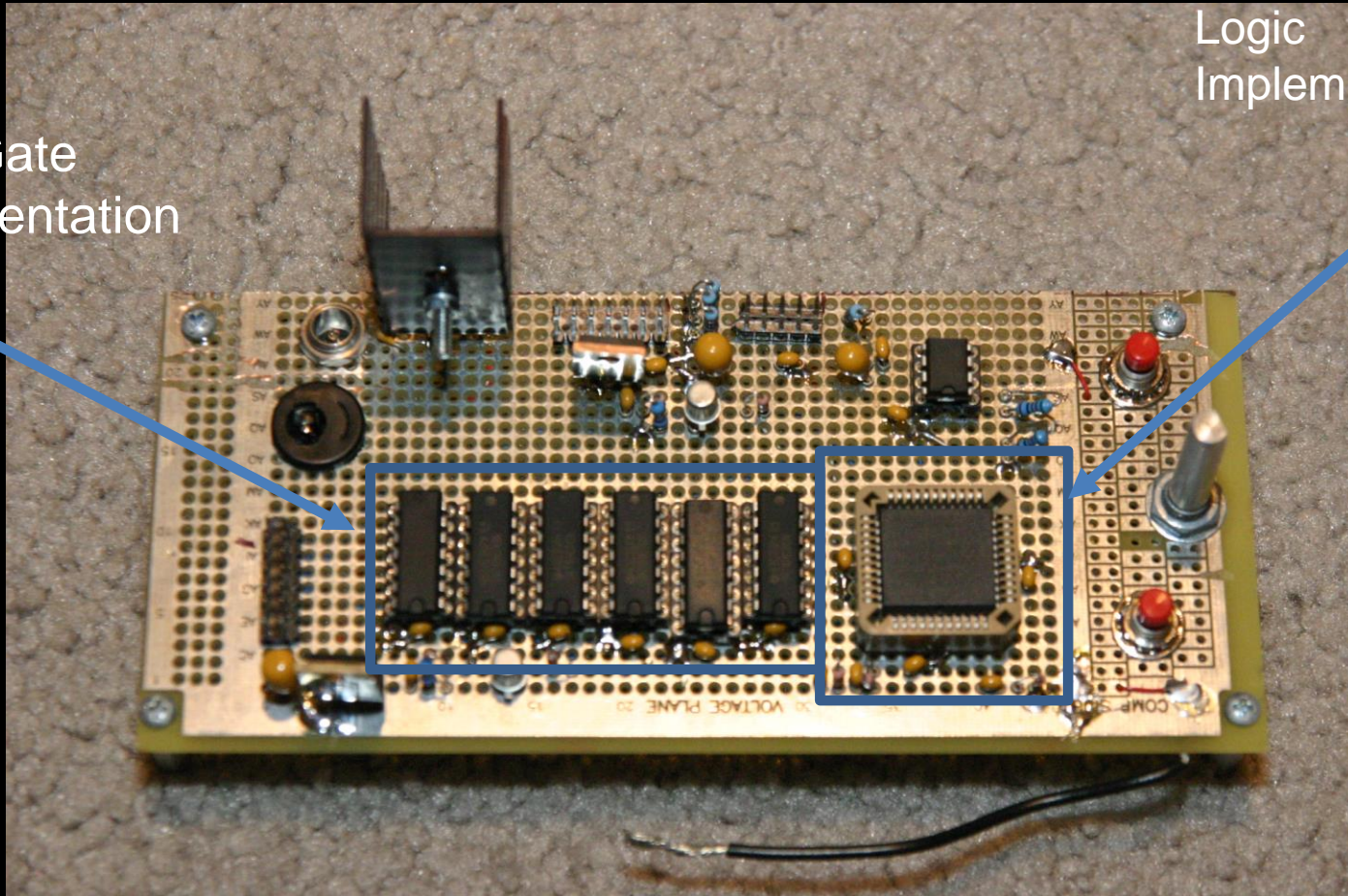
Programmable Logic Code –
Performs same function as logic gates

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Board space required for the two options:

Logic Gate
Implementation

Programmable
Logic
Implementation



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Hand Controller – Circuit board parts placement

R = resistors

C = capacitors

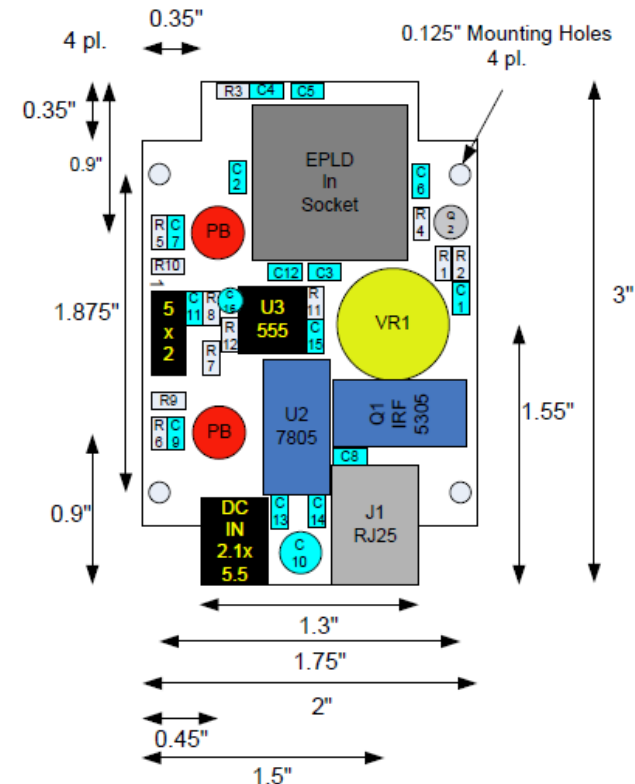
Q = transistors

U = integrated circuits

PB = push button switch

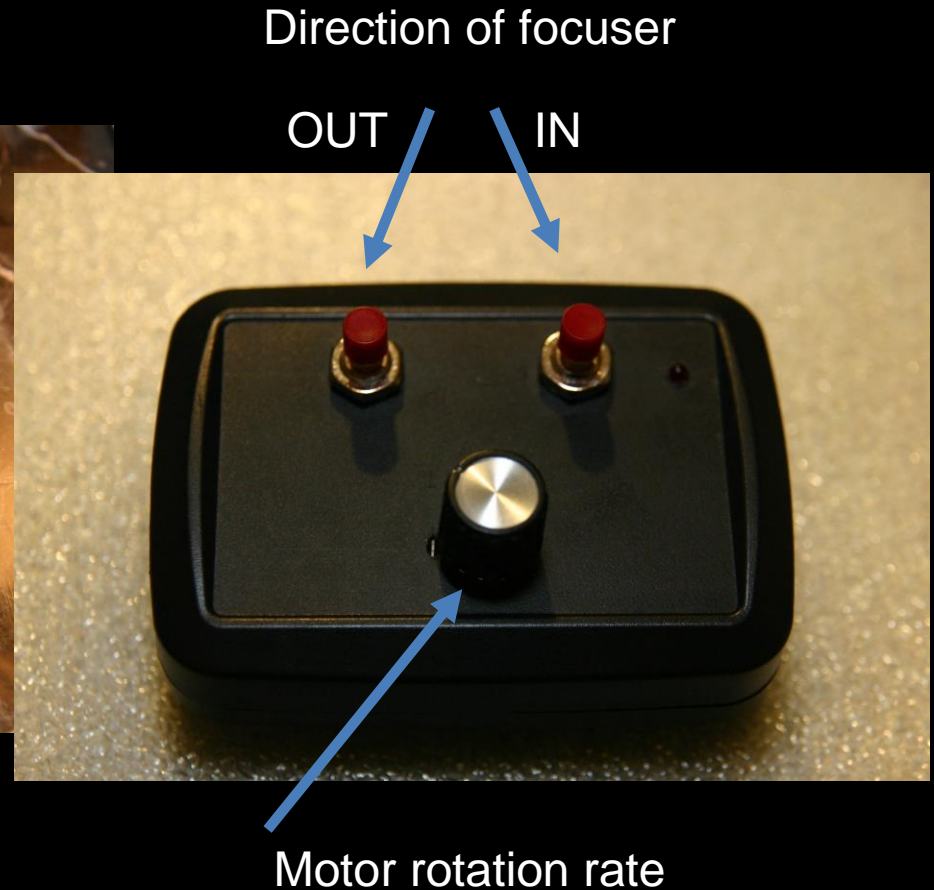
VR = variable resistor

Electronic Focuser HC Circuit Board



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Hand Controller



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Cabling



AC to DC Converter
2.1mm x 5.5mm Plug
7 to 35VDC
Connects to
Hand Controller



RJ25 Cable
Connects Hand
Controller to Motor
Driver Board
Note – Same as
Autoguiding Cable



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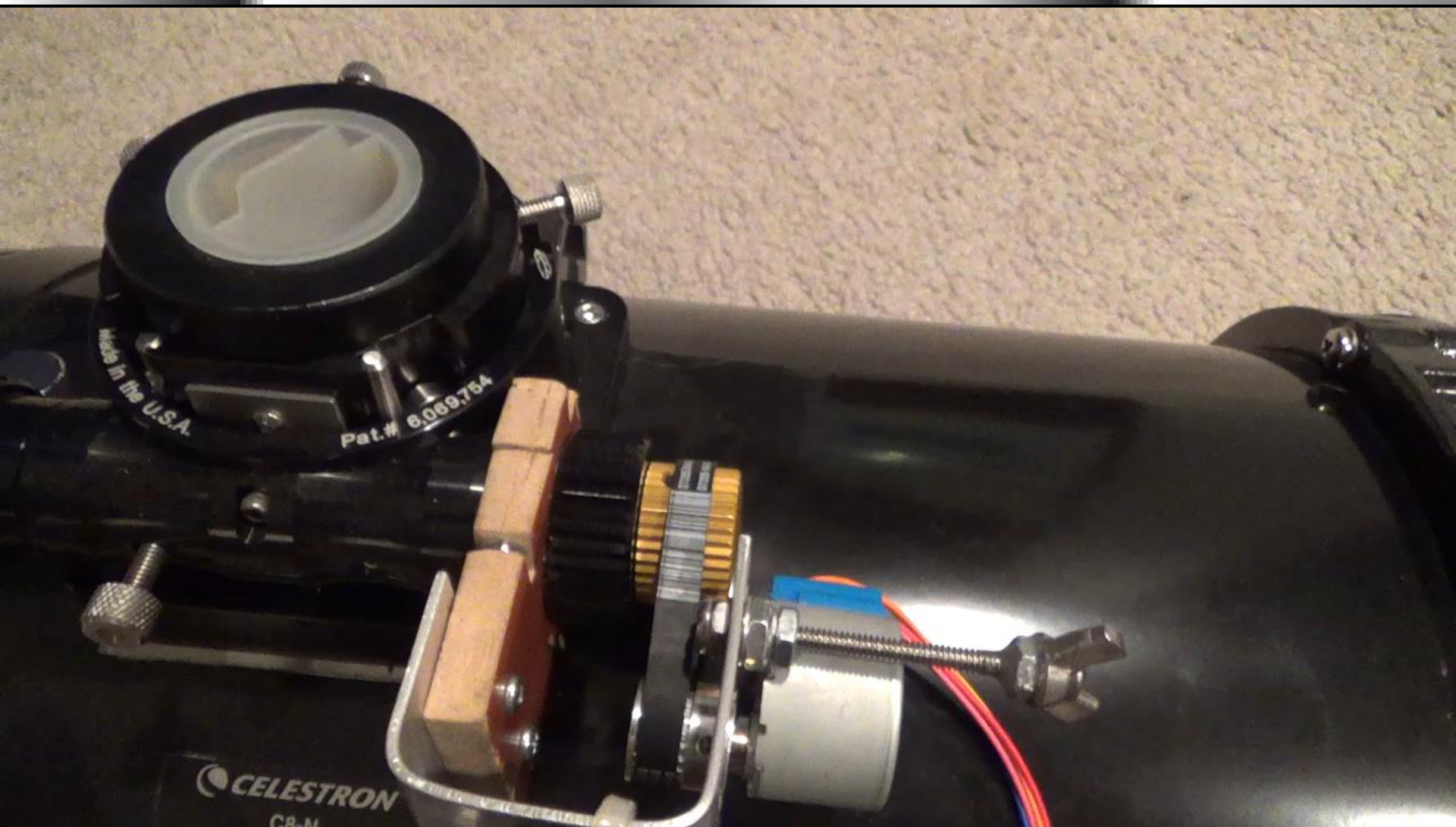
Cost of Project:

Motor & Driver Board:	\$3.42
Belt:	\$3.84
Pulley:	\$4.50
Electronic Parts:	\$31.05
Enclosure:	\$5.00

Total: \$47.81

(Does not include shipping & tax)

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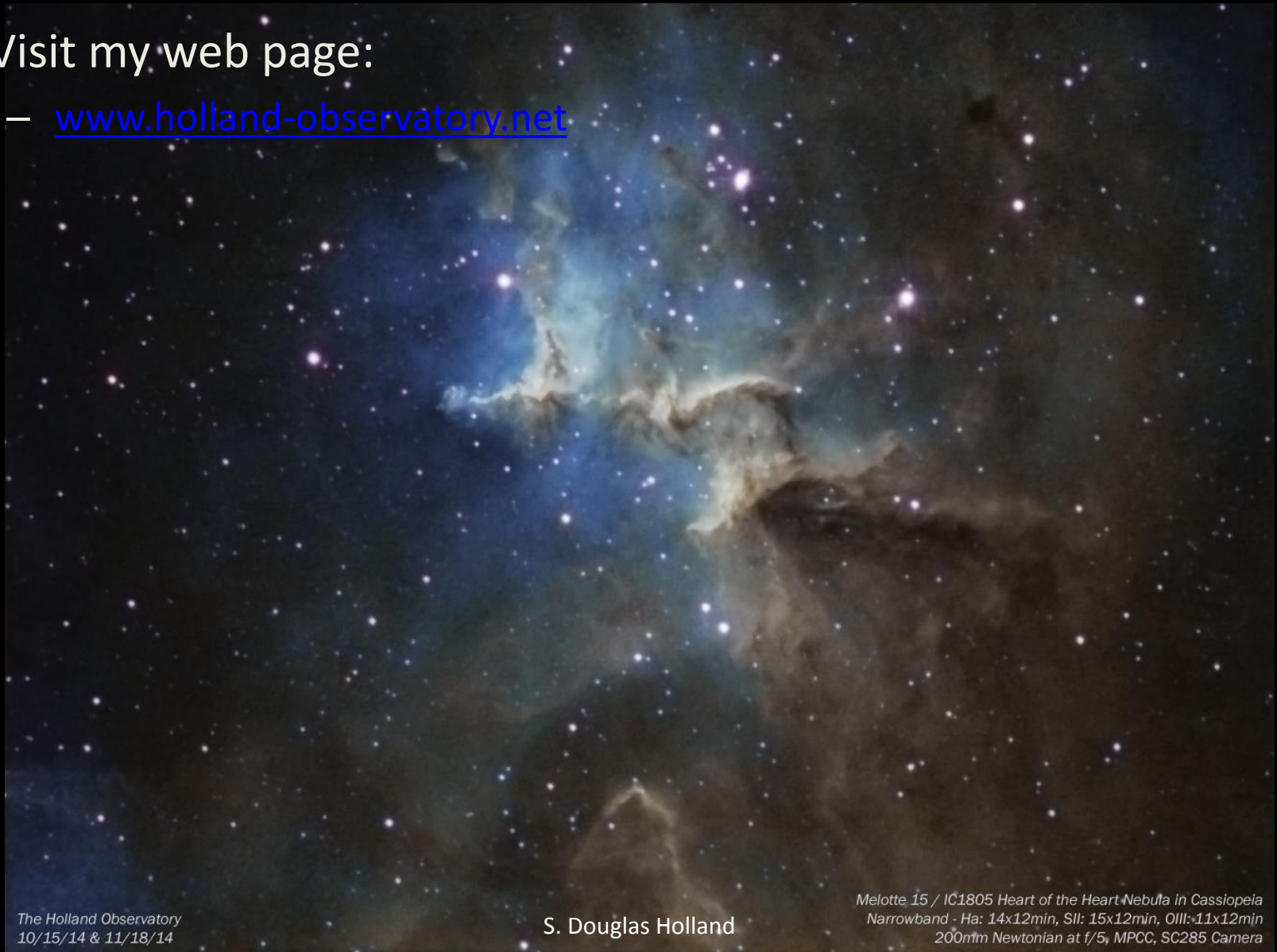


Video of Focuser Operation

S. Douglas Holland

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- Visit my web page:
 - www.holland-observatory.net



The Holland Observatory
10/15/14 & 11/18/14

S. Douglas Holland

Melotte 15 / IC1805 Heart of the Heart Nebula in Cassiopeia
Narrowband - Ha: 14x12min, SII: 15x12min, OIII: 11x12min
200mm Newtonian at f/5, MPCC, SC285 Camera