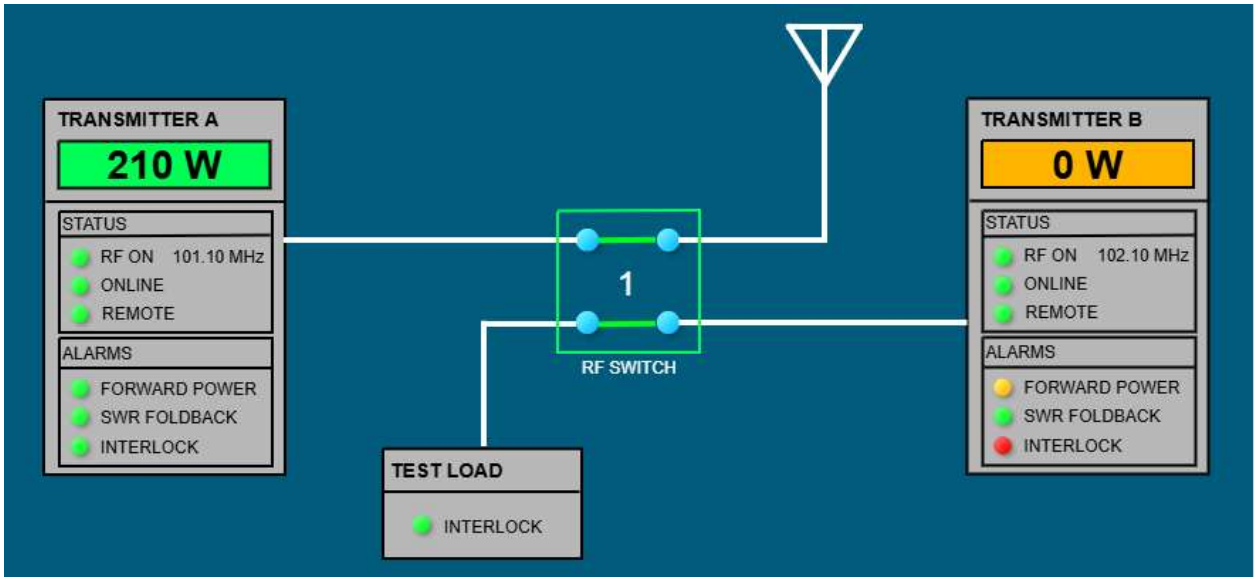
Post NAB 2025

Nautel N+1 Solutions

Introduction

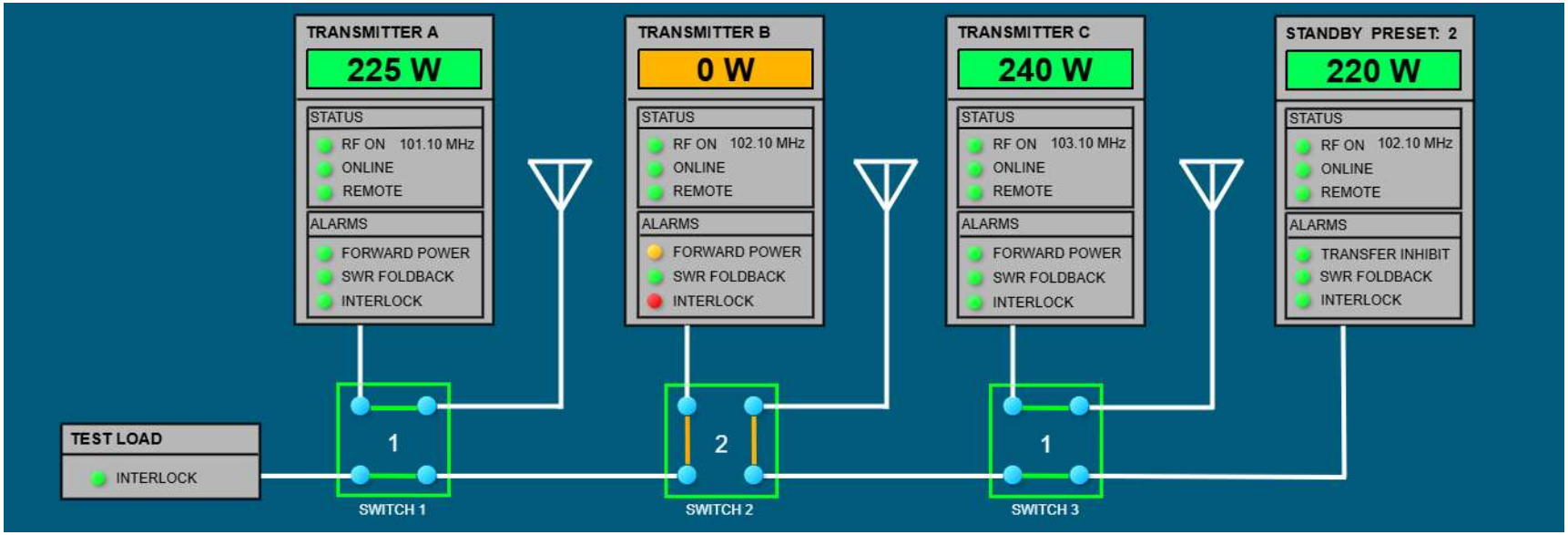
- Main/Standby systems are commonly used to provide redundancy at broadcast transmitter sites. A control system monitors the “main” (on-air) transmitter and automatically transfers to the “standby” transmitter if a failure is detected in the “main” transmitter.
- A failure is defined as a drop in RF power below a threshold, or a loss of transmitter AC power.



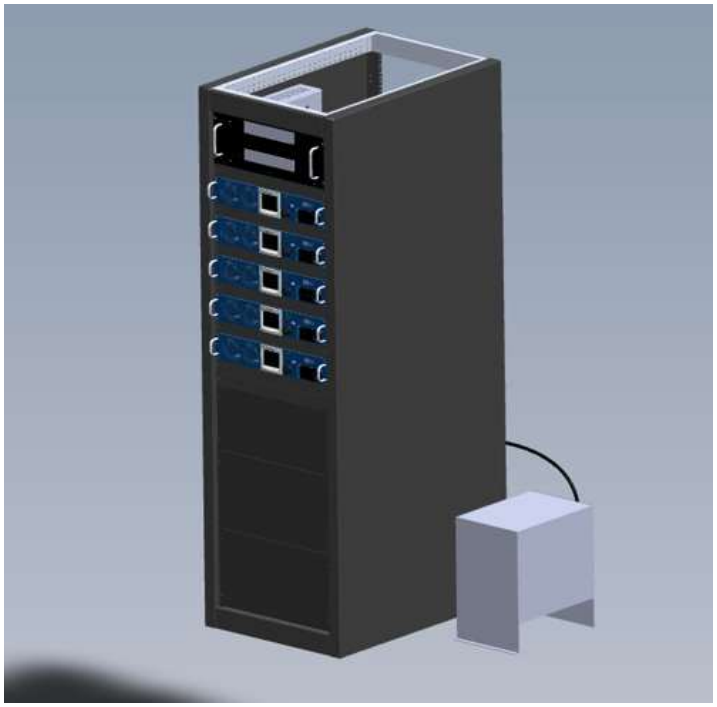
Main/Standby System

Introduction

- For FM broadcast stations where multiple channels may be co-located, a more economical alternative to the traditional main/standby system is the N+1 system. The N+1 system allows a single standby transmitter to provide a back-up for multiple (N) main transmitters.
  - Saves on cost of multiple standby transmitters
  - Used when there is no competition on access to the standby transmitter (state broadcasting etc.)



N+1 System

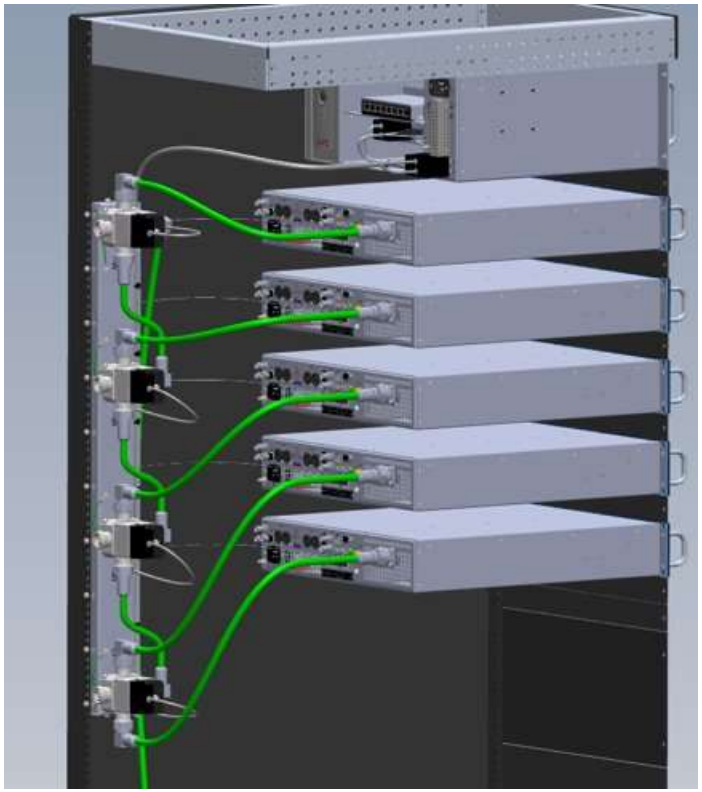


- Comprises:
  - N main transmitters
  - 1 Standby transmitter
  - N+1 coaxial switch matrix
    - N - 4 port transfer switches
  - Test Load
  - Program Router
  - N+1 Controller

Transmitters

- Main transmitters should all be of the same product family (eg Nautel Vx, GV, NVLT).
  - Main transmitters need not all be the same nameplate power, but often are.
- Standby transmitter should be of same product family as main transmitters.
  - Standby transmitter power range should be sufficient to allow adequate back up of any main transmitter.
- Required transmitter interfaces:
  - interlock connection
  - ethernet (SNMP)

Coaxial Switch Matrix



- N coaxial switches are required with interconnecting coaxial cables.
- When the system is running normally, all coaxial switches are in position 1.
  - each main transmitter is routed to its antenna port.
  - standby transmitter is routed thru each switch to the test load port.
- When a transfer occurs, the switch associated with the transferred main transmitter is set to position 2.
  - The transferred main transmitter is routed to the test load port.
  - The standby transmitter is routed to the antenna port associated with the transferred main transmitter.
  - The correct active preset is selected on the standby transmitter to duplicate the power, frequency and program of the failed main transmitter.
  - The program router is configured to apply the program of the failed main transmitter to the standby transmitter.

Test Load

- A suitably rated test load is required by the system.
- The test load is used for off-air testing of either the standby transmitter or the transferred main transmitter.
- The transmitter applied to the test load is inhibited by the system until the user initiates a test (Off-Air Test).
- In order to protect the test load, the N+1 controller requires a closed contact (test load interlock) to indicate it is safe to apply RF power to the test load, when an Off-Air Test is initiated by the user.

Program Router

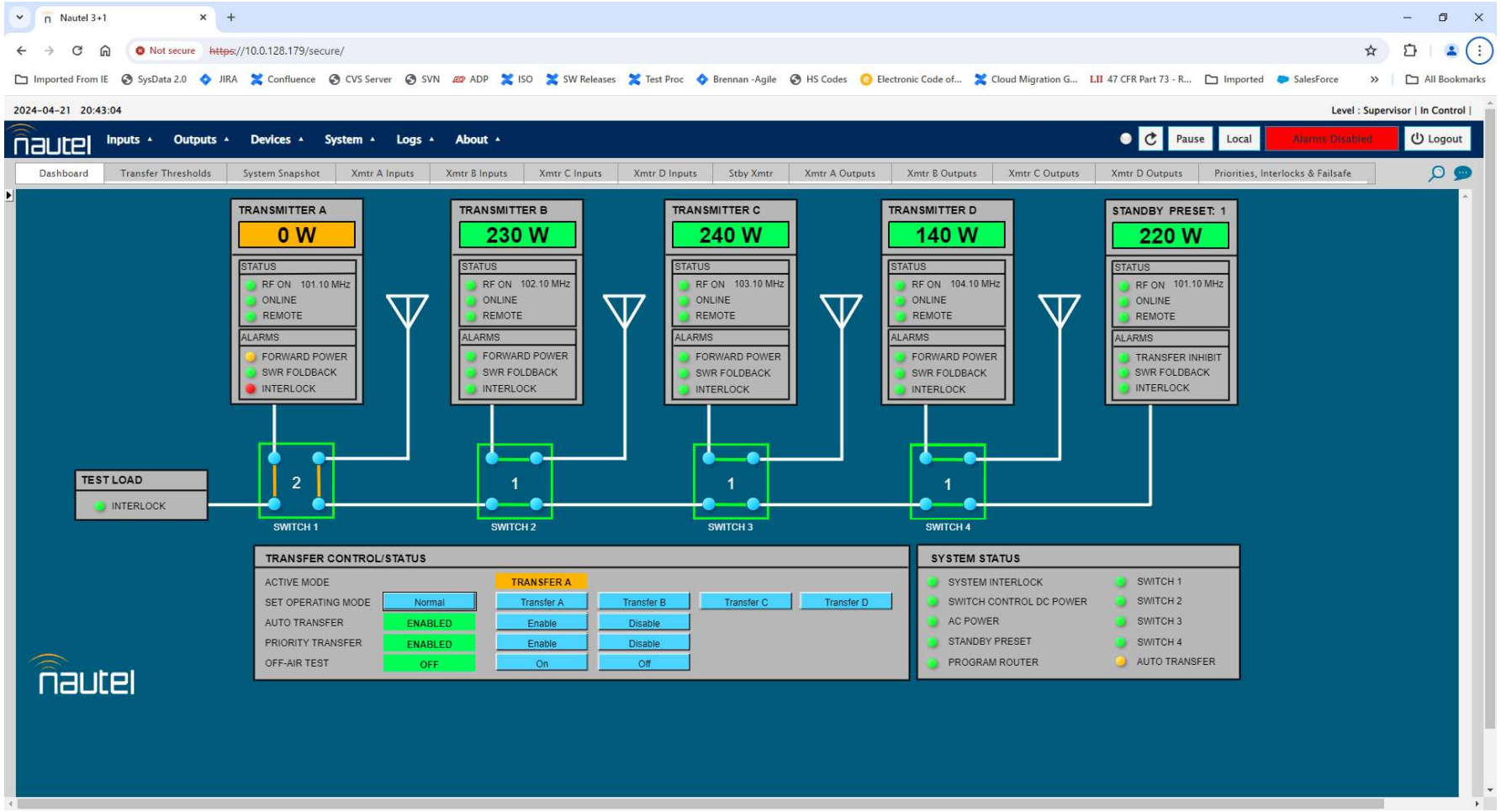
- A passive program router is provided as part of the system to route the correct program to the standby transmitter when it is operating as a backup to a transferred main transmitter.
  - The position of the router is controlled by the N+1 controller and monitored to insure it is in the correct position.
  - To allow a single router to be used, all the main transmitters must use the same program format (eg AES, Analog L/R, MPX).

- For systems where the main transmitters do not all use the same program format (or if multiple formats are used on the same transmitter (eg AES, RDS)), a separate router is required for each unique format.
  - The N+1 controller router position control relays will drive all routers
  - Only the position of the first router is monitored.

N+1 Controller

- The SC4 (Nautel badged Davicom Cortex 320) forms the heart of the N+1 Controller.
  - Integral web server, SNMP manager, and configuration and workspace development environment
    - Remote user interface via web page
    - Control and monitoring of multiple SNMP devices (Nautel transmitters, other devices)
      - Virtual logic gates allow implementation of logic functions to manage system control
      - Virtual relays provide memory elements
      - Flags, counters, math functions etc, allow for complex control functionality
    - Multiple password protected user accounts with customizable access rights
    - Events logging
  - Physical I/O
    - 16 Metering inputs
    - 4 digital status inputs
    - 6 control relays
  - USB (modbus) interface allows expansion of physical I/O (control relays, meters, digital status inputs)
  - Expandable N-value:
    - Baseline systems up to 4+1
    - Up to 6+1 (with expansion I/O modules)
  - UPS backup for up to 30 minutes of operation

4+1 Web Dashboard



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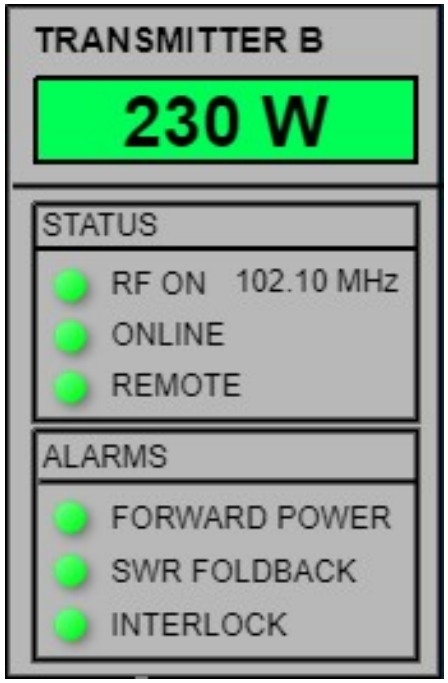
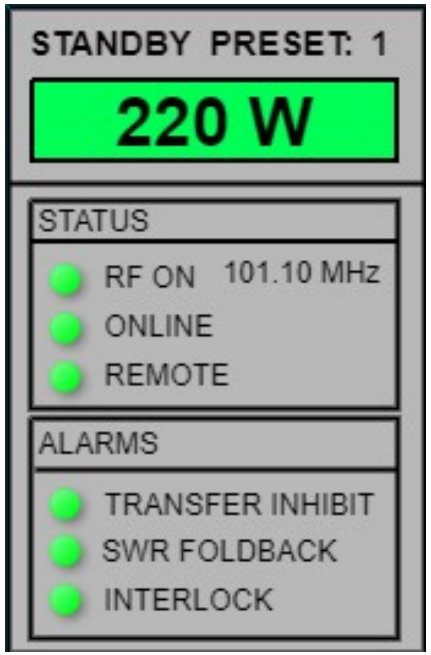
Main Transmitter

- Main Transmitter monitoring
  - SNMP Communication (online)
  - RF On
  - Remote
  - Forward Power
  - SWR Foldback
  - Frequency (display only)
  - Use of color coding to indicate normal/abnormal conditions
    - Green (normal)
    - Amber (abnormal)
    - Red (alarm)



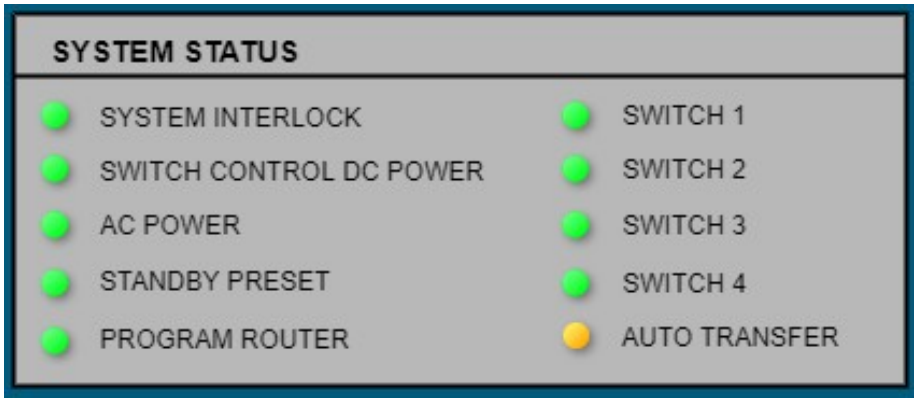
Standby Transmitter

- Standby Transmitter Monitoring
  - SNMP Communication (online)
  - RF On
  - Remote
  - Transfer Inhibit
  - SWR Foldback
  - Frequency (display only)
  - Active Preset
    - Preset 1 duplicates transmitter A settings
    - Preset 2 duplicates transmitter B settings
    - etc
  - Use of color coding to indicate normal/abnormal conditions
    - Green (normal)
    - Amber (abnormal)
    - Red (alarm)



System Monitoring

- System Monitoring
  - System Interlock
    - Inhibits all transmitters
  - Switch DC Supply
    - Inhibits auto transfer
  - AC Power
    - Inhibits auto transfer
  - Standby Preset
    - Inhibits standby transmitter
  - Program Router
    - Inhibits standby transmitter
  - Transfer switch status
    - Switch fault inhibits associated main transmitter and standby transmitter
  - Auto Transfer



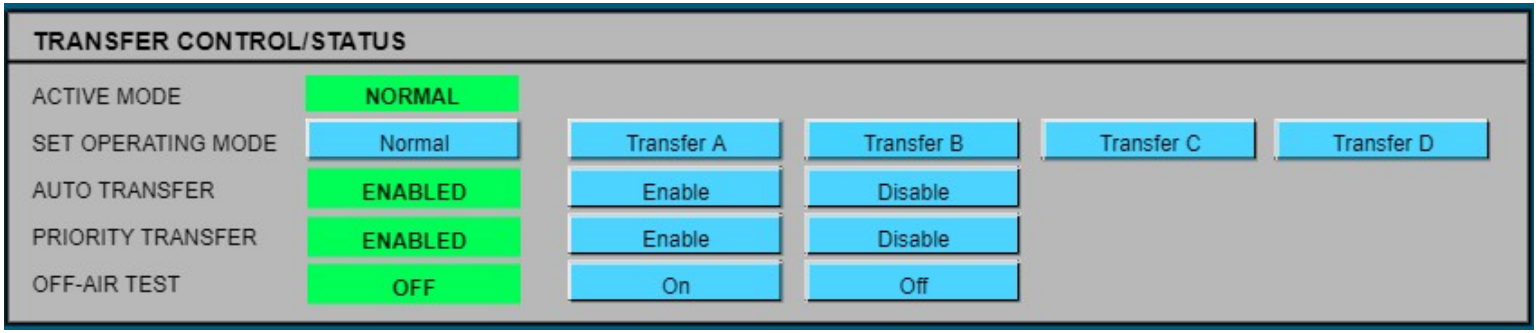
Automatic Transfer Triggers

- Main transmitter RF power below threshold for period exceeding delay time
  - Individually adjustable threshold
  - Individually adjustable time delay
  - SNMP polling latency will add ~1sec to programmed delay
- Main Transmitter Offline (indicative of loss of transmitter AC power)
  - Detected by loss of SNMP communication
  - Detection speed < 5sec (typical)

Automatic Transfer Inhibits

- Any of these conditions inhibit all automatic transfers
  - Standby Transmitter RF Off
  - Standby Transmitter not in Remote
  - Standby Transmitter Offline
  - System Interlock Open
  - Transfer Switch Fault
  - Transfer Switch DC Power Fault (does not cause Transfer Inhibit alarm)
  - SC4 Boot flag (auto transfer remains inhibited for 30 seconds after flag clears)
  - AC Power Fail (auto transfer remains inhibited for 2minutes following restoration of AC power)
- Any of these conditions will prevent automatic transfer of the particular main transmitter
  - Main Transmitter RF Off
  - Main Transmitter SWR Foldback

Transfer Control/Status



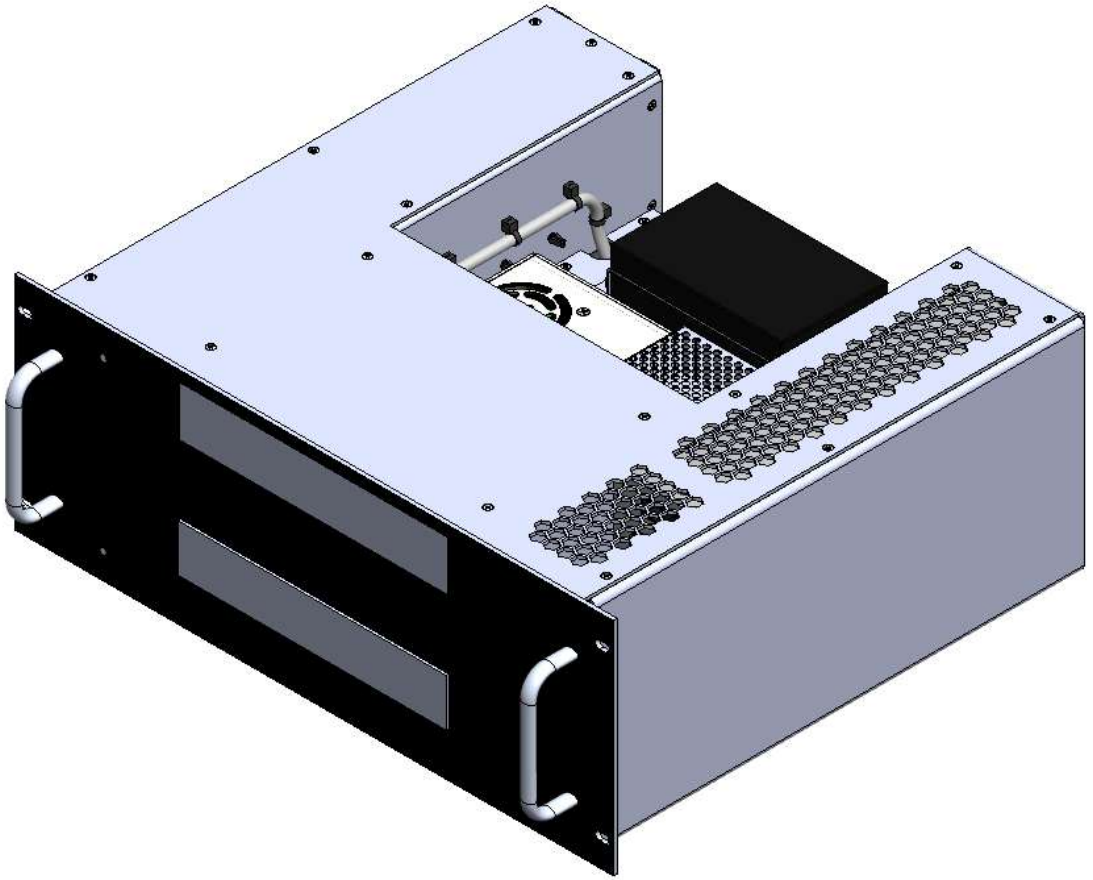
- System Controls/Status
  - Display of Active mode
  - Set Operating Mode (Normal, Transfer A, Transfer B…Transfer X)
  - Enable/Disable Auto Transfer
    - When Normal operating mode is selected Auto Transfer will be enabled automatically
    - If Transfer X is selected manually, Auto Transfer is disabled
  - Enable/Disable Priority Transfer
  - Off-Air Test On/Off
    - Used to operate the standby or transferred main transmitter into a test load for troubleshooting/maintenance.
    - If the system has Auto Transfer enabled and an Auto Transfer is triggered while Off-Air test is on, the Off-Air test will be cancelled to allow the transfer to complete.

Priority Transfer

- Priority Transfer
  - When enabled the first main transmitter in the system has priority and then the next and so on.
    - For a 4+1 system, Transmitter A has highest priority then Transmitter B, then C and then D
    - Priority Transfer Example
      - System operating in Normal mode with Priority Transfer Enabled
        - » Transmitter D fails. The N+1 controller will transfer D to the test load and route the standby transmitter to the D antenna, and configure the standby transmitter for the D frequency, power and program
        - » Next transmitter C fails. The N+1 controller will transfer C to the test load and route the standby transmitter to the C antenna, and configure the standby transmitter for the C frequency, power and program. Transmitter D will be placed back on air.
        - » Next transmitter B fails. The N+1 controller will transfer B to the test load and route the standby transmitter to the B antenna, and configure the standby transmitter for the B frequency, power and program. Transmitter C will be placed back on air.
        - » Next transmitter A fails. The N+1 controller will transfer A to the test load and route the standby transmitter to the A antenna, and configure the standby transmitter for the A frequency, power and program. Transmitter B will be placed back on air.
        - » No further automatic transfers will occur, until the system is re-armed (set to Normal).
  - When disabled the first failed transmitter is backed up (first come, first served)
    - No further automatic transfers will occur, until the system is re-armed (set to Normal).

N+1 Controller Physical Details

- 19” Rack Mount (4U)
- 16.9” deep



N+1 Controller Front View

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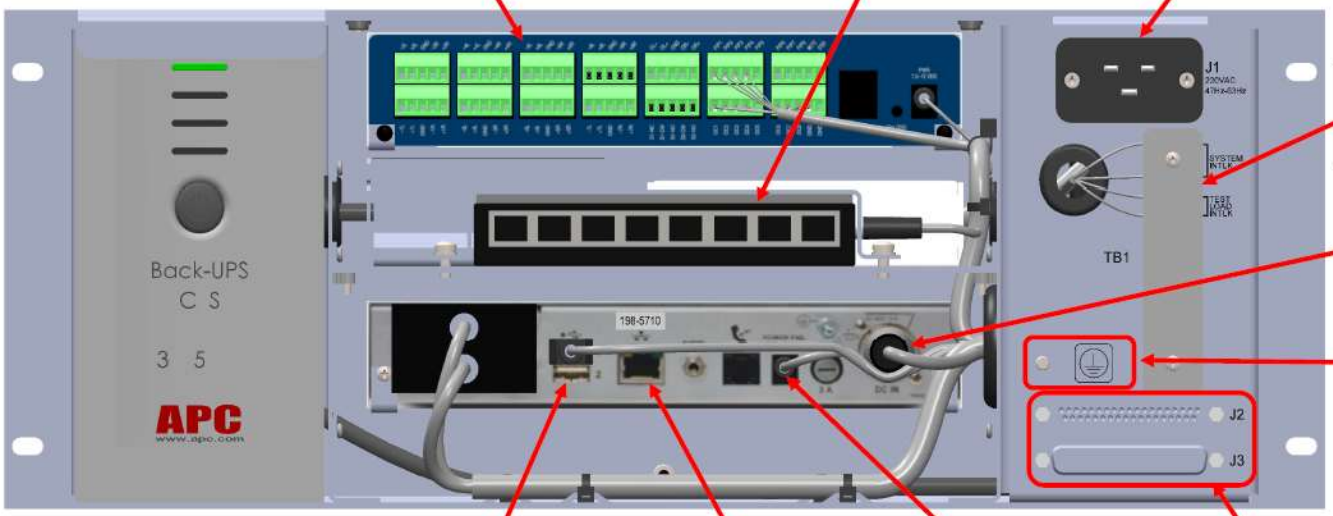
N+1 Controller Rear View



Audio Switcher
Routes the main audio to the standby transmitter in the event of a failure (used in N+1 applications only).

Ethernet Switch
Provides LAN connections to all transmitters (main-standby applications use a 5-port device).

AC Input
Accepts nominal 230 Vac, 1 Ø, 60 Hz power source.

Terminal Block
Facilitates connections for the System and Test Load interlocks (shown with cover installed).

DC IN jack
XLR connector accepts +12 V dc power input to the SC4.

Ground Screw
Connect a low impedance conductor to the station's reference ground to provide lightning protection.

USB Port
Provides data transfer from USB to RS-485 to the Remote I/O Module.

Ethernet Port
Provides IP access to the SC4 via the Ethernet Switch.

Power Fail
Monitors the presence of the main Ac power using an external +12 V dc adapter.

I/O Connectors
37 pin D-sub connectors facilitates interconnections to the transmitter system. These connectors control the transmitter interlocks, switch positions, and monitor switch status (J3 not used in main-standby applications).

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Thank you!
Questions?