



# S.E. AutoPilot

## GENERATION 2

(with Follow-up Option)

### The Control Unit

A reliable, high quality electronics package based on Wagner's long line of proven autopilots. The "Special Edition" offers an exceptional combination of value and performance. It is housed in a high impact, non-magnetic splashproof case.

Updated circuitry design now permits optional input from a rudder follow-up unit for use with unequal displacement steering cylinders or rudder angle indicators. Full follow-up electric steering controllers may also be used when a follow-up unit is installed.



### The Compass

A large, fully gimballed magnetic compass ensures stability and system sensitivity. Two sizes, 5" (125 mm) and 7" (180 mm) are available from Wagner and are chosen according to overall vessel characteristics. They are easy reading and suitable for use as the main navigation compass or may be located in a remote position to avoid magnetic interference.

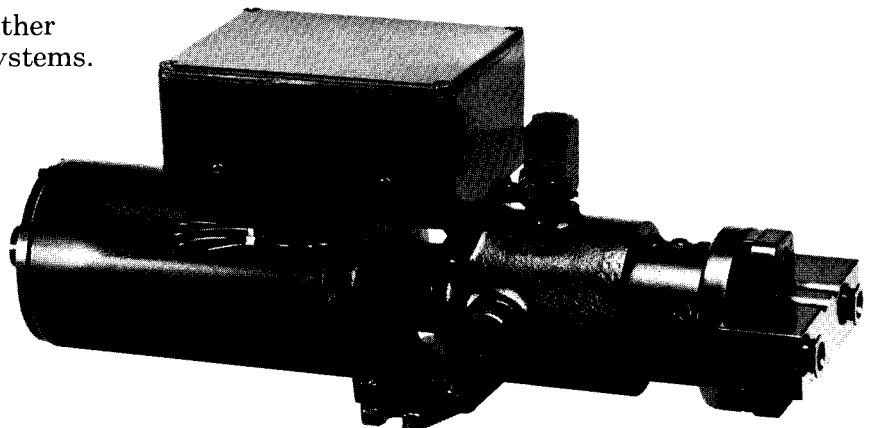
A precision flux-gate sensor is used as a heading reference. It is supplied with the Wagner compasses, or it may be mounted onto a customer's own compass.

### The Drive Unit

The S.E. AutoPilot operates with either hydraulic or mechanical steering systems.

All Wagner hydraulic pumpsets are adjustable volume types so that the correct rudder speed can be set with a wide range of steering cylinder sizes. This permits the "fine tuning" necessary for optimum performance of an autopilot.

Control of relays and solenoids is featured. The S.E. AutoPilot may be economically retrofitted to existing drive units.

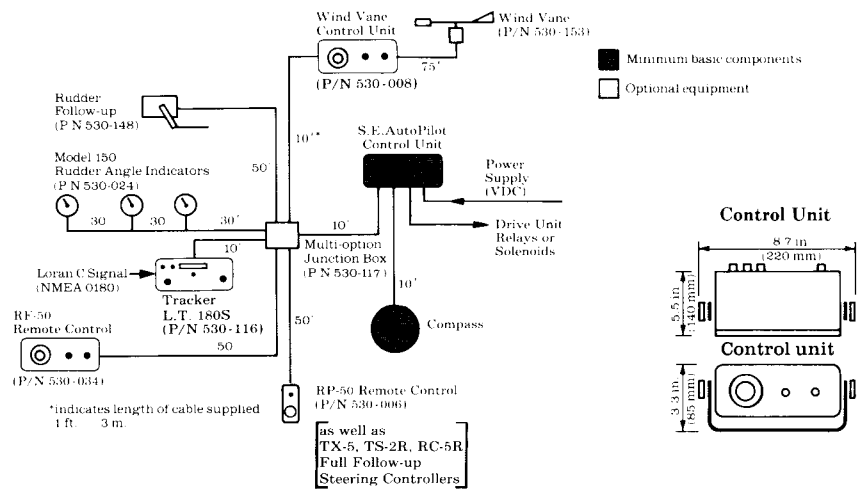


*The Wagner PV100-XX-TR Pumpset*

## Features

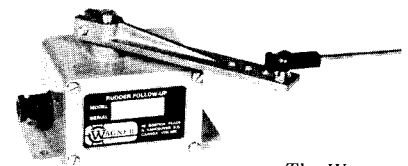
- Basic system is 3 components.
- Synthesized rudder feedback is standard but may be overridden if optional rudder follow-up unit is installed.
- Adjustable SEA STATE (damping) control optimizes course accuracy in all sea conditions.
- Adjustable RUDDER control alters amount of rudder applied in response to changing sea conditions and vessel speed.
- COUNTER RUDDER circuit stabilizes course in following seas. Rate of change of heading is constantly monitored and amount of rudder applied is varied as required. Usually found only in most expensive autopilots.
- AUTOMATIC RUDDER TRIM circuit compensates for persistent imbalancing force on vessel. This features *automatic reset* to prevent trim accumulation each time a course change is made.
- Course changes up to 180 degrees are possible without loss of control.
- Port and starboard indicator lights assist course setting and display steering activity.
- Two types of waterproof remote stations are offered. A permanently mounted unit (RF-50) and a hand-held portable unit (RP-50). Both provide identical operation: remote course setting and dodging.
- Designed for use with Wagner "Tracker LT180S" coupler.
- Optional Wind Vane Unit available for sailboats.
- Optional Interface available for electronic flux gate compasses.
- Optional Flushmount Bezel available for Control Unit.

## Specifications

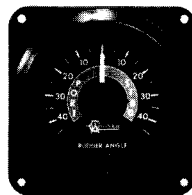


## Optional Equipment

The Wagner Rudder Follow-up may be connected directly to the S.E. AutoPilot for use on larger vessels, those with unequal displacement steering cylinders or where rudder angle indicators are required.



The Wagner Rudder Follow-up



The Wagner Model 150 Rudder Angle Indicator

The Wagner Model 150 Rudder Angle Indicator accurately shows the position of your rudder when dodging, power steering, or course changing.

The Wagner RP-50 Remote Control provides full function control of course setting, course changing, dodging, and power steering.



The Wagner RP-50 Remote Control

## Steering System Drive Units

Hydraulic Steering*	VOLTAGE (VDC)	PART NO.	TYPE OF CONTROL
PV100-XX-TR	12	530-145	Solid state control
	24	530-146	
	32	530-147	
PV100-XX-SC	12	530-138	Solenoid control
	24	530-139	
	32	530-089	

### Mechanical Steering

MDU20-XX-RC	12	530-087	Relay control
	24	530-088	
	32	530-089	
Solenoid Bypass†	12	80-700040	Solid state control
	12	80-700041	
	32	80-700042	

### Typical Ratings

	PV100-12-TR	PV100-12-SC
Avg. continuous current	1 to 2 amps	7 amps
Peak current	20 amps	22 amps
Max. solenoid current	—	2.5 amps

### NOTE:

\* A wide range of Wagner engine-driven pumpsets are also available.

† This system also requires a PV100-XX-TR pumpset and a separate hydraulic cylinder. Part number given is for cylinder bypass solenoid valve only.

-XX- in model code indicates voltage of drive unit.

Your Wagner dealer will assist you in the selection, installation, maintenance and servicing of your Wagner autopilot system.

Wagner marine hydraulic steering systems and autopilots are represented in over 60 countries.



**Wagner Engineering Ltd.**  
 40 Gostick Place,  
 North Vancouver, B.C.  
 Canada V7M 3G2  
 Telephone (604) 988-1111  
 Telex 04-352755  
 Telefax (604) 988-8809

**Wagner —  
 dependable  
 since 1937**

Wagner reserves the right to make product and specification changes without notice.

## SECTION IV: SERVICE

### A. ROUTINE MAINTENANCE

The S.E. Autopilot is all solid state construction and no routine electrical maintenance is required other than periodic performance checks. Maintenance instructions for Wagner drive units are included in the manuals supplied separately.

### B. TROUBLE SHOOTING

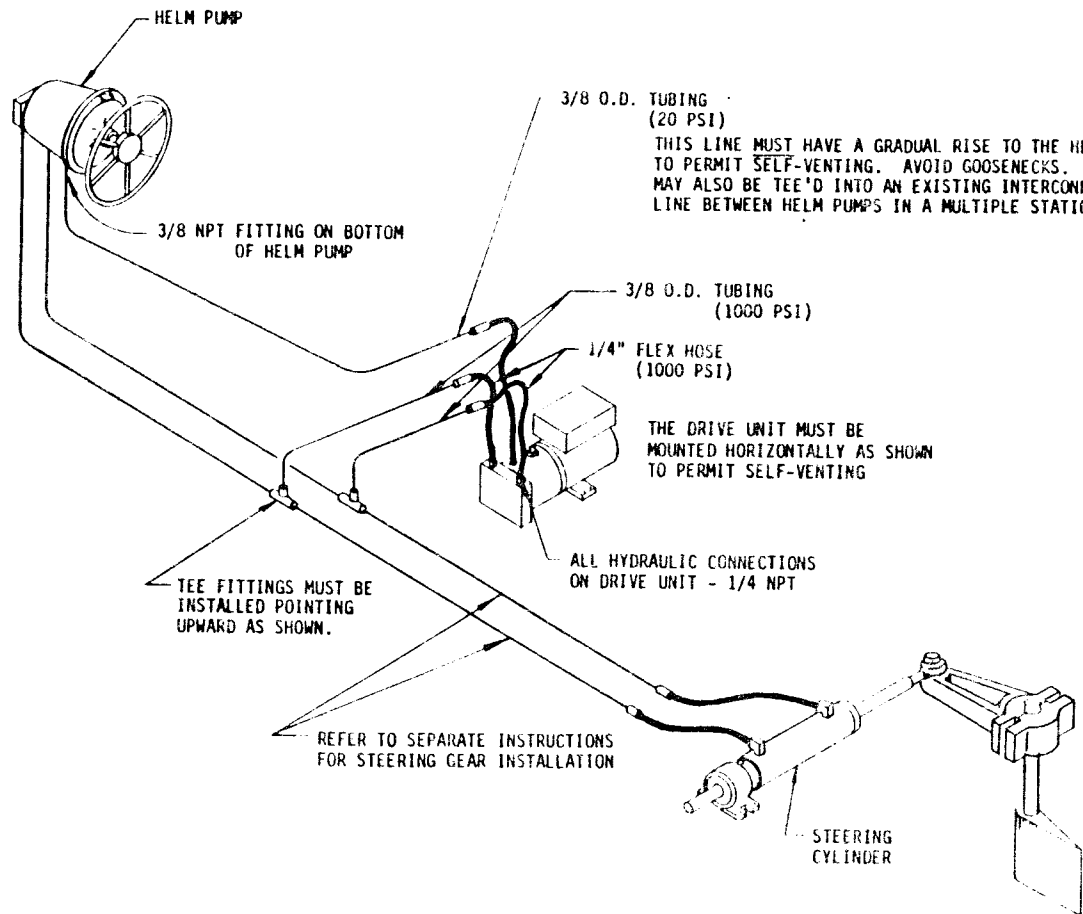
The following test procedure is confined to external checks due to the sophisticated nature of the electronic circuitry. The schematic diagrams accompanying the TECHNICAL DESCRIPTION will allow a competent technician to diagnose any internal component problem. FIELD SERVICE SHOULD ONLY BE ATTEMPTED IF THE OPERATIONAL CHARACTERISTICS OF THE AUTOPILOT ARE FULLY UNDERSTOOD AND ONLY AFTER THE EXTERNAL CHECKS ARE PERFORMED. If all external operations and voltages appear normal yet the autopilot does not function properly, carefully repeat all installation and test procedures in SECTIONS II and III.

NOTE: A good quality voltmeter will be necessary to assure the reliability of required measurements. When making measurements, be certain that the meter probes penetrate the protective lacquer coating applied to both sides of the printed circuit boards.

1. Turn RUDDER control to 'SET' position (fully CCW)
2. Turn SEA STATE control to 'ON' position (rotate CW)
3. Rotate the course setting dial through 360 degrees -- the RED (port) lamp should be on for 180 degrees of the rotation and the GREEN (starboard) lamp for the remaining 180 degrees.
4. If neither lamp goes on, check the following:
  - a) The battery voltage with the electric motor operating. MINIMUM is 10 VDC for a 12 volt system, 20 VDC for a 24 volt system and 26 VDC for a 32 volt system.
  - b) The regulated voltage (across Terminals 13 and 16 on TB1 in the control unit). The READING SHOULD BE 7.6 - 8.4 VDC.
  - c) The V Reference voltage (measured between Terminals 15 and 16 on TB1). The READING SHOULD BE ONE-HALF OF REGULATED VOLTAGE MEASURED IN b) above.

If the regulated voltage is not correct, the problem is most likely a defective integrated circuit in the switching regulator. If either the regulated voltage or the +4 VDC Reference voltage is not correct, refer to a qualified technician for servicing.

5. If one lamp remains illuminated for more than 180 degrees of the dial or both lamps go out at several places on the dial, check the following:
  - a) The compass cable and sensor are properly plugged in.
  - b) The cable is not damaged.
  - c) The sensor is properly mounted to the underside of the compass. A very close mounting of the sensor to a powerful compass may cause this. Refer to the factory.
  - d) The synchro windings or slip rings are not open circuit or intermittent.
  
6. If the autopilot appears to operate, but follows the wrong course, check the following:
  - a) The compass is mounted with the lubber aligned parallel to the fore-aft line of the vessel.
  - b) The sensor fore-aft line is aligned with the compass lubber line. The 'F' (fore) mark on the sensor must be forward.
  - c) The compass dial or synchro mounting is not loose or misaligned.
  - d) The rudder turns in a direction to steer the vessel to starboard when the GREEN lamp is on.
  - e) The desired course is being set correctly. See SECTION I: AUTOPILOT CONTROLS.
  
7. If the drive unit does not operate, or only operates the rudder in one direction, the following tests must be made.
  - a) Check that the cable from the control unit to the drive unit is not damaged and is properly connected at the terminal block in the control unit. Inspect the wiring and connections to the pumpset relays or solenoid valve.
  - b) Check both solenoids (or relays) to ensure one or both are not sticking or open circuited.



3/8 O.D. TUBING (20 PSI)  
 THIS LINE MUST HAVE A GRADUAL RISE TO THE HELM PUMP TO PERMIT SELF-VENTING. AVOID GOOSENECKS. THIS LINE MAY ALSO BE TEE'D INTO AN EXISTING INTERCONNECTING LINE BETWEEN HELM PUMPS IN A MULTIPLE STATION STEERING SYSTEM.

3/8 O.D. TUBING (1000 PSI)

1/4" FLEX HOSE (1000 PSI)


THE DRIVE UNIT MUST BE MOUNTED HORIZONTALLY AS SHOWN TO PERMIT SELF-VENTING

ALL HYDRAULIC CONNECTIONS ON DRIVE UNIT - 1/4 NPT

TEE FITTINGS MUST BE INSTALLED POINTING UPWARD AS SHOWN.

REFER TO SEPARATE INSTRUCTIONS FOR STEERING GEAR INSTALLATION

STEERING CYLINDER

DETAIL	QUANTITY	DESCRIPTION	MATERIAL
 <b>WAGNER ENGINEERING LTD.</b> 40 GOSTICK PLACE NORTH VANCOUVER B. C. CANADA V7M 3G2 Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS			
TITLE			
<b>MODEL PV100-XX-TR/SC DRIVE UNIT WITH MANUAL HYDRAULIC STEERING</b>			
DRAWN	DATE	SCALE	QUOTE NO
TK	11/1/80		
REVISION NOTES			DRAWING NO
			B-4-930
			REV.
			02

NPT: AMERICAN NATIONAL PIPE THREAD

PCL 10003 - W E

## SECTION V : HYDRAULICS

### A. DRIVE UNITS (PUMPSETS)

The S.E. Autopilot operates with hydraulic and mechanical steering systems controlled by either relays or solenoids. This section of the manual deals specifically with hydraulic drive units (pumpsets). Several Wagner pumpsets are available and installation details are enclosed with the individual units. The following is a list of Wagner pumpsets and the reference numbers of their manuals.

PUMPSET DESCRIPTION	MANUAL REF. NO.
Type 2A	190-0007
PV100-XX-TR	790-045
Engine driven (No. 1 or 2 Uniblock)	190-0006

The pumpset must be matched to the displacement of the steering system it is intended to operate. That is, it must provide the correct oil flow to operate the steering system from one hard-over position to the other within 14 to 18 seconds to obtain optimum performance. A high flow rate, causing excessively fast operation, will cause course overshoot. A lower flow rate, causing excessively slow operation, will result in a wandering course and generally unsatisfactory performance.

The steering cylinder must be an equal displacement type in order to obtain the same rudder speed when moving in both the port and starboard directions.

The desirable flow rate must be obtainable from the pumpset at the maximum hull speed of the vessel. In this condition, the pressure developed by the pumpset must be adequate to move the rudder through the  $\pm 15$  degree control range. This will ensure that the 'DODGER' switch on the remote control will operate within this rudder angle. (NOTE: The DODGER switch is not intended as a power steering switch when the autopilot is operating. To obtain more than 15 degrees of rudder with the DODGER switch, the RUDDER control should be in the 'SET' position. If the pumpset is not powerful enough, full rudder angle at full speed will not be obtainable.)

The S.E. Autopilot can also be used with most relay or solenoid controlled drive units offered by other autopilot manufacturers. However, in these applications, WAGNER, while guaranteeing their own products, cannot accept total responsibility for the system performance as the quality of drive units varies widely. Refer to SECTION II, A.3. for installation and wiring information.

### B. INSTALLATION (Refer to DWG. No. B-4-930)

It is assumed that the hydraulic steering system has been previously installed. If this autopilot was purchased at the same time as the steering system, the steering should be installed first (but not filled with oil). The tee fittings for the connection of the drive unit (pumpset) should be put in place during the installation of the steering lines.

1. PIPING THE SYSTEM - Keep working conditions as clean as possible. Contamination of any form must be prevented from entering the system. Some common contaminants are Teflon tape, pipe fitting compound, metal filings, any form of dust and pieces of wiping rags. It is essential that all hydraulic tubing is clean inside before starting the installation.

Teflon tape or pipe fitting compounds, commonly used to seal threaded NPT joints, must be used sparingly and applied only to the male threads. The first two threads of the fitting should not be covered. If it is necessary to remove a fitting for any reason, the female thread must be cleaned before reinstalling the fitting.

Soft refrigeration-type copper tubing is recommended and should be at least 3/8 outside diameter and capable of the working pressures as indicated on DWG. B-4-930-01. Long lengths of flexible hose must not be used in place of the recommended tubing as it will adversely affect the performance of the system.

The tubing should be installed with lengths as straight as possible. Bends should be as gradual as possible. Goosenecks (a vertical bend resembling an inverted drain trap, commonly used on the waste drain of a wash basin) must be avoided, otherwise vent plugs must be installed at the high point of the bend to provide a means for removing entrapped air.

Flare-type fittings are recommended for problem-free connections rather than in-line compression-type fittings.

2. RECOMMENDED OILS - Any oil suitable for hydraulic winch drives is acceptable, but the following listed oils are preferred, due to their superior qualities.

CHEVRON: AW Machine 32, EP Hydraulic MV

ESSO : Nuto H32

GULF : Harmony AW32, Harmony HVI 36

MOBILE : DTE 24, DTE 13

SHELL : Tellus 32, Tellus T37

TEXACO : Rando HD32, Rando HD AZ

DO NOT USE BRAKE FLUID

(A limited stock of the preferred type oil is available and may be ordered from the Wagner factory.)

3. FILLING THE SYSTEM - The main steering lines between the helm pump(s) and cylinder must be filled first. The system is filled through a header tank (if installed) or the highest (or only) helm pump in the system. The filler hole on all other helm pumps must be closed with a pipe plug. Refer to the piping diagram in the appropriate pumpset installation manual.

Pour oil slowly into the header tank or filler tube of the highest helm pump and begin turning the steering wheel at this highest (or only) helm pump steadily in one direction only, checking the oil level periodically to prevent pumping air, until the system begins to feel solid. If the steering system is a type N with bleed fittings at the cylinder ports, one fitting can be opened slightly (on the side being filled) to purge entrapped air from the lines quickly. If the system does not contain these fittings, the cylinder tubing fitting can be backed out slightly, but wiping rags must be placed under the cylinder to contain the expelled oil.

Now turn the helm pump steadily in the opposite direction until the system again begins to feel solid.

Progress to the next lower pump and repeat this procedure. Remember to periodically check the oil level in the header tank or the highest helm pump. When all pumps have been turned as described, the steering system should be sufficiently full to be operated by the autopilot pumpset.

The drive unit should not be operated until the drive unit pump is filled with oil. The tubing fitting on the reservoir connection on top of the pump should be backed out to ensure that the pump is full. Loosening this fitting will release air trapped in the reservoir line. If the pump seems extremely noisy, it should only be operated in 10 - 15 second intervals until the flow evens out. If the pump is allowed to operate without oil, damage may result.

It will take time for all the air to be removed from the system but working it for 10 - 15 minutes and then allowing it to rest for a few hours is the fastest method of removing the air. It is advisable to keep a wiping rag around the filler during this initial rest period in case oil is foamed out with venting air. The system will not be smoothly responsive until most of the air is expelled.

When the system is full, refer to SECTION III: TESTS and ADJUSTMENTS, A. 4 INITIAL TEST and B. SEA TESTS to test the installation of the autopilot system.

### C. SERVICE

The oil should be checked periodically to make sure no leaks have developed. An external inspection of the system components is also suggested to ensure that leakage or other problems are not developing. Normally, no routine maintenance will be required on a properly installed system. All seals are designed for long life in normal service.

The following descriptions of problems and their most likely causes are listed to assist owner field servicing. If a problem cannot be resolved, refer to the factory.



1. If the steering wheel is stiff to turn or the pumpset will not operate the cylinder, check the following:
  - a) The rudder stock for binding in its bearings. Remove the cylinder clevis pin and operate the wheel and also the pumpset again. If the cylinder operates, the problem is not in the steering system. If the cylinder does not move and the wheel is still hard to turn, check:
  - b) The system is free of entrapped air.
  - c) The system is piped using only the recommended copper tubing and the two short lengths of flex hose supplied for the cylinder connection.
  - d) The hydraulic oil is one of the types recommended, that is, not more viscous (thicker) than automatic transmission fluid.
  - e) The copper tubing used is at least the size recommended.
  - f) The fittings on the steering cylinder are not screwed in too far and are jamming the piston rod. IF THE ROD IS SCRATCHED, IT MUST BE REPLACED and PISTON ROD SEAL DAMAGE IS ALSO LIKELY.
  
2. If the steering wheel continues to turn easily and the cylinder does not feel like it reaches hardover or the pumpset appears to be pumping, but the cylinder is not responding, check the following:
  - a) The cylinder bypass valve (if installed) has been left in the open position. It must be closed.
  - b) That all system fittings are tight.
  - c) The system is free of entrapped air. If air is in the system, the wheel will spring back when turned and released.
  - d) A lockvalve on another helm pump is not contaminated. This is indicated by the wheel turning at that station. That lockvalve must be disassembled and cleaned. When removing the slotted inserts, take care not to lose the retained spring and steel ball or to damage the seals.
  - e) The cylinder piston seals are not damaged. All of the above should be checked and determined to be satisfactory first. Remove the cylinder clevis pin and attempt to push the cylinder rod fully back and forth by hand. If the rod moves, the piston seals must be replaced. Oil leaking along the cylinder rod from either end of the cylinder indicates the rod seals are defective and must be replaced.

If there is contamination in the steering system, all components, including the helm pumps must be disassembled and cleaned and the tubing flushed. Kerosene, Varsol or Diesel oil is suitable for this flushing operation.

If the quality of the hydraulic oil is questionable, or water appears to be in the system, the system oil should be replaced with new oil from the recommended list.

3. If the pumpset operates the cylinder erratically, or the number of wheel turns is different when turning hardover to port and hardover to starboard, check the following:
  - a) The system is free of entrapped air.
  - b) The system is piped using only the recommended copper tubing and the two short lengths of flex hose supplied for the cylinder connection.



1111 NW BALLARD WAY, SEATTLE, WA 98107, (206) 789-1802

TOLL FREE: (800) 423-3509 FAX: (206) 789-1802, Ext. 34

## PRICE LIST – WAGNER SE GENERATION 2

Effective June 1, 1988

### SE GENERATION 2 SYSTEM INCLUDES

1-530-144 SE Gen 2 Control Head .....	\$1,215.00
1-530-067 5" Saura Compass with Sensor .....	550.00
1-530-148 Universal Follow Up (recommended) .....	240.00
1-530-145/146/147 PV100-12/24/32-TR Pumpset .....	1,225.00
TOTAL – 3,230.00	

### COMPASS OPTIONS

530-067 5" Saura Compass with sensor .....	550.00
530-068 7" Saura Compass with sensor .....	1,285.00
530-070 Compass Hood for 5" Saura Compass .....	250.00
530-071 Compass Hood for 7" Saura Compass .....	250.00
105-2055 Bottom lighting for 7" Saura Compass .....	24.50
109-2107 Quadrantal Spheres with brackets .....	230.00
113-1746 Viewing Prism .....	50.00

### PUMPSET OPTIONS

530-145/146/147 PV100-12/24/32-TR Reversing ¼ HP .....	1,225.00
530-138/139/140 PV100-12/24/32-SC Solenoid Control .....	1,865.00
530-031/032/033 2A Pumpset 12/24/32 ½ HP .....	2,575.00

### ACCESSORIES

530-018 Jog Steering Lever .....	250.00
530-026 TS2R Proportional Steer Lever (530-148 required) .....	525.00
530-027 RC5R Proportional Steer Remote (530-148 required) .....	295.00
530-006 RP50 Portable Remote Course Change .....	395.00
530-034 RF50 Fixed Remote Course Change .....	395.00
530-095 Flush Mount Bezel (new style) .....	42.00
530-116 LT 180s Loran Interface .....	960.00
530-148 Universal Follow Up .....	240.00

Prices are F.O.B. Seattle, Washington and subject to change without notice.



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TOLL FREE: (800) 423-3509 FAX: (206) 789-1802, Ext. 34

## PRICE LIST – WAGNER MICROPILOT

Effective June 1, 1988

### MICROPILOT SYSTEM — INCLUDES

1-530-135	Control Unit .....	\$ 805.00
1-530-143	Fluxgate Compass .....	460.00
1-530-167	Micro Follow Up .....	160.00
1-530-145/146/147	PV100-12/24/32-TR Pumpset .....	1,225.00
	TOTAL –	2,650.00

### COMPASS OPTIONS

530-154	Compass Splitter Box (required w/ Mag Compass) .....	260.00
530-155	Sine-Cos Sensor w/ Mounting Kit .....	205.00
530-156	5" Magnetic Compass w/ Sine-Cos Sensor .....	575.00
530-157	7" Magnetic Compass w/ Sine-Cos Sensor .....	1,310.00
530-070	Compass Hood for 5" Saura Compass .....	250.00
530-071	Compass Hood for 7" Saura Compass .....	250.00
105-2055	Bottom Lighting for 7" Saura Compass .....	24.50
109-2107	Quadrantal Spheres with Brackets .....	230.00
113-1746	Viewing Prism .....	50.00

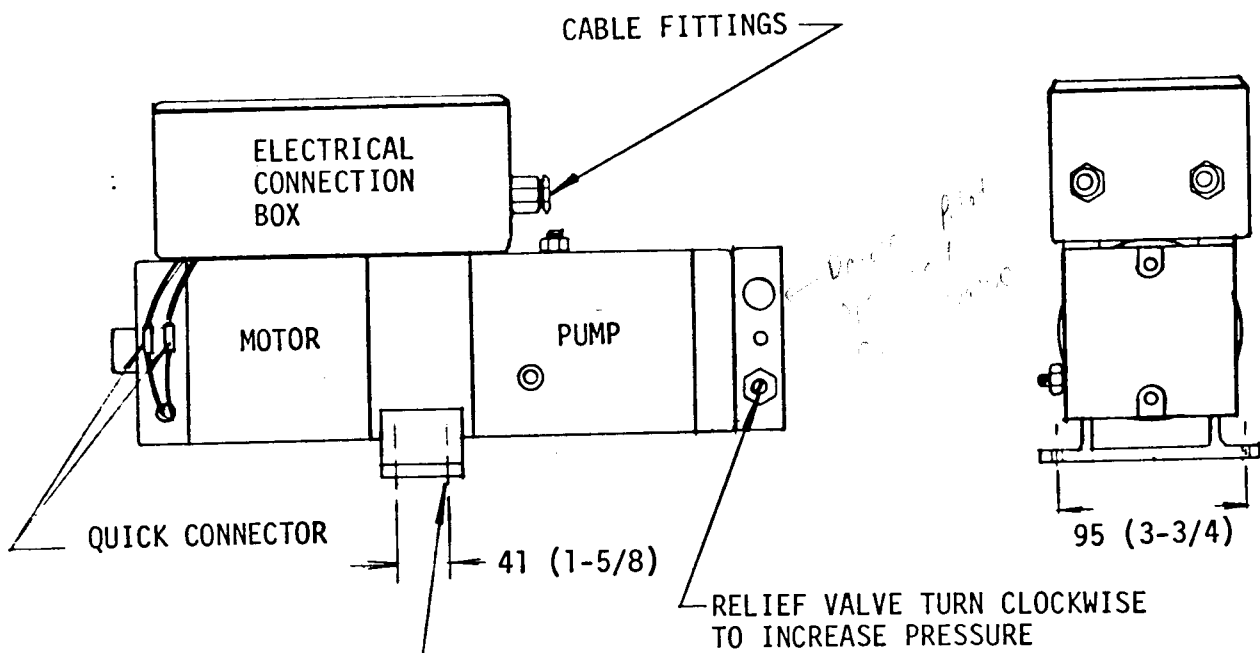
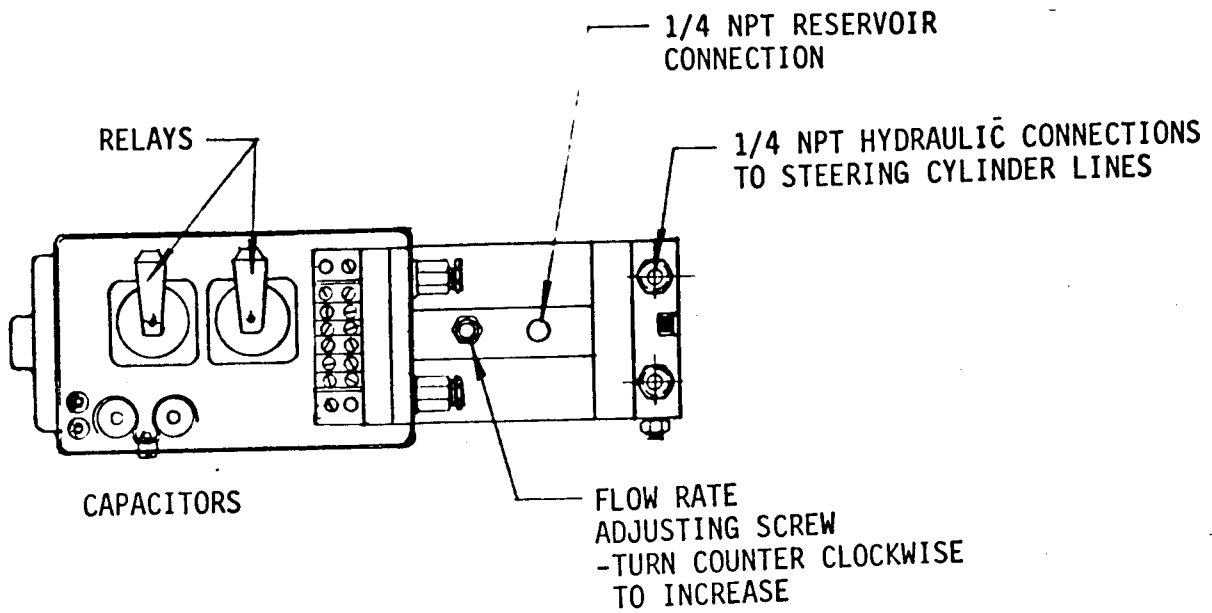
### PUMPSET OPTIONS

530-163	TR (Motor Control) Box w/ 30' Cable .....	510.00
	(TR Box required when Solenoid Control or Relay Control Pumpsets are used. Specify voltage).	

### ACCESSORIES

530-024	150A Extra Meter (requires 530-151 & 530-167) .....	148.00
530-095	Flush Mount Bezel (new style) .....	42.00
530-149	RCP Portable Remote w/ 50' Cable .....	460.00
530-150	RCF Fixed Remote .....	460.00
530-151	Multi Option Junction Box .....	170.00
530-152	AC180 Intrfc Board (requires 530-151) .....	160.00
530-167	Micro Follow Up .....	160.00

Prices are F.O.B. Seattle, Washington and subject to change without notice.



OVERALL DIMENSIONS  
 LENGTH: 343 (13-1/2)  
 WIDTH : 121 ( 4-3/4)  
 HEIGHT: 191 ( 7-1/2)  
 WEIGHT: 10 Kg (22 lbs)

MOUNTING HOLES  
 FOR M8 (5/16) BOLTS  
 - 4 REQ'D

NPT: AMERICAN NATIONAL  
 PIPE THREAD

ALL DIMENSIONS: MM (IN)

MODEL PV 125R-XX-RC PUMPSET O.A.DIMENSIONS

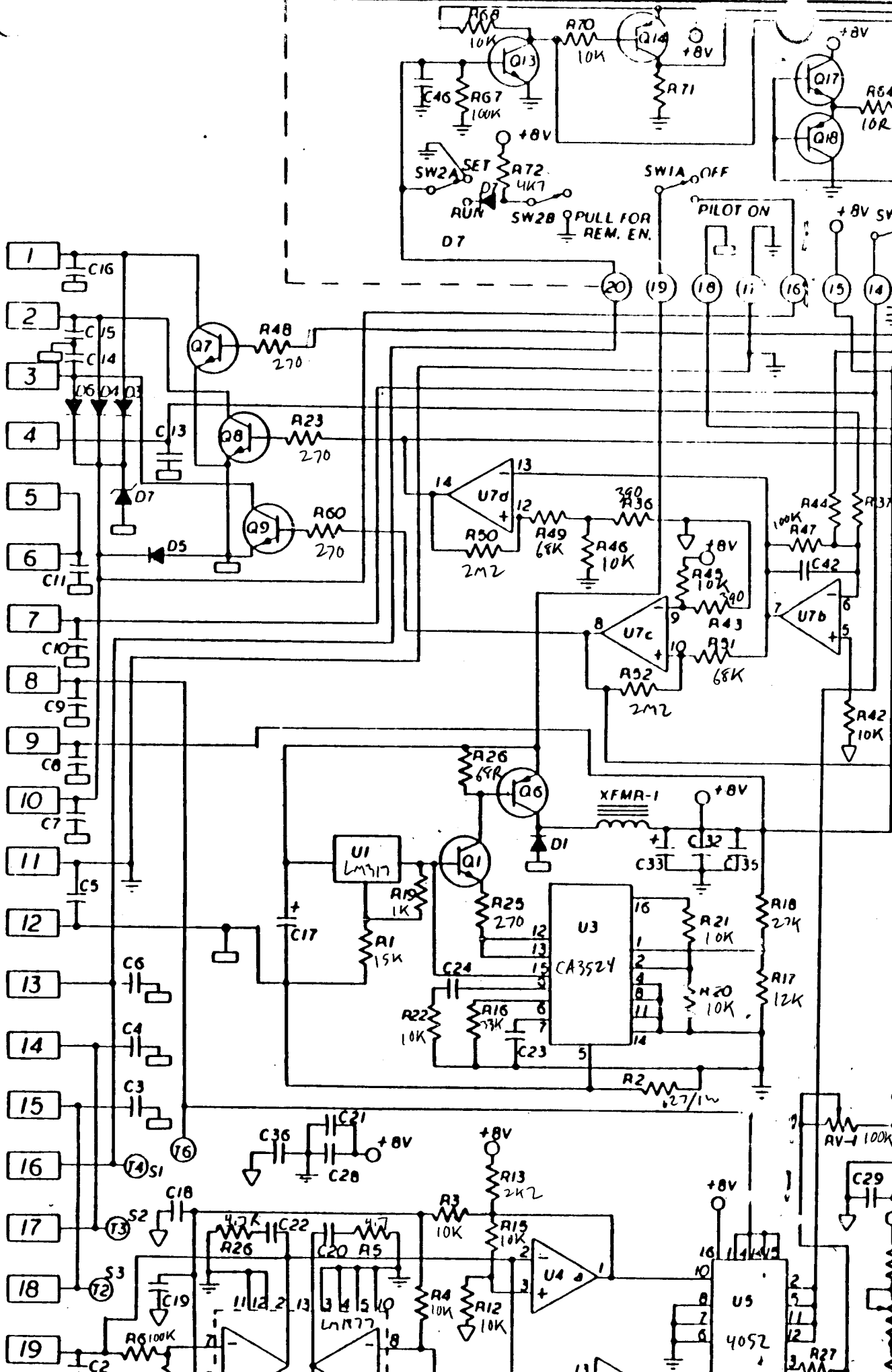
**WAGNER ENGINEERING LTD.**

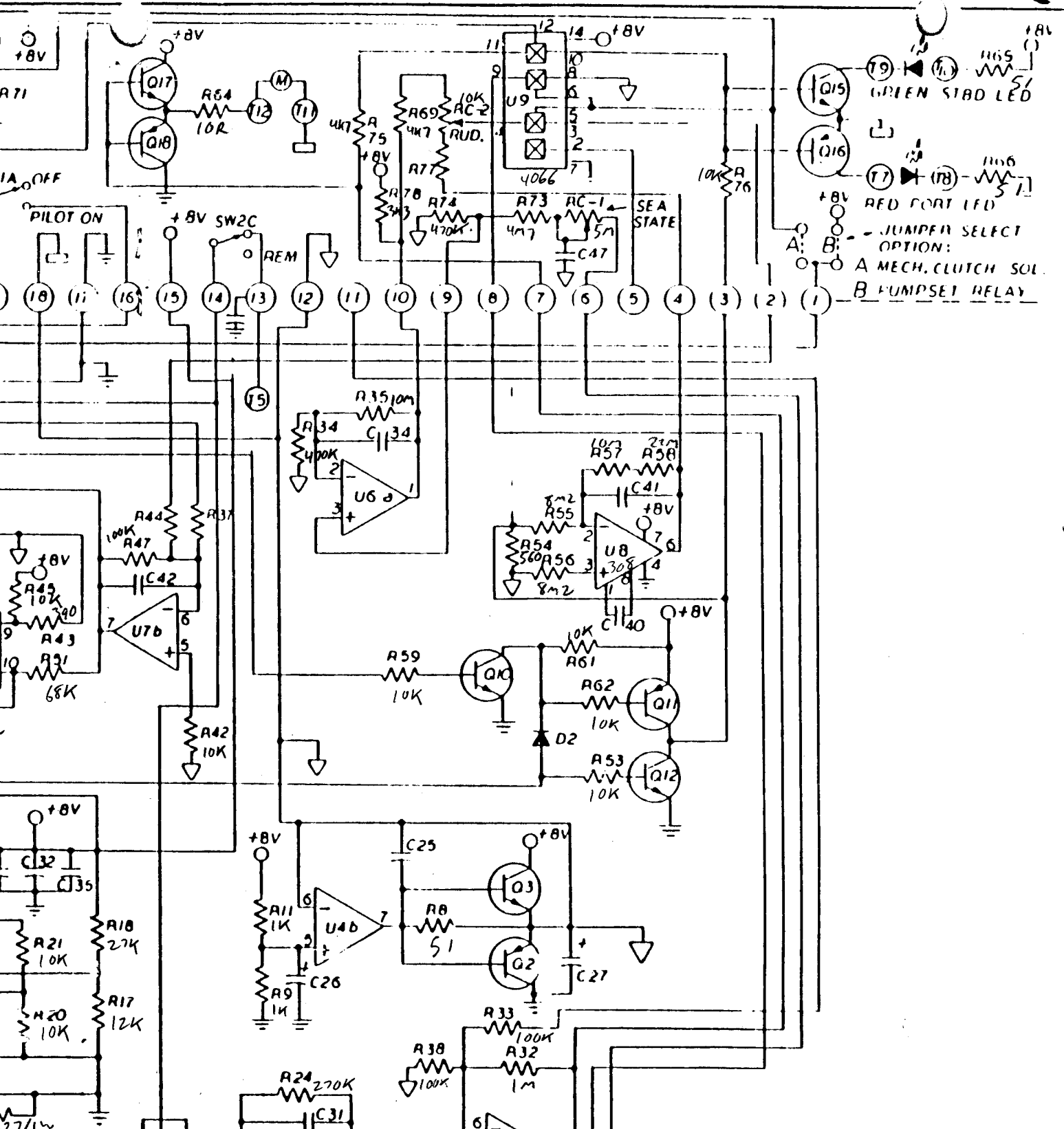
40 GOSTICK PLACE, NORTH VANCOUVER, B. C. CANADA V7M3G2

Manufacturers of MARINE HYDRAULIC STEERING GEARS and AUTOMATIC PILOTS

DATE	DWG No.	REV.
	A-1-369	
DRAWN		
<i>D. J.</i>		

IL 6549A - W.E.





GREEN STRIP LED  
 RED PORT LED  
 - JUMPER SELECT OPTION:  
 A: MECH. CLUTCH SOL.  
 B: PUMPSET RELAY

## SE AUTOPILOT

DETAIL	QUANTITY	DESCRIPTION	MATERIAL
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**WAGNER ENGINEERING LTD.**  
 40 DOSTICK PLACE NORTH VANCOUVER B.C. CANADA V1M 4J2  
 Manufacturers of MARINE HYDRAULIC STEERING GEARS & AUTOMATIC PILOTS

**CONTROL UNIT SCHEMATIC**  
**(PCB: 505-026 & 505-027)**

DRAWN WLOS	DATE SEPT 81	SCALE	QUOTE NO
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