

# Antenna & Systems Monitoring



Application Note

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The measurement, monitoring and reporting of the performance of wireless network infrastructure has come a long way over past years. Many modern base station repeaters provide integrated measurement capabilities, but the use of combining and/or isolators in the RF path from the base station transmitter output to the antenna isolates the repeaters from reporting most problems that may occur within the combiner and antenna sub-systems.

The inherent inaccuracies of using in-line wattmeters (or sampler detectors) to measure forward and reverse power on multi-carrier systems, due to the carriers' ever-changing random phase relationships, results in random and inaccurate measurement values. Connecting such devices into multi-carrier locations within the system often introduces intermodulation into the system, risking optimum network performance.


The use of an Antenna System Monitor (ASM) facilitates the per-channel measurement of each transmitter's forward and reverse power, the system's transmit-to-receive isolation, receive signal levels and much, much more....

## Overview



The Antenna System Monitor can be used to measure and monitor the following network performance parameters for up to 80 channels that may be distributed across up to four (or more) separate combiner systems;

- Transmitters' Forward Power (*from -50dBm to +60dBm per channel*)
- Antenna VSWR (*from 1:1 to 20:1 per channel*)
- Receive (RSSI) levels (*from -110dBm to -50dBm per channel*)
- Tx-Rx Antenna Isolation, Rx System Gain/Ripple, and Tx Carrier Rejection (for up to 20 frequencies)



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# Antenna System Monitor

Model - DSAPM3852K2

## System Overview

Customer Name -

Radio Co.

Site Name -

MT Smith

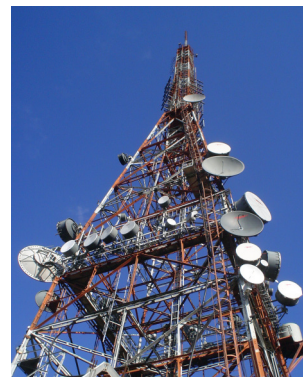
Group	Tx Antenna Reference	Channel Count	Alarm Status
<b>Antenna Isolation</b>			
<b>Rx Channels 1-20</b>		13	FAIL
<b>Rx Channels 21-40</b>		10	FAIL
<b>Rx Channels 41-60</b>		9	FAIL
<b>Rx Channels 61-80</b>		0	OK
<b>Tx Port 1</b>			
Feeder #1		8	FAIL
<b>Tx Port 2</b>			
Feeder #2		4	OK
<b>Tx Port 3</b>			
Feeder #3		2	OK
<b>Tx Port 4</b>			
Not defined		0	OK
<b>System</b>			FAIL

[Help](#)
[Refresh](#)

These measurements are logged and stored in ASM non-volatile memory, with historical performance data available for review or downloading. The following data from logging can be shown graphically or downloaded as a CSV text file;

- Transmitter Power (Max/Min)
- Antenna VSWR (Max/Min)
- Receive Channel Usage (%)
- GUI Login Event Log
- Rx System Gain and Flatness
- SAM Inputs (if optional SAM fitted)
- Rx Diversity RF Paths and Off-Air Receive levels (if optional RSM fitted)
- Transmitter Channel Utilisation (%)
- Receive Level (Max/Min)
- Alarm Event Log
- Antenna Isolation
- Tx Rejection

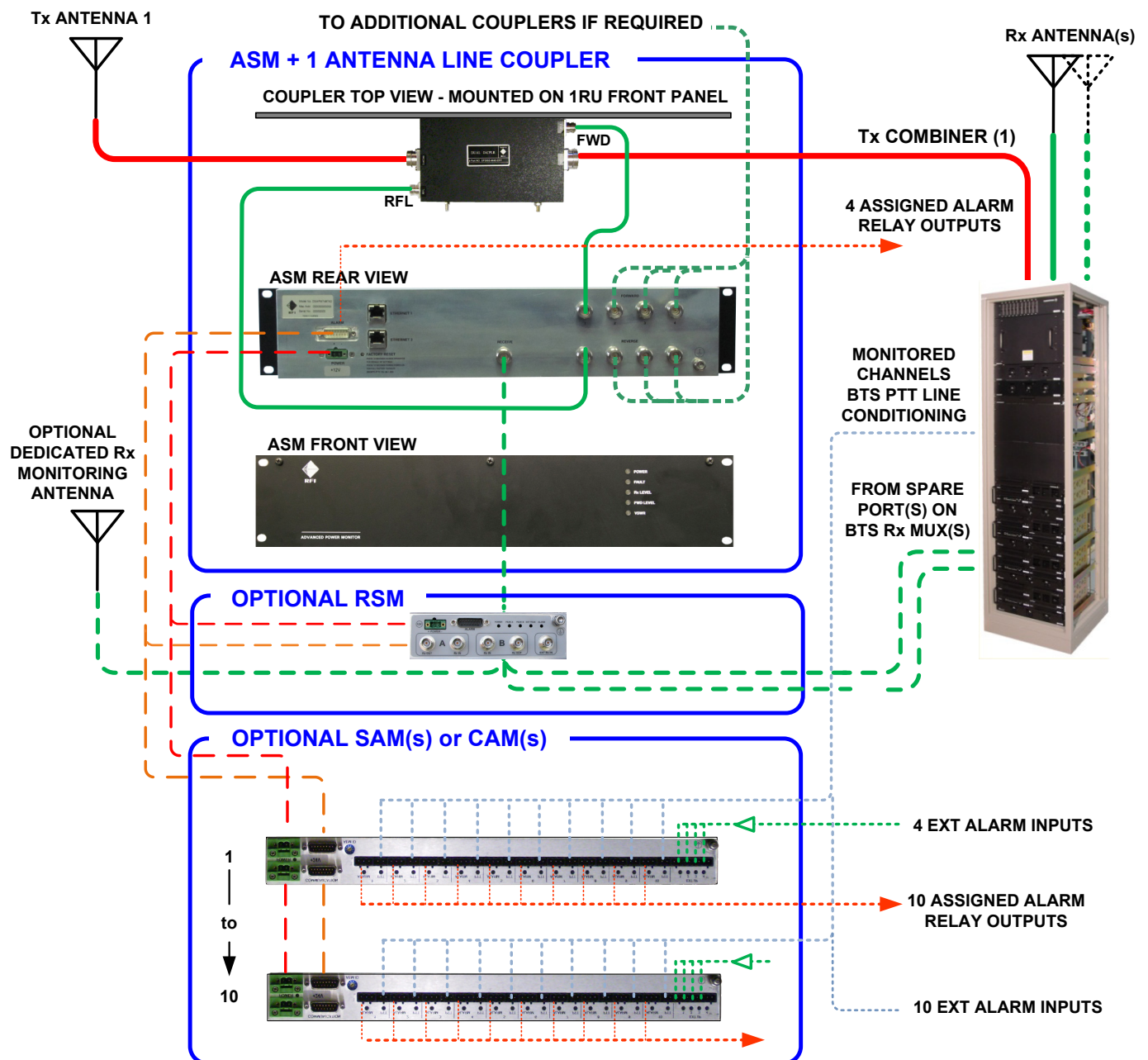
Once installed, the ASM is non-intrusive to the network and continuously monitors the RF performance of the site "24x7" on a detailed per-channel basis. This enables performance-impacting issues at a site to be detected, measured and reported as soon as they occur – often before network users experience them. The extensive testing capability of the ASM allows many Periodic Maintenance Inspection (PMI) tests to be performed without the usual site outages and their impact on network availability.



Up to ten (10) Site Alarm Modules (SAMs) may be connected to an ASM, adding the monitoring of temperature, analogue voltages and digital inputs, in addition to providing multiple relay outputs, to enhance an ASM's functionality.

An optional Receive Systems Module (RSM) may also be connected to an ASM, adding the monitoring of Diversity Receive RF signal paths (as used in some digital networks), in addition to an isolated external antenna port – for enhanced off-air monitoring of signals – such as a DAS, or adjacent networks sites' coverage propagation.

## Interconnection



**ASM System Interconnection Diagram**

# Applications

The Antenna System Monitor is ideally suited to a wide range of applications supporting wireless networks. Its capabilities cater for analogue, digital, FDMA and TDMA networks.

The user-friendly integral ASM Graphical User Interface (GUI) displays measurement values, alarm statuses, allows parameter configuration, and is compatible with computer and handheld device users. The dry-relay contacts, SNMP, SMTP (Email) and UDP /TCPIP Manager Messages interfaces in the ASM provide a broad range of alarm notification capabilities.

When an optional Site Alarm Module (SAM) is fitted, it's temperature, analogue, and digital inputs enhance the RF measurement capabilities of the ASM, and the SAM's multiple dry-relay outputs enable individual alarm conditions to be monitored separately – or used for specific control functions. For example, the digital inputs of the SAM can be configured to provide logical 'AND' functionality with the ASM's Tx or Rx level measurements, allowing a range of Trunking, Voting Shelf, Tx Steering Shelf and other radio system architectures to be monitored and alarmed.



An optional Receive Systems Module (RSM) can be added to an ASM at any time, facilitating the monitoring, measurement and alarming of a network site utilising Receiver Dual Diversity or two separate Rx antennas. The RSM also features a unique "RF Peak Level Detector" capability that can measure high levels of RF that may be overloading the network's base station receivers and degrading network performance. Alarm thresholds can be configured for these received signal level peaks so that alarms can be actioned when they occur, and these events can be measured and logged by the ASM to assist fault-finding activities. The RSM also features an External Antenna Input for the enhanced monitoring of signals outside the site's Rx Multicoupler passband(s) – such as the off-air monitoring of the coverage propagation of adjacent network sites, the monitoring of the signal propagation of a co-sited Distributed Antenna System (DAS), and much more .....

## Network Site Monitoring

When installed at a network site, an ASM can measure base station transmitter combiner output powers and antenna VSWRs, and receive levels from network terminals, remote RTUs or adjacent network sites – all on a per-channel basis. In addition, the site's transmit-to-receive isolation, receiver antenna and feeder cable, and the receiver multicoupling system's gain, ripple, and transmitter carrier rejection can be measured, benchmarked, and regularly retested to confirm continuing correct operation.

The programming of alarm thresholds values can be set based on network user's coverage requirements, coverage overlap from adjoining sites, and maintenance obligations. Alarm events can notify maintenance personnel of a developing fault and, subject to the severity of the fault's impact on network users, an appropriate response can be actioned.

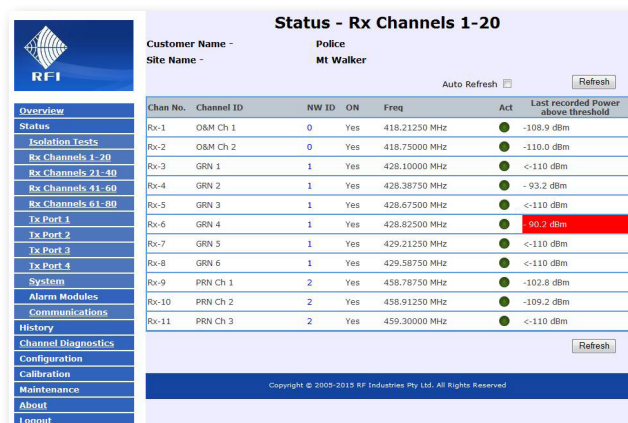
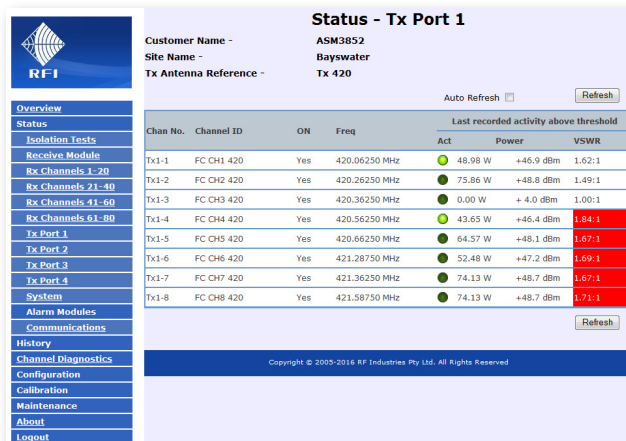
For example, if an antenna VSWR alarm is configured to trigger when it reaches 1.8:1, a decision can be made on the priority of response required. If the event occurred at 2am on Saturday morning, and the site benefitted from coverage overlap from surrounding sites, a response decision might be to schedule the maintenance activity for 9am Monday morning as the level of impact may be determined as 'minor'.

This may prevent an after-hours callout for a rigger and after-hours duty technician – potentially saving thousands of dollars. However, the VSWR could then be monitored and any further degradation could still result in an escalation in response if required. Alternatively, if a fault showed a “low” base station Tx output level, but a good antenna VSWR, then the response might be to send the duty technician with base station spares – rather than taking a rigger and a crew with a spare antenna – another significant saving in response costs.

Importantly, if an outage was required to exchange a partially faulty antenna, but the level of impact was ‘minor’, then a routine outage could be planned for a future date, rather than an ‘urgent’ outage on short notice, whilst still monitoring the fault in case it degraded further. In addition to the cost saving in delaying an unnecessary urgent response, the network users are not inconvenienced by an unplanned outage on short notice, a significant issue in operations and mission critical networks.

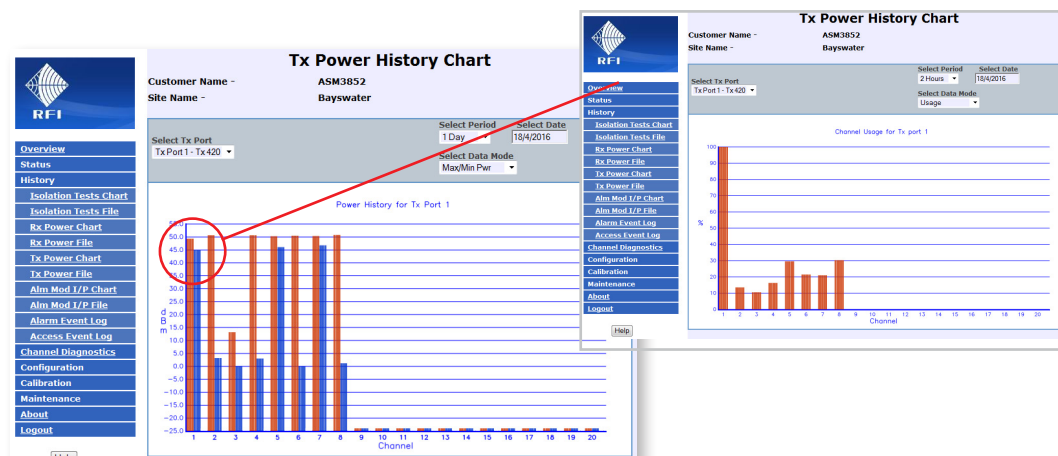
The ability of the ASM to interface to multiple Tx combiner and Rx multicoupler systems, and its ability to monitor, measure and alarm each frequency on those systems on a true per-channel basis, provides a network operator with exceptional detail on the performance of the RF operational parameters of their network site(s).

Each channel’s monitored parameters can have individual alarm thresholds configured, allowing the different equipment on shared combiner systems to be appropriately monitored.



An “Activity” indicator (ACT) next to the reading for each channel indicates if the value displayed was active during the last measurement cycle, or whether it is an old reading from past traffic on the channel.

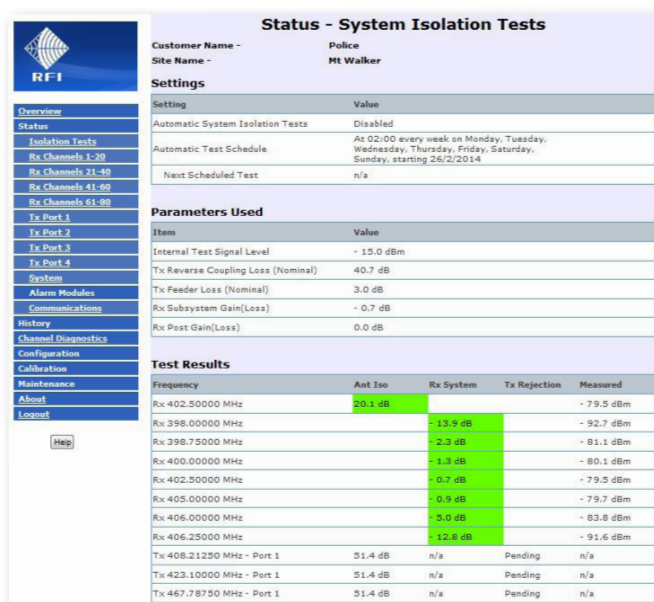
All ASM measurements and alarm events are stored in non-volatile memory. The time and date stamped History and Alarm Event Logs can be viewed to identify or analyze network performance problems. These log files can also be downloaded as .CSV text files, and used to create customized reports if desired.



Low and high level alarm thresholds can be configured on most measurements, providing a comprehensive network RF testing capability to ASM users. Alarms are presented on front panel LEDs, and they can also be configured to be presented via dry relay contacts, displayed in the ASM's Graphical User Interface (GUI), retrieved or sent via SNMP, or sent as SMTP (Email) messages or UDP Traffic and Status data packets.

A comprehensive Alarm Log is also available to provide a history of alarm events. This log can also be downloaded as a CSV text file and used to create KPI reports such as the number of faults, operating duration, MTBF, or MTTR. When coupled with the History Log, this could be used to provide a series of datasets on recurring faults, unreliable equipments and related maintenance metrics.

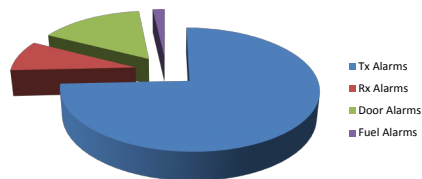
History log files from one or more sites can be collected, collated, and presented in reports (created in Excel™ etc) to show overall network performance



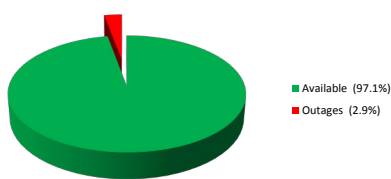
```
16/10/12, 13:05:30, TX STAT, Tx2-3, +42.0; 1.31, PWR=OK; VSWR=FAIL; VCO=OK; TX=ON
16/10/12, 13:05:30, RX STAT, Rx-44, <-110, PWR=FAIL; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-43, -109.3, PWR=OK; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-36, -108.8, PWR=OK; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-33, <-110, PWR=FAIL; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-28, -107.9, PWR=OK; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-24, - 87.2, PWR=OK; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-9, <-110, PWR=FAIL; VCO=OK; RX=ON
16/10/12, 13:05:30, RX STAT, Rx-5, <-110, PWR=FAIL; VCO=OK; RX=ON
16/10/12, 13:05:30, SYS STAT, , SYS=FAIL, RX=FAIL, TXPWR=FAIL, TXVSWR=FAIL
```

The ASM's functionality provides network owners and operators with a unique and comprehensive monitoring, measurement and alarming capability that enhances their ability to maintain their network, at its optimum performance and availability levels, cost effectively.

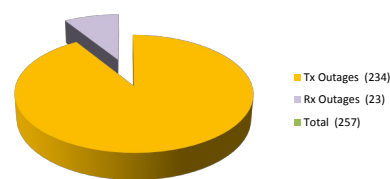
Alarms by Type (2011/12)



Network Availability (2011/12)



Total Alarm Hours (2011/12)



## OMCS & PMCS Software Integration – Manager Messages

Manager Messages are short and efficient data packets that can be sent by the ASM, in either UDP or TCP/IP protocols, to nominated IP addresses for use by third party application software. Traffic messages are sent by the ASM whenever a on/off change in the monitored Tx channel(s) occurs, and a Status message is sent whenever any change in any Alarm Status occurs. Manager Messages are configured in the ASM GUI, and their use allows Traffic and Alarm Status messages from one or more ASMs to be conveniently monitored by a single host (i.e. a Network Management System).

## Channel Diagnostics

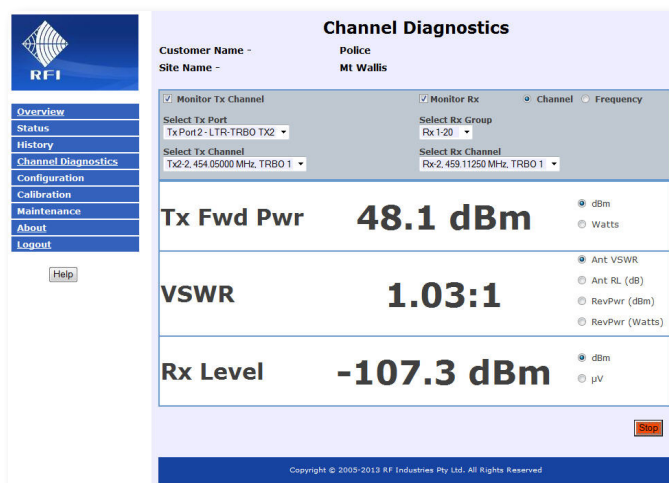
The ASM also provides a GUI screen called Channel Diagnostics. When this screen is being viewed, the normal per-channel measurement and data logging of all of the programmed frequencies is paused, and only the Tx and/or Rx frequency selected on this Channel Diagnostics page is monitored and measured. This allows a faster measurement refresh cycle to be provided during this focussed measurement activity.

### Tx Monitoring

When Monitor Tx Channel is selected and the Start button clicked, the nominated frequency is measured. This may be considered similar to a digital power meter, with both Tx Forward Power and VSWR being displayed. This capability may be used to assist base station testing or combiner tuning activities, or to monitor one channel constantly.

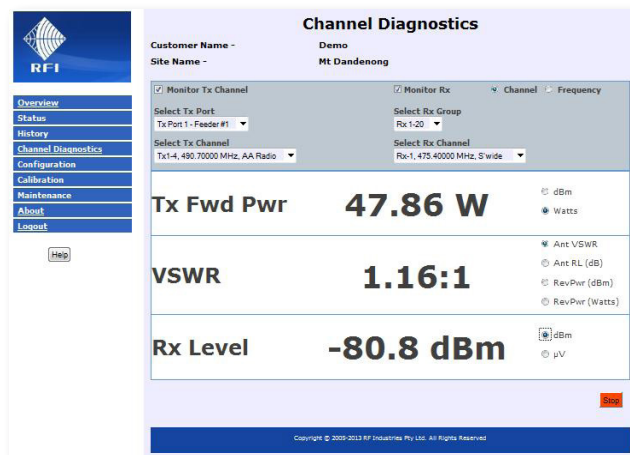
### Rx Monitoring

When Monitor Rx Channel is selected in "Channel" mode, the nominated frequency is measured. Monitor Rx may be used for several testing purposes. It can be used to monitor the subscriber terminal inbound (or uplink) signal. This is the base station's received signal (RSSI), and the resulting keyed Tx output is displayed as the Tx Fwd Pwr. A displayed inbound Rx level, without a corresponding Tx Fwd Pwr value, may indicate a faulty base station – or an illegal user or other interfering signal operating on the monitored Rx frequency.



In each of the Tx and Rx measurement fields the unit of measure can be selected for user convenience. When the user navigates to another GUI screen, or if the Channel Diagnostics screen has not been used for a period of time, then the normal per-channel measurement and data logging of all the ASM's programmed frequencies automatically resumes.

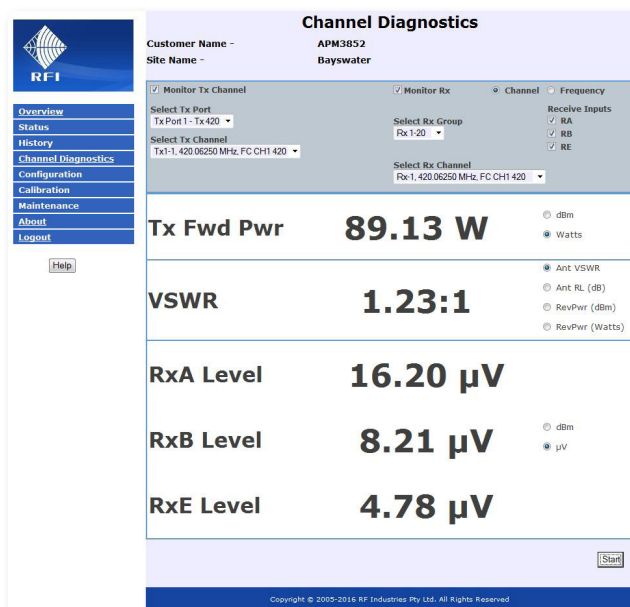
If the optional RSM module is fitted, the ASM can display the RSSI of both RF signal paths in a dual Rx diversity system (RxA and RxB), in addition to an isolated External Rx signal path (Rx E), which may be used to monitor Signals outside the site's Rx passbands – such as the off-air monitoring of adjacent sites' Tx frequencies, or of a co-sited Distributed Antenna System (DAS).



When the Monitor Rx Channel is in "Frequency" mode, any frequency may be selected from the drop-down fields (or entered directly) and monitored when the Start button is clicked.

Transmitters at the site not being directly measured by the ASM will usually be measurable on the ASM's Rx port at a level attenuated by the Rx system's preselector rejection and Tx-Rx antenna isolation at the monitored Tx frequency.

This feature may be used to monitor other frequencies at the site, assisting in fault finding activities such as desense or intermodulation analysis by monitoring the level and co-incidence of other site users' Tx or Rx activity.



## Receive Systems Module

An (optional) Receive Systems Module (RSM) may be fitted to an ASM to support networks using two receive antennas, such as systems using dual diversity or redundant Rx antennas.

The RSM may be added to an ASM at any time – providing a network technology upgrade path as and when required.

The RSM also improves the ASM's Rx Sensitivity capability and provides an enhanced ability to monitor frequencies in other applications - such as the off-air monitoring of adjacent network sites' coverage propagation, the monitoring of a DAS, and much more...

Status	
Item	Status
Alarm Status	OK
RxA Peak Level	- 53.4 dBm
RxA Current Level	- 57.7 dBm
RxB Peak Level	- 54.0 dBm
RxB Current Level	- 58.5 dBm
Antenna (Rx) Peak Level	- 50.0 dBm
Antenna (Rx) Current Level	< - 65.0 dBm
Power Supply	OK
<input type="button" value="Reset Peak Levels"/> <input type="button" value="Refresh"/>	

The RSM adds Dual Diversity, dual Rx Antenna and Hot/ Standby Rx Antenna (RxA, RxB) and External Antenna (Rx) configurability into the ASM GUI and is selectable and configurable on a per-channel basis. Rx level measurements for all three receive paths (RxA, RxB and Rx) may now be used in the Status, System Isolation Tests and Channel Diagnostics pages of the ASM GUI.

RFI

Overview

Status

Isolation Tests

Reactive Module

Rx Channels 1-20

Rx Channels 21-40

Rx Channels 41-60

Rx Channels 61-80

Tx Port 1

Tx Port 2

Tx Port 3

Tx Port 4

System

Alarm Modules

Communications

History

Channel Diagnostics

Configuration

Calibration

Maintenance

About

Logout

Help

Customer Name -  
Site Name -

ASM3852  
Bayswater

Settings

Value

Automatic System Isolation Tests  
Enabled

Automatic Test Schedule  
Every Hour, starting at 19:30

Next Scheduled Test  
Mon Apr 18 19:30:00 2016

Parameters Used

Item

Value

Internal Test Signal Level  
- 15.0 dbm

Tx Reverse Coupling Loss (Nominal)  
35.4 dB

Tx Feeder Loss (Nominal)  
3.0 dB

System

RA

RB

RE

Alarm Modules

Rx Subsystem Gain(Loss)  
0.0 dB

0.0 dB

+10.0 dB

Communications

Rx Post Gain(Loss)  
0.0 dB

0.0 dB

0.0 dB

Test Results

Frequency

Ant Iso (dB)

RA

RB

RE

Rx System (dB)

RA

RB

RE

Tx Rejection (dB)

RA

RB

RE

Measured (dBm)

RA

RB

RE


Rx 421.000000 MHz

52.5

62.9

74.9

<



Overview

Status

Isolation Tests

Receive Module

Rx Channels 1-20

Rx Channels 21-80

Rx Channels 81-160

Rx Channels 161-240

Tx Port 1

Tx Port 2

Tx Port 3

Tx Port 4

System

Alarm Modules

Communications

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Channel Diagnostics

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Login

Status - Rx Channels 1-20

ASM3852

Bayswater

Auto Refresh

Refresh

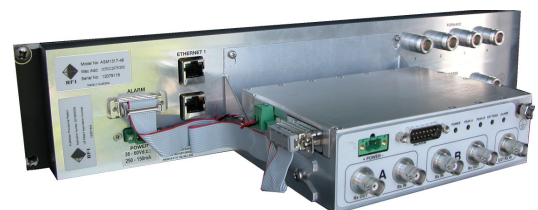
Chan No.	Channel ID	RA	RB	RE	Freq	Last recorded Power above threshold		
						RA	RB	RE
Rx-1	FC CH1 420	Yes	Yes	Yes	420.06250 MHz	<div><div></div></div> - 82.5 dBm	<div><div></div></div> - 85.6 dBm	<div><div></div></div> < -125 dBm
Rx-2	FC CH2 420	Yes	Yes	No	420.26250 MHz	<div><div></div></div> - 81.1 dBm	<div><div></div></div> - 85.7 dBm	
Rx-3	FC CH3 420	Yes	Yes	No	420.36250 MHz	<div><div></div></div> < -125 dBm	<div><div></div></div> < -125 dBm	
Rx-4	FC CH4 420	Yes	Yes	No	420.46250 MHz	<div><div></div></div> - 82.8 dBm	<div><div></div></div> - 86.8 dBm	
Rx-5	FC CH5 420	Yes	Yes	No	420.66250 MHz	<div><div></div></div> - 81.6 dBm	<div><div></div></div> - 86.3 dBm	
Rx-6	FC CH6 420	Yes	No	No	421.26750 MHz	<div><div></div></div> - 82.3 dBm		
Rx-7	FC CH7 420	Yes	No	No	421.36250 MHz	<div><div></div></div> - 82.1 dBm		
Rx-8	FC CH8 420	Yes	No	No	421.58750 MHz	<div><div></div></div> - 82.0 dBm		
Rx-9	Building DAS	No	No	Yes	468.10000 MHz			<div><div></div></div> < -125 dBm

Refresh

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The RSM also features a unique "RF Peak Level Detector" capability that can measure high levels of RF, even of very short burst duration, that may be overloading the network's base station receivers and degrading network performance. Alarm thresholds can be configured for these received signal level peaks so that alarms can be actioned when they occur, and these events are measured, logged and may be viewed in the ASM GUI to assist fault-finding activities.

Channel Diagnostics	
<b>Customer Name -</b> ASM3852 <b>Site Name -</b> Bayswater	
<input checked="" type="checkbox"/> Monitor Tx Channel <input checked="" type="checkbox"/> Monitor Rx <input type="checkbox"/> Channel <input type="checkbox"/> Frequency	
Select Tx Port: Tx Port 1 - Tx 420 Select Tx Channel: Tx1-1, 420.06250 MHz, FC CH1 420	Select Rx Group: Rx 1-20 Select Rx Channel: Rx1-1, 420.06250 MHz, FC CH1 420
<b>Tx Fwd Pwr</b>	<b>58.88 W</b>
<b>VSWR</b>	<b>1.53:1</b>
<b>RxA Level</b>	<b>17.36 <math>\mu</math>V</b>
<b>RxB Level</b>	<b>9.87 <math>\mu</math>V</b>
<b>RxE Level</b>	<b>3.75 <math>\mu</math>V</b>



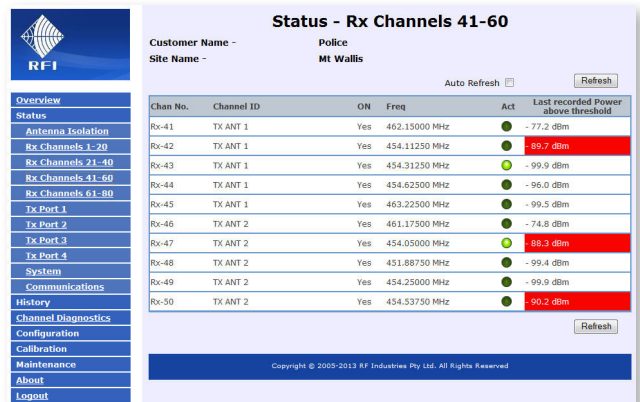
Optional Receive Systems Module (RSM)

## Monitoring Co-Sited Transmitters

Other site users' transmitters, that are not combined in the Tx Combiners connected to the ASM, may also be monitored by entering them as frequencies in the Rx Frequency screens of the GUI. This monitoring method allows those other frequencies to be measured and logged, providing level and activity data over time.

This is particularly useful in assisting the tracing of intermodulation mixes when other site users' transmitters are suspected of involvement.

Suspected frequencies can be entered in spare Rx channel positions, with the Act indicator showing the simultaneous keying of monitored frequencies. The ability to assign "detection" (alarm) thresholds to these measurements allows alarm notifications to be triggered. Time and data stamped ASM History logs and the ability to view this activity remotely via the GUI provides additional fault-finding capabilities to assist in the resolution of site performance issues.



Chan No.	Channel ID	ON	Freq	Act	Last recorded Power above threshold
Rx-41	TX ANT 1	Yes	462.15000 MHz	●	- 77.2 dBm
Rx-42	TX ANT 1	Yes	454.11250 MHz	●	89.7 dBm
Rx-43	TX ANT 1	Yes	454.31250 MHz	●	- 99.9 dBm
Rx-44	TX ANT 1	Yes	454.62500 MHz	●	- 96.0 dBm
Rx-45	TX ANT 1	Yes	463.22500 MHz	●	- 99.5 dBm
Rx-46	TX ANT 2	Yes	461.17500 MHz	●	- 74.8 dBm
Rx-47	TX ANT 2	Yes	454.05000 MHz	●	88.3 dBm
Rx-48	TX ANT 2	Yes	451.88750 MHz	●	- 99.4 dBm
Rx-49	TX ANT 2	Yes	454.25000 MHz	●	- 99.9 dBm
Rx-50	TX ANT 2	Yes	454.53750 MHz	●	90.2 dBm

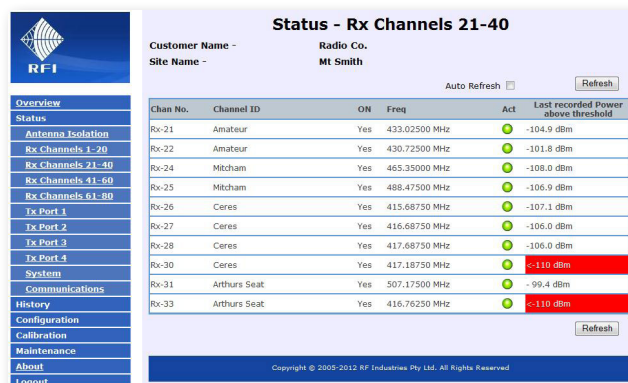
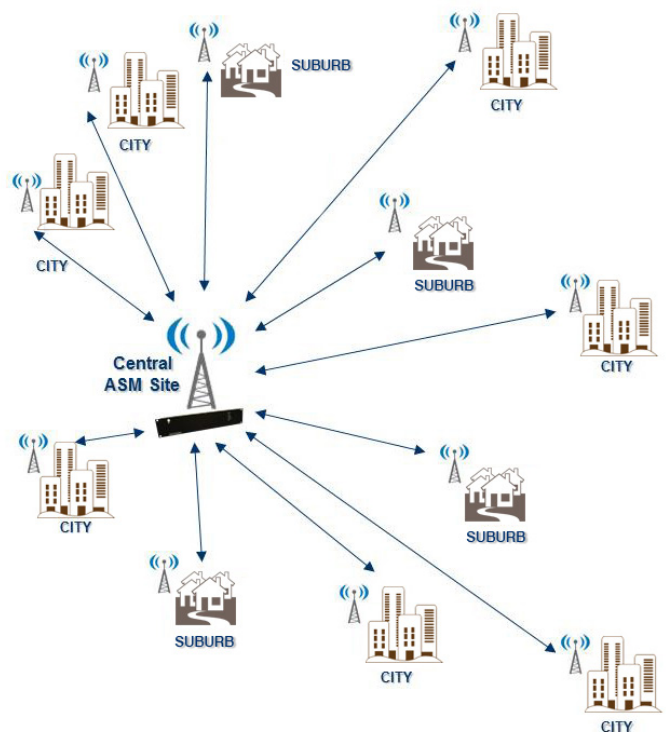
## Adjacent Sites-Monitoring

If an ASM is installed at a dominant "high" network site, it can also be configured to 'off-air' monitor channels from surrounding network sites. In trunking networks, this is particularly useful for monitoring a control channel from adjacent sites.

This concept requires adequate isolation between the ASM site's Tx antenna and the off-air Rx antenna and provides basic monitoring of coverage - yet confirms the continuing operation of other sites within the network.

Adding more ASMs to other sites adds more data, providing more than one signal level reading from each site – more thoroughly confirming network and coverage performance.

Multiple sites' data can also be collected, collated and presented to identify performance impacting changes in network coverage performance.

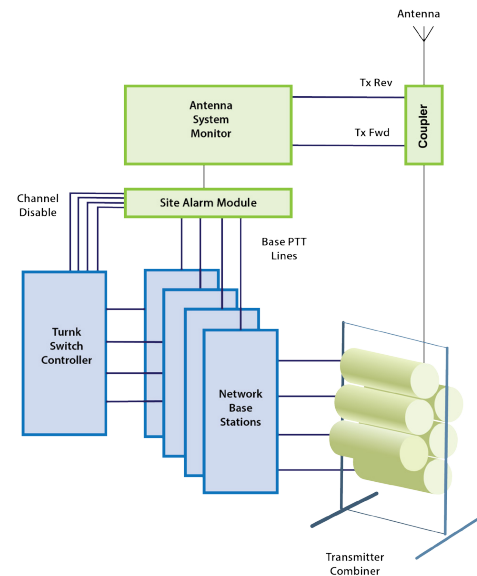


Chan No.	Channel ID	ON	Freq	Act	Last recorded Power above threshold
Rx-21	Amateur	Yes	433.02500 MHz	●	-104.9 dBm
Rx-22	Amateur	Yes	430.72500 MHz	●	-101.8 dBm
Rx-24	Mitcham	Yes	465.35000 MHz	●	-108.0 dBm
Rx-25	Mitcham	Yes	488.47500 MHz	●	-106.9 dBm
Rx-26	Ceres	Yes	415.68750 MHz	●	-107.1 dBm
Rx-27	Ceres	Yes	416.68750 MHz	●	-106.0 dBm
Rx-28	Ceres	Yes	417.68750 MHz	●	-106.0 dBm
Rx-30	Ceres	Yes	417.18750 MHz	●	<-110 dBm
Rx-31	Arthurs Seat	Yes	507.17500 MHz	●	- 99.4 dBm
Rx-33	Arthurs Seat	Yes	416.76250 MHz	●	<-110 dBm

## Base Station Failure

Using an (optional) Site Alarm Module (SAM), the ASM can provide Base Station monitoring in DMR (and other) radio systems. The alarm status from each monitored channel can be assigned to a SAM relay output, and a failure on a base station channel can create an alarm output that is connected back to the trunking controller or individual bases to de-allocate the failed channel.

Using the "Digital Input" affiliated to each SAM relay output ensures that the trunking base station's keying is monitored, and a total RF output failure is recognised – rather than interpreted as valid "no channel activity". SAM outputs can also be manually activated and de-activated via the GUI if the deactivation of one or more channels is desired.

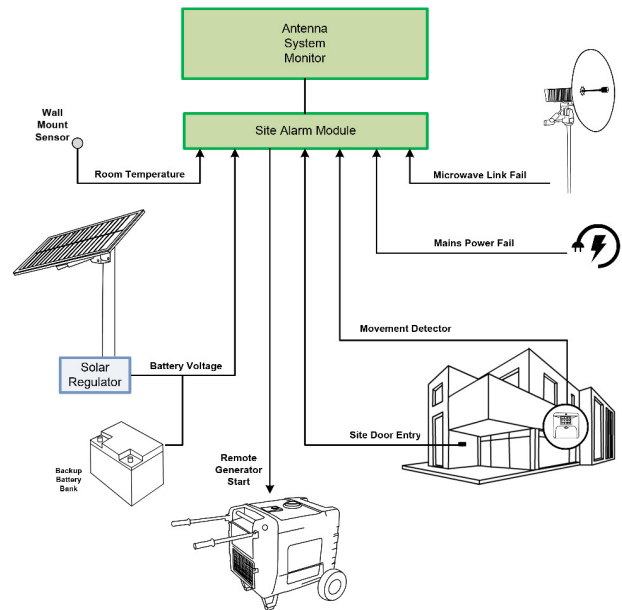



## Site Equipment Monitoring

When fitted with an (optional) Site Alarm Module (SAM), the ASM can also provide monitoring of temperature, analogue voltages and test points, and general purpose digital logic and alarm lines.

The alarm status from each SAM input is represented in the ASM webserver GUI, and alarm events trigger SNMP traps, SMTP (Email) messages and Manager Messages for alarm reporting.

A selection of temperature, analogue voltages and digital logic levels can be monitored by one SAM, with ten (10) alarm relay outputs that can be mapped to alarm states for ASM monitored channels, SAM Inputs, or RSM Inputs. Up to ten (10) SAM's can be connected to one ASM for additional monitoring capacity if required.





RFI

# Status - Site Alarm Monitor, Module 1

Customer Name -

Police

Site Name -

Mt Shaddock

Model	Serial Number	Firmware Version	Hardware Revision	
SAM	13058071	2.0	1	
External Alarm Input				
Input ID	Input Value		Status	
Ext1-1	Temperature	20.7 °C	OK	
Ext1-2	Battery Bank #1	12.23 V	OK	
Ext1-3	Door Entry	High	OK	
Ext1-4	Movement Sensor	High	OK	
Digital Input				
Input ID	Function		Status	
DI1-1	Base Station #1	General Purpose	OK	
DI1-2	Base Station #2	General Purpose	OK	
DI1-3	Link #1	General Purpose	OK	
DI1-4	Link #2	General Purpose	OK	
DI1-5	Mains Power	General Purpose	OK	
DI1-6	Hot/Standby	PTT	Inactive	
DI1-7	Not defined	Not in use		
DI1-8	Not defined	Not in use		
DI1-9	Not defined	Not in use		
DI1-10	Not defined	Not in use		
Alarm Output				
Port	Channel	Status		
SAM1-1	Alarm not in use	Inactive		

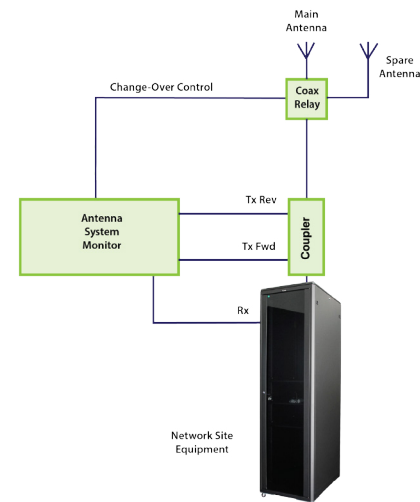


Optional Site Alarm Module (SAM)

## Antenna Change-Over

Another application for the Antenna System Monitor (ASM) is to control an automatic Antenna Change-Over unit (ACO). Antenna performance can be monitored by the Tx forward power and VSWR measurement cycle of the ASM.

If an alarm is detected on one (or more) transmitter antennas, the alarm relay output(s) of the ASM can be used to activate a coaxial relay to switch in a stand-by antenna (or antennas). ASM outputs can also be manually activated and de-activated via the GUI if the manual change-over or testing of antennas is desired. This capability is beneficial on remote sites where access to the site could be restricted for prolonged periods due to seasonal weather.



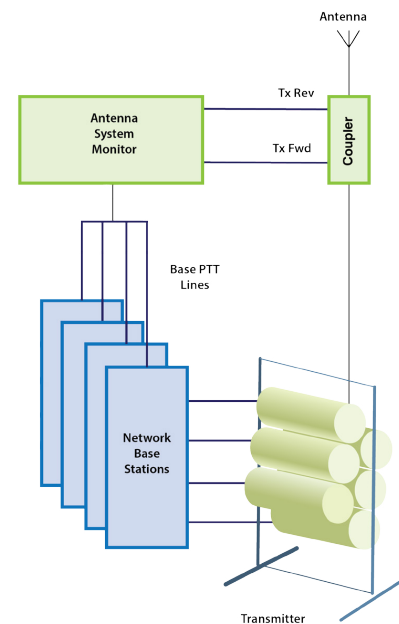
## Remote Base Station Control

The relay outputs of the Antenna System Monitor (ASM), or a Site Alarm Module (SAM) if additional output capacity is required, can be controlled via the ASM GUI. These outputs can be used to control external equipment items – including base stations. Coverage drive-testing can be assisted by activating test transmitters remotely via the ASM GUI. The ease of access of the GUI provides flexible control functionality that can be used to facilitate remote control capabilities at a communications site.

Relay	Alarm Source	Status
Relay 1	Summary Alarm	Active
Relay 2	Rx-1, 418.21250 MHz, O&M Ch 1	Active
Relay 3	Tx Power	Inactive
Relay 4	Tx VSWR	Inactive

Alarm Output	Alarm Source	Status
SAM1-1	Tx1-1, 408.21250 MHz, O&M Ch 1	Inactive
SAM1-2	Ext1-2, Battery Bank	Inactive
SAM1-3	Alarm not in use	Inactive
SAM1-4	Alarm not in use	Inactive
SAM1-5	Alarm not in use	Inactive
SAM1-6	Alarm not in use	Inactive
SAM1-7	Alarm not in use	Inactive
SAM1-8	Alarm not in use	Inactive
SAM1-9	Alarm not in use	Inactive
SAM1-10	Alarm not in use	Inactive

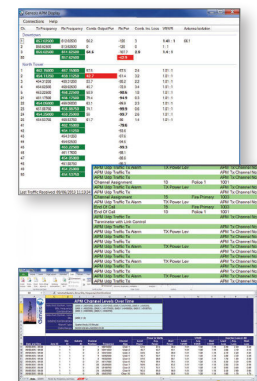


## Genesis GenWatch3® Support

The ASM is supported in Genesis GenWatch3® software, providing RF power information to supplement the call activity, busies, system health, and the vast amount of additional data available to users' through GenWatch®.

This means system owners have an unparalleled view of the user's call experience from multiple angles.

Visit <http://genesisworld.com/enhancements/APM/>

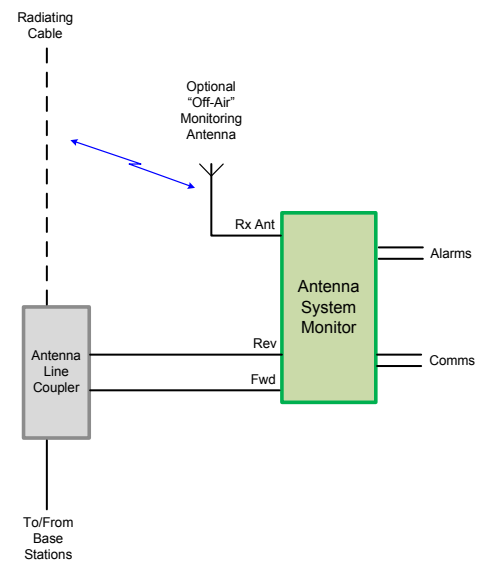


## Distributed Antenna Systems (DAS)

A Distributed Antenna System (DAS) can also be monitored using an Antenna System Monitor. Like any antenna, the DAS can have the forward power and its VSWR performance measured – on a per-channel basis.

An ‘off-air’ antenna can also be fitted to monitor the radiated signal level from the DAS – with this level having an alarm threshold value set to detect any “coverage-impacting” drop in signal levels within the system.

Using an (optional) Site Alarm Module (SAM), the DAS head-end can also be monitored and alarmed by the ASM. This monitoring could include the room or equipment door entry, equipment alarm outputs, battery temperature, battery and output voltages of the Power Supply or UPS, and any other equipment alarm outputs.



## Non-Intrusive Periodic Maintenance Inspections (PMIs)

The Antenna System Monitor (ASM) is non-intrusive to a network once its sampling coupler is installed.

The ASM measures and reports on the monitored RF performance parameters on a continuous “24x7” basis, allowing the measured values to be logged during normal network operation and without impacting its users. In addition, alarm events (when the programmable alarm thresholds are exceeded) can be reported back to a Network Operations Control Center (NOCC) or maintenance personnel via the Alarm Relays, SNMP, SMTP (Email) or Manager Messages alarm reporting.

Using the ASM’s collected History and Alarm event data, in conjunction with accessing the unit and its current performance measurements “real-time” via its friendly Graphical User Interface (GUI) when required, provides the ability to measure and confirm most network RF performance parameters without a planned or unplanned network outage. In circumstances, this capability can remove (or greatly reduce) the need for regular PMIs - and their associated network outages and the impact these have on operations-critical network users.

The benefits in network maintenance cost reductions in minimising the number of visits to sites, particularly ones that are remote or that have otherwise limited access, can be significant. The availability of downloadable data that can be formatted and presented in regular reports further improves network availability, fault and mean time to repair (MTTR) monitoring and KPI measurement.

Coupled with the capability to more intuitively assess network RF performance problems and the “network-availability” effects of alarm events as they unfold, the Antenna System Monitor (ASM) provides a compelling Return-On-Investment (ROI) proposition for its inclusion in every network site build.

## New Features, Upgrades, and Documentation

There is an active product development roadmap for the Antenna System Monitor. New features are available in regular firmware releases. Firmware updates can be easily uploaded (locally or remotely) to an ASM. Firmware update files, SNMP MIB files, Service Bulletins and User Manuals are available in the ‘Monitoring’ products category at [www.rfi-motorola.com](http://www.rfi-motorola.com)

# Features and Benefits

- **Allows many PMI's to be performed non-intrusively, without a site outage impacting network users (i.e. no more scheduled network outages)**
- Observe network RF performance locally, or remotely, via a user friendly webserver GUI - with SNMP, SMTP (Email), Manager Messages, and relay outputs available for alarm notifications.
- **Measure and monitor the output of high power multi-carrier transmit combiners on a per-channel basis – without the limitations of in-line wattmeters and RF “samplers”**
- Measure and monitor other network RF parameters (receive levels, system isolation, etc)
- **Allows and Tx and Rx frequencies to be analyzed to assist in the identification of interference (IM, desense, etc), illegal carriers, frequency re-use problems and other performance impacting issues.**
- Measure and monitor site alarms and equipment operating status' using (optional) Site Alarm Module(s) using temperature, analogue and digital inputs. Map individual ASM channel alarms to ASM and or SAM alarm relay outputs for remote control, antenna change-over, hot/standby, and other applications.
- **Measure and monitor Dual Diversity and External Receive signals using the (optional) Receive Systems Module (RSM) that may be added to an ASM at any time – supporting network technology upgrades.**
- Store historical data for later display or download
- **24x7 non-intrusive monitoring and the setting of minimum and/or maximum alarm thresholds allows the speedy detection and notification of performance-impacting changes in the networks performance**
- Configuration data (frequencies, alarm thresholds, etc) is easily entered via an integral webserver GUI, or via a Configuration File Load/Save selection.
- **Allows intuitive assessment of site faults prior to despatching personnel to site**
- Assists in determining the need for specialised personnel (i.e. riggers) and likely required spares (such as antennas) to be determined prior to travelling to site in response to a reported fault, minimising unnecessary maintenance costs.
- **Reduces maintenance effort by enabling better analysis of the likely fault cause prior to deploying resources to site, and allows appropriate spares to be taken to site**
- Allows earlier planning of network outages if required for fault rectification. Reduces 'unplanned' outages on short notice
- **Detects the onset of fault conditions “as they occur” and often before network user's notice the impact of the fault – allowing a faster response to be initiated and resulting in better Mean Time To Repair (MTTR) performance to be achieved**
- Facilitates a more detailed assessment of the impact of the fault on network performance. Is it a minor reduction of coverage, is it on just one channel, or is it a more extensive impact on the network's grade of service?
- **Provides detailed data of ongoing network performance, faults and restorations – within the RF environment. Downloadable log files allow the importation and processing of data into spreadsheets, producing network performance, maintenance and other KPI reports.**
- The ASM is supported in Genesis GenWatch3® software, providing RF power information to supplement the call activity, busies, system health, and the vast amount of additional data available to users' through GenWatch®.

# Antenna System Monitor

132-174MHz / 380-520MHz / 746-870MHz / 870-960MHz

Performance Monitoring of FWD and RFL Tx Power, Receive RSSI and System Isolation measurements

ASM1317 / ASM3852 / ASM7487 / ASM8796



The Antenna System Monitor (ASM) provides channel specific forward and reflected transmitted power monitoring, Rx RSSI levels for up to 80 channels, and system isolation measurements. Four paired sets of forward and reflected Tx power measurement inputs facilitate monitoring via high power in-line couplers. The low loss Antenna Line Coupler is inserted after the Tx combiner on the antenna feeder cable. All frequencies, channel bandwidths and alarm level thresholds are software definable on a per-channel basis. A DB15 rear mounted connector provides alarm reporting outputs that can be hardwired into most alarm reporting facilities. The LED's on the front panel of the ASM allow visual confirmation of the ASM's operating and alarm status. Configuration, diagnostics and communication management is facilitated through the use of an on-board webserver GUI. Optional Site Alarm Modules (SAMs) and a Receive Systems Module (RSM) may be added to enhance measurement and alarm output capabilities.

## Features:

- Individual channel monitoring of Tx forward and reflected power and Rx levels in multi-channel, multi-carrier systems.
- Non-intrusive 24x7 measurement, monitoring and alarm reporting of a system's RF performance parameters.
- Capable of monitoring up to 80 channels across multiple combiner systems
- Analogue, Digital, FDMA and TDMA compatible
- Local or Remote configuration and firmware updating via RJ45 Ethernet port and integral webserver.
- ASM supplied with one Antenna Line Coupler, additional couplers may be ordered separately if required.

FRONT VIEW



REAR VIEW



## Specifications

Antenna System Monitor	ASM
Frequency Range (4 separate frequency models)	132-174MHz, 380-520MHz, 746-870MHz or 870-960MHz
Maximum number of monitored channels	80
Available Tx forward power / VSWR monitoring port inputs	4 pairs
Available Rx RSSI level monitoring ports	1 (up to 3 if RSM fitted)
Rx monitoring port input range	-110dBm to -50dBm (up to -125dBm if RSM fitted)
Frequency channel step size (Tx & Rx)	1.25kHz
Channel measurement bandwidths	12.5kHz and 25kHz
Max spurious or IM products	-30dBm
Conducted emissions	Complies with CISPR22 Part B, FCC Part 15 (15.207)
Radiated emissions	Complies with CISPR22 Part B, FCC Part 15 (15.209)
RF Termination connectors	N (F)
Communication interface ports	2 x rear mounted TCP/IP Ethernet ports (RJ45)
Internal alarm relay contacts output connector	Rear mounted DB15 (M)
Visual alarm notification	Front panel mounted LED's
Configurable alarms	Summary Fault / Tx FWD power / VSWR / RSSI & System Isolation
Alarm support	GUI / Relay Output / SNMP V2c Traps / SMTP Email / UDP Packets
Power supply options	11-36VDC, 36-60VDC or 100-240VAC
DC power connector	Polarised 2-pin Phoenix connector
Mounting	2RU 19" rack mounting
Dimensions	19x2x3.5" / 483x50x89mm (incl connectors)
Weight	< 4.4lbs / 2kgs
Operational temperature range	14° F to 140° F / -10° C to +60° C

For more detailed information on the ASM, SAM and RSM products please refer to the User Manuals, Product Briefs, Service Bulletins, Application Notes, Firmware Updates, SNMP MIB files and other support information located at [www.rfi-motorola.com](http://www.rfi-motorola.com).

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## Site Alarm Module (SAM)

Site Alarm Module, programmable alarm monitor.

Optional dedicated alarm outputs and monitored inputs module for the ASM

SAM0000



The Site Alarm Module (SAM) is an optional module used with the Antenna System Monitor (ASM) to allocate dedicated relay outputs for up to ten (10) alarm states for ASM monitored channels, SAM Inputs, or RSM Inputs. Up to ten (10) SAMs can be easily (daisy-chained) onto one ASM to increase the number of monitored channels with dedicated alarm outputs.

Site Alarm Modules (SAM) and Channel Alarm Modules (CAM) may be mixed on one ASM if desired. The ASM auto-detects SAM modules when they are connected, and through the GUI (Graphical User Interface) of the ASM the user can configure which of the SAM outputs are assigned to respective ASM monitored channels. Conditional alarm status is a feature that allows the individual base station PTT lines to be compared with the ASM channel alarm status, allowing a no RF output from the base station to be recognised and raise an alarm event. Four (4) additional general purpose alarm inputs are also available on each SAM to monitor site alarms - such as temperature, battery voltages, site access doors and other site conditions. Front and rear LED's provide a visual indication of the status of all 10 output and 4 input alarm states.

### Features:

- User assigned 10-Ch alarm relay module
- Auto detected by ASM when connected
- Conditional Tx PTT or Rx Unsquelch status alarm monitoring
- Compact 1RU 19" rack mountable shelf.
- Expandable to a total of 10 SAM's (and CAMs) per ASM - each monitoring up to 10 Channels.
- Latched alarm outputs for Hot/Standby base station and Auto-Change Over (ACO) antenna control
- Up to 10 user configurable Tx PTT or Rx Unsquelch activated or general purpose logic alarm inputs
- Up to 4 user configurable general purpose temperature, analogue or logic alarm inputs
- Communications interface and power daisy-chained between ASM and respective SAM's
- Front and rear alarm relay activation notification LED's



FRONT VIEW



REAR VIEW

### Specifications

Model Number		SAM0000 or SAM0000-48
Alarm outputs		10
Alarm contact type		Dry Relay N.O. / Common / N.C.
Alarm contact rating - max		50VDC 1A
Alarm inputs		10 (Tx PTT by channel, Rx Unsquelch by channel, or individual general purpose digital inputs) 4 (general purpose temperature, analogue voltage or digital inputs)
Alarm inputs (refer manual for detailed explanation)	PTT or digital logic:	"0" = <2.5VDC "1" = > 2.5VDC
	Temperature:	-67° to +257° F or -55° to +125° C
	Analogue:	0VDC to +5VDC or +60VDC to -60VDC or +5VDC to -60VDC
Visual alarm notification		Front and Rear panel mounted LED's
Power Supply options (ASM - daisy chained)		9-36VDC or 36-60VDC
Connectors (Note: All connectors on rear)	External Alarm inputs:	1 x Polarized 8-pin Phoenix connector
	Channel Alarm Outputs:	10 x Polarized 3-pin Phoenix connector
	Channel Alarm Inputs:	10 x Polarized 2-pin Phoenix connector
	Power Supply:	2 x Polarized 2-pin Phoenix connector
	Comms Interface:	2 x DB15 (M)
Mounting		1RU 19 Rack mounting
Dimensions		W 19" x H 1.75" x D 3" / W 483 x H 45 X D 77mm
Weight		< 2.2lbs / <1kg
Operational temperature range		- 22° F to 140° F / - 30° C to + 60° C

## Receive Systems Module (RSM)

2 Receive System Inputs and 1 External Rx Input

Optional Dual Diversity, dual Rx antennas, hot/standby Rx antennas, and external receive path monitoring module for the ASM



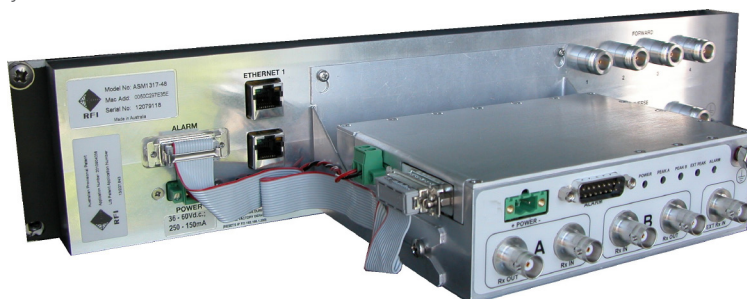
The Receive Systems Module (RSM) is an optional module that may be used with the Antenna System Monitor (ASM) to monitor a dual diversity (i.e. two Rx paths) antenna system. An isolated external off-air Rx path may also be monitored to facilitate additional ASM network monitoring functionality. Peak RF input levels are independently detected, monitored and alarmed for all RF inputs, allowing high RF signal levels that may be impacting Rx system performance to be detected, measured, reported and alarmed - assisting in fault-finding activities. The RSM can be easily added to an ASM at any time, providing a network migration path from non-diversity to diversity technologies. When a RSM is connected to the ASM, the ASM will auto-detect its presence, displaying the respective RSM configuration pages via the ASM GUI (Graphical User Interface). Rear LED's provide a visual indication of the status of the Power, Rx Inputs' levels and alarms.

### Features:

- Dual Diversity Rx Antenna Monitoring
- Two Rx Antennas (or Hot/Standby Rx Antennas) Monitoring
- Isolated External "Off-Air" Rx Path monitoring
- Peak RF Input Levels detection, measurement and alarming
- Auto detected by ASM
- Compact 1RU 19" rack mountable shelf.
- Power daisy-chained from ASM
- Communications interface daisy-chained from ASM



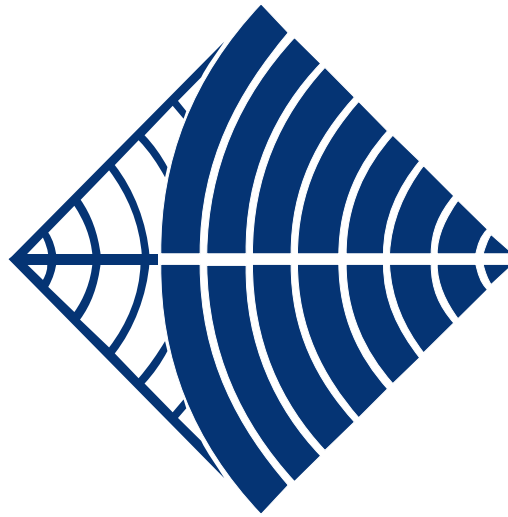
REAR VIEW



RSM fitted to Antenna System Monitor

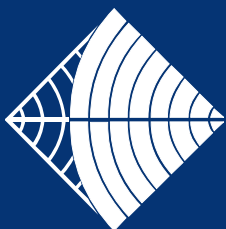
### Specifications

Model Number		RSM0000 or RSM0000-48
Frequency Range		132 - 960MHz
Impedance		50 ohms
Return Loss (all ports)		> 14dB
Maximum RF Input Level (no damage)		0 dBm
Peak Detector Response Time		> 3mS
Peak Detector Alarm Threshold (GUI selectable per port)		-35 to -55 dBm
Peak Detector Warning Threshold (GUI selectable per port)		-40 to -65 dBm
Rx Gain (GUI selectable per Rx path)		0 to 15dB
Isolation between RF Inputs		> 55dB
Visual alarm notification		Rear panel mounted LEDs
Power Supply options (ASM - daisy chained)		9-36VDC or 36-60VDC
Connectors	Connection to ASM	N (Male)
	RF In and RF Out	BNC (Female)
	Power Supply	2 x Polarized 2-pin Phoenix connector
	Comms Interface	2 x DB15 (Male)
Dimensions		W 6.7 x H 2.56 x D 5.9" / W 170 x H 65 X D 150mm (including bracket)
Weight		< 2.2lbs / 1kgs
Operational temperature range		-22° F to 140° F / -30° C to +60° C



# RFI

## TECHNOLOGY SOLUTIONS



# RFI

TECHNOLOGY SOLUTIONS

### Local Support

#### NSW

99 Station Road  
Seven Hills NSW 2147  
Phone: (02) 8814 2300  
Fax: (02) 9630 0844

#### VIC

46 Corporate Boulevard  
Bayswater VIC 3153  
Phone: (03) 9751 7500  
Fax: (03) 9751 7588

#### WA

Unit 3, 35 Colin Jamieson Drive  
Welshpool, WA, 6106, Australia  
Phone: (08) 9331 0600  
Fax: (08) 9311 0688

#### QLD and International Sales

30 Raubers Road  
Banyo QLD 4014  
Phone: (07) 3621 9400  
Fax: (07) 3252 5505

### International Support

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