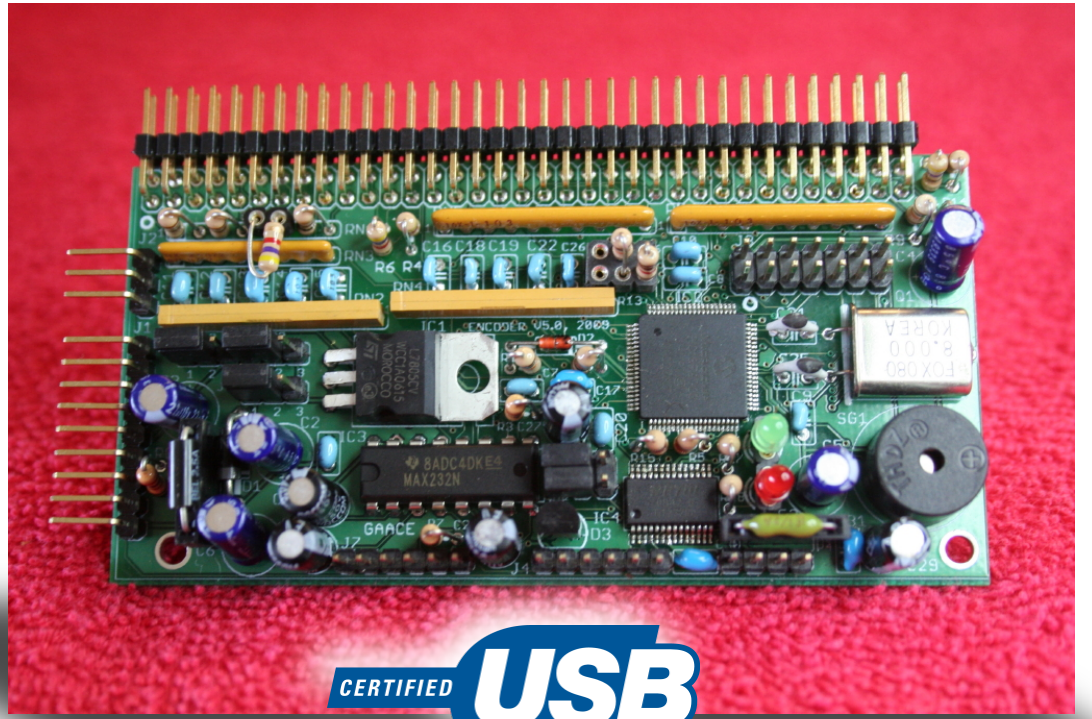
MicroStar 2000
Encoder Revision 5.0



The Latest In The MicroStar 2000 Encoder Line From GAA Custom Electronics

gaa@owt.com

Links and Useful Information

- ***GAA WEBSITE*:** All things MicroStar and a few other interesting goodies. http://www.mstar2k.com
- ***USB RETROFIT ADAPTER:*** An add-on module for upgrading Rev 3.0/4.0/4.1 encoders to USB. Available directly from Jon Crick (j.crick@earthlink.net)
- ***GAA KITS:*** Inexpensive kits for most of the GAA line of products. Kees Talen (http://www.qsl.net/k5bcq/MS2K/MS2K.html
- ***ASSEMBLY SERVICE:*** Want an assembled and tested GAA product at a reasonable price? Need your USB adapter installed in an existing transmitter? Need a custom transmitter built from Microstar components? Contact Danny Miller (millerdg@charter.net)
- ***COMPONENT RESOURCES:***
  - **All Electronics** (Surplus electronic parts) **http://www.allelectronics.com/**
  - **Electronics Goldmine** (Surplus electronics parts) **http://www.goldmine-elec.com/**
  - **Circuit Specialists** (Electronic parts and Salecom switches) **http://www.circuitspecialists.com/**
  - **Unicorn Electronics** (Inexpensive headers and electronic parts) **http://www.unicornelectronics.com/**
  - **Mouser** (Retail electronic parts) **http://www.mouser.com/**
  - **Digikey** (Retail electronic parts) **http://www.digikey.com/**
  - **Marvin P. Jones & Associates** (Surplus electronic parts) **http://www.mpja.com/**
  - **SparkFun Electronics** (Electronic parts and fun stuff) **http://www.sparkfun.com/**
  - **SMC Electronics** (Small electronics parts supplier) **http://smcelectronics.com/index.shtml**

Encoder Revision History

The MicroStar 2000 Encoder project started in 2000 with the first PC boards built in 2001. Below is a brief history of the Encoder hardware revisions.

- Rev 1.0: Powered by the Microchip PIC 17C766. Only 2 were built.

- Rev 2.0: Initial release to about 30 early customers through Cabi's MP8000 list. These PC boards had no solder mask or silk screen.

- Rev 3.0: The final PIC 17C766 design, several hundred of these PC boards were produced.

- Rev 4.0: A major board redesign for the Microchip PIC 18F8722 and were smaller than the older Rev 3.0 boards. An adapter board was also made available that would allow upgrade of Rev 3.0 boards to the new PIC. Over 100 Rev 4.0 boards were produced.

- Rev 4.1: Essentially a Rev 4.0 board with solder mask covered vias to make fabrication a bit easier.

- **Rev 5.0: An updated design that features an on-board USB interface! With the newer computers being built without serial ports, a USB to serial converter is necessary for the computer to communicate with the encoder when using the Microstar PC application to change aircraft settings or upgrade firmware. With the addition of USB to the Microstar encoder, the adapter is no longer necessary and a USB A male to mini-B male cable is all that is required between the PC and encoder. The footprint and mounting dimensions are the same as the Rev 4.0/4.1 boards making upgrading very easy.**

The USB upgrade was designed by Jon Crick and donated to the Microstar project. **Many thanks Jon!** **[NOTE: Jon has also designed and is producing a USB retrofit adapter for Rev 3.0/4.0/4.1 boards. See the GAA website under "USB ADAPTER" for details or contact Jon directly (See "Links and Useful Information" for contact details)].**

Encoder USB Build Options

Rev 5.0 encoder allows the builder to select several communication options via onboard jumpers. The builder may elect to fully populate the board and select back and forth between all options at will or select a single option and delete the unneeded components. The options are as follows:

OPTION 1: USB and RS232 (selectable via jumpers)

- Allows communication from the encoder to the Microstar PC application via **USB** or **RS232** depending on the jumper settings.
- RS232 is retained to allow buddy box use AND support of negative bias voltage displays.
- Install jumpers on JP5 from pins 1 to 3, and 2 to 4 to use the USB port.
- Install jumpers on JP5 from pins 3 to 5, and 4 to 6 to use the RS232 port.

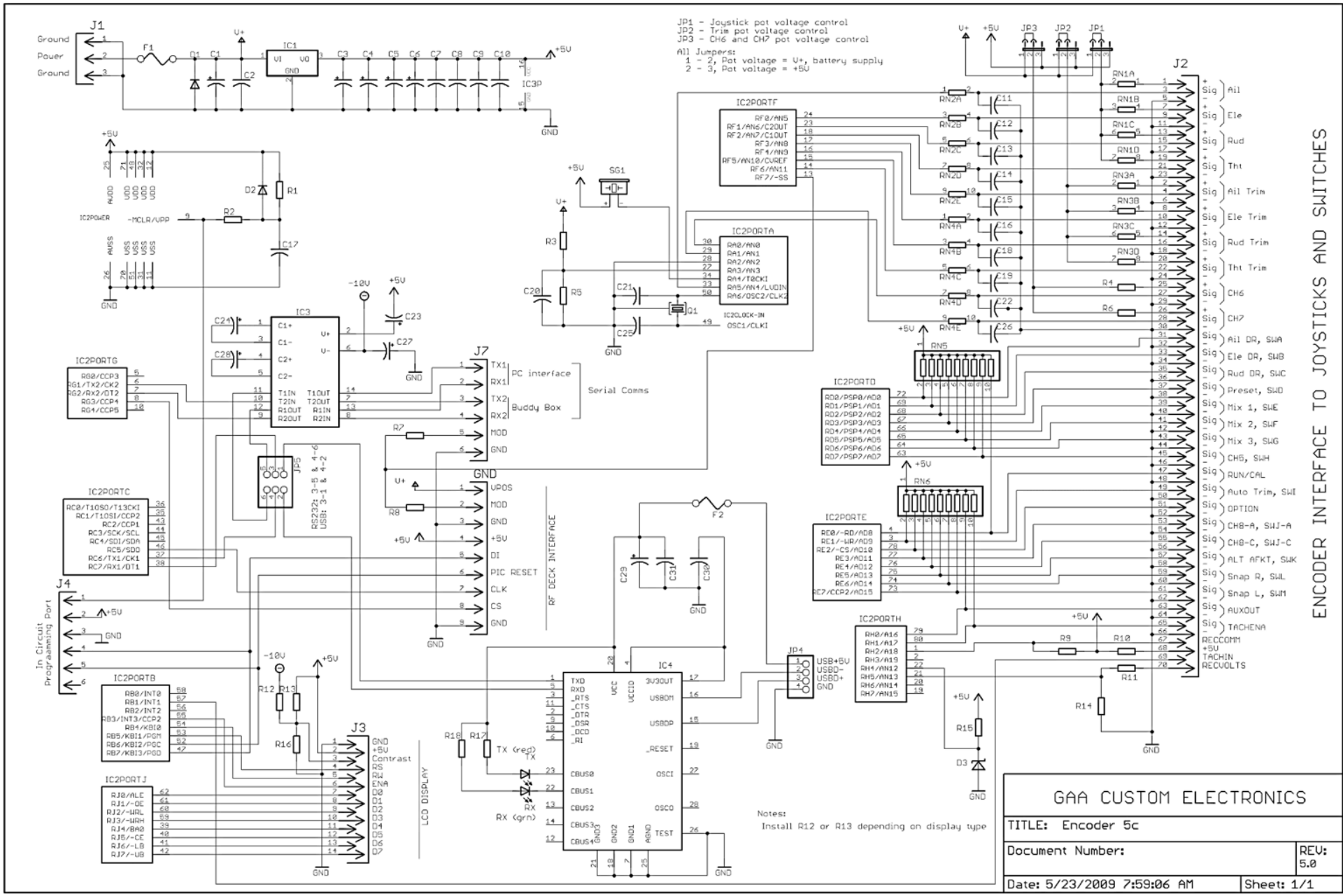
OPTION 2: RS232 only, USB disabled via jumper (The 5.0 board will work like a 4.0/4.1 board)

- Communication from the encoder to the Microstar PC application will be via RS232 (serial) port on the PC.
- RS232 allows buddy box use AND support of negative bias voltage displays.
- Install jumpers on JP5 from pins 3 to 5, and 4 to 6.
- The following parts are not required and may be omitted if desired: IC4, R17, R18, C29, C30, C31, RX/TX LEDs, JP4, F2, and the USB breakout board (BOB-08401).

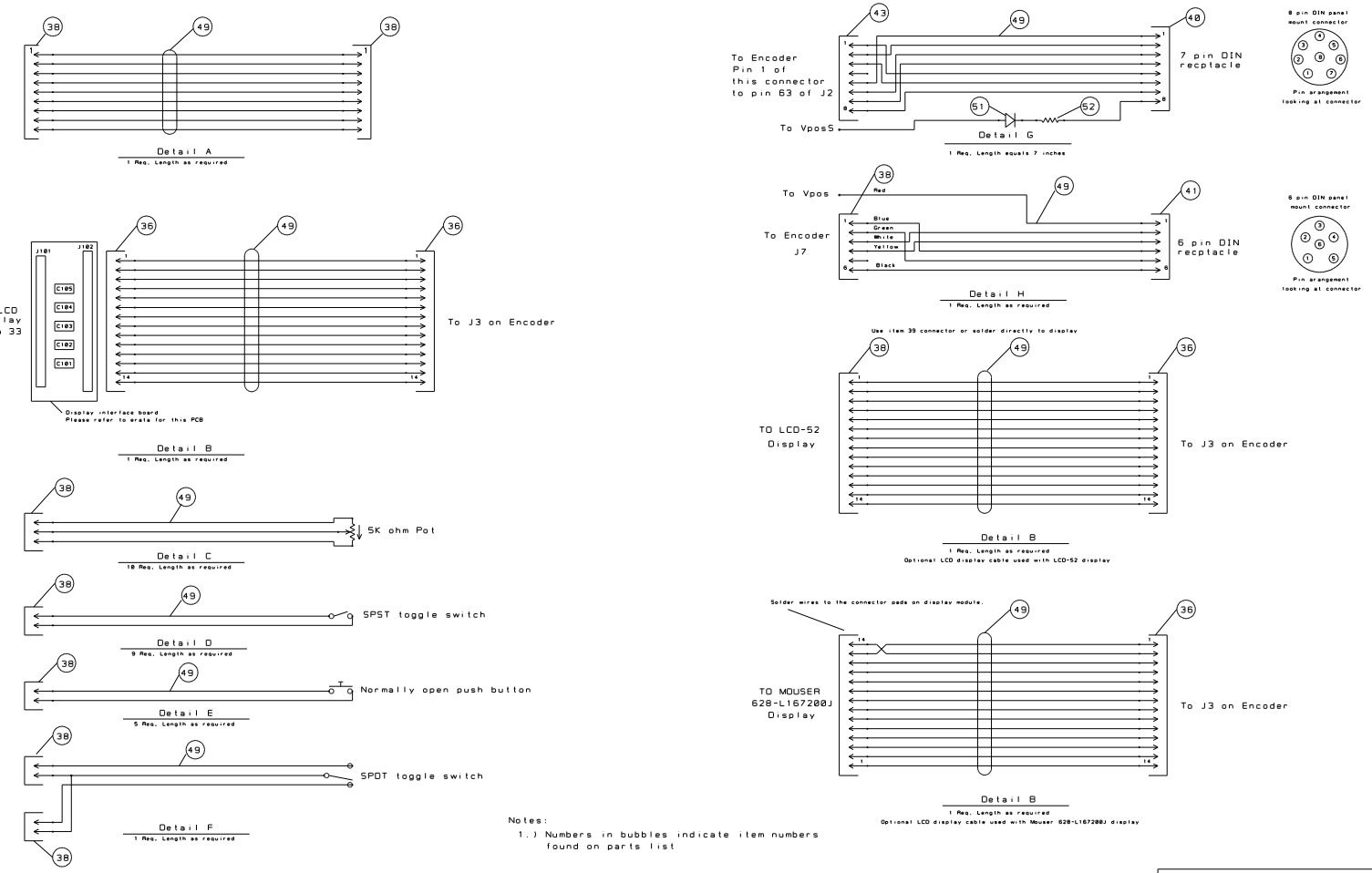
OPTION 3: USB only, RS232 disabled by part deletion

- For this option, the following parts must be omitted: IC3, C23, C24, C27, and C28.
- Please note that some displays use a negative bias voltage that is generated by the MAX232 chip and using this option will result in no negative bias supply, also the MicroStar buddy box mode will not work with option because the required serial interface will not be present.
- Allows communication from the encoder to the Microstar PC application via **USB ONLY**
- Install jumpers on JP5 from pins 1 to 3, and 2 to 4.

Encoder Schematic



Encoder Cabling

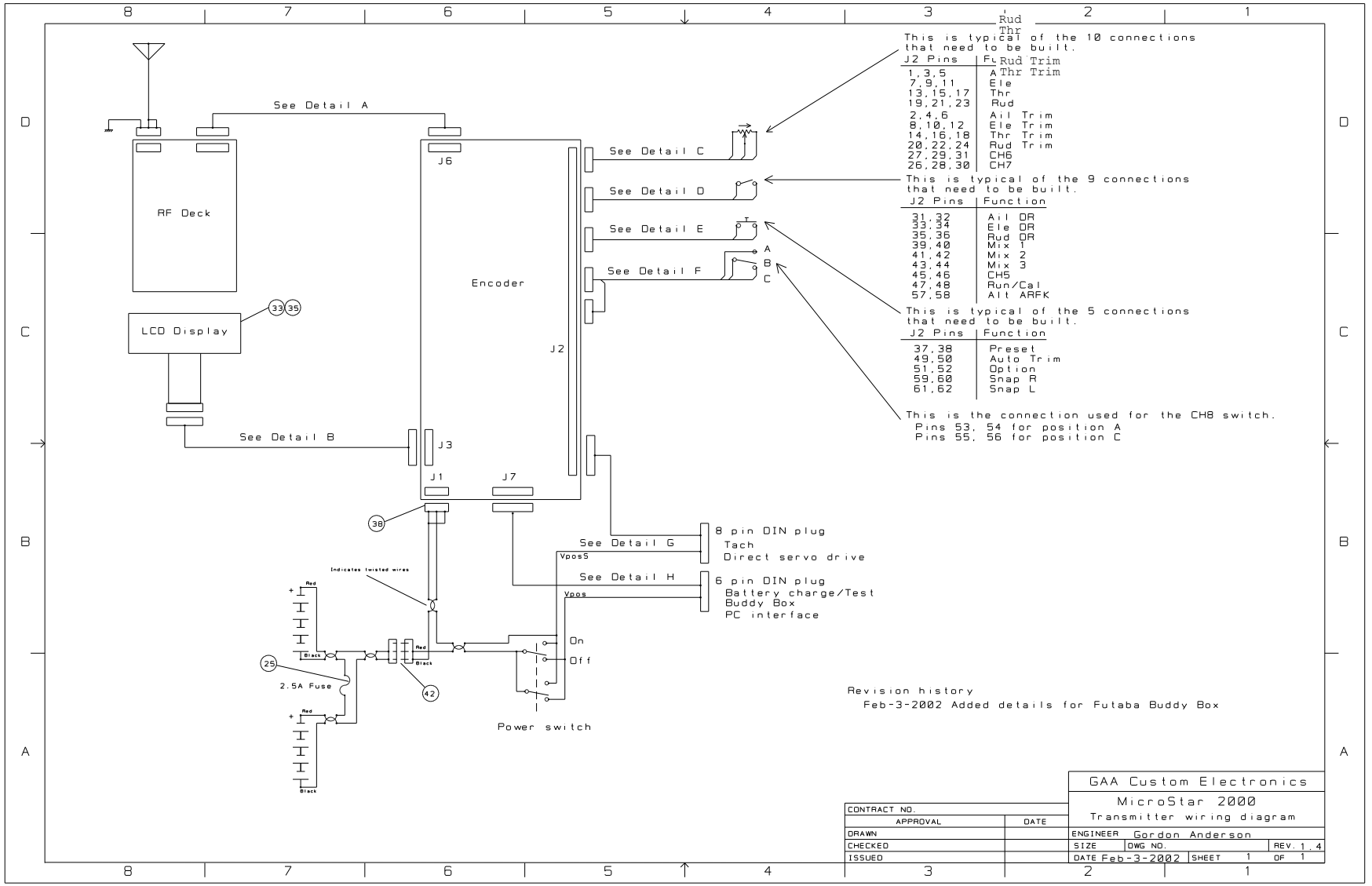


Notes:
1.) Numbers in bubbles indicate item numbers found on parts list

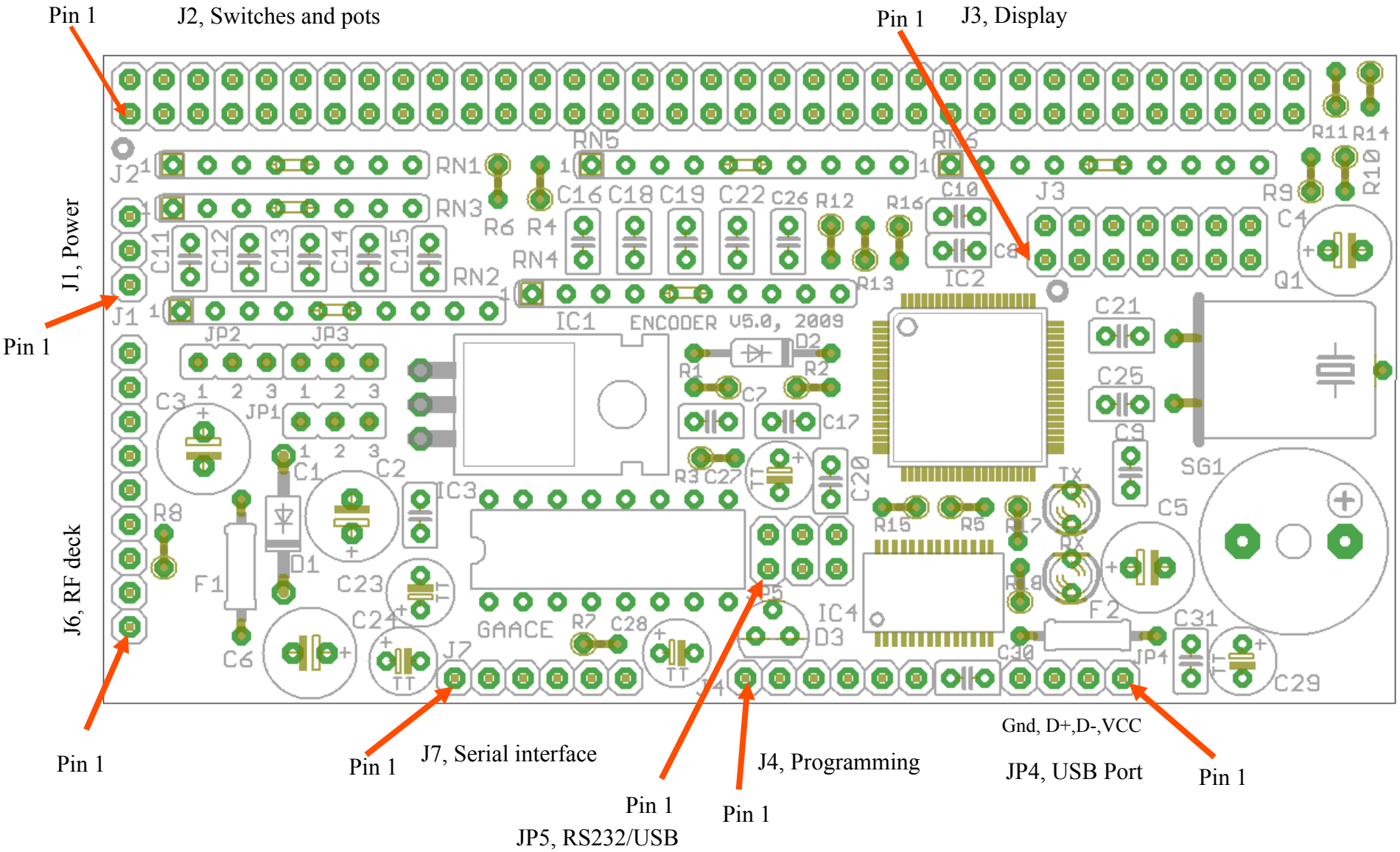
Revision history:
Feb-3-2002 Added details for Futaba Buddy Box support

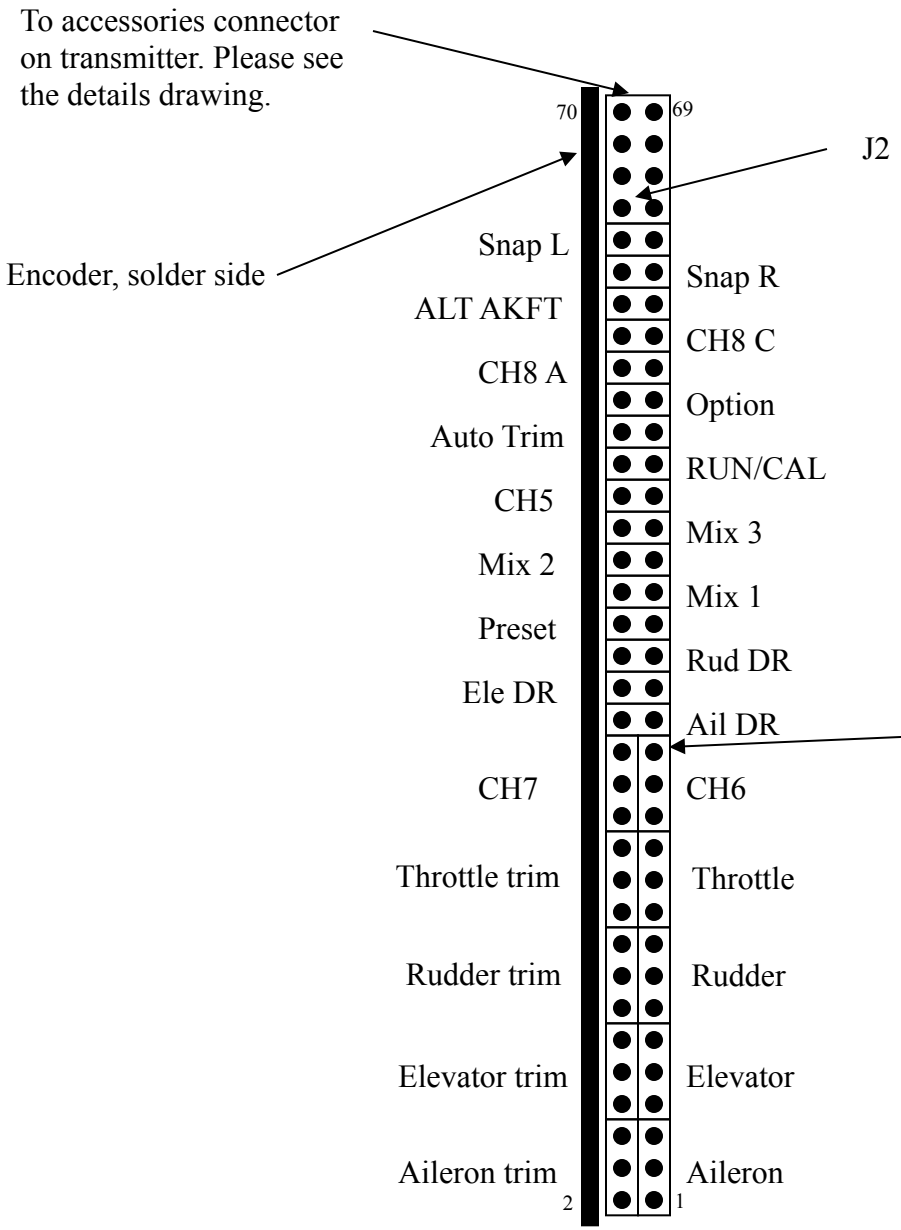
CONTRACT NO.		GAA Custom Electronics
APPROVAL	DATE	MicroStar 2000 Cable Details
DRAWN		ENGINEER Gordon Anderson
CHECKED		SIZE / DWG NO. / REV. 1.5
ISSUED		DATE FEB-3-2002 / SHEET 1 OF 1

Encoder Block Diagram



Encoder Load Map - Top, Component Side





Encoder J2 connector pin assignments

Each of these connectors are cut from parts list item 37. You will need 10 three pin connectors and 16 two pin connectors.

Unused switch inputs can be left open. Unused joystick pot inputs should be grounded for proper operation. This can be done using a shorting jumper. i.e. if the aileron trim pot is not used short J2 pins 4 to 6.

Encoder Parts List, Rev 5.0

Item	Quanity	ID	Part number	Description	Supplier	Cost each	Total cost
Encoder Circuit Board and Components							
1	1	RN1	268-100-RC	100 ohm resistor network, individual	Mouser	0.20	0.20
2	2	RN2, RN4	652-4610X-2LF-1K	1K ohm resistor network, individual	Mouser	0.34	0.68
3	1	RN3	268-4.7K-RC	4.7K ohm resistor network, individual	Mouser	0.20	0.20
4	2	RN5,RN6	266-10K-RC	10K ohm resistor network, bussed	Mouser	0.25	0.50
5	3	R1,R9,,R13 (or R12 see notes)	10KQBK-ND	10K ohm, 1/4 watt	Digikey	0.05	0.15
6	4	R2,R5,R7,R15	1.0KQBK-ND	1K ohm, 1/4 watt	Digikey	0.05	0.20
7	2	R17, R18	330QBK-ND	330 ohm, 1/4 watt	Digikey	0.05	0.10
8	1	R11	470QBK-ND	470 ohm, 1/4 watt	Digikey	0.05	0.05
9	1	R14	220QBK-ND	220 ohm, 1/4 watt	Digikey	0.05	0.05
10	2	R3,R8	2.7KQBK-ND	2.7K ohm, 1/4 watt	Digikey	0.05	0.10
11	2	R4,R6	4.7KQBK-ND	4.7K ohm, 1/4 watt	Digikey	0.05	0.10
12	1	R10	1.0QBK-ND	1 ohm, 1/4 watt	Digikey	0.05	0.05
13	1	R16	1.0KQBK-ND	1K ohm, 1/4 watt, adjust value to set display contrast	Digikey	0.05	0.05
14	5	C1,C3,C4,C5,C6	P981-ND	22uF 35V cap	Digikey	0.11	0.55
15	1	C29	P916-ND	10uF 25V cap	Digikey	0.19	0.19
16	4	C23,C24,C27,C28	P993-ND	1 uF 50V	Digikey	0.08	0.32
17	16	C2,C7-C16,C18-C20,C22,C26	495-1066-1-ND	0.015 uF 50V ceramic	Digikey	0.14	2.24
18	2	C21,C25	490-3684-ND	12 pF, 50V, NPO ceramic	Digikey	0.28	0.56
19	3	C17,C30,C31	490-3810-ND	0.1 uF, 50V, ceramic	Digikey	0.16	0.48
20	1	SG1	102-1115-ND	Piezo Buzzer	Digikey	2.64	2.64
21	1	IC1	NJM#7805FA-ND	7805 5V regulator	Digikey	0.60	0.60
22	1	IC2	PIC18F8722-I/PT-ND	18F8722 PIC Microcontroller	Digikey	17.75	17.75
23	1	IC3	511-ST232EBN	RS232 level converter	Mouser	1.50	1.50
24	1	IC4	895-FT232RL	USB interface	Mouser	4.50	4.50
25	1	F1	F2321-ND	2.5 Amp pico fuse	Digikey	0.61	0.61
26	1	F2	F2311-ND	0.5 Amp pio fuse	Digikey	0.61	0.61
27	1	D1	1N4004GICT-ND	1N4004	Digikey	0.07	0.07
28	1	D2	1N4148DICT-ND	1N4148 signal diode	Digikey	0.03	0.03
29	1	D3	296-9559-5-ND	2.5 volt reference diode	Digikey	0.80	0.80
30	1	J2	S2111E-36-ND	Right angle header x 2	Digikey	3.96	3.96
31	1	J1,J6	S1111E-36-ND	Right angle header x 1	Digikey	2.11	2.11
32	1	J4,J7,JP1,JP2,JP3,JP4	S1011E-36-ND	Header x 1	Digikey	1.51	1.51
33	1	J3,JP5	S2011E-36-ND	Header x 2	Digikey	2.74	2.74
34	1	TX	67-1064-ND	Red LED	Digikey	0.10	0.10
35	1	RX	67-1062-ND	Green LED	Digikey	0.33	0.33
36	1	Q1	X021-ND	8MHz crystal	Digikey	0.40	0.40
37	1		BOB-08401	Breakout Board for USB miniB	Sparkfun	1.95	1.95
38	1	as needed	4 conductor shielded cable	Ground shield at connector			
					Grand total		48.98

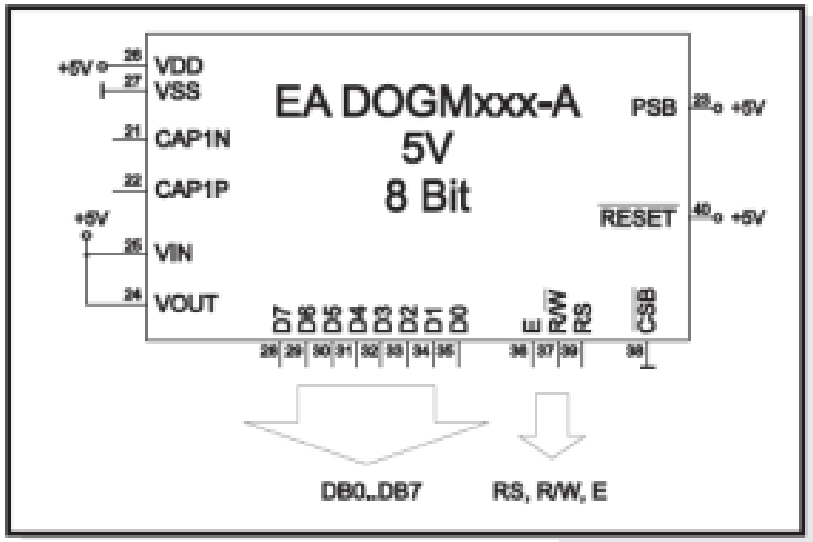
Transmitter Components

Item	Quanity	ID	Part number	Description	Supplier	Cost each	Total cost	Notes	Option 1	Option 2	Option 3
32	1		67-1768-ND	2 X 16 LCD display	Digikey	10.34	10.34	3	10.34		
			67-1769-ND	2 X 16 LCD display (option)	Digikey	11.38	0				
33	1		73-1177-ND	2 X 16 LCD on glass display	Digikey	15.08	15.08	3		15.08	
34	1	J101	HFG24T-ND	1mm Flex connector, RA	Digikey	1.37	1.37	4		1.37	
35	1		PRD250LPW-ND	Bezel	Digikey	3	3	2			
36	1		164-9007	IDC 2 x 7 connectors	Mouser	0.5	0.5		0.5	0.5	
37											
38	3		929974-01-36-ND	Single row female	Digikey	1.23	3.69	2	3.69	3.69	3.69
39	2		534-612	Threaded bracket	Mouser	0.14	0.28		0.28	0.28	0.28
40	1		CP-1280-ND	8 pin DIN recptacle	Digikey	0.86	0.86		0.86	0.86	0.86
41	1		CP-1260-ND	6 pin DIN recptacle	Digikey	0.74	0.74		0.74	0.74	0.74
42	1		336DN3	3 pin deans connector pair	CERMARK	2	2	2			
43	1		929975-01-36-ND	Dual row female	Digikey	2.04	2.04		2.04	2.04	2.04
44	5	C101-C105	140-CC502B104K	0.1 uF capacitor, 1205	Mouser	0.07	0.35	1,4		0.35	
45	1		HFF18T-ND	1mm Flex connector	Digikey	0.88	0.88	5			0.88
46	1		260-100K	100K resistor, 805	Mouser	0.08	0.08	5			0.08
47	1		R011-10-ND	25 conductor multi ribbon	Digikey	5.69	5.69	2	5.69	5.69	5.69
48	1			Encoder PCB	GAA	10	10		10	10	10
49	1			On glass display PCB	GAA	2	2			2	
50	1		ECM-A1010	4x12 LCD display	Earth Tech	3	3	3			3
51	1		11DQ3-ND	Shottky Rectifier	Digikey	0.38	0.38	2			
52	1		1.0QBK-ND	1.0 ohm 1/4 W resistor	Digikey	0.28	0.28	2,6			

Notes				
1	Sold in pkg of 10	2 x 16 standard display total cost	34.14	
2	Optional	2 x 16 on glass display total cost		42.6
3	Other display options are posible, select item 32, 33, or 50	4 x 12 surplus display total cost		27.26
4	Needed for item 33			
5	Used for Earth Tech 4x12 display			
6	Sold in pkg of 5			

The item numbers on this parts list refer to MicroStar 2000 "Transmitter Wiring Diagram" and "Cable Details" drawings.

DOGM162 Display Connection Details
(Another display option!)



Pin	Symbol	Level	Function
1	NC		(A1+: LED backlight)
2	NC		(C1-: LED backlight)
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19	NC		(C2-: LED backlight)
20	NC		(A2+: LED backlight)
21	CAP1N	-	Voltage Booster + (0,1..1uF)
22	CAP1P	-	Voltage Booster - (0,1..1uF)
23	PSB	H / L	L= Serial Mode, H= Parallel Mode
24	VOUT	-	Voltage Booster Output
25	VIN	-	Voltage Booster Input
26	VDD	H	Power Supply +3,3..5V
27	VSS	L	Power Supply 0V (GND)
28	D7	H / L	Display Data (MSB)
29	D6	H / L	Display Data
30	D5	H / L	Display Data
31	D4	H / L	Display Data
32	D3	H / L	Display Data
33	D2	H / L	Display Data
34	D1	H / L	Display Data
35	D0	H / L	Display Data (LSB)
36	E	H	Enable (falling edge)
37	R/W	H / L	L= Write, H=Read
38	CSB	L	Chip Select
39	RS	H / L	L= Command, H= Data
40	RESET	L	Reset

DOGM162 Display Connection Details

DOG display pin number	Encoder J3 pin number
21	NC
22	NC
23	2
24	2
25	2
26	2
27	1
28	14
29	13
30	12
31	11
32	10
33	9
34	8
35	7
36	6
37	5
38	1
39	4
40	2

Note:

1.) R12, R13, and R16 are not required when using the DOG display.

2.) The DOGM162 display is not shown on the parts list but is supported by the Encoder firmware.

ENCODER 5.0 GENERAL BUILD NOTES

1. If USB is used, installation of the FTDI VCP Windows drivers are necessary on the computer running the Microstar PC application. The Windows drivers may be downloaded from http://www.ftdichip.com/Drivers/VCP.htm.

2. R17, R18, TX, and RX (item numbers 7, 34, and 35) can be optional components for the USB function. Builders may omit them since they'll be enclosed in the case. Alternately, they might choose to extend the LEDs to the case exterior using wires.

3. For single stick transmitters, resistor network RN1 is not used. Instead use 4 individual resistors populating positions RN1-1, RN1-2 and RN1-4 with 100 ohm resistors and position RN1-3 with a 4.7K resistor.

4. For the USB cable between the encoder and the breakout board (BOB-08401), an old USB cable is an excellent source (for example, a USB mouse or keyboard). Suggested mounting of the BOB-08401 to the transmitter case is two 4-40 standoffs and two nuts on the board with two 4-40 screws holding the board to the case.

5. If you want to save 55 cents on the FT232RL, order it from SparkFun with the required breakout board (BOB-08401).