MOTOVATOR

Installation and Configuration

WYBRON INCORPORATED

MOTOVATOR

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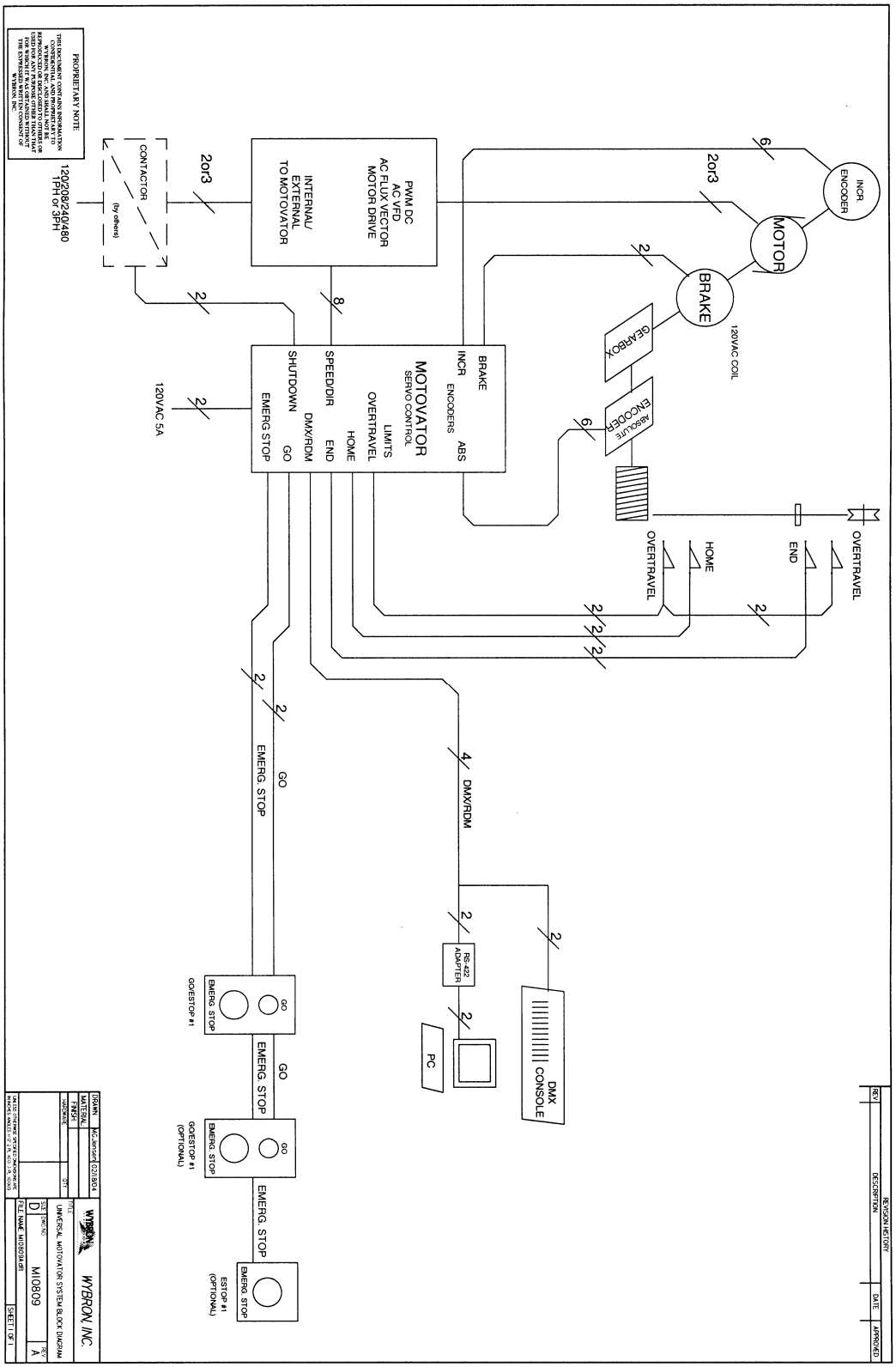
System Installation

1.1Motovator System Block Diagram



1.2 Location and Mounting

The enclosure must be mounted so as to allow free air circulation. It is not necessary that it be mounted to a vertical surface. Mount using #10 or _" hardware in four keyhole slots.

1.3 Connecting the Limit and Overtravel Switches

Overtravel switches are used to prevent physical damage or danger to personnel in the event of a drive system failure. The Overtravel circuit depends only on electromechanical relays arranged in a fail-safe configuration.

The Overtravel circuit is a closed loop, and is intended to pass through a normally closed switch at each end of the mechanical travel of the system. If either switch opens, the system stops. Connect the overtravel loop to J2, terminals 5 and 6. If overtravel switches are not to be used, jumper terminals 5 and 6.

Limit switches are used to provide an absolute position reference for the system when it is first switched on, and to stop normal motion before an overtravel condition is reached. The Limit switches are mounted at each end of travel so that they are activated BEFORE the Overtravel switches. Two Limit inputs are provided: Home, at the near end of travel, and Index, at the far end. Limit switches are also Normally Closed, open at limit. They are individually connected to J2 terminals 1 and 2 (Home) and J2 terminals 3 and 4 (Index).

The system may be configured to use Home only, Home and Index, or neither limit switch. If either switch will not be used, jumper the terminals to which it would be connected. Operation is described in the System Configuration, section 10.

1.4 Installing Modules in the Chassis

The combination of modules and chassis will depend on the application for Motovator. AC motors, DC motors, and hydraulic systems can be controlled with Motovator. Specific connection diagrams for high and low voltage wiring, as well as VF drive programming instructions (if used) will be provided at the time of order.

Motovator module options include:

- Universal Power Supply
- Integral HP Power Supply
- Position Controller
- Servo Drive Assembly
- PWM DC Servo Amplifier
- AC Variable Frequency Drive
- AC Flux Vector Drive

Motovator chassis options include:

- Two Gang Chassis
- Four Gang Chassis
- Six Gang Chassis

1.5 Connecting the Incremental Encoder

The incremental encoder provides primary position and speed feedback information to the PID controller. It must be rigidly connected to the motor-gearbox-load system such that the shaft

position of the encoder unambiguously reflects the final position of the motion system. Any clutches or other “slip” elements must NOT be located between the encoder and the load, unless a dual encoder tracking system is used!

The incremental encoder is a 6 wire device: Power, Ground, Phase A+, Phase A-, Phase B+ and Phase B-. Connection from the encoder to the Motovator MUST be made using 3 pair, INDIVIDUALLY shielded pair controlled capacitance cable, Alpha 6010C or equivalent. The Motovator will work with encoders that operate on either +5VDC or +9 to +12VDC. Set the INCR POWER jumper (see fig 1) to 5 or 9 volts as required. See the wiring diagram in section 4.2.8 and connect the incremental encoder to J6 as follows:

J6 terminal 1: Phase A+
J6 terminal 2: Phase A-
J6 terminal 3: Phase B+
J6 terminal 4: Phase B-
J6 terminal 5: Power
J6 terminal 6: Ground

1.6 Connecting the Absolute Encoder

The (optional) absolute encoder is used to load the initial position of the system at power up without reference to Home and Index limit switches, and also to provide redundancy of position for safety purposes. The absolute encoder may also be used as a master position reference in a system with slip between the motor and the load, such as occurs in a rim drive turntable system. The Motovator supports ONLY the US Digital A2 Hybrid encoder, which provides both absolute and incremental functions on a single shaft. See section 4.2.11 and 4.2.12 and connect the A2 Absolute encoder as follows:

J8 terminal 1:	Ground	A2 Pin 1 (white)
J8 terminal 2:	Busy +	A2 Pin 2 (black)
J8 terminal 3:	Busy -	A2 Pin 3 (red)
J8 terminal 4:	+12V	A2 Pin 4 (green)
J8 terminal 5:	Data +	A2 Pin 5 (yellow)
J8 terminal 6:	Data -	A2 Pin 6 (blue)

Make certain that the absolute encoder Duplex Select jumper (near J8) is set to H.

The absolute encoder is a single-turn device. Wybron supplies the encoder for direct connection to a turntable, where 1 revolution of the table corresponds to 1 revolution of the encoder, and also in gear-driven models for use with drapery hoists, tracked stage winches and other machines where the output shaft operates through multiple turns. In that case, the gear reduction ratio is chosen so that the absolute encoder shaft rotates less than 300 degrees for the entire range of motion of the machine.

1.7 Connecting the GO and ESTOP

For safety reasons, it is important to have three independent means of stopping a motion system. A failure in any two of the control system should not prevent the system from being stopped. The Motovator requires two current loop circuits in addition to a valid DMX512 data connection. The GO loop enables motion when closed and forces a smooth stop when opened. The ESTOP loop disconnects the motor from the servo amplifier using relay logic only.

Refer to section 4.2.16 and 4.2.17 for wiring diagrams for the GO / ESTOP circuit. Connect a normally OPEN operator “GO” button between J9 terminal 1 and J9 terminal 2. This button should be located within easy reach of the DMX512 controller.

Connect a normally CLOSED Emergency Stop switch between J9 terminal 1 and J9 terminal 3. More than one Emergency Stop switch may be connected in series, such that opening any of the switches opens the connection between terminals 1 and 3. Locate one Emergency Stop switch near the operator GO button, and another near the actual moving objects that the system controls. This will allow a person near the object to stop the motor in an emergency.

1.8 Connecting DMX

Any standard DMX512 controller that transmits all 512 channels may control the Motovator. As an additional safety measure, the Motovator will not operate unless it receives an entire 512 channel DMX frame. Also, channels 509, 510, 511 and 512 are used to enable status readback from individual Motovators.

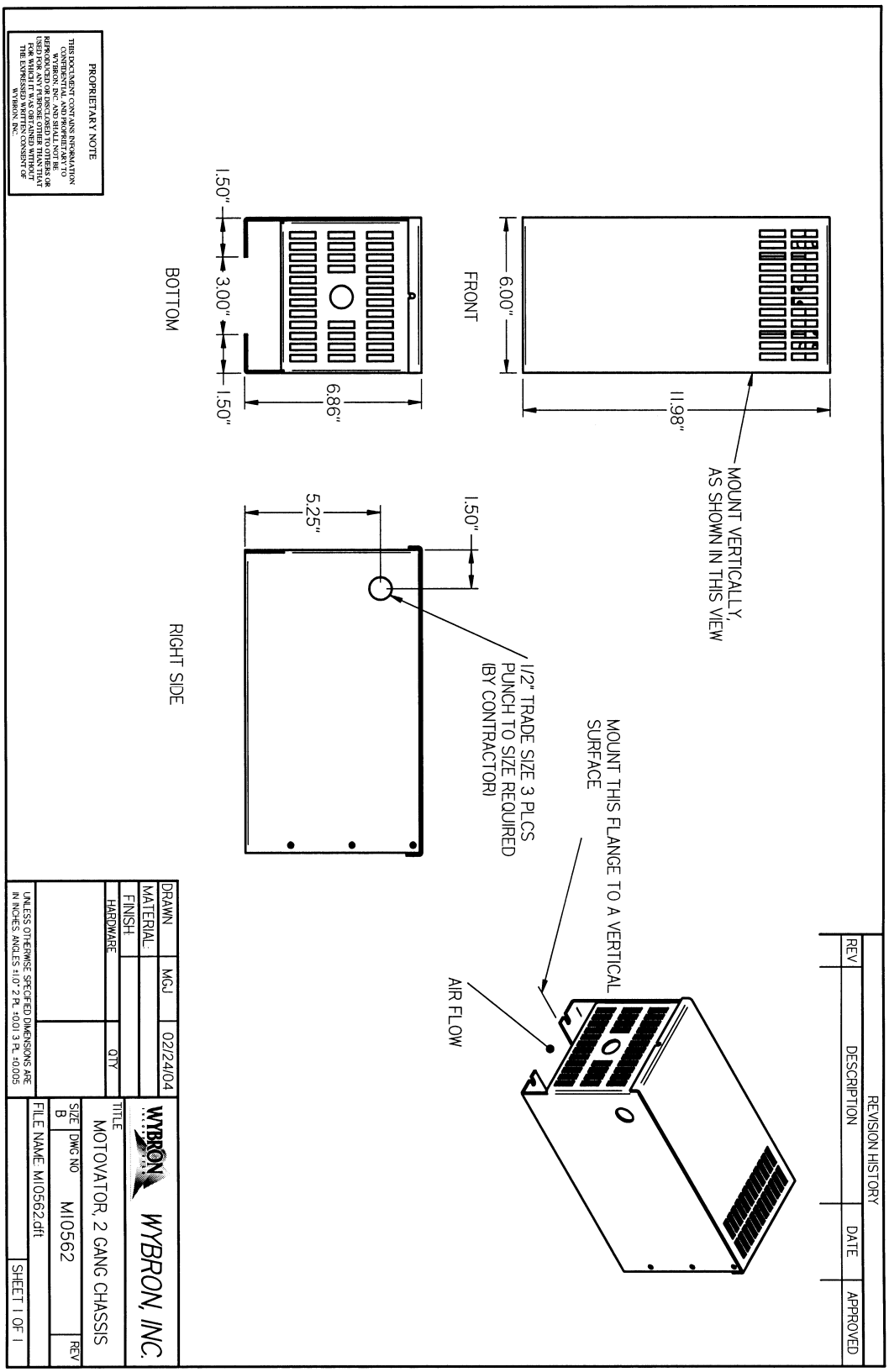
Refer to the wiring diagram in section 4.2.14 and connect the DMX512 source as follows:

J7 terminal 1	Ground, (shield)	XLR pin 1
J7 terminal 2	Data -	XLR Pin 2
J7 terminal 3	Data +	XLR Pin 3

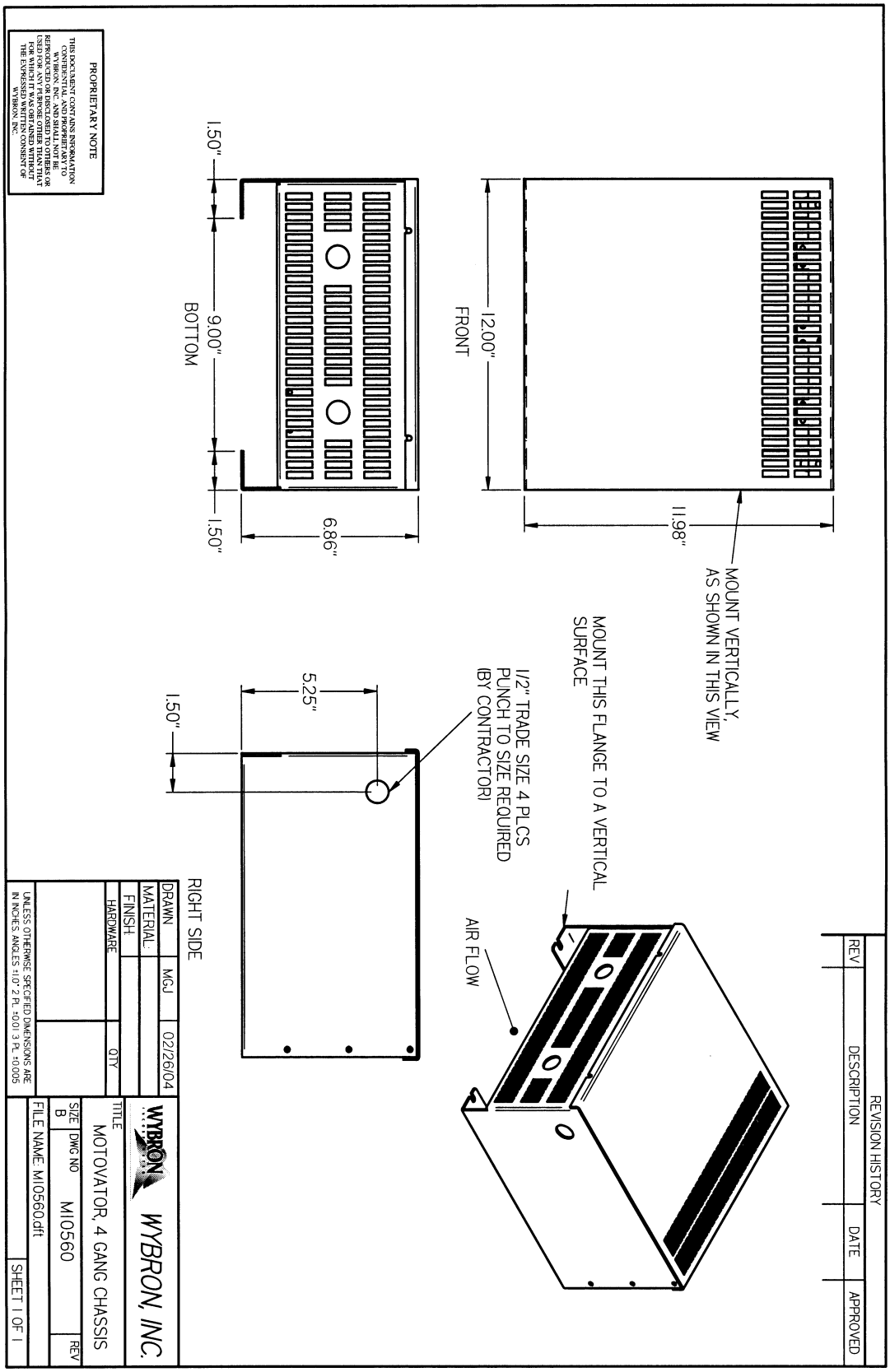
Use Belden 9729 or equivalent, individually shielded twisted pair.

1.9 Mechanical Specifications and Wiring Diagrams

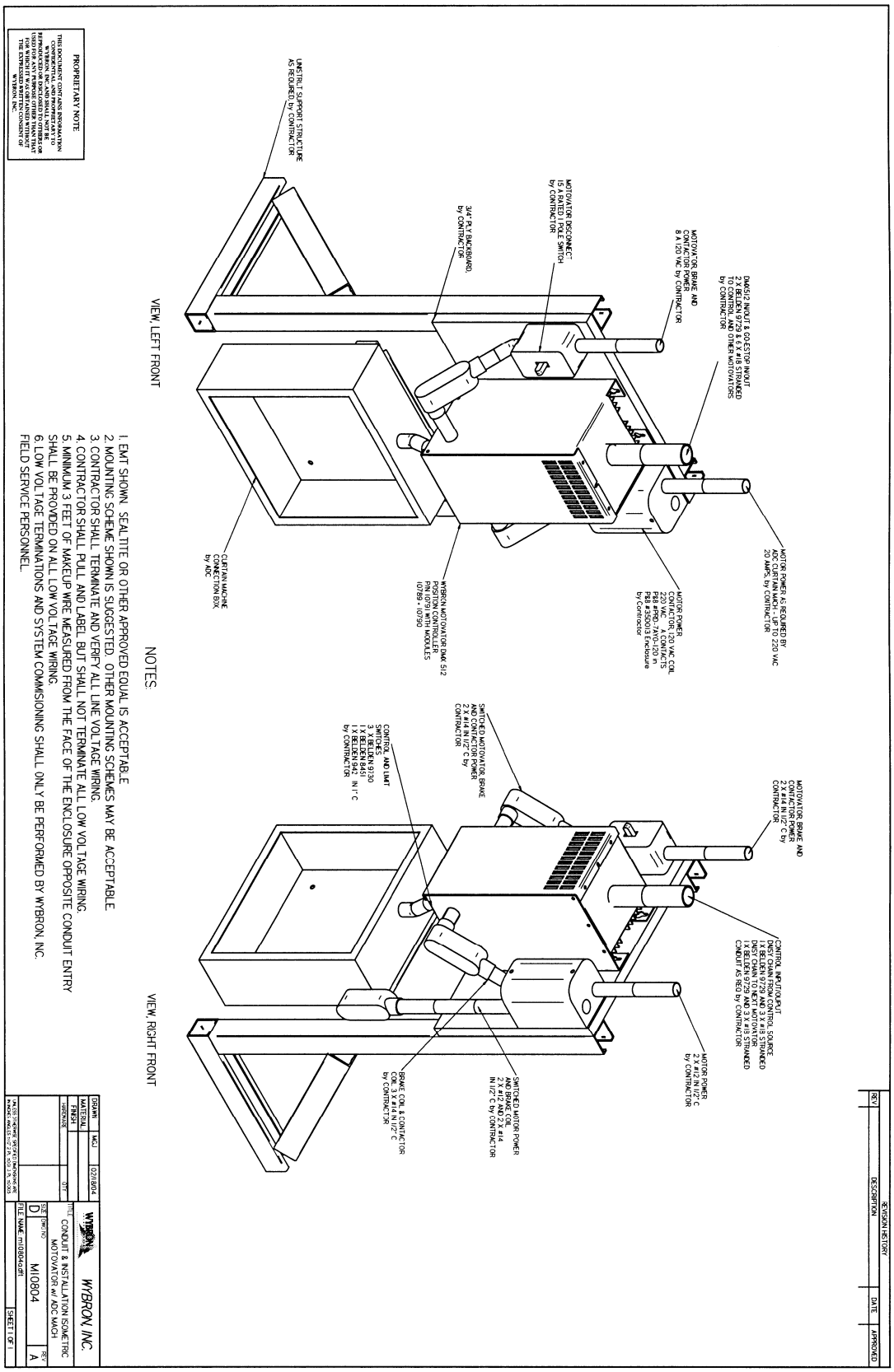
1.9.1 Two Gang Chassis



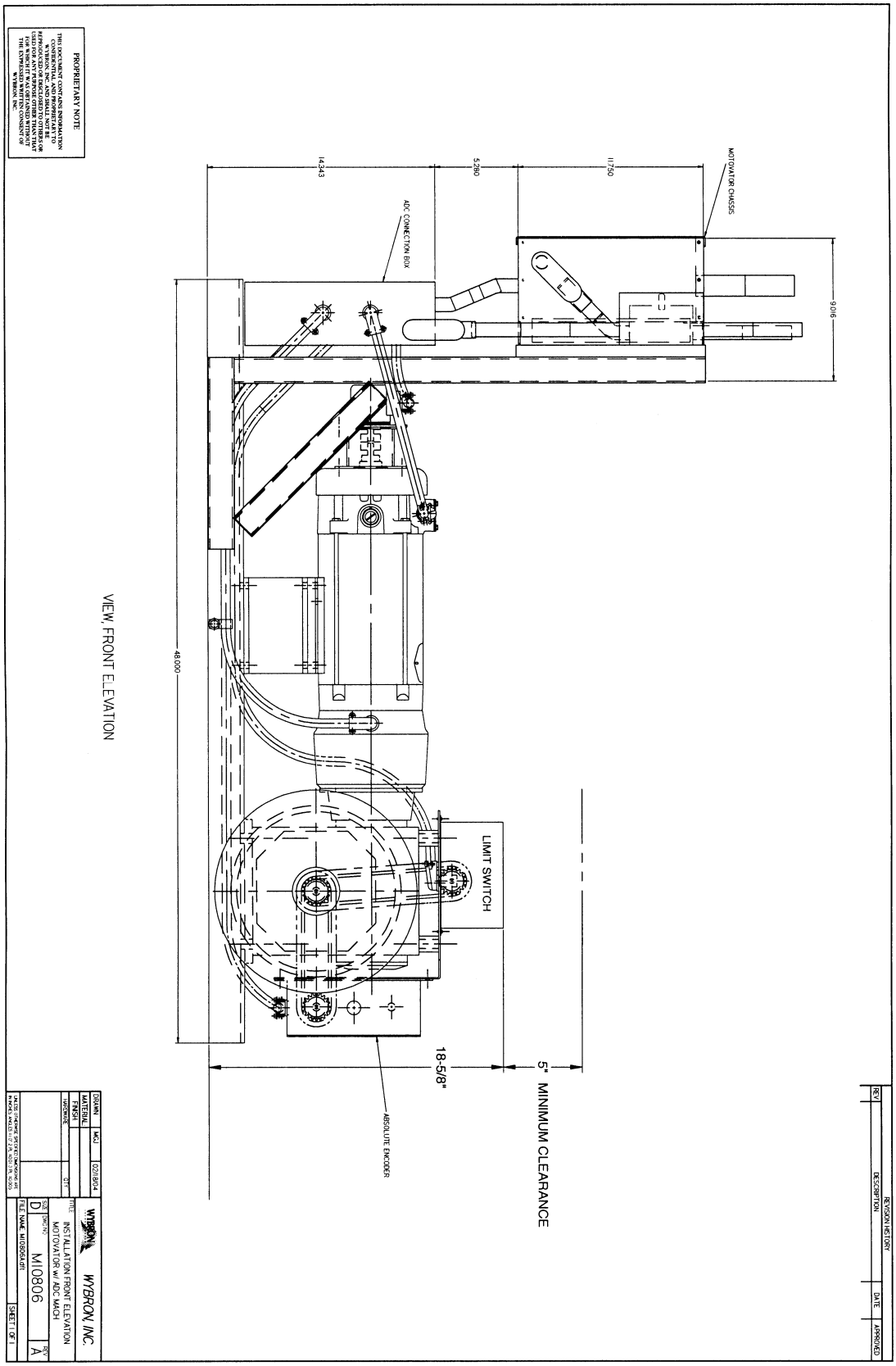
1.9.2 Four Gang Chassis



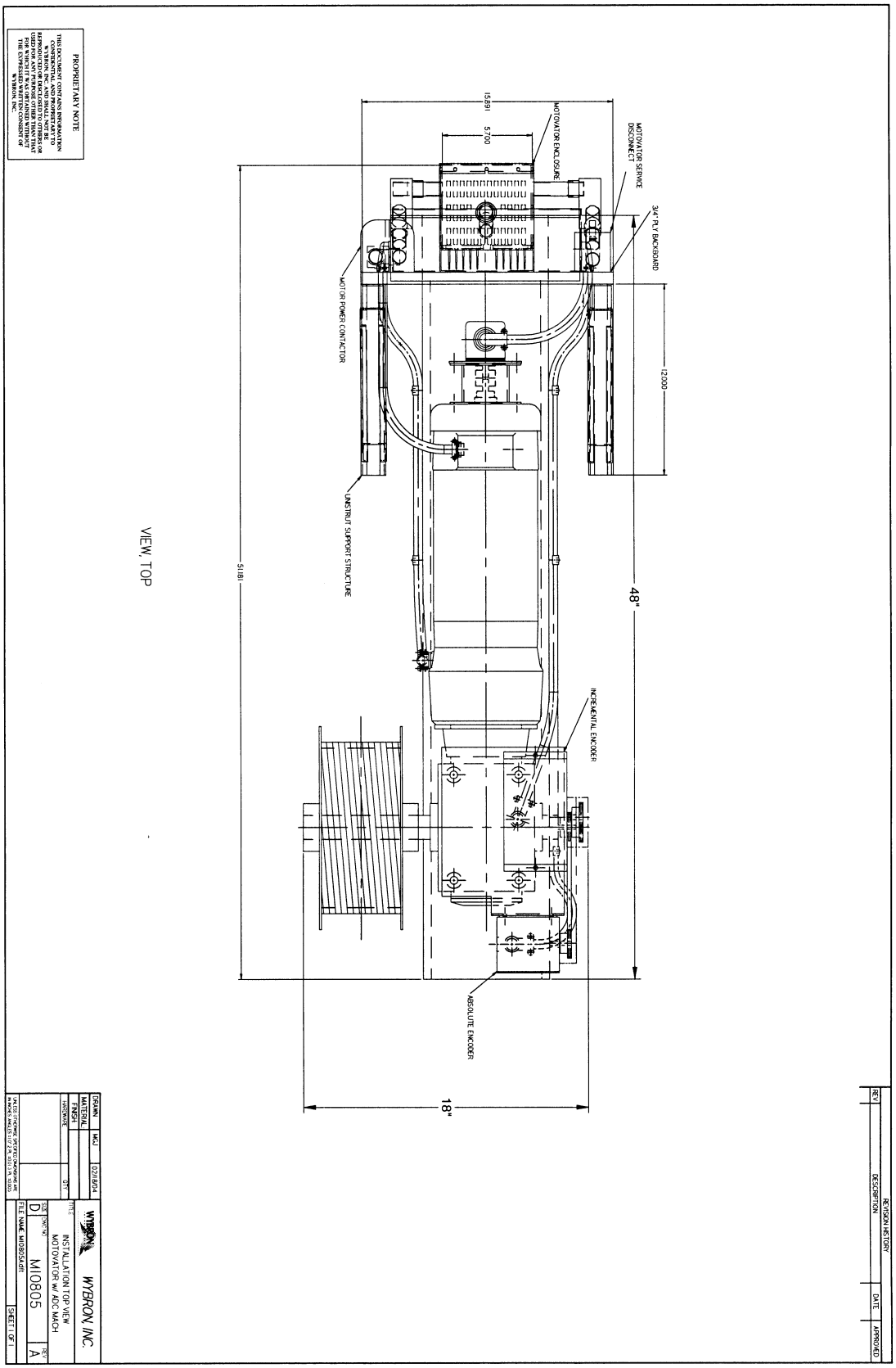
1.9.3 Conduit and Installation Isometric Motovator with ADC Machine



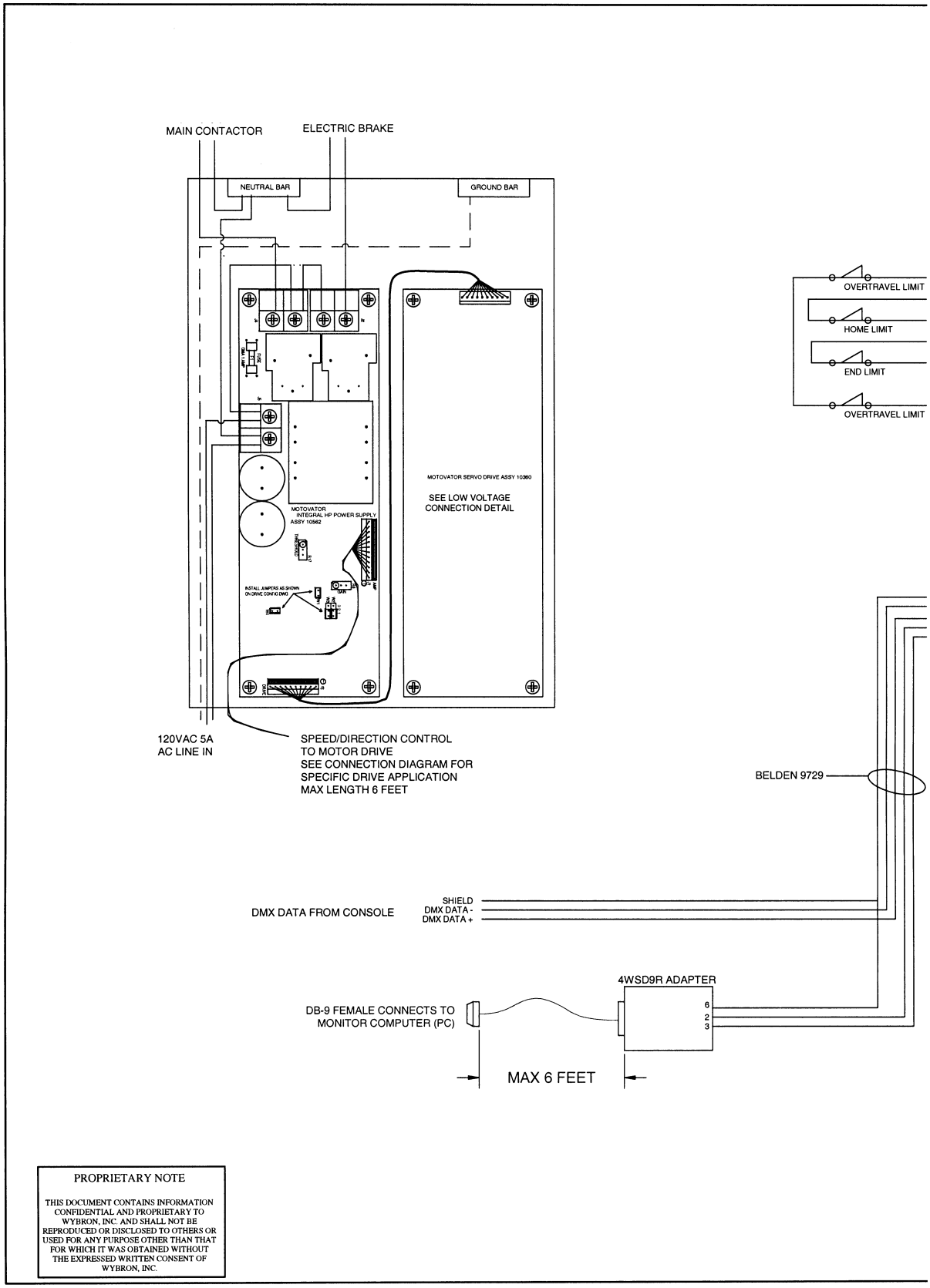
1.9.4 Motovator Installation with ADC Machine Front Elevation View



1.9.5 Motovator Installation with ADC Machine Top View



1.9.6 Universal Motovator Connection Diagram



REVISION HISTORY			
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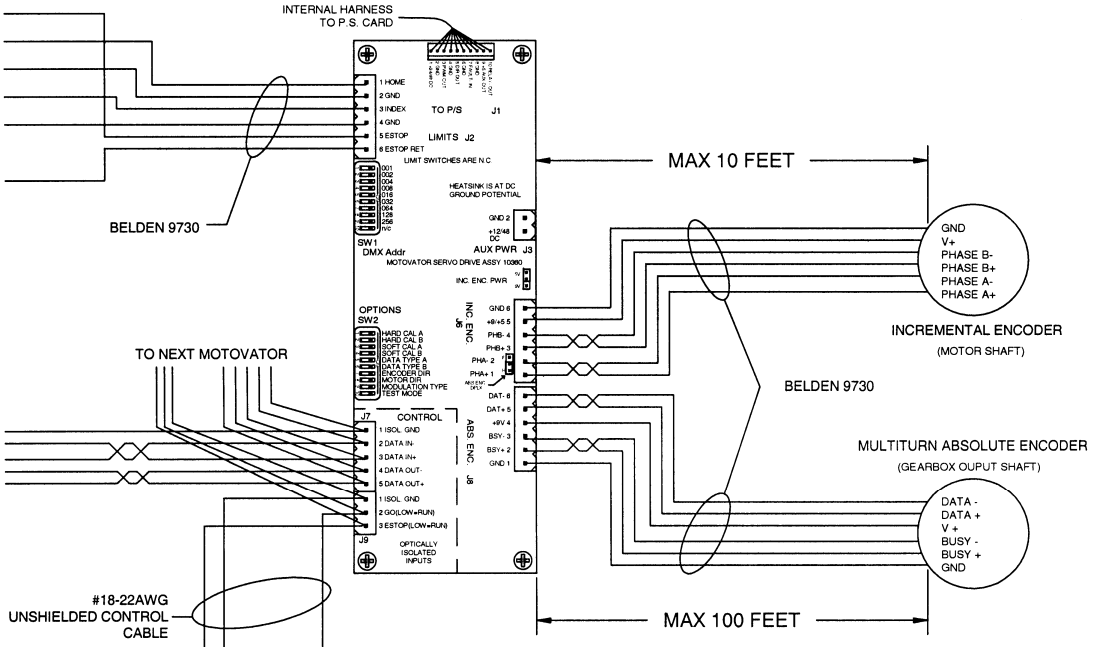


DRAWN	M.G.Jensen	02/18/04
MATERIAL:		
FINISH:		
HARDWARE		QTY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. ANGLES ±1.0° 2 PL ±0.01 3 PL ±0.005

WYBRON, INC.

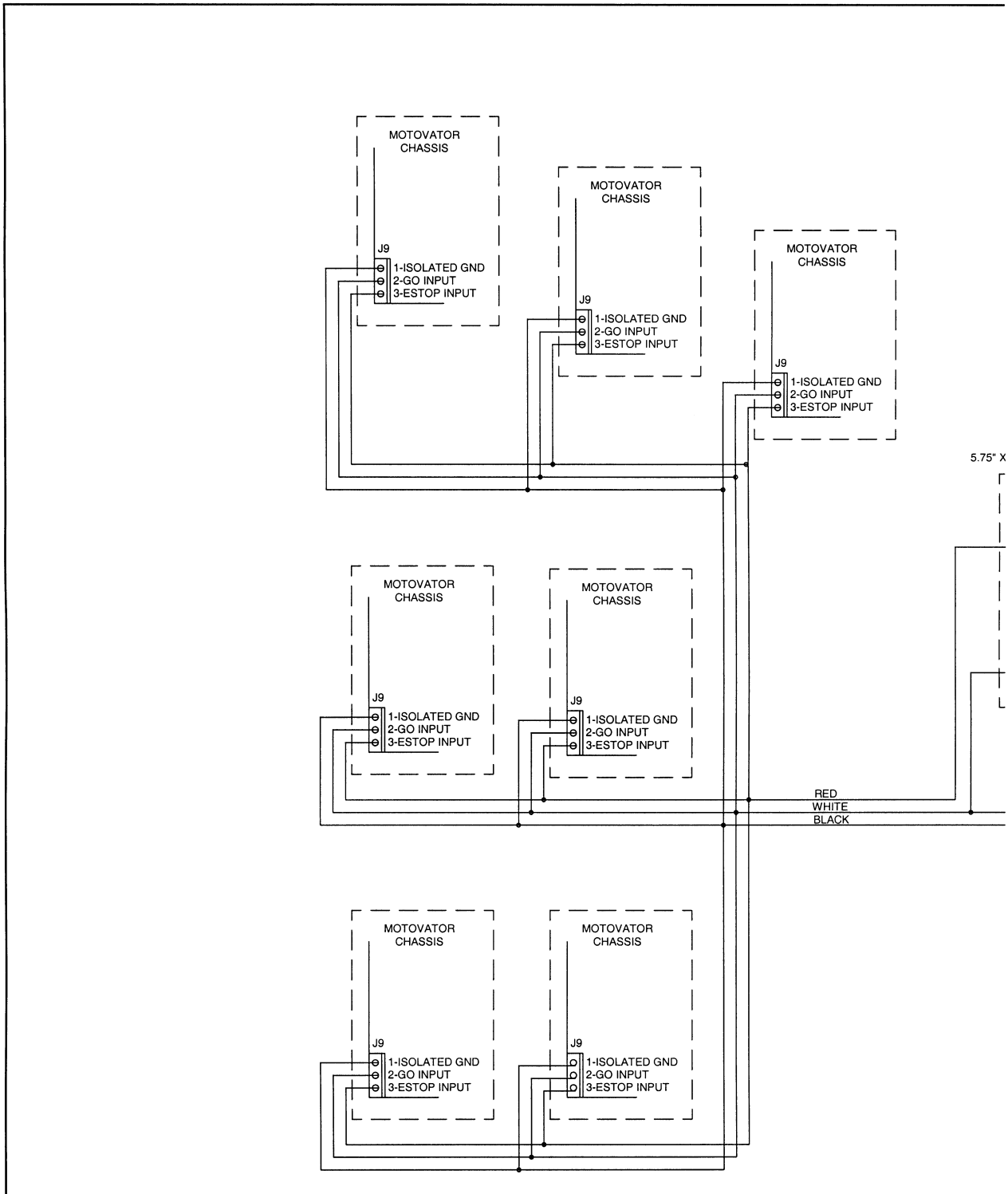
TITLE: UNIVERSAL MOTOVATOR CONNECTION DIAGRAM

SIZE	DWG NO	REV
D	M10810	A

FILE NAME: M10810A.dft

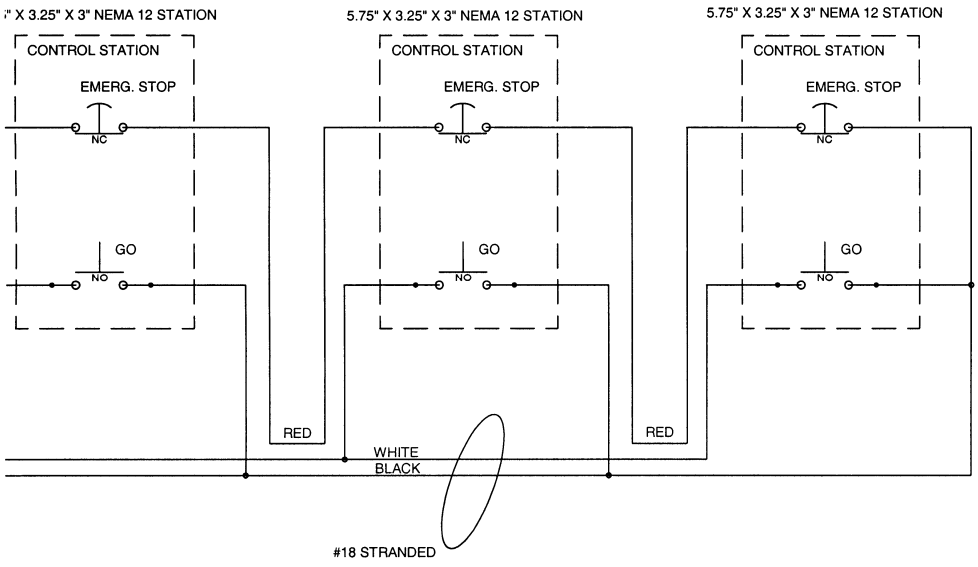
SHEET 1 OF 1

1.9.7 Nine Axis Motovator GO/ESTOP Riser Diagram



REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED

NOTE: ALL SWITCHES AND INDICATORS ARE CUTLER-HAMMER OR EQUIV. 30MM OILTIGHT



DRAWN	MGJ	02/26/04
MATERIAL:		
FINISH:		
HARDWARE:		QTY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES ANGLES ±1.0° 2 PL ±0.01 3 PL ±0.005

WYBRON, INC.

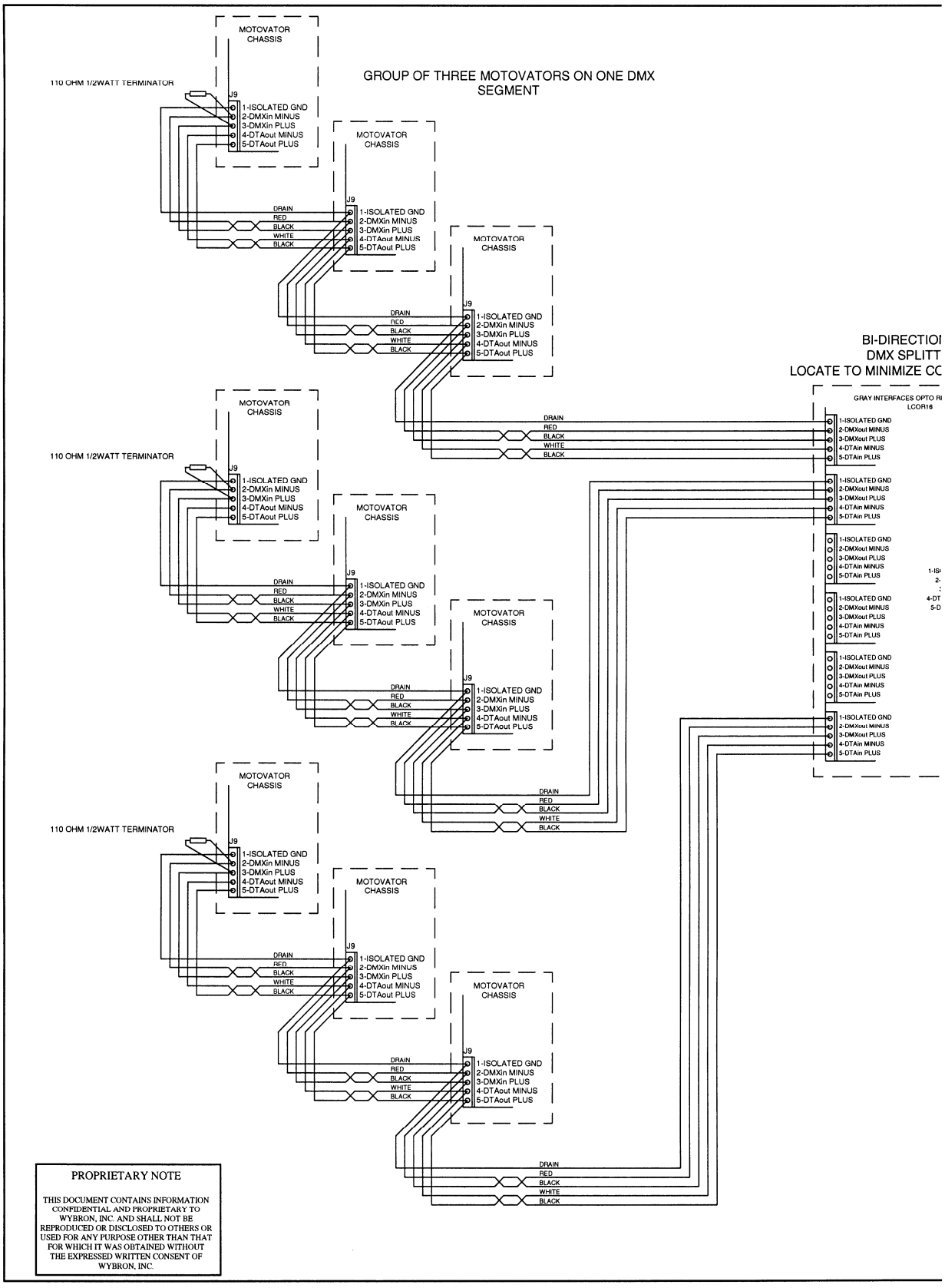
TITLE: 9 AXIS MOTOVATOR
GO-ESTOP RISER DIAGRAM

SIZE	DWG NO	REV
D	M10818	A

FILE NAME: M10818A.dft

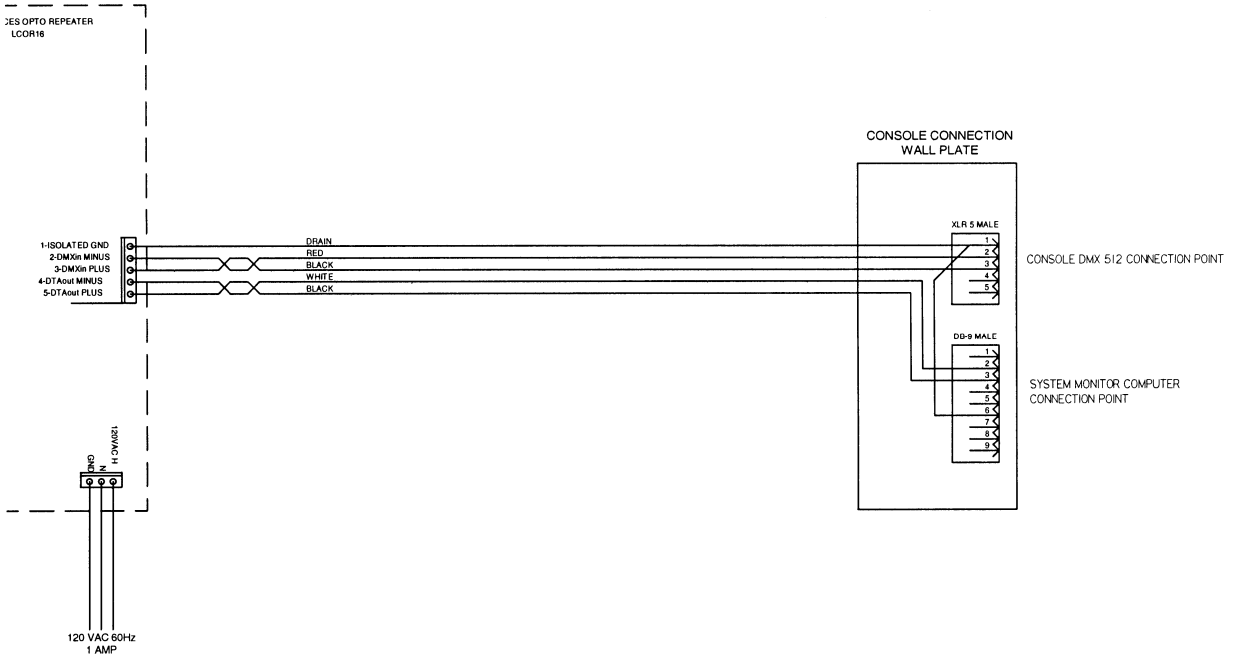
SHEET 1 OF 1

1.9.8 Typical Motovator DMX512 and Talkback Riser Diagram



REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED

ECTIONAL
SPLITTER
IZE CONDUIT RUNS



NOTES

1. ALL CONTROL CABLE SHALL BE BELDEN 9729
2. PULL ALL CABLES POINT TO POINT AS SHOWN
3. NO SPLICES OR JUNCTIONS ARE PERMITTED - CONNECT DIRECTLY TO TERMINALS AS SHOWN
4. DMX512 CABLES SHALL NOT SHARE RACEWAYS OR CONDUITS WITH LINE VOLTAGE CONDUCTORS.

DRAWN	MGJ	02/26/04
MATERIAL:		
FINISH:		
HARDWARE		QTY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. ANGLES ±1.0° 2 PL ±0.01 3 PL ±0.005

WYBRON, INC.

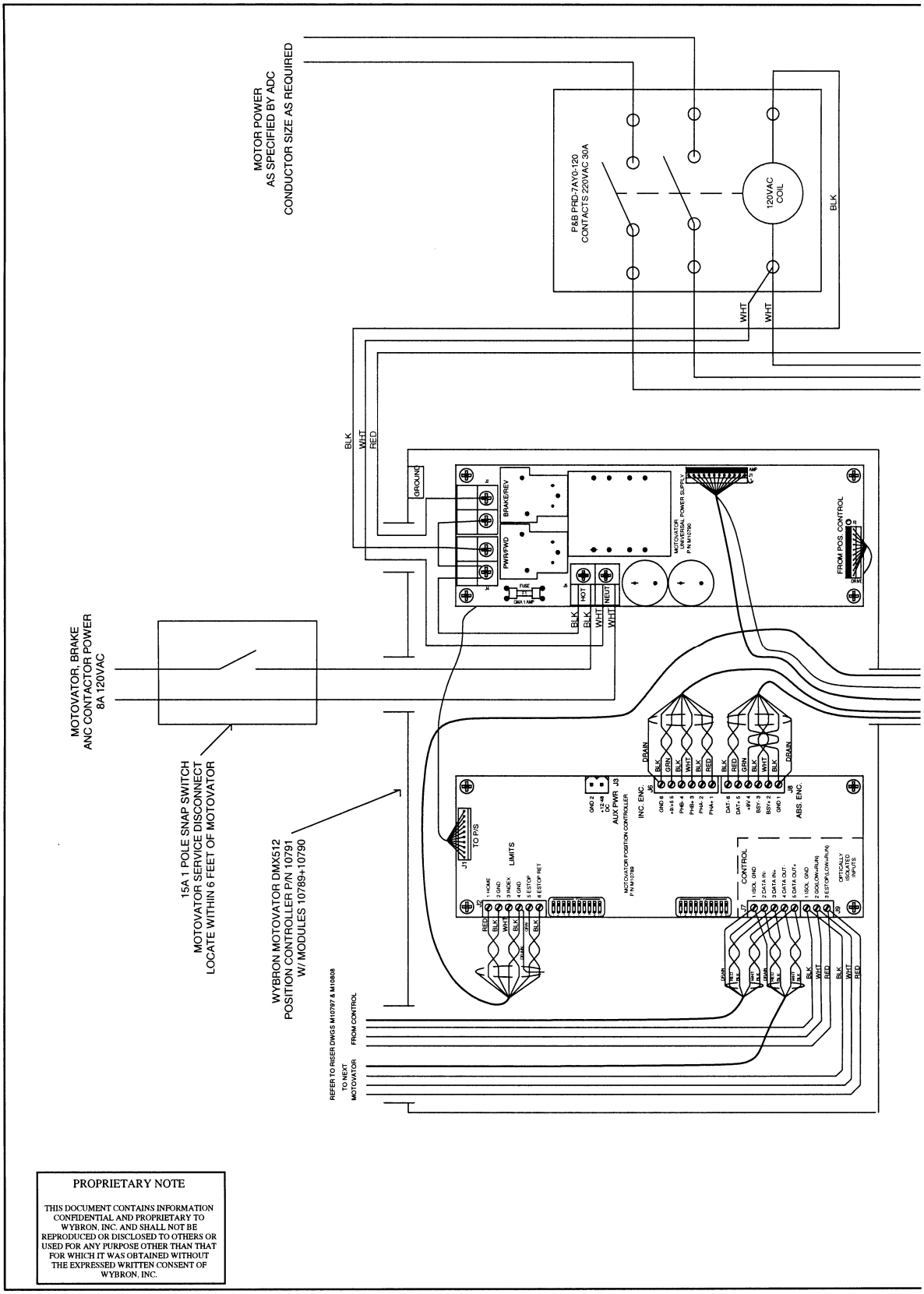
TITLE: TYPICAL MOTOVATOR DMX512 AND TALKBACK RISER DIAGRAM

SIZE	DWG NO	REV
D	M10819	A

FILE NAME: M10819A.dft

SHEET 1 OF 1

1.9.9 Motovator Connection Diagram for ADC Curtain Machine Application



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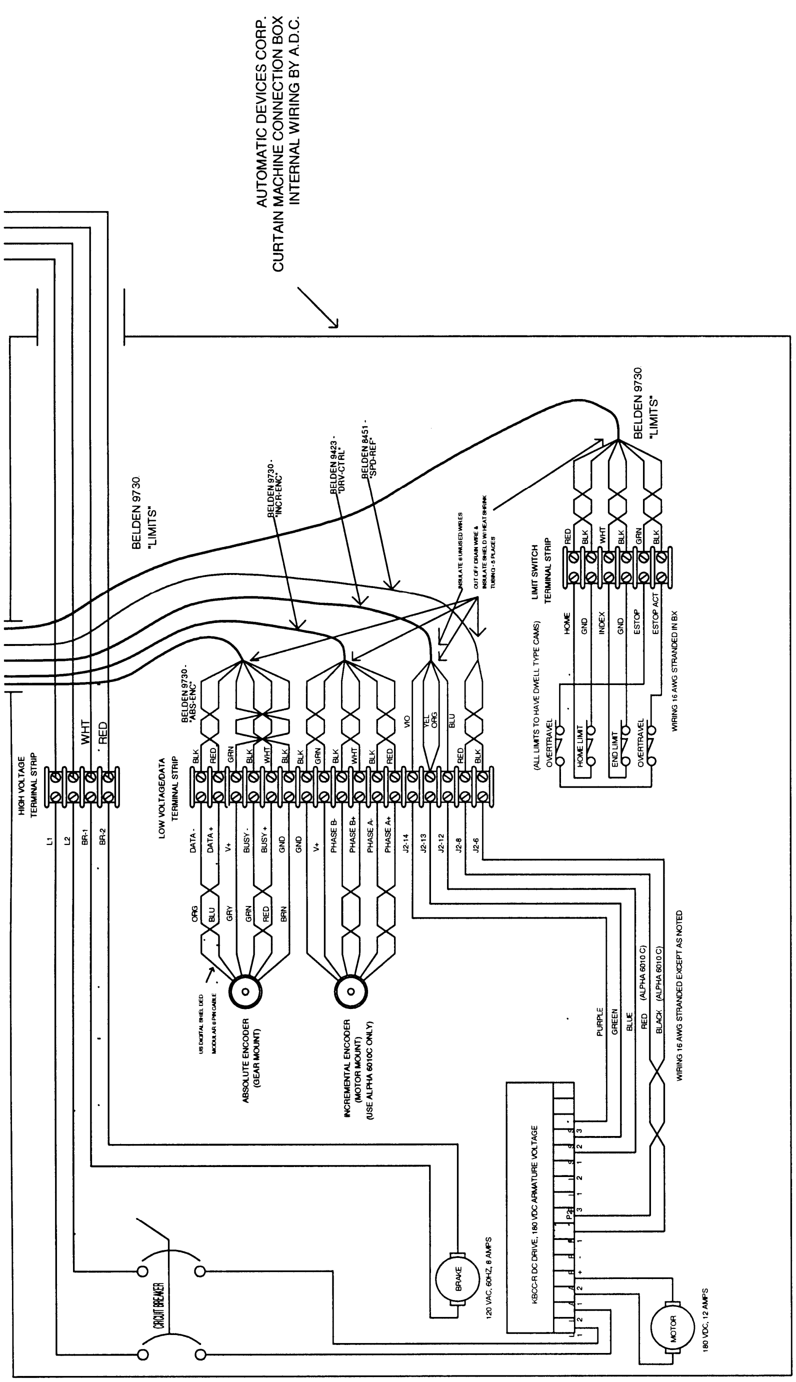
REVISION HISTORY			
REV	DESCRIPTION	DATE	APPROVED



DRAWN	MGJ	02/23/04	WYBRON, INC.
MATERIAL:			
FINISH:			TITLE CONNECTION DIAGRAM, MOTOVATOR ADC CURTAIN MACHINE APPLICATION
HARDWARE		QTY	SIZE D — DWG NO MI0807 — REV A
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES ANGLES ±1.0° 2 PL ±0.01 3 PL ±0.005			FILE NAME: MI0807A.dft — SHEET 1 OF 1

Configuring Motovator

2.1 PC Monitoring Motovator

The Motovator may be connected to a computer running a terminal emulator program to enable the operator to view operational status and setup information. PC monitoring must be used during configuration.

The following is required to monitor Motovator with a PC:

- A computer with an available RS232 port and Anita terminal emulator software installed. (Anita terminal emulator software available from Wybron)
- The Anita profile for Motovator, motovator.wcf (supplied on a disk shipped with new Motovator systems, or can be downloaded from www.wybron.com)
- A RS422 to RS232 adapter. (Available from Wybron)
- Motovator DMX/talkback Y-cable. (Available from Wybron)

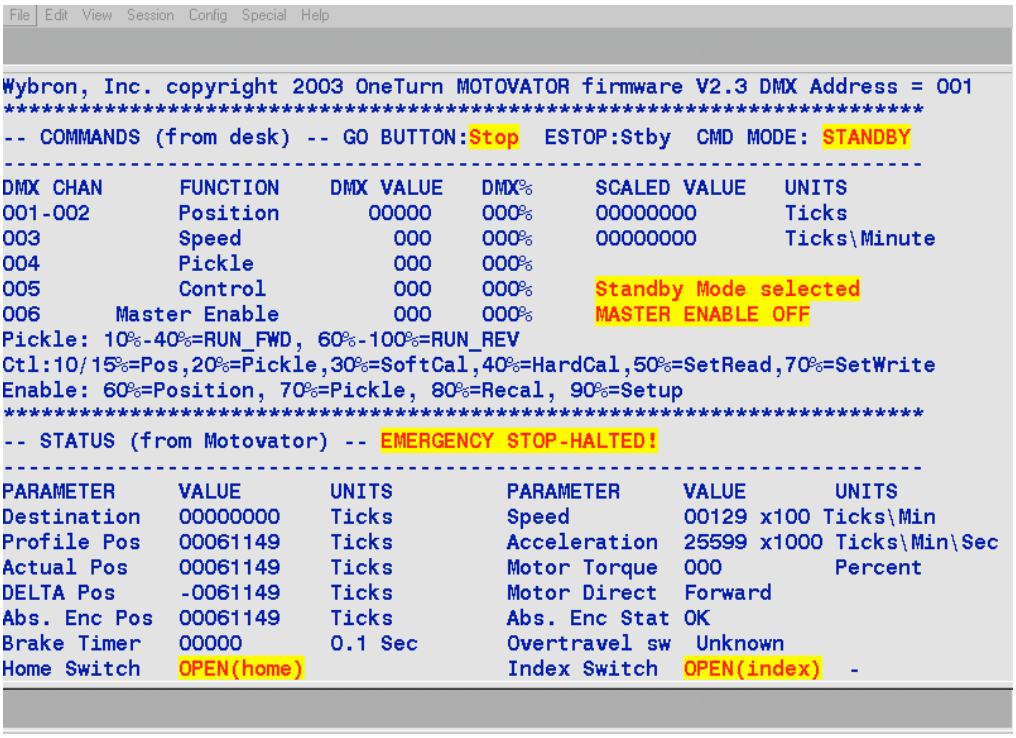
Install the Anita terminal emulator and run the software. From Anita, load the Motovator profile motovator.wcf using the File/: LoadConfig options to set Anita to operate properly with Motovator. Connect Motovator to the PC RS232 port using the RS422 to RS232 adapter and the Motovator DMX/Talkback Y-cable. Refer to section 4.2.15 for instructions on creating your own DMX/Talkback Y-cable. The following sections 2.1.1 – 2.1.3 give examples of the screens that will be used during configuration.

2.1.1 Setup screen

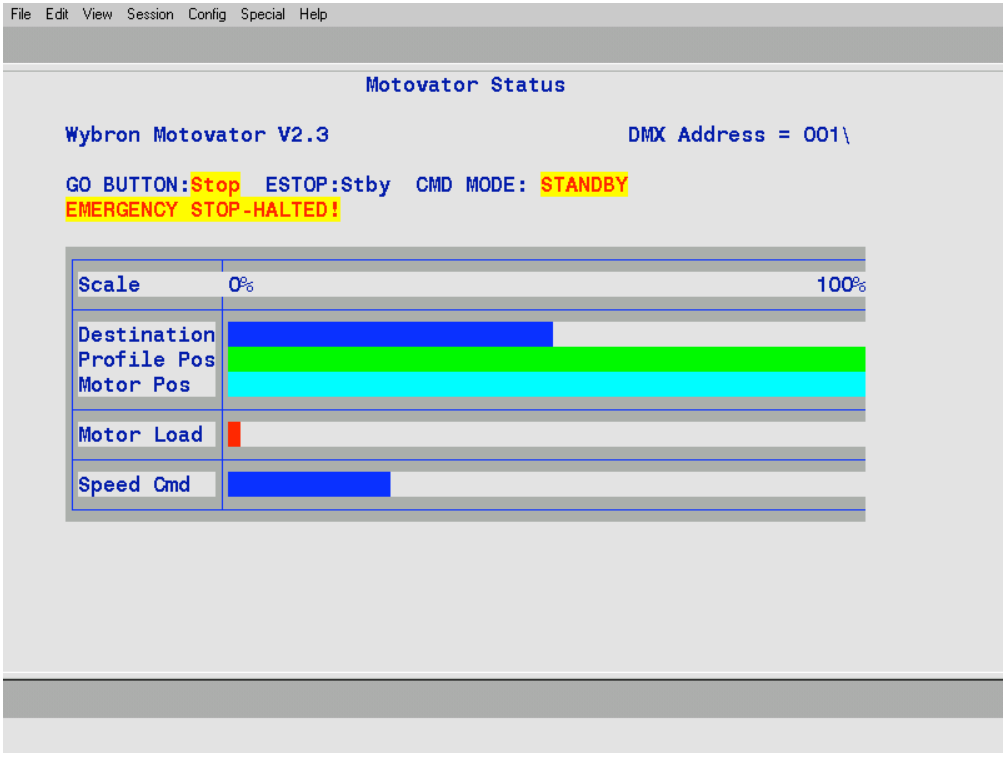
File Edit View Session Config Special Help

```
-- COMMANDS (from desk) -- GO BUTTON:Stop  ESTOP:Stby  CMD MODE: SETUP READ
-- STATUS (from Motovator) -- EMERGENCY STOP-HALTED!
-- SETUP READ (FROM Motovator) -- DMX Address =  001       |
DMX CHAN      FUNCTION    DMX VALUE   DMX%     STORED VALUE   UNITS
478-479       Gain-Kp     00000       000%     04864          NONE
480-481       Gain-Ki     00000       000%     00000          NONE
482-483       Gain-Kd     00000       000%     00000          NONE
484-485       Integ Lim   00000       000%     00000          Ticks
486-487       Integ Delta 00000       000%     00000          Ticks
488-489       Min Speed   00000       000%     00000       x100 Ticks\Min
490-491       Max Speed   00000       000%     10000       x100 Ticks\Min
492-493       CAL Speed   00000       000%     04608       x100 Ticks\Min
494-495       Accel Rate  00000       000%     00768       x1000 Ticks\Min\Sec
496-497       CAL Accel   00000       000%     47872       x1000 Ticks\Min\Sec
498-500       Min Pos     00000000    000%     00000000       Ticks
501-503       Max Pos     00000000    000%     00051454       Ticks
504-505       Index Off   00000       000%     00000          Ticks
506           Stall Thr.  000         000%     048            Percent
507           Stall Time  000         000%     117         x10 Milliseconds
508           Brake Time  000         000%     000         x100 Milliseconds
NOT DMX CTRLD Enc. Ratio  1.000000                     Incr ticks/Abs Tick
OPT. Sw 1-2   Hard Cal:   Wake@Home   OPT. Sw 3-4  Soft Cal:   Absolute Enc.
OPT. Sw 7     Enc Dir:    Forward     OPT. Sw 8    Motor Dir:  Forward
OPT. Sw 9     Mod Type Sign-Magnitude OPT. Sw 10   Open Loop Mode: NORMAL
```

2.1.2 Text Run Screen



2.1.3 Graph Run Screen



2.2 Configuration Dipswitches

The Motovator hardware must be configured for your application using the dipswitches (SW2) on the Position Controller PC board. Use the following definitions to determine the best configuration for your application and note the dipswitch settings that are required. *The switches will be set in a later step.*

2.2.1 Hard Recal Type

A Hard Recal resets all error conditions, and resets the Home position and maximum travel distance of the motor. Four different methods of determining these are available, and are selected using Options dipswitches 1 and 2.

Wake@Home hard cal sets the present position to 0, sets the maximum position to the MaxPos stored in EEPROM, then runs to the MinPos stored in EEPROM. If SoftRecal is set to Absolute, then the absolute encoder will be set to 000 when the position is set to 000.
(Switches 1 and 2 OFF)

Stall@Home hard cal runs in reverse to stall, OFFSETS off of the hard stop the distance set by Index Offset and sets that position as 0, then sets the maximum position to the MaxPos to stored in EEPROM and runs to the MinPos stored in EEPROM. If SoftRecal is set to Absolute, then the absolute encoder will be set to 000 when the position is set to 000.
(Switch 1 ON, Switch 2 OFF)

HomeLimit hard cal runs in reverse to the Home limit switch, sets that position as 0, sets the maximum position to the MaxPos to stored in EEPROM, then runs to the MinPos stored in EEPROM. If SoftRecal is set to Absolute, then the absolute encoder will be set to 000 when the position is set to 000.
(Switch 1 OFF, Switch 2 ON)
DualLimit hard cal runs in reverse to the Home limit switch, sets that position as 0, then runs to the Index limit switch and sets that position MINUS THE Index Offset as the maximum position. It then returns to the MinPos stored in EEPROM. If SoftRecal is set to Absolute, then the absolute encoder will be set to 000 when the position is set to 000.
(Switches 1 and 2 ON)

2.2.2 Soft Recal Type

A Soft Recal, which is executed every time power is switched on, resets all error conditions, and re-loads the Home position and maximum travel distances. Four different methods of re-loading are available, and are selected using Options dipswitches 3 and 4.

Wake at Last Position soft cal loads the last position saved in EEPROM as the present position, and sets the maximum position to the MaxPos stored in EEPROM. The system is then ready to run without further movement or delay. The last position is stored whenever the motor transitions from moving to not moving. As long as the motor is brought to a halt under Motovator control, the last position will be valid. If power is lost WHILE THE MOTOR IS MOVING, then the last position will NOT be valid, and Wake at Last Position will fail. IF the last position load fails, a hard recal will be required.
(Switches 3 and 4 OFF)

Cal from Absolute soft cal loads the present position from the absolute encoder, and sets the maximum position to the MaxPos to stored in EEPROM. The system is then ready to run without further movement or delay. If the absolute encoder position is not valid (if the absolute encoder power supply failed, for example) this position reload will fail and a hard

recal will be required.
(Switch 3 ON, Switch 4 OFF)

ManualHardCal forces the user to initiate a Hard Recal sequence using the DMX512 link and the GO button. Releasing GO or pushing ESTOP will abort the cal and return to an UNCALed state. Normal operation begins upon completion of the cal sequence.
(Switch 3 OFF, Switch 4 ON)

AutoHardCal automatically initiates a Hard Recal sequence the first time GO is pressed. The hard recal will continue as long as GO is held, ESTOP is OK, and the sequence is not complete. Releasing GO or pushing ESTOP will abort the cal and return to an UNCALed state. Normal operation begins upon completion of the cal sequence.
(Switch 3 ON, Switch 4 ON)

2.2.3 Linear / Rotary Mode

Linear Mode for use with hoists, winches, traveler curtain, etc.
(Switch 5 OFF)

Rotary Mode for use with turntables.
(Switch 5 ON)

2.2.4 Absolute Encoder Direction

Absolute Encoder Direction is used to reverse the rotation direction of the absolute encoder.
(Switch 6 will be set during the Open Loop Test)

2.2.5 Incremental Encoder Direction

Incremental Encoder Direction is used to reverse the rotation direction of the incremental encoder.
(Switch 7 will be set during the Open Loop Test)

2.2.6 Motor Direction

Motor Direction is used to reverse the rotation direction of the motor.
(Switch 8 will be set during the Open Loop Test)

2.2.7 Parameter Write Protect

Write enable: New setup parameter values can be written
(Switch 9 ON)

Write protect: EEPROM memory is protected from inadvertent write.
(Switch 9 OFF)

2.2.8 Open Loop Mode

Open Loop Enable In this mode the user has direct control over the speed and direction signals applied to the VF drive or servo amplifier. The PID servo loop is disabled. *This mode is used during setup only.*
(Switch 10 ON)

Open Loop Disable In this mode the PID servo loop has control over the speed and direction signals applied to the VF drive or servo amplifier. This mode is used after the system has been configured, during normal operation.
(Switch 10 OFF)

2.3 Open Loop Test

The motor must be set up so that 0 is at Home, and Full is at the end of travel. The encoder(s) must be matched to the motor, so that the position increases as the motor rotates forward. This is done using OPEN LOOP test mode, in conjunction with a DMX512 control source, and a computer running a terminal emulator.

For these tests the motor must be energized and used to move the encoder(s), and if the encoder(s) is (are) connected directly to the load, the load as well. Please read through each step before performing the step. *Be sure to use caution when performing these operations.*

For this test, set the switches (SW1, SW2 on the Motovator Position Controller PC board) as follows:

SW1---- DMX Addr: 000 (ALL SW1 Switches OFF)
SW2---- OPTIONS: Switches 1 – 8 OFF
Switches 9 and 10 ON

Make sure that the DMX controller, monitoring computer and GO and ESTOP switches are connected as described in previous sections.

With the ESTOP switch OPEN (STOPPED) and the GO switch OPEN (NOT GO), apply power to the Motovator.

1. Observe that the RED LED is ON, and the GREEN LED is flashing a Morse 'X' (-..-).

2. Make certain the motor and load are free to move. Set the ESTOP switch to RUN (CLOSED). *IF THE MOTOR MOVES, OPEN THE ESTOP SWITCH!* If the motor moves at this point, there is a hardware fault. Return the unit for repair.

3. Set the GO switch to GO (CLOSED). *IF THE MOTOR MOVES, OPEN THE GO AND ESTOP SWITCHES!* If the motor moves at this point, there is a hardware fault. Return the unit for repair. Otherwise, observe that the RED LED turns OFF, and that the GREEN LED flashes Morse 'Z' (--..).

4. Launch the Anita terminal emulator on the computer, set for 9600 baud, 8 bits no parity. Make sure that the port selected is the port to which the return data line from the Motovator is connected.

5. Switch on the DMX source. Observe that the GREEN LED changes to Morse 'EZ' (./--..).

6. Observe that the PC displays the Motovator Status screen, and that the STATUS line reads -OPEN LOOP MODE-.

7. Verify that the display indicates as follows: GO Button: RUN, ESTOP: RUN, Overtravel Sw OK (closed).

8. Open the overtravel limit switches one at a time. Observe that when each switch is opened the display indicates Overtravel Sw: FAIL (open). Close all overtravel switches when

finished.

9. Slowly increase the level on DMX channel 3. The motor should begin to rotate as the level is increased. Note the direction of rotation then return channel 3 to 0. The motor should stop. *IF THE MOTOR DOES NOT STOP, OPEN the ESTOP switch*, and send the unit for repair. Release the GO button. Note that the GO button should be pushed during this sequence of tests in order to allow the motor to run. If at any time the motor moves WITHOUT the GO button pressed, there is a problem!

10. If the motor rotated in a POSITIVE direction, i.e. moved the load from Home towards the end of travel, motor direction is correct. If not, TURN OFF THE POWER TO THE MOTOVATOR. Set Options switch 8 (Motor Direction) ON. Re-apply power and re-test the motor direction.

11. Note the Actual Position displayed on the PC. Advance DMX channel 3 until the motor begins to move. Note the change in actual position. If it is a positive change (the number is changing to a larger positive value or a smaller negative value) the encoder direction is correct. If not, TURN OFF THE POWER TO THE MOTOVATOR. Set Options switch 7 (Incremental Encoder Direction) ON. Re-apply power and re-test the encoder direction.

12. Increase the level of DMX channel 1 to 100%. This will select Reverse motor rotation.

13. Slowly increase the level of DMX channel 3. The motor should now rotate in reverse. Return channel 3 to 0.

14. Using channel 1 for direction and channel 3 for speed control, move the load to the approximate center of travel.

15. OPEN the GO and ESTOP switches.

16. Observe the status of the HOME and INDEX switches on the computer. Verify that both switches are CLOSED.

17. Manually operate the Home and Index switches, and observe that the PC screen indicates Home Switch OPEN and Index Switch OPEN.

18. Turn OFF the power to the Motovator, and set Options dipswitch 10 (Open Loop Mode) OFF. That concludes the motor and encoder direction test.

2.4 Setting Operating Parameters

The remaining operating parameters will be set using the DMX source and the terminal emulator. First, however, several calculations are required.

2.4.1 Calculate Maximum Operating Speed

The speed of the system is entered in hundreds of Ticks Per Minute or hTPM. This may be calculated as follows:

If the encoder is mounted directly to the motor:

TPM = (Encoder Resolution (lines)) * 4 * (maximum motor speed in RPM)
hTPM = TPM / 100

For example, using an encoder with 512 lines of resolution and a 1725 RPM motor:

TPM = (512 lines) * 4 * (1725RPM) = 3532800 TPM

then convert to hTPM:

hTPM = (3532800 TPM) / 100 = 35328 hTPM

If the encoder is mounted to the load, after a gear reduction stage:

TPM = (Encoder Resolution (lines)) * 4 * (max. motor speed in RPM) / Gear ratio
hTPM = TPM / 100

For example, using a 512 encoder on a 1725 RPM motor with a 10:1 gearbox:

TPM = (512 lines) * 4 * (1725 RPM) / 10 = 353280 TPM

then convert TPM to hTPM, rounding to the nearest unit

hTPM = (353280 TPM) / 100 ≈ 3533 hTPM

2.4.2 Calculate the calibration speed

This is the speed at which the system should run while attempting to locate the Home and Index limit switches. It is calculated in the same way as the maximum speed, substituting the motor RPM desired for the maximum motor RPM.

2.4.3 Calculate the minimum operating speed

This is calculated the same as maximum operating speed, substituting the minimum motor speed desired.

2.4.4 Calculate the acceleration rate

This value is entered in thousands of Ticks Per Minute per second (or kTPM/sec.), and represents the number of thousands of ticks per minute that the speed will increase for every second of acceleration. For example, if the maximum speed was set to 60,000 TPM (or 600 hTPM) and the acceleration was set to 6000 TPM/sec (or 6 kTPM/sec), then it would take 10 seconds for the motor to accelerate to full speed.

TPM/sec = MaxSpeed(TPM) / seconds to accelerate
kTPM/sec = (TPM/sec) / 1000

For example, using the maximum operating speed calculated above for the 1725RPM motor, with a 512 encoder and no gearbox, calculate a 7 second acceleration time (note maximum speed units are TPM, not hTPM):

TPM/sec = (3532800 TPM) / (7 sec) = 24729600 TPM/sec

then convert to kTPM and round to nearest unit:

kTPM = (24729600 TPM/sec) / 1000 ≈ 24730 kTPM/sec

2.4.5 Calculate the calibration acceleration rate

This is simple! Use 0.1 seconds as the time, and the calibration speed as the speed.

TPM/sec = Calibration speed(TPM) / 0.1 seconds

The remaining values are entered directly in obvious units. The operating parameters are stored in the Motovator in an Electrically Erasable Programmable Read Only Memory, or EEPROM. This memory will hold its contents without power for at least 10 years. Once these values are entered in to the EEPROM you should have no further need to change them. It is a very good idea to make a complete record of the setup data so that it can be re-entered if for any reason the EEPROM should become damaged or corrupt. The easiest way to do this is to use the print screen option in the terminal emulator program. Further, after the setting of the parameters is complete, the parameter memory may be write-protected by setting Options Switch 9 (Write Enable) OFF.

2.4.6 Enter the Operating Parameters

Motovator should be setup the same as is was for the open loop test.

1. OPEN the ESTOP switch, to prevent motor motion.

2. Use the Address and Options switch settings as follows:
   DMX Addr (SW1)
   ALL OFF
   OPTIONS (SW2)
   1-2 OFF (Use present position as 0)
   3-4 ON (Auto Hardcal)
   5-6 OFF (Linear mode, absolute encoder forward)
   7 and 8 as they were set in the open loop test earlier (*Very Important!*)
   Option 9 ON (Write Enabled)
   Option 10 OFF (Open Loop Mode Disabled)

3. Apply power to the Motovator.

4. Set DMX channel 5 to 50% and channel 6 to 90%. This selects Setup Read mode.

5. Observe that the Setup Read screen is displayed on the terminal emulator.
   IMPORTANT! If this Motovator was previously set up, use the File/Print Screen option on the PC to print the screen for future reference!

6. Set DMX channel 5 to 70%. This selects Setup Write mode, and (after a 2 second delay) sets all operating parameters to the values sent on the DMX link (in this case, all 0).

7. Set the operating parameters using DMX channels, as follows:

Parameters are set using one or more DMX channels. In the case where more than one channel is specified, the lowest number is the most significant (or “coarsest”) part of the value. For example, if two channels are used, the low channel represents increments of 256, and the high channel increments of 1. With a three channel value, the first (lowest) channel represents an increment of 65535. Some of the single channel values are interpreted according to a table, which will be given when required. Note that these are actual, DECIMAL (0-255) DMX output values, and *NOT* percentage levels. Refer to your lightboard manual for information on displaying dimmer levels as 0-255.

Initial setup should be as follows:

DMX Channel	Parameter	DMX Value
474-475:	Kp:	1024 (channel 474 = 4, channel 475 = 0)
476-477:	Ki:	0
478-479:	Kd:	0
480-481:	Integration Limit:	0
482-483:	Integration Delta:	0
484-485:	Minimum speed:	Set to value calculated earlier in units of hTPM
486-487:	Maximum speed:	Set to value calculated earlier in units of hTPM
488-489:	Calibration speed:	Set to value calculated earlier in units of hTPM
490-491:	Accel rate:	65535
492-493:	Cal Accel rate:	Set to value calculated earlier, in kTPM/sec
494-496:	Minimum position:	0
497-499:	Maximum position:	(100% ON ALL THREE CHANNELS - 8388607)
500-501:	Index Offset:	0
502:	Stall Threshold:	50
503:	Stall time:	50
504:	Brake Time:	0
505:	Absolute Encoder Mode:	0
506:	Incremental to Absolute ratio Incremental counts:	1
507:	Incremental to Absolute ratio Absolute counts:	1

Observe that the values entered appear on the setup screen. Adjust the levels on the lightboard until the "DMX VALUE" column matches the values shown in the table above. Record the complete setup as a “preset” on the lightboard, so that it can be easily re-created and edited. After recording the preset, set DMX channel 5 to 50%. This will return to Setup Read mode. Verify that the "STORED VALUES" match the "DMX VALUES", and that both match the table above. If they do not, return to Setup Write and try again. If this does not work the unit requires repair.

2.5 Tuning the Servo

If the previous sections have been completed, the system is ready to test in closed-loop position mode. It is important that the load be positioned as near the center of its travel as possible. This will give the largest amount of room for movement if something should go wrong with the position loop. *CAUTION!* The usual failure mode of a position servo is to run away at full speed in reverse. The Motovator will automatically shut off the safety relay if it detects this condition, but it takes approximately 1 second to do so. If at any time something happens that appears dangerous, or that does not make sense, *OPEN THE ESTOP SWITCH!* This will remove power to the motor and allow it to stop.

2.5.1 First Test of Positioning Mode

1. Using the setup of section 2.4.6, reapply power to the Motovator.

2. Set ALL DMX channels to 0.

3. Set ESTOP to RUN. Make sure GO is released.

4. Observe the Status screen on the terminal emulator. Verify:
   GO BUTTON: STOP ESTOP: Stby CMD MODE: STANDBY

5. Push and hold GO. Observe the ESTOP changes to STOP and that GO changes to RUN Release GO.

6. Set DMX channel 5 to 10% and channel 6 to 60%

7. Observe that CMD MODE changes to POSITION.

8. Push and hold GO. Observe that STATUS is FOLLOWING DMX - HOLDING AT POSITION. Release GO.

9. Set DMX channel 3 to 100% (full speed)

10. Set DMX channel 1 to 100 %. Push and hold GO. The motor should start to accelerate forward. Release GO. The motor should slow and stop.

11. Set DMX channel 1 to 0% . Push and hold GO. The motor should accelerate in Reverse, return to its original position and stop. Release GO.

2.5.2 Setting the Proportional Gain (Kp)

This is one of the constants that controls the force that is applied to move the motor towards its destination. Kp sets the amount of torque per tick of error that will be applied. The larger the value, the “stiffer” the servo will be. This value should be set so as to reduce the static error to a small value and provide good step response, while producing relatively small amounts of “overshoot”.

1. If the motor “overshot” the Home position in section 2.5.1, step 11, the Kp gain must be reduced. Otherwise, it must be increased until the motor DOES overshoot. To change Kp, load the preset that was recorded in the ‘Setting Operating Parameters’ section. This will force the Motovator back into Command Write mode. Change the levels of DMX channels 478 and 479. Re-record the new levels as a new preset.

2. After increasing or decreasing Kp, repeat the tests in step L The goal is “snappy” response, low static error, and moderate (less than 2 turns) of overshoot. Record a new preset after each change. This way you will be able to “back up” to a previous setup without re-doing anything.

2.5.3 Setting the Derivative Gain (Kd)

Kd sets the amount of torque per tick of error change per unit time that will be applied. The larger the value the more “damping” will be applied. Kd has the effect of reducing overshoot.

1. Load the preset recorded in section 2.5.2 step 2. Initially, set Kd = Kp * 3. Repeat the step position test (section 2.5.1 steps 10 and 11). If the motor continues to overshoot, double Kd. If it does not overshoot, cut Kd in half. Continue this process until Kd is optimized to the minimum value that eliminates all overshoot.

2. Record a new setup preset.

2.5.4 Setting the Integral Gain (Ki)

Ki acts on the history of the error - the integral of error over time, correcting static errors that remain due to friction, gravity, or some other constant force. Ki is the most difficult servo parameter to optimize as there are three controls that interact: Ki itself, Integration Limit and Integration Delta. *Ki and its related parameters can also cause dramatic servo instability, so proceed with caution!*

1. Load the preset recorded in section 2.5.3, step 2. Initially, set the Integral parameters as follows: Ki = Kp * 0.05, Integration Limit = Kp * 0.1, Integration Delta = observed static error * 2.

2. Observe the static error after making the changes in the previous step. If it has been reduced to 0, repeat the test in section 2.5.1 step 10 and 11. If the servo is stable (no overshoot, good step response) tuning is complete. If there is overshoot, reduce Ki to half of its value and repeat.

3. Record a new setup preset.

4. Open the GO and ESTOP switches.

2.5.5 Set up for normal operation

Now that servo tuning is complete, the operating parameters must be set for normal operation.

1. Load the preset recorded in the previous section, step 3.

2. Set channels 490-491 (Accel Rate) to the value calculated in step 2.4.4.

3. Record a new setup preset.

4. Load the setup into EEPROM memory - Set DMX channel 5 to 70% and channel 6 to 90%. Wait for the PC to display the WRITE screen.

5. Set DMX channel 5 to 50%. Print the screen to make a printed record of the servo operating parameters.

6. Set DMX channel 5 to 10% and channel 6 to 60%.

2.6 Setting Travel Limits and Setup Parameters

The servo system is now ready to control the position and speed of the motor, but it does not know where HOME is located, or what the maximum length of travel is to INDEX. Setting these parameters depends upon the type of Hard Cal that was chosen in section 2.2.1. Follow the next instructions below, then jump to the block of instructions that correlates to your Hard Cal selection.

2.6.1 Set the Hard Cal Type

1. Set Hard Cal type by changing 'Options' switches 1 and 2 to the positions chosen in section 2.2.1.

2. Cycle power to the Motovator to reload the new settings.

3. Jump to section:
   2.6.2 for 'Wake @ Home' hard cal instructions
   2.6.3 for 'Stall @ Home' hard cal instructions
   2.6.4 for 'Home Limit' hard cal instructions
   2.6.5 for 'Dual Limit' hard cal instructions

2.6.2 Home and Index for 'Wake @ Home' Hard Cal Setting

Finding HOME
Position the load at the home position, and execute a user hard cal.

1. Set DMX channel 5 to 20% and channel 6 to 70% (selects "pickle" mode)

2. Set DMX channel 3 to 50% (selects 50% speed)

3. CLOSE the GO and ESTOP switches.

4. To move toward home, set channel 4 to 70%. To move toward index, set it to 30%

5. Using the GO switch and channels 3 and 4, position the load at the HOME position.

6. OPEN the GO switch.

7. Set channel 5 to 40% and channel 6 to 80%, CLOSE the GO switch.

8. After a 2 second delay, observe that the status changes to HARD CAL COMPLETE.

9. OPEN the GO switch and set DMX channel 5 to 10% and channel 6 to 60%.

Finding Length of Travel
Move the load to the end of travel, note the position and enter it into the setup EEPROM

10. Set DMX channel 5 to 20% and channel 6 to 70% (selects "pickle" mode)

11. Set DMX channel 3 to 50% (selects 50% speed)

12. CLOSE the GO and ESTOP switches.

13. Set channel 4 to 30%.

14. Using the GO switch and channels 3 and 4, position the load at the end of travel position.

15. OPEN the GO switch.

16. Note the actual position, it will be recorded later.

17. Load the last setup preset that was recorded.

18. Set DMX channels 501-503 to the position noted in step 16.

19. Record a new setup preset, save the new setup values to EEPROM, and print a hard copy of the setup screen.

20. Set DMX channel 5 to 10% and channel 6 to 60%

21. Set DMX channels 1 and 2 to 0%, and channel 3 to 50%

22. CLOSE the GO switch. The load will move back to the Home position.

23. OPEN the GO switch. The drive is now ready for use.

2.6.3 Home and Index for 'Stall @ Home' Hard Cal Setting

Finding HOME

Set the Stall threshold and time and Index Offset, and execute a user hard cal.

1. Set DMX channel 5 to 20% and channel 6 to 70% (selects "pickle" mode)

2. Set DMX channel 3 to 50% (selects 50% speed)

3. CLOSE the GO and ESTOP switches.

4. Set DMX channel 4 to 30%. This will force the motor to move toward Index.

5. Note the Motor Torque displayed on the PC. Open the GO switch.

6. Set DMX channel 4, 5 and 6 to 0.

7. Load the setup preset recorded in section 2.5.5 step 3.

8. Set DMX channel 502 (Stall Threshold) to the value (in percent) noted in section 2.6.3 step 5 * 1.5

9. Set DMX channels 500-501(Index Offset) to the distance (in ticks) from the hard stop to the HOME position.

10. Load the new setup values into EEPROM (ch 5 to 70%, ch 6 to 90%, hold, then restore to 50% and 90%), and record a new setup preset.

11. Set DMX channel 5 to 40% and channel 6 to 80%

12. CLOSE the GO switch. The load will move towards HOME. When the load reaches

home, and runs into the HOME stop, it will stop moving. The motor torque will increase, trying harder to move the load. When the torque reaches the Stall Threshold set in step 8, and remains there without moving the motor for the time set in Stall Time the system will recognize a stall, and stop the motor. The load will then move away from the hard stop the distance set in step 9, and stop.

13. Observe that the status changes to HARD CAL COMPLETE.

14. OPEN the GO switch and set DMX channel 5 to 10% and channel 6 to 60%.

Finding Length of Travel
Move the load to the end of travel, note the position and enter it into the setup EEPROM

15. Set DMX channel 5 to 20% and channel 6 to 70% (selects “pickle” mode)

16. Set DMX channel 3 to 50% (selects 50% speed)

17. CLOSE the GO and ESTOP switches.

18. Set channel 4 to 30%.

19. Using the GO switch and channels 3 and 4, position the load at the end of travel position.

20. OPEN the GO switch.

21. Note the Actual Position; it will be recorded later.

22. Load the last setup preset that was recorded.

23. Set DMX channels 501-503 to the position noted in step 21.

24. Record a new setup preset, save the new setup values to EEPROM, and print a hard copy of the setup screen.

25. Set DMX channel 5 to 10% and channel 6 to 60%

26. Set DMX channels 1 and 2 to 0%, and channel 3 to 50%

27. CLOSE the GO switch. The load will move back to the Home position.

28. OPEN the GO switch. The drive is now ready for use.

2.6.4 Home and Index for ‘Home Limit’ Hard Cal Setting

Finding HOME
Execute a hard recal.

1. Set DMX channel 5 to 40% and channel 6 to 80%

2. CLOSE the GO switch. The load will move towards HOME. When the load reaches the HOME switch, it will stop.

3. Observe that the status changes to HARD CAL COMPLETE.

4. OPEN the GO switch and set DMX channel 5 to 10% and channel 6 to 60%.

Finding Length of Travel
Move the load to the end of travel, note the position and enter it into the setup EEPROM

5. Set DMX channel 5 to 20% and channel 6 to 70% (selects “pickle” mode)

6. Set DMX channel 3 to 50% (selects 50% speed)

7. CLOSE the GO and ESTOP switches.

8. Set channel 4 to 30%.

9. Using the GO switch and channels 3 and 4, position the load at the end of travel position.

10. OPEN the GO switch.

11. Note the Actual Position; it will be recorded later.

12. Load the last setup preset that was recorded.

13. Set DMX channels 501-503 to the position noted in step 11.

14. Record a new setup preset, save the new setup values to EEPROM, and print a hard copy of the setup screen.

15. Set DMX channel 5 to 10% and channel 6 to 60%

16. Set DMX channels 1 and 2 to 0%, and channel 3 to 50%

17. CLOSE the GO switch. The load will move back to the Home position.

18. OPEN the GO switch. The drive is now ready for use.

2.6.5 Home and Index for ‘Dual Limit’ Hard Cal Setting

Home and Index limits, and automatically loading length of travel

1. Execute a hard recal.

2. Set DMX channel 5 to 40% and channel 6 to 80%

3. CLOSE the GO switch. The load will move towards HOME. When the load reaches the HOME switch, it will stop and reverse direction. Continue to hold the GO switch closed. The load will move towards the INDEX switch. When the load reaches the INDEX switch, it will reverse and return home.

4. Observe that the status changes to HARD CAL COMPLETE.

5. OPEN the GO switch and set DMX channel 5 to 10% and channel 6 to 60%.

6. The drive is now ready for use.

2.7 Setting Power Up Action

The system is now set up to find its operating limits, however it does not know what to do on power up. This action depends upon the settings of Options switches 3 and 4 (SW2).

2.7.1 Set the Soft Cal Type

Set Options switches 3 and 4 to the positions chosen in Section 2.2.2. Cycle power to the Motovator to re-load the new settings. Based on the Soft Cal type, follow the appropriate instruction block below.

2.7.2 Wake at Last Position

This mode requires no further setup. It will operate properly as long as:

1. The Motovator was Hard Recalled properly.

2. The motor is STOPPED and has been stopped for AT LEAST 10 SECONDS when the Motovator is powered down.

3. The motor is NOT moved while power is off

2.7.3 Cal from Absolute Encoder

This mode requires the optional A2 absolute position encoder. There are two basic modes of operation:

TURNTABLE: The A2 Single Turn absolute encoder must be connected by a low backlash 1:1 drive directly to the turntable, such that 1 turn of the turntable results in 1 turn of the encoder shaft. This is usually accomplished with a timing belt or timing chain. Turntable mode is selected when Options Switch 5 is ON (Rotary Mode).

MULTI-TURN: The A2 Multi-Turn Geared absolute encoder must be connected to the load such that the total number of turns of the absolute encoder shaft is less than the encoder multi-turn rating. Encoders are available in 16 and 32 turns. Multi-turn mode is selected when Options Switch 5 is OFF (Linear Mode).

Example: A curtain machine has an output drum that turns 17 full turns to open the curtain fully. A 32 turn absolute encoder would be connected via a 1:1 timing belt or chain to the output drum.

1. Calculate the ration of Incremental encoder counts to absolute encoder counts

   <u>Turntable mode:</u>
   Incr. Counts = (Incremental Encoder Pulses per Revolution * 4 * (motor turns per 1 turntable turn)
   Abs. Counts = 65536
   Reduce the fraction: Incr. Counts / Abs. Counts.

   <u>Multi-Turn mode:</u>
   Incr. Counts = (Incremental Encoder Pulses per Revolution * 4 * (motor turns per 1 turn of output shaft)
   Abs. Counts = 65536
   Reduce the fraction: Incr. Counts / Abs. Counts

2. Load the setup preset recorded in section 2.6.2 step 19 if ‘Wake @ Home’ Hard Cal was used, section 2.6.3 step 24 if ‘Stall @ Home’ Hard Cal was used, section 2.6.4 step 14, or section 2.5.5 step 3 if ‘Dual Limit’ Hard Cal was used.

3. Set DMX channel 506 to the REDUCED Incr. Counts from step 1 of this section.

4. Set DMX channel 507 to the REDUCED Absolute Counts from step 1 of this section.

5. Select the absolute encoder mode using DMX channel 505:
   0%: Independent Mode. The absolute encoder is read only on power up, to load the position into the Motovator.
   50%: Compare Mode. In addition to reloading position, the absolute and incremental positions are compared during operation. If the two positions differ by more than 10% of the total system travel, an error will be generated and motion will stop.
   100%: Track Mode: In addition to reloading position, the absolute encoder is treated as a "master position reference" and is used to update the system position during operation. This mode is used when there is "slip" between the motor shaft and the load - typically for rim-drive turntables. If the instantaneous difference between the absolute and the incremental encoders ever exceeds 10% of the total system travel, an error will be generated and motion will stop.

6. Load the new setup values into EEPROM (ch. 5 to 70%, ch. 6 to 90%, hold, then restore to 50% and 90%), and record a new setup preset.

7. Set DMX channel 5 to 40% and channel 6 to 80%

8. CLOSE the GO switch. This will force a Hard Recal using the selected Hard Recal mode. After Hard Recal completes, the absolute encoder will be reset to 0.

9. Observe that the Ab. Enc Stat on the PC screen is OK. If not, execute a second Hard Recal. If the status remains not OK, call for service assistance.

10. Check absolute encoder operation: Set DMX channel 5 to 10% and channel 6 to 60%. Set channel 1 to 100% and channel 3 to 30%. This will schedule a move in the FORWARD direction. Push and hold GO and observe that the motor moves FORWARD.

11. Verify that the Abs Enc Pos and the Actual Pos track. There may be a slight (less than 50 count) difference, but they must otherwise track.

12. If the Absolute and Incremental positions diverge, then the operation direction of the absolute encoder must be reversed. Set Options Switch 6 to ON (SW2), and repeat steps 7 through 11 of this section.

13. Note the Actual and Abs Enc Positions.

14. Cycle power to the Motovator. Observe that the Actual and Abs Enc positions are re-loaded with the positions that were noted.

2.7.4 Manual Hard Cal

This mode requires no further setup. The user *MUST* initiate a hard recal EACH time the Motovator is turned on.

1. Set channel 5 to 40% and channel 6 to 80%.

2. Press and HOLD Go. The Hard Cal sequence will run.

3. When Hard Cal is complete, the system is ready to run.

2.7.5 Auto Hard Cal

This mode requires no further setup. A Hard Cal is automatically scheduled when the Motovator is turned on.

1. To begin operation, Press and HOLD GO. The hard call will begin.

2. On completion of hard cal, the unit is ready to run, and will begin following DMX commands.

2.8 Setting DMX Address and Write Protect

1. Wait at least 10 seconds after stopping the motor then switch off power to the Motovator.

2. Set Options Switch 9 to OFF (SW2) to write protect the setup memory. This switch must be set back to ON if it is necessary to change the setup in the future.

3. Set the address at which the first channel of the 6 channel control group should be located on the Address dipswitch. Note that addresses start at 1. Refer to the Address Table included with this document for switch settings.

4. Switch power back on. Verify the address by setting channels 510, 511, and 512 to select read back. NOTE that EACH Motovator on a DMX link MUST have a unique address!

2.9 DMX Address Table

Address	SW9	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1
Debug001	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF
11	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON	ON
12	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF
13	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF	ON
14	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	OFF
15	OFF	OFF	OFF	OFF	OFF	ON	ON	ON	ON
16	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
17	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON
18	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF
19	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON	ON
20	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF
21	OFF	OFF	OFF	OFF	ON	OFF	ON	OFF	ON
22	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	OFF
23	OFF	OFF	OFF	OFF	ON	OFF	ON	ON	ON
24	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF
25	OFF	OFF	OFF	OFF	ON	ON	OFF	OFF	ON
26	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	OFF
27	OFF	OFF	OFF	OFF	ON	ON	OFF	ON	ON
28	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	OFF
29	OFF	OFF	OFF	OFF	ON	ON	ON	OFF	ON
30	OFF	OFF	OFF	OFF	ON	ON	ON	ON	OFF
31	OFF	OFF	OFF	OFF	ON	ON	ON	ON	ON
32	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF
33	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON
34	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF
35	OFF	OFF	OFF	ON	OFF	OFF	OFF	ON	ON
36	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF
37	OFF	OFF	OFF	ON	OFF	OFF	ON	OFF	ON
38	OFF	OFF	OFF	ON	OFF	OFF	ON	ON	OFF
39	OFF	OFF	OFF	ON	OFF	OFF	ON	ON	ON
40	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF
41	OFF	OFF	OFF	ON	OFF	ON	OFF	OFF	ON
42	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	OFF
43	OFF	OFF	OFF	ON	OFF	ON	OFF	ON	ON
44	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	OFF
45	OFF	OFF	OFF	ON	OFF	ON	ON	OFF	ON
46	OFF	OFF	OFF	ON	OFF	ON	ON	ON	OFF

47	OFF	OFF	OFF	ON	OFF	ON	ON	ON	ON
48	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	OFF
49	OFF	OFF	OFF	ON	ON	OFF	OFF	OFF	ON
50	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	OFF
51	OFF	OFF	OFF	ON	ON	OFF	OFF	ON	ON
52	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	OFF
53	OFF	OFF	OFF	ON	ON	OFF	ON	OFF	ON
54	OFF	OFF	OFF	ON	ON	OFF	ON	ON	OFF
55	OFF	OFF	OFF	ON	ON	OFF	ON	ON	ON
56	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	OFF
57	OFF	OFF	OFF	ON	ON	ON	OFF	OFF	ON
58	OFF	OFF	OFF	ON	ON	ON	OFF	ON	OFF
59	OFF	OFF	OFF	ON	ON	ON	OFF	ON	ON
60	OFF	OFF	OFF	ON	ON	ON	ON	OFF	OFF
61	OFF	OFF	OFF	ON	ON	ON	ON	OFF	ON
62	OFF	OFF	OFF	ON	ON	ON	ON	ON	OFF
63	OFF	OFF	OFF	ON	ON	ON	ON	ON	ON
64	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF
65	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	ON
66	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON	OFF
67	OFF	OFF	ON	OFF	OFF	OFF	OFF	ON	ON
68	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	OFF
69	OFF	OFF	ON	OFF	OFF	OFF	ON	OFF	ON
70	OFF	OFF	ON	OFF	OFF	OFF	ON	ON	OFF
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72	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	OFF
73	OFF	OFF	ON	OFF	OFF	ON	OFF	OFF	ON
74	OFF	OFF	ON	OFF	OFF	ON	OFF	ON	OFF
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76	OFF	OFF	ON	OFF	OFF	ON	ON	OFF	OFF
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80	OFF	OFF	ON	OFF	ON	OFF	OFF	OFF	OFF
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84	OFF	OFF	ON	OFF	ON	OFF	ON	OFF	OFF
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86	OFF	OFF	ON	OFF	ON	OFF	ON	ON	OFF
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88	OFF	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
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92	OFF	OFF	ON	OFF	ON	ON	ON	OFF	OFF
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94	OFF	OFF	ON	OFF	ON	ON	ON	ON	OFF
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98	OFF	OFF	ON	ON	OFF	OFF	OFF	ON	OFF

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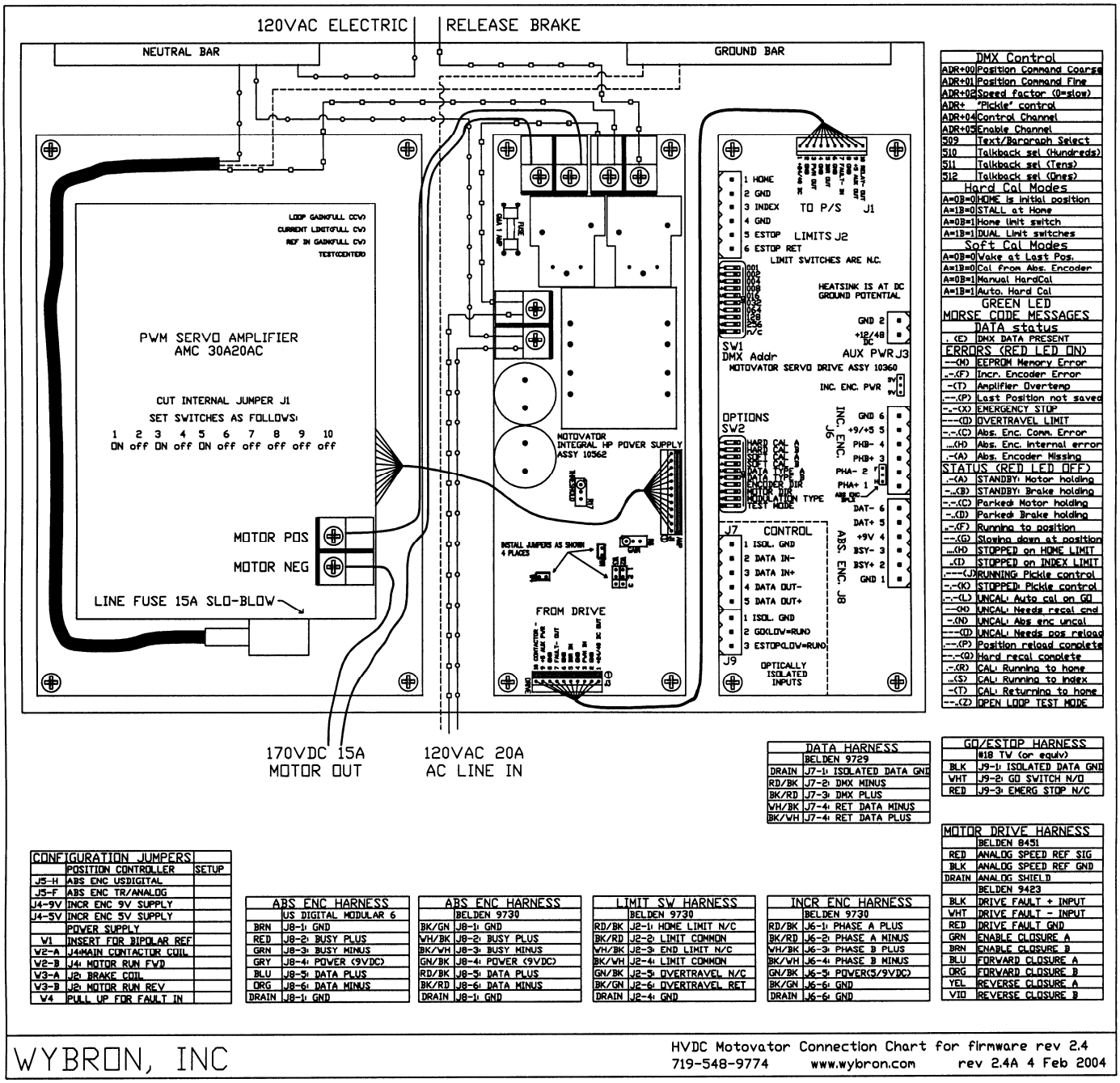
457	ON	ON	ON	OFF	OFF	ON	OFF	OFF	ON
458	ON	ON	ON	OFF	OFF	ON	OFF	ON	OFF
459	ON	ON	ON	OFF	OFF	ON	OFF	ON	ON
460	ON	ON	ON	OFF	OFF	ON	ON	OFF	OFF
461	ON	ON	ON	OFF	OFF	ON	ON	OFF	ON
462	ON	ON	ON	OFF	OFF	ON	ON	ON	OFF

463	ON	ON	ON	OFF	OFF	ON	ON	ON	ON
464	ON	ON	ON	OFF	ON	OFF	OFF	OFF	OFF
465	ON	ON	ON	OFF	ON	OFF	OFF	OFF	ON
466	ON	ON	ON	OFF	ON	OFF	OFF	ON	OFF
467	ON	ON	ON	OFF	ON	OFF	OFF	ON	ON
468	ON	ON	ON	OFF	ON	OFF	ON	OFF	OFF
469	ON	ON	ON	OFF	ON	OFF	ON	OFF	ON
470	ON	ON	ON	OFF	ON	OFF	ON	ON	OFF
471	ON	ON	ON	OFF	ON	OFF	ON	ON	ON
472	ON	ON	ON	OFF	ON	ON	OFF	OFF	OFF
473	ON	ON	ON	OFF	ON	ON	OFF	OFF	ON
474	ON	ON	ON	OFF	ON	ON	OFF	ON	OFF
475	ON	ON	ON	OFF	ON	ON	OFF	ON	ON
476	ON	ON	ON	OFF	ON	ON	ON	OFF	OFF
477	ON	ON	ON	OFF	ON	ON	ON	OFF	ON
478	ON	ON	ON	OFF	ON	ON	ON	ON	OFF
479	ON	ON	ON	OFF	ON	ON	ON	ON	ON
480	ON	ON	ON	ON	OFF	OFF	OFF	OFF	OFF
481	ON	ON	ON	ON	OFF	OFF	OFF	OFF	ON
482	ON	ON	ON	ON	OFF	OFF	OFF	ON	OFF
483	ON	ON	ON	ON	OFF	OFF	OFF	ON	ON
484	ON	ON	ON	ON	OFF	OFF	ON	OFF	OFF
485	ON	ON	ON	ON	OFF	OFF	ON	OFF	ON
486	ON	ON	ON	ON	OFF	OFF	ON	ON	OFF
487	ON	ON	ON	ON	OFF	OFF	ON	ON	ON
488	ON	ON	ON	ON	OFF	ON	OFF	OFF	OFF
489	ON	ON	ON	ON	OFF	ON	OFF	OFF	ON
490	ON	ON	ON	ON	OFF	ON	OFF	ON	OFF
491	ON	ON	ON	ON	OFF	ON	OFF	ON	ON
492	ON	ON	ON	ON	OFF	ON	ON	OFF	OFF
493	ON	ON	ON	ON	OFF	ON	ON	OFF	ON
494	ON	ON	ON	ON	OFF	ON	ON	ON	OFF
495	ON	ON	ON	ON	OFF	ON	ON	ON	ON
496	ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF
497	ON	ON	ON	ON	ON	OFF	OFF	OFF	ON
498	ON	ON	ON	ON	ON	OFF	OFF	ON	OFF
499	ON	ON	ON	ON	ON	OFF	OFF	ON	ON
500	ON	ON	ON	ON	ON	OFF	ON	OFF	OFF
501	ON	ON	ON	ON	ON	OFF	ON	OFF	ON
502	ON	ON	ON	ON	ON	OFF	ON	ON	OFF
503	ON	ON	ON	ON	ON	OFF	ON	ON	ON
504	ON	ON	ON	ON	ON	ON	OFF	OFF	OFF
505	ON	ON	ON	ON	ON	ON	OFF	OFF	ON
506	ON	ON	ON	ON	ON	ON	OFF	ON	OFF
507	ON	ON	ON	ON	ON	ON	OFF	ON	ON
508	ON	ON	ON	ON	ON	ON	ON	OFF	OFF
509	ON	ON	ON	ON	ON	ON	ON	OFF	ON
510	ON	ON	ON	ON	ON	ON	ON	ON	OFF
RDM	ON	ON	ON	ON	ON	ON	ON	ON	ON

2.10 Connection Charts

2.10.1 HVDC Connection Chart



DMX Control	
ADR+00	Position Command Coarse
ADR+01	Position Command Fine
ADR+02	Speed factor (0=slow)
ADR+	'Pickle' control
ADR+04	Control Channel
ADR+05	Enable Channel
509	Text/Paragraph Select
510	Talkback set (Hundreds)
511	Talkback set (Tens)
512	Talkback set (Ones)
Hard Cal Modes	
A=0B=0	HOME is initial position
A=1B=0	STALL at Home
A=0B=1	Home limit switch
A=1B=1	DUAL Limit switches
Soft Cal Modes	
A=0B=0	Wake at Last Pos.
A=1B=0	Cal from Abs. Encoder
A=0B=1	Manual HardCal
A=1B=1	Auto. Hard Cal
GREEN LED MORSE CODE MESSAGES	
DATA status	
. (E)	DMX DATA PRESENT
ERRORS (RED LED ON)	
--(M)	EEPROM Memory Error
.-.(F)	Incr. Encoder Error
-(T)	Amplifier Overtemp
.--.(P)	Last Position not saved
-.-(X)	EMERGENCY STOP
---(O)	OVERTRAVEL LIMIT
-.-.(C)	Abs. Enc. Comm. Error
....(H)	Abs. Enc. internal error
.-(A)	Abs. Encoder Missing
STATUS (RED LED OFF)	
.-(A)	STANDBY: Motor holding
-...(B)	STANDBY: Brake holding
-.-.(C)	Parked: Motor holding
-..(D)	Parked: Brake holding
..-.(F)	Running to position
--.(G)	Slowing down at position
....(H)	STOPPED on HOME LIMIT
..(I)	STOPPED on INDEX LIMIT
.----(J)	RUNNING: Pickle control
-.-(K)	STOPPED: Pickle control
.-..(L)	UNCAL: Auto cal on GO
--(M)	UNCAL: Needs recal cmd
-.(N)	UNCAL: Abs enc uncal
---(O)	UNCAL: Needs pos reload
.--.(P)	Position reload complete
--.-(Q)	Hard recal complete
.-.(R)	CAL: Running to home
...(S)	CAL: Running to index
-(T)	CAL: Returning to home
--..(Z)	OPEN LOOP TEST MODE

DATA HARNESS	BELDEN 9729
DRAIN	J7-1: ISOLATED DATA GND
RD/BK	J7-2: DMX MINUS
BK/RD	J7-3: DMX PLUS
WH/BK	J7-4: RET DATA MINUS
BK/WH	J7-4: RET DATA PLUS

GO/ESTOP HARNESS	#18 TW (or equiv)
BLK	J9-1: ISOLATED DATA GND
WHT	J9-2: GO SWITCH N/O
RED	J9-3: EMERG STOP N/C

CONFIGURATION JUMPERS		
	POSITION CONTROLLER	SETUP
J5-H	ABS ENC USDIGITAL	
J5-F	ABS ENC TR/ANALOG	
J4-9V	INCR ENC 9V SUPPLY	
J4-5V	INCR ENC 5V SUPPLY	
	POWER SUPPLY	
W1	INSERT FOR BIPOLAR REF	
W2-A	J4:MAIN CONTACTOR COIL	
W2-B	J4: MOTOR RUN FWD	
W3-A	J2: BRAKE COIL	
W3-B	J2: MOTOR RUN REV	
W4	PULL UP FOR FAULT IN	

ABS ENC HARNESS	US DIGITAL MODULAR 6
BRN	J8-1: GND
RED	J8-2: BUSY PLUS
GRN	J8-3: BUSY MINUS
GRY	J8-4: POWER (9VDC)
BLU	J8-5: DATA PLUS
ORG	J8-6: DATA MINUS
DRAIN	J8-1: GND

ABS ENC HARNESS	BELDEN 9730
BK/GN	J8-1: GND
WH/BK	J8-2: BUSY PLUS
BK/WH	J8-3: BUSY MINUS
GN/BK	J8-4: POWER (9VDC)
RD/BK	J8-5: DATA PLUS
BK/RD	J8-6: DATA MINUS
DRAIN	J8-1: GND

LIMIT SW HARNESS	BELDEN 9730
RD/BK	J2-1: HOME LIMIT N/C
BK/RD	J2-2: LIMIT COMMON
WH/BK	J2-3: END LIMIT N/C
BK/WH	J2-4: LIMIT COMMON
GN/BK	J2-5: OVERTRAVEL N/C
BK/GN	J2-6: OVERTRAVEL RET
DRAIN	J2-4: GND

INCR ENC HARNESS	BELDEN 9730
RD/BK	J6-1: PHASE A PLUS
BK/RD	J6-2: PHASE A MINUS
WH/BK	J6-3: PHASE B PLUS
BK/WH	J6-4: PHASE B MINUS
GN/BK	J6-5: POWER(5/9VDC)
BK/GN	J6-6: GND
DRAIN	J6-6: GND

MOTOR DRIVE HARNESS	BELDEN 8451
RED	ANALOG SPEED REF SIG
BLK	ANALOG SPEED REF GND
DRAIN	ANALOG SHIELD
	BELDEN 9423
BLK	DRIVE FAULT + INPUT
WHT	DRIVE FAULT - INPUT
RED	DRIVE FAULT GND
GRN	ENABLE CLOSURE A
BRN	ENABLE CLOSURE B
BLU	FORWARD CLOSURE A
ORG	FORWARD CLOSURE B
YEL	REVERSE CLOSURE A
VIO	REVERSE CLOSURE B

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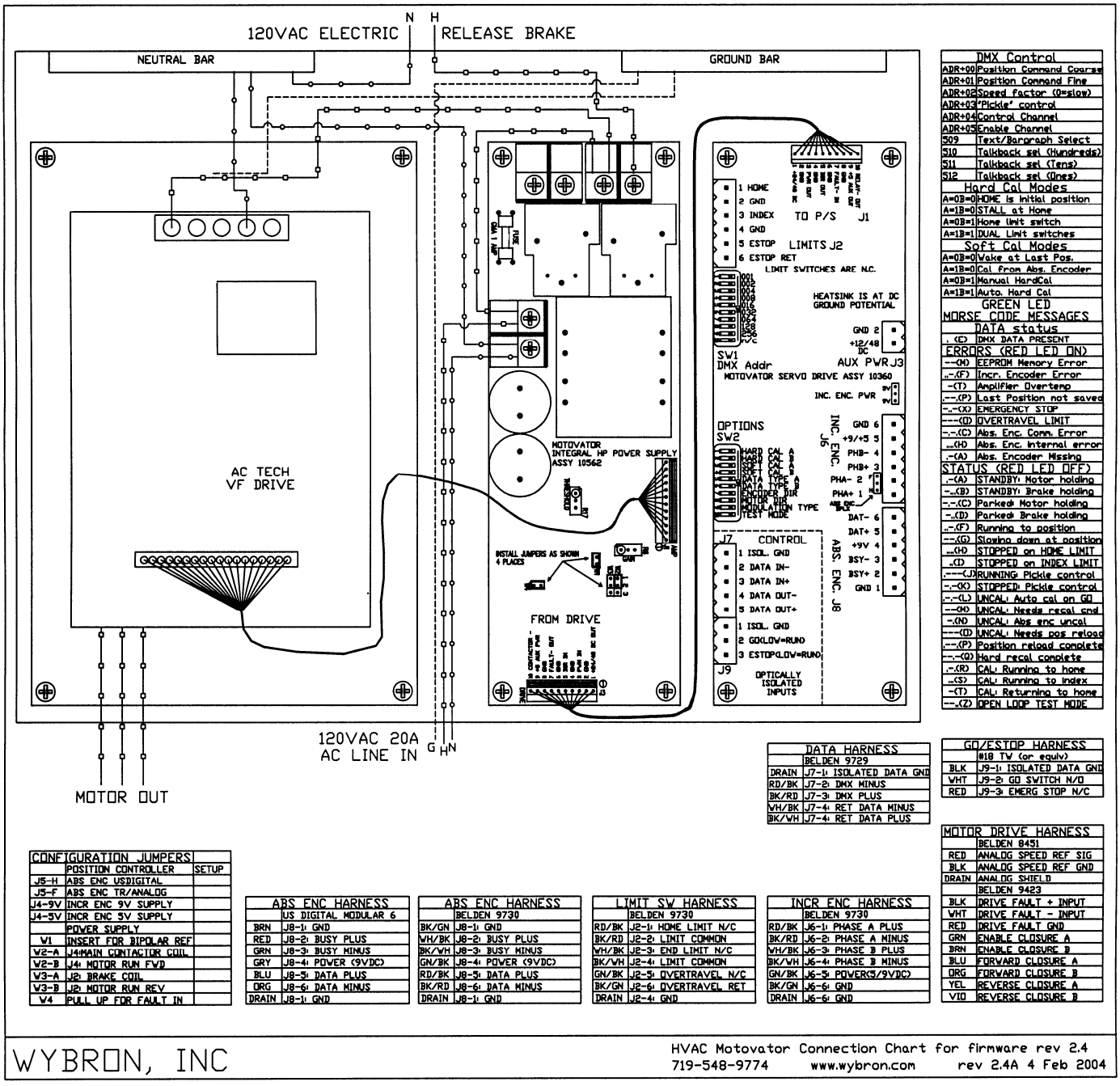
HVDC Motovator Connection Chart for firmware rev 2.4
719-548-9774 www.wybron.com rev 2.4A 4 Feb 2004

2.10.2 HVAC Motovator Connection Chart



DMX Control	
ADR+00	Position Command Coarse
ADR+01	Position Command Fine
ADR+02	Speed factor (0=slow)
ADR+03	'Pickle' control
ADR+04	Control Channel
ADR+05	Enable Channel
509	Text/Paragraph Select
510	Talkback ssi (Hundreds)
511	Talkback ssi (Tens)
512	Talkback ssi (Ones)
Hard Cal Modes	
A=0B=0	HOME is initial position
A=1B=0	STALL at Home
A=0B=1	Home limit switch
A=1B=1	DUAL limit switches
Soft Cal Modes	
A=0B=0	Wake at Last Pos.
A=1B=0	Cal from Abs. Encoder
A=0B=1	Manual HardCal
A=1B=1	Auto. Hard Cal
GREEN LED MORSE CODE MESSAGES	
DATA status	
. (C)	DMX DATA PRESENT
ERRORS (RED LED ON)	
--(M)	EEPROM Memory Error
.-(F)	Incr. Encoder Error
-(T)	Amplifier Overtemp
.--.(P)	Last Position not saved
-.-(X)	EMERGENCY STOP
---(O)	OVERTRAVEL LIMIT
-.-.(C)	Abs. Enc. Comm. Error
...(H)	Abs. Enc. Internal error
.-(A)	Abs. Encoder Missing
STATUS (RED LED OFF)	
.-(A)	STANDBY: Motor holding
-...(B)	STANDBY: Brake holding
-.-.(C)	Parked: Motor holding
-..(D)	Parked: Brake holding
..-.(F)	Running to position
--.(G)	Slowing down at position
....(H)	STOPPED on HOME LIMIT
..(I)	STOPPED on INDEX LIMIT
.---(J)	RUNNING: Pickle control
-.-(K)	STOPPED: Pickle control
.-..(L)	UNCAL: Auto cal on GO
--(M)	UNCAL: Needs recal cmd
-.(N)	UNCAL: Abs enc uncal
---(O)	UNCAL: Needs pos reload
.--.(P)	Position reload complete
--.-(Q)	Hard recal complete
.-.(R)	CAL: Running to home
...(S)	CAL: Running to index
-(T)	CAL: Returning to home
--..(Z)	OPEN LOOP TEST MODE

DATA HARNESS	
	BELDEN 9729
DRAIN	J7-1: ISOLATED DATA GND
RD/BK	J7-2: DMX MINUS
BK/RD	J7-3: DMX PLUS
WH/BK	J7-4: RET DATA MINUS
BK/WH	J7-4: RET DATA PLUS

GO/ESTOP HARNESS	
	#18 TV (or equiv)
BLK	J9-1: ISOLATED DATA GND
WHT	J9-2: GO SWITCH N/O
RED	J9-3: EMERG STOP N/C

CONFIGURATION JUMPERS		
	POSITION CONTROLLER	SETUP
J5-H	ABS ENC USDIGITAL	
J5-F	ABS ENC TR/ANALOG	
J4-9V	INCR ENC 9V SUPPLY	
J4-5V	INCR ENC 5V SUPPLY	
	POWER SUPPLY	
W1	INSERT FOR BIPOLAR REF	
W2-A	J4:MAIN CONTACTOR COIL	
W2-B	J4: MOTOR RUN FWD	
W3-A	J2: BRAKE COIL	
W3-B	J2: MOTOR RUN REV	
W4	PULL UP FOR FAULT IN	

ABS ENC HARNESS	
	US DIGITAL MODULAR 6
BRN	J8-1: GND
RED	J8-2: BUSY PLUS
GRN	J8-3: BUSY MINUS
GRY	J8-4: POWER (9VDC)
BLU	J8-5: DATA PLUS
ORG	J8-6: DATA MINUS
DRAIN	J8-1: GND

ABS ENC HARNESS	
	BELDEN 9730
BK/GN	J8-1: GND
WH/BK	J8-2: BUSY PLUS
BK/WH	J8-3: BUSY MINUS
GN/BK	J8-4: POWER (9VDC)
RD/BK	J8-5: DATA PLUS
BK/RD	J8-6: DATA MINUS
DRAIN	J8-1: GND

LIMIT SW HARNESS	
	BELDEN 9730
RD/BK	J2-1: HOME LIMIT N/C
BK/RD	J2-2: LIMIT COMMON
WH/BK	J2-3: END LIMIT N/C
BK/WH	J2-4: LIMIT COMMON
GN/BK	J2-5: OVERTRAVEL N/C
BK/GN	J2-6: OVERTRAVEL RET
DRAIN	J2-4: GND

INCR ENC HARNESS	
	BELDEN 9730
RD/BK	J6-1: PHASE A PLUS
BK/RD	J6-2: PHASE A MINUS
WH/BK	J6-3: PHASE B PLUS
BK/WH	J6-4: PHASE B MINUS
GN/BK	J6-5: POWER5/9VDC)
BK/GN	J6-6: GND
DRAIN	J6-6: GND

MOTOR DRIVE HARNESS	
	BELDEN 8451
RED	ANALOG SPEED REF SIG
BLK	ANALOG SPEED REF GND
DRAIN	ANALOG SHIELD
	BELDEN 9423
BLK	DRIVE FAULT + INPUT
WHT	DRIVE FAULT - INPUT
RED	DRIVE FAULT GND
GRN	ENABLE CLOSURE A
BRN	ENABLE CLOSURE B
BLU	FORWARD CLOSURE A
ORG	FORWARD CLOSURE B
YEL	REVERSE CLOSURE A
VIO	REVERSE CLOSURE B

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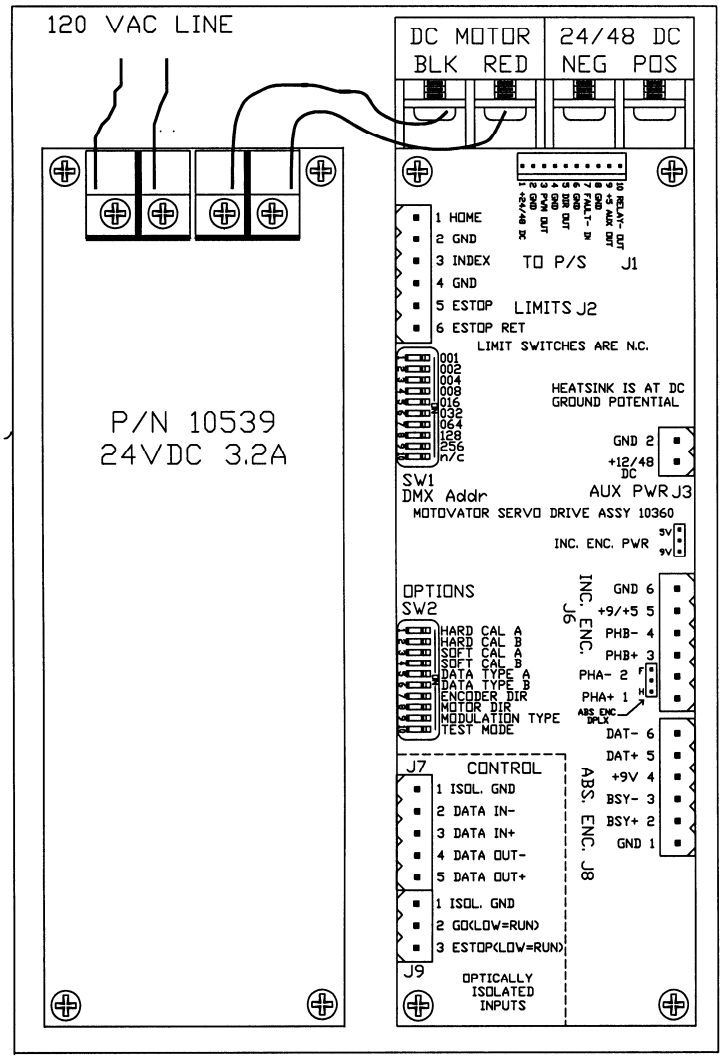
2.10.3 LVDC Motovator Connection Chart



DMX Control	
ADR+00	Position Command Coarse
ADR+01	Position Command Fine
ADR+02	Speed factor (0=slow)
ADR+03	'Pickle' control
ADR+04	Control Channel
ADR+05	Enable Channel
509	Text/Bargraph Select
510	Talkback sel (Hundreds)
511	Talkback sel (Tens)
512	Talkback sel (Ones)
Hard Cal Modes	
A=0B=0	HOME is initial position
A=1B=0	STALL at Home
A=0B=1	Home limit switch
A=1B=1	DUAL Limit switches
Soft Cal Modes	
A=0B=0	Wake at Last Pos.
A=1B=0	Cal from Abs. Encoder
A=0B=1	Manual HardCal
A=1B=1	Auto. Hard Cal
GREEN LED MORSE CODE MESSAGES	
DATA status	
. (E)	DMX DATA PRESENT
ERRORS (RED LED ON)	
--(M)	EEPROM Memory Error
..-.(F)	Incr. Encoder Error
-(T)	Amplifier Overtemp
.--.(P)	Last Position not saved
-..-(X)	EMERGENCY STOP
---(O)	OVERTRAVEL LIMIT
-.-.(C)	Abs. Enc. Comm. Error
....(H)	Abs. Enc. Internal error
.-(A)	Abs. Encoder Missing
STATUS (RED LED OFF)	
.-(A)	STANDBY: Motor holding
-...(B)	STANDBY: Brake holding
-.-.(C)	Parked: Motor holding
-..(D)	Parked: Brake holding
..-.(F)	Running to position
--.(G)	Slowing down at position
....(H)	STOPPED on HOME LIMIT
..(I)	STOPPED on INDEX LIMIT
.---(J)	RUNNING: Pickle control
-.-(K)	STOPPED: Pickle control
.-.-(L)	UNCAL: Auto cal on GO
--(M)	UNCAL: Needs recal cmd
-.(N)	UNCAL: Abs enc uncal
---(O)	UNCAL: Needs pos reload
.--.(P)	Position reload complete
--.-(Q)	Hard recal complete
.-.(R)	CAL: Running to home
...(S)	CAL: Running to index
-(T)	CAL: Returning to home
--..(Z)	OPEN LOOP TEST MODE

CONFIGURATION JUMPERS		
		SETUP
J5-H	ABS ENC USDIGITAL	
J5-F	ABS ENC TR/ANALOG	
J4-9V	INCR ENC 9V SUPPLY	
J4-5V	INCR ENC 5V SUPPLY	

DATA HARNESS	
	BELDEN 9729
DRAIN	J7-1: ISOLATED DATA GND
RD/BK	J7-2: DMX MINUS
BK/RD	J7-3: DMX PLUS
WH/BK	J7-4: RET DATA MINUS
BK/WH	J7-4: RET DATA PLUS

GO/ESTOP HARNESS	
	#18 TW (or equiv)
BLK	J9-1: ISOLATED DATA GND
WHT	J9-2: GO SWITCH N/O
RED	J9-3: EMERG STOP N/C

MOTOR DRIVE HARNESS	
	BELDEN 8451
RED	ANALOG SPEED REF SIG
BLK	ANALOG SPEED REF GND
DRAIN	ANALOG SHIELD
	BELDEN 9423
BLK	DRIVE FAULT + INPUT
WHT	DRIVE FAULT - INPUT
RED	DRIVE FAULT GND
GRN	ENABLE CLOSURE A
BRN	ENABLE CLOSURE B
BLU	FORWARD CLOSURE A
ORG	FORWARD CLOSURE B
YEL	REVERSE CLOSURE A
VIO	REVERSE CLOSURE B

ABS ENC HARNESS	
	US DIGITAL MODULAR 6
BRN	J8-1: GND
RED	J8-2: BUSY PLUS
GRN	J8-3: BUSY MINUS
GRY	J8-4: POWER (9VDC)
BLU	J8-5: DATA PLUS
ORG	J8-6: DATA MINUS
DRAIN	J8-1: GND

ABS ENC HARNESS	
	BELDEN 9730
BK/GN	J8-1: GND
WH/BK	J8-2: BUSY PLUS
BK/WH	J8-3: BUSY MINUS
GN/BK	J8-4: POWER (9VDC)
RD/BK	J8-5: DATA PLUS
BK/RD	J8-6: DATA MINUS
DRAIN	J8-1: GND

LIMIT SW HARNESS	
	BELDEN 9730
RD/BK	J2-1: HOME LIMIT N/C
BK/RD	J2-2: LIMIT COMMON
WH/BK	J2-3: END LIMIT N/C
BK/WH	J2-4: LIMIT COMMON
GN/BK	J2-5: OVERTRAVEL N/C
BK/GN	J2-6: OVERTRAVEL RET
DRAIN	J2-4: GND

INCR ENC HARNESS	
	BELDEN 9730
RD/BK	J6-1: PHASE A PLUS
BK/RD	J6-2: PHASE A MINUS
WH/BK	J6-3: PHASE B PLUS
BK/WH	J6-4: PHASE B MINUS
GN/BK	J6-5: POWER(5/9VDC)
BK/GN	J6-6: GND
DRAIN	J6-6: GND

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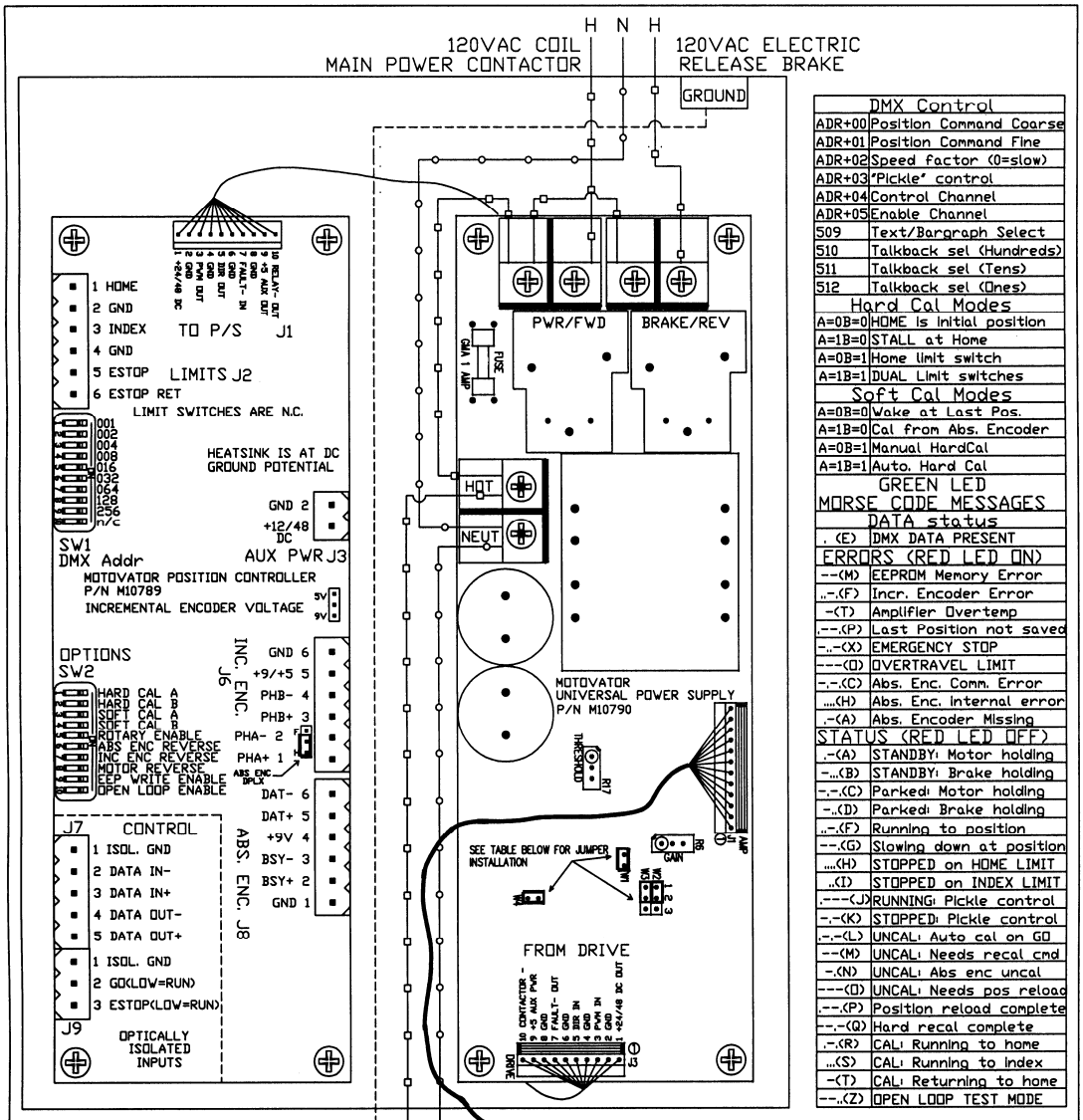
2.10.4 UNIV Motovator Connection Chart



DMX Control	
ADR+00	Position Command Coarse
ADR+01	Position Command Fine
ADR+02	Speed factor (0=slow)
ADR+03	"Pickle" control
ADR+04	Control Channel
ADR+05	Enable Channel
509	Text/Bargraph Select
510	Talkback sel (Hundreds)
511	Talkback sel (Tens)
512	Talkback sel (Ones)
Hard Cal Modes	
A=0B=0	HOME is initial position
A=1B=0	STALL at Home
A=0B=1	Home limit switch
A=1B=1	DUAL Limit switches
Soft Cal Modes	
A=0B=0	Wake at Last Pos.
A=1B=0	Cal from Abs. Encoder
A=0B=1	Manual HardCal
A=1B=1	Auto. Hard Cal
GREEN LED MORSE CODE MESSAGES	
DATA status	
. (E)	DMX DATA PRESENT
ERRORS (RED LED ON)	
--(M)	EEPROM Memory Error
..-.(F)	Incr. Encoder Error
-(T)	Amplifier Overtemp
.--.(P)	Last Position not saved
-..-(X)	EMERGENCY STOP
---(O)	OVERTRAVEL LIMIT
-.-.(C)	Abs. Enc. Comm. Error
....(H)	Abs. Enc. internal error
.-(A)	Abs. Encoder Missing
STATUS (RED LED OFF)	
.-(A)	STANDBY: Motor holding
-...(B)	STANDBY: Brake holding
-.-.(C)	Parked: Motor holding
-..(D)	Parked: Brake holding
..-.(F)	Running to position
--.(G)	Slowing down at position
....(H)	STOPPED on HOME LIMIT
..(I)	STOPPED on INDEX LIMIT
.---(J)	RUNNING: Pickle control
-.-(K)	STOPPED: Pickle control
.-.-(L)	UNCAL: Auto cal on GO
--(M)	UNCAL: Needs recal cmd
-.(N)	UNCAL: Abs enc uncal
---(O)	UNCAL: Needs pos reload
.--.(P)	Position reload complete
--.-(Q)	Hard recal complete
.-.(R)	CAL: Running to home
...(S)	CAL: Running to index
-(T)	CAL: Returning to home
--..(Z)	OPEN LOOP TEST MODE

CONFIGURATION JUMPERS		
	POSITION CONTROLLER	SETUP
J5-H	ABS ENC USDIGITAL	
J5-F	ABS ENC TR/ANALOG	
J4-9V	INCR ENC 9V SUPPLY	
J4-5V	INCR ENC 5V SUPPLY	
	POWER SUPPLY	
W1	INSERT FOR BIPOLAR REF	
W2-A	J4:MAIN CONTACTOR COIL	
W2-B	J4: MOTOR RUN FWD	
W3-A	J2: BRAKE COIL	
W3-B	J2: MOTOR RUN REV	
W4	PULL UP FOR FAULT IN	

DATA HARNESS	
	BELDEN 9729
DRAIN	J7-1: ISOLATED DATA GND
RD/BK	J7-2: DMX MINUS
BK/RD	J7-3: DMX PLUS
WH/BK	J7-4: RET DATA MINUS
BK/WH	J7-5: RET DATA PLUS

GO/ESTOP HARNESS	
	#18 Stranded
BLK	J9-1: ISOLATED DATA GND
WHT	J9-2: GO SWITCH N/O
RED	J9-3: EMERG STOP N/C

MOTOR DRIVE HARNESS	
	BELDEN 8451
RED	ANALOG SPEED REF SIG
BLK	ANALOG SPEED REF GND
DRAIN	ANALOG SHIELD
	BELDEN 9423
BLK	DRIVE FAULT + INPUT
WHT	DRIVE FAULT - INPUT
RED	DRIVE FAULT GND
GRN	ENABLE CLOSURE A
BRN	ENABLE CLOSURE B
BLU	FORWARD CLOSURE A
ORG	FORWARD CLOSURE B
YEL	REVERSE CLOSURE A
VIO	REVERSE CLOSURE B

ABS ENC HARNESS	
	US DIGITAL MODULAR 6
BRN	J8-1: GND
RED	J8-2: BUSY PLUS
GRN	J8-3: BUSY MINUS
GRY	J8-4: POWER (9VDC)
BLU	J8-5: DATA PLUS
ORG	J8-6: DATA MINUS
DRAIN	J8-1: GND

ABS ENC HARNESS	
	BELDEN 9730
BK/GN	J8-1: GND
WH/BK	J8-2: BUSY PLUS
BK/WH	J8-3: BUSY MINUS
GN/BK	J8-4: POWER (9VDC)
RD/BK	J8-5: DATA PLUS
BK/RD	J8-6: DATA MINUS
DRAIN	J8-1: GND

LIMIT SW HARNESS	
	BELDEN 9730
RD/BK	J2-1: HOME LIMIT N/C
BK/RD	J2-2: LIMIT COMMON
WH/BK	J2-3: END LIMIT N/C
BK/WH	J2-4: LIMIT COMMON
GN/BK	J2-5: OVERTRAVEL N/C
BK/GN	J2-6: OVERTRAVEL RET
DRAIN	J2-4: GND

INCR ENC HARNESS	
	BELDEN 9730
RD/BK	J6-1: PHASE A PLUS
BK/RD	J6-2: PHASE A MINUS
WH/BK	J6-3: PHASE B PLUS
BK/WH	J6-4: PHASE B MINUS
GN/BK	J6-5: POWER(5/9VDC)
BK/GN	J6-6: GND
DRAIN	J6-6: GND

WYBRON, INC
UNIV Motovator Connection Chart for firmware rev 2.4
719-548-9774 www.wybron.com rev 2.4A 4 Feb 2004

Technical Information

3.1 Motovator Fault List

This section is included to aid in resolving Motovator error conditions. Call Wybron technical support if the fault you encounter is not covered or is not solved after following the instructions below.

3.1.1 Incremental Encoder Error

Explanation:

- Motor position is not following the profiler position.

Causes:

- The motor is stalled (Mechanical jam)
- Motor is not connected to the drive
- Drive is not powered
- Drive is not working
- Incremental encoder is unplugged
- Incremental encoder wiring failure
- Max speed is set too high (faster than motor can run)
- Accel or Cal Accel is set to high (faster than motor can accelerate)

Solutions:

- Remove power from Motovator
- Check for mechanical jam
- Check motor connections
- Check drive connections and operation
- Check incremental encoder connections and wiring
- If fault occurred during configuration, reduce max speed and accel
- If fault occurred during normal operation, check max speed and accel has not been inadvertently changed
- Re-establish ‘Home position using the procedures in section 2.6 and verify normal operation

3.1.2 Amplifier Over-temperature

Explanation:

- Drive fault has been sensed by Motovator

Causes:

- Drive is not connected to Motovator
- Drive is in a fault state

Solutions:

- Verify connections between Motovator and the drive

- Resolve drive fault using drive manufacturer's procedures
- Cycle power to Motovator
- Re-establish 'Home' position using the procedures in section 2.6 and verify normal operation

3.1.3 Memory Error / E^2PROM Memory Error

Explanation:

- There was an internal software or hardware fault corrupting memory

Causes:

- Recent electrical noise event, such as a lightning strike
- Internal hardware fault

Solutions:

- Cycle power to Motovator, keeping power off for at least 5 seconds. Verify configuration parameters have not been erased.
- If configuration parameters were erased reload parameters from records or re-configure Motovator
- Re-establish 'Home position using the procedures in section 2.6 and verify normal operation

3.1.4 Last Position Error

Explanation:

- Motor was moving when power failed to Motovator. Motovator sets 'Move begun' and 'Move complete' flags to recognize when power (and position) is lost.

Causes:

- Motovator lost power while moving
- Motovator power turned off when a move appeared to be complete, but was not

Solutions:

- Avoid this fault by waiting approximately 10 seconds after last move completes to remove power to Motovator.
- Re-establish 'Home' position using the procedures in section 2.6 and verify normal operation

3.1.5 Overtravel Limit

Explanation:

- Motovator sensed that the Overtravel Limit switch is open

Causes:

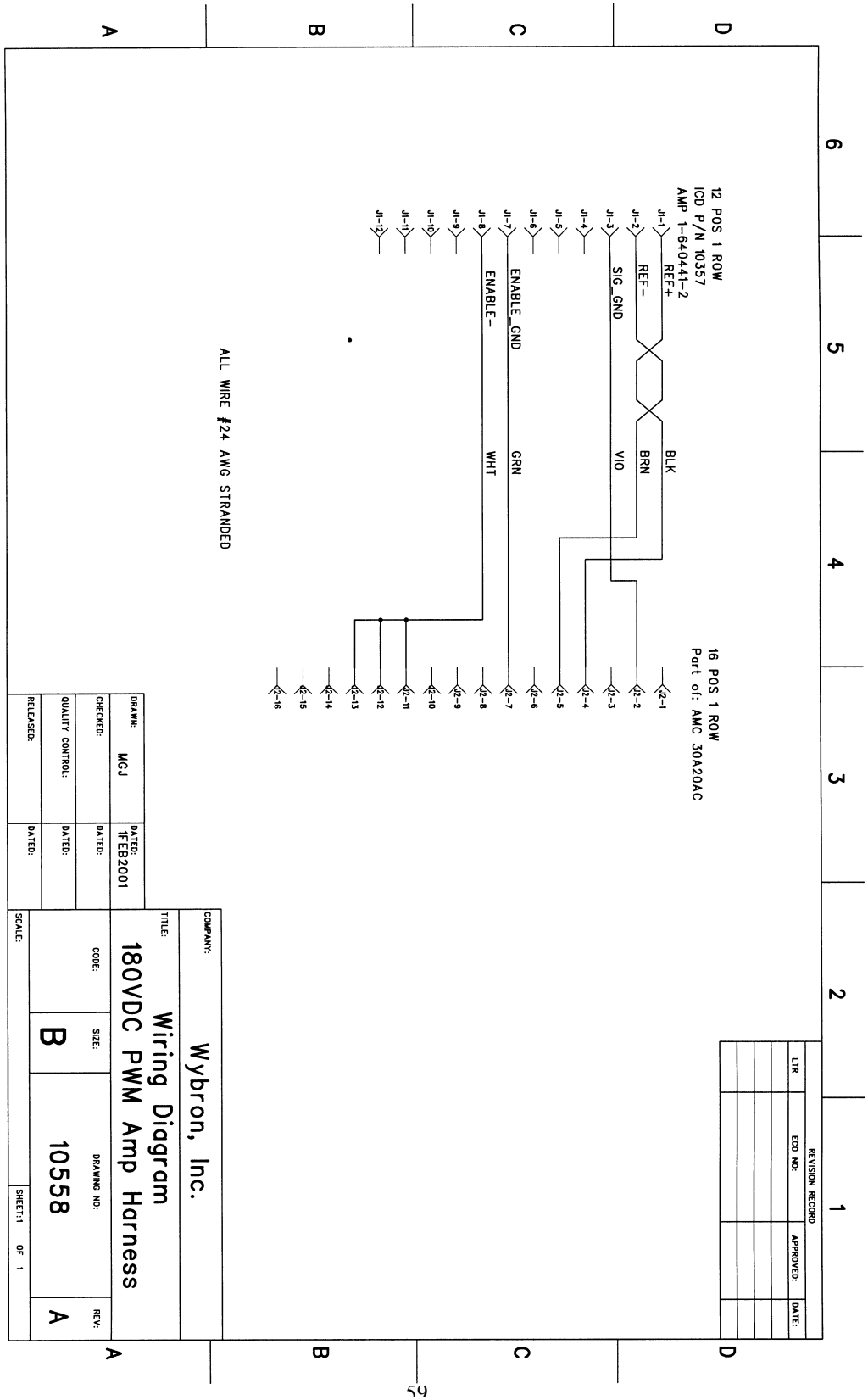
- Overtravel limit switch has been tripped
- Overtravel limit switch wiring fault
- Motor was moved while Motovator was off

Solutions:

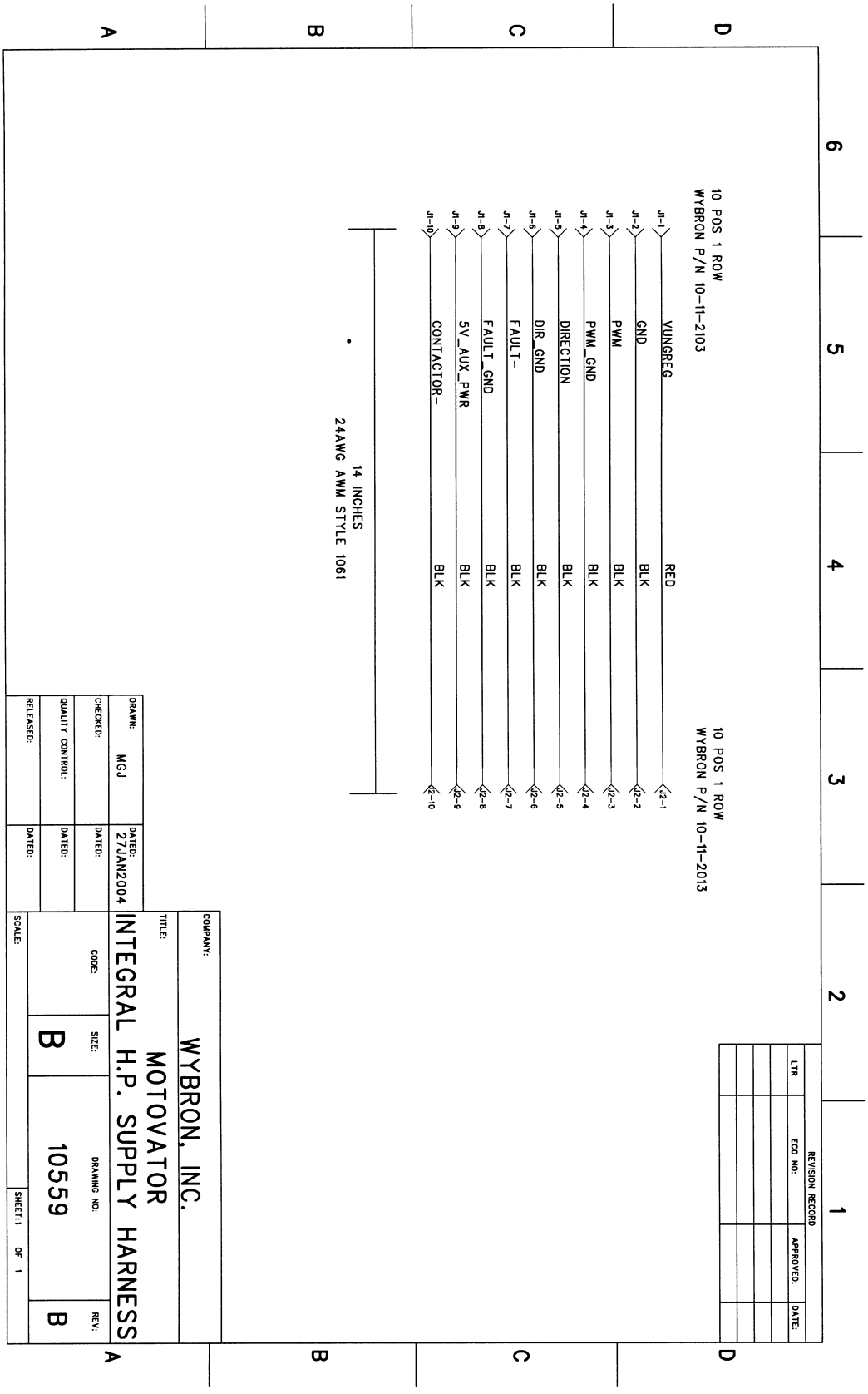
- Disconnect power to Motovator
- Manually move the load off of the overtravel limit switch
- Reconnect power to Motovator
- Re-establish ‘Home position using the procedures in section 2.6 and verify normal operation.

3.2 Motovator Wiring Diagrams

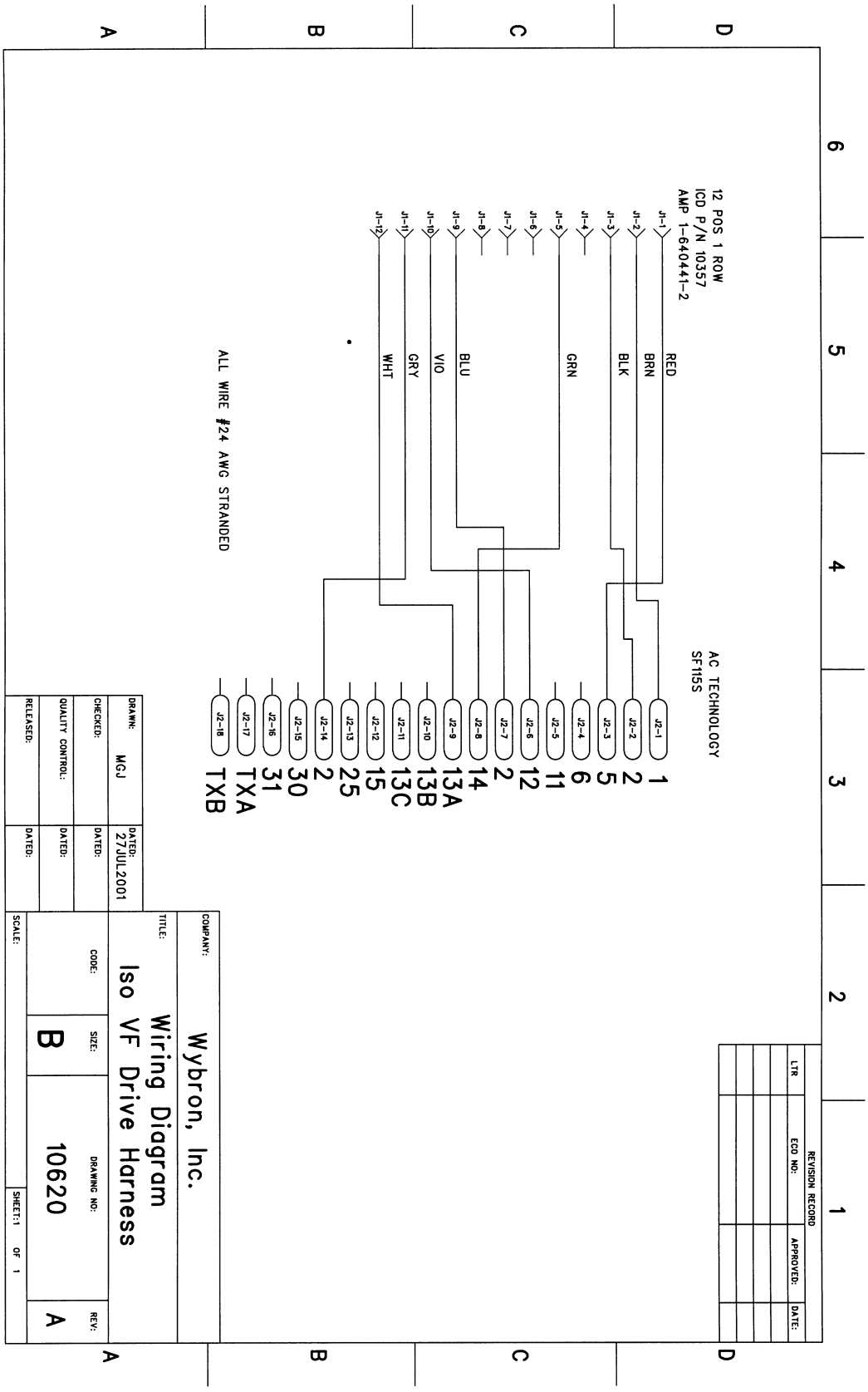
3.2.1 180VDC PWM Amp Harness



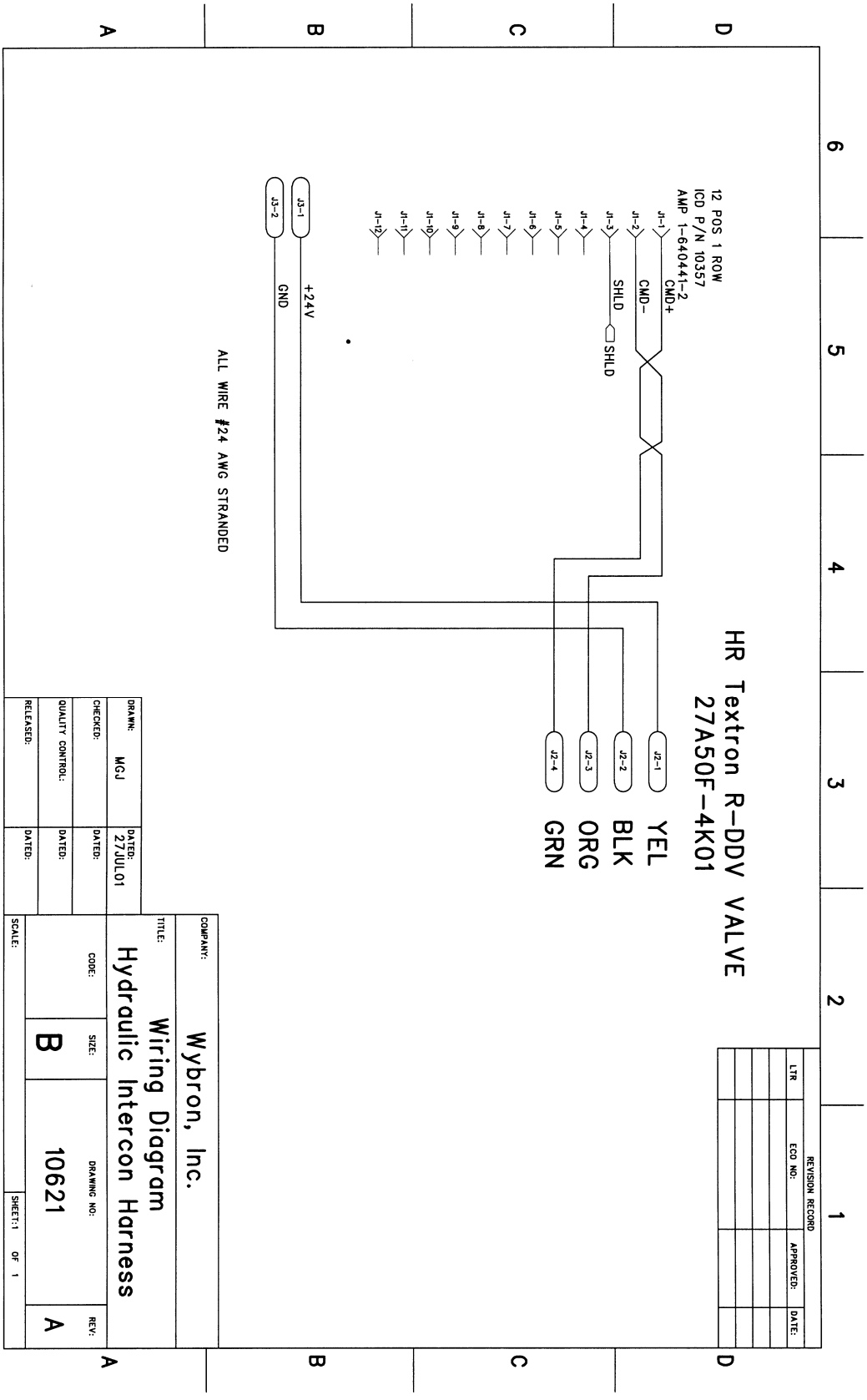
3.2.2 Integral H.P. Supply Harness



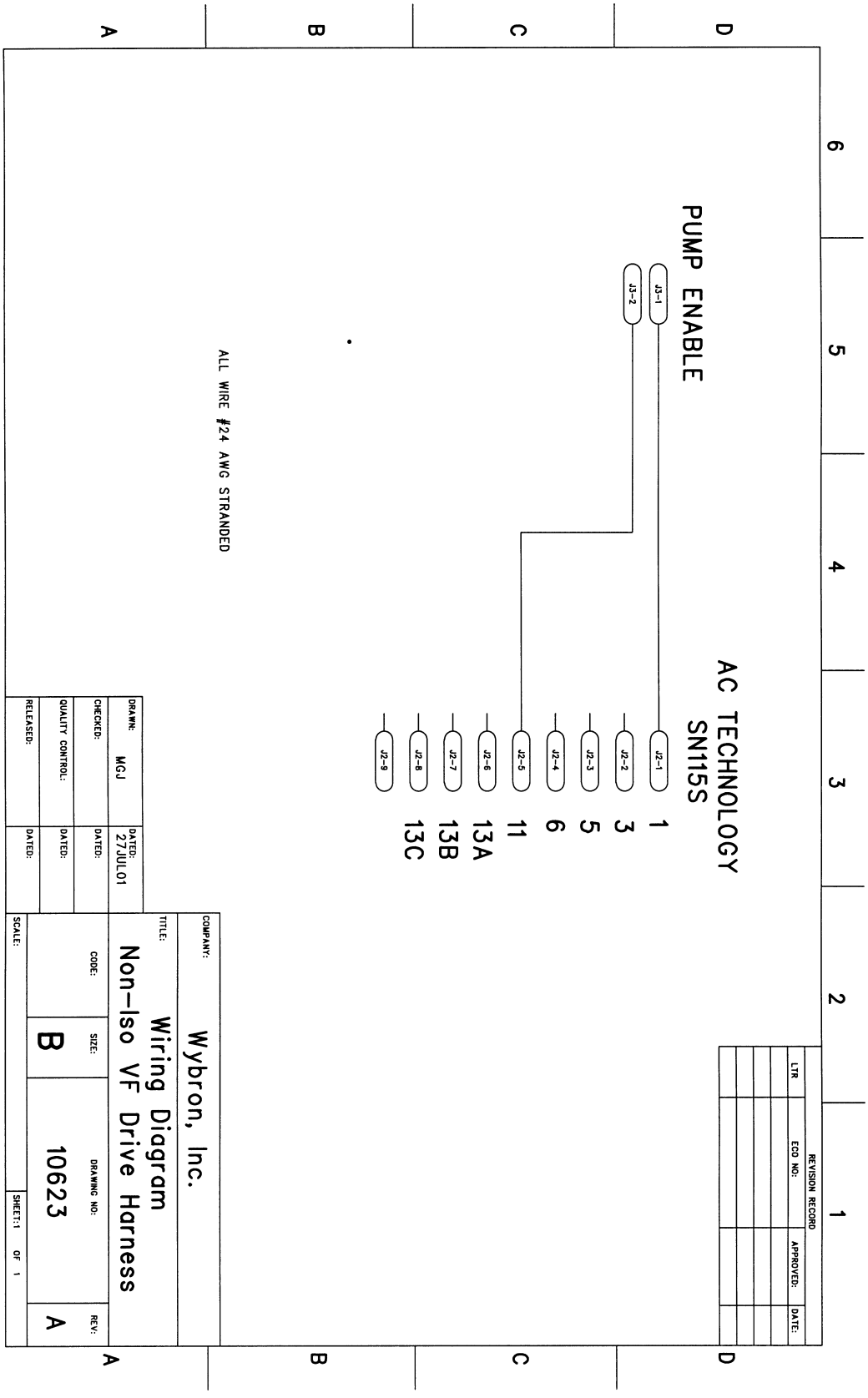
3.2.3 Iso VF Drive Harness



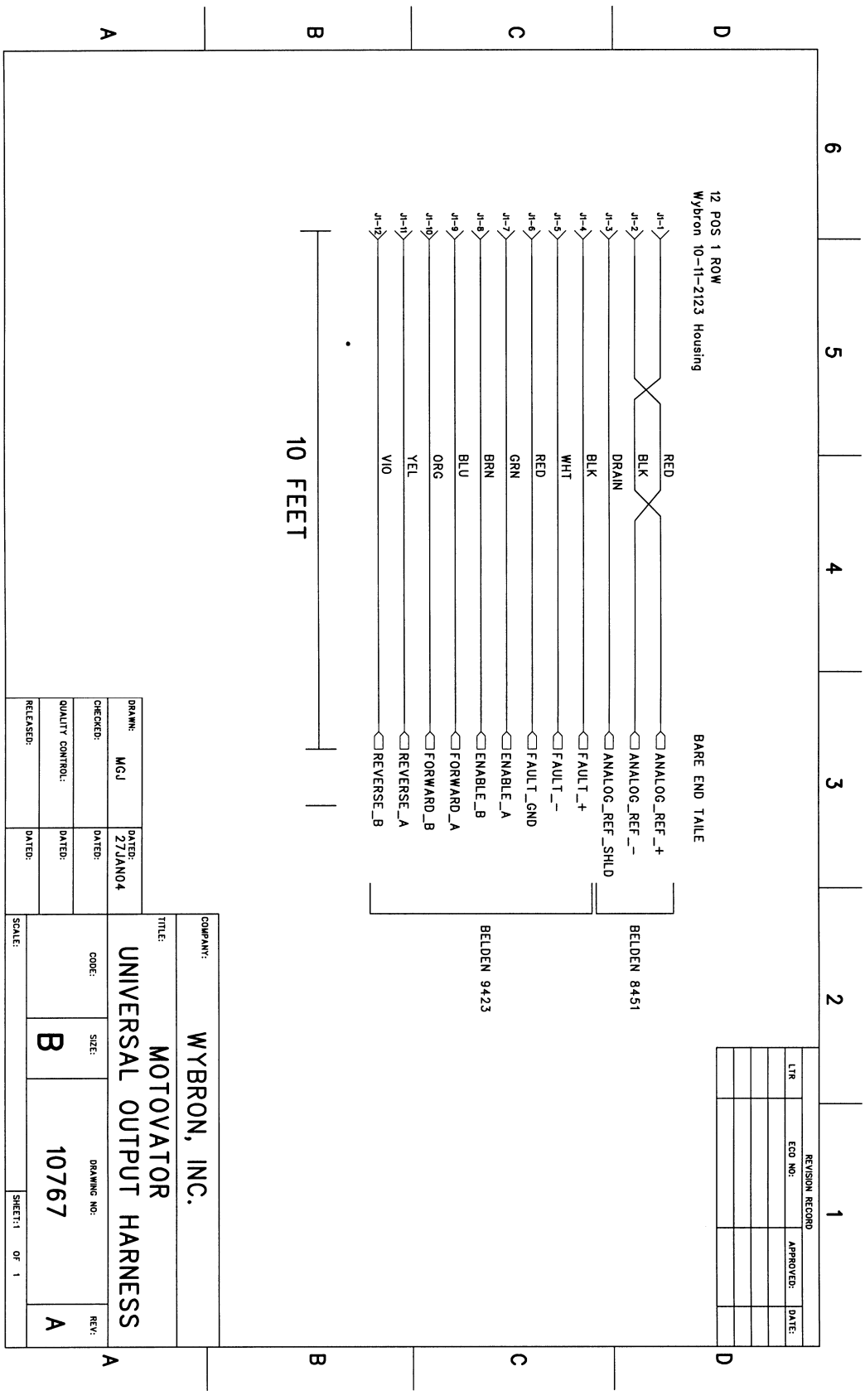
3.2.4 Hydraulic Interconnection Harness



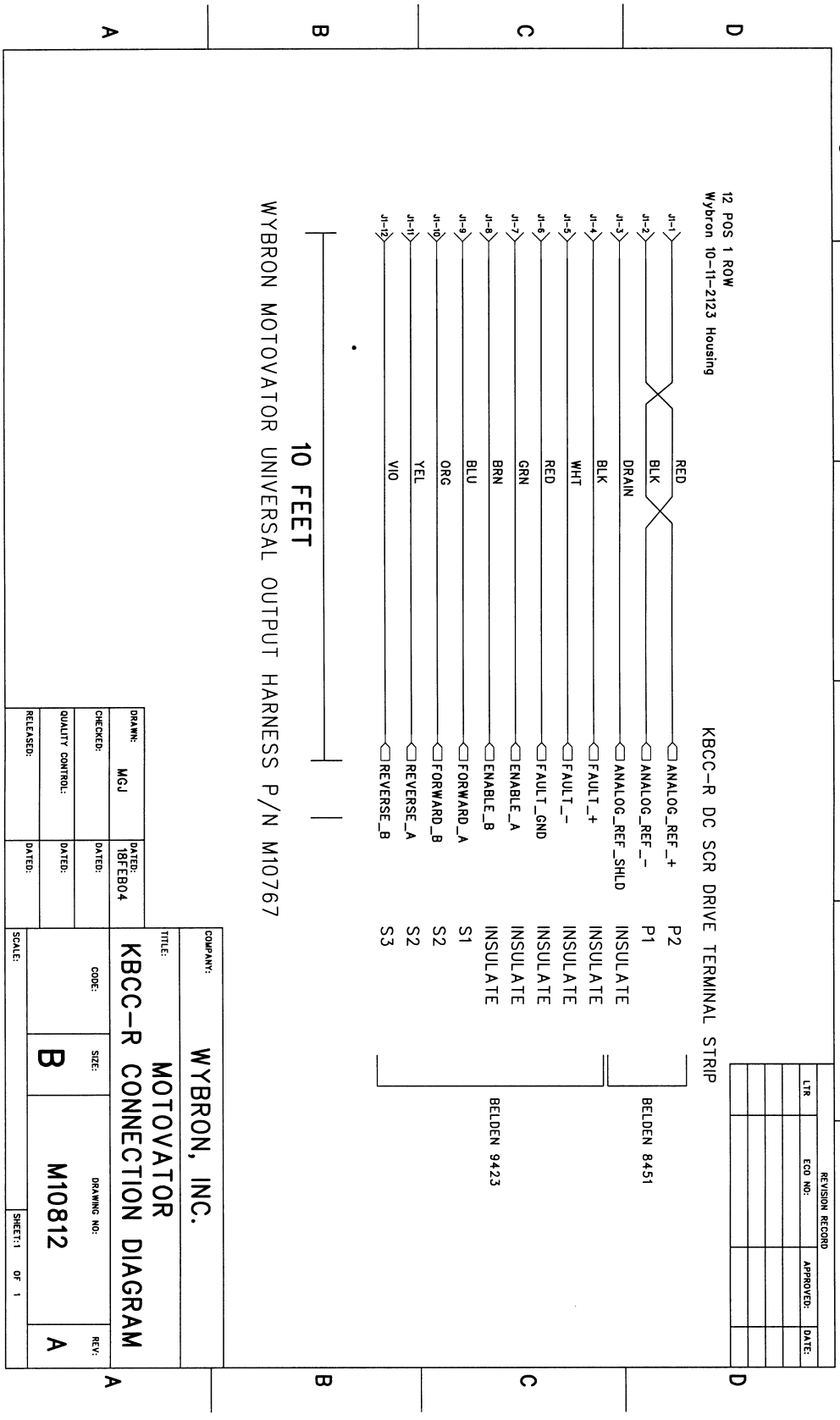
3.2.5 Non-Iso VF Drive Harness



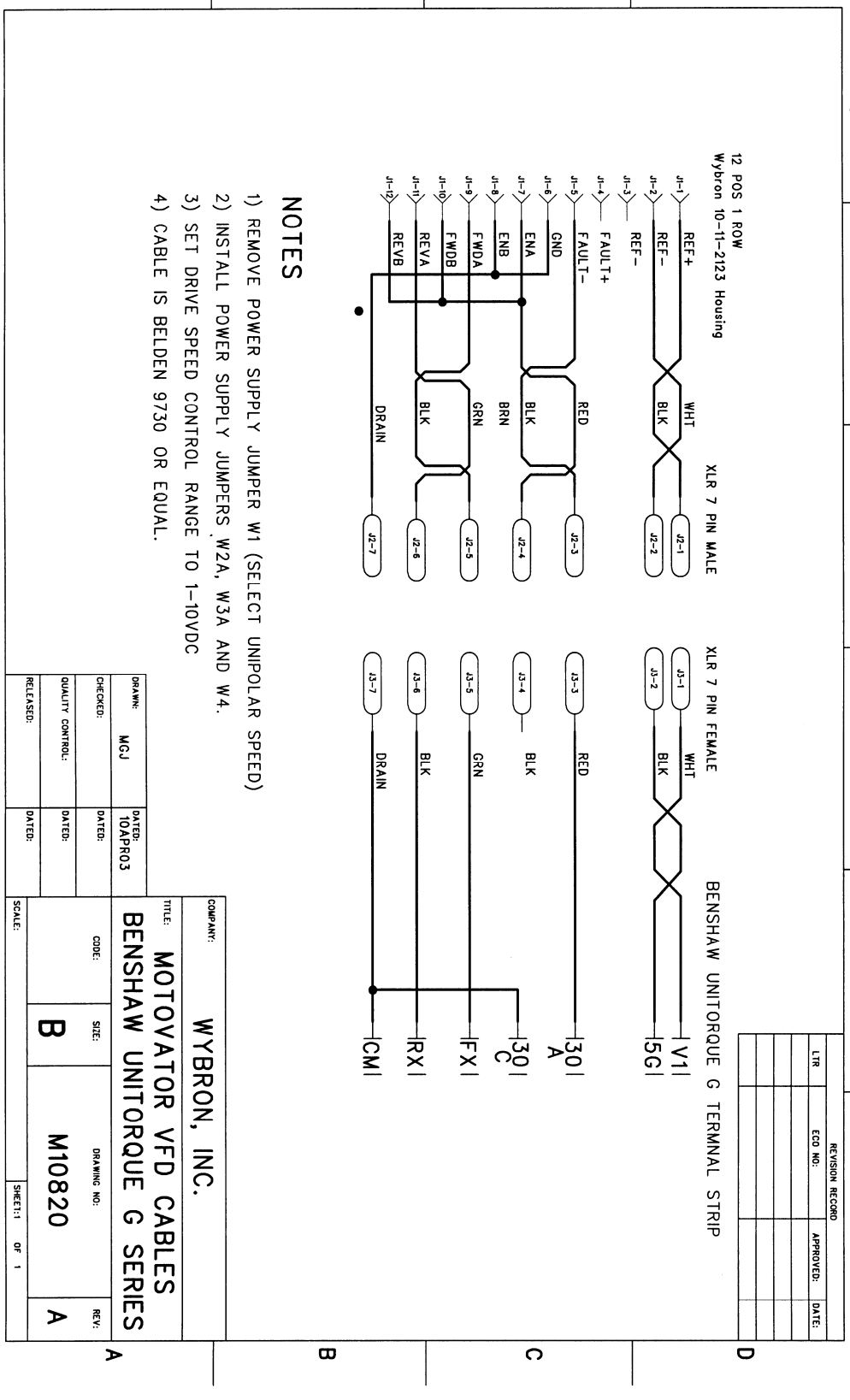
3.2.6 Universal Output Harness



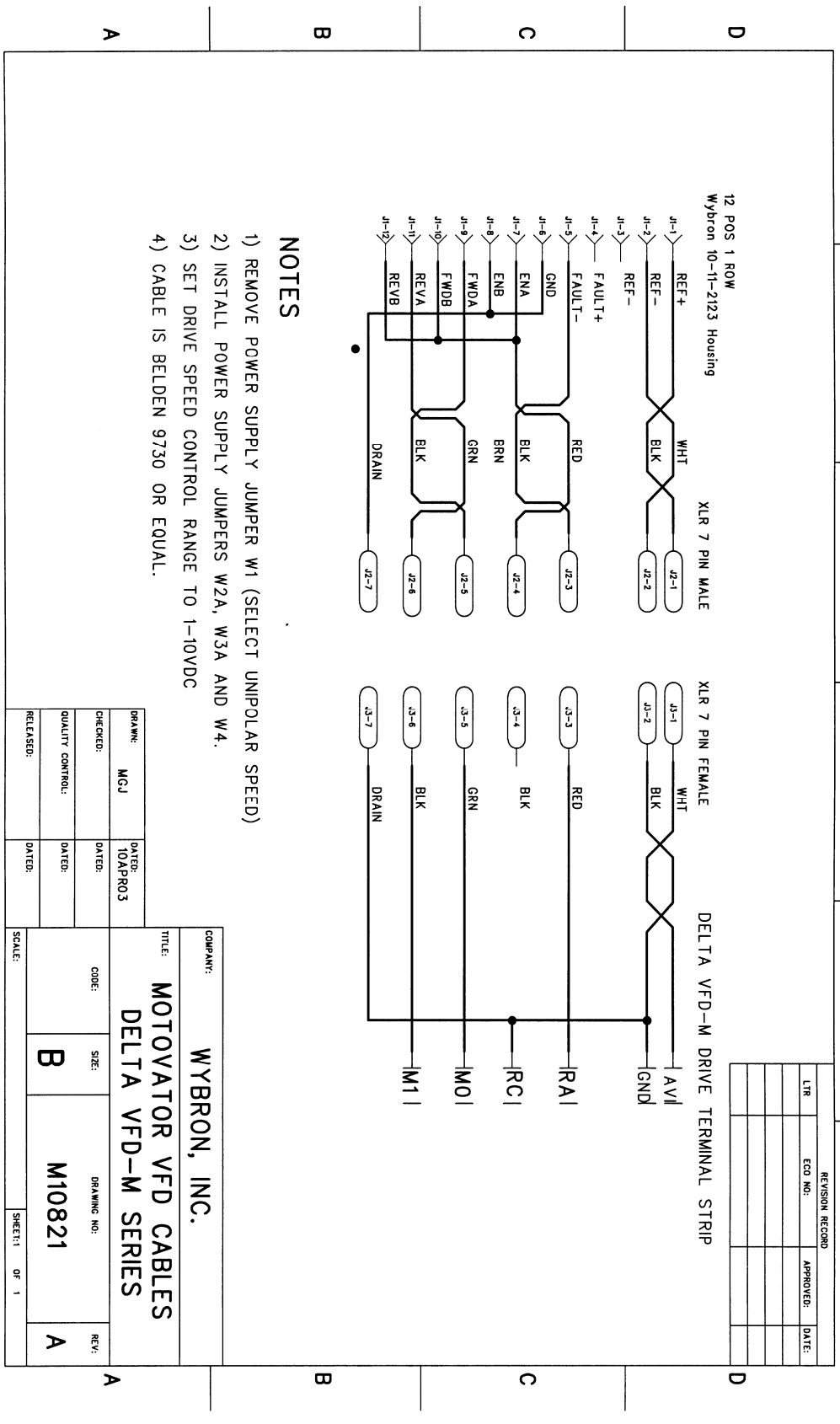
3.2.7 KBCC-R DC Drive Harness



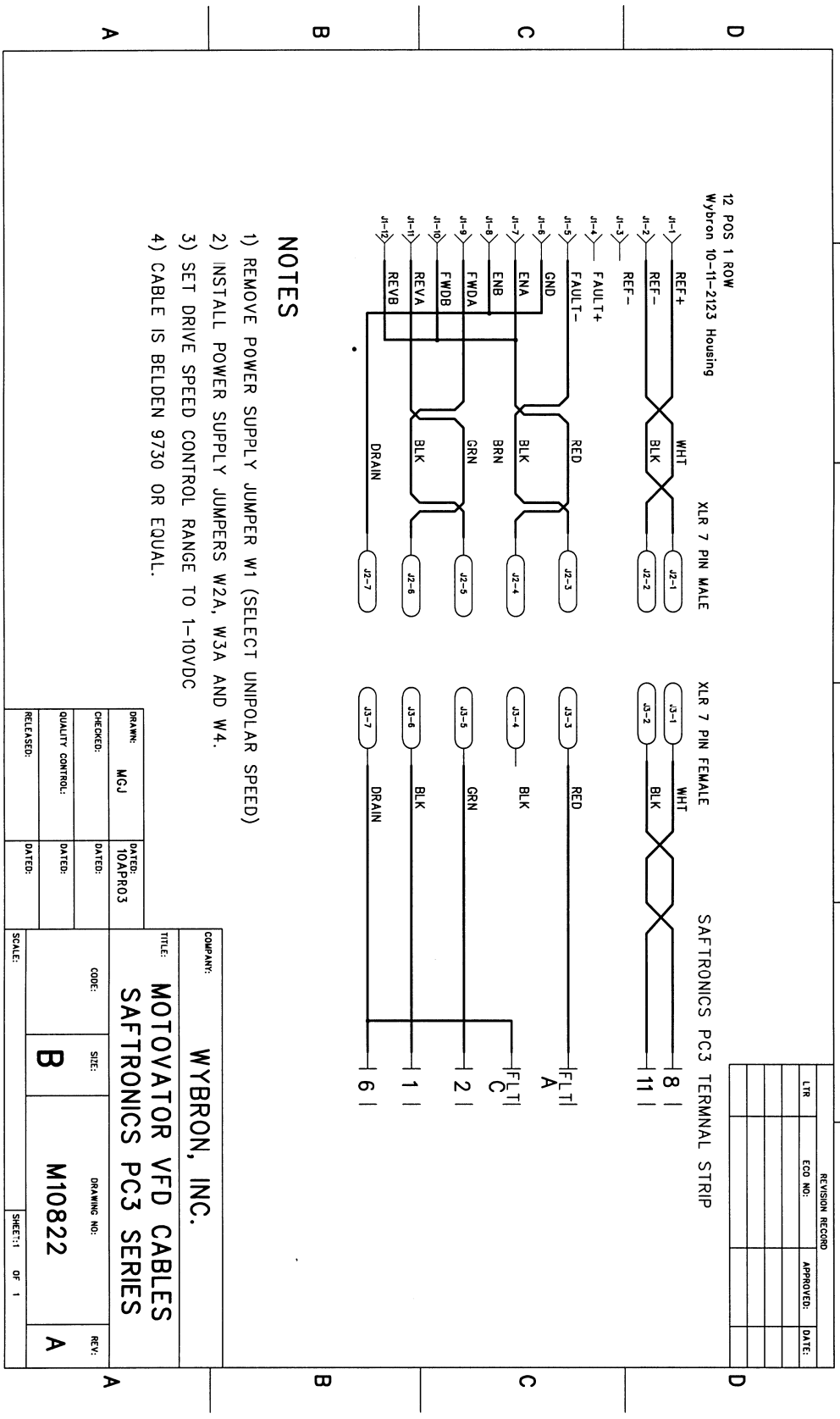
3.2.8 Motovator VFD Cables Benshaw Unitorque G Series



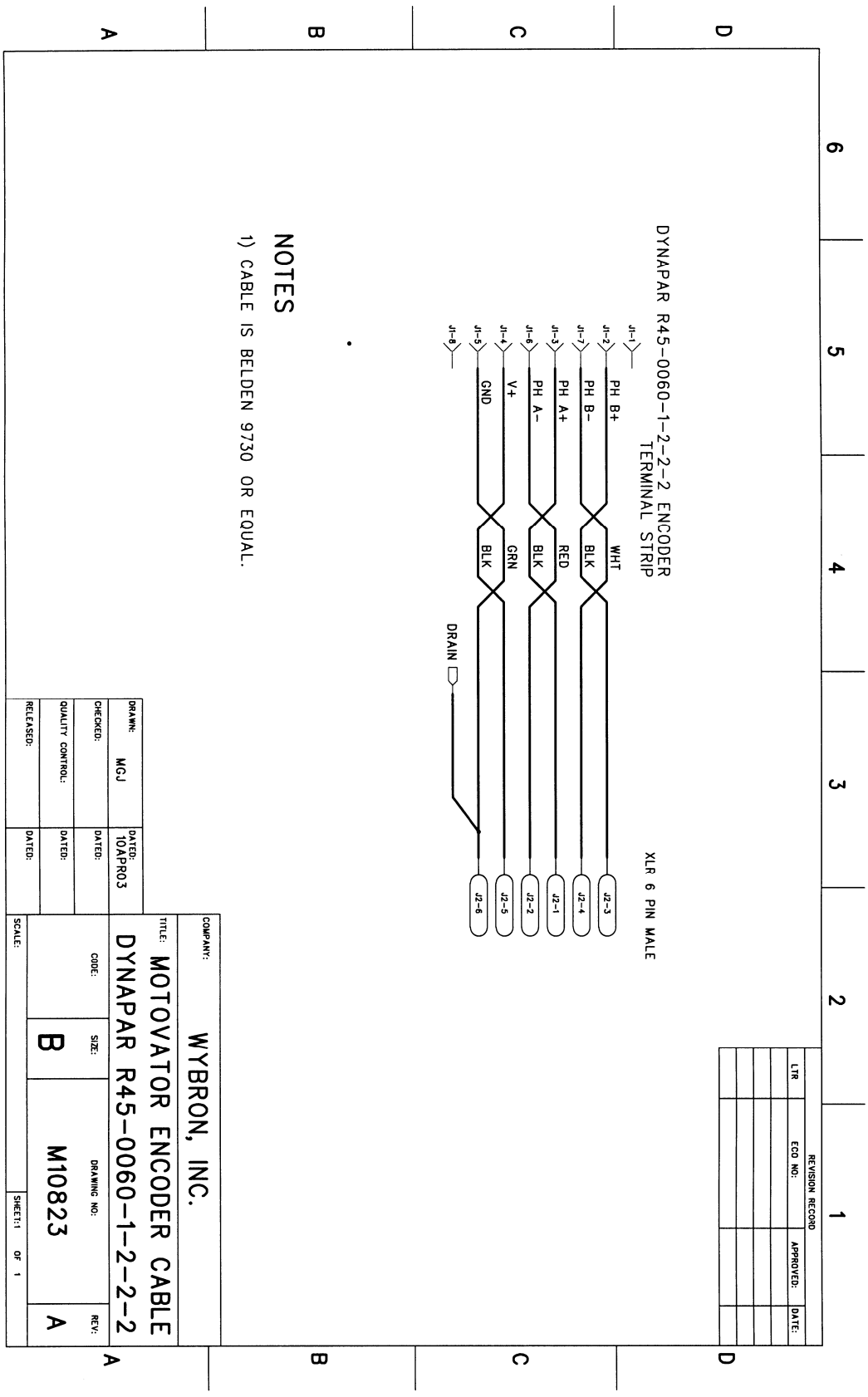
3.2.9 Motovator VFD Cables Delta VFD-M Series



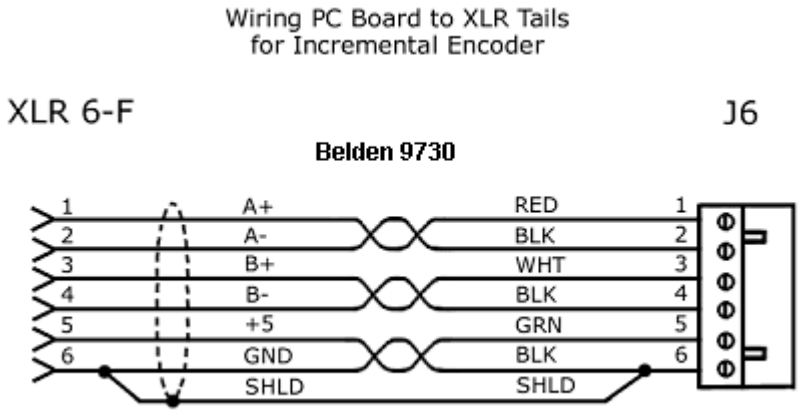
3.2.10 Motovator VFD Cables Saftronics PC3 Series



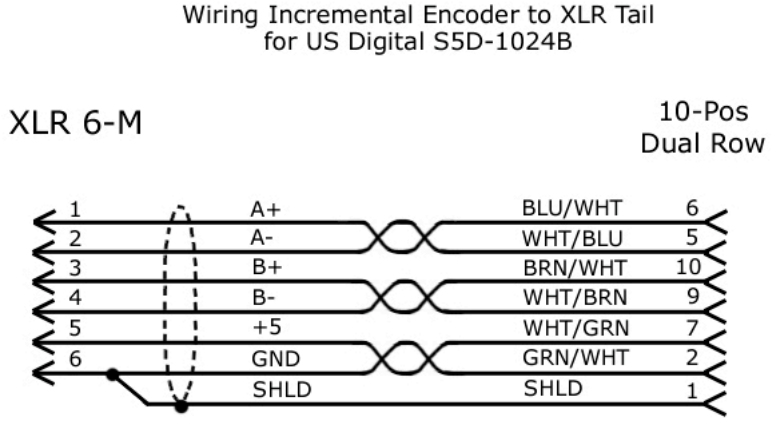
3.2.11 Motovator Encoder Cable Dynapar R45-0060-1-2-2-2



3.2.12 PC Board to XLR Tail for Incremental Encoder

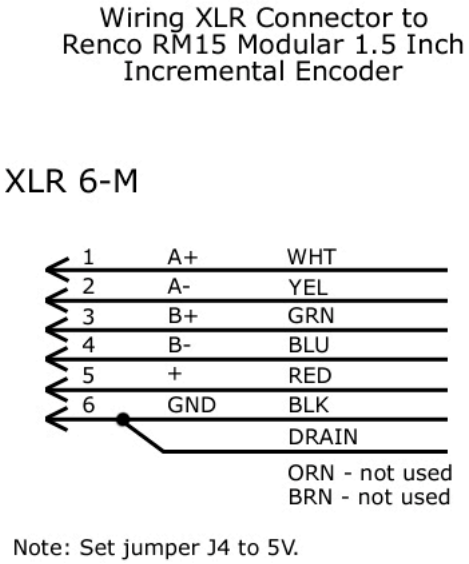


3.2.13 US Digital S5D-1024B Incremental Encoder to XLR

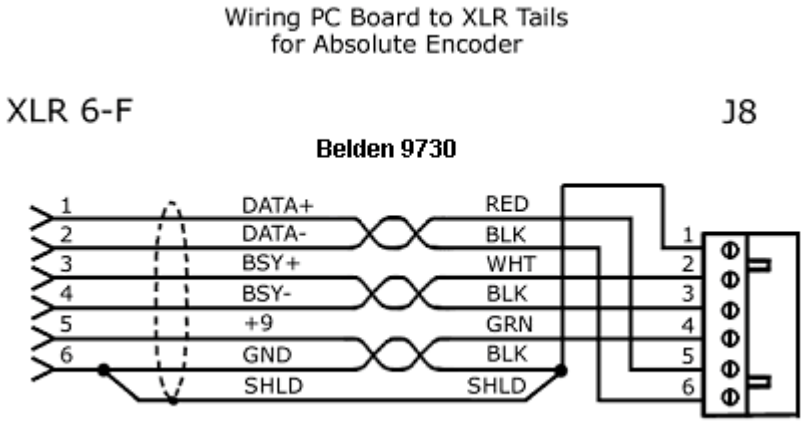


Notes:
1. Set jumper J4 to 5V.
2. Cable with 10-position dual row connector is US Digital part# CA3619-6FT. For more information please see US Digital product literature.

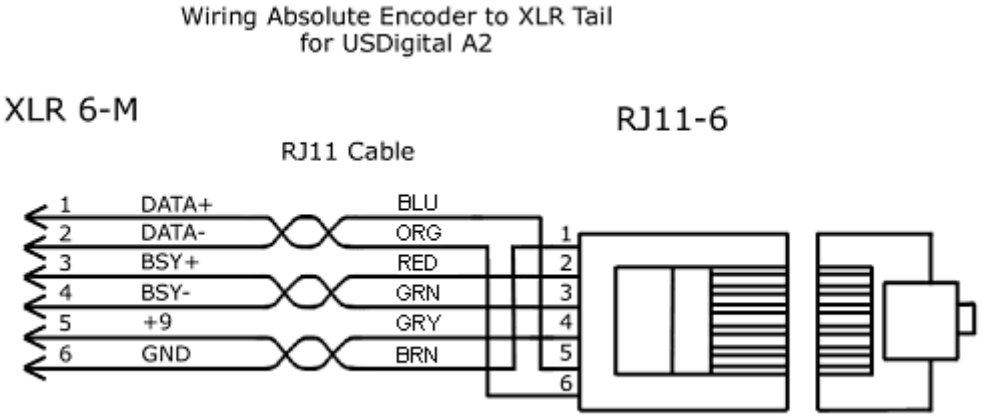
3.2.14 Renco RM15 Modular 1.5” Incremental Encoder to XLR



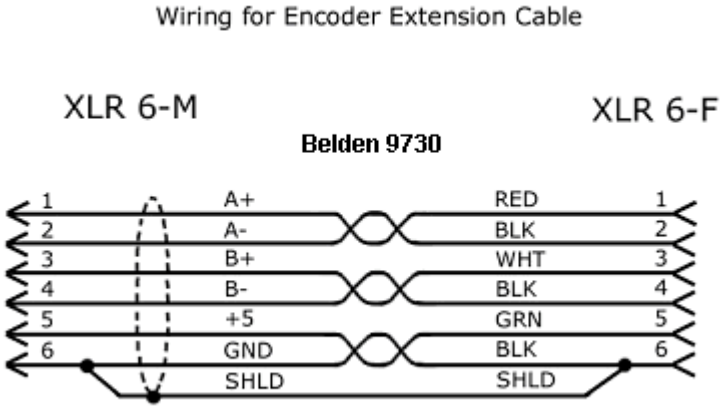
3.2.15 PC Board to XLR Tail for Absolute Encoder



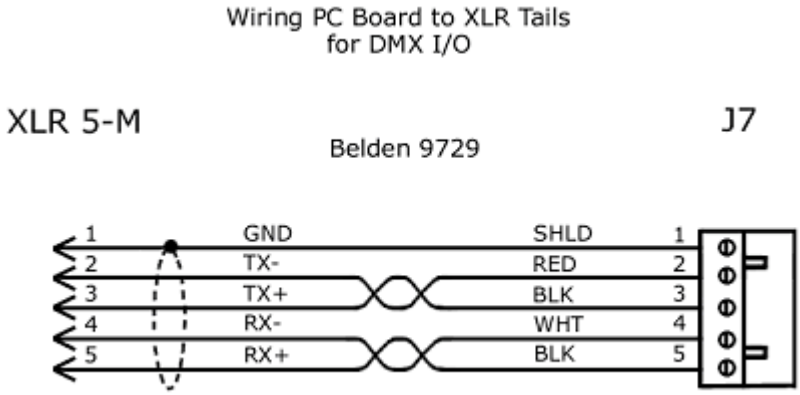
3.2.16 US Digital A2 Absolute Encoder to XLR Tail



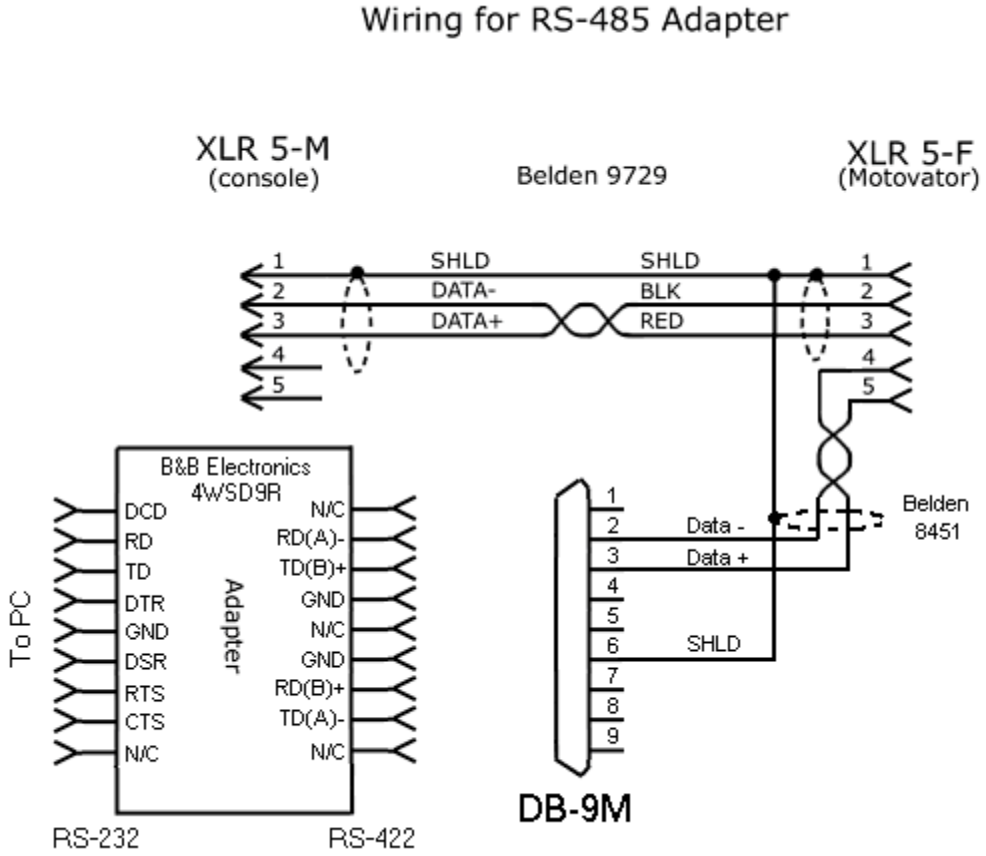
3.2.17 Universal Encoder Extension Cable



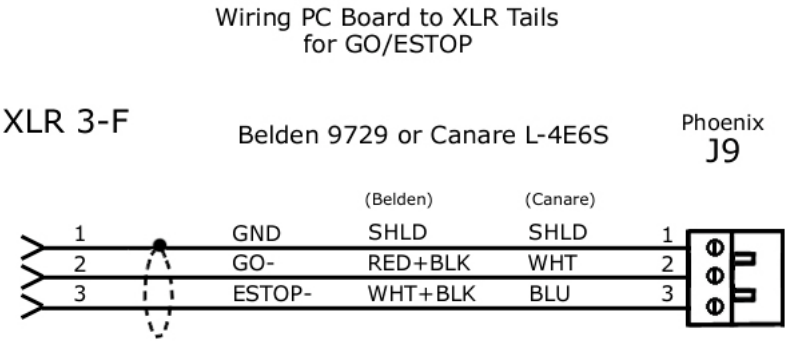
3.2.18 PC Board to XLR Tails for DMX I/O



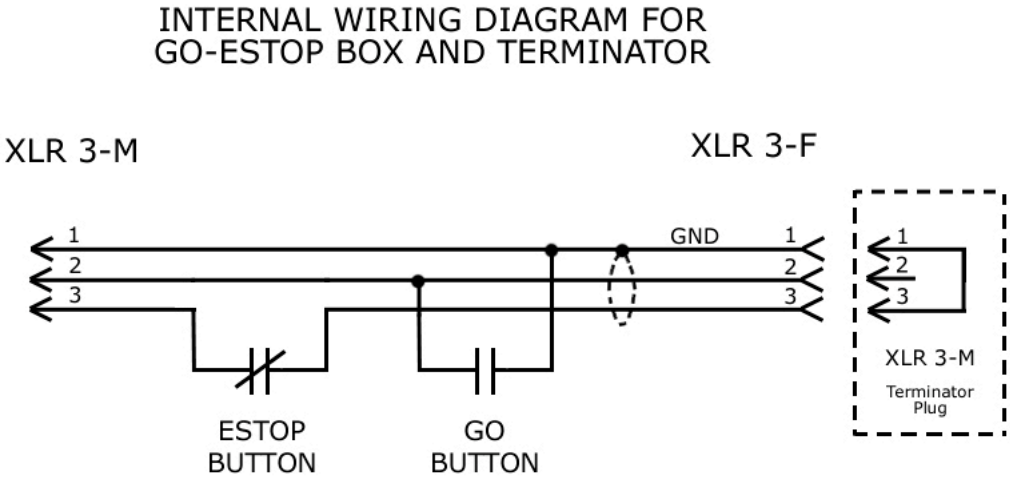
3.2.19 Wiring for DMX / RS-422 Adapter



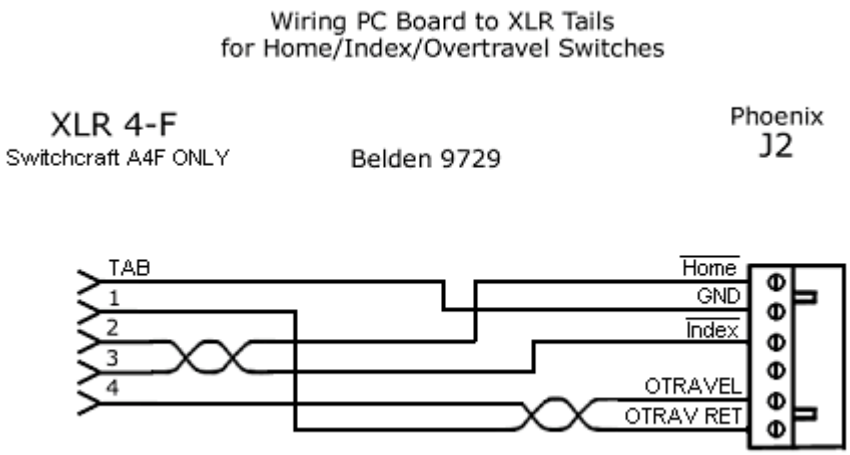
3.2.20 PC Board to XLR Tails for GO / ESTOP



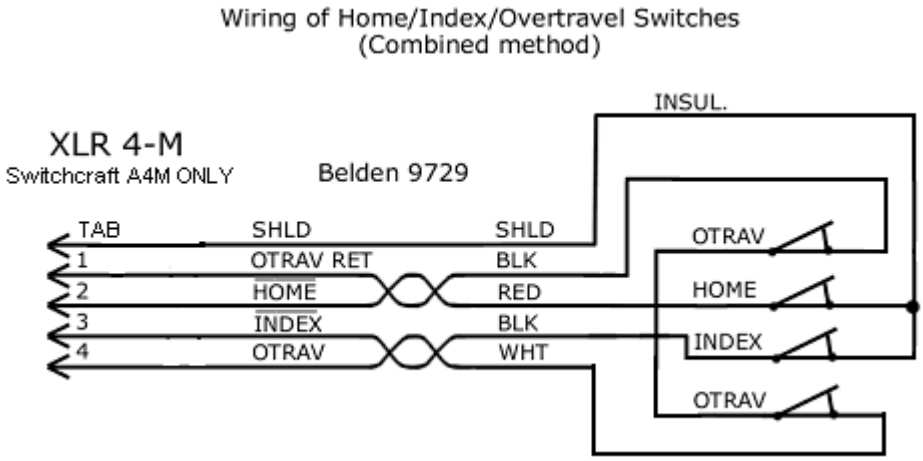
3.2.21 GO / ESTOP Box and Terminator Wiring Diagram



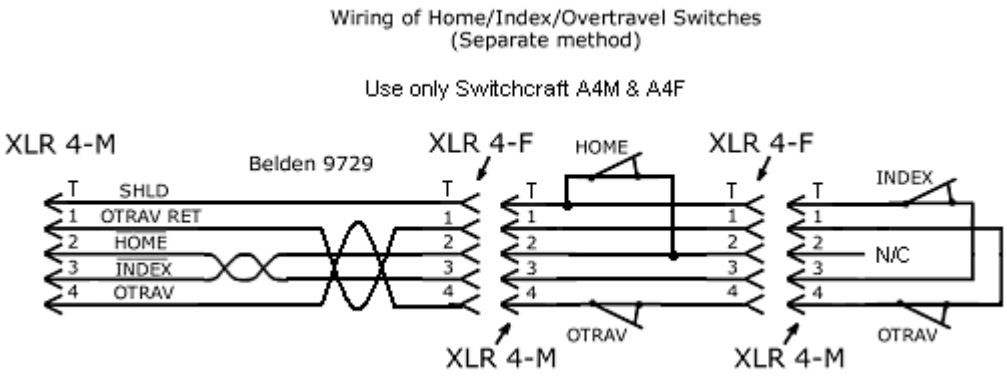
3.2.22 PC Board to XLR Tail for Home/Index/Overtravel Switches



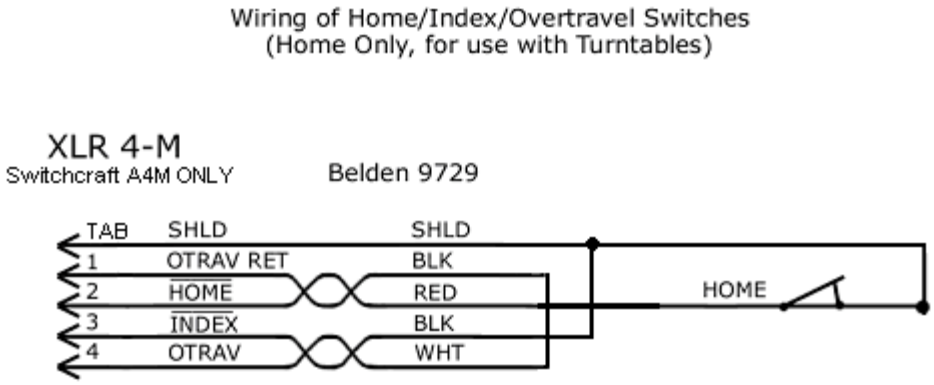
3.2.23 Combined Method of Wiring Home/Index/Overtravel Switches to XLR



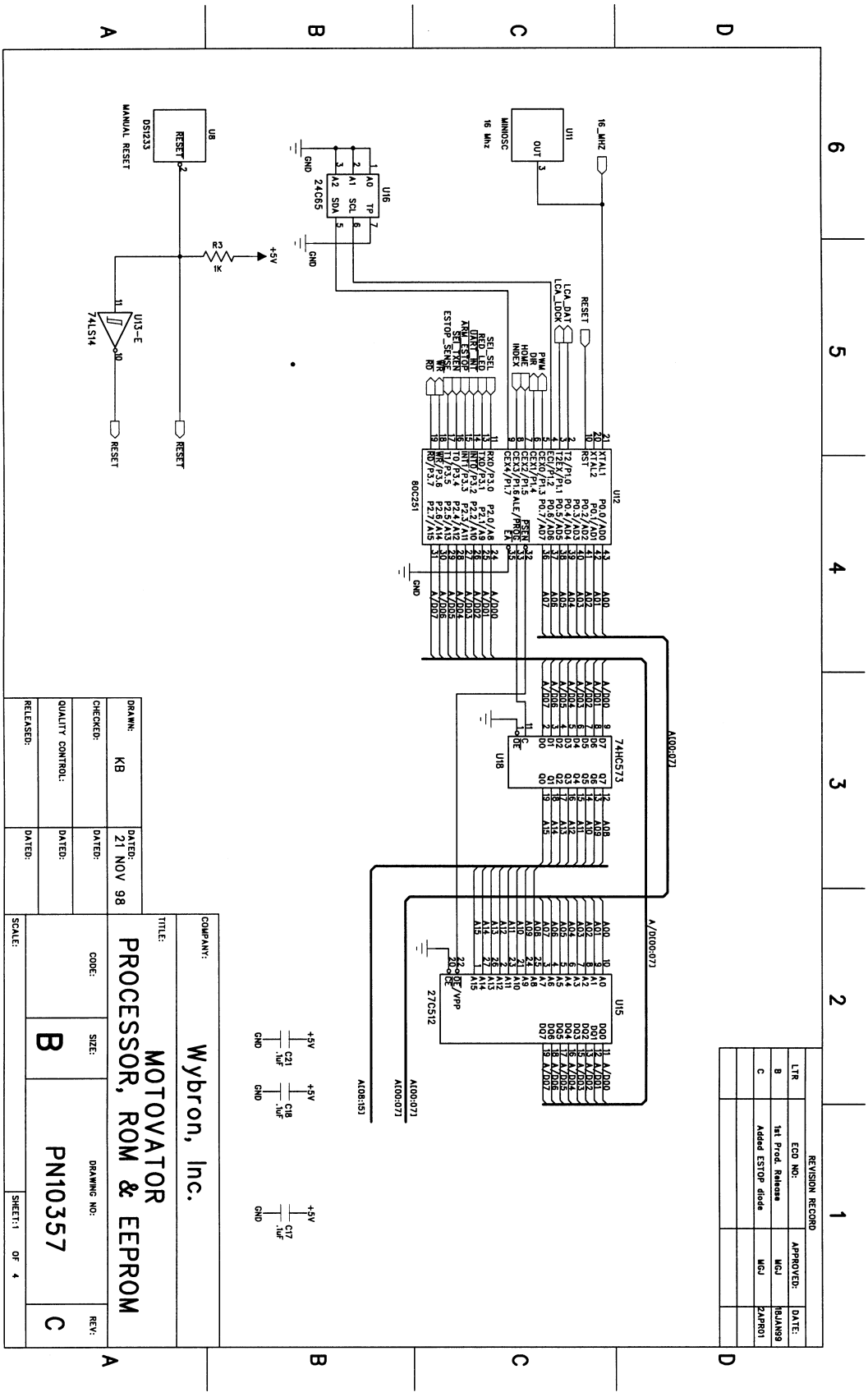
3.2.24 Separate Method of Wiring Home/Index/Overtravel Switches to XLR

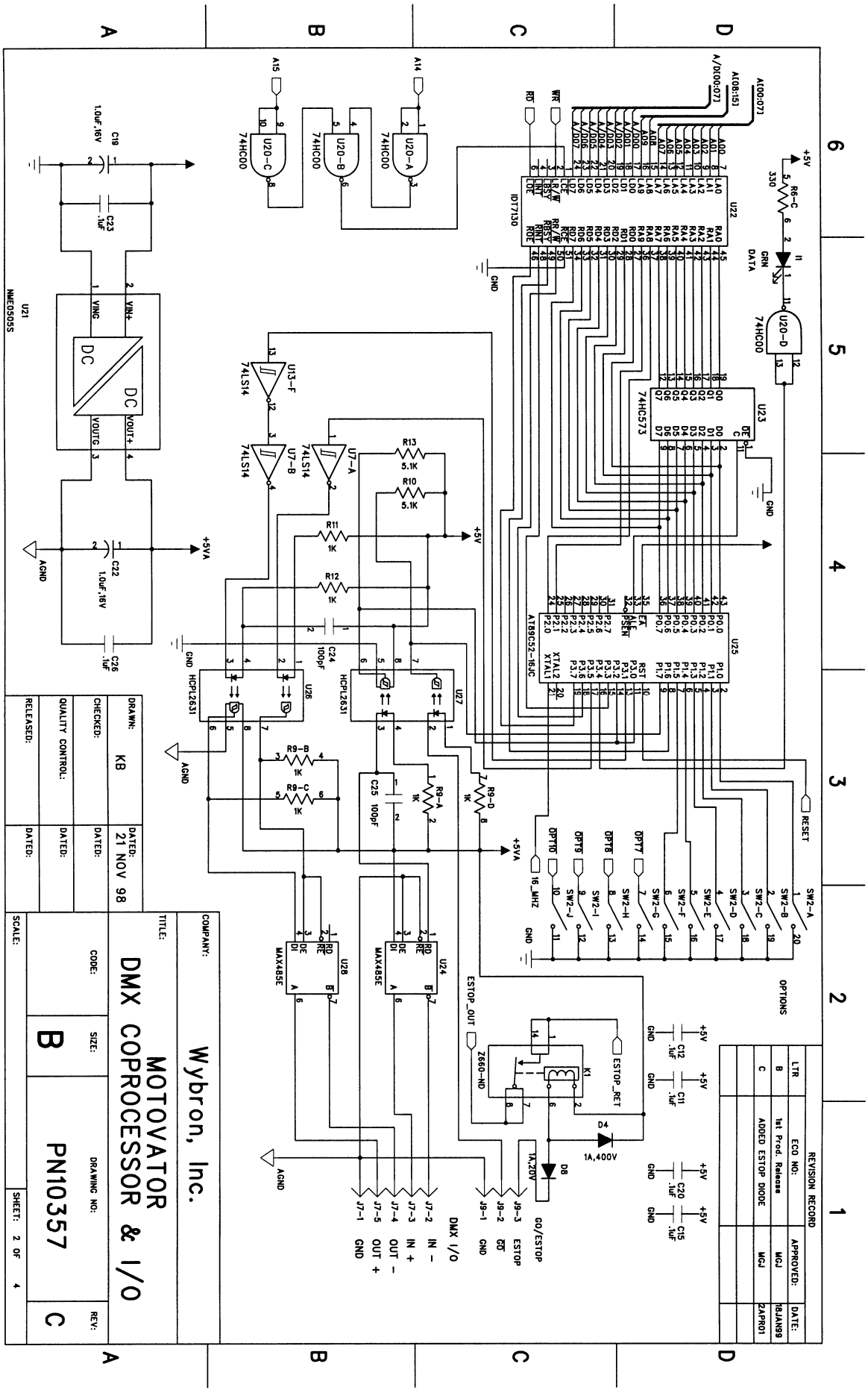


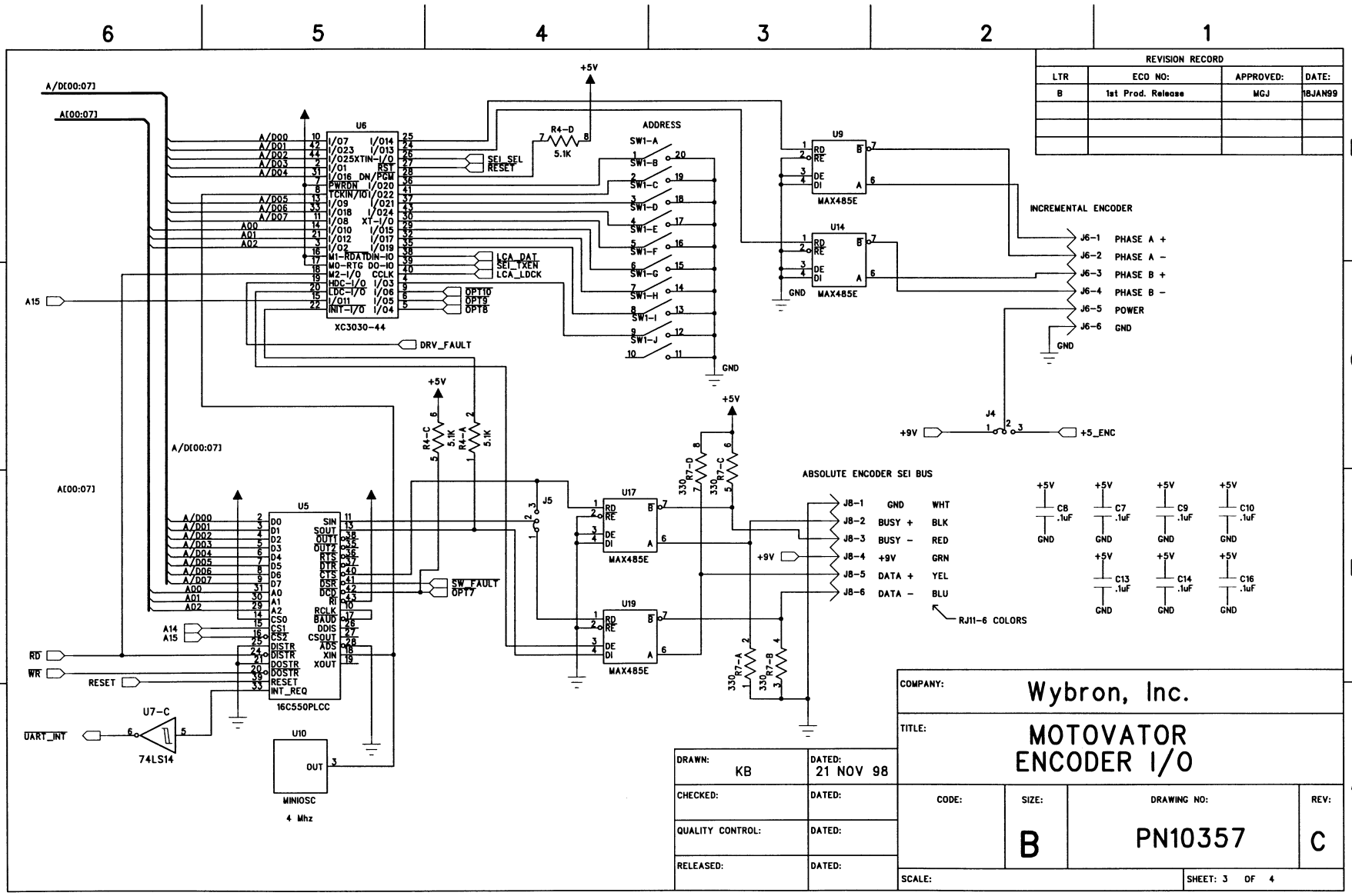
3.2.25 Turntable Method of Wiring Home/Index/Overtravel Switches (Home Only)



3.3 Schematic Diagrams




REVISION RECORD
LTR
ECO NO:
APPROVED:
DATE:
B
1st Prod. Release
MGJ
18JAN99
C
ADDED ESTOP DIODE
MGJ
2APR01
COMPANY:
Wybron, Inc.
TITLE:
MOTOVATOR
COPROCESSOR & I/O
DRAWN:
KB
DATED:
21 NOV 98
CHECKED:
QUALITY CONTROL:
RELEASED:
CODE:
SIZE:
B
DRAWING NO:
PN10357
REV:
C
SCALE:
SHEET: 2 OF 4
OPTIONS
DMX I/O
J7-2 IN -
J7-3 IN +
J7-4 OUT -
J7-5 OUT +
J7-1 GND
J9-1 GND
J9-2 6D
J9-3 ESTOP
GO/ESTOP
ESTOP_OUT
ESTOP_RET
RESET
16_MHZ
+5V
+5VA
AGND
GND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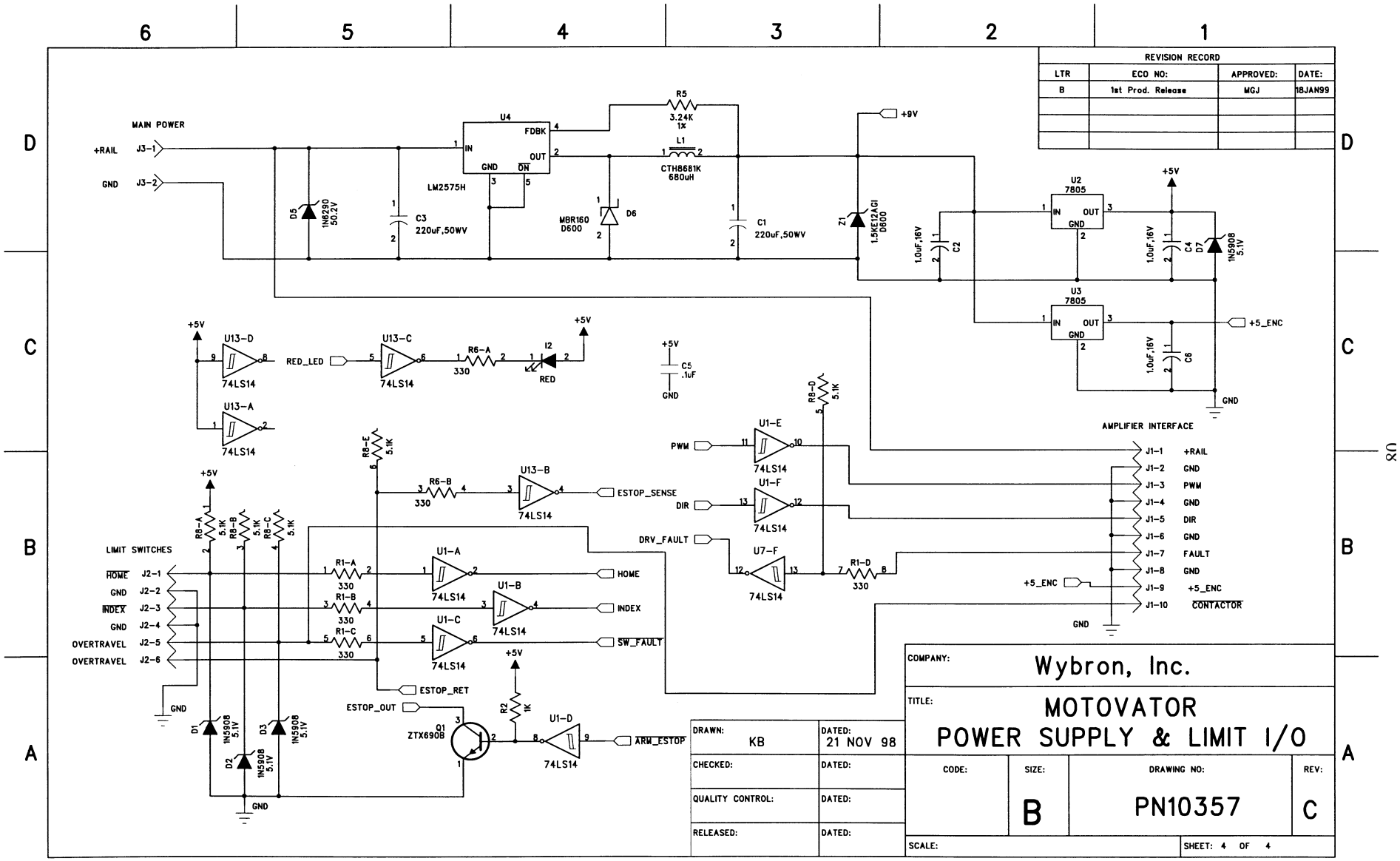
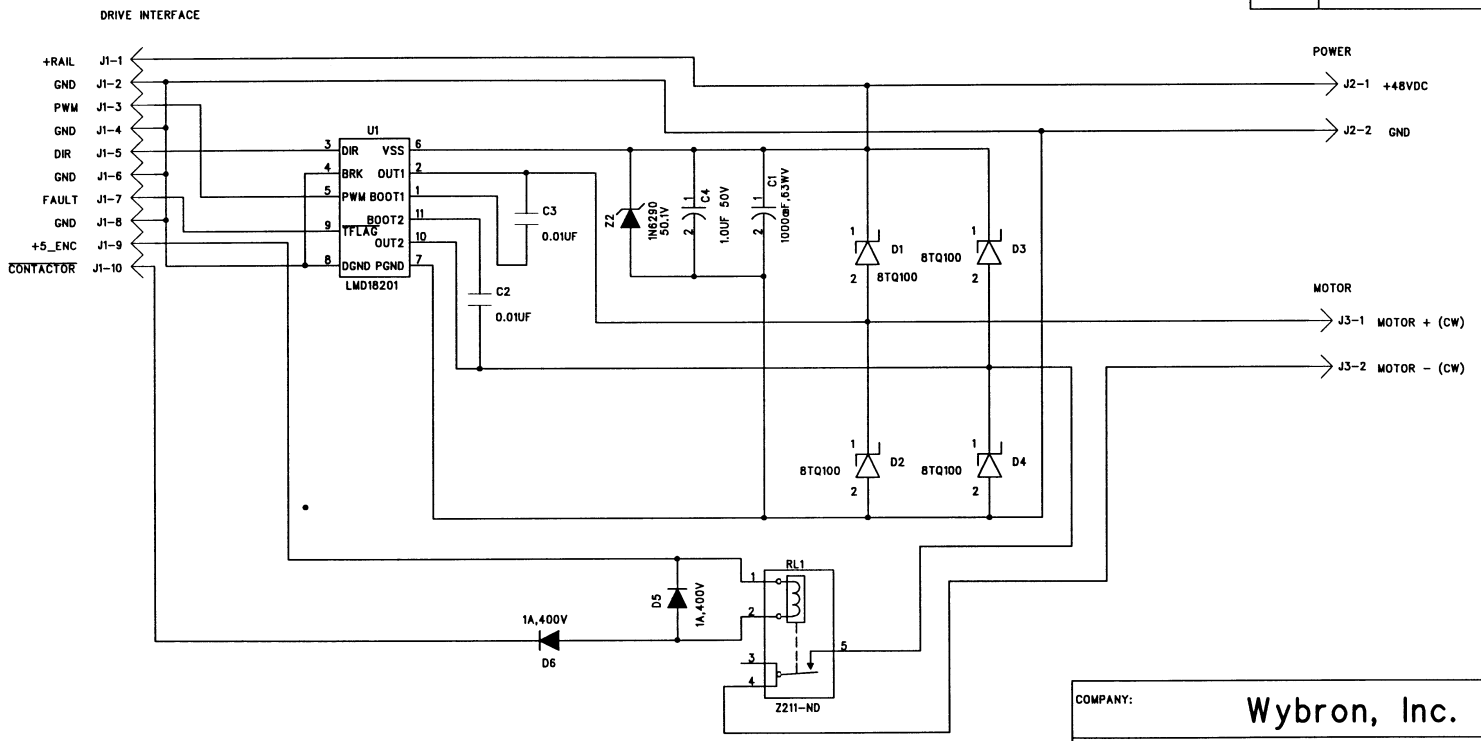
XC3030-44
U5
16C550PLCC
U10
MINIOSC
4 Mhz
U7-C
74LS14
U9
U14
U17
U19
MAX485E
ADDRESS
SW1-A
SW1-B
SW1-C
SW1-D
SW1-E
SW1-F
SW1-G
SW1-H
SW1-I
SW1-J
R4-D
5.1K
R4-C
R4-A
R7-D
R7-C
R7-A
R7-B
330
INCREMENTAL ENCODER
J6-1 PHASE A +
J6-2 PHASE A -
J6-3 PHASE B +
J6-4 PHASE B -
J6-5 POWER
J6-6 GND
J4
+9V
+5_ENC
ABSOLUTE ENCODER SEI BUS
J8-1 GND WHT
J8-2 BUSY + BLK
J8-3 BUSY - RED
J8-4 +9V GRN
J8-5 DATA + YEL
J8-6 DATA - BLU
RJ11-6 COLORS
J5
C6 .1uF
C7 .1uF
C9 .1uF
C10 .1uF
C13 .1uF
C14 .1uF
C16 .1uF
SEI_SEL
RESET
LCA_DAT
SEI_TXEN
LCA_LDCK
OPT10
OPT9
OPT8
DRV_FAULT
SW_FAULT
OPT7
UART_INT
RD
WR
RESET
INT_REQ
A14
A15
A00
A01
A02
DRAWN: KB
DATED: 21 NOV 98
CHECKED:
QUALITY CONTROL:
RELEASED:
COMPANY: Wybron, Inc.
TITLE: MOTOVATOR ENCODER I/O
CODE:
SIZE: B
DRAWING NO: PN10357
REV: C
SCALE:
SHEET: 3 OF 4


REVISION RECORD
LTR | ECO NO: | APPROVED: | DATE:
B | 1st Prod. Release | MGJ | 18JAN99
MAIN POWER
+RAIL J3-1
GND J3-2
U4
LM2575H
FDBK
IN
OUT
GND
ON
R5
3.24K
1%
L1
CTH8681K
680uH
+9V
D5
1N6290
50.2V
C3
220uF,50WV
MBR160
D600
D6
C1
220uF,50WV
Z1
1.5KE12AGI
D600
U2
7805
U3
7805
C2
1.0uF,16V
C4
1.0uF,16V
D7
1N5908
5.1V
C6
1.0uF,16V
+5V
+5_ENC
GND
U13-D
U13-C
U13-A
U13-B
74LS14
RED_LED
R6-A
330
I2
RED
C5
.1uF
R8-A
5.1K
R8-B
5.1K
R8-C
5.1K
R8-D
5.1K
R8-E
5.1K
R6-B
330
ESTOP_SENSE
U1-E
PWM
U1-F
DIR
DRV_FAULT
U7-F
R1-D
330
AMPLIFIER INTERFACE
J1-1 +RAIL
J1-2 GND
J1-3 PWM
J1-4 GND
J1-5 DIR
J1-6 GND
J1-7 FAULT
J1-8 GND
J1-9 +5_ENC
J1-10 CONTACTOR
LIMIT SWITCHES
HOME J2-1
GND J2-2
INDEX J2-3
GND J2-4
OVERTRAVEL J2-5
OVERTRAVEL J2-6
R1-A
330
R1-B
330
R1-C
330
U1-A
U1-B
U1-C
HOME
INDEX
SW_FAULT
ESTOP_RET
ESTOP_OUT
R2
1K
Q1
ZTX690B
U1-D
ARM_ESTOP
D1
1N5908
5.1V
D2
1N5908
5.1V
D3
1N5908
5.1V
DRAWN: KB DATED: 21 NOV 98
CHECKED: DATED:
QUALITY CONTROL: DATED:
RELEASED: DATED:
COMPANY: Wybron, Inc.
TITLE: MOTOVATOR
POWER SUPPLY & LIMIT I/O
CODE:
SIZE: B
DRAWING NO: PN10357
REV: C
SCALE:
SHEET: 4 OF 4

REVISION RECORD			
LTR	ECO NO:	APPROVED:	DATE:



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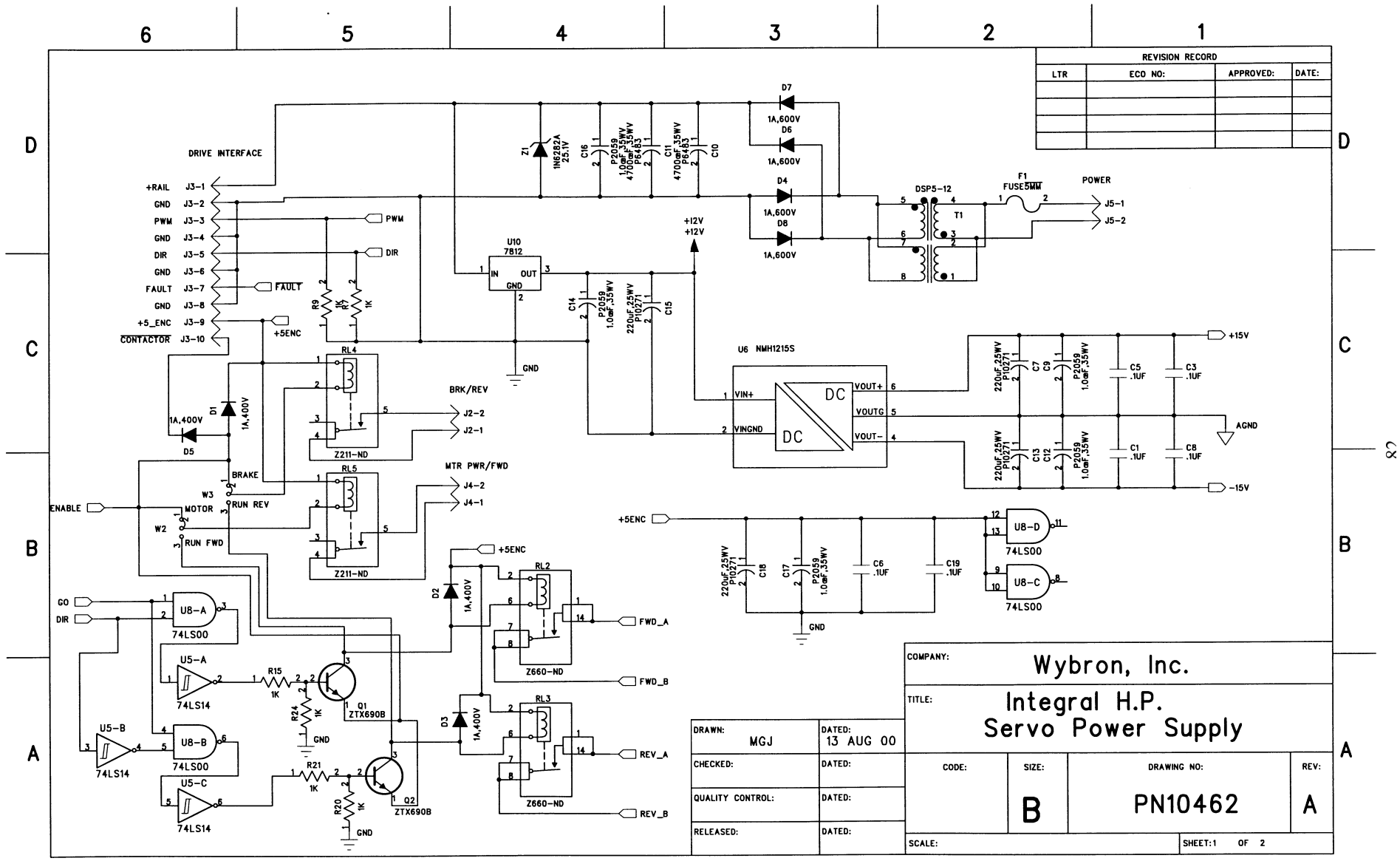
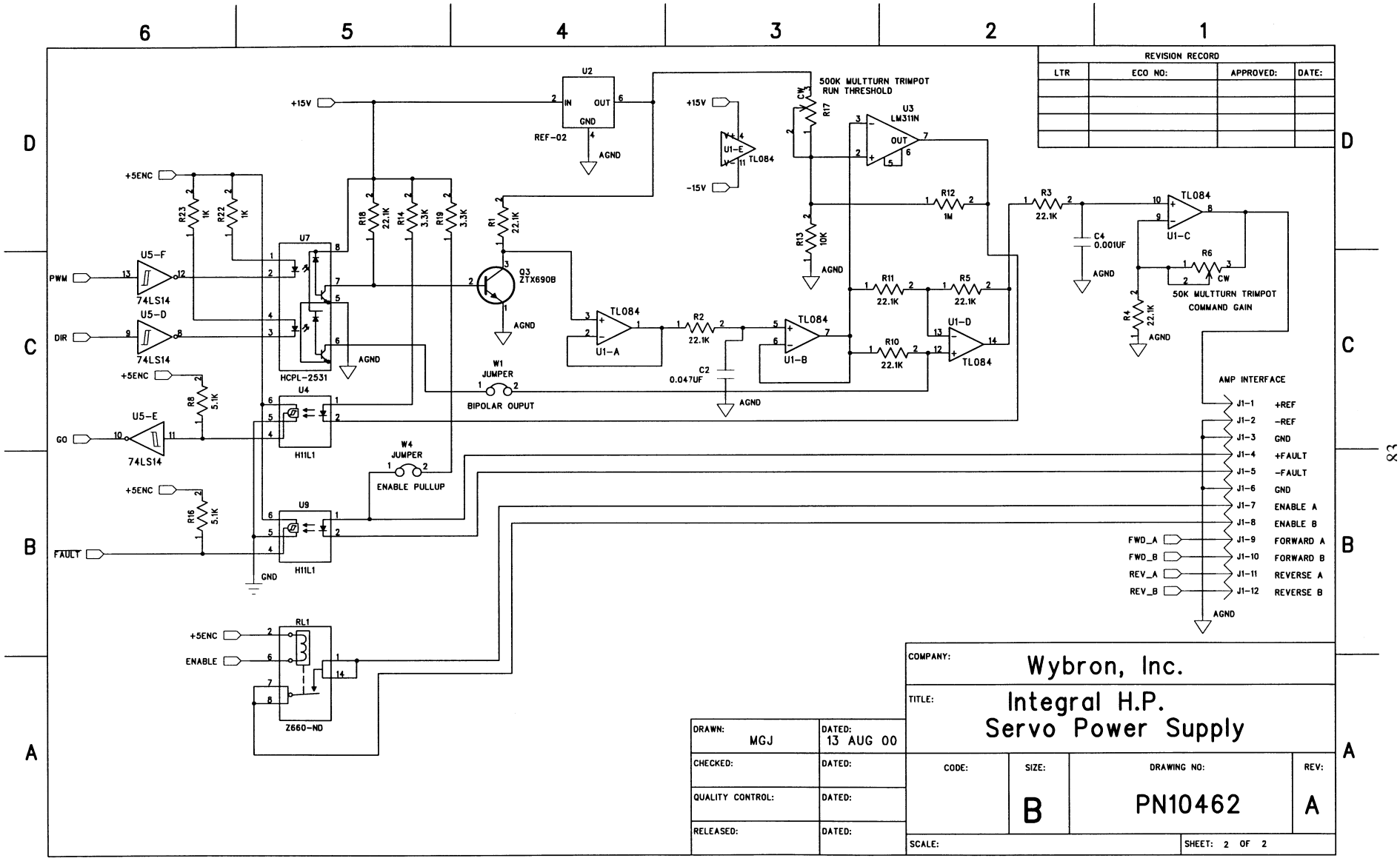
CHECKED:	DATED:	TITLE: Fractional H.P. Servo Amplifier	
QUALITY CONTROL:	DATED:	CODE:	SIZE: B
RELEASED:	DATED:	DRAWING NO: PN10362	REV: A
		SCALE:	SHEET:1 OF 1


REVISION RECORD
LTR
ECO NO:
APPROVED:
DATE:
DRIVE INTERFACE
+RAIL J3-1
GND J3-2
PWM J3-3
GND J3-4
DIR J3-5
GND J3-6
FAULT J3-7
GND J3-8
+5_ENC J3-9
CONTACTOR J3-10
PWM
DIR
FAULT
+5ENC
Z1 1N6282A 25.1V
D7 1A,600V
D6 1A,600V
D4 1A,600V
D8 1A,600V
DSP5-12
T1
F1 FUSE5MM
POWER
J5-1
J5-2
U10 7812
IN OUT GND
+12V
U6 NMH1215S
VIN+ VINGND VOUT+ VOUTG VOUT-
DC DC
+15V
AGND
-15V
RL4 Z211-ND
RL5 Z211-ND
RL2 Z660-ND
RL3 Z660-ND
BRK/REV
J2-2
J2-1
MTR PWR/FWD
J4-2
J4-1
D1 1A,400V
D5 1A,400V
D2 1A,400V
D3 1A,400V
BRAKE
MOTOR
RUN REV
RUN FWD
W3
W2
ENABLE
GO
DIR
U8-A 74LS00
U8-B 74LS00
U8-C 74LS00
U8-D 74LS00
U5-A 74LS14
U5-B 74LS14
U5-C 74LS14
R15 1K
R24 1K
R21 1K
R20 1K
Q1 ZTX690B
Q2 ZTX690B
FWD_A
FWD_B
REV_A
REV_B
GND
DRAWN: MGJ
DATED: 13 AUG 00
CHECKED:
QUALITY CONTROL:
RELEASED:
COMPANY: Wybron, Inc.
TITLE: Integral H.P. Servo Power Supply
CODE:
SIZE: B
DRAWING NO: PN10462
REV: A
SCALE:
SHEET:1 OF 2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APPROVED:
DATE:
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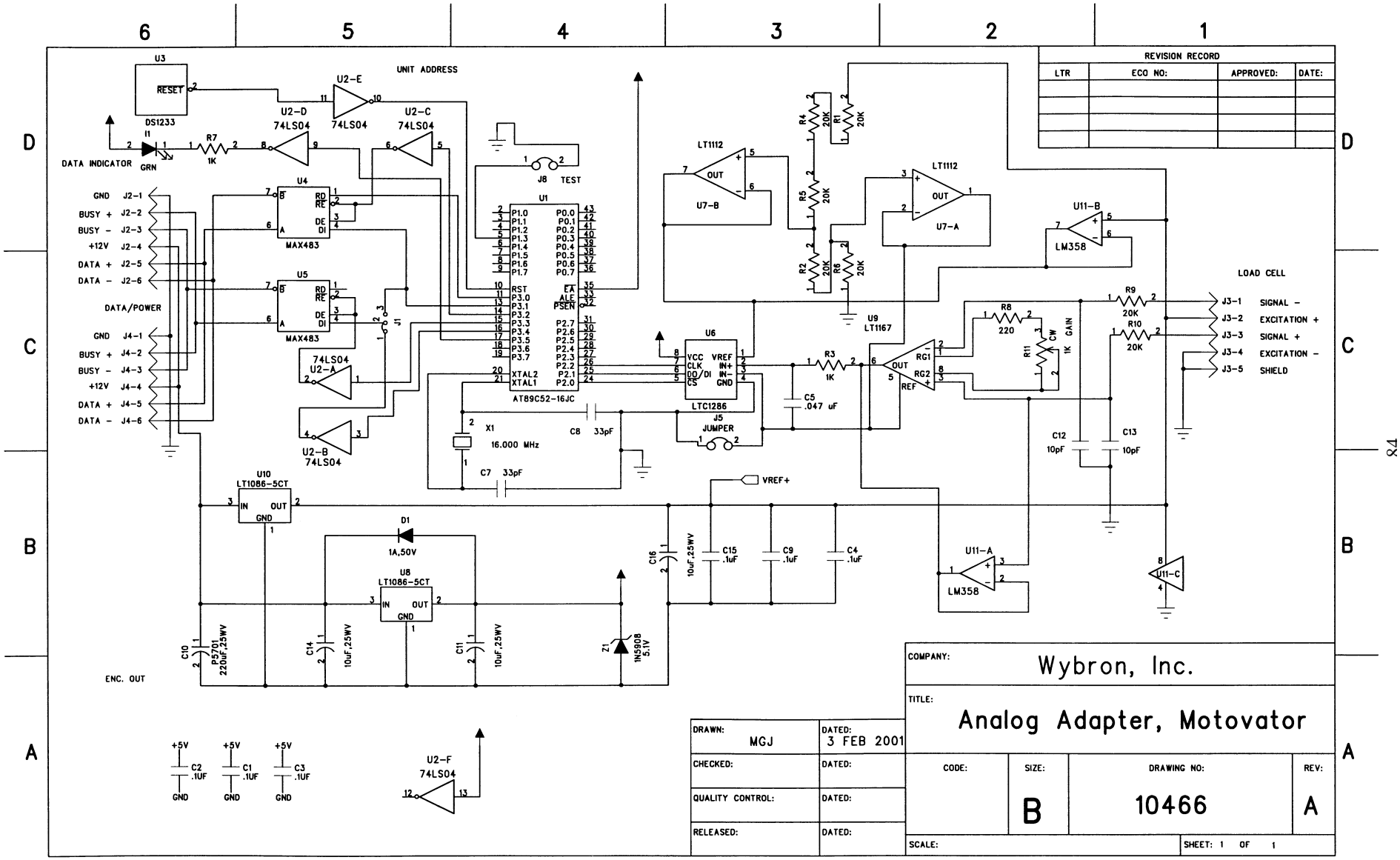
500K MULTTURN TRIMPOT
RUN THRESHOLD
U3
LM311N
R17
R13 10K
R12 1M
R1 22.1K
Q3 ZTX690B
U1-A
U1-B
U1-C
U1-D
U1-E
TL084
R2 22.1K
C2 0.047UF
R11 22.1K
R5 22.1K
R10 22.1K
R3 22.1K
C4 0.001UF
R6
50K MULTTURN TRIMPOT
COMMAND GAIN
R4 22.1K
-15V
+5ENC
R23 1K
R22 1K
R18 22.1K
R14 3.3K
R19 3.3K
U5-F
U5-D
U5-E
74LS14
PWM
DIR
GO
U7
HCPL-2531
U4
H11L1
U9
H11L1
R8 5.1K
R16 5.1K
FAULT
GND
W1
JUMPER
BIPOLAR OUPUT
W4
JUMPER
ENABLE PULLUP
RL1
ENABLE
Z660-ND
AMP INTERFACE
J1-1 +REF
J1-2 -REF
J1-3 GND
J1-4 +FAULT
J1-5 -FAULT
J1-6 GND
J1-7 ENABLE A
J1-8 ENABLE B
J1-9 FORWARD A
J1-10 FORWARD B
J1-11 REVERSE A
J1-12 REVERSE B
FWD_A
FWD_B
REV_A
REV_B
DRAWN: MGJ
DATED: 13 AUG 00
CHECKED:
QUALITY CONTROL:
RELEASED:
COMPANY: Wybron, Inc.
TITLE: Integral H.P. Servo Power Supply
CODE:
SIZE: B
DRAWING NO: PN10462
REV: A
SCALE:
SHEET: 2 OF 2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APPROVED:
DATE:
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ENC. OUT
LOAD CELL
SIGNAL –
EXCITATION +
SIGNAL +
EXCITATION –
SHIELD
VREF+
JUMPER
16.000 MHz
AT89C52-16JC
LTC1286
MAX483
LT1112
LM358
LT1167
DS1233
74LS04
LT1086-5CT
1A,50V
1N5908 5.1V
P5701 220uF,25WV
10uF,25WV
.1uF
.047 uF
33pF
10pF
1K
20K
220
Wybron, Inc.
Analog Adapter, Motovator
DRAWN: MGJ
DATED: 3 FEB 2001
CHECKED:
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RELEASED:
CODE:
SIZE: B
DRAWING NO: 10466
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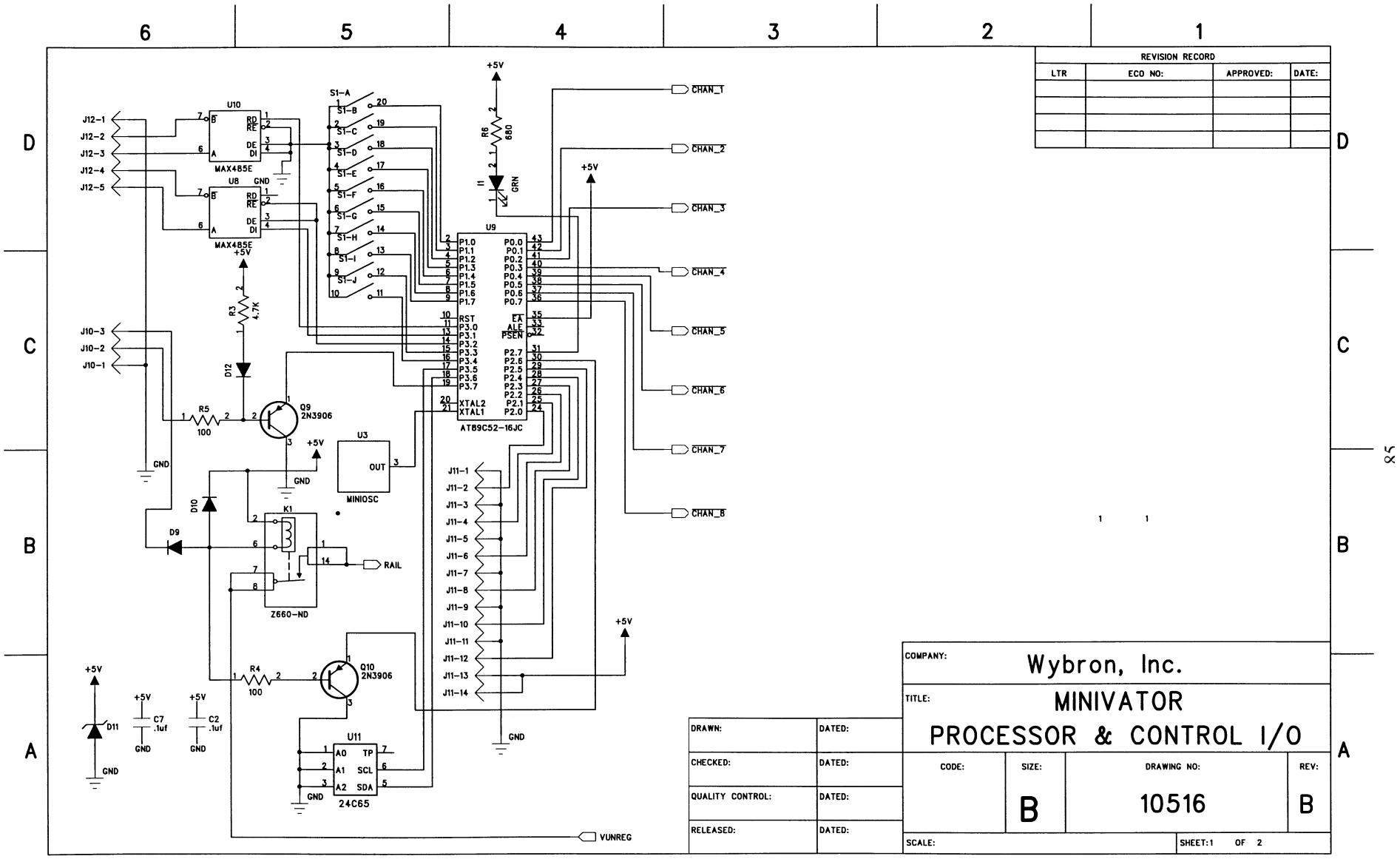
6
5
4
3
2
1
D
C
B
A
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LTR
ECO NO:
APPROVED:
DATE:
U10
MAX485E
U8
MAX485E
J12-1
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S1-A
S1-B
S1-C
S1-D
S1-E
S1-F
S1-G
S1-H
S1-I
S1-J
+5V
R6
680
I1
GRN
R3
4.7K
D12
R5
100
Q9
2N3906
GND
U3
OUT
MINIOSC
D10
D9
K1
Z660-ND
RAIL
U9
AT89C52-16JC
CHAN_1
CHAN_2
CHAN_3
CHAN_4
CHAN_5
CHAN_6
CHAN_7
CHAN_8
J11-1
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J11-7
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J11-9
J11-10
J11-11
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J11-13
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Q10
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C7
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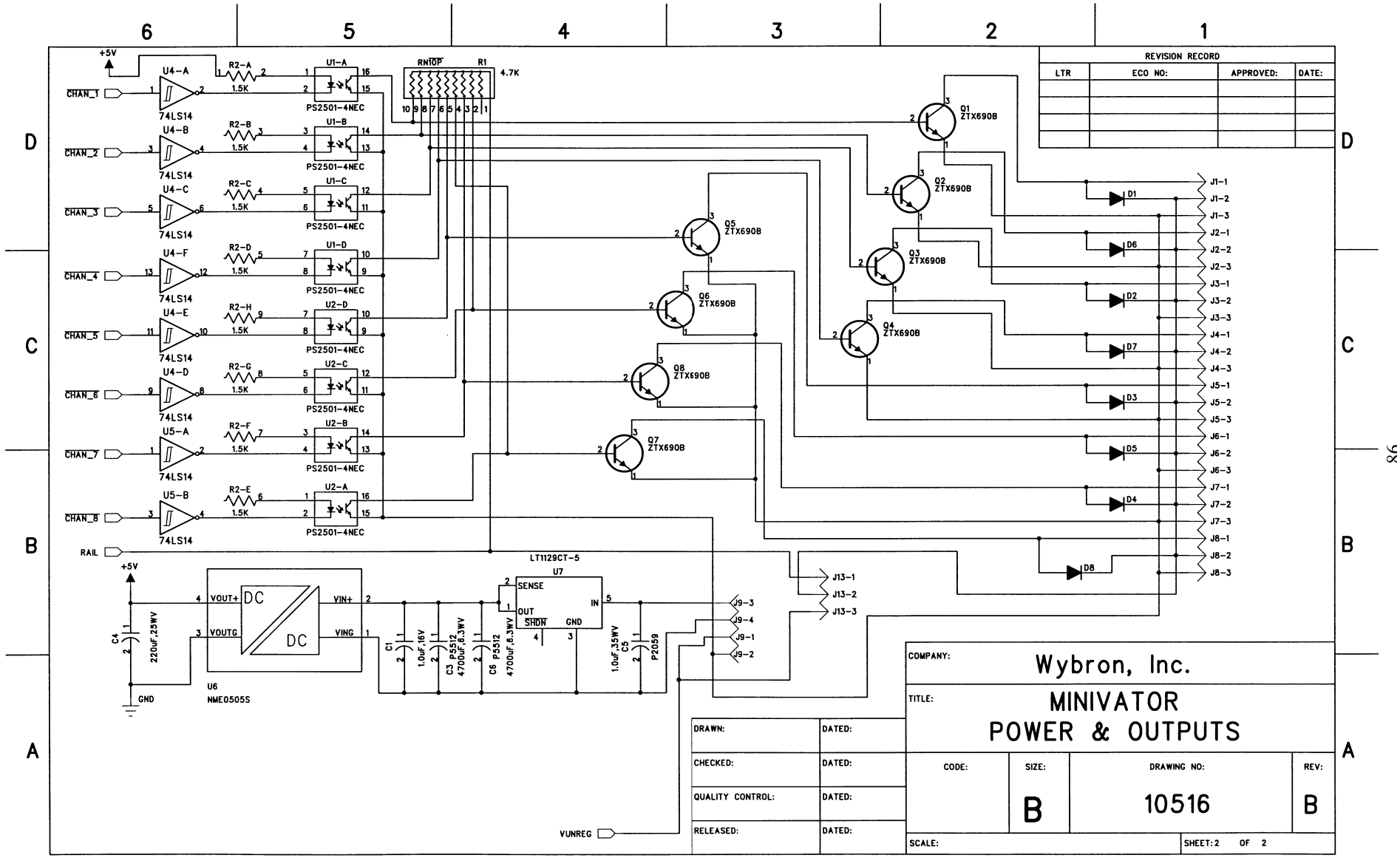
C2
.1uf
U11
24C65
VUNREG
DRAWN:
DATED:
CHECKED:
QUALITY CONTROL:
RELEASED:
COMPANY:
Wybron, Inc.
TITLE:
MINIVATOR
PROCESSOR & CONTROL I/O
CODE:
SIZE:
B
DRAWING NO:
10516
REV:
B
SCALE:
SHEET:1 OF 2

85


6
5
4
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2
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D
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B
A
+5V
CHAN_1
CHAN_2
CHAN_3
CHAN_4
CHAN_5
CHAN_6
CHAN_7
CHAN_8
RAIL
U4-A
U4-B
U4-C
U4-F
U4-E
U4-D
U5-A
U5-B
74LS14
R2-A
R2-B
R2-C
R2-D
R2-H
R2-G
R2-F
R2-E
1.5K
U1-A
U1-B
U1-C
U1-D
U2-D
U2-C
U2-B
U2-A
PS2501-4NEC
RN10P
R1
4.7K
Q1 ZTX690B
Q2 ZTX690B
Q3 ZTX690B
Q4 ZTX690B
Q5 ZTX690B
Q6 ZTX690B
Q8 ZTX690B
Q7 ZTX690B
D1
D6
D2
D7
D3
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U7
SENSE
OUT
SHDN
GND
IN
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J13-2
J13-3
J9-3
J9-4
J9-1
J9-2
VIN+
VING
VOUT+
VOUTG
DC
C4
220uF,25WV
C1
1.0uF,16V
C3 P5512
4700uF,6.3WV
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NME0505S
GND
VUNREG
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APPROVED:
DATE:
COMPANY:
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MINIVATOR
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DRAWN:
DATED:
CHECKED:
DATED:
QUALITY CONTROL:
DATED:
RELEASED:
DATED:
CODE:
SIZE:
B
DRAWING NO:
10516
REV:
B
SCALE:
SHEET: 2 OF 2

3.4 Configuration Quick Reference

Base Addr	474		MOTOVATOR SETUP V2.4 DMX CHART				20 January 2004 MGJ
Fixt DMX	PATCHED	Function	Description	Decimal	Percent	Notes	Controller Type and Range
		SERVO-Kp					Slider control 0-65535
1	474		Kp Coarse (MSB)	0-255	0-100		
2	475		Kp Fine (LSB)	0-255	0-100		
		SERVO-Ki					Slider control 0-65535
3	476		Ki Coarse (MSB)	0-255	0-100		
4	477		Ki Fine (LSB)	0-255	0-100		
		SERVO-Kd					Slider control 0-65535
5	478		Kd Coarse (MSB)	0-255	0-100		
6	479		Kd Fine (LSB)	0-255	0-100		
		SERVO-Integration Limit	UNITS: Ticks				Slider control 0-65535
7	480		Integration Limit Coarse (MSB)	0-255	0-100		
8	481		Integration Limit Fine (LSB)	0-255	0-100		
		SERVO-Integration Delta	UNITS: Ticks				Slider control 0-65535
9	482		Integration Delta Coarse (MSB)	0-255	0-100		
10	483		Integration Delta Fine (LSB)	0-255	0-100		
		MINIMUM SPEED	UNITS: X100 Ticks per Minute				Slider control 0-65535
11	484		Minimum Speed Coarse (MSB)	0-255	0-100		
12	485		Minimum Speed Fine (LSB)	0-255	0-100		
		MAXIMUM SPEED	UNITS: X100 Ticks per Minute				Slider control 0-65535
13	486		Maximum Speed Coarse (MSB)	0-255	0-100		
14	487		Maximum Speed Fine (LSB)	0-255	0-100		
		CALIBRATION SPEED	UNITS: X100 Ticks per Minute				Slider control 0-65535
15	488		Calibration Speed Coarse (MSB)	0-255	0-100		
16	489		Calibration Speed Fine (LSB)	0-255	0-100		
		RUNNING ACCELERATION	UNITS: X1000 Ticks per Minute per Second				Slider control 0-65535
17	490		Running Acceleration Coarse (MSB)	0-255	0-100		
18	491		Running Acceleration Fine (LSB)	0-255	0-100		
		CALIBRATION ACCELERATION	UNITS: X1000 Ticks per Minute per Second				Slider control 0-65535
19	492		Calibration Acceleration Coarse (MSB)	0-255	0-100		
20	493		Calibration Acceleration Fine (LSB)	0-255	0-100		
		MINIMUM OPERATING POSITION	UNITS: Ticks				Slider control 0-16,77,215 (24 bits)
21	494		Minimum Position Very Coarse	0-255	0-100		
22	495		Minimum Position Coarse (MSB)	0-255	0-100		
23	496		Minimum Position Fine (LSB)	0-255	0-100		
		MAXIMUM OPERATING POSITION	UNITS: Ticks				Slider control 0-16,77,215 (24 bits)
24	497		Maximum Position Very Coarse	0-255	0-100		
25	498		Maximum Position Coarse (MSB)	0-255	0-100		
26	499		Maximum Position Fine (LSB)	0-255	0-100		
		INDEX or STALL OFFSET	UNITS: Ticks				Slider control 0-65535
27	500		Offset Coarse (MSB)	0-255	0-100		
28	501		Offset Fine (LSB)	0-255	0-100		
29	502	**STALL TORQUE THRESHOLD**	UNITS: Percent Motor Command				Slider control 0-256
			Stall Torque Threshold	0-255	0-100		
30	503	**STALL TIMEOUT**	UNITS: X10 Milliseconds				Slider control 0-256
			Stall Timeout	0-255	0-100		
31	504	**BRAKE SET TIMEOUT**	UNITS: X100 Milliseconds				
			Brakes ALWAYS released	0	0		DMX = 0: Radio button "NO BRAKE" DMX = 0
			Brake Set Timeout	1-255	1-100		Slider "BRK TIME" 1-255 - DMX = 1-255
32	505	**ABSOLUTE ENCODER MODE**					
			Absolute Encoder Mode: INDEPENDENT	0-102	0-40%		Radio button "INDEPEND" - DMX = 0
			Absolute Encoder Mode: COMPARE	103-229	41-90%		Radio button "COMPARE" - DMX = 128
			Absolute Encoder Mode: AUTOTRACK	230-255	91-100%		Radio button "TRACK" - DMX = 255
		ENCODER COUNTS RATIO	UNITS: Ticks				
33	506		Incremental Encoder Ticks	0-255	0-100		Slider control 0-256
34	507		Absolute Encoder Ticks	0-255	0-100		Slider control 0-256
		NOTES:					
		1. This "fixture" is used to set up the configurable parameters on each Motovator or Rotovator.					
		2. ONE Setup fixture should be created for EACH UNIVERSE, and patched starting at dimmer channel 474 and using channels 474-507.					
		3. The ONE Setup fixture is used to set up the configurable parameters of ALL Motovators on a DMX universe.					

Base Addre	1		MOTOVATOR V2.4 DMX CHART			20 January 2004 MGJ	
Fixt DMX	PATCHED	Function	Description	Decimal	Percent	Notes	Controller type and Output Values
		POSITION					Position Controller 0-65535
1	1		Position Coarse (MSB)	0-255	0-100		
2	2		Position Fine (LSB)	0-255	0-100		
3	3	**SPEED/TIME**					Slider 0-255
		IF CONTROL=Speed:	Speed (0=MinSpeed, Full=MaxSpeed)	0-255	0-100	Function depends on value in CONTROL channel	
		IF CONTROL=TIME:	Time (0=0 time, 255=25.5 seconds	0-255	0-100	Function depends on value in CONTROL channel	
4	4	**PICKLE**					
			Pickle STOP	0-24	0-9		Selector button "PickleOFF" - DMX = 0
			Pickle RUN FORWARD	25-127	10-50	Active only in when CONTROL& ENABLE select PICKLE	Selector button "PickleFWD" - DMX = 64
			Pickle RUN REVERSE	130-229	51-90	Active only in when CONTROL& ENABLE select PICKLE	Selector button "PickleREV" - DMX = 192
			Pickle STOP	All values not listed above			
5	5	**CONTROL**					
			--Stop	0-21	0-8		Selector button "STOP" - DMX = 0
			Control POSITION:SPEED	22-28	9-11		Selector button "POS/SPEED" - DMX = 25
			Control POSITION:TIME	36-41	14-16		Selector button "POS/TIME" - DMX = 39
			Control PICKLE	48-53	19-21		Selector button "PICKLE" - DMX = 51
			Control SOFT RECAL	73-79	29-31		Selector button "SOFTCAL" - DMX = 76
			Control HARD RECAL	99-105	39-41		Selector button "HARDCAL" - DMX = 102
			Control SETUP READ	124-130	49-51		Selector button "SETREAD" - DMX = 127
			Control SETUP WRITE	176-181	69-71		Selector button "SETWRITE" - DMX = 179
			--Stop	All values not listed above			
	6	**ENABLE**					
			--Disable	0-149	0-58		Selector button "DISABLE" - DMX = 0
			Enable POSITION	150-156	59-61		Selector button "POSITION" - DMX = 153
			Enable PICKLE	176-181	69-71		Selector button "PICKLE" - DMX = 179
			Enable RECAL	201-206	79-81		Selector button "RECAL" - DMX = 204
			Enable SETUP	227-232	89-91		Selector button "SETUP" - DMX = 230
			--Disable	All values not listed above			

Base Addre	1		ROTOVATOR V2.4 DMX CHART			20 January 2004 MGJ	
Fixt DMX	PATCHED	Function	Description	Decimal	Percent	Notes	Controller type and Output Values
		POSITION					Position Controller 0-65535
1	1		Position Coarse (MSB)	0-255	0-100		
2	2		Position Fine (LSB)	0-255	0-100		
3	3	**SPEED/TIME**					Slider 0-255
		IF CONTROL=Speed:	Speed (0=MinSpeed, Full=MaxSpeed)	0-255	0-100	Function depends on value in CONTROL channel	
		IF CONTROL=TIME:	Time (0=0 time, 255=25.5 seconds	0-255	0-100	Function depends on value in CONTROL channel	
4	4	**PICKLE**					
		IF CONTROL=Position:	Linear Mode ("Wrap/Unwrap")	0-24	0-9	Active only in when CONTROL& ENABLE select POSITION	Selector button "LINEAR" - DMX = 0
		' " "	Rotate Clockwise ONLY	25-127	10-50	Active only in when CONTROL& ENABLE select POSITION	Selector button "CW ONLY" - DMX = 64
		' " "	Rotate Counter Clockwise ONLY	130-229	51-90	Active only in when CONTROL& ENABLE select POSITION	Selector button "CCW ONLY" - DMX = 192
		' " "	Rotate shortest distance	230-255	91-100	Active only in when CONTROL& ENABLE select POSITION	Selector button "SHORTEST" - DMX = 255
		IF CONTROL=Pickle:	ROTATE STOP	0-24	0-9		Selector button "PickleOFF" - DMX = 0
		' " "	ROTATE CLOCKWISE	25-127	10-50	Active only in when CONTROL& ENABLE select PICKLE	Selector button "PickleFWD" - DMX = 64
		' " "	ROTATE COUNTERCLOCKWISE	130-229	51-90	Active only in when CONTROL& ENABLE select PICKLE	Selector button "PickleREV" - DMX = 192
		' " "	ROTATE STOP	All values not listed above			
5	5	**CONTROL**					
			--Stop	0-21	0-8		Selector button "STOP" - DMX = 0
			Control POSITION:SPEED	22-28	9-11		Selector button "POS/SPEED" - DMX = 25
			Control POSITION:TIME	36-41	14-16		Selector button "POS/TIME" - DMX = 39
			Control PICKLE	48-53	19-21		Selector button "PICKLE" - DMX = 51
			Control SOFT RECAL	73-79	29-31		Selector button "SOFTCAL" - DMX = 76
			Control HARD RECAL	99-105	39-41		Selector button "HARDCAL" - DMX = 102
			Control SETUP READ	124-130	49-51		Selector button "SETREAD" - DMX = 127
			Control SETUP WRITE	176-181	69-71		Selector button "SETWRITE" - DMX = 179
			--Stop	All values not listed above			
	6	**ENABLE**					
			--Disable	0-149	0-58		Selector button "DISABLE" - DMX = 0
			Enable POSITION	150-156	59-61		Selector button "POSITION" - DMX = 153
			Enable PICKLE	176-181	69-71		Selector button "PICKLE" - DMX = 179
			Enable RECAL	201-206	79-81		Selector button "RECAL" - DMX = 204
			Enable SETUP	227-232	89-91		Selector button "SETUP" - DMX = 230
			--Disable	All values not listed above			

Base Addr	509		MOTOVATOR V2.4 DISPLAY CONTROL DMX CHART					20 January 2004 MGJ
Fixt DMX	PATCHED	Function	Description	Decimal	Percent	Notes	Parameter Category	Controller type and Output Values
1	509	**DISPLAY TYPE**					Xtra	
			Display TEXT	0-127	0-49			Selector button "TEXT" - DMX = 0
			Display BAR GRAPH	128-255	50-100			Selector button "GRAPH" - DMX = 255
2	510	**DISPLAY SELECT HUNDREDS**					Xtra	
			SELECT 0__	0-10	0%			Selector button "0--" - DMX = 0
			SELECT 1__	11-35	10%			Selector button "1--" - DMX = 25
			SELECT 2__	36-61	20%			Selector button "2--" - DMX = 50
			SELECT 3__	62-86	30%			Selector button "3--" - DMX = 75
			SELECT 4__	87-112	40%			Selector button "4--" - DMX = 100
			SELECT 5__	113-137	50%			Selector button "5--" - DMX = 125
			SELECT 6__	138-163	60%			Selector button "6--" - DMX = 150
			SELECT 7__	164-188	70%			Selector button "7--" - DMX = 175
			SELECT 8__	189-214	80%			Selector button "8--" - DMX = 200
			SELECT 9__	215-239	90%			Selector button "9--" - DMX = 225
3	511	**DISPLAY SELECT TENS**						
			SELECT_0_	0-10	0%			Selector button "-0-" - DMX = 0
			SELECT_1_	11-35	10%			Selector button "-1-" - DMX = 25
			SELECT_2_	36-61	20%			Selector button "-2-" - DMX = 50
			SELECT_3_	62-86	30%			Selector button "-3-" - DMX = 75
			SELECT_4_	87-112	40%			Selector button "-4-" - DMX = 100
			SELECT_5_	113-137	50%			Selector button "-5-" - DMX = 125
			SELECT_6_	138-163	60%			Selector button "-6-" - DMX = 150
			SELECT_7_	164-188	70%			Selector button "-7-" - DMX = 175
			SELECT_8_	189-214	80%			Selector button "-8-" - DMX = 200
			SELECT_9_	215-239	90%			Selector button "-9-" - DMX = 225
4	512	**DISPLAY SELECT ONES**						
			SELECT__0	0-10	0%			Selector button "--0" - DMX = 0
			SELECT__1	11-35	10%			Selector button "--1" - DMX = 25
			SELECT__2	36-61	20%			Selector button "--2" - DMX = 50
			SELECT__3	62-86	30%			Selector button "--3" - DMX = 75
			SELECT__4	87-112	40%			Selector button "--4" - DMX = 100
			SELECT__5	113-137	50%			Selector button "--5" - DMX = 125
			SELECT__6	138-163	60%			Selector button "--6" - DMX = 150
			SELECT__7	164-188	70%			Selector button "--7" - DMX = 175
			SELECT__8	189-214	80%			Selector button "--8" - DMX = 200
			SELECT__9	215-239	90%			Selector button "--9" - DMX = 225
		NOTES:						
		1. This "fixture" is used to control the status display generated by each Motovator or Rotovator.						
		2. ONE Display Control fixture should be created for EACH UNIVERSE, and patched starting at dimmer channel 509 and using channels 509-512.						
		3. The ONE Display Control fixture is used to control the display functions of ALL Motovators on a DMX universe.						
		USAGE EXAMPLES:						
		1. Select the Motovator set to a start address of 1 to Bar Graph mode:						
			DMX 509 @ 100%					
			DMX 510 @ 0%					
			DMX 511 @ 0%					
			DMX 512 @ 10%					
		1. Select the Motovator set to a start address of 123 to Text mode:						
			DMX 509 @ 0%					
			DMX 510 @ 10%					
			DMX 511 @ 20%					
			DMX 512 @ 30%					