



FBS-870F6T SERIES 1310nm Optical Transmitter



SAFETY CONSIDERATIONS



CAUTION
RISK OF ELECTRICAL SHOCK
Do Not Open



Avis – Risqué de choc électrique Ne Pas Ouvrir

For user safety, one or more of the caution labels shown here may be affixed to the side or rear panels of this equipment. The significance of the two symbols enclosed by triangles is described below.



This symbol means that dangerous voltages are present within the equipment. These voltages are not insulated and may be of sufficient strength to cause serious bodily injury if touched. This symbol may also appear on schematics.



This symbol calls attention to a critical procedure or means that refer you to the instruction manual for operating or service information. Only qualified service personnel are to install or service the equipment. This symbol may also appear in text and on schematics.

WARNING: To reduce the risk of fire or electrical shock, do not expose this equipment to rain or moisture.



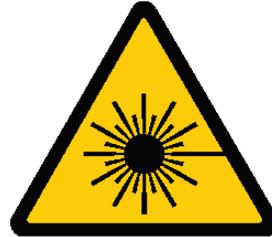
IMPORTANT SAFEGUARDS

DAWNco strongly advises you to read and understand the following safety instructions prior to installing and operating this equipment.

- **Read These Instructions First.** All safety and operating instructions should be read before installing or operating this equipment. Safety and operating instructions should be retained for future reference
- **Retain This Instruction Manual** Safety and operating instructions should be retained for future reference.
- **Heed Warnings** All warnings on the equipment and in this Owner's Manual should be adhered to.
- **Ventilation** Do not block or cover openings in this equipment. These are provided for ventilation and protection from overheating. **Maximum operating ambient temperature is 40°C.**
- **Power Sources** Operate this equipment only from the type of power source indicated on the rear panel. **CAUTION: For continued protection against risk of fire, replace the fuse (if necessary) with one of only the same type and rating.**
- **Grounding or Polarization** This equipment may be equipped with a polarized AC line plug (a plug having one blade wider than the other or a different shape.). This plug will fit into the power outlet only one way. This is a safety feature. If you are unable to insert the plug into the outlet, try reversing the plug. If the plug still does not fit, contact your electrician to replace your obsolete outlet. Do not defeat the safety purpose of a polarized plug.
- **Servicing** Refer all servicing to qualified personnel. Opening or removing covers may expose dangerous voltages. When replacement parts are required, make sure the service technician uses only replacement parts recommended by DAWNco. Unauthorized substitutions may result in fire, electric shock, or improper operation of the unit.
- **Cleaning** Unplug the unit from the AC power outlet before cleaning. Do not use liquid or aerosol cleaners.
- **Lightning.** For added protection during a lightning storm or when the equipment is left unattended or unused for long periods, unplug it from the power outlet and disconnect the cables between the equipment and the antenna subsystem. These precautions will prevent damage to the equipment that could be caused by lightning strikes or power line surges.
- **NOTE TO CATV SYSTEM INSTALLERS:** This reminder is provided to call your attention to NEC Articles 810-21, 820-22, and 820-40 that provide guidelines for proper grounding. In particular, these articles specify that the cable ground shall be connected to the building grounding system, as close to the point of cable entry as practical.
- **Optical Output Safety, General.** 1310nm Optical Transmitter units may emit harmful invisible laser radiation. These products may emit harmful laser radiation if powered on and the case is opened or the beam path is exposed.



Laser Safety Information:



The FBS-870F6T Optical Transmitter modules are classified as Class 1M per IEC/EN 60825-1/A2:2001. This product complies with FDA/CDRH, 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50 dated 26 July, 2001.

Viewing the laser output with certain optical instruments (for example, eye loupes, magnifiers and microscopes) within a distance of 100 mm may pose an eye hazard.

Laser power up to 20 mW at 1310 nm could be accessible if optical connector is open or fiber is broken. Lasers are on (powered) whenever the DLC chassis is powered.

CAUTION: Use of controls, adjustments, and procedures other than those specified herein may result in hazardous laser radiation exposure.



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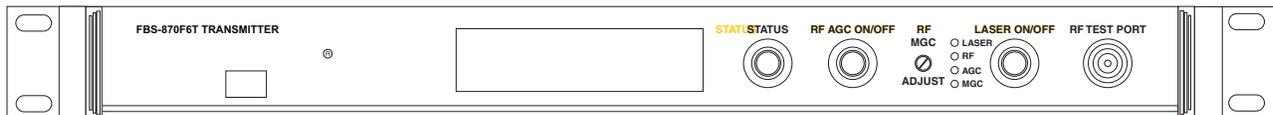
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Chapter 1 Introduction

1. Introducing the FBS-870F6T Optical Transmitter.



The FBS-870F6T Optical Transmitter is a 1 RU (1.75 high x 19 inches) chassis with one 1310 nanometer (nm.) Optical Transmitter included. The FBS accepts an analog input in the 54 to 860 MHz range and modulates this RF signal onto an internally generated optical signal source for transmission over single mode optical fiber systems to a distant optical receiver that removes the original RF signals from the optical carrier and outputs the 54 to 860 MHz RF signal for further use at that location. The use of the 1310nm Optical Transmitter allows transmission over distances beyond reasonable RF transmission distances with significantly less impairments. Users of this device will include anyone carrying video and data in a RF signal; most commonly, cable companies that need to add one to a handful of additional 1310 nm signals to an existing headend or hub, or add a single remote RF signal carriage from a hub or secondary headend back to the main headend or to another hub.

The FBS-x may be ordered with a range of optical output powers by substituting the desired power (in dBm) for the '-x' in FBS-x. This power is fixed in the factory at time of manufacture, based on part and design selections. Users should identify the 'link' budget for the distances, splits, and splices in their fiber, plus the optical power needed for their receiver input before ordering the transmitters. Users may add external optical attenuation to tune (reduce) the optical power into their link if the transmitter output is higher than the application needs. Contact your Dawnco Sales Representative for further assistance if needed.

Optical output connectors on the Dawnco FBS are SC/APC type, common to the cable industry and used for their low loss and back reflection. Other connectors, most commonly, FC/APC type are used and may be available; see your sales representative for special ordering.

The FBS accepts an RF signal within the 54 to 860 MHz range, using a cable industry standard F-connector. This signal may carry analog NTSC modulated carriers or QAM carriers or any mixture of analog and QAM carriers. The signal may be one 6 MHz modulated channel (or less) or up to 134 channels. Specification for RF signal input are based on 78 channels of load (power) and users are encouraged to adjust input levels up or down depending on load to optimize RF signal C/N, CTB, and CSO distortions at the receive site.



The FBS offer both manual RF gain control (MGC) and automatic RF gain control (AGC) modes. Users are alerted to the mode which has been selected by two LEDs that indicate either AGC mode or MGC mode is active. For most RF signals, users may select AGC mode to control variations in the RF signal over time and maintain consistent modulation of the RF signal onto the optical carrier. This is the recommended mode. A RF level LED alerts the user when the RF signal level may be excessively low, too low for the AGC to maintain consistent operation. For situations where the RF signal is low level or low power (low number of channels in the RF signal), the MGC mode allows you to set the gain as needed in your system.

The FBS transmitter includes an autoranging power supply and may be installed in 120 or 240 VAC systems by purchasing an appropriate power cord at the local PC computer shop if the supplied cord is not appropriate.

Operation is simple and, once set-up within the constraints of your application, the FBS will continued to operate unattended. The FBS will return to your set operating condition after power outages and brown-outs.

This manual details the unit specifications, describes any issues that may be critical to your installation, discusses the operation, and, finally, outlines actions if you have problems with the unit. If you read and follow the installation and operation chapters, the FBS should provide you years of simple, reliable operation

2. Features

- Wide bandwidth, 54~860MHz, high-performance single-mode 1310nm optical fiber transmitter
- Supports analog and QAM digital applications
- Wide range laser options, from 6dBm to 14dBm (4mW to 26mW), for multiple broadband applications
- Optical power monitoring of input RF, and laser status
- RS232 port
- Manual or automatic gain controls RF input level
- Automatic gain controlled input allows unit to maintain the same optical output with varying inputs without distortion
- Input voltage between 90-260Vac, unit can be used for NTSC and PAL systems
- Front panel RF test port -20dB
- Low power consumption



Chapter 2 Specifications

1. RF Performance

SPECIFICATION	LIMITS
Frequency Range	50 to 860 MHz (EIA channels 2~135)
Connector	F-connector, female
Impedance	75 ohm
Input Return Loss	≥ 15 dB
Input RF Level	+15 to 20 dBmV
AGC Control Range	± 5 dB
MGC Control Range	± 5 dB
RF Frequency response (flatness)	± 1 dB
Carrier-to-Noise Ratio	≥ 50 dBc*
Composite Second Order (CSO)	≥ 65 dBc*
Composite Triple Beat (CTB)	≥ 68 dBc*
Front Panel Test Port Level	-20 dB from Input

* Results based on 110 channel Matrix carrier input, fiber link, and -1 dBm optical receiver input level.

2. Optical Performance

SPECIFICATION	LIMITS
Wavelength	1310 nm.
Output Level (varies by model number)	6, 7, 8, 9, 10, 11, 12, 13, 14 dBm
Output Connector	SC/APC (FC/APC optional)
OMI	4%

3. General

SPECIFICATION	LIMITS
Input power	90 VAC to 264 VAC at 47 Hz to 63 Hz, 30 watt typ.
Power cord	NEMA 15P to IEC320 male on chassis
Fuse	5MF 500/250V (BEL) (spare in IEC320 socket)
Temperature Range	-10 to +50°C (+40°C max. recommended)
Relative Humidity (non-condensing)	0 to 95%
Altitude	0 to 15,000 ft
Weight	9.15 lb.
Size:	1 RU (1.75")H x 19"W x 13"D



Chapter 3

Installation and Operation

1. Unpacking the Unit

Please inspect the cartons on receipt and note damage to the carton and inspect for possible unit damage. If damage is found, please contact shipper immediately, before unpacking, to follow that shipper's procedure for claims.

Please open the carton and unpack carefully. Locate items such as the owner's manual and power cord. Do not connect a unit to power if there is serious mechanical damage to prevent possibly unsafe conditions.

2. Before Mounting

The FBS transmitter has no internal configuration switches and no internal user adjustments or controls. To prevent unsafe conditions, please do not open the unit. Opening the FBS transmitter will also **void the warranty**.

3. Rack Mounting

The unit is designed for installation in an EIA Standard 19-inch (480 mm) equipment rack.

3.1 Spacing

It is generally a good practice to leave one open slot (approximately 1 3/4 inch) between units to allow for cooling and provide maximum reliability. From the front of the rack, cover any open slots with a blank plate to prevent dust from entering the rack.

3.2 Cooling

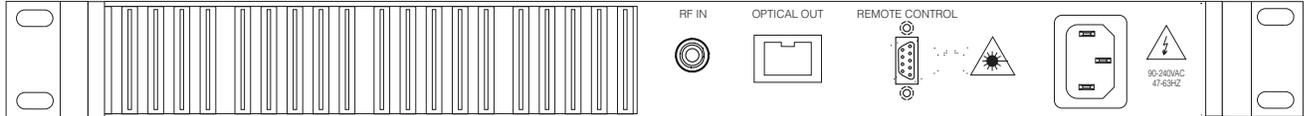
If other equipment is installed in the same rack or nearby racks as the FBS transmitter, check to ensure that adequate cooling measures have been provided for all equipment in the rack. Do not restrict the airflow through the equipment's vents on the top cover. The FBS has been designed to effectively dissipate its own heat, but heat from other rack-mounted components may adversely affect the unit, including side exhaust from equipment in an adjacent rack.

3.3 Securing the Unit

Slide the **FBS** transmitter into the rack opening. Please use **FOUR** mounting screws in the front panel mounting handles. (Included with unit) Insert one screw in the lower hole on the left and on the right, and then snug both screws to hold the chassis. Place additional screws in the upper holes, and screw until snug. Tighten all four screws equally and securely.



4. Making Rear Panel Connections



FBS Transmitter Rear Panel

4.1 Power Connection and Initial Power Up

Insert the supplied power cord into the IEC320 male power socket on the chassis. Plug the opposite end of the cord into your local power source. The FBS includes an autoranging power supply for power source of 120 or 220 or 240 VAC, 50 or 60 cycles

- Make sure the power connection includes a third wire ground; please do not use two wire extension cords between the Mains and the FBS transmitter.
- If the power cord supplied does not match your local power sockets, please acquire a replacement at the local PC computer store with the correct plug. A qualified technician may cut the supplied plug off the cord, strip the wires and affix an appropriate plug, but please use a three connection power plug and connect all three wires in the cord

After connecting the power cord, the unit will begin to operate. There is no on-off switch. The front panel channel window should light up momentarily after power is applied. Observe the front panel LASER LED; if this is lighted green, press LASER ON_OFF button to turn off the transmitter output and the LED becomes red.

Because there is no RF input connection at this time, RF LED will be flashing and the Status display window will display "Warning ... RF Input too low!"

The STATUS button allows you to step through the various displays as you press repeatedly. A tone is heard when you press this button.

4.2 Checking Optical Power Output

At this point, you may check the optical power output if desired, if you have an optical power meter and a fiber jumper.

- Press the STATUS button until the power output display is visible.
- The power output will stabilize after a short period of time of operating. When the power output displayed stabilizes (at the transmitter's target output level), you may make the measurement.
- Remove and retain the cover of the rear panel optical connector, or lift the hinged lid of the bulkhead connector if so equipped. Prepare the jumper by cleaning the optical tip. Failure to clean the fiber cables inserted into the FBS transmitter will cause dirt to accumulate in the FBS connector and decrease output power.

FAILURE TO CLEAN THE FIBER CABLES BEFORE INSERTION INTO THE FBS IS CONSIDERED ABUSE AND REPAIRS DUE TO DIRTY CONNECTORS ARE NOT COVERED UNDER WARRANTY.



Example of a fiber cable cleaner (source: Fiber Instrument Sales, www.fiberinstrumentsales.com).

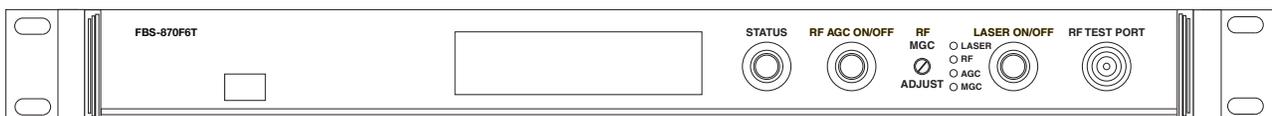
- Clean the jumper and connect to the Optical Power Meter.
- Check that the front panel LASER LED is lighted green; if not, press the LASER ON/OFF button to turn the LED to green.
- Operate the power meter per the owner's manual to read the output level. See table in chapter 4 to convert mW to dBm if needed.
- When finished, press LASER ON/OFF to turn off the output (LED turns red), and unplug the power cord

4.3 RF Input Connections

Connect the RF input signals to the rear panel F-connector labeled RF IN. In most cases, the input signal will have more than 6 channels (90 MHz of occupied bandwidth). If this is correct, proceed to check that the input level is in the range described in the Specifications section (approximately 15 dBmV as a nominal value). Use a RF spectrum analyzer or signal power meter. If you have less than 6 channels (90 MHz. of occupied bandwidth), see the section below

You may monitor this input signal from the front panel; the FBS includes a -20 dB directional coupler to divert a small amount of this signal to the front panel F-connector labeled RF TEST PORT. The -20 dB level is approximate and varied do to parts variations. If the level is critical to your monitoring application, you may wish to measure the RF signal as you connect to the rear panel (with power on), then immediately measure the level at the front panel test port and note the exact difference.

5. Front Panel Operations



FBS-870F6T Transmitter Front Panel



5.1 Using the Status Button

The STATUS button controls what is displayed on the front panel LCD. By pressing the STATUS button repeatedly, you may cycle through pages that display RF input parameters, Power output, Power Supply status and more. Some pages will display only when the LASER ON/OFF is selected "on".

5.2 Selecting AGC Mode

For most applications, the desired mode is AGC ON. Variations in RF input level due to drift and thermal changes in the equipment feeding the signal to the FBS are compensated and the signal from the other end of the link remains consistent.

To select the AGC ON mode, press the RF AGC ON/OFF button to light the led labeled AGC.

When the input signal is at or near the nominal 15 dBmV levels, the AGC circuitry will internally adjust to control the 1310nm Optical Transmitter modulation. If the RF LEVEL LED continues to flash and the front panel displays "Warning...!!! Input RF is too low" or "Warning...!!! Input RF is too high", you must either adjust the RF input level at the signal source or use MGC mode.

5.3 Selecting MGC Mode

To select the MGC ON mode (to turn off AGC mode), press the RF AGC ON/OFF button to light the led labeled MGC.

Select the MGC mode if:

- Your application has a desired variation of the input level to be passed onto the receive end of your link.
- Your application has an input that is too high level or too low level to allow AGC to control it.
- If you have less than 6 channels in your input RF signal. The AGC circuitry may read the levels of the RF signals in error and overdrive the 1310nm Optical Transmitter circuitry causing "clipping" distortions that create catastrophic signal impairments. When you have less than 6 channels (90 MHz of occupied bandwidth) in the lower part of the 54-860 MHz range, please select MGC mode.

5.4 Adjusting Input Level for Reduced Number of RF Channels

Laser transmitters are sensitive to both input (peak) level and the total power input. Designs are targeted at typical loading of about 80 channels. There is sufficient "headroom" in the design to allow for significant variations in channel count (occupied bandwidth) so as many as 130 channel input are not a problem and do not force a reduction of the input level target from a nominal 15 dBmV level. (Reducing the level may result in undesirable degradation of C/N.)

If you have significantly less than 80 channels occupied, i.e., below 20 channels or 120 MHz of occupied bandwidth, you may wish to increase the input RF level if your source can supply the higher level to optimizing C/N and other performance factors.

- Place the unit in MGC mode.



NOTE: The RF LEVEL LED may light (flash) and the front panel display “Warning...!!! Input RF is too low” when a small number of channels (small occupied bandwidth) is input even though the RF signal is at the desired level. The RF circuitry sense a wide bandwidth and averages the signal level; when only a small portion of the bandwidth is occupied at proper levels and the remainder is unoccupied, the sensor circuitry reports a low level.

- Adjust the source to supply the level noted in the table from chapter 5.

6. Connecting to your fiber network

- After configuring the RF input and the front panel controls, re-confirm the optical power output.
- Press the front panel LASER ON/OFF button to turn off the transmitter.
- Remove the optical jumper form the rear panel OPTICAL OUT connector.
- Clean the connector tip of the jumper to your patch panel or other fiber connection to your network and insert it into the OPTICAL OUT connector until fully seated. If you are using FC connector type, twist connector ferrule until it is fully seated on the threads of the PFT connector and snug moderately. Do not over tighten.

FAILURE TO CLEAN THE FIBER CABLES BEFORE INSERTION INTO THE FBS IS CONSIDERED ABUSE AND REPAIRS DUE TO DIRTY CONNECTORS ARE NOT COVERED UNDER WARRANTY.

8. Maintenance

The FBS Transmitter contains no internal user adjustments.

The FBS transmitter will beep repeatedly and flash the LASER LED when the power supply is out of specification. Check the front panel display for an error message, i.e., “+5v Error Please check the power supply”. If this occurs, return the FBS for repair as outlined in the Customer Service chapter.



8.1 Decreased Output Due to Contamination

The most likely cause of decreased optical output is contamination in the OPTICAL OUT connector. The optical jumper connectors may be contaminated by the slightest touch to human skin or other apparently clean surfaces. This contamination is transferred in to the bulkhead connector and remains when the jumper is removed from the FBS transmitter. Over time, it will cause decreased and intermittent output levels. Users may correct this condition as follows using commonly available fiber cleaner kits.

1. Remove fiber jumper from OPTICAL OUTPUT connector
2. Unplug unit from power source. Open top cover by removing 12 screws, sliding top plate back and lift at rear. Find and remove internal fiber connector at OPTICAL OUT bulkhead connector and set aside. Exercise care that you do not bend or damage the internal fiber.
3. Clean bulkhead connector using any commonly available fiber cleaning kit, preferably a stick cleaner. Slide stick into the bulkhead and scrub contamination of the bulkhead. In the absence of commercial cleaning tools, a pipecleaner and isopropyl alcohol may be used. A less effective solution is to use canned (clean) air with nozzle to blow contamination out of the bulkhead.
4. Clean internal fiber connector using handheld fiber connector cleaner (as shown earlier in this manual) and insert directly into the bulkhead connector until fully seated. If using FC type, screw ferrule onto bulkhead connector until snug.
5. Clean and insert protective cover in inside of bulkhead connector if an external fiber connector is not to be plugged into the FBS immediately.
6. Replace FBS top cover and snug 12 screws. Do not over tighten. Replace in rack and connect power cord.
7. Clean external fiber (jumper) connector using handheld fiber connector cleaner (as shown earlier in this manual) and insert directly into the bulkhead connector until fully seated. If using FC type, screw ferrule onto bulkhead connector until snug.



Chapter 4

Input Level versus Channel Loading

The Transmitters are designed to properly modulate the light output with a specified number of 6 MHz. channels. The FBS-x Specifications shows unit operation with 78 NTSC channels at 15 dBmV input level each, plus 300 MHz of QAM channels at -6 dB (9 dBmV) input level. If the number of higher level NTSC signals is reduced, the input levels may be increased to provide the same laser drive level and end-to-end performance.

The formula to use is: Desired Input Level =

$$\text{Specified Input Level} - 10\text{Log}(\text{actual channel count} / \text{specified channels})$$

Table of Input Level vs. Channel Count

Channels actually input	Delta	Input Level	Channels actually input	Delta	Input Level	Channels actually input	Delta	Input Level	Channels actually input	Delta	Input Level
1	18.92	33.92	21	5.70	20.70	41	2.79	17.79	61	1.07	16.07
2	15.91	30.91	22	5.50	20.50	42	2.69	17.69	62	1.00	16.00
3	14.15	29.15	23	5.30	20.30	43	2.59	17.59	63	0.93	15.93
4	12.90	27.90	24	5.12	20.12	44	2.49	17.49	64	0.86	15.86
5	11.93	26.93	25	4.94	19.94	45	2.39	17.39	65	0.79	15.79
6	11.14	26.14	26	4.77	19.77	46	2.29	17.29	66	0.73	15.73
7	10.47	25.47	27	4.61	19.61	47	2.20	17.20	67	0.66	15.66
8	9.89	24.89	28	4.45	19.45	48	2.11	17.11	68	0.60	15.60
9	9.38	24.38	29	4.30	19.30	49	2.02	17.02	69	0.53	15.53
10	8.92	23.92	30	4.15	19.15	50	1.93	16.93	70	0.47	15.47
11	8.51	23.51	31	4.01	19.01	51	1.85	16.85	71	0.41	15.41
12	8.13	23.13	32	3.87	18.87	52	1.76	16.76	72	0.35	15.35
13	7.78	22.78	33	3.74	18.74	53	1.68	16.68	73	0.29	15.29
14	7.46	22.46	34	3.61	18.61	54	1.60	16.60	74	0.23	15.23
15	7.16	22.16	35	3.48	18.48	55	1.52	16.52	75	0.17	15.17
16	6.88	21.88	36	3.36	18.36	56	1.44	16.44	76	0.11	15.11
17	6.62	21.62	37	3.24	18.24	57	1.36	16.36	77	0.06	15.06
18	6.37	21.37	38	3.12	18.12	58	1.29	16.29	78	0.00	15.00
19	6.13	21.13	39	3.01	18.01	59	1.21	16.21	79	-0.06	14.94
20	5.91	20.91	40	2.90	17.90	60	1.14	16.14	80	-0.11	14.89



Chapter 5 Output Power by Model

- The table on the following pages is provided for reference. The table displays the FBS model number and the corresponding output power in dBm units and in mW (milliWatt) units.

MODEL NUMBER VERSUS OUTPUT POWER IN dBm AND mW.

MODEL NUMBER	OUTPUT POWER IN dBm	OUTPUT POWER IN mW
PFT-6	6.0 dBm	4 mW
PFT -7	7.0 dBm	5 mW
PFT -8	8 dBm	7 mW
PFT -9	9.0 dBm	8 mW
PFT -10	10.0 dBm	10 mW
PFT -11	11 dBm	14 mW
PFT -12	12.0 dBm	16 mW
PFT -13	13.0 dBm	20 mW
PFT -14	14 dBm	26 mW

Notes:

- $\text{dBm} = (10\text{Log}_{10}(\text{milliWatts}))$
- $\text{milliWatts} = 10^{(\text{dBm}/10)}$
- 1 milliWatt = 0 dBm