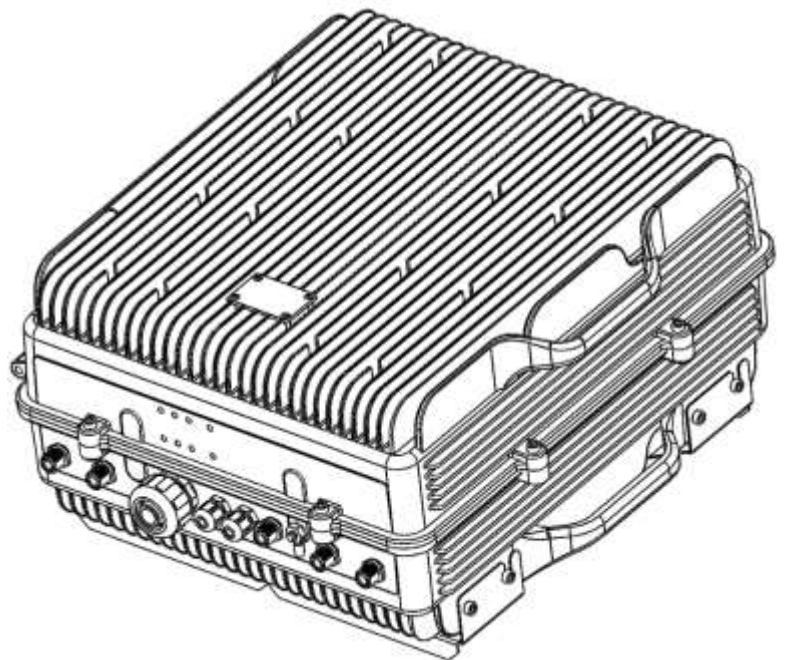




# DH4L – UHF Low Digital Fiber DAS User & Installation Manual



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Document History

Description	Revision	Date Issued
Original version	1.0	July 3 <sup>rd</sup> , 2014
General Review	2.0	March 2 <sup>nd</sup> , 2016

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## About this manual

This manual describes installation, commissioning, operation and maintenance of the **Fiplex UHF Low Digital Fiber DAS**, and **Fiplex Control Software (FCS)**. The hardware included in this manual corresponds to the **Digital Master Unit DH4L00-M (DM)**, and **Digital Remote Unit DH4L37-R (DR)**.

The first part of the manual describes the Digital Fiber DAS hardware and the second part describes the software.

Hardware and software mentioned in this manual are subjected to continuous development and improvement. Consequently, there may be minor discrepancies between the information in the manual and the performance and design of the hardware and software. Specifications, dimensions and other statements mentioned in this manual are subject to change without notice.

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# Contents

<b>Part 1 HARDWARE</b> .....	¡Error! Marcador no definido.
1. Safety .....	¡Error! Marcador no definido.
2. Product Description .....	4
2.1 Digital Master Unit Ports .....	5
2.2 Digital Remote Unit Ports .....	6
2.3 Connection Diagram .....	7
2.4 FO Connection.....	8
2.4.1 FO Connection in Master Unit .....	8
2.4.2 FO Connection in Remote Unit.....	9
2.5 Interface with signal source .....	10
3 Installation.....	12
Mounting .....	12
Opening and Closing the Cabinet.....	15
Nema4X considerations .....	19
4 Commissioning .....	20
4.1 Connection step by step .....	20
4.2 Starting Operation.....	23
4.3 Status Indicators .....	27
4.4 Laboratory Measurements.....	28
<b>Part 2 SOFTWARE</b> .....	<b>29</b>
5 Introduction.....	29
6 USB Software.....	29
6.1 Software description (Digital Master) .....	29
6.2 RF parameters description (Digital Master) .....	31
6.3 Software description (Remote Unit) .....	36
7 Local Software. Installation and troubleshooting .....	37
7.1 Installation .....	37

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## Abbreviations

AGC	Automatic Gain Control
AMPS	Advanced Mobile Phone Service
ARFCN	Absolute Radio Frequency Channel Number
BCCH	Broadcast Control Channel (GSM broadcast channel time slot)
BS	Base Station, BS antenna = towards the base station
CDMA	Code Division Multiple Access
DC	Direct Current
DCS	Digital Communication System (same as PCN)
DL	Downlink signal direction (from base station via repeater to mobile station)
DPLX	Duplex filter
EEPROM	Electrical Erasable Programmable Read Only Memory
EGSM	Extended Global System for Mobile communication
ETACS	Extended Total Access Communication System
ETSI	European Telecommunications Standard Institute
FCS	Fiplex Control Software
GSM	Global System for Mobile communication
HW	Hardware
LED	Light Emitting Diode
LNA	Low Noise Amplifier, uplink and downlink
MS	Mobile Station, MS antenna = towards the mobile station
OMS	Operation and Maintenance System
OL	Overload
PA	Power Amplifier
PCN	Personal Communication Network (same as DCS)
PCS	Personal Communication System
PS	Power Supply
RF	Radio Frequency
RSSI	Received Signal Strength Indication
SW	Software
TDMA	Time Division Multiple Access
UL	Uplink signal direction (from mobile station via repeater to base station)
WEEE	Waste of Electric and Electronic Equipment

## Part 1 HARDWARE

### 1. Safety

#### Dangerous Voltage Warning

Any personnel involved in installation, operation or service of Fiplex Digital Fiber DAS **must** understand and obey the following:



The power supply unit in Digital Fiber DAS supplied from the mains contains dangerous voltage level, which can cause electric shock. Switch the mains off prior to any work in such a Digital Fiber DAS. Any local regulations are to be followed when servicing Digital Fiber DAS. Authorized service personnel only are allowed to service Digital Fiber DAS while the main is switched on.

Any Digital Fiber DAS, including this Digital Fiber DAS, will generate radio signals and thereby give rise to electromagnetic fields that may be hazardous to the health of any person who is extensively exposed to the signals at the immediate proximity of the Digital Fiber DAS and the Digital Fiber DAS antennas.

#### Radiation Hazard Warning

##### R&TTE Compliance Statement

This equipment complies with the appropriate essential requirements of Article 3 of the R&TTE Directive 1999/5/EC.

##### Station Ground



BTS chassis, Digital Fiber DAS, feeders, donor antenna, service antenna/s and auxiliary equipment (splitters, tabs, .etc) are required to be bonded to protective grounding using the bonding stud or screw provided with each unit.



##### Electrostatic Discharge

Static electricity means no risk of personal injury but it can severely damage essential parts of the Digital Fiber DAS, if not handled carefully.

Parts on the printed circuit boards as well as other parts in the Digital Fiber DAS are sensitive to electrostatic discharge.

**Never touch printed circuit boards or uninsulated conductor surfaces unless absolutely necessary.**

If you must handle printed circuit boards or uninsulated conductor surfaces, use ESD protective equipment, or first touch the Digital Fiber DAS chassis with your hand and then do not move your feet on the floor.

Never let your clothes touch printed circuit boards or uninsulated conductor surfaces.



##### Disposal of Electric and Electronic Waste

Pursuant to the WEEE EU Directive electronic and electrical waste must not be disposed of with unsorted waste. Please contact your local recycling authority for disposal of this product.

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## **FCC Compliance**

This is a Class B signal booster

**WARNING:** This is a 90.219 Class B device. This is **NOT** a **CONSUMER** device. It is designed for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS**. You **MUST** have an **FCC LICENSE** or express consent of an FCC Licensee to operate this device. You **MUST** register Class B signal boosters (as defined in 47 CFR 90.219) online at [www.fcc.gov/signal-boosters/registration](http://www.fcc.gov/signal-boosters/registration). Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation. The installation procedure must result in the signal booster complying with FCC requirements 90.219(d). In order to meet FCC requirements 90.219(d), it may be necessary for the installer to reduce the UL and/or DL output power for certain installations.



**ATTENTION:** This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.



**ATTENTION:** FCC regulation mandate that the ERP of type B signal boosters should not exceed 5W. This Digital Fiber DAS has a maximum DL composite output power of 5W (+37dBm) and UL composite output power of +24dBm, therefore the gain of the DL antenna should be of 0dBi or less and maintain a minimum separation of 55 cm from all persons, and the gain of the UL antenna should be 13dBi or less and maintain a minimum separation of 55 cm from all persons.

## **IC Compliance**

As per RSS 131 Issue 2:

- Nominal passband gain: 80dB max
- Nominal bandwidth: 90 kHz maximum for Canada market
- Rated mean output power: +37dBm maximum in DL and +24dBm maximum in UL
- Input and Output impedances: 50 ohms

The Manufacturer's rated output power of this equipment is for single carrier operation. For situations when multiple carrier signals are present, the rating would have to be reduced by 3.5 dB, especially where the output signal is re-radiated and can cause interference to adjacent band users. This power reduction is to be by means of input power or gain reduction and not by an attenuator at the output of the device.

RF Exposure Statement for ISED: "This device complies with Health Canada's Safety Code. The installer of this device should ensure that RF radiation is not emitted in excess of the Health Canada's requirement. Information can be obtained at [http://www.hc-sc.gc.ca/ewh-smrt/pubs/radiation/radio\\_guide-lignes\\_direct/index-eng.php](http://www.hc-sc.gc.ca/ewh-smrt/pubs/radiation/radio_guide-lignes_direct/index-eng.php)"

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The antenna/s used for this transmitter must be installed to provide a separation of at least 55 cm in DL and 55 cm in UL from all persons and must not be collocated or operating in conjunction with any other antenna or transmitter. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

*Selon RSS 131 Issue 2:*

- *Gain de bande passante nominal: 80dB max*
- *Bande passante nominale: 90kHz maximum pour le marché canadien*
- *Puissance nominale de sortie moyenne: + 37dBm maximum en DL et +24dBm maximum en UL.*
- *Impédances d'entrée et de sortie: 50 ohms*

*La puissance de sortie nominale du fabricant de cet équipement est pour le fonctionnement d'une seule porteuse. Pour les situations où plusieurs signaux de porteuse sont présents, la cote devrait être réduite de 3,5 dB, en particulier lorsque le signal de sortie est ré-irradié et peut causer des interférences aux utilisateurs de bande adjacents. Cette réduction de puissance doit se faire au moyen d'une puissance d'entrée ou d'une réduction de gain et non pas par un atténuateur à la sortie du dispositif.*

*Déclaration d'exposition RF pour ISED: «Cet appareil est conforme au Code de sécurité de Santé Canada. L'installateur de cet appareil doit s'assurer que les rayonnements RF ne sont pas émis au-delà de l'exigence de Santé Canada. Vous pouvez obtenir de l'information à l'adresse [http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio\\_guide-lignes\\_direct/index-fra.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct/index-fra.php).*

*L'antenne utilisée pour cet émetteur doit être installée de manière à assurer une séparation d'au moins 55 cm dans DL et 55 cm dans UL de toutes les personnes et ne doit pas être placée ni fonctionner avec une autre antenne ou émetteur. Les changements ou modifications non expressément approuvés par la partie responsable de la conformité pourraient annuler l'autorisation de l'utilisateur d'utiliser l'équipement.*



---

## Product Description.

The UHF Low Fiplex Digital DAS has a modular structure that consists in two different modules in star configuration, the Digital Master Unit model DH4L00-M (center of the star) and Digital Remote Unit model DH4L37-R (legs of the star) that can operate in the UHF frequency range of 406-424MHz. Each one of the different modules is enclosed in the same or equivalent case, therefore, product description and installing instruction sections are valid for all of them.

The Fiplex Digital Master is a RF-to-Fiber and Fiber-to-RF conversion system. These conversions are done using FPGA based Digital Signal Processing. It provides a connection to the Base Station and it centralises all the connectivity of the DAS. It also provides the possibility to connect up to six Digital Remote Units.

The Digital Remote Unit, also is a RF-to-Fiber and Fiber-to-RF conversion system. These conversions are also made using FPGA based Digital Signal Processing. It provides amplification to the RF signals needed to provide signal amplification into the target area.

The Master and Remote Units is where the RF interfaces are located, the Master Unit has the "To Base" RF Port, and the Remote Unit has the "To Mobile" RF Port.

The advantages of using digital signal transportation over fiber are to avoid the addition of the fiber analog noise when it is used to transport analog signals. Along with this, the UL squelch of the Digital Remote Unit works not only per channel but also per time slot, this makes the Fiplex Digital DAS solution unique by its outstanding management of the UL noise.

The Fiplex Digital Master Unit also provides an access point to monitor and control all the system parameters not only of the Digital Master Unit but also to each Digital Remote Unit connected on the system. This connection can be done locally via USB or Web-Browser, or remotely using Ethernet (via SNMP protocol).

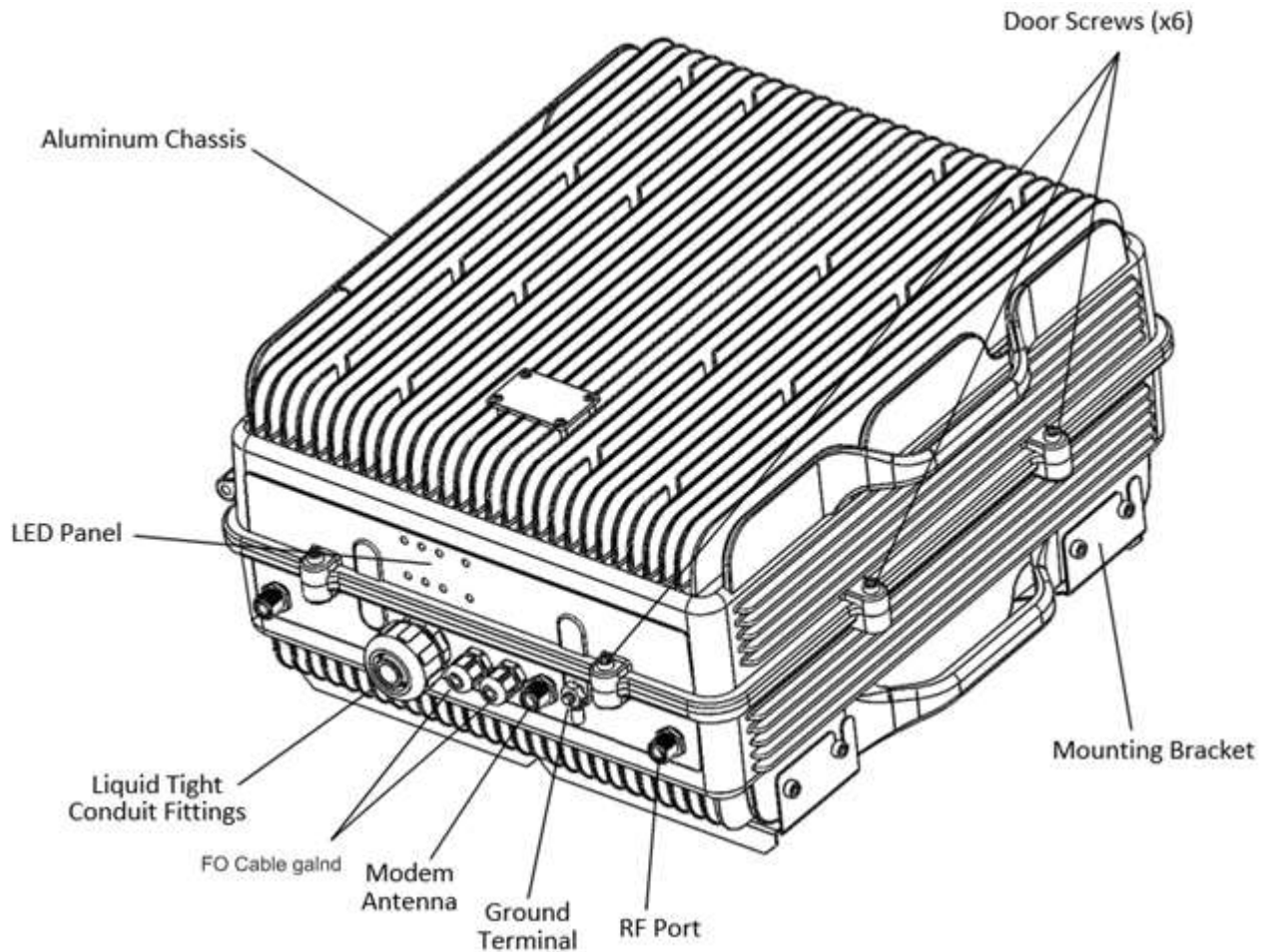
The DH4-L series are NFPA Ready orderable with AC or DC option. As optional it can have remote control via Ethernet or via wireless modem.

The Digital Master Unit and the Digital Remote Units both have heavy duty IP67/NEMA4X cabinet for outdoor usage, it is designed to be wall or pole mounted, however, to mount on standard 19" rack, a special mounting kit can be supplied.

For more details refer to the product datasheet.

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## 2.1 Digital Master Unit Ports

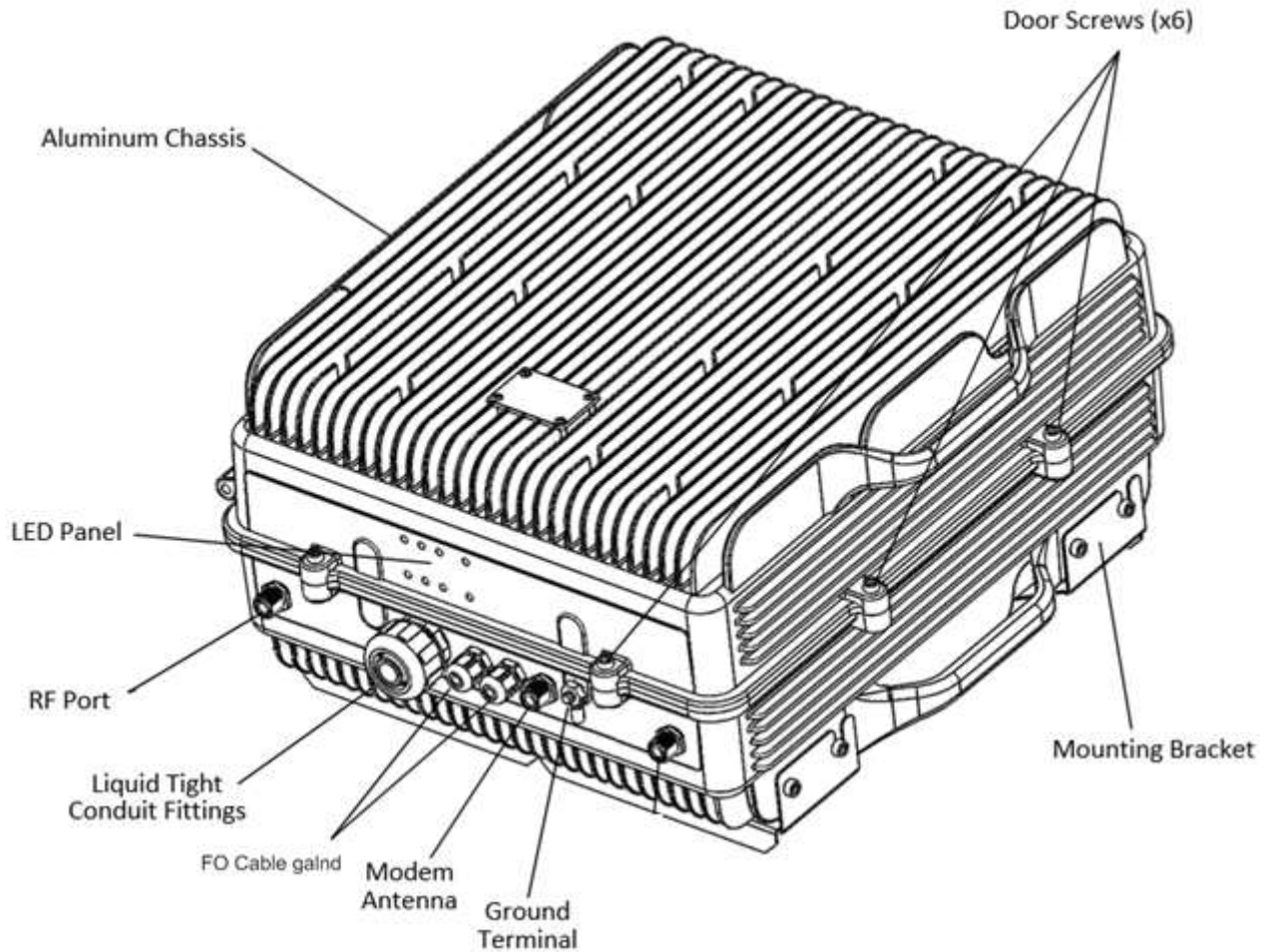


If the Digital Master Unit is equipped with internal duplexers, the enclosure will only have one “To Base” RF Port.

If the Digital Master is prepared for custom external duplexers, the enclosure will have two RF Ports, “DI In” and “UL Out”.

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## 2.2 Digital Remote Unit Ports

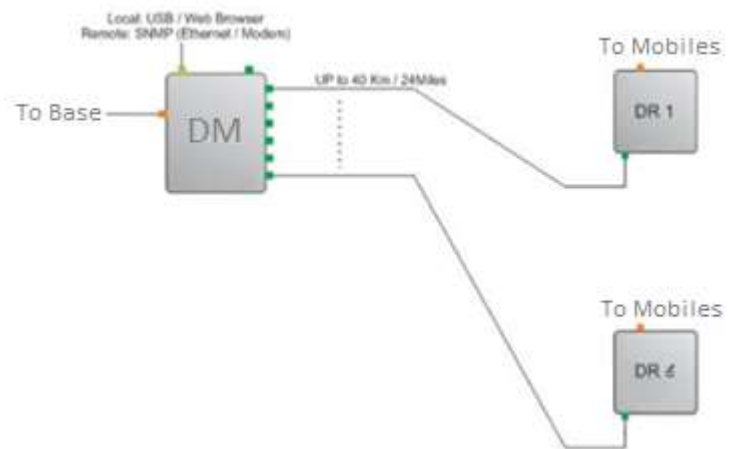


If the Digital Remote Unit is equipped with internal duplexers, the enclosure will only have one “To Mobile” RF Port.

If the Digital Remote Unit is prepared for custom external duplexers, the enclosure will have two RF Ports, “DI Out” and “UL In”.

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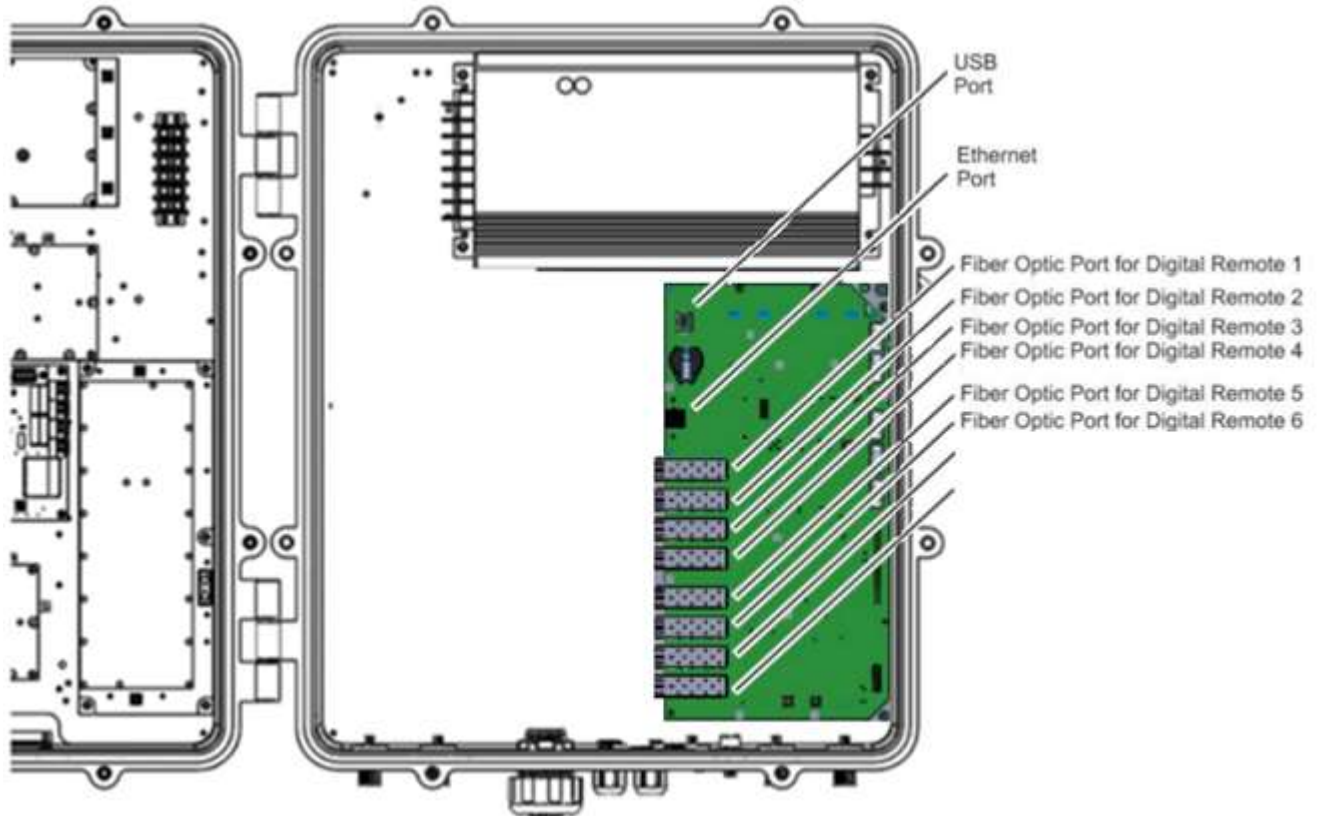
## 2.3 Connection Diagram



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## 2.4 FO Connection

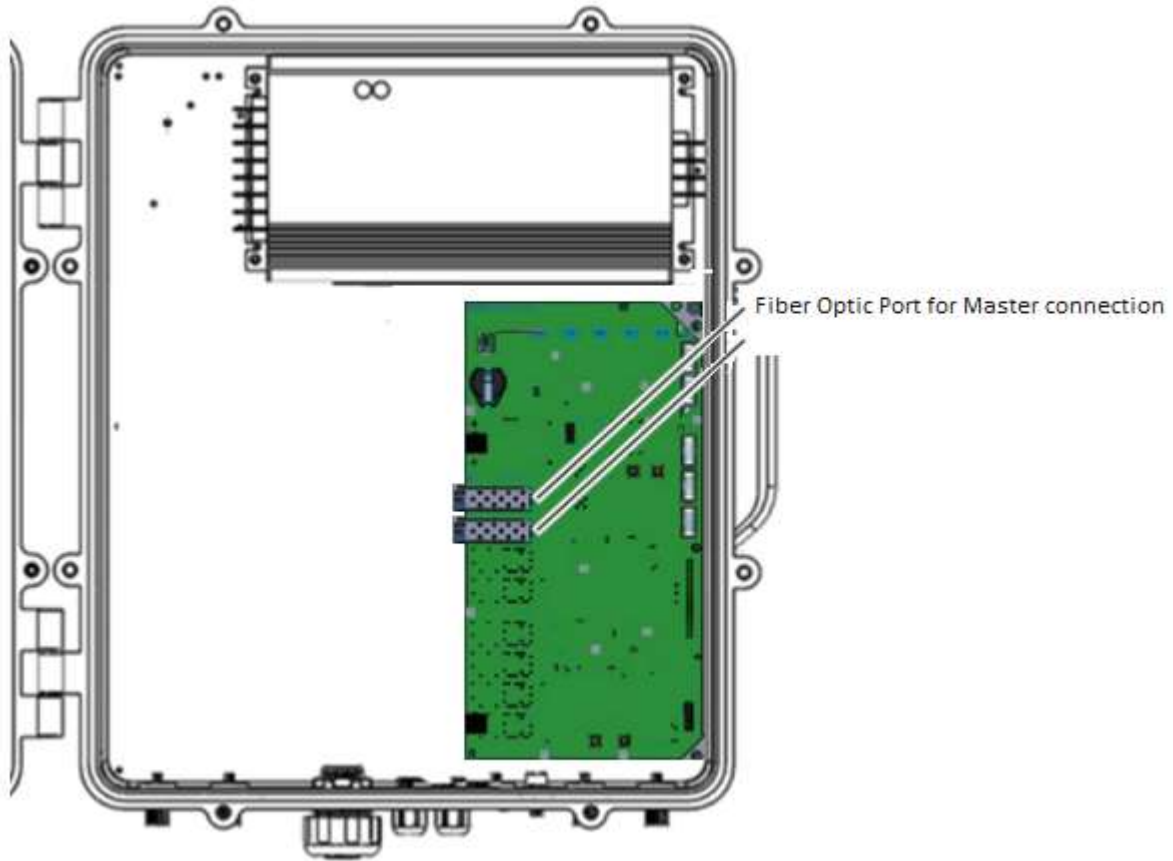
### 2.4.1 FO Connection in Master Unit



Note: Each fiber connection is performed with simplex fiber and LC-APC connector.

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## 2.4.2 FO Connection in Remote Unit

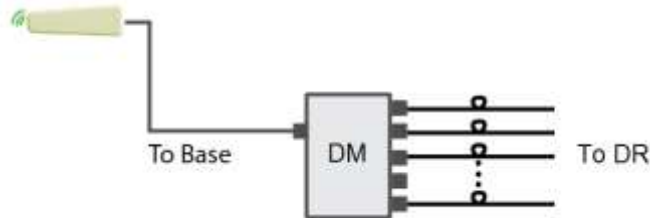


Note: Each fiber connection is performed with simplex fiber and LC-APC connector.

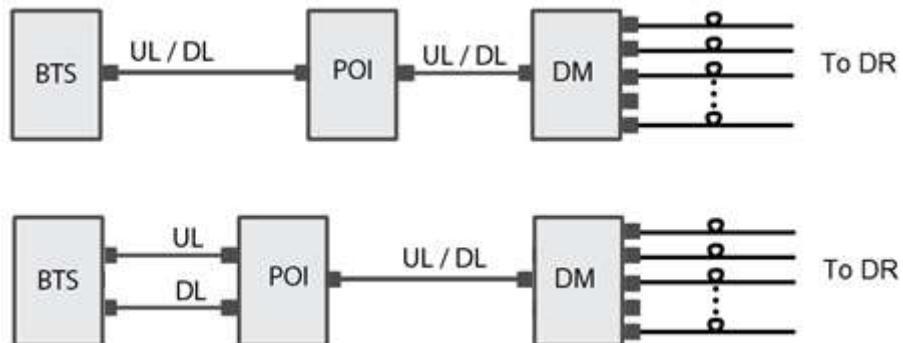
## 2.5 Interface with signal source

The interface with a Signal Source can be done in three different ways, depending on the availability of separated UL and DL connectors.

In cases when the signal source will be picked from the air, there is no need to add a Signal Booster to feed the Digital Master. The Digital Master in its standard configuration can pick the signals from the air just by connecting a donor antenna to it.



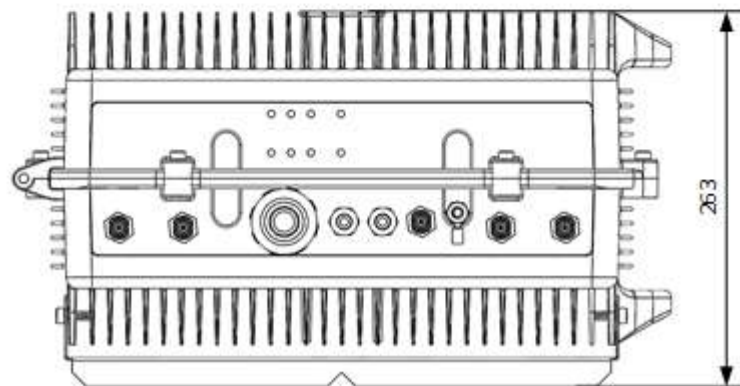
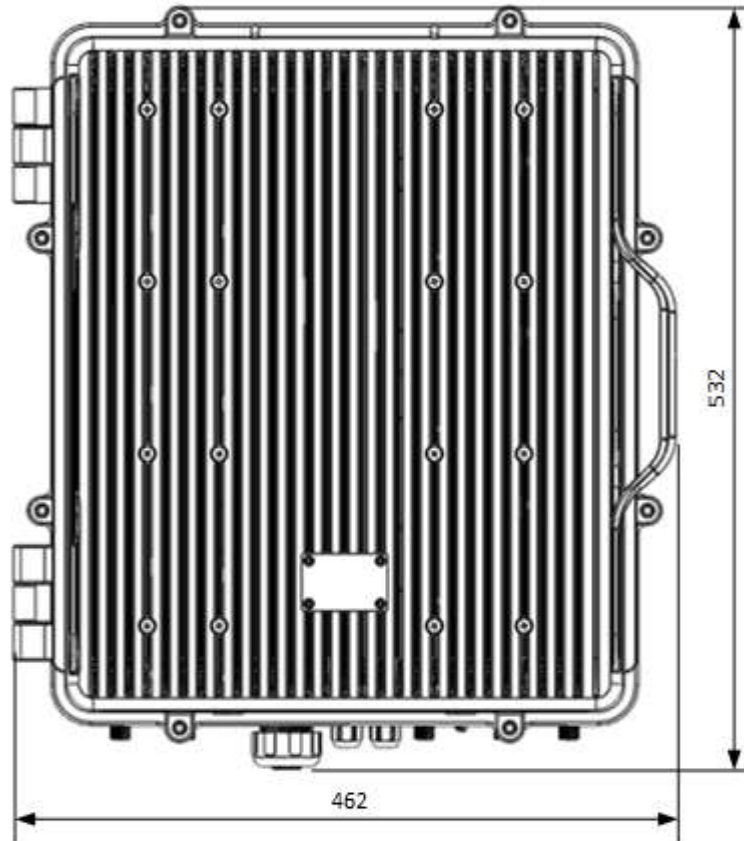
In case when a BTS is used as a Signal Source and the coupling is made thru a Point Of Interconnection (POI). A POI, can consist on a simple attenuator, duplexer, coupler or a combination of them and it is needed to accommodate the DL level to the design requested level.



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## 2.6 Dimensions

### 2.6.1 Digital Master and Remote Unit Cabinet Dimensions





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## 3 Installation

### Mounting the cabinet

Fiplex Digital Signal Booster is designed for outdoor usage with a weather proof outdoor NEMA4 cabinet that can be mounted without any kind of shelter from rain, snow or hail.

However, to improve reliability, it is recommended to mount the Digital Signal Booster on a site with shelter from direct exposure to sun, rain, snow and hailing.

It is not recommended to operate the Signal Booster under bad weather conditions, such as:

- Intense rainfall, snowfall or hail
- Storm or high wind
- Extremely low or high temperature
- High humidity of the air

### Mounting

#### 1. Mount the bracket

The Signal Booster can be mounted on a wall or pole. These mounting cases are shown below in Figure 1 and Figure 2. The bracket is provided with the Signal Booster.

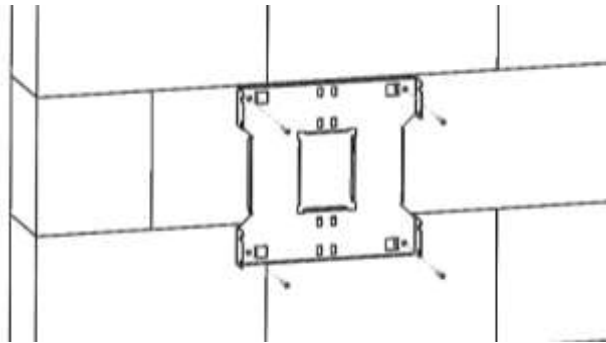


Figure 1

Figure 1 shows a bracket attachment to a wall using three fixing screws.

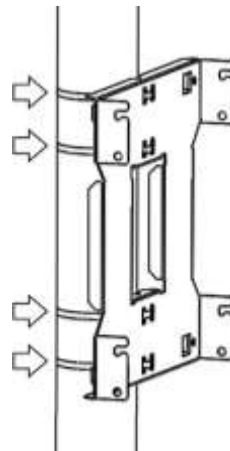


Figure 2

Figure 2 shows a bracket attachment to a pipe using four inox hose clamps (provided with bracket).

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2. After attaching the bracket hang the Signal Booster as shown in Figure 3.

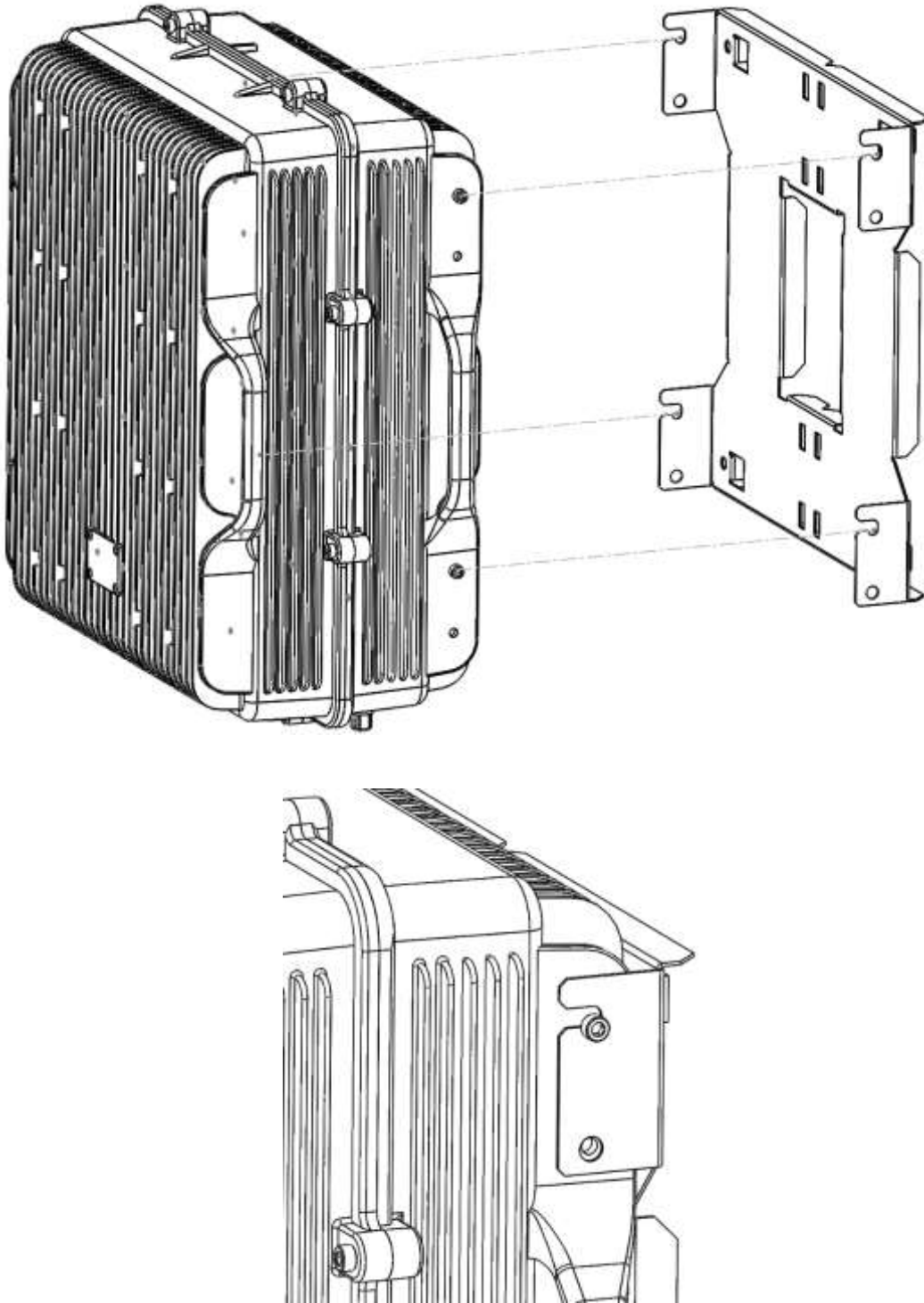


Figure 3

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3. Secure the cabinet to the bracket as shown in Figure 4. To attach the Signal Booster's cabinet to the bracket use the provided four M6 x 1/2" allen screws.

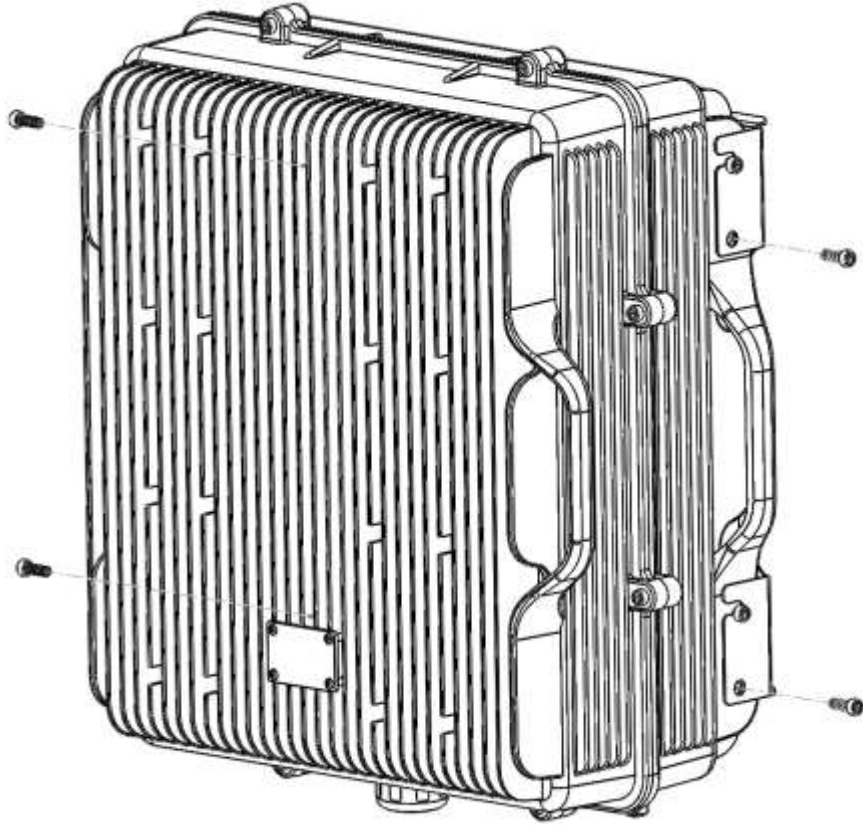
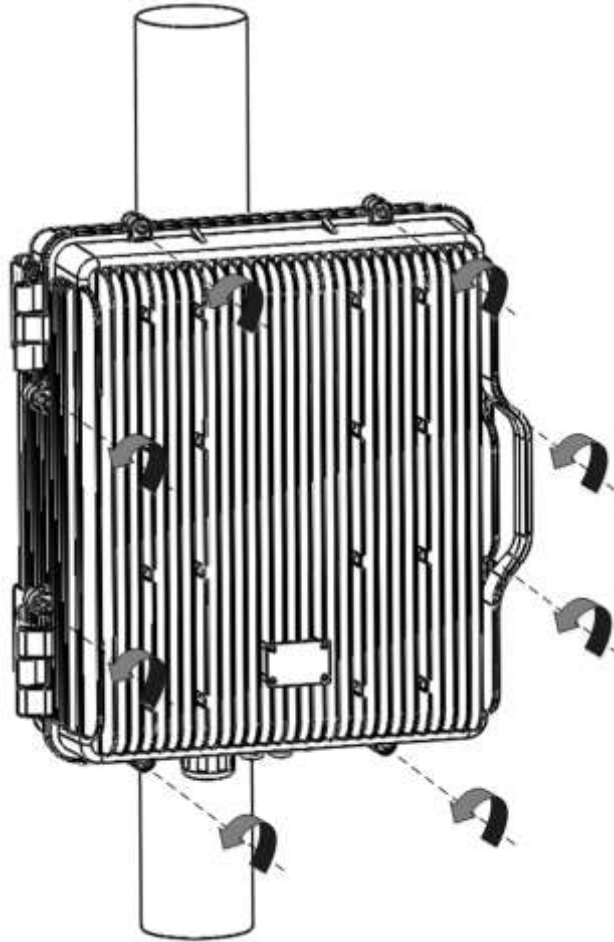


Figure 4

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## Opening and Closing the Cabinet

To open the cabinet, release the 8 door screws indicated in figure 5 using the provided special allen key.

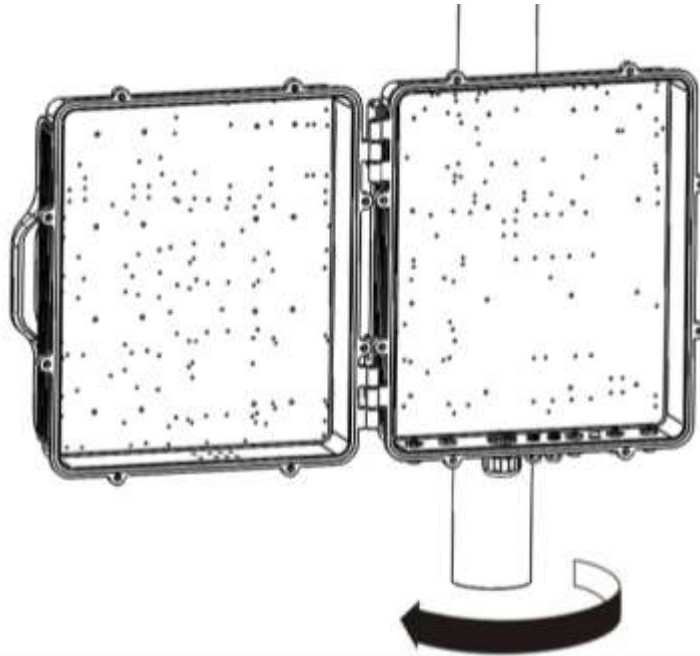


A - Release Signal Booster cover.

Figure 5

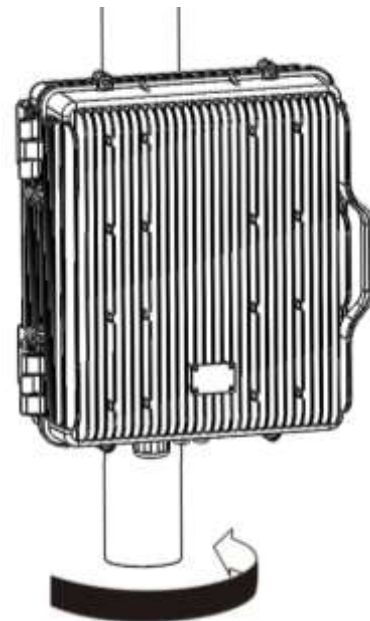
Use the special allen key N°6





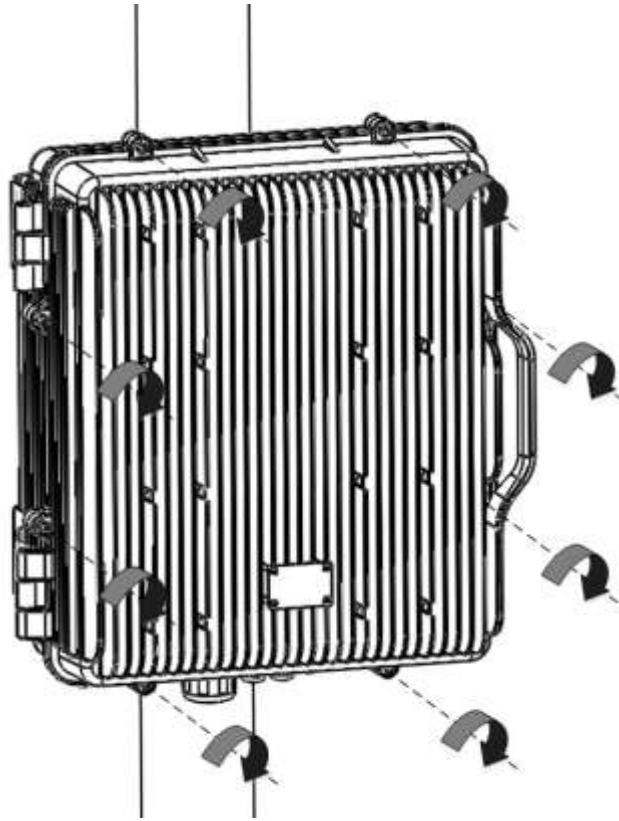
B - Open the Signal Booster cover.

Figure 6



C - Close the Signal Booster cover.

Figure 7



D - Secure Signal Booster cover.

Figure 8

---

## Use of Liquid Tight Conduit

The unit has available a Liquid Tight Conduit Fitting connector. The unit as standard has the connector installed, so if the user requires to use this connector, if available, the NFPA cables, Ethernet, DC and AC cables can be routed through this connector.

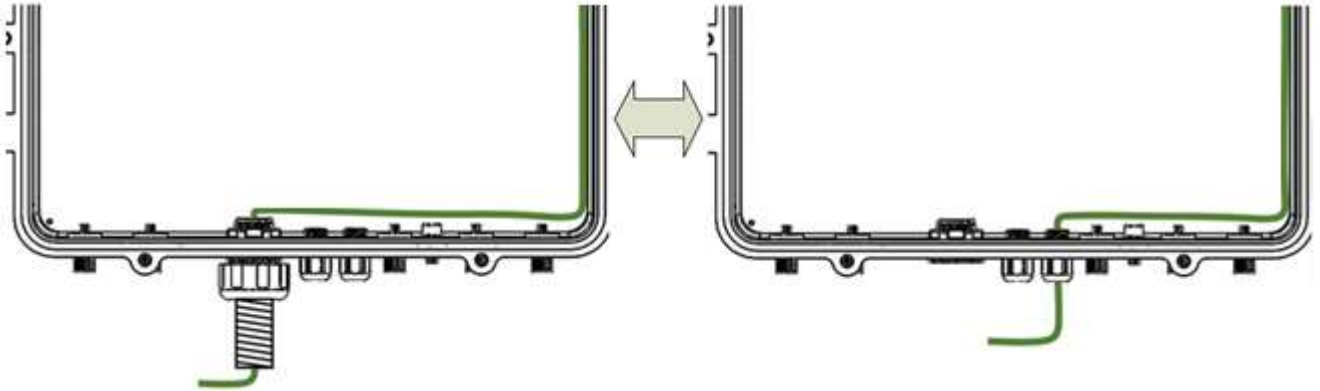
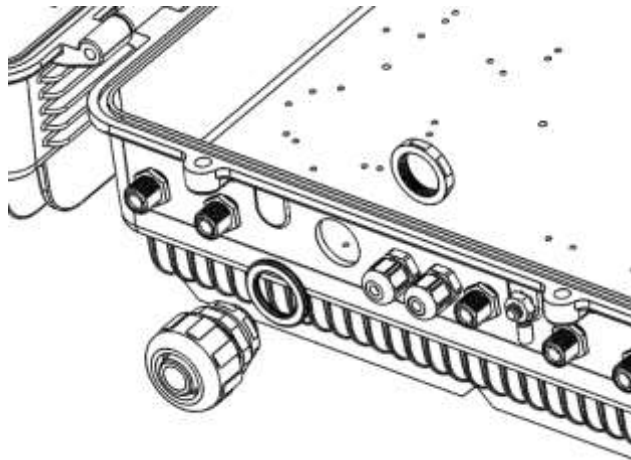
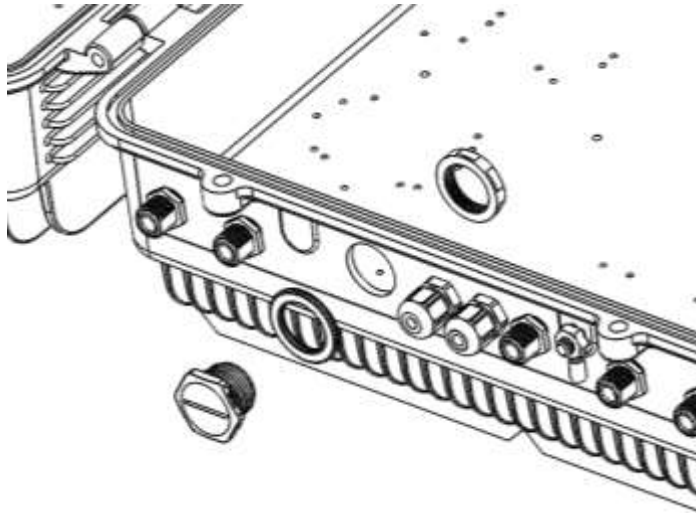


Figure 9; AC Routing through cable gland or conduit connector

If the is not going to use Liquid Tight Conduits, then the connector should be replaced by the provided sealing cup as indicated in Figure 10.



A - Remove the conduit connector



B – Install the sealing cup

Figure 10; Replacement of Conduit connector to sealing cup

#### Nema4X considerations

This device is equipped with a Nema4X enclosure, however, to ensure the Nema rating, the user must have the following considerations:

1. Correct use of the Liquid Tight Conduit. In case this interface is not used, it should be replaced with the sealing cup.
2. Sealing cups should be installed in the non-used cable glands.
3. The RF Ports should be perfectly mated.



---

## 4 Commissioning

### 4.1 Connection step by step

Connect the RF ports, Power, Fibers and Ethernet Cable Glands location, for Master and Remote units following the next steps:

1. For Master Unit:
  - a. Master Unit with internal duplexers
    - i. Connect the signal coupled from the base station to the "To Base" RF port. N type female connectors are used in the unit. The coupling to Base station can be done with a Donor antenna or through a POI.
    - ii. Connect fiber cables to internal optical modules. LC-APC connectors are used in the unit. Connect the remote units on the dedicated ports.
    - iii. Connect USB Cable for local management.
  - b. Master Unit with external duplexers
    - i. Connect the signal coming through the external duplexer using the "UL Out" and "DL in" RF ports. N type female connectors are used in the unit.
    - ii. Connect fiber cables to internal optical modules. LC-APC connectors are used in the unit. Connect the remote units on the dedicated ports.
    - iii. Connect USB Cable for local management.
2. For Remote Unit:
  - a. Remote Unit with internal duplexers
    - i. Connect service antenna ("RF To Mobile" port) coaxial cable to remote unit. N type female connectors are used in the unit.
    - ii. Connect fiber cable to internal optical module. LC-APC connector is used in the unit.
  - b. Remote Unit with external duplexers
    - i. Connect the remote unit to the external duplexer using the "DL Out" and "UL In" RF Ports. N type female connectors are used in the unit.
    - ii. Connect fiber cable to internal optical module. LC-APC connector is used in the unit.
3. Once RF ports of the unit are properly loaded connect the Main Power the AC or DC source depending on the model.

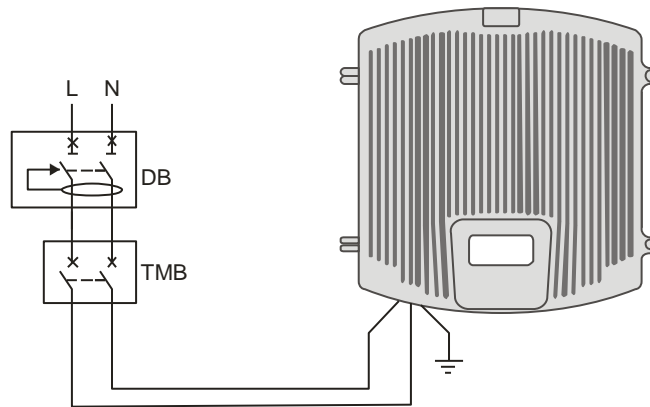
If using the AC model, electrical installation must provide differential and thermo-magnetic breaker elements according to electric safety international regulations.

If using the DC model, the Main Power cable provided with the unit has three poles:

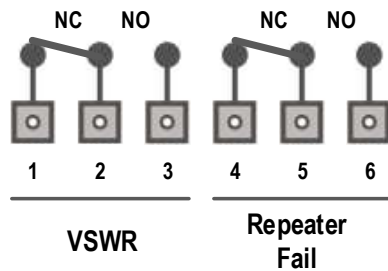
- The Green cable is connected to the chassis.
- The Blue cable should be connected to the most positive source tension.
- The Brown cable should be connected to the most negative source tension.

For -48VDC supply voltage, connect the 0V(GND) reference to the Green and Blue cable, and the -48VDC to the Brown cable.

For +48VDC supply voltage, connect the 0V(GND) reference to the Green and Brown cable, and the +48VDC to the Blue cable.



- If the Remote Unit has the NFPA Option, there is a dedicated cable gland for this purpose. A multi-conductor cable can be used to connect the NFPA dry contacts to the Fire Department Control Box.



Status of contacts (**Alarms Off**)

- Pin 1 – 2 = VSWR (normally closed contact)
- Pin 2 – 3 = VSWR (normally open contact)
- Pin 4 – 5 = Repeater Fail (normally closed contact)
- Pin 5 – 6 = Repeater Fail (normally open contact)

Figure 11; NFPA Dry Contact connection configuration

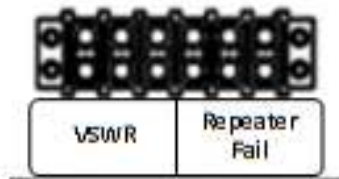


Figure 12; NFPA Dry Contact connection location inside the cabinet

- Once the unit has been connected to the power source, it takes about 30 seconds to run a booting routine. After that time unit is ready to be connected via USB cable to the Digital Master to a computer running Fiplex Control Software (FCS) in order to be properly configured.

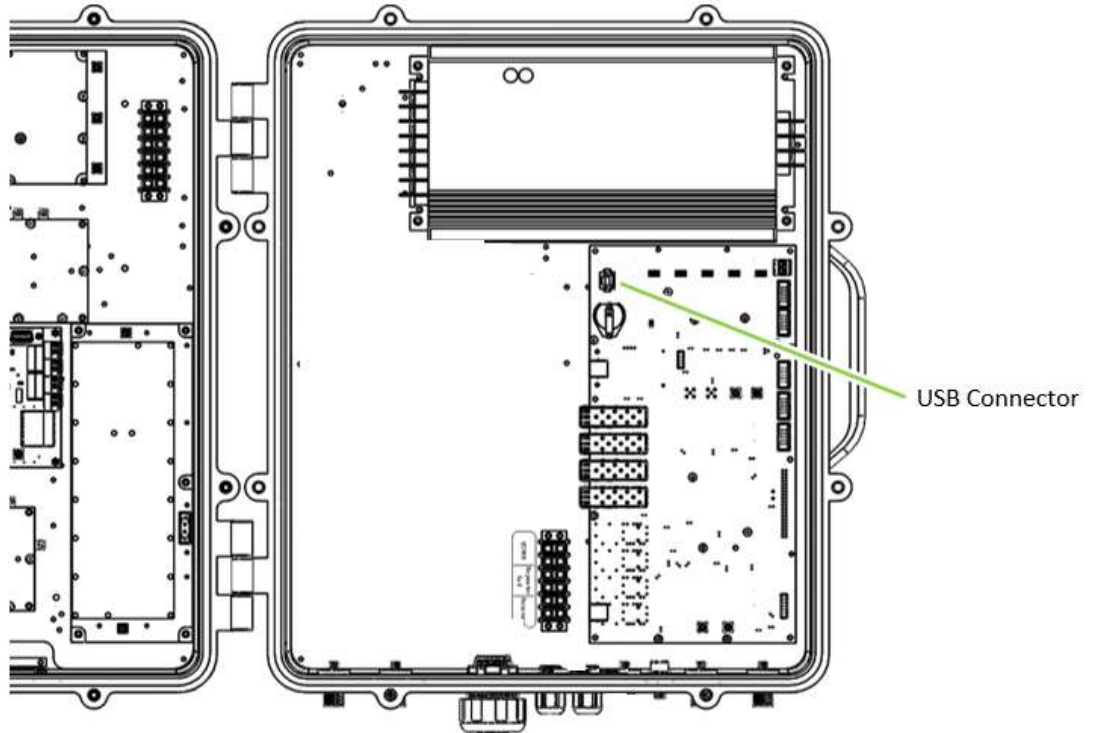


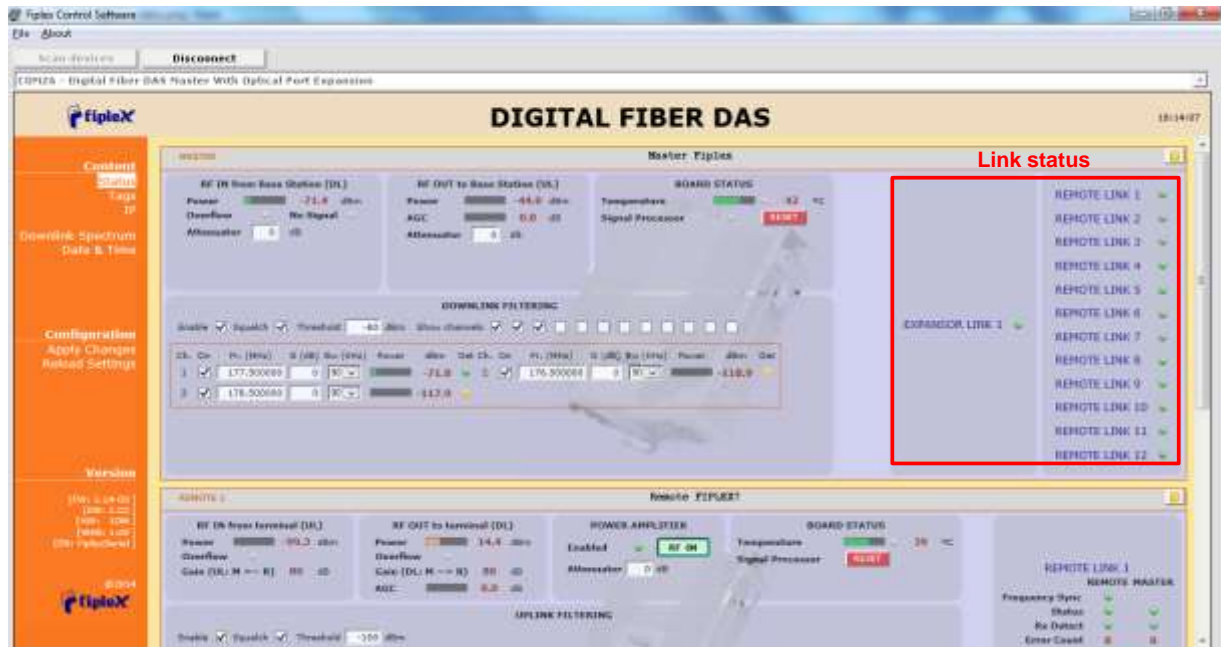
Figure 13; USB Port location inside the cabinet

## 4.2 Starting Operation

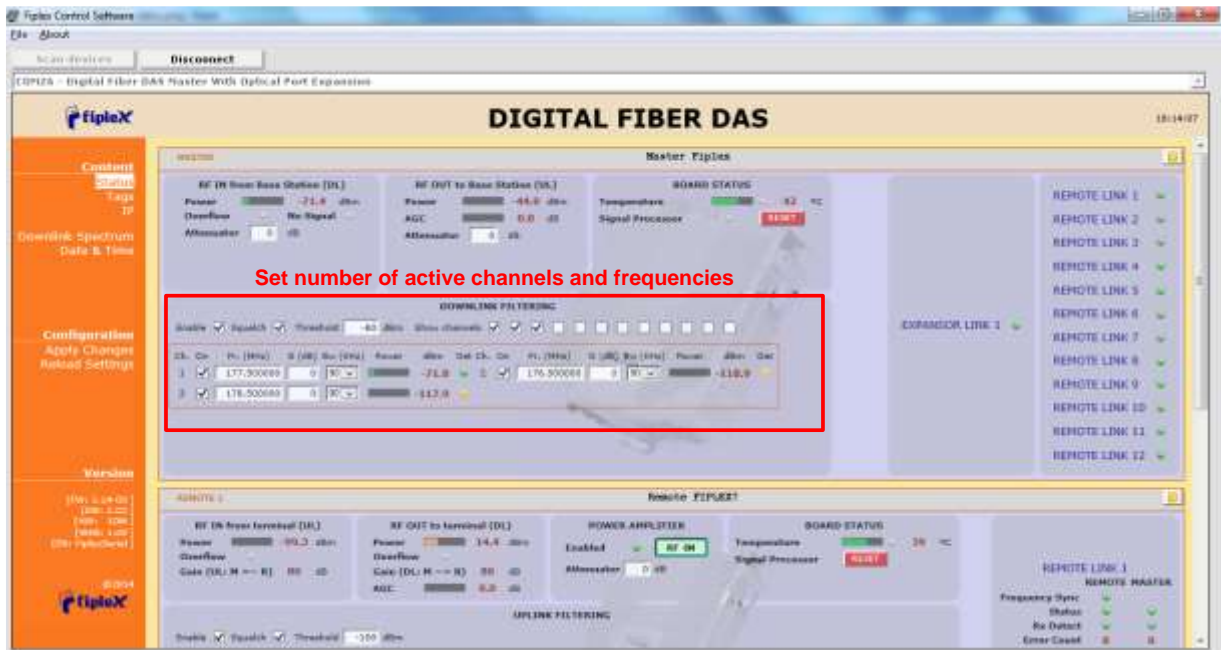


**BE SURE THAT “TO MOBILE” AND “TO BASE” PORTS ARE PROPERLY LOADED EITHER WITH 50 OHMS DUMMY LOADS, OR RADIATING SYSTEM.**

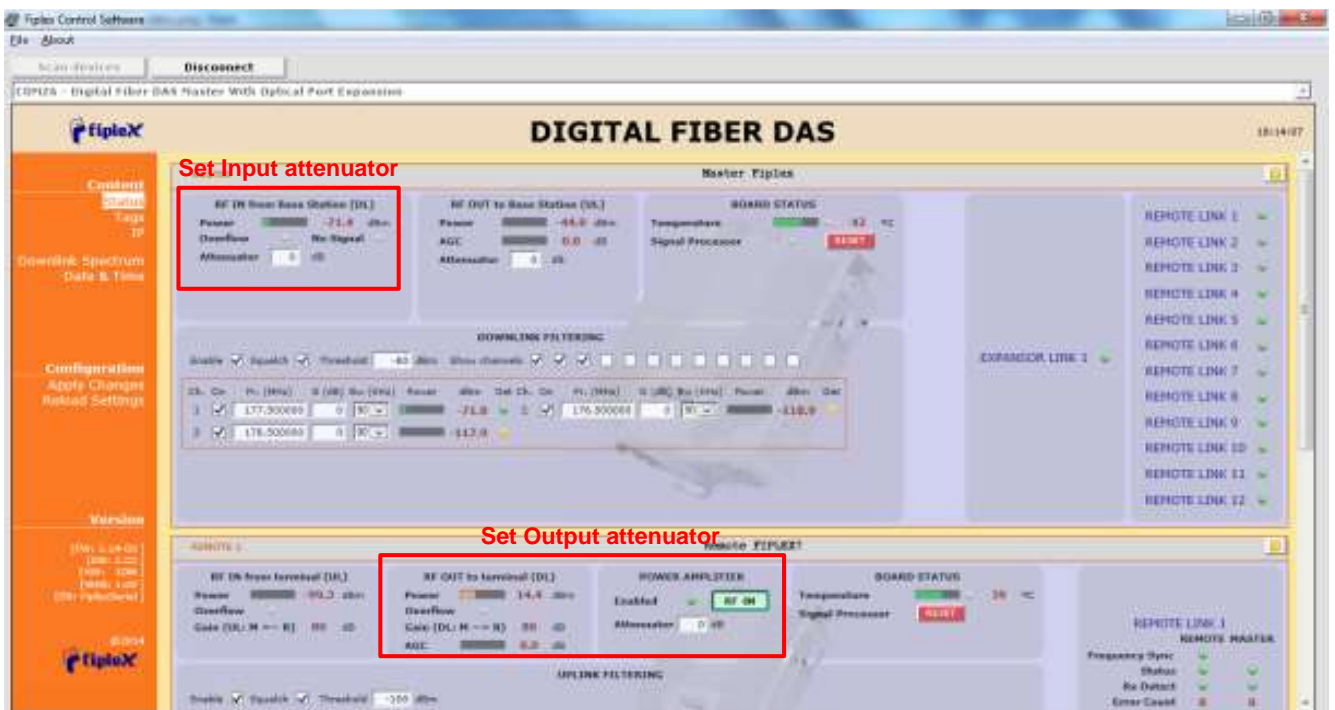
1. Turn on the repeater, connect computer to repeater through USB cable, and run Fiplex Control Software. Check that all remote units are connected to the master through fiber optic checking link status.



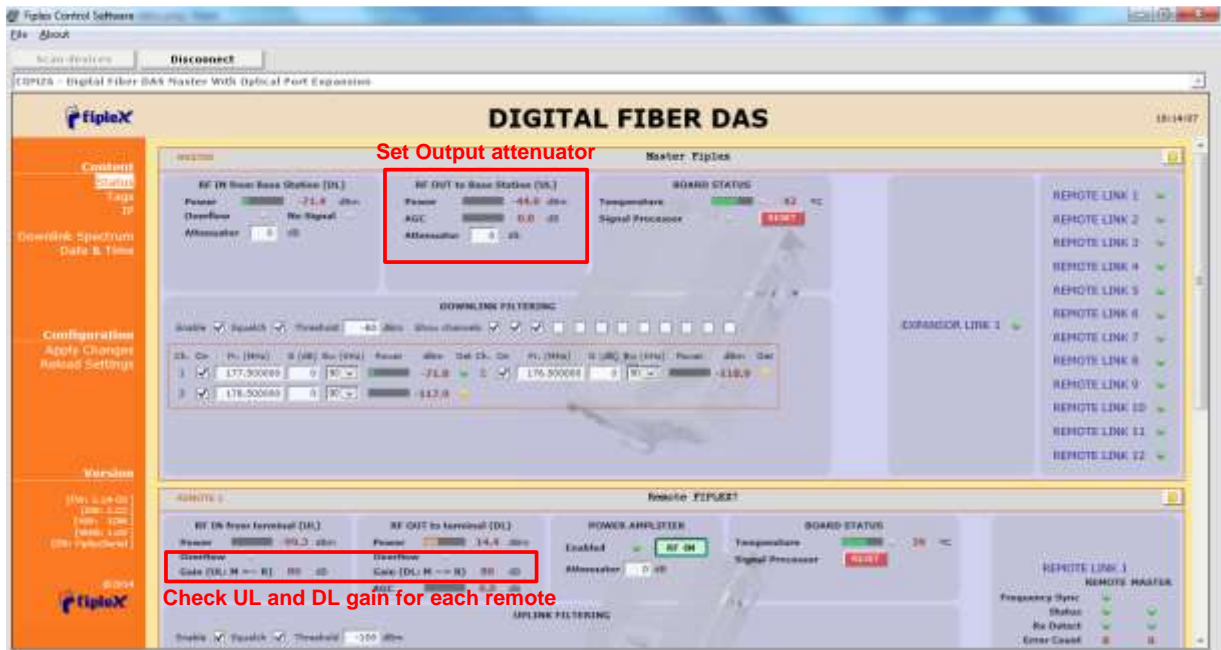
2. Enable channel filtering if needed and setup desired channel frequencies. If Fiplex Digital Fiber DAS is used as channel selective, user has to know what frequencies are used in base station. Each channel can be enabled independently. Channels not used can be showed / hidden using the “Show channels” checkboxes. If remote units are on and connected through optical fiber, the corresponding uplink frequencies will be automatically set, too.



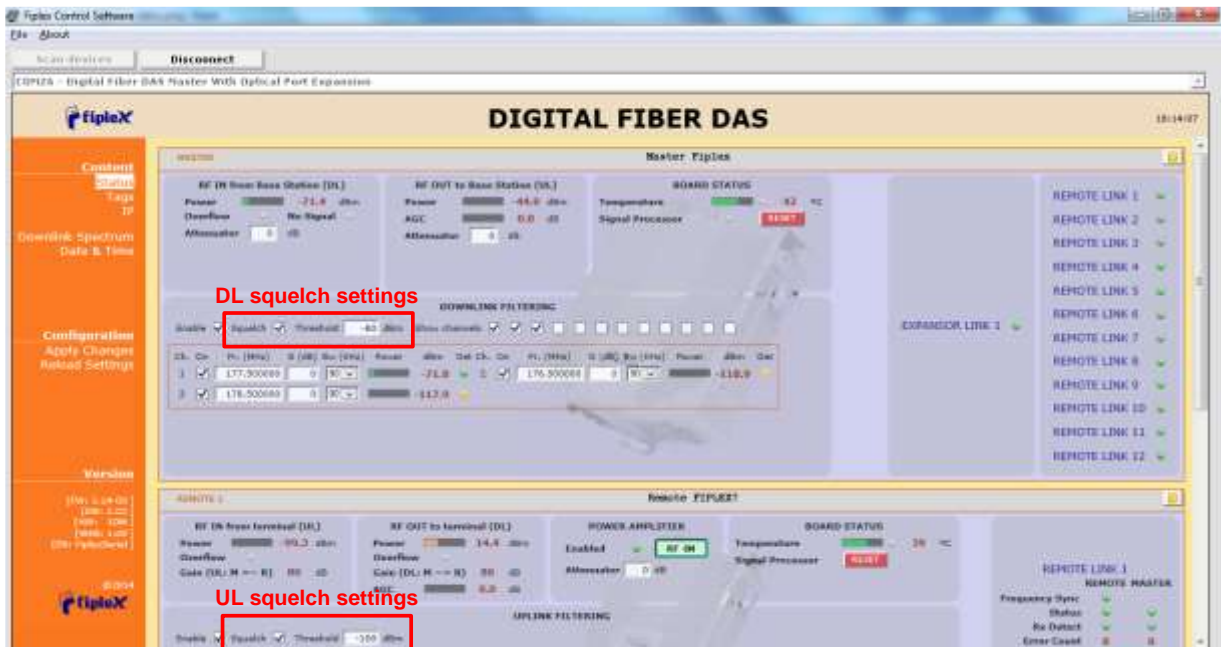
3. According to DL RF input levels, program input attenuator to avoid input overflow, and output attenuator for each remote to obtain desired output level in each remote.



4. Reciprocally, set UL band gain adjusting output attenuator of master unit. It is recommended that DL gain and UL gain be equal.



- Set up squelch settings. Controls are independent in UL (for each remote) and DL (master) bands. Typical values for UL are between -110dBm and -100dBm for squelch threshold. For DL, recommended value for squelch threshold is minimum level received in any active channel minus 10dB.



- Setup desired filter bandwidth, depending on presence of adjacent channels. In principle, recommended bandwidth filter is 90KHz due to its low delay, but if adjacent signal is detected, narrow filters can be used. Fine gain can be set to equalize input signals.



FileX Control Software

Disconnect

CPM2A - Digital Fiber DAS Master With Optical Port Expansion

## DIGITAL FIBER DAS

10/14/07

**Conditions**

RF

Downlink Spectrum Data & Time

---

**Configuration**

Apply Changes

Reload Settings

---

**Version**

FileX v. 1.4.0.0

Build: 1004

Date: 10/07

FileX Technology

**Master FileX**

**RF IN from Base Station (DL)**

Power: -21.8 dBm

Overflow: No Signal

Attenuator: 0 dB

**RF OUT to Base Station (UL)**

Power: -44.0 dBm

AGC: 0.0 dB

Attenuator: 0 dB

**BOARD STATUS**

Temperature: 42 °C

Signal Processor: FAULT

**DOWNLINK FILTERING**

Stable  Squelch  Threshold: -83 dBm Show Channels

Ch.	Ch. (MHz)	Power	dBm	Del.	Ch. (MHz)	Power	dBm	Del.
1	177.500000	0	0		176.500000	0	0	
2	178.500000	0	0					

**Remote: EXP501**

**RF IN from Terminal (DL)**

Power: -90.3 dBm

Overflow: No Signal

Gate (DL: M → R): 00 dB

**RF OUT to Terminal (UL)**

Power: 14.4 dBm

Gate (UL: M → R): 00 dB

AGC: 0.0 dB

**POWER AMPLIFIER**

Enabled:  RF ON

Attenuator: 0 dB

**BOARD STATUS**

Temperature: 36 °C

Signal Processor: FAULT

**UPLINK FILTERING**

Stable  Squelch  Threshold: -350 dBm

REMOTE LINK 1

REMOTE LINK 2

REMOTE LINK 3

REMOTE LINK 4

REMOTE LINK 5

REMOTE LINK 6

REMOTE LINK 7

REMOTE LINK 8

REMOTE LINK 9

REMOTE LINK 10

REMOTE LINK 11

REMOTE LINK 12

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EXPANSION LINK 1

Filters and fine gain settings

### 4.3 Status Indicators

There is an indicator panel located at the front panel of the repeater. This led panel works as a status monitor, in order indicate warning or alarms of repeater

There are four leds, first one the power ON indication led, labelled "PWR".

A Second led, labelled "STS" summarizes warnings regarding critical operational conditions of the repeater.

Third and fourth led summarizes operational conditions for uplink "UL" and downlink "DL" chains. In general, leds has four states: off, slow blinking, fast blinking, on. Table 1 describes alarm and warning conditions for each led state in the master device and Table 2 is for remote devices.














**Table 1**

Indicator Panel	LED indication description
	Unit is not powered or fail in power supply
	Normal state: Unit is powered on
	Normal state
	HW fail: digital signal processor is not detected Temperature: very high internal unit temperature Optical fiber alarm in at least one link
	TBS Warning: No signal is detected coming from base station
	Normal state
	RF input overflow: maximum level at RF input is exceeded
	Normal state
Where:	
	Led OFF
	Led slow blinking with period of 2 seconds aprox. WARNING
	Led fast blinking with period of 0.5 seconds aprox. ALARM
	Led ON



**Table 2**

Indicator Panel	LED indication description
	Unit is not powered or fail in power supply
	Normal state: Unit is powered on
	Normal state
	HW fail: digital signal processor is not detected Temperature: very high internal Unit temperature Optical fiber alarm in at least one link
	Normal state
	PA Overflow or excessive temperature alarm.
	PA Underflow: PA output level is lower than +25dBm
	Normal state
Where:	
	Led OFF
	Led slow blinking with period of 2 seconds aprox. WARNING
	Led fast blinking with period of 0.5 seconds aprox. ALARM
	Led ON

#### 4.4 Laboratory Measurements

For specific parameters verification and laboratory tests, please contact factory. Detailed procedures, recommended tests set up, and a knowledge engineering team will bring adequate support to perform this measurements in a comfortable and safely way.

## Part 2 SOFTWARE

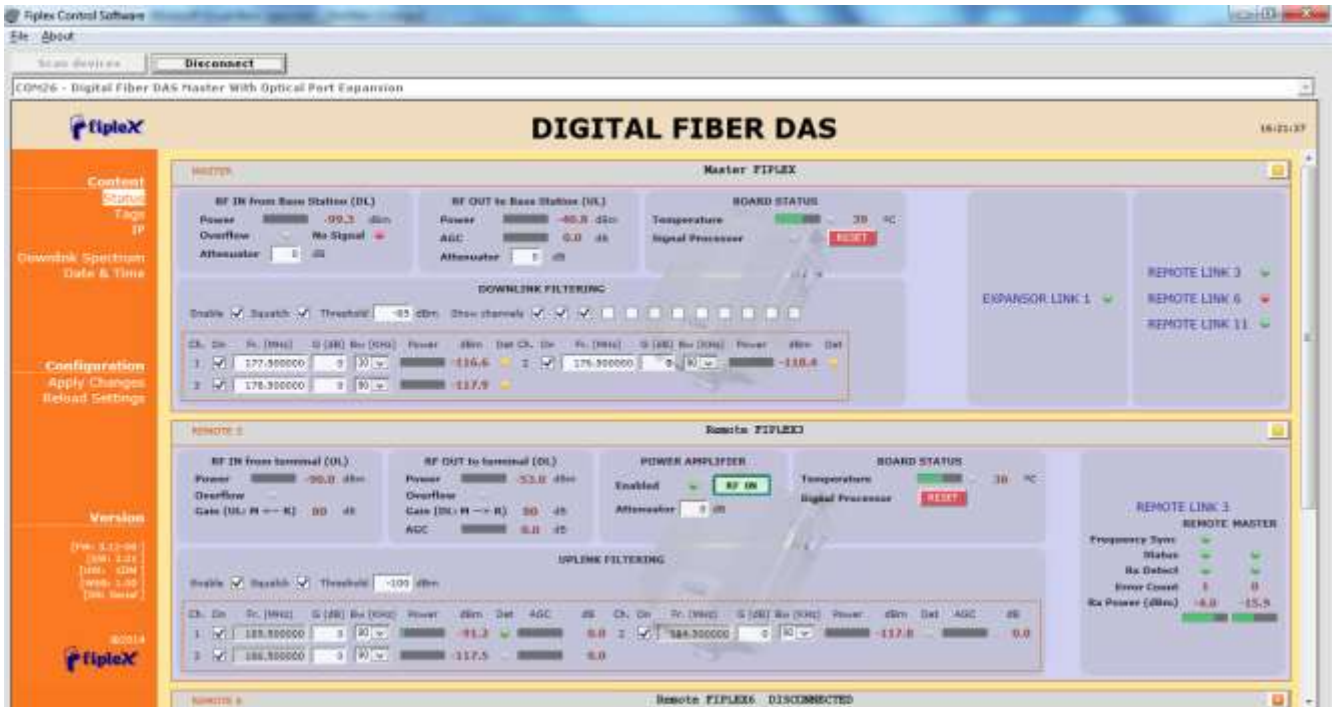
### 5 Introduction

Fiplex Fiber DAS can be fully configured and monitored through USB connection. Digital Master unit receives through optical links monitoring and configuration data from remotes units. For this reason, whole system can be fully configured and supervised from digital master unit.

### 6 USB Software

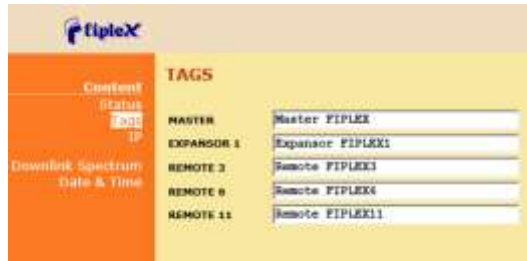
#### 6.1 Software description (Digital Master)

If software has been successfully installed and connected to Digital Master (see section 7) status screen will appear. In this screen, RF configurations parameters (channel frequencies, bandwidth filter, gains / attenuation) and RF and optical links monitoring (RF input/output levels, AGC status, optical link status) are shown.

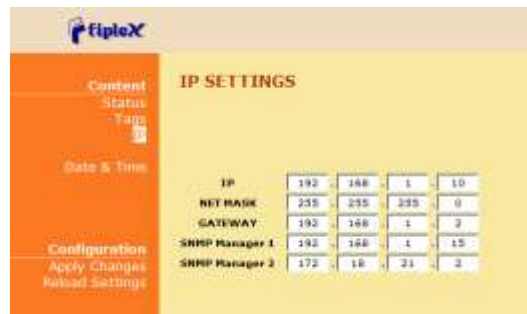


At left side of webpage, configuration menus are shown:

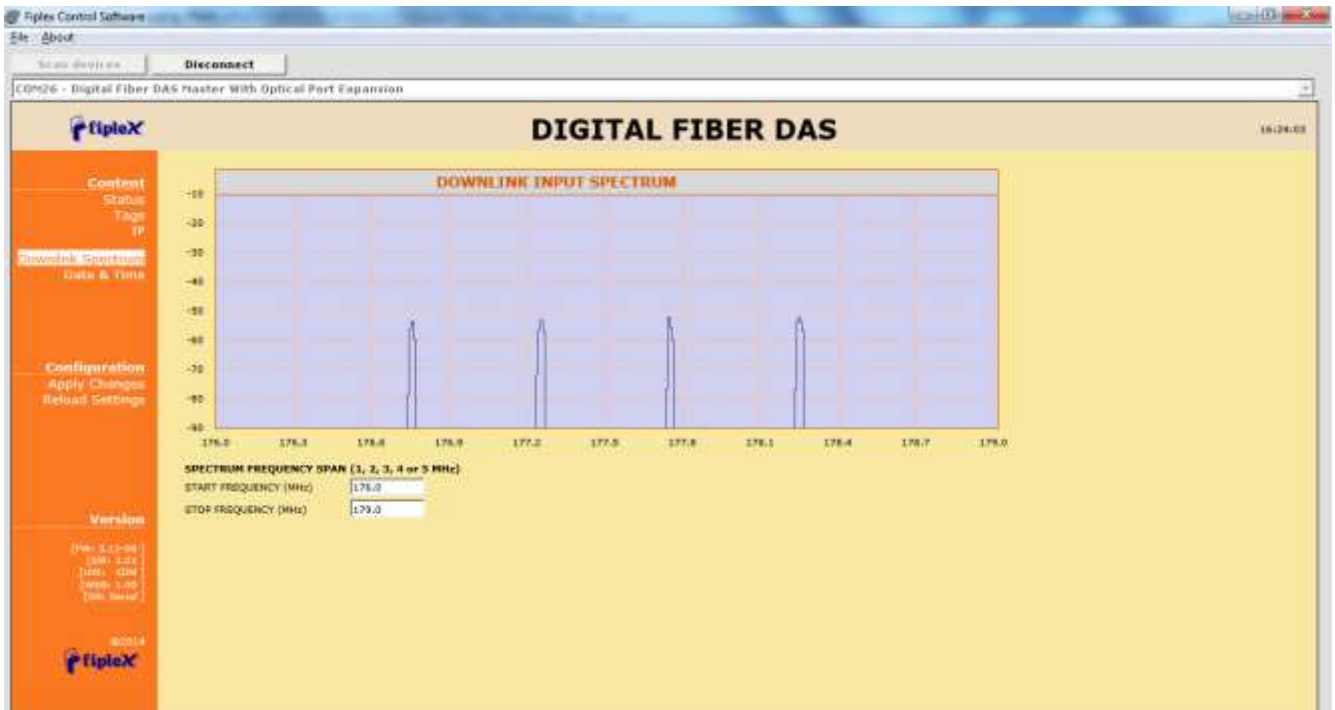
- Content
- Status: whole RF configuration and monitoring parameters are shown. These parameters are described in next section.
- Tag: user can set a tag to ease repeater identification. For modifying the TAG, write a new value in text field and click over Apply Changes link



- IP: At this page (for units with Ethernet supervision), IP addresses configuration and addresses of SNMP Managers are shown. User can set addresses of two SNMP Managers (IP where SNMP agent will send TRAP information). To modify, click over Apply Changes link after writing new values on text fields. Also router 3G IP address can be viewed in this screen (if 3G router option is installed)



- Downlink Spectrum: in order to know input signal: level of desired channels, unwanted channel levels, Digital Master provides an spectrum analyzer that shows input signal in frequency domain.



- Date & Time (for units with Ethernet supervision): page to modify real time clock. When the repeater is not powered, this clock runs with a voltage supply provided by

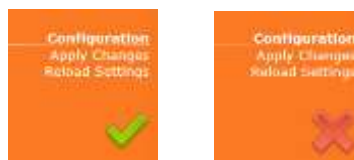
a 3V lithium battery, button type of 20mm (CR2032) with 220mA·h. This suffices for at least half year. When the repeater is powered, no current is drained from the battery. So, actual battery life will depend on repeater usage. For battery replacement, please locate battery holder between USB and Ethernet connectors on main board. Battery positive side is UP, i.e. on holder clip.



After clicking on “Apply Changes” link, next message will appear, warning the user that system needs to be rebooted.



- Configuration
  - Apply Changes: as it is said above, this link is used to load changes to the repeater, in configuration, tag, IP, password and date and time menus. After any configuration change, web page will show and icon that allows user to know if configuration has been successfully applied:



- Reload Settings: clicking this link, repeater configuration data is refreshed.
- Version: shows hardware, firmware and software versions of repeater and serial number.

## 6.2 RF parameters description (Digital Master)

“Status” menu shows whole RF configuration and RF and optical links monitoring data that are distributed along the webpage.

The first frame called “MASTER” is placed in top of webpage, showing configuration of digital master unit. Below this, some frames titled “REMOTE 1”, “REMOTE 2”... . There is one for each remote unit connected to the master, and configuration and status information related to each remote can be viewed. Next figures show these frames:



- Digital Master frame. There are five sub-sections inside this frame:



- Downlink filtering: this section contains fields to modify channel frequencies, squelch options and filtering options. Parameters are described in following table:

Parameter	Range	Description
Frequency	Downlink band	Downlink frequency channels. Frequency resolution is 3.125KHz
Channel enable	Enabled / disabled	Each of 12 channels can be enabled/disabled
Bw Filter	90KHz / 45KHz / 30KHz	Bandwidth of channels filter can be independently adjusted (if filtering is enabled)
Fine Gain Adjust	-5 to +5dB	If filtering is enabled, gain of each channel can be fine adjusted
Power indicator	---	Level of each channel, measured according to its bandwidth filter, is shown in dBm units. Led indicator shows if levels exceeds squelch threshold (green) or not (yellow).
Squelch enable control	Enabled / disabled	Enabling this control, repeater does not transmit in each channel if RF input power do not exceed the threshold level configured according to next row
Squelch threshold control	-90dBm to 40dBm	If squelch is enabled, input levels below this threshold are not transmitted.
Filtering enable	Enabled / disabled	Filtering option can be bypassed. If filtering is disabled, fine gain adjustments and squelch options are ignored



- Master RF Input parameters. Next table describes information of this frame:

Parameter	Range	Description
Broad band level	---	This indicator shows input level measured along DL band
Overflow	Grey: normal state / Red: alarm state	This indicator shows overflow on input circuitry is occurring. This condition can be avoided increasing input attenuator

Input Attenuator - RF IN from TBS (DL)	0dB to 30dB	Input attenuator to accommodate input levels. This value must be set to avoid overflow condition. Together with output attenuator of remotes sets the downlink gain: <b>G_DL (dB) = 80 – AttINmaster(dB) – AttOUTremote(dB)</b>
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- o Master RF Output parameters. Next table describes information of this frame:

Parameter	Range	Description
UL Output power	---	This indicator shows output level in UL band
AGC	Grey: normal state / Red: alarm state	This indicator shows gain reduction that master unit is applying at RF output to prevent PA UL overload
Output Attenuator RF OUT to Base Station (UL)	0dB to 30dB	Output attenuator to adjust UL gain. System UL gain can be computed as: <b>G_UL (dB) = 80 – AttOUTmaster(dB)</b>



- o Master Board status: general parameters of master unit are contained in this frame

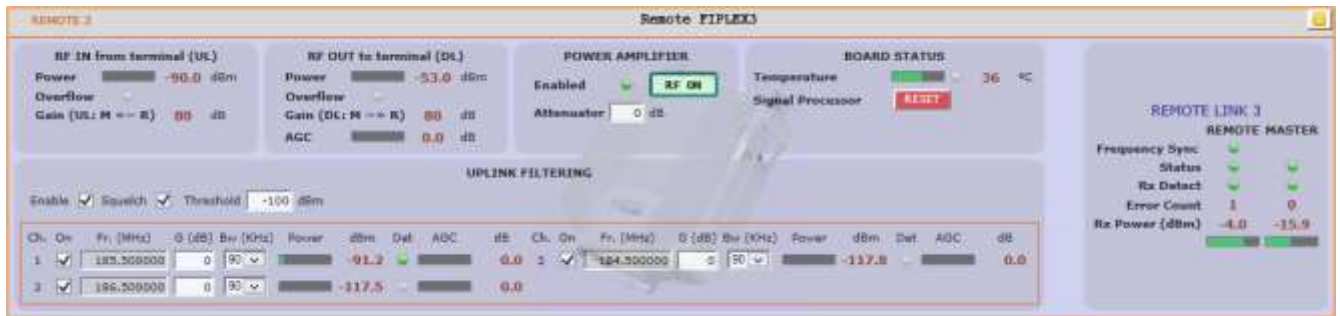
Parameter	Range	Description
Temperature	---	This indicator shows unit temperature
High temperature alarm	Grey: normal state / Red: alarm state	High temperature alarm condition is indicated with this led.
Signal processor alarm	Grey: normal state / Red: alarm state	Alarm indicates that digital signal processor is not working properly.
RESET control	---	With this control, unit can be restarted



- o Optical link status: each indicator shows optical link status between digital master and each remote unit. Clicking on “REMOTE LINK n” detailed monitoring data of each optical link can be viewed: voltage, current and temperature of



each optical module, transmitted and received optical power, and alarms related to digital data recovery system.

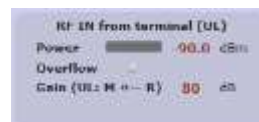


- Remote frame: shows configuration and monitoring information of each remote unit. The frame is divided in the following sections:



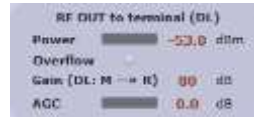
- Uplink filtering: this section shows equivalent parameters of downlink filtering of master unit.

Parameter	Range	Description
Frequency	UL band	Uplink frequency channels. These frequencies are derived automatically from downlink frequencies, taking into account frequency separation between DL and UL bands
Channel enable	Enabled / disabled	Each of 12 channels can be enabled/disabled
Bw Filter	90KHz / 45KHz / 30KHz	Bandwidth of channels filter can be independently adjusted (if filtering is enabled)
Fine Gain Adjust	-5 to +5dB	If filtering is enabled, gain of each channel can be fine adjusted
Power indicator	---	Level of each channel, measured according to its bandwidth filter, is shown in dBm units. Led indicator shows if levels exceeds squelch threshold (green) or not (yellow).
AGC	---	Show gain reduction to prevent overloading in AGC per channel
Squelch enable control	Enabled / disabled	Enabling this control, repeater does not transmit in each channel if RF input power do not exceed the threshold level configured according to next row
Squelch threshold control	-110dBm to -70dBm	If squelch is enabled, input levels below this threshold are not transmitted.
Filtering enable	Enabled / disabled	Filtering option can be bypassed. If filtering is disabled, fine gain adjustments and squelch options are ignored



- Remote RF Input parameters. Next table describes information of this frame:

Parameter	Range	Description
Broad band level	---	This indicator shows input level measured in UL band
Overflow	Grey: normal state / Red: alarm state	This indicator shows overflow on input circuitry is occurring.
Uplink gain from remote to master	--	Shows system uplink gain for each remote. Can be calculated as: <b>G_UL (dB) = 80 – AttOutMaster(dB)</b>



- Remote RF Output parameters. Next table describes information of this frame:

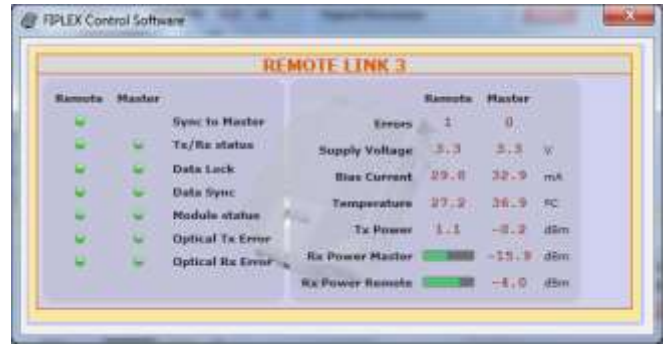
Parameter	Range	Description
Output power level	---	This indicator shows the PA output power
PA Overflow	Grey: normal state / Red: alarm state	Indicates that PA is overloaded. Condition is output power higher than +43dBm
Downlink gain from master to remote	---	Shows downlink gain for each remote. Can be calculated as: <b>G_DL (dB) = 80 – AttInMaster(dB) – AttOutRemote(dB)</b>
AGC	---	Shows gain reduction applied in DL band signal to prevent PA overload



- RF on/off control and Board Status:

Parameter	Range	Description
RF on/off Indicator	Green: RF Enabled / Red: RF Disabled	This indicator shows PA status. Power amplifier can be automatically disabled if other alarm conditions occurs: a) Fail in optical link b) PA Overflow
RF Enable Control	On / Off	With this control RF DL and UL chains can be disabled
Output attenuator	0 to 40dB	This control sets the output attenuation used to set DL gain together with Master Input Attenuator
Temperature	---	This indicator shows unit temperature
High temperature alarm	Grey: normal state / Red: alarm state	High temperature alarm condition is indicated with this led.
RESET control	---	With this control, unit can be restarted





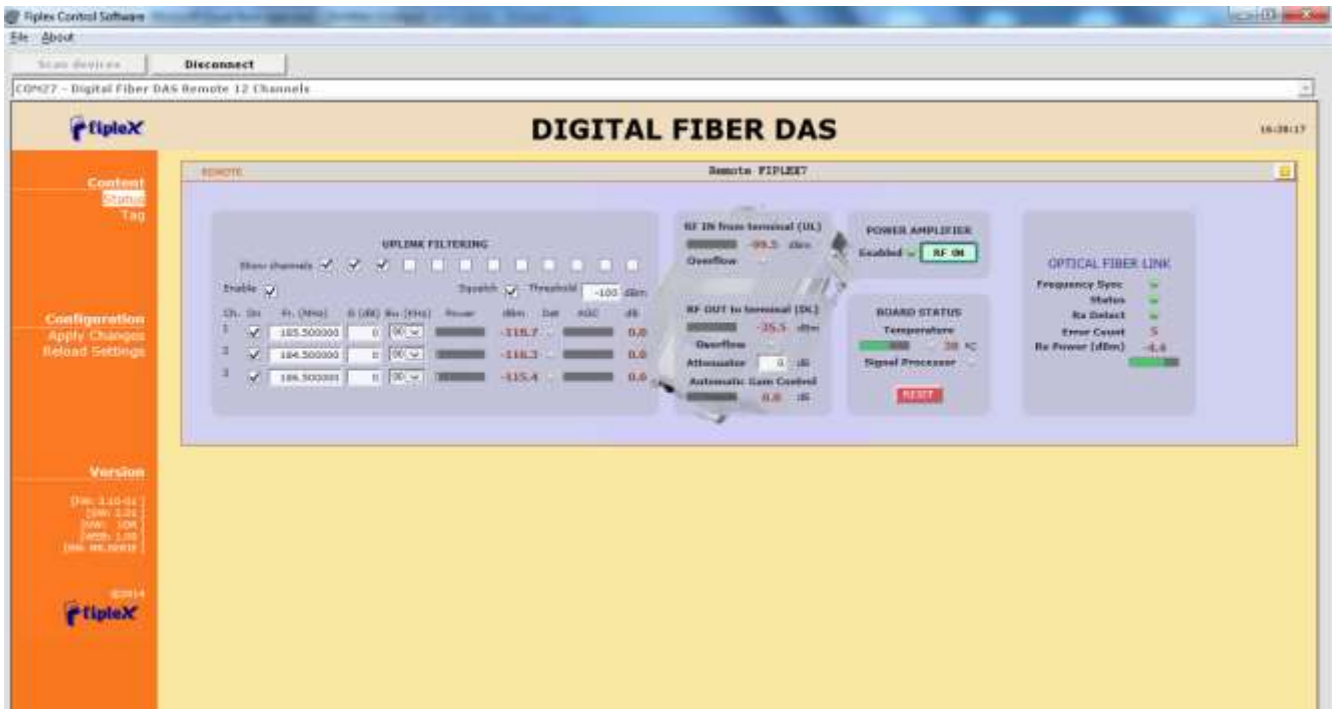
- Optical link status: shows optical link status between master and each remote unit. Moreover, clicking on “REMOTE LINK n” detailed monitoring data of each optical link can be viewed: voltage, current and temperature of each optical module, transmitted and received optical power, and alarms related to digital data recovery system. The main window shows only general parameters:

Parameter	Range	Description
Frequency Sync	Green: Normal state / Red: Alarm state	This indicator shows frequency synchronization status between master and remote unit
Status	Green: Normal state Yellow: Warning state Red: Alarm state	This indicator summarizes the status of optical module based in voltage, current, temperature and optical transmitted power
Rx Detect	Green: Normal state Yellow: Warning state Red: Alarm state	This indicator summarizes the status of optical reception based in received optical power and digital data recovery system
Error Count	---	Counter that it is incremented when optical link fails.
Rx Power	---	Shows optical received power. For reliable optical link, RX power must be higher than -25dBm

### 6.3 Software description (Remote Unit)

While software connected to digital master allows configuration and monitoring of whole system, if software is connected to remote unit, only parameters of this unit can be viewed / modified.

Then, status screen of remote unit only shows information regarding this unit:



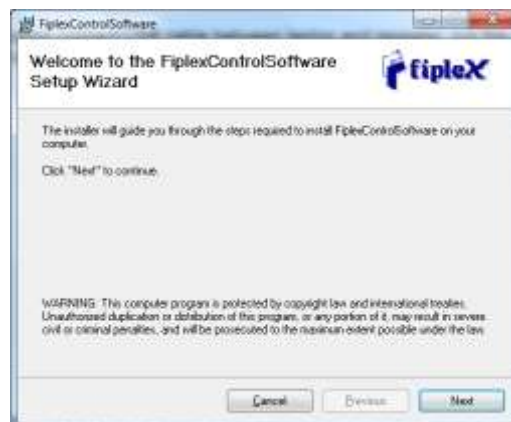
Distribution and meaning of the controls contained in status page are very similar to single remote frame of master status page, only optical frame is different due to only remote side of optical link is monitored.

## 7 Local Software. Installation and troubleshooting

### 7.1 Installation

The following section will describe the steps to be followed in order to install and use the Fiplex Control software with your Fiplex repeater.

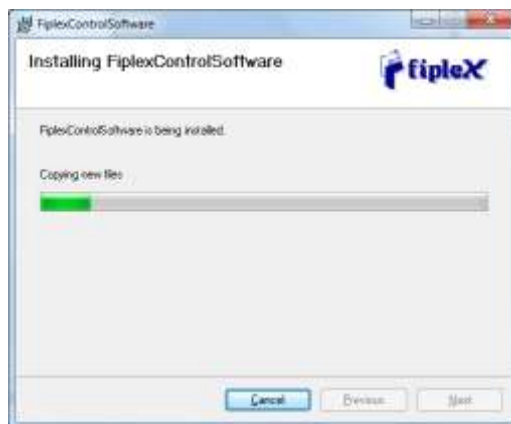
1. Before connect USB cable between computer and repeater, run the FiplexControlSoftware.msi File. Next screen will appear...



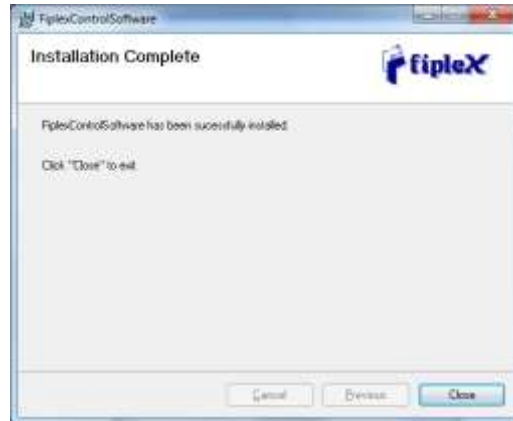
- Choose the default installation path "C:\Program Files (x86)\FiplexControlSoftware". Note that this can change according to your system configuration (32bits or 64bits), language and Windows Version.



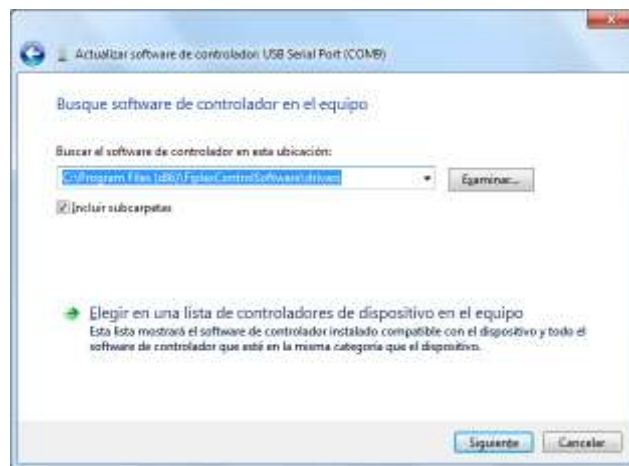
- The installer will start to copy the necessary files.



- After installation has completed, a shortcut in user desktop will appear.



5. Connect USB cable between computer and repeater, keeping the repeater powered off. Usually, drivers will be automatically installed, but depending on Windows version, screen asking for drivers of new device can appear. Drivers can be found in application folder: C:\Program Files (x86)\FiplexControlSoftware\drivers”.



6. Turn on the Repeater



**BE SURE THAT “TO MOBILE” AND “TO BASE” PORTS ARE PROPERLY LOADED EITHER WITH 50 OHMS DUMMY LOADS, OR RADIATING SYSTEM.**

7. Execute the Fiplex Control Software. Next window will appear:



User interface has the following controls:

- Scan Devices Button: refresh the available COM ports and identify Fiplex devices
- Connection Button: connect / disconnect software from repeater
- List of available devices: below two buttons, is placed a dropdown list that shows all available COM ports. Available COM ports not related to Fiplex devices will be shown with its number and “Unknown device” label. COM ports related to Fiplex devices will show a device description.
- Embedded Web browser: graphical area where configuration and monitoring parameters will be shown.
- File menu: contains menus to save repeater configuration to a file and load configuration from file to repeater.

NOTE: if Fiplex Repeater is not turned on, related COM port will appear as “Unknown device”

8. Click “Scan Devices”

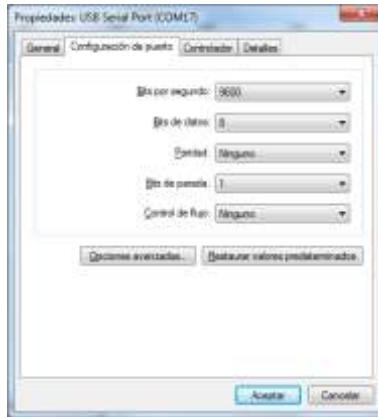


Now, the Fiplex unit is shown in the list of available devices, and connection button is enabled.

NOTE: Fiplex repeater could not appear in list, if COM port number is higher than COM16, depending on Windows version. COM port number can be forced to arbitrary number (below COM16) through Device Administrator. In order to change COM number, click "Properties" pop-up menu:



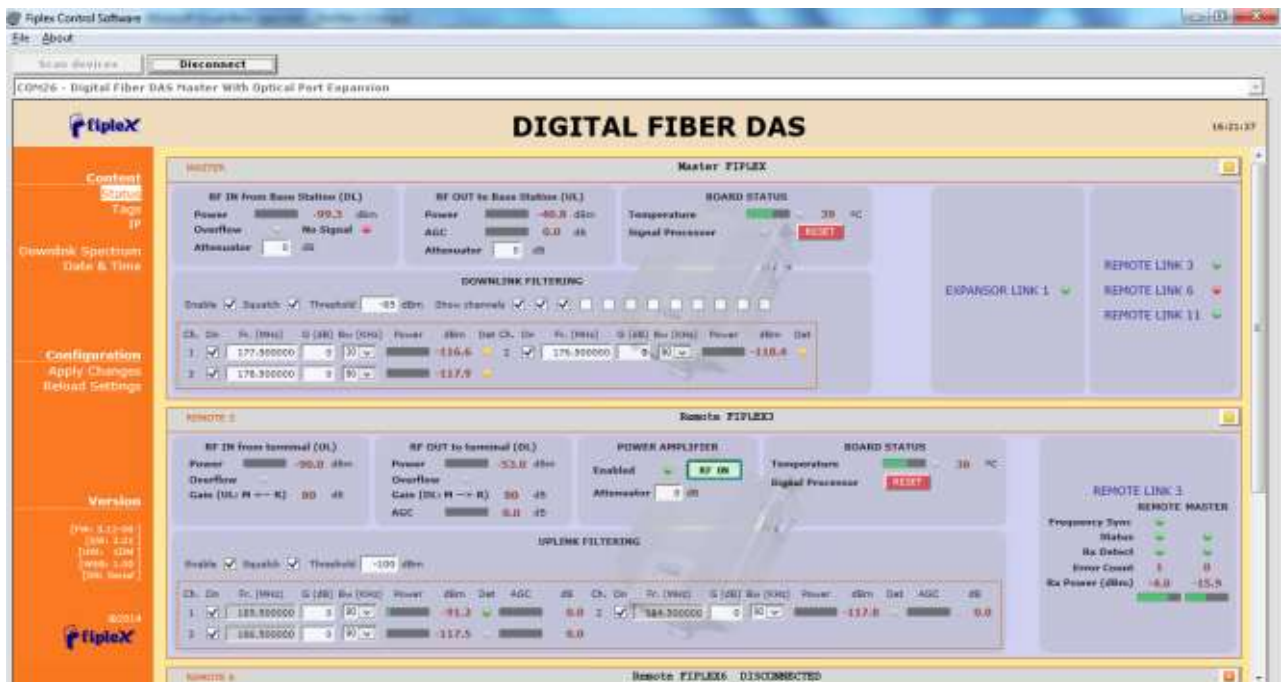
Click "Advanced Options"



Change COM port number



- Click "Connect". Fiplex Control Software window will be automatically maximized, and it will show the configuration screen described in previous sections.



- 
10. Once system is configured, user can disconnect software using connection button, now labelled “Disconnect”. Initial window will be shown.

If repeater is disconnected or turned off, while Fiplex Control Software is connected to device, software will go back to initial window. Moreover, if some communication problem occurs while device is monitored, the software will go back to initial state as well.

11. Remote unit can be controlled through USB port. In this case, Fiplex Control Software will show that connected device is a remote unit.



After click on “Connect” button, program will show only remote configuration and monitoring parameters, with same graphical interface described in previous sections:



