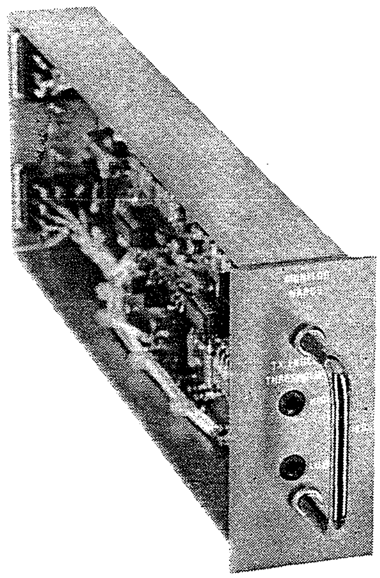
SERVICE INSTRUCTION

NAPC5

MONITOR MODULE



NAUTICAL ELECTRONIC LABORATORIES LIMITED

RR1 TANTALLON, HACKETT'S COVE

HALIFAX COUNTY, NOVA SCOTIA, CANADA

B0J 3J0

LIST OF EFFECTIVE PAGES

The list of effective pages lists the status of all pages in this manual. Pages of the original issue are identified by a zero in the Change No. column. Pages subsequently changed are identified by the date of the change number. On a changed page, the text affected by the latest change is indicated by a vertical bar in the margin opposite the changed material.

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INTRODUCTION

1. The NAPC5 monitor module contains circuitry which monitors critical functions of Nautel's AMPFET series of transmitters and generates control signals to protect the transmitter when a fault condition exists. It also generates alarm signals for local and external monitoring, to alert users and maintainers a fault condition exists. Trouble shooting and repair of the module is performed on a work bench independent of it's associated transmitter. This document provides the information required for a competent 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 NAPC5 monitor module utilizes a formed, metal box as the module chassis. Two electrical connectors and a guide pin are installed on the rear of the module; and a stamped panel containing a handle and two transmitter fault threshold adjustment access holes is installed on the front. All electrical components, except a fuse which is mounted on the chassis, are mounted on a printed circuit board (A1) and are interconnected by the circuit board's printed pattern. Interconnecting wiring from the connectors and the fuse is connected by soldering to standoff terminals on the circuit board. Refer to figure 3 for the assembly detail of the monitor module.

THEORY OF OPERATION

4. The NAPC5 monitor module monitors the critical functions of its associated AMPFET transmitter and generates control signals to protect the transmitter when a fault condition exists and produces fault alarm signals to alert users/maintainers that a fault exists. Refer to figure 3 for the electrical schematic.

4.1 SWR ALARM: A dc 'refl pwr' signal, which is proportional to the level of the reflected power sensed by the associated transmitter's rf power probe, is applied thru P2-10 to the inverting gate of comparator U1B.

4.1.1 When the reflected power is acceptable, the dc 'refl pwr' signal will be less positive than the dc voltage on the non-inverting gate of U1B, provided by voltage divider R25/R27/R28. U1B's output will be an open circuit to ground and 15 volts dc will be applied thru R30 to the inverting gate of U1D. The inverting gate of U1-D will be more positive than the voltage on its non-inverting gate, provided by voltage divider R31/R32. U1D's output will be a low resistance (forward diode resistance) to ground. The junction of R33/R34 will be clamped to ground, causing transistor Q5 to be reverse biased (turned off). The 'SWR alarm' output on P2-9 will be an open circuit.

4.1.2 When the reflected power is not acceptable, the dc 'refl pwr' signal will be more positive than the dc voltage on the non-inverting gate of U1B. U1B's output will be a low impedance (forward diode resistance) to ground causing the inverting gate of U1D to be clamped to ground. U1D's output will be an open circuit to ground and 15 volts dc will be applied to the base of transistor Q5. Q5 will be forward biased (turned on), and a ground will be applied to P2-9 as the 'SWR alarm' signal to the transmitters SWR ALARM lamp.

4.2 BUFFERED REFLECTED POWER: The dc 'refl pwr' signal, which is proportional to the level of reflected power sensed by the associated transmitter's rf power probe, from P2-10; is also applied thru voltage divider R23/R24 to the non-inverting gate of comparator U1A, which is connected as a follower amplifier. The dc 'refl pwr' signal is smoothed to the average value of the detected reflected power by capacitor C5 and resistor R26. The output of U1A will follow changes in the 'refl pwr' signal and will be a dc voltage which is 0.924 of its level. U1A's output is applied to P1-4 as the 'buffered refl pwr' signal for application to a monitoring circuit which is remote from the associated transmitter.

4.3 RF DRIVE FAULT DETECTOR: A dc 'detected rf drive' signal, which is proportional to the level of the rf drive being applied to the associated transmitters power amplifiers, is applied thru P1-10 to the non-inverting gate of comparator U1C.

4.3.1 When the rf drive level is acceptable, the dc 'detected rf drive' signal will be more positive than the dc voltage (rf drive fault threshold) on the inverting gate of U1C, provided by voltage divider R3/R4. U1C's output will be an open circuit to ground and 15 volts dc will be applied thru R5/R6 to the base of transistor Q1. Q1 will be reverse biased (turned off), which in turn will cause the base/emitter junction of transistor Q2 to be reverse biased. Q2 will be turned off and 15 volts dc will be applied thru R8 and P1-8 as the 'mod drive enable' signal. A 15 volt dc 'mod drive enable' will enable the modulation drive from the modulation driver module in the associated transmitter. When Q1 is turned off, 15 volts dc is removed from P1-11, and a 'rf drive alarm' signal will not be applied to P1-11.

4.3.2 When the rf drive level falls below the acceptable limit, the dc 'detected rf drive' signal will be less positive than the dc voltage (rf drive fault threshold) on the inverting gate of U1C. U1C's output will be a low impedance (forward diode resistance) to ground. The junction of R5/R6 will be clamped to ground causing transistor Q1 it to be forward biased (turned on), which in turn will cause the base/emitter junction of transistor Q2 to be forward biased. Q2 will be turned on and a ground will be applied to P1-8 as the 'mod drive enable' signal. A ground potential 'mod drive enable' signal will inhibit the modulation drive from the modulation driver module in the associated transmitter. When Q1 is turned on, 15 volts dc is applied thru Q1 to P1-11 as the 'rf drive alarm' signal. A 15 volt dc 'rf drive alarm' signal will turn on the associated transmitter's RF DRIVE ALARM lamp.

4.4 TRANSMITTER FAULT DETECTOR: A dc 'fwd power' signal, which is proportional to the level of forward rf power sensed by the associated transmitter's rf power probe, is applied thru P2-1 to the non-inverting gates of comparators U2C and U2B. The dc 'fwd power' signal is filtered of any modulation component and smoothed to the average value of the detected forward power by capacitor C3 and resistor R11.

4.4.1 High Power Operation: When the associated transmitter is operating in its high power mode, a 'reduce power' signal will not be applied to P2-3 and transistor Q3 will be reverse biased (turned off). HIGH POWER potentiometer R19, of voltage divider R15/R19/R20 is adjusted to apply a threshold voltage to the inverting gate of U2C; which represents the minimum, high, forward power acceptable before a fault alarm is generated.

4.4.1.1 When the dc 'fwd power' signal is more positive than the threshold voltage on the inverting gate of U2C, U2C's output will be an open circuit to ground. 15 volts dc will be applied thru R21 to the base of transistor Q4 causing it to be forward biased (turned on). A ground will be applied to P2-4 as the 'tx fault alarm' signal. When a ground potential 'tx fault alarm' signal is applied to P2-4, it energizes the associated transmitter's tx fault relay, which inhibits local and remote transmitter fault alarm indications.

4.4.1.2 When the dc 'fwd power' signal is less positive than the threshold voltage on the inverting gate of U2C, indicating a loss of rf power output, U2C's output will be a low impedance (forward diode resistance) to ground. The base of Q4 will be clamped to ground, causing it to be reverse biased (turned off). The 'tx fault alarm' signal will be removed from P2-4. When the 'tx fault alarm' signal is removed from P2-4, the associated transmitter's tx fault relay will de-energize causing local and remote transmitter fault alarm indications to turn on.

4.4.2 Low Power Operation: When the associated transmitter is operating in its low power mode, a 15 volt dc 'reduce power' signal will be applied to P2-3 and transistor Q3 will be forward biased (turned on). The inverting gate of U2C will be clamped to ground and its output will be an open circuit to ground. LOW POWER potentiometer R17, of voltage divider R16/R17/R18 is adjusted to apply a threshold voltage to the inverting gate of U2B; which represents the minimum, low, forward power acceptable before a fault alarm is generated.

4.4.2.1 When the dc 'fwd power' signal is more positive than the threshold voltage on the inverting gate of U2B, U2B's output will be an open circuit to ground. 15 volts dc will be applied thru R21 to the base of transistor Q4, causing it to be forward biased (turned on). A ground will be applied to P2-4 as the 'tx fault alarm' signal. When a ground potential 'tx fault alarm' signal is applied to P2-4, it energizes the associated transmitter's tx fault relay, which inhibits local and remote transmitter fault alarm indications.

4.4.2.2 When the dc 'fwd power' signal is less positive than the threshold voltage on the inverting gate of U2B, indicating a loss of rf power output, U2B's output will be a low impedance (forward diode resistance) to ground. The base of Q4 will be clamped to ground, causing it to be reverse biased (turned off). The 'tx fault alarm' signal will be removed from P2-4. When the 'tx fault alarm' signal is removed from P2-4, the associated transmitter's tx fault relay will de-energize causing local and remote transmitter fault alarm indications to turn on.

4.5 BUFFERED FORWARD POWER: The dc 'fwd power' signal, which is proportional to the level of forward power sensed by the associated transmitter's rf power probe, from P2-1; is also applied to the non-inverting gate of comparator U2A which is connected as a follower amplifier. The output of U2A will follow changes in the 'buffered fwd pwr' signal and will be a dc voltage which is 0.924 of its level (determined by voltage divider R9/R10). U2A's output is applied to P1-1 as the 'buffered fwd pwr' signal for application to a monitoring circuit which is remote from the associated transmitter.

4.6 PA FAILURE DETECTOR: 24 volts dc is applied thru P2-5, L3/R48 and P2-8 to three PA fault relay coils in the modulator module of the associated transmitter.

4.6.1 When a power amplifier fault signal, from PA fault detectors in the rf drive circuit of the associated transmitter, is not present; the relays in the modulator module of the associated transmitter will not be energized and current will not flow thru L3/R48. The control gate of programmeable unijunction transistor Q6 will be reversed biased and it will not be conducting. 15 volts dc will be applied thru R51 to the inverting gate of comparator U3C causing its output to be a low impedance (forward diode resistance) to ground. A ground potential 'rf drive enable' signal will be applied thru P2-7 to enable the rf drive in the rf driver of the associated transmitter.

4.6.2 When a power amplifier fault signal, from the PA fault detectors in the rf drive circuit of the associated transmitter, occurs; a ground will be applied to a relay in the modulator module of the associated transmitter and current will flow thru L3/R48. During the initial current surge and prior to the relay energizing, a voltage spike will be developed across L3 which will forward bias programmeable unijunction transistor Q6. Q6 will turn on, discharge capacitor C12 and apply a ground to the inverting gate of comparator U3C. U3C's output will be an open circuit to ground. Q6 will turn off immediately after the initial voltage spike from L3, but the inverting gate of U3C will be held less positive than its non-inverting gate until C12 charges to a voltage greater than that provided by voltage divider R52/R53. The ground potential 'rf drive enable' signal will be removed from P2-7 and the rf drive from the rf driver of the associated transmitter will be inhibited for approximately 60 milliseconds. The removal of the 'rf drive enable' signal will ensure there is no rf output while the contacts of the PA fault relays in the modulator of the associated transmitter are making and breaking.

4.7 CURRENT PROBE: A rf current probe in the associated transmitter provides a dc voltage which is representative of the rf output current being produced by the transmitter's power amplifiers. This voltage is applied thru P1-3 to the non-inverting gates of comparators U3B and U3A as the 'rf current' signal. U3B provides instantaneous response to excessive over-current conditions and U3C provides a delayed response to marginal over-current conditions.

4.7.1 Normal Condition: When the rf current level is less than the acceptable limits, the 'rf current' signal on the non-inverting gates of U3B and U3A will be less positive than the voltages provided by voltage divider R36/R37/R38, on their inverting gates. U3B's output will be a low impedance to ground (forward diode resistance), clamping the anode of diode CR2 to ground. U3A's output will be a low impedance to ground (forward diode resistance), causing the non-inverting gate of U3D to be clamped to ground after C8, C9 and C10 have discharged. U3D's output will be a low impedance to ground (forward diode resistance), clamping the anode of diode CR3 to ground. When the anodes of CR2 and CR3 are both clamped to ground, 'rf current cutback' signal will not be produced.

4.7.2 Marginal Over-current Condition: When the 'rf current' signal's voltage is marginally in excess of the acceptable rf current limit (more than 3.7 volts dc but less than 5.7 volts dc), the non-inverting gate of U3B will be less positive than its inverting gate. U3B's output will be a low impedance to ground (forward diode resistance), clamping the anode of diode CR2 to ground. The non-inverting gate of U3A will be more positive than its inverting gate and U3A's output will be an open circuit to ground. Capacitors C8, C9 and C10 will charge towards 15 volts dc thru R40, R41, R42 and R43. If the marginal over-current condition remains until C10 has charged to approximately 3.2 volts dc, the non-inverting gate of U3D will go more positive than the voltage provided by voltage divider R45/R46 on its inverting gate. U3D's output will be an open circuit to ground, and 15 volts dc will be applied thru R47 and CR3 to P1-6 as the 'rf current cutback' signal. The 'rf current cutback' signal will activate a modulation drive cutback circuit in the modulator driver of the associated transmitter.

4.7.3 Excessive Over-current Condition: When the 'rf current' signal's voltage is greatly in excess of the acceptable rf current limit (more than 5.7 volts dc) the non-inverting gate of U3B will be more positive than its inverting gate and U3C's output will instantaneously switch to an open circuit to ground. 15 volts dc will be applied thru R39 and CR2 to P1-6 as the 'rf current cutback' signal. The 'rf current cutback' signal will activate a modulation drive cutback circuit in the modulator driver of the associated transmitter.

TROUBLESHOOTING

5. Troubleshooting of monitor modules that are defective or are suspected of being defective consists of performing a visual inspection and then conducting a functional test to isolate the defective components.

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

5.2 VISUAL INSPECTION: It is recommended that a visual inspection be performed on the monitor module prior to applying power. Inspect the module for the following:

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

(b) Verify fuse F1 is the correct value and is not defective.

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

(d) Verify connectors P1 and P2 do not contain damaged or loose pins and that they are securely fastened to the chassis.

(e) Verify the guide pin is present and that it is securely fastened.

(f) Verify all wiring insulation is not pinched, frayed, broken or otherwise damaged.

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

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

(i) Verify all fastening hardware is securely tightened.

5.3 FUNCTIONAL TEST: Functional testing of the monitor module is the recommended first step in troubleshooting a defective module and 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 testing and adjustment of the monitor module is performed with the module installed in the transmitter it will be used in. Instructions are provided in the associated transmitter's instruction manual.

(a) Verify the visual inspection has been completed.

(b) Connect the NAPC5 monitor module to the test setup depicted in figure 1.

(c) Switch on test setup's 15 volt dc power supply and verify its output is 14.3 volts dc.

5.3.1 SWR Detector/Buffered Reflected Power Test: Check the function of the SWR detector and buffered refelected power circuits as follows:

(a) Connect a variable dc power supply that has been preset to 0.0 volts dc between terminal 7(+) of the printed circuit board and chassis ground.

(b) Connect a digital voltmeter, set to measure dc voltage, between terminal 6(+) of the printed circuit board and chassis ground.

(c) Digital voltmeter indication shall be 0.0 volts dc and test setup's SWR ALARM lamp shall not be turned on.

(d) Slowly increase output of variable dc power supply until test setup's SWR ALARM lamp just turns on.

(e) Output of dc power supply shall be 1.04 $\pm$ 0.4 volts dc.

(f) Digital voltmeter indication shall be 0.924 times reading obtained in step (e) plus/minus 5%.

(g) Disconnect variable dc power supply and digital voltmeter.

5.3.2 RF Drive Fault Detector Test: Check the function of the rf drive fault detector circuit as follows:

(a) Connect a variable dc power supply that has been preset to approximately 0.0 volts dc between terminal 16(+) of printed circuit board A1 and chassis ground.

(b) Connect a digital voltmeter, set to measure dc voltage, between terminal 13(+) of printed circuit board A1 and chassis ground.

(c) Digital voltmeter indication shall be approximately 0.0 volts dc and test setup's RF DRIVE ALARM lamp shall be turned on.

(d) Slowly increase output of variable dc power supply until test setup's RF DRIVE ALARM lamp just turns off. Digital voltmeter indiction shall simultaneously indicate approximately 15 volts dc.

(e) Output of dc power supply shall be 34.0 $\pm$ 1.0 volts dc.

(f) Disconnect variable dc power supply and digital voltmeter.

5.3.3 Transmitter Fault Detector/Buffered Forward Power Test: Check the function of the transmitter fault detector and buffered forward power circuit as follows:

(a) Connect a variable dc power supply that has been preset to 5.56 volts dc between terminal 18(+) of printed circuit board A1 and chassis ground.

(b) Connect a digital voltmeter, set to measure dc voltage, between terminal 9(+) of printed circuit board A1 and chassis ground.

(c) Set test setup's REDUCE POWER switch to its open (off) position.

(d) Set HIGH POWER potentiometer R19 fully counter clockwise.

(e) Set LOW POWER potentiometer R17 fully counter clockwise.

(f) Test setup's TX FAULT ALARM lamp shall be turned on and digital voltmeter indication shall be 5.14 volts dc plus/minus 5%.

NOTE
Digital voltmeter indication shall follow changes in the output of the variable dc power supply. Digital voltmeter indication shall be 0.924 $\pm$5% of the power supply output.

(g) Set output of variable dc power supply to 4.5 volts dc.

(h) Test setup's TX FAULT ALARM lamp shall remain on.

(i) Adjust HIGH POWER potentiometer R19 clockwise until test setup's TX FAULT ALARM lamp just turns off.

(i) Adjust HIGH POWER potentiometer R19 counter clockwise until test setup's TX FAULT ALARM lamp just turns on.

(j) Set test setup's REDUCE POWER switch to its closed (on) position.

(k) Set output of variable dc power supply to 2.8 volts dc.

(l) Test setup's TX FAULT ALARM lamp shall remain on.

(m) Adjust LOW POWER potentiometer R17 clockwise until test setup's TX FAULT ALARM lamp just turns off.

(n) Adjust LOW POWER potentiometer R17 counter clockwise until test setup's TX FAULT ALARM lamp just turns on.

(o) Disconnect variable dc power supply and digital voltmeter.

5.3.4 PA Failure Detector Test: Check the function of the power amplifier failure detector circuit as follows:

(a) Connect a variable dc power supply that has been preset to 24.0 volts dc between terminal 4(+) of the printed circuit board and chassis ground.

(b) Set test setup's PA FAIL switch to its open (off) position.

(c) Connect an oscilloscope, set to read a 15 volt peak-to-peak waveform with a time base of 100 milliseconds, between terminal 12 of printed circuit board A1 and chassis ground.

(d) Oscilloscope trace should indicate zero volts dc.

(e) Observe oscilloscope waveform and simultaneously set test setup's PA FAIL switch to its closed (on) position.

(f) Oscilloscope trace shall indicate +15 volts dc for 60 $\pm$5 milliseconds immediately after test setup's PA FAIL switch is closed.

(g) Disconnect variable dc power supply and oscilloscope.

5.3.5 Current Probe Test: Check the function of the current probe circuit as follows:

(a) Connect a variable dc power supply that has been preset to 0.0 volts dc between terminal 1(+) of printed circuit board A1 and chassis ground.

(b) Connect a digital voltmeter, set to measure dc voltage, between terminal 10(+) of printed circuit board A1 and chassis ground.

(c) Digital voltmeter indication shall be 0.0 volts dc.

(d) Slowly increase output of variable dc power supply until digital voltmeter indication switches to 15 volts dc.

(e) Output of dc power supply shall be 3.45 $\pm$ 0.1 volts dc.

(f) Verify the marginal over-current portion of the current probe is providing the 15 volts dc by connecting the digital voltmeter between the junction of R39/CR2 and chassis ground.

(g) Digital voltmeter indication in step (f) shall be zero volts dc.

(h) Continue to slowly increase the output of the variable dc power supply until digital voltmeter indication switches to 15 volts dc.

(i) Output of dc power supply shall be 5.35 $\pm$ 0.1 volts dc.

(j) Disconnect variable dc power supply and digital voltmeter.

5.4 COMPLETION OF TESTS: On the complettion of the functional tests, switch off the 15 volt dc power supply and disconnect the monitor module from the test setup.

REPAIR

6. There are no special repair instructions. Observe normal care and precautions when handling CMOS solid state devices and removing and replacing components soldered to the printed pattern of printed circuit board A1.

NOTE

Refer to table 2 for interconnecting wiring information and to figure 4 for assembly detail of the monitor module.

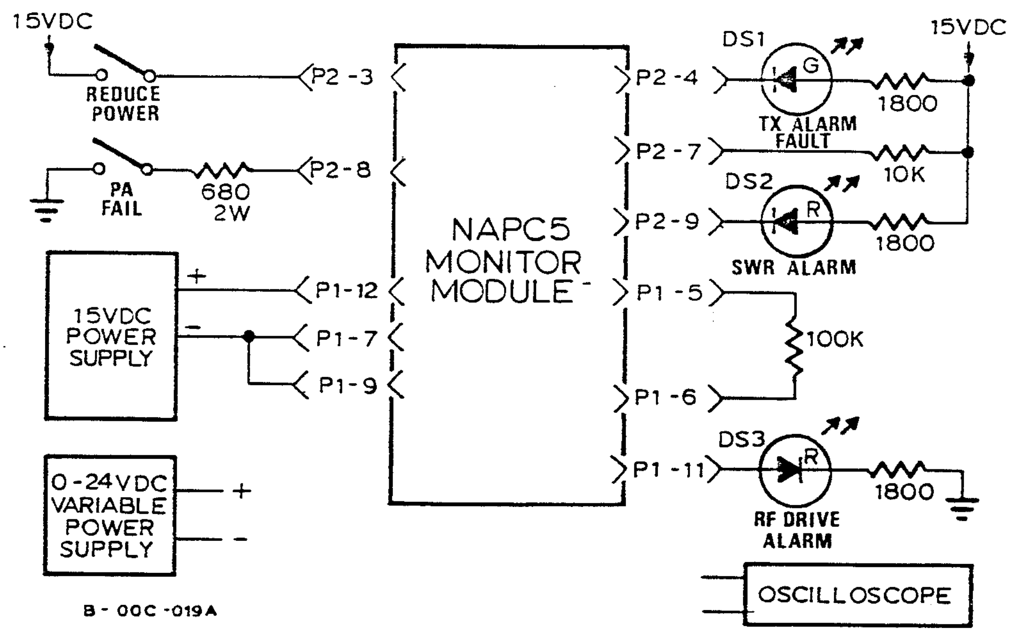

Figure 1 Test Setup for NAPC5 Monitor Module

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, $\pm 0.5\%$ accuracy. Beckman 3010
Oscilloscope	15 MHz. Tektronics Model T922
15 Vdc Power Supply	15 volts dc, rated at 1 Ampere minimum
Variable dc Power Supply	0.0 to 24 volts dc, rated at 1 Ampere minimum

Table 2 Wiring List - NAPC5 Monitor Module

SOURCE	DESTINATION	CODE		SIZE	FUNCTION
P1-1	A1-9	1	White	22	
P1-4	A1-6	2	White	22	
P1-3	A1-1	3	Core	RG188A/U	(WE38)
P1-2	A1-2	-	Shield	-	
P1-6	A1-10	4	Core	RG188A/U	(WE38)
P1-5	A1-11	-	Shield	-	
P1-7	Ground	5	Black	22	
P1-8	A1-13	6	White	22	
P1-9	Ground	7	Black	22	
P1-10	A1-16	8	White	22	
P1-11	A1-14	9	White	22	
P1-12	XF1-1	10	Red	22	
XF1-2	A1-5	11	Red	22	
P2-1	A1-18	12	White	22	
P2-2	A1-19	13	White	22	
P2-3	A1-20	14	Core	RG188A/U	(WE38)
Ground	A1 Ground Lug	-	Shield		
P2-4	A1-17	15	White	22	
P2-5	A1-4	16	Orange	22	
P2-6	Ground	17	Black	22	
P2-7	A1-12	18	White	22	
P2-8	A1-3	19	Orange	22	
P2-9	A1-15	20	White	22	
P2-10	A1-7	21	Core	RG188A/U	(WE38)
P2-11	A1-8	-	Shield		

Table 3 NAPC5 Monitor Module Reference Designation Index

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
-	Monitor Module	NAPC5	139-3062	37338
A1	Monitor Printed Circuit Board Assy	139-3064	139-3064	37338
A1C1	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A1C2	Capacitor, Ceramic, 0.22uF 10%, 50V	CCG08	CKR06BX224KL	56289
A1C3	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A1C4	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C5	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A1C6	Capacitor, Tantalum, 6.8uF 10%, 35V	CCP19	CSR13F685KM	56289
A1C7	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C8	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C9	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C10	Capacitor, Tantalum, 1.0uF 10%, 50V	CCP24	CSR13G105KM	56289
A1C11	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
A1C12	Capacitor, Ceramic, 1.0uF 10%, 50V	CCG10	CKR06BX105KL	56289
A1C13	Capacitor, Ceramic, 0.01uF 10%, 100V	CCG04	CKR05BX103KL	56289
A1CR1	Diode	QAP29	1N4938	01295
A1CR2	Diode	QAP29	1N4938	01295
A1CR3	Diode	QAP29	1N4938	01295
A1CR4	Diode	QAP29	1N4938	01295
A1CR5	Diode	QAP29	1N4938	01295
A1CR6	Diode, Zener, 7.5V	QK01	1N755	01295
A1L1	Inductor, 1000uH	LAP39	SWD1000	00213
A1L2	Inductor, 100uH	LAP35	SWD100	00213
A1L3	Inductor, 27uH	139-3036	139-3036	37338
A1Q1	Transistor, PNP	QAP09	2N2907	04713
A1Q2	Transistor, NPN	QAP06	2N2222	04713
A1Q3	Transistor, NPN	QAP06	2N2222	04713
A1Q4	Transistor, NPN	QAP06	2N2222	04713
A1Q5	Transistor, NPN	QAP06	2N2222	04713
A1Q6	Transistor, Programmable	QAP19	2N6116	04713
A1R1	Resistor, Film, 68K ohms 2% 1/2W	RD17	RL20S683G	36002
A1R2	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R3	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	36002
A1R4	Resistor, Film, 15K ohms, 2% 1/2W	RD09	RL20S153G	36002
A1R5	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	36002
A1R6	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	36002
A1R7	Resistor, Film, 56K ohms, 2% 1/2W	RAP16	RL20S563G	36002
A1R8	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	36002
A1R9	Resistor, Film, 8200 ohms, 2% 1/2W	RD06	RL20S822G	36002
A1R10	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R11	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R12	Resistor, Film, 56K ohms, 2% 1/2W	RAP16	RL20S563G	36002
A1R13	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R14	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R15	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	36002
A1R16	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	36002
A1R17	Resistor, Variable, 10K ohms, 1/2W	RW04	3339-W-1-103	80294
A1R18	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	36002

Table 3 NAPC5 Monitor Module Reference Designation Index (Continued)

REF DES	NAME OF PART AND DESCRIPTION	NAUTEL'S PART NO.	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE
A1R19	Resistor, Variable, 10K ohms, 1/2W	RW04	3339-W-1-103	80294
A1R20	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	36002
A1R21	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R22	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R23	Resistor, Film, 8200 ohms, 2% 1/2W	RD06	RL20S822G	36002
A1R24	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R25	Resistor, Film, 39K ohms, 2% 1/2W	RD14	RL20S393G	36002
A1R26	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R27	Resistor, Film, 47K ohms 2% 1/2W	RD15	RL20S473G	36002
A1R28	Resistor, Film, 3300 ohms, 2% 1/2W	RAP11	RL20S332G	36002
A1R29	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R30	Resistor, Film, 1M ohms, 2% 1/2W	RD31	RL20S105G	14674
A1R31	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R32	Resistor, Film, 56K ohms, 2% 1/2W	RAP16	RL20S563G	36002
A1R33	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R34	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R35	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A1R36	Resistor, Film, 82K ohms, 2% 1/2W	RD18	RL20S823G	36002
A1R37	Resistor, Film, 18K ohms, 2% 1/2W	RAP14	RL20S183G	36002
A1R38	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	36002
A1R39	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R40	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R41	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R42	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R43	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R44	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R45	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R46	Resistor, Film, 27K ohms, 2% 1/2W	RD12	RL20S273G	36002
A1R47	Resistor, Film, 5600 ohms, 2% 1/2W	RAP12	RL20S562G	36002
A1R48	Resistor, Film, 5.6 ohms, 2% 1/2W	RC10	A20-5.6 Ohms-2%	36002
A1R49	Resistor, Film, 1000 ohms, 2% 1/2W	RAP09	RL20S102G	36002
A1R50	Resistor, Film, 180K ohms, 2% 1/2W	RAP18	RL20S184G	36002
A1R51	Resistor, Film, 100K ohms, 2% 1/2W	RAP17	RL20S104G	36002
A1R52	Resistor, Film, 10K ohms, 2% 1/2W	RAP13	RL20S103G	36002
A1R53	Resistor, Film, 33K ohms, 2% 1/2W	RAP15	RL20S333G	36002
A1R54	Resistor, Film, 1800 ohms, 2% 1/2W	RAP10	RL20S182G	36002
A1R55	Resistor, Comp, 1.8M ohms, 5% 1/2W	RF34	RC20GF185J	36002
A1U1	IC, Comparator, Quad	UL02	MC3302L	04713
A1U2	IC, Comparator, Quad	UL02	MC3302L	04713
A1U3	IC, Comparator, Quad	UL02	MC3302L	04713
A1XU1	Socket, Integrated Circuit, 14-pin	UC02	640-357-1	71785
A1XU2	Socket, Integrated Circuit, 14-pin	UC02	640-357-1	71785
A1XU3	Socket, Integrated Circuit, 14-pin	UC02	640-357-1	71785
F1	Fuse, 0.25A, 250V, Slow Blow	FB11	323.250	75915
P1	Connector, Plug, 12-pin	JD11	P-3312-AB	13150
P2	Connector, Plug, 12-pin	JD11	P-3312-AB	13150
XF1	Fuse Block, 1-pole, Type 3AG	FA26	357001	75915

Table 4 NAPC5 Monitor Module Quantities Per Unit Index

NAUTEL'S PART NO.	NAME OF PART AND DESCRIPTION	JAN, MIL OR MFR PART NO.	(OEM) MFR CODE	TOTAL IDENT PARTS
NAPC5	Monitor Module	139-3062	37338	REF
139-3036	Inductor, 27uH	139-3036	37338	1
139-3064	Monitor Printed Circuit Board Assy	139-3064	37338	1
CCG04	Capacitor, Ceramic, 0.01uF 10%, 100V	CKR05BX103KL	56289	2
CCG08	Capacitor, Ceramic, 0.22uF 10%, 50V	CKR06BX224KL	56289	1
CCG10	Capacitor, Ceramic, 1.0uF 10%, 50V	CKR06BX105KL	56289	1
CCP19	Capacitor, Tantalum, 6.8uF 10%, 35V	CSR13F685KM	56289	4
CCP24	Capacitor, Tantalum, 1.0uF 10%, 50V	CSR13G105KM	56289	5
FA26	Fuse Block, 1-pole, Type 3AG	357001	75915	1
FB11	Fuse, 0.25A, 250V, Slow Blow	323.250	75915	1
JD11	Connector, Plug, 12-pin	P-3312-AB	13150	2
LAP35	Inductor, 100uH	SWD100	00213	1
LAP39	Inductor, 1000uH	SWD1000	00213	1
QAP06	Transistor, NPN	2N2222	04713	4
QAP09	Transistor, PNP	2N2907	04713	1
QAP19	Transistor, Programmable	2N6116	04713	1
QAP29	Diode	1N4938	01295	5
QK01	Diode, Zener, 7.5V	1N755	01295	1
RAP09	Resistor, Film, 1000 ohms, 2% 1/2W	RL20S102G	36002	2
RAP10	Resistor, Film, 1800 ohms, 2% 1/2W	RL20S182G	36002	1
RAP11	Resistor, Film, 3300 ohms, 2% 1/2W	RL20S332G	36002	3
RAP12	Resistor, Film, 5600 ohms, 2% 1/2W	RL20S562G	36002	9
RAP13	Resistor, Film, 10K ohms, 2% 1/2W	RL20S103G	36002	6
RAP14	Resistor, Film, 18K ohms, 2% 1/2W	RL20S183G	36002	5
RAP15	Resistor, Film, 33K ohms, 2% 1/2W	RL20S333G	36002	4
RAP16	Resistor, Film, 56K ohms, 2% 1/2W	RL20S563G	36002	3
RAP17	Resistor, Film, 100K ohms, 2% 1/2W	RL20S104G	36002	8
RAP18	Resistor, Film, 180K ohms, 2% 1/2W	RL20S184G	36002	1
RC10	Resistor, Film, 5.6 ohms, 2% 1/2W	A20-5.6 Ohms-2%	36002	1
RD06	Resistor, Film, 8200 ohms, 2% 1/2W	RL20S822G	36002	2
RD09	Resistor, Film, 15K ohms, 2% 1/2W	RL20S153G	36002	4
RD12	Resistor, Film, 27K ohms, 2% 1/2W	RL20S273G	36002	1
RD14	Resistor, Film, 39K ohms, 2% 1/2W	RL20S393G	36002	1
RD15	Resistor, Film, 47K ohms 2% 1/2W	RL20S473G	36002	1
RD17	Resistor, Film, 68K ohms 2% 1/2W	RL20S683G	36002	1
RD18	Resistor, Film, 82K ohms, 2% 1/2W	RL20S823G	36002	1
RD31	Resistor, Film, 1M ohms, 2% 1/2W	RL20S105G	14674	1
RF34	Resistor, Comp, 1.8M ohms, 5% 1/2W	RC20GF185J	36002	1
RW04	Resistor, Variable, 10K ohms, 1/2W	3339-W-1-103	80294	2
UC02	Socket, Integrated Circuit, 14-pin	640-357-1	71785	3
UL02	IC, Comparator, Quad	MC3302	04713	3

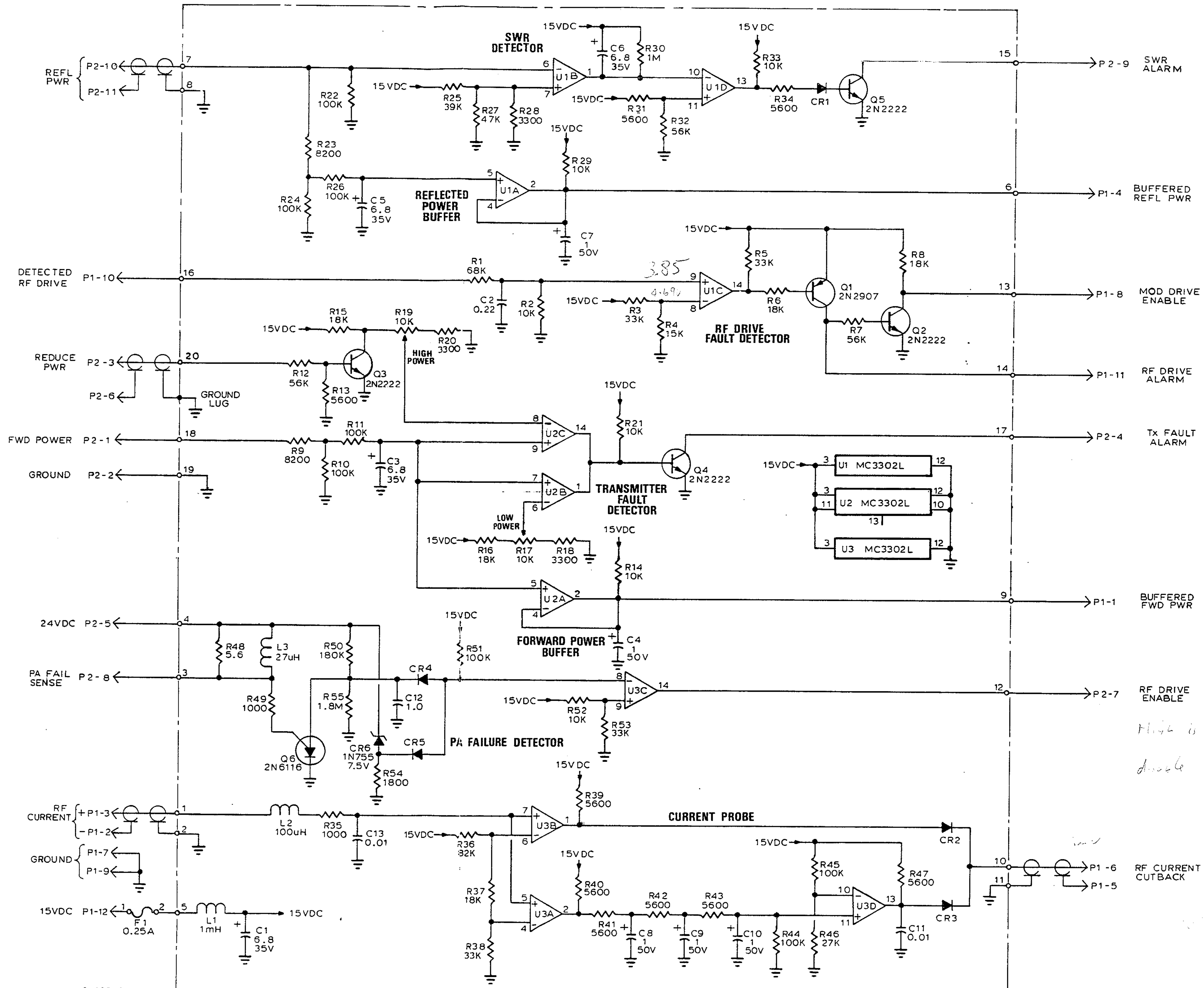

Figure 2 Electrical Schematic - NAPC5 Monitor Module

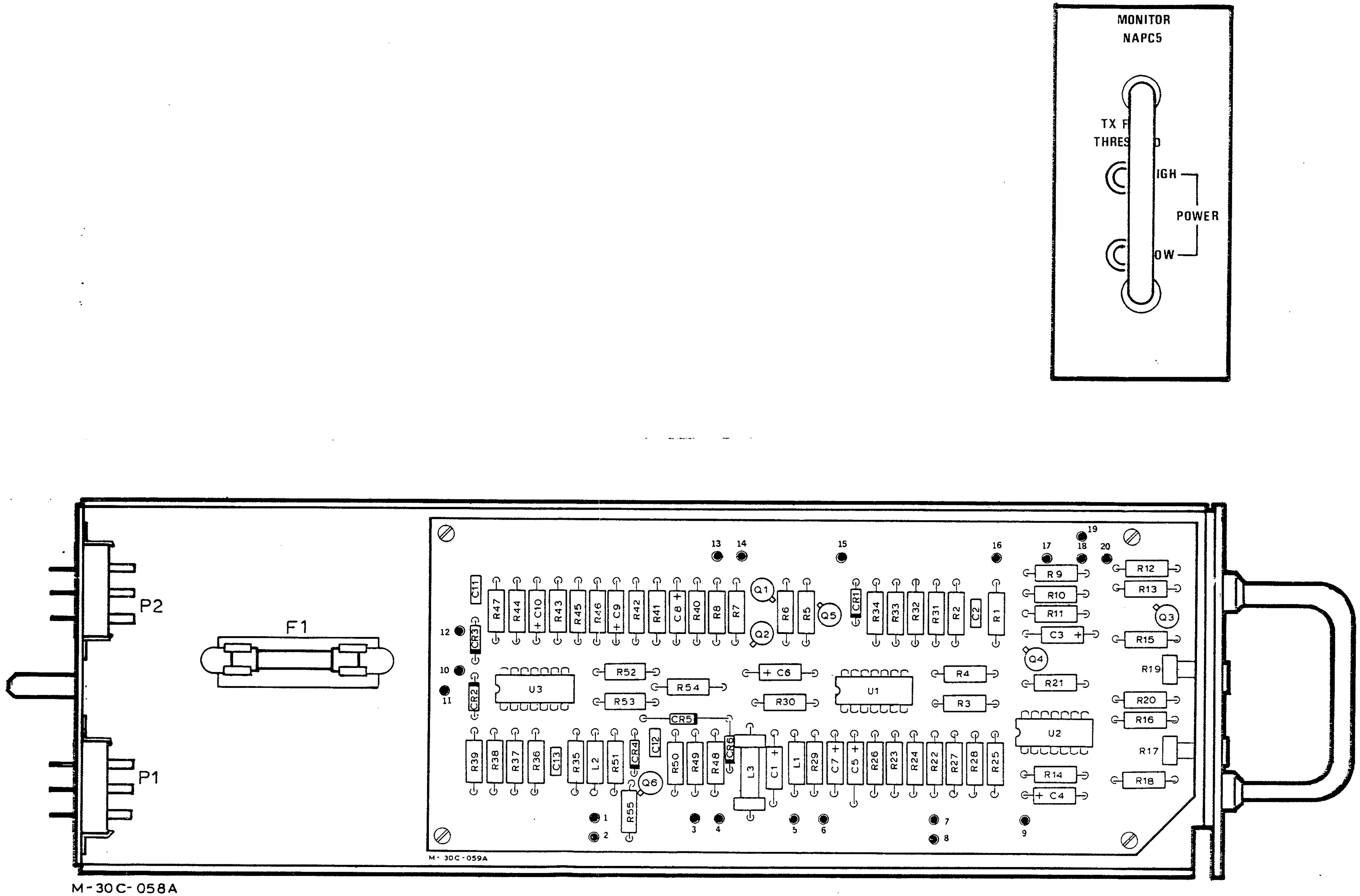

Figure 3 Assembly Detail - NAPC5 Monitor Module