Aeroflex / Weinschel Subsystems

Cellular Testing Subsystem
Design Concepts

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TABLE OF CONTENTS

1.0 Introduction

Aeroflex / Weinschel is pleased to present this technical paper describing cellular test subsystems capabilities. Having designed, developed and manufactured test and measurement subsystems for global leaders in both the wireless and cable telecommunications markets, Weinschel is uniquely qualified to offer custom, solution-based subsystems to support the full spectrum of applications both in development and fielded today. With nearly fifty years of experience in supplying quality products to the test and measurement industry, Weinschel is well positioned to deliver subsystems designs based upon the capabilities outlined in this paper.

2.0 Scope

This document is the basis for designing and developing cellular test subsystems including a wide variety of common test and measurement functions to address application-specific customer requirements. These functions can be combined to provide made-to-order solutions meeting the specific needs of market-driven customers in the wireless industry in a cost effective, high performance, readily available subsystem. Test measurement applications including channel-to-channel interference, spurious intermodulation, signal strength, and transmitter-to-receiver cross coupling are just a few of the roles that can be filled by Weinschel subsystems incorporating one or more of these functions. Descriptions of the functions listed below are provided in the pages that follow:

- Isolation Function (IF)
- Receiver Test Function (RTF)
- Transmitter Test Function (TTF)
- Antenna Test Function (ATF)
- RF Switching/Combining Function (SCF)
- Transmission Path Fading Function (TPFF)
- Transmission Multipath Function (TMF)
- Cellular Handoff Function (CHF)
- High-Power, Hot-Switched Attenuator Function (HHAF)

Aeroflex / Weinschel invites customer inquiries based upon these functional building blocks, and offers a wide range of design flexibility to address specific customer needs.

3.0 Function Descriptions

3.1. Isolation Function (IF)

3.1.1 This Function is typically used in engineering development and base station configurations to test radio receivers where there exists a requirement for high isolation from a transmitter output.

3.1.2 The Isolation Function is comprised of an isolator-circulator string for each of a specified number of branches, with a single circulator tap provided at each branch. All components in the IF are rated to handle RF power up to 100 watts (+50 dBm) RMS at the reverse ports.

3.1.3 Typical specifications for the IF include:

3.1.3.1	Frequency range:	1.5 to 2.7 GHz
3.1.3.2	Two-tone IM products:	-80 dBc maximum (two 10-watt tones)
3.1.3.3	VSWR:	1.22:1, all ports

3.1.4 A block diagram illustrating a typical Isolation Function is depicted in Figure 1 below.

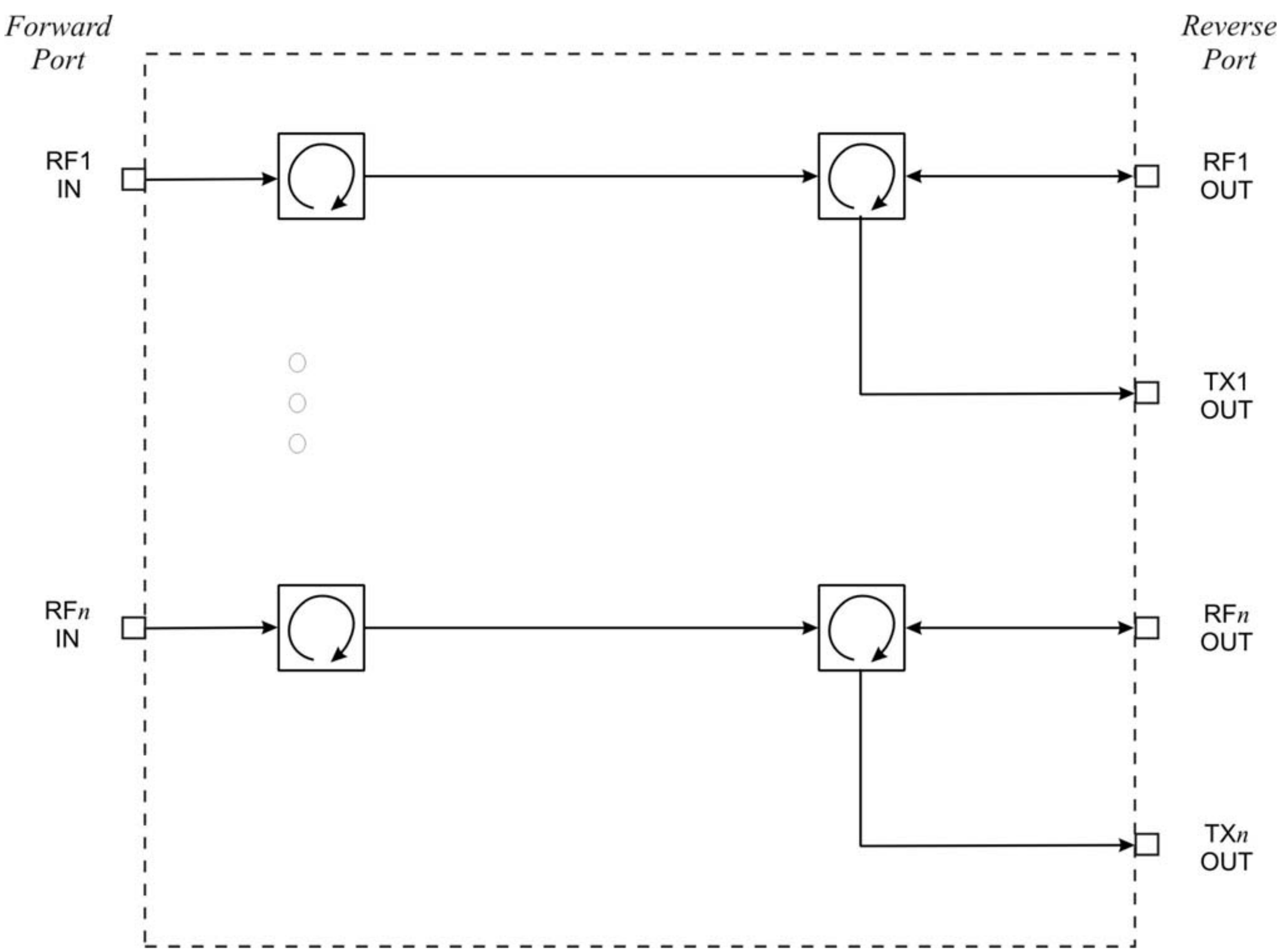

Figure 1. Isolator Function

3.2. Receiver Test Function (RTF)

3.2.1 This Function is typically used in engineering development and base station configurations to test radio receivers with RF outputs as high as 1 watt RMS (+30 dBm) over a frequency range of 1.5 to 3.0 GHz.

3.2.2 The Receiver Test Function is an RF switching/combining unit that remotely routes different external signal sources or optional external test system signals to multiple external outputs. The components used in the RTF provide an overall two-tone intermodulation-free dynamic range of more than 80 dB. Capabilities inherent in this Function include:

3.2.2.1 Signal source combination and configuration,
3.2.2.2 Direct coupling of signal sources to external outputs,
3.2.2.3 Support for external options for separate branches,
3.2.2.4 Diversity support in two branches, and
3.2.2.5 Extended output power control through step attenuators.

3.2.3 Typical specifications for the RTF include:

3.2.3.1	Frequency range:	1.5 to 3.0 GHz
3.2.3.2	Two-tone IM products: (two 1-watt tones @ 5 MHz)	-80 dBc maximum
3.2.3.3	VSWR, all ports:	1.29:1 1.7 to 2.2 GHz 1.40:1 1.5 to 3.0 GHz
3.2.3.4	Attenuation range/step size:	0 to 40 dB/10 dB step
3.2.3.5	Control:	GPIB interface

3.2.4 A block diagram illustrating a typical Receiver Test Function is depicted in Figure 2 next page.

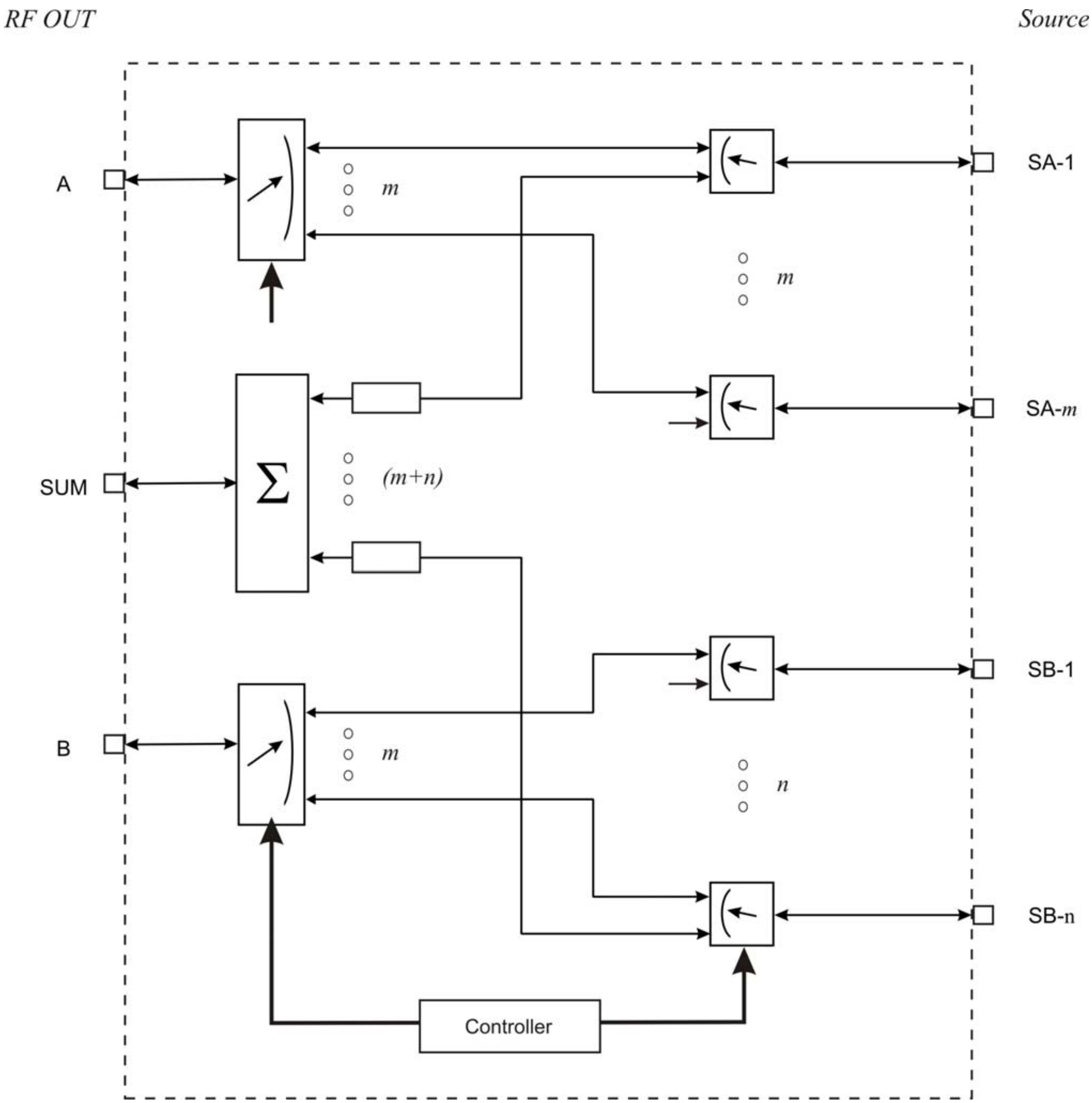

Figure 2. Receiver Test Function Block Diagram

3.3. Transmitter Test Function (TTF)

3.3.1 This Function is typically used in engineering development and base station configurations to test radio transmitters with RF outputs as high as 50 watts RMS (+ 47 dBm) over a frequency range of 1.5 to 3.0 GHz.

3.3.2 The Transmitter Test Function, like the Receiver Test Function above, is an RF switching/combining unit that remotely routes different external signal sources or optional test system external signal sources to multiple external outputs. The components used in the TTF provide an overall two-tone intermodulation-free dynamic range of more than 80 dB. Features inherent in this Function include:

3.3.2.1 Signal source combination and configuration,
3.3.2.2 Transmitter diversity support in two branches,
3.3.2.3 Transmitter intermodulation measurement support,
3.3.2.4 Optional additional filtering for increased dynamic range, and
3.3.2.5 Direct WCDMA signal routing to an output port for measurement capability.

3.3.3 Typical specifications for the TTF include:

3.3.3.1	Frequency range:	0.1 to 13 GHz
3.3.3.2	Two-tone IM products: (two 2-watt tones)	-110 dBc maximum
3.3.3.3	VSWR, all ports:	1.4:1 1.7 to 2.2 GHz 2.0:1 0.1 to 13. GHz
3.3.3.4	Control:	GPIB interface

3.3.4 A block diagram illustrating a typical Transmitter Test Function is depicted in Figure 3 next page.

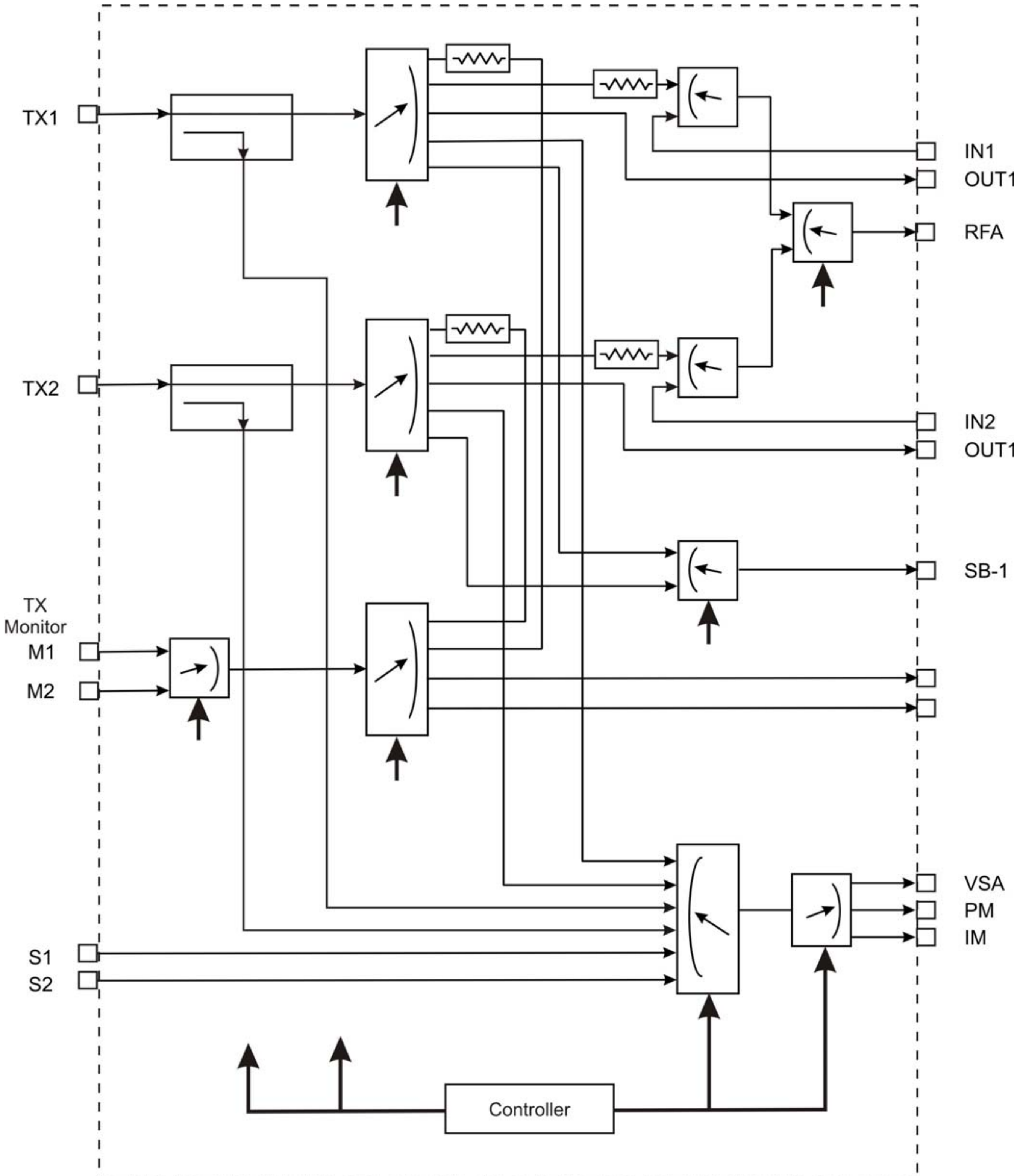

Figure 3. Transmitter Test Function Block Diagram

3.4. Antenna Test Function (ATF)

3.4.1 This Function is typically used to simulate RF leakage between base station antennas.

3.4.2 The Antenna Test Function is an antenna transmitter leakage simulator comprised of coupling, switching, and attenuating capabilities of RF signals at power levels up to 100 watts RMS (+50 dBm) over a wide frequency range. The components used in the ATF provide a typical overall two-tone intermodulation-free dynamic range of more than 125 dB. Major features of this Function include:

3.4.2.1 Antenna-to-antenna RF leakage simulation,
3.4.2.2 External interference signal source support,
3.4.2.3 Wide frequency range of 100 KHz to 13 GHz at the RF outputs, and
3.4.2.5 Diversity support in two branches.

3.4.3 Typical specifications for the ATF include:

3.4.3.1	Frequency range, all paths:	1.9 to 2.2 GHz
	RF inputs to outputs:	0.1 to 13 GHz
3.4.3.2	Two-tone IM products: (two 20-watt tones)	-125 dBc maximum
3.4.3.3	VSWR:	1.4:1 1.9 to 2.2 GHz 2.0:1 0.1 to 13 GHz
3.4.3.4	Attenuation range/step size:	0 to 15 dB/1 dB step
3.4.3.5	Control:	GPIB interface

3.4.4 A block diagram illustrating a typical Antenna Test Function is depicted in Figure 4 next page.

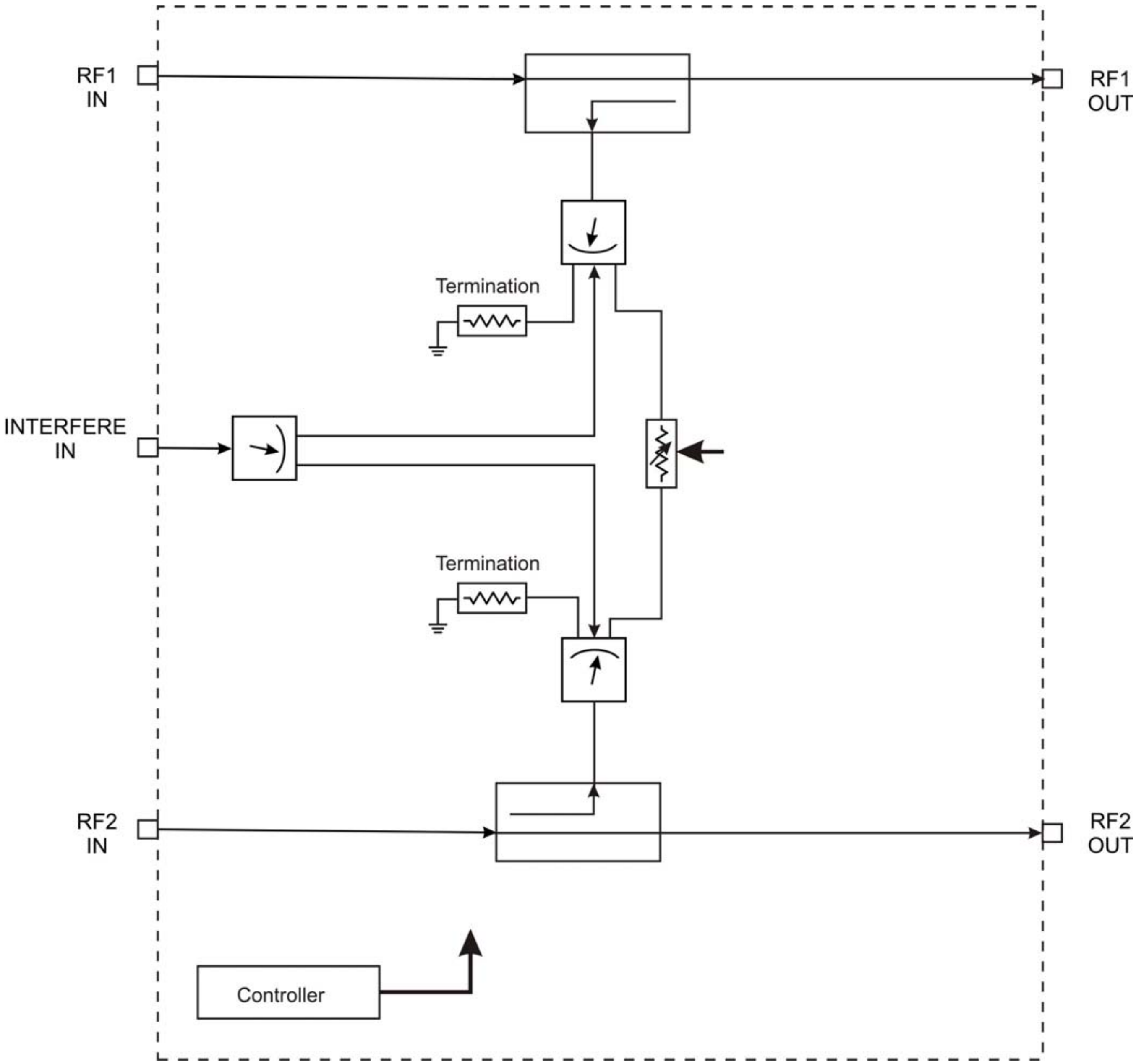

Figure 4. Antenna Test Function Block Diagram

3.5. RF Switching/Combining Function (SCF)

3.5.1 This Function is typically used to test both RF transmitters and receivers simultaneously and in multiple combinations at transmit RF power levels as high as 100 watts (+50 dBm).

3.5.2 The RF Switching/Combining Function is an integration of many of the features and capabilities of the RTF and TTF described above, and can be made to address the following base station configurations:

3.5.2.1 Three-sector configuration,
3.5.2.2 Modified three-sector configuration,
3.5.2.3 Six-sector configuration, and
3.5.2.4 Modified six-sector configuration.

3.5.3 The SCF provides the following major features:

3.5.3.1 High power support for transmitter testing,
3.5.3.2 Two each six-sector transmitter line inputs,
3.5.3.3 Multiple monitor inputs,
3.5.3.4 Antenna leakage simulation with variable leakage ratio,
3.5.3.5 Four receiver signal source inputs,
3.5.3.6 One receiver port with extended input power control,
3.5.3.7 Receiver signal power splitting for faster receiver testing, and
3.5.3.8 Diversity support in two branches.

3.5.4 Typical specifications for the SCF include:

3.5.4.1	Frequency range:	0.1 to 13 GHz
3.5.4.2	Two-tone IM products: (two 0.5-watt tones)	-80 dBc maximum
3.5.4.3	VSWR, all ports:	1.4:1 1.5 to 2.7 GHz 2.0:1 0.1 to 13. GHz
3.5.4.4	Attenuation range/step size:	0 to 1 dB/0.1 dB step 0 to 110 dB/10 dB
3.5.4.5	Control:	GPIB interface

3.5.5 A block diagram illustrating a typical RF Switching/Combining Function is depicted in Figure 5 next page.

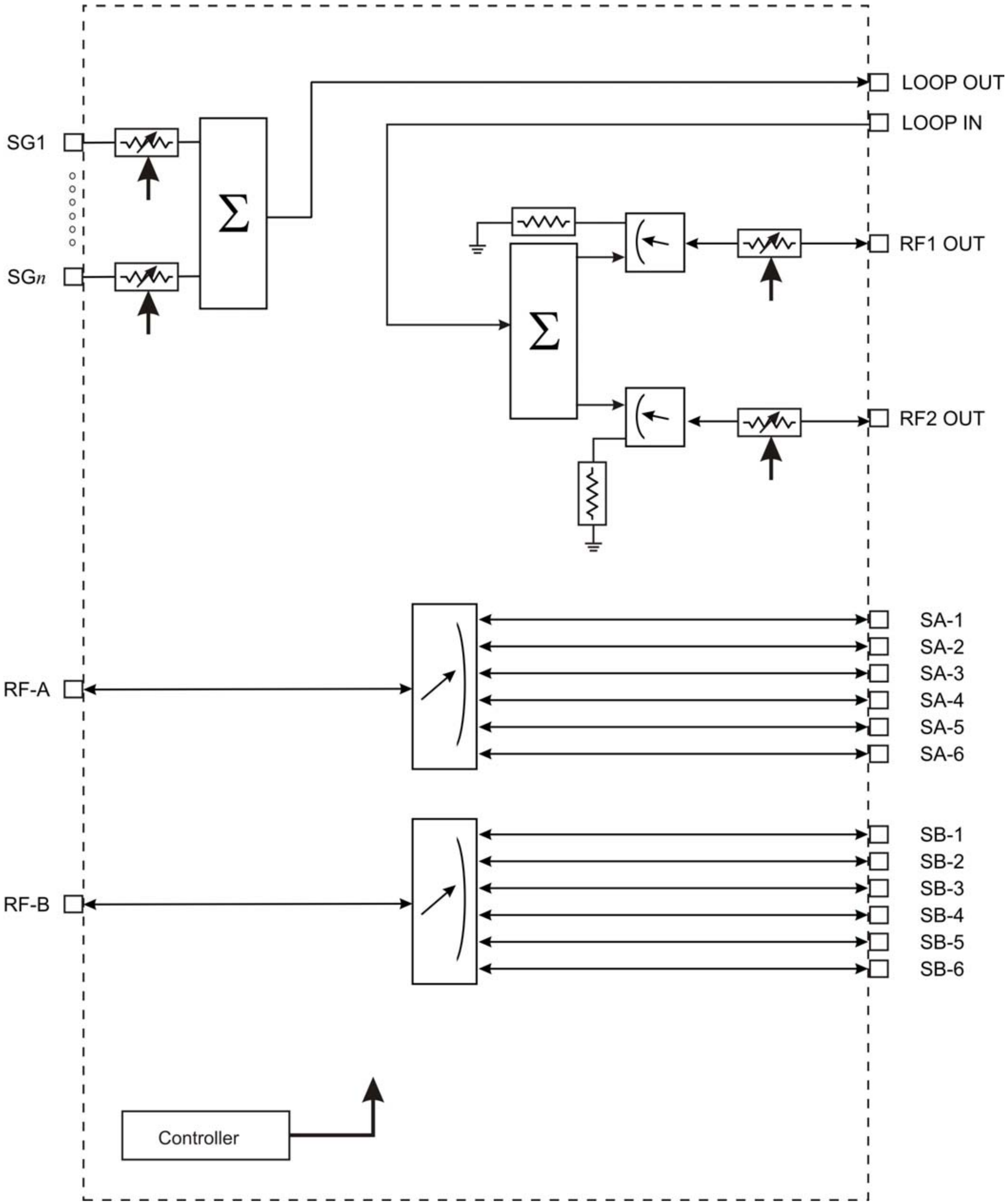

Figure 5. RF Switching/Combining Function Block Diagram

3.6. Transmission Path Fading Function (TPFF)

3.6.1 This Function is typically used to simulate path fading in tests required to evaluate cellular system and receiver performance in dynamic mobile environments.

3.6.2 The Transmission Path Fading Function is comprised of selectable RF signal inputs and outputs, and fast-switching step attenuators, to simulate fading typically experienced in mobile telecommunications scenarios.

3.6.3 Typical specifications for the TPFF include:

3.6.3.1	Frequency range:	1.7 to 2.2 GHz
3.6.3.2	Two-tone IM products: (two 1-watt tones)	-80 dBc maximum
3.6.3.3	VSWR, all ports:	1.4:1
3.6.3.4	Attenuation range/step size:	0 to 10 dB/1 dB step 0 to 100 dB/10 dB
3.6.3.5	Control:	GPIB interface

3.6.4 A block diagram illustrating a typical Transmission Path Fading Function is depicted in Figure 6 below.

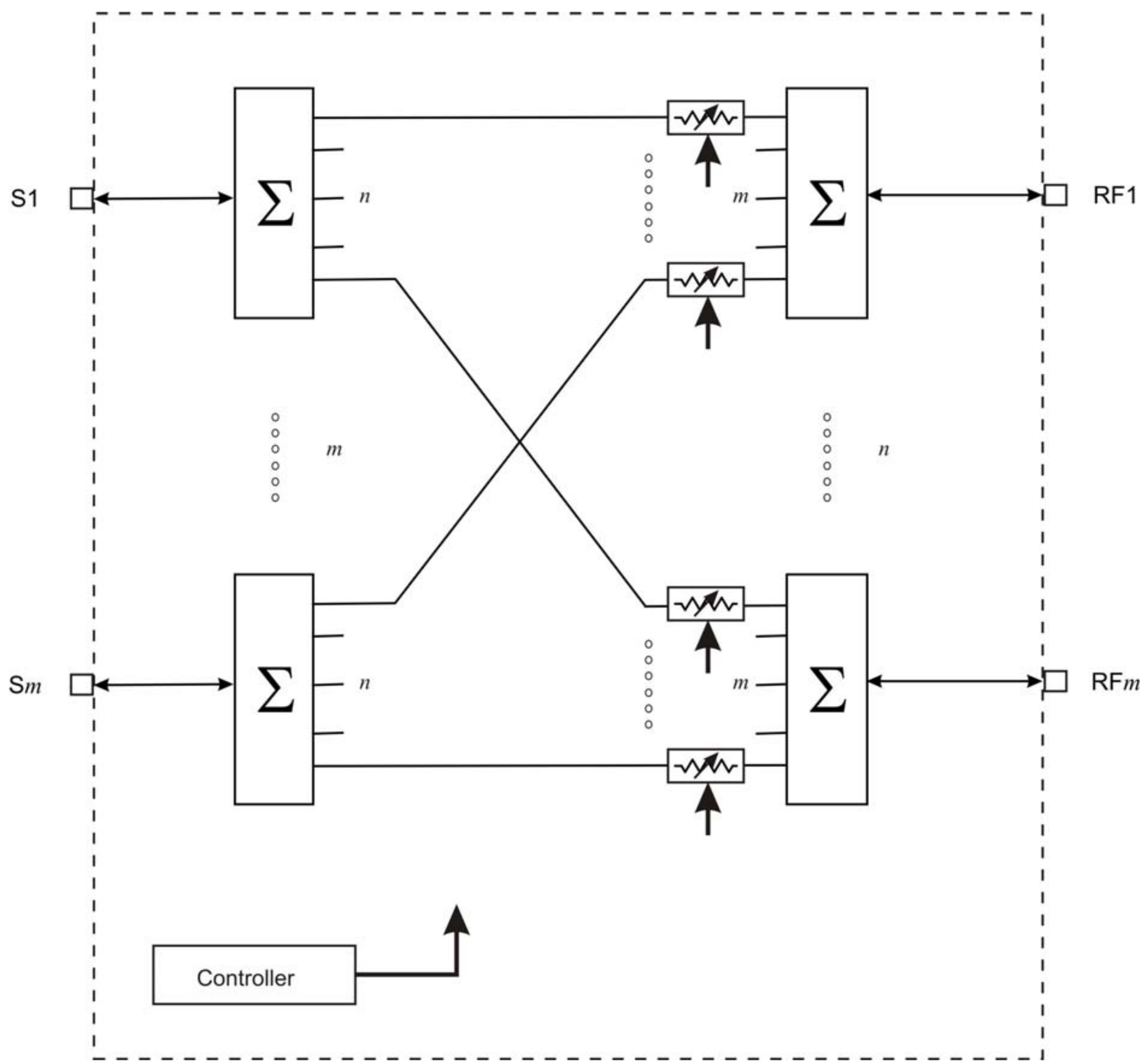

Figure 6. Transmission Path Fading Function Block Diagram

3.7. Transmission Multipath Function (TMF)

3.7.1 This Function is typically used to evaluate effects of transmission multipath phenomena on cellular base station and handset performance.

3.7.2 The Transmission Multipath Function is comprised of two or more RF signal paths, each containing programmable attenuators and phase shifters, with integrated signal combining and monitoring ports.

3.7.3 Typical specifications for the TMF include:

3.7.3.1	Frequency range:	1.7 to 2.2 GHz
3.7.3.2	Two-tone IM products: (two 1-watt tones)	-80 dBc maximum
3.7.3.3	VSWR, all ports:	1.4:1
3.7.3.4	Attenuation range/step size:	0 to 10 dB/1 dB step
3.7.3.5	Phase shift range:	0 to 270 degrees
3.7.3.6	Control:	GPIB interface

3.7.4 A block diagram illustrating a typical Transmission Multipath Function is depicted in Figure 7 below.

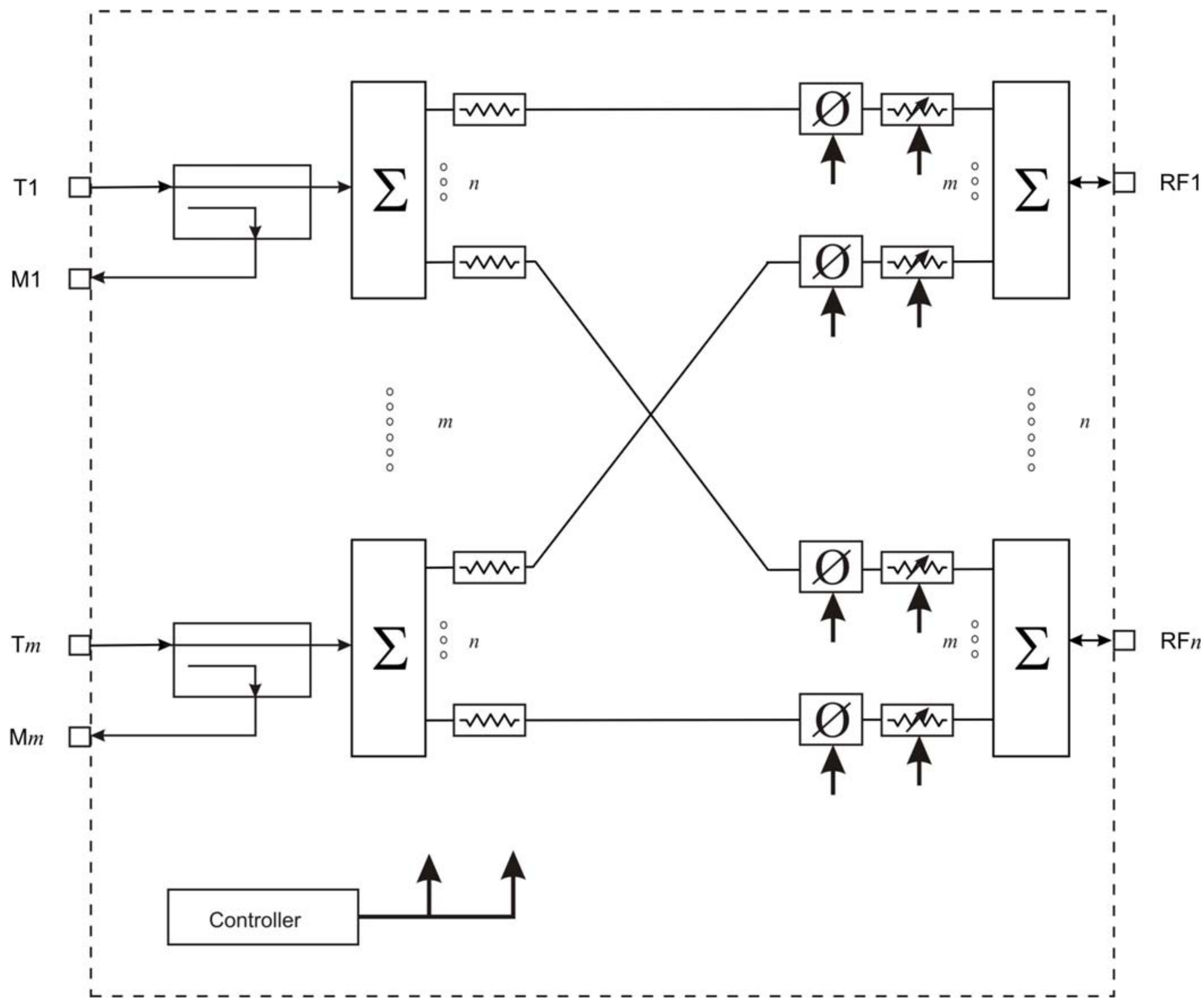

Figure 7. Transmission Multipath Function Block Diagram

3.8. Cellular Handoff Function (CHF)

3.8.1 This Function is typically used to evaluate cellular handoff characteristics of base stations in engineering development, modification or test.

3.8.2 The Cellular Handoff Function combines many of the features of the TPFF and TMF described above to simulate a real-world receive signal environment.

3.8.3 Typical specifications for the CHF include:

3.8.3.1	Frequency range:	1.7 to 2.2 GHz
3.8.3.2	Two-tone IM products: (two 1-watt tones)	-80 dBc maximum
3.8.3.3	VSWR, all ports:	1.4:1
3.8.3.4	Attenuation range/step size:	0 to 10 dB/1 dB step 0 to 100 dB/10 dB
3.8.3.5	Phase shift range:	0 to 270 degrees
3.8.3.6	Control:	GPIB interface

3.8.4 A block diagram illustrating a typical Cellular Handoff Function is depicted in Figure 8 below.

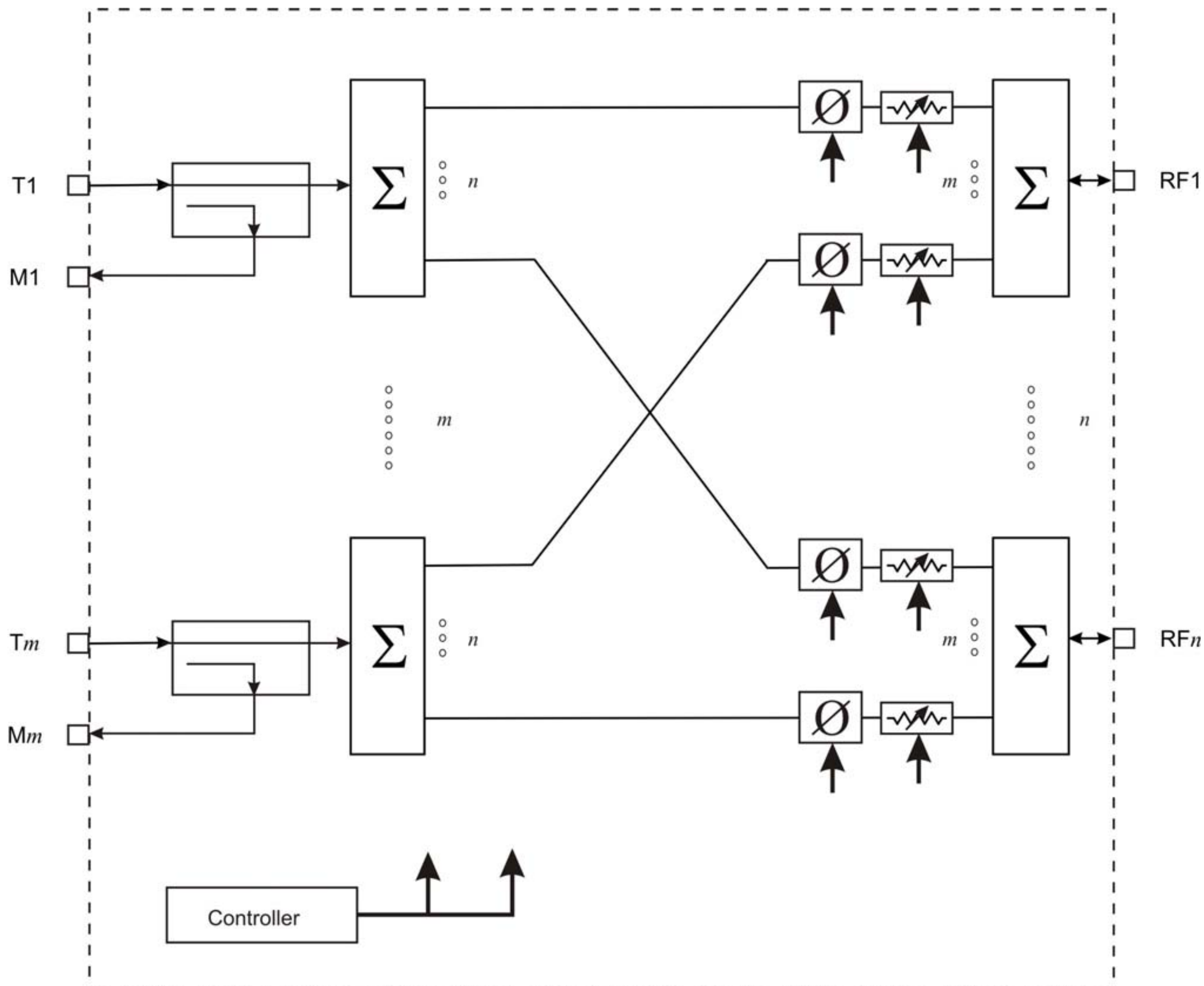

Figure 8. Cellular Handoff Function Block Diagram

3.9. High-Power, Hot-Switched Attenuator Function (HHAF)

3.9.1 This Function is typically employed in design engineering and base station evaluation testing to provide real-time, hot-switched changes in transmit power at levels up to 100 watts (+ 50 dBm).

3.9.2 The High-Power, Hot-Switched Attenuator Function is comprised of a high-power RF transfer switch terminated at one port into a high-power load, and, at the other port, into one or more programmable attenuators. The RF transfer switch of the HHAF provides a minimum of 10,000 switch cycles at rated power without degradation of the modulated RF signal quality. Features include:

3.9.2.1 100-watt hot-switch capability
3.9.3.2 Power handling to 100 watts RMS
3.9.3.3 Relative vs. nominal attenuation step function

3.9.3 Typical specifications for the HHAF include:

3.9.3.1	Frequency range:	0.1 to 13 GHz
3.9.3.2	Two-tone IM products: (two 20-watt tones)	-100 dBc maximum
3.9.3.3	VSWR, all ports:	1.45:1 0.1 to 5 GHz 1.95:1 5 to 13 GHz
3.9.3.4	Attenuation range/step size:	0 to 15 dB/1 dB step 0 to 31 dB/1 dB step
3.9.3.5	RF Power rating:	100 watts to 3 GHz 50 watts to 13 GHz
3.9.3.6	Control:	GPIB interface

3.9.4 A block diagram illustrating a typical High-Power, Hot-Switched Attenuator Function is depicted in Figure 9 below.

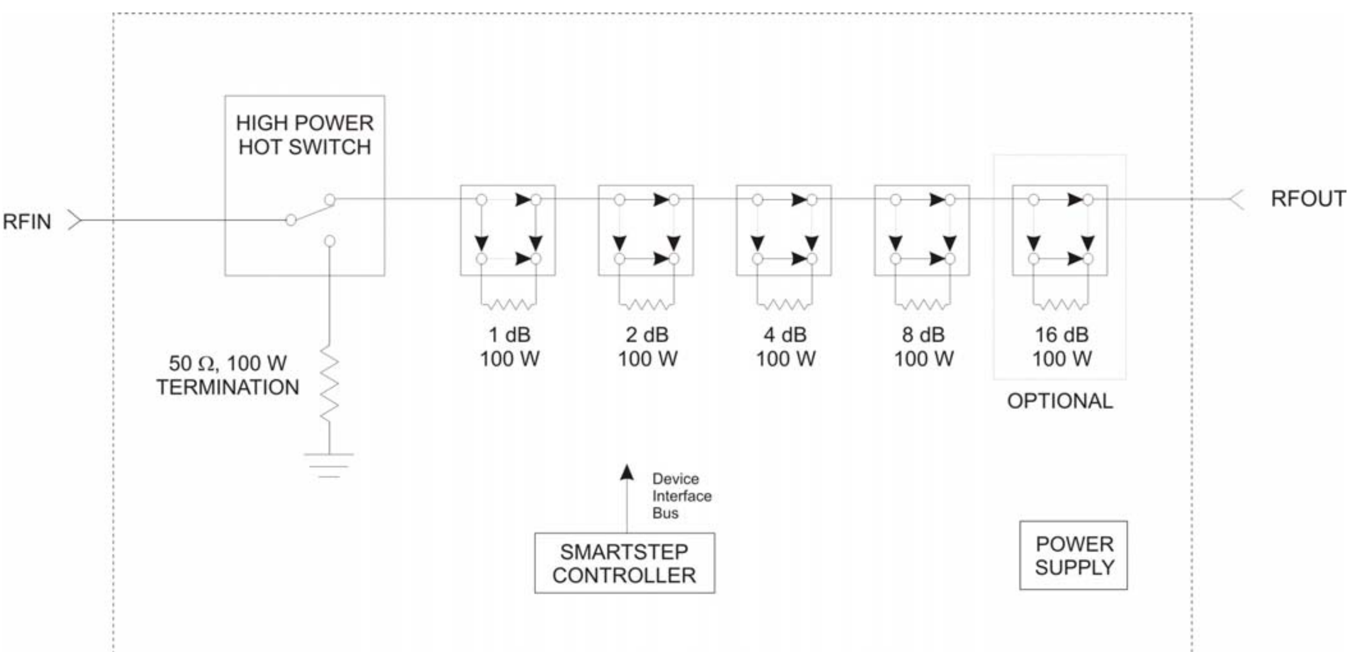

Figure 9. High-Power, Hot-Switched Attenuator Function Block Diagram

4.0 Applications

Aeroflex / Weinschel has approached the diverse test and measurement needs of the wireless industry by providing a functional "building block" approach that affords the customer maximum flexibility in designing and realizing a subsystem tailored to his or her specific applications and requirements.

The designer is limited only by his or her ingenuity and individual requirements in customizing an approach that addresses the need. Inherent in this functional approach is the capability to modify designs within each function to add channels, signal injection and monitoring ports, as well as to later expand the test subsystem to include additional functionality.

The modular approach taken by Weinschel allows added flexibility to mechanically configure functions in efficiently packaged rack-mounted or bench options, depending upon the customer's needs. Weinschel has a wealth of experience in providing test and measurement solutions ranging from a single, bench unit to full racks of integrated subsystems.

5.0 Certification

Each subsystem can have a CE certification.

6.0 Quality Assurance

Aeroflex / Weinschel will implement its standard quality assurance program for development, fabrication, assembly, alignment and test of the deliverable items. This program supports compliance with the inspection requirements of ISO 9001.

7.0 Warranty

Aeroflex / Weinschel supplies a one year warranty on all proprietary equipment. All units under warranty that need repair will be repaired at the Frederick Maryland facility.

8.0 Design Rights

Aeroflex / Weinschel will retain all proprietary rights to the all the subsystem listed in this document. Aeroflex / Weinschel will assign special model number to these items at the time of order.