Equipment Reliability

The modern RF Microwave Repeater incorporates multiple features that increase equipment reliability. Since these repeaters are used in remote locations, reliability is especially important.

Amplifiers

The microwave amplifiers are constructed, as internally redundant meaning that inside the amplifier housing are multiple redundant amplifiers. The amplifier is designed with stage-by-stage redundancy. Each gain stage is built as a parallel balanced unit whereby one half can fail without causing the system to fail. This is a type of *soft fail* design.

When half of a parallel stage fails, the gain is reduced by 6 dB as follows: 3 dB due to the stage failure, and another 3 dB due to unbalancing of the combining hybrid (Lange Coupler type).

Multiple half-stage failures can occur providing no one stage has failures in both halves or branches. The resulting reliability of this design is greater than two complete singled-ended amplifiers, externally combined. Note that no switches or protection logic are used, further simplifying the design and increasing reliability.

Microwave system design normally calls for fade margins of 32 to 50 dB. This margin allows for failure of several stages before unfaded outage occurs and the failure is detected. If the repeater AGC/ALC has sufficient reserve, the output level may remain constant.

Two sensor means are used detect amplifier failure. The first is RF output power. A built-in diode detector produces a DC voltage in proportion to the RF output power level.

This voltage is monitored in the companion (optional) RMAS-120 Alarm Transmit Unit. Should the voltage indicate a 5 dB or more drop from nominal level, an alarm is issued. The second is a current sensor, which monitors the DC current flowing into the amplifier. The sensor is a simple small resistance shunt and a differential metering circuit. The metering circuit in the companion RMAS-120 Alarm Transmit Unit feeds a comparison circuit which determines an out of range condition. The limits are _ normal and twice (2x) normal current draw.

Note that the repeater or amplifier output level can drop to alarm levels due to an input fade or terminal transmitter failure. Fading is normally brief and transmitter failures will likely issue their own alarms.

Beyond the sensors built into the repeater equipment, terminal radio AGC or receive signal levels can be used to indicate a possible failure. Should the levels drop by more than 5 dB and not indicate fading activity, and then amplifier failure can be suspected.

By observing these alarm conditions, a failure matrix can be created to assist in fault location.

Battery Feed

Each amplifier has two battery inputs. These provide for combining redundant battery sources and for load balancing on solar electric battery power systems. The primary battery input passes through a Schottky Diode with a small 0.2-Volt drop. The secondary battery input passes through a Silicon Diode with a larger 0.6-Volt drop. The offset in voltage drops causes equal voltage batteries to provide current through the primary input.

A duplex repeater has half the amplifiers wired for A-Battery primary and the other half for B-Battery primary thus balancing the load. Should either of the battery sources fail, the remaining battery will feed the entire repeater at full power.

The RMAS-120 Alarm Transmit Unit monitors the battery voltages and will issue an alarm should either voltage drop below 11.5 VDC.

RMAS-120 Remote Monitor and Alarm System

This optional companion equipment provides comprehensive monitoring of repeater, power and site conditions. Local LED indicators show conditions. These LEDs may be operated in a press-to-view mode to conserve power in unattended locations.

Remote monitoring is achieved by transmitting the alarm telemetry on one or more microwave carriers passing

Peninsula Engineering Solutions, inc.
39 Grand Canyon Lane
San Ramon, California 94583, USA

Phone: 925.901.0103
Fax: 925.901.0403
Website: www.peninsulaengineering.com

through the RF repeater.

The 16 b/s, 32-baud serial data stream can be fed to all amplifiers equipped. Inside each amplifier, an amplitude modulator imposes a 1 dB Peak-to-Peak carrier variation at about 32 Hz. The terminal radio receiver's AGC circuit detects this modulation. The AGC loop senses the modulation as *fast fading* since the modulation frequency is within that range. The AGC loop tracks and removes the modulation prior to carrier demodulation. This way the alarm telemetry does not interfere with the normal radio operation.

The RMAS Alarm Receiver Unit connects to the terminal radio receiver AGC control voltage and demodulates the telemetry stream. Now the RF repeater alarms can be displayed and extended to other supervisory equipment.

Normally this alarm telemetry is transmitted in one direction to one alarm receiver. For greater system redundancy in duplex repeaters, carriers in both directions can be modulated, transmitting in both directions to alarm receivers at each terminal end.

Peninsula Engineering Solutions, inc.
39 Grand Canyon Lane
San Ramon, California 94583, USA

Phone: 925.901.0103
Fax: 925.901.0403
Website: www.peninsulaengineering.com