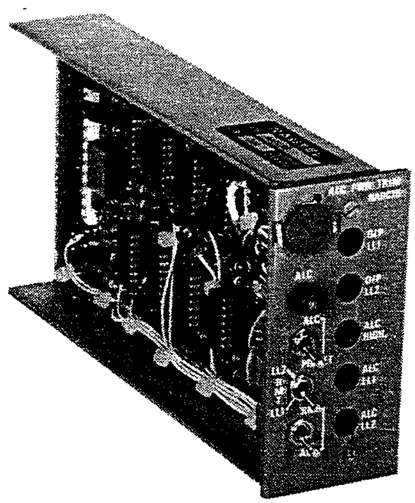
SERVICE INSTRUCTION

NAPC18

AUTOMATIC LEVEL CONTROL/ REMOTE POWER TRIM MODULE



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LIST OF EFFECTIVE PAGES

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INTRODUCTION

1. The NAPC18 automatic level control/remote power trim (ALC/power trim) module, when used in conjunction with an NAPE27 modulator driver module, provides the following control functions for its associated transmitter:

(a) Provision to select one of three preset output power levels, locally or remotely.

(b) Automatically maintain the output power level to within one percent of the selected preset value. Compensates for any change that would cause the output power level to decrease by eighteen percent or increase by nine percent. Available only when manual level control not selected.

(c) Manually control the output power level from a remote location. Provides up to an eighteen percent increase or a nine percent decrease from the preset output power level in two percent increments. Available only when automatic level control not selected.

The NAPC18 ALC/power trim module provides an alarm signal that indicates the power trim control circuit is at either its maximum or minimum position. It also provides outputs to indicate 'low level 1' or 'low level 2' has been selected. Troubleshooting and repair of the module is performed on a work bench independent of the associated transmitter. This document provides information necessary for a technician to understand the operation of the electrical circuits and the procedures to restore defective modules to a serviceable status, using tools and test equipment normally available at an AM radio station workshop. An alternative to procedures provided in this document is to utilize Nautel's module exchange/repair service facilities.

FACTORY EXCHANGE/REPAIR SERVICE

2. Nautel provides a factory, module exchange/repair service for users of Nautel's AMPFET series of transmitters. Users who do not have repair facilities or who are not able to repair a module may utilize this service for a nominal fee.

MECHANICAL CONFIGURATION

3. The NAPC18 ALC/power trim module utilizes a formed metal box as its chassis. Electrical connection to the associated transmitter's driver unit is by mating the mass termination assembly (MTA) connector on a flying lead, from the driver unit, to an MTA square post header (A1J1) on the module's printed circuit board. Electrical interconnection between the NAPC18 ALC/power trim module and its associated NAPE27 modulator driver module is by an interconnecting cable that connects to locking, miniature, hexagonal connectors on their front panels. Controls and indicators are mounted on, or accessible through the front panel of the module. All electrical components, except the controls and indicators on the front panel, are mounted on a printed circuit board. The NAPC18 ALC/power trim module is secured to the associated transmitter's driver unit by two screws that pass through two holes in its base plate. Refer to figure FO-4 for assembly detail of the NAPC18 ALC/power trim module.

ALC/POWER TRIM MODULE OVERVIEW (see figure FO-1)

4. Figure FO-1 presents a block diagram of the NAPC18 ALC/power trim module. The following overview description is based on this illustration. For a more detailed description refer to paragraph 5.

4.1 POWER LEVEL SELECTOR OVERVIEW: The power level selector is a logic circuit that interfaces the local and remote power level selectors with the circuits that determine the power level. It provides a 'high level' output, as the power level control for the automatic increase/decrease generator when a 'low power' input is not being applied. Whenever a 'low power' input is being applied, it provides a 'low level 1' or 'low level 2' output as the power level control for the automatic increase/decrease generator and the carrier level attenuator. It provides a 'low level 1' output whenever a remote 'low level 1' input is being applied or the local power level selector switch is set to LL1. It provides a 'low level 2' output whenever a remote 'low level 2' input is being applied or the local power level selector switch is set to LL2. Whenever a 'low level 1' is being applied to the automatic increase/decrease generator and the carrier level attenuator, a buffered 'low level 1' output is also generated for external monitoring. Whenever a 'low level 2' is being applied, a buffered 'low level 2' output is generated for external monitoring.

4.2 FORWARD POWER FILTER/BUFFER OVERVIEW: The 'forward power' input to the forward power filter/buffer is a dc voltage, with an amplitude that is proportional to the associated transmitter's forward power level, that has the modulation audio component superimposed on it. The forward power filter/buffer is a three-pole low-pass filter, with a cutoff frequency of approximately 1 Hz, that removes the audio component from the 'forward power' dc voltage input and provides a buffered dc voltage, as its output, that is proportional to the forward power output level.

4.3 AUTOMATIC INCREASE/DECREASE GENERATOR OVERVIEW: The automatic increase/decrease control generator compares the dc voltage, that is representative of the forward power level, from the forward power filter/buffer to a preset reference voltage. When the dc voltage is less than the reference voltage, the automatic increase/decrease control generator will produce an 'increase' output. When the dc voltage is greater than the reference voltage, the automatic increase/decrease control generator will produce a 'decrease' output. There are three preset attenuators, with each representing an output power level. Each attenuator voltage is set during calibration to provide the required reference voltage when the rf output is the desired level. The selected attenuator is determined by the status of the 'high level', 'low level 1' or 'low level 2' inputs. When the associated transmitter's forward power level is being maintained within two percent of the preset level, the ALC light emitting diode will be on.

4.4 ATTENUATOR CONTROL OVERVIEW: The attenuator control circuit generates a four-bit binary output as the control signal for the carrier level attenuator. When the ALC/PRESET switch is set to PRESET, the binary output is set to 10 (0101). This is a fixed reference setting that permits the output power levels and automatic level control reference level to be preset during calibration. When the ALC/PRESET switch is set to ALC, the four-bit binary word is determined by the status of the remotely provided 'increase' or 'decrease' inputs, when the mode selector switch is set to RMT, or by the locally produced 'increase' or 'decrease' inputs, when the mode selector switch is set to ALC. When an 'increase' or a 'decrease' input is being applied, an 1.0 Hz internal clock will retard or advance the binary output count at the rate of one count per second. When an 'increase' input is applied, the binary output will count down towards zero (0000). When a 'decrease' input is applied, the binary output will count up towards 15 (1111). An ALC alarm signal will be produced for external monitoring whenever the binary count reaches its minimum count (0000) or its maximum count (1111).

4.5 CARRIER LEVEL ATTENUATOR OVERVIEW: The carrier level attenuator is a dual function attenuator that attenuates the 'carrier reference' input to the 'PWM control' level that will eventually cause the associated transmitter to provide and maintain the desired rf output. The binary output of the attenuator control circuit controls a 16-step attenuator. Attenuation is minimum when the binary count is (0000); maximum when the binary count is 15 (1111); or a fixed reference, for calibration purposes, when the binary count is ten (0101). The 'low level 1' and 'low level 2' inputs control a second attenuator that applies an adjustable attenuator when either is present. The adjustable attenuator is preset during calibration for the 'PWM control' level required to produce the desired low level 1 or low level 2 outputs. The 'mod bal' inputs are applied to a potentiometer that is adjusted during calibration for a fixed modulation index for all three power levels.

DETAILED THEORY OF OPERATION (see figures FO-2 and FO-3)

5. The following description expands on the overview presented in paragraph 4 and provides a detailed description of each function in the NAPC18 ALC/power trim module, based on the electrical schematic depicted in figures FO-2 and FO-3.

5.1 POWER LEVEL SELECTOR DESCRIPTION: LL1/RMT/LL2 switch allows local selection of 'LL1' or 'LL2' by controlling gates U1C and U1D, respectively, when they have been enabled by the low power input on J1-7. Whenever 'LL1' or 'LL2' is selected, gates U1A and U1B inhibit the remote low level controls from latching relay K1. When the REMOTE position is selected, gates U1C and U1D are inhibited while U1A and U1B are enabled, thus allowing selection of 'LL1' or 'LL2' by latching relay K1, whenever low power input is present. Latching relay K1 is controlled by momentarily grounding either J1-6 or J1-8 when the control common on J1-9 is connected to 24 volts. The 'LL1' outputs of gates U1A and U1C are ORed on gate U2D, while the 'LL2' outputs of gates U1B and U1D are ORed on gate U2B. The outputs of U2D and U2B are applied to the 'automatic increase/decrease generator' and the 'carrier level attenuator' directly, with buffered outputs being applied to J1-2 and J1-3. When the low power input to J1-7 is absent; i.e., the transmitter is in the 'high power' condition, a high power control is generated by U3A and applied to automatic increase/decrease generator.

5.2 FORWARD POWER FILTER/BUFFER DESCRIPTION: The forward power signal on J1-4 is filtered by the nominal 1 Hz low-pass filter R8, C2, R9, C3, R10, C4 and R11, then buffered by U4C, before being applied to the automatic increase/decrease generator.

5.3 AUTOMATIC INCREASE/DECREASE GENERATOR DESCRIPTION: The buffered forward power signal is applied to the ALC control circuit via either the 'ALC HIGH', 'ALC LL1' or 'ALC LL2' potentiometers. Selection of the appropriate potentiometer is made by the analog gates of U5which are controlled by the outputs of the power level selector. The ALC potentiometers are used to attenuate the forward power signal at U4D-12 to the appropriate reference level when the transmitter output is preset to the required level for each output power. This reference level is a nominal 6.5 volts divided by the gain of U4D which results in a reference level of 1.16 volts at U4D-12. For the ALC circuit to function, the desired forward power must produce a forward power signal in excess of that level. This corresponds to the following power outputs for the transmitters as indicated:

TRANSMITTER	10 kW	5 kW	2.5 kW	1 kW
MINIMUM POWER for ALC	200 Watts	100 Watts	50 Watts	50 Watts

The signal on U4D-12 is amplified by a factor of 5.6 and applied to U6B-4 and U6A-7. When the output of U4D is greater than the reference on U6B-5, the output on U6B-2 will be low which will provide a 'decrease' signal to the ALC/RMT switch and turn off ALC indicator DS1 via U6D. When the output of U4D is less than the reference on U6A-6, the output on U6A-1 will be low which will provide an increase signal to ALC/RMT switch and turn off ALC indicator DS1 via U6C. Whenever the output of U4D lies within the voltage increment across R21, nominally between 6.47 and 6.54 volts, the outputs of both U6A and U6B will be high and ALC indicator DS1 will be 'on', indicating the output power is at the initial predetermined level.

5.4 ATTENUATOR CONTROL DESCRIPTION: The attenuator control circuitry consists primarily of one-second clock U7 and UP/DOWN counter U8 which are controlled by the increase/decrease signals from RMT/ALC switch S2 and ALC/PRESET control switch S3. The preset condition is used to set the 'HIGH', 'LL1' and 'LL2' power levels of the transmitter to their desired levels. When the output power levels have been set to their desired levels (see transmitter alignment procedures) the 'ALC HIGH', 'ALC LL1' and 'ALC LL2' levels are adjusted and then ALC/PRESET switch S3 is set to ALC for normal operation. When S2 and S3 are both set to ALC, the UP/DOWN counter is controlled by the output of the automatic increase/decrease generator. When S3 is set to 'ALC' and S2 is set to 'RMT', the UP/DOWN counter is controlled by remote increase/decrease inputs. The increase control from S2 is applied via Schmidt gates U11C and U11D to the flip-flop composed of U12A and U12B and to the reset input of 1 Hz clock U7. When the increase control is low (active state), the 1 Hz clock reset will be released on U7-6, allowing it to provide a clock input to U8. Simultaneously, the UP/DOWN input U8-10 will be low, causing the counter to count down. This down count will continue until the increase control goes high (inactive state). Should the increase control remain low until the output of U8 reaches '0000', the carry out signal on U8-7 will inhibit the clock input via gate U3B, while providing an ALC alarm at J1-12 via U3D and Q1. Similarly, the decrease control from S2 will enable the 1 Hz clock and cause the UP/DOWN to count up by placing a high level at U8-10. Should the counter reach a state of '1111', with the input to pin 10 high, the carry out on U8-7 will inhibit the clock and produce an ALC alarm.

5.5 CARRIER LEVEL ATTENUATOR DESCRIPTION: The carrier reference signal from associated modulator driver module NAPE27 is buffered by U10A; then attenuated by R36 by an amount determined by the output of UP/DOWN counter U8. This attenuator allows a variation of +18 percent, -9 percent relative to the preset level. Attenuation is done in a binary function with the smallest of each of the 16 steps representing approximately two percent in output power. ALC/power trim attenuator output is buffered by U10B; then applied through the low level attenuator comprising R42, R44 and R46. This attenuator is controlled by 'low level 1' and 'low level 2' outputs of the power level selector. 'O/P LL1' control allows adjustment of the transmitter's 'low level 1' rf output level; 'O/P LL2' control allows adjustment of the transmitter's 'low level 2' rf output level. When the transmitter is in the 'high power' state, no attenuation occurs across R42. The signal is then buffered by U10D and applied back to the NAPE27 modulator driver module as a pulse-width modulator control signal.

To maintain a constant modulation index for all three power levels, the attenuation of the carrier reference signal must be to a voltage that corresponds to zero carrier output. This is achieved by establishing the MOD BAL reference at the output of U10C-8. MOD BAL control R35 is adjusted as per procedures outlined in the transmitter alignment to give an output level of approximately 1/1000th of the nominal rated output of the transmitter.

TROUBLESHOOTING

6. Troubleshooting NAPC18 ALC/power trim modules that are defective, or suspect of being defective, consists of performing a visual inspection and then conducting a functional test to isolate the defective components.

6.1 TEST EQUIPMENT AND SPECIAL TOOLS: The test equipment required is listed in table 1. There are no special tools required.

6.2 REMOVAL OF NAPC18 ALC/POWER TRIM MODULE: To remove the NAPC18 ALC/power trim module from a transmitter for visual inspection and testing, it is necessary to remove the mounting screws fastening it to the driver unit assembly. These screws are accessible by removing the modulator module directly below the NAPC18, or in the case of an AMPFET 1 transmitter, by removing the control panel.

NOTE

Follow normal safety procedures before removing the appropriate unit. Refer to transmitter instruction manual.

6.3 VISUAL INSPECTION: It is recommended that a visual inspection be performed on the NAPC18 ALC/power trim module before conducting electrical tests. Inspect for the following:

(a) Inspect all electrical components for evidence of overheating or physical damage.

(b) Inspect all solder connections for good mechanical bond and adequate solder.

(c) Verify that no wiring insulation is damaged.

(d) Verify that wire strands of wiring conductors are not broken or otherwise damaged.

(e) Verify the chassis and printed circuit board is free from solder slivers and other conductive foreign objects.

(f) Verify all integrated circuit devices are installed and firmly seated in their sockets.

(g) Verify all fastening hardware is securely tightened.

6.4 CALIBRATION/FUNCTIONAL TEST: Functional testing and calibration of the NAPC18 ALC/power trim module is the recommended first step in troubleshooting a defective module. It also verifies the module is operating within design limits after corrective action has been taken. Modules that meet the requirements of the functional test may be considered to be operating satisfactorily and returned to service.

NOTE

Final adjustment of the ALC/power trim module is performed with the module installed in its associated transmitter. In particular, it is necessary to readjust the MOD BAL control after the module has been installed in the transmitter.

6.4.1 <u>Preparation for Test/Calibration</u>: Prepare the NAPC18 ALC/power trim module for test as follows:

(a) Verify the visual inspection has been completed.

(b) Connect the module to be tested/calibrated to the test setup shown in figure 1.

(c) Set module switches as follows:

ALC-PRESET	to	PRESET
LL2-RMT-LL1	to	RMT
RMT-ALC	to	RMT

(d) Adjust R1, of the test setup, for a 9.0 volt dc 'FWD PWR' input on A1J1-4.

(e) Measure the dc voltage on A1U10-8 and record the value.

(f) Adjust R2, of the test setup, to give a voltage at J1-B, PWM control that is 1.50 volts below that on A1U10-8. Record this voltage as the nominal carrier reference voltage.

6.4.2 <u>MOD BAL Control Test</u>: Proceed as follows:

(a) With the NAPC18 ALC/power trim module connected as detailed in paragraph 6.4.1, monitor the dc voltage at A1U10-8.

(b) Adjust the MOD BAL control fully clockwise, then fully counterclockwise. Check that the dc voltage varies over the range 5.5 volts to 9.5 volts.

(c) Reset MOD BAL control to give initial value measured in paragraph 6.4.1(e).

6.4.3 <u>Power Trim Test</u>: Proceed as follows:

(a) With the NAPC18 ALC/power trim module connected as detailed in paragraph 6.4.1, monitor the dc voltage at J1-B. This should be the carrier reference voltage of 6.4.1(f). (NOTE: This corresponds to the high power PWM control voltage.)

(b) Check the ALC ALARM output on A1J1-12 is at 15 V.

(c) Set PRESET-ALC switch to ALC. Monitor the voltage on J1-B when REMOTE/INCREASE control at A1J1-5 is held to ground. The voltage should decrease (corresponding to an increase in transmitter output power) in ten steps at one-second intervals until it reaches a nominal value of 1.62 volts below the voltage recorded in paragraph 6.4.1(e).

(d) When the PWM control voltage reaches a constant level, check that the ALC alarm output on A1J1-12 goes to a nominal zero volts.

(e) Disconnect REMOTE/INCREASE control at A1J1-5 from ground and ground the REMOTE/DECREASE control at A1J1-1. The voltage of J1-B should increase in 16 steps at one-second intervals until it reaches a nominal value of 1.42 volts ~~below~~ above the voltage measured in paragraph 6.4.1(e).

(f) When the PWM control voltage reaches a constant level, check that the ALC alarm output on A1J1-12 goes to a nominal zero volts.

(g) Remove the ground from A1J1-1. The voltage on J1-B should remain constant.

(h) Switch ALC-PRESET switch to PRESET. The voltage on J1-B should return to the level recorded in step (a). The ALC ALARM output should be +15 volts.

6.4.4 'Low Level 1' Test: Proceed as follows:

(a) With the NAPC18 ALC/power trim module connected as detailed in paragraph 6.4.1, connect the low power input A1J1-7 to +15 volts. Set LL2-RMT-LL1 switch to LL1. (NOTE: This corresponds to local selection of 'low level 1'.)

(b) Monitor the output on J1-B and record the value measured.

(c) By varying O/P LL1 control, check that the voltage on J1-B can be adjusted from a minimum of 1.30 volts to a maximum of 0.10 volts below that measured in paragraph 6.4.1(e).

(d) Reset O/P LL1 control to give the voltage recorded in step (b).

6.4.5 'Low Level 2' Test: Proceed as follows:

(a) With set up as in paragraph 6.4.4, switch LL2-RMT-LL1 switch to LL2. (This corresponds to local selection of LL2.)

(b) Repeat steps 6.4.3(b); (c); (d), adjusting O/P LL2 control rather than O/P LL1 control.

6.4.6 Remote Selector Test: Proceed as follows:

(a) With NAPC18 ALC/power trim module connected as detailed in paragraph 6.4.1, set LL2-RMT-LL1 switch to REMOTE, noting that A1J1-7 is not connected to +15 volts.)

(b) Voltage at J1-B should be that measured in paragraph 6.4.1(f), corresponding to high carrier level.

(c) Check that voltages on A1J1-2 and A1J1-3 are a nominal zero volts.

(d) Connect A1J1-7 to +15 V and momentarily ground remote 'low level 1' input at A1J1-6. The voltage on J1-B should be that recorded in paragraph 6.4.4(b), corresponding to 'low level 1'.

(e) Check that voltage on A1J1-2 goes to a nominal 15 volts.

(f) Momentarily ground remote 'low level 2' input at A1J1-8. The voltage on J1-B should be that recorded in paragraph 6.4.5(b), corresponding to 'low level 2'.

(g) Check that voltage on A1J1-3 goes to a nominal 15 volts.

(h) Disconnect A1J1-7 from +15 volts and check that voltages on J1-B, A1J1-2 and A1J1-3 return to the values measured in steps (b) and (c).

6.4.7 ALC Test: Proceed as follows:

(a) With the NAPC18 ALC/power trim module connected as detailed in set up as outlined in paragraph 6.4.1, monitor the voltage at the FWD PWR input on A1J1-4.

(b) Slowly adjust R1 of test circuit until green ALC indicator turns on. Record voltage.

(c) Adjust R1 of test circuit to give 10 volts at A1J1-4. Check that ALC HIGH control can be adjusted clockwise to turn on the ALC indicator.

(d) Adjust R1 of test circuit to give 1.0 volts at A1J1-4. Check that ALC HIGH control can be adjusted counterclockwise to turn on the ALC indicator.

(e) Set FWD PWR input voltage to that recorded in step (b). Adjust ALC HIGH control until ALC lamp turns on.

(f) Connect low power input A1J1-7 to +15 V. Check that LL2-RMT-LL1 is in LL1. Repeat steps (b) thru (e), substituting ALC LL1 control for ALC HIGH control.

(g) Set LL2-RMT-LL1 to LL2. Repeat steps (b) thru (e), substituting ALC LL2 control for ALC HIGH control.

(h) Reset NAPC18 to initial conditions of steps (a) and (b). A1J1-7 disconnected from +15 V.

(i) Monitor voltage on J1-B (this should be the level recorded in paragraph 6.4.1 step (f).)

(j) Set ALC-PRESET switch to ALC. The voltage on J1-B should remain the same and the ALC lamp should remain on.

(k) Reduce FWD PWR input voltage slightly (more than one percent). ALC lamp should turn off and the voltage on J1-B should decrease as outlined in paragraph 6.4.3(c).

(l) Increase forward power input voltage to slightly above that recorded in paragraph 6.4.7(b). The voltage on J1-B should increase as outlined in paragraph 6.4.3(e).

(m) Reset forward power voltage to that recorded in paragraph 6.4.7(b). ALC lamp should turn on and voltage on J1-B should return to that recorded in para 6.4.1(f).

6.5 INSERVICE ALIGNMENT OF MOD BAL: Due to variations within individual transmitters, it may be necessary to realign MOD BAL potentiometer A1R35 after the module has been installed. To gain access to A1R35, it is necessary to remove module mounting screws, or in the case of AMPFET 5 or AMPFET 10 transmitters, to remove standby NAPE19 modulator driver module. The following procedure should be used to align the MOD BAL control.

(a) Switch off transmitter and carry out necessary steps to gain access to A1R35 with a suitable tuning tool (see paragraph 6.5).

(b) Switch on transmitter in 'low level 2'.

(c) Adjust LL2 O/P control fully counterclockwise for a minimum ~~maximum~~ output power.

(d) The indicated output power should give a deflection of between one-quarter and one-eighth inch on the forward power meter in its lowest range. If this is the case, no adjustment of A1R35 is necessary.

(e) Should the deflection on the FWD PWR meter be greater than one-quarter inch, adjust A1R35 until a deflection between one-eighth and one-quarter inch is achieved.

(f) Should the MOD DRIVE alarm turn on, adjust A1R35 by one-quarter turn and reset the transmitter, if necessary.

(g) Repeat steps (d) thru (f) until a deflection of one-eighth to one-quarter inch is achieved with no mod drive alarm.

(h) Switch off the transmitter. Mount all modules in their normal configuration.

(i) The transmitter should now be ready for normal operation. However, it may be necessary to readjust the output level controls following realignment of the MOD BAL control.

6.6 COMPLETION OF TESTS: NAPC18 ALC/power trim modules that meet all requirements of paragraphs 6.4 and 6.5 may be considered to be satisfactory and returned to service. Upon installation in the transmitter, it may be necessary to realign module controls to meet the operational requirements of the transmitter. Refer to the installation and calibration procedures of the associated transmitter's technical instruction manual.

REPAIR

7. There are no special repair procedures for the ALC/power trim module other than normal precautions to be observed when handling CMOS devices. Gain access to the printed wiring side of printed circuit board A1 by removing the four countersunk screws on the outside of the chassis and swinging the printed circuit board on its cable harness without removing the interconnecting wires. Upon reassembly, ensure the wires are not pinched when the screws are tightened.

Table 1 Test Equipment

NOMENCLATURE	PART, MODEL, OR TYPE NUMBER (EQUIVALENTS MAY BE USED)
Digital Multimeter	3 1/2 digit, ac and dc volts ohms and amps, ±0.5% accuracy, Beckman 3010
Oscilloscope	15 MHz Tektronix Model T922
15 Vdc Power Supply	15 volts dc, 1 ampere
24 Vdc Power Supply	24 volts dc, 1 ampere
Resistor	3 - 1000 ohms
Potentiometer	2 - 1000 ohms
Clip leads	

Table 2 Wiring List - NAPC18 ALC/Power Trim Module

SOURCE	DESTINATION	CODE		SIZE	REMARKS
A1-B	J1-D	1	White	24	See Note 1
A1-C	J1-E	2	White	24	See Note 1
A1-D	J1-B	3	Core		WE38
A1-E	J1-C	-	Shield		
A1-E	J1-H	4	Black	22	See Note 2
A1-F	J1-F	5	Red	22	See Note 2
A1-H	S3-2	6	White	24	
A1-J	S2-1	7	White	24	
A1-K	S2-2	8	White	24	
A1-L	S2-5	9	White	24	
A1-M	S2-6	10	White	24	
A1-N	XDS1-Anode	11	White	24	
A1-P	S1-4	12	White	24	
A1-R	S1-1	13	White	24	
A1-S	S1-5	14	White	24	
A1-T	J1-A	15	White	24	
A1-V	S2-4	16	White	24	
A1-W	S2-3	17	White	24	
A1-X	S1-3	18	White	24	
XDS1-Cathode	Ground	-	Black	22	Jumper
S1-2	Ground	-	Black	22	Jumper
S3-1	Ground	-	Black	22	Jumper
S1-2	S1-6	Tinned Copper		24	Jumper

NOTES:

1. Wires No 1 and 2 form a twisted a pair
2. Wires No 4 and 4 form a twisted a pair

Table 3 NAPC18 Reference Designation Index

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL's PART NO.	JAN, MIL OR MFR PART NO.
-	ALC Power Trim Assembly	NAPC18	139-3118
A1	ALC Power Trim Circuit PCB Assembly	139-3115	139-3115
A1C 1	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C 2	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C 3	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C 4	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C 5	Capacitor, Ceramic, 0.47uF 10%, 50V	CCG09	CKR06BX474KL
A1C 6	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C 7	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C 8	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C 9	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KL
A1C10	Capacitor, Ceramic, 0.001uF 10%, 200V	CCG01	CKR05BX102KL
A1C11	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C12	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C13	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C14	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C15	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C16	Capacitor, Mica, 1000pF 2%, 500V	CB37	CM06FD102G03
A1C17	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C18	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM
A1C19	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C20	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C21	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM
A1C22	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL
A1C23	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C24	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1C25	Capacitor, Ceramic, 0.1uF 10%, 100V	CCG07	CKR06BX104KL
A1CR1	Diode, General Purpose, Small Signal	QAP29	1N4938
A1CR2	Diode, General Purpose, Small Signal	QAP29	1N4938
A1CR3	Diode, General Purpose, Small Signal	QAP29	1N4938
A1CR4	Diode, General Purpose, Small Signal	QAP29	1N4938
A1J1	MTA, Square Post Header Assy, 12-pin	JU21	1-640383-2
A1K1	Relay, Latching, 24Vdc Coil	KB20	G2NK-2124P-DC24
A1Q1	Transistor, NPN	QAP06	2N2222
A1Q2	Transistor, Field Effect, N Channel	QAP15	IRFF120
A1Q3	Transistor, Field Effect, N Channel	QAP15	IRFF120
A1R 1	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 2	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 3	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 4	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 5	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 6	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R 7	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R 8	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G
A1R 9	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G
A1R10	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G
A1R11	Resistor, Film, 180K ohms, 2% 1/2W	RAP18	RL20S184G
A1R12	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G

Table 3 NAPC18 Reference Designation Index (Continued)

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL's PART NO.	JAN, MIL OR MFR PART NO.
A1R13	Resistor, Variable, 100K ohms, 3/4W	RW33	43P104
A1R14	Resistor, Variable, 100K ohms, 3/4W	RW33	43P104
A1R15	Resistor, Variable, 100K ohms, 3/4W	RW33	43P104
A1R16	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R17	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R18	Resistor, Film, 56K ohms, 2% 1/2W	RAP16	RL20S563G
A1R19	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R20	Resistor, Film, 12K ohms, 2% 1/2W	RD08	RL20S123G
A1R21	Resistor, Film, 100 ohms, 2% 1/2W	RAP05	RL20S101G
A1R22	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R23	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R24	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R25	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R26	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G
A1R27	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R28	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R29	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R30	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G
A1R31	Not Used		
A1R32	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G
A1R33	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R34	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R35	Resistor, Variable, 10K ohms, 1/2W	RW08	63P103T000
A1R36	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R37	Resistor, Film, 100K ohms, 1% 1/2W	RP28	M22D-100K Ohms-1%
A1R38	Resistor, Film, 49.9K ohms, 1% 1/2W	RS32	RN60D4992F
A1R39	Resistor, Film, 24.9K ohms, 1% 1/2W	RS33	RN60D2492F
A1R40	Resistor, Film, 12.4K ohms, 1% 1/2W	RQ29	M22D-12.4K Ohms-1%
A1R41	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G
A1R42	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G
A1R43	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R44	Resistor, Variable, 10K ohms, 3/4W	RW32	43P103
A1R45	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R46	Resistor, Variable, 10K ohms, 3/4W	RW32	43P103
A1R47	Resistor, Film, 330 ohms, 2% 1/2W	RAP07	RL20S331G
A1R48	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1R49	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G
A1U 1	IC, CMOS, Quad, 2-input AND Gates	UB20	MC14081BAL
A1U 2	IC, CMOS, Quad, 2-input OR Gates	UB22	MC14071BAL
A1U 3	IC, CMOS, Quad, 2-input NAND Gates	UB03	MC14011BAL
A1U 4	IC, Operational Amplifiers, Quad	UC15	MC3403L
A1U 5	IC, CMOS, Quad, Analog Switch	UB10	MC14066BAL
A1U 6	IC, Comparator, Quad	UL02	MC3302L
A1U 7	IC, CMOS, Oscillator/Timer	UB12	MC14541BAL
A1U 8	IC, CMOS, Binary Up/Down Counter	UC10	MC14516BAL
A1U 9	IC, CMOS, Quad, Analog Switch	UB10	MC14066BAL
A1U10	IC, Operational Amplifiers, Quad	UC15	MC3403L
A1U11	IC, CMOS, Quad, 2-I/P NAND Schmitt Trig	UD01	MC14093BAL

Table 3 NAPC18 Reference Designation Index (Continued)

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL's PART NO.	JAN, MIL OR MFR PART NO.
A1U12	IC, CMOS, Quad, 2-input NAND Gates	UB03	MC14011BAL
A1XU 1	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 2	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 3	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 4	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 5	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 6	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 7	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU 8	Socket, Integrated Circuit, 16-pin	UC03	640358-1
A1XU 9	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU10	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU11	Socket, Integrated Circuit, 14-pin	UC02	640357-1
A1XU12	Socket, Integrated Circuit, 14-pin	UC02	640357-1
DS1	Diode, Light Emitting, Green	QK12	5082-4992
J1	Connector, 7-pin, Panel Mount	J001	126-198
S1	Switch, Toggle, 2PDT, Centre Off	SA22	MSTE-206P
S2	Switch, Toggle, 2PDT	SA21	MSTE-206N
S3	Switch, Toggle, 1PDT	SA26	MSTE-106D
XDS1	Socket, LED	QK25	PS-200-B

Table 4 NAPC18 Parts Per Unit Index

NAUTEL's PART NO.	NAME OF PART AND DESCRIPTION	JAN, MIL OR MFR PART NO.	OEM CODE	TOTAL IDENT PARTS
NAPC18	ALC Power Trim Assembly	139-3118	37338	-
139-3115	ALC Power Trim Circuit PCB Assembly	139-3115	37338	1
CB37	Capacitor, Mica, 1000pF 2%, 500V	CM06FD102G03	14655	1
CCG01	Capacitor, Ceramic, 0.001uF 10%, 200V	CKR05BX102KL	56289	2
CCG04	Capacitor, Ceramic, 0.01uF 10%, 100V	CKR05BX103KL	56289	6
CCG07	Capacitor, Ceramic, 0.1uF 10%, 100V	CKR06BX104KL	56289	7
CCG09	Capacitor, Ceramic, 0.47uF 10%, 50V	CKR06BX474KL	56289	1
CCP19	Capacitor, Tantalum, 6.8uF 10%, 35V	CSR13F685KM	56289	1
CCP24	Capacitor, Tantalum, 1.0uF 10%, 50V	CSR13G105KM	56289	7
J001	Connector, 7-pin, Panel Mount	126-198	02660	1
JU21	MTA, Square Post Header Assy, 12-pin	1-640383-2	09482	1
KB20	Relay, Latching, 24Vdc Coil	G2NK-2124P-DC24	34361	1
QAP06	Transistor, NPN	2N2222	04713	1
QAP15	Transistor, Field Effect, N Channel	IRFF120	81483	2
QAP29	Diode, General Purpose, Small Signal	1N4938	01295	4
QK12	Diode, Light Emitting, Green	5082-4992	50434	1
QK25	Socket, LED	PS-200-B	15513	1
RAP05	Resistor, Film, 100 ohms, 2% 1/2W	RL20S101G	36002	1
RAP07	Resistor, Film, 330 ohms, 2% 1/2W	RL20S331G	36002	1
RAP09	Resistor, Film, 1000 ohms, 2% 1/2W	RL20S102G	36002	6
RAP11	Resistor, Film, 3300 ohms, 2% 1/2W	RL20S332G	36002	1
RAP12	Resistor, Film, 5600 ohms, 2% 1/2W	RL20S562G	36002	2
RAP13	Resistor, Film, 10K ohms, 2% 1/2W	RL20S103G	36002	8
RAP15	Resistor, Film, 33K ohms, 2% 1/2W	RL20S333G	36002	3
RAP16	Resistor, Film, 56K ohms, 2% 1/2W	RL20S563G	36002	1
RAP17	Resistor, Film, 100K ohms, 2% 1/2W	RL20S104G	36002	13
RAP18	Resistor, Film, 180K ohms, 2% 1/2W	RL20S184G	36002	1
RD08	Resistor, Film, 12K ohms, 2% 1/2W	RL20S123G	36002	1
RP28	Resistor, Film, 100K ohms, 1% 1/2W	M22D-100K Ohms-1%	36002	1
RQ29	Resistor, Film, 12.4K ohms, 1% 1/2W	M22D-12.4K Ohms-1%	36002	1
RS32	Resistor, Film, 49.9K ohms, 1% 1/2W	RN60D4992F	36002	1
RS33	Resistor, Film, 24.9K ohms, 1% 1/2W	RN60D2492F	36002	1
RW08	Resistor, Variable, 10K ohms, 1/2W	63P103T000	02111	1
RW32	Resistor, Variable, 10K ohms, 3/4W	43P103	02111	2
RW33	Resistor, Variable, 100K ohms, 3/4W	43P104	02111	3
SA21	Switch, Toggle, 2PDT	MSTE-206N	95146	1
SA22	Switch, Toggle, 2PDT, Centre Off	MSTE-206P	95146	1
SA26	Switch, Toggle, 1PDT	MSTE-106D	95146	1
UB03	IC, CMOS, Quad, 2-input NAND Gates	MC14011BAL	04713	2
UB10	IC, CMOS, Quad, Analog Switch	MC14066BAL	04713	2
UB12	IC, CMOS, Oscillator/Timer	MC14541BAL	04713	1
UB20	IC, CMOS, Quad, 2-input AND Gates	MC14081BAL	04713	1
UB22	IC, CMOS, Quad, 2-input OR Gates	MC14071BAL	04713	1
UC02	Socket, Integrated Circuit, 14-pin	640357-1	00779	11
UC03	Socket, Integrated Circuit, 16-pin	640358-1	00779	1
UC10	IC, CMOS, Binary Up/Down Counter	MC14516BAL	04713	1
UC15	IC, Operational Amplifiers, Quad	MC3403L	04713	2
UD01	IC, CMOS, Quad, 2-I/P NAND Schmitt Trig	MC14093BAL	04713	1
UL02	IC, Comparator, Quad	MC3302L	04713	1

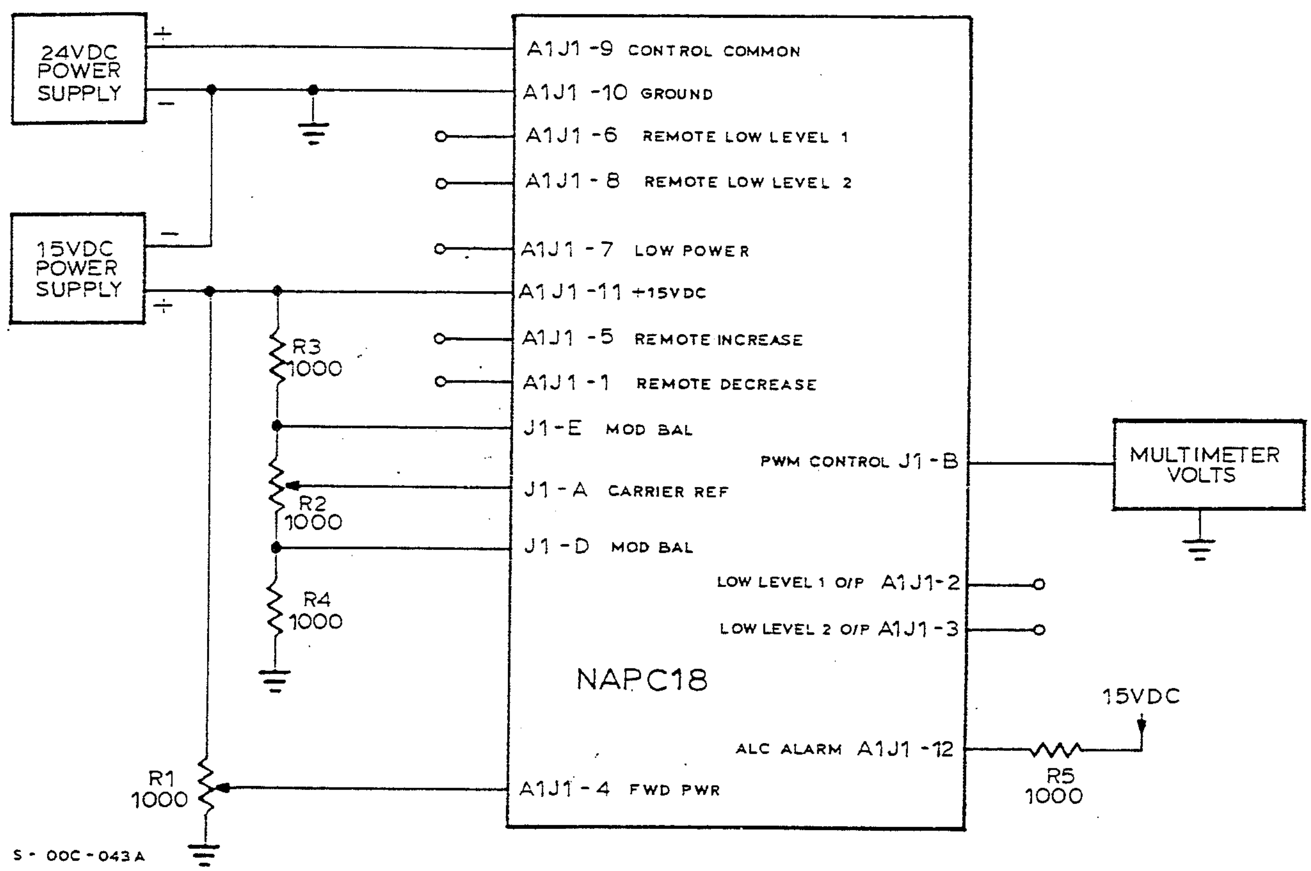

Figure 1 Test Setup

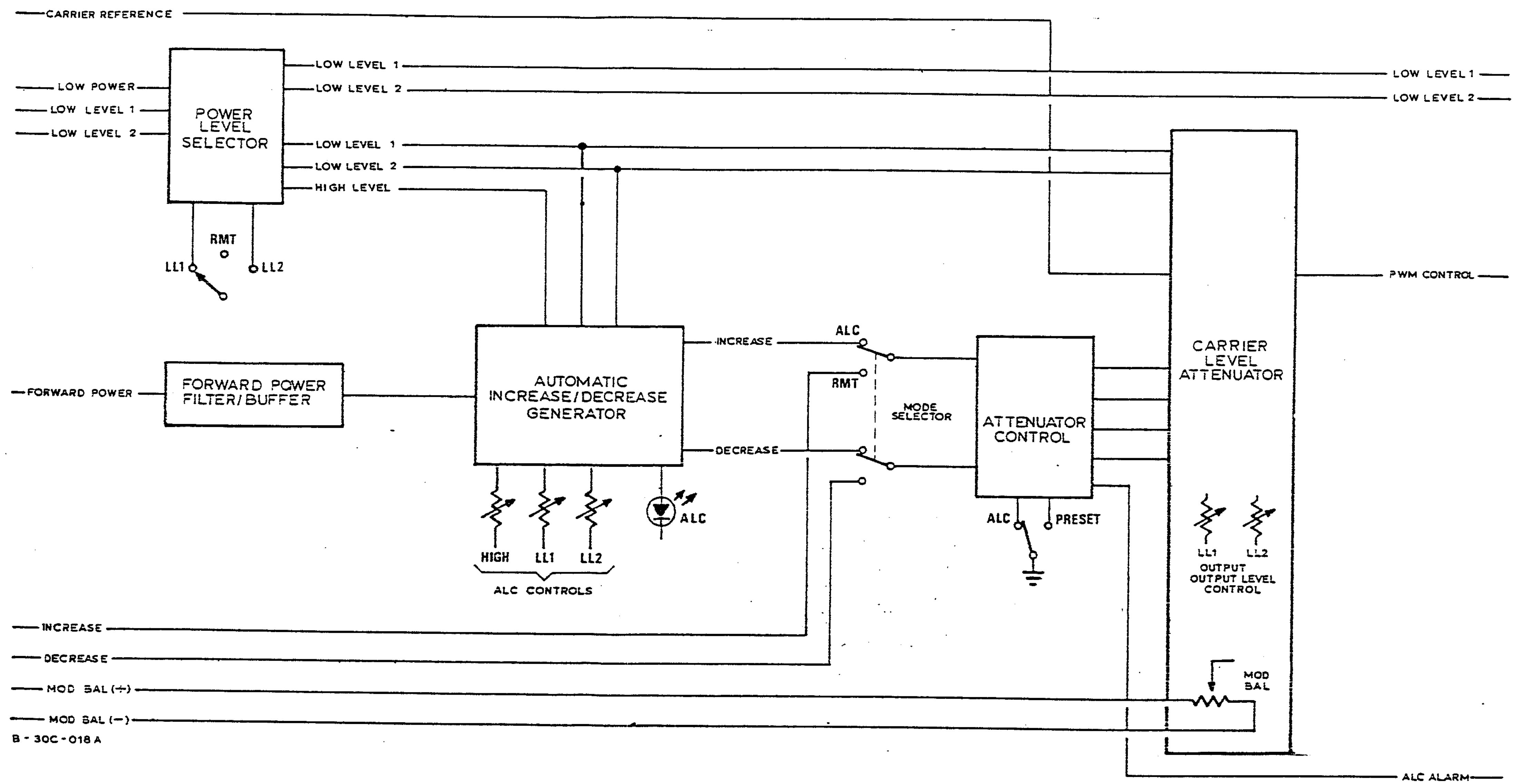

Figure FO-1 Block Diagram - NAPC18 ALC Power Trim Module

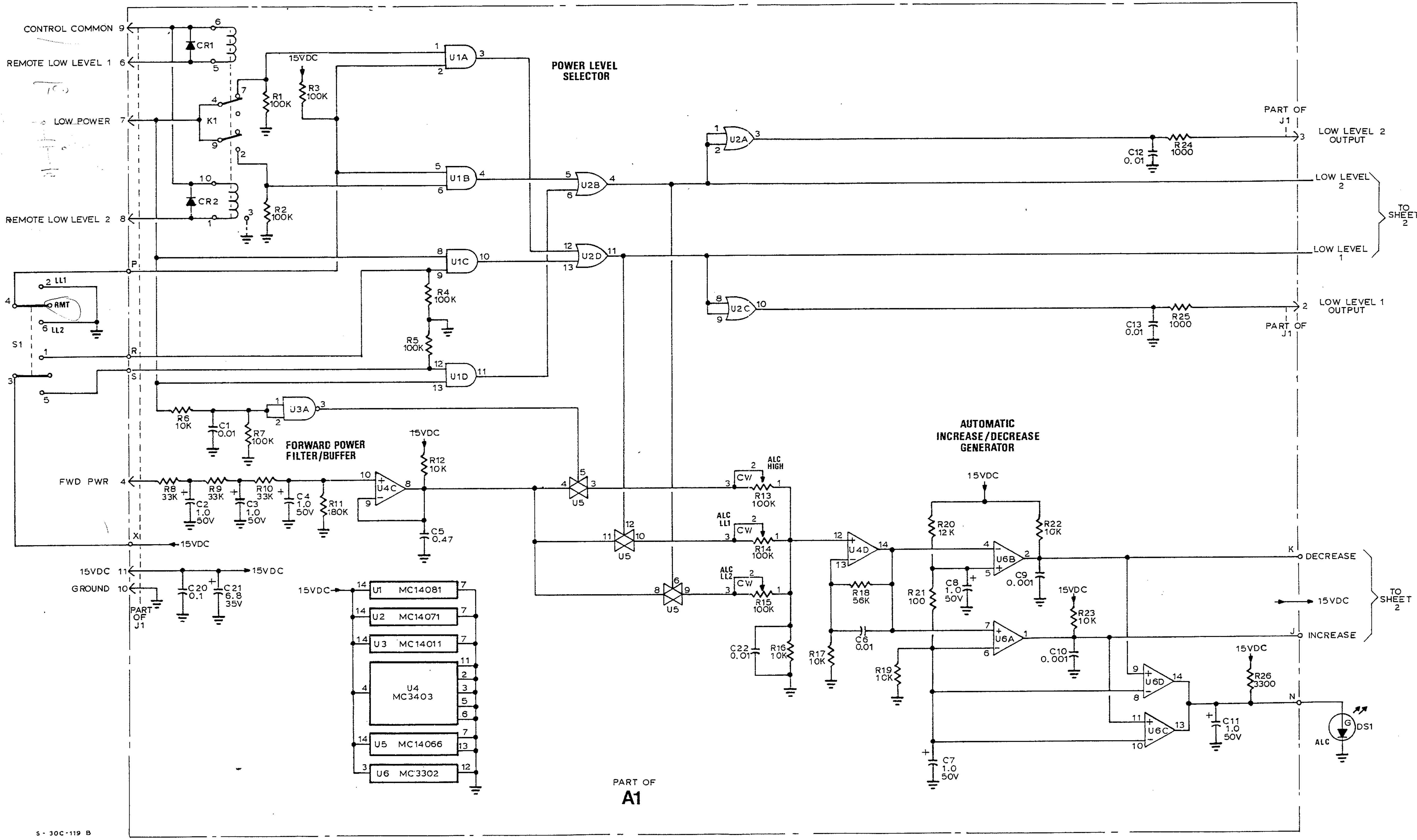

Figure FO-2 Electrical Schematic - NAPC18 ALC Power Trim Module (Sheet 1 of 2)

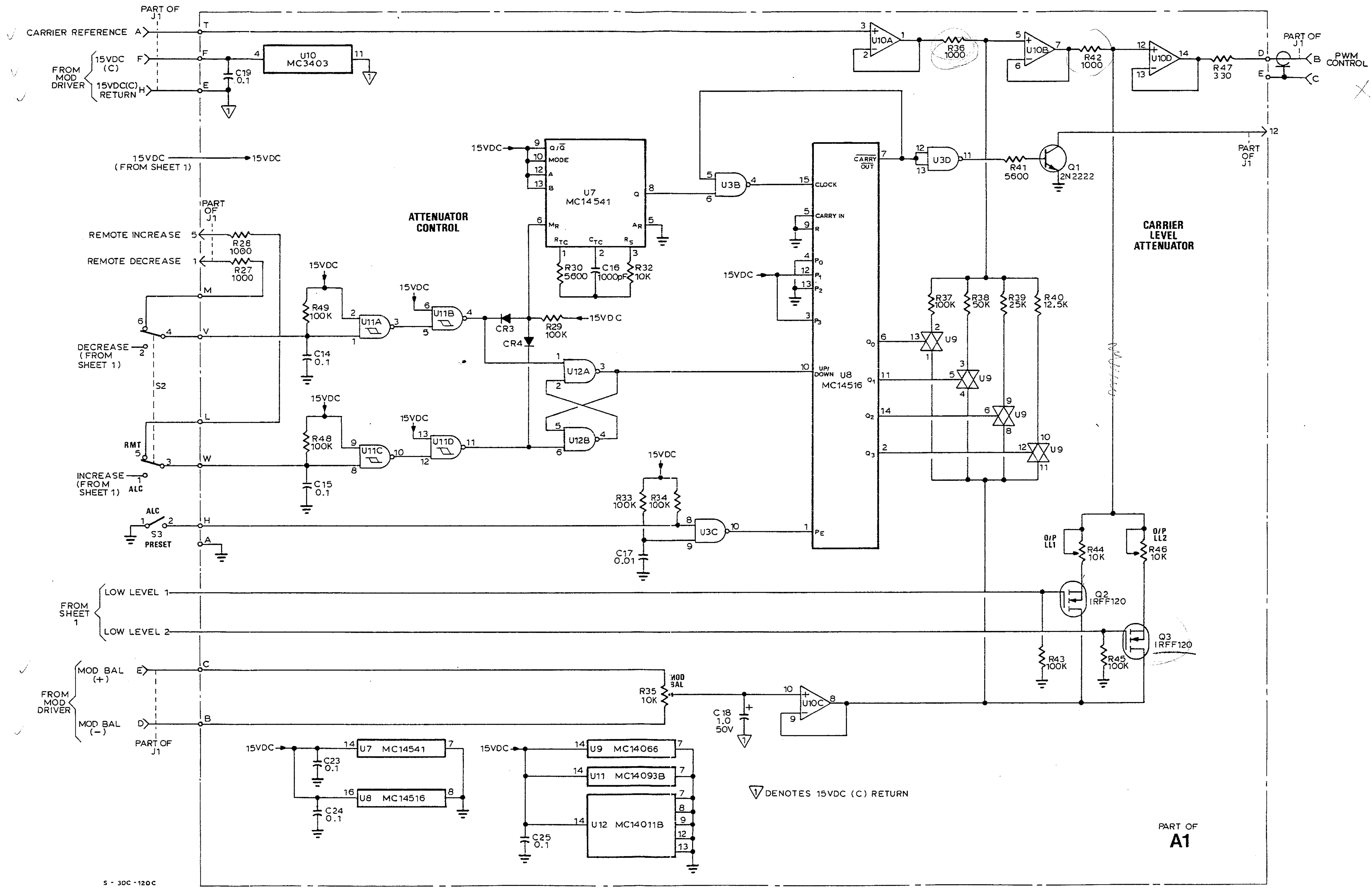

Figure FO-3 Electrical Schematic - NAPC18 ALC Power Trim Module (Sheet 2 of 2)

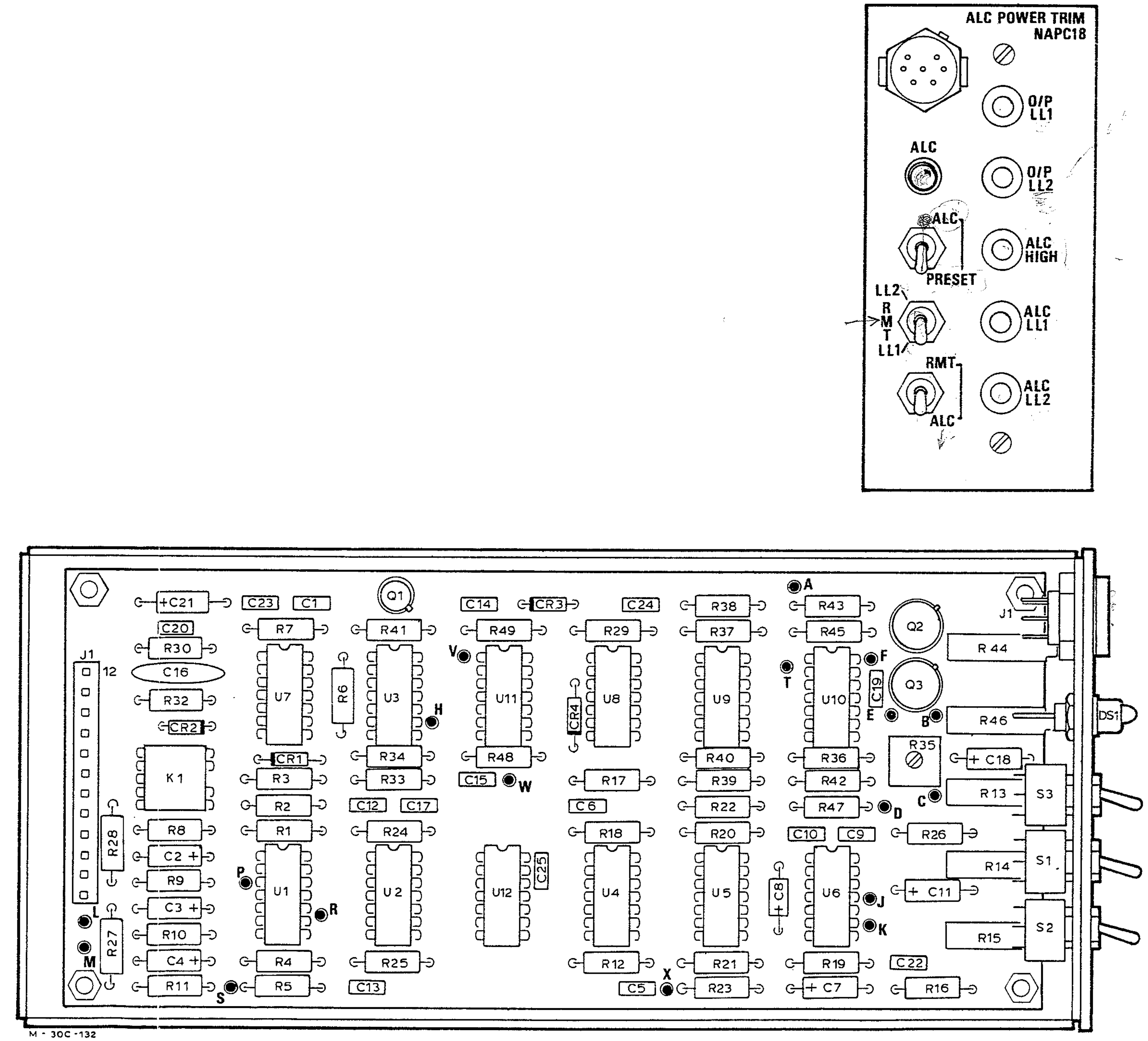

Figure FO-4 Assembly Detail - NAPC18 ALC Power Trim Module