

Application Note: FORAX “Laser” LED States and Diagnosing Optical Fiber Faults

The FORAX RIU tri-state light emitting diode (LED) labeled “LASER” indicates the state of two different but related physical links, the optical link and the comm link¹. This information can be used to help diagnose the quality of the uplink and downlink optical connections:

- Color is used to indicate the state of the optical link. The optical link is considered to be in three states, good (GREEN), weak (AMBER), and bad (RED).
- Cadence is used to indicate the state of the comm link. The comm link is considered to be in two states, good (SOLID) and bad (FLASHING).

The comm link is used to transfer the AIU optical link information back to the RIU, so when the AIU-to RIU-optical link is bad, there is no information available about the RIU-to-AIU fiber.

The table at right shows the nine possible states of the optical fiber plant and the corresponding RIU LASER LED states. Some optical fiber states are ambiguous because there are only 5 LED states for 9 optical plant states. However, by implementing optical fiber repairs in an appropriate sequence, all states can be fixed in an unambiguous and efficient manner.

Quality of Optical Fiber Plant RIU <.....> AIU	RIU LASER STATE
>>>>> Good <<<<<< Good	Solid Green
>>>XXX>>> Bad <<<<<<<< Good	Flashing Green
>>>>>>> Good <<<XXX<<< Bad	Solid Red
>>>XXX>>> Bad <<<XXX>>> Bad	Solid Red
>>>>>>> Good <<<.....<<< Weak	Solid Amber
>>>.....>>> Weak <<<<<<< Good	Solid Amber
>>>.....>>> Weak <<<.....<<< Weak	Solid Amber
>>>XXX>>> Bad <<<.....<<< Weak	Flashing Amber
>>>.....>>> Weak <<<XXX<<< Bad	Solid Red

NOTE: It can take up to 60 seconds for the “comm” link to establish itself and indicate its state via the “laser” LED. Therefore, wait at least 1 minute after reconfiguring optical fiber cables before reading the status of the “laser” LED.

TROUBLE SHOOTING FLOW – UNAMBIGUOUS STATES

- Solid Green** Done, all is good.
- Flashing Green** RIU-to-AIU fiber bad.
- Flashing Amber** RIU-to-AIU fiber bad ...and... AIU-to-RIU fiber weak.

¹ The comm link is an out-of-band RF signal that enables the RIU and AIU to exchange command and status information.

TROUBLE SHOOTING FLOW – AMBIGUOUS STATES

Solid Amber with both fibers connected

Disconnect RIU-to-AIU fiber.

Flashing Amber indicates weak AIU-to-RIU fiber for certain and a weak RIU-to-AIU fiber is possible, so:

- Repair AIU-to-RIU fiber (leave RIU-to-AIU disconnected), to get Flashing Green.
- Reconnect RIU-to-AIU fiber.

Solid Green Done, all is good.

Solid Amber RIU-to-AIU fiber is also weak, repair to get Solid Green.

Alternate Method

- Disconnect RIU-to-AIU fiber.
- Flashing Amber indicates weak AIU-to-RIU fiber for certain, weak AIU-to-RIU fiber possible, so replace the AIU-to-RIU path with the disconnected path.

Flashing Green The NOW disconnected fiber path is the only weak path.

Flashing Amber ... Both fiber paths are weak.

Flashing Green indicates weak RIU-to-AIU fiber.

- Repair RIU-to-AIU fiber to get Solid Green.

Solid Green Done, all is good.

Solid Red with both fibers connected

The AIU-to-RIU fiber is always bad, so repair the AIU-to-RIU fiber first in order to change LED state and indicate other potential problems. After the AIU-to-RIU repair:

Solid Green Done, all is good.

Solid Red AIU-to-RIU fiber repair failed.

Flashing Green RIU-to-AIU fiber was also bad, repair for Solid Green.

Solid Amber RIU-to-AIU fiber was also weak, repair for Solid Green.

Alternate Method

- Swap paths so that the RIU-to-AIU fiber becomes the AIU-to-RIU fiber and vice versa.

Solid Red Both paths bad.

Flashing Green The NOW RIU-to-AIU path is bad, repair for Solid Green.

Flashing Amber ... The NOW RIU-to-AIU fiber is bad ...and... the NOW AIU-to-RIU fiber is weak, repair both for Solid Green.

Troubleshooting ... In Conclusion:

RED means AIU-to-RIU must be repaired, but there may be hidden RIU-to-AIU problems, repair the AIU-to-RIU first and then maybe the RIU-to-AIU.

SOLID AMBER can be made less ambiguous by disconnecting the RIU-to-AIU path.

SIGNAL TRACING

If a hand held power meter and known-good optical patch cable is available, then signal tracing can be implemented.

Using an AIU or RIU as a test source

3mW minimum should be measured at the optical TX port of an RIU or AIU. Syntonics typically sets the lasers to 3.6mW to overcome internal optical connector losses and launch at least 3mW into the fiber that connects to the optical TX port. A handheld meter and good patch cable typically yields optical power readings of ~3.4mW at the optical TX port.

How “good,” “weak,” and “bad” are defined

Assuming 3mW optical TX power:

- “Good” is defined as greater than 475 μ W at the RX optical port, or less than 8dB optical loss.
- “Weak” is defined as between 190-to-475 μ W at the RX optical port, or approximately 8-to-12 dB of optical loss.
- “Bad” is defined as less than 190 μ W at the RX port, or more than 12 dB loss.

Note: The good-bad-weak values are approximate with an approximate ± 0.5 dB tolerance. If the actual optical power is near a threshold value, the RIU could indicate either state.

Note: Increasing the optical power does not overcome the effect of optical loss on the RF path. The only means to fix optical loss problems is by reducing the optical loss or, in the case of long-haul fiber, using an optical amplifier.

Other effects of optical loss problems

FORAX always transmits RX or TX RF onto the lasers and a LASER alarm does *not* stop this. However, once the RX optical link becomes weak, RF RX performance may be compromised. This will depend partly on the attached radio receiver and antenna. The RF loss is twice the optical loss, so 12 dB of optical loss represents 24 dB of RF loss. If a TX optical path becomes weak then the output TX RF power may no longer be within specification. With about 10-12 dB optical loss, the AIU will no longer sense enough TX RF to switch into TX mode and the TX path will become inoperative.