

# Testing Optical Feeds in Wireless Systems

## Remote Radio Units (RRU) and Distributed Antenna Systems (DAS)

MT9090A/MU909011A  
Network Master Optical Fault Locator (OTDR)

By Stephen Colangelo

### Background

Since optical fibers feature less loss than traditional coax cables, many equipment vendors are transitioning to optical feeds as a way to extend the distance from the amplifier or between components. Although this may not seem like a major change, working with optical fibers requires very different tools and procedures.

This application note covers the proper methods for cleaning and testing optical feeds. The examples below are for the Ericsson RBS 3418/3518 radio base station with RRU 22 xx40 remote radio units however the process should be similar for other models and vendors as well as distributed antenna systems.

### Selecting the Right Testing Tools

There are several methods and tools for testing optical fibers:

1. **Power Meters and Lights Sources** simulate Tx and Rx and provide very accurate results however they require access to both ends of the fiber which may not be possible due to the mounting location of the RRU. They also can not isolate problems within a fiber.
2. **OTDRs or Fault Locators** use sort of a “radar” within fiber to graph all of its characteristics. They are the workhorse for optical testing since they provide details of each characteristic (connector, bending stress, etc.) as well as the overall characteristics. Not all OTDRs and Fault Locators are created equal however so it is important to select a tool that features very high resolution, short deadzones and is very easy to use. Short-range fault locators like the Anritsu Network Master MT9090A are the perfect tool for this application. Since this product was designed specifically for testing short fibers, all testing parameters are fixed which greatly simplifies operation. A testing sequence is also built-in to guide novice users.
3. **USB-based Connector Inspection Microscopes** provide a safe, effective way to inspect the cleanliness and condition of optical connectors. The USB interface provides a method to interface with a test set and display the image on the screen. It also provides a method to save the image for review by managers or inclusion into reports.
4. Assortment of connector tips, cleaning supplies and testing jumpers for connection to the fiber.

## Locating Optical Feeds

With most radio base stations, the optical feed cable is a duplex cable that plugs directly into one of the sector ports of the transmission card. **NOTE:** there may be multiple RRU cables plugged into each RBS so care should be taken not to disconnect an RRU already in service. Proper cable labeling is recommended.

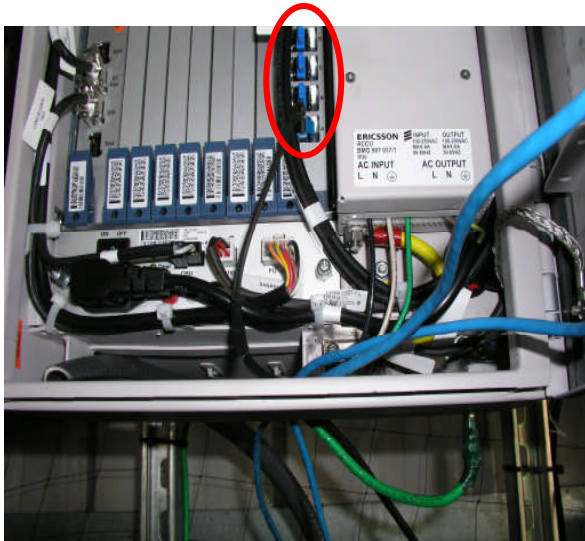


Figure 1 – an RBS with a single RRU optically connected

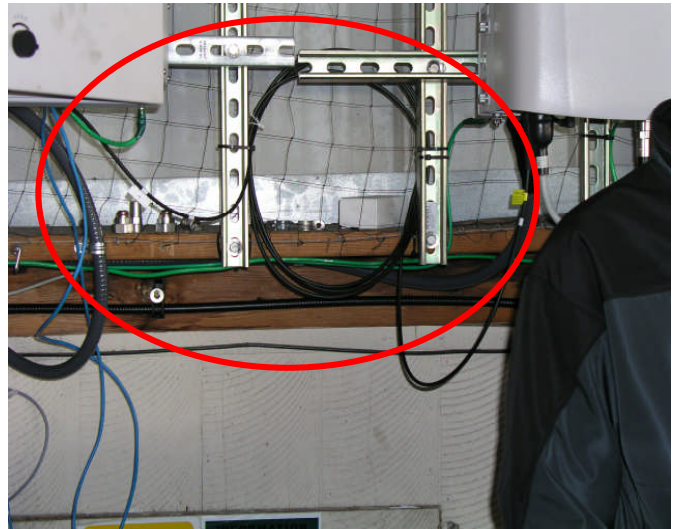




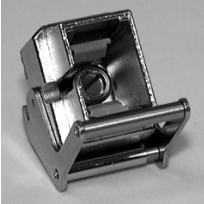
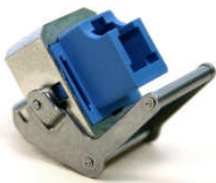












Figure 2 – typical optical feed placement between RBS and RRU

## Identifying Optical Connector Types

Several connector types are available for optical feeder cables. The most common are shown below with each available in either **SIMPLEX** (one fiber) or **DUPLEX** (two fibers) configurations.

	SC	LC	FC	ST
Connector Image	 Simplex SC	 Duplex LC	 Simplex FC	 Multiple Simplex ST
OTDR Adapter	 P/N: J0619B	 P/N: J1413A or J1270	 P/N: J0617B	 P/N: J0618D
Microscope Adapter to view optical feed cable	 Universal tip with larger (2.5mm) sleeve	 Universal tip with smaller (1.25mm) sleeve	 Universal tip with larger (2.5mm) sleeve	 Universal tip with larger (2.5mm) sleeve
Microscope Adapter to view optical RBS card connector	 SC bulkhead tip	 LC bulkhead tip	 FC bulkhead tip	 ST bulkhead tip

\* NOTE: not all tips shown are included with base kit

## Verifying Connector Cleanliness and Condition

It has been said that up to 70% of all troubleshooting and system errors are the result of dirty or damaged connectors. When dealing with optical fibers, connector condition and cleanliness are two of the most important factors. Dirty or damaged connectors will reduce the quality of transmissions and cause large amounts of light to be reflected which may potentially damage transmitters. By using proper cleaning and inspection techniques, system turn up errors can be virtually eliminated and network reliability greatly increased.

### Typical testing procedure using a **USB VIDEO INSPECTION PROBE (VIP):**

- Locate and remove the optical feeder cable from the RBS.
- Clean both the optical feeder connectors and the internal jack using approved company cleaning procedures. HINT: always dry clean first – only use wet cleaning methods for removing embedded dirt.
- Connect the microscope to the USB port of the test set.
  - Anritsu Model MT9090A features plug and play so the application will launch automatically.
  - Anritsu Model MT9083A requires pressing the TOP MENU key and selecting VIP.
- Select and install the proper scope tip for the feed cable based on the connector identification chart.
- Plug the feed cable into the microscope probe and verify the condition.

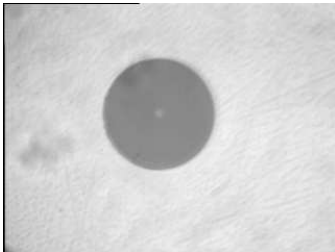


Figure 3 – a properly cleaned connector in good condition

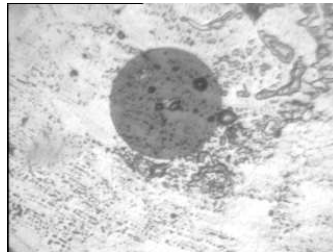


Figure 4 – a dirty connector

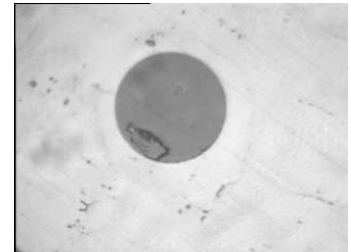


Figure 5 – a chipped connector

NOTE: The small, lighter colored dot in the center is the fiber core and of most importance.

- If good and clean, repeat for second connector if duplex.
- If it is still dirty, re-clean and re-inspect. If cleaning does not help, replace the optical feed cable.
- Select and install the proper scope tip for the RBS internal jack based on the connector identification chart in the previous section.
- Plug the microscope probe into one of the internal card ports and verify the condition.
- If good and clean, repeat for second port.
- If it is still dirty, re-clean and re-inspect. If cleaning does not help, it may require RBS card replacement.
- Disconnect the microscope USB cable if desired to extend battery life.

## Verifying Fiber Properties – Loss, Length and Placement

Since optical fibers are made of glass, greater care must be taken during the handling and placement compared to traditional coax. If a fiber is spooled too tightly or creased, it may crack or at least suffer from high loss - much like when a garden hose is kinked. The excessive bending or kinking of an optical fiber is typically known as a **macro bend**. Common causes of macrobends are bending the fiber too sharply near the connector, pinching it in the door of the equipment or installing a tie wrap too tight. The good news is that most macrobends can just be straightened out without any permanent damage – again, much like a garden hose.

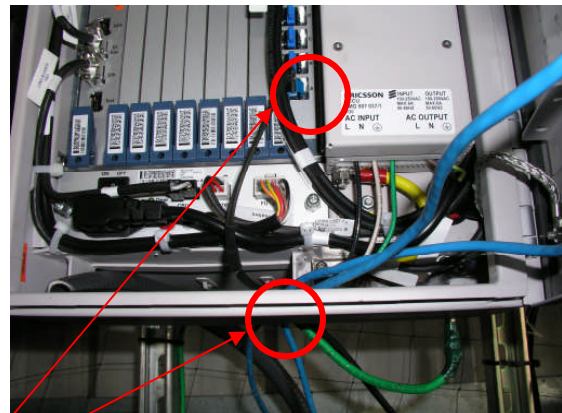
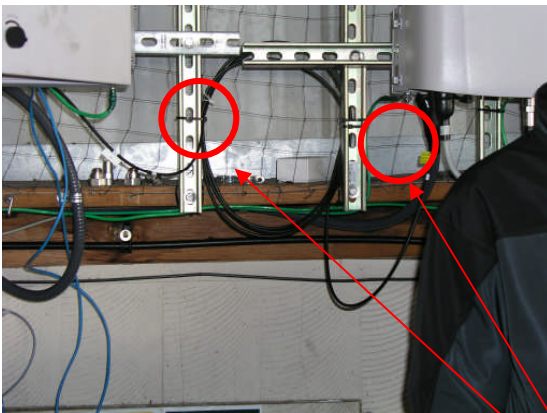


Figure 6 - High losses can be introduced from macrobends caused by tie wraps or sharp bends.

**Loss** – a loss of signal strength can greatly affect the quality of data transmitted. As such, the amount of loss should be kept to a minimum. Since most of the optical feed cable lengths are short (<1000ft), the majority of the loss will come from the connector matings. A typical rule of thumb is that each connector pair mating can have 0.5dB of loss. As such, a typical short optical feed will have an acceptable loss of 1.0 to 1.5dB (2 connectors x 0.5db each + the fiber loss). Since these cables are pre-terminated from a continuous strand of glass, there should be no other points of loss in the fiber cable.

Typical testing procedure using the MT9090A:

- o Press the MENU/POWER button to power on the MT9090A
- o After a quick boot-up, the power meter screen appears.
- o Slide the connector cover to the left and remove the OTDR connector adapter by rotating the handle toward the center of the connector. The adapter should now slide straight up and off.
- o Clean the optical connector using approved company cleaning procedures.
- o Line the white ceramic connector up with the hole in the adapter and slide the adapter down gently. When seated, rotate the handle to the left until it locks.
- o Determine if the optical feeder cable is simplex (single connector) or duplex (dual connectors).

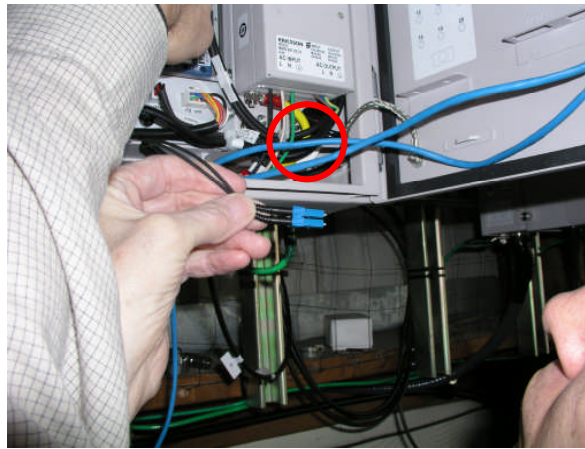


Figure 7 – Duplex optical feed (two connectors/cables)

- o If optical feeder cable features a simplex connector, connect directly to the OTDR port.
- o If optical feeder cable features duplex connectors:
  - Clean and connect a fiber jumper to the OTDR.
  - Connect the other end of the jumper to one side of a female adapter – this adapter acts as an interconnect between the jumper and the optical feeder cable.
- o If screen shows “UNDER RANGE”, then you are ready to test since no transmission signal is detected. If a value is shown, the system is active and should NOT be tested.

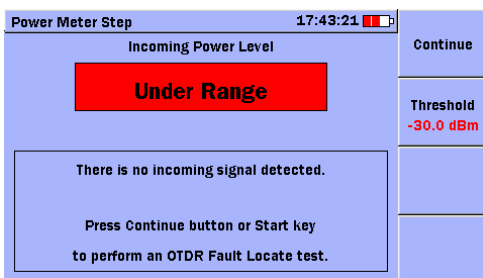


Figure 8 – UNDER RANGE confirming no signal is present

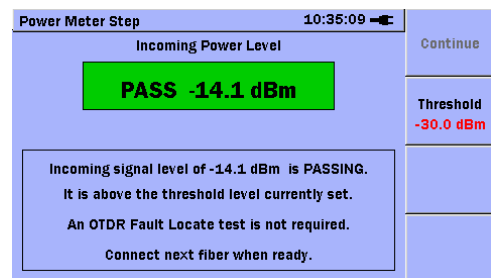


Figure 9 – A signal level displayed confirming transmission signal is present – DO NOT TEST

- o Press CONTINUE to verify connection check level.
  - o If the connection level is at least FAIR, the test will automatically begin.
  - o If the connection level is POOR, re-clean and re-insert the fiber under test as directed.
    - NOTE: a minimum fiber length of about 15ft is required for connection check to operate. Press F2 (CONTINUE) if fiber is shorter than 15ft. Connection Check can also be deactivated in the setup menu.



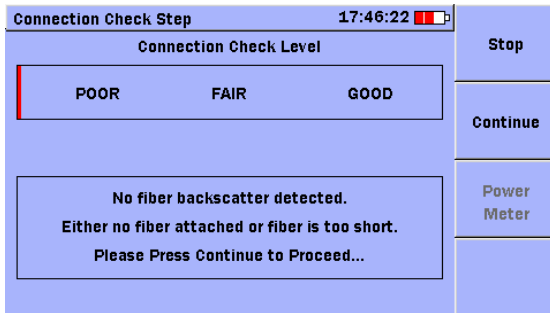


Figure 10 – connector is either dirty or not seated properly

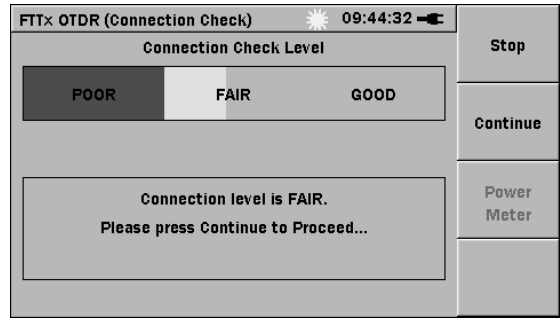


Figure 11 – FAIR to GOOD is OK to test

- The progress will be updated on the screen and test results clearly displayed upon completion.
  - END/FAULT DISTANCE is the total fiber length.
  - LOSS AT OTDR CONNECTION is only the loss of the initial connector (at the OTDR).
  - TOTAL LOSS is the total loss of the entire optical feeder fiber.
    - The PASS/FAIL threshold default is 1.50dB which should be an acceptable value for fibers up to 1000ft. If possible, verify with a network engineer or system vendor.
    - Threshold value can easily be set by pressing F2 (Total Loss Threshold) and adjusting value. Press SET when finished.

Fault Locate Step					18:12:20	Stop
Analysis Summary					PASS	Total Loss Threshold
End/Fault Distance					55 ft	
Loss at OTDR Connection					0.67 dB	
Total Loss (Incl Loss at OTDR)					0.67 dB	
Total Loss Threshold					1.50 dB	Power Meter
No.	Distance (ft)	Type	Loss (dB)	Refl. (dB)		View Trace
1.1	0	↗	N/A	N/A		
1.2	5	↘	N/A	>-58.6		
2	55	↘	END	>-70.0		

Figure 12 – Fiber PASSED based on threshold

Fault Locate Step					18:02:15	Stop
Analysis Summary					FAIL	Total Loss Threshold
End/Fault Distance					50 ft	
Loss at OTDR Connection					3.00 dB	
Total Loss (Incl Loss at OTDR)					N/A	
Total Loss Threshold					1.50 dB	Power Meter
No.	Distance (ft)	Type	Loss (dB)	Refl. (dB)		View Trace
1.1	0	↗	N/A	N/A		
1.2	4	↘	N/A	>-60.6		
1.3	50	↘	END	>-69.0		

Figure 13 – Fiber FAILED based on threshold

After results are viewed, they can be stored to either internal memory or an external USB memory stick if desired.

- Press the MENU/POWER button and highlight SAVE, then press SET.
- The SAVE AS: box will be highlighted. Press SET to bring up the on-screen keyboard and enter name of file to be stored. Press F4 (OK).
- Confirm DEVICE location for file save (INTERNAL is internal memory, USB is an external USB device - test set will default to USB whenever a USB device is inserted). Press F1 (SAVE TRACE) to store file.

Typical testing procedure using the Anritsu **ACCESS MASTER MT9083**:

- The procedure for using the MT9083 is very similar except OTDR (FAULT LOCATE) must be selected from the top menu after power up.

## Conclusion

With the right tools and testing procedures, proper installation and maintenance of optical feed cables can be achieved with fewer errors and improved Quality of Service (QoS).

## Anritsu Field Optical Solutions

### **MT9083 ACCESS Master Series**

The ACCESS Master MT9083 is the first all-in-one tool that does not compromise performance. It features extremely high resolution to see those closely spaced splices and connectors, while still being able to certify 100+ km spans- quickly and accurately. Whatever your work, construction or maintenance, long haul or intra-building, Anritsu has an MT9083 model for your needs.



### **MT9090A Network Master**

The MT9090A Network Master is a palm-size, field modular platform designed for first level fault isolation. Its small size, simple interface, rugged/sealed design and low price make it just right for large-scale technician deployment. Test modules include OTDR/fault locator and CWDM channel analysis.



### **CMA50 Optical Loss Test Set**

All-in-one light source, power meter, visual fault locator and optical return loss meter for optical fiber construction and maintenance. They are offered with common calibration wavelength and connector options to meet any testing requirement from FTtx networks to long haul telephony links to multimode LAN, and CATV.



### **CMA5 Optical Power Meter and Light Source**

The CMA5 Series Power Meters are ideal for attenuation and power throughput measurements on point-to-point fiber optic links. The CMA5 Series Light Sources provide an economical and stable laser source for use in point-to-point attenuation measurement. They feature a rugged design, built to withstand the difficult testing environment of fiber optic cable installation and maintenance.



Specifications are subject to change without notice.

#### **Anritsu Corporation**

5-1-1 Onna, Atsugi-shi, Kanagawa, 243-8555 Japan  
Phone: +81-46-223-1111  
Fax: +81-46-296-1264

#### **• U.S.A.**

##### **Anritsu Company**

1155 East Collins Blvd., Suite 100, Richardson, TX 75081, U.S.A.  
Toll Free: 1-800-267-4878  
Phone: +1-972-644-1777  
Fax: +1-972-671-1877

#### **• Canada**

##### **Anritsu Electronics Ltd.**

700 Silver Seven Road, Suite 120, Kanata, Ontario K2V 1C3, Canada  
Phone: +1-613-591-2003  
Fax: +1-613-591-1006

#### **• Brazil**

##### **Anritsu Eletrônica Ltda.**

Praca Amadeu Amaral, 27 - 1 Andar  
01327-010-Paraiso-São Paulo-Brazil  
Phone: +55-11-3283-2511  
Fax: +55-11-3288-6940

#### **• Mexico**

##### **Anritsu Company, S.A. de C.V.**

Av. Ejército Nacional No. 579 Piso 9, Col. Granada  
11520 México, D.F., México  
Phone: +52-55-1101-2370  
Fax: +52-55-5254-3147

#### **• U.K.**

##### **Anritsu EMEA Ltd.**

200 Capability Green, Luton, Bedfordshire, LU1 3LU, U.K.  
Phone: +44-1582-433200  
Fax: +44-1582-731303

#### **• France**

##### **Anritsu S.A.**

16/18 avenue du Québec-SILIC 720  
91961 COURTABŒUF CEDEX, France  
Phone: +33-1-60-92-15-50  
Fax: +33-1-64-46-10-65

#### **• Germany**

##### **Anritsu GmbH**

Nemetschek Haus, Konrad-Zuse-Platz 1  
81829 München, Germany  
Phone: +49-89-442308-0  
Fax: +49-89-442308-55

#### **• Italy**

##### **Anritsu S.p.A.**

Via Elio Vittorini 129, 00144 Roma, Italy  
Phone: +39-6-509-9711  
Fax: +39-6-502-2425

#### **• Sweden**

##### **Anritsu AB**

Borgarfjordsgatan 13, 164 40 KISTA, Sweden  
Phone: +46-8-534-707-00  
Fax: +46-8-534-707-30

#### **• Finland**

##### **Anritsu AB**

Teknobulevardi 3-5, FI-01530 VANTAA, Finland  
Phone: +358-20-741-8100  
Fax: +358-20-741-8111

#### **• Denmark**

##### **Anritsu A/S**

Kirkebjerg Allé 90, DK-2605 Brøndby, Denmark  
Phone: +45-72112200  
Fax: +45-72112210

#### **• Spain**

##### **Anritsu EMEA Ltd.**

##### **Oficina de Representación en España**

Edificio Veganova  
Avda de la Vega, n° 1 (edf 8, pl 1, of 8)  
28108 ALCOBENDAS - Madrid, Spain  
Phone: +34-914905761  
Fax: +34-914905762

#### **• Russia**

##### **Anritsu EMEA Ltd.**

##### **Representation Office in Russia**

Tverskaya str. 16/2, bld. 1, 7th floor.  
Russia, 125009, Moscow  
Phone: +7-495-363-1694  
Fax: +7-495-935-8962

#### **• United Arab Emirates**

##### **Anritsu EMEA Ltd.**

##### **Dubai Liaison Office**

P O Box 500413 - Dubai Internet City  
Al Thuraya Building, Tower 1, Suit 701, 7th Floor  
Dubai, United Arab Emirates  
Phone: +971-4-3670352  
Fax: +971-4-3688460

#### **• Singapore**

##### **Anritsu Pte. Ltd.**

60 Alexandra Terrace, #02-08, The Comtech (Lobby A)  
Singapore 118502  
Phone: +65-6292-2400  
Fax: +65-6282-2533

#### **• India**

##### **Anritsu Pte. Ltd.**

##### **India Branch Office**

3rd Floor, Shri Lakshminarayan Niwas, #2726,  
HAL 3rd Stage, Bangalore - 560 036, India  
Phone: +91-80-4058-1300  
Fax: +91-80-4058-1301

#### **• P.R. China (Hong Kong)**

##### **Anritsu Company Ltd.**

Units 4 & 5, 28th Floor, Greenfield Tower, Concordia Plaza,  
No. 1 Science Museum Road, Tsim Sha Tsui East,  
Kowloon, Hong Kong  
Phone: +852-2301-4980  
Fax: +852-2301-3545

#### **• P.R. China (Beijing)**

##### **Anritsu Company Ltd.**

##### **Beijing Representative Office**

Room 2008, Beijing Fortune Building,  
No. 5, Dong-San-Huan Bei Road,  
Chao-Yang District, Beijing 100004, P.R. China  
Phone: +86-10-6590-9230  
Fax: +86-10-6590-9235

#### **• Korea**

##### **Anritsu Corporation, Ltd.**

8F Hyunjuk Building, 832-41, Yeoksam Dong,  
Kangnam-ku, Seoul, 135-080, Korea  
Phone: +82-2-553-6603  
Fax: +82-2-553-6604

#### **• Australia**

##### **Anritsu Pty. Ltd.**

Unit 21/270 Ferntree Gully Road, Notting Hill,  
Victoria 3168, Australia  
Phone: +61-3-9558-8177  
Fax: +61-3-9558-8255

#### **• Taiwan**

##### **Anritsu Company Inc.**

7F, No. 316, Sec. 1, Neihu Rd., Taipei 114, Taiwan  
Phone: +886-2-8751-1816  
Fax: +886-2-8751-1817