MODEL 602-A FISH COUNTER

GENERAL DESCRIPTION

The Smith-Root fish counting system is based on a balanced bridge principle. The bridge is made up of several elements mounted in one or two tunnels with water passing through them along with additional circuitry internal to the counting system. The main advantages of this system are that the system may be set up and operating in a matter of minutes. The system stays balanced with changing water conditions and does not require frequent adjustment or maintainance.

The electronic fish counting system operates in the following manner: Water passes through one or two stainless steel tunnels, the inside walls of which are insulated. Ring electrodes are imbedded into the inner surface of each tunnel and make electrical contact with the water. The water's conductivity between these electrodes forms an electrical resistance which is used as two arms of a balanced bridge circuit. The other two arms of the bridge are made up of a number of resistive and capacitive elements within the counter. The bridge is energized by a low voltage alternating current at a frequency of about 1 KHZ.

In operation the bridge is brought into balance, then when a fish passes into a tunnel, the tunnel's resistance changes, causing the bridge to become unbalanced. This unbalance signal is used to activate a front panel counting register thus tallying a count.

The Model 601 Electronic Fish Counter has one front panel counting register that simply tallys the count of actual fish passage in either direction.

The Model 602 Electronic Fish Counter is a phase sensitive model that has two front panel counting registers to tally upstream and downstream counts. The Model 602 uses a computer logic network to detect upstream or downstream fish movement by noting which tunnel electrodes were unbalanced first. Upon passage of the fish through the tunnel, a computation is made and a count is tallied on either the upstream or downstream front panel counting register corresponding to the direction of fish travel.

The circuits are all solid state with latest integrated circuits throughout. All circuits are mounted on plug-in modules which can be easily replaced in the field, should any circuit faults ever arise. The balancing procedure is simple and may be completed in a few minutes. No test equipment is required. A front panel meter is provided to insure that all circuits are performing properly.

COUNTING TUNNELS

The Model 601 and 602 Electronic Fish Counting Systems can be used with a variety of tunnel sizes and configurations depending on the size of fish to be counted. The smallest practical tunnel diameter that may be used with these systems is about 0.75 inch and the largest diameter is about 24 inches. The tunnels may be round, square or rectangular and are made of stainless steel.

Standard Smith-Root tunnels are round and are available in a number of sizes. There are two basic configurations, three element and five element. Both types of tunnels work on the same principle. The conductance or resistance between an active element and a guard or ground element. The system must have two active elements and at least two guard elements to function. These active and guard elements are imbedded into the insulated inside walls of the tunnel.

A three element tunnel is constructed with one active element placed around the inside at the center of the tunnel. One guard element is placed on each end of the tunnel.

The systems must have two three element tunnels to function. Three element tunnels are normally used when there is a viewing area at the fish counting station. One tunnel is placed on either end of the viewing area and the fish may be observed passing through the counting station as they are being counted. In this case, the output of the fish counter may be used to activate a videotape recording system, or other photographic recording equipment to maintain a 24 hour unmanned surveilance of fish passage.

A five element tunnel is constructed with a guard ring around the inside center of the tunnel. One active element is placed half way between the center guard ring and each end. One more guard ring is placed on both ends of the tunnel. A five element tunnel is actually two three element tunnels in one.

Only one five element tunnel is required for operation of the system. A five element tunnel would normally be used where a visual check or count is not desired. As when counting downstream migrants leaving a fish hatchery.

Only one tunnel configuration is best suited for any particular application. Two three element tunnels or one five element tunnel will work with either fish counting system. Various tunnel sizes and configuragions may be made to fit your particular application.

CONTROLS AND TERMINALS

The purpose and function of the controls and plugs of the Model 602 A Electronic Fish Counter are as follows:

POWER INPUT CABLE - Located extreme left on rear panel. When the 117VAC/12VDC switch, located on front panel is at 117VAC position, the power input cable supplies 117 volts 60 cps to the power supply circuits. This must be connected to a grounded outlet.

EXTERNAL 12VDC PLUG- Located on rear panel. When the 117VAC/12VDC switch, located on front panel is at 12VDC position, this plug will supply the power needed. Pin "A" should be connected to the positive (+) side of external battery # 1. Pin "B" should be connected to the negative (—) side of battery # 1. Pin "C" should be connected to the positive (+) of battery # 2. Pin "D" should be connected to the negative (—) side of battery # 2.

EVENT RECORDER PLUG- Located on rear panel. Unless otherwise ordered this plug supplies a positive 10VDC level when the system is unblanced. Pin "A" supplies 10VDC when the "DOWN" side of the bridge is unbalanced. Pin "B" supplies 10VDC when the UP side is unbalanced. Pin K is the common or ground for both sides. This output is used to drive a low current, high impedance recorder This plug can be modified for other applications. (Consult factory).

TUNNEL BNC INPUT CONNECTORS- Located extreme right on rear panel. Cables from counting tunnels connect here. Cable from down stream tunnel connects to left side and cable from upstream connects to right side.

DOWN STREAM MECHANICAL REGISTER- Located upper right of control panel. This register tallies count of fish passing in DOWN stream direction.

UP STREAM MECHANICAL REGISTER- Located upper left of control panel. This register tallies count of fish passing in UP stream direction.

METER- Located in upper center of control panel. Used during set-up and calibration. Monitors power supply voltages and tunnel balance.

FUSE- Located right side of control panel. Protects internal circuitry against short circuits. This is an 1/2 amp fuse. If the fuse blows, determine why it blew before replacing fuse.

FUNCTION SWITCH- Located center right on control panel. Controls function of meter.

INDICATOR LIGHT- Located center on control panel. This will glow when system is turned ON, when powered by 117 VAC ONLY.

SENSITIVITY CONTROLS:

HIGH/LOW SWITCH-Located left side of control panel. COURSE sensitivity setting.

0-10 CONTROL-Located center of left control panel. Used to set lower size limit of fish to be counted. FINE sensitivity setting.

ON/OFF SWITCH-Located bottom left of control panel. Turns system ON and OFF when 117 VAC power is used and 117 VAC/12 VDC switch is in the 117 VAC position.

117 VAC/12 VDC SWITCH- Located bottom left of control panel. Controls mode of input power. When system is powered by 117 VAC this switch must be in the 117 VAC position When system is powered by EXTERNAL 12 VDC this switch must be in 12 VDC position.

RES. BALANCE CONTROL- Located bottom center left of control panel. Used to balance resistance to match tunnel's resistance during set-up calibration procedure.

CAP. BALANCE CONTROL- Located bottom center right of control panel. Used to balance capacitance to match tunnel and cable's capacitance during set-up calibration procedure.

SET-UP AND OPERATION PROCEDURES

The initial settings of the controls should be as follows:

1. 117 VAC/12VDC SWITCH- Set to 117 VAC position
2. ON/OFF SWITCH- Set to OFF position
3. FUNCTION SELECTOR SWITCH- Set to OFF position
4. SENSITIVITY CONTROL- Set to ZERO
5. SENSITIVITY SWITCH- Set to HIGH
6. RESISTIVE BALANCE- Set to about 5.0
7. CAPACITIVE BALANCE- Set to about 5.0

1. a. To use 115 volts 60 HZ input power, simply plug the input power cable into 115 volt 60 HZ grounded outlet. Place the ON/OFF switch in the ON position and the indicator light will glow. Power is now applied to the counter circuits.

When battery operating is desired, two 12 volt storage batteries must be provided.

Connections For 12 Volt EXTERNAL POWER MUST Be As Follows:

1. Connect the negative pole of the first battery to TERMINAL # B

2. Connect the positive pole of the first battery to TERMINAL # A

3. Connect the negative pole of the second battery to TERMINAL # D

4. Connect the positive pole of the second battery to TERMINAL # C

Now before going further, check your connections to be sure they are exactly as stated above. When you are sure the connections are correct place the INTERNAL/EXTERNAL power switch on the rear panel to the EXTERNAL position. Power is now applied to the counter circuits. NOTE: When using the external power, the indicator light on the front panel will not glow and the front panel ON/OFF switch has no effect.

After the 117 VAC or 12VDC power sourse has been connected and appropiate switches turned on, proceed as follows:

1. Set the FUNCTION SELECTOR switch to the NEGATIVE 12 volt position. The meter will go full left.

2. Set the FUNCTION SELECTOR switch to the POSITIVE 12 volt position. The meter will go full right. The negative and positive 12 volt positions of the FUNCTION SELECTOR switch are used to monitor the outputs of the internal power supply or to check the two external 12 volt batteries.

3. Set the FUNCTION SELECTOR switch to the NULL position. Increase the SENSITIVITY CONTROL until the meter deflects approximately half way to the right. Adjust alternately the RESISTIVE BALANCE and CAPACITIVE BALANCE until the meter centers. Repeat until SENSITIVITY CONTROL is at maximum and the meter is centered.

4. Set the FUNCTION SELECTOR switch to the BALANCE position. The meter should be nearly centered. NOTE: The needle may not be exactly at center but may be one or two divisions off of center. This is normal and may be corrected by a slight adjustment of the RESISTIVE BALANCE control.

5. Reset the FISH COUNT mechanical register to read all ZEROS by depressing the button located on the face of each register. NOTE: Do not reset the mechanical registers while the system is counting or the the registers may be damaged.

6. Set the SENSITIVITY CONTROL and HIGH-LOW switch to obtain the desired sensitivity for the size of fish to be counted. Some experimentation will have to be done to determine the proper sensitivity setting. The higher the number of the control setting, the smaller size fish the system will count. Normally for small tunnels and average water the HIGH-LOW switch can be left in the LOW position.

The Model 602-A Electronic Fish Counting System is now balanced and ready to count fish. The meter may be used to check NULL, BALANCE, or the SUPPLY VOLTAGES at any time during operation. This will not effect the operation of this system. After initial set-up the FUNCTION SELECTOR SWITCH if usually left in the BALANCE position. When in the BALANCE position the METER is actually monitoring tunnel balance. Whenever a fish enters the tunnel, the meter will deflect either right or left. Corresponding to which tunnel element is unbalanced.

When a fish passes through BOTH tunnel elements in sequence, a count will tally on either the UPSTREAM OR DOWNSTREAM register corresponding to the direction of fish travel.

SPECIFICATIONS MODEL 602-A ELECTRONIC FISH COUNTING SYSTEM

Detection Principle	Water Conductivity Bridge
Water Conductivity Range	500 to 10,000 ohms/Cm^3
Type of Bridge	Hybrid Coil
Type of Detection	Phase Sensitivity
Count Sensitivity	0.1% Bridge Unbalance
Tunnel Size Required	.75 to 24 Inches
Tunnel Cable Length Maximum	500 Feet
Count Rate	20 Counts Per Second
Counter Capacity	6 Digits (999,999 Counts)
Power Requirements	117 Vac 60 cps or External Batteries
Power Consumption	5 Watts
Size	5 1/2" high X 13" wide X 10 1/2# deep
Weight	Approx. 20 Lbs.

MODEL 602-A ALIGNMENT PROCEDURE

1. Mechanical Examination and Pre-Set Controls

A. Visually examine all terminals top and bottom for hair ends that may lodge into unnoticed locations. Check for good solder joints on all terminals.

B. Check that all knobs and switchs are mechanically tight and that they move properly.

C. Zero meter by adjusting screw in face of meter.

D. Reset Mechanical Counter to zero fish counts.

E. Set sensitivity control to zero.

F. Set high-low switch to high.

G. Set Res. Balance to 5.00 on dial.

H. Set Cap. Balance to 5.00 on dial.

I. Set function switch to off.

J. Set power switch to off.

K. Set 117VAC/12VDC switch to 117VAC.

2. Check For Shorts In AC Power Circuits

A. With power cord unplugged, check across AC line with ohmeter set to R X 1 position. The reading should be infinite.

B. Insert a 1/2 amp fuse in fuse socket located on control panel. With ohmeter still connected as in step "A" turn Power switch on. The ohmeter should read approximately 27 ohms.

C. Turn Power switch OFF and remove ohmeter.

3. Check For Shorts in +12v & -12v Power Buss

A. Connect ohmeter between PSC and +12v test point. Set ohmeter to RX 1000 range. Make sure all printed circuit cards are removed.

A capacitance kick is normal. Meter should settle down to a reading close to infinite.

B. Repeat ohmeter tests as in step "A" but connect ohmeter to PSC and 12 volt test point. Remove ohmeter.

4. Make AC Test With Variac

A. With power switch in the OFF position plug power cable into a variac. Have the variac turned to zero.

B. Connect AC voltmeter between green wires on TZ secondary. Set voltmeter to 60 volt range.

C. Advance variac slightly, the meter should begin to read. Continue advancing variac until a reading of 26 volts is reached. The variac should be near 117 VAC setting.

D. Power Indicator light on front panel should be lit.

E. Turn Variac back to zero.

5. Test +12 and -12 Volt Power Supplies

A. Insert printed circuit card PS-600-P into position P 8.

B. Plug power card into variac as in step 4-A above.

C. Connect DC voltmeter between PSC and +12 volt test points. Set voltmeter to 12 volt range. Turn AC power switch to ON.

D. Advance variac slightly. A reading should be seen on the voltmeter.

E. Advance variac. The +12 volts should be reached with a reading of about 80 volts on the variac and remain at 12 volts as the variac is advanced to 117VAC and beyond.

F. Turn the variac back to ZERO and insert printed circuit card PS-600-N into plug P 9.

G. Connect the DC voltmeter between PSC and -12 volt test points and repeat steps 5 D and 5 E.

H. Turn variac to zero and turn AC power switch to OFF.

I. Plug AC power cord into standard 117VAC outlet.

6. Check Oscillator Output

A. Insert printed circuit card SR-300 into position P 1.

B. Turn AC Power Switch ON.

C. Observe signal at TP-1 with a calibrated oscilloscope. The signal should be a 1 KHZ sine wave approximately 10 volts amppli-tude peak to peak. If amplitude is not correct adjust R 6 located on SR-300 PC card.

D. Turn AC Power Switch OFF.

7. Check Oscillator Output Amplifier

A. Insert printed circuit card SR-301 in position P 2.

B. Turn AC Power Switch ON.

C. With the Hi-Low switch set to High, rotate the Sensitivity control clockwise and observe with an oscilloscope 0 to 10 volts peak to peak at TP 2.

8. Check High-Low Switch Operation

A. Set the High-Low Switch to LOW and observe 0-4 volts peak to peak at TP 2. When the sensitivity is rotated from 0 to 10.

B. Set High-Low Switch back to HIGH position.

9. Adjust C 809 and C 811

A. Connect a VTVM from J 801 to PSC.

B. Set voltmeter range to 3 VAC.

C. Preset C 809 and C 811 to mid range.

D. Rotate Sensitivity Control clockwise until the meter indicates 1.5v.

E. Move the VTVM to J 802 and carefully observe the reading. If there is any difference between the readings, adjust C 809 and or C 811 until the readings are the same. Alternately move the VTVM between J 801 and J 802 while adjusting C 809 and C 811.

10. Check 90° Phase

A. Connect External Sync of an oscilloscope to TP 1. Set oscilloscope sweep speed to display one cycle while observing TP 1.

B. Alternately observe TP 1 and TP 2 for 90° relationship.

11. Check Bridge Balance

A. Connect tunnel simulator to BNC terminals J 801 and J 802.

B. Make sure "R" Bal and "C" Bal are preset to 5.0 on dials.

C. Turn Sensitivity knob fully clockwise.

D. Observe TP 3 with oscilloscope set for .05 v/cm vertical deflection.

E. Alternately adjust "R" Bal and "C" Bal for minimum or null reading on oscilloscope. The minimum voltage as seen on the oscilloscope should be 10 M volts peak to peak.

F. Turn AC Power Switch to OFF position.

12. Check Error Amplifier Gain

A. Plug SR-302 into position P 3 via plug-in extender.

B. Turn AC Power Switch to ON.

C. Monitor TP 4 with oscilloscope set to .5 volts/cm vertical deflection.

D. The voltage as seen on the oscilloscope should be .2 volts peak to peak.

13. Check Error Amp AGC

A. Turn Sensitivity Control to ZERO.

B. Turn "R" Bal dial to 25. This unbalances the bridge circuit grossly.

C. While observing TP 4 as in step 11-C turn up sensitivity knob. Note that the peak to peak amplitude limits at approximately 10 volts.

D. If the voltage is not near 10 volts peak to peak, adjust R 207 located near the center of printed circuit card SR-302, to obtain 10 volts peak to peak when sensitivity is fully clockwise. AGC action should first be observed at about 5 on the sensitivity dial.

E. Turn AC power OFF and remove card extends from position P 3 and insert printed circuit card SR-302 into position P 3.

F. Remove oscilloscope from TP 4.

G. Turn sensitivity knob to ZERO

14. Adjust Discriminator Balance And Gain

A. Insert printed circuit card SR-303 into position P 4 via plug-in extender.

B. Turn AC power switch to ON.

C. Turn Function Switch to NULL and adjust "R" Bal and "C" Bal to null meter while advancing the sensitivity control. When bridge is properly balanced the meter will indicate zero on the front panel meter with the sensitivity advanced fully clockwise.

D. Turn Sensitivity control to zero and switch Function switch to Balance. position.

E. Preset R 304 (nearest outside edge of SR 303) to approximately mid position.

F. Adjust R 305 (Near center of SR 303) until front panel meter indicates exactly zero.

G. Turn Sensitivity control to 10. (fully clockwise)

H. If the needle moves from zero, slightly adjust "R" Bal to set meter on zero.

I. Throw switch on Tunnel Simulator to UP unbalance 0.1 %. Meter should move to the right and indicate near 25.

J. Throw switch to unbalance DOWN 0.1 %. The meter should move to the left and indicate 25.

K. If the meter does not indicate at least 25 in both directions, turn R 304 CCW slightly and repeat step F for zero indication on the meter. Repeat steps I, J, and K as necessary. If UP and DOWN reading vary more than ten from each other, replace IC 301 and or Q 302.

L. Observe TP 5 with an oscilloscope set to 1 volt per CM vertical deflection. Throw unbalance switch on Tunnel Simulator from UP to DOWN and observe approximately plus 1.2 volts when unbalanced in the UP position and approximately minus 1.2 volts when unbalanced in the DOWN position.

M. Set the Tunnel Simulator to balanced position.

N. Turn AC power to OFF and remove card extender from position P 4. Insert PC card SR-303 into position P 4.

15. Check Dual Schmitt For Proper Operation

A. Insert PC Card SR-304 into position P 5.

B. Turn AC power to ON.

C. Observe TP 6 with an oscilloscope set to 5 volts per CM vertical deflection.

D. Throw unbalance switch to DOWN position on Tunnel Simulator. A positive 10 volts should appear on TP 6.

E. Move oscilloscope to TP 7. Throw unbalance switch to UP on Tunnel Simulator. A positive 10 volts should appear on TP 7.

F. Check that when Tunnel Simulator is in Balanced position that 0 volts output appears at TP 6 and TP 7.

16. Check Event Recorder Outputs

A. Connect the oscilloscope to DOWN output terminal A on rear plug. Throw unbalance switch on tunnel simulator to DOWN position. A positive 10 volts should appear.

B. Connect the oscilloscope to UP output terminal B. Throw unbalance switch to UP position. A positive 10 volts should appear.

C. Check that when Tunnel Simulator is in the balanced position that there is 0 volts output appears at UP and DOWN outputs of plug. Turn AC power OFF.

17. Check Logic and One-Shot for Proper Operation

A. Insert PC card SR-305 into position P 6 and insert PC card SR-306 into position P 7.

B. Connect oscilloscope to TP 8 and turn AC power ON.

C. Wait 20 seconds before proceeding.

D. Throw tunnel simulator unbalance switch to DOWN and then to UP. When switched to UP a neg. going 12 v, 30 millisecond wide pulse should have been observed. Also a fish count should tally on the UP stream mechanical register.

E. Move the oscilloscope to TP 9.

G. Throw the tunnel simulator unbalance switch to UP and then to DOWN. When switched to DOWN a neg. going 12 v, 30 millisecond wide pulse should have been observed. Also a fish count should tally on the DOWN stream mechanical register.

H. Connect oscilloscope to positive side of C 504 on SR 305 card.

I. Wait 20 seconds before proceeding.

J. Throw the tunnel simulator UNBALANCE switch to UP and return to BALANCE. C 504 will charge slowly, reaching a full charge between 10 to 15 seconds and returning to zero.

K. Throw the tunnel simulator switch to DOWN and return to BALANCE. C 504 will charge slowly, reaching a full charge between 10 to 15 seconds and returning to zero.

L. No count should have been observed on either the UP or DOWN stream registers.

18. Check For External Power Operation

A. Connect two 12 volt D. C. power sources to the EXT 12VDC plug. Make sure polarities are correct.

B. Throw the 117 VAC/12VDC switch to the 12VDC position.

C. Throw control panel Meter Function switch to + 12 and to −12 positions to observe proper voltages. Meter should indicate first 100 to the right then 100 to the left.

D. Observe that the counter functions normally as in step 17.

E. Switch 117 VAC/12VDC switch back to 117 VAC position and disconnect batteries.

19. Check For Mechanical Tightness

A. Check that all screws have lock washers.

B. Check all screws for tightness. Replace any stripped or damaged screws.

C. Make sure all mounted components are tight.

D. Dress up all cable runs and leads.

MODEL 602-A FISH COUNTER

NOTE:
All capacitance in MFD & all resistance in OHMS unless indicated.

ITEM	VALUE	MANUFACTURER	PART NO.
C 1	.0016 1%	Cornell-Dubilier	5A5D16GF
C 2	.016 1%	Cornell-Dubilier	1AD3516GF
C 3	120 PF	Cornell-Dubilier	CD10E 121G500
C 4	.01 100V	Aerovox	TTP01
C 5	4.7 6V Elec.	Components	CT475
C 6	25 15V Elec.	International	TAW 25 TE15
C 7	25 15V Elec.	International	TAW 25 TE15
C101	.05 100V	International	EM 500-1
C102	.1 100V	International	EM 1000-1
C103	.0022 100V	International	EM 22-1
C104	.1 100V	International	EM 1000-1
C105	.1 100V	International	EM 1000-1
C106	25 15V Elec.	International	TAW 25 TE15
C107	25 15V Elec.	International	TAW 25 TE15
C201	.001 100V	International	EM 10-1
C202	.001 100V	International	EM 10-1
C203	.1 100V	International	EM 1000-1
C204	.47 25V Elec.	Components	CT474
C205	.001 100V	International	EM 10-1
C206	25 15V Elec.	International	TAW 25 TE15
C207	25 15V Elec.	International	TAW 25 TE15
C301	25 15V Elec.	International	TAW 25 TE15

C302	.01 100V	Aerovox	TTP01
C303	.1 100V	International	EM 1000-1
C304	2.2 15V Elec.	Components	CT 225
C305	2.2 15V Elec.	Components	CT 225
C306	2.2 15V Elec.	Components	CT 225
C307	2.2 15V Elec.	Components	Ct 225
C401	25 15V Elec.	International	TAW 25 TE15
C501	.01	Aervox	TTP01
C502	.01	Aerovox	TTP01
C503	25 uf	International	TAW 25 TE15
C504	25 uf	International	TAW 25 TE15
C601	2.2 15V Elec.	Components	CT 225
C602	25 15V Elec.	International	TAW 25 TE15
C603	2.2 15V Elec.	Components	CT 225
C801	.02 400V	Aerovox	GPD Z5&203P
C802	.02 400V	Aerovox	GPD Z5U203P
C803	100 50V Elec.	International	TAW 100 TN50
C804	100 50V Elec.	International	TAW 100 TN50
C805	25 15V Elec.	International	TAW 25 TE15
C806	25 15V Elec.	International	TAW 25 TE15
C807	500 35V Elec.	International	TAW 500 TX35
C808	1 100V NP	Mylar	X663FI
C809	7-35 PF	Centralab	827-D
C 810	7-35 PF	Centralab	827-D
Clamp cable		Smith	835

D 1	IN789	General Elec.	
D101	IN789	General Elec.	
D102	IN789	General Elec.	
D201	IN789	General Elec.	
D401	IN789	General Elec.	
D402	IN789	General Elec.	
D403	IN789	General Elec.	
D404	IN789	General Elec.	
D501	IN789	General Elec.	
D502	IN789	General Elec.	
D604	HEP 170	Motorola	
D605	IN789	General Elec.	
D606	IN789	General Elec.	
D 601	IN789	Gene ral Elec.	
D602	IN789	General Elec	
D603	HEP 170	Motorola	
D701	HEP 170	Motorola	
D702	HEP 170	Motorola	
D703	HEP 170	Motorola	
D704	HEP 170	Motorola	
D705	9.1V Z IW	Cont inental Device	3212049
D706	9. IV Z IW	Continental Device	3212049
DX801	Dial	Duncan	model 81
DX802	Dial	Duncan	model 81
DX803	Dial	Kurz-Kasch	S-292-3L
DX804	Dial	Kurz-Kasch	S-292-3L

F801	Fuse Holder	Bussman	HKL
Fuse	AGC 1/2	Bussman	
Front Panel		Smith-Root	
IC I	741DJ	Amelco	
IC101	741DJ	Amelco	
IC201	741DJ	Amelco	
IC202	741DJ	Amelco	
IC301	741DJ	Amelco	
IC501	312CJ	Amelco	
IC502	321CJ	Amelco	
IC601	342CJ	Amelco	
IC701	741DJ	Amelco	
IC702	741DJ	Amelco	
J801	BNC	King	KC-74-12
J802	BNC	King	KC-74-12
J803		Cannon	KPT 02A12-105
J804		Cannon	KPT 02A8-45
J805	Power Cable	Belden	17236-SV
JX801	Cover	King	KC-81-01
JX802	Cover	King	KC-81-01
JX803	Cover	Bendix	10-101960-123
JX804	Cover	Bendix	10-101960-83
L801	Light	Alco	BNE 2
Lug Large		Smith	1497
Lug Small	#4	Smith	1410-4

M801	Meter	Monarc	PMC3S
MC801	Counter	Rowan	2140-61AAH
MC802	Counter	Rowan	2140-61AAH
P 1	Amphenol	Amphenol	143-015-01
P 2		Amphenol	143-015-01
P' 3		Amphenol	143-015-01
P 4		Amphenol	143-015-01
P 5		Amphenol	143-015-01
P 6		Amphenol	143-015-01
P 7		Amphenol	143-015-01
P 8		Amphenol	143-015-01
P 9		Amphenol	143-015-01
Q 1	2N4303	Motorola	
Q201	2N4303	Motorola	
Q301	2N3704	Motorola	
Q302	2N2641	Motorola	
Q401	2N3704	Motorola	
Q402	2N3704	Motorola	
Q403	2N3702	Motorola	
Q404	2N3702	Motorola	
Q405	2N3702	Motorola	
Q406	2N3704	Motorola	
Q407	2N3702	Motorola	
Q501	2N4871	Motorola	
Q502	2N3704	Motorola	
Q601	HEP243	Motorola	

Q602	HEP243	Motorola	
Q701	HEP242	Motorola	
Q702	HEP243	Motorola	
R I	100K . 05%	Electra	MF52C-E-1003-D
R 2	10K . 05%	Electra	MF52C-E-1002-D
R 3	200K . 05%	Electra	MF52C-E-2003-D
R 4	10. 5K . 05%	Electra	MF52C-E-1052-D
R 5	470K	Beschlag	BB470 K
R 6	IM	Mallory	MTC 16 L 4
R101	100 K	Beschlag	BB100K
R102	10 K	Beschlag	BB10K
R103	20K	Beschlag	BB20K
R104	100K	Beschlag	BB100K
R105	33K	Beschlag	BB33K
R106	120K	Beschlag	BB120K
R107	120K	Beschlag	BB120K
R108	120K	Beschlag	BB120K
R201	33K	Beschlag	BB33K
R202	20K	Beschlag	BB20K
R203	I K	Beschlag	BBIK
R204	IM	Beschalg	BBIM
R205	IK	Beschlag	BBIK
R206	I00 K	Beschlag	BB100K
R301	2. 7K	Beschlag	BB2K7
R302	2. 7K	Beschlag	BB2K7
R303	27K	Beschlag	BB27K

R304	500	Mallory	MTC52L4
R305	500	Mallory	MTC52L4
R306	12K	Beschlag	BB12K
R307	680	Beschlag	BB680E
R308	10K	Beschlag	BB10K
R309	22K	Beschlag	BB22K
R310	10K	Beschlag	BB10K
R311	27K	Beschlag	BB27K
R312	22K	Beschlag	BB22K
R313	12K	Beschlag	BB12K
R401	15K	Beschlag	BB15K
R402	9.1K	Beschlag	BB9K1
R403	1K	Beschlag	BB1K
R404	2.2K	Beschlag	BB2K2
R405	2.2K'	Beschlag	BB2K2
R406	2.4K	Beschlag	BB2K4
R407	1K	Beschlag	BB1K
R408	9.1K	Beschlag	BB9K1
R409	2.2K	Beschlag	BB2K2
R410	15K	Beschlag	BB15K
R411	2.4K	Beschlag	BB2K4
R412	4.7K	Beschlag	BB4K7
R413	1K	Beschlag	BB1K
R414	2.2K	Beschlag	BB2K2

R501	2.2K	Beschlag	BB2K2
R502	2.2K	Beschlag	BB2K2
R503	100K	Beschlag	BB100K
R504	47	Beschlag	BB47E
R505	22K	Beschlag	BB22K
R601	2.2K	Beschlag	BB2K2
R602	2.2K	Beschlag	BB2K2
R701	3.9K	Beschlag	BB3K9
R702	3.9K	Beschlag	BB3K9
R703	5K	Mallory	MTC53L4
R704	4.7K	Beschlag	BB4K7
R705	5K	Mallory	MTC53L4
R706	4 7K	Beschlag	BB4K7
R801	56 1/2W	Beschlag	BI/8 56E
R802	82K 1/2W	Beschlag	B1/8 82K
R803	5K 10T	Duncan	3253 5K
R804	5K 10T	Duncan	3253 5K
R805	1K 1/2W	Beschlag	B1/8 1K
R806	1K 1/2W	Beschlag	B1/8 1K
R807	5K pot	Clarostat	5363 5K
R808	5.6K 1/2W	Beschlag	B1/8 5K6
R809	1K 1/2W	Beschlag	B1/8 1K
Screw	4-40x1 PH	Smith	
Screw	6-32x1/3 PH	Smith	

Screw	6-32x3/8 FH		
Screw	6-32x3/8 PH		
Screw	6-32x1/2 PH		
Screw	10-32x1/2 OH		
Stand Off	Smith		8354
SW801	SPST	Cutler-Hammer	7580K6
SW802	SPST	Cutler-Hammer	7580K6
SW803	1P12Pos.		
SW804	DPDT	Cutler-Hammer	7591K6
Test Points		USECO	1280 D
T 1		UTC	A-20
T 2		Stancor	P8180
T 3		Smith-Root	