

# Vx4N900

## **4-Output Optical Node**

Installation & Operation  
Manual

# Introduction

This manual describes the basic operation, function, installation, operation procedure, notes, and maintenance of Vx4N900 CATV outdoor optical node. Users are advised to read the manual thoroughly before installation.

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# Chapter 1 Introduction

## Overview

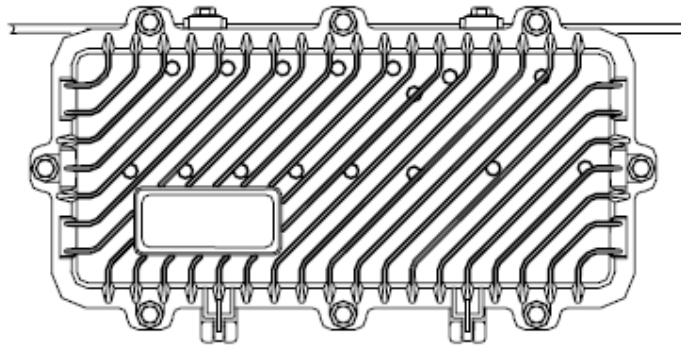
Vx4N900 is a 4 port optical node that is capable of providing up to 48dBmV output power at 870MHz, with an optical input level from -6dBm to +2dBm. This optical node can be configured to have up to 3 optical receivers and 2 return path transmitters. Vx4N900 can be powered by one or two power supplies. When two power supplies are used, each power supply provides 50% of the loading. If one of these fails, the other will assume 100% of the node's powering requirements, ensuring the continuous operation of the node. The return path in the Vx4N900 optical node can be configured in 3 different ways by changing the low pass filter, providing a flexible node for HFC networks.

## Features

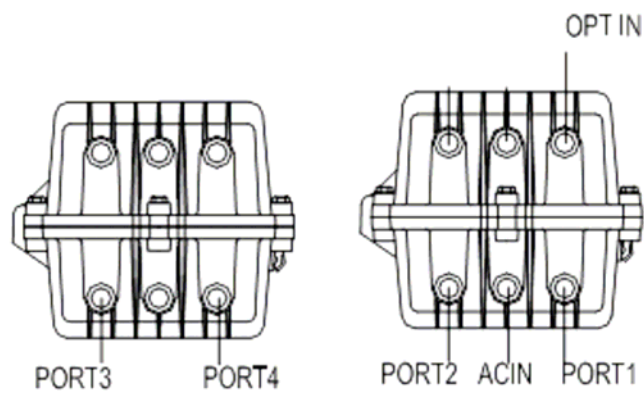
- ◆ 870MHz Bandwidth
- ◆ 3 optical receiver modules
- ◆ 2 return optical transmitter modules
- ◆ 4 high output driven paths
- ◆ Optional power supply redundancy
- ◆ Plug in equalizers and attenuator pads
- ◆ Individual attenuator control on each separate return path
- ◆ 15 continuous Ampere power passing
- ◆ Optional status monitoring and control
- ◆ Optical Input Power: -6dBm to +2dBm
- ◆ Aluminum-Alloy housing, Anti-oxidation design

## Housing

Vx4N900 is sealed in a two-piece die-cast aluminum housing which consists of a removable lid (with optical receiver, optical transmitter, fiber management tray and power supply inside) and a housing base (with RF module).



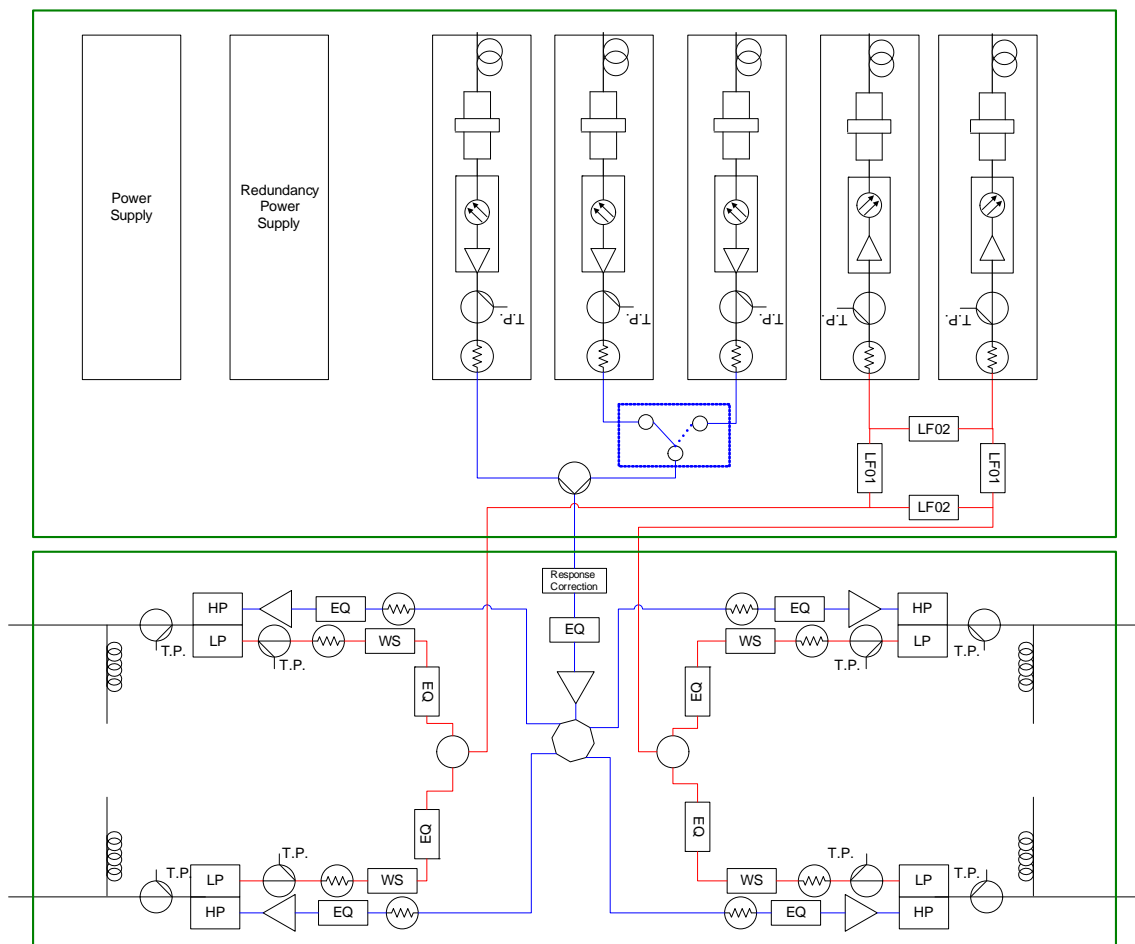
Pic 1-1 The front view of housing



Pic 1-2 The port for housing

# Chapter 2 Product Description

## Block diagram



# Specifications

Parameter	Units	Spec.	Note
<b>Forward</b>			
<b>Optical Performance</b>			
Optical wavelength	nm	1290 to 1600	
Optical input power	dBm	-6 to +2	
Optical return loss	dB	>40	
<b>Station Performance</b>			
Housing passband	MHz	5 to 1000	
Maximum input current	A	15	
<b>RF Section Performance</b>			
RF bandwidth	MHz	47/54/87 to 870	
Return Loss	dB	<-16	
Flatness	dB	+/-1.0	
Gain slope	dB	12+/-1	
RF output power @54/550/750/870MHz	dBmV	35/44/47/48	-1dBm optical input, OMI=3.5%
Test point	dB	-20+/-1	
<b>RF Section Distortion Performance</b>			
CNR	dB	>51	1,2
CSO	dB	>63	1,2
CTB	dB	>65	1,2
XMOD	dB	>63	1,2

1. Link performance with 10km fiber + attenuator, optical input power -1dBm

2. 77 NTSC analog channels loading

<b>Reverse</b>			
<b>Optical Performance</b>			
Optical wavelength	nm	1310nm	
Optical output power	mW	FP 0.5 to 1 DFB 1 to 2	
<b>RF Performance</b>			
RF bandwidth	MHz	5 to 30/42/65	
Return Loss	dB	<-16	
Flatness	dB	+/-1	
RF input to node	dBmV	22+/-1	
Test point	dB	-20+/-1	
<b>RF Link Performance</b>			
CNR	dB	>51	10km fiber + att.
CSO	dBc	<-55 for FP <-60 for DFB	1

1. Two tone test, f1 = 13 MHz, f2 = 19 MHz, optical input power to receiver= -6dBm(10km fiber + attenuator)

## Electrical

Input voltage range	VAC	40 to 95	
AC input frequency range	Hz	47 to 63	
Power consumption	W	<80	Full loading

## Physical

Dimensions	mm	480Lx255Wx225H	
Weight	Kg	15	

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## Absolute Maximum Ratings

These are absolute stress ratings only. Stresses in excess of the absolute maximum ratings can cause permanent damage to the node. Functional operation of the device is not implied at these conditions. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

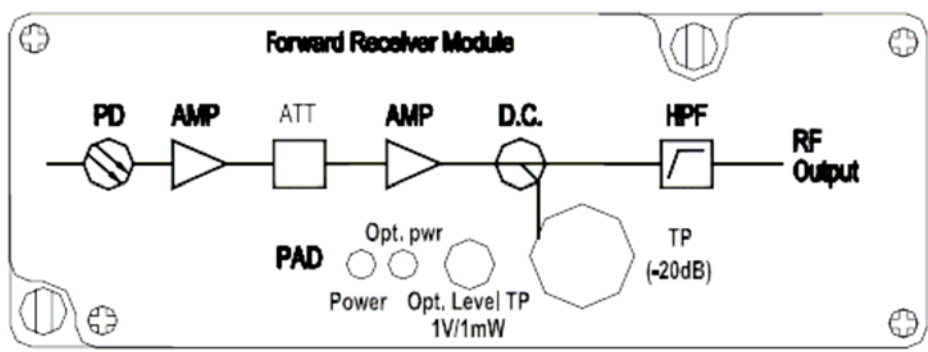
Parameter	Symbol	Unit	Min	Max
Operating temperature	Top	°C	-25	55
Storage temperature	Tstg	°C	-40	70
Humidity	H	%		95, non-condensing

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## Optical node components

### Optical receiver

The Vx4N900Rx optical receiver converts the optical input into RF output. It has an LED to indicate the presence of an optical signal. A -20dB test point is used to test the RF output of the receiver.



Pic 2-1 Block diagram of optical receiver

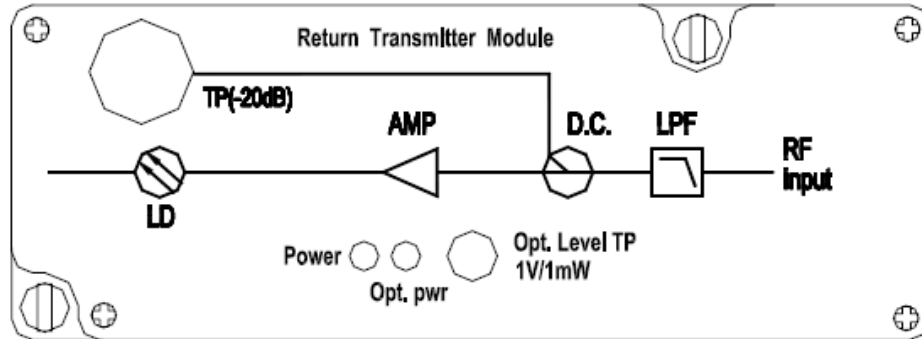
Item	Description
Optical test point	DC voltage test point to indicate optical input power, 1VDC=1mW
Power LED	Lit when DC powering presents (RED)
Optical in LED	Lit when optical input power in normal range (GREEN)

Table 2-1 Optical input power VS test point voltage

Input power(dBm)	Input power(mW)	Voltage(V)
5	3.16	3.16
4.5	2.82	2.82
4	2.51	2.51
3.5	2.24	2.24
3	2.0	2.0
2.5	1.78	1.78
2	1.58	1.58
1.5	1.41	1.41
1	1.26	1.26
0.5	1.12	1.12
0	1.0	1.0
-0.5	0.89	0.89
-1	0.79	0.79
-1.5	0.71	0.71
-2	0.63	0.63
-2.5	0.56	0.56
-3	0.50	0.50
-3.5	0.45	0.45
-4	0.41	0.4
-4.5	0.35	0.35
-5	0.32	0.32
-5.5	0.28	0.28
-6	0.25	0.25

## Optical transmitter

The **FP1 and FP2** (.5-1.0mW, FP 1310nm with or without isolator), **DF0 and DF1** (1.0-2.0mW, DFB 1310nm with or without isolator), and **DF2** (3.0mW, DFB 1310nm with isolator) optical transmitters allow RF return path signals to be sent back via fiber. A -20dB test point is used to test the RF input level to the transmitter.



Pic 2-2 Block diagram of optical transmitter

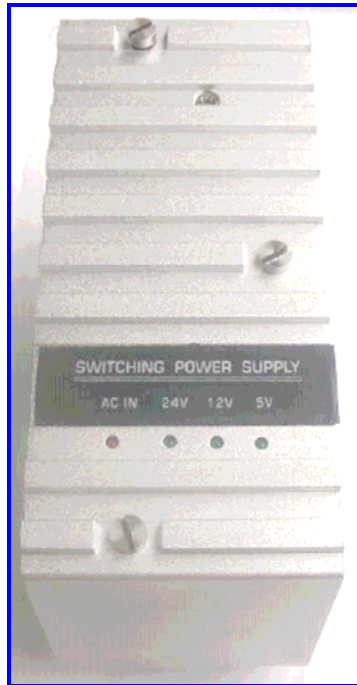
Item	Description
Optical test point	DC voltage test point to indicate optical output power, 1VDC=1mW
Power LED	Lit when DC powering presents (GREEN)
Optical in LED	Lit when optical input power in normal range (GREEN)

Table 2-2 Optical output power VS test point voltage

Optical power(dBm)	Voltage(V)	Optical power(dBm)	Voltage(V)
-10	0.1	0.8	1.25
-6	0.25	1.4	1.5
-3	0.5	2.3	1.75
-1.5	0.75	3	2
0	1		

## Power supply

The Vx4N900-PS power supply module accepts a quasi-square wave input between 40 to 95 VAC to provide outputs of +24, +12, and +5 volts. Two Vx4N900-PS can be used to provide powering redundancy.



Pic 2-3 Power supply

## Equalizer

Equalizer (see pic 2-4) are used to make adjustments in the output slope of the node when needed. The equalizers are used in both the forward and reverse paths. Forward equalizers go from 0dB to 20dB in 2dB steps (E00, E02, E04...E18, and E20). The reverse equalizers go from 0dB to 10dB in 2dB steps (RE00, RE02, RE04...RE08, and RE10).



Pic 2-4 Equalizer

## PAD

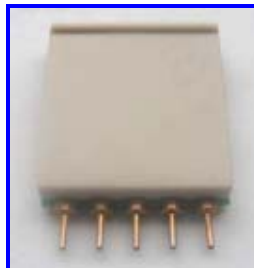
Attenuator pads (see pic 2-5) adjust signal levels when setting up RF inputs and outputs. The values of these attenuator pads goes from 0dB to 20dB in 2dB steps (P00, P02, P04...P18, and P20).



Pic 2-5 Pad

## Low pass filter

There are two types of low pass filters for Vx4N900 optical node: LF-01 and LF-02. LF-02 low pass filter is designed with coupler functionality. LF-01 and LF-02 are used for return path transmitter configurations.



Pic 2-6 Low pass filter

## Diplex filter

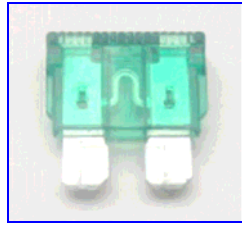
Diplex filter for both the forward and return path signals and are available in standard worldwide frequency splits.



Pic 2-7 Diplexer filter

## Fuse

Fuse is used for powering routing in the Vx4N900, see pic 2-8



Pic 2-8 Fuse

## Chapter 3 Installation and setup

### Packing list

Please check follow item after receiving the node

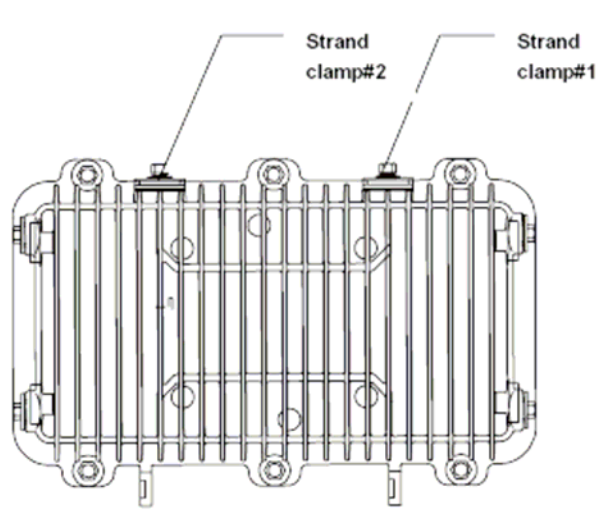
- Check the outside carton for any damage
- Open the carton
- Check the node for any damage
- Check that all accessories are with the node

The accessories shipped with Vx4N900 optical node are as below table 3-1

Item	Specification	Quantity
Equalizer(forward)	0dB	1pcs
Pad	0dB	1pcs
Operation manual	--	1pcs
Test report	--	1pcs

### Mounting the housing

- Loosen the two strand clamps on the housing (see pic 3-1 for locations).
- Determine the position of the optical node on the strand.
- Slip the strand into each strand clamp and torque the two strand clamp bolts from 60 to 80 in-lbs.
  - Note: Do not over-tighten the bolts, as this will damage them.

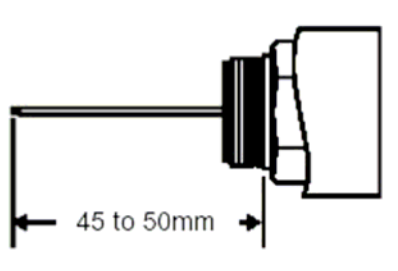


Pic 3-1 Strand clamp bolts

## Connector installation

The procedure to install the pin-type RF connector into the housing is:

- Remove the caps from the housing.
- Cut the pin length as below pic 3-2

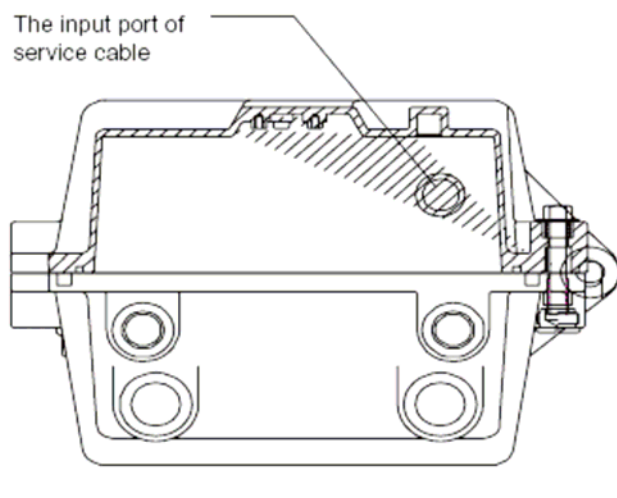


Pic 3-2 Pin length of RF connector

- Install the RF connector into the housing per the recommendations of the RF connector manufacturer

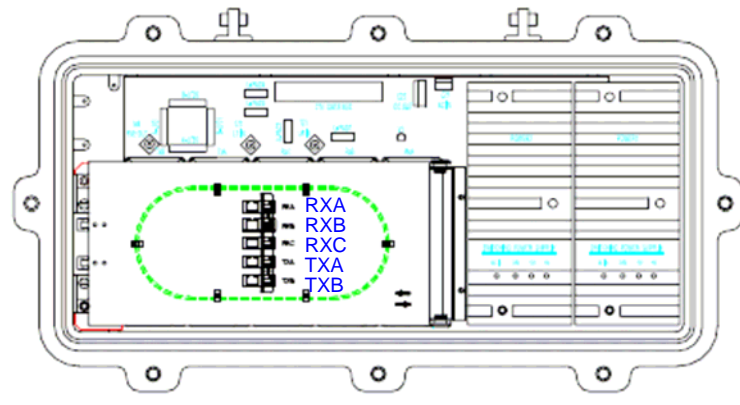
The procedure to install the service cable into the housing is:

- Insert the service cable into the housing per 3-3 below



Pic 3-3 the input port of fiber service cable

In the fiber management tray, plug the right connector to internal connector adaptor, please make sure the connector types are identical, as pic 3-4.



Pic 3-4 Fiber management tray

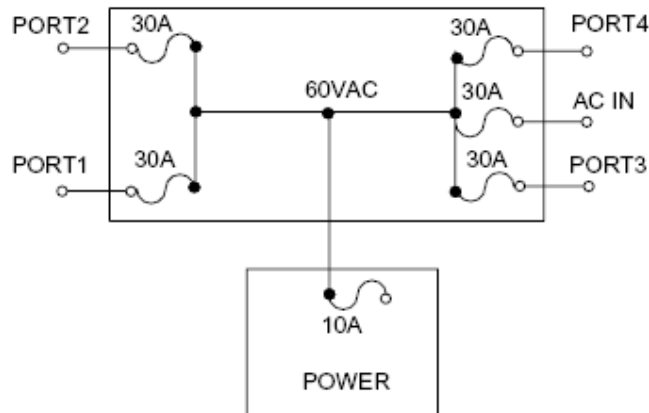
## Powering

### Check the voltage of input power

The Vx4N900-PS power supply module accepts a quasi-square wave input between 40 to 95 VAC (frequency from 47 to 63 Hz) to provide outputs of +24, +12, and +5 volts. The node can be configured with two power supplies for redundancy.

### Check the power input port

Select a port to provide the powering and insert the fuse into the correct location. See pic 3-5 for the fuse configuration for Vx4N900. The LED will light when the fuse is inserted.



Pic 3-5 Fuse configuration

### Routing the power

Select ports to route the power, and then insert the fuse into the correct location.

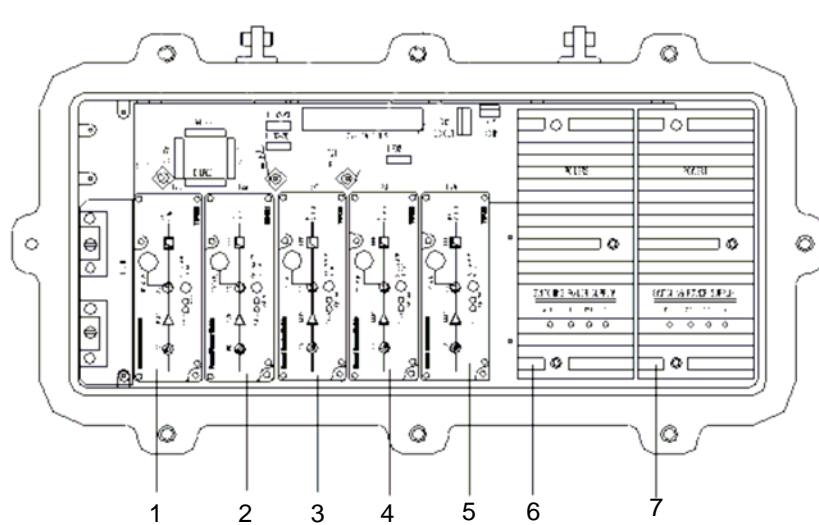
## Setup the node

### Forward path adjustment

Vx4N900 can be equipped with 3 optical receiver modules (A,B,C), the bandwidth of each is from 45 to 870MHz. Path A and B back each other up.

Vale Systems recommend the following configurations:

1. Using path C only (for video & data)
2. Using path A, and path B as a back up(for video & data)
3. Path C transmits video, path A & B transmits data



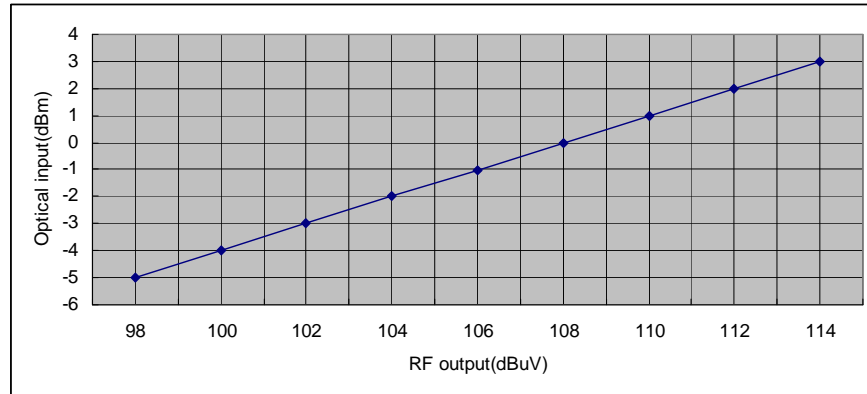
Item	Module
1	Return transmitter B
2	Return transmitter A
3	Forward receiver C
4	Forward receiver B
5	Forward receiver A
6	Power supply 2
7	Power supply 1

Pic 3-6 Location for main modules

Use the equalizers and attenuator pads to adjust the RF output power and slope according to system specification. The highest level can not exceed 48dBmV. To adjust the output level for a certain port, you adjust the corresponding attenuator pad (P00-P20). When adjusting the slope with equalizers, the slope of each output level will change (the slope range is 7-15dB).

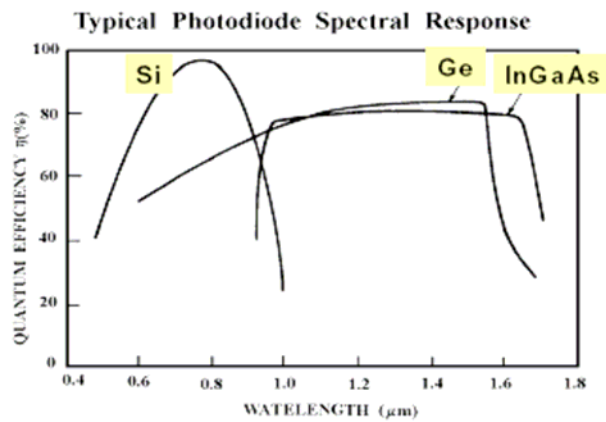
The corresponding output level can only be decreased, and slope can only be increased.

The relation between input optical power & output level is as below pic 3-7:



Pic 3-7 RF output level VS optical input power

We use InGaAs PIN photodiode as optical power detector (see pic 3-8)



Pic 3-8 InGaAs photodiode responsivity curve

Return path adjustment

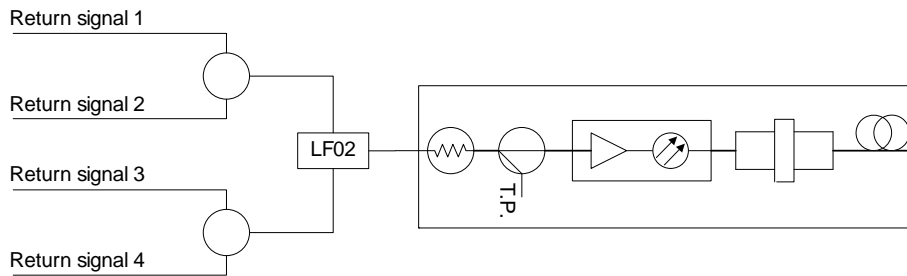
Return path

Vx4N900 node can be configured with both **FP and DFB 1310nm** return path transmitters for different applications:

1. **FP1** - 0.5-1.0mW, FP 1310nm, without isolator
2. **FP2** - 0.5-1.0mW, FP 1310nm, with isolator
3. **DF0** - 1.0-2.0mW, DFB 1310nm, without isolator
4. **DF1** - 1.0-2.0mW, DFB 1310nm, with isolator
5. **DF2** - 3.0mW, DFB P1310nm, with isolator

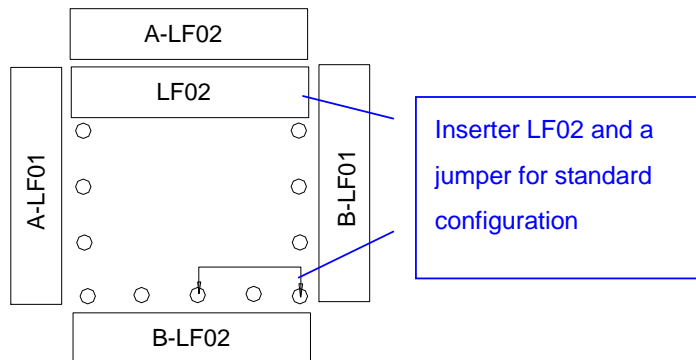
**Standard Configuration:**

4 return path signals mix together by using the LP filter LF02 and transmit it through return laser transmitters to the head-end. The return path transmitter must be placed in the location A of Return transmitter (see pic 3-6).



Pic 3-9 Standard configuration for return path

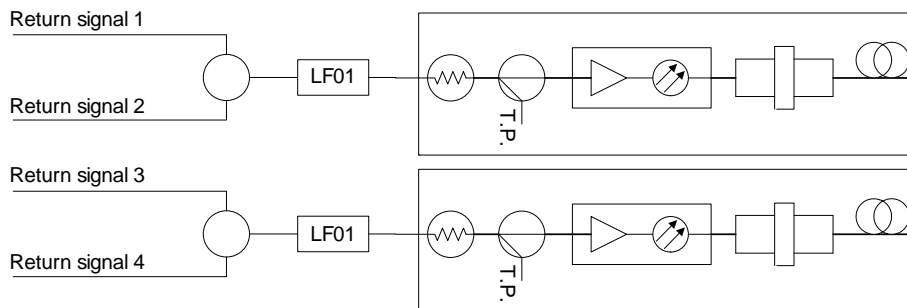
The standard return path configuration is to insert a low pass filter LF-02 into the location (as pic 3-10). A jumper is also needed for this configuration.



Pic 3-10 Low pass filter insertion for standard configuration

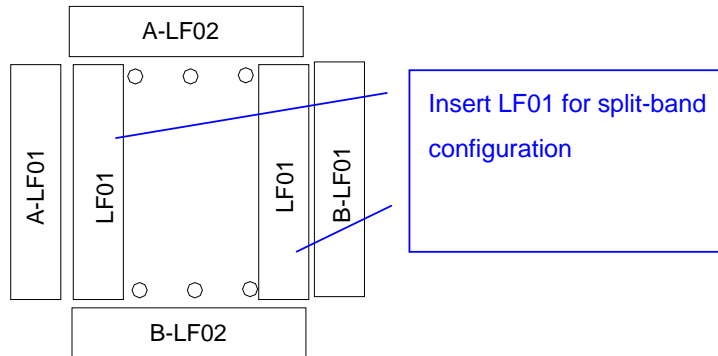
**Split-band Configuration:**

Using the LP filter LF01, two of the four RF return signals are fed to one optical transmitter, while the remaining two signals are fed to the other transmitter.



Pic 3-11 Split-band configuration for return path

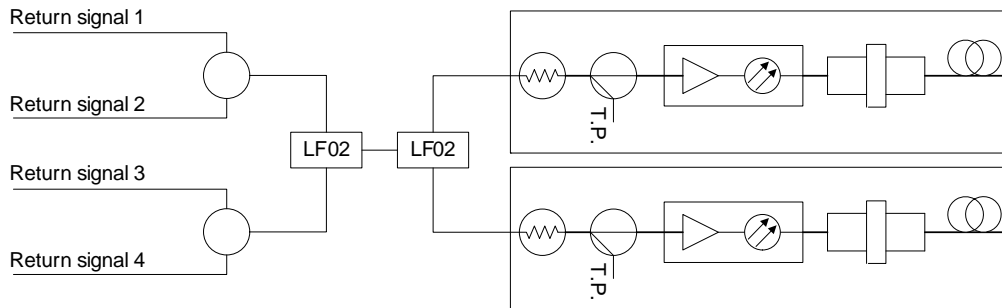
To configure the split-band return path configuration, insert two low pass filters LF-01 into the location as pic 3-12.



Pic 3-12 Low pass filter insertion for split-band configuration

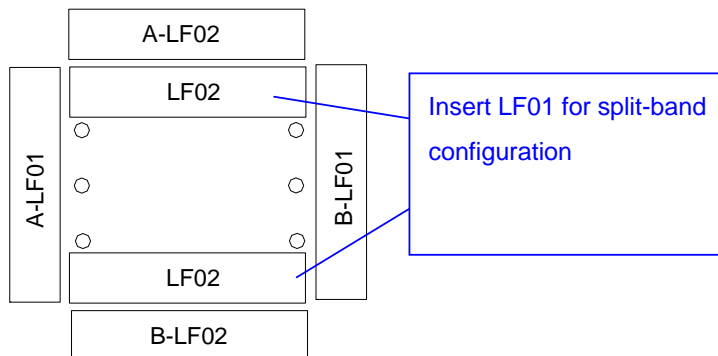
**Redundancy Configuration:**

Mixes 4 return path signals together and transmit it through both return transmitters. In the event that one path fails, it will be automatically rerouted to the other.



Pic 3-13 Redundancy configuration for return path

To configure the split-band return path configuration, insert two low pass filters LF-02 into the location as pic 3-14.

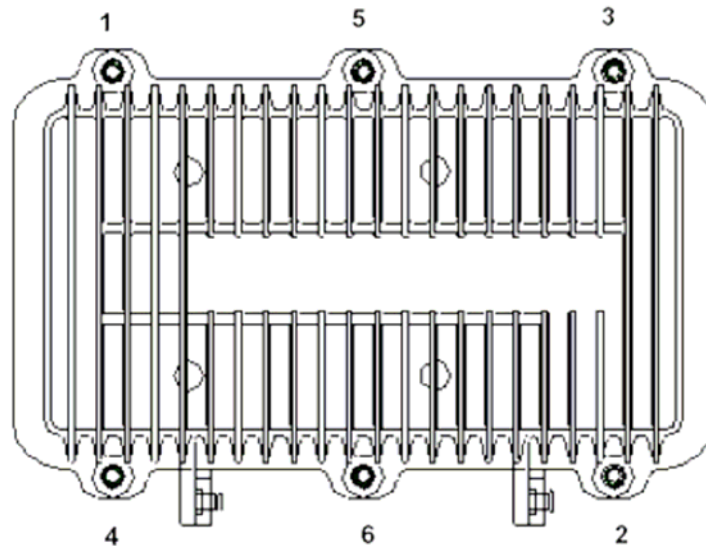


Pic 3-12 Low pass filter location for split-band configuration

## Close the housing

Before closing the housing, ensure that:

- All screws holding the RF module are in place and properly tightened (the module will not dissipate heat adequately if not properly seated against the housing).
- All screws attaching the metal cover plate to the RF module are tightened.
- All ports plugs on unused ports are in place and properly tightened to prevent water entry.
- All RF and fiber connectors are properly installed and properly tightened to prevent water entry.
- After you have correctly set all RF levels and verified installation and tightness of all ports and screws, close the housing cover and finger tighten the four cover bolts. With a torque wrench, initially tighten all six bolts to 15 inch-pounds by following the sequence as shown in Figure 3-5, below. Repeat the same sequence using a final torque of 60-80 inch-pounds.



Pic 3-x Housing cover bolts tightening sequence

## Troubleshooting

When there is no RF output or the RF output level is lower than expected:

- Open the node housing
- Check if AC power exists at the input test point and verify that the input levels are correct.

If there is no AC power, check that the fuse is properly inserted.

If there is AC power, then check the DC output power, verify that the +24, +12, and +5VDC are correct at the power supply test point. Replace the power supply module if they are not correct.

If there is no problem with the power supply, verify that all pads and equalizers are in place and fully seated in the sockets.

If all pads are working properly, replace the RF module.