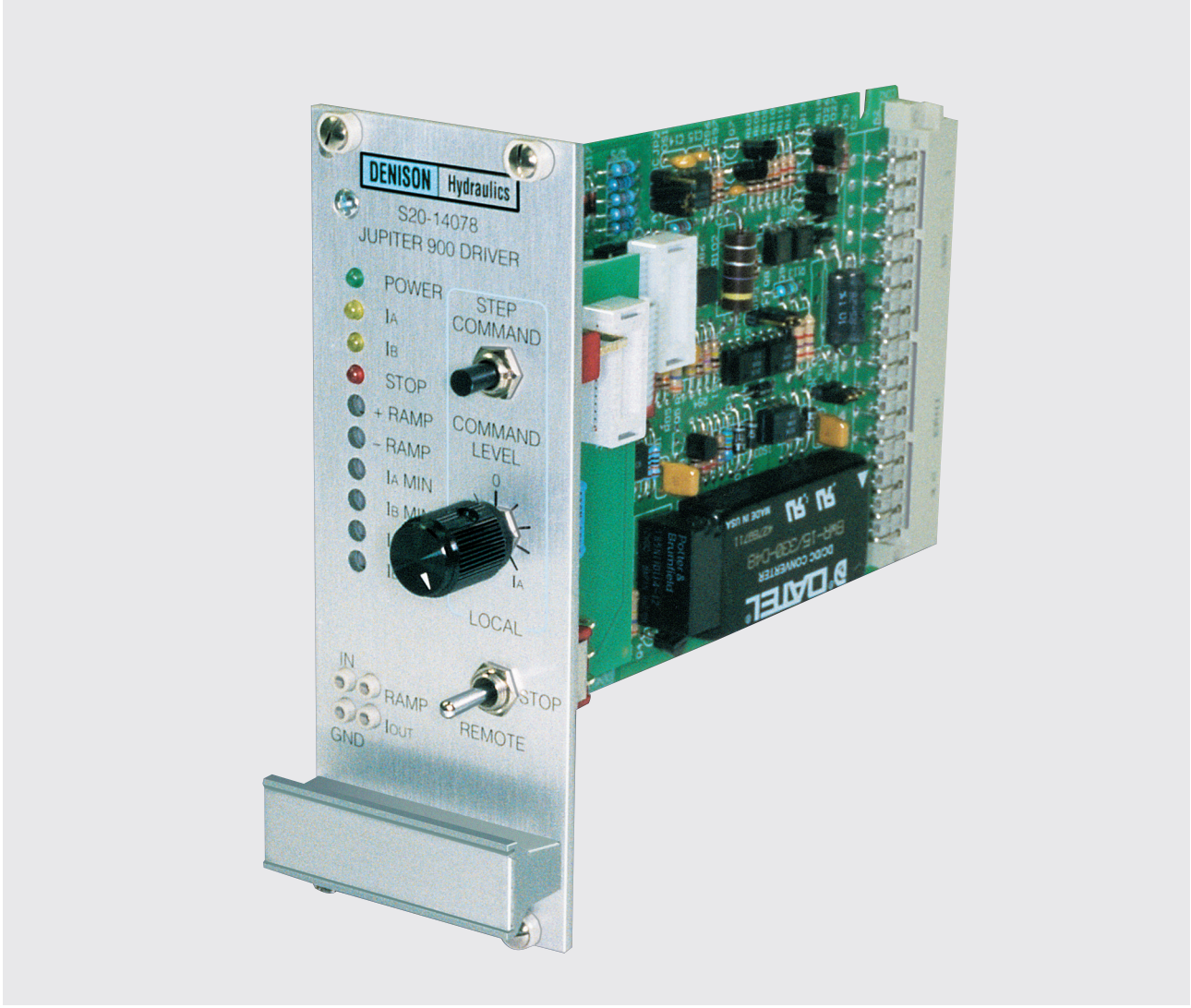
DENISON HYDRAULICS
Jupiter 900 Driver Card
Eurocard Version

Series S20-14078-0 Design C/D



Publ. 9-AM682-A *replaces 9-AM682*

DENISON Hydraulics

DECLARATION OF CONFORMITY
PER EMC DIRECTIVE 89/336/EEC AND EN45014

MANUFACTURER'S NAME DENISON HYDRAULICS

MANUFACTURER'S ADDRESS 14249 Industrial Parkway
Marysville, Ohio 43040-9504, USA

declares that the product

PRODUCT NAME Jupiter 900 Driver Card

PRODUCT PART NUMBER S20-14078-0

conforms to the following product specifications

EMC: EN50081-2: March 1994 generic emissions for heavy industry[1]
EN55011: 7/1992 radiated or conducted EMI – 30-1000MHz

EN50082-2: 1995 generic immunity for heavy industry[1]
ENV50140: 8/1993 – 10V/m, 80-1000MHz – Performance Criteria B

EN61000-4-2, IEC801-2 electrostatic discharge (ESD)
8KV air discharge – Performance Criteria A
4KV contact discharge – Performance Criteria A

EN61000-4-4: 5/1995 fast transient rejection
2KV power supply wires – Performance Criteria B

SUPPLEMENTARY INFORMATION

The product was tested in an EMC TEST Laboratory in Germany and herewith complies with the EMC Directive 89/336 and the CE Marking requirements.

[1] The product was tested in a typical system configuration with DENISON HYDRAULICS Jupiter Series products or recommended second source products. The tested product was mounted in a NEMA 4 enclosure (or equivalent) and all cables exiting the enclosure were shielded (screened). Enclosure and cable shields were connected to earth ground (PE).

USA CONTACT

Office of Director of Quality
DENISON HYDRAULICS
14249 Industrial Parkway
Marysville, Ohio 43040

EUROPEAN CONTACT

DENISON HYDRAULICS Sales Office
or Office of Quality Manager
DENISON HYDRAULICS GmbH
Gerresheimer Strasse 9
D-40721 Hilden
Deutschland

See Installation & Operation Guidelines under Procedures.

IMPROVEMENTS AND CHANGES WORTH NOTING

1. Improved power supply specification — 22-29VDC(min-max): unit will tolerate overvoltage excursions up to 40 volts.

   The old version specified 24-28VDC, (minimum to maximum). If the input voltage accidentally exceeded 30 volts, including any AC peaks, the converter would fail permanently. Mobile applications with battery chargers could exceed the 30 volts; but also fixed industrial applications with unregulated, 28VDC power supplies will readily exceed 35 volts due to AC input tolerance and output load variations.

2. Eliminated the two 1/2 amp Micro-Fuses. The new DC-DC converter has internal short-circuit protection, eliminating the need for fuses. Total current available from ±15Vdc source is 330mA, that is, onboard and off-board. Unit has over-current protection.

3. Front panel STEP COMMAND is functional in both LOCAL and REMOTE modes. Older versions only worked in LOCAL mode.

4. Added option to permit isolated power source for E-STOP function. This option is factory set to operate as previous versions. If isolated power source is desired, move jumper JP4 from position A-B (internal GND) to B-C (isolated GND) and connect the isolated power ground to terminal C24 E-STOP RET. It made sense to provide this isolation option to the E-STOP function since the SOFT-STOP and REV CMD function can be isolated.

NOTE: Terminal C24 on versions prior to REV. C was REV CMD RET. Terminal C22 is now the REV CMD RET and SOFT-STOP RET. (We ran out of terminals).

5. Added 400 Hz, as a third choice for pulse-width modulation frequency. The factory set is 200Hz, JP2 (A-B). For 400Hz set jumper JP2 to B-C and for 120Hz remove the jumper (store the jumper on one of the pins).

6. The Ramp time minimum values have increased to 0.2 and 0.8 seconds. This should be of little consequence in most application. The ramp function can be shut off if desired.

7. The IA and IB LED's illuminate somewhat proportionately to the output current. This is a good troubleshooting tool.

PAGE

European EMC Directive 89/336/EEC
Declaration of Conformity i

product update information ii

table of contents iii

technical specifications 1-2
power supply requirements 1
reference voltages 1
remote inputs 1
operating temperature 1
ramp generator 1
output driver 1
feedback inputs 1
input command disable 1
emergency stop input 1
reverse CMD input 1
soft stop input 1
LED indicators 2
potentiometer adjustments 2
front panel local controls 2
front panel test points 2
mechanical 2
I/O connector pin assignment 2
product description 3
system features 3
general 3
functional description 4-5
input 4
output 4
PWM frequency 4
ramp generator 4
front panel controls & indicators 4
emergency stop option 4
soft stop option 5
reverse CMD option 5
ramp-at-zero option 5
closed-loop-control 5
remote operation only 5
procedure 6
installation & operation guidelines 6
set-up procedure 6
installation drawings 7-9
eurocard holder outline 7
power supply outline 8
900 driver card outline 9
jumper & switch settings 9
900 driver functional block diagram 10
input signal options diagrams 11-12
remote voltage & potentiometer 11
current-loop with interlock 12
application diagrams 13-19
open-loop control scheme 13
closed-loop control scheme 13
most common application 14
open-loop speed w/ hp limit 15
closed-loop speed w/ command forward 16
closed-loop speed w/ com. forward & hp lmt 17
closed-loop speed w/ pi 18
closed-loop speed w/ pi & hp lmt 19

POWER SUPPLY REQUIREMENTS	22-29VDC @ 1 Amp (nominal)	
REFERENCE VOLTAGES	*Available to user*	+15VDC @ 250 mA (max.) –15VDC @ 250 mA (max.) +10VDC @ 0.0025 Amps max. –10VDC @ 0.0025 Amps max.
REMOTE INPUTS	*Potentiometer*	10K Ohms nominal, 5K Ohms minimum
	Input voltage range	±5VDC, ±10VDC
	Input impedance	100K Ohms, 200K Ohms
	Current loop input	4-20mA, ±20mA
	Current loop input impedance	249 Ohms
	Auxiliary voltage input	±10VDC
	Reverse command input	+15 - +24VDC
	Soft stop input	+15 - +24VDC
OPERATING TEMPERATURE RANGE	0-70°C	
RAMP GENERATOR	*Switchable (DIP switch)*	On or Off
	Positive ramp (rising) range A	0.2-6 sec.
	Positive ramp (rising) range B	0.8-40 sec.
	Negative ramp (falling) range A	0.2-6 sec.
	Negative ramp (falling) range B	0.8-40 sec.
OUTPUT DRIVER	*Pulse width modulation (PWM) driver with current feedback and short circuit protection.*	
	PWM frequency	120Hz, JP2 position no jumper 200Hz, JP2 position A-B 400Hz JP2 position B-C
	$I_{(A,B)}$ *minimum*	0-460mA
	$I_{(A,B)}$ *maximum w/24 Ohm load*	I_{min} - 800mA
FEEDBACK INPUTS	*Horsepower limiting command*	±10VDC
	Major loop	±10VDC
INPUT COMMAND DISABLE	*Gnd to disable*	
EMERGENCY STOP INPUT	Apply +15 to 24VDC for normal operation (optical isolation if desired). Remove 24VDC for emergency stop. Remove jumper JP4 for isolated signal source.	
REVERSE CMD INPUT (OPTICALLY ISOLATED)	No connection for normal operation. Apply +15V to 24VDC and GND to reverse command.	
SOFT STOP INPUT (OPTICALLY ISOLATED)	JP3 factory set to position B-C, soft stop disabled. Set JP3 to position A-B to enable soft stop. Apply 15V to 24VDC and GND for normal operation. Remove 24VDC for soft stop.	

DESCRIPTION

LED INDICATORS

Power	±15VDC supply operational
I_A	Output current to coil A
I_B	Output current to coil B
Stop	Both “A” & “B” coils disabled, same as emergency stop.

POTENTIOMETER ADJUSTMENTS

+ Ramp	Adjusts positive ramping time
– Ramp	Adjusts negative ramping time
I_A Min	Adjusts coil A minimum current
I_B Min	Adjusts coil B minimum current
I_A Max	Adjusts coil A maximum current
I_B Max	Adjusts coil B maximum current

FRONT PANEL LOCAL CONTROLS

Local-Stop-Remote switch	Selects the mode of operation for the driver card. Card can be jumpered for remote operation only; set JP1 to B-C.
Command level potentiometer	Adjusts the input command when switched to local mode.
Step command push-button	Forces the local remote input command to zero when pressed. Facilitates ramp adjustment.

FRONT PANEL TEST POINTS

In	Input command (±10VDC)
Ramp	Ramp output (±10VDC)
Out	Coil current scaled to ±1mV per ±1mA Coil A is a positive value, Coil B is a negative value
Gnd	Signal ground reference

MECHANICAL

Dimensions, eurocard	3U, 100 x 160mm (3.9 x 6.3 in.)
Dimensions, Card w/Front Panel	128.4 H x 193 D x 50.5 W mm (5 H x 7.6 D x 2 W in.)
Connector	DIN 32C, male
Weight	0.22 kg (0.484 Lbs.)

I/O CONNECTOR PIN ASSIGNMENTS S20-14078

A2:	+10V Ref. @ 2.5mA	C2:	Test Point Command In
A4:	–10V Ref. @ 2.5mA	C4:	Test Point Ramp First-Stage Ampl.
A6:	±5V Command	C6:	Test Point Ramp Out
A8:	±10V Command	C8:	Test Point Current Out Coil A/B
A10:	±10V AUX Command	C10:	Coil A PWM Output
A12:	Signal Ground	C12:	Coil A Return
A14:	Current-Loop In	C14:	Ramp-at-Zero Open-Collector Unit
A16:	Current-Loop Ret	C16:	Command Inverted
A18:	Major-Loop Feedback	C18:	Coil B PWM Output
A20:	HP Limiting Command	C20:	Coil B Return
A22:	Soft-Stop Input	C22:	Soft-Stop Return / Rev. Comm. Ret.
A24:	Reverse Command Input	C24:	E-Stop Return
A26:	Signal Ground	C26:	Command Disable CMDDIS/
A28:	E-Stop Input	C28:	+15V @ 250mA Power Out
A30:	DC Power Input	C30:	–15V @ 100mA Power Out
A32:	Power Ground	C32:	Power Ground

SYSTEM FEATURES

- Controls 9A electro hydraulic control for Gold Cup Series and premier open loop pumps
- Open or closed loop control (w/options card S20-11716-0)
- Eurocard format (see S20-14087-0 for panel mount version)
- Separately adjustable positive and negative ramps (0.2-40 sec.)
- Multiple input commands
- Remote potentiometer (10K CT)
- ±5VDC and ±10VDC voltage inputs
- +4-20mA and ±0-20mA current loop inputs
- Auxiliary inputs
- Soft stop option
- Emergency stop option
- Reverse command option
- Front panel operator controls
- Easy calibration
- LED control indicators
- Potentiometer adjustments
- Special field calibration features
- Special safety features

GENERAL

Jupiter driver card S20-14078-0-0 is a bidirectional pulse-width modulated current coil driver used for proportional open-loop control of the 9A electro hydraulic controlled pumps. Input commands to the card may be voltages, current loop, or potentiometer, single ended or differential. Multiple input commands are permitted but must be interlocked by the user to insure that the card is controlled by only one input at a time. The card also features two ranges of positive and negative ramping, remote emergency shutdown control, options for soft stop, emergency stop and reverse command, as well as provisions for closed-loop control with the Jupiter Options Card S20-11716. The driver card is packaged in a 3U eurocard size and may be operated with stand alone DC power supplies or with the Jupiter 900 power supply 762-30026, which provides the required DC power in a panel mount package.

Open loop control

The driver card with its power supply accessory is used for open-loop control. It provides multiple input commands, ramping, and front panel set-up controls. The panel mounted power supply, 762-30026, furnishes the driver card with regulated DC power and features screw terminals for simplified panel wiring.

Closed loop control

The options card, S20-11716, is used in conjunction with the driver card for precise closed-loop control. It features digital and DC tachometer feedback, horsepower limiting, and PI control of feedback error. A panel mounted eurocard holder with screw terminals is available for easy mounting. Power for the options card is obtained from the driver card's power supply.

INPUT

Local or **remote** input is selected via a switch located on the front panel. In **local** mode a single-turn front panel **command level** potentiometer provides ± full-scale input. **Local** mode is recommended for system set-up process only.

In **remote** mode several user wired input options are available. This mode is the primary method of wiring the card for inputs from standard industrial control sources such as voltage and current-loop signal generators. The user has a choice of voltage, current-loop or potentiometer when using the remote input. Voltage inputs may be ±5V, or ±10V. Current-loop inputs are differential 4-20mA[1] or ±0-20mA. DIP switches on board are for current-loop set-up.

When in **remote** an **auxilliary** ±10V input is available. This input provides the user more input options. With all the remote input options provided, it is the user's responsibility to interlock multiple inputs if driver card is to be controlled by one input at a time.

[1] The **reverse CMD** input can be used to obtain bidirectional operation.

On revision level C and up, the **step command** pushbutton also operates when in **remote** mode permitting accurate ramp time settings on the remote signal that is used in actual operation.

OUTPUT

The output stage of the driver card is a two channel PWM (Pulse Width Modulated) current source with current feedback for precise control of the current through the coil regardless of the changes in coil resistance. The two outputs are protected against short circuits across the coil and short circuits to ground.

PWM FREQUENCY

The frequency of the **PWM** high current driver is factory set to 200Hz (JP2 A-B). **JP2** allows the frequency to be lowered to 120Hz by removing the **JP2** jumper, or raised to 400Hz by moving **JP2** to position B-C. The 120Hz frequency setting produces more dithering effect and reduces hysteresis.

RAMP GENERATOR

Adjustable positive and negative ramping of the output is provided in two ranges of 0.2-6 and 0.8-40 seconds. Ramping on-off and ramping ranges are selected by dip switches on the card. The **command level** potentiometer and the **step command** pushbutton located on the front panel may be used for accurate adjustments of ramp times.

FRONT PANEL CONTROLS AND INDICATORS

Key indicators, potentiometer adjustments, switches and test points are brought out to the front panel for monitoring, set-up and calibration purposes. **LEDs** are provided for indicating the status of the power (internal ±15VDC supplies), the coil that is energized and the state of the emergency stop function.

Potentiometer adjustments include **±ramps, $I_{A,B}$ min** and **$I_{A,B}$ max**. Test points are furnished for measurement of the input, output, ramp and signal ground. A l**ocal - stop - remote** switch is provided to switch control of the card from local front panel control to user-wired remote control. **Stop** de-energizes emergency shut-down relay **K1,** removing 24VDC from the **PWM** driver circuit. Jumper **JP1** will allow the card to be placed in **remote** mode and disable the front panel **local - stop - remote** switch, the **step command** push-button and the **command level** potentiometer. The **command level** potentiometer is used in conjunction with the **step command** push-button for set-up and calibration of the driver card. Pressing then releasing the **step command** push-button in local mode triggers the ramping of the output from zero current to the current level set by the **command level** potentiometer, permitting accurate and simple adjustment of both the positive and negative ramp times. On revision level C and up, the **step command** pushbutton also operates when in **remote** mode permitting accurate ramp time settings on the remote signal that is used in actual operation.

EMERGENCY STOP OPTION

The emergency stop (E-stop) input controls the K1 relay that provides 24VDC to the output driver stage. Applying logic level +15 to 24VDC to the E-stop enables the driver card output stage. Removing the E-stop signal will abruptly halt the output current. (See **soft-stop** option). In revision level C and up an isolated E-stop signal option is provided. If an isolated E-stop signal is required, remove the JP4 jumper and connect the isolated signal common to terminal C24.

SOFT STOP OPTION

The **soft stop** option is used to set the output current to zero at a rate set by the **ramp** circuit. Placing **JP3** in the A-B position will enable the **soft stop** option, position B-C will disable the **soft stop** option. If the **soft stop** is enabled 24VDC and **GND** must be connected to the **soft stop** input for normal operation. Removing 24VDC from the **soft stop** input will turn off the output at a rate set by the **ramp** settings.

REVERSE CMD OPTION

Connecting 24VDC and **GND** across the **reverse CMD** input will cause the output to switch the current from one channel to the other at a rate set by the **ramp** circuit. This will allow a unipolar command signal to control the pump on both sides of center.

> **WARNING:** Once the **reverse CMD** input has been energized loss of this signal will reverse the driver cards output signal.

RAMP-AT-ZERO OPTION

The **ramp-at-zero** is an output that indicates when the ramp circuit output is at zero. The **ramp-at-zero** output is 15VDC when ramp is at zero and **0VDC** when ramp is not at zero. One application for the **ramp-at-zero** function is to hold the integrator of the Jupiter options card, S20-11716, at zero when system command is zero.

CLOSED-LOOP-CONTROL

The driver card operating as a stand alone driver is used primarily for open-loop control. With the **Jupiter options card,** S20-11716, the driver card can be used for closed-loop speed control systems. The options card provides digital encoder and DC tachometer feedback, horsepower limiting and PI control of the feedback error.

REMOTE OPERATION ONLY

The front panel controls are factory enabled by JP1 at position A-B. Moving JP1 to position B-C disables the front panel controls for remote only operation.

INSTALLATION & OPERATION GUIDELINES

- For EMC compatibility, card must be installed in a NEMA 4 or equivalent enclosure; connect enclosure to earth ground.
- Shield (screen) all wires entering enclosure. Connect card end of shield to earth ground. Leave other end of shield open.
- Use Denison Hydraulics recommended power supply P/N 762-30036.
- Disconnect power before inserting or removing card.
- Use high resistance meter for all testpoint measurements, Ri > 100K.
- Maximum wire length between driver card and pump 9A control valve is 150 feet of 16 AWG, operating at minimum 22VDC supply voltage, 0.35A coil current and 80°C fluid temperature. When using 14 AWG distance can be increased to 240 feet.

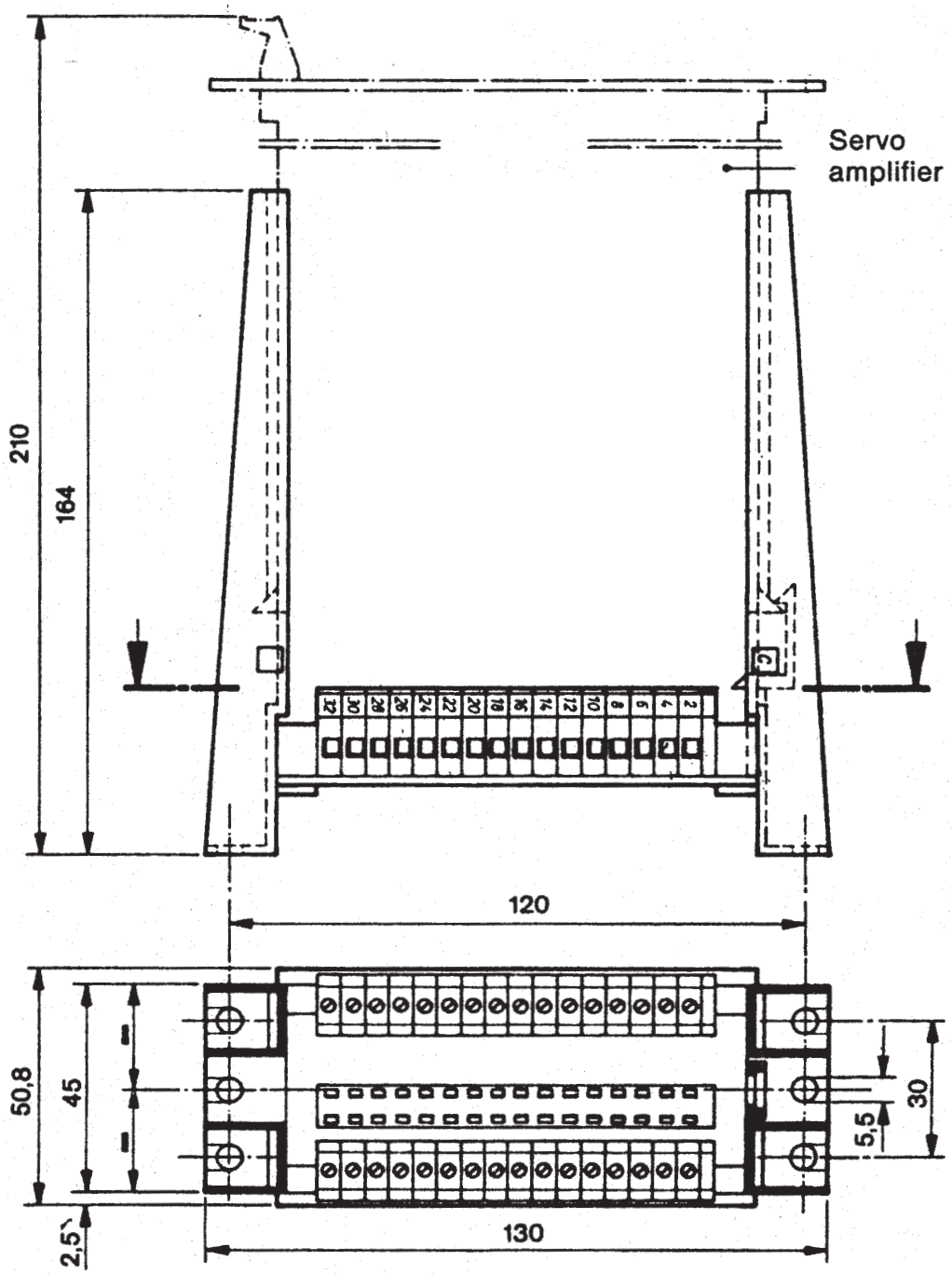
SET-UP PROCEDURE

1. With the hydraulic system de-energized, connect the Jupiter 900 driver card according to the attached block diagram, then apply 24VDC to the driver card. The **power LED** should be illuminated and the **stop LED** should not be illuminated.
2. If the **power LED** is not lit, check the wiring and apply power again.
3. Connect a **DVM** (digital volt meter) to the IOUT test point and the **GND** test point on the front panel. Apply a positive 3% command signal to the appropriate input. Adjust the **IA min** potentiometer until a value of +0.124VDC (+0.124A) is read on the **DVM**. Apply a negative 3% command signal to the appropriate input. Adjust the **IB min** potentiometer until a value of –0.124VDC (–0.124A) is read on the **DVM.** This is a preliminary setting.
4. Apply a positive 100% command signal to the appropriate input, then adjust the **IA max** potentiometer to give a value of +0.30VDC (+0.30A) on the **DVM.** Apply a negative 100% command signal to the appropriate input, then adjust the **IB max** potentiometer to give a value of –0.30VDC (–0.30A) on the **DVM.** This is a preliminary setting.

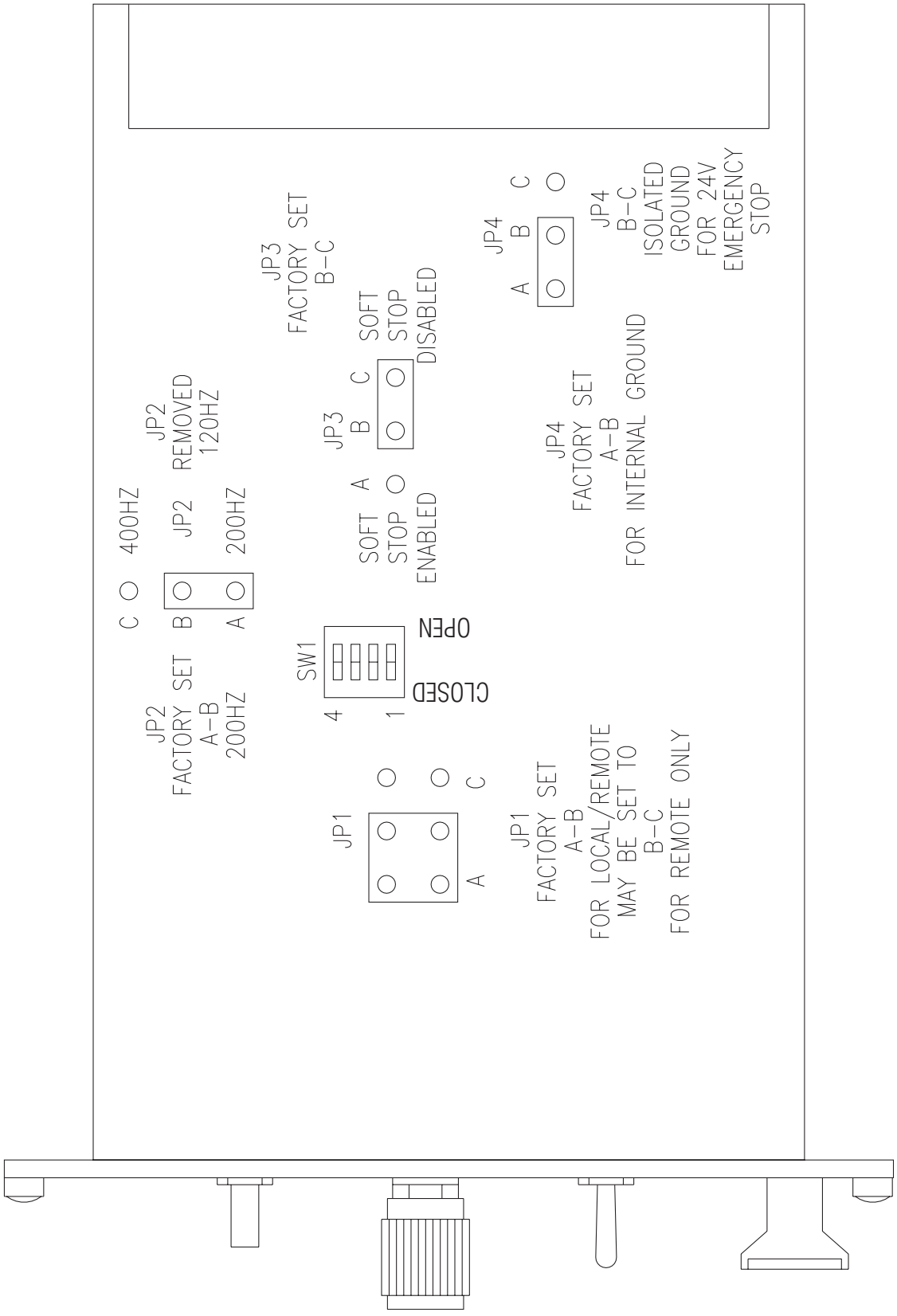
Note: Before energizing hydraulic system make sure that system can handle high flow rate and that max pressure limit is set to prevent system damage.

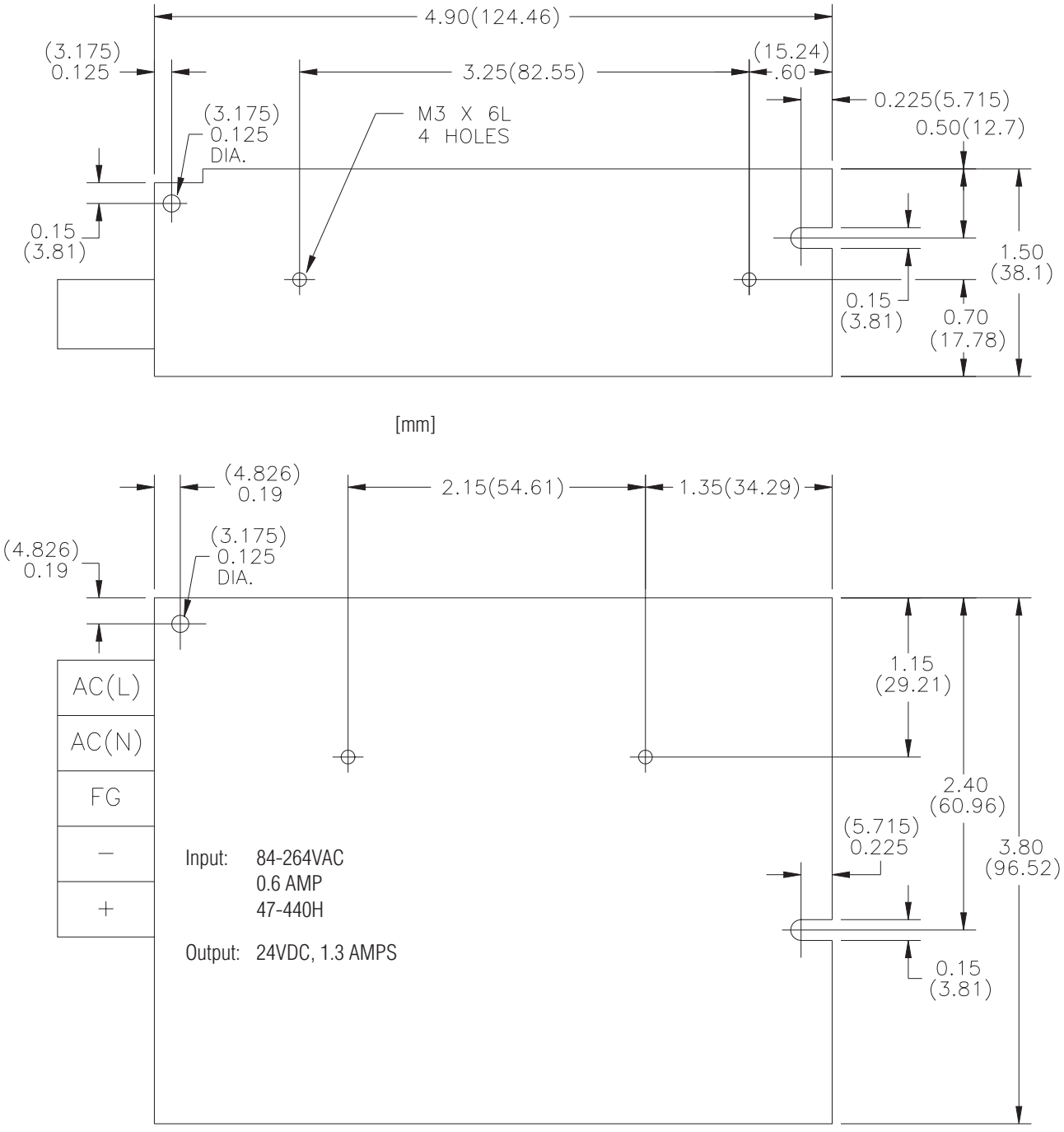
5. Set the command signal to 0% and energize the hydraulic system. Slowy set command signal to +100% and then adjust **IA MAX** potentiometer for desired max hydraulic flow. Slowly decrease command signal while observing DVM at IOUT testpoint. Set command slightly above the IMIN trip point and then adjust **IA MIN** potentiometer until the minimum hydraulic output is at the desired level. Repeat the **IMAX** and **IMIN** adjustments for best hydraulic operating characteristic. Adjustments have slight interaction.
6. For bi-directional systems repeat step 5 above with a negative command signal and adjust **IB MAX** and **IB MIN** for best operating characteristics.

EUROCARD HOLDER
701-00007-8



JUMPER & SWITCH LOCATIONS



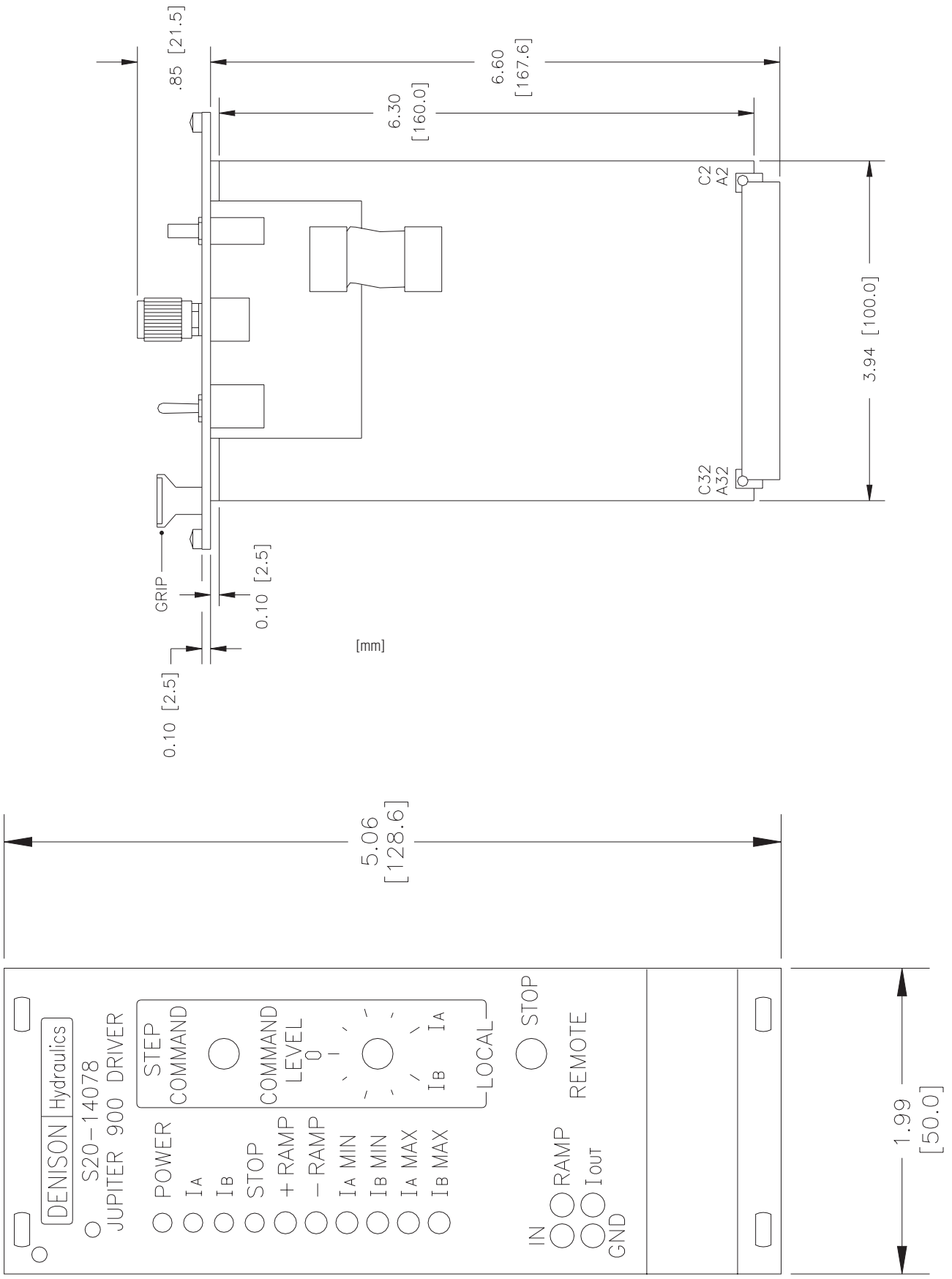


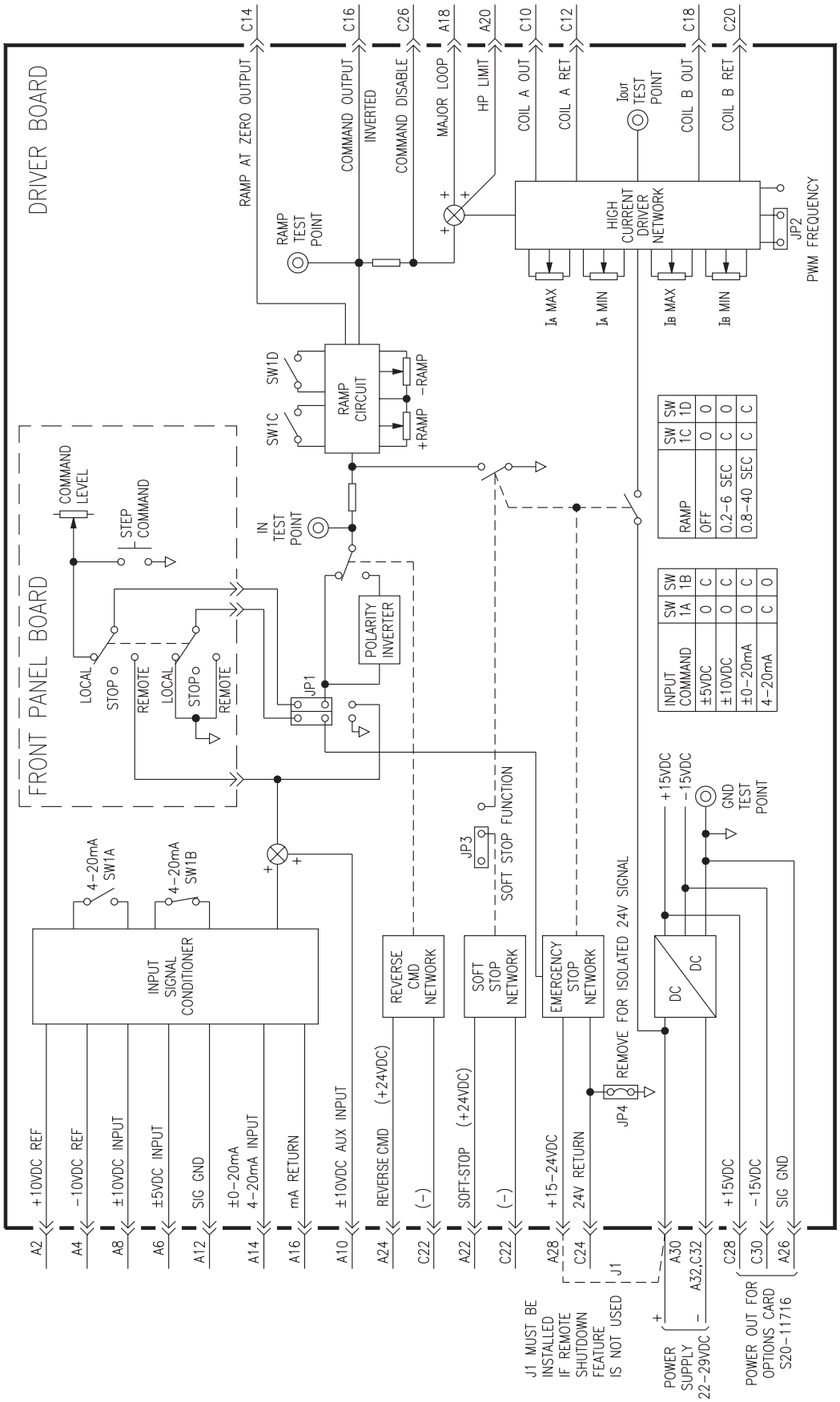
BOTTOM VIEW

762−30026 POWER SUPPLY MOUNTING HOLES

DIMENSIONS IN INCHES [MILLIMETERS]

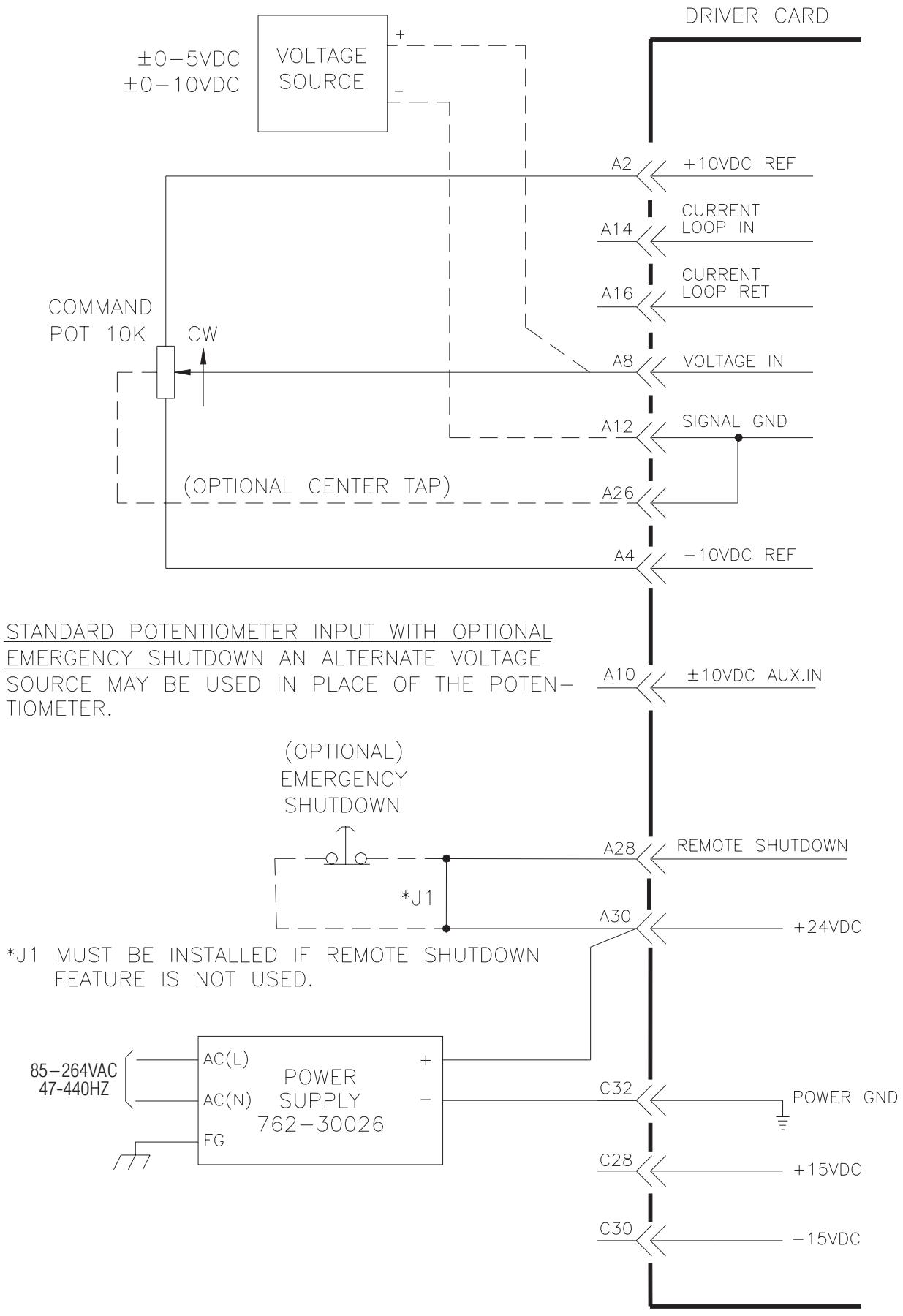
TOP VIEW DRIVER CARD



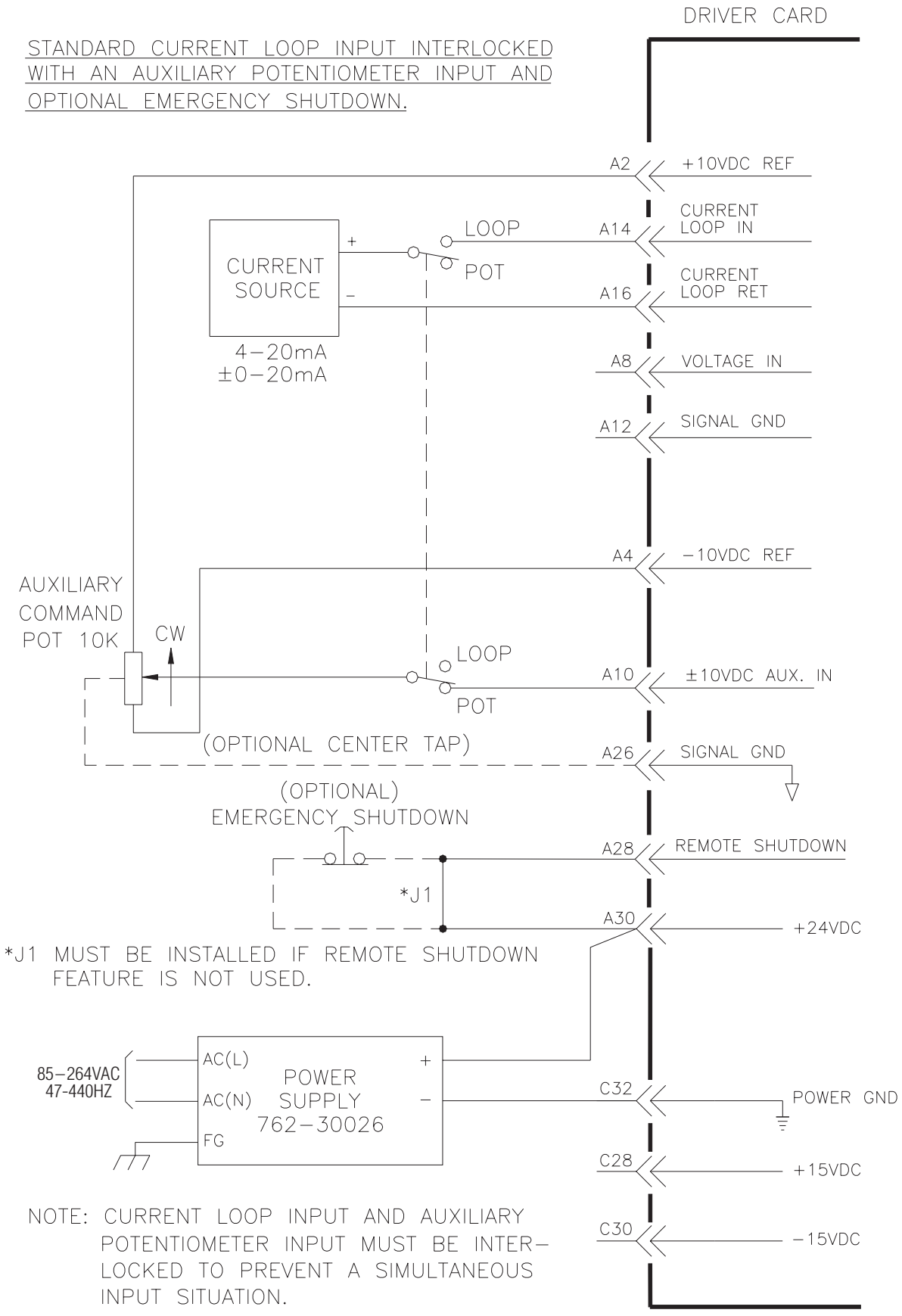


Block Diagram

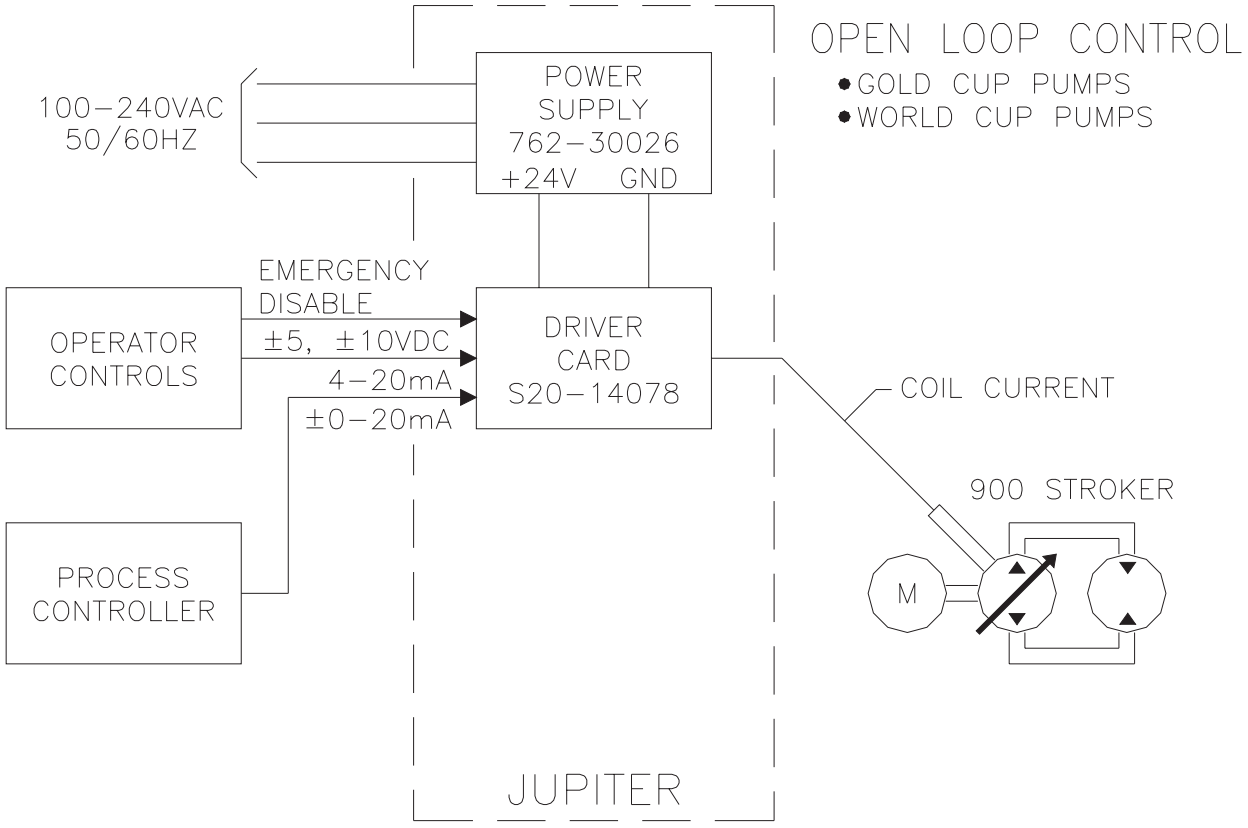
Jupiter 900 Driver Eurocard Version S20-14078-0

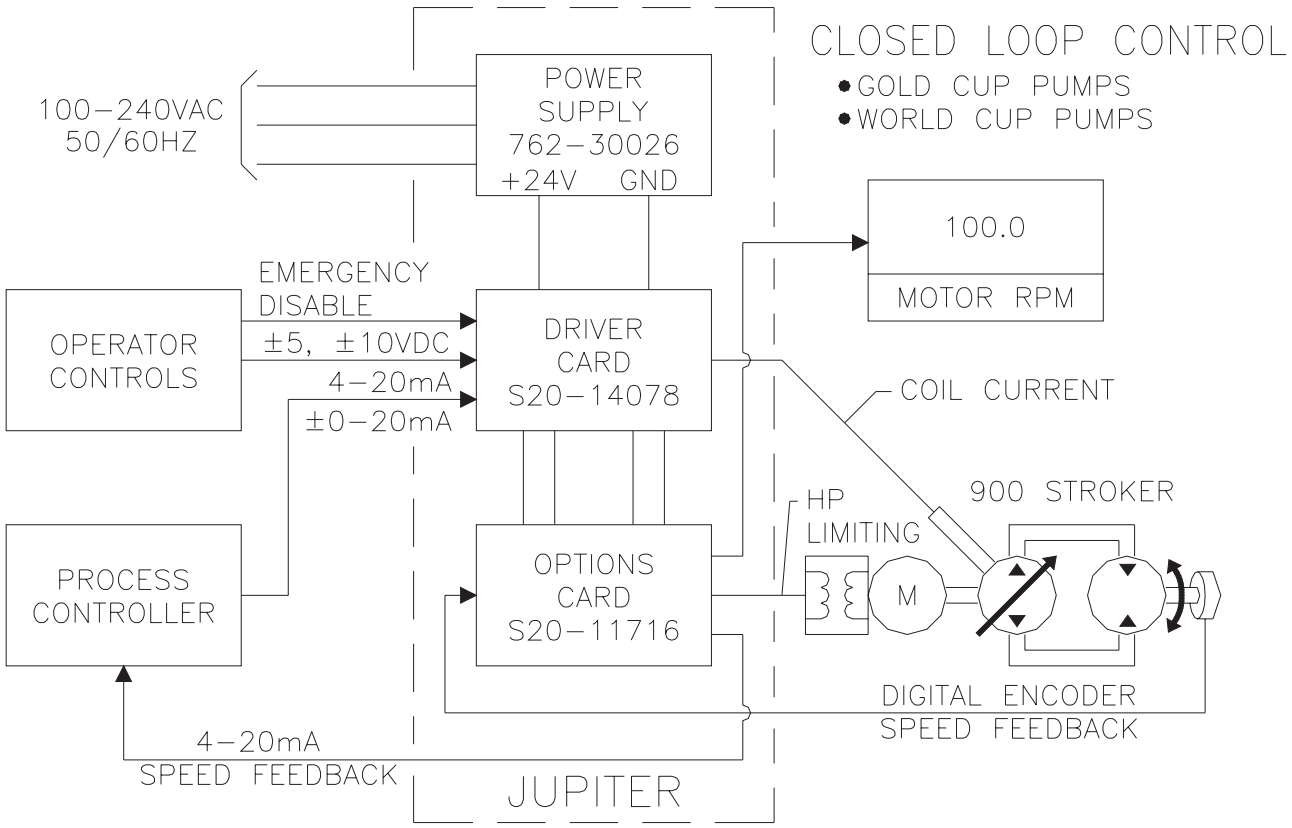


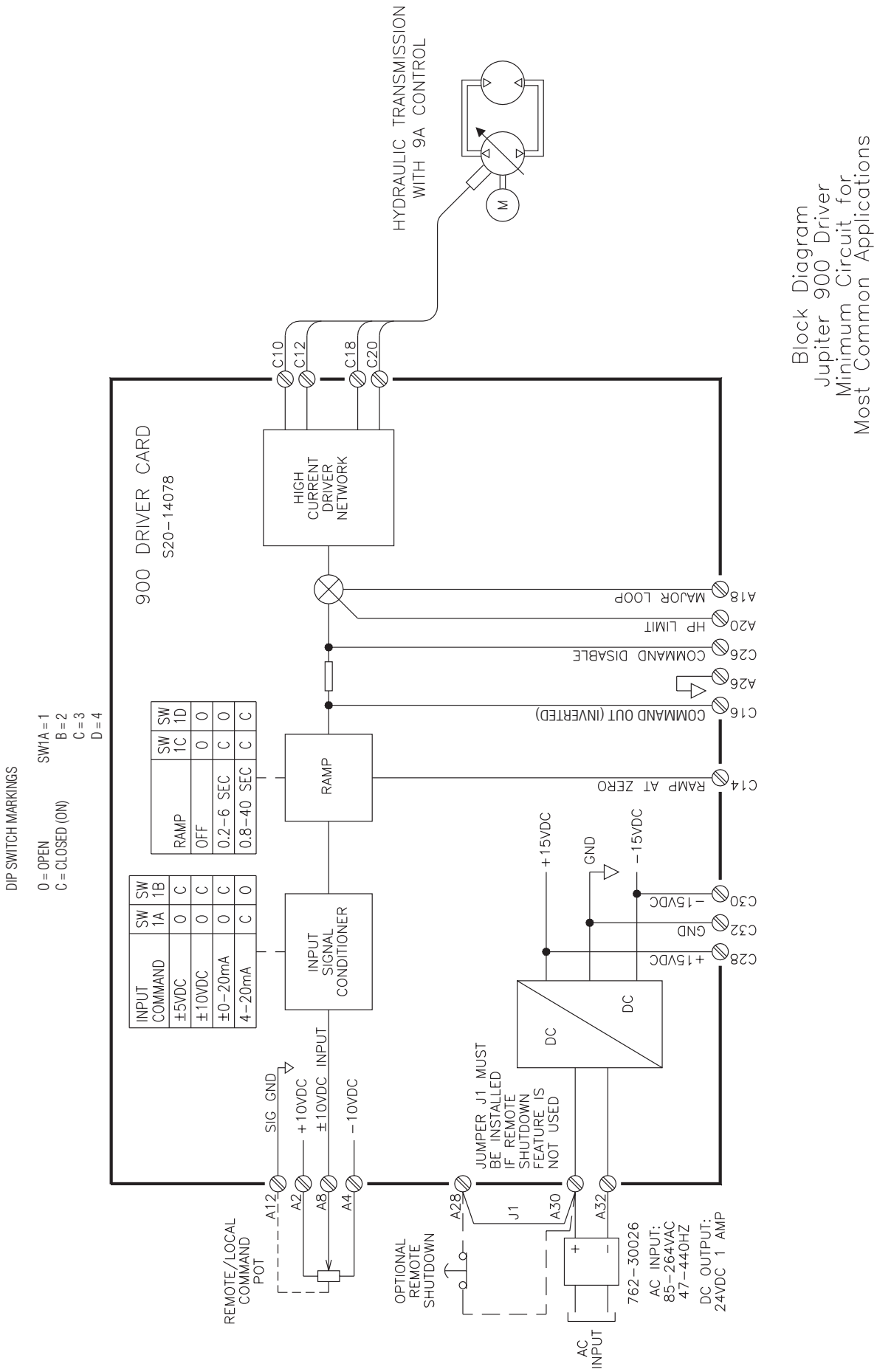
REMOTE VOLTAGE AND POTENTIOMETER INPUT CONNECTIONS

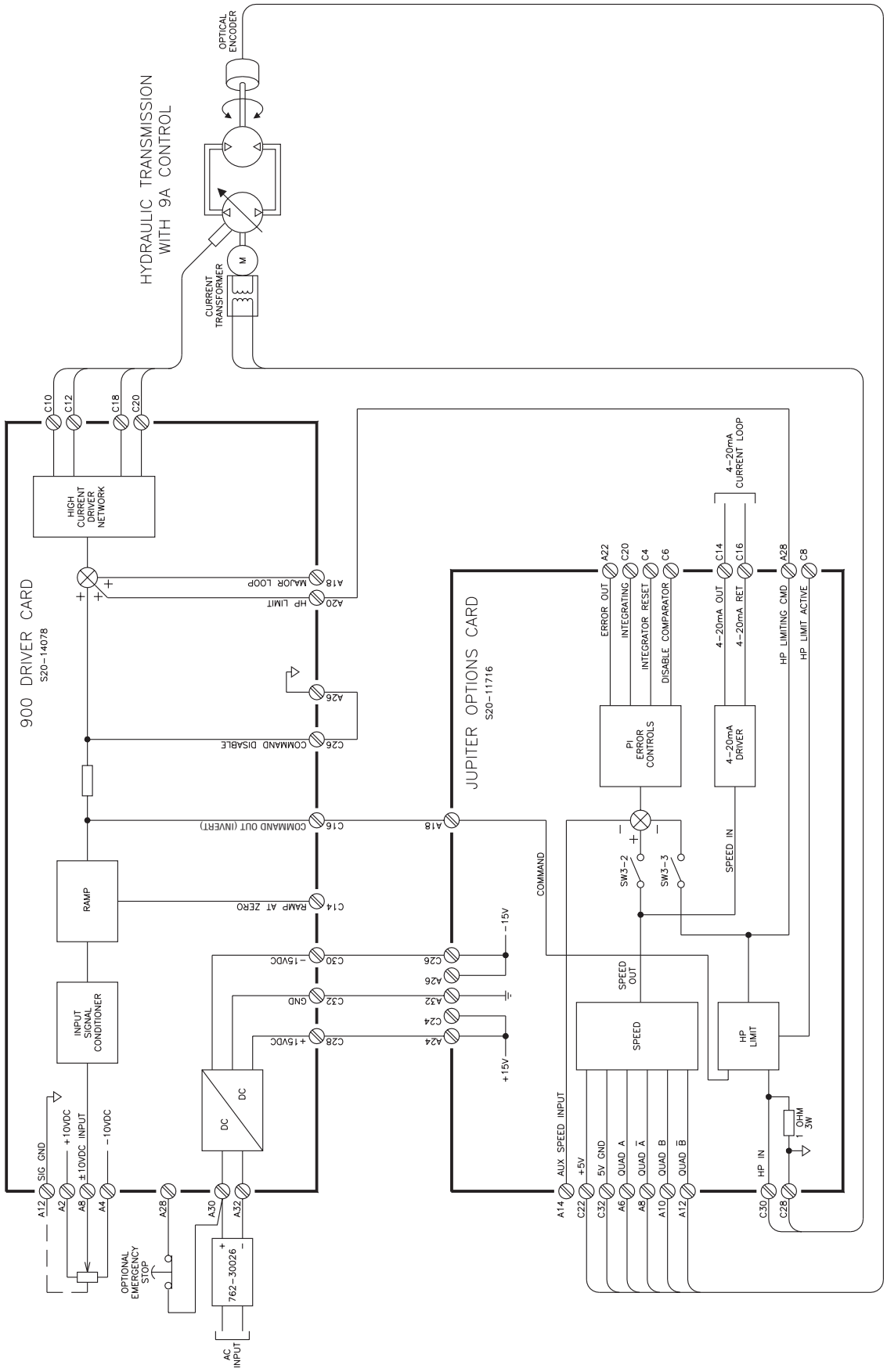


CURRENT LOOP INPUT CONNECTIONS


OPEN LOOP CONTROL
• GOLD CUP PUMPS
• WORLD CUP PUMPS
100–240VAC
50/60HZ
POWER
SUPPLY
762–30026
+24V GND
EMERGENCY
DISABLE
±5, ±10VDC
4–20mA
±0–20mA
OPERATOR
CONTROLS
PROCESS
CONTROLLER
DRIVER
CARD
S20–14078
COIL CURRENT
900 STROKER
M
JUPITER

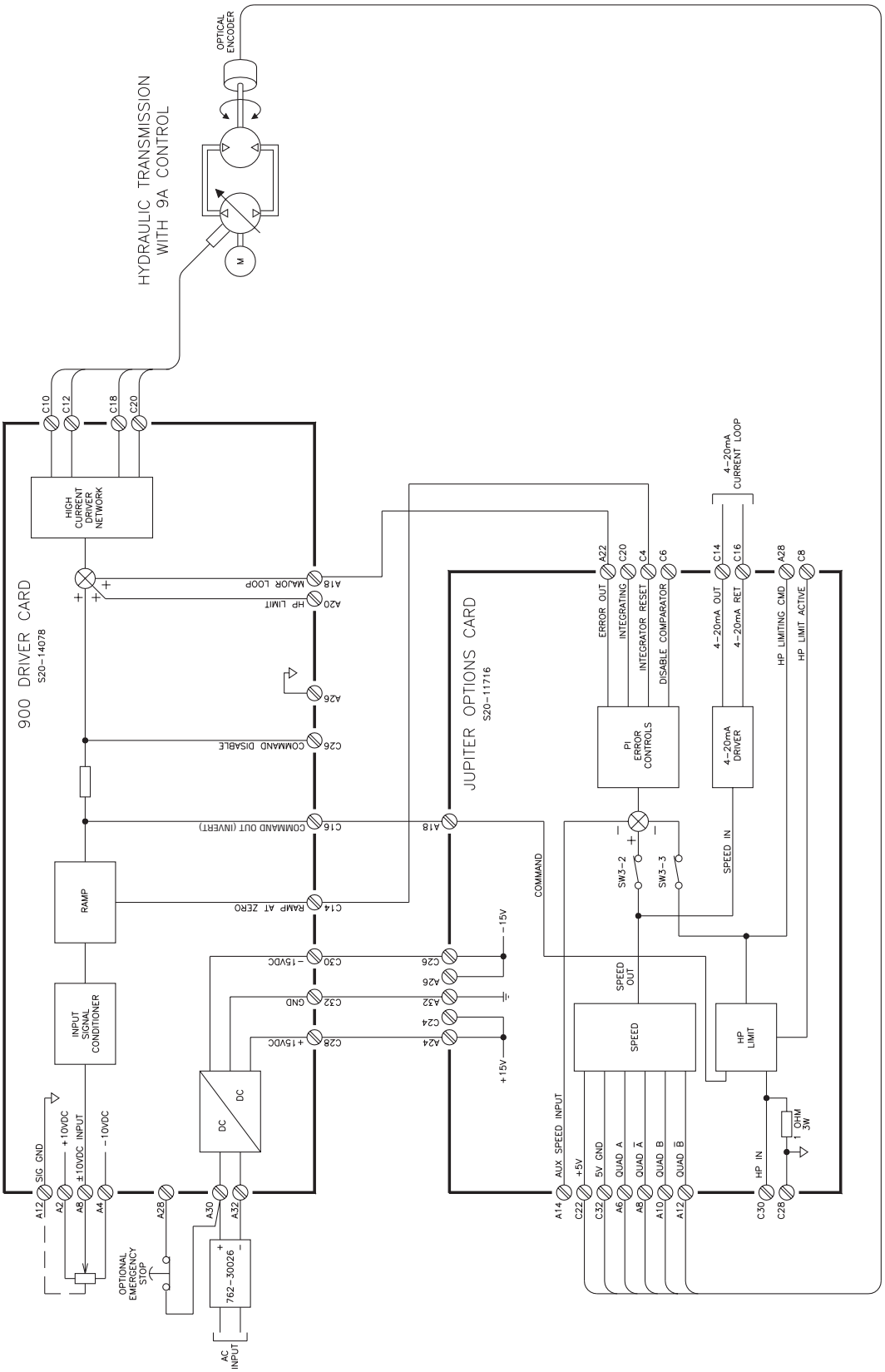

CLOSED LOOP CONTROL
• GOLD CUP PUMPS
• WORLD CUP PUMPS
100–240VAC
50/60HZ
POWER
SUPPLY
762–30026
+24V GND
100.0
MOTOR RPM
EMERGENCY
DISABLE
±5, ±10VDC
4–20mA
±0–20mA
OPERATOR
CONTROLS
DRIVER
CARD
S20–14078
COIL CURRENT
HP
LIMITING
900 STROKER
PROCESS
CONTROLLER
OPTIONS
CARD
S20–11716
M
DIGITAL ENCODER
SPEED FEEDBACK
4–20mA
SPEED FEEDBACK
JUPITER


Block Diagram
Jupiter 900 Driver
Minimum Circuit for
Most Common Applications
HYDRAULIC TRANSMISSION
WITH 9A CONTROL
M
900 DRIVER CARD
S20-14078
C10
C12
C18
C20
HIGH
CURRENT
DRIVER
NETWORK
A18 MAJOR LOOP
A20 HP LIMIT
C26 COMMAND DISABLE
A26
C16 COMMAND OUT (INVERTED)
C14 RAMP AT ZERO
RAMP
INPUT
COMMAND
SW 1A
SW 1B
±5VDC 0 C
±10VDC 0 C
±0-20mA 0 C
4-20mA C 0
RAMP
SW 1C
SW 1D
OFF 0 0
0.2-6 SEC C 0
0.8-40 SEC C C
INPUT
SIGNAL
CONDITIONER
DIP SWITCH MARKINGS
0 = OPEN
C = CLOSED (ON)
SW1A = 1
B = 2
C = 3
D = 4
+15VDC
GND
-15VDC
C30 -15VDC
C32 GND
C28 +15VDC
DC
DC
JUMPER J1 MUST
BE INSTALLED
IF REMOTE
SHUTDOWN
FEATURE IS
NOT USED
SIG GND
+10VDC
±10VDC INPUT
-10VDC
A12
A2
A8
A4
A28
J1
A30
A32
REMOTE/LOCAL
COMMAND
POT
OPTIONAL
REMOTE
SHUTDOWN
AC
INPUT
762-30026
AC INPUT:
85-264VAC
47-440HZ
DC OUTPUT:
24VDC 1 AMP



BLOCK DIAGRAM

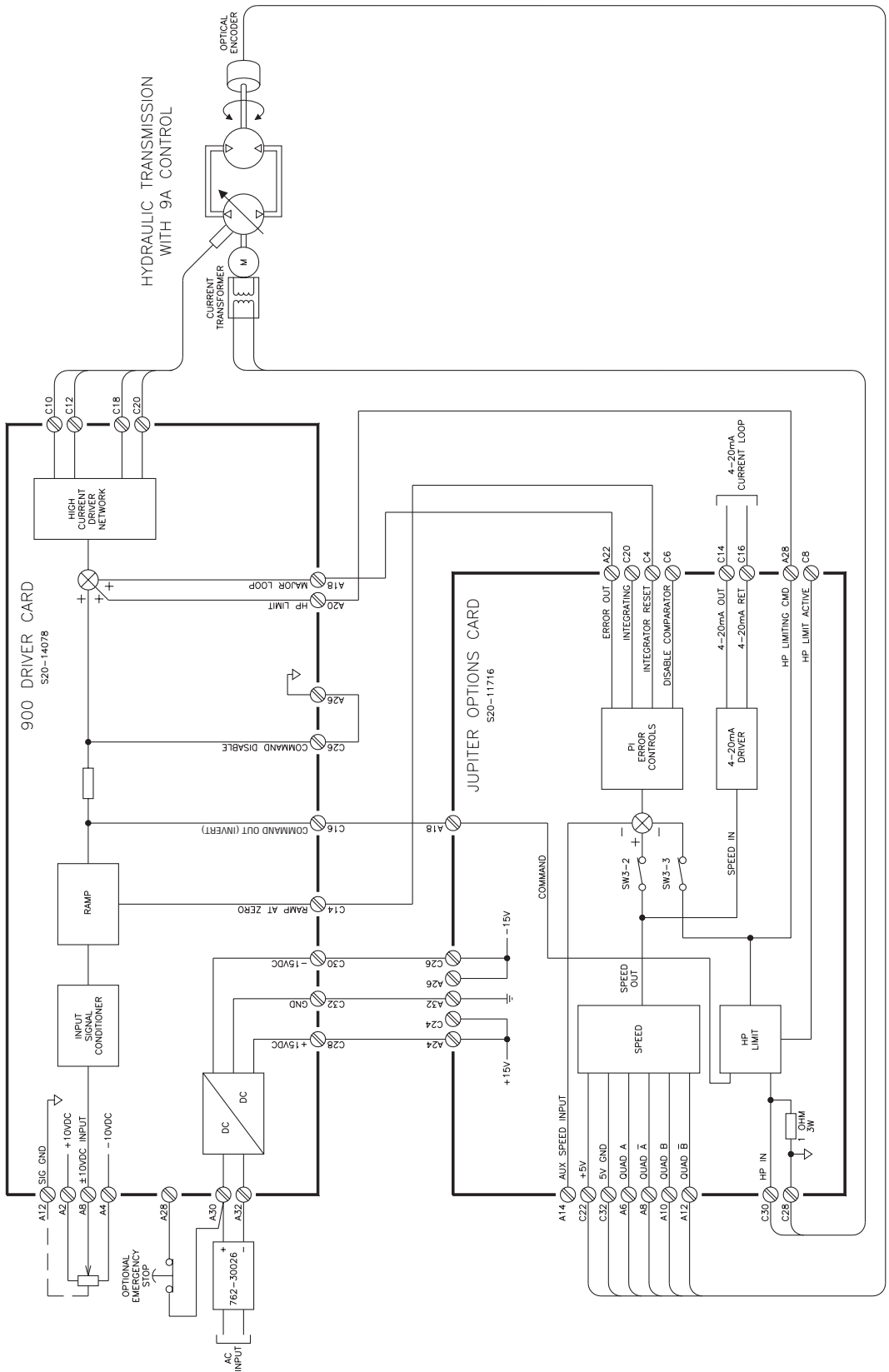
JUPITER 900 DRIVER WITH OPTIONS CARD
OPEN-LOOP SPEED CONTROL WITH HORSEPOWER LIMITING



BLOCK DIAGRAM

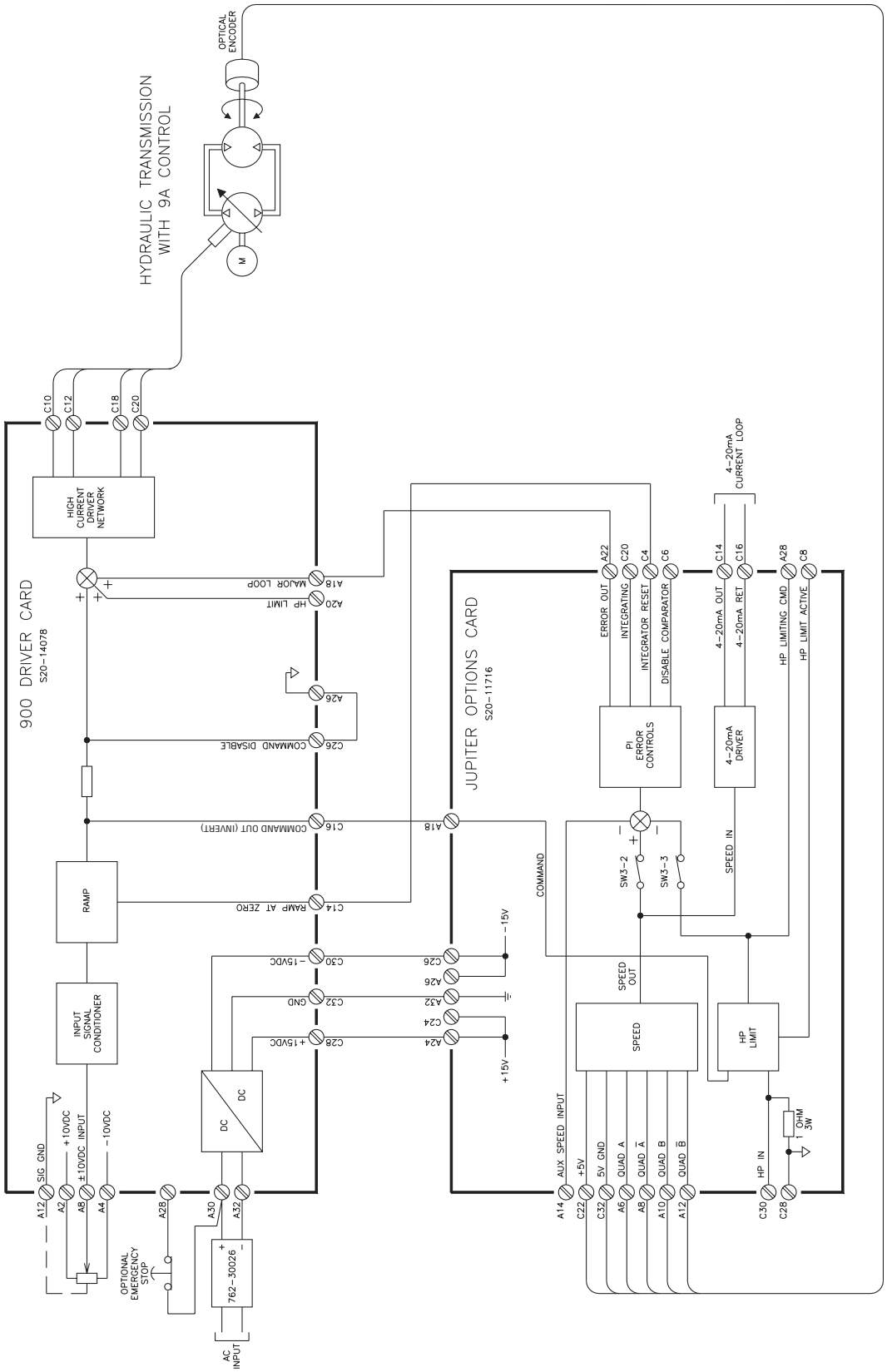
JUPITER 900 DRIVER WITH OPTIONS CARD

CLOSED-LOOP SPEED CONTROL WITH COMMAND FEEDFORWARDING



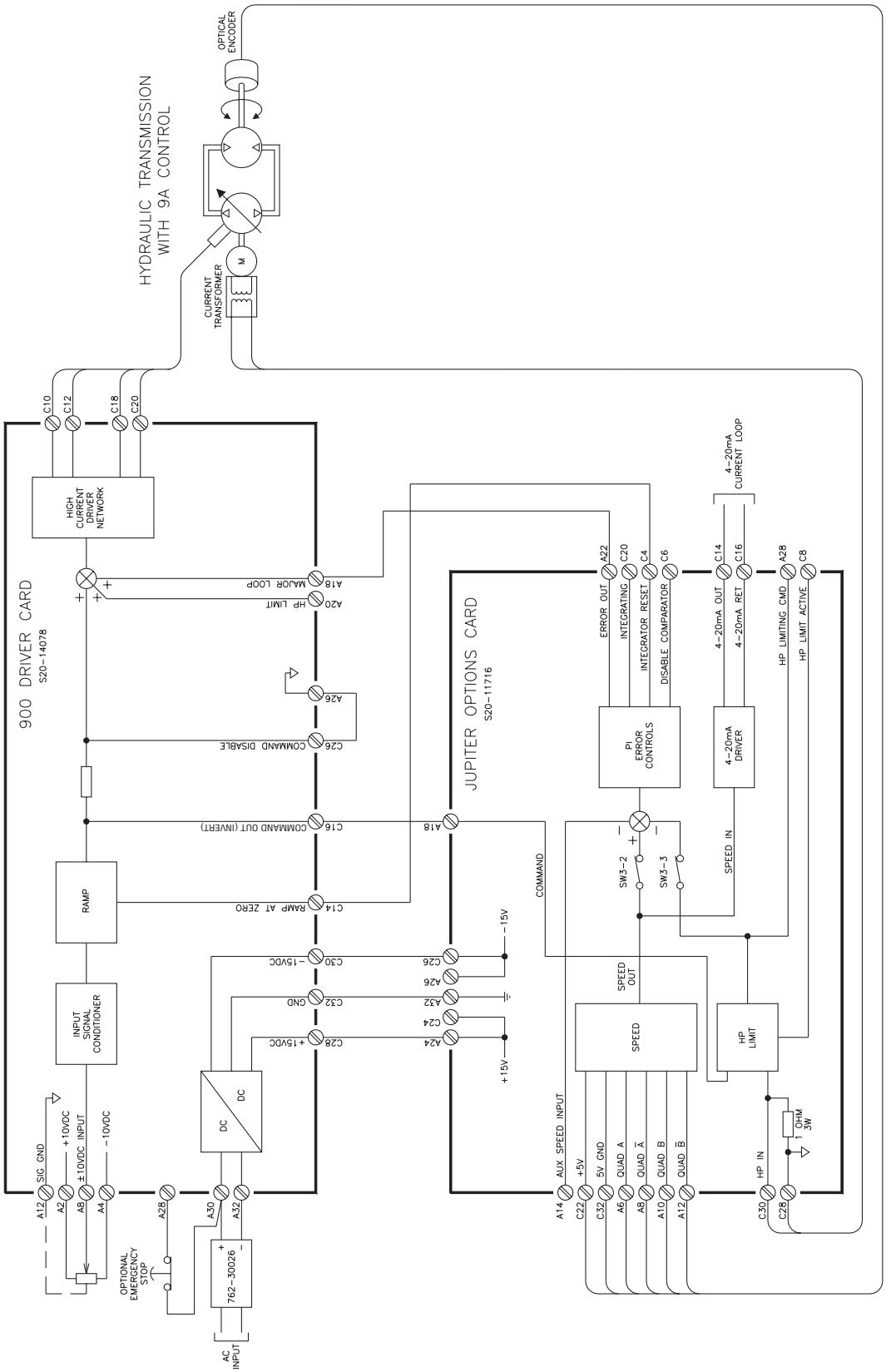
BLOCK DIAGRAM

JUPITER 900 DRIVER WITH OPTIONS CARD
CLOSED-LOOP SPEED CONTROL WITH
COMMAND FEEDFORWARDING AND HORSEPOWER LIMITING



BLOCK DIAGRAM

JUPITER 900 DRIVER WITH OPTIONS CARD
CLOSED-LOOP SPEED CONTROL WITH PI



BLOCK DIAGRAM
JUPITER 900 DRIVER WITH OPTIONS CARD
CLOSED-LOOP SPEED CONTROL WITH
PI AND HORSEPOWER LIMITING

SALES & SERVICE WORLDWIDE

International Distributors
In Europe:
Cyprus
Eastern Europe
The Faroe Islands
Finland
Greece
Iceland
Norway
Portugal
Switzerland
Turkey

In Africa:
Algeria
Egypt
Ivory Coast
Morocco
Nigeria
South Africa
Togo
Tunisia

In Middle East:
Iran
Israel
Lebanon
Pakistan
Qatar
Saudi Arabia
Syria
United Arab Emirates

In Far East:
Indonesia
Korea
Malaysia
New Zealand
Philippines
Thailand

Australia
DENISON HYDRAULICS Pty. Ltd.
41-43 St. Hillers Road
P.O. Box 192
Auburn, N.S.W. 2144
Tel. (612) 9646 5200
Fax (612) 9643 1305
Other sales offices:
Queensland
South Wantirna Victoria
Western Australia

Austria
DENISON HYDRAULIK GmbH
Zweigniederlassung Linz
Haidbachstraße 69
A-4061 Pasching
Tel. (43) 7229 4887
Fax (43) 7229 63092

Benelux
DENISON HYDRAULICS
BENELUX B. V.
Pascalstraat 100
3316 Dordrecht
Holland
Tel. (31) 786179 900
Fax (31) 786175 755

Canada
DENISON HYDRAULICS
CANADA Inc.
2320 Bristol Circle, Unit 1
Oakville, ON L6H 5S2
Tel. (905) 829 5800
Fax (905) 829 5805
Other sales offices:
Montreal, QC
Calgary, AB

China, P.R.
DENISON HYDRAULICS Ltd.
3F, No. 1, Mao Jia Zhai, Bai Lian Jing
Pudong New Area
Shanghai 200126,
Tel. (86) 21 5886 8991
Fax (86) 21 5886 1978

Denmark
DENISON HYDRAULIK
DENMARK A/S
Industrikrogen 2
DK-2635 Ishöj
Tel. (45) 4371 15 00
Fax (45) 4371 15 16

Finland
DENISON HYDRAULICS
P.O. Box 36
FIN-08101 Lohja
Tel. (358) 208 33 045
Fax (358) 207 33 045

France
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon
Tel. (33) 2 48 53 01 20
Fax (33) 2 48 75 02 91
Other sales offices:
Bordeaux
Lyon
Paris

Germany
DENISON HYDRAULIK GmbH
Herderstrasse 26
D-40721 Hilden
Tel. (49) 2103 940-6
Fax (49) 2103 940-880
Other sales offices:
Dresden
Hanover
Stuttgart

Great Britain
DENISON HYDRAULICS U.K.
Ltd.
Kenmore Road
Wakefield 41, Industrial Estate
Wakefield, WF20XE
West Yorkshire
England
Tel. (44) 19 24 826 021
Fax (44) 19 24 826 146
Other sales offices:
Burgess Hill

Hong Kong, N. T.
DENISON HYDRAULICS Ltd.
Unit 3, 25/F Wharf Cable Tower
9 Hoi Shing Road
Tsuen Wan
Tel. (852) 24988381
Fax (852) 24991522

Italy
DENISON HYDRAULICS S.r.l.
Viale Europa 68
20090 Cusago
Tel. (39) 2 90 33 01
Fax (39) 2 90 39 06 94

Japan
DENISON JAPAN Inc.
4-2-1 Tsujido-Shinmachi
Fujisawa 251,
Tel. (81) 466 35 3257
Fax (81) 466 35 2029
Other sales office:
Osaka

Mexico, Central America, South America and Caribbean Countries Contact
DENISON HYDRAULICS Inc.
6167 NW 181 Terrace Circle North
Miami, FL 33015, USA
Tel. (305) 362 2246
Fax (305) 362 6220

Other European, Middle East and African Countries Contact
DENISON HYDRAULICS
FRANCE SA
14, route du Bois Blanc
BP 539
18105 Vierzon Cedex
France
Tel. (33) 2 48 53 01 45
Fax (33) 2 48 53 01 46

Singapore
DENISON HYDRAULICS S.E.A.
Pte. Ltd.
No. 11 Lorong Tukang Dua
2261 Singapore
Tel. (65) 2687840
Fax (65) 2687847

Spain
DENISON HYDRAULICS, S.A.
Gomis, 1
08023 Barcelona
Tel. (34) 3418 46 87
Fax (34) 3211 65 07
Other sales offices:
San Sebastian

Sweden
DENISON HYDRAULICS
SVENSKA AB
Sporregatan 13
213 77 - Malmö
Tel. (46) 40 21 04 40
Fax (46) 40 21 47 26
Other sales offices:
Spånga

Taiwan, R.O.C.
DENISON HYDRAULICS Ltd.
6F-10, No. 79, Sec. 2, Roosevelt Road
Taipei,
Tel. (886) 2 3645101 / 3645102
Fax (886) 2 3639025

USA
DENISON HYDRAULICS Inc.
14249 Industrial Parkway
Marysville, OH 43040
Tel. 937 644 3915
Fax 937 642 3738
For nearest Distributor:
Call toll free 1 800 551 5956
Other sales offices:
Fulton, CA
Mulberry, FL
Moline, IL
Rock Island, IL
Kentwood, MI
Portland, OR
Collierville, TN
Arlington, TX
Houston, TX

Your local DENISON representative

Printed in U.S.A. 7/98

DENISON Hydraulics

Internet: http://www.denisonhydraulics.com
E-mail: denison@denisonhydraulics.com