LBON320ACT

OBI Free Mini RFoG Optical Node

User Manual

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1. GENERAL INTRODUCTION

LBON320ACT is a new member to the family of compact bi-directional RFoG optical nodes using WDM transmission, the ideal platform for delivering upstream and downstream DOCSIS voice, video, and high-speed data services over for FTTX applications. The LBON320ACT optical network unit combines the superior proven technologies of both the RF amplifier and optical components. Tested in accordance with SCTE 174 2018 RFoG Specification, the LBON320ACT delivers industry-leading performance, reliability and flexibility with full 1218MHz bandwidth capacity. The LBON320ACT incorporates Automatic Gain Control (AGC) circuit to maintain the output level over an input optical power range of -6 to +2dBm and 1610nm 2mw DFB "Burst mode" upstream laser transmitter.

In efforts to eliminate the problem of OBI from RFoG FTTH networks the LBON320ACT provides OBI elimination in networks with multiple upstream lasers in passive optical splitter network. LBON320ACT eliminates OBI by offsetting wavelengths by 0.5nm, without compromising the network performance and allows operators to deliver higher capacity DOCSIS 3.0 and 3.1 technologies efficiently. LBON320ACT provides groups of 8 stable upstream wavelengths, separated by 0.5nm and thermally controlled to maintain its chosen wavelength over temperatures from -40^{0}C to +60^{0}C (-40^{0}F to +140^{0}F). User gets to choose from a group of 8 wavelengths from 1603.5nm to 1616.5nm via the interactive front panel on the ONU.

LBON320ACT uses LED display to show the selected channel/wavelength of the ONU. The LED display will also show optical receive input level in dBm. A push button beside the display allows the user to select the desired wavelength. The LBON320ACT supports 42/54 MHz, 65/85 MHz and 85/102 MHz frequency splits.

2. FEATURES

- Eliminates OBI
- User selectable 8 wavelengths separated by 0.5nm with the press of a button
- Thermally controlled stable DFB laser rated for -40^{0}C to +60^{0}C (-40^{0}F to +140^{0}F) operation
- LED display for displaying wavelengths and ONU status
- Input Optical Wavelength: 1550 nm
- Optical (AGC): -6 to +2 dBm
- Transmit Wavelength: 1610 ± 6.5 nm
- Downstream BW: 102 MHz to 1218 MHz
- Upstream BW: 5 MHz to 85 MHz
- Other Available RF splits: 42/54MHz, 65/85MHz, 85/102MHz
- Output RF level 20 dBmV @ 1002 MHz
- RF Bi-directional Test Point: -20dB
- Power ON, Optical I/P; Optical Tx LED indicators

3. PRECAUTIONS

1. Before installation or operation of unit, carefully go through this manual.
2. Install power adapter in a safe place without any other objects on it.
3. Care should be taken around an operating optical laser.
4. The unit will produce a little heat when operating, do not cover ventilation fins.
5. Do not open unit due to failure. Contact Lindsay Broadband.

4. SAFETY NOTES

NO SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

- The LBON320ACT ONU employs an infrared laser device that emits invisible light, which can permanently damage the retina of an eye.
- Avoid direct exposure to the laser light source.
- Never stare directly into a fiber or at any mirror-like surface that could reflect light emitted from an un-terminated fiber.
- Never view an active fiber through optical instruments.

5. FRONT PANEL DESCRIPTION

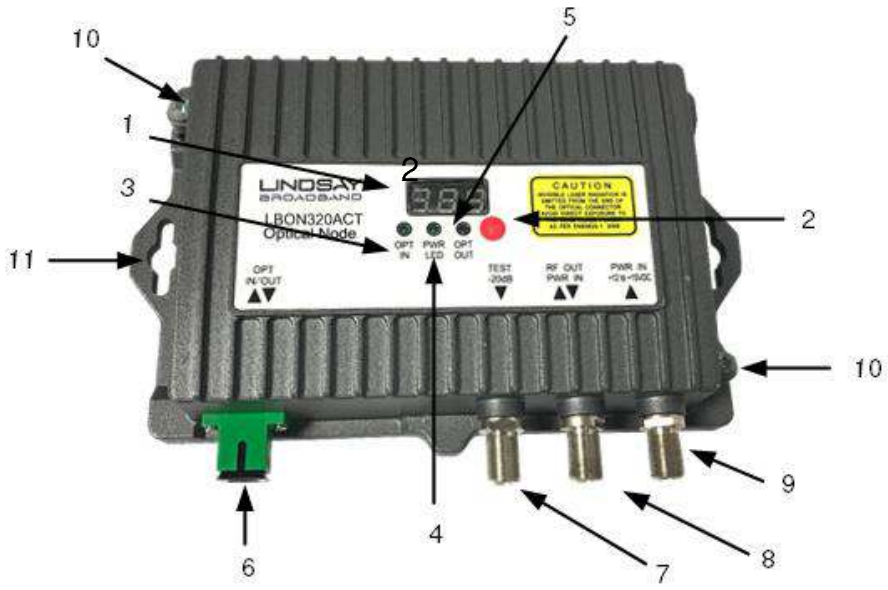

Figure 1: Front Panel description of LBON320ACT

1. The LED display shows the selected channel/wavelength of the ONU. And will also show optical receive input level in dBm.
2. Push button for setup and monitoring.
3. Optical IN Indicator: If receiving power is ≥ -10 dBm, OPT IN LED is illuminated.
4. Power ON Status Indicator：Power on and normal, PWR LED is illuminated.
5. Laser Transmit Status Indicator: If return laser is active, OPT OUT is illuminated.
6. Optical Input/output Port: SC/APC adapter
7. RF Test Point: Bi-directional RF level monitoring test point, -20dB relative to RF port
8. RF In/Out Port: Forward signal output port, return signal input port as well as +12~15V DC power port using power inserter.
9. Power In Port: +12~15V DC input port
10. Grounding stud
11. Mounting handles

6. BLOCK DIAGRAM

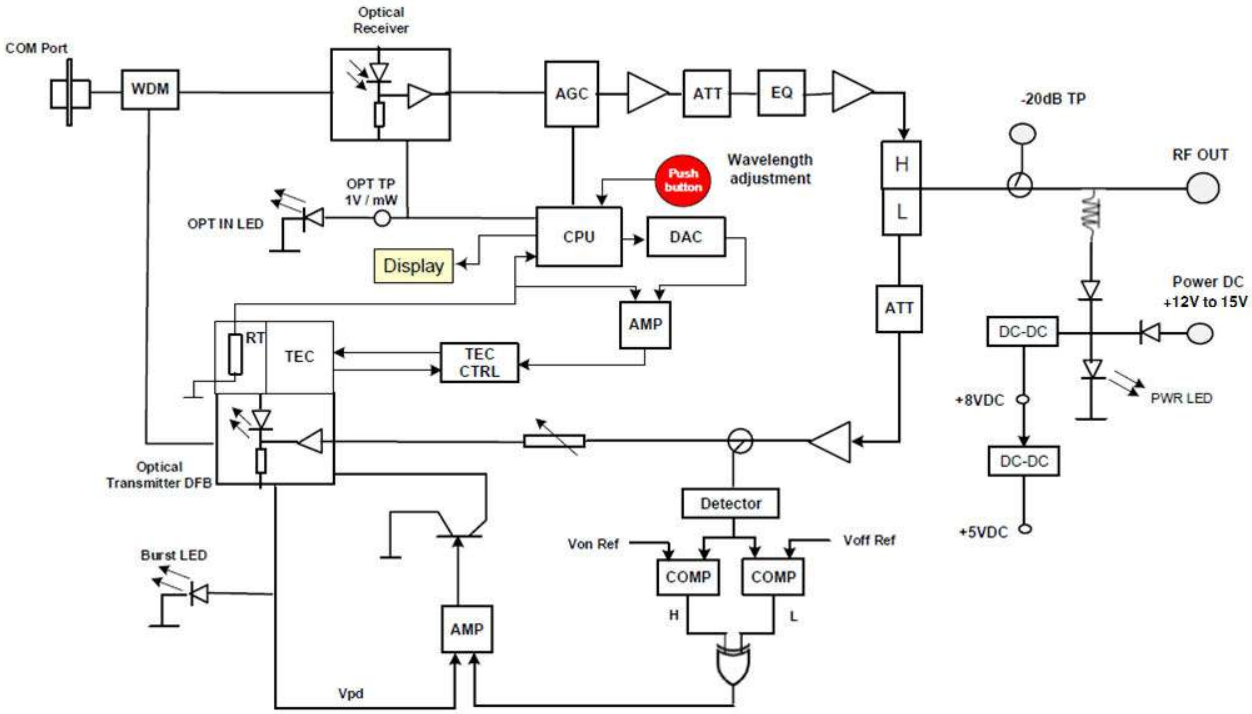

Figure 2: LBON320ACT Block Diagram

7. SPECIFICATIONS

Parameter	Specification		
Forward Receiver	**Min**	**Typ**	**Max**
Optical Receive Wavelength		1540-1565 nm	
Optical Input Power (optical AGC)		-6 to +2 dBm	
Optical Input Return Loss	45 dB Min		
RF Frequency Range (1)	102 MHz		1218MHz
Flatness of Frequency Response (f = f_{min} to 1218 MHz)		± 1 dB	
Output Return Loss (f = f_{min} to 1218 MHz)	16 dB		
Reference Output Level (@ 1002 MHz (±2 dB)) (4)		20 dBmV	
Slope (RF Frequency Range (±1 dB))		6 dB	
C/N (2)	50 dB	51 dB	
CTB (2)			-65 dB
CSO (2)			-60 dB
Return Transmitter	**Min**	**Typ**	**Max**
Optical Wavelength (6)		1610 ± 6.5 nm	
Optical Wavelength separation (6)		0.5 nm	
Optical Wavelength drift over temperature		≤ 0.05 nm	
Optical Output Power		2 mW	
RF Input Level (total power)		20-40 dBmV	
Dynamic Input Range (3)		15 dB	
Frequency Range (1)	5 MHz		85 MHz
Flatness of Frequency Response (f = 5 to f_{max} MHz)		±0.75 dB	±1 dB
Input Return Loss (f = 5 to f_{max} MHz)	16 dB		
Optical Output Return Loss	45 dB Min		
Tx OMI (5)		60%	
Laser Turn ON Level (±1.5 dB)		5 dBmV	
Laser Turn OFF Level (±1.5 dB)		-4 dBmV	
Laser Turn ON Time		1.3 µs	
Laser Turn OFF Time		1.6 µs	
Power, Environmental & Physical			
Total Power Consumption (with 15 VDC power pack)	≤ 6.5 W		
Operating Temperature	-40°C to +60°C (-40°F to +140°F)		
Dimensions (H x W x D)	3.4"H x 6.7"W x 1.5"D (8.6H x 17.0W x 3.8D cm)		
Weight	1.55 lb (0.70 kg)		

NOTES:

(1) Other diplex splits available: 42/54 MHz; 65/85 MHz

(2) -1 dBm optical input, 3.5% OMI/channel, 54 to 550 MHz analog channels, and digital compressed channels

(3) NPR @ 30 dB. Measured using a receiver with an equivalent input noise (EIN) of < 2.5 $pA/Hz^{0.5}$ with a link budget of 23 dB (20 km fiber + passive loss). NPR test performed with 80 MHz noise loading.

(4) 3.5% OMI/channel

(5) SCTE 174 2010 with a single 39 dBmV tone. 60% ± 3 dB.

(6) Groups of 8 user selectable optical wavelengths separated by 0.5nm to choose from 1603.5 – 1616.5nm.

8. Ordering Matrix

	Fwd Output Level		Total Return Input Power		Laser Type		Tx Power		Optical Connector		Tx Wavelength		Sub Split		Power Adapter
LBON320ACT	-	xx	-	xx	-	x	-	x	-	xx	-	xx	-	xx	-	xx
		20 = 20 dBmV		25 = 25 dBmV		D = DFB		2 = 2 mW		SA = SC/APC		61 = 1610 nm		45 = 42/54		00 = None
		36 = 36 dBmV		30 = 30 dBmV						SU = SC/UPC				68 = 65/85		01 = N. America
														81 = 85/102		02 = Europe

For example: LBON320ACT-20-30-D-2-SA-61-81-00

LBON320ACT OBI Free Mini RFoG Optical Node, 20dBmV Forward Output levels, 30dBmV Total Return Input Power; 2mW DFB Laser, SC/APC Optical connector, 1610nm Tx wavelength, 85/102MHz sub-split and no power adapter.

9. OPERATION AND SETUP

Each ONU will have a group of 8 wavelengths based on the laser's median wavelength. The median wavelength will be in the range of 1610±6.5nm. For setup use the wavelength chart in Figure 3.

ʎ 37	1603.5 nm
ʎ 38	1604 nm
ʎ 39	1604.5 nm
ʎ 40	1605 nm
ʎ 41	1605.5 nm
ʎ 42	1606 nm
ʎ 43	1606.5 nm
ʎ 44	1607 nm
ʎ 45	1607.5 nm
ʎ 46	1608 nm
ʎ 47	1608.5 nm
ʎ 48	1609 nm
ʎ 49	1609.5 nm
ʎ 50	1610 nm
ʎ 51	1610.5 nm
ʎ 52	1611 nm
ʎ 53	1611.5 nm
ʎ 54	1612 nm
ʎ 55	1612.5 nm
ʎ 56	1613 nm
ʎ 57	1613.5 nm
ʎ 58	1614 nm
ʎ 59	1614.5 nm
ʎ 60	1615 nm
ʎ 61	1615.5 nm
ʎ 62	1616 nm
ʎ 63	1616.5 nm

1610nm ±5nm Centre Wavelength

Figure 3: Wavelength chart for LBON320ACT

For example: A group of wavelengths from λ52 to λ59 has been shown. The median wavelength for this group is λ55 i.e. 1612.5nm. See Figure 4.

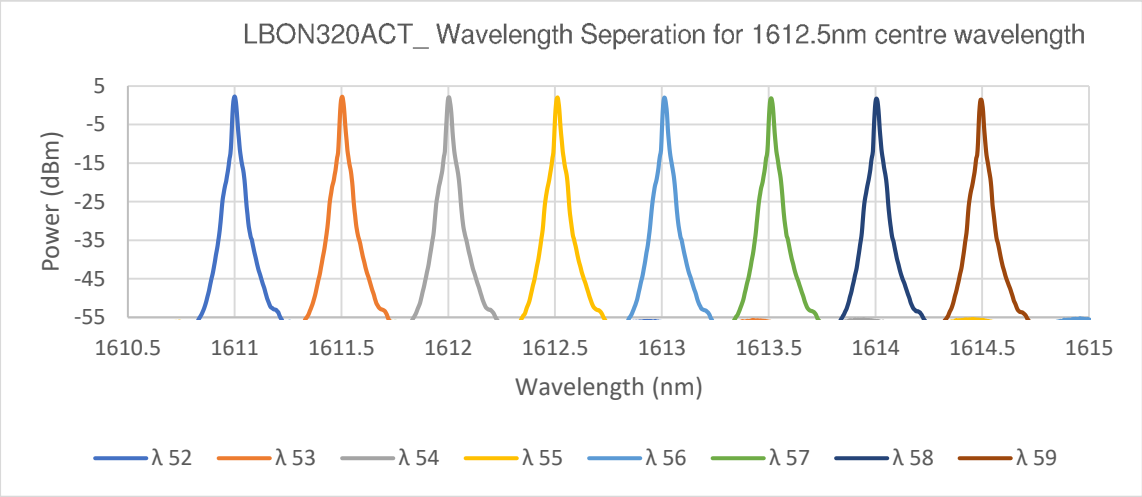

Figure 4: Wavelength separation and group

1. Connect the grounding wire to the grounding stud on the ONU.

2. Carefully clean all the fiber optic connectors and jumper cables. Use appropriate cleaning swabs for fiber optic cables and connectors. Check for contamination/blemish on the fiber cable and connector with a fiber inspecting microscope. Ensure the fiber optic connectors and jumper cables are clean. Also ensure optical jumper connectors are matched properly to the device adapters. (i.e. SC/APC to SC/APC). Using mismatched connectors will damage the equipment and degrade performance. Ensure each fiber has a matching connector.

3. Using an optical power meter, measure the 1550nm input optical power level at the fiber optic connector coming into the node. The acceptable range is -6 to +2 dBm.

4. Connect incoming fiber to the fiber adapter and power the unit by applying +12V to 15VDC to the PWR IN port. Power can also be applied through the RF OUT/PWR IN port by combining RF and Power via Power inserter.
5. The Lindsay's LBON320ACT has 3 LED status indicators.

LED	Status	Indication
OPT IN	OFF	Optical Input Power < -10dBm
OPT IN	**GREEN**	Optical Input Power ≥ -10 dBm
OPT OUT	OFF	Upstream RF signal is ≤ -4dBmv ± 1dB
OPT OUT	**GREEN**	Upstream RF signal is ≥ +5dBmv ± 1dB
PWR LED	OFF	No DC power
PWR LED	**GREEN**	Unit is powered ON

6. When the Receive Optical power is within range, the OPT IN LED will turn **GREEN**. Press the push button twice to display the received optical power on the LED display. If the optical received power is lower than -10dBm, the LED display will show "---". If the received optical power is too high (> 3 dBm), the LED display will flash 3 times every minute to indicate high optical receive power. If the LED display is flashing, please attenuate the optical input levels into the ONU. High optical input levels could saturate/overload the receiver and possibly damage the receiver.

7. After 1 minute of inactivity, the LED display will turn OFF. To turn the LED display back ON, press the push button on the LBON320ACT front panel.

8. Verify RF output levels, use the -20dB RF Test point which has 20dB lower levels than the RF output port. RF Output levels will be as specified only with 3.5% or higher OMI from 1550nm Transmitter.
9. The unit can display the selected wavelength, highest wavelength, lowest wavelength and Received optical power of the ONU. See Figure 5.

	Status	Example			Interpretation	Example Picture
1	Current Wavelength Setting	λ	5	5	Current Wavelength on this ONU is λ55 = 1612.5nm	
2	Received Optical Power	-	1 .	2	Optical Power received is -1.2 dBm	
3	High Limit Wavelength	H	5	9	The highest wavelength that can be set on this ONU is λ59 = 1614.5nm	
4	Low Limit Wavelength	L	5	2	The lowest wavelength that can be set on this ONU is λ52 = 1611nm	

Figure 5: Display settings interpretation

10. To check or change the current wavelength:
    a. Push the button on the LBON320ACT once. It will first display the "current wavelength" of the ONU. If this is your preferred wavelength setting (refer to chart in Figure 3), proceed to step #11. If you would like to change the current wavelength setting, follow steps 10.b through 10.e.

    b. To change the current wavelength setting, press and hold the push button for 3 seconds, until the display changes from "λ55" to "S55". The LED screen starts flashing. Release the push button.

c. Press the push button and the display will change from “S55” to “S56”. Push the button once more to go to the next wavelength (i.e. “S57”). Once the display reaches the highest wavelength (i.e. “S59” in this example), press the button once again, the display will cycle to its lowest wavelength limit (i.e. “S52”).

d. Continue pressing the push button until you have reached the desired wavelength (let’s assume “S54”). To set the desired wavelength, press and hold the button for 3 seconds. The display will change from “S54” to “λ54” and the display will stop flashing.

e. The transmit wavelength on this ONU is set to “λ54” i.e. 1612.0 nm.
f. To check the highest wavelength on any ONU, press the button three times when the screen is off/idle. The “Hxx” number will give the highest wavelength on the ONU. Press the button once more to check the lowest wavelength of the ONU. “Lxx” number will give the lowest wavelength on the ONU. In this example the highest wavelength is “H59” 1614.5nm, and the lowest wavelength is “L52” 1611.0nm.

11. Upstream RF signal is to be injected into the RF input/output port. Make sure the signal is within the upstream bandwidth (5 to 42MHz, 5 to 65MHz or 5 to 85 MHz). If the input signal is > +5dBmV, the Transmit Laser will turn ON and OPT OUT LED will illuminate **GREEN**.

12. The upstream input level range is 20 to 40 dBmV total power and can be checked on the bi-directional test point. Note, test point is -20dB relative to the RF port.

13. This concludes the setup of the LBON320ACT.

10. TROUBLE SHOOTING

1. **No power on the ONU**
    a. Check Coaxial cable and connectors
    b. Check power adapter for proper DC voltage (+12V to 15VDC).
    c. Check with a different 12V or 15V power pack that is at least rated for more than 500mA.
    d. Powering via the RF OUT PWR IN port using power inserter.
    e. Check for intermittent connections.

2. **Low or No downstream output level**
    a. Verify optical receive level is within receive range (-6dBm to +2dBm) and 1540nm to 1565nm. Verify the optical signals have 3.5% OMI.
    b. Check and clean the optical connector and adapter.
    c. Check OPT IN LED. It should be ON if above conditions are met. Refer to operation and setup for details.
    d. Check for intermittent connections or pinched fibers.

3. **Low or No Upstream Transmit level**
    a. Check the upstream RF level is within 20-40dBmV total power level
    b. Ensure bandwidth upstream frequency is within the selected return bandwidth.
    c. Check with a CW carrier to keep the transmit laser ON. -20dB test point can also be used to inject a test carrier.
    d. Check using optical power meter with 1610nm setting to verify output power is in spec (3dBm).
    e. Check for intermittent connections or pinched fibers.

4. If problem is not resolved, replace ONU.

5. Contact Lindsay Broadband. Do not open the unit. It will void the warranty.