# VS2.5 Transmitter

# Troubleshooting Manual

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The comparisons and other information provided in this document have been prepared in good faith based on publicly available information. The reader is encouraged to consult the respective manufacturer's most recent published data for verification.

# Contents

# Release control record

| Issue | Date | Reason |
|---|---|---|
| 11.0 | 2019-05-10 | Supports hardware NARF66I/04 and NARF66I/05.<br>Supports software version VS SW 5.2 and higher. |

# Section 1: Responding to alarms

This section provides instructions you need when performing troubleshooting on the VS2.5 transmitter. This section includes the following topics:



If none of the procedures and alarms described in this section address your problem, contact Nautel for assistance. See "Technical support" on page ix.

## Corrective maintenance

Corrective maintenance procedures consist of identifying and correcting defects or deficiencies that arise during transmitter operation. Local and/or remote alarm signals are generated when a malfunction occurs. If an alarm condition is caused by a malfunction in the RF power stage, the transmitter may maintain operation at a reduced RF output level. The nature of the fault – and station policy – will dictate whether an immediate maintenance response is necessary. Fault analysis and rectification may be conducted from three different levels, with a different technical competence level required for each: on-air troubleshooting, remote or local, and off-air troubleshooting.

CAUTION:
The transmitter contains many solid state devices that may be damaged if subjected to excessive heat or high voltage transients. Every effort must be taken to ensure that circuits are not overdriven or disconnected from their loads while turned on.

## On-air troubleshooting

On-air troubleshooting can be performed from a remote location, or locally at the transmitter site.

### Remote troubleshooting

Remote on-air troubleshooting consists of monitoring the transmitter's radiated signal using an on-air monitor or via a LAN connection, and observing the status of each remote fault alarm indicator. Information obtained from these sources should enable an operator to decide whether an alarm response may be deferred to a more convenient time, an immediate corrective action must be taken, or if a standby transmitter must be enabled (if one is available). It is recommended that the significance of remote indications, and the appropriate responses, be incorporated into a station's standard operating procedures. Refer to "Identifying and troubleshooting an alarm" on page 1-4 to determine the remedial action for a given fault.

### Local troubleshooting

Local on-air troubleshooting consists of monitoring the transmitter's integral meters and fault alarm indicators. Analysis of this data will normally identify the type of fault, and in most cases will determine what corrective action must be taken. Refer to "Identifying and troubleshooting an alarm" on page 1-4 to determine the remedial action for a given fault.

The power amplifier stage contains an integral modular reserve (IMR) feature. This feature permits the transmitter to operate at a reduced RF output level when a malfunction occurs in one of its power modules. Station operating procedures will dictate whether a reduced RF output level is acceptable. When a reduced RF output level can be tolerated, replacement of the defective RF components may be deferred to a convenient time.

## Off-air troubleshooting

Off-air troubleshooting must be performed when routine on-air calibration adjustments will not restore operation.

It is recommended that the transmitter's output be connected to a precision 50 Ω resistive dummy load (rated for at least the maximum transmitter power rating of 2500 W) before starting off-air troubleshooting procedures. If an appropriate dummy load is not available, troubleshooting for a majority of faults can be performed with the RF power stage turned off. The transmitter may remain connected to its antenna system for these procedures.

CAUTION:
Reduce the RF output level to a minimal value when troubleshooting faults in the transmitter. This is particularly important when the transmitter's cover is removed - where possible overheating could occur - or when the transmitter is connected to the antenna system.

# Electrostatic protection

The transmitter's assemblies contain semiconductor devices that are susceptible to damage from electrostatic discharge. The following precautions must be observed when handling an assembly which contains these devices.

CAUTION:
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. Semiconductor devices such as integrated circuits, field-effect transistors, thyristors and Schottky diodes may be damaged by this high voltage unless adequate precautions are taken.

## Electrical discharging of personnel

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

## Handling/Storage

An assembly should be placed in an anti-static bag when it is not installed in a host transmitter, or when it is not undergoing maintenance. Electronic components should be stored in anti-static materials.

## Tools/Test equipment

Testing and maintenance equipment – including soldering and unsoldering tools – should be suitable (i.e., grounded tip) for contact with static sensitive semiconductor devices.

## Stress current protection

Every precaution should be taken to ensure the static sensitive semiconductor devices are protected from unnecessary stress current. This is achieved by ensuring that current is not flowing when an electrical connection is broken, and that voltages are not present on external control/monitoring circuits when they are connected.

# Identifying and troubleshooting an alarm

You can identify an alarm locally by viewing the front panel (see "Front panel alarm checks") or remotely by viewing the AUI's Transmitter Status page (see "AUI Transmitter status page checks" on page 1-7).

## Front panel alarm checks

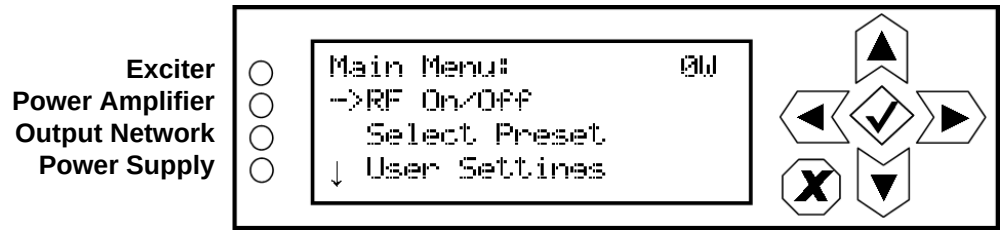
There two ways to check for alarms on the front panel:

- Alarm/status LEDs
- View alarms screen - see page 1-5

### Alarm/status LEDs

There are four LEDs on the left-hand side of the LCD display that provide information about the operational status of the transmitter - Exciter, Power Amplifier, Output Network and Power Supply (see Figure 1.1). The LEDs can glow green, amber or red. Typically, green indicates normal operation, amber indicates a warning, and red indicates a fault or error.

**Figure 1.1: Alarm/Status LEDs**




When an LED is:

- green - transmitter is on, with no known faults.
- amber - a fault is present that may cause a reduction in RF power, but the transmitter is still producing RF power.
- red - a fault is present and the transmitter is not producing RF power.

When a fault is present, the transmitter may still produce an RF output. In this case, or if the transmitter has shut down, you should schedule and commence more in-depth fault diagnosis. See "View alarms screen" on page 1-5.

### View alarms screen

If an alarm exists and is currently being recognized by the transmitter system, it is displayed in the View Alarms screen (Main Menu -> View Status -> View Alarms) of the front panel Display (see Figure 1.2).

**Figure 1.2: View Alarms Screen**

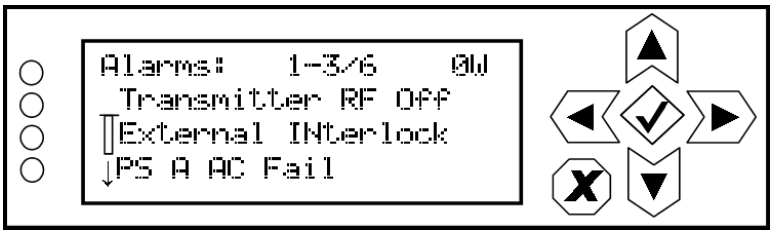



Table 1.1 on page 1-9 contains a column for most alarms that can occur, sorted alpha-numerically. The Description and Troubleshooting Action column provides a brief description of the alarm, troubleshooting tips and a cross-reference to more troubleshooting, if applicable.

1. Scroll through the View Alarms screen to view the active faults.

2. Attempt to clear any latching alarms by pressing the checkmark button in the Main Menu -> Reset Alarms screen. If the alarm persists, it will not clear from the display.

3. Locate the alarm name in Table 1.1 on page 1-9 to determine the cause of the alarm and perform any recommended procedures in the Description and Troubleshooting Action column. This may also lead to replacing a suspect PWB, power supply or fan, as detailed in "Replacing a suspect PWB, power supply or fan" on page 1-32.

*NOTE:*
*Before undertaking any troubleshooting, record all meter readings and note if any other alarms are displayed on the* View Alarms *screen. Record all alarms.*

*NOTE:*
*Table 1.1 on page 1-9 contains a column for most* **Alarms** *that can occur, sorted alphanumerically for each sub-system, including both the names displayed on the AUI and, if different, the front panel UI (in parentheses).*

*The* **Description and Troubleshooting Action** *column provides a description of the alarm, troubleshooting tips and a link to detailed troubleshooting, as applicable.*

4. Refer also to Table 1.2 on page 1-27 for *Summary* alarms that can occur - when properly configured - as remotely monitored outputs.

> *NOTE:*
> *Table 1.2 lists the Summary alarms that can be configured for remote monitoring through the front panel UI's Main Menu -> User Settings -> Remote I/O -> Remote Outputs screen (see the "Operating the Transmitter" section of the Operations & Maintenance Manual for configuration details). Each Summary alarm can be triggered by any one alarm in a specific sub-set, as shown in Table 1.2. The Description and Trigger Alarms column of Table 1.2 provides a brief description of the summary alarm and a list of the triggering alarms. To determine the root cause(s) of a Summary Alarm, check the front panel UI for an offending trigger alarm and refer to its troubleshooting information in Table 1.1 on page 1-9 for more details.*

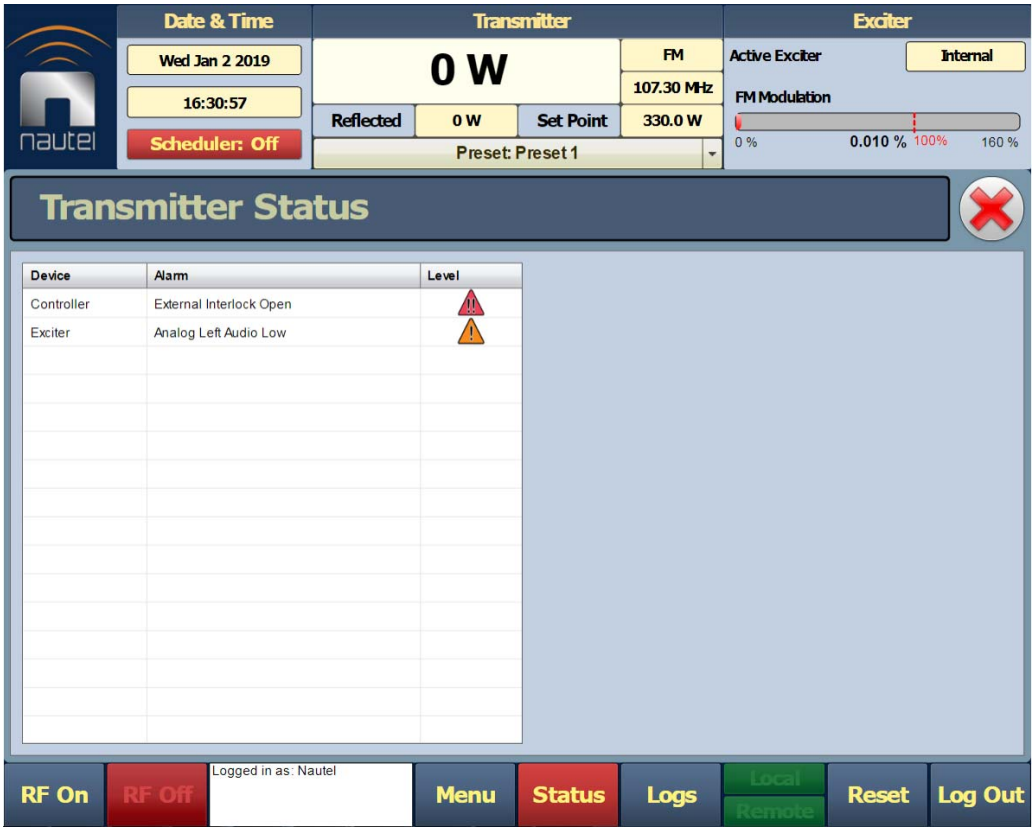
5. If troubleshooting and subsequent replacement of a suspect PWB or module causes the alarm to disappear from the View Alarms screen, the alarm has been successfully cleared. If the fault condition does not clear, contact Nautel.

## AUI Transmitter status page checks

If an alarm exists and is being recognized by the transmitter (i.e., the Status button at the bottom of the AUI display will be red), it is displayed on the transmitter status page (see Figure 1.3). The Device name indicates the sub-system origin of the alarm. The sub-systems that can be displayed are:

- Controller: All alarms in this sub-system apply to the controller.
- Exciter: All alarms in this sub-system apply to the exciter.

**Figure 1.3: Transmitter Status Page**




1. Click the Status button to go to the Transmitter Status page (see Figure 1.3). View the list of active faults. Alarms are listed by their origin (Device column), then by name (Alarm column), and then by severity (Level column) [single orange ! indicates low severity (RF output not affected); single red ! indicates medium severity (RF output is reduced); two red ! indicates high severity (RF output is inhibited)].

2. Attempt to clear any latching alarms by pressing the Reset button on the bottom banner of the page. If the alarm persists, it will not be cleared from the display.

3. Locate the alarm name in Table 1.1 on page 1-9 to determine the cause of the alarm and perform any recommended procedures in the Description and Troubleshooting Action column. This may also lead to replacing a suspect PWB, power supply or fan, as detailed in "Replacing a suspect PWB, power supply or fan" on page 1-32.

*NOTE:*
*Before undertaking any troubleshooting, record all meter readings and note if any other alarms are displayed on the* View Alarms *page. Record all alarms. Use the remote AUI's Critical Parameters page (Menu -> User Settings) to Capture Meters and Capture Alarms, which copies meter readings and active alarms into a spreadsheet for future reference.*

*NOTE:*
*Table 1.1 on page 1-9 contains a column for most* **Alarms** *that can occur, sorted alphanumerically for each sub-system, including both the names displayed on the AUI and, if different, the front panel UI (in parentheses).*

*The* **Description and Troubleshooting Action** *column provides a description of the alarm, troubleshooting tips and a link to detailed troubleshooting, as applicable.*

4. Refer also to Table 1.2 on page 1-27 for *Summary* alarms that can occur - when properly configured - as remotely monitored outputs.

*NOTE:*
*Table 1.2 lists the Summary alarms that can be configured for remote monitoring through the remote AUI's Menu ->Remote I/O -> Remote Outputs page (see the "Operating the Transmitter" section of the Operations & Maintenance Manual for configuration details). Each Summary alarm can be triggered by any one alarm in a specific sub-set, as shown in Table 1.2. The Description and Trigger Alarms column of Table 1.2 provides a brief description of the summary alarm and a list of the triggering alarms. To determine the root cause(s) of a Summary Alarm, check the remote AUI for an offending trigger alarm and refer to its troubleshooting information in Table 1.1 on page 1-9 for more details.*

5. If troubleshooting and subsequent replacement of a suspect PWB or module causes the alarm to disappear from the Transmitter Status page, the alarm has been successfully cleared. If the fault condition does not clear, contact Nautel.

**Table 1.1: Troubleshooting Alarms**

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| +1.2V Supply Fail (+1.2V Fail) | PS (red) | This alarm occurs if the +1.2 V supply on the exciter/control PWB (A1) is outside of its acceptable voltage range (between +1.1 V and +1.3 V). The VS2.5 takes no action on this alarm. Check for a **+5V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP3 (+1.2 V) and TP4 (ground) of the exciter/control PWB. If the measured value is within the acceptable range, suspect the sampling circuitry on the exciter/control PWB (A1). If not, use a digital multimeter to measure between TP5 and TP4 (ground). The measured voltage should be between +4.5 V and +5.5 V. If the measured voltage is within the acceptable range, the power supply circuitry on the exciter/control PWB has failed. Replace the exciter/control PWB (see "Exciter/Control PWB Replacement" on page 1-46). If not, check ribbon cable W4 for damage, and verify connectors W4P1 and W4P2 are properly seated in A1J11 and A2J6 respectively. If there are no visible problems with the ribbon cable, contact Nautel for further support. |
| +1.8V Supply Fail (+1.8V Fail) | PS (red) | This alarm occurs if the +1.8 V supply on the exciter/control PWB (A1) is outside of its acceptable voltage range (between +1.6 V and +2.0 V). The VS2.5 takes no action on this alarm. Check for a **+3.3V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP2 and TP4 of the exciter/control PWB. If the measured value is within the acceptable range, suspect the sampling circuitry on the exciter/control PWB. If not, the power supply circuitry has failed on the exciter/control PWB. If necessary, replace the exciter/control PWB (see "Exciter/Control PWB Replacement" on page 1-46). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| +15V Supply Fail (+15V Fail) | PS (amber) | This alarm occurs if the +15 V supply from the PS distribution PWB (A2) is outside of its acceptable voltage range (between +13.5 V and +16.5 V). The VS2.5 takes no action on this alarm. Check for a **+48V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP1 (+15 V) and TP3 (ground) of the PS distribution PWB. If the measured value is not within the acceptable range, the power supply circuitry on the PS distribution PWB has likely failed. If the measured value is within the acceptable range, check ribbon cable W2 for damage and that connectors W2P1 and W2P2 are properly seated in A1J12 and A2J7 respectively. If there are no visible problems with the ribbon cable, suspect the sampling circuitry on the PS distribution PWB. If necessary, replace the PS distribution PWB (see "PS Distribution PWB Replacement" on page 1-49). If the alarm persists after replacing the PS distribution PWB, suspect the exciter/control PWB (A1). |
| -15V Supply Fail (-15V Fail) | PS (amber) | This alarm occurs if the -15 V supply on exciter/control PWB (A1) is outside of its acceptable voltage range (between -13.5 V and -16.5 V). The VS2.5 takes no action on this alarm. Check for a **+15V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP11 and TP7 (ground) of the exciter/control PWB. If the measured value is within the acceptable range, suspect the sampling circuitry on the exciter/control PWB. If not, use a digital multimeter to measure between TP23 and TP4 (ground). The measured voltage should be between +13.5 V and +16.5 V. If the measured voltage is within the acceptable range, the power supply circuitry on the exciter/control PWB has failed. Replace the exciter/control PWB (see "Exciter/Control PWB Replacement" on page 1-46). If not, check ribbon cable W4 for damage and that connectors W4P1 and W4P2 are properly seated in A1J11 and A2J6 respectively. If there are no visible problems with the ribbon cable, contact Nautel for further support. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| +3.3V Supply Fail (+3.3V Fail) | PS (red) | This alarm occurs if the +3.3 V supply on the exciter/control PWB (A1) is outside of its acceptable voltage range (between +3.0 V and +3.6 V). The VS2.5 takes no action on this alarm. Check for a **+5V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP1 (+3.3 V) and TP4 (ground) of the exciter/control PWB. If the measured value is within the acceptable range, suspect the sampling circuitry on the exciter/control PWB. If not, use a digital multimeter to measure between TP5 and TP4 (ground). The measured voltage should be between +4.5 V and +5.5 V. If the measured voltage is within the acceptable range, the power supply circuitry on the exciter/control PWB has failed. Replace the exciter/control PWB (see "Exciter/Control PWB Replacement" on page 1-46). If not, check ribbon cable W4 for damage and that connectors W4P1 and W4P2 are properly seated in A1J11 and A2J6 respectively. If there are no visible problems with the ribbon cable, contact Nautel for further support. |
| +5V Supply Fail (+5V Fail) | PS (red) | This alarm occurs if the +5V-B supply from the PS distribution PWB (A2) is outside of its acceptable voltage range (between +4.5 and +5.5 V). The VS2.5 takes no action on this alarm. Check for **+48V Supply Fail** alarm: If present, follow the associated troubleshooting procedure. If not present, use a digital multimeter to measure between TP20 (+5V-B) and TP28 (ground) of the PS distribution PWB. If the measured value is not within the acceptable range, the power supply circuitry on the PS distribution PWB has failed. If the measured value is within the acceptable range, check ribbon cable W2 for damage and that W2P1 and W2P2 are properly seated in A1J12 and A2J7 respectively. If there are no visible problems with the ribbon cable, suspect the sampling circuitry on the PS distribution PWB. Replace the PS distribution PWB (see "PS Distribution PWB Replacement" on page 1-49). If the alarm persists after replacing the PS distribution PWB, suspect the exciter/control PWB (A1). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| All Power Amplifiers Inactive (All PAs Inactive) | PA (red) | This alarm indicates that all of the PAs in the system or all of the power supply modules in the system have failed simultaneously; therefore PA failure alarms or power supply module related alarms should also be present. If there are power supply module related alarms present, or an **IPA Output Low** alarm, follow the associated troubleshooting procedure. If there are no power supply module related alarms, with RF turned on, use a digital multimeter to measure the voltage between pad V and pad W on any PA. If the voltage does not fall within an acceptable range (between 2.3 V and 3 V), suspect the exciter/control PWB (A1). If the voltage does fall in the acceptable range, perform the "PA resistance checks" on page 1-35. If there is no problem found with any of the PAs, or the alarm still persists after replacing all of the damaged PAs, suspect the PS distribution PWB (A2). |
| Analog Left Audio Low (Anlg Left Aud Low) | Exciter (amber) | This alarm indicates the analog left audio input level is too low or is not applied. The VS2.5 takes no action on this alarm. |
| Analog Right Audio Low (Anlg Right Aud Low) | Exciter (amber) | This alarm indicates the analog right audio input level is too low or is not applied. The VS2.5 takes no action on this alarm. |
| Audio Loss | Exciter (red) | This alarm, enabled by the user, indicates that the exciter's audio modulation level is below the level specified in the mod loss settings of the active preset [see page 2-72 (remote AUI) or "Mod Loss" on page 2-93 (front panel UI)] of the Operations and Maintenance Manuals to enable/disable this alarm and to configure the resulting action). Depending on the setting, this alarm could trigger a preset change, inhibit RF or have no effect (alarm only). Check the appropriate program input(s) and the mod loss setting for the preset. |
| Audio Processor Offline | Exciter (amber) | This alarm occurs if the exciter is configured to include an Orban Inside audio processor, but it is not communicating with the processor on the internal serial bus. Check all connections to the Orban Inside audio processor card. |
| Audio Processor Output Fail | Exciter (amber) | This alarm occurs if the exciter is configured to include an Orban Inside audio processor, but it is not detecting audio from the processor. Check all connections to the Orban Inside audio processor card. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Audio Shutdown | Exciter (red) | This alarm occurs if the exciter's audio processing and FM modulation code is shut down. Should display only during a software upgrade. |
| Composite Audio Low (MPX Aud Low) | Exciter (amber) | This alarm indicates the composite audio input level is too low. The VS2.5 takes no action on this alarm. |
| CPLD Version Mismatch (CPLD Ver Mismatch) | Exciter (red) | This alarm indicates that the CPLD version installed on the transmitter does not match the version expected to be seen by the version of code installed on the DSP. The VS2.5 will not be able to turn RF on. Contact Nautel for further assistance. |
| Cutback Active | Output Network (amber) | This alarm occurs whenever the transmitter experiences a cutback. A cutback (reduction in power) occurs when repeated shutback alarms occur within a prescribed time period. Shutbacks occur when the transmitter's peak reflected power exceeds 2:1 due to a transient SWR condition (arc or lightning) within the output transmission line or antenna system. The transmitter shuts back and recovers to a series of cutback levels (depending on the severity of the alarm), with each level being a 1/8th reduction in power from the previous cutback level, starting from the preset setpoint. Inspect the output transmission line for punctures or damage. After repairing damage, or if no damage is found, attempt to reset the latched condition [using the remote AUI's **Reset** button (see "Reset:" on page 2-18 of the Operations and Maintenance Manual) or using the local front panel display (see "Resetting Alarms" on page 2-96 of the Operations and Maintenance Manual)]. If no damage can be found, suspect a fault with the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50). |
| Digital Audio Low (Digital 1 Aud Low) | Exciter (amber) | This alarm indicates the corresponding digital input level is too low and is typically accompanied by a SRC1 Unlock alarm (see its description and troubleshooting action). If no accompanying SRC alarm exists, suspect a problem with the external audio processor or studio feed. The VS2.5 takes no action on this alarm. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Discharging PA Volts (Discharging PA V) | PS (red) | This alarm occurs when the transmitter has initiated a shutback sequence, and residual PA voltage energy stored in the capacitors in the power supplies and PAs is being discharged. During a shutback sequence, the RF drive to the PAs is turned off immediately after the event, and this occurs faster than the power supply modules can be inhibited. Therefore, PA voltage is still being applied to the capacitors with no drive to discharge the energy. To discharge the stored energy from the capacitors, the PA bias is increased to a discharge level after the power supplies have been inhibited. This causes the stored energy to be dissipated through dc current in the FET. This alarm should only occur with a **Residual PA Volts Present** alarm. See **Residual PA Volts Present** alarm for more information. |
| Entered Firmware Upgrade (Exc Firmware Upgr) | Exciter (red) | This alarm occurs when the exciter is in “firmware upgrade” mode. It should only be displayed during a transmitter software upgrade. |
| Exciter Offline | Exciter (red) | For use with VS-HD exciter only. This alarm occurs if the serial communication fails between the controller and the exciter, or a problem has occurred with the exciter. Check all connections to the exciter and make sure that its controller front panel power LED is on. |
| External Interlock Open (External Interlock) | Exciter (red) | This alarm occurs when the external interlock input wired to the exciter/control PWB (A1) is open. The VS2.5 will not be able to enable its RF output. Check the interlock connection between A1J2A-19 and A1J2A-20 on the rear of the transmitter. If the interlock connection is intact, check that all external interlock switches are closed. If no problem is found with the connection at the transmitter or any of the external interlock switches, suspect a problem with the interlock circuitry on the exciter/control PWB (A1). |
| External Mute (Ext Mute) | Exciter (red) | For use with VS-HD exciter only. This alarm occurs if the exciter has been muted (0W) by the transmitter. This is typical when the transmitter is in an “RF Off” condition, or any other condition that causes the RF drive to be inhibited (external interlock open, etc.). If this alarm persists and there are no other inhibiting alarms present, check the connections between the VSHD exciter and the VS transmitter, verify the preset settings and verify IBOC settings. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Fan 1 - 7 Fail | Output Network (amber) | This alarm occurs if the speed of one of the transmitter's cooling fans is below 3000 RPM (half of its nominal value of 6000 RPM). If any of fans 3 through 7 fail, the VS2.5 will reduce its maximum power setting based on the number of fan failures that have occurred (see Table 1.3 on page 1-31). If either fan 1 or 2 fail, the VS2.5 takes no action (no effect on the RF output). If the alarm occurs for fans 1 or 2, check the connection between the indicated fan and the PS distribution PWB (A2). If the alarm occurs for fans 3, 4, 5, 6 or 7, check the connection between the indicated fan and the splitter PWB (A4). If these connections look OK, replace the indicated fan (see "Cooling fan replacement - fans 3 (B3) through 7 (B7)" on page 1-42). If the alarm still occurs after the fan has been replaced, suspect the PS distribution PWB for fans 1 or 2 and suspect the exciter/control PWB (A1) for fans 3 through 7. |
| Forward Power Limiting (Fwd Power Limiting) | Output Network (amber) | When the **High Forward Power** alarm is active, the **Forward Power Limiting** alarm occurs if its associated threshold is exceeded (1.063 times the maximum power setting; 2976 W). The transmitter will fold back the forward power each time the threshold is exceeded. This alarm occurs only if the exciter ALC cannot respond fast enough to transmitter load changes. Inspect the antenna network attached to the transmitter. If there are no major issues with the antenna network that would cause an impedance change (icing for example) suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50) |
| Forward Power Low (Fwd Power Low) | Output Network (amber) | This alarm occurs if the transmitter's average forward power falls below the low forward power threshold (defaulted to 50% of the preset power level and is user adjustable) due to PA failures, fan failures, SWR foldback or a pre-amp/IPA failure. The VS2.5 takes no action on this alarm. Check for associated alarms, and follow the associated troubleshooting procedure if present. If no other alarms are being indicated, with RF turned on, use a digital multimeter to measure the voltage between pad V and pad W on any PA. If the voltage does not fall within an acceptable range (between 2.3 V and 3 V), suspect the exciter/control PWB (A1). If the voltage is within this range, suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Forward Power Shutdown (Fwd Power Shutdown) | Output Network (red) | This alarm occurs if the transmitter tries to reduce the forward power below minimum (64 W) due to repeated **Forward Power Limiting** alarms. The transmitter latches off. See **Forward Power Limiting** for troubleshooting tips. |
| Forward Power Very Low (Fwd Power Very Low) | Output Network (amber) | This alarm occurs if the transmitter's average forward power falls below the very low forward power threshold (defaulted to 12.5% of the preset power level and is user adjustable) due to PA failures, fan failures, or SWR foldback. The VS2.5 takes no action on this alarm. See **Forward Power Low** for troubleshooting tips. |
| High Forward Power (High Fwd Power) | Output Network (amber) | This alarm occurs if the transmitter's average forward power exceeds the high forward power threshold (1.036 times the maximum power setting; 2901 W). This alarm occurs only if the exciter ALC cannot respond fast enough to transmitter load changes. The VS2.5 takes no action on this alarm. Check for associated alarms and follow the associated troubleshooting procedure, if present. If no other alarms exist, inspect the antenna network attached to the transmitter. If there are no major issues with the antenna network that would cause an impedance change (icing for example) suspect the combiner interface PWB (A12) (see “Combiner Interface PWB Replacement” on page 1-50). |
| High Reject Power | Output Network (amber) | This alarm occurs if the control system determines that the calculated power in any reject resistor exceeds the high reject power threshold (320 W). The VS2.5 takes no action on this alarm. Check for associated alarms, and follow the associated troubleshooting procedure if present. Typically, high reject power is the result of a PA failure or removal. If no other alarms are being indicated, contact Nautel for further support. |
| High Reflected Power | Output Network (amber) | This alarm occurs if the transmitter's average reflected power exceeds the high SWR threshold (72 W). The VS2.5 takes no action on this alarm. Inspect the antenna and transmission line system for damage or de-tuning. If there are no major issues with the antenna network that would cause an impedance change (icing for example), suspect the combiner interface PWB (A12) (see “Combiner Interface PWB Replacement” on page 1-50). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| High SWR Shutdown | Output Network (red) | This alarm occurs if the transmitter tries to reduce the forward power below a level that is equivalent to a 3:1 VSWR (forward power of 412 W) at the SWR Foldback threshold (reflected power of 103 W) due to a gradually degrading load match. This alarm causes the transmitter to latch off. Inspect the antenna and transmission line system for damage or de-tuning. If there are no major issues with the antenna network that would cause an impedance change (icing for example), suspect the combiner interface PWB (A12) (see “Combiner Interface PWB Replacement” on page 1-50). |
| Host Network Down | Exciter (amber) | This alarm indicates that the microcontroller that runs the remote interfacing applications is unable to acquire an IP address. When this alarm is present, the communication between the LAN controller (server) and the transmitter server that was once established has now been lost. It will not be possible to access any of the remote AUI functionality. Check that the Ethernet cable is properly connected to A1J8A (LAN) on the rear of the transmitter. If the alarm is still present see “Network Setup” on page 2-127 of the Operations and Maintenance Manual for information on setting up the network connection. Disable the alarm by setting DHCP to OFF and setting the IP Address to all zeroes (i.e. 0.0.0.0). |
| Host Not Booted | Exciter (amber) | This alarm indicates that the controller’s host has not finished booting. The remote AUI will not yet be available. Occurrence of this alarm is normal for approximately one to five minutes while the host is booting, immediately after ac power has been applied/ restored or after a software upgrade. If this alarm continues to occur more than 30 minutes after ac power has been applied to the transmitter, cycle (turn off, then on) the ac power. If the alarm persists after 30 minutes, replace the exciter/control PWB (A1) (see “Exciter/Control PWB Replacement” on page 1-46). |
| Host Not Responding | Exciter (amber) | This alarm indicates that the microcontroller (host) that runs the remote interfacing applications is not communicating with the transmitter’s primary microcontroller (DSP). If the watchdog function is enabled, the DSP will automatically reset the host. If this alarm persists for more than 10 minutes, try cycling power (off, then on) to the transmitter. If the alarm persists, replace the exciter/control PWB (A1) if necessary (see “Exciter/Control PWB Replacement” on page 1-46). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Insufficient Fans Active (Insuf. Fans Active) | Output Network (red) | This alarm indicates that the fans in the transmitter's RF power stage are not running. This alarm causes the transmitter to shut down, and clears when the system detects a running fan in the RF power stage. See **Fan Fail** alarm for troubleshooting information. |
| Invalid HD Data | - | This alarms occurs, in FM+HD or HD mode, if IBOC data is detected from the Exgine PWB, but is not usable (all logic 0s). Digital carriers are muted. Check the IBOC data source. |
| IPA Fail | PA (red) | This alarm occurs if the **IPA Output Low** alarm is present and the measured IPA current is below 225 mA. The VS2.5 takes no action on this alarm. See **IPA Output Low** for troubleshooting tips. |
| IPA Output High | PA (red) | This alarm occurs if the pre-amp/IPA PWB's (A5) forward power is greater than the IPA Output High threshold (36 W). If this condition persists, replace the pre-amp/IPA PWB (A5) (see "Pre-amp/IPA PWB replacement" on page 1-42). The VS2.5 takes no action on this alarm. If this alarm persists after replacing the pre-amp/IPA PWB, suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50) or the exciter/control PWB (A1) (see "Exciter/Control PWB Replacement" on page 1-46). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| IPA Output Low | PA (red) | This alarm occurs if the pre-amp/IPA PWB's (A5) forward power is less than the IPA Output Low threshold (14.4 W). This alarm causes the controller to limit the PA voltage to 30 V. Check for a **+48V Supply Fail** alarm and follow the associated troubleshooting procedure if present. **IPA Fail** and **Pre-amp Fail** alarms may also be present. If no associated alarms are present, turn RF off and run the bias routine in the front panel's **Main Menu -> System Settings -> Calibration** menu. If the alarm persists, enable RF and use a digital multimeter to measure the voltage between pad B on pre-amp/IPA PWB (pre-amp bias) and chassis (ground) and also between pad C on pre-amp/IPA PWB (IPA bias) and chassis (ground). If the voltage is less than 1 V at either of these points, suspect the exciter/control PWB (A1). If the voltage is greater than 1 V at both of these points, use a digital multimeter to measure between pad E (IPA volts) on the pre-amp IPA PWB and chassis (ground). If the measured voltage is not within an acceptable range (between +43 V and +48 V), with ac power off, perform a continuity check across F1 of the PS distribution PWB (A2). If the measurement is greater than 1 Ω, replace the fuse (Nautel Part # FA57 in the ancillary kit). If the measurement is less than 1 Ω, or replacing the fuse does not clear the alarm, replace the pre-amp/IPA PWB (A5) (see "Pre-amp/IPA PWB replacement" on page 1-42). If the voltage on pad E is acceptable, use a digital multimeter to measure between pad D (pre-amp volts) on the pre-amp IPA PWB and chassis (ground). If the measured voltage is not within an acceptable range (between +43 V and +48 V), replace the pre-amp/IPA PWB (A5) (see "Pre-amp/IPA PWB replacement" on page 1-42). If the voltage is acceptable, or replacing the pre-amp/IPA PWB does not clear the alarm condition, suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50) or the exciter/control PWB (A1) (see "Exciter/Control PWB Replacement" on page 1-46). |
| Low Battery | Exciter (amber) | This alarm occurs if the backup battery voltage falls below an acceptable level (2.7 V). The VS2.5 takes no action on this alarm. Use a digital multimeter to measure the battery voltage (with ac power on). If the battery voltage is low, replace the battery. If battery voltage is OK, cycle ac power (off, then on). If the alarm does not clear, suspect the exciter/control PWB (A1). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| LVPS Fail (+48V Fail) | PS (red) | This alarm occurs if the output of the +48 V power supply (U4) is outside of its acceptable voltage range (between +43 and +53 V). The VS2.5 takes no action on this alarm. Use a digital multimeter to measure between +V and -V of the +48 V power supply. If the measured value is not within the acceptable range, replace the +48 V power supply (see "+48 V Power Supply Replacement" on page 1-41). If the measured value is within the acceptable range, use a digital multimeter to measure the voltage between TP4 (+48V) and TP3 (ground) on the PS distribution PWB (A2). If the measured value is not within the acceptable range, suspect the connection between the +48V power supply and the PS distribution PWB, and contact Nautel for further assistance. If the measured value is within the acceptable range, check ribbon cable W2 for damage and that W2P1 and W2P2 are properly seated in A1J12 and A2J7 respectively. If there are no visible problems with the ribbon cable, suspect the sampling circuitry on the PS distribution PWB. If necessary, replace the PS distribution PWB (see "PS Distribution PWB Replacement" on page 1-49). If the alarm persists after replacing the PS distribution PWB, suspect the exciter/control PWB (A1). |
| Mode/ Frequency Mismatch | Exciter (red) | For use with VS-HD exciter only. This alarm occurs if there is a mismatch between the operating mode or carrier frequency of the transmitter and the exciter. Suspect a possible communication problem between the controller and exciter. The alarm should clear once the transmitter transfers the preset settings to the exciter. |
| No 1 PPS | Exciter (amber) | This alarm occurs if the pilot phase locking to 1 PPS is enabled and the 1 PPS signal is not present. Check the 1 PPS input. If there are no problems with the 1 PPS signal and connection, suspect the exciter/control PWB (A1).The VS2.5 takes no action on this alarm. |
| No External 10 MHz (No Ext 10MHz) | Exciter (amber) | This alarm occurs if frequency locking to an external 10 MHz source is enabled and no external 10 MHz is detected. The exciter will automatically switch over to the internal 10 MHz reference, and will continue to run. Check the 10 MHz input. If there are no problems with the 10 MHz signal and connection, suspect the exciter/control PWB (A1). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| No HD Data | Exciter (amber) | This alarm occurs, in FM+HD or HD mode, if IBOC data is not detected from the VSHD exciter's Exgine PWB. Digital carriers are muted. Verify the RJ45 cable (W1) between the **XMTR LINK (A1J2)** connector on the rear of the VS-HD exciter and the **XMTR LINK (A1J1)** connector on the rear of the transmitter is seated properly. Check that the Exgine PWB is correctly powered up. |
| No Internal 10 MHz | Exciter (red) | This alarm occurs if no 10 MHz clock is being detected on the exciter/control PWB (A1). This alarm will cause the transmitter to shut-down and the exciter/controller PWB may not be running. Replace the exciter/control PWB (see "Exciter/Control PWB Replacement" on page 1-46). |
| PA 1 - 4 Fail | PA (amber) | This alarm occurs if the dc input current for the indicated PA has fallen below a predetermined threshold (typically less than 50% of the average PA current of the operational PAs, or below 500 mA, whichever is lower). This may be caused by a cabling fault on the PA, loss of PA voltage or bias, or a defective FET. The transmitter's output power will be reduced (see Table 1.3 on page 1-31) and this condition could cause **Per PA Foldback** and **Reject Foldback** alarms. Check for an **All Power Amplifiers Inactive** alarm and follow the associated troubleshooting procedure if present. If the **All Power Amplifiers Inactive** alarm is not present, perform the "PA resistance checks" on page 1-37. If there is no problem found with the PAs, or the alarm still persists after replacing the PA, suspect the PS distribution PWB (A2). |
| PA Over Temperature (PA Over Temp) | PA (red) | This alarm occurs when the temperature as measured by RT1 or RT2 exceeds 85°C (185°F). This alarm will cause the transmitter to shut down and latch off. Check for **Fan Fail** alarms and follow the associated troubleshooting procedure if present. If no **Fan Fail** alarms are present, check the transmitter's air filter and clean or replace as required (see Section 3, "Routine maintenance of the Operations and Maintenance Manual). If the alarm persists, suspect the exciter/control PWB (A1). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| PA Pwr Foldback | Output Network (amber) | This alarm occurs if the control system determines that the calculated dissipation in any FET on a PA is above the high dissipation threshold (300 W), or the forward power being asked for out of an individual PA [calculated as (output power - combiner losses) / number of active PAs in the system] is above the PA output high threshold (850 W). The forward power of the transmitter will be limited to a level such that neither of these thresholds are exceeded. Check for associated alarms. Typically, the assertion of this alarm is the result of a PA failure or removal, or a high SWR condition. If no other alarms are being indicated, contact Nautel for further support. |
| PA Volts Fail | PS (amber) | This alarm is for indication only, and occurs when the voltage output by the power supply module does not match what the controller thinks it should be based on the control signal it is sending to the power supply module. No action is taken on this alarm. This alarm may show up when turning RF on or off. |
| Pilot Unsync | Exciter (amber) | This alarm occurs if there is no synchronization between the 10 MHz and 1PPS signals. It may indicate that the GPS receiver is not detecting a signal. Check the GPS receiver and antenna.The VS2.5 takes no action on this alarm. |
| PLL Unlock | Exciter (red) | This alarm indicates that the exciter's master clock is not locked. Possible causes are an out-of-range 10 MHz input or a hardware failure on the exciter/control PWB (A1). The VS2.5's RF output is inhibited. |
| Preamp Fail | PA (red) | This alarm occurs if the **IPA Output Low** alarm is present and the measured pre-amp current is below 17.5 mA. The VS2.5 takes no action on this alarm. See **IPA Output Low** for troubleshooting tips. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| PS A (or B) AC Fail | PS (amber) | This alarm occurs if power supply module A (U1) or B (U2) is reporting an ac failure, indicating its ac input voltage is less than 175 V ac. The VS2.5 will reduce its maximum power if only one power supply module failed (see Table 1.3 on page 1-31). Check the ac voltage applied to the power supply module. If the ac voltage is acceptable, try replacing the indicated power supply module with a new module, or changing the position of the indicated power supply within the transmitter (see "Power Supply Module Replacement" on page 1-40). If the fault moves with the power supply module, replace the power supply module. If the fault does not move with the power supply module, or if replacing it with a new power supply module does not clear the fault, suspect the PS distribution PWB (A2). |
| PS A (or B) Fail | PS (amber) | This alarm occurs if power supply module A (U1) or B (U2) is reporting a PS failure, indicating its output voltage is outside of its acceptable range. The VS2.5 will reduce its maximum power if only one power supply module failed (see Table 1.3 on page 1-31). Try replacing the indicated power supply module with a new module, or changing the position of the indicated power supply within the transmitter (see "Power Supply Module Replacement" on page 1-40). If the fault moves with the power supply module, replace the power supply module. If the fault does not move with the power supply module, or if replacing it with a new power supply module does not clear the fault, suspect the PS distribution PWB (A2) or the exciter/control PWB (A1). |
| PS A (or B) Missing | PS (amber) | This alarm occurs if power supply module A (U1) or B (U2) is not being detected or has been removed. The VS2.5 will reduce its maximum power if only one power supply module failed (see Table 1.3 on page 1-31). If there is a power supply module in the position being indicated by the alarm, try replacing the indicated power supply module with a new module, or changing the position of the indicated power supply within the transmitter (see "Power Supply Module Replacement" on page 1-40). If the fault moves with the power supply module, replace the power supply module. If the fault does not move with the power supply module, or if replacing it with a new power supply module does not clear the fault, suspect the PS distribution PWB (A2). |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| PS A (or B) Over Temperature (PS A Over Temp) | PS (amber) | This alarm occurs if power supply module A (U1) or B (U2) is reporting a high temperature alarm, indicating its operating temperature has exceeded its internal threshold. The VS2.5 will reduce its maximum power if only one power supply module failed (see Table 1.3 on page 1-31). This alarm is most likely caused by a module fan failure or blockage. Allow the module to cool and attempt to reset the alarm. Verify the module turns on and its fan is operational. If the fan is not operational, inspect it for possible blockage. If a problem is found, replace the power supply module (see "Power Supply Module Replacement" on page 1-40). If there is no problem found, inspect the transmitter's air filter and clean or replace as required (see Section 3, "Routine maintenance of the Operations and Maintenance Manual). If the alarm persists, try replacing the indicated power supply module with a new module, or changing the position of the indicated power supply within the transmitter (see "Power Supply Module Replacement" on page 1-40). If the fault moves with the power supply module, replace the power supply module. If the fault does not move with the power supply module, or if replacing it with a new power supply module does not clear the fault, suspect the PS distribution PWB (A2). |
| Rebooted Exciter | Exciter (red) | This is an informational alarm only that is displayed when the watchdog timer reboots the transmitter's main microcontroller (DSP). Typically, this alarm will show up after an ac power interruption. |
| Reboot Required (Exc Need Reboot) | Exciter (red) | This alarm indicates that exciter setup changes have been made, typically via the Hardware Configuration page of the AUI. Typically, the DSP will reboot itself automatically; however, if this alarm persists for more than five minutes, cycle the transmitter's ac power (off, then on) to store the changes. |
| Reject Foldback | Output Network (amber) | This alarm occurs if the control system determines that the calculated power in any reject resistor exceeds the reject power foldback threshold (400 W). The forward power of the transmitter will be limited to a level such that this threshold is not exceeded. This alarm should be accompanied by a **High Reject** alarm. Check for other associated alarms, and follow the associated troubleshooting procedure if present. Typically, high reject power is the result of a PA failure or removal. If no other alarms are being indicated, contact Nautel for further support. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| Reject Shutback | Output Network (red) | This alarm occurs if the control system determines that the calculated power in any reject resistor exceeds the reject power shutback threshold (480 W). This alarm will initiate an immediate shutdown of the transmitter's RF output. The transmitter will then attempt to turn RF on and increase the forward power of the transmitter to a level such that the reject foldback threshold is not exceeded. This alarm should be accompanied by a **High Reject** alarm and possibly a **Reject Foldback** alarm. Check for other associated alarms, and follow the associated troubleshooting procedure if present. Typically, a reject shutback is the result of a sudden PA failure. If no other alarms are being indicated, contact Nautel for further support. |
| Residual PA Volts Present (Residual PA V Pres) | PS (red) | This alarm indicates that after the transmitter has turned off its RF output, it is unable to discharge the PA volts to a level that is below 3 V. This condition will not allow the transmitter to turn on its RF output; however the condition will be cleared once the PA volts reaches a level that is below 3 V. This condition will typically occur with a failed PA or power supply module. Check for associated alarms and follow the associated troubleshooting procedure, as applicable. If no associated alarms are present, suspect the PS distribution PWB (A2) or the exciter/control PWB (A1). |
| Running Bias Routine | - | This is an informational alarm only that is displayed when the bias routine has been initiated. |
| SCA1 Low | Exciter (amber) | This alarm indicates the SCA 1 input level is too low or is not applied. The VS2.5 takes no action on this alarm. |
| SCA2 Low | Exciter (amber) | This alarm indicates the SCA 2 input level is too low or is not applied. The VS2.5 takes no action on this alarm. |
| SRC1 Unlock | Exciter (amber) | This alarm indicates that no valid AES/EBU stream data is being detected on the selected AES/EBU. The VS2.5 takes no action on this alarm. |

| Alarm Name AUI and (Front Panel) | Front Panel LED (color) | Description and Troubleshooting Action |
|---|---|---|
| SWR Foldback | Output Network (amber) | This alarm occurs if the transmitter's average reflected power exceeds the SWR foldback threshold (103 W) due to a gradually degrading load match. The forward power of the transmitter will be limited to a level such that this threshold is not exceeded. If the load match improves while the transmitter is producing RF output, the forward power will increase. If the transmitter folds back to a forward power that is equivalent to a 3:1 VSWR at the SWR Foldback threshold (forward power of 412 W), an **SWR Shutdown** alarm occurs.<br><br>Inspect the antenna and transmission line system for damage or de-tuning. If there are no major issues with the antenna network that would cause an impedance change (icing for example), suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50). |
| SWR Shutback | Output Network (red) | This alarm occurs if the transmitter's reflected power suddenly exceeds the SWR shutback threshold, which is the reflected power that is equivalent to a 2:1 VSWR at max power (311 W) due to a transient SWR condition (arc or lightning) within the output transmission line or antenna system. Attempt to reset the latched condition by pressing **Reset** [using the remote AUI's **Reset** button (see "Reset:" on page 2-18 of the Operations and Maintenance Manual) or using the local front panel display (see "Resetting Alarms" on page 2-96 of the Operations and Maintenance Manual)]. Inspect the output transmission line for punctures or damage. If no damage can be found, suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-50). See also **Cutback Active** alarm. |
| Unsigned DSP Image (Exc Bad DSP Image) | Exciter (red) | This alarm indicates that the exciter is operating with 'unsigned code', but is otherwise operational. This alarm may only be displayed if the transmitter is operating with a 'beta' version of factory software. |

**Table 1.2: Troubleshooting Summary Alarms**

| Summary Alarm Name | Description and Triggering Alarms |
|---|---|
| AC | This summary alarm is triggered if any of the following ac power related alarms occur:<br><br>PS A AC Fail<br>PS B AC Fail<br>PS C AC Fail |
| Audio Loss | This summary alarm is triggered if any of the following audio loss related alarms occur:<br><br>Audio Loss<br>Audio Shutdown |
| Exciter | This summary alarm is triggered if any of the following Exciter related alarms occur:<br><br>Analog Audio Left Low<br>Analog Audio Right Low<br>Audio Loss<br>Audio Proc. Offline<br>Audio Proc. O/P Fail<br>Audio Shutdown<br>Composite Audio Low<br>Digital Audio Low<br>Entered Firmware Upgrade<br>Exciter Offline<br>External Interlock Open<br>Host Network Down<br>Host Not Booted<br>Host Not Responding<br>Low Battery<br>Missing Preset<br>Mode/Freq. Mismatch<br>Need Reboot For Settings<br>No External 10 MHz<br>No HD Data<br>No Internal 10 MHz<br>No 1 PPS<br>Pilot Unsync<br>PLL Unlock<br>Rebooted Exciter<br>SCA1/2 Audio Low<br>SRC1 Unlock<br>Unsigned DSP Image |
| External | This summary alarm is triggered if any of the following external alarms occur:<br><br>External Interlock Open<br>No External 10 MHz |
| HD | This summary alarm is triggered if any of the following digital (HD) alarms occur:<br><br>No HD Data |
| High Reflected (Power) | This summary alarm is triggered if any of the following high reflected power related alarms occur:<br><br>High SWR Shutdown<br>PA Pwr Foldback<br>SWR Foldback<br>SWR Shutback |
| High Temperature | This summary alarm is triggered if any of the following temperature related alarms occur:<br><br>Fan 1 - 7 Fail<br>High Temperature Latch<br>PA Over Temperature<br>PS A, B or C Over Temp |

**Table 1.2: Troubleshooting Summary Alarms**

| Summary Alarm Name | Description and Triggering Alarms |
|---|---|
| Low Battery/Memory | This summary alarm is triggered if any of the following battery or memory related alarms occur:<br><br>Entered Firmware Upgrade<br>Low Battery<br>Missing Preset<br>Need Reboot For Settings<br>Rebooted Exciter<br>Unsigned DSP Image |
| Maintenance Required | This summary alarm is triggered if any of the following maintenance related alarms occur:<br><br>+15V Supply Fail<br>-15V Supply Fail<br>Audio Processor Offline<br>Audio Processor O/P Fail<br>High SWR<br>Low Battery<br>No External 10MHz<br>No 1 PPS<br>Pilot Unsync |
| Off Air | This summary alarm is triggered if any of the following off-air related alarms occur:<br><br>All Power Amplifiers Inactive<br>Audio Loss<br>Discharging PA Volts<br>Entered Firmware Upgrade<br>External Interlock<br>Forward Power Shutdown<br>Insufficient Fans Active<br>IPA Fail<br>IPA Output High<br>IPA Output Low<br>Missing Preset<br>Need Reboot For Settings<br>No HD Data<br>No Internal 10MHz<br>PA Volts Fail<br>PLL Unlock<br>Preamp Fail<br>SRC 1/2 Unlock<br>Reject Shutback<br>Residual PA Volts Present<br>SWR Shutback<br>SWR Shutdown<br>Unsigned DSP Image<br>+1.2V Supply Fail<br>+1.8V Supply Fail<br>+3.3V Supply Fail<br>+48V Supply Fail<br>+5V Supply Fail |
| Output Network | This summary alarm is triggered if any of the following output network related alarms occur:<br><br>Cutback Active<br>Fan 1 - 7 Fail<br>Forward Power Limiting<br>Forward Power Low<br>Forward Power Shutdown<br>Forward Power Very Low<br>High Forward Power<br>High Reject Power<br>High SWR<br>High SWR Shutdown<br>High Temperature Latch<br>Insufficient Fans Active<br>PA Pwr Foldback<br>Reject Foldback<br>Reject Shutback<br>SWR Foldback<br>SWR Shutback |
| Power Amplifier | This summary alarm is triggered if any of the following power amplifier (PA) related alarms occur:<br><br>All PAs Inactive<br>HD PA Fault Foldback<br>IPA Fail<br>IPA Output High<br>IPA Output Low<br>PA Over Temperature<br>PA 1 - 4 Fail<br>Preamp Fail |

**Table 1.2: Troubleshooting Summary Alarms**

| Summary Alarm Name | Description and Triggering Alarms |
|---|---|
| Power Supply | This summary alarm is triggered if any of the following power supply related alarms occur:<br><br>Discharging PA Volts<br>PA Volts Fail<br>PS A, B or C AC Fail<br>PS A, B or C Fail<br>PS A, B or C Missing<br>PS A, B or C Over Temp<br>Residual PA Volts Present<br>+1.2V Fail<br>+15V Fail<br>-15V Fail<br>+1.8V Fail<br>+3.3V Fail<br>+48V Fail<br>+5V Fail |
| Reduced Power | This summary alarm is triggered if any of the following reduced power related alarms occur:<br><br>Cutback Active<br>Fan 1 - 7 Fail<br>Forward Power Limiting<br>Forward Power Low<br>Forward Power Very Low<br>HD PA Fault Foldback<br>High Temperature Latch<br>PA Over Temperature<br>PA Pwr Foldback<br>Reject Foldback<br>SWR Foldback<br>PA 1 - 4 Fail<br>PS A, B or C AC Fail<br>PS A, B or C Fail<br>PS A, B or C Missing<br>PS A, B or C Over Temp<br>PS Current Foldback |

# Troubleshooting tips

## AUI lockup

If the remotely accessed AUI screen stops responding, and subsequent attempts to re-access the AUI are unsuccessful, verify that all network settings are correct (see Network Setup in the Operations and Maintenance Manual). If all network settings are correct and the AUI continues to be inaccessible, perform the ARM Reset procedure in the Operations and Maintenance Manual. If the AUI is still inaccessible, try cycling (turn off, then on) the ac power. If the problem persists, contact Nautel for further assistance.

## Operating with defective PAs or cooling fans

It is permissible to operate the transmitter with multiple defective power amplifier PWBs or cooling fans. Table 1.3 shows the approximate remaining output power when power amplifiers (PAs) or cooling fans fail.

*NOTE:*
*There are several combinations of PA, PS module or fan failures that can affect the RF output. Table 1.3 shows the maximum RF output power that can be expected for a given condition. In the event that PA, PS and fan failures occur simultaneously, the maximum RF output power is limited to the lowest maximum power of each individual condition.*

CAUTION:
Defective PAs must remain installed in order for the transmitter to continue operating. Operation with removed PAs may result in an unstable RF output and possible damage to transmitter circuitry.

**Table 1.3: Output Power Level vs. PA or Fan Failure**

| PA PWB or Fan Failures | Maximum RF Output Power, Typical (W) |
|---|---|
| 1 PA fan (B3 - B7) | 2800 (full power) |
| 2 PA fans (B3 - B7) | 1400 (half power) |
| 3 PA fans (B3 - B7) | 64 (minimum power) |
| 4 PA fans (B3 - B7) | 64 (minimum power) |
| 5 PA fans (B3 - B7) | 0 (RF output is inhibited until at least 1 fan is replaced) |
| 1 or 2 fans (B1, B2) | 2800 (full power) |
| 1 PA PWB (A6 - A9) | 1400 |
| 2 PA PWBs (A6 - A9) | 350, depending on PA positions |
| 3 PA PWBs (A6 - A9) | 100 |
| 1 PS module (U1 or U2) | 350 |

# Replacing a suspect PWB, power supply or fan

## Maintenance philosophy

Maintenance on a VS2.5 transmitter consists of replacing any of the PWBs, power supplies or fans identified in Table 1.4 on page 1-33.

## Special Tools and Test Equipment

The following tools and test equipment are required to troubleshoot a VS2.5 transmitter.

- Digital multimeter
- Torque screwdriver, capable of torquing up to 2.2 N-m (20 in.-lbs). Required for installing securing hardware for PA PWB FETs and power supply connections.
- Soldering iron and desoldering tool
- VS2.5 station spares kit, if purchased (contains replacement PA PWBs, pre-amp/ IPA PWBs and cooling fans)
- Electrical schematics in Section 5 of this manual.
- Mechanical drawings in Section 6 of this manual.

## Electrostatic Precautions

The VS2.5 transmitter contains semiconductor devices that are susceptible to damage from electrostatic discharge. Be sure to follow the electrostatic precautions in "Electrostatic protection" on page 1-3 at all times.

## Preparation for replacing a PWB or module

1. Disable the VS2.5's RF output (RF off) and set its AC POWER switch to the off position. Disconnect all cabling from the rear of the VS2.5, remove the VS2.5 from its host cabinet and place the VS2.5 on a suitable work surface.

2. Based on the alarm that prompted troubleshooting, replace the appropriate PWB, module or cooling fan (see the appropriate replacement procedure in Table 1.4 on page 1-33).

*NOTE:*
*If a power amplifier (PA) failure occurs, you must replace the entire power amplifier PWB, rather than an individual FET. A spare PA PWB (NAPA31C) is provided in the transmitter station spares kit, if purchased. To order a station spares kit contact Nautel. Failure to observe this recommendation may void your equipment warranty or cause further failures.*

**Table 1.4: Replacement Procedures**

| Module | Replacement Procedure |
|---|---|
| PA PWB | See page 1-34 |
| Pre-amp/IPA PWB | See page 1-39 |
| Power Supply Module | See page 1-40 |
| +48 V Power Supply | See page 1-41 |
| Cooling Fan (B3 through B7) | See page 1-42 |
| Cooling Fan (B1 and B2) | See page 1-44 |
| Exciter/Control PWB | See page 1-46 |
| PS Distribution PWB | See page 1-49 |
| Combiner Interface PWB | See page 1-50 |

## PA PWB replacement

See Figure MD-2 in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's bottom cover. Retain hardware for re-installation.

2. Before replacing a suspect PA PWB, verify the fault is with the suspect PA PWB by performing the continuity and resistance checks detailed in "PA resistance checks" on page 1-35. If you are prompted to replace a PA PWB, return to Step 3 of this procedure.

3. Unsolder and remove the five solder connections to the defective PA PWB. They include two 24 AWG links (to pads V and X), a white 12 AWG wire (to pad U) and a black 12 AWG wire (to pad T). If you are removing PA # 3 (A8), note that the black 12 AWG wire is secured, using a terminal lug, to the front, left screw that secures A8 to the heat sink.

4. Remove the two #4 screws, split and flat washers securing the FET to the heat sink.

5. Remove the four M3 screws securing the PA PWB to the heat sink. Remove the PA PWB from the heat sink.

6. Clean the heat sink surface with a soft cloth and non-abrasive grease remover. **Do not** use any material that may scratch the heat sink surface.

7. Obtain the replacement NAPA31C PA PWB from the station spares kit, if purchased.

> *NOTE:*
> *FETs are static sensitive. Handle the PA PWB in a static protected manner.*

8. Spread a small amount of thermal compound (Nautel Part #HAG39, from the station spares kit), in a thin even layer, on the bottom of the FET flange on the new PA PWB. If the layer of thermal compound is too thick, the FET junction may operate at a higher temperature, possibly shortening the FET's lifespan.

9. Secure the PA PWB on the module's heat sink using the four screws removed in Step 5. Ensure correct orientation (same as the adjacent PWB). Do not tighten the four screws at this time.

> *NOTE:*
> *If you are replacing PA # 3 (A8), re-install wire #44 to the front left screw that secures A8 to the heat sink.*

> CAUTION:
> When installing FET securing hardware, you can damage the FET case if you fully tighten one screw while the other is loose. Avoid this by alternately tightening the two screws.

10. Secure the FET (Q1) with two # 4 screws, a mini-flat washer and a new split washer. Using a torque screwdriver, alternate tightening the left and right screws on each FET, a quarter turn at a time, until 6 in-lbs (0.67 N-m) of torque has been applied.

11. Tighten the four PWB screws.

12. Solder the wires removed in Step 3. If necessary, refer to Table 4.3, "Wiring List - VS1 Transmitter" for wiring details for A6 through A9.

13. Re-install the transmitter's bottom cover.

14. Re-install the transmitter in its host cabinet, reconnect all cables and restore operation by enabling ac and RF power.

## PA RESISTANCE CHECKS

1. Using a digital multimeter, check the continuity of fuse F1 on the suspect PA PWB.

   - If the measurement is an open circuit, replace the PA PWB (see "PA PWB replacement" on page 1-34).
   - If the measurement is short circuit (near 0 Ω), proceed to Step 2.

2. Using a digital multimeter, measure the resistance between each gate lead of the FET and the metal flange of the FET.

   - If the measurement is less than 8 kΩ, replace the PA PWB (see "PA PWB replacement" on page 1-34).
   - If the measurement is between 8 kΩ and 17.5 kΩ, check the other PA PWBs for a failure. If none have failed, replace the original suspect PA PWB.
   - If the measurement is greater than 17.5 kΩ, proceed to Step 3.

3. Using a digital multimeter, check the continuity between each drain lead of the FET (positive meter probe) and the metal flange of the FET (negative meter probe).

   - If the measurement is open circuit, the PA PWB is OK and does not require replacement. Continue troubleshooting; suspect a problem with an associated PWB.
   - If the measurement is not open circuit, replace the PA PWB (see "PA PWB replacement" on page 1-34).

## Pre-amp/IPA PWB replacement

See Figure MD-2 in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's bottom cover. Retain hardware for re-installation.

2. Unsolder and remove the six solder connections to the pre-amp/IPA PWB (A5). They include two white, 16 AWG wires (to pads D and E), two tinned copper jumpers (to pads B and C), a white coaxial cable (to pads A and G) and two 20 AWG links (to pads F and H).

3. Remove the two M3 screws, Belleville and flat washers securing each of the clamps that secure FETs Q1 and Q2 to the heat sink.

4. Remove the four M3 screws securing the pre-amp/IPA PWB to the heat sink, noting one of the securing screws also holds thermistor RT1 in place (see Figure MD-2). Temporarily move RT1 and its associated wiring to allow removal of the pre-amp/IPA PWB.

5. Remove the pre-amp/IPA PWB from the heat sink, noting the orientation.

6. Clean the heat sink surface with a soft cloth and non-abrasive grease remover. **Do not** use any material that may scratch the heat sink surface.

7. Obtain the replacement NAPA28B pre-amp/IPA PWB from the station spares kit, if purchased.

> *NOTE:*
> *FETs are static sensitive. Handle the PA PWB in a static protected manner.*

8. Spread a small amount of thermal compound (Nautel Part # HAG39, from the station spares kit), in a thin, even layer, on the bottom surface of the pre-amp/IPA PWB palette and on the top and bottom of the RT1 tab, removed in Step 4. Use thermal compound to cover the threads on the M3 screw that secures RT1 in Step 4.

9. Secure the pre-amp/IPA PWB on the heat sink using the four screws removed in Step 4, noting the correct orientation. Re-install thermistor RT1 under one of the securing screws. Do not tighten the four screws at this time.

CAUTION:
When securing FET hardware, you can damage the FET case if you fully tighten one screw while the other is loose. Avoid this by alternately tightening the two screws.

10. Install FET clamps (Nautel Part # 211-1215) on Q1 and Q2, ensuring they are parallel to the heat sink. Loosely secure each FET (Q1 and Q2) with two M3 screws, two Belleville washers [use two new washers (Nautel Part # HAJ59) provided with the replacement kit, if applicable, otherwise re-use the washers removed in Step 3; note orientation] and two flat washers (see Figure 1.4 on page 1-39). Turn screws until they barely put pressure on the clamp.

11. Using a torque screwdriver, alternate tightening the left and right screws on each FET clamp, a quarter turn at a time, until 5 inch-pounds (0.56 Newton-meters) of torque has been applied.

12. Tighten the four M3 PWB screws. Use a torque screwdriver to tighten RT1's securing screw to 9 inch pounds (1.0 Newton-meters).

13. Solder the wires removed in Step 2. If necessary, refer to Section 4 of this manual for wiring details for A5.

14. Re-install the transmitter's bottom cover.

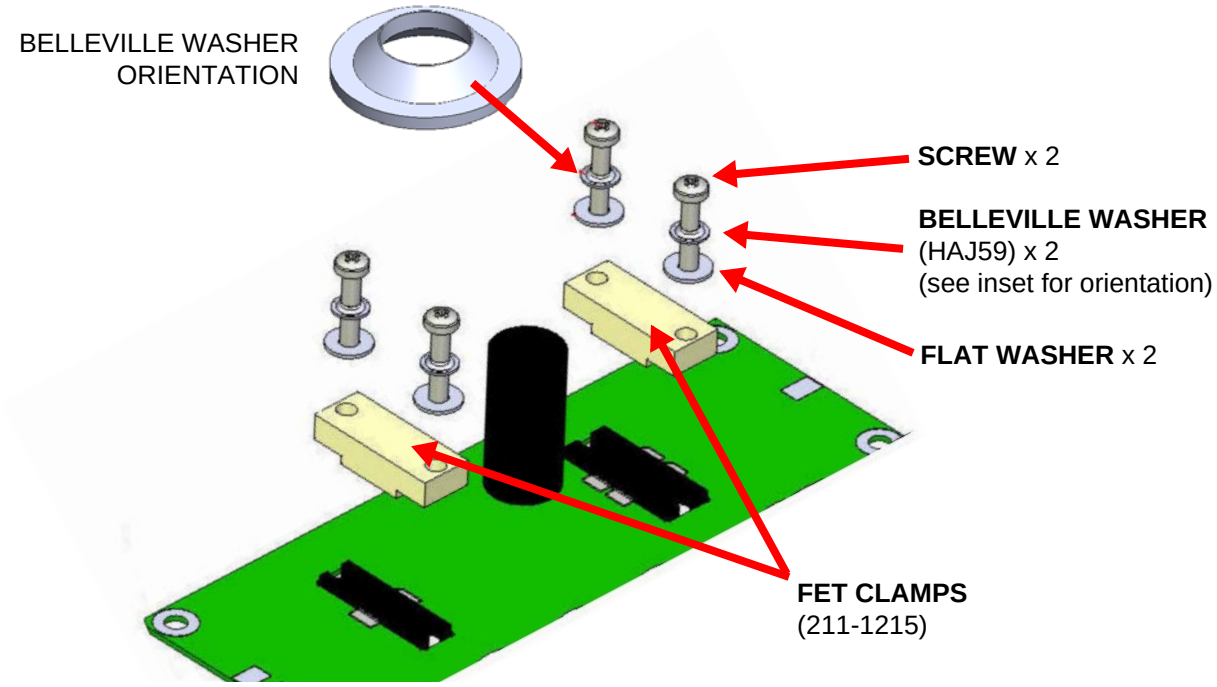
15. Remove the transmitter's top cover. Check the continuity across fuse F1 on the PS distribution PWB (A2). If the resistance is greater than 1 Ω, replace fuse F1 (Nautel Part # FA57, located in the ancillary kit) and re-install the transmitter's top cover.

16. Re-install the transmitter in its cabinet and reconnect all cables. Enable ac power.

17. With RF off and the system interlock circuit intact (closed), initiate a Bias Routine using the front panel UI (see Main Menu -> System Settings -> Calibration menu; refer to the Operations and Maintenance Manual for more detail).

18. Enable the transmitter's RF output (RF on).

**Figure 1.4: Pre-amp/IPA PWB mounting hardware**



## Power Supply Module Replacement

See Figure MD-1 (top view) in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's top cover. Retain hardware for re-installation.

2. Remove the securing bracket from the front of the power supply module (U1 or U2) by removing two M3 screws in the top of the bracket and two M4 countersunk screws in each side of the transmitter chassis. Note the orientation of the bracket for installation of the new power supply module. Retain hardware.

3. Slide the power supply module toward the front of the transmitter to disengage it from its mating connector.

4. Remove the power supply module from the transmitter.

5. Locate or obtain a replacement power supply module (Nautel Part # UG69J). Reverse Step 1 through Step 4 to reinstall the new power supply module.

6. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

## +48 V Power Supply Replacement

See Figure MD-1 (top view) in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's top cover. Retain hardware for re-installation.

2. Remove the two M3 screws and two countersunk M4 screws that secure the +48 V power supply (U4) (and its mounting bracket) to the transmitter. Retain hardware.

3. Remove the +48 V power supply from the transmitter and remove the four countersunk M4 screws and hardware securing the mounting bracket to the power supply. Retain the mounting bracket for use with the new power supply. Note the orientation of the bracket and power supply for installation of the new power supply.

4. Disconnect wires # 10, 11, 12, 13 and 14 from the +48 V power supply's terminal block, noting their destinations.

5. Locate or obtain a replacement +48 V power supply (Nautel Part # UG75). Install the mounting bracket on the new power supply and reverse Step 1 through Step 4 to reinstall the new +48 V power supply. If necessary, refer to Section 4 of this manual for wiring details for U4. Torque all terminal connections on U4 to 11 inch pounds (1.2 Newton-meters).

6. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

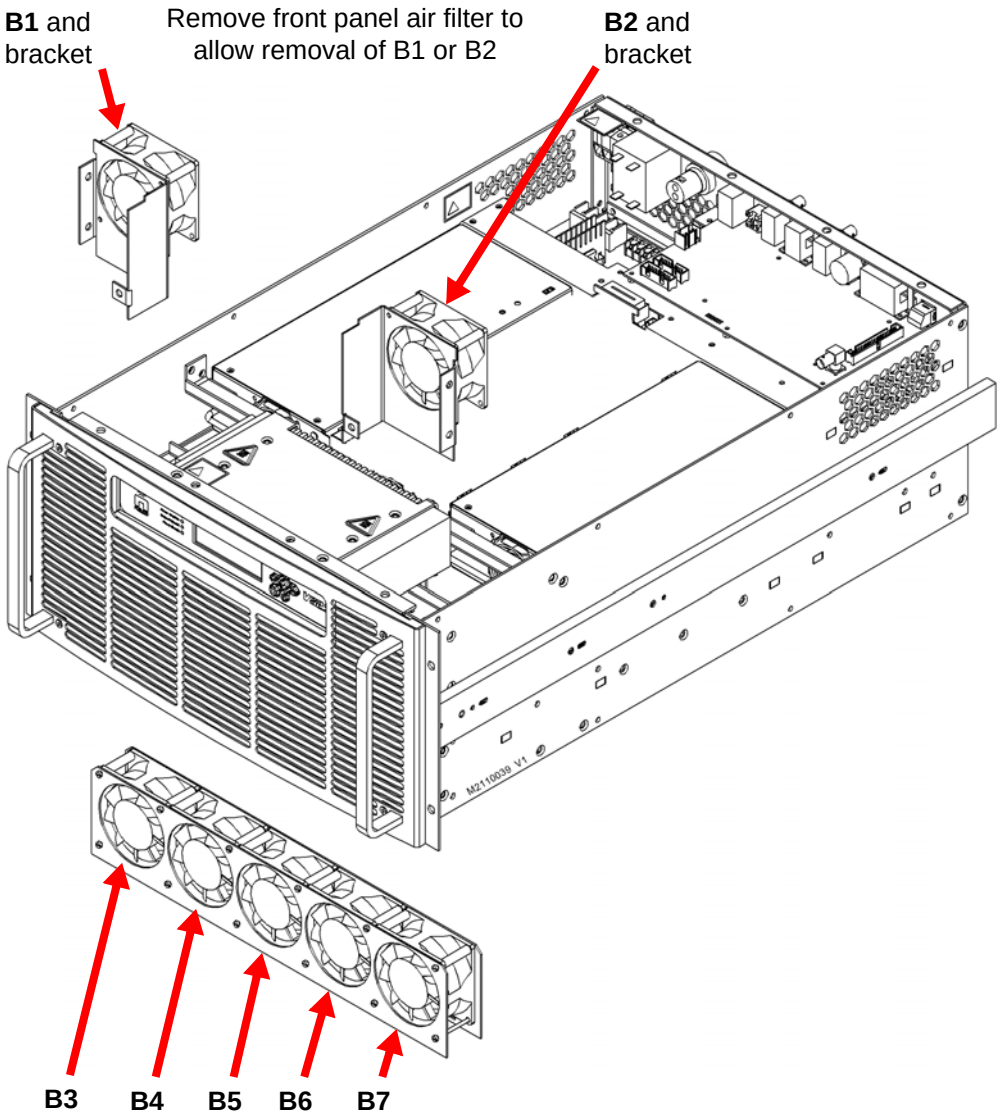
## Cooling fan replacement - fans 3 (B3) through 7 (B7)

See Figure MD-2 (bottom view) in the Mechanical Drawings section (Section 6) of this manual.

CAUTION:
Do not replace a cooling fan while ac power is applied to the transmitter. Failure to observe this could result in damage to the fan's associated tachometer circuitry.

1. Remove the transmitter's bottom cover. Retain hardware for re-installation.
2. Disconnect the fan mating plugs (B3P1 through B7P1) from splitter PWB (A4).
3. Slide the cooling fan bracket assembly out of the transmitter chassis (see Figure 1.5 on page 1-43).
4. Remove and retain all M3 screws and other hardware that secures the fans to the mounting brackets. Note the orientation of brackets and fans before disassembling.
5. Obtain a replacement fan (Nautel Part # ZAP50) from the station spares kit, if purchased, or a suitable equivalent (vendor part # is Minebea Motor Mfg. Co. 3115RL-07W-B79-E51).
6. Install the replacement fan, along with the other functional fans, on the mounting brackets using retained screws.
7. Re-install the cooling fan bracket assembly in the transmitter chassis. Keep the fan bracket level when installing in the transmitter. Failure to do so could cause the bracket to bind and break the plastic slides if excessive force is used.
8. Reconnect the fan mating plugs to the splitter PWB (A4). If necessary, refer to Table 4.4, "Connector Mating Information - VS1 Transmitter" for connector mating details for A4.
9. Re-install the transmitter's bottom cover.
10. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

**Figure 1.5: Fan Bracket Removal**



## Cooling fan replacement - fans 1 (B1) and 2 (B2)

See Figure MD-2 (bottom view) in the Mechanical Drawings section (Section 6) of this manual.

CAUTION:
Do not replace a cooling fan while ac power is applied to the transmitter. Failure to observe this could result in damage to the fan's associated tachometer circuitry.

1. Remove the transmitter's top cover. Retain hardware for re-installation.

2. Disconnect the associated fan mating plug (B1P1 or B2P1).

3. Remove the front panel air filter to gain access to fan bracket securing hardware (see "Replacing a damaged air filter" on page 3-2 of the Operations and Maintenance Manual for instructions on removing and re-installing the air filter).

4. Remove three countersunk M4 screws securing the fan bracket to the transmitter chassis (see Figure 1.5 on page 1-43), noting there is one in the front and two on the sides. Remove the bracket, with fan, noting proper orientation for re-assembly. Retain hardware.

5. Remove and retain all M3 screws and other hardware that secures the fan to the mounting bracket. Note the orientation of the bracket and fan before disassembling.

6. Remove the clip-on ferrite (Nautel Part # LA52) from the fan that is being replaced.

7. Obtain a replacement fan (Nautel Part # ZAP42) from the station spares kit, if purchased, or a suitable equivalent (vendor part # is Sanyo Denki 9G0848G103).

8. Install the clip-on ferrite on the wiring for the new fan. Secure the ferrite using a tyrap (Nautel Part # HT29) on each side of the ferrite. See the other fans for reference.

9. Install the replacement fan on the mounting bracket using retained screws.

10. Re-install the cooling fan bracket assembly in the transmitter chassis using retained screws.

11. Reconnect the fan mating plug to its associated mate (B1P1 to J5, B1P2 to J6). If necessary, refer to Section 4 of this manual for connector mating details.

12. Re-install front panel air filter.

13. Re-install the transmitter's top cover.

14. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

## Exciter/Control PWB Replacement

See Figure MD-1 (top view) in the Mechanical Drawings section (Section 6) of this manual.

> *NOTE:*
> *The exciter/control PWB is static sensitive and must be handled in a static protected manner.*

1. Remove the transmitter's top cover. Retain hardware for re-installation.

2. Disconnect all mating plugs from the exciter/control PWB (A1), both inside the transmitter and at the rear of the transmitter.

3. At the rear panel, remove any securing hardware for connectors that protrude through the rear panel. Retain all hardware for re-installation.

   - Locate the two DB-25 connectors (J2A and J2B) and the two DB-9 connectors (J5A and J5B) on the rear panel. Using a 5 mm nut driver or socket, remove the mounting nuts.

   - Locate the AES/EBU XLR audio connector (J3) on the rear panel. Remove the two small pan-head Phillips screws.

   - Remove the silver push button connector lock ("push" lever) on the XLR connector. Locate the HAS78 removal tool from the ancillary kit, provided with the transmitter. Follow the manufacturer's instructions in Figure 1.6 on page 1-47 to remove the push button. You will need access to the front and rear of the receptacle to remove it.

4. See Figure 1.7 on page 1-47. Remove the locking rings from five BNC connectors (J4A, J4B, J6A, J6B and J7). To remove the locking rings, use small 4 - 6 inch slip-jaw pliers. Gently loosen (do not tightly pinch or deform) each locking ring. Typically, half a turn with the pliers will loosen a locking ring enough to remove it by hand. Remove and retain the locking rings.

5. Remove the three small Phillips screws, which mount the front of the exciter/control PWB to the chassis, located along the edge of the exciter/control PWB. Retain hardware for re-installation.

**Figure 1.6: Removing the XLR connector's "push" lever**

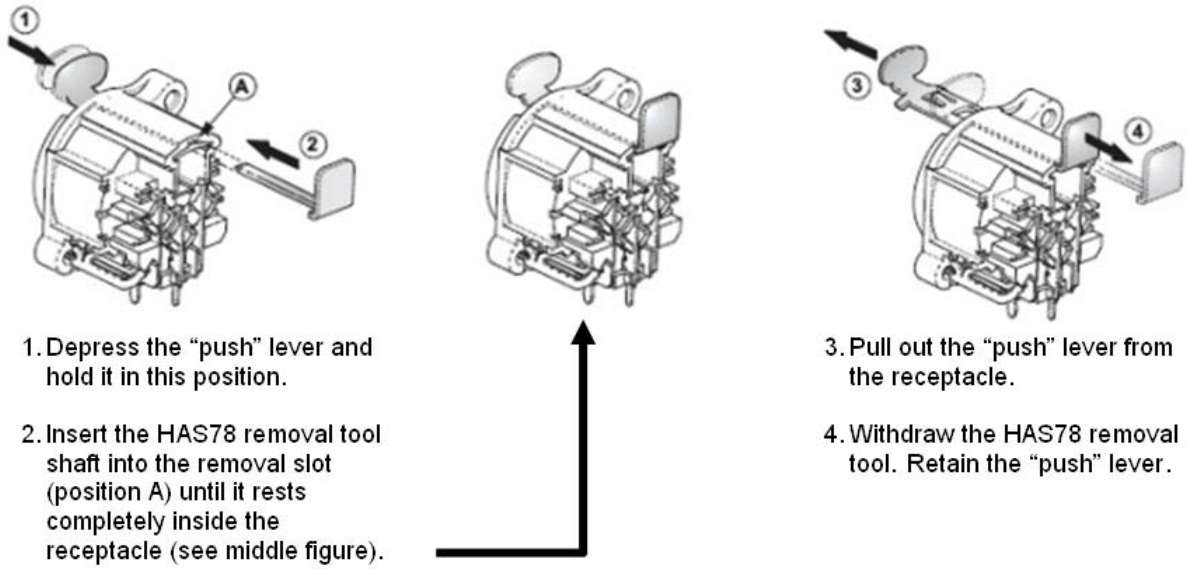



**Figure 1.7: Loosening the BNC connector's locking ring**

6. Slightly lift the front edge of the exciter/control PWB and withdraw towards the front of the transmitter.

7. Locate or obtain a replacement exciter/control PWB (Nautel Part # NAPE87B). Remove the "push" lever from the XLR connector as detailed in Step 3.

CAUTION:
When re-installing the exciter/control PWB, lift the PWB high enough so that mounting pillars do not damage parts on the underside of the PWB.

8. Install the replacement exciter/control PWB. Replace all hardware for the through-chassis connectors. Take care not to over-tighten the BNC connector locking rings.

9. Install the three Philips screws that mount the front of the exciter/control PWB to the chassis.

10. Install the "push" lever into the XLR connector. Align it with the slot located on the top section of the connector body and gently press it into position.

11. Reconnect all internal and external cables to the exciter/control PWB. If necessary, refer to Section 4 of this manual for connector mating details for A1.

12. Remove the "Interlock" jumper, if applicable, from J2A of the original exciter/control PWB and reinstall it on the new exciter/control PWB between J2A pins 19 and 20.

13. Reinstall the transmitter's top cover.

14. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power. The new exciter/control PWB is shipped with all standard or default power presets and audio settings. Check and restore them to your specific site requirements.

15. Locate the scale factor date recorded during transmitter commissioning (see Section 8 of the *Installation Manual*) and go to the Main Menu -> System Settings -> Factory Settings -> Calibration -> Cal Values screen. Enter the recorded scale factor values in the Fwd Scale and Rfld Scale screens.

## PS Distribution PWB Replacement

*NOTE:*
*The PS distribution PWB is static sensitive. Handled it in a static protected manner.*

See Figure MD-1 (top view) in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's top cover. Retain hardware for re-installation.

2. Temporarily remove the power supply modules (U1 and U2) from the transmitter (see "Power Supply Module Replacement" on page 1-40).

3. Remove the exciter/control PWB (A1) (see "Exciter/Control PWB Replacement" on page 1-46).

4. Remove the five screws that secure the exciter deck [see Figure MD-1 in the Mechanical Drawings section (Section 6) of this manual] and pull the deck up and forward. Pop out all tyrap anchors, noting their location and orientation for re-assembly. Make sure the exciter wiring and associated items are clear of the PS distribution PWB.

5. Disconnect ribbon cable plugs W2P2 and W4P2 and MTA connectors P7 and P8 from the PS distribution PWB (A2). Remove the 17 wires (#7 through 14 and 25 through 33) connected to terminal blocks TB1 through TB4.

6. Remove the two screws that secure each cover to connectors A2J1, A2J2 and A2J3. Retain the covers and screws.

7. Use a 5.5 mm nut driver to remove the 12 M3 nuts, split and flat washers that secure the PS distribution PWB to the transmitter. Retain hardware.

8. Remove the PS distribution PWB from the transmitter.

9. Locate or obtain a replacement PS distribution PWB (Nautel Part # NAPS53). Reverse Step 1 through Step 8 to reinstall the new PS distribution PWB. If necessary, refer to the Wiring Lists section (Section 4) for wiring and connector mating details for A2. Torque connections on TB2 to 6 inch pounds (0.67 Newton-meters). Torque connections on TB1, TB3 and TB4 to 20 inch pounds (2.24 Newton-meters).

10. Reinstall the transmitter's top cover.

11. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

## Combiner Interface PWB Replacement

See Figure MD-2 (top view) in the Mechanical Drawings section (Section 6) of this manual.

1. Remove the transmitter's bottom cover. Retain hardware for re-installation.

2. Disconnect the four tinned copper wire jumpers that are connected to pads A, B, C and D.

3. Remove the four M3 screws that secure the combiner interface PWB to the transmitter chassis. Do not remove the two screws next to the pins of J1 (one on either side of J1). Retain hardware.

4. Remove the combiner interface PWB from the transmitter by pulling straight up (i.e., disconnecting from edge card connector). Note the orientation of the PWB for installing the replacement PWB.

5. Locate or obtain a replacement combiner interface PWB (Nautel Part # NAPI139). Reverse Step 1 through Step 4 to reinstall the new combiner interface PWB. If necessary, refer to the Wiring Lists section (Section 4) for wiring details for A12.

6. Reinstall the transmitter's bottom cover.

7. Re-install the transmitter in its host cabinet, reconnect all interconnect cables and restore operation by enabling ac and RF power.

# Section 2: Detailed Circuit Descriptions

Refer to the functional block diagram: **"Block Diagram - VS2.5 Transmitter" on page 1-7** and high level descriptions of the *VS2.5 Operation and Maintenance Manual*.

This section provides a detailed description of the transmitter's key modules and assemblies, including:



## VS2.5 electrical schematics

The descriptions in this section all refer to the VS2.5 electrical schematics listed in Table 5.1 on page 5-5 of the *VS2.5 Troubleshooting Manual*.

## Exciter/control PWB (NAPE87B)

Detailed theory for the exciter/control PWB (A1) is not included in this manual.

# PS distribution PWB (NAPS53)

See electrical schematic Figure SD-3.

## Interfacing

The PS distribution PWB provides the interface between the VS2.5's power supplies and the rest of the transmitter. It passes:

- ac voltage from the AC INPUT to power supply modules U1 and U2.
- PA voltage from power supply module U1 to power amplifier (PA) PWBs A6 and A8.
- PA voltage from power supply module U2 to power amplifier (PA) PWBs A7 and A9.
- Pre-amp voltage (+48 V) from +48 V power supply U4 to pre-amp/IPA PWB A5 (pre-amp V delivered via exciter/control PWB A1 and interface PWB A3).
- Power supply control voltage and power supply inhibit signal from exciter/control PWB A1 to power supply modules U1 and U2.

## Power supply monitoring

A 10-bit ADC IC U9 accepts several power supply related inputs (PA volts, PA current, pre-amp current, IPA current, +48 V, +15 V and +5 V) and converts them to a digital data stream on the *MISO ADC* output (J7-2). This output is applied to the exciter/control PWB for monitoring and protection purposes.

## Power supply module fault monitoring

Two 8-bit shift register ICs, U4 and U5, accept the status and alarm signals from the power supply modules (U1 and U2) (PS present, PS ac fail, PS temp and PS fail) and converts them to a serial data stream on the *MISO 165* output (J7-4). This output is applied to the exciter/control PWB for monitoring and protection purposes. If a power supply module fault occurs, the exciter/control PWB will inhibit the power supply module via the *# 595 CS* - input (J7-6).

## Fan enable

Transistor Q3, FET Q2 and associated components form a fan enable circuit that controls the application of power supply voltage (+48 V) to the cooling fans (B1 through B7). When the transmitter's RF status is 'on', the *Fan Enable* input (J6-2) is logic high and transistor Q3 turns on. This causes FET Q2 to turn on, allowing +48 V to be applied to the *Fan V (+)* outputs (J6-11, 12 and 13), enabling fans B3 through B7, and to the *Fan 1 V (+)* (J4-3) and *Fan 2 V (+)* outputs (J5-3), enabling the power supply module fans. When the transmitter's RF status is 'off', transistor Q3 turns off. This causes FET Q2 to turn off, preventing +48 V from being applied to all *Fan V (+)* outputs; hence disabling the fans.

### Fan monitoring

8-bit shift register IC U5 accepts the fan tach signals from fans B1 and B2 and converts them to a serial data stream on the *MISO 165* output (J7-4). This output is applied to the exciter/control PWB for monitoring purposes.

### LVPS

Two +48 V to +5 V dc-dc converters (U16 and U17) and their associated components generate the +5 V rail that is applied to circuitry throughout the transmitter.

A +48 V to +15 V converter (U1) and its associated components generate the +15 V that is applied to the exciter/control PWB.

## Pre-amp/IPA PWB (NAPA28B)

See electrical schematic Figure SD-4.

The pre-amp/IPA PWB (A5) accepts the RF output of the exciter/control PWB (A1), or external source, and amplifies it to an intermediate RF drive level for application to the PA PWBs (A6 through A9) via the splitter PWB (A4). The pre-amp/IPA PWB contains two N-channel FETs (Q1 and Q2) and associated components configured as a two-stage RF power amplifier. The RF output is generated by the *Pre-amp V* and *IPA V* levels provided by the PS distribution PWB (A2), and the *Pre-amp Bias* and *IPA Bias* outputs from the exciter/control PWB (A1). The RF output level is controlled by the RF input level generated by the exciter/control PWB. Cooling air for the pre-amp PWB is provided by fan B1.

The *RF Drive* input is applied to the gate of FET Q1 through a series of micro-strip transmission line sections and capacitors C1 and C2 and inductor L1, which provide impedance matching to transform the 50 ohm input to low impedance for application to Q1. Additional micro-strip transmission line sections at the output of Q1, as well as inductors L8 and L9 and capacitors C16 and C17, impedance match the Q1 output signal to 50 ohms. The impedance matched output of Q1 is applied to the gate of FET Q2 through a series of micro-strip transmission line sections and associated components, including capacitor C18 and inductor L10, which provide impedance matching to transform the 50 ohm input to low impedance for application to Q2. Additional micro-strip transmission line sections at the output of Q2, as well as inductors L16 and L17 and capacitors C25 through C27, impedance match the *RF Output* signal to 50 ohms. .

The *Pre-amp V* input is applied to capacitors C29, C10, C11 and C12, which act as a broadband decoupling network. Capacitor C15 and inductors L5 and L7 provide low-pass filtering of the RF signal back to the ac-dc power stage.

The *IPA V* input is applied to capacitors C19, C21, C22 and C24, which act as a broadband decoupling network. Capacitor C23 and inductors L14 and L15 provide low-pass filtering of the RF signal back to the ac-dc power stage.

The *Pre-amp Bias* input voltage is provided by the exciter/control PWB to establish a dc bias current for Q1.

The *IPA Bias* input voltage is provided by the exciter/control PWB to establish a dc bias current for Q2.

## Power amplifier PWB (NAPA31C)

See electrical schematic Figure SD-5.

Each power amplifier (PA) PWB (A6 through A9) accepts the RF output of the pre-amp/IPA PWB (A5), which has been split four ways by the splitter PWB (A4), and amplifies it to its RF output level. Each PA PWB is a push-pull, RF power amplifier that is capable of providing 850 W of RF power in the FM broadcast band (87.5 to 108.0 MHz). The RF output is controlled by the *PA V* level generated by the power supply modules, the *PA Bias* output from the exciter/control PWB (A1), and the RF drive level generated by the IPA PWB. Cooling air for the PA PWBs is provided by fans B3 through B7.

The *RF Drive* input is applied to transformer T3, which is connected as a balun to provide balanced, 180° out-of-phase, RF drive signals to the individual gates of dual N-channel power MOSFET (Q1). Inductors L1, L2 and L3, capacitor C18 and transformer T3 provide impedance matching, which transforms the 50 ohm input to low impedance for application to Q1. The PA voltage is applied to the individual drains of Q1 via transformer T2, which, along with capacitors C14 and C15, cable T1 and inductor L4, transforms the impedance at the RF output, ensuring an optimum (low) impedance is presented at Q1's output. Cable T1 converts the balanced RF signal to an unbalanced RF Output signal. Capacitors C8, C10, C12 and C19 are used as dc blocking capacitors.

The *PA V* input is applied to capacitors C1, C2, C3, C4, C5, C9, C11, C13, C17, C21 and C22, which act as a broadband decoupling network. Capacitor C20 and resistors R4 and R5 provide low-pass filtering of the RF signal back to the ac-dc power stage.

The *PA Bias* input voltage is provided by the exciter/control PWB to establish a dc bias current for Q1. The bias current depends on the operating mode. The *PA Bias* voltage is applied to a low-pass filter circuit, formed by resistor R3 and capacitor C6, and is then applied to a voltage divider formed by resistors R3 and R1. Diodes CR1 and CR2 prevent the bias voltage from dropping below -6 V and damaging the FET.

# Section 3: Parts Lists

## Parts information

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.

## Family tree

Figure 3.1 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.

## 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., NAPA31C) assigned to the assembly containing the part or the full reference designation, including the reference designation of all higher assemblies, must be known.

### When the Nautel nomenclature is known:

- Refer to the family tree (Figure 3.1 on page 3-4) 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.

### When the reference designation is known:

- Refer to the family tree depicted in Figure 3.1 on page 3-4 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.

## Reference designation lists

Reference designation lists are provided for:

- assemblies with an alpha-prefixed Nautel nomenclature (e.g., NAPA31C)
- cable harnesses with a numbered Nautel part (e.g., 211-8204-01)
- optional kits with a numbered Nautel part

To obtain the full reference designation for a specific part the Nautel configuration control number must be located in the family tree (Figure 3.1 on page 3-4) 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.

# Column content

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

## 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.

### 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 VS2.5's overall parts list, or the top block in the family tree shown in Figure 3.1 on page 3-4 to determine where to locate its part information.

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.

### 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., NAPA*) 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 Responding to Alarms section of this manual, otherwise contact Nautel to order a replacement part or to request assistance to find a suitable replacement.*

### 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.

### Reference Designation column

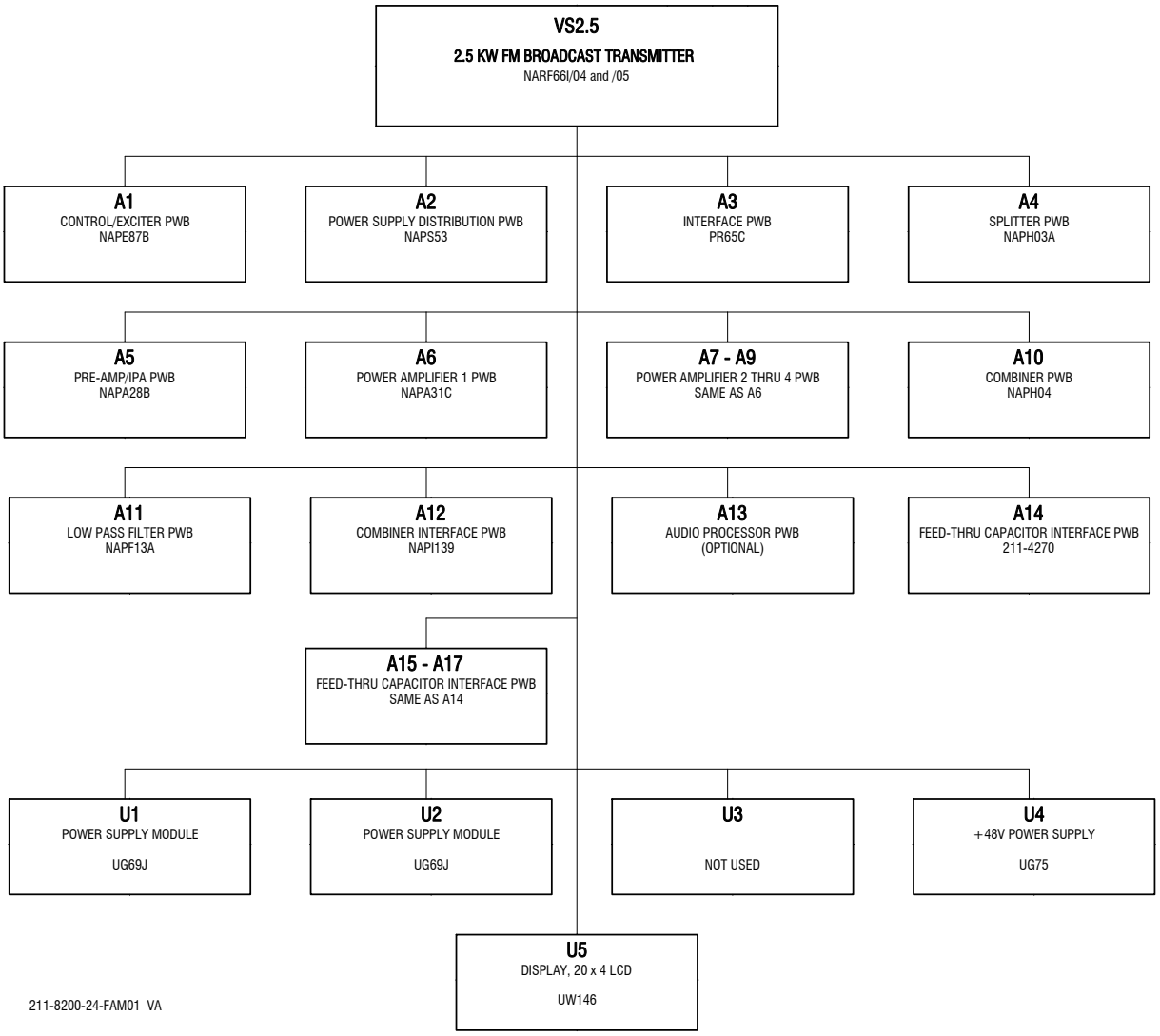
The Reference Designation column contains the reference designation(s) for a specific part. When multiple reference designations apply to a part, they are sorted alphanumerically. These designations are assigned in accordance with the requirements of American Society of Mechanical Engineers ASME Y14.44-2008.

## Common abbreviations/acronyms

The following abbreviations/acronyms may appear in the *Description* column:

- SMT: Denotes item is designed to be installed using Surface Mount Technology.
- MTA: Denotes item is a Mass Termination Assembly connector.
- SIP: Single In-line Package
- DIP: Dual In-line Package
- IDC: Denotes item is an Insulation Displacement connector for ribbon cable.

## Figure 3.1: VS2.5 Family Tree



**StockCode:** NARF66I/04
**Description:** Final Assy, VS2.5, 7/16 DIN, (w/o JA55),Dual Power, Supply, RLS 10

| Component Lvl, StockCode | Description | Reference Designation |
|---|---|---|
| 01 **200-5112** | **USB Mod, Programmed VS (Handbook)** | |
| 01 **211-4270** | **Feed-Thru Capacitor Interface Assy, VS2.5** | A14, A15, A16, A17 |
| 02 JT139 | Terminal Block, 4-Pos, Tri-Bar rier, 30A, PWB Moun | TB01 |
| 01 **211-5034** | **Fan Mod (ZAP50)** | B01, B02 |
| 01 **211-8204-02** | **Cable Assy, VS2.5** | |
| 02 JDP24 | Conn, Coax, BNC, Plug, 50ohm, Crimp | W5P1, W5P2, W6P1 |
| 02 JN61 | Conn, 16 Pin, Dual Row Crimp | P05 |
| 02 JN65 | Conn, Edge Card to Ribbon Cbl, 40pin, Dual Row, 30 | W1P2 |
| 02 JP45 | Conn, Recept, Ribbon Cable, 20 pin | W2P1, W2P2, W4P1, W4P2 |
| 02 JP51 | Conn, Recept, Ribbon Cable, 40 pin | W1P1 |
| 02 JT60 | Conn, Coax, BNC, Recept, Bulkhead, RG188 | J03, J04 |
| 02 JU02 | MTA, Standard Dust Cover, 4 pi n | P06 |
| 02 JU27 | MTA, Keyed Closed End Housing, 4 pin,22AWG | P06 |
| 02 JU46 | MTA,Closed End Housing,3 pin, 22 AWG | P07, P08 |
| 02 JU47 | MTA,Standard Dust Cover,3 pin | J05, J06, P07, P08 |
| 02 JU58 | Conn, Contact for Socket DF11, 22AWG | P05 |
| 02 JU65 | Conn, MTA, Wire-Wire Pst Hsng, 3-pin, 22 AWG | J05, J06 |
| 02 LA52 | Ferrite, Clip-On, NiZn, 320ohm s @ 100 MHz | W5L1 |
| 01 **211-8974-06** | **Packing Supplies, VS2.5** | |
| 02 211-8005-08 | Ancillary Kit (VS300, VS1, VS2.5) | |
| 02 211-8980-03 | Installation Kit, VS2.5 | |
| 03 211-5060 | Interlock Jumper Wire | |
| 03 211-5120-01 | AC Entrance Box, VS2.5 Assy | |

| Component Lvl. StockCode | Description | Reference Designation |
|---|---|---|
| 01 **BAP44** | **LED, Pilot Light, Amber, 230 Vac** | DS01 |
| 01 **CBP08** | **Capacitor, Feed-Thru, Ceramic, 1000pF** | C01, C02, C03, C04, C05, C06, C07, C08, C09 |
| 01 **JA44** | **Conn, Coax, Recept, 7/16 DIN, Panel,50ohm** | J02 |
| 01 **JT140** | **Terminal Block, Feed Thru, 1 pole, Grey, 10mm(2),** | TB01, TB02 |
| 01 **JT141** | **Terminal Block, Feed Thru, 1 pole,Grn/Yel,10mm(2),** | TB03 |
| 01 **LA64** | **Ferrite, 28 MTL, ribbon cable, 20 POS, Metal clip,** | L08 |
| 01 **NAPA28B** | **PA PWB Assy, Pre-Amp/IPA** | A05 |
| 02 CBP18 | Capacitor, Electrolytic, 330uF , 63V, 20% Radial L | C19 |
| 02 CCFS28 | Cap,SMT,Ceramic,47pF,2%,50V, C0G,0603 | C02 |
| 02 CCFS66 | Cap, SMT, Ceramic, 10+/-0.5pF, 100V COG, 1206 | C17 |
| 02 CCFS67 | Cap, SMT, Ceramic, 12+/-0.5pF, 100V COG, 1206 | C13, C14 |
| 02 CCFS68 | Cap, SMT, Ceramic, 1000pF, 5%, 100V, C0G, 1206 | C28 |
| 02 CCFS69 | Cap, SMT, Ceramic, 47pF, 5%, 50V, C0G, 0805 | C18 |
| 02 CS91 | Capacitor, SMT, Porcelain,30pF 500V, 2% | C25, C26, C27 |
| 02 CT20 | Capacitor, SMT, Ceramic, 1000p F, 5%, 63V | C01, C06, C15, C16, C20 |
| 02 CT53 | Capacitor,SMT,Ceramic,0.001uF, 50V,10% | C23 |
| 02 CT61 | Capacitor, SMT, Ceramic, 0.022 uF, 100V, 10%, 1206 | C04, C05, C08, C09, C11, C12, C21, C22 |
| 02 CT66 | Capacitor, SMT, Ceramic, 0.1uF 10%, 100V | C03, C07, C10, C24 |
| 02 CT68 | Cap, SMT, Electrolytic, 68uF, 20%, 63V | C29 |
| 02 LA51 | Inductor, used with PA NAPA16 & 20 | L14 |
| 02 LA56 | Bead, Ferrite, SMT, 95 ohm, 2.85mm H x 9.6mm Lg | L02, L03, L06, L13 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | LA57 | Bead, Ferrite, SMT, 47ohm, 2.85mm H x 5.10mm Lg | L12 |
| 02 | LS26 | Inductor, SMT, 82nH, 2%, 2.5A, 4.20mm H x 4.95mm | L05 |
| 02 | LS27 | Inductor, SMT, 120nH, 2%,1.5A, 4.20mm H x 4.95mm | L07 |
| 02 | LS28 | Inductor, SMT, 35.5nH, 2%, 4A, 3.15mm H x 6.86mm L | L08, L09 |
| 02 | LS29 | Inductor, SMT, 43nH, 2%, 4A, 3.15mm H x 6.86mm Lg | L01, L04 |
| 02 | LS33 | Inductor, SMT, 17.5nH, 5%, 4A 3.15mm H x 6.86mm L | L11 |
| 02 | LS36 | Inductor, SMT, 33nH, 2%, 3A, 4.2mm H x 4.95mm L | L10 |
| 02 | LS38 | Inductor, SMT, 28nH | L15 |
| 02 | LS39 | Inductor, SMT, 12nH | L16, L17 |
| 02 | QAP60 | Transistor, FET, N-Channel, LDMOS, 10W, 50V | Q01 |
| 02 | QAP61 | Transistor, FET, N-Channel LDMOS, 150W, 50V | Q02 |
| 02 | RAD12 | Resistor, SMT, MF, 82.5 Ohms, 1% 1/4W | R01 |
| 02 | RAD14 | Resistor, SMT, MF, 121 Ohms, 1% 1/4W | R03 |
| 02 | RFCS03 | Resistor, SMT, Film, 27.4 ohm, 1%, 1/2W | R02 |
| 01 | **NAPA31C** | **PA PWB Assy, LDMOS (QAP66)** | A06, A07, A08, A09 |
| 02 | CS94 | Capacitor, SMT, Porcelain,36pF 500V, 2% | C18 |
| 02 | CS95 | Capacitor, SMT, Porcelain,15pF 500V, 2% | C15 |
| 02 | CS96 | Capacitor, SMT, Porcelain, 2pF 500V, +/-0.1pF | C14 |
| 02 | CT52 | Capacitor,SMT,Ceramic,470pF, 200V,10% | C17 |
| 02 | CT53 | Capacitor,SMT,Ceramic,0.001uF, 50V,10% | C08, C10, C12, C16 |
| 02 | CT66 | Capacitor, SMT, Ceramic, 0.1uF 10%, 100V | C06, C20 |
| 02 | CT74 | Cap, SMT, Ceramic, 10uF, X7R, 100V, Stacked | C21, C22 |
| 02 | CT75 | Cap, SMT, Electrolytic, 470uF, 20%, 63VDC, Low ESR | C01, C02, C03, C04, C05 |
| 02 | CT79 | Capacitor, SMT, Ceramic,0.01uF 50V, 10% | C11, C13 |
| 02 | FA64 | Fuse, SMT, 125VAC, VDC, 30A, Fast Acting | F01 |
| 02 | LS26 | Inductor, SMT, 82nH, 2%, 2.5A, 4.20mm H x 4.95mm | L05 |
| 02 | LS40 | Inductor, SMT, 5nH, 5%, Mini Spring | L01, L03 |
| 02 | LS41 | Inductor, SMT, 100nH, 5%, Midi Spring | L02 |
| 02 | QAP66 | Transistor, FET, LDMOS, Dual, Ruggedized | Q01 |
| 02 | QDSS01 | Diode,SMT,Schottky,30V,0.2A, SOD-323 | CR01 |
| 02 | QDZS01 | Diode,SMT,Zener,5.1V,5%,3W,SMB | CR02 |
| 02 | RAD45 | Resistor, SMT, MF, 47.5K Ohms, 1% 1/4W | R01 |

| Component Lvl, StockCode | | Description | Reference Designation |
|---|---|---|---|
| 02 | RAD49Z | Resistor,SMT,MF,10ohms, 1%,2W | R02 |
| 02 | RAD54Z | Resistor,SMT,4.7 ohms, 5%,2W | R04, R05 |
| 02 | RAD80 | Resistor, SMT,10k Ohms, 1%, 1W 2512 | R03 |
| 02 | TZ118 | Transformer, Gate Drive, VHF, 3T/1 Turn | T03 |
| 02 | WE54 | Cable, Coax, 12 Ohm, 600V, 200 C, TFE | T02A, T02B |
| 02 | WE56 | Cable, Coax, 50 Ohm, 70% VP, 150C, PTFE, 11mm Min | T01 |
| 01 | **NAPE87B** | **Exciter/Controller PWB Assy, VS/NVLT w/CE** | A01 |
| 02 | BBHT01 | Holder, 20mm Coin Cell, PWB Mt | XBT01 |
| 02 | BBLT01 | Battery, Lithium, 3V,20mm Coin Cell | BT01 |
| 02 | CCFS01 | Cap,SMT,Ceramic,0.001uF,10%,50 V,X7R,0603 | C008, C033, C122, C125, C127, C152, C158, C159, C161, C162, C175, C176, C180, C182, C183, C185,, C188, C189, C193, C194, C198, C199, C200, C203, C205, C206, C222, C223, C224, C225, C228, C229,, C230, C233, C234, C237, C251, C253, C255, C353, C354, C355, C360, C364, C366, C369, C370, C382,, C383, C384, C386, C387, C392, C393, C398, C399, C400, C401, C502, C503, C539, C591 |
| 02 | CCFS02 | Cap,SMT,Ceramic,0.0022uF,10%, 50V,X7R,0603 | C128 |
| 02 | CCFS03 | Cap,SMT,Ceramic,0.0047uF,10%, 50V,X7R,0603 | C022, C035, C063, C069 |
| 02 | CCFS04 | Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603 | C243, C256, C257, C258, C259, C273, C274, C275, C276, C286, C287, C288, C296, C297, C299, C300,, C305, C306, C310, C311, C315, C316, C319, C320, C323, C324, C325, C326, C411 |
| 02 | CCFS06 | Cap,SMT,Ceramic,0.047uF,10%,50 V,X7R,0603 | C034, C067 |
| 02 | CCFS10 | Cap,SMT,Ceramic,1uF,10%,25V, ,X7R,1206 | C174, C177, C266, C280 |
| 02 | CCFS23 | Cap,SMT,Ceramic,18pF,2%,50V, C0G,0603 | C018, C021, C027, C028, C062, C066, C073, C079, C134, C141, C171, C173, C464, C473, C544, C578,, C585 |
| 02 | CCFS24 | Cap,SMT,Ceramic,22pF,2%,50V, C0G,0603 | C014, C017, C039, C046, C047, C053, C054, C058, C059, C077, C106, C107, C108, C109, C112, C129,, C133, C142, C534, C579, C580, C582 |
| 02 | CCFS32 | Cap,SMT,Ceramic,100pF,2%,50V, C0G,0603 | C020, C030, C042, C051, C061, C083, C088, C093, C094, C097, C098, C104, C110, C138, C208, C210,, C220, C227, C289, C290, C292, C293, C437, C459, C467, C485, C499, C505, C518, C542, C543, C570, C587 |
| 02 | CCFS33 | Cap,SMT,Ceramic,150pF,1%,50V, C0G,0603 | C445 |
| 02 | CCFS34 | Cap,SMT,Ceramic,220pF,2%,50V, C0G,0603 | C029, C068 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | CCFS37 | Cap,SMT,Ceramic,390pF,2%,50V, C0G,0603 | C529 |
| 02 | CCFS38 | Cap,SMT,Ceramic,470pF,2%,50V, C0G,0603 | C015, C016, C023, C038, C045, C048, C052, C055, C057, C060, C071, C074, C078, C115, C116, C117,, C118, C119, C120, C130, C143, C155, C409, C429, C434, C435, C525, C548, C550, C574, C575, C581, C593 |
| 02 | CCFS42 | Cap,SMT,Ceramic,1000pF,2%,50V, C0G,0805 | C090, C092, C095, C096, C099, C105, C191, C192, C196, C271, C367, C368 |
| 02 | CCFS47 | Cap,SMT,Ceramic,3900pF,2%,50V, C0G,1206 | C436 |
| 02 | CCFS52 | Cap, SMT, Ceramic, 0.1uF, 10% 25V X7R, 0603 | C002, C003, C011, C013, C019, C025, C026, C037, C040, C050, C056, C065, C070, C072, C075, C076,, C080, C082, C087, C091, C111, C113, C114, C121, C124, C126, C132, C137, C139, C146, C147, C148,, C149, C151, C153, C154, C156, C163, C164, C165, C166, C167, C168, C170, C172, C178, C184, C187,, C195, C201, C202, C207, C209, C216, C217, C218, C219, C226, C231, C232, C235, C238, C239, C240,, C241, C244, C245, C246, C247, C248, C249, C250, C254, C261, C262, C264, C268, C269, C270, C277,, C281, C282, C283, C284, C285, C291, C294, C295, C298, C301, C302, C303, C304, C307, C308, C309,, C312, C313, C314, C318, C321, C322, C327, C328, C329, C331, C334, C338, C339, C340, C341, C342,, C343, C344, C349, C350, C356, C357, C358, C359, C361, C362, C363, C371, C372, C373, C374, C375,, C376, C377, C378, C379, C380, C381, C385, C388, C389, C390, C394, C395, C402, C403, C404, C407,, C410, C412, C413, C415, C416, C417, C419, C421, C422, C423, C424, C426, C427, C432, C433, C438,, C439, C440, C441, C442, C443, C444, C446, C447, C448, C449, C456, C457, C458, C461, C462, C463,, C465, C466, C468, C469, C470, C471, C472, C474, C475, C476, C477, C478, C479, C480, C481, C482,, C483, C484, C486, C487, C488, C489, C490, C491, C492, C493, C494, C495, C496, C497, C498, C500,, C501, C506, C507, C508, C509, C510, C511, C512, C513, C514, C515, C516, C517, C520, C521, C522,, C524, C526, C528, C530, C531, C532, C533, C536, C541, C545, C546, C547, C549, C551, C553, C554,, C555, C556, C557, C560, C562, C563, C564, C566, C568, C573, C583, C584, C586, C588, C589, C592 |
| 02 | CCFS53 | Cap, SMT, Ceramic,47uF,20%, 6.3V, 1210 | C009, C010, C012, C043, C044, C049, C430, C460, C576, C577 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | CCFS57 | Cap,SMT,Ceramic,10uF,20%,6.3V, X5R,0805 | C001, C005, C006, C007, C081, C084, C086, C089, C131, C150, C179, C181, C337, C347, C348, C504,, C523, C527, C569, C571, C572 |
| 02 | CCFS58 | Cap,SMT,Ceramic,22uF,20%,6.3V, X5R,1206 | C140, C186, C330, C332, C333, C336, C346, C397, C405, C406 |
| 02 | CCFS60 | Cap,SMT,Ceramic,1uF,10%,100V, X7R,1210 | C031, C123, C214, C215, C236, C558, C567 |
| 02 | CCFS62 | Cap, SMT, Ceramic, 10uF, 10%, 25V | C265, C418, C425, C537, C538, C540 |
| 02 | CCFS73 | Cap, SMT, Ceramic, 1uF, 10%, 16V, X5R, 0603 | C024, C041, C064, C085, C135, C136, C144, C145, C157, C160, C204, C252, C345, C351, C352, C365,, C391, C519, C590 |
| 02 | CT51 | Capacitor,SMT,Ceramic,0.1uF, 100V,10% | C032, C197, C213, C221, C561, C565 |
| 02 | CT85 | Cap, SMT, Ceramic, 3 Terminal, 22pF, 16vDC, 600mA | C100, C101, C102, C103, C260, C263, C267, C272, C278, C279, C335, C396, C408, C414, C450, C451,, C452, C453, C454, C594 |
| 02 | CT86 | Cap, SMT, Ceramic, 3 Terminal, 1000pF, 16vDC, 600m | C242, C317, C420, C428, C431, C455 |
| 02 | CTFS04 | Cap,SMT,Tantalum,100uF,10%,10V ,2917 | C004, C036, C190, C535, C552 |
| 02 | CX38 | Cap,SMT,Ceramic,4.7uF,10%,10V, X5R, 1206 | C169, C559 |
| 02 | HAJ66 | Terminal, SMT, Test Point, PWB | TP04, TP06, TP07, TP15, TP18, TP19, TP20 |
| 02 | JF47 | Conn, Header,Square Post,Gold, Dual,40-pin | J17, J19 |
| 02 | JM44 | Conn, Modular Jack, RJ45, Shld , Side, PWB, 50u | J01 |
| 02 | JM49 | Conn, Socket, 1xMag RJ45 + 2x USB-A | J08 |
| 02 | JQ15 | Conn, Post Shunt, 2 Pos, .10 C entreline | E01, E02 |
| 02 | JQ16 | Conn, Header, SIP,12 Pin Break away,.10 Ctr | J16, J21, XE01, XE02 |
| 02 | JQ53 | Conn, Header, Ribbon Cbl, 40- Pin | J15 |
| 02 | JQ55 | Conn, Header, Ribbon Cbl, 20 Pin | J11, J12 |
| 02 | JQ76 | Conn, Header, Ribbon Cable 14 pin | J13 |
| 02 | JS21 | Conn, BNC, Recept, Rt Angle, P WB Mt | J14 |
| 02 | JT100 | Conn, Dual, BNC, PWB, Rt Angle | J04, J06 |
| 02 | JT121 | Conn, Dual, D-Sub, F/M, 9 pin, Rt. Angle, PWB | J05 |
| 02 | JT61 | Conn, BNC, Recept, 50ohm,Insul , Rt Angle | J07 |
| 02 | JT78 | Connector,Dual,D-Sub,M/F, 25-pin,Rt Agl,PWB | J02 |
| 02 | JT87 | Conn,3-pin,PWB Mount, Fem, XLR | J03 |
| 02 | JU25 | MTA, Keyed Square Post Header Assy, 4 pin | J10 |
| 02 | JU74 | Conn, 2mm, Shrouded Header, PH Series, Top, White | J09 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | LCFS01 | Inductor, SMT, Choke, 600ohms, 2A, 0805 | L002, L004, L005, L006, L007, L010, L011, L012, L016, L017, L018, L019, L020, L023, L024, L025,, L028, L029, L030, L031, L033, L035, L036, L037, L038, L039, L040, L042, L043, L044, L045, L046,, L047, L048, L049, L050, L051, L052, L053, L054, L055, L056, L057, L058, L059, L060, L061, L062,, L064, L069, L071, L073, L074, L075, L076, L077, L078, L080, L081, L082, L083, L084, L086, L087,, L088, L089, L090, L097, L098, L099, L100, L102, L103, L110, L111, L122, L123, L124, L125, L129,, L130, L131, L132, L133, L134, L137, L138, L140, L144, L145, L146, L147, L154, L155, L156, L157,, L158, L159, L160, L161, L162, L163, L164, L171, L174, L176, L177 |
| 02 | LCFS02 | Inductor, SMT, Choke, 2000 ohm s, 80mA, 0805 | L022, L034, L093, L095, L105, L106, L107, L108, L109, L126, L127, L128, L135, L136, L139, L141,, L142, L143, L148, L149, L150, L151, L152, L153, L165, L166, L167, L168, L169, L170, L172, L173,, L175, L179 |
| 02 | LS17 | Inductor,SMT,Pwr,Shielded,P116 7 Series,3.5A,3.6uH | L003, L013 |
| 02 | LS20 | Inductor,SMT,560nH,325mA,2520 | L008, L009, L021, L041 |
| 02 | LS22 | Choke,SMT,Common Mode,2200 ohm ,200mA,1206 | L117, L119 |
| 02 | LS24 | Inductor, SMT, 10uH, 2.4A, RMS | L027 |
| 02 | LS48 | Choke, SMT, Common Mode, 600 ohm, 260mA | L063, L065, L066, L067, L068, L070, L072, L079, L085, L091, L092, L094, L096, L101, L104, L112,, L113, L114, L115, L116, L118, L120, L121, L178, L180 |
| 02 | QBNS01 | Transistor,SMT,NPN,Switch/Amp ,SOT-23 | Q01, Q02, Q04 |
| 02 | QDDS02 | Diode, SMT, Schottky, 40V, 1A, SMA | CR01 |
| 02 | QDRS01 | Diode,SMT,Switching,250V,0.2A, SOD-323 | CR04, CR05, CR06, CR07, CR08, CR09, CR10, CR11, CR12, CR13, CR14, CR15, CR16, CR17, CR18, CR19 |
| 02 | QDSS01 | Diode,SMT,Schottky,30V,0.2A, SOD-323 | CR02, CR03, CR22, CR23 |
| 02 | QM48 | Diode,SMT,Transient Suppr,10V, SMB | CR20, CR21 |
| 02 | QS26 | Transistor, SMT, P-Channel FET 130mA | Q03 |
| 02 | RAD26 | Resistor, SMT, MF, 1210 Ohms, 1% 1/4W | R085, R086, R093, R094 |
| 02 | RAD33 | Resistor, SMT, MF, 4750 Ohms, 1%, 1/4W | R172, R173, R174, R175, R176, R180, R181, R183, R184, R187, R188 |
| 02 | RAD44 | Resistor, SMT, MF, 39.2K Ohms, 1% 1/4W | R399, R402, R407, R410 |
| 02 | RAD53 | Resistor,SMT,MF,49.9ohms,1%, 1/10W,0603 | R170 |
| 02 | RAD57 | Resistor, SMT, 25.5 ohms, 1%, 2512 | R182, R197 |
| 02 | RAE25 | Resistor,SMT,MF,3.74K,1%,1/10W ,0603 | R021 |
| 02 | RAE31 | Resistor,SMT,MF,6.49K,1%,1/10W ,0603 | R003 |

| Component Lvl, StockCode | | Description | Reference Designation |
|---|---|---|---|
| 02 | RAE34 | Resistor,SMT,MF,49.9R,1%,1/10W 0603 | R240, R241, R465, R469, R473, R474 |
| 02 | RFFS01 | Resistor,SMT,MF,0.0ohms,Jumper ,0603 | R207, R208, R325 |
| 02 | RFFS02 | Resistor,SMT,MF,1.00ohms,1%, 1/10W,0603 | R119, R120, R121, R132, R186, R346, R347, R356, R357, R379 |
| 02 | RFFS10 | Resistor,SMT,MF,4.75ohms,1%, 1/10W,0603 | R019, R028, R030, R039, R128, R136, R222, R236, R242, R247, R249, R250, R252, R256, R257, R265,, R419, R431, R446, R457, R459, R475 |
| 02 | RFFS15 | Resistor,SMT,MF,12.1ohms,1%, 1/10W,0603 | R142, R143, R144, R145, R146, R147, R152, R153, R157, R158, R160, R161, R162, R163, R167, R168 |
| 02 | RFFS18 | Resistor,SMT,MF,22.1ohms,1%, 1/10W,0603 | R063, R067, R075, R076, R077, R079, R083, R097, R113, R117, R122, R124, R125, R149, R166, R178,, R198, R210, R253, R254, R262, R303, R324, R337, R370, R384, R386, R390, R406, R422, R424, R436,, R438, R444, R445, R454, R483 |
| 02 | RFFS19 | Resistor,SMT,MF,27.4ohms,1%, 1/10W,0603 | R015, R016, R023, R024, R464, R470 |
| 02 | RFFS21 | Resistor,SMT,MF,39.2ohms,1%, 1/10W,0603 | R082, R089, R090, R098, R479, R480, R481, R482 |
| 02 | RFFS23 | Resistor,SMT,MF,56.2ohms,1%, 1/10W,0603 | R335, R336 |
| 02 | RFFS26 | Resistor,SMT,MF,100ohms,1%, 1/10W,0603 | R046, R048, R060, R064, R069, R072, R116, R118, R129, R150, R151, R193, R215, R220, R227, R228,, R229, R243, R244, R259, R260, R263, R288, R319, R320, R321, R322, R327, R328, R329, R330 |
| 02 | RFFS27 | Resistor,SMT,MF,121ohms,1%, 1/10W,0603 | R139 |
| 02 | RFFS28 | Resistor,SMT,MF,150ohms,1%, 1/10W,0603 | R070, R071 |
| 02 | RFFS29 | Resistor,SMT,MF,182ohms,1%, 1/10W,0603 | R223, R238 |
| 02 | RFFS30 | Resistor,SMT,MF,221ohms,1%, 1/10W,0603 | R025, R044 |
| 02 | RFFS31 | Resistor,SMT,MF,274ohms,1%, 1/10W,0603 | R022, R050, R058, R099, R100, R103, R104, R134, R397, R405, R409, R412, R414, R426, R434, R440,, R484 |
| 02 | RFFS33 | Resistor,SMT,MF,392ohms,1%, 1/10W,0603 | R052, R054, R055, R065, R066, R068, R073, R074, R420, R427, R428 |
| 02 | RFFS34 | Resistor,SMT,MF,475ohms,1%, 1/10W,0603 | R001, R007, R012, R013, R029, R031, R033, R034, R035, R040, R059, R105, R106, R107, R108, R114,, R127, R209, R221, R237, R239, R361, R363, R371, R375, R380, R382, R388, R430, R451, R460, R461, R466 |
| 02 | RFFS36 | Resistor,SMT,MF,681ohms,1%, 1/10W,0603 | R396, R404, R408, R411 |
| 02 | RFFS37 | Resistor,SMT,MF,825ohms,1%, 1/10W,0603 | R360 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | RFFS38 | Resistor,SMT,MF,1000ohms,1%, 1/10W,0603 | R017, R037, R042, R043, R062, R078, R081, R087, R088, R095, R096, R115, R189, R196, R199, R205,, R211, R218, R219, R224, R225, R226, R232, R233, R234, R235, R255, R258, R264, R266, R268, R271,, R272, R274, R276, R277, R278, R281, R282, R310, R311, R333, R352, R364, R393, R394, R395, R400,, R413, R416, R417, R468 |
| 02 | RFFS39 | Resistor,SMT,MF,1210ohms,1%, 1/10W,0603 | R004, R005, R006, R036, R140 |
| 02 | RFFS40 | Resistor,SMT,MF,1500ohms,1%, 1/10W,0603 | R201, R202, R365, R366, R367, R447 |
| 02 | RFFS42 | Resistor,SMT,MF,2210ohms,1%, 1/10W,0603 | R126, R131, R203, R204, R348, R350, R376, R381, R389, R391, R392 |
| 02 | RFFS45 | Resistor,SMT,MF,3920ohms,1%, 1/10W,0603 | R027, R047 |
| 02 | RFFS46 | Resistor,SMT,MF,4750ohms,1%, 1/10W,0603 | R101, R111, R130, R156, R309, R312, R334, R351, R425 |
| 02 | RFFS50 | Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603 | R002, R008, R011, R018, R026, R032, R045, R049, R051, R053, R057, R061, R080, R084, R091, R092,, R102, R110, R133, R137, R138, R154, R155, R159, R164, R165, R169, R171, R177, R179, R185, R190,, R191, R192, R195, R200, R206, R212, R213, R214, R217, R261, R267, R284, R285, R286, R287, R289,, R290, R291, R292, R293, R294, R295, R296, R297, R298, R299, R300, R301, R302, R304, R305, R306,, R307, R308, R313, R315, R316, R317, R338, R345, R349, R353, R372, R385, R415, R418, R421, R423,, R429, R432, R433, R435, R437, R439, R441, R442, R443, R448, R449, R453, R462, R463, R485, R486, R487 |
| 02 | RFFS52 | Resistor,SMT,MF,15.0Kohms,1%, 1/10W,0603 | R014, R450, R452, R455, R456, R458, R471, R472 |
| 02 | RFFS54 | Resistor,SMT,MF,22.1Kohms,1%, 1/10W,0603 | R010, R112 |
| 02 | RFFS57 | Resistor,SMT,MF,39.2Kohms,1%, 1/10W,0603 | R216 |
| 02 | RFFS58 | Resistor,SMT,MF,47.5Kohms,1%, 1/10W,0603 | R194, R269, R270, R279, R280 |
| 02 | RFFS59 | Resistor,SMT,MF,56.2Kohms,1%, 1/10W,0603 | R383 |
| 02 | RFFS60 | Resistor,SMT,MF,68.1Kohms,1%, 1/10W,0603 | R056 |
| 02 | RFFS62 | Resistor,SMT,MF,100Kohms,1%, 1/10W,0603 | R020, R038, R467 |
| 02 | RFFS63 | Resistor,SMT,MF,121Kohms,1%, 1/10W,0603 | R403 |
| 02 | RFFS65 | Resistor,SMT,MF,182Kohms,1%, 1/10W,0603 | R109 |
| 02 | RFFS66 | Resistor,SMT,MF,221Kohms,1%, 1/10W,0603 | R009 |
| 02 | RFFS74 | Resistor,SMT,MF,1.00Mohms,1%, 1/10W,0603 | R123 |
| 02 | RFFS83 | Resistor,SMT,MF,28.7K Ohms,1%, 1/10W,0603 | R041 |
| 02 | RFFS87 | Resistor, SMT, 200ohm, 1%, 1/10W, 0603 | R135, R141, R355, R359 |
| 02 | RFFS88 | Resistor, SMT, MF, 10.0Mohms, 1%, 1/10W, 0603 | R148 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | RT50 | Resistor,SMT,MF,0.0 ohms, Jumper,0805 | R344, R476, R477, R478, R488 |
| 02 | RX62 | Thermistor, PTC, SMT, 1206, 125mA Hold | RT01 |
| 02 | SD77 | Switch, SMT, SPST, Momentary, w/ESD gnd | S01 |
| 02 | TZ102 | Transformer, SMT, Balun, 4.5- 1000MHz | T02, T03 |
| 02 | TZ103 | Transformer, SMT, 4:1, 2-300 MHz | T04 |
| 02 | TZ88 | Transformer,SMT,50 ohms,0.03 to 125MHz | T01 |
| 02 | UC77 | IC, Temp, Sensor, 3.3V, 1-Wire MSOP-8 | U105 |
| 02 | UD65 | IC,SMT,Differential Line Receivr, 100dB CMR | U013 |
| 02 | UD80 | IC, SMT, Inverter, UHS, Dual, UnBFR, 6p SC70 1.2mm | U056, U075 |
| 02 | UDLS03 | IC,SMT,CMOS,Hex Schm,Trig,Inv, SOIC-14 | U103 |
| 02 | UDLS04 | IC,SMT,CMOS,8-Bit Shft Reg,Par I/P, SOIC-16 | U087 |
| 02 | UDLS05 | IC,SMT,CMOS,8-Bit Shft Reg,Par O/P, SOIC-16 | U090 |
| 02 | UDLS09 | IC,SMT,CMOS,Hex Inverter,Unbuf f,SO-14 | U001 |
| 02 | UDMS11 | IC. SMT, NAND Flash 4Gb, x8, 1b ECC, TSOP-48 | U015 |
| 02 | UDOS01 | IC,SMT,Dual Optocoupler,SOIC-8 | U079, U080, U085, U086, U092, U093 |
| 02 | UDTS05 | IC,SMT,RS-232 Transceiver,3.3V ,SO-16 | U050 |
| 02 | UDTS06 | IC, SMT, USB-OTG Transceiver, QFN-24 | U011 |
| 02 | UDTS07 | IC, SMT, Full Duplex RS485 RxTx, SOIC-8 | U100, U102 |
| 02 | ULAS01 | IC,SMT,Opamp,Quad,Single Suppl y,SOIC-14 | U077, U095, U096 |
| 02 | UM100 | LC Filter, SMT, 0603, 200MHz, 16Vdc, 150mA, 25pF, | U044, U045, U046, U047, U116, U117, U118, U121, U122 |
| 02 | UM102 | Filter LC, SMT, 0603, 500MHz, 16Vdv, 200mA, 10pF, | U107, U119 |
| 02 | UM86 | Filter, SMT, Band Pass FM, 20MHz BW | U076 |
| 02 | UMDS01 | IC,SMT,DAC,8-Bit,4-ch,SPI, SOIC-14 | U073, U088, U089 |
| 02 | UP104 | IC, SMT, Voltage Regulator, Dual, ADJ TSSOP16 | U066 |
| 02 | UP105 | IC, SMT, DC-DC Converter, Boost/Inverting MSOP8 | U052 |
| 02 | UP108 | IC, SMT, Quad USB Power Contro ller, SOIC-16 | U009 |
| 02 | UP93 | IC,SMT,Op Amp,Audio,Dual,SO-8 | U017, U018, U030, U037, U038, U059 |
| 02 | US06 | IC, SMT, CMOS, PLL, 6GHz, TSSOP-16 | U065 |
| 02 | US07 | IC, SMT, ADC, 1.25MSPS, 16bit, TQFP-48 | U019 |
| 02 | US08 | IC, SMT, Blackfin DSP, 500MHz, bga-316 | U063 |
| 02 | US09 | IC, SMT, Battery Backup,SOIC-8 | U002 |
| 02 | US12 | Bridge Recitifier, 400V, 0.5A, SOIC-4 | U110, U111, U113, U120 |
| 02 | US13 | IC, SMT, SDRAM, 16Mx16, 3.3V, TSOP-54 | U104, U108, U109 |
| 02 | US16 | IC, SMT, Differential Audio Am p, MSOP-8 | U021, U031, U036 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | US19 | IC, SMT, Digital Step Attenator, QFN-20 | U094 |
| 02 | US20 | IC, SMT, stereo Volume Control , SOIC-16 | U014 |
| 02 | US21 | IC, SMT, SiGe Gain Block, 20dB , SOT-89-3 | U099 |
| 02 | US23 | IC, SMT, Power Shift Register, SOIC-16 | U060, U068 |
| 02 | US25 | IC, SMT, ADC, 11-ch, 10-bit, 3.3V, SPI, SSOP-20 | U098 |
| 02 | US30 | IC, SMT, CMOS, Quad And Gate, SOIC-14 | U016, U020, U054 |
| 02 | US31 | IC, SMT, CMOS, Quad Tri-State Buff, SOIC-14 | U106, U112 |
| 02 | US35 | IC, SMT, RF QDUC, 1GSPS, TQFP- 100 | U062 |
| 02 | US37 | IC, SMT, Audio DAC, 24-bit, 96 KHz, SSOP-16 | U067 |
| 02 | US39 | IC, SMT, Stereo ADC, 24-bit, 216KHz, SSOp-28 | U033 |
| 02 | US43 | Oscillator, SMT, VCSO, 983.04 MHz Fund, LVPECL | Y04 |
| 02 | UT100 | Oscillator,SMT,25MHz,3.3V | Y05 |
| 02 | UT110 | IC, Voltage Regulator, 1.5A, ADJ, Low Drop | U003 |
| 02 | UT114 | IC, Voltage Regulator, +8V, 1A DPAK | U091 |
| 02 | UT115 | IC, SMT, ARM Processor, 266MHz TFBGA296 | U029 |
| 02 | UT116 | Oscillator, SMT, TCVCXO, 3.3V, 2ppm, 5x3.2mm | U082 |
| 02 | UT83 | IC,SMT,Ultrafast Single Supply Comparator,TSSOP | U055, U097 |
| 02 | UT93 | IC,SMT,Voltage Regulator,5V, 1A, D2PAK | U012 |
| 02 | UW110 | Res, SMT Network, 0402x8, 4.7K , 5% | U022, U023, U024, U032, U078, U081, U084 |
| 02 | UW125 | IC, SMT, SPI Flash, 32Mbit, SOIC8W | U053, U115 |
| 02 | UW63 | Res,SMT Network,0402x8,39R | U005, U007, U025, U028, U034, U035, U039, U040, U041, U042, U043, U057, U058, U061, U064, U069,, U070, U071 |
| 02 | UW80 | IC,SMT,SRC,Async,2-ch,TQFP-48 | U072 |
| 02 | UW90 | IC,SMT,Quad 2 TO 1 DATA Sel/ Mux 3 States Output,3 | U048, U051, U101, U114 |
| 02 | UW91 | IC,SMT,SPI UART,3.3V | U049 |
| 02 | UX123 | IC, SMT, 4-port USB Hub, LQFP- 32 | U008 |
| 02 | UX124 | IC, SMT, CPLD, 3.3V, 144 Macro cell, 100-TQFP | U074 |
| 02 | UX64 | IC,SMT,Power Supervisor,Dual I/P,33/1.5V,MSOP | U026 |
| 02 | UX65 | IC,SMT,3A Sync Buck Converter, SO-20 w/pwr pad | U006, U010 |
| 02 | UX83 | IC,SMT,2.5V Reference,0.1%,SOT -23-6 | U027, U083 |
| 02 | UX93Z | IC,SMT,Ethernet Phy,3.3V,LQFP 48 | U004 |
| 02 | XFPS07 | Crystal, SMT, Fund, 12MHz | Y03 |
| 02 | XFPS10 | Crystal,SMT,Fund,ParRes,32.768 kHz, 20ppm, 12.5pF, | Y02, Y07 |

| Component Lvl, StockCode | Description | Reference Designation |
|---|---|---|
| 01 **NAPF13A** | **RF LPF PWB Assy, VS 2.5** | A11 |
| 02 CS100 | Capacitor, SMT, Porcelain,20pF 500V, 2% | C08 |
| 02 CS99 | Capacitor, SMT, Porcelain,18pF 500V, 2% | C07 |
| 02 LA61 | Inductor, Filter Coil, 85nH, 4 turns, 1/8" Refrig | L01, L02, L03, L04, L05 |
| 02 LA62 | Inductor, Staic Drain Choke, 550nH, 14 turns, 16 A | L06 |
| 01 **NAPH03A** | **Splitter PWB Assy, VS2.5** | A04 |
| 02 CCFS04 | Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603 | C05, C06, C07, C12, C13, C18, C19, C24, C25, C30, C31, C32 |
| 02 CT50 | Capacitor,SMT,Ceramic,0.01uF, 100V,10% | C02, C04, C09, C11, C15, C16, C21, C22, C27, C28 |
| 02 CT66 | Capacitor, SMT, Ceramic, 0.1uF 10%, 100V | C03, C10, C17, C23, C29 |
| 02 JN68 | Conn, Edge Card, 3A, 28 Contac ts, Dual Row, 30u G | J06 |
| 02 JS21 | Conn, BNC, Recept, Rt Angle, P WB Mt | J07, J08 |
| 02 JU60 | MTA, Keyed Square Post Header Assy, 3 pin | J01, J02, J03, J04, J05 |
| 02 RFFS01 | Resistor,SMT,MF,0.0ohms,Jumper ,0603 | R04, R06, R07, R08, R09, R10 |
| 02 RT16 | Thermistor, PTC, .50-.77 Ohms, 0.5A Hold | RT01, RT02, RT03, RT04, RT05 |
| 02 RT57 | Resistor, SMT, AIN, 100 ohms, 2%, 30W, 3725 | R01, R03 |
| 02 RT60 | Resistor, Chip, AIN, 50 Ohm, 2%, 30W, 3725 | R02 |
| 01 **NAPH04** | **Combiner PWB Assy, VS2.5** | A10 |
| 02 CS92 | Capacitor, SMT, Porcelain, 4.7 pF, 500V, +/-0.1pF | C01, C02 |
| 02 RAD52 | Resistor,2512 SMT,100 ohms, 1%,1W, | R01, R02, R03, R04 |
| 01 **NAPI139** | **Combiner Interface PWB Assy, VS2.5** | A12 |
| 02 CCFS04 | Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603 | C03, C09, C13 |
| 02 CCFS07 | Cap,SMT,Ceramic,0.1uF,10%,50V, X7R,0805 | C04, C11, C18 |
| 02 CCFS10 | Cap,SMT,Ceramic,1uF,10%,25V, ,X7R,1206 | C02, C05, C14 |
| 02 CCFS33 | Cap,SMT,Ceramic,150pF,1%,50V, C0G,0603 | C19 |
| 02 CCFS62 | Cap, SMT, Ceramic, 10uF, 10%, 25V | C01, C06, C15 |
| 02 CX38 | Cap,SMT,Ceramic,4.7uF,10%,10V, X5R, 1206 | C12, C17 |

| Component Lvl, StockCode | | Description | Reference Designation |
|---|---|---|---|
| 02 | HAJ66 | Terminal, SMT, Test Point, PWB | TP01, TP02, TP03, TP04 |
| 02 | JN69 | Conn, Edge Card, 3A, 12 Contac ts, Dual Row, 30u G | J01 |
| 02 | LS42 | Inductor, SMT, 17.5nH, 2%, 4A, 3.15mm H x 6.86mm L | L01 |
| 02 | RAD11 | Resistor, SMT, MF, 68.1 Ohms, 1% 1/4W | R09, R17, R21 |
| 02 | RAD12 | Resistor, SMT, MF, 82.5 Ohms, 1% 1/4W | R24 |
| 02 | RAD14 | Resistor, SMT, MF, 121 Ohms, 1% 1/4W | R04, R07, R12 |
| 02 | RAD15 | Resistor, SMT, MF, 150 Ohms, 1% 1/4W | R05, R08, R20 |
| 02 | RAD17 | Resistor, SMT, MF, 221 Ohms, 1% 1/4W | R06, R14, R16 |
| 02 | RAD18 | Resistor, SMT, MF, 274 Ohms, 1% 1/4W | R23, R25 |
| 02 | RAD19 | Resistor, SMT, MF, 332 Ohms, 1% 1/4W | R22, R26 |
| 02 | RAD23 | Resistor, SMT, MF, 681 Ohms, 1% 1/4W | R11, R15 |
| 02 | RAD25 | Resistor, SMT, MF, 1000 Ohms, 1% 1/4W | R13 |
| 02 | RAE21 | Resistor, SMT, MF, 49.9 Ohms, 1% 1/4W | R18 |
| 02 | RFFS50 | Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603 | R01, R02, R03, R19 |
| 02 | UX122 | IC, SMT, tru RMS power detecto r, 5.5V | U01, U02, U03 |
| 01 | **NAPS53** | **PS Distribution PWB Assy, VS2.5 (two PS)** | A02 |
| 02 | CCFS04 | Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603 | C005, C018, C019, C020, C021, C022, C023, C024, C025, C026, C028, C030, C031, C035, C036, C037,, C038, C039, C040, C041, C042, C048, C052, C053, C070, C073, C082, C083, C084, C085, C086, C087,, C088, C089, C104, C122 |
| 02 | CCFS52 | Cap, SMT, Ceramic, 0.1uF, 10% 25V X7R, 0603 | C007, C027, C032, C033, C043, C051, C059, C060, C061, C062, C063, C064, C067, C068, C069, C071,, C072, C074, C075, C076, C077, C079, C080, C081, C105, C123 |
| 02 | CCFS60 | Cap,SMT,Ceramic,1uF,10%,100V, X7R,1210 | C003, C006, C008, C010, C011, C014, C092, C094, C095, C096, C097, C101, C112, C114, C115, C116,, C117, C120 |
| 02 | CCFS71 | Cap, SMT, Ceramic, 0.68uF, 10% 100V X7R 1210 | C044, C045, C046, C047 |
| 02 | CT50 | Capacitor,SMT,Ceramic,0.01uF, 100V,10% | C002, C012, C015, C050, C055, C057, C091, C100, C108, C111, C119 |
| 02 | CT66 | Capacitor, SMT, Ceramic, 0.1uF 10%, 100V | C001, C013, C016, C017, C029, C049, C054, C056, C058, C090, C098, C099, C102, C106, C107, C109,, C110, C118 |
| 02 | CTFS01 | Cap,SMT,Tantalum,10uF,10%,16V, 1411 | C103, C121 |
| 02 | CTFS02 | Cap,SMT,Tantalum,1uF,10%,35V, 1411 | C078 |
| 02 | CTFS03 | Cap,SMT,Tantalum,10uF,10%,35V, 2917 | C009 |
| 02 | FA56 | Fuse, SMT, Fuse Block, 7A VeryFast Acting Installe | F01 |

| Component Lvl. | StockCode | Description | Reference Designation |
|---|---|---|---|
| 02 | HAJ66 | Terminal, SMT, Test Point, PWB | TP02, TP03, TP12, TP21, TP28 |
| 02 | JA95 | Conn, 47 Contact, F, 90 deg, PWB Mt | J01, J03 |
| 02 | JQ55 | Conn, Header, Ribbon Cbl, 20 Pin | J06, J07 |
| 02 | JT139 | Terminal Block, 4-Pos, Tri-Bar rier, 30A, PWB Moun | TB01, TB03, TB04 |
| 02 | JT48 | Terminal Block, 6-Pos, Dual Ba rrier, 20A | TB02 |
| 02 | JU60 | MTA, Keyed Square Post Header Assy, 3 pin | J04, J05 |
| 02 | LCFS01 | Inductor, SMT, Choke, 600ohms, 2A, 0805 | L02, L03, L04, L05, L06, L08, L09, L10, L11, L13, L15, L16, L17, L18, L19, L20, L21, L22, L23, L24 |
| 02 | LS16 | Inductor,SMT,Pwr,Shielded Drum Core,P1167series, 2 | L01, L25, L26 |
| 02 | LS17 | Inductor,SMT,Pwr,Shielded,P116 7 Series,3.5A,3.6uH | L14 |
| 02 | LS25 | Choke, SMT, Common Mode, 2800 ohm, 1.5A | L07 |
| 02 | QBNS01 | Transistor,SMT,NPN,Switch/Amp ,SOT-23 | Q03 |
| 02 | QDLS01 | Diode, SMT, LED, Green, (560nm), 0603 | DS01, DS02, DS03, DS04 |
| 02 | QDRS01 | Diode,SMT,Switching,250V,0.2A, SOD-323 | CR07, CR08, CR09, CR10 |
| 02 | QR70 | Suppressor, Transient Voltage, SMT 60V Clamp | CR01, CR02, CR03, CR04, CR05, CR06 |
| 02 | QR71 | Transistor, FET, P-channel, D2Pak | Q02 |
| 02 | RAD27 | Resistor, SMT, MF, 1500 Ohms, 1% 1/4W | R001 |
| 02 | RAD37 | Resistor, SMT, MF, 10.0K Ohms, 1%, 1/4W | R006 |
| 02 | RAD41 | Resistor, SMT, MF, 22.1K Ohms, 1% 1/4W | R049 |
| 02 | RAD48 | Resistor, SMT, MF, 82.5K Ohms, 1% 1/4W | R050 |
| 02 | RAD74 | Resistor, SMT, 0.1ohms, 1206, 1% 1/4W | R055 |
| 02 | RFCS02 | Resistor, SMT, 0.015 Ohm, 1%, 1W | R005 |
| 02 | RFCS04 | Resistor, SMT, 0.002 ohms, 1%, 5W | R089, R090, R092, R096 |
| 02 | RFFS01 | Resistor,SMT,MF,0.0ohms,Jumper ,0603 | R004 |
| 02 | RFFS26 | Resistor,SMT,MF,100ohms,1%, 1/10W,0603 | R008, R009, R010, R011, R012, R013, R014, R015, R016, R025, R040, R041, R042, R043, R044, R045,, R046, R047, R058, R059, R060, R074, R077, R078, R079 |
| 02 | RFFS32 | Resistor,SMT,MF,332ohms,1%, 1/10W,0603 | R094, R101 |
| 02 | RFFS38 | Resistor,SMT,MF,1000ohms,1%, 1/10W,0603 | R052 |
| 02 | RFFS46 | Resistor,SMT,MF,4750ohms,1%, 1/10W,0603 | R061 |
| 02 | RFFS48 | Resistor,SMT,MF,6810ohms,1%, 1/10W,0603 | R068 |
| 02 | RFFS50 | Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603 | R002, R017, R018, R019, R020, R021, R022, R023, R024, R026, R027, R028, R029, R032, R033, R034,, R035, R036, R037, R038, R039, R048, R066, R072, R073, R080, R095, R102 |

| Component Lvl, StockCode | Description | Reference Designation |
|---|---|---|
| 02 RFFS52 | Resistor,SMT,MF,15.0Kohms,1%, 1/10W,0603 | R069 |
| 02 RFFS54 | Resistor,SMT,MF,22.1Kohms,1%, 1/10W,0603 | R064 |
| 02 RFFS61 | Resistor,SMT,MF,82.5Kohms,1%, 1/10W,0603 | R065 |
| 02 RFFS62 | Resistor,SMT,MF,100Kohms,1%, 1/10W,0603 | R007, R063 |
| 02 RFFS63 | Resistor,SMT,MF,121Kohms,1%, 1/10W,0603 | R062 |
| 02 RFFS70 | Resistor,SMT,MF,475Kohms,1%, 1/10W,0603 | R030, R051, R083, R084, R085, R087 |
| 02 RFFS77 | Resistor,SMT,MF,1.82Mohms,1%, 1/10W,0603 | R075, R076, R081, R082 |
| 02 RT16 | Thermistor, PTC, .50-.77 Ohms, 0.5A Hold | RT05, RT06 |
| 02 RT17 | Thermistor, PTC, .15-.25 Ohms, 1.1A Hold | RT01, RT04, RT07, RT08 |
| 02 RT19 | Thermistor, PTC, .05-.08 Ohms, 2.5A Hold | RT03 |
| 02 UDLS04 | IC,SMT,CMOS,8-Bit Shft Reg,Par I/P, SOIC-16 | U04, U05 |
| 02 UDLS05 | IC,SMT,CMOS,8-Bit Shft Reg,Par O/P, SOIC-16 | U06 |
| 02 UG35 | IC,CMOS,Hex Schmitt,Trigger Inverter, SOIC-14 | U02 |
| 02 ULAS02 | IC,SMT,Opamp,Quad,Rail-To-Rail ,SOIC-14 | U08, U11 |
| 02 ULRS02 | IC,SMT,4.096V Reference,0.1%, SOT-23-6 | U10 |
| 02 UMAS01 | IC,SMT,ADC,10-Bit,11-ch,SPI, SOIC-20 | U09 |
| 02 UT74 | IC, Amplifier, Instrumentation | U03, U07, U12, U13, U14, U15 |
| 02 UW113 | Power Supply, DC to DC, 36-75 In, 5 Out, 3A | U16, U17 |
| 02 UW85 | Power Supply,DC-DC,36-75 In, 15 Out, 1A | U01 |
| **01 PR65C** | **PWB Detail, Interface** | A03 |
| **01 RT69** | **Res, (BeO), 50 ohms, 5%, 250W, Flng Mt w/stress re** | A10R10, A10R5, A10R6, A10R9 |
| **01 RT70** | **Res, (BeO), 100 ohms, 5%, 250W Flng Mt w/stress re** | A10R7, A10R8 |
| **01 RX49** | **Thermistor,-30/105ºC,10Kohms@ 25ºC,Neg,Bvalue 3435** | RT01, RT02 |
| **01 SB48** | **Circuit Breaker,2-pole,30A,240 Vac** | CB01 |

| Component Lvl, StockCode | Description | Reference Designation |
|---|---|---|
| 01 **UG69J** | **Pwr Sply, 7-53Vdc, 2000W, 50A 90-264Vac, Hi-Eff (8** | U01, U02 |
| 01 **UG75** | **Power Supply, 48V@320W, 88-264 VAC, PFC, EMI** | U04 |
| 01 **UW137** | **Attenuator, Flange Mount, 150W 3dB** | A10U1 |
| 01 **UW146** | **Display, 20x4 LCD, 3.3 - 5V, -20/+70** | U05 |
| 01 **UX158** | **Coupler, Hybrid, 90 degrees, 3dB, 600W, Caseless** | A04U1 |
| 01 **ZAP50** | **Fan, 80mm, Brushless, 48Vdc, EMI Caps, Tach w/conn** | B03, B04, B05, B06, B07 |

END OF ITEM

# Section 4: Wiring/connector lists

This section contains the wiring information for the hard-wired assemblies of the transmitter, and applicable connector mating information.

## Wiring lists provided

Wiring lists are provided in tabular format. Table 4.1 on page 4-2 lists the tables containing wiring information. These tables provide non-printed wiring pattern, point-to-point (source and destination) interconnection information.

## Wiring lists not provided

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

- Assemblies that have a separate maintenance manual. Refer to the appropriate maintenance manual for detailed wiring information for these assemblies, if provided.
- Assemblies that have their wiring information shown in tables on their assembly detail drawing(s). Refer to the *Mechanical Drawings* section of this manual for detailed wiring information for these assemblies.

## Connector mating information

Where applicable, a connector mating table is provided after the corresponding wiring list. Table 4.2 on page 4-2 identifies all provided connector information.

## Wire colours

Every effort is made to manufacture assemblies using the wire colour shown in the **Colour** column of the wiring list tables. Sometimes, a white wire will be substituted for the listed colour. In such cases, wires must be identified by their assigned numbers.

## Printed wiring board patterns

Printed wiring pattern information for printed wiring boards (PWBs) is beyond the scope of this manual, and therefore not provided.

**Table 4.1: Wiring Lists Provided**

| Table # | Description |
|---|---|
| Table 4.3 | Wiring List - VS2.5 Transmitter (page 4-2) |

**Table 4.2: Connector Mating Information Provided**

| Table # | Description |
|---|---|
| Table 4.4 | Connector Mating Information - VS2.5 Transmitter (page 4-5) |

**Table 4.3: Wiring List - VS2.5 Transmitter**

| Source | Destination | Wire # | Colour | Size | Remarks |
|---|---|---|---|---|---|
| TB1-2 | CB1-L1/IN | 1 | White | 12 | |
| CB1-L1/IN | DS1-X1 | 2 | White | 16 | |
| TB2-2 | CB1-L2/IN | 3 | White | 12 | |
| CB1-L2/IN | DS1-X2 | 4 | White | 16 | |
| TB3-2 | E2 | 5 | Grn/Yel | 12 | |
| E3 | E2 | 6 | Grn/Yel | 12 | |
| CB1-L1/OUT | A2TB1-4 | 7 | White | 12 | |
| CB1-L2/OUT | A2TB1-3 | 8 | White | 12 | |
| E2 | A2TB1-2 | 9 | Grn/Yel | 12 | |
| A2TB2-6 | U4-L | 10 | White | 14 | |
| A2TB2-5 | U4-N | 11 | White | 14 | |
| A2TB2-4 | U4-GND | 12 | Grn/Yel | 14 | |
| A2TB2-1 | U4-(+V) | 13 | White | 16 | |
| A2TB2-3 | U4-(-V) | 14 | Black | 14 | |
| P5-1 | P6-2 | 15 | White | 22 | |
| P5-2 | P6-3 | 16 | White | 22 | |
| P5-15 | P6-4 | 17 | Black | 22 | |
| P5-16 | P6-1 | 18 | White | 22 | |

**Table 4.3: Wiring List - VS2.5 Transmitter**

| Source | Destination | Wire # | Colour | Size | Remarks |
|---|---|---|---|---|---|
| P7-1 | J5-1 | 19 | Yellow | 22 | |
| P7-2 | J5-2 | 20 | Black | 22 | |
| P7-3 | J5-3 | 21 | Red | 22 | |
| P8-1 | J6-1 | 22 | Yellow | 22 | |
| P8-2 | J6-2 | 23 | Black | 22 | |
| P8-3 | J6-3 | 24 | Red | 22 | |
| A2TB4-1 | A15TB1-3 | 25 | White | 12 | |
| A2TB3-1 | A15TB1-4 | 26 | Black | 12 | |
| A2TB4-2 | A15TB1-1 | 27 | White | 12 | |
| A2TB3-2 | A15TB1-2 | 28 | Black | 12 | |
| A2TB4-3 | A14TB1-3 | 29 | White | 12 | |
| A2TB3-3 | A14TB1-4 | 30 | Black | 12 | |
| A2TB4-4 | A14TB1-1 | 31 | White | 12 | |
| A2TB3-4 | A14TB1-2 | 32 | Black | 12 | |
| A2TB2-2 | C9E2 | 33 | White | 16 | |
| W5P1-Center | W5P2-Center | 34 | Conductor | - | 50 Ohm Coax |
| W5P1-Shield | W5P2-Shield | 34 | Shield | - | 50 Ohm Coax |
| A10-S | W6P1-Center | 35 | Conductor | - | 50 Ohm Coax |
| A10-R | W6P1-Shield | 35 | Shield | - | 50 Ohm Coax |
| A4-R | A5-D | 36 | White | 16 | |
| A4-A | A5-A | - | - | 24 | Link |
| A4-B | A5-B | - | - | 24 | Link |
| A4-C | A5-C | - | - | 24 | Link |
| A4-D | A6-V | - | - | 24 | Link |
| A4-F | A6-X | - | - | 24 | Link |
| A4-G | A7-V | - | - | 24 | Link |
| A4-J | A7-X | - | - | 24 | Link |
| A4-K | A8-V | - | - | 24 | Link |
| A4-M | A8-X | - | - | 24 | Link |
| A4-N | A9-V | - | - | 24 | Link |

**Table 4.3: Wiring List - VS2.5 Transmitter**

| Source | Destination | Wire # | Colour | Size | Remarks |
|---|---|---|---|---|---|
| A4-Q | A9-X | - | - | 24 | Link |
| A5-F | A10-Z | - | - | 20 | Link |
| A5-H | A10-AA | - | - | 20 | Link |
| A6-D | A10-CC | - | - | 16 | Link |
| A7-D | A10-FF | - | - | 16 | Link |
| A8-D | A10-JJ | - | - | 16 | Link |
| A9-D | A10-MM | - | - | 16 | Link |
| A10-V | A12-D | - | - | 24 | Link |
| A10-T | A12-C | - | - | 24 | Link |
| A10-L | A12-B | - | - | 24 | Link |
| J3-Center | A10-C | 37 | Conductor | - | 50 Ohm Coax |
| J3-Shield | A10-B | 37 | Shield | - | 50 Ohm Coax |
| J4-Center | A10-E | 38 | Conductor | - | 50 Ohm Coax |
| J4-Shield | A10-D | 38 | Shield | - | 50 Ohm Coax |
| A16TB1-3 | A6-U | 39 | White | 12 | |
| A16TB1-4 | A6-T | 40 | Black | 12 | |
| A16TB1-1 | A7-U | 41 | White | 12 | |
| A16TB1-2 | A7-T | 42 | Black | 12 | |
| A17TB1-3 | A8-U | 43 | White | 12 | |
| A17TB1-4 | A8-GND | 44 | Black | 12 | |
| A17TB1-1 | A9-U | 45 | White | 12 | |
| A17TB1-2 | A9-T | 46 | Black | 12 | |
| C9E1 | A5-E | 47 | White | 16 | |

**Table 4.4: Connector Mating Information - VS2.5 Transmitter**

| Connector | Mate | Remarks |
|---|---|---|
| B1P1 | J5 | Fan1 Connection |
| B2P1 | J6 | Fan2 Connection |
| B3P1 | A4J1 | Fan3 Connection |
| B4P1 | A4J2 | Fan4 Connection |
| B5P1 | A4J3 | Fan5 Connection |
| B6P1 | A4J4 | Fan6 Connection |
| B7P1 | A4J5 | Fan7 Connection |
| P1 | Not Used | Not Used |
| P2 | Not Used | Not Used |
| P3 | Not Used | Not Used |
| P4 | Not Used | Not Used |
| P5 | U5H1 | Front Display |
| P6 | A1J10 | Front Display |
| P7 | A2J4 | B1 Fan Supply |
| P8 | A2J5 | B2 Fan Supply |
| W1P1 | A1J15 | Interface I/O |
| W1P2 | A3P1 | Interface I/O |
| W2P1 | A1J12 | Power Supply Control I/O |
| W2P2 | A1J7 | Power Supply Control I/O |
| W4P1 | A1J11 | Low Voltage I/O |
| W4P2 | A2J6 | Low Voltage I/O |
| W5P1 | A1J14 | RF Drive |
| W5P2 | A4J7 | RF Drive |
| W6P1 | A4J8 | RF Drive |

# Section 5: Reading Electrical Schematics

This section contains electrical schematics and logic diagrams for the transmitter. Block diagrams, simplified electrical schematics, and logic diagrams may be included. Refer to Table 5.1 on page 5-4 for an itemized listing.

## Component values

Unless otherwise specified on the logic or schematic diagram, the following defaults apply:

- Resistor values are shown in ohms (K = 1,000 and M = 1,000,000)
- Resistor power ratings are not shown when less than 0.5 W
- Capacitor values are shown in microfarads (uF)
- Unidentified diodes are part number 1N4938 (Nautel Part # QAP29)

## Graphic symbols

The graphic symbols used on electrical schematics are in accordance with *American National Standard ANSI Y32.2-1975 - Graphic Symbols for Electrical and Electronic Diagrams*.

## Logic symbols

The logic symbols used on electrical schematics and logic diagrams are in accordance with *American National Standard ANSI Y32.14-1975 - Graphic Symbols for Logic Diagrams*.

## Reference designations

Referenced designations were assigned in accordance with *American Society of Mechanical Engineers ASME Y14.44-2008 - Reference Designations for Electrical and Electronic Parts and Equipment*.

Each electrical symbol is identified with its basic reference designation. To obtain the full reference designation for a specific part, prefix this basic identifier with the reference designation assigned to all higher assemblies. For example, the complete designation for a resistor (R1) on a printed wiring board (A1), that is part of a larger board (A2), would be A2A1R1.

## Unique symbols

Nautel uses unique symbols on electrical schematics to describe logic (two-state) signals. These signals differ from single-state signals or analog signals that may have multiple values.

### Type of inputs and outputs

On electrical schematics, names used to describe logic (two-state) input and output signals are prefixed with a # symbol.

### Logic level convention

The # prefix identifies an input or output signal that has two distinct states: high and low.

The suffix on an input or output signal name identifies the *active* (true) state of the signal. The *high suffix* (+) indicates the more positive of the two levels used to represent the logic states. The *low suffix* (-) indicates the less positive of the two levels.

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* (true) state, and high represents the *inactive* (false) state.

## Identifying schematic diagrams

Each electrical schematic in this section is identified by a number that is both the figure number and the page number. The numbers are assigned sequentially are prefixed by the letters SD. The electrical schematics and logic diagrams included in this section are listed in Table 5.1 on page 5-4.

## 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. Normally, inputs originate on the left-hand side and outputs 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 or assembly was not necessarily a factor during creation of the schematic. The full reference designation assigned to a part or assembly, in conjunction with the family tree (see* Section 3, "Parts Lists" on page 3-1*) and the assembly detail drawings (see* Section 6, "Mechanical Drawings" on page 6-1*), will identify its location.*

Figures SD-1 and SD-2 identify each major stage and its detailed interconnection. Each stage contains cross-references that identify which blocks are the signal sources for inputs, or the destinations for outputs.

When a sub-function is treated as a block in figures SD-1 and SD-2, its detailed circuit information is included in its own schematic drawing(s), which is also included in this section.

## Locating schematic diagram(s) for a functional block

The text inside a functional block provides the key to locating its schematic diagram(s).

1. When a functional block is assigned a reference designation (e.g., A2A1), refer to the family trees in Section 3, "Parts Lists" on page 3-1. Follow the family tree branches to the block that contains the desired reference designation, and associated Nautel nomenclature (e.g., NAPA31C PA PWB). Note the reference designations and Nautel nomenclatures of all higher assemblies in the path, if applicable.
   **Example:** A6 NAPA31C PA PWB.

2. Refer to Table 5.1 on page 5-4 and use the reference designation and Nautel nomenclature to identify the appropriate schematic diagram(s).
   **Example:** NAPA31C PA PWB is shown on schematic SD-7.

3. If necessary, refer to the referenced figure in the schematics at the end of this section and locate the next, lower-level assembly. Then, repeat this procedure until the desired schematic diagram is found.

## Locating a part or assembly on a schematic

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

1. Refer to the family trees in Section 3, "Parts Lists" on page 3-1.

2. Follow the family tree branches to the block that contains the desired reference designation, while noting the Nautel nomenclatures and names of all higher assemblies in the path, as applicable. **Example:** A5 NAPA31C PA PWB.

> *Note: The drawings in the* Mechanical Drawings *section depict the assembly detail of the transmitter and its modules and assemblies.*

3. Refer to Table 6.1 in Section 6, "Mechanical Drawings" on page 6-1. Use the Nautel nomenclature and name of each family tree block in the path, starting at the highest assembly – this is normally Figure MD-1 – to determine the figure number(s) for that assembly.
   **Example:** NAPA31C PA PWB is shown on MD-7.

4. Refer to the referenced figure (e.g., MD-7) in Section 6.1, "List of Mechanical Drawings" on page 6-2 to locate the desired part or assembly.

**Table 5.1: List of Electrical Schematics**

| Figure # | Title |
|---|---|
| SD-1 | VS2.5 Transmitter - Ac-Dc and Exciter/Control Stages (Sheet 1 of 2) |
| SD-2 | VS2.5 Transmitter - Ac-Dc and Exciter/Control Stages (Sheet 2 of 2) |
| SD-3 | VS2.5 Transmitter - RF Drive and RF Power Stages |
| SD-4 | NAPS53 Power Supply Distribution PWB (Sheet 1 of 2) |
| SD-5 | NAPS53 Power Supply Distribution PWB (Sheet 2 of 2) |
| SD-6 | NAPA28B Pre-Amp/IPA PWB |
| SD-7 | NAPA31C PA PWB |

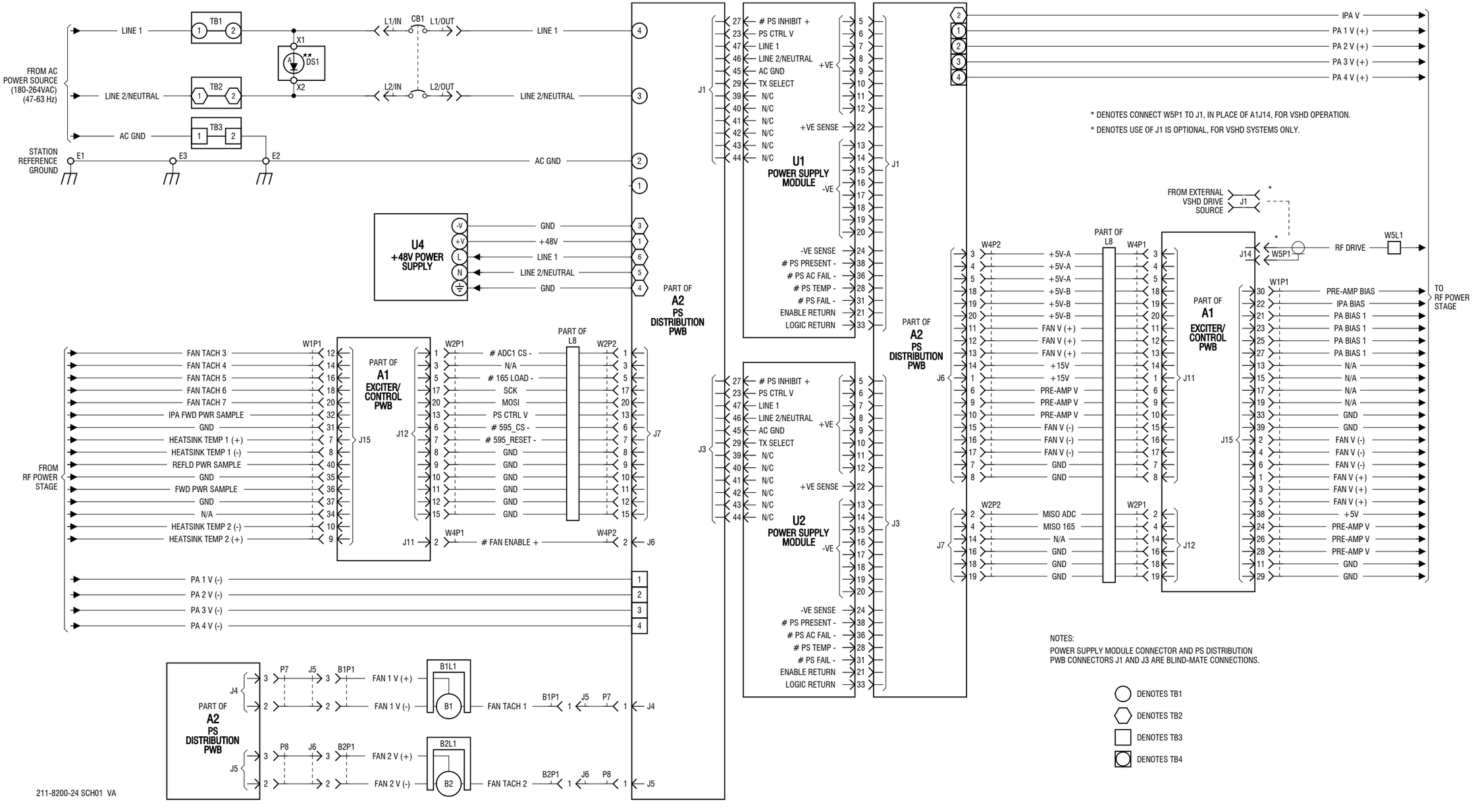
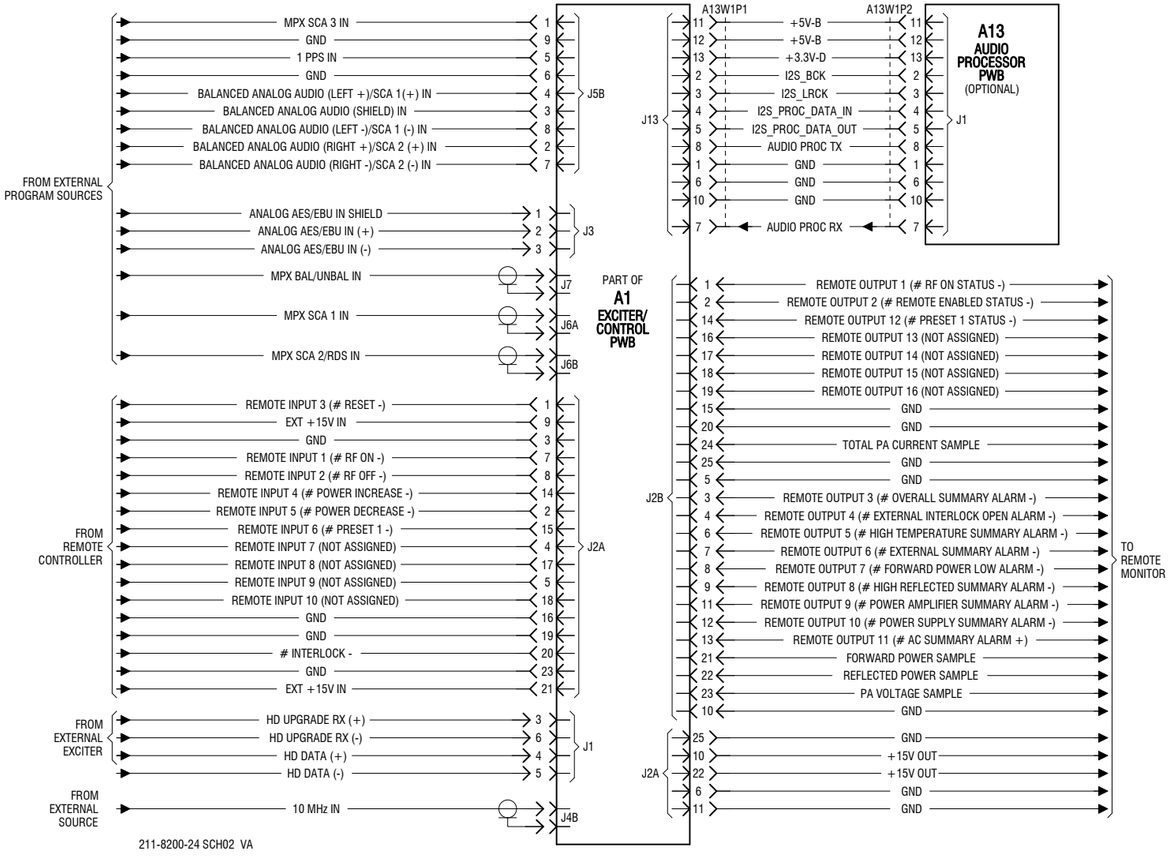



*Figure SD-1: VS2.5 Transmitter - Ac-Dc and Exciter/Control Stages (Sheet 1 of 2)*




NOTES:

REMOTE INPUTS AND OUTPUTS ARE USER CONFIGURABLE.
DEFAULT SETTINGS ARE SHOWN IN BRACKETS.

*Figure SD-2: VS2.5 Transmitter - Ac-Dc and Exciter/Control Stages (Sheet 2 of 2)*

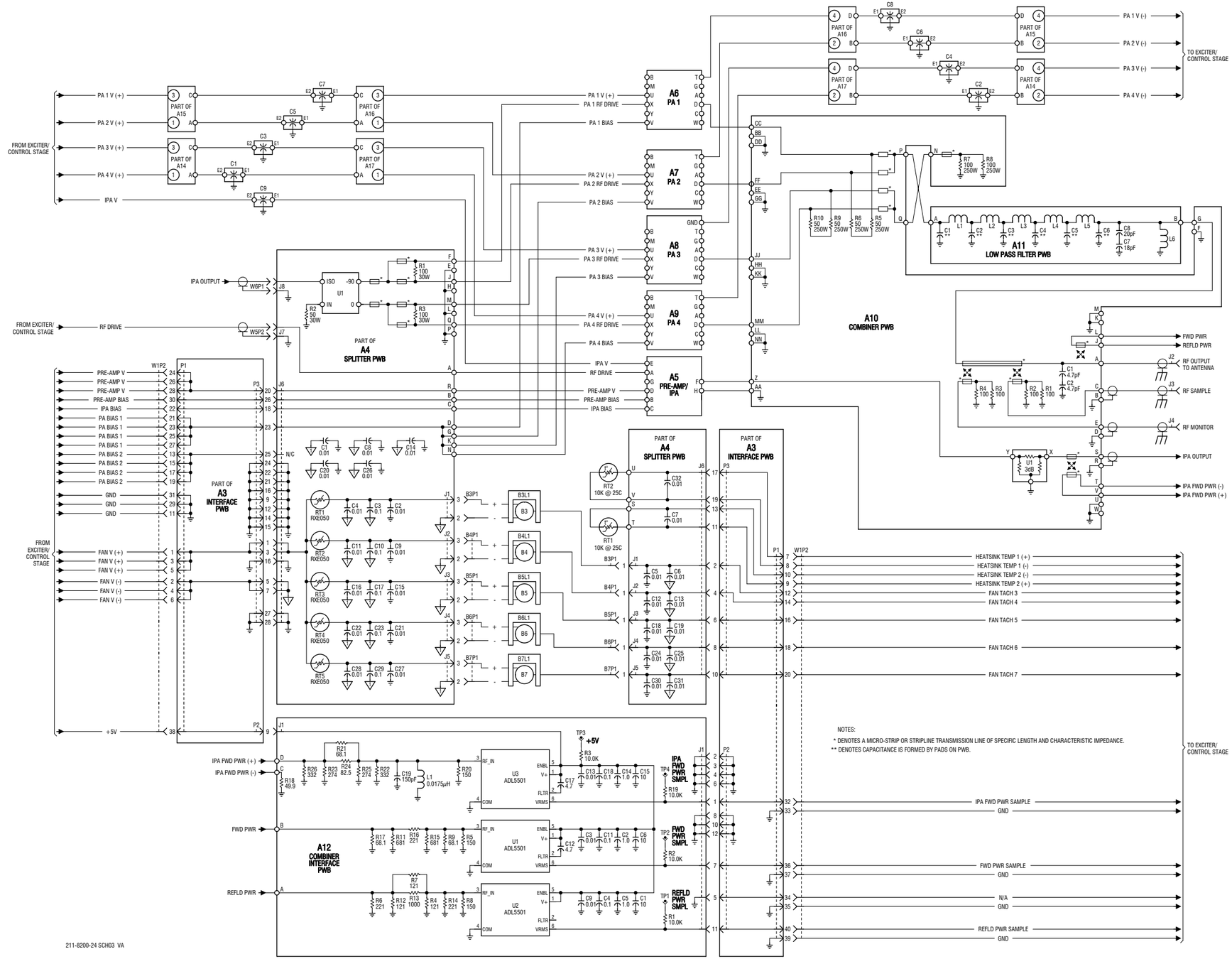



*Figure SD-3: VS2.5 Transmitter - RF Drive and RF Power Stages*

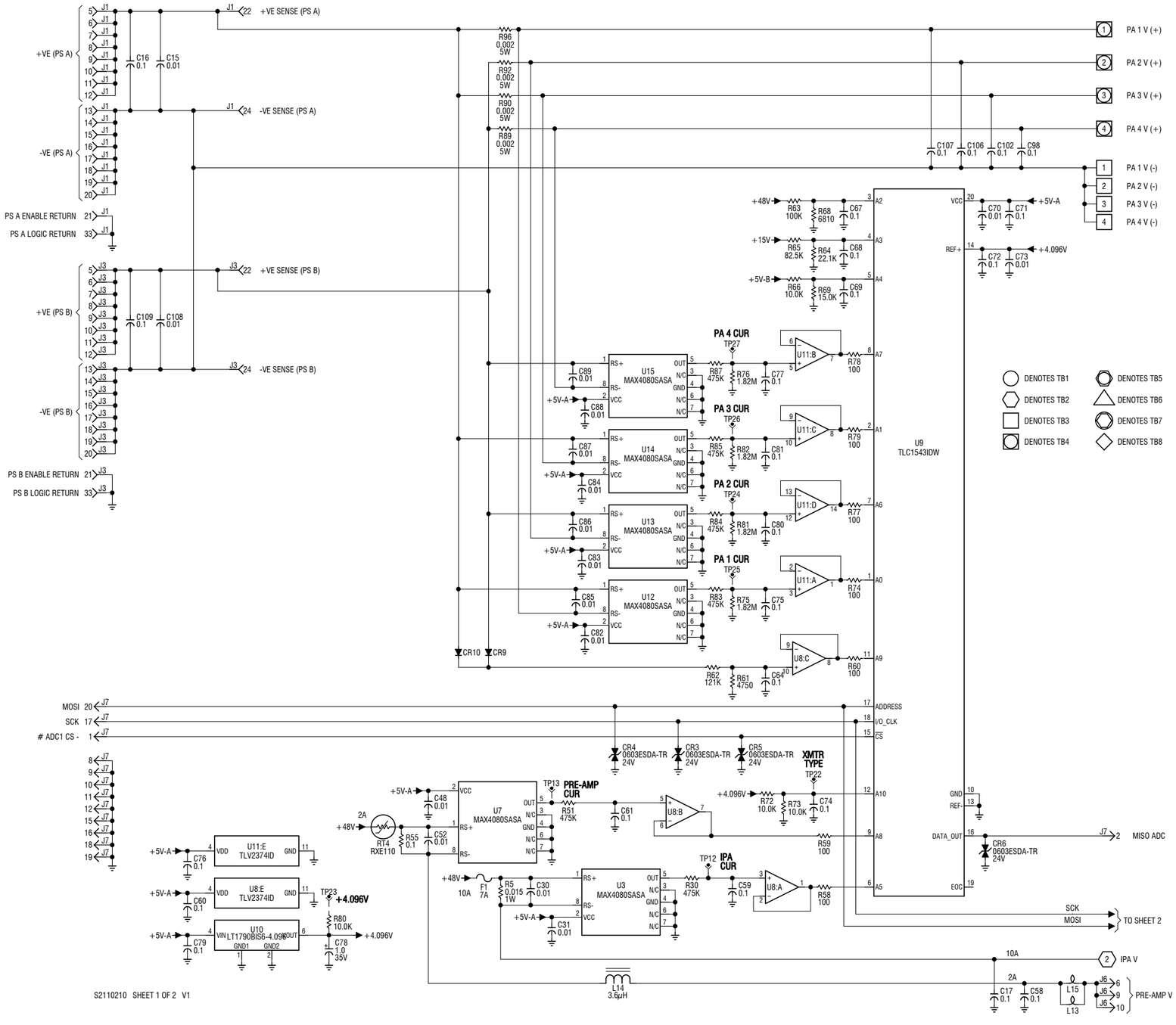



*Figure SD-4: NAPS53 Power Supply Distribution PWB (Sheet 1 of 2)*

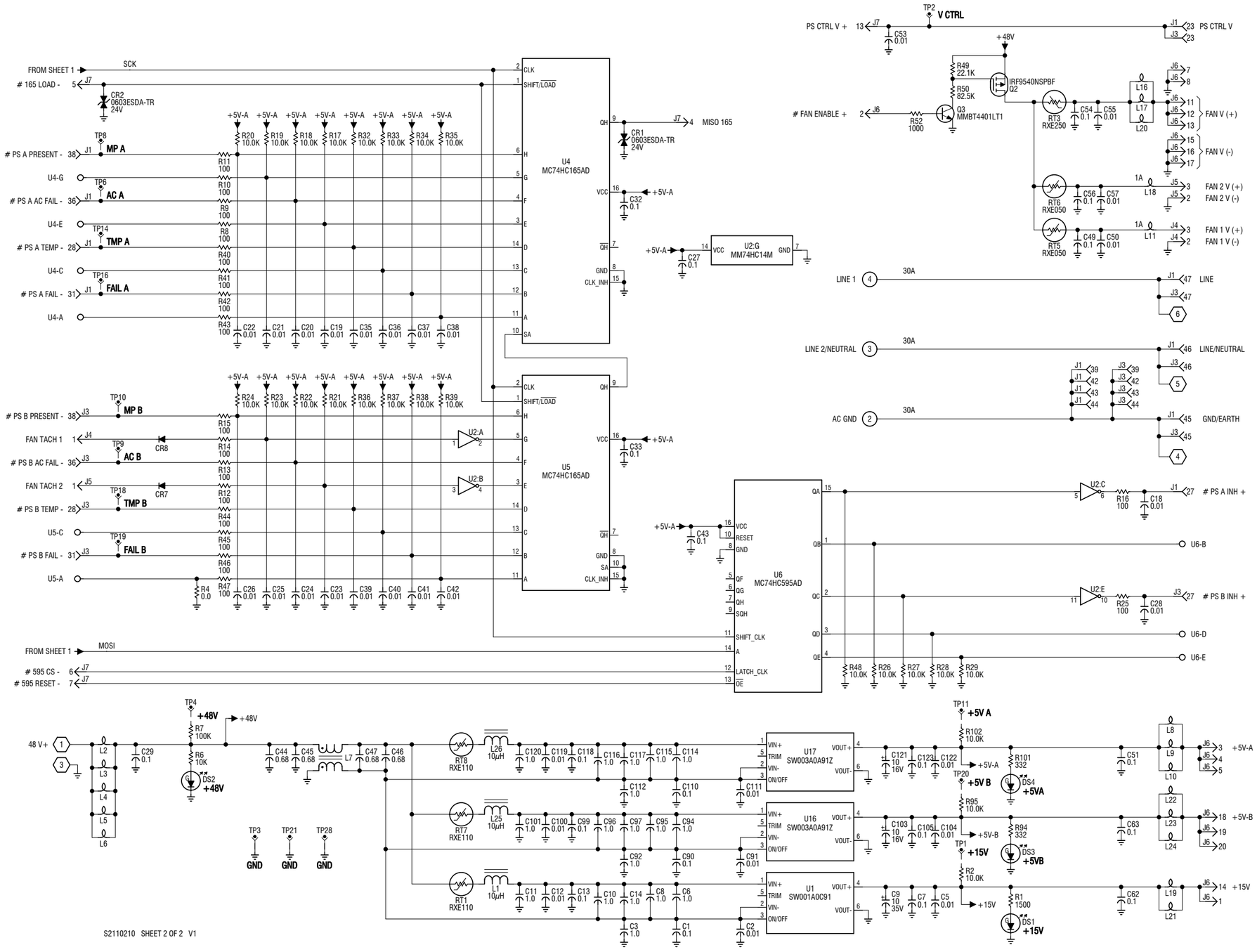
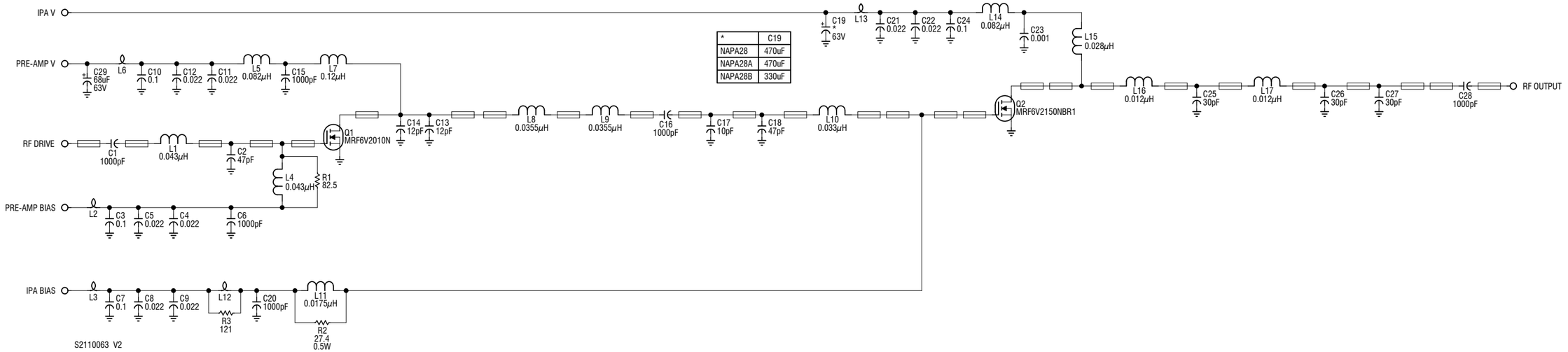



*Figure SD-5: NAPS53 Power Supply Distribution PWB (Sheet 2 of 2)*




| * | C19 |
|---|---|
| NAPA28 | 470uF |
| NAPA28A | 470uF |
| NAPA28B | 330uF |

*Figure SD-6: NAPA28B Pre-Amp/IPA PWB*

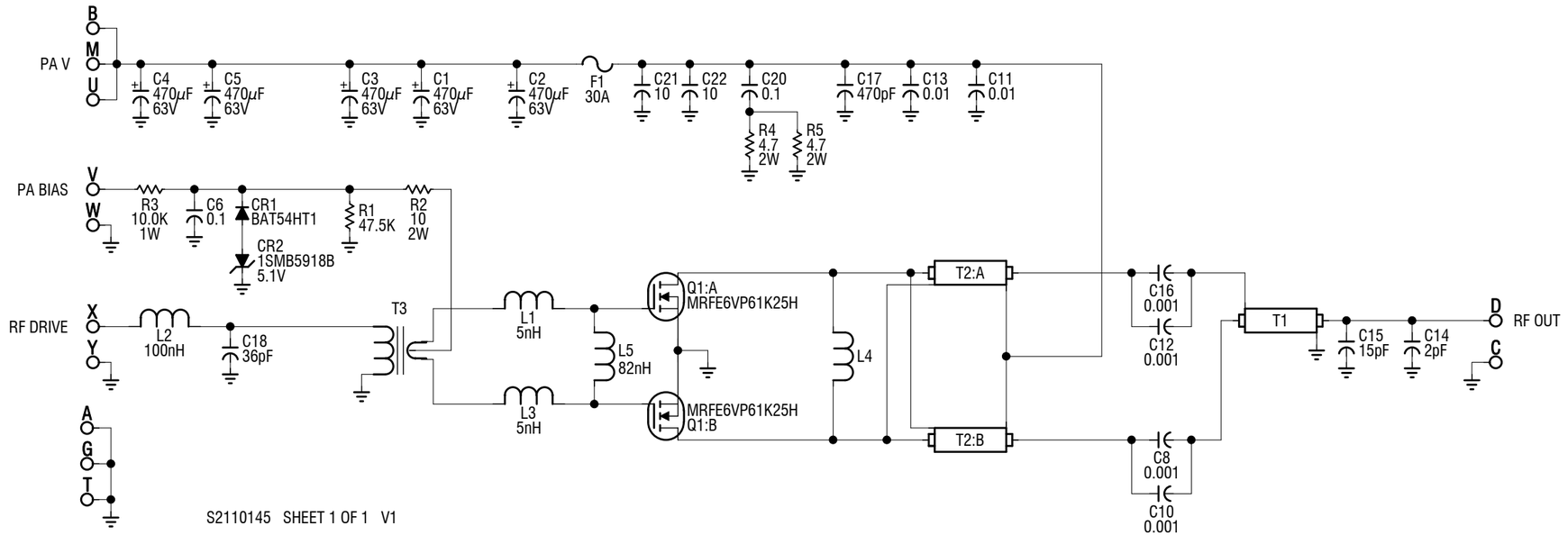



*Figure SD-7: NAPA31C PA PWB*

# Section 6: Mechanical Drawings

This section contains mechanical drawings for assemblies of the transmitter. Dimensional drawings may be included. Refer to Table 6.1 on page 6-2 for an itemized list.

Assembly detail drawings for assemblies and modules that have separate manuals are not included. Refer to the appropriate maintenance manual for the assembly detail of these assemblies.

## Identifying mechanical drawings

Each mechanical drawing 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 6.1 on page 6-2.

## 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 or 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 or assembly actually installed. In this case, always refer to the assembly detail drawing of the module or assembly for detailed information.

## Locating a part or assembly on a mechanical drawing

1. When a part or assembly is assigned a reference designation (e.g., A2 or A2R1), refer to the family trees in Section 3, "Parts Lists" on page 3-1. Follow the family tree branches to the block that contains the desired reference designation and Nautel nomenclature (e.g., NAPA31C PA PWB). Note the reference designations and Nautel nomenclatures of all higher assemblies in the path, as applicable.
   **Example:** A6 NAPA31C PA PWB.

2. Refer to Table 6.1 on page 6-2. Use the reference designation and Nautel nomenclature to identify the appropriate mechanical drawing.
   **Example:** NAPA31C PA PWB is shown on schematic MD-7.

3. If necessary, refer to the referenced figure (e.g., MD-7) in the mechanical drawings at the end of this section and locate the next, lower-level assembly. Then, repeat this procedure until the desired part or assembly is found.

**Table 6.1: List of Mechanical Drawings**

| Figure # | Title |
|---|---|
| MD-1 | VS2.5 Transmitter (Front, Rear and Top Views) |
| MD-2 | VS2.5 Transmitter (Bottom and Side Views) |
| MD-3 | NAPE87B Exciter/Control PWB |
| MD-4 | NAPS53 PS Distribution PWB |
| MD-5 | NAPH03A Splitter PWB |
| MD-6 | NAPA28B Pre-Amp/IPA PWB |
| MD-7 | NAPA31C PA PWB |
| MD-8 | NAPH04 Combiner PWB |
| MD-9 | NAPF13A RF Low Pass Filter PWB |
| MD-10 | NAPI139 Combiner Interface PWB |

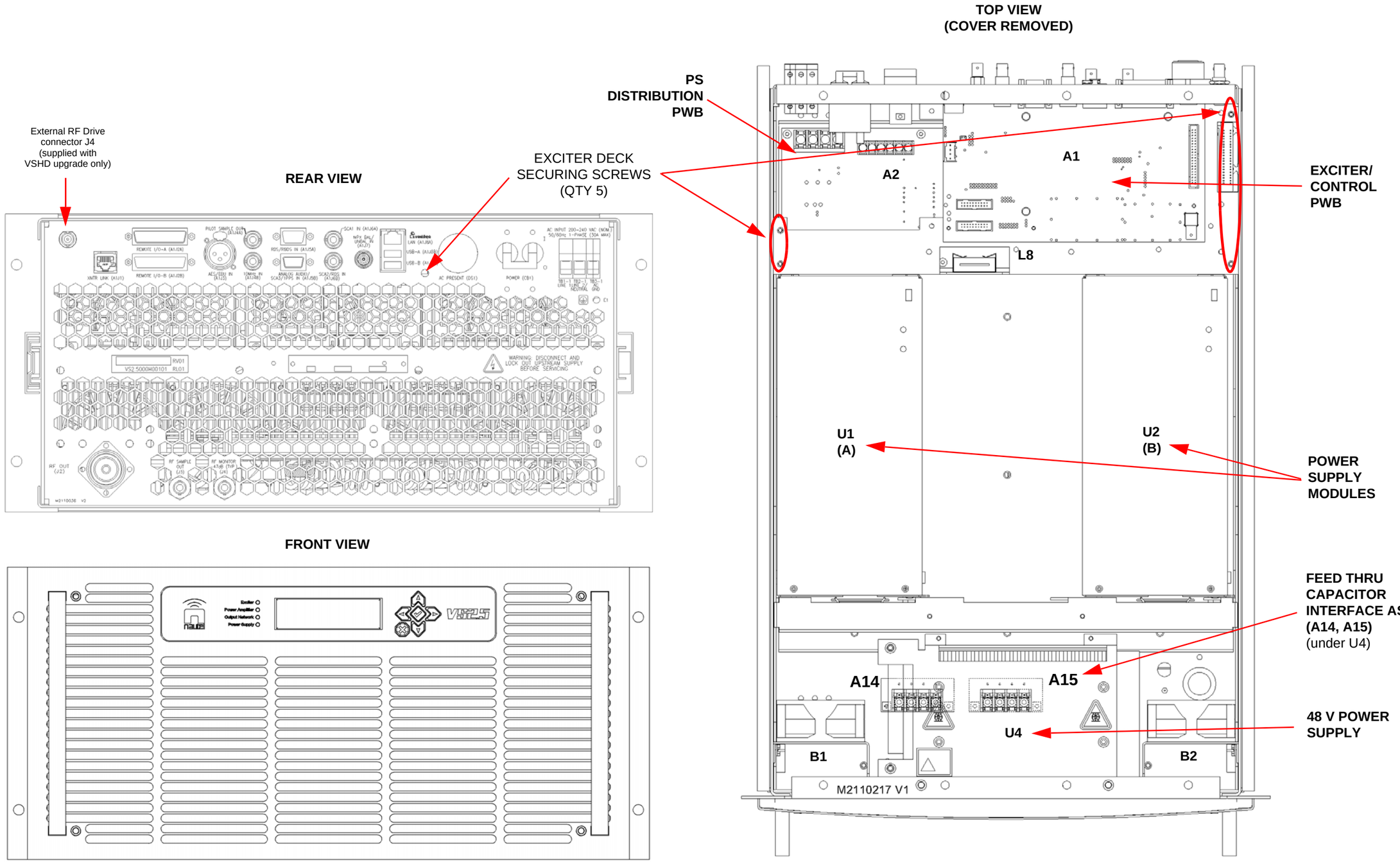



*Figure MD-1: VS2.5 Transmitter (Front, Rear and Top Views)*

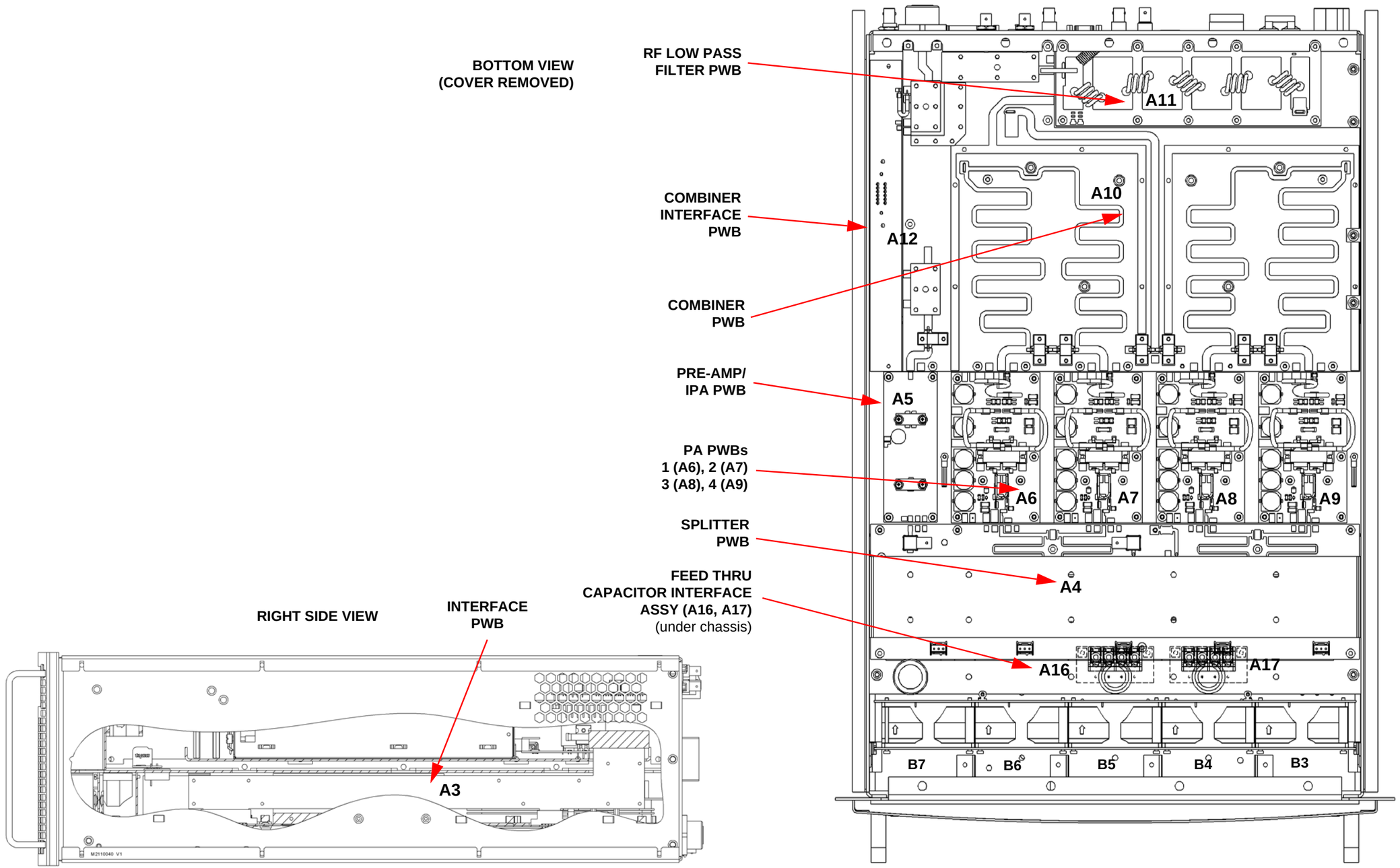



*Figure MD-2: VS2.5 Transmitter (Bottom and Side Views)*

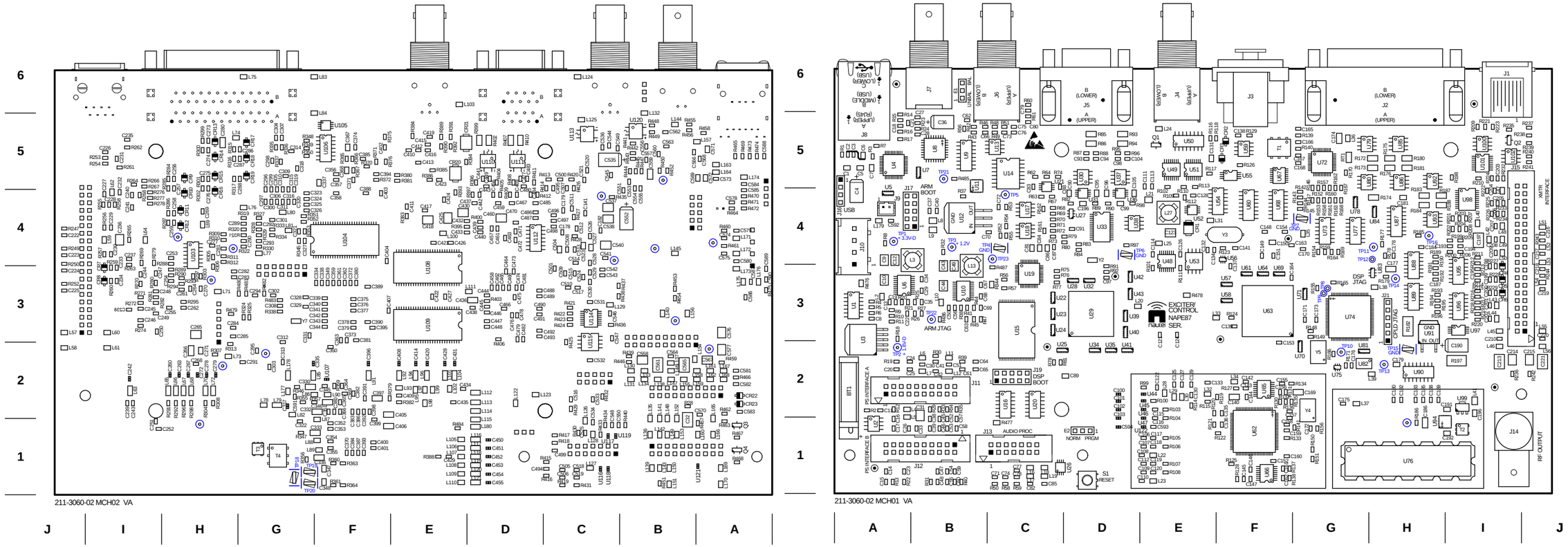



*Figure MD-3: NAPE87B Exciter/Control PWB*

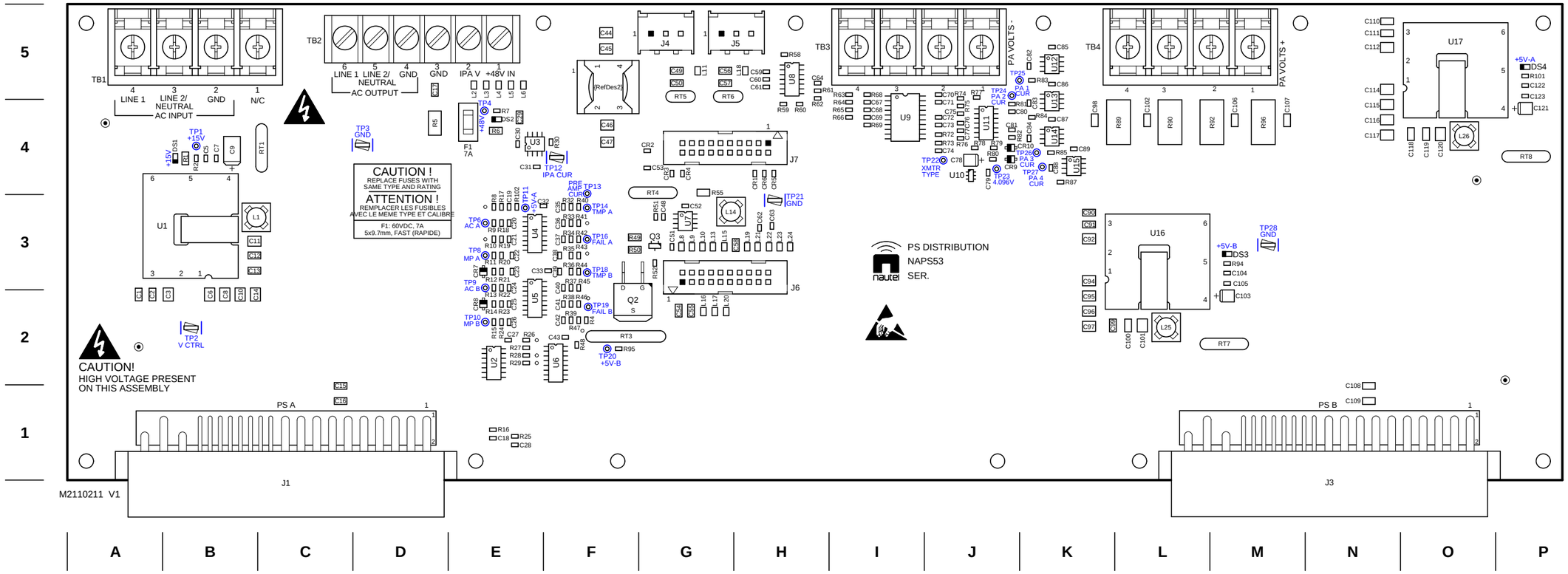



*Figure MD-4: NAPS53 PS Distribution PWB*

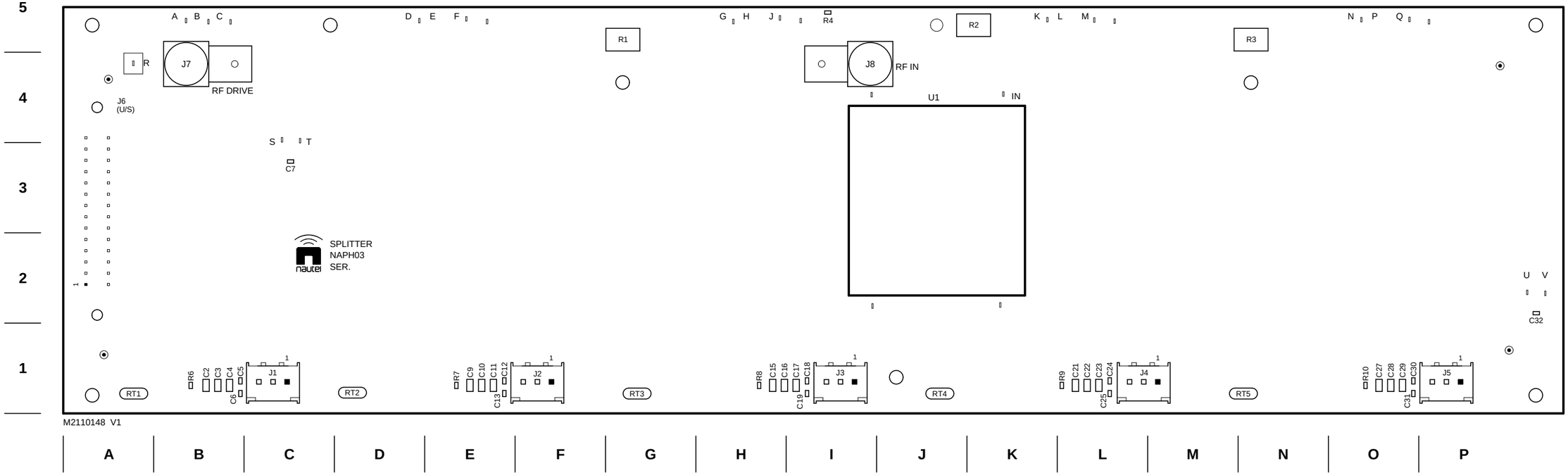



*Figure MD-5: NAPH03A Splitter PWB*

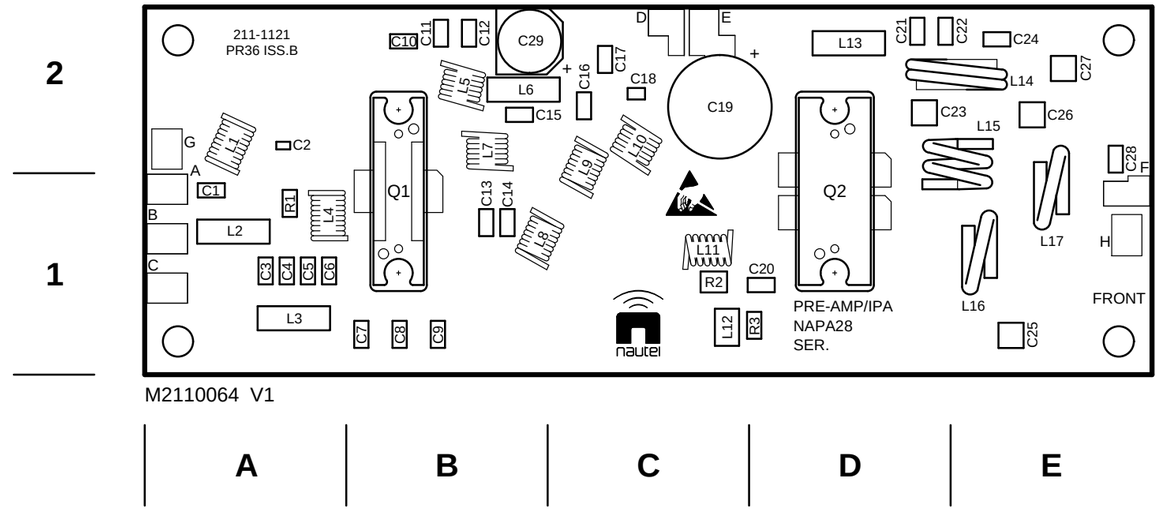



*Figure MD-6: NAPA28B Pre-Amp/IPA PWB*

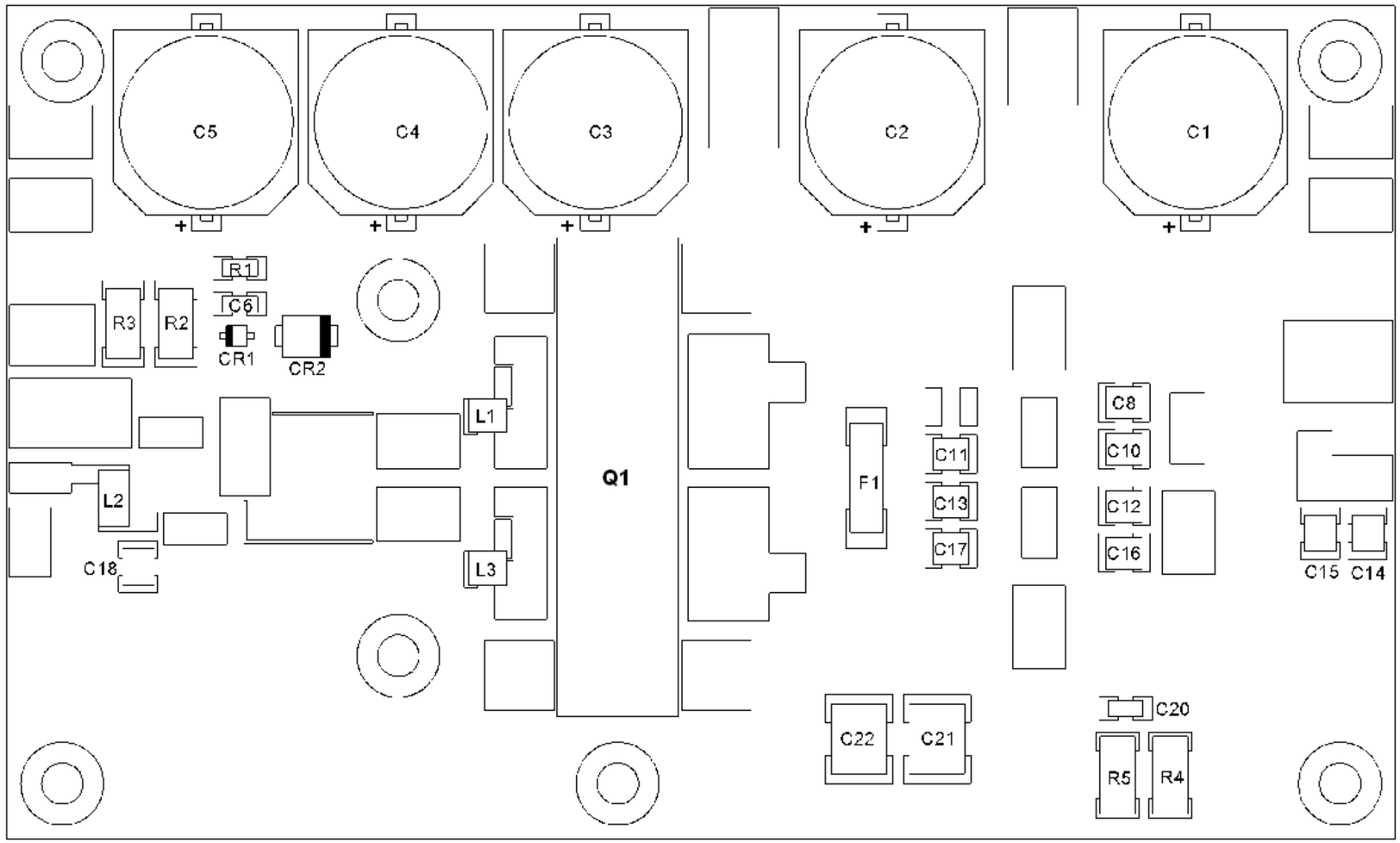



*Figure MD-7: NAPA31C PA PWB*

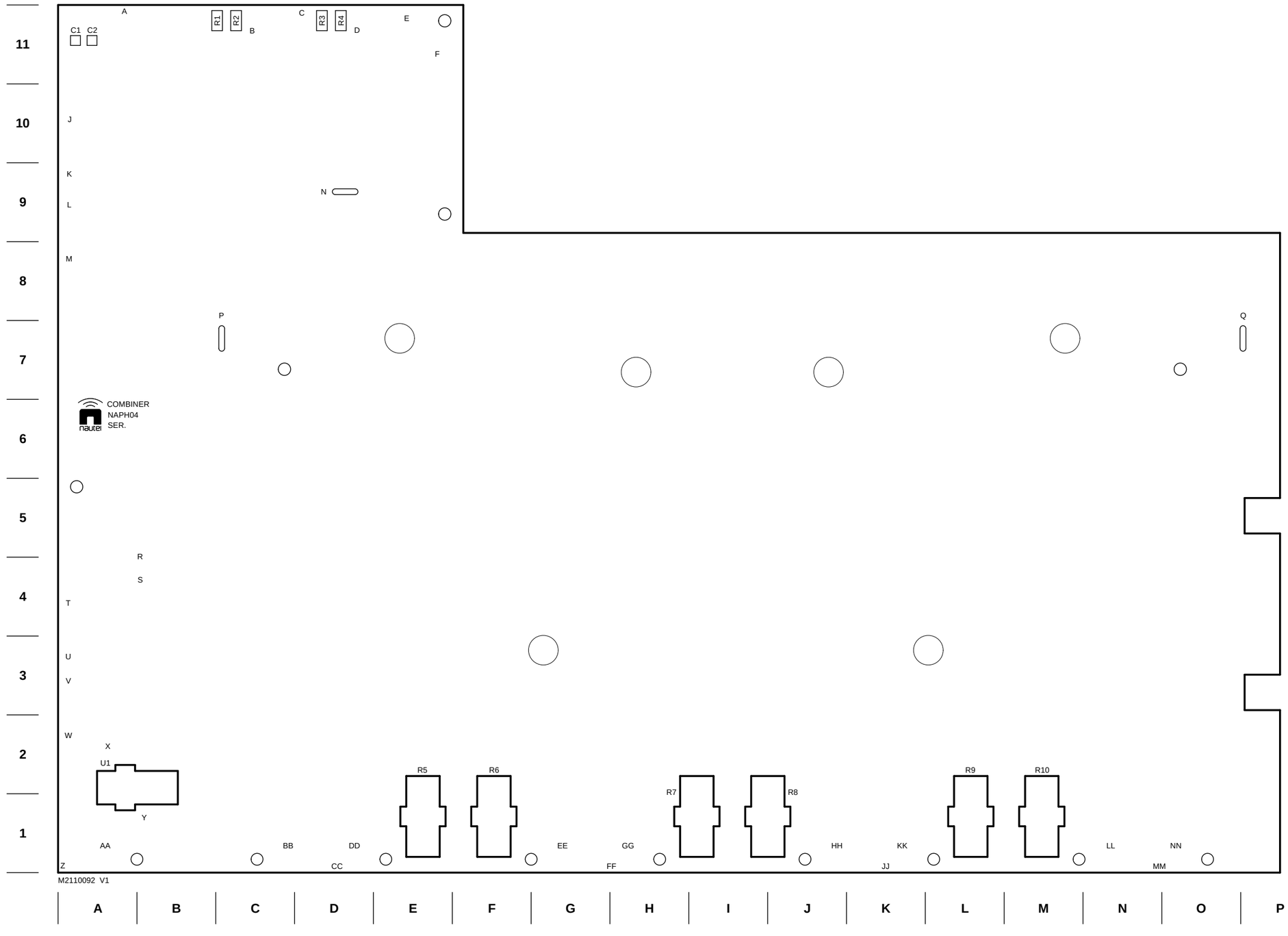



*Figure MD-8: NAPH04 Combiner PWB*

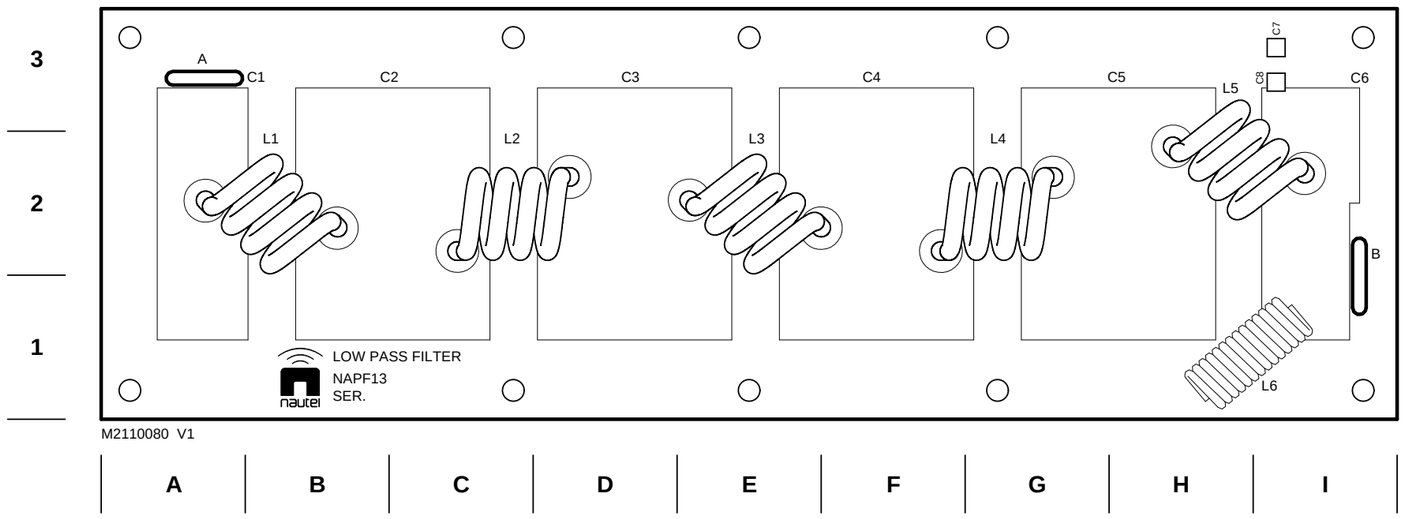



*Figure MD-9: NAPF13A RF Low Pass Filter PWB*

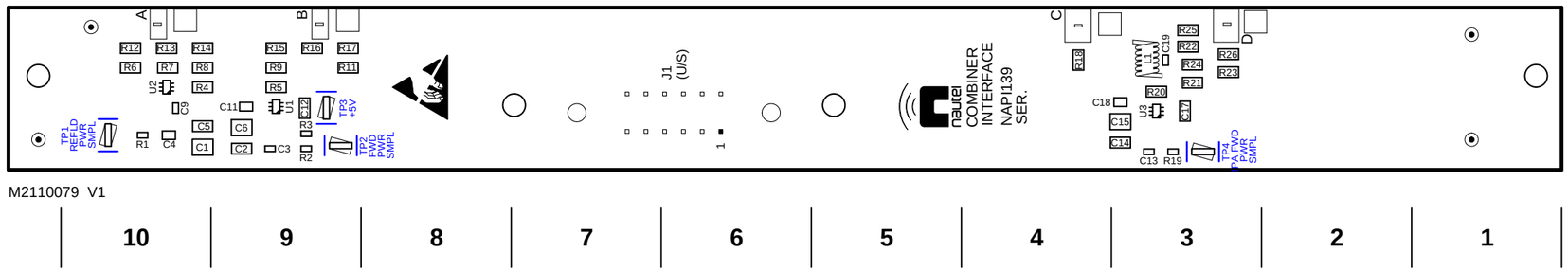



*Figure MD-10: NAPI139 Combiner Interface PWB*

# Section 7: List of terms

This section defines some of the terms that are used in Nautel documentation.

AES-EBU. Audio Engineering Society/European Broadcasting Union (AES/EBU) is the name of a digital audio transfer standard. The AES/EBU digital interface is usually implemented using 3-pin XLR connectors (the same type connector used in professional microphones). One cable carries both left-channel and right-channel audio data to the receiving device.

ARM. Advanced RISC (Reduced Instruction Set Computer) Machine. The specific ARM used in VS transmitters is ARM926, and is used for remote AUI functionality.

AUI. The Advanced User Interface is the web interface that allows for extensive control and monitoring of the transmitter.

Cutback. A reduction in RF output power, caused by the occurrence of multiple shutbacks within a pre-defined period.

Cycling ac power. Turning off (disabling), then turning on (enabling) the ac power source.

DHCP. Dynamic Host Carrier Protocol.

DSP. Digital Signal Processing. Used for transmitter control and signal processing.

EEPROM. Electrically Erasable Programmable Read-Only Memory.

Foldback. A reduction in RF output power, caused by adverse load conditions (high VSWR). No shutbacks or cutbacks have occurred.

Intermediate Power Amplifier (IPA). Refers to circuitry within the transmitter that amplifies the exciter's RF output to a level sufficient to drive the final RF amplifiers.

Latching alarm. An alarm that, while active, keeps the transmitter in an 'RF inhibited' state. This type of alarm (e.g., High SWR Shutdown) require a reset - via the front panel or remote AUI - to attempt to restore transmitter operation.

LED. Light Emitting Diode (also referred to as lamp).

LUT. Look-Up Table.

MPX. Refers to the multiplexed baseband signal. Also referred to as the composite signal.

**Preset.** A setting that controls power level, frequency and audio parameters. The VS2.5 allows you to pre-program multiple presets.

**PWB.** Printed Wiring Board.

**Shutback.** A complete, but temporary loss of RF output power, caused by any one of a variety of faults, including high VSWR, high reject load power, RF drive failure, or an open external interlock.

**Shutdown.** A complete and permanent loss of RF output power. Typically follows repeated cutback, foldback or shutback events.

**SPI.** Serial Peripheral Interface. A synchronous serial data link standard that operates in full duplex mode. Devices communicate in master/slave mode where the master device initiates the data frame. Multiple slave devices are allowed with individual slave select (chip select) lines. Also referred to as a "four wire" serial bus.

**Surge protection panel.** An electrical panel that protects equipment from electrical surges in the ac power supply, antenna or site ground caused by lightning strikes.

**VSWR.** Voltage standing wave ratio. This is an expression of the ratio of forward voltage to reverse voltage on the feedline and antenna system. An ideal VSWR of 1:1 provides maximum transmitter-antenna efficiency.

# VS2.5 TROUBLESHOOTING MANUAL

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