VS1 Transmitter

Troubleshooting Manual

Document:NHB-VS1-TRB

Issue: 11.0 2019-01-04

Status: Standard

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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	2019-01-04	Supports hardware NARF65J/02 and NARF65J/03. 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 VS1 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 1400 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

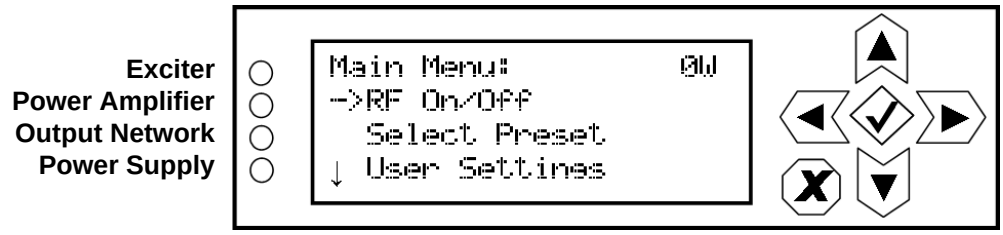
There two ways to check for alarms on the front panel:

- 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

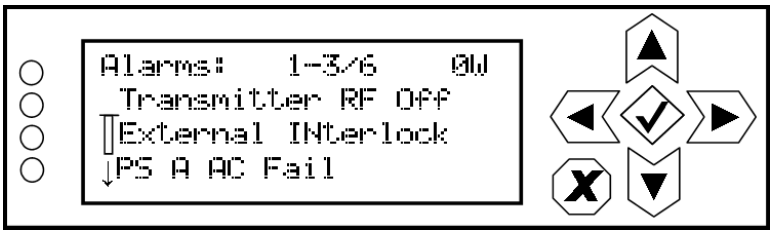


Table 1.1 on page 1-9 contains a column for most alarms that can occur, sorted alpha-numerically. The Description and Troubleshooting Action column provides a brief description of the alarm, troubleshooting tips and a cross-reference to more troubleshooting, if applicable.

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 1-31.

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 1-25 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.*

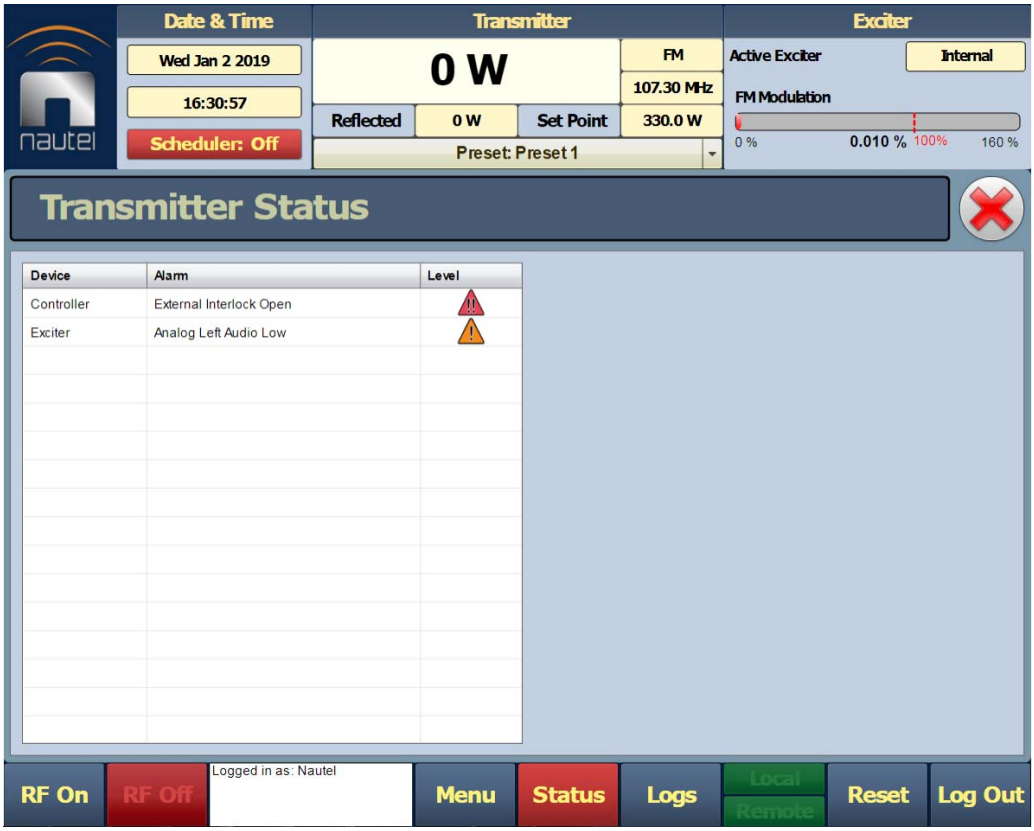
5. If troubleshooting and subsequent replacement of a suspect PWB or module causes the alarm to disappear from the View Alarms screen, the alarm has been successfully cleared. If the fault condition does not clear, contact Nautel.

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 1-31.

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 1-25 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 VS1 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 1-43). If not, check ribbon cable W4 for damage, and verify connectors W4P1 and W4P2 are properly seated in A1J11 and A2J3 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 VS1 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 1-43).

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 VS1 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 TP8 (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 A2J2 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 1-46). 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 VS1 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 1-43). If not, check ribbon cable W4 for damage and that connectors W4P1 and W4P2 are properly seated in A1J11 and A2J3 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 VS1 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 1-43). If not, check ribbon cable W4 for damage and that connectors W4P1 and W4P2 are properly seated in A1J11 and A2J3 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 VS1 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 TP2 (+5V-B) and TP8 (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 A2J2 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 1-46). 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 or the power supply module has failed; 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, perform the "PA resistance checks" on page 1-34. 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 VS1 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 VS1 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.
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.

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
Composite Audio Low (MPX Aud Low)	Exciter (amber)	This alarm indicates the composite audio input level is too low. The VS1 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 VS1 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 1-47).
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 VS1 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 VS1 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 - 3 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). The VS1 will reduce its maximum power setting based on the number of fan failures that have occurred (see Table 1.4 on page 1-30). 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" on page 1-41). If the alarm still occurs after the fan has been replaced, suspect the exciter/control PWB (A1).
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; 1488 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 1-47)
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 VS1 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, perform the "PA resistance checks" on page 1-34, else suspect the combiner interface PWB (A12) (see "Combiner Interface PWB Replacement" on page 1-47).
Forward Power Shutdown (Fwd Power Shutdown)	Output Network (red)	This alarm occurs if the transmitter tries to reduce the forward power below minimum (32 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 VS1 takes no action on this alarm. See **Forward Power Low** for troubleshooting tips.

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
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; 1450 W). This alarm occurs only if the exciter ALC cannot respond fast enough to transmitter load changes. The VS1 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 1-47).
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 (148 W). The VS1 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 (35 W). The VS1 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 1-47).
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 204 W) at the SWR Foldback threshold (reflected power of 51 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 1-47).

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
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 1-43).
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 1-43).
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 VS1 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
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 (130%). If this condition persists, replace the pre-amp/IPA PWB (A5) (see "Pre-amp/IPA PWB replacement" on page 1-36). The VS1 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 1-47) or the exciter/control PWB (A1) (see "Exciter/Control PWB Replacement" on page 1-43).
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 (70%). 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 1-36). 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 1-36). 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 1-47) or the exciter/control PWB (A1) (see "Exciter/Control PWB Replacement" on page 1-43).

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
Low Battery	Exciter (amber)	This alarm occurs if the backup battery voltage falls below an acceptable level (2.7 V). The VS1 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).
LVPS Fail (+48V Fail)	PS (red)	This alarm occurs if the output of the +48 V power supply (U3) is outside of its acceptable voltage range (between +43 and +53 V). The VS1 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 1-40). If the measured value is within the acceptable range, use a digital multimeter to measure the voltage between TP17 (+48V) and TP8 (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 A2J2 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 1-46). 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 VS1 takes no action on this alarm.

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
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).
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 1-43).
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 1.4 on page 1-30) 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 1-34. 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 70°C (158°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 (170 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 (400 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 (red)	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 VS1 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 VS1'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 VS1 takes no action on this alarm. See **IPA Output Low** for troubleshooting tips.
PS A AC Fail	PS (red)	This alarm occurs if the power supply module (U2) is reporting an ac failure, indicating its ac input voltage is less than 175 V ac. The VS1 will inhibit its RF output until the alarm is cleared. Check the ac voltage applied to the power supply module. If the ac voltage is acceptable, try replacing the power supply module with a new module (see "Power Supply Module Replacement" on page 1-39).

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
PS A Fail	PS (red)	This alarm occurs if the power supply module (U2) is reporting a PS failure, indicating its output voltage is outside of its acceptable range. The VS1 will inhibit its RF output until the alarm is cleared. Try replacing the power supply module with a new module (see "Power Supply Module Replacement" on page 1-39). 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 Missing	PS (red)	This alarm occurs if the power supply module (U2) is not being detected or has been removed. The VS1 will inhibit its RF output until the alarm is cleared. If there is a power supply module in the transmitter, try replacing the power supply module with a new module (see "Power Supply Module Replacement" on page 1-39). If replacing it with a new power supply module does not clear the fault, suspect the PS distribution PWB (A2).
PS A Over Temperature (PS A Over Temp)	PS (red)	This alarm occurs if the power supply module (U2)is reporting a high temperature alarm, indicating its operating temperature has exceeded its internal threshold. The VS1 will inhibit its RF output until the alarm is cleared. 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 1-39). 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 power supply module with a new module (see "Power Supply Module Replacement" on page 1-39). 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.

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
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 (185 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.
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 (222 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 VS1 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 VS1 takes no action on this alarm.

Alarm Name AUI and (Front Panel)	Front Panel LED (color)	Description and Troubleshooting Action
SRC1 Unlock	Exciter (amber)	This alarm indicates that no valid AES/EBU stream data is being detected on the selected AES/EBU. The VS1 takes no action on this alarm.
SWR Foldback	Output Network (amber)	This alarm occurs if the transmitter's average reflected power exceeds the SWR foldback threshold (51 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 204 W), an **SWR Shutdown** alarm occurs. Refer to Table 1.4 on page 1-30 to determine the approximate operating forward power levels for FM+HD systems [with more aggressive (Efficiency Priority) and less aggressive (MER Priority) HD PowerBoost] at various injection levels. 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 1-47).
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 (156 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 1-47). 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: PS A AC Fail
Audio Loss	This summary alarm is triggered if any of the following audio loss related alarms occur: Audio Loss Audio Shutdown
Exciter	This summary alarm is triggered if any of the following Exciter related alarms occur: Analog Audio Left Low Analog Audio Right Low Audio Loss Audio Proc. Offline Audio Proc. O/P Fail Audio Shutdown Composite Audio Low Digital Audio Low Entered Firmware Upgrade Exciter Offline External Interlock Open Host Network Down Host Not Booted Host Not Responding Low Battery Missing Preset Mode/Freq. Mismatch Need Reboot For Settings No External 10 MHz No HD Data No Internal 10 MHz No 1 PPS Pilot Unsync PLL Unlock Rebooted Exciter SCA1/2 Audio Low SRC1 Unlock Unsigned DSP Image
External	This summary alarm is triggered if any of the following external alarms occur: External Interlock Open No External 10 MHz
HD	This summary alarm is triggered if any of the following digital (HD) alarms occur: No HD Data
High Reflected (Power)	This summary alarm is triggered if any of the following high reflected power related alarms occur: High SWR Shutdown PA Pwr Foldback SWR Foldback SWR Shutback
High Temperature	This summary alarm is triggered if any of the following temperature related alarms occur: Fan 1 - 3 Fail High Temperature Latch PA Over Temperature PS A 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: Entered Firmware Upgrade Low Battery
Maintenance Required	This summary alarm is triggered if any of the following maintenance related alarms occur: +15V Supply Fail -15V Supply Fail Audio Processor Offline Audio Processor O/P Fail High SWR Low Battery No External 10MHz No 1 PPS Pilot Unsync
Off Air	This summary alarm is triggered if any of the following off-air related alarms occur: All Power Amplifiers Inactive Audio Loss Discharging PA Volts Entered Firmware Upgrade External Interlock Forward Power Shutdown Insufficient Fans Active IPA Fail IPA Output High IPA Output Low Missing Preset Need Reboot For Settings No HD Data No Internal 10MHz PA Volts Fail PLL Unlock Preamp Fail SRC 1/2 Unlock Reject Shutback Residual PA Volts Present SWR Shutback SWR Shutdown Unsigned DSP Image +1.2V Supply Fail +1.8V Supply Fail +3.3V Supply Fail +48V Supply Fail +5V Supply Fail PS A AC Fail PS A Missing PS A Overtemp
Output Network	This summary alarm is triggered if any of the following output network related alarms occur: Cutback Active Fan 1 - 3 Fail Forward Power Limiting Forward Power Low Forward Power Shutdown Forward Power Very Low High Forward Power High Reject Power High SWR High SWR Shutdown High Temperature Latch Insufficient Fans Active PA Pwr Foldback Reject Foldback Reject Shutback SWR Foldback SWR Shutback
Power Amplifier	This summary alarm is triggered if any of the following power amplifier (PA) related alarms occur: All PAs Inactive HD PA Fault Foldback IPA Fail IPA Output High IPA Output Low PA Over Temperature PA 1 - 4 Fail 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: Discharging PA Volts PA Volts Fail PS A AC Fail PS A Fail PS A Missing PS A Over Temp Residual PA Volts Present +1.2V Fail +15V Fail -15V Fail +1.8V Fail +3.3V Fail +48V Fail +5V Fail
Reduced Power	This summary alarm is triggered if any of the following reduced power related alarms occur: Cutback Active Fan 1 - 3 Fail Forward Power Limiting Forward Power Low Forward Power Very Low HD PA Fault Foldback High Temperature Latch PA Over Temperature PA Pwr Foldback Reject Foldback SWR Foldback PA 1 - 4 Fail

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 1.4 shows the approximate remaining output power when power amplifiers (PAs) or cooling fans fail.

NOTE:
There are several combinations of PA or fan failures that can affect the RF output. Table 1.4 shows the maximum RF output power that can be expected for a given condition. In the event that PAand 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 fan (B1, B2 or B3)	1250
2 fans (B1, B2 or B3)	700
3 fans (B1, B2 or B3)	0 (RF output is inhibited until at least 1 fan is replaced)
1 PA PWB (A6 - A9)	560
2 PA PWBs (A6 - A9)	350
3 PA PWBs (A6 - A9)	60

Operating in FM+HD mode with SWR Foldback

When an SWR Foldback alarm occurs, the VS1's forward power will be reduced to a level that maintains an SWR that is below the foldback threshold. For FM+HD systems, the reduced forward power also depends on the injection level (e.g., -20 dBc, -14 dBc, etc.) and the aggressiveness of Nautel HD Power Boost [MER (less aggressive) or Efficiency (more aggressive), as set in the HD PowerBoost Priority field of FM+HD presets]. Table 1.4 shows the approximate maximum forward power expectation for various FM+HD injection levels, with Efficiency and MER priority.

Table 1.4: Output Power vs SWR and FM+HD Injection Levels (-20, -14 and -10 dBc)

VSWR	Maximum Output Power (W)					
	MER Priority			Efficiency Priority		
	-20 dBc	-14 dBc	-10 dBc	-20 dBc	-14 dBc	-10 dBc
1.2:1 to 1.35:1	812	594	437	912	703	527
1.35:1 to 1.5:1	440	450	355	510	585	482
1.5:1 to 2:1	385	340	230	445	430	345
2.1:1 to 3:1	275	230	160	335	315	240

NOTE: To determine the maximum output power for other injection levels, linearly interpolate between the injection levels shown, for the effective injection level.

Replacing a suspect PWB, power supply or fan

Maintenance philosophy

Maintenance on a VS1 transmitter consists of replacing any of the PWBs, power supplies or fans identified in Table 1.5 on page 1-32.

Special Tools and Test Equipment

The following tools and test equipment are required to troubleshoot a VS1 transmitter.

- Digital multimeter
- Torque screwdriver, capable of torquing up to 1.2 N-m (11 in.-lbs). Required for installing securing hardware for PA PWB FETs and power supply connections.
- Soldering iron and desoldering tool
- VS1 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 VS1 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 VS1's RF output (RF off) and set its AC POWER switch to the off position. Disconnect all cabling from the rear of the VS1, remove the VS1 from its host cabinet and place the VS1 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 1.5 on page 1-32).

> *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 (NAPA23/03A) 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 1.5: Replacement Procedures

Module	Replacement Procedure
PA PWB	See page 1-33
Pre-amp/IPA PWB	See page 1-36
Power Supply Module	See page 1-39
+48 V Power Supply	See page 1-40
Cooling Fan	See page 1-41
Exciter/Control PWB	See page 1-43
PS Distribution PWB	See page 1-46
Combiner Interface PWB	See page 1-47

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 the 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 1-34. If you are prompted to replace a PA PWB, return to Step 3 of this procedure.

3. Unsolder and remove the three solder connections to the defective PA PWB. They include a white, 16 AWG wire (to pad B), a tinned copper jumper (to pad A or E) and either a tinned copper jumper (to pad F) or a white coaxial cable (to pads F and G).

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, noting the proper orientation for installation of the new PA PWB. If you are removing PA # 4 (A9), note that one of the securing screws also holds thermistor RT2 in place (see Figure MD-2 in section 6 of this manual). Temporarily move RT2 and its associated wiring to allow removal of the PA PWB.

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 NAPA23/03A PA PWB from the station spares kit, if purchased.

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

8. If you are replacing PA # 4 (A9), spread a small amount of thermal compound (Nautel Part # HAG39, from the station spares kit), in a thin, even layer, on the top and bottom of the RT2 tab, removed in Step 5. Use thermal compound to cover the threads on the M3 screw that secures RT2 in Step 9.

9. 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.

10. 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). If you are replacing PA # 4 (A9), re-install thermistor RT2 under the appropriate securing screw (see Figure MD-2 in section 6 of this manual). Do not tighten the four screws at this time.

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.

11. 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 inch-pounds (0.67 Newton-meters) of torque has been applied.

12. Tighten the four PWB screws. If replacing PA # 4 (A9), use a torque screwdriver to tighten RT2's securing screw to 9 inch pounds (1.0 Newton-meters).

13. Solder the wires removed in Step 3. If necessary, refer to Section 4 of this manual for wiring details for A6 through A9.

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

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

PA resistance checks

1. 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 14 kΩ, replace the PA PWB (see "PA PWB replacement" on page 1-33).
   - If the measurement is between 14 kΩ and 20 kΩ, check the other PA PWBs for a failure. If none of the other PA PWBs have failed, replace the original suspect PA PWB.
   - If the measurement is greater than 20 kΩ, proceed to Step 2.

2. 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 and suspect a problem with an associated PWB.
   - If the measurement is not open circuit, replace the PA PWB (see "PA PWB replacement" on page 1-33).

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 1-38). 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.

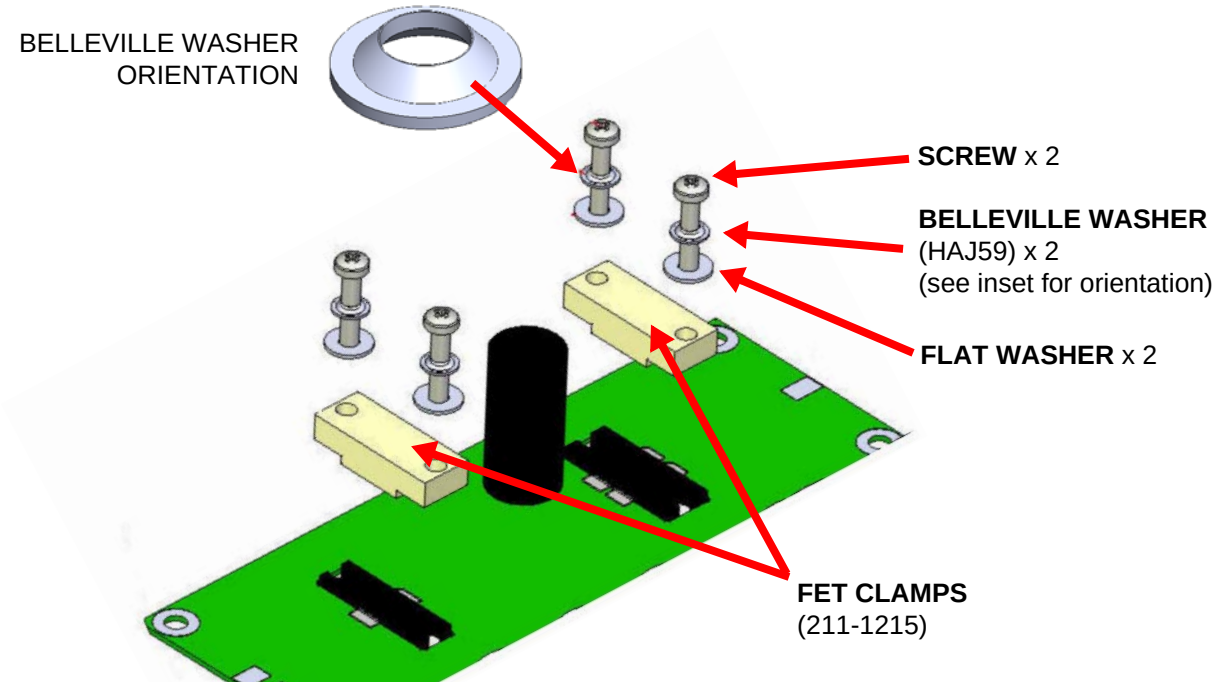
15. Remove the transmitter's top cover. Check the continuity across fuse F1 on the PS distribution PWB (A2). If the resistance is greater than 1 Ω, replace fuse F1 (Nautel Part # FA57, located in the ancillary kit) and re-install the transmitter's top cover.

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

17. Perform the VS1 IPA Output Power Configuration procedure in Information Sheet IS16007, which is available in the NUG section of the Nautel website.

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 (U2) by removing two M3 screws . 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-2 (bottom view) in the Mechanical Drawings section (Section 6) of this manual.

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

2. Remove the four sets of M3 hardware that secure the +48 V power supply (U3) (and its mounting brackets) to the transmitter. Retain hardware.

3. Remove the +48 V power supply from the transmitter and remove the two mounting brackets for use with the new power supply. Note the orientation of each bracket for installation of the new power supply.

4. Disconnect wires # 7, 8, 9, 12 and 13 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 two mounting brackets 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 U3. Torque all terminal connections on U3 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.

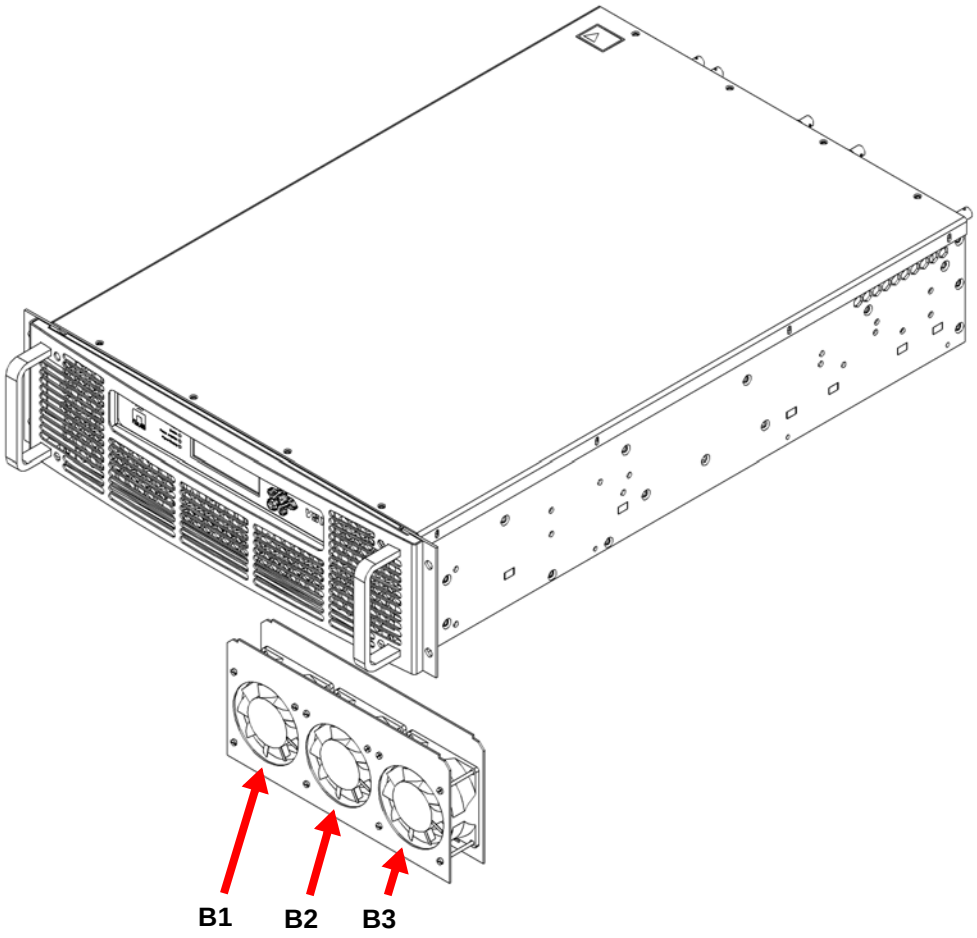
Cooling fan replacement

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 (B1P1 through B3P1) from splitter PWB (A4).
3. Slide the cooling fan bracket assembly out of the transmitter chassis (see Figure 1.5 on page 1-42).
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 bracket assembly

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.

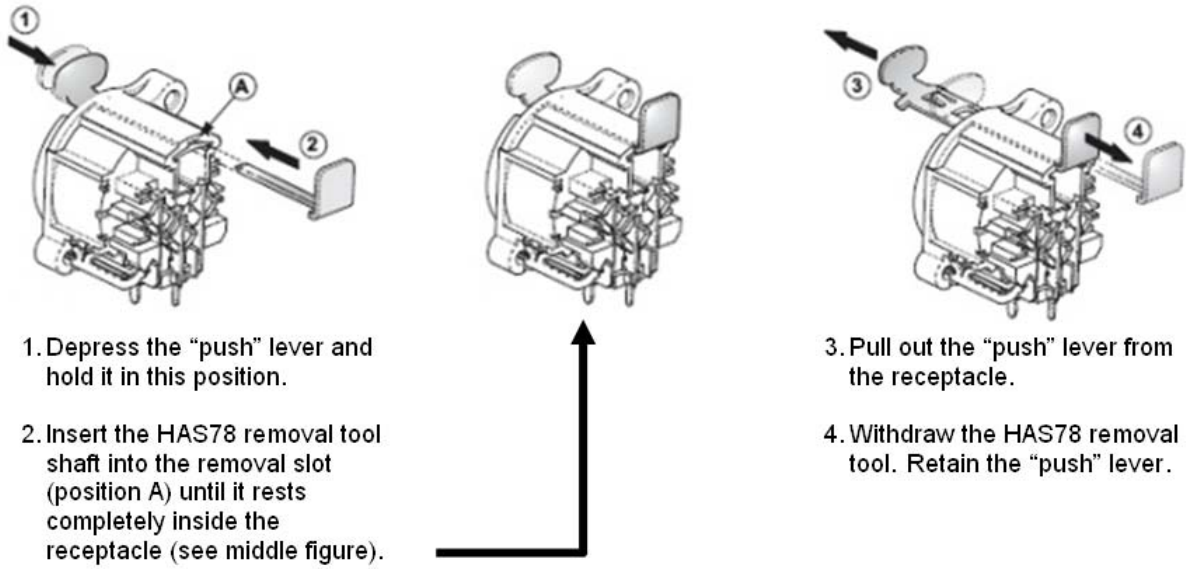
   - Locate the AES/EBU XLR audio connector (J3) on the rear panel. Remove the two small pan-head Phillips screws.

   - 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 1-44 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 1-44. 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



1. Depress the "push" lever and hold it in this position.
2. Insert the HAS78 removal tool shaft into the removal slot (position A) until it rests completely inside the receptacle (see middle figure).
3. Pull out the "push" lever from the receptacle.
4. Withdraw the HAS78 removal tool. Retain the "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 module (U2) from the transmitter (see "Power Supply Module Replacement" on page 1-39).

3. Disconnect ribbon cable plugs W2P2 and W4P2 and quick-disconnects P7 and P8 from the PS distribution PWB (A2). Remove the nine wires [(# 10, 11, 12, 13, 14, 16, 18, 20 and 22) connected to terminals E3 and E5 and terminal blocks TB1 and TB2.

4. Remove the two screws that secure the cover to connector A2J1. Retain the cover and screws.

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

6. Remove the PS distribution PWB from the transmitter.

7. Locate or obtain a replacement PS distribution PWB (Nautel Part # NAPS41A). Reverse Step 1 through Step 6 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 TB1 and TB2 to 6 inch pounds (0.67 Newton-meters). Torque connections on E3 and E5 to 20 inch pounds (2.24 Newton-meters).

8. Reinstall the transmitter's top cover.

9. 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 # NAPI136). 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 - VS1 Transmitter**" **on page 1-7** and high level descriptions of the *VS1 Operation and Maintenance Manual*.

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

VS1 electrical schematics

The descriptions in this section all refer to the VS1 electrical schematics listed in Table 5.1 on page 5-4 of the *VS1 Troubleshooting Manual*.

Exciter/control PWB (NAPE87B)

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

PS distribution PWB (NAPS41A)

See electrical schematic Figure SD-3.

Interfacing

The PS distribution PWB provides the interface between the VS1's power supplies and the rest of the transmitter. It passes:

- ac voltage from the AC INPUT (U1) to the power supply module (U2).
- PA voltage from the power supply module (U2) to the power amplifier (PA) PWBs (A6 through A9).
- Pre-amp voltage (+48 V) from the +48 V power supply (U3) to the pre-amp/IPA PWB (A5) [pre-amp V delivered via the exciter/control PWB (A1) and the interface PWB (A3)].
- Power supply control voltage and power supply inhibit signal from the exciter/control PWB (A1) to the power supply module (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 (J2-2). This output is applied to the exciter/control PWB for monitoring and protection purposes.

Power supply module fault monitoring

An 8-bit shift register IC U5 accepts the status and alarm signals from the power supply module (U2) (PS present, PS ac fail, PS temp and PS fail) and converts them to a serial data stream on the *MISO 165* output (J2-4). 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 *PS Inhibit* input (J2-6).

Fan enable

Transistor Q2, FET Q1 and associated components form a fan enable circuit that controls the application of power supply voltage (+48 V) to the cooling fans (B1, B2 and B3). When the transmitter's RF status is 'on', the *Fan Enable* input (J3-2) is logic high and transistor Q1 turns on. This causes FET Q2 to turn on, allowing +48 V to be applied to the *Fan V (+)* outputs (J3-11, 12 and 13), enabling fans B1, B2 and B3. When the transmitter's RF status is 'off', transistor Q1 turns off. This causes FET Q2 to turn off, preventing +48 V from being applied to the *Fan V (+)* outputs; hence disabling the fans.

LVPS

Two +48 V to +5 V dc-dc converters (U2 and U12) 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 (NAPA23/03A)

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 350 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 module, 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 B1, B2 and B3.

The *RF Drive* input is applied to cable T1, 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). Cables T2:A and T2:B, as well as capacitors C2, C6, C7 and C17, inductor L2 (part of R12/R13 leads) and resistors R5, R8, R9, R10, R12 and R13 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 inductors L4 and L5, which provide proper resonating reactance for Q1's output. Cable T3:A and T3:B transform the impedance at the RF output, ensuring an optimum (low) impedance is presented at Q1's output. Cable T4 converts the balanced RF signal to an unbalanced RF Output signal.

The *PA V* input is applied to capacitors C1, C3, C5, C8 and C11, which act as a broadband decoupling network. Capacitor C13 and inductor L3 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.

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., NAPA23/03A) 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., NAPA23/03A)
- cable harnesses with a numbered Nautel part (e.g., 211-8104-02)
- 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 VS1'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

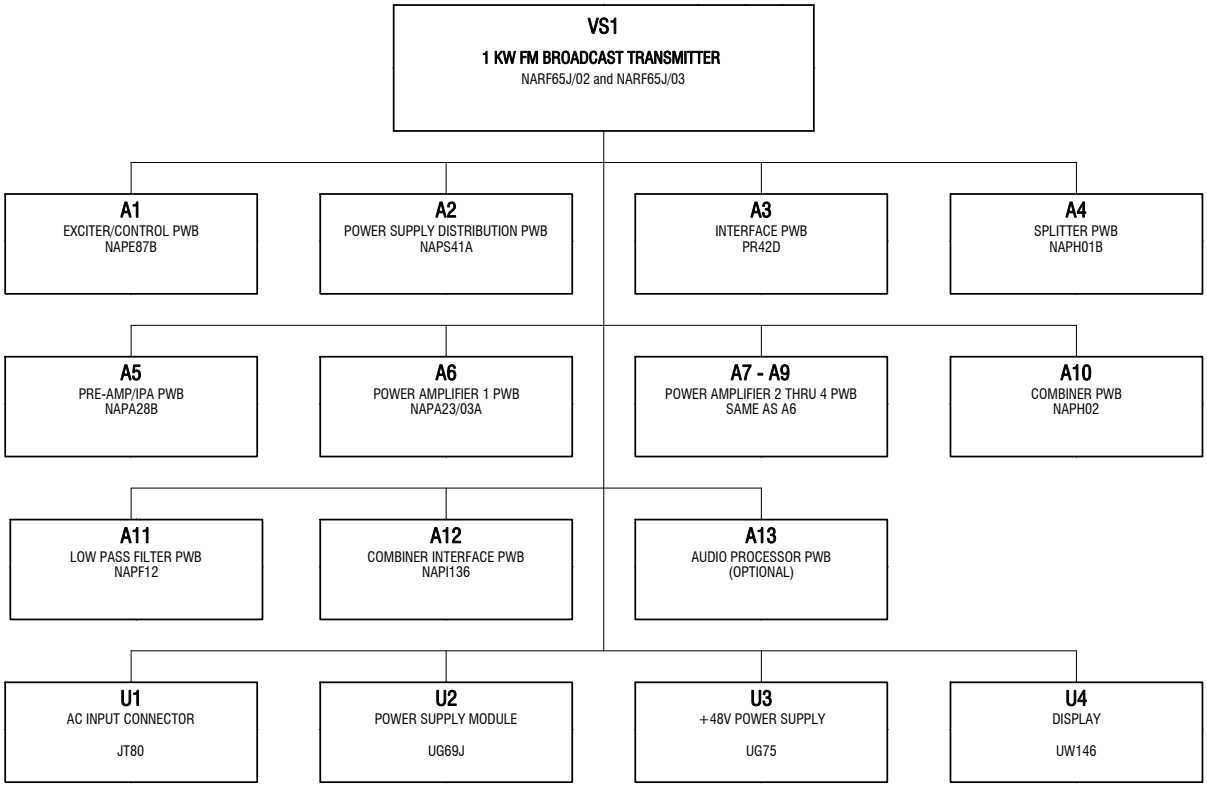
The Reference Designation column contains the reference designation(s) for a specific part. When multiple reference designations apply to a part, they are sorted alphanumerically. These designations are assigned in accordance with the requirements of American Society of Mechanical Engineers ASME Y14.44-2008.

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: VS1 Family Tree



211-8100-22-FAM01 VA

StockCode: NARF65J/02
Description: Final Assy VS1, 7/16 DIN (w/o JA55) - RLS 11,

Component Lvl, StockCode	Description	Reference Designation
01 **200-5112**	**USB Mod, Programmed VS (Handbook)**	
01 **211-8104-02**	**Cableset Assy, VS1**	
02 JDP24	Conn, Coax, BNC, Plug, 50ohm, Crimp	W5P1
02 JN61	Conn, 16 Pin, Dual Row Crimp	P09
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	P10
02 JU27	MTA, Keyed Closed End Housing, 4 pin,22AWG	P10
02 JU58	Conn, Contact for Socket DF11, 22AWG	P09
02 LA52	Ferrite, Clip-On, NiZn, 320ohm s @ 100 MHz	W5L1
01 **211-8973-06**	**Packing Supplies VS1**	
02 211-8005-08	Ancillary Kit (VS300, VS1, VS2.5)	
02 211-8978-05	Installation Kit, VS300/VS1	
03 211-5060	Interlock Jumper Wire	
01 **CBP08**	**Capacitor, Feed-Thru, Ceramic, 1000pF**	C01, C02, C03, C04, C05
01 **JA44**	**Conn, Coax, Recept, 7/16 DIN, Panel,50ohm**	J02
01 **JT80**	**Conn,Recept,AC,250V,20A, Quick-Dis**	U01
01 **LA02**	**Toroid, Ferrite, 12.7mm, K Mtl**	L01, L02
01 **LA64**	**Ferrite, 28 MTL, ribbon cable, 20 POS, Metal clip,**	L04
01 **NAPA23/03A**	**PA PWB Assy, VS Series**	A06, A07, A08, A09
02 CAP16	Capacitor, Ceramic, 1.0uF 100V	C05, C08
02 CAP81	Cap, Electrolytic, 1000uF, +/- 20%, 63V Radial Lea	C16
02 CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C10
02 CT38	Capacitor, Metal, Polyester, 1 0uF 100V	C01, C03
02 CT47	Capacitor,SMT,Ceramic,15pF,50V ,5%	C02, C17
02 CT48	Capacitor,SMT,Ceramic,56pF,50V ,5%	C07
02 CT49	Capacitor,SMT,Ceramic,100pF,50 V,5%	C06
02 CT50	Capacitor,SMT,Ceramic,0.01uF, 100V,10%	C09, C12
02 CT51	Capacitor,SMT,Ceramic,0.1uF, 100V,10%	C11
02 CT52	Capacitor,SMT,Ceramic,470pF, 200V,10%	C13

Component Lvl, StockCode	Description	Reference Designation
02 CT53	Capacitor,SMT,Ceramic,0.001uF, 50V,10%	C14, C15
02 LA42	Core, Ferrite, 2 hole, 4B1 mtl	L01
02 LA45	Core, Ferrite, 2 Hole, K Mtl	L06, L07
02 LA50	Inductor, Horseshoe, used with PA NAPA16 & 20	L04, L05
02 LA51	Inductor, used with PA NAPA16 & 20	L03
02 QAP58	Transistor, (BeO), FET, N Channel, Dual	Q01
02 RAD39	Resistor, SMT, MF, 15K Ohms, 1%, 1/4W	R01, R02
02 RAD45	Resistor, SMT, MF, 47.5K Ohms, 1% 1/4W	R11
02 RAD50Z	Resistor,SMT,MF,20ohms, 1%,2W	R03, R04, R05, R08, R09, R10
02 RBP01	Resistor, Film, 10 Ohms, 5%, 2 W	R12, R13
02 WB05	Wire, 16 AWG, Stranded, White	L01
02 WE38	Cable, Coax, 50ohm, Strand, RG 188A/U	T01
02 WE46	Cable,Coax,50 ohm,82.5% VP,SR Jacket,NEWcel-GX16	T04
02 WF17	Wire, 22 AWG, Stranded, 1-cond /shield,Tef	T02A, T02B
02 WF22	Wire, 16 AWG, 1-Cond/Shield, T eflon	T03A, T03B
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
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

Component Lvl.	StockCode	Description	Reference Designation
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	**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
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

Component Lvl. StockCode		Description	Reference Designation
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
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

Component Lvl.	StockCode	Description	Reference Designation
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
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

Component Lvl.	StockCode	Description	Reference Designation
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
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

Component Lvl.	StockCode	Description	Reference Designation
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
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

Component Lvl, StockCode	Description	Reference Designation
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
01 NAPF12	**RF LPF PWB Assy, VS 1**	A11
02 LA61	Inductor, Filter Coil, 85nH, 4 turns, 1/8" Refrig	L01, L02, L03, L04, L05
01 NAPH01B	**Splitter PWB Assy, VS1**	A04
02 CCFS04	Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603	C01, C02, C06, C08, C12, C14, C18, C20
02 CCFS42	Cap,SMT,Ceramic,1000pF,2%,50V, C0G,0805	C07, C13, C19
02 CCG04	Capacitor, Ceramic, 0.01uF 10% 100V	C21, C22
02 CT50	Capacitor,SMT,Ceramic,0.01uF, 100V,10%	C03, C05, C09, C11, C15, C16
02 CT66	Capacitor, SMT, Ceramic, 0.1uF 10%, 100V	C04, C10, C17
02 JN68	Conn, Edge Card, 3A, 28 Contac ts, Dual Row, 30u G	J04
02 JU60	MTA, Keyed Square Post Header Assy, 3 pin	J01, J02, J03

Component Lvl, StockCode	Description	Reference Designation
02 LA56	Bead, Ferrite, SMT, 95 ohm, 2.85mm H x 9.6mm Lg	L01, L02, L03, L04
02 RT16	Thermistor, PTC, .50-.77 Ohms, 0.5A Hold	RT01, RT02, RT03
02 RT60	Resistor, Chip, AIN, 50 Ohm, 2%, 30W	R01, R02, R03, R04
01 NAPH02	**Combiner PWB Assy, VS1**	A10
02 LA62	Inductor, Staic Drain Choke, 550nH, 14 turns, 16 A	L01
02 RAD11	Resistor, SMT, MF, 68.1 Ohms, 1% 1/4W	R07, R16
02 RAD12	Resistor, SMT, MF, 82.5 Ohms, 1% 1/4W	R06, R15
02 RAD15	Resistor, SMT, MF, 150 Ohms, 1% 1/4W	R01, R02, R03, R10, R11, R12
02 RAD18	Resistor, SMT, MF, 274 Ohms, 1% 1/4W	R05, R08, R14, R17
02 RAD19	Resistor, SMT, MF, 332 Ohms, 1% 1/4W	R04, R09, R13, R18
01 NAPI136	**Combiner Interface PWB Assy, VS1**	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
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, R22, R26
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, R24
02 RAD23	Resistor, SMT, MF, 681 Ohms, 1% 1/4W	R11, R15, R23, R25
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 NAPS41A	**PS Distribution PWB, Assy, VS1**	A02
02 CCFS04	Cap,SMT,Ceramic,0.01uF,10%,50V ,X7R,0603	C09, C11, C29, C30, C34, C35, C36, C37, C39, C41, C42, C43, C44, C45, C55, C60, C64, C71, C73, C76,, C80, C83, C84, C86 C88, C90, C91, C92
02 CCFS07	Cap,SMT,Ceramic,0.1uF,10%,50V, X7R,0805	C13, C14, C32, C51, C52, C53, C54, C57, C62, C72, C82
02 CCFS52	Cap, SMT, Ceramic, 0.1uF, 10% 25V X7R, 0603	C31, C33, C38, C40, C56, C58, C70, C74, C75

Component Lvl.	StockCode	Description	Reference Designation
02	CCFS60	Cap,SMT,Ceramic,1uF,10%,100V, X7R,1210	C05, C06, C10, C12, C16, C18, C19, C20, C21, C25, C26, C28, C67, C69, C77, C78, C81, C87
02	CCFS71	Cap, SMT, Ceramic, 0.68uF, 10% 100V X7R 1210	C46, C47, C63, C66
02	CCG01	Capacitor, Ceramic, 0.001uF 10 % 200V	C94
02	CT50	Capacitor,SMT,Ceramic,0.01uF, 100V,10%	C03, C04, C22, C27, C49, C61, C68, C89
02	CT51	Capacitor,SMT,Ceramic,0.1uF, 100V,10%	C01, C02, C23, C24, C50, C59, C65, C93
02	CTFS01	Cap,SMT,Tantalum,10uF,10%,16V, 1411	C17, C79
02	CTFS02	Cap,SMT,Tantalum,1uF,10%,35V, 1411	C48
02	CTFS03	Cap,SMT,Tantalum,10uF,10%,35V, 2917	C15
02	FA56	Fuse, SMT, Fuse Block, 7A VeryFast Acting Installe	F01
02	HAC55	Terminal,PC Screw 10-32,30 Amp	E03, E05
02	HAJ66	Terminal, SMT, Test Point, PWB	TP07, TP08, TP09, TP15, TP16, TP19, TP20, TP22, TP23, TP2
02	HR26	Connector, Quick-Dis, M, 1/4 Tab, PWB	E01, E02
02	JA95	Conn, 47 Contact, F, 90 deg, PWB Mt	J01
02	JQ55	Conn, Header, Ribbon Cbl, 20 Pin	J02, J03
02	JT44	Terminal Block, 4-Pos, Dual Ba rrier, 20A	TB01, TB02
02	LS16	Inductor,SMT,Pwr,Shielded Drum Core,P1167series, 2	L01, L02, L04
02	LS17	Inductor,SMT,Pwr,Shielded,P116 7 Series,3.5A,3.6uH	L05
02	LS25	Choke, SMT, Common Mode, 2800 ohm, 1.5A	L03
02	QBNS01	Transistor,SMT,NPN,Switch/Amp ,SOT-23	Q02
02	QDLS01	Diode, SMT, LED, Green, (560nm), 0603	DS01, DS02, DS03, DS04
02	QR70	Suppressor, Transient Voltage, SMT 60V Clamp	CR01, CR02, CR03, CR04, CR05, CR06
02	QR71	Transistor, FET, P-channel, D2Pak	Q01
02	RAD13	Resistor, SMT, MF, 100 Ohms, 1% 1/4W	R05, R07, R09, R11, R23, R25, R27, R29
02	RAD27	Resistor, SMT, MF, 1500 Ohms, 1% 1/4W	R01
02	RAD33	Resistor, SMT, MF, 4750 Ohms, 1%, 1/4W	R06, R08, R10, R12, R24, R26, R28, R30
02	RAD37	Resistor, SMT, MF, 10.0K Ohms, 1%, 1/4W	R52
02	RAD41	Resistor, SMT, MF, 22.1K Ohms, 1% 1/4W	R50
02	RAD48	Resistor, SMT, MF, 82.5K Ohms, 1% 1/4W	R46
02	RAD74	Resistor, SMT, 0.1ohms, 1206, 1% 1/4W	R18
02	RFCS01	Resistor,SMT,MF,0.005ohms,1%, 1W,2512	R42, R48, R53, R59
02	RFCS02	Resistor, SMT, 0.015 Ohm, 1%, 1W	R13
02	RFFS26	Resistor,SMT,MF,100ohms,1%, 1/10W,0603	R15, R16, R20, R43, R44, R56, R57
02	RFFS32	Resistor,SMT,MF,332ohms,1%, 1/10W,0603	R02, R65
02	RFFS38	Resistor,SMT,MF,1000ohms,1%, 1/10W,0603	R49
02	RFFS43	Resistor,SMT,MF,2740ohms,1%, 1/10W,0603	R55

Component Lvl, StockCode	Description	Reference Designation
02 RFFS46	Resistor,SMT,MF,4750ohms,1%, 1/10W,0603	R21, R54
02 RFFS48	Resistor,SMT,MF,6810ohms,1%, 1/10W,0603	R36
02 RFFS50	Resistor,SMT,MF,10.0Kohms,1%, 1/10W,0603	R03, R04, R35, R41, R63
02 RFFS52	Resistor,SMT,MF,15.0Kohms,1%, 1/10W,0603	R38
02 RFFS54	Resistor,SMT,MF,22.1Kohms,1%, 1/10W,0603	R37
02 RFFS61	Resistor,SMT,MF,82.5Kohms,1%, 1/10W,0603	R34
02 RFFS62	Resistor,SMT,MF,100Kohms,1%, 1/10W,0603	R33, R45
02 RFFS63	Resistor,SMT,MF,121Kohms,1%, 1/10W,0603	R22
02 RFFS70	Resistor,SMT,MF,475Kohms,1%, 1/10W,0603	R17, R31, R40, R47, R60, R62
02 RFFS77	Resistor,SMT,MF,1.82Mohms,1%, 1/10W,0603	R39, R51, R58, R61
02 RT17	Thermistor, PTC, .15-.25 Ohms, 1.1A Hold	RT01, RT02, RT05, RT06
02 RT19	Thermistor, PTC, .05-.08 Ohms, 2.5A Hold	RT03, RT04
02 UDLS04	IC,SMT,CMOS,8-Bit Shft Reg,Par I/P, SOIC-16	U05
02 ULAS02	IC,SMT,Opamp,Quad,Rail-To-Rail ,SOIC-14	U04, U10
02 ULRS02	IC,SMT,4.096V Reference,0.1%, SOT-23-6	U07
02 UMAS01	IC,SMT,ADC,10-Bit,11-ch,SPI, SOIC-20	U09
02 UT74	IC, Amplifier, Instrumentation	U03, U06, U08, U11, U13, U14
02 UW113	Power Supply, DC to DC, 36-75 In, 5 Out, 3A	U02, U12
02 UW85	Power Supply,DC-DC,36-75 In, 15 Out, 1A	U01
01 PR42D	**PWB Detail, Interface**	A03
01 RT69	**Res, (BeO), 50 ohms, 5%, 250W, Flng Mt w/stress re**	A10R19, A10R20, A10R21, A10R22
01 RX49	**Thermistor,-30/105ºC,10Kohms@ 25ºC,Neg,Bvalue 3435**	RT01, RT02
01 SB65	**Circuit Breaker, 240V, 20A, Thermal, 2-Pole No rel**	CB01
01 UG69J	**Pwr Sply, 7-53Vdc, 2000W, 50A 90-264Vac, Hi-Eff (8**	U02
01 UG75	**Power Supply, 48V@320W, 88-264 VAC, PFC, EMI**	U03
01 UW146	**Display, 20x4 LCD, 3.3 - 5V, -20/+70**	U04
01 ZAP50	**Fan, 80mm, Brushless, 48Vdc, EMI Caps, Tach w/conn**	B01, B02, B03

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 - VS1 Transmitter (page 4-3)

Table 4.2: Connector Mating Information Provided

Table #	Description
Table 4.4	Connector Mating Information - VS1 Transmitter (page 4-5)

Table 4.3: Wiring List - VS1 Transmitter

Source	Destination	Wire #	Colour	Size	Remarks
U1-L	CB1P1	1	Grey	14	
U1-N	CB1P2	2	Grey	14	
U1-GND	E2	3	Grn/Yel	14	
-	-	4			Not Used
CB1-3	A2E1	5	Grey	14	
CB1-4	A2E2	6	Grey	14	
CB1-3	U3-L	7	Grey	14	
CB1-4	U3-N	8	Grey	14	
E2	U3-GND	9	Grn/Yel	14	
E2	A2E3	10	Grn/Yel	14	
A2E3	A2E5	11	Grn/Yel	14	
U3-(+V)	A2TB2-1	12	White	16	
U3-(-V)	A2TB2-3	13	Black	16	
A2TB2-2	C1E1	14	White	16	
C1E2	A5-E	15	White	16	
A2TB1-1	C2E1	16	White	16	
C2E2	A6-B	17	White	16	
A2TB1-2	C3E1	18	White	16	
C3E2	A7-B	19	White	16	
A2TB1-3	C4E1	20	White	16	
C4E2	A8-B	21	White	16	
A2TB1-4	C5E1	22	White	16	
C5E2	A9-B	23	White	16	
A4-Q	A5-D	24	White	16	
P9-1	P10-2	25	White	22	
P9-2	P10-3	26	White	22	
P9-15	P10-4	27	Black	22	
P9-16	P10-1	28	White	22	
W5P1-Center	A5-A	29	Conductor	-	50 Ohm Coax
W5P1-Shield	A5-G	29	Shield	-	50 Ohm Coax
A10-F	A4-S	30	Conductor	-	50 Ohm Coax
A10-E	A4-R	30	Shield	-	50 Ohm Coax
A4-M	A6-F	31	Conductor	-	50 Ohm Coax
A4-L	A6-G	31	Shield	-	50 Ohm Coax
A4-N	A9-F	32	Conductor	-	50 Ohm Coax

Table 4.3: Wiring List - VS1 Transmitter

Source	Destination	Wire #	Colour	Size	Remarks
A4-P	A9-G	32	Shield	-	50 Ohm Coax
A10-DD	A10-X	33	Conductor	-	50 Ohm Coax
A10-EE	A10-Y	33	Shield	-	50 Ohm Coax
A10-CC	A10-W	34	Conductor	-	50 Ohm Coax
A10-BB	A10-V	34	Shield	-	50 Ohm Coax
J3-Center	A10-Q	35	Conductor	-	50 Ohm Coax
J3-Shield	A10-P	35	Shield	-	50 Ohm Coax
J4-Center	A10-M	36	Conductor	-	50 Ohm Coax
J4-Shield	A10-L	36	Shield	-	50 Ohm Coax
A4-A	A5-B	-	-	24	Link
A4-B	A5-C	-	-	24	Link
A4-C	A6-A	-	-	24	Link
A4-D	A7-A	-	-	24	Link
A4-F	A7-F	-	-	24	Link
A4-G	A8-F	-	-	24	Link
A4-J	A8-E	-	-	24	Link
A4-K	A9-E	-	-	24	Link
A5-F	A10-J	-	-	20	Link
A6-C	A10-Z	-	-	20	Link
A7-C	A10-CC	-	-	20	Link
A8-C	A10-DD	-	-	20	Link
A9-C	A10-GG	-	-	20	Link
A10-H	A12-D	-	-	24	Link
A10-G	A12-C	-	-	24	Link
A10-C	A12-B	-	-	24	Link
A10-B	A12-A	-	-	24	Link
J2-Center	A10-A	-	-	14	Link
A5-H	A10-K	-	-	20	Link

Table 4.4: Connector Mating Information - VS1 Transmitter

Connector	Mate	Remarks
P1	Not Used	
P2	Not Used	
P3	Not Used	
P4	Not Used	
P5	Not Used	
P6	Not Used	
P7	Not Used	
P8	Not Used	
P9	U4H1	Front Display
P10	A1J10	Front Display
W1P1	A1J15	Interface I/O
W1P2	A3P1	Interface I/O
W2P1	A1J12	Power Supply Control I/O
W2P2	A2J2	Power Supply Control I/O
**W3P1	A1J13	Audio processor (optional)
**W3P2	A13J1	Audio processor (optional)
W4P1	A1J11	Low Voltage I/O
W4P2	A2J3	Low Voltage I/O
W5P1	A1J14	RF Drive Out
B1P1	A4J1	Fan1 Connection
B2P1	A4J2	Fan2 Connection
B3P1	A4J3	Fan3 Connection

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., NAPA23/03A PA PWB). Note the reference designations and Nautel nomenclatures of all higher assemblies in the path, if applicable.
   Example: A5 NAPA23/03A 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: NAPA23/03A PA PWB is shown on schematic SD-5.

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 NAPA23/03A 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: NAPA23/03A 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	VS1 Transmitter - Ac-Dc and Exciter/Control Stages
SD-2	VS1 Transmitter - RF Drive and RF Power Stages
SD-3	NAPS41A PS Distribution PWB
SD-4	NAPA28B Pre-Amp PA PWB
SD-5	NAPA23/03A PA PWB

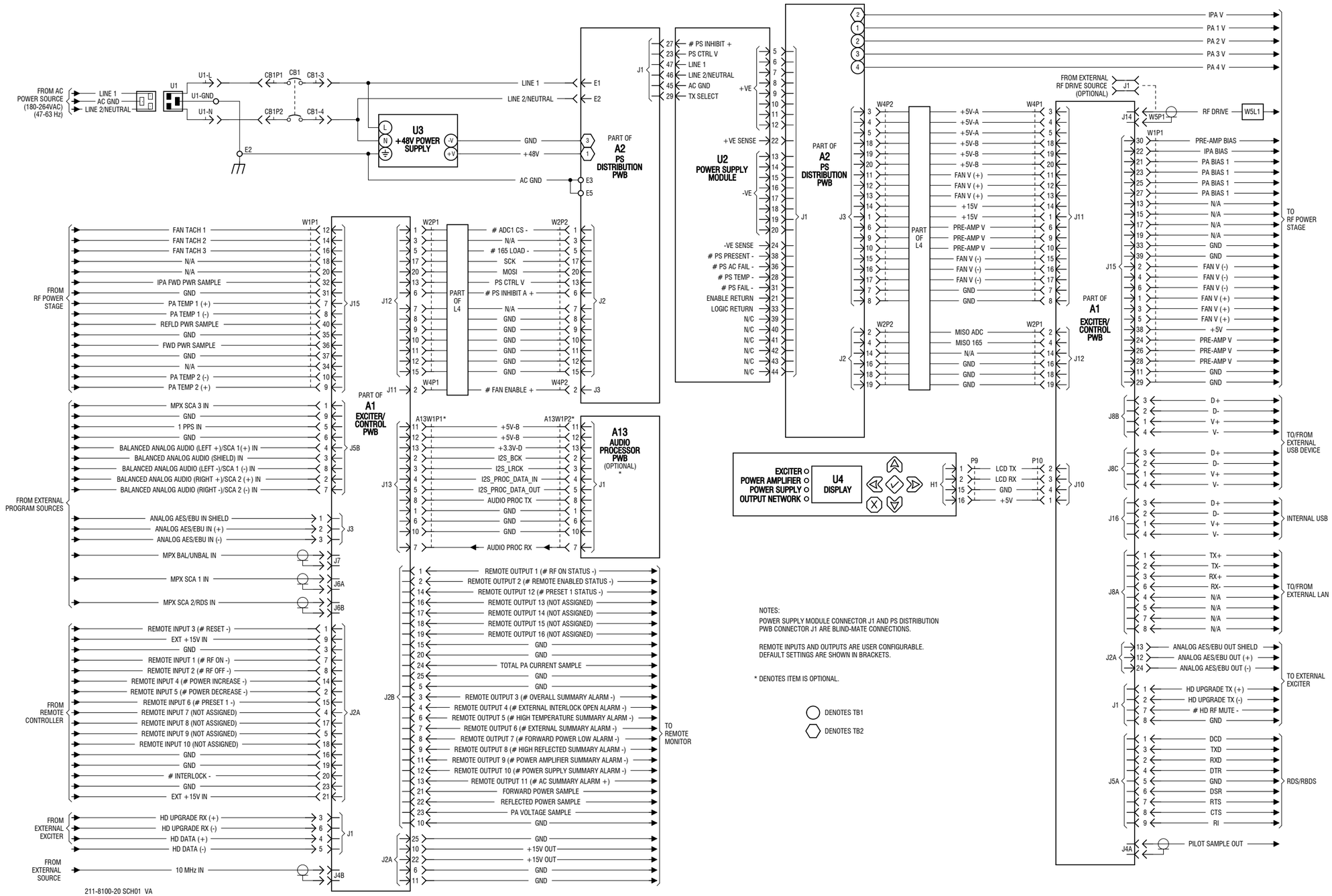


Figure SD-1: VS1 Transmitter - Ac-Dc and Exciter/Control Stages

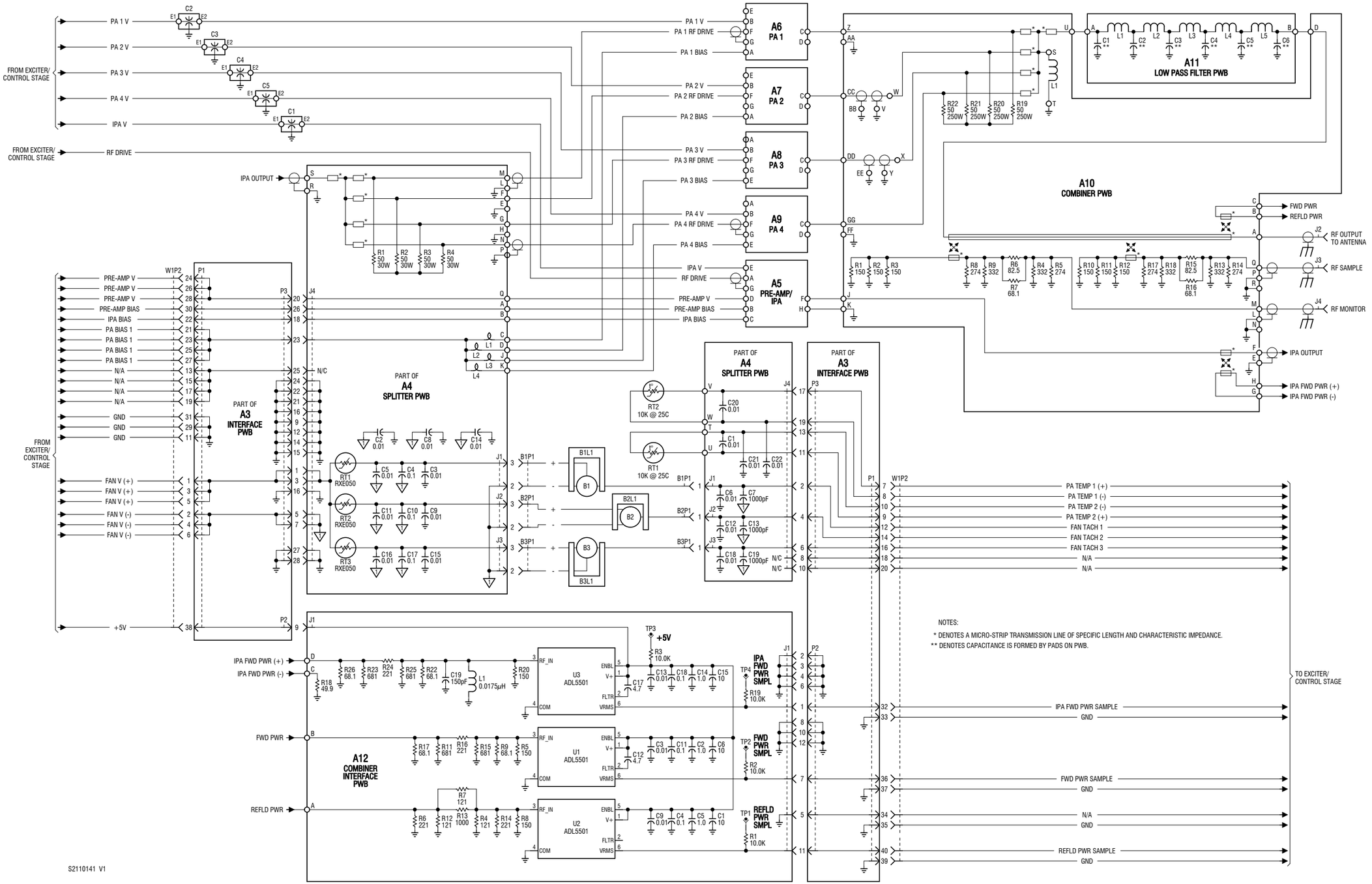


Figure SD-2: VS1 Transmitter - RF Drive and RF Power Stages

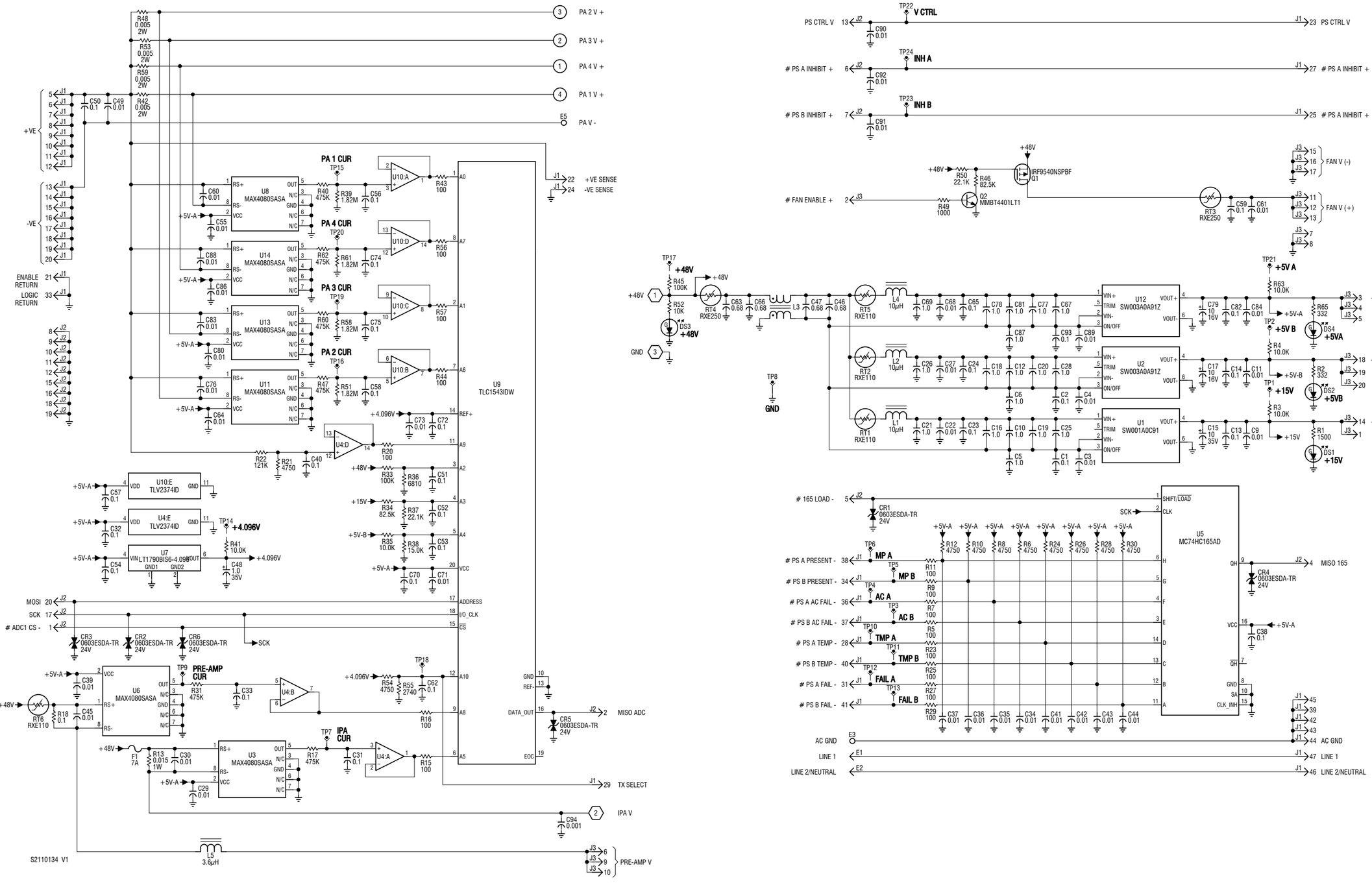
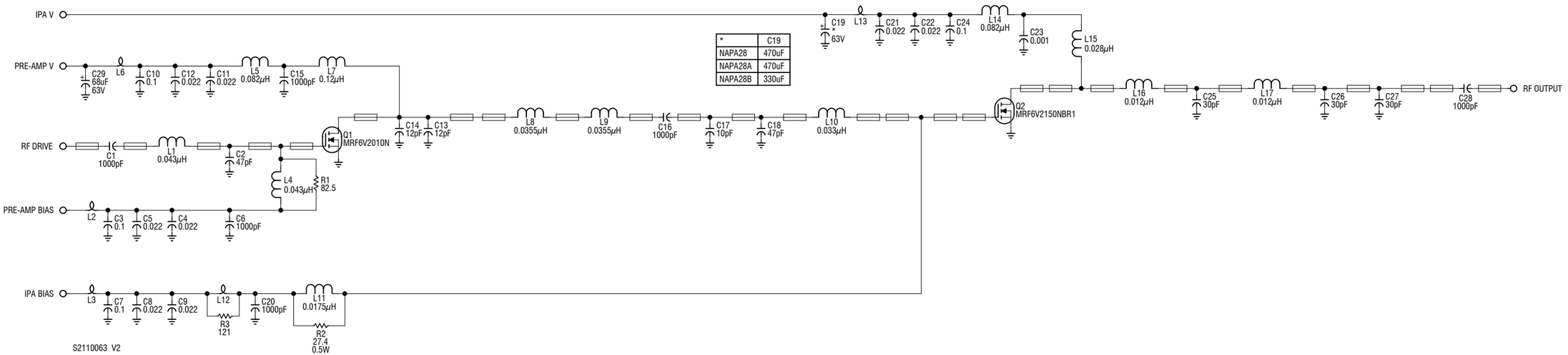


Figure SD-3: NAPS41A PS Distribution PWB



*	C19
NAPA28	470uF
NAPA28A	470uF
NAPA28B	330uF

Figure SD-4: NAPA28B Pre-Amp PA PWB

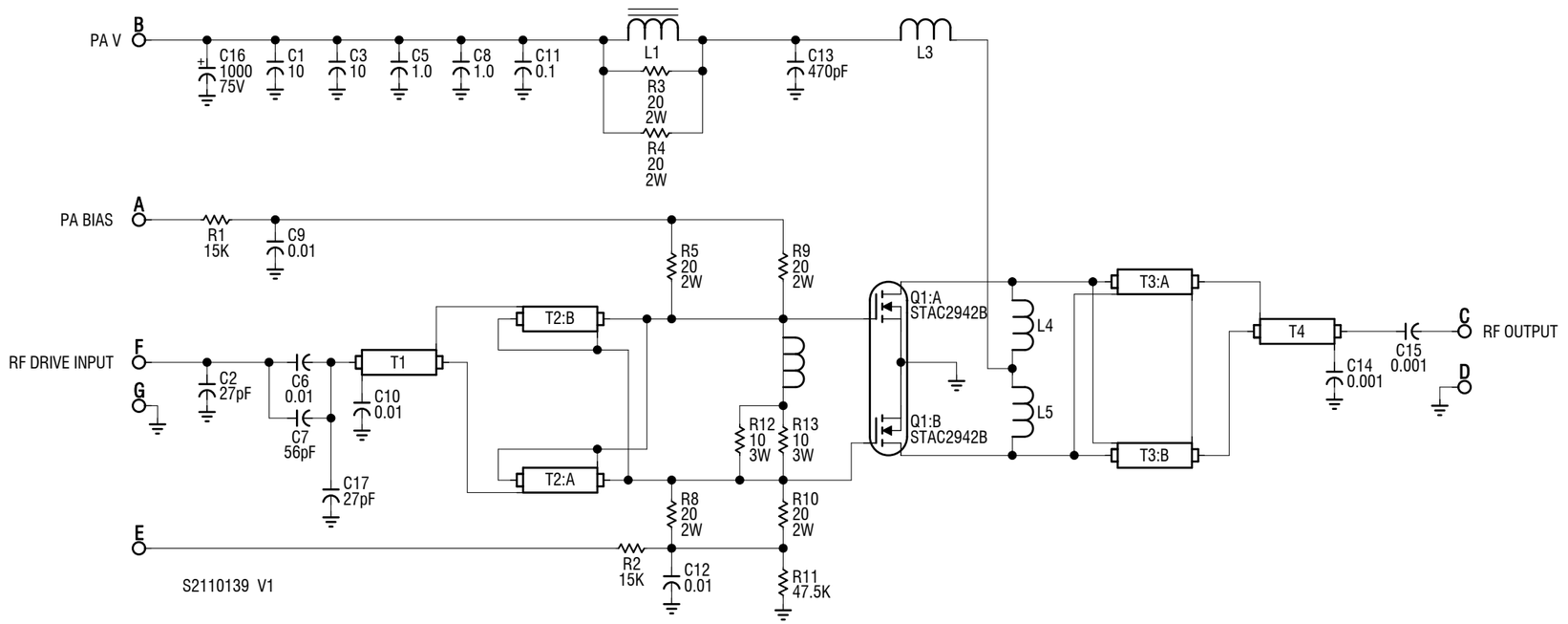


Figure SD-5: NAPA23/03A PA PWB

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., NAPA23/03A PA PWB). Note the reference designations and Nautel nomenclatures of all higher assemblies in the path, as applicable.
   Example: A6 NAPA23/03A 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: NAPA23/03A 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	VS1 Transmitter (Front, Rear and Top Views)
MD-2	VS1 Transmitter (Bottom and Side Views)
MD-3	NAPE87B Exciter/Control PWB
MD-4	NAPS41A PS Distribution PWB
MD-5	NAPH01B Splitter PWB
MD-6	NAPA28B Pre-Amp PA PWB
MD-7	NAPA23/03A PA PWB
MD-8	NAPH02A Combiner PWB
MD-9	NAPF12 RF Low Pass Filter PWB
MD-10	NAPI136 Combiner Interface PWB

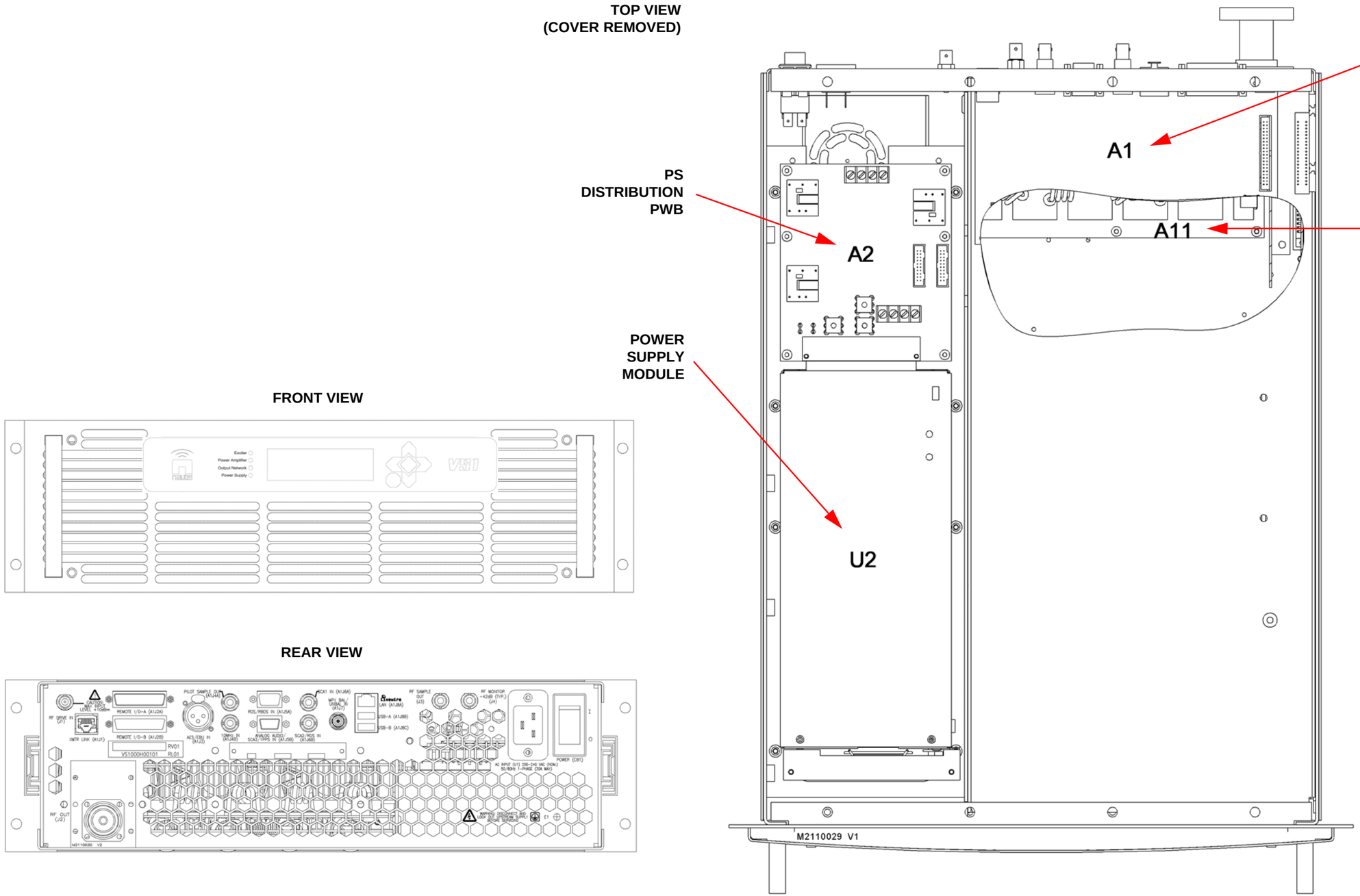


Figure MD-1: VS1 Transmitter (Front, Rear and Top Views)

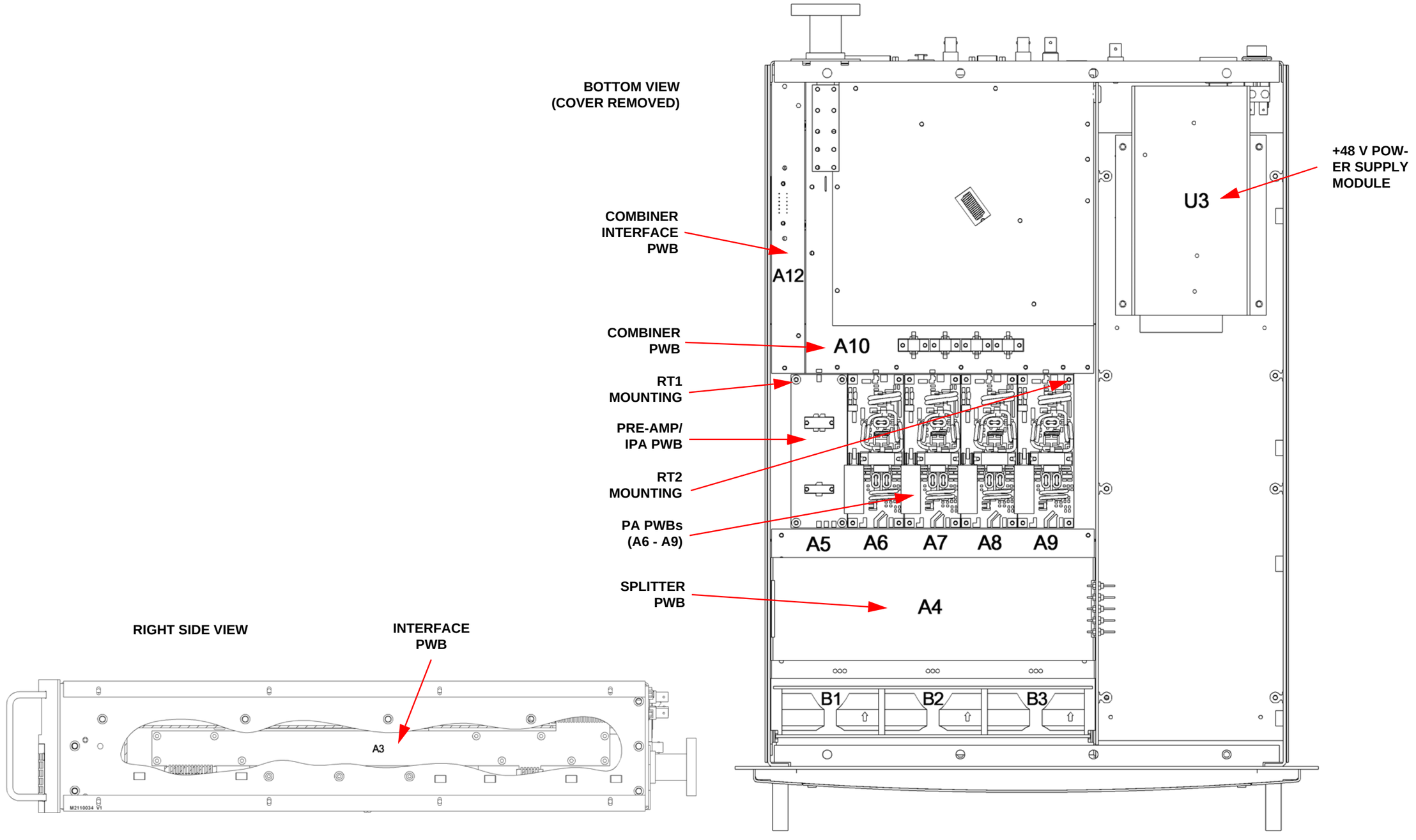


Figure MD-2: VS1 Transmitter (Bottom and Side Views)

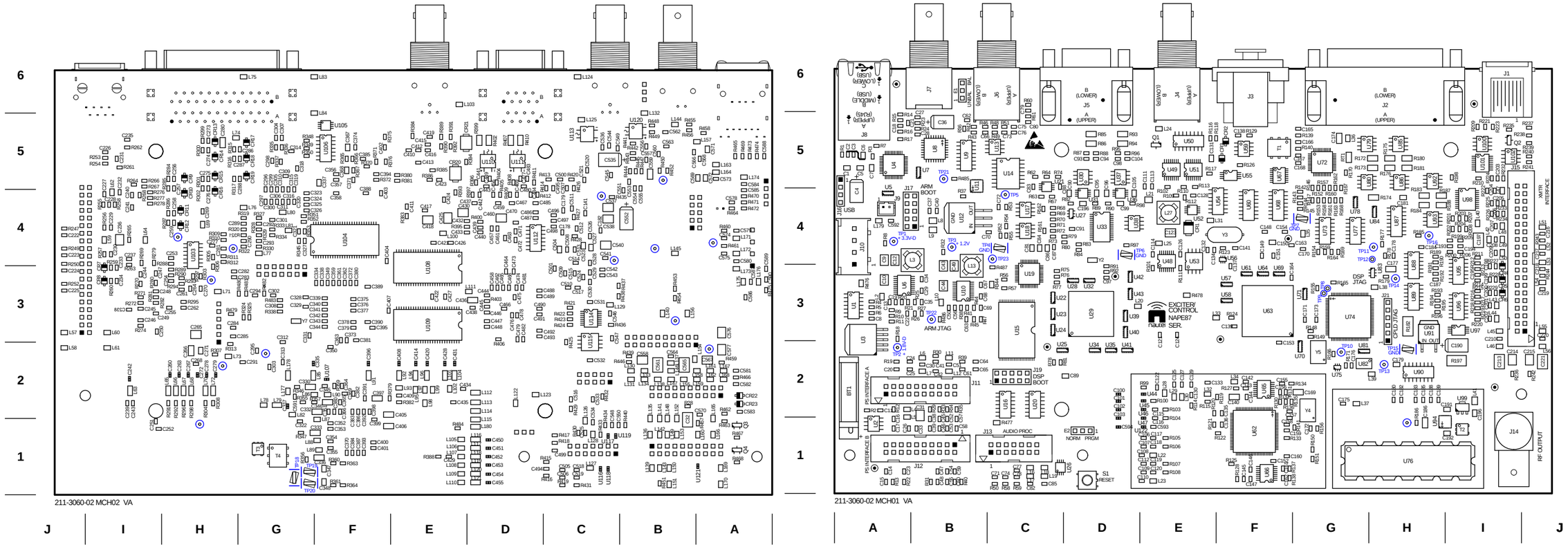
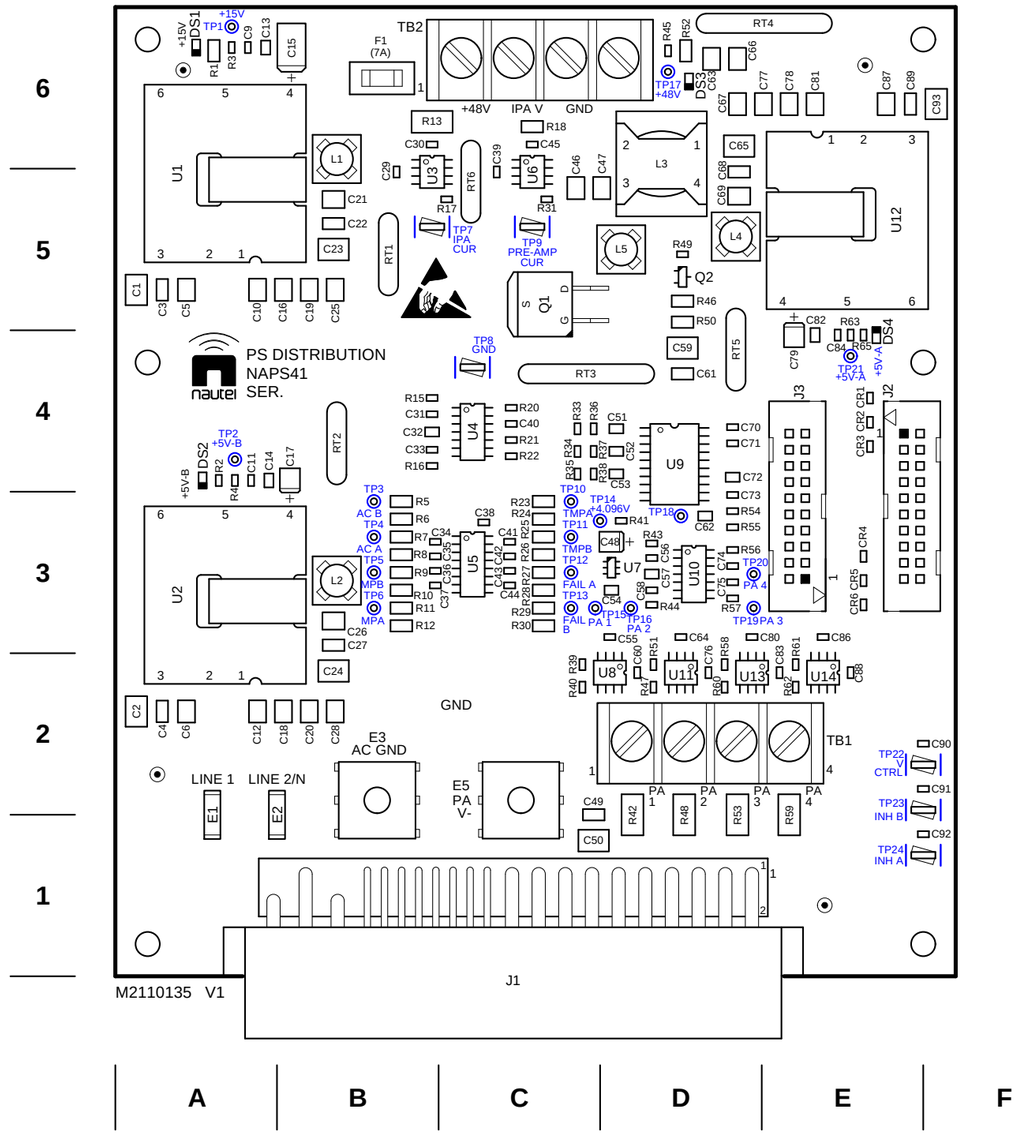


Figure MD-3: NAPE87B Exciter/Control PWB



C94 LOCATED ON REVERSE SIDE

Figure MD-4: NAPS41A PS Distribution PWB

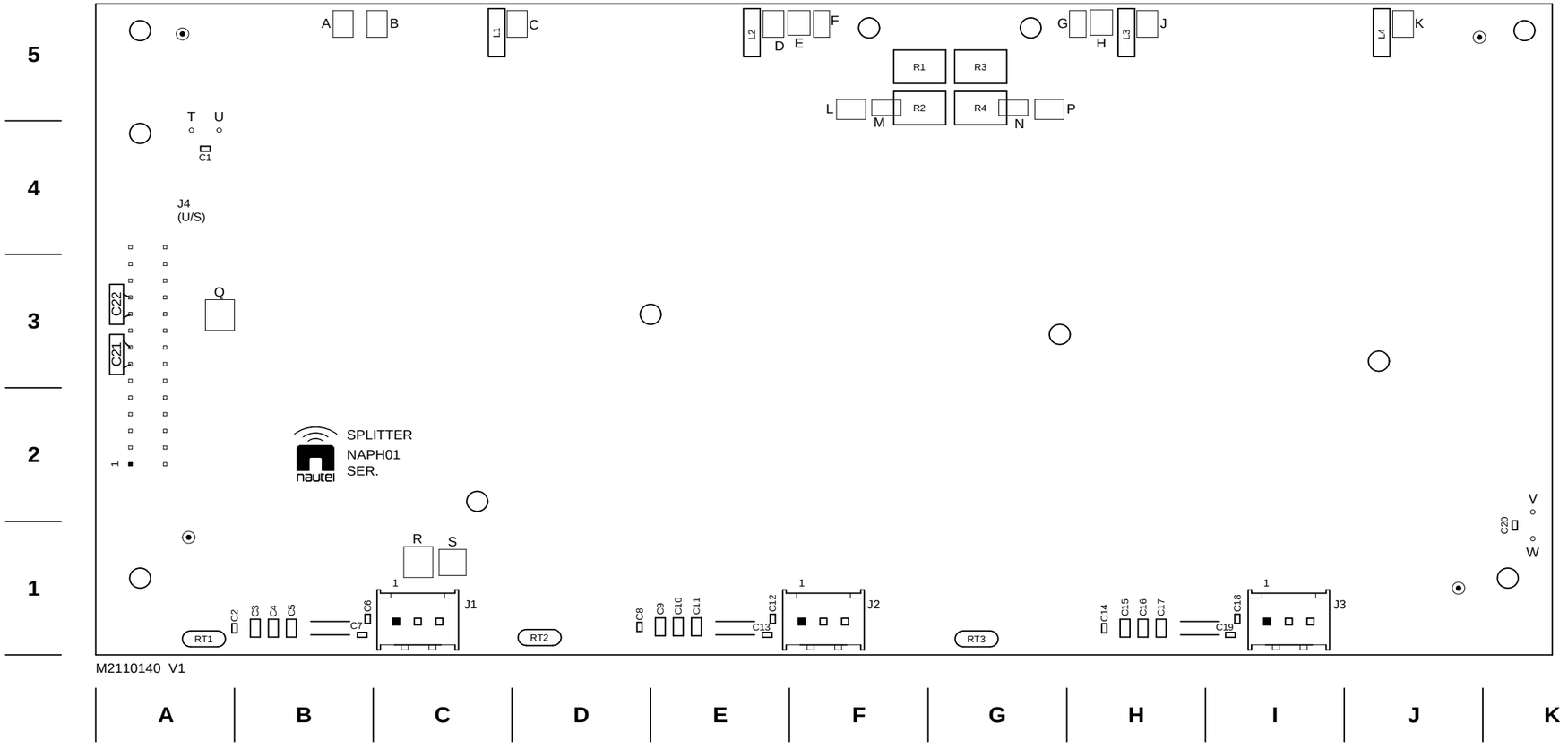


Figure MD-5: NAPH01B Splitter PWB

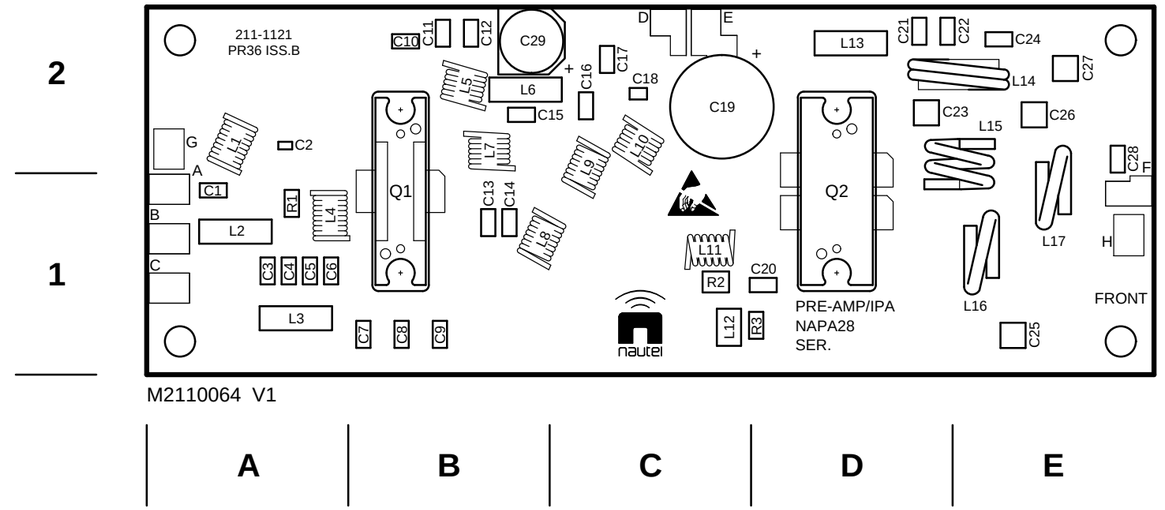


Figure MD-6: NAPA28B Pre-Amp PA PWB

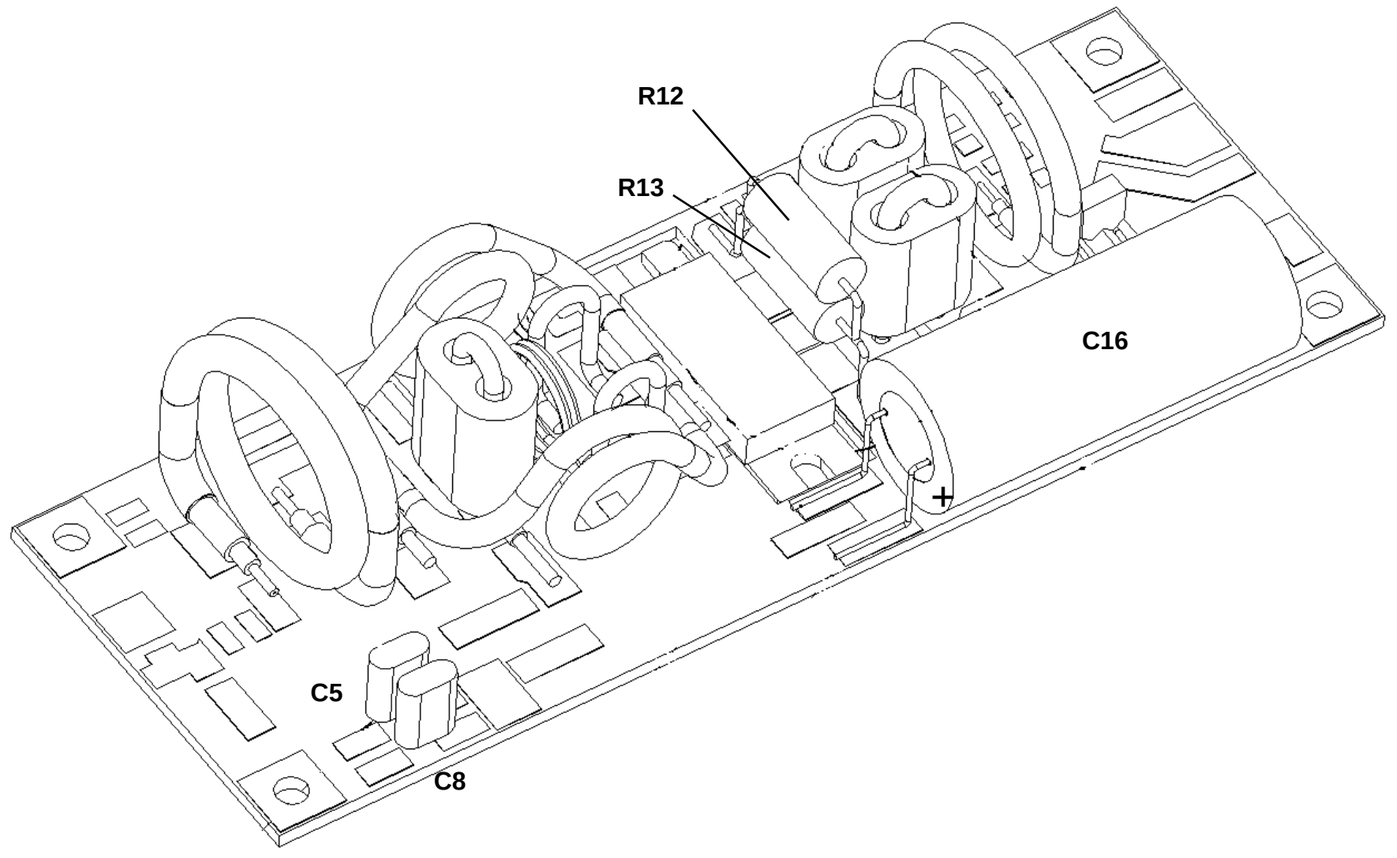


Figure MD-7: NAPA23/03A PA PWB

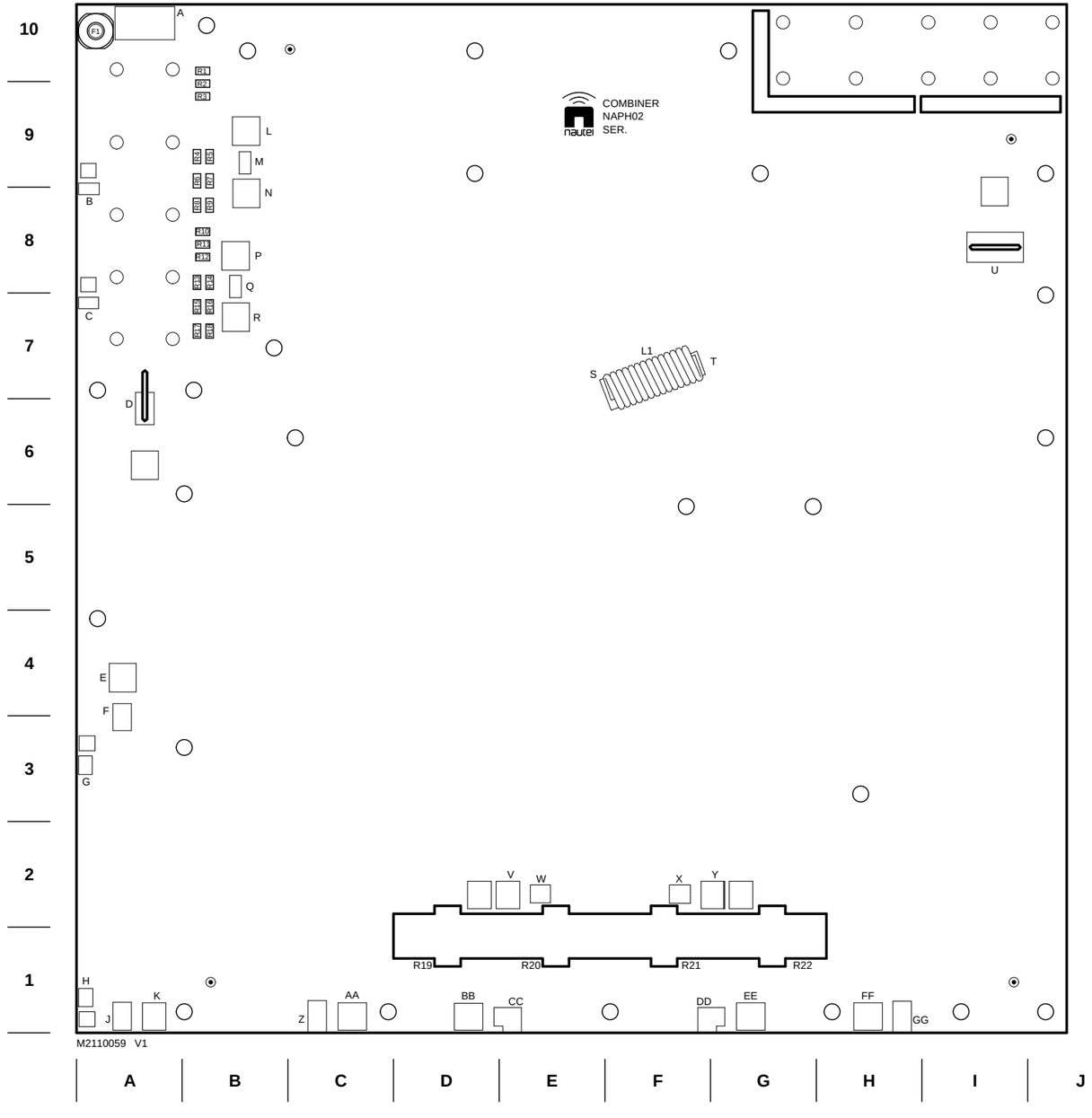


Figure MD-8: NAPH02A Combiner PWB

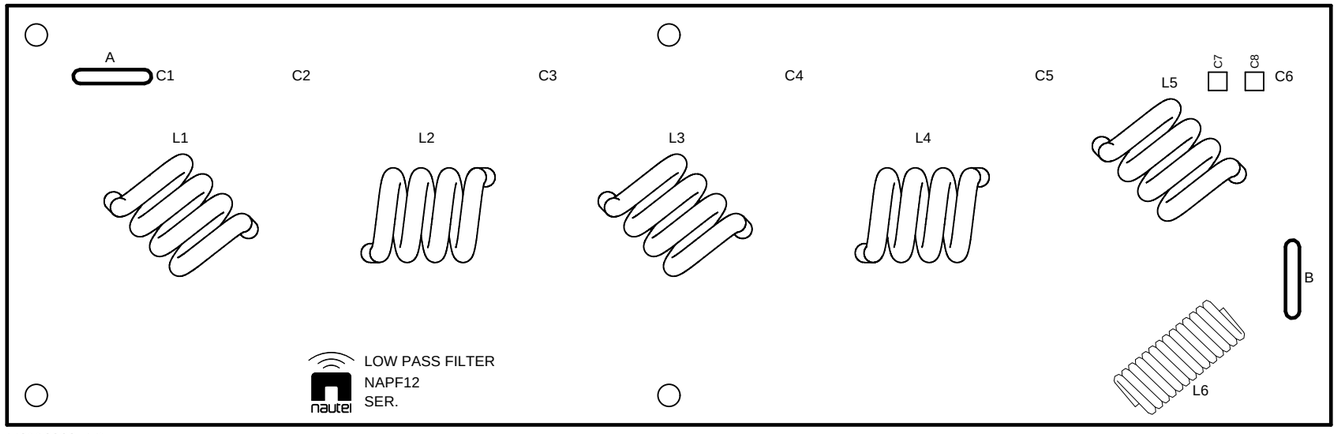


Figure MD-9: NAPF12 RF Low Pass Filter PWB

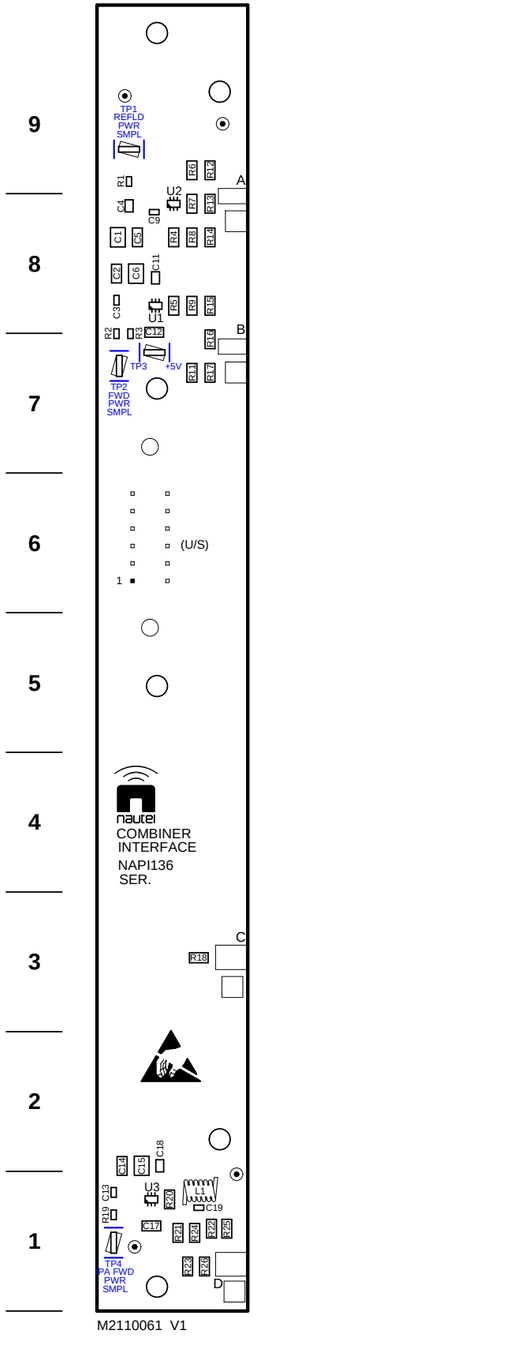


Figure MD-10: NAPI136 Combiner Interface PWB

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 VS1 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.

VS1 TROUBLESHOOTING MANUAL

Document: NHB-VS1-TRB

Issue: 11.0 2019-01-04

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