Agilent
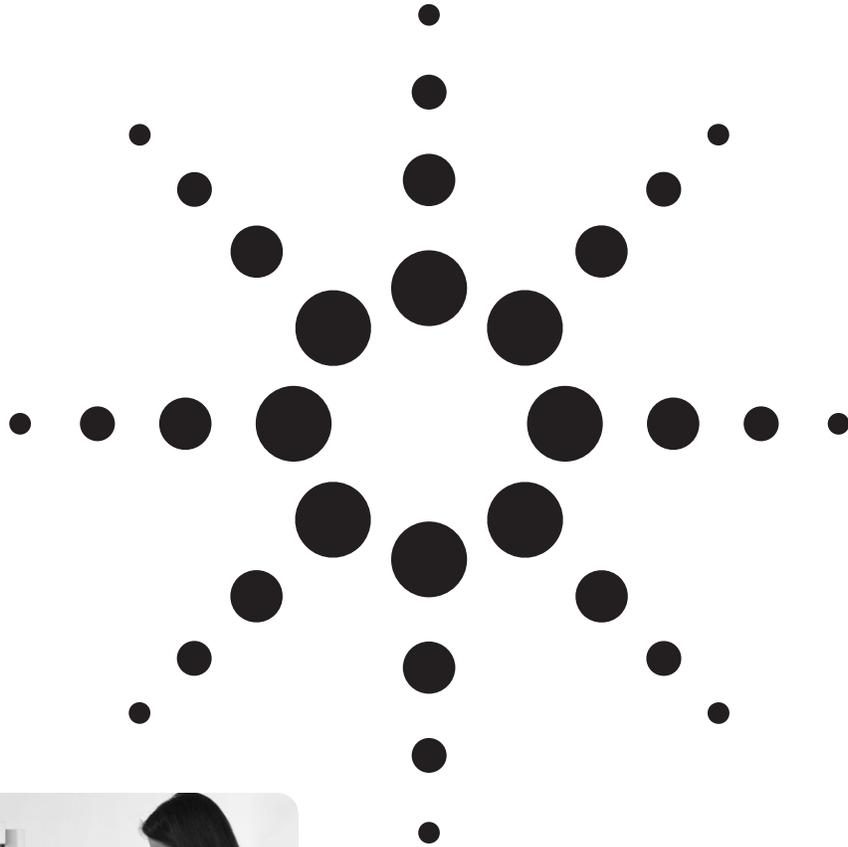**E8421A Fixture Integration with a Test System**
Product Note

Introduction

The E8421A fixture is a stand-alone test fixture that provides RF isolation of the device under test (DUT) from the outside environment and provides many of the functions previously contained in the test system, including:

- Integrated fixture power and control: serial fixture I/O, driver, software, and power supply

- Integrated serial DUT communications, level shift, and inversion

- Integrated switching and signal distribution, and DMM multiplexing

- Integrated programmable reference level digital I/O

- Integrated audio signal conditioning

- Integrated pneumatics: six user-assigned valves, pilot valve, and pressure regulator

The fixture consists of a standard base and a removable nest, which allows the interface between the fixture and the DUT to be customized. The nest can be designed by the customer, a customer's thirdparty resource, or Agilent. A diagnostic loop-back nest and software is available and highly recommended for determining whether the cause of a problem is the fixture or the custom nest.

Simple BNC, N-type, and D-Sub connections on the rear of the fixture provide connection to the test system resources – DMM, DUT power supply, RF communications test box, DUT serial, and fixture control. Software is included to enable troubleshooting and functional verification of the fixture. Additional features include EEPROM storage for counters for all automatic actuations, and calibration storage for audio test paths.

The following options are available for the E8421A fixture:

E8421A-010	RF absorber kit
E8421A-020	Two additional RF paths and RF switch
E8421A-100	Diagnostic loopback nest
E8421A-140	Rack mount slide kit
E8421A-160	Generic test system cables
E8421A-200	Final nest kit
E8421A-210	Quick nest kit
E8421A-220	Board test kit
E8421A-230	Acoustic transducer kit for fixture
E8421A-240	Non-parametric OTA RF coupler
E8421A-300	Spare Parts Kit
E8421A-ABA	US English manual set

Integration of a fixture:

Connecting the fixture to a test system is a four-step process

1. Installing the physical fixture
2. Establishing connections from the fixture to the test system
3. Customizing the fixture nest
4. Interfacing the test set with phone test plan

Installing the fixture

The E8421A is capable of operation in both manual and automated manufacturing environments.

• Manual operation installations require a non-skid structure that is capable of supporting at least 75 pounds (28 kg) and prevents the fixture from sliding on the surface when the drawer is opened and closed.

• For installation in standard EIA 19-inch test racks, the E8421A-140 slide mount kit is recommended since it provides easy RF chamber mainence access through the fixture's side panels.

• Installations with automated DUT handling are enabled with an alignment hole and slot, which provides accurate positioning and securing of the fixture on the robot interface. Bushings included in the nest/fixture interface provide accurate positioning of the DUT relative to the base plate. Dimensions are contained in the fixture manual. Communication between the DUT handler and the fixture is performed through the PC.

The following commands are used to open and close the drawer in an automated environment:

```
pFixture->Command->DrawerOpen()
pFixture->Command->DrawerClose()
```

Establishing connections

Standard connections between the E8421A and the test system are made using off the shelf cabling including BNC, N-Type, and D-sub connectors. Connections are established as follows:

Cable type	Fixture connection	Test system connection
BNC	DMM	DMM
BNC	Audio In	Audio Source Out
BNC	Audio Out Hi	Audio Input Hi
BNC	Audio Out Low	Audio Input Low
BNC	Trigger	Trigger in for time critical measurements like GSM
9-pin D-Sub	DUT Power	DUT Power Supply (battery and charger)
N-Type	RF	RF Test Set
9-pin D-Sub	Fixture Serial	PC Com port 1
9-pin D-Sub	DUT Serial	PC Com port 2

Agilent part number E8421A-160 provides generic test system cables to connect to the system resources listed above. The BNC cables provided in E8421A-160 are terminated at both ends with male BNC connectors except for a banana plug connection to the DMM. The N-type RF cable is terminated with N-male connectors. The DUT power cable is 18-AWG twisted shielded pair terminated in a 9-pin D-Sub female connector at the fixture. The serial cables are standard null modem cables. Pin-outs for these cables can be found in the E8421A-ABA manual.

One IEC320 power cord connector is located on the rear of the unit for connection to 100-240 volt service. The fixture draws 80 VA during operation. The power cable is localized to the shipping address.

One 6-mm push-on pneumatic connector requires a connection to filtered dry compressed air. The minimum air pressure required is 475-800 kPa (69-116 psi).

Customizing the fixture nest

The standard fixture base brings a defined set of resources from the fixture and system to the nest interface. The fixture nest is where customization of the interface between the fixture and the DUT occurs. This nest can be designed by the customer, a customer's third party resource, or Agilent. Refer to the document *"Agilent E8421 Wireless Test Fixture Final (or Board) Nest Tailoring Manual"* (Available from your Agilent field representative.) when designing the electrical and mechanical interface from E8421A to the DUT. This document provides all electrical and mechanical information to define this interface.

Fixture software interface

To interface to the fixture, a Windows® communication (COM) driver is used. The following is a Visual C++ example of how to initialize the driver and send commands. The full command set is contained in the fixture manual.

```
//Example C++ program using the fixture driver
//*************************************************************

// These defines are needed by the two following #includes to specify the platform
// type.
#ifndef _WIN32_WINNT
#define _WIN32_WINNT 0x0400
#endif

#include <objbase.h> // Needed for CoInitializeEx

#include <atlbase.h> // Needed for USES_CONVERSION...

// Import the type library information found the AgilenFixtureServer.exe
// file. This allows us to use smart pointers to access the components
// found in AgilentFixtureServer's type library.
//
#import "AgilentFixtureServer.exe"
using namespace FixtureLib;

void main()
{
    // Initialize COM for this thread.
    CoInitializeEx(NULL,COINIT_MULTITHREADED);

    // Create an instance of the driver using the IFixturePtr smart pointer
    IFixture pIFixture;
    pIFixture = IFixturePtr(__uuidof(Fixture));

    // Needed to allow us to use the T2OLE macros below
    USES_CONVERSION;

    // Set which com port to use
    pIFixture->Session->Address = T2OLE("COM1");

    // Activate/initialize the driver
    pIFixture->Session->Activate();

    // Send the command to open the drawer.
    pIFixture->Command->Action->DrawerOpen();

    Sleep(1000);

    // Send the command to close the drawer
    pIFixture->Command->DrawerClose();

    // Set the audio input path to use the Earpiece microphone
    pIFixture->Hardware->Audio->InputPathSet(audioInputEarpieceMic);

    // Set the audio output path to route through the system connector
    pIFixture->Hardware->Audio->OutputPathSet(audioOutputSysOut);

// Close the com port and release the driver.
    pIFixture->Session->Deactivate();

    // Release the object
    pIFixture.Release();

    // Uninitialize COM
    CoUninitialize();
}
```

Nest designs and macros

Nest designers should use the document *"Agilent E8421 Wireless Test Fixture Final (or Board) Nest Tailoring Manual"* when designing the electrical interface from E8421A to the DUT. This document provides tables to define this interface. Although a custom nest PCA may be designed for this interface, the basic design of the interface will remain the same.

Standard macro files are available on the Agilent web-site **www.agilent.com/find/e8421a** for the E8421A and also should be included with the nest. If all actuations have not had a macro created for them, use the document *"Agilent E8421 Wireless Test Fixture Final (or Board) Nest Tailoring Manual"* to help create the additional macros required. These macros can be called at any time from the testplan to engage or disengage any of the individual actuations, or the entire sequence "_NestPostCloseDrawer".

The following is a sample macro for DUT engage actuation:

```
/****************************************************************************/

/* Post-Close Drawer will be called immediately after the
        drawer is closed by the drawer close macro.
*/
#Alias(131, "_NestPostCloseDrawer");
MacroSet(131)
{

        /* Engage System connector */
        MacroRun(140);
        (RegisterRead(0) ? Jump(9) : Continue());


        /* Engage Battery connector */
        MacroRun(144);
        (RegisterRead(0) ? Jump(9) : Continue());


        /* Engage RF connector */
        MacroRun(142);
        (RegisterRead(0) ? Jump(9) : Continue());


        /* Engage (lower) the Upper Nest */
        MacroRun(136);
        (RegisterRead(0) ? Jump(9) : Continue());


        /* Write to status bit 9, indicating that the fixture is "Ready To Test".
            This is what the testplan is looking for to begin testing.

        */
        WriteStatus(9, 1);


        /* Return indicating success */
        Return(0);

Label(9);

        /* Post an error indicating failure */
        PostError(55);

    /* Return indicating failure */
        Return(1);
}


/* This macro engages the DUT2 (System Connector) actuation on the lower nest.
    If the actuation doesn't complete within 300ms a timeout error is posted
*/
#Alias(140, "_NestSysConnEngage");
MacroSet(140)
{
```

```
    /* Write to the valve to cause the actuation to occur */
      ValveWrite(valve04_Dut2, 0);


      /* We now will loop, looking for the sensors to indicate the correct
          state.  If that state is not found after a certain amount of time, error.
      */

      /* Initialize the looping/timeout register*/
      RegisterWrite(1, 0);

Label(1);

    /* Increment the looping register */
      RegisterIncrement(1);


      /* We will check the two sensors to verify that the actuation was successful.

    If the sensorDut2Eng sensor is low AND the sensorDut2Dis sensor is high,
    this means the engagement is complete, so return success.

          NOTE: we are using embedded conditional statements here.  The inner
          conditional will not run unless the outer condition is true.  The outer
          verifies that it's sensor is low, the inner verifies that it's sensor is high
      */
      (  (SensorRead (sensorDut2Eng)  == 0 )  ?
      (  (SensorRead (sensorDut2Dis) == 1 )  ? Return (0  :
Continue (     :Continue());

      /* If we've reached our timeout, jump to label 9
          otherwise continue and loop

          NOTE: our delay is ~100ms*3 = 300ms, modify this multiplier
          to adjust the timeout value.
      */
      ( (RegisterRead(1) == 3) ? Jump(9) : Continue()) ;


      /* Delay for approx ~50ms*2 = ~100ms, this is what gives us a fairly
          accurate timeout value.  A delay of 1 will delay for 50ms.
      */
      Delay(2);

    /* Jump back to the beginning of the timeout loop */
      Jump(1);

Label(9);

      /* Since there was a failure, re-disengage the actuation*/
      ValveWrite(valve04_Dut2, 1);

      /* Post an error indicating the timeout failure */
      PostError(72);

      /* Return indicating failure */
      Return(1);
}
```

Integrating the test executive and phone test plan

When designing the nest, using the Agilent document *"Agilent E8421 Wireless Test Fixture Final (or Board) Nest Tailoring Manual"* will simplify choosing the command selection necessary for setting-up the E8421A resources. Using this guide and the commands contained in the software manual, the hardware in the E8421A is easily controlled. An example of the commands typically used in a test plan is shown below:

Fixture->Macro->RunByAlias-
>_NestClampDisengage
    Runs the Nest DUT disengage
    macro defined above.

Fixture->Command->Status-
>StatusReadyToTest
    Polls the fixture while waiting
    for the "Ready To Test" state
    which indicates that the fixture
    is ready for the testplan to begin.

Fixture->Command->SetTestResult
(resultPass or resultFail)
    Informs the fixture of the result
    of the test, causing the correct
    LED indicator to light and for the
    drawer to open to allow for the
    next test.

Fixture->Hardware->Audio->InputPathSet
(InputPathOfChoice)
Fixture->Hardware->Audio->OutputPathSet
(OutputPathOfChoice)
    Sets up the Audio paths.

The default hardware configuration for the E8421A is as follows:

Pneumatics: Not energized [At power up all the pneumatic valves are de-energized, including the pilot valve. The default state for all valves when the pilot valve is close is de-energized, which implies that the drawer is closed, that the upper nest is up, and all other actuators are in the de-energized valve position.]

Audio Output: Mouthpiece speaker

Audio Input: Earpiece microphone (low gain)

DMM Multiplexer: Deselected

PIO: All 12 outputs high (inactive), pulled up to nominally 3 V, input threshold 1.5 V nominal

Trigger: PIO (12) selected, non-inverting

DUT Serial: 2 or 4 wire configuration, non-inverting, with nominally 3 V outputs and 1.5 V inputs

GP Relays: Not energized (NC configuration)

PREF1 and 2: Off (high impedance state)

If the DUT being integrated requires a different setup than the default, refer to the fixture manual for commands to configure the fixture for your application.

Additional features for acoustic test, RF calibration, and preventative maintenance

Audio calibration values stored in EEPROM

The microphones in the fixture and nest can be calibrated using a Bruell and Kjaer BK4231 acoustic calibrator. The calibration values can then be stored in EEPROM in the fixture for the ear-piece and in the nest for buzzer and leveling microphones. The values are retrieved using the **Fixture->Hardware->Audio->CalDataGet** command. Refer to the fixture manual for specifics on the representative values stored in the EEPROMs.

RF calibration

RF calibration can be performed using the N to SMA connector integrated into the front door of the fixture. A limited number of calibration data points can be stored in EEPROM within the fixture, and retrieved using the **Fixture->Hardware->RF->CalDataGet** command. Refer to the fixture manual for specifics on the representative values stored in the EEPROMs.

Preventive maintenance alarms

The counts for each pneumatic actuation, which are stored in EEPROM, can be used to provide preventive maintenance alarms. The command to retrieve all of the count values is **Fixture->Command->Counter->Readall**.

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