J1000
1,000 Watt
AM Broadcast
Transmitter

Repair Manual

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Warranty

by Nautel Limited/Nautel Inc. (herein after referred to as Nautel)

Nautel guarantees all mechanical and electrical parts of Nautel Transmitters for a period of forty-eight months, and all other Nautel manufactured equipment for a period of twelve months from date of shipment, provided the equipment has been installed, operated and maintained in accordance with Nautel's recommendations, and the equipment has not been misused, neglected or modified. Nautel's liability is limited, at the absolute discretion of Nautel, to repairing or replacing returned equipment that to the satisfaction of Nautel has been found defective.

Warranty for third-party items is provided by the Original Equipment Manufacturer. Exercise of such warranty shall be between the Buyer and the Third-Party.

1. Properly qualified technical personnel must install, maintain, and repair the equipment in accordance with Nautel recommendations and good engineering practice.

2. A "Part Failure" shall be deemed to have occurred when the part has become defective, or does not have the characteristics required for the specified equipment performance:

    a. when the equipment is operated within the design parameters, and
    b. when the equipment is installed and adjusted according to Nautel's prescribed procedures as stated in the instruction manual.

3. Nautel shall provide replacements for all "Parts" to the Buyer when they become defective during the warranty period, and upon the return of the defective part. Replacement parts warranty to be 90 days or end of original warranty; whichever comes first.

4. If the Buyer receives a replacement module, as part of Nautel's module exchange program, the old module must be returned to Nautel within 30 days of receipt of the new module, at the buyers expense. If the old module is not received after 30 days, the customer will be invoiced. The buyer is responsible for installing the replacement/repaired module in the transmitter.

5. In the event that a "Part" fails during the warranty period and causes damage to a subassembly which cannot be readily repaired in the field, the entire subassembly so damaged may be returned to Nautel for repair. The repairs will be made without charge to the Buyer.

6. Written authorization must be obtained before returning any equipment or goods for any reason. Equipment or goods returned under this warranty shall be delivered to Nautel's premises at the Buyer's expense. Where no-charge warranty replacements or repairs are provided under items 2, 3, 4, or 5, Nautel will pay that part of the shipping costs incurred in returning the part/assembly to the Buyer. Note: the Buyer is responsible for any and all import fees, duties or taxes.

7. Nautel does not warrant or guarantee, and will not be liable for:

    a. defects or failures caused in whole or in part by abuse, misuse, unauthorized repair attempts, unauthorized alteration or modification of the equipment;
    b. equipment built to customer specifications that is later found not to meet customer needs or expectation;
    c. performance of equipment when it is used in combination with other equipment not purchased, specified, or approved by Nautel;
    d. damages and performance limitations due to outside forces such as lightning, excessive heat or cold, excessive AC surges or high corrosive environments;
    e. changes made by personnel other than Nautel authorized personnel, including charges incurred; and
    f. for any costs for labor performed by the customer without Nautel's prior written approval.

8. Nautel does not warrant that software:

    a. is free of errors, bugs or defects;
    b. will be compatible with third party software;
    c. results, output or data provided through or generated by the software are accurate, complete, or reliable; and
    d. errors found will be corrected.

9. Nautel shall have the right and shall be provided full access to investigate whether failures have been caused by factors beyond its control.

10. In no event shall Nautel be liable for any consequential damages arising from the use of this equipment

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12. Third party items ordered, the guarantee/warranty of these items will be from the manufacturer of these items. Exercise of such warranty shall be between the Buyer and the third party provider.

13. Nautel provides telephone and email support for its products for the life of the product at no charge. After the warranty period, parts and on-site support for the equipment are offered at a rate to be determined upon request.

Customer Service Notice

A 'Technical Assistance' and 'Plug-in Module Exchange' service is available to Nautel users.

All equipment being returned to Nautel and all requests for repairs or replacements should be marked with a Nautel provided RMA number and addressed to the appropriate Nautel facility:

Nautel Limited
10089 Peggy's Cove Road
Hackett's Cove, NS, Canada B3Z 3J4
Tel: 902-823-2233/Fax: 902-823-3183

24 Hour Answering Service (902) 823-3900

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Factory Support

TECHNICAL ASSISTANCE
Nautel's field service department provides telephone technical assistance 24 hours a day, seven days a week. Requests via facsimile or e-mail received after Nautel's normal working hours are responded to the next working day. Contact the appropriate field service centre from the following:

U.S.A. customers use:	Nautel Incorporated 201 Target Industrial Circle Bangor, Maine 04401	T.+1.207.947.8200 (24 hours) or 877 6 nautel (628835) F.+1.207.947.3693
All other customers use:	Nautel Limited 10089 Peggy's Cove Road, Hackett's Cove, NS, Canada B3Z 3J4	T. +1.902.823.3900 (24 hours) or 877 6 nautel (628835) F. +1.902.823.3183 E-Mail support@nautel.com Web www.nautel.com

MODULE EXCHANGE SERVICE
In order to provide Nautel customers with fast and efficient service in the event of a problem, Nautel operates a factory rebuilt module exchange service which takes full advantage of the high degree of module redundancy in Nautel equipment. This module exchange service is operated from Nautel's factory in Bangor, Maine and Hackett's Cove, Nova Scotia. These two locations allow us to provide a quick turn around service to keep our customers on the air. During the transmitter's warranty period, up to 48 months from shipment, repair and exchange of modules is at no charge to the customer. When the warranty has expired, a charge of 80% of the list price for all exchanged modules is made. If the faulty module is returned to Nautel within 30 days, a credit is issued reducing this charge by one half to 40% of the list price. U.S.A. customers are required to contact our Bangor, Maine facility. Canadian and overseas customers should contact our Nova Scotia, Canada facility.

EQUIPMENT BEING RETURNED TO NAUTEL
For all equipment being returned to Nautel and all requests for repairs or replacements:

- Obtain an RMA number from Nautel (you must have an RMA number to return equipment)
- Mark the item as 'field return'
- Mark the item with the RMA number assigned by Nautel
- Address the item to the appropriate Nautel facility

Please provide complete and accurate information regarding the equipment being returned. This will ensure Nautel can provide prompt attention so that replacement parts can be shipped as soon as possible. Refer to the nameplate on the transmitter and/or the appropriate module/assembly to obtain name, type, part and serial number information. Refer to the parts list of this manual or the appropriate service instruction manual for additional ordering information.

The following information should accompany each request:

* Model of Equipment
* Serial number of Equipment
* Name of Part/Assembly
Serial number of Part/Assembly
* Complete reference designation of Part/Assembly
* Nautel's part number of Part/Assembly
* OEM's part number of Part/Assembly
Number of hours in Use
Nature of defect
* Return shipping address

* Denotes minimum information required to order spare/replacement parts

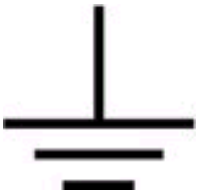
SAFETY

Symbols

The following are general definitions for safety symbols used on the equipment or in the Installation and Operation Manual:

DANGER – HIGH VOLTAGE

Indicates dangerous voltages (in excess of 72 volts), capable of causing a fatal electrical shock, are present on or near parts bearing this label.



GROUND (EARTH)

Used with wiring terminals to indicate the terminal must be connected to earth ground before operating equipment. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electrical shock. Also used on electrical schematics to indicate a part that is connected to earth ground.

GROUND (PROTECTIVE or SAFETY)

Used with protective (safety) conductor terminals to indicate the terminal must be connected to ground before operating the equipment. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electrical shock.

WARNING — A WARNING denotes a hazard. It identifies an operating procedure or condition which, if not strictly observed or adhered to, could result in injury or death to personnel. Throughout the *Repair Manual*, a WARNING will immediately precede the text to which it applies.

CAUTION — A CAUTION denotes a hazard. It identifies an operating procedure or condition which, if not strictly observed or adhered to, could result in damage to, or destruction of the equipment. Throughout the *Repair Manual*, a CAUTION will immediately precede the text to which it applies.

NOTE — A NOTE denotes important information pertaining to an operating procedure, condition, statement, etc., which is essential to highlight. A NOTE may precede or follow the text to which it applies.

SAFETY

Toxic Hazard Warning

There may be devices used in this equipment containing beryllium oxide ceramic, which is non-hazardous during normal device operation and under normal device failure conditions. These devices are specifically identified in the equipment parts list(s) by including ‘BeO’ in the part’s description.

DO NOT cut, crush or grind devices because the resulting dust may be **HAZARDOUS IF INHALED**. Unserviceable devices should be disposed of as harmful waste.

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Release Control Record

Issue	Date	Reason
7.0	03 June 2020	Release 7 of product (NARA40F)

J1000
REPAIR MANUAL

Section 1 GENERAL INFORMATION

1.1 PURPOSE AND SCOPE OF MANUAL

The J1000 *Repair* manual provides in-depth component level maintenance and troubleshooting procedures beyond that provided in the *Installation and Operation* manual. These procedures include typical test voltages/waveforms and detailed electrical schematics for all transmitter assemblies. The information in this manual is intended for use by an experienced electronic technician.

1.1.1 Family Tree

The family tree for the J1000 transmitter is depicted in Figure 4-1. It identifies the major assemblies and shows the hierarchical assembly relationship. It also identifies the reference designation assigned to each assembly and where their parts list is located.

J1000
REPAIR MANUAL

Section 2 THEORY OF OPERATION

2.1 INTRODUCTION

The theory of operation for the J1000 AM broadcast transmitter is presented in this section. Unique circuits are explained. Electrical schematics, referenced throughout the text by an SD-#, are located in Section 6.

2.2 TRANSMITTER OVERVIEW

The transmitter operates at one fixed frequency between 530 kHz and 1,610 kHz and provides up to 1,100 W of RF output power. It may be operated locally when co-located with the studio, or remotely when the studio is at a different site. The transmitter circuitry is subdivided into four functional blocks - exciter stage, ac/RF power stage, RF combiner/output filter stage and control/ monitor stage (see Figure 2-1).

2.3 EXCITER STAGE

The exciter stage contains two exciter sections (A and B) that can be selected automatically or by local or remote control. Each exciter generates its own RF frequency source, PDM, and digital control signals for use in the RF power stage. The exciter stage consists of exciter interface PWB (1A3), RF synthesizer PWBs A (1A4) and B (1A6, if installed), interphase PDM driver PWBs A (1A5) and B (1A7, if installed), power supply assembly (1A8) and LVPS buck converter PWB (1A9). See Figure SD-2.

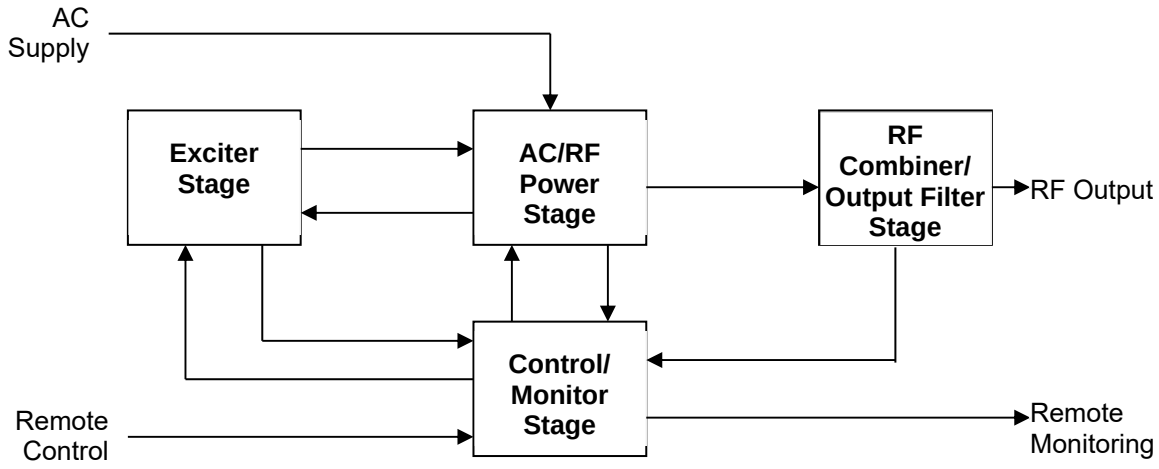


Figure 2-1: J1000 Transmitter Block Diagram

2.3.1 Exciter Interface PWB

The exciter interface PWB (1A3) provides signal distribution and interconnection for power supply assemblies A and B, RF synthesizer PWBs, and interphase PDM driver PWBs (see Figure SD-11).

2.3.1.1 Exciter Selection

The selection of regulated voltages, carrier frequency signals, and f_{PDM} signals depends on the position of relays K1 and K2. Relays K1 and K2 remain in their de-energized state until a +5 V *Changeover Relay Control* signal is applied to the gate of FET Q2. The ±15 V and ±5 V sources are applied to RF synthesizer PWB (A) and interphase PDM driver PWB (A). The f_{PDM} for the RF power stages is sourced from interphase driver PWB (A). When a +5 V *Changeover Relay Control* signal is present, relays K1 and K2 switch to their energized state enabling the B exciter circuits.

2.3.1.2 RF Drive Monitor

The RF drive (f_C) signal applied by the active exciter is monitored by transistor Q7. If the f_C signal is not present, transistor Q7 turns off and an *RF Osc Fail* signal is applied to the control/monitor function. This will initiate an exciter changeover or transmitter shutback.

2.3.2 RF Synthesizer PWBs

The RF synthesizer PWBs (1A4 and, if installed, 1A6) use direct digital synthesis (DDS) to generate carrier frequencies within the AM broadcast band (535 kHz to 1,610 kHz). The output of a digital synthesizer integrated circuit with internal high-speed 12-bit digital-to-analog converter is low-pass filtered to provide a sinusoidal continuous output. The sine wave is digitized and divided by a factor of four to obtain the carrier frequency. The digitized sine wave is also divided by a factor of N to obtain a $2f_{PDM}$ frequency that ultimately determines the transmitter's pulse duration modulation (PDM) frequency. The RF synthesizer PWB consists of a microprocessor, direct digital synthesizer, low pass filter, digitizer, balanced drive, and N divider. See Figures SD-12 and SD-13.

2.3.2.1 Microprocessor

The microprocessor consists of an 87C51 integrated circuit (U4), which is clocked at the system oscillator frequency (10.0000 MHz). Firmware resides in U4's internal four kilobytes of EPROM memory. The microprocessor generates control information for the DDS circuit, generates control information for the N divider circuit, and provides the appropriate sequence and control signals to all power modules during transmitter tuning, where required by the host transmitter.

2.3.2.1.1 DDS Control Information

The RF carrier frequency is set using five binary coded decimal (BCD) switches (S1 through S5). When a current-sink-to-ground is applied at the *Reset DDS* input, or during turn on, the *microprocessor* monitors these switches and outputs the appropriate 48-bit value to the DDS Frequency Tuning Word #1 register. The 48-bit value is written in six consecutive bytes to the DDS's six internal registers. The *sclk* signal is enabled on each write cycle.

2.3.2.1.2 N Divider Control Information

The $4f_C/B$ frequency is divided by an 'N' factor to provide $2f_{PDM}$ output frequency between 126 kHz and 134 kHz (when E3 is set in **LOW PDM** mode) or between 245 kHz and 276 kHz (when E3 is set in **HIGH PDM** mode) (see formula below). The microprocessor determines the value of N and outputs the information at pins 2, 3, 4, 5, 6 and 7. The N divider circuit uses this information as the N dividing factor. J1000 transmitters use the **HIGH PDM** mode.

- for f_{PDM} = 130 kHz (HIGH PDM position):

f_C and f_{PDM} are expressed in kHz

$$2f_{PDM} = \frac{4f_C}{\text{int}\left[\frac{2f_C + 65}{130}\right]}$$

2.3.2.1.3 RF Drive Tuning Control

U4 is a microprocessor integrated circuit which monitors the status of control signals provided by the transmitter, where required. It also provides control outputs that enable the RF drive tuning circuits and inhibit the pulse duration modulation (PDM) while the RF drive tuning is enabled. These inputs/ outputs are not applicable to J1000 transmitters.

2.3.2.2 Direct Digital Synthesizer

The direct digital synthesizer consists of integrated circuit U5 (AD98525Q) and associated components. It generates a frequency of $4f_C$ based on information provided by microprocessor U4 (refer to paragraph 2.3.2.1). Integrated circuit U5 is a CMOS, numerically controlled oscillator with a 48-bit phase accumulator and 12-bit digital-to-analog converter (DAC). The phase accumulator, which is responsible for generating an output frequency, is presented with a 48-bit value from the Frequency Tuning Word 1 registers, whose contents determine the FTW as follows:

The 10 MHz clock input is coupled with U5's internal programmable reference clock multiplier. This results in a system clock of 50 MHz (i.e., SYSCLK = 50 MHz).

The 12-bit output from the phase accumulator is input to the DAC, which outputs a stepped sine wave at a frequency of $4fc$. The $4fc$ output is then low-pass filtered to remove high frequency components.

2.3.2.3 Low Pass Filter

A low-pass filter consisting of C21, L1, and C23 removes the high frequency images present in the DDS output signal. The output is a sine wave at a frequency of $4f_C$.

2.3.2.4 Digitizer

The output of the low-pass filter is connected to a digitizer circuit consisting of transistor Q4, inverter U10:B, and associated components. Inverter U10:B outputs an approximate square wave at a frequency of $4f_C$, which is applied to a ÷4 circuit and to the N divider circuit.

2.3.2.5 Waveform Symmetry

RF DRIVE SYMMETRY potentiometer R32 is adjusted for an RF drive output waveform, which is a symmetrical square wave (50% duty cycle), as measured at the input to the balanced drive circuit (TP6). The position of **SYMMETRY ADJ** shorting jumper E6 determines when the RF drive symmetry circuit is enabled or disabled. E6 should be installed in the **ENABLE** position (shorting pins 1 and 2) when used in an AM broadcast transmitter.

2.3.2.6 Balanced Drive

The balanced drive buffer is a switching circuit that ensures the rise and fall times of its output square wave are minimal. The f_C signal is a 15 V peak-to-peak square wave that is the low level RF drive signal for the RF power stage of the transmitter.

2.3.2.6.1 Balanced Drive Matching

Shorting shunt post E5 is installed on seven-position header XE5 to choose the optimum capacitor and resistor values. It is installed in the **D** position (shorting pins 7 and 8) for J1000 transmitters.

2.3.2.7 N Divider

The N divider circuit is a cascade counter made up of integrated circuits U6, U7, and inverters U8:A and U8:F. The $4f_C/B$ signal is divided by N to provide a $2f_{PDM}$ frequency, which is between 126 kHz and 134 kHz (when E3 is set in **LOW PDM** mode) or between 245 kHz and 276 kHz (when E3 is set in **HIGH PDM** mode). The value of N is supplied by microprocessor U4 (refer to paragraph 2.3.2.1.2). The $2f_{PDM}$ output, which is nominal 5 V peak-to-peak pulses, is applied to the transmitter's pulse duration modulation (PDM) generation circuit, and ultimately determines the PDM frequency.

2.3.2.8 RF Drive Source Selection

The RF drive source may be provided by the integral numerically controlled oscillator, an external RF generator at fc, or a 10 MHz reference. The position of shorting shunt posts E1, E2 and E4 determine which RF drive source is selected.

2.3.2.8.1 Internal fc Source

When the integral numerically controlled oscillator's output is used as the RF drive source, the shorting shunt posts must be configured as follows:

- E1 in **INT** position (pins 2 and 3 shorted)
- E2 in **INT** position (pins 2 and 3 shorted)
- E4 in **INT** position (pins 2 and 3 shorted)

2.3.2.8.2 External fc Source

When an externally generated carrier frequency is used as the RF drive source, the shorting shunt posts are configured as follows:

- E1 in **INT** position (pins 2 and 3 shorted)
- E2 in **INT** position (pins 2 and 3 shorted)
- E4 in **EXT** position (pins 1 and 2 shorted)

The applied RF must be precisely the carrier frequency (fc) and its peak-to-peak voltage (sine or square wave) must be more than 5.0 V but less than 12.0 V.

2.3.2.8.3 External 10 MHz Source

When an external 10 MHz signal is used as the RF drive source, the shorting shunt posts are configured as follows:

- E1 in **EXT** position (pins 1 and 2 shorted)
- E2 in **EXT** position (pins 1 and 2 shorted)
- E4 in **INT** position (pins 2 and 3 shorted)

Cables are provided in the transmitter's ancillary kit to connect between J7 (and J8, for dual exciters) of the remote interface PWB and J2 of the RF synthesizer PWB(s). The applied RF must be precisely 10.00 MHz and its peak-to-peak voltage (sine or square wave) must be more than 2.2 V but less than 8.0 V.

2.3.3 Interphase PDM Driver PWBs

The interphase PDM driver PWBs (1A5 and 1A7) produces two pulse trains of variable width as its PDM (*PDM 1* and *PDM 2*) outputs. Each pulse train contains the same data but are offset from each other by one-half their repetition rate. The PDM repetition rate (f_{PDM}) is a fixed frequency normally between 128 kHz and 140 kHz. The frequency is determined by the $2f_{PDM}$ input, which is a derivative of the carrier frequency. These PDM drive signals determine the transmitter output power level, as well as the output modulation level, when applied to the modulator assemblies in RF power modules A and B (see Figure SD-14).

2.3.3.1 Carrier Level Control

The carrier level control circuit consists of U6, U2A, U2D, U3B, U3D, and their associated components. U6 is a four-quadrant analog multiplier connected as a variable gain, wide-band, linear amplifier. The modulation reference (I^1) input is multiplied by a factor determined by the level of the *carrier ref* (I^2) and *B+ ref* (I^4) inputs to determine the gain and, in turn, the I^3 output.

2.3.3.1.1 When there is no *unbalanced audio* input at J1-15, U2D's output (TP6), which is the modulation reference, will be a nominal 1.4 V. When a pure audio sine wave is present at a level that will produce 100% modulation, the output of U2D will be a sine wave varying from 0 V to 3.9 V. The resulting current flow through R12 is U6's I^1 input.

2.3.3.1.2 The *carrier ref* input at J1-2 is a dc voltage directly proportional to the expected RF carrier level squared. When the expected carrier level is the transmitter's rated carrier level, the *carrier ref* input and the output of buffer U2A (TP5) are a nominal 4.7 V. The resulting current flow through R13 is U6's I^2 input.

2.3.3.1.3 The *B+ ref (1)* input at J1-3 is a dc voltage directly proportional to the B+ voltage being applied to the transmitter's RF power stage. When the B+ voltage is 350 V (for high power operation), the *B+ ref (1)* input and, in turn, the output of buffer U3D (TP3), are a nominal 6.1 V. The resulting current flow through R20 is U6's I^4 input.

2.3.3.1.4 The gain of U6 and, in turn, the current flowing from its I^3 output, is determined by the following formula:

$$\frac{I^2}{I^4} \times I^1 = I^3$$

When the *carrier ref* input (I^2) is 4.7 V (transmitter's rated carrier level) and the *B+ ref (1)* input (I^4) is 6.1 V (B+ voltage of 350V), the gain of U6 is 0.76 for the modulating reference applied to I^1. U6's I^3 output current is 0.76 times its I^1 input current. U3B is connected as a less than unity amplifier and its gain is summed with U6's gain. The end result is the total voltage gain of the circuit, relative to the voltage at the output of U2D (1.4 V when no audio is present), is a nominal 0.67 when **GAIN TRIM** potentiometer R31 is set to the centre of its range. When there is no modulation present, the *carrier ref* + *audio* output of U3B (TP8) is 0.94 V (1.4 V x 0.67).

The gain of U6 will change in direct proportion to changes in the *carrier ref* voltage. If the *carrier ref* voltage is set to 0 V, or it is clamped to ground because Q1 is turned on, U6's gain is minimum (zero). In turn, the modulating reference's multiplication factor is minimum (zero). The transmitter's RF output is turned off.

The gain of U6 will change in inverse proportion to changes in the *B+ ref (1)* input. This feature eliminates the need for sophisticated filtering of the transmitter's B+ power supply and maintains the transmitter's RF output at the original level for B+ voltage variations of ±10%.

2.3.3.1.5 GAIN TRIM potentiometer R31 provides a nominal 10% adjustment in the *carrier ref* + *audio* output of U3B. It is adjusted in dual exciter applications to compensate for tolerance differences in the PDM generators of exciter A and exciter B. When it is set properly, the transmitter's RF output is the same when either exciter is selected, provided the same *carrier ref* is being applied.

2.3.3.2 PDM Divider

The PDM divider circuit divides the $2f_{PDM}$ input frequency (J1-7) by two. The resulting f_{PDM} output (J1-10) is a 0 V to 15 V square wave. Unless otherwise established during the transmitter's manufacture, it should be a fixed frequency, nominally 130 kHz.

2.3.3.3 Linear Integrator

The linear integrator circuit converts the f_{PDM} square wave on its input to a triangular waveform at its output. The triangular waveform has negative and positive voltage excursions of equal amplitude and duration. The long R/C time constant formed by C42/R57 ensures a linear rise and fall time. Since the R/C time constant is fixed, the waveform amplitude varies over the frequency range of f_{PDM}. The charge/ discharge time and waveform amplitude are maximum at the lowest frequency.

2.3.3.4 Integrator Peak Detector

The integrator peak detector circuit detects the positive going excursions of the linear integrator's triangular waveform. A portion of the resulting positive dc voltage (nominally 1.8 V) at U8A's output, is applied to the inverting input of differential amplifier U3A. The *carrier ref* + *audio* output of U3A is offset by this voltage which is proportional to the triangular waveform voltage peaks. This offset effectively sets the *carrier ref* + *audio*'s zero power reference to the triangular waveform's peak voltage. This technique ensures no RF output is produced when the *carrier ref* input (J1-2) is 0 V. It also ensures the RF output is reduced to near 0 W at the 100% modulation envelope valleys when operating at the transmitter's rated carrier level.

2.3.3.5 Interphase PDM Generator

The interphase PDM generator consists of two variable pulse duration generators (PDM1 and PDM2). Both produce identical 0 V to +15 V rectangular waveforms at the f_{PDM} repetition rate, but they are offset from each other by one half of the repetition rate. The waveform on/off ratio (duty cycle) is directly proportional to the carrier level and amplitude of the modulating audio. The transmitter utilizes three B+ voltage levels to maximize performance. As the RF output power is increased from 0 W (B+ voltage is 150 V), the PDM duty cycle increases proportionally. When the RF output is increased to a level where the PDM duty cycle reaches 45%, the controller/display PWB initiates a B+ voltage increase (to 250 V) and a PDM duty cycle decrease (to 27%). When the RF output is increased to a level where the PDM duty cycle again reaches 45%, the controller/ display PWB initiates a B+ voltage increase (to 350 V) and a PDM duty cycle decrease (to 32%).

2.3.3.5.1 PDM1 Generator

The PDM1 generator consists of U10B, Q4, Q5, and their associated components. The compensated *carrier ref + audio* input from the integrator peak detector circuit is applied to differential amplifier U10B's non-inverting input, where it is compared to the triangular waveform from the linear integrator circuit. When the compensated *carrier ref + audio* is more positive than the triangular waveform, U10B's output is an open collector. +15 V is applied through R60 and R62 to the balanced drive formed by Q4/Q5. Q4 turns on and applies +15 V to K1-3 as the PDM1 output (Q5 is off). For the remainder of the triangular waveform's period, the compensated *carrier ref + audio* is less positive than the triangular waveform. U10B's output is a current-sink-to -15 V and Q4 turns off. Q5 turns on and clamps the PDM1 output to ground. The minimum 'on time' (zero RF power) occurs at the negative peaks of the triangular waveform. See Figure 2-2 for a timing diagram.

2.3.3.5.2 PDM2 Generator

The PDM2 generator consists of U3C, U11B, Q6, Q, and their associated components. It operates similar to the PDM1 generator except U3C inverts the compensated *carrier ref + audio* input and applies it to differential comparator U11B's inverting input. The result is a PDM2 'on period' when the compensated *carrier ref + audio* is less positive than the triangular waveform and produces a minimum 'on time' at the positive peaks of the triangular waveform. The on/off ratio of the PDM1 and PDM2 outputs are the same, but the zero-power reference change for the PDM2 output is offset, relative to the PDM1 output, by one half of the PDM repetition rate.

2.3.3.6 PDM Fault Detector

The PDM fault detector circuit contains two identical voltage-controlled switches (one for each PDM output) that control the 'set/'reset' status of the shutback latch circuit and, in turn, controls the on/off status of relay K1. For explanation purposes, only the PDM1 fault detector is described.

2.3.3.6.1 The PDM1 fault detector circuit consists of U12A and its associated components. R67/C58 form an integrator with a long time constant, relative to the PDM frequency. C58's charge voltage is applied to U12A's inverting input and compared to the 7.3 V reference voltage applied to its non-inverting input from voltage divider R70/R71/ R72. U12A's output is an open collector and has no influence when C58's charge voltage is less positive than the reference voltage. U12A's output will switch to a current-sink-to-ground when C58's charge voltage goes more positive than the reference voltage.

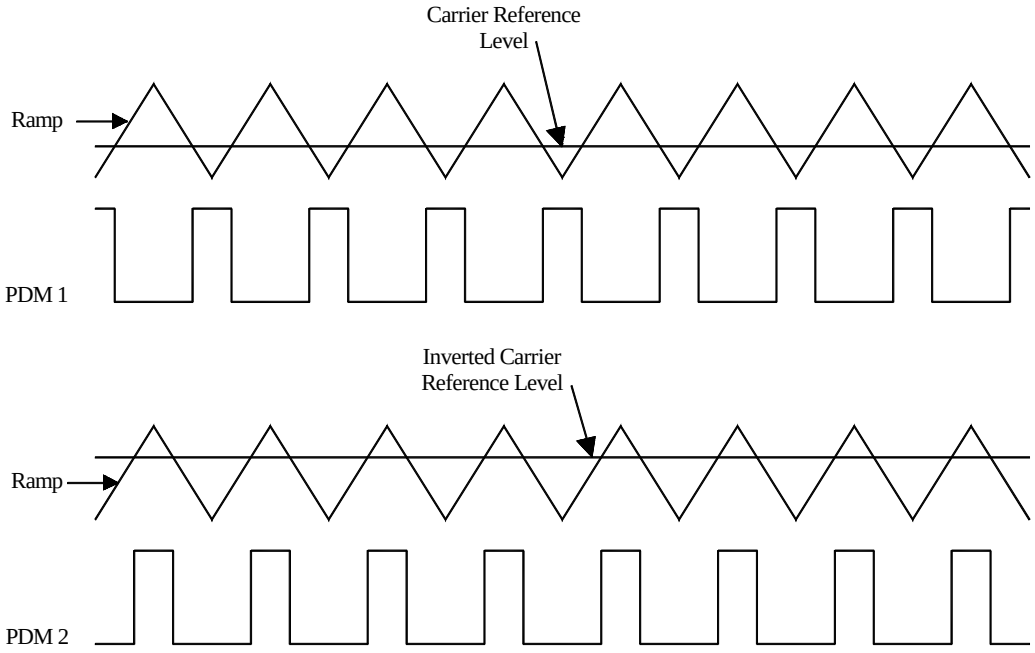


Figure 2-2: Timing Diagram for PDM Differential Amplifier

2.3.3.6.2 During normal operation, C58 will charge through R67 towards 15 V when the PDM1 output is 15 V (during its 'on time') and CR3 is reversed biased. It will instantly discharge to ground potential, through CR3, when the PDM1 output switches to 0 V (during its 'off time'). The repetition rate of the PDM1 on/off periods ensures the charge on C58 will not exceed 7.3 V, provided each PDM1 cycle contains an 'off time'. If a PDM failure occurs that produces a continuous 'on time', C58 will charge more positively than 7.3 V. U12A's output will switch to a current-sink-to-ground and toggle the shutback latch circuit to its 'set' state.

2.3.3.7 Shutback Latch

The shutback latch circuit inhibits the 'on time' of the PDM outputs and, in turn, the RF output of the transmitter whenever a transmitter originated *Inhibit PDM* (J1-16) command is applied. This circuit provides additional protection to the transmitter's RF power stages when faults are detected or actions are initiated that may cause RF stress current thresholds to be exceeded. Its function is to de-energize K1 and disconnect the *PDM 1*/*PDM 2* outputs from the transmitter circuits when the PDM fault detector output is a current-sink-to-ground (logic low). It also inhibits the PDM generators when relay K1 is de-energized or when a logic true *inhibit PDM* command is applied to J1-16.

U9A/U9B form a bistable flip/flop. The flip-flop's output, at U9-3, will be 15 V (logic high) when in its 'reset' state, and a current-sink-to-ground (logic low) when in its 'set' state.

Normally the *inhibit PDM* input and the output of the PDM fault detector circuit, which are the flip-flop's controlling inputs, are open collector. 5 V (logic high) are applied to U9-1 and U9-5 through their pull-up resistors and the flip-flop is latched in its 'reset' state. Relay K1 is held energized and the PDM outputs are applied to the transmitter circuits.

If a PDM fault is sensed, the PDM fault detector circuit applies a current-sink-to-ground (logic low) to U9-5 and causes the flip-flop to switch to and latch in its 'set' state. Relay K1 de-energizes and disconnects both PDM outputs from the transmitter circuits. The *PDM latch* output (J1-11) is activated (5 V). This condition is maintained until the flip-flop is reset by the removal of the logic low from U9-5 (no PDM fault) and the application of logic low to U9-1 (a logic true current-sink-to-ground *reset PDM* command is applied to J1-1).

2.3.3.8 PDM Inhibit

The PDM inhibit circuit consists of U9D, Q2, Q3, and their associated circuits. Its function is to instantly clamp the output of both PDM generators to ground (zero carrier level) whenever a logic true (current-sink-to-ground) *inhibit PDM* input is applied to J1-16, or when the PDM fault detector circuit senses a PDM fault and the shutback latch circuit's flip-flop is latched in its 'set' state. When neither of these conditions are true, the PDM inhibit circuit has no influence.

2.3.3.9 Dump Circuit

The dump circuit consists of operational amplifiers U2C, U8C, U8B, and associated components. The carrier insertion voltage at TP6 (nominally 1.4 V plus modulating audio) is applied to the inverting input of amplifier U8C (gain = 33.2) via unity gain amplifier U2C. When the modulating audio crosses the threshold on U8C's non-inverting input, established by **DUMP** potentiometer R59, U8C generates a positive voltage burst for use by the transmitter's RF power stage.

2.3.4 Power Supply Assembly

The power supply assembly (1A8) is a 100 W, universal input, 24 V output power supply. The transmitter's ac input is applied to the CN1 connector and the regulated 24 V output is provided on the CN2 connector. From there it is applied as the dc input source for the LVPS buck converter PWB.

2.3.5 LVPS Buck Converter PWB

The LVPS buck converter PWB (1A9) accepts the 24 V supply from the power supply assembly and provides regulated ± 15 V and ± 5 V supplies for the exciter stage and the remaining functional blocks of the transmitter (see Figure SD-15).

2.3.5.1 Dc-Dc Converter

Q1 and Q2 are fixed frequency power switching regulators. Their PWM signal outputs determine the output voltage. Q1 generates the ± 15 V supplies and Q2 generates the ± 5 V supplies. Feedback applied to pin 1 of each device adjusts the pulse width to regulate the output voltage.

2.3.5.2 Ac Sample

The ac supply voltage is applied to the primary of sample transformer T1. Diodes CR8 and CR18, capacitor C5, and resistors R5, R6, and R11 provide a half-wave rectified, attenuated sample of the ac signal at J2-29 and J2-30. This sample is used by the transmitter for control and display purposes.

2.3.5.3 LVPS Failure Detector

The half-wave rectified ac signal is also applied to an LVPS failure detection circuit. This circuit consists of comparators U1A and U1B, opto-coupler U2, and associated components. Zener diodes CR15 and CR16 regulate the ac signal to 9.4 V, which is used to apply a high limit reference voltage (3.4 V) to U1A's negative input and a low limit reference voltage (2.7 V) to U1B's positive input. Each of the low voltage power supplies are scaled and applied to both the high and low limit detectors. If a low voltage supply increases or decreases beyond acceptable limits, the output of the associated detector will switch to an open collector. Opto-coupler U2 will turn on and apply a ground potential (0 V) to the *LVPS Fail* output for that PWB.

2.4 AC/RF POWER STAGE

The ac/RF power stage (see Figure SD-3) contains two RF power modules (A and B). Circuitry within the RF power modules convert the transmitter's ac input to the B+ dc supply used by the RF power modules.

2.4.1 RF Power Modules

Each RF power module (2A1 and 2A2 see Figure SD-16) contributes up to 550 W unmodulated RF carrier power to the transmitter's RF output. Each RF power module contains a wideband RF amplifier, a modulator, and a modulator filter. A forward converter PWB is provided to convert the ac input voltage to the high-level B+ voltage used by the modulator assembly. A power module interface PWB is provided to interface control/monitor signals between the RF power modules and the exciter interface PWB as required. The RF power module outputs are applied to the RF combiner/filter stage.

2.4.1.1 Forward Converter PWB

The forward converter PWB (A1 - see Figure SD-17) is a switch mode power supply that converts the transmitter's 170-270 V ac input voltage to the B+ voltage (350/250/150 V) used by the modulator.

2.4.1.1.1 Rectifier

The ac input voltage is rectified by diodes U1 and U2, providing a dc voltage across capacitors C12 through C17. Varistors RV1 through RV3 provide protection from high voltage transients. **AC IND** lamp DS1 provides a status indication of the ac voltage on the RF power module.

2.4.1.1.2 Switching Signal

IC U3 is a high current FET driver that provides a switching PWM signal (0-18 V) to the primary of transformer T2. The secondaries of T2 control the on/off status of FETs Q1 and Q2, which in turn switch the rectified ac voltage to the primary of step-up transformer T1.

2.4.1.1.3 B+ Voltage

The secondaries of step-up transformer T1 are rectified by diodes CR9, CR10, CR11, CR13, CR14, and CR15. These voltages are applied through chokes L4, L5 and L6 and combine to form the high-level B+ voltage at the dc output (J4-1). Samples of the B+ voltage (resistors R9, R26 and R27) and current (transformer T3 and associated components) are applied to inputs of current mode PWM controller U8, which provides PWM switching information to regulate the B+ voltage. FETs Q4, Q5 and resistors R10, R24 and R25, in conjunction with opto-couplers U4 and U6, provide a means to adjust the attenuated voltage applied to U8, thereby adjusting the level of the B+ voltage.

2.4.1.1.4 Inhibit

When an RF power module fault occurs, the *Inhibit* signal (J1-7) is logic high. Opto-coupler U7 turns on and inhibits the B+ voltage via U8. Opto-coupler U9 turns on causing FET Q7 to be biased off, which disables fan operation while the B+ voltage is inhibited.

2.4.1.1.5 Temperature

Temperature sensor U11, operational amplifier U5:A and associated components form a temperature monitoring circuit for the RF power module. A dc voltage, representative of the temperature, is applied to *Temperature* output (J1-12).

2.4.1.2 Power Module Interface PWB

With the exception of the B+ input to the modulator, the power module interface PWB (A2) provides the input and output connections for the associated RF power module's power amplifier and modulator.

2.4.1.3 Modulator

The modulator assembly (A3) is effectively a logic level converter that converts the low level (0-15 V) logic of the *PDM* input to a high level (0-B+) logic *PDM (B+)* output.

2.4.1.3.1 13 V Power Supply

The 15 V *LO* output (pin 1) of FET driver U1 is full-wave rectified by the bridge rectifier formed by CR1 through CR4, at the PDM frequency. The resultant dc voltage is filtered by capacitor C7 and limited to 13 V by zener diode CR5.

The power supply's less positive output is referenced to the source terminal of power MOSFET Q1 via resistor R7. Therefore, the positive output is always 13 V more positive than the voltage on the FET source terminal. The 13 V output is applied to the V_B (+) and V_S (-) inputs of FET driver U1 as the switched gate drive for the power MOSFETs. Transformer T1 provides isolation between the high- and low-level signals.

2.4.1.3.2 FET Driver

FET driver U1 is an integrated circuit configured to produce outputs as follows:

- When the H_{IN} input is high (+1 5 V), H_O output is the dc voltage applied to V_B input.
- When the H_{IN} input is low (0 V), H_O output is the reference voltage applied to V_S input.

The H_O output, which contains the PDM data, is applied to the gate of power MOSFET Q1 as its on/off control.

2.4.1.3.3 B+ Switching MOSFET

Power MOSFET Q1 is connected to switch the B+Vdc on and off at the on/off ratio of the PDM data on U1's H_O output, which is applied to its gate. The resultant *PDM (B+)* output contains the PDM data applied to J2-7 at a high (0-B+) logic level. Free-wheeling diode CR6 prevents negative overshoot by providing current flow when MOSFET Q1 is switched off.

2.4.1.3.4 Dump Circuit

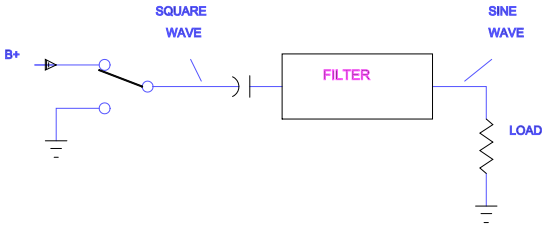
The dump circuit consists of FET Q2 and associated components. During high trough modulation peaks, the average current flowing into the modulator filter is low and the drain-source capacitance of modulator MOSFET Q1 becomes a finite factor in transmitter linearity. A pulse is applied to the modulator's *dump* input (J2-9) during the -95% to –100% modulation intervals to discharge the residual capacitance on MOSFET Q1.

2.4.1.4 Modulator Filter PWB

The modulator filter PWB comprises inductors L1 through L3 and capacitors C1 through C3 as well as C2 of the power amplifier (A5). These components form a low pass filter designed to pass the audio components but reject the PDM frequency. When no modulating audio information is present, the *PA Volts* output will be a dc voltage equal to the modulator input voltage multiplied by the duty cycle of the PDM (B+) signal. Capacitor C5 in conjunction with L3 is resonant at a frequency to provide optimal rejection of the PDM frequency.

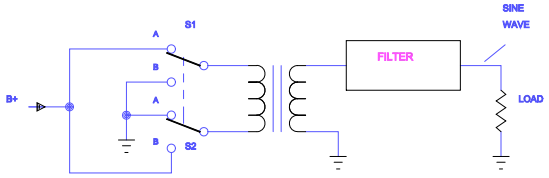
2.4.1.5 Power Amplifier

The power amplifier (A5) uses two parallel-connected pairs of MOSFETs (Q1 through Q4) to produce an unfiltered, modulated RF output. The MOSFETs are connected as cascode or 'H' bridge class 'D' amplifiers, which switch the *PA volts* at the RF drive frequency (refer to Figure 2-3 for a description of class D operation using power MOSFETs). RF drive splitter transformer T1 splits the *RF drive* signal and applies it to MOSFETs Q1 through Q4 with the required phase relationship. Transistor Q5 and associated components detect the RF drive level and provide an alarm signal to the controller/display PWB. Resistors R5 through R7 provide a *PA Volts Sample* for front panel monitoring.



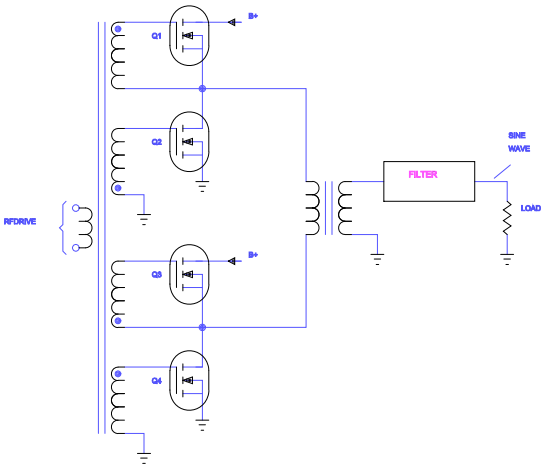
SIMPLE CLASS 'D' OPERATION

If the switch is opened and closed with a 50% duty cycle, a square wave at the switching frequency will result at the filter input. If the filter is designed to pass the switching frequency, but attenuate its harmonics, a sine wave is applied to the load.



PUSH-PULL CLASS 'D' OPERATION

If S1 and S2 are opened and closed with a 50% duty cycle, a square wave of current, at the switching frequency, is passed through the primary of the transformer and transformed to its secondary. If the filter is designed to pass the switching frequency, but attenuate its harmonics, a sine wave is applied to the load.



POWER MOSFET CLASS 'D' OPERATION

Power MOSFETs can be used to replace the switches as depicted in the simple class 'D' operation and push-pull class 'D' operation examples. Note that the switch contacts are replaced by the phase-oriented secondaries of an RF drive transformer. Q1 corresponds to S1-A, Q2 to S1-B, Q3 to S2-B and Q4 to S2-A, as depicted in the push-pull class 'D' operation example. Q1 and Q4 turn on/off together and Q2 and Q3 turn on/off together.

Figure 2-3: Simplified Principles of Class 'D' Operation

2.5 RF COMBINER/FILTER STAGE

The RF combiner/filter stage contains an RF combiner and a bandpass filter that produce the transmitter's final RF output (see Figure SD-3). A forward/reflected power probe and an RF current probe provide samples of the transmitter's RF output, forward power, reflected power and RF current.

2.5.1 Hybrid Combiner/Matching Transformers

The outputs of the two RF power modules are applied to hybrid combiner transformer T1. The combined output of transformer T1 is applied to matching transformer T2, which steps up combiner transformer T1's output impedance from 25 Ω to 50 Ω. When the RF signals applied to combiner transformer T1 are of equal amplitude and phase, no signal is applied to the *Reject Load* output (J2). When an amplitude or phase difference occurs, an RF voltage proportional to that difference is applied to the *Reject Load* output (J2). An external load connected to J2 will dissipate the reject power.

2.5.2 RF Output Filter

The output of the hybrid combiner is applied, via RF filter input PWB A2A3, to an RF output filter. The RF output filter, consisting of capacitors C1 through C3 and inductors L1 through L3, is a band pass filter with a series trap tuned to the carrier frequency's third harmonic. Its nominal input and output impedance is 50 Ω and it has a loaded Q of '2'. The filter removes unwanted harmonics from the hybrid combiner's output and provides the transmitter's final *RF output* (J1). The filter also contains an RF current probe and a forward/reflected power probe. These probes monitor the RF and provide outputs that are monitored by protection circuits. Transient suppressor zener diodes A2A4CR4 through A2A4CR9 provide transient protection for the RF output.

2.5.3 RF Current Probe

The RF current probe circuitry, located on the RF filter input PWB (A2A3), monitors the RF current applied to the RF output filter and produces an RF voltage proportional to the RF current. This voltage is applied to A2A4J1-11 as the *RF current sample* output. The *RF current sample* output is applied to the controller/display PWB's high RF current detector and metering circuit. This high RF current detector produces a high RF current alarm and causes the transmitter's RF output to shut back (turn off) when the RF current exceeds a threshold that represents the maximum stress current for the RF power modules.

2.5.4 Forward/Reflected Power Probe

The forward/reflected power probe circuit, located on forward/reflected power probe PWB A2A4, consists of 20:1 RF current transformer T1, 80:4 RF voltage transformer T3 and associated components. These transformers form the current and voltage arms of a forward/reflected power bridge, which samples the RF output.

The current flowing into the RF output passes through transformer T1's primary. The current in T1's secondary develops a voltage across resistors R3 through R7 that is proportional to the RF output current. The anti-phase voltage across the secondary of RF voltage transformer T3 is applied (summed) to the centre-tap of T1's secondary. When the RF output impedance is precisely 50 Ω, the RF current waveform is in-phase and of equal amplitude to the RF voltage waveform on one half of T1's center-tapped secondary and equal amplitude, but 180° out-of-phase on the other half.

The in-phase voltages are summed, rectified by CR4, low-pass filtered by L3/C2/L4, resulting in a dc voltage being applied to the *Fwd Pwr Sample* output (J1-1). This voltage is proportional to the RF output's forward power level.

The out-of-phase voltages are summed, rectified by CR1, low-pass filtered by L1/C1/L2, resulting in a dc voltage being applied to the *Refld Pwr Sample* output (J1-5). This voltage is proportional to the RF output's reflected power level.

T3's secondary voltage, which is a true sample of the RF output's voltage waveform, is also applied to the *RF Sample* output (J1-9). This output is applied to the remote interface PWB's **RF MONITOR OUT** BNC to allow for monitoring by a modulation monitor and test equipment during maintenance.

2.6 CONTROL/MONITOR STAGE

The control/monitor stage (see Figure SD-1A and SD-1B) consists of the front panel metering, controller/display PWB, remote interface PWB and optional NxLink Ethernet interface module.

2.6.1 Front Panel Metering

The front panel of the exciter/control assembly (Unit 1) provides local controls and a graphic user interface to display operating status, root cause fault detection, RF power, and critical dc voltage/current levels. The front panel is divided into three sections – system diagram, diagnostic display and control.

2.6.1.1 System Diagram

The system diagram is a functional flow diagram of the transmitter. Each section of the flow diagram contains an alarm lamp, which turns on when a fault occurs in that section. Refer to Section 3 of the *Installation and Operation* manual for a description of each lamp. If a lamp is flashing, the transmitter has entered a cutback (reduced power) mode of operation. The lamp that is flashing is likely the cause for the cutback.

2.6.1.2 Diagnostic Display

The diagnostic display is a graphic user interface (GUI) that is navigated using five soft-keys. The majority of the transmitter's local control (exciter selection, power level, etc.) and monitoring (critical parameter levels, alarm events, etc.) may be performed from menus on this display. Refer to Section 3 of the *Installation and Operation* manual for a detailed description of the diagnostic display.

2.6.1.3 Control Switches

The control switches determine the transmitter's control location (local or remote) and its RF status (on or off).

2.6.1.3.1 Local/Remote Selection

When **Local** is selected, all remote control functions, except RF off, are disabled and have no influence on the transmitter's operating status or pre-set RF power levels. When **Remote** is selected, all front panel control functions, except **RF Off**, are disabled and have no influence on the transmitter's operating status or pre-set RF power levels.

2.6.1.3.2 RF On/RF Off Selection

When **RF On** is selected (enabled in **Local** mode only), the transmitter's RF power stage is enabled to provide an RF output. When **RF Off** is selected (enabled in **Local** and **Remote** modes), the transmitter's RF power stage is inhibited.

2.6.2 Controller/Display PWB

The controller/display PWB (1A1 - see Figures SD-4 through SD-7) performs the following functions:

- Produces dc voltage *carrier reference* outputs that determine the forward power (RF carrier) level of the RF output. These voltages are the reference voltages for variable pulse duration modulation (PDM) generators in the exciter stage.
- Monitors critical parameters and causes the *carrier reference* voltage to turn off (shutback) or reduce (cutback) when fault threshold limits are exceeded.
- Identifies out-of-tolerance parameters when the carrier level is shutback/cutback by providing a local visual indication or a remote electrical status output.
- Selects the exciter (A or B) that will provide the RF drive and PDM drive to the RF power stage's RF amplifiers.
- Determines RF power stage on/off status.
- Interfaces with the front panel's diagnostic display.

2.6.2.1 Carrier Reference Voltage

The *carrier ref (A)* (J4-14) and *(B)* (J4-16) outputs are applied to the interphase PDM driver PWB of each exciter to generate the PDM drive pulse that ultimately controls the RF output of the transmitter. Micro-controller U4 produces variable pulse width, 100 kHz signals as the source for the *carrier ref* outputs. The carrier reference filter consists of operational amplifiers U7A, U7B and associated components to form a Bessel filter with a nominal 5 Hz cut-off frequency. The carrier reference filter is provided to remove all switching components from the carrier reference line.

2.6.2.2 Alarm Threshold Circuits

Certain parameters that are monitored by the controller/display PWB can initiate an alarm indication and appropriate transmitter control if an out of tolerance condition occurs.

2.6.2.2.1 Ac Supply Voltage

The *Ac Pwr* input (J4-22) is an unregulated dc voltage that is proportional to the ac power source voltage. The input is filtered and buffered (by operational amplifier U24D) and compared to a pre-determined *low ac ref* fault threshold (on operational amplifier U27C). If the *Ac Pwr* voltage falls below this threshold, the *carrier ref (A)* and *(B)* outputs are clamped to 0 V and the *shutback (A)* (J5-1) and *(B)* (J5-2) outputs will switch to 0 V and inhibit the exciter stage's modulator drive. The transmitter's RF output is turned off (shutback) and will remain off until the ac power voltage is restored to an acceptable voltage. The system diagram's **AC Mains** lamp will display a fault condition. An *Ac Sample* signal is applied to A/D converter U28 for application to the front panel's diagnostic display.

2.6.2.2.2 Reflected Power Monitor

The *refld pwr* input (J7-4) is a dc voltage that is proportional to the reflected power sensed at the transmitter's output. The input is filtered and applied to the *Ext Refld Pwr Sample* output (J1-5) for remote monitoring.

The signal is then buffered (by operational amplifier U33A) and compared to a pre-determined *refld pwr shtbk ref* fault threshold (on operational amplifier U35A). When the reflected power exceeds 150 W, the *refld pwr* input is more than the fault threshold. The *carrier ref (A)* and *(B)* outputs will be clamped to 0 V and the *shutback (A)* (J5-1) and *(B)* (J5-2) outputs will switch to 0 V and inhibit the exciter stage's modulator drive. A clock pulse is also applied to an alarm count/cutback circuit in complex programmable logic device (CPLD) U14. The RF output will instantly shut back (turn off). This signal is also monitored by operational amplifiers U35B and U35C, which determine the amount of cutback applied to the RF output. The system diagram's **Output Network** lamp will display a fault condition. A *Refld Pwr Sample* signal is applied to A/D converter U28 for application to the front panel's diagnostic display.

Turning off the RF output will result in the *refld pwr* input being reduced to 0 V. The *carrier ref (A)* and *(B)* outputs are restored to their pre-shutback levels, the *shutback A* and *B* outputs return to open collector, and the RF output is restored at an exponential rate. If the fault threshold is exceeded before the pre-set power level is reached, the shutback cycle is repeated. If four or more shutback cycle clock pulses are applied within any five-second period, the *carrier ref* outputs is cutback (reduced) until the carrier level is cutback (reduced) to a level that results in an acceptable reflected power. When the transmitter has entered cutback mode, the system diagram's **Output Network** lamp will flash on and off. When the *refld pwr* input returns to or is maintained at a level that is less than the fault threshold, the s*hutback* outputs will return to open collector but the system diagram's **Output Network** lamp will continue to display a fault as a maintenance aid. The lamp will remain on until reset by the diagnostic display menu.

2.6.2.2.3 RF Current Monitor

The *RF current* input (J7-8) is an RF voltage that is proportional to the total RF current being applied to the RF output filter by the RF power modules. The input is filtered and buffered (by operational amplifier U33B) and compared to a pre-determined *RF current ref* fault threshold (on operational amplifier U35D). When the RF current exceeds the fault threshold, the *carrier ref (A)* and *(B)* outputs are clamped to 0 V and the *shutback (A)* (J5-1) and *(B)* (J5-2) outputs will switch to 0 V and inhibit the exciter stage's modulator drive. A clock pulse is also applied to CPLD U14's alarm count/cutback circuit. The RF output is instantly shutback (turned off). The system diagram's **Output Network** lamp will display a fault condition. An *RF Current Sample* signal is applied to A/D converter U29 for application to the front panel's diagnostic display.

Turning off the RF output will result in the *RF current* input being reduced to 0 V. The *carrier ref (A)* and *(B)* outputs are restored to their pre-shutback levels, the *shutback A* and *B* outputs return to open collector, and the RF output is restored at an exponential rate. If the fault threshold is exceeded before the pre-set power level is reached, the shutback cycle is repeated. If three or more shutback cycle clock pulses are applied within any three second period, the *carrier ref* outputs are cutback (reduced) until the carrier level is cutback (reduced) to a level that results in an acceptable RF current level. When the transmitter has entered cutback mode, the system diagram's **Output Network** lamp will flash on and off. When the *RF current* input returns to or is maintained at a level which is less than the fault threshold, the s*hutback* outputs will return to open collector but the system diagram's **Output Network** lamp will continue to display a fault as a maintenance aid. The lamp will remain on until reset by the diagnostic display menu.

2.6.2.3 Sample Monitoring Circuits

In addition to the parameters described in paragraph 1.6.2.2, various parameters are applied to the controller/display PWB for local (via the front panel's diagnostic display) and/or external (via the remote interface PWB) monitoring. In most cases, these parameters also have associated alarm detection circuitry, but it is not resident on the controller/display PWB.

2.6.2.3.1 B+ Voltage

The *B+ (A)* (J4-24) and *B+ (B)* (J4-26) inputs are dc voltages which represent the positive dc voltage applied to RF power modules A and B as their high current voltage source. The inputs are filtered and buffered by operational amplifiers U24B and U37A. *B+ (A) Sample* and *B+ (B) Sample* signals are applied to A/D converter U29 for application to the front panel's diagnostic display. The ORed output of the *B+ sample* inputs is applied to the *Ext B+ Sample* output (J1-19), then applied to the remote interface PWB for external monitoring.

2.6.2.3.2 PDM Drive

The *PDM (A)* (J4-10) and *PDM (B)* (J4-12) inputs are pulses which represent the PDM signal applied to RF power modules A and B. The inputs are buffered by operational amplifiers U36D and U36B and then filtered through operational amplifiers U38B and U38D and associated components. *PDM (A) Sample* and *PDM (B) Sample* signals are applied to A/D converter U28 for application to the front panel's diagnostic display.

2.6.2.3.3 Dc Current

The *Dc Current (A)* (J8-19) and *Dc Current (B)* (J8-39) inputs are dc voltages which represent the dc current being drawn by RF power modules A and B. The inputs are buffered by operational amplifiers U36A and U36C and then filtered through operational amplifiers U38C and U38A and associated components. *Dc Current (A) Sample* and *Dc Current (B) Sample* signals are applied to A/D converter U28 for application to the front panel's diagnostic display. The ORed output of the *Dc Current Sample* inputs is applied to the *Ext Dc Current Sample* output (J1-17), and then applied to the remote interface PWB for external monitoring.

2.6.2.3.4 PA Voltage

The *PA Volts (A)* (J4-6) and *PA Volts (B)* (J4-8) inputs are dc voltages which represent the voltage applied to the power amplifiers in RF power modules A and B. The inputs are buffered by operational amplifiers U33C and U33D and then filtered through operational amplifiers U37B and U37D and associated components. *PA Volts (A) Sample* and *PA Volts (B) Sample* signals are applied to A/D converter U29 for application to the front panel's diagnostic display.

2.6.2.3.5 Forward Power

The *Fwd Pwr* input (J7-2) is a dc voltage that represents the forward power at the transmitter's RF output. The input is buffered by operational amplifier U32D and then filtered through operational amplifier U26B and associated components. A *Fwd Pwr Sample* signal is applied to A/D converter U28 for application to the front panel's diagnostic display. The *Fwd Pwr* input is also applied to the *Ext Fwd Pwr Sample* output (J1-3), then applied to the remote interface PWB for external monitoring. The buffered *Fwd Pwr* signal is low-pass filtered through operational amplifier U32B and associated components and applied to the *Ext Audio* output (J1-7), then applied to the remote interface PWB for external monitoring. The *Ext Mod % Sample* and *Audio (Speaker)* outputs are not used in J1000 transmitters.

2.6.2.3.6 Low Voltage Power Supplies

Attenuated, buffered samples of all low voltage dc power supplies (+24 V, ± 15 V and ± 5 V) are applied to A/D converters U28 and U29 for application to the front panel's diagnostic display. Lamps DS9 through DS13 indicate the presence of these voltages.

2.6.2.4 Microcontroller

Microcontroller IC U4 interfaces between the diagnostic display and its associated soft-keys. It generates the *Carrier Ref* signal (see paragraph 1.6.2.1), which ultimately determines the forward power level of the transmitter. It also acts as an internal and external serial interface for transmitter alarm and status signals.

2.6.2.5 CPLD

Complex Programmable Logic Device (CPLD) U14 continuously reads digital inputs for all transmitter alarm events. It is programmed to perform root cause detection of a fault as well as high-speed fault protection. Depending on the nature of the fault, the CPLD generates transmitter S*hutback* outputs (J5-1 and J5-2) or various digital control/inhibit signals via a parallel data buss.

2.6.3 Remote Interface PWB

The remote interface PWB (1A2 - see Figures SD-8 through SD-10) performs the following functions:

- Buffers all external transmitter remote control inputs and transmitter remote status/alarm outputs.
- Provides buffered, analog sample voltages proportional to the B+ supply voltage, total dc current, audio, forward power, and reflected power for external monitoring.
- Conditions the audio (analog or DAB) input's gain and provides filtering and modulation protection.
- Provides monitoring samples of the transmitter's RF output (both analog and DAB). The magnitude of the analog sample is automatically adjusted to ensure a relatively constant voltage, nominally 1V RMS, regardless of RF output level.
- Provides the connection for the system's external interlock circuit between TB2-15 and TB2-16.

2.6.3.1 Remote Inputs

RFI filtering is provided on all control input lines to ensure transmitter operation is not interrupted due to RF pick-up on control lines. Opto-couplers are provided to buffer/isolate the external circuits and prevent any unwanted transients from affecting transmitter operation. The position of shorting jumpers E8 through E22 and E27 allow the control inputs to be configured to operate from a single-ended or differential input. Refer to section 2 of *the Installation and Operation* manual for detailed description on single-ended versus differential inputs.

2.6.3.2 Remote Outputs

Remote alarm/status outputs are provided on terminals of the remote interface PWB. A darlington transistor for each alarm/status output provides a negative logic (current-sink-to-ground) output when a logic 'true' (alarm condition or active status) exists. The switching circuit provides an open collector during logic 'false' conditions (non-alarm or non-active status condition) and has no influence on the external monitoring circuit. Each monitoring circuit must present impedance between the switching device and a positive dc voltage source that will result in a current flow of not more than 50 mA. +24 V is available for use by the remote monitoring circuits on TB4-18.

2.6.3.3 Audio Input

The transmitter's audio input is applied to the **AUDIO INPUT** terminals (TB2-12/13/14), for analog audio, or to RJ45 connectors J2 [**MAG (HD-R)**] and J3 [**PHASE (HD-R)**], for HD-R operation. The audio signal is then applied to the balance/unbalance circuit. The position of shorting jumpers E1 and E2 determine the amplitude modulating source – **HD-R** or normal **AUDIO** program.

2.6.3.4 Balance/Unbalance Circuit

The balance/unbalance circuit, which converts the balanced audio input or HD-R magnitude input to an unbalanced signal, consists of U2A or U5A and its associated components. The output of differential amplifier U2A or U5A is an unbalanced audio that is a positive voltage for positive half cycles and a negative voltage for negative half cycles. Any unwanted noise transients that are induced on the audio input will be in-phase and of equal amplitude. Since the transients are in-phase and of equal amplitude, they have no influence on U2A's or U5A's output and they will not appear at U2A's or U5A's output.

2.6.3.5 Zero Crossing Detectors

The audio zero crossing detector consists of U11B, Q1, CR1, and associated components. The HD-R zero crossing detector consists of U9A, Q6, CR38, and associated components. These circuits are the +15 V charge voltage sources for C32 during the negative audio half-cycles. During positive audio half-cycles they are effectively open circuit and have no influence on the charge state of C32. A small dc bias (0.3 V) is present on U11B's non-inverting input or U9A's inverting input for HD-R and DRM operation.

2.6.3.6 Modulation Level Detector

The modulation level detector circuit monitors the on/off times of the *Fwd Pwr Sample* output for excessive on times. It automatically inhibits a portion of any modulating audio's positive going half-cycle that would cause excessive 'on times' and result in the stress current threshold of the transmitter's RF power amplifier stages being exceeded. The circuit consists of comparators U11C, U11D, U12A, U12B, U12C, U12D and their associated components. It provides a discharge path to -15 V for C32 when the 'on time' of the *Fwd Pwr Sample* signal will result in modulation peaks that exceed safe operating levels

2.6.3.6.1 The *Fwd Pwr Sample* input, applied to the inverting inputs of each comparator, is a varying positive dc voltage directly proportional to the RF output's modulation envelope. The audio component is synchronized with the audio output of U11B and is the most positive at the peak of the modulating audio's positive half-cycle.

2.6.3.6.2 Each comparator has a reference voltage applied to its non-inverting input that represents the RF stress current threshold for a specific carrier level/audio amplitude/audio frequency combination (see Table 2-1). **SET THRESHOLD** potentiometer R45 is adjusted to precisely set the threshold voltages, when the PWB is installed in a transmitter.

2.6.3.6.3 When the voltage representing the modulation envelope exceeds the RF stress current threshold of a comparator, that comparator connects its output resistor to -15 V and provides a discharge path for C32. The time for C32 to discharge to a negative voltage is dictated by the number of resistors connected to -15 V (modulation amplitude) and the period of time they are connected (audio frequency). C32's discharge time (dictated by the R/C time constant) is progressively faster as the modulation depth increases (more comparator thresholds are exceeded) and it has a longer time to discharge as the audio frequency decreases. Refer to Table 2-1 for the duration of a positive half-cycle at the lowest unaffected audio frequency for specific modulation depths.

Table 2-1: Peak Modulation Limit Threshold

Mod Depth Peak)	Lowest Unaffected Freq (Hz)	Duration (ms)
85%	10	50.0
95%	11	46.6
105%	20	25.6
115%	32	15.4
125%	56	8.9
135%	96	5.2

2.6.3.7 Audio Chopper

The audio chopper circuit consists of U11A, Q2, Q7, and their associated components. It inhibits some portion of positive audio half-cycles that cause modulation peaks/durations that exceed the RF stress current threshold of the transmitter's RF power amplifiers. It accomplishes this by clamping the modulating audio to ground whenever the charge voltage on C32 switches from a positive value to a negative value and retains this state until C32's charge voltage returns to a positive value at the end of the positive audio half-cycle.

When C32 has a positive voltage charge, U11A's non-inverting input is more positive than its inverting input. U11A's output is an open collector. Q2 and Q7 are reverse biased and have no influence on the modulating audio or HD-R. Q4 is also reverse biased. The *mod prot/audio limit* output (J1-31) is open collector (logic negative state). When the modulation level detector circuit provides C32 a discharge path to -15 V (because one or more RF stress current thresholds have been exceeded) for a long enough period of time to achieve a negative voltage charge, U11A's non-inverting input will go less positive than its inverting input. U11A's output is a current-sink-to -15V and causes Q2, Q7 and Q4 to be forward biased (turned on). The modulating audio or HD-R magnitude signal is clamped to ground by Q2 or Q7 until the start of the next negative audio half-cycle (for the balance of the current positive audio half-cycle), when the zero-crossing detector circuit provides a low impedance source to +15 V and charges C32 to a positive value. The *Mod Prot/Audio Limit* output is a current-sink-to-ground (logic true state) for each offending positive audio half-cycle. The system diagram's **Exciter** lamp will flash on and off when this circuit is active.

2.6.3.8 Audio Gain

U9B is connected as a unity gain, buffer amplifier. **AUDIO GAIN** potentiometer R23 is adjusted for the desired modulation depth when the interphase PDM driver PWB is installed in its host transmitter. It has sufficient range to set the modulation depth at 100% when the audio input is between 0 dBm and +12 dBm.

2.6.3.9 Audio Filter

The audio filter circuit is a low pass filter with a -1.0 dB, high frequency roll-off at one of four user-selected frequencies. The **AUDIO FILTER** switch S1 has settings to select one of four roll-off frequencies (16 kHz, 13.5 kHz, 10.5 kHz or 7.5 kHz). The high frequency roll-off selection is normally dictated by complex factors, such as an antenna with sideband limitations, square wave overshoot, or the equipment that pre-processes the audio. The **AUDIO FILTER** switch and audio filter are bypassed (using shorting jumpers E3 and E4) when digital program input is used.

2.6.3.10 RF Monitor Level

The *RF Monitor In* input (J13) is applied to a group of series resistors, each in parallel with contacts of a relay switching circuit. The *serial data out (2)* signal, applied to the *A* input (pin 14) of 8-bit shift register U39, and represents the carrier reference level, hence the transmitter's RF output. U39's parallel *Q* outputs energize the appropriate relay(s) to provide 1.0 V RMS into a 1,000 Ω or 50 Ω load as the *RF Monitor Out* output (J14), when the RF output is between 100 W and 1,100 W.

2.6.3.11 Magnitude Gain

MAG GAIN potentiometer R36 is adjusted for the correct magnitude signal when connected to an NE IBOC exciter for HD-R operation.

2.6.4 NxLink Ethernet Interface Module (Optional)

See the NxLink manual. An optional NxLink Ethernet interface module (U200) converts the internal serial protocol to Ethernet for external interfacing. When U200 is used, internal transmitter wiring is provided to supply the module's +15 V power supply.

J1000
REPAIR MANUAL

Section 3 COMPONENT LEVEL TROUBLESHOOTING

3.1 INTRODUCTION

The information provided in this section is intended to assist an experienced electronic technician in fault diagnosis and isolation of a problem to the component level. It is assumed that system level troubleshooting as outlined in the *Installation and Operation* manual has been performed and the problem has been isolated to a particular PWB or assembly.

3.2 ELECTROSTATIC DISCHARGE PROTECTION

The transmitter's PWBs/assemblies contain semiconductor devices that are susceptible to damage from electrostatic discharge (ESD). The following precautions should be taken when handling an assembly that contains these devices:

NOTE

Electrostatic energy is produced when two insulating materials are rubbed together. A person wearing rubber-soled shoes, walking across a nylon carpet or a waxed floor can generate an extremely large electrostatic charge. This effect is magnified during periods of low humidity. This high voltage may damage semiconductor devices such as integrated circuits, field-effect transistors, thyristors and Schottky diodes unless adequate precautions are taken.

3.2.1 Discharging of Personnel

Personnel must be electrically discharged by a suitable ground system (anti-static mats, grounding straps) when removing an assembly from the transmitter and while handling the assembly for maintenance procedures.

3.2.2 Handling/Storage

The assembly should be placed in an anti-static bag when it is not installed in a host transmitter or when it is not being subjected to maintenance procedures. Electronic components should be stored in anti-static materials.

3.2.3 Tools/Test Equipment

Testing and maintenance equipment, including soldering and unsoldering tools, should be suitable for contact with static sensitive semiconductor devices. A 40 W, temperature controlled soldering iron is recommended.

3.2.4 Stress Current Protection

Precautions should be taken to ensure the static sensitive semiconductor devices are protected from unnecessary stress current. This is achieved by ensuring:

- Current is not flowing when an electrical connection is broken.
- Voltages are not present on external control/monitoring circuits when they are connected.

3.3 COMPONENT REPLACEMENT PRECAUTIONS

When replacing a part on a PWB or assembly, the following precautions must be taken:

- Ensure all PWBs are at least two-sided and contain through-hole plating. Use of excessive heat or excessive mechanical force can damage the PWB. Multi-layer PWBs are more susceptible to damage than two-sided PWBs.
- DO NOT replace components while the PWB/assembly is mounted in the transmitter.
- When removing a defective component, cut the body from the legs before unsoldering the component. This will reduce the heat stress to the PWB's traces.
- Use a solder removal tool or solder wick whenever possible to remove the solder from the component's legs before removing the device.
- Pre-form the legs of a replacement component to fit the PWB hole spacing. This also applies to ICs that mount in sockets.
- For mechanically fastened components, such as power MOSFETs, secure the mechanical connection before soldering the legs to reduce the stress on the solder connection.

3.4 SURFACE MOUNT TECHNOLOGY

Surface mount technology (SMT) enables more efficient use of board space than with through-hole technology, but component replacement is more difficult. It is not practical to place SMT components in the transmitter spares kit because of their small size. f the repair site is not already equipped to handle surface-mount technology, the following guidelines will aid in component replacement:

3.4.1 Location of Parts

SMT components are predominantly on controller/display PWB 1A1 and remote interface PWB 1A2. The RF synthesizer PWB(s) (1A4 and, if installed, 1A6) has two SMT integrated circuits. SMT components are 0603 – 6 mm x 3 mm.

3.4.2 Soldering Guidelines

The following guidelines are provided to aid the maintainer when soldering SMT components on a PWB:

(a) Recommended soldering aids:

- needle tip for soldering iron
- SMT solder (low melting point, fine diameter)
- water-soluble, 'no-clean' solder flux pen
- magnifying glass
- steady hand

(b) Ensure pads are sufficiently cleaned, using solder braid.

(c) Apply a thin layer of solder flux on the pads.

(d) For ICs, place the IC on the pads, noting alignment, and gently press it in place. The flux should have enough adhesion to hold the chip in place.

(e) Carefully solder one corner pin, then verify the IC's alignment. Solder the opposite corner pin, then verify alignment again.

(f) If alignment is correct, carefully solder each pin, in order, around the IC.

(g) If a solder bridge occurs, use a very fine solder wick to remove it.

3.5 FET CHECKING/REPLACEMENT

The transmitter contains many FETs and other switching semiconductor devices. The FETs most likely to fail are located on RF power modules A (2A1) and B (2A2). In the case of a failure caused in the RF power module, it is recommended the following devices be checked and, if necessary, replaced:

- power MOSFET Q1 (Nautel Part # QAP49) of modulator A3
- power MOSFETs Q1 through Q4 (Nautel Part # QAP75) of power amplifier A5
- FETs Q1 and Q2 (Nautel Part # QR54) of forward converter PWB A1.

(a) Unsolder the gate pins of the device under test and all parallel devices. Refer to the assembly's electrical schematic in Section 6 to determine the parallel devices, if applicable. Refer to the assembly's detail drawing in Section 7 to verify device pin-out.

NOTE

A MOSFET under test must be turned on by applying a dc voltage between its gate and source terminals. Some digital multimeters have sufficient dc voltage on their test leads when set to 'diode' or 'resistance' positions. If the digital multimeter being used does not have sufficient voltage (9V battery recommended), an alternate dc voltage source must be obtained.

(b) Turn off the suspect FET and all parallel devices by shorting the gate to source. Using a digital multimeter, momentarily place the negative lead on the gate pin and positive lead on the source pin for each FET in the circuit.

(c) Measure the drain-source resistance with positive lead on the drain and the negative lead on the source. Digital multimeter reading will indicate an open circuit.

(d) Measure the drain-source resistance with the negative lead on the drain and the positive lead on the source. Digital multimeter reading will indicate a diode pedestal.

(e) If the requirements of steps (c) and (d) are not met, replace the device as detailed in steps (i) through (m).

(f) Turn on the device under test by placing the positive lead on the gate and the negative lead on the source.

(g) Measure the drain-source resistance with the positive lead on the drain and the negative lead on the source. Digital multimeter reading will indicate a short circuit.

(h) If the requirement of step (g) is met, the FET is operational. Turn it off and verify as detailed in steps (b) and (c), and then proceed to the next suspect device. If the requirement of step (g) is not met, replace the device as detailed in steps (i) through (m).

(i) Unsolder the drain and source pins of the defective device.

(j) Remove the hardware securing the device in place and remove the defective device. Ensure the associated heat sink surface on the input PWB is cleaned.

NOTE

FETs are static sensitive. Ensure replacement devices are handled in a manner that protects the FETs from static.

(k) Apply a thin, even coat of thermal compound on the bottom of the new device.

(l) Reinstall the device on its associated, cleaned heat sink using the hardware removed in step (j). The Belleville (cupped) washer must be replaced with a new washer (Nautel Part # HZ48, located in ancillary kit). Both sides of the insulator (if replaced) should have a thin, even coat of thermal compound applied. Refer to the assembly's detail drawing in Section 7 to verify the hardware orientation for the device being replaced.

(m) Using a torque screwdriver, tighten mounting hardware to the value (typically 3 to 4 inch-pounds) specified on the assembly's detail drawing in Section 7, ensuring that the pins of the device are aligned with their corresponding solder terminals. Solder the pins to their associated terminals.

3.6 TROUBLESHOOTING REFERENCE DATA

Typical waveforms are provided for critical signals to assist in isolating a fault to a particular component or circuit. This data can only be verified when the referenced assembly is still installed in the transmitter. Electrical schematics for all PWBs and assemblies are provided in Section 6 of this manual.

WARNING

Nautel does not recommend troubleshooting the RF power module's forward converter PWB (2A1A1 or 2A2A1) while the transmitter is turned on. Voltages that are hazardous to life are present near the step-up transformer (T4) on the PWB.

NOTE

The data provided in this section is intended to represent the nominal level only. Component tolerances and carrier frequency may cause slight differences in the measured and presented data. For voltage levels dependent on the level of another parameter, that parameter's level has been noted next to the test voltage.

All measurements/waveforms have been recorded with the transmitter output power set to 1,000 W, unless otherwise specified.

Test point references are included with each waveform's title.

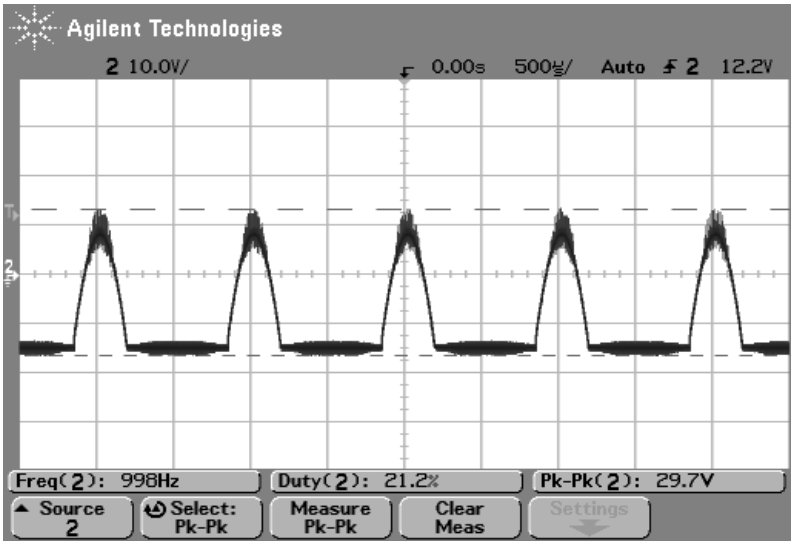


Figure 3-1: Dump Input to Modulator
(Measured at TP3 of power module interface PWB 2A1A2 or 2A2A2)

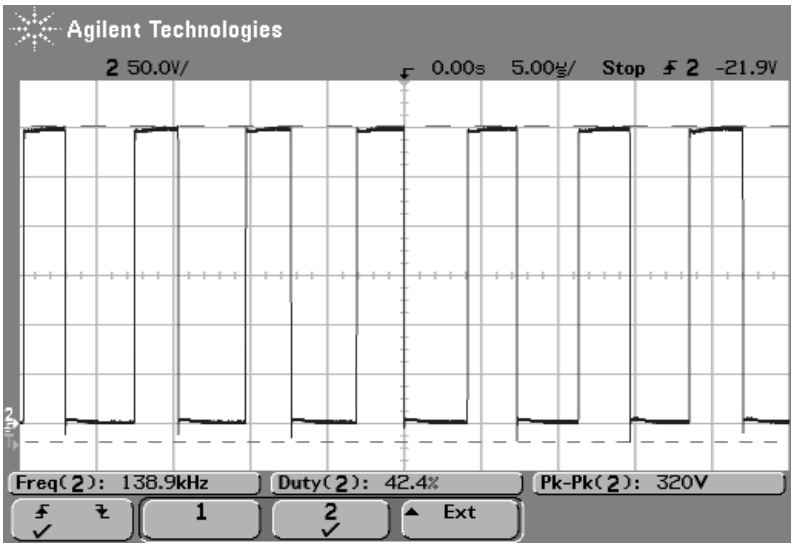


Figure 3-2: PDM (B+) Output of Modulator
(Measured at E1 of modulator 2A1A3 or 2A2A3 or at 'B' terminal of modulator filter PWB 2A1A4 or 2A2A4)

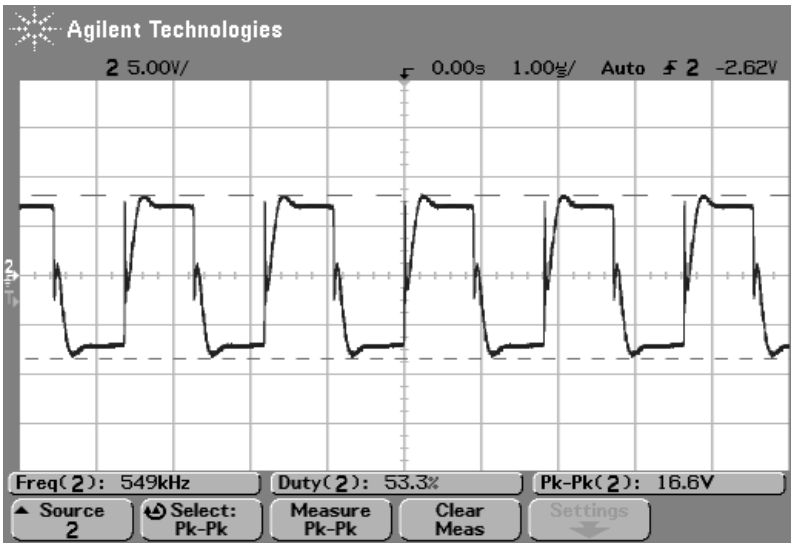


Figure 3-3: RF Drive Input to Power Amplifier
(Measured at CR5-Anode of power amplifier 2A1A5 or 2A2A5)

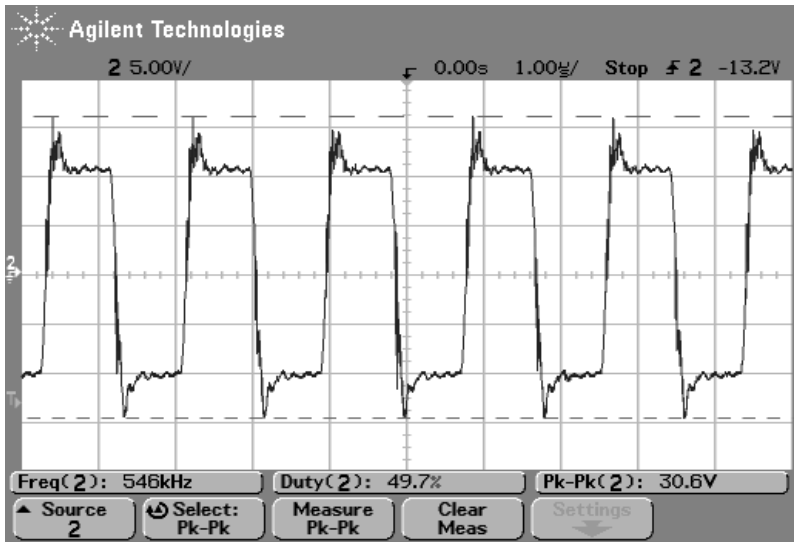


Figure 3-4: Power Amplifier FET Gate Input
(Measured at gate of Q1 through Q4 of power amplifier 2A1A5 or 2A2A5)

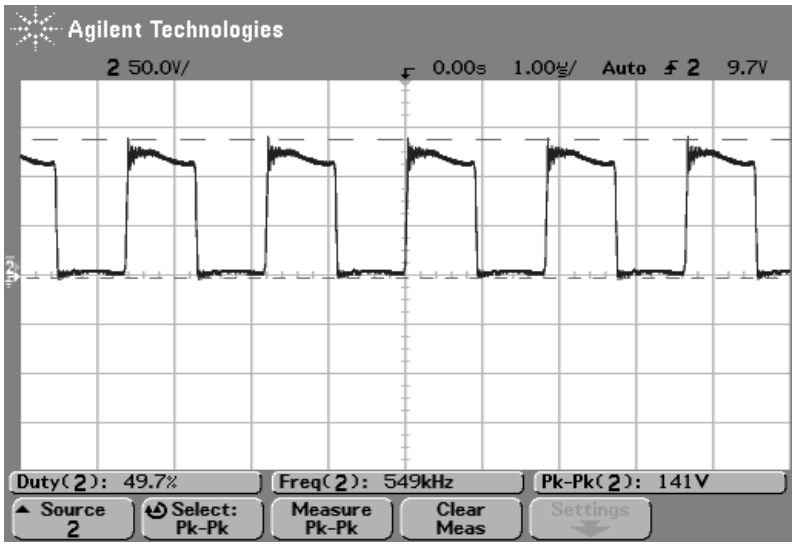


Figure 3-5: RF Output of Power Amplifier
(Measured at E2 or E3 of power amplifier 2A1A5 or 2A2A5)

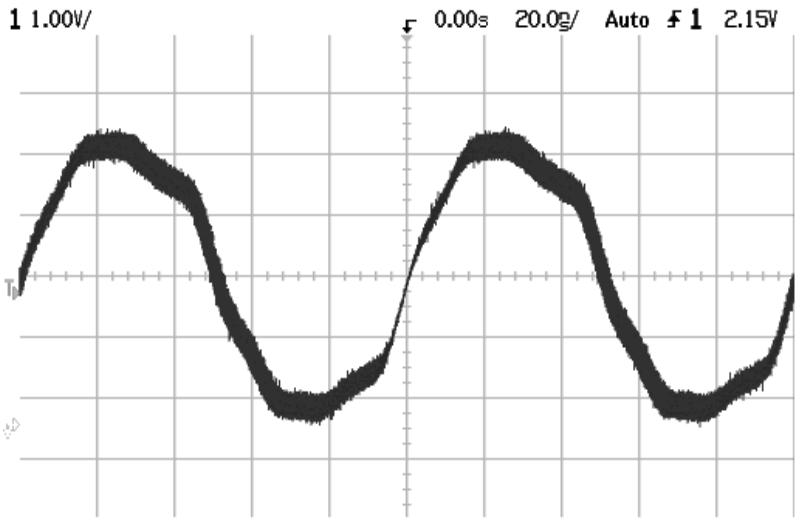


Figure 3-6: Internal 10 MHz Reference Signal
(Measured at U1-Out of RF synthesizer PWB 1A4 or 1A6. **REFERENCE (A)** jumper E1 installed in **INT** position)

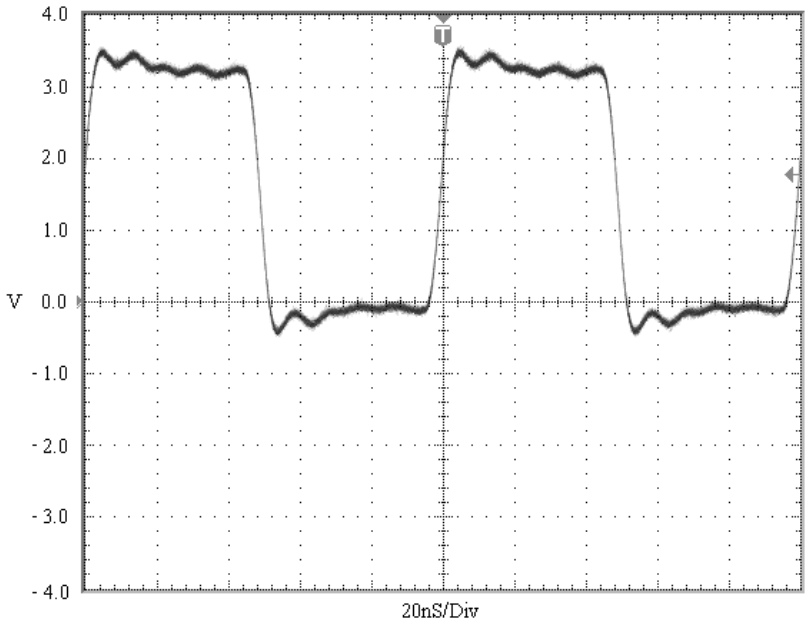


Figure 3-7: 10 MHz Reference Signal for RF Synthesizer PWB
(Measured at TP1 of RF synthesizer PWB 1A4 or 1A6)

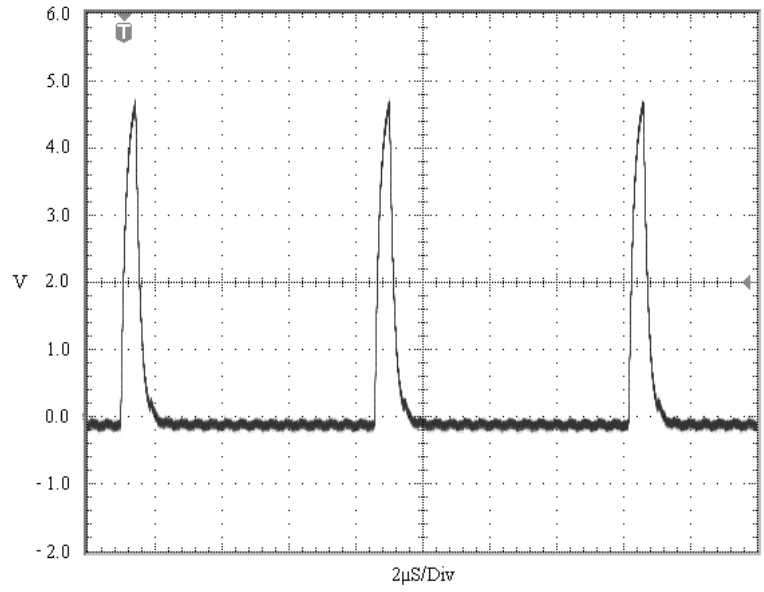


Figure 3-8: 2ƒPDM Generator
(Measured at TP2 of RF synthesizer PWB 1A4 or 1A6)

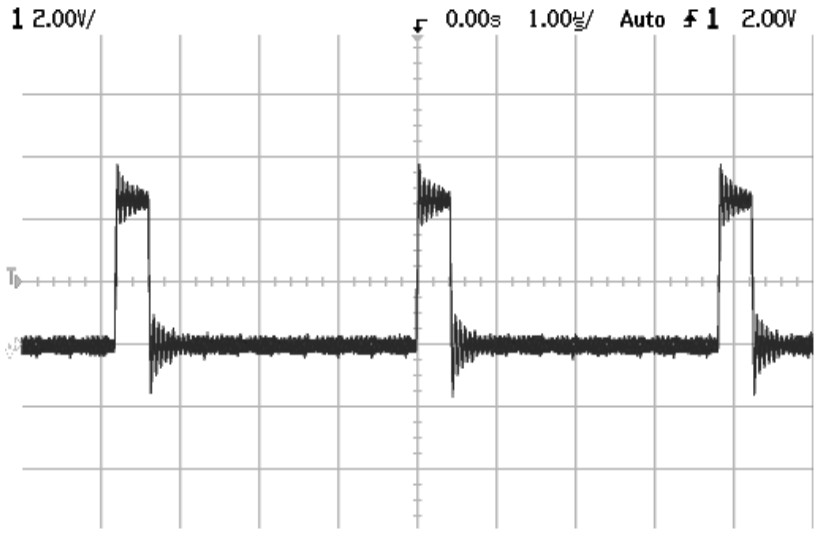


Figure 3-9: 2ƒPDM Output of RF Synthesizer
(Measured at J1-25 or U8-12 of RF synthesizer PWB 1A4 or 1A6)

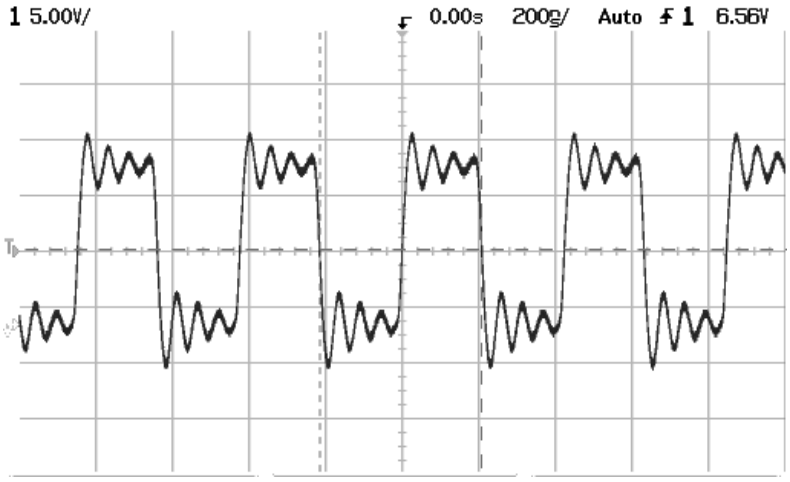


Figure 3-10: 4ƒc/B Signal
(Measured at U10-4 of RF synthesizer PWB 1A4 or 1A6)

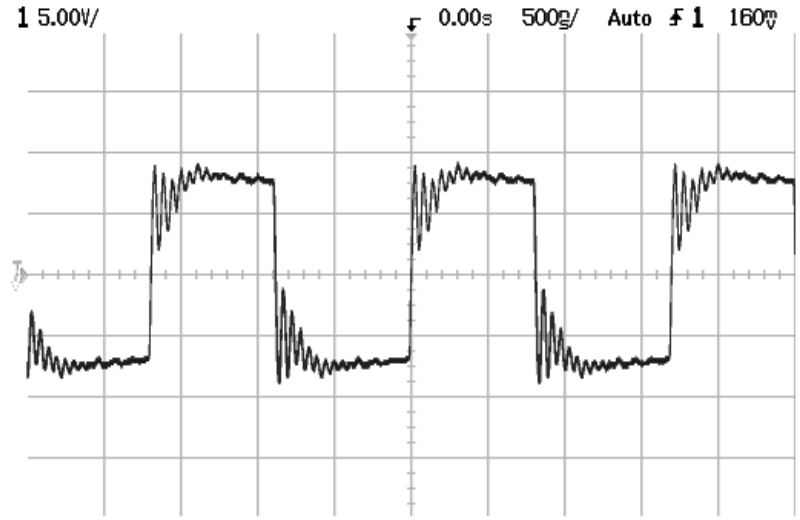


Figure 3-11: 4ƒc ÷ 4 Circuit Output
(Measured at U12-1 of RF synthesizer PWB 1A4 or 1A6)

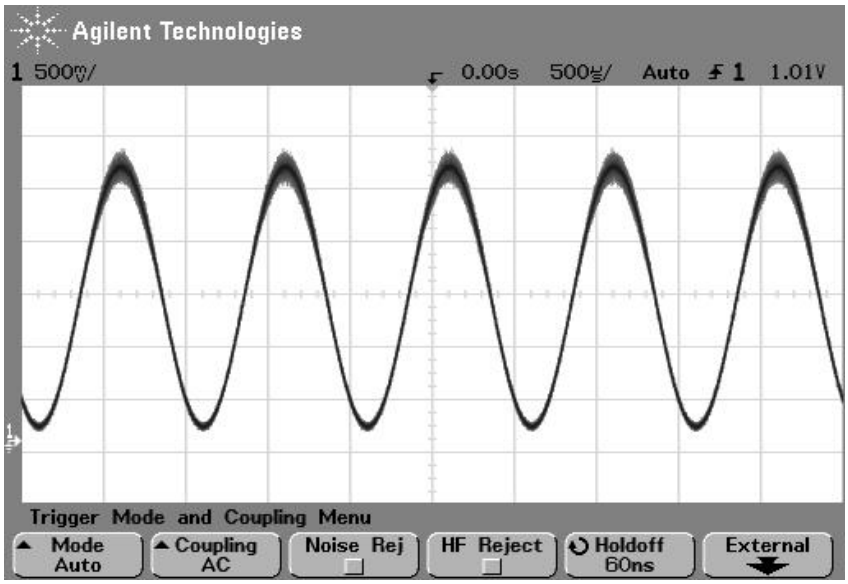


Figure 3-12: Unbalanced Audio
(Measured at U9-8 of remote interface PWB 1A2)

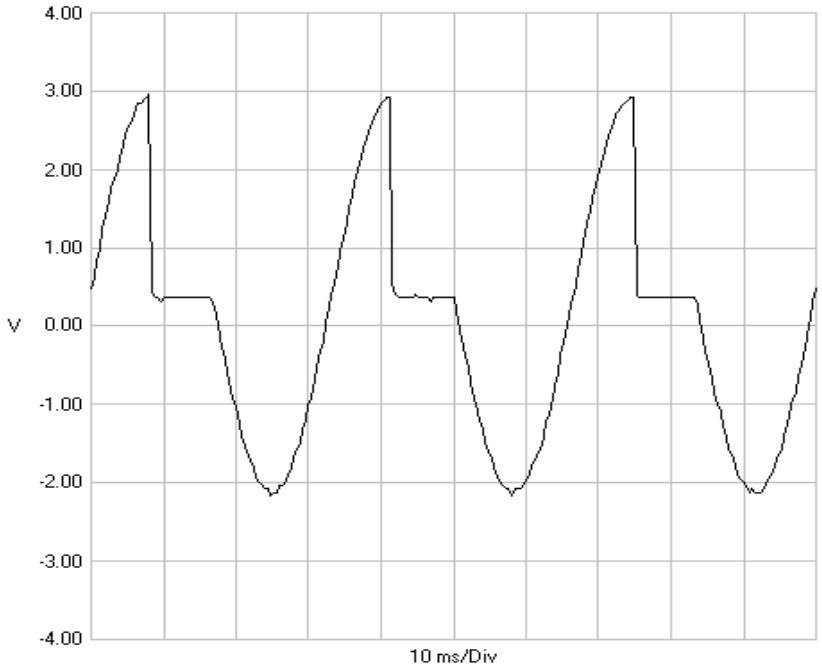


Figure 3-13: Audio Chopper
(Measured at TP7 of remote interface PWB 1A2)

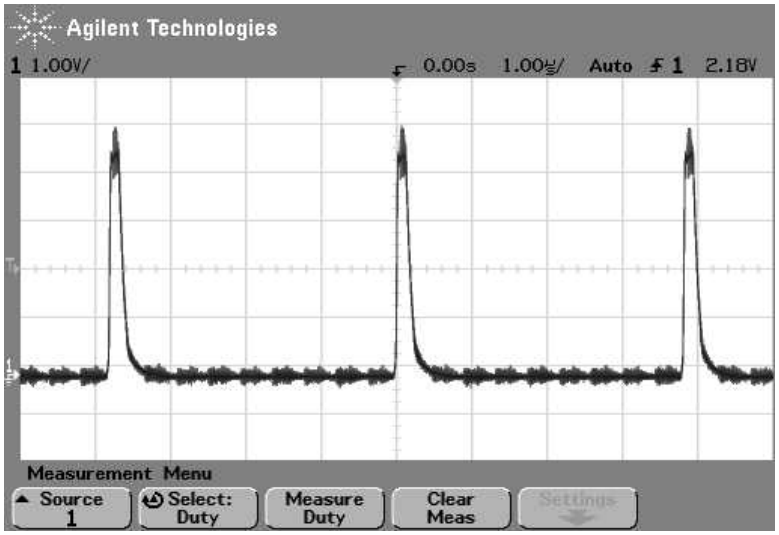


Figure 3-14: 2ƒPDM Input to Interphase PDM Driver PWB
(Measured at J1-7 or U1-3 of interphase PDM driver PWB 1A5 or 1A7)

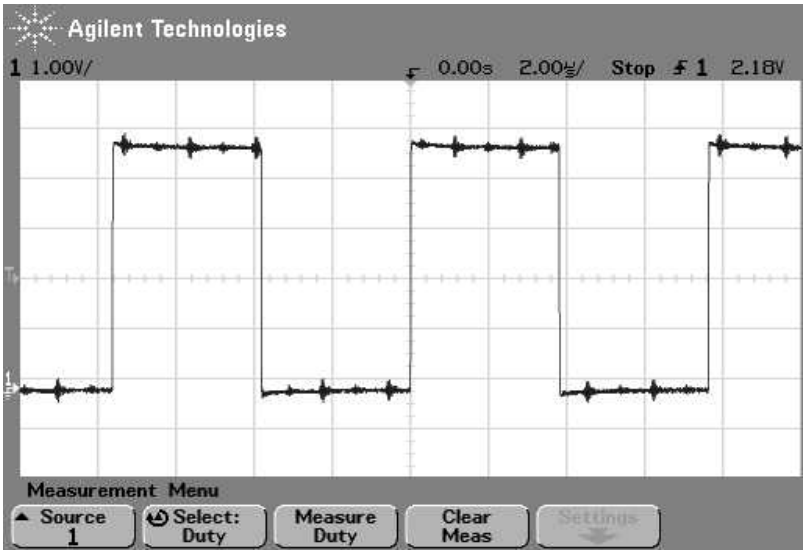


Figure 3-15: ƒPDM – Linear Integrator Input
(Measured at TP2 of interphase PDM driver PWB 1A5 or 1A7)

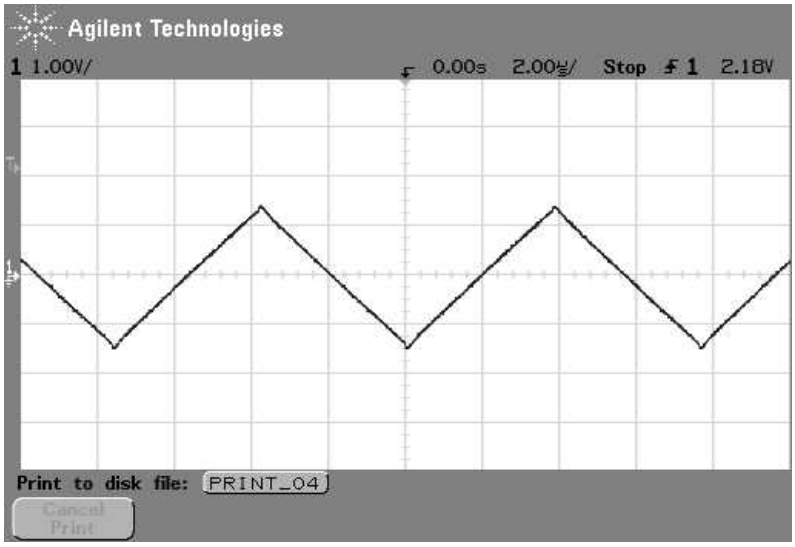


Figure 3-16: Linear Integrator (Ramp) Output
(Measured at TP7 of interphase PDM driver PWB 1A5 or 1A7)

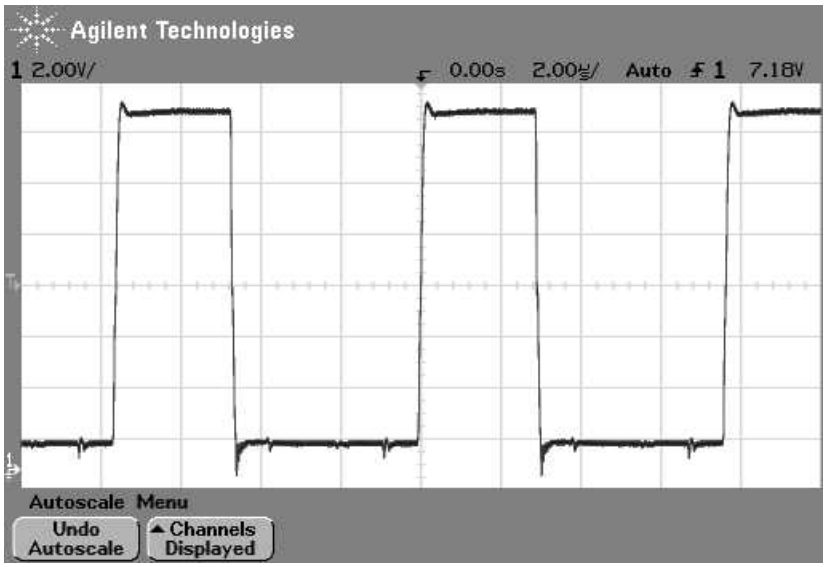


Figure 3-17: Interphase PDM Generator (PDM1) Output
(Measured at TP17 of interphase PDM driver PWB 1A5 or 1A7)

J1000
REPAIR MANUAL

Section 4 PARTS INFORMATION

4.1 INTRODUCTION

This section contains reference designation lists that provide descriptive and provisioning information for all electrical and mechanical parts that have an assigned reference designation and form a part of the subject equipment.

Topics in this section include:

- Family Tree – see 4.2
- How to Locate Information About a Specific Part – see 4.3
- Reference Designation Lists – see 4.4
- Column Content – see 4.5

4.2 FAMILY TREE

Figure 4-1 depicts the family tree for the subject equipment. It is based on the descending order of the reference designation hierarchy and identifies all assemblies that have an assigned Nautel configuration control number.

4.3 HOW TO LOCATE INFORMATION ABOUT A SPECIFIC PART

To locate the information for a specific part, the assigned reference designation for the part must be known. In addition, the Nautel nomenclature (e.g., NAP31/02B) assigned to the assembly containing the part or the full reference designation, including the reference designation of all higher assemblies, must be known.

4.3.1 When the Nautel Nomenclature is Known:

- Refer to the family tree (Figure 4-1) and identify the block(s) associated with the Nautel nomenclature. Locate the part's reference designation in the identified reference designation list in this section, noting they are sorted alphanumerically.

4.3.2 When the Reference Designation is Known:

- Refer to the family tree (Figure 4-1) with the full reference designation.
- Follow the family tree branches to the block that represents the lowest level assembly assigned a Nautel configuration control number, then locate the reference designation information for that Nautel configuration control number.
- Locate the part's reference designation and associated Nautel Part # in the list provided at the end of this section. In a PDF manual, use Ctrl-F (find) to quickly locate the reference designation.

4.4 REFERENCE DESIGNATION LISTS

Reference designation lists are provided for:

- assemblies that are assigned an alpha-prefixed Nautel nomenclature (e.g., NAP31/02B)
- cable harnesses that are assigned a numbered Nautel part (e.g., 197-8060)
- optional kits that are assigned a numbered Nautel part (e.g., 197-3005)

To obtain the full reference designation for a specific part the Nautel configuration control number must be located in the family tree (Figure 4-1) to include the reference designation of all higher-level assemblies. The reference designation lists are presented in alphanumeric order - for each component level of the transmitter - are divided into columns to aid in locating specific information.

4.5 COLUMN CONTENT

The following paragraphs provide an explanation of the purpose and contents of each column in the part number indexes.

4.5.1 Component Level, Stock Code Column

This column contains the Component Level number (01 through 10, as required) and the Nautel Stock Code (part number) assigned to each part.

4.5.2 Component Level

This number represents the level of a component in relation to the highest-level parts list. In this case the highest-level parts list is the J1000's overall parts list, or the top block in the family tree shown in Figure 4-1.

Components that are directly descended from the highest-level parts list are component level 01. The associated stock code and description for level 01 items appear in bold text in the reference designation list, followed by their sub-assembly components, as applicable. Level 01 items are sorted alphanumerically.

Components that are directly descended from component level 01 items are component level 02. The associated stock code and description for level 02 items appear below their associated level 01 component, slightly indented, followed by their sub-assembly components, as applicable. Level 02 items are sorted alphanumerically.

Component level 03 through 10 items, as applicable, descend similarly to component level 02 items, with continuing indentations to identify each new level.

4.5.3 Stock Code

This number is Nautel's drawing number for Nautel manufactured parts, Nautel's configuration control number for assemblies that are under configuration control management, or Nautel's inventory management number for purchased parts. When a Nautel configuration control number (e.g., NAPC*) is shown in this column, its sub-assembly reference designation items are listed below it.

NOTE

This section includes Nautel part numbers only. It does not include original equipment manufacturer (OEM) information (i.e., vendor part numbers). Some vendor information is provided in the J1000 documentation, otherwise contact Nautel to order a replacement part or to request assistance to find a suitable replacement.

4.5.4 Description Column

The Description column contains the name and descriptive information for each part. The key word is presented first, followed by the adjective identifiers.

4.5.5 Reference Designation Column

The Reference Designation column contains the reference designation(s) for a specific part. When multiple reference designations apply to a part, they are sorted alphanumerically. These designations are assigned in accordance with the requirements of IPC-2612-2010 - Sectional Requirements for Electronic Diagramming Documentation (Schematic and Logic Descriptions.

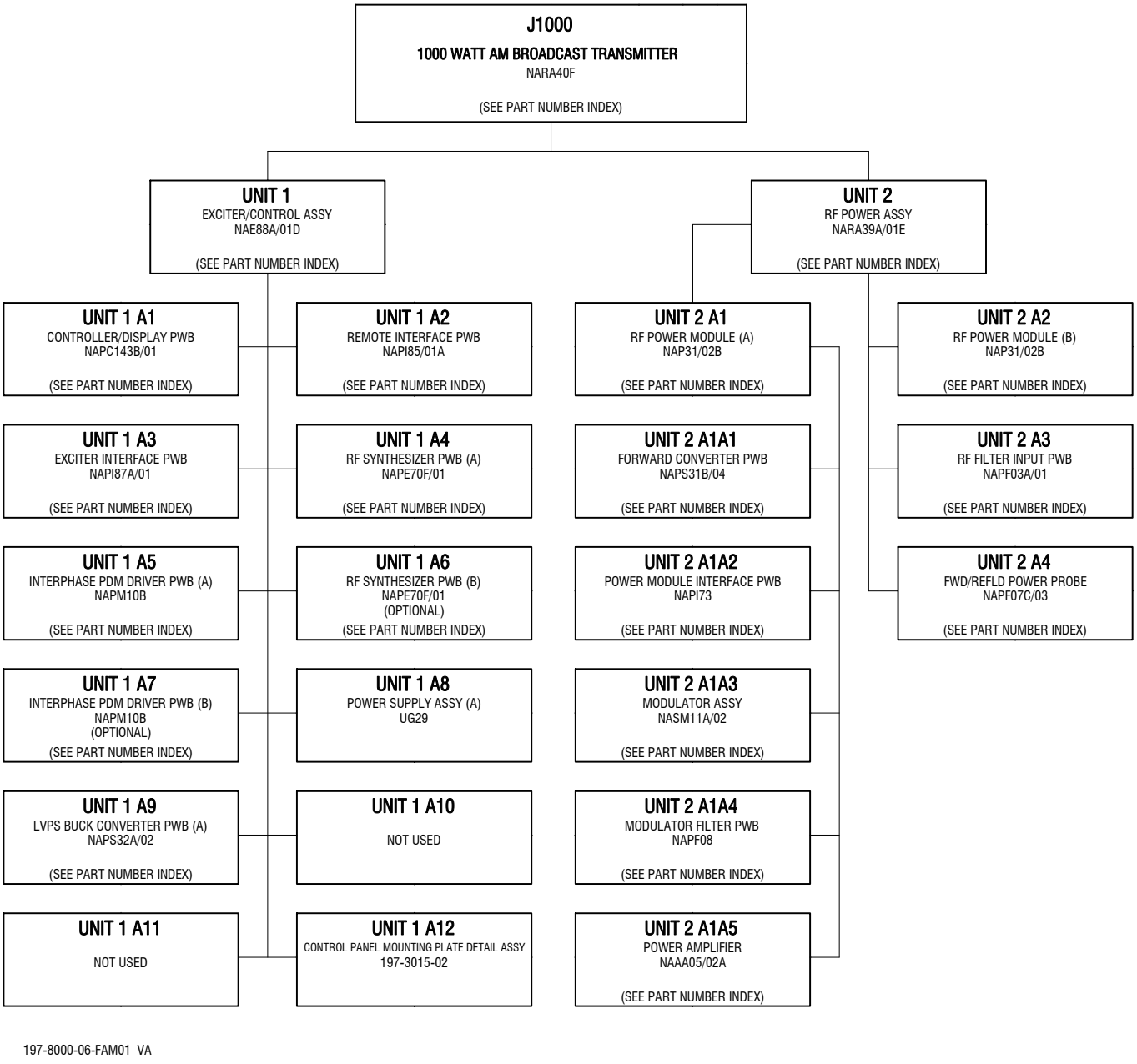


Figure 4-1 Family Tree – J1000 1,000 Watt AM Broadcast Transmitter

StockCode: NARA40F
Description: Final Assembly, J1000,

Component Lvl. StockCode	Description	Reference Designation
01 **197-5010-01**	**Reject Load Assy**	UNIT 3
02 JDP21	Conn, Coax, N, Recept, Panel, 50ohm	J01
02 RX47	Res,Wirewound,Silicon,225w,150 ohms,Brckt	R01, R02, R03
01 **197-8008-02**	**Ancillary Kit, J1000**	
02 175-5030-03	Equipment Hardware Kit (Metric)	
02 197-5031	J1000 Output Connector Hardwar e Kit	
02 197-8010-06	Output Connector Assy - 7/8 EIA	
02 197-8010-07	Output Connector Assy - STUD	
02 197-8040	10MHz Cable	
03 JDP24	Conn, Coax, BNC, Plug, 50ohm, Crimp	P35
03 JT38	Conn, Plug, Crimp, Coax, RG188 Type	P34
02 197-8040-01	10MHz Cable	
03 JDP24	Conn, Coax, BNC, Plug, 50ohm, Crimp	P37
03 JT38	Conn, Plug, Crimp, Coax, RG188 Type	P36
01 **197-8011-01**	**Reject Load Cable**	W300
02 JDP22	Conn, Coax, N, Plug, 50ohm, Cr imp, RG58	W300P1, W300P2
01 **NAE88A/01D**	**Exciter/Control Assy, J1000, Rls 7**	UNIT 1
02 197-3015-02	Control Panel Mounting Plate Detail assy	A12
02 197-5021	ZA53 Fan Mod, J1000	B01, B02
03 189-5003	Connector Kit, Plug 3-Pin	
02 197-8160-01	J1000 Exciter/Control Cable Set	
03 JP45	Conn, Recept, Ribbon Cable, 20 pin	W5P1, W5P2
03 JP51	Conn, Recept, Ribbon Cable, 40 pin	W1P1, W1P2, W2P1, W2P2, W3P1, W3P2, W4P1, W4P2
03 JT40	Conn, Recept, Mate-N-Lok, 3 pi n, Mini	P06, P07
03 JT42	Conn, Contact, Socket, 22-18, Mate-N-Lok	P06, P07
03 JU02	MTA, Standard Dust Cover, 4 pi n	P05
03 JU07	MTA, Standard Dust Cover, 8 pi n	P04
03 JU27	MTA, Keyed Closed End Housing, 4 pin,22AWG	P05
03 JU28	MTA, Keyed Closed End Housing, 8 pin,22AWG	P04
03 JU39	MTA, Keyed Closed End Housing, 5 pin, 18 AWG	P01
03 JU40	MTA, Standard Dust Cover,5-pin	P01
02 197-8164	Interconnect Cable Set J1000	
03 JDP25	Conn, Coax, BNC, Plug, 50ohm, Clamp	P102
03 JK16	Conn, Shell, D-Sub, 25 pin, T- Screw	P100, P101

Component Lvl.	StockCode	Description	Reference Designation
03	JP45	Conn, Recept, Ribbon Cable, 20 pin	W100P2, W100P3
03	JP51	Conn, Recept, Ribbon Cable, 40 pin	W100P1
03	JT30	Conn, IDC, D-Sub, S, HDE-20, 2 5-Pos	P101
03	JT31	Conn, IDC, D-Sub, P, HDE-20, 2 5-Pos	P100
03	JT33	Conn, Shell, D-Sub, 15-Pos, T- Screw	P103, P104, P105, P106
03	JT62	Conn, IDC, D-Sub, S, HDE-20, 15-Pos	P103, P104, P105, P106
02	206-5914	Tyrap Anchor Assy	
02	JA76	Conn,Coupler,RJ45,Feed-Thru, Shielded	J02
02	JT80	Conn,Recept,AC,250V,20A, Quick-Dis	J01
02	NAPC143B/01	Controller/Display PWB Assy	A01
03	197-2020	Mod, UT81	U15
03	BBHT01	Holder, 20mm Coin Cell, PWB Mt	XBT1
03	BBLT01	Battery, Lithium, 3V,20mm Coin Cell	BT1
03	CCFS01	Cap,SMT,Ceramic,0.001uF,10%,50V,X7R,0603	C035, C036, C037, C038, C039, C040, C041, C042, C043, C044, C045, C046, C047, C048, C049, C050,, C051, C052, C053, C054, C055, C056, C057, C059, C060, C061, C140, C141
03	CCFS04	Cap,SMT,Ceramic,0.01uF,10%,50V,X7R,0603	C010, C014, C016, C018, C019, C021, C023, C024, C028, C065, C066, C069, C072, C073, C076, C077,, C082, C083, C084, C085, C107, C108, C123, C129, C130, C131, C132, C133, C162
03	CCFS07	Cap,SMT,Ceramic,0.1uF,10%,50V,X7R,0805	C002, C003, C004, C005, C006, C007, C008, C011, C012, C013, C020, C022, C025, C031, C032, C033,, C034, C058, C062, C063, C064, C067, C068, C070, C071, C074, C075, C078, C079, C080, C081, C086,, C087, C088, C089, C090, C091, C092, C093, C094, C095, C096, C097, C100, C101, C102, C103, C104,, C111, C112, C113, C114, C115, C121, C122, C124, C125, C126, C127, C128, C134, C136, C137, C138,, C139, C142, C144, C148, C149, C150, C151, C152, C154, C155, C160, C163, C164, C165, C166, C167,, C168, C169, C170, C171, C172, C173, C174, C175, C176, C177, C178, C179, C180, C181, C182, C183,, C184, C185, C186, C187, C188, C189, C190, C191, C192, C193, C194, C195
03	CCFS09	Cap,SMT,Ceramic,0.47uF,10%,25V,X7R,0805	C026, C027, C029, C030
03	CCFS23	Cap,SMT,Ceramic,18pF,2%,50V, C0G,0603	C015, C017
03	CTFS02	Cap,SMT,Tantalum,1uF,10%,35V, 1411	C001, C009, C135
03	CTFS03	Cap,SMT,Tantalum,10uF,10%,35V, 2917	C116, C117, C118, C119, C120
03	JF47	Conn, Header,Square Post,Gold, Dual,40-pin	J03, J09
03	JP52	Conn, Header, Ribbon Cbl, 40 p in	J01, J04, J05, J08

Component Lvl.	StockCode	Description	Reference Designation
03	JQ16	Conn, Header, SIP, 12 Pin Breakaway, 10 Ctr	J06, J10
03	JS43	Conn, Plug, D-Sub, 25 pin, Ver t PWB	J07
03	JT58	Conn, Socket, Breakaway, PWB Mt, .1 Ctr	XU15
03	LCFS01	Inductor, SMT, Choke, 600ohms, 2A, 0805	L01, L02, L03, L04, L05, L07, L08, L09, L10, L11, L12, L13, L14, L15, L16, L17
03	QBNS01	Transistor,SMT,NPN,Switch/Amp ,SOT-23	Q03, Q04
03	QDLS01	Diode, SMT, LED, Green, (560nm), 0603	DS09, DS10, DS11, DS12, DS13
03	QDSS01	Diode, SMT, Schottky, 30V, 0.2A, SOD-323	CR01, CR02, CR03, CR04, CR05, CR06, CR07, CR08, CR09, CR14, CR15, CR16, CR17, CR18
03	QK03	Diode, Zener, 39V, 1.5W, 2%	CR10, CR11, CR12, CR13
03	QN54	Transistor, FET, N Channel	Q01, Q02, Q05
03	RAB32	Resistor, MF, 3.92K Ohms, 1PC 1/4W	R137
03	RAD17	Resistor, SMT, MF, 221 Ohms, 1% 1/4W	R004, R019
03	RC11	Resistor, Film, 6.81 Ohms, 1PC 1/2W	R081, R082
03	RFFS01	Resistor,SMT,MF,0.0ohms,Jumper ,0603	R094, R105, R168, R181, R185, R186
03	RFFS26	Resistor, SMT, MF, 100ohms, 1%, 1/10W, 0603	R003, R010, R011, R023, R040, R041, R120, R121, R122, R123, R124, R191, R192, R196, R252, R253,, R254, R255, R256, R257, R258, R259, R260
03	RFFS34	Resistor,SMT,MF,475ohms,1%, 1/10W,0603	R005, R006, R007, R008, R009, R012, R013, R014, R017, R018, R132, R142
03	RFFS36	Resistor, SMT, MF, 681ohms, 1%, 1/10W, 0603	R015, R016
03	RFFS38	Resistor,SMT,MF,1000ohms,1%, 1/10W,0603	R025, R026, R078, R079, R112, R117, R118, R119, R134, R140, R145, R190, R205, R206, R207, R208,, R209, R212, R213
03	RFFS39	Resistor,SMT,MF,1210ohms,1%, 1/10W,0603	R110, R111, R133, R139
03	RFFS40	Resistor,SMT,MF,1500ohms,1%, 1/10W,0603	R108, R109, R138, R163, R164, R182, R183, R226
03	RFFS41	Resistor,SMT,MF,1820ohms,1%, 1/10W,0603	R106, R107
03	RFFS42	Resistor,SMT,MF,2210ohms,1%, 1/10W,0603	R270, R271, R272, R273, R274, R275, R277, R278, R279, R280, R282, R283
03	RFFS43	Resistor, SMT, MF, 2740ohms, 1%, 1/10W, 0603	R104
03	RFFS44	Resistor,SMT,MF,3320ohms,1%, 1/10W,0603	R031, R032
03	RFFS46	Resistor, SMT, MF, 4750ohms, 1%, 1/10W, 0603	R020, R042, R045, R046, R047, R048, R049, R050, R051, R052, R053, R054, R055, R056, R057, R058,, R059, R060, R061, R062, R063, R064, R065, R066, R067, R068, R069, R070, R071, R072, R115, R116,, R135, R136, R187, R193, R199, R200, R203, R204, R251, R266, R276, R281
03	RFFS47	Resistor, SMT, MF, 5620ohms, 1%, 1/10W, 0603	R146
03	RFFS48	Resistor, SMT, MF, 6810ohms, 1%, 1/10W, 0603	R144

Component Lvl.	StockCode	Description	Reference Designation
03	RFFS49	Resistor,SMT,MF,8250ohms,1%, 1/10W,0603	R143
03	RFFS50	Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603	R022, R024, R027, R028, R029, R030, R035, R043, R044, R073, R074, R075, R076, R077, R080, R083,, R084, R085, R086, R087, R088, R096, R099, R101, R102, R103, R125, R126, R129, R147, R148, R154,, R155, R156, R157, R195, R210, R211, R214, R215, R216, R217, R218, R219, R220, R221, R222, R223,, R224, R225, R234, R235, R261, R262, R263, R264, R265
03	RFFS51	Resistor,SMT,MF,12.1Kohms,1%, 1/10W,0603	R093
03	RFFS52	Resistor,SMT,MF,15.0Kohms,1%, 1/10W,0603	R141
03	RFFS55	Resistor,SMT,MF,27.4Kohms,1%, 1/10W,0603	R098
03	RFFS58	Resistor, SMT, MF, 47.5Kohms, 1%, 1/10W, 0603	R092, R097
03	RFFS62	Resistor,SMT,MF,100Kohms,1%, 1/10W,0603	R174, R175, R243
03	RFFS63	Resistor, SMT, MF, 121Kohms, 1%, 1/10W, 0603	R033, R034, R036, R037
03	RFFS65	Resistor, SMT, MF, 182Kohms, 1%, 1/10W, 0603	R038, R039
03	RFFS70	Resistor, SMT, MF, 475Kohms, 1%, 1/10W, 0603	R165, R166, R171, R172, R179, R180, R227, R228, R229, R230, R231, R232, R233, R236, R237, R238,, R239, R240, R241, R242, R244, R245, R246, R247, R248, R249, R250
03	UDAS01	IC,SMT,Trans Array, 7 Darl., SOIC-16	U02, U20, U21, U22, U23
03	UDLS01	IC,SMT,CMOS,Octal Flip Flop, SOIC-20	U17, U18, U19
03	UDLS02	IC, SMT, CMOS, Octal Latch, SOIC-20	U16
03	UDMS01	IC, SMT, SRAM, 32Kx8, SOIC-28 (Wide)	U08
03	UDMS02	IC, SMT, Micro, ADC, PWM,Flash , TQFP-64	U04
03	UDPS01	IC,SMT,Complex Program Logic Dev, PLCC-84	U14
03	UDSS01	IC,SMT,Non-Volatile RAM Ctrlr, SOIC-8	U06
03	UDTS01	IC,SMT,Real-Time Clock,SPI, SOIC-16	U05
03	UDTS03	IC,SMT,RS-485 Transceiver,Sgl ,SOIC-8	U03
03	UDTS05	IC, SMT, RS-232 Transceiver, 3.3V, SO-16	U01
03	UG35	IC, CMOS, Hex Schmitt, Trigger Inverter, SOIC-14	U09, U10, U11, U12, U13
03	ULAS01	IC,SMT,Opamp,Quad,Single Suppl y,SOIC-14	U07, U32, U33, U36
03	ULAS02	IC,SMT,Opamp,Quad,Rail-To-Rail ,SOIC-14	U24, U25, U26, U37, U38
03	ULCS01	IC,SMT,Comparator,Quad,SOIC-14	U27, U35
03	ULRS01	IC,SMT,5V Reference,0.1%,SOT- 23-6	U31
03	UMAS01	IC,SMT,ADC,10-Bit,11-ch,SPI, SOIC-20	U28, U29
03	UW57	IC,SMT,DAC,8-bit,8-ch,SPI,SOIC -20	U30
03	XFPS10	Crystal,SMT,Fund,ParRes,32.768 kHz, 20ppm, 12.5pF,	Y02
03	XFPS11	Crystal, SMT, Fund, 11.0592MHz	Y01

Component Lvl.	StockCode	Description	Reference Designation
02	NAPE70F/01	RF Synthesizer PWB Assy	A04
03	190-5043-07	IC, Programmed Microcontroller DDS	U04
03	CB25	Capacitor, Mica, Dipped, 100pF 2% 500V	C22
03	CB32	Capacitor, Mica, Dipped, 390pF 2% 500V	C21, C23
03	CCG01	Capacitor, Ceramic, 0.001uF 10 % 200V	C54
03	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C05, C19, C20, C25, C27, C44
03	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C02, C03, C06, C07, C08, C09, C10, C11, C12, C13, C14, C15, C16, C17, C18, C26, C28, C33, C34, C39,, C46, C47, C48, C55, C56, C57, C59, C60, C61
03	CCG08	Capacitor, Ceramic, 0.22uF 10% 50V	C32
03	CCG09	Capacitor, Ceramic, 0.47uF 10% 50V	C36, C58
03	CCP16	Capacitor, Tantalum, 2.2uF 10P C 20V	C04
03	CCP36	Capacitor, Tantalum, Dipped, 1 0uF, 35V	C24, C29, C30, C31, C35, C37, C38, C40, C42, C43
03	CM01	Capacitor, Tantalum, 47uF 10% 20V	C41
03	JF35	Conn, BNC, Recept, PWB Mt	J02
03	JQ15	Conn, Post Shunt, 2 Pos, .10 C entreline	E01, E02, E03, E04, E05, E06
03	JQ16	Conn, Header, SIP, 12 Pin Breakaway, 10 Ctr	XE01, XE02, XE03, XE04, XE06, XE5A, XE5B
03	JS13	Conn, Socket, D-Sub, 25 pin, P WB Mt	J01
03	JU24	MTA, Keyed Square Post Header Assy, 8 pin	J03
03	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L02, L03, L04, L05, L06, L07, L08, L09
03	LAP28	Inductor, Moulded, Shielded, 1.8uH	L01
03	QA15	Transistor, NPN, Switch/Amplif ier	Q01, Q02, Q03, Q04
03	QA23	Transistor, PNP, Switch/Amplif ier	Q06
03	QAP04	Transistor, NPN, General Purpo se	Q05
03	QAP29	Diode, General Purpose, 200V, 0.1A	CR02, CR03, CR04, CR05, CR06
03	QR15	Diode, Schottky	CR01
03	RAB01	Resistor, MF, 10.0 Ohms, 1PC 1 /4W	R17, R18, R19, R53
03	RAB06	Resistor, MF, 27.4 Ohms, 1PC 1 /4W	R47
03	RAB09	Resistor, MF, 47.5 Ohms, 1PC 1 /4W	R10, R11, R12, R14, R46
03	RAB12	Resistor, MF, 82.5 Ohms, 1PC 1 /4W	R20
03	RAB13	Resistor, MF, 100 Ohms, 1PC 1/ 4W	R01, R06, R08, R09, R15, R26, R51
03	RAB18	Resistor, MF, 274 Ohms, 1PC 1/ 4W	R05
03	RAB22	Resistor, MF, 562 Ohms, 1PC 1/ 4W	R31, R33
03	RAB25	Resistor, MF, 1K Ohms, 1PC 1/4 W	R03, R04
03	RAB26	Resistor, MF, 1.21K Ohms, 1PC 1/4W	R07, R45
03	RAB27	Resistor, MF, 1.50K Ohms, 1PC 1/4W	R25

Component Lvl.	StockCode	Description	Reference Designation
03	RAB28	Resistor, MF, 1.82K Ohms, 1PC 1/4W	R23
03	RAB29	Resistor, MF, 2.21K Ohms, 1PC 1/4W	R34
03	RAB30	Resistor, MF, 2.74K Ohms, 1PC 1/4W	R43
03	RAB31	Resistor, MF, 3.32K Ohms, 1PC 1/4W	R37, R38
03	RAB32	Resistor, MF, 3.92K Ohms, 1PC 1/4W	R13
03	RAB33	Resistor, MF, 4.75K Ohms, 1PC 1/4W	R02, R24, R35, R48, R49, R50, R60
03	RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R16, R27, R28, R29, R42
03	RAB42	Resistor, MF, 27.4K Ohms, 1PC 1/4W	R22
03	RBP03	Resistor, Film, 22 Ohms, 5% 2W	R21
03	RFFS46	Resistor, SMT, MF, 4750ohms, 1%, 1/10W, 0603	R54, R55, R56, R57, R59, R61, R62, R63
03	RT07	Res, Network, SIP, 9 x 4700 Oh ms, 2% Bus	U02
03	RV06	Resistor, Variable, Film, 1000 Ohms, 1/2W	R32
03	SB40	Switch, DIP, Rotary, 10-pos, B CD	S01, S02, S03, S04, S05
03	UB15	IC, CMOS, Dual, Type D, Flip F lop	U12
03	UC02	Socket, IC, 14-pin	XU03, XU08, XU10, XU12
03	UC03	Socket, IC, 16-pin, 0.1" Pitch, 0.3" Width	XU06, XU07
03	UD43	Socket, IC, 6-pin	XS01, XS02, XS03, XS04, XS05
03	UDLS10	IC,SMT,CMOS,Quad 2-Input NAND Gate,SO-14	U15
03	UG03	IC, CMOS, Hex Inverter	U03
03	UM23	IC, CMOS, Hex Schmitt Trigger	U10
03	UT55	Oscillator, TCXO, 10.000MHz, 2ppm	U01
03	UT56	IC, CMOS, Synchronous Counter	U06, U07
03	UT58	IC, CMOS, 48-bit DDS	U05
03	UT59	IC, Voltage Regulator, +3.3V, 1A	U11
03	UW90	IC,SMT,Quad 2 TO 1 DATA Sel/ Mux 3 States Output,3	U14
03	UX11	IC, CMOS, Hex Inverter	U08
03	UX17	IC, Voltage Regulator, +5V, 1A , Plastic	U09
02	NAPI85/01A	Remote Interface PWB Assy	A02
03	196-3081	Transformer Assy	T02
03	206-5028	JMT01 Pin Mod	J02, J03
03	CCFS01	Cap,SMT,Ceramic,0.001uF,10%,50V,X7R,0603	C127
03	CCFS04	Cap,SMT,Ceramic,0.01uF,10%,50V,X7R,0603	C021, C022, C025, C026, C028, C069, C071, C072, C073, C083, C084, C085, C116, C122, C125
03	CCFS06	Cap, SMT, Ceramic, 0.047uF, 10%, 50V, X7R, 0603	C032

Component Lvl.	StockCode	Description	Reference Designation
03	CCFS07	Cap,SMT,Ceramic,0.1uF,10%,50V,X7R,0805	C001, C002, C003, C004, C008, C009, C010, C011, C013, C016, C017, C020, C027, C029, C037, C038,, C039, C040, C044, C045, C046, C047, C048, C061, C062, C064, C065, C066, C076, C077, C081, C082,, C086, C087, C088, C089, C090, C091, C092, C093, C094, C095, C096, C097, C098, C099, C100, C101,, C102, C103, C104, C105, C106, C107, C108, C109, C110, C111, C112, C113, C114, C115, C117, C118,, C119, C120, C121, C123, C128, C129, C131
03	CCFS23	Cap,SMT,Ceramic,18pF,2%,50V, C0G,0603	C124, C126
03	CCFS33	Cap,SMT,Ceramic,150pF,1%,50V, C0G,0603	C005, C007, C018, C019
03	CCFS42	Cap,SMT,Ceramic,1000pF,2%,50V, C0G,0805	C036, C041, C042
03	CTFS01	Cap,SMT,Tantalum,10uF,10%,16V, 1411	C056
03	CTFS03	Cap,SMT,Tantalum,10uF,10%,35V, 2917	C012, C014, C015, C043, C057, C058, C059, C080
03	JF35	Conn, BNC, Recept, PWB Mt	J06, J09, J13, J14
03	JF47	Conn, Header,Square Post,Gold, Dual,40-pin	J11, XE07
03	JQ15	Conn, Post Shunt, 2 Pos, .10 C entreline	E01, E02, E07, E08, E09, E10, E11, E12, E13, E14, E15, E16, E17, E18, E19, E20, E21, E22, E27, E30
03	JQ16	Conn, Header, SIP, 12 Pin Breakaway, 10 Ctr	XE01, XE02, XE08, XE09, XE10, XE11, XE12, XE13, XE14, XE15, XE16, XE17, XE18, XE19, XE20, XE21,, XE22, XE27, XE30
03	JQ53	Conn, Header, Ribbon Cbl, 40- Pin	J01
03	JQ55	Conn, Header, Ribbon Cbl, 20 Pin	J04
03	JR49	Terminal Block,5mm,3-pos,PWB Mt,Angled,Blue	TB01, TB02, TB04
03	JS50	Conn, Socket, D-Sub, 9-Pin, Vertical PWB	J10
03	JT43	Conn, Coax, Recept, 20 Deg. Low Profile	J07, J08
03	KC18	Relay, 5V Coil, 2PDT, 1A	K01, K02, K03, K04, K05, K06, K07, K08
03	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L07, L08, L09, L10, L14
03	LCFS01	Inductor, SMT, Choke, 600ohms, 2A, 0805	L01, L02, L03, L04, L05, L15, L16, L17
03	QBNS01	Transistor,SMT,NPN,Switch/Amp ,SOT-23	Q01, Q07, Q08
03	QDRS01	Diode,SMT,Switching,250V,0.2A, SOD-323	CR01, CR03, CR04, CR05, CR10, CR11, CR12, CR13, CR14, CR15, CR16, CR17, CR18, CR19, CR20, CR21,, CR22, CR23, CR24, CR25, CR26, CR27, CR28, CR29, CR30, CR31, CR32, CR33, CR34, CR35, CR36, CR37,, CR38, CR39, CR40
03	QDZS04	Diode,SMT,Zener,39V,5%,3W,SMB	CR06, CR07, CR08, CR09
03	QK19	Diode, Zener, 13V, 1W, 10%	CR02
03	RAB05	Resistor, MF, 22.1 Ohms, 1PC 1 /4W	R202, R205
03	RAB07	Resistor, MF, 33.2 Ohms, 1PC 1 /4W	R204
03	RAB08	Resistor, MF, 39.2 Ohms, 1PC 1 /4W	R203

Component Lvl.	StockCode	Description	Reference Designation
03	RAB10	Resistor, MF, 56.2 Ohms, 1PC 1 /4W	R214
03	RAB13	Resistor, MF, 100 Ohms, 1PC 1/ 4W	R200
03	RAB14	Resistor, MF, 121 Ohms, 1%, 1/ 4W	R201
03	RAB16	Resistor, MF, 182 Ohms, 1PC 1/ 4W	R199
03	RAC23	Resistor, MF, 301 Ohms, 1% 1/4W	R002, R003, R011, R012
03	RAD17	Resistor, SMT, MF, 221 Ohms, 1% 1/4W	R154, R155
03	RAD31	Resistor, SMT, MF, 3320 Ohms, 1% 1/4W	R097
03	RAD37	Resistor, SMT, MF, 10.0K Ohms, 1%, 1/4W	R024, R025
03	RC26	Resistor, Film, 120 Ohms, 2PC 1/2W	R040
03	RC41	Resistor, Film, 2200 Ohms, 2PC 1/2W	R098, R099, R125, R126, R127, R128, R129, R130, R131, R132, R149, R150, R151, R152, R153, R172
03	RD38	Resistor, Variable, Film, 20K Ohms, 1/2W	R045
03	RFFS01	Resistor,SMT,MF,0.0ohms,Jumper ,0603	R010, R026
03	RFFS11	Resistor, SMT, MF, 5.62ohms, 1%, 1/10W, 0603	R212, R213
03	RFFS12	Resistor, SMT, MF, 6.81ohms, 1%, 1/10W, 0603	R208
03	RFFS14	Resistor, SMT, MF, 10.0ohms, 1%, 1/10W, 0603	R007, R008, R015, R016, R017, R018, R096, R105, R106, R107, R108, R109, R110, R111, R112, R113,, R114, R115, R116, R117, R118, R119, R120, R121, R122, R123, R124, R209, R210, R211
03	RFFS15	Resistor, SMT, MF, 12.1ohms, 1%, 1/10W, 0603	R207
03	RFFS16	Resistor, SMT, MF, 15.0ohms, 1%, 1/10W, 0603	R206
03	RFFS26	Resistor, SMT, MF, 100ohms, 1%, 1/10W, 0603	R068, R089
03	RFFS31	Resistor, SMT, MF, 274ohms, 1%, 1/10W, 0603	R046
03	RFFS34	Resistor,SMT,MF,475ohms,1%, 1/10W,0603	R019, R042
03	RFFS37	Resistor, SMT, MF, 825ohms, 1%, 1/10W, 0603	R005
03	RFFS38	Resistor,SMT,MF,1000ohms,1%, 1/10W,0603	R047, R048, R049, R050, R056
03	RFFS39	Resistor,SMT,MF,1210ohms,1%, 1/10W,0603	R043, R044
03	RFFS44	Resistor,SMT,MF,3320ohms,1%, 1/10W,0603	R006
03	RFFS45	Resistor,SMT,MF,3920ohms,1%, 1/10W,0603	R080, R083
03	RFFS46	Resistor, SMT, MF, 4750ohms, 1%, 1/10W, 0603	R064, R103, R104, R141, R142, R143, R144, R145, R146, R147, R148, R161, R162, R163, R164, R165,, R168, R169, R184
03	RFFS48	Resistor, SMT, MF, 6810ohms, 1%, 1/10W, 0603	R051
03	RFFS50	Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603	R001, R004, R013, R014, R038, R039, R082, R084, R091, R092, R100, R101, R102, R133, R134, R135,, R136, R137, R138, R139, R140, R156, R157, R158, R159, R160, R166, R170, R171, R177

Component Lvl.	StockCode	Description	Reference Designation
03	RFFS51	Resistor,SMT,MF,12.1Kohms,1%, 1/10W,0603	R022, R041
03	RFFS52	Resistor,SMT,MF,15.0Kohms,1%, 1/10W,0603	R052, R054, R075
03	RFFS55	Resistor,SMT,MF,27.4Kohms,1%, 1/10W,0603	R077
03	RFFS56	Resistor, SMT, MF, 33.2Kohms, 1%, 1/10W, 0603	R058
03	RFFS58	Resistor, SMT, MF, 47.5Kohms, 1%, 1/10W, 0603	R030, R037
03	RFFS59	Resistor,SMT,MF,56.2Kohms,1%, 1/10W,0603	R059, R076
03	RFFS62	Resistor,SMT,MF,100Kohms,1%, 1/10W,0603	R060, R065, R067, R094
03	RFFS64	Resistor,SMT,MF,150Kohms,1%, 1/10W,0603	R061, R063
03	RFFS70	Resistor, SMT, MF, 475Kohms, 1%, 1/10W, 0603	R009, R020, R021, R027, R028, R074
03	RFFS72	Resistor, SMT, MF, 681Kohms, 1%, 1/10W, 0603	R062
03	RT17	Thermistor, PTC, .15-.25 Ohms, 1.1A Hold	RT01, RT02
03	RV10	Resistor, Variable, Film, 5000 Ohms, 1/2W	R023
03	RW09	Resistor, Variable, Film, 10K Ohms, 1/2W	R036
03	SC33	Switch, DIP, 2-way, 1PST	S01
03	UDAS01	IC,SMT,Trans Array, 7 Darl., SOIC-16	U13, U15, U16, U17, U40
03	UDLS04	IC,SMT,CMOS,8-Bit Shft Reg,Par I/P, SOIC-16	U25, U32
03	UDLS05	IC,SMT,CMOS,8-Bit Shft Reg,Par O/P, SOIC-16	U18, U19, U20, U39
03	UDLS06	IC,SMT,CMOS,Quad Tri-State Buf fer, SOIC-14	U33
03	UDMS03	IC, SMT, Micro, ADC, PWM,Flash , TQFP-32	U31
03	UDOS01	IC,SMT,Dual Optocoupler,SOIC-8	U14, U21, U22, U23, U24, U28, U29, U30
03	UDSS02	IC,SMT,Microprocessor Supervisor 4.38V, SC70	U27
03	UDTS03	IC,SMT,RS-485 Transceiver,Sgl ,SOIC-8	U26
03	ULAS01	IC,SMT,Opamp,Quad,Single Suppl y,SOIC-14	U04, U09
03	ULCS01	IC,SMT,Comparator,Quad,SOIC-14	U11, U12
03	UP98	IC,SMT,Instrumentation Amp, SOIC-8	U02, U05
03	XFPS03	Crystal,SMT,Fund,Par Res, 3.6864MHz,Comm	Y01
02	NAPI87A/01	Exciter Interface PWB Assy, J1000	A03
03	202-5084	KC101 MOD	K01
03	CCG02	Capacitor, Ceramic, 0.0022uF 1 0% 100V	C18, C21
03	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C02
03	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C09, C13
03	CCG09	Capacitor, Ceramic, 0.47uF 10% 50V	C10
03	CCP36	Capacitor, Tantalum, Dipped, 1 0uF, 35V	C03, C04, C05, C06
03	JP46	Conn, Header, Ribbon Cbl, 20 p in	J06
03	JP52	Conn, Header, Ribbon Cbl, 40 p in	J05, J07, J10

Component Lvl.	StockCode	Description	Reference Designation
03	JS12	Conn, Plug, D-Sub, 25 pin, PWB Mt	J01, J02
03	JS13	Conn, Socket, D-Sub, 25 pin, P WB Mt	J03, J04
03	JS18	Conn, Plug, D-Sub, 15 pin, PWB Mt	J08, J09
03	JT43	Conn, Coax, Recept, 20 Deg. Low Profile	J11, J12, J13, J14
03	KC14	Relay, 24Vdc Coil, 4PDT, 5A	K02
03	KC19	Relay Socket, 1310 Series, PWB Mount	XK02
03	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L01, L02, L03, L04
03	QA45	Transistor, NPN, Switch/Amplif ier	Q07
03	QAP04	Transistor, NPN, General Purpo se	Q03
03	QAP29	Diode, General Purpose, 200V, 0.1A	CR01, CR02, CR04, CR05
03	QN54	Transistor, FET, N Channel	Q02
03	QS13	Diode, Schottky, 1A 40V	CR06, CR07
03	QS18	Transistor, PNP, TO-220, 100V	Q04
03	RAB26	Resistor, MF, 1.21K Ohms, 1PC 1/4W	R03
03	RAB31	Resistor, MF, 3.32K Ohms, 1PC 1/4W	R25, R30
03	RAB33	Resistor, MF, 4.75K Ohms, 1PC 1/4W	R04
03	RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R22, R39
03	RAB41	Resistor, MF, 22.1K Ohms, 1PC 1/4W	R21, R38
03	RAB43	Resistor, MF, 33.2K Ohms, 1PC 1/4W	R16
03	RAB44	Resistor, MF, 39.2K Ohms, 1PC 1/4W	R18, R36
03	RAB46	Resistor, MF, 56.2K Ohms, 1PC 1/4W	R19, R37
03	RAC01	Resistor, MF, 100K Ohms, 1PC 1 /4W	R02, R35
03	RAC02	Resistor, MF, 121K Ohms, 1PC 1 /4W	R01, R13
03	RAC28	Resistor, MF, 10K Ohms, 0.1%, 1/4W	R31
03	UM23	IC, CMOS, Hex Schmitt Trigger	U01
02	NAPM10B	Interphase PDM Driver	A05
03	193-7007	UN48Z to DIP Socket Adaption Assy	U06
03	CB25	Capacitor, Mica, Dipped, 100pF 2% 500V	C14, C25, C49, C50
03	CB31	Capacitor, Mica, Dipped, 330pF 2% 500V	C27
03	CCG01	Capacitor, Ceramic, 0.001uF 10 % 200V	C45, C48, C51, C52, C53, C63, C69, C70
03	CCG03	Capacitor, Ceramic, 0.0047uF 10% 100V	C08, C31
03	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C58, C59
03	CCG06	Capacitor, Ceramic, 0.047uF 10 % 100V	C26
03	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C11, C15, C16, C17, C21, C22, C23, C28, C29, C33, C34, C35, C36, C37, C38, C40, C42, C44, C46, C54,, C55, C60, C61, C62, C65, C66, C67, C68

Component Lvl.	StockCode	Description	Reference Designation
03	CCG08	Capacitor, Ceramic, 0.22uF 10% 50V	C41
03	CCP36	Capacitor, Tantalum, Dipped, 1 0uF, 35V	C01, C02, C03, C04, C09, C10, C12, C18, C39, C43, C47, C56, C57, C64
03	JQ15	Conn, Post Shunt, 2 Pos, .10 C entreline	E01, E02
03	JQ16	Conn, Header, SIP, 12 Pin Breakaway, 10 Ctr	XE01, XE02
03	JS12	Conn, Plug, D-Sub, 25 pin, PWB Mt	J01
03	KC18	Relay, 5V Coil, 2PDT, 1A	K01
03	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L01, L02, L04, L06, L08
03	QA44	Transistor, PNP, Switch/Amplif ier	Q05, Q07
03	QA45	Transistor, NPN, Switch/Amplif ier	Q01, Q02, Q03, Q04, Q06, Q10
03	QAP29	Diode, General Purpose, 200V, 0.1A	CR01, CR02, CR03, CR04, CR05
03	RAB01	Resistor, MF, 10.0 Ohms, 1PC 1 /4W	R74, R75, R76
03	RAB22	Resistor, MF, 562 Ohms, 1PC 1/ 4W	R05, R50, R53
03	RAB25	Resistor, MF, 1K Ohms, 1PC 1/4 W	R06, R08, R14, R22, R26, R33, R37, R51, R52, R54, R55, R56, R62, R63, R69, R77, R78
03	RAB26	Resistor, MF, 1.21K Ohms, 1PC 1/4W	R25, R60, R61
03	RAB27	Resistor, MF, 1.50K Ohms, 1PC 1/4W	R73
03	RAB33	Resistor, MF, 4.75K Ohms, 1PC 1/4W	R71, R72
03	RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R03, R10, R18, R34, R35, R48, R57, R70, R83
03	RAB39	Resistor, MF, 15.0K Ohms, 1PC 1/4W	R58
03	RAB40	Resistor, MF, 18.2K Ohms, 1PC 1/4W	R27
03	RAB41	Resistor, MF, 22.1K Ohms, 1PC 1/4W	R12
03	RAB43	Resistor, MF, 33.2K Ohms, 1PC 1/4W	R80
03	RAB45	Resistor, MF, 47.5K Ohms, 1PC 1/4W	R13, R20
03	RAB46	Resistor, MF, 56.2K Ohms, 1PC 1/4W	R65, R66
03	RAB48	Resistor, MF, 82.5K Ohms, 1PC 1/4W	R82
03	RAC01	Resistor, MF, 100K Ohms, 1PC 1 /4W	R01, R07, R16, R23, R36
03	RAC09	Resistor, MF, 475K Ohms, 1% 1/4W	R81
03	RAC11	Resistor, MF, 681K Ohms, 1% 1/4W	R04, R15
03	RAC13	Resistor, MF, 1.00M Ohms, 1% 1/4W	R67, R68
03	RAC17	Resistor, MF, 2.21M Ohms, 1% 1/4W	R11, R29, R30
03	RAC28	Resistor, MF, 10K Ohms, 0.1%, 1/4W	R38, R39, R42, R44, R46, R49
03	RAC32	Resistor, MF, 4990 Ohms, 1% 1/4W	R47
03	RV06	Resistor, Variable, Film, 1000 Ohms, 1/2W	R59
03	RV10	Resistor, Variable, Film, 5000 Ohms, 1/2W	R31
03	UD07	IC, Comparator, Dual, High Spe ed	U05, U10, U11

Component Lvl.	StockCode	Description	Reference Designation
03	UL02	IC, Comparator, Quad	U12
03	UM15	IC, CMOS, Quad, 2-input NAND G Ate	U09
03	UM26	IC, Op Amp, Dual, Single Supply	U13
03	UN25	IC, Op Amp, Dual	U07, U08
03	UR42	IC, Op Amp, Quad, Single Supply	U02, U03
03	UX13	IC, CMOS, Dual, Type D, Flip-F lop	U01
03	UX17	IC, Voltage Regulator, +5V, 1A , Plastic	U04
02	NAPS32A/02	LVPS Buck Converter PWB Assy	A09
03	CCP36	Capacitor, Tantalum, Dipped, 1 0uF, 35V	C26
03	CT32	Capacitor, Elect, 100uF 100V	C05
03	NAPS32A/00	LVPS Buck Converter PWB Assy	
04	197-7030-01	Coupled Inductor Assembly	L01, L02
04	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C11, C14, C16, C19
04	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C04, C06, C25
04	CCG09	Capacitor, Ceramic, 0.47uF 10% 50V	C08, C10, C13, C15, C18, C20, C21, C22, C23, C24
04	CT41	Capacitor, Elect, 1000uF 50V	C01, C02, C03, C07, C09, C12
04	HR26	Connector, Quick-Dis, M, 1/4 Tab, PWB	E01, E02
04	JP52	Conn, Header, Ribbon Cbl, 40 p in	J01, J02
04	JU20	MTA, Square Post Header Assy, 4 pin	J03
04	QAP29	Diode, General Purpose, 200V, 0.1A	CR08, CR09, CR13, CR14, CR18
04	QM42	Diode, Pwr Rectifier, 200V,15A , Ultrafast	CR01
04	QM43	Diode, Schottky Rectifier, 45V , 16A	CR07, CR11
04	QN03	Diode, Zener, 18V, 1W, 5%	CR17
04	QN19	Diode, Zener, 4.7V, 500mW, 1%	CR15, CR16
04	QN22	Diode, Zener, 6.2V, 1.5W, 2%	CR12
04	QN38	Diode, Power Rectifier, 200V 1A	CR06, CR10
04	RAB19	Resistor, MF, 332 Ohms, 1PC 1/ 4W	R20
04	RAB25	Resistor, MF, 1K Ohms, 1PC 1/4 W	R02
04	RAB29	Resistor, MF, 2.21K Ohms, 1PC 1/4W	R03, R06, R18
04	RAB31	Resistor, MF, 3.32K Ohms, 1PC 1/4W	R19
04	RAB33	Resistor, MF, 4.75K Ohms, 1PC 1/4W	R23, R24
04	RAB35	Resistor, MF, 6.81K Ohms, 1PC 1/4W	R01, R07
04	RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R17
04	RAB38	Resistor, MF, 12.1K Ohms, 1PC 1/4W	R13, R22
04	RAB39	Resistor, MF, 15.0K Ohms, 1PC 1/4W	R11

Component Lvl.	StockCode	Description	Reference Designation
04	RAB40	Resistor, MF, 18.2K Ohms, 1PC 1/4W	R09, R15
04	RAB41	Resistor, MF, 22.1K Ohms, 1PC 1/4W	R05
04	RAB42	Resistor, MF, 27.4K Ohms, 1PC 1/4W	R10
04	RAB44	Resistor, MF, 39.2K Ohms, 1PC 1/4W	R12, R14, R16
04	RAB47	Resistor, MF, 68.1K Ohms, 1PC 1/4W	R04, R08
04	RAP09	Resistor, Film, 1000 Ohms, 2PC 1/2W	R21, R28, R29
04	RAP12	Resistor, Film, 5600 Ohms, 2% 1/2W	R25
04	RT17	Thermistor, PTC, .15-.25 Ohms, 1.1A Hold	RT04
04	RT19	Thermistor, PTC, .05-.08 Ohms, 2.5A Hold	RT01, RT03
04	TD46	Signal Transformer, 1.1VA 230V/36V	T01
04	UD57	IC, Inverting Switching Regula tor, 5A	Q01, Q02
04	UM53	Optocoupler/Optoisolator, 6-Pi n DIP	U02
04	UT11	IC, Comparator, Dual	U01
03	QM42	Diode, Pwr Rectifier, 200V,15A , Ultrafast	CR03, CR05
03	QN38	Diode, Power Rectifier, 200V 1A	CR02, CR04
03	RAP09	Resistor, Film, 1000 Ohms, 2PC 1/2W	R27
02	UG29	Power Supply Univ. Input, 24V Output 100W	A08
01	**NARA39A/01E**	**RF Power Assy, J1000 (Robust)**	UNIT 2
02	197-1092-01	Inductor Assy	L01, L04
02	197-6015	Combiner Xfmr Assy	T01
03	184-3230	Core Clamp Assy	
02	197-6016-01	Transformer Assy	T02
02	197-8010	Output Connector Assy - Type N	J01
02	206-5914	Tyrap Anchor Assy	
02	BA43	Fuseholder, 30A, 600V, Type MD A5	XF01, XF02, XF03, XF04
02	CYP43	Capacitor, Cast Mica, 1000pF 5 PC 5000V, No Mounti	C07
02	FA34	Fuse, 20A, 500Vdc, Non Time De lay, KLM	F01, F02, F03, F04
02	JDP21	Conn, Coax, N, Recept, Panel, 50ohm	J02
02	JT38	Conn, Plug, Crimp, Coax, RG188 Type	P03, P04
02	JT46	Conn, Contact, Socket, 18-14, Mate-N-Lock	P01, P02
02	JT50	Conn, Plug, 3-Pin, Mate-N-Lok	P01, P02
02	JT64	Conn, Pin, Header, 3-Pin Mate'n Lock	J04, J05
02	JT80	Conn,Recept,AC,250V,20A, Quick-Dis	J03
02	NAP31/02B	RF Power Module Assy, J1000 (Robust)	A01, A02
03	197-1015	Ribbon Cable Assy	W01, W02

Component Lvl. StockCode	Description	Reference Designation
04 JP50	Conn, Recept, Ribbon Cable, 10 pin	P01, P02
03 197-1021	RF Output Transformer Assy	T01
04 JT46	Conn, Contact, Socket, 18-14, Mate-N-Lock	P01
04 JT50	Conn, Plug, 3-Pin, Mate-N-Lok	P01
03 197-5022	ZA48 Fan Mod (J1000)	B01
03 JT46	Conn, Contact, Socket, 18-14, Mate-N-Lock	P02, P03
03 JT50	Conn, Plug, 3-Pin, Mate-N-Lok	P02, P03
03 NAAA05/02A	J1000 Power Amplifier Assy which uses new FET QAP7	A05
04 197-1020-01	RF Drive Transformer Assy	T01
04 CAP16	Capacitor, Ceramic, 1.0uF 100V	C01, C05, C06
04 CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C04
04 CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C07
04 CCG09	Capacitor, Ceramic, 0.47uF 10% 50V	C03
04 CP30	Capacitor,Polyprop,0.056uF,10% ,600V	C02
04 FA08	Fuse, 1A, 250V, Slow, 3AG	F01
04 FA31	Fuseholder, PWB Mount, Type 3A G	XF01
04 HR26	Connector, Quick-Dis, M, 1/4 Tab, PWB	E01, E02, E03
04 JA49	Conn, Header, Ribbon Cbl, 10 p in	J01
04 QA45	Transistor, NPN, Switch/Amplif ier	Q05
04 QAP29	Diode, General Purpose, 200V, 0.1A	CR05
04 QAP75	Transistor, MOSFET, N-Channel, 600V, 12A, TO-247	Q01, Q02, Q03, Q04
04 RAB25	Resistor, MF, 1K Ohms, 1PC 1/4 W	R06, R07
04 RAB36	Resistor, MF, 8.25K Ohms, 1PC 1/4W	R04
04 RAB39	Resistor, MF, 15.0K Ohms, 1PC 1/4W	R03
04 RAB56	Resistor, Film, 5 Ohms, 1%, 15W, Non-Inductive, TO	R02
04 RBP07	Resistor, Film, 100 Ohms, 5% 2W	R01
04 RBP22	Resistor, Film, 33K Ohms, 5%, 2W	R05
04 UD54	IC, Mosfet Driver, T0220-5-12A	U01
03 NAPF08	Modulator Filter PWB Assy	A04
04 CCC36	Capacitor, Mica, Dipped, 3900p F 5% 500V	C05
04 CP26	Capacitor, Polyprop, 0.033uF, 5%, 600V	C02, C04
04 CT45	Capacitor, Polyprop, 0.1uF, 600V	C01, C03
04 HX74	Clip, Spring, Mounting Clamp for PQ35/35 Core	L01, L02, L03
04 LY41	Pot Core (halves), 35mm, PC44 Gapped	L01, L02, L03
04 LY42	Bobbin for 35mm Pot Core	L01, L02, L03

Component Lvl.	StockCode	Description	Reference Designation
04	QM45	Diode, Power Rectifier, 1000V, 8A	CR01
04	WB37	Wire, Solderable, 155C 270/40 Litz 16AWG	L01, L02, L03
03	NAPI73	Power Module Interface PWB Assy	A02
04	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C01, C02
04	JA49	Conn, Header, Ribbon Cbl, 10 p in	J01, J02
04	JS18	Conn, Plug, D-Sub, 15 pin, PWB Mt	J03
04	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L01, L02
03	NAPS31B/04	SPS, Fwd Conv PWB Assy	A01
04	HX42	Conn, Quick-Dis, M, 1/4 Tab, PWB,Rt Angle	E01, E02, E03
04	JP54	Conn, Header, Ribbon Cbl, Rt A ngle,20 pin	J01
04	JT49	Conn, Pin Header, 3-Pin, Mate- N-Lok	J03
04	NAPS31B/00	SPS, Fwd Converter PWB Assy	
05	197-1105	Inductor Assy	L04, L05, L06
05	CAP16	Capacitor, Ceramic, 1.0uF 100V	C02, C10, C18, C29
05	CAP47	Capacitor, Ceramic, 2700pF, 1% , 100V	C31
05	CB25	Capacitor, Mica, Dipped, 100pF 2% 500V	C35
05	CB33	Capacitor, Mica, Dipped, 470pF 2% 500V	C19
05	CB37	Capacitor, Mica, Dipped, 1000p F 2% 500V	C26
05	CBP15	Capacitor, Electrolytic, 470uF, 450V	C12, C13, C15
05	CCG01	Capacitor, Ceramic, 0.001uF 10 % 200V	C01, C16, C22, C34, C37, C38
05	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C14, C28, C30, C36
05	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C05, C06, C07, C24, C25, C33
05	CCG09	Capacitor, Ceramic, 0.47uF 10% 50V	C32, C41
05	CCG44	Capacitor, Ceramic, Y, 0.01uF 250VAC	C09, C11
05	CCG45	Capacitor, Ceramic, Coated, 2. 2uF 20% 50V	C08
05	CD47	Capacitor, Metal,Polyprop, 3.3 uF, 10%, 250V	C43, C44, C45
05	CT16	Capacitor, Dipped Mica, 220pF 5% 1000V	C20, C21, C23
05	CT39	Capacitor,Polypro,0.015uF 800Vac	C04
05	CT40	Capacitor, Metal,Polyprop, 5uF +/-20% 600V	C17, C27
05	JT65	Conn, Pin Header,3-Pin, Mate-N-Lok, Vert	J02
05	LA16	Inductor, Choke, 2.5 Turns, J Mtl	L01
05	QAP29	Diode, General Purpose, 200V, 0.1A	CR03, CR05
05	QI29	Diode, Zener Transient Supress or, 20V	CR04
05	QI46	Varistor, 300VAC, 173J, Clamp 775V	RV01, RV02, RV03
05	QK12	Diode, LED, Green	DS02

Component Lvl.	StockCode	Description	Reference Designation
05	QK14	Diode, LED, Amber	DS01
05	QL23	Diode, Zener, 16V, 1.5W, 2%	CR18
05	QM07	Diode, Zener, 5.1V, 1W, 5%	CR17
05	QM52	Diode, Rect, 1200V,8 Amp Ultrafast, Soft Recovery	CR06, CR07, CR09, CR10, CR11, CR13, CR14, CR15, CR20
05	QN54	Transistor, FET, N Channel	Q04, Q05, Q08
05	QR13	Transistor, FET, N Channel, 10 0V, 8A	Q07
05	QR54	Transistor, FET, 600V, 44A, TO264	Q01, Q02
05	QS13	Diode, Schottky, 1A 40V	CR01, CR02, CR12, CR16, CR19, CR21
05	RAB01	Resistor, MF, 10.0 Ohms, 1PC 1 /4W	R51, R68
05	RAB08	Resistor, MF, 39.2 Ohms, 1PC 1 /4W	R52, R63
05	RAB11	Resistor, MF, 68.1 Ohms, 1PC 1 /4W	R22
05	RAB13	Resistor, MF, 100 Ohms, 1PC 1/ 4W	R54
05	RAB14	Resistor, MF, 121 Ohms, 1%, 1/ 4W	R55
05	RAB16	Resistor, MF, 182 Ohms, 1PC 1/ 4W	R46
05	RAB19	Resistor, MF, 332 Ohms, 1PC 1/ 4W	R12, R35
05	RAB20	Resistor, MF, 392 Ohms, 1PC 1/ 4W	R23
05	RAB23	Resistor, MF, 681 Ohms, 1PC 1/ 4W	R29, R64
05	RAB24	Resistor, MF, 825 Ohms, 1PC 1/ 4W	R47
05	RAB25	Resistor, MF, 1K Ohms, 1PC 1/4 W	R03, R39, R44, R49, R65, R69
05	RAB27	Resistor, MF, 1.50K Ohms, 1PC 1/4W	R53
05	RAB29	Resistor, MF, 2.21K Ohms, 1PC 1/4W	R28
05	RAB34	Resistor, MF, 5.62K Ohms, 1PC 1/4W	R61
05	RAB35	Resistor, MF, 6.81K Ohms, 1PC 1/4W	R30
05	RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R02, R04, R32, R33, R37, R40, R41, R56, R62, R66, R67
05	RAC19	Resistor, MF, 3.32M Ohms, 1% 1/4W	R05
05	RBP25	Resistor, Film, 100K Ohms, 5%, 2W	R01, R07
05	RBP33	Resistor, Film, 390 Ohms, 5%, 2W	R13, R14, R15, R16, R17, R18, R19, R20, R21
05	RC15	Resistor, Film, 15 Ohms, 2PC 1 /2W	R58
05	RD31	Resistor, Film, 1M Ohms, 2PC 1 /2W	R09
05	RN13	Resistor, Wirewound, 33K ohms, 1PC5W	R43
05	RT12	Resistor, Wirewound, 0.2 ohms, 1%, 3W	R50
05	RT16	Thermistor, PTC, .50-.77 Ohms, 0.5A Hold	RT01
05	RZ04	Resistor, Film, 3.32 Ohms, 1PC 1/2W	R57
05	TA44D	Transformer, Double Ended, Forward Converter	T01
05	TG48	Choke, Common Mode High L, .58 mH, 13Amps	L03

Component Lvl.	StockCode	Description	Reference Designation
05	TZ51	Transformer, Current Sense, Hi gh Freq	T03
05	TZ74	Transformer, Gate Drive, High Freq	T02
05	UC58	IC,Low Voltage Temp Sensor, +/-3 Deg,TO-92	U11
05	UM53	Optocoupler/Optoisolator, 6-Pi n DIP	U04, U06, U07, U09
05	UR42	IC, Op Amp, Quad, Single Supply	U05
05	UR68	Diode, Power Rectifier, 1600V Dual 2x28A	U01, U02
05	UR72	IC, Current Mode PWM Controller	U08
05	UT36	Voltage Regulator, Adj Voltage, 3A	U10
05	UT45	IC, FET Driver, High Current, 8-Pin	U03
04	RAB28	Resistor, MF, 1.82K Ohms, 1PC 1/4W	R27
04	RAB33	Resistor, MF, 4.75K Ohms, 1PC 1/4W	R25
04	RAB39	Resistor, MF, 15.0K Ohms, 1PC 1/4W	R26
04	RAB41	Resistor, MF, 22.1K Ohms, 1PC 1/4W	R10, R24
03	NASM11A/02	Modulator (Jazz) Assy	A03
04	CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C10
04	JT49	Conn, Pin Header, 3-Pin, Mate- N-Lok	J01
04	LXP20	Bead, Ferrite, 3.5mm, B Mtl	L01
04	NASM11A/00	Modulator Assy	
05	197-1019	Transformer Assy	T01
05	CBP15	Capacitor, Electrolytic, 470uF, 450V	C04, C05, C06
05	CCG07	Capacitor, Ceramic, 0.1uF 10% 100V	C01, C03, C09
05	CCP19	Capacitor, Tantalum, 6.8uF 10PC 35V	C02, C07
05	CT44	Capacitor, Polyprop, 0.12uF, 5%, 600V	C08
05	HAM52	Connector, Quick-Dis, M, 3/16 Tab PWB	E02
05	HR26	Connector, Quick-Dis, M, 1/4 Tab, PWB	E01
05	JA49	Conn, Header, Ribbon Cbl, 10 p in	J02
05	QAP29	Diode, General Purpose, 200V, 0.1A	CR01, CR02, CR03, CR04
05	QE28	Diode, General Purpose, 400V, 1A	CR12
05	QI29	Diode, Zener Transient Supress or, 20V	CR09, CR10, CR13
05	QK19	Diode, Zener, 13V, 1W, 10%	CR05
05	QM19	Diode, LED, Yellow, 8.6mm Lg	DS01
05	QM22	Diode, Power Rectifier, 4A, Ul tra Fast	CR06
05	RAB01	Resistor, MF, 10.0 Ohms, 1PC 1 /4W	R04
05	RAB07	Resistor, MF, 33.2 Ohms, 1PC 1 /4W	R01
05	RAB28	Resistor, MF, 1.82K Ohms, 1PC 1/4W	R05

Component Lvl. StockCode	Description	Reference Designation
05 RAB39	Resistor, MF, 15.0K Ohms, 1PC 1/4W	R10, R11
05 RBP22	Resistor, Film, 33K Ohms, 5%, 2W	R09
05 RBP24	Resistor, Film, 68K Ohms, 5%, 2W	R02, R03
05 RC05	Resistor, Film, 2.21 Ohms, 1%, 1/2W	R07
05 UC02	Socket, IC, 14-pin	XU01
05 UN18	IC, MOS Gate Driver, High Volt age	U01
04 QAP49	Transistor, FET, N Channel	Q01
04 QAP50	St Transistor, FET, N, Channel	Q02
04 QI29	Diode, Zener Transient Supress or, 20V	CR11
04 QM22	Diode, Power Rectifier, 4A, Ul tra Fast	CR07
04 QR24	Diode, Ultrafast, Soft Recover y, 600V, 8A	CR08
04 RAB01	Resistor, MF, 10.0 Ohms, 1PC 1 /4W	R06
04 RAB37	Resistor, MF, 10.0K Ohms, 1PC 1/4W	R12
04 RBP40	Resistor, Film, 3.9 Ohms, 5%, 2W	R08
02 NAPF03A/01	RF Filter Input PWB Assy	A03
03 165-6022	Current Transformer	T01
03 HAC48	Terminal, Screw, 10-32	E01, E02, E03, E04, E05, E09
03 HR26	Connector, Quick-Dis, M, 1/4 Tab, PWB	E06, E07, E08
03 JT43	Conn, Coax, Recept, 20 Deg. Low Profile	J01
03 QAP29	Diode, General Purpose, 200V, 0.1A	CR01
03 RAP01	Resistor, Film, 10 Ohms, 2% 1/2W	R01
03 RC20	Resistor, Film, 39 Ohms, 2PC 1 /2W	R02
02 NAPF07C/03	RF Power Probe (JAZZ) PWB Assy	A04
03 HAC48	Terminal, Screw, 10-32	E01, E02, E03, E04
03 JT43	Conn, Coax, Recept, 20 Deg. Low Profile	J02
03 NAPF07C/00	RF Power Probe PWB Assy	
04 165-6034-01	Electrostatic Shield Assy	
04 195-9060	Voltage Transformer	T03
04 195-9064	RF Current Transformer	T02
04 195-9065	Transformer Assy	T01
04 CB40	Capacitor, Mica, Dipped, 1800pF 2% 500V	C01, C02
04 JB33	Terminal Block, 4-pos, Double, 30A	TB01
04 JS13	Conn, Socket, D-Sub, 25 pin, P WB Mt	J01
04 LAP41	Inductor, Moulded, Shielded, 1 0000uH	L01, L02, L03, L04
04 QN33	Diode, Power Rectifier, 1A, Ul traFast	CR01, CR02, CR03, CR04

Component Lvl.	StockCode	Description	Reference Designation
04	RBP07	Resistor, Film, 100 Ohms, 5% 2W	R09, R10
04	RBP13	Resistor, Film, 1000 Ohms, 5%, 2W	R03, R04, R05, R06, R07
04	RD03	Resistor, Film, 4700 Ohms, 2PC 1/2W	R08, R11
03	UM83	Surge Arrestor, 470 Vdc, +/- 15PC	CR05, CR06, CR07

J1000
REPAIR MANUAL

Section 5 WIRING INFORMATION

5.1 INTRODUCTION

This section contains wiring information for hard-wired assemblies of the subject unit. Refer to Table 5-1 for an itemized listing of assemblies that have wiring lists.

5.2 WIRING LISTS NOT PROVIDED

Separate wiring lists are not provided for some assemblies, including:

- Assemblies that have separate maintenance manuals. Refer to the associated maintenance manual for detailed wiring information of these assemblies.
- Assemblies that have their wiring information adequately depicted/ tabulated on their assembly detail drawings. Refer to the associated assembly detail drawing for detailed wiring information of these assemblies.

5.3 PRINTED WIRING PATTERNS

Printed wiring pattern information is beyond the scope of this manual. Therefore, detailed printed wiring patterns for printed circuit boards are not included.

5.4 WIRE COLOURS

Every effort is made to manufacture the assemblies using wire that is the colour tabulated in the 'Code' column of the wiring list tables. In some instances, a white wire will be substituted. In this case identification must be determined by locating the assigned identification number.

5.5 WIRING LIST PROVIDED

Wiring lists are provided in table format. A list of the table numbers and the associated wiring list are shown in Table 5-1. These lists provide non-printed wiring pattern, point-to-point (source/destination) inter-connecting information.

Table 5-1: Wiring Lists Provided

Table #	Description
5-2	Wiring List - J1000 Transmitter – Interconnect Wiring
5-3	Wiring List - NAE88A/01D Exciter/Control Assembly
5-4	Wiring List - NARA39A/01E RF Power Assembly
5-5	Wiring List - NAP31/02B RF Power Module
5-6	Connector Mating Information - J1000 Transmitter
5-7	Connector Mating Information - NAE88A/01D Exciter/Control Assembly
5-8	Connector Mating Information - NARA39A/01E RF Power Assembly
5-9	Connector Mating Information - NAP31/02B RF Power Module

Table 5-2: Wiring List – J1000 Transmitter – Interconnect Wiring

Source	Destination	Wire #.	Color	Size	Remarks
P104-01	P103-01	301	Core	22	1-Conductor
P104-09	P103-09	301	Shield	-	Shielded
P104-03	P103-03	302	Core	22	1-Conductor
P104-10	P103-10	302	Shield	-	Shielded
P104-04	P103-04	303	White	22	
P104-05	P103-05	304	Core	22	1-Conductor
P104-06	P103-06	304	Shield	-	Shielded
P104-07	P103-07	305	Core	22	1-Conductor
P104-08	P103-08	305	Shield	-	Shielded
P104-13	P103-13	306	Core	22	1-Conductor
P104-12	P103-12	306	Shield	-	Shielded
P104-15	P103-15	308	Core	22	1-Conductor
P104-14	P103-14	308	Shield	-	Shielded
P106-01	P105-01	309	Core	22	1-Conductor
P106-09	P105-09	309	Shield	-	Shielded
P106-03	P105-03	310	Core	22	1-Conductor
P106-10	P105-10	310	Shield	-	Shielded
P106-04	P105-04	311	White	22	
P106-05	P105-05	312	Core	22	1-Conductor
P106-06	P105-06	312	Shield	-	Shielded
P106-07	P105-07	313	Core	22	1-Conductor
P106-08	P105-08	313	Shield	-	Shielded
P106-13	P105-13	314	Core	22	1-Conductor
P106-12	P105-12	314	Shield	-	Shielded
-	-	315	Not Used		
P106-15	P105-15	316	Core	22	1-Conductor
P106-14	P105-14	316	Shield	-	Shielded
P100-11	P101-08	317	Core	22	1-Conductor
P100-12	P101-09	317	Shield	-	Shielded
P100-01	P101-02	318	Core	22	1-Conductor
P100-02	P101-03	318	Shield	-	Shielded
P100-05	P101-04	319	Core	22	1-Conductor
P100-06	P101-05	319	Shield	-	Shielded
P100-09	P102	320	Core	22	1-Conductor
P100-10	P102	320	Shield	-	Shielded
P103-02	P104-02	325	White	22	
P105-02	P106-02	326	White	22	

Table 5-3: Wiring List – NAE88A/01D Exciter/Control Assembly

Source	Destination	Wire #	Color	Size	Remarks
P4-01	P5-01	321	White	22	
P4-02	P5-02	322	White	22	
P4-05	P5-03	323	Black	22	
P4-06	P5-04	324	Black	22	
J1-N	P1-03	401	White	20	
J1-N	P2	402	White	20	
J1-L	P1-05	403	White	20	
J1-L	P3	404	White	20	
J1-Gnd	Chassis Gnd	405	Grn/Yel	14	
Chassis Gnd	P1-01	410	Black	20	
P4-01	P6-01	-	White	22	
P4-02	P7-01	-	White	22	
P4-05	P6-03	-	Black	22	
P4-06	P7-03	-	Black	22	
**W200P1-(+)	A2TB4-18	–	Blk/Grey	22	NxLink
**W200P1-(-)	A2TB4-17	–	Blk	22	NxLink

NOTE:

** Wire installed only if NxLink Ethernet Interface Module (U200) is installed

Table 5-4: Wiring List - NARA39A/01E RF Power Assembly

Source	Destination	Wire #	Color	Size	Remarks
T1-01	J4-01	-	Yellow	14	T1 Lead
GND-3	J4-03	-	Yellow	14	
T1-04	J5-01	-	Yellow	14	T1 Lead
GND-3	J5-03	-	Yellow	14	
T1-05	J2-Centre	-	Yellow	14	T1 Lead
T1-06	GND-3	-	Yellow	14	T1 Lead
T1-02	A3E6	-	Yellow	14	T1 Lead
T1-03	A3E6	-	Yellow	14	T1 Lead
T2-01	A3E8	-	Yellow	14	T2 Lead
T2-02	GND-3	-	Yellow	14	T2 Lead
T2-03	A3T1	-	Yellow	14	T2 Lead
T2-04	A3E7	-	Yellow	14	T2 Lead
T2-05	A3T1	-	Yellow	14	T2 Lead
T2-06	A3E7	-	Yellow	14	T2 Lead
L1-02	A3E1	-	Black	660/46	L1 Lead
L1-03	A3E2	-	Black	660/46	L1 Lead
L1-01	A3E3	-	Black	660/46	L1 Lead
A3E5	A4E4	-	Yellow	12	
L3-01	GND-4	-	Yellow	12	
A3E4	L3 Clip	-	Yellow	12	
A3E9	L2 Clip	-	Yellow	12	
J3-LINE	F1-Centre	-	White	14	
J3-NEUTRAL	F3-Centre	-	White	14	
J3-GND	GND-1	-	Grn/Yw	14	
P01-02	F3 Side	-	Blue	14	
P02-02	F4 Side	-	Blue	14	
J3-LINE	F2-Centre	-	White	14	
J3-NEUTRAL	F4-Centre	-	White	14	
F1 Side	P01-01	-	Brown	14	
F2 Side	P02-01	-	Brown	14	
GND-2	P01-03	-	Grn/Yw	14	
GND-2	P02-03	-	Grn/Yw	14	
L4-02	A4E1	-	Black	660/46	L4 Lead
L4-03	A4E2	-	Black	660/46	L4 Lead
L4-01	A4E3	-	Black	660/46	L4 Lead
E2	J1-Centre	-	Yellow	14	
L2-01	GND-3	-	Yellow	12	
GND-2	P01	-	Shield	14	
GND-2	P02	-	Shield	14	
A4TB1-04	E1	-	Yellow	14	
A4E4	L5-2	-	Yellow	12	
L5-1	C7-1	-	Yellow	12	
P03-Centre	P04-Centre	-	Core	RG188A/U	Coaxial Cable
P03-Shell	P04-Shell	-	Shield	-	

NOTE: Wire sizes 660/46 indicate 660 strands of 46 AWG litz wire.

Table 5-5: Wiring List - NAP31/02B RF Power Module

Source	Destination	Wire #	Color	Size	Remarks
P3-01	P2-01	-	White	14	
P3-03	P2-03	-	Black	14	

Table 5-6: Connector Mating Information - J1000 Transmitter

Connector	Mate
P100	2A4J1
P101	1A1J7
P102	1A2J13
P103	1A3J8
P104	2A1A2J3
P105	1A3J9
P106	2A2A2J3
W100P1	1A1J8
W100P2	2A1A1J1
W100P3	2A2A1J1
*W200P1	*U200-POWER
*W201P1	*1A2J10
*W201P2	*U200-Port 1
*W202P1	*U200-Ethernet
*W202P2	*J2 (Modular RJ45 Jack)

NOTE:

* Cable installed only if NxLink Ethernet Interface Module (U200) is installed

Table 5-7: Connector Mating Information – NAE88A/01D Exciter/Control Assembly

Connector	Mate
P1	A8CN1
P2	A9E1
P3	A9E2
P4	A8CN2
P5	A9J3
P6	B1P1
P7	B2P1
W1P1	A2J1
W1P2	A1J1
W2P1	A1J4
W2P2	A3J5
W3P1	A1J5
W3P2	A3J7
W4P1	A9J2
W4P2	A3J10
W5P1	A3J6
W5P2	A2J4
W6P1 *	A1J10

NOTE: * cable part of front panel display A12

Table 5-8: Connector Mating Information – NARA39A/01E RF Power Assembly

Connector	Mate
P1	A1A1J3
P2	A2A1J3
P3	A3J1
P4	A4J2
A1P1	J4
A2P1	J5

Table 5-9: Connector Mating Information – NAP31/02B RF Power Module

Connector	Mate
P2	A1J2
P3	A3J1
P4	A1E1
P5	A1E2
P6	A1E3
W1P1	A2J2
W1P2	A3J2
W2P1	A2J1
W2P2	A5J1

J1000
REPAIR MANUAL

Section 6 ELECTRICAL SCHEMATICS

6.1 INTRODUCTION

This section contains electrical schematics for the subject equipment. Block diagrams, simplified electrical schematics, and logic diagrams may also be included. Refer to Table 6-1 for an itemized listing.

6.2 COMPONENT VALUES

Unless otherwise specified on the logic/ schematic diagram, the following applies:

- Resistor values are shown in ohms (Ω).
  (K = 1000 and M = 1 000 000).
- Resistor power ratings are not shown when less than 0.5 W.
- Capacitor values are shown in microfarads (μF).
- Unidentified diodes are part number 1N4938.

6.3 GRAPHIC SYMBOLS

The graphic symbols used are in accordance with IPC-2612-2010 - Sectional Requirements for Electronic Diagramming Documentation (Schematic and Logic Descriptions).

6.4 LOGIC SYMBOLS

The logic symbols used on electrical schematics and logic diagrams are in accordance with IPC-2612-2010.

6.5 REFERENCE DESIGNATIONS

Reference designations were assigned in accordance with IPC-2612-2010. Each electrical symbol is identified with its basic reference designation. To obtain the full reference designation for a specific part, this basic identifier must be prefixed with the reference designation assigned to all higher assemblies.

6.6 UNIQUE SYMBOLOGY

Nautel utilizes unique symbology on electrical schematics to describe two-state (logic) inputs/outputs that differ from those inputs/ outputs having only one distinct state or multiple states (analog).

6.6.1 Type of Inputs/Outputs

On electrical schematics, names used to describe two-state (logic) inputs/outputs are prefixed by a '#'. Those inputs/outputs representing a one-state or analog signal will have no prefix.

6.6.2 Logic Level/Convention

The '#' prefix identifies an input/output that has two distinct states - 'high' and 'low'. A suffix, '+' or '-', identifies the active (true) state of the input/output. The 'high' (+) is the more positive of the two levels used to represent the logic states. The 'low' (-) is the less positive of the two levels used to represent the logic states. Two types of logic, positive and negative, may be represented on a particular schematic. In positive logic, 'high' represents the active (true) state and 'low' represents the inactive (false) state. In negative logic, 'low' represents the active state and 'high' represents the inactive state.

6.7 IDENTIFICATION OF SCHEMATIC DIAGRAMS

A number that is both the figure number and the page number identifies each illustration in this section. The numbers are assigned sequentially and are prefixed by the letters 'SD-'. The electrical schematics/logic diagrams included in this section are listed in Table 6-1.

6.8 STRUCTURE OF SCHEMATICS

The electrical schematics are structured in a hierarchical format that is based on function and signal flow. Wherever practical, the signal flow is from left to right. Inputs normally originate on the left-hand side and outputs will extend to the right-hand side. Exceptions are shown by an arrow indicating the direction of signal flow.

NOTE

The physical location of a part/assembly was not necessarily a factor when a schematic was drawn. The full reference designation assigned to a part/assembly, in conjunction with the family tree in Figure 4-1 and the assembly detail drawings in section 7, will identify its location.

Figures SD-1 through SD-3 identify each major stage and its detailed interconnection. Each stage contains cross-references that identify which block is the signal source for inputs or the destination for outputs.

When a sub-function is treated as a block in Figures SD-1 through SD-3, its detailed circuit information is included in its own schematic drawing(s), also included in this section.

6.9 LOCATING THE SCHEMATIC DIAGRAM(S) FOR A FUNCTIONAL BLOCK

The text inside a functional block provides the key to locating its schematic diagram(s). When a functional block is assigned a reference designation, refer to the family tree depicted in Figure 4-1 and follow the family tree branches to the block that contains the reference designation and associated Nautel nomenclature (e.g., NAP31/02B). Refer to Table 6-1 with the Nautel nomenclature number and/or the description to identify the appropriate figure number(s).

6.10 LOCATING A PART/ASSEMBLY IDENTIFIED ON A SCHEMATIC

The full reference designation assigned to a part/assembly is the key to physically locating that part/assembly.

NOTE

Full reference designations contain the assembly hierarchical coding. When the end item is divided into units (cabinets), the first coding is a unit number (1, 2, 3, etc). When the end item is divided into assemblies, the first coding is an assembly number (A1, A2, A3, etc). If a unit or an assembly is divided into sub-assemblies, assembly coding that identifies assembly relationship (1A1, A2A1, A2A1A1, etc) is added.

Refer to the family tree depicted in Figure 4-1 with the full reference designation and follow the family tree branches to the appropriate block, noting the name and Nautel nomenclature number of all higher assemblies in the path.

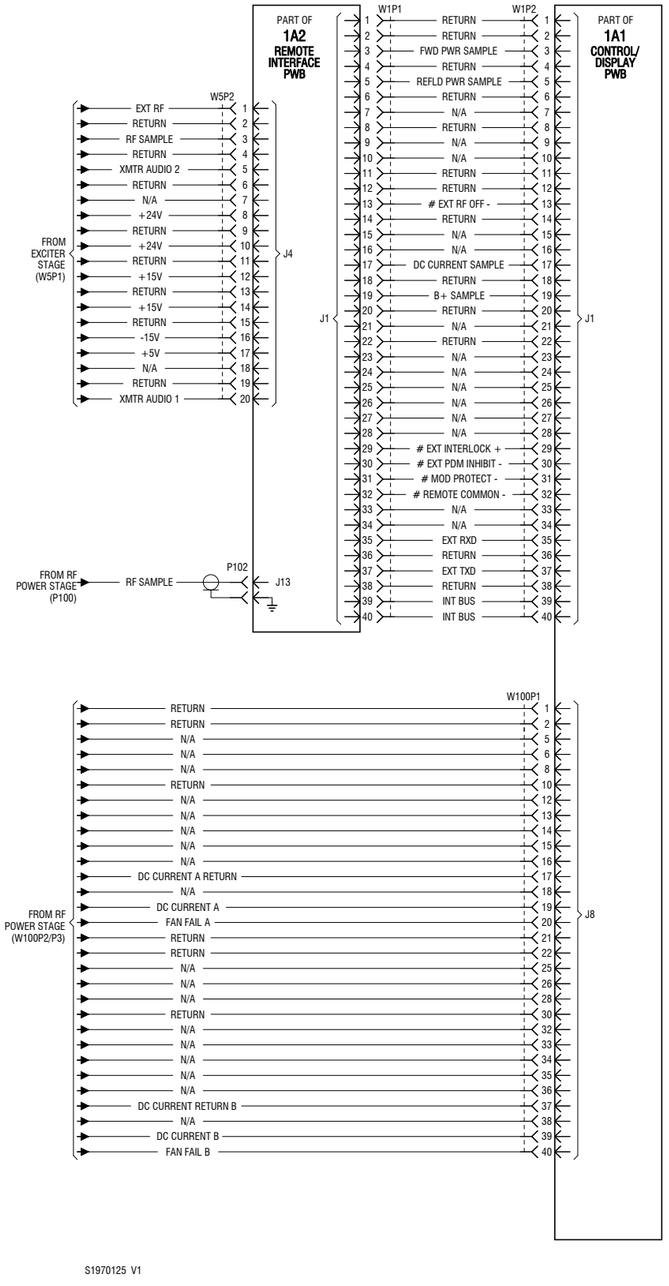
NOTE

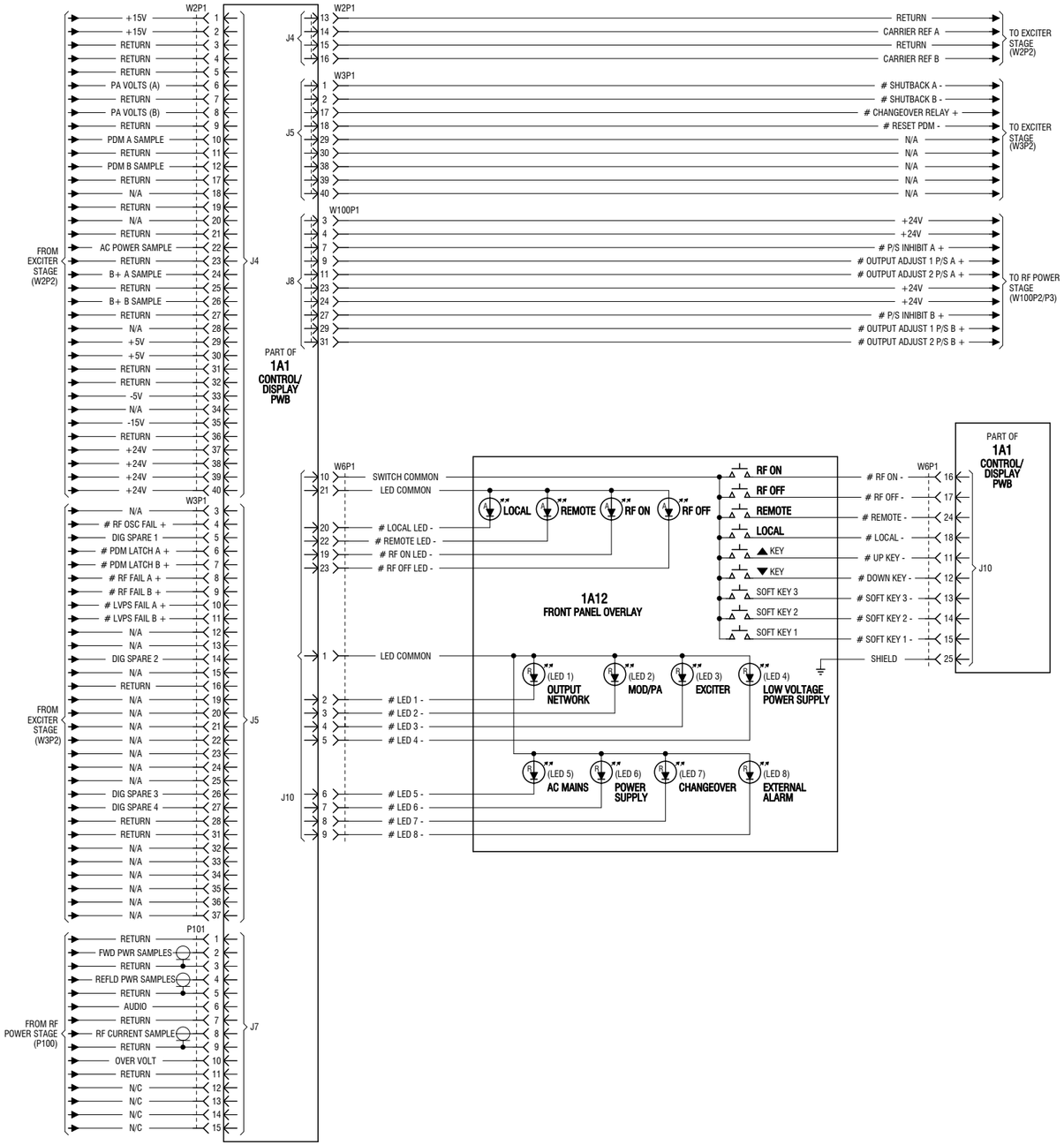
The drawings in Section 7 depict the assembly detail of the transmitter and its modules/ assemblies.

Refer to Table 7-1 with the name and Nautel nomenclature number of each family tree block in the path, starting at the highest assembly (normally Figure MD-1) and determine the figure number(s) for that assembly. Refer to the referenced figure and locate the next lower level assembly. Repeat this procedure until the location of the required part/assembly is found.

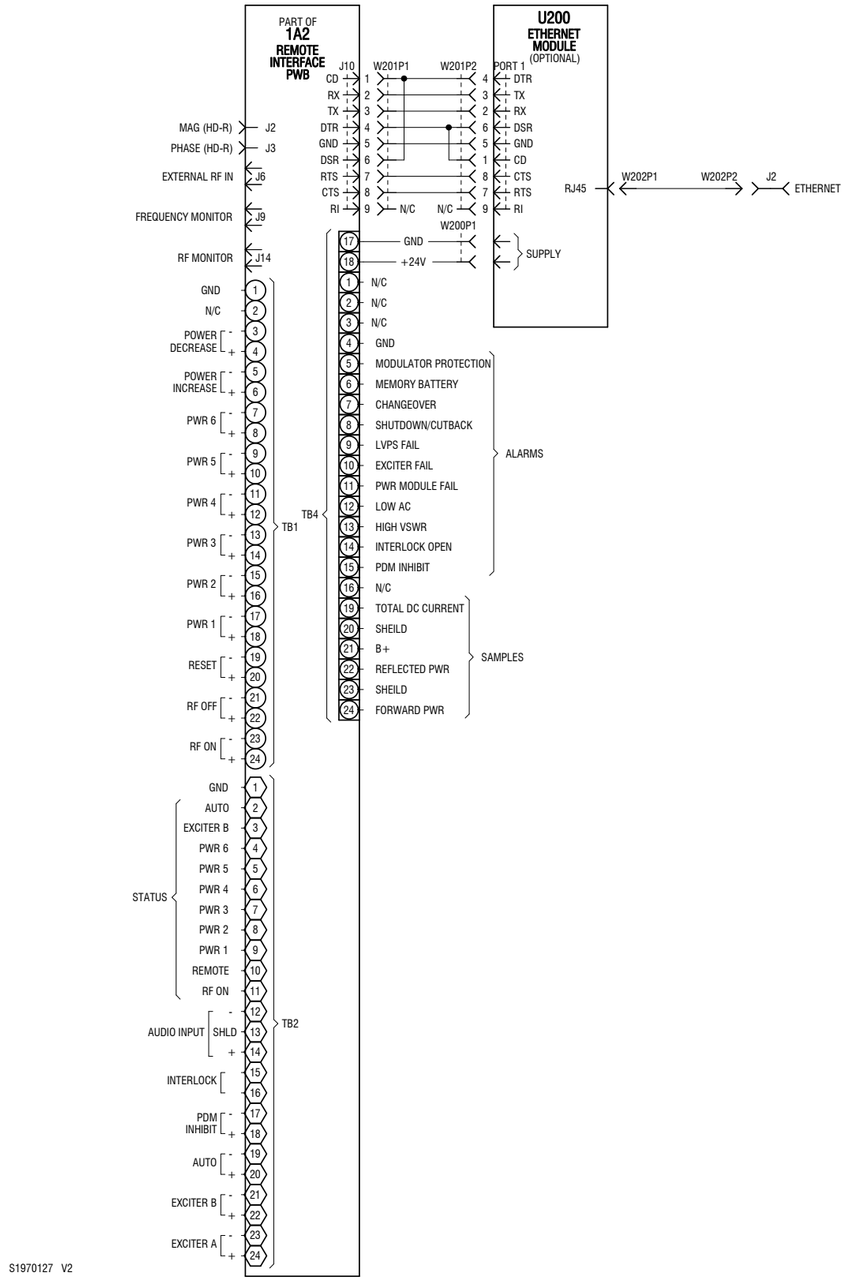
Table 6-1: Electrical Schematics

Figure #	Description
SD-1A	Electrical Schematic - J1000 Transmitter - Control/Monitor Function (1 of 2)
SD-1B	Electrical Schematic - J1000 Transmitter - Control/Monitor Function (2 of 2)
SD-2	Electrical Schematic - J1000 Transmitter - Exciter Stage
SD-3	Electrical Schematic - J1000 Transmitter - RF Power Stage
SD-4	Electrical Schematic - Controller/Display PWB (NAPC143B/01) Sheet 1 of 4
SD-5	Electrical Schematic - Controller/Display PWB (NAPC143B/01) Sheet 2 of 4
SD-6	Electrical Schematic - Controller/Display PWB (NAPC143B/01) Sheet 3 of 4
SD-7	Electrical Schematic - Controller/Display PWB (NAPC143B/01) Sheet 4 of 4
SD-8	Electrical Schematic - Remote Interface PWB (NAPI85/01A) Sheet 1 of 3
SD-9	Electrical Schematic - Remote Interface PWB (NAPI85/01A) Sheet 2 of 3
SD-10	Electrical Schematic - Remote Interface PWB (NAPI85/01A) Sheet 3 of 3
SD-11	Electrical Schematic - Exciter Interface PWB (NAPI87A/01)
SD-12	Electrical Schematic - RF Synthesizer PWB (NAPE70F/01) Sheet 1 of 2
SD-13	Electrical Schematic - RF Synthesizer PWB (NAPE70F/01) Sheet 2 of 2
SD-14	Electrical Schematic - Interphase PDM Driver PWB (NAPM10B)
SD-15	Electrical Schematic - LVPS Buck Converter PWB (NAPS32A/02)
SD-16	Electrical Schematic - RF Power Module (NAP31/02B)
SD-17	Electrical Schematic - Forward Converter PWB (NAPS31B/04)

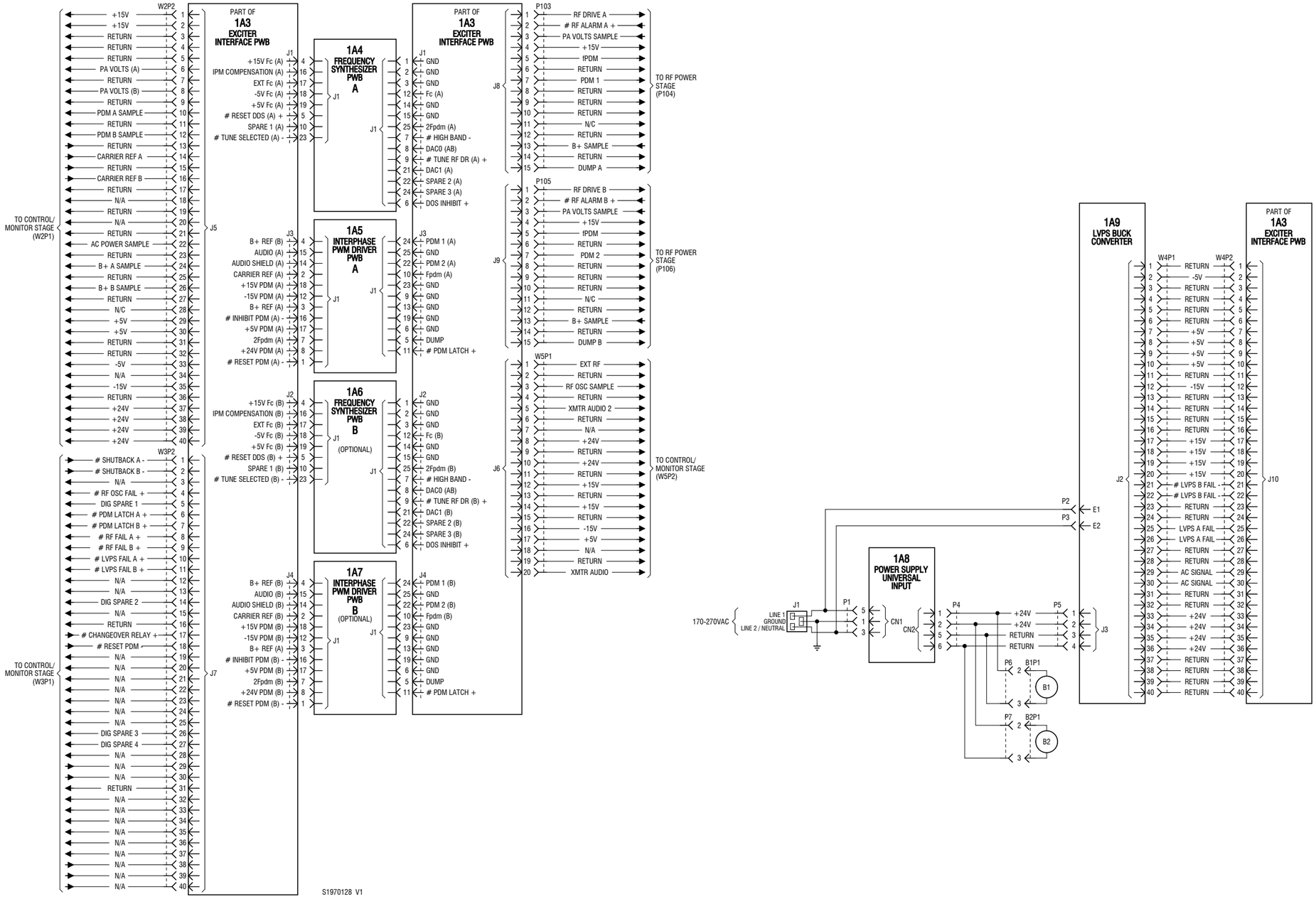




Electrical Schematic - J1000 Transmitter - Control/Monitor Function			
Issue 7.0	Not to Scale	Figure SD-1A	Sheet 1 of 2

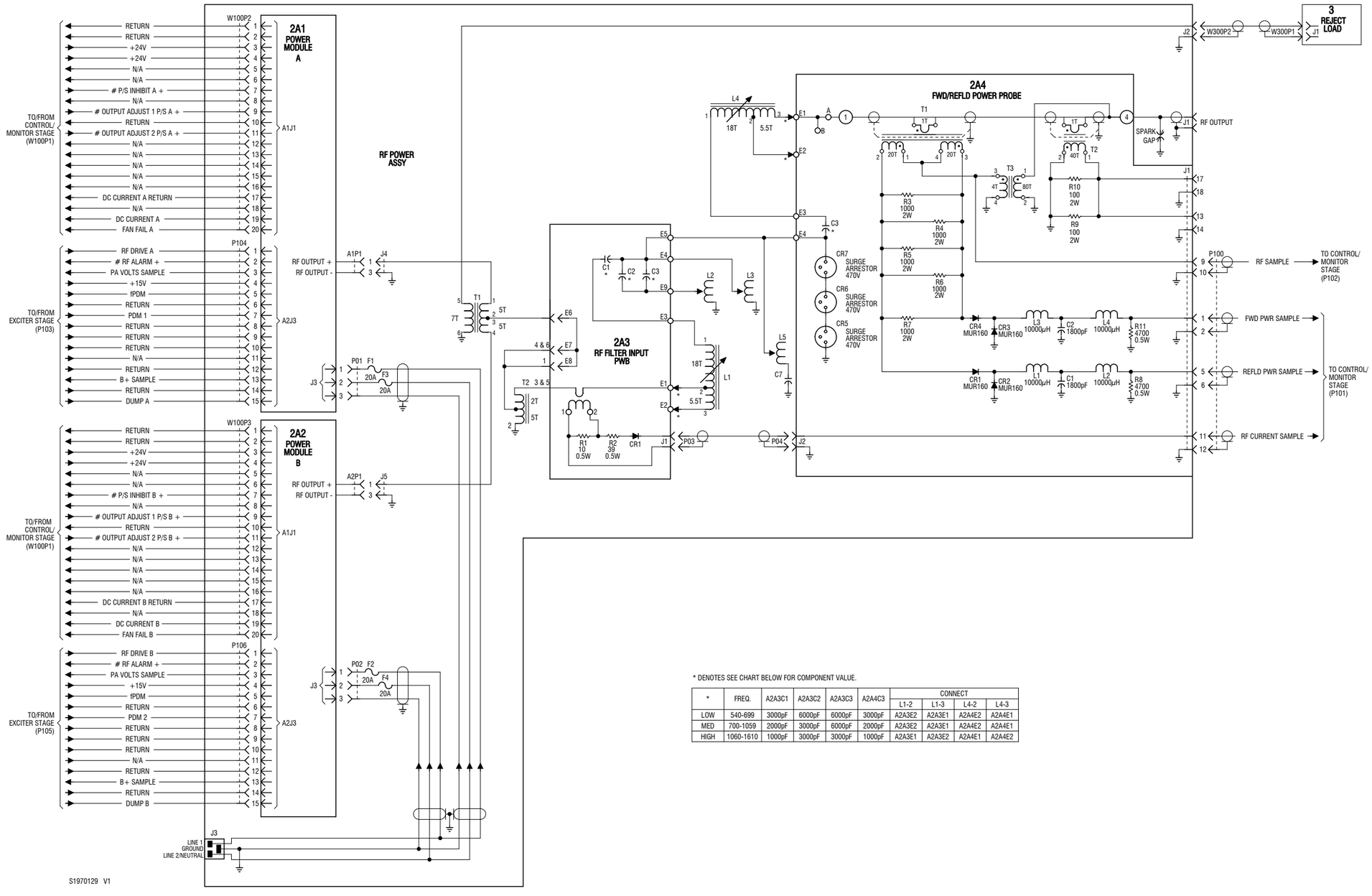


Electrical Schematic - J1000 Transmitter - Control/Monitor Function			
Issue 7.0	Not to Scale	Figure SD-1B	Sheet 2 of 2



Dimensions = mm (inches)

Electrical Schematic - J1000 Transmitter – Exciter Stage			
Issue 7.0	Not to Scale	Figure SD-2	Sheet 1 of 1

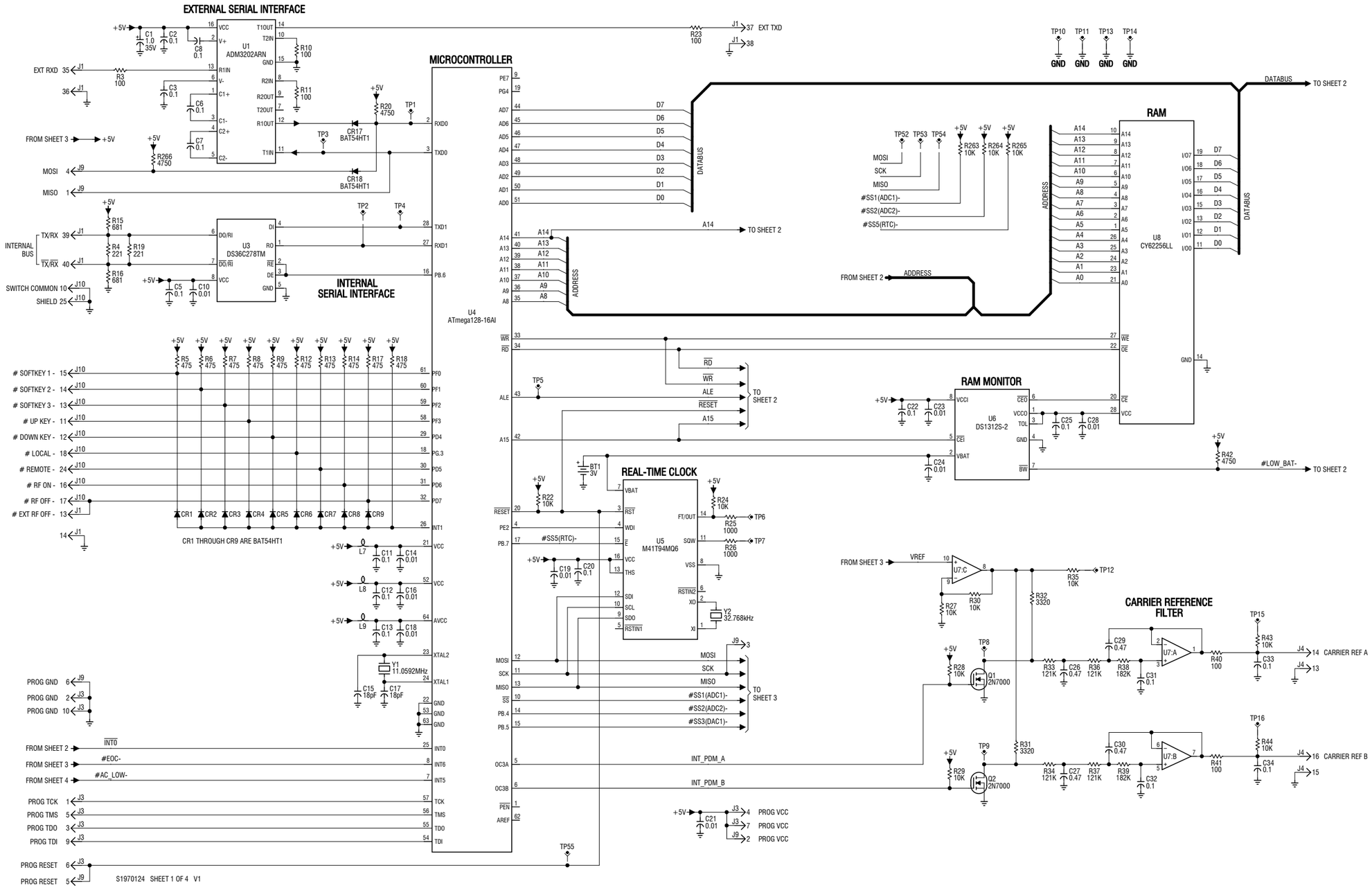


* DENOTES SEE CHART BELOW FOR COMPONENT VALUE.

*	FREQ.	A2A3C1	A2A3C2	A2A3C3	A2A4C3	CONNECT			
						L1-2	L1-3	L4-2	L4-3
LOW	540-699	3000pF	6000pF	6000pF	3000pF	A2A3E2	A2A3E1	A2A4E2	A2A4E1
MED	700-1059	2000pF	3000pF	6000pF	2000pF	A2A3E2	A2A3E1	A2A4E2	A2A4E1
HIGH	1060-1610	1000pF	3000pF	3000pF	1000pF	A2A3E1	A2A3E2	A2A4E1	A2A4E2

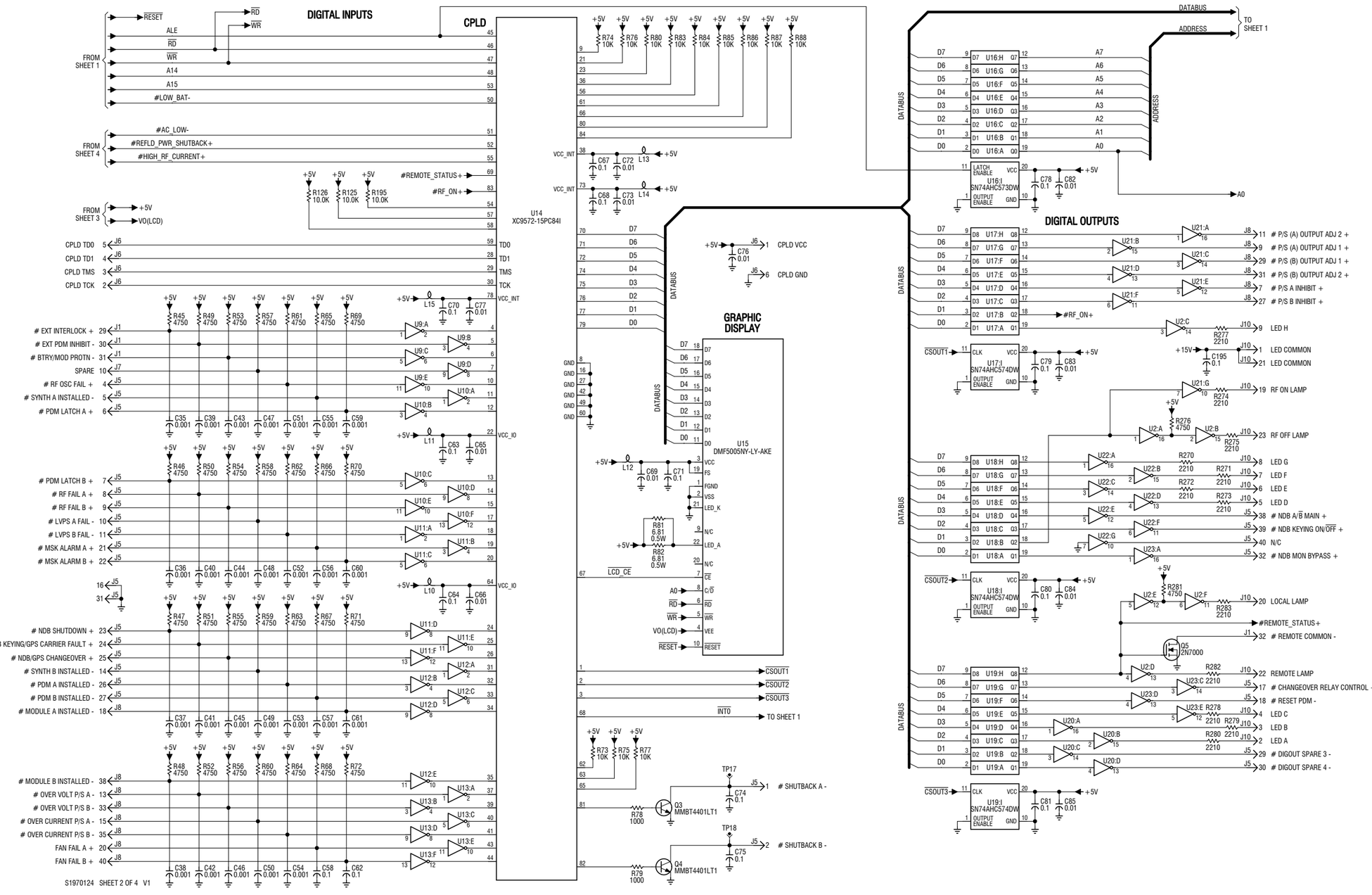
Dimensions = mm (inches)

Electrical Schematic - J1000 Transmitter – RF Power Stage			
Issue 7.0	Not to Scale	Figure SD-3	Sheet 1 of 1



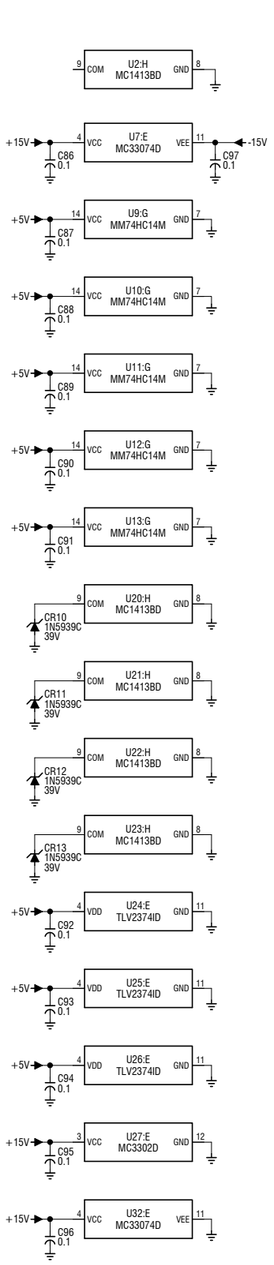
Dimensions = mm (inches)

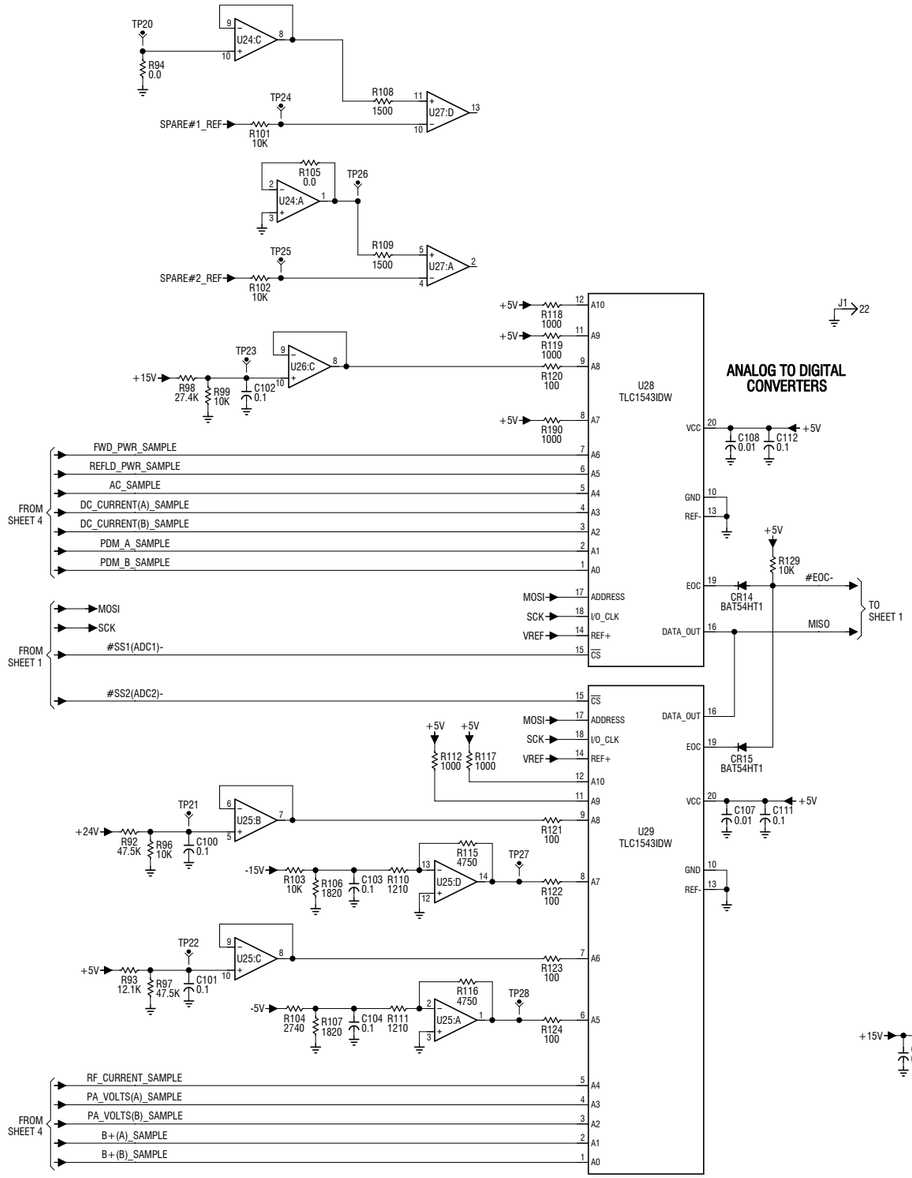
Electrical Schematic - Controller/Display PWB (NAPC143B/01)			
Issue 7.0	Not to Scale	Figure SD-4	Sheet 1 of 4

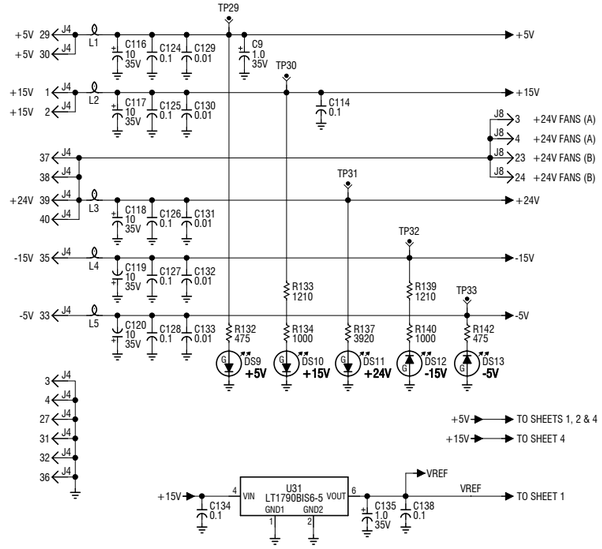


Dimensions = mm (inches)

Electrical Schematic - Controller/Display PWB (NAPC143B/01)			
Issue 7.0	Not to Scale	Figure SD-5	Sheet 2 of 4



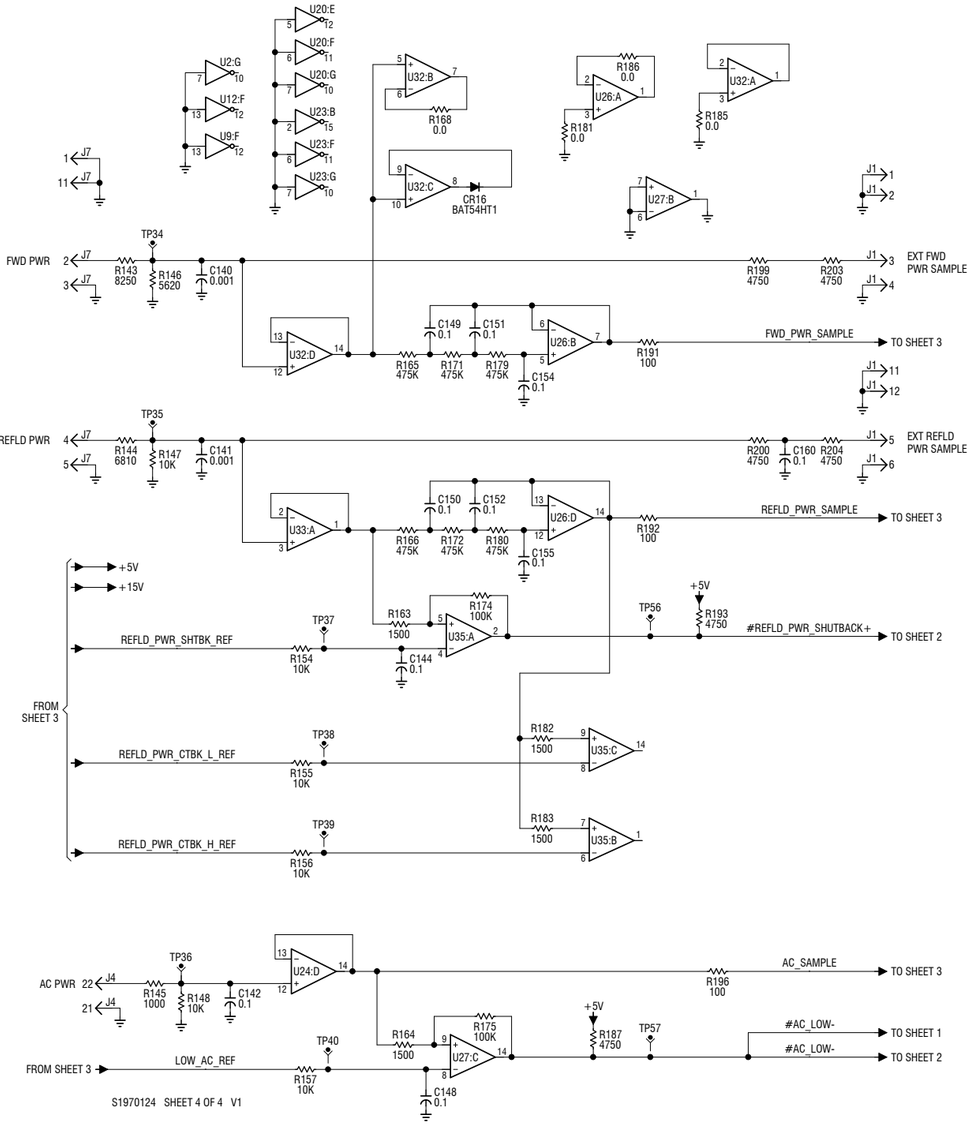


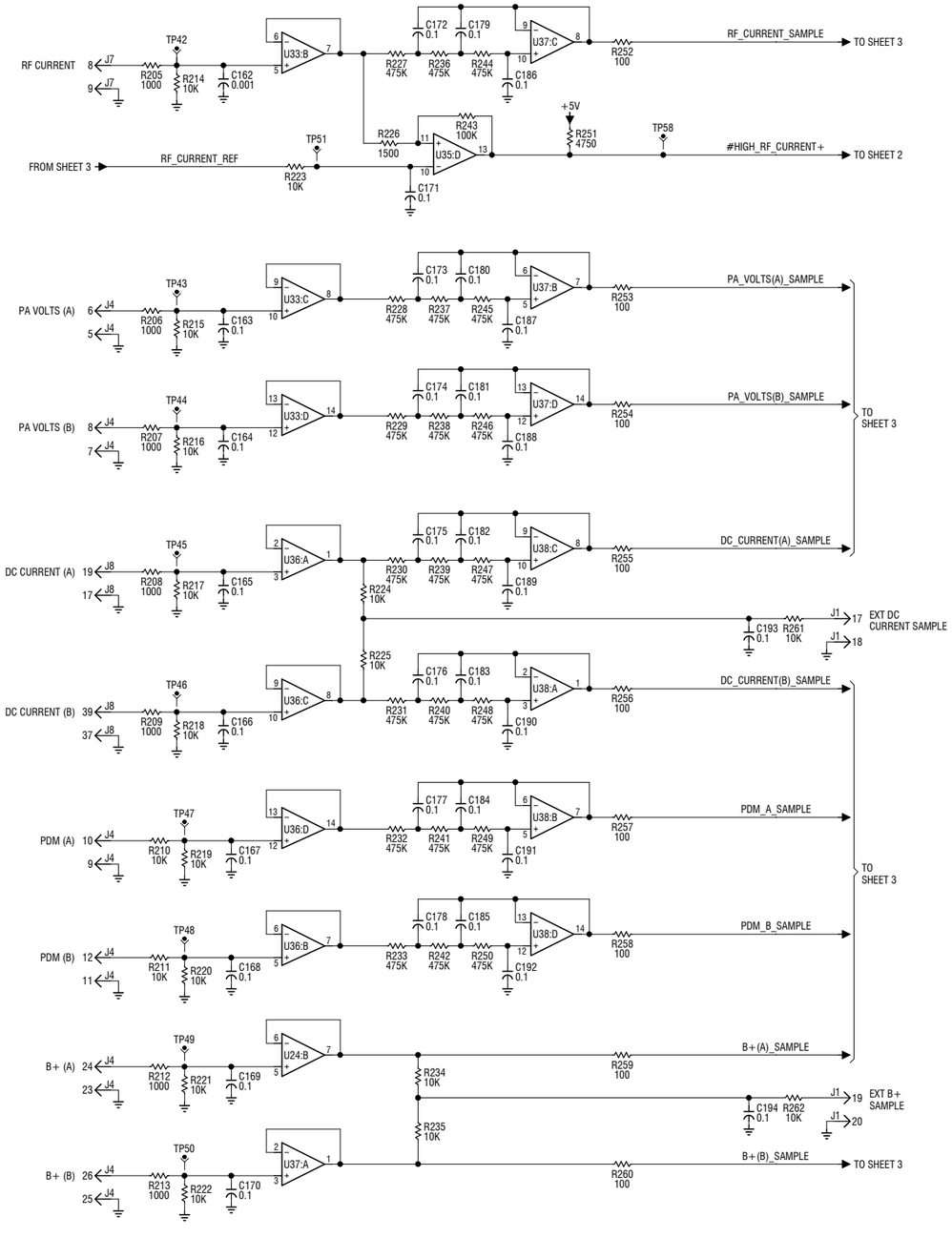


S1970124 SHEET 3 OF 4 V1

Dimensions = mm (inches)

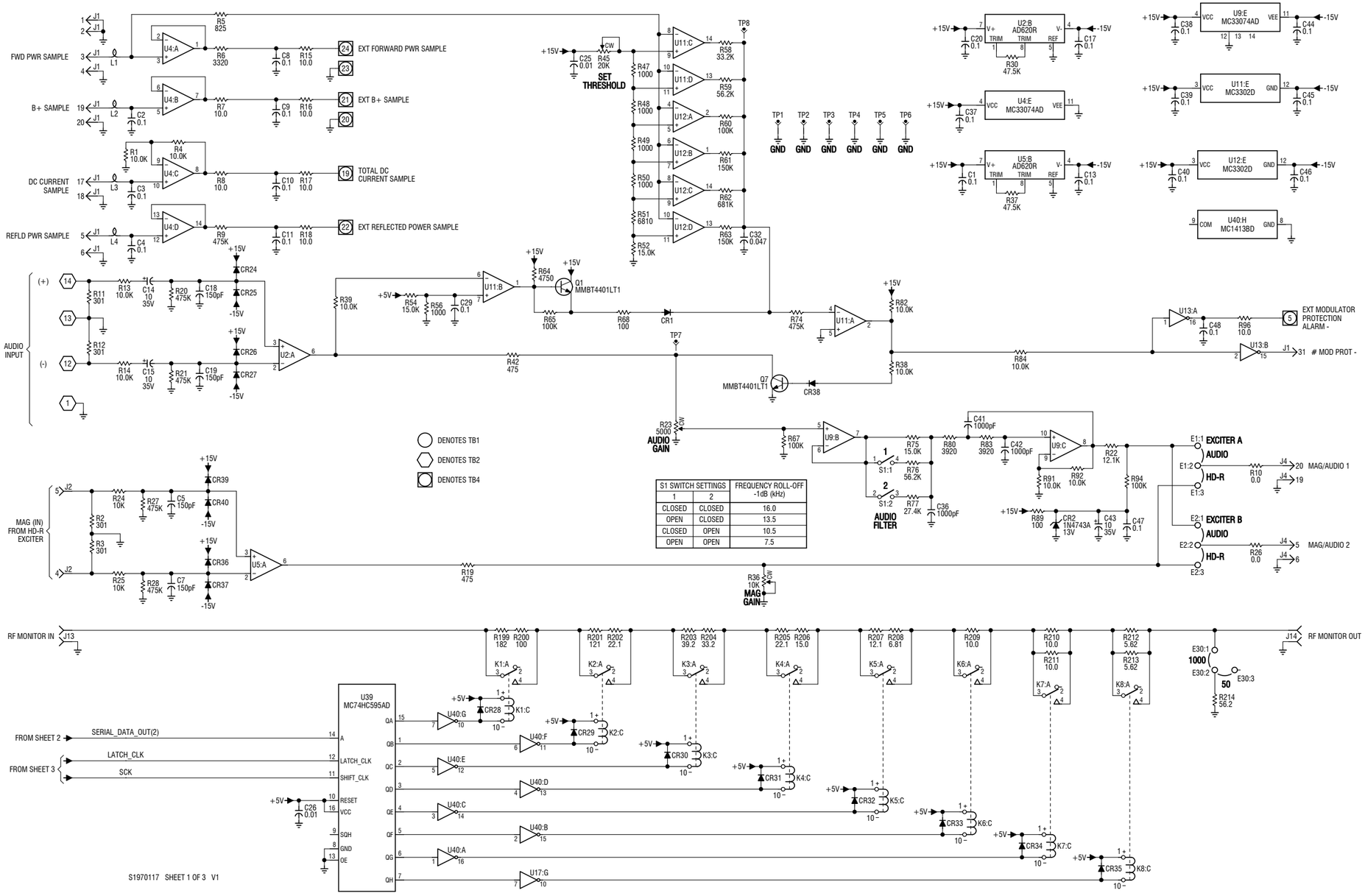
Electrical Schematic - Controller/Display PWB (NAPC143B/01)			
Issue 7.0	Not to Scale	Figure SD-6	Sheet 3 of 4





Dimensions = mm (inches)

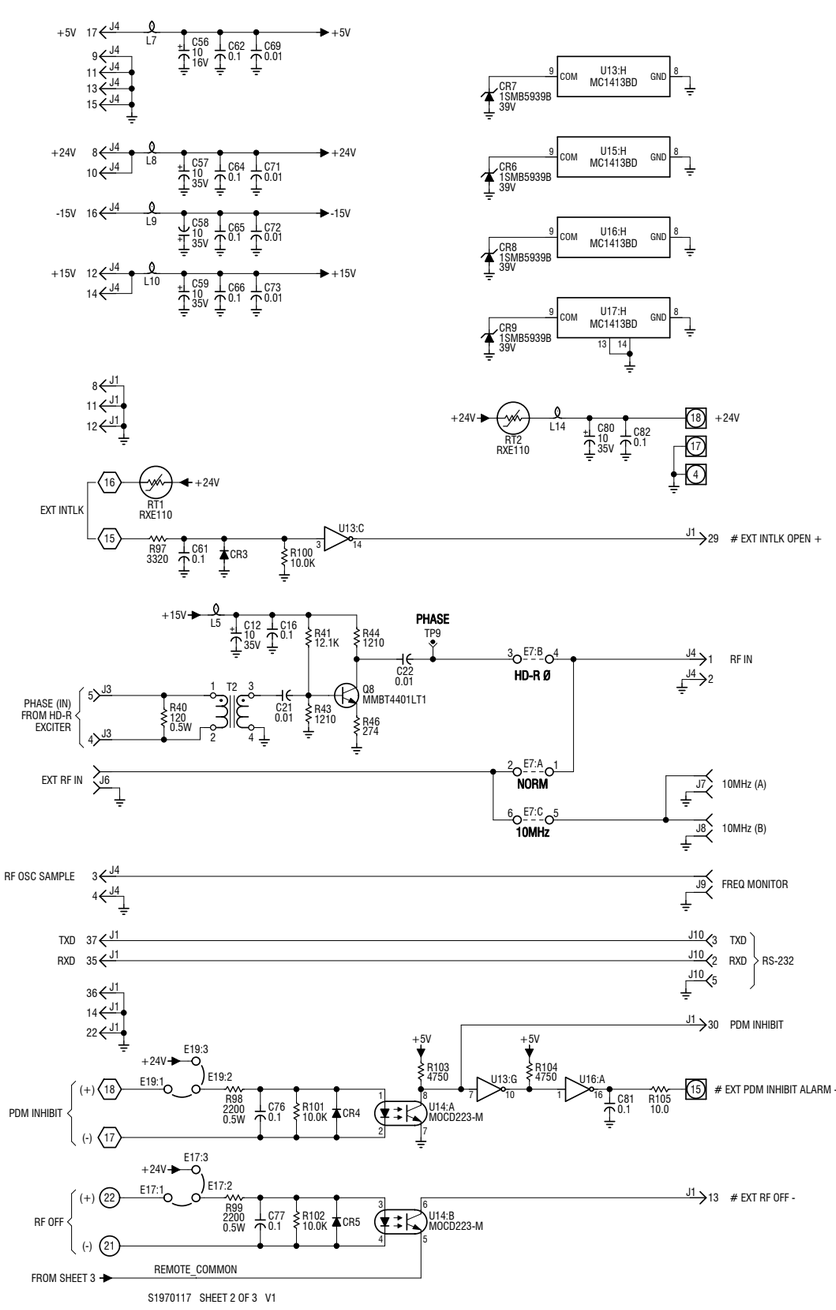
Electrical Schematic - Controller/Display PWB (NAPC143B/01)			
Issue 7.0	Not to Scale	Figure SD-7	Sheet 4 of 4



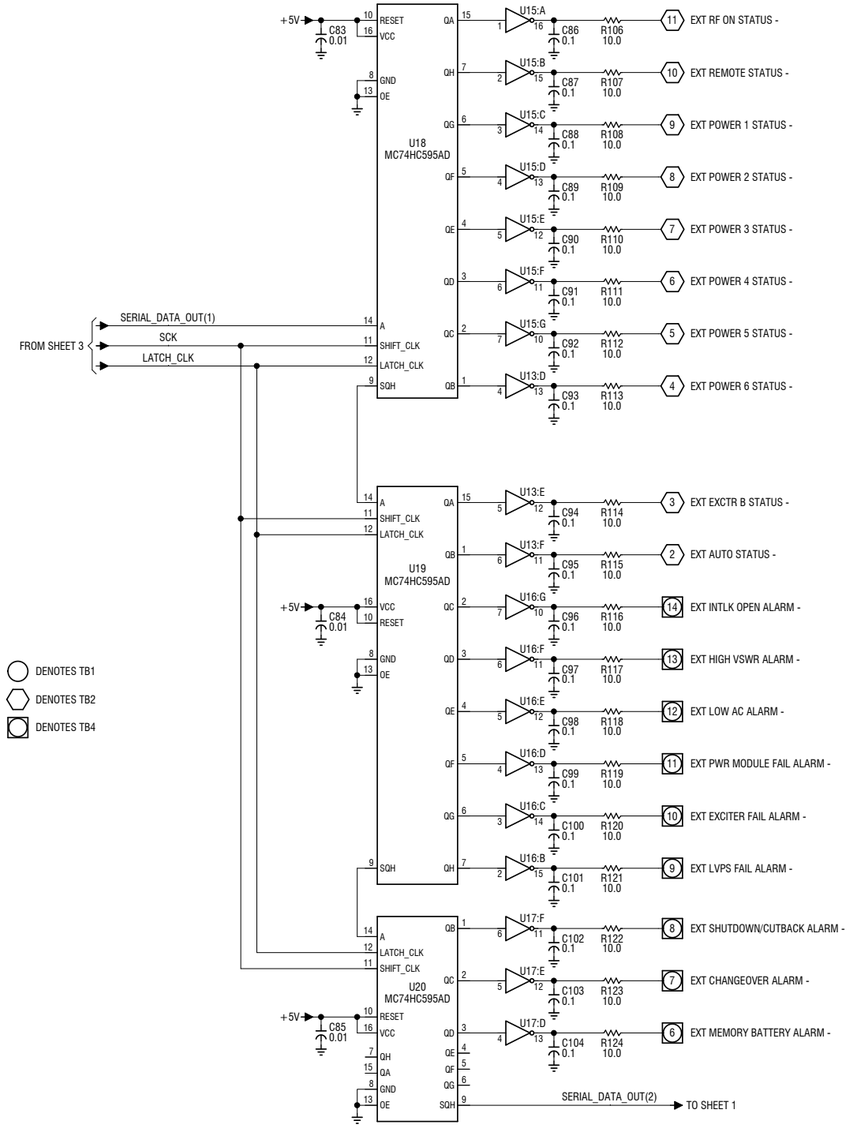
S1 SWITCH SETTINGS		FREQUENCY ROLL-OFF -1dB (kHz)
1	2	
CLOSED	CLOSED	16.0
OPEN	CLOSED	13.5
CLOSED	OPEN	10.5
OPEN	OPEN	7.5

Dimensions = mm (inches)

Electrical Schematic – Remote Interface PWB (NAPI85/01A)			
Issue 7.0	Not to Scale	Figure SD-8	Sheet 1 of 3

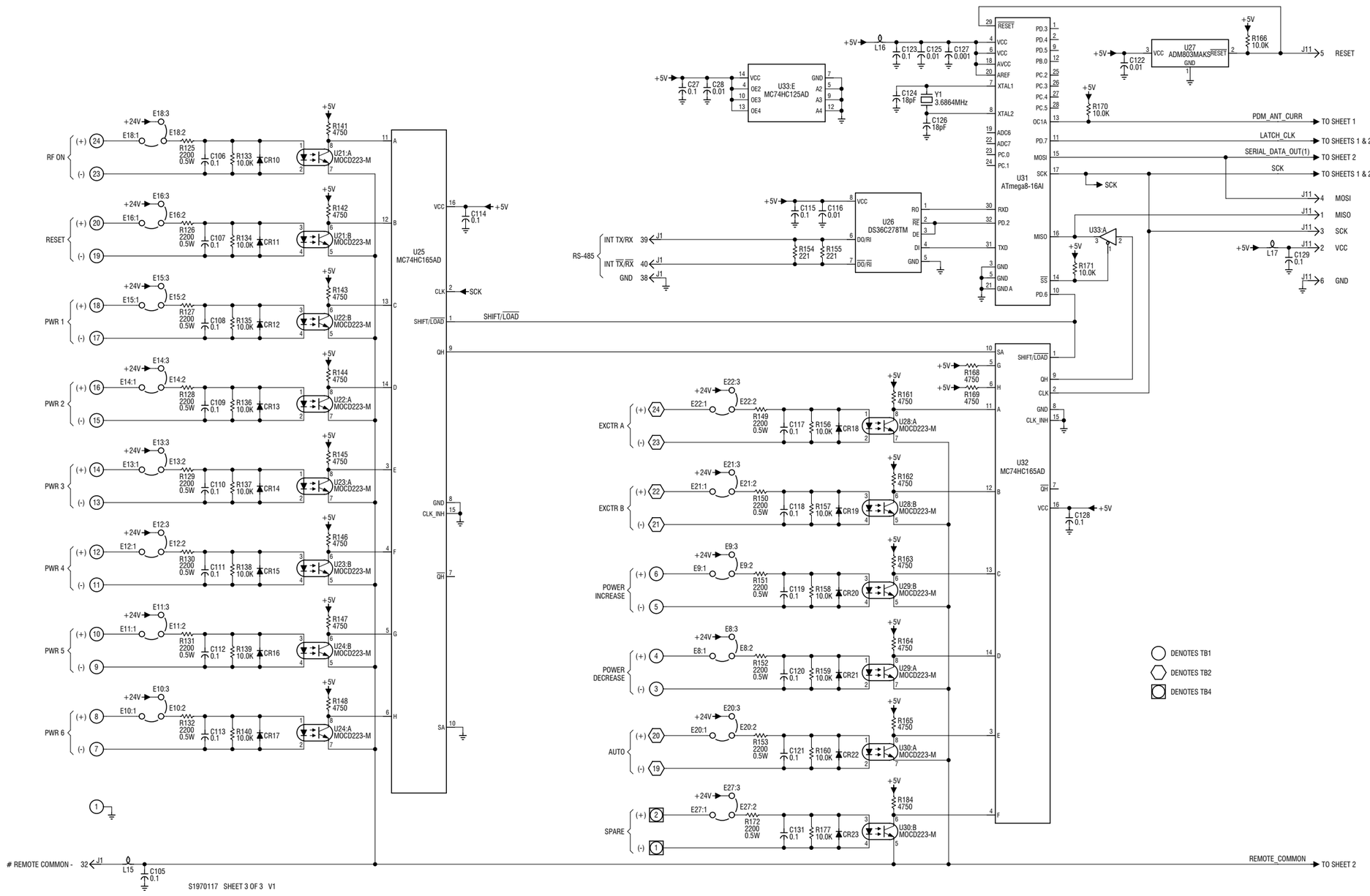


S1970117 SHEET 2 OF 3 V1



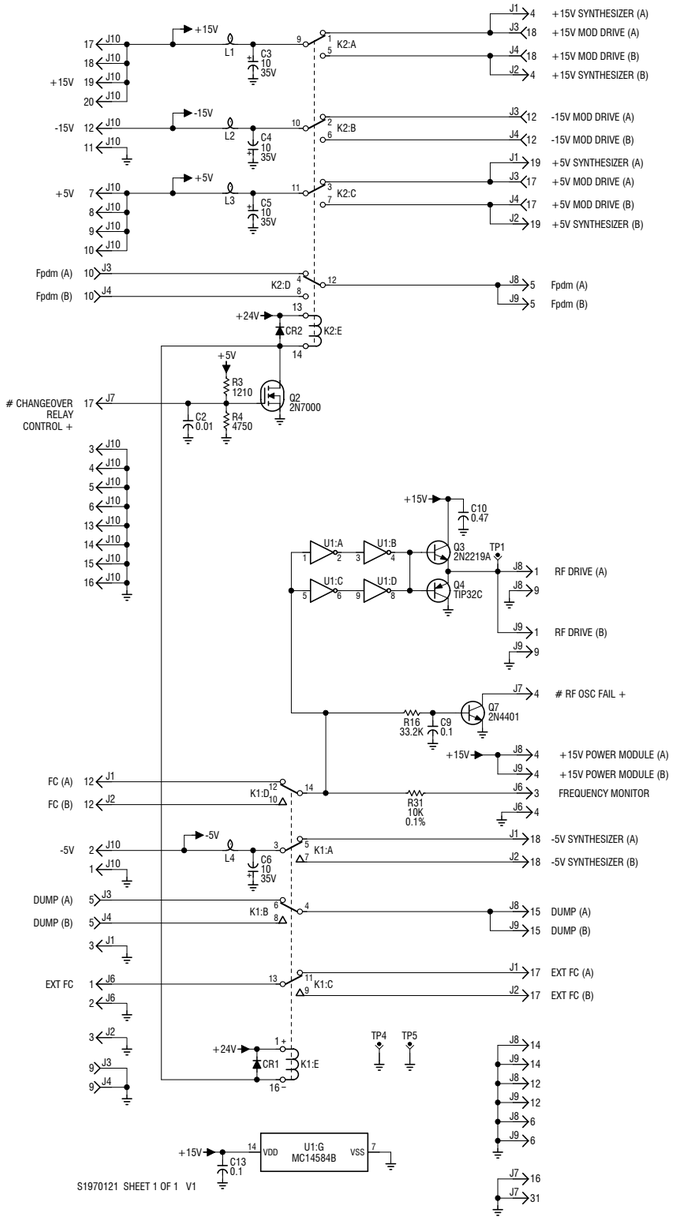
Dimensions = mm (inches)

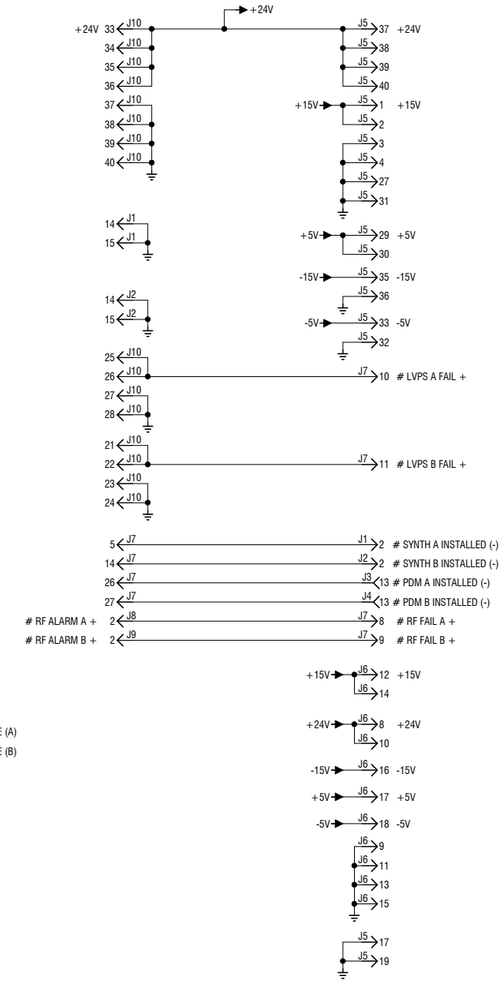
Electrical Schematic - Remote Interface PWB (NAPI85/01A)			
Issue 7.0	Not to Scale	Figure SD-9	Sheet 2 of 3

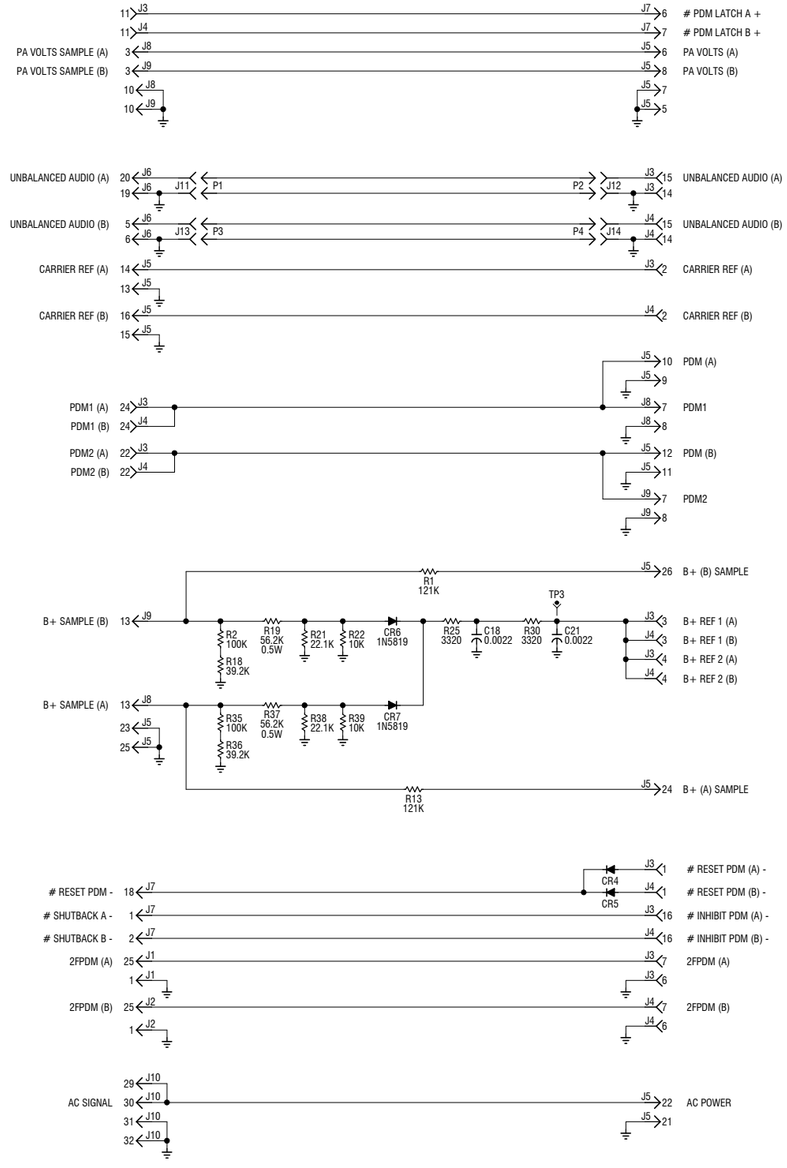


Dimensions = mm (inches)

Electrical Schematic - Remote Interface PWB (NAPI85/01A)			
Issue 7.0	Not to Scale	Figure SD-10	Sheet 3 of 3

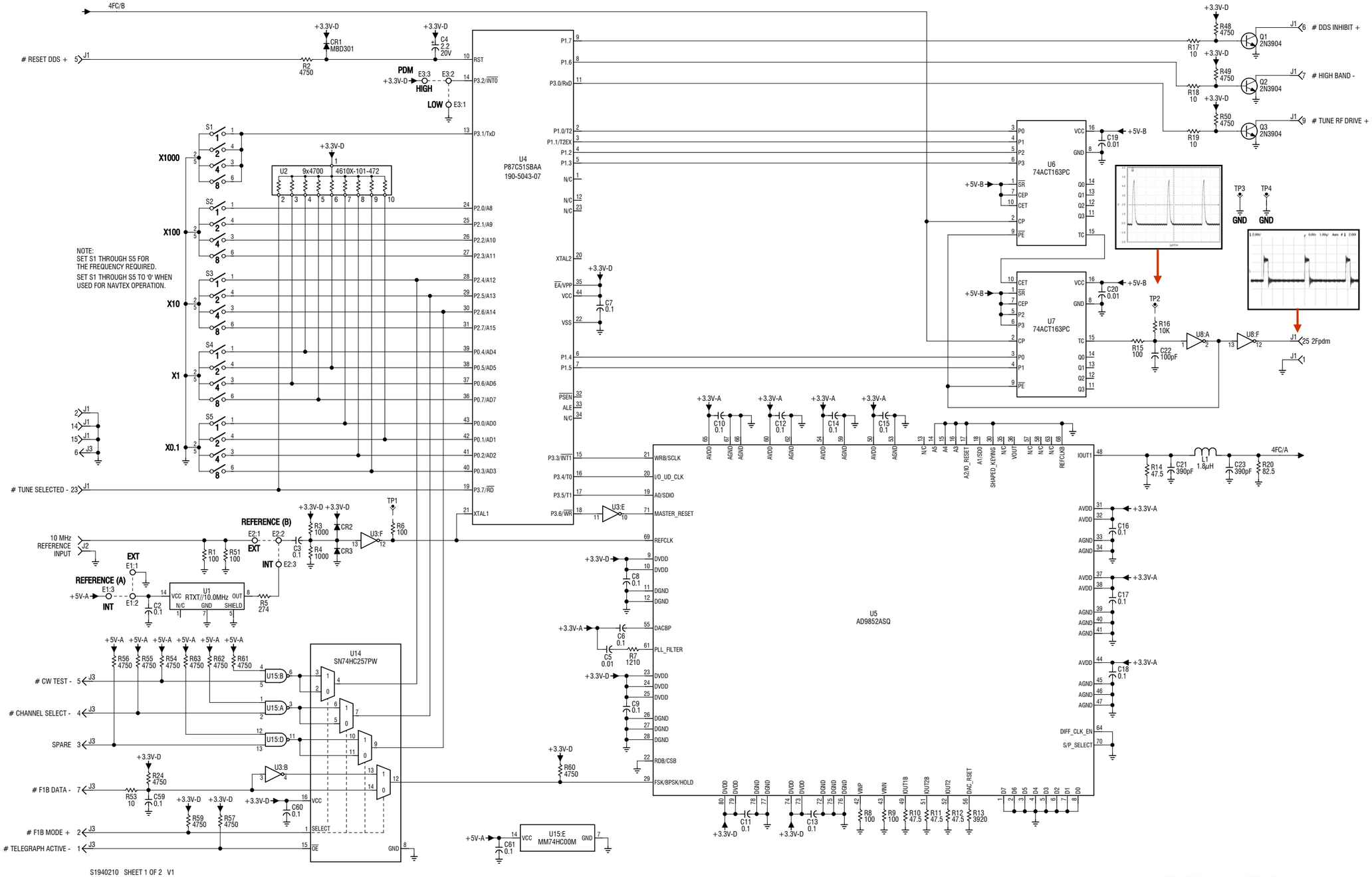




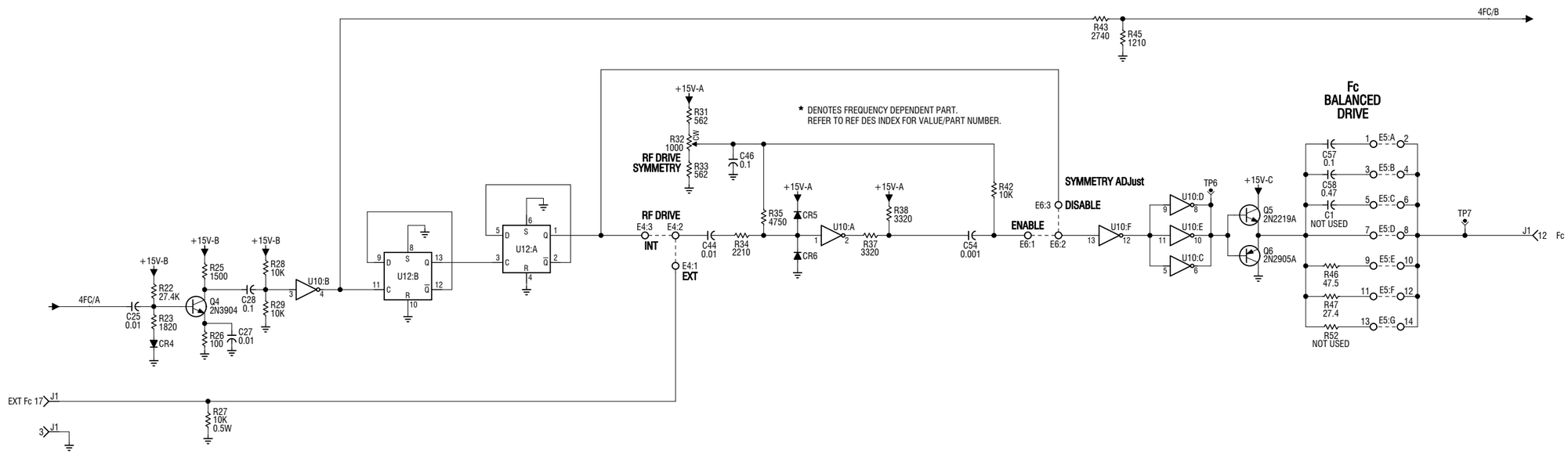


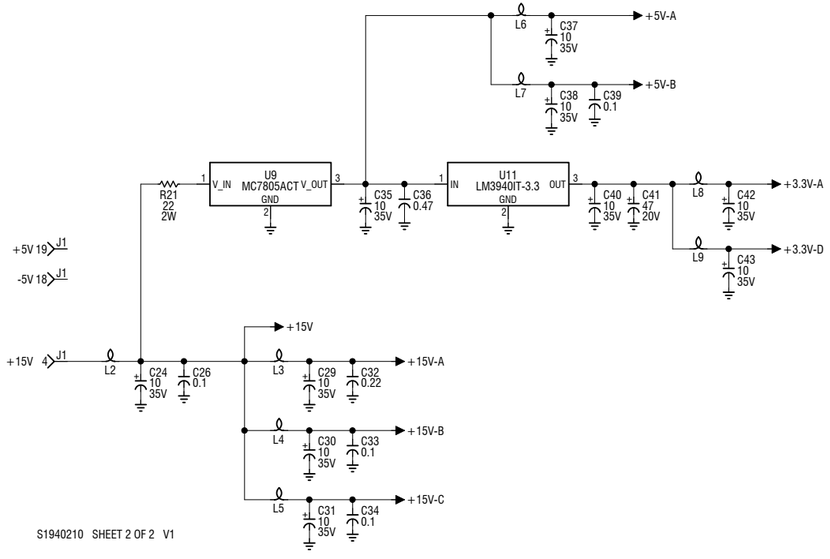
Dimensions = mm (inches)

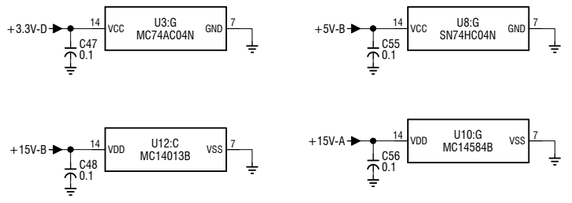
Electrical Schematic – Exciter Interface PWB (NAPI87A/01)			
Issue 7.0	Not to Scale	Figure SD-11	Sheet 1 of 1



Electrical Schematic – RF Synthesizer PWB (NAPE70F/01)			
Issue 7.0	Not to Scale	Figure SD-12	Sheet 1 of 2

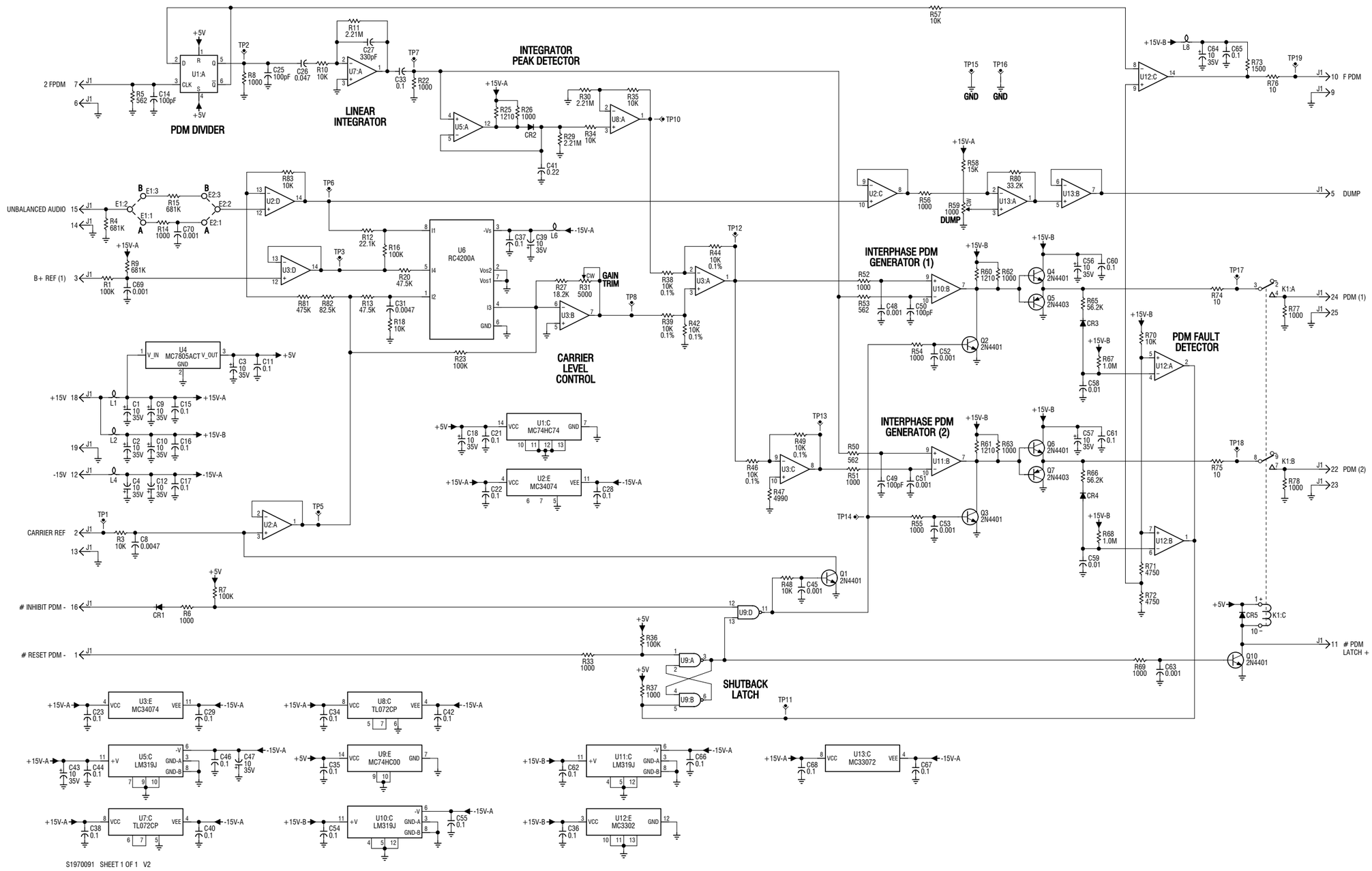






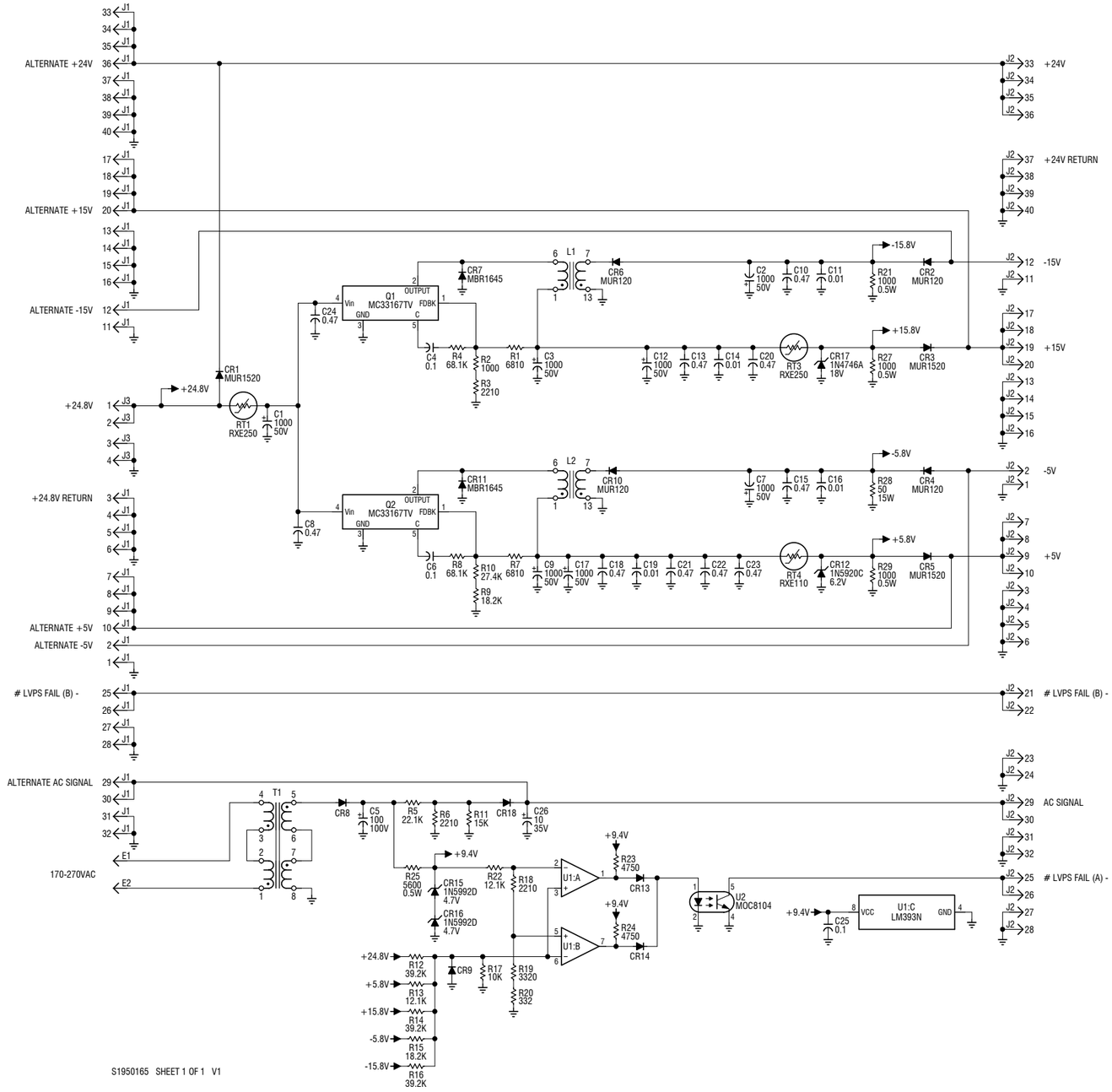
Dimensions = mm (inches)

Electrical Schematic - RF Synthesizer PWB (NAPE70F/01)			
Issue 7.0	Not to Scale	Figure SD-13	Sheet 2 of 2



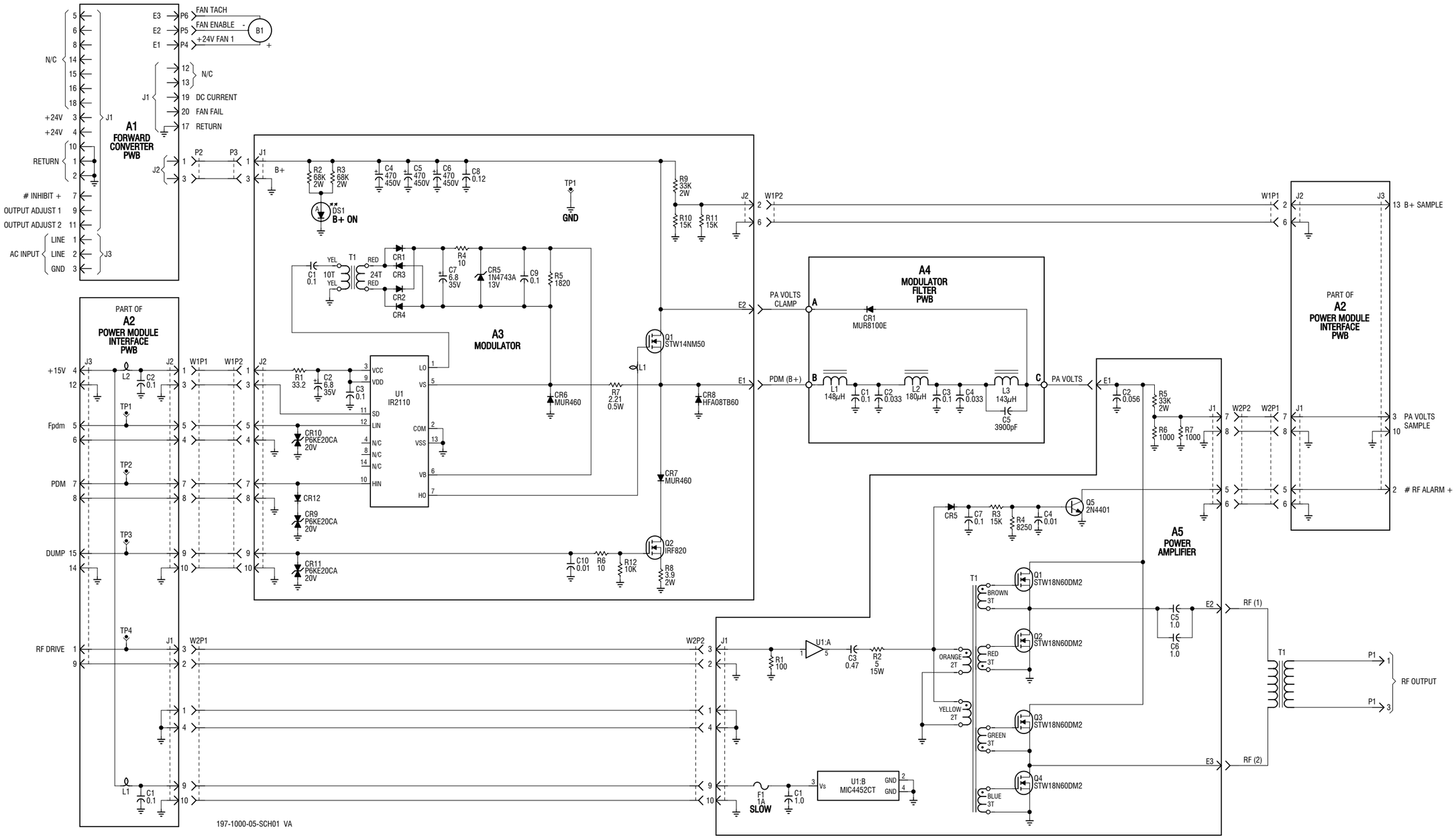
Dimensions = mm (inches)

Electrical Schematic - Interphase PDM Driver PWB (NAPM10B)			
Issue 7.0	Not to Scale	Figure SD-14	Sheet 1 of 1



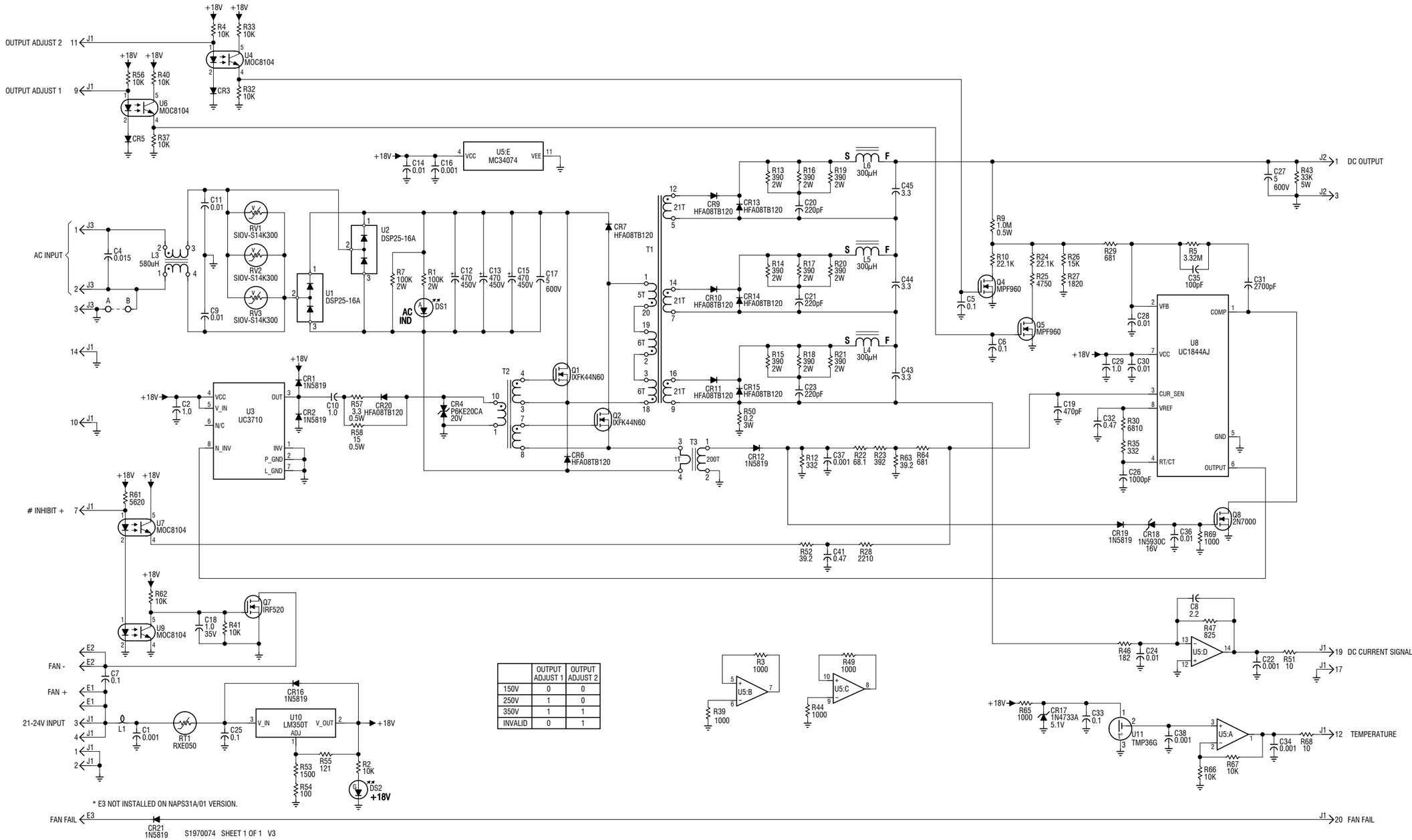
Dimensions = mm (inches)

Electrical Schematic – LVPS Buck Converter PWB (NAPS32A/02)			
Issue 7.0	Not to Scale	Figure SD-15	Sheet 1 of 1



Dimensions = mm (inches)

Electrical Schematic – RF Power Module (NAP31/02B)			
Issue 7.0	Not to Scale	Figure SD-16	Sheet 1 of 1



	OUTPUT ADJUST 1	OUTPUT ADJUST 2
150V	0	0
250V	1	0
350V	1	1
INVALID	0	1

Dimensions = mm (inches)

Electrical Schematic – Forward Converter PWB (NAPS31B/04)			
Issue 7.0	Not to Scale	Figure SD-17	Sheet 1 of 1

J1000
REPAIR MANUAL

Section 7 MECHANICAL DRAWINGS

7.1 INTRODUCTION

This section contains mechanical drawings for assemblies of the subject equipment. Dimensional drawings may be included. Refer to Table 7-1 for an itemized list. Assembly detail drawings for assemblies/ modules that have separate maintenance manuals are not included. Refer to the appropriate maintenance manual for the assembly detail of these assemblies.

7.2 LOCATING ASSEMBLY DETAIL DRAWINGS

Each illustration in this section is identified by a number that is both the figure number and the page number. The numbers are assigned sequentially and are prefixed by the letters 'MD-'. Drawings in this section are listed in Table 7-1.

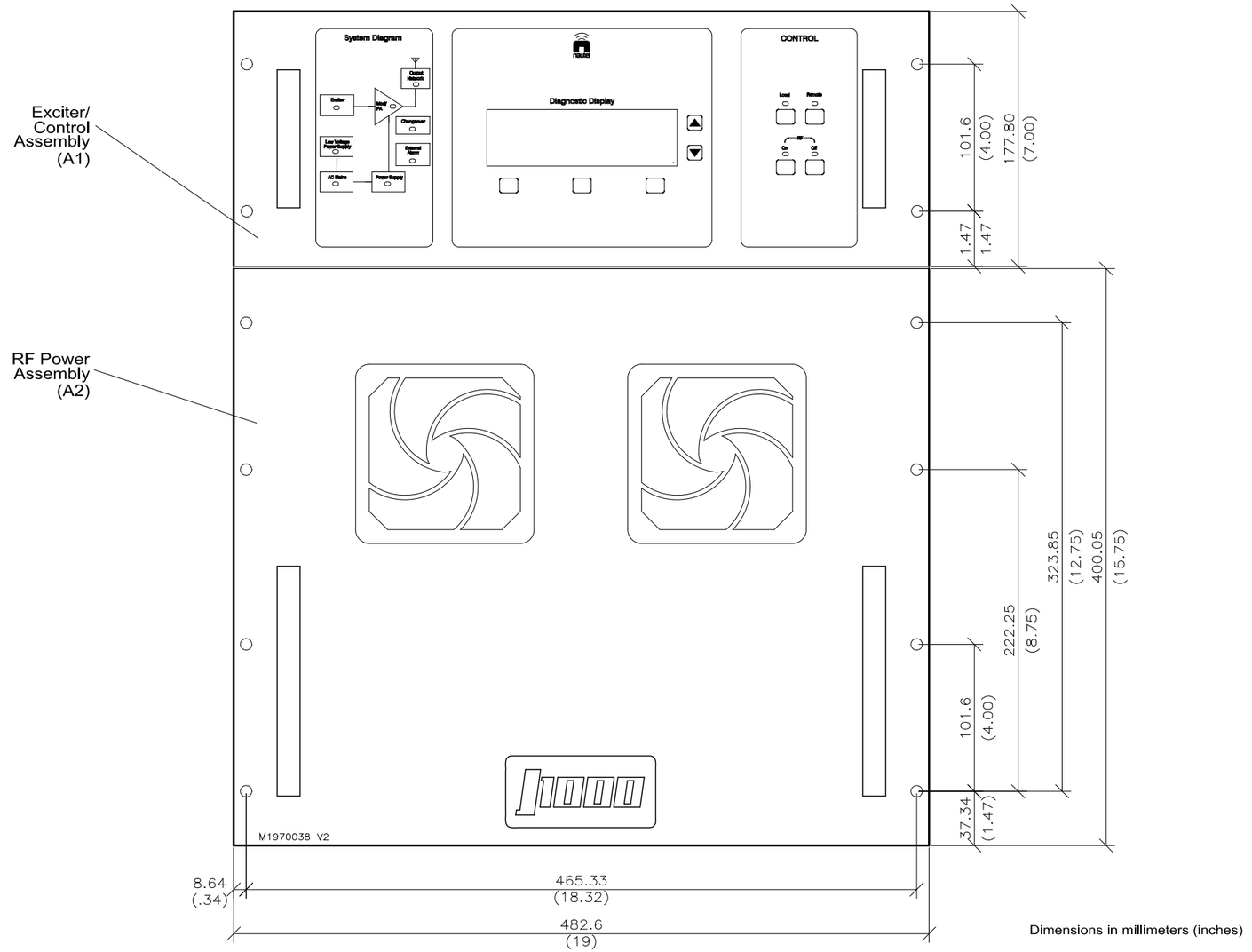
7.3 CONTENT OF MECHANICAL DRAWINGS

Mechanical drawings are illustrations that depict the location of electrical components and show assembly outline detail. Dimensional information is included, where appropriate.

When a module/assembly is the subject of its own assembly detail drawing and it is also shown in a higher level assembly, the detail depicted in the higher level assembly may have minor differences from the module/ assembly actually installed. In this case, always refer to the assembly detail drawing of the module/assembly for detailed information.

Table 7-1: Mechanical Drawings

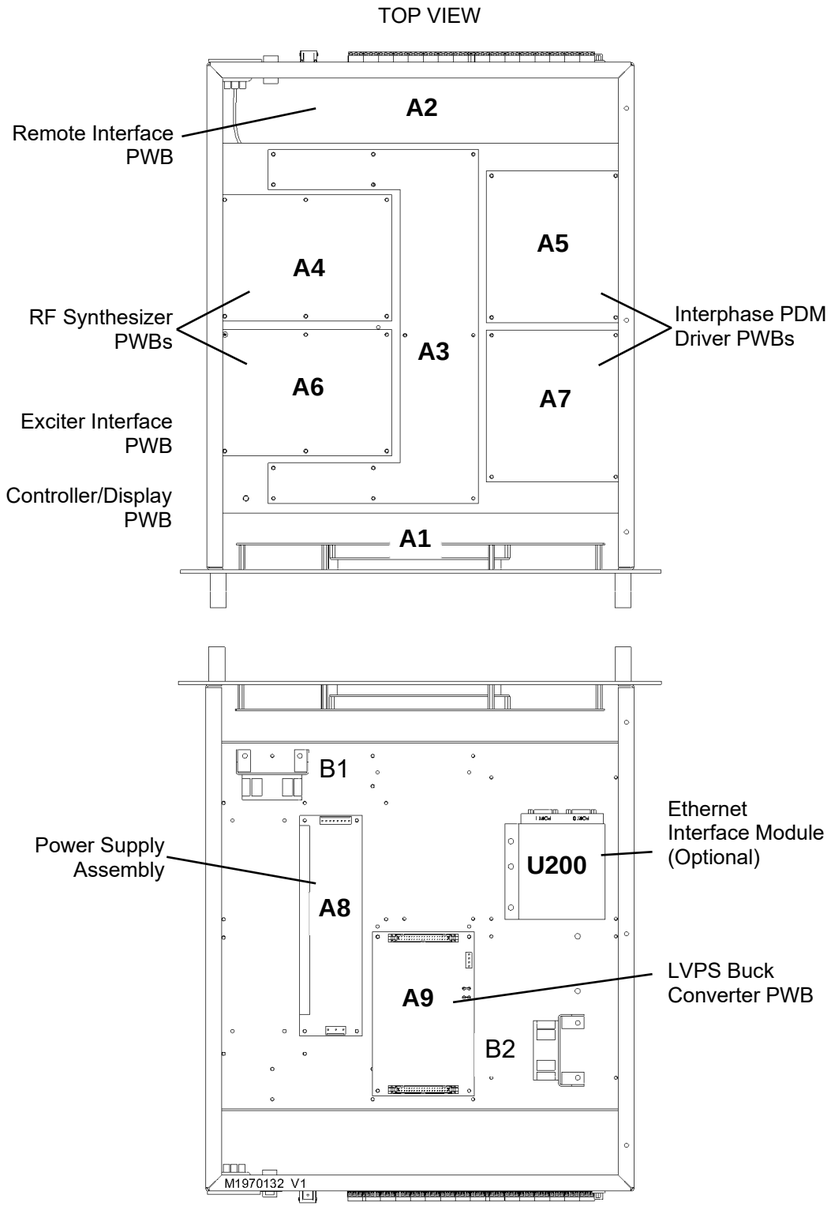
Figure #	Description
MD-1	Assembly Detail/Dimensional Information - J1000 AM Broadcast Transmitter
MD-2	Assembly Detail – NAE88A/01D Exciter/Control Assembly
MD-3	Assembly Detail – NAPC143B/01 Controller/Display PWB
MD-4	Assembly Detail – NAPI85/01A Remote Interface PWB
MD-5	Assembly Detail – NAPI87A/01 Exciter Interface PWB
MD-6	Assembly Detail – NAPE70F/01 RF Synthesizer PWB
MD-7	Assembly Detail – NAPM10B Interphase PDM Driver PWB
MD-8	Assembly Detail – NAPS32A/02 LVPS Buck Converter PWB
MD-9	Assembly Detail – NARA39A/01E RF Power Assembly
MD-10	Assembly Detail – NAP31/02B RF Power Module
MD-11	Assembly Detail – NAPS31B/04 Forward Converter PWB
MD-12	Assembly Detail – NAPI73 Power Module Interface PWB
MD-13	Assembly Detail – NASM11A/02 Modulator
MD-14	Assembly Detail – NAPF08 Modulator Filter PWB
MD-15	Assembly Detail – NAAA05/02A Power Amplifier
MD-16	Assembly Detail – NAPF03A/01 RF Filter Input PWB
MD-17	Assembly Detail – NAPF07C/03 Forward/Reflected Power Probe



Dimensions in millimeters (inches)

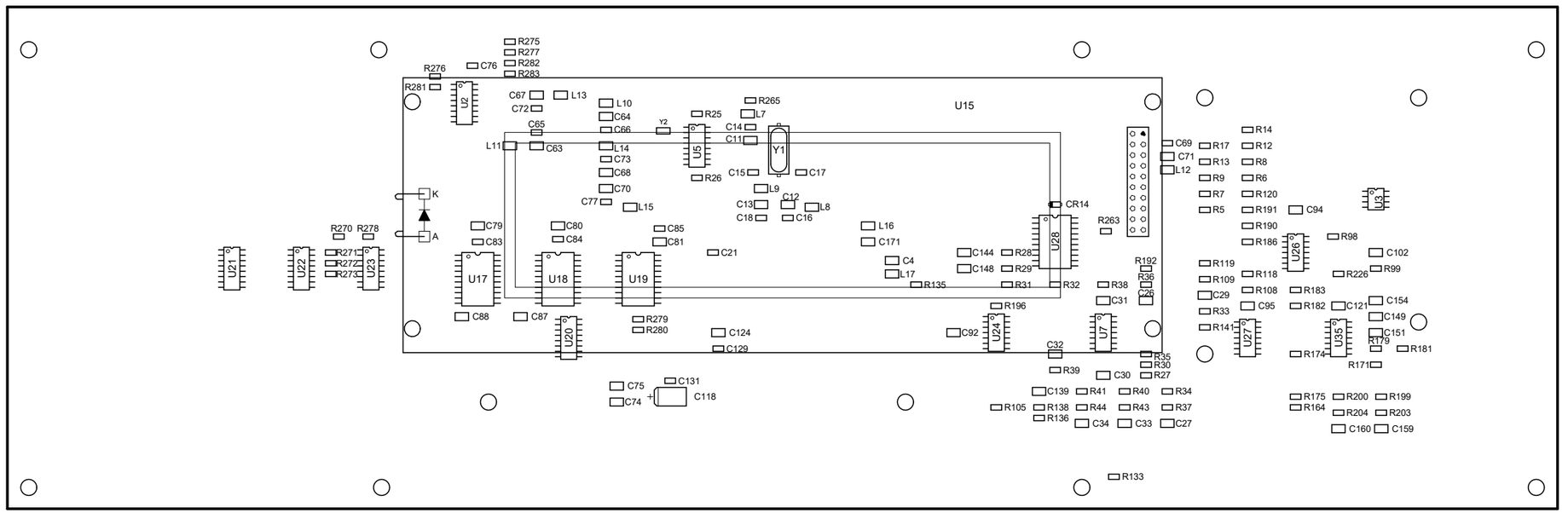
Dimensions = mm (inches)

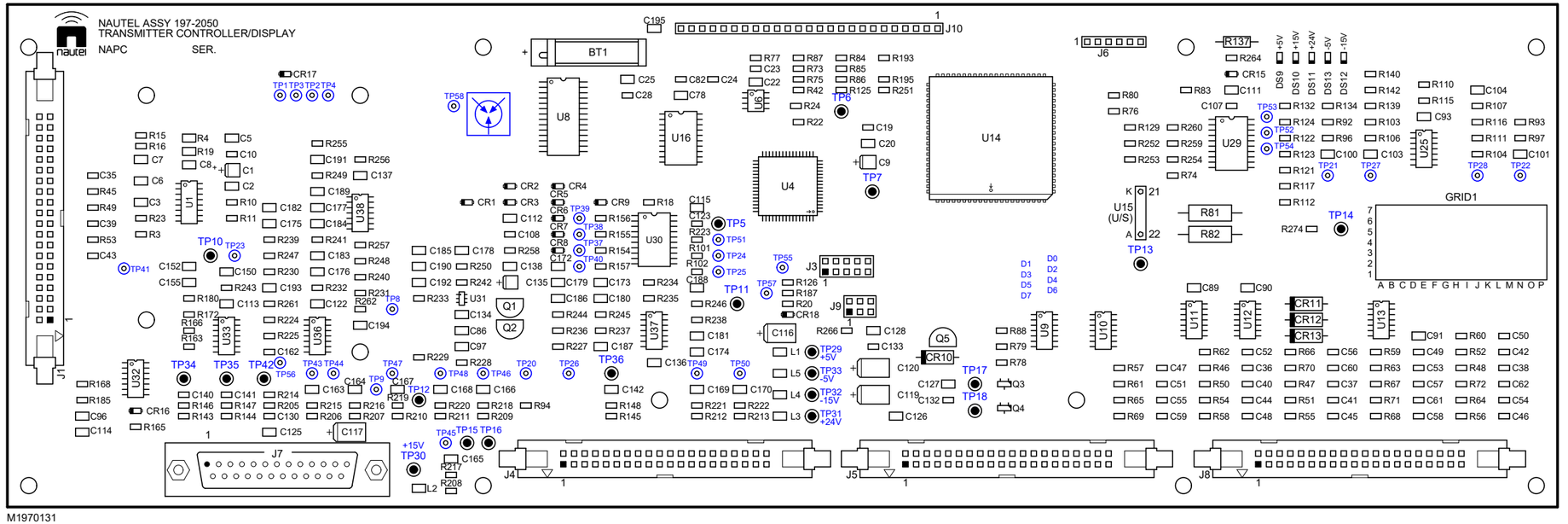
Assembly Detail/Dimensional Information - J1000 AM Broadcast Transmitter			
Issue 7.0	Not to Scale	Figure MD-1	Sheet 1 of 1



Dimensions = mm (inches)

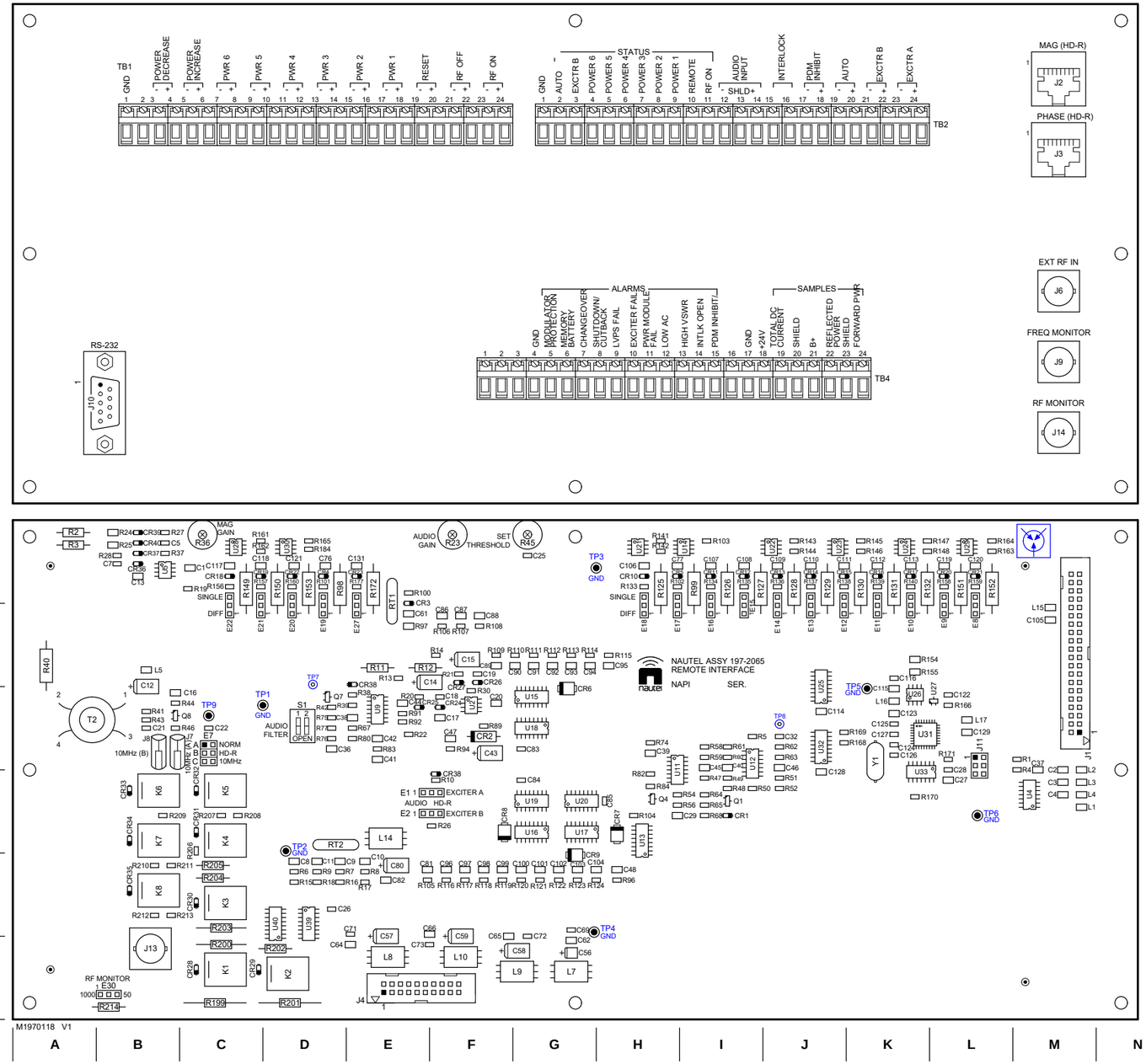
Assembly Detail - NAE88A/01C Exciter/Control Assembly			
Issue 7.0	Not to Scale	Figure MD-2	Sheet 1 of 1





M1970131

Assembly Detail – NAPC143B/01 Controller/Display PWB			
Issue 7.0	Not to Scale	Figure MD-3	Sheet 1 of 1

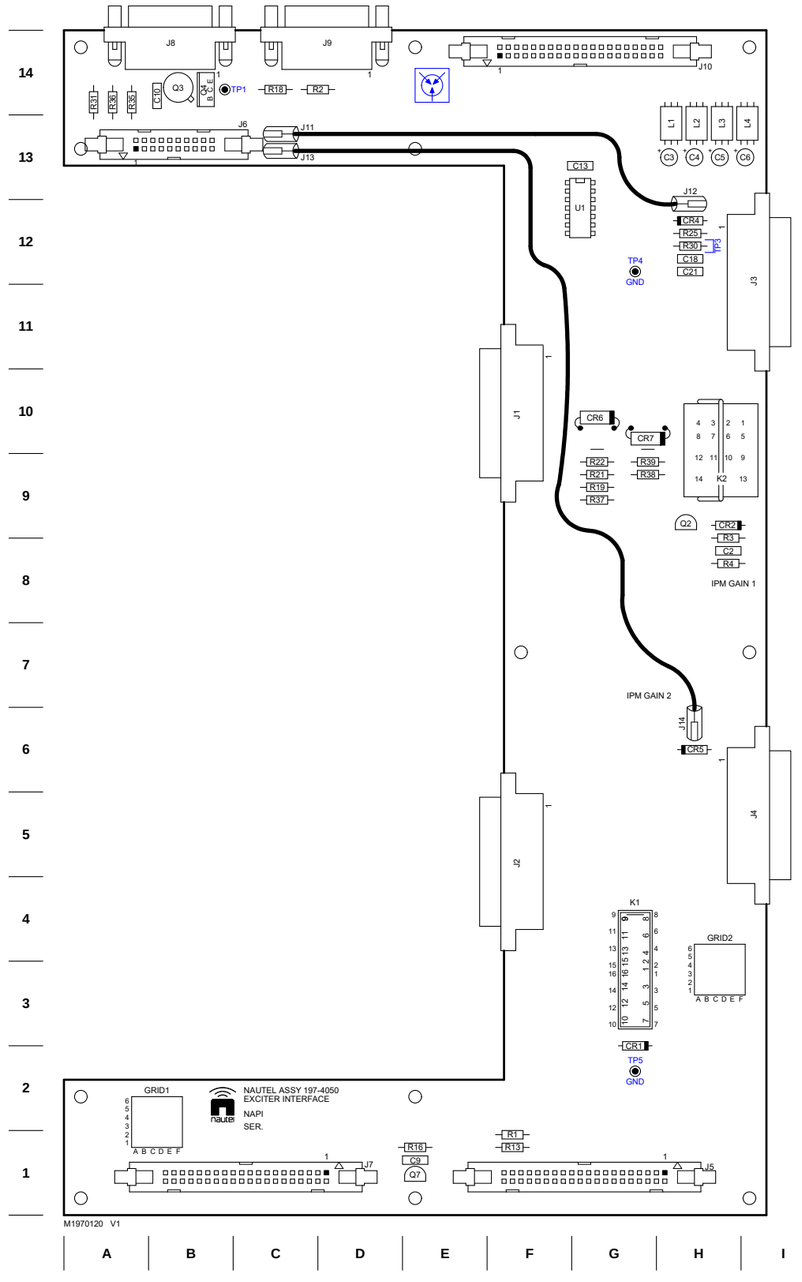


REAR SIDE

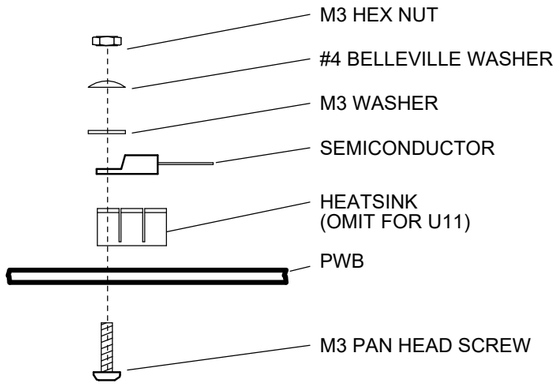
FRONT SIDE

M1970118 V1

Assembly Detail – NAPI85/01A Remote Interface PWB			
Issue 7.0	Not to Scale	Figure MD-4	Sheet 1 of 1

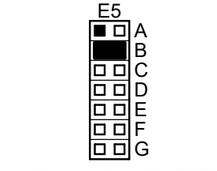


Assembly Detail – NAPI87A/01 Exciter Interface PWB			
Issue 7.0	Not to Scale	Figure MD-5	Sheet 1 of 1

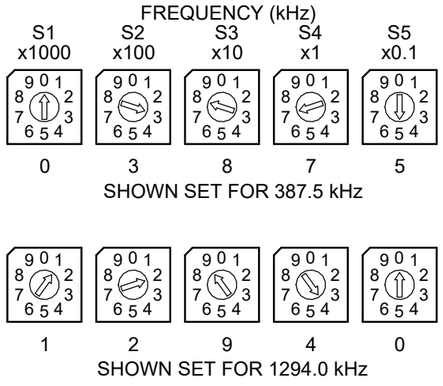


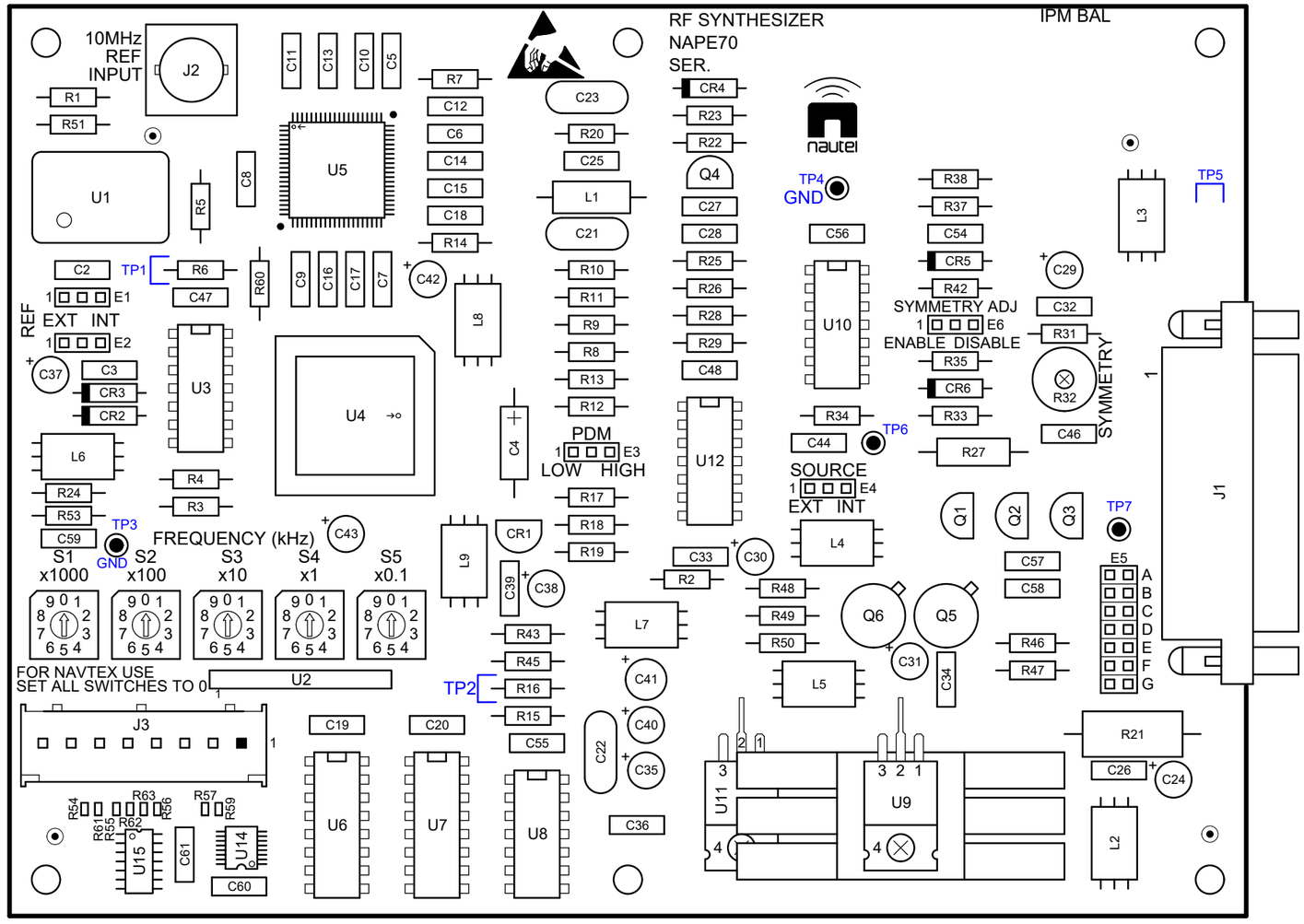
U9 & U11 MOUNTING DETAIL

TORQUE ATACHING HARDWARE TO
4.0 INCH POUNDS (0.45 NEWTON METERS)



SHOWN CONNECTED
IN 'B' POSITION

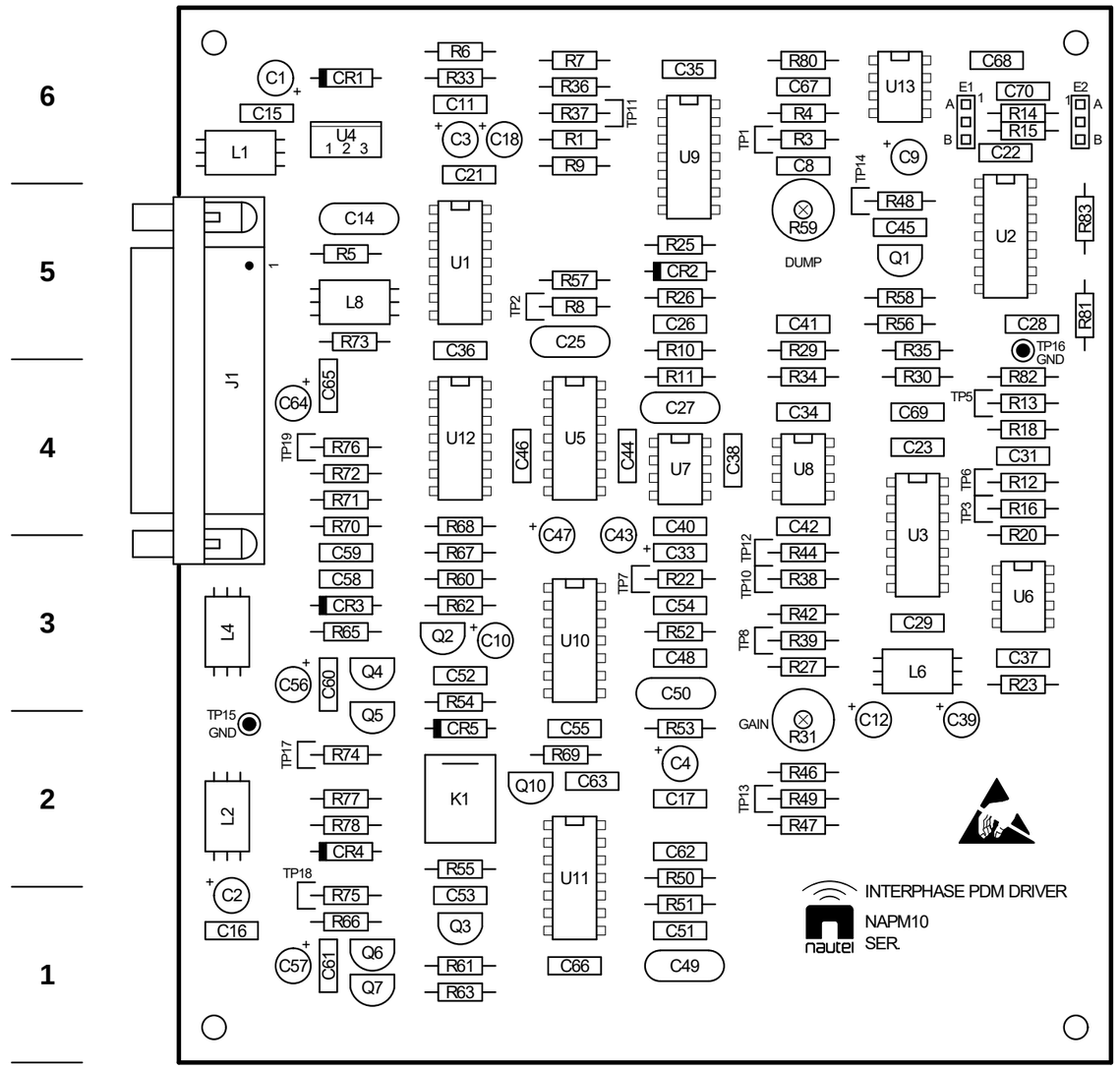




M1940211 V1

Dimensions = mm (inches)

Assembly Detail – NAPE70F/01 RF Synthesizer PWB			
Issue 7.0	Not to Scale	Figure MD-6	Sheet 1 of 1

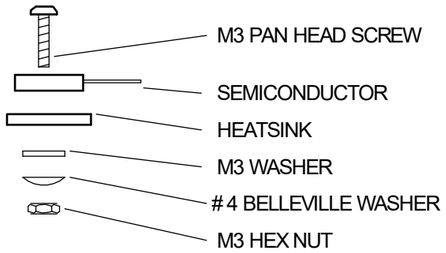


M1970092 V2

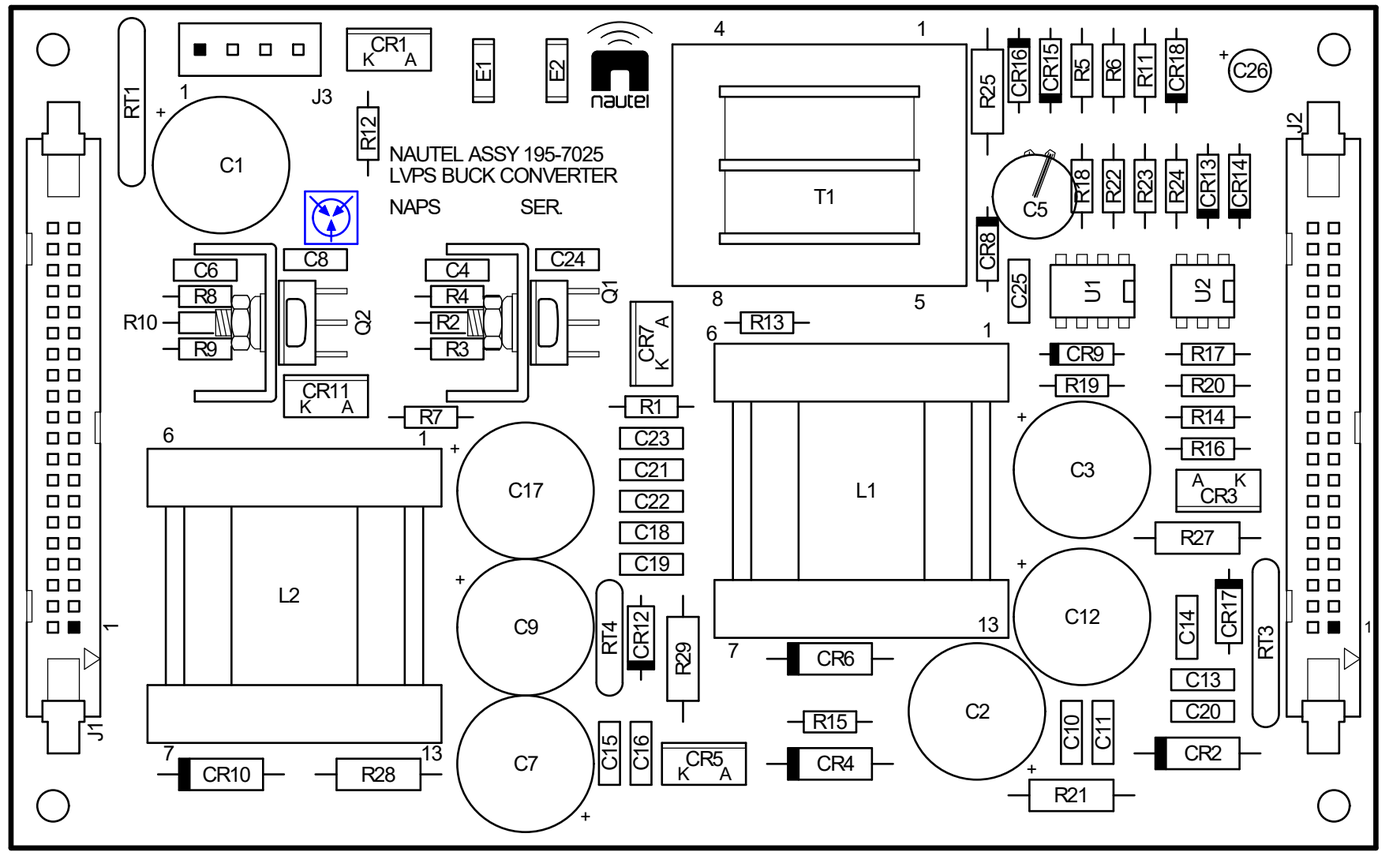
Dimensions = mm (inches)

Assembly Detail – NAPM10B Interphase PDM Driver PWB			
Issue 7.0	Not to Scale	Figure MD-7	Sheet 1 of 1

nautel

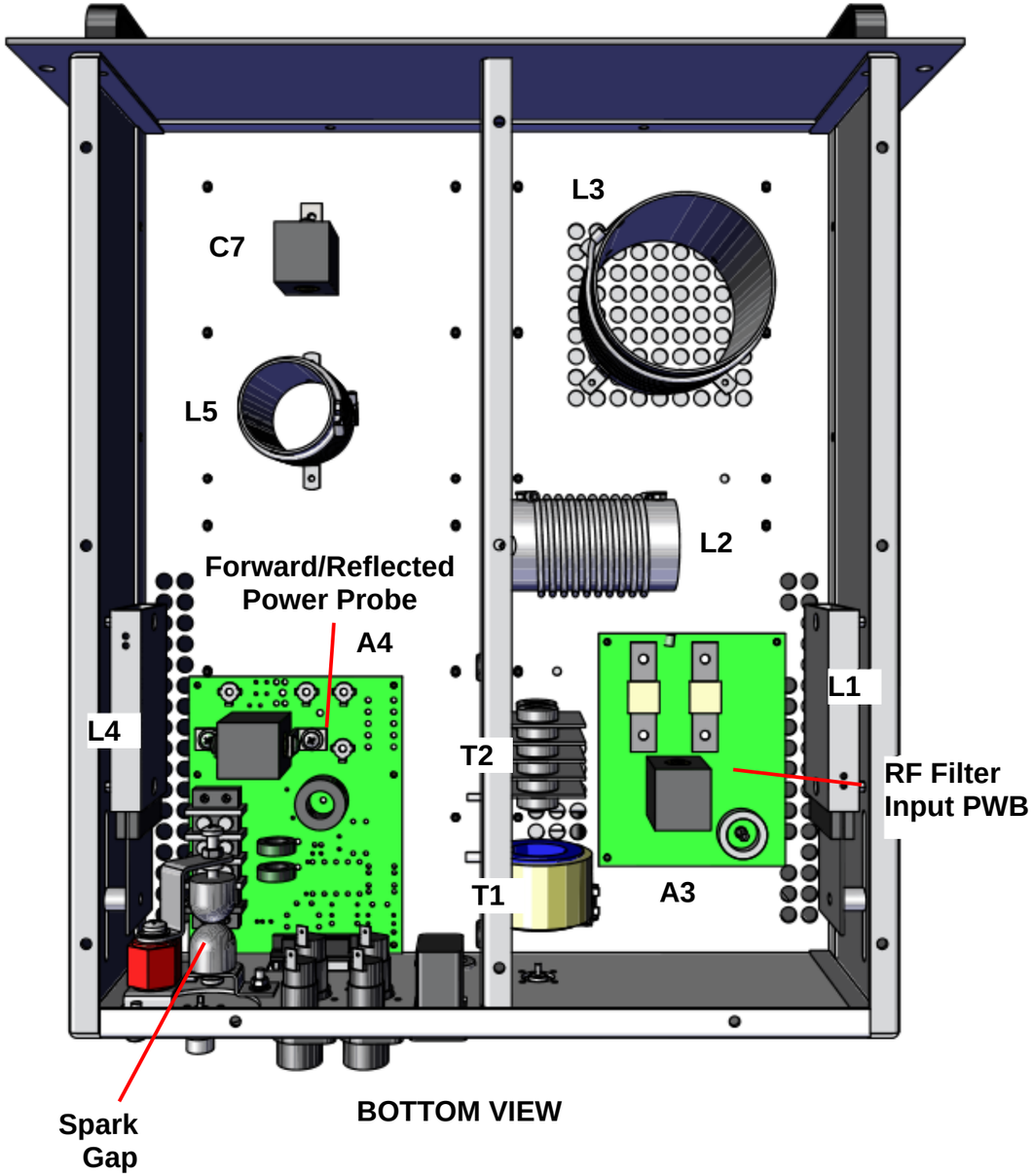


Q1 & Q2 MOUNTING DETAIL
TORQUE ATTACHING HARDWARE TO
4.0 INCH POUNDS (0.45 NEWTON METRES)

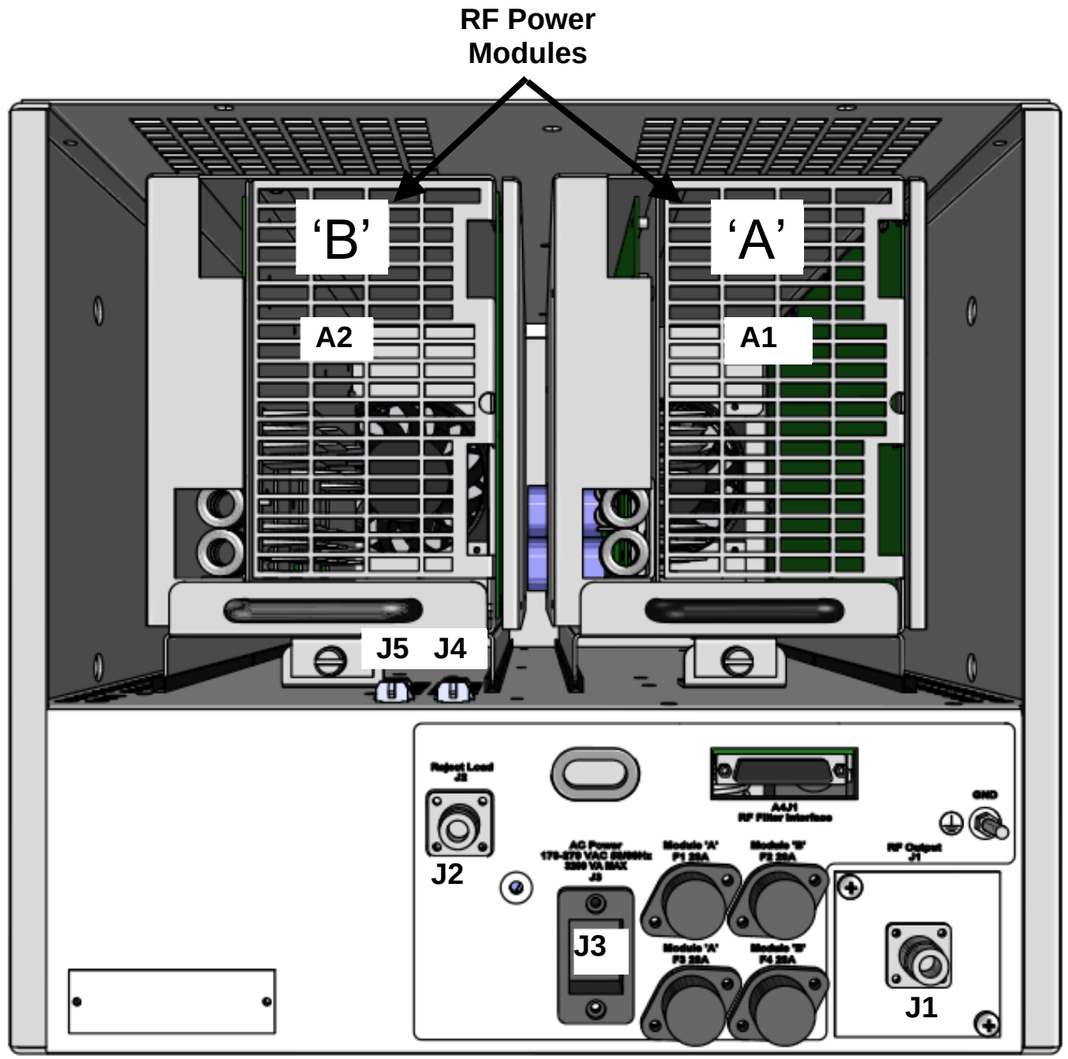


Dimensions = mm (inches)

Assembly Detail – NAPS32A/02 LVPS Buck Converter PWB			
Issue 7.0	Not to Scale	Figure MD-8	Sheet 1 of 1



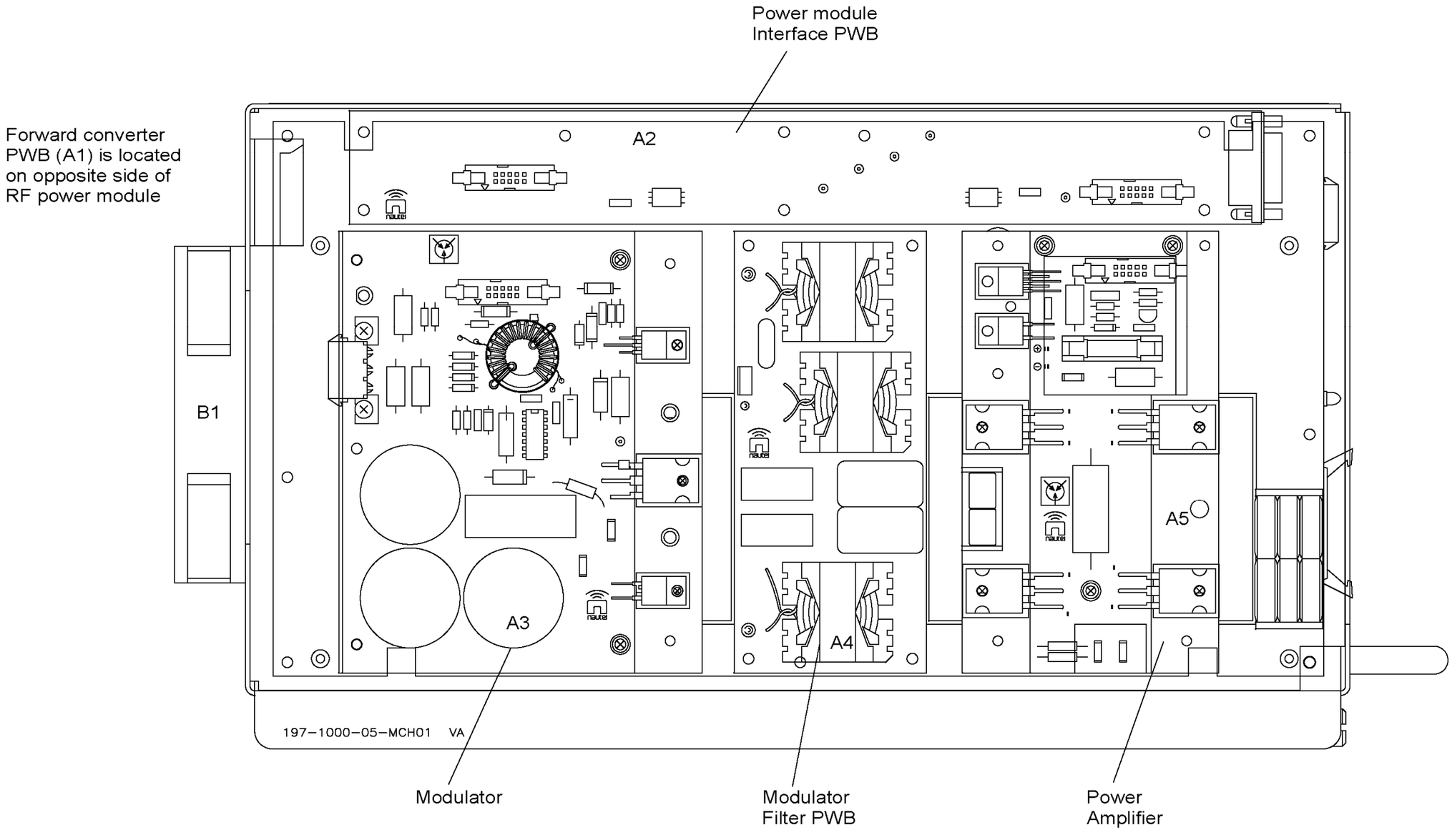
BOTTOM VIEW



REAR VIEW

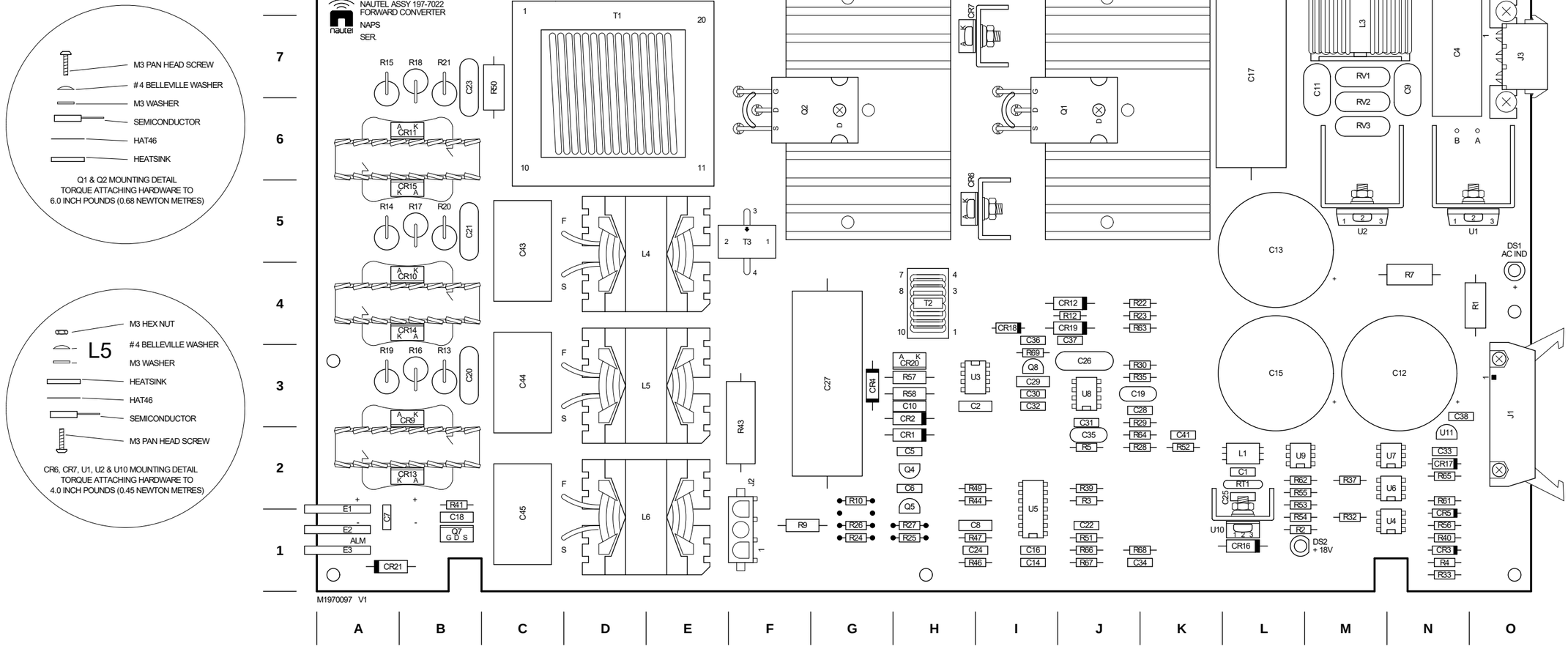
Dimensions = mm (inches)

Assembly Detail – NARA39A/01E RF Power Assembly			
Issue 7.0	Not to Scale	Figure MD-9	Sheet 1 of 1



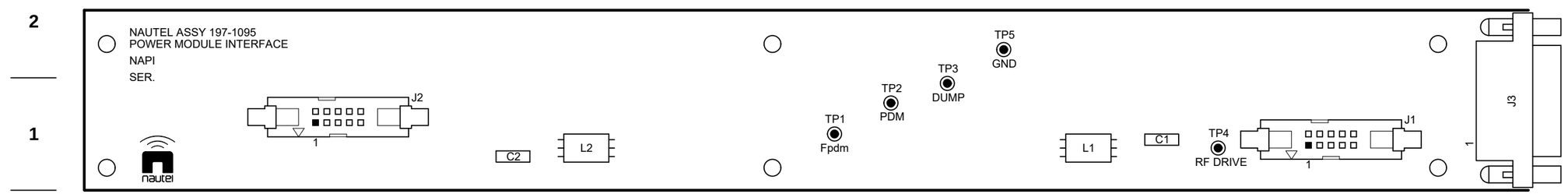
Dimensions = mm (inches)

Assembly Detail – NAP31/02B RF Power Module			
Issue 7.0	Not to Scale	Figure MD-10	Sheet 1 of 1



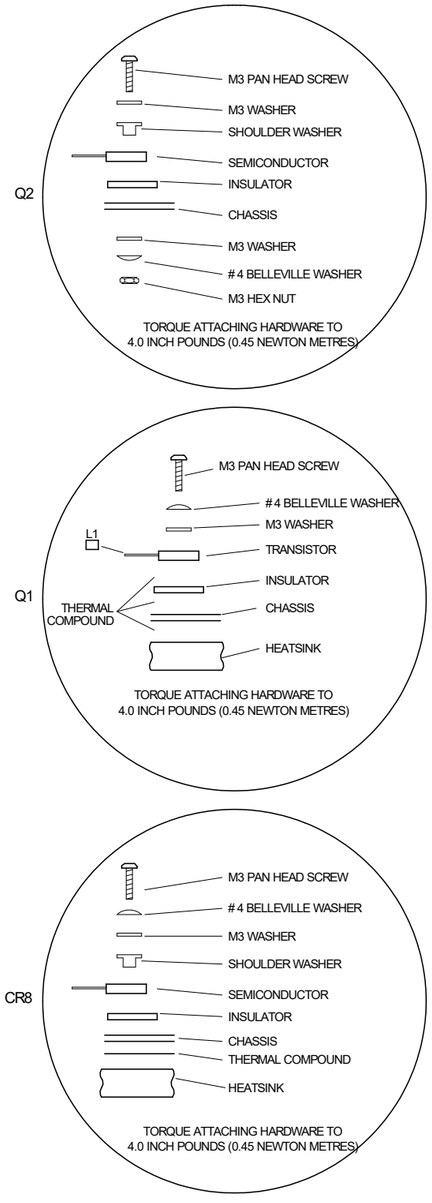
Dimensions = mm (inches)

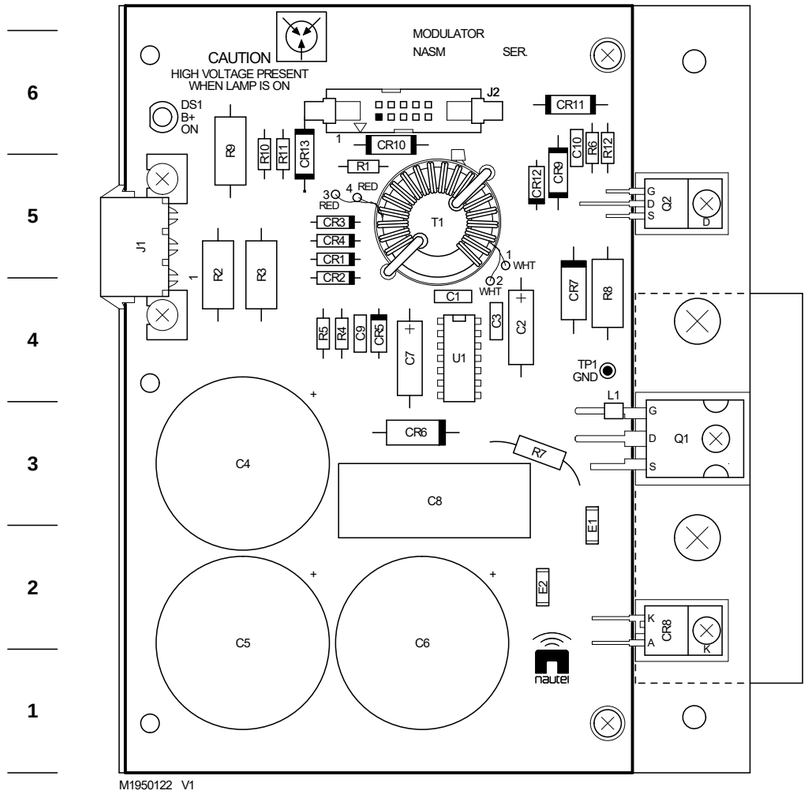
Assembly Detail – NAPS31B/04 Forward Converter PWB			
Issue 7.0	Not to Scale	Figure MD-11	Sheet 1 of 1

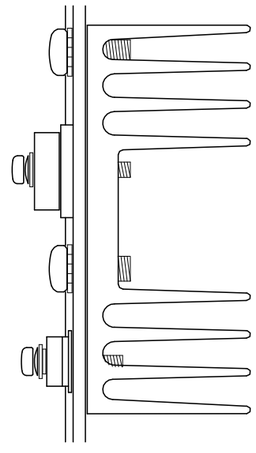


Dimensions = mm (inches)

Assembly Detail – NAPI73 Power Module Interface PWB			
Issue 7.0	Not to Scale	Figure MD-12	Sheet 1 of 1

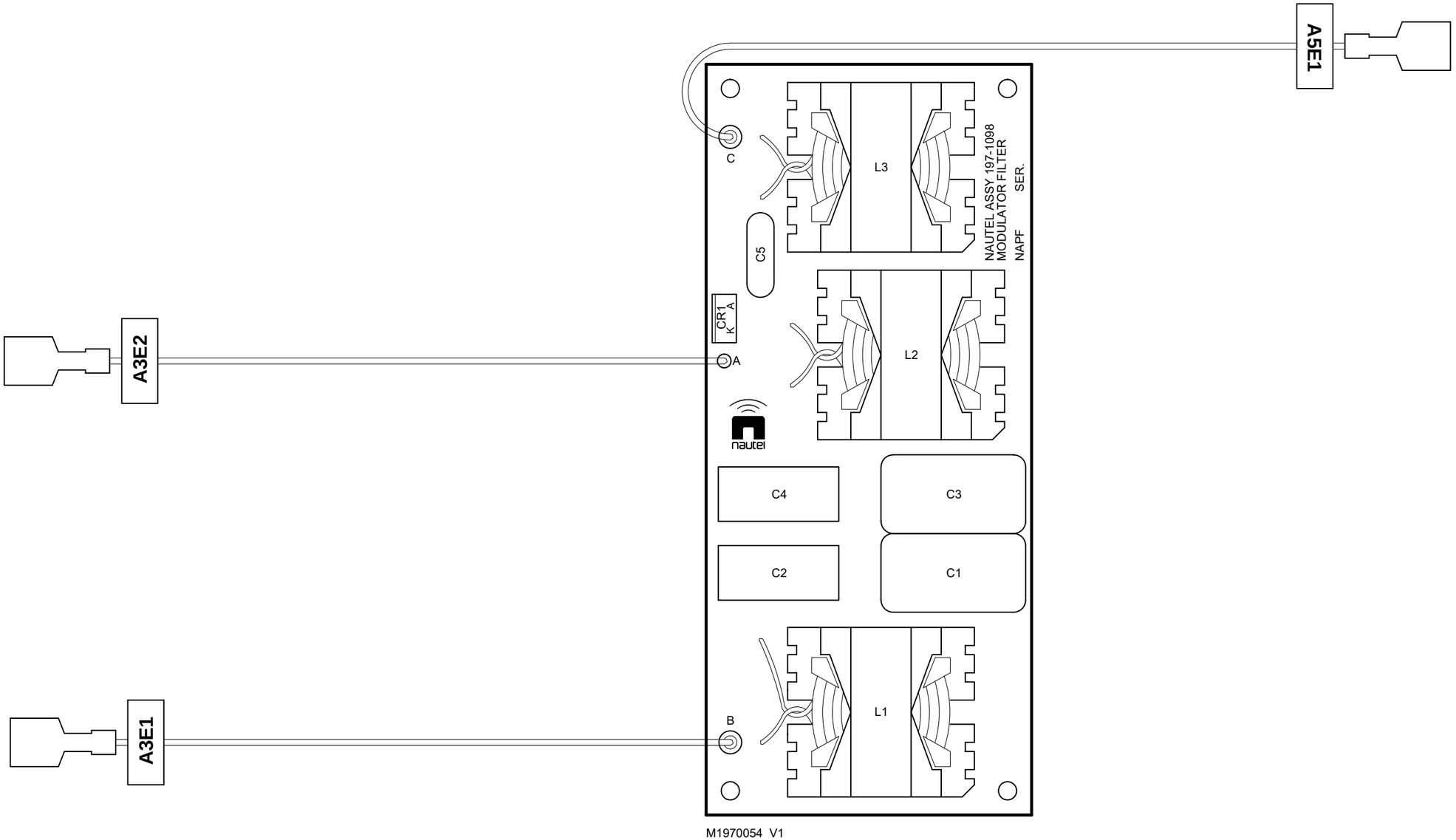






Dimensions = mm (inches)

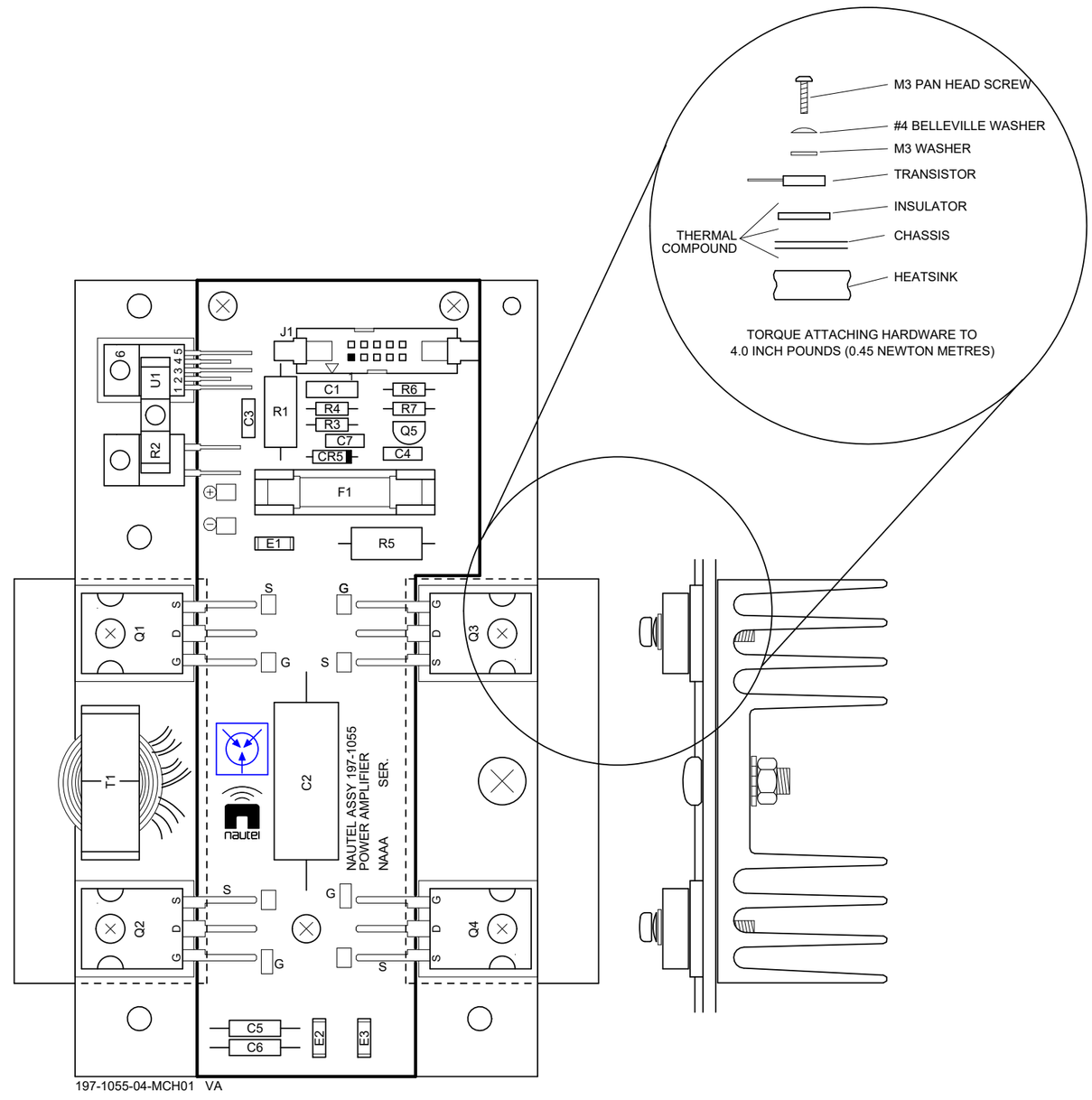
Assembly Detail – NASM11A/02 Modulator			
Issue 7.0	Not to Scale	Figure MD-13	Sheet 1 of 1



M1970054 V1

Dimensions = mm (inches)

Assembly Detail – NAPF08 Modulator Filter PWB			
Issue 7.0	Not to Scale	Figure MD-14	Sheet 1 of 1

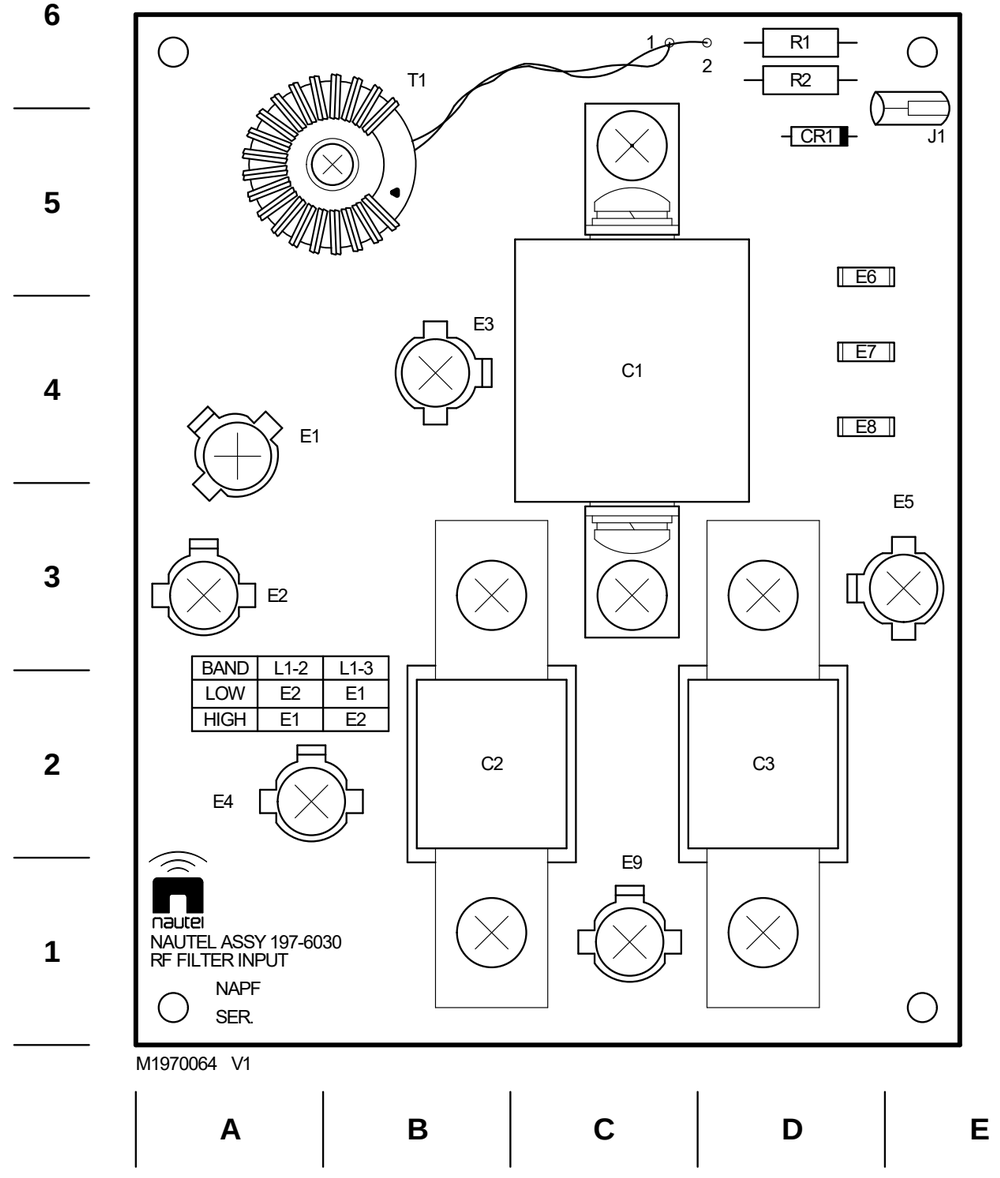


TRANSFORMER T1 CONNECTIONS. TWIST GROUPED WIRES TOGETHER

ORANGE	+ PAD NEAR R2
YELLOW	+ PAD NEAR R2
ORANGE/BLACK	- PAD NEAR R2
YELLOW/BLACK	- PAD NEAR R2
BROWN	Q1-GATE
BROWN/BLACK	Q1-SOURCE
RED	Q2-SOURCE
RED/BLACK	Q2-GATE
GREEN	Q3-SOURCE
GREEN/BLACK	Q3-GATE
BLUE	Q4-GATE
BLUE/BLACK	Q4-SOURCE

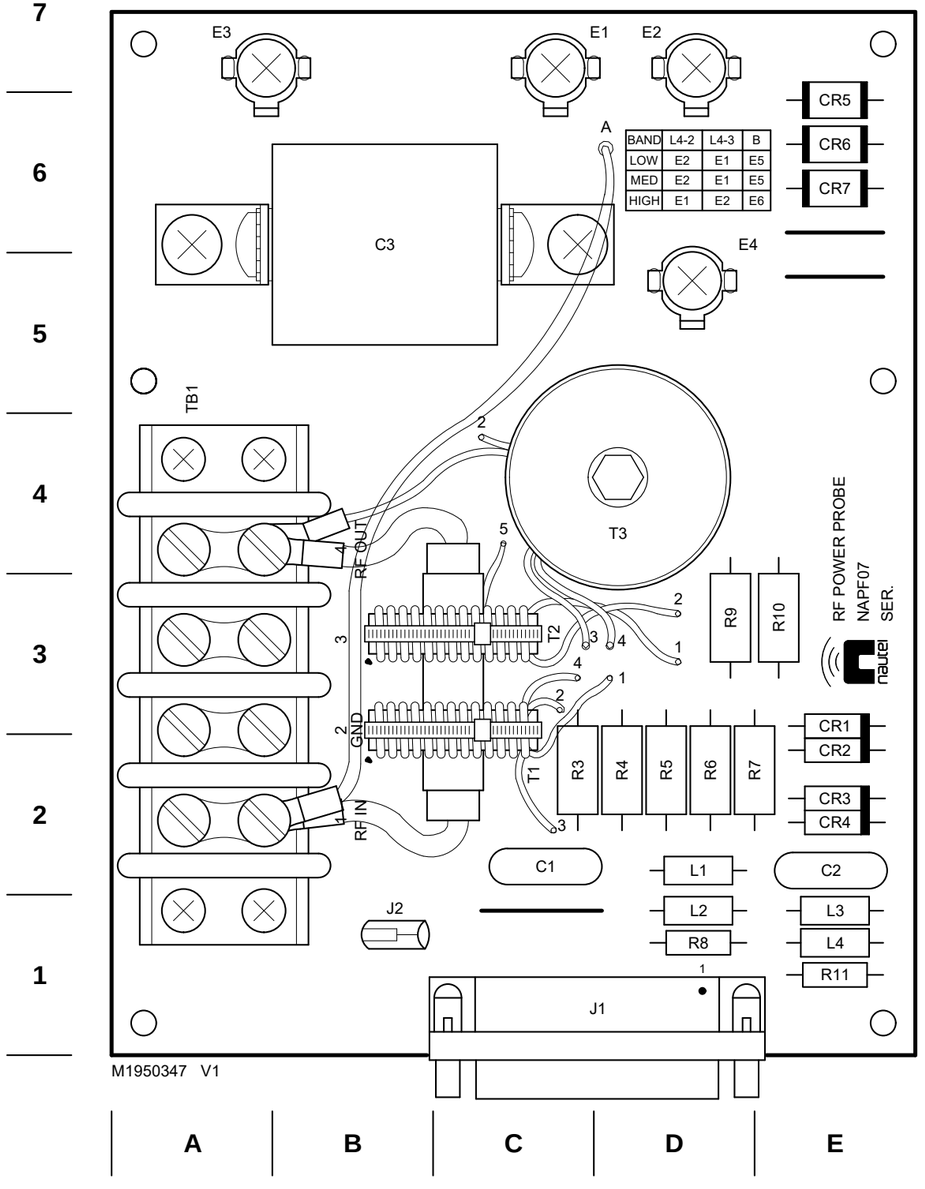
Dimensions = mm (inches)

Assembly Detail – NAAA05/02A Power Amplifier			
Issue 7.0	Not to Scale	Figure MD-15	Sheet 1 of 1



Dimensions = mm (inches)

Assembly Detail – NAPF03A/01 RF Filter Input PWB			
Issue 7.0	Not to Scale	Figure MD-16	Sheet 1 of 1



Dimensions = mm (inches)

Assembly Detail – NAPF07C/03 Forward/Reflected Power Probe			
Issue 7.0	Not to Scale	Figure MD-17	Sheet 1 of 1