Configuration Guide
For the Agilent TS-5500 Family of
Cellular Phone Functional Testers

Table of Contents

Introduction
Planning
    Test Plan
    Customization
    Maintenance, Installation, Support
Identify Requirements
    Equipment
    Installation, Training, Support, Maintenance
Configure the TS-5500
Complete TS-5500 Products and Options

Introduction

This document addresses configuring and ordering the TS-5500. This includes selecting options to create a specific test stand and the customization considerations necessary to complete the tester. Other literature describes the features, capabilities, and test software development environment for the TS-5500 Family. This Configuration Guide considers the complete system requirements to make a very good first pass configuration of the TS-5500. Since configuring the TS-5500 requires detailed knowledge of both the test system and the mobile phone, you must work closely with Agilent's system engineers to develop a final configuration.

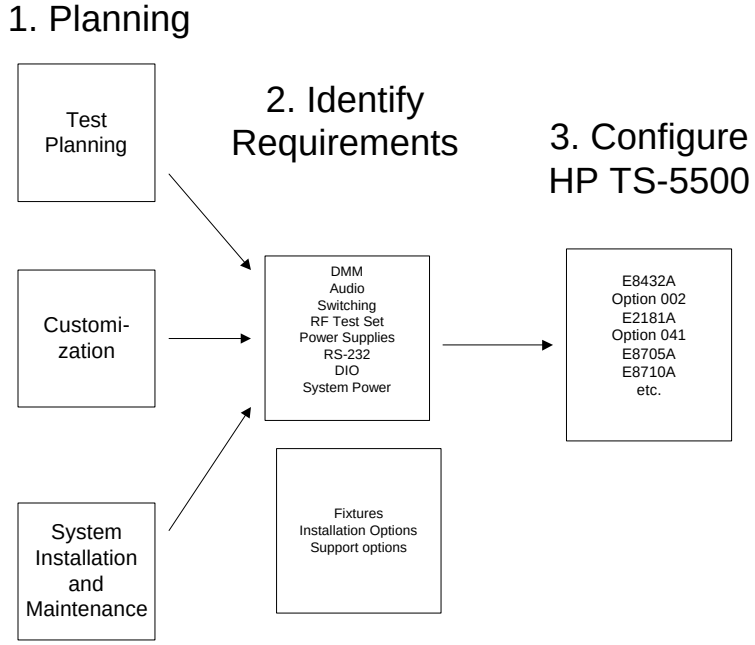
To configure the TS-5500 you should be planning at least these items:

1. Test Planning
You need to plan and identify the tests that need to be performed at the specific test stage and the requirements of the system to make these tests

2. Customization Activities
Since you build a complete system from the TS-5500 platform, customization planning becomes an important step in configuration. For example, you need to consider interfacing to fixtures and automation, completing the test plan, operator

interface and serial phone communication software before selecting the appropriate options.

3. Line/System Installation and Support
Any system that is installed into the manufacturing line needs planning for the installation and support. When you configure the TS-5500, you need to consider supplying ac mains power, system up-time support, application support and training.



After planning the test requirements, customization, installation and support, you should be able to list the requirements, resources and equipment needed. The final step in this process is to configure the TS-5500 using the Agilent models and option numbers.

1. Planning

Test Planning
The first step in configuring the TS-5500 is to identify the tests that are to be performed in the specific test stage. The TS-5500 includes or can be configured to handle the following general areas of testing. Most mobile phones have these areas or groups of tests performed at various manufacturing stages. This discussion is intended to help you configure the necessary TS-5500 options.

Turn-on Tests

When the mobile is in its loaded printed circuit board stage, many turn-on tests are generally performed. For example, you would configure a Digital Multimeter (DMM) and multiplexer for basic probing of power supplies, test points, or continuity. You may also download software to the phone requiring you to use the RS-232 interface plus custom software for communicating with the phone. More sophisticated testing could require flexible switching of stimulus/response instruments.

Equipment Needed	**Yes/No**
One DMM	
One Multiplexer per phone	
Additional Multiplexers	
Flexible Low Frequency Switching per phone	
One RS-232 per Phone	

Battery Emulation and Measurement

A very important test requirement is checking the mobile's circuitry for the appropriate draw on the battery. Battery life on the mobile is a critical end user feature and directly related to the voltage/current characteristics. The 66312/32 Dynamic DC Measurement Source is used for battery emulation and measuring current draw at various levels.

Equipment Needed	**Yes/No**
Agilent Dynamic DC Power Supply	

Battery Charging Circuitry

Besides testing the draw on the battery, the phone may have a battery charging circuitry for re-charging the battery. The TS-5550 system offers a combination of the 6612 for powering the circuit and 66312/66322 for sinking and measuring currents.

Equipment Needed	**Yes/No**
Dynamic DC Power Supply	
6612 Power Supply	

Phone Power Calibration

All mobiles must have the power transmitter and receiver adjusted and frequency calibrated. The RF Test Set is the critical instrument for this testing. A communication link, i.e. RS-232, to the internal circuitry of the phone is also required for making the adjustments. Sometimes a signal generator, RF

power meter, or spectrum analyzer are needed in calibrating the phone's transmitter and receiver.

Equipment Needed	Yes/No
One RF Test Set per phone	
One RS-232 per Phone	
Special RF Signal Generator	
Special Power Meter	
Special Spectrum Analyzer	

Radio Tests or Final Tests

The classic tests for GSM, CDMA, or TDMA communication verification are always made at some stage in the production line. Sometimes these tests are made with communication to the mobile and sometimes testing is done "over-the-air" or using the RF connection on the phone. In any case, these tests require the RF Test Sets.

Equipment Needed	Yes/No
One RF Test Set per phone	
One RS-232 per Phone	

Audio Tests

Many production lines have automated testing of the audio circuitry in the phone, e.g. microphone, speakers, and circuitry. You can use either the audio capability in the RF Test Set or a higher performance VXI DSP module in the TS-5550. For single tone or multi-tone stimulus/response testing, use VXI E1432 DSP with the supplied connections through the mass interconnect. The TS-5550 has the Audio Source Multiplexed to the BNC's on the ExpressConnect. The audio inputs are multiplexed to the DSP via the eight channel breakout box. Phone communication may be needed in this test, depending on the specific requirements.

Equipment Needed	Yes/No
Audio in RF Test Set	
One Audio VXI DSP Module	
One RS-232 per Phone	

Customization Activities

The following are typical tasks to complete the cell phone tester. Adding customization to the TS-5500 Platform creates a custom system that meets specific test requirements.

Create Test Plans and Actions
The TS-5500 includes generic test plans, tests, measurements, actions, and utilities to build a custom test plan for any of the testing required. To create test plans and custom actions written in C++, you will need the Developer Software and License. To run the tests on an TS-5500 the appropriate software is loaded on the VXI Embedded Controller and a run-time license is included.

Hardware/Software Needed	**Yes/No**
One PC for up to four sets of equipment	
One Developer Software, Manuals and License	
Developer Training	

Phone Communication
Communicating with the phone's internal circuitry is a proprietary technique. The TS-5500 supplies general hardware with the RS-232 interface. You can create a custom action for communicating with the phone using the Phone Communications Assistant. Or, you can create a custom action using the TS-5500 Developer's software which includes Microsoft Developer Studio.

Hardware/Software Needed	**Yes/No**
One RS-232 per phone	
One Developer Software, Manuals and License	

Interface to Factory Database
The TS-5500 stores parametric data for each test on each mobile in a file. Transfer of this data to a factory computer that runs SQC reports or supports factory-wide information requires some programming. Post processing of this test data in standard spreadsheet software is also possible.

Interface to Fixture and Factory Automation

If you are using the TS-50 Fixtures for Final Test and Board Test, your customization job is greatly simplified. The TS-50 Fixtures are complete kits, so you only need to add the custom

interface to the phone. Design and cabling to the TS-5500 is provided as an option.

Many factory automation devices use an RS-232 or Centronics Parallel interface. These devices can be controlled by the TS-5500 using the System RS-232/Parallel Ports. Many fixtures require digital I/O for sense and control. Other fixtures may require an RS-232 interface. A general purpose relay may be used to switch a device on/off. Fixtures and factory automation may use power from the system. This power is supplied with the utility power supplies.

For each system, a custom cable/interface from the Express Connect to the phone/fixture must be created. The mating connector parts are available to create this cable. Since RF cabling is not supplied with the TS-5500, the RF connections and cabling from the instruments to the phone should also be designed and created.

Equipment Needed	**Yes/No**
RS-232/Parallel control for each fixture	
Low power sense/control	
General Purpose Switching	
Barcode Reader	
Strip Printer	
Utility Power	
Express Connect Mating Connectors to cable to fixture	
Fixture Kit(s)	

RF Path Characterization
Agilent has created specific software routines to help characterize the RF path in the system and store the appropriate offsets in a table that is used to automatically compensate the measurements. The Signal Generator and Power Meter are used to create a semi-automatic characterization procedure. Agilent provides examples so you can create a test plan for characterization and use an operator interface panel.

Other RF Measurements
Testing a specific phone design may require out-of-band spurious measurements or low level measurements with a spectrum analyzer. In addition, an antenna test would require a spectrum analyzer, either built into the RF Test Set or standalone.

Hardware/Software Needed	Yes/No
TS-5500 Developer Software	
TS-5500 RF ExpressConnect Hardware	
Custom RF Path Hardware	
Power Meter	
Signal Generator	
Spectrum Analyzer	

Operator Interface

Agilent supplies a sample operator interface that manages a four-up system, including operator log-ins, starting test plans and fixtures. A custom operator interface should be developed using the Visual Basic software provided in the TS-5500 Developer Software package. The TS-5500 system does not include display, mouse or keyboard, so an appropriate SVGA display, PC mouse and local language keyboard must be ordered separately. Special Touch screen displays or large displays may be needed.

Hardware/Software Needed	Yes/No
TS-5500 Developer Software	
Local Language Keyboard	
PC Mouse	
SVGA Display	
Visual Basic Training	
Special PC Monitor	

Database Interface

The TS-5500 logs all parametric and pass/fail information stamped with date, time and serial number to a file. Factory databases or SQC software will need to access this data. Typically a custom program is created to upload the data to a central computer from each test system. While the test data is in standard formats, many times it is formatted to fit with the factory computer systems.

System Maintenance and Installation Considerations

Installation

The TS-5500 System must be connected to a dedicated circuit in the factory. This main factory circuit is connected to the Power Distribution Unit (PDU). The PDU can be configured for numerous power situations. Typically, this work is done by an electrician. Other installation considerations include

physical layout of the equipment rack and connecting to the fixtures and assembly line or automated equipment. Refer to the manual Chapter 2 System Installation for more details on site preparation and system power.

Support Planning
Since most factories want maximum uptime for these systems, a cooperative support plan should be developed. The manufacturing site should have people trained to verify and diagnose system failures using the TS-5500 verification fixture and test plan. The manufacturing site should have a spare parts inventory. Agilent will provide back-up support with phone assistance and next day on-site support.

Support Needed	**Yes/No**
System Installation	
Verification Fixture, Verification Test Plan and Diagnostics	
Spare Parts Kit	
Maintenance Training	

2. Identify Requirements

At this point in the configuration process, a list of the requirements and resources needed to configure the system has been developed. Here is an example list of potential resources needed:

- ❑ DMM
- ❑ Multiplexer
- ❑ RS-232 per phone
- ❑ Battery Emulation power
- ❑ Battery Charger Power
- ❑ RF Test Set per phone
- ❑
- ❑ Audio
- ❑ Developer Software and License
- ❑ Manuals
- ❑ DIO for fixture control
- ❑ RS-232 for fixture control
- ❑ Utility power for fixtures
- ❑ General purpose switching
- ❑ Utility power for GP switching
- ❑ Matrix switching
- ❑ Mating connectors for mass interconnect
- ❑ RF connections
- ❑ Other RF instruments for path characterization
- ❑ Operator Interface panel/software
- ❑ Custom software routine
- ❑ Bar Code reader via RS-232
- ❑ Strip Printer via RS-232
- ❑ PC Monitor, Keyboard, Mouse
- ❑ Test Developer Training
- ❑ Site Preparation
- ❑ System Installation
- ❑ Power to system
- ❑ Spare parts
- ❑ Diagnostic/Verification Tools
- ❑ Maintenance Training
- ❑ Technical Support

3. Configure TS-5500

TS-5500 System Design Overview

It is important to have an understanding of the system design to make the proper choices for configuration. The TS-5500 Product Notes cover the features of each of the hardware and software pieces in the system. This configuration discussion builds on that knowledge and introduces more internal design concepts, including types of resources and interconnection diagrams.

TS-5500 Family of Systems

There are two members of the TS-5500 family: TS-5530 and TS-5550. The following table offers a quick comparison of features and capabilities:

You should select one of the systems as the basis of your configuration. The following table is a comparison based on application requirements:

	TS-5530	TS-5550
DIO	96 channels max	Only limited by VXI modules
RS-232	Two per phone; four system RS-232	Only limited by VXI modules
Number of Phones	One or two per system	Two to four per system
Charging Circuitry	No	Yes
DMM	No	Yes
Other VXI Instruments	No	Yes
Audio Tests	Use RF Test Set	VXI DSP Option

For comparison purposes the following items are identical for each of the two family members:

Test Executive Software
Software Test Plans, Actions, Measurements and Utilities
Rack sizes, power distribution
Integration and Cabling
PC, Mouse, Keyboard and Monitor
RF Test Sets (GSM,CDMA, TDMA, PCS)
Manual Fixture Solution

TS-5500 Resources
The TS-5500 has "shared", "system", and "per UUT" resources that must be understood to configure a system.

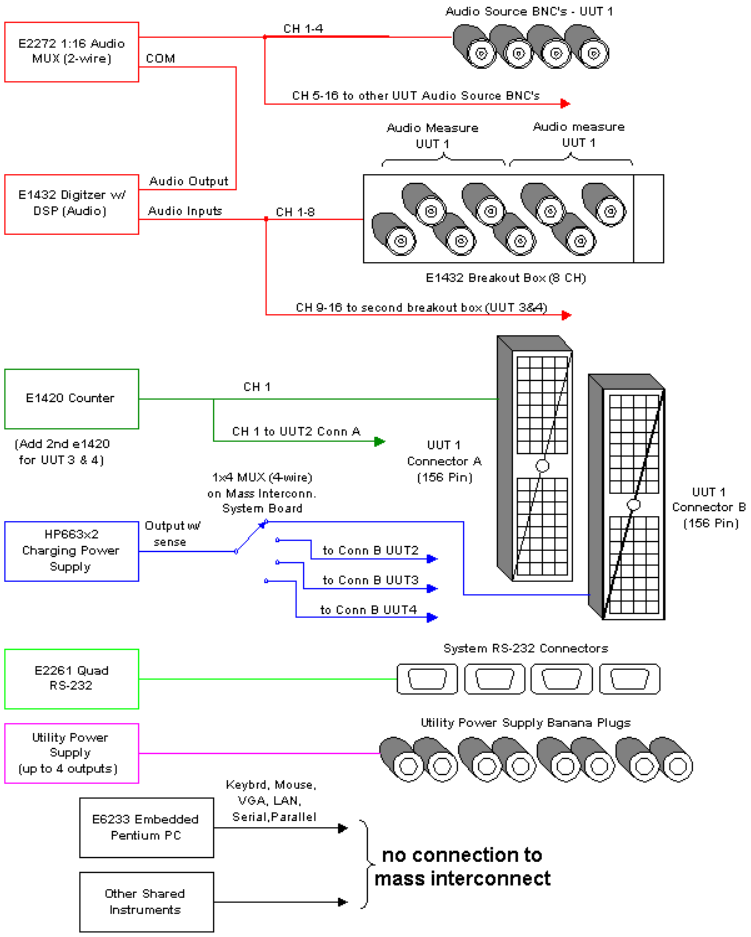
Shared Resources

One Audio DSP is shared for the multiple UUT's because the test time is generally very short. The charging power supply (6612), Counter and DMM are shared resources.

System Resources

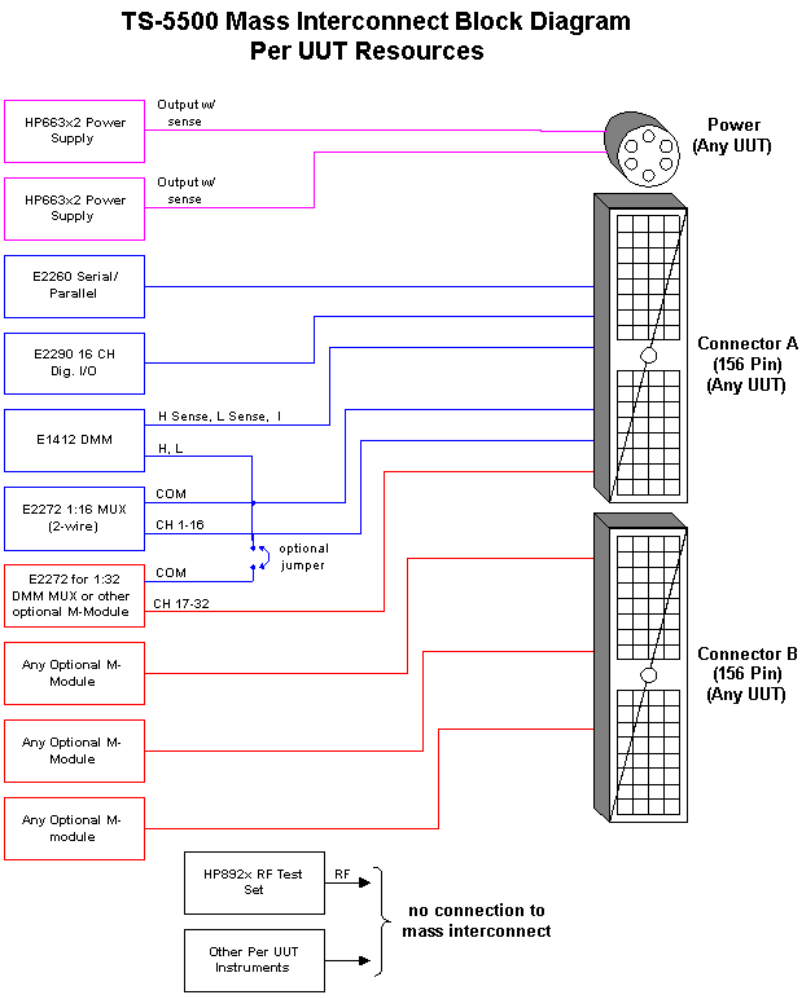
There are RS-232 ports and utility power supplies that are common for each system. These RS-232 ports are used for driving factory automation, handlers, and other operator devices, e.g. barcode readers, strip printers, or button boxes.

TS-5500 Mass Interconnect Block Diagram
Shared Resources



"Per UUT" Resources

Since the RF Test Set (892x) does the bulk of the measurements on the phone, one is required per phone/UUT. The VXI M-modules used in switching, phone communication and I/O are configured per UUT. The phone battery is emulated by the 66300 Series Dynamic DC Source and Measurement. The DIO lines are typically used to drive and sense in each UUT fixture.



Typical Steps for Configuring a TS-5500

To configure a TS-5500 system involves selecting products and options from a menu. You need to select a base system, appropriate family options and support options.

1. Selecting a Base System

There are a few key decisions that allow you to select a base system. You must decide:
1. Number of phones per system and
2. Flexible and/or expandable measurement requirements

a) Number of Phones per System
It is always most economical to maximize the number of phones per system tested. With the multiple-up concept, capital and integration costs are reduced. Also, operator

interfaces are minimized, e.g. strip printers, monitor, barcode readers.

Some of the considerations in maximizing the number of phones tested per system relate to the philosophy of testing, optimizing test times, and integration into the manufacturing floor.

Testing using a multiple-up philosophy is a relatively new concept and may be perceived as risky. For example, if the test system fails, multiple stations will be down. Since the highest failure rate items in a test system are the "per UUT" resources, such as the RF Test Set, there is an insignificant failure rate difference between the multiple-up strategy and a one-up philosophy. The multiple-up TS-5500 will simply run only test plans for the working RF Test Sets.

With the shared resource concept in the TS-5500, sometimes the system computer will need to arbitrate the usage of the shared resources, e.g. audio test module or DMM. Also with a four-up system, the overhead on the system computer running four concurrent sets of equipment may be a 5 to 7% burden. So, if maximizing test time is the over-riding factor above the savings on integration and capital costs, then reduce the number of UUT's tested per system.

When integrating the TS-5500 into the manufacturing line, consider physical layouts, regulatory requirements, and fixturing issues. For example, in some factories 2m height racks may not be allowed. Sometimes, operators must move a significant distance between fixtures, so a common monitor, barcode reader, and printer becomes less effective. If the fixtures are large and spaced apart, the test operator may need to move large distances between loading/unloading four fixtures and handling the shared barcode reader.

Number of Phones Tested Per System	**TS-5500 Base Model Number**
One	E8431A
Two	E8432A or E8452A
Three	E8453A
Four	E8454A

2. Flexible and/or Expandable Measurement Requirements

If you want a two-up system, then you must decide between the TS-5530 and TS-5550 configurations. The TS-5550 is the most flexible and expandable. The TS-5530 provides just enough test capability for a lower cost.
Examples of flexibility included in the TS-5550 are
a. DMM and/or Switching

One DMM is included in the base TS-5550 systems for shared measurements. A multiplexer is connected to the DMM for each UUT. The DMM is also required for using the system verification and diagnostics fixture. If the test plan requires a significant amount of DMM probing, consider an additional DMM per UUT to decrease test time. By adding a DMM per UUT, it will no longer be a shared resource.

b. Audio Test Module

Both family members can use the RF test set capability to verify audio with a single tone source and measurement. The TS-5550 has an Audio Test Module based on the VXI DSP card. It is a shared resource for all UUT's in the test system. Each option provides for multiple inputs and outputs for each phone tested per system. A single audio source is switched to the different UUT points using a built-in mux. Audio measurements are also multiplexed via special signal conditioning to the VXI DSP card.

c. Optional M-modules per phone

More M-modules for switching, sensing or controlling can be added to the system. For example, driving an automated fixture will require more than the standard number of DIO lines. Each UUT should have the same additional M-modules.

d. Checking Battery Charging Circuitry

If you are testing the phone's battery charging circuitry, the 6612 can be added in the TS-5550 systems.

2. Select Common TS-5500 Family Configurations

a. RF Test Sets and RF path
One RF test set is required for each phone tested in the system. An RF path is available from Agilent as an option or as custom

work. The RF path characterization software is provided with the TS-5500.

b. Rack Size

The TS-5500 offers racks in two heights: 1.6m and 2.0m. You should add up the total amount of rack space needed for the spacific configuration before choosing a rack size. Any four-up system requires the 2.0m rack. PCS or GSM-dual-band the RF Test Sets require more rack space, so you will need to trade off the number of phones tested per system versus rack height. For example, with PCS or GSM-dual-band RF test sets, a 1.6m rack is limited to a 2-up configuration.

c. PDU Power (200-400V)

The TS-5500 requries a dedicated ac mains power circuit. This power circuit should be installed by a certified electrician.
The options and configuration matrix from the manual
Cabling done by electrician.

d. Utility Power Configuration

Also, you need to configure the utility power supply for connecting to fixture, automation equipment or other circuitry.

e. Operator Options
A 17 inch monitor should be chosen via option. Touch screens can be added as a special option.

The Keyboard, mouse and Monitor connections to the TS-5500 are via the ExpressConnect. Depending on the position of the keyboard, mouse and monitor, extension cables may be needed.

The four RS-232 ports on the TS-5500 ExpressConnect have 9 pin connectors typical to those on a PC. These 9 pin connectors are connected to the system printer using typical 9 pin to 25 pin printer cables.

Be sure to consider the space the keyboard, mouse, monitor, and/or printer will take. A small work surface may be added into the rack as an option. Preferably, most manufacturing environments have specific requirements and desires for the operator's working area.

3. Select TS-5500 Support Configurations

Support options, training, developer license

Developer License E2174A
Included in the base system is license to runs software.
Included in Developer License is VB, C++, to develop custom actions and operator/user interface.
The Developer License E2174A includes manuals?

Standard Configurations; Rack drawings

4. Complete TS-5500 Products and Options

To completely configure a TS-5500 system, you need to select:

- Base System
- Family System Options
- System Support Options and Accessories

TS-5500 Base Systems

One-up TS-5530 Base System

Product Number	Description
E8431A	TS-5531 Base System tests one mobile phone and includes:
	Vectra with hard disk, CD-ROM, 3 1/2 floppy, LAN Card, and Windows NT 4.0; HP-IB interface
	Built-in RS-232 channels: 2 for phone communications and 4 for system I/O (such as bar code readers)
	28 TTL DIO channels and 4 open-collector DIO channels
	One Phone power supply (66311B)
	Utility Power Supplies (configured with E2181A)
	TS-5530 Series ExpressConnect
	Test executive and instrument drivers software
	Systems Integration of all options and standard instruments, including choice of rack and all racking hardware
	Power Distribution Unit to power instruments and fans (power cord and connector to ac mains not included)

E8431A Option 030	1.6 meter rack
E8431A Option 031	2.0 meter rack
E8431A Option 250	ExpressConnect RF Interface for Signal Generator

Two-up TS-5530 Base System

Product Number	**Description**
E8432A	TS-5532 Base System tests two mobile phones and includes:
	Vectra with hard disk, CD-ROM, 3 1/2 floppy, LAN Card, and Windows NT 4.0; HP-IB interface
	Built-in RS-232 channels: 4 for phone communications (2 per phone) and 4 for system I/O (such as bar code readers)
	28 TTL DIO channels and 4 open-collector DIO channels per phone
	Two Phone power supply (66311B)
	Utility Power Supplies (configured with E2181A)
	TS-5530 Series ExpressConnect
	Test executive and instrument drivers software
	Systems Integration of all options and standard instruments, including choice of rack and all racking hardware
	Power Distribution Unit to power instruments and fans (power cord and connector to ac mains not included)
E8432A Option 030	1.6 meter rack
E8432A Option 031	2.0 meter rack
E8432A Option 250	ExpressConnect RF Interface for Signal Generator

Two-up TS-5550 Base System

Product Number	**Description**
E8452A	TS-5552 Base System tests two mobile phones and includes:
	Vectra with hard disk, CD-ROM, 3 1/2 floppy, LAN Card, and Windows NT 4.0; HP-IB and P1394 (Firewire) interfaces
	C-size VXI Cardcage
	System Resources: Two RS-232Centronics and two 16 Channel DIO One shared DMM with Multiplexer per phone
	Quad RS-232 M-module per phone

	Two Phone power supply (66311B)
	Utility Power Supplies (configured with E2181A)
	TS-5550 Series ExpressConnect for two UUT's
	Test executive and instrument drivers software
	Systems Integration of all options and standard instruments, including choice of rack and all racking hardware
	Power Distribution Unit to power instruments and fans (power cord and connector to ac mains not included)
E8452A Option 030	1.6 meter rack
E8452A Option 031	2.0 meter rack
E8452A Option 210	RS-232/Centronics M-module (Includes one RS-232/Centronics M-module and ExpressConnect Cable)
E8452A Option 211	Quad RS-232 M-module (Includes one quad RS-232 M-module and ExpressConnect Cable)
E8452A Option 215	16 Channel GP Relay M-module (Includes one 16 Channel GP Relay M-module and ExpressConnect Cable)
E8452A Option 216	4 x 4 Matrix M-module (Includes one Matrix M-module and ExpressConnect Cable)
E8452A Option 217	Dual 8-to-1 Mux M-module (Includes one Multiplexer M-module and ExpressConnect Cable)
E8452A Option 218	16 Bit I/O M-module (Includes one 16 Bit Digital I/O M-module and ExpressConnect Cable)
E8452A Option 250	ExpressConnect RF Interface for Signal Generator
E8452A Option 410	DSP Audio Test Module
E8452A Option 415	Additional DMM per phone
E8452A Option 416	Add 16 DMM Input Channels per phone
E8452A Option 420	Two channel Frequency Counter (shared resource)
E8452A Option 480	0 - 20 V DC Charging Supply (Includes one 6612 Power Supply, cabling and integration)
E8452A Option 760	TS-5550 Verification Fixture

Three-up TS-5550 Base System

Product Number	**Description**
E8453A	TS-5553 Base System tests three mobile phones and includes:

	Vectra with hard disk, CD-ROM, 3 1/2 floppy, LAN Card, and Windows NT 4.0; HP-IB and P1394 (Firewire) interfaces
	C-size VXI Cardcage
	System Resources: Three RS-232Centronics and three 16 Channel DIO One shared DMM with Multiplexer per phone
	Quad RS-232 M-module per phone
	Three Phone power supply (66311B)
	Utility Power Supplies (configured with E2181A)
	TS-5550 Series ExpressConnect for three UUT's
	Test executive and instrument drivers software
	Systems Integration of all options and standard instruments, including choice of rack and all racking hardware
	Power Distribution Unit to power instruments and fans (power cord and connector to ac mains not included)
E8453A Option 030	1.6 meter rack
E8453A Option 031	2.0 meter rack
E8453A Option 210	RS-232/Centronics M-module (Includes one RS-232/Centronics M-module and ExpressConnect Cable)
E8453A Option 211	Quad RS-232 M-module (Includes one quad RS-232 M-module and ExpressConnect Cable)
E8453A Option 215	16 Channel GP Relay M-module (Includes one 16 Channel GP Relay M-module and ExpressConnect Cable)
E8453A Option 216	4 x 4 Matrix M-module (Includes one Matrix M-module and ExpressConnect Cable)
E8453A Option 217	Dual 8-to-1 Mux M-module (Includes one Multiplexer M-module and ExpressConnect Cable)
E8453A Option 218	16 Bit I/O M-module (Includes one 16 Bit Digital I/O M-module and ExpressConnect Cable)
E8453A Option 250	ExpressConnect RF Interface for Signal Generator
E8453A Option 410	DSP Audio Test Module
E8453A Option 415	Additional DMM per phone
E8453A Option 416	Add 16 DMM Input Channels per phone
E8453A Option 420	Two channel Frequency Counter (shared resource)
E8453A Option 480	0 - 20 V DC Charging Supply (Includes one 6612 Power Supply, cabling and integration)

E8453A Option 760	TS-5550 Verification Fixture

Four-up TS-5550 Base System

Product Number	Description
E8454A	TS-5554 Base System tests four mobile phones and includes:
	Vectra with hard disk, CD-ROM, 3 1/2 floppy, LAN Card, and Windows NT 4.0; HP-IB and P1394 (Firewire) interfaces
	C-size VXI Cardcage
	System Resources: Four RS-232Centronics and four 16 Channel DIO One shared DMM with Multiplexer per phone
	Quad RS-232 M-module per phone
	Four Phone power supply (66311B)
	Utility Power Supplies (configured with E2181A)
	TS-5550 Series ExpressConnect for four UUT's
	Test executive and instrument drivers software
	Systems Integration of all options and standard instruments, including choice of rack and all racking hardware
	Power Distribution Unit to power instruments and fans (power cord and connector to ac mains not included)
E8454A Option 030	1.6 meter rack
E8454A Option 031	2.0 meter rack
E8454A Option 210	RS-232/Centronics M-module (Includes one RS-232/Centronics M-module and ExpressConnect Cable)
E8454A Option 211	Quad RS-232 M-module (Includes one quad RS-232 M-module and ExpressConnect Cable)
E8454A Option 215	16 Channel GP Relay M-module (Includes one 16 Channel GP Relay M-module and ExpressConnect Cable)
E8454A Option 216	4 x 4 Matrix M-module (Includes one Matrix M-module and ExpressConnect Cable)
E8454A Option 217	Dual 8-to-1 Mux M-module (Includes one Multiplexer M-module and ExpressConnect Cable)
E8454A Option 218	16 Bit I/O M-module (Includes one 16 Bit Digital I/O M-module and ExpressConnect Cable)
E8454A Option 250	ExpressConnect RF Interface for Signal Generator

E8454A Option 410	DSP Audio Test Module
E8454A Option 415	Additional DMM per phone
E8454A Option 416	Add 16 DMM Input Channels per phone
E8454A Option 420	Two channel Frequency Counter (shared resource)
E8454A Option 480	0 - 20 V DC Charging Supply (Includes one 6612 Power Supply, cabling and integration)
E8454A Option 760	TS-5550 Verification Fixture

The base systems are a core set of equipment for testing one to four phones.
They include the serial interfaces, digital I/O, phone and utility power, power distribution, racking, cabling, and PC.

The TS-5550 Base Systems includes the fundamental VXI modules for serial interface with two phones and a modest amount of sensing and control. The Dual RS-232/Centronics module and 16 bit Digital I/O are intended to control each fixture and phone. One Quad RS-232 is also included for control of barcode readers and other system peripheral devices. Considering the potential need for additional I/O for each phone or fixture control, extra VXI M-module carriers are included in the base system. A utility power supply is included, but it must be configured with a "no charge" Family Option. The system power must be configured with the Family Options 05A - 0EJ.

Each of the base systems has one phone power supply and two RS-232's per phone tested. One Phone Power Supply is required for each phone tested in the system, so it is included in the base system. In a multiple-up system, we rack mount two 66311B's beside each other to save rack space.

The software in the base system is a run-time version of the TS-5500, so it executes from the operator interface, but you can not develop test plans or actions. Order the E2174B to get test development software.
You must have one development License per engineer. See E2181A opt. 370.

Because the TS-5500 is intended for use in manufacturing, manuals are not included with the base system.

Rack Choices

Each Base System must have a rack option specified as Option 030 or 031.
The rack choice depends on a number of factors, primarily on the amount of equipment needed. However, a four-up configuration will only fit in a 2m rack. A four-up TDMA/IS-136 will not fit in a 2 m rack; we recommend only using a two-up or possibly a three-up configuration.

Additional Inputs/Outputs in TS-5550
For more inputs/outputs than the standard TS-5550, the following options can be used. Ordering these options allows us to configure and cable the VXI M-module to each UUT connector. The Base system has 4 M-module carriers that can hold 5 modules each for a maximum of 20 total M-modules. For more than 20 M-modules, add another M-module carrier with Option 205.
The additional VXI DMM, counter, and audio module take up slots in the VXI Mainframe. The standard TS-5500 has 6 slots taken by the Firewire interface, DMM, and M-module carriers, leaving 6 slots for other instruments or M-module carriers.

(Drawing of VXI CC with slots taken by Slot 0, DMM, and Carriers)

The Charging Power Supply option is only for use in TS-5550 Series (E845xA). Only one Option 480 is required for up to four phones because it is a shared resource.

Each Base System must also use E2181A for TS-5500 Family System Options to specify more system requirements. The base system, E2181A options, and E87xx RF Test Sets must be on the same order to get a completely integrated system.

Mating connectors for the ExpressConnect should be ordered as E6244A.

TS-5500 Family Options

Utility Power Supply Configurations
(Must order one utility power supply option)

Product Number	**Option Number**	**Description**
E2181A	Option 041	Utility Power Supply Configuration: 5V, +12V, -12V, 24V
E2181A	Option 042	Utility Power Supply

		Configuration: 3.3V, 5V, 12V, 24V

Utility power is used for various purposes. For example, a pre-amplifier used for audio testing would require + 12V and -12 V. The +5V would be used for pull-ups. The 24V is typically used for actuators and switches, e.g. RF switches. If you don't have a preference for utility power, then order Option 041, because it provides the best flexibility of voltages.

PC Monitors

E2181A	Option 051	17 Inch Color Monitor for PC (Price is included in Base Systems, but must order option)
E2181A	Option 050	Work Surface (not installed)

A 17 inch monitor is included in the base system. The monitor is not mounted in the rack, so plan a space on a work area for the monitor, mouse and keyboard. Consult the factory for special options on other monitors.
The Option 050 Work Surface is not installed in the rack because it will protrude from the system rack and would most likely be damaged in shipment. As space will be left in the rack for easy installation of the work surface.

Peripherals

Product Number	**Option Number**	**Description**
E2181A		Factory peripherals
	Option 070	Fixed Position Barcode Scanner Kit
	Option 071	RS-232 Handheld Barcode Scanner Kit
	Option 080	RS-232 Strip Printer

These factory peripherals are not installed in the rack, so you can easily integrate them into the TS-5500 and position them near the operator.

Optional RF Equipment

E2181A Option 450	Signal Generator integrated into TS-5500 (For use with ExpressConnect RF Interface; E4420B with Option 1E5)

Other RF equipment is supplied as a special option; consult the factory.

TS-5500 Software Formats
Must choose one software format to be installed on PC.

Product Number	Option Number	Description
E2181A	Option 305	Analog Support
	Option 310	GSM/8922 Radio Format
	Option 311	GSM/8960 Radio Format
	Option 315	TDMA Radio Format
	Option 320	CDMA Radio Format (For either 8924C or E8285A)
	Option 370	TS-5500 Test Development Software Installed on PC

These options allow for a run time license on the test systems.
The Option 370 allows the test development and test execution on the same system.

Mobile Phone Test Sets
The TS-5500 system must include RF Test Sets or the options 050/051 below. There must be one RF Test Set per phone.

1. GSM, GSM/DCS/PCS Choices

Product Number	Option Number	Description
E8709A		Integrates 8960 GSM Test Set into TS-5500 (Includes E5515A and E1960A)
	Option 050	Customer-supplied 8960
	Option 051	Customer-installed 8960
E8710A		Integrates 8922M GSM Test Set into TS-5500 (Includes 8922M and Option 006)
	Option 001	High Stability Timebase for 8922M
	Option 050	Customer-supplied 8922M
	Option 051	Customer-installed 8922M
E8711A		8922P GSM/PCS Multi-band Test Set (Includes 8922P and Option 006)
	Option 001	High Stability Timebase for 8922P
	Option 050	Customer-supplied 8922P with PCS
	Option 051	Customer-installed 8922P with PCS

2. CDMA, CDMA/PCS

Product Number	Option Number	Description
E8712A		Integrates 8924C CDMA Test Set into TS-5500
	Option 050	Customer-supplied 8924C
	Option 051	Customer-installed 8924C with PCS
E8713A		Integrates 8924C CDMA Test Set with PCS into TS-5500
	Option 050	Customer Supplied 8924C with PCS
	Option 051	Customer-installed 8924C with PCS
E8713B		Integrates E8285A CDMA/PCS Test Set into TS-5500
	Option 050	Customer Supplied E8285A
	Option 051	Customer-installed E8285A

3. TDMA, IS-136, Analog

Product Number	Option Number	Description
E8714A		Integrates 8920B TDMA Test Set into TS-5500 (Includes 8920B with Options 800, 0B0, 004, 006, 013, 014, 031, 051, 102, and appropriate rack mounting)
	Option 001	High Stability Timebase
	Option 050	Customer-supplied 8920B/800
	Option 051	Customer-installed 8920B/800
E8715A		Integrates 8920B TDMA/PCS Test Set into TS-5500 (Includes 8920B with Options 801, 0B0, 004, 006, 013, 014, 031, 051, 102, and appropriate rack mounting)
	Option 001	High Stability Timebase
	Option 050	Customer Supplied 8920B/801
	Option 051	Customer-installed 8920B/801
E8716A		Integrates 8920B (Analog only) into TS-5500 (Includes 8920B with Options 0B0, 004, 006, 013, 014, 031, 102, and appropriate rack mounting)
	Option 001	High Stability Timebase
	Option 050	Customer Supplied 8920B
	Option 051	Customer-installed 8920B

If the E87xxA model numbers are on the same order with the TS-5500 base system, we will install the RF Test Sets into the rack and cable them as appropriate.
If the customer already owns the RF Test Sets and wants to install them in the TS-5500, the use Option 050. Coordination and communication of shipping information is necessary; contact Agilent for special instructions and conditions. Agilent will also check the RF Test Sets for the appropriate firmware revision and download new firmware if necessary. A re-calibration of the cal constants will also be included with new firmware.

Option 051 is used when the customer already has the appropriate 89xx RF Test Set. In this case the factory will leave a space for each test set. Agilent will install the rails and HP-IB and power cables for easy rack mounting by the customer.

System Power
All TS-5500 configurations require more than 20A at 120V nominal, so a Power Distribution Unit (PDU) is used to supply power to the instruments, fans, and power supplies. The PDU must be connected to >200 V, so the amperes required is lower, thereby reducing the size (AWG) of power cord required. The system power options configure the Power Distribution Unit (PDU) to accept a certain ac mains power. The instruments and fans are powered by 200-240V from the PDU.

The TS-5500 System does not include a power cable because of the variety of methods to connect the PDU to the ac mains. This power cable should be added by a qualified electrician.

System Power Options (Must order one power option)

Option Number	**Description**
Option 05B	220V Two Phase, Open Delta; P Junc Earth; 3-wire
Option 05C	220V Three Phase or Wye; 3-wire
Option 05E	220V Three Phase Wye with Neutral; 4-wire
Option 05F	230V Single-Phase Earthed; 2-wire
Option 05G	230V Two Phase, Open Delta; P Junc Earth; 3 -wire
Option 05H	230V Three Phase Delta or Wye; 3-wire
Option 05J	240V Single-Phase Earthed; 2-wire
Option 05K	240V Two Phase Open Delta; P Junc Earth; 3-

	wire
Option 05L	400V Three Phase Wye with Neutral; 4-wire
Option 05M	220V Single-Phase Earthed; 2-wire
Option 05V	200V Single-Phase Earthed; 2-wire
Option 0E3	200V (200V to 240V) Power
Option 0E5	380V Three Phase Power
Option 0E6	240V Three Phase Delta or Wye; 3-wire
Option 0E7	415V Three Phase Wye with Neutral; 4-wire
Option 0EB	220V Single-Phase Non-Earthed; 2-wire
Option 0EC	240V Single-Phase Non-Earthed; 2-wire
Option 0EF	208V Three Phase Wye with Neutral; 4-wire
Option 0EG	220V Single Phase CT; 3-wire
Option 0EH	240V Single Phase CT; 3-wire
Option 0EJ	230V Single Phase Non-Earthed; 2-wire

These power options apply to all base system models: E8431A, E8432A, E8452A, E8453A, and E8454A. This PDU and its configuration are the same as the 3070 Board Test System PDU.

System Current Requirements

System Configuration	**Current Required at 220V Nominal**	
E8452A (2-up)	21A	
E8453A (3-up)		
E8454A (4-up)		
E8431A(1-up)		
E8432A (2-up)		

Each TS-5500 system must have power provided to the PDU from the ac mains at the installation site. The TS-5500 requires a dedicated circuit to be installed by a certified electrician.
Option W41 provides assistance in installing the system.
Option W41 includes:

- System unpacking and removal of packing material from customer site
- Attachment of monitor, keyboard, mouse and LAN cable to embedded PC
- Power cord connection to system's PDU
- Work surface installation (if Option 050 is ordered)
- Confirmation of hardware and software installation
- System verification using the TS-5500 Diagnostic fixture

The RF path characterization to the phone is not included with system installation. RF path characterization should be included with test development activities.

Power Option Recommendations

An electrician may not be available to advise you in selecting the appropriate power option, so we recommend the following TS-5500 power options based on our knowledge of local ac mains available. To change the power option/configuration for connecting to ac mains involves re-wiring the PDU locally. Refer to the 1135 Power Distribution Unit User's Manual.

Country/Region	**TS-5500 Option**
USA,Canada	Option 0EF
Europe/Australia	Options 05M, 05F, 05J
PRC	
Japan	Option
Korea	
Taiwan	
Hong Kong	Option 05V

TS-5500 Support Options and Accessories

Test Development Software

Product Number	**Option Number**	**Description**
E2174B		TS-5500 Action Development Software and License (includes license, software, Visual basic, and Visual C++. Required for custom action or operator interface development)

Each test developer must purchase this software and license. A site license is not available. The TS-5500 software is shipped on CD. So, the E2174B allows test developers to install this software on their development computer and system.

Manuals

E2182A	Option 700	Adds VXI and instrument manuals
	Option 705	Adds TS-5500 Programming Manuals

In production/manufacturing systems, one manual set is usually sufficient for multiple systems on the line. E2182A Option 700 adds the manuals, including all instruments and VXI manuals to the system. E2182A Option 705 adds the TS-5500 manuals. Otherwise, TS-5500 manuals, VXI Card and M-module manuals are not included; other Instrument manuals (89xx, 66312) are also not included. Usually the customer's production/test engineering department has one master set of manuals, or one set is ordered for each test system developer.

TS-5500 Manuals	**GSM**	**CDMA**
TS-5500 ExpressConnect Wiring Guide	E2170-90006	
TS-5500 Hardware Reference Manual	E2170-90007	
TS-5500 System Programming Guide	E2170-90000	E2189-90000

To obtain these manuals, VXI manuals, or other instrument manuals as a separate item, contact the Distribution Center.

Training

Product Number	**Option Number**	**Description**
E2182A	Option 710	User Training Course (in Loveland CO USA, price is per student, includes materials and 3 days training)
E2182A	Option 720	Maintenance Training Course (in Loveland CO USA, price is per student, includes materials and 5 days training)

Mating Connectors

The TS-5500 family of systems must be connected to the phone or fixture.

The TS-5530 uses commonly available connectors for the UUT connections. The mating power supply connectors can be ordered from Agilent.

E6244A	Option 005	TS-5550 Fixture Connectors (Includes two mating Cannon connectors for each phone.)
	Option 013	Crimp Tool for Canon connector contacts
	Option 014	Extractor Tool for Canon connector

	Option 015	Crimp Tool for AMP Power Connectors
	Option 016	Extractor Tool for AMP Power Connectors

The TS-5550 is mechanically connected to the phone or fixture with the E6244A. One E6244A must be ordered at no charge, then add one Option 005 to receive the parts to build a mating connector for each phone/fixture. One crimp tool and extractor tool is required to build the mating Cannon connectors. For the Amp power connectors the crimp tool is optional because both solder and crimp contacts are included.

Fixtures

Manual Fixture Kits that easily adapt to the TS-5500 family are available from Agilent.

E8705A		TS-50 RF Final Fixture Kit (Includes shielded enclosure, adaptable phone nest, PCB for shielding and level shifting)
	Option 101	Audio Test Adapter Kit (Includes speaker and microphone pick-ups, mounting hardware)
	Option 005	Five Pack
	Option 010	Ten Pack
	Option 105	Five Pack of Audio Kits
	Option 110	Ten Pack of Audio Kits
	Option 700	TS-50 Assembly Manual
E8706A		TS-50 RF Board Test Fixture Kits (Includes shielded enclosure, board compression, PCB for shielding and level shifting)
	Option 005	Five Pack
	Option 010	Ten Pack
	Option 201	Standard Board Test Adapter Kit (Includes 3 boards for pins, compress boards, pin shields)
	Option 205	Five Pack of Board Test Adapter Kit
	Option 210	Ten Pack of Board Test Adapter Kit
	Option 700	TS-50 Assembly Manual

Warranty

Agilent's standard system warranty is one year, next-day on-site, except for the RF Test Sets. If the RF Test Sets fail, they must be returned to an appropriate Agilent service center that

can repair and calibrate these units. All other TS-5500 parts may be replace on-site as a pre-calibrated replaceable unit.

Installation Option

Product Number	Option Number	Description
E2182A	W41	One year on-site warranty with Agilent Installation

Spares Kit

1. Order Options 301, 302, 303, and 304. These contain all of the common modules, common M-modules, and common cables in the system.
2. Select options 310 - 326 as appropriate for the system configurations that are being supported
3. Options 350 - 390 are included in the bundled options 301-304. Options 350-390 should be used to replace items in the original spares kit or to order extra replacement parts.

Product Number	Option Number	Description
E6192A		Spare Parts Kit
	Option 301	TS-5550 Common Modules, Part 1
	Option 302	TS-5550 Common Modules, Part 2
	Option 303	TS-5550 Common M-modules
	Option 304	TS-5550 Common Cables
	Option 310	Spare E2176A Universal Counter
	Option 311	Spare E2177A/Option 001 Audio Module
	Option 312	Spare E2177A/Option 002 Audio Module
	Option 313	Spare E2177A/Option 003 and 004 Audio Module
	Option 314	Spare E8710 GSM Test Set
	Option 315	Spare E8711 GSM/PCS Test Set
	Option 316	Spare E8712 CDMA Test Set
	Option 317	Spare E8712 CDMA/PCS Test Set
	Option 320	Spare E8700 40 W Power Supply
	Option 321	Spare E8702 100 W Power Supply
	Option 322	Spare Battery Charger Power Supply

	Option 323	Spare Utility Power Supply (3.3V, 5V, 12V, 24V)
	Option 324	Spare Utility Power Supply (5V, 12V, 24V)
	Option 325	Spare Utility Power Supply (5V, +12V, -12V)
	Option 326	D2818A/ABA 17" Ultra VGA Monitor
	Option 350	Spare E6233A Embedded PC with 64MB
	Option 351	Spare E2175B DMM
	Option 352	Spare E1401B VXI Mainframe
	Option 353	Spare TS-5500 ExpressConnect mechanical assembly
	Option 354	Spare TS-5500 ExpressConnect System PCB
	Option 355	Spare TS-5500 ExpressConnect UUT PCB
	Option 356	Spare TS-5500 PDU
	Option 360	Spare Dual RS-232 M-module
	Option 361	Spare Quad RS-232 M-module
	Option 362	Spare 16 Channel GP Relay M-module
	Option 363	Spare 4x4 Matrix M-module
	Option 364	Spare 16-to-1 Mux M-module
	Option 365	Spare 16 Channel Digital I/O M-module
	Option 366	Spare M-module Carrier
	Option 370	Spare Audio DSP Source to System PCB
	Option 371	Spare M-module to UUT PCB cable
	Option 372	Spare Internal M-module to UUT PCB cable
	Option 373	Spare UUT PCB to System PCB Jumper
	Option 374	Spare Utility Power Supply to ExpressConnect cable
	Option 375	Spare Charger Power Supply to ExpressConnect cable
	Option 376	Spare Relay power jumper cable to System PCB
	Option 377	Spare RS-232 4 channel breakout cable
	Option 378	Spare Power Switch to PDU cable
	Option 379	Spare PDU outlet box cable kit
	Option 380	Spare Audio Source multiplexer to System PCB cable
	Option 381	Spare DMM to UUT PCB cable
	Option 382	Spare Dual Audio DSP to ExpressConnect breakout cable
	Option 383	Spare 1.6m Rack
	Option 384	Spare Phone Power Supply to

		ExpressConnect cable
	Option 386	Spare Counter to ExpressConnect Cable
	Option 387	Spare Audio Breakout Box
	Option 389	Spare ExpressConnect Ground wire
	Option 390	Spare Jumper for dual DMM Multiplexer

Most TS-5500's will be installed in manufacturing sites where up-time is critical. Customers must be able to diagnose and troubleshoot system failures on-site to maximize up-time. Customers should have one spares kit in the appropriate configuration to cover all the TS-5500 systems at one site. Agilent can provide on-site support assistance.