APPENDIX B - MOUNT SPECIFIC DATA
For
ANDREW Trifold

This appendix describes RC3000 operations unique for Andrew 3.7/4.5m. Trifold mounts equipped with the VS-1 Antenna Interface Unit (AIU). Differences between this version and the operation described in the "baseline" RC3000 manual are noted on a paragraph by paragraph basis.

Manual Organization

This appendix is provided as a supplement to the baseline RC3000 manual.

RC3000 Features – Configuration

A RC3000D version of hardware is required for this mount. The mount model will be designated as N1.

Software will be designated as RC3K-N1-xxx

1.3.1 Controller Description

The model RC3000D differs from a baseline RC3000 in the following ways:

RESOLVER BOARD. A resolver to digital conversion board has been added to the baseline RC3000 hardware. A schematic of this board is shown in section 4.2.

VS-1 COMMAND BOARD. In place of a DC Motor Control module, a VS-1 command board is used to generate drive signals to the VS-1 AIU. A schematic of this board is shown in section 4.2.

1.3.2 System Interface Requirements

The interface requirements for this mount are very similar to the "standard" RC3000 interface described in the baseline manual. The main difference are:

- instead of generating drive voltage from the controller, the RC3000D generates drive commands to the VS-1 AIU. The VS-1 will then generate the actual drive voltage to the mount.

- limit switch inputs from the mount are interpreted by the VS-1. The RC3000D allows for the setting of "software limits".

- azimuth, elevation and polarization resolver position feedback is passed through the VS-1 to the RC3000D

The RC3000D essentially looks like an Andrew APC-100 or APC-300 controller to the VS-1 AIU.

1.3.3 Operational Overview

The operation of the N1 version is almost identical to that described in the baseline manual. Differences will be noted in the appropriate paragraphs.

1.3.7 Drive System

Position Sensing and Limits. Azimuth, elevation and polarization software limits are implemented.

Jam and Runaway Sensing. Jammed and runaway sensing is based on resolver counts.

2.1.4 Inclinometer Orientation

For the Trifold mount (N1), the inclinometer should be 15 degrees clockwise beyond vertical when the reflector is at the 60.0 degree look (RF) angle position.

2.2 Electrical Connections

2.2.1 Power Entry

The RC3000D uses a 1 Amp fast-blow fuse. Note: this smaller value fuse may be used since the RC3000D does not generate the actual drive voltage.

2.2.2 Motor Drive

J7 generates drive signals to the VS-1 AIU per the following table.

J7 PIN	VS-1 Drive Signal
A	AZ – EAST
B	AZ – WEST
C	AZ – FAST
D	AZ – SLOW
E	EL – DOWN
F	EL –UP
G	EL – FAST
H	EL – SLOW
J	POL – CCW
K	POL – CW
L	AZ + EAST
M	POL + CW

2.2.4 Limit Switches

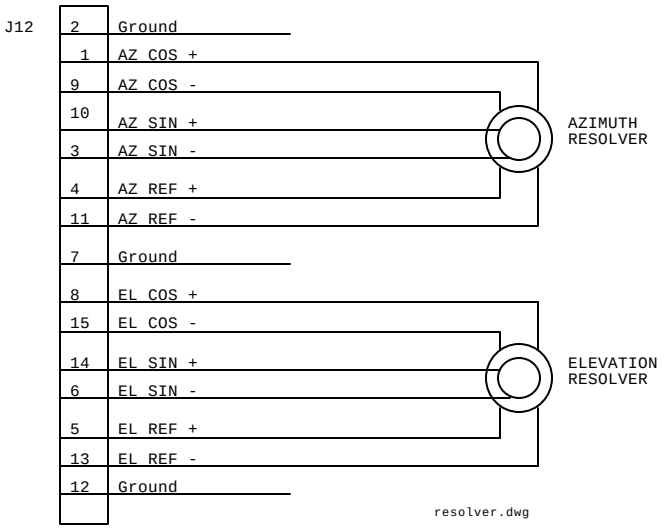
No limit switch indications come to the RC3000D from the mount. All limit switch inputs are hardwired inside the RC3000D.

2.2.10 Pulse Sensor

J4 is used for the polarization resolver input.

2.2.12 Waveguide Switch

J12 is used for the azimuth and elevation resolver interface.



2.3.2 Elevation Calibration

Sensor Polarity. The inclinometer should increase in voltage when going up, elevation resolver count should also increase.

Elevation Reference Position. Both the inclinometer and elevation resolver should be calibrated while the reflector is at the 60.0 degree RF look angle (i.e. the elevation reference position).

With the inclinometer oriented as described in 2.1.4 the elevation reference voltage should be approximately 2.70 volts.

Rotate the elevation resolver until a raw resolver angle of approximately 180.0 degrees in seen in the MAINTENANCE-VOLTS screen. Lock the elevation resolver in place and observe the raw resolver angle. Subtract 60.0 from this observed angle and enter it as the elevation resolver offset (see 3.3.1.2.2).

2.3.3 Azimuth Calibration.

The only position sensor on the azimuth axis is the resolver.

Sensor Polarity. Azimuth resolver “counts” should increase as the mount rotates clockwise. If it does not, the polarity may be changed by setting the azimuth resolver reverse flag.

Azimuth Reference Position. - Position the mount at the azimuth stow position as exactly as possible. Loosen and adjust the azimuth resolver to be as close to 180 degrees (seen at a/d volts screen 3.3.2.1) as possible. The azimuth resolver offset will be 0.0 – “raw resolver angle”.

Azimuth Limits. This version of the RC3000 implements “software” limits. The azimuth CW and CCW pulse limits (3.3.1.3.3) should be set to values that reflect the azimuth resolver count values near the end of azimuth travel. When the RC3000 senses that the azimuth axis has reached these values, it will generate a “software” limit condition even though the actual hardware limit has not been reached. If the user does not want to use the “software limit” feature, set these configuration items to values outside the range of normal azimuth travel.

2.3.4 Polarization Calibration.

Since the polarization axis uses a resolver for feedback, its calibration will be performed the same way as the azimuth axis.

2.4.4 Pulse Scale Factors.

This step in not applicable to the RC3000D. The correct scale factor for resolver "counts" of 10,431 counts per radian is set as the default in software.

3.2.1 Manual Mode.

The scroll up key will switch the display between azimuth, elevation and polarization angles to resolver "counts". The azimuth and polarization angles are generated as a function of the resolver feedback. Elevation angle represents true mount elevation based on feedback from the inclinometer.

3.3.1.2.2 Elevation Calibration.

In addition to the normal inclinometer calibration items, two elevation resolver calibration items are included.

```
REF_V:1.69 OFF:  0.0        CONFIG-ELEV
 DOWN:  0   UP: 90.0   SF:50.00
 LOOK:1    RES: 0.0   REV:0
SET REFERENCE VOLTAGE <0.50 – 3.50>
```

RES: ELEV RESOLVER OFFSET<+/-300.00 DEGREES>
The elev_resolver_offset configuration item defines the offset to be applied to the angle read directly from the elevation resolver for the purpose of displaying elevation angle. Example: If when at the elevation reference (reflector vertical) position the raw elevation resolver angle reads 122.0, a elev_resolver_offset of -100.0 will result in a resolver based elevation angle of 22.0.

REV: ELEV RESOLVER<0-NORMAL 1-REVERSED>
The elev_resolver_reversed configuration item defines whether the polarity of the elevation resolver matches that of the RC3000 resolver circuitry. If the raw elevation resolver angle decreases as the mount moves up, the elev_resolver_reversed item must be described as reversed.

3.3.1.2.3 Azimuth Calibration

In addition to the normal azimuth calibration items, two azimuth resolver calibration items are included. No azimuth reference_voltage item is displayed since no azimuth potentiometer is present.

```
           OFF: 0.0         CONFIG-AZIM
  CCW:180   CW:180
  RES: 0.0 REV:0
AZIM RESOLVER OFFSET<+/-300.00 DEGREES>
```

RES: AZIM RESOLVER OFFSET<+/-300.00 DEGREES>

The azim_resolver_offset configuration item defines the offset to be applied to the angle read directly from the azimuth resolver for the purpose of displaying azimuth angle. Example: If when at the azimuth stow position the raw azimuth resolver angle reads 181.3, a azim_resolver_offset of –181.3 will result in a resolver based azimuth angle of 0.0.

REV: ELEV RESOLVER<0-NORMAL 1-REVERSED>
The elev_resolver_reversed configuration item defines whether the polarity of the elevation resolver matches that of the RC3000 resolver circuitry. If the raw elevation resolver angle decreases as the mount moves up, the elev_resolver_reversed item must be described as reversed.

3.3.1.3.2 Azimuth Pot Drive

Since no potentiometer exists on the azimuth axis, these items actually are used to tune azimuth movements based on angles derived from the resolver feedback.

3.3.1.3.3 Azimuth Pulse Drive
3.3.1.3.6 Elevation Pulse Drive

The items on the Pulse Drive screens are actually used to tune drive movements based on resolver "counts". The resolver counts are used in the same fashion as pulse counts are used for making precise movements (during tracking, recall) of the mount.

NOTE: the azimuth and elevation pulses_per_radian values are set to 10,431. This is the number of resolver counts per radian.
360 degrees / 65536 total counts = 0.005493164 degrees/count or 182.044 counts/degree.
182.044 counts/degree * 57.29 degrees/radian = 10431 counts/radian

3.3.1.3.4 Azimuth Drive Monitoring
3.3.1.3.7 Elevation Drive Monitoring
The items on the Drive Monitoring screens are actually used to tune drive movements based on resolver "counts". The resolver counts are used in the same fashion as pulse counts are used for making precise movements of the mount.

3.3.2.1 Analog to Digital Voltages

In addition to the normal voltages displayed this screen also shows "raw resolver" angles and counts.

```
AZ: 1.114   181.30 33004    AD VOLTAGES
EL: 1.143 1 122.30 22264
POL:2.237  181.30 33044
SIG: 3.756(1) <1>RF <2>SS1 <3>SS2 <4>GND
```

The azimuth, elevation and polarization resolver angles and counts displayed are read directly from the resolvers without being biased by offset terms. The displayed values will reflect if the azimuth, elevation or polarization resolver polarity has been reversed.

3.3.1.2 Reset Defaults

The following table supplies the default configuration item values for each model of mount.

Space has also been provided to record installation specific changes to the configuration items. Note: recording of installation specific changes to defaults may prove valuable when trying to restore system configuration.

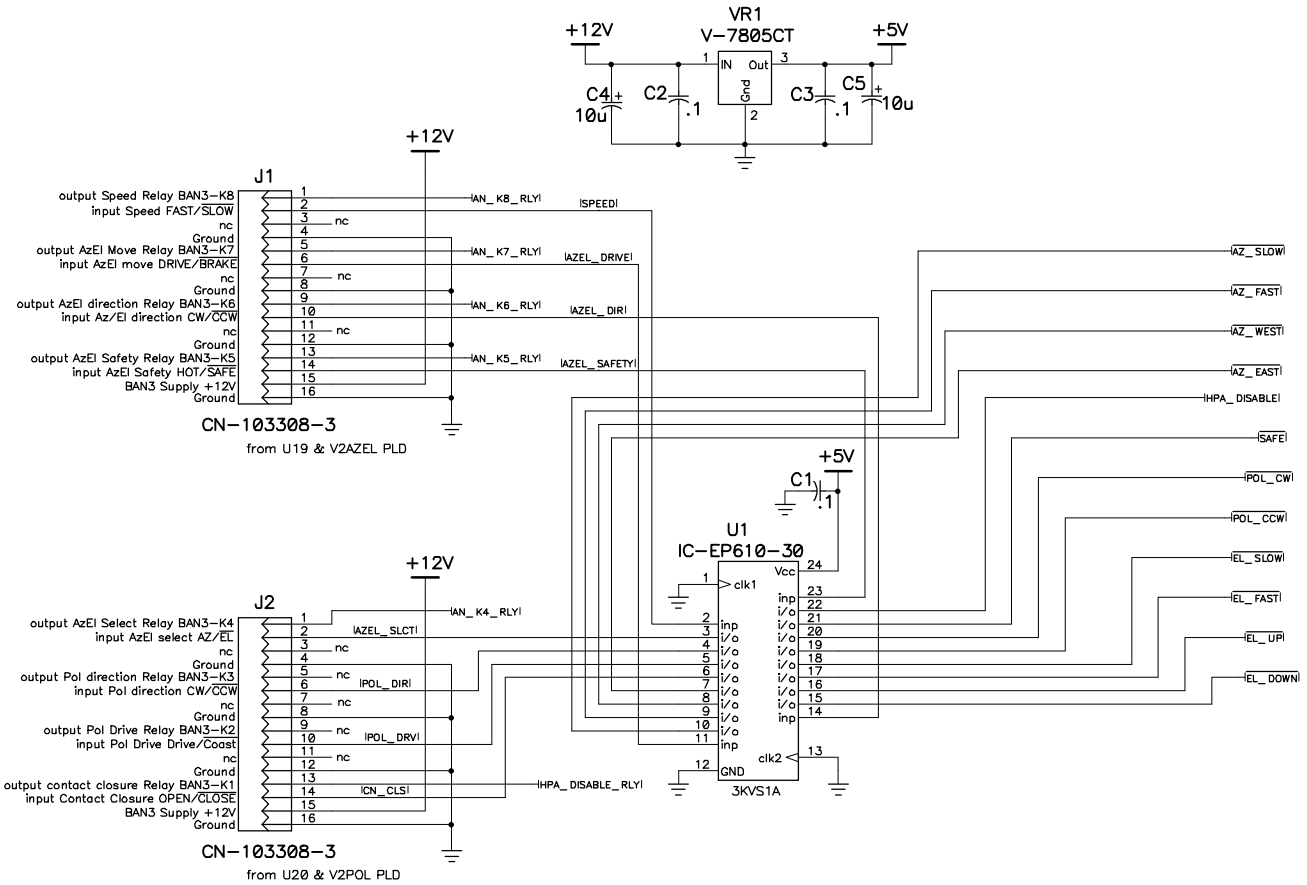
CONFIGURATION ITEM	N1							INSTALL VALUE
SYSTEM DEFINITION								
GPS_present	1							
Compass_present	1							
Mode	2							
antenna_size_cm	450							
Waveguide_Switch_Present	0							
AZIMUTH CALIBRATION								
Azim_offset	0.0							
ccw_azim_limit	165							
Cw_azim_limit	165							
Resolver Offset	-180.0							
Resolver Direction	0							
ELEVATION CALIBRATION								
Zero Voltage	270							
Elev_offset	0.0							
Up_elev_limit	90							
Down_elev_limit	0							
Elevation_Scale_Factor	50.00							
Resolver Offset	-120.0							
Resolver Direction	0							
Elevation_look_configuration	1							
POLARIZATION CAL								
Resolver Offset	-180.0							
Resolver Direction	0							
Polarization_Offset	0.0							
CW Polarization Limit	90.0							
CCW Polarization Limit	90.0							
Polarization_type	2							
H/V_Reference	1							
Default Horizontal Position	-45.0							
Default Vertical Position	45.0							
Pol_Automove_Enable	1							
SIGNAL PARAMETERS								
Channel 1 Polarity	1							
Channel 1 Threshold	100							
Channel 1 Delay	0.1							
Channel 1 Lock Type	0							
Channel 2 Polarity	1							
Channel 2 Threshold	100							
Channel 2 Delay	0.1							
Channel 2 Lock Type	0							
AUTOPEAK								
Autopeak Enabled	0							
Signal Source	1							
RF Band	1							
Spiral Search AZ Limit	3							
Spiral Search EL Limit	3							
Spiral Signal Threshold	200							
Scan Range Limit	8							
Scan Signal Threshold	200							

CONFIGURATION ITEM	N1							INSTALL VALUE
AZIMUTH POT DRIVE								
Fast/Slow Threshold	0.3							
Maximum Position Error	0.1							
Coast Threshold	0.1							
Maximum Retry Count	3							
AZIMUTH PULSE DRIVE								
Pulse Scale Factor	10431							
CW Pulse Limit	63000							
CCW Pulse Limit	2000							
Fast/Slow Threshold	50							
Maximum Position Error	0							
Coast Threshold	3							
Maximum Retry Count	3							
AZIM DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	1000							
Slow Deadband	500							
ELEV POT DRIVE								
Fast/Slow Threshold	0.8							
Maximum Position Error	0.2							
Coast Threshold	0.4							
Maximum Retry Count	3							
ELEV PULSE DRIVE								
Pulse Scale Factor	10431							
UP Pulse Limit	39000							
Down Pulse Limit	21000							
Fast/Slow Threshold	100							
Maximum Position Error	0							
Coast Threshold	3							
Maximum Retry Count	3							
ELEV DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	1000							
Slow Deadband	500							
POL POT DRIVE								
Fast/Slow Threshold	2.0							
Maximum Position Error	0.5							
Coast Threshold	0.3							
Maximum Retry Count	3							
POL DRIVE MONITORING								
Jam Slop	1							
Runaway Slop	200							
Fast Deadband	1000							
Slow Deadband	500							

CONFIGURATION ITEM	N1							INSTALL VALUE
TRACK								
Search Enable	0							
Max Track Error	3							
Search Width	4							
Peakup Holdoff Time	120							
Track Signal Source	2							
Signal Sample Time	2							
REMOTE CONTROL								
Remote Enabled	1							
Bus Address	50							
Baud Rate	6							
STOW / DEPLOY								
AZ STOW	0.0							
EL STOW	95.0							
PL STOW	0.0							
AZ DEPLOY	0.0							
EL DEPLOY	60.0							
PL DEPLOY	0.0							
PL ENABLED	0							

4.2 schematics

VS-1 card
Resolver card

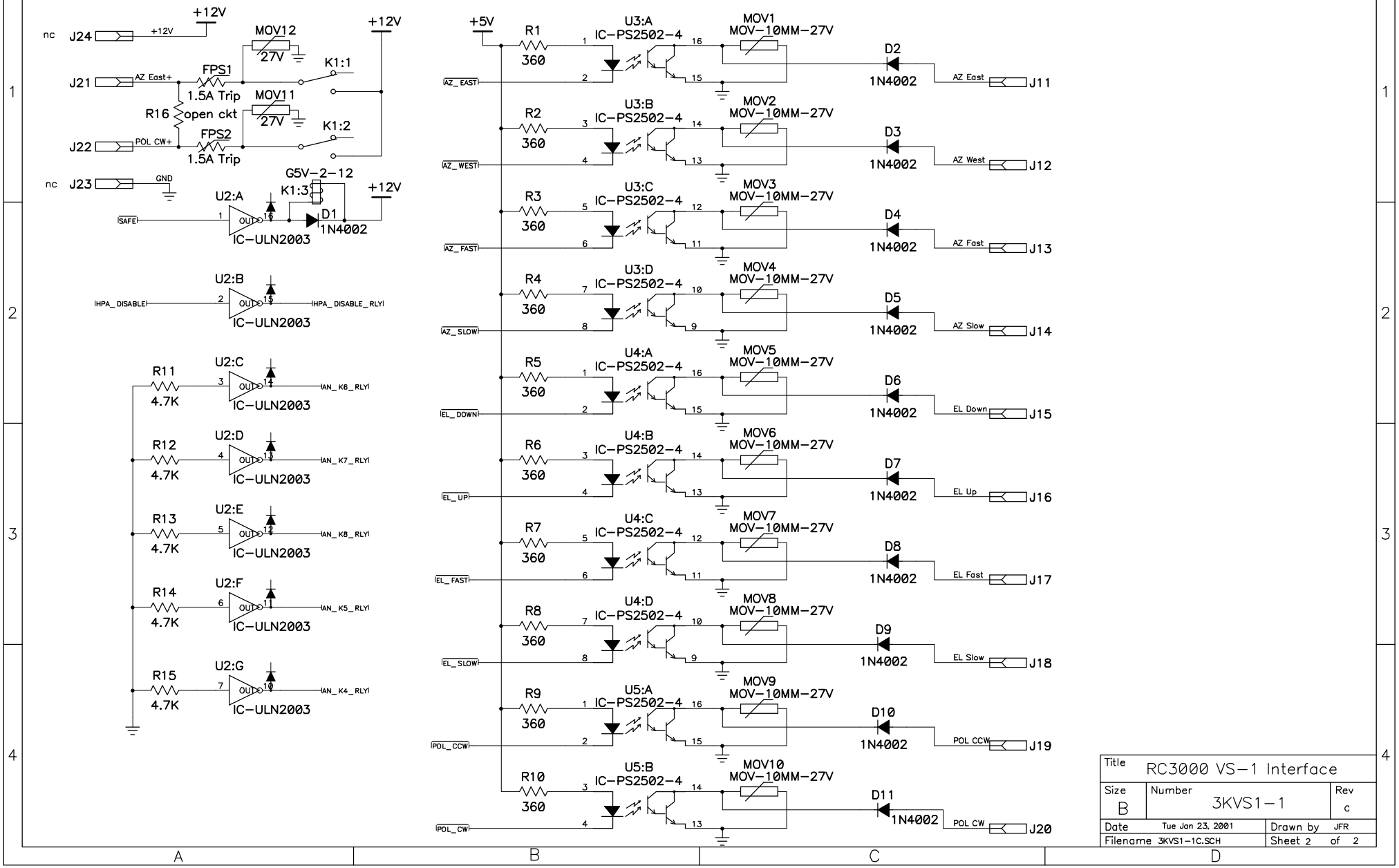


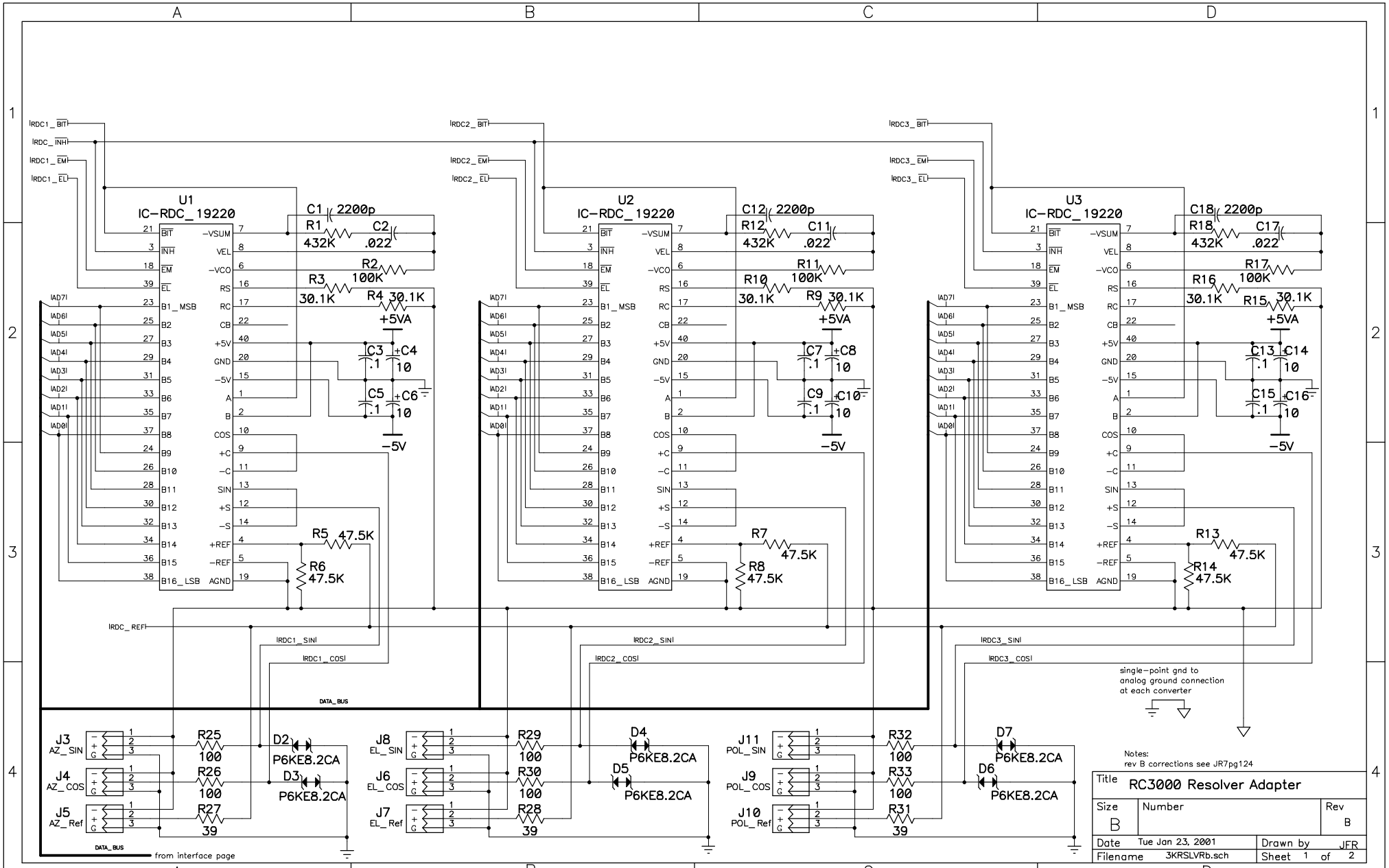
Notes:

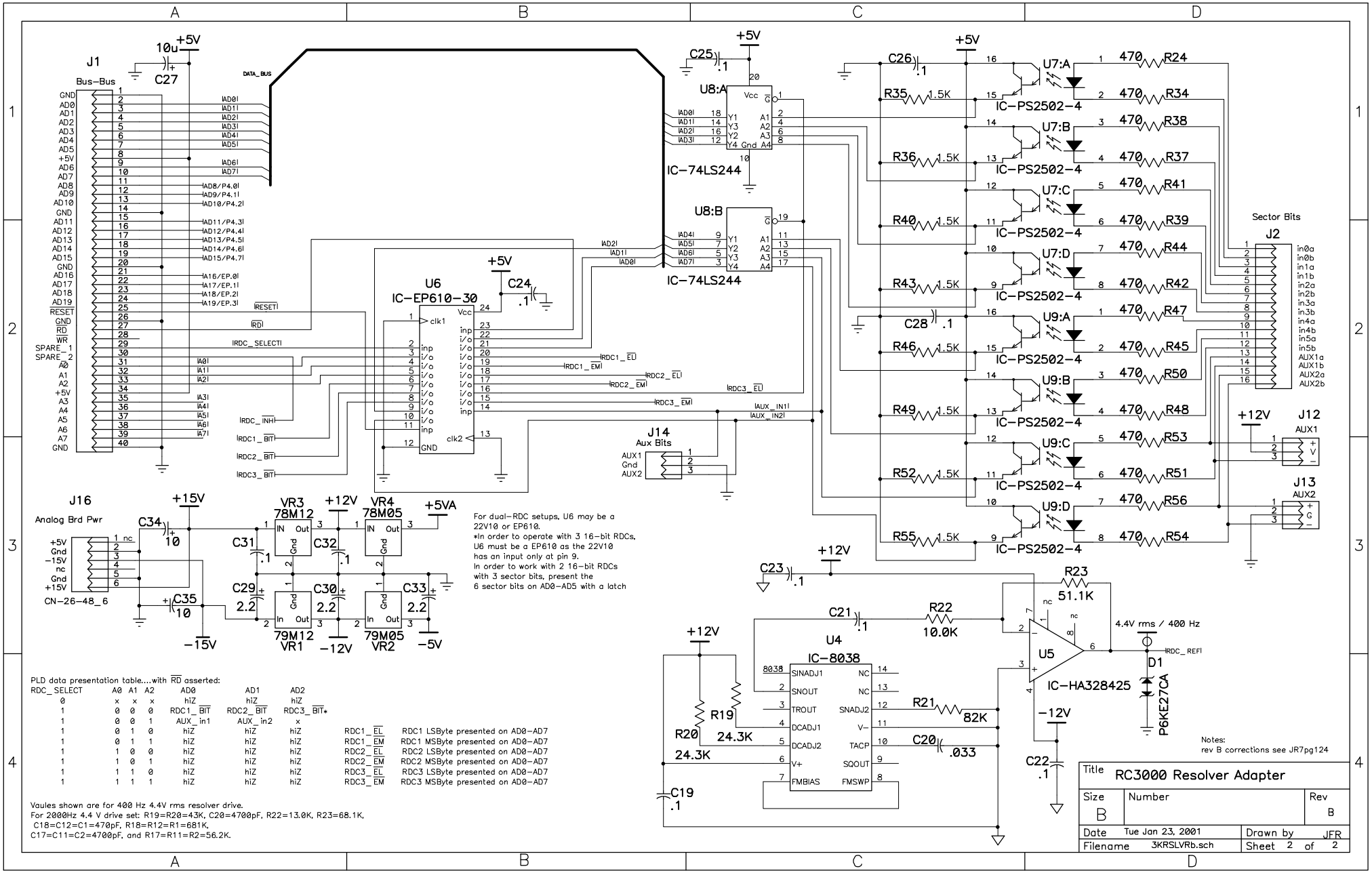
Rev B. – EL_UP swapped with EL_Down and POL_CW swapped with POL_CCW to account for a schematic capture mistake.... a revision of the PLD code was also done.

Rev C. – Major change to board, changed from high-side drive to low-side drive, 10 cuts to bottom traces, 10 cuts to top traces, 12 jumpers on bottom of board. reverse 10 diodes, remove R16.

Title	RC3000 VS-1 Interface		
Size B	Number 3KVS1-1		Rev C
Date	Tue Jan 23, 2001	Drawn by	JFR
Filename	3KVS1-1C.SCH	Sheet 1	of 2


A
B
C
D
1
2
3
4
nc
J24
+12V
MOV12
27V
J21
AZ East+
FPS1
1.5A Trip
K1:1
R16
open ckt
MOV11
27V
J22
POL CW+
FPS2
1.5A Trip
K1:2
nc
J23
GND
G5V-2-12
K1:3
U2:A
SAFE
OUT
IC-ULN2003
D1
1N4002
U2:B
HPA_DISABLE
HPA_DISABLE_RLY
R11
4.7K
U2:C
AN_K6_RLY
R12
4.7K
U2:D
AN_K7_RLY
R13
4.7K
U2:E
AN_K8_RLY
R14
4.7K
U2:F
AN_K5_RLY
R15
4.7K
U2:G
AN_K4_RLY
+5V
R1
360
U3:A
IC-PS2502-4
MOV1
MOV-10MM-27V
D2
1N4002
AZ East
J11
AZ_EAST
R2
360
U3:B
MOV2
D3
AZ West
J12
AZ_WEST
R3
360
U3:C
MOV3
D4
AZ Fast
J13
AZ_FAST
R4
360
U3:D
MOV4
D5
AZ Slow
J14
AZ_SLOW
R5
360
U4:A
MOV5
D6
EL Down
J15
EL_DOWN
R6
360
U4:B
MOV6
D7
EL Up
J16
EL_UP
R7
360
U4:C
MOV7
D8
EL Fast
J17
EL_FAST
R8
360
U4:D
MOV8
D9
EL Slow
J18
EL_SLOW
R9
360
U5:A
MOV9
D10
POL CCW
J19
POL_CCW
R10
360
U5:B
MOV10
D11
POL CW
J20
POL_CW
Title
RC3000 VS-1 Interface
Size
B
Number
3KVS1-1
Rev
c
Date
Tue Jan 23, 2001
Drawn by
JFR
Filename
3KVS1-1C.SCH
Sheet 2 of 2


A
B
C
D
1
2
3
4
U1
IC-RDC_19220
U2
IC-RDC_19220
U3
IC-RDC_19220
C1 2200p
R1 432K
C2 .022
R2 100K
R3 30.1K
R4 30.1K
C12 2200p
R12 432K
C11 .022
R11 100K
R10 30.1K
R9 30.1K
C18 2200p
R18 432K
C17 .022
R17 100K
R16 30.1K
R15 30.1K
+5VA
-5V
C3 .1
C4 10
C5 .1
C6 10
C7 .1
C8 10
C9 .1
C10 10
C13 .1
C14 10
C15 .1
C16 10
R5 47.5K
R6 47.5K
R7 47.5K
R8 47.5K
R13 47.5K
R14 47.5K
IRDC1_BIT
IRDC_INH
IRDC1_EM
IRDC1_EL
IRDC2_BIT
IRDC2_EM
IRDC2_EL
IRDC3_BIT
IRDC3_EM
IRDC3_EL
IAD7I
IAD6I
IAD5I
IAD4I
IAD3I
IAD2I
IAD1I
IAD0I
IRDC_REFI
IRDC1_SINI
IRDC1_COSI
IRDC2_SINI
IRDC2_COSI
IRDC3_SINI
IRDC3_COSI
DATA_BUS
single-point gnd to analog ground connection at each converter
J3 AZ_SIN
J4 AZ_COS
J5 AZ_Ref
J8 EL_SIN
J6 EL_COS
J7 EL_Ref
J11 POL_SIN
J9 POL_COS
J10 POL_Ref
R25 100
R26 100
R27 39
R29 100
R30 100
R28 39
R32 100
R33 100
R31 39
D2 P6KE8.2CA
D3 P6KE8.2CA
D4 P6KE8.2CA
D5 P6KE8.2CA
D7 P6KE8.2CA
D6 P6KE8.2CA
DATA_BUS
from interface page
Notes:
rev B corrections see JR7pg124
Title RC3000 Resolver Adapter
Size B
Number
Rev B
Date Tue Jan 23, 2001
Drawn by JFR
Filename 3KRSLVRb.sch
Sheet 1 of 2



For dual-RDC setups, U6 may be a 22V10 or EP610.
*In order to operate with 3 16-bit RDCs, U6 must be a EP610 as the 22V10 has an input only at pin 9.
In order to work with 2 16-bit RDCs with 3 sector bits, present the 6 sector bits on AD0-AD5 with a latch

PLD data presentation table....with $\overline{RD}$ asserted:

RDC_SELECT	A0	A1	A2	AD0	AD1	AD2	
0	x	x	x	hiZ	hiZ	hiZ	
1	0	0	0	RDC1_$\overline{BIT}$	RDC2_$\overline{BIT}$	RDC3_$\overline{BIT}$*	
1	0	0	1	AUX_in1	AUX_in2	x	
1	0	1	0	hiZ	hiZ	hiZ	RDC1_$\overline{EL}$ RDC1 LSByte presented on AD0-AD7
1	0	1	1	hiZ	hiZ	hiZ	RDC1_$\overline{EM}$ RDC1 MSByte presented on AD0-AD7
1	1	0	0	hiZ	hiZ	hiZ	RDC2_$\overline{EL}$ RDC2 LSByte presented on AD0-AD7
1	1	0	1	hiZ	hiZ	hiZ	RDC2_$\overline{EM}$ RDC2 MSByte presented on AD0-AD7
1	1	1	0	hiZ	hiZ	hiZ	RDC3_$\overline{EL}$ RDC3 LSByte presented on AD0-AD7
1	1	1	1	hiZ	hiZ	hiZ	RDC3_$\overline{EM}$ RDC3 MSByte presented on AD0-AD7

Vaules shown are for 400 Hz 4.4V rms resolver drive.
For 2000Hz 4.4 V drive set: R19=R20=43K, C20=4700pF, R22=13.0K, R23=68.1K,
C18=C12=C1=470pF, R18=R12=R1=681K,
C17=C11=C2=4700pF, and R17=R11=R2=56.2K.